Atlas of Inland Fishes *of* New York

by
Douglas M. Carlson,
Robert A. Daniels,
and Jeremy J. Wright

New York State Museum Record 7

Atlas of Inland Fishes of New York

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By Douglas M. Carlson, Robert A. Daniels, and Jeremy J. Wright

With maps created by Richard A. McDonald

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Preface

Due to New York's unique geographical and hydrological location within the context of recent geological history, its freshwater fish species represent one of the richest and most scientifically fascinating ichthyofaunas in the Northeastern United States. It is therefore not surprising that New York State and its native fish assemblages played an integral role in the early development of North American ichthyology, with major contributions to this field of study continuing into the 20th century and beyond. The species diversity of New York's watersheds offers ready opportunities for the ecological and evolutionary comparison of fishes from very different geographical regions, with the state's three major drainage basins (the Saint Lawrence River, Allegheny River, and the Atlantic Slope) having quite distinctive groups of fishes, owing to the different refugia from which these areas were colonized following the last glacial retreat.

The most recent comprehensive examination of New York's freshwater fish species and their distributions is C.L. Smith's "Inland Fishes of New York State", which was based on historical records and surveys conducted from the 1970s to the mid-1980s and preceded the era of electronic storage. The interconnectedness of the state's watersheds (via canals) and the resulting movements of fish species to non-native areas, anthropogenic introductions of exotic species to several of the state's watersheds, and the reduction in range and/or extirpation of several species have collectively necessitated the production of updated versions of distribution maps for New York freshwater fishes. This atlas project began in 2011 and included a recent data series of statewide stream surveys from 1998-2012. These recent records and all of the others used in the production of this atlas will be made available through an electronic database to assist in any further analyses that readers might develop.

The users of this atlas, whether they are anglers, amateur naturalists, or professional scientists, are provided with several resources to determine where a specific fish species has been known to occur in the state throughout the past and present. The distributional "dot" maps are self-explanatory and the hydrological unit code (HUC) maps offer greater levels of hydrological resolution for species records from different time periods. The watershed maps rely on the same set of records and visualize the process of fish disappearing from or arriving in a new area. Watershed-based annotations for each species allow further interpretation of the collection events used to create these maps. Finally, the extensive use and citation of published literature will allow the reader to find more in-depth studies about fish assemblages of a particular region or a particular species' biology or distributional patterns.

Many cooperators and contributors made this atlas possible, most importantly the museums, government agencies, universities, and colleagues that shared their fish records. The previous statewide fish surveys of the NY Biological Survey in 1926-39 and of C.L. Smith were the foundations for this atlas and a majority of the records came from the NYS Department of Environmental Conservation. Dozens of other sources were also used, as described by Carlson and Daniels (2004). Artwork by Ellen Edmonson and Hugh Chrisp came from the NY Biological Survey, as listed by George et al. (1986). Maps were drawn and redrawn several times by Richard McDonald. Rodger Klindt of NYSDEC and Bryan Weatherwax and Rick Morse of the NYSM were very helpful in resolving many of the more complicated records.

Introduction

The geographic range of any species of freshwater fish depends upon the availability of a suitable, or at least acceptable, physico-chemical habitat, the presence of historic and current dispersal routes, and the existence of a compatible biotic community, including adequate prey and a suitable balance of predators and competitors. Species distributions are dynamic over both large and small time scales and, in recent centuries, have been increasingly affected by the activities of humans as they alter streams and lakes, use surrounding land for new activities, and introduce exotic species. It is certain that the range of many species today differs from their distribution a decade ago and will also differ from the range of many of these fishes a decade from now. In contrast, range maps are static. Their ubiquity lends them a sense of permanence, and it is not unusual to accept the demarcations of a map as the actual limits of a fish's range. By nature, a published range map cannot respond to the extirpations of small populations, range expansions and contractions due to habitat modification, or introductions and invasions, all of which continuously affect a species' range. Nonetheless, range maps have value both as historical records and as useful approximations of the geographical distributions of different fish species.

The 179 species distribution maps included here are meant to provide complete information on the range of each species of freshwater or diadromous fish found in the inland waters of New York. Our goal in generating the maps was to collate all current information on the distribution of each species by recording each documented collection as a point on the map. The dots represent vouchered specimens and unvouchered records from surveys and field notes. To emphasize distributional changes on the dot maps, the points are coded on all maps: clear for records before 1977 and solid surrounded by green if the capture date is 1977 or later. The maps include records of collections from the nineteenth century to 2012; records of specimens representing significant range extensions are included to 2015. The intensity of sampling efforts in New York's fresh waters has varied over time; after the watershed surveys of the 1920s and 1930s, sampling effort declined and there were periods of relative inactivity. In 1977, C. Lavett Smith, of the American Museum of Natural History, intensified his collecting efforts to gather information for his book, *The Inland Fishes of New York State* (Smith 1985). Because of the greater effort put into sampling by Smith and others, which has been sustained to the present, 1 January 1977 is the date we use to separate recent from earlier records.

We also present distributional information on a second set of maps that record the presence and absence of each species by watershed as defined by the United States Geological Survey (not to be confused with the 18 traditionally recognized major New York State watersheds referenced elsewhere in species annotations) using 10-digit hydrologic unit codes (HUC-10). This set of maps resulted from a coordinated effort between the United States Geological Survey (USGS), and the Environmental Protection Agency (EPA). The Watershed Boundary Dataset (WBD) was created from a variety of sources from each state and aggregated into a standard national layer for use in strategic planning and accountability (available for download at http://nhd.usgs.gov/; accessed 09/08/2010). On these maps, red watersheds are those with collections that were made prior to 1977, yellow watersheds are those with collections in or after 1977, and green watersheds are those where collections were made during both periods. The number printed in each colored watershed shows the number of records. These watershed maps are modified to also show dots for 24 species (Table 1) where many of the occurrences are in larger water bodies not covered by HUC units. Users should, therefore, be able to assess gross changes in range over time, with a summary of the number of HUC-10's in each category provided in Table 1. These data are intended to aid in a state or regional assessment of natural resources and are not intended for use at a scale finer than 1:100,000. The generalized locations are not exact survey sites. Mapping with Geographic Information System tools was performed by Richard P. McDonald.

Table 1. List of fish shown in these watershed maps. The total number of mini-watersheds or hydrologic unit code (HUC-10) occupied are shown along with the break-down by time period (pre and post 1977). Twenty four species, as marked with an asterisk, show incomplete values due to their range in larger lakes and rivers without HUC units.

		Watershed Units (HUC-10's)			
Scientific Name	Common Name	Total No. HUCs	Early Only	Recent Only	Both Periods
Ichthyomyzon bdellium	Ohio Lamprey	10		9	1
Ichthyomyzon fossor	Northern Brook Lamprey	9		7	2
Ichthyomyzon greeleyi	Mountain Brook Lamprey	5		4	1
Ichthyomyzon unicuspis	Silver Lamprey	26	8	13	5
Lampetra appendix	American Brook Lamprey	55	6	22	27
Petromyzon marinus	Sea Lamprey	87	29	31	27

Table 1. List of fish shown in these watershed maps (cont.)

		Watershed Units (HUC-10's)			
Scientific Name	Common Name	Total No. HUCs	Early Only	Recent Only	Both Periods
Acipenser brevirostrum	Shortnose Sturgeon	7	2		5
Acipenser fulvescens	Lake Sturgeon*	37	3	21	13
Acipenser oxyrinchus	Atlantic Sturgeon	6	4		2
Polyodon spathula	Paddlefish	5	2	2	1
Lepisosteus osseus	Longnose Gar	54	17	20	17
Amia calva	Bowfin	51	6	28	17
Hiodon tergisus	Mooneye	22	11	7	4
Anguilla rostrata	American Eel	176	61	24	91
Alosa aestivalis	Blueback Herring*	33	7	11	15
Alosa pseudoharengus	Alewife*	122	23	46	53
Alosa sapidissima	American Shad	29	9	8	12
Dorosoma cepedianum	Gizzard Shad	97	7	68	22
Campostoma anomalum	Central Stoneroller	171	11	38	122
Carassius auratus	Goldfish	109	26	33	50
Phoxinus eos	Northern Redbelly Dace	122	22	43	57
Phoxinus neogaeus	Finescale Dace	26	15	6	5
Clinostomus elongatus	Redside Dace	121	23	14	84
Couesius plumbeus	Lake Chub	47	26	5	16
Ctenopharyngodon idella	Grass Carp	14		14	
Cyprinella analostana	Satinfin Shiner	103	40	25	38
Cyprinella spiloptera	Spotfin Shiner	180	21	79	80
Cyprinus carpio	Common Carp	238	20	48	170
Erimystax dissimilis	Streamline Chub	6		3	3
Erimystax x-punctatus	Gravel Chub	4	2	1	1
Exoglossum laurae	Tonguetied Minnow	18	4	1	13
Exoglossum maxillingua	Cutlip Minnow	235	17	25	193
Hybognathus hankinsoni	Brassy Minnow	59	27	23	9
Hybognathus regis	Eastern Silvery Minnow	91	40	26	25
Hybopsis amblops	Bigeye Chub	22	14	2	6
Luxilus chrysocephalus	Striped Shiner	57	12	22	23
Luxilus cornutus	Common Shiner	309	13	6	290
Lythrurus umbratilis	Redfin Shiner	10	5	3	2
Macrhybopsis storeriana	Silver Chub	7	7		
Margariscus margarita	Allegheny Pearl Dace	90	25	21	44
Margariscus nachtriebi	Northern Pearl Dace	49	15	16	18
Nocomis biguttatus	Hornyhead Chub	55	19	18	18
Nocomis micropogon	River Chub	73	9	7	57
Notemigonus crysoleucas	Golden Shiner	318	8	30	280
Notropis bifrenatus	Bridle Shiner	131	67	29	35
Notropis amoenus	Comely Shiner	60	39	10	11

Table 1. List of fish shown in these watershed maps (cont.)

		Watershed Units (HUC-10's)			
Scientific Name	Common Name	Total No. HUCs	Early Only	Recent Only	Both Periods
Notropis anogenus	Pugnose Shiner*	5	3	1	1
Notropis atherinoides	Emerald Shiner	156	24	70	62
Notropis buccatus	Silverjaw Minnow	4		4	
Notropis chalybaeus	Ironcolor Shiner	2	1		1
Notropis dorsalis	Bigmouth Shiner	37	9	14	14
Notropis heterodon	Blackchin Shiner	48	31	10	7
Notropis heterolepis	Blacknose Shiner	78	43	22	13
Notropis hudsonius	Spottail Shiner	220	30	55	135
Notropis photogenis	Silver Shiner	15	1	5	9
Notropis procne	Swallowtail Shiner	29	13	6	10
Notropis rubellus	Rosyface Shiner	149	27	48	74
Notropis stramineus	Sand Shiner	82	16	33	33
Notropis volucellus	Mimic Shiner	123	20	60	43
Pimephales notatus	Bluntnose Minnow	270	7	64	199
Pimephales promelas	Fathead Minnow	252	16	133	103
Rhinichthys atratulus	Eastern Blacknose Dace	244	6	6	232
Rhinichthys cataractae	Longnose Dace	281	29	16	236
Rhinichthys obtusus	Western Blacknose Dace	57	2	2	53
Rhodeus sericeus	Bitterling	2	1		1
Scardinius erythrophthalmus	Rudd	46		45	1
Semotilus atromaculatus	Creek Chub	313	3	7	303
Semotilus corporalis	Fallfish	219	13	27	179
Tinca tinca	Tench	2		2	
Carpiodes cyprinus	Quillback	48	9	29	10
Catostomus catostomus	Longnose Sucker*	99	43	15	41
Catostomus commersonii	White Sucker	318	2	8	308
Catostomus utawana	Summer Sucker	8	3	1	4
Erimyzon oblongus	Creek Chubsucker	81	29	4	48
Erimyzon sucetta	Lake Chubsucker	4	4		
Hypentelium nigricans	Northern Hog Sucker	201	21	35	145
Ictiobus bubalus	Smallmouth Bufffalo*	0			
Ictiobus cyprinellus	Bigmouth Buffalo*	3		3	
Minytrema melanops	Spotted Sucker*	1		1	
Moxostoma anisurum	Silver Redhorse	71	19	28	24
Moxostoma breviceps	Smallmouth Redhorse	10		5	5
Moxostoma carinatum	River Redhorse	4		4	
Moxostoma duquesnei	Black Redhorse	21	2	12	7
Moxostoma erythrurum	Golden Redhorse	47	5	21	21

Table 1. List of fish shown in these watershed maps (cont.)

		Watershed Units (HUC-10's)			
Scientific Name	**Common Name**	**Total No. HUCs**	**Early Only**	**Recent Only**	**Both Periods**
Moxostoma macrolepidotum	Shorthead Redhorse	101	20	37	44
Moxostoma valenciennesi	Greater Redhorse	33	5	24	4
Misgurnus anguillicaudatus	Oriental Weatherfish	8		8	
Ameiurus catus	White Catfish	28	3	11	14
Ameiurus melas	Black Bullhead	21	14	3	4
Ameiurus natalis	Yellow Bullhead	130	9	84	37
Ameiurus nebulosus	Brown Bullhead	322	8	11	303
Ictalurus punctatus	Channel Catfish	88	14	51	23
Noturus flavus	Stonecat	100	17	27	56
Noturus gyrinus	Tadpole Madtom	79	26	26	27
Noturus insignis	Margined Madtom	132	16	50	66
Noturus miurus	Brindled Madtom	26	8	11	7
Osmerus mordax	Rainbow Smelt	79	16	31	32
Coregonus artedi	Cisco*	43	17	3	23
Coregonus clupeaformis	Lake Whitefish*	53	25	3	25
Coregonus hoyi	Bloater*	1	1		
Coregonus kiyi	Kiyi*	1	1		
Coregonus reighardi	Shortnose Cisco*	0			
Oncorhynchus gorbuscha	Pink Salmon*	2		2	
Oncorhynchus kisutch	Coho Salmon*	17	1	9	7
Oncorhynchus mykiss	Rainbow Trout*	264	56	42	166
Oncorhynchus nerka	Sockeye Salmon	21	6	8	7
Oncorhynchus tshawytscha	Chinook Salmon*	26	4	20	2
Prosopium cylindraceum	Round Whitefish*	30	19	2	9
Salmo salar	Atlantic Salmon	69	17	27	25
Salmo trutta	Brown Trout	288	24	19	245
Salvelinus fontinalis	Brook Trout	281	37	10	234
S. fontinalis x S. namaycush	Splake	40	16	4	20
Salvelinus namaycush	Lake Trout*	89	25	9	55
Esox americanus americanus	Redfin Pickerel	65	7	25	33
Esox americanus vermiculatus	Grass Pickerel	60	24	16	20
Esox lucius	Northern Pike	212	31	52	129
Esox niger	Chain Pickerel	58	1	54	3
E. lucius x E. masquinongy	Tiger Muskellunge	48	13	22	13
Esox masquinongy	Muskellunge	222	29	41	152
Umbra limi	Central Mudminnow	171	15	77	79
Umbra pygmaea	Eastern Mudminnow	21	4	4	13
Percopsis omiscomaycus	Trout-perch	70	22	14	34

Table 1. List of fish shown in these watershed maps (cont.)

		Watershed Units (HUC-10's)			
Scientific Name	Common Name	Total No. HUCs	Early Only	Recent Only	Both Periods
Aphredoderus sayanus	Pirate Perch	14	6	4	4
Lota lota	Burbot	60	17	16	27
Microgadus tomcod	Atlantic Tomcod	14	6	4	4
Labidesthes sicculus	Brook Silverside	84	9	55	20
Fundulus diaphanus	Banded Killifish	232	38	54	140
Fundulus heteroclitus	Mummichog	35	10	5	20
Gambusia affinis	Western Mosquitofish	11		11	
Apeltes quadracus	Fourspine Stickleback	29	8	2	19
Culaea inconstans	Brook Stickleback	166	25	66	75
Gasterosteus aculeatus	Threespine Stickleback*	25	16	6	3
Pungitius pungitius	Ninespine Stickleback*	17	10	5	2
Cottus bairdii	Mottled Sculpin	116	17	24	75
Cottus cognatus	Slimy Sculpin	190	32	43	115
Cottus ricei	Spoonhead Sculpin*	1	1		
Myoxocephalus thompsonii	Deepwater Sculpin*	2	2		
Morone americana	White Perch	103	9	41	53
Morone chrysops	White Bass*	48	19	17	12
Morone saxatilis	Striped Bass	23	1	10	12
Acantharchus pomotis	Mud Sunfish	1	1		
Ambloplites rupestris	Rock Bass	306	14	21	271
Enneacanthus gloriosus	Bluespotted Sunfish	13		4	9
Enneacanthus obesus	Banded Sunfish	4	2	1	1
Lepomis auritus	Redbreast Sunfish	115	11	23	81
Lepomis cyanellus	Green Sunfish	94	3	82	9
Lepomis gibbosus	Pumpkinseed	325	2	12	311
Lepomis gulosus	Warmouth	6		4	2
Lepomis macrochirus	Bluegill	279	18	66	195
Lepomis peltastes	Northern Sunfish	10	4	4	2
Micropterus dolomieu	Smallmouth Bass	311	20	22	269
Micropterus salmoides	Largemouth Bass	308	7	50	251
Pomoxis annularis	White Crappie	80	20	37	23
Pomoxis nigromaculatus	Black Crappie	231	26	67	138
Ammocrypta pellucida	Eastern Sand Darter	17	2	14	1
Etheostoma blennioides	Greenside Darter	80	6	32	42
Etheostoma caeruleum	Rainbow Darter	55	2	18	35
Etheostoma camurum	Bluebreast Darter	2		1	1
Etheostoma exile	Iowa Darter	40	20	11	9
Etheostoma flabellare	Fantail Darter	168	8	40	120

Table 1. List of fish shown in these watershed maps (cont.)

		Watershed Units (HUC-10's)			
Scientific Name	Common Name	Total No. HUCs	Early Only	Recent Only	Both Periods
Etheostoma fusiforme	Swamp Darter	3			3
Etheostoma maculatum	Spotted Darter	1			1
Etheostoma nigrum	Johnny Darter	92	4	17	71
Etheostoma olmstedi	Tessellated Darter	248	6	60	182
Etheostoma variatum	Variegate Darter	13	1	5	7
Etheostoma zonale	Banded Darter	42		34	8
Perca flavescens	Yellow Perch	310	25	17	268
Percina caprodes	Logperch	163	20	49	94
Percina copelandi	Channel Darter	33	10	16	7
Percina evides	Gilt Darter	4	2	2	
Percina macrocephala	Longhead Darter	6	1	3	2
Percina maculata	Blackside Darter	57	8	13	36
Percina peltata	Shield Darter	56	5	7	44
Sander canadensis	Sauger	10	9		1
Sander vitreus	Walleye	223	55	33	135
Sander glaucus	Blue Pike	7	7		
Aplodinotus grunniens	Freshwater Drum	59	10	32	17
Neogobius melanostomus	Round Goby	37		37	
Channa argus	Northern Snakehead	3		3	

Documentation for these maps is derived from state agency records, museum catalog records, university collection records, gray literature (including government and private reports, master's theses and doctoral dissertations) and published accounts. We bring together this documentation, with references where available, and include anecdotal information from these different sources. These details provide more information on the distribution of inland fishes, including specific records of important changes in distribution. Although the annotations are meant to be comprehensive, we provide readers with additional sources of information that they can use to corroborate and verify these notes and find additional information. In addition to the species represented by range maps, we include annotated information on the distribution of four other species. Three of these species are found either at a single site or are present only in the Hudson River estuary. The fourth is an undescribed taxon found in the eastern Adirondack Mountains.

New York State is drained by five large drainages (Mississippi, Saint Lawrence, Susquehanna, Delaware and Hudson River drainages) and several minor ones (e.g., Housatonic, Newark Bay). Traditionally, these have been divided into 18 watersheds, based on a statewide survey conducted between 1926 and 1939 (Fig. 1). Because of this tradition, apparent anomalies in watershed patterns are retained here in most cases. For example, although the Niagara River is better associated with the Ontario watershed, we continue to use the original Erie-Niagara watershed. The one modification made in the watershed boundaries is the transfer of the Cayuta Creek basin from the Chemung to the Susquehanna watershed. When describing an area smaller than a watershed, we use the term basin.

We assume that the reader will have a fair understanding of the geography of New York, although we realize that this will not be the case for all users. The watershed map (Fig. 1) will orient the reader to the basic unit of discussion. A county map, showing some of the larger cities, is provided as an extra aid (Fig. 2). Exact location of basins and individual lakes and streams will require the use of more detailed maps, many of which can be found online.

In each account, we provide details for each species by watershed. The earliest records are usually from the watershed surveys conducted from 1926 through 1939 (Moore 1927-1940, Daniels 2011) although, when available and appropriate, earlier reports are cited. Numbers in parentheses after each watershed indicate the period during which the species was noted, as follows: before 1940 = 1, 1941-1987 = 2, and 1988-2015 = 3. Group 1 includes museum records beginning in the nineteenth

century but largely comprises records obtained during the watershed surveys conducted between 1926 and 1939. Group 2 includes agency and museum records, including about 800 records from the surveys conducted by C. Lavett Smith and his colleagues, which culminated with the publication of his book in 1985. Group 3 includes records from the sampling efforts of the authors, agency records, and their colleagues through 2012; records are also included through 2015 if they represent a significant range expansion. Bold numbers indicate non-native species. See Appendix Table 1 for a summary of these occurrence details. The number of species recorded from each watershed ranged from 57-132, which is slightly greater than the range determined by Carlson and Daniels (2004).

In this text, reports of species without attribution are all from the New York State Department of Environmental Conservation (NYSDEC). Museum acronyms follow Sabaj Pérez (2014): AMNH (American Museum Natural History, New York), ANSP (Academy of Natural Sciences, Philadelphia, PA), CAS (California Academy of Science, San Francisco, CA) CUMV (Cornell University, Ithaca, NY), MCZ (Harvard University, Boston, MA), NYSM (New York State Museum, Albany, NY), OSUM (Ohio State University Museum of Biological Diversity, Columbus, OH), PSU (Pennsylvania State University, University Park, PA), RWLC (State University of New York College of Environmental Sciences and Forestry, Roosevelt Wild Life Collection, Syracuse, NY), UMMZ (University of Michigan, Ann Arbor, MI), and USNM (United States National Museum, Smithsonian, Washington DC). Other abbreviations frequently used are: ALSC (Adirondack Lake Survey Corporation), SUNY (State University of New York), USEPA (United States Environmental Protection Agency), USGS (United States Geological Survey) and USFWS (United States Fish and Wildlife Service). The database can be downloaded at http://www.nysm.nysed.gov/nysm-fish-atlas-database.

Figure 1. Watersheds of New York State.

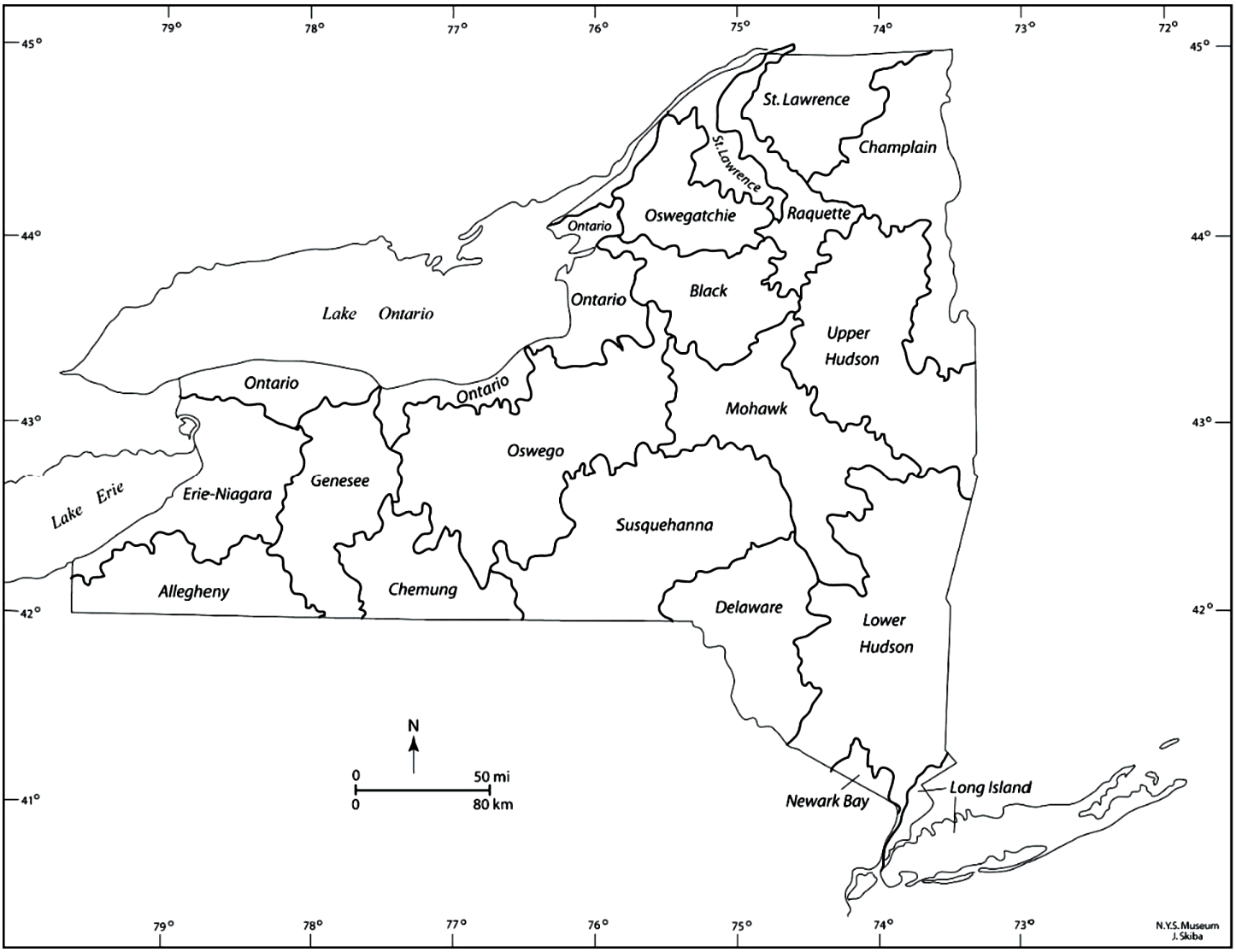
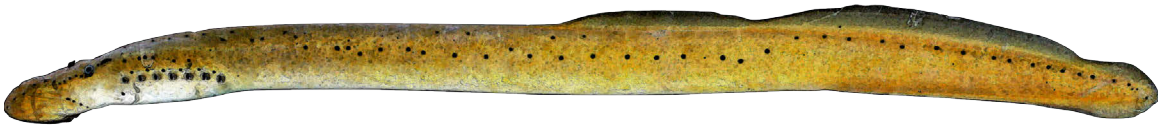


Figure 2. Counties of New York State.

Petromyzontidae, Lampreys

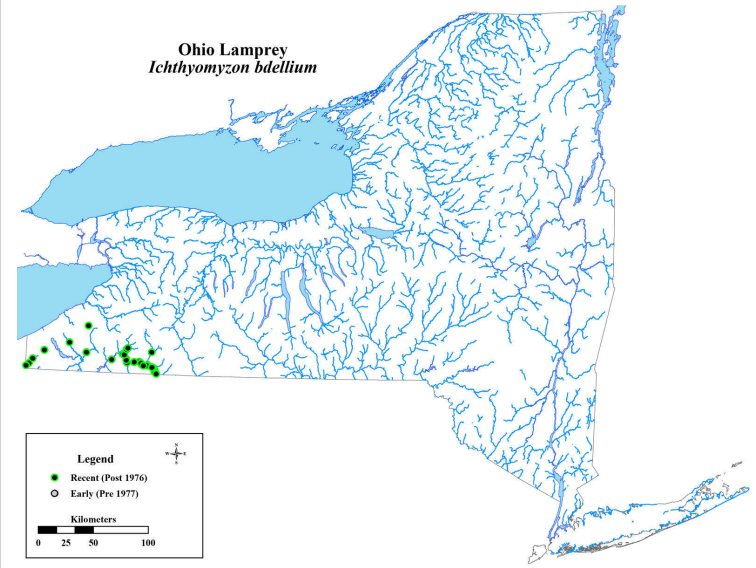
Lampreys are primitive fishes that spend their two-phase life cycles in streams and lakes or the ocean, depending on the species. Six species occur in New York, but only one species is found statewide in all drainages. All are native. One species is anadromous. Three species are parasitic as adults; the other three, known as brook lampreys, do not feed as adults. Three species have restricted ranges and low abundance in the state.

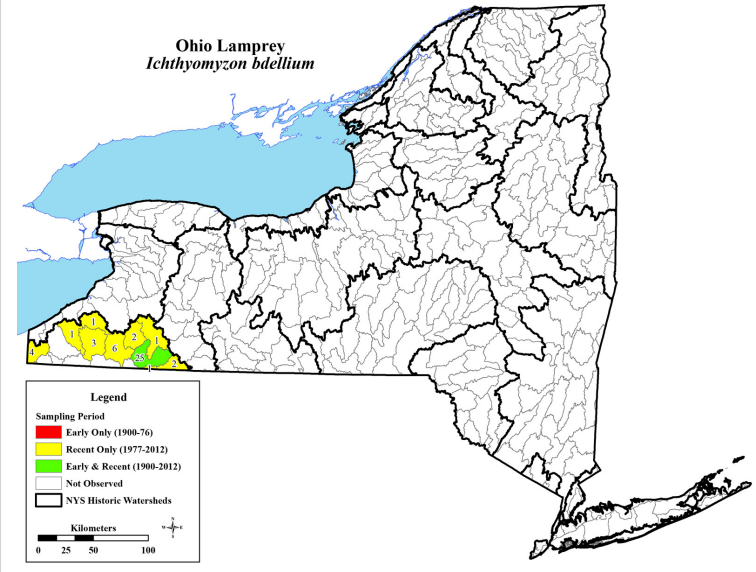
Ichthyomyzon bdellium, Ohio Lamprey



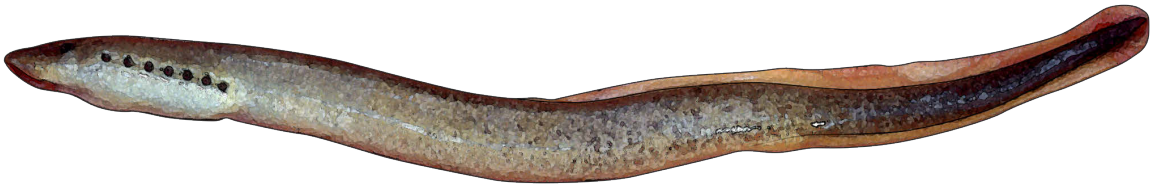
This lamprey inhabits medium-sized and larger streams with clean sand and is native to the Allegheny watershed in New York.

Allegheny (2,3). First collected from the Allegheny River near Vandalia in 1961 (Smith 1985), Ohio Lamprey has been taken throughout the watershed. Although not collected earlier in New York waters, this species is widely distributed throughout the Ohio River system and was probably present in New York during the 1937 watershed survey. Among the early Allegheny River collection locations were Salamanca, Olean, Weston Mills, and at the mouth of Red House Brook. Specimens were collected at locations close to Portville and Vandalia several times in 2006-07. This species has also been taken in Olean, Great Valley, and Oswayo creeks of the eastern basin, Conewango Creek near Kennedy in 2001 in the central basin (NYSM 52655), and in French Creek in the western basin (Smith 1985; Hansen and Ramm 1994). Identification of the Ohio Lamprey and the Mountain Brook Lamprey can only be confirmed with an adult specimen, as it is not possible to use physical characteristics to differentiate between the ammocoetes, or juveniles, of these two species. In general, adult lampreys are captured less frequently than ammocoetes but, because adults of parasitic lampreys live longer than the adults of their non-parasitic congeners, adults of the parasitic species tend to be captured more frequently. This may account for the greater number of records of the parasitic Ohio Lamprey when compared to those of the sympatric Mountain Brook Lamprey.

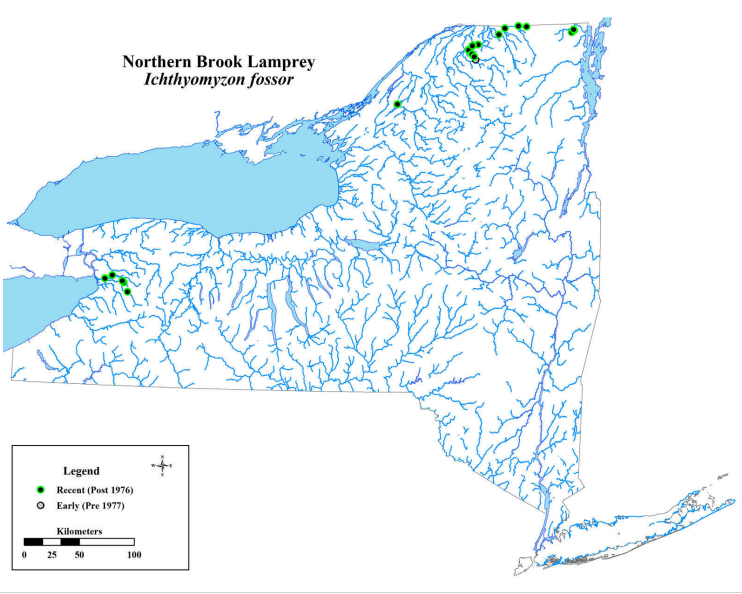


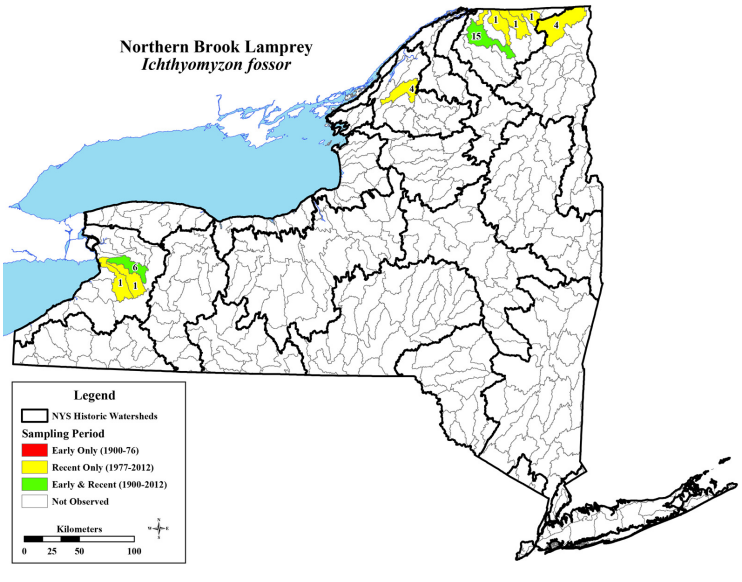


Ichthyomyzon fossor, Northern Brook Lamprey



This species is present in the Erie-Niagara, Saint Lawrence, Oswegatchie, and Champlain watersheds. It inhabits medium-sized and small streams where water temperatures are cooler (Becker 1983). Docker (2009) and Docker et al. (2012) suggest that this species and the Silver Lamprey are ecotypes of a single species, although this interpretation is controversial (Renaud et al. 2009).





Erie-Niagara (1,2,3). Greeley (1929) reported that Prof. T.L. Hankinson collected this species in Little Buffalo Creek near Elma on 12 June 1928 and that larvae were collected in the mud at the same site on 17 June 1928. Specimens were next collected from the same stream, near Lancaster, in 1973 (AMNH 36919) and at Elma in 1979 (AMNH 42356). In 1988, lamprey control crews collected Northern Brook Lamprey in Cayuga Creek, and repeated sampling efforts were successful in both Little Buffalo and Cayuga creeks in 1998, 2002, and 2013. Records from Cattaraugus Creek tributaries in 1960-1981 and 2005 (USFWS, unpubl. field notes) and from upper Cattaraugus Creek near Arcade (Lee et al. 1980) lack voucher specimens and are probably erroneous.

Saint Lawrence (2,3). The earliest records are from 1972 from Allen Brook, Plum Brook, Redwater Creek, Trout River, Chateaugay River, Lawrence Brook, and Hinchinbrook Brook. Spawning was observed in Allen Brook on 14 May 1999.

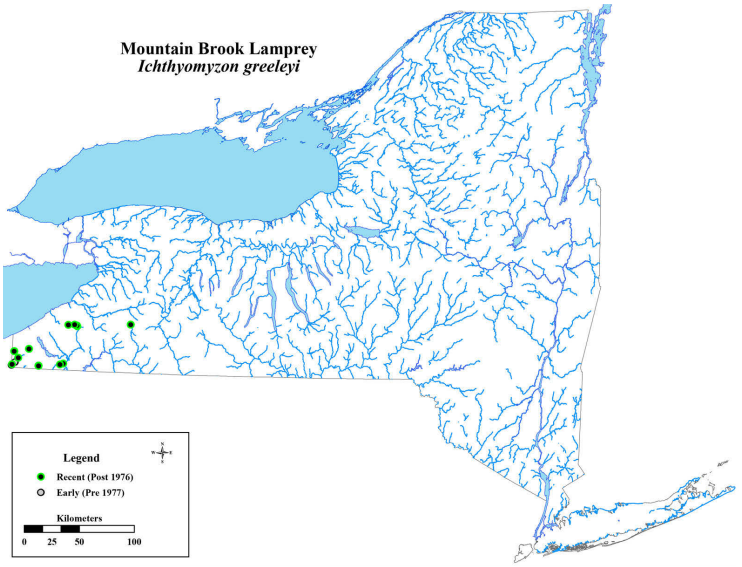
Oswegatchie (3). This species was first reported from a pre-spawning congregation observed on 20 May 2013 in the river below Elmdale. This stream is larger than others used by this species in New York but is not unlike others described by Becker (1983).

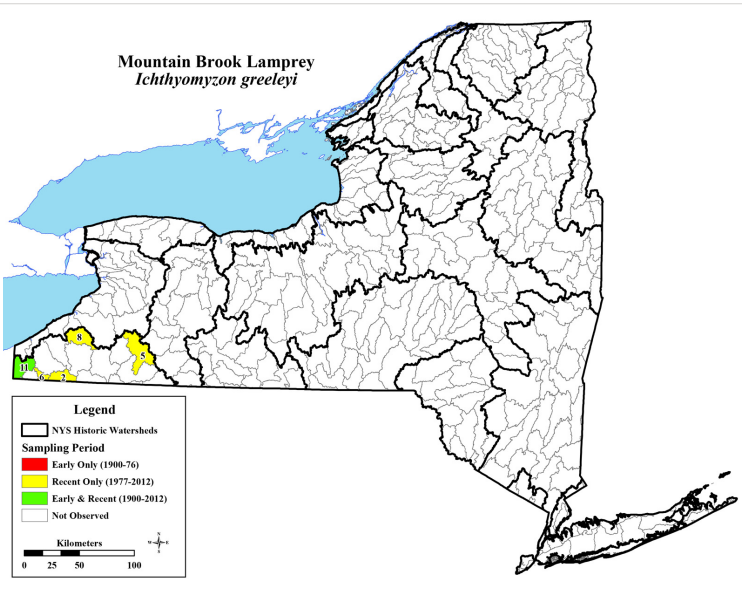
Champlain (3). The only specimens of this species from this watershed are advanced ammocoetes that were taken near the mouth of the Great Chazy River in 1992, 1996, and 2000 (NYSM 53425) during lamprey control efforts. Earlier records exist from tributaries in Vermont (Langdon et al. 2006).

Ichthyomyzon greeleyi, Mountain Brook Lamprey

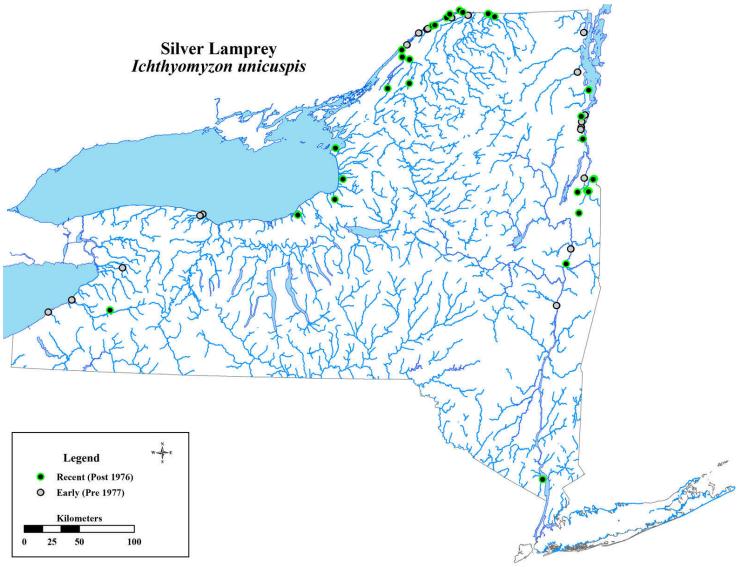
This species occurs in medium-sized and smaller streams with clean sand and is found in the Allegheny watershed in New York.

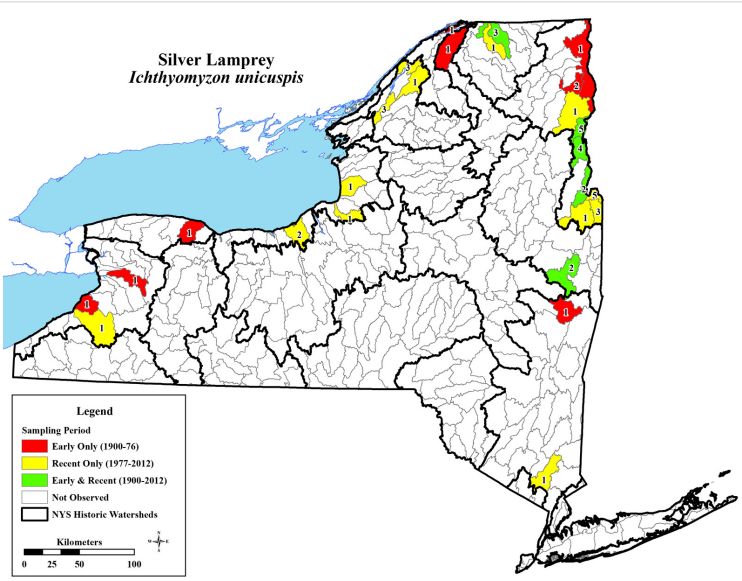
Allegheny (1,2,3). First reported by Greeley (1938), the non-parasitic Mountain Brook Lamprey was most often caught in French Creek until recent years. This species has been taken in very few additional locations, but has been recorded in each of the three basins of the watershed (French Creek, Conewango Creek and the Allegheny River), namely in West Branch French Creek in 2003 (NYSM 55994) and 2010, West Branch Conewango Creek in 2005 (NYSM 59328) and 2009, and Ischua Creek, a tributary of the eastern basin, in 2005 (NYSM 59329). In addition to these adults, juveniles have been collected in each of these areas as well as in Stillwater and Conewango creeks. Spawning was documented in West Branch Conewango Creek on 25 May 2009 and 22 May 2012 and in Little Brokenstraw Creek in 2013 and 2014 (NYSM 71570). This lamprey also has been reported farther south in Little Brokenstraw Creek in Pennsylvania (Criswell and Stauffer 2011).





Ichthyomyzon unicuspis, Silver Lamprey





This species is native to the watersheds of the Saint Lawrence River drainage, including the Erie-Niagara, Ontario, Oswegatchie, Raquette, Saint Lawrence, and Champlain watersheds. It has also been reported from the upper and lower Hudson watersheds as an exotic species. As noted above, Docker (2009) and Docker et al. (2012) suggest that the Silver Lamprey and Northern Brook Lamprey are ecotypes of a single species, but Renaud et al. (2009) viewed both species as valid.

Erie-Niagara (1,3). Greeley (1929) noted the presence of this species as a parasite in Lake Erie; it was collected in the lake near Irving, as well as in Little Buffalo Creek near Elma. In the 1990s, this species was also caught by lamprey control crews in the Buffalo River, and in Buffalo, Canadaway, Spooner, and Cattaraugus creeks.

Ontario (1,3). Greeley (1940) reported that records at the University of Rochester indicated that this species was collected from Braddock Bay on 14 May 1902 and from the Salmon River (Monroe County) on 1 June 1929. Recently, adults were caught at Little Sandy Creek in 1998 (NYSM 56106) and around Henderson Bay in 1999.

Oswegatchie (3). The earliest record is a report of an individual regurgitated by an angled Fallfish caught near Richville in 1990. Recent records include catches in the lower Oswegatchie River in 2009-10 (HDT/DTA 2010) and in the Indian River at Rossie in 2012. The latter was an individual attached to a Lake Sturgeon.

Raquette (1). Greeley (1934) included this species in this watershed based on anecdotal reports of its presence in the lower Raquette River and on the observation of an individual attached to a sturgeon at the power canal weir in the Saint Lawrence River. No specimens have been reported from this watershed since the 1930s.

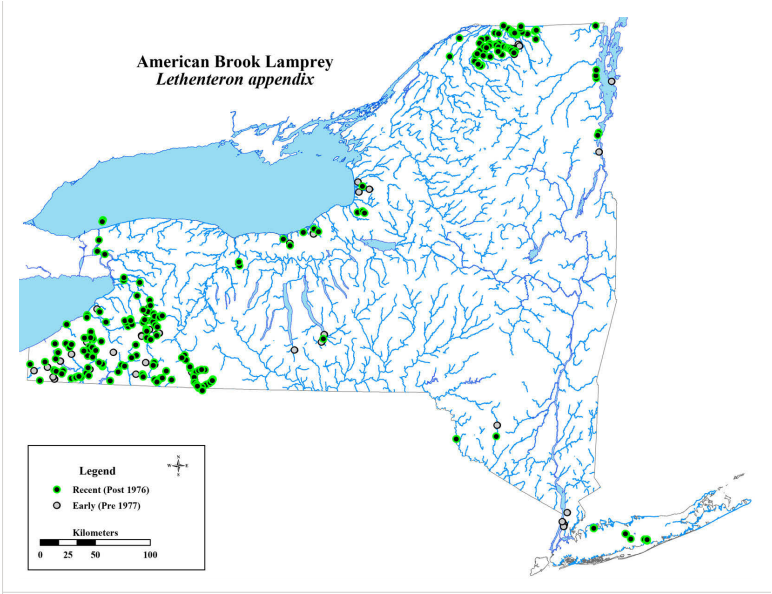
Saint Lawrence (1,3). Greeley (1931) reported that a single specimen was seen in the lower part of the Salmon River at Fort Covington, and others were observed in the Saint Lawrence River near Massena. Individuals have been recorded at both sites in recent years.

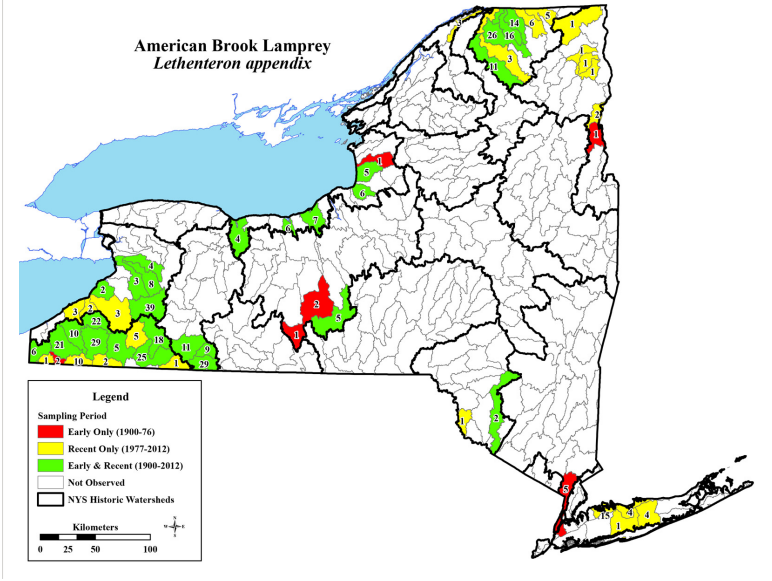
Champlain (1,2,3). Greeley (1930) reported this parasitic lamprey on suckers and smelt from the lake and noted that a nest was located in Putnam Creek in June 1929. Silver Lampreys have been caught in the mouths of Mullen Brook in 1963, Mount Hope Brook in 1985, and ammocoetes were found during lamprey control efforts in Beaver Brook in 1990. More recently, this species has been captured at the mouth of Mettawee River and in the Champlain Canal at Smith Basin in 2011 (University of Vermont, unpubl. field notes).

Upper Hudson (**1,2**). Two specimens were collected from the Hudson River from 1937-38 at Coveville, Saratoga County (NYSM 11620, 11618), with two additional, later collections near Stillwater, one in 1960 (CUMZ 36855) and one in 1980 (NYSM 48910).

Lower Hudson (**2**). The only records of this species from the lower watershed are from rkm 229 in 1974 (AMNH 37205) and rkm 53 in 1977 (AMNH 39529).

Lethenteron appendix, American Brook Lamprey





This non-parasitic species is widely distributed in the state and has been reported from the Allegheny, Erie-Niagara, Genesee, Ontario, Oswego, Oswegatchie, Saint Lawrence, Champlain, Delaware, Lower Hudson, and Long Island watersheds. Surprisingly, American Brook Lampreys are absent from lowland streams of the Black River and the Tug Hill region, even though they occur in the Saint Lawrence River drainage east and west of this area.

Allegheny (1,2,3). This lamprey inhabits all three basins of the watershed. It was noted in the Ohio River system by Bean (1903). Greeley (1938) reported it only from the central basin. The American Brook Lamprey currently inhabits tributaries of Conewango Creek, Chautauqua Lake, and the Allegheny River near Vandalia. Specimens have been collected several times in French Creek, most recently in 2001 (NYSM 53284). This species is the most frequently caught lamprey in the entire watershed and is most prevalent in the Conewango Creek basin, where it was taken at 19% of the sites during a 2004-05 survey.

Erie-Niagara (1,2,3). Greeley (1929) reported that Dr. G. C. Embody collected ammocoetes in Lime Lake outlet and noted other collections from Cattaraugus Creek near Springville. Lamprey control teams found this species in several tributaries of Lake Erie in the 1990s. American Brook Lampreys were reported in the lower Niagara River in 1987.

Ontario (2,3). Specimens from Irondequoit Creek (CUMV 28012) date to 1942. More recent capture sites include a tributary of Sterling Creek in 1960, Irondequoit Creek in 1981, First Creek in 1989, Red Creek in 1992, Snake and Sodus creeks in 1994, Lindsey Creek in 1997, Grindstone Creek in 2002 (N. Mandrak, University of Toronto, pers. comm.), Sterling Creek in 2002 (S. Coglin University of Maine, pers. comm.), Sterling Valley Creek in 2009, and in Lake Ontario at depths up to 110 m in 2007 (R. O'Gorman, USGS Oswego, pers. comm.).

Genesee (2,3). All records are from the upper watershed in Allegany County. The earliest record is from the Genesee River near Wellsville in 1940 (CUMV 44991). There are recent records from the Genesee River and four of its tributaries.

Oswego (1,2,3). The first records are from a tributary of Seneca Lake in 1884 (Gage 1928) and Cayuga Lake in 1886. The Cayuga Lake population was the model for a classic life history study by Gage (1928). There are no additional records from Seneca Lake, but the species was repeatedly caught in Cayuga Inlet through 1960 by conventional sampling. While evaluating Sea Lamprey control efforts in Cayuga Inlet in 1986, Hulbert (1987) recorded this species; it has not been reported since. Its absence from recent surveys suggest that is has become extremely rare in the system or has been extirpated.

Species continued on next page

Saint Lawrence (2,3). In 1955, this species was first collected in the watershed from Lawrence Brook. More recent records are from the Little Salmon River in 1992, Allen Brook in 1998, Trout Brook, which is a tributary of Allen Brook, the Little Trout River in 2007, and from the Grass River near Madrid in 1992-2006.

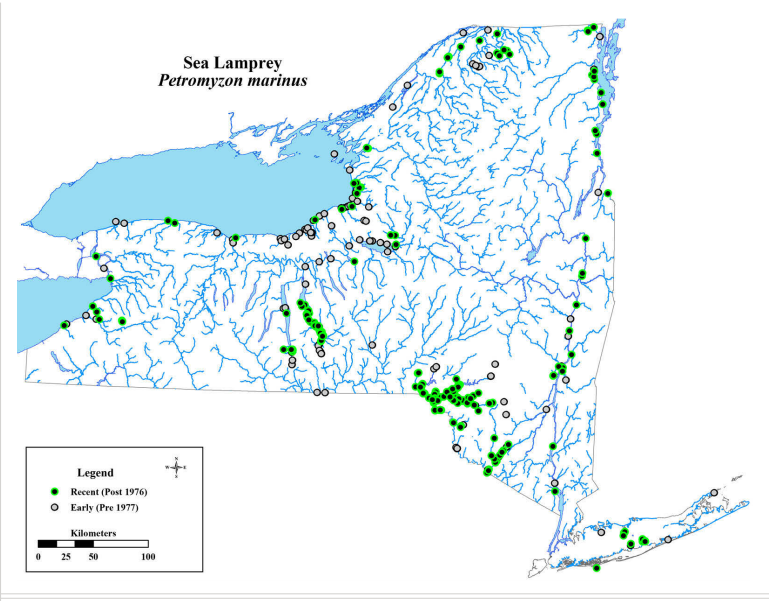
Champlain (1,2,3). This species was taken at the mouth of Putnam Creek during the 1929 watershed survey (Greeley 1930) and from the Salmon River near Plattsburgh in 1952 (CUMV 21943). Many recent captures have been reported from the Great Chazy River. Ammocoetes were found in the Ausable River in 1990, 1994, 1999, and 2002 as a result of lamprey control efforts.

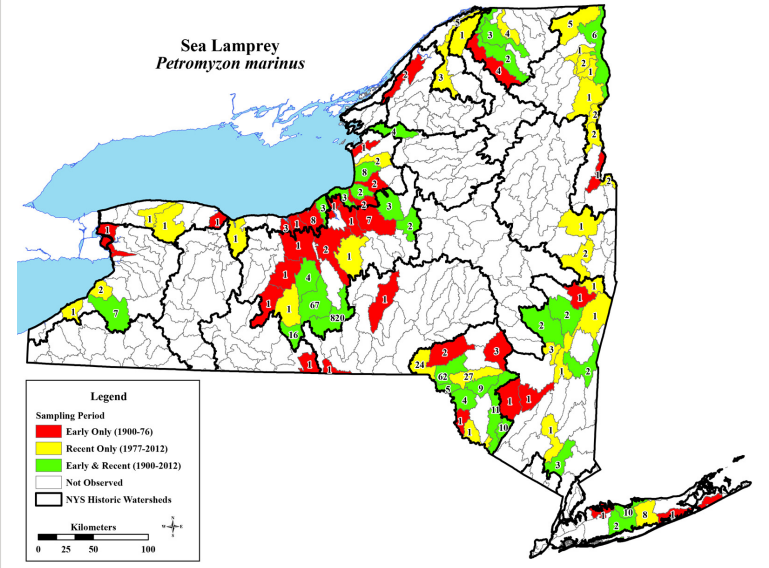
Delaware (1,2,3). The earliest records are from the Neversink River near Fallsburg and date from the mid-1800s (MCZ 3527). In 1984, this species was caught near Narrowsburg (PSU 1540). In 2011, specimens were taken in the Neversink River at Bridgeville (NYSM 67543)

Lower Hudson (1,2). DeKay (1842) noted that this species was present in the lower Hudson River. Greeley (1937) stated: "The locality given by Dean and Sumner for this species is in Tibbit's Brook, Lincoln Park, a few rods from the station of the New York and Putnam Railroad, above Van Cortlandt Lake. Spawning was observed April 16, 1897." Harding reported the species at the same location in 1909 (AMNH 13279). The only other record was from the Saw Mill River in 1956. Renaud et al. (2016) examined several specimens from the Lower Hudson watershed and determined that they were not American Brook Lamprey. American Brook Lampreys have also been reported from the upper Wallkill River in New Jersey (J. Vile, New Jersey Department of Environmental Protection, pers. comm.).

Long Island (2,3). The earliest record is from 1969, in the Connetquot River at Islip (AMNH 55643). American Brook Lampreys have been found in Big and Beaver brooks in Nassau County and the Swan, Patchogue and Nissequogue rivers in Suffolk County since the 1980s.

Petromyzon marinus, Sea Lamprey





This anadromous species has been reported from throughout the state and was probably much more common prior to the construction of dams on some of the larger rivers. Sea Lampreys have been reported from the Erie-Niagara, Ontario, Oswego, Black, Oswegatchie, Raquette, Saint Lawrence, Champlain, Susquehanna, Delaware, the upper and lower Hudson, and Long Island watersheds. Expansion into Lake Erie, where this species is non-native, was accomplished about 100 years after canals joined Lakes Erie and Ontario. This is a highly-managed species, and efforts to control its abundance continue throughout much of its range.

Erie-Niagara (**2,3**). The Sea Lamprey invaded Lake Erie by 1921 (Hubbs and Pope 1937), but the earliest specimen taken from a New York stream is from Clear Creek in 1962. The in-lake distribution in Lake Erie is described by Lawrie (1970), Pearce et al. (1980), and Sullivan et al. (2003). In 1976, specimens were caught at four locations in Lake Erie, Cattaraugus Creek, and the Niagara River near Grand Island (W. Hadley, SUNY Buffalo, unpubl. field notes).

Ontario (1,2,3). The earliest record in this watershed dates to 1835 (Lark 1973). Greeley (1940) noted: "... lamprey ascending streams to spawn. Two specimens found dead in the Salmon River below Pulaski, June 8, were the only traces noted of the breeding run...records in the collections of the University of Rochester indicate one Monroe County stream (Salmon Creek) to be used by lampreys... Irondequoit and Sodus bays also have occasional lampreys." Recent articles (Larson et al. 2003; Sullivan and Adair 2010) describe modern distribution patterns and control programs. Waldman et al. (2004) contended that the species is native to the lake; Eshenroder (2009) argued that the Sea Lamprey is not native to Lake Ontario, which was rebutted by Waldman et al. (2009).

Oswego (1,2,3). Sea Lampreys were first noted in Seneca and Cayuga lakes in 1875 (Gage 1928) and were well established by the 1890s (Gage 1893). Bean (1903) reported *Petromyzon marinus unicolor* from Cayuga Lake Inlet in 1886, and Greeley (1928) noted its presence in Oneida Lake. Individuals are still caught in the larger lakes of this watershed, despite control measures that are designed to lower lamprey abundance and mitigate damage to the sport fishery (Hulbert 1987). Whether this species is native or exotic to this watershed has generated a number of publications (e.g., Brussard et al. 1981, Wright et al. 1985, Eschenroder 2009); we treat it as native (Waldman et al. 2004).

Species continued on next page

Black (2,3). Specimens have been taken from the lower reaches of the Black River. In 1994, the dam at Dexter was determined to be only a partial barrier to upstream movement (Schiavone and Adams 1995), so the dam facility was redesigned in an effort to block upstream passage. Chemical treatment has been regularly applied in the large sand delta downstream of the mouth to eradicate Sea Lamprey ammocoetes.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that "a single specimen, an adult, was collected in the St. Regis River at Hogansburg on June 13. It was found dead in shallow water below the lower most riffle of the stream." In the last two decades, this species has been caught several times in the Saint Regis River and its tributaries, as well as the Grass River (e.g., NYSM 59575).

Oswegatchie (1). Prior to damming the main channel in the early 1900s, Sea Lampreys may have resided in the lower reaches of the main channel upstream to Heuvelton (rkm 18). Odell (1932) noted its presence in Black and Butterfield lakes in the Indian River basin.

Raquette (3). Juveniles were found at Raymondville (rkm 31) in 1994 (NYSM 43949) and 2007 (NYSM 62721).

Champlain (1,2,3). DeKay (1842) described *Ammocoetes unicolor* from specimens from Lake Champlain provided by Z. Thompson. DeKay's *A. unicolor* has since been synonymized with the Sea Lamprey. Thompson (1853) reported this species in the lake, but Evermann and Kendall (1896, 1902) did not capture any and merely cited Thompson. Greeley (1930) noted that the species "occurs in Lake Champlain, where it is moderately common...The larvae have the same habits as those of the preceding species [Silver Lamprey] and were found associated with them in Putnam Creek." Although these earlier studies report Sea Lampreys in the lake, Plosila et al. (1986) expressed skepticism. We accept these early records but recognize that the first vouchered specimen came from Chazy Landing (Greeley 1930). Wilson (1955) sampled extensively and reported catches in the lake. Control programs have been under way since 1988 (Fisheries Technical Commission 1999). Recent genetic studies have shown the Sea Lamprey to be native to the basin (Bryan el al. 2005; Waldman et al. 2006) and Marsden and Langdon (2012) examined changes in predator-prey relationships.

Chemung (1). There are no records of Sea Lampreys in this watershed. Because the species was reported in the Susquehanna River in Pennsylvania (Fowler 1919) and New York (Greeley 1936), however, it is likely that it was native to this watershed as well.

Susquehanna (1). Greeley (1936) noted that Sea Lampreys were rare. He (Greeley 1936) continued: "The survey did not obtain any Susquehanna specimens but it was reported that larvae were sometimes secured from the Otselic River near Whitney Point and near Lisle. Dr. H.S. Gage has noted sea lampreys in the Susquehanna area." The records mentioned by Greeley (1936) are from 1907 (Gage 1927). Fowler (1919) described the species' distribution just downstream in Pennsylvania.

Delaware (1,2,3). Greeley (1936) noted: "Moderately common in the Delaware River and many tributaries...The frequency ranking for this species was 30th for the Delaware [i.e., present in 2.5% of samples]. The larvae, which live in the mud, are an important source of bait for bass. The main Delaware is the most important spawning area, but lampreys also ascend Callicoon Creek, Tenmile River, Neversink River, Brasher Kill, Beaver Kill and the East Branch of the Delaware River." This species continues to be widely distributed in the watershed, and ammocoetes were caught in 2011 in the Neversink River at Bridgeville, 42 km above the mouth.

Upper Hudson (2). Makarowicz (1983) reported captures at nine sites in 1983, in the Hudson River between Lock 1 and Lock 4.

Lower Hudson (1,2,3). Greeley (1935) provided a history of the Sea Lamprey in the Hudson River: "Fishermen reported observing sea lampreys just below Troy dam and in lower Hannacrois Creek." DeKay (1842) wrote: "I have observed them at Albany in the spring, and was assured that they were taken a few miles below that city." Other records included an ammocoete from Rondout Creek and an adult from Catskill Creek, and Greeley (1937) continued: "It is of interest that the sea lamprey is much less common in the Hudson River than in the Delaware." Sea Lampreys continue to be captured and observed in Hudson River tributaries (Evans and Limburg 2014). Spawning was observed at the lower falls of Kaaterskill Creek on 20 May 1988 (DMC, pers. obs.).

Long Island (1,2,3). Greeley (1939a) reported that this species was common and that it used lower reaches of streams of both the north and south shores for spawning. It was collected in the Nissequogue, West Branch Nissequogue, Swan, Patchogue, and Connetquot rivers in Suffolk County in the 1990s and 2000s.

Acipenseridae, Sturgeons

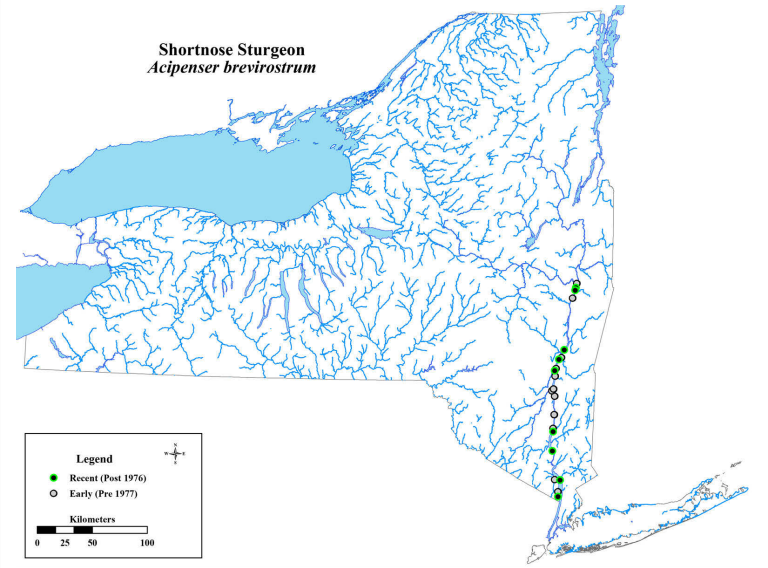
Sturgeons are arguably the most distinctive fishes found in the freshwaters of New York. Their distribution in New York is confined to the largest rivers and lakes. The largest species in the state is anadromous, a second species is estuarine, and the third species is only found in freshwater. All three species are native to the state, rare, and classified as Threatened or Endangered.

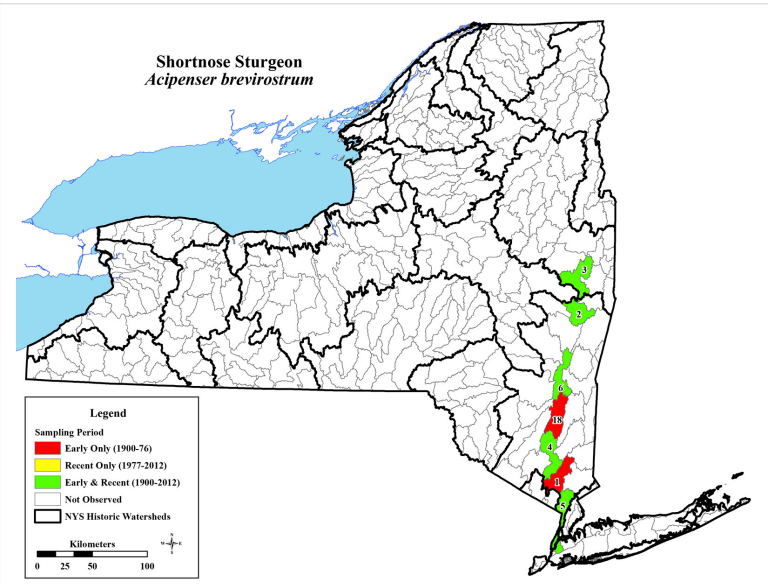
Acipenser brevirostrum, Shortnose Sturgeon

This is an estuarine species, being found in the lower Hudson River. It travels into marine waters infrequently. This species is federally listed as an Endangered Species.

Upper Hudson (1). Dovel et al. (1992) noted that Shortnose Sturgeon moved upriver into this watershed and were reported spawning below Cohoes Falls in 1811. Sturgeon were also described in areas upstream of Albany in 1749 as leaping high into the air, especially on summer evenings (Brumbach and Bender 1986). Access to the upper watershed ceased with the addition of various barriers, especially the Federal Dam at Troy, completed in 1916. There is no evidence that this species moves through the lock associated with the dam.

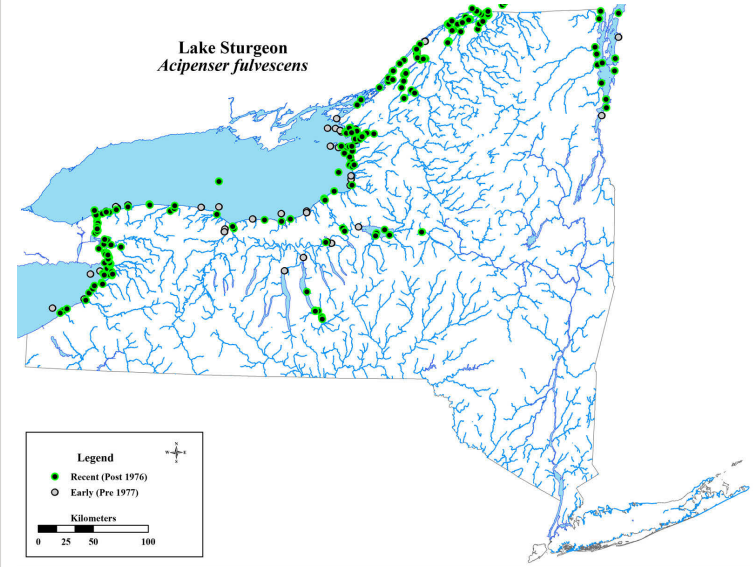
Lower Hudson (1,2,3). Greeley (1935) wrote: "This is one of the rarest of the North American fishes, the Hudson River being one of the few places where it is still to be found." He (Greeley 1935) also noted: "It does not reach a large size. An adult female containing spawn of mature size was taken in the Hudson River in the vicinity of Albany during February 1934." Studies since the 1970s have reported details of Shortnose Sturgeon spawning success and population size (Dovel et al. 1992, Bain 1997, Woodland and Secor 2007). At present, this species is known to spawn downriver of the Federal Dam, and its inland population is confined to the lower Hudson watershed (Woodland and Secor 2007).

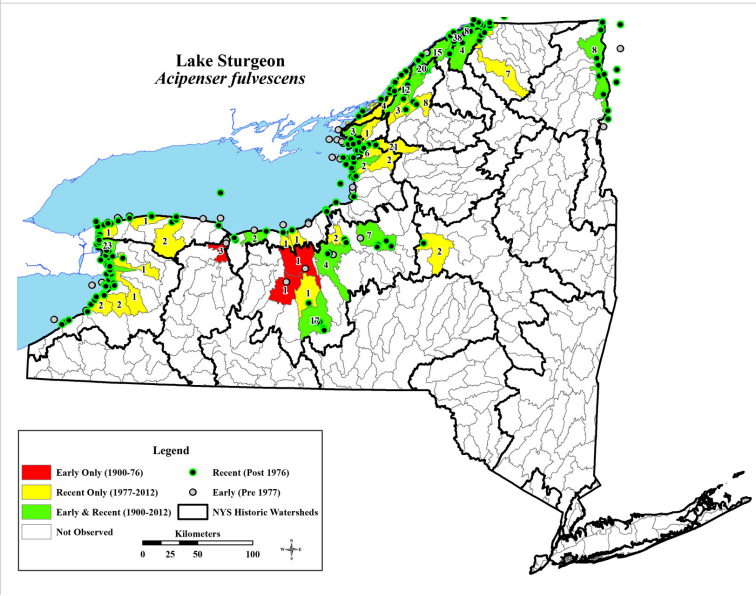




Acipenser fulvescens, Lake Sturgeon

The Lake Sturgeon is native to the Erie-Niagara, Ontario, Genesee, Oswego, Black, Oswegatchie, Raquette, Saint Lawrence, and Champlain watersheds; it is exotic in the Mohawk watershed. This species is classified as Threatened in New York.





Erie-Niagara (1,2,3). Greeley (1929) noted: "Although once an important commercial fish in Lake Erie and the Niagara River, few are now taken." Smith and Snell (1891) described historic catches and spawning areas near Buffalo and Cattaraugus Creek. Catches have become more common in the upper Niagara River, and a yearling was seen at Black Rock Canal near Buffalo in 1993. From 2001-2003, about 35 individuals were found dead along the Lake Erie shore. Death resulted from Type E Botulism, which was traced to the fish's diet of Round Goby and zebra mussel (Stone and Okoniewski 2002). Spawning aggregations were observed in May 2009, near Buffalo Harbor. The lower Niagara River appears to be the most important spawning area for this species in the state.

Ontario (1,2,3). Greeley (1940) noted: "Two specimens were obtained through courtesy of fishermen of the Selkirk region. The University of Rochester has a specimen from Lake Ontario off Lake Bluff, October 23, 1928 [CUMZ 28084]." Evermann and Kendall (1902b) reported collections at Cape Vincent. Smith and Snell (1891) described the Lake Ontario fishery. Studies conducted in the late 1990s showed a recovering population in the lower Niagara River (Hughes 2002), and the trend toward recovery was supported by similar studies in 2010 (Gorsky et al. 2013).

Genesee (1). Greeley (1927) noted that this species rarely ascended into the lower Genesee River. However, its abundance in this area may have been greater in the decades prior to the 1926 survey. For example, spawning aggregations were described below the falls at Rochester by Seth Green in 1864. An anecdotal report noted juveniles dead below the lower falls in the 1970s. Experimental stocking in this same area in 2003-05 was followed by several captures by anglers and netting by USGS personnel from the Cortland Office.

Oswego (1,2,3). Incidental captures were reported from Oneida and Cayuga lakes as early as 1858. Reed and Wright (1909) reported Lake Sturgeon in Cayuga Lake and from the Seneca and Cayuga Canal near Montezuma. Greeley (1928), based on anecdotal reports of a local resident, Earl Brown of Oswego, noted that sturgeon sometimes ascend the lower part of the Oswego River. Spawning aggregations in the Oswego River have only been documented downstream of Oswego,

Species continued on next page

leading Carlson (1995) to conclude that these sturgeon are part of the Lake Ontario population. A stocking program has been underway since 1995, and fish have been reintroduced in Oneida and Cayuga lakes; observations of sturgeon over 1 m in length are not uncommon in Oneida Lake and the Oswego River.

Black (2,3). Specimens have been taken at the mouth of the Black River and as far upstream as the dam at Dexter. A local commercial harvest existed prior to 1960 and spawning was reported during this period (Jolliff and Eckert 1971). Klindt and Adams (2006) documented spawning as well. Welsh et al. (2008) found that the genome of this population differs from that of populations at Niagara Falls and downstream of Moses Sanders Dam on the Saint Lawrence River.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that the Lake Sturgeon was "moderately common in the St. Lawrence River...It is reported to be taken, quite frequently, in the lower waters of the larger rivers, particularly the Grass... Although sturgeon are commercially extinct at the present date in many waters of the Great Lakes, the St. Lawrence fishery appears to be comparatively good." Lake Sturgeon were caught during extensive sampling of the area from 1998-2007 (Hayes 2000; Carlson et al. 2002; Trested 2010). Studies by Welsh and May (2007) and Welsh et al. (2008) indicated that the Saint Lawrence River supports several genetically distinct populations. From 2000-2006, the Saint Regis River from Brasher Falls to Hogansburg was stocked with juvenile sturgeon (Dittman et al. 2010a). The area below the Moses Saunders Dam appears to be the second most important spawning site in New York.

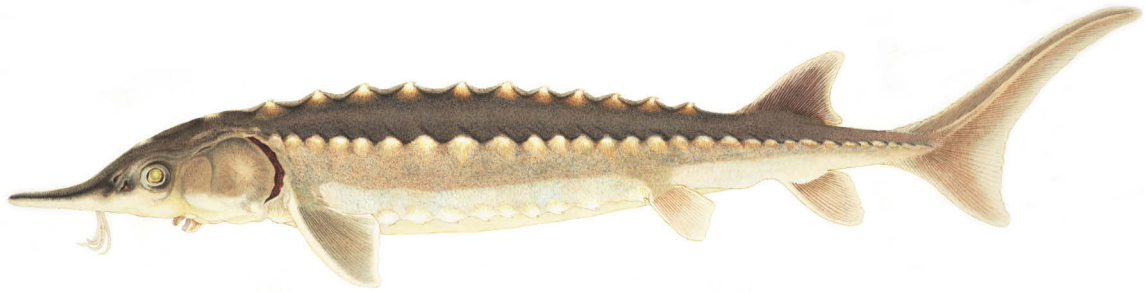
Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that no Lake Sturgeon were collected during the survey but noted that they were reported from Black Lake and the lower reaches of the Oswegatchie River. This species was commercially harvested in this area from the early twentieth century into the 1960s. Fish were stocked in Black Lake and the Oswegatchie River between Elmdale and Wegatchie from 1995-2004. An assessment of the program determined that the population now inhabits the 100 km of river to Natural Dam and the lower 30 km of Indian River, including Black Lake (Carlson et al. 2002). Seventeen years after the first stocking of fingerlings, Lake Sturgeon were observed spawning upstream of Black Lake in 2012 according to the USGS Office in Cortland.

Raquette (1,3). There are anecdotal reports of sturgeon ascending this river (Greeley 1934) and in 1994, some spawning adults were caught at Raymondville, 30 km from the mouth. Fingerlings were stocked in 2004 and 2013, and juveniles were caught at Massena in 2007. USGS personnel speculated that these may have been stocked individuals.

Champlain (1,3). Greeley (1930) indicated that this species was uncommon. He (Greeley 1930) went on to note: "A single specimen was obtained from near Rock Island [which is in Vermont] in a gill net...Apparently there are few, if any, taken by fishermen now." Moreau et al. (1993) described spawning areas in Vermont, but there is no report on spawning areas that may exist in New York. Use of these Vermont spawning areas appears to be continuous, with collections of adults, eggs, and/or larvae in Otter Creek and the Winooski, Lamoille, and Missisquoi rivers from 1998-2005 (MacKenzie 2008).

Mohawk (**3**). Since 2000, this species has become abundant in Oneida Lake in the Oswego watershed, which is directly connected to the Mohawk watershed by the Erie Canal. Outmigrants have been captured in the Rome and Utica portions of the canal in 2000.

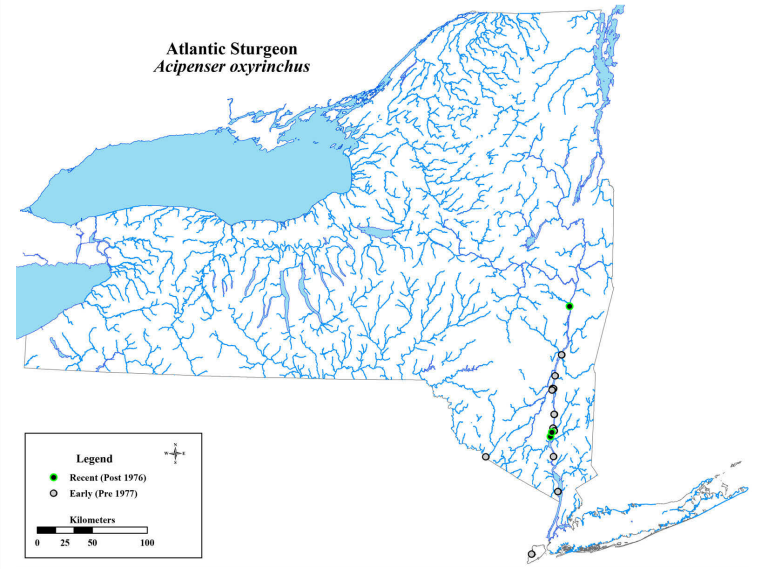
Acipenser oxyrinchus, Atlantic Sturgeon

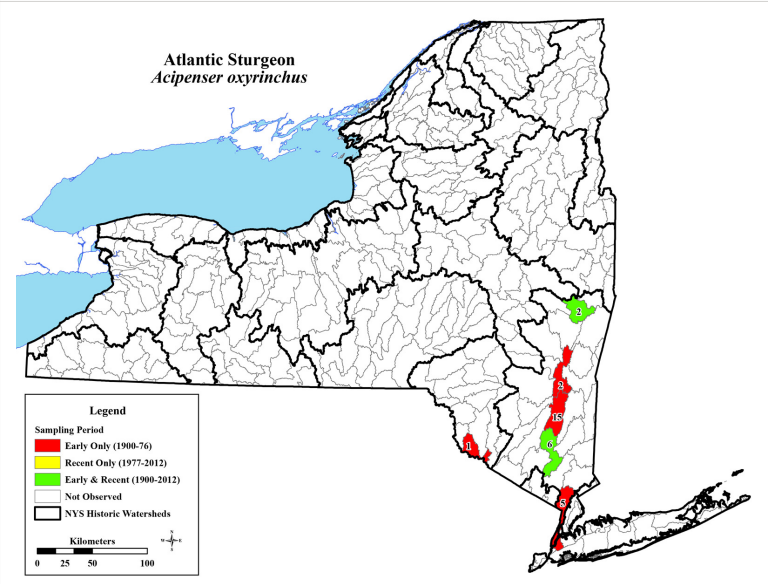


This anadromous species, or rather the distinct populations associated with the Mid-Atlantic states, was listed as Endangered under the Endangered Species Act in 2012. It migrates up large coastal rivers, like the Delaware and Hudson rivers, to its spawning areas.

Delaware (1). The only New York record is a newspaper report describing an observation from the vicinity of Port Jervis (Nelson 1890).

Lower Hudson (1,2,3). Greeley (1935) noted that the Hudson River population was in decline: “Large sturgeon, once the object of a considerable fishery in the Hudson, are now scarce but are still taken occasionally, rarely as far upstream as Albany. The immature young sturgeon, usually less than two feet long, are well known to the shad fisherman under the name of ‘pelican.’” Greeley (1937) also noted that Atlantic Sturgeon were most common downriver of the city of Hudson. More recently, this species has been most common downriver of Kingston (Smith 1985). Management agencies had unsuccessfully hoped to manage declining coastal stocks without an endangered species classification; Dovel et al. (1992), Bain (1997) and Kahnle et al. (2007) have discussed its status, but Atlantic Sturgeon was nonetheless recommended for listing in 2010.

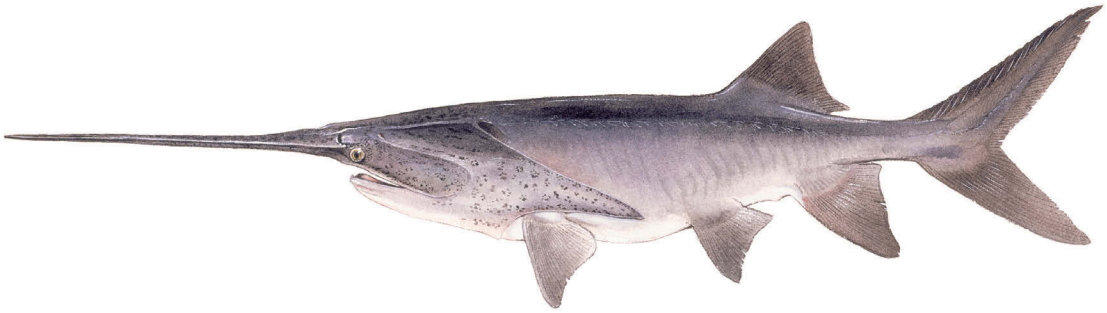




Polyodontidae, Paddlefishes

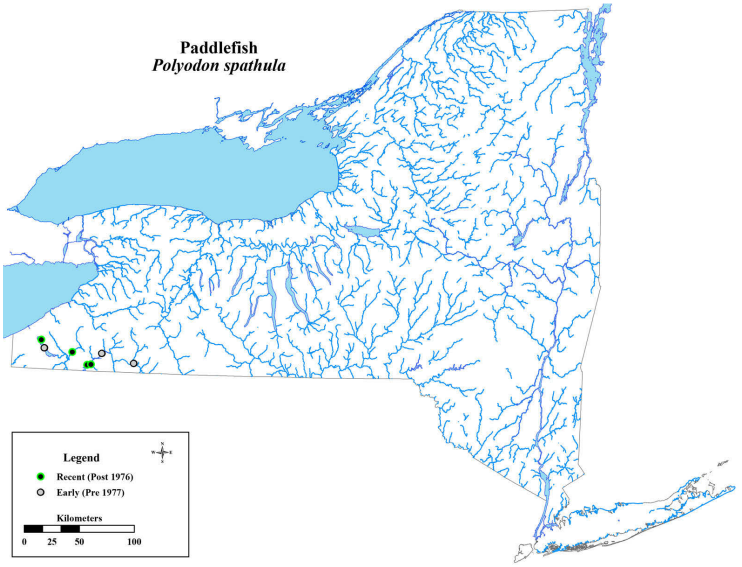
The presence of a native population of Paddlefish in the Allegheny watershed in New York is supported by only a few early accounts. The species had been extirpated from New York but was recently reintroduced and, although still rare, a population is establishing itself.

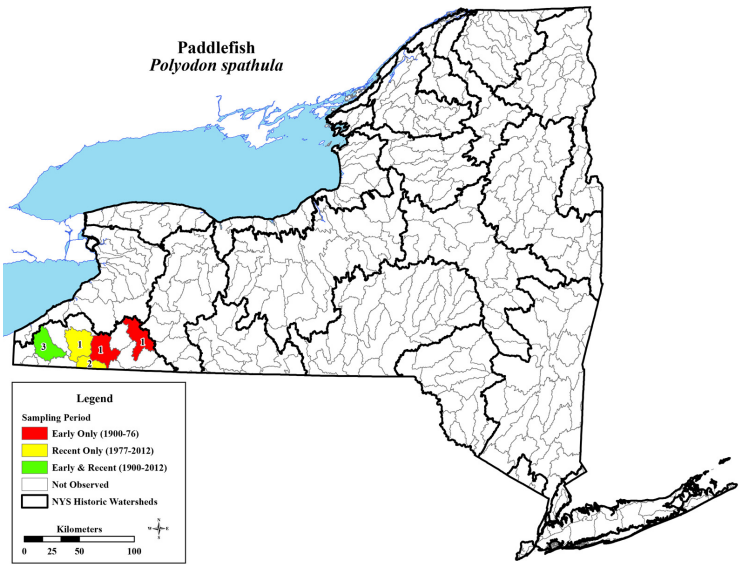
Polyodon spathula, Paddlefish



The Paddlefish is an inhabitant of backwaters of low-gradient rivers and lakes in the Allegheny watershed, such as Chautauqua Lake. Smith (1985), citing Trautman (1981), discussed the status of this species in Lake Erie and noted that there were only a few reliable accounts, none of which was in New York. This species is identified as a High Priority Species of Greatest Conservation Need in New York.

Allegheny (1,3). The earliest record of this species in New York is a newspaper account from the *Jamestown Post Journal*, dated July 15, 1872. Evermann and Goldsborough (1902) noted a report from Chautauqua Lake in 1890. Fowler (1907, 1919) recorded Paddlefish from the Allegheny River near Salamanca and Olean in New York and farther upstream in McKean County, PA. There are no records of capture or observation after these, and the species was presumed to be extirpated above Kinzua Dam. From 1998 to 2013, fingerlings were released into the Allegheny River, Conewango Creek, and Chautauqua Lake as part of a restoration program (Brewer and Clancy 2015). Although a sexually mature Paddlefish was found in 2010, evidence of successful reproduction has not been observed (Budnik et al. 2014). As an additional management concern, Budnik et al. (2014) reported that almost half of the radio-tagged individuals left the reservoir during the four-year study period, many by passing through the Kinzua Dam with unknown consequences.





Lepisosteidae, Gars

Gars are native to the Mississippi and Saint Lawrence drainages and populations in New York are disjunct. Only one species has been documented in the state. The status of two other species merits comment, however. Smith (1985) suggested that the Spotted Gar (*Lepisosteus oculatus*) is a possible inhabitant of the state. It is present in Lake Erie but has not yet been reported in New York waters. The Shortnose Gar (*Lepisosteus platostomus*) was reported from Chautauqua Lake in the 1890s (Evermann and Goldsborough 1902). Smith (1985) was lukewarm in his treatment of this species and noted that no specimens were vouchered for later identification, and McKeown (2000) was openly skeptical. Without evidence to the contrary, we accept Evermann and Goldsborough's (1902) report of Shortnose Gar in New York. Neither the Shortnose nor the Spotted Gar are treated further in this atlas.

Lepisosteus osseus, Longnose Gar

This is a widely distributed but rarely observed species found in the Allegheny, Erie-Niagara, Ontario, Genesee, Oswego, Black, Saint Lawrence, Oswegatchie, Raquette, and Champlain watersheds, where it is native, and in the Lower Hudson watershed, where it is introduced.

Allegheny (1,2,3). Longnose Gars have been, and continue to be, reported from Chautauqua Lake. A specimen was collected in Goose Creek, a south-shore tributary of Chautauqua Lake, in 1860 (CUMV 41278). The only recent stream records are from Goose Creek, where the species was taken between 1920 and 1940, and the Chadakoin River, a few miles downstream from the lake, in 1989.

Erie-Niagara (1,2,3). This species was moderately common in Lake Erie and the Niagara River during the 1928 survey (Greeley 1929). There are also records from the Niagara River and the lower portions of the Buffalo River and Eighteenmile, Walnut, Muddy, and Cattaraugus creeks.

Ontario (1,2,3). Greeley (1940) noted: "Records obtained by the survey include the following: South Pond, Sodus Bay, Long Pond, Port Bay, Irondequoit Bay, Selkirk Pond, Blind Sodus Bay, and Cranberry Pond." During the past decade, this species was captured more frequently, but its range has not increased beyond the same lowland areas where it was reported in the 1930s.

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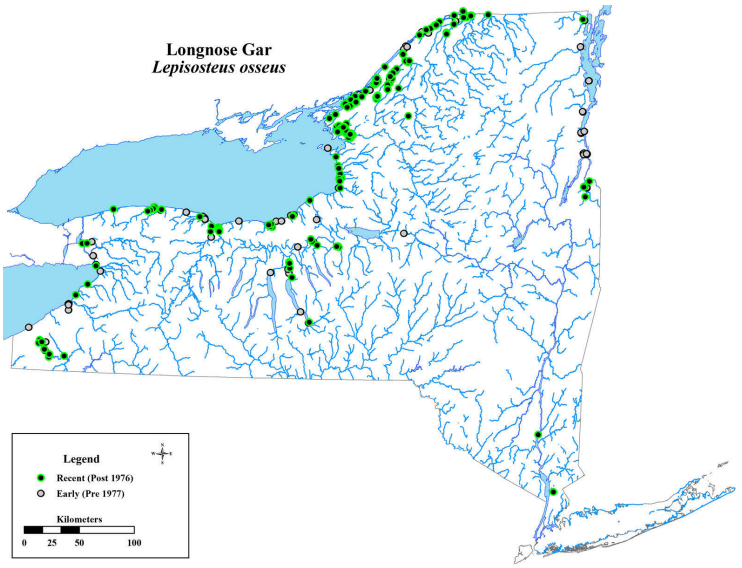
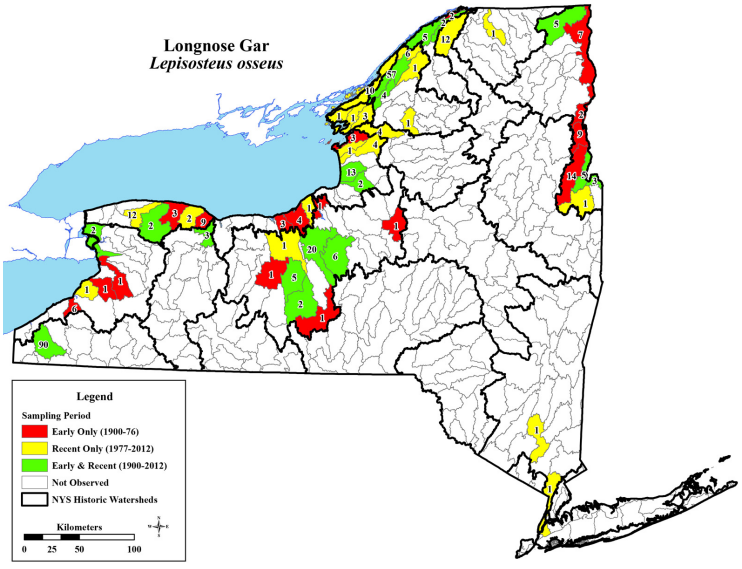




Genesee (2,3). Greeley (1927) speculated that this species "doubtless enters the mouth of the Genesee River, though none were seen." The first records upstream of the falls in Rochester and at the Erie Canal were in 1975. A specimen was taken downstream of the falls in 2001.

Oswego (1,2,3). Greeley (1928) reported this species from Oswego watershed lakes and rivers, including the Seneca and Oswego rivers. He (Greeley 1928) also noted that it was once common but had declined in abundance in the years prior to the survey. A specimen taken in the 1850s (MCZ 23503) is reported to be from Rome, NY. Because the exact location of the collection is uncertain, we assume that the collector named the nearest city to the collection site. Rome is near Oneida Lake and a collection from this lake or its tributaries would not be unusual; a collection from the Mohawk River or the Erie Canal in Rome would be surprising but possible. Occasional catches still occur as far east as Onondaga Lake, where this species was caught in 1990.

Black (1,3). Specimens have been collected at the mouth (Greeley and Bishop 1932) and as far upstream as the dam at Dexter. More recent sightings are only from the mouth of the river.

Saint Lawrence (1,2,3). According to Greeley and Greene (1931): "It inhabits the St. Lawrence River and comes into the lower courses of streams...Young specimens were obtained at the mouth of Little Sucker Brook on July 1 and in the lower Grass River near Massena on July 17." Catches remain episodic.

Oswegatchie (1,2,3). Greeley and Bishop (1932) focused on the problem between anecdotal information and survey attempts when they noted that "Black Lake is reported to have many gar but only four were collected in the many seine hauls made there. However, several adults were seen, apparently spawning on rocks below the main dam at Rossie, in the Indian River on May 29 (C.W. Greene). This is just above Black Lake." Odell (1932) noted that Longnose Gars were common in Butterfield Lake, where they continue to be commonly caught in recent decades. A 1990 record from Mud Lake may represent an individual from a stocking attempt that failed to establish a sustainable population; no gar have been collected from the lake since.

Raquette (1,3). Greeley (1934) only reported this fish from the mouth of the Raquette River and noted that it ascended from the Saint Lawrence River. It is still occasionally caught in the area.

Champlain (1,2,3). Greeley (1930) noted that this species was "common in Lake Champlain, especially in the shallow, weedy bays. It is very common in South Bay, Missisquoi Bay, and near mouths of creeks where there are weed beds." This assessment was corroborated by Trembley (1930). In recent decades, this species was recorded from the same areas noted in the 1920s and has also been collected in the Champlain Canal.

Lower Hudson (**3**). Longnose Gars have been collected at two sites in this watershed: in the Hudson River in 1989 (NYSM 31041) and the Sawmill River in 1994 (AMNH 228138).

Amiidae, Bowfin

Bowfins are found in slow-moving, weedy areas in large streams and in lakes. This fish occurs in most drainages in the state, but populations are widely separated and relatively small. The species is native to New York, although it is likely that it has been introduced into certain southern drainages in the state.

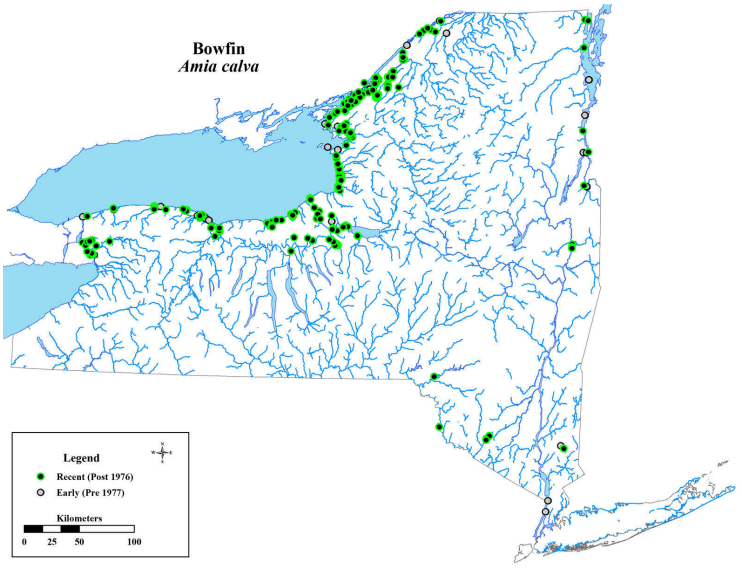
Amia calva, Bowfin

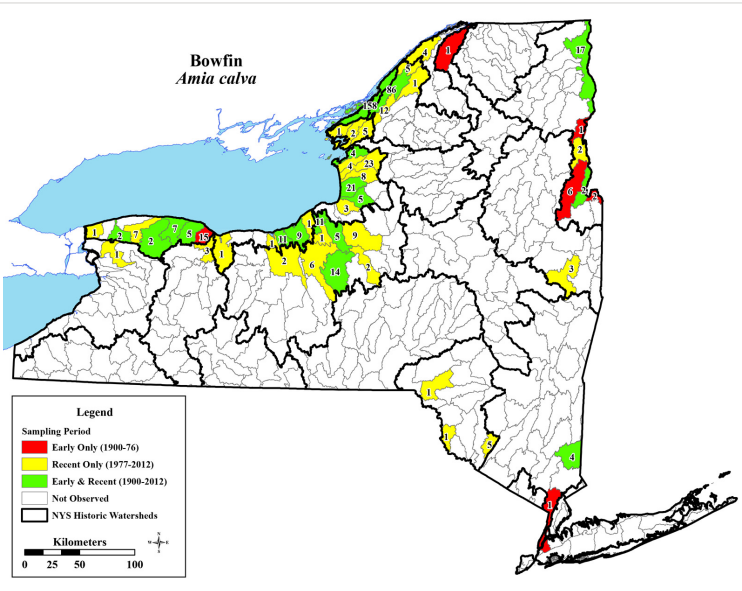
This species is native to the Saint Lawrence River watersheds (Erie-Niagara, Ontario, Genesee, Oswego, Black, Oswegatchie, Raquette, Saint Lawrence and Champlain) and exotic to those of the southern tier (Delaware, Upper and Lower Hudson) and Long Island.

Erie-Niagara (1,2,3). None were reported by Greeley (1929), but Bean (1903) listed this species as being present in the Great Lakes system and it was collected near Buffalo in the early 1900s (MCZ 154872). The second recorded capture was in 1961, and this species is now recognized as being widely distributed in weedy areas of the upper Niagara River.

Ontario (1,2,3). Greeley (1940) wrote that "specimens were taken in Cranberry, Round, Buck, Long, and South ponds; in Braddock, Little Sodus, East, Port, Sodus and Irondequoit bays; and in two streams near the mouths (Oak Orchard Creek and tributary 1 of the Salmon River near Hilton)." Bowfin have also been reported from Sandy Creek in Jefferson County. More recent capture sites include these same areas, as well as Lakeview Pond and Chaumont Bay.

Genesee (2,3). Greeley (1927) speculated that this species moved into the mouth of the river from Lake Ontario, but none were collected during the 1926 survey. Specimens were collected in the downstream section of the river in 1949 (CUMV 22487) and in 2002, suggesting that Bowfin remain rare below Rochester Falls. In 1978 and 1979, individuals were taken above Rochester Falls in the Seneca Park Ponds near the Genesee River. The presence of this species above the falls may result from stocking, or out-migrants from the Erie Canal may inhabit the ponds, at least temporarily.





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Oswego (1,2,3). Early information was anecdotal. According to Greeley (1928), the species "occurs in the Seneca river, Cayuga, Neahtawanta and Oneida lakes and other large bodies of water. Formerly it was very common in Cayuga lake and the Seneca river but now nearly exterminated, probably due to the draining of the marsh areas where it spawned." Specimens have occasionally been caught in these areas more recently, which suggests that the species has re-established itself. Bowfin have become common in Oneida and Cross lakes and are occasionally reported in the Erie Canal near Montezuma (B. Trometer, USFWS, Basom, NY, pers. comm.).

Black (3). The lower portion of the river is accessible to fishes present in Lake Ontario. The species probably enters this part of the river regularly but has only been reported once, in 2003.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that "one specimen was taken in a trap net set in the St. Lawrence River at Ogdensburg September 6. A very large dogfish, over 20 inches long, was seen in a shallow weed-choked lagoon at the mouth of Tibbits Creek (at Ogdensburg) on the night of September 11." Greeley and Bishop (1932) listed an additional five collection sites in the watershed. Most recent records are from the Thousand Islands region of the Saint Lawrence River, with several others from areas near Massena.

Oswegatchie (1,2,3). Greeley and Bishop (1932) collected 169 individuals from "a single school of young…noted on June 20th in Black Lake." They (Greeley and Bishop 1932) also reported that "a large adult was seined from Black Creek (tributary 8 of Black Lake)." Bowfin continue to be caught in the lowland areas and in Butterfield Lake.

Raquette (1). Greeley (1934) noted: "A large specimen was taken in the Raquette River below the Raymondville dam." No recent records exist.

Champlain (1,2,3). Evermann and Kendall (1902a) recorded Bowfin from the lake at Whitehall and Westport. Greeley (1930) collected individuals at Ticonderoga and in Missiquoi Bay. More recently, specimens were collected from South Bay in 1979 (AMNH 43889), Bulwagga Bay in 1980 (AMNH 43865), the lower Great Chazy River in 1984 (AMNH 55853), and again at Ticonderoga in 2009.

Delaware (**2,3**). The only catches have been from Basher Kill marsh and the Delaware River; the earliest records are from 1981 (NYSM 58735).

Upper Hudson (**3**). The earliest record in the upper Hudson River is from 2007, in the vicinity of Schuylerville. These individuals may be stocked or may be out-migrants from Lake Champlain.

Lower Hudson (**2,3**). The earliest records are from the 1940s, one from Hastings-on-Hudson in 1941 (AMNH 15797) and the other from the Bronx in 1945 (AMNH 16650). In 1988, Bowfin were found in the main channel near Norrie Point, rkm 140. The species has also been taken in the West Branch Croton River and West Branch Croton Reservoir in the 1970s and 1980s. The disjunct nature of these capture sites and the infrequency of capture suggest point introductions.

Long Island (**2**). There is a single record from Canaan Lake, north of Patchogue, in 1972 (AMNH 30936).

Hiodontidae, Mooneyes

A single species is found in New York in larger rivers and lakes and is rare. This species is identified as Threatened in New York.

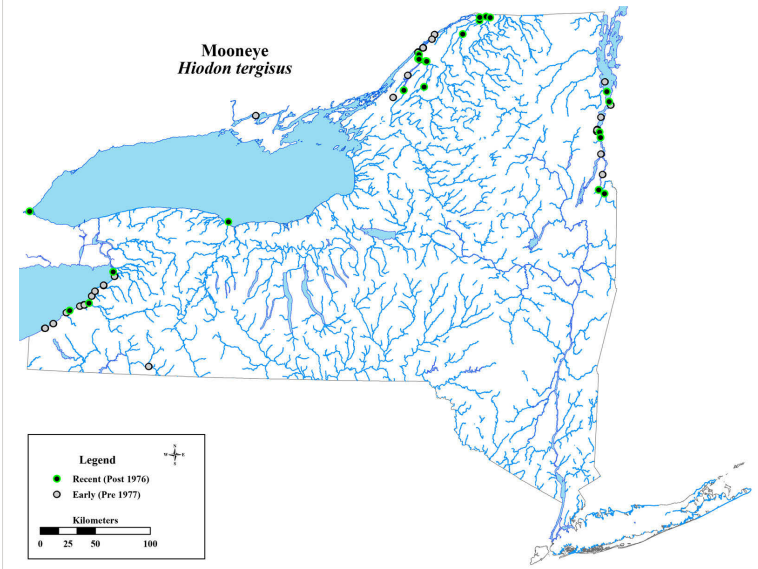
Hiodon tergisus, Mooneye

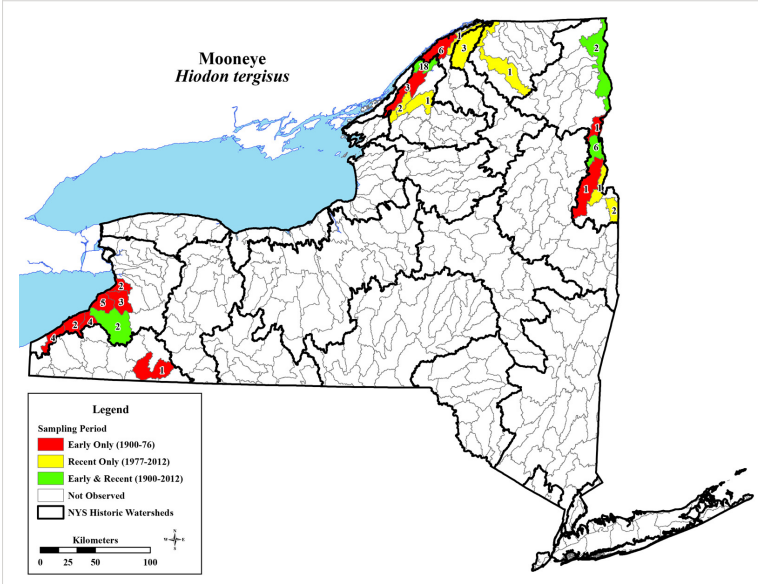
There is an early report from the Allegheny watershed, but all other records in New York are from the Saint Lawrence River watersheds.

Allegheny (1). DeKay (1842) reported Mooneye from the New York portion of the Allegheny River and Bean (1903) cited DeKay. This species is currently found in the Ohio River basin (Lee et al. 1980) but only downstream of the Allegheny River confluence.

Erie-Niagara (1,3). Greeley (1929) noted that this species was common in Lake Erie and that schools were observed along shorelines and in the mouths of streams, including Eighteenmile, Silver, Canadaway, and Muddy creeks. After the late 1990s, catches in the Dunkirk and Buffalo areas of Lake Erie and in the lower reaches of Cattaraugus Creek during spawning have been sporadic.

Ontario (1,3). Greeley and Bishop (1932) and Greeley (1940) reported this species as present but based that on earlier reports or anecdotal information. Crossman and Van Meter (1979) explained the presence of this species in the Bay of Quinte (Dymond et al. 1929) as the result of fish straying from the Trent River. Although a lake-dwelling species, its presence in the lake is rare and disjunct, and individuals may be strays from the Saint Lawrence or Niagara rivers. A few individuals were caught in Hamilton Harbor in 1984 and the Bay of Quinte in 2001 (Ontario Ministry of Natural Resources 2004). Brazner et al. (2007) reported a Mooneye near Braddock Bay in 2003, but no specimen was vouchered.





Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that Mooneyes were relatively common in the main channel. In addition, they (Greeley and Greene 1931) noted that "a gill net, set at the mouth of Tibbits Creek (at Ogdensburg) took 20 large mooneyes on the night of July

Species continued on next page

3. These were adult fish and some of them, at least, were in spawning condition." Another specimen was caught in 1933 at Massena (Greeley 1934). Mooneyes have been caught in the Thousand Islands region on the Canadian side of the river in 1987 and 1991 (Ontario Ministry of Natural Resources 2004). Other recent records include: the Saint Lawrence River at Ogdensburg in 1973, upstream of Iroquois Dam in 1976, the lower Grass River in 1995, and from the Saint Regis River at Hogansburg in 2012 (USGS). Episodic Mooneye catches in the Canadian part of the river downstream of New York have been reported as well (Mongeau 1979; LaViolette et al. 2003).

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported catches from the Oswegatchie River at Ogdensburg. They (Greeley and Bishop 1932) further noted: "Eggs of the mooneye were numerous in the Oswegatchie River just below the Ogdensburg dam, June 3. They were in the same habitat as eggs of *Moxostoma aureolum* [= *M. macrolepidotum*], among rocks in rapid current in a depth of water of two feet and less." In the early 2000s, individuals were caught below Heuvelton and at Remmington Rapids at the tail end of the Heuvelton impoundment and near Eel Weir State Park (HDT/DTA 2010). A small population has maintained itself in Black Lake, where spawning has also been observed at Rossie.

Raquette (3). An individual was caught by an angler just below Raymondville in 2006. In 2011, this species was taken in nets near the mouth of the river (J. McKenna, USGS, Cortland, pers. comm.).

Champlain (1,2,3). The presence of Mooneye in the lake was first reported by Thompson (1842). Greeley (1930) noted that this species was not common, "although in late summer a few are caught by anglers near Port Henry. These fish are said to come close to shore in schools, especially on still nights, and to bite well on a bait of minnows, grasshoppers, or worms." No specimens were obtained during the 1929 survey of the watershed (Greeley 1930), but angler catches were examined on 3 August 1931 at Port Henry, and these anglers reported that Mooneyes were caught near the Port Henry dock each year (Greeley 1932). Anderson (1978) reported a catch in 1976 from just south of the Bouquet River to Lewis Creek (VT). In 1985, a specimen was taken at Crown Point State Campsite (NYSM 24802). An angler reported another individual from the Mettawee River in 1989 (D. Bouton, NYSDEC, pers. comm.). Larval fish collections east of Bouquet River Point on 23 May 2000 included several late yolk sac larvae (M. Malchoff, NY Sea Grant, pers. comm.) and on 16 May 2001, yolk sac larvae were again caught northeast of Split Rock (NYSM 62018).

Anguillidae, Freshwater Eels

The American Eel is native to all drainages in New York. The life cycle of this species is complex: adults leave freshwater to spawn in the Sargasso Sea; larvae, called leptocephali, drift and then actively migrate to coastal streams; once in freshwater they transform and move upstream, some traveling thousands of kilometers. Individuals grow in freshwater for several years and then begin the migration back to the ocean and spawning grounds. Historically, it was not unusual to find large eels in small pools in upland streams throughout the state. Because they are migratory, they inhabit multiple habitats at different times during their lives. This species is identified as a High Priority Species of Greatest Conservation Need in New York.

Anguilla rostrata, American Eel

This catadromous species has been reported from all of New York's watersheds but is not native to Lake Erie.

Allegheny (1,2). Fowler (1919) reported American Eels in Potter County, PA, upstream of the New York portion of the river, which means that this species at least must have migrated through New York at this time. This species was not caught by Greeley (1938) in New York, nor by Raney (1938) in a more extensive survey of the Ohio River basin in Pennsylvania. The Kinzua Dam now blocks upstream movement. The Pennsylvania Fish Commission stocked elvers in 1963 in the Allegheny Reservoir, and two were caught by anglers near Olean after 1967 (Eaton et al. 1982). Individuals were caught sporadically during electrofishing surveys in the Allegheny River, Oil Creek, and Lower Cassadaga Lake between 1967 and 1970.

Erie-Niagara (**1,2,3**). Greeley (1929) noted that "Most of the eels taken within the area under study are caught at the mouth of the Niagara River, with hook and line." Because the Niagara River of this watershed is below Niagara Falls, fish in this portion of the watershed are native. Few eels have been caught upstream of Niagara Falls. These fish, which were from the Buffalo area in 1963, 1964, and 1987, as well as Dunkirk (Smith and Snell 1891), were not native.

Ontario (1,2,3). Few American Eels were collected during the watershed survey of 1939, and Greeley (1940) noted that assessing abundance and distribution based on gillnet catches of eels is difficult.

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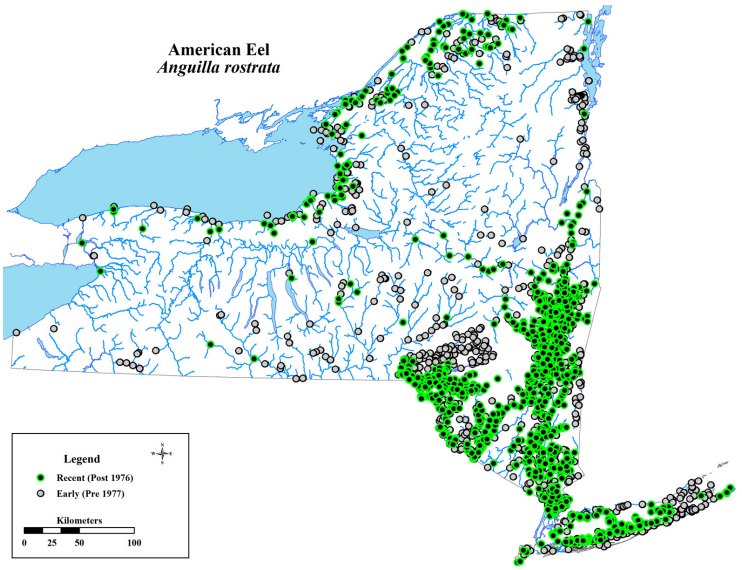

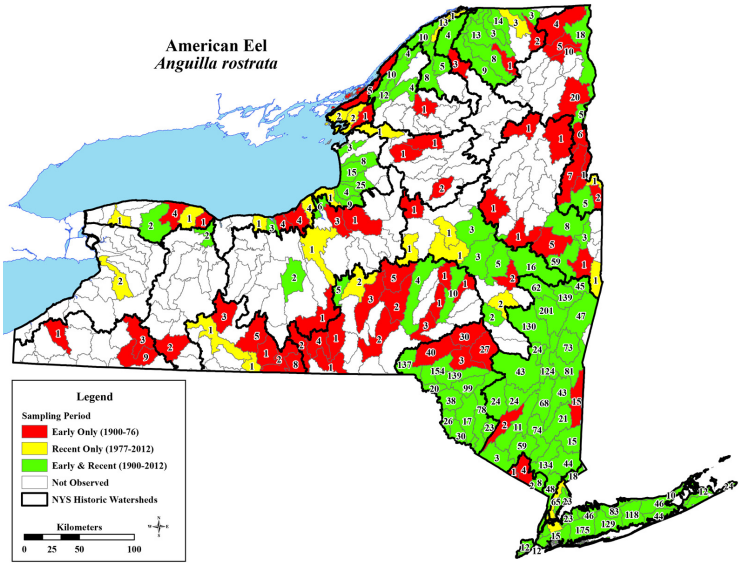

Between 1960 and 1986, specimens were collected at 25 sites within the Lake Ontario watershed, including the lake; between 1987 and 2005, eels were taken in nine waters, including Lake Ontario. This suggests a reduction in abundance and range but in itself is inconclusive. The area near the mouth of the Black River supported a commercial fishery through the 1980s, but an extensive survey of that entire area, including Chaumont Bay, in 1996 encountered only one American Eel. The loss of the commercial fishery supports the contention of a population decline, which has been seen throughout the Northeast, particularly in the Saint Lawrence River drainage (Haro et al. 2000).

Genesee (1,2,3). Greeley (1927) noted the importance of barriers to the distribution of the American Eel in this system: "Occurs above Rochester Falls but is rare. (Mr. Edw. Bush of Rochester has taken it about 10 miles south of the city.) [It] does not occur above Portageville Falls." There are two records from Rushford Lake in 1937, but these are not likely to be in the native range of the species (S. Cornett, NYSDEC Allegany, pers. comm. 2005). It is probable that the Rochester Falls, which are a substantial barrier to upstream migration, limited the native range of this species to the main channel and tributaries downstream. It is also possible that small numbers could have bypassed the falls under extreme conditions, and the ability to circumvent the falls increased with the construction of canals in the nineteenth century. This species was stocked above the falls by the US Fish Commission in 1877 (Wright 2006).

Oswego (1,2,3). In the late 1920s, Greeley (1928) noted that the American Eel was "moderately common throughout the Clyde, Seneca, Oneida and Oswego Rivers and Cayuga Lake." Eels gained access to Keuka Lake through the locks of the Crooked Lake canal, and after this artificial system was abandoned, they declined and were extirpated from the lake (Eaton 1928; Dittman et al. 2010b). Recent reports of their capture in this watershed are rare.

Black (1,2,3). Mather (1886) reported the American Eel from Adirondack watersheds and cited a personal communication with C. Hart Merriam, who noted that "eels are common in Black River and in many of its tributaries." Greeley and Bishop (1932) reported only two catches resulting from their own survey work. Dams on the river between Dexter and Carthage have blocked passage since the early 1900s, as have the dams on the Saint Lawrence River. Long-time resident Roger Sheppard of Lyons Falls, when recalling his childhood in the 1920s, remembered seeing dozens of eels among the springtime frenzy of fish using the flooded river flats for feeding near Greig. Only four records exist of catches upstream of Dexter since 1931: Woodhull Lake in 1954, Crystal Creek in 1960, Bear Lake in 1978, and Black River at Glen Park in 1993. A massive fish kill occurred in 2005 on the Black River near Greig, where 2,621 fish of 21 species were examined and identified (McCullough and Hart 2010); none were American Eels and the species is likely extirpated from this upstream area.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that American Eels were common in the Saint Lawrence River and were also present at Lake Ozonia and Meecham Lake. There was an historic eel fishery on the Saint Lawrence River and its tributaries, where the catch was transported to market alive in specially designed scows (Greeley and Greene 1931). Construction of dams at Montreal and Massena coincided with declines in eel abundance in the river and its tributaries. In 2000, an eel ladder was installed on the Moses Saunders Dam on the Saint Lawrence River to mitigate, with some success, the effects of the dam and turbines on upstream and downstream migration (Kleinschmidt 2007). Despite the fact that dams have existed in the system for decades, eels have continued to decline in abundance over the last 20 years throughout the Saint Lawrence and Lake Ontario watersheds (Haro et al. 2000; Caron et al. 2003, Dittman et al. 2010c).

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that "one individual from Lake Ontario was seen and another was collected in the lower Oswegatchie River at Ogdensburg…Probably eels are less common than formerly in upland waters due to the increased number of dams." American Eels were reported 14 times between 1951 and 1973 and nine times between 1986 and 1996; there have been no reports since 1996. During earlier years, most collections in the watershed have been in the Indian River system and extended as far upstream as Red Lake (rkm 26, or 37 km from Saint Lawrence). In the main channel, eels have been reported as far upstream as Emeryville (rkm 106) and in a tributary to Silvia Lake (Dittman et al. 2010c). The farthest upstream record is from a tributary of the West Branch Oswegatchie River at rkm 27, which is 138 km from the Saint Lawrence. The eel fishery in this watershed was substantial, given that an eel weir was maintained into the 1930s in the lower Oswegatchie River just below the mouth of the Indian River. This area was later developed into Eel Weir State Park, and a hydroelectric dam in the area became the Eel Weir Dam.

Raquette (1,2,3). Greeley (1934) reported that there were occasional catches in the lower Raquette River, below Raymondville. Catches have been reported as far upstream as Higley Flow (Niagara Mohawk Power Corporation 1999).

Champlain (1,2,3). Greeley (1930) noted that American Eels were "common in Lake Champlain, ascending large streams… Although the species was recorded from Lake George in 1817 it is apparently rare or absent there now." The only recent record is from 1995 in Halfway Creek, which may have been a transient from the Upper Hudson watershed. Dittman et al. (2009a) described recent restoration efforts.

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Chemung (1,2). Greeley (1938) stated that "a single specimen from Waneta Lake constitutes the only record from survey collections but eels are reported as occasionally taken in the Chemung River, Cayuta Creek and a few other waters." Dittman et al. (2009b) noted that the species initially inhabited most of the basin. The most recent records are from the Chemung, Canisteo, and Cohocton Rivers in 1983.

Susquehanna (1,2,3). Greeley (1936) noted that dams in the main channel of the river in Pennsylvania have reduced the number of eels reaching New York waters and they were consequently taken at less than 1% of the watershed survey sample sites. Commercial catches at eel weirs near Waverly ended by the 1930s. Records prior to the 1900s are few, but eels were considered so numerous in Otsego, Goodyear, and Canadarago lakes that the species was labeled a nuisance, and a detriment to ongoing smallmouth bass stocking efforts (Odell and Senning 1938). Dittman et al. (2009b) argued that, prior to dam construction in Pennsylvania in the nineteenth century, the American Eel inhabited most of the basin and migrated great distances upstream. Since 1975, there have been only four reports of this species in the watershed, all of which were from the upper Tioughnioga River or Goodyear Lake.

Delaware (1,2,3). In 1935, the commercial weir eel fishery dominated catches in the New York portion of the river, although American Eels were found in only 3% of the watershed survey samples (Greeley 1936). Bishop (1936) noted that there were 23 weirs actively fished in the autumn of 1935 between Port Jervis and Eel Weir Hollow that supported a primarily local market. Currently, the commercial fishery remains important and is concentrated downstream of many headwater dams (Dittman et al. 2010b).

Upper Hudson (1,2,3). Greeley and Bishop (1933) noted that "the Hudson River and lakes situated at the lower elevations, such as Saratoga Lake, are the best eel waters of the area. A weir is operated on Fish Creek at Grangerville…A few eels are reported to be caught in several of the Adirondack lakes of the watershed, even as far upstream as Lake Harris. Mather [1886] reported eels in Piseco and Pleasant Lakes." Recent records are sparse. Three reports exist from the 1930s, five from the 1970s, three from the 1990s, and three from the 2000s, but these reports, mostly from the Hudson River main channel, may underestimate the abundance of eels in the watershed. The farthest upstream sighting in recent times was just above Hudson Falls in 1980 (Dittman et al. 2009c).

Mohawk (1,2,3). At the mouth of the Mohawk River are the Cohoes Falls. Cognizant of this, Greeley (1935) noted that "in waters above barriers eels are much less numerous, but sufficient numbers ascend the Mohawk and other tributaries of the Hudson to give the species a wide range in this area. A few eels even reach some of the upland lakes and anglers reported eels present in the Wager and Little Bowman Lakes (elevations over 1,400 feet [425 m])." In colonial days, there were commercial harvests in the Mohawk River above Cohoes Falls, where weirs were constructed (Dittman et al. 2009c). The American Eel is less common recently but is still caught in the main channel as far west as Herkimer, as well as in Schoharie and West Canada creeks.

Lower Hudson (1,2,3). Mearns (1898) noted: "The Eel is common in all our waters. Specimens weighing five pounds apiece are sometimes taken in mountain ponds and streams. Eels are sometimes found in damp meadows under stones, usually near springs from which rivulets flow." Greeley (1937) stated that American Eels were abundant in the Hudson River, and that "a number of streams and lakes were also found to have this species…In many tributary creeks along the Hudson, small eels are very numerous. Very small eels in the 'glass eel' stage were taken, on several occasions, from deeper areas of the river, in the trawl." Greeley (1935) reported that "small eels of various sizes are abundant in the lower waters of many tributaries of the Hudson…On May 18, several specimens in the 'glass eel' stage were taken in the lower Muitzes Kill [rkm 218], a tributary of Schodack Creek. These colorless, transparent little eels were swimming in the pool at the base of a falls, a behavior in marked contrast to that of young eels which had already transformed to the pigmented stage and were to be found hiding under shelter of stones." This is a useful summary and, given that it is over seven decades old, still descriptive of the watershed. Although population declines in most coastal rivers are severe (Machut et al. 2007; Machut et al. 2009), the American Eel remains an important component of the Lower Hudson River fauna (Daniels et al. 2005).

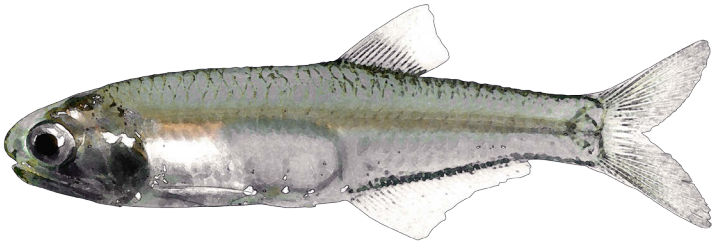
Newark Bay (1,2,3). Greeley (1937) found this species in 3% of the samples taken during the 1936 survey of the watershed. There are two recent records: in a tributary of the Hackensack River in 1981 and in the Saddle River in 2010.

Long Island (1,2,3). In the survey of this watershed, Greeley (1939a) stated that "the eel, encountered in 83 Long Island survey collections, stands first in frequency." Eels were also present in 3% of the samples taken in streams draining into Long Island Sound in Westchester County (Greeley 1937). A commercial fishery continues on Long Island, although Dittman et al. (2009d) noted that catches have declined in recent years.

Engraulidae, Anchovies

These small fishes inhabit oceans and estuaries around the world and many species support important commercial fisheries. Two species are present in inland waters in New York. The Bay Anchovy is an estuarine form and the Striped Anchovy, *Anchoa hepsetus*, is an occasional stray in the Hudson River and other coastal streams. We did not develop maps for either of these species, as all catch records are from the Hudson River Estuary.

Anchoa mitchilli, Bay Anchovy



This small, virtually transparent fish is found off the Atlantic coast from Yucatan, Mexico to the Gulf of Maine. It is a resident of the Hudson River estuary, occurring in both brackish and freshwater. The Bay Anchovy is a Species of Greatest Conservation Need in New York.

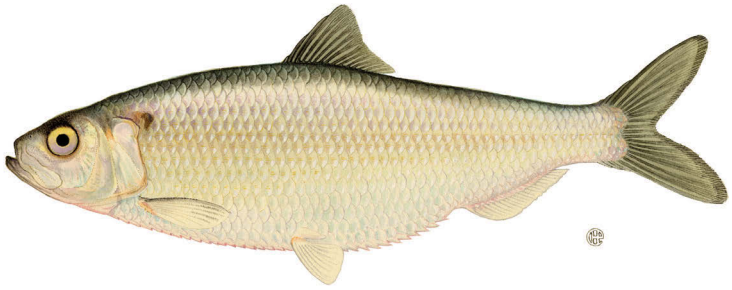
Lower Hudson (1,2,3). Bean (1903) noted that this was a marine species found in bays on Long Island and made no mention of it in coastal streams or the Hudson River Estuary. Bay Anchovies are, however, known in the Hudson River as far upstream as the Troy locks (Smith 1985). They use the estuary for spawning and as a nursery, with adults and young being found as far upstream as Albany (Schmidt 1992, ASAAC 2013), although records indicate a higher presence in Newburgh Bay, with highest occurrence in south Haverstraw Bay. Catches have declined since the late 1980s (Shultz et al. 2008).

Long Island (1,2,3). Greeley (1939a) did not report any Bay Anchovies taken from inland waters, although there were catches from Massapequa Creek and the Connetquot River in 1938. In contrast, individuals were frequently collected along the island's coastal areas (Greeley 1939b), and Perlmutter (1939) emphasized their high abundance and importance to commercial fisheries as both a forage fish and in their own right. This species continues to be occasionally caught in inland waters and is commonly caught along the coast.

Clupeidae, Herrings

Herrings include five inland species that inhabit New York lakes and streams; one species is only found in freshwater, one is a summer resident, and the other three are anadromous. All five species are lake or large river fishes and all are native to at least part of the state. Modern distributions of several species include successfully introduced populations. Three other species appear in New York's rivers as strays from nearby marine populations and can temporarily be found in high abundance in the lower Hudson River on occasion. These species are the Menhaden (*Brevoortia tyrannus*), Atlantic Herring (*Clupea harengus*), and Round Herring (*Etrumeus teres*). These three species are not treated further in this atlas.

Alosa aestivalis, Blueback Herring



This anadromous species has been reported from the Upper Hudson, Lower Hudson, and Long Island watersheds, where it is native, and in the Ontario, Oswego, Saint Lawrence, Champlain, and Mohawk watersheds, where it is not.

Ontario (**3**). First discovered in catches of juvenile fish near Oswego in 1995 (Owens et al. 1998), the arrival of this species in the watershed was summarized by Mills et al. (2003), who speculated that it migrated through the Mohawk River, Erie Canal, and Oneida Lake. An adult-sized individual was caught in 2006, near Ginna Nuclear Power Station east of Rochester (R. O'Gorman, USGS Oswego, pers. comm.). Although different size classes have been caught over the years, there is no conclusive evidence that the species is fully established in the watershed.

Oswego (**3**). In 1994, this species was caught in Oneida Lake. Yearlings were caught in Fish Creek and Oneida Lake in 1995, which suggested spawning within the watershed. Spawning has been confirmed in Ninemile Creek near Rome (Owens et al. 1998). With Oneida Lake as the source population, Blueback Herring entered the Oswego River, where thousands of juveniles were reported near Minetto in 1994 (R. O'Gorman, USGS, Oswego, pers. comm.). Individuals of several size classes were caught in Oneida Lake during the decade between 1994 and 2005, but there are no catch records after 2005. Although the Blueback Herring seemed poised to expand throughout the watershed, it appears to have failed to establish a sustainable population.

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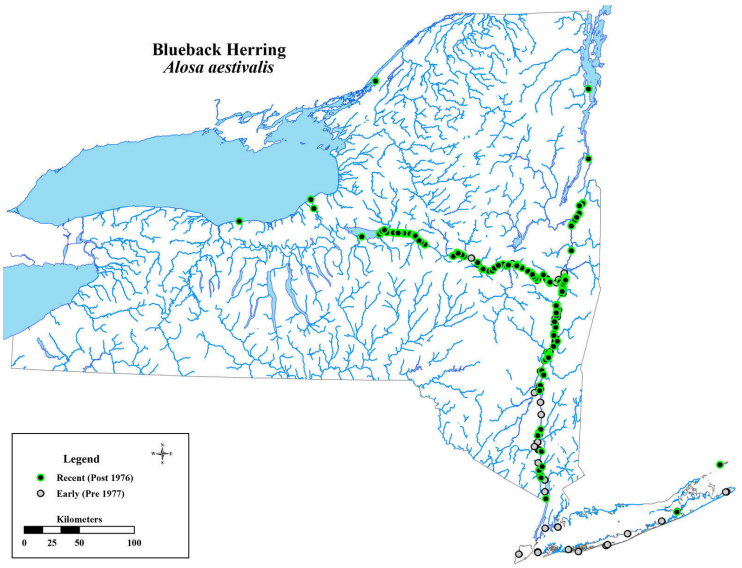
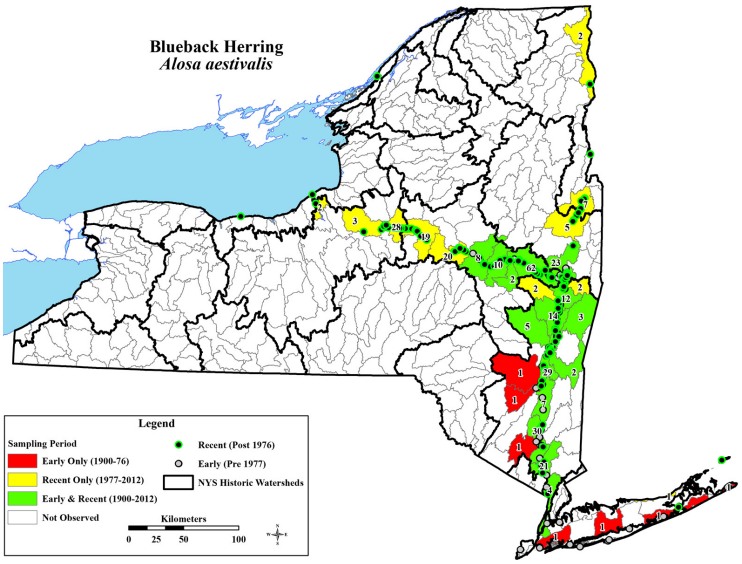




Saint Lawrence (**3**). A single specimen from Chippewa Bay, at the east end of the Thousand Islands area, was taken in 2002 (NYSM 54305) and another in 2012 (NYSM 68133). It is useful to consider why only two individuals have been caught in this vast watershed in a ten-year period: they may simply have been out-migrants from Lake Ontario or canals. More ominously, they may be the vanguard of ocean-run individuals responding to warmer water temperatures as a result of global warming. Either way, the impact of this species on the watershed remains minimal at this time.

Champlain (**2,3**). The Blueback Herring was first reported in Lake Champlain in the late 1970s (Plosila and LaBar 1981), likely having migrated north through the Champlain Canal (Marsden and Hauser 2009), as individuals have been documented in the canal in 1983 (Makarewicz 1983), 2008 (NYSM 64254), and 2010 (E. Marsden, University of Vermont, pers. comm.). There is no evidence of reproduction within the watershed, so the persistence of this species is best explained by frequent migration through the Champlain Canal.

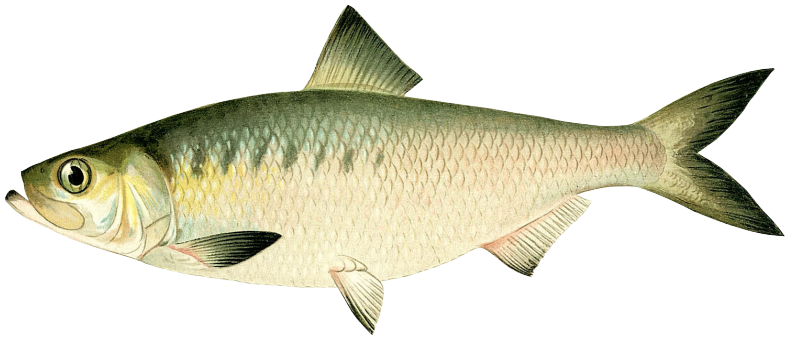
Upper Hudson (1,2,3). The only early record is a 1934 specimen collected at the mouth of Deep Kill, rkm 256 (NYSM 287). Before construction of a barrier dam at Troy, Blueback Herring could migrate upstream as far as Fish Creek, rkm 286, and up that tributary to the first riffle downstream of Saratoga Lake (Brumbach and Bender 1986). In 2010, specimens were collected in the Hudson River downstream of Lock 1 (rkm 265) and in the Champlain Canal at Fort Edward (rkm 300) (E. Marsden, University of Vermont, unpubl. data).

Mohawk (**1,2,3**). Greeley (1935) reported adults from the lower Mohawk River and in Crescent and Niskayuna Lakes. He (Greeley 1935) further noted that "this is apparently the first reported occurrence of a freshwater population of [*A.*] *aestivalis*." The species is a seasonal resident in the Erie Canal. A spawning aggregation was seen in Ninemile Creek in May 1986 (Jack Skea, NYSDEC, pers. comm.). Adults migrate from the Hudson River and juveniles provide important forage for Smallmouth Bass in the Mohawk River (McBride1985a; Simon et al. 2007). Annual migrations to the middle section of the Mohawk River, to Little Falls at rkm 120, were observed until 2004. None were subsequently observed, until Trometer et al. (2010) reported fish as far upstream as Utica at rkm 155.

Lower Hudson (1,2,3). Greeley (1937) reported that juveniles were found at several localities in the Hudson River during the summer. Sampling began after the spawning runs were completed, which could explain the relatively low frequency of occurrence of 2%. Severe population declines have occurred in most coastal rivers (Atlantic States Marine Fisheries Commission 2012; Limburg and Waldman 2009) and Daniels et al. (2005) reported a decline in abundance in the lower Hudson River. Simon et al. (2007) attributed the lengthy spawning runs to the upper river and into the Mohawk River in the 1980s to higher population numbers. With declines in population, spawning migrations are now shorter (Schmidt et al. 2003).

Long Island (1,2,3). Greeley (1939a) did not note the presence of Blueback Herring in the general survey of the freshwaters of Long Island, although individuals were taken in marine waters (Greeley 1939b). The species was also not mentioned in reports by Bean (1899) or Scott (1902). Specimens were collected on Staten Island in 1975 (e.g. NYSM 54715) and in eastern coastal bays in 1991 (NYSM 41535). No Blueback Herring were collected during extensive sampling of eastern Long Island in 2008-09 (Malaty 2014).

Alosa mediocris, Hickory Shad

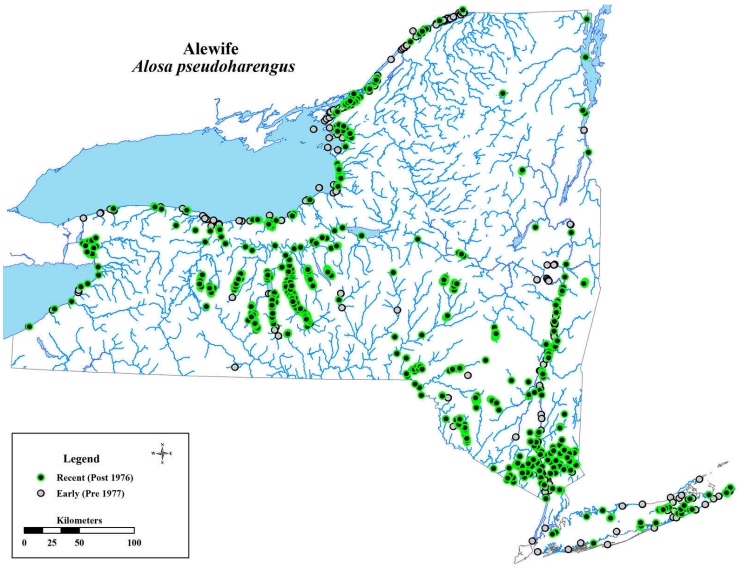


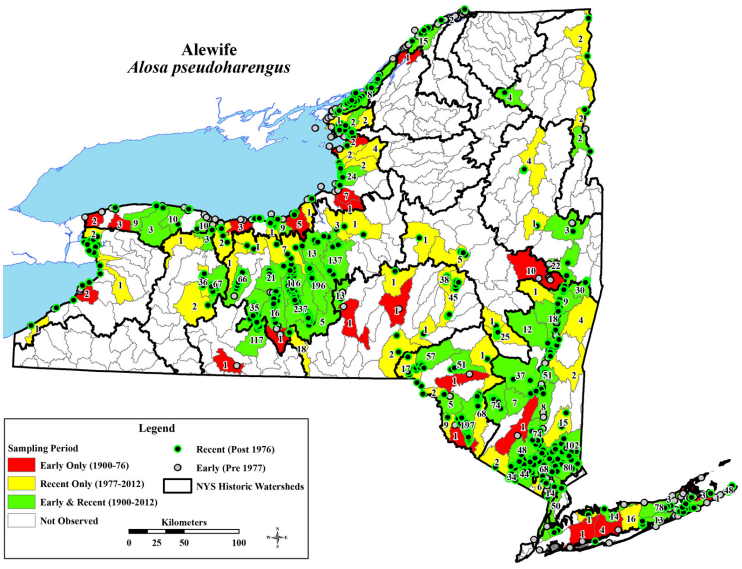
This marine species has been reported in the two New York watersheds with estuaries, which are the Lower Hudson and Long Island. We did not develop a map for this species because all catch records are from the Hudson River Estuary.

Lower Hudson (1,2,3). This species has been found in the main channel of the Hudson River upstream to Catskill Creek at rkm 180 (Smith and Lake 1990) and to rkm 224 in 1995 (NYSM 59255). It is rare in estuaries (Smith 1985), and it was not collected during synoptic surveys conducted in 1934 and 1936 (Greeley 1935, 1937). Despite omitting this species from the survey report, specimens were collected at four sites in the Hudson River in April 1936, before the survey teams began work. Because of the commercial importance of members of this genus, staff made contacts with commercial fishermen and followed their catches beginning in early April 1936; these specimens are stored at the NYSM (Curran and Ries 1937). Hickory Shad continue to be rarely caught (Daniels et al. 2005).

Long Island (1). A single record from Sebonac Creek (NYSM 314) is one of several collections made in 1938; the remaining collections are better characterized as near shore (Greeley 1939b). There are over 100 recent records from near shore areas of Long Island, including Hempstead Harbor and Little Neck, Jamaica, Great South, and Peconic bays (J.Hornstein NYSDEC, East Setauket, unpubl. data), but these are all marine collections.

Alosa pseudoharengus, Alewife





This anadromous species has been reported in the Erie-Niagara, Ontario, Genesee, Oswego, Saint Lawrence, Chemung, Susquehanna, Delaware, Upper Hudson, Lower Hudson, and Long Island watersheds. It is a non-native species in the Champlain, Mohawk, and Newark Bay watersheds. The status of the Alewife in Lake Ontario and its tributaries is difficult to assess because the species was not reported from the system until 1873 and the routes taken to access the system are unknown. Because this fish is native to the Saint Lawrence River, the most economical assessment is to include Lake Ontario and its tributaries to the first barrier in the species' native range but to exclude Lake Erie and the Genesee River upstream of the Rochester Falls. We recognize that the native populations at many sites were affected by numerous, and sometimes unrecorded, stocking events.

Erie-Niagara (**1,2,3**). Alewives were first reported in Lake Erie in Canada in 1931 (Dymond 1922). Although Greeley (1929) reported the species as common in the lower Niagara River at Lake Ontario, specimens were not taken in the upper Niagara River until 1961, which are the first records for the New York portion of this watershed. Individuals have since been taken in Lake Erie and the mouths of the Buffalo River and Cattaraugus Creek.

Ontario (1,2,3). Greeley (1940) noted that Alewife abundance in Lake Ontario, from an academic perspective, was one of the most "outstanding features" of the lake. The more mundane aspects of this abundance included stunting, trophic competition with other small fish, predation on young game fish, and annual die-offs that fouled the beaches. The species was first reported in the lake in 1873 (Smith 1985), and the first of the major die-offs occurred in the 1890s (Crossman and Van Meter 1979). It is considered to be native in Lake Ontario (Miller 1957), but Smith (1968) suggested that it was introduced.

Genesee (1,2,3). Greeley (1927) reported that Alewives entered the river mouth in great numbers in spring to spawn. No spawning runs have been reported in the last several decades. Lakes upstream of Rochester Falls were stocked and the earliest records of catches are from Canadice and Hemlock Lakes in 1957. Since then, Alewife catches from Conesus Lake in 1983, Dansville Reservoir in 1993, and Black Creek in 2000 have been reported. The species was caught in Rushford Lake in the 1960s but has not been reported since, suggesting that stocking attempts there failed.

Species continued on next page

Oswego (1,2,3). Alewives were abundant in Cayuga and Seneca lakes by 1868 (Smith 1970), and by 1927, the species was also found in the Oswego River, Finger Lakes, and Oneida Lake (Greeley 1928). Complicating any assessment of its distribution, this species was stocked as a favored forage for gamefish in several lakes (Smith 1985). This herring remains common throughout the watershed.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted the presence of both adult and juvenile fish in the main channel and lowermost tributaries. More recent collections are from these same areas.

Champlain (**1,2,3**). Alewife was not reported during the 1929 synoptic survey (Greeley 1930). However, specimens (NYSM 61222) collected in 1929 from the lake were later determined to be larval alewife (Schmidt and Morse 2011). The next in-lake record is from the mouth of the Pike River, Quebec, in the 1990s (R. Langdon, Vermont Fish and Wildlife Department, pers. comm.). Alewife was reported in Lake Saint Catherine near Poultney, Vermont in 1997 (Marsden and Hauser 2009). The species became established in Lake Champlain after 2003 (Marsden and Hauser 2009). In 1962 and 1996, specimens were reported at higher elevations in Green Pond, Franklin County. The complex history of Alewife in Lake Champlain, with spot captures in distant parts of the lake and upland ponds, overlooked identifications, and spot captures spanning several decades, suggests that viable populations in the lake and watershed may have been established earlier than currently thought. Alternatively, populations may have gained a limited foothold several times in the last eight decades or at several sites.

Chemung (1,2,3). Alewives were collected in Lamoka and Waneta lakes and taken at 5% of the sites sampled during the 1937 watershed survey (Greeley 1938). Gerstell (1998) noted that the fish present in this watershed are introduced and not remnants of the anadromous fish that entered the river before 1806. Individuals continue to be caught episodically. In 1947, specimens were collected at Waneta Lake (CUMV 66725) and Tuscarora Creek (CUMV 68298).

Susquehanna (1,2,3). The earliest records are of ocean migrants, but the number of anadromous fish that were able to ascend this river diminished after 1806, when the first dams were built on the lower Susquehanna River in Pennsylvania (Gerstell 1998). Larger and higher dams were constructed during the nineteenth and early twentieth centuries that effectively blocked all upstream migration by 1910. Landlocked populations were established by 1961 in Little York Lake and Polkville Pond in Cortland County, as well as in Mead Pond in Chenango County. After 1988, additional waters including Otsego, Goodyear, Canadarago, and Cayuta lakes, as well as Durkee Park Pond, were stocked. Individuals caught in the Susquehanna River at Afton in 1996 were probably escapees from ponds.

Delaware (1,2,3). This anadramous species migrated into the system in the nineteenth century, but anadromous fish stopped using the upper river (Kasper 1994) until recently, when specimens were caught near the New Jersey border in the 2000s (C. Apse, The Nature Conservancy, pers. comm.). Numerous catches from the many reservoirs in the upper watershed are from stocked, landlocked populations. Records from 1979 (AMNH 42472), 1996, and 2005 in downstream areas are probably out-migrants from upstream impoundments.

Upper Hudson (1,2,3). Greeley (1935) reported non-migratory populations in Round and Ballston lakes and noted that this species was common in the Hudson River. Like other anadromous fishes, Alewives moved upstream into this watershed before the Federal Dam and Lock were constructed in Troy at rkm 248 (Daniels et al. 2011b). This lock limits upstream passage, but upland lakes continue to support resident populations. In 1975, individuals were found as far upriver as Fort Edward (rkm 310).

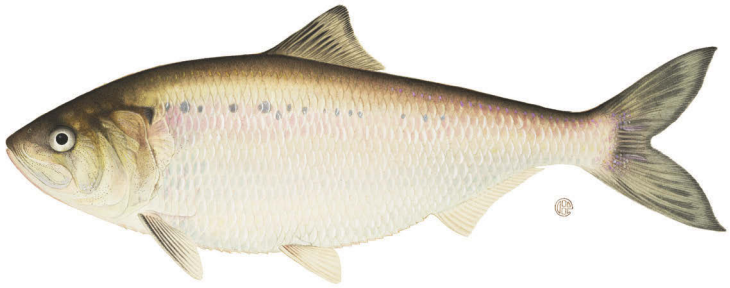
Mohawk (**1,2,3**). Cohoes Falls acts as a barrier to fish dispersal into the Mohawk River from the Hudson River except, perhaps, under extreme flow conditions. Several individuals were caught in the lower Mohawk River in 1934, which Greeley (1935) regarded as non-migratory residents. The presence of a few individuals is difficult to assess. These individuals might have been sea-run fish that used the locks of the Erie Canal to gain access to the river. It is also possible that they were members of a land-locked population that established itself upstream of the falls, either by gaining access through the locks or by stocking. Specimens continue to be caught in this watershed in small numbers in both the main river and the Schoharie Reservoir.

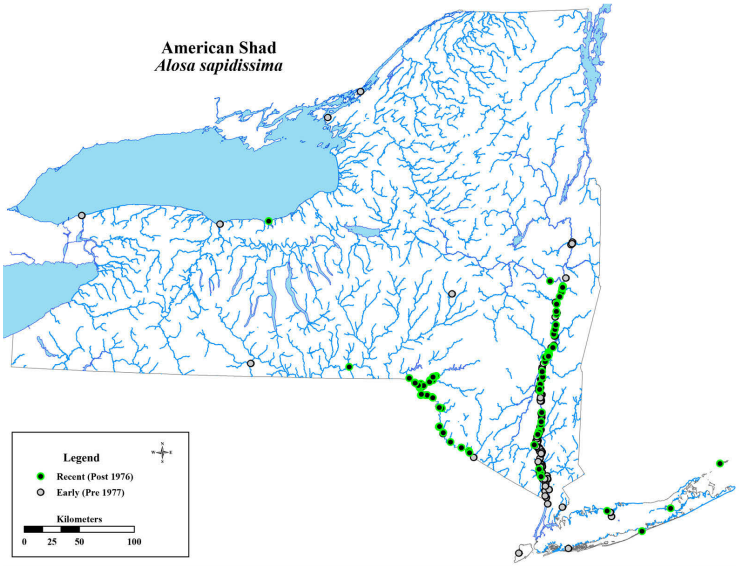
Lower Hudson (1,2,3). Greeley (1937) noted that Alewives were abundant and that they ascended the river during the spring in large numbers to spawn in the river and the lowest reaches of its tributaries. He also noted that a few yearling individuals were found during the summer but that these individuals were scarce, leading him to conclude that most individuals leave the river during their first summer. Smith (1985) reported that this species does not travel as far upstream as other river herrings. Alewife abundance has declined in most coastal rivers, including the Hudson River (Daniels et al. 2005).

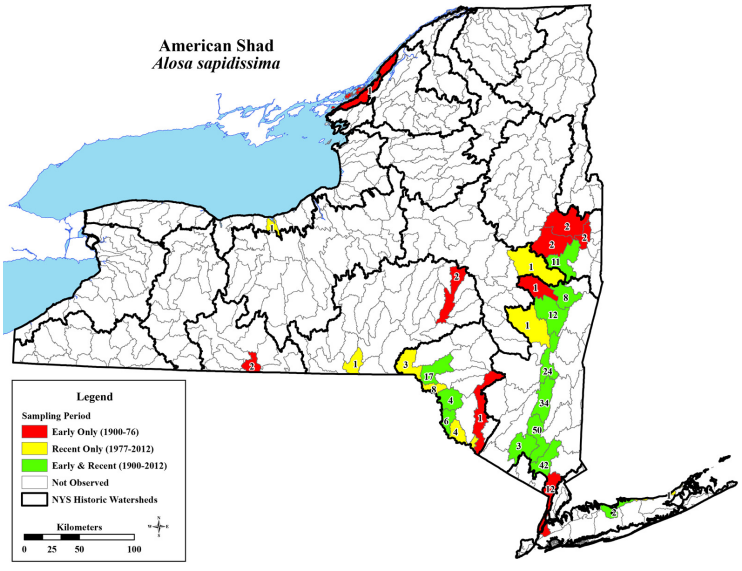
Newark Bay (**1,2,3**). Greeley (1937) found Alewives at 2.5% of the watershed survey sample sites, including in Greenwood Lake. The species continues to be found in lakes, where it is stocked as a favored forage for gamefish.

Long Island (1,2,3). Greeley (1939) reported that the Alewife was a locally common anadromous fish during its breeding season. He also noted that dams on two larger streams, the Carmans and Connetquot rivers, limited access to areas that were formerly available for spawning. Alewife runs remain fairly common in Peconic Bay, with well-documented runs in the Peconic River, Big Fresh Pond Outlet, and in most north shore streams from Baiting Hollow to Fort Salonga, as well as in Ligone Brook in Sag Harbor in 2010.

Alosa sapidissima, American Shad







This anadromous species has been reported from the Chemung, Susquehanna, Delaware, Upper Hudson, Lower Hudson, Long Island, and Mohawk watersheds, where it is native, and from the Ontario watershed, where it has been introduced.

Ontario (**1,3**). Dymond et al. (1929) first recorded commercial catches near the mouth of the Niagara River. Evermann and Kendall (1901) listed 1870-78 as the years in which this species was stocked, and Smith (1892) described its life history in the lake. A single record near Cape Vincent was reported in 1931 (Greeley 1932). The introduction did not lead to a sustained population in the lake, so records from Irondequoit Bay in 1957 (CUMV34832) and catches of several yearlings in Sodus Bay in 2006 (NYSM 61099) cannot be easily explained. Smith (1985) noted that American Shad occur in the Saint Lawrence River and could move into the lake.

Chemung (1). Sea-run fish once entered the river freely but were blocked by dams built in Pennsylvania after 1806 (Gerstell 1998). Fish were once reported as far upstream as the Canisteo River, but the American Shad has been absent from the watershed for over 200 years. A restoration program began in 2002 that included fish passage facilities in Pennsylvania and annual stocking in New York from 2002-06 but, to date, has been unsuccessful in re-establishing the species in this watershed.

Susquehanna (1,3). The situation in this watershed is identical to that of the Chemung: shad migrated from the ocean until dams on the lower river blocked upstream movement (Gerstell 1998). Fish were reported as far upstream as Otsego Lake (Cooper 1851). An attempt to restore sea-run fish to the Susquehanna River in Pennsylvania and New York began in 2002 and included annual stocking in New York from 2002-2006. In May 2004, a 406 mm individual was caught in the river near Vestal, but there have been no additional reports of American Shad in the watershed.

Delaware (1,2,3). In his account of this species, Greeley (1936) wrote: “Moderately common in the Delaware River and East Branch. Adults, including ripe males and females with nearly ripe eggs, were noted just below Hancock on June 2...The numbers of shad ascending this far up the river probably fluctuate with variations in conditions from year to year. Bean [1903]

Species continued on next page

records an instance of a heavy run up into the headwater region, believed to be correlated with cold water temperatures during May…The young remain in the river all summer and are considered valuable as forage for bass." Bishop (1936) noted that both the commercial and local fishery were important. The sport fishery today has diminished in all but the lower stretches of the West Branch but remains popular in the East Branch and the main channel.

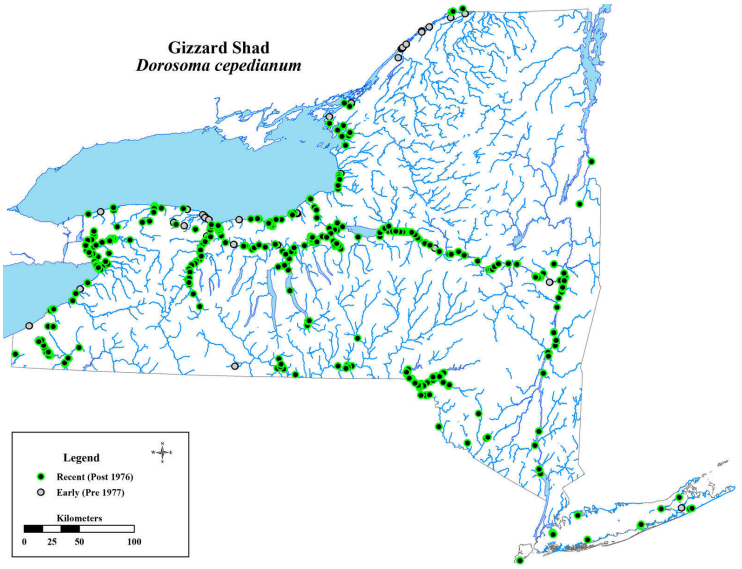
Upper Hudson (1,2). According to Sharpe (1909), "The Hudson River in the town of Greenwich was stocked [as used by Sharpe, "stocked" means it was abundant and not that it was introduced] with shad, which made their yearly runs up the river until the state built feeder dams for the canals…Every settler in the town salted a barrel or more of shad which lasted until their return the next year…" Greeley and Bishop (1933) reported that the American Shad was "extinct" in the upper river. Before completion of the Federal Dam at Troy, shad entered Fish Creek and reached the first riffle near Saratoga Lake or Thompsons Mill (Brumbach 1986). Individuals were caught near the mouth of the Mohawk as recently as 1972.

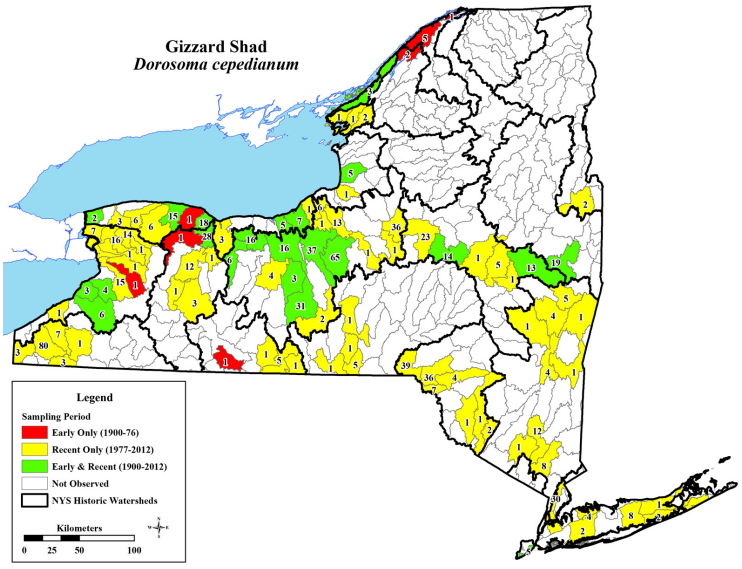
Mohawk (1,2,3). Historically, American Shad would not have been able to enter the vast majority of this watershed because of the Cohoes Falls, even though individuals were found in the river mouth. This species has gained access to the rest of the Mohawk watershed by using the locks of the Erie Canal, and spawning occurred at least one year in the early 1980s, at Vischer Ferry (AMNH 55444). It continues to be found at the Mohawk River's mouth and so is native to the watershed. At the same time, it is important to remember that this species gained access to the watershed upstream of Cohoes Falls by the canal or by stocking and so is exotic in most of the watershed.

Lower Hudson (1,2,3). American Shad were abundant during the fishing season of 1934 (Greeley 1935), but the abundance of this species, which has been commercially important from colonial times forward, has waxed and waned depending on environmental conditions and, more importantly, commercial activity (Daniels et al. 2011b). All but a very few records are from the tidal Hudson Estuary, and most spawning occurs between Croton and Catskill (Smith 1985). The commercial and sport fisheries have declined and were closed in 2010.

Long Island (1). Historically, American Shad were not abundant on Long Island (Greeley 1939a). The only recent records are from tidal areas (e.g., Arthur Kill, Great South Bay), which are not inland waters.

Dorosoma cepedianum, Gizzard Shad





This species is native to the Erie-Niagara, Ontario, Oswego, Saint Lawrence, and Black River watersheds of the Saint Lawrence River drainage. In recent decades, it has gained access to the Allegheny, Genesee, Champlain, Chemung, Susquehanna, Delaware, Upper Hudson, Mohawk, Lower Hudson, and Long Island watersheds.

Allegheny (**3**). Gizzard Shad were introduced into Chautauqua Lake (McKeown 2000) and are present in Conewango Creek (Pomeroy 1995, Daniels et al. 2006b). Specimens were taken in the Allegheny Reservoir in the 1980s (J. Evans, NYSDEC, pers. com.), but there is no evidence that a population has become established there.

Erie-Niagara (1,2,3). Greeley (1929) suggested that this species is exotic in the lake and postulated that it entered via canals. However, S.F. Baird collected a large specimen in the lake in 1853 (NYSM 11765). Carlson and Daniels (2004), among others, list it as native.

Ontario (1,2,3). In the 1939 watershed survey, Gizzard Shad were collected in Irondequoit Bay, Cranberry Pond, and Long Pond, where the species was abundant (Greeley 1940). In recent years, specimens have occasionally been caught in the eastern bays of the lake as well.

Genesee (**2,3**). This species was first caught in the Genesee River in 1970. It was introduced upstream of Rochester Falls and has been caught as far upstream as Canaseraga Creek.

Oswego (1,2,3). Gizzard Shad were taken in Cayuga Lake as early as 1916 (CUMV 7224). Greeley (1928) listed the Gizzard Shad as rare but present in the rivers and lakes of this watershed. The range of this species in this system began to expand in the 1970s and it was reported in Oneida Lake in 1984. The species is widely distributed among the larger lakes.

Black (3). The lower reaches of this watershed are accessible to fishes present in Lake Ontario. Although Gizzard Shad have always had access to this area, there is only a single report of the species' presence in this watershed—an individual caught in the main channel below Dexter, in 2003.

Species continued on next page

Saint Lawrence (2,3). Gizzard Shad were caught in the main channel and in French Creek as early as 1971. Individuals continue to be caught in the main channel as far downstream as Massena, but there are no records of captures downstream of the Moses Saunders Dam.

Champlain (**3**). This species was caught in Halfway Brook in 1999. This was the first record in the New York portion of this watershed, although a Gizzard Shad was sighted in southern Lake Champlain, below Benson's Landing, Vermont, in 1993 (Marsden and Hauser 2009).

Chemung (**3**). There are six records of this species from 2002-06, all in the main channel (e.g., NYSM 54488).

Susquehanna (**3**). In 1988, Gizzard Shad were taken in the Tioughnioga, Otselic, and Susquehanna rivers in the Binghamton area.

Delaware (**2,3**). This species was first caught in the Bashakill in 1981. In recent years, specimens have been taken in most sections of the larger rivers but have not been collected in the many impoundments.

Upper Hudson (**2,3**). Gizzard Shad were taken in the main channel at the mouth of the Mohawk River in 1975 and near Mechanicville in 1983 (Makarowicz 1983). Individuals were also found in Round Lake as early as 1987.

Mohawk (**2,3**). This species has been collected in the Mohawk River/Erie Canal and in the lower reaches of tributaries since 1973. The likely route of entry is through the canal corridor from Oneida Lake.

Lower Hudson (**2,3**). The first report of this species from this watershed was in 1972 (Daniels et al. 2005). Since 1975, it has frequently been reported from the main channel and lower reaches of the major tributaries.

Long Island (**1,2,3**). A specimen was taken on Staten Island in 1976. Since the 1990s, the Gizzard Shad has become widespread in Nassau, Suffolk, and Queens counties.

Cyprinidae, Minnows and Carps

In New York, the family Cyprinidae contains more representative species, 49, than any other family. Many of these species have limited ranges and are only found in specific habitats in one or two drainages. Others are ubiquitous and are present throughout the state in a variety of different habitats. Six species are introduced from Europe or Asia; all other species are native to New York, although there have been numerous transdrainage introductions.

Campostoma anomalum, Central Stoneroller

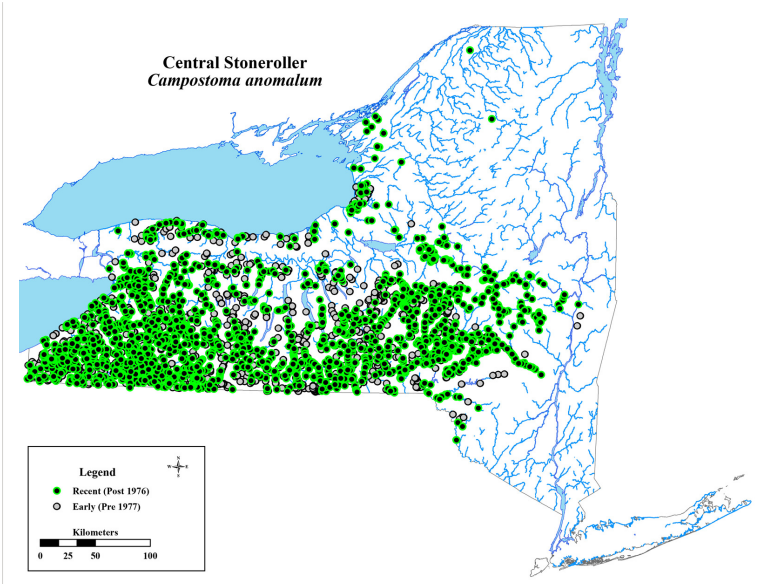
This minnow is native to seven watersheds in western and central New York. It is common in, but not native to, the Delaware and Mohawk watersheds. There are only a few records from the Black, Saint Lawrence, Raquette, Upper Hudson, and Lower Hudson watersheds, where it is also an exotic species.

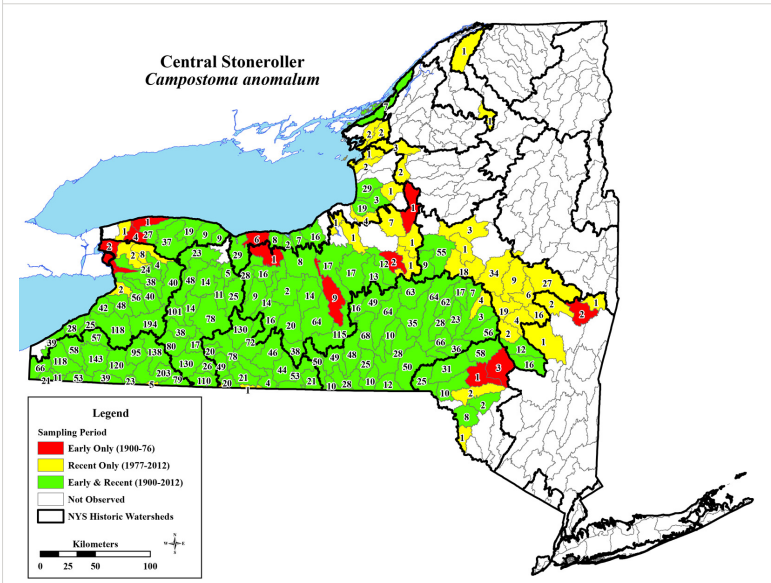
Allegheny (1,2,3). Central Stonerollers were collected at 60% of the sites sampled in the 1937 survey (Greeley 1938). This species remains among the most common minnows in all three basins of the watershed and was caught in both the main channel and tributaries. During surveys conducted during the last three decades, the species continued to be present at over 60% of the sample sites.

Erie-Niagara (1,2,3). Greeley (1929) reported that this species was common and found in lowland, shallow, warm creeks but was absent from headwaters and rare in Lake Erie itself. It is widespread and commonly caught today.

Ontario (1,2,3). Greeley (1940) noted that this was a stream fish and most of the 68 records were from stream sites; specimens regarded as strays were taken in Carlton Lake, the Erie Canal, and Irondequoit Bay. These early records were from 37 waters west of Jefferson County. Central Stonerollers remain common in these waters and have also been taken at many sites in Jefferson County in recent decades.

Genesee (1,2,3). This species was commonly taken in warm, shallow streams but was rare in cool-water streams (Greeley 1927). It remains widespread and is among the five most commonly caught stream fishes in recent surveys.





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Oswego (1,2,3). Greeley (1928) stated that this species was “restricted to the western part of the drainage where it occurs in warm shallow creeks over a rubble, gravel or mud bottom in a strong to moderate current.” It is generally found west of Ganargua Creek but has been reported in recent years throughout the watershed, including in the Seneca and Oswego rivers, Cayuga Lake, and West Branch Fish Creek. The frequency of occurrence in streams from 1996-2010 was about 20%.

Black (**3**). The range of this species did not extend farther east than the tributaries of eastern Lake Ontario in the 1930s (Greeley and Bishop 1932). It has only been reported from streams in the lake plane of Jefferson County north of the Black River watershed since 1963. The first records in the watershed were from upstream sites: Mill Creek near Boonville in 1992 and Deer River in Copenhagen in 1994 (NYSM 43656). Subsequent efforts to find established populations were unsuccessful until specimens were repeatedly found in Philomel Creek after 2006. Earlier captures were probably inadvertent baitfish releases. Although Central Stonerollers have direct access to this watershed, we treat the species as non-native because the original collection sites were upstream, disjunct, and appear to have been spot introductions rather than the result of a naturally expanding population.

Saint Lawrence (**2,3**). Records of the Central Stoneroller from this watershed are rare and include reports from Mullet and French Creeks in 1963, 1972, 1982, and 1993. In 1985, specimens were taken from Horseshoe Pond (AMNH 235246), a headwater pond where this species was probably introduced. In 2009, specimens were collected from Barrett Creek (NYSM 65472).

Raquette (**3**). The only record of this species in the watershed is a collection from Plum Brook in 1998 (NYSM 49588).

Chemung (1,2,3). Central Stonerollers were present in 49% of the samples from the 1937 survey of this watershed (Greeley 1938). The species remains abundant and widely distributed.

Susquehanna (1,2,3). This minnow inhabited rivers and larger creeks and was collected at 15% of the sample sites in the 1935 watershed survey but was not reported east of Unadilla (Greeley 1936)**.** By the 1970s, the species had expanded its range into the upper part of the watershed and by 2004 it was widespread and present in many streams, including Charlotte and Schenevus creeks.

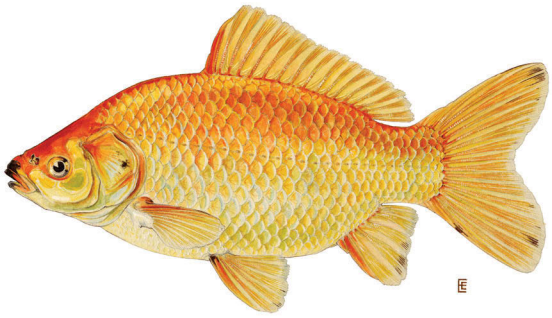
Delaware (**2,3**). Central Stonerollers were not reported from this watershed in the 1930s (Greeley 1936). The species was present, however, in 1956 when surveys were resumed after a 20-year lapse. It is relatively widespread today.

Upper Hudson (**2,3**). This species was reported in the Hoosic River in 1983 and Fishing Brook in 2007.

Mohawk (**2,3**). The first report of the Central Stoneroller in this watershed was in Bear Kill in 1963. By the 1980s, the species had become widespread, with collections in Ninemile Creek as early as 1980 (NYSM 6490). It is now found throughout the watershed in the Mohawk River and most of its tributaries, as well as at upland sites in the Helderbergs and Catskills (e.g., NYSM 45437).

Lower Hudson (**2,3**). Central Stonerollers were first reported from this watershed in the Moordener Kill in 1963. In the 1990s, individuals were reported from the Hunger Kill and Kaikout Kill. No voucher specimens were kept for any of these reports. In 2005, this species was caught at the mouth of the Poesten Kill (NYSM 58486) and in Tenmile Creek. Schmidt et al. (2007) rejected earlier sightings that lacked voucher specimens and reported the Poesten Kill collection as the first capture in the tidal river system. These areas were re-sampled in 2009, but no additional captures were made.

Carassius auratus, Goldfish



This is perhaps the first exotic fish species introduced into New York (DeKay 1842). It is now established in fifteen watersheds but is absent from the Adirondack Mountains.

Allegheny (**1,2,3**). Goldfish have maintained a presence in Chautauqua Lake for decades. The species has recently been found in streams, most notably Dodge Creek.

Erie-Niagara (**1,2,3**). Greeley (1929) noted that Goldfish were "common in Lake Erie in shallow parts, especially bays and creek mouths." This species hybridizes with common carp, and both Goldfish and hybrids are commonly caught in the upper Niagara River and in the Buffalo area.

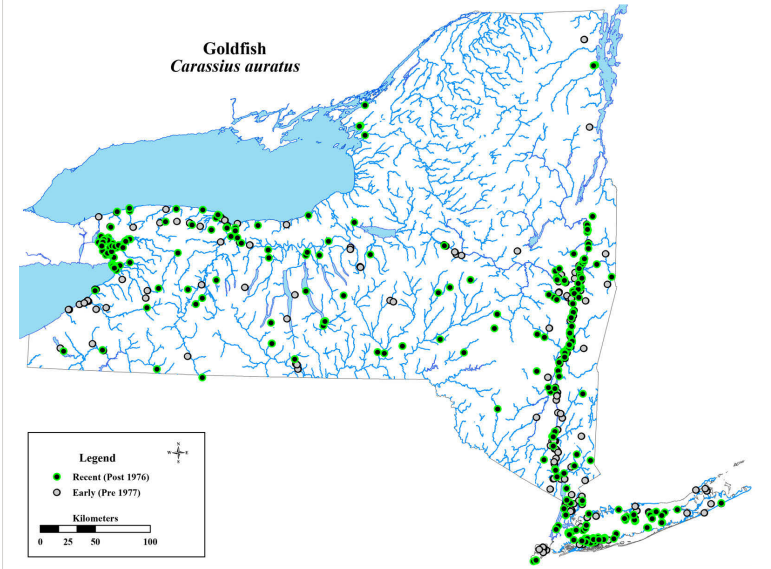
Ontario (**1,2,3**). Specimens were caught in Sodus Bay, Eighteenmile Creek, and Johnson Creek during the 1939 survey of the Lake Ontario watershed (Greeley 1940). The species is now widely distributed.

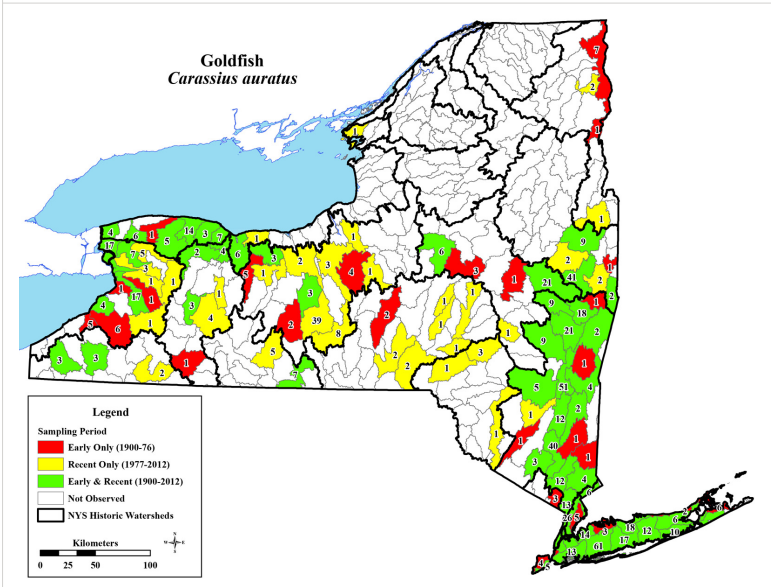
Genesee (**1,2,3**). Goldfish are not widespread in this watershed but have been reported at least twice from the main channel, Erie Canal, Keshequa Creek, and Silver Lake. There is a single record of occurrence at seven additional sites.

Oswego (**1,2,3**). To date, specimens have been found in Cayuga Lake, the Seneca River, the Erie Canal, Kennedy Creek, Geddes Brook, Rock Stream, Limestone Creek, North Brook, and Caughdenoy Creek.

Saint Lawrence (**2**). This species was reported from the mouth of French Creek in 1978.

Champlain (**2,3**). Reports of Goldfish in Lake Champlain are sporadic but cover several decades, with catches in 1962, 1967, and 2000.





Chemung (**1,2,3**). Greeley (1938) reported the presence of Goldfish in Eldridge Lake and the species was also recorded in Perkins Pond in the 1930s. It was taken again in Eldridge Lake in 1973, in Miller and Wayer ponds in the late 1970s, a pond in Elmira in 1988, Meads Creek in 1997-1998, and Waneta Lake in 2002 (J. Haynes, SUNY Brockport, pers. comm.).

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Susquehanna (**1,3**). Although rare, this species is established in Perkins Pond and the Otselic River, near South Otselic (Greeley 1936). Since 1935, it has been found in Catatonk Creek in 1939, Basswood Pond in 1999 (although the pond was reclaimed in 2001), Otsego Lake in 2007, and two small ponds near Edmeston and East Sidney in 2009.

Delaware (**3**). Only a few records exist: Rexmere Pond in Stamford in 1988, the Pepacton Reservoir in 1997, and the Neversink River at Hasbrook in 2002 (C. Apse, The Nature Conservancy, pers. comm.).

Upper Hudson (**1,2,3**). This was not a commonly caught species in early surveys, with records only from the main channel, the Champlain Canal, and the lower reaches of tributaries (Greeley and Bishop 1933). Goldfish were relatively common in these same areas in the 1970s and 1980s, but survey work in the 1990s and 2000s indicates that the species has declined in abundance.

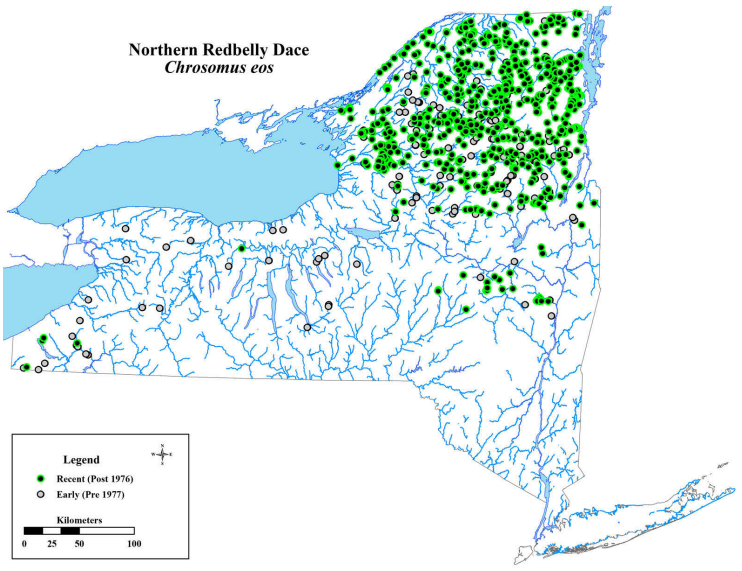
Mohawk (**1,2,3**). Greeley (1935) reported only two collections: the Old Erie Canal at Rexford and the Erie Canal at Waterford. The species is now more widespread, with collections throughout the drainage in the main channel, the Erie Canal, and multiple tributaries.

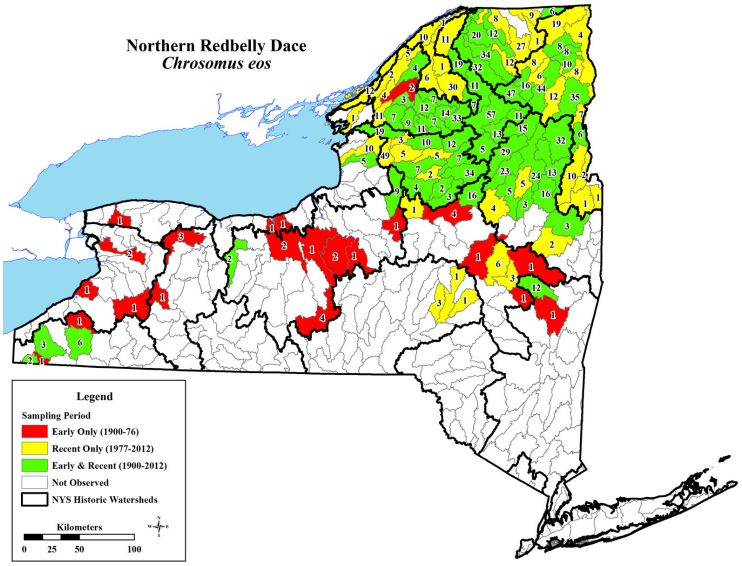
Lower Hudson (**1,2,3**). Goldfish are widespread in this watershed, which is where the species was first introduced to the state (DeKay 1842). Greeley (1937) noted that Goldfish were abundant in the main channel and in the lower stretches of tributaries, and mentioned that hybrids with Common Carp were present. There was a population decline in the Hudson River in the 1980s due to furunculosis, which resulted in the collapse of the small commercial fishery. Populations have since recovered to some extent (Daniels et al. 2005).

Newark Bay (**1,2**). There are three records from this watershed: Pascack Brook in 1936, the West Branch Hackensack River near Spring Valley in 1962, and Lake Lucille in 1967.

Long Island (**1,2,3**). Greeley (1939a) stated: “The survey collections indicate a somewhat higher abundance for goldfish than for carp in the smaller bodies of water...On Staten Island one collection from Willow Brook contained goldfish.” The species continues to be widespread.

Chrosomus eos, Northern Redbelly Dace





This small, brightly-colored minnow is found primarily in watersheds of the Adirondack Mountains and Great Lakes, with limited representation in 11 other watersheds.

Allegheny (1,2,3). This species was caught in 1937, 1979 (Smith 1985), 1994, and 2002 in small upland tributaries of the Conewango Creek basin.

Erie-Niagara (1,2). Hankinson (1921) caught Northern Redbelly Dace in Big Sister Creek. Greeley (1929) reported that this species was found in several sluggish streams and small ponds. A third record exists from a tributary of Cattaraugus Creek in 1956.

Ontario (1,2,3). Greeley (1940) reported that "Tributary 3 of Eighteenmile Creek, near Gasport, was found to be inhabited by this minnow. There are several other records in the collections of the University of Rochester, including Glenmark Creek at head of Sodus Bay, August 20, 1928, and Wolcott Creek, November 4, 1932." The only other reports of this species in the watershed are from Abijah Creek in 1977, Sandy Creek in 1999, and the Chaumont River in 2001.

Genesee (2). There are four records from Mill Brook, Bush Brook, and Onion Creek during surveys between 1947 and 1968. None was vouchered at a museum.

Oswego (1,2,3). Few records, all from upland streams and ponds, exist from this watershed. The only recent records are from the southern Tug Hill region from 1997-2007 and Ganargua Creek in 2004.

Black (1,2,3). Greeley and Bishop (1932) noted that Northern Redbelly Dace were often associated with Brook Trout, which frequently preyed upon these minnows, in the upland streams of the Adirondack Mountains. The species continues to be caught during lake surveys, although the presence of introduced game fish in many lakes may have affected its abundance.

Saint Lawrence (1,2,3). According to Greeley and Greene (1931), "This is possibly the most abundant minnow of the Adirondack area of the watershed. The greatest abundance is reached in ponds and bog streams, particularly where these bodies of water are small." Given the tolerance of this species to acidic conditions found in bog streams, its prevalence in this

Species continued on next page

watershed may have been affected favorably by the acidification of the area in the later part of the twentieth century. During surveys from 1984-1986, Northern Redbelly Dace were collected from 40% of the lakes sampled in the Adirondacks (Gallagher and Baker 1990).

Oswegatchie (1,2,3). Greeley and Bishop (1932) compared this species to its congener, the Finescale Dace, noting that both used the same general habitat but that the Northern Redbelly Dace was more widely distributed. The species continues to be caught regularly throughout upland streams and lakes in this watershed.

Raquette (1,2,3). During the survey of this watershed, Northern Redbelly Dace were common in Adirondack lakes, ponds, and streams, but were taken in only a single lowland locality, Trout Brook (Greeley 1934). Recent records show that this species still occurs in many waters at low and higher elevations.

Champlain (1,2,3). According to Greeley (1930), Northern Redbelly Dace were "common in a great number of the Adirondack ponds, and in small, sluggish streams. It was found only in the Saranac, Ausable and Big [sic] Chazy drainages. This species is able to thrive in stagnant, weed-choked creeks where it is surprising to find any fish alive." Contrary to Greeley's (1930) assessment, this species is not associated with stagnant waters, although it often is present in bog ponds. In recent surveys, specimens were also collected in the Boquet and Mettawee river systems.

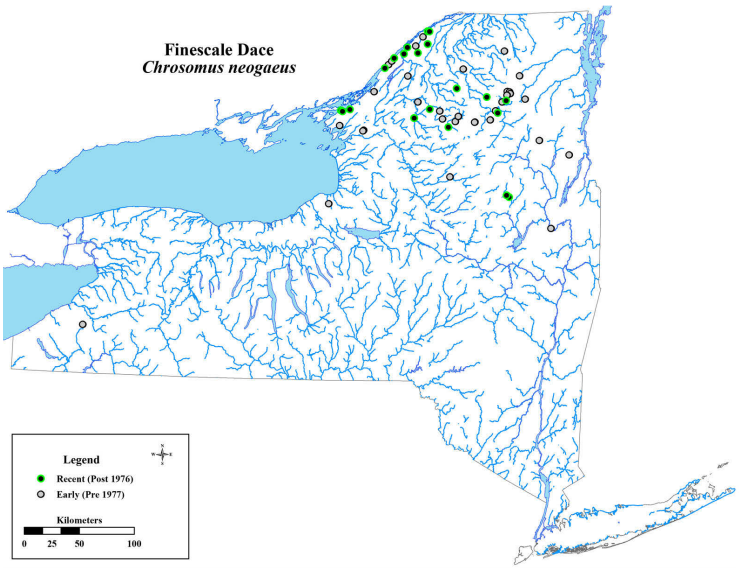
Susquehanna (3). This species is present downstream in Pennsylvania (Lee et al. 1981) and was probably present in headwater streams in New York. It has not been collected recently in Catskill streams, but since 2007, it has been found in tributaries of Canadarago Lake, as well as in Shadow, Clark (NYSM 66988), and Barton (C. Millard, USEPA, pers. comm.) brooks.

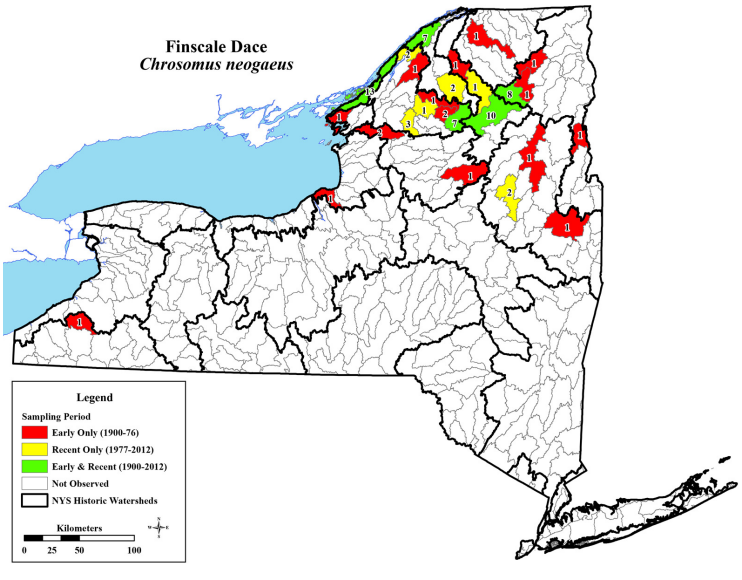
Upper Hudson (1,2,3). This species is widespread in ponds and low-velocity streams in the Adirondack Mountains and recent records show that it still inhabits these waters.

Mohawk (1,2,3). This minnow was taken in a number of lakes and streams in the 1934 watershed survey (Greeley 1935). Specimens continue to be taken regularly during surveys.

Lower Hudson (1,2,3). Greeley (1935) found this species in Vly Creek, a tributary of the Normans Kill in Albany County. Specimens have consistently been found in this creek. The only other report is from Coeymans Creek in 1972.

Chrosomus neogaeus, Finescale Dace





This dace inhabits small streams and is native in eight of 18 New York watersheds, including the Allegheny, Upper Hudson, and several watersheds in the Saint Lawrence River drainage. This species is rare in each of the watersheds in which it is found.

Allegheny (1,2). Finescale Dace were caught in 1937 in Johnson Creek, a tributary of Conewango Creek. Despite meticulous vouchering of specimens during the watershed survey, we could not locate these specimens. A second unverified report is from an unnamed tributary of a different Johnson Creek, a headwater tributary of Ischua Creek, in the eastern basin.

Ontario (1). Only two records exist from this watershed: Three Mile Creek of Chaumont Bay in 1931 (CUMV 66404) and Catfish Creek in 1939 (CUMV 68557). The species appears to be extirpated from this watershed.

Black (1,2). Greeley and Bishop (1932) noted that Finescale Dace were found "in two streams of the Black River drainage (Philomel Creek and a tributary of Lake Rondaxe). At nearly all of the places where the fine-scaled dace was found, *Chrosomus eos* was also taken and hybrids between these two species were found." Collections with both species and hybrids are reiterated in accounts for other Adirondack Mountain watersheds (Greeley and Greene 1931; Greeley 1934). The presence of hybrids suggests the possibility of a unisexual population in these streams (Dawley et al. 1987). In 1951, this species was taken in Little Moose Lake Outlet in the Town of Webb (CUMV 20484). Other records include catches at Black River near Pine Creek in 1940 and Whetstone Marsh Reservoir in 1975, but these identifications were made in the field and are suspect. Philomel Creek was resampled in 2006, and the tributaries of Lake Rondaxe were resampled extensively during the Adirondacks Effects Assessment Program from 1998-2006 (Daniels et al. 2011a), but this species was never collected, although *Chrosomus eos* was taken regularly.

Saint Lawrence (1,2,3). Finescale Dace occurred in several streams and ponds of the Grass, Saint Regis, and Salmon River systems, as well as in Sucker Brook (Greeley and Greene 1931). Recent records are from Sucker Brook in 1980 (NYSM 6502), Ormsbee Pond in 1986 (AMNH 234582), Ingram Stream in 1994, Brandy Brook in 2007, and from both Wheeler Creek and the Saint Lawrence River at Ogdensburg in 2009.

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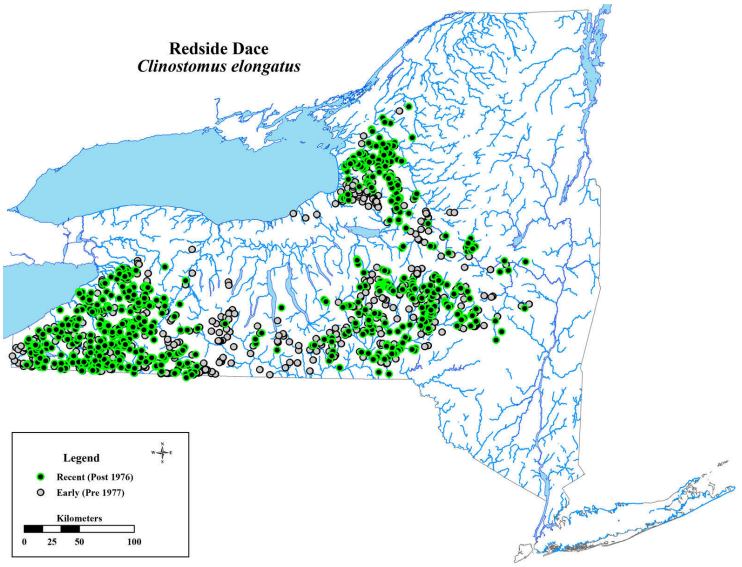
Oswegatchie (1,2,3). Finescale Dace were collected at several localities in the 1931 survey of this watershed, including Cranberry Lake (Greeley and Bishop 1932). The only recent captures were from the main channel upstream of Cranberry Lake in 1992, a tributary to the West Branch Oswegatchie River in 2006 (NYSM 61331), and Lisbon Creek in 2008 (NYSM 64487).

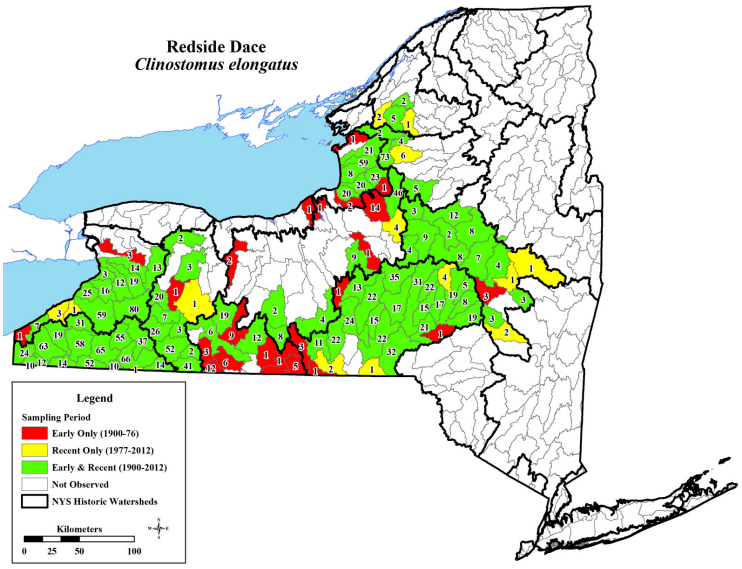
Raquette (1,2,3). Greeley (1934) reported that "...typical *Pfrille neogaea* was taken at each of the following localities: Line Pond, Rock Pond, Moody Pond and Hichins Pond. At several other localities, Dead Creek, Lake Eaton outlet, Jenkins Brook, Barney Pond and Trout Pond, hybrids between this species and *Chrosomus eos* were found." Recent records include catches in a tributary of Calkins Brook in 1955, Line Pond in 1986 (Adirondack Lake Survey Corporation 2014), and the Jordan River in 2008 (C. Millard, USEPA, pers. comm.).

Champlain (1,2,3). Greeley (1930) noted that the only records from this watershed were from headwater ponds and streams in the Saranac River system. The only recent reports were from Military Pond in 1983, Pork Chop Pond in 1984 (AMNH 234559), and Arnold Brook in 1993.

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported collections at Wolf Pond of the Boreas River and in a tributary of Indian Lake. They (Greeley and Bishop 1933) also recorded hybrids between this species and *Chrosomus eos* from "King's Flow, Long Pond, Whitaker Lake, and Cedar River, Hamilton County; Cheney Pond Flow and Clear Pond, Essex County; Kayaderosseras Creek, Saratoga County; and a tributary of Millington Brook, Warren County." Other records exist from Heath Brook near Corinth in 1961 (CUMV 41159), Geyser Brook in 1995, and the Sacandaga River in 1997, but specimens were not vouchered from any of these sites. None were collected during a 2008 survey, suggesting that this species has suffered a serious decline in this watershed.

Clinostomus elongatus, Redside Dace





This spectacular minnow has a range that extends across southern, western and central New York and is present in the Allegheny, Erie-Niagara, Ontario, Genesee, Oswego, Black, Oswegatchie, Chemung, Susquehanna, and Mohawk watersheds.

Allegheny (1,2,3). Redside Dace were collected at 27% of the survey sample sites in 1937 and were common in French Creek, the Conewango Creek system, and in the tributaries of the Allegheny River (Greeley 1938). Recent surveys place this species in about 40% of sampling sites, where it is typical of pool habitats in upland streams.

Erie-Niagara (1,2,3). In the 1928 survey, Redside Dace were generally common but reached their highest abundance in small, cold-water streams with mud or rubble substrates (Greeley 1929). The species continues to be found throughout the watershed.

Ontario (1,2,3). Greeley (1940) noted that this species was only found in Oswego and Jefferson counties and was abundant in the trout streams of the Salmon River and Sandy Creek systems. In later surveys, populations were found in streams to the north and west, such as Mill Creek near Sackets Harbor and Muck Creek near Hannibal.

Genesee (1,2,3). Greeley (1927) reported that Redside Dace were common. The species appears to be less abundant during recent surveys, but it is still present in over 20 streams in the upper part of the watershed.

Oswego (1,2,3). According to Greeley (1928), Redside Dace were rare in this watershed. However, specimens were taken in 1974 in Catharine Creek, which flows in the south end of Seneca Lake (R. Roecker SUNY Geneseo, unpubl. field notes), and have also been found in several streams in the northern part of the drainage, as well as in Oneida Lake tributaries, where this minnow is associated with brook trout. In recent surveys, this species was found to be widespread in Tug Hill streams but rare in lowland streams.

Black (1,2,3). Greeley and Bishop (1932) noted that this species occurred at elevations to 530 m, but it was not widely distributed. All records, historical and recent, are from the Tug Hill Plateau side of the drainage.

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Oswegatchie (1,2,3). Redside Dace were essentially absent from this watershed in 1931, when one specimen was found in Rockwell Creek near Antwerp (Greeley and Bishop 1932). More recently, this species has been caught in tributaries of the Indian River, Black Creek at Reedville Road, and tributaries of the Oswegatchie River near Gouverneur.

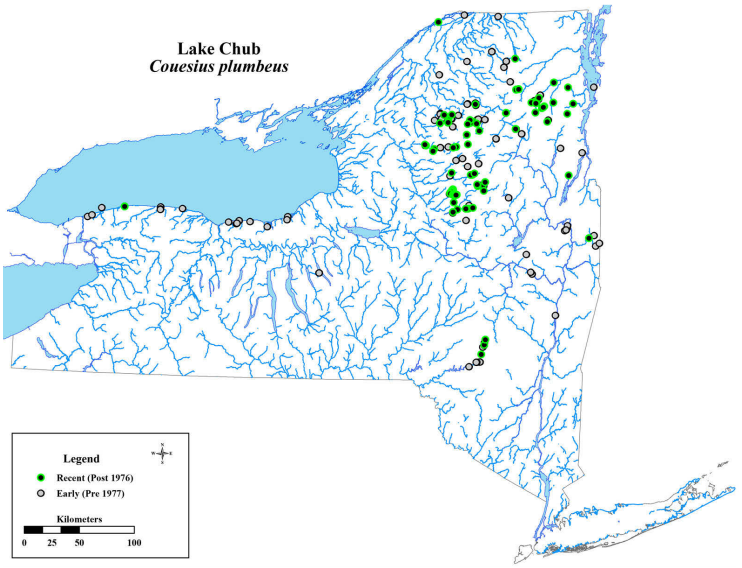
Chemung (1,2,3). Greeley (1938) reported that this fish was found in many creeks but was not particularly abundant, with captures at 14% of the watershed survey sites. When compared to 1937, reports of Redside Dace have declined during the past thirty years and there appears to have been a major decline in this watershed. The few recent records are from Canisteo Creek in 1994 and Meads Creek in 1998.

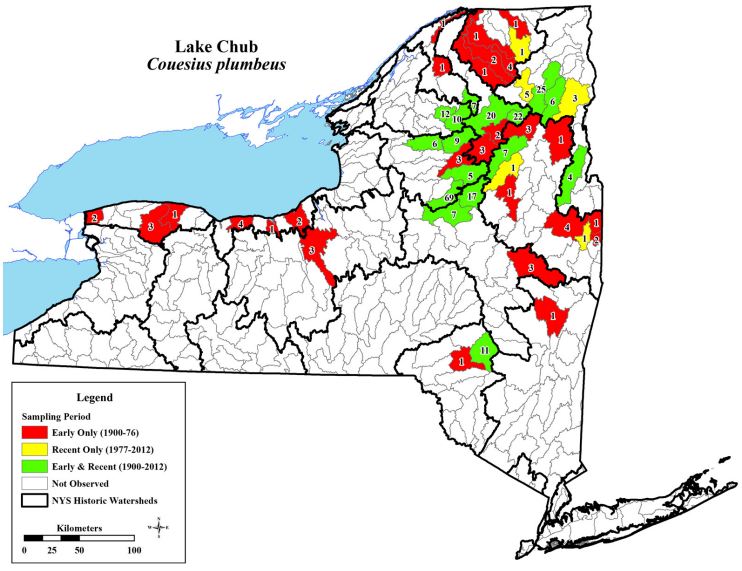
Susquehanna (1,2,3). Redside Dace were common in this watershed in 1935 (Greeley 1936). As is true in the Chemung watershed, which is the western part of this drainage, the decline of the species in this watershed is extreme: in 1935 Redside Dace were taken in 25% of stream samples, whereas from 1996-2010, capture frequency was 4%. Despite the lower frequency of capture, this species is still widely distributed and is found in the middle and upper watershed, as well as in the main channel.

Mohawk (1,2,3). Greeley (1935) noted that this species was locally common and found in tributaries of the Mohawk River but not in the main channel. It remains widely distributed, with records from several streams from the 1950s through 2000s. Crum Creek, a northern tributary, had repeated collections during this period, as did tributaries of Schoharie Creek, a southern stream (Daniels and Wisniewski 1994). The only records of Redside Dace in the Adirondack portion of this watershed are from East Canada Creek and two tributaries of West Canada Creek, placing them at elevations between 300 and 435 m. Smith (1985) explained the presence of this species in the Hudson River drainage as dispersal into the system soon after the glacial retreat, when these streams were connected to western drainages and before the Mohawk-Hudson outlet was opened to the Atlantic Ocean. Individuals in the Mohawk watershed represent the only population of this species in a northern mid-Atlantic drainage, which suggests that these fish have been isolated for 12-15 millennia.

Couesius plumbeus, Lake Chub

This species is an inhabitant of cold-water lakes and streams with clean gravel. The Lake Chub is native to 11 watersheds in the Saint Lawrence, Delaware, and Hudson River drainages. Greeley (1935) reported that several specimens that were collected in the Delaware, Mohawk, and Lower Hudson watersheds were an undescribed species in this genus. Regrettably, he did not include any rationale to support this contention. Two lots survive from these collections: the Vloman Kill (CUMZ 48166) and the East Branch Delaware River (CUMZ 55507). The Lake Chub is identified as a Species of Greatest Conservation Need in New York.





Ontario (1,2). Greeley (1940) reported that Lake Chubs were present in the lake itself, as well as in tributaries and ponds on the lake plain. Young and juvenile individuals were collected, as were adults in breeding condition, on 19 April 1939 in a small stream near Webster, Monroe County. This species was rare in the 1939 survey and remains so. Other collections include Lake Ontario off Wilson in 1942 (CUMV 27494), First Creek of Sodus Bay in1962, and Salmon Creek, Wayne County, in 1972. A 1972 lake-wide study rarely found Lake Chubs in the eastern tributaries, but the species was more prevalent in the western tributaries of the watershed (Christie and Thomas 1981). In 1985-86, specimens were repeatedly caught near the Somerset Power Plant (Beak Consultants Incorporated 1986). Based on extensive sampling in subsequent years, Owens et al. (2003) concluded that this species was in decline in this watershed.

Oswego (1). Lake Chubs were caught in the shallow waters of Owasco and Skaneateles lakes in 1927 (Greeley 1928). None have been caught in this watershed since.

Black (1,2,3). Greeley and Bishop (1932) found this species to be “Common in Adirondack waters of the Oswegatchie and Black drainages. It inhabits both lakes and streams and where it is found trout are almost invariably present.” Most records are from headwater areas of the Black, Moose, and Beaver rivers, largely stemming from power plant relicensing surveys

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conducted in the Beaver River in the 1980s (Niagara Mohawk Power Corporation 1991a). Lake Chubs are tolerant of lower-pH conditions than many other minnows (Driscoll et al. 1991), which benefited this species during the acidification of many Adirondack waters in recent decades. Frequency of occurrence, distribution, and abundance appear steady in this watershed.

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that this species was "locally common in ponds, lakes and cold streams of the Adirondacks. Collections were obtained from Massawepie Lake, Lower St. Regis Lake, Grass River Flow, Deer River Flow and in several streams tributary to the St. Regis River and to Deer River Flow." They also noted that this minnow was a reliable indicator of trout habitat. Lake Chubs were present in Van Rensselaer Creek in 1974 and were collected in Debar Pond (AMNH 259021) and Massawepie Pond (AMNH 235231) in the mid-1980s. The species was last caught in Lake Saint Lawrence in 1987 (Klindt 2007).

Oswegatchie (1,2,3). Greeley and Bishop (1932) noted that Lake Chubs were common in lakes and streams and were often found with trout. In the 1970s, as well as in the 2000s, this species was caught in headwater streams across the watershed.

Raquette (1,2,3). This species was rare in this watershed in 1933, with Greeley (1934) stating that "only a few records were obtained: Horseshoe Lake, Sagamore Lake, Queer Lake, Horseshoe Lake outlet and a tributary of Long Lake at Long Lake village." Individuals were found in tributaries of Moose Pond in 1972. In the mid-1980s, Lake Chubs were captured in five ponds (Adirondack Lake Survey Corporation 2014) and were found again in three of these ponds in the 1990s.

Champlain (1,2,3). This species was uncommon in 1929 and was only found in cold headwater streams of the Saranac and Ausable basins (Greeley 1930). In 1937, specimens were collected in Northwest Bay Brook, a tributary of Lake George (NYSM 25196), and in Lake George itself (NYSM 26208). Lake Chubs were collected in Upper Cascade Lake in 1951 and in Lower Cascade Lake in 1984 (AMNH 234520). Anderson (1978) reported a catch on the Vermont side of Lake Champlain in 1977. Specimens were again collected in Northwest Bay Brook in 1985 (NYSM 15578). Recent records are from higher elevations of the Adirondacks in the West Branch Ausable and Chubb rivers, as well as Towbridge Brook.

Delaware (1,2,3). Greeley (1936) regarded the specimens taken from this watershed as an undescribed species. These specimens were found in limited numbers at five localities in the East Branch Delaware River and its tributaries. Additional collections were made in Bush Kill in 1966 (CUMV 50885), in the Delaware River near Roxbury in 1976 (AMNH 38824), and near the mouth of Pleasant Valley Brook in 1972, 1976 and 1993. More recent records are from 1993 (NYSM 42497) and 2012, when many historic sites were revisited. The species persists in the watershed but remains restricted in range.

Upper Hudson (1,2,3). Lake Chubs were found in the upper Batten Kill (NYSM 4565), which Greeley and Bishop (1933) noted was a stream that contained other glacial relict fishes. Although they (Greeley and Bishop 1933) noted that the distribution of the species was more restricted in this watershed than in other Adirondack watersheds, between 1950 and 1970 individuals were encountered in Johnson, Vly, and White creeks, Fortsville Brook, and Newcomb and Paradox lakes. In later years, specimens have been found in Cedar Lake in 1983, Otter Lake in 1987 (AMNH 258587), and again in the Batten Kill in 1999.

Mohawk (1,2,3). Greeley (1935) reported this species from several lakes and streams, noting that it was often found in association with trout. There are also early records from the Mohawk River in Schenectady County, which Greeley (1935) suggested might be an undescribed conspecific. West Canada Creek and its tributaries, in which this species was common in the 1930s, still support a population, with catches in 1979, 2001 and 2008. Populations appear to have declined in the lakes of this basin, though.

Lower Hudson (1). The only record from this watershed is represented by the unusual specimens mentioned by Greeley (1935), from the Vloman Kill of Albany County. No Lake Chubs have been found in this watershed in recent years.

Ctenopharyngodon idella, Grass Carp

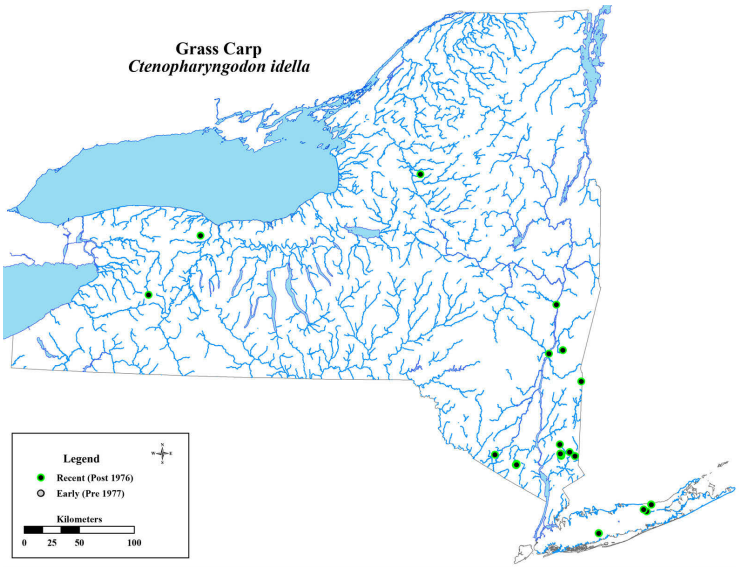
This Asian carp species was introduced into New York in the 1980s, when it became legal to stock a sterile hybrid in private ponds to control aquatic vegetation. Private citizens continue to stock Grass Carp in most parts of the state. Although no Grass Carp have been stocked directly in the public waters of the state, individuals have been found in the Erie-Niagara, Black, Lower Hudson, and Long Island watersheds. Despite having escaped to lakes and streams, there have been no reports of successful reproduction.

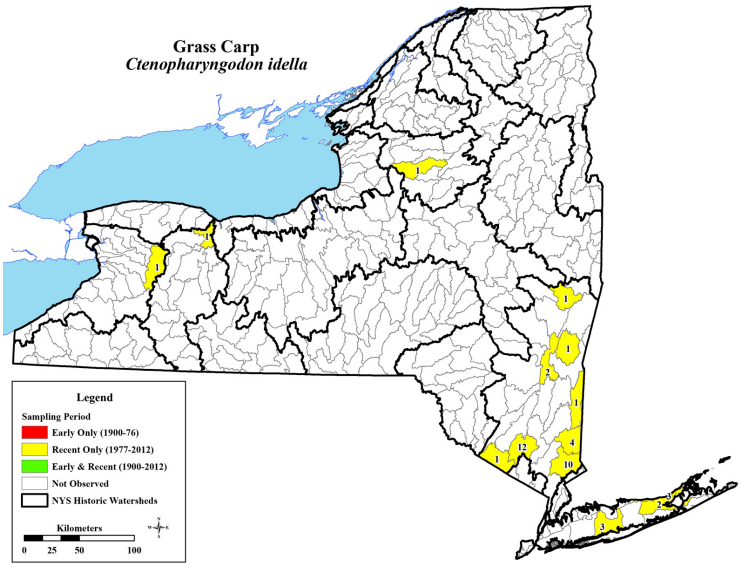
Erie-Niagara (**3**). This species has been stocked in many small ponds to control aquatic plants and it has been reported in a pond at a Girl Scout camp near Sardinia.

Black (**3**). A specimen was caught in 1994 in Lake of the Pines, near Brantingham.

Lower Hudson (**3**). Escapees were reported in 1988 in a pond in Claverack (Smith and Lake 1990) and Grass Carp have since been caught in the Hudson River at the mouth of Catskill Creek in 1992, 2002, and 2008, and in the Roeliff Jansen Kill in the late 1980s.

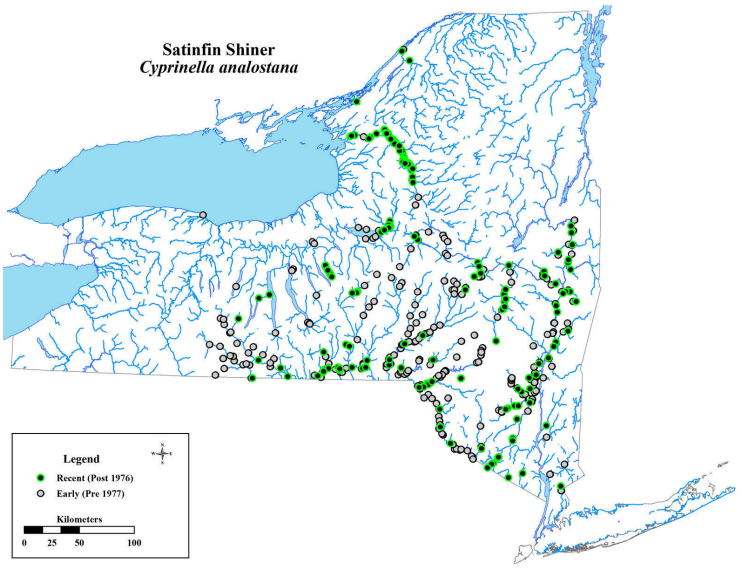
Long Island (**2,3**). Sterile triploid Grass Carp were stocked in study ponds in 1986 (Woltmann 1989) to assess their effectiveness in vegetation control and then to aid in developing statewide stocking recommendations. The species was reported from Arrowhead Pond in 1995 and Belmont Lake in 2004.



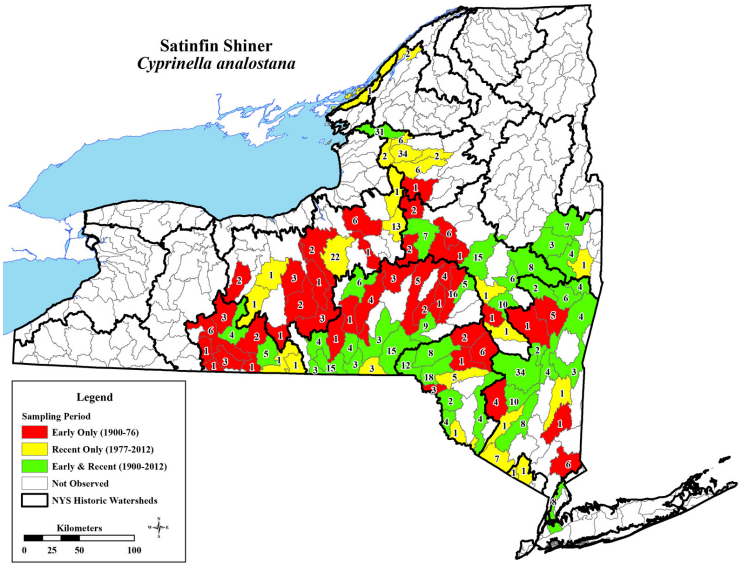


Cyprinella analostana, Satinfin Shiner

This minnow inhabits medium-sized creeks and occurs in 13 of 18 New York watersheds. It is native to the seven southern watersheds and probably non-native in the Ontario, Oswego, Black, Oswegatchie, Saint Lawrence, and Long Island watersheds. This species is easily confused with the related Spotfin Shiner. Because of this, reports based on unvouchered field identifications without supporting data are not included on our maps.



Ontario (**2,3**). Satinfin Shiners were first reported by Gibbs (1963) in a tributary west of Rochester near Lake Ontario, but no further specimens have been caught at this site, despite repeated efforts. In 2000 (NYSM 33354) and 2005 (NYSM 59097), this species was caught in Black River Bay, where the Black River flows into the lake. The Satinfin Shiner is the predominant *Cyprinella* species in the Black River watershed.



Oswego (**1,2,3**). No Satinfin Shiners were caught during the extensive 1927 survey of this watershed (Greeley 1928). Meek, however, collected specimens near Ithaca in the 1880s (CAS-SU 3737, 3748) and additional collections were made in the southern end of Cayuga Lake in 1952 (CUMV 34332), 1959 (CUMV 32802), and 1961 (CUMV 42657). The only recent record of this species from the Finger Lakes region is from the outlet of Keuka Lake in 2005 (NYSM 59764). In 1940, Satinfin Shiners were caught at several sites on Oneida Lake, at the eastern end of this watershed (CUMV 39383, 39490, 39605), and several more were caught in 1941. This was the only species of *Cyprinella* reported in a survey of Oneida Lake's major tributary, Fish Creek, in 1995. It was considered native by Gibbs (1963) and Underhill (1986), but seems more likely to be exotic to this watershed, based both on its absence during the earliest survey and on plausible dispersal routes provided by canals. Its restricted range in the western watershed seems to have contracted and Gibbs (1963) argued that it was being displaced by the Spotfin Shiner. In contrast, the range of this species has continued to expand in the eastern watershed. Satinfin Shiners were also reported at two locations near Otisco Lake in the mid-1990s, but the reports are based on unverified field identifications.

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Black (**1,3**). Greeley and Bishop (1932) reported that "a few specimens, the first records for the Great Lakes drainage, were taken in two feeders of the Black River Canal near Boonville. It is probable that the changes in water connections incidental to construction of the canal and its feeder system, are responsible for its presence here. Doubtless it is to be regarded as an immigrant from the Mohawk system." The authors were apparently not familiar with a specimen collected from Cemetery Creek in Watertown in 1894 (USNM 70045), which clouds the canal migrant explanation. Since the initial watershed survey report, this species has been reported many times from the Black River and lower tributary reaches. Unfortunately, many records are suspect because of the difficulty involved with field identifications of this species.

Saint Lawrence (**1,3**). The only records of the Satinfin Shiner from this watershed are from the Saint Lawrence River at Ogdensburg in the early 1900s (USNM 20098) and from Mullet Creek in 2002 (NYSM 54049).

Oswegatchie (**3**). This species was reported from the mouth of the Oswegatchie River a short distance from its confluence with the Saint Lawrence River in 2007 and from the Oswegatchie River at Heuvelton (C. Millard, USEPA, pers. comm.) in 2009. In 2013, specimens were collected from Sixberry Lake, in the Indian River basin (NYSM 69789). The nearest confirmed, established population is in the Black River, with episodic reports in adjacent areas in Lake Ontario and the Saint Lawrence River.

Chemung (1,2,3). Greeley (1938) stated that "rivers and large creeks of the Chemung Watershed have this species in moderate numbers, as indicated by the 21 collecting stations at which it was found." During the 1937 watershed survey, Satinfin Shiners were found in the Canisteo, Cohocton, and Tioga rivers. In the last 50 years, this species has been reported only six times from Five Mile Creek and the Canisteo River, three times from the Chemung River (e.g., AMNH 49044), and once from the Tioga River at the state line in 1984 (PSU 1194). Between 2001 and 2004, the watershed was surveyed to assess the status of this species and no specimens were found. There are two unconfirmed records: Chemung River at Lowman in 2001 and at Corning in 2008. This species, therefore, appears to have undergone a dramatic decline in the Chemung watershed.

Susquehanna (1,2,3). Satinfin Shiners were relatively common in 1935, being present at 12% of the watershed survey sample sites. They were found to be present in larger streams of the watershed, but Otsego Lake was the only lake in which this minnow was taken (Greeley 1936). Stone (1940) and Gibbs (1963) also collected specimens during extensive surveys of the watershed. More recently, collections have been made in Cayuta Creek, a tributary of the Susquehanna River, at Doraville in 1977 (AMNH 48450) and Cherry Valley Creek in 1978 (AMNH 41222). In addition, this species has been collected from Catatonk Creek in 1982 and 1994 (CUMZ 67882, 75662), the Susquehanna River at Binghamton in 2004 (NYSM 56568) and 2007, and again from Cherry Valley Creek in 2004 (NYSM 57080). There appears to have been a population decline in upstream areas of this watershed and Gibbs (1963) suggested that this species was being replaced by the Spotfin Shiner.

Delaware (1,2,3). Greeley (1936) reported that Satinfin Shiners were collected at 12% (n=54) of the watershed survey sites sampled. This species was collected over 40 times between 1951 and 1988 but only ten times from 1991 to the present, with similar amounts of sampling effort.

Upper Hudson (1,2,3). Greeley and Bishop (1933) did not list this species, although they noted that several of the Spotfin Shiners captured, particularly those caught downstream of Hudson Falls, showed "a trend toward analostanus" and concluded that these specimens could have been intergrades. Since the 1930s, Satinfin Shiners have been caught in Paradox Lake in 1965, the Hoosic River in 1978 (AMNH 41116), Saratoga Lake in 2006 (NYSM 61237), and both the Hudson River and Saratoga Lake in 2008. Additional records from Paradox Lake, Huse Pond, and a tributary of Sacandaga Reservoir seem questionable and lack voucher specimens.

Mohawk (1,2,3). Greeley (1935) reported collections from the Mohawk River and many of its tributaries. He also commented that this species interbred with the Spotfin Shiner, but was more likely to be found in larger creeks, such as Schoharie and West Canada, than its congener. Because this minnow is present in these larger creeks, it is a frequent associate of Smallmouth Bass. Recent records show that Satinfin Shiners persist in the watershed, with collections in Schoharie Creek, the Mohawk River, Canajoharie Creek, and Alplaus Kill. The Mohawk watershed is connected to the Oswego watershed by the Erie Canal, and it is possible that Satinfin Shiners in Oneida Lake and its tributaries emigrated through the canal from this watershed.

Lower Hudson (1,2,3). Greeley (1937) reported this species from Catskill, Esopus, and Rondout creeks, Roeliff Jansen Kill, and the Croton and Wallkill rivers and other tributaries, but not in the main channel. Spotfin Shiners were also found in Coxsackie Creek, Normans Kill, Poesten Kill, and Hannacrois Creek (Greeley 1935). Since the 1930s, there have been several confirmed records from the watershed, including: Hudson River at Staatsburg in 1954 (CUMV 26443), at Athens in 1976 (AMNH 38652), and at Bethlehem in 1978 (AMNH 41000), in the Shawangunk Kill in 1978 (AMNH 40768), and in Kline Kill in 1978 (AMNH 41177), as well as in several of the streams where specimens were found in the 1930s. Several records in NYSDEC

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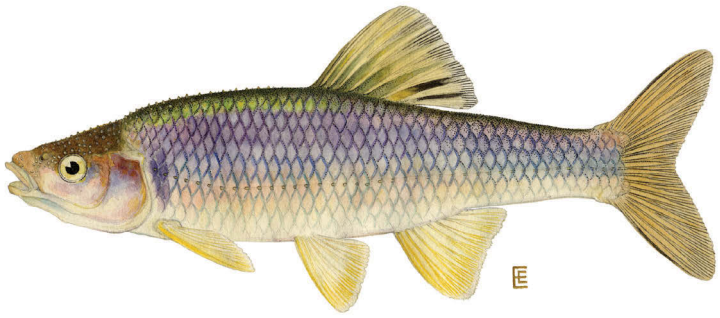
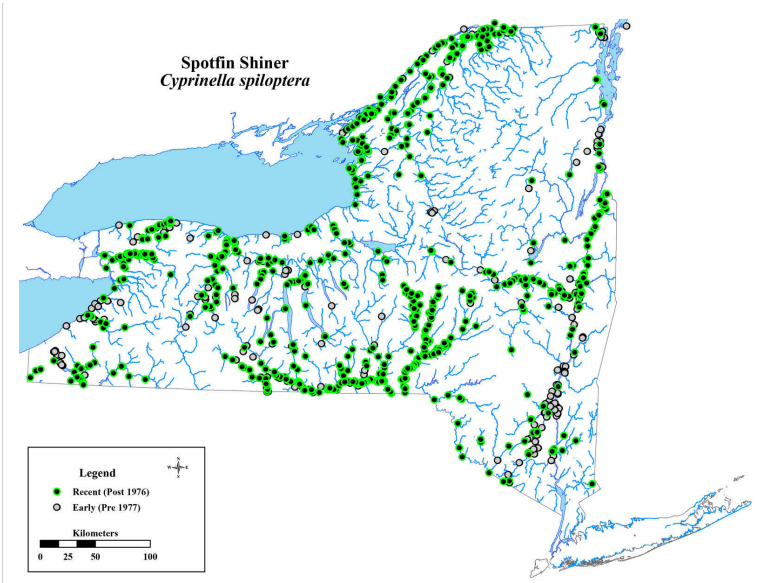
files may be invalid because field identifications did not distinguish between this species and the Spotfin Shiner. Recent records have been confirmed from Whippoorwill Creek in 2000, Beaver Kill (of Kaaterskill Creek) in 2005, Wynants Kill in 2009 (NYSM 64882), and the Wallkill River (NYSM 66003) and Roeliff Jansen Kill in 2010.

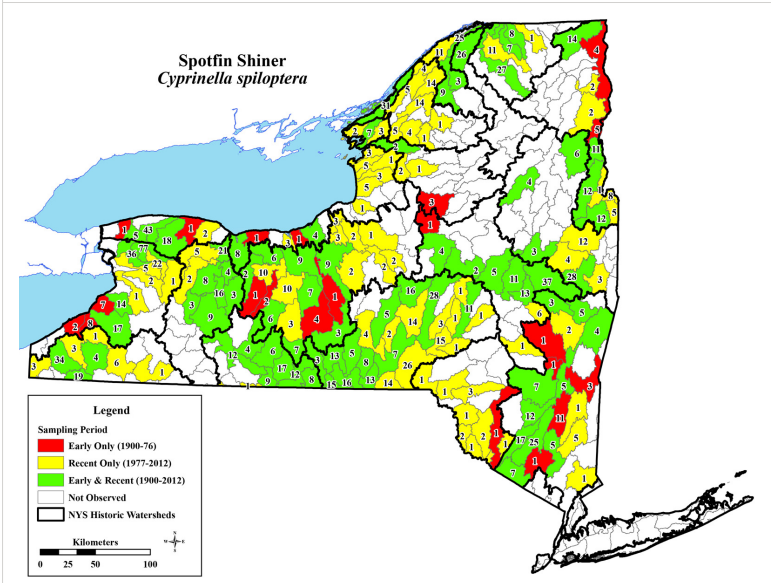
Newark Bay (2,3). This species is uncommon in this watershed, with reports from Greenwood Lake in 1977 (AMNH 45622) and Lake Stahahe in 2002 (NYSM 54169).

Long Island (**1,3**). Satinfin Shiners are not found on the islands, but inhabit an impoundment of the Bronx River, which drains into Long Island Sound from Westchester County. Greeley (1937) reported this species in 9% of the samples taken during the watershed survey and noted its presence in Kensico Reservoir. Specimens were again taken in Whippoorwill Creek, a tributary to the reservoir, in 2000 (NYSM 52304). The reservoir is part of the New York City water supply system and is fed water from the Mohawk and upper Delaware watersheds through an extensive aqueduct system. It is possible that the Satinfin Shiner gained access to this watershed via bulk water transport through the aqueduct system.

Cyprinella spiloptera, Spotfin Shiner







This minnow is found in all watersheds in New York, except for Newark Bay and Long Island. The species is also absent from the higher elevations in the Adirondack Mountains. As was the case with the previous species, unconfirmed reports are not included on the map without additional documentation.

Allegheny (1,2,3). Greeley (1938) reported this "handsome" species from Chautauqua Lake and other parts of the Conewango Creek basin. It was first caught in the eastern basin in 1999, although Fowler (1919) recorded it upstream in McKean County, Pennsylvania. Populations have persisted in Chautauqua Lake and specimens were caught in the main stream of Conewango Creek in 1993 (Pomeroy 1995). Its presence in French Creek was first noticed in 1979 (CUMV 65491), but it was also reported downstream in Pennsylvania (Cooper 1983).

Erie-Niagara (1,2,3). Greeley (1929) noted that Spotfin Shiners were rare in Lake Erie but common in several tributaries. The species remains widespread and relatively common in this watershed.

Ontario (1,2,3). Greeley (1940) noted that "the 30 records of this minnow represent a wide range of large creeks, bays, the Barge Canal system, Glenwood and Carlton lakes." Although widely distributed, this species was not abundant at any particular site, which is similar to its current status.

Genesee (1,2,3). Spotfin Shiners were reported to be rare in the river and larger tributaries but common in Conesus Lake (Greeley 1927). Catch frequency seems to have increased for this species in recent years; since the 1960s, it has been reported from Black, Canaseraga, Conesus, Honeoye, Oatka, and Red creeks, the Genesee River, and Conesus Lake.

Oswego (1,2,3). Greeley (1928) reported that this species was moderately common in the lakes and larger, warm streams of the watershed. It remains widely distributed.

Black (1,2,3). In 1931, Spotfin Shiners were collected from Mill Creek in Boonville, two sections of the Black River Feeder Canal in Boonville, and the Black River east of Watertown (Greeley and Bishop 1932). The next time the capture of this species was confirmed was in the Deer River in 1991 (NYSM 41576), with subsequent collections from Lacey Creek in 1992

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(NYSM 42417) and Mill Creek near Lowville in 2000 (NYSM 52166). Among 27 specimens collected from this watershed between 1991 and 2012, only the three above were determined to be Spotfin Shiners; the remaining specimens were all Satinfin Shiners. When these two species are sympatric, it is necessary to voucher specimens for positive identification. Because reports are unreliable, it is conservative to assume that most of the Cyprinella one encounters in this watershed are Satinfin Shiners.

Saint Lawrence (1,3). Evermann and Kendall (1902b) reported this species from the Saint Lawrence River near Cape Vincent. Specimens were not taken at any main stem river site in the 1930 survey, but individuals were found in tributaries of the Grass, Saint Regis, and Little Salmon rivers (Greeley and Greene 1931). The species continues to be widespread in these lower elevation areas.

Oswegatchie (1,2,3). This species was reported by Greeley and Bishop (1932) below the dam at Ogdensburg, and in 1979, it was caught much farther upstream (NYSM 41316). Since 1990, Spotfin Shiners have become relatively widespread at lower elevations.

Raquette (1,2,3). Greeley (1934) reported that a single specimen was taken at the mouth of Squeak Brook. Later collections include: Hall Creek in 1979 (AMNH 44844), Earls Creek in 1997, and the Raquette River in 1999 and 2012 (NYSM 67902). This species is still uncommon in the watershed.

Champlain (1,2,3). Greeley (1930) reported that Spotfin Shiners were common in Lake Champlain and that a few specimens were taken in Lake George near its outlet. The species remains widely distributed at lower elevations.

Chemung (1,2,3). Spotfin Shiners were taken in 9% of the collections and in seven streams during the 1937 watershed survey (Greeley 1938). In collections made between 1996 and 2010, this minnow was present at 34% of the sites and in 11 streams, which suggests that its range is increasing in this watershed.

Susquehanna (1,2,3). Greeley (1936) reported that Spotfin Shiners were rare in this watershed and that populations were concentrated in the lower river and larger tributaries including Owego, Nanticoke, and Mud creeks and the Unadilla and Chenango rivers. This species was not present in upland areas on the east side of the watershed. Based on recent surveys, it has become more widespread and is found in areas farther upstream. Frequency of occurrence rose from 2% in 1935 to 20% in the 2000s.

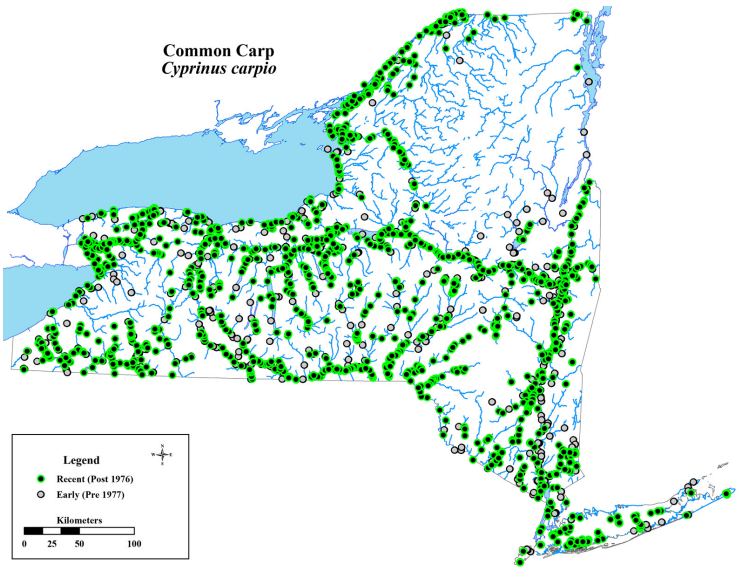
Delaware (2,3). Greeley (1936) reported that Spotfin Shiners were absent from this watershed. The earliest verified record is from the Neversink River at Cuddebackville in 1975 (AMNH 38877). In 1993, this species was found in the Delaware River at its confluence with Ten Mile Creek (R. Ross, USGS, unpubl. field notes). In 2003, specimens were collected from the East Branch Delaware River near the Beaver Kill (NYSM 55364), at Wiley Creek near Wurtsboro (C. Apse The Nature Conservancy, pers. comm.), and again from the Neversink River at Port Jervis. In 2005, individuals were caught at two sites on the Delaware River in Sullivan County (NYSM 59745, 59768).

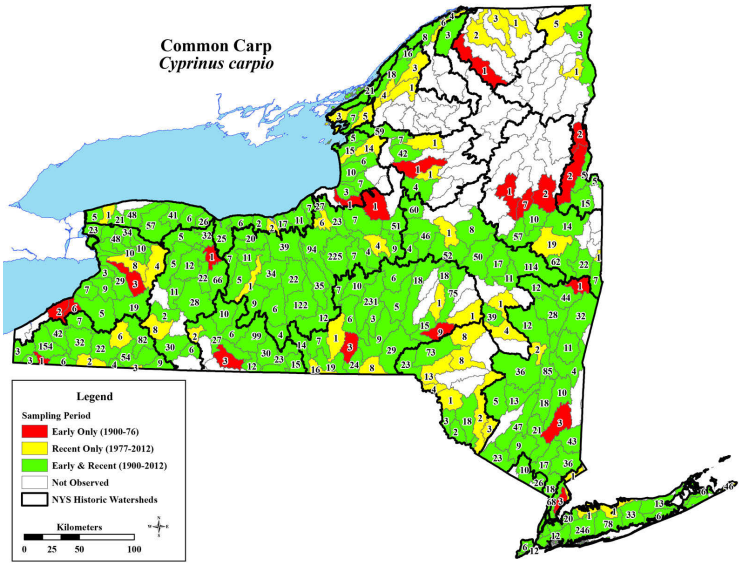
Upper Hudson (1,2,3). This is the only member of this genus reported by Greeley and Bishop (1933) from this watershed. Specimens from the upper river, e.g., Huse Pond, Essex County, are typical Spotfin Shiners (NYSM 26214). In contrast, as noted earlier, specimens taken downriver shared characteristics with the Satinfin Shiner, but Greeley and Bishop (1933) noted that the possibility of intergrades was not demonstrated, nor did they identify the shared characteristics. Later workers have concluded that these fish were Spotfin Shiners (e.g., Smith 1985). During the 1932 survey, this species was an important forage fish in Saratoga Lake. Catches are more widespread in recent times. Although typically a lowland species, it was captured in Schroon Lake in 1992 (NYSM 41883), which, like the 1932 Huse Pond catch, is among the few higher elevation localities where this species occurs.

Mohawk (1,2,3). Greeley (1935) reported that this species was common enough to be regarded as an important forage species. It continues to be present in the Mohawk River, the lower reaches of major tributaries, the Schoharie Reservoir, and Collins Lake.

Lower Hudson (1,2,3). Spotfin Shiners were collected at 48 sites during the 1936 watershed survey (Greeley 1937) and inhabited large parts of the Wallkill River and Rondout Creek. In addition, Greeley (1937) opined that the widespread presence of this fish provides evidence of an extension of the range of midwestern fish into eastern waters, suggesting that he regarded Spotfin Shiners as exotic to this watershed. Although an interesting hypothesis, he did not provide details; the species was regarded as native by Schmidt (1986), Smith (1985), and Carlson and Daniels (2004). It is currently widespread in the larger streams.

Cyprinus carpio, Common Carp





This Eurasian carp species is well established in New York and is present in lowland areas of all 18 watersheds, but is largely absent at higher elevations.

Allegheny (**1,2,3**). Common Carp were collected in all three basins of the Allegheny watershed during the 1937 survey (Greeley 1938) and Becker (1982) caught this species in 55% of his samples during a 1979-80 survey of the Allegheny River. The species was firmly established in the watershed and had graduated to nuisance status in Chautauqua Lake by the 1930s (Greeley 1938). In recent surveys, it has been found in the main channel of the Allegheny River, Red House Brook, Conewango Creek and its tributaries, and French Creek.

Erie-Niagara (**1,2,3**). This species was widespread in Lake Erie by 1928 and supported a commercial and artisan fishery (Greeley 1929). It was also present in the Niagara River and the lower reaches of all tributaries. It remains common to abundant in larger waters and is frequently caught.

Ontario (**1,2,3**). Common Carp were common in the bays of the lake and in many of its larger tributaries in the 1939 watershed survey (Greeley 1940). The species is now widely distributed.

Genesee (**1,2,3**). Greeley (1927) reported that Common Carp were “locally common in deep, sluggish parts of the Genesee River, the lower waters of some of the largest tributaries and in the lakes. Very common in the lower Genesee River in the spring when it runs from Lake Ontario to spawn.” The species remains common in this watershed.

Oswego (**1,2,3**). This species was common in lakes and sluggish streams and frequently was associated with aquatic vegetation (Greeley 1928). Oglesby (1978) reported that the Common Carp was established in Cayuga Lake by the end of the nineteenth century. Its abundance in Oneida Lake led to an examination on how to control population levels (Smallwood and Struthers 1928), although Greeley (1928) noted that there was an active sport fishery at the time and a potentially valuable commercial fishery. The species remains common and the frequency of capture in streams from 1996 through 2010 was 10%.

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Black (**1,2,3**). Common Carp were commonly caught in the 1931 watershed survey (Greeley and Bishop 1932). Most records are from the main channel. In 2005, a major fish kill occurred in a 40-km reach upstream of Carthage; Common Carp was one of the few species that did not die in large numbers.

Saint Lawrence (**1,2,3**). Greeley and Greene (1931) stated: "Although carp may be rather common at certain favorable locations along the Saint Lawrence, they are by no means abundant in the river as a whole." More recently, the Saint Lawrence River upstream and downstream of Moses Saunders Dam contains a substantial population, which supports a popular sport fishery.

Oswegatchie (**2,3**). Common Carp were established more recently in this watershed than others in New York. The first record was in Clear Lake in 1962, with subsequent records in the Oswegatchie River in 1990 and Black Lake in 1995.

Raquette (**1,3**). Common Carp were rare in this watershed in 1933, prompting Greeley (1934) to note that the Raquette did not have a "carp problem." In his account, he noted that individuals were occasionally speared below the dam at Raymondville but only one specimen, a small male in breeding color, was collected during the survey, from tributary 2 of the Squeak River, on 11 July 1933. Specimens have been collected as far upstream as Norwood Reservoir in recent years (Niagara Mohawk Power Corporation 1991b, 1991c).

Champlain (**1,2,3**). The Common Carp was not included in a list of species known to occur in Lake Champlain as of 1894 (Evermann and Kendall 1902a). By 1929, it was widely distributed in the lake but restricted to shallow, weedy areas (Greeley 1930), which is a frequently encountered habitat in this lake. The species remains widely distributed in the lake and lowland streams.

Chemung (**1,2,3**). By 1937, Common Carp were well established in this watershed and present in the larger rivers and in Lamoka and Waneta lakes (Greeley 1938). Populations remain abundant and are widespread in the lakes and large rivers.

Susquehanna (**1,2,3**). Greeley (1936) listed this species as rare in this watershed, although he noted that it had long been present. Common Carp were taken in the main channel and in several of the larger tributaries with confluences in the lower river during the 1935 survey of this watershed. It was also found in several lakes, including Otsego, Goodyear, and Spencer. Today, Common Carp are commonly caught in all of the larger water bodies within this watershed.

Delaware (**1,2,3**). No Common Carp were found during survey work in 1935 (Greeley 1936), but there was an anecdotal report from the river at Pond Eddy and near Barryville. The species is widely distributed in the larger streams and many of the lakes of the watershed today.

Upper Hudson (**1,2,3**). Greeley's (1933) summation provides a thorough overview of the status of this fish in 1932: "Although not generally distributed throughout the region, the carp is locally abundant in several bodies of water, especially the Sacandaga Reservoir and Saratoga Lake. It is found in the Hudson River, more abundantly below Hudson Falls, where it enters weedy bays of creek mouths to spawn. Within the Sacandaga Reservoir area, carp were found well up in several trout streams; Paul Creek and East Stony Creek." Common Carp remain common in this watershed.

Mohawk (**1,2,3**). Greeley (1935) stated: "The Mohawk and Hudson have proven favorable to the increase of the carp, which is the most important commercial fish species within the area covered by the survey. Delta Lake and…many of the creeks entering the Mohawk…contain carp." Common Carp are no longer commercially important in this watershed but remain common.

Lower Hudson (**1,2,3**). DeKay (1842) reported that the first stocking of Common Carp in the Hudson River occurred in 1831. Although there is some contention about this date (see Daniels et al. 2011b), Common Carp have nonetheless been present in the river for well over a century. In 1936, Greeley (1937) reported that this species was found throughout the watershed, including in the main channel, where most were taken, in larger tributaries, particularly at their mouths, and in lakes and reservoirs. The species is still abundant, although there is currently no commercial fishery. Hybrids between Goldfish and Common Carp are occasionally taken.

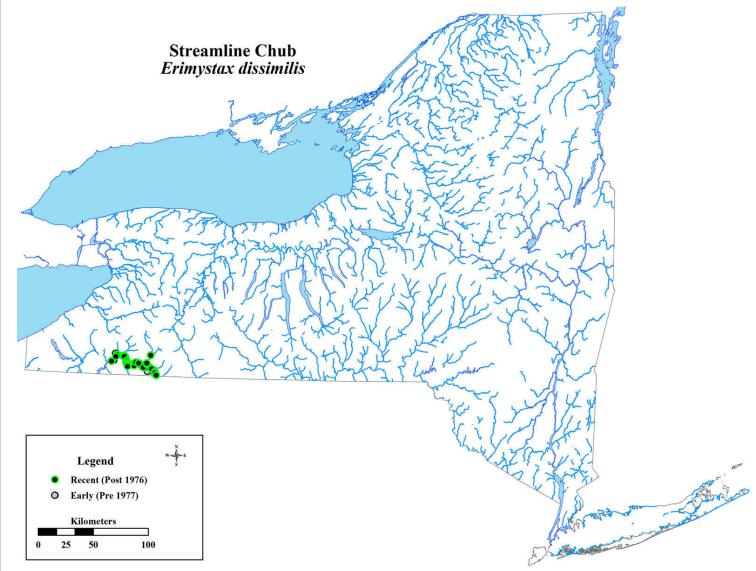
Newark Bay (**1,2,3**). Greeley (1938) noted the presence of Common Carp in this watershed at just over 1% of the watershed survey sample sites. More recently, the species has been found in many waters, including the Ramapo and Hackensack rivers and DeForest and Rockland lakes.

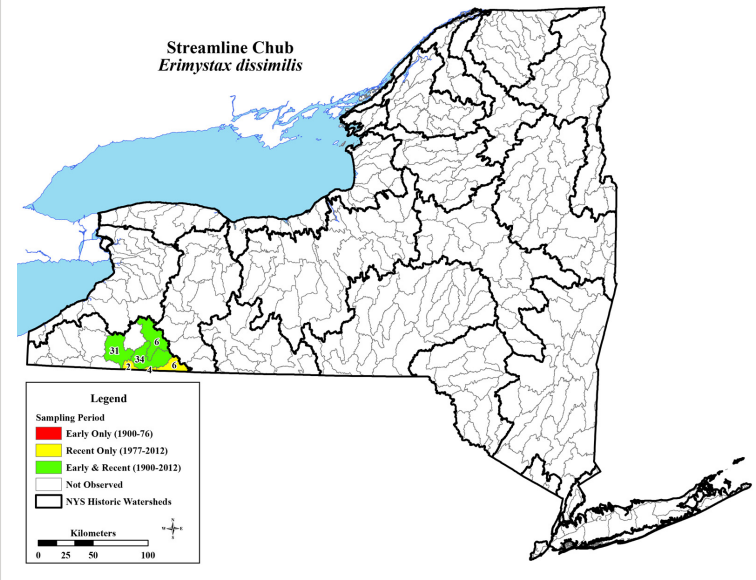
Long Island (**1,2,3**). Greeley (1939a) noted that "the introduction of carp has established this species in moderate numbers in a considerable number of streams and lakes of the region." In fact, this species' abundance was great enough to support a commercial fishery. Recent records show that Common Carp are still present in many waters.

Erimystax dissimilis, Streamline Chub

This chub occurs in medium-sized and larger streams with clean gravel, and is native to the eastern Allegheny watershed.

Allegheny (1,2,3). During the 1937 survey, Streamline Chubs were taken from riffles in the Allegheny River and Oswayo, Olean, Tunungwant, and Haskell creeks (Greeley 1938). Specimens were collected at 2% of the survey sample (Greeley 1938), but, in surveys over the last three decades, this species was more common, being present at about 10% of the sites sampled. This increase in numbers occurred despite the fact that the impounding of Allegheny Reservoir eliminated about half of the Streamline Chub's available habitat in the watershed and may be related to an increase in the amount of riffle habitat used by this species.

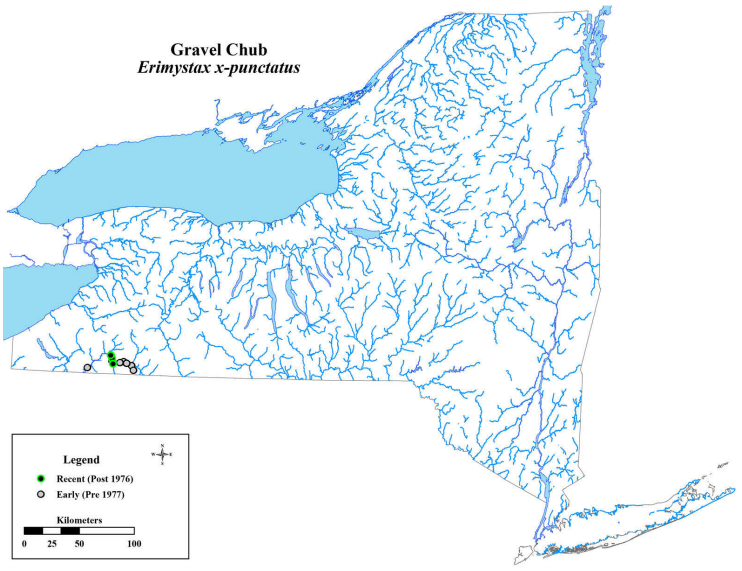


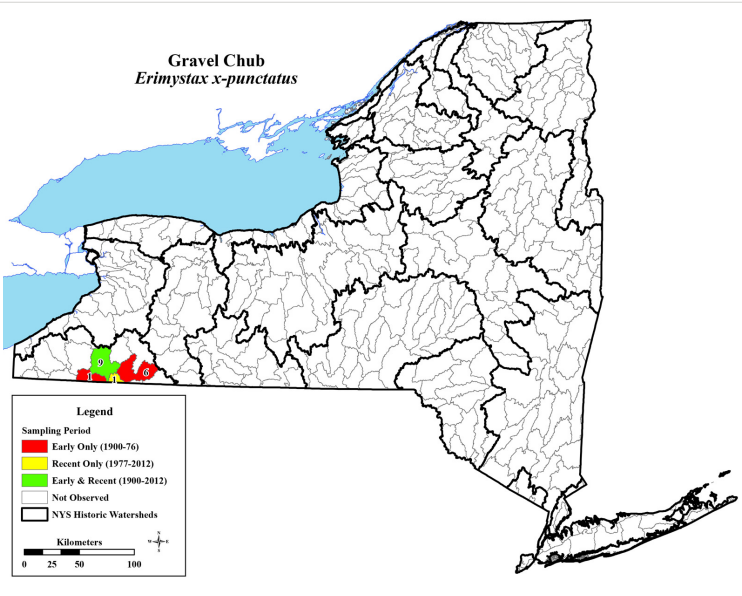


Erimystax x-punctatus, Gravel Chub

The Gravel Chub occurs in medium-sized streams with clean gravel, and is native to the eastern basin of the Allegheny watershed. This species would be designated a Species of Greatest Conservation Need in New York, but it appears to be extirpated.

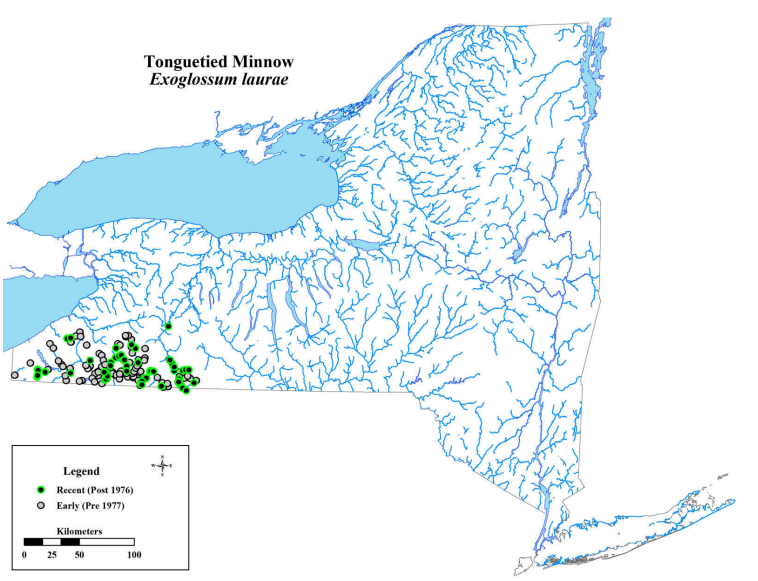
Allegheny (1,2). Although this species was collected during the 1937 watershed survey in the Allegheny River at the mouth of Pierce Run (UMMZ 180963) and in South Carrollton, it had not been formally described (Hubbs and Crowe 1956) and consequently was not reported (Greeley 1938). Eaton et al. (1982) reported individuals in the reach of the Allegheny River between Salamanca and Olean, as well as in Tunungwant and Haskell creeks as late as 1979. The 1937 site at the mouth of Pierce Run is now inundated by the Allegheny Reservoir.

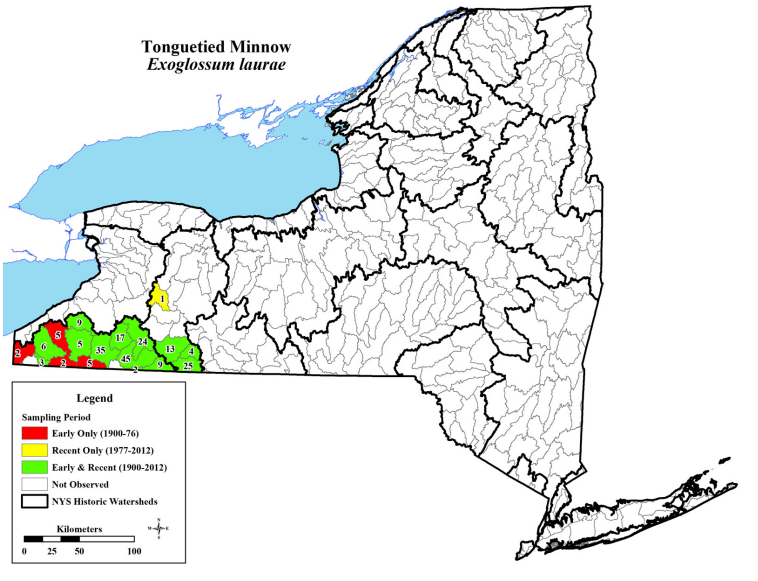




Exoglossum laurae, Tonguetied Minnow

The Tonguetied Minnow is native to the southwest corner of the state, in the Allegheny and Genesee watersheds. It is an inhabitant of pools of small to medium-sized streams with clean gravel. This species is regarded as a Species of Greatest Conservation Need in New York.



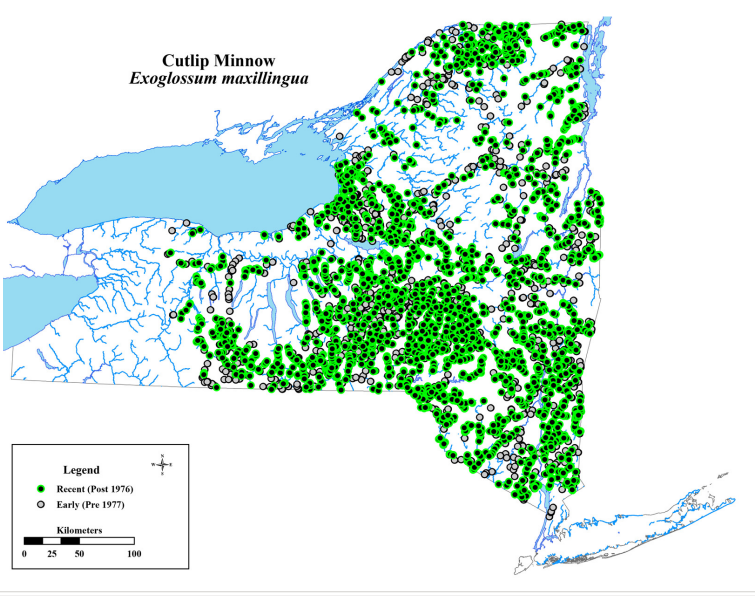


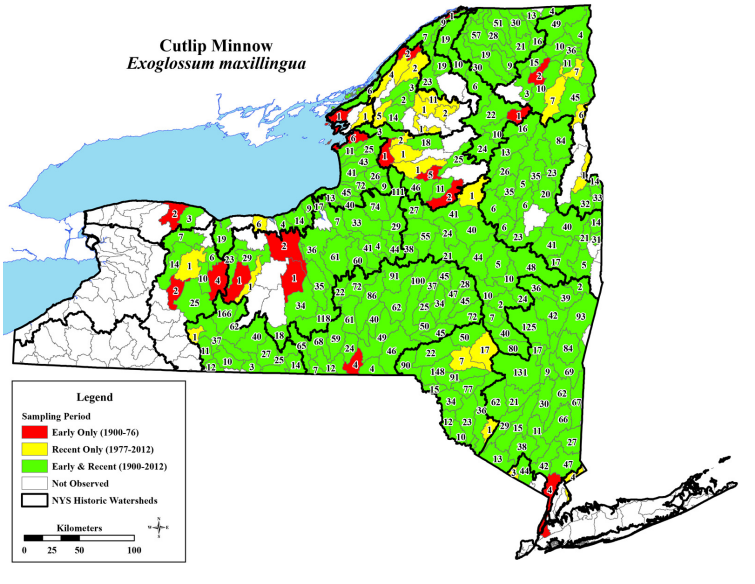
Allegheny (1,2,3). Greeley (1938) reported that this minnow was found in a large number of creeks as well as in the Allegheny River itself, and was sufficiently abundant to be an important forage fish. Tonguetied Minnows were found in 39 waters, or almost 25% of the sample sites in all three basins of the watershed (Greeley 1938). The species was widely distributed in Red House Brook and its tributaries during a survey of Allegany State Park in 1984-85, although it was relatively rare. When this survey was repeated in 1998, a single individual was found (NYSM 48392; Daniels 1998). In synoptic surveys conducted in 1989 and 2004, specimens were collected in six waters. In other recent surveys, this species was found in an additional nine streams. It has not been collected in French Creek since the 1930s (NYSM 5150). Overall, Tonguetied Minnow populations appear to be declining in this watershed.

Genesee (1,2,3). This species was captured in the Genesee River near the Pennsylvania border in 1926 but had not yet been described (Hubbs 1931). It continues to be found only in the area upstream of Portageville Falls, with its congener the Cutlip Minnow present in the watershed downstream of the falls (see below). Interestingly, there is evidence of hybridization between the two species in the upper watershed (K. Oswald, Miami University of Ohio, pers. comm.) although no Cutlip Minnows have been reported yet upstream of the falls. During a survey conducted in 2013, where the Tonguetied Minnow was the most frequently captured species, no hybrids were collected.

Exoglossum maxillingua, Cutlip Minnow

This species occurs in 16 New York watersheds and is absent only from the Allegheny and Erie-Niagara watersheds. Although the species is present in the Genesee River watershed, it is only found downstream or Portageville Falls and is replaced by its congener, the Tonguetied Minnow, at upstream sites. Early workers repeatedly noted that this was a stream fish, but it has frequently been caught in standing water in recent surveys.





Ontario (1,2,3). Greeley (1940) recorded this minnow in the eastern part of the watershed where it was collected at more than 70 sites, "many from trout waters." During this survey, Cutlip Minnows were captured in Salmon Creek and the west branch of Sandy Creek, which were the only captures west of Sodus Bay in Monroe County. In the 1970s, this species was found in Monroe County tributaries, including those of Maxwell Bay and Irondequoit Bay, and in 2003, it was found in Buttonwood Creek. Sandy Creek remains as the western extent of the range of this species in this watershed.

Genesee (1,2,3). Cutlip Minnows have only been found in the Genesee River and its larger tributaries downstream of Mount Morris and Portageville Falls.

Oswego (1,2,3). This species is common and widely distributed in this watershed, and neither its range nor frequency of occurrence has changed since the 1927 watershed survey (Greeley 1928).

Black (1,2,3). Greeley and Bishop (1932) reported that Cutlip Minnows were frequently found in trout streams, particularly in the Moose River system. The species continues to be found in tributaries of the Black, Beaver, and Sugar rivers, as well as in the Moose River.

Saint Lawrence (1,2,3). Greeley and Greene (1931) stated that "this large, dark minnow is found in the St. Lawrence River and all tributary systems of the region. In the Grass and St. Regis drainages it is found well up into the Adirondacks." Specimens were only found in streams, however, not ponds. Recent records show a wider distribution for this species, including the occasional pond capture.

Species continued on next page

Oswegatchie (1,2,3). Cutlip Minnows were collected twice in lowland streams in 1931 (Greeley and Bishop 1932) and remained relatively rare through 1977, during which time the species was reported an additional three times. Recent collections exist from throughout the watershed, including sites at higher elevations.

Raquette (1,2,3). This species is found throughout the watershed and was widely distributed in both lowland and upland streams and ponds in the 1933 survey of the Raquette system (Greeley 1934). Its distribution remains essentially unchanged.

Champlain (1,2,3). According to Greeley (1930), this species was "common in creeks and rivers of the Big [sic] Chazy, Little Chazy, Saranac, Little Ausable and Ausable systems where it is found above falls." During this survey, the species was reported as a stray in Lake Champlain, with Greeley (1930) noting that it was "distinctly" a stream fish. Cutlip Minnows continue to be found in many waters.

Chemung (1,2,3). Greeley (1938) reported that this species was found at 33% of the watershed survey sample sites. It continues to be abundant and widespread in this watershed.

Susquehanna (1,2,3). This minnow was frequently caught during the 1935 watershed survey (Greeley 1936) and continues to be widely distributed in this watershed.

Delaware (1,2,3). Cutlip Minnows were taken at only 1% of the watershed survey sample (Greeley 1936). They have been taken much more frequently in recent surveys, where this species was found in 40% of the samples taken.

Upper Hudson (1,2,3). Greeley and Bishop (1933) described this fish as widely distributed in both creeks and ponds in this watershed. Recent records show that Cutlip Minnows still inhabit many areas throughout the Upper Hudson system.

Mohawk (1,2,3). Greeley (1935) noted that the Cutlip Minnow is a stream fish and was captured in "flowing waters of comparatively shallow depth," but it was also taken in Delta Lake. He (Greeley 1935) also noted that this species was not found in headwaters. Recent collections show that this species is still found in many waters and it is now a frequent inhabitant of higher-elevation sites (e.g. NYSM 45469).

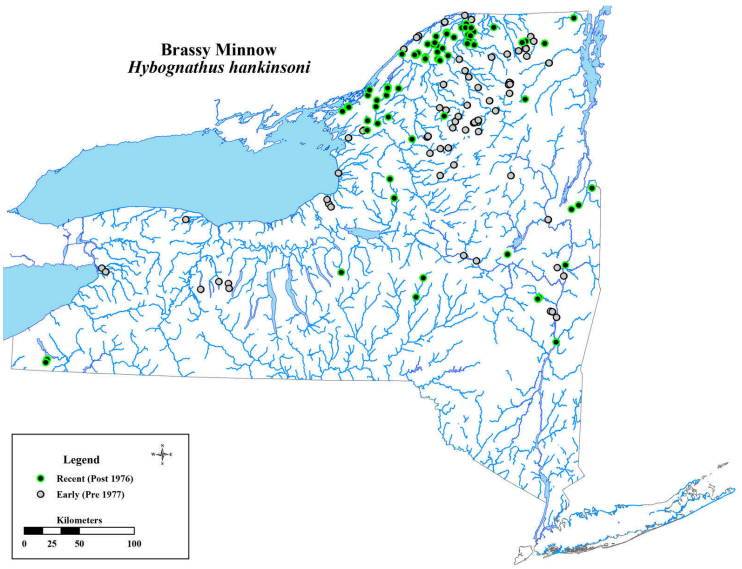
Lower Hudson (1,2,3). Greeley (1937) again reported that this fish had a "decided preference" for streams, although it was occasionally found in reservoirs. Cutlip Minnows continue to be found throughout the watershed.

Newark Bay (1,2,3). Greeley (1937) noted that this species was caught at 12% of the watershed survey sites sampled. It continues to be present in many waters.

Long Island (3). Cutlip Minnows were first collected in 1994, and later in 2005, in the Mianus River. Jacobs and O'Donnell (2009) list the species in the downstream reaches of this stream in Connecticut as well. There are no records of this species from the islands of this watershed.

Hybognathus hankinsoni, Brassy Minnow

This small minnow, typically found in small streams, is native to 12 of the state's 18 watersheds. It is also present in the Susquehanna and Allegheny watersheds, where it has been introduced.

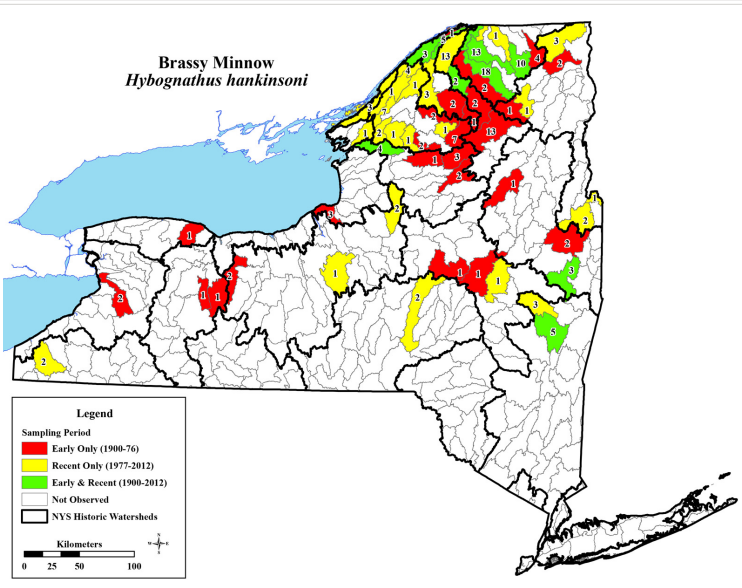


Allegheny (**3**). Brassy minnows were collected from Ball Creek and South Branch Goose Creek, tributaries of Chautauqua Lake, in 1989 (NYSM 40335) and 2004 (NYSM 50131), respectively.

Erie-Niagara (1). Greeley (1929) reported that a single specimen was taken from Cazenovia Creek near Buffalo on August 8, 1893 (USNM 89362). Interestingly, this specimen was used as a paratype in the description of this species (Hubbs, in Jordan 1929).

Ontario (1,3). Early records include captures in Sandy Creek at Woodville in 1931 (NYSM 5251), the Lake Ontario shore near the Black River in 1931 (e.g., NYSM 5230), and West Creek in 1935 (CUMV 27305). In 1939, specimens were collected from Vermilion Pond and Catfish Creek in Oswego County (Greeley 1940). More recently, this species was found at Gillette Creek north of Watertown in 1992.

Genesee (2). The Brassy Minnow is known from only two records in this watershed: Honeoye Lake outlet in 1946 (CUMV 65973) and Conesus Inlet in 1966.



Oswego (2,3). The Brassy Minnow was not included in the species list from the 1927 survey of this watershed (Greeley 1928) and there are no museum records from that time period. The species was reported from Ganargua Creek in 1968, Onondaga Creek in 1989, and Broad Brook, a tributary of the East Branch Fish Creek, in 2001. Specimens were also collected from Oneida Lake in the late 1980s (J.L. Forney, Cornell University, pers. comm.).

Black (1,2,3). Greeley and Bishop (1932) stated that this species was "widely distributed in upland lakes and sluggish streams of the Oswegatchie and Black River drainages and occur[s] in only a few of the lowland streams, as Philomel Creek." More recently, specimens were taken in Trout Brook near Dexter in 1994 (NYSM 44090), a ditch/stream near Dadville in 1998 (NYSM 49011), and Philomel Creek in 2006.

Species continued on next page

Saint Lawrence (1,2,3). Brassy Minnows were frequently taken in the 1930 survey, but only from Adirondack waters and only from lakes or “more quiet parts of streams” (Greeley and Greene 1931). In 1979, this species was found in the Little River, a tributary of the Grass River (AMNH 44907). In a 2006 survey, specimens were caught in several streams of the Saint Regis River basin, and one stream in the Grass River system.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported this species to be “moderately common…widely distributed in upland lakes and sluggish streams.” Brassy Minnows remained moderately common in recent stream surveys, but most reports were from lower elevation sites.

Raquette (1,2,3). Greeley (1934) reported this species from numerous higher-elevation ponds in the watershed and from several sites in the Bog River. Recent records are from lower-elevation streams, like Trout Brook and the Raquette River downstream of Raymondville. The last record from a pond was from Little Tupper Lake in 1950.

Champlain (1,2,3). Greeley (1930) reported several sites in the Saranac River basin where Brassy Minnows were taken. During 1986 ALSC surveys of higher elevation sites, specimens were captured in Mud Pond, Clinton County (AMNH 235379). A second capture from the Adirondack region occurred in 2013, when specimens were collected in Little Ray Brook (NYSM 69791). There are recent unverified reports from the Great Chazy River in 1994, Halfway Creek in 1996, and Mud Brook in 2008. Despite extensive sampling in the 2000s, this species has been reported only twice, suggesting a decline in numbers and range within the watershed.

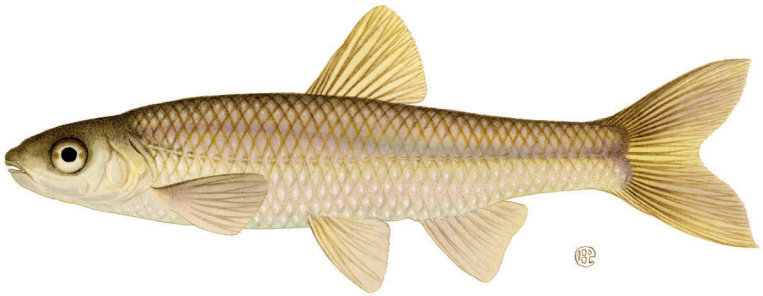
Susquehanna (**2**). In 1979, specimens were taken at two sites in the Unadilla River (AMNH 42626, 42642). There are no recent records.

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported that “this minnow is much less widely distributed on the south side of the Adirondacks than on the north,” and cited only four capture sites. A fifth site, a small tributary of the Hudson River, was added in 1934 (Greeley 1935). In 1973, an individual was taken from a tributary near Mechanicville (AMNH 223882). In 2014, a specimen was collected at Schuyler Creek (NYSM 70336), indicating that this species has persisted in the watershed, but that it remains rare.

Mohawk (1,3). In line with Greeley and Bishop’s (1933) comment on the relative rarity of this species in the southern Adirondacks, Greeley (1935) did not report any captures in the 1934 survey of this watershed. This may have been an oversight, however, because specimens exist from Mohawk watershed sites sampled during the 1934 survey: a backwater of the Mohawk River near Caroga Creek (NYSM 5361) and Crum Creek near Indian Castle (NYSM 5359). This species was also reported from Hale Creek, near Gloversville, in 1996.

Lower Hudson (1,2,3). Greeley (1935) noted that this species was rare, but was found in Vlomans Kill (NYSM 5239). Specimens were collected from Black Creek, a tributary of Normans Kill, in 1977 (AMNH 48160), 1994 (NYSM 43170), and 2009. There are no records from tributaries in the southern part of the watershed.

Hybognathus regius, Eastern Silvery Minnow



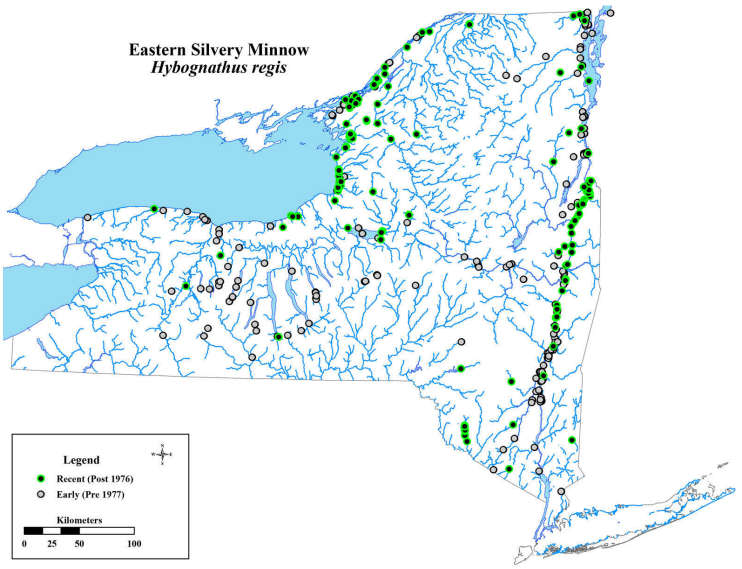
A second member of the genus *Hybognathus* is found in New York and inhabits medium-sized streams and large lakes at lower elevations. The Eastern Silvery Minnow is native to 14 watersheds.

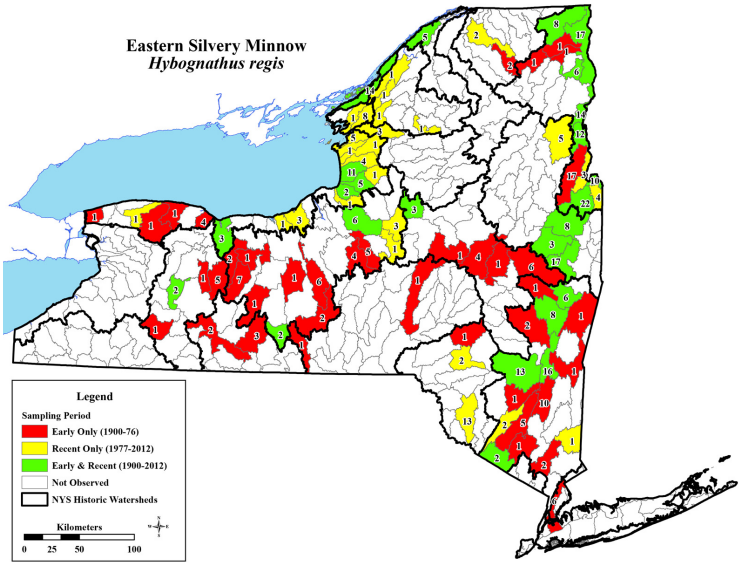
Ontario (1,2,3). In the 1939 watershed survey, this minnow was found in bays of Lake Ontario as far west as a tributary of Johnson Creek and as far east as Sandy Creek (Greeley 1940). In recent years, its distribution remains similar to that described from 1939, but the capture frequency is greater in the eastern part of its range. There are few recent records west of Port Bay.

Genesee (1,2). A single specimen was collected from lower Black Creek during the 1926 watershed survey (Greeley 1927). There are records from Honeoye Lake in 1946 (CUMV 68311), Allen Creek in 1952 (CUMV 22360), Mill Creek in 1962, and from Silver and Hemlock lakes, where this species was caught prior to 1963. Records from surveys undertaken at SUNY Geneseo (unpubl. field notes) include catches from Conesus Lake Inlet in 1965 and from the Genesee River at Mount Morris in 1982.

Oswego (1,2,3). During the 1927 survey, Eastern Silvery Minnows were found in most of the larger lakes of this watershed, as well as in tributaries of Oneida Lake (Greeley 1928). There are few recent records, all of which are west of Oneida Lake, indicating that populations have declined.

Black (3). Eastern Silvery Minnows are rare in this watershed, with confirmed records from the Black River above the falls in Carthage in 1992 (NYSM 42277) and from the Black River below Dexter Dam in 1999 (NYSM 50733) and 2006. A NYSDEC record from Otter Lake in 1949 is unconfirmed.





Saint Lawrence (3). There are few records of the species from this watershed. Most are from the Thousand Islands area of the Saint Lawrence River and its tributaries between Clayton and Ogdensburg. In addition, there is a 1977 record from the Saint Regis River at its confluence with the Deer River and a 1993 record from the Grass River (NYSM 43049).

Oswegatchie (3). As with other Saint Lawrence River tributaries, there are few records for this watershed. Specimens were taken in the upper reaches of Black Lake, where it merges with the Indian River, in 1997 (NYSM 47887) and 1998 (NYSM 49013).

Species continued on next page

Champlain (1,2,3). Greeley (1930) found this species to be “abundant in Lake Champlain, where it is one of the most common minnows. It is especially numerous near marshes and ascends the lower courses of many of the larger streams. In the Mettawee system it occurs far above the river mouth.” Eastern Silvery Minnows continue to be readily found in the lower reaches of streams and in lakes. Records from higher elevations are few, and include a capture from Clear Lake Inlet in 1929, the Ausable River system at Ausable Forks (AMNH 44721), and the Great Chazy River (AMNH 44737) in 1979.

Chemung (1,2). In the 1937 watershed survey, six specimens were collected from Lamoka Lake (Greeley 1938). Additional collections were made in 1947 and 1956 from the Canisteo River, Carrington Creek, and Waneta Lake. No Eastern Silvery Minnows have been collected in this watershed since.

Susquehanna (1,2). Specimens were taken from the De Ruyter and Erieville reservoirs in 1935 (Greeley 1936), Cayuta Lake in 1952 (CUMV 30699), and Beaver Creek in 1964. Eastern Silvery Minnows have not been found in this watershed since 1964.

Delaware (1,3). A single specimen was collected from the West Branch of the Delaware River near Bloomville in 1935 (NYSM 5311). More recently, this species was reported from the Pepacton Reservoir in 1991, Rio Reservoir in 1993, and Swinging Bridge Reservoir in 1998 and 2001. No voucher specimens associated with these reports were retained, however.

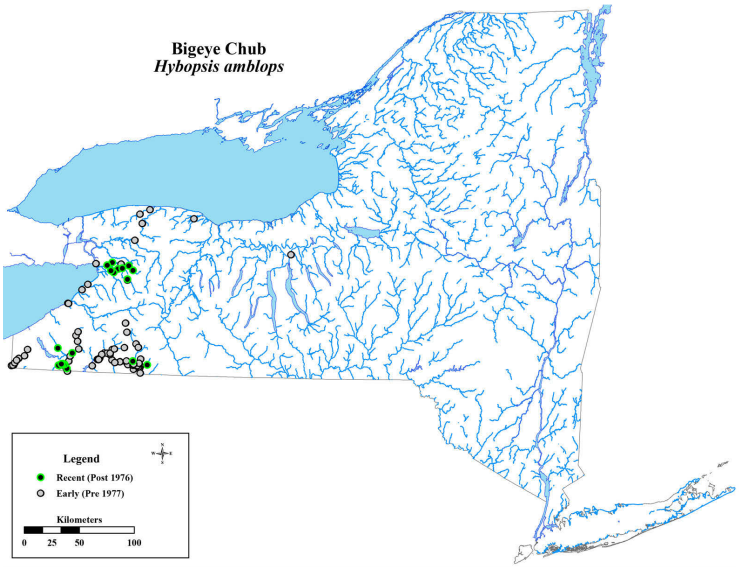
Upper Hudson (1,2,3). Greeley and Bishop (1933) stated: “This is apparently one of the important minnow species of Saratoga Lake and it is also found in the Hudson River and lower parts of several of the larger tributaries below Hudson Falls.” This pattern seems unchanged in recent times.

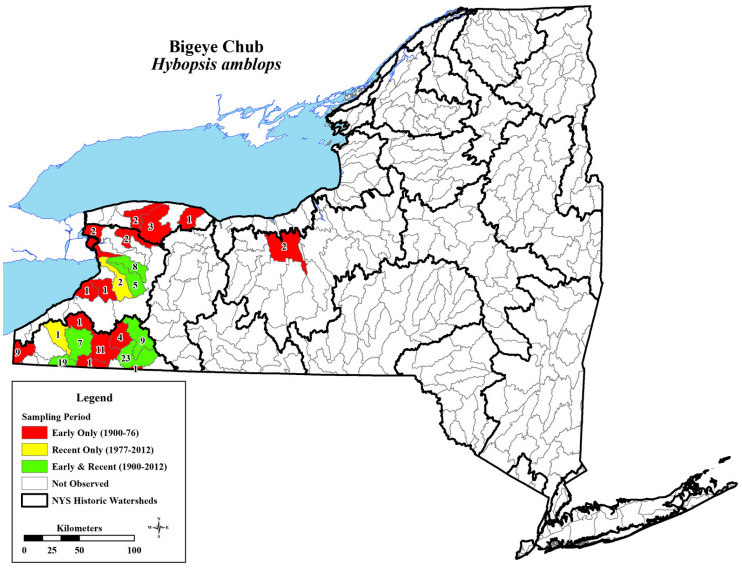
Mohawk (1,2,3). Greeley (1935) recorded this species in the Mohawk River, in the lower courses of several tributaries, and in Delta and Mariaville lakes. He also noted that Eastern Silvery Minnows had been abundant in Delta Lake until the early 1930s but had become scarce by the time of the 1934 survey. In recent surveys, specimens have been taken from Delta Lake, Schoharie Creek, Lisha Kill, and Canajoharie Creek.

Lower Hudson (1,2,3). During the 1936 Lower Hudson survey, Eastern Silvery Minnows were found in the Hudson River, lower reaches of its major tributaries, the Kensico and Ashokan reservoirs, and in the Wallkill River and Moodna Creek basins (Greeley 1937). The few recent records have been from the Hudson River and tributary mouths, the Ashokan Reservoir, Wickham Lake, and Dwaar Kill (NYSM 71077).

Long Island (1). Greeley (1937) reported that this minnow was collected in 7% of samples taken in the streams draining into Long Island Sound from Westchester County. It was present in the Kensico Reservoir and the upper Bronx River but was absent from the islands, and has not been collected since the 1936 survey of this watershed. The native status of the Eastern Silvery Minnow in this watershed is uncertain. It may have gained access to this watershed from the Lower Hudson watershed, where it is common, through a relatively recent headwater stream capture. Alternatively, the species may have gained access during prehistoric times when the stream channels were in flux due to the recent retreat of glaciers. Entry by these methods would confirm it as native. Individuals may also have been transported into the watershed from the Delaware or Mohawk watersheds during water transfers for the New York City water supply, in which case, the species would be exotic. Until additional information surfaces, we treat this species as native to this watershed.

Hybopsis amblops, Bigeye Chub





This relatively rare fish inhabits clean, gravelly sections of larger streams in western New York. The species is native in all four of the New York watersheds in which it is present and it has been designated as a Species of Greatest Conservation Need in New York.

Allegheny (1,2,3). The Bigeye Chub was the most frequently encountered of the three species of large-scaled, run-dwelling chubs in pre-1974 surveys of this watershed. Greeley (1938) noted that this species was limited to the main channel of the river and warmer streams and that, although it was not particularly rare, it was not taken in large numbers anywhere. During the 1937 survey, Bigeye Chubs were collected from French Creek, the Conewango Creek basin, and in the Allegheny River and several of its tributary streams. The last known collection from the French Creek basin was in 1951 (CUMV 20030). In the eastern basin, specimens were collected at several sites between 1963 (CUMV 44618) and 1989 (NYSM 40306) but have not been collected since. All recent collections (since 2000) have been from Stillwater, Cassadaga, and Conewango creeks, in the central basin (Daniels et al. 2006b). Although this species is still present in the central basin, the frequency of capture has declined in recent years.

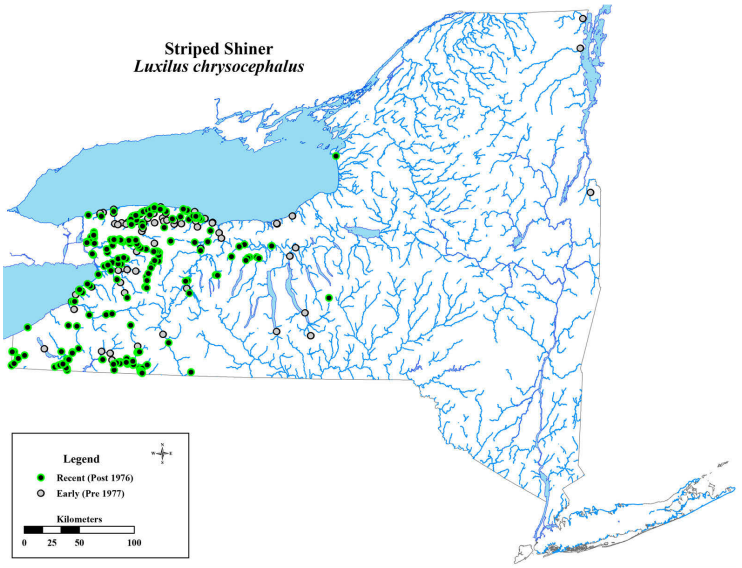
Erie-Niagara (1,2,3). According to Greeley (1929), "This rather insignificant appearing fish is found in the lower courses of streams of the southern and eastern part of the area. It was most common in the Buffalo Creek system, frequenting shallow, mud flats, where the current was moderate." Hankinson (1924) had earlier reported captures from Tonawanda and Eighteenmile creeks. Several Erie County streams, like Buffalo, Little Buffalo, Cayuga, Cazenovia, and Eighteenmile creeks, supported populations of this species as recently as 2014 (NYSM 70605).

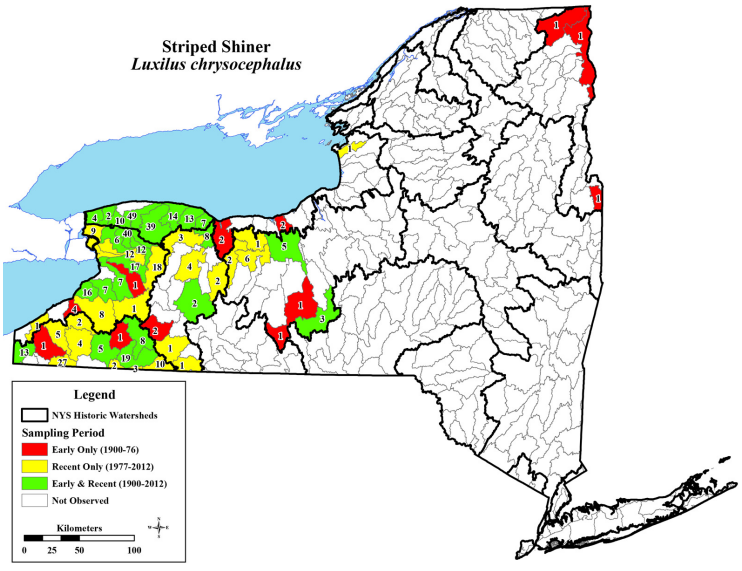
Ontario (1,2). Greeley (1940) reported Bigeye Chubs from Glenwood Lake and Johnson Creek, but they were not common at any site. Greeley (1929) had opined that the eastern distributional limit of this species was Tonawanda Creek, but the catches in these tributaries of western Lake Ontario suggested that its range extended farther east. The only more recent report in this watershed, however, was from Salmon Creek, west of Hilton, in 1957 (CUMV 76940). The species, therefore, appears to be extirpated from this watershed.

Oswego (1). Meek (1889) recorded captures at Montezuma Marsh in 1886 (CUMV 2023). There appear to be no further records from this watershed.

Luxilus chrysocephalus, Striped Shiner

Due to their morphological similarity, this species and its congener, *Luxilus cornutus*, were treated as subspecies during the statewide watershed surveys. Because of this similarity, field identifications from areas where the species co-occur may be suspect for both species in the early surveys. A second problem with the similarity between these two congeners is that many inexperienced field workers may inadvertently identify an individual as the more ubiquitous Common Shiner, meaning that Striped Shiners might be more abundant than unvouchered records suggest. Striped Shiners are found in five western and northern watersheds and are native to all five.





Allegheny (1,2,3). Greeley's (1938) assessment of the abundance and range of the Striped Shiner was influenced by the difficulty of dealing with subspecies that were thought to co-occur. He limited his discussion to "representative" specimens, i.e., those individuals that fit the description of this species completely, and treated all individuals that showed "intermediate" characteristics as Common Shiners. Therefore, the Striped Shiner was reported from only 11 sites in the Allegheny River and the lower reaches of its larger tributaries, as well as Chautauqua Lake. Subsequent examination of many of the vouchered specimens identified as Common Shiners or as intermediates during the survey showed them to be Striped Shiners, which means that the species was more widely distributed in 1937 than reported. Striped Shiners were occasionally caught with Common Shiners during the survey. Results of recent surveys show that this species remains abundant in the larger, warmer, slower streams and lakes of the watershed. During surveys conducted in the 1980s and 1990s, Striped Shiners were found at approximately 20% of the sites sampled.

Erie-Niagara (1,2,3). In 1928, this species was found in the lower courses of streams, Lake Erie, and the Niagara River, where it was relatively abundant (Greeley 1929). Striped Shiners remain common and widespread in this watershed.

Ontario (1,2,3). Greeley (1940) again noted problems with intergrades between this species and the Common Shiner, but nonetheless reported that Striped Shiners were found at 80 low-elevation sites, including several bays in Lake Ontario, larger streams, the Erie Canal, and Glenwood and Carlton lakes. Until recent survey work, the eastern extent of the range of this

Species continued on next page

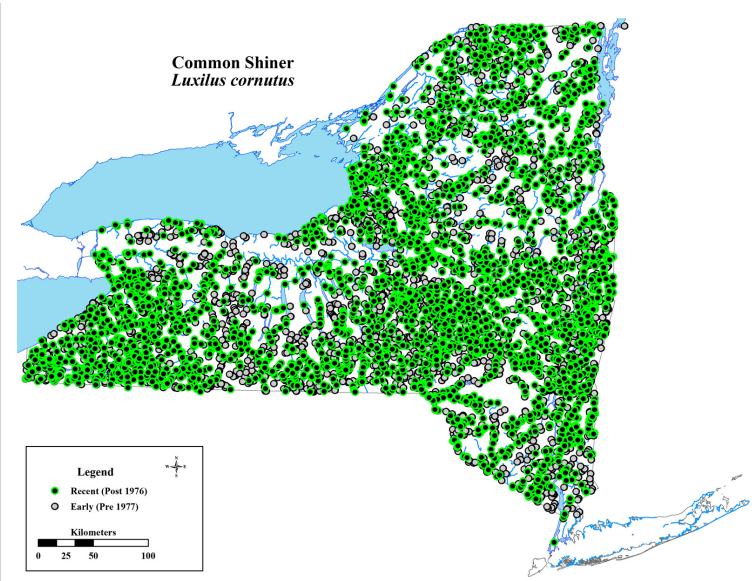
minnow was thought to be limited to sites west of a line running south from Little Sodus Bay at Fair Haven (Smith 1985, Lee et al. 1981). In 2005, specimens were caught in Stony Creek, a tributary of the eastern part of Lake Ontario (NYSM 59044). (See Oswego watershed account as well).

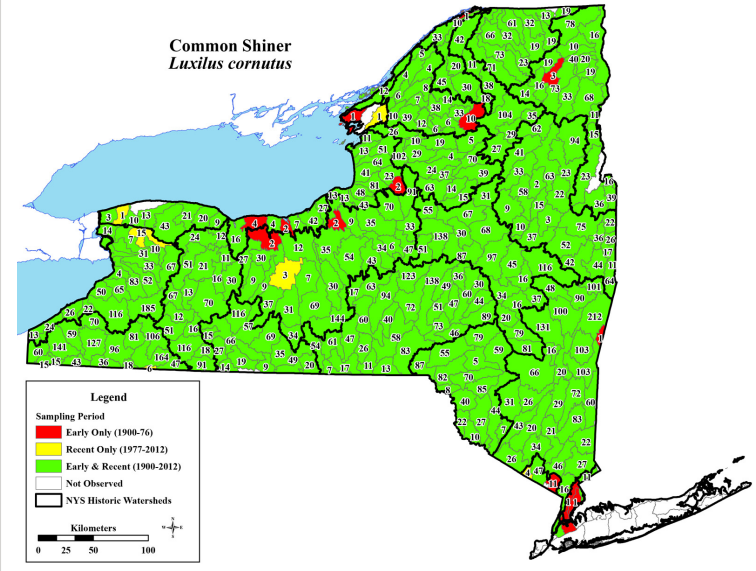
Genesee (1,2,3). Greeley (1927) reported that this species was "common in the Genesee River for about 10 miles above Rochester falls and in lower Black Creek (Monroe Co.). A few specimens were taken at the mouth of the river." Striped Shiners continue to be found in the lower part of the basin. They are rarely caught upstream of Canaseraga and Keshequa creeks, but one record does exist from Cryder Creek near the Pennsylvania state line (AMNH 223472).

Oswego (1,2,3). Meek (1889) reported this species from Montezuma Marsh. Greeley (1928) noted that Striped Shiners were "found in lowland creeks and rivers of the northern part of the drainage," which included Buttermilk Creek, Owasco Outlet, the Seneca River and its tributaries, and the northwest corner of the watershed. In recent survey work, Striped Shiners have continued to be found in the western part of the watershed, in Red and Ganargua creeks and Canandaigua Outlet. Several sites in Fall Creek produced the only recent record from the central part of the watershed (NYSM 59082). In the eastern part of the watershed, this minnow was caught in the West Branch Fish Creek in 1940 (CUMV 66468) and the Erie Canal near New London in 1983 (NYSM 50619).

Champlain (1,3). According to Greeley (1930), "a form having coarse scales, is less common but occurs in lower courses of many streams. The two subspecies are not listed separately here because of their intergradation in certain localities, and the consequent impossibility of determining all specimens as one or the other subspecies." There is a 1929 record for this species (NYSM 25160), however, and in 2013, specimens were captured in the Boquet (NYSM 69641), Great Chazy (NYSM 69613), and Little Chazy (NYSM 69557) rivers. This disjunct part of the range of this species is a few hundred kilometers farther east than recognized by Smith (1985) and others, but Raney reported it from this watershed (see Carlson et al. 2000), and we recognize it as native because it is native elsewhere in this drainage and there are no substantial barriers to its dispersal.

Luxilus cornutus, Common Shiner





This ubiquitous species inhabits medium-sized and headwater streams and lakes. It occurs in all 18 of New York's watersheds. It is not found on Long Island but is present in Westchester County streams that flow into Long Island Sound, which constitutes the northwestern part of the Long Island watershed. The distributions and abundances of species like the Common Shiner, which are habitat generalists with excellent dispersal behaviors, seem to change little when examined over periods of several decades to a century.

Allegheny (1,2,3). Common Shiners were among the most commonly collected fish in the Allegheny River and were also common in most tributaries during the 1937 survey of this watershed (Greeley 1938). Specimens continue to be frequently collected in recent surveys as well.

Erie-Niagara (1,2,3). Greeley (1929) noted that this species was "widely distributed, occurring in nearly every creek." It remains a frequently encountered fish in this watershed.

Ontario (1,2,3). According to Greeley (1940), this species was "one of the predominant creek fish of the region." It is still widespread and common in this watershed.

Genesee (1,2,3). In the 1926 survey of this watershed, Common Shiners were found in Fulmer Valley Stream and Vandermark Creek, both upstream sites; they were less common in the lower waters of the watershed, where Striped Shiners were more frequently found (Greeley 1927). The species is now widespread in this watershed.

Oswego (1,2,3). Common Shiners are abundant and widespread in this watershed. There are over one thousand records from this watershed, predominantly from before 1977. The frequency of occurrence of this species in stream samples from the 1920s was 6% whereas in recent surveys, the frequency of occurrence was 16%.

Species continued on next page

Black (1,2,3). Greeley and Bishop (1932) noted that this minnow is a common lake fish in the Adirondacks, although Common Shiners were also common in streams in both extreme headwaters and more lowland areas. This species is sensitive to acidification (e.g., Heard et al. 1997) and its range and abundance may have been affected by lowered pH in this and other Adirondack watersheds.

Saint Lawrence (1,2,3). Greeley and Greene (1931) stated that this species was "one of the commonest and most widely distributed minnows of the region, occurring in most creeks and rivers, including the St. Lawrence. In the Adirondack area it is often a lake fish and specimens were taken in Massawepie, Ozonia, St. Regis, Meacham and several smaller lakes." Recent records show that Common Shiners still occur in many areas of this watershed.

Oswegatchie (1,2,3). The Common Shiner was a frequently encountered lake fish during the 1930s (Greeley and Bishop 1932) and remains common throughout the Adirondack portion of this watershed.

Raquette (1,2,3). According to Greeley (1934), "the common shiner inhabits the St. Lawrence, Raquette River and most tributaries of the latter. It is found [in] lakes and ponds of the Adirondack part of the drainage...Like other native minnows, the common shiner usually does not maintain itself well where bass and other introduced warm-water game fish have become established." This introduction of exotic predators appears to represent one of the few restrictions on the abundance of this minnow, particularly in lakes. Recent records show that Common Shiners still occur in many areas of this watershed.

Champlain (1,2,3). This minnow was abundant in both the Adirondack portion of the watershed and in lowland streams, as well as the lake itself (Greeley 1930). It remains a common species throughout the watershed.

Chemung (1,2,3). This species has been abundant and widespread during all surveys of this watershed. Common Shiners were present in nearly half of all stream samples in all surveys conducted between 1937 and the 2000s.

Susquehanna (1,2,3). Greeley (1936) noted that "the 450 records of this species place it first among the minnows. It is probably the most abundant fish of the region, being found in practically all streams except extreme headwaters." In later surveys, Common Shiners remained numerous but not dominant. Other minnows, like the Cutlip Minnow, Bluntnose Minnow, and Eastern Blacknose Dace, were more frequently caught, but these later surveys used electrofishing units more heavily than seines, which were the primary tool used in the earlier watershed surveys. The differences in capture technique may account for the differences seen in catch frequencies and abundances, with seines preferentially capturing species dwelling in the water column and electrofishing enabling better captures of demersal species.

Delaware (1,2,3). The results of the Delaware watershed survey were combined with those from the Susquehanna in Greeley's (1936) report. Thus, his quote regarding the general distribution and abundance of this species in the Susquehanna system applies equally to the Delaware. Common Shiners have continued to be common and widespread in later surveys.

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported that this species was "abundant and widely distributed in large and small streams as well as in many lakes, particularly those of the Adirondack area." Recent records show that it still occurs in many areas of this watershed.

Mohawk (1,2,3). In his account of this species, Greeley (1935) stated: "It is widely distributed, and although principally a creek fish, it is found in many of the upland lakes...exceeded by no other minnow except the horned dace [= Creek Chub]." DeKay (1842) also mentioned that the specimens he examined were from the Mohawk River. The species remains common in more recent surveys of the watershed.

Lower Hudson (1,2,3). Greeley's (1937) treatment of the Common Shiner in this watershed is potentially confusing. He reported this species in tributary streams and noted that it "strays" into the Hudson River and several reservoirs. He also mentioned that a number of individuals, particularly those found in the Beaver Kill, a stream of the Catskill Creek system, were *Notropis cornutus chrysocephalus*, based on predorsal-scale counts. He referred to the two forms as "intergrading subspecies" but relied on the predorsal-scale count alone in his assessment. In a widely distributed species like the Common Shiner, mensural characteristics are often highly variable, and in areas of allopatry, this variability tends to increase and we have observed that predorsal-scale counts are highly variable in this watershed. Common Shiners remain abundant and wide-ranging in many waters.

Newark Bay (1,2,3). Greeley (1937) noted that this species was present at 21% of the survey sites in this watershed. Recent records show that it is still present in many waters.

Long Island (1,2,3). In the 1936 survey of this watershed, Common Shiners were found in 23% of the streams draining the northern slope of Long Island Sound in Westchester County (Greeley 1937). Specimens continue to be found in these streams. The species has not been reported from Long Island itself, however.

Lythrurus umbratilis, Redfin Shiner

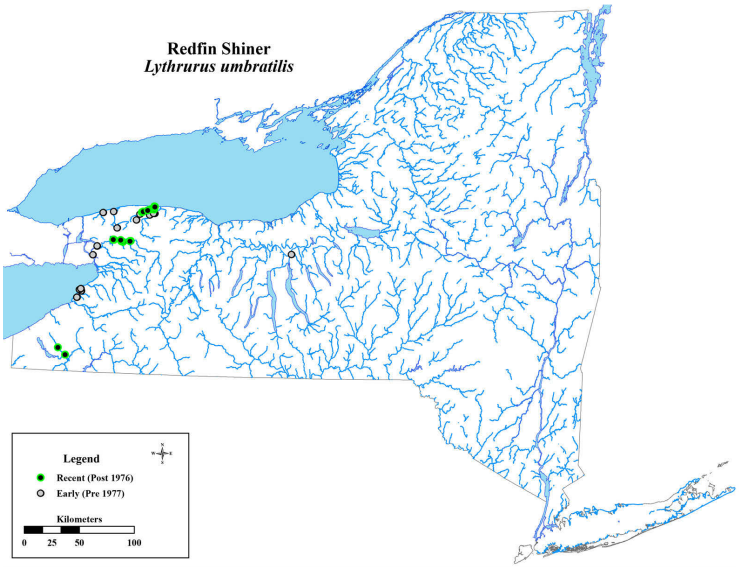
This deep-bodied minnow lives in low-gradient streams with clean gravel and sparse submerged aquatic vegetation. It is native to four watersheds in western and central New York but is rarely encountered. This species has been designated as a Species of Greatest Conservation Need in New York.

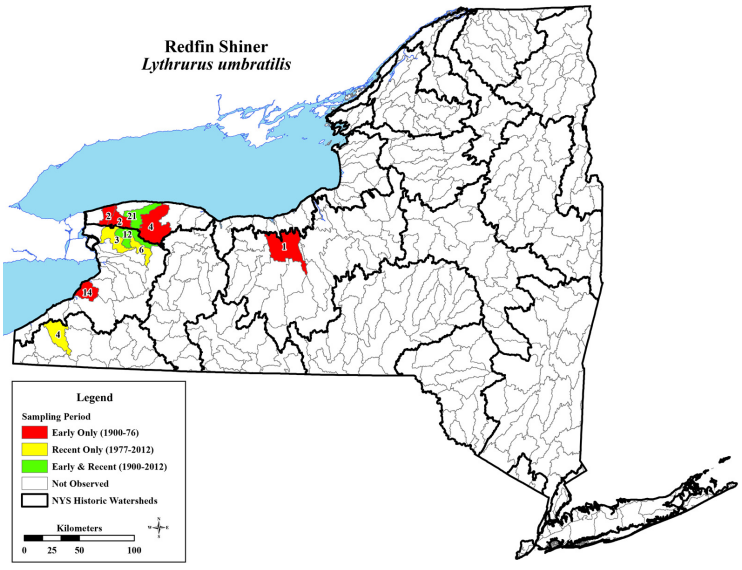
Allegheny (3). Redfin Shiners were caught in lower Cassadaga Creek in 2005 (NYSM 58627, 58902). This was the first record of the species in the watershed (Daniels et al. 2006a).

Erie-Niagara (1,2,3). Greeley (1929) noted that T.L. Hankinson first reported this species in June 1921 and that during the 1928 survey, it was restricted to two weedy creeks near Angola: Muddy and Little Sister creeks. Specimens were collected in the same area in 1949 (AMNH 21100, 21107). Since 1975, Redfin Shiners have been caught in the Niagara River (AMNH 38978), as well as Tonawanda and Murder creeks (NYSM 62897).

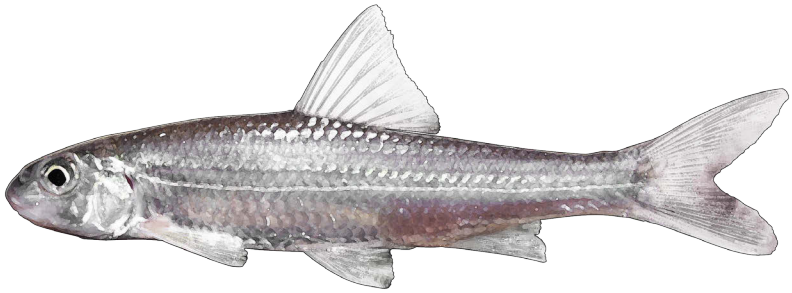
Ontario (1,3). Redfin Shiners were collected from Oak Orchard (CUMV 27632) and Otter (CUMV 27749) creeks in 1931, and Jeddo Creek (CUMV 27633) in 1934. Greeley (1940) recorded collections from the Erie Canal near Lockport, Carlton Lake, and Eighteenmile, Twelvemile, and Johnson creeks. Recent collections have only been made from Johnson Creek. Spawning males were collected from Johnson Creek at Lyndonville on 3 June 2005 (S. Wells, SUNY Brockport, pers. comm.).

Oswego (1). Meek (1889) recorded a specimen "from a small stream near Montezuma Dry Dock." We have been unable to locate the specimen and are unaware of any more recent collections.





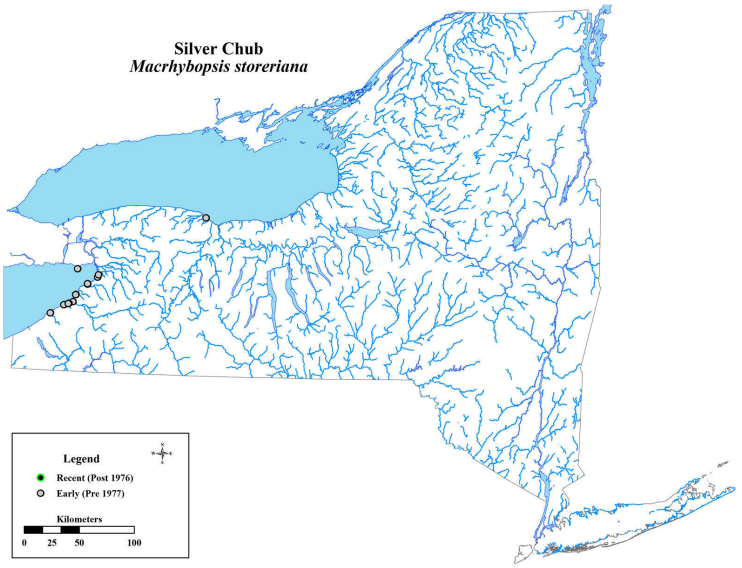
Macrhybopsis storeriana, Silver Chub

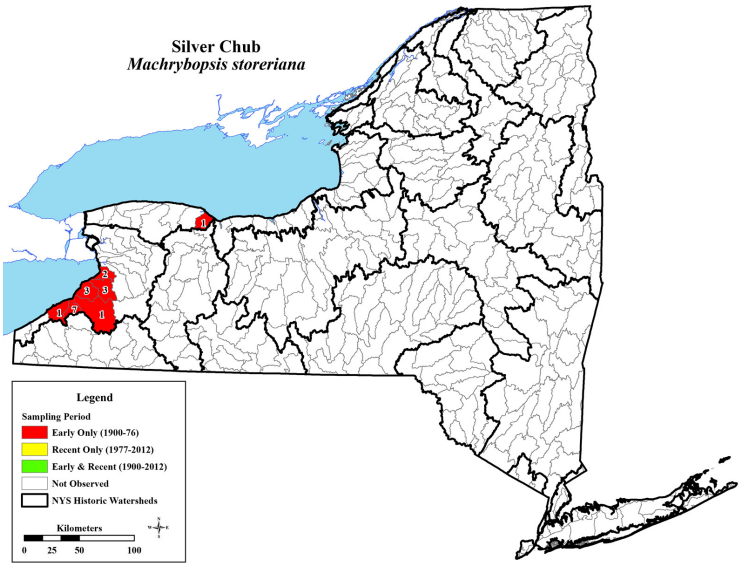


This extremely rare species is native to Lakes Erie and Ontario.

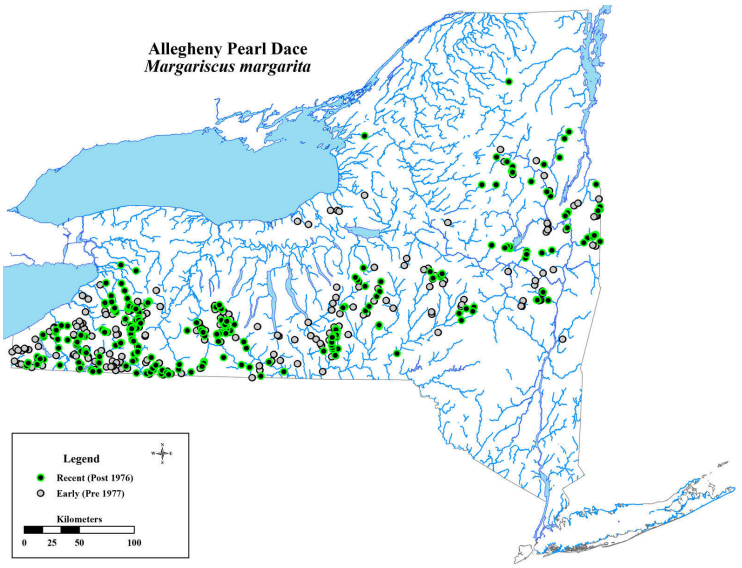
Erie-Niagara (1). Greeley (1929) reported that Silver Chubs were common in Lake Erie and in the mouths of tributary creeks, with collections from Eighteenmile (NYSM 35146), Silver (NYSM 5408), and Muddy (NYSM 5404) creeks. The species is apparently extirpated from the New York portion of the lake, as no additional specimens have been reported from New York waters since the 1928 survey of this watershed. Populations have recovered to a limited extent in western Lake Erie since the 2000s, however (COSEWIC 2012).

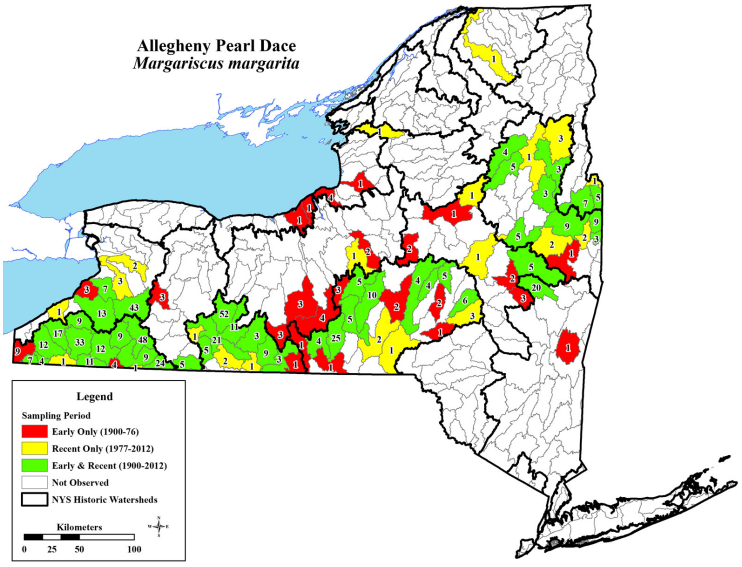
Ontario (1). Evermann and Kendall (1902) stated that this species was "found only in Long Pond at Charlotte where but three specimens were obtained." Smith (1985) presumed this report to be an error, but Dymond et al. (1929) reported that Silver Chubs were caught near Toronto and in the Bay of Quinte, which lends credibility to the early report from Long Point. The spotty distribution of this species in Lake Ontario suggests that there may not have been an established population in the lake, but only occasional out-migrants from Lake Erie.





Margariscus margarita, Allegheny Pearl Dace





The two subspecies of Pearl Dace were recently elevated to full species, following Page et al. (2013). The species are not entirely separated by watersheds; in general, the Northern Pearl Dace is found in the Saint Lawrence drainage and the Allegheny Pearl Dace inhabits the Allegheny, Chemung, and Susquehanna watersheds, as well as the upper reaches of the Genesee, Oswego, Champlain, Upper Hudson, Mohawk, and Lower Hudson watersheds. Maps in Smith (1985) and Carlson et al. (2000) show the few records from New York identified to subspecies, and these were our basis for assigning a single species in each of the 14 watersheds. In watersheds where both species occur, we only used verified museum records. In 2014, however, Allegheny Pearl Dace and possible intergrades (e.g., NYSM 71582, tributary of the Lower Saint Regis River, 2014 71547, Jacobs Creek, 2014) were collected in the northern watersheds where they had not previously been reported.

Allegheny (1,2,3). Allegheny Pearl Dace inhabited clear headwater areas of smaller streams throughout the watershed. The species was found at 18% of the stream sites in 1937 (Greeley 1938) but only 2% of the sites sampled in the 1990s-2000s. It was present in French Creek samples in 1937 (Greeley 1938) and in the 1980s (Daniels 1989).

Erie-Niagara (1,2,3). Greeley (1929) reported that this fish was uncommon and limited to a few small, upland streams. Recent surveys indicate that this species is widely distributed in tributaries.

Genesee (1,2,3). Allegheny Pearl Dace were found in the headwaters of the watershed in 1926 and were common in these small, cool streams (Greeley 1927). No specimens were found in tributaries downriver. The species continues to be locally common in areas upstream of Portageville in the Genesee River and its tributaries, such as East Koy Creek (NYSM 32155, CUMV 9036) and Cryder Creek (AMNH 223478).

Species continued on next page

Oswego (1,2,3). Allegheny Pearl Dace were rare in the 1927 watershed survey and were limited to the extreme headwaters (Greeley 1928). Greeley suggested that this species probably gained access to these waters when they were connected to the Susquehanna River drainage. Smith (1985) mapped several more recent records from Limestone Creek (AMNH 42768), Cayuga Inlet, and Catharine Creek (NYSM 46039).

Black (3). This species was found in a tributary to the Black River in Watertown in 2014 (NYSM 71073), and hybrids with the Northern Pearl Dace were collected in Jacobs Creek (NYSM 71547).

Saint Lawrence (3). Allegheny Pearl Dace were collected from a tributary to the Saint Regis River in 2014 (NYSM 71582). Hybrids with the Northern Pearl Dace were also collected at this site (NYSM 71581).

Champlain (1,2,3). Greeley (1930) noted that this minnow was collected in headwater streams of the Mettawee River, including Wood Creek, which has been heavily modified by the Champlain Canal. Unpublished field notes associated with the 1929 survey of the watershed specifically state that these specimens were the nominal subspecies. The specimens were not saved, so this identification could not be verified. Attempts to find Pearl Dace in the southern area of the watershed in the 1980s and 1990s were successful at six sites, but, again, specimens were not retained.

Chemung (1,2,3). This species occurred at about 10% of the sites sampled in the 1937 watershed survey, often in trout streams (Greeley 1938). Specimens have been taken at a similar proportion of sites in surveys conducted in the 2000s.

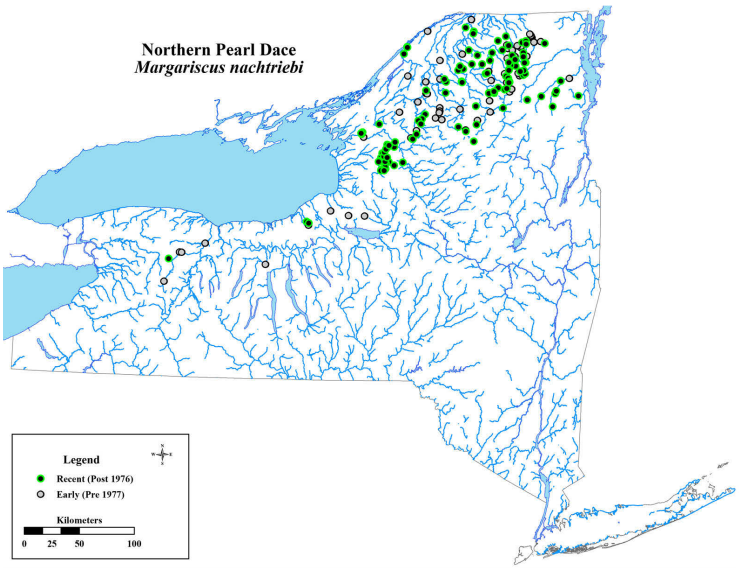
Susquehanna (1,2,3). This species was found in about 5% of the stream sites sampled in surveys conducted during both the 1930s and 2000s.

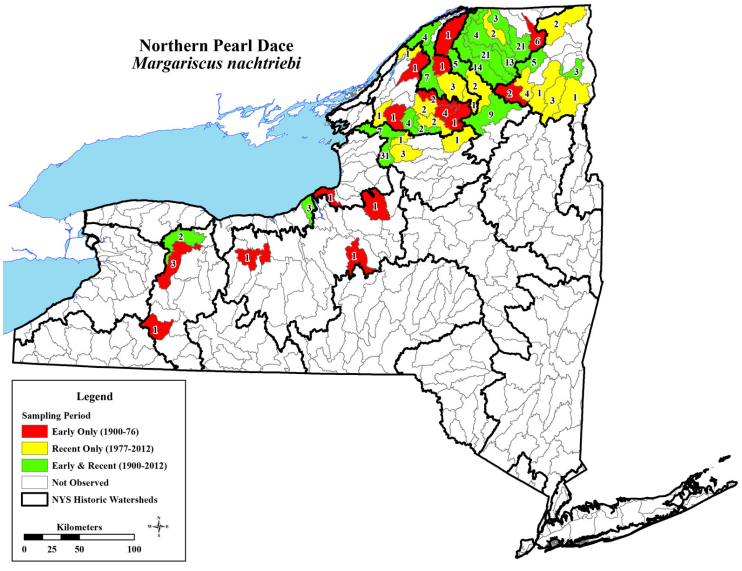
Upper Hudson (1,2,3). Greeley and Bishop (1933) noted that this was a widely distributed minnow in streams and was also found in a few Adirondack ponds (e.g., King's Flow and Tirrell Pond). There are fewer recent records, although individuals were caught in Mason Lake and Spectacle and Eagles Nest ponds in 1987 (Gallagher and Baker 1990). The current distribution pattern of this species, with scattered occurrences at higher and lower elevations, appears similar to that observed in earlier surveys.

Mohawk (1,2,3). In the 1934 survey of this watershed, this species was caught at one locality in Oriskany Creek near Deansboro (Greeley 1935). Specimens had also been collected from a nearby tributary, Tinney Brook, in 1916 (CUMV 4340). There are additional collections from Albany County in Beaverdam Creek in 1982 (NYSM 10165) and again in 1996 (NYSM 45529), the Switzkill in 1996 (NYSM 45503), and from Saratoga County in 1993 and 2006 (NYSM 61236).

Lower Hudson (1,2,3). In the 1934 watershed survey, Allegheny Pearl Dace were found in Vly Creek and Hunger Kill, both in Albany County (Greeley 1935). Recent records are from the same creek systems, including Becker Brook in 1975, a tributary of Vly Creek in 1978 (AMNH 41016) and 2009, and East Branch Hunger Kill in 2010 (NYSM 66076). There are no records from the east bank tributaries of this watershed.

Margariscus nachtriebi, Northern Pearl Dace





This minnow is native to eight watersheds in the Saint Lawrence River drainage.

Ontario (1,3). Greeley (1940) suggested that both *Margariscus* species were present in this watershed. Northern Pearl Dace were rare and were only collected in Oswego County. At one site on Ninemile Creek, a specimen was identified as this species. Smith (1985) regarded all captures from this watershed as the northern species. Northern Pearl Dace were found at Ninemile Creek in 2003 when it was resurveyed, as well as in a nearby tributary, Harris Hill Brook, in 2004 (NYSM 57101).

Genesee (1,2). Smith (1985) recorded captures from Black Creek in Monroe County in 1982 (e.g., AMNH 223382) and in the next large basin to the south, Oatka Creek, in 1926 and from 1964-74. This species was apparently rare in other downstream areas, with Allegheny Pearl Dace replacing Northern Pearl Dace at all sites upriver of Portageville Falls.

Oswego (1,2). Greeley (1928) reported this species as rare and limited to "a few streams in the northern part of the watershed." Specimens were found east of Syracuse and north of Oneida Lake (CUMV 2599) and at a western site, a tributary of Canandaigua Outlet (CUMV 3104). The last report from this watershed was in 1959, from a site near Canandaigua Outlet.

Black (1,2,3). Northern Pearl Dace were found in an unnamed tributary to the Black River near Watertown in 1931 (Greeley and Bishop 1932). Specimens were found near the same area in later collections, as well as in the Deer River and several of its tributaries.

Saint Lawrence (1,2,3). In the 1930 survey, this species was present in all major stream systems in the watershed, usually near headwaters (Greeley and Greene 1931). Northern Pearl Dace continue to be found in the Saint Regis and Salmon River basins, but in the Grass River system, they appear to occur only in Elm Creek.

Oswegatchie (1,2,3). This was not a common fish in the 1931 survey of this watershed. Greeley and Bishop (1932) reported a few specimens from Cranberry Lake, several creek captures, and at least one individual from a pond (Mud Pond). Recent surveys show a similar pattern to that observed in 1931.

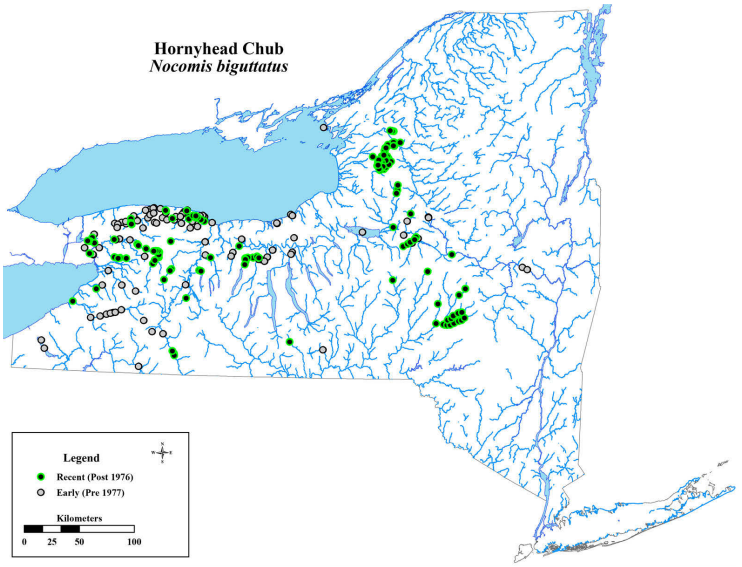
Species continued on next page

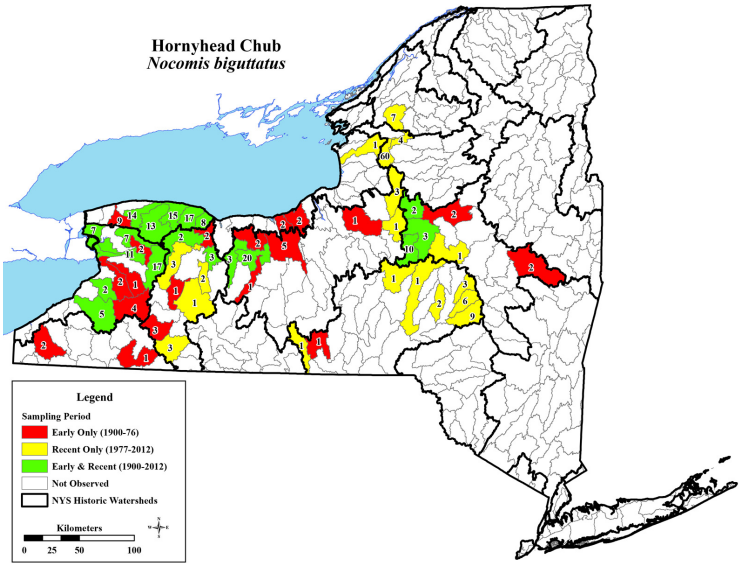
Raquette (1,2,3). Greeley (1934) reported that “this minnow was found only in upper Trout Brook (tributary 9 of Raquette River), in Robin Lake, Horseshoe Lake, and Rock Pond.” In the 1980s, Northern Pearl Dace were collected in seven ponds, including Rock Pond (Adirondack Lake Survey Corporation 2014). This species was not found in Trout Brook during extensive sampling in 2007, and it has not been collected from any of this watershed’s streams since 1931.

Champlain (1,2,3). According to Greeley (1930), this species was “locally common in ponds, lakes and streams of the Adirondacks, at the headwaters of the Saranac and Ausable systems and in a few of the small, weedy creeks tributary to the Big [sic] Chazy system. It is a typical bog-water fish and is one of the native fishes of the Adirondacks.” There have been numerous recent catches in several Adirondack streams but not in the Great Chazy system. One of the more southerly sites was a mountain top site at Lower Ausable Lake in 1985 (Adirondack Lakes Survey Corporation 2014).

Nocomis biguttatus, Hornyhead Chub

This stream-dwelling chub is native to the five western watersheds of New York. The species is also found, but is not native, in four central watersheds (Black, Oswegatchie, Susquehanna, and Mohawk).





Allegheny (1,2,3). Hornyhead Chubs have been reported in the main channel of the Allegheny River and at the mouths of Five Mile, Haskell, Tunungwant, and Dodge creeks but were neither encountered nor reported by Greeley (1938). Schwartz (1954) reported this species from French Creek. Researchers from Saint Bonaventure sampled the watershed extensively but did not capture this species until 1981. These records were not recognized by Smith (1985), but capture locations were depicted in Lee et al. (1980). The species has also been reported from the Allegheny River in Pennsylvania (Argent et al. 1997a), and this record may be the one cited from McKean County in 1926 by Fowler (1907) and Fowler and Carlson (1927). The only verified records from the Conewango Creek basin are from Chautauqua Lake in 1923 (RWLC, uncatalogued specimen) and 1935 (NYSM 5653).

Erie-Niagara (1,2,3). Greeley (1929) reported that this species was uncommon overall and was "restricted to the eastern part of the drainage, where it is locally common in many warm streams of the Tonawanda Creek system." This minnow remains uncommon in recent surveys but has extended its range south to Delaware Creek (W. Hadley, SUNY Buffalo, unpubl. field notes) and west to Cattaraugus Creek (NYSM 56562) and the Niagara River (e.g. NYSM 53453).

Ontario (1,2,3). During the 1939 watershed survey, Hornyhead Chubs were collected at 43 sites in creeks in the western part of the watershed, where they were often abundant, but none were found east of Mudge Creek, which flows into Sodus Bay in Wayne County (Greeley 1940). In 1891, a specimen was collected farther east at Grenadier Island (UMMZ 162257), but there are no recent collections east of Sodus Bay. This species was also taken in bays of Lake Ontario (Odell 1940) and a few smaller ponds west of Rochester (Senning 1940) in the 1930s. In recent reports, Hornyhead Chubs were found in several western streams but not in bays or ponds. The species has also been reported in two eastern streams in Jefferson County, and these might represent either a natural range expansion or point introductions.

Species continued on next page

Genesee (1,2,3). In the 1926 survey of the Genesee watershed, Hornyhead Chubs were caught in the Genesee River south of Rochester and in Black Creek, in Monroe County (Greeley 1927). Recent records show that this species persists in the same large, lowland streams.

Oswego (1,2,3). This minnow was collected in 1886 by Meek and Harris at Montezuma (CUMV 659). Greeley's (1928) assessment of the range and habitat of this species was that it occurred in "sluggish to moderate current in warm streams of the northern part of the drainage, often among vegetation." Hornyhead Chubs were reported from Cold Springs Brook, a tributary of Seneca River, at Weedsport in 1953 and from Ganargua Creek in 1959 (Cornell University Ichthyology Class, unpubl. field notes). Recent records include catches from Canandaigua Outlet in 1981 (AMNH 223270) and 2003-11, and from the eastern part of the basin, such as from a tributary of Fish Creek in 1992 (NYSM 42200) and Little Alder Creek in 2002.

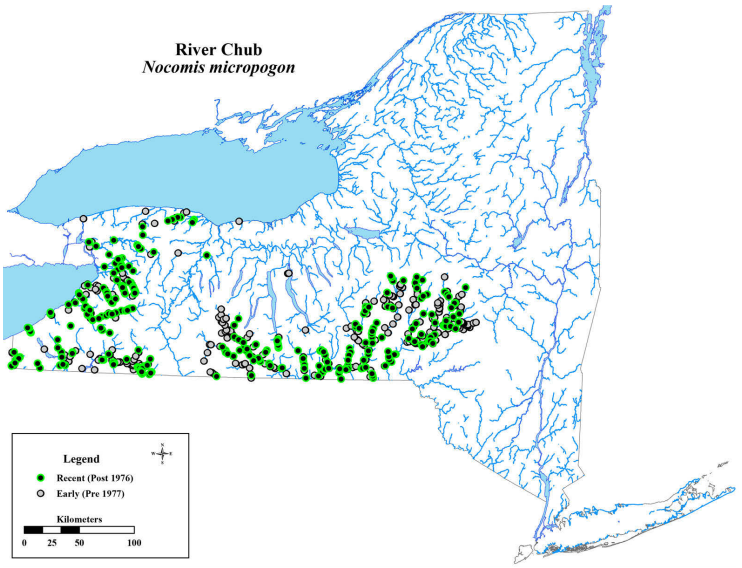
Black (**3**). The Hornyhead Chub was first identified in this watershed in 1990 from a Deer River collection (NYSM 41365). Specimens were later collected from Deer River tributaries, as well as nearby Swiss, Stony, and Mill creeks (e.g., NYSM 43078). The number of collections from this watershed suggests that this was an established population when it was first reported. An unvouchered record, identified as *Hybopsis* sp., from Cobb Creek in 1971 may have been a Hornyhead Chub. Although it was unfortunate that the collector did not voucher the specimen and referred it to an improbable genus, he did recognize that it was not one of the other species found in the watershed. Hornyhead Chub is the only likely identification.

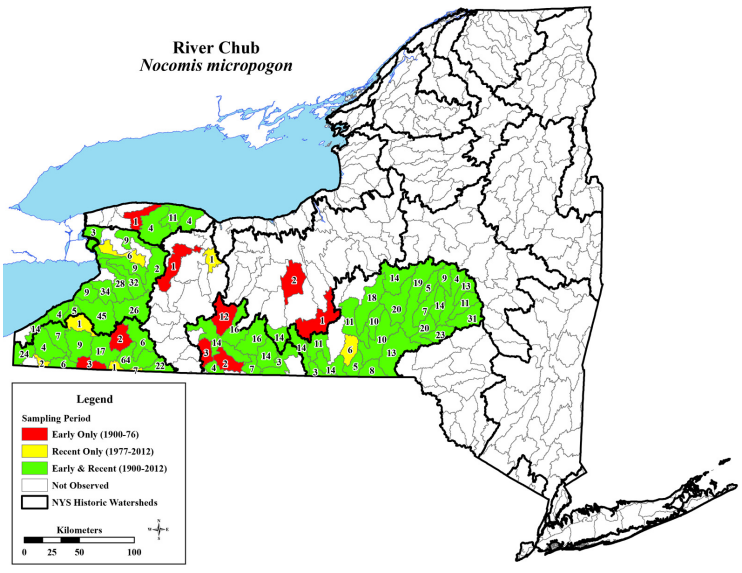
Oswegatchie (**3**). The only record from this watershed is a capture from West Branch Black Creek, near Fort Drum, in 2010 (NYSM 65947).

Susquehanna (**2,3**). Hornyhead Chubs were first reported from Catatonk Creek in 1964 (CUMV 81451), Cherry Valley Creek in 1978 (AMNH 41220), and the upper Chenango River in 1979 (AMNH 42679). We were unable to verify a record from Cayuta Creek in 1990. Since 2004, this species has been reported from the eastern tributaries, including Cherry Valley, Charlotte, Elk, Schenevus, and Otego creeks (e.g., NYSM 57488).

Mohawk (**1,2,3**). Greeley (1935) reported: "Only nine records were obtained: from Delta Lake, tributary 240 of the Mohawk River near Pattersonville and East Cranesville, and at several localities in the Oriskany Creek system." A specimen was also collected from Cincinnati Creek in 1959 (NYSM 65660). Records from recent surveys indicate that Hornyhead Chubs still occur in these same waters.

Nocomis micropogon, River Chub





This minnow is native to five watersheds in western and south central New York and is also found in the Oswego watershed, where it was likely introduced.

Allegheny (1,2,3). River Chubs were collected at several locations along the Allegheny River during surveys conducted in 1937, the 1980s, and the 2000s. Young individuals were typically found in the mouths of tributaries (Becker 1982), and adults were caught in larger tributaries like Red House Brook and Haskell, Dodge, Oswayo, Conewango, Cassadaga, and French creeks.

Erie-Niagara (1,2,3). This species was common in larger streams but absent from headwaters in the 1928 survey of this watershed (Greeley 1929). In recent surveys, River Chubs were more commonly caught and more widespread than Hornyhead Chubs. The two species occasionally co-occur.

Ontario (1,2,3). Greeley (1940) stated that "in the Lake Ontario Watershed the range of this species does not appear to extend east of Rochester. The eight records obtained were from creeks of Orleans and Monroe counties and Glenwood Lake." In 1976, this species was reported east of Rochester in Ontario County, but this record lacks any voucher specimens. In recent surveys, as in 1939, the River Chub continues to be less common than its congener, the Hornyhead Chub.

Genesee (2). River Chubs were collected from Oatka Creek in 1973 (W. Hadley, SUNY Buffalo, unpubl. field notes) and Honeoye Creek in 1982 (AMNH 224638). Two unvouchered records from 1988 that were from sites farther upstream are treated as misidentifications.

Oswego (**1,2,3**). Greeley (1928) reported that the River Chub was represented by a single record from Catharine Creek near Montour Falls on July 8, 1927. He (Greeley 1928) further noted that the species was "doubtless an immigrant species, having entered from the Susquehanna system through an old canal which once connected to this drainage." This species was considered native by Underhill (1986), however, perhaps based on a 1951 Cayuga Lake record (CUMV 45257). Later records

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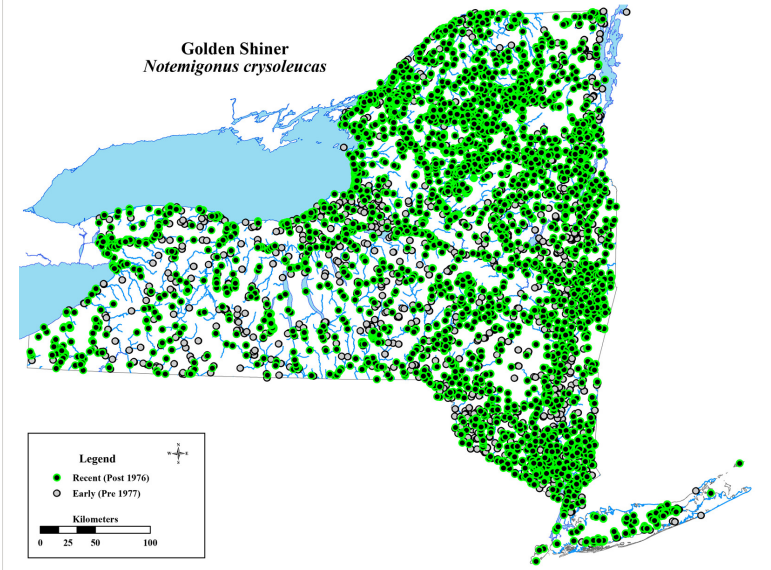
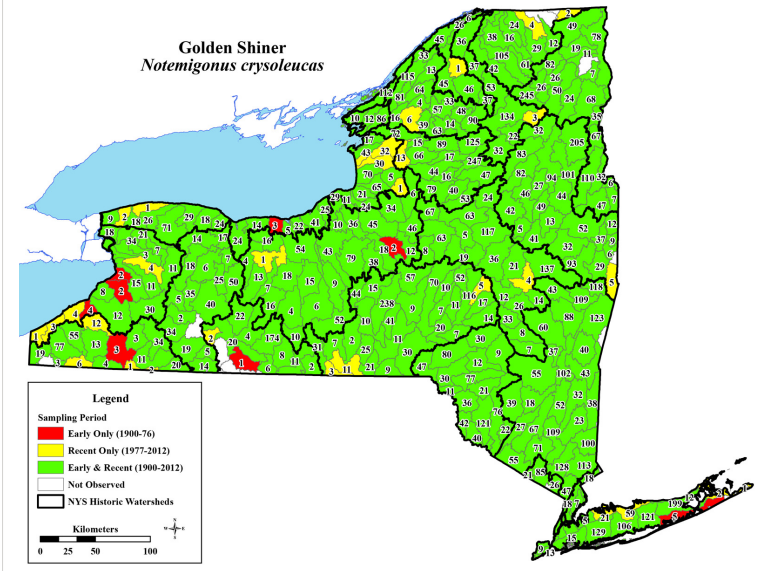
are from the same vicinity: Canoga Creek, a tributary of Cayuga Lake, in 1960 and 1963, and Catharine Creek in the 2000s. Reports from Canandaigua Outlet in the 2000s are likely incorrect, because only Hornyhead Chubs have been vouchered from this area.

Chemung (1,2,3). This species was common and widespread, being caught at 15% of the sample sites in the 1937 survey of the watershed (Greeley 1938). River Chubs were present in 10% of the samples in 2001-02 surveys and typically inhabited medium-sized and larger streams.

Susquehanna (1,2,3). Greeley (1936) reported that this species was widely distributed in the streams of this watershed. River Chubs have been collected at over 10% of the sample sites from both early and recent surveys, and have typically been found in medium-sized and larger streams.

Notemigonus crysoleucas, Golden Shiner





This ubiquitous species is native to streams and lakes in all of New York's 18 watersheds. It has probably been introduced to high-elevation ponds, such as those in the upland Adirondack watersheds.

Allegheny (1,2,3). Golden shiners were collected at 5% of the sites sampled in the 1937 watershed survey (Greeley 1938). Greeley (1938) noted that they were found in a variety of waters, ponds, backwaters, and slow stream reaches but were rare in Chautauqua Lake despite what appeared to be abundant suitable habitat. In recent stream surveys, specimens were collected at about 3% of the sites in the entire drainage, but in 15% of the samples in the Conewango Creek basin.

Erie-Niagara (1,2,3). Greeley (1929) noted that this species "prefers a habitat where there is aquatic vegetation. Specimens were found in Lake Erie, in sheltered bays and in many weedy streams and ponds." Results from recent surveys show that the species remains common throughout the watershed.

Ontario (1,2,3). Greeley (1940), in his account of this species, wrote that "the 154 collections indicated it to be widely distributed throughout the region in the bays, ponds and more sluggish streams." Golden Shiners continue to be present in many waters throughout the watershed.

Genesee (1,2,3). Greeley (1928) reported that this species was found in lakes and warm, weedy streams, notably Black Creek in Monroe County. Recent records show that this minnow still occurs throughout the watershed.

Oswego (1,2,3). This species has been abundant and widely distributed during all surveys of this watershed. It occurred in 10-20% of the streams surveyed in 1927 and in the 2000s.

Black (1,2,3). According to Greeley and Bishop (1932), "it is widely distributed over the lowland area in the St. Lawrence River, Lake Ontario and many lakes and streams, particularly the more sluggish ones." These authors also noted that this minnow was present in many Adirondack lakes but that it was probably not native to many of them—for example, the Fulton Chain, where it was not reported by Mather (1886). Gallagher and Baker (1990) noted that the species was exotic and was

Species continued on next page

present in more lakes than all but one other species in surveys conducted in the mid-1980s. In fact, Golden Shiners were caught in more lakes than were Brook Trout. In surveys conducted between 1995 and 2006, Daniels et al. (2011a) found this species in 9 of 14 lakes in this watershed.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that this species was very abundant, particularly in low-elevation sites in the Saint Lawrence River and lower reaches of tributary streams. Golden Shiners continue to be common at low-elevation sites in recent surveys but are also widely distributed and common at higher elevations, where the species has been introduced in recent years.

Oswegatchie (1,2,3). Although this species was widely distributed in lowland lakes in 1931, Cranberry Lake was the only upland body of water in this watershed where this minnow was found (Greeley and Bishop 1932). Golden Shiners remain common throughout the watershed.

Raquette (1,2,3). Greeley (1934) wrote: "This well-known bait minnow was noted from localities representing both the lowland and upland regions of the Raquette drainage; Long Lake and tributaries, Lake Eaton, Pleasant Lake, Lily Pad Pond, Squeak River, Hutchins Brook (tributary 4 of the Raquette River), and Plum Brook. It does not have a general distribution throughout the Adirondack part of the watershed and to what extent it is native to the upland localities is uncertain." Although Greeley (1934) noted that Golden Shiners were locally common, the only upland areas with records in 1933 were three tributaries of Lake Eaton (unpubl. field notes). Greeley's (1934) account repeats the belief that this minnow has been introduced into upland lakes and streams in the Adirondacks. Specimens have been collected from 23 upland waters during recent surveys.

Champlain (1,2,3). Greeley (1930) noted that this species was common in the watershed and was present in Lakes Champlain and George, in lakes in the Saranac and Mettawee basins, and in the sluggish creeks of the Great Chazy, Little Chazy, and Mettawee rivers. The species remains widespread in this watershed.

Chemung (1,2,3). Greeley (1938) stated that "lakes, ponds and streams of the Chemung area are rather well supplied with this first class bait and forage species. It is absent in large mileage of the more rocky streams and reaches highest abundance in sluggish streams or lakes where there are weed beds." During the 1937 survey of this watershed, Golden Shiners were caught at 20% of the sample sites. The species remains common and widespread in lakes and streams and was present in 10% of the samples in later stream surveys.

Susquehanna (1,2,3). This species was frequently caught and widely distributed in both lakes and streams during the 1935 watershed survey (Greeley 1936). Greeley (1936) further noted that this minnow was most abundant in areas without swift current and was absent from long stretches of the faster streams. Golden Shiners occurred in over 5% of stream survey samples taken during any time period.

Delaware (1,2,3). In 1935, this species ranked fifth in frequency of capture and was present in 30% of the samples taken during the survey of this watershed (Greeley 1936). Greeley (1936) also noted that this minnow was abundant in slack-water reaches. Golden Shiners remain widespread in the Delaware watershed.

Upper Hudson (1,2,3). This species has been widespread and abundant during all surveys from 1932 to date. It is not native to higher elevations in the Adirondack Mountains, however.

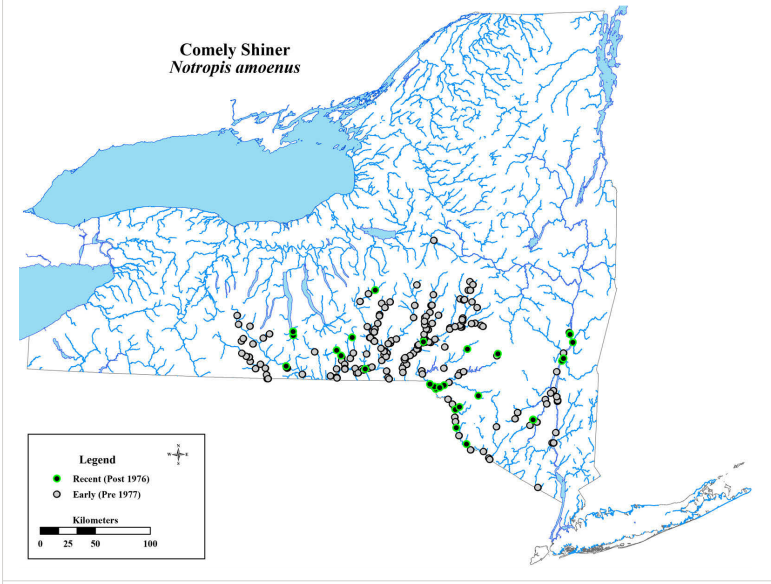
Mohawk (1,2,3). In the 1934 survey, Golden Shiners were taken in all manner of lakes and streams throughout the watershed, where they were abundant (Greeley 1935). This species continues to be collected regularly from lakes and sluggish lotic systems in this watershed.

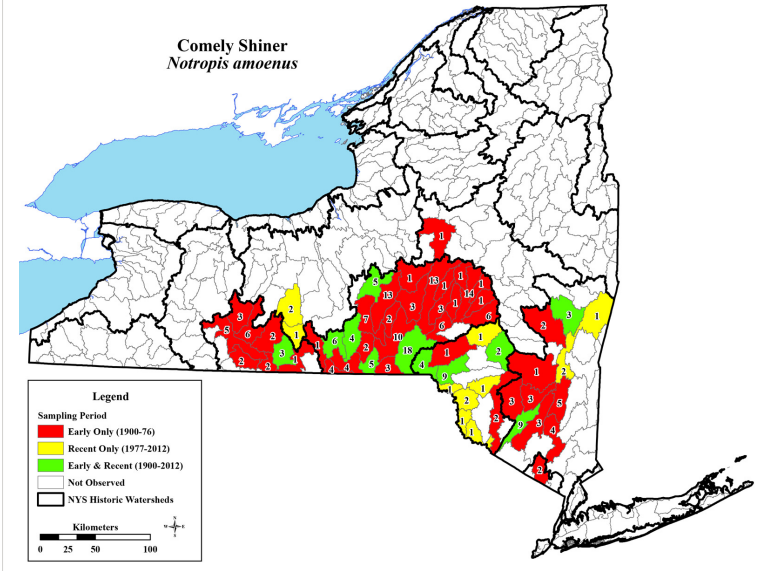
Lower Hudson (1,2,3). Golden Shiners were abundant during the 1936 survey of this watershed and were captured at 313 sites in the main channel, lakes, and sluggish streams, although a few specimens were found in more quiet stretches of rapid streams (Greeley 1937). The species continues to be found regularly and in abundance throughout the watershed.

Newark Bay (1,2,3). This species is widespread and is commonly caught in lakes and streams. The waters with the most records include Greenwood and Rockland lakes and the Mahwah and Hackensack rivers.

Long Island (1,2,3). The presence of a primary freshwater species on Long Island suggests that this species is either a relict that gained access to the island during the early post-Pleistocene or that it has been introduced. There are no available data that can aid in choosing between these options. Golden Shiners were widely distributed during the 1938 survey and were taken at 33 sites (Greeley 1939a). This minnow was also present in a collection from Willow Brook on Staten Island in 1938. Specimens have been found regularly during recent surveys and were also found in ponds on Fishers Island (e.g., NYSM 41497) during the early 1990s.

Notropis amoenus, Comely Shiner





The Comely Shiner occurs in medium-sized streams with clean gravel and is native to the Chemung, Susquehanna, and Delaware watersheds. When the 1926-1939 New York State watershed surveys were conducted, this species was identified as a subspecies of the Rosyface Shiner, and both field notes and the published species accounts note the difficulty in separating them when they co-occurred within a single watershed. Although we no longer recognize sympatric subspecies, it was common to do so in the 1930s. This species is also found in the Oswego, Mohawk, Lower Hudson, and Newark Bay watersheds, where it is not native. The Comely Shiner has been designated as a Species of Greatest Conservation Need in New York.

Oswego (**1,2,3**). This minnow was not reported from the 1927 survey of this watershed (Greeley 1928). Specimens were collected from Seneca Lake in 1939 (CUMV 27651) and from Catharine Creek at Montour Falls in 1943 (CUMV 50849). Because these were the first records of this species in the watershed, it is likely that it was an introduced species. Populations have persisted in the southern part of this watershed, with catches in 2003 (NYSM 55600) and 2010 (NYSM 66069).

Chemung (1,2). Greeley (1938) wrote: “This minnow seems to be restricted to stream habitats and was taken 19 times in collections made in the rivers and larger creeks of the Chemung area.” During the 1937 watershed survey, this species was found in 11 streams, including the Canisteo, Cohocton, Chemung, and Tioga rivers, and its frequency of occurrence was 10%. In 1944, it was collected at two sites where it had previously been recorded, as well as Baldwin and Wynkoop creeks. Comely Shiners have only been collected at two sites in the Chemung system since then: Campbell Creek in 1974 and Sing Sing Creek in 1977 (AMNH 49060). This species may, therefore, be extirpated from the watershed.

Susquehanna (1,2,3). Greeley (1936) noted the difficulty in identifying this species in the Susquehanna watershed because Rosyface Shiners were also present there. He (Greeley 1936) commented: “While not all of the Susquehanna specimens showed a tendency to vary toward *rubellus* in characteristics, often it proved impossible to differentiate the two species because of a certain number of specimens showing intermediate characteristics.” In determining abundance of this species in the watershed, intermediate forms were regarded as Comely Shiners, leading Greeley (1936) to conclude that this was the more frequently caught form. Snelson (1968) examined the available specimens from collections at CUMV, AMNH, and NYSM. Of the specimens from the 1935 survey identified as Comely Shiners in field notes (114 individuals from 21 sites), those

Species continued on next page

from only 11 sites were verified as belonging to this species. Thus, the recalculated frequency of occurrence of this species is 5% rather than the 10% based on field note identifications. Snelson (1968) added 28 records, mostly in the Owego Creek basin. In 1977, C.L. Smith surveyed the area and collected this species at 5% of his sample sites. Specimens were found in the Susquehanna River at Sidney (AMNH 49006), in the East Branch Owego Creek in 1979 (AMNH 43911), and East Branch Tioughnioga Creek in 1977 (AMNH 40517). In 2002, Comely Shiners were collected from Wilseyville Creek (NYSM 54154) and Catatonk Creek (NYSM 57370), and from the Susquehanna River at Vestal in 2004 (NYSM, 57444). Catches since 1935 suggest that this species is in decline throughout the watershed.

Delaware (1,2,3). In contrast to the situation in the Susquehanna watershed, where the identity of this species was confounded by its morphological similarity to the Rosyface Shiner and the collection of a large number of intergrades, Greeley (1936) found that the specimens from this watershed conformed to the description of the species and were easily identifiable. Comely Shiners were found at 23 sample sites. The species' frequency of occurrence has remained consistent over the last several decades, with specimens being caught at 26 sites from 1956-1984 and 13 sites between 2001 and 2005. These more recent records include catches from the West Branch Delaware River from Delhi to its mouth (NYSM 59681), the East Branch Delaware River near Peas Eddy Brook (NYSM 52796, 58714), and the main channel at Callicoon (NYSM 59678), Barryville (NYSM 59715), and Narrowsburg (NYSM 59746). Additional specimens were collected from the Hancock area in 2013 (NYSM 69968, 69977).

Mohawk (**1**). Greeley (1935) noted that two specimens were collected from the Erie Canal at Crane Creek. We were unable to locate these specimens, however. This species has not been collected in the watershed since 1934, suggesting that it is either extirpated or that the two specimens were misidentified.

Lower Hudson (**1,2,3**). In 1936, this species was collected at 13 sites in the main channel and in the lower reaches of major tributaries, including the Wallkill River and Rondout and Esopus creeks (Greeley 1937). Again, identification problems came into play in Rondout Creek, where several individuals were identified as intermediate between this species and the Rosyface Shiner. More recently, specimens have been found in Coxsackie Cove in 1990 (NYSM 41443), Stockport Flats in 1991 (NYSM 41472), and in the main channel at Germantown in 2000 (NYSM 51806) and in 2014 (J. Kurtenbach, EPA New Jersey, pers. comm.). The Comely Shiner, like the Shield Darter, is common in the neighboring Delaware River system and both species may have been introduced from that watershed. Whatever the location of the source population, the introduction of this species to the watershed must have been early, because it was already widely distributed in the Lower Hudson in 1936. A persistent population may occur in the Shawangunk Kill, where specimens have been collected in 1977 (AMNH 45596) and 2010 (NYSM 65995), but the species is rarely caught and may be declining elsewhere in the watershed.

Newark Bay (**1**). Greeley (1937) reported the presence of Comely Shiners in the Ramapo River; this is the only record of the species in this watershed. The entire watershed has undergone severe channel modifications and intense urbanization over the last eight decades, which may explain the apparent extirpation of this minnow. Carlson and Daniels (2004) classify it as non-native to this watershed.

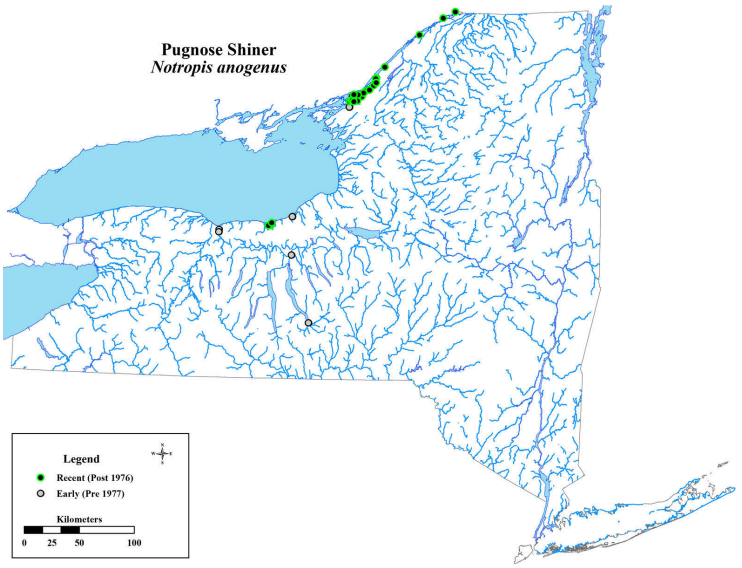
Notropis anogenus, Pugnose Shiner

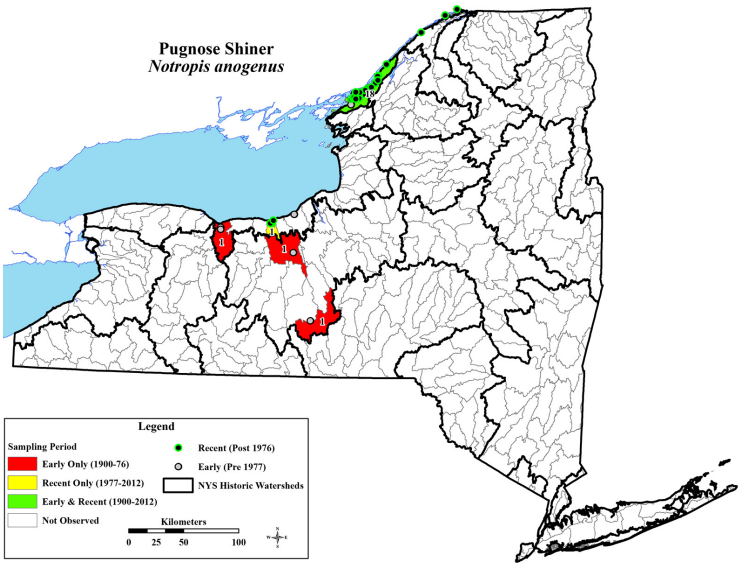
This blackline shiner is native in three of the state's 18 watersheds. It lives near-shore in dense submerged aquatic vegetation in Lake Ontario, the Saint Lawrence River, and Cayuga Lake. The Pugnose Shiner is classified as endangered in New York and Canada, with a recovery program underway in Ontario (McCusker et al. 2014).

Ontario (1,3). Greeley (1940) reported this "little fish" from Little Sodus and Irondequoit bays and noted that populations were disjunct. More recently, specimens have been collected from Sodus Bay since 1997. The population there appears to be well established and is recognized as being genetically distinct from the stocks in the Saint Lawrence River (McCusker and Mandrak 2014).

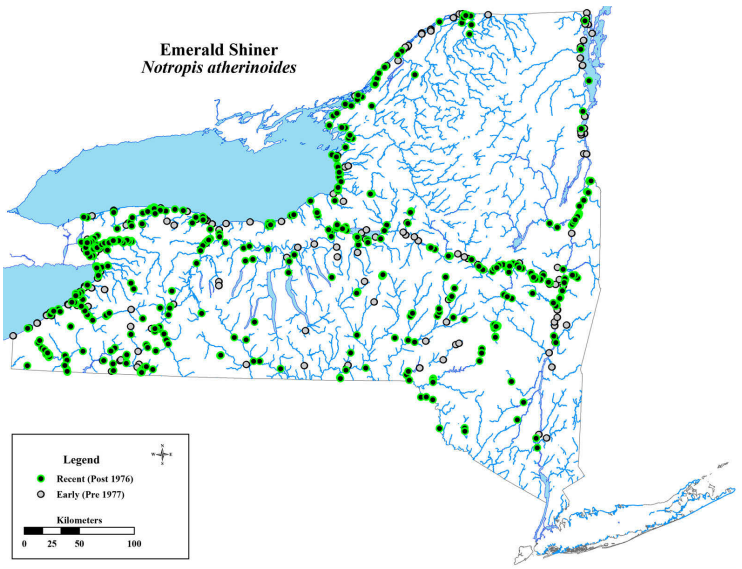
Oswego (1). Meek (1889) recorded this species from the old canal near Montezuma, and Reed and Wright (1909) noted collections from the mouth of Fall Creek and the lower course of Sixmile Creek at Ithaca. Pugnose Shiners were absent from collections during the 1927 survey of this watershed (Greeley 1928), and no specimens have recently been caught despite extensive sampling efforts.

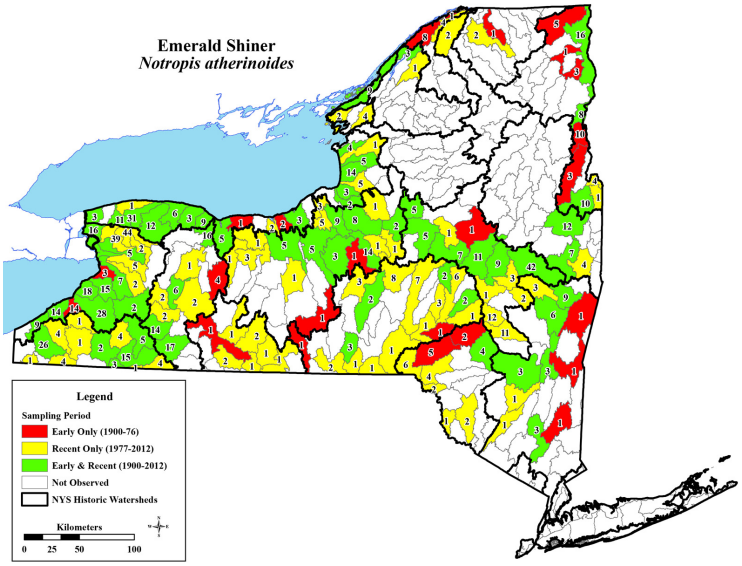
Saint Lawrence (1,2,3). Greeley and Bishop (1932) noted that this species was rare and was collected at a single site in French Creek near Clayton. Carlson (1997a) was unable to establish the actual location of this site. Recently, specimens were collected at several locations in the Thousand Islands area, at Chippewa Bay in 2002 (NYSM 54378), Cartier State Park in 2009 (NYSM 65037, 65527), and at the Iroquois Dam in 2012. On the Ontario side of the river, this species was reported from Niarn and Moulinette islands in 2011 (N. Mandrak, University of Toronto, pers. comm.).





Notropis atherinoides, Emerald Shiner





This shiner is found in 15 watersheds throughout the state but is absent from the Black, Newark Bay, and Long Island watersheds. The species is native to the northern and western watersheds, but has been introduced to the Atlantic slope watersheds.

Allegheny (1,2,3). Emerald Shiners were not collected in the 1937 watershed survey (Greeley 1938) but were collected from the main channel of the Allegheny and in several tributaries by T.L. Hankinson in 1921 (Hankinson 1927). The species was also taken from Chautauqua Lake in 1928 (CUMV 66531). This minnow was stocked in the Allegheny Reservoir in 1972 and 1974 (Cooper and Wagner 1980) and has also been collected from Tunungwant Creek from 1977-78, the Allegheny River in 1977 (AMNH 49207), 1980, and 1998, Oswayo Creek in 1977 (AMNH 49235) and 1998 (NYSM 48702), and Cassadaga Creek in 1979 (AMNH 42256) and 2005 (NYSM 58631). The species remains rare in this drainage.

Erie-Niagara (1,2,3). Greeley (1929) noted that this was the most abundant fish in Lake Erie. He (Greeley 1929) also remarked that Emerald Shiners were found in schools in deep and shallow water and that they were abundant in the Niagara River and in larger tributaries. This assessment was reiterated by Buckingham et al. (1977), who commented that this minnow becomes very abundant in the lake and the Niagara River at times. Emerald Shiners continue to be found in abundance in recent surveys.

Ontario (1,2,3). Greeley (1940) wrote that "most of the 36 occurrences in survey collections were from the bays although the Barge Canal, Glenwood Lake and a few of the larger creeks such as Eighteenmile, Johnson and Sandy Creeks also yielded records." The species is now widely distributed throughout the watershed.

Genesee (1,2,3). Greeley (1927) indicated that Emerald Shiners were more likely to be found at downstream sites in this watershed. This pattern was also reported by Smith (1985), and most recent collections are from the Genesee River in Monroe County and from Lake Rushford.

Oswego (1,2,3). This species was generally uncommon in the watershed survey of 1927 but was abundant in Oneida Lake (Greeley 1928). The frequency of occurrence in streams from 1996-2010 was 6%.

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Black. Greeley and Bishop (1932) did not find this species during the survey of this watershed, although they noted that it was found nearby in the Saint Lawrence River. There are no confirmed records of Emerald Shiners in this watershed. The few recent records that do exist, from a Black River study by Beak Consultants Incorporated in 1994 and collections made near Carthage in 2005 and 2006 are not supported with voucher specimens.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that although this minnow was abundant in Lake Erie, the other Great Lakes, and Lake Champlain, it was uncommon in the Saint Lawrence River. They (Greeley and Greene 1931) continued: "This slender minnow...is not very common in the St. Lawrence River. A few specimens were collected along shore in the river and at the mouths of several tributaries, none being taken at any great distance upstream." Emerald Shiners continue to be caught in the Saint Lawrence River and adjoining waters.

Oswegatchie (2,3). No individuals were caught in this watershed during the 1931 survey (Greeley and Bishop 1932). The only two known records are from the Oswegatchie River at Dekalb in 1979 (AMNH 44878) and at Ogdensburg near the mouth in 2007 (NYSM 62766).

Raquette (3). This species has been caught only twice in lowland tributaries, at Earls Creek in 1997 (NYSM 47805) and at the mouth of an unnamed tributary of the Raquette River in 2007.

Champlain (1,2,3). Emerald Shiners were common in the 1929 Lake Champlain watershed survey, where they were found in open water, near-shore marshes, and the lower reaches of tributary streams (Greeley 1930). The species remains widely distributed in the lake and tributaries to the south.

Chemung (**2,3**). Emerald Shiners were apparently absent from the watershed in 1937 (Greeley 1938). The species was first reported in 1976 and was captured at two sites in the main channel in 1977 (AMNH 49043, 49079). Since then, this minnow has been reported from the Tioga River, the Canisteo River, Waneta Lake, and Mud Creek (AMNH 226941).

Susquehanna (**1,2,3**). Greeley (1936) noted that this species was absent from watershed survey samples in 1935, but the unpublished field notes from the survey show a catch from the Otselic River. There are few historic records and most are from lakes. More recent surveys have found Emerald Shiners in Cayuta Creek in 1976, the Susquehanna River in 1989 (NYSM 40513) and 2004 (NYSM 57065), Otsego Lake in 1993 (NYSM 13260), and the Chenango River in 2004 (NYSM 57516).

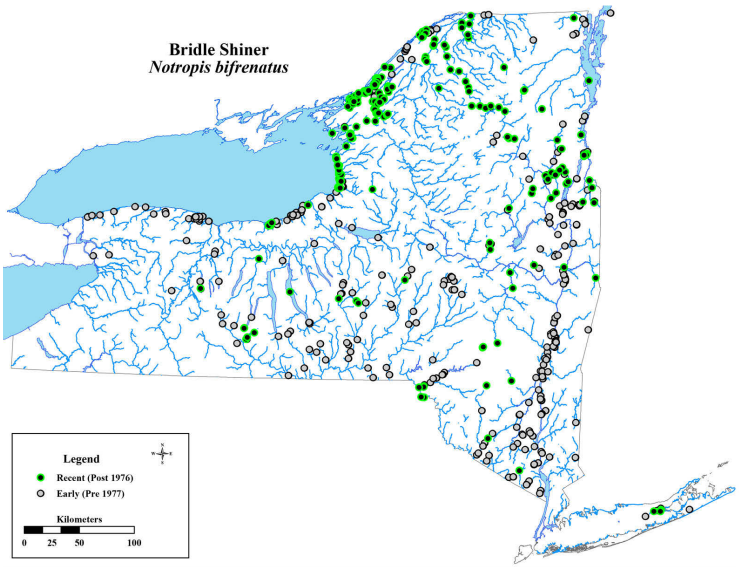
Delaware (**2,3**). This species was first reported from this watershed in 1972. By 2005, it had been reported at an additional 14 sites. Only a single 2005 record from the Delaware River is supported by a voucher specimen (NYSM 59474), however. Without actual specimens, there is no way of verifying the earlier reports.

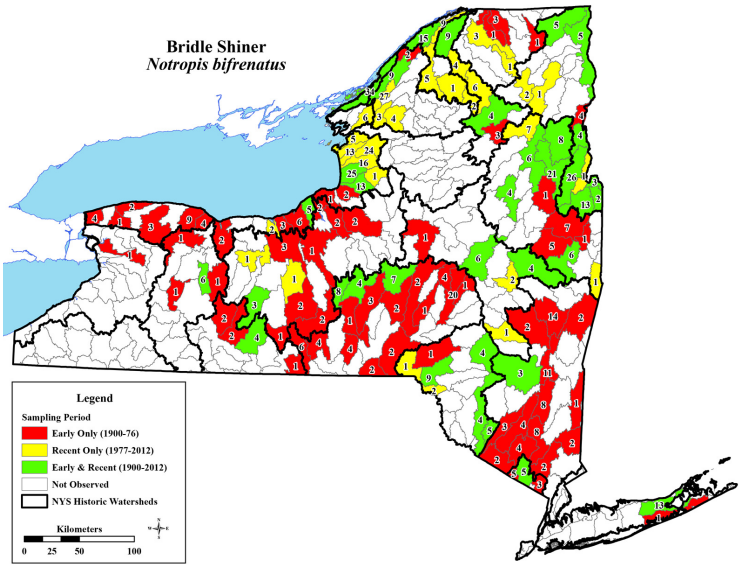
Upper Hudson (**1,2,3**). This species was only found at one site in the 1932 survey, the lower Moses Kill near Fort Edward (Greeley and Bishop 1933). Specimens were collected near the confluence of the Mohawk River in 1967 (AMNH 26511, 26498) and in 1998. The continued presence of this species in the watershed may be due to out-migrants from the neighboring Mohawk watershed, where it is abundant. No Emerald Shiners were caught in an extensive survey conducted in 2008 by NYSDEC, but they were reported from the confluence of the Hudson and Sacandaga rivers in 2008 (C. Millard, EPA National Rivers Study, pers. comm.). This species has been reported from the Tomhannock Reservoir multiple times between 1991 and 2008.

Mohawk (**1,2,3**). Greeley (1935) noted that this minnow was found in the Mohawk River, the Erie Canal, Delta Lake, and in the lower reaches of the larger tributaries. He also noted that Emerald Shiners were harvested from Oneida Lake and stocked in many small lakes. Recent records show that this species is still present in these same waters, with upstream expansion of its range in some of the tributaries. For example, a specimen was taken in Schoharie Creek at the mouth of Fox Creek in 2009 (NYSM 64969). Emerald Shiners were sufficiently abundant in the Mohawk River to support a commercial bait fishery until recently.

Lower Hudson (**1,2,3**). Emerald Shiners were collected in the main channel and some of the larger upriver tributaries in the 1934 survey (Greeley 1935). No specimens were collected downriver when that portion of the watershed was sampled in 1936 (Greeley 1937). Specimens continue to be caught, albeit rarely, on both banks of the Hudson River throughout its entire length.

Notropis bifrenatus, Bridle Shiner





This blackline shiner lives in nearshore areas of lakes and streams and is usually associated with submerged aquatic vegetation. The species is native to all 16 of the watersheds in which it has been found. It has not been reported from either the Allegheny or Black watersheds. The Bridle Shiner has been designated a Species of Greatest Conservation Need in New York.

Erie-Niagara (1,2). Wollman (1893) collected this species from Cazenovia Creek in 1893 (USNM 73437) and Hankinson (1924) collected it from Ellicott Creek at Williamsville during surveys conducted from 1920-21. Bridle Shiners were not reported by Greeley (1929) from the extensive survey work conducted in this watershed in 1928. The species was reported from the Niagara River in 1960, but no voucher specimens were retained. No additional Bridle Shiners have been reported from this watershed in the last half-century.

Ontario (1,2). The earliest record in this watershed is from Twelvemile Creek in 1920 (ANSP 50207). In 1924, A.H. Wright collected Bridle Shiners in streams near Hilton (CUMV 626). In 1928, this species was caught at two sites near Braddock Bay, Monroe County (UMMZ 99167, 99168). Greeley (1940) wrote: "Although an eastern species, the Cayuga minnow has populated creeks well into Niagara County." The weedy bays of Lake Ontario from the Niagara River to the Thousand Island area of the Saint Lawrence River supported disjunct populations of this species during the 1939 survey. By the 1950s, the western range of this species did not extend beyond Braddock Bay (CUMV 18943). Although still common in many eastern bays of Lake Ontario, no specimens have been found west of Sodus Bay in recent collections. The most recent collections were in the 1950s, from West Creek (CUMV 18943) and Golden Hill Creek.

Genesee (2,3). Bridle Shiners were first reported from this watershed in 1940 from Conesus Lake. The species is extremely rare and, to date, has only been found in Conesus Lake, Silver Lake, Churchville Pond, and Honeoye Lake (CUMV 68312). A population is still present in Conesus Inlet (NYSM 55358).

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Oswego (1,2,3). Early records from this watershed include Meek's specimen from Cayuga Lake from the 1880s (UMMZ 247179), a 1900 capture from Fall Creek (ANSP 40215), a 1902 capture near Ithaca (UMMZ 60573), and specimens from Oneida Lake in 1916 (UMMZ 81290) and 1925 (UMMZ 81289). Greeley (1928) noted that this minnow was common in lakes, ponds and warm streams, and was often associated with mud substrate and abundant aquatic vegetation. There are 109 records from Cayuga and Seneca lakes up to the 1970s, but only seven since then. Since 1981, Bridle Shiners have been found in Keuka (NYSM 56808) and Cayuga lakes, as well as Canandaigua Outlet (upper Clyde River). The frequency of catches in lakes has not been well tracked over time, but it appears to have decreased in recent years.

Saint Lawrence (1,2,3). Greeley and Greene (1931) stated that this species was "common, but restricted to lowland areas. It is seldom found above the mouths of streams but is very common in marsh areas along the St. Lawrence River, particularly in lagoons at the mouths of streams. In the case of a few streams which have no barriers to upward migration, it extends upstream for several miles." Bridle Shiners are nonetheless rare in tributary basins, although a notation of a catch in Greeley's unpublished field notes in Little Salmon River in 1930 and a capture in the Deer River at Helena in 1997 indicate that they are present. The earliest records of this minnow in the upstream, northeastern portions of the Saint Regis and Grass River basins are from the late 1990s. The species is now found in the headwaters of the Grass River. In the mainstream Saint Lawrence River, Bridle Shiners were commonly caught in recent surveys in the Thousand Island area to as far downstream as Waddington in New York and Cornwall in Ontario, although they have become rarer at downstream sites.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that Bridle Shiners were common but restricted to lowland waters. Specimens were collected from Lisbon Creek in 1931 and Beaver Creek in 1933 (UMMZ 95720). Nearly all recent and historic catches have come from lakes in the Indian River system.

Raquette (1,2,3). Greeley (1934) noted that, despite this minnow being common in the Saint Lawrence River, it was rare in this watershed and found in only two areas: a tributary of Squeak Brook and in Long Lake and its tributaries. Squeak Brook, with direct access to the Saint Lawrence River, was a likely capture site, but Long Lake is farther upstream, and Greeley (1934) concluded that the species was introduced into the lake. In recent years, Bridle Shiners have been found to be more widespread in upland sites in this watershed and in other Adirondack watersheds as well, indicating that they may be native but slow to disperse upstream. Specimens have been taken from Wolf Creek near Tupper Lake in 1965 and 2007, Dead Creek near Piercefield in 1978 (AMNH 41330), from three main stem impoundments in 1995, Squeak Brook in 1997 and 2001, the Raquette River east of Tupper Lake, and impoundments of the river at Potsdam (NYSM 63006) and Norwood (NYSM 62769) in 2007. Bridle Shiners were also caught below Raymondville in 1985 (Niagara Mohawk Power Corporation 1991b) and in 1997 (NYSM 47720).

Champlain (1,2,3). Greeley (1930) reported that this species was "very common in Lake Champlain and in Lake George, especially near marshes. In the southern section of the drainage, in the Mettawee system, it occurs in many of the ponds, above falls." Bridle Shiners were reported from 20 locations prior to 1975. Since then, collections have been reported from Lake Champlain (NYSM 49453), Lake George (NYSM 59125), Round Pond in 1984, the Poultney River (Facey and Labar 1989), the Great Chazy River in 1994, Trout Lake (NYSM 53931), the Saranac River in 2008, and two tributaries of the Mettawee River in 2008. The species was last caught in the Little Chazy River in 1954. Changes in the distribution of this species throughout the Champlain watershed since the 1929 survey do not appear to be significant.

Chemung (1,2,3). Greeley (1937) collected this species at six sites and noted that its range was confined to the Cohocton Creek system. In 1944, a collection was reported from Baldwin Creek near Elmira (CUMV 45104), an eastern tributary. Most recent catches have been from the Cohocton system near Bradford and Sonora, a range even more restricted than has previously been reported.

Susquehanna (1,2,3). This species was widely distributed during the 1935 survey and was typically found in lakes and streams with abundant aquatic vegetation (Greeley 1936). Prior to the mid-1930s, Bridle Shiners had been collected from 24 waters. Between 1936 and 1980, specimens were present in 20 collections. This minnow has only been collected four times in this watershed since 1980, including catches in the Sangerfield River, Chenango Creek, and West Branch Tioughnioga River. Despite recent sampling efforts, no Bridle Shiners have been found in Otsego, Canadarago, Weaver, Eaton, and Tully lakes.

Delaware (1,2,3). Bridle Shiners were found at 19 locations, or 3% of the sample sites in this watershed, during the 1935 survey (Greeley 1936). There were nine records from 1952-1979 and six during a 2005-06 survey. Recent collection sites include the Basher Kill (NYSM 6573), headwaters of the East Branch Delaware River near Roxbury (NYSM 59424), near the mouth of the West Branch Delaware opposite Shehawken Creek, PA (NYSM 58933), and Peas Eddy near the mouth of the East

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Branch Delaware (NYSM 59460). The species has also been reported from the Delaware River about 16 km downstream of Hancock at Equinuck, PA. Recently, individuals were discovered much farther downstream in Marshalls Creek, PA (Leckvarcik 2001, 2006).

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported that Bridle Shiners were common in the lowlands of this watershed, primarily downriver of Glens Falls. Records from lotic environments include collections from Town Brook in 1959 and the Hudson River at Warrensburg in 1934 and 2008. Since the 1970s, specimens have been collected in some of the lakes where the species was historically found, as well as Kayaderosseras Creek, the Schroon River, Little Snook Kill, and Drummond Creek. In 1978, a specimen was collected from the Hoosic River (AMNH 41136), from which this species was also recorded upstream in Massachusetts (Hartel et al. 2002). Recently, collections have been made from headwaters, such as Fishing Brook in 2009 (NYSM 64718) and the nearby County Line Flow in 2007 (NYSM 62505).

Mohawk (1,2,3). Greeley (1935) reported that this minnow was uncommon in the watershed and was present at only three sites: East Caroga Lake, Caroga Creek, and an unnamed tributary at the headwaters of the Mohawk River (NYSM 27276). Smith (1985) recorded a collection from Caroga Creek in 1979. One specimen was caught in 1982 from Walker Brook (NYSM 8541), and there are records from Alplaus Kill in 1965 and 1993 and East Caroga Lake in 2005. Clearly this species remains rare in this watershed.

Lower Hudson (1,2,3). In the 1930s, most of the 75+ collections from this watershed were from weedy habitats in standing or slow-water habitats along the Hudson River, lower reaches of tributaries, or in lowland ponds; the species was listed as common (Greeley 1935, 1937). Recent collections include reports from Queechy Lake in 1975, the Hudson River in 1976 (NYSM 11693), and the Ashokan Reservoir in 1987. Bridle Shiners also inhabited the Swamp River in the Housatonic drainage in the 1930s, which is southwest of the Massachusetts sites where Carmignani (2012) studied the species' habitat use. Despite continuous survey work, no specimens have been collected from this watershed in the past 25 years, suggesting a major range loss for this species.

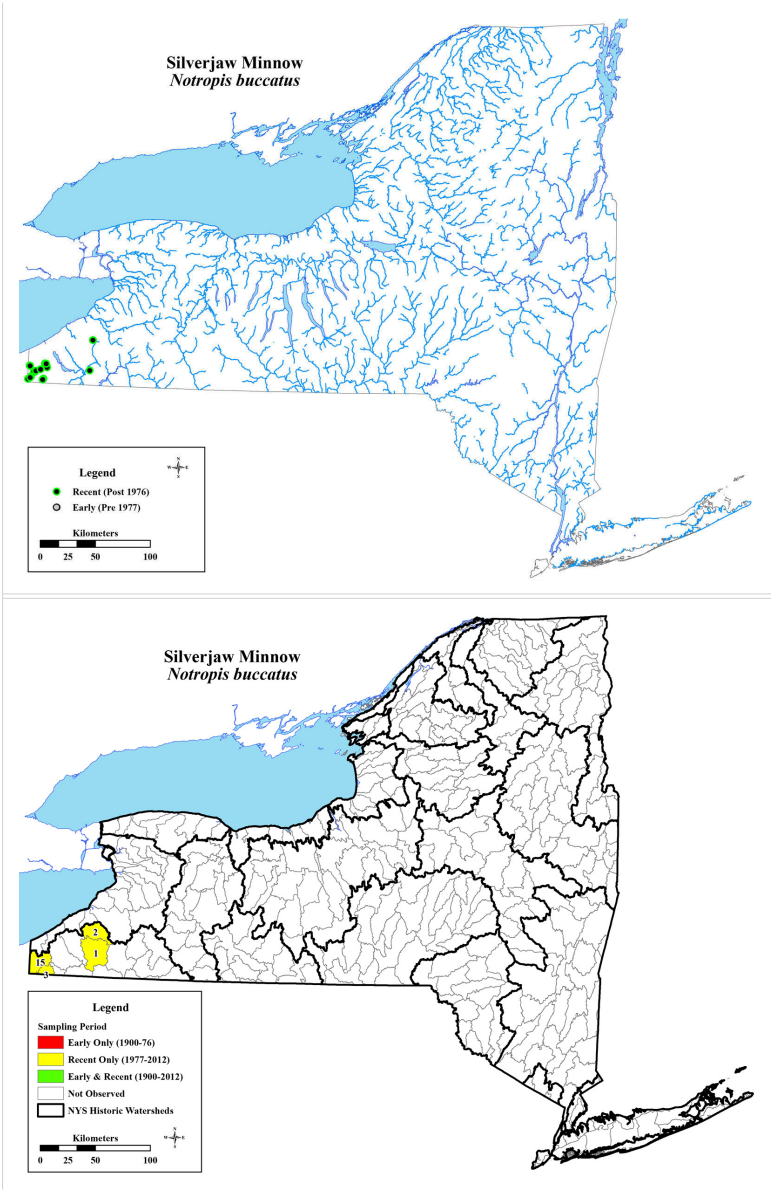
Newark Bay (1,2,3). The earliest records in this watershed are from the Hackensack (NYSM 27337) and Mahwah rivers in 1936. Specimens were found in an upstream area of the Mahwah River in 1976 (AMNH 38699) and in Little Dam Lake, a pond in Sterling Forest State Park, in 1998 (NYSM 48316).

Long Island (1,2,3). Greeley (1939) stated that "this small minnow is locally common. Specimens were taken only at the following localities, all toward the eastern end of Long Island: Watermill Pond, Peconic River at Sweyze and near Manorville." Although this species is common to abundant where found, its range is severely restricted and it is absent from most of the island. The earliest record in this watershed is from the Moravian Cemetery on Staten Island in 1909 (ANSP 17893). All recent records are from a few areas of the Little Peconic River near Riverhead (e.g., NYSM14855 in 1985; NYSM 66248 in 2010). Like other primary freshwater fishes, the ability of this minnow to disperse to the off shore islands in this watershed is limited. The species is assumed to be native, but its inability to disperse through saltwater and its limited range on Long Island suggest that it may have been introduced, although this introduction would have occurred over a century ago.

Notropis buccatus, Silverjaw Minnow

This minnow was discovered to occur in New York in the 1970s and is only found in the Allegheny watershed.

Allegheny (2,3). Silverjaw Minnows were first reported from the Brownell Branch of Brokenstraw Creek in 1979 (AMNH 42270). The species is native to the Allegheny River system and is likely an example of upstream natural dispersal into both the Conewango and French Creek basins. In contrast, no specimens have been found in the main stem Allegheny River in New York, to which access is blocked by the Kinzua Dam. More recent collections include Mud Creek, West Branch Conewango Creek, French Creek (NYSM 70118), and West Branch French Creek (NYSM 66205).

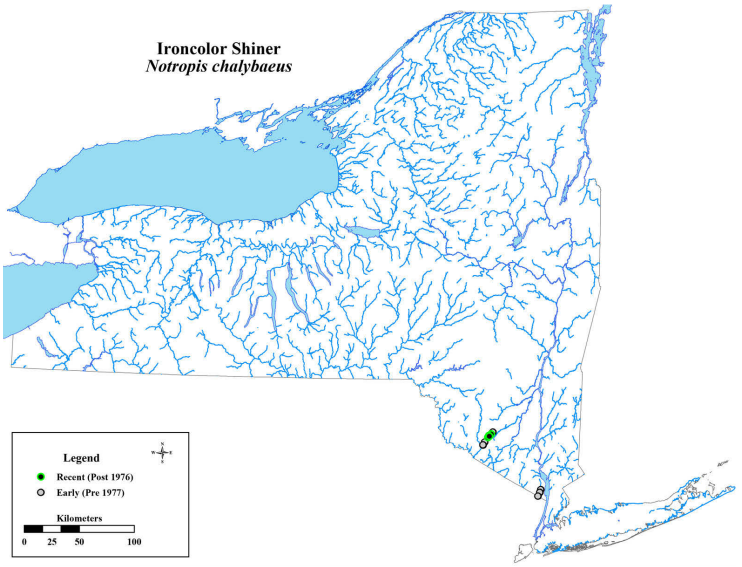


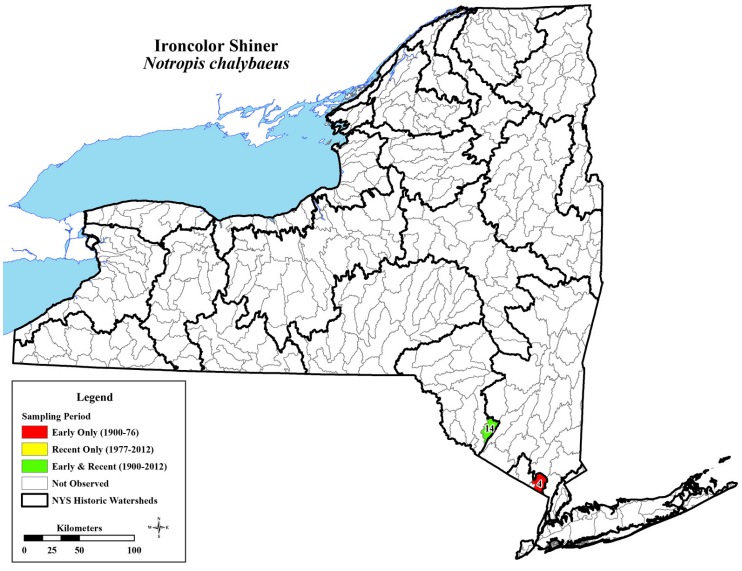
Notropis chalybaeus, Ironcolor Shiner

This small blackline shiner occurs in medium-sized streams in the Delaware and Newark Bay watersheds, where it is native. It is often associated with abundant submerged aquatic vegetation. This species has been designated as a Species of Greatest Conservation Need in New York.

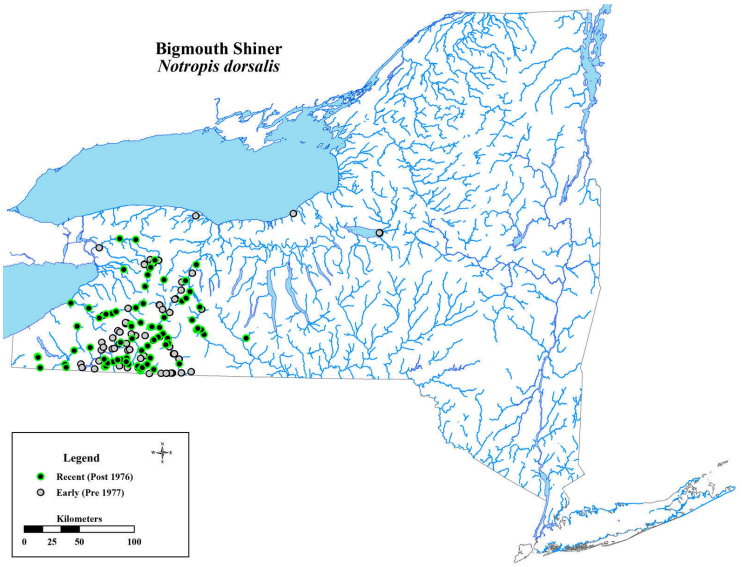
Delaware (1,2,3). Greeley (1936) described the range of this species and summed up its rarity in New York: "The Basher Kill, a tributary of the Neversink River, was the only stream found to be inhabited by this minnow, which was taken near Brookville Station and at Cuddebackville. These are apparently the first records obtained for New York. The range of the species is largely to the south along the coastal plain." The 10 km-long upland marsh in the Basher Kill (aka Bashakill) at Westbrookville is the only site where this species has been found in recent decades, but it has consistently been caught there. Ironcolor Shiners have recently been discovered much farther downstream, in Marshalls Creek, PA (Leckvarcik 2001, 2006).

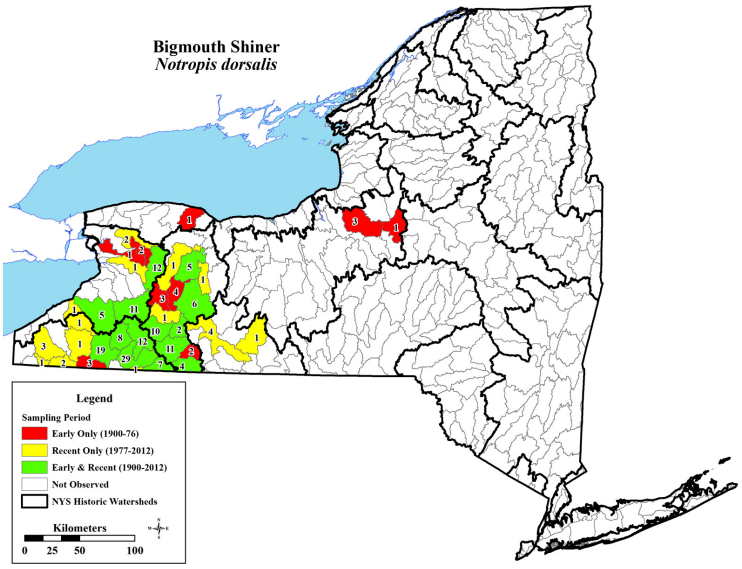
Newark Bay (1). Greeley (1937) reported that this species was abundant in the Hackensack River, a sluggish and weedy stream. This stream and its tributary, Nauraushaun Brook, were the only sites where Ironcolor Shiners were caught during the 1936 survey, and no specimens have been found in this watershed since.





Notropis dorsalis, Bigmouth Shiner





This minnow has been reported from six watersheds in western New York. These populations form a disjunct eastern grouping, separated from the center of the distribution for this species, which is farther west in the upper Mississippi and Missouri River systems. Bigmouth Shiners are found in medium-sized streams, often associated with clean gravel. The species is native in five of its resident watersheds and is exotic to the Chemung watershed. The Bigmouth Shiner has been designated as a Species of Greatest Conservation Need in New York.

Allegheny (1,2,3). Bigmouth Shiners inhabited smaller streams in the most upstream parts of the Allegheny River in Pennsylvania and were described as *Notropis keimi* by Fowler (1907). In New York, Dence (1928) reported this species from tributaries near Portville, Olean, and Salamanca, and in many of the inundated tributaries of what is now the Allegheny Reservoir. Greeley (1938) noted that this minnow was absent from the main channel of the Allegheny but that it populated many of the tributaries. Specimens were found in the 1980s in Red House Brook, Great Valley Creek, and Tunungwant Creek and their tributaries, as well as many of the streams in Allegany State Park. Bigmouth Shiners continue to be collected in these areas, as well as in Oil Creek in 2001 (NYSM 53200) and Dodge Creek in 2003 (NYSM 55323). They have also been found in the Allegheny River (e.g., NYSM 62312 in 2007), Little Genesee Creek (AMNH 42851), and Ischua Creek (AMNH 42194) in 1979 and 2013 (NYSM 69762). The entry of this species into the central basin of this watershed appears to coincide with the entry of *Notropis bucattus* in the 1980s. The few records in the central basin are from Little Brokenstraw Creek in 1981 (AMNH 226797), Brokenstraw Creek in 1985 (NYSM 15460), and Goose Creek, a tributary of Chautauqua Lake, in 1989 (NYSM 40252) and 2004 (NYSM 56944). Loss of suitable habitat may account for declines in abundance and range reductions of this species in recent years.

Erie-Niagara (1,2,3). In the 1928 survey of this watershed, Bigmouth Shiners were common in Tonawanda and Ellicott creeks and their tributaries but were not taken in Lake Erie (Greeley 1929). In recent years, this species has been reported from Halfway Brook near Irving, as well as from Connoisauley, Cattaraugus (NYSM 69418), Buffalo, and Tonawanda (NYSM 69500) creeks, and some of their major tributaries.

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Ontario (2). There are only two catch records of Bigmouth Shiners in this watershed: West Creek near Rochester in 1950 (CUMV 18942) and near Fair Haven in 1951 (CUMV 34187).

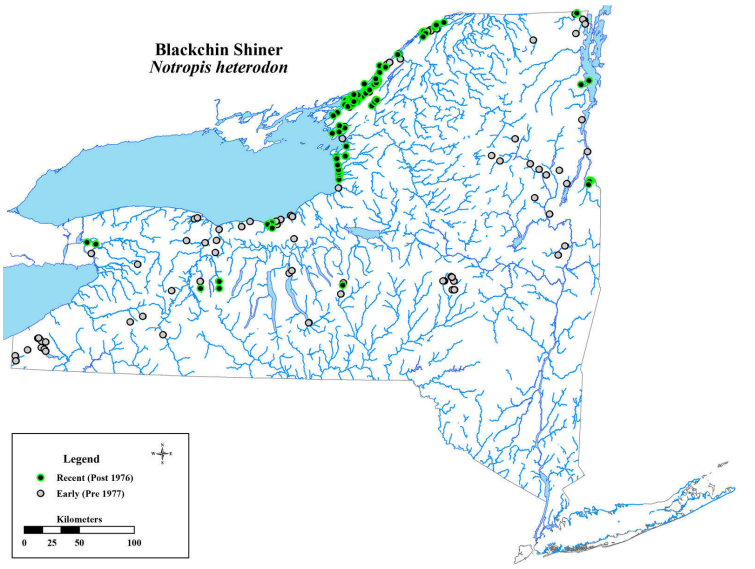
Genesee (1,2,3). Greeley (1927) noted that this species was rare but present in the main channel and larger, warm tributaries, such as Canaseraga Creek near Dansville**.** This minnow is still found in the upstream part of the watershed, with the farthest downstream record being from Beards Creek in 2002 (NYSM 54182).

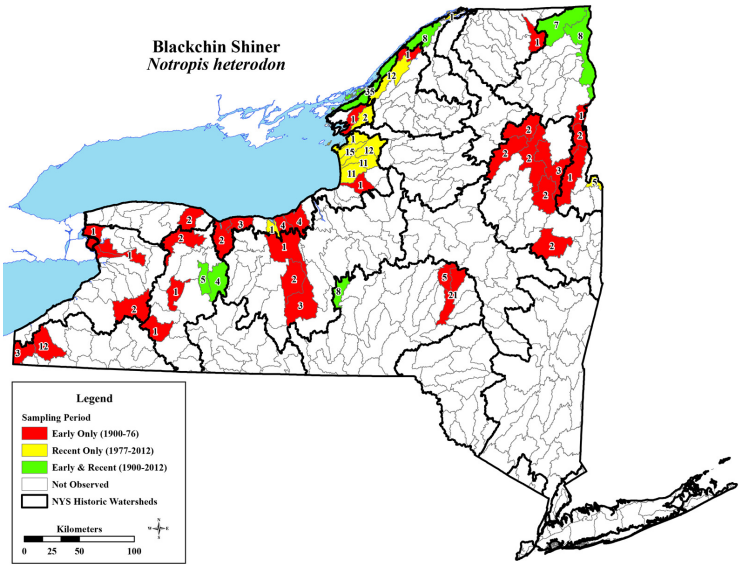
Oswego (1). Greeley (1928) reported a personal communication from Professor T.L. Hankinson, who said that he and Mr. Dence seined some small minnows from Oneida Lake that they identified as Bigmouth Shiners. Hankinson and Dence continued to sample these fish from Sylvan Beach on Oneida Lake and Fish Creek from 1927-1933 (RWLC 3654, CUMV 42438; Adams and Hankinson 1928). This species is not typically, or even rarely, found in lakes (Smith 1985) and even Greeley (1927) noted its preference for streams, so its presence in these lake samples on the periphery of its range is curious. There have been no other catches in the Oswego watershed since 1933.

Chemung (**2,3**). Smith (1985) noted that Bigmouth Shiners were first caught in 1981 in three areas of the Canisteo River basin (AMNH 226678, 226684, 226943) and they have more recently been found in the same area in 2003 (NYSM 55450). Smith (1985) suggested that the species entered this watershed from the nearby ditch in Arkville, which connects to upper Canaseraga Creek in the Genesee watershed.

Notropis heterodon, Blackchin Shiner

This blackline shiner lives in streams and littoral zones of lakes that have abundant, submerged aquatic vegetation. Blackchin Shiners are found in 10 of 18 New York watersheds and are native to all of them. In northern areas, this minnow is generally found in lowlands. This species is currently classified as a Species of Greatest Conservation Need.





Allegheny (1,2). The only records of Blackchin Shiners in this watershed are from French Creek (CUMV 68804) and Findley Lake (NYSM 5573) in the western basin and several collections from Chautauqua Lake in the central basin (Greeley 1938). Despite extensive sampling, the species has not been found in this watershed since 1948.

Erie-Niagara (1,2,3). Greeley (1929) collected a few specimens among weed beds from a single site on the Niagara River. This species has been found in Lime Lake, Moores Pond, and Ellicott Creek as recently as 1957, but, without voucher specimens, confirmation of these questionable records is not possible. More recent records from the upper Niagara River include captures in 2001 (New York Power Authority 2001) and 2007 (NYSM 62676).

Ontario (1,2,3). In the 1939 survey of this watershed, this species was absent from collections west of Rochester. Specimens were found, however, at 18 localities in Lake Ontario bays to the east (Greeley 1940). The few early collections from outside of Lake Ontario or its bays were from Mendon Ponds in 1928 (CUMV 33248), Kettle (also known as Round) Pond near Pittsford in 1939 (NYSM 26154), and Ore Bed Pond near the Village of Ontario in the early 1950s. Blackchin Shiners continue to be found in the eastern and central bays of Lake Ontario (primarily Chaumont and Sodus bays) and a few inland ponds.

Genesee (1,2,3). Greeley (1927) found a few small specimens among weed beds in Black Creek, a large tributary entering the Genesee River upstream of Rochester. After 1926, all specimens have been found at more upstream sites. In 1940, this minnow was found in Conesus Lake, Silver Lake, and Churchville Pond. In 1968, Blackchin Shiners were again caught at Conesus Lake (NYSM 43183), as well as Little Beards Creek (NYSM 43271), and in 2003, this species was present in Conesus Lake Inlet. In 2008, a specimen was collected from Honeoye Lake (NYSM 64228).

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Oswego (1,2). Reed and Wright (1909) recorded this species from Cayuga Lake and Beaver Brook. Greeley (1928) also reported the presence of Blackchin Shiners in Cayuga Lake, where they were usually taken near weed beds (CUMV 4338). Specimens have been collected repeatedly from Cross Lake in the 1930s (RWLC 292, 303, 310) and from Oneida Lake in 1928 (RWLC 718). In the 1940s and 1950s, this species was collected from Duck Lake and Yawger Creek, a tributary to Cayuga Lake. Throughout the watershed, there is a total of 26 records prior to 1961 and only one since then. In 1983, the species was reported from a tributary of East Branch Fish Creek but there are no voucher specimens, rendering this identification questionable at best.

Saint Lawrence (1,2,3). Greeley (1931) noted that several specimens were taken from weedy lagoons at the mouths of Sucker Brook, Brandy Brook, and Coles Creek but that this minnow was rare in the watershed. In recent surveys, most catches in the main channel have been from Chippewa Bay to Clayton (Carlson 1997), but exceptions include collections from sites farther east, like Lower Chatauguay Lake in 1930 and the Saint Lawrence River at Wilson Hill in 2007 (NYSM 62659) and 2010. The distribution of this species in the watershed does not generally extend upstream in the tributaries, although, again, there are exceptions, such as a site 11 km upstream in Sucker Brook in 2007 (NYSM 63446).

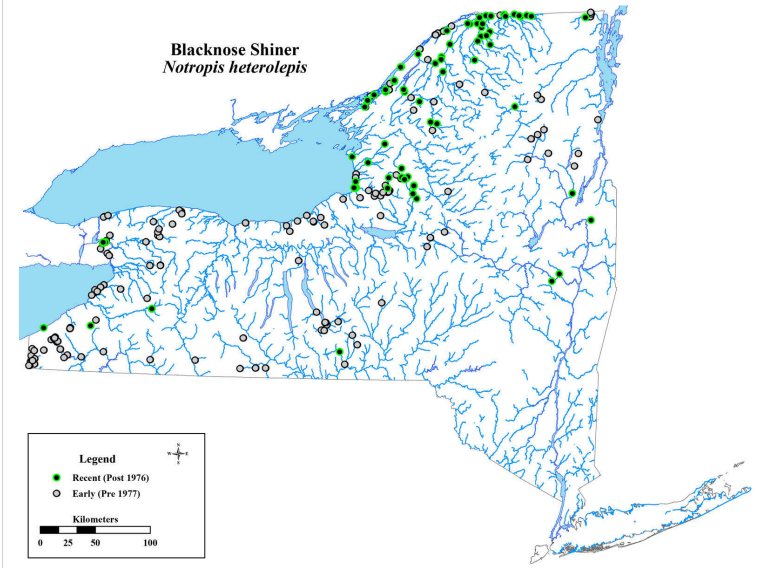
Oswegatchie (1,3). Greeley and Bishop (1932) regarded this species as moderately common, but Millsite Lake is the only site with records from the 1931 watershed survey (NYSM 5581). Blackchin Shiners were repeatedly caught in both Millsite and Crystal lakes in the mid-1990s.

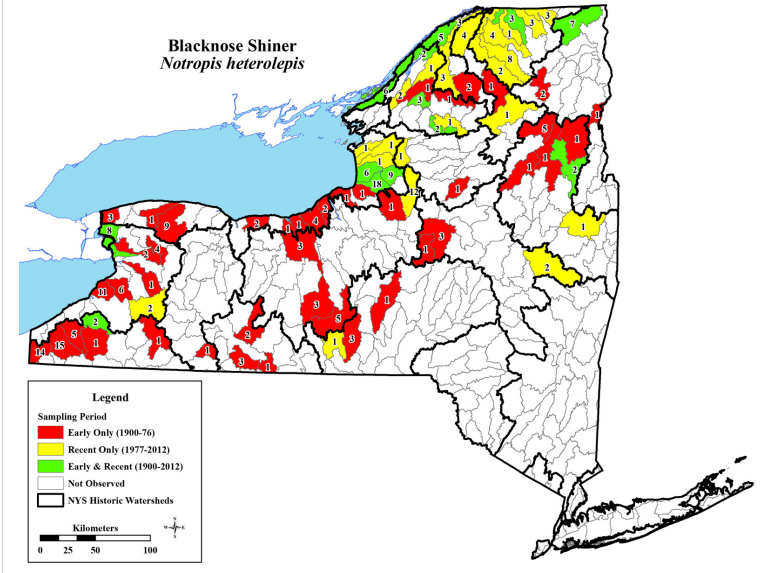
Champlain (1,2,3). Greeley (1930) noted that this minnow was not common but was nonetheless widely distributed in Lake Champlain and the mouths of tributaries, although it ranged farther upstream in some tributaries, such as the Great Chazy River. Blackchin Shiners still occur in Lake Champlain, the Great Chazy River upstream of Champlain Village, Beaver Creek, and the Poultney River (Facey and Labar 1989).

Susquehanna (1,2,3). This species was moderately common during the 1935 survey of this watershed, with captures coming from lakes or streams associated with lakes. Recent collections include Canadarago Lake in 1976 (Green and Smith 1976) and Tully Lake in 1994 (NYSM 43643) and 2005 (NYSM, 59390). Collections made in Catatonk Creek and other parts of the Owego basin in 1978-92 lack voucher specimens and, because the habitat at these sites was not typical of this species, are suspected to be erroneous. Tully Lake may support the only extant population of Blackchin Shiners in this watershed.

Upper Hudson (1,2). Greeley and Bishop (1933) noted that Blackchin Shiners were moderately common at the sites where they were found in 1932. Though these sites were few, they included Bird Pond, Rich (NYSM 5588), Brant, Loon (NYSM 5586), and Saratoga lakes, and tributaries of Saratoga Lake. In 1933, this species was collected from Big Sucker Brook of Huntington Forest (RWLC 3665). Specimens were collected from Balfour Lake in 1946 and Fourth Lake in 1973. The species has not been found in this watershed since 1974.

Notropis heterolepis, Blacknose Shiner





Like the other blackline shiners discussed here, Blacknose Shiners occur in lakes and streams with submerged aquatic vegetation. This species is sometimes found in low-gradient areas with trout and is native to 14 of New York's 18 watersheds. This species is currently classified as a Species of Greatest Conservation Need.

Allegheny (1,2,3). In the 1937 watershed survey, Blacknose Shiners were caught in Olean, Goose, and French creeks, several of their tributaries, and six lakes (Greeley 1938). The species was collected from French Creek again in 1948 (CUMV 68805). In surveys conducted between 1985 and 1989, this minnow was found in Ischua, French, and West Branch French creeks. Most recently, specimens were collected in West Branch Conewango Creek in 2001 and a tributary of French Creek in Sherman in 2013.

Erie-Niagara (1,2,3). According to Greeley (1929), this species was "found in sluggish streams and ponds and in sheltered bays of Lake Erie. A common fish of swamp situations." (Greeley 1929). The 1928 survey yielded catches from sites in Tonawanda, Murder, and Ellicott creeks, but no Blacknose Shiners have been caught in these creeks recently. In 1952, a single specimen was collected from Cayuga Creek in Niagara County (NYSM 65685). Additional collections were made from Buffalo Creek in 1975 (AMNH 38954), Chautauqua Creek near its mouth in 1979 (AMNH 42301), and from upstream areas of Cattaraugus Creek in 1981 (AMNH 226754). There have been multiple reports from the upper Niagara River between 2001 and 2012.

Ontario (1,2,3). Greeley (1940) reported that this shiner was collected at 35 sites and that it was more widely distributed than the other blackline shiners in the watershed because it ranged into higher elevations: "Most of the specimens were from lowland creeks but the Redfield Flow and several tributaries above this, up to at least 1,080 feet [330 m] elevation, proved to have this minnow." In addition to upland sites, Blacknose Shiners were recorded in ten bays (including Irondequoit Bay) and in parts of Oak Orchard and Jeddo creeks. In the 1940s and 1950s, specimens were frequently caught in Red Creek at Westbury, a site sampled repeatedly by the Ichthyology Course at Cornell University (unpubl. field notes, CUMV 49661). In 1964, the species was reported in Port Bay. Recent catches are from sites in the Salmon River basin,

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South Sandy Creek, and from headwater streams such as Staplin Creek near Watertown. There have been unconfirmed reports of catches from Sterling Pond in 2003 (Great Lakes Environmental Indicators Program, unpubl. data). Despite extensive sampling in western bays of the lake, very few Blacknose Shiners have been found. This minnow may, therefore, be in decline in this watershed.

Genesee (1). Only one specimen was collected during the 1926 watershed survey (Greeley 1927). It was caught in Dykes Creek, an upland site, during the first week of sampling (NYSM 28094). No Blacknose Shiners have been caught in this watershed since 1926.

Oswego (1,2,3). Greeley (1928) reported that this minnow was common but only in the downstream part of the watershed and in Cayuga Lake, i.e., in standing water or low-velocity streams. There are 66 records of catches made after the 1927 survey. The 12 records of specimens collected after 1963 are from the Tug Hill region and none are from sites west of Syracuse.

Black (1,3). This minnow was first reported from White Lake Outlet in 1927 (UMMZ 81291). Greeley and Bishop (1932) did not find this species during the 1931 synoptic survey, however. The second report was from Edick Creek, a tributary of Sears Pond, in 2005. Although Blacknose Shiners are found in Tug Hill streams of the Oswego and Ontario watersheds to the west, they remain very rare in this watershed.

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that "specimens were collected in the North Branch of the Grass River (the Stillwater), Sucker Brook at mouth and nearly a mile [1.6 km] above the mouth, and in Pike Creek (tributary of the Salmon River). Although reaching into the edge of the Adirondacks (Stillwater of the Grass River) this minnow now seems to be absent over most of the Adirondack upland waters." Blacknose Shiners were also present in bays of the Saint Lawrence River and continue to be found there (e.g. NYSM 65556 in 2009). In fact, the current range of this species includes not only its historic range, but also the middle segments of larger tributaries like the Salmon, Grass, and Saint Regis Rivers. The species remains absent from the upland areas of the Adirondack Park, however.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that Blacknose Shiners were not uncommon at the sites in this watershed where they occurred, and that they were found at higher elevations (to 275 m) than the other blackline shiner species. The species was found in the West Branch Oswegatchie River, Lisbon Creek, Mud Pond, and a tributary near Matoon Creek in 1931. Since then, it has been collected from the Indian and Oswegatchie Rivers in 1955 and the Middle Branch Oswegatchie and West Branch Oswegatchie Rivers in 2007 (NYSM 62294).

Raquette (2,3). Greeley (1934) did not list this minnow from this watershed. Until recently, its presence in the watershed was based on unvouchered reports, at least one of which was in error: Niagara Mohawk Power Corporation (1991b) cited Greeley (1934) as reporting Blacknose Shiners from the watershed in 1933. Pasko (1957) reported catches from the Raquette River in 1951, in the area later inundated by the Carry Falls Reservoir. During surveys from 1985-1989, the species was reported from the tailwaters of reservoirs at Norwood and Raymondville (Niagara Mohawk Power Corporation 1991b, c). These areas were revisited in 2007, but only Bridle Shiners were caught. In 2011, specimens were caught in the main channel at Hutchins Creek (NYSM 67253).

Champlain (1,2,3). In the 1929 survey, Blacknose Shiners were only found in the Great Chazy River and its tributary, Beaver Creek, where they were locally common (Greeley 1930). They were also found in these streams in 1998 and 2008. Specimens have also been collected from the Saranac River in 1961 (CUMV 41513) and Little Ray Brook in 1966. In 2010, this species was reported from the Champlain Canal near Fort Ann (E. Marsden, University of Vermont, pers. comm.).

Chemung (1,2,3). According to Greeley (1938), "the distribution of this minnow is very sparse in the Chemung area, where three occurrences in the Cohocton and Canisteo systems represent the only records obtained." Two of these sites were downstream, including the Tuscorora Creek collection. A record not listed by Greeley (1938) is a 1937 collection from the South Branch Canisteo Creek (CUMV 5553). Recent records, including a 1970 record from the Tioga River and two undated captures from Waneta Lake, were rejected because the sites were upriver, where this species had not been reported previously, and they lacked voucher specimens. This species may be extirpated from the watershed.

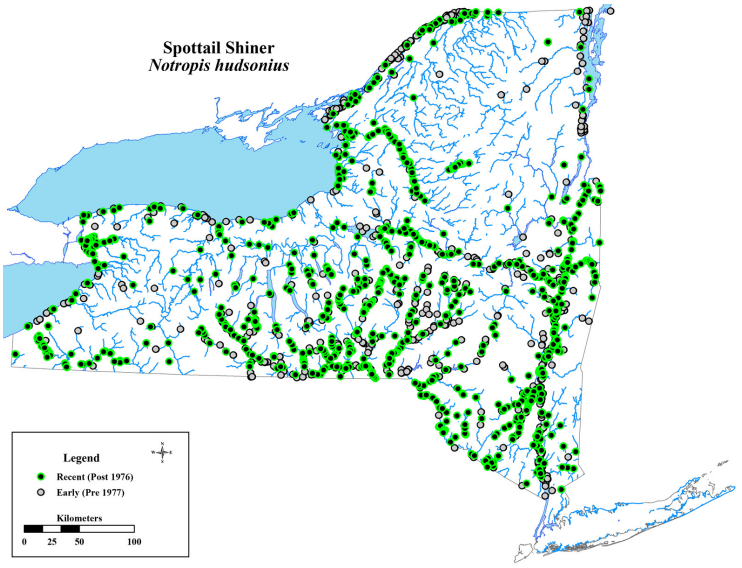
Susquehanna (1,2). Greeley (1936) reported two collections from this watershed: Wilson Creek near Berkshire and Mud Creek at Union Valley. Blacknose Shiners were present in East Branch Owego Creek in 1951 (CUMV 19984) and were also reported there by Sheldon (1968). No specimens were found during extensive sampling of this creek from 2002-2004 (Stewart et al. 2005).

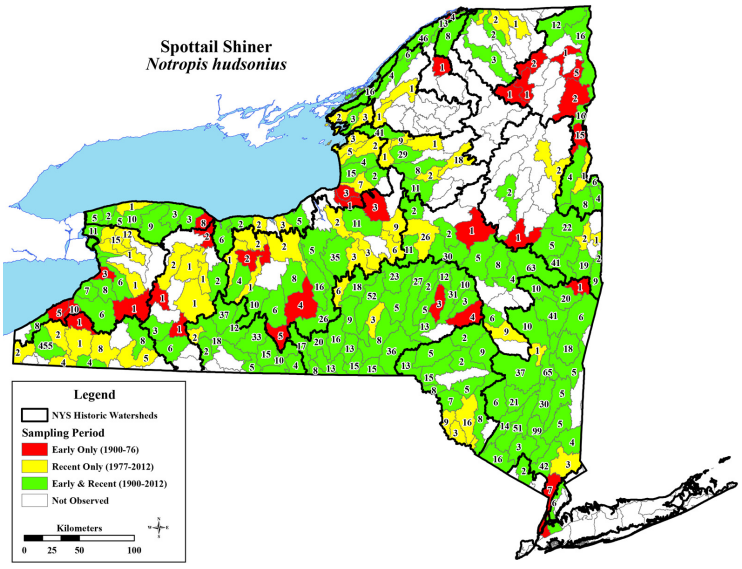
Species continued on next page

Upper Hudson (1,2,3). Greeley and Bishop (1933) listed this species as moderately common at the few sites where it was found: Wolf, Beaver, Alder, Sprague, Bullhead, and Grassy ponds, and Rich (NYSM 5718), Sanford, and Newcomb lakes. In 1933 and 1934, Blacknose Shiners were collected from Big Sucker Brook of the Huntington Wildlife Forest (RWLC 3674). More recent collections are from Newcomb Lake in 1972, the Schroon River above Warrensburg in 2007, Fishing Brook in 2007 (NYSM 63342), and County Line Flow in 2008 (NYSM 63846).

Mohawk (1,2). There are only two records of this shiner from the 1934 watershed survey: Nine-mile Creek and a nearby, small, unnamed tributary (tributary 224) of the Mohawk River (Greeley 1935). Both sites are in the headwaters of the watershed. In 1951, the species was found at another headwater tributary, Oriskany Creek (CUMV 20418). Two unconfirmed reports, from Alplaus Kill in 1977 and Poentic Kill in 1980, are downriver sites and may be misidentifications.

Notropis hudsonius, Spottail Shiner





This shiner, described in 1824 by DeWitt Clinton, a Governor of New York, inhabits larger streams and lakes and is often a major component of the open water forage-fish assemblage. The native range of this species extends into 16 New York watersheds and it is also a non-native species in the Allegheny watershed and Westchester County drainages of the Long Island watershed. Although Spottail Shiners are native to 16 watersheds, the range of the species within each watershed has undoubtedly been increased, particularly into upland waters, by introductions and dispersal through canals.

Allegheny (**1,2,3**). The Spottail Shiner has been reported from the three New York basins of the Allegheny watershed, but the reports are from different periods, it has never been widely distributed, and its presence appears to be result of early introductions. In the central basin, in Chautauqua Lake, it was first reported in 1901 (Evermann and Goldborough 1902) and Greeley (1938) collected specimens from the lake and Conewango Creek in 1937. In the eastern basin, this species was introduced to the Allegheny Reservoir in 1972 and 1974, but was native to the Allegheny River downstream (Raney 1938). The species was first documented with an eastern basin collection in 1980 (Becker 1982), and Eaton et al. (1982) suggested that its introduction into the Allegheny Reservoir accounted for its presence in the Allegheny River upstream to Salamanca. The first record from the western basin dates to 1995, when the species was found in Findley Lake. Spottail Shiners are considered non-native to this watershed by Hocutt et al. (1986) and given that their presence in the New York portion of the watershed is confined to lakes and their tributaries, their presence may be wholly accounted for by early introductions.

Erie-Niagara (1,2,3). Spottail Shiners were abundant in Lake Erie and some of the larger creeks during the 1928 watershed survey (Greeley 1929). Today, this species is widespread and relatively common.

Ontario (1,2,3). This shiner was found at 36 sites during the 1939 survey, and was common in the lake, Erie Canal, and in the lower reaches of streams (Greeley 1940). The species remains common and widespread in the watershed.

Species continued on next page

Genesee (1,2,3). Spottail Shiners were reported to be common in the downstream reaches of the river and adjacent tributaries by Greeley (1927). They remain common in streams downriver of Rochester Falls. Specimens have also been taken at upstream sites, like Wiscoy Creek in 1940 (CUMV 44806) and the Genesee River near Angelica in 1981 (AMNH 226708).

Oswego (1,2,3). Greeley (1928) noted that this minnow was common and was found in lakes and large streams, which make up the majority of water bodies in this watershed. Later surveys have continued to find Spottail Shiners in lakes and large streams, where they remain common.

Black (1,2,3). Greeley and Bishop (1932) noted that Spottail Shiners were abundant, particularly in the main channel and mouths of tributaries. Three of the seven early collections were downstream of Watertown and definitely in the species' native range. They (Greeley and Bishop 1932) emphasized that this minnow also was found at elevations to 340 m and suggested that its presence at these higher elevation sites may "perhaps be due to the Black River Canal." Most recent records are from the Black River and tributary mouths, but specimens have also been found in the Fulton Chain of lakes (NYSM 67918).

Saint Lawrence (1,2,3). This shiner was abundant in the 1930 survey of this watershed, "probably more abundant than any other fish in the St. Lawrence River," according to Greeley and Greene (1931). Despite the large populations of this species in the river itself, Greeley and Green (1931) noted that "it does not occur far upstream in tributaries." Records from 2009-2010 indicate that Spottail Shiners are less common in the Saint Lawrence River than they were in 1976 (Carlson and McKenna 2014). The species continues to be uncommon in tributaries, particularly in upstream areas.

Oswegatchie (1,2,3). Spottail Shiners were found in lowland lakes during the 1931 watershed survey (Greeley and Bishop 1932), as well as in the Oswegatchie River in 1933 (UMMZ 95735). The species' current status appears to be unchanged, but there have been relatively few reports since the 1931 survey (NYSM 44541, CUMV 20259).

Raquette (1,3). Greeley (1934) noted that Spottail Shiners were present in the lower river, downstream of Raymondville. To date, there are only seven reports of this species from this watershed, all of which are from downstream sites.

Champlain (1,2,3). This species was very common in Lake Champlain and in the lower reaches of larger tributaries during the 1929 watershed survey (Greeley 1930). Specimens continue to be collected from the lake (as recently as 2013, NYSM 69880) and many of its tributaries.

Chemung (1,2,3). This species was present in the Canisteo, Tioga and Chemung rivers and in a tributary of the Cohocton River during the 1938 watershed survey (Greeley 1938). It is now common and widespread.

Susquehanna (1,2,3). Greeley (1936) noted that Spottail Shiners were common and found in many larger streams, but that Otsego Lake was the only lake in the watershed inhabited by this species. Odell and Senning (1936), however, reported that the species was fairly common in both Canadarago and Goodyear lakes. All three lakes still contain this minnow. Its frequency of occurrence in stream samples was 25% in the 1935 survey and 9% in stream surveys from 1996-2010, indicating a significant decrease. We currently have no plausible explanation for this decline. Although apparently more rare than they once were, Spottail Shiners are still widespread in this watershed.

Delaware (1,2,3). This minnow was present at 28 sites (8% of all sites) in larger streams that were sampled during the 1935 watershed survey (Greeley 1936). This species continues to be caught with regularity.

Upper Hudson (1,2,3). Greeley and Bishop (1933) noted that Spottail Shiners were scarce in this watershed. Specimens were collected at three sites in the main channel, in the Moses Kill, and in Saratoga Lake. More recent survey work shows that the species has persisted at these sites, and it has also been found in the Sacandaga River, Hoosic River, Tomhannock Reservoir, and Batten Kill.

Mohawk (1,2,3). Greeley (1935) noted that this species was locally very common in the main channel and in the lower courses of many tributaries, but that it was absent from upland sites. Recent records show Spottail Shiners in many waters, including some at higher elevations (e.g., NYSM 45101).

Lower Hudson (1,2,3). The lower Hudson River is the type locality for the Spottail Shiner. Greeley (1937) recorded specimens from 122 sites from the main channel, the lower reaches of tributaries, and reservoirs on both sides of the river. Records from 2009 included catches in the Wallkill River from New Paltz to the New Jersey state line, and in Rondout and Esopus creeks. Daniels et al. (2005) noted that the abundance of this species has declined in the Hudson River.

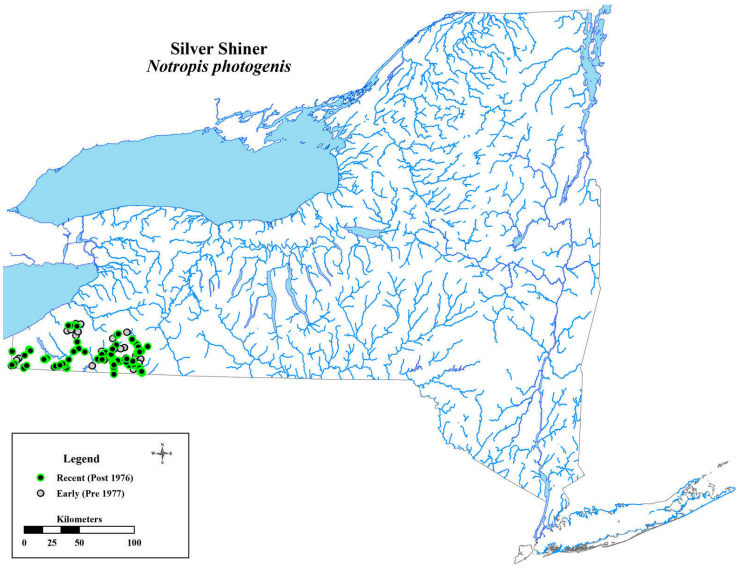
Newark Bay (2,3). Spottail Shiners are surprisingly rare in this watershed, and none were collected during the 1936 survey (Greeley 1937). In 1976, an individual was taken from the Ramapo River (AMNH 38624) and in 1996, specimens were caught in the Mahwah River (NYSM 45813).

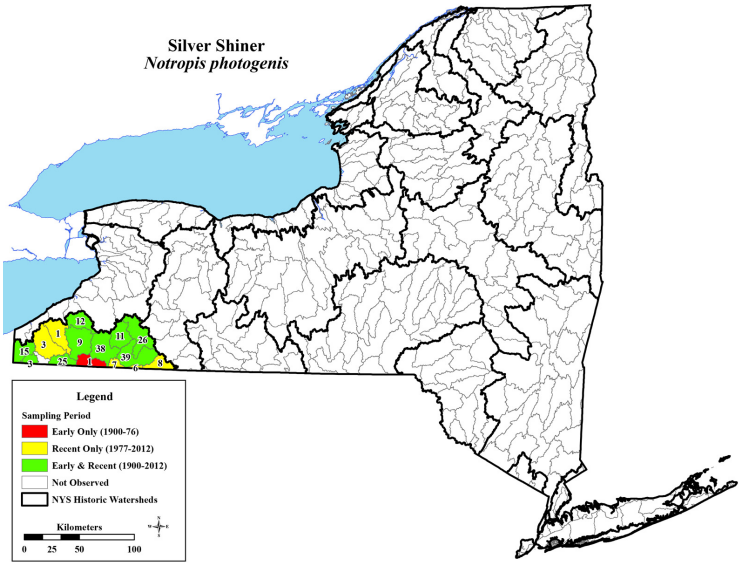
Long Island (**1,2**). This species is not found on the islands but has been found in the Kensico Reservoir, an impoundment of the Bronx River in Westchester County. Specimens were collected from the reservoir in 1936 and 1986, and may episodically gain access through water transport via the aqueducts feeding the reservoir with water from the Mohawk and Delaware watersheds.

Notropis photogenis, Silver Shiner

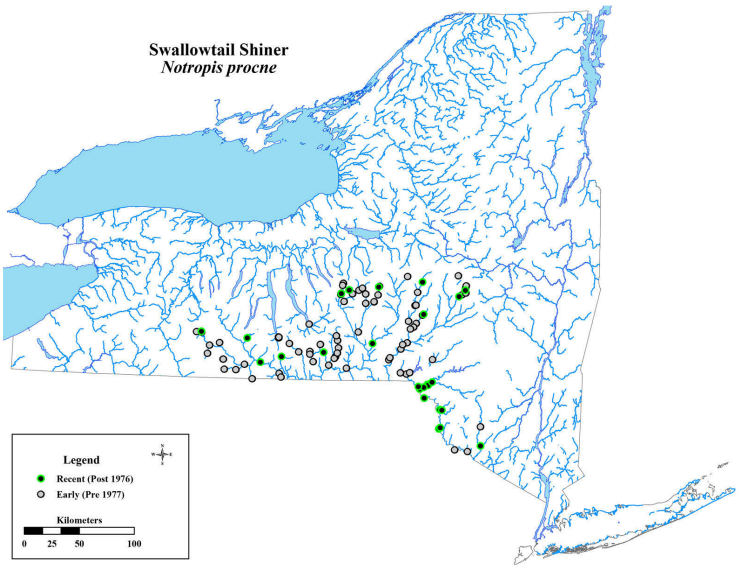
In New York, this shiner is only found in the Allegheny watershed, where it is native.

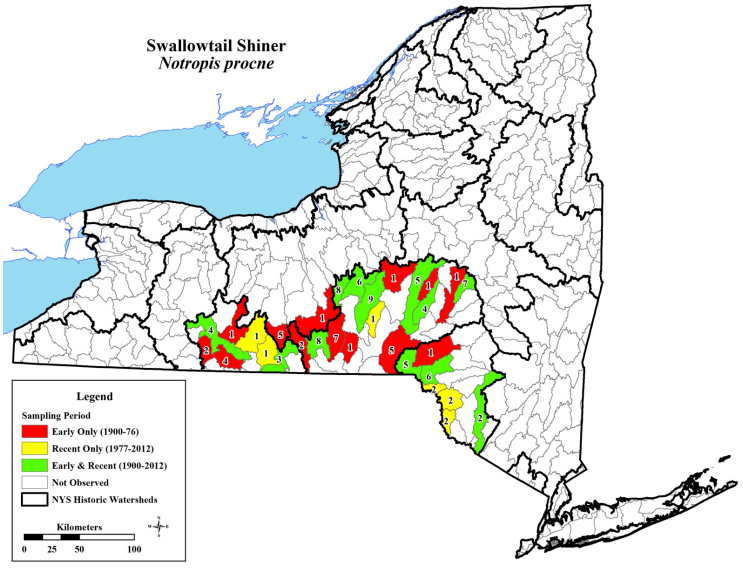
Allegheny (1,2,3). Greeley (1938) reported that Silver Shiners were collected at 49 sites in the larger streams, or 12% of all samples taken in the 1937 watershed survey. This species has been found in all three of the watershed's major basins, but its frequency of occurrence has varied among surveys. It remains relatively common (Carlson et al. 1999).





Notropis procne, Swallowtail Shiner





This blackline shiner occurs in medium-sized streams with clean gravel, as well as some lakes. The species is native to 3 of New York's 18 watersheds. Populations in the Oswego and Lower Hudson watersheds, if they are still present, are introduced.

Oswego (**1,2**). H.D. Reed collected a specimen from Fall Creek, near Ithaca, in 1899 (ANSP 40342). Greeley (1928) noted that two specimens were found in Catharine Creek near Montour Falls. He (Greeley 1928) also mentioned that this minnow was unknown from other Lake Ontario tributaries and that it probably gained access to the site from an abandoned canal that once connected Seneca Lake to the Susquehanna River drainage (for a different assessment, see Daniels 2001). In 1972, specimens were again collected from Catharine Creek (NYSM 46078). Smith (1985) entertained three hypotheses regarding the introduction of this species to the watershed: 1) It migrated through a canal; 2) It represents a relict population from a postglacial migration, when the Finger Lakes drained into the Susquehanna River; 3) It gained access to this watershed from a postglacial stream capture. The species may also simply have been introduced by accident or through a bait bucket transfer. Despite intensive sampling in recent years, no additional specimens have been caught.

Chemung (1,2,3). In his report on the 1937 watershed survey, Greeley (1938) reported that Swallowtail Shiners were present at 14 sites in the larger streams of the watershed but were never sufficiently numerous to be a major component of any local assemblage. Specimens were found in eight streams in 1937, but have only been taken at five sites in the last 45 years: the Cohocton River in 1971 (NYSM 43229), Newtown Creek in 1977 (AMNH 49031), the Canisteo River in 1981 (AMNH 226686), the Chemung River in 2002 (NYSM 54483) and Sanford Pond Outlet in 2003 (NYSM 55463). Although rare in the 1937 survey, a lack of more than five records in recent years, despite a serious effort to find this species, suggests a significant decline in numbers and range in this watershed.

Susquehanna (1,2,3). Greeley (1936) noted that this species was a "moderately common" stream-dwelling fish that occasionally occurred in lakes. Odell (1936) listed the Swallowtail Shiner as fairly common in York, Tully, and Green lakes. This minnow was collected at 30 locations prior to 1950. Recent records include: Cherry Valley Creek in 1978 (AMNH 41226),

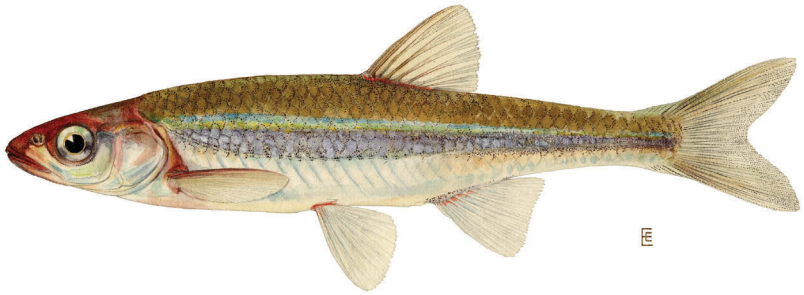
Species continued on next page

Genegantslet Creek in 1979 (AMNH 44504), and Cherry Valley Creek again in 2008. Specimens were also collected from Willseyville Creek in the mid-1960s (CUMV 51314, 62607) and 2002, as well as from Catatonk Creek, the Unadilla River at Leonardsville, and East Branch Tioughnioga Creek in the early 2000s (S. Coglin, SUNY, College of Environmental Science and Forestry, pers. comm.). In 2004, when NYSDEC undertook an extensive survey revisiting sites where Swallowtail Shiners had previously been caught, a specimen was collected from Butternut Creek at Morris (NYSM 57093). In 2008, the species was found in Upper Little York Lake. Although Swallowtail Shiners are still found in this watershed, their numbers have declined. Catatonk Creek is currently favored as a sampling site for the Cornell University Ichthyology Class. In 2002, the class collected specimens there for the eleventh time in as many years. The site is interesting in that many unusual shiners have been collected there over the years and, as a mid-level headwater area with a low rate of environmental change, it may serve as a refuge for sensitive species like the Swallowtail Shiner.

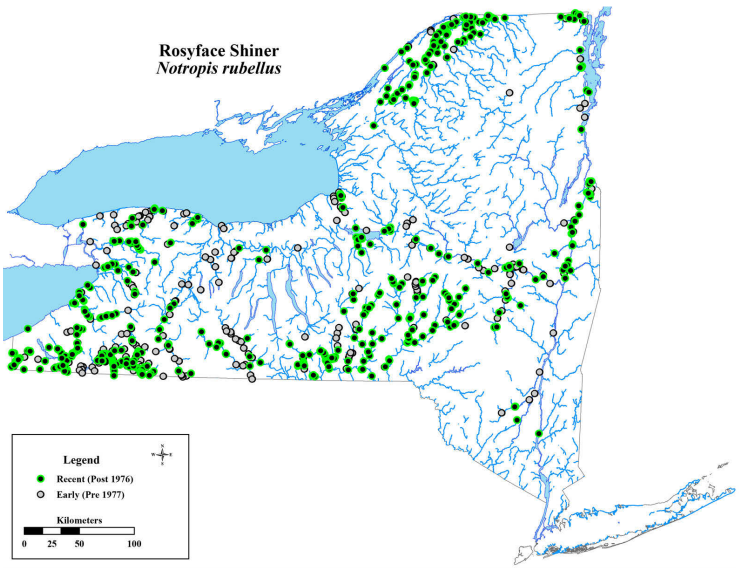
Delaware (1,2,3). Swallowtail Shiners were collected in only four stream locations during the 1935 survey of this watershed (Greeley 1936). Twenty-one captures were reported between 1956 and 1988 and 16 from 1994-2005, which suggests that there has been little change in the frequency of occurrence of this species. The more recent collections have been from the Delaware River and its east and west branches, Callicoon Creek in 1994 and 2005 (NYSM 59645), and the Neversink River in 1956 (CUMV 69153) and in 2004 (R. Horwitz, Philadelphia Academy of Natural Science, pers. comm.).

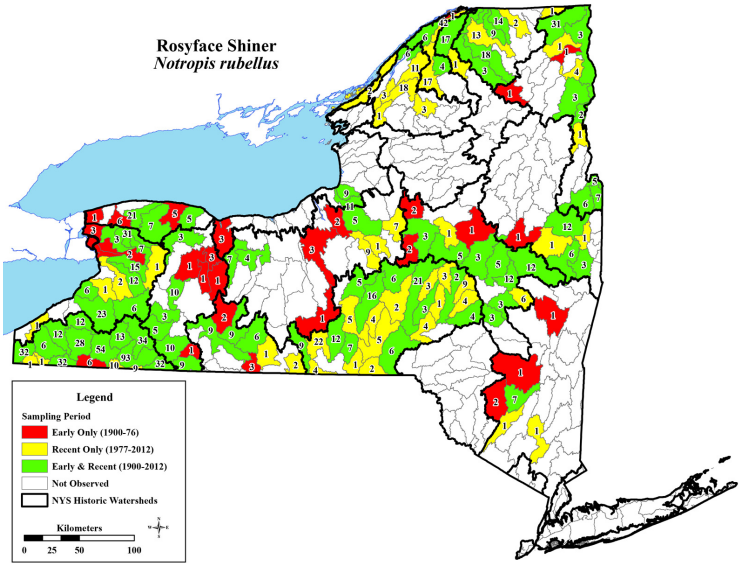
Lower Hudson (**1**). Three specimens were collected in 1884 from the Hudson River at Castleton (USNM 36765). No Swallowtail Shiners have been found in the Hudson River drainage since. This collection appears to be an anomaly and suggests a resemblance to the cases of *Notropis amoenus* and *Percina peltata*, two other Delaware River drainage fishes that somehow gained access to the Lower Hudson watershed.

Notropis rubellus, Rosyface Shiner



This elegant shiner occurs in low-elevation, medium-sized streams with structured run-riffle habitat. Rosyface Shiners are present in, and native to, 14 of the state's watersheds.





Allegheny (1,2,3). Rosyface Shiners were common in the Allegheny River and larger tributaries throughout the watershed, being present at 38% of the sites sampled during the watershed survey (Greeley 1938). Pfeiffer (1955) frequently caught this minnow in areas of Five Mile Creek. In recent surveys, its frequency of occurrence ranged from 19% to 35%, suggesting that there has been little change in its status.

Erie-Niagara (1,2,3). Dymond (1922) listed this species as a resident of Lake Erie. Greeley (1929) noted its absence from the lake and stated that it "is found in several of the larger creeks, usually where there is strong current." This minnow continues to be widespread and relatively common in the watershed.

Ontario (1,2,3). Greeley (1940) noted specifically that Rosyface Shiners were absent from Lake Ontario and its bays and that most of the 31 watershed survey records were from larger creeks. Johnson Creek, the Little Salmon River, and Grindstone Creek are among the few streams where the species still occurs in this watershed.

Genesee (1,2,3). Greeley (1927) stated that Rosyface Shiners were "common in the Genesee River and its larger tributaries." The species remains widespread in the watershed.

Oswego (1,2,3). Greeley (1928) reported that this species was common but restricted to downstream sites, specifically warm, rapidly flowing streams with rubble substrate. Recent surveys have shown that the species is no longer widely distributed and its frequency of occurrence in streams is just 4%. The typical habitat of this minnow has been grossly degraded in this watershed during the last century, where it has been altered for transportation canals and by prevailing land-use practices.

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Saint Lawrence (1,2,3). Evermann and Kendall (1902b) collected this species in the main channel near Ogdensburg. Greeley and Greene (1931) noted that Rosyface Shiners were limited to the lower reaches of tributaries except in the Grass River, where, like other species, they were found at upstream sites, including near Canton. Recent records show that the species still occurs in many areas of the watershed.

Oswegatchie (1,2,3). Greeley and Bishop (1932) noted that this shiner was common at lowland stream sites and that "in the Oswegatchie River its range extends as far upstream as Black Lake." Specimens were caught as far upstream as Wegatchie (AMNH 48231) as recently as 1977, and Rosyface Shiners are occasionally caught up to Emeryville and the lower part of the West Branch Oswegatchie River. Many of the recent collections are well upstream of the 1931 watershed survey sites, which suggests a range expansion in this watershed.

Raquette (1,2,3). Evermann and Kendall (1902b) reported this species at Norfolk, approximately 45 km upstream. Greeley (1934) made collections at three lowland localities: two in the Raquette River near Parkhurst Brook and in Trout Brook at West Potsdam. In 1989, Rosyface Shiners were found as far upstream as Norfolk (Niagara Mohawk Power Corporation 1991c). In 2007, individuals were collected at Potsdam, about 70 km upstream of the mouth, and specimens have been collected at additional upstream sites as recently as 2012 (NYSM 67899).

Champlain (1,2,3). Greeley (1930) reported that this species was "restricted to the lower courses of the larger tributaries of Lake Champlain, except in the Big [sic] Chazy system where it ranges as far upstream as the vicinity of Mooers Forks and in the Mettawee River where it was found as far as tributary 27 [which is in Vermont]. This minnow is quite characteristic of large shallow streams and is apt to be found in or near rapids." Although not reported by Odell (1930), he collected specimens at least twice in Lake Champlain (NYSM 28483, 28485). A 1929 record from Lake Clear (NYSM 41183) is an unusual site for this species in that it is a lake and at a high elevation. Rosyface Shiners remain common in the large tributaries of this watershed.

Chemung (1,2,3). Greeley (1938) noted that this species was taken at 15 sites in the Cohocton, Tioga, and Canisteo rivers. Recent survey results suggest that the status of this species in this watershed is unchanged.

Susquehanna (1,2,3). This minnow was rare in early watershed surveys, with specimens collected from Center Brook near New Berlin, Cayuta Creek, and a few other creeks (Greeley 1936, 1938). Greeley (1936) recognized, however, that the identification of this species was difficult because of its similarity to the sympatric *Notropis amoenus*, which he regarded as more abundant in this watershed. Snelson (1968) and Raney (1969) noted this confusion and re-examined specimens of these two species vouchered during the 1935 survey, reassigning many of the lots originally identified as *N. amoenus* to *N. rubellus*. With these changes, 32 of the records from the 1935 survey represent this species, substantially more than the five sites reported by Greeley (1936). The new tally makes the frequency of occurrence of this species during the watershed survey 15%. Stream survey work from the 1970s and 2000s found Rosyface Shiners throughout the watershed, with a frequency of occurrence of 25%. In 2013, a specimen was found in the extreme headwaters of the watershed, in Charlotte Creek (NYSM 69959).

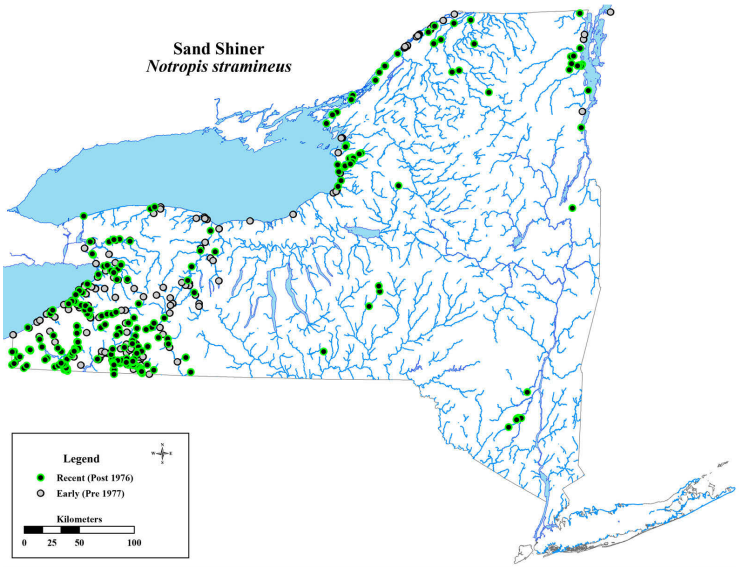
Upper Hudson (1,2,3). In their account of this species, Greeley and Bishop (1931) stated: "This minnow, which is usually restricted to fast water of the larger streams, was found only in tributaries of the Sacandaga Reservoir, in the Hudson River and in tributaries entering the river below Hudson Falls." Rosyface Shiners continue to be found in the main channel and larger tributaries, such as the Hoosic River in 1978 (AMNH 41108), the Hudson River in 1988 (NYSM 64354), Kayaderosseras Creek in 2006 (NYSM 61246), Moses Kill in 2008 (NYSM 64195), and several sites in the Champlain Canal (e.g. NYSM 63706).

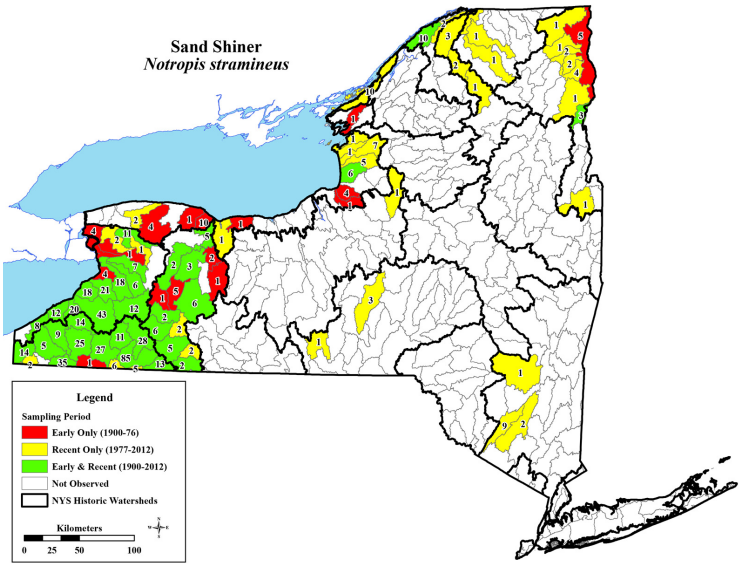
Mohawk (1,2,3). Rosyface Shiners were locally common and found in the lower reaches of streams with swift current during the 1934 watershed survey (Greeley 1935). Since this survey, the species' range in the watershed has increased It continues to be common in tributary systems, but recent collections are often from higher elevations (NYSM 68752) and the Mohawk River itself (NYSM 62636).

Lower Hudson (1,2,3). This species was only taken at two sites in Rondout Creek during the 1936 watershed survey (UMMZ 114229; Greeley 1937). Its range within the watershed has increased since the 1936 survey, with later collections including the Shawangunk Kill in 1978 (AMNH 55191), Rondout Creek in 1979 (AMNH 41818), the Hudson River in 1979 (NYSM 39936), and Normans Kill (NYSM 60306) and Plattekill (NYSM 39535) in the 1980s.

Notropis stramineus, Sand Shiner

This straw-colored minnow lives in streams and large lakes and, as its common name indicates, is often associated with sandy bottoms. The species is native to nine western and northern New York watersheds and is also found in three Atlantic slope watersheds, where it is introduced.





Allegheny (1,2,3). Sand Shiners were widely distributed in tributaries throughout the watershed and were also found in the main channel of the Allegheny (Greeley 1938). The species remains an important component in the fish community assemblages of each of the three basins in this watershed and has remained common at sites surveyed in the 1980s, 1990s, and into this century.

Erie-Niagara (1,2,3). Greeley (1929) reported that Sand Shiners were abundant in Lake Erie and in the lower reaches of many of the larger tributaries. The species remains widespread and relatively common in this watershed.

Ontario (1,2,3). Greeley (1940) stated that "the shore zone of Lake Ontario is well supplied with this minnow, especially where there are sand beaches." Sand Shiners were also found in many tributary streams from Orleans County to Jefferson County. The species has been found in the same areas in recent surveys. The two eastern-most locations are South Sandy Creek and Sandy Creek, where this minnow was collected in the 1990s and 2000s.

Genesee (1,2,3). Greeley (1927) reported that Sand Shiners were common in the Genesee River and in large, warm tributaries. Recent records show little change in the distribution of the species.

Oswego (3). This species was not collected during the synoptic survey of the watershed in 1927 (Greeley 1928). The only confirmed record is a 1992 capture from Sucker Creek near Michigan Mills (NYSM 42195), in the Tug Hill region.

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Saint Lawrence (1,2,3). Greeley (1931) reported that this species was rare and that it was found only in the main channel near Ogdensburg, although unpublished field notes documented it in the Salmon River, and it was also caught in the mouth of Brandy Brook (NYSM 28688). Sand Shiners continue to be found in small numbers in the Saint Lawrence River as recently as 2014 (e.g., NYSM 71372). The only records in tributaries come from the Grass River at Madrid in 2005 (NYSM 59573) and Allen Brook in 2008 (NYSM 64439).

Oswegatchie (3). From 2012-13, this species was collected for the first time in this watershed from the Oswegatchie River near Oxbow and near Heuvelton, as well as in Black Lake (J. McKenna, USGS, Cortland, pers. comm.). Although Sand Shiners had not been reported from this system previously, there are no historical natural barriers barring access to this watershed from the Saint Lawrence River. Until additional information arises, the conservative assessment would be to treat this as a natural range expansion.

Raquette (3). A lone specimen was caught in Trout Brook in 2007 (NYSM 62702). The species was reported twice from the Raquette River south of Potsdam in 1992-93, but no specimens were retained, and these reports are, therefore, possibly erroneous.

Champlain (1,2,3). In the 1929 survey, the range of this species in the Champlain watershed was restricted to the northern areas of the lake, where it was collected from Missisquoi Bay, VT, to as far south as the mouth of the Saranac River (Greeley 1930). Despite Greeley's (1930) report, however, the survey also collected specimens from Hoisington Brook (NYSM 28563), which is at Westport. In the 1980s, Sand Shiners were collected from the Ausable and Boquet rivers (NYSM 17749, 15770) and the lake itself, adjacent to these tributaries. The species is also known from the Poultney River system (Plosila et al. 1986).

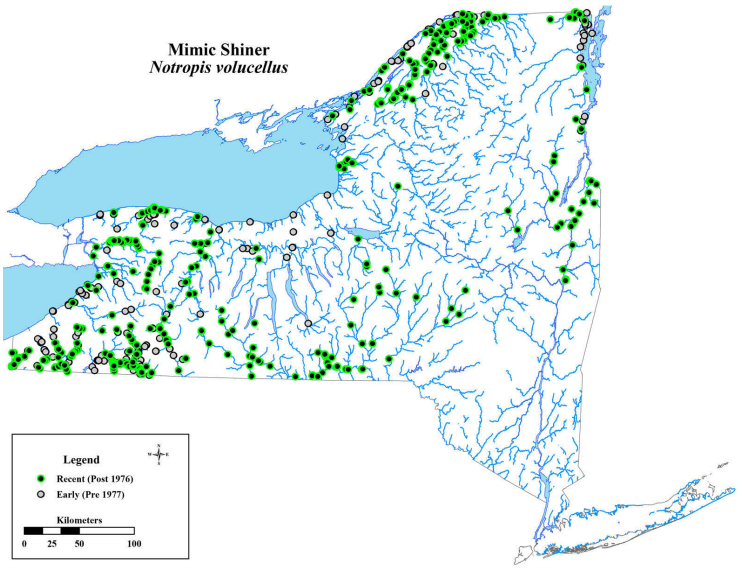
Chemung (**3**). Sand Shiners were found in Canisteo Creek in 2002 (NYSM 54012) and later in the Chemung River, in 2008 (C. Millard, USEPA, pers. comm.).

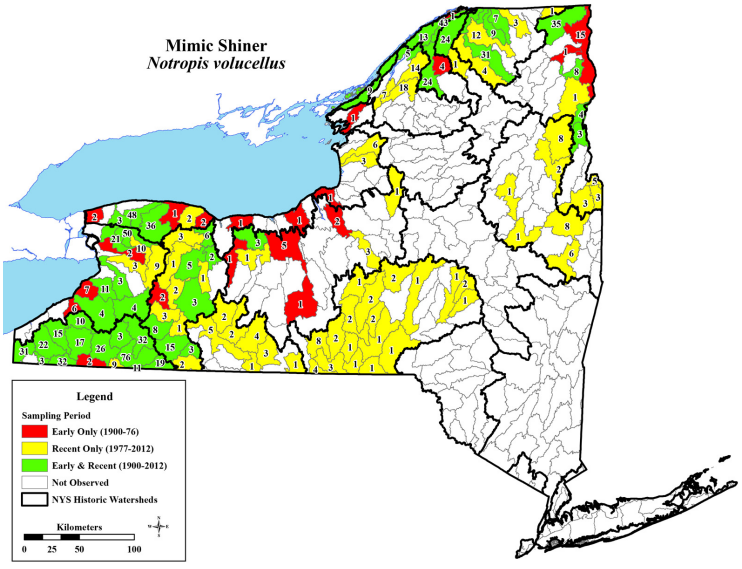
Susquehanna (**3**). The first collection of Sand Shiners from this watershed was reported from Catatonk Creek in 1994 (CUMV 75689). In 2004, specimens were found at two locations in the Otselic River (NYSM 56547, 57448).

Lower Hudson (**2,3**). The earliest records from this watershed were in 1977, from the Shawangunk Kill (AMNH 45600) and Rondout Creek (NYSM 14442). Specimens were found in the Wallkill River soon after, in 1978 (NYSM 58966). More recent records include: the Shawangunk Kill in 1980 (NYSM 60286), the Wallkill River in 1994 (NYSM 47095), and again at the Shawangunk Kill (NYSM 64919, 65033) and the Wallkill River (NYSM 64906), as well as in Esopus Creek (NYSM 65141), in 2009. The Shawangunk Kill population is persistent, with a collection in 2013 as well (NYSM 69845). The first collection of specimens from Palmaghatt Kill was taken in 2014 (NYSM 70427).

Notropis volucellus, Mimic Shiner

This shiner, which often varies slightly in appearance by drainage, lives in quieter parts of streams and lakes and is often abundant in submerged aquatic vegetation. The species is native to ten western and northern watersheds and is also found in the Chemung, Susquehanna, and Upper Hudson watersheds, where it is an exotic species.





Allegheny (1,2,3). Greeley (1938) noted that this minnow was abundant in Chautauqua Lake, where large schools occurred, and was also widely distributed in warm-water streams. During surveys in the 1980s, 1990s, and 2000s, Mimic Shiners were found in the Allegheny River and its larger tributaries in all three basins.

Erie-Niagara (1,2,3). Greeley (1929) reported Mimic Shiners from Lake Erie, stream mouths, and larger, more sluggish streams, such as Ellicott Creek**.** This species remains widespread and relatively common in the watershed.

Ontario (1,2,3). Mimic Shiners were collected at 26 sites in low-elevation streams, the Erie Canal system, and several ponds and bays over the course of the 1939 watershed survey (Greeley 1940). The species continues to be found at sites in the lake and its embayments, as well as in lowland streams, more frequently in the western part of the watershed.

Genesee (1,2,3). The curious absence of this species from the 1926 survey account (Greeley 1927) is not easily explained, given that specimens were collected from Canaseraga Creek (unpubl. field catalog) and the Genesee River (UMMZ 72062) during the survey. Currently, this minnow is widespread throughout the watershed, even in headwaters such as Dyke Creek (NYSM 54225).

Oswego (1,2,3). Mimic Shiners were listed as fairly common in this watershed and were typically caught at sites with aquatic vegetation, although specimens were occasionally caught in open water areas with mud substrates (Greeley 1928). This species is still common and it has expanded its range to sites on the periphery of the watershed, such as Little Alder Creek (NYSM 43684).

Species continued on next page

Black (1,3). On 7 July 1931, this species was collected east of Watertown in the Black River (unpubl. field catalog), but it was not listed by Greeley and Bishop (1932) in the watershed survey report. In 1994, specimens were found much farther upstream in the Sugar River, just above its mouth (NYSM 43980). The species is now rare or extirpated in this watershed.

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that this species was abundant in the main channel of the Saint Lawrence River and the lower reaches of its tributaries. Mimic Shiners were absent from upland areas, except in the Grass River, where the species' range extended upstream of Canton. Recent surveys show the frequency of occurrence in streams at 24%.

Oswegatchie (2,3). Mimic Shiners first were reported from the Oswegatchie River in 1977 (AMNH 48228). Since then, specimens have been caught episodically, with the latest catches occurring in 2014 (NYSM 71379). In the mid-1990s, this minnow was found in the Indian River system and catches there have continued as well. Although present in the Saint Lawrence watershed in the 1930s, the species apparently did not inhabit the lower courses of this watershed and has not yet expanded upstream of the first natural barrier near Gouverneur.

Raquette (1,3). During the 1934 survey, this species was present at three sites downriver of the Raymondville Dam: Hutchins, Plum (NYSM 38063) and Trout (NYSM 38062) brooks (Greeley 1934). More recently, specimens were collected from the main channel downstream of Massena in the 1990s and 2000s, and in 2010, 2011, and 2014. Upstream exceptions include specimens from Norwood (NYSM 62977) and Potsdam (NYSM 63005) in 2007.

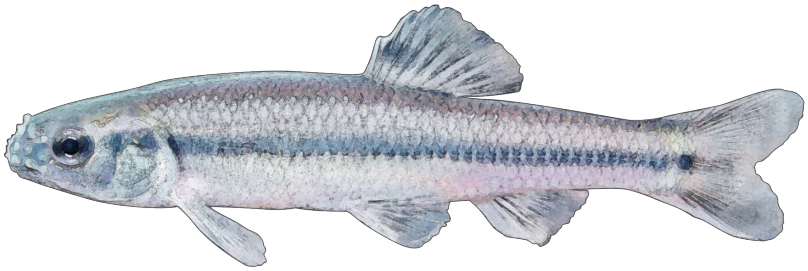
Champlain (1,2,3). Greeley (1930) reported that Mimic Shiners were abundant in the lake and in the downstream stretches of larger tributaries. In the Great Chazy and Little Chazy systems, this species occurred upstream of the falls as well. It remains widely distributed in these same lowland streams and lakes, as well as in tributaries as far south as Halfway Creek (NYSM 51499). A higher elevation capture was reported from North Pond (at 485 m), but no specimen was vouchered.

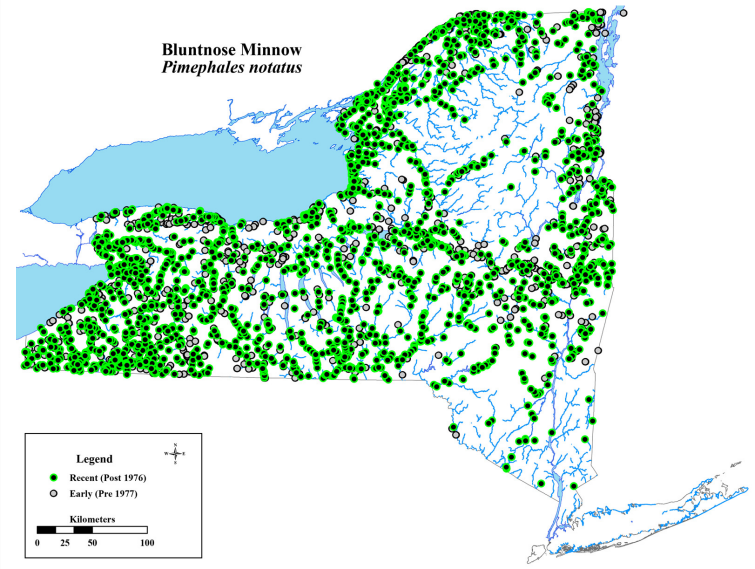
Chemung (**3**). In 1979, this species was reported from Five Mile Creek, but no specimen was vouchered. Mimic Shiners were first confirmed in this watershed by collections from Meads Creek (NYSM 52841) and the Canisteo River (NYSM 54473, 54503, 54509) in 2001. Since then, specimens have been caught at over 15 sites, including the Cohocton, Tioga, and Chemung rivers, and Campbell and Sing Sing creeks.

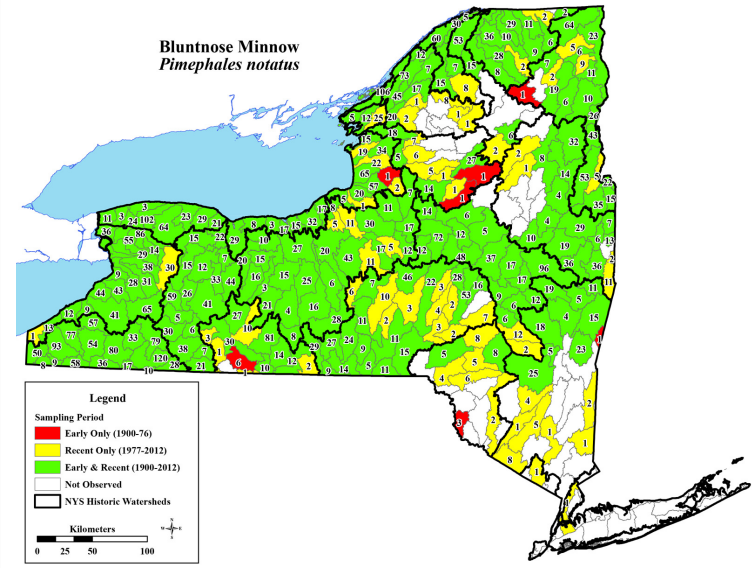
Susquehanna (**3**). Mimic Shiners were first collected from Catatonk Creek in 1996 (CUMV 77524), although a record exists from 1975 in the Susquehanna River that is not supported with a voucher specimen. Since 2000, this species has been found at 35 locations, including the Susquehanna River at Barton, and Chenango, Cherry Valley, Little Nanticoke, and West Branch Owego creeks. This minnow has notably been found at several sites that formerly supported Swallowtail Shiners. In Pennsylvania, this species was introduced prior to 1977 (Malick 1978; McKeown 1984).

Upper Hudson (**3**). Mimic Shiners were caught at several sites in Schroon Lake in 1992 (e.g., NYSM 41843). The species continues to be found in Schroon Lake, Lake Algonquin, and at several locations in the Hudson and Sacandaga rivers. Specimens have also been taken in feeder streams to the Champlain Canal as early as 1999 (NYSM 51499), with a 2013 collection coming from the canal itself (NYSM 67173).

Pimephales notatus, Bluntnose Minnow







This ubiquitous minnow is native to 16 watersheds. The species has also been introduced to the Long Island and Newark Bay watersheds.

Allegheny (1,2,3). Bluntnose Minnows were widely distributed and had a frequency of occurrence of about 50% in the 1937 watershed survey (Greeley 1938). This species continues to be among the most frequently collected minnows in the watershed.

Erie-Niagara (1,2,3). Greeley (1929) noted that this species was abundant and predominant in larger creeks and ponds. He also reported that Bluntnose Minnows occurred in Lake Erie, but only in sheltered areas. This species has been found to be widespread and relatively common in more recent surveys.

Genesee (1,2,3). This species was common in warm streams, ponds, and lakes during the 1926 survey (Greeley 1927) and remains widely distributed. It is among the five most commonly caught fish species in more recent surveys.

Ontario (1,2,3). Greeley (1940) reported that Bluntnose Minnows were well represented in bays, lakes, and streams and that specimens were taken at 191 sites, which represented more occurrences than any other minnow. The species remains widespread and relatively common.

Oswego (1,2,3). Greeley (1928) noted that this minnow was abundant in lakes, ponds, and warm streams, “usually over a mud bottom and in moderate, sluggish or stagnant current.” Bluntnose Minnows are still widely distributed in this watershed and the frequency of occurrence in streams between 1996-2010 was 35%.

Black (1,2,3). Greeley and Bishop (1932) reported that this was an abundant species in all lowland lakes and streams but that it was absent from upland sites, except in the Black River Canal feeders near Boonville, at an elevation of 340 m. The range and abundance of this species in the watershed has remained stable over time.

Species continued on next page

Saint Lawrence (1,2,3). Greeley and Greene (1931) stated that "this is one of the commonest fishes of the St. Lawrence River and lower parts of entering streams. In the Grass system it is found as far upstream as Canton, but it was not found in the Adirondack area. In the St. Lawrence River it is widespread, not being restricted to any single type of environment but occurring in weedy and open areas." This species has been widespread and relatively common in recent surveys and is now also found in Adirondack lakes (Gallagher and Baker 1990).

Oswegatchie (1,2,3). This species was abundant at all low-elevation sites sampled during the 1931 watershed survey (Greeley and Bishop 1932), and recent work indicates that this has not changed.

Raquette (1,2,3). Bluntnose Minnows were common in the 1933 survey and were found in the main stem of the river and most tributaries as far upstream as Parkhurst Brook, which is upstream of Potsdam (Greeley 1934). Today, this species is widespread and relatively common throughout the watershed.

Champlain (1,2,3). During the 1929 survey of this watershed, Bluntnose Minnows were very common in Lake Champlain, the lower waters of its tributaries, and in Lake George (Greeley 1930). In the Mettawee, Great Chazy, and Little Chazy rivers, this minnow was found in lowland areas and above the first falls (Greeley 1930). This species continues to be one of the more commonly caught minnows in streams.

Chemung (1,2,3). In the 1937 survey, Bluntnose Minnows were taken in 10% of the stream collections. In recent surveys, this species showed a significant increase, being found at 68% of stream sample sites.

Susquehanna (1,2,3). Greeley (1936) reported that this species was locally common but not frequently encountered. In the 1935 survey, it was taken in 9% of the stream collections but in recent surveys, it was found at 39% of the sample sites. This represents a significant increase in frequency of occurrence.

Delaware (1,2,3). Bluntnose Minnows were found in warm streams and ponds but were infrequently encountered during the 1935 watershed survey (Greeley 1936). The species continues to be found but remains relatively rare in the watershed. Arndt (2004) lists this species as non-native to this drainage in New Jersey.

Upper Hudson (1,2,3). This species was common in the 1932 survey, but was not found in upland waters (Greeley and Bishop 1933). It appears to be more widespread in recent surveys and has probably been introduced to upland areas, such as Mayfield Creek (George 1981a).

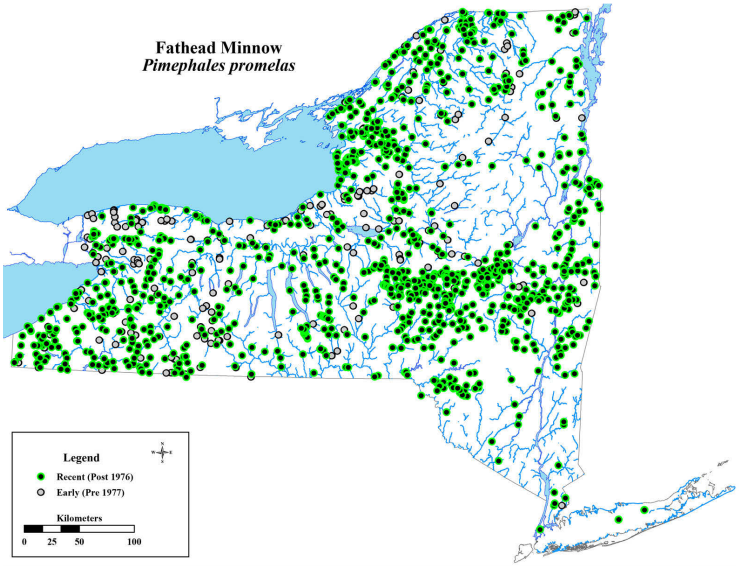
Mohawk (1,2,3). Greeley (1935) listed Bluntnose Minnows as common in lakes and streams, but absent from the higher elevations of both the Adirondacks and Catskills. Recent records place this species in many waters, including upland sites, particularly in the Catskills.

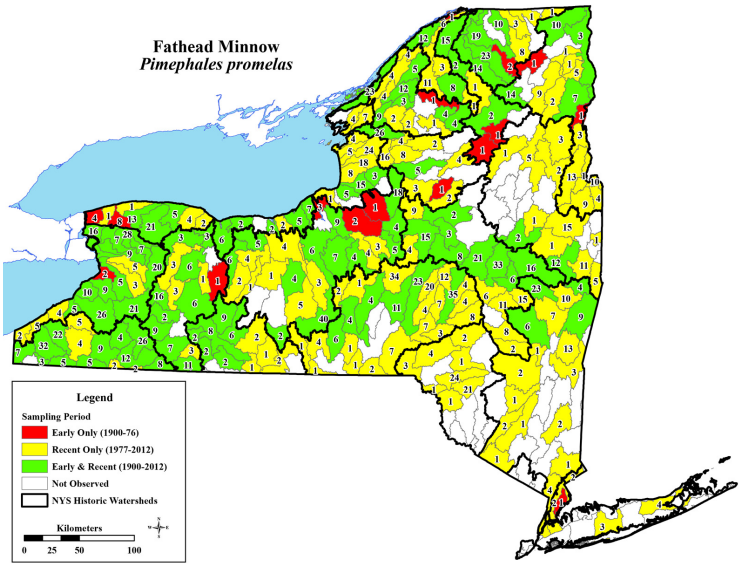
Lower Hudson (1,2,3). The curious rarity of this minnow in the 1936 survey of this watershed was noted by Greeley (1937). Specimens were only found in Kaaterskill Creek (NYSM 29283) and its tributary, the Beaver Kill (NYSM 29282). In recent years, the presence of this species in the watershed has greatly expanded, although it remains absent from the Croton River, Wappinger Creek, and Fishkill systems. The Bluntnose Minnow has been introduced to many of the sites in its expanded range farther to the east, where streams flow south into Connecticut (Jacobs and O'Donnell 2009).

Newark Bay (**3**). A single record exists for this species, from a tributary of the Mahwah River in 1989, but no specimen was vouchered. Additional records exist from downstream sites in New Jersey, where the species is considered to be non-native (Arndt 2004).

Long Island (**3**). Bluntnose Minnows have not been reported from any island site. The only record, which lacks a voucher specimen, is from a headwater tributary of the Bronx River, upstream of the Kensico Reservoir in Westchester County, in 2000.

Pimephales promelas, Fathead Minnow





This minnow is native to the Allegheny and all Saint Lawrence watersheds and is an exotic species in all of the Atlantic slope watersheds in which it is found. The Fathead Minnow inhabits 17 of New York's 18 watersheds, being absent only from the Newark Bay system.

Allegheny (1,2,3). Fathead Minnows were relatively rare in the 1937 survey (Greeley 1938). In recent surveys, this species has been found in the main channel of the river, streams, oxbow lakes, and other backwater areas, as well as in lakes and ponds throughout the watershed. Populations occasionally occur as monocultures in small upland ponds in huge numbers, like in the Allegany State Park near Limestone (NYSM 14109).

Erie-Niagara (1,2,3). Greeley (1929) reported that this minnow was common and locally abundant in several small ponds, but that it became rare at sites where many species occurred (for example, only a few individuals were taken at the mouths of several Lake Erie tributaries). This species was widespread and relatively common during more recent surveys.

Ontario (1,2,3). There were 35 collections of Fathead Minnows during the 1939 watershed survey, where this species was found in creek systems, in several ponds, and in the Erie Canal (Greeley 1940). It continues to be commonly caught.

Genesee (1,2,3). This species was listed as rare and was reported from relatively few creeks and ponds during the 1926 survey (Greeley 1927). It has become more common in recent years.

Oswego (1,2,3). Greeley (1928) stated that Fathead Minnows were uncommon in the 1927 watershed survey, being "found in certain of the smaller creeks and ponds, especially in swamp situations where the bottom was muck and the current sluggish or stagnant." The species is now widely distributed, with a frequency of occurrence in streams of 18% between 1996 and 2010, a significant increase from 1927.

Black (1,2,3). This minnow was found in Bear Lake and in lowland waters but at few other sites in the watershed survey (Greeley and Bishop 1932). Recent records include catches from most of these sites, as well as many additional ones.

Species continued on next page

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that "this is primarily a fish of the upland areas, being common in many of the Adirondack ponds and streams of each of the drainages except the Chateaugay system. Near the mouths of the streams, where numerous lowland species are present, this one is rare or absent." This passage reflects the authors' contention that biological interactions affect the distribution of this small fish. Fathead Minnows are more widespread in recent years and were caught in the Marble River at its confluence with the Chateauguay River in 2007 (NYSM 62443).

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that this species was found in Cranberry Lake and several other lakes and streams of the upland region, where is it not native; it was less common at lowland sites. Its current distribution in this watershed is somewhat more widespread than it was in the 1930s.

Raquette (1,3). Greeley (1934) reported that this species was locally common and that it was found in upland ponds and headwater creeks. It continues to be commonly caught in these same areas.

Champlain (1,2,3). Fathead Minnows were uncommon in the 1929 watershed survey but were present in bog ponds and small sluggish streams of the headwaters of the Saranac and Great Chazy Rivers (Greeley 1930). Recent survey work documented this minnow from many of the sites at which it was found earlier. The species has been introduced into higher elevation lakes and streams (George 1981a).

Chemung (**1,2,3**). This species was rare in the 1937 survey but was found in stream and pond sites, where it was occasionally numerous (Greeley 1938). It has become widespread in this watershed.

Susquehanna (**1,2,3**). Greeley (1936) listed this species as rare and recorded it from Otsego Lake and six stream sites, including headwater areas such as Kortright Creek (NYSM 21586). The frequency of occurrence of Fathead Minnows was 2% in 1935, whereas the species occurred at 15% of the sample sites from surveys conducted in the 2000s. This represents a significant increase.

Delaware (**2,3**). Fathead Minnows were not found in this watershed in 1935 (Greeley 1936). The species was first collected from Callicoon Creek in 1979 (AMNH 41896). Since then, this minnow has been reported from this watershed 60 times.

Upper Hudson (**1,2,3**). Although no specimens were collected during the synoptic 1932 survey, Greeley and Bishop (1933) noted that a single specimen was taken from Mayfield Creek in the Sacandaga system the previous year (NYSM 38049). This minnow is now widespread and has probably been introduced in several waters at higher elevations, such as Spectacle Pond and Palmer Lake (Gallagher and Baker 1990).

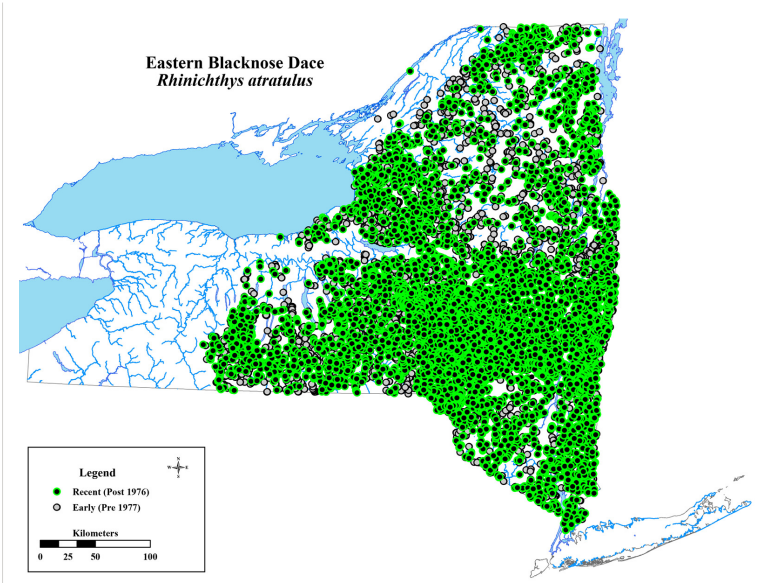
Mohawk (**1,2,3**). Greeley (1935) reported that this species was uncommon, although it was taken at 18 (or 3%) of the watershed survey sites and was abundant at some of them. He (Greeley 1935) even mentioned a small pond next to the Mohawk River where this was the only fish species present. In recent stream surveys, its frequency of occurrence has increased to 26% of the sites sampled. Fathead Minnows are now present throughout the watershed, including headwater sites like Scott Creek (NYSM 11575).

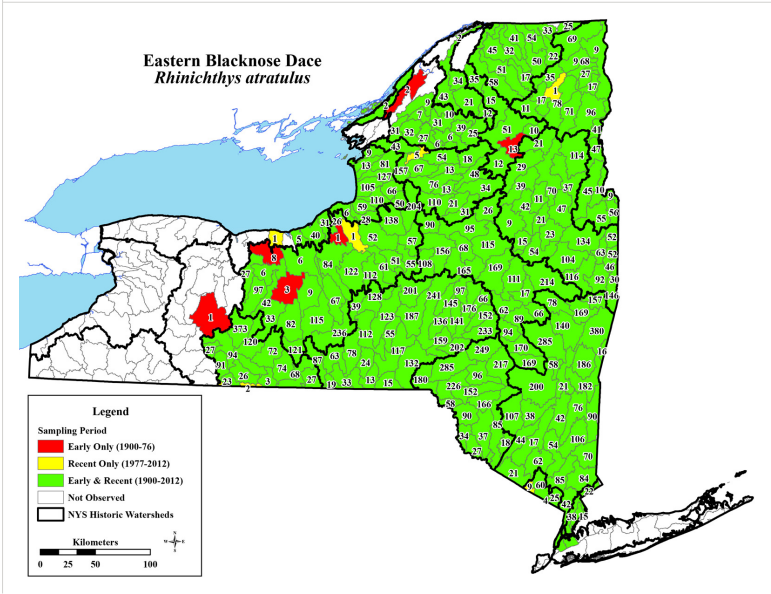
Lower Hudson (**1,2,3**). This minnow was first found in the headwaters of the Normans Kill (NYSM 21563) and in Trautner Lake (Greeley 1937). Recent records exist from many areas, including the main channel of the Hudson River and headwater streams. This species is also found in isolated ponds, such as those in Central Park (NYSM 55970).

Long Island (**1,3**). In 1936, Fathead Minnows were collected from the Mamaroneck River, a stream draining into the Long Island Sound (NYSM 19628). Specimens were also found in the Bronx River in 1998 (NYSM 49258) and in 2007. Since 2006, this species has been found in two ponds on Long Island: Horn Pond (NYSM 63812) and Ronkonkoma Swamp.

Rhinichthys atratulus, Eastern Blacknose Dace

The recent taxonomic history of this wide-ranging species, or species complex, is muddled and confusing. In New York, two morphologically distinct groups occur. Smith (1985) separated them using male coloration and caudal peduncle depth. He (Smith 1985) argued that, because the status of these two groups was in flux, it was best to treat each as a species so that the information about the two forms would be kept separate. This was sound advice. Recently, Kraczkowski and Chernoff (2014) analyzed two mitochondrial genes and nine microsatellite loci and found genetic differences between the two species. Additional genetic differences were found by April et al. (2014). The Eastern Blacknose Dace inhabits smaller streams and some lakes, particularly in the Adirondacks. It is the quintessential high-elevation species and is found in all of the New York watersheds east of the Genesee, which agrees with the results of Kraczkowski and Chernoff (2014).





Ontario (1,2,3). Greeley (1940) identified Wolcott Creek, which flows into Port Bay in Wayne County, as the western extent of the range of this species. Between 2005 and 2009, the area was sampled heavily and the western boundary seemed better placed at Mudge Creek, which flows into East Bay. Mudge Creek had both Eastern and Western Blacknose Dace as determined by genetic tests (Kraczkowski and Chernoff 2014). Specimens that were not confirmed with genetic analysis were collected west of Sodus Bay in Salmon Creek, the tributary to Maxwell Bay. The breadth of the zone of overlap where both Eastern and Western Blacknose Dace occur in this watershed is about 30 km, and includes the creeks between Red Creek and Salmon Creek, which is just west of Sodus Bay.

Oswego (1,2,3). In the 1927 watershed survey, this species was abundant in small, shallow creeks, whether warm or cool, and was often associated with gravel or rubble substrates, as well as with the presence of Brook Trout (Greeley 1928). Eastern Blacknose Dace remain common and widely distributed in upland streams.

Species continued on next page

Black (1,2,3). Greeley and Bishop (1932) found this species to be abundant and that it occurred in nearly all streams of the region except the small, direct tributaries of the Saint Lawrence River. It was also present in most of the Adirondack lakes. The range and abundance of this dace have not varied in recent years.

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that Eastern Blacknose Dace were abundant throughout the region, except in the Saint Lawrence River and the lower reaches of the larger tributaries. Without actually explaining why, Greeley and Greene (1931) noted that this species was abundant in brooks and lakes where the species assemblage was depauperate. In fact, they found no other species that was as well adapted to these marginal sites. The species remains widespread at higher elevations.

Oswegatchie (1,2,3). This minnow was abundant in streams and lakes but was rare or absent from lowland sites during the watershed survey (Greeley and Bishop 1932). The species remains widely distributed in this watershed.

Raquette (1,2,3). Greeley (1934) noted that "most of the upland brooks have the black-nosed dace (sic) and it is found in a few brooks of the lowland region. It occurs in a number of lakes and ponds which have not been stocked with perch, bass or others of the introduced species destructive to native minnows." Here, Greeley (1934) was bolder in his assessment of the factors affecting the distribution of this species, specifically identifying introduced predatory fishes, which has been demonstrated to be largely correct (e.g., Whittier and Kincaid 1999). The results of recent survey work in streams show a substantial decrease in the abundance of this species.

Champlain (1,2,3). According to Greeley (1930), this species was "a very common stream fish throughout the region and is also found in ponds and small lakes of the Adirondacks. It inhabits both cold and warm streams but is not common in the deep sluggish parts. It reaches its greatest abundance in headwater streams which are small, shallow and with many riffles." Eastern Blacknose Dace have frequently been caught and were widely distributed in recent survey work.

Chemung (1,2,3). This was usually the predominant species in smaller streams, both cool and warm, permanent and intermittent (Greeley 1938). Eastern Blacknose Dace remain abundant and widespread throughout this watershed.

Susquehanna (1,2,3). This species was the fifth most frequently encountered fish during the 1935 watershed survey, being present at 42% of the sample sites (Greeley 1936). It was absent in lakes and was rarely found in the larger streams but was found in practically all of the smaller creeks (Greeley 1936). During recent surveys, Eastern Blacknose Dace were similarly abundant and widespread, being found at over 40% of the sample sites.

Delaware (1,2,3). This was the second most common species encountered in the 1935 survey of this watershed, with a frequency of occurrence of 36% (Greeley 1936). It was present in smaller streams but not in lakes or the main channel (Greeley 1936). The species continues to be widespread and abundant in the Delaware watershed.

Upper Hudson (1,2,3). Eastern Blacknose Dace were abundant and were found in most of the small streams of the watershed during the 1932 survey (Greeley and Bishop 1933). This species was absent from larger streams and lakes but was common in smaller Adirondack lakes, particularly those that "have not had the natural fish association upset by the introduction of bass, pickerel or other warm water game fishes." (Greeley and Bishop 1933). In streams, this is still among the three most commonly caught minnows. The status of the Eastern Blacknose Dace in lakes has changed, however. Specimens were found in 44 of the 171 ponds sampled in the 1930s and in only 8 of over 160 ponds surveyed by the ALSC in the 1980s (Greeley and Bishop 1933; Gallagher and Baker 1990).

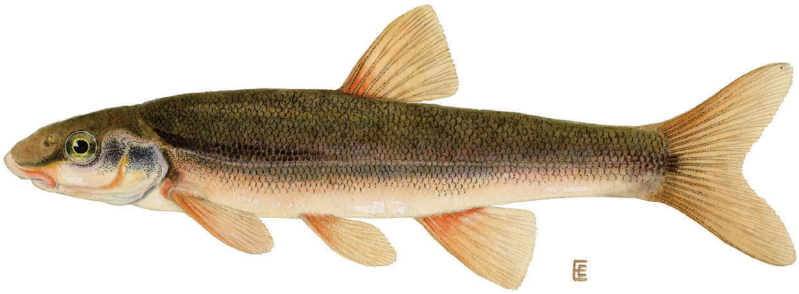
Mohawk (1,2,3). Greeley (1935) listed this species as abundant and present in most of the upland streams and lakes of the watershed but rare or absent from larger, lower-elevation bodies of water. Recent records indicate that Eastern Blacknose Dace still occur in many waters that are, again, smaller and mostly at higher elevations.

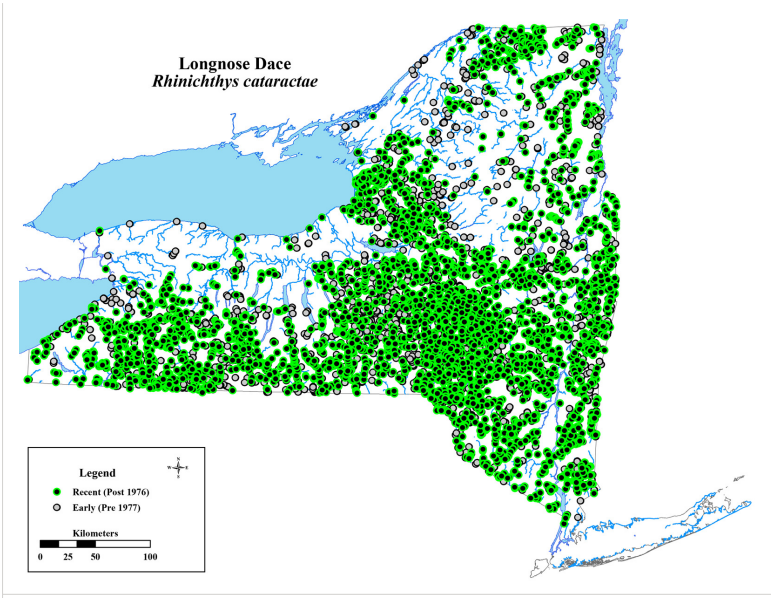
Lower Hudson (1,2,3). This species was collected 196 times during the watershed survey, mostly from headwater creeks (Greeley 1937). It continues to be the most common stream minnow encountered in this watershed.

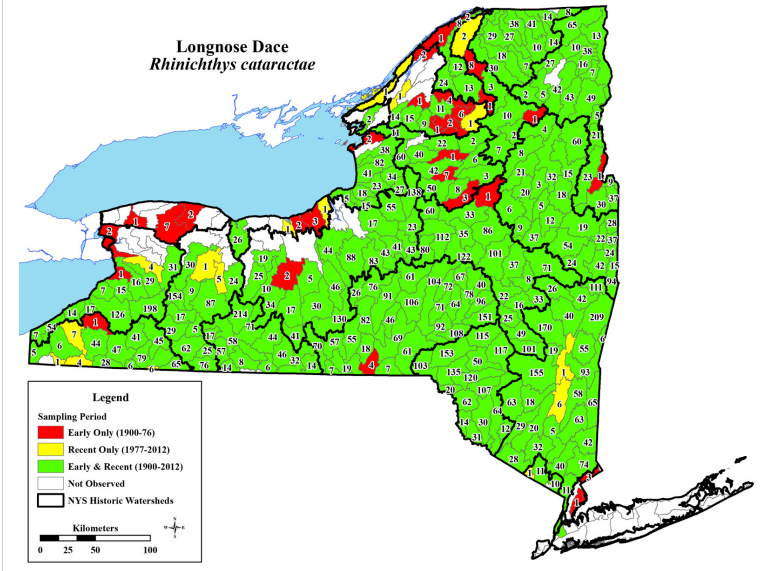
Newark Bay (1,2,3). This species has been abundant and widespread during all surveys of this watershed.

Long Island (1,2,3). This species is present in the small coastal streams of the mainland in Westchester County, and, in 1936, it was collected at 36% of the watershed survey sample sites (Greeley 1937). Eastern Blacknose Dace remain common in this part of the watershed and have not been found on any of the islands.

Rhinichthys cataractae, Longnose Dace







This dace inhabits medium-sized streams, large rivers, and large lakes with gravel and rubble bottoms and strong current or wave action. Longnose Dace also seem to thrive in urban settings if the streams have appropriate habitat. The species is found in all 18 of New York's watersheds but is not found on Long Island.

Allegheny (1,2,3). Longnose Dace were common in riffles and areas of high stream gradient throughout the watershed, including those in the main channel of the Allegheny River, and were caught at about 8% of the watershed survey sample sites (Greeley 1938). In recent surveys, the species' frequency of occurrence was around 30% in the western and eastern basins and 8% in the central basin. This minnow was not caught in the central basin (Conewango Creek and its tributaries) until 1962 (Carlson et al. 1999). This basin, which is dominated by sluggish, meandering streams with mud bottoms, provided little optimal habitat for this fish and poor dispersal corridors. The sites in the Conewango Creek system where this species has been found are smaller tributaries with strong riffle-run habitats and gravel-rubble substrates.

Erie-Niagara (1,2,3). This species was common in streams and along rocky shorelines in Lake Erie during the 1928 watershed survey (Greeley 1929). In later surveys, it has remained widespread and relatively common.

Ontario (1,2,3). Although wide ranging, this species was collected at only 22 sites throughout the watershed, all of which were either swift, shallow streams or within the wave zone of rocky shores of Lake Ontario (Greeley 1940). It continues to be a primarily lowland species in this watershed, and it is still widespread and relatively common in these areas. Specimens were, however, found in riffles of the Salmon River at an elevation of 533 m.

Genesee (1,2,3). Greeley (1927) listed this species as moderately common in the watershed and typical of shallow, rapid, warm streams. Similar results exist for more recent survey work as well.

Oswego (1,2,3). Longnose Dace were common and present in shallow streams with "rapid to torrential" current and rubble bottoms during the 1927 watershed survey (Greeley 1928). The species remains common and widely distributed in this watershed.

Species continued on next page

Black (1,2,3). This minnow was common during the 1931 survey of this watershed and, although it was not widely distributed in upland sites in general, it was found in lakes and streams of up to 550 m in elevation (Greeley and Bishop 1932). Recent catch records indicate that Longnose Dace have persisted in areas where they were previously reported.

Saint Lawrence (1,2,3). Greeley and Greene (1931), in their account of this species, stated "...it is entirely absent from streams at higher elevations and inhabits lower courses of St. Lawrence tributaries, as well as the river proper." These authors apparently overlooked the single high-elevation Adirondack record (NYSM 21460), which is from the Saint Regis River at 490 m in 1930. Later collections indicate that this species has maintained itself in the main channel and lower tributaries and is now also found more frequently at higher elevations.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that Longnose Dace were common in lowland streams throughout the watershed. The species continues to be present at lowland sites, but its range expanded into higher elevations between the 1950s and 1970s.

Raquette (1,2,3). Greeley (1934) reported that this fish was common in the watershed and that it occurred in many streams, including higher-elevation sites like Ampersand Brook at 550 m (NYSM 21457). Longnose Dace continue to be widely distributed and common in this watershed.

Champlain (1,2,3). In the 1929 watershed survey, this was a common species in streams with higher velocity but became less abundant as elevation increased (Greeley 1930). Longnose Dace also inhabited the rocky shorelines of Lake Champlain but were rare in Lake George. The species has been found in these same areas in later surveys.

Chemung (1,2,3). The frequency of occurrence of this species was 45% during the 1937 watershed survey (Greeley 1938). It continues to be abundant and widespread throughout the watershed.

Susquehanna (1,2,3). Greeley (1936) classified this species as abundant. He also compared its abundance favorably to that of the Eastern Blacknose Dace, arguing that, although the Longnose Dace was encountered less frequently, its preferred habitat was more readily available, so much so that its numbers probably equaled that of the Eastern Blacknose Dace. The species continues to be abundant and widespread in this watershed, with a frequency of occurrence of 40% in stream surveys from 1998-2010.

Delaware (1,2,3). This species was listed as abundant and was taken at 24% of the 1935 watershed survey sample sites; it was typically found under stones in rapids (Greeley 1936). The widespread distribution of Longnose Dace throughout the watershed remains unchanged, but there has been an increase in catch frequency, the most recently reported value being 38% from surveys conducted in the 2000s.

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported that this species was common, more so on the south side of the Adirondacks (Hudson drainage) than on the north (Saint Lawrence drainage) and that it was found at elevations to 640 m. Populations continue to be robust in recent stream survey work, with the species showing a 23% frequency of occurrence.

Mohawk (1,2,3). Greeley (1935) noted that Longnose Dace were abundant, with a frequency of occurrence of 19% and that most collections were from swift streams. Recent records show that this minnow's widespread distribution in the watershed remains unchanged but that there has been a significant increase in the catch frequency, which was found to be 43% in the 2000s.

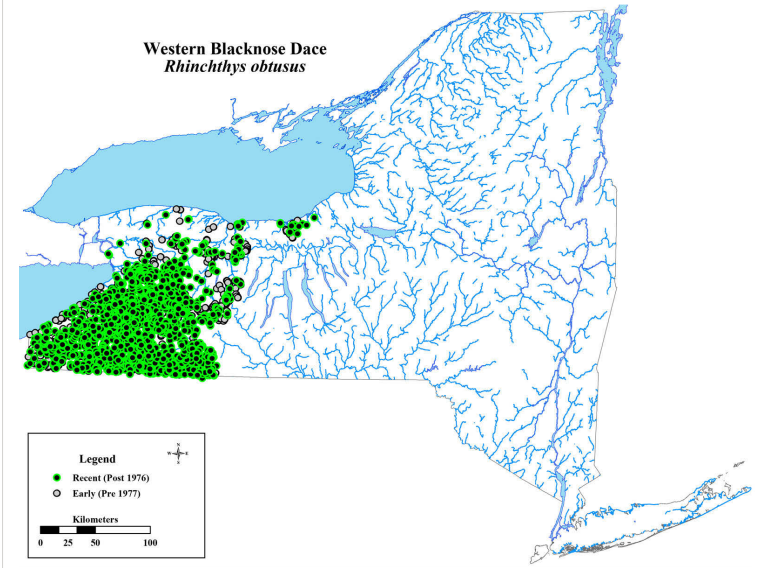
Lower Hudson (1,2,3). This species was common during the 1936 watershed survey, with all 88 collections coming from streams or stream mouths (Greeley 1937). Recent records show that Longnose Dace still occur in many streams and that there has been a significant increase in the catch frequency, which was most recently found to be 42%. Limburg et al. (2005) argue that this species is increasing in abundance in streams where urbanization has resulted in increased channelization.

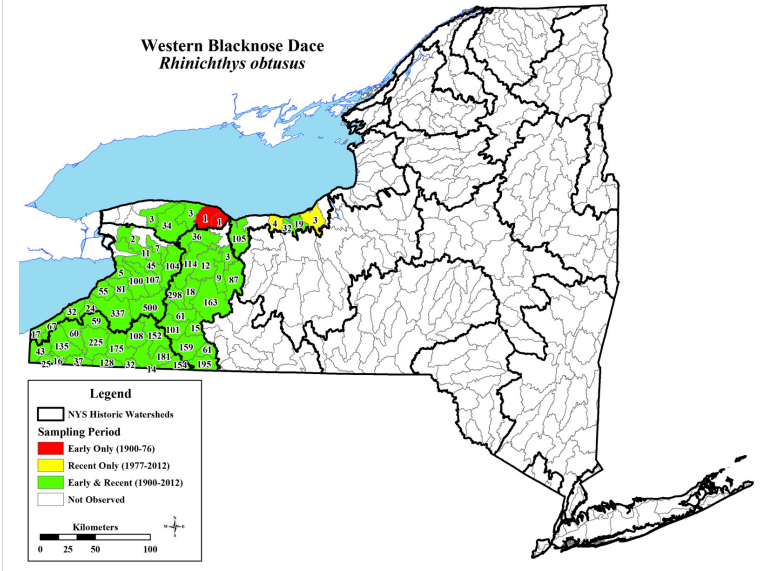
Newark Bay (1,2,3). This species was widespread, relatively common, and was collected at 2.5% of the sampling sites during the 1936 survey (Greeley 1937). It remains common, and streams with frequent catch records include the Ramapo and Hackensack rivers and Nauraushaun and Pascack brooks.

Long Island (1,2,3). This species has not been found on Long, Fishers, or Staten islands but does inhabit a stream flowing into Long Island Sound from Westchester County. During the 1936 survey, Longnose Dace were present in 20% of the samples from the Mianus River (Greeley 1937). Since 1956, this minnow has also been common in the Mill River, near Sarles Corners.

Rhinichthys obtusus, Western Blacknose Dace

This dace inhabits smaller streams and lakes. It is typically an upland form but has been found at lower-elevation sites on occasion. The species is found in New York's four western watersheds. A zone of overlap and perhaps hybridization exists in the Ontario watershed. Smith (1985) referred to this species as *Rhinichthys meleagris*. Based on recent work, we follow Kraczkowski and Chernoff (2014) in using *R. obtusus* as the name for the Western Blacknose Dace.





Allegheny (1,2,3). This minnow was abundant in streams and was caught at roughly 40% of the sites sampled during the 1937 survey of this watershed (Greeley 1938). Western Blacknose Dace continued to be common in the smaller tributaries throughout the watershed (Pfeiffer 1942), and all recent survey work indicates that this species remains abundant in this watershed.

Erie-Niagara (1,2,3). This minnow was abundant and was found in most small streams during the watershed survey; it was rare in the lower reaches of the larger streams and absent from Lake Erie, except as a stray (Greeley 1929). Western Blacknose Dace remain widespread and relatively common throughout the watershed.

Ontario (1,2,3). Greeley (1940) noted that "the distribution of this dace begins where the preceding one [Eastern Blacknose Dace] leaves off. The 15 collections made represent the streams west of Wolcott, Mudge Creek in Wayne County extending westward into Niagara County." The frequency of occurrence of this species was only 3% in both early and recent survey periods. The area of overlap between Western and Eastern Blacknose Dace was heavily sampled in 2005 and again in 2009 to collect specimens and genetic samples to delineate the range of each form and the area where they occur sympatrically. The Western Blacknose Dace was found to extend east into Cayuga County to Sterling Creek, based on the morphological characteristics of specimens. Several studies have questioned the validity of separating the various forms within this species complex (e.g., Fraser et al. 2005). Samples were shipped to researchers at the University of Michigan and Wesleyan University for genetic analysis. These samples indicated that Western Blacknose Dace occurred east to Red Creek (Kraczkowski and Chernoff 2014),

Species continued on next page

a creek east of Greeley's boundary of Wolcott Creek but west of Sterling Creek, where morphology-based identifications place the boundary (G. Smith, University of Michigan, pers. comm.). Because Eastern Blacknose Dace were found in Salmon Creek just west of Sodus Bay, there is a zone of overlap of 30 km. This raises the question of hybridization. Greeley (1940) specifically noted that a colleague at the University of Rochester, Mark Hall, found no evidence of intergradation between these forms and concluded that specific status for each was reasonable.

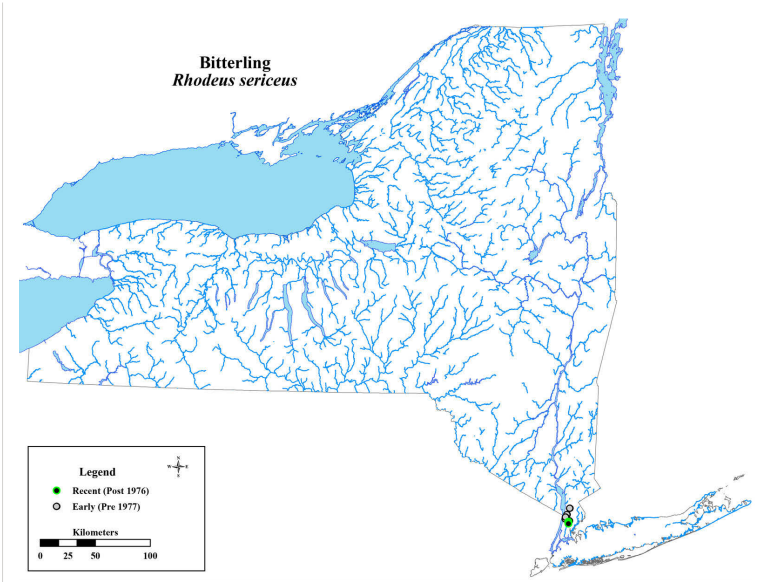
Genesee (1,2,3). Greeley (1927) noted that this species was abundant in small creeks but rare or absent in the main channel, even in the shallower parts. The Western Blacknose Dace is among the five most commonly caught stream fishes in this watershed, and there has been a significant increase in the catch frequency, which was most recently reported to be 43%.

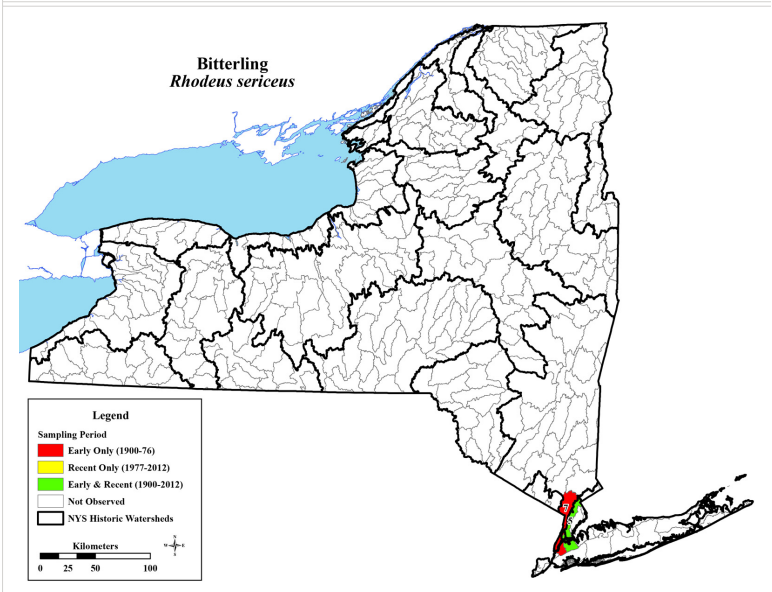
Rhodeus sericeus, Bitterling

This European minnow has been found in low-gradient streams in two adjacent watersheds near New York City. It was introduced in the early 1900s as a pharmaceutical test animal.

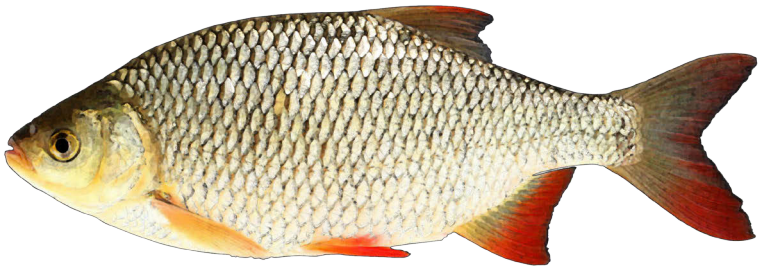
Lower Hudson (**1,2**). The earliest record of this species from the watershed is from 1923 (Schmidt et al. 1981). By 1936, Bitterling were well established in the Sawmill River (Greeley 1936). The species was last reported in 1950 and 1951 (NYSM 66884, CUMV 23611, AMNH 42444).

Long Island (**1,2**). Bitterling had become well established in the Bronx River by 1936 (Greeley 1937), although the species was present in this stream in 1923 as well (Schmidt et al. 1981). Specimens were last collected there in 1981 (NYSM 58904, 60106).

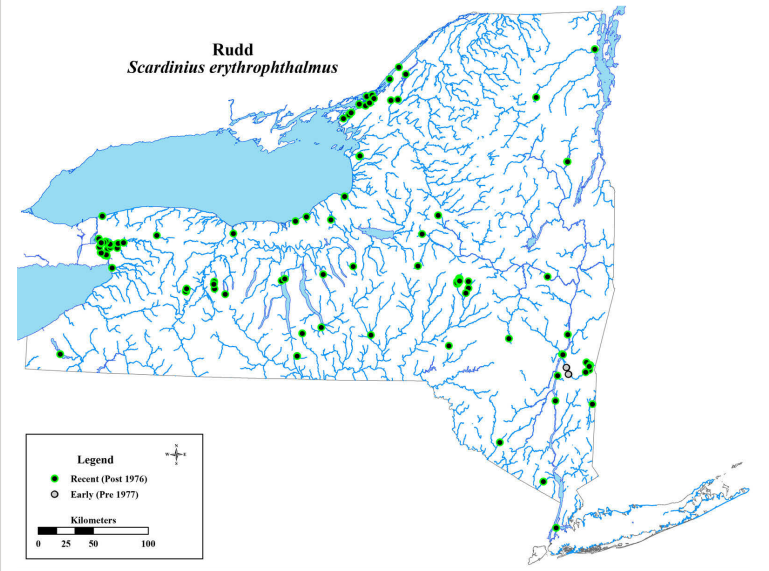


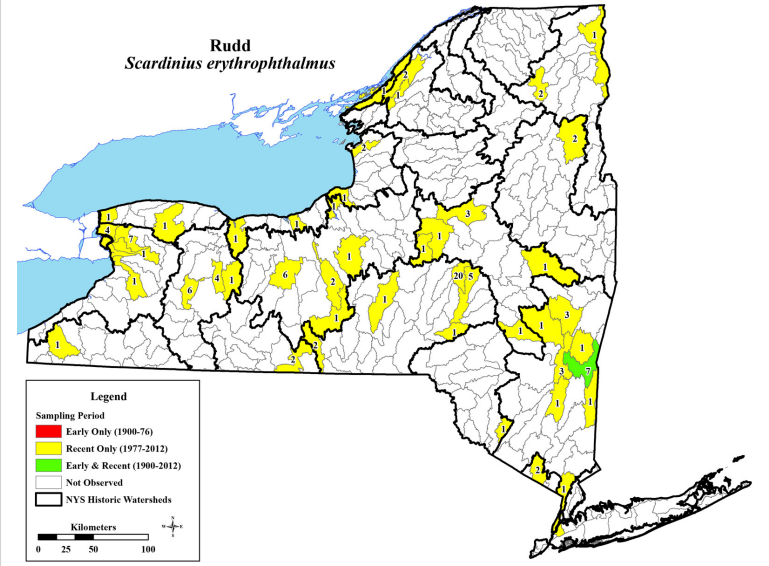


Scardinius erythrophthalmus, Rudd



This medium-sized European carp species lives in lakes and streams. It was first introduced to New York in a tributary of the Lower Hudson watershed in the 1920s, where it remained without expanding its range for seven decades. In the late 1980s, Rudd became popular bait fish and were shipped into the state from southern distributors. At this point, largely due to bait releases, the species has begun to turn up across the state. Today, it is known from 15 New York watersheds. It is absent only from the Long Island, Black, and Raquette River systems. Most records are post-1990 and are scattered among all of these watersheds. There are a few records from the Adirondacks. In most (but not all) of the watersheds, this species does not appear to have established itself; the catches across the years may be the result of reintroductions rather than recruitment from breeding individuals. The oldest museum records are collections from Central Park lakes in 1911 and 1912 (AMNH 4280 and ANSP 46521, respectively). Specimens were also collected from a hatchery pond in Ithaca in 1931 (CUMV 2885). This species was successfully established in Copake Lake and Robinson Pond in the late 1920s, but those populations were slow to expand their ranges.





Allegheny (**3**). The only report of Rudd in this watershed was from Chautauqua Lake in 1988.

Erie-Niagara (**3**). Catches are known from the Buffalo River in 1991 and the Niagara River in 1998 (NYSM 49631) and 2007 (NYSM 62677). Rudd continue to be caught on occasion and are considered to be abundant (Kapuscinski and Farrell 2012).

Genesee (**3**). Rudd have been reported from Conesus (1995-2003), Silver (1990-2009) and Hemlock (2005) lakes.

Ontario (**3**). This species has been found in the Iroquois National Wildlife Reserve in 1992 (NYSM 41752), Sixtown (Crystal) Pond in 1993, Little Sodus Bay from 1994-95, Irondequoit Bay and Port Bay in 1997, Butterfly Creek in 2011, and Fourmile Creek in 2012. These catches appear to be from continuous introductions rather than successful spawning.

Oswego (**3**). At present, there are only ten records known from this watershed: Skaneateles Lake in 1990, Lake Neatahwanta in 1992, Cayuga Inlet in 1993, Owasco Lake in 2002, Onondaga Creek in 2004 (NYSM 60158), and Seneca Lake in 2010, 2013 (NYSM 68516), and 2014 (NYSM 71098, 71244, 71258).

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Saint Lawrence (**3**)**.** Records are known from the Thousand Islands area of the river between 1989 and 2007, and nearby Scotch Brook in 2009.

Oswegatchie (**3**). Records exist from Black, Muskellunge, and Millsite lakes from 1990-1996.

Champlain (**3**). This species was caught at Plattsburgh in 2009. The first report from this watershed, however, was in Lake Champlain at Keeler Bay, Vermont, in 1991 (C. McKenzie, Vermont Department of Fish and Wildlife, pers. comm.). Rudd were reported from Lake Flower in 2015.

Chemung (**3**). Rudd were reported from the Sullivanville Reservoir in 1991.

Susquehanna (**3**). Rudd were caught in Canadarago Lake in 1989 (CUMV 72312) and 2010, Otsego Lake in 1993 (NYSM 13255) and 2008, the Whitney Point Reservoir in 2004, and Cayuta Lake in 2006.

Delaware (**3**). The only known record is from the Basher Kill in 1990 (AMNH 223149).

Upper Hudson (**3**). A single specimen was found in Schroon Lake in 1992 (NYSM 41850).

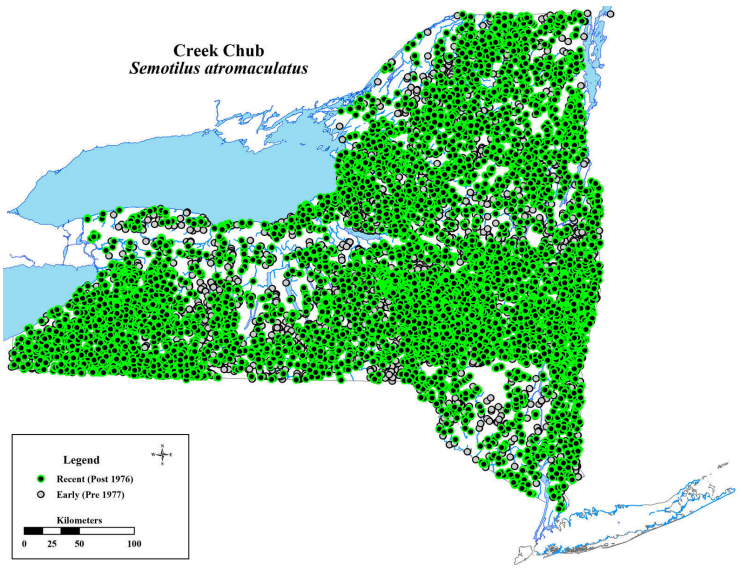
Mohawk (**3**). This species was caught in the Mohawk River at Lock 9 in 1994, Oriskany Creek near the falls in 2000, at a sportsman club pond near Steuben in 2000 and 2002, and in the Schoharie Reservoir in 2010.

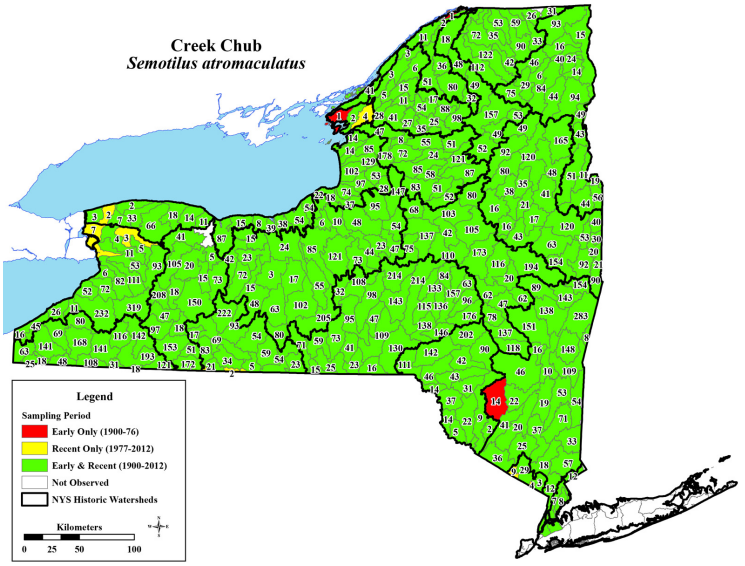
Lower Hudson (**1,2,3**). The only long-established Rudd population in the state is found in this watershed. Four specimens were taken from the Roeliff Jansen Kill during the 1936 watershed survey (Greeley 1937). Earlier records indicate that the fish was at least present in Robinson Pond, an in-stream pond of the Roeliff Jansen Kill (NYSM 11742), and nearby Copake Lake (AMNH 5731) in the 1920s. Rudd have regularly been caught in these areas, and specimens accessioned in collections provide an excellent record of the species' continued presence over time: AMNH 55048 in 1978, AMNH 58445 in 1988 and NYSM 65136 in 2007. Beginning in 1990, individuals have been taken many times from the Hudson River in Columbia, Greene, and Dutchess counties. This species, however, has not been collected from the pond in Central Park, New York City, since 1911. In 2009, Rudd were reported from Webatuck Creek (Dutchess County), part of the Housatonic River drainage, which, in New York, is traditionally regarded as part of this watershed.

Newark Bay (**3**). A single specimen was caught in the Mahwah River in 2010 (NYSM 66098).

Semotilus atromaculatus, Creek Chub

This ubiquitous minnow lives in streams and lakes, including headwaters and upland lakes, and is tolerant of degraded sites. It has superb dispersal capabilities and is one of only a few species in the state that is able to gain access to high-elevation sites. The native range of this species extends through all of New York's mainland watersheds but it is not present on Long Island.





Allegheny (1,2,3). According to Greeley (1938), "virtually every small creek of the entire region is populated with chubs although these fish are scarce or lacking in large streams and only rarely taken in lakes of the area." In the 1937 watershed survey, Creek Chubs were taken at 53% of the total sites sampled and 60% of the stream sites (Greeley (1938). Creek Chubs were commonly collected in the main channel and in small tributaries throughout the drainage in recent surveys of all three basins. This included a 56% frequency of occurrence in the central basin, where the streams are generally sluggish, warm, and deep.

Erie-Niagara (1,2,3). Greeley (1929) categorized this species as abundant and noted that it inhabited almost every stream sampled, although it was less common in large streams and was rare in the lake itself. In surveys over the last eight decades, Creek Chubs have remained widespread and abundant.

Ontario (1,2,3). Greeley (1940) noted that this species was collected at 167 sites, i.e., it was present in virtually every stream system, including headwaters. Creek Chubs also occurred in ponds and lakes, including Lake Ontario, even though they are primarily stream fish. The range and abundance of the species has remained unchanged over the years.

Genesee (1,2,3). This minnow was abundant in small streams and less common in larger, deeper streams and lakes (Greeley 1927). The species remains widely distributed and is among the five most commonly caught stream fishes in this watershed.

Oswego (1,2,3). This species was abundant during the 1927 watershed survey and was found in streams and lakes, where it was often associated with trout (Greeley 1928). Creek Chubs remain widely distributed, with a frequency of occurrence in streams of 26% between 1996 and 2010.

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Black (1,2,3). During the 1931 watershed survey, Creek Chubs were abundant and were found in most small streams and upland lakes but were rare in larger streams and lowland lakes (Greeley and Bishop 1932). Recent records indicate that the species still is found at the sites where it was previously reported.

Saint Lawrence (1,2,3). In their account of this species, Greeley and Greene (1931) stated: "...it is a headwater species and rarely occurs in the lower streams...Specimens were collected in a great many of the Adirondack lakes and ponds as well as in a large number of streams from headwaters downwards in greater or less degree." Recent distribution records show this minnow in many of the waters from which it was previously reported.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that Creek Chubs were abundant at upland sites and rare at lowland sites during the 1931 watershed survey. This pattern is still found in this watershed.

Raquette (1,2,3). As was true for all other Adirondack watersheds, Creek Chubs were abundant in the upland creeks and lakes but rare at lowland sites during the 1933 survey of this watershed (Greeley 1934). The distribution and abundance of this species in the watershed in recent years differs little from the 1933 survey.

Champlain (1,2,3). Greeley (1930) found that this species was "very common in creeks of the entire region, and in many ponds and small lakes of the Adirondacks. It is of frequent occurrence in headwater streams and is a common inhabitant of the trout streams as well as of warmer creeks. Although present at the mouths of most of the smaller tributaries of Lake Champlain it is exceedingly rare in the lake itself." This species is still one of the more commonly caught minnows in the streams and upland lakes of this watershed.

Chemung (1,2,3). Greeley (1938) reported that Creek Chubs were abundant and were present at 55% of the watershed survey sample sites. The species continues to be common, being found at 46% of the stream sites sampled in recent survey work.

Susquehanna (1,2,3). This minnow was abundant and was present in 43% of the sites sampled in the 1935 survey of the Susquehanna watershed (Greeley 1936). Specimens were mainly caught in smaller creeks as this species tends to avoid larger streams. In later work, Creek Chubs occurred at 41% of the stream sites sampled.

Delaware (1,2,3). This species was abundant during the 1935 survey and was caught at 20% of the sites sampled in the Delaware watershed, with those sites predominantly being located in smaller streams (Greeley 1936). Creek Chubs continue to be widespread and frequently caught in this watershed, with specimens being found at 10% of the stream sites sampled in recent surveys.

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported that this minnow was abundant and widely distributed in streams and upland ponds during the watershed survey. Its status in recent surveys has remained unchanged.

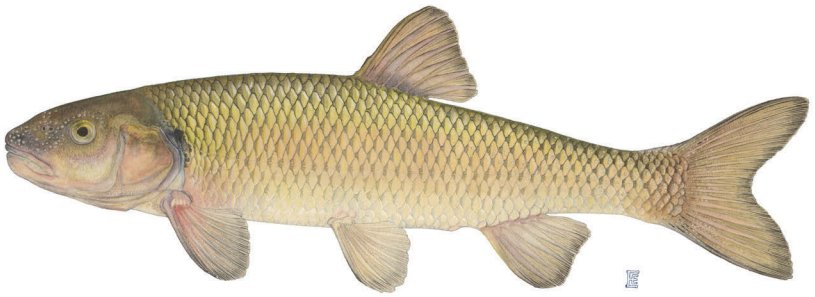
Mohawk (1,2,3). Greeley (1935) noted that Creek Chubs were abundant, being found in "creeks, lakes, ponds and rivers." Recent records indicate that this species persists at many of the sites where it was captured in the 1934 watershed survey.

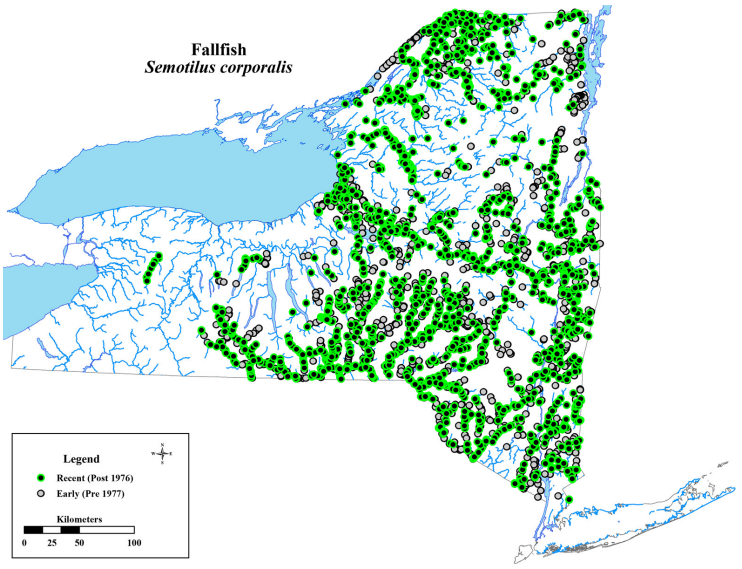
Lower Hudson (1,2,3). Greeley (1938) ranked this species as abundant; it was caught at 138 sites in this watershed, mostly in smaller creeks, and only rarely in the main channel and lakes. Creek Chubs continue to be abundant in streams and rare in the main channel.

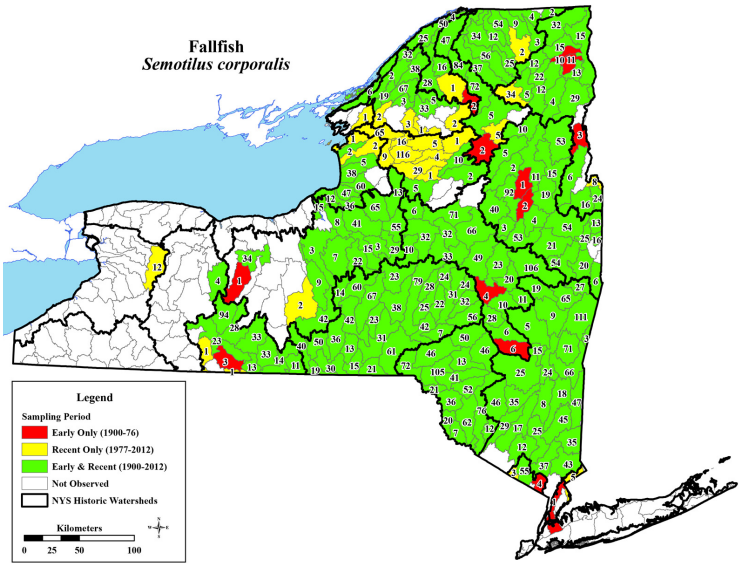
Newark Bay (1,2,3). This species was widespread and common in this watershed in both the 1936 watershed survey (Greeley 1937) and in surveys during later years.

Long Island (1,2,3). Creek Chubs are not present on the islands but occur in the streams draining into the Long Island Sound in Westchester County. In 1936, this species was collected at 17% of the watershed survey sample sites (Greeley 1937), including the Mamaroneck River (NYSM 14996). Its status in these streams appears stable, and it has been collected from the Mianus River basin in 1994 and 2005.

Semotilus corporalis, Fallfish







This large, piscivorous minnow inhabits medium-sized and larger streams and is often associated with sandy bottoms. The Fallfish ranges throughout all of New York's Atlantic slope watersheds but is found in only some of the Great Lakes and Saint Lawrence watersheds, generally east of the Genesee River. In the narrow band of tributaries along the south shore of Lake Ontario, the range of this species extends only to the Oswego River. It has also been introduced in western New York and in upland Adirondack lakes and streams.

Erie-Niagara (**2,3**). This species was first reported from Tonawanda Creek by W. Hadley (SUNY Buffalo, unpubl. field notes) in 1978 and it was collected again at this site in 1981 (AMNH 227023) and 2011 (NYSM 67121).

Ontario (1,2,3). The curious distribution of this species in this watershed remains puzzling. Fallfish are present in the eastern part of Lake Ontario and in the tributaries of this area. Greeley (1940) noted that the 52 records from the 1939 survey of this watershed were in low-elevation streams in Oswego County. Specimens were previously found in additional streams in Jefferson County (Greeley and Bishop 1932). It is curious, however, that a large minnow with free access to Lake Ontario has not colonized any western tributaries or, for that matter, the western part of the lake. The species continues to be collected readily in the eastern tributaries and, to date, the westernmost tributary in which Fallfish have been found is Catfish Creek, which is one tributary east of the Oswego River.

Genesee (**2**). The Fallfish was not among the species recorded from the watershed survey by Greeley (1927). In 1950, this species was caught in Mill Creek, a tributary of Honeoye Creek. Specimens were reported from Cryder Creek in 1961 and a tributary of Oatka Creek in 1969. In 1981, specimens were collected from Honeoye Creek (AMNH 224592). In all four cases, no second catch was made at the site, so it is unlikely that these introductions resulted in established populations.

Oswego (1,2,3). Fallfish were taken from large, swift streams and occasionally from lakes during the 1927 survey (Greeley 1928). The species remains widely distributed, with a frequency of occurrence in streams of 17% from 1996-2010.

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Black (**2,3**). This species was first reported from this watershed in 1961, from the Middle Branch Moose River at Old Forge. Because this was an upriver site, with several natural barriers downstream, it is likely that the species was introduced. In 1971, Fallfish were reported from two tributaries of the Black River, several km downstream of the Black River Feeder Canal crossing at Boonville. In both streams, the specimens were taken downstream of the Black River Feeder Canal crossing. Intensive survey work from 1976-77 did not turn up any individuals in the Black River (although there may be identification errors in these surveys (Panek 1978)), and it was not until 1982 that any Fallfish were found in the Black River itself. Sampling from 1992-93 found this species to be widespread in all seine collections as far downstream as Carthage and as far upstream as the Sugar River. The species has clearly become well established in this watershed. No Fallfish have yet been reported in the reaches of this river downstream of any barriers. Because this minnow is native to Lake Ontario, its presence in this watershed downstream of barriers would be a natural range expansion and its status will have to be reassessed.

Saint Lawrence (1,2,3). Fallfish were abundant and were present in the river and all lowland sites during the 1930 watershed survey but were absent from upland sites (Greeley and Greene 1931). The species has been introduced at many upland sites and now occurs farther upstream, including a 2002 report of Fallfish from the Osgood River, near Paul Smiths College.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that this species was abundant in the lower river and all its downriver tributaries. Its range has expanded in recent decades to include sites upstream of Cranberry Lake and into the West Branch Oswegatchie River. Fallfish have also been caught more frequently in recent years, with a frequency of occurrence of 35%.

Raquette (1,2,3). Greeley (1934) listed this minnow as common, noting that it was not found at higher elevations sites but was present in the Raquette River from Stark Falls to its mouth, as well as in the tributaries of this stretch of the river. In 2007, Fallfish were found as far upstream as West Potsdam (NYSM 62667) and Tupper Lake.

Champlain (1,2,3). Greeley (1930) noted that the Fallfish was “common in lower courses of the larger creeks entering Lake Champlain and not rare in the lake. It is also recorded from Lake George.” The species remains common in these lakes, and it is now present at many higher-elevation sites, where it has been introduced in recent decades.

Chemung (1,2,3). Fallfish were collected from over 30% of the 1937 watershed survey sample sites, with individuals being found in the rivers and larger tributaries of the watershed (Greeley 1938). This species was collected at 37% of stream sites in later surveys, indicating that it remains common and widespread.

Susquehanna (1,2,3). This species was abundant in samples from larger streams and was the seventh most frequently encountered species in the 1935 watershed survey (Greeley 1936). In later surveys, it occurred at over 32% of the sites sampled.

Delaware (1,2,3). This minnow was among the most frequently caught fishes in the watershed and was found in all of the larger streams sampled during the watershed survey (Greeley 1936). The species remains widespread and common in this watershed.

Upper Hudson (1,2,3). During the 1932 watershed survey, this fish was found in the river and lower-elevation tributaries, as well as at many upland sites (Greeley and Bishop 1933). Fallfish were not initially found at higher elevations, and Mather (1886) presented information indicating that the species was introduced into Piseco Lake in the headwaters of the Sacandaga River in the late 1870s. Expansion into other headwater sites occurred in subsequent years via connecting streams. In recent years, Fallfish have been caught less frequently in streams than in the 1932 survey.

Mohawk (1,2,3). Greeley (1935) stated: “Large chubs are gamy and inhabit fast waters like trout or small-mouthed bass and will take artificial or natural baits with a readiness that makes them annoying to anglers bent on better game…While native to a large area, the fallfish is absent from a large region of upland waters. Unfortunately, it has been introduced into the West Canada Creek in the region from the falls above Wilmurt to the Hinckley dam….” Fallfish continue to be found throughout the watershed and have gained access to additional upland sites in recent decades.

Lower Hudson (1,2,3). This species was listed as abundant during the 1937 watershed survey, being present at 15% of the sites sampled, with most of the 139 records coming from medium-sized to large streams, including the Hudson River (Greeley 1938). Although its frequency of occurrence has remained around 15% in recent surveys, this minnow has become less widespread in streams, and captures in the main channel have become relatively rare.

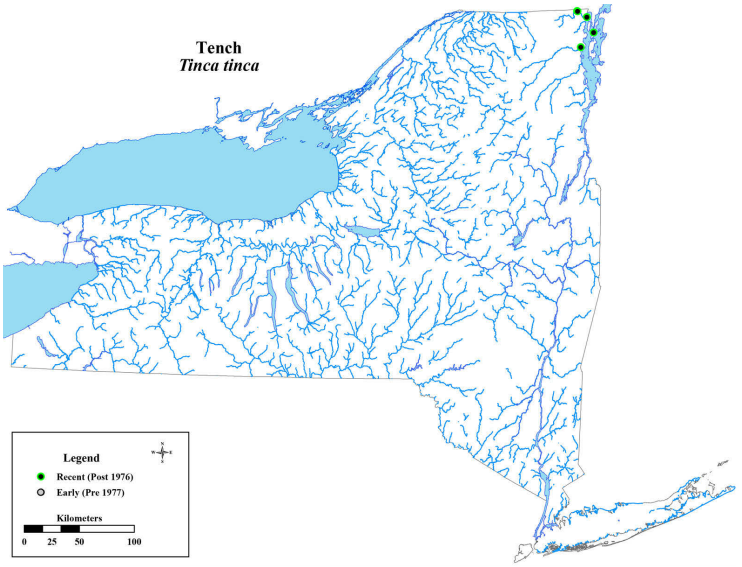
Newark Bay (1,2,3). This species was collected at 13% of the sample sites in the 1936 survey (Greeley 1937). Most of the many recent records of this species in the watershed are from the Ramapo River.

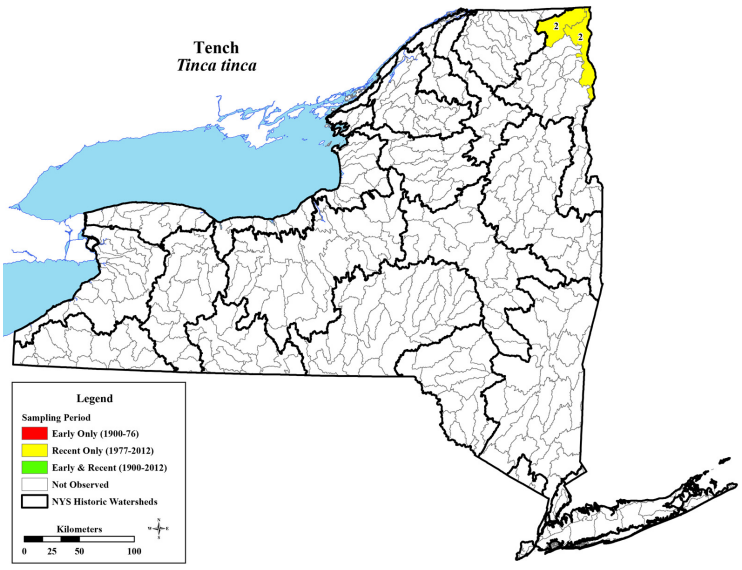
Long Island (1,3). Fallfish were absent from the islands (Greeley 1939a) but present in the Bronx River, Westchester County, in 1936 (Greeley 1937). The species continues to be reported from streams draining into Long Island Sound, such as the Mianus River in 1994 and the Byram River in 2010.

Tinca tinca, Tench

This Eurasian carp established itself in Lake Champlain around 2000, presumably from downstream migrants that gained access to the system after escaping from aquaculture ponds in Quebec. Tench had previously been reported on Long Island (Lee et al. 1980), but that introduction apparently failed to establish itself.

Champlain (**3**). Escaped fish were found reproducing in the downstream reaches of the Richelieu River in Quebec as early as 1991. Tench were first caught in New York from the Great Chazy River in 2000. A panfish buyer reported Tench in the summer of 2002 at North Hero, VT (B. Chipman, Vermont Department of Fish and Wildlife, pers. comm.), but these fish may not have been captured in the lake. More recently, specimens were caught at Kings Bay and at Plattsburgh in 2009, near Plattsburg in 2010 (NYSM 67136), and in Dead Creek (NYSM 69877) and at Rouse's Point (NYSM 69575) in 2013.





Catostomidae, Suckers

Suckers are typically large fish and are readily identified by their fleshy lips and subterminal mouths. Most sucker species are demersal insectivores. Species of the genera *Minytrema*, *Moxostoma*, *Ictiobus*, and *Carpiodes* are typical of large rivers and lakes and, in New York, are found in Lakes Erie and Ontario, the larger interior lakes, and in river main channels and major tributaries. Species in the genera *Catostomus*, *Hypentelium*, and *Erimyzon* inhabit a wide variety of habitats, from headwater brooks and ponds to rivers and lakes. There are 13 catostomid species that are native to New York. In recent years, three additional species and a hybrid form have become established in Lake Erie and have immigrated into New York waters; their overall distributional status is, as yet, undetermined. A word of caution about early identifications of *Moxostoma* records–the taxonomy of this genus was not well understood until a monographic treatment of the group by Jenkins (1970). As a result, early identifications combined species, ignored other species, and misidentified still others. Without vouchered specimens that enabled later researchers to identify the species caught, these identifications are highly suspect. Luckily, many of the specimens collected during early surveys were accessioned into museum collections.

Carpiodes cyprinus, Quillback

This species inhabits large rivers and lakes in the Allegheny watershed and the Saint Lawrence drainage. Quillbacks require streams with gravel or rubble for spawning. Because this sucker species inhabits areas that are more difficult to sample, it is probably underrepresented in reports and among voucher specimens. The status of this species in the watersheds of the Saint Lawrence River drainage cannot be adequately explained with the available information. Underhill (1986) treated the Quillback as native to this drainage. All collections save one, however, were taken within the last 70 years and there are relatively few reports. As is true for all species that are regarded as native in Lake Erie, their status downstream of Niagara Falls is dependent upon the dispersal route taken. Dispersing over or around the falls during periods of high water flow would make them native; use of the Welland Canal or actual stocking would make them non-native. Until additional information about these populations becomes available, we follow Underhill (1986) and treat them as native.

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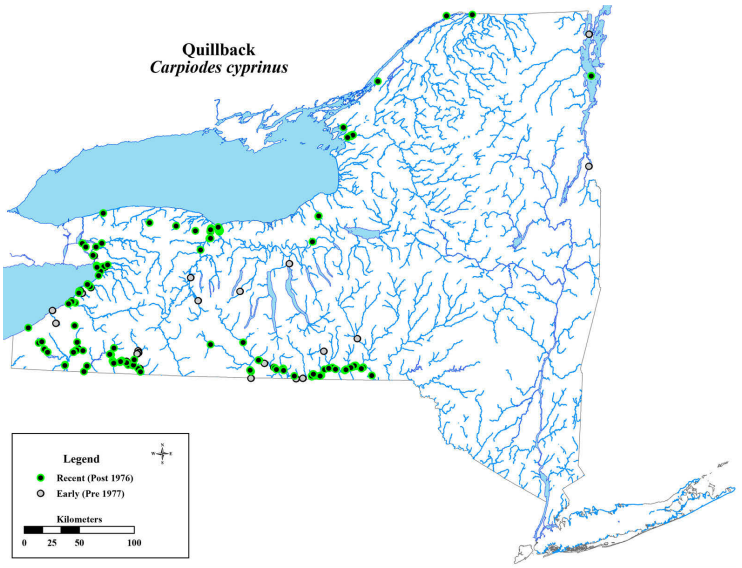
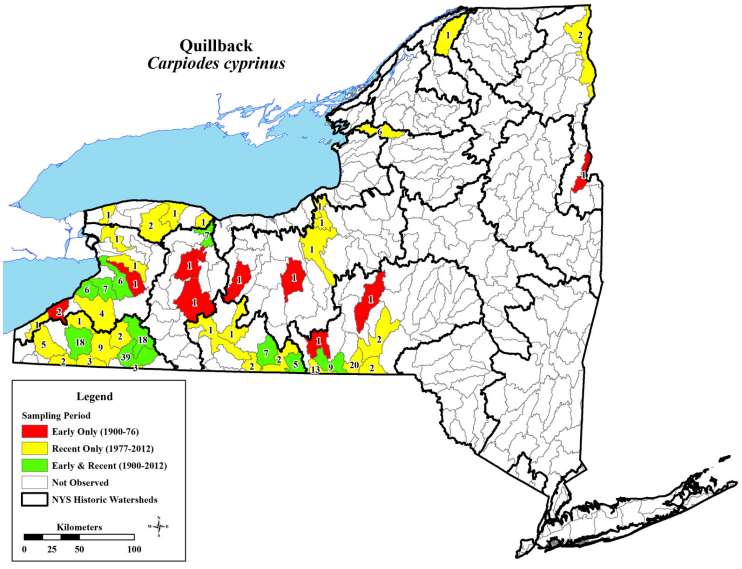




Allegheny (1,2,3). A single individual was taken in 1937 from the Allegheny River near Olean (Greeley 1938). Since then, individuals have frequently been caught in the main channel. This species has also been taken in the lower reaches of main-channel tributary creeks, like Chipmunk Creek (Becker 1982). In the central basin, Quillbacks are regularly taken in Conewango Creek (Smith 1985, Pomeroy 1995). No records exist from the western basin. This fish is a mainstay of Allegheny River fish communities in Pennsylvania, so its rarity in the 1937 survey of this watershed (Greeley 1938) is curious, particularly because the New York portion of the watershed was not isolated by the Kinzua Dam, which was completed in 1965. It is possible that, without the reservoir, the deep-water habitat favored by the Quillback was not adequately available. Subsequent increases in numbers may, therefore, be related to the creation of the reservoir.

Erie-Niagara (1,2,3). In 1894, Cloudsley Rutter collected a specimen from Silver Creek, a tributary to Lake Erie (USNM 58743). Greeley (1929) noted that the Quillback was common in Lake Erie and migrated well up into creeks to spawn. In fact, he noted that large numbers were taken from Cattaraugus Creek in the spring, in a cottage or commercial fishery. The species remains common in Lake Erie and continues to be caught in Cattaraugus Creek.

Ontario (2,3). Beginning in the 1970s, Quillbacks have been reported from Irondequoit Bay, East Branch Twelve Mile Creek, and Chaumont Bay. Crossman and Van Meter (1979) noted occasional records as strays from Lake Erie.

Genesee (2,3). This species has been caught in Canasaraga Creek in 1960 and the Genesee River in 1971 (NYSM 43236), where it continues to be caught regularly.

Oswego (2,3). The earliest records of Quillbacks in this watershed were from the West River, south of Canandaigua Lake, and from Cayuga Lake in 1955 (USNM 21085). Since then, specimens have been collected only two additional times: from Cross Lake in 1994 and the Oswego River in 1997 (NYSM 46875).

Black (3). This species has only been caught at the mouth of Black River.

Saint Lawrence (2,3). This species was reported from Chippewa Bay of the Saint Lawrence River in the 1970s (Dunning et al. 1978). It was also reported downstream, near Massena, in 2001 and 2014.

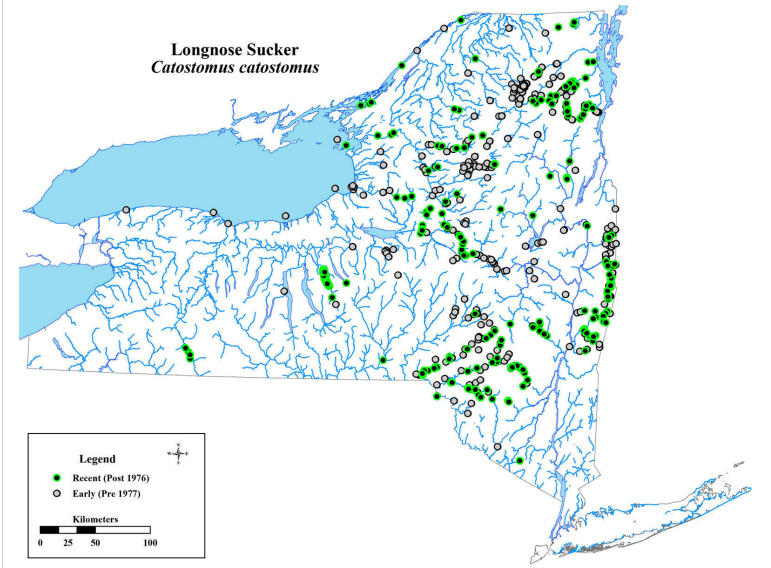
Champlain (1). Evermann and Kendall (1902a) reported Quillbacks from the lake. Although the species is likely to be present in the New York portion of the lake, all recent records are from Vermont, spanning the period from 1970-2001 and including sites at Burlington Harbor and Mississquoi Bay (Anderson 1978; Langdon et al. 2006).

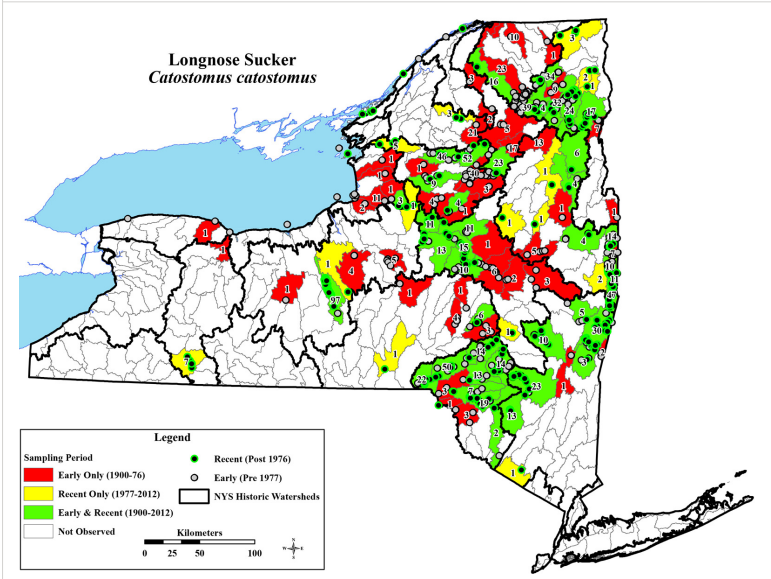
Chemung (1,2,3). Greeley (1938) reported on a few young specimens that were seined in the Cowanesque River at the Pennsylvania state line. The species remains rare in catches in recent years but has collectively been caught nine times in the Chemung, Tioga, Canisteo, and Cohocton rivers.

Susquehanna (2,3). The first reports of the Quillback from this watershed were from the Otselic River in 1970 and from the Susquehanna River near Owego in 1971 and near Kirkwood in 1979 (AMNH 43954). Since the 1990s, this species has been reported many times from the Susquehanna River upstream to Binghamton.

Catostomus catostomus, Longnose Sucker

This sucker lives in cooler streams and lakes and is native to 13 of New York's 18 watersheds. Numbers have declined in the Ontario, Susquehanna, and Raquette watersheds, with the species appearing to be most stable in eastern and northern watersheds. It continues to be found in about half of the areas where it was known historically. A dwarf form, described as *Catostomus nanomyzon* Mather, has been recognized as either a distinct species or subspecies by some authors. This form has been reported from Adirondack lakes in several watersheds, and stream-dwelling individuals in the Upper and Lower Hudson and Delaware watersheds rarely exceed the size typical of the dwarf suckers found in the Adirondack watersheds. There is no recent re-evaluation of the taxonomy of this potential species complex of fishes. Fetzner and Rawlins (2007), however, found no genetic differences among populations and did include some individuals from New York in their analysis. LePage (2014) studied a group of conspecifics in western Canada and, although he reported differences between dwarf and full-sized populations, also did not treat the dwarf form as a distinct taxon. Following these authors and the current widely accepted taxonomy, we do not recognize the dwarf form as a separate taxon here.





Ontario (1,2). Greeley (1940) reported that Longnose Suckers were found at two sites during the watershed survey: Redfield Reservoir and Mill Stream, a tributary of the North Branch of the Salmon River (NYSM 26002). At least one specimen, however, was also taken from the lake itself in 1939 (NYSM 13853). Longnose Suckers were also collected from Abaijah Creek in 1975 and the upper Salmon River in 1979 (AMNH 43732) and 1982. Greeley (1940) also noted that commercial fishermen reported the species to be abundant in Lake Ontario, but records for the lake have been inconsistent. Specimens were collected from 1942-43 and one was netted in 1980 in the eastern part of the lake. A lake-wide study in 1972 captured none, however, and none were found during survey work from 1972-1998 (Owens et al. 2003) or 1978-1997 (O'Gorman and Burnett 2001). Therefore, despite the anecdotal report in Greeley (1940), this species has never been demonstrated to be common in the watershed, and it appears to have substantially declined in recent decades.

Species continued on next page

Genesee (1,2,3). Before 1910, Seth Green collected an individual near Rochester (MCZ 18358) that could be from this watershed, although this species is rare in low-elevation sites today. The first report from farther upstream in the Genesee River was a 1980 collection made near Scio (Allegany County), and Longnose Suckers continue to be caught in the reach between Belmont and Scio (e.g., NYSM 53930 in 1987).

Oswego (1,2,3). This species was rare during the 1927 watershed survey, with the only specimens taken from deep water in Owasco Lake (Greeley 1928). Later reports also exist from upstream at Owasco Inlet. In 1954, several specimens were taken from Seneca Lake (CUMV 28977). The species remains difficult to capture, but its status in the watershed seems unchanged in recent years.

Black (1,2,3). Greeley and Bishop (1932) reported that this species was common in the Adirondacks and, conversely, rare or absent from collections at lower elevations. More recent catches have spanned the watershed and include: Little Otter Lake in 1992, the Black River at rkm 8 in 1993, Lake Lila in 1995, Woodhull Creek in 2003, and Stillwater Reservoir in 2010.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that Longnose Suckers were moderately common in the Adirondack area of the watershed and that most of the specimens collected came from the Saint Regis chain of lakes. The species continued to be caught in the Saint Regis basin with regularity until 1986. Only one specimen has been taken from the basin since, at the Allen Falls Reservoir in 1997. A single record also exists from Jocks Pond in the Grass River basin in 1968. Although Greeley and Greene (1931) emphasized that this was a cool-water, upland species, six records exist from the Saint Lawrence River: two from the Thousand Islands area in 1982 and 1984 (McCullough and Hart 2007), two near Ogdensburg in 1977 (Panek 1978) and 1993, and two from Lake Saint Lawrence in 1981 and 1997 (Klindt 2007).

Oswegatchie (1,2). This sucker was reported as common in the Adirondacks by Greeley and Bishop (1932). In 1940, two specimens were taken from the West Branch Oswegatchie River at Jerden Falls (CUMV 8992). The species was reported from Cranberry Lake in 1969, and the last records from the Oswegatchie basin are from 1982 in the Flat Rock and Browns Falls reservoirs. The Longnose Sucker, therefore, appears to be extirpated from this watershed.

Raquette (1,2,3). This species was common in Adirondack lakes during the 1933 survey, with Raquette, Tupper, Eaton, Mohegan, and Sagamore lakes serving as a few examples of collection localities (Greeley 1934). Recent records exist from Hannawa Falls in 1983 (Niagara Mohawk Power Corporation 1991b), Sagamore Lake in 1986 and 1997 (Daniels et al. 2011a), and Piercefield Flow in 1991 (Preist et al. 1994).

Champlain (1,2,3). Lesueur (1817) documented Longnose Suckers in Lake Champlain, but no specimens have been collected from the lake in recent decades. A specimen was collected from Lake George in 1850 (USNM 1). Greeley (1930) noted that this species was common in many of the Adirondack lakes and streams of the Saranac and Ausable systems. Recent catches are from these same systems.

Susquehanna (2,3). In 1950, three specimens were collected from Otego Creek (CUMV 19095). Between 1957 and 1972, Longnose Suckers were collected at 12 sites in the upper watershed. In 1978, a pair of specimens was collected from Elk Creek near Schenevus (AMNH 41244). Since 1978, the continued presence of this species in the watershed is supported by a single capture at Chenango Bridge in 2008 (C. Millard, USEPA National Rivers Study, pers. comm.).

Delaware (1,2,3). There are 15 records of this species from the 1935 survey, all from streams of the East Branch and West Branch Delaware River (Greeley 1936). Greeley (1936) identified each specimen as *Catostomus catostomus nanomyzon*, noting that adults in breeding conditions were taken as late as July 18. Specimens continue to be collected during routine DEC sportfish surveys and in more intensive surveys of the East Branch and West Branch Delaware River, the Cannonsville and Pepacton reservoirs and several smaller streams. Recent reports are from upstream of Hancock, but, prior to 1980, individuals were collected farther downstream in Orange and Sullivan counties (CUMV 34796, AMNH 38568).

Upper Hudson (1,2,3). Greeley and Bishop (1933) noted that Longnose Suckers were rare in the watershed surveys of the 1930s. Collections were reported from Schroon Lake and Mayfield Creek in the Sacandaga system, the upper Batten Kill, and the cold tributaries of Hedges Lake in the 1932 survey (Greeley and Bishop 1933), and from the Owl Kill, Lansing Kill, and Little Hoosic River in the 1934 survey (Greeley 1935). The species continues to be found in Schroon Lake, Newcomb Lake, and East Stony Creek. Smaller individuals have been taken from the eastern tributaries, in Washington and Rensselaer counties, in the 1990s and 2000s.

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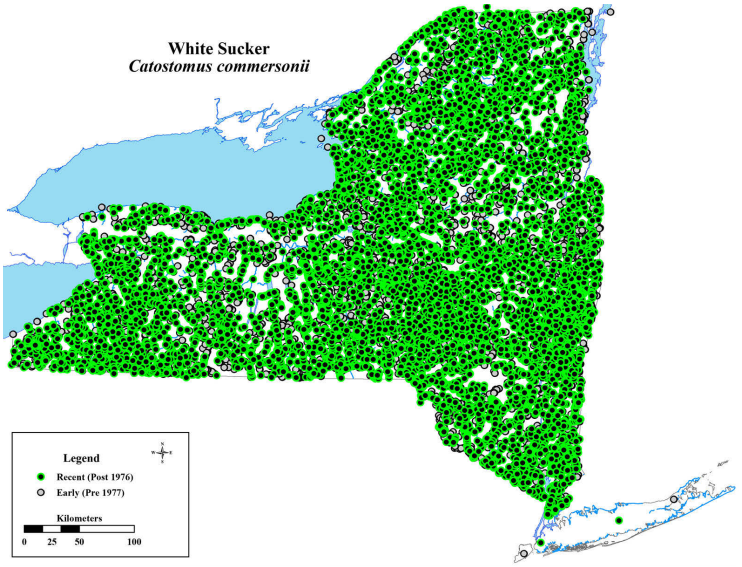
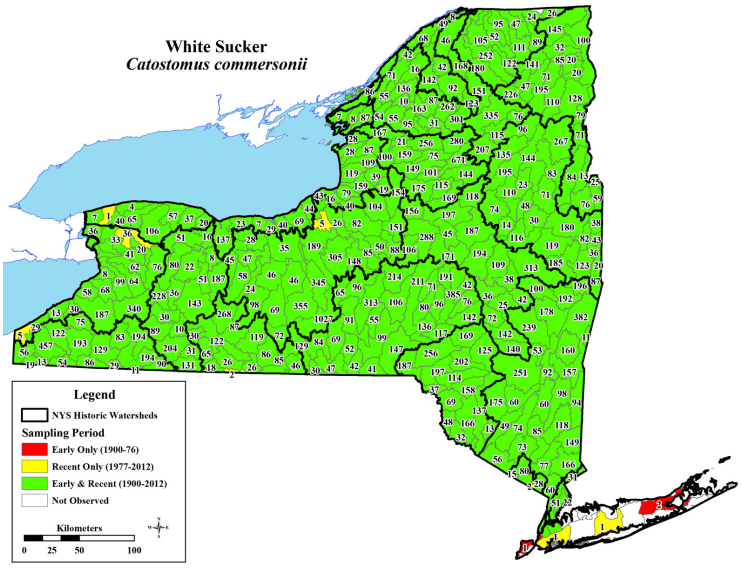
Mohawk (1,2,3). In the 1934 survey, Greeley (1935) reported records from West Canada Creek, East Canada Creek, the Old Erie Canal, and seven Mohawk River tributaries (of which Flat Creek was the farthest downstream). More recent records are from Schoharie Creek near Blenheim in 1990, and from the Mohawk River upstream of Little Falls, West Canada Creek, and the mouth of Cincinnati Creek in 2008 (NYSM 64229). All records after 1955 are from upstream sites, either in the western part of the watershed or in the Catskills or Adirondack Mountains, suggesting a range retraction.

Lower Hudson (1,2,3). Greeley (1935, 1937) noted that this species was found in Kinderhook and Claverack creeks, the Kline Kill, the Black River, Catskill Creek, the Green River, and the Roeliff Jansen Kill. In the 1990s and 2000s, Longnose Suckers continued to be collected in these streams and have also been found in the Esopus, Rondout, and Wallkill systems. Recent collections include tributaries of Esopus Creek downstream of the portal at Shandaken in 2009 (NYSM 65100) and the Moordener Kill in 2013 (NYSM 68592). A single record exists from Quaker Creek next to the New Jersey state line in 1991, although the species has not been reported that far south from any other stream in this area.

Catostomus commersonii, White Sucker





This opportunistic species seems to live everywhere. It is found in main river channels and tributary streams, including headwaters, ponds, and lakes, and has few habitat requirements, although it depends on gravel areas for spawning. White Suckers are found in all 18 watersheds in the state. The species was historically absent from Staten, Long, and Fishers islands, as well as some of the higher-elevation ponds of the Adirondacks. This is the most frequently caught stream fish in the state and, as such, these watershed accounts will focus only on interesting attributes of the species or on recent range extensions.

Allegheny (1,2,3). This species is ubiquitous in tributaries throughout all three basins of the watershed and has been encountered frequently during all sampling periods.

Erie-Niagara (1,2,3). This species is widespread and relatively common.

Ontario (1,2,3). The species has been widespread and commonly encountered during all surveys.

Genesee (1,2,3). This species is widely distributed and is among the five most commonly caught stream fishes in this watershed.

Oswego (1,2,3). White Suckers are abundant and widespread throughout the watershed.

Black (1,2,3). Greeley and Bishop (1932) pointed out that “nearly every body of water, whether stream, lake or small pond has this fish.” The species remains abundant and widespread.

Saint Lawrence (1,2,3). Greeley and Greene’s (1931) account emphasized the dominance of this fish: “It would hardly be an exaggeration to say that this species inhabits every body of water in the region. It is found in small ponds, large lakes, and streams ranging in size from small brooks to the St. Lawrence River.” This assessment remains valid in recent years.

Oswegatchie (1,2,3). White Suckers were, and continue to be, abundant and widespread throughout this watershed.

Species continued on next page

Raquette (1,2,3). Greeley (1934) dealt extensively with the forms of White Sucker present in this watershed–forms that were readily distinguishable but taxonomically unsettled. He (Greeley 1934) noted that in the Saint Lawrence and Raquette rivers and tributaries, “at least as far upstream as Stafford Brook, there is a sucker with large scales, a more massive pharyngeal bone, and distinctly inferior mouth.” White Suckers continue to be abundant and widespread throughout the watershed.

Champlain (1,2,3). This species is abundant and widely distributed, inhabiting lakes, creeks, and many ponds throughout the region.

Chemung (1,2,3). White Suckers were abundant and widespread during earlier surveys, and this species continues to be a dominant fish in the watershed.

Susquehanna (1,2,3). In 1879, a White Sucker was taken in Cooper’s Lake (= Otsego Lake; USNM 23469). Greeley (1936) stated: “This species has the ability to get along under almost all conditions presented by waters of the region. It is lacking in many streams at the extreme headwaters but is present in nearly every other type of habitat.” This was the most frequently caught species in the 1935 survey. In later surveys, this species occurred at over 50% of the sites sampled.

Delaware (1,2,3). In this watershed, the White Sucker was the most frequently caught species during the 1935 watershed survey, with specimens taken in the main channel, large and small tributaries, headwaters, lakes, and reservoirs (Greeley 1936). The species remains abundant and widespread throughout the watershed.

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported: “The sucker is the most generally distributed species of fish in the region, occurring in nearly all streams, lakes and ponds from which collections were taken.” White Suckers remain abundant and widespread in the Upper Hudson watershed.

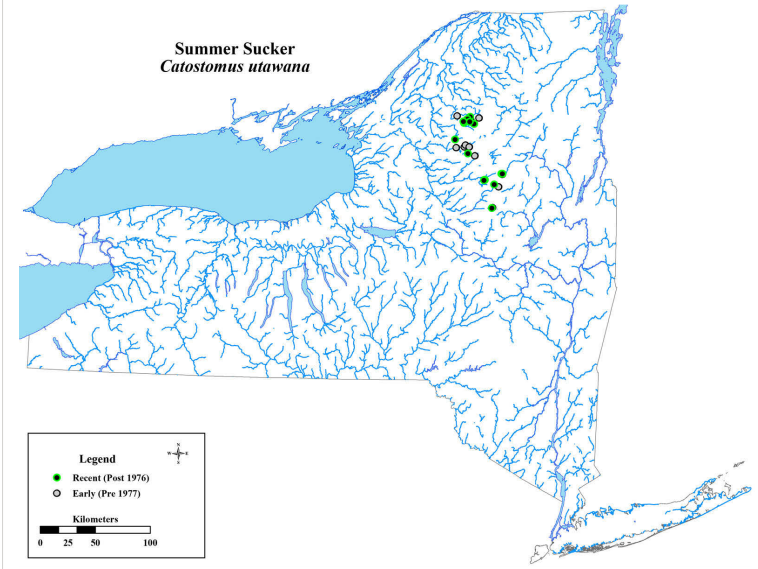
Mohawk (1,2,3). In both early (Greeley 1935) and later surveys, the White Sucker has been the most abundant and widely distributed species in this watershed.

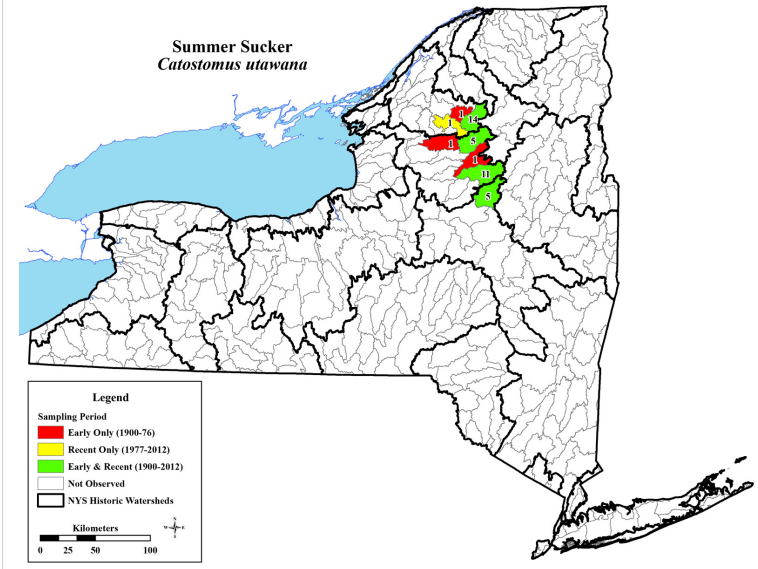
Lower Hudson (1,2,3). During the 1936 survey, White Suckers were found throughout the watershed and were present at most sites, with the exception that they were scarce in extreme headwaters and the lower part of the estuary, where the water becomes more brackish (Greeley 1937). This was the most commonly caught species in streams in the 1990s and 2000s although, more recently, it has not been caught as frequently in the main channel of the Hudson River (Daniels 1995).

Newark Bay (1,2,3) White Suckers are common throughout the watershed.

Long Island (1,2,3). In 1938, several specimens were taken from Fresh Kill on Staten Island (NYSM 33109), and this was the only island site where White Suckers were taken during the watershed survey (Greeley 1939a). The species was common, however, in mainland streams in Westchester County, such as the Mianus, Mamaroneck, Bronx, Byram, and Wampus rivers, where it occurred at 57% of the sites sampled (Greeley 1937). A museum record from Suffolk County in 1930 (NYSM 11592) is the earliest report of this species on Long Island. Specimens were taken from Marratooka Lake in 1954, in New York City in 1997, and from Lake Ronkonkoma in 1999. There have been no subsequent island collections and it appears that no populations have become established there. Specimens continue to be taken from Westchester County streams with regularity.

Catostomus utawana, Summer Sucker





This small sucker lives in small headwater lakes and streams of the western Adirondack Mountains and was historically thought to be native to 6 of 18 New York watersheds. The species continues to be found in the Black, Oswegatchie, Upper Hudson, and Mohawk watersheds. The status of populations in the Saint Lawrence, Raquette, and Champlain watersheds is unclear. Mather (1886) described this species from breeding fish taken from Minnow Pond near Blue Mountain Lake (Raquette watershed) and from Big Moose Lake (Black watershed) on June 26, 1882 (USNM 33918, 33919). The Summer Sucker is currently the only endemic species in the state and was recently redescribed (Morse and Daniels 2009, lectotype USNM 392731). The range of this species is restricted and poorly defined (Morse 2007). During the earlier surveys, this form was treated as either a subspecies or as a distinct morph of White Sucker. These accounts are often confusing and incomplete, so its historical range is as poorly defined as its current range. Summer Sucker characteristics that differ from those of the White Sucker include spawning times extending beyond mid-June, slower growth rates, and subtle morphometric measurements (Morse 2007). This species has been designated as a Species of Greatest Conservation Need in New York.

Black (1,2,3). Greeley and Bishop (1932) listed this species as locally common and found it in many high-elevation lakes; specimens were taken at the Beaver River Flow, downstream of the Stillwater Reservoir. These specimens, collected on July 7, 1931, were later confirmed as this species. Repeated efforts to recapture Summer Suckers at this site have been unsuccessful. A population was, however, reported from Razorback Pond, a small pond upstream of the reservoir, in 1976 and from 2010-2014. This sucker has recently been found in several lakes in Hamilton County, including Little Moose Lake in 1972 (CUMV 68889) and from 2006-2013, Squaw Lake (Morse 2007), and nearby Beaver Lake in 2008 (R. Morse, NYSM, pers. comm.).

Saint Lawrence. Greeley and Greene (1931) listed this species as “moderately common” in the Saint Regis lakes and mentioned that spawning was observed in a tributary of Lower Saint Regis Lake on 14 June 1930. In recent surveys, late-spawning suckers have not been found in any of the lakes where they were common in 1930. Re-examination of the specimens caught in 1930 (NYSM 32925, 13441 and 13462) showed they had morphometric measurements inconsistent with Summer Suckers. Recently collected suckers from these same waters have measurements that conformed to those present in

Species continued on next page

individuals from 1930; these individuals are, therefore, also not *C. utawana* (R. Morse, NYSM, pers. comm.). We do not consider any of the fish currently inhabiting this watershed to be *C. utawana* and do not include points on the distribution map for this species.

Oswegatchie (1,3). Summer Suckers were locally common during the 1931 watershed survey, and a spawning run was encountered in the Oswegatchie River at Wanakena (NYSM 38624) and in Dead Creek on 2 June 1931 (Greeley and Bishop 1932). Specimens were also collected from Otter Pond in 1931 (NYSM 38425). Kendall and Dence (1929) observed a spawning migration upstream of Cranberry Lake at Little Falls on 31 May 1919. These areas were revisited in 2008 and 2009, and individuals were found in the Oswegatchie River at Wanakena (NYSM 70237), at Little Falls (NYSM 65109), and in the outlet of Otter Pond (NYSM 65104). No individuals were found in Otter Pond itself in 2009, however. In 2009 and 2010, fish were found in Gregg Lake and Cowhorn Pond, respectively. Additional survey work in this watershed is necessary to more completely evaluate the status of this species.

Raquette. Greeley (1934) reported that this species was locally common and that specimens were taken from Lake Eaton, South Pond, Long Pond, Otter Pond, Little Rock Pond, and the Salmon River, which is the inlet of South Pond. Two specimens were also found in Minnow Pond, near Blue Mountain Lake, in 1882 (USNM 33918). Extensive recent surveys show that late spawning suckers remain only in Long Pond (NYSM 70034), but measurements of these fish demonstrate no concordance with those of the Summer Sucker (R. Morse, NYSM, pers. comm.). Additional information is needed on this group of fish from the Raquette watershed. Until studies are completed, the status of this species in this watershed is uncertain, and we do not include the records on our map.

Champlain. Greeley (1930) did not report finding this species in the 1929 survey of the watershed. Greeley did collect *Catostomus* specimens, however, in the outlet to Lake Clear (UMMZ 95616) and the outlet to Little Clear Pond (UMMZ 95619) in 1930. These two lakes are in the extreme headwaters of the Saranac River system and are just across the divide from the Saint Regis lakes of the Saint Lawrence watershed, where *C. utawana* was locally common. This group of individuals is currently under study because their genetic characteristics differ from those of the western Adirondacks populations (E. Hekkala, Fordham University, pers. comm.). Our map does not include these records.

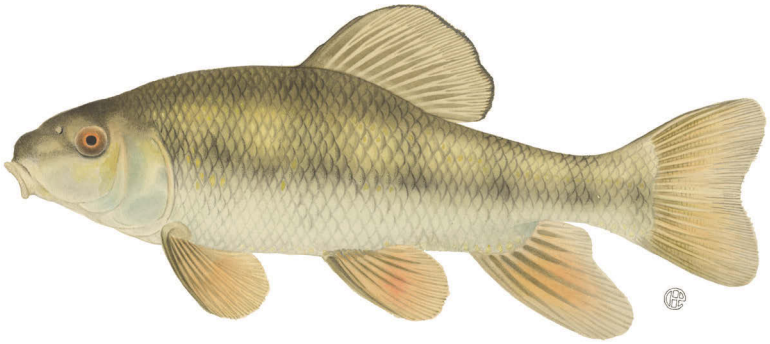
Mohawk (1,2,3). This species was rarely found during the 1934 survey of the watershed and was reported only from the West Canada Creek basin, specifically in Little Pine, West, and Sampson lakes (Greeley 1935). On re-examination, Morse (2007) was able to confirm only the specimens from Little Pine Lake as Summer Suckers (NYSM 33225). Webster (1973) collected this species from Pine Lake, where it was found again in 2008 (NYSM 64182), with additional recent records coming from Little Pine Lake in 2009 and West Lake in 2014 (NYSM 71222). Although Sampson Lake was surveyed in 2011, no Summer Suckers were found.

Upper Hudson. Webster (1972) collected fish that he called *C. utawana* in Elk Lake and Tirrell Pond and similar collections were made in 2010 and 2013 (NYSM 70036, 70035). These populations show spawning chronology in agreement with the Summer Sucker but have morphometric discrepancies from western Adirondack populations (R. Morse, NYSM, pers. comm.). Due to these discrepancies, our map does not show the watershed records mentioned above.

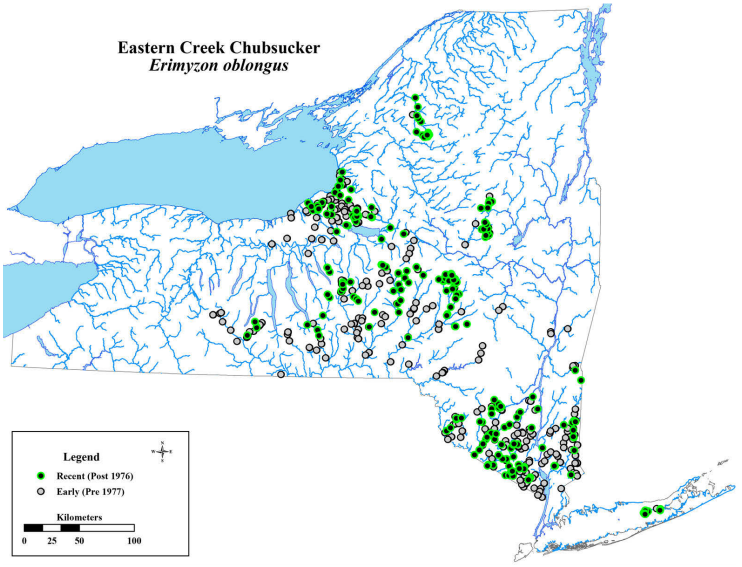
Catostomus sp. cf. *utawana*, Undescribed species from the eastern Adirondacks

Measurements of specimens collected from Elk Lake in 1972 and in 2009 (NYSM 70259) differed from both *C. commersonii* and *C. utawana*. These specimens did show late-spawning characteristics like *C. utawana*, however (Carlson et al. 2015). We tentatively treat fish in these populations as a separate taxon because they cannot be placed definitively in a described species. Suckers with similar late-spawning characteristics were also found in waters of the Upper Hudson (Boreas Ponds), Saint Lawrence (Fish Pond), Raquette (Thirtyfive Outlet), and Champlain (Lower Ausable Lake) watersheds. We do not provide a range map, but, after additional studies are completed, we expect that maps for this taxon will be developed. This taxon has been designated as a Species of Greatest Conservation Need in New York.

Erimyzon oblongus, Eastern Creek Chubsucker

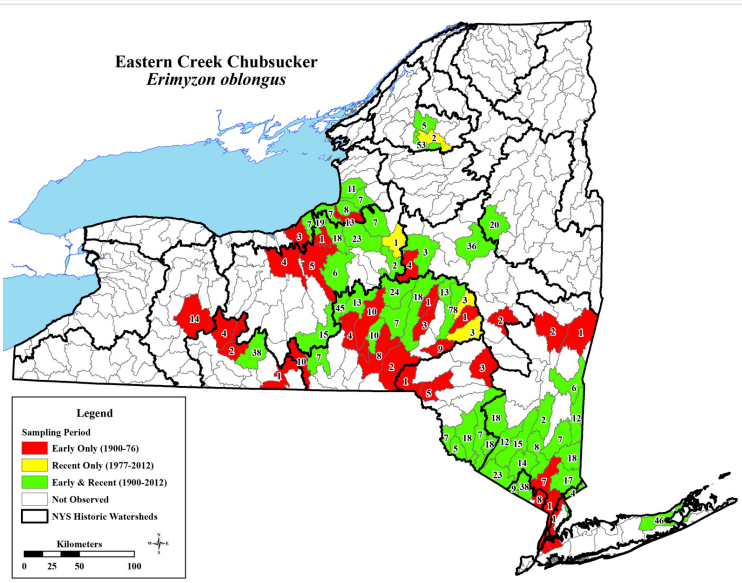


This medium-sized sucker inhabits lowland and upland streams and lakes and often occurs in dark-stained waters. It is found in the state's eight Atlantic Slope watersheds as well as four of the watersheds in the Saint Lawrence River drainage.



Ontario (1,2,3). Greeley (1940) noted: "Although common in sluggish, lowland creeks of the eastern part of the Lake Ontario Watershed, this sucker was not found west of Blind Sodus Bay." This species continues to be collected episodically in the eastern part of the watershed, including records from a tributary of South Pond in 1981 (AMNH 227048), Sage Creek in 2005, and Rice Creek (NYSM 61365) in 2006.

Oswego (1,2,3). Greeley (1928) reported that this species was common in "shallow weedy areas of lakes, rivers, ponds and warm streams, where the current is moderate to stagnant and the bottom usually soft." Eastern Creek Chubsuckers continue to occasionally be caught throughout the watershed, although catches have declined in the Clyde River basin in the western part of the watershed.



Oswegatchie (2,3). This species was first reported in 1955 from Long Pond in Lewis County. More recently, specimens have been collected from the Middle Branch Oswegatchie River in 1996 (NYSM 45890) and the West Branch Oswegatchie River in 2007 (NYSM 62292).

Chemung (1,2,3). Eastern Creek Chubsuckers were found at about 13% of the sites sampled during the 1937 survey of this watershed (Greeley 1938). Since 1969, this species has been reported only seven times, with most of these reports coming from the areas near Waneta and Lamoka lakes in 1993. Although the species was collected frequently in the western part of the watershed in 1937, it has not been reported from these streams in recent surveys, which suggests a major range contraction in this watershed.

Susquehanna (1,2,3). Greeley (1936) noted that this sucker was common in the watershed, being found in most lakes and ponds as well as in low-velocity streams. The species continues to be found at many upstream sites, for example, at Cayuta Lake in 1993 (NYSM 13327), but collections from downstream sites have become rare, suggesting a recent range loss in this watershed.

Species continued on next page

Delaware (1,2,3). Eastern Creek Chubsuckers were common in the 1935 survey, where they were collected at nine sites (Greeley 1936). The species continues to be found in this watershed, with recent collections from Basher Kill marsh, White Lake outlet, the Neversink River, Fox Pond, and off-channel pools of the Delaware River (R. Horwitz, ANSP, pers. comm.). This species has been collected from 12 bodies of water since 1935, but none are in the western (Delaware County) part of the watershed, which was part of the historic range of this sucker.

Upper Hudson (2,3). A collection from Loon Lake in 1946 (CUMV 70353) represents the first report of this species from this watershed. In 1957, it was also reported from Mud Lake, in Hamilton County. In the 1980s, Eastern Creek Chubsuckers were found in three ponds (Gallagher and Baker 1990). Other recent reports are from Spy Lake, Piseco Lake, the West Branch Sacandaga River, and several records from Oxbow Lake.

Mohawk (1,2,3). DeKay (1842) noted that this species was found in this watershed. Greeley (1935) collected specimens from a variety of sites, such as: "...West and East Stoner Lakes, Green Lake, Pine Lake, West Lake, Otter Lake, Third Lake, Fourth Lake, Lelands Pond, tributary 240, tributary 88 of the Schoharie Creek near Middleburgh, and the Chenango Canal at the headwaters of Oriskany Creek." The species continues to be reported at a few upland sites but has not been collected from either Schoharie or Oriskany creeks since 1970.

Lower Hudson (1,2,3). Greeley (1937) characterized this species as abundant and widely distributed, particularly in lakes and low-velocity streams. Eastern Creek Chubsuckers have consistently been reported from sites throughout the watershed, such as the Normans Kill in 1969 (NYSM 61134) and Whaley Brook in 1985 (NYSM 59060). Even more recently, in the 2000s, specimens were frequently collected from the East Branch Croton, Swamp and Wallkill rivers, Shawangunk Kill, and Pochuck Creek.

Newark Bay (1,2,3). Fowler collected Eastern Creek Chubsuckers in Naushonk Creek in 1914. In 1927, specimens were collected from the Mahwah River at the state line (UMMZ 89300). In 1936, this species was collected at several sites in the Hackensack and Mahwah River basins (e.g., NYSM 18260, 18289). Since then, additional collections have been made from Sterling Brook in 1998 (NYSM 48758), Little Dam Lake in 1999 (NYSM 50997), and Island Pond.

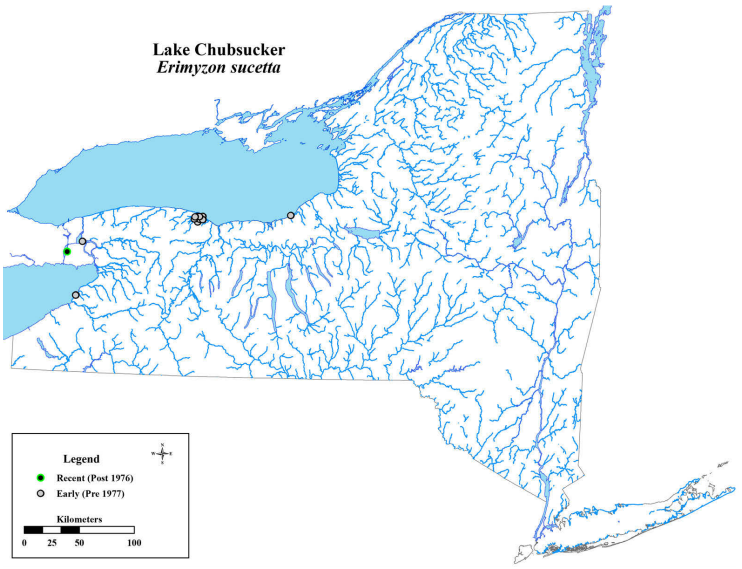
Long Island (1,2,3). The status of this primary freshwater fish on Long Island is presumed to be native, but its scarcity in the watershed does not preclude an early introduction. During the watershed survey, Greeley (1939) noted that Eastern Creek Chubsuckers were scarce in the Peconic River, which is at the eastern end of the island, with individuals only being found in an in-stream pond (CUMV 6262). The species continues to be taken in this basin from both the river and connected ponds, such as Swan Pond in 1973 (CUMV 54105), Duck Pond in 1985 (NYSM 14838), and Sweezy Pond in 2010 (NYSM 66243).

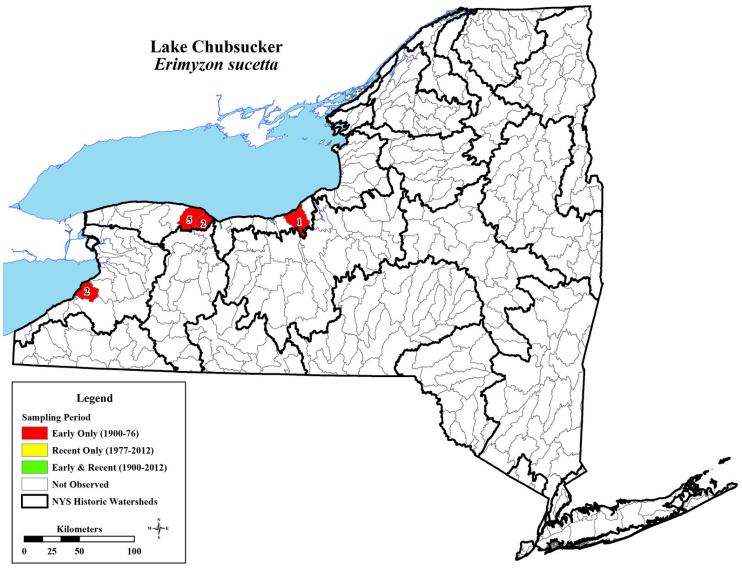
Erimyzon sucetta, Lake Chubsucker

This species, formerly called the Sweet Sucker, once occurred in densely vegetated bays of Lake Ontario west of Rochester and in the mouths of Lake Erie tributaries. The last New York records are from 1939 in Lake Ontario, despite the fact that this species continues to be caught near the lake just west of Niagara Falls in Canada (Mandrak and Crossman 1996). The Lake Chubsucker is, at best, extremely rare in New York and is classified as a Threatened Species in the state.

Erie-Niagara (1). In the 1928 watershed survey, one specimen was caught in Muddy Creek near Angola (Greeley 1929, NYSM 13736). No further records exist from the New York portion of this watershed.

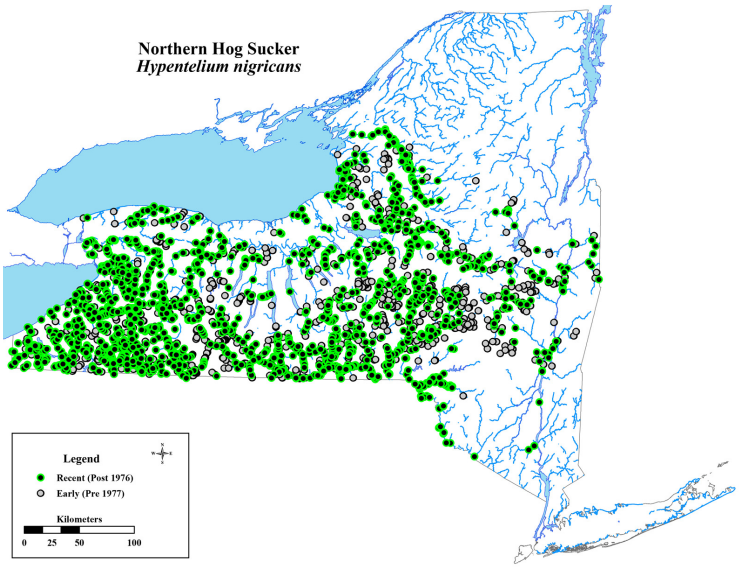
Ontario (1). A specimen was collected in the mid-19th century, from North Creek at Braddock Bay (CUMV 65398). Greeley (1940) noted that the taxonomic status of the Lake Chubsucker in New York was uncertain and that additional work was needed before a new subspecies, which was apparently found in this watershed, could be described. Individuals have become so rare that it might not be possible to resolve any remaining taxonomic uncertainty at this date. During the 1920s and 1930s, Lake Chubsuckers were collected seven times from several tributaries that flowed into Braddock Bay or Long Pond, namely West, Buttonwood, Northrup, and North Creeks (e.g., CUMV 2322, 2350, 10283, 65395). During the 1939 survey of this watershed, this species was again collected from West and Buttonwood creeks, as well as from Blind Sodus Bay (Greeley 1940). In Ontario, specimens were caught from 1970-2008 in Tees and Lyons creeks, which are tributaries of the Welland Canal (Marson et al. 2009).

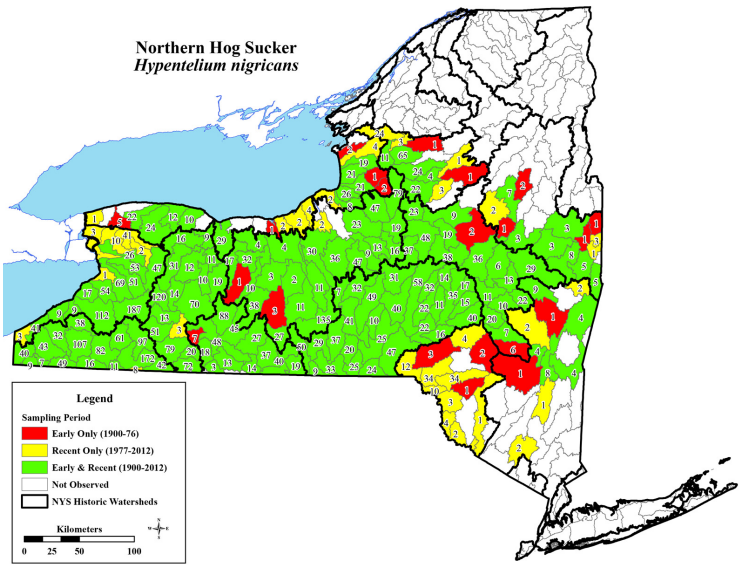




Hypentelium nigricans, Northern Hog Sucker

This distinctive, relatively small-bodied sucker inhabits streams and lakes. The species depends on gravel for spawning and generally congregates in areas with current. Northern Hog Suckers occur throughout the state, with the exception of the Saint Lawrence, Oswegatchie, Raquette, Champlain, Newark Bay, and Long Island watersheds. Although this species may be introduced into the Black River watershed, it may simply be a late arrival as a result of a natural range expansion.





Allegheny (1,2,3). Northern Hog Suckers were found in streams throughout the watershed, including the main stem Allegheny River during the 1937 survey (Greeley 1938). The frequency of occurrence of this species in streams was 44%, which has increased to almost 50% in recent surveys.

Erie-Niagara (1,2,3). Greeley (1929) reported that this species was common and present in the lake, usually near stream mouths. It remains widespread and relatively common in this watershed.

Ontario (1,2,3). Greeley (1940) noted: "Distributional records of the survey indicate this species to be widely distributed in lowland creeks of the area and it was also represented from the Barge Canal system and Glenwood Lake." During the 1939 survey, this species was collected from ten bodies of water. Between 1987 and 2005, it was collected from 17 waters.

Genesee (1,2,3). This species was listed as abundant by Greeley (1927), who noted that it was found in streams with swift current and hard substrates. Northern Hog Suckers continue to be widely distributed throughout this watershed in recent surveys.

Oswego (1,2,3). This sucker was commonly encountered in the 1927 survey (Greeley 1928). The species continues to be widely distributed, with a frequency of occurrence in streams of 21% from 1996-2010.

Black (**2,3**). Specimens were collected from Wolf Lake in 1945 (RWLC 2013) and from the Black River in Oneida County in 1950 (CUMV 71970); these are the earliest reports of this species in this watershed. The species was also reported from Pine Creek 1953. Later collections include specimens from the Deer River in the early 1990s (NYSM 41581, 43065) and the Sugar River in 1994 (NYSM 43986). Although the Black River is a tributary of Lake Ontario, where this species is native, the fact that

Species continued on next page

all collections in this watershed are from headwaters suggests that this species has been artificially introduced. If specimens had been collected at downstream sites, the presence of Northern Hog Suckers in this watershed could be the result of a range expansion, in which case we would regard the species as native. Although we tentatively list the species as non-native here, its status in this watershed is contentious and unresolved with the data currently available.

Chemung (1,2,3). Greeley (1938) reported that this species was found at 27% of the sites sampled during the 1937 survey. It remains abundant and widespread throughout the watershed.

Susquehanna (1,2,3). Northern Hog Suckers were listed as very common in streams during the 1935 watershed survey (Greeley 1936). The frequency of occurrence of this species in 1935 as well as in recent surveys was 20%.

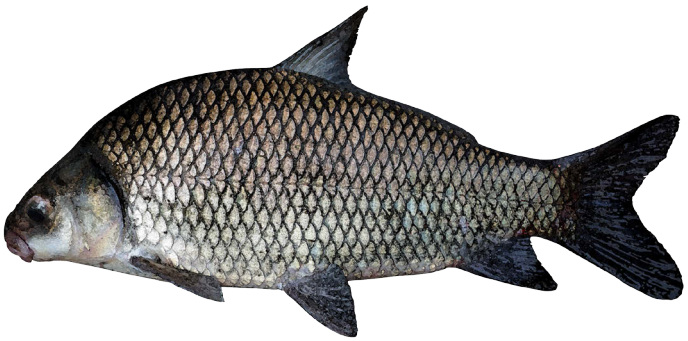
Delaware (2,3). This species was not collected during the synoptic survey in 1935 (Greeley 1936). The first record of this fish in the watershed is from 1956 (CUMV 77037), and it was collected again a year later (CUMV 31309), in the West and East Branches of the Delaware River, respectively. Northern Hog Suckers have been collected regularly but sparingly to the present, with a frequency of occurrence in later stream surveys of 9%. Specimens have been collected in the main channel, the major branch channels, and several smaller tributaries. Downstream, in New Jersey and Pennsylvania, this sucker is rare, and Arndt (2004) treats it as a native species.

Upper Hudson (1,2,3). This species was not found in the upper part of the watershed during the 1932 survey (Greeley and Bishop 1933) but was later collected from three low-elevation tributaries of the Upper Hudson: the Little Hoosic River, Tomhannock Creek, and Deep Kill (Greeley 1935). In this lower part of the watershed, Northern Hog Suckers are still frequently caught in tributaries of the Hudson and Hoosic rivers as well as the Battenkill. Hudson Falls may have been an effective barrier and the boundary of the historical distribution of this species. The earliest upriver record is one from the Sacandaga River in 1956. Currently, this species is found both upstream and downstream of the Sacandaga Reservoir to elevations of 380 m. Although it is possible that the Northern Hog Sucker gained access to the upper river from an out-migration of the population that occurs downstream of Hudson Falls or that it was overlooked during early surveys, it is equally likely that it was introduced to this area.

Mohawk (1,2,3). Greeley (1935) regarded this species as common and found it in lakes and sluggish streams. In contrast to other watersheds, Northern Hog Suckers were collected at several upland sites, including Delta Lake (NYSM 33465) and at an elevation of 362 m in Fox Creek (Greeley 1935). The species continues to appear in catches throughout the watershed, including those at middle elevations.

Lower Hudson (1,2,3). Northern Hog Suckers were rare in the surveys of the watershed in the 1930s, being found only at a few low-elevation sites in the Hudson River, Roeliff Jansen Kill, Kaaterskill Creek, and Normans Kill, as well as in Stockport, Hannacrois, and Tomhannock creeks (Greeley 1935, 1937). The species continues to be relatively rare in recent surveys although it has been found in the main channel more frequently. There are only 11 records from the watershed since 1989, all of which are from locations north of Kingston, with the exception of catches from Moodna Creek in 1977 and 1983.

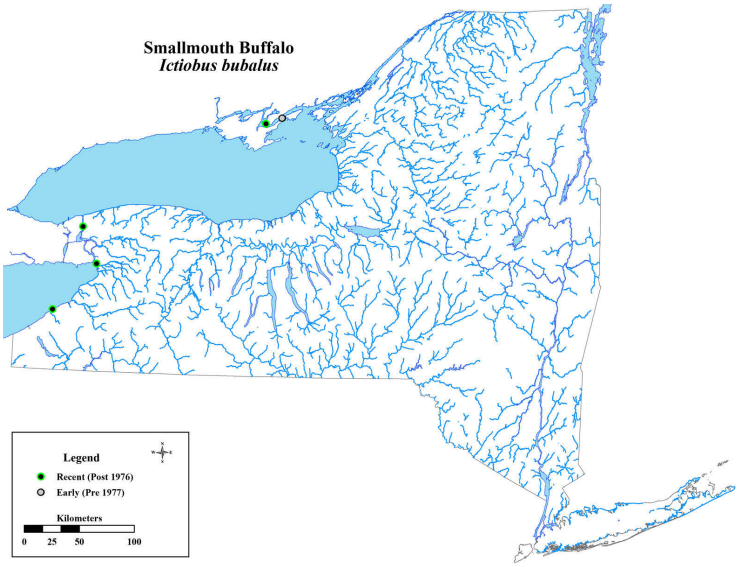
Ictiobus bubalus, Smallmouth Buffalo



This Mississippian sucker has been reported from Lake Erie, but the taxonomic status of these individuals remains uncertain; Trautman (1981) only listed hybrids from Lake Erie. Individuals of uncertain taxonomy have also been taken from the Canadian portion of Lake Ontario. Whatever their taxonomic status, these populations are introduced into the lower Great Lakes (Smith 2004). The individuals taken from these areas may be hybrids with Black Buffalo, *Ictiobus niger*, which has also been introduced into these watersheds. We follow Bart et al. (2010) and treat the Smallmouth Buffalo as present in New York watersheds because museum records exist. At present, however, most of these museum specimens and records have not been confirmed at the species level. This account may, therefore, need revision when extant and future specimens are more closely examined.

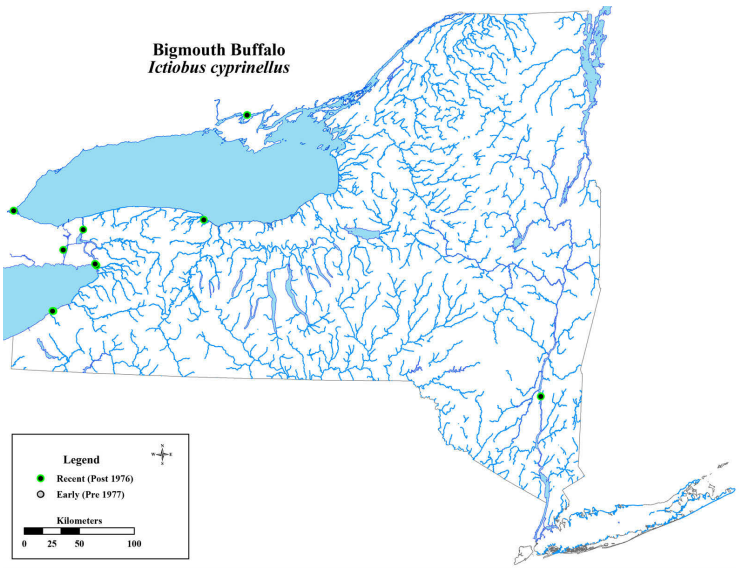
Erie-Niagara (**3**). A large individual was taken from Dunkirk Harbor in 2008 (NYSM 64510). The attribution of this specimen is questionable. The species was also documented in the Buffalo River in 2006 (Herbert 2010).

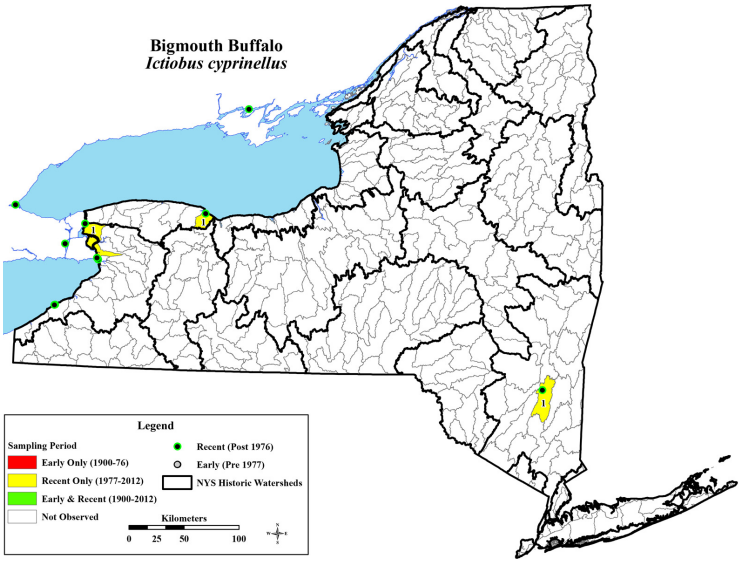
Ontario (**3**). An unattributed Buffalo specimen was taken from the Bay of Quinte, Canada, in 1972 (ROM 94066) and one small specimen was caught near Lewiston in 2004 (NYSM 57131).



Watershed maps only show records as locations in 10-digit HUC units for inland New York waters. Records from large water bodies across state borders are excluded, and all of the Smallmouth Buffalo records were of this type. Therefore, a HUC analysis could not be performed and the map is not shown here.

Ictiobus cyprinellus, Bigmouth Buffalo





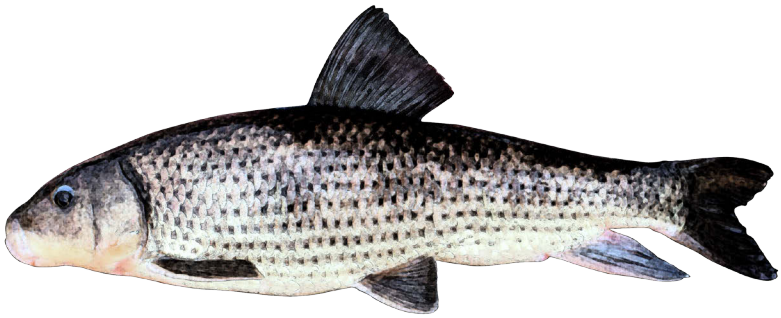
Reports from the mid- to late 1800s suggest that this sucker, though apparently rare, is native to Lake Erie (Scott and Crossman 1973; Trautman 1981). Additional museum records of specimens from the western portion of the lake did not begin to appear until the 1940s (e.g., UMMZ 201641, OSUM 12229). The species was first reported from eastern Lake Erie in the 1920s (ANSP 147892) but was not found in this part of the lake again until the 1990s. The status of the Lake Ontario population is not definitively known. The species would be considered exotic if it were stocked or if the Welland Canal had been used to gain access. It would be considered native in the event that it gained access via the Niagara River. In 1997, a specimen was collected from the Welland River in association with the canal (ROM 70778). The conservative approach would be to accept this species as native until additional information becomes available.

Erie-Niagara (3). This species has been reported near Presque Isle, Pennsylvania, since 1925 (Cooper 1983), with more recent catches reported between 1986 and 1997 (C. Murray, Pennsylvania Fish and Boat Commission, Fairview, PA, pers. comm.). It was reported from Dunkirk Harbor in 1995, when spawning was observed, and continues to be taken episodically (e.g., NYSM 55130 in 2003). The species was also documented in the Buffalo River in 2006 (Herbert 2010) and Buffalo Harbor in 2012.

Ontario (3). Bigmouth Buffalo have been reported in Canada from the Bay of Quinte in 1981 (ROM 37952) and Hamilton Harbor in 2006 (ROM 80639). There have also been later catches from the Bay of Quinte area (COSEWIC 2009). Specimens were taken near Rochester in the 2010s (including one from Long Pond off Braddock Bay in 2012) and were identified as this species based on descriptions by Holm et al. (2009).

Lower Hudson (**3**). A specimen was taken from the Hudson River near Esopus Meadows in 2007 (NYSM 62662).

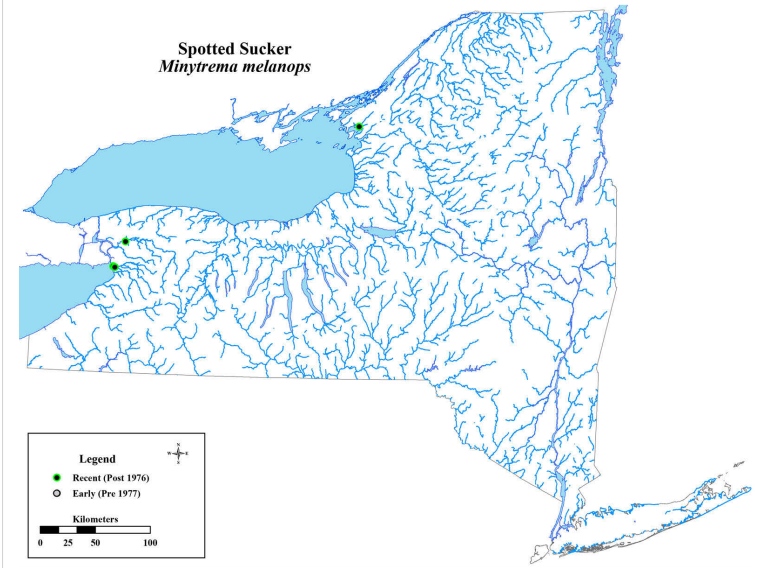
Minytrema melanops, Spotted Sucker

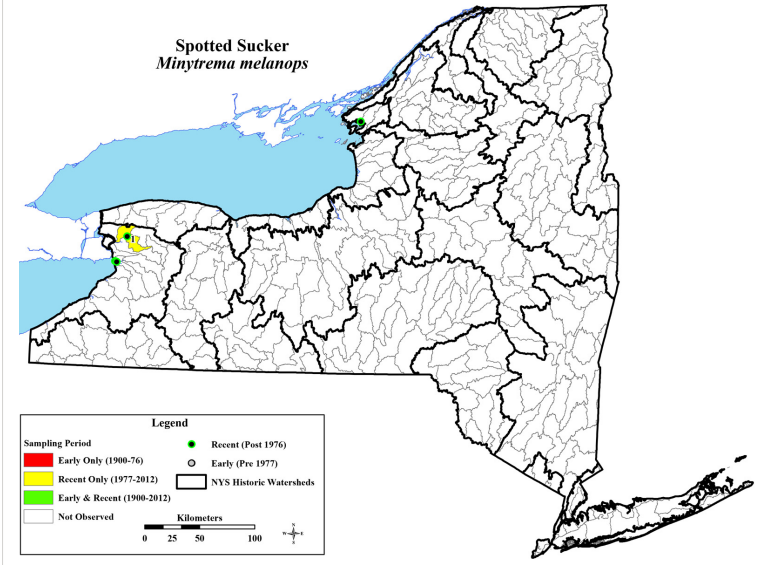


Although historically present in western Lake Erie, Lake Huron, and Lake Michigan, this species was first reported from New York waters in the 2000s. It first appeared in Canadian waters in 1962 (Edwards and Staton 2009). As with the genera *Carpiodes* and *Ictiobus*, the native status of this sucker in Saint Lawrence River drainage watersheds is dependent upon how it entered these new areas, i.e., whether by range expansion through natural waterways or stocking. Again, the conservative approach is to treat the Spotted Sucker as native, because a simple range expansion is possible, and wait for additional information.

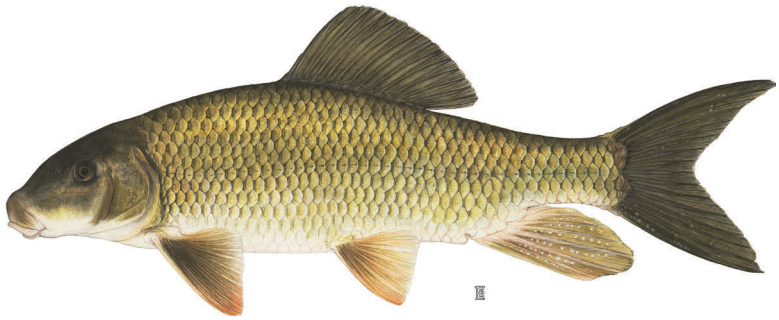
Erie-Niagara (3). This species was reported from the Buffalo River in 2006 and from Tonawanda Creek/ Erie Canal in 2007 (NYSM 62256). Records from Ontario are few and from much farther west (Edwards and Staton 2009).

Ontario (3). An angler reported catching a Spotted Sucker from Chaumont Bay in 2003, substantiating this report with a convincing photograph. Serious efforts were undertaken to catch additional specimens in 2004 and 2005 but were unsuccessful.





Moxostoma anisurum, Silver Redhorse

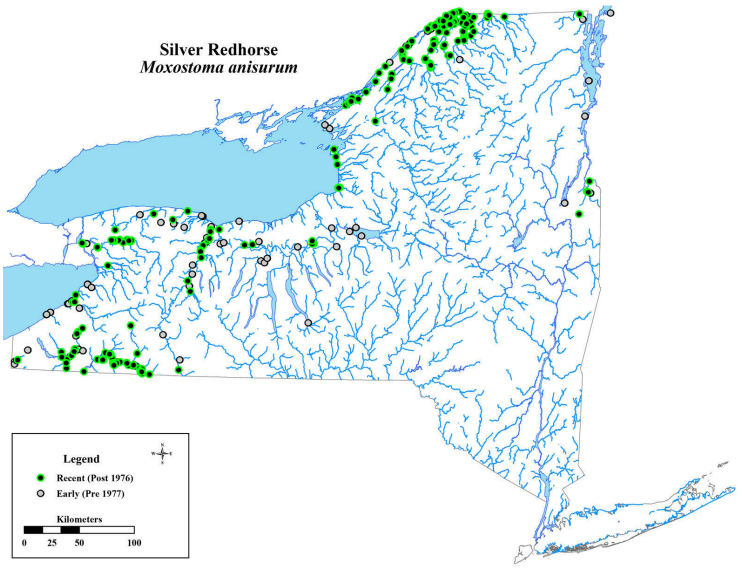


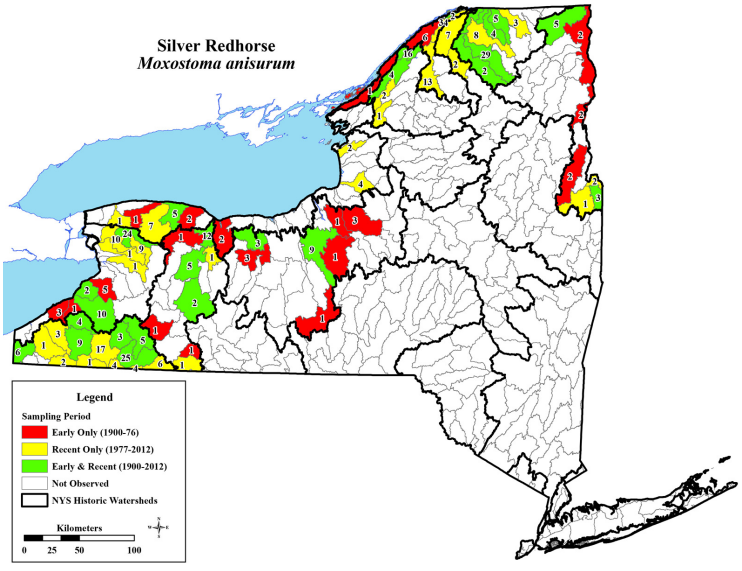
This large fish inhabits large rivers and lakes and spawns on clean gravel. Its range includes the Allegheny and all of the Saint Lawrence watersheds, except the Black River. Its range has increased in the Allegheny, and its catch frequency has increased in the Saint Lawrence watershed.

Allegheny (1,2,3). Greeley (1938) reported that the larger streams of the watershed supported "moderate numbers" of Silver Redhorse, with individuals being found at 4% of the 1937 survey sample sites. During this early survey, the species was found in all three basins. In surveys conducted between 1998 and 2008, this sucker was again found in all three basins, with an average frequency of occurrence of 9%.

Erie-Niagara (1,2,3). This sucker was common in Lake Erie, and Greeley (1929) implied that it used tributaries of the lake as spawning and nursery areas only. This is not the case, however, and this species continues to be found in the lake and its tributaries (particularly the lower reaches) and in the Niagara River. In Tonawanda Creek, its range extends upstream and into Murder Creek.

Ontario (1,2,3). One specimen was collected from Johnson Creek during the 1939 watershed survey, but Greeley (1940) noted that the University of Rochester collections contained specimens from Salmon Creek (Monroe County) in 1904 (Wright 2006) and the Erie Canal near Pittsford in 1934 (now at CUMV 28002). Silver Redhorses continue to be caught in this watershed, with recent specimens having been taken from Oak Orchard Creek, near Rochester, the Salmon River in Oswego County, and Lake Ontario tributaries in Jefferson County.





Genesee (1,2,3). Greeley (1927) reported this species to be common, noting that it was usually found in pools with some current in large, warm streams. Silver Redhorses continue to be found throughout the watershed, including upstream of the Portageville Falls in 1982 (AMNH 223458) and in smaller streams, like Beards Creek in 2002 (NYSM 54287).

Oswego (1,2,3). Greeley (1928) listed this redhorse as moderately common in larger streams. It continues to be found in the largest rivers and lakes of this watershed.

Species continued on next page

Saint Lawrence (1,2,3). Silver Redhorses were present at 1% of the watershed survey sites and were found in the Saint Lawrence River and the lower reaches of main channel tributaries (Greeley and Greene 1931). By the 1990s and 2000s, the frequency of occurrence of this species had increased to 21% in the Saint Lawrence, Saint Regis, and Grass rivers and their tributaries. The farthest upstream capture site was in the Grass River near Canton in 2010 (NYSM 65939).

Oswegatchie (1,3). Greeley and Bishop (1932) listed this species as rare during the 1931 watershed survey. Although it was present in Lake Ontario and the Saint Lawrence River, it only appeared to ascend a few kilometers up this tributary system. Watershed survey specimens were only taken from Black and Butterfield lakes (Odell 1932). The Silver Redhorse remains rare in this watershed and has not been found upstream of Rossie in the Indian River and Heuvelton in the Oswegatchie River.

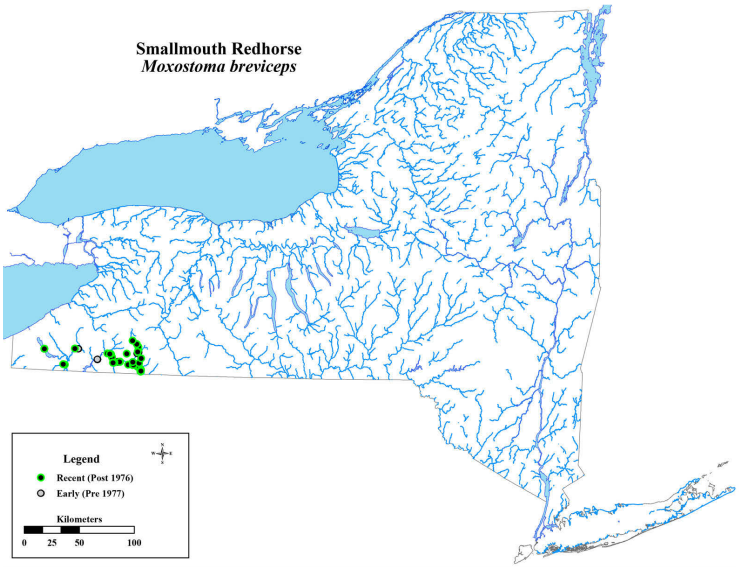
Raquette (1,2,3). Greeley (1934) implied that this sucker used Saint Lawrence tributaries, like the Raquette River, as spawning sites and nursery grounds and that adults do not remain in these areas; consequently, the species was rare during the 1933 survey of this watershed. He (Greeley 1934) noted, however, that the population at Potsdam Flow, where this species was listed as common, was permanent because it was separated from the Saint Lawrence River by several barriers to migration. Recent collections have documented this species in the Norwood Reservoir on the Raquette River, and individuals continue to be found in the Potsdam area, where specimens were caught in Parkhurst Brook in 1979 (AMNH 44834).

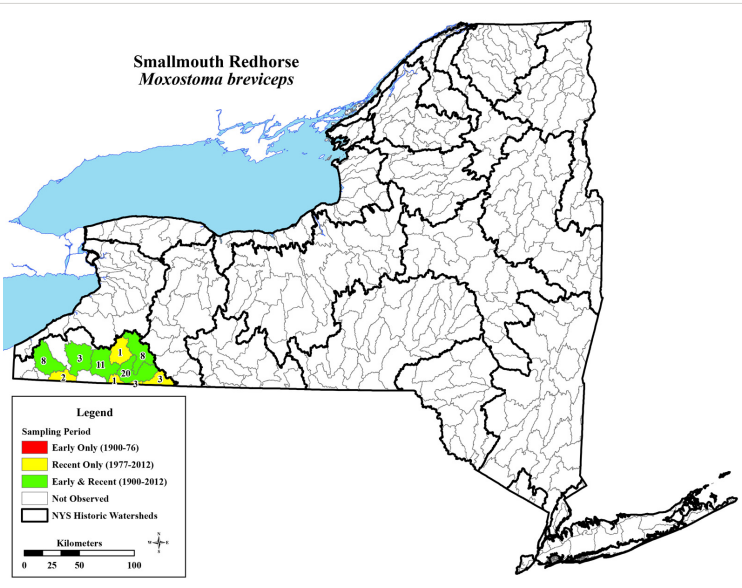
Champlain (1,2,3). Silver Redhorses were uncommon but widely distributed in Lake Champlain during the 1929 survey and also entered the mouths of tributary streams, including the Great Chazy and Mettawee rivers (Greeley 1930). A specimen was also taken from Lake George in 1929 (NYSM 38187), but there have been no additional reports of this species in the lake since then. This sucker was repeatedly collected from the Mettawee and Poultney rivers in the 1980s. More recently, it has been reported from the Great Chazy, Poultney, and Mettawee rivers in the 2000s and 2010s. In 2010, this species was collected from the Champlain Canal (E. Marsden, University of Vermont, pers. comm.). We rejected a 1954 record from Round Pond. No specimen was vouchered, and the pond, which is a remote, high-elevation site, lacks an adequate dispersal route and suitable habitat for this species.

Moxostoma breviceps, Smallmouth Redhorse

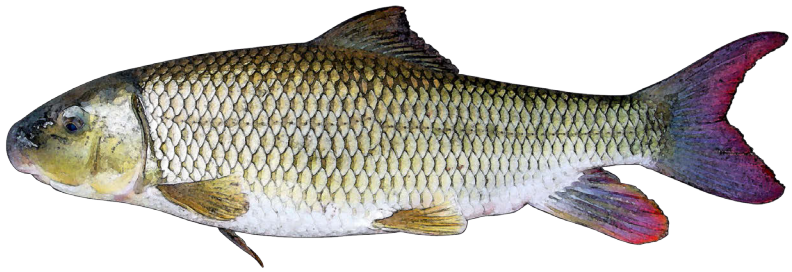
This species inhabits larger streams and lakes, where it spawns on gravel. In New York, it is only found in the Allegheny River watershed.

Allegheny (1,2,3). Specimens were only taken from the main stem Allegheny River during the 1937 watershed survey (Greeley 1938). The species has since been reported from the Allegheny Reservoir in Pennsylvania (Cooper and Wagner 1980) and the main channel upstream of the reservoir (Becker 1982). Smallmouth Redhorses have been collected with some frequency from the main channel of the eastern basin since the 1980s, most recently in 2013 (NYSM 69771), as well as from Olean (Smith 1985; Daniels 1989), Tunungwant (NYSM 14790), Dodge (NYSM 55320), Fivemile (NYSM 40231), and Oswayo (NYSM 48551) creeks. Specimens were found in Conewango Creek in the central basin in 1967, 1973, and 2005 and also in Stillwater Creek in 2004.



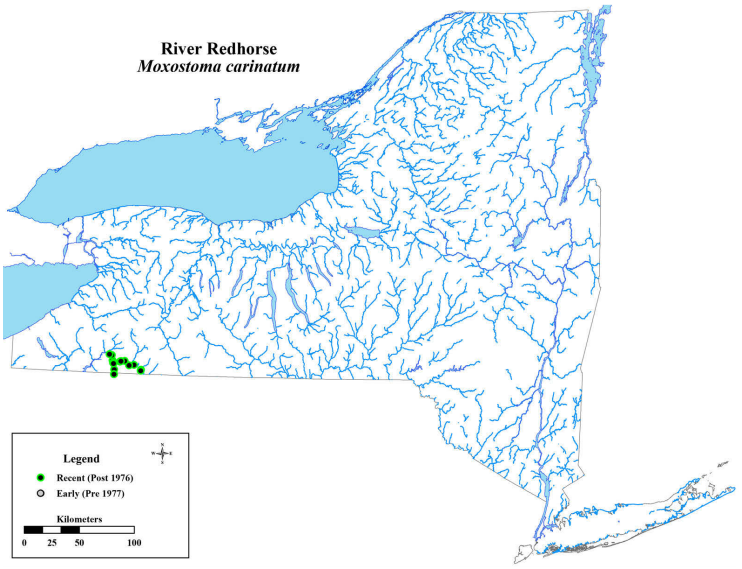


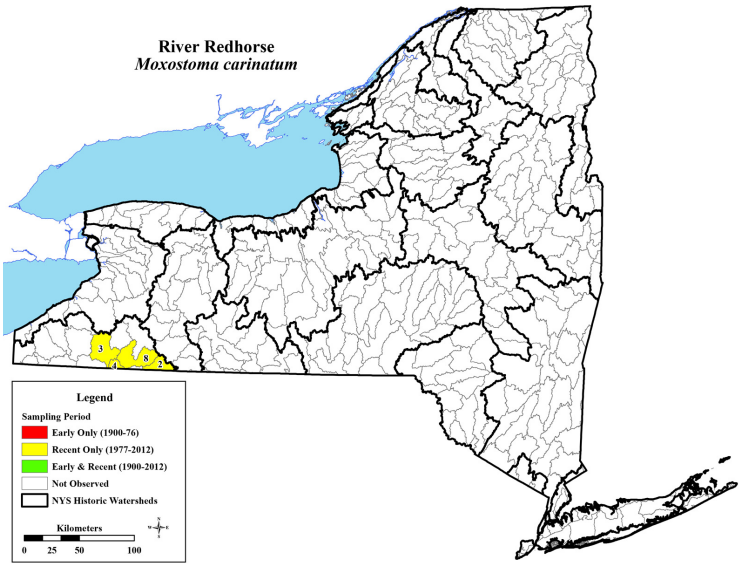
Moxostoma carinatum, River Redhorse



This large redhorse occurs in rivers. In New York, it is only present in the eastern basin of the Allegheny River watershed. The species has increased its range and abundance in the last 30 years, and, although its range is restricted, it is secure. The River Redhorse is classified as a Species of Greatest Conservation Need in New York. The range of this species includes two disjunct groups: one in the lower Saint Lawrence River drainage and the other occupying much of the Mississippi River drainage and Lakes Erie, Huron and Michigan. Trautman (1981) documented this species from Lake Erie tributaries, and Hubbs (1926) listed it from Lake Erie itself. This redhorse was not collected during the 1928 survey of the New York portion of the lake (Greeley 1929) and has also not been reported there in recent years.

Allegheny (2,3). Watershed records for the River Redhorse are from Tungunwant Creek in 1978 (Cervone et al. 1985), the Allegheny Reservoir and River near Salamanca in 1980 (Becker 1982) and 1994 (NYSM 52543), Oswayo Creek in 1998 (NYSM 48550), and Dodge Creek in 2003 (NYSM 55319). There are also several records from the Allegheny River in 2012 and 2013. The species is a rare fish in this drainage, but its rarity may be slightly overestimated because it is somewhat difficult to identify.





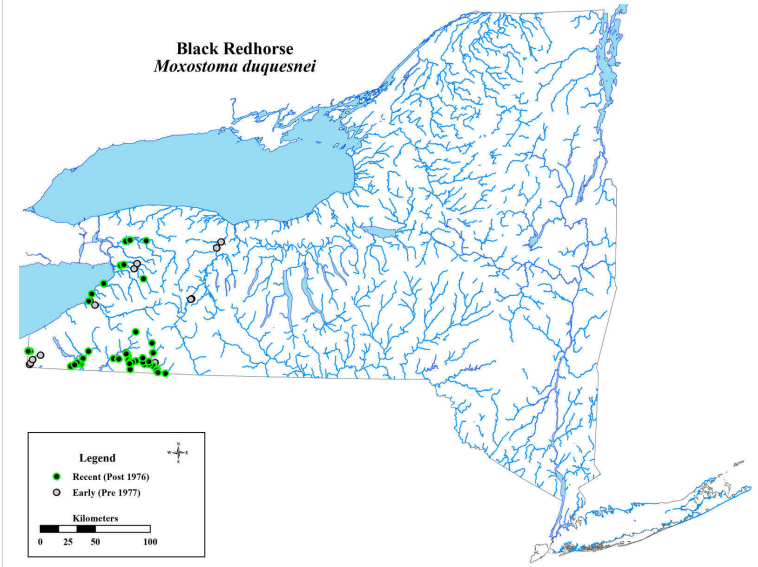
Moxostoma duquesnei, Black Redhorse

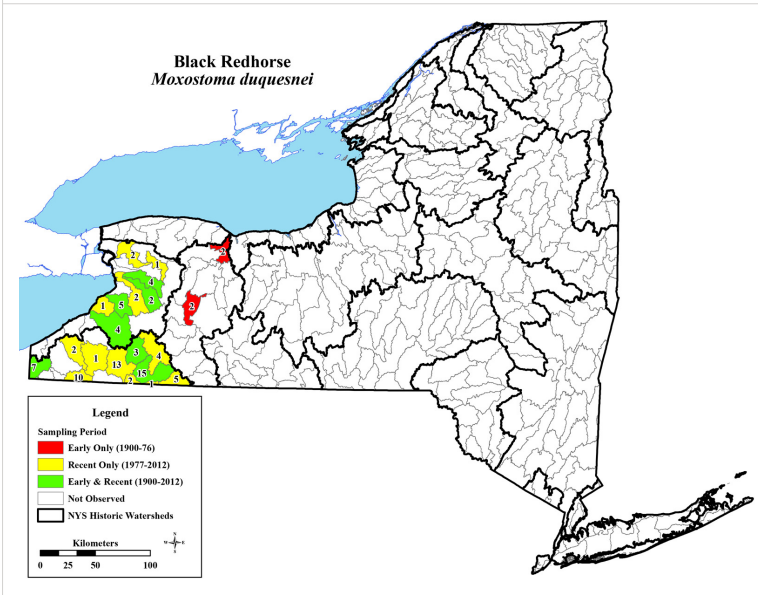
This medium-sized fish lives in larger streams with clean gravel and is native to three watersheds in the western third of the state. The Black Redhorse has been classified as a Species of Special Concern, but recent trends suggest that it should be downgraded and reclassified as a Species of Greatest Conservation Need.

Allegheny (1,2,3). Greeley (1937) reported that this species was rare, being caught at only two sites or 1% of the sites sampled during the 1936 watershed survey. Black Redhorses have been encountered more frequently in later surveys, with a frequency of occurrence of about 10%. This species was caught in the Allegheny River in 1979 and 1980 (Becker 1982), some direct tributaries in 1998 (Daniels 1998), French Creek in 1998 (NYSM 49667), the Conewango Creek basin from 2003-2005 (Morse et al. 2009), and Oswayo Creek in 2013 (NYSM 69244).

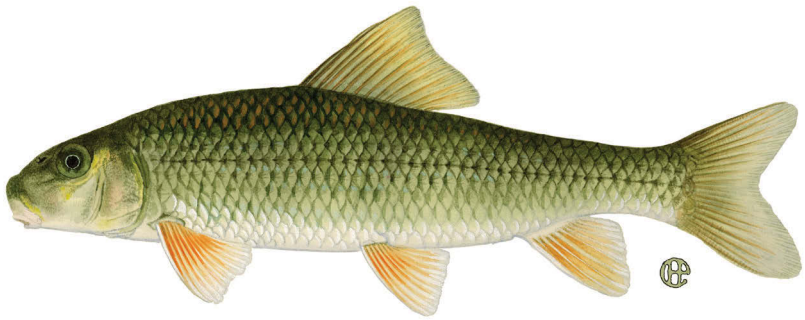
Erie-Niagara (1,2,3). This species was uncommon in catches during the 1928 watershed survey but was collected from Lake Erie and the mouths of several creeks, particularly Eighteenmile Creek. Hankinson (1924) noted that the Black Redhorse was present in Cattaraugus and Buffalo creeks as well. There are post-1999 records from these three creeks, as well as from Muddy, Cayuga, Tonawanda, and Murder creeks. The increased number of recent records suggests that this species is more abundant in the Erie watershed today than during earlier surveys.

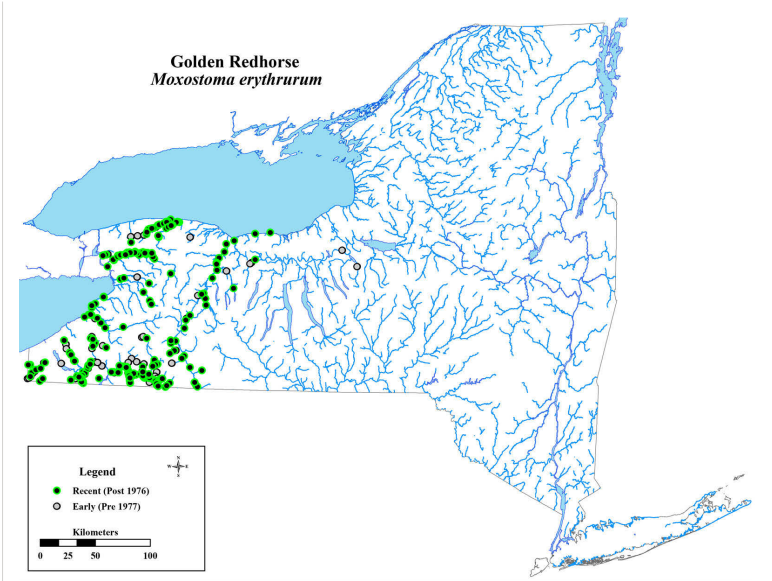
Genesee (1). Although Greeley (1927) did not recognize this species during the 1926 survey, it was nonetheless taken at three sites in the Genesee River (CUMV 820, 1953, NYSM 41423). No specimens have been reported from this watershed since 1926.

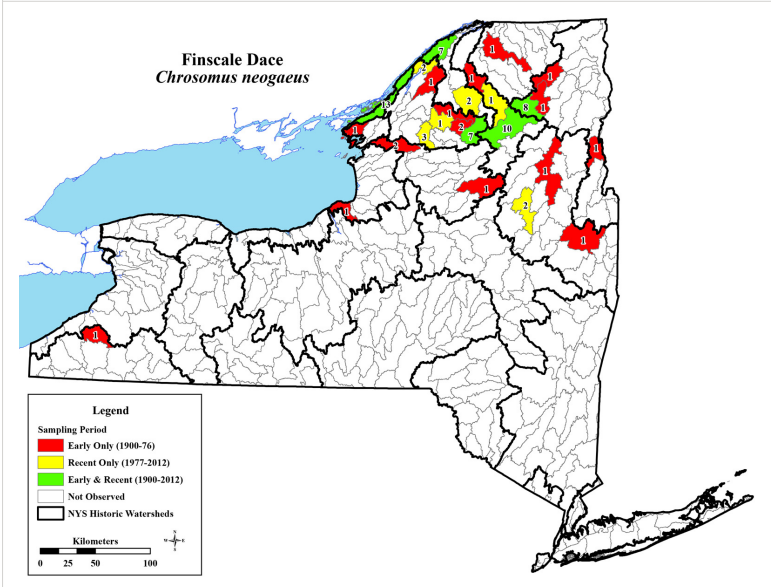




Moxostoma erythrurum, Golden Redhorse







This medium-sized fish inhabits large rivers and large lakes, where it depends on smaller streams with clean gravel for spawning. The Golden Redhorse is found in western New York in the Allegheny, Erie-Niagara, Ontario, Genesee, and Oswego watersheds. Its range and frequency of occurrence appear to be increasing. In the 1920s, the scientific name used for this fish, *Moxostoma aureolum*, was also used for the Shorthead Redhorse. The veracity of some reports can, therefore, not be confirmed due to a lack of voucher specimens.

Allegheny (1,2,3). This species was the most frequently caught redhorse during the 1937 watershed survey, where it was found in larger streams with an overall frequency of occurrence of 12% (Greeley 1938). A third of the Golden Redhorse records are from the Allegheny River, and it also was found in the slower waters of Red House Brook, and Olean, Oswayo, Tunungwant, Conewango, and French creeks. It was collected at 25% of the stream sample sites during surveys conducted in the 2000s.

Erie-Niagara (1,2,3). Golden Redhorses were common in Lake Erie and the mouths of its tributaries during the watershed survey (Greeley 1929). This species continues to be widespread and relatively common but tends to only be found in the lower reaches of streams; for example, in Cattaraugus Creek, no individuals have ever been documented upstream of Gowanda.

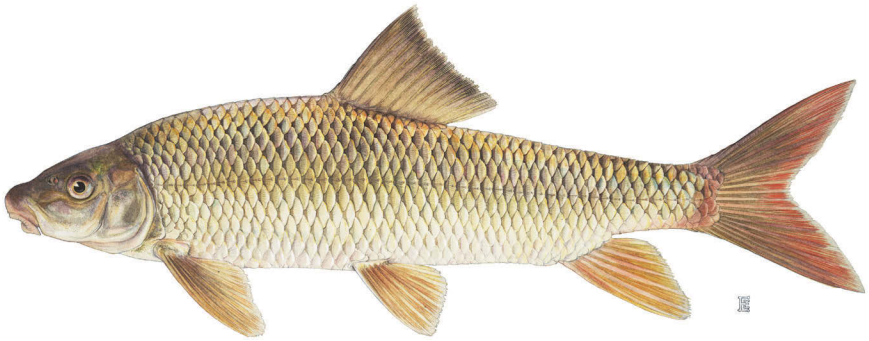
Ontario (1,2,3). This species was collected at 15 lowland sites in the western counties during the 1939 watershed survey (Greeley 1940). Greeley (1940) also noted that a specimen "from wide-waters of the Barge Canal at Spencerport, July 3, 1931, is in the [University of] Rochester collection." That specimen has been lost, but UMMZ 91537 contains a specimen from the same locality, collected on 28 June 1929. The Golden Redhorse continues to be found in Lake Ontario in the western counties but has now been collected as far east as the Ginna Nuclear Power Station north of the Village of Ontario Center, where the species was collected in 2003.

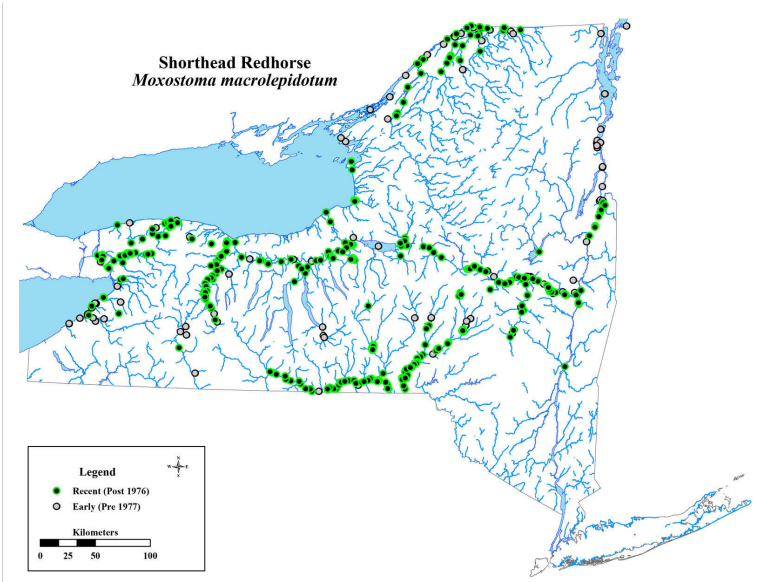
Species continued on next page

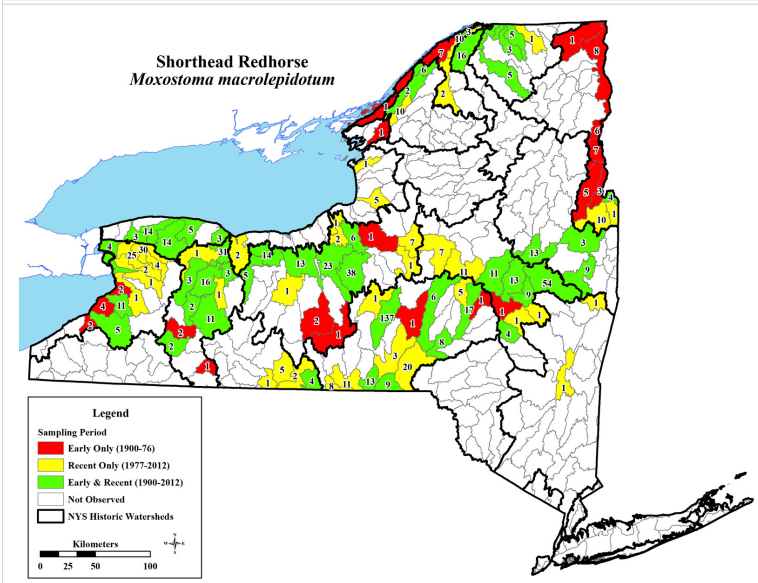
Genesee (1,2,3). Greeley (1927) noted that this species was taken in large, warm streams, and watershed survey specimens exist from Black (NYSM 38217) and Honeoye (NYSM 38196) creeks. In surveys conducted from 2000-2003, this was the most commonly caught of the redhorse species in this watershed, and it was also taken again at Black (NYSM 52301) and Honeoye (NYSM 54194) creeks.

Oswego (1,2). In 1914, this species was caught in the Seneca River near Syracuse and, in 1916, it was found in Onondaga Creek (RWLC 2041). In 1955 and 1959, specimens were taken from Ganaragua Creek near Macedon. In 1978, individuals were found in Mud Creek near Macedon (AMNH 41663). A lack of recent records may indicate that there is no longer a resident population in this watershed. This system is connected to the Ontario and Genesee watersheds by the Erie Canal, however, and individuals from these other watersheds may enter the Oswego watershed as strays.

Moxostoma macrolepidotum, Shorthead Redhorse







This large redhorse inhabits larger streams and lakes, possibly entering streams for spawning. The Shorthead Redhorse has been reported from 11 of New York's watersheds and is absent from the Allegheny, Black, Delaware, Long Island, and Newark Bay watersheds. Early records for this species are problematic due to the early use of two scientific names to refer to this single species: *Moxostoma aureolum* and *M. lesueurii*. Adding to this confusion is the historical use of the name *M. aureolum* to refer to an additional species, the Golden Redhorse (*M. erythrurum*), as discussed above. Museum specimens are, therefore, crucial in assessing the historical range of this species, and we do not include early records that lack voucher specimens in our maps.

Erie-Niagara (1,2,3). During the 1928 survey, this species was common in Lake Erie and the Niagara River as well as their tributaries (Greeley 1929). The species remains present in the lake and the Niagara River. In recent years, a resident population that does not migrate from the Niagara River has been documented in Tonawanda Creek. Other records from Eighteenmile Creek (AMNH 45986) and South Branch Eighteenmile Creek might represent a second non-migratory, resident population.

Ontario (1,2,3). Evermann and Kendall (1901) noted that Shorthead Redhorses were common in the lake. Greeley (1940) reported that this species was more common in the western tributaries but commented that it might have declined since the 1900s. In recent years, this redhorse has been found in tributaries and near-shore areas of Lake Ontario.

Genesee (1,2,3). This sucker was commonly caught during the 1926 survey (Greeley 1927). Few records exist from upstream of Portageville Falls on the Genesee River, but Shorthead Redhorses remain relatively common at downriver sites.

Oswego (1,2,3). Adams and Hankinson (1916) reported this species from Oneida Lake. Greeley (1928) noted that the Shorthead Redhorse was rare and that small specimens were taken from Canandaigua Outlet. In the last several decades, specimens have been taken at 83 locations, primarily from large rivers and Cayuga, Oneida, Cross, and Onondaga lakes.

Species continued on next page

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that Shorthead Redhorses were common in the Saint Lawrence River, noting that they ascended larger streams to spawn. At present, the species is relatively widespread in the lowland river segments of the watershed.

Oswegatchie (1,2,3). Greeley and Bishop (1932) ranked this species as the dominant redhorse in the watershed even though they reported that it was rare. During the 1931 survey, a single individual was taken from Black Lake and a few individuals were observed in the lower reaches of the river. Shorthead Redhorses continue to be found in the lower river but have also recently been found as far upstream as Red Lake in the Indian River system.

Raquette (1,2,3). In his account of this species, Greeley (1934) stated: "Locally common in the Raquette River below Raymondville. There is a spring run of this species from the St. Lawrence River...According to information given by those who spear suckers in the Raymondville vicinity, this is the most numerous of the red-fin suckers." The species continues to be found in the river as well as in the Norfolk and Norwood Reservoirs, where it was caught in 1975 and 1995, respectively.

Champlain (1,2,3). Louis Agassiz collected this species near Ticonderoga in the mid-1800s (MCZ 2171). The Shorthead Redhorse was common in Lake Champlain and in the lower courses of many of its tributary creeks in the 1929 watershed survey (Greeley 1930). The species is no longer common in the watershed, but, in recent years, individuals have been caught in Lake Champlain in 1972, South Bay in 1976 (Dudones 1977), the Mettawee River in 1984 (NYSM 10273), and the Champlain Canal in the 1980s and in 2009. A record from Taylor Pond, an upland lake, in 1970 is from an unlikely area and lacks any voucher specimens; we, therefore, treat this report as an error.

Chemung (2,3). This species was absent from the catches of the 1937 watershed survey (Greeley 1938). Since 1967, Shorthead Redhorses have been taken, albeit rarely, from the Cohocton and Chemung rivers.

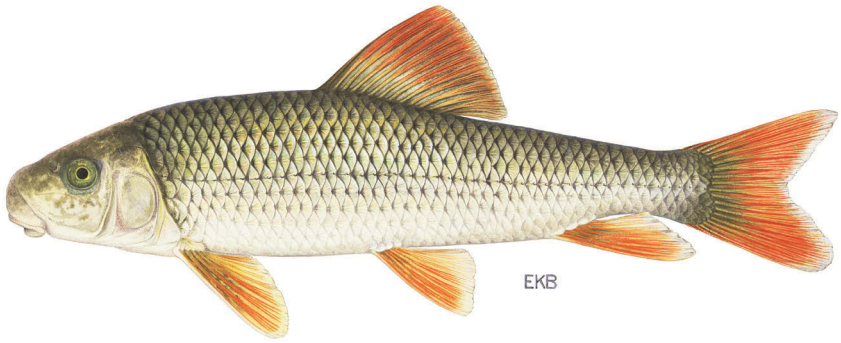
Susquehanna (1,2,3). An early specimen exists from Nichols (Tioga County) in 1854 (MCZ 2170). This species was rare in the 1935 survey, but specimens were taken at Goodyear Lake, the Susquehanna River near Apalachin, the Chenango River at Norwich, and the Unadilla River near New Berlin (Greeley 1936). Recent catches have been rare but include Goodyear and Canadarago lakes, the Whitney Point Reservoir, Catatonk Creek (NYSM 53550), and the Susquehanna River at Kirkwood (AMNH 43946).

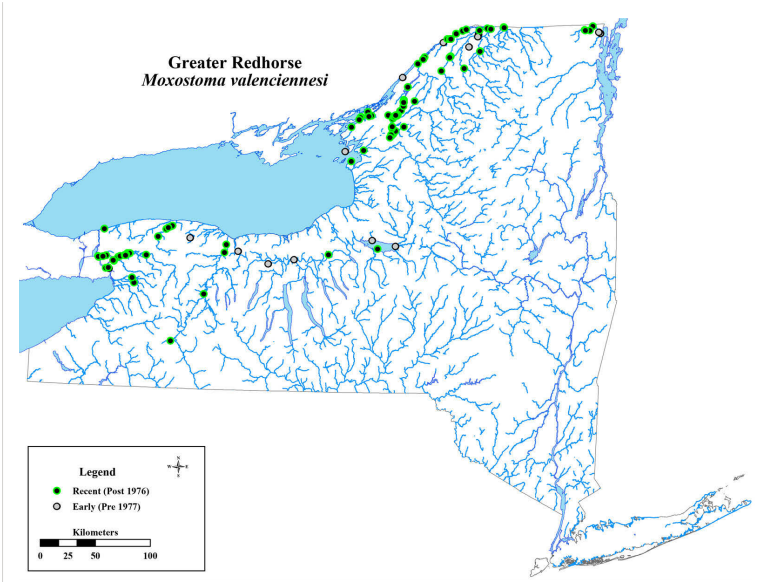
Upper Hudson (2,3). In their report on the 1932 survey, Greeley and Bishop (1933) devoted a paragraph to a fish that they did not catch during the survey and that was not identified beyond *Moxostoma* sp.: "Although no specimens were taken by the survey, reports were received from several persons familiar with the Hudson River over a period of many years, that a very coarse scaled sucker of larger size than the common sucker was formerly taken in the lower reaches of the Snook Kill and other streams entering the Hudson River below Hudson Falls." With the presence of a *Moxostoma* species long suspected in this watershed, it is not surprising that a Shorthead Redhorse was eventually caught in the Hudson River near Mechanicville in 1973 (AMNH 223883). The species was also reported father upstream in the Great Sacandaga Reservoir in 1975 (Shupp 1976) and again in 1982. As an upland reservoir, which is upstream of a major dam, this reservoir is an unlikely habitat for this species, and it is likely that it was released into the reservoir by humans. An additional specimen was collected from the Hudson River at the mouth of the Deer Kill in 2013 (NYSM 69042). We regard this species as native to this watershed because it is common, with a relatively long record in the Mohawk watershed (see Daniels et al. 2011b for an assessment). Individuals from the Champlain watershed have also had access to this watershed via the Champlain Canal during the last century and a half, however. Without additional information on the populations of this fish in the Hudson River drainage, treating it as native is the more conservative approach.

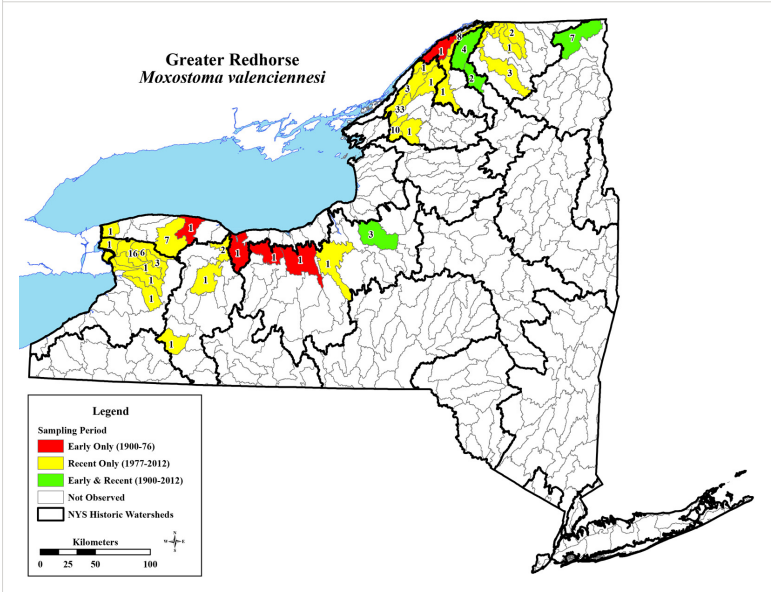
Mohawk (1,2,3). This species was common during the 1934 watershed survey, being found at 19 collecting stations along the Mohawk River and in two tributaries, Briggs Creek and lower Schoharie Creek (Greeley 1935). The species continues to be taken regularly with little change in either abundance or range, although there are a few additional recent records at upstream sites.

Lower Hudson (2,3). Shorthead Redhorses were not collected in this watershed during the 1936 survey (Greeley 1937). The earliest report of this species from the watershed was from the Hudson River at the Troy Dam in 1983, where a specimen was again collected in 2013 (NYSM 69044). There were three additional reports from the upper estuary area from 1990-1992. In 2000, a specimen was collected from the Poesten Kill (NYSM 51655), and spawning was later observed at the mouth of this creek (R. Schmidt, Simons Rock College, pers. comm.). In 2007, a specimen was taken from the main channel at Catskill (NYSM 62660). The status of this species in this watershed is dependent on its dispersal route (Daniels et al. 2011b), though we tentatively treat it as native here.

Moxostoma valenciennesi, Greater Redhorse







This large redhorse species inhabits large rivers and lakes, where it spawns on clean gravel. The Greater Redhorse occurs throughout the Saint Lawrence drainage, except for the Black River watershed. Its range has recently increased in the Erie, Genesee, and Oswegatchie watersheds.

Allegheny (**3**). An individual was caught in Chautauqua Lake in 2003 (NYSM 55312). This specimen was the result of an introduction, the long-term consequences of which have yet to be resolved. The species has not been reported since this capture, so it may have failed to establish itself in this watershed.

Erie-Niagara (1,2,3). Greeley (1929) did not report this species from the 1928 watershed survey. Trautman (1981) reported that since 1925, it was confined to the Maumee system in the Lake Erie watershed, although a specimen was collected from Ellicott Creek in 1938 (CUMV 72309). More recent captures have been from Lake Como, the Niagara River in 1975 (AMNH 38970), and Buffalo Creek at Elma in 1977 (AMNH 45945). Specimens were also taken from the Erie Canal in Niagara County in 2006 (NYSM 60594) and Tonawanda Creek in 2006 (NYSM 61289).

Ontario (1,2,3). A specimen was taken from Irondequoit Bay in 1929 (CUMV 28003). Greeley (1940) reported that a single specimen was taken from the Erie Canal. Greeley and Bishop (1932) noted that this species was rare in the eastern part of the watershed, being represented by only two small specimens from Stony Creek. In recent years, Greater Redhorses have been collected from two impoundments on Oak Orchard Creek, the mouth of Fourmile Creek (NYSM 68096), Henderson Bay (NYSM 52735), and again from Stony Creek in 2005 (NYSM 59699).

Genesee (3). This species was first reported from this watershed at a site in the Genesee River near its mouth, downstream of Rochester, in 1992. Specimens were collected farther upstream of Rochester Falls and in Beards Creek (NYSM 54288) in 2002 and from the Erie Canal at Rochester in 2007. The species also was reported from Rushford Lake in 2005, which is likely the result of an introduction.

Species continued on next page

Oswego (1,2,3). In 1910, this species was caught in the Clyde River (USNM 203066), but it was not reported during the later 1927 survey of the watershed (Greeley 1928). Additional specimens were caught at several sites on Oneida Lake in the 1950s, 1960s, and 1990s. In 1994, this redhorse was reported from Cross Lake (T. Whittier, Oregon State University, Corvallis, OR, EMAP field notes).

Saint Lawrence (1,3). Greeley and Greene (1931) reported that one specimen was collected from the Saint Lawrence River near Waddington and that several others were caught in Sucker Brook near its mouth. Greater Redhorses have been reported several times from the Saint Lawrence River, Grass River, and their tributaries from 1995-2006.

Oswegatchie (2,3) An angler's catch in 1947 at Rensselaer Falls is the first report of this species in the watershed. Most recent catches are from the Indian River basin as far upstream as Evans Mills.

Raquette (1,3). During the 1933 survey, the Greater Redhorse was locally common in Squeak, Plum, and Parkhurst brooks, all of which are lowland tributaries of the Raquette River (Greeley 1934). The only recent reports of this species in the watershed are from Parkhurst Brook in 2004 and 2007.

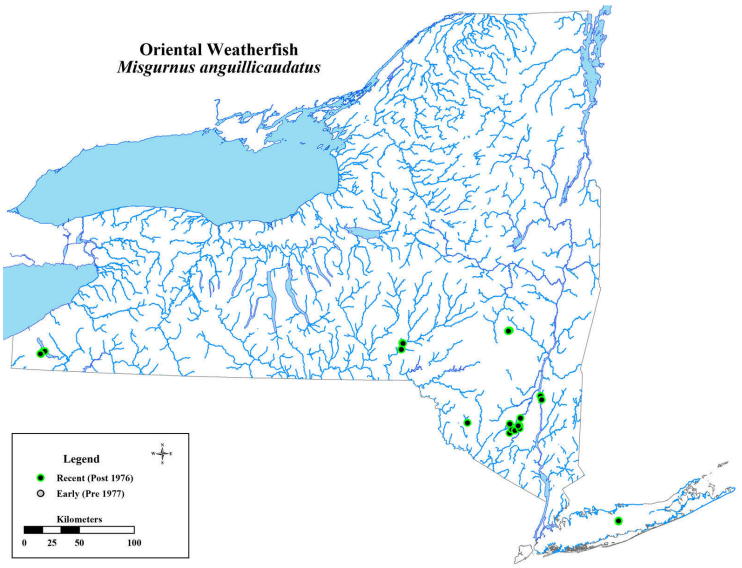
Champlain (1,3). This species was locally common in the lower course of the Great Chazy River, where 20 specimens were collected during the 1929 watershed survey, but no specimens were found in any other tributary or in the lake itself (Greeley 1930). Between 1999 and 2012, Greater Redhorses were again found in the Great Chazy River. Records from Vermont span the same period and extend as far south as Grand Isle (R. Langdon, Vermont Fish and Wildlife Department, pers. comm.).

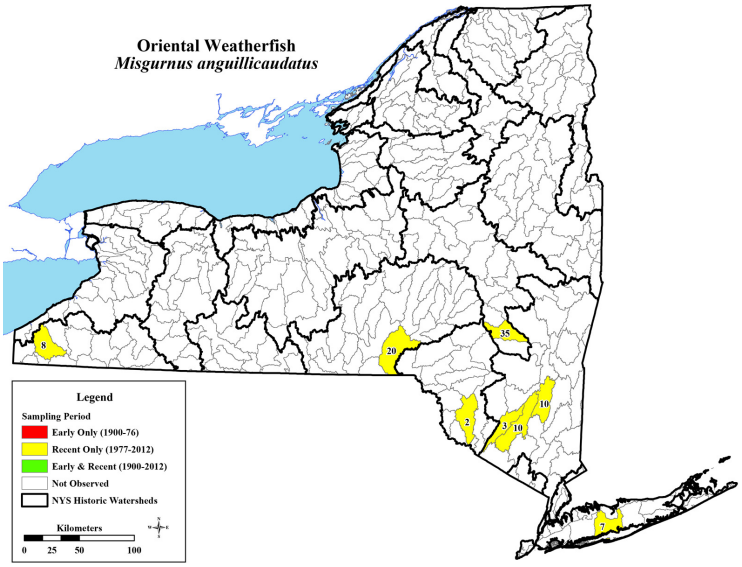
Cobitidae, Loaches

Loaches are cypriniform fishes that are native to Europe, Asia, and Africa. Their species diversity is greatest in southeastern Asia. They tend to be slender, elongate fishes, and many are popular in the aquarium trade.

Misgurnus anguillicaudatus, Oriental Weatherfish

This East Asian loach is an exotic species that was first caught in New York waters in 2001 but is likely to have been established since the 1990s. This is a popular aquarium species and was likely released by aquarists. Oriental Weatherfish live in low-gradient streams and ponds with silt bottoms and can tolerate degraded habitats with hypoxic or anoxic water due to their ability to breathe atmospheric oxygen. This species has been found in the state's southern watersheds, including the Allegheny, Susquehanna, Delaware, Mohawk, Lower Hudson, and Long Island. It appears to be established in at least some, if not all, of these watersheds.





Allegheny (**3**). Oriental Weatherfish have repeatedly been collected from Ball Creek, a tributary of Chautauqua Lake, from 2001 to 2013 (NYSM 53924, 57313).

Delaware (**3**). Oriental Weatherfish were caught in Kinne Brook, a tributary of Swinging Bridge Reservoir near Monticello, in 2014 (S. Wells, NYSDEC, pers. comm., NYSM 70945).

Susquehanna (**3**). This species was first reported from a small tributary of the Susquehanna River near Bainbridge in 2010 (NYSM 66576). The following year, Oriental Weatherfish were collected approximately 7 km downstream in Wiley Brook (Wells 2014).

Mohawk (**3**). In 2010, this weatherfish was found in an unnamed, high-elevation tributary of the Manorkill, a tributary to the Schoharie Reservoir (S. Wells, NYSDEC, pers. comm.). Fish were abundant in a 200-m stretch of stream, an adjoining pond, and an in-stream pond from which almost 200 individuals were collected. In 2011, this species was again found in the Manorkill (NYSM 67853).

Lower Hudson (**3**). In 2009, Oriental Weatherfish were collected at several sites on the Dwaarkill and some of its unnamed tributaries (e.g., NYSM 64731, 65157), the mouth of the Shawangunk Kill (NYSM 64926), and an unnamed tributary of the Wallkill River (NYSM 64927). In 2010, the species was found in the Wallkill River as far upstream as the dam at the Village

Species continued on next page

of Wallkill. In 2013, this loach was again collected from the Dwaarkill (NYSM 69502) as well as the Esopus Creek basin (NYSM 68732, 68734), where the species was again found in 2014 (NYSM 70643). These sites are all in western tributaries of the Hudson River, but the species has recently jumped the river and was collected from the Indian Kill near Staatsburg in 2013 (NYSM 69379), with several additional collections made at this site in 2014 (e.g., NYSM 71046). Schmidt and Schmidt (2014) detailed aspects of the life history of this exotic species in the watershed.

Long Island (**3**). The Oriental Weatherfish was first documented in 2003 in a retention pond connected to Ronkonkoma Swamp (NYSM 54195) and was collected again in this area in 2009 (NYSM 65240) and 2010 (NYSM 66271).

Ictaluridae, Catfishes

Several of New York's catfish species grow to a relatively large size and are often important game and food fishes. *Ameiurus* and *Ictalurus* species are primarily found in larger rivers, lakes and ponds. There are representative species of one or both of these genera in every watershed in New York, although, for some species, their current distribution is the result of introductions into new watersheds. Madtoms (genus *Noturus*) are smaller catfishes. The four species present in the state are stream-dwelling fish with limited ranges, although these species have also seen range expansions in recent years.

Ameiurus catus, White Catfish

This species lives in coastal rivers and has been introduced to some lakes and reservoirs. The White Catfish is largely estuarine, and its native range in New York is thus limited to the Hudson River Estuary and the lower portions of the Upper Hudson, Mohawk, and Delaware rivers, as well as the Newark Bay watershed. We omitted two records from the map: Fowler archived a specimen from Lake George (ANSP 8537), and there is a 2001 report from Grassy Sprain Reservoir in the Westchester County portion of the Long Island watershed. We treat these records as anomalies due to the absence of any other reports of this species from either watershed.

Delaware (2,3). Springer and Groutage (1962) reported capturing this species in the New York portion of the Delaware River in 1959, and this is the only record that supports the native status of this species in this watershed. Historically, White Catfish were common in the river below the New York state border (Keller 2011). A specimen was reported from Cliff Lake in 1977 (AMNH 48419), presumably as the result of an introduction. Additional introduced populations began to be reported from several upland reservoirs after 1983, such as the Toronto, Swinging Bridge, Rio, Mongaup Falls, Pepacton, and Neversink reservoirs, as well as White Lake.

Upper Hudson (2,3). This species has only been found near the mouth of the Mohawk River and other areas near the downstream margin of this watershed (Makarowicz 1983).

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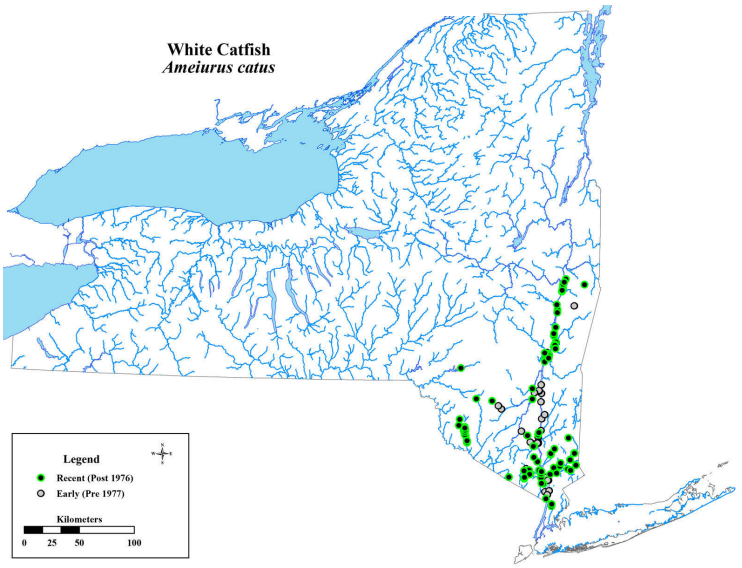
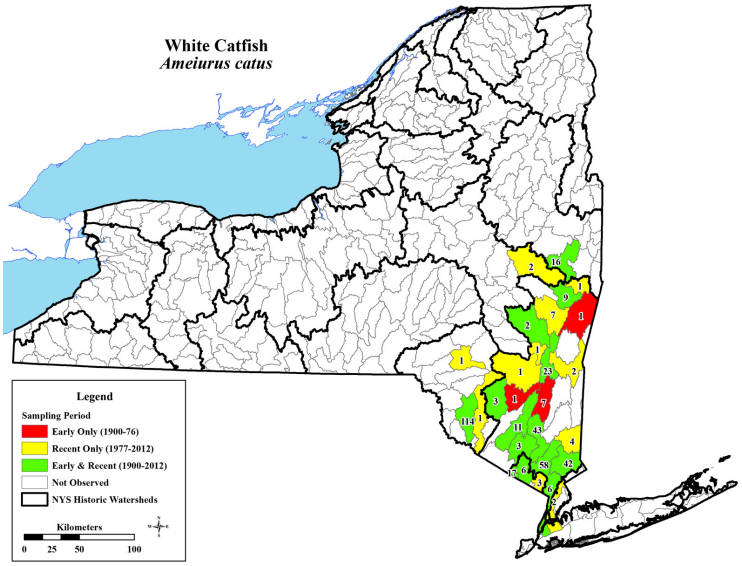


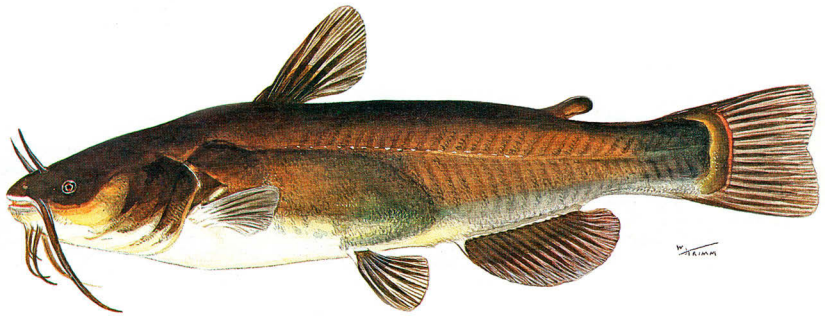


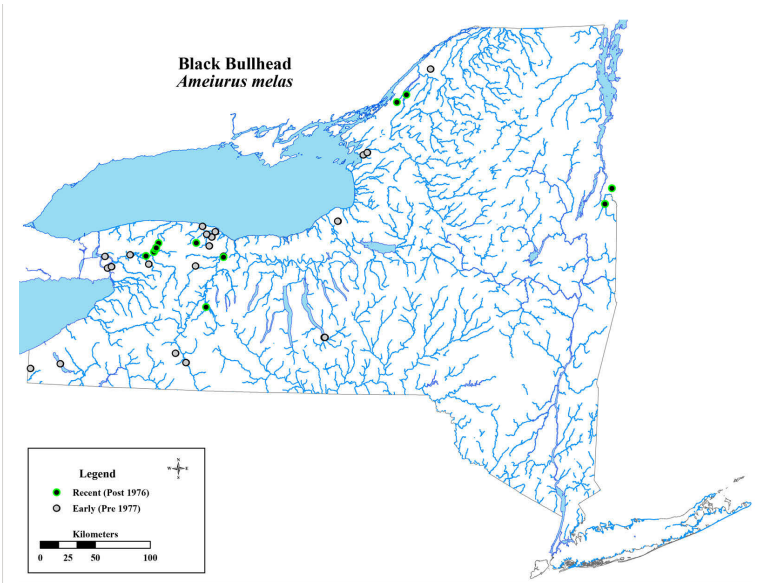
Mohawk (2). In 1983, this species was caught at the mouth of the Mohawk River (Makarowicz 1983). A 1998 record from Lock 21, which is west of Rome, is unconfirmed and is, therefore, not included on our map.

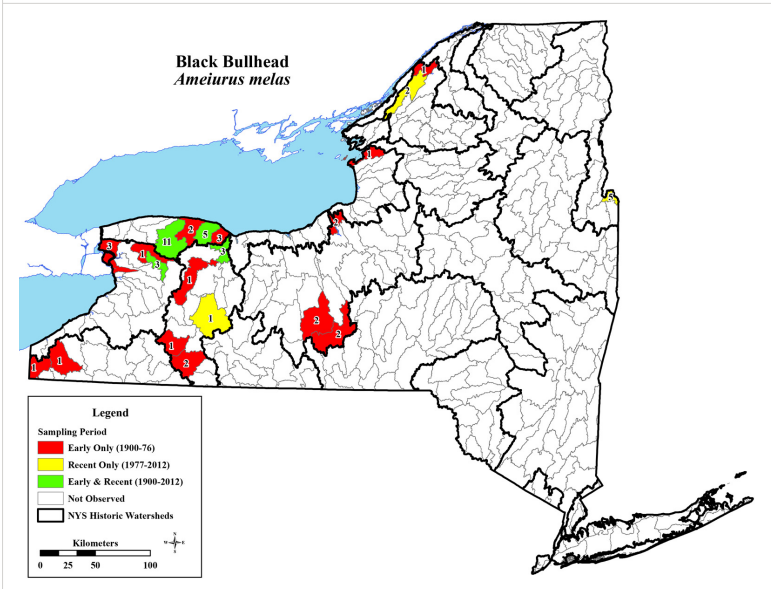
Lower Hudson (1,2,3). Mearns (1898) noted that White Catfish were abundant in the river. Greeley (1938) reported that this species was moderately common and was found in the main channel as far downriver as the transition point to brackish water. He also reported this catfish from Rondout Creek, Brooks Lake, and Lake Tiorati. Greeley (1938) also noted that the species had been introduced into upland lakes as a game fish without much success or interest on the part of anglers. The White Catfish continues to be introduced to the area and has become established in additional reservoirs and ponds in this watershed, such as Underhill Pond in 1981 and Mill Pond in 1984, which are in Columbia and Rensselaer counties, respectively. The abundance of this species in the river may have declined as a result of Channel Catfish becoming established there (Jordan et al. 2004).

Newark Bay (1,2,3). White Catfish have been reported from Greenwood Lake in 1936 (NYSM 38686) and 1990, and from Lake Sebago in 1987 (ALSC, unpubl. data).

Ameiurus melas, Black Bullhead







Black Bullheads inhabit muddy ditches, streams and ponds. The species is native to western and northern New York and has also been introduced into three watersheds in the eastern part of the state. This catfish is apparently extirpated from the Allegheny and possibly from the Oswego watersheds. Records of Black Bullheads also exist from the Susquehanna, Delaware, Upper Hudson, Mohawk, Lower Hudson, and Long Island watersheds. The species has also been reported from the Black and Saint Lawrence watersheds, but these reports are not confirmed and are not shown on the map. Due to the difficulty of distinguishing this species from congeners and the lack of voucher specimens associated with any of these records, we do not include them on our distribution maps for the species.

Allegheny (1). The presence of Black Bullheads in New York's portion of the Allegheny River system is based on a single capture of three individuals from Chautauqua Lake in 1935 (NYSM 5647). In 1972, this catfish was collected from a tributary of French Creek (W. Hadley, SUNY Buffalo, unpubl. field notes). The species is native to, and widely distributed throughout, the rest of the upper Mississippi River drainage (Lee et al. 1980).

Erie-Niagara (1,2,3). Greeley (1929) reported that this species was present in Lake Erie, although none were collected during the 1928 watershed survey. Fowler (1919) listed the Black Bullhead as a resident of the lake in Pennsylvania. Although not associated with the watershed survey, a collection was made at Sheridan Park in Buffalo in 1928 (CUMV 2679). In 1972, W. Hadley (SUNY Buffalo, unpubl. field notes) reported this species from the Niagara River, as well as Tonawanda, Murder, and Bull creeks. During a Department of Environmental Conservation program to promote urban fishing that began in the late 1970s, this species was stocked in ponds in Buffalo (Frisa 1977, Lange 1984), but there are no recent records of catches in urban ponds. A specimen was caught in a northern feeder canal connected to Tonawanda Creek (NYSM 62675) in 2007 and at the nearby Murder Creek in 2014 (NYSM 71080).

Species continued on next page

Ontario (1,2,3). Evermann and Kendall (1901) reported that this species was found in Sandy Creek near North Hamlin and Mill Creek near Sacketts Harbor in 1894. According to Greeley (1940), this species was taken by J. R. Westman and M. A. Hall at West Creek (Monroe County), 1 km upstream of its mouth, on June 1, 1933 (CUMV 27529). Black Bullheads were collected from both Oak Orchard Creek and a crossover canal that connects Oak Orchard and Tonawanda (Erie-Niagara watershed) creeks from 1971-1973 and 2005-2012 (NYSM 59161, 65980, 68381). The species has also been introduced into an isolated pond at SUNY Brockport, where it was caught in 2013 (NYSM 69989).

Genesee (1,2,3). In his report on the 1926 watershed survey, Greeley (1927) stated: "Our two specimens are from warm streams: Genesee river below dam at Belmont; and a tributary of Black Creek (Allegany Co.) [CUMV1124]." All recent records are from the area downstream of Mount Morris, including Oatka Creek near Leroy in 1971 (W. Hadley, SUNY Buffalo, pers. comm.), East Branch Red Creek near Rochester in 1974 (W. Hadley, SUNY Buffalo, pers. comm.), and Keshequa Creek in 1979 (CUMV 56069). A specimen was collected again at the East Branch Red Creek site near Rochester in 2013 (NYSM 69793).

Oswego (1,2). There are few verified reports of this species from the watershed. Verifiable records include captures in Black Creek near Fulton in 1927 (CUMV 7036), Cayuga Lake at Stewart Park in 1938 (CUMV 53832), and Cayuga Inlet near Fleming School in 1946 (CUMV 53685). Earlier records exist from Flint Creek and the Rome Reservoir, but these and other later reports lack voucher specimens. As such, these reports are suspect and are not shown on the map. Although there are few records from this watershed, there is little reason to regard these fish as exotic because Lake Ontario populations would have free access to this watershed via the Oswego River.

Oswegatchie (1,3). A single specimen was caught in Lisbon Creek during the 1931 watershed survey (CUMV 55460). In 2012, Black Bullheads were found in Black Creek, a tributary of Black Lake, as well as in Black Lake itself (USGS Cortland, unpubl. field notes). The species was reported from three ponds in Lewis County in 1970, but these identifications cannot be confirmed.

Champlain (1,2,3). The earliest record from this watershed is from an unspecified location, identified only as "Lake Champlain," in the 1880s (MCZ 25664). In recent years, Black Bullheads have consistently been collected from Mud Brook, including records from 2004 (NYSM 57546), 2006 (NYSM 60875), and 2011 (NYSM 66920). In 1983 and 2003, specimens were collected from tributaries on the Vermont side of the lake (MCZ 60522, 163467). The species has also been reported from the Little Ausable River in 1962, Lake Champlain in 1976, and Upper Saranac Lake in 1977, but these identifications have not been supported with voucher specimens. Lee et al. (1980) and Page and Burr (1991) classify this species as non-native to this watershed but give no rationale for doing so. Because this catfish has been reported from this watershed and because it is regarded as native in other Saint Lawrence River drainage watersheds, we favor treating it as native.

Susquehanna. Between 1972 and 1976, Black Bullheads were reported from Wilber and Youngs lakes and the West Branch Tioughnioga River, but no specimens were kept and the points are not shown on our map.

Delaware. This bullhead was reported from Hankins Creek near Obenburg in 1985 and Mongaup Creek in 2001, but the identifications were not confirmed and the records are, therefore, not shown on our map.

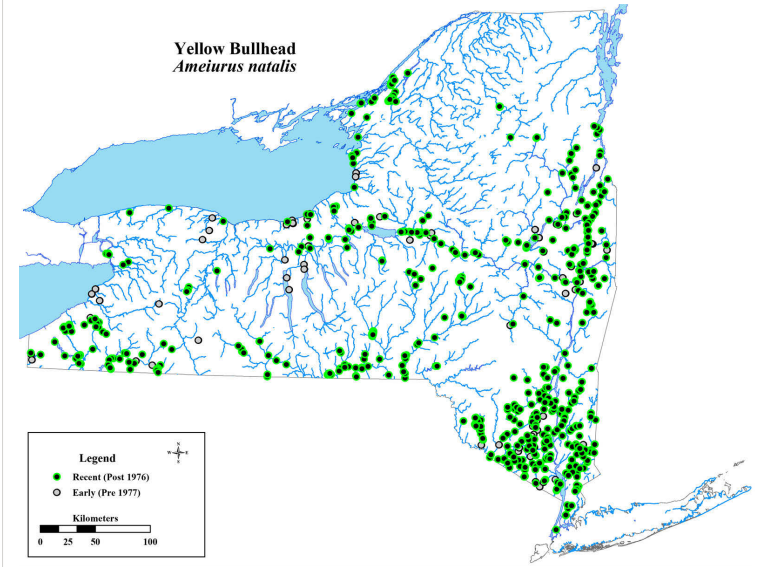
Upper Hudson. DeKay (1842) and Bean (1903) list the Black Bullhead as present in this watershed and it was reported from Kayaderosseras Creek in field notes from the 1932 survey, but Greeley (1933) rejected this identification as well as the reports of DeKay and Bean. The species was reported from several ponds in the 1950s, but these identifications could not be confirmed.

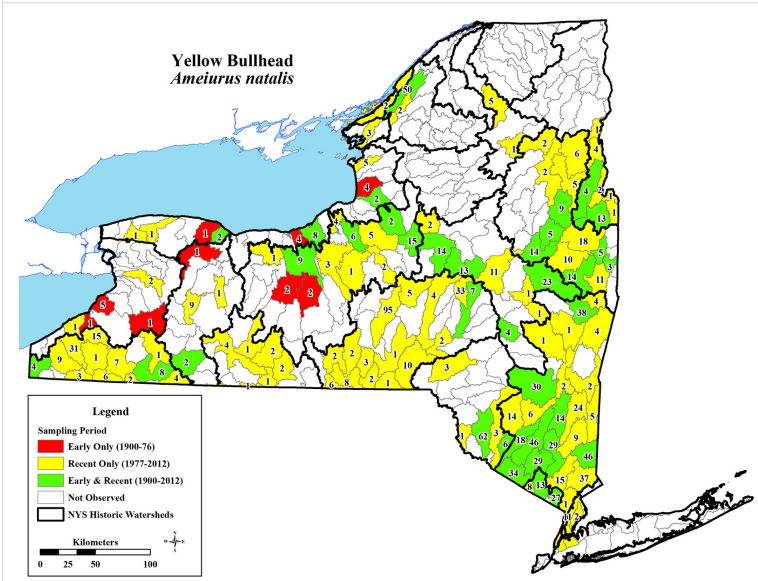
Mohawk. Between 1960 and 1975, Black Bullheads were reported from the Erie Canal near Ninemile Creek as well as several ponds, but the identifications could not be confirmed and the records are not included on our map.

Lower Hudson. There are no confirmed records of this species from this watershed. Reports of its presence in the Hudson River, Swamp River, and various ponds dating from 1971-1997 exist, but identifications were not verified and the reports are not included on our map.

Long Island. Lange (1983) reported on urban fishing programs from the 1980s, including stocking of Black Bullheads in Prospect Park Lake. There are no recent reports from this lake or any other in this watershed. A putative Black Bullhead from Jones (Mill) Pond in Hempstead (Nassau County) was caught in 1993 and currently holds the state record for this species, but the identification has since been questioned.

Ameiurus natalis, Yellow Bullhead





This bullhead occurs in vegetated lakes and low-gradient streams with clear water. The species has been reported from all of New York's watersheds although it is not native to four of them. In some of these watersheds, and particularly those of the southern tier, the range and frequency of occurrence of this species have increased substantially in recent years.

Allegheny (1,2,3). Greeley (1938) reported that this species was only found in Findley Lake (NYSM 33615), which is in the French Creek basin, during the 1937 Allegheny watershed survey. In 1947, a specimen was collected from the central basin in East Mud Lake (CUMV 68245). Yellow Bullheads are now found throughout the watershed. Eaton et al. (1982) noted that individuals were collected near Olean in 1965, which is the earliest documented record of this species in the eastern basin. Hankinson (1927) and Dence (1928) reported its presence in the Allegheny River, but Eaton et al. (1982) could not confirm these earlier reports. This catfish was found at 10% of the sites sampled during a 2005-2006 survey of the central basin, and it continues to be caught, although somewhat infrequently, throughout the watershed.

Erie-Niagara (1,2,3). In 1894, Cloudsley Rutter caught this bullhead species in Fish Creek near Buffalo (USNM 69993). Hankinson (1923) caught it in Cattaraugus Creek in 1921. Greeley (1929) listed the species as rare in this watershed, reporting that it was taken from Muddy and Little Sister creeks and in Lake Erie at Dunkirk Bay. Yellow Bullheads were again found in Cattaraugus Creek in 1967, and in Cayuga Creek and the Niagara River from 1998-2003.

Ontario (1,2,3). In 1903, this species was collected repeatedly from Buttonwood Creek (Wright 2006) and continued to be collected in the area near Hilton in subsequent years, including records from North Creek in 1904 (CUMV 72184), North Salmon and Northrup creeks in 1924 (CUMV 447), and Black Creek in 1927 (CUMV 2108). In 1911, Weed caught an individual at the head of Sodus Bay (USNM 93838). Greeley (1940) reported that Yellow Bullheads were uncommon in the watershed and were mostly found in the bays of the lake and their tributaries. The species has been found to be more widely distributed in recent surveys.

Species continued on next page

Genesee (2,3). The earliest record from this watershed is from Churchville Pond of Black Creek in 1947. Since then, specimens have been caught in Silver, Rushford, and Conesus (AMNH 227197) lakes. Results of recent surveys do not indicate that the species is expanding its range in this watershed.

Oswego (1,2,3). Yellow Bullheads were caught in Cayuga Lake in 1877 (CUMV 888) and Seneca Lake in 1899 (USNM 77868). Greeley (1928) regarded the species as uncommon in the watershed, noting that it was usually caught in sluggish bodies of water like Oneida and Cayuga lakes, the Seneca River, and weedy streams in the northern part of the watershed. In recent surveys, specimens have been collected from these same waters as well as the Erie Canal.

Black (1). The only record from this watershed is an 1894 capture from the Black River near Huntingtonville (USNM 69994).

Saint Lawrence (2,3). The few records of Yellow Bullheads in this watershed are from the Thousand Islands area of the Saint Lawrence River from 1976-2012. The species has not been reported downriver of Chippewa Bay nor from upland areas.

Oswegatchie (1,2,3). Greeley and Bishop (1932) listed this species as rare; in fact, they reported that it was only taken in Black Lake, also noting that this was the easternmost site in the Saint Lawrence drainage where Yellow Bullheads were found. The species has been caught more recently in the western part of the watershed in waters around Black Lake and in the Indian River lakes.

Raquette (**3**). This species was collected from the Piercefield Flow in 2009 and 2010. This is a high-elevation site and upstream of numerous barriers that would block natural range expansion from any potential lowland populations.

Champlain (2,3). In 1962, this species was caught in Rush Pond in Warren County. Yellow Bullheads were caught in Lake George in 1974 (NYSM 10252), Lake Champlain in 1978 (AMNH 41393) and 1979 (AMNH 43881), the Mettawee River in 1982 (NYSM 11434), the Poultney River in 1983 (R. Langdon, Vermont Department of Fish and Wildlife, pers. comm.), Mount Hope Brook in 1985 (Bouton 1986), and at several of the same localities during surveys between 2004 and 2008. Catches from the Champlain Canal have become common in recent years. The range and frequency of occurrence of this species appear to be increasing in this watershed. Although Greeley and Bishop (1932) commented that this species did not occur farther east than Black Lake in the Saint Lawrence drainage, Lee et al. (1980) treat this watershed as part of this bullhead's native range. Because it is regarded as native in other Saint Lawrence River drainage watersheds, the conservative approach is to regard it as native here as well.

Chemung (**3**). This catfish was first caught in this watershed in 2001 at Meads Creek. Since then, the species has been found in the Cohocton, Canisteo, and Chemung rivers.

Susquehanna (**2,3**). Beginning in 1961, this species has been reported in Goodyear Lake, Chittning Pond, Whitney Point Reservoir, and Trout Brook. In the 1970s and 1980s, it was found in the main channel of the Susquehanna River (AMNH 223609), Castle Creek (AMNH 43971), and Catatonk Creek (CUMV 84520). During the last decade, Yellow Bullheads have been collected from several additional waters.

Delaware (**2,3**). In this watershed, the Yellow Bullhead was first caught in tributaries of the Mongaup River in 1974. The species was taken from the Neversink basin during survey work from 1976-77 (e.g., AMNH 38557) and in the Mongaup and Tenmile rivers in the 1990s. In the past decade, specimens have continued to be collected from the Neversink system (C. Apse, The Nature Conservancy, pers. comm.).

Upper Hudson (1,2,3). Spencer F. Baird collected a Yellow Bullhead in Essex County in the middle of the nineteenth century (ANSP 8535). Greeley and Bishop (1933) reported that this species was caught in the Sacandaga Reservoir during the 1932 watershed survey and Greeley (1935) also listed it from the Owl Kill in the Hoosic River basin. A collection from Knob Pond, Essex County (NYSM 33612), was also made in 1932. In recent decades, this bullhead's range has expanded in the watershed; it is currently present as far upstream as Harris Lake and has also been introduced into several upstream stream and lake sites.

Mohawk (1,2,3). During the 1934 synoptic survey, this species was only found in Lake Niskayuna (Greeley 1935). Through the 1980s, it was reported often in the main channel of the Mohawk River (e.g., NYSM 9482) and in lowland lakes. Yellow Bullheads continue to be reported, primarily in lakes and ponds.

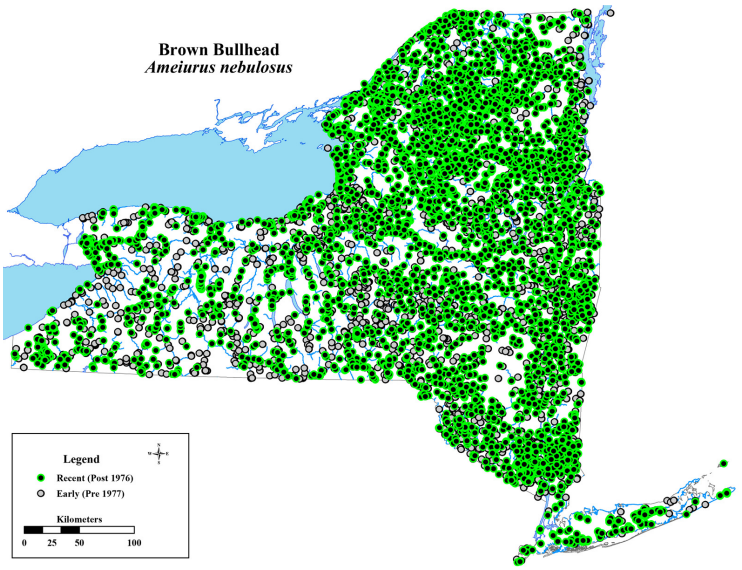
Lower Hudson (1,2,3). Greeley (1937) described this species as rare and unimportant as a game fish. Specimens were taken at several sites in the Wallkill River and in Brown's Farm Pond, now named the Silver Stream Reservoir. All early records from this watershed are from the western tributaries. Recent catches have been made from tributaries on both banks, including the Roeliff Jansen Kill, Wappinger Creek, and the Croton River.

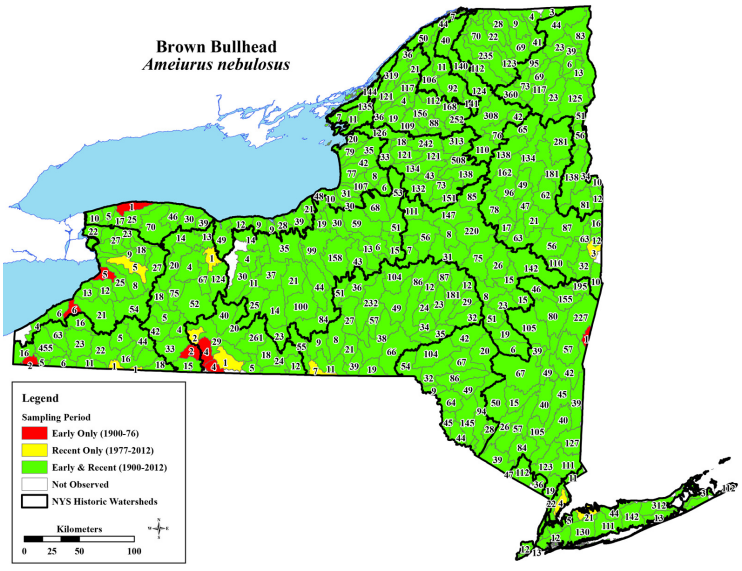
Newark Bay (1,2,3). Greeley (1937) noted the presence of this species in the Ramapo River. In the 1960s, Yellow Bullheads were caught in the Mahwah and Hackensack rivers and have recently been reported from Rockland, DeForest, and Greenwood lakes.

Long Island (3). Yellow Bullheads have not been found on the islands in this watershed. The only records for this species are from the Kensico Reservoir in 1991 and 2010, the Bronx River from 2007-2010, and from Prospect Park Lake in the Bronx in 2012.

Ameiurus nebulosus, Brown Bullhead

This ubiquitous bullhead lives in lakes and rivers with muddy bottoms or dense submerged aquatic vegetation. This catfish is a trophic generalist and is tolerant of degraded conditions. All of New York's watersheds contain Brown Bullheads and they are among the most frequently caught fishes in the state. The species is native throughout most of the state but has been introduced in the upland ponds of the Adirondack Mountains (George 1981a).





Allegheny (1,2,3). In his report on the 1937 watershed survey, Greeley (1938) noted: "Although absent from a large mileage of the more rapid streams, good bullhead spots are to be found here and there along some of the rivers and larger creeks where the flow is sluggish." He (Greeley 1938) also noted that Brown Bullheads were relatively common, being caught at 23% of the survey sample sites. In recent surveys, this species has continued to be widely distributed in all three basins. It is largely absent from streams but abounds in slower waters and ponds.

Erie-Niagara (1,2,3). Greeley (1929) listed this bullhead as common (in fact, the species was common enough to support a commercial seine fishery), noting that it was found in slow-water streams and ponds as well as in sheltered bays of Lake Erie. The lake no longer supports a commercial fishery (Einhouse et al. 2005), but bullheads are still popular sport fish. The frequency of occurrence of this species in this watershed shows a precipitous decline. In 1928, it was reported at 10% of the survey sample sites, whereas in surveys conducted in the 2000s, it was present at only 1% of the sites sampled.

Ontario (1,2,3). This was the most abundant food fish in the 1939 watershed survey, where it was found in ponds, bays, low-velocity streams, and Lake Ontario itself (Greeley 1940). Its distribution and abundance remains unchanged.

Genesee (1,2,3). Brown Bullheads were locally abundant during the 1926 survey (Greeley 1927) and remain abundant and widely distributed throughout this watershed.

Oswego (1,2,3). According to Greeley (1928), Brown Bullheads were "abundant throughout the region, in lakes, ponds, and warm sluggish streams." The species remains widespread in this watershed.

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Black (1,2,3). During the 1931 watershed survey, this species was abundant, particularly at lowland sites (Greeley and Bishop 1932). Although Mather (1886) mentioned its presence in upland lakes, and he actually accessioned a lot collected from the Fulton Chain in 1882 (USNM 32777), this species has probably been introduced into most of the many upland lakes where it is found (George 1981a; Gallagher and Baker 1990). Currently, this catfish species remains widespread in this watershed.

Saint Lawrence (1,2,3). Greeley and Greene (1931) described the species as very common and present at both lowland and Adirondack sites sampled during the 1930 survey. There is no indication that its distribution or abundance has changed.

Oswegatchie (1,2,3). Brown Bullheads were abundant at both lowland and upland sites during the 1931 survey of this watershed (Greeley and Bishop 1932). The species remains abundant throughout the watershed.

Raquette (1,2,3). Greeley (1934) reported that this species was abundant and that its "natural distribution throughout the Raquette Watershed is extensive, and suitable lakes, ponds and streams throughout most of the area contain this species." He (Greeley 1934) continued with an unexplained exception, reported from anecdotes of anglers, that Brown Bullheads had recently become scarce in Tupper Lake and the river downstream of the lake, which, in retrospect, suggests an isolated die-off, as the species remains abundant and widespread, including in Tupper Lake.

Champlain (1,2,3). A Brown Bullhead specimen was caught in 1850 from Lake Champlain at Westport (USNM 1488). During the 1929 watershed survey, Greeley (1930) noted that this species was "widely distributed and common in Lake Champlain, Lake George, and many of the interior lakes and ponds." The species remains widespread in the major lowland lakes and is also common in the upland lakes in the Adirondack Mountains.

Chemung (1,2,3). Brown Bullheads were present at 15% of the 1937 watershed survey sample sites (Greeley 1938), and they continue to be abundant and widespread throughout this watershed.

Susquehanna (1,2,3). Greeley (1936) noted that this species was a common and typical pond inhabitant that also used low-velocity streams. Its status in this watershed remains unchanged.

Delaware (1,2,3). Brown Bullheads were common during the 1935 survey (Greeley 1936) and have remained a commonly caught fish in later survey work.

Upper Hudson (1,2,3). During the 1932 survey, Brown Bullheads were common in the lowland lakes, where individuals grew to large sizes, and in upland ponds and slow streams, where fish remained relatively small and recreationally unimportant (Greeley and Bishop 1933). The species is still taken in most lakes and ponds throughout the watershed.

Mohawk (1,2,3). This bullhead was a popular, abundant, and widespread game fish at the time of the watershed survey (Greeley 1935). The species remains widespread and abundant in the Mohawk watershed.

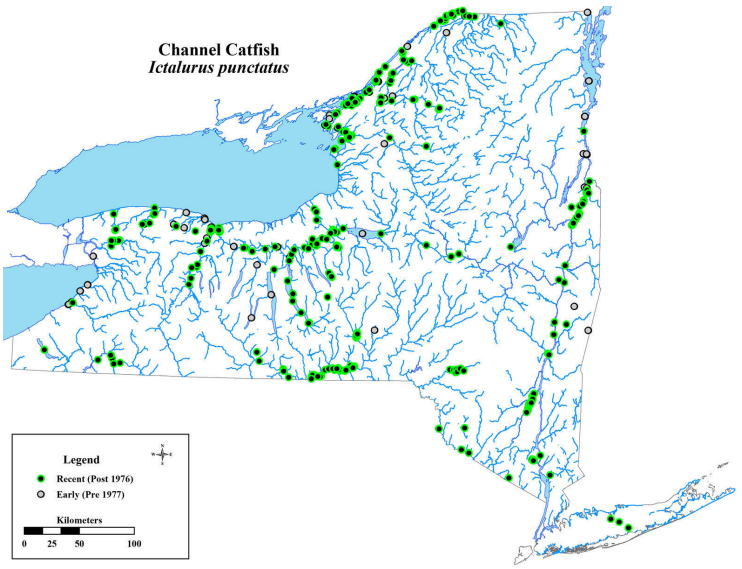
Lower Hudson (1,2,3). Brown Bullheads were collected at over 200 watershed survey sample sites, which, according to Greeley (1937), encompassed "a wide range of habitats including the Hudson River, sluggish creeks, reservoirs, ponds and lakes." The species is still common in the estuary, tributary streams, and ponds.

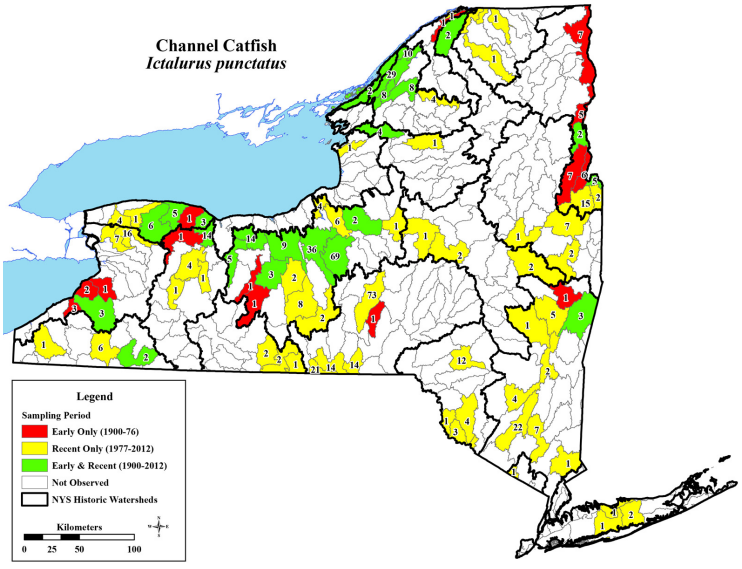
Newark Bay (1,2,3). Greeley (1937) reported that Brown Bullheads were abundant and were found at 37% of the survey sample sites. This catfish remains abundant and widespread throughout the watershed.

Long Island (1,2,3). Spencer F. Baird collected a specimen at Riverhead in 1854 (USNM 1431). In the synoptic surveys of the 1930s, this species was widely distributed, being found in ponds on Long and Staten islands (Greeley 1939a), as well as in Westchester County (Greeley 1937). Brown Bullheads continue to be abundant and widely distributed on Long and Fishers islands and in Westchester County.

Ictalurus punctatus, Channel Catfish

This widely distributed catfish species lives in lowland lakes and rivers with meandering channels and deep scour holes. Because New York is on the periphery of its native range, these habitat characteristics differ slightly from those found in populations occupying the heart of its range. In New York, Channel Catfish are locally abundant at only a small number of sites. The species is native to downstream areas of all nine of the watersheds of the Saint Lawrence drainage and has been introduced to, and become established in, the state's remaining nine watersheds in recent decades.





Allegheny (**2,3**). Channel Catfish have been stocked in the Allegheny Reservoir since 1968 (Eaton et al. 1982). The species was first caught in the New York portion of the Allegheny River by an angler in 1972 and was later reported by Becker (1982). Continued stocking in the Pennsylvania portion of the Allegheny Reservoir has resulted in an established population, with catches reported by anglers in 2004. Two young-of-year individuals were collected from the Allegheny River in 2013 (NYSM 70136). Channel Catfish were reported from Chautauqua Lake in 1982 and anglers have reported individuals at downstream sites on Conewango Creek as well.

Erie-Niagara (1,2,3). In 1894, Cloudsley Rutter collected specimens from Fish Creek near Buffalo (USNM 70010). Greeley (1929) reported this species to be common in Lake Erie, the Niagara River, large streams, and, in spring, at the mouths of smaller creeks. Results of recent work indicate that its abundance and distribution in this watershed are unchanged.

Ontario (1,2,3). Evermann and Kendall (1901) reported this species from the eastern basin in 1894 and Dymond et al. (1929) listed it as a component of the fish assemblage in the Canadian part of the lake. Greeley (1940) noted anecdotal reports of its presence in the lake but did not report any captures during the watershed survey. Lantry (2012) reported catches from this watershed through the 2000s and included records from Lake Ontario, its border waters including Irondequoit, Chaumont, and Black River bays, and the Erie Canal.

Species continued on next page

Genesee (2,3). This species was first collected in this watershed in 1975, when it was caught both in the 10 km segment below Rochester Falls as well as upstream of the falls. Other recent capture locations upstream of the falls, where this catfish is not native, include Black Creek and the Genesee River at Oatka Creek (NYSM 54344). Its range in this watershed extends as far upstream as Mount Morris.

Oswego (1,2,3). The Channel Catfish was documented in Cayuga Lake as early as 1902 (CUMV 36945). Greeley (1928) listed the species as common in rivers and in Cross and Oneida lakes. This catfish continues to be reported from the watershed in the larger rivers, the canal system, and lakes.

Black (2,3). Channel Catfish have been reported from Soft Maple Reservoir, Pleasant Lake, and the Black River at Carthage. Although these reports are from sites scattered throughout the watershed, there is little evidence that these single-specimen catches are from established populations. In 2009, individuals were caught in the main channel near the mouth by anglers and during agency surveys.

Saint Lawrence (1,2,3). Evermann and Kendall (1902b) listed several sites where Channel Catfish were captured, but Greeley and Greene (1931) reported than none were caught during the 1930 survey of the watershed. They (Greeley and Greene 1931) did, however, cite anecdotal reports of catches near Ogdensburg by anglers. Recently, this species has been reported from the Saint Lawrence River and the lower Salmon, lower Saint Regis, and lower Grass rivers (Normandeau Associates, Inc. 2007).

Oswegatchie (1,2,3). Greeley and Bishop (1932) noted that this species was rare and was only found in Black Lake and the lower course of the Oswegatchie River. More recently, Channel Catfish have been found in the upper Indian River near Hanson Bridge, Red Lake, and areas near the Flat Rock Reservoir and other impoundments near Edwards.

Raquette (1,3). Greeley (1935) included an account for this species based on reports of captures downstream of Raymondville from several reliable sources. The species still occurs downstream of Massena, where individual fish may move between the lower Raquette and Saint Lawrence rivers. An unusual 1933 record from Owls Head Pond, in the Adirondacks, was apparently from a failed stocking effort and is, therefore, not included on the map.

Champlain (1,2,3). Evermann and Kendall (1902a) listed this species from Lake Champlain. Greeley (1930) noted that Channel Catfish were moderately common throughout the lake but were most abundant in the shallower South Bay. Specimens were also taken from Ticonderoga Creek, the outlet of Lake George (NYSM 38688), and the South Bay of Lake Champlain (NYSM 33627). Recent records include collections from the Champlain Canal in 1980 and 2008 (NYSM 6220, NYSM 64253), the Poultney River in 2001 (NYSM 52928), and the Mettawee River in 2013 (NYSM 69312).

Chemung (**2,3**). The first reported Channel Catfish catch in this watershed was from Waneta Lake in 1978 (Green 1986). Lane (1991), based on an angler's report, noted the species' presence in the Chemung River in 1990. It was not until 2003, however, that a confirmed capture was reported from the Chemung River.

Susquehanna (**2,3**). The first report of Channel Catfish from this watershed is an E.C. Raney collection from Owego Creek, dated 1962 (CUMV 48726). There is some confusion on this date because the lot may have been mixed with some 1965 captures. The species was later reported from ponds in Broome and Chenango counties in 1969 and 1982. Catches after 1989 include fish from the Whitney Point Reservoir and the Susquehanna River (NYSM 40516).

Delaware (**2,3**). The few records from this watershed include specimens collected from the Swinging Bridge Reservoir in 1984, the Delaware River in 1989 and 2007 (R. Horwitz, ANSP, pers. comm.), and the Pepacton Reservoir in 1997. In 2002, this species was caught in the lower reaches of the Neversink River. Arndt (2004) treats the Channel Catfish as native to the Delaware watershed in New Jersey; we treat it as exotic to the upper drainage in New York.

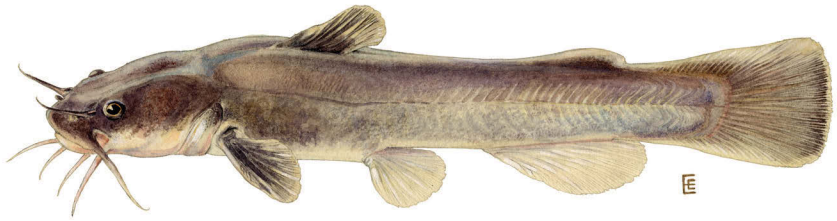
Upper Hudson (**2,3**). This catfish was first reported in this watershed from Lake Lauderdale in 1973. Since then, the species has been reported from the Great Sacandaga Reservoir, Electric Lake in Rensselaer County, and the Hudson River near its confluence with the Mohawk River (NYSM 73453) and near Corinth (NYSM 26344).

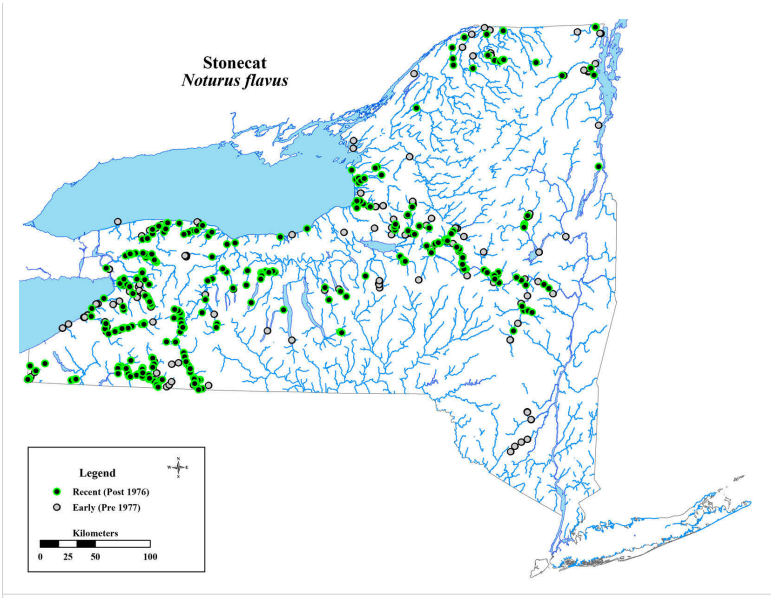
Mohawk (**2,3**). Records exist from the Mohawk River at its mouth and from the stretch between Utica and Little Falls between 1983 and 2004. In 2014, a specimen was collected upstream of the Lock 6 State Canal Park, near the Route 9 river crossing (NYSM 70716).

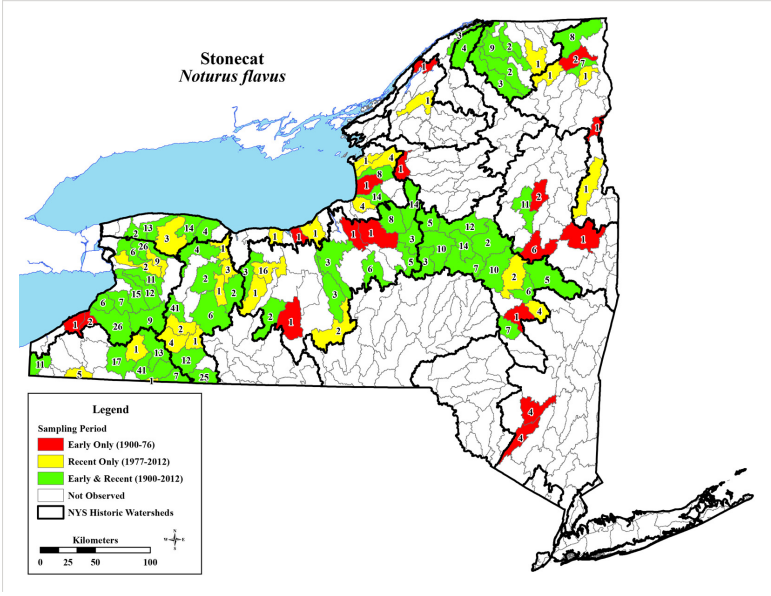
Lower Hudson (**2,3**). Smith and Lake (1990) listed the first record of this species from the watershed in 1974. Channel Catfish are now commonly caught in the Hudson River (Jordan et al. 2004; NYSM 65856, 69047), the Sturgeon Pool of the Wallkill River, and a few reservoirs.

Newark Bay (**3**). There is a single record from Greenwood Lake in 1990.

Long Island (**3**). There are three records of Channel Catfish from this watershed, with confirmed captures in the Nissequogue River in 1993, Lake Ronkonkoma in 2007, and the Patchogue River in 2010.







This madtom lives in large to medium-sized streams in habitat dominated by rubble and moderate to fast current. The species also inhabits rocky, wave-swept shores of larger lakes. The Stonecat is native to all of the 13 New York watersheds where it is found. This species can potentially be confused with the Margined Madtom (*N. insignis*) in field identifications, which again emphasizes the need to retain voucher specimens during surveys and other collection efforts.

Allegheny (1,2,3). Greeley (1938) reported that Stonecats were found at 4% of the sites sampled during the 1937 watershed survey, primarily in the Allegheny River, French Creek, and larger tributaries. The species was not caught in the central basin until it was taken from Stillwater Creek in 1992 and 2004 (Daniels et al. 2006a). This madtom continues to be collected with regularity from all three basins, where appropriate habitat is available.

Erie-Niagara (1,2,3). This species was collected from Fish Creek near Buffalo (USNM 70012) and Cattaraugus Creek at Gowanda (USNM 70014) in the 1890s. Greeley (1929) reported catches from the larger streams in the watershed and noted that Stonecats were common in Lake Erie, primarily along rocky shorelines but also to depths of 10 m or more. This catfish has become rare in Lake Erie in recent years but continues to be found in over ten streams throughout the watershed.

Ontario (1,2,3). Early collections from this watershed include: Lake Ontario at Ninemile Point in 1893 (USNM 70013) and Lake Ontario at Hilton Beach in 1903 (CUMV 2460) and 1907 (CUMV 27074). These early collections appear to support Greeley's (1940) opinion that Stonecats were abundant in the lake, but the sites where specimens were caught during the 1939 watershed survey were primarily at fast-flowing, rocky stretches of streams. The species is still reasonably widespread throughout the watershed.

Genesee (1,2,3). This species was rare during the 1926 watershed survey and most of the sites where it was found were in upstream portions of the Genesee River. The majority of recent records (e.g., NYSM 69255, 69470) are also from portions of the river that are upstream of Mount Morris.

Species continued on next page

Oswego (1,2,3). Greeley (1928) listed this species as rare in this watershed, stating: “Only three specimens have been obtained from this drainage, two from Skaneateles Lake. The other specimen...was taken from Ganargua Creek near Fairville September 9, the prey of a water snake 24 inches in length.” The Stonecat remains rare in the Oswego watershed, with only a few recent catches, including records from Oneida Creek, Canandaigua Outlet (NYSM 67012), and large lakes like Oneida Lake (CUMV 79069).

Black (1). In the 1931 watershed survey, this species was only collected from the Deer River and no records have been confirmed since then. There have been reports of catches at four locations between 1954 and 1987 in the middle and upper sections of the watershed, from Pine Creek in 1989, and the Black River near Carthage in 1993 and 1994 (Beak Consultants, Incorporated 1994). Collection reports after 1950 are suspect and were not included on the map because they are likely misidentifications. The Margined Madtom gained access to the watershed before 1983 (see below) and appears to be expanding its range, possibly at the expense of this species.

Saint Lawrence (1,2,3). A single Stonecat specimen was collected in 1853 near Madrid (USNM 1472). Greeley and Greene (1931) noted: “This species probably inhabits the St. Lawrence River although none was found in the river itself. However, specimens were secured in the lower waters of three of the larger tributaries (Little Salmon River near Fort Covington, St. Regis at Hogansburg, and Grass River at Massena).” In the following year, however, Greeley and Bishop (1932) casually noted that Stonecats were common in the Saint Lawrence River. The species remains common in the watershed, but recent records only include catches from eastern basins, such as the West Branch Saint Regis, Deer, Grass, and Saint Lawrence rivers. Interestingly, a Grass River collection from 2007 (NYSM 62530) is from a site near Madrid, where this madtom was first documented in the watershed.

Oswegatchie (3). Greeley and Bishop (1932) noted that Stonecats were common in the Saint Lawrence River and the mouth of the Oswegatchie River but that none were found during the 1931 survey of this watershed. Of the 15 reports from 1962-2012, none can be verified and we suspect that most were misidentifications. Additional reports from Black Creek near Fort Drum also are treated as misidentifications. A specimen recorded from the Oswegatchie River in 1991 (Carlson 1992a, b) was found being preyed upon by a water snake. Thus, only one record is included on the map.

Raquette (1,2,3). Greeley (1934) listed this species as rare in this watershed, with the only collections during the watershed survey coming from two sites in Trout Brook. Stonecats have been caught in Trout Brook repeatedly over the last several decades, most recently in 2007 (NYSM 62661). Between 1969 and 1997, there were several records from sites at higher elevations; we reject these as likely misidentifications.

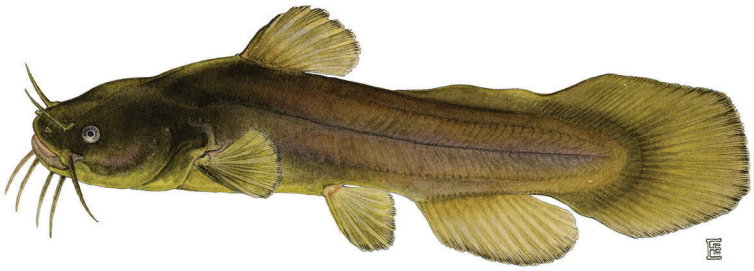
Champlain (1,2,3). Greeley (1930) reported that a single specimen was collected from the Great Chazy River during the 1929 watershed survey. Recent catches include sites on the Salmon River, Trout Brook, Little Ausable River, and Great Chazy River. Collections from the North Branch Saranac River are from higher elevations.

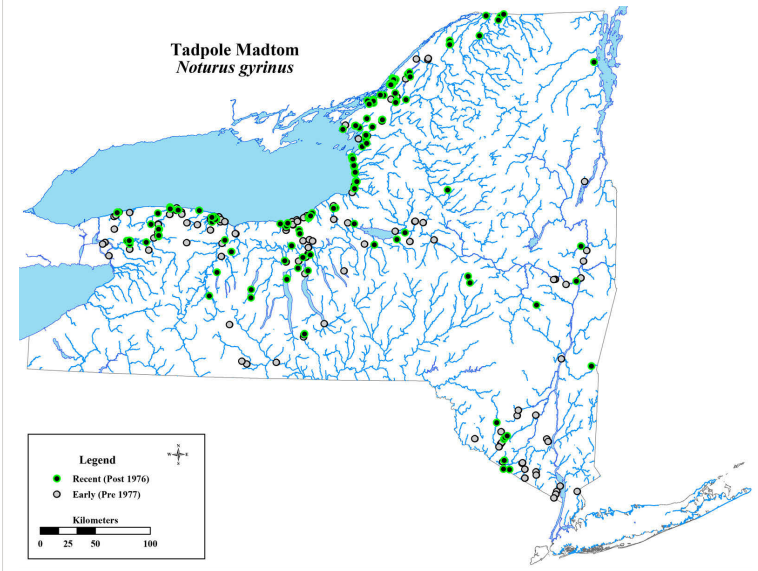
Upper Hudson (1,2,3). This species was listed as moderately common during the watershed survey but only in the Sacandaga Reservoir and its outlet and tributaries (Greeley and Bishop 1933). Reports of this species continue to as recently as 2002, but only one, from the Sacandaga River basin near Wells, is verified (AMNH 43670). No Stonecats were caught during repeated visits to several sites in the basin in 2008. Records of this madtom from the Schroon River area from 1987-2007 cannot be verified and are rejected as misidentifications due to the Margined Madtom gaining access to the area in the 1990s.

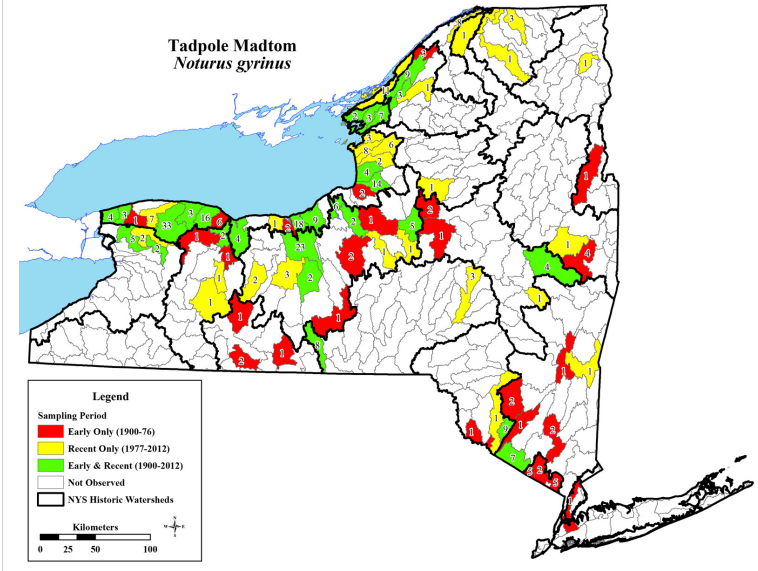
Mohawk (1,2,3). Greeley (1935) found Stonecats at nine sites on the Mohawk River or its tributaries. The species continues to be found in the lower reaches of major tributaries and in the main channel.

Lower Hudson (1,2). There is only one confirmed Stonecat record from this watershed: Rondout Creek in 1936 (NYSM 13959). Since then, the species has been reported rarely and no specimens have been retained to verify these records. A few records from tributaries of Rondout Creek in the 1950s seem credible. Other reports that we reject as likely misidentifications are from the East Branch Croton River in 1980, Lake Tiorati in 1992, and the Otter Kill in 1961.

Noturus gyrinus, Tadpole Madtom







This relatively small-bodied madtom lives in lowland lakes, bays, and stream reaches with dense aquatic vegetation and low current. The species is present in 17 New York watersheds and it is native to all of them except Long Island. There are a few records from upland sites in the Adirondacks. Range losses are apparent in the Chemung, Newark Bay, and western Long Island watersheds.

Erie-Niagara (1,2,3). Greeley (1929) listed the Tadpole Madtom as rare, with reports of specimens from the Erie Canal and tributaries of Tonawanda Creek. More recent records are from the Niagara River in 1975 (AMNH 38981) and 1986, and Tonawanda Creek and its tributaries from 2004-2011 (NYSM 57232, 67042).

Ontario (1,2,3). Tadpole Madtoms were caught in several tributaries from 1903-04 (Wright 2006) and several times in 1909 by A.C. Weed (e.g., USNM 64300). The species was common in ponds and was taken at 58 sites in the 1939 survey, all at low elevations (Greeley 1940). This catfish remains common in Lake Ontario bays and in lowland streams.

Genesee (1,2). Fowler (1907) reported this species from the Genesee River in Pennsylvania, but Greeley (1927) did not report any captures during the 1926 survey. In 1934, Tadpole Madtoms were caught in Black Creek near Byron. Between 1968-1982, individuals were reported from the Rochester area, a ditch north of Dansville, and Conesus Lake.

Oswego (1,2,3). Seth E. Meek and colleagues collected a specimen at Montezuma in 1886 (CUMV 2024). During the 1927 survey, Tadpole Madtoms were common in streams, the Erie Canal in the northern part of the watershed, and in Cayuga Lake (Greeley 1928). There are numerous records of catches in Cayuga Lake over the last several decades as well as in Seneca (NYSM 68514), Owasco (CUMV 32787), Oneida (CUMV 39505), and Cazenovia (CUMV 67866) lakes.

Black (1,2). During the 1931 watershed survey, this species was only found at the mouth of the Black River (Greeley and Bishop 1932). It continues to occur nearby in the Black River Bay of Lake Ontario. A specimen collected in 1985 from Long Lake, near McKeever (NYSM 53411), is the only confirmed specimen from an upland site in this watershed.

Species continued on next page

Saint Lawrence (1,2,3). Greeley and Greene (1931) did not report finding this species during the 1930 watershed survey. Greeley and Bishop (1932) collected it at multiple sites the following year, however, including an individual in Tibbetts Creek, which, they noted, was the easternmost record for the river in New York. Recent records are from the Thousand Island region, the Grass (NYSM 49484) and Saint Regis rivers, and Pike Creek.

Oswegatchie (1,3). Most records are from Black Lake and nearby lowland areas. The Tadpole Madtom is rare in this watershed.

Raquette (3). The species was caught near the mouth of the Raquette River at Rooseveltown in 2004.

Champlain (2,3). George (1981b) reported a single catch from Lake George in 1973. In 1990, Tadpole Madtoms were caught in the lower Little Chazy River (Fisheries Technical Committee, Lake Champlain Fish and Wildlife Management Cooperative 1999). There are additional records from farther north, in the Richelieu River of Quebec (Scott and Crossman 1979).

Chemung (1,2). The earliest record from this watershed is from the Chemung River at Gibson in 1910 (USNM 196732). During surveys from 1955-56, Tadpole Madtoms were caught three times in North Branch Tuscarora and Neil creeks. This species is now rare, at best, in this watershed.

Susquehanna (1,2,3). Tadpole Madtoms were not collected during the 1935 survey of this watershed (Greeley 1936). In 1937, however, Greeley (1938) reported on specimens from Cayuta Lake and Cayuta Creek. More recent reports are from tributaries of Otsego Lake (Smith 1985). Other recent records are from a tributary of Cayuta Lake in 2004 (NYSM 57000), the mouths of the northern tributaries of Otsego Lake in 2009, and a tributary of Weaver Lake in 2010 (NYSM 66428). This species is very rare in this watershed. Records from tributaries of Canasawacta Creek near Norwich in 1976 are not included because they lack voucher specimens.

Delaware (1,2,3). In his report on the 1935 watershed survey, Greeley (1936) noted: “Several localities in the Basher Kill system yielded a few specimens and two individuals were taken in Yankee Lake...The specimens were taken in weedy habitats.” Several specimens were also caught in Highland Lake in 1935 (NYSM 15596), which is the westernmost record in this watershed. Tadpole Madtoms continue to be taken from the Basher Kill and they were also taken from Fowlwood Brook in 2002 (C. Apse, The Nature Conservancy, pers. comm.).

Upper Hudson (1,2). This species was rare during the surveys of the 1930s, being found at only three sites in 1932 and 1934, which were a cove and abandoned canal reach near Coveville, at Bemus Heights, and the Hudson River 9 km north of Troy (Greeley and Bishop 1933; Greeley 1935). The only known capture since the 1930s was from Fish Creek in 1980 (AMNH 43868).

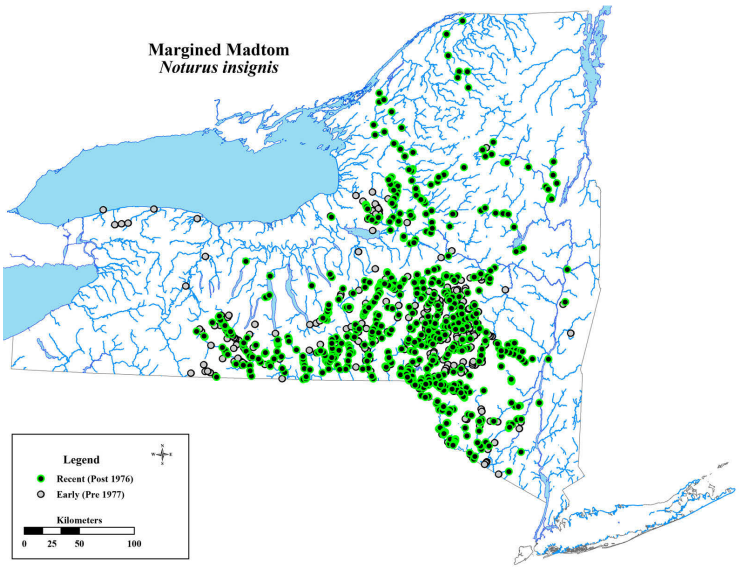
Mohawk (1,2,3). Tadpole Madtoms were found at four widely dispersed sites during the 1934 watershed survey: Delta Lake, two sites on the Mohawk River, and Saunders Lake outlet (Greeley 1935). Specimens were collected from the Switzkill in 1982 and 1985 (NYSM 10145, 15523) and the Mohawk River at Waterford in 2009 (NYSM 65114). No specimens have been collected in the western part of the watershed over the last several decades.

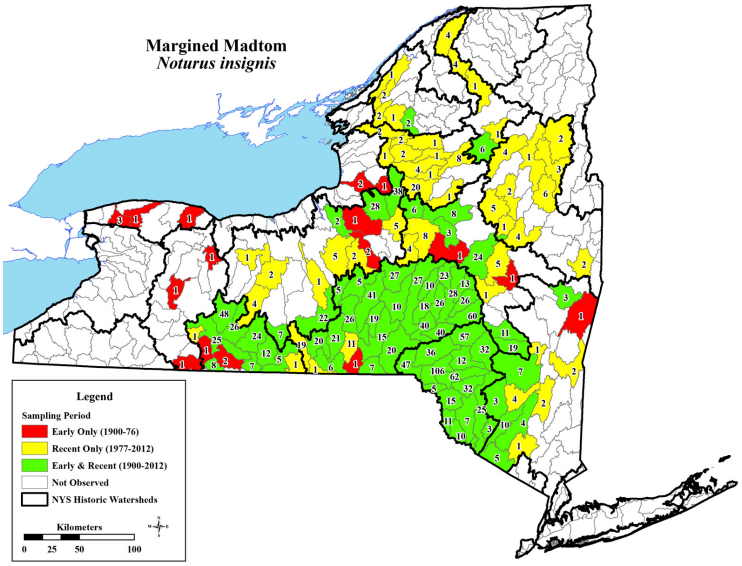
Lower Hudson (1,2,3). Greeley (1937) noted that this species was found in weedy streams and weed beds in lakes, specifically in Rockland and Glenmere lakes, Quassaic Creek, and several Wallkill River tributaries. In 1979, C.L. Smith collected two specimens from Pochuck Creek (AMNH 45511). Records also exist from tributaries of Rondout and Quassaic creeks in 1981 and the Wallkill River near the state line in 2009 (NYSM 65011). Carlson (1986) reported a record from a Hudson River power plant study near Albany in the 1970s, but the specimen was not archived and could not be verified. The only record from the eastern part of the watershed is from the Roeliff Jansen Kill in 1981 (AMNH 55183).

Newark Bay (1). The earliest known collection is a lot from the Hackensack River near Piermont in 1854 (USNM 1430). Tadpole Madtoms were common during the 1936 survey and were collected from Greenwood Lake and the Hackensack and Ramapo rivers (Greeley 1937). Arndt (2004) listed the species as present in New Jersey waters, but there are no recent records from New York.

Long Island (**1**). The only record from this watershed is from a headwater reservoir of the Bronx River (Odell 1936). No records are known from adjacent Connecticut streams (Jacobs and O’Donnell 2009). This madtom is not native to the watershed, and its early presence there was probably the result of water transfer via the New York City aqueducts.

Noturus insignis, Margined Madtom





This stream-dwelling fish is usually associated with rubble-boulder substrates and moderate current. The species is native to three Atlantic slope watersheds and, in the last half-century, has become established in nine other New York watersheds. Field identifications of this species are easily confused with the Stonecat, which has been a perennial problem with this fish and has resulted in our rejection of some records. This species has expanded its range and greatly increased its frequency of occurrence in recent years and it is possible that it has done so at the expense of native fishes, particularly the Stonecat.

Ontario (**1,2**). The first collection of Margined Madtoms in this watershed was from Salmon Creek in 1933 (CUMV 82758). Between 1942 and 1958, the species was reported six times, but these identifications are not verified and could be incorrect. This madtom has not been reported from the watershed since the 1950s, suggesting that its introduction was unsuccessful.

Genesee (**2**). There are only three reports of this species from this watershed: Cryder Creek in 1955 (CUMV 29522) and the Genesee River and Honeoye Creek in 1968 and 1970, respectively (R. Roecker, SUNY Geneseo, unpubl. field notes). It appears to have failed to establish itself in this watershed.

Oswego (**1,2,3**). Two specimens were collected during the 1927 watershed survey, one from Keuka Lake and one from Canada Creek (Greeley 1928). Greeley (1928) offers an explanation of how this species gained access to the watershed: “This species was found to be common under stones at the headwaters of Tioughnioga Creek (middle branch), a Susquehanna stream that has been diverted artificially into the Oswego drainage.” This madtom is now widely distributed in the watershed and its range is still expanding.

Black (**2,3**). Margined Madtoms first appeared in reports on collections made in the Sugar River in 1983, but the species was first confirmed in this watershed in 1993 from the headwaters of the Black River near Forestport (NYSM 43033). After 1997, this species’ frequency of capture increased in the upper drainage, with continued reports from the Black and Moose rivers after 2000. Recent records include the Moose River in 2011 (NYSM 67100), the Black River in 2012 (NYSM 68121), and even upland lakes, such as Lake Rondaxe in 2011 (NYSM 66903). To date, this species has expanded its range in the upper watershed and has been infrequently collected as far downstream as Deferiet.

Species continued on next page

Saint Lawrence. There are several reports of this species from this watershed, but no specimens have been vouchered. The earliest of these was from the Grass River in 1988. Margined Madtoms have since been reported from the Salmon River upstream of Chasm Falls in 2007. Several other catches were made from the Thousand Islands area of the Saint Lawrence River in 2005 (J. Farrell, SUNY-ESF, unpubl. field notes). We treat all of these records as misidentifications and do not include any occurrences of Margined Madtoms from this watershed on our maps. In 2014, a vouchered specimen was caught in the Raquette River, within 5 km of the Saint Lawrence River (NYSM 71436).

Oswegatchie (**2,3**). Margined Madtoms were reported from the Indian River near Natural Bridge in 1955 and near Red Lake in 1994 (NYSM 44061). This madtom has become widely dispersed through the eastern part of the watershed; the only record from the western portions is from a tributary of Black Lake.

Raquette (**2,3**). In 1975, C.L. Smith collected this species from Forked Lake (AMNH 38868). Since then, Margined Madtoms have dispersed throughout this watershed. The species has been reported from Colton (AMNH 41323) and as far upstream as the Marion River and Blue Mountain Lake (NYSM 43442). Downstream records include catches from Raymondville in 2012 (NYSM 67905), Squeak Brook in 2012 (J. McKenna USGS, Cortland, NY, pers. comm.), and in the main channel within 5 km of the mouth in 2014 (NYSM 71436).

Chemung (1,2,3). Greeley (1938) reported that Margined Madtoms were found at 14% of the 1937 watershed survey sample sites in rivers and creeks. This species continues to be common and widespread, and its range has expanded in recent years.

Susquehanna (1,2,3). Greeley (1936) noted: “This little catfish… is the most important bait fish of the region for use in river fishing…These fish inhabit nearly all of the rocky streams of larger size, usually hiding under boulders during the day.” The importance of this species as a bait fish may account for the number of introductions that have occurred in other watersheds (Carlson and Daniels 2004). It remains common throughout this watershed.

Delaware (1,2,3). Greeley (1936) listed this species as very common. It was found throughout the watershed during the watershed survey and continues to be abundant, with a high frequency of occurrence.

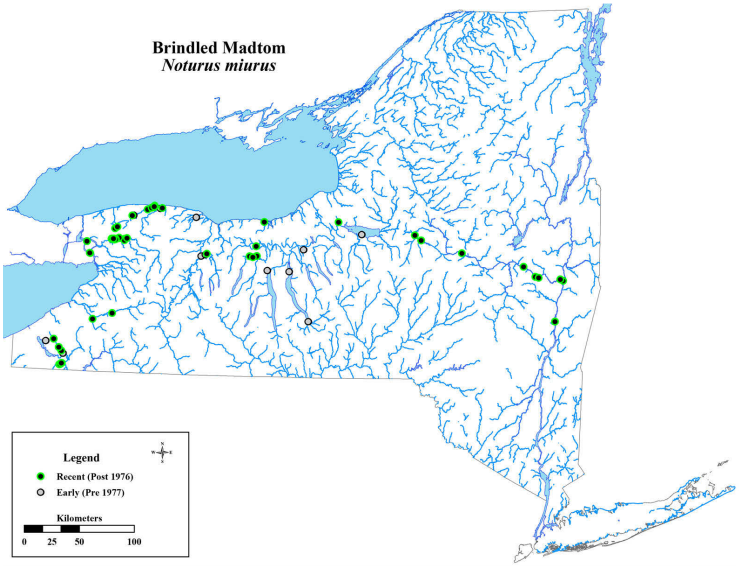
Upper Hudson (**2,3**). The earliest record of the Margined Madtom in this watershed was a 1979 collection from the Hudson River, near the Schroon River confluence at Warrensburg (AMNH 44645). In 1992, specimens were found in the Schroon River near Riverbank (NYSM 46962) and Schroon Lake (NYSM 41844). By 2008, this species was widespread, occurring at 9% of survey sample sites.

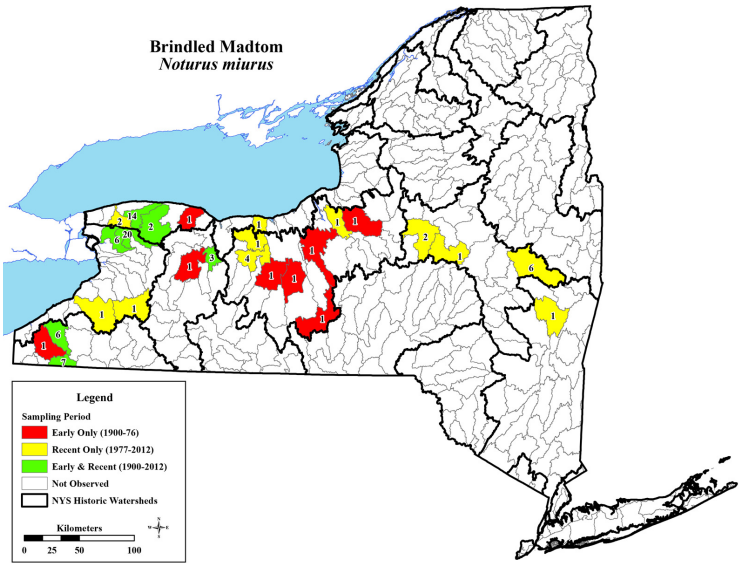
Mohawk (**1,2,3**). Greeley (1935) reported a limited range for this species, with only three specimens collected. These were from the Mohawk River near the Village of Northwestern, Steele Creek at Ilion, and Delta Lake. Margined Madtoms now occur throughout the system and are common in the Catskill Mountains in the upper Schoharie Creek basin.

Lower Hudson (**1,2,3**). This fish was listed as rare by Greeley (1937), with eight reported collections all coming from the Wallkill River and Rondout Creek systems. The species has also been reported farther upstream in the New Jersey portion of the Wallkill River (Arndt 2004). In recent times, Margined Madtoms have been found in more northern tributaries, such as Esopus and Kaaterskill creeks and the Shawangunk Kill.

Newark Bay. A 1991 report from the Ringwood River was not confirmed and may be a misidentification. We do not include this record on our maps.

Noturus miurus, Brindled Madtom





This fish is typical of silty, weedy areas in lower stream reaches. Brindled Madtoms are native to four watersheds in the western Great Lakes as well as the Allegheny River watershed. The species has also become established as a non-native species in the Mohawk and Lower Hudson watersheds.

Allegheny (1,2,3). Barton W. Evermann collected a specimen from Chautauqua Lake in 1901 (USNM 73419). Brindled Madtoms were rare during the 1937 watershed survey and were caught at only three sites on Stillwater Creek, Cassadaga Creek, and Chautauqua Lake, all of which are in the Conewango Creek basin (Greeley 1938). The species has also been found in French Creek downstream of the New York state line (Cooper 1983, Lee et al. 1980). This catfish remains rare in the Allegheny watershed, with the only recent collections coming from Stillwater Creek in 1981 (AMNH 226788) and Cassadaga Creek in 2004 (NYSM 57858) and again in 2012 (NYSM 68040).

Erie-Niagara (2,3). This species has been reported from Tonawanda Creek in 1947 and 1975 (AMNH 39201) and the upper Niagara River in 1973 (W. Hadley, SUNY, Buffalo, pers. comm.) and 1998 (NYSM 50729). More recently, specimens have been collected from Cattaraugus Creek in 2006, South Branch Cattaraugus Creek in 2007, and the Erie Canal near Tonawanda Creek in 2008. Lee et al. (1980) list this species from the Pennsylvania waters of Lake Erie.

Ontario (1,2,3). Evermann and Kendall (1901) noted the presence of the Brindled Madtom in Salmon Creek in 1894. Wright (2006) collected specimens from 1903-1907 and again from 1924-1926; he listed the species as uncommon. Greeley (1940) stated: “Survey collections from Johnson, Oak Orchard and Eighteenmile Creeks had this fish, which apparently does not extend very far eastward.” The species was collected from the Erie Canal at Lockport in 2005 (NYSM 59160) and appears to have also extended its range eastward. The farthest collection to the east is from Salmon Creek just upstream of Maxwell Bay (Wayne County) in 2005.

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Genesee (2). In 1940, a specimen was collected from the Genesee River near Rush (CUMV 27776). Brindled Madtoms were also found in Honeoye Creek in 1952 (R. Roecker, SUNY Geneseo, unpubl. field notes) and 1982 (AMNH 223308). There are no additional recent records from this watershed.

Oswego (1,2,3). Adams and Hankinson (1916) documented this madtom in the Oneida Lake basin, but the last report from this area was in 1958. A 2011 collection from Caughdenoy Creek (NYSM 66974), a tributary of the Oneida River, is close to sites where the species was collected early in the twentieth century. There are also numerous collections from Cayuga Lake in the 1960s. This catfish continues to be caught in Cayuga and Seneca lakes, Ganargua Creek, and Canandaigua Outlet.

Mohawk (**2,3**). This species was first collected in this watershed from the Mohawk River/Erie Canal in 1979. All eight of the catches since 1979 are from the Erie Canal, with a range extending from Utica to Albany.

Lower Hudson (**3**). A Brindled Madtom was collected from the Hudson River near New Baltimore in 2014 (NYSM 73163).

Osmeridae, Smelts

Most smelt species are marine or anadromous and only one species is found in New York's freshwaters–the Rainbow Smelt. Anadromous and landlocked populations both occur in the state. Some of the inland, landlocked populations are the result of introductions.

Osmerus mordax, Rainbow Smelt

This fish is anadromous in the coastal streams of the Lower Hudson and Long Island watersheds and is native as a landlocked population in Lake Champlain. The species been introduced into 13 other watersheds in the state.

Erie-Niagara (**1,2,3**). Rainbow Smelt were first collected from north central Lake Erie in 1931 (Smith 1985). The first recorded catch in New York was in 1960, and most of the recent records are from Lake Erie (e.g., NYSM 30004 in 2001), the Niagara River (e.g., NYSM 57523 in 2004), and tributary mouths, such as a 2005 capture from Bull Creek. This is the most abundant cold-water forage fish in the lake (Coldwater Task Group 2014).

Ontario (**1,2,3**). Greeley (1940) reported that the Rainbow Smelt was rare in Lake Ontario and that the first capture of the species in the lake occurred in 1929 off Sodus Point, with the vouchered specimen being kept at the University of Rochester. Regrettably, this specimen has either been discarded or misplaced in recent decades as it could not be located. Smith (1985), among others, treats this smelt as not native to this watershed. Spawning runs in tributaries became more obvious in the 1940s, and a commercial fishery developed in the 1950s (Smith 1985). In recent years, the species' abundance has fluctuated due to increased predation and poor recruitment in some years (Owens et al. 2003).

Genesee (**2,3**). In 1957, Rainbow Smelt were caught in Hemlock and Canadice lakes and continue to be caught in these lakes to the present.

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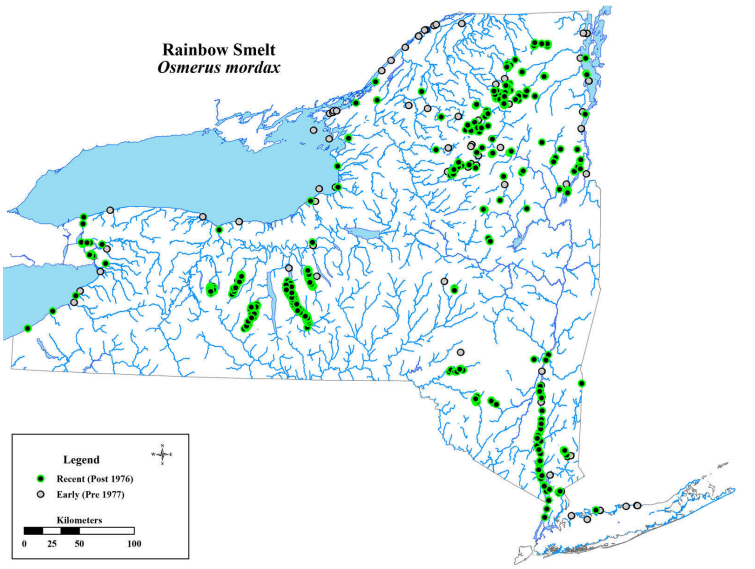

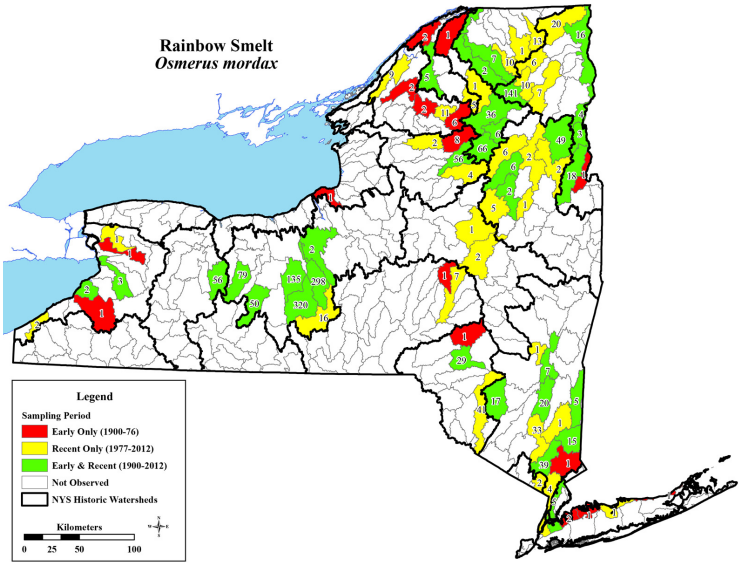

Oswego (**1,2,3**). This species was stocked as forage for gamefish in the larger lakes, like Cayuga Lake, in the late 1920s (Oglesby 1978). Rainbow Smelt continue to be found in the deeper areas of these lakes.

Black (**1,2,3**). Greeley and Bishop (1932) noted that Rainbow Smelt were present in the Stillwater Reservoir and the Fulton Chain of lakes but that they did not know the date of these introductions. In recent decades, this species' presence has been reported from about a dozen lakes in the Old Forge area, such as Moss Lake from 1994 to 2005 (e.g., NYSM 58535). The last record from the Stillwater Reservoir was in 1972, but smelt continue to be present in the area and were caught in the Moshier Reservoir, which is the next reservoir downstream of Stillwater, in 2010.

Saint Lawrence (**1,2,3**). Greeley and Greene (1931) stated: "This species was planted in Bay Pond, and in Follensby Jr Pond in 1926 [information provided by J.M. McDonald of Bay Pond, Inc.]. We were unable to take collections from these ponds, but the smelt is reported to be common in both." Rainbow Smelt were first reported from the Saint Lawrence River at the mouth of Ganonaque Creek in 1939, and the first record in United States waters was in 1975. Records from inland waters include Trout Lake and Slush Pond in 1952, Spectacle Pond in 1978, and Massawepie Lake in 2005.

Oswegatchie (**1,2,3**). An established population had been present in Sylvia Lake for several years, when the area was surveyed by Greeley and Bishop (1932). Rainbow Smelt have also been reported from Cranberry, Millsite, Star, Portaferry, and Spectacle lakes.

Raquette (**1,2,3**). Greeley (1934) noted that the Rainbow Smelt was introduced into several lakes in the region and that specimens were taken from Raquette, Forked, and Mohegan lakes. A specimen had previously been collected in 1915 from Tupper Lake (MCZ 34870), suggesting a very early introduction. Additional lakes have been stocked in recent decades, and many catch records exist from surveys by the ALSC from 1985-1986 (Gallagher and Baker 1990) and the New York State Department of Environmental Conservation from 1988 to the present.

Champlain (1,2,3). Greene (1930) reviewed the status of this fish in Lake Champlain. He noted that the earliest reports were made by DeKay (1842). Early specimens from the lake date from 1854 (MCZ 26593), 1873 (USNM 32565), and 1877 (USNM 20908). Greene (1930) also reported on two strains, based on adult size, that were thought to inhabit the lake, although he also reported that the lake had been stocked with Long Island fish from 1919 to 1928, which genetically altered the established population and may have swamped out the native form. According to Greeley (1930), smelt were very common in the lake during the 1929 survey. He (Greeley 1930) also reported that the species had been stocked in Little Clear Pond prior to 1904 (NYSM 1294) and, from there, had become established in the Saranac chain of lakes. There has been a traditional sport fishery through the ice, but it, along with a local harvest of fish during spawning runs in numerous tributaries in both Lake Champlain and Lake George, has declined in recent years. More detail on upland populations was provided by George (1981a) and the Fisheries Technical Committee of the Lake Champlain Fish and Wildlife Management Cooperative (1999).

Susquehanna (**2,3**). Otsego Lake has supported this species since the 1970s, and there was a popular sport dip net fishery in the early 1980s. There is only one record from Canadarago Lake in 1969, which suggests that Rainbow Smelt did not establish a population there.

Delaware (**1,2,3**). Greeley (1936) reported that this species was established in Lake Delaware, but that report was based on specimens collected in 1930, as the lake was not sampled during the 1935 watershed survey. Rainbow Smelt have also been reported from the watershed's two largest impoundments, the Pepacton (in 1971 and 2008) and Neversink (in 1977 and 1993 (NYSM 43535) reservoirs.

Upper Hudson (**1,2,3**). Greeley and Bishop (1933) noted that this species had established itself in Schroon Lake. Prior to the construction of the Troy Dam, there was no obstacle to spawning runs into the Upper Hudson watershed by anadromous fish, but we have not been able to find any records that document runs that far upstream. Smelt continue to be found in Schroon Lake (NYSM 41871) and other lakes in the watershed.

Mohawk (**3**)**.** Rainbow Smelt have been present in West Caroga Lake since 1989. The species also occurs in nearby Canada Lake.

Lower Hudson (1,2,3). Greeley (1937) collected this species at seven sites during summer surveys but noted that young individuals were caught mid-river. He (Greeley 1937) noted, based on reports of local fishermen, that the survey year of 1936 had fewer smelt than normally expected, which suggests that annual fluctuations were common. There are abundant records from the Hudson River, but numbers have declined in recent years, leading Daniels et al. (2005) to report that spawning

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runs had all but disappeared from the river. The Rainbow Smelt is at the southern edge of its range in the Hudson River and temperatures there may no longer be suitable. The species has been introduced into some of the mountain reservoirs of this watershed.

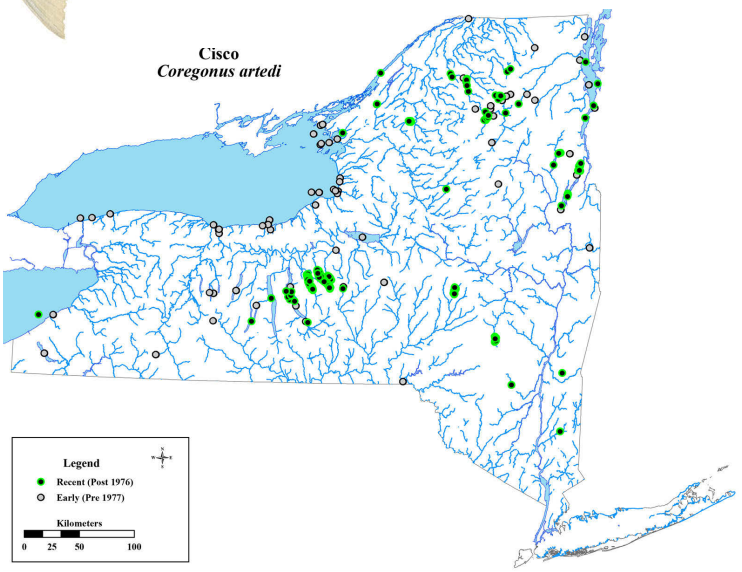
Newark Bay (1,3). DeKay (1842) noted the presence of Rainbow Smelt in the Hackensack and Passaic rivers. This species was taken from Rockland Lake in 1980, with this population most probably resulting from a stocking event.

Long Island (1). The earliest museum record from this watershed is an 1878 catch (USNM 20948). Greeley's (1939) account is enlightening: "As the smelt is a species which spawns in fresh-water streams it should be listed even though much of its life is spent in a strictly marine environment. Some idea of the former abundance of this small but high-quality food fish can be derived from the following statement by DeKay, p. 224; "It comes to us from the north in November and December, abounding in our salt-water streams, and is sold by measure in the markets. They are derived chiefly from the small streams emptying into Long Island sound, and from the Hackensack and Passaic rivers in New Jersey. A small stream at Cold Spring Harbor has had a run of smelt except in the past several years." The only record from the 1938 watershed survey was from Dosoris Pond although smelt were caught at some saltwater sites.

Salmonidae, Trouts

The trout family includes trouts, chars, salmons, whitefishes, and graylings, which are among the most desirable game fishes on the planet. This group is native to northern, temperate climate areas, but representatives of the most popular species have been introduced across the globe. In New York, various species are found in all types of waters, from headwater brooks to the largest main river channels, from mountain ponds to large, lowland lakes. Whitefishes (*Coregonus* and *Prosopium*) are almost exclusively lake dwellers. The other genera are found in both flowing and standing waters. One species is threatened and three others are extirpated from the state. Of the 17 species reported from New York, six are exotic.

Coregonus artedi, Cisco



Ciscoes, also called Lake Herring, are found in cold lakes and inhabit deep, cooler water below the metalimnion during the summer. The species is native to ten watersheds in the Saint Lawrence drainage, as well as the Finger Lakes, lower elevation lakes of the Adirondacks, and Chautauqua Lake. Ciscoes are found in, but are not native to, six other watersheds, mostly on the southern tier. Many of these waters were actively stocked in the late 1800s and early 1900s. In recent years, the abundance of this species has declined in the westernmost watersheds and lower elevation lakes, including Lake Erie. This species has been designated as a Species of Greatest Conservation Need in New York.

Allegheny (1,2). During the 1937 survey of this watershed, Ciscoes were only found in Chautauqua Lake, where several specimens were collected during seven sampling events (Greeley 1938). Additional specimens were collected in 1943 and 1944 (CUMV 17065, 66508). According to McKeown (2000), this species is now extirpated from the lake.

Erie-Niagara (1,2,3). Greeley (1929) noted the presence of two subspecies in Lake Erie, remarking that both were common. The characters that he (Greeley 1929) used to recognize these two forms are not clear and no specimens were collected during the survey, nor were any obtained from commercial fishermen. This species was commercially harvested during 1928 and Greeley (1929) commented that it was

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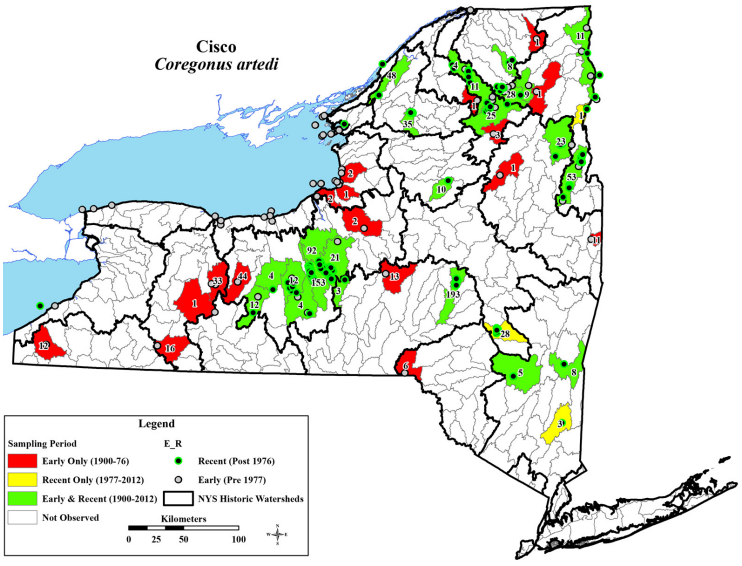

in decline, probably due to over fishing, particularly during the autumn when this species spawns. The fishery collapsed after 1945 and Ciscoes have been thought to be extirpated from the lake (Nepszy 1999). Ryan et al. (2003), however, countered that this species was occasionally caught by commercial fishermen in Ontario and in the western part of the lake. There are no recent records from New York waters and only a few catches in nets from central Lake Erie in Ontario. A recovery effort has been considered (Oldenburg et al. 2007) but has yet to be fully implemented.

Ontario (1,2,3). Greeley (1940) listed three distinct forms in the lake: a slim-bodied form, a deep-bodied form, and a form with an asymmetrical tail found in Irondequoit Bay. None of these forms are recognized as taxonomically distinct today, and these distinctions were questioned during the 1930s as well. Unfortunately, Greeley (1940) did not provide information on Cisco abundance, although he did mention that a commercial and sport fishery existed. The species continues to be caught in the lake and its bays, although recent population fluctuations have been substantial (summarized by Owens et al. (2003).

Genesee (1,2). Bean (1901) published a plate by the illustrator S.F. Denton entitled "Cisco from Hemlock Lake (*Argyrosomus artedi* Le Sueur)," with the presence of this species in the lake being corroborated by specimens collected in 1902 (NYSM 734) and 1933 (CUMZ 28089). Greeley (1927) noted that the surveyors "observed fishes of this type jumping at the surface of the lake, but were unable to collect any specimens." Ciscoes were also reported by anglers at the time of the survey. The species was reported from Rushford Lake, an impoundment, from 1937-1966 and from Canadice Lake from 1957-1972. Both populations were probably remnants of early stocking efforts in central New York lakes. No specimens have been collected from this watershed in recent years.

Oswego (1,2,3). Adams and Hankinson (1916) collected this species from Oneida Lake and Greeley (1928) reported that it formerly occurred in Onondaga Lake, where it was known as the "Tullibee." The species is now extirpated from Onondaga Lake, but it continues to be present in the larger, cold lakes.

Black (**2**). Between 1974 and 1981, Ciscoes were present in Woodhull Lake, where they may have been introduced. This introduction apparently failed, as no subsequent reports exist.

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that although young-of-year fish were abundant in June in the main channel of the Saint Lawrence River at Ogdensburg and Waddington, no larger fish were collected during the 1930 watershed survey. In 1933, additional young were collected from the main channel, which suggested to Greeley (1934) that this species only used the main channel as a nursery area. The last recorded catch of this species was from the Thousand Islands area in 1989. Ciscoes have been stocked in upland Adirondack lakes and some of these stockings resulted in established populations. The last catch from Meacham Lake was in 1968 and the last one from Massawepie Lake was in 1969.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported: "This inland lake herring was taken only in Millsite Lake where a large series of specimens was taken in a gill net set June 26 in 30 to 70 feet of water." Despite some confusion over the existence of several (sub)species, Greeley and Bishop (1932) noted the presence of this group in the nearby waters of the Saint Lawrence drainage and seemed puzzled by the lack of catches in this watershed. Established populations remain in Millsite Lake and Lake Bonaparte.

Raquette (**1,2,3**). Greeley (1934) noted that "this species has been established in the Tupper Lake chain, evidently by means of plantings." Survey specimens were found in Big Wolf Pond (NYSM 704), Little Wolf Pond (NYSM 725), Simon Pond (NYSM 703) and Tupper Lake (NYSM 700). Because there are no early records from the surrounding lowlands of the Adirondacks, it is likely that the Cisco is non-native in this watershed. There are several records from Tupper Lake and Raquette River impoundments from the 1990s to the present.

Champlain (1,2,3). During the 1929 survey, Ciscoes were common in Lake George (where they were locally named Lake George Smelt) and moderately common in Lake Champlain (Greeley 1930). The species was introduced into several higher-elevation lakes, where it continues to be caught. Catches from Lake Champlain were reported in the 1950s (Halnon 1963), 1970s (Anderson 1978), and from 1990-2000s (Staats and Pientka 2012).

Chemung (**2**). In 1947, this species was caught in Loon Lake. This is the only report of the species in this watershed, suggesting that it was introduced but failed to establish itself.

Susquehanna (**2,3**). Ciscoes were first reported from Otsego Lake in 1955, where they were inadvertently stocked (Sanford 1984; McBride and Sanford 1997). This species was also stocked in Green and Hatch lakes prior to the early 1900s, but it was not reported in catches until 1959 and 1964, respectively. The Green Lake population is extant and specimens were caught downstream in Tully Lake in 2008.

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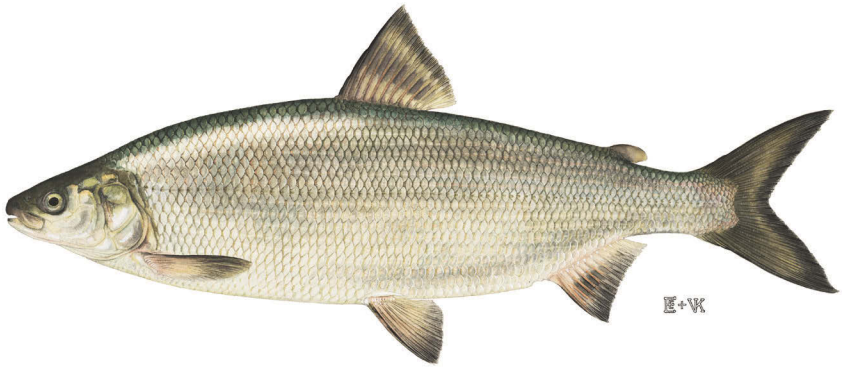
Delaware (**2**). In the early 1960s, this species was caught in Oquaga Lake after being stocked there. It has not been caught since and is presumed to be a failed stocking effort.

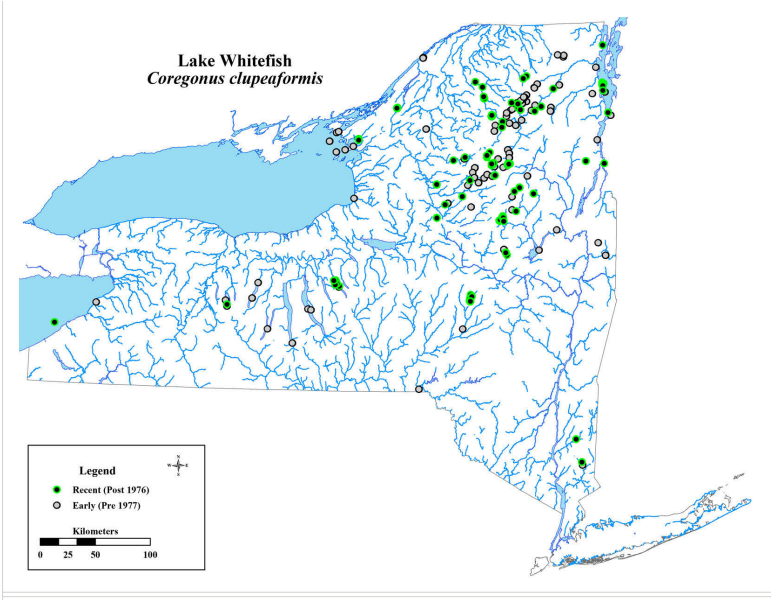
Upper Hudson (1,2,3). Greeley and Bishop's (1933) account nicely elaborates the problems that arise when assessing the native status of species: "In Hedges Lake this fish is fairly common. According to records of the Conservation Department it was introduced here from stock obtained from Lake St. Catherine, VT. [At least by 1912, when six specimens were collected (NYSM 732.]...[A] small form of the lake herring was found to be common in Paradox Lake. We can find no record of stocking of any lake herring there and it is probable that this fish is native. Since the same form of lake herring is found in Lake George, only a few miles distant from Paradox, there is some evidence that the two lakes might have been populated by the same natural invasion of fish." This account, however, ignores the evidence scattered throughout the literature of early stockings (detailed, for example, by George (1981a)). Ciscoes still occur in Paradox Lake and were found in five other lakes during the 1960s and 1970s, including Schroon Lake, where they were probably stocked.

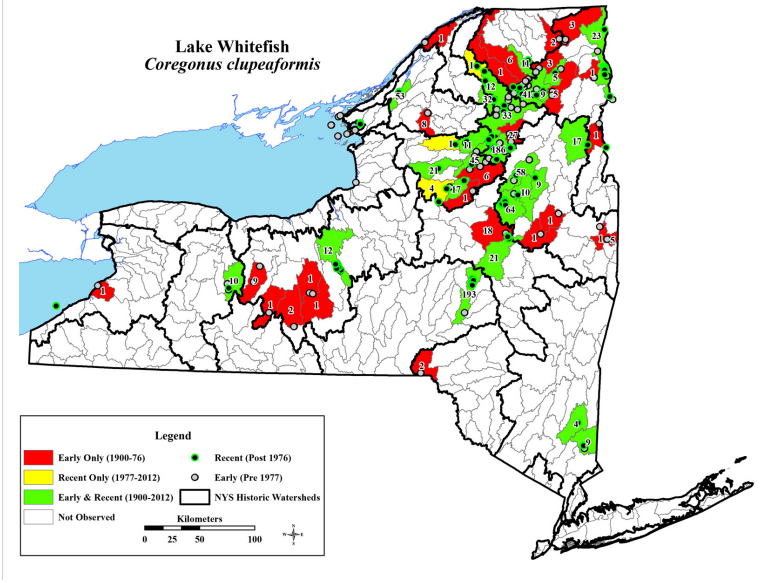
Mohawk (**2,3**). This species was first collected from the Schoharie Reservoir, where it continues to be caught, in 1969.

Lower Hudson (**2,3**). Ciscoes have been reported from the Ashokan Reservoir, Lake Taghkanic, and Sylvan Lake.

Coregonus clupeaformis, Lake Whitefish







This relatively large whitefish inhabits large, deep, low-elevation, cold-water lakes. It historically supported commercial fisheries in several lakes throughout the state because of its abundance and vulnerability to capture. It is native to eight New York watersheds and has been introduced into six additional ones.

Erie-Niagara (1,2,3). Greeley (1929) listed this species as common and briefly reviewed its importance to the commercial fishery, noting that its numbers had declined. It continued to decline from overharvest and environmental degradation, including the introduction of exotic species in Lake Erie. Populations have remained low in the eastern basin (Lake Erie Standing Technical Committee and Task Group Chairmen 1990), although individuals are caught with some regularity in New York waters. Populations have recently increased in the western basin (Lake Erie Standing Technical Committee and Task Group Chairmen 1990).

Ontario (1,2,3). No Lake Whitefish were caught during the 1939 watershed survey, which sampled only the bay areas of Lake Ontario (Greeley 1940), although several were taken later in 1942 (e.g., CUMV 36937). There are a few earlier specimens, such as NYSM 735 or USNM 125957, both from 1912. In 1880, the commercial harvest was over 450 MT, but in the twentieth century, the harvest has never exceeded 40 MT (Greeley 1940). In 1885, the commercial catch from the New York portion of the lake was more or less evenly distributed across the area from Rochester to Cape Vincent (Smith 1891). Most recent catch records are from eastern Lake Ontario; since 1997, there are 450 records from areas northeast of Oswego and only seven records from areas west of Oswego (J. Lantry, DEC Cape Vincent, pers. comm.). Hoyle (2005) summarized recent population fluctuations in relation to the zebra mussel invasion. As recently as 2004, young-of-year have been reported from Lake Ontario bays, including Chaumont Bay (R. O'Gorman, USGS, Oswego, NY, pers. comm.).

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Genesee (1,2,3). During the 1926 survey, Lake Whitefish were present in Hemlock Lake and were also reported from Silver Lake (Greeley 1927). The species has been reported from Hemlock Lake as recently as 2007.

Oswego (1,2,3). Greeley (1928) reported that within this watershed, this species was restricted to the Finger Lakes and was common in Canandaigua Lake. Eaton (1928) reported its presence in Keuka Lake as well. More recently, Lake Whitefish have been found in Seneca, Cayuga, and Skaneateles Lakes.

Black (**1,2,3**). Greeley and Bishop (1932) reported that this species was probably not native to Adirondack lakes but that it had been stocked in several of them. During the watershed survey, Lake Whitefish were collected from the Fulton Chain, Big Moose, and Limekiln lakes. Specimens have also been taken from Brantingham and Salmon lakes. Stocking records indicate that this whitefish was widely introduced to several smaller lakes, such as Dart, Little Moose, and South lakes. The species has not been collected recently in some of these lakes, but most of the waters with previous records continue to support this species. From 1965-2007, Lake Whitefish were collected from the Stillwater Reservoir, which is not surprising given that Salmon Lake is upstream and the reservoir population could easily stem from out-migrants of this population.

Saint Lawrence (1,2,3). Evermann and Kendall (1902b) collected this species from Chateaugay Lake in 1900 and Greeley and Greene (1931) collected it there again in 1930 but noted that it was "growing scarce." The only specimens from the Saint Lawrence River are from 1930 (NYSM 722) and 1936 (UMMZ 95651), even though this species continues to be reported from nearby Lake Ontario. Greeley and Greene (1931) also reported that Lake Whitefish occurred in Lower Saint Regis, Meacham, and Massawepie lakes, where a stocking program continued until the 1940s. Massawepie Lake is the only population with recent catch records.

Oswegatchie (1,2,3). This species was collected from the Lake of the Woods in 1931 (Greeley and Bishop 1932), where it still occurs today. The only other records from this watershed are from Lake Bonaparte from 1931-1976–stocked fish established a temporarily viable population that appears to have eventually failed.

Raquette (**1,2,3**). The Lake Whitefish was common during the 1933 watershed survey and was found in the larger lakes of the watershed. All of these populations are probably the result of stocking efforts, however (Greeley 1934). Most of these lakes still support these non-native populations.

Champlain (1,2,3). Greeley (1930) listed this species as common in the lake. He (Greeley 1930) also noted that it was a popular game fish in "most of the Adirondack lakes in this drainage, notably Saranac, Placid and Clear," where it had been introduced. Finally, Greeley (1940) noted that the population in Chazy Lake was regarded as native. Halnon (1963) reported catches from the Vermont part of Lake Champlain in the 1950s and Anderson (1978) discussed catches from the 1970s. A limited commercial fishery continued in the Quebec portion of Lake Champlain's Missisiquoi Bay into the 1980s. The species has been caught in New York waters as recently as 2007, and Herbst and Marsden (2011) argued that the Champlain population was not as diminished as had been assumed because good recruitment continues in some areas where the Lake Whitefish was historically important. Several Adirondack lakes still support established populations.

Susquehanna (1,2,3). In this drainage, Lake Whitefish are only found in Lake Otsego, a headwater lake. The species has been present in the lake as far back as there are records, and DeKay (1842) stated: "It appears to be peculiar to Otsego Lake, and is daily decreasing in numbers." These few words are the basis for treating this population as native and also demonstrate how important this species was as a food source; it was even named Otsego Bass. An early specimen dates to 1891 (USNM 43231), but Bean (1903), curiously, overlooked it. Greeley (1936) listed the species as very common in the lake. More recently, Lake Whitefish have been caught in Goodyear Lake, a downstream impoundment. Recent catches are much reduced in Otsego Lake and the introduction of the Alewife may have contributed to this decrease.

Delaware (**2**). This species was caught in Oquaga Lake in 1948 (CUMV 33787) and again in 1960. It was stocked in this reservoir, with apparently limited, short-term success.

Upper Hudson (**1,2,3**). Greeley and Bishop (1933) reported that Lake Whitefish were common in Adirondack lakes, where the species was widely introduced from stocks originating at the Saranac Hatchery. They (Greeley and Bishop 1933) noted that the species was present in many lakes, including Piseco, Lewey, Indian, Sacandaga, Pleasant, Mason, Eagle, Summit, and Hedges lakes. A few of these lakes still support these non-native populations.

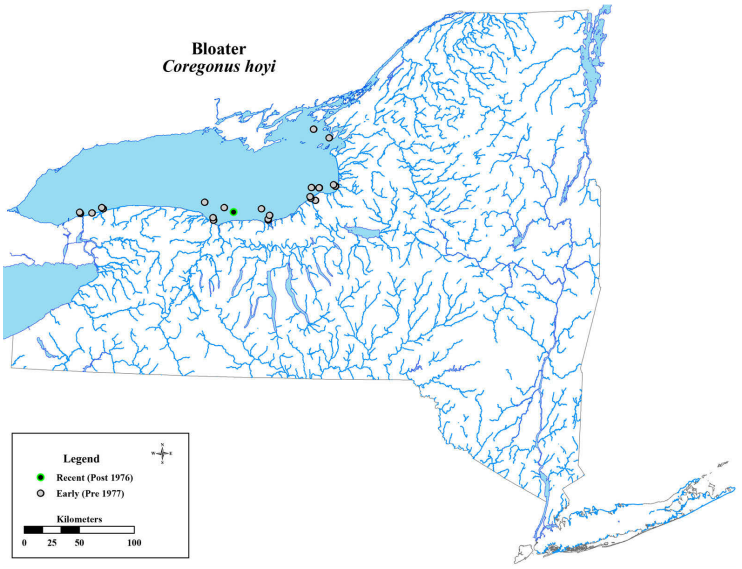
Mohawk (**1,2,3**). This whitefish was rare in this watershed during the 1934 survey, where it was found in Caroga and Canada lakes (Greeley 1935). More recently, it has been reported from East Echo Lake. A 1934 record from Schoharie Creek seems likely to be a misidentification and was, therefore, not included on the map.

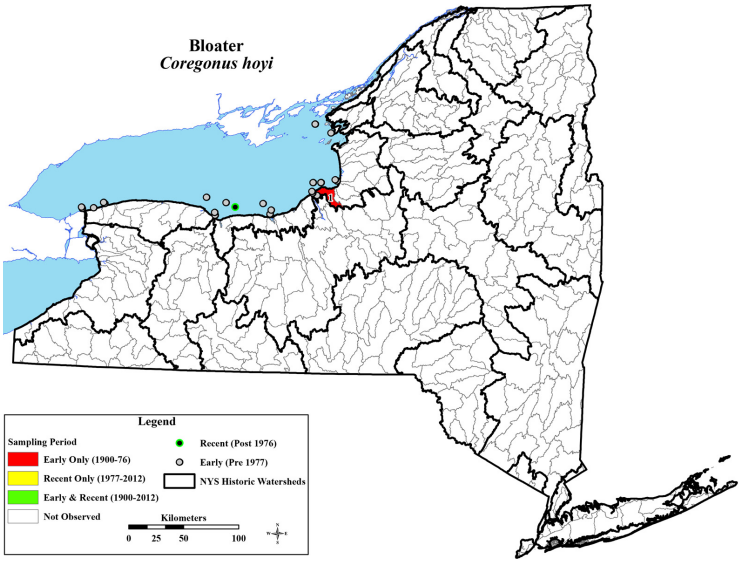
Lower Hudson (**1,2,3**). Greeley (1938) reported that this species was taken from Lake Gleneida but was generally absent from the lakes of southern New York. It still is still present in Lake Gleneida and has been found in Sylvan Lake as well.

Coregonus hoyi, Bloater

This deepwater cisco is an obligate lacustrine species and, in New York, was only found in Lake Ontario. Lee et al. (1980) limited its range to the upper Great Lakes, Lake Ontario, and Lake Nipigon, noting that it was probably extirpated from the latter two lakes. This species has been designated as a Species of Greatest Conservation Need in New York.

Ontario (1,2). MCZ 27322 is a specimen collected in 1854 at Buffalo. Although the locality is at odds with the currently accepted range of the species, it does place this species in the area at an early date. Koelz collected specimens from Lake Ontario in the early 1920s (e.g., ANSP 102915) and Greeley (1940) noted the presence of this species in the lake but did not report collecting any during the 1939 watershed survey. This deepwater cisco species occurred between 38 and 120 m, reaching its maximum abundance between 75 and 90 m (Connerton and Stewart 2013). The Lake Ontario cisco fishery was dominated by Bloater in 1942 because the other species had been depleted and the early maturity of this species provided a survival advantage (Stone 1947). By 1960, the deepwater fishery was gone. The last catch of Bloater in Ontario waters was near Toronto in 1972 (Connerton and Stewart 2013) and, in New York waters, near Rochester in 1983. The species is now extirpated from Lake Ontario. Owens et al. (2003) blamed its decline on Alewife predation of Bloater fry. A restoration program involving USGS, NYSDEC, and the Ontario Ministry of Natural Resources, which included a stocking component, began in 2012 (Connerton and Stewart 2013).

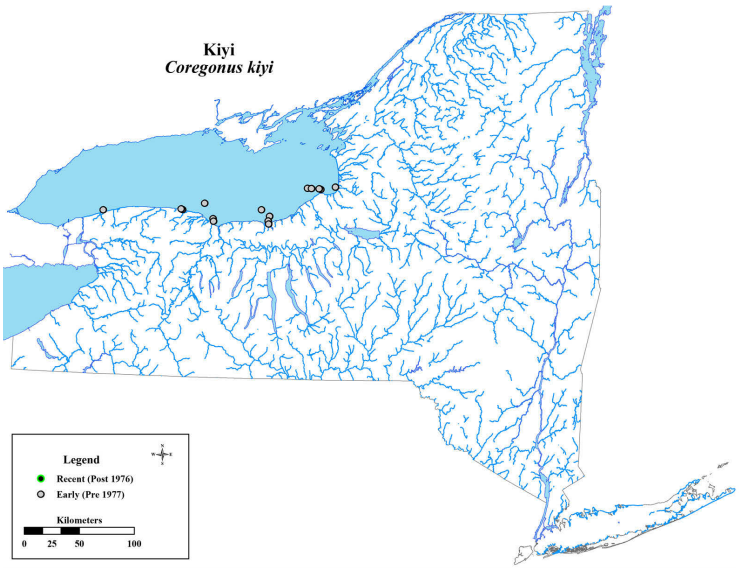


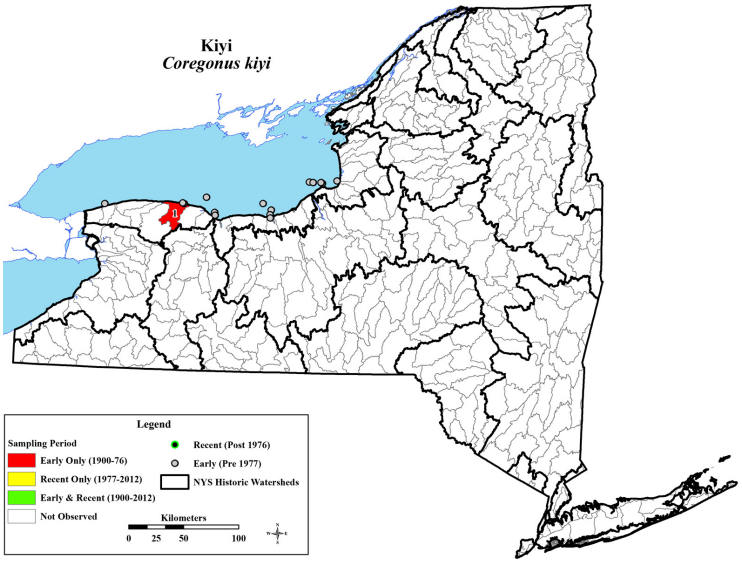


Coregonus kiyi, Kiyi

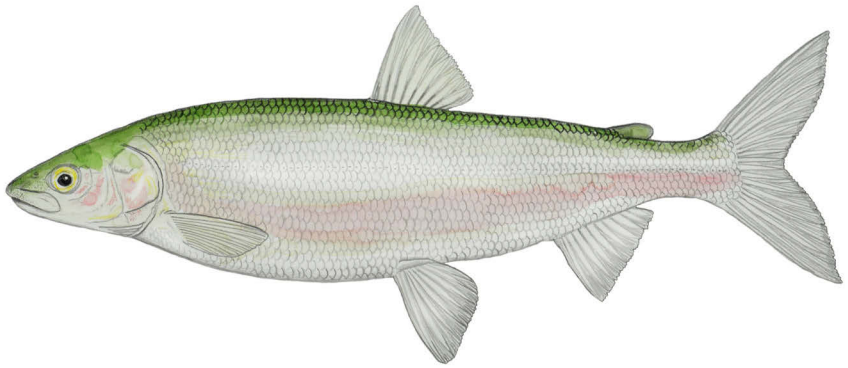
This deepwater cisco is an obligate lacustrine species and is native to the upper Great Lakes and Lake Ontario (Lee et al. 1980). Lake Superior supports the only known extant population of the species.

Ontario (1,2). The Kiyi occurred between 75 and 145 m, reaching its maximum abundance at about 125 m (Connerton and Stewart 2013). The Lake Ontario fishery for all ciscoes, which was well underway in 1875, gradually declined through about 1940 and was gone by 1960 (Connerton and Stewart 2013). Greeley (1940) noted that this species was too small to be caught in the gillnets used in the fishery, and, because it was a smaller species (around 330 mm), it was not as highly regarded in New York as it was in Ontario (Stone 1947). The last Lake Ontario catch record for Kiyi was in 1964 at Oswego (Wells 1969), and the species is considered to be extirpated from the state.



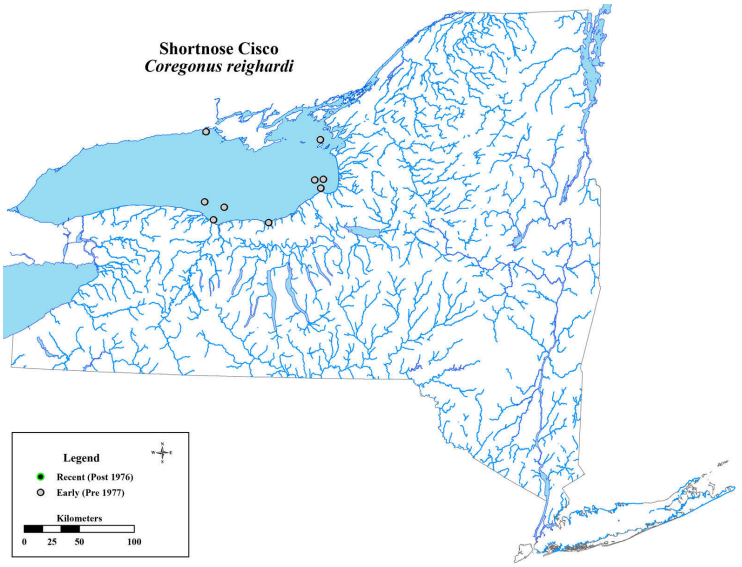


Coregonus reighardi, Shortnose Cisco



This deepwater cisco is an obligate lake-dwelling species that was native to the upper Great Lakes and Lake Ontario (Lee et al. 1980). The IUCN classifies this species as “Critically Endangered” (Gimenez Dixon 1996), whereas the U.S. Fish and Wildlife Service and Ontario Ministry of Natural Resources consider it to already be extinct.

Ontario (1,2). The Lake Ontario cisco fishery placed a high value on this species because it was fat, and its decline is largely due to overfishing (Greeley 1940). Stone (1947) provided information on catches of this species in the state. The last New York record for Shortnose Cisco was at Rochester in 1964 (Wells 1969), and the species is now extirpated. Webb and Todd (1995) and COSEWIC (2005) treat this species as extinct because it has not been caught in the Great Lakes since a catch from Lake Huron in 1985.



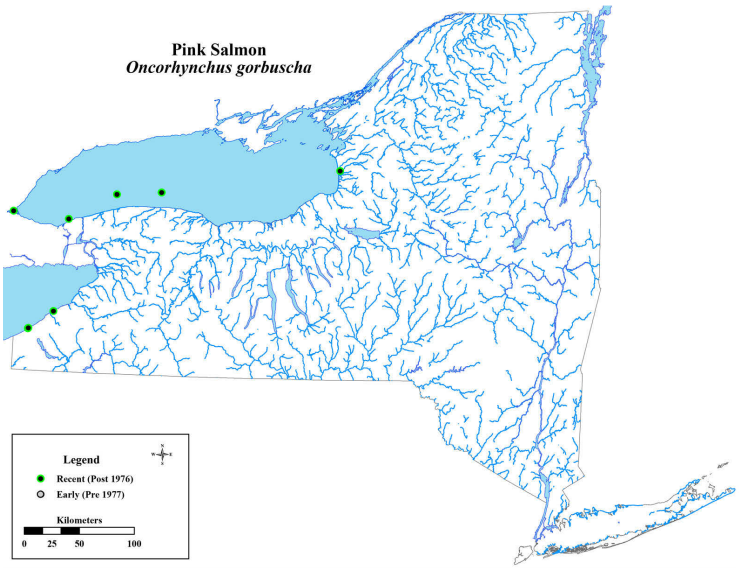
Watershed maps only show records as locations in 10-digit HUC units for inland New York waters. Records from large water bodies across state borders are excluded, and all of the Shortnose Cisco records were of this type. Therefore, a HUC analysis could not be performed and the map is not shown here.

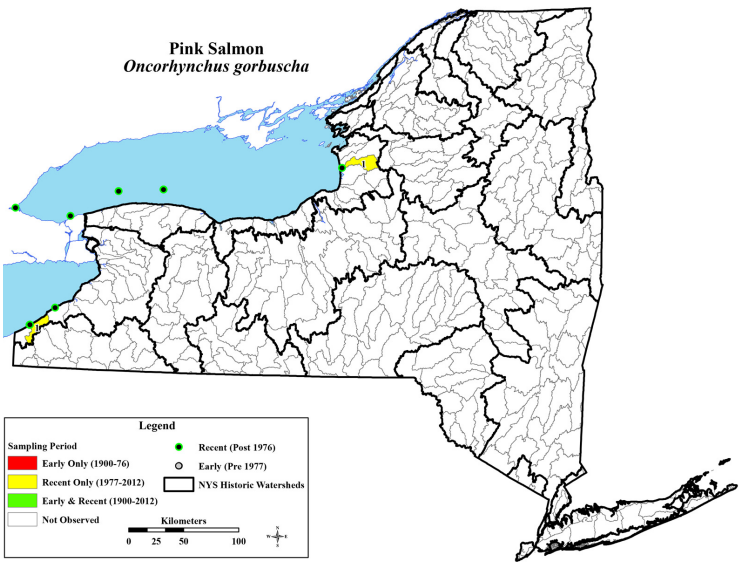
Oncorhynchus gorbuscha, Pink Salmon

This Pacific salmon was introduced into the upper Great Lakes (Lee et al. 1980) and now occurs in Lake Ontario and Lake Erie in New York, where it is captured infrequently. The species has limited spawning runs near Hamilton Harbor in western Lake Ontario.

Erie-Niagara (**2,3**). There are no stocking records for this fish from the lake and all individuals that are caught are out-migrants from the upper Great Lakes. The Pink Salmon was first reported from the lake in 1979 and no in-lake recruitment has been documented (Lange 1984). The most recent angler catches were reported in 2004.

Ontario (**2,3**). Anglers are more successful in Lake Ontario than in Lake Erie because Pink Salmon have been stocked there and are known to reproduce in the Ontario waters of Lake Ontario (Dermott and Timmins 1986). Angler catches from New York areas of Lake Ontario were reported in 1992, 2004, and 2007.





Oncorhynchus kisutch, Coho Salmon

Coho Salmon spawn in tributaries of the Great Lakes and live in the open waters of the deeper parts of the lakes. New York populations are maintained by annual stocking, but there is limited natural recruitment in the Ontario watershed. These stocking efforts, which began in the 1970s, have resulted in the development of an important fishery in Lake Ontario.

Erie-Niagara (**2,3**). The first reports of this species from New York were in 1968, and stocking efforts in this watershed began in 1970. New York's stocking program ended in 1992 and Pennsylvania's program ended in 2003, which led to an almost negligible number of catches by 2003 and 2004 (Coldwater Task Group 2014).

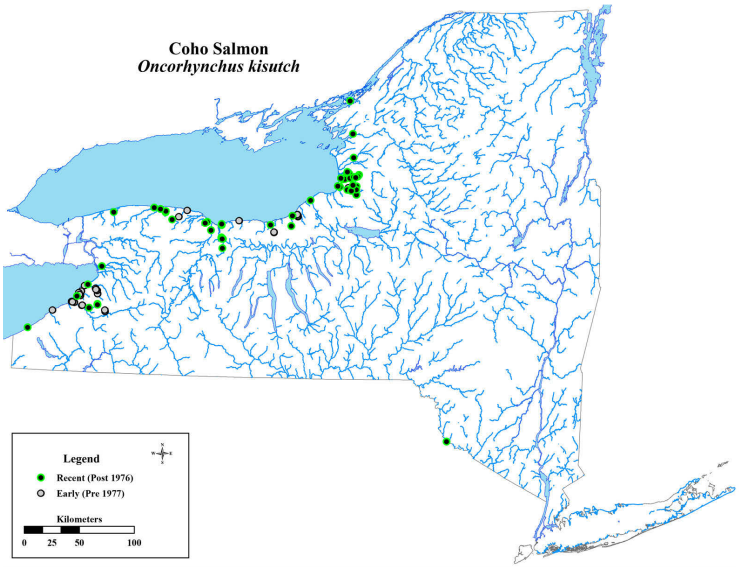
Ontario (**2,3**). The most aggressive Lake Ontario stocking programs began after 1970. These efforts developed a self-sustaining population, although it is supported by continued stocking (Mikol and Hadley 1979). The sport fishery is exceptionally popular (Mills et al. 2003). Coho Salmon are occasionally caught in the lower Niagara River (Prindle and Bishop 2013).

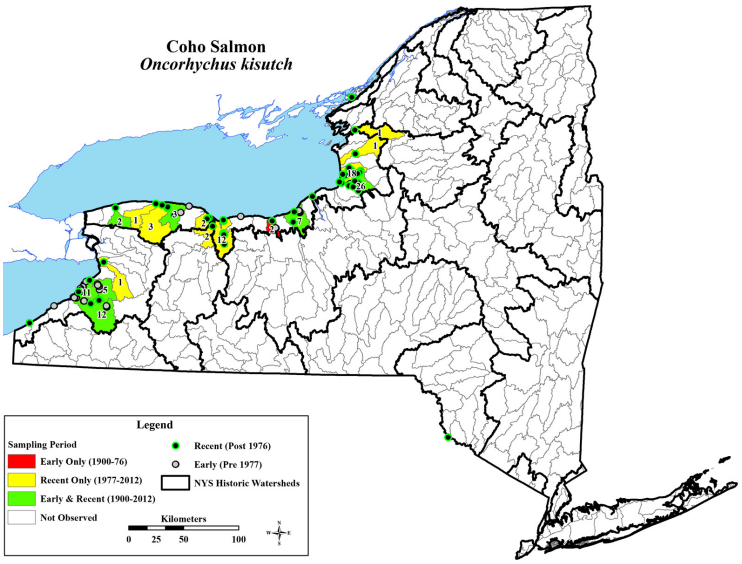
Genesee (**3**). This species was first reported from the mouth of the Genesee River in 1992. Although it is still present in the watershed, angler catches are infrequent (Prindle and Bishop 2012).

Oswego (**3**). Anglers have reported Coho Salmon from the river mouth near Oswego (Prindle and Bishop 2013).

Saint Lawrence (**2**). Records exist from the Saint Lawrence River main channel after 1982.

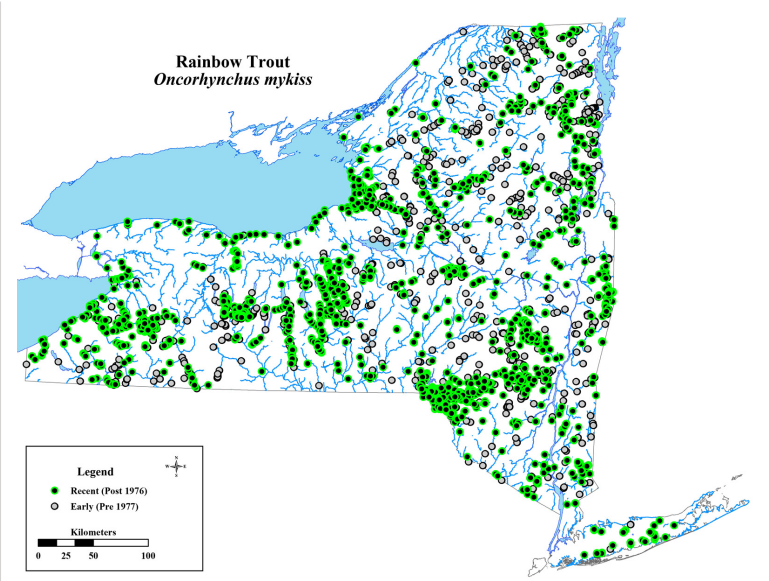
Delaware (**2**). In 1986, this species was caught in the Delaware River at Barryville. This record was possibly the result of an introduction in New Jersey.

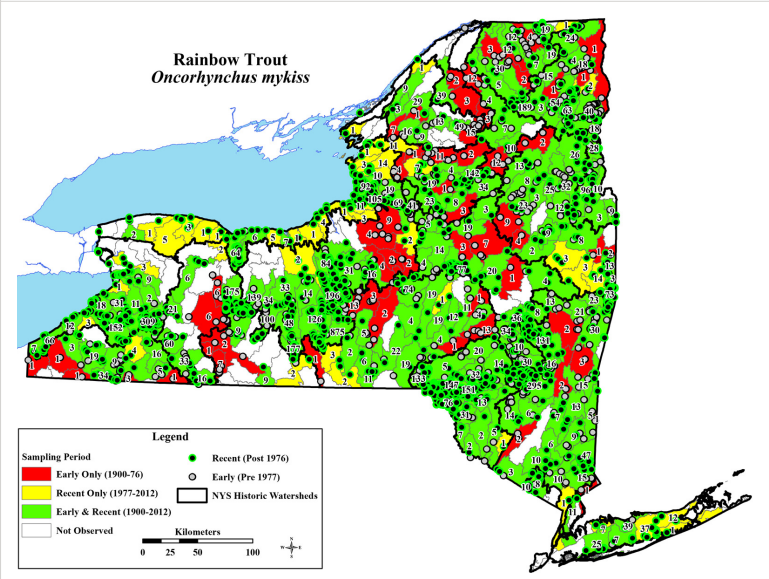




Oncorhynchus mykiss, Rainbow Trout

This Pacific Coast native lives in cold-water streams and lakes and depends on clean gravel areas for spawning. It is an exotic species in New York and has been introduced into every one of the state's watersheds. Annual stocking continues in many lakes to augment low natural recruitment. Naturalized populations support major sport fisheries in tributaries of Lakes Erie and Ontario as well as the Finger Lakes. Fish that migrate from the Great Lakes to spawn in tributaries are called steelhead, although this term usually refers to sea-run stocks. Other naturalized stream populations with more localized ranges are found in the upper Genesee River and the eastern Adirondack, Catskill, and Allegheny mountains.





Allegheny (**1,2,3**). Greeley (1938) noted that the stocking efforts in this watershed showed slight success and fish were found at only three sites. Rainbow Trout remain rare in this watershed, although the species continues to be stocked in a few small lakes and streams, including Great Valley Creek and some tributaries of Conewango Creek. Reproduction has been reported from some tributaries in the eastern basin.

Erie-Niagara (**1,2,3**). Greeley (1929) reported that both steelhead and a non-migratory strain had been planted in this watershed and noted that both forms were established but present in limited numbers. In 1928, there were eight streams that contained Rainbow Trout. In recent times, steelhead have become the primary sport species in the Lake Erie tributary fishery (Coldwater Task Group 2014) and Culligan et al. (2005) rated each major tributary as a spawning stream. This species was caught in 32 streams between 1986 and 2002. Several tributaries, about half of which are in the Cattaraugus Creek system, have self-sustaining populations that are not migrants from Lake Erie.

Ontario (**1,2,3**). Greeley (1940) noted that this trout was "firmly established" in Redfield Flow and its tributaries and was also present in Castor Pond (NYSM 753) and Irondequoit Creek. A steelhead fishery has been developed in Lake Ontario since the 1970s (Mills et al. 2003), which has resulted in successful spawning runs in many tributaries, particularly those on the eastern shore.

Species continued on next page

Genesee (**1,2,3**). Greeley (1927) listed this species as locally common but sufficiently specific in its habitat needs that it was only successful in tributaries that fed directly into large, cool lakes or streams. He (Greeley 1927) also noted that "...one of the best rainbow streams is the Genesee River north of Belmont," because it flowed into the Belmont dam impoundment. Rainbow Trout continue to be found in this watershed, where appropriate habitat is present.

Oswego (**1,2,3**). No specimens were retained from the 1927 survey of the watershed (Greeley 1928), and the species was apparently overlooked in the survey report, but it was recorded several times in field notes. In each of the Finger Lakes, except Owasco, there are Rainbow Trout spawning runs into tributaries that sustain these fisheries (Schaffner and Ogelsby 1978). Spawning populations are not found in any non-lake associated streams in this watershed. In Cayuga Lake, the stocking of a migratory strain in the 1950s developed a very popular, though limited, fishery (Youngs and Ogelsby 1972).

Black (**1,2,3**). Mather (1886) reported that Rainbow Trout were brought from California and stocked at several sites in the watershed, including the Fulton Chain and the Moose River. Greeley and Bishop (1932) noted that this fish was uncommon and the least abundant of the trout species in the watershed; early stocking attempts were unsuccessful, but individuals were reported from the Deer River during the survey. There are no currently known, naturalized populations in the watershed except for Lake Ontario fish that migrate into the lower portion of the Black River seasonally.

Saint Lawrence (**1,2,3**). Greeley and Greene (1931) noted that Rainbow Trout were present in the streams and lakes of the Salmon and Chateaugay systems and in a few additional lakes. Self-sustaining populations are still present in both systems.

Oswegatchie (**1,2,3**). Greeley and Bishop (1932) reported that "specimens were taken in Star Lake, and Twin Lakes of the Oswegatchie drainage, Little River at Oswegatchie and from the Oswegatchie above Fine." There are no naturalized populations in this watershed although stocking continues in a few lakes.

Raquette (**1,2,3**). Greeley's (1934) assessment was that the success of Rainbow Trout stockings was limited in this watershed because there were few suitable spawning sites, and, as a result, the species was uncommon. Nonetheless, stocking efforts continue and catches are regularly reported.

Champlain (**1,2,3**). Rainbow Trout were common in both the Ausable and Great Chazy systems during the 1929 watershed survey and were also present in several other streams (Greeley 1930). The species is still present throughout the watershed, and several streams have naturalized populations.

Chemung (**1,2,3**). Greeley (1938) only listed this species from Bennett Creek, a tributary of the Canisteo River. A population is also present in the Cohocton River. Recent collections from Neil Creek, a tributary of Cohocton River, and Carrington Creek, a tributary of the Canisteo River, support the presence of self-sustaining populations in these systems. Rainbow Trout have also been stocked in Erwin, Cameron, and Alpaughs ponds, Almond Lake, and an unnamed pond near the headwaters of Newtown Creek.

Susquehanna (**1,2,3**). Greeley (1936) reported: "Specimens were taken at only five localities, all in streams...At two of these the fish which were taken were recently planted as indicated by their coloration. Reports of occasional rainbow trout were recorded from three other Susquehanna drainage localities...The scarcity of rainbows as compared to other trout in the streams strengthens the general conclusion that rainbows seldom maintain a breeding population except under conditions such as to allow the fish access to a lake or other large body of water." In the 1960s, Rainbow Trout were present in 16 streams and 20 lakes in the watershed. Finally, accepting Greeley's (1936) assessment, stocking of this species in streams was discontinued in the 1970s, although stocking continues in Basswood Pond, Bowman Lake, Gilbert Lake, and others.

Delaware (**1,2,3**). Greeley (1936) noted reports of Rainbow Trout from four sites and that "occasional large rainbows are said to be taken in the Delaware River." There is little natural reproduction in the smaller streams of the watershed, although both Brook and Brown Trout successfully reproduce in these streams. The Rainbow Trout began to increase its range in the watershed in the early 1990s and now supports the predominant fishery in the river below the two largest impoundments. Suitable spawning areas enhance the fishery in many tributaries near Hancock (McBride 2002).

Upper Hudson (**1,2,3**). This species was uncommon during the watershed surveys and was collected at only two sites, although it was reported anecdotally from several other areas (Greeley and Bishop 1933). Naturalized populations remain in some streams, such as the Schroon, Hudson, and Hoosic rivers and their tributaries. Rainbow Trout continue to be stocked in several lakes.

Species continued on next page

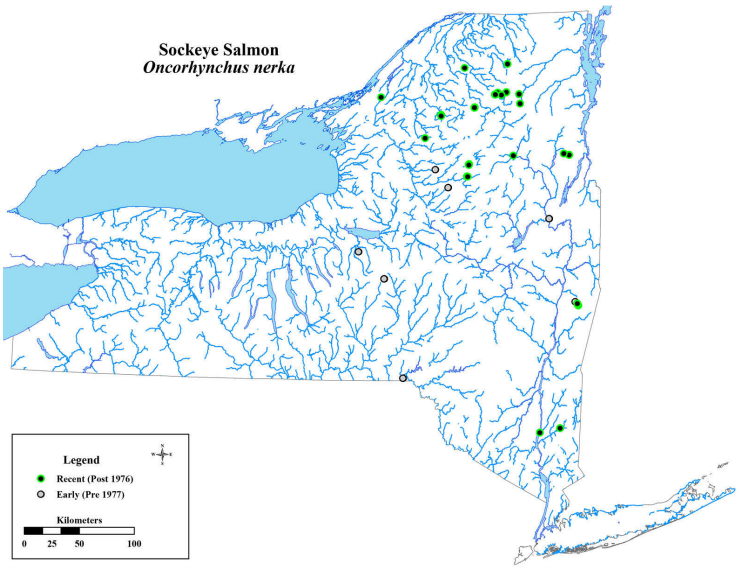
Mohawk (**1,2,3**). Greeley (1935) listed Rainbow Trout as locally common in streams, particularly in the upper Schoharie Creek basin, but present in only one lake (Delta Lake). He (Greeley 1935) also noted that although this species may mature in many streams, there was little evidence of reproduction. Since 1986, however, naturalized populations have been found in 12 upland streams. Recent stocking efforts have been limited to lakes.

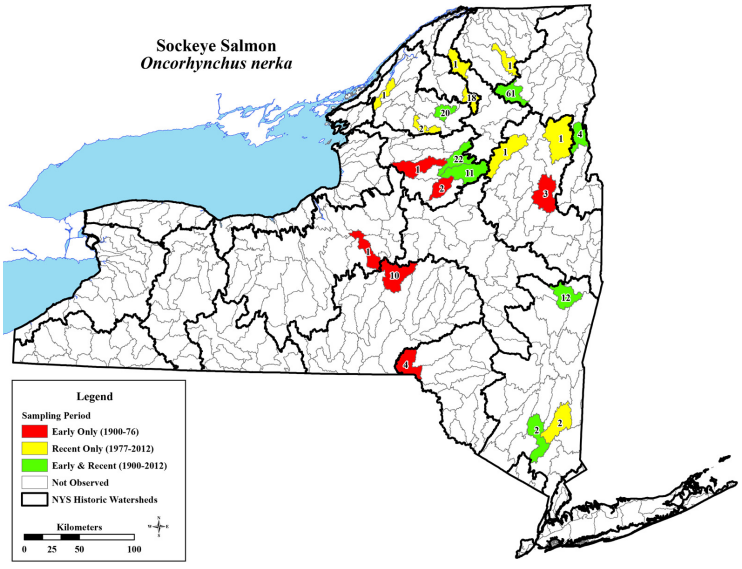
Lower Hudson (**1,2,3**). Resident populations of this species were present in many headwater Catskills streams, where it reproduces "at a small size" (Greeley 1937). Wild populations continue to exist in Esopus and Catskill creeks, the Croton River, and their tributaries. Many lakes also are stocked annually.

Newark Bay (**1,2,3**). Rainbow Trout were present in just 1% of the 1936 survey samples (Greeley 1937). The species has been found in the Ramapo River, as well as in Greenwood and Sterling lakes, in both the 1930s and 1990s-2000s. None were reported from this watershed between 1936 and 1983. A Rainbow Trout record from the Ramapo River in 1983 probably marked the start of a stocking program. There are several waters in this system that are cool enough to be suited for trout, but, in this watershed, Rainbow Trout are not stocked as frequently as other trout species.

Long Island (**1,2,3**). Because the Rainbow Trout is a popular game fish, it is fitting that the first New York record for this species is from the South Side Sportsman Club in Oakdale in 1887 (USNM 39154). Despite the recreational popularity of this species, it remained rare in this watershed for some time. Greeley's (1939) assessment was: "A single individual seen in the lower Connetquot River, June 23, was the only rainbow trout encountered during the survey but this species was reported from Massapequa Reservoir and Lower Twin Pond. There are said to be some large rainbows in South Bay, ascending the streams for short distances. It is of interest to note that no evidence of young from natural reproduction was obtained in the seine collections." Annual stocking efforts continue, and this species can be found at a variety of sites throughout this watershed.

Oncorhynchus nerka, Sockeye Salmon





This Pacific salmon has been stocked in nine watersheds in northern and eastern New York. Reproduction has been limited and the fishery was enhanced with continued stocking until recently. The landlocked form of Sockeye Salmon is called Kokanee and tends to grow to a smaller maximum size than anadromous individuals.

Oswego (**2**). Sockeye Salmon were stocked in some of the deeper lakes as forage for other game fish. The only location where this species was actually taken by anglers is Green Lake (Onondaga County), where it was caught in 1954 and 1960.

Black (**2,3**). This salmon has been stocked in several waters annually. It was caught in Third Bisby Lake in 1958, Mitchell Pond between 1968 and 1984, Big Otter Lake in 1972, and Bug Lake in 1985 and 2005.

Saint Lawrence (**3**). Stocking in 1992 established a population in Deer Pond. Sockeye Salmon are present in a small number of other ponds as well.

Oswegatchie (**2,3**). North Twin Lake is the only water where this species has established itself after initial stocking efforts. Annual stocking, however, has occurred in several mountain lakes over the years.

Champlain (**2,3**). Sockeye Salmon were caught in Lake Colby Pond in 1969 and Little Green Pond in 1985 (AMNH 234550). Additional lakes were stocked and have spotty catch records in the 1980s and 1990s.

Susquehanna (**2**). This species was stocked in Hatch Lake in the 1960s resulting in two catch records from 1964 and 1966. There have been no reports of catches after stocking ended.

Delaware (**2**). Sockeye Salmon were caught in Oquaga Lake in 1960 and 1961. These were stocked fish, and that program was abandoned in the mid-1960s. There are no further records from this watershed.

Upper Hudson (**2,3**). This salmon was stocked in Lake Luzerne in the 1960s. The only more recent records are from Crane Pond in 1987 and Clear Pond in 1996.

Lower Hudson (**2,3**). Sockeye Salmon were present in Glass Lake as early as 1960. The species is also present in Crooked, Crystal, and Sylvan lakes, where spawning has been reported but with limited recruitment. Catches were also reported from the Hudson River in 1974, 1986, and 1997.

Oncorhynchus tshawytscha, Chinook Salmon

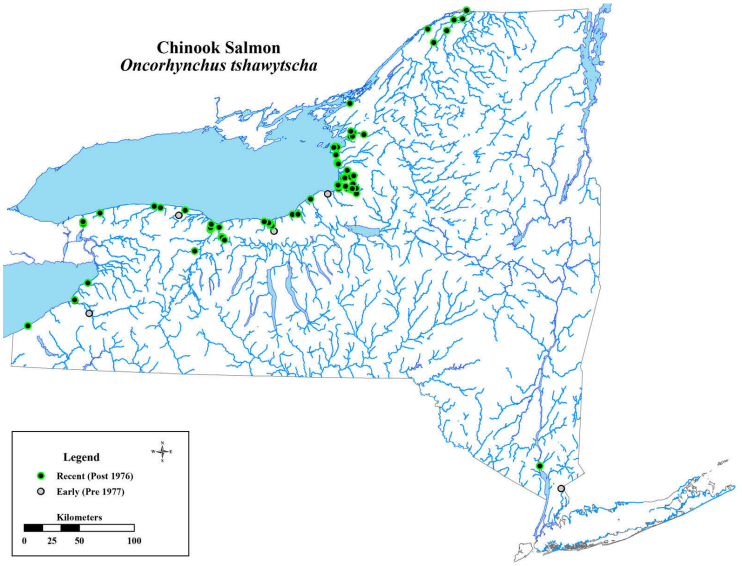
This species is the largest of the Pacific salmons. It generally occurs in the deeper, colder parts of Lake Ontario. Spawning occurs in the Salmon River in Oswego County and an aggressive stocking program is also in place. The stocking of this non-native species, beginning in the 1970s, has created a popular recreational fishery.

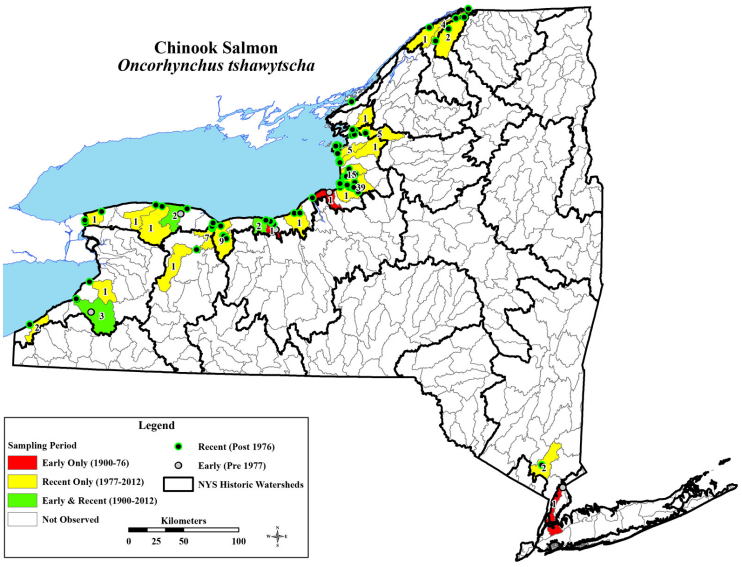
Erie-Niagara (**2,3**). In 1974, W. Hadley (SUNY Buffalo, unpubl. field notes) reported a catch from Cattaraugus Creek, where this species was stocked between 1973 and 1997. A specimen was also collected from Lake Erie at Chautauqua Creek in 1981 (AMNH 224522). Einhouse et al. (2005) reported that this fishery declined precipitously when stocking was discontinued. Some natural reproduction occurs in Lake Erie tributaries, which may account for the few individuals reported over the last decade.

Ontario (**1,2,3**). The introduction of this species and records of catches of large individuals are discussed by Dymond et al. (1929). Although stocking efforts did not result in an established population, more aggressive stocking programs beginning in 1970 have been successful in developing a sport fishery, particularly in Lake Ontario and the Salmon River in Oswego County. Although Connerton et al. (2009) reported that natural recruitment in tributaries is substantial, the species continues to be stocked.

Genesee (**2,3**). Specimens have been taken at the mouth of the Genesee River since 1978. A report of a catch from Oatka Creek in 1978 is presumed to be a misidentification.

Oswego (**3**). Chinook Salmon have been reported from the mouth of the Oswego River near Oswego by anglers (Prindle and Bishop 2013).





Black (**3**). This species is found in the lower Black River as far upstream as Dexter. Fish ladders provide access as far upstream as Watertown, where spawning occurs with limited success.

Species continued on next page

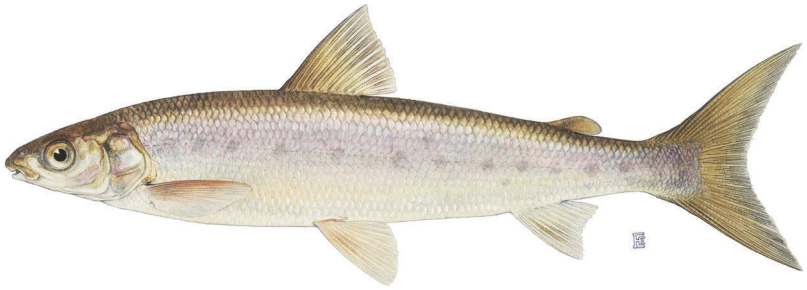
Saint Lawrence (**2,3**). Chinook Salmon have consistently been reported from the main channel of the Saint Lawrence River and the lower reaches of tributaries from the early 1980s through the 2000s (Normandeau Associates, Inc. 2007). Spawning and successful hatches were documented in the Saint Lawrence River at Cornwall (Ribey 1997) as well as in the Grass River at Madrid in 2012 (NYSM 67849).

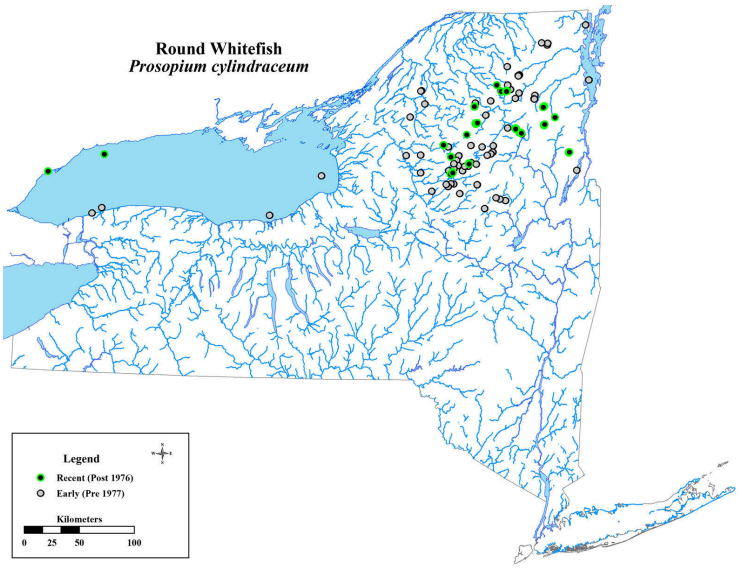
Raquette (**3**). Fingerlings have been caught below Raymondville at Trout Brook and a spawning run ascends the Raquette River for several kilometers.

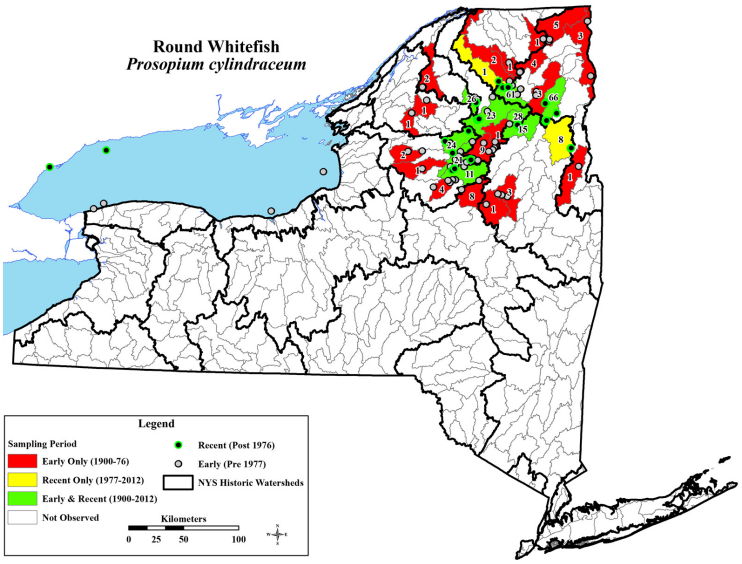
Lower Hudson (**3**). In 1988, a single specimen was caught in the main channel of the Hudson River (Smith and Lake 1990). There are no further records of this species from this watershed.

Long Island (**1**). The only record of Chinook Salmon from this watershed is one from the Kensico Reservoir (Bronx River) in 1938 (NYSM 738), which is the result of an early and short-lived stocking program. This species has not been reported from other streams draining into Long Island Sound nor any of the streams or lakes on the islands.

Prosopium cylindraceum, Round Whitefish







This is one of the few North Temperate fishes that is an obligate lake-dweller. The Round Whitefish lives in well-oxygenated, deep lakes and is native to seven Adirondack watersheds. The species was stocked in the Oswegatchie watershed in the early 1900s, but there have been no catches reported since 1955. In the last half-century, the range of this whitefish has decreased and it is now extirpated from the Saint Lawrence watershed. Today, Round Whitefish are known from eight historic sites, and a stocking program has established two additional self-sustaining populations within the species' former range. Additional lakes have also been stocked, but natural reproduction in these waters has yet to be observed. This species is classified as Endangered by the state of New York.

Ontario (1,2). Prior to 1890, Round Whitefish were known to frequent the deeper parts of Lake Ontario (Smith 1892). When working on his definitive monograph of the group, Koelz (1929) captured two specimens in gill nets set in Canadian waters of the lake in 1921 (UMMZ 53136, 53205) and one near Sandy Creek in 1923 (UMMZ 62427). Greeley (1940) noted that this species was rare and that its status had not changed during the time that records had been kept. Stone (1947) reported records of catches from intermediate depths near Sodus Point in 1942. A lake-wide study in 1972 captured Round Whitefish rarely along the central north shore in Ontario (Christie and Thomas 1981). Despite its apparent scarcity, this species continues to be a part of the commercial harvest in Ontario.

Black (1,2,3). Greeley and Bishop (1932) listed this species as uncommon and reported that it was only caught in three lakes during the 1931 watershed survey, two of which were in the Fulton Chain, with the other being Limekiln Lake. Neth (1955) reported that the population in Little Moose Lake was native and that these fish were used as brood stock in the late 1800s. Little Moose Lake is the only lake in this watershed where there is an extant, original population (NYSM 49399). Since 1999, Round Whitefish have been stocked in Eighth Lake of the Fulton Chain, Bug, Eagles Nest, and Evergreen lakes, and Buck Pond. Reproduction has been documented in Evergreen Lake in 2010 and 2013. Before the 1930s, this species was present in 13 other waters as well, making this watershed home to more populations of this fish than any other in the state (Steinhart et al. 2007).

Species continued on next page

Saint Lawrence (1,2,3). Mather (1886) noted the presence of this species in Clear Pond and Massawepie Lake. He (Mather 1886) also noted that it was so common in Adirondack lakes that it was "salted for winter use by those living in the woods." Greeley and Greene (1931) cautioned that because Mather (1886) did not record the presence of any other species of whitefish, the abundance of Round Whitefish that he reported is suspect. They (Greeley and Greene 1931) went on to report that they did not find this species in either Clear Pond or Massawepie Lake during the 1930 watershed survey and that it was apparently absent from most of its earlier reported range. All native populations have disappeared from this watershed, but Round Whitefish have been stocked in a few inland water bodies, such as Deer, Cat, and Darning Needle ponds, as well as Massawepie Lake.

Oswegatchie (**1,2**). Steinhart et al. (2007) included only two records from this watershed: one from Lake Bonaparte in 1894 and the other from Jones Pond in 1955. These catches may have been the result of stocking in these areas in the early 1900s.

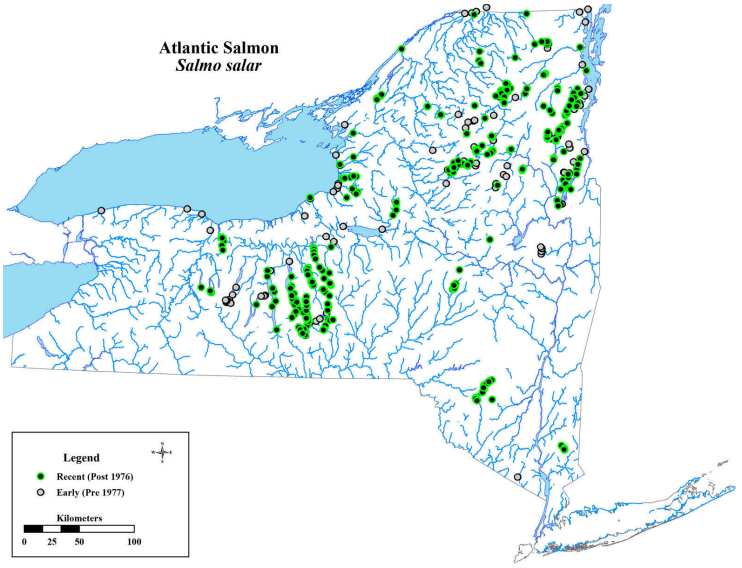
Raquette (1,2,3). Greeley (1934) listed this species as rare and reported that the only specimen caught during the 1933 survey of this watershed was from South Pond (NYSM 12636); he conceded, however, that it might have been present in other lakes where survey sampling efforts were limited. Moose Pond is the only body of water in this watershed with an extant, original population (NYSM 46786), but Round Whitefish has been stocked in Trout Pond, where there was evidence of natural reproduction in 2014.

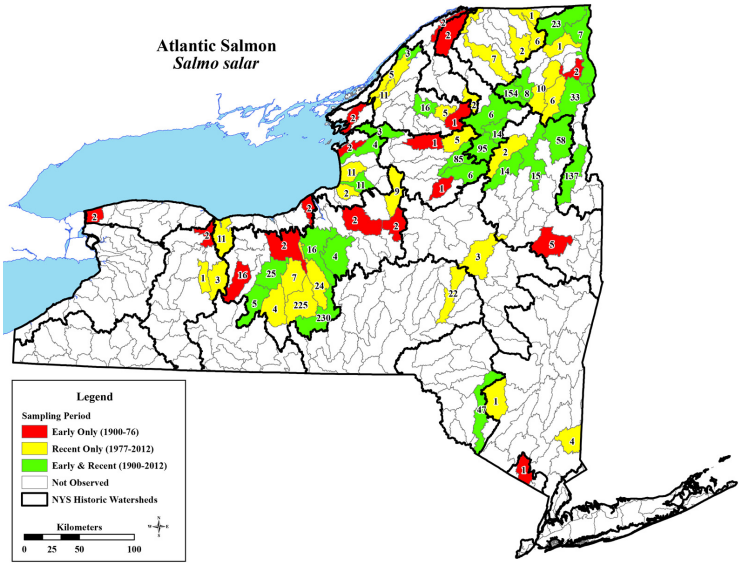
Champlain (1,2,3). This species was reported from the lake by Evermann and Kendall (1902a), and it was also collected from the lake in the 1929 watershed survey (NYSM 12941). Greeley (1930) noted that the Round Whitefish was "apparently native to many of the Adirondack lakes," but this qualified statement suggests that he was uncertain of its actual status because of the many early misidentifications reported. He (Greeley 1930) went on to note that the species was abundant in Chazy Lake, but that its size rarely exceeded the legal minimum limit and it was rarely sought by anglers. Finally, Greeley (1930) noted that this whitefish was extirpated from the Saranac lakes, where it had once been common. It has not been caught in Lake Champlain in recent decades, but it is found in upland lakes such as Hoel Pond, Upper Ausable, Upper Cascade, and Lower Cascade lakes. It has been stocked in Chapel, Ledge, Little Green, and Fishbrook ponds, but the status of these populations is unknown.

Upper Hudson (1,2,3). Mather (1886) reported this fish from Lake Pleasant, Round Pond, and Sacandaga Lake. Greeley and Bishop (1933) noted that the species was scarce in this watershed and that it inhabited only two lakes, Gilman and Piseco. Round Whitefish are also indigenous to Newcomb Lake, with catch records from 1972 and 2005. Individuals were stocked in Rock Pond from 2005-06.

Mohawk (1,2). This species was rare during the 1934 survey of this watershed, being represented by a single collection of three individuals from West Canada Lake (Greeley 1935). The Round Whitefish was likely extirpated from the lake by 1975 and Steinhart et al. (2007) recommended the initiation of a stocking program to restore the population. Stocking occurred in 2013 and 2014, and an assessment of survivorship in 2014 was favorable.

Salmo salar, Atlantic Salmon





This is an anadromous fish that migrates into northern coastal rivers from the ocean to spawn. It also lives in inland lakes, where populations have become landlocked; these populations may be either native or introduced. Dozens of tributaries of Lake Ontario, the Finger Lakes, the Saint Lawrence River, and Lake Champlain supported landlocked spawning runs until the late 1800s, when a variety of environmental alterations (dams that blocked migration, pollution, introduction of exotic species, over fishing, etc.) caused population declines and the eventual extirpation of this species in these watersheds. Stocking programs now support a fishery in 13 watersheds, but recruitment from natural spawning remains low (Neth and Barnhart 1983). The Atlantic Salmon is thought to be native to the lower parts of eight of these watersheds, but, with this species in particular, separating myth from fact is often difficult. This species has been designated as a Species of Greatest Conservation Need in New York.

Ontario (1,2,3). Smith (1892) noted that a well-established fishery existed before the 1880s. Kendall (1924) reviewed the status of Atlantic Salmon in this watershed and noted that they once inhabited the lake and carried out spawning runs in at least the Oswego and Salmon rivers. Parsons (1973) listed 14 other streams that supported runs prior to 1900. The earliest known specimen is an 1858 fish from western New York (MCZ 22757; it is possible that this specimen is from the Genesee or Oswego watersheds). Greeley (1940) noted that these early fish were presumed to be sea-run individuals but also noted that scale analysis of the few available specimens indicated that the fish were from landlocked populations. At any rate, the species was extirpated from the watershed by the early twentieth century. Stocking programs in the 1990s produced a fishery, but spawning success was extremely limited and occurred in only two streams in the eastern basin (Owens et al. 2003). Spawning and recruitment of young in the Salmon River (Oswego County) was documented in 2009 (Johnson et al. 2010) as well as from 2010-2012.

Genesee (1,3). The earliest record is from the 1800s, below the falls at Rochester (Black 1944). In the 1990s, Atlantic Salmon were stocked in Hemlock and Conesus lakes; all recent records are catches from these two lakes.

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Oswego (1,2,3). Richardson (1836) quoted DeWitt Clinton who, in the early 1800s, noted: "They pass Oswego at the entrance of this river in April, and are then in fine order, and spread all over the western waters in that direction, returning to Lake Ontario in October, much reduced in size and fatness." Greeley (1928) listed the species as extinct but noted that landlocked salmon young from eggs transported from Maine were stocked in Skaneateles Lake and were said to be not infrequently taken there. Webster (1982) detailed the extensive range of this salmon in the watershed prior to 1900. Although Atlantic Salmon have been stocked in recent decades, Fisher et al. (1996) was unable to document any successful reproduction in the Finger Lakes and noted that poor nutrition remained a problem for these fish. Survival of landlocked salmon stocked in East Branch Fish Creek and Point Rock Creek after 1999 has apparently been favorable, with catches reported as recently as 2013 (NYSM 69938).

Black (1,2,3). Mather (1886) reported that this species was stocked in the Fulton Chain, Woodhull Lake, and other Adirondack waters. This report can be at least partially confirmed, as specimens from Woodhull Lake in 1882 are known to exist (USNM 30702, 32470). Greeley and Bishop (1932) reported that no specimens were taken by the 1931 watershed survey. Parsons (1973) noted that the Black River to Great Falls in Watertown was a spawning stream for native Atlantic Salmon. In recent decades, stocking programs, particularly in Lake Ontario, have resulted in angler catches, and spawning adults were observed in the fish ladder at Dexter during fall monitoring from 1997-2003 (R. McCullough, NYSDEC, pers. comm.) Parr have been reported downstream of Dexter since stocking programs have begun. Lakes with recent catches of stocked fish include Third and Fourth Lakes of the Fulton Chain, Little Moose Lake, and Lake Lila.

Saint Lawrence (1,2,3). Greeley and Greene (1931) referred to Atlantic Salmon as extinct in the watershed, although they noted that individuals had previously been documented ascending the Saint Lawrence River and its tributaries to enter Lake Ontario and its tributaries. Stocking programs maintained fisheries, first in Upper Spectacle Pond and later in Upper Chateaugay Lake, Upper Saint Regis Lake, Debar Pond, and Lake Ozonia. Stocking also continues in Lake Ontario, with some of these fish occasionally straying into this watershed when water temperatures are appropriate.

Oswegatchie (1,2,3). Greeley and Bishop (1932) noted that this species was no longer present in this watershed but, as Parsons (1973) reported, that native fish used to make spawning runs into the lower Oswegatchie River, perhaps as far upstream as Natural Dam, until the late 1800s. Stocked fish from Lake Ontario occasionally stray into the Saint Lawrence River when water temperatures are cool, and these fish can sometimes reach the mouth of this watershed (Carlson and LaPan 1997). Fisheries have been sustained by stocking in Lake of the Woods as well as Portaferry, Sixberry, Star, and Millsite lakes.

Raquette (1,2,3). Greeley (1934) reported that this species was "moderately common in a few lakes of the region into which it has been stocked. Several specimens were secured from Lake Eaton, one was taken in Forked Lake, and a juvenile individual was caught in Brandreth Lake outlet." Parsons (1973) noted that the main channel Raquette River was an Atlantic Salmon spawning stream, which led Priest et al. (1994) to include the stretch of the river up to Hanawa Falls as part of the native range of this species. Many lakes are stocked annually, which has established several popular angling venues.

Champlain (1,2,3). Watson (1876) noted that Atlantic Salmon were abundant in the lake into the early 19th century. Edmunds (1874) noted that the species historically ascended all the major Champlain tributaries in both New York and Vermont. Greeley (1930) noted that this salmon was extirpated from the lake and tributaries by the time of the 1929 watershed survey, reporting that the last run in the Ausable River was said to have been in 1838. DeKay (1842) vividly described the harvest of these fish, and overfishing undoubtedly had a major impact on the species. Greeley (1930) listed a number of other factors that also contributed to the loss of this species. Despite the loss of sea-run populations, Greeley (1930) reported that land-locked fish had been stocked in Lake George and the Saranac chain of lakes. Stocking programs continue in many areas throughout the watershed.

Susquehanna (**2,3**). Beginning in the 1980s, this species has been stocked in Otsego Lake, where a popular sport fishery has developed. Cornwell (1994) documented spawning and successful recruitment in downstream stretches of the main channel Susquehanna River and in tributary streams.

Delaware (**2,3**). This species has been stocked in the streams of this watershed, and, in the 1970s and 1980s, Atlantic Salmon were caught in the Neversink Reservoir, Biscuit and Fall creeks, and the Neversink River and its West Branch. Annual stocking continues.

Upper Hudson (**1,2,3**). The earliest record is an 1885 specimen (USNM 37313) from Glens Falls, collected by A.N. Cheney. Because the capture locality is vague, it is difficult to assess the value of this record and fit it into context. Greeley and Bishop (1933) wrote that there was a stocked population in only one lake in this watershed, but their field notes indicated that this

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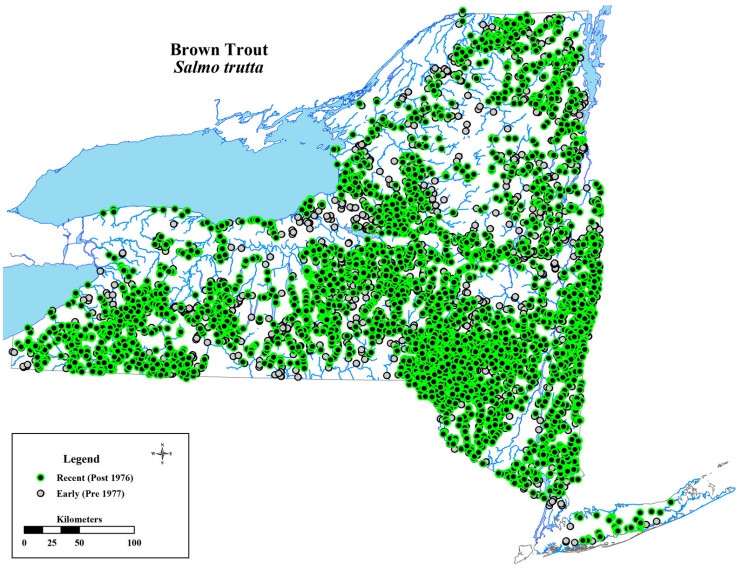
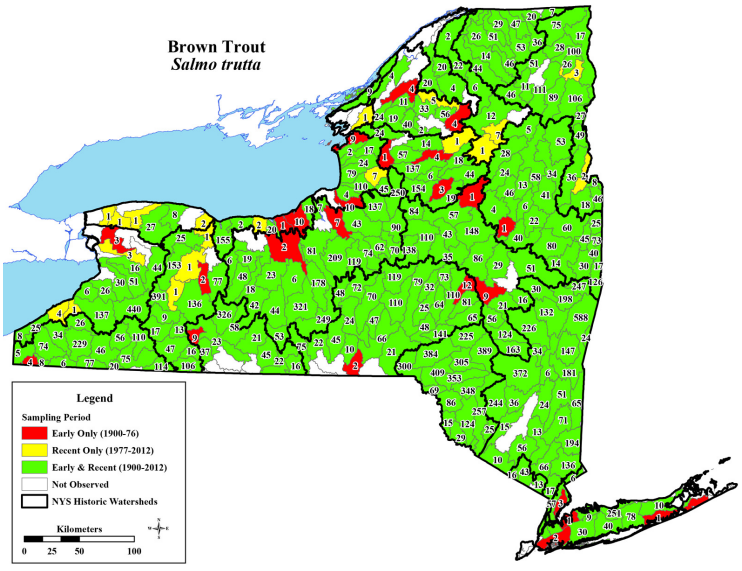
species was present in Clear (NYSM 757) and Knob ponds in Essex County. Stocking continues in several waters (George 1981a). Recently, Atlantic Salmon have been reported from Thirteenth Lake, Branch Creek, and the Schroon River. Preall (1997) observed reproduction in areas upstream of Schroon Lake.

Mohawk (**2,3**). This species was stocked in West Caroga Lake in the 1980s to develop a sport fishery, with two catches reported from 1987-89. An individual was captured in the outlet stream of the state fish hatchery at Van Hornesville in 1997.

Lower Hudson (**1,2,3**). Juet (1909) reported that "salmons" were observed in the river in 1609 during Hudson's exploration. This has been a controversial observation and was largely discredited by Webster (1982). Daniels et al. (2011b) analyzed Juet's list of fishes present in 1609, reaching the same conclusion as Webster. Nonetheless, additional reports of Atlantic Salmon in the river exist. For example, DeKay (1842) states: "The Sea Salmon rarely now appears on our coast, except as a straggling visitor. Such an occurrence took place in August, 1840, when a salmon, weighing eight pounds, entered the Hudson river, and ascended it more than one hundred and fifty miles, when it was taken near Troy." Greeley (1937) reported that no specimens were taken during the 1936 watershed survey. This species has been stocked in some reservoirs, with a 1981 report from the Rondout Reservoir and a 2002 catch in the West Branch Reservoir.

Newark Bay (**1**). Greeley (1938) noted that this species was only present in Tuxedo Lake, where it had been maintained by private stocking.





This European native was introduced into New York in 1883 (Smith 1985) and has been stocked throughout the state. It inhabits lakes and streams with cool water temperatures and spawns in streams with clean gravel. Although natural recruitment occurs in some systems, Brown Trout continue to be annually stocked in most watersheds. Greeley and Bishop (1932) noted in italics: "...it is to be hoped that they will not become sufficiently numerous there [Oswegatchie River near Wanakena] to displace the native brook trout." Of course, the species has done exactly that throughout much of the state.

Allegheny (**1,2,3**). Brown Trout have been stocked and reproduce in several streams of this watershed. In the 1937 survey, this species was found in 27 streams (Greeley 1938). During surveys conducted between 1987 and 2002, this trout was taken from 83 streams and had completely replaced the Brook Trout in many of them.

Erie-Niagara (**1,2,3**). Greeley (1929) listed this species as common in some of the 18 streams in which it was caught in the 1928 survey of this watershed. Eight of these streams were in the Cattaraugus Creek system. Between 1986 and 2002, this species was caught in 43 streams and was the most frequently encountered trout species in the watershed. This trout has also become important in Lake Erie, where the fishery (which extends into adjacent tributaries) recently had Brown Trout composing 6% of the catch (Einhouse et al. 2005).

Ontario (**1,2,3**). Wright (2006) reported that Brown Trout were introduced into Monroe County in 1886, and an extensive stocking effort continued through the later part of the nineteenth century. Greeley (1940) indicated that this species was locally important as a game fish but that its distribution was limited within the watershed, with specimens being found in nine streams or about 5% of the streams surveyed in the 1939 watershed survey. Four of these streams were lowland sites outside the Tug Hill region, which is the major upland area in the watershed. In contrast, Brown Trout were found in 17 (or 23%) of the streams sampled in surveys conducted between 1985 and 2002, where only six were in lowland areas. The species has thus clearly expanded its range in the watershed in recent decades, largely through continuing stocking programs.

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Genesee (**1,2,3**). Greeley (1927) noted that this species was "the most common trout of the region," being well established in every stream where suitable habitat was available, including the Genesee River main channel. At present, Oatka and Wiscoy creeks support popular trout fisheries, and there are many additional streams with wild populations.

Oswego (**1,2,3**). Brown Trout were common and widely distributed during the 1927 watershed survey due to active stocking (Greeley 1928). The species remains abundant and widely distributed throughout the watershed.

Black (**1,2,3**). This species was common during the 1931 survey, with specimens being collected from Crystal, Fish, Pine, Mile, Bear, Alder, and Little Black creeks as well as Fall Brook and the Black River (Greeley and Bishop 1932). During the last several decades, naturalized populations have displaced Brook Trout in many areas, and stocking supplements the fisheries in several larger streams.

Saint Lawrence (**1,2,3**). Greeley and Greene's (1931) assessment was that "this is an introduced species which has become well established in many of the streams and ponds of the region. In the Salmon River, it is the predominant species of trout and furnishes good fishing. Brown trout were collected in several streams of the Grass, St. Regis, and Chateaugay watersheds. They were also taken in gill-net catches in a number of lakes and ponds notably Chateaugay Lake, Lake Titus, and Ragged Lake." Brown Trout continue to be found in streams and lakes throughout the watershed.

Oswegatchie (**1,2,3**). This species has been introduced into streams and ponds throughout the watershed. The 1931 watershed survey collected specimens from the Indian River as well as Nick's and Shipman ponds (Greeley and Bishop 1932). Recent records show that Brown Trout still occur in many waters.

Raquette (**1,2,3**). Greeley (1934) reported that this trout was locally common in streams where it was stocked or into which it had spread. He did not report its presence in any ponds, although specimens were taken in outlet streams. The species remains locally common throughout the watershed.

Champlain (**1,2,3**). In his report on the 1929 watershed survey, Greeley (1930) stated that Brown Trout were "common throughout the region in suitable streams," where populations were established by stocking. The species continues to be found in streams and ponds throughout the watershed. Beginning in the 1980s, a new stocking program was initiated for Lake Champlain, which led to a successful sport fishery in the lake.

Chemung (**1,2,3**). Brown Trout were present at 8% of the sample sites during the 1937 survey (Greeley 1938). During surveys conducted after 1975, this species was caught in 48 streams. One of the most successful stream fisheries in the watershed is that of the upper Cohocton River.

Susquehanna (**1,2,3**). This species was common and was the trout species most frequently encountered during the 1935 watershed survey (Greeley 1936). In recent decades, naturalized populations have been documented in many streams, and annual stocking supports sport fisheries throughout the watershed, to the detriment of native Brook Trout.

Delaware (**1,2,3**). This species was very common, and was again the predominant trout species encountered during the 1935 survey of this watershed; in fact, some streams in this watershed were famous Brown Trout fly fishing sites (Greeley 1936). Naturalized populations and annual stocking support the modern sport fishery in this watershed. Although Brown Trout occur in the many reservoirs in this watershed, spawning occurs in stream reaches upstream of reservoirs or in tributaries (McBride 2002).

Upper Hudson (**1,2,3**). According to Greeley and Bishop (1933), this was the most frequently encountered trout species in both streams and lakes at mid-elevations, but it was not as widely distributed as the native Brook Trout. Brown Trout continue to be stocked throughout the watershed and remain in many fish assemblages in both streams and lakes.

Mohawk (**1,2,3**). This was the most commonly encountered stream trout during the 1934 survey, but the species was absent from many upland waters and was not found in ponds (Greeley 1935). Brown Trout remain common in this watershed, and more recent collections have now been made from additional upland waters (e.g., NYSM 12802).

Lower Hudson (**1,2,3**). As was true for other southern tier watersheds, the Brown Trout was the dominant trout in this watershed, being present in most suitable streams and lakes or reservoirs (Greeley 1935, 1937). It was the eleventh most commonly caught species in stream collections of the 1930s and the twelfth most commonly caught fish in the 2000s.

Newark Bay (**1,2,3**). Brown Trout were reported in just over 1% of the samples taken in this watershed during the 1936 survey (Greeley 1937), with field notes recording the species in seven waters. Since 1995, this species has been found in the Ramapo River, Greenwood and Sterling lakes, and Pine Meadow Brook.

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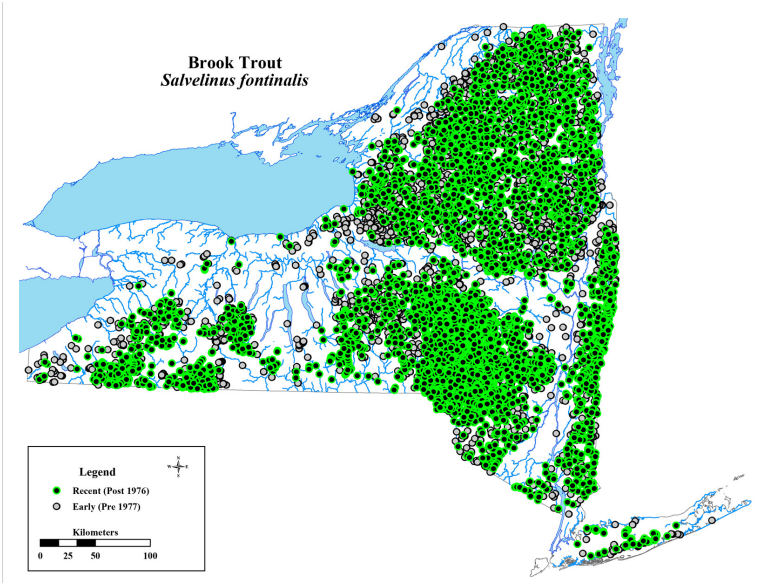
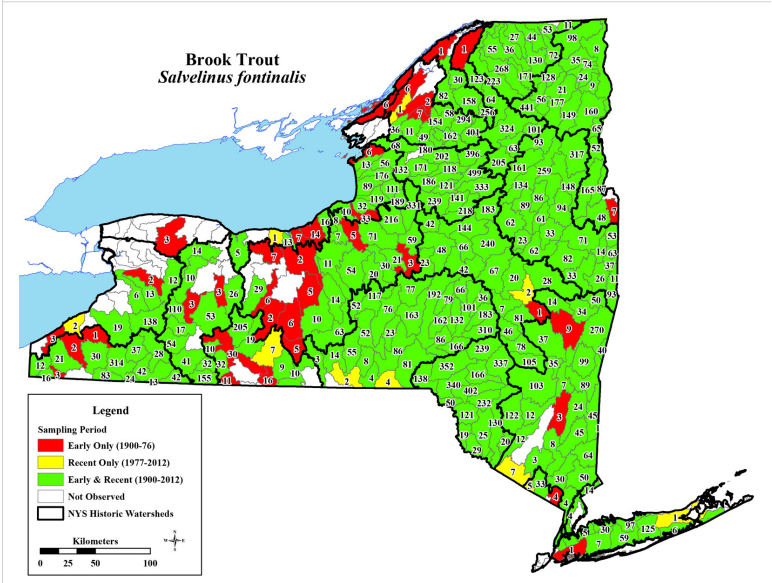
Long Island (**1,2,3**). Although stocking of this species began in the 19th century (documented by collections from Cold Spring Harbor (where there was a state hatchery) in 1894 (USNM 45452) and a nearby stream in 1898 (USNM 67351)), Greeley (1939) noted that these introductions were only moderately successful. He (Greeley 1939) went on to comment that this was one of the few watersheds in the state where natural reproduction of the native Brook Trout exceeded that of the exotic Brown Trout. Finally, Greeley (1939) reported that sea-run fish were present but rare. A local collector, Roy Latham, provided the only example, which was a fish taken off Orient. Sea-run varieties have been reported rarely in recent times, but other strains are widely stocked and support a sport fishery across the island.

Salvelinus fontinalis, Brook Trout





This is the state freshwater fish of New York. The Brook Trout lives in cold-water streams and lakes and depends on clean gravel for spawning. The species is native to all of the state's 18 watersheds, although it has been stocked and managed in additional waters within these watersheds where it was not originally found. Its range has diminished in all watersheds as a result of, for example, changing land-use practices, altered in-stream habitats, and the introduction of exotic species, such as the Brown Trout. Several populations of Brook Trout are recognized as Heritage Strains. Keller (1979) defined a Heritage Strain of Brook Trout as a genetically distinct group of individuals of common origin and identified by the waters of origin of the parent stocks. Keller (1979) listed 11 populations and Perkins et al. (1993) treated 24 populations as Heritage Strains. This species has been designated as a Species of Greatest Conservation Need in New York.

Allegheny (1,2,3). The Brook Trout is the only native salmonid species in this watershed. In surveys during the 1930s, Brook Trout were collected from 36 streams in the eastern basin and 17 streams in the central basin (Greeley 1938). Greeley's (1938) account is astute in its assessment of the status of this fish. Because of massive environmental change (deforestation, removal of riparian vegetation, high runoff) and overfishing, particularly of large individuals, Brook Trout had become limited to extreme headwaters and, by the 1930s, had a significantly reduced range in the watershed. In recent decades, stocking of various hatchery strains has also affected native stocks, and Perkins et al. (1995) noted genetic distinctions among the streams of the watershed. In the last three decades, Brook Trout have been caught in 57 streams in the eastern basin but only eight streams in the central (Conewango Creek) basin.

Erie-Niagara (1,2,3). This species was found in cool-water, upland sites (Greeley 1929) and was caught in 23 streams or 28% of the sites sampled during the 1928 watershed survey (Greeley 1929). Nineteen of these sites were in Cattaraugus Creek or its tributaries. Greeley (1929) suggested that the range and abundance of this species had declined from historic highs due to its

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popularity as a sport fish even though its numbers in the watershed had been enhanced by stocking. Brook Trout populations have continued to decline in recent times. Brook Trout are still stocked in many headwater streams of the watershed, and the species' range has declined very little.

Ontario (1,2,3). Several early collections attest to the historical presence of this species at lowland sites, including specimens from Mumford in 1867 (MCZ 25672) and North Rose in 1907 (CUMV 7834). Greeley (1940) documented Brook Trout in spring-fed streams throughout the watershed and in cooler, headwater streams, with the Salmon River system, particularly upstream of the Redfield Reservoir, yielding most of the watershed survey catches. Brook Trout were present in 68 of the streams (38% of samples) surveyed in the 1930s, with only four of these streams being outside the upland Tug Hill region. Surveys conducted between 1985 and 2002 suggest that its range in the watershed has been reduced, as Brook Trout were found in only 20 streams or 27% of the samples taken, all of which were in the Tug Hill region.

Genesee (1,2,3). Turner (1851) reported that Brook Trout were abundant in the region. Because of the hatchery at Caledonia (founded in 1864), there are several early specimens from this watershed, including specimens from 1878 (e.g., USNM 20986) and from 1896 and 1898 (e.g., AMNH 616, 612 respectively). Greeley (1927) listed the species as common at suitable sites, but these sites were confined to small, mostly headwater streams. The limited range of the species in this watershed has not changed in recent decades.

Oswego (1,2,3). Early specimens from Ithaca in 1884 (CUMV 498) and Auburn in 1909 (CUMV 2931) document the presence of Brook Trout in this watershed. Greeley (1928) noted that this species was common in the coldest streams and cold ponds. It remains abundant and widely distributed in this watershed.

Black (1,2,3). Greeley and Bishop (1932) ranked this species as common in the Adirondack portion of the watershed, reporting collections from 67 localities and an additional 15 anecdotal accounts. They (Greeley and Bishop 1932) cautioned, however, that Brook Trout had already become scarce in many of the lakes where they were historically present. Heritage Strains exist in two ponds, Horn Lake and Windfall Pond (Perkins et al. 1995). Hatchery fish are extensively stocked in the upland lakes and streams of this watershed to maintain the sport fishery.

Saint Lawrence (1,2,3). Greeley and Greene (1931) gave the following assessment of this species: "Common in streams, ponds and lakes of the Adirondack area of the watershed, where it is both the most common and most highly regarded of the game fishes. Since this species cannot exist in waters which reach a high temperature, it has disappeared from many streams following cutting off of timber cover. In many ponds the brook trout has entirely disappeared following the introduction of perch, pickerel or bass (the three combined or any one of them)...Extensive plantings of hatchery fish have been a large factor in keeping up its numbers." This account nicely sums up the general history of this fish in New York: it is immensely popular; its range is limited by environmental constraints; its range and abundance have been compromised by environmental degradation, introduction of exotic species, and overfishing; and its numbers have been enhanced by stocking. Little has changed in the past eight decades. Brook Trout continue to be found throughout the uplands of this watershed, and populations are supplemented by extensive annual stocking.

Oswegatchie (1,2,3). The Brook Trout was the most common game fish found in the 1931 survey of this watershed, with individuals taken at 29 sites and reported from five more (Greeley and Bishop 1932). New fish are stocked annually in many of the streams and lakes in this watershed, which accounts for the relative stability of the range and frequency of occurrence of the species.

Raquette (1,2,3). Greeley's (1934) account for this watershed mirrors that listed for other Adirondack systems: Brook Trout were common and widely distributed throughout the watershed (except at lowland sites) and were probably the most frequently encountered trout, but had been exterminated in many of the larger streams and lakes within the preceding 50 years due to, among other things, the introduction of "perch, bass, northern pike and walleyed pike." During the 1933 survey, this species was present at 49 stream and 53 lake sites. It remains the preferred trout in the system and is stocked extensively.

Champlain (1,2,3). This species was common in suitable cold streams and ponds throughout the region during the 1929 survey (Greeley 1930). Brook Trout occur in many Adirondack ponds, and populations are maintained by wild reproduction in about 12% of these (Gallagher and Baker 1990). There is also an extensive annual stocking program.

Chemung (1,2,3). Greeley (1938) reported that the Brook Trout was limited to headwaters because of environmental degradation at lowland sites and was represented at just over 1% of the sites sampled. This species was caught in over 40 (mostly headwater) streams during surveys conducted after 1986. The upper Cohocton River provides a high-quality fishery.

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Susquehanna (1,2,3). Greeley (1936) listed this species as common in headwater areas, but he noted that populations had declined due to both environmental change and the introduction of Brown Trout. During stream sampling over the last 15 years, Brook Trout were collected from 47 waters. The species remains relatively common and is stocked throughout the watershed.

Delaware (1,2,3). The oldest specimen known from this watershed is an 1871 collection from Fallsburg, in the Neversink River basin (MCZ 7044). The species had already declined in this watershed by the time of the 1935 watershed survey, although it remained common, particularly in upland sites, and was the eleventh most frequently encountered species (Greeley 1936). This species continues to be caught frequently throughout the region, although acid precipitation led to loss of nursery habitat and a reduction in its range. The Tunis Lake population is a heritage strain, and it has been stocked in several other ponds to increase the chances of its survival. Brown Trout x Brook Trout hybrids were caught in the Beaver Kill and Shin Creek in 2001.

Upper Hudson (1,2,3). Greeley and Bishop (1933) described this species as the most commonly caught game fish in the watershed, where it was found at 109 localities in cold-water streams and lakes. Brook Trout continue to be common in the area, with enhancement from annual stocking.

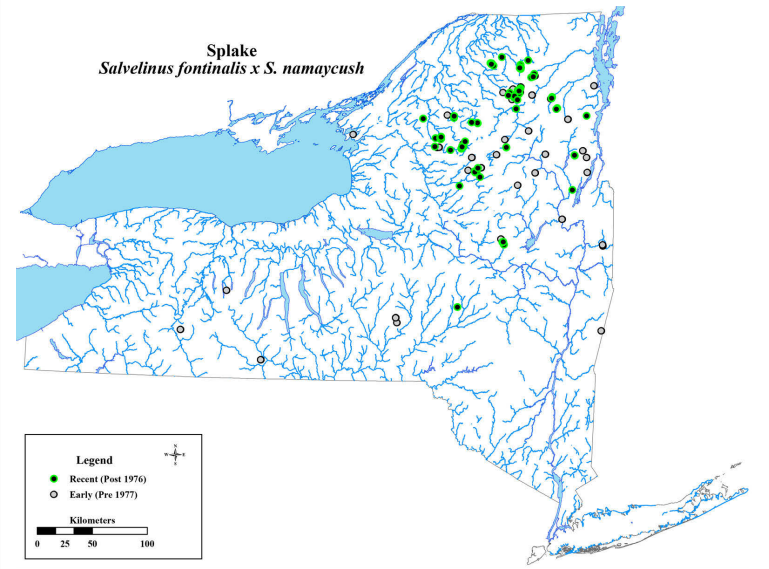
Mohawk (1,2,3). This was the most widely distributed game fish in the watershed during the 1934 survey and was the dominant species in upland lakes and streams, although its range was decreasing due to the degradation of suitable habitat (Greeley 1935). Brook Trout nonetheless remain common and widespread at upland sites.

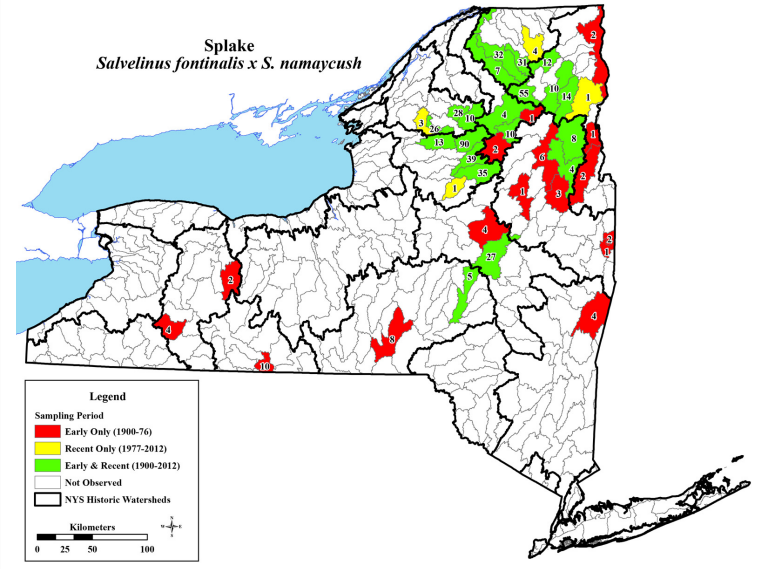
Lower Hudson (1,2,3). Mearns (1898) reported Brook Trout from brooks, ponds, and in the main channel of the Hudson River. Greeley (1937) listed this species as common, being present in spring-fed or headwater streams but absent from most lakes, ponds, and large streams. He (Greeley 1937) also reported that the species was present at 50 sites and that it was extremely rare in the Hudson River's main channel. This trout remains common in Catskill streams and is still also present at other sites in the watershed.

Newark Bay (1,2,3). Brook Trout have been reported from several sites, including the Ringwood River, Stony Brook, and Torne Brook.

Long Island (1,2,3). In 1878, a specimen was collected at Ridgewood (USNM 20950), and another was taken from Cold Spring Harbor in 1898 (AMNH 666). Brook Trout were common during the watershed survey, with records from the less densely populated Suffolk County (Greeley 1939a). Several specimens were taken from brackish water as well. Although there is some natural recruitment, the island sport fishery is largely supported by stocking. Several specimens were collected from the Mianus River in the 2000s (e.g., NYSM 64386). Kozlowski (2001) described the Mud Creek population as a heritage strain. Panek (1983) documented that 90% of trout stream habitat had been lost across all of Long Island after the late 1930s, largely due to increased urbanization. The basins that lost the least amount of trout habitat included the Carmans, Connetquot, and Nissequogue rivers (C. Guthrie, NYSDEC, Stony Brook, pers. comm.).

Salvelinus fontinalis x Salvelinus namaycush, Splake





This hatchery-created hybrid is stocked in cold lakes to support sport fishing. Stocking programs began in 1953 (Deuel 1958), and fish have since been stocked in 12 watersheds within the state.

Ontario (**2**). This hybrid has been reported only once in this watershed, from Chaumont Bay in 1972 (Christie and Thomas 1981). Stocking of Splake in Lake Ontario was discontinued, and Crossman and VanMeter (1979) provide a summary of all stocking records of this hybrid in Lake Ontario.

Genesee (**2**). The first record from this watershed was in 1964, from Allen Pond, with a later capture in Canadice Lake in 1966. Stocking programs have been discontinued in this watershed.

Black (**2,3**). Splake have been stocked in ten upland lakes, with many catches reported after 1954.

Saint Lawrence (**2,3**). Early stocking programs, which began in 1962, maintained fisheries in nine lakes east of the mouth of the Raquette River. Currently, Splake are stocked in Boy Scout Clear and Debar ponds, Lake Ozonia, and Meacham Lake.

Oswegatchie (**2,3**). Stocking in this watershed began in 1963, and annual stocking maintains fisheries in several ponds, including Long, Long Level, Darning Needle, and Twin ponds.

Raquette (**2,3**). Beginning in 1963 and continuing into the 1970s, Splake were present in Lake Eaton, Moose, Panther, South, and Lower Sargent Ponds. Individuals were still found in Panther Pond in 1983 and South Pond in 1993.

Champlain (**2,3**). Splake were first stocked in this watershed in 1957. In the 1960s, records were obtained from about 20 ponds, but the only recent records are from Connery Pond in 1992 and West Pine Pond in 2009.

Chemung (**2**). This hybrid was stocked in Erwin Pond, but the only catch records are from 1963-64.

Susquehanna (**2**). From 1963-1978, Arnold and Bowman lakes were stocked, and catch records exist through 1978 from both lakes as well as Bowman Creek.

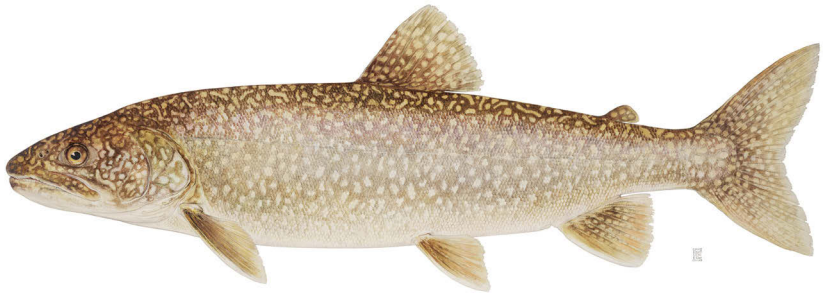
Species continued on next page

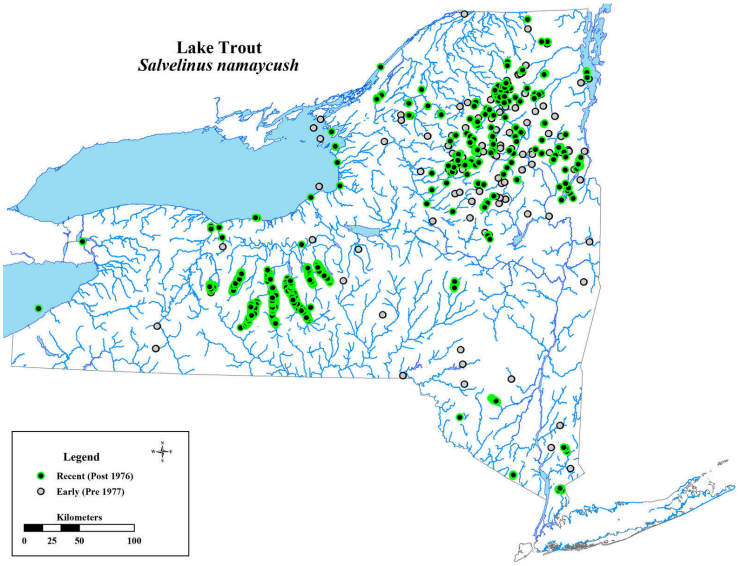
Upper Hudson (**2,3**). Stocking of Splake began in this watershed in 1963. Individuals have been caught in Eagle Lake in the 1970s and Goose Pond in 1987 and 2006.

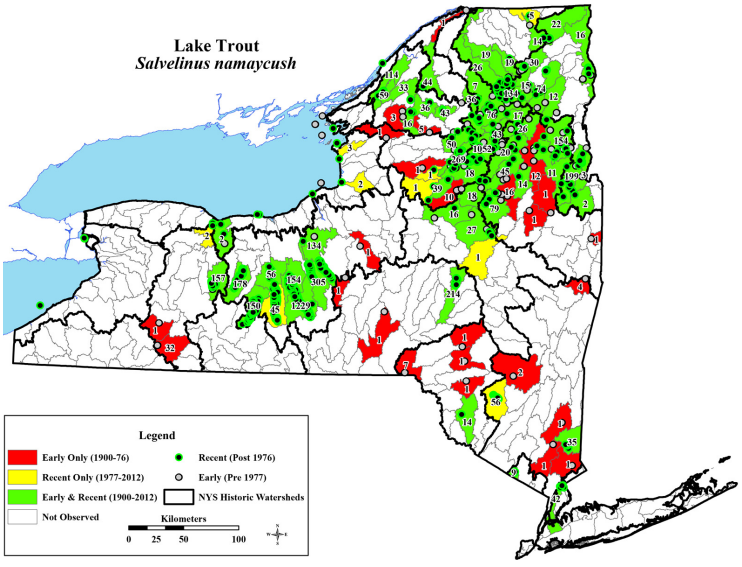
Mohawk (**2,3**). Splake were first stocked in this watershed in 1966 and have been caught in Canada Lake in 1972, East Caroga Lake in 1989, and West Caroga Lake in 2004.

Lower Hudson (**2**). The only known records for this watershed are from Queechy Lake in the 1960s and 1970s, although stocking began in 1964.

Salvelinus namaycush, Lake Trout







This char inhabits cold-water lakes and is frequently stocked to develop or enhance sport fisheries. It is native to 12 New York watersheds, but, because of stocking, populations are genetically mixed. Lake Trout have been regularly stocked in four additional southern watersheds, where the species is not native. An inventory in 1976 (Plosila 1977) showed that this species inhabited 121 lakes, mostly in the Adirondacks. In many lakes, natural reproduction no longer occurs; these fisheries depend on annual stocking to maintain adequate population levels. This species has been designated as a Species of Greatest Conservation Need in New York.

Erie-Niagara (1,2,3). Greeley (1929) reported that Lake Trout were uncommon, restricted to the deep parts of the lake, and commercially unimportant. The species was extirpated by the 1930s due to overfishing and the invasion of the Great Lakes by the Sea Lamprey. Stocking has re-established and maintained the sport fishery in recent years. These programs have experimented with different strains in an effort to find fish that will reproduce in the lake (Ryan et al. 2003; Einhouse et al. 2005).

Ontario (1,2,3). This species was not collected by surveyors in 1939, but Greeley (1940) noted that it was commercially important in the lake. Dymond et al. (1929) reported that the Lake Ontario catch represented 15% of the total Great Lakes catch. Nonetheless, the Lake Trout was extirpated by the 1950s because of overfishing and Sea Lamprey depredations (Schneider et al. 1996). Currently, stocking maintains the fishery, and a variety of strains have been introduced in an effort to develop a self-sustaining population (Perkins et al. 1995; O'Gorman et al. 1998), with limited success (Owens et al. 2003; Mills et al. 2003).

Genesee (1,2,3). An 1880 specimen from Hemlock Lake (USNM 26325) is the earliest record known from this watershed. Greeley (1927) confirmed that Lake Trout were still present in Hemlock Lake with the capture of a young individual and also reported an angler catch from Conesus Lake, where anecdotal reports indicated that the species was rare. Stocking maintains fisheries in Hemlock and Canadice lakes.

Species continued on next page

Oswego (1,2,3). There are a number of early museum records of Lake Trout from the Finger Lakes, including an 1891 fish from Cayuga Lake (CUMV 55725) and an 1899 catch from Seneca Lake (USNM 77866), to list examples. Greeley (1928) listed the species as common but restricted to the deeper Finger Lakes, where it was an important game and market fish. It continues to inhabit the deep lakes, but in-lake reproduction in Cayuga Lake has been problematic, so hatchery fish are regularly stocked.

Black (1,2,3). In 1877, two specimens from Bisby Lake were deposited at the Smithsonian Institution (USNM 17013, 17014). Greeley and Bishop (1932) noted that this species was caught in Woodhull Lake, Big Burnt Lake, South Lake, Big Moose Lake, and in several lakes of the Fulton Chain during the 1931 watershed survey. In recent decades, Lake Trout have been reported from 26 lakes in this watershed, and there are additional records from private ponds of the Adirondack League Club. Many of these lakes are regularly stocked to offset habitat degradation and the effects of introduced species.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that Lake Trout were moderately common in several Adirondack lakes and that specimens were collected from Massawepie, Meacham, and Chateaugay lakes. They (Greeley and Greene 1931) added: “This species was formerly second only to the brook trout as a game fish but it has now become extinct in several lakes which once supported it in large numbers (notably Lake Ozonia).” Greeley (1934) later conceded that specimens were found in the main stem Saint Lawrence River but relegated them to stray status. The recent status of this species in the watershed is less robust. Pfeiffer (1979) listed few Adirondack waters with wild populations, but among them were Massawepie and Upper Saint Regis lakes as well as Saint Regis and Big Fish ponds. Lake Trout populations are maintained by hatchery stocks in all other areas of the watershed where they occur.

Oswegatchie (1,2,3). Greeley and Bishop (1932) recorded this species from Millsite and Star lakes. It still inhabits Millsite Lake, which is among the few lakes where natural reproduction is successful enough to sustain the fishery without supplemental stocking of hatchery fish. In contrast, natural reproduction in Lake Bonaparte has diminished in the last few decades and now requires annual stocking to support the sport fishery. Long and Portaferry lakes also supported strong Lake Trout fisheries (Pfeiffer 1979), although the Portaferry Lake fishery has diminished recently.

Raquette (1,2,3). The earliest specimen recorded from this watershed was from Raquette Lake in 1877 (USNM 17012). Watershed survey specimens were taken from Blue Mountain, Raquette, Eaton, Sagamore, Wolf, Mohegan, Madeleine, and Robin lakes as well as from Lower Sargent and South ponds (Greeley 1934). Lake Trout are still common in cold-water lakes in this watershed. Annual egg-take operations in Raquette Lake are the main source for propagating fingerlings for stocking throughout northern New York (Plosila 1977b) even though this population is not self-sustaining (Plosila 1977a).

Champlain (1,2,3). Greeley (1930) reported that this species was moderately common in deep lakes, including Lake George, Lake Placid, and Upper Saranac and Chazy lakes. He (Greeley 1930) went on to note that it was historically present in Lake Champlain but was apparently extirpated, perhaps due to the over-harvest of spawning individuals by local residents in the 19th century. Plosila and Anderson (1985) concluded that the Lake Trout had been extirpated from the lake by the mid-1900s, whereas the Strategic Plan for Lake Champlain Fisheries (USFWS 2008) identified 1900 as the final year that Lake Trout were present. Recently, stocking has been used to re-establish a fishery in the lake. New York stocks a Finger Lakes strain, and Vermont stocks fingerlings from eggs taken from Lake Champlain. Ellrott and Marsden (2004) documented spawning and successful hatches in Lake Champlain, but there appears to be no or very limited (0.5-1%) natural recruitment (Marsden and Langdon 2012). Sea Lamprey have caused high Lake Trout mortality in Lake Champlain, with lamprey control programs being initiated in the 1980s. Lake Trout inhabit many Adirondack ponds, where over 80% of populations are maintained by natural reproduction (Gallagher and Baker 1990).

Susquehanna (1,2,3). Greeley (1936), based on DeKay (1842), regarded Lake Trout as native to this watershed but noted that the 1935 watershed survey only caught them in Otsego Lake, where eggs and fry were also observed. Otsego Lake remains the only place in the watershed where this species occurs, and spawning has been documented in recent years at a few locations (Sanford 1984; Tibbits 2005).

Delaware (**1,2,3**). Watershed survey specimens were taken from Oquaga Lake, and there were anecdotal reports of this species’ presence in Perch Lake and Lake Delaware (Greeley 1936). Lake Trout were present in Oquaga Lake from 1935 to at least 1962 and in White Lake to 1983. Annual stocking continues in White Lake, but we have found no records of recent catches.

Species continued on next page

Upper Hudson (1,2,3). Greeley and Bishop (1933) listed this species as moderately common in Adirondack lakes with deep, cold water, including Piseco, Pleasant, Sacandaga, Gilman, Faun, Newcomb, Schroon, and Paradox lakes, as well as Upper and Lower Dug Mountain, Bigsby, and Sand ponds, with additional angler reports from Thirteenth Lake and Lower Siamese Pond. In recent years, most of this watershed's Lake Trout populations, with the exception of a few waters, are sustained by stocking because natural reproduction is not adequate.

Mohawk (1,2,3). This species was uncommon in this watershed during the 1934 survey, with only four individuals total being taken from Canada, West Canada, and Green lakes, although it also was reported to inhabit Big Rock, Nine Corner, Spruce, and Long lakes (Greeley 1935). The recent status of Lake Trout in the watershed is basically unchanged, with populations, which have been augmented through stocking efforts, being present in several lakes.

Lower Hudson (**1,2,3**). In the 1936 watershed survey, specimens were taken from Lake Iglead and Lake Gleneida and were also reported from Sylvan Lake (Greeley 1937). There are recent records from these three lakes as well as from the Rondout and West Branch reservoirs. These fisheries are all dependent on annual stocking.

Newark Bay (**1,3**). Lake Trout inhabit Sterling Lake, where the fishery is maintained by annual stocking.

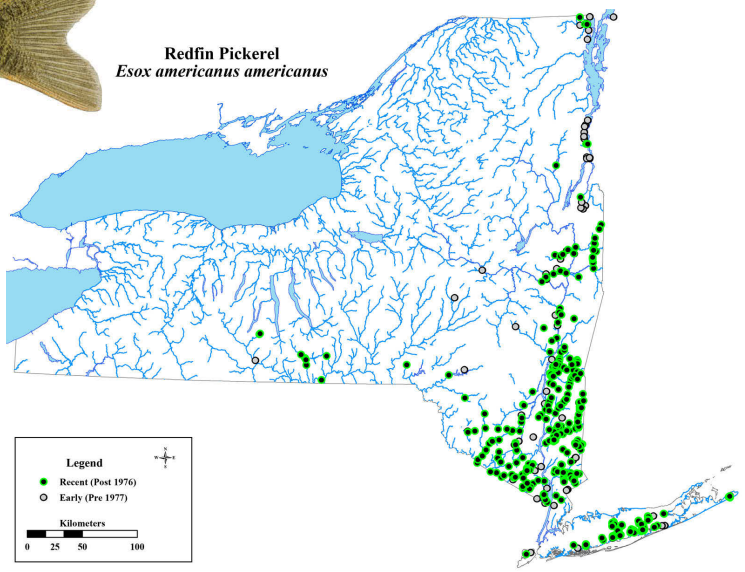
Long Island (**1,2,3**). Greeley (1937) reported this species from the Kensico Reservoir, where it was and continues to be stocked. Lake Trout have not been found elsewhere in this watershed.

Esocidae, Pikes and Mudminnows

Four species of pike, all in the genus *Esox*, are native to New York and are found in most of the state's watersheds although the distribution of each has been enhanced by successful introductions into new lakes and river systems. Due to its continental range, one of these species, *Esox americanus*, is typically treated at the subspecies level, and we follow that convention here. We also include information on a sterile hybrid that has been widely stocked in the state. All of the species in this genus are relatively abundant in New York and typically live in slow-water streams, lakes, and ponds, in close proximity to aquatic vegetation.

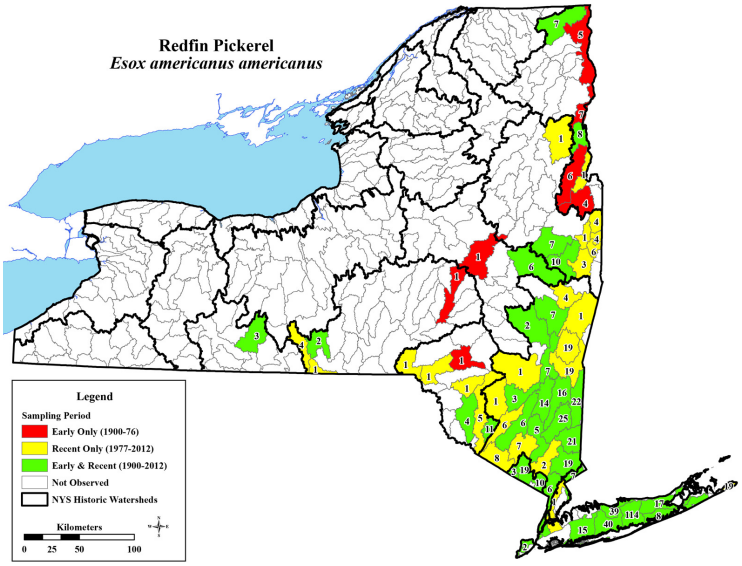
Two species of mudminnow inhabit stagnant or slow-water, weedy streams, marshes, and ponds in New York. One species is found on Long Island, other coastal streams, and in the lower tributaries of the Hudson River. The other species is native to western and northern New York but has steadily expanded its range into the southeastern and upland areas of the state over the last two centuries, recently arriving in the Hudson River drainage. Neither species is rare.

Esox americanus americanus, Redfin Pickerel



This relatively small pike lives in lowland streams, bays, and ponds with thick vegetation. The species is known from eight Atlantic slope watersheds and the Champlain watershed. Its range does not overlap with the range of its conspecific, the Grass Pickerel, which is discussed in the following account. The Redfin Pickerel is likely non-native to the few higher-elevation waters of the Adirondacks where it has been caught, and its status in the Champlain watershed remains uncertain.

Champlain (**1,2,3**). Greeley (1930) listed this species as moderately common in Lake Champlain and the lower courses of its weedier tributaries. He (Greeley 1930) also noted that it occurred upstream of falls in the Great Chazy, Little Chazy, and Mettawee basins. The watershed survey specimens were identified as *E. vermiculatus*, however, which is now the name for the western subspecies. After re-examination, we can confirm that these specimens are, in fact, the eastern subspecies. Recent records from the Great Chazy and Mettawee basins, Mount Hope Brook (NYSM 15556), and Putnam Creek (NYSM 57470) show that the distribution of this fish has not changed substantially in the last nine decades. The status of this subspecies in the Lake Champlain watershed is controversial, however. Bean (1903) did not list it as present in this watershed. Scott and



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Crossman (1973), based on its gradual range expansion north into Quebec (documented by Lachance (2001)), regarded it as not native. Carlson and Daniels (2004) and USFWS (2008) also treat this subspecies as non-native. Facey and LaBar (1989) reported that in Vermont, this pike was present at intermediate elevations in the Castleton River of the Poultney system. Richard Langdon (Vermont Fish and Game, pers. comm.) noted that the earliest Vermont records were from lakes at these intermediate elevations, which could have served as refugia. Langdon et al. (2006) and Marsden and Langdon (2012) treat the Redfin Pickerel as native, likely using this reasoning. April et al. (2013) also regards this species as native in this watershed. This presumes a somewhat less parsimonious scenario than a simple range expansion, however, in which the Redfin Pickerel was an early entrant into the Champlain watershed, was extirpated from Lake Champlain but survived in the upland ponds and then recolonized the lake at some point after Bean's (1903) assessment.

Chemung (2,3). The lack of early records from this watershed (and the following one) is surprising, given that the Redfin Pickerel is native to the Susquehanna River drainage. Although the species is widely distributed in the downriver portion of this drainage (Lee et al. 1980), its rarity in the New York portion might be related to weak dispersal ability or inadequate dispersal corridors, as suitable habitat appears to be available (and even abundant) in New York. Two specimens were caught in Meads Creek in 1944 (CUMV 53663), and additional individuals were caught in Lamoka Lake in 1978 (Green et al. 1996) and 2004.

Susquehanna (1,2,3). In 1937, several specimens were caught in Cayuta Creek (NYSM 13294). Redfin Pickerel were present in Otsego Lake prior to 1960 (J. New, SUNY Oneonta, pers. comm.), but this population was previously attributed to *E. a. vermiculatus* and no specimens were vouchered. This subspecies has recently been recorded from Cayuta Creek and the Susquehanna River.

Delaware (1,2,3). Greeley (1936) noted that Redfin Pickerel were only found in the Basher Kill during the 1935 watershed survey. Recent survey work has shown that this subspecies remains in the Basher Kill (NYSM 46031) and is now also found in the Swinging Bridge Reservoir, Tremper Kill, Lake Beaver Kill, Gold Creek, and the Neversink River. (R. Horwitz, ANSP, pers. comm.).

Upper Hudson (1,2,3). Greeley and Bishop (1933) reported that the Redfin Pickerel was moderately common in weedy streams downstream of Hudson Falls, and it was also present in the main channel of the upper Hudson River. Recent catches indicate that this pike remains present and widely distributed in streams and ponds throughout the watershed. It has been found in Schroon Lake in 1992 (NYSM 41891), a pond near Dwaas Kill in 1995 (NYSM 44182), and the Owl Kill in 2000, as well as at several lower elevation locations during a 2008 survey.

Mohawk (1,2,3). Greeley (1935) noted only a single record from this watershed during the 1934 survey: "... all but one of the 26 collections are from the Hudson River or direct tributaries. One individual was taken in Alplaus Creek but the species does not seem to have reached far up the Mohawk." Recent collections exist from the Alplaus Kill and its tributary, Indian Kill, as well as a nearby unnamed tributary of the Mohawk River.

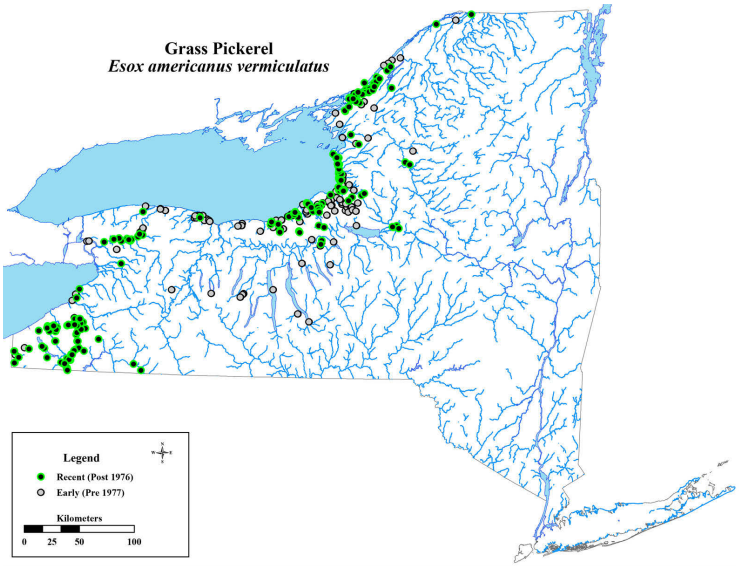
Lower Hudson (1,2,3). The oldest known specimen from this watershed is a Spencer F. Baird fish from the Hudson River at Sing Sing (now Ossining), collected in 1854 (USNM 7106). Greeley (1937) recorded this subspecies as common and noted that it was caught at 155 sites throughout the watershed but was absent from rocky headwater streams. He (Greeley 1937) also noted that this was primarily a creek fish, eschewing larger waters unless abundant aquatic vegetation was present. Earlier records, such as two from 1913 (NYSM 1876, 11678), suggest that it might have been more common in the main channel historically, however. Redfin Pickerel remain common in this watershed, and the species has expanded its range to tributaries in the northern counties of the watershed.

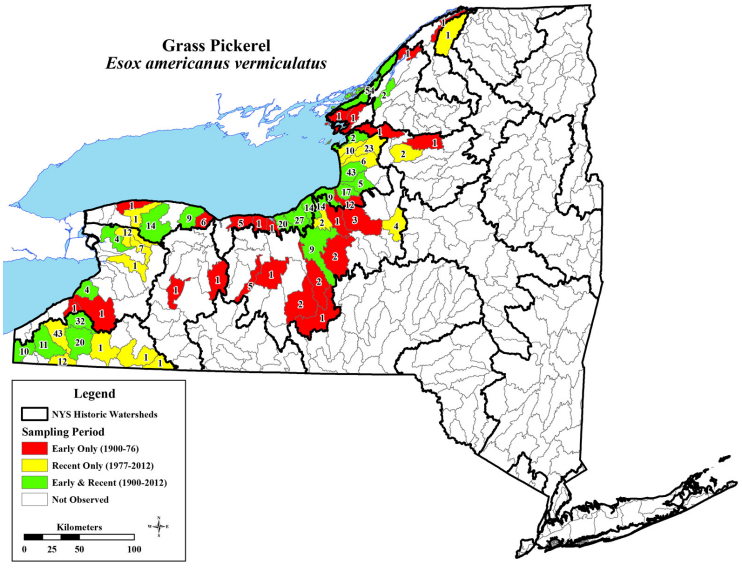
Newark Bay (1,2,3). Several specimens were caught in the Hackensack (e.g., NYSM 1497) and Mahwah (NYSM 1831) rivers and in Greenwood Lake (NYSM 1789) during the 1936 survey. More recent records indicate that Redfin Pickerel continue to be found in both rivers (e.g., AMNH 38676) as well as in Little Dam Pond (NYSM 48311), Greenwood Lake (AMNH 45624), and the Ramapo River.

Long Island (1,2,3). Bean (1902) found this subspecies at several sites on Long Island during his late 19th-century survey (e.g., USNM 49065, 35968). Greeley (1939a) described this fish as common and widely distributed in streams and ponds during the 1938 watershed survey, with 32 Suffolk County and 11 Nassau County records. Redfin Pickerel were also present in Willow Brook and Clove Lake on Staten Island (Greeley 1939a) and in most of the streams draining into Long Island Sound in Westchester County (Greeley 1937). This pickerel remains common throughout the watershed. An *Esox americanus* X *Esox niger* hybrid specimen has also been found in this watershed (NYSM 1756).

Esox americanus vermiculatus, Grass Pickerel

This subspecies is similar to its conspecific in that it occurs in lowland streams, bays, and ponds with thick vegetation. This is a western subspecies, and there are records from eight Great Lakes watersheds as well as the Allegheny watershed. The Grass Pickerel no longer occurs in the Genesee and southern part of the Oswego watersheds.





Allegheny (2,3). Fowler (1907, 1919) reported that Grass Pickerel inhabited the Allegheny River system upstream of the New York state line. The earliest New York record is a 1964 capture from Conewango Creek headwaters. During a 2005-06 survey of the Conewango Creek system, this subspecies was present at 19% of the sites sampled. In the last three decades, it has been found at a few sites in the eastern basin, such as Oswayo Creek (NYSM 58665), as well as in French Creek (NYSM 67749).

Erie-Niagara (1,2,3). Greeley (1929) listed Grass Pickerel as common and present in the Niagara River, sluggish streams, and in the mouths of Lake Erie tributaries. There is a long record of captures dating to the present from Tonawanda Creek and its tributaries, Little Sister Creek (AMNH 45997), Muddy Creek, and the Niagara River.

Ontario (1,2,3). An 1894 specimen was collected from Sodus Bay (USNM 63669), and Wright (2006) collected additional early specimens from North and Buttonwood creeks in the early 1900s. Greeley (1940) stated that this was a “fish which thrives in swamps, the little pickerel was found to be present in many bays and sluggish streams over a wide range of territory exclusive of higher elevation areas.” Grass Pickerel were collected at 61 sites during the 1939 survey and continue to be found at the sites where they have historically been present.

Genesee (1,2). Grass Pickerel were caught in Hemlock Lake in 1880 (USNM 26320) and Black Creek in 1894 (USNM 174815). Greeley (1927) did not report any collections during the synoptic survey of 1926, and the most recent report was from Silver Lake in 1973.

Species continued on next page

Oswego (1,2,3). Greeley (1928) reported that this subspecies was not uncommon in this watershed but that its range was limited to the low-velocity weedy streams of the northern part of the watershed and Cross Lake. It was also present (but rare) in the deep lakes of the southern part of the watershed as evidenced by an 1899 specimen from Seneca Lake (USNM 77863). The few recent collections are from the northeastern part of the watershed, and there are no recent records from southern historical capture sites.

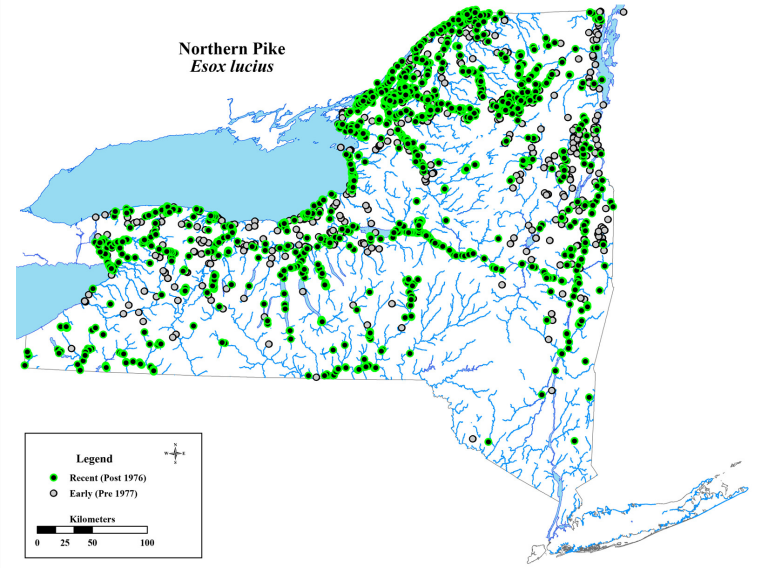
Black (1,2,3). The earliest record from the Black River was in 1894 at Huntingtonville (USNM 125685). Greeley and Bishop (1932) listed this pickerel as moderately common at lowland sites, where it was collected from stream mouths but not from the larger waters. The most recent authenticated record was from a site near Lowville in 1992. In 1965, Grass Pickerel were recorded from Black Creek, a tributary of the Beaver River, and in 1966, one was reported from Catspaw Lake. Both reports were initially assumed to be misidentifications, but, with the 1992 capture verified, we now regard the two 1960s reports as valid. These three sites are all upland; the current status of this subspecies at historical lowland collection sites is unknown.

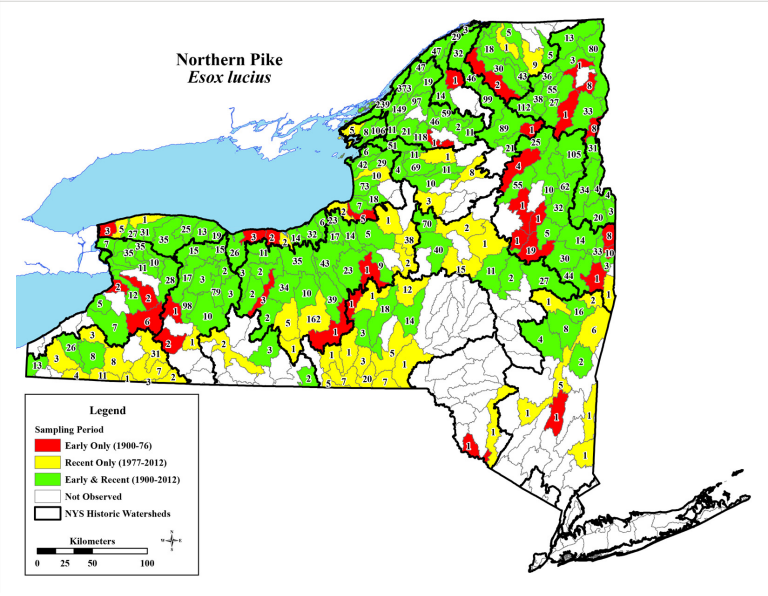
Saint Lawrence (1,2,3). Neither Bean (1903) nor Greeley and Greene (1931) reported the presence of this subspecies in this watershed, although Greeley and Bishop (1932) did note that it was present in stream mouths of Saint Lawrence tributaries. The few recent records are from the main stem Saint Lawrence River and the lower reaches of its tributaries.

Oswegatchie (2,3). Greeley and Bishop (1932) specifically noted the absence of Grass Pickerel from this watershed. Only two records are known: one from Black Creek in 1951 and the other from Pleasant Lake in 2005.

Raquette (3). Two records, one from the mouth of the Raquette River in 1988 (Sloan and Jock 1990) and the other from the same area in 2004 (J. McKenna USGS, Cortland, pers. comm.), are the only known reports of Grass Pickerel in this watershed.

Esox lucius, Northern Pike





This important game fish inhabits lakes and large rivers with associated wetlands and submerged aquatic vegetation. The species is native to the Great Lakes watersheds but has also been introduced to the Allegheny and Atlantic slope watersheds and is continuing to expand its range to lakes at higher elevations of the Adirondacks. At present, it remains absent only from Long Island and Newark Bay.

Allegheny (**2,3**). Northern Pike were first stocked in the Allegheny Reservoir in 1968 and were commonly caught in the Allegheny River upstream of the reservoir by the late 1970s. By the mid-1970s, this species was present in all three basins in the watershed. Anecdotal reports from anglers indicate its presence in French Creek at the state line. In the Conewango Creek basin, a specimen was taken from Cassadaga Creek in 1989 (NYSM 40438), with additional collections from 4% of the sites sampled during surveys in 2004 and 2005. In the eastern basin, individuals have been found in Tunungwant Creek. Northern Pike also occur in Chautauqua, Cassadaga, Cuba, and Findley lakes in addition to the main channel of the Allegheny River.

Erie-Niagara (1,2,3). Greeley (1929) noted that this species was common in large, weedy streams but was rare in the lake itself, except at the mouths of tributaries. Watershed survey specimens were taken at Little Sister, Cayuga, and Rush creeks in the Lake Erie basin and from Tonawanda Creek and the Erie Canal in the Niagara River basin. The status of this species in the watershed is unchanged, and the upper Niagara River continues to support a popular sport fishery.

Ontario (1,2,3). USNM 174816 is a specimen taken from the eastern end of Lake Ontario on 29 October 1800, clearly one of the earliest extant ichthyological specimens from the state. Wright (2006) noted that Northern Pike were common in ponds and sluggish streams and that stocking, presumably to supplement the already popular fishery, began in the early 1890s. Greeley (1940) praised this game fish and the fishery in this watershed, where individuals were collected at 73 sites in Lake Ontario bays as well as from many ponds and streams. These collections included both young and adult fish, suggesting a strong population. The species remains widely distributed in this watershed and continues to support an important sport fishery.

Species continued on next page

Genesee (1,2,3). Greeley (1927) reported that this species was locally common and was found in "Silver lake, Conesus Lake, Genesee river about 10 miles south of Rochester, Black creek (Monroe Co.). Reported by fishermen north of Rochester to run up from Lake Ontario to spawn in marshes along the lower river. 'There was no pickerel or pike above Genesee Falls, until 1810 when William Wadsworth and some others caught pickerel in Lake Ontario and other Lake fish and put them into Conesus Lake.' (Turner, 1851, p. 375)." It is not clear from this description whether Northern Pike were introduced into Conesus Lake, but Wright (2006) listed stocking records for Northern Pike in the Genesee River above the rapids, i.e., Rochester Falls, in the 1870s and 1880s. The status of the species in this watershed is unchanged.

Oswego (1,2,3). Greeley (1928) reported that Northern Pike were common in lakes, rivers, and larger streams and that the fishery was particularly important in Cayuga Lake [the oldest specimen from this lake is from 1885 (CUMV 848)] and the Seneca and Oswego rivers. The species continues to be found throughout the watershed.

Black (1,2,3). Northern Pike were common in lowland lakes and the lower reaches of the Black River during the 1931 watershed survey but had not yet been introduced into any Adirondack lakes (Greeley and Bishop 1932). In recent decades, this species has gained access to some upland lakes, such as the Fulton Chain. Nonetheless, it is now under pressure from an expansion of the range and abundance of Chain Pickerel in this watershed, a problem which is compounded by the lack of typical spawning and nursery areas in the middle section of the river (with the exception of the vast woody marsh at the mouth of the Independence River).

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that "in the St. Lawrence River and lower waters of entering streams, the northern pike is a native fish and is rather numerous." They (Greeley and Greene 1931) went on to note that the species was not native to upland waters and to examine the effect of introductions into these waters, stating: "The northern pike was not native in the waters of the Adirondacks but has been introduced into many lakes, mostly by private enterprise. By destroying other fishes in such waters it has done great harm, particularly to brook trout fishing." In recent decades, Northern Pike have continued to be widely distributed in the main channel, lowland lakes, and streams and are now common in some Adirondack lakes.

Oswegatchie (1,2,3). Greeley and Bishop (1932) noted that this species was common and widely distributed, mainly in bays, creek mouths, and lowland lakes, but was not found in Adirondack lakes. It remains common in low-elevation streams and lakes but has also become established in upland areas, such as Cranberry Lake.

Raquette (1,2,3). Mather (1886) reported that the Northern Pike was introduced into Long Lake between 1860 and 1863; the earliest specimen from this lake is USNM 32773, from 1882. By 1933, the species was present in the main channel downstream of Buttermilk Falls, which is just upstream of Long Lake (Greeley 1934). Greeley (1934) went on to note that an "epoch of pike fishing supplanted the original trout fishing of an extensive area of lake and river." The arrival of this species eliminated trout fishing between Buttermilk and Hannawa falls, the natural downstream barrier to the suite of fishes present in the lowland lakes and streams. Today, it is widely distributed in the watershed.

Champlain (1,2,3). During the 1929 survey, Northern Pike were frequently encountered in Lake Champlain, Lake George, and many other lakes as well as in the lower stretches of the larger streams (Greeley 1930). The species is native to Lake Champlain and to its tributaries downstream of their first barriers, but by the time of the 1929 survey, this pike had been distributed throughout the watershed, largely by "individual initiative" (Greeley 1930). Northern Pike remain widespread throughout the watershed.

Chemung (**1,2,3**). This species has been reported from the Waverly Reservoir in 1937 and Meads Creek in 1956 as well as from Waneta Lake and the Canisteo and Chemung rivers in the 2000s.

Susquehanna (**2,3**). The earliest record from this watershed is from Deans Pond (Cortland County) in 1959. In the 1960s, Northern Pike were reported from seven waters. In recent decades, this species also has been found in medium-sized and larger rivers throughout the watershed.

Delaware (**1,2**). Northern Pike have been reported from Lake Devenoge in 1935 and Beaverdam Pond in 1980.

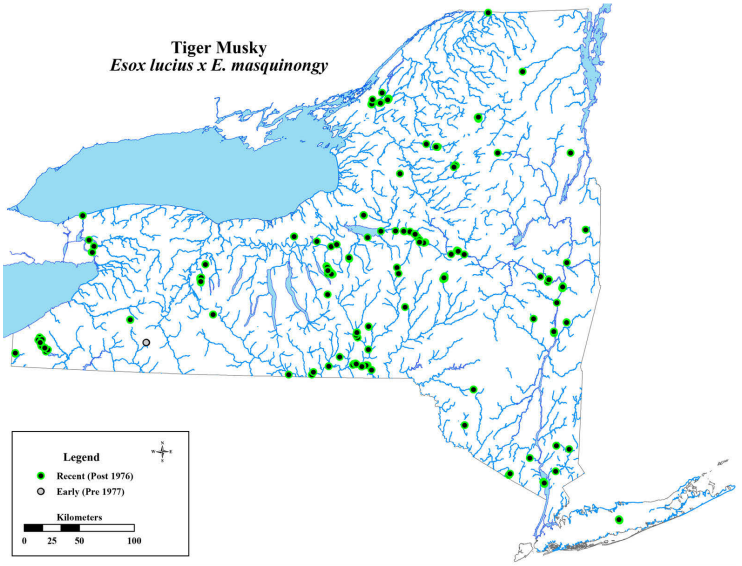
Upper Hudson (**1,2,3**). Greeley and Bishop (1933) reported that this species was common and widely distributed in lakes and larger streams during the 1932 watershed survey. The earliest specimen from Saratoga Lake is from 1921 (NYSM 1635). Another specimen was taken from Saratoga Lake in 1926 (NYSM 1463) and by 1932, Northern Pike were well established in the Sacandaga Reservoir (NYSM 13278) and Lake Luzerne (NYSM 13370). Greeley and Bishop (1933) went on to state that this was the second most frequently encountered warm-water fish in the watershed, a surprising statistic for an exotic species (the most common was the Smallmouth Bass, which is also an introduced species). The results of recent surveys show that this species still inhabits many waters.

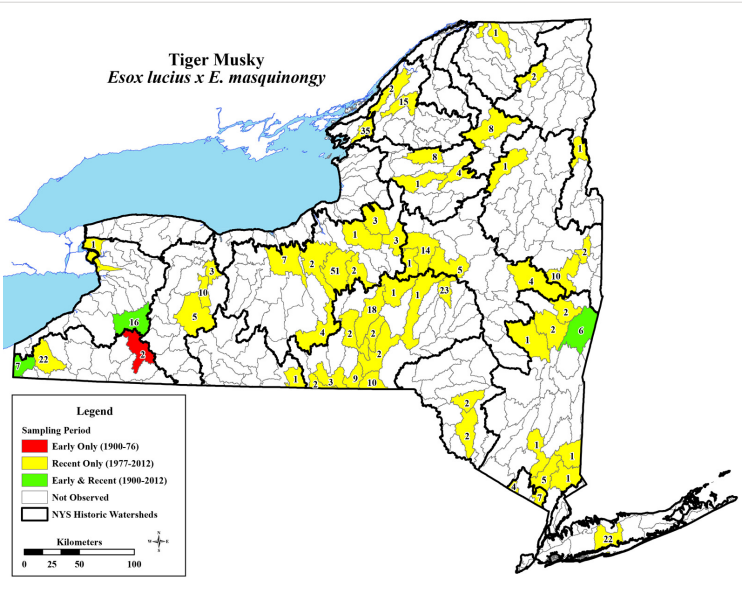
Species continued on next page

Mohawk (**1,2,3**). Despite what was happening in neighboring watersheds, Greeley (1935), perhaps with some surprise, reported that no specimens were collected during the survey of this watershed; Northern Pike were reported by anglers from three lakes in the following year, however. The species now occurs throughout the Mohawk River system, from the mouth (NYSM 69043) to as far upstream as West Leyden. Several lakes in the Adirondacks also have naturalized populations.

Lower Hudson (**1,2,3**). No Northern Pike were caught during the 1936 survey (Greeley 1937), but individuals were reported from the Hudson River and one pond (by anglers). Reports exist from Kinderhook, Copake, and Burden lakes and from the northern half of the Hudson River, including records from Rensselaer County in 1981 (NYSM 59254), Greene County in 1990 (NYSM 32989), and Dutchess County in 2003 (NYSM 55123).

Esox lucius x Esox masquinongy, Tiger Muskellunge





This hybrid has been introduced into many lakes and large rivers since 1967 (Festa 1989). Its favored habitats contain significant vegetation, but larger fish probably move off shore into deeper waters during warmer parts of the year. It has no, or limited, reproductive capabilities. Tiger Muskellunge have been stocked in all of New York's watersheds, with the exception of the Saint Lawrence, but a naturally occurring hybrid has been reported in that watershed.

Allegheny (**2,3**). Stocking of this hybrid in Findley and Cuba lakes began in 1974, and these efforts were among the first in the state. Anglers reported catching Tiger Muskellunge in Chautauqua Lake after 1988.

Erie-Niagara (**2,3**). Tiger Muskellunge have been stocked in Lime Lake since 1974. There are records of natural hybrids from the Niagara River.

Ontario (**3**). Since 1995, this hybrid has been taken from Hyde Lake. The fishery in this lake is maintained by stocking.

Genesee (**3**). Conesus Lake and another small pond near Avon were stocked with Tiger Muskellunge in the 1990s. An unusual report from south of Rochester in the Genesee River and the Erie Canal in 2007 may have been an escapee from one of these waters.

Oswego (**2,3**). This fish is stocked in shallow lakes and, since 1979, has been caught in eight waters, including Otisco, Onondaga, and Duck lakes, Lake Como, and the Erie Canal.

Black (**3**). There have been catches in the Mosher and Soft Maple reservoirs and Third Lake of the Fulton Chain, where this hybrid has been stocked.

Saint Lawrence (**3**). New York State does not stock this hybrid in the Saint Lawrence River. A hybrid specimen was caught in the Salmon River at Fort Covington in 2004, however; this could have been a natural hybrid or a stray from Quebec Province, where Tiger Muskellunge are stocked.

Oswegatchie (**3**). Stocking has occurred in the Indian River lakes since the late 1990s. Successful catches have been reported from Payne, Moon, Clear, and Grass lakes.

Raquette (**3**). Tiger Muskellunge have been stocked in Horseshoe Lake since the late 1980s.

Champlain (**2,3**). Individuals were collected from Buck Pond in 1984 and Putnam Pond in 1997.

Chemung (**3**). The earliest record in this watershed is from Loon Lake in 1990. This hybrid was also reported from the Chemung River in 2003.

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Susquehanna (**2,3**). Tiger Muskellunge have been stocked in Chenango and Canadarago lakes, Long Pond, the Whitney Point Reservoir, and the Chenango and Susquehanna rivers. Catches were reported from Chenango Lake and Long Pond in 1979.

Delaware (**2**). Individuals were caught in Mongaup Pond in 1978 and the Swinging Bridge Reservoir in 1983, both of which were areas where this hybrid form had been stocked. The Tiger Muskellunge stocking program was terminated in both waters in 1982.

Upper Hudson (**3**). Catches have been reported from Cossayuna Lake and Lake Durant since 2002.

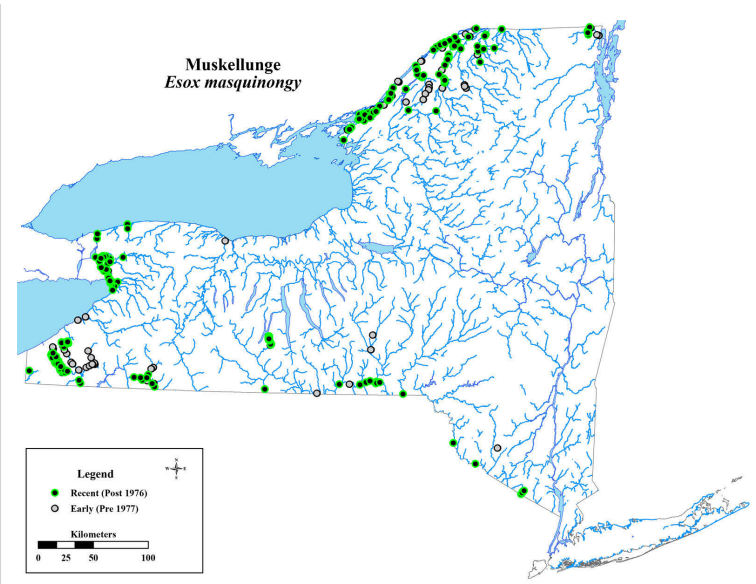
Mohawk (**2,3**). Annual stocking has maintained a fishery in the Mohawk River and Erie Canal since 1984.

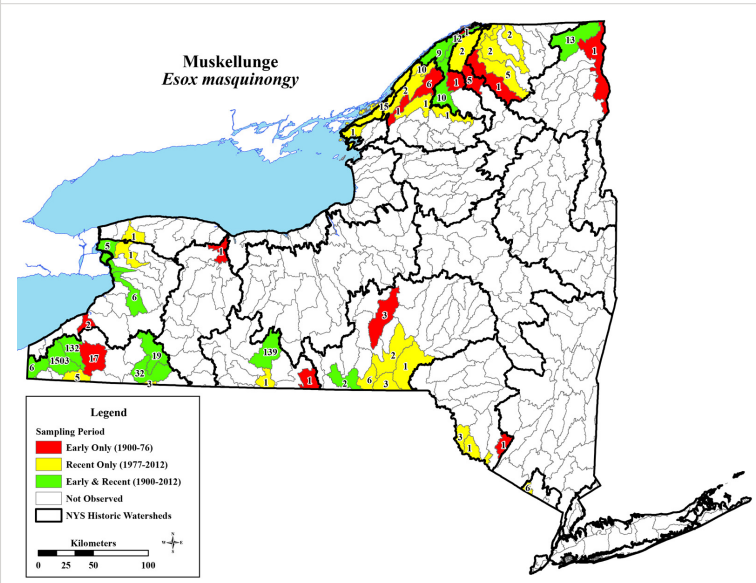
Lower Hudson (**2,3**). Tiger Muskellunge have been caught in at least six waters in recent years, including Kinderhook Lake and the New Croton Reservoir. Hudson River catches since 1982 are presumed to be strays from the Mohawk River.

Newark Bay (**3**). Records come from stocking programs in Rockland and Greenwood lakes from 1990-2003.

Long Island (**2,3**). Tiger Muskellunge were stocked in Lake Ronkonkoma from 1982-1993, and catches have been reported in 1998 and 2004.

Esox masquinongy, Muskellunge





This is the largest of the pikes and an important game fish. Muskellunge are associated with abundant aquatic vegetation in large rivers with moderate current and in cool lakes. The species is native to the Allegheny watershed and the watersheds of the Saint Lawrence River drainage but has been stocked throughout the state and now occurs in a total of 13 watersheds. This species has been designated as a Species of Greatest Conservation Need in New York.

Allegheny (1,2,3). By the time Greeley (1938) was reporting on the 1937 watershed survey, Muskellunge populations were declining in this watershed, although specimens had been taken at 5% of the survey sample sites. He (Greeley 1938) noted that the Chautauqua Lake population was the strongest but that the species was also found in Cassadaga, Bear, and Findley lakes as well as in Cassadaga and Conewango creeks and the Allegheny River. Greeley (1938) attributed this decline to the loss of suitable spawning and/or nursery habitat, which may have been the result of shoreline modifications, loss of riparian vegetation, and land-use practices in the surrounding watershed. Recent surveys have reported Muskellunge from the Allegheny River, Olean, Conewango, and Cassadaga creeks, and Chautauqua Lake. NYSDEC stocks this species in each of these streams, and the USFWS stocks it in the Allegheny Reservoir. Lack of suitable habitat for successful recruitment remains a problem, but catches of young Muskellunge in Conewango Creek in 2012 (NYSM 67816) suggest that, at least in this basin, natural reproduction still occurs.

Erie-Niagara (1,2,3). Lake Erie is the type locality for this species (Smith 1985). It was uncommon in the New York portion of the watershed during the 1928 survey, with catches from the upper Niagara River and Eagle Bay in Lake Erie (Greeley 1929) as well as Cattaraugus Creek (NYSM 38519). Recent records are spotty. Wilkinson (1993) mapped available spawning areas in the Niagara River, and the lower reaches of tributaries on Grand Island, like Spicer and Little Creeks, have been surveyed. Specimens were caught in the Niagara River in 1975 (AMNH 36915) and 2010 (NYSM 66111), lower Cattaraugus Creek in 1976 (W. Hadley, SUNY Buffalo, unpubl. field notes), and Tonawanda Creek in 2000 (NYSM 52174). The fishery in the upper Niagara River and Buffalo Harbor was popular in the early to mid-1990s, but catch rates have declined in subsequent years (Einhouse et al. 2005).

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Ontario (1,3). No Muskellunge were caught during the 1939 survey (Greeley 1940), but earlier catches had been reported (Dymond et al. 1929). Important spawning areas are just outside the boundaries of this watershed, in the Saint Lawrence and Niagara rivers. Fish are regularly caught in the lake, however, primarily in eastern bays near Henderson and Chaumont.

Genesee (1). Seth Green reported that, prior to 1900, Muskellunge were only found in the mouth of the Genesee River (Black 1944). Greeley (1927) stated that this species was introduced into Honeoye and Conesus lakes but also noted that no specimens were caught or observed during the 1926 survey. No further records exist from this watershed.

Saint Lawrence (1,2,3). This species was common in the Saint Lawrence River during the 1930 watershed survey and also at least entered the lower reaches of tributaries. It may have been resident in some of these tributaries, however, such as the Grass River upstream to the mouth of the Little River (Greeley and Greene 1931). Muskellunge remain relatively common in this watershed and were documented in the Saint Regis/Deer River basin as far upstream as North Lawrence and Trout Brook in 1977.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that only two specimens were obtained during the 1931 survey, one from Ogdensburg and the other from Eel Bay of the Saint Lawrence River, although the species was also reported from the Oswegatchie River as far upstream as Richville in field notes. It was also taken from Pleasant Lake in 1931, but Odell (1932), based on anecdotal reports, listed it in Black and Butterfield lakes as well. Later catches from the Oswegatchie River documented Muskellunge as far upstream as Elmdale in 1955 and Oxbow in 1990 (NYSM 41299).

Raquette (1,2,3). No Muskellunge were caught during the 1933 survey (Greeley 1934) although occasional catches were reported in the lower river and from several Raquette River reservoirs, where they were probably stocked. In recent decades, the species has been reported from the lower river, including records in 1988 (NYSM 30000; Sloan and Jock (1990)), 1989 (Niagara Mohawk Power Corporation 1991b), and 2007 (NYSM 62291).

Champlain (1,2,3). This species was widely distributed and reported to be locally common at some sites sampled during the 1929 watershed survey (in the Great Chazy River for example) but was uncommon elsewhere (Greeley 1930). There have been no reported catches from Lake Champlain after the 1970s (Marsden and Langdon 2012). Demong (1995) reported that stocking of the Chautauqua strain occurred in the Great Chazy River, but the viability of this program was never assessed.

Chemung (**2,3**). Reports include catches from the Chemung River in 1980, the Tioga River in 2007, and Waneta Lake. These fish might have been migrants from fish that were stocked in Pennsylvania.

Susquehanna (**2,3**). In 1966, this species was caught near Whitney Point. More recent collections are from the Susquehanna River near Windsor in 1995, near Binghamton in 2002, and near Barton in 2004. Muskellunge are stocked in the Pennsylvania portion of the watershed and also spawn in the Susquehanna River near the mouth of the Chenango River (D. Lemon, NYSDEC, pers. comm.).

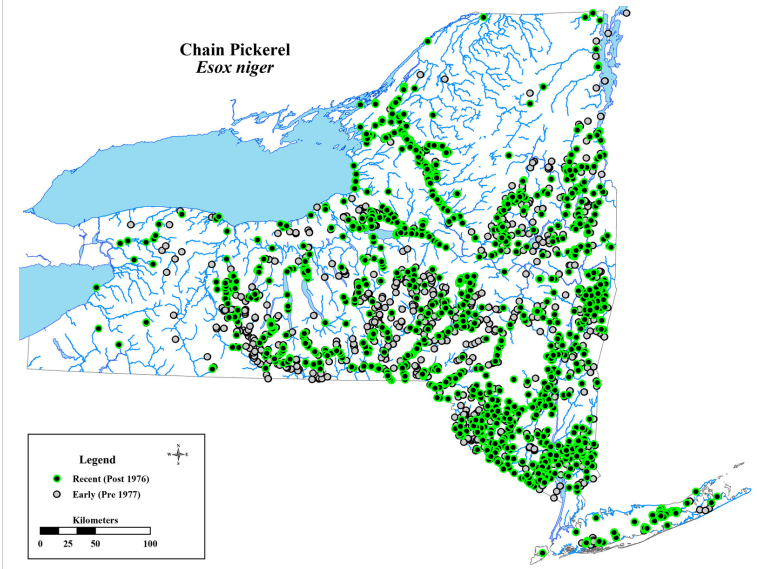
Delaware (**1,3**). This species was reported from Lake Louise Marie in 1935. It is stocked in the New Jersey portion of the Delaware River, and individuals have been caught from 19-57 km upstream of the state line between 1993-1995 and also at Hancock in 2006 (R. Horwitz, ANSP, pers. comm.).

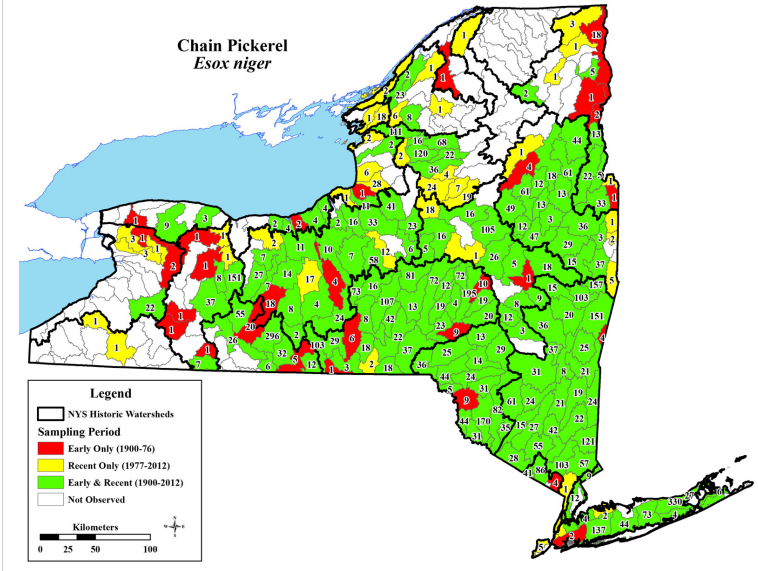
Upper Hudson (**1**). Muskellunge were reported from Woodruff Pond and Indian Lake in 1932. These are possible remnants of a failed stocking effort to develop a fishery and are not included on the maps because no additional catches have ever been reported.

Mohawk (**2**). This species was caught at the mouth of Nine Mile Creek in 1981 and 1982. These individuals may have inadvertently been introduced when Tiger Muskellunge were stocked.

Newark Bay (**3**) New Jersey stocked Muskellunge in Greenwood Lake, where catches were reported between 1997 and 2003.

Esox niger, Chain Pickerel





This pickerel inhabits lakes and large rivers with associated submerged aquatic vegetation. It is native to the Atlantic slope and parts of Saint Lawrence River drainage watersheds located in the center of the state. Because this species is a favored sport fish, it has been introduced to several other watersheds in the state and continues to expand its range to lakes at higher elevations in the eastern Adirondacks (in both the Mohawk and Upper Hudson watersheds).

Allegheny (**3**). There are three reports of Chain Pickerel from this watershed: Conewango Creek near Dayton in 2000 (NYSM 52262), a tributary of lower Conewango Creek in 2006 (Morse et al. 2007), and Little Valley Creek in 2009 (C. Millard, USEPA National Rivers Study, pers. comm.). There are no voucher specimens for the latter two collections.

Erie-Niagara (**1,2,3**). Fowler (1909) listed this species as introduced into this watershed. Greeley (1929) noted that it was present in Lime Lake, and a specimen was also collected from Lewis Lake (NYSM 2078). More recently, Chain Pickerel have also been introduced to Crow, Little Tonawanda, Tonawanda, and Ellicott creeks, as well as Harlow Lake. In 2012, there was an angler report from Lake Erie at Sturgeon Point Harbor.

Ontario (1,2,3). Smith (1985), Carlson and Daniels (2004), and Ricciardi (2006) all treat Chain Pickerel as native to the eastern part of the watershed. More recent capture locations extend from Braddock Bay to Chaumont Bay and also include upstream lakes and stream sites.

Genesee (1,2,3). During the 1926 survey, this species was locally common in Honeoye, Canadice, and Hemlock Lakes but rare in the Genesee River (Greeley 1927). Wright (2006) noted the early stocking of Chain Pickerel and stated that the species was not native upstream of Rochester. Individuals were collected from Cryder Creek, an upstream tributary, between 1986 and 2002.

Oswego (1,2,3). Greeley (1928) stated that the Chain Pickerel was “common in the southern part of the drainage. In lakes, ponds and sluggish weedy streams. Occurs in Oneida Lake and in the Seneca and Oswego rivers.” In recent collections, this species has been found throughout the watershed.

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Black (1,2,3). Chain Pickerel were relatively rare in this watershed in 1931 but were nonetheless present in both streams and lakes (Greeley and Bishop 1932). During this survey, specimens were found in Paynes, Pleasant, and Catspaw lakes. Based on unpublished field notes, this species was more commonly caught than Northern Pike. During the next period of intensive sampling in the Black River from 1975-1979, Northern Pike far outnumbered pickerel. In recent decades, the Chain Pickerel has been the more abundant species by far (Carlson 1996, McCullough and Hart 2010). Because the sampling effort during each of these collection events was comparable, the observed fluctuations suggest that both populations have not yet reached equilibrium. Stocking of this species was reported in the early 1900s and was a common recommendation in the 1930s (e.g., Greeley and Bishop 1932). In recent surveys, this pickerel was widespread in larger streams and was also present in many lakes in the watershed.

Saint Lawrence (**1,2,3**). Although Bean (1903) included this species in his list for the Saint Lawrence River, Greeley and Greene (1931) did not report capturing any Chain Pickerel during the 1930 survey. The earliest record is from the Grass River in 1930; other records include Mullett Creek in 1981 and the Saint Lawrence River near Massena in 1994 (Normandeau Associates, Inc. 1995) and near Benedict Island in 1996 (NYSM 45853).

Oswegatchie (**1,2,3**). Greeley and Bishop (1932) reported that a single specimen was taken from Pleasant Creek. Other early records, both from 1931, include specimens from Limestone Quarry (NYSM 13244) and Old Iron Mine Pond (NYSM 13242). Recent collections comprise many additional records from the Indian River basin (e.g., AMNH 48241 in 1977), and Chain Pickerel are now found as far upstream as Antwerp (rkm 65). Although Smith (1985) treated this species as native to the watershed, these few records are more indicative of range expansion from an introduction, and we continue to treat it is non-native (Carlson and Daniels 2004).

Raquette (**3**). Sloan and Jock (1990) first reported this species from the lower Raquette River in 1988.

Champlain (1,2,3). During the 1929 survey, Chain Pickerel were found in several bays of Lake Champlain, near the mouths of several tributaries, and in many of the ponds in the southern Mettawee River basin (Greeley 1930). Like many other sport fishes, this species has been widely introduced at higher elevations in this watershed.

Chemung (1,2,3). Chain Pickerel were collected at 40% of the watershed survey sample sites in 1937 (Greeley 1938). The species remains abundant and widespread in this watershed.

Susquehanna (1,2,3). Greeley (1936) noted that this species was very common, representing the seventh most frequently encountered species in this watershed. It remains abundant and widespread and was present at over 10% of survey sample sites from 1996-2010.

Delaware (1,2,3). The Chain Pickerel was also very common in this watershed, being the twelfth most frequently caught species during the 1935 watershed survey (Greeley 1936). Greeley (1936) noted that “sluggish streams are likely to favor its increase, and dams often create conditions favorable to pickerel, at considerable detriment to trout in adjoining stream areas.” This species continues to be widespread and common in recent decades, particularly in reservoirs.

Upper Hudson (1,2,3). Greeley and Bishop (1933) provided the following assessment of this species: “Common but not very widely distributed in the region. This is an important game fish in the Sacandaga Reservoir and in the Hudson River. Many ponds of the Sacandaga drainage are inhabited by the pickerel and it is probably native to some of these. In headwater lakes of this drainage, however, particularly the Piseco and Pleasant chain, the pickerel is reported to have been absent until its introduction there.” Recent records show that the Chain Pickerel still occurs in many areas of this watershed.

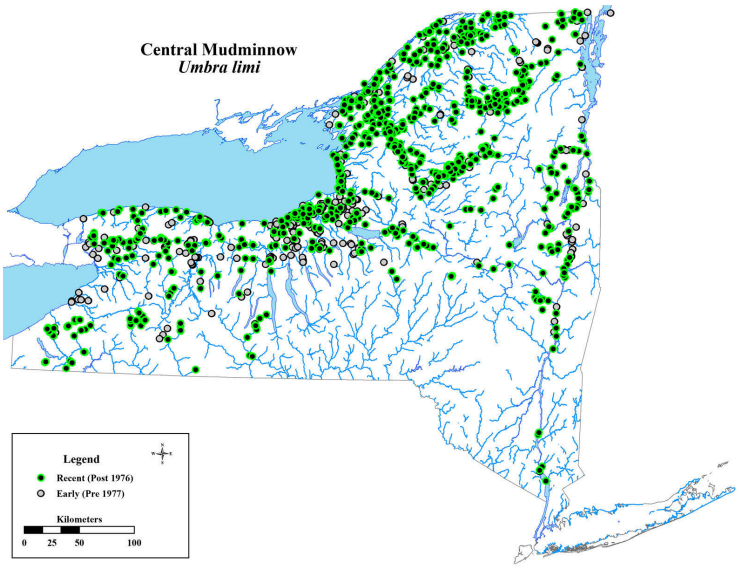
Mohawk (1,2,3). Greeley (1935) noted that this species was very common in the Mohawk River and its tributaries during the 1934 survey, and was native to the lowland reaches of the watershed. Mather (1886) had previously reported that Chain Pickerel had been stocked in upland lakes, specifically Ayer’s, Dexter, and two of the Spectacle lakes, in 1842. Recent records exist from throughout the watershed.

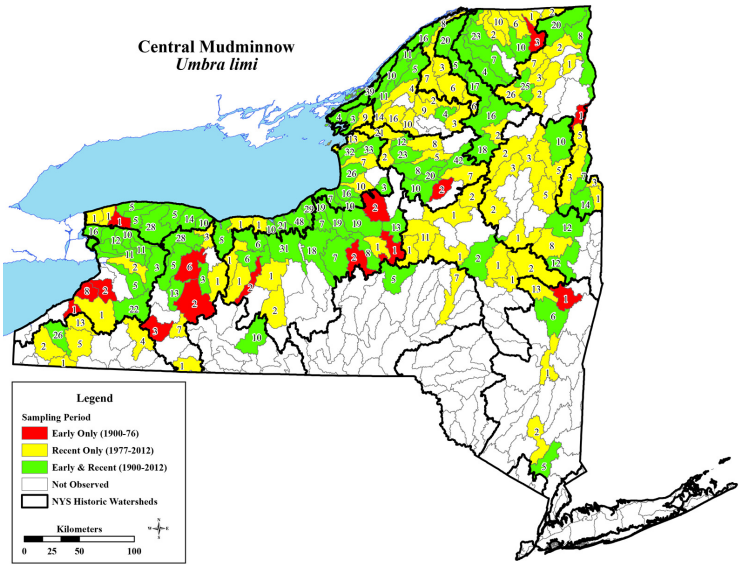
Lower Hudson (1,2,3). This species was common during the 1936 watershed survey and was present in lakes and streams throughout the watershed (Greeley 1937). Recent records show that it still occurs in many waters.

Newark Bay (1,2,3). Odell and Senning (1937) reported Chain Pickerel to be fairly common in Greenwood Lake. The species is now widely distributed in streams and lakes in this small watershed.

Long Island (1,2,3). Early records include two specimens collected by T.R. Bean in 1898 (USNM 49008, 49009). Chain Pickerel were moderately common in many ponds and the Peconic River during the 1938 watershed survey but were also present throughout the island (Greeley 1939a). Odell and Senning (1937) recorded the species from Byram Lake, and Senning (1939) noted that it was present in 26% of pond collections from the island in 1938. It remains common and widespread.

Umbra limi, Central Mudminnow





This small fish lives in small streams and ponds, often where stagnant, anoxic, and/or low pH conditions prevail. It has expanded its range by using canal routes (Daniels 2001) or through intentional introductions, particularly in the Adirondacks. The species is native to the Allegheny and several of the Saint Lawrence River drainage watersheds but is not native to upland sites in these watersheds and is not native to any part of the Chemung, Susquehanna, Upper Hudson, Mohawk, and Lower Hudson watersheds, where it is also found. The Central Mudminnow is known to hybridize with the Eastern Mudminnow in the Lower Hudson River watershed (Schmidt and Daniels 2006).

Allegheny (1,2,3). Central Mudminnows were found at four sites in the Conewango Creek basin (1% of the total 1937 watershed survey samples) and were always associated with slow current and abundant aquatic vegetation (Greeley 1938). The species continues to be confined to the central basin, and, in surveys conducted in the mid-2000s, it was found at 8% of the sites sampled.

Erie-Niagara (1,2,3). Greeley (1929) noted that this mudminnow was present in streams of the northeastern area of the watershed, but was rare and confined to weed beds in the lake itself. Since the mid-1960s, it has been reported from the upper areas of Cattaraugus Creek. This species was found at 10% of the stream sites sampled in the 2000s.

Ontario (1,2,3). Early specimens from Glenmark Creek in 1907 (USNM 62492) and Sodus Bay in 1909 (e.g., USNM 64311) document the early presence of this species in the lake and its tributaries, and Wright (2006) also noted that it was common in his surveys during the same decade. Greeley (1940) reported that Central Mudminnows were present at 39 watershed survey sites and stated: “The mud minnow might be said to be the last fish to give up to the encroachment of the land since it is often found in swamps where there is more organic matter than most fish can stand.” Most recent collections are from boggy areas of bays of Lake Ontario, river mouths, and many low-velocity upland areas.

Genesee (1,2,3). This species was locally common during the 1926 survey but was only found in tributaries of Black Creek (Greeley 1927). Currently, Central Mudminnows are found throughout the watershed, including upriver sites like Angelica Creek in 2002 (NYSM 54101).

Species continued on next page

Oswego (1,2,3). Early records exist from Montezuma in 1886 (CUMV 657) and Weedsport in 1905 (CUMV 33337). This fish was common in the low-velocity waters that dominate the northern part of the watershed, but it was also not rare elsewhere in the watershed during the 1927 survey (Greeley 1928). Occasional recent collections show that the species remains widely dispersed throughout this watershed.

Black (**2,3**). No specimens were collected during the 1931 watershed survey (Greeley and Bishop 1932). The first reports of this species are from Little Moose and White lakes in 1954. By the 1970s, the Central Mudminnow was widespread, and, by the 1990s and into this century, it was found throughout the watershed in both lakes and streams. The changing waterscape of this watershed has made conditions for range expansion ideal for this species, with its tolerance for boggy environments (Smith 1985). It is often the first species to establish itself in high-elevation, acidified lakes, such as Indian Lake in 2004 (NYSM 56714).

Saint Lawrence (1,2,3). Greeley and Greene (1931) listed this fish as uncommon, but, when present, it was found in dense vegetation in creeks near the river as well as the Chateaugay Lakes and many of their tributaries. Central Mudminnows were absent from the Saint Lawrence River itself, however. Greeley and Greene (1931) also mentioned that this species was absent from the Adirondack portion of the watershed except for the Lake Ozonia basin. In recent decades, the species has become more widespread in lowland areas and much more abundant at higher elevations.

Oswegatchie (1,2,3). During the 1931 watershed survey, Central Mudminnows were present at lowland sites where aquatic vegetation dominated (Greeley and Bishop 1932). The species continues to be found in these areas and was also found in the upland Lake Bonaparte in 1990.

Raquette (1,2,3). This was primarily a lowland species that was locally common at only a few sites during the 1933 survey (Greeley 1934). Only one of these sites, a tributary of Sterling Pond (NYSM 1335), was above 130 m in elevation. Another series of specimens was from a quarry pond (NYSM 1317), where Central Mudminnows had been introduced. The recent spread of this species throughout the watershed has been substantial, particularly to ponds and bogs, and it also now occurs in the major lakes at the head of the watershed as indicated by, for example, a record from Blue Mountain Lake in 1994 (NYSM 43640).

Champlain (1,2,3). Central Mudminnows were generally uncommon during the 1929 survey, but specimens were collected from Lake Champlain at Missisquoi Bay in Vermont and at the mouth of the Ausable River; the species was also common in both the Great Chazy and Mettawee systems (Greeley 1930). In subsequent years, this mudminnow has been introduced to many waters at higher elevations, such as Saranac Lake (AMNH 41284), and is now common throughout the watershed.

Chemung (**2,3**). This species was first reported from this watershed in 1968 and has since been found in Waneta and Lamoka lakes, Meads Creek (NYSM 55552), and the Cohocton River (NYSM 54457).

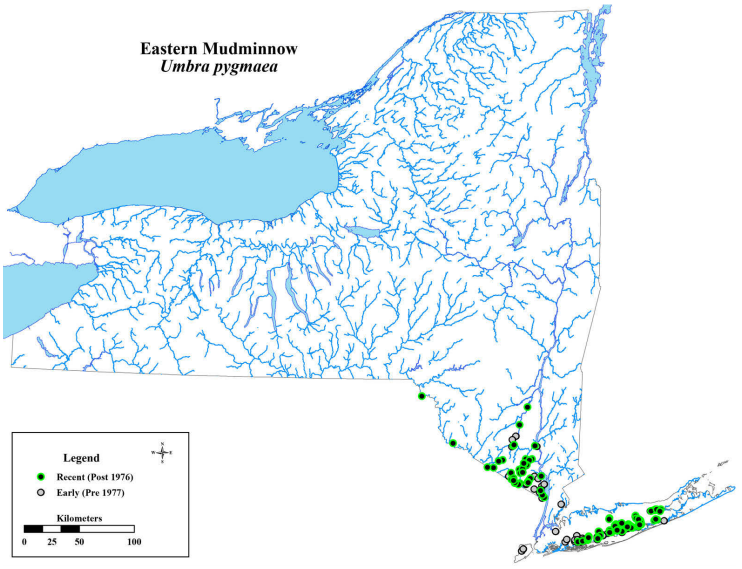
Susquehanna (**2,3**). In 1979, a specimen was collected from a small stream east of Morrisville. Since then, this species has been reported from Payne Brook, the headwaters of Otsego Lake, a canal remnant at the upper end of the Chenango Canal, and the Susquehanna River near Kirkwood. The few voucher specimens from this watershed are from the site near Morrisville in 1979 (AMNH 42751) and Cripple Creek in 1996 (NYSM 45800).

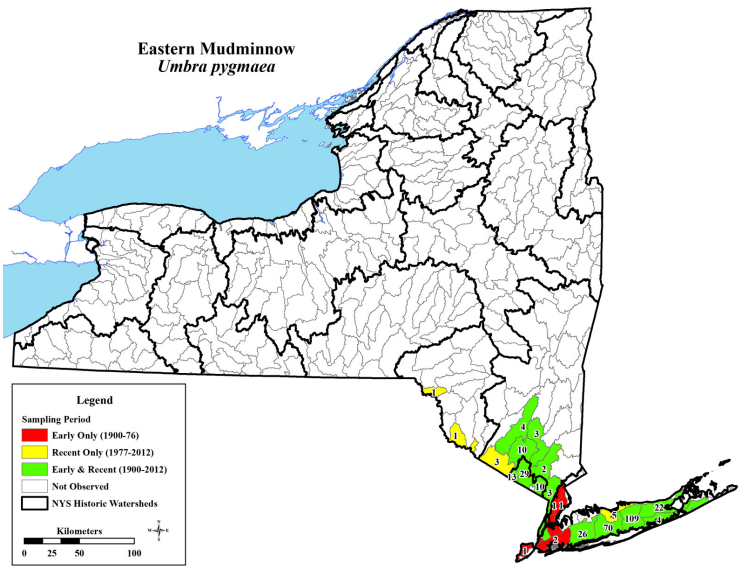
Upper Hudson (**2,3**). This mudminnow was reported from Eagle Lake in 1953 and was widespread across higher and lower elevation sites by the 1970s.

Mohawk (**1,2,3**). Greeley (1935) collected a single individual in a remnant stretch of the old Erie Canal just upstream of Caroga Creek. In 1957, this species was collected in this watershed for a second time at Pine Woods Brook, and, by the 1970s, it had been reported from several locations. Central Mudminnows are now found along the entire Mohawk River, in Adirondack ponds and streams, and in Schoharie and Oriskany creeks. This watershed is directly tied to the Oswego watershed by the Erie Canal, which connects Oneida Lake to the upper Mohawk River. There is a strong possibility that the Central Mudminnow used the canal to gain access to this watershed. More than any other species, it is suited to the habitats provided by the abandoned sections of the canal (Daniels 2001).

Lower Hudson (**2,3**). In 1967, this species was reported from the Hudson River near Coeymans (AMNH 33477). In 1976, it was collected downstream in the river near Peekskill (NYSM 1310). Since the 1970s, Central Mudminnows have been collected from the lower Hudson River in most counties, and they are locally common in several tributaries in Albany County.

Umbra pygmaea, Eastern Mudminnow





Like its congener, this mudminnow occurs in small streams and ponds that are often boggy and/or stagnant. The type locality for this species is Piermont, a village in Rockland County. It is native to the Long Island, Lower Hudson, Newark Bay, and Delaware watersheds in southeastern New York. As mentioned above, the Eastern Mudminnow is known to hybridize with the Central Mudminnow (Schmidt and Daniels 2006).

Delaware (3). Recent collections from the Delaware River in New York represent a natural upriver range expansion from the downriver population. This species was known to be widely distributed in the southern part of the drainage in New Jersey and Pennsylvania (Lee et al. 1980), but Arndt (2004) also reported catches just south of the New York border in New Jersey. In 2004, R. Horwitz (ANSP, pers. comm.) collected specimens from an off-channel pool of the Delaware River at the mouth of Halfway Brook at Barryville as well as from sites a few kilometers away, in Pennsylvania (near Shohola and Equinuck).

Lower Hudson (1,2,3). Greeley (1937) noted the rarity of this species and only reported its presence in Woodbury and Sparkill creeks. Since the 1970s, it has been found to the north and west of these earlier sites and has been collected at sites in the Wallkill River as recently as 2010 (NYSM 65921). It appears that this mudminnow no longer inhabits the Sparkill (Stevens and Schmidt 1993, Schmidt and Daniels 2006, J. Rosko, Saint Thomas Aquinas College, Sparkill, NY, pers. comm. 2010). The species has never been reported from any sites on the eastern bank of the watershed.

Newark Bay (1,2,3). During the 1936 survey, Eastern Mudminnows were found at Spruce, Greenwood, Cranberry and Rockland lakes, the Hackensack and Mahwah rivers, and Pascack Brook (Greeley 1937). The species remains widespread in this small watershed.

Long Island (1,2,3). Greeley (1939) listed this species as common and widely distributed, with collections from 36 sites on Long Island as well as Willow Brook on Staten Island. It is still widespread on Long Island. Eastern Mudminnows have not been collected on Fishers Island, and there is only one report from Westchester County, where the species was found in the Mamaroneck Reservoir in 1954.

Percopsidae, Trout-perches

This small family, which is endemic to North America, includes just two species, one of which is present in the state. This species is found in lake and riverine habitats and, in New York, occurs in the Allegheny watershed as well as the Saint Lawrence and Hudson River drainage basins.

Percopsis omiscomaycus, Trout-perch

This species lives in the cooler parts of lowland streams and lakes. It has occasionally been collected at depths over 60 m. The Trout-perch is native to 11 watersheds in the state.

Allegheny (1,2,3). Greeley (1938) reported that this species was collected at 6% of the sites sampled during the watershed survey, primarily in the Allegheny River and its tributaries in the central and eastern basins. In the last several decades, specimens have been collected from the Allegheny River and Olean, Ischua, Haskell, Great Valley, Tunungwant (Daniels 1989), Oswayo (NYSM 60756), and Little Genesee creeks (AMNH 42032) in the eastern basin. In the central basin, Trout-perch have been found in Conewango (Smith 1985, Pomeroy 1995), Cassadaga, and Little Brokenstraw creeks. In a survey of the Conewango Creek system in 2005 and 2006, this species was found at 13% of the sites sampled.

Erie-Niagara (1,2,3). Greeley (1929) noted: “This little, spotted fish is one of the most common ones of Lake Erie. A small number were collected in the Niagara River.” The species was documented from the Niagara River in 1893 as well (USNM 70060). The lake population may not be as robust now as it was at the time of Greeley’s early report, but the species continues to inhabit the lake (NYSM 30044) and its tributaries (AMNH 42313).

Ontario (1,2,3). This species was collected off Ninemile Point in 1893 (Evermann and Kendall 1901), but was apparently difficult to find in the 1900s (Wright

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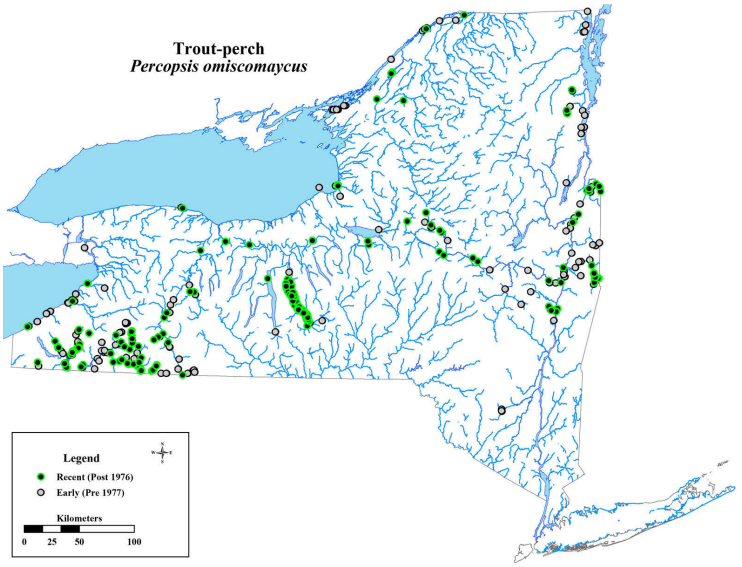
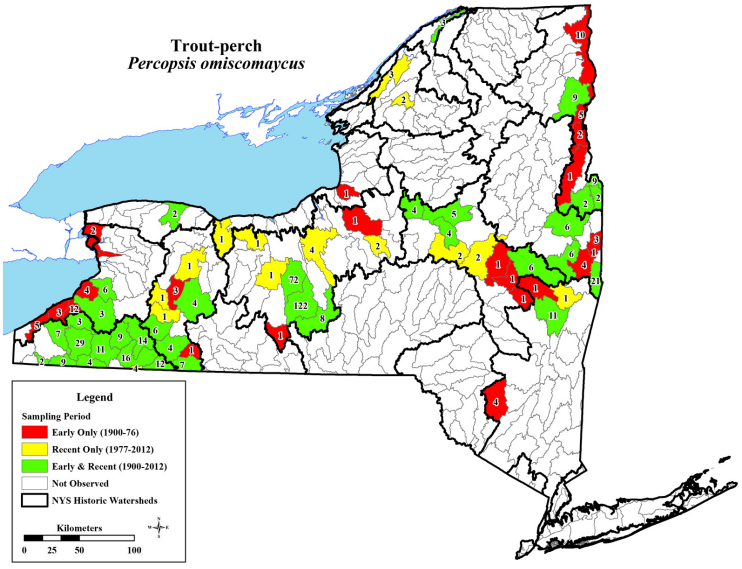




2006) and 1939 (Greeley 1940), although Greeley speculated that it was common in Lake Ontario. Recent collections include reports from the Salmon River (McKenna 2003), the Erie Canal in Monroe County (Trometer et al. 2010), and Lake Ontario (Owens et al. 2003).

Genesee (1,2,3). Greeley (1926) listed this species as common and present in large, warm streams with moderate current, with collections being made throughout the watershed. Trout-perch captures continue to be regularly reported, including collections from Black Creek in 1977 (AMNH 45896) and 2002 (NYSM 54231).

Oswego (1,2,3). Greeley (1928) noted that this species was not uncommon and that it "occurs in Cayuga and Oneida lakes, and specimens were taken in the Clyde River in deep water where the current was sluggish and the bottom muddy." The Cornell University Museum of Vertebrates holds dozens of specimens collected from Cayuga Lake and its tributaries between 1900 and 1913. More recently, Trout-perch have been reported from lower Fall Creek of Cayuga Lake, Seneca and Oneida lakes, and Canaseraga Creek.

Saint Lawrence (1,2,3). Evermann and Kendall (1902b) collected a specimen from the Saint Lawrence River at Cape Vincent in 1894 (USNM 63713). Greeley and Greene (1931) collected just three specimens at a site on the Grass River at Massena and consequently listed the species as rare. Trout-perch were actively collected from the Thousand Islands area in 1976 (e.g., NYSM 42520). The species remains relatively rare in this watershed, however, although recent catches were made from the mouth of the Grass River in 2010.

Oswegatchie (2,3). This species was not found during the 1931 survey (Greeley and Bishop 1932) and remains rare in the watershed, with records from Black Lake in 1986, Millsite Lake in 1991, and Sawyer Creek in 2012 (NYSM 68111). The Sawyer Creek site, at 110 m, is located above the barrier near Gouverneur that delineates the upstream range of most lowland species and represents a higher elevation than is typical for this species.

Champlain (1,2,3). The earliest known specimen from this watershed was collected from the Boquet River by S.F. Baird in 1853 (NYSM 11458). This species was common in Lake Champlain and creek mouths during the 1929 survey and was also present in the Mettawee River, where it was collected as far upstream as the Vermont border (Greeley 1930). Given several downstream barriers, this seems too far upstream, however, and no voucher specimens were found to support this claim. Recent records exist from the Poultney River in 2004, Mettawee River in 2010, and Champlain Canal in 2010 (E. Marsden, University of Vermont, unpubl. field notes).

Upper Hudson (1,2,3). Greeley and Bishop (1933) described this species as moderately common in the main channel and some tributaries downstream of Hudson Falls. They (Greeley and Bishop 1933) also reported on a disjunct population: "In the upper Batten Kill a colony of this species inhabits the cold trout waters in the vicinity of East Salem, separated from the Hudson River by impassable barriers." NYSM 2346 contains several individuals from this population. No specimens have been recorded from the upper Batten Kill since 1956, however. Trout-perch continue to inhabit the main channel and its tributaries downstream of Hudson Falls, with many reports from the 1970s and 1980s (Makarewicz 1983) and recent catches from the Hoosic River (NYSM 64083).

Mohawk (1,2,3). This species was locally common during the watershed survey but was limited to low-elevation stream sites, with Delta Lake being the only lacustrine collection site (Greeley 1935). Most recent records are from the Mohawk River and the lower parts of larger tributaries, including West Canada Creek to Poland and into Cincinnati Creek (NYSM 64231). One specimen was collected at the mouth of the Mohawk River downstream of the falls in 1999 (NYSM 51148).

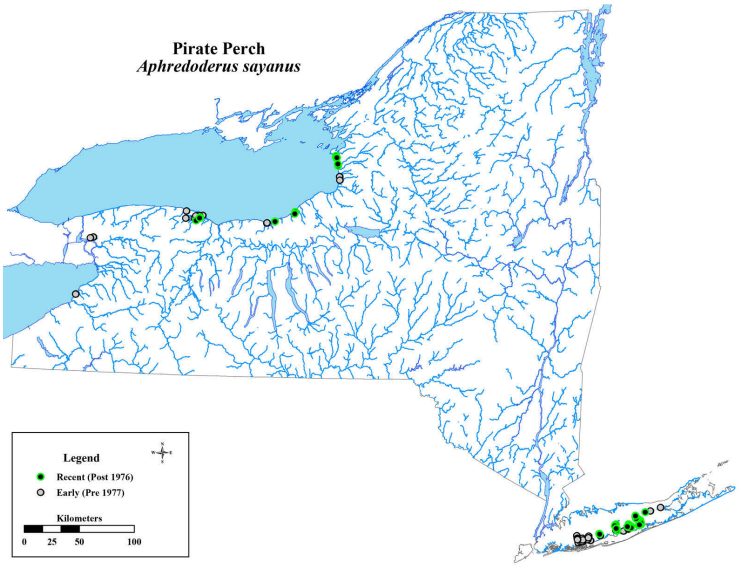
Lower Hudson (1,2,3). Trout-perch were locally common during the 1934 survey and were collected from several tributaries in the northern counties (Greeley 1935). In the downriver area, however, the species was rare and was only found in the Rondout Creek system, in the creek itself as well as in Honk Lake (Greeley 1937). This Rondout Creek population was curiously distant from the others in this watershed, and Trout-perch have not been collected from the system in recent decades. Some of the more northern waters from which this fish was recorded in the 1930s include the Vloman Kill, Coeymans Creek, and Deep Kill, with additional later collections from the Bozen Kill. Recent catches have been made in the same waters where the species was present in the 1930s, including the Hudson River in 1974, Coeymans Creek in 2009, the Vloman Kill in 2013 (NYSM 68600), and one of its tributaries in 2008.

Aphredoderidae, Pirate Perch

The Pirate Perch is the only species in this family. It is a small fish that is generally found in weedy, slow-water habitats. In New York, this species is found in tributaries to the Great Lakes and on Long Island. Individuals from these disjunct populations are sufficiently different in appearance to be treated as subspecies, both of which are native to the state.

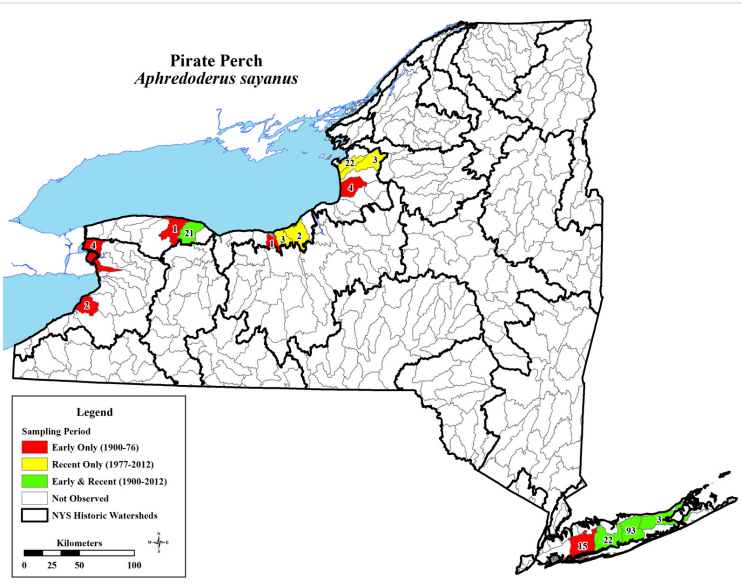
Aphredoderus sayanus, Pirate Perch

This small, cryptic fish resides in low-gradient streams with clay or sand substrates and some debris. Its range is U-shaped (Lee et al. 1980), and, as a consequence, there is no connection between populations of the western and eastern subspecies. The western subspecies (*Aphredoderus sayanus gibbosus*) is native to two watersheds in western and central New York. It has declined to levels below detection in the Erie-Niagara watershed, but numbers have increased in tributaries in the Ontario watershed. In New York, it is classified as Species of Greatest Conservation Need. The eastern subspecies (*A. s. sayanus*) lives in the streams and ponds of Long Island but is no longer found in streams of the western, more urbanized part of the island.



Erie-Niagara (1). Greeley (1929) noted the rarity of Pirate Perch in this watershed by reporting a few specimens from Cayuga Creek near Niagara Falls. A specimen was also collected from its tributary, Bergholtz Creek, in 1928 (CUMV 2705). Lee et al. (1980) indicated a collection near the mouth of Cattaraugus Creek, but we have not been able to validate this record.

Ontario (1,2,3). Wright (2006) was the first to collect this species in this watershed in 1904. He collected several individuals from Buttonwood Creek and North Creek and added even more records in subsequent years. He was still collecting this species well into the 1920s, including records from North Creek in 1924 (CUMV 450) and Buttonwood Creek in 1929 (CUMV 66169). Notwithstanding these early records, this species was rare during the



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1939 watershed survey, and its distribution was spotty, with just two records from Oswego County and three from Monroe County (Greeley 1940). Specimens were again collected from North Creek in 1948 (AMNH 41752), but Buttonwood Creek in Monroe County is the only stream where there is a more or less continuous record of this species, with collections in 1939 (NYSM 2285), 1962, 1981 (AMNH 227027), 1997 (NYSM 47752), and 2003. Additional recent collections include: Sterling Creek Pond in 1996 (NYSM 46038) and 1998 (NYSM 49320), Lakeview Pond in 2003 (NYSM 55475) and 2004, Stony Creek Bay in 2004 (A. Trebitz, USEPA, unpubl. data), Black Pond in 2005 (NYSM 59151) and from 2010-2014, and East Bay, Lake Ontario, in 2008 (NYSM 64340). These records clearly indicate that the range of this species has extended farther east in recent years.

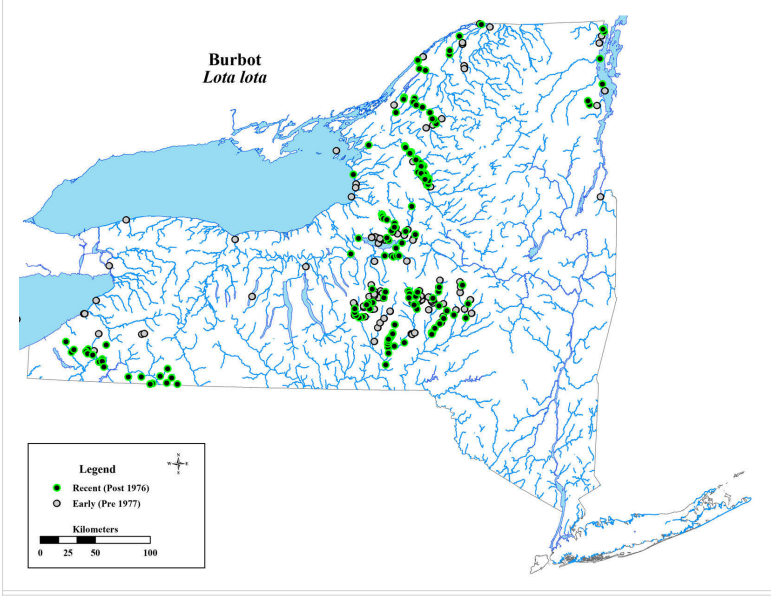
Long Island (1,2,3). Bean (1902) reported several collections from Long Island beginning in 1884 (USNM 35970). Greeley (1939) stated: "...the pirate perch occurs in a large number of Long Island streams, particularly the smaller ones and was represented in 11 collections from Nassau County, 15 from Suffolk. It is moderately common but seldom noticed because of its small size and habit of hiding in weeds or debris." There are records from several sites in Suffolk County as recently as 2009, 2013, and 2015, including the Connetquot River (NYSM 65233, 73312). The species was last collected in Nassau County in 1954, however.

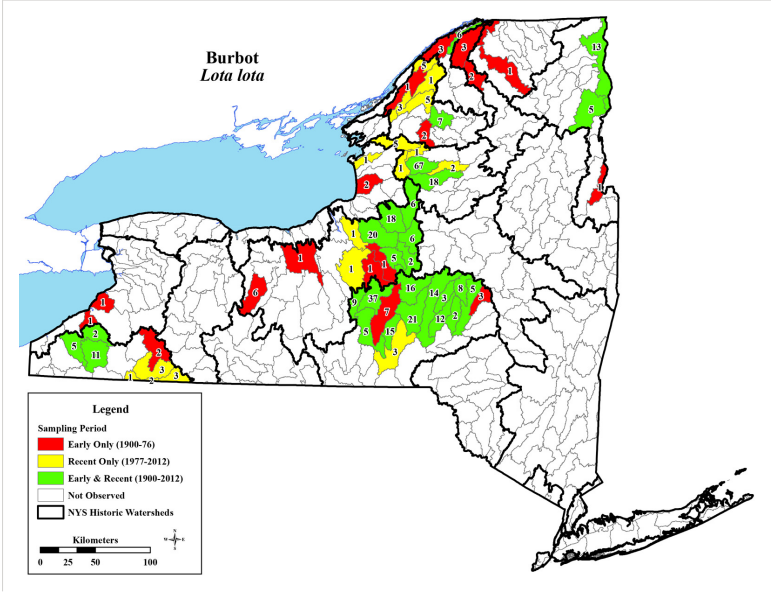
Gadidae, Cods

Cods are marine fishes; only one species inhabits freshwater and its range is circumpolar. Several species are estuarine, and many marine species stray into coastal streams. The single freshwater species, the Burbot, is present in the Allegheny and Susquehanna watersheds as well as several in the Saint Lawrence River drainage. Burbot are found in a variety of habitats but typically live in large lakes and the main channels of rivers. The Atlantic Tomcod is an additional estuarine species that is found in the lower Hudson River.

Lota lota, Burbot

This species inhabits lowland lakes and rivers, where cooler temperatures prevail. It is widespread in the Allegheny and the watersheds of the Saint Lawrence River drainage. Burbot have not been reported from the Genesee or Atlantic slope watersheds, except for the Susquehanna watershed.





Allegheny (1,2,3). During the 1937 survey of the watershed, Burbot were taken from Bear Lake Outlet and Johnson Creek, both of which are in the central basin (Greeley 1938). The species was caught on the Allegheny River at the mouth of Ten Mile Creek in 1980, which was the first capture reported in the eastern basin. All other recent captures have been from the Conewango Creek, or central basin, such as a specimen from Clear Creek in 2004 (NYSM 57172). Access to the eastern basin from Pennsylvania would depend on downstream migration from the Allegheny headwaters, where this species is found (Fischer 2008). Fischer (2008) concluded that the populations in the upper Allegheny and Susquehanna rivers (see below) were relictual and resulted from a post-glacial dispersal into the two watersheds. Interestingly, Burbot are absent from the Allegheny River system downstream of the New York border, which allows the possibility that the Conewango Creek population might also be relict, resulting from dispersal soon after the retreat of the glaciers.

Erie-Niagara (1,2,3). This species was common in the lake, and a commercial fishery was developing in 1928 (Greeley 1929). Until 2004, it was gradually increasing in abundance in the offshore waters of Lake Erie, but, in subsequent years, abundance began to decline because of persistently low recruitment (Coldwater Task Group 2014). No Burbot have been caught from tributary mouths or farther inland in the watershed since 1928.

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Ontario (1,2,3). This species once supported a commercial fishery in Lake Ontario, although Greeley (1940) noted that it was not present in the areas sampled during the summer survey, i.e., bays and streams. Burbot were only occasionally caught during extensive trawl sampling in Lake Ontario in subsequent years (Owens et al. 2003), and the species' abundance remains low due to competition with Alewives and predation by Sea Lampreys (Stapanin et al. 2008).

Oswego (1,2,3). This species was common in Canandaigua Lake and was also present in the Seneca River and Oneida Lake during the 1927 survey (Greeley 1928). An 1875 record from Cayuga Lake (Meek 1889) suggests that Burbot were once present there but had become extirpated because of extensive modifications to Montezuma Marsh at the northern end of the lake. The last record from Canandaigua Lake was in 1974 (AMNH 98177). This species has been reported from Oneida Lake and its tributaries continuously, with collections as recently as 2004 (CUMV 90271). Recent population declines in Oneida Lake have been attributed to water temperature increases (Jackson et al. 2008).

Black (1,2,3). Although Greeley and Bishop (1932) did not report any collections from the 1931 survey of this watershed, this species was reported from Roaring Brook in their field notes. More recently, the presence of Burbot has been documented in the Black River between Carthage and Lyons Falls, and the species' range extends into tributaries as far upstream as the first barrier. Tributaries are probably important spawning areas and young-of-year were found in these streams in 1992 and 2014. Large numbers were collected from Carthage to Lowville in 2005 after a fish kill (McCullough and Hart 2010).

Saint Lawrence (1,2,3). The 1930 watershed survey documented Burbot in the Saint Lawrence River below Ogdensburg and in the Saint Regis River at Hogansburg, but the species was absent from the interior lakes of this watershed (Greeley and Greene 1931). It remains rare. Specimens were taken downstream of Moses-Saunders Dam in 1976, from the Thousand Islands area from 1982-1986, and near Massena in 1994. Inland records include the Grass River at Massena in 1951 (CUMV 20997) and from Louisville and Madrid in the 1990s. Burbot are infrequently caught in the Saint Lawrence River, usually by anglers while ice fishing.

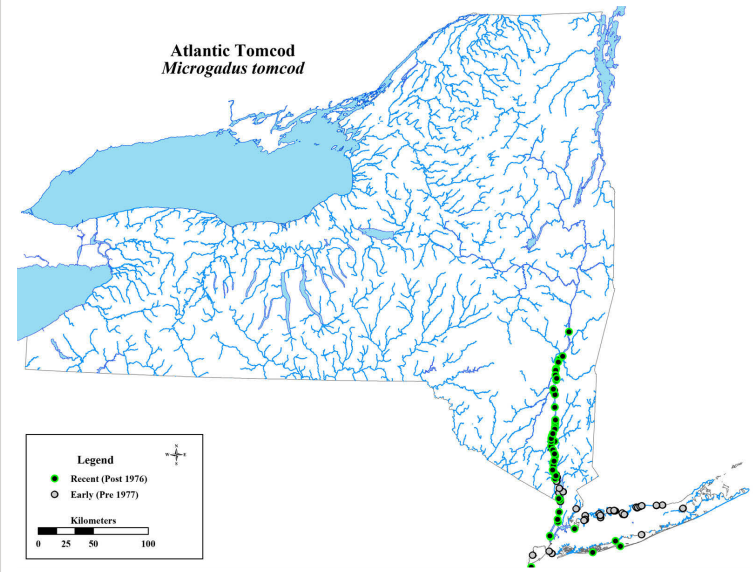
Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that the watershed survey party collected one specimen from Black Lake, but a specimen from Lake Bonaparte also exists from this survey (NYSM 15090). Recently, Burbot have been caught in Red Lake, the Oswegatchie River at Elmdale, and the West Branch Oswegatchie River.

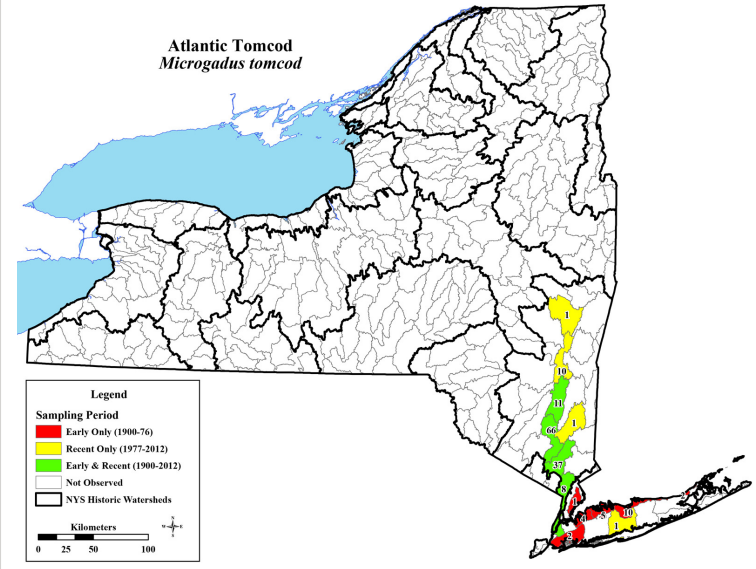
Raquette (1,2,3). This fish was locally common in this watershed during the 1933 survey, although it was not widely distributed (Greeley 1934). It is clear in Greeley's (1934) account that he had begun to recognize that Burbot were not limited to deep-water habitats but could also maintain stream populations, even if the stream section was isolated from deeper water by impassable barriers as was the case in Lower Stafford Brook. More recently, individuals have been taken from Parkhurst Brook in 1972 and the Raquette River below Raymondville in 1989.

Champlain (1,2,3). Burbot were moderately common in Lake Champlain during the 1929 survey, where individuals were caught with gill nets. A single additional watershed survey specimen was taken from a tributary of the Great Chazy River (Greeley 1930). Recent catches are rare but include records from the North Branch Boquet River in 1954 and 1991 as well as Lake Champlain in 1969, 1970, 2007, and 2009.

Susquehanna (1,2,3). This species was rare but was taken from Otsego Lake and the Otselic River near Lisle and near South Otselic during the 1935 survey (Greeley 1936). In the early 1950s, Burbot were collected at several sites in Cortland, Otsego, and Chenango counties, with specimens accessioned into the collection at Cornell University. Currently, the range of this species extends west to the Chenango and Tioughnioga rivers, and it continues to be found in the Susquehanna River main channel and its tributaries. Populations seem to be stable in most small and medium-sized streams as well as in larger lakes.

Microgadus tomcod, Atlantic Tomcod





This small cod is an estuarine species, and the only breeding population in New York is found in the lower Hudson River. The Hudson River is the southernmost estuary that this species inhabits. Although primarily a brackish-water species, some individuals have historically been taken farther upstream. It also strays into Long Island streams. The Atlantic Tomcod is listed as a Species of Greatest Conservation Need by the State of New York.

Lower Hudson (1,2,3). DeKay (1842) wrote that individuals "ascend rivers even into fresh water. Dr. Eights [James Eights, a naturalist, see McKinley (2005)] informed me that they appear at Albany in abundance, at intervals of six and eight years." The farthest recent upriver collection consists of larval fish from Rensselaer County in 1988 (NYSM 53903). Greeley (1937) listed this species as rare, with relatively few individuals caught during the watershed survey, all of which were immature and taken in late summer. This may reflect the life history of this species, which is an annual fish that spawns under ice in the winter, rather than its actual abundance in the river. The Atlantic Tomcod is a main channel species, and the only record of a tributary capture is from Sparkill Creek in 2009. Daniels et al. (2005) tracked changes in abundance from highs in the 1970s and 1980s to a catastrophic decline in numbers by the 2000s, which they attributed to higher water temperatures.

Long Island (1,2,3). Bean (1902) collected this species from Great South Bay and Peconic Bay in 1898. Its range was reduced considerably by the time of the 1938 survey, when it was taken in beach seines along the north shore, with a southwestern limit at Gravesend Bay and the northeastern limit not reaching Orient Point. Atlantic Tomcod were apparently absent from Peconic Bay and Great South Bay and, in fact, from the entire southern shore (Greeley 1939b). There are few recent records from inland waters, but specimens have been collected from the Arthur Kill in 1975 (e.g. NYSM 54755), Little Neck Bay in 1984 (NYSM 14698), and New York Harbor in 2002 (NYSM 63355). Nearshore marine samples collected by Malaty (2014) in 2010 did not produce any Tomcod, in contrast to the 25 capture locations reported in 1938 (Greeley 1939b).

Atherinopsidae, New World Silversides

New world silversides are freshwater, estuarine, or marine species. Although four species are found in New York's inland waters, only one species is restricted to freshwater. The Brook Silverside occurs in the watersheds of the Saint Lawrence drainage and the Allegheny River and has recently populated the Hudson River drainage. It is found in vegetated areas of streams and lakes. The other three species, *Membras martinica*, *Menidia beryllina*, and *Menidia menidia*, are found in the lower Hudson River and coastal streams on Long Island and Westchester County. They are not considered to be inland species and are, therefore, outside the scope of this map series.

Labidesthes sicculus, Brook Silverside

This small, elegant fish is a surface feeder that occurs in lowland streams and large lakes with abundant aquatic vegetation. The Brook Silverside is native to the Allegheny and seven Saint Lawrence River watersheds and has also become established in the Lake Champlain, Mohawk, and Upper and Lower Hudson River watersheds. The species is currently undergoing a range expansion.

Allegheny (1,2,3). Brook Silversides were taken at 7% of the sample sites in the 1937 watershed survey, but all of these were in the central basin and most were in Chautauqua Lake, where the species was abundant (Greeley 1937). The survey also collected specimens from tributaries of Chautauqua Lake, Bear Lake, and the outlet of Cassadaga Lake. This species continues to inhabit these areas and in a 2004-05 survey of the central basin, it was found at two sites in Conewango and Cassadaga creeks (Daniels et al. 2006b). Individuals were again collected from Conewango Creek in 2012 (NYSM 67809) and from the Chadakoin River in 2013 (NYSM 70111).

Erie-Niagara (1,2,3). This species was rare during the 1928 survey of this watershed and was collected from just two Lake Erie sites at the mouths of Silver and Eighteenmile creeks (Greeley 1929). It remains rare in Lake Erie, with the only recent report coming from the mouth of Cattaraugus Creek in the 1970s (W. Hadley, SUNY Buffalo, pers. comm.). Recently, Brook Silversides have been collected in the Buffalo area, from the Niagara River in 2001 (NYSM 52284, 53444) and Tonawanda Creek in 1998 (49493), 1999 (NYSM 51474), and 2011.

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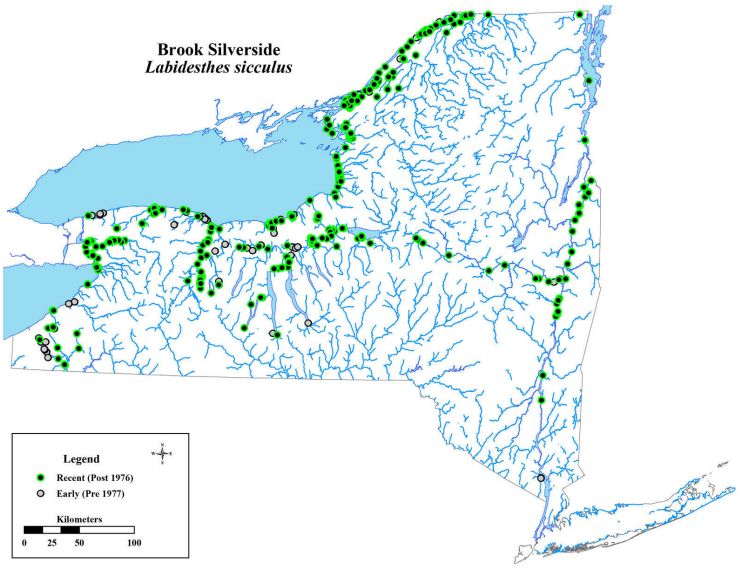
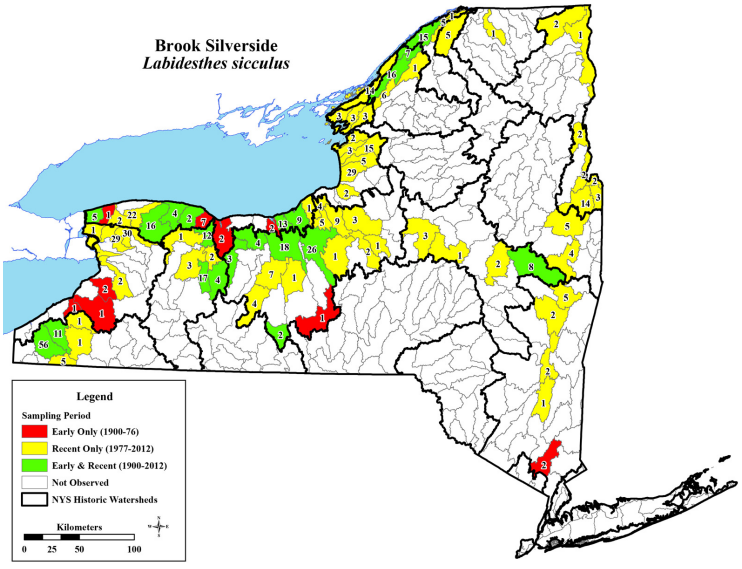




Ontario (1,2,3). During the 1939 watershed survey, this species was widely distributed within Lake Ontario bays, creek mouths, and ponds adjacent to the lake, including Carlton and Mendon ponds and the Erie Canal (Greeley 1940). The species remains widely distributed in the watershed and is frequently caught in the Erie Canal.

Genesee (2,3). The first collections from this watershed are from Conesus Lake in 1940 (CUMV 73430) and Honeoye Lake in 1942 (CUMV 27910). Brook Silversides were again collected from Honeoye Lake in 1948 (CUMV 68324) and 1963 (NYSM 43335) and from Conesus Lake in 1968 (NYSM 43239). Specimens were taken from the Genesee River in 2002 (NYSM 54341, 54345) and from Red Creek in 2011 (NYSM 67194). The species is rare in this watershed. Although it is native, its original range was probably limited to the river and its tributaries downstream of Rochester Falls.

Oswego (1,2,3). Greeley (1928) listed the Brook Silverside as uncommon in this watershed but noted specimens from Cayuga Lake and the Seneca and Clyde rivers. Currently, the species is more widely distributed and is commonly caught in Cayuga, Seneca, Cross, and Oneida lakes, the Seneca and Oswego rivers, and the Erie Canal.

Saint Lawrence (1,2,3). This species was rare in the 1930 survey and was represented by just three specimens taken near the mouth of Sucker Brook (Greeley and Greene 1931). It was, however, listed as “moderately common” in the Saint Lawrence River in the 1931 survey (Greeley and Bishop 1932). In recent years, Brook Silversides have been reported rarely, with a few records from the Saint Lawrence River and the lower portion of a few tributaries, such as the Grass River in 1997 (NYSM 47682) and the Little Salmon River in 2004 (NYSM 56895).

Oswegatchie (1,3). Greeley and Bishop (1932) reported captures from Black Lake and the mouths of its tributaries. Recently, this species has been reported at downstream sites on the Oswegatchie River and in Butterfield Lake.

Raquette (3). The Brook Silverside was first collected in this watershed in 1997 from the Raquette River downstream of Raymondville (NYSM 47723). To date, no captures have been reported upstream of this part of the river.

Champlain (**3**). Brook Silversides became established in Lake Champlain in the mid-1990s. Marsden et al. (2000) posited that they traveled there through canals, most probably the Champlain Canal. In 2013, a specimen was collected from the Mettawee River (NYSM 69304).

Upper Hudson (**3**). It is difficult to date the arrival of this species in this watershed. It was present in the Mohawk and Lower Hudson watersheds and, more importantly, the Erie Canal in the 1990s. The earliest record for this watershed is from Mechanicville at Lock 3 in 2000 (NYSM 51849). There were several reports of this species in the main channel between Troy and Fort Edward in 2007 and 2008. Brook Silversides must have been common in the watershed earlier than 2000, however, if the Lake Champlain population was established by migrants from the Mohawk using the Champlain Canal in the 1990s.

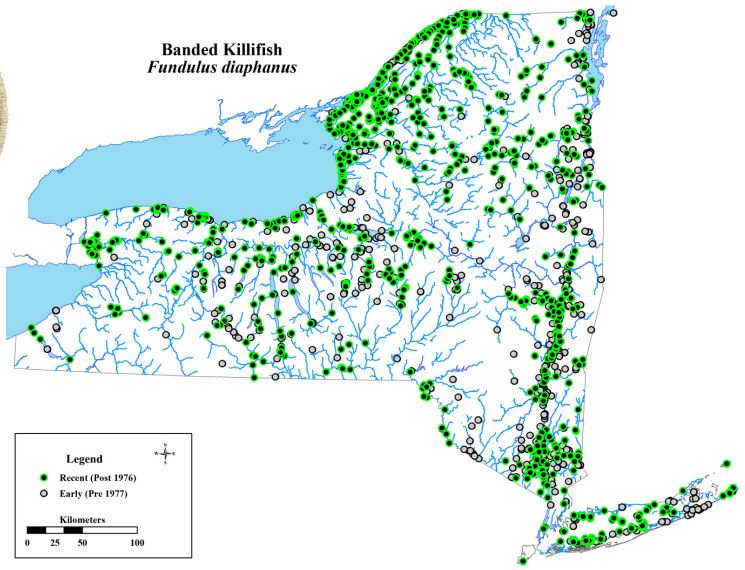
Mohawk (**1,3**). Greeley (1935) reported that specimens were only taken at four sites in the Mohawk River near Crescent and Halfmoon lakes and at the mouths of two tributaries flowing into the lakes. Brook Silversides were not reported from the watershed after the mid-1930s until specimens were taken from the Mohawk River at the mouth of Schoharie Creek (NYSM 44769) and from Collins Lake (NYSM 50870) in 1995 and 1996. Since then, the species has been widely collected from the river and the Erie Canal, from the mouth of Oriskany Creek (NYSM 54370) to below the falls at Peebles Island (NYSM 51149). It is likely that it gained access to this watershed by migrating through the Erie Canal from populations in the Oswego watershed.

Lower Hudson (**2,3**). A single specimen exists from the Hudson River at Haverstraw Bay, which was collected in 1954 (CUMV 66989). The extensive sampling conducted in the river by the power companies in the 1970s-1980s failed to produce another specimen. The progression of this species in its most recent invasion of this watershed is relatively well documented, however. Brook Silversides were well established in the Mohawk River by the early 1990s and possibly earlier. Specimens were found in the Hudson River at Albany in 1992 (NYSM 59288) and at Staatsburg in 1996 (NYSM 58960). Individuals have been caught repeatedly in the river and some of its tributaries between the Federal Lock in Troy and Staatsburg, about 90 km downriver from 2000-present.

Fundulidae, Topminnows

The members of this North American killifish family are soft-rayed fishes with supraterminal mouths, giving them an advantage in feeding at the water surface. They are small, like minnows, but visibly differ from the members of the Cyprinidae by having teeth on their jaws and scales on their heads. These are egg-laying fishes, unlike their close relatives, the livebearers. Although five species are found in inland waters in New York, only one is a strictly freshwater species. This species is native to all drainages in the state and is typically found in near-shore lake habitats or in slow-water streams, often being associated with areas with abundant aquatic vegetation. The other four species have strong marine affinities and occur sporadically in estuarine habitats in the lower Hudson River, in the streams of Long Island, and in adjacent marine environments. Of the four species, three are relatively rare in the inland waters of the state, but the Mummichog (*Fundulus heteroclitus*) has maintained permanent, disjunct populations in the freshwater portion of the Hudson River and Long Island. The Spotfin Killifish (*Fundulus luciae*) was reported from Piermont in 2000 (NYSM 52033), and a Striped Killifish (*Fundulus majalis*) specimen has been collected at rkm 25 (NYSM 11820), but neither species has been encountered at numerous sites or at a single site repeatedly. Only the two species with freshwater populations have maps in this volume.

Fundulus diaphanus, Banded Killifish



This species inhabits lakes at lower and intermediate elevations, large rivers, and many coastal areas. It is native to all New York watersheds but is not native in the Adirondacks.

Allegheny (1,2,3). Banded Killifish were present at less than 1% of the sample sites during the 1937 watershed survey, all of which were in Upper Cassadaga Lake (Greeley 1938). More recently, specimens have been collected from Cassadaga Creek in 1979 (AMNH 42259) and Chautauqua Lake in 2003 (NYSM 55721), but the species nonetheless remains rare in this watershed.

Erie-Niagara (1,2,3). Greeley (1929) reported the presence of this species in the upper Niagara River and in Lake Erie, where it was restricted to sheltered bays. More recently, specimens have been taken from Crystal Lake in the Cattaraugus Creek basin in 1981 (AMNH 224512), Tonawanda Creek in 2000 (NYSM 52179), and the Niagara River in 2001 (NYSM 53463) and 2012.

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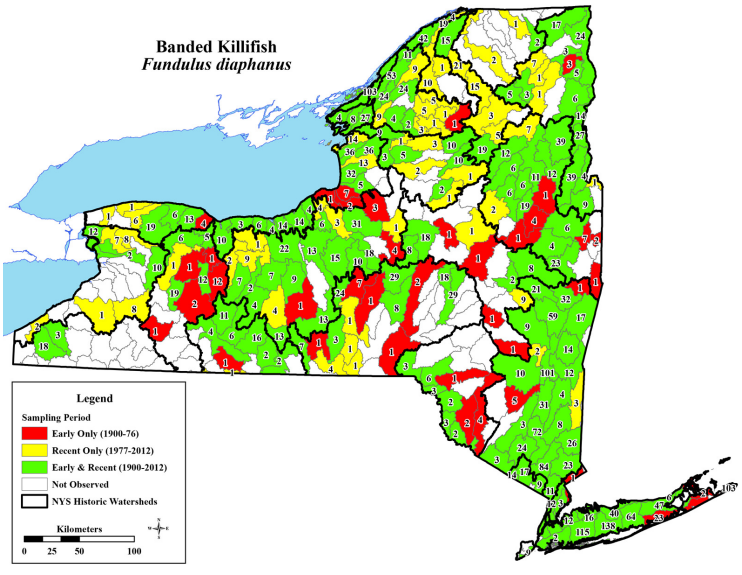


Ontario (1,2,3). During the 1939 survey, Banded Killifish were abundant in Lake Ontario bays as well as in ponds and streams and were only absent from waters at higher elevations (Greeley 1940). The species remains abundant and widely distributed throughout the watershed.

Genesee (1,2,3). Because this species was common in Lake Ontario, Greeley (1927) speculated that it should be common in the mouth of the Genesee River but reported that watershed survey specimens were only collected from Black Creek. A specimen was again collected from Black Creek in 2000 (NYSM 52296), and Banded Killifish now occur in some lakes and most of the larger streams in the watershed.

Oswego (1,2,3). This killifish was common in the shallow waters of lakes and rivers throughout the watershed during the 1927 survey (Greeley 1928). The species continues to be frequently reported and is widely distributed.

Black (1,2,3). During the 1931 survey of this watershed, Banded Killifish were only found at the mouth of the Black River (Greeley and Bishop 1932). By 1956, the species was widespread in lakes and streams, but the frequency of occurrence has remained low until at least 2006. Populations are locally abundant, however, in many of the Adirondack lakes in which this species occurs (Daniels et al. 2011a). The Banded Killifish is only native in the downriver part of the watershed adjacent to Lake Ontario.

Saint Lawrence (1,2,3). This species was found in the Saint Lawrence River and in the lower reaches of tributaries during the 1930 survey, with Greeley and Greene (1931) specifically noting that it did not occur in the upland ponds and streams in the Adirondack Mountains. Banded Killifish are now widespread at both lowland and upland sites.

Oswegatchie (1,2,3). Watershed survey specimens were collected at several lowland sites, including Black and Millsite lakes and the Oswegatchie River (Greeley and Bishop 1932). More recent reports also exist from higher-elevation sites, like Cranberry Lake (NYSM 60991).

Raquette (1,2,3). This species was rare during the 1933 survey and was only collected from a lowland stretch of the Raquette River and Lower Brown Tract Pond (Greeley 1934). Lower Brown Tract Pond, at around 543 m, is separated from the downstream collection by almost the entire length of the river, so Greeley (1934) surmised that the presence of Banded Killifish there resulted from an introduction. The species is now widespread in this watershed.

Champlain (1,2,3). Banded Killifish were common in Lake Champlain, Lake George, and in a number of ponds and streams during the 1929 survey (Greeley 1930). In recent decades, this species has also become widespread at higher elevations.

Chemung (1,2,3). Specimens were present in 6.5% of the 1937 watershed survey samples and were found in lakes and streams, including Lamoka and Sanford lakes, the Cohocton and Canisteo rivers, and several tributary streams (Greeley 1938). The species remains common and widespread in lakes and larger streams of this watershed.

Susquehanna (1,2,3). Banded Killifish were found in streams and lakes but were absent from headwater areas in the 1935 survey (Greeley 1936). This species occurred at about 2% of stream sample sites in both the 1935 survey and in surveys conducted over the last two decades.

Delaware (1,2,3). Greeley (1936) reported that Banded Killifish were present in both streams and lakes and that high population densities were observed in the main channel of the Delaware River near Port Jervis in spring. The species remains common and widely distributed at low and mid-elevation sites.

Upper Hudson (1,2,3). During the 1932 survey, this fish was common in many ponds of the Sacandaga and Schroon River basins and in protected areas of the Upper Hudson's main channel (Greeley and Bishop 1933). Banded Killifish are now more widespread and are found throughout the watershed, even at higher elevations, such as a record from Piseco Lake in 1994 (NYSM 43652).

Mohawk (1,2,3). This species was widely distributed throughout the watershed and was occasionally locally abundant during the 1934 survey (Greeley 1935). Recent records exist from the Mohawk River (from its mouth to Oriskany Creek) and also from several tributaries. There are only two reports of this species at higher-elevation sites in the Catskill or Adirondack mountains at Gooseberry and Middle Sprite creeks.

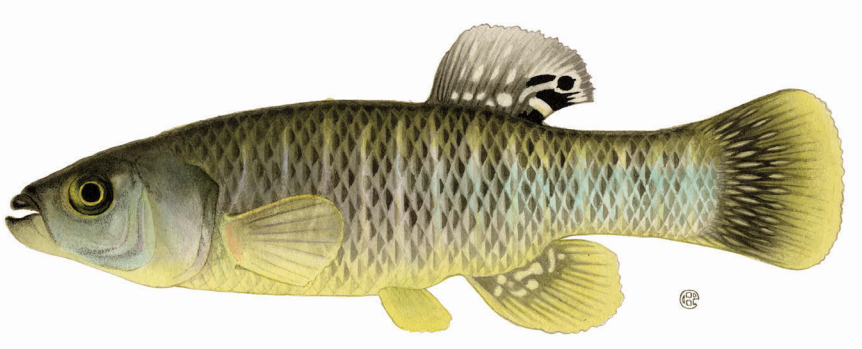
Lower Hudson (1,2,3). Greeley (1937), in his account of this species, reported that "although most numerous in tidewater areas, it also inhabits a number of lakes, reservoirs and streams well up from mouths. Its range extends into salt water. Mearns [1898] recorded this species from several ponds of the Hudson Highlands region." Banded Killifish remain common in this system, particularly in the main channel but also in ponds and tributary streams.

Species continued on next page

Newark Bay (1,2,3). This species was present in 20% of the samples taken during the 1936 survey (Greeley 1937) and remains common in the watershed, where it is particularly abundant in ponds. It has been collected in most of the larger water bodies, including Greenwood, DeForest, Rockland and Sterling lakes, the Ramapo River, and Nauraushaun Brook.

Long Island (1,2,3). Greeley (1939) listed the Banded Killifish as common and wide ranging, noting that it was more numerous than any minnow species, effectively replacing that family of primary fishes on these islands. It continues to be frequently encountered and locally abundant in this watershed.

Fundulus heteroclitus, Mummichog

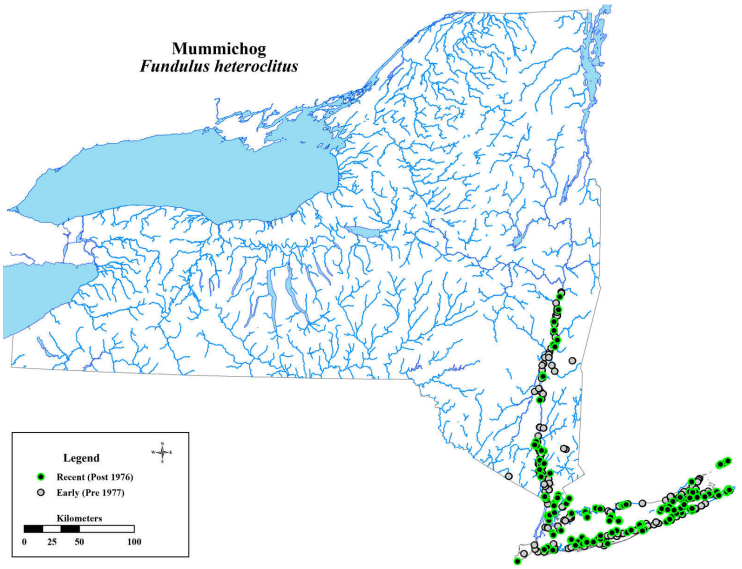


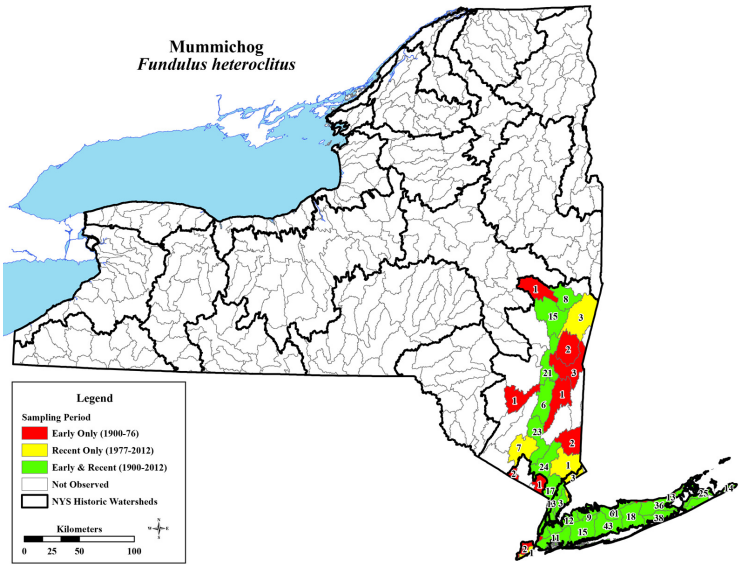
This sexually dimorphic species occurs in streams and ponds of the Long Island watershed and in the Hudson River Estuary. It is often associated with aquatic vegetation. Although primarily a brackish water species, some populations are completely limited to freshwater.

Lower Hudson (1,2,3). Greeley (1935) reported that the majority of watershed survey catches were from the tidewater and upper estuary region, although specimens were also caught in Round and Copake lakes. In the 1936 survey, Mummichogs were reported at 65 sites, most in the tidewater and lower estuary portion of the river (Greeley 1937). There are isolated populations in Sparkill Creek, Stockport Creek, and a few reservoirs and lakes.

Newark Bay (**1**). Mummichogs were present in Greenwood (NYSM 34349) and Rockland (NYSM 19639) lakes in 1936, where the species was probably introduced (Greeley 1937).

Long Island (1,2,3). This killifish was not abundant at most of the freshwater stream and pond sites where it was collected in the 1938 survey, except at Brownings Lake, where the species was reported to be common (Greeley 1939a). Greeley (1939a) also reported that Mummichogs were present in Staten Island stream collections. Specimens were also collected from stream basins of Westchester County in 1936 (e.g. NYSM 34325). There is an isolated population in the Bronx River (Saramitan and Schmidt 1982) and in several ponds on Long Island and Fishers Island.





Poeciliidae, Livebearers

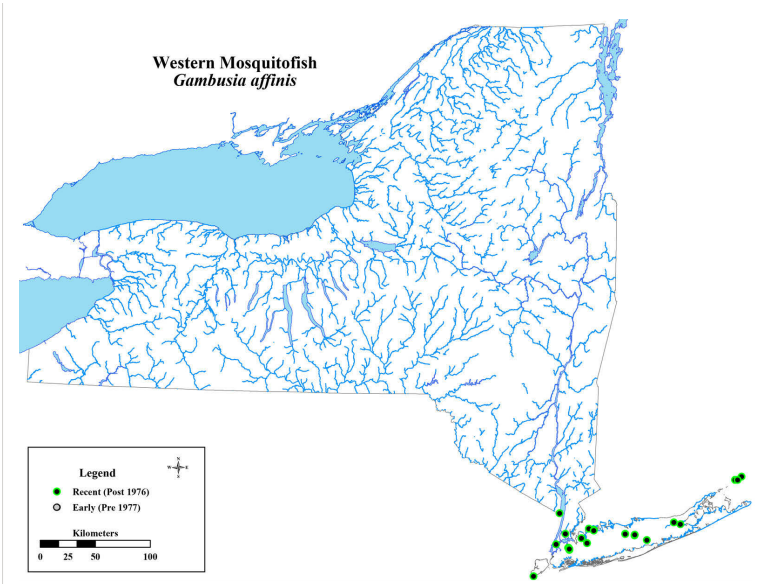
Most of the species in this family, as the common name suggests, carry embryos and release live young. There are over 300 species in the family, and representatives are found in North and South America and Africa. These species are similar in appearance to killifish, but males often have a modified anal fin, or gonopodium, which is used for insemination. No members of this family are native to New York although the natural range of the Eastern Mosquitofish (*Gambusia holbrooki*) reaches into New Jersey (Page and Burr 1991).

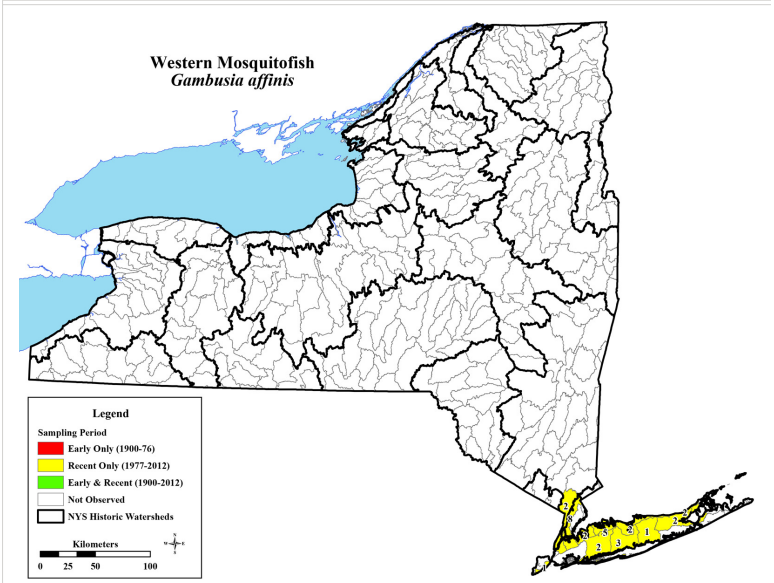
Gambusia affinis, Western Mosquitofish

This fish lives in quiet backwaters, ditches, and ponds. It is native to the southern and midwestern United States. Since 1979, the species has become established in two watersheds near New York City. It is particularly difficult to assess the range of this fish in the state for two reasons. Because stock is available commercially, mosquitofish can be introduced into any pond at any time. Secondly, this species is apparently intolerant of northern winters, but the degree of intolerance varies with the source population. Thus, the presence of this fish in any body of water may be ephemeral. The populations discussed below are those that show some degree of persistence.

Lower Hudson (**3**). Western Mosquitofish were first caught at the mouth of Sparkill Creek in 1992 (Mills et al. 1997, Stevens and Schmidt 1993), and J. Rosko (Saint Thomas Aquinas College, pers. comm.) reported additional captures in 1998 and 2000. The species has also been collected from ponds in Central Park, New York City, in 1982 (AMNH 223644), 2002 (NYSM 55967), and 2003 (NYSM 55262).

Long Island (**2,3**). The earliest record in this watershed is from Lake Ronkonkoma in 1979 (AMNH 44917), where mosquitofish were again collected in 2009 and 2010 (NYSM 65241 and 66276, respectively). On Fishers Island, specimens were collected from Barleyfield Pond in 1991 and 1994 (NYSM 41494, 43602). This species has been collected sporadically from ponds and ditches in Queens, Nassau, and Suffolk counties from 1979 through 2013. There are also records from the Bronx River in 2003 (Rachlin et al. 2007).

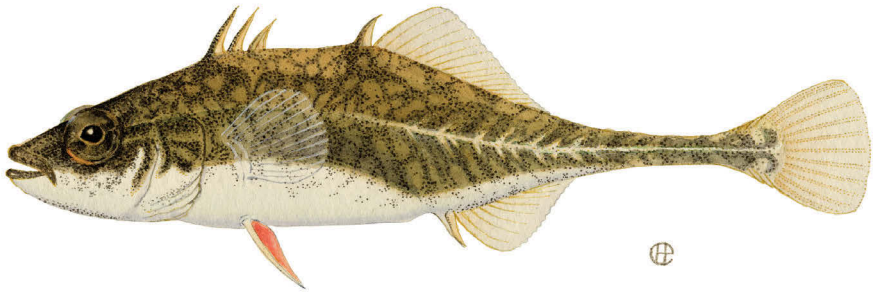




Gasterosteidae, Sticklebacks

The sticklebacks are small fish with stout dorsal, anal, and pectoral-fin spines. The family contains few species but ranges throughout the northern hemisphere. In New York, one species is strictly freshwater and is present in most watersheds. The other three species are found in fresh, brackish, and marine waters. The freshwater populations of the marine species have extremely limited ranges. All are native to the state.

Apeltes quadracus, Fourspine Stickleback



This species lives in the ocean and in coastal streams, like the Hudson River. Individuals have been collected in tributaries of the Hudson River as far upriver as the City of Hudson. Favored habitats include dense vegetation and cool water.

Upper Hudson (1). The only record from this watershed is from the Hudson River near Waterford in 1934 (NYSM 3322). Although Greeley (1935) noted that this was an extension of the range of this species, it is more likely that this individual was a stray rather than a resident of the area. Depending upon the size of the downriver population, it is possible that Fourspine Sticklebacks continue to stray into this watershed occasionally, but documenting their presence would be difficult and would mostly be based on luck.

Lower Hudson (1,2,3). Greeley (1935, 1937) noted that this species was moderately common during the watershed surveys, being collected at 70 sites in the main channel of the Lower Hudson and in the lower reaches of tributaries, mostly in tidewater areas. Its range in this watershed extended from the mouth of the Hudson River to Green Island near Troy as well as into the Normans Kill. The exceptions to the tidewater rule were a number of collections in 1934 from Kinderhook Lake (NYSM 3372) and Mud Creek in the Claverack Creek basin (NYSM 3374). The Mud Creek population is isolated and has persisted, with collections in 1987 (NYSM 26349) and 2003 (NYSM 55396). In recent years, the frequency of occurrence and abundance of this species has declined (Strayer et al. 2004, Daniels et al. 2005, R. Adams, NYSDEC, New Paltz, pers. comm.).

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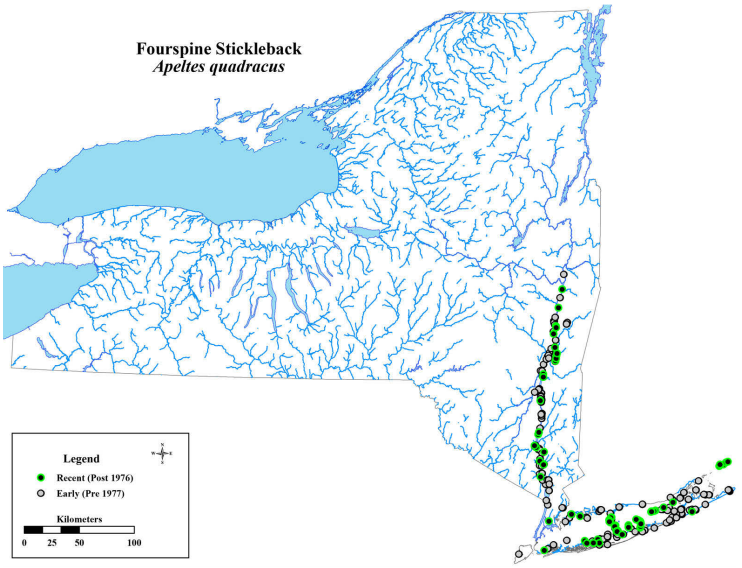
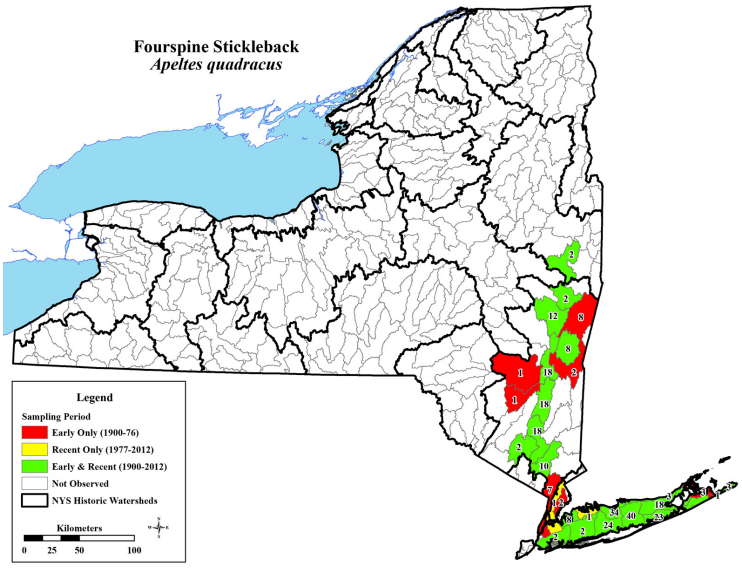
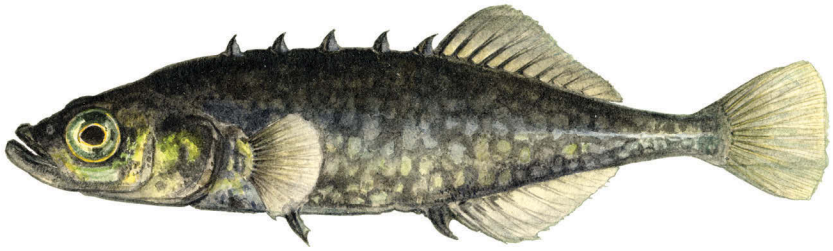


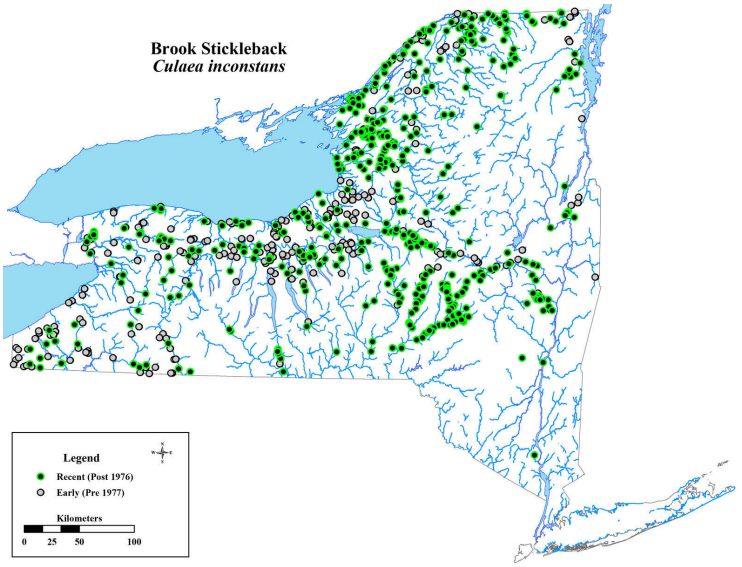


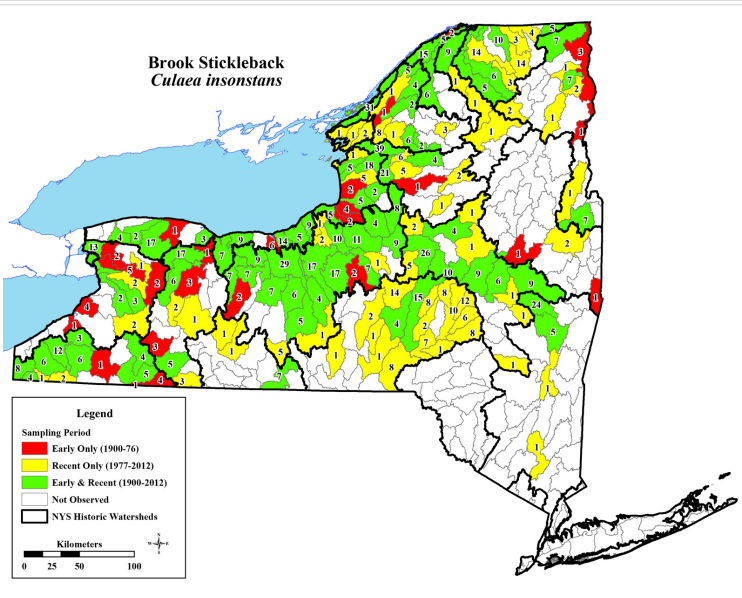
Long Island (1,2,3). Greeley (1939) reported that Fourspine Sticklebacks maintained resident populations in weedy areas of many streams and a few ponds and were also present in small, temporary waters, like ditches. The species continues to be found at many sites on Long Island, but all recent freshwater collections have been from Suffolk County. Individuals were collected from some Westchester County streams, such as the Mamaroneck River, in 1936 (NYSM 3351) and have recently been found in the Bronx River (Rachlin et al. 2007, NYSM 52615). Specimens were collected at several freshwater sites on Fishers Island in the early 1990s (e.g., NYSM 6284).

Culaea inconstans, Brook Stickleback



This freshwater stickleback inhabits ponds and slow-moving creeks with clear, cool water and thick vegetation. It has been reported from all of New York's watersheds, with the exceptions of the Delaware, Newark Bay, and Long Island watersheds. The species is relatively rare in the watersheds of the Hudson River drainage.





Allegheny (1,2,3). Brook Sticklebacks were found at 26 stream sites or 6.5% of the sites sampled during the 1937 survey in all three basins of the watershed (Greeley 1938). Individuals can still be consistently caught in all three basins, albeit with relatively low abundance.

Erie-Niagara (1,2,3). Greeley (1929) mentioned that this species was common in the watershed, particularly in the Niagara River and Tonawanda Creek systems. Recent reports are relatively rare, but specimens have been collected from the same general area, for example, from Cayuga Creek in 1981 (AMNH 227174) and in 2001 (NYSM 52830).

Ontario (1,2,3). Brook Sticklebacks were collected at 29 sites in 1939, leading Greeley (1940) to describe the species as "widely distributed but not very common." Its status is unchanged; it remains widely distributed and relatively rare.

Genesee (1,2,3). This stickleback was listed as locally common and was collected from both downriver (Black Creek and its tributaries) and upriver (Browning Cove) sites during the 1926 survey (Greeley 1927). Recent collections from Spring Creek (NYSM 54294) and the upper Genesee River (AMNH 224499) document its continued presence at both upriver and downriver sites.

Oswego (1,2,3). Greeley (1928) reported that this species was found throughout the watershed and was largely confined to weedy streams and ponds but that it was also found in lakes in both shallow and deep water. Its current status in the watershed is unchanged from this earlier assessment.

Black (1,2,3). This fish was common during the 1931 survey of the watershed, particularly at lowland sites, but was also found at elevations of up to 500 m, although it was not common at Adirondack sites (Greeley and Bishop 1932). The species continues to be common at lowland sites and is now more widespread at higher elevations.

Species continued on next page

Saint Lawrence (1,2,3). Brook Sticklebacks were found in all of the tributaries of the Saint Lawrence River but not in the river itself except near the mouth of Polly Brook (Greeley and Greene 1931). Greeley and Greene (1931) also mentioned that no specimens were found in any Adirondack stream or pond. The species has become more widespread in recent times and is now found in the Saint Lawrence River (NYSM 45852) and rarely in the Adirondacks, including a record from DeBar Pond in 1980.

Oswegatchie (1,2,3). During the 1931 survey, Brook Sticklebacks were found in small, weedy creeks and occasionally in larger rivers but never at altitudes higher than 250 m (Greeley and Bishop 1932). There has been little change in the species' range and abundance in recent decades.

Raquette (1,2,3). This species was locally common and present in lowland creeks and ponds during the 1933 survey (Greeley 1934). In recent decades, its range has expanded to include multiple upland sites.

Champlain (1,2,3). This fish was uncommon during the 1929 watershed survey, but, in contrast to other watersheds where it was a lowland species, it was found in small, slow, headwater streams in the Great Chazy, Mettawee, and Little Ausable River basins, where some sites were "thickly populated with this tiny fish" (Greeley 1930). Brook Sticklebacks remain rare in the watershed but were taken from Lake George in 1964 (NYSM 51191) and continue to be found in the Great Chazy and Little Chazy rivers.

Chemung (1,2,3). Greeley (1938) recorded Eldridge Lake as the only watershed survey capture locality. There have been six additional collections more recently, demonstrating that this species currently has a wider range within the watershed but continued low abundance.

Susquehanna (1,2,3). Brook Sticklebacks were found at two sites during the 1935 survey in the extreme headwaters of the Unadilla River and its tributary, North Winfield Creek (Greeley 1936). The range of this species has expanded since the 1930s, however. Smith (1985) reported catches from Genegantslet Creek and the upper Unadilla River. Individuals were reported from Fly Creek (Chenango County) in the 1970s and from the headwaters of the Chenango River in the 1990s. In surveys conducted in the 2000s, this fish was found at 10% of the stream sample sites.

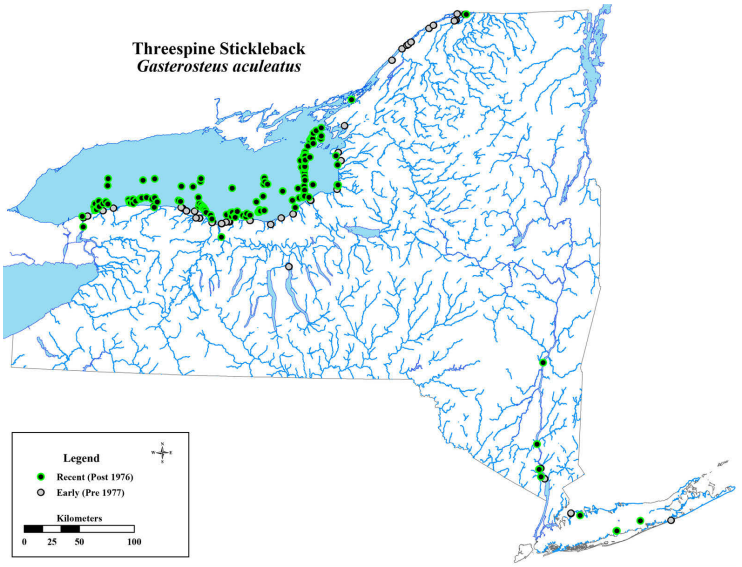
Upper Hudson (1,2,3). The Brook Stickleback is rare in this watershed. To date, specimens have only been collected four times. These include records from the Little Hoosic River in 1934 (NYSM 3217), a tributary of the Sacandaga River in 1956, Heath Brook in 1993, and a tributary to the Champlain Canal at Fort Edward in 2007.

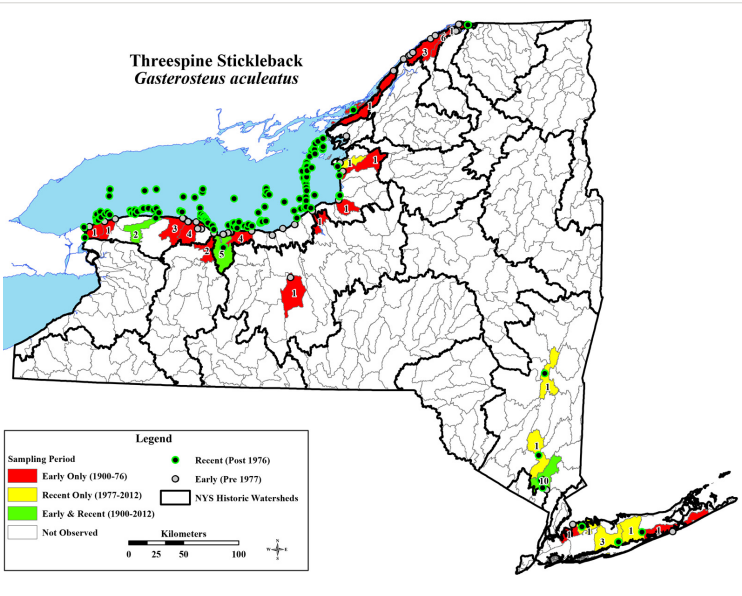
Mohawk (1,2,3). Greeley (1935) listed this species as rare but present at a few lowland sites in the Mohawk River and the downstream reaches of its tributaries as well as in remnants of the old Erie Canal. Brook Sticklebacks remain relatively rare in this watershed, but more recent collections span lower elevation sites from the Alplus Kill near its mouth (NYSM 69219) to Oriskany Creek (NYSM 50073).

Lower Hudson (1,2,3). During the 1934 survey, this species was found in a few low-velocity streams in Albany County (Greeley 1935). It continues to be collected from these streams and has also been reported from Round Pond, which is a higher-elevation pond in Orange County, the Hudson River at Nyack (AMNH 223859), and Sparkill Marsh (AMNH 223842).

Gasterosteus aculeatus, Threespine Stickleback

This wide-ranging species lives in the ocean and coastal streams, with inland populations existing in a few large lakes. In New York, it has been reported from six watersheds in both coastal streams and inland lakes. Because of its wide distribution, the status of this species is difficult to assess. It is extirpated from at least one of the lakes in which it historically occurred and may be declining in marine systems (not considered in this atlas), but populations appear to be stable in other areas.





Ontario (1,2,3). Wright (2006) collected this species at several near-lake sites in 1903-1905, and it had been recorded even earlier by Evermann and Kendall (1901). Threespine Sticklebacks were taken at 12 sites in this watershed in 1939 and were present in large numbers at the mouth of the Niagara River, causing Greeley (1940) to opine that "probably it ranges over much of Lake Ontario." After sampling extensively in the lake, Owens et al. (2003) concluded that this fish is still abundant there.

Genesee (1). This species was collected at the mouth of the Genesee River during the 1926 watershed survey (Greeley 1927). Specimens have not been recently collected in this area even though suitable habitat appears to be available.

Oswego (1,2). Greeley (1928) reported that this stickleback was "common at the mouth of the Oswego River but has not been found above the first dam at Oswego." A 1966 record from Cayuga Lake (NYSM 43257) lacks specific locality data. Between 1956 and 1961, Threespine Sticklebacks were reported in four collections from upstream sites in Yawger and Big Salmon creeks, which are tributaries of Cayuga Lake. Although this is a distinctive and easily identifiable fish, these sites are upstream of impassable barriers and no voucher specimens were retained. Because these identifications are suspect, we do not include these sites on the map even though it is possible that this species was introduced into these creeks and lived in them for several years. If populations were, in fact, ever present at these sites, they appear to be extirpated.

Saint Lawrence (1,2,3). Greeley and Greene (1931) found Threespine Sticklebacks in the main channel of the Saint Lawrence River and at the mouths of tributaries, such as the Grass River, where specimens were also found as far upstream as Massena (UMMZ 95667). The lack of many recent collections suggests that this species is rare in the watershed. Specimens

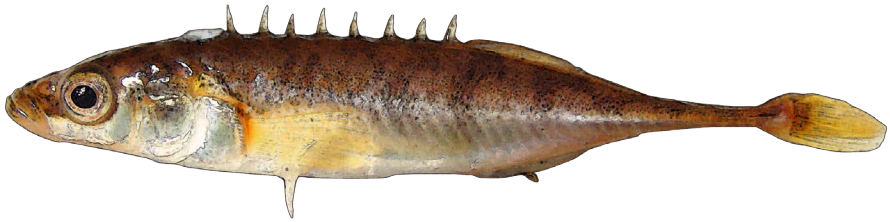
Species continued on next page

were more recently collected from the Saint Lawrence River near Little Sucker Brook in 1976 (NYSM 42577). Dunning et al. (1978) also reported this species from the Thousand Islands area and in 2003, it was collected near Wellesley Island (NYSM 55618).

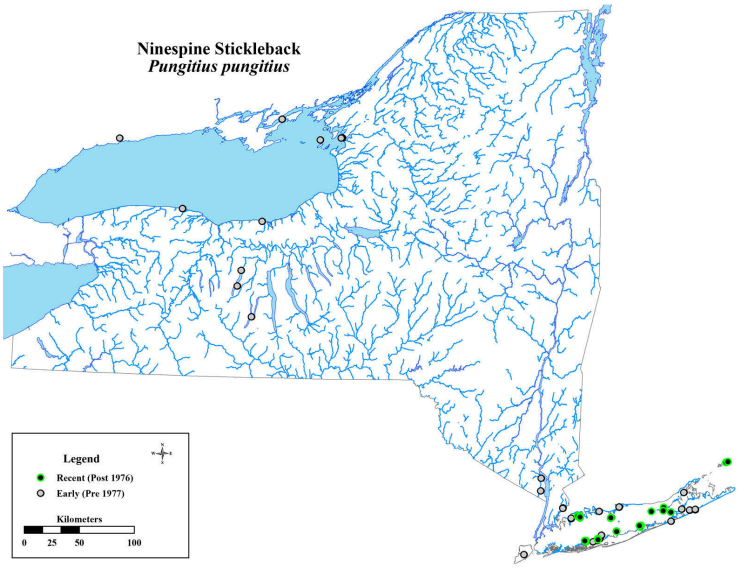
Lower Hudson (1,2,3). No specimens were collected from this watershed in the 1936 survey (Greeley 1937), but DeKay (1842) reported that he had "noticed" Threespine Sticklebacks in freshwater as far inland as Albany. The species was collected as far inland as rkm 100 in the 1970s (usually adjacent to a power generating station), and many specimens are in the collections at the NYSM. The last recorded catch was a specimen from the Hudson River near Beacon in 1988 (NYSM 45609).

Long Island (2,3). This species was not reported from any freshwater site sampled during the 1938 watershed survey (Greeley 1939a), although there were a number of marine catches recorded. The earliest record is from the Connetquot River in 1956 (CUMV 30276). More recently, Threespine Sticklebacks have been taken from the Carmans River, Connetquot River, and Mill Pond Creek. The species was still found but remained uncommon in marine tidewater areas (Malaty 2014) and marine bays from 1984-2011 (R. McDonald, NYSDEC, pers. comm.).

Pungitius pungitius, Ninespine Stickleback

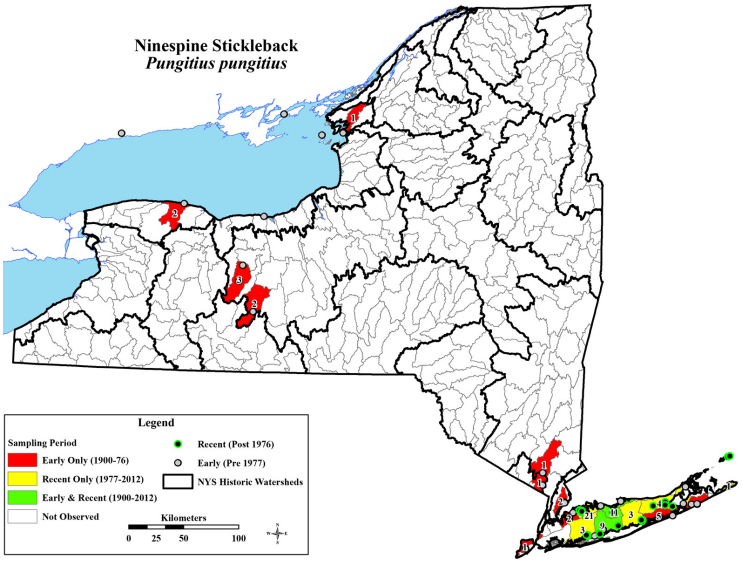


This species, which is found in Asia, Europe, and North America, lives in the ocean, coastal streams, and inland lakes. In New York, it has been found in three inland lakes, but no individuals have been captured recently. Records from coastal areas date back to the 19th century and continue to be generated from the coastal streams in the Long Island watershed.



Ontario (1,2). In 1931, specimens were collected from Sherwin Bay (NYSM 3289) and near the international boundary southwest of Cape Vincent (NYSM 3287). In 1939, Greeley (1940) caught no Ninespine Sticklebacks, but he nonetheless listed the species in his watershed survey report due to a few specimens that washed up on the beaches near Yanty Creek in Monroe County (CUMV 7222). There are additional records from the Canadian side of the lake in 1928 and 1946. The lack of any additional records in almost 70 years would appear to indicate that the species is extirpated from this watershed.

Oswego (1,2). Greeley (1928) reported that two specimens were removed from the stomachs of Lake Trout taken from deep water in Canandaigua Lake. Dead individuals were collected at the lake surface in 1971 (Eaton and Kardos 1972). There are numerous collections from multiple sites on Keuka Lake from the late 1930s and early 1940s, and these specimens are accessioned into the fish collection at the CUMV. No Ninespine Sticklebacks have been found in this watershed since 1941.



Lower Hudson (2). The single record for this watershed is a specimen from the Hudson River at Haverstraw Beach in 1954 (CUMV 26314).

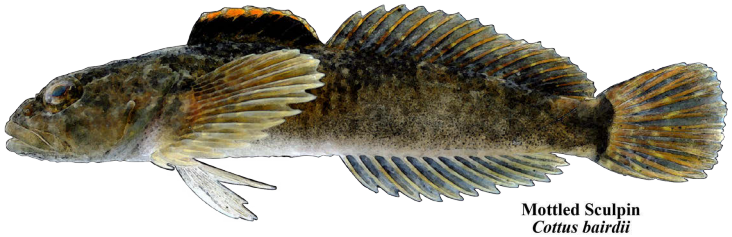
Newark Bay (1). Bean (1903) reported in a footnote that this species was recorded from the Hackensack River.

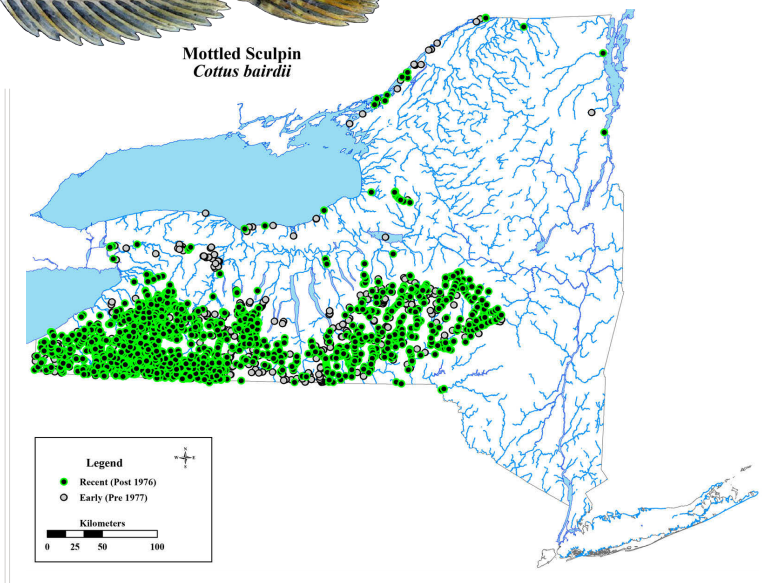
Long Island (1,2,3). During the 1938 watershed survey, Ninespine Sticklebacks were reported from the lower sections of streams (primarily in Suffolk County) but were also present in the Carmans River in Nassau County and on Staten Island (Greeley 1939a). A single specimen was also collected from the Mamaroneck River in 1936 (NYSM 3291). More recent catches include records from Beaver Brook (Nassau County), Alley Pond (Queens County) in 2012 (NYSM 68344), and several streams in Suffolk County as recently as 2011 (NYSM 66984). In the early 1990s, this species was also found in several ponds on Fishers Island (e.g., NYSM 6285).

Cottidae, Sculpins

Sculpins are found in freshwater, brackish, and marine environments. This is a large family of fishes, which contains species that are tolerant of a range of salinities, although most individual species are not euryhaline and rarely move between fresh and salt waters. There are four strictly freshwater species in New York, and these are the only ones included in this atlas. These species are small, demersal fish and occur throughout the state. Two are typical of mid or high-elevation streams and are occasionally found in the wave zones of lakes. The other two species are found in deep-water habitats in the Great Lakes. All are native to New York drainages but have limited ranges within the state. The two deep-water forms are rare and are protected as Threatened or Endangered species. Two other species, *Myoxocephalus aenaeus* and *M. octodecemspinosus*, episodically stray into the Hudson River and other coastal streams and may use these areas as nursery grounds, as larval fish have frequently been found there.

Cottus bairdii, Mottled Sculpin





This species typically lives in the riffles of cooler streams or in rubble-bottom areas in lakes but is also tolerant of warmer streams. It is a nesting species that requires some shelter and is, therefore, typically associated with rubble substrates. The Mottled Sculpin occurs in watersheds across central and western New York and also in the lower reaches of watersheds draining into the Saint Lawrence River. There are ten watersheds where the species is native and one area of the Delaware River system where it has been introduced and has become established. Its frequency of occurrence in streams has increased in recent years, but its overall range appears unchanged. Mottled and Slimy Sculpins are similar in appearance and are often difficult to identify positively without careful examination. As a result, misidentifications are not uncommon.

Allegheny (1,2,3). Greeley (1938) reported catches at 20% of the watershed survey sample sites, which were in either cold or cool waters. This species was a common inhabitant of the small tributaries of the entire drainage and occurred farther upstream than any other species (Liegey et al. 1955). In recent stream surveys, Mottled Sculpins were collected at 46% of the sites sampled and were found in both small and large tributaries. There are only seven records from lakes throughout the watershed, but none of these is more recent than 1959.

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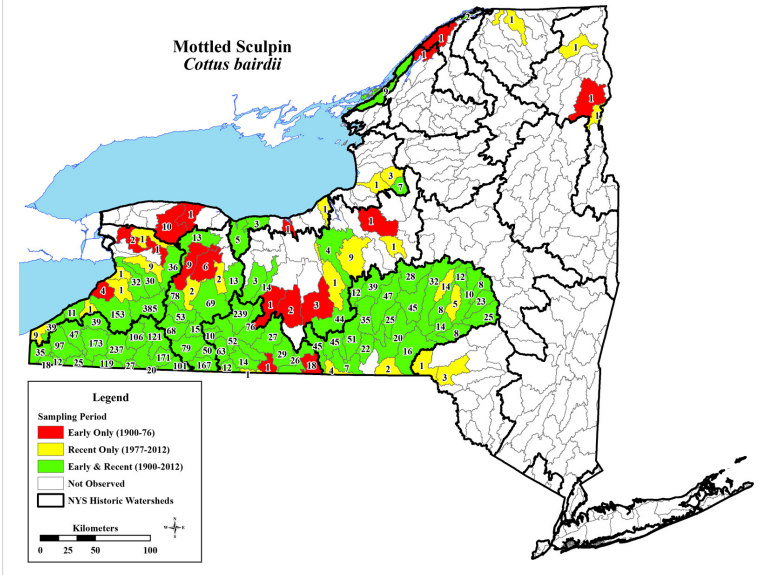


Erie-Niagara (1,2,3). This species was common in streams and particularly in headwater creeks during the 1928 survey, and it was also found in both shallow and deep waters in Lake Erie and the Niagara River (Greeley 1929). It remains abundant and widespread in streams but is now absent from Lake Erie.

Ontario (1,2,3). Greeley (1940) suspected that the abundance of this species was underestimated because it occurred in deep water, which was not routinely sampled (at least not late in the season). He (Greeley 1940) noted that until June, individuals were taken at creek mouths. Collections from tributaries included the mouths of streams in Wayne County (Bear, Salmon and Third creeks) and Monroe County (Mill, Fourmile and Shipbuilder creeks). More recently, Mottled Sculpins have been collected from eastern tributaries like the Salmon River in the 1980s and 1990s and the North Branch Salmon River in 2006 (NYSM 61283). The species has occasionally been caught in Lake Ontario trawls at depths greater than 25 m but is considered rare (R. Owens, USGS Oswego, pers. comm.).

Genesee (1,2,3). During the 1926 survey, this species occurred in warm and cold waters but seemed to avoid large streams, such as the Genesee River (Greeley 1927). It continues to be abundant and widespread in this watershed.

Oswego (1,2,3). Greeley (1928) noted that Mottled Sculpins were moderately common in the southern and eastern part of the watershed, occurring in rocky streams and in Cayuga, Seneca, Keuka, Canandaigua, and Oneida lakes. The frequency of occurrence of this species in streams was low (5%) from 1996-2010.

Saint Lawrence (1,2,3). This species was collected from shallow water in the main channel of the Saint Lawrence River in both 1930 and 1931, but it was relatively rare (Greeley and Greene 1931; Greeley and Bishop 1932). It remains rare in this watershed, but it was collected from the Salmon River at Westville Center in 2007 (NYSM 62834) and Chippewa Creek near Hammond in 2009 (NYSM 65495).

Champlain (1,2,3). Mottled Sculpins were rare in 1929 watershed survey catches. Greeley (1930) noted that two specimens were taken in Lake Champlain near Port Henry in May “and a third specimen was taken from the stomach of an eel.” None were caught during the summer, so Greeley (1930) speculated that the species probably lives in deep water. More recent collections exist from Lake Champlain (e.g., NYSM 16791) and McKenzie Brook (NYSM 46740) in the mid-1980s and from the mouth of the Saranac River in 2004 (NYSM 57507).

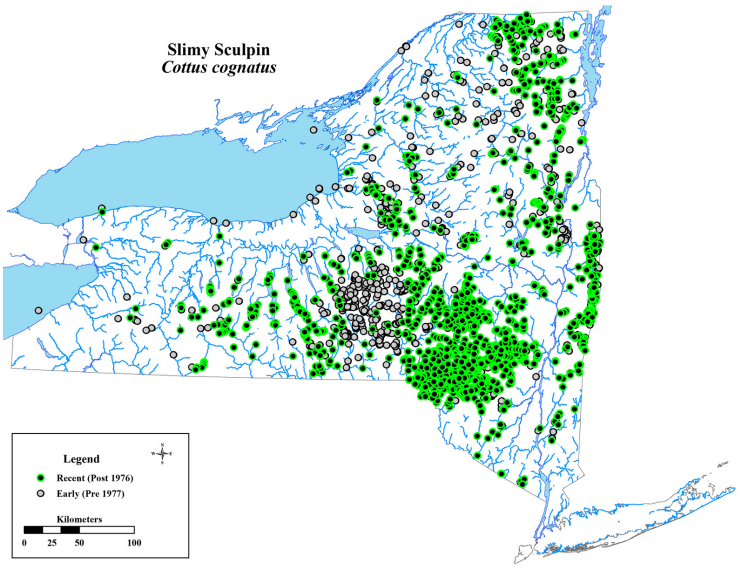
Chemung (1,2,3). This species was collected at 25% of the sample sites in the 1937 survey (Greeley 1938) and remains abundant and widespread throughout the watershed.

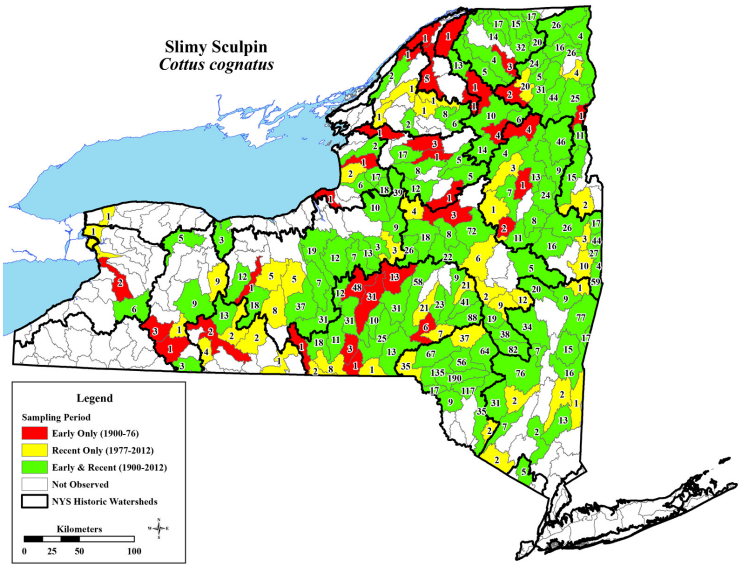
Susquehanna (1,2,3). Mottled Sculpins were found in streams throughout the watershed during the 1935 survey (Greeley 1936). Individuals were found at 23% of the stream sites sampled in 1935 and at 45% of sites sampled in surveys conducted from 1996-2010.

Delaware (**3**). This fish was not collected from this watershed in the 1935 survey (Greeley 1936). Argent et al. (1997b) reported that it was present in Shehawken Creek in Pennsylvania, which is just across the state line from Hancock, New York. In 1998, specimens were collected from the West Branch Delaware River at Hancock (USNM 354883). The species was later reported from the East Branch Delaware River and near the mouth of Cadosia Creek in 2005 and 2006 (NYSM 60887). Sculpins are sometimes used as bait, which may explain how this species gained access to the watershed.

Cottus cognatus, Slimy Sculpin

This sculpin lives in coldwater streams and lakes, generally in riffle habitats with mixed gravel-rubble substrate. It is a nest-guarding species and requires some water flow and shelter. The Slimy Sculpin occupies deeper areas of the Finger Lakes and Lake Ontario and is among the few species found in headwater streams. It occurs in all of New York's watersheds except for the Allegheny and Long Island but is uncommon in the lake plains and rarely found at lower elevations.





Erie-Niagara (1,2). According to Greeley (1929), "the only definite records for Lake Erie are those collected from deep water by the lake survey party," which were later identified by Marie Poland Fish. Slimy Sculpins have not been reported from Lake Erie in recent years (Ryan et al. 1999). There are six more recent reports from this watershed, including specimens from the Cattaraugus Creek basin collected between 1962 and 1981 (e.g., AMNH 226747). These recent results suggest a range loss in this watershed.

Ontario (1,2,3). In the 1939 survey, this sculpin was found in trout streams of the Salmon River system at elevations between 300 and 400 m. Many individuals were caught in Lake Ontario during extensive sampling in subsequent years, but numbers have declined in the southeast portion of the lake since the 1990s. This was related to lower productivity and colonization by dreissenid mussels (Owens et al. 2003) and to predation by lake trout (Owens and Bergstedt 1994). This species continues to be the most regularly caught sculpin in the eastern Lake Ontario eastern basin, and it also continues to be found in eastern tributaries.

Genesee (1,2,3). Fowler (1907) reported the presence of Slimy Sculpins in the Genesee River at Gold, PA. Because of this record, Greeley (1927) opined that the species should also occur in the New York portion of the watershed, although no specimens were taken during survey work. This species has been caught infrequently and only in headwater streams, such as a tributary of Hemlock Creek in 1948 (NYSM 50116).

Oswego (1,2,3). This species was collected from several Finger Lakes and the headwaters of Oneida Lake tributaries during the 1927 watershed survey (Greeley 1928). Based on recent collections, this sculpin continues to inhabit cold streams in most parts of the watershed. Its frequency of occurrence in streams was 3% from 1996-2010.

Species continued on next page

Black (1,2,3). Greeley and Bishop (1932) noted that Slimy Sculpins were moderately common but limited to upland streams; Big Moose Lake was the only lake where specimens were found. This species continues to be a common stream dweller at upland sites in the watershed and is now also found in many upland lakes.

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported: "We have not taken *Cottus cognatus* in any but cold waters, where temperatures were suitable for brook trout. It is widely distributed through the Adirondacks and specimens were taken in many ponds and streams of all major stream systems. It is mostly absent in lower sections of the streams, near the St. Lawrence River." There are three records from western tributaries during the 1930s but none in recent decades. The species is still common and widely distributed in eastern tributaries, however, such as the Saint Regis and Salmon River basins.

Oswegatchie (1,2,3). During the 1931 survey, this species was only found in upland streams and Cranberry Lake (Greeley and Bishop 1932). Now, it is relatively widespread in this watershed's cold-water streams.

Raquette (1,2,3). Slimy Sculpins were primarily found in cold-water streams during the 1933 survey but were also present in lakes, including individuals that were taken in a trap at 21 m in Blue Mountain Lake (Greeley 1934). The species is currently relatively widespread in the cold-water streams of the upper watershed.

Champlain (1,2,3). During the 1929 survey, this sculpin was common in the cool waters of the Great Chazy, Saranac, and Ausable River basins, as well as in Lake George and its tributaries (Greeley 1930). It remains relatively widespread in northern tributary systems but has only been taken three times in the southern counties since 1985 (e.g., NYSM 57346).

Chemung (1,2,3). The Slimy Sculpin is rare in this watershed and is limited to headwater areas. Greeley (1938) noted that survey specimens were taken from Cold Spring Brook, in the Cohocton River system. Twenty-four records exist from 1960-2012, but only two specimens were vouchered for later confirmation. Specimens were taken from Meads Creek in 1998 (USNM 353045) and 2002 (NYSM 52844).

Susquehanna (1,2,3). Greeley (1936) reported that this species was present in cold-water streams and Otsego Lake but was less common in the watershed than the Mottled Sculpin. It was present at about 3% of the stream sites sampled in recent decades, mostly in headwater areas, and continues to be less abundant and less widespread than its congener.

Delaware (1,2,3). This was the predominant fish in many headwater streams throughout the watershed during the 1935 survey (Greeley 1935). Slimy Sculpins continue to be widespread and frequently caught in both the main channel of the Delaware River and its tributaries.

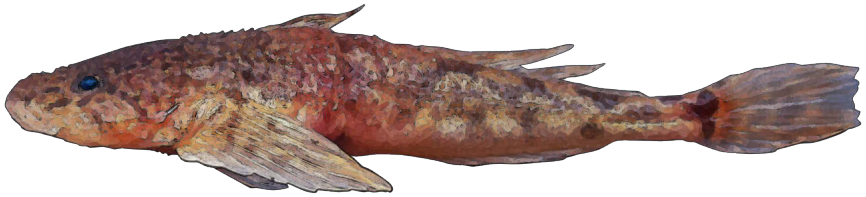
Upper Hudson (1,2,3). During the 1932 survey, this species was present in trout streams and cold-water lakes, but its distribution within the watershed was spotty (Greeley and Bishop 1933). In recent decades, it has expanded its range to include most of the cold-water areas in the watershed.

Mohawk (1,2,3). Greeley (1935) listed this species as locally common but restricted to cold water, reporting collections from streams of the upper Mohawk River, Oriskany and Steele creeks, tributaries of West Canada Creek, and several streams of the Schoharie Creek basin. It continues to be widespread and present in many of these same waters.

Lower Hudson (1,2,3). The distribution pattern of this cold-water species in the 1936 survey of this watershed was typical of that seen in other watersheds, where it was primarily a headwater fish but was also found in spring-fed streams, some of which are at low elevations (Greeley 1937). Slimy Sculpins continue to inhabit cold-water sites and to be relatively widespread throughout the watershed.

Newark Bay (2,3). Reports exist from Stony and Torne in 1962, 1993, and 1998. Recent efforts to find this species in either brook were unsuccessful.

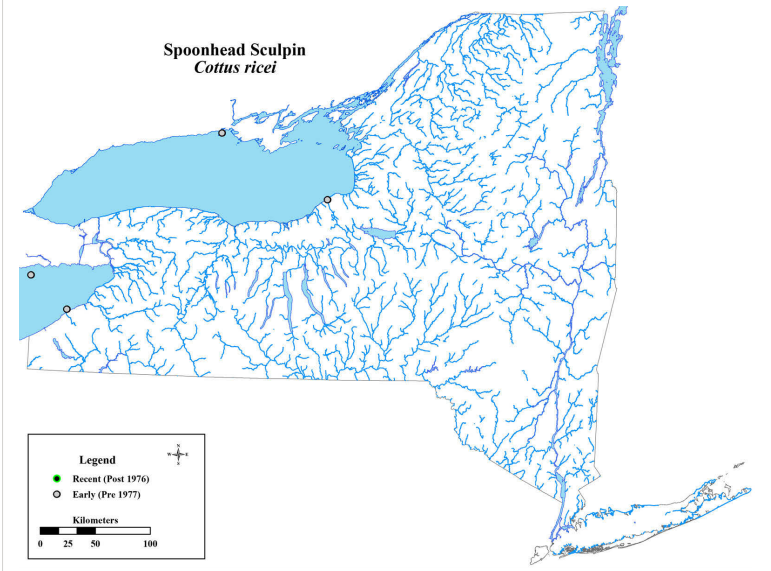
Cottus ricei, Spoonhead Sculpin

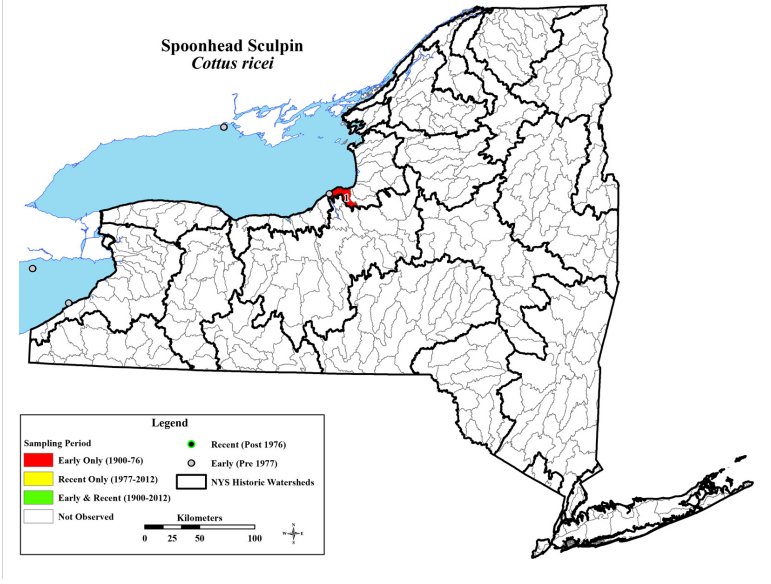


This demersal species is protected as an Endangered Species. In New York, it was historically found in Lake Erie and Lake Ontario, where it lived off shore in deep water. No specimens have been collected from the New York waters of either lake in recent years, although there are recent records from Lake Erie in Ontario provincial waters. The Spoonhead Sculpin is presumed to be extirpated from the Ontario and Erie-Niagara watersheds of New York.

Erie-Niagara. (1). Greeley (1929) reported an off-shore catch near Dunkirk, but he was referring to reports by Fish (1929, 1932), who reported the catch location farther north in Ontario. The only documented New York catch was from the stomach of a Burbot taken near Dunkirk in 1928 (Fish 1932). The last record from Lake Erie was farther west in Ohio in 1950 (Trautman 1981).

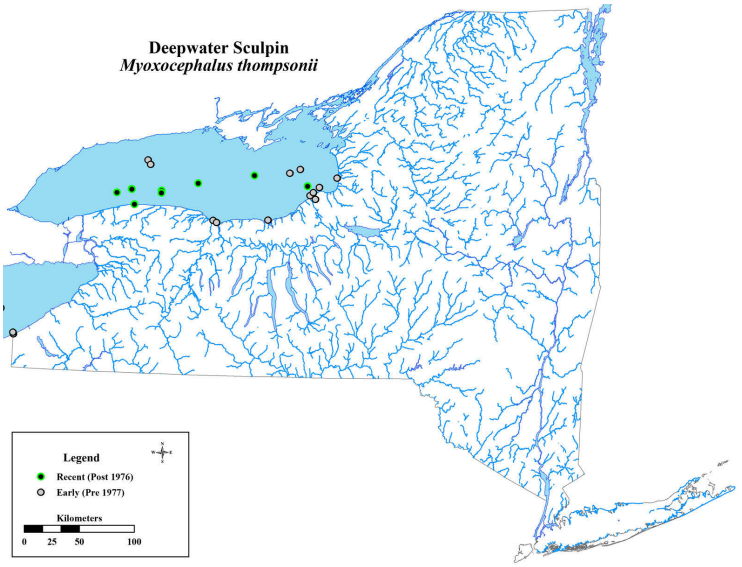
Ontario (2). Four specimens were collected from Lake Ontario off Oswego in 45-55 m of water in 1942 (CUMV 27836). These specimens have been lost, but we accept the record because the species has also been caught in the Canadian portion of the lake (Hubbs 1919, Lee et al. 1981). This is the only collection from New York waters, and the Spoonhead Sculpin is presumed to be extirpated from this watershed.





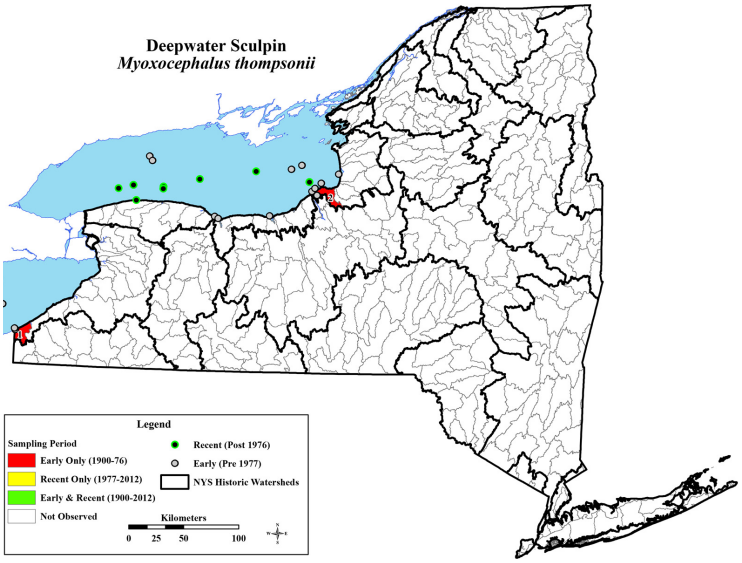
Myoxocephalus thompsonii, Deepwater Sculpin

This species lives off shore in the deep bottom waters of cold lakes. Its range in Lake Ontario is little changed from early surveys, but it has not been recently reported from Lake Erie. The Deepwater Sculpin was previously presumed to be extirpated from New York's waters but was rediscovered in 1995; it is now classified as an Endangered Species.



Erie-Niagara (1). Greeley (1929) noted that specimens identified by Marie Poland Fish were taken from deep waters in "young fish trawls." Roseman et al. (1998) reported that larval sculpin drifted into western Lake Erie from Lakes Huron and Saint Clair in 1995.

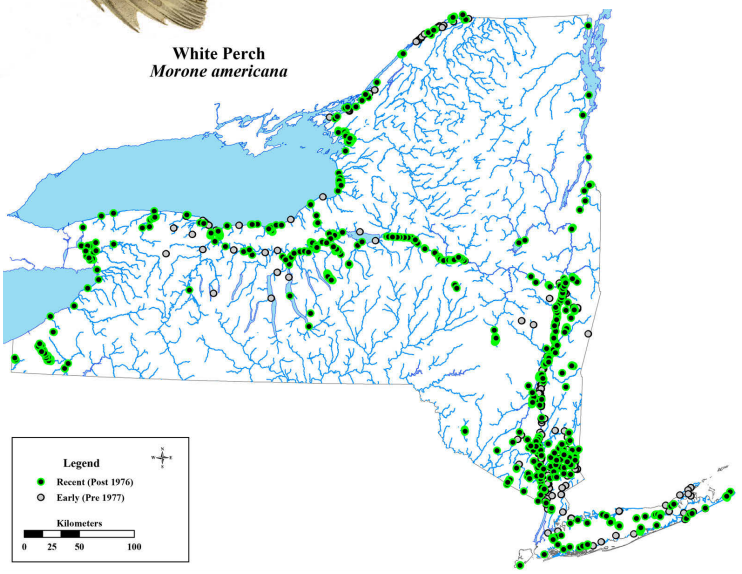
Ontario (1,2,3). Evermann and Kendall (1901) reported this species from a small creek near Nine Mile Point, and Dymond et al. (1929) noted that it was abundant in deep water. Greeley (1940) did not report any collections from the 1939 survey but mentioned a University of Rochester specimen taken from Lake Ontario off Sodus Bay at a depth of 120 m in October 1936 (CUMV 27693). From 1921-1923, several specimens were caught by W. Koelz and accessioned into the UMMZ fish collection. In 1942, U.B. Stone similarly deposited several specimens at the CUMV. Individuals were caught at three sites in Canada in a lake-wide survey in 1972 (Lantry et al. 2007, COSEWIC 2006; ROM 70627). The species was presumed to be extirpated from New York for a time because no specimens had been collected from Lake Ontario since 1972, but from 1996-2006, specimens were caught near Oswego and elsewhere (Owens et al. 2003, Lantry et al. 2007). Deepwater Sculpins have been caught more frequently in recent years, and there were uncommonly high catches in 2012 (Weidel et al. 2013, B. Weidel, USGS Oswego, pers. comm.), which suggests a gradual increase in the abundance of this species.



Moronidae, Temperate Basses

Temperate basses are important sport fish species, three of which are found in New York. The White Bass is a strictly freshwater fish, the White Perch is estuarine, and the Striped Bass is anadromous. All three tend to be large river fishes, although White Perch and White Bass also fare well in lakes. All are native to New York but have expanded their ranges in recent decades, either by migrating through canals or by stocking. A *Morone chrysops* x *M. saxatilis* hybrid has also been introduced into lakes in the state, but stocking was discontinued in 1988.

Morone americana, White Perch



This relatively small, temperate bass is a denizen of shallow, turbid areas in the few coastal rivers of the state, primarily in the Lower Hudson, Newark Bay, and Long Island watersheds. It began its westward expansion through the New York State Canal System by the mid-1930s (Smith 1985) and has also been introduced into many rivers, lakes, and reservoirs. The species is now present in 12 additional watersheds.

Allegheny (**3**). This species was first collected from Chautauqua Lake in 1987 and from Conewango Creek in 1993. In the 1990s, specimens were taken from Findley, Cuba, and Chautauqua lakes (P. McKeown, NYSDEC Olean, pers. comm.). In 2005, individuals were also taken from Cassadaga Creek near Jamestown (Daniels et al. 2006b).

Erie-Niagara (**2,3**). This fish was first reported in 1961 from the upper Niagara River. It is now abundant in Lake Erie, the Niagara River, and other large streams in the watershed, such as Tonawanda Creek (NYSM 52313).

Ontario (**2,3**). The first reported catch from this watershed was in the Bay of Quinte in 1952. Since then, White Perch have become widespread in Lake Ontario and the Erie Canal. The species has also become common in a few inland waters since 1989, such as two impoundments on Oak Orchard Creek downstream of the Erie Canal.

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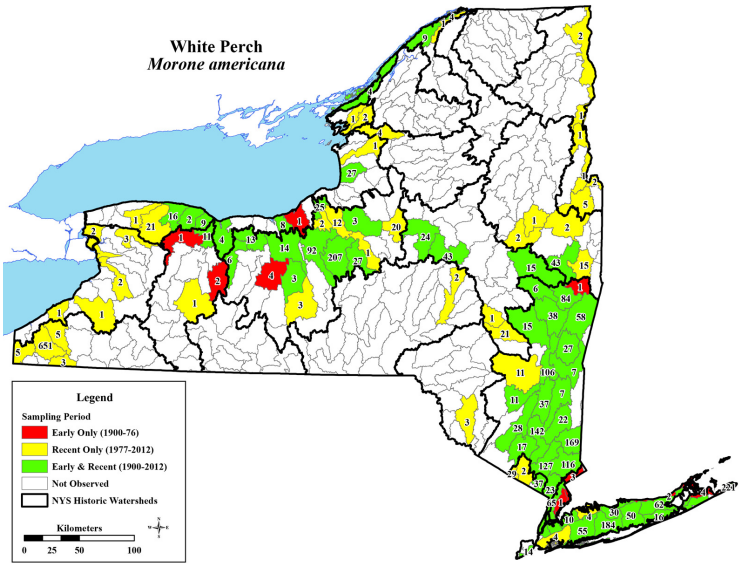


Genesee (**2,3**). In 1947, this species was reported from Godfrey Pond. It has also been taken from the Genesee River in the 1960s and Canaseraga Creek in 1990. It has not gained access to sites upstream of Portageville Falls.

Oswego (**2,3**). White Perch were discovered in Cross Lake in 1948, suggesting to Smith (1985) that the species was probably in Oneida Lake by 1946-47 as it expanded its range through the Erie Canal from the east. This fish is now established in all parts of the Canal system, such as the Clyde River and Cayuga, Seneca, and Onondaga lakes, as well as in nearby waters, including Neahtawanta and Otisco lakes and the Jamesville Reservoir.

Black (**3**). White Perch were reported from the mouth of Black River from 2001-2006.

Saint Lawrence (**1,2,3**). The earliest record from the Saint Lawrence River was from a site near Massena in 1933. The species was next reported in the 1950s and was widespread by the 1970s (e.g., NYSM 42556) but only at the mouths of tributaries, such as the Grass River (NYSM 47683).

Raquette (**3**). This species was reported from the mouth of the river in 1988. Anecdotal accounts of captures in Tupper and Raquette lakes in the 1970s are not supported with voucher specimens nor with captures in later years, and were, therefore, not included on the map.

Champlain (**2,3**). This species has been established in this watershed since 1984 (Plosila and Nashett 1990). It now is widespread throughout Lake Champlain and the Champlain Canal.

Susquehanna (**3**). A 2008 report exists from Otsego Lake.

Delaware (**3**). The White Perch is a native species in the Delaware River downstream of the New York state line in New Jersey (Arndt 2004) and Pennsylvania (Cooper 1983), but there are no records of riverine catches in New York. In 2001 and 2011-12, individuals were caught in the Swinging Bridge Reservoir, where this species may have been accidentally stocked.

Upper Hudson (1,2,3). The native range of this species in this watershed extended as far upstream as Hudson Falls. In recent years, it has been caught in the Hudson River as far upstream as Lock 1 or Campbell Island and just north of the watershed boundary in the Champlain Canal. White Perch were reported from Tomhannock Reservoir in 1991 and the Great Sacandaga Reservoir in 2007.

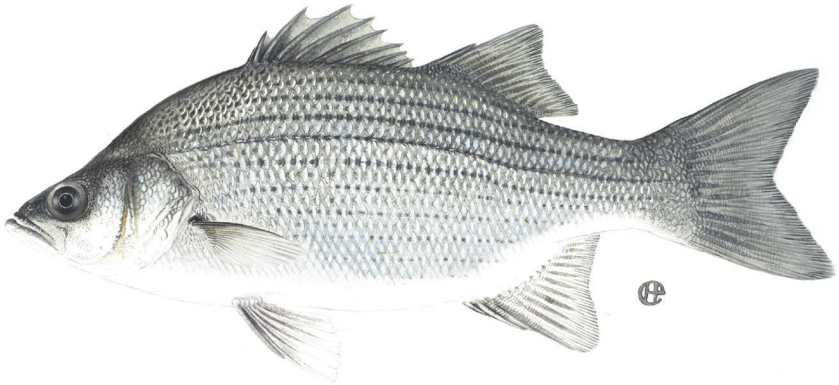
Mohawk (1,2,3). The native range of White Perch in this watershed is limited to the several hundred meters downstream of the Cohoes Falls. Greeley (1935) reported the species from the lower Mohawk River, with the western limit of its range at Rexford. Because this is upstream of the Cohoes Falls, White Perch had gained access (as an exotic species) to the area by the 1930s. Recent records show that the species is found throughout the Mohawk River and has also been present in the Schoharie Reservoir since 2001.

Lower Hudson (1,2,3). Greeley (1937) described this fish as one of the predominant species in the Hudson River, the reservoirs of the Croton River system, and many lakes in the watershed. He also noted that it was introduced into some lakes, with Burden and Glass lakes and Coopers Pond (all in Rensselaer County) being several examples. This species continues to be a prominent component of the fish community in the Hudson River, many lakes, and the larger tributaries. In more recent decades, White Perch have continued to gain access to upland lakes, including Copake Lake in 1949, Kinderhook Lake in 1969, and the Ashokan Reservoir in 2012.

Newark Bay (1,2,3). White Perch are present in the Hackensack River. The species has also been introduced into Deforest, Rockland, and Greenwood lakes.

Long Island (1,2,3). Greeley (1939) listed this species as common in ponds and streams on Long Island, and it was also taken at Wolfe Park Pond on Staten Island. It remains common on Long Island and is found in many of the tidal rivers, including the Carmans, Nissequogue, Peconic, and Connetquot rivers, as well as Sunken Meadow Creek. White Perch are abundant in Lake Ronkonkoma and Fort Pond.

Morone chrysops, White Bass



This species lives in large lakes and rivers and is tolerant of high turbidity. Its native range in New York includes the Allegheny and several Great Lakes watersheds. In recent decades, the species has used inter-drainage canal connections to expand its range eastward to the Mohawk and Lower Hudson watersheds.

Allegheny (2,3). Fowler (1919) reported White Bass upstream of the New York stretch of the Allegheny River in McKean County, PA, but there is no evidence of downstream expansion of the species' range in recent years. The species was not reported in New York until 1970, when it was taken from Chautauqua Lake after stocking (McKeown 2000). Specimens were collected from Conewango Creek in the central basin in 2001 (NYSM 52653) and 2005. Even though White Bass were stocked and a population developed in the Allegheny Reservoir in Pennsylvania (Cooper and Wagner 1980), there were no records from the eastern basin until 1989, when the species was reported in Quaker Lake, an impoundment connected to the Allegheny Reservoir. This cold-water impoundment is unlikely to support any natural recruitment, and there have been no additional records. The Allegheny Reservoir population expanded upstream into New York, where specimens were caught near Salamanca in 2013 (e.g., NYSM 69768).

Erie-Niagara (1,2,3). Greeley (1929) noted that White Bass were common in Lake Erie, the Niagara River, and in the mouths of streams, such as Cattaraugus Creek. More recently, the species has typically been found in Lake Erie and tributary mouths but has also been reported from Tonawanda Creek, the Erie Canal, and Delaware Park Lake.

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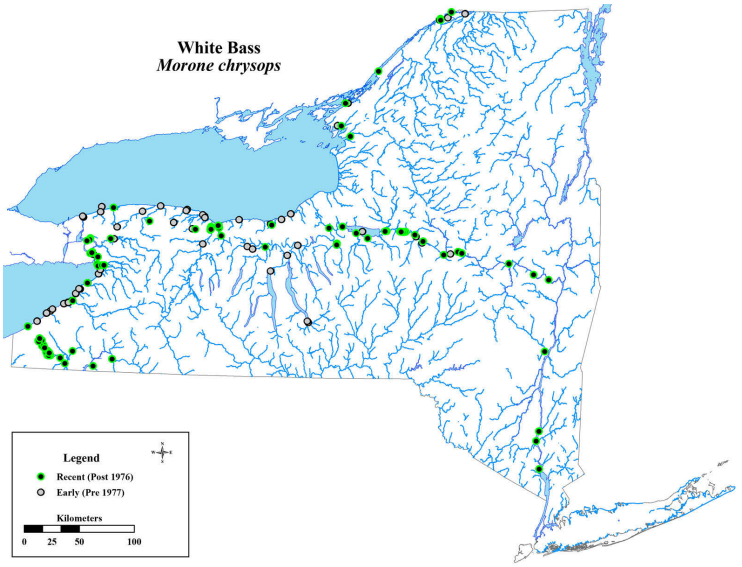
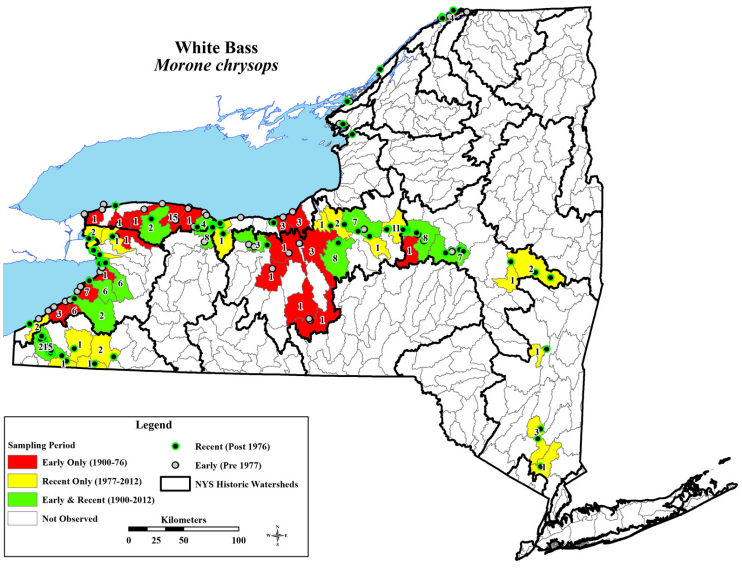




Ontario (1,2,3). This species was described as scarce and was collected only seven times during the 1939 survey, mostly from bays or creek mouths (Greeley 1940). It was also found in the Erie Canal, however. The Salmon River, Sandy Creek, and Chaumont Bay have provided additional, more recent records. White Bass are rarely caught inland but appear to be widespread in the bays and shore areas of Lake Ontario.

Genesee (2,3). Although no specimens were reported from the 1926 survey (Greeley 1927), the White Bass is native to this watershed downstream of Rochester Falls. The first watershed record is from the Genesee River in 1957, upstream of Rochester and the falls. In 1992, this species was reported from the main channel of the river at its mouth.

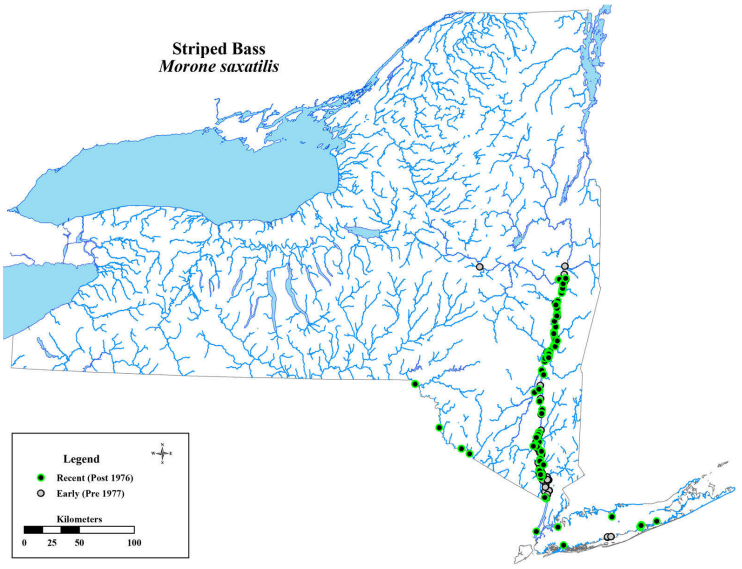
Oswego (1,2,3). Reed and Wright (1909) reported on the presence of this species in Cayuga Lake. Greeley (1928) reported that it was "not uncommon in the rivers and a few of the lakes." In recent times, White Bass have been reported from Seneca, Oneida, and Onondaga lakes, Ganargua Creek, and the Erie Canal.
Saint Lawrence (2,3). This species was first recorded from this watershed in 1975. All reports have been from the main channel or the downstream reaches of tributaries. Until 2005, all reports had been downstream of Ogdensburg although recently, White Bass have been taken in the Thousand Islands area.

Mohawk (**2,3**). No specimens were collected during the 1934 survey, but Greeley (1935) noted that this fish was present in Oneida Lake and might have been the species reported as "striped bass" from the Mohawk River near Fort Plain. Since 1975, White Bass have become established and widespread in the lower and middle Mohawk River. Larvae at 21–25 mm SL were collected from the river at Utica on 27 June 27 2009 (NYSM 65194).

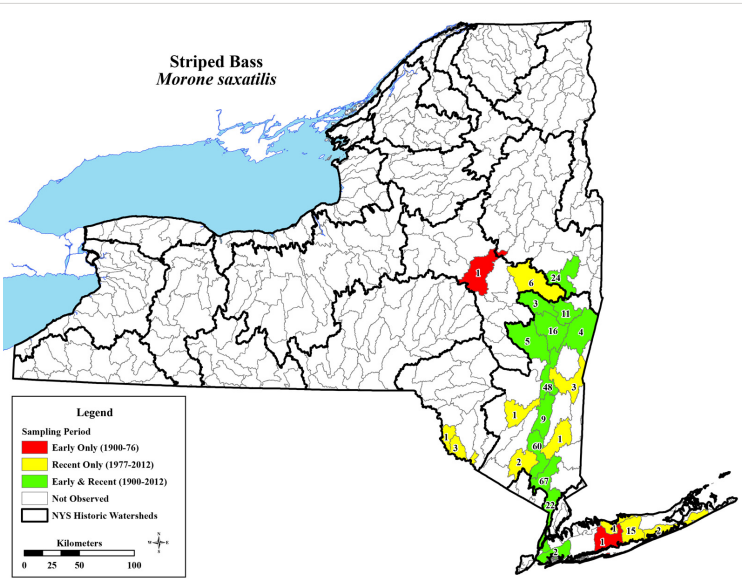
Lower Hudson (**2,3**). White Bass have been in the Hudson River since the 1970s, when individuals were caught in Rockland (NYSM 3519), Westchester (NYSM 3520), and Greene counties. The species appears to be relatively rare in this watershed.

Morone saxatilis, Striped Bass

This very popular sport fish lives in the ocean and migrates into coastal rivers to spawn. Adults return to the ocean, but the estuaries serve as nursery areas and individuals may spend several years there before migrating out to sea. In New York, Striped Bass are found in the Atlantic Slope watersheds.



Delaware (3). Although this species historically migrated into the lower Delaware River drainage, it had not been reported from the New York portion of the watershed until 1993. During the last few decades, individuals have been caught in the Delaware and West Branch Delaware rivers. There are no reports of Striped Bass spawning in the New York portion of the watershed, so they likely only use this area for feeding. More details of the life history of this species have been reported by Waldman and Wirgin (1994).



Upper Hudson (1,2,3). DeKay (1842) described the upriver limit of this species as the area around the mouth of the Mohawk River. Dams built in the watershed beginning in the early 1800s would have blocked the route taken by this fish as it followed the migrations of other anadromous forage fish. The Troy Dam blocked passage into this watershed, but individuals still gain access through the Federal Lock at the dam. In recent years, the farthest upstream record was at the mouth of the Hoosic River in 1972, where an individual navigated three additional locks. In 2008, a juvenile was found upstream of the mouth of the Mohawk River, just downstream of the second dam.

Mohawk (1,2). DeKay (1842) stated that Striped Bass ascended up the Hudson River and had been taken from the Mohawk River under the Cohoes Falls, 3.6 km above the mouth. A record from 1934 exists from Fort Plain, 102 km from the mouth (mentioned in field notes but not described by Greeley (1935) and presumed to be a white bass; see above). Passage around Cohoes Falls through locks is possible, and more recent records suggest that Striped Bass use this route, as the species has been reported 9 km upstream of Cohoes Falls in 1979. The species continues to occasionally be found downstream of Cohoes Falls, where an individual was reported in 1983.

Species continued on next page

Lower Hudson (1,2,3). This species had already declined in abundance when a part of the watershed was surveyed in 1934 leading Greeley (1935) to note: “Limited numbers are said to be appearing in the Hudson River and it is to be hoped that this valuable species will increase.” During the 1936 survey of the remaining part of the watershed, Curran and Ries (1937) noted that large commercial catches were reported at downriver sites like Croton Point, Nyack, and Newburgh. Few adults were taken during this survey, but juveniles were abundant from Hudson to New York (Curran and Ries 1937). Populations continued to increase, and it was this species that generated the greatest outcry over losses due to impingement at water intakes in the 1960s (Boyle 1969). There was a collapse in the coastal population in the 1980s. Mitigation measures designed to increase population size were implemented in the 1980s and included an experimental hatchery to produce fingerlings for release into the river. New regulations and interstate planning resulted in a coast-wide recovery by 1995 (Limburg et al. 2006), which developed into the now-important Hudson River sport fishery. The Striped Bass has been affected negatively, however, by the invasion of exotic Zebra Mussels (Strayer et al. 2004).

Long Island (2,3). No specimens were found during the 1938 survey of freshwaters in this watershed (Greeley 1939a), but that may have been the result of the time of year that sampling took place rather than the actual absence of this species. The earliest record is one from Motts Creek in 1964. Since 1990, Striped Bass have frequently been caught in the Carmans River although there is no evidence that individuals spawn in this river.

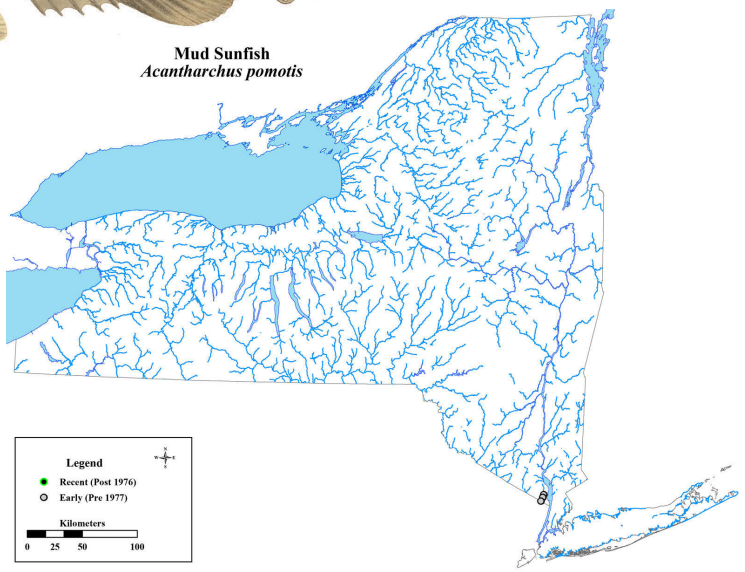
Centrarchidae, Sunfishes

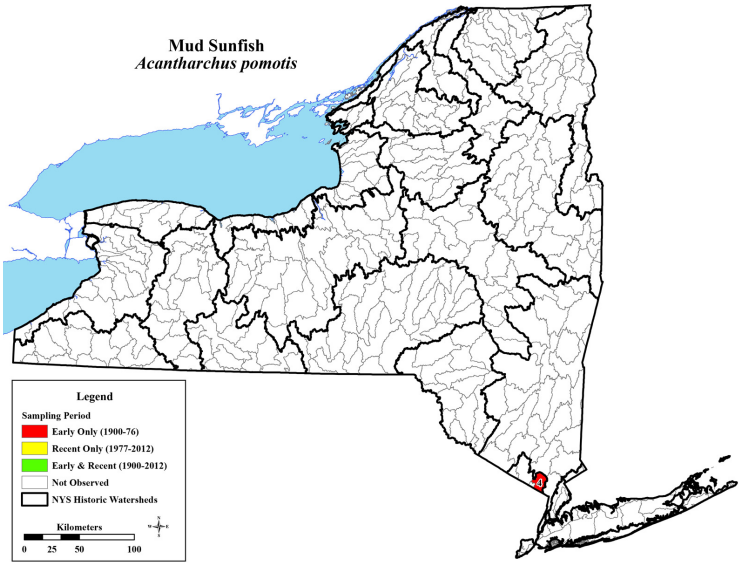
Sunfishes and black basses are primarily found in ponds, lakes, and larger streams and are present in all drainages in New York. Despite their use of slow-water habitats, it is not unusual to find individuals in pools of smaller streams as well. Although several species have been introduced to new drainages within the state, only two of the 14 species found in New York are entirely exotic. The ranges of three of the native species are limited to a few ponds or streams and, consequently, they are protected by the state as Threatened Species. One species has been extirpated from the New York portion of its range.

Acantharchus pomotis, Mud Sunfish

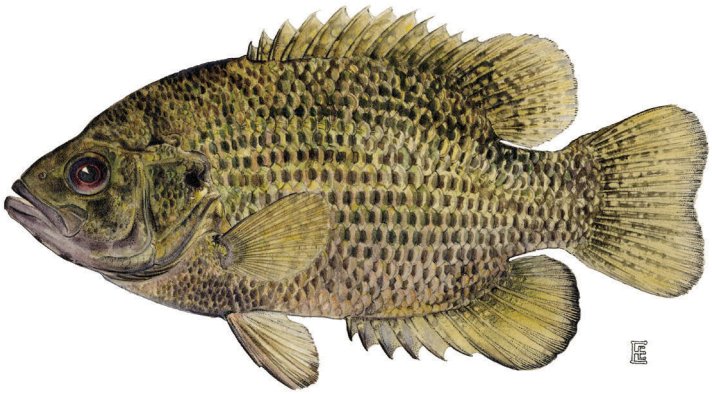
This small, drab sunfish occurs in sluggish lowland streams with mud or silt bottoms. It is a coastal species and ranges from southeastern New York to Florida. The only New York records are from the Hackensack River. The species is classified as Threatened and is likely extirpated from the state.

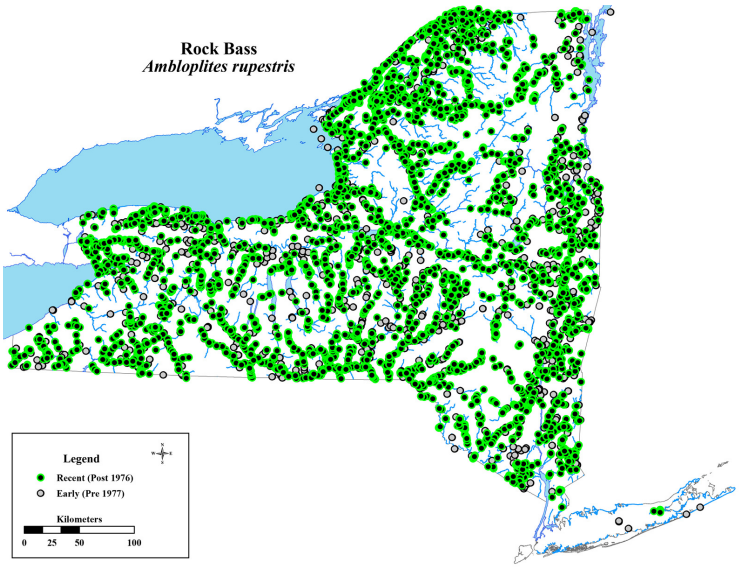
Newark Bay (1). Specimens were collected at three sites on the Hackensack River (Rockland County) during the 1936 survey (Greeley 1937). Despite a continuous effort to locate Mud Sunfish in this watershed, the species has not been collected in New York since 1937, although it is present in other neighboring watersheds in New Jersey (Arndt 2004).

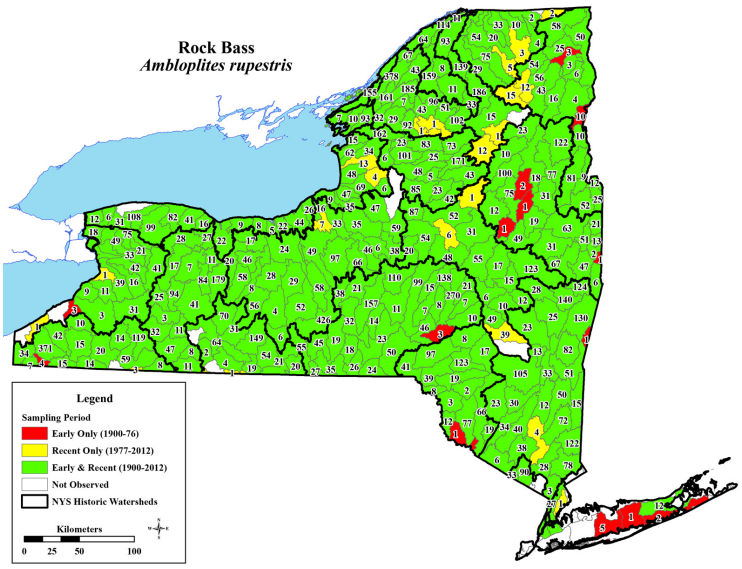




Ambloplites rupestris, Rock Bass







Rock Bass live in streams and lakes, where they use gravel areas of streams or rocky shores of lakes for spawning. This species is found in all of New York's watersheds but is non-native to the Atlantic Slope watersheds and to upland sites in the Adirondacks. It is one of the most successful exotic species in these watersheds, where it has become both abundant and widely distributed.

Allegheny (1,2,3). This species was widely distributed, being taken at 22% of the total watershed survey sample sites in both streams and lakes (Greeley 1938). It was present in all three basins of the watershed and was collected at 12% of stream sampling sites in 1937 as well as in 17% of stream samples taken between 1996 and 2010.

Erie-Niagara (1,2,3). Greeley (1929) noted that this species was abundant and was "the most plentiful member of the sunfish family. It is found in almost all waters of the drainage, except very small or very cold streams. In Lake Erie this species is often taken by anglers seeking bass or perch, and it is also of some commercial importance." Rock Bass continue to be found throughout the watershed.

Ontario (1,2,3). During the 1939 watershed survey, Rock Bass were collected at over 200 sites in Lake Ontario, in ponds, and in streams at lower elevations (Greeley 1940). The species continues to be widely distributed in this watershed.

Genesee (1,2,3). During the 1926 survey, this species was common in weed beds in the main channel of the Genesee River, its largest tributaries, and in lakes and some ponds (Greeley 1927). The Rock Bass remains a common and wide-ranging species in this watershed.

Oswego (1,2,3). Greeley (1928) noted that this species was "common throughout the region in lakes, rivers, ponds and warm streams. Often occurs in sluggish current over a mud bottom." Rock Bass continue to be commonly caught and are widely distributed in the Oswego watershed.

Species continued on next page

Black (1,2,3). Greeley and Bishop (1932) noted that this species was among the most commonly encountered sport fishes in the watershed; it was common in lowland streams and lakes and was also found in upland lakes to elevations of at least 500 m. They (Greeley and Bishop 1932) also noted that Rock Bass should not be introduced into upland sites because of the species' deleterious effects on more valuable, native game fish. The range and abundance of this species have nonetheless increased in the intervening decades, and it is now common at many upland sites (Daniels et al. 2011a).

Saint Lawrence (1,2,3). Greeley and Greene (1931) described this species as very common in the main channel of the Saint Lawrence River and the lower reaches of its tributaries; in these tributaries, Rock Bass could range far upstream. For example, in the Grass River, the species was native up to 60 km from the mouth, although it was not native to Adirondack waters. This species continues to be a common, popular sport fish at lowland sites and has gained access to many upland sites as well.

Oswegatchie (1,2,3). Rock Bass were common and widely distributed at lowland sites during the 1931 watershed survey (Greeley and Bishop 1932). The species remains common at lowland sites, and its range has expanded to include many Adirondack lakes (e.g., Cranberry Lake, elevation 451 m, NYSM 61001).

Raquette (1,2,3). Greeley (1934) listed Rock Bass as common but restricted to the 100 km downriver of South Colton; i.e., the species was absent from the upland lakes and streams in the Adirondack Mountains. In recent decades, it has been found in most of the large lakes of the upper watershed, for example, Blue Mountain Lake in 1994 (NYSM 43772).

Champlain (1,2,3). During the 1929 survey, Rock Bass were common in Lake Champlain and Lake George and their tributaries as well as in ponds in the southern part of the watershed (Greeley 1930). Watershed survey specimens were also found in Silver Lake (NYSM 3655) at an elevation of 550 m, where this species had been introduced. It remains common in the watershed, and populations are well established in many upland lakes.

Chemung (1,2,3). Rock Bass were collected at 23% of the watershed survey sample sites, which included both streams and lakes (Greeley 1938). The species remains abundant and widespread in this watershed.

Susquehanna (**1,2,3**). Greeley (1936) listed Rock Bass as very common in streams and lakes. This species was found at over 25% of the stream sites in both the 1935 survey and in surveys conducted in the 2000s.

Delaware (**1,2,3**). Rock Bass were very common during the 1935 survey but were not found in the lakes and reservoirs of the watershed (Greeley 1936). The species remains widespread.

Upper Hudson (**1,2,3**). Greeley and Bishop (1933) questioned the native status of this species in this watershed and categorically listed it as exotic at upland sites, where it was present in several lakes at elevations higher than 475 m. Recent records exist from both low and high-elevation sites.

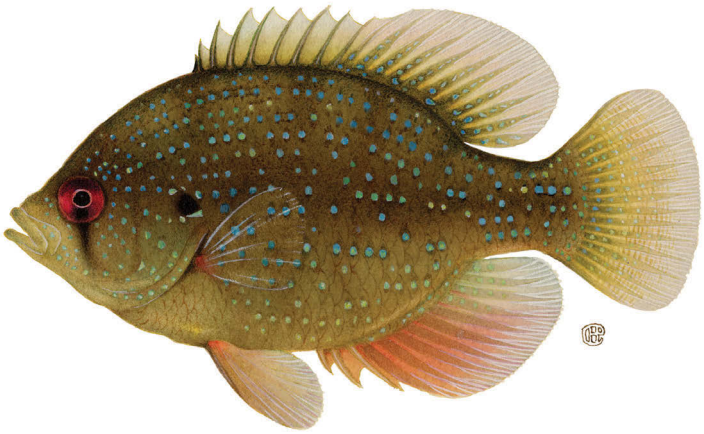
Mohawk (**1,2,3**). During the 1934 survey, Rock Bass were very common in this watershed, being found in the main channel, lower reaches of tributaries, and in lakes and streams in the Adirondack and Catskill mountains (Greeley 1935). The species remains abundant and widespread.

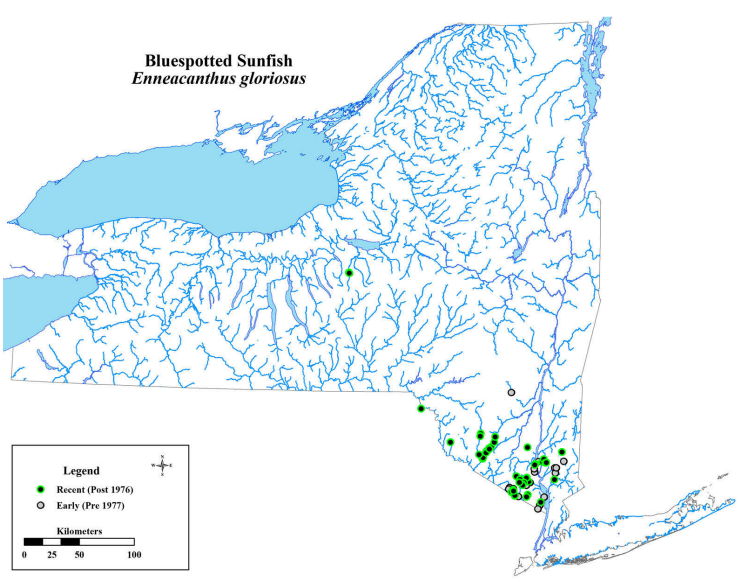
Lower Hudson (**1,2,3**). DeKay (1842) wrote that the Rock Bass was first noted in the Hudson River after the construction of the Erie and Champlain canals and that the species was firmly established in this watershed by the 1840s (Daniels et al. 2005). Greeley (1937) reported that it was found in the main channel, tributaries, and ponds throughout the watershed and was present at almost 17% of the sample sites in the 1936 survey. This species continues to be present and abundant in the main channel, other lowland sites, and many upland sites.

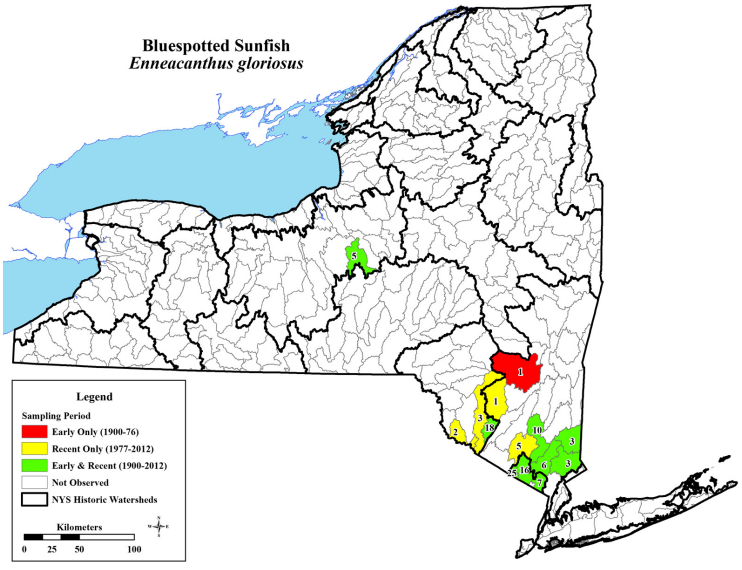
Newark Bay (**1,2,3**). Greeley (1937) documented Rock Bass in 26% of the survey samples taken in this watershed. The species remains abundant and widespread.

Long Island (**1,2,3**). Greeley (1939) noted that Rock Bass had not been introduced into many sites on the island and were collected or reported from only three lakes (Ronkonkoma, Wildwood (Great Pond), and Patchogue) during the 1938 survey. Individuals were also present in about 17% of the survey samples from Westchester County streams flowing into Long Island Sound (Greeley 1937). More recently, this species has been found in the Little River, but it has not been collected from Lake Ronkonkoma since 1956 nor has it been reported from Patchogue Lake since 1938.

Enneacanthus gloriosus, Bluespotted Sunfish







This brightly-colored, small sunfish inhabits lakes and a few slow-moving streams in southeastern New York. The Bluespotted Sunfish often favors darkly-stained waters with abundant submerged aquatic vegetation and mucky bottoms. The species is native to the Lower Hudson, Delaware, and Newark Bay watersheds, and an introduced population is established in a reservoir near Syracuse.

Oswego (**2,3**). An introduced population has sustained itself in the Jamesville Reservoir since 1970 (Werner 1972). The most recent catch was in 2011 (NYSM 66915).

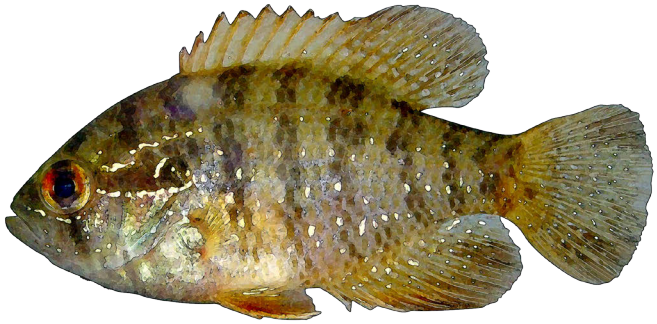
Delaware (1,2,3). Within its restricted range, this species was locally common (and even abundant) in the Basher Kill and was also taken at Read Flat on the East Branch Delaware River (Greeley 1936). It remains common in the Basher Kill but was not taken at Read Flat during surveys in 2005 and 2013, where isolated backwaters suitable for sunfish had been replaced through streambed cutting and filling. Specimens were recently taken from Delaware River backwater ponds near Equinuck, PA, Barryville, NY, and across from Callicoon, NY (R. Horwitz, ANSP, pers. comm.). One specimen was also taken from the Neversink River at Bridgeville in 2003 (NYSM 56000).

Lower Hudson (1,2,3). Bluespotted Sunfish were collected by Edgar. A. Mearns at Long Pond (Orange County; AMNH 1203) and Bog Meadow Pond in 1883 (AMNH 12133), and at Southerland Pond in 1910 (USNM 67113). Aaron L. Treadwell collected an additional specimen from the Ashokan Reservoir in 1909 (AMNH 12083). This species was rare in catches of the 1936 watershed survey, but it was caught in lakes and streams on both sides of the Hudson River and in the main channel (Greeley 1937). In recent years, its range and relative abundance have remained constant, although there are no recent records from sites as far north as the Ashokan Reservoir.

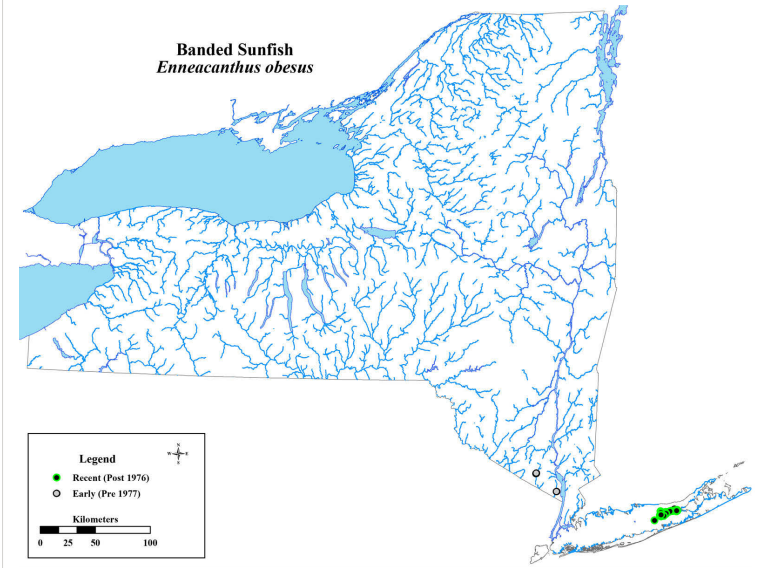
Species continued on next page

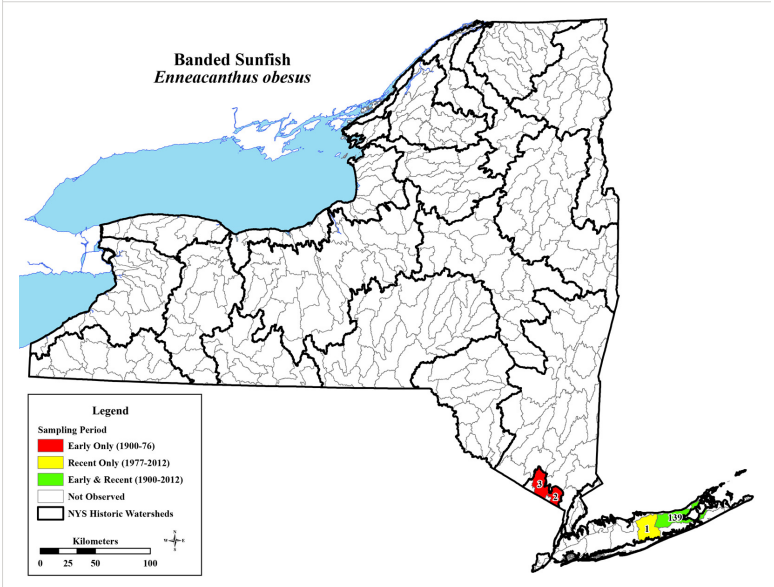
Newark Bay (1,2,3). Greeley (1937) reported collections from Greenwood, Rockland, and Sterling lakes, Island Pond, and the Hackensack and Middle Kanawha rivers. This species continues to be collected at these sites. Some early accessioned collections, particularly those of T.L. Hankinson at RWLC, were initially reported as Banded Sunfish but were later re-identified as Bluespotted Sunfish (e.g., RWLC 2385).

Enneacanthus obesus, Banded Sunfish



This coastal plains species occurs in ponds, bogs, and medium-sized streams with dense aquatic vegetation. It is present in the southeastern corner of the state, where it is native to the Newark Bay and Long Island watersheds, although it has likely been extirpated from the Newark Bay system. On Long Island, its range has retreated to about half of what it was in 1938, but Banded Sunfish remain common in about 30 ponds. Some of these ponds are vulnerable to dewatering for residential and urban development, however, and the species is currently classified as Threatened in New York State.

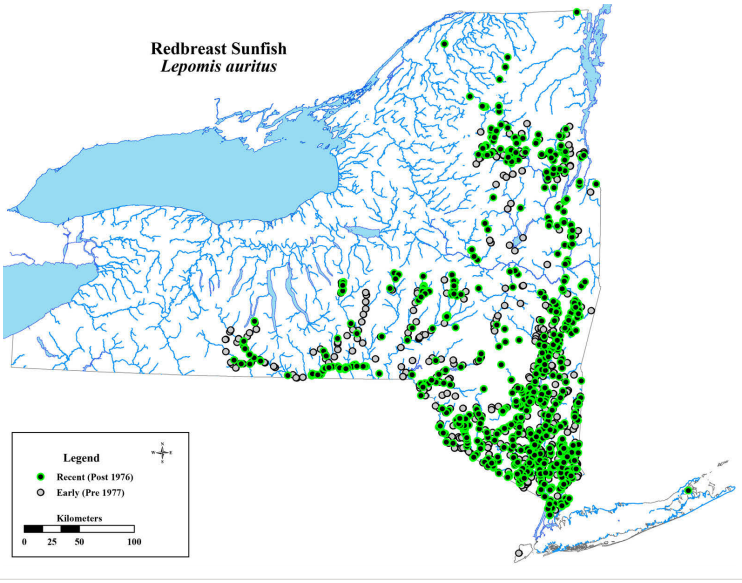


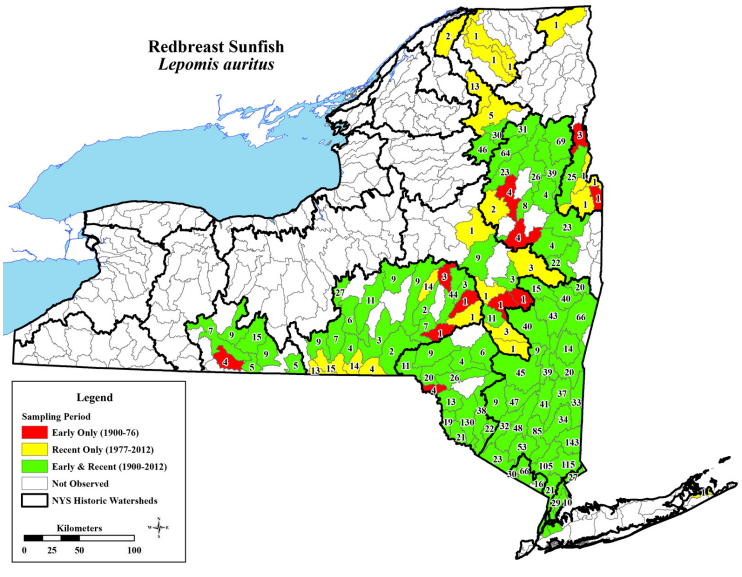


Newark Bay (1). Greeley (1937) reported that Banded Sunfish were taken from two lakes in the Passiac River basin near the New Jersey border, Spruce Lake and Cranberry Pond, and he noted that these specimens were the first occurrence records from the state. The specimens from Cranberry Pond (NYSM 3986) were later determined to be Bluespotted Sunfish. Interestingly, Bean (1903) credited Eugene Smith with the observation that this species inhabited the entire Hackensack Valley, but there are no specimens to support that observation. Arndt (2004) did not report its presence in any Newark Bay ponds in New Jersey, but he did note its presence in an upstream area of the Wallkill basin, a tributary to the Lower Hudson River. No verified collections of Banded Sunfish exist from the Newark Bay watershed, however, since 1936.

Long Island (1,2,3). In 1936, specimens were collected from Deep (UMMZ 103859) and Swan (UMMZ 103861) ponds and Forest Lake (UMMZ 103860). During the 1938 watershed survey, Banded Sunfish were locally common but restricted to the Peconic River system of Suffolk County (Greeley 1939a). This species has been documented in 28 warm-water ponds in the Peconic River basin as recently as 2010.

Lepomis auritus, Redbreast Sunfish





This sunfish inhabits lakes and rivers. It is native to Atlantic slope drainages, and George (1981a) also listed it as native to the Lake Champlain watershed. In New York, this species is native to nine watersheds and has been introduced into two.

Saint Lawrence (**2**). Smith (1985) recorded the presence of Redbreast Sunfish at three sites in the headwaters of the eastern tributaries of the Saint Regis River basin based on collections made in 1978 (e.g., AMNH 41340). There are no more recent records for this species from this watershed.

Raquette (**1,2,3**). In Greeley's (1934) report for this species, he wrote: "Locally common. This sunfish apparently is restricted to the upper lakes of the Raquette chain (Blue Mountain Lake to Long Lake) and connecting waters...Since it is not generally distributed in the upland ponds, there is a reason to suppose that it is not native to the Raquette drainage." Since 1999, Redbreast Sunfish have been collected over 30 times in this watershed. The species is now found as far downstream as Norwood (e.g., in 2007, NYSM 62949), approximately 50 km from the mouth of the river, which represents an extensive increase in its range within this watershed.

Champlain (1,2,3). The Redbreast Sunfish was historically common in Lake George (Sibley 1922). Greeley (1930) also found the species in Lake George and its outlet as well as in the Mettawee and Little Chazy River systems. George (1981b) also noted its presence in Lake George. Individuals are now rarely caught, and catch localities are disjunct although the Lake George population remains secure. Specimens were taken from the Poultney River in 1979 (AMNH 43863) and the Great Chazy River in 1998. This watershed is the only part of the Saint Lawrence drainage where Redbreast Sunfish are native.

Species continued on next page

Chemung (1,2,3). During the 1937 survey, this species was found in Lamoka Lake and many of the streams of the watershed and was present at 10% of the sites sampled (Greeley 1938). It continues to occasionally be caught and is present in the Canisteo, Cohocton, and Chemung rivers. This sunfish also continues to be present but relatively rare in Lamoka and Waneta lakes.

Susquehanna (1,2,3). Redbreast Sunfish were found throughout the watershed and were taken at 10% of the sample sites in the 1935 survey, mostly in streams (Greeley 1936). In recent decades, the frequency of occurrence of this species was only 4% of stream catches, but it is still widely distributed.

Delaware (1,2,3). Greeley (1936) reported that Redbreast Sunfish were present at 14% of the survey sample sites and that the species was widely distributed throughout the watershed. He (Greeley 1936) also noted that because individuals grew to a large size in the Delaware River and its main branches, this was an attractive sport fish. This sunfish remains widespread and abundant in this watershed.

Upper Hudson (1,2,3). This species was present in the Hudson River and lowland lakes like Saratoga Lake, but Greeley and Bishop (1933) also noted that its range extended well into upland sites in the Adirondack Mountains. It remains common and is present in many areas of the watershed.

Mohawk (1,2,3). During the 1934 watershed survey, Redbreast Sunfish were present in streams and several lakes in the eastern part of the watershed, mostly at lowland sites (Greeley 1935). The species was common in Caroga Lake, however, at an elevation of 440 m (Odell 1935). This sunfish is currently relatively rare in this watershed, with collections from the Blenheim-Gilboa Reservoir in 1973 and from Schoharie Creek in 1976 (AMNH 39251), 1996 (NYSM 44790), and 2008.

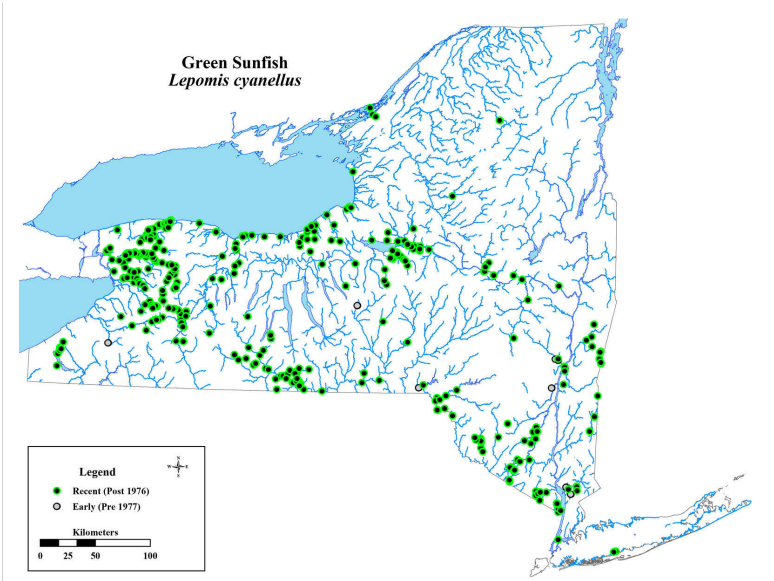
Lower Hudson (1,2,3). This species was abundant and present throughout the watershed during the 1936 survey, being collected at 30% of the sites sampled (Greeley 1937). In recent surveys, this sunfish continues to be widely distributed and abundant in the main channel, tributaries, and many lakes and reservoirs.

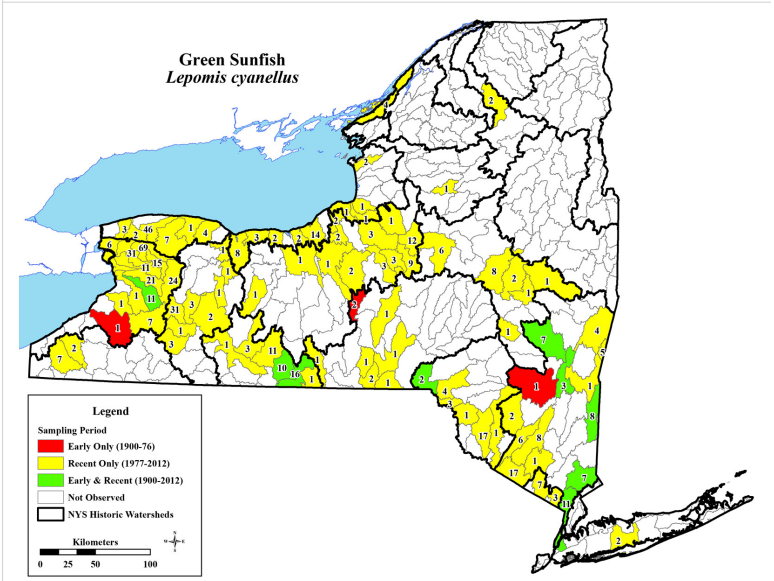
Newark Bay (1,2,3). Greeley (1937) reported the presence of Redbreast Sunfish at 36% of the sites sampled in this small watershed. There has been no change in the species' status in recent years.

Long Island (1,2,3). No Redbreast Sunfish were collected on Long Island during the 1938 survey (Greeley 1939a). The species was common in the streams draining into Long Island Sound from Westchester County, however, where it was present in 38% of the samples taken (Greeley 1937). It continues to be found in these Westchester County streams. In recent years, it has also been collected from the Arthur Kill on Staten Island in 1975 (NYSM 54718) and on Shelter Island in 2002 (NYSM 55264), both of which are the result of introductions.

Lepomis cyanellus, Green Sunfish

This sunfish lives in streams and lakes and nests in gravel/rubble substrates. The species was first introduced into New York around the beginning of the 20th century and has expanded its range rapidly in the state in the last 20 years. There are recent records from all of the state's watersheds, with the exception of the Oswegatchie, Lake Champlain, and the Upper Hudson.





Allegheny (**3**). The first reported capture from this watershed was from Dewittville Creek in 1994. More recently, Green Sunfish have been collected from four other tributaries of Chautauqua Lake as well as Bear Lake Inlet (NYSM 56651), Stillwater Creek (NYSM 57452), the Brokenstraw Creek system (NYSM 70141), and Pierce Run (NYSM 69719). The species is most prevalent in the central, or Conewango Creek, basin but is also present in the eastern basin.

Erie-Niagara (**2,3**). This species was found in Cabic Pond in 1970 and in Buffalo Creek in 1975 (W. Hadley, SUNY Buffalo, unpubl. field notes) and again in 1977 (AMNH 45949). Its distribution in this watershed has steadily increased over the last two decades and now includes many waters, with collections from Tonawanda Creek as recently as 2013 (NYSM 69491).

Ontario (**2,3**). In 1942, several individuals were collected at Wilson Harbor near the mouth of the Niagara River (CUMV 27384). Green Sunfish have been reported in 18 waters since 1986 in both the lake itself (CUMV 88808) and in tributaries, with collections from Johnson Creek as recently as 2007 (NYSM 62872) and Oak Orchard Creek in 2013.

Genesee (**3**). This sunfish was first reported from this watershed in 1990. Since 2007, it has been reported from nine different waters, including the main channel of the Genesee River (NYSM 54215).

Oswego (**3**). Meek (1889) reported specimens near Montezuma, and Adams and Hankinson (1916) did likewise from Oneida Lake at the mouth of Big Bay Creek , but, in both cases, these determinations were not firm, the specimens could not be found, and both were thus regarded as misidentifications by Carlson and Daniels (2004). After 1995, reports from Oswego Harbor and tributaries of Oneida Lake became common. Green Sunfish are now present in lakes and larger streams in the eastern (e.g., Mud Creek, NYSM 69811) and central (e.g., Seneca Lake, NYSM 70242) portions of the watershed.

Species continued on next page

Black (**3**). To date, this species has only been reported from the Moose River near McKeever in 2006.

Saint Lawrence (**3**). Individuals were collected from the mouth of Mullet Creek and the Thousand Islands area (B. Murry, SUNY ESF, pers. comm.) in 2002, with an additional Mullet Creek record from 2009.

Raquette (**3**). The only record of the Green Sunfish in this watershed is from the Piercefield Flow in 2009.

Chemung (**1,2,3**). Greeley (1938) recorded a single small specimen from Sing Sing Creek and noted that it was probably the result of an introduction. Green Sunfish were collected again from Sing Sing Creek in 1977 (AMNH 49064) and 2007. The species has become common and widespread in this watershed.

Susquehanna (**2,3**). This species was first reported in 1949 at Willseyville Creek (CUMV 44550). It has slowly expanded its range in this watershed over the subsequent decades, with later records including Owego Creek at Richford in 1950 (CUMV 65999), the Chenango River in 1962 (CUMV 43033), Michigan Hollow Pond in Danby in 1967 (CUMV 81599), Green Lake in 1970, and the Susquehanna River in 1993. In the 2000s, additional specimens were found in Cayuta Creek (NYSM 56913), Nanticoke Creek (NYSM 57217), and Eddy Creek.

Delaware (**2,3**). The Green Sunfish was first reported in this watershed from Oquaga Creek in 1967. Individuals were repeatedly taken from the Swinging Bridge Reservoir between 1997 and 2008. Specimens were collected at 12 stream sites during a 2005 survey.

Mohawk (**2,3**). The earliest record from this watershed is from Schoharie Creek at Esperance in 1982 (NYSM 10486). Green Sunfish were collected from Crum Creek in 1998 (NYSM 48730) and the Erie Canal (Oneida County) in 2001. Reports of this species are becoming more frequent and come from many parts of the watershed.

Lower Hudson (**1,2,3**). Green Sunfish were rare in this watershed in 1936, and Greeley (1937) reported that the presence of this species “in the small lake on the Campfire Club grounds near Millwood and in the New Croton Reservoir are apparently the first records of this species in the State. It…may likely have been accidentally introduced with the stock of blue-gill sunfish which were placed in the Campfire Lake, an artificial pond.” A few individuals were found in the main channel as early as 1975. In recent decades, the species has been widely collected in this watershed but has not yet been reported from the Catskill Mountains or any Albany County sites.

Newark Bay (**3**). Green Sunfish were first reported from Stony Brook in 1992 and were later found in the Mahwah, Ramapo, and Hackensack rivers.

Long Island (**3**). This species is well established in a pond in Central Park, New York City and was also found in Santapogue Creek, a short stream near Babylon, in 2011 (NYSM 66982).

Lepomis gibbosus, Pumpkinseed

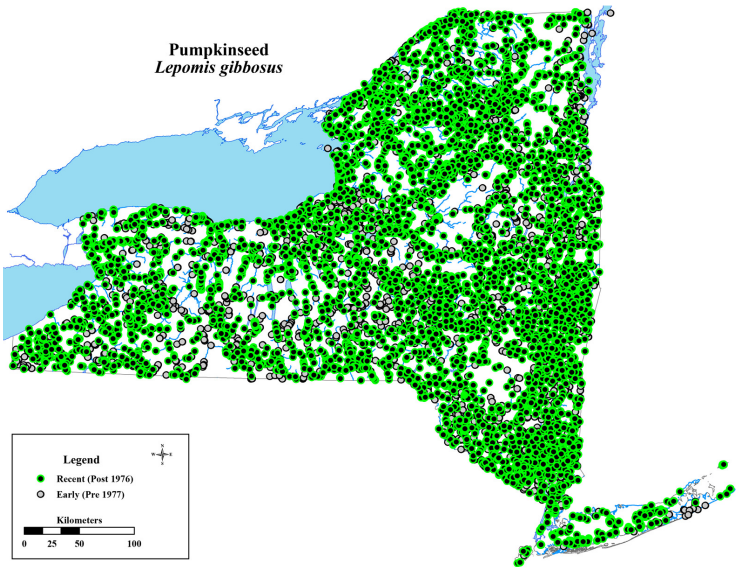
This fish inhabits lakes and streams, is generally associated with submerged aquatic vegetation, and is present in all 18 watersheds in the state. It has been introduced to many upland ponds in the Adirondacks, and George (1981a) regarded the species as non-native there. Introductions were often undocumented and clearly were well underway during the middle of the 19th century, however, because Mather (1886) and Bean (1903) regarded this sunfish as native to the Adirondack lakes.

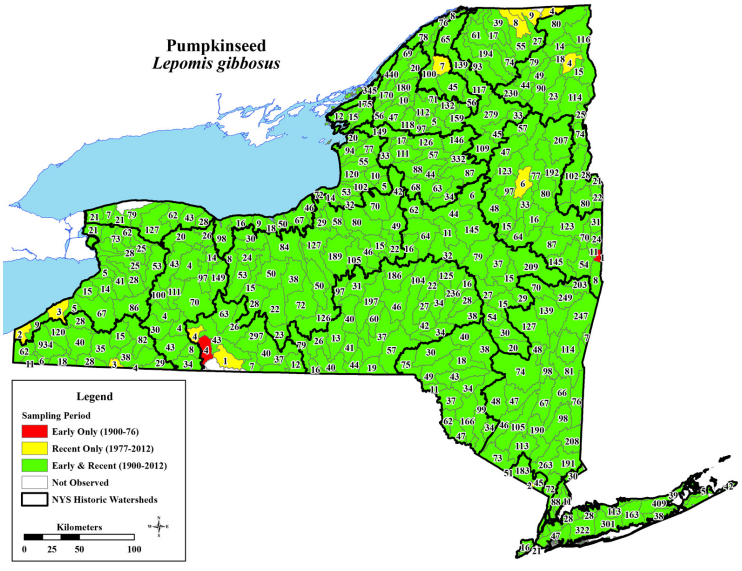
Allegheny (1,2,3). Pumpkinseeds were collected at 36% of the watershed survey sample sites in both lakes and streams (Greeley 1938). This species remains the dominant pond fish in this area and continues to be found in all three basins of the watershed. It was present at approximately 25% of all sites surveyed during the last three decades although most of the sites sampled were in streams.

Erie-Niagara (1,2,3). Greeley (1929) ranked this species as common and reported that it was found in ponds and sluggish streams, often associated with aquatic vegetation. Its status in this watershed is unchanged.

Ontario (1,2,3). Greeley (1940) stated that this species was common and was the "predominant sunfish of the region, present in nearly every pond, bay and sluggish stream." Pumpkinseeds remain common and widely distributed in this watershed and are found in the same types of habitat.

Genesee (1,2,3). This sunfish was common in lakes and low-velocity streams like the Genesee River and Black Creek but was rare in the other streams sampled by the 1926 survey (Greeley 1927). It was common and widely distributed during recent surveys.





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Oswego (1,2,3). Greeley (1928) listed the Pumpkinseed as abundant and present in all major lakes in the watershed except for Skaneateles and the polluted Onondaga; the species was less common in streams. It is now commonly caught and widely distributed.

Black (1,2,3). This was the most abundant member of its family in this watershed during the 1931 survey at both low-elevation and upland sites (Greeley and Bishop 1932). The current status of the species in the watershed is unchanged.

Saint Lawrence (1,2,3). This was the most widely distributed sunfish in the watershed, being present in the main channel, most tributaries, and lakes throughout the watershed (Greeley and Greene 1931). It continues to be abundant and widely distributed.

Oswegatchie (1,2,3). Pumpkinseeds were common throughout the watershed during the 1931 survey and were present primarily in ponds but were also found in streams (Greeley and Bishop 1932). The species remains common and widespread.

Raquette (1,2,3). Greeley (1934) stated that "most lakes, ponds and sluggish streams of the survey area are inhabited by this sunfish." Its status in this watershed is unchanged.

Champlain (1,2,3). During the 1929 survey of this watershed, Pumpkinseeds were widely distributed and common in Lake Champlain, Lake George, most lakes, and many streams (Greeley 1930). Recent surveys indicate that the species remains common and widespread.

Chemung (1,2,3). Greeley (1938) reported that this species was present at 31% of the sites sampled during the 1937 survey. It remains common and widespread throughout the watershed.

Susquehanna (1,2,3). This sunfish was ranked as abundant and was present at 32% of the sites sampled during the 1935 survey, although most of these occurrences were from lake sites (Greeley 1936). Pumpkinseeds were found at over a quarter of the stream sites sampled in recent surveys.

Delaware (1,2,3). This species was abundant and was found in 28% of the 1935 watershed survey samples (Greeley 1936). It continues to be common and widespread in recent surveys.

Upper Hudson (1,2,3). Pumpkinseeds were found in lakes and slow-water streams throughout the watershed during the 1932 survey (Greeley and Bishop 1933). Recent records show that the status of this species in the Upper Hudson system is unchanged.

Mohawk (1,2,3). This species was ranked as abundant and was found throughout the watershed during the 1934 survey, including in the main channel, larger streams, the Erie Canal, and lakes (Greeley 1935). Recent records continue to document Pumpkinseeds in many waters.

Lower Hudson (1,2,3). This was the most frequently caught species during the 1936 watershed survey. Individuals were found at 47% of the sites sampled, including most lakes, numerous streams, and the Hudson River itself (Greeley 1937). Although the species no longer shows the highest frequency of occurrence for the watershed, it remains common and widespread.

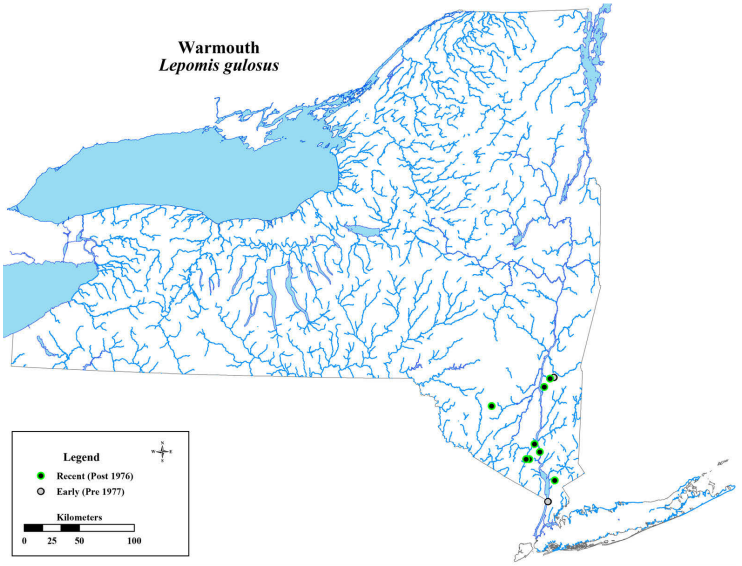
Newark Bay (1,2,3). Pumpkinseeds were present at 67% of the watershed survey sample sites (Greeley 1937) and remain abundant and widespread in this system.

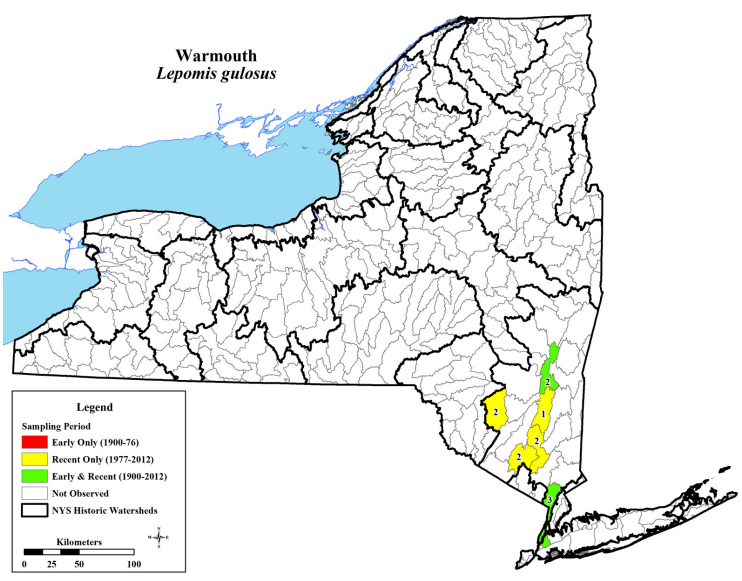
Long Island (1,2,3). This sunfish was widely distributed on Long and Staten islands and was collected from lakes and streams in all counties (Greeley 1939a). It was also collected at 38% of the sites sampled in the streams draining into Long Island Sound (Greeley 1937). During the last two decades, Pumpkinseeds have been collected on Long, Staten, Manhattan, and Fishers islands, and in Westchester County streams.

Lepomis gulosus, Warmouth

This exotic sunfish was first detected in New York in 1936. It occurs in medium-sized streams and lakes and is associated with soft substrates and dense vegetation. The Warmouth appears to be non-invasive and has not expanded its range beyond the Lower Hudson watershed, where it was first introduced.

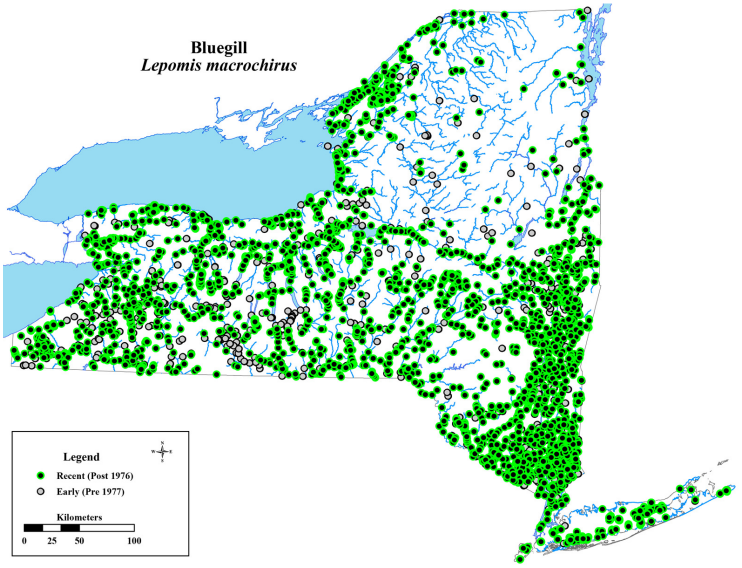
Lower Hudson (**1,2,3**). Greeley (1937) reported: "Three specimens, taken in the Saw Kill near Annandale, afford the first record of this species for the State. This introduction parallels that of the green sunfish as both species are of mid-western range and appear to have been accidentally introduced." Warmouths were again collected from the Saw Kill in 1990 and 2003 (NYSM 55165), but no individuals were collected during a 2007 survey. Additional specimens have been collected from the following localities: the Hudson River in 1976 (AMNH 48296) and 1977 (NYSM 11242); Woodbury Creek in 1978 (AMNH 40735, NYSM 11857) and again in 2009; Kinderogen Lake near Mount Pleasant in 1987 (ALSC, unpubl. field notes); Ulster Heights Lake in 1987 (ALSC, unpubl. field notes); Lake Frederick in 1997 and 1998 (NYSM 48779); Black Creek in 2003 (NYSM 55481); Landsman Kill near Rhinebeck in 2009; Moodna Creek in 2009 (NYSM 65005); and ponds on the West Point Academy in the 2000s (R. Schmidt, Simons Rock College, MA, pers. comm.).

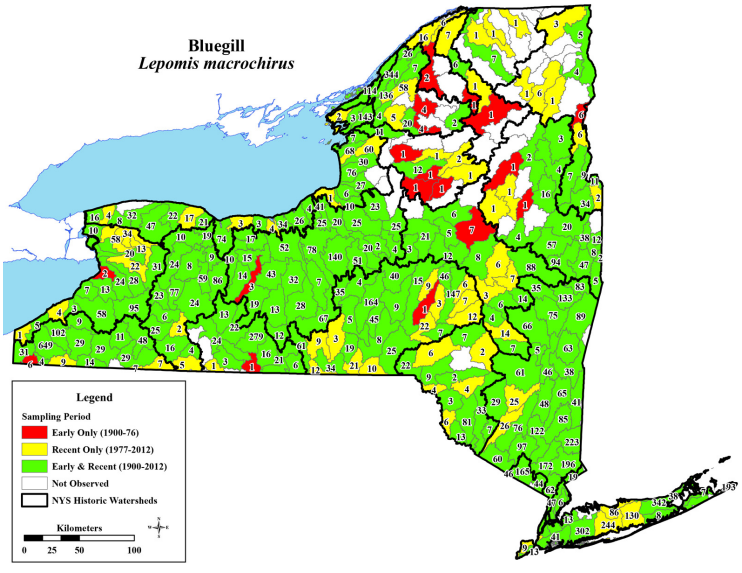




Lepomis macrochirus, Bluegill

This species lives in lakes and in some larger rivers. It is native to the southern and western Saint Lawrence drainage watersheds and non-native in all nine Atlantic Slope watersheds, where initial introductions probably occurred early in the 20th century but lack concrete documentation. Bluegills were relatively rare in each of these Atlantic Slope watersheds during the surveys in the 1930s, but this sunfish is among the most successful exotic species in the state and had become commonplace and wide ranging by the end of the 20th century. It has also been introduced into the Adirondack region.





Allegheny (1,2,3). This species was collected at 18% of the watershed survey sample sites, primarily in Chautauqua Lake, other lakes, smaller ponds, and a few river sites (Greeley 1938). It continues to inhabit backwater areas of the Allegheny River, lakes, and several slow-water tributaries in all three basins of the watershed. During surveys over the last two decades, Bluegills were collected at 14% of the sites sampled in the central basin, where the rivers are particularly sluggish, whereas individuals were present at only 5% of sites throughout the watershed.

Erie-Niagara (1,2,3). Greeley (1929) noted that this sunfish was rare in the watershed, too rare in fact to be a viable sport fish, although there were records from Lake Erie. The species has become widespread and is relatively common today.

Ontario (1,2,3). During the 1939 survey, Bluegills were collected at 70 sites, with the heaviest concentrations in the bays of Lake Ontario; individuals were also found in ponds throughout the watershed (Greeley 1940). This species remains widely distributed.

Genesee (1,2,3). Although Greeley (1927) did not report the presence of this species in the watershed, there is a 1926 report from a small pond in Chili (Monroe County). It is now widely distributed in ponds and lakes.

Species continued on next page

Oswego (1,2,3). Greeley (1928) reported that this species was not uncommon and was found in "large, sluggish, warm streams, ponds and weedy lakes. Specimens were taken in the Seneca river, Cross, Cayuga and Neahtawanta lakes and in Junius ponds." Today, Bluegills are commonly caught and widely distributed.

Black (**2,3**). This species was first reported in 1948 from Copper Lake (Lewis County). It is treated as an exotic species in this watershed, although Lake Ontario fish have free access to the lower 2 km of the river. Bluegills are now present at several upland sites, where they have been stocked.

Saint Lawrence (2,3). The earliest report from this watershed is from the Thousand Islands area in 1955. Since then, Bluegills have been introduced to a few sites, for example, Lake Ozonia, the Grass River, and the Deer River.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported that this species was taken from only four lowland lakes: Black, Millsite, Butterfield, and Muskellunge. It is now more widely distributed and also is found at higher elevations, where it has been introduced.

Raquette (**1,2,3**). Although Greeley (1934) did not credit the surveyors with any captures of this species, it was collected from four upland ponds in 1933: Clear Pond (NYSM 24218), Utowana (NYSM 35979) and Forked Lakes (NYSM 40959), and the outlet of Eagle Lake (NYSM 40960). Bluegills are now widespread in this watershed.

Champlain (1,2,3). This sunfish was common in South Bay of Lake Champlain but was not reported elsewhere during the 1929 survey (Greeley 1930). In recent surveys, it was found to be widely distributed in ponds and lakes.

Chemung (**1,2,3**). Bluegills were taken at 3% of the sample sites during the 1937 survey of this watershed; captures were from Goodhue Lake, Lake Salubria, and a few sites on the Chemung and Canisteo rivers (Greeley 1938). Since 1937, this species has become common and widespread, establishing itself in most of the watershed's lakes and many medium-sized streams.

Susquehanna (**1,2,3**). Bluegills were found at less than 1% of the watershed survey sample sites but were established in Goodyear Lake and the Susquehanna River, with specimens from the latter being collected near Oneonta (Greeley 1936). The species has since become established in most lakes and many medium-sized streams throughout the watershed.

Delaware (**1,2,3**). Greeley (1935) reported that "a single individual was taken from the lower Neversink River near Port Jervis, the only Delaware record obtained." Bluegills are now widespread in the lakes of this watershed and also occurred in 4% of stream samples in recent surveys.

Upper Hudson (**1,2,3**). This species was rare in the watershed overall during the 1932 survey but was common at the few sites where it was found (Greeley and Bishop 1933). Greeley and Bishop (1933) mentioned that the Hudson River at Coveville was a favored site, where the Bluegill was an important sport fish, and a local angler reported that it had been introduced a few years earlier. Bluegills are now found throughout the watershed, including upland sites like Sacandaga Lake (NYSM 50881).

Mohawk (**2,3**). This species did not occur in the Mohawk watershed survey samples in 1934 (Greeley 1935). The first record in this watershed is from 1953 and, by the 1980s, Bluegills were widespread in the main channel and tributaries on both the north and south banks, including upland sites in the Adirondacks, Helderbergs, and Catskills.

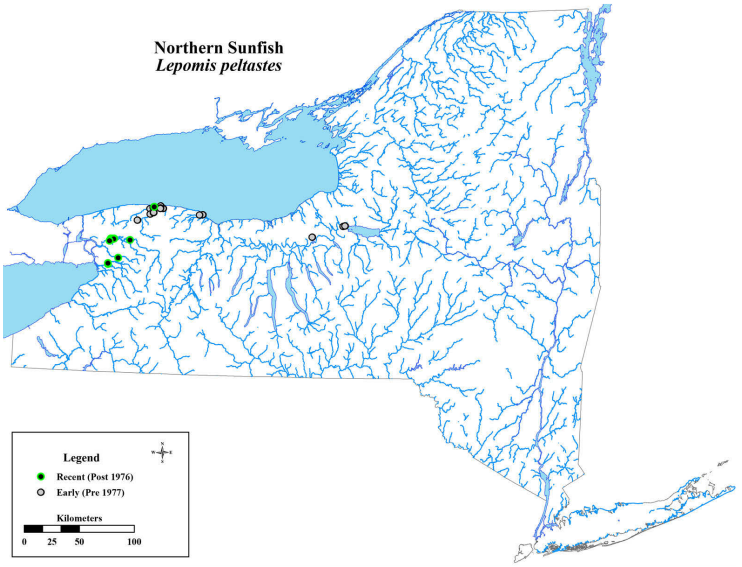
Lower Hudson (**1,2,3**). This species was found at 6% of the watershed survey sample sites, mostly in lakes, ponds, sluggish streams, and coves along the Hudson River (Greeley 1937). It has become far more widespread in recent times, and its frequency of occurrence in recent surveys was 46%.

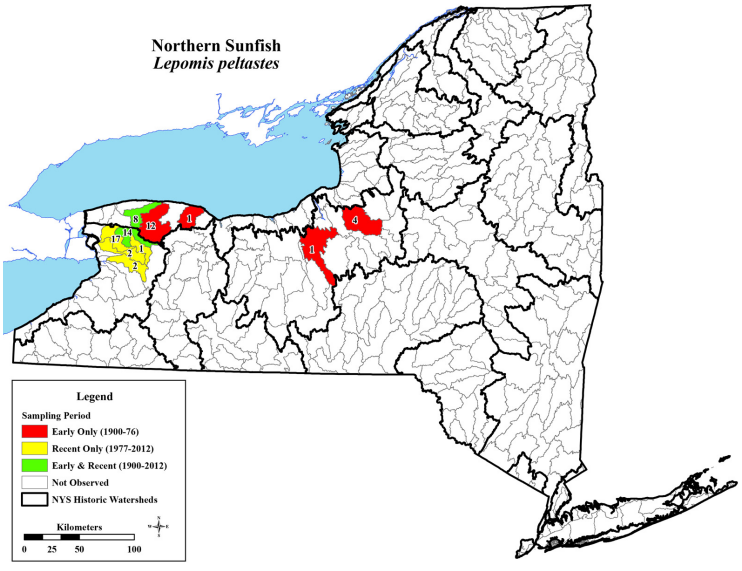
Newark Bay (**1,2,3**). Bluegills were collected at 20% of the sampled sites in the 1936 survey (Greeley 1937). Recent records indicate its presence in many waters.

Long Island (**1,2,3**). Greeley (1939a) stated: "Although locally common in the Peconic River and found also in Crooked Pond, near Sag Harbor, this species is not widely distributed in the area." Bluegills were also rare in streams draining into the north shore of Long Island Sound, registering a 4% frequency of occurrence. The species continues to be caught in the Peconic River but remains relatively rare in this watershed.

Lepomis peltastes, Northern Sunfish

Northern Sunfish are found in low-gradient streams and lakes and are associated with submerged aquatic vegetation and sand substrates. The species is native to three watersheds in western and central New York. It has declined to levels below detection in the Oswego watershed and has similarly declined in tributaries of Lake Ontario. In 2006, a stocking program was begun to mitigate further declines. The only area in the state with a wild sustained population is a 6 km segment of Tonawanda Creek near Buffalo. The Northern Sunfish has been classified as a Threatened Species in New York. There are numerous reports from other watersheds in the state, including museum specimens identified as this species, but they have been determined to be Redbreast Sunfish.





Erie-Niagara (2,3). The Northern Sunfish was not caught during the 1928 survey, although Greeley (1929) recognized its presence in the watershed farther west in Ohio based on previously published lists. The first specimen from the New York portion of the watershed was taken in 1974 (W. Hadley, SUNY Buffalo, unpubl. field notes), from Tonawanda Creek at Millersport, with additional specimens collected there in 1975 (AMNH 38679). This population, confined to a 6 km reach, was the only viable population in the state into the 2000s. Despite repeated attempts to capture specimens since 2009, none have been caught. Beginning in 2006, this sunfish has been stocked in Cayuga Creek and Murder Creek, a tributary of Tonawanda Creek. The Cayuga Creek population may have become established because young individuals were collected there in 2012 (NYSM 68387). A 2010 status check in Murder Creek showed that individuals had survived and that they were congregating on potential spawning areas. Northern Sunfish were also stocked in Ellicott Creek, and individuals were caught there in 2012 during the program assessment.

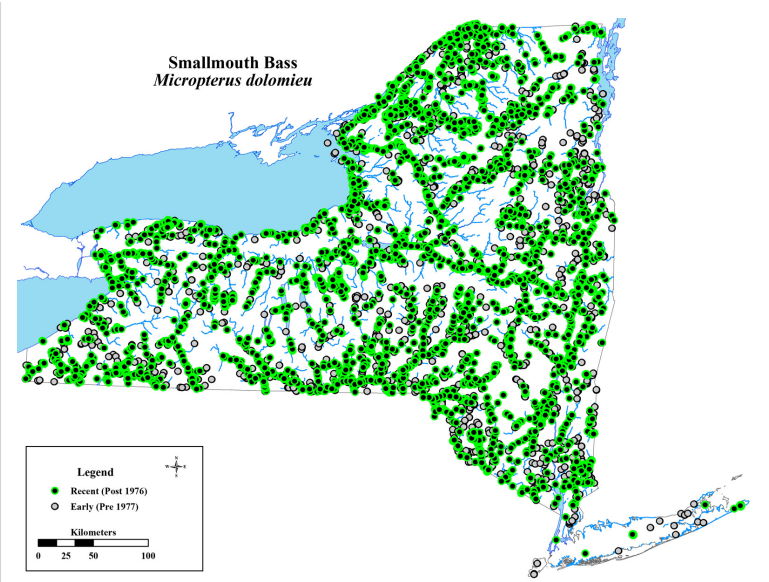
Species continued on next page

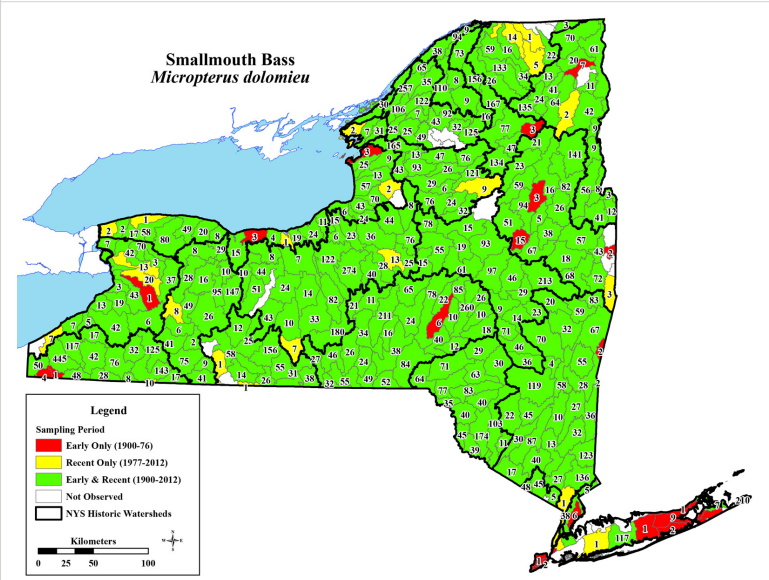
Ontario (1,2,3). Greeley (1940) noted that this species was well established in two stream systems: Oak Orchard and Johnson creeks. Additional reports from 1939 included West Creek and Braddock Bay (unpubl. field notes). In 1940, specimens were again taken from Johnson Creek (CUMV 8977). The only recent reports from Johnson Creek were in 2003 and 2004 at Kuckville. From 2006–2014, Northern Sunfish were stocked in Marsh, Johnson, and Oak Orchard creeks. Stocked fish were recaptured from Oak Orchard Creek in 2014, but no spawning activity nor young-of-year have been observed.

Oswego (1,2). Greeley (1928) noted that Professor T.L. Hankinson obtained specimens at the outlet of Oneida Lake, but none were collected during the 1927 survey. Edward Raney (Cornell University, unpubl. notes) collected this species from Cross Lake and again from Oneida Lake Outlet in the 1940s. Fingerlings have been stocked in Oneida Lake tributaries from 2007-2012, but the success of this program has not been assessed.

Micropterus dolomieu, Smallmouth Bass

This black bass inhabits streams and lakes in areas associated with cobble and submerged aquatic vegetation. Spawning occurs in streams with clean gravel, and this species favors cooler and more riverine conditions than its congener, the Largemouth Bass (Smith 1985). Smallmouth Bass are native to the Allegheny and the Saint Lawrence River drainage watersheds, including Lake Champlain. The species has become established in all of the state's remaining watersheds and in many areas of the Adirondacks. In many cases, its initial introduction into the Atlantic Slope watersheds had occurred by the middle of the 19th century (Daniels et al. 2005).





Allegheny (1,2,3). Smallmouth Bass were collected at 38% of the sites sampled in lakes and larger streams during the 1937 survey (Greeley 1938). In stream surveys conducted after 1996, this species was found at a similar frequency and continued to be present in lakes as well. It can currently be found in all three basins in the watershed.

Erie-Niagara (1,2,3). Greeley (1929) listed this species as common in the lake, the Niagara River, and in larger creeks, like Cattaraugus Creek. It remains abundant in streams and provides a popular sport fishery in Lake Erie (Einhouse et al. 2005).

Ontario (1,2,3). Greeley (1940) reported that this species "constitutes an important asset, providing one of the most popular sports of the region. The survey collection records for this species total 132 and represent Lake Ontario, the bays, numerous ponds and larger creeks." It remains widely distributed, and the popular fishery continues to be economically important.

Genesee (1,2,3). Greeley (1927) described this fish as the most important game fish in the watershed. During the watershed survey, it was present in large warm tributaries and common in the Genesee River upstream of Rochester Falls and downstream of Wellsville as well as in Conesus and Hemlock lakes (Greeley 1927). Smallmouth Bass were rare in Silver Lake and apparently absent from Honeoye Lake and the Genesee River downstream of the falls, however (Greeley 1927). The species is still found in larger streams and lakes throughout the watershed.

Species continued on next page

Oswego (1,2,3). During the 1927 survey, Smallmouth Bass were common in lakes and large, warm streams, often in strong current (Greeley 1928). The species continues to be commonly caught and widely distributed.

Black (1,2,3). This is a common lowland species, but it has also been introduced into upland sites. According to Mather (1886), it was common in the upper Black and Moose rivers and the Fulton Chain of lakes by 1882. Greeley and Bishop (1932), as they did in several reports, reiterated the problems associated with assessing the native status of this species and also noted the undesirability of continued expansion in the Adirondack portion of the watershed, particularly in that this expansion resulted in declines in the native trout population. This bass is now widespread and present in many lakes and larger streams in the watershed. It continues to be stocked, often in lakes where earlier stocking attempts have failed (Daniels et al. 2011a).

Saint Lawrence (1,2,3). Greeley and Greene (1931) stated: "The black bass is the most popular game fish of the St. Lawrence River. In the lower reaches of the larger tributaries it is also found and in the Grass River its natural range extends as far upstream as Pyrites. In waters of greater elevation, as in the Adirondack area, the bass is not native...The introduction of bass into lakes of the Adirondacks has not been wise, due to the resulting damage to trout fishing and to the fact that bass fishing rarely maintains itself well in small lakes having a rather limited supply of minnows or other small fish." Despite this early warning, the species is now widely distributed. The frequency of Smallmouth Bass occurrence in streams from 1996–2010 was 43%, which is higher than the 13% reported in the 1930s.

Oswegatchie (1,2,3). This species was common at all of the lowland sites within the watershed during the 1931 survey and had also been planted at many upland sites (Greeley and Bishop 1932). It remains common at lowland sites and is widespread in upland lakes even though the effects of acidification may have limited its abundance and range.

Raquette (1,2,3). Greeley (1934) listed this bass as common and noted that it was native at lowland sites but had expanded its range greatly due to stocking and outmigration from the points of introduction. Greeley (1934) wrote that it was "now present in all of the principal lakes of the Raquette chain..." The species is widely distributed in the watershed today.

Champlain (1,2,3). According to Greeley (1930), Smallmouth Bass were moderately common in the watershed during the 1929 survey. Although native to Lake Champlain, this species was introduced into most of the inland lakes and ponds. Currently, it is widely distributed in both streams and lakes in this watershed.

Chemung (**1,2,3**). Greeley (1938) noted that this species was abundant and was collected at 27% of the sample sites during the 1937 survey. It remains abundant and widespread within the watershed.

Susquehanna (**1,2,3**). The Smallmouth Bass is not native to this watershed but had established a strong population by the time of the 1935 survey, when individuals were collected at 38% of the sample sites (Greeley 1936). This species occurred at about 30% of the stream sample sites in recent surveys.

Delaware (**1,2,3**). Greeley (1936) noted that this species was present in 26% of the samples taken in the 1935 watershed survey. It remains widespread.

Upper Hudson (**1,2,3**). Greeley and Bishop (1933) noted that the Smallmouth Bass was introduced to this watershed early and that the species continued to be introduced in new waters, many of them smaller ponds in the Adirondack Mountains, with poor results. The problem, most noticeable in small ponds, was twofold: trout declined and black bass populations became stunted. Currently, the species is widely distributed and continues to occasionally be introduced into new lakes (see Daniels et al. 2011a).

Mohawk (**1,2,3**). During the 1934 survey, Smallmouth Bass were common and were found in rivers and lakes as well as at higher elevations, where populations were the result of stocking (Greeley 1935). The species remains widespread and common in this watershed.

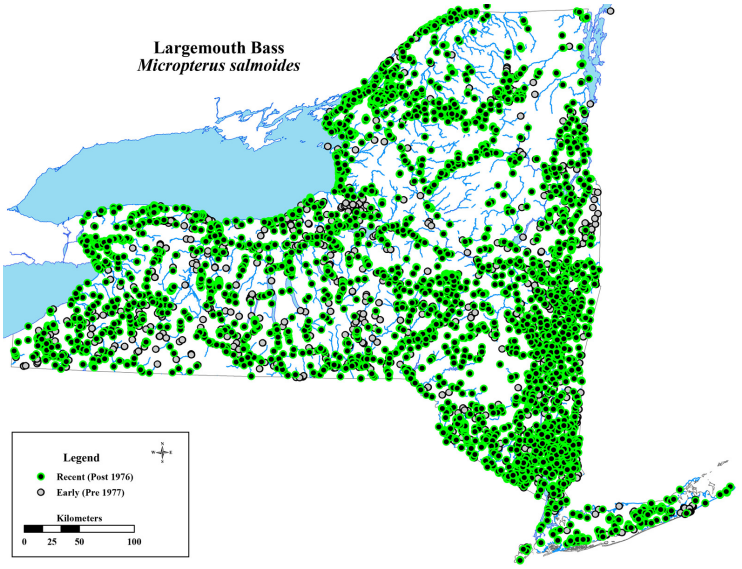
Lower Hudson (**1,2,3**). Smallmouth Bass were present in 20% of the survey samples taken in 1936 (Greeley 1937). The species is widespread in the watershed today.

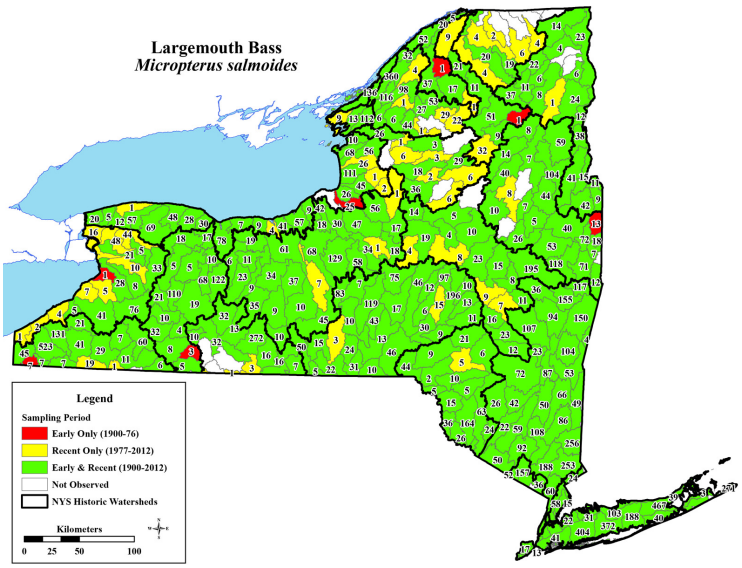
Newark Bay (**1,2,3**). Greeley (1937) noted the frequency of occurrence of this species in the 1936 survey at 31%. The species is still widely distributed today.

Long Island (**1,2,3**). Greeley (1939a) reported that "this popular game fish has been rather widely introduced on Long Island but cannot be called more than locally common." This suggests that, despite stocking efforts, suitable habitat was limited. Individuals were present in 19% of the samples taken from north shore streams (Greeley 1937). Smallmouth Bass are still present on Long Island and in Westchester County.

Micropterus salmoides, Largemouth Bass

This extremely popular game fish inhabits lakes and large rivers in areas associated with submerged aquatic vegetation. It is native to most of the watersheds of the Saint Lawrence River drainage and also the Allegheny watershed. The Largemouth Bass has become established in all the state's remaining watersheds, with stocking efforts beginning early in the 19th century (Cheney 1897). Its range continues to expand due to stocking, which is often unsanctioned, in the Adirondacks and elsewhere.





Allegheny (1,2,3). Individuals were captured at 21% of the sites sampled in the 1937 survey, almost exclusively in ponds or lakes (Greeley 1938). Largemouth Bass continue to inhabit backwater areas, lakes, and slow-moving water in all three basins, where specimens were taken at 12% of sites during stream surveys conducted after 1990.

Erie-Niagara (1,2,3). Greeley (1929) reported that this species was uncommon in the watershed and was limited to "weedy areas" such as Dunkirk Harbor, Lime and Crystal lakes, and large, slow-water streams. It has become more abundant in recent years and is now found throughout the watershed.

Ontario (1,2,3). This species had a wide distribution at the time of the 1939 survey and was present in sheltered areas of the lake (such as the bays) and in ponds and streams on the lake plain (Greeley 1940). Excluding Lake Ontario and its bays, Largemouth Bass were reported from 68 bodies of water during this early survey. Specimens were found in 56 waters during surveys of the last three decades, suggesting that the species has changed little in terms of frequency of occurrence or abundance.

Genesee (1,2,3). The 1926 survey found this species to be rare in the Genesee River but common in warmer waters such as Honeoye, Hemlock, Conesus, and Silver lakes (Greeley 1927). It is currently found throughout the watershed.

Oswego (1,2,3). Greeley (1928) reported that Largemouth Bass were common in warm lakes and sluggish streams and were associated with abundant aquatic vegetation. The frequency of occurrence of this species remains high and it is widespread in the watershed.

Species continued on next page

Black (1,2,3). Although this species was common in the Saint Lawrence River and adjacent tributaries, it was rare in this watershed and was collected at only two sites in the 1931 survey: the Black River near Carthage and Middle Branch Moose River near Old Forge (Greeley and Bishop 1932). It has been reported from over 25 waters in recent decades and is expanding its range through introductions and subsequent dispersal to neighboring waters (Daniels et al. 2008).

Saint Lawrence (1,2,3). Greeley and Greene (1931) reported that this species was rare, that relatively few were taken by anglers, and that the surveyors had collected no adults in the main channel. It is now more widespread in lowlands and is also common at higher-elevation sites.

Oswegatchie (1,2,3). Largemouth Bass were locally common in Black Lake and neighboring lowland lakes at the time of the 1931 survey (Greeley and Bishop 1932). Individuals are now taken throughout the watershed.

Raquette (1,2,3). This species was rare in the 1933 survey and is native only at lowland sites; Greeley (1934) reported that it was only found in Pleasant Lake and Lilypad Pond. Previously, Evermann and Kendall (1902b) had noted its presence in Follensby Pond. A specimen was also collected from Blue Mountain Lake in 1933 (NYSM 43445). The species is now widespread in the watershed, including many of the upland lakes.

Champlain (**1,2,3**). Greeley (1930) noted that Largemouth Bass were common in the lake and well established in ponds in the southern part of the watershed but also noted that this species was "slightly inferior in game qualities" to the Smallmouth Bass, which reflects an attitude quite different from that held today. The species is now widely distributed in ponds and lakes throughout the watershed.

Chemung (**1,2,3**). Individuals were present in 13% of the samples taken in the 1937 survey (Greeley 1938). The species is now more frequently encountered and wide-ranging, and was found in 34% of the stream samples from surveys conducted between 1996 and 2010.

Susquehanna (**1,2,3**). Largemouth Bass had been widely introduced into the watershed by the time of the 1935 survey, with Greeley (1936) reporting that the species was moderately common and present at 22% of the sites sampled. Odell and Senning (1936) reported it as common or abundant in 15 of the 20 lakes sampled. In recent stream surveys, individuals were collected in 16% of the samples, which was similar to the number of stream collections made during the 1935 survey.

Delaware (**1,2,3**). This species was relatively rare in this watershed during the 1935 survey, being present in only 5% of the samples taken (Greeley 1936) and receiving a rank no higher than "common" in the seven lakes in which it was found (out of 17 lakes sampled; Odell and Senning 1936). Today, the species is widespread in the watershed.

Upper Hudson (**1,2,3**). This fish was common during the 1932 survey and was the dominant species in areas with abundant aquatic vegetation, such as coves in the Hudson River and Cossyuna and Brant lakes (Greeley and Bishop 1933). Recent records show that Largemouth Bass still occur in many waters.

Mohawk (**1,2,3**). This species was common during the watershed survey but was largely confined to the river and its tributaries downstream of Little Falls (Greeley 1935). Although Largemouth Bass were present at sites in the Adirondacks, the species was largely absent in the Catskills and Helderbergs. Recent collections exist from throughout the watershed, including the highlands on the south side of the river (particularly after the 1980s).

Lower Hudson (**1,2,3**). Greeley (1937) described this species as abundant and the predominant game fish in many lakes and reservoirs, slack water areas of the main channel, and sluggish streams. It was taken at 25% of the 1936 survey sites sampled and is even more widely distributed today.

Newark Bay (**1,2,3**). Largemouth Bass were present in 48% of the survey samples taken in 1936 (Greeley 1937); the species remains common and widespread.

Long Island (**1,2,3**). The Largemouth Bass was the major freshwater game fish of Long and Staten islands and was collected at 55 of the 1938 watershed survey sites (Greeley 1939a). It was also important in streams draining into the north shore of Long Island Sound, where individuals were found in 23% of the samples (Greeley 1937). Recent records show that the species still occurs in many waters.

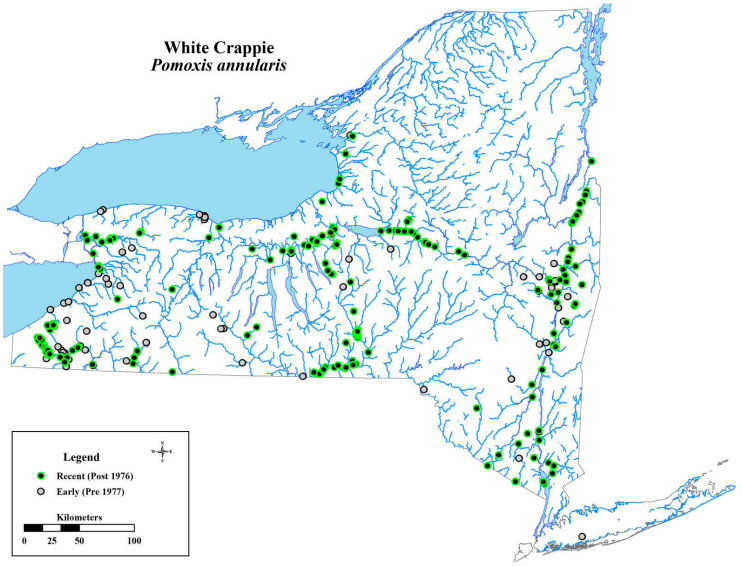
Pomoxis annularis, White Crappie

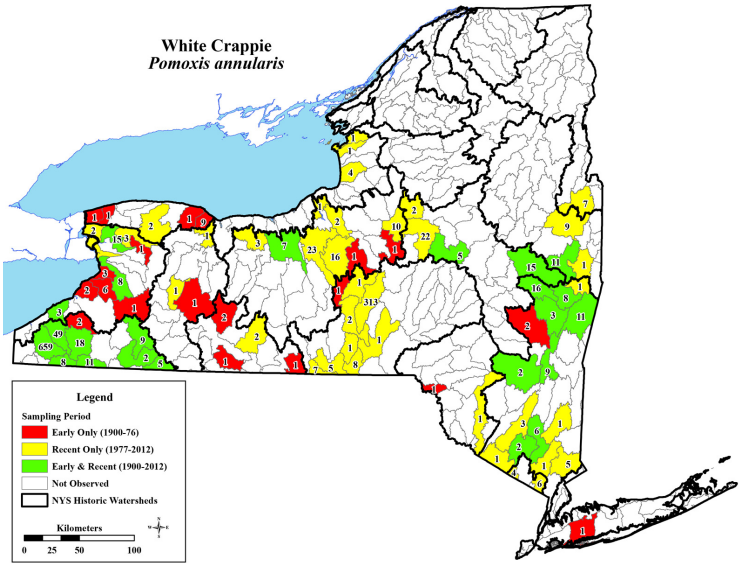
This species lives in lakes and some large rivers in areas associated with submerged aquatic vegetation. It is tolerant of turbid waters. The White Crappie is primarily an upper Mississippian species and, in New York, is only native to the Allegheny, Erie-Niagara, and Ontario watersheds. It has been introduced to many lakes, but the species does not seem to have continued to expand its range in recent decades.

Allegheny (1,2,3). During the 1937 survey, the White Crappie was restricted to the central (Conewango Creek) basin, where the species inhabited Chautauqua, Cassadaga, and Bear lakes as well as slow-water streams, like Conewango and Cassadaga creeks (Greeley 1938). More recently, individuals have been found in backwater areas of the Allegheny River and Conewango Creek (Becker 1982, Pomeroy 1995).

Erie-Niagara (1,2,3). This species was not taken frequently during the watershed survey, but specimens were caught in sheltered bays of Lake Erie and at creek mouths (Greeley 1929). White Crappies continue to be caught occasionally, and additional records include collections from the Niagara River in 2000 (NYSM 52289), Tonawanda Creek in 2001 (NYSM 53024), and isolated ponds.

Ontario (1,2,3). Greeley (1940) noted that White Crappies were found in only eight survey samples, all from the western part of the watershed. Range expansion did not begin until 1995, when the species began to be reported in the eastern part as well. These sites include South Sandy Pond and Black River Bay. This species continues to be found in the western part of the watershed, e.g., Oak Orchard Creek in 2012 (NYSM 68091) but generally remains rare throughout the watershed.





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Genesee (**2,3**). There are only two records of captures from this watershed. In 1981, specimens were collected from the Genesee River near the confluences of the Erie Canal and Red Creek (AMNH 224603). In 1989, this species was reported in Silver Lake.

Oswego (**1,2,3**). This species was collected at Montezuma in 1886 (CUMV 2025). The next report was from a tributary of Oneida Lake in 1963. Since then, White Crappies have been reported from 13 waters.

Champlain (**3**). In the mid-1990s, White Crappies were reported to be abundant in southern Lake Champlain but rare in the Vermont tributaries (Langdon et al. 2006). No similar reports exist for the New York part of the lake. The only recent collection in New York is from 2008 in the Champlain Canal near Fort Ann (NYSM 63975).

Chemung (**2,3**). The earliest specimen from this watershed was caught in 1947 at Tuscarora Creek (CUMV 68294). Only a few other records exist from this watershed, including catches in Loon and Lamoka lakes and the Chemung River. The species still persists in the watershed, with the most recent vouchered collection being taken from Sanford Pond Outlet in 2003 (NYSM 55464).

Susquehanna (**2,3**). The earliest vouchered specimen from this watershed is from Owego Creek in 1962 (CUMV 48727). White Crappies have been reported from the West Branch Tioughnioga Creek in 1965, the Susquehanna River in 1982 (AMNH 223622) and 1998 (USNM 353107), and the Chenango River in 1998 (USNM 354131). The species has also become established in the Whitney Point Reservoir and a few other ponds.

Delaware (**2,3**). This species was reported from Somerset Lake in 1963 and Morningside Lake in 1988.

Upper Hudson (**2,3**). White Crappies were recorded in Round Lake in 1967. The species is established in the Valley Falls Reservoir of the Hoosic River and in lock-dams of the Hudson River.

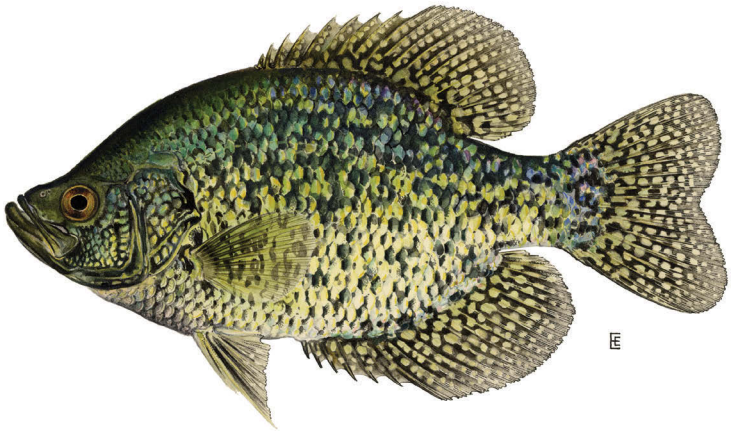
Mohawk (**1,2,3**). Greeley (1935) found White Crappies in the lower Mohawk River and its tributaries, as well as Crescent Lake (CUMV 36933) and concluded that the species had been stocked. Individuals continue to be found in the lower Mohawk, with records from Collins Lake (NYSM 50903) and reports from Delta Lake in the headwaters of the watershed.

Lower Hudson (**1,2,3**). Greeley (1935) collected specimens from Papscanee Creek and Normans Kill. Since then, White Crappies have been taken from the Hudson River from Albany/Rensselaer to Orange counties, western tributaries, such as the Wallkill River (NYSM 65010), and locations on the eastern bank, such as Mohansic Lake (AMNH 261619).

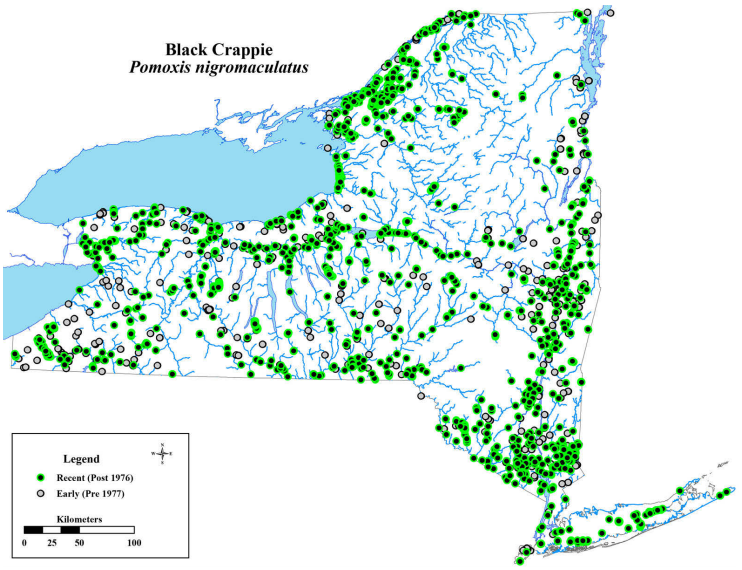
Newark Bay (**3**). The only record of this species in the watershed is of three individuals taken in trap nets set in Eagle Lake in 1999 (Sterling Forest Survey, unpubl. field notes, NYSM).

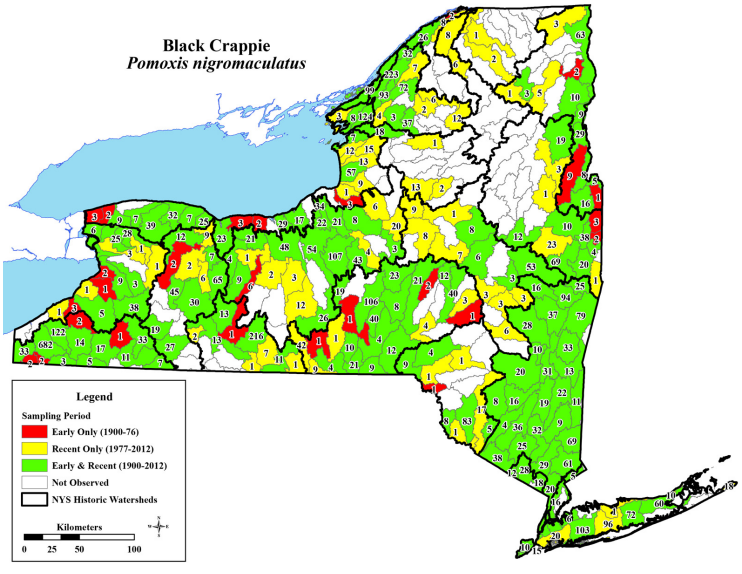
Long Island (**1**). Greeley (1939a) collected specimens from Brownings Lake (Nassau County). These are the only records from this watershed.

Pomoxis nigromaculatus, Black Crappie



This fish, once going by the more picturesque names of Calico Bass or Strawberry Bass, lives in lakes and some large rivers in areas associated with submerged aquatic vegetation. It occurs in all 18 of New York's watersheds but is only native to the Allegheny and most of the Saint Lawrence River drainage watersheds. The species has been introduced into the Raquette, Champlain, and all nine Atlantic Slope watersheds, and into many upland lakes in the Saint Lawrence watersheds.





Allegheny (1,2,3). Black Crappies were present in 21% of the watershed survey samples and were found in lakes or sluggish streams in all three basins (Greeley 1938). While there are early records from the eastern basin, such as NYSM 36565 from Red House Brook, the species was most prevalent in Chautauqua Lake and supported a strong spring fishery. Although the Black Crappie is native to this watershed, Greeley (1938) noted that the Chautauqua Lake population was the result of stocking fish from Sodus Bay, Lake Ontario. There are no recent records from French Creek, but the species continues to be found in the eastern and central basins as well as upland ponds of the western basin. Collectively, this fish occurred in about 2% of stream samples from recent surveys. Black Crappies are also present in most of the larger lakes in the watershed.

Erie-Niagara (1,2,3). This species was collected from Silver (USNM 70008) and Fish creeks (USNM 70009) in 1894. It was not collected during the 1928 watershed survey, however (Greeley 1929). Recently, captures have been reported from Lake Erie, the Niagara River, and tributaries of both.

Ontario (1,2,3). Wright (2006) collected specimens from Northrup Creek in 1904 and also reported on earlier catches in the watershed. Black Crappies were present in 62 watershed survey samples, mostly from bays in Lake

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Ontario but also from Carlton Lake and a few other floodplain lakes (Greeley 1940). This species has recently become more widespread in Lake Ontario bays and nearby lakes and has also been taken from streams, such as Oak Orchard Creek (NYSM 67661), and the canal system (NYSM 61146).

Genesee (1,2,3). No specimens were collected during the 1926 survey, but Greeley (1927) speculated that Black Crappies entered the mouth of the Genesee River. In the early 1800s, Seth Green recorded a catch from a stream near Caledonia (MCZ 9625). The species was next reported from Silver Lake in 1940 and is now found in many larger waters.

Oswego (1,2,3). Greeley (1928) reported that Black Crappies were "not uncommon" and were found in the Clyde, Seneca, and Oswego rivers, with occasional captures from Cayuga, Cross, and Neahtawanta lakes. The species is now widely distributed, and the catch frequency in streams was 5% in surveys conducted between 1996 and 2010.

Black (2,3). Black Crappies were common in Lake Ontario (Greeley 1940) and although not reported during the 1931 survey, were probably present in the lower reaches of the Black River (Greeley and Bishop 1932). The first confirmed record from this watershed is from Pleasant Lake in 1953, where this species was probably introduced. It continues to be caught in the main channel and in upland lakes on occasion.

Saint Lawrence (1,2,3). Records from the 1931 survey are restricted to sluggish streams in the Saint Lawrence River floodplain, such as Crooked, French, and Cranberry creeks (Greeley and Bishop 1932). Nearly all other records, including more recent ones, are from the Saint Lawrence River.

Oswegatchie (1,2,3). Field notes from 1931 recorded Black Crappies in Lake Bonaparte. The species became well established in several of the Indian River lakes after 1970, which coincided with a decline of Walleye populations (Schiavone 1983, 1985). Individuals continue to occasionally be collected from the Oswegatchie River (NYSM 64283).

Raquette (**2,3**). The first report from this watershed is from Barney Pond in 1985 (AMNH 254330). Recently, Black Crappies have been reported from six waters.

Champlain (**1,2,3**). This species was moderately common and wide ranging in Lake Champlain during the 1929 survey, with the greatest concentration in South Bay. It had also been introduced into Warm Pond, from which it spread to surrounding waters (Greeley 1930). Black Crappies continue to be taken episodically in Lake Champlain and are now more widespread in upland lakes. Young-of-year were taken from the Champlain Canal in 2011 (NYSM 67780), and the species may be a common entrant to the canal system.

Chemung (**1,2,3**). Black Crappies were collected at 6% of the sample sites in the 1937 survey of this watershed, all of which were in lakes (Greeley 1938). Recent work suggests that the species is becoming more common and widespread.

Susquehanna (**1,2,3**). Individuals were found at 2% of the watershed survey sample sites, which included reservoirs, lakes, the main channel of the Susquehanna River, and larger tributaries (Greeley 1935). Black Crappies are now found in over 40 waters and were present in 1% of stream samples from recent surveys.

Delaware (**1,2,3**). This species was collected at two sites in the 1935 survey: Silver and Crystal lakes (Greeley 1936). Recent records are more widespread, but remain mostly from lakes.

Upper Hudson (**1,2,3**). Greeley and Bishop (1933) listed this fish as rare, with collections from the Hudson River at Coveville, the lower Moses Kill, and a stream at Bemus Heights. All of these were downriver of Hudson Falls, and the authors speculated that the species was introduced. Recent work suggests that it is more widespread, including upland sites.

Mohawk (**1,2,3**). This species was absent from the upper watershed but was collected at 37 sites in the lower watershed during the 1934 survey, including sites in the main channel, lakes, and some tributaries (Greeley 1935). Greeley (1935) postulated that it may have been introduced with stock provided by the U.S. Bureau of Fisheries. Recent records exist from many waters.

Lower Hudson (**1,2,3**). In the 1936 survey, Black Crappies were mostly caught in lakes, although several collections were made from the Hudson River and its tributaries (Greeley 1937). Although Greeley (1937) listed the species as common, it was collected at only 6% of the watershed survey sample sites. In recent decades, it has been caught in the main channel, in lakes and reservoirs, and in tributary systems on both banks.

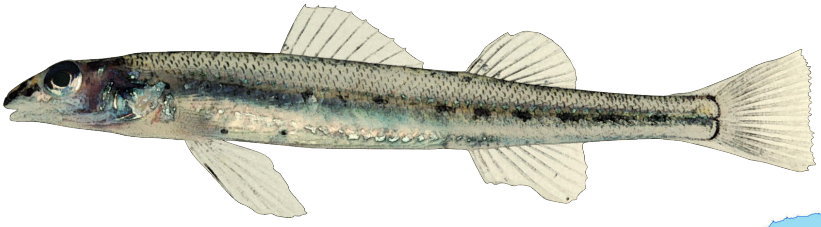
Newark Bay (**1,2,3**). This species was represented in 1% of the 1936 survey samples (Greeley 1937). Recent records show it in many waters today.

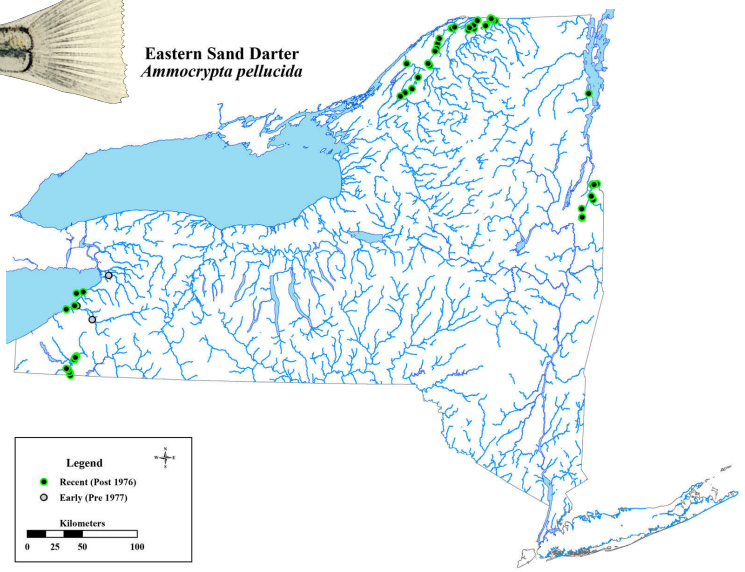
Long Island (**1,2,3**). Greeley (1939) noted that the introduction of this species to this watershed had generally not been successful. It was established at only one site on Long Island, Lower Twin Pond (Nassau County), but was also established at several sites on Staten Island, including Wolfes Pond, Clove Lake, and Martlings Pond. Black Crappies are now commonly caught throughout the watershed.

Percidae, Perches

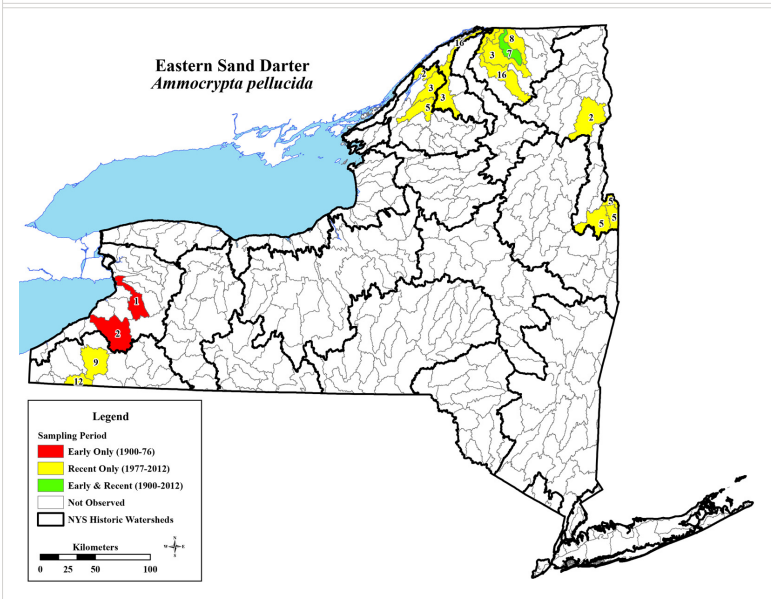
Perches are freshwater fishes and include species that are native to North America and Europe. In North America, there are two types of perches that are similar in appearance but very different in size. One group includes important sport fishes that are primarily lake dwelling, and the other includes many small, often brightly colored demersal fish, called darters, which are largely confined to streams. The taxonomic treatment of these fishes divides the North American species of the family into two subfamilies and within one of the subfamilies, two tribes. Smith (1985) can be consulted for additional information on the higher taxonomy of this group. There are representatives of the family in all New York watersheds. Several species are native to most if not all of the state's watersheds, but many others have restricted ranges and are found in just a few. The sport fish species have been stocked throughout the state, but a surprising number of darters have also been transplanted to non-native watersheds. There are 21 species present in the state, all of which are native to at least one New York watershed. Many of the darters are rare and some are protected. Sauger populations have declined in the last several decades, and the Blue Pike, which was once commercially important, is likely extinct.

Ammocrypta pellucida, Eastern Sand Darter





This small, translucent fish lives in medium-sized streams and larger rivers with clean sand and low gradient. Early reports documented this species in the Erie-Niagara and Saint Lawrence watersheds. It has been found in three additional watersheds in the last four decades, and its presence in these areas is difficult to assess. Each had been sampled extensively during the 1920s and 1930s and Eastern Sand Darters were not found, perhaps because they were actually absent or because the species was so rare that it was simply overlooked. As environmental conditions have changed in these watersheds over the decades, suitable habitat may have become available, allowing for short-distance range expansions and increases in abundance. There is little evidence that this species is a good disperser, so range expansion by invasion seems unlikely. The possibility of human-aided stocking cannot be ruled out although it seems unlikely. The Eastern Sand Darter is currently classified as Threatened in New York; its status should be reviewed.



Allegheny (3). The Eastern Sand Darter was first collected from the New York portion of this watershed in 2004, although Cooper (1983) previously reported it from French Creek, downstream in Pennsylvania. It is present in Conewango Creek, upstream from the Pennsylvania line for about 22 km, and in the lower part of Stillwater Creek, both of which are streams

Species continued on next page

in the central basin (Daniels et al. 2006a, b). The species continues to be found in this area. [In 2003, one of the authors met two local octogenarians that described a small, “transparent fish that used to jump” along the sand beds that were common in lower Conewango Creek when they were young, in the late 1920s and early 1930s. They also noted that the clean sand beds began to disappear in the 1930s, and they were pleased that they were able to see them again in the new century. It is interesting that their youth spent playing on the sand beds was before the 1937 survey of the watershed and this conversation took place a year before another author caught the first Eastern Sand Darter reported from this watershed.]

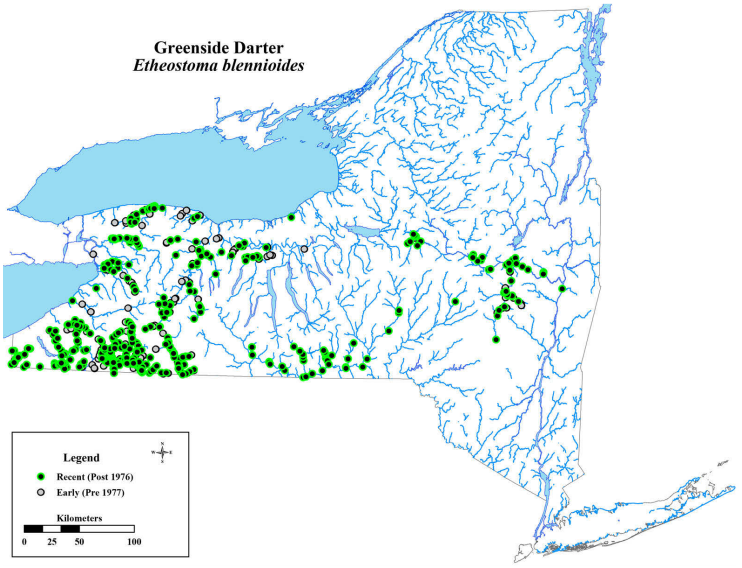
Erie-Niagara (1,3). Albert J. Woolman (1895) found this species in 1893 in Cazenovia Creek near Buffalo (USNM 62841) and Cattaraugus Creek at Gowanda (USNM 69959) and at Irving (USNM 62839). Greeley (1929) reported its absence from this watershed and speculated that pollution had caused its extirpation. Individuals have been collected in Lake Erie from Sturgeon Point to the mouth of Cattaraugus Creek between 1991 and 2013. Catches declined after 2005, but the species continues to be taken regularly. The arrival of the Round Goby and its increase in abundance in the near-shore area of the lake appears to coincide with fewer catches of Eastern Sand Darters (Poos et al. 2010).

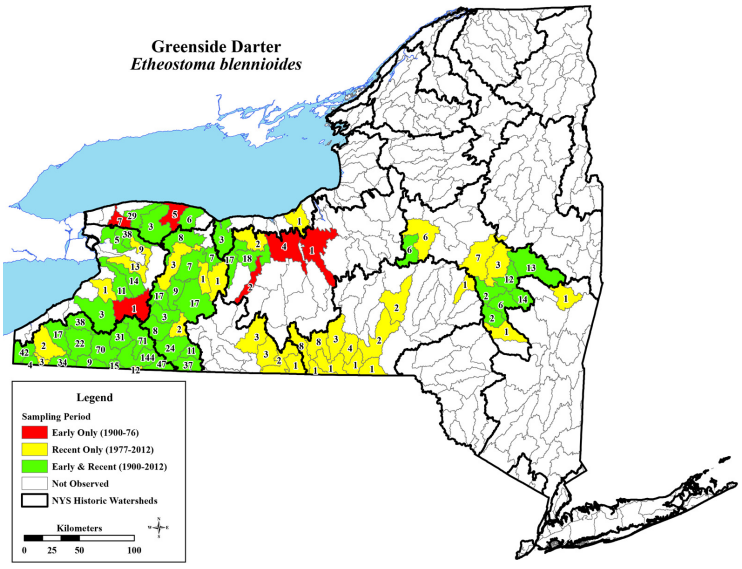
Saint Lawrence (1,3). Greeley and Greene (1931) noted that Eastern Sand Darters were rare and that only two specimens were collected, both of which were from the Little Salmon River near Fort Covington. Since 1999, the species has been caught in the Salmon, Saint Regis, Deer, and Grass rivers. Bouton (1991) surveyed the Salmon River basin extensively between 1987 and 1991 and found that the population was stable, with CPUE’s comparable to those in the Mettawee and Poultney rivers of the Champlain watershed. In 2012, surveyors found that the Salmon River population had extended its range 6 km farther upstream than previously known to sites upstream of the Little Salmon River.

Oswegatchie (3). In 2007, specimens were collected from the Oswegatchie River at Dekalb (NYSM 62671) and Richville (NYSM 62764). Subsequent captures have also been from the main channel at Little Bow Road in 2008 (NYSM 64088), at the confluence with the Indian River in 2009 (NYSM 65000), and at Elmdale in 2013 (NYSM 68763). In the seven years that have elapsed since the first discovery of this species in the watershed, it has been found in approximately 45 km of the river.

Champlain (2,3). This species was first reported from the Mettawee River in 1979 (AMNH 43854). In 1983, it was found in the Poultney River (Daniels 1993). Eastern Sand Darters continue to be caught in these streams during routine survey work. In the Poultney River basin, this darter is found at Coggman Creek near the river’s mouth on East Bay of Lake Champlain. The species has also been found in Halfway Creek in 2008 (NYSM 64105) and the Champlain Canal south of Lock 9 in 2011 (NYSM 64252). In 2013, individuals were caught in the lower Boquet River (NYSM 69634), 97 km north of previous records in the Lake Champlain basin. Facey (1998) reported a similar northward range extension on the Vermont side of the lake.

Etheostoma blennioides, Greenside Darter





Two subspecies of Greenside Darter are found in New York and both live in riffles over clean gravel. The nominal subspecies is found in the Allegheny watershed and the upper Genesee River system. *Etheostoma blennioides pholidotum* is present in the Erie-Niagara, Ontario, and Mohawk watersheds, and the lower Genesee River system. Both subspecies are native and abundant in their respective watersheds. The species has been introduced into the Susquehanna, Chemung, and perhaps, Lower Hudson watersheds.

Allegheny (1,2,3). Greeley (1938) reported this species from 21% of the watershed survey sample sites, with all records coming from stream sites, usually in riffles. Yochim (1981) found it throughout the Allegheny River in riffles and shallows with abundant aquatic vegetation or filamentous algae. The species also occurred in larger tributaries throughout all three segments of the watershed. In surveys conducted in all three basins after 1984, Greenside Darters were found at about 30% of the sample sites.

Erie-Niagara (1,2,3). Greeley (1929) listed this darter as uncommon but present in shallow, warm streams emptying into the lake. The species is widespread and relatively common today.

Ontario (1,2,3). Greenside Darters were only found in the western tributaries of the lake, all west of Irondequoit Creek (Greeley 1940). Wright (2006) listed the species as abundant in Salmon Creek in 1904 and 1905. The easternmost record is from Blind Sodus Creek in 1979, but no specimen is available for verification.

Genesee (1,2,3). During the 1926 survey, this species was moderately common in the Genesee River as far upstream as Belmont and in some of the largest tributaries, like Black and Honeoye creeks (Greeley 1927). It remains common throughout the watershed and extends as far upstream as the Pennsylvania state line.

Oswego (1,2,3). Greeley (1928) reported that Greenside Darters inhabited large, warm streams of the northwestern part of the drainage, where they were associated with “rapid or strong current where the bottom is rubble.” The species is still found in streams west of Ganargua Creek. The easternmost record is from 1953 from a tributary of the Seneca River near Weedsport (CUMV 23042). There are reports of catches in streams north of Oneida Lake but as there are no voucher specimens, these records are not included on our map.

Species continued on next page

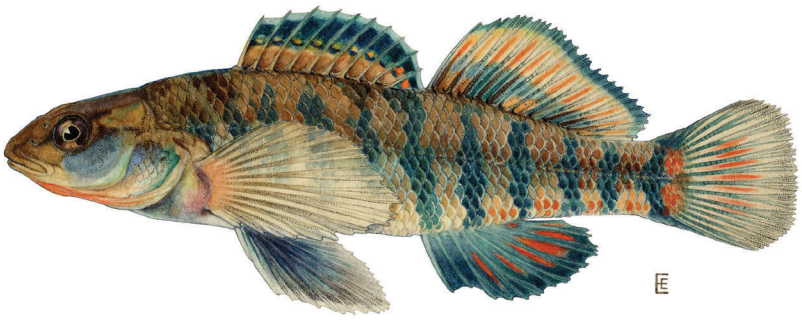
Chemung (**3**). This darter was first reported from the Chemung River in 1989. No supporting voucher specimens were kept, however, and a 2002-2003 survey of the area failed to find any Greenside Darters. In 2007, specimens were collected from Meads and Sing Sing (NYSM 62774) creeks, and again from Meads Creek in 2013. In 2008, this species was reported from the main channel at Corning (C. Millard, USEPA National Rivers Study, pers. comm.). These recent sites are much farther downstream in the watershed than a 2001 report of this species in the Cohocton River. To date, no collections have been confirmed at any upstream sites, including the Cohocton River site.

Susquehanna (**3**). Cooper (1983) classified this fish as a recent immigrant in Pennsylvania, where it was first discovered in 1962. The decision to treat this species as native may have been based on Denoncourt et al. (1977), who suggested that the Susquehanna River population resulted from an Allegheny River system stream capture. Although this is plausible, Greenside Darters are typically absent from headwater streams, which are the types of streams that occasionally shift drainages. It is more likely that this species was introduced, perhaps at several sites, and expanded its range to now include a major part of the drainage. Neely and George (2006) speculated that it was a bait-bucket release and they, Carlson and Daniels (2004), and Starnes et al. (2011) treat the Greenside Darter as exotic in this drainage. The earliest records in the New York portion of the watershed are from Catatonk Creek in 1998 (NYMS 49640) and 2000 (CUMV 81856). Records from Cayuta Creek in the 1990s are not included on our maps because the identifications could not be verified. Since the first verified report in 1998, this species has expanded its range to include much of the watershed: it was caught in the Owego Creek basin (NYSM 57327) and Nanticoke Creek (NYSM 56908) in 2004, Cherry Valley Creek in 2007 (NYSM 63003), and the Chenango River in 2008 (C. Millard, USEPA National Rivers Study, pers. comm.).

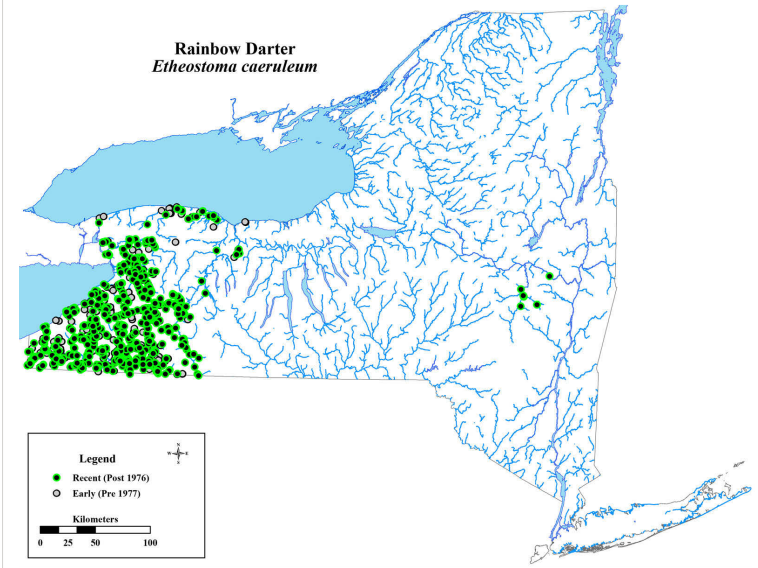
Mohawk (1,2,3). This species was an uncommon catch during the 1934 survey, and all collections were from low-elevation sites in either the main channel or larger tributaries, like Oriskany and Schoharie creeks and the Alplaus Kill (Greeley 1935). In recent decades, it has continued to be found in these creeks, but its range has expanded to include some upstream sites, such as the Mohawk River in Oneida County (NYSM 51503). This darter is widely distributed in Schoharie Creek and its downstream tributaries but has not been reported upstream of the Schoharie Reservoir.

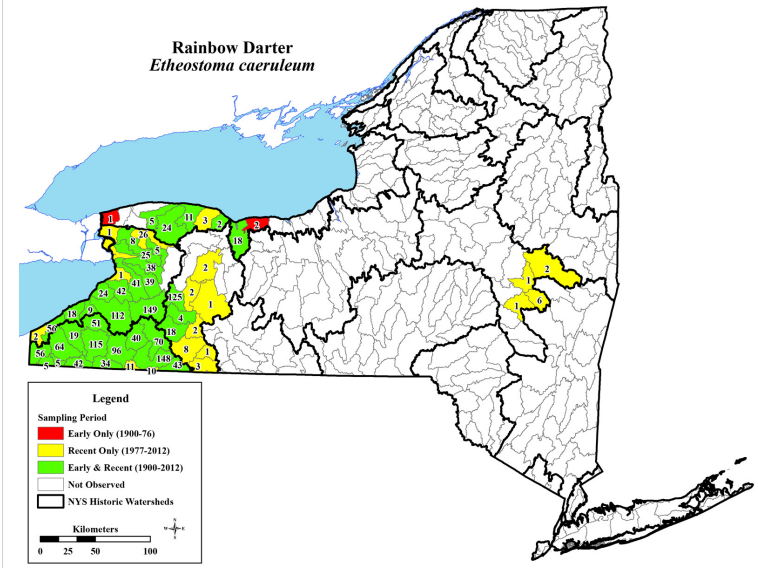
Lower Hudson (2). Carlson (1986) reported a catch near the Port of Albany in 1983. There is no voucher specimen, however. No Greenside Darters have been collected from the watershed since.

Etheostoma caeruleum, Rainbow Darter



This colorful darter is a typical riffle species, which is associated with clean gravel and rubble and fast current. It is native to the three western watersheds, where it is abundant. In tributaries of Lake Ontario, its native range extends only as far east as Rochester. The Rainbow Darter was introduced to, and is becoming more widespread in, the Genesee watershed, and it was also recently found in a tributary of Schoharie Creek and is now expanding its range in the Mohawk watershed.





Allegheny (1,2,3). Greeley (1938) noted that this species was found at 34% of the watershed survey sample sites. Streams were the dominant habitat used, but populations were also present in Cassadaga and Chautauqua lakes. The species remains abundant and widely distributed in this watershed. The Rainbow Darter is present in small tributaries farther upstream than any other darter species except for the Fantail Darter. Nemecek (1980) noted that this species has very broad habitat tolerances but is negatively affected by higher temperatures.

Erie-Niagara (1,2,3). During the 1928 survey, Rainbow Darters were found in the majority of streams that drained into Lake Erie but were largely absent from tributaries of the Niagara River (Greeley 1929). Today, this species is widespread and relatively common.

Ontario (1,2,3). Greeley (1940) noted that this was a relatively rare stream species that was not found east of Irondequoit Creek. No specimens were found in the streams sampled by Wright (2006) from 1904-1905. The species remains confined to the western part of the watershed, and its range is currently perhaps even more constricted, with the easternmost recent collection coming from West Creek of Braddock Bay in 1980.

Genesee (**2,3**). The first record in this watershed is from Caneadea Creek in 1953, with additional specimens collected from the Genesee River at Filmore in 1978 (AMNH 41475). This darter has expanded its range downstream in subsequent years, and it is now common in the upper and middle sections of the watershed. The farthest downstream collection is from the Genesee River at the mouth of Oatka Creek (NYSM 54346).

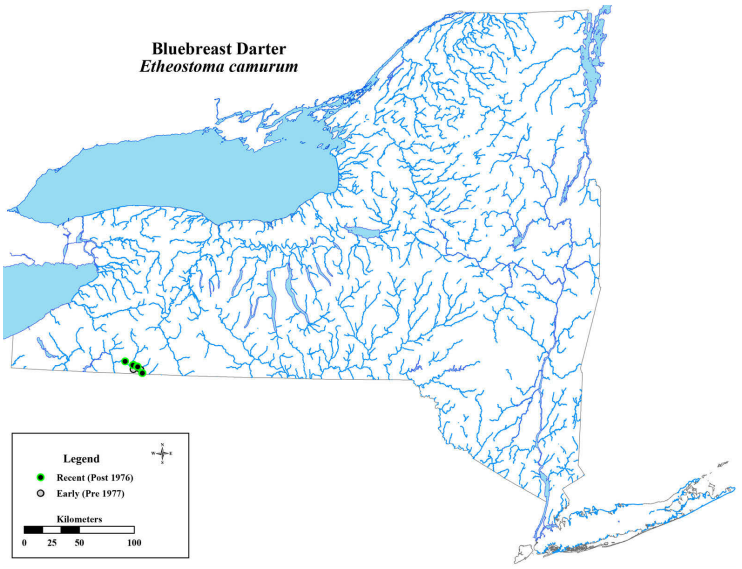
Species continued on next page

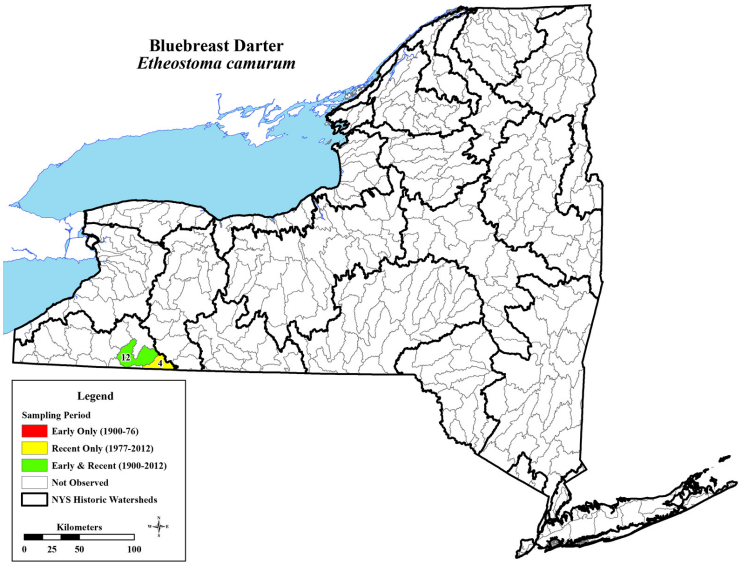
Mohawk (**3**). This species was first reported from Fox Creek, a tributary of Schoharie Creek, in 2009 (NYSM 64851) and has steadily expanded its range in subsequent years. In 2013, it was collected from the Mohawk River at the mouth of Plotter Kill (NYSM 68721), 77 km from the site of its first capture in Fox Creek, and individuals were also present 18 km upstream of the introduction site in the Switz Kill (NYSM 68691). In 2014, Rainbow Darters were found downstream from the introduction site in both Schoharie Creek (NYSM 70467) and Cripplebush Creek (NYSM 70411).

Etheostoma camurum, Bluebreast Darter

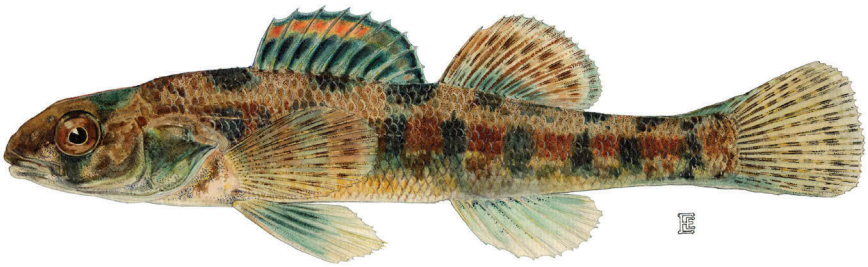
This darter is a habitat specialist that lives in large and medium-sized streams in deep riffles and is associated with gravel and rubble substrates. It is native to the Allegheny watershed. The species was not reported until 1973, and in recent surveys it has been caught infrequently. The Bluebreast Darter is classified as Endangered in New York because it is rare, but there are no clear trends suggesting a decline in numbers.

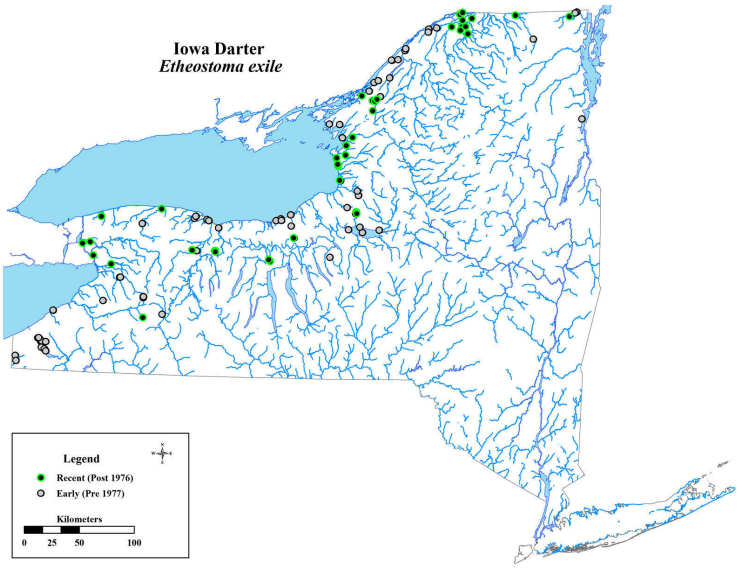
Allegheny (2,3). The first catches of Bluebreast Darters in New York were in fast, deep riffles of the Allegheny River near Weston Mills in 1973 and at Steam Valley Road in 1975 (Smith 1985). Individuals were caught in Oswayo Creek in 1985, 1989 (NYSM 40207), 2001 (NYSM 53216), and 2012. Repeated efforts to capture this species in the Allegheny River were not successful until 2006-2008 and 2013, when it was caught in the reach downstream of Weston Mills (NYSM 63712, 69753). Brewer (2015) reported that it occupied a 19 km section of the main channel. This rare species has also been caught in French Creek, just downstream of the state line in Pennsylvania (Raney 1938, Schwartz 1954).

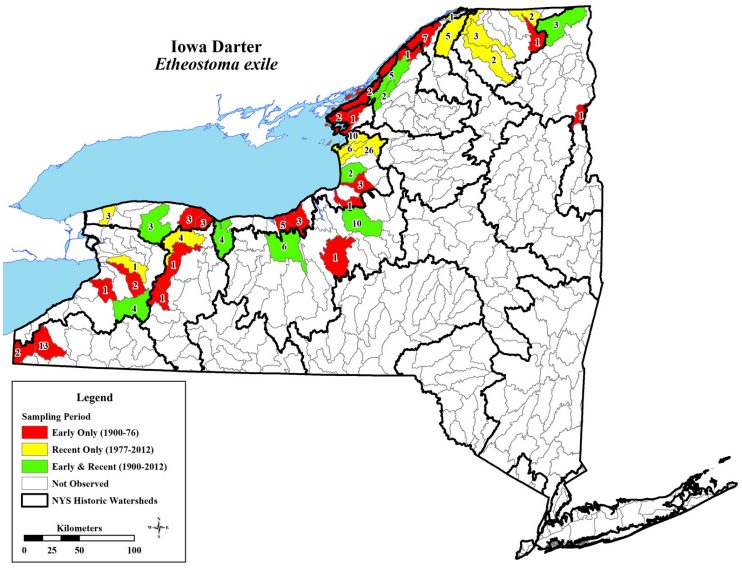




Etheostoma exile, Iowa Darter







Unlike many of the members of this genus that are found in New York, the Iowa Darter lives in lakes, low gradient streams, and larger rivers, usually associated with submerged aquatic vegetation and gravel. It is native to the Allegheny watershed and most of the Saint Lawrence River Drainage watersheds. Populations have declined to levels below detection in the Allegheny watershed; there are no clear trends in other watersheds. Most records are from Lake Ontario bays and inland waters. The Iowa Darter has been classified as a Species of Greatest Conservation Need in New York.

Allegheny (1). Greeley (1938) reported this species at 2% of the watershed survey sample sites, all of which were in either Findley or Chautauqua lakes. The only stream collections of Iowa Darters are from Thomas Creek, a tributary of French Creek, in 1928 (NYSM 13721) and West Branch French Creek just downstream of Findley Lake in 1948 (CUMV 68818). There are no recent reports of captures in this watershed.

Erie-Niagara (1,2,3). During the 1928 survey, Iowa Darters were found in Java Lake and were locally common in Lake Erie bays, especially Dunkirk Harbor (Greeley 1929). In 1947, the species was collected from Pond Brook, a tributary of Eighteenmile Creek. Individuals were also taken from Crystal Lake in 1981. Later collections came from isolated ponds in the headwaters of Slate Bottom Creek in 2005 and the upper Niagara River. During a 2001 survey, Iowa Darters were collected at 5% of the sample sites in the Niagara River (New York Power Authority 2001).

Ontario (1,2,3). This species was found at 12 watershed survey sites in bays, ponds, and low-velocity streams along the entire south shore of the lake (Greeley 1940). Wright (2006) collected it from North Creek in 1904. Between 1975 and 2007, Iowa Darters were also found at 12 sites along the south shore of the lake, including several sites in the eastern basin as well as Sterling Creek (Brazner et al. 2007), Marsh Creek, Mendon Ponds, and the upper reaches of East Branch Twelvemile Creek in the western basin. Although the species remains widely distributed, it has been collected less frequently in recent decades.

Genesee (1,2,3). The Iowa Darter is rare in this watershed. It was collected from Blue Pond near Scottsville in 1931 (CUMV 27400) and 2012 (NYSM 67653), and from Wiscoy Creek in 1974.

Species continued on next page

Oswego (1,2,3). Greeley (1928) reported that this species was common in ponds with swampy conditions in the northern part of the watershed, including Duck Lake and Vandermark, South, and Mud ponds. In the early 1940s, it was collected at two sites on Oneida Lake (CUMV 39024, 39500). In 1981, specimens were collected again at Duck Lake (AMNH 227075) and Vandermark Pond (AMNH 227084). More recently, this darter was collected from Junius Pond in 2005 and North Pond in 2011.

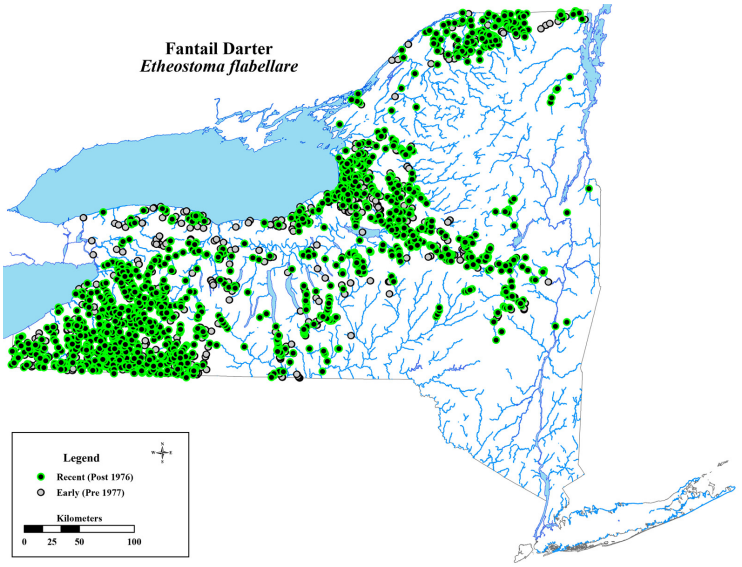
Saint Lawrence (1,2,3). According to Greeley and Greene (1931), the Iowa Darter "is a fish of sheltered weed beds and was found only in sluggish creeks and in stream mouths along the Saint Lawrence River. It does not inhabit streams far above the level of this river. Tibbits Creek, Sucker Brook and Little Sucker Brook are the only waters in which it was taken." There was also one 1930 record from Coles Brook (NYSM 13716) and one from Lower Chateaugay Lake (J. Greeley, unpubl. field notes). In recent years, individuals have been caught at a few locations on the Saint Lawrence River and in tributaries as far east as Oak Creek, a tributary of the Trout River, where the species was caught in 2012.

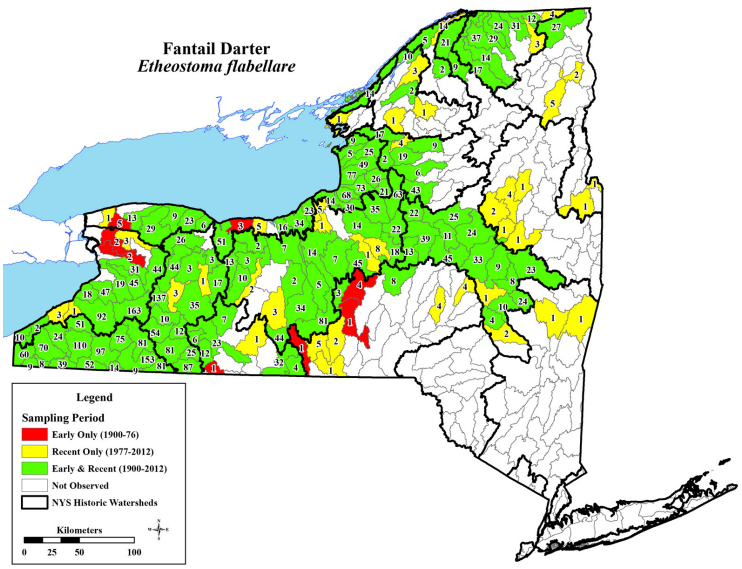
Oswegatchie (1,2,3). Greeley and Bishop (1931) noted that Iowa Darters were most abundant in weedy areas of the lowland lakes of this watershed; the species was never found in open water. It was caught in Black (NYSM 13705) and Millsite (NYSM 13698) lakes and their tributaries. This darter has not been frequently caught in recent years but has been taken from Millsite, Hickory, and Clear lakes as well as Black Creek near Theresa.

Raquette (3). The only records of the species in this watershed are from Squeak Brook in 2001 (NYSM 53052) and 2004 (NYSM 57289) and the Raquette River near Massena in 2013 (J. McKenna, USGS, Cortland NY, pers. comm.).

Champlain (1,3). Greeley (1930) only collected this species in Beaver Creek, "a warm, weedy creek with dark water." Despite several attempts to collect this species in recent decades, the only successful capture was from a sidewater of the Great Chazy River near Mooers (NYSM 64204), approximately 2 km upstream of Beaver Creek, in 2008.

Etheostoma flabellare, Fantail Darter





This darkly pigmented darter lives in stream riffles and is usually associated with gravel and rubble but is sometimes found where slabs of limestone predominate. It inhabits all of New York's watersheds, except for the Delaware, Newark Bay, and Long Island. The species is rare in the Susquehanna watershed, and it may be a recent immigrant to the Lower Hudson.

Allegheny (1,2,3). The Fantail Darter was among the most frequently collected darters in the Allegheny River system, with representatives in 44% of the watershed survey samples taken (Greeley 1938). Greeley (1938) also noted that it rarely occurred in lakes, with the exception of Chautauqua Lake, where it was common at nearshore sites. In surveys conducted in recent decades, this has remained the most frequently encountered darter species and was found at over half of the sample sites. It was usually found in riffles of small to moderate-size tributaries in all three basins of the watershed but occasionally in riffles of the main channel of the Allegheny. The species was the dominant darter in headwaters as well and ascended tributaries higher than any other type of darter.

Erie-Niagara (1,2,3). Greeley (1929) reported that Fantail Darters inhabited most stream systems in the watershed and ranged farther into headwaters than any other darter. This species is widespread and relatively common today.

Ontario (1,2,3). This species was found throughout the watershed during the 1939 survey and was the most frequently encountered darter, with 116 collections (Greeley 1940). It continues to be a dominant component of streams in the watershed.

Genesee (1,2,3). During the 1926 survey, this darter was common in rapid, shallow streams but was also rarely found in the main channel downstream of Portageville Falls (Greeley 1927). It continues to be common throughout the watershed.

Oswego (1,2,3). Greeley (1928) listed this species as common in warm or cool streams with hard substrates and high velocity. Although rarer, it was also present near creek mouths in several Finger Lakes. Currently, the species is widely distributed, with a frequency of catch in streams of 19% during surveys conducted between 1996 and 2010.

Black (1,2,3). Greeley and Bishop (1932) noted that Fantail Darters were found in smaller streams throughout the watershed, including headwater streams at elevations of 425 m. The species continues to be collected from lower elevation streams in the watershed.

Species continued on next page

Saint Lawrence (1,2,3). This species was present in many of the tributaries, but no watershed survey specimens were collected from either the main channel of the Saint Lawrence River or the headwaters in the Adirondack Mountains (Greeley and Greene 1931). Fantail Darters have been found in smaller lowland streams in recent decades.

Oswegatchie (1,2,3). During the 1931 survey, Fantail Darters were most frequently taken from small creeks and at the mouth of the Oswegatchie River (Greeley and Bishop 1932). In 1979, individuals were caught in the Oswegatchie River near Ogdensburg (AMNH 44854) and at Dekalb (AMNH 44880). In 2007, the species was again taken from the river at Eel Weir State Park. This darter is relatively rare in this watershed, which differs from the situation in most of the other Saint Lawrence River watersheds.

Raquette (1,2,3). This species was common during the 1933 survey but was confined to the river and tributaries downstream of Hannawa Falls; several specimens were taken from rock pools below the Raymondville dam (Greeley 1934). It continues to be found in smaller lowland streams.

Champlain (1,2,3). Fantail Darters were locally common during the 1929 survey but were restricted to the Great Chazy River and its tributaries (Greeley 1930). The species is still found in the Great Chazy River basin and now also occurs in the Ausable River and its tributaries near Clintonville. It has not been reported from the middle portion of the watershed but does occur at the southern end of the watershed in Mount Hope Brook (NYSM 44101), Mud Brook, and tributaries of Halfway Brook. In Vermont, this darter is found in the upper Missisquoi River system (Langdon et al. 2006).

Chemung (1,2,3). Individuals were present at 4% of the watershed survey sample sites and were restricted to the creeks of the Canisteo system and Newtown Creek, a Chemung River tributary (Greeley 1938). The species has become more common and widespread in recent decades.

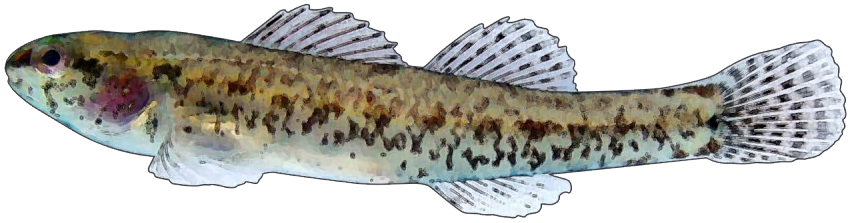
Susquehanna (2,3). The first report of this species from the watershed was in 1954, when specimens were taken from Danby Creek (CUMV 45007). It was also reported from two ponds near Cortland and from Pleasant Brook, near Smyrna. Since then, specimens have been taken from Owego and Otego creeks and the Tioughnioga and Chenango rivers and their tributaries on rare occasions. Cooper (1983) noted that the species was rare in Pennsylvania.

Upper Hudson (2,3). Fantail Darters have only been collected from the Sacandaga River basin, with the first record in 1979 (AMNH 43679). Subsequently, the species has only been collected four more times in this basin, in 2002 and 2008.

Mohawk (1,2,3). Greeley (1935) listed this species as moderately common and present in shallow tributary streams and also in Delta Lake. It continues to be caught throughout the watershed. Greeley (1935) also noted that this was a western species and speculated, without providing details, that it had invaded this watershed and was presumably in the early stages of the invasion because it hadn't yet arrived in the Hudson River drainage. How it accomplished the invasion is key to establishing whether or not it is native to this and the two other Hudson River watersheds, but, at present, no additional information is available.

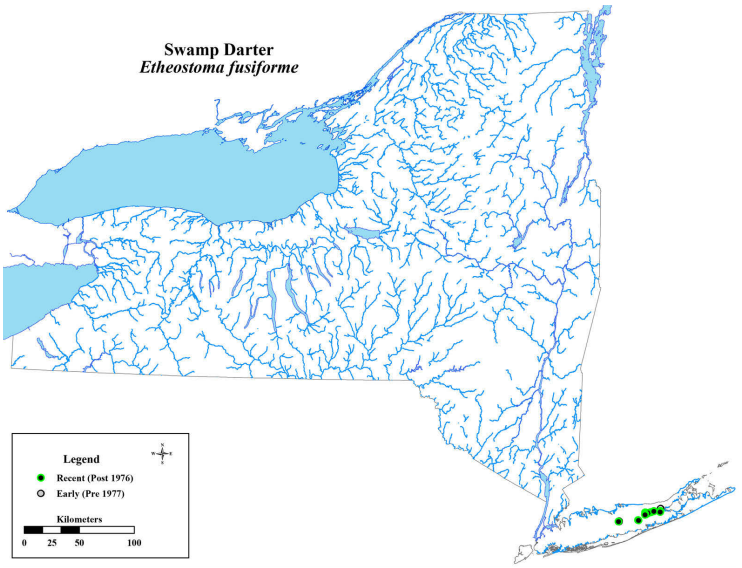
Lower Hudson (2,3). There are two reports of captures in this watershed: the Hudson River near Schodack in 1983 and Kinderhook Lake in 2001. Neither collection was vouchered. This watershed is sampled heavily, and the lack of additional records suggests that the Fantail Darter is, at best, extremely rare.

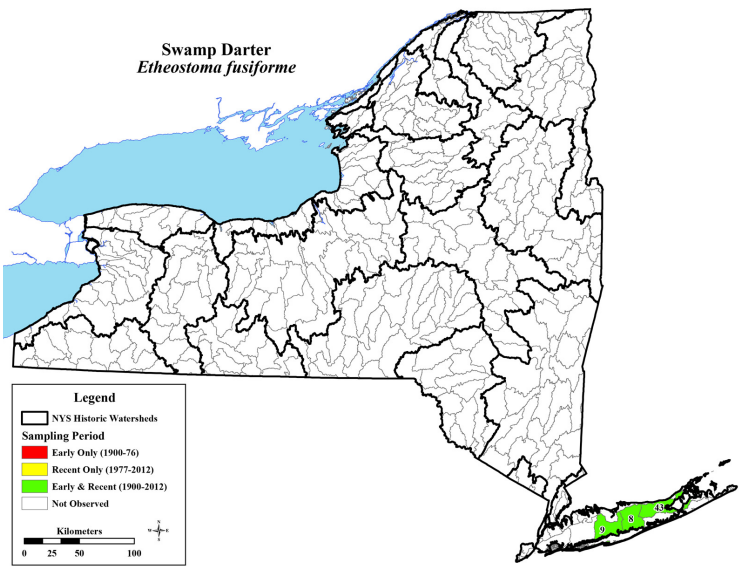
Etheostoma fusiforme, Swamp Darter



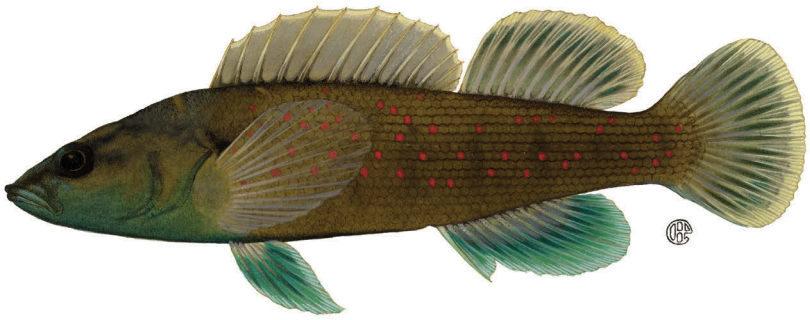
This darter is found exclusively on the Atlantic coastal plain and inhabits ponds and medium-sized streams with dense aquatic vegetation. In New York, it is only found on Long Island. Although the range of this species is restricted, it seems secure. The Swamp Darter is vulnerable to loss of habitat due to dewatering for residential and urban development and is classified as a Threatened Species in New York.

Long Island (1,2,3). Greeley (1939) stated: "... this darter was not known to inhabit New York State waters until found by the survey on Long Island. Collections were taken from Lake Ronkonkoma, Little River and Merritt Pond." In the 1950s, collections were repeatedly made at several sites, including Lake Ronkonkoma, Lower Lake Yaphank, and Wildwood Lake, with specimens accessioned at CUMV. In the last three decades, Swamp Darters have been found in about 20 waters, all in Suffolk County.



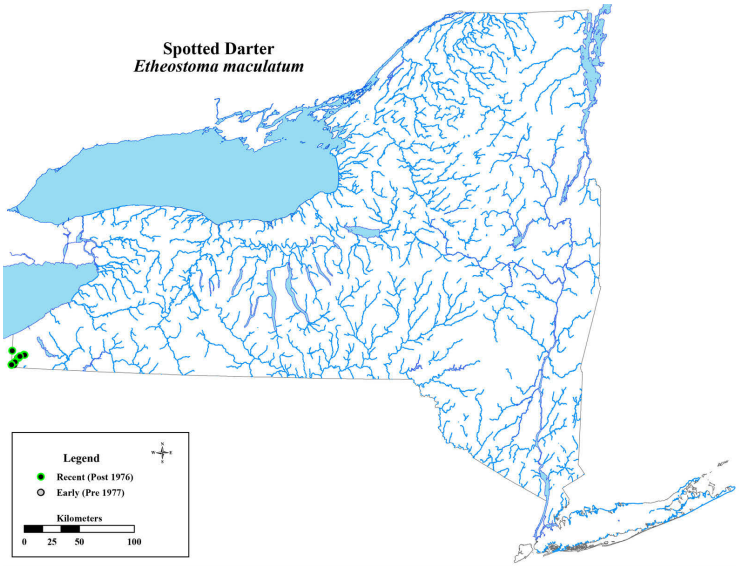


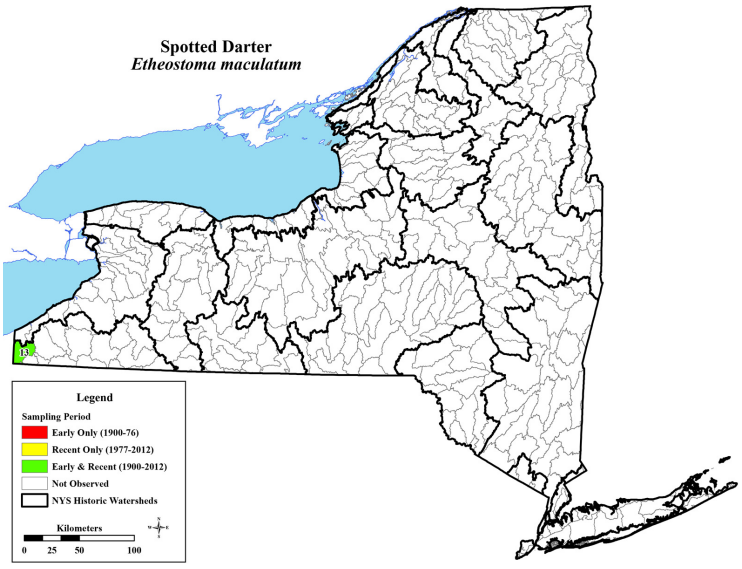
Etheostoma maculatum, Spotted Darter



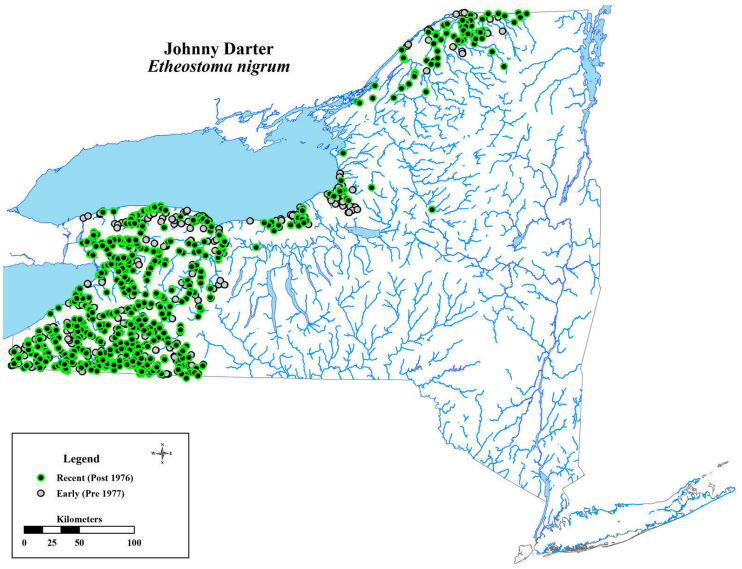
The Spotted Darter lives in medium-sized streams with clean gravel and, in New York, is only found in French Creek in the Allegheny watershed. Though its range is severely restricted in the state, the species appears secure. Changing land-use practices in the basin could affect its in-stream habitat, distribution, and abundance in the future, however. It is classified as a Threatened Species by the state of New York.

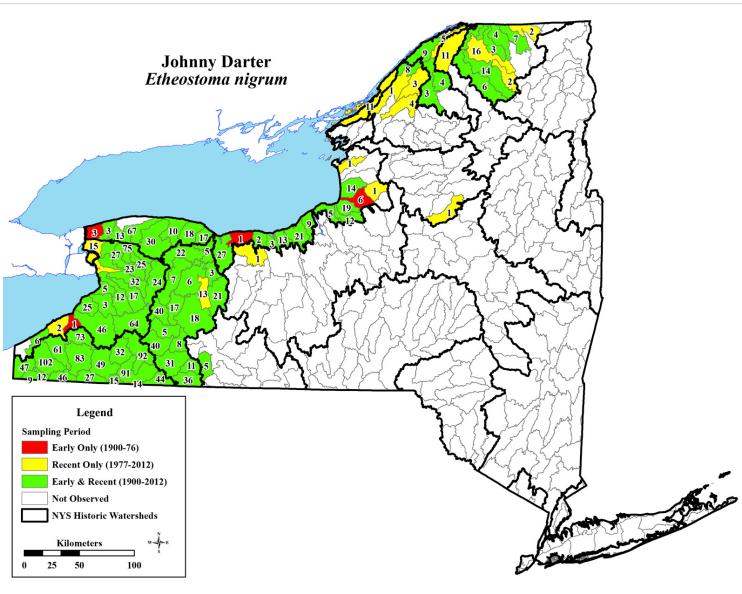
Allegheny (1,2,3). The Spotted Darter was rare during the 1937 survey, being present at just 1% of the sampled sites, all of which were in French Creek (Greeley 1938). It continues to be found only in the lower 21 km of French Creek, with collections as recent as 2013. The species is more common in Pennsylvania (Schwartz 1965, Cooper 1985), where it occurs in French Creek and the Allegheny River. The scarcity of this darter in New York is cause for concern. The Nature Conservancy developed a continuing program to protect imperiled species in French Creek, including this one, by creating fenced buffer strips (Bowers et al. 1992, Goforth and Bain 1997).





Etheostoma nigrum, Johnny Darter





This darter and the Tessellated Darter were once treated as subspecies, which makes it difficult to tease out information about their distributions from historic records. The fact that their ranges overlap in certain watersheds adds to the difficulty at times. The Johnny Darter lives in streams and occasionally in ponds but do not have rigid habitat requirements. In streams where the two species co-occur, Johnny Darters tend to inhabit upstream sites and sites with gravel or rubble substrates. This species is native in nine western or northern New York watersheds and is non-native in, and confined to a limited area of, the Chemung watershed.

Allegheny (1,2,3). During the 1937 survey, Johnny Darters were common in tributaries and were only occasionally caught in the Allegheny River and the major lakes; individuals were taken at 41% of the sites sampled (Greeley 1938). During more recent surveys, the species continued to be abundant and widely distributed, and was present in over 50% of the samples. Early records suggested that it was rare in the main channel, but after 2000 it has become common. It is found in all three basins of the watershed.

Erie-Niagara (1,2,3). This species was common, widely distributed, and found in most streams, Lake Erie, and the Niagara River during the 1928 survey (Greeley 1929). Its distribution and abundance remains unchanged.

Ontario (1,2,3). Both the Johnny and Tessellated Darter are found in this watershed. Greeley (1940) noted that Johnny Darters were present in stream collections west of the Little Salmon River system in Oswego County but that some form of Tessellated Darter (perhaps intergrades) was typical of the bays and low-elevation creeks. The specimens from the 1939 survey housed at NYSM were re-examined, and the divide fell slightly farther east, at the Salmon River (Oswego County). Smith (1985) included fewer collections from the central part of the watershed in his range maps and showed the Johnny Darter no further east than Sterling Creek. Mandrak and Crossman (1992), dealing with the Canadian side of the lake, showed both species mixed from east to west—the same pattern shown on the maps in this atlas. In the critical zone of overlap, i.e., in Niagara, Orleans, Wayne, Ontario, and Oswego counties, we only retained a record for mapping if specimens were examined by C.L. Smith of the AMNH or by R.S. Morse or B.R. Weatherwax of the NYSM. Unverified records collected between 1960 and 2011 were not included on the map. Trawl catches in Lake Ontario

Species continued on next page

have typically been referred to the Johnny Darter (Owens et al. 2003), which seems contrary to Greeley's (1940) assessment that Johnny Darters were present at stream sites and Tessellated Darters were present in the lake bays and lowland creeks. These points are also not mapped here.

Genesee (1,2,3). Greeley (1927) reported that this species was found throughout the watershed in a variety of habitats. As was conventional at the time, he did not recognize the Tessellated Darter, but, although relatively rare, it is nonetheless present in the watershed and was likely present in 1926. Stillman (1984) noted that Johnny and Tessellated darters hybridize in this watershed. The Johnny Darter remains common throughout the watershed and is the dominant species.

Oswego (3). There are no early records of this species from this watershed (Greeley 1928) and only one recent record: in 2003, specimens were collected from Ganargua Creek near Newark (NYSM 55765). In contrast, there are 86 lots of Tessellated Darters housed at the NYSM that were collected from this watershed over the same period.

Black (3). The only collection from this watershed is one from the Black River in 1993 (NYSM 43021). All other reports lack verification and are not included on the map.

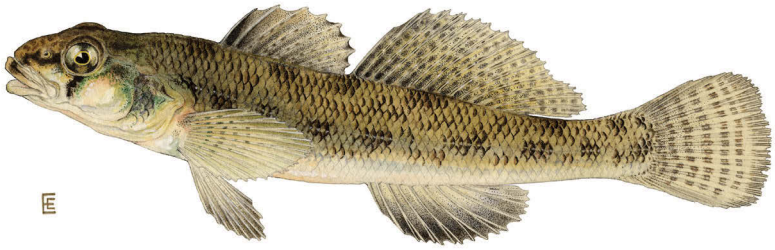
Saint Lawrence (1,2,3). This species was not reported by Greeley and Greene (1931), who listed only the Tessellated Darter from this watershed. Some of the specimens collected during the 1930 survey were later re-identified as Johnny Darters, however (NYSM 48508, 48505). The species primarily inhabits the lower and middle reaches of the larger tributaries and is rarely caught in the main channel. In the 1930s and again in 2007 and 2009, it was taken at higher elevations in the Adirondacks from the West Branch Saint Regis River (NYSM 62822) and Mill Creek (NYSM 62837). Chapleau and Pageau (1985) noted that Johnny and Tessellated darters co-occur in the river.

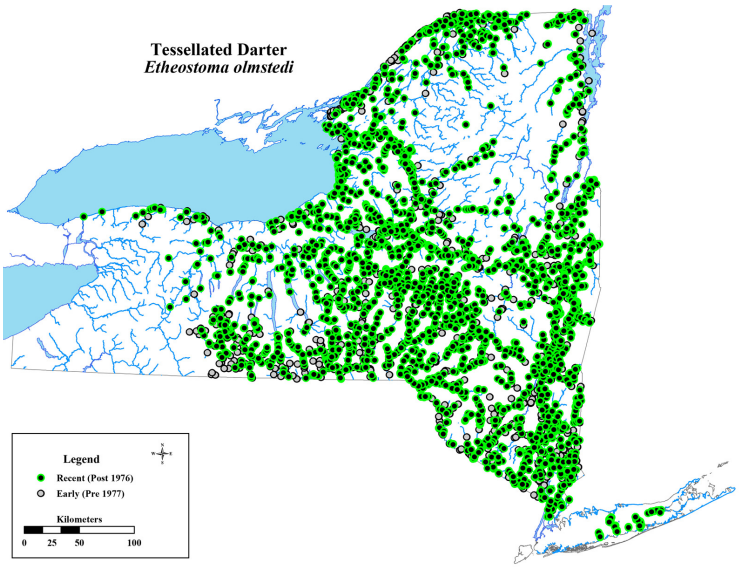
Oswegatchie (1,2,3). Greeley and Bishop (1932) did not report this species during the synoptic survey of the watershed although one lot (NYSM 53714) has since been re-identified as containing Johnny Darters. Smith (1985) showed records from three locations between Eel Weir State Park and Wegatchie. Since 2010, this darter has been collected from the Oswegatchie and Indian rivers several times.

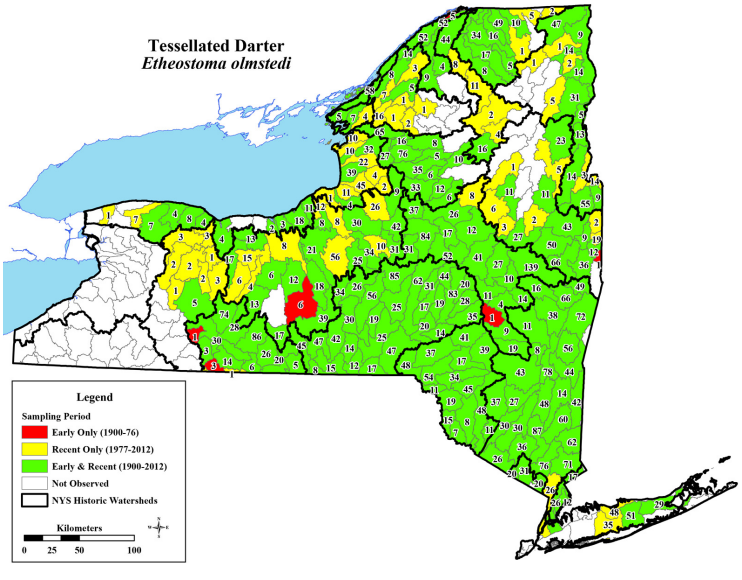
Raquette (1,3). Specimens were collected from the Raquette River below Norfolk in 1933 (NYSM 53679). The next records are all from after 1997 and include Squeak Brook in 2001 (NYSM 53053) and Trout Brook in 2007 (NYSM 62652).

Chemung (**1,2,3**). Greeley (1938) reported: "In the headwaters of Bennett Creek, of the Canisteo River system, the western johnny darter has penetrated the Chemung territory." This 1937 specimen (NYSM 53786) has been re-examined and its identification confirmed. Over the years, many individuals have been captured during routine surveys and, based on field identifications, were reported as Johnny Darter. Whether these identifications were correct is not known, as no voucher specimens were retained. In 1952, individuals were caught in Bennett Creek farther downstream than the 1937 site, and the identification of this collection has been confirmed (CUMV 25366). The CUMV holds 18 additional samples from this area collected between 1943 and 1958, however, which are Tessellated Darters or hybrids. In 2004, Johnny Darters were again collected from Bennett Creek at Rexville (NYSM 57678).

Etheostoma olmstedi, Tessellated Darter







It is difficult to discuss the distribution of this fish without also discussing that of the congeneric Johnny Darter. In watersheds where the two species co-occur, the distribution descriptions are comparative, and both accounts should be read to gain a fuller understanding of their ranges. This darter lives in streams and ponds with sand or mud bottoms. It inhabits all of New York's watersheds except for the Allegheny and Erie-Niagara and is generally widespread, with the exception of the western Ontario and Genesee watersheds. The species is more frequently caught today than in the past, but this may be the result of using sampling gear that is better suited to catching demersal fishes.

Ontario (1,2,3). Greeley (1940) noted that this species (treated as a subspecies in his report) was found at lower elevation sites throughout the watershed and in the bays of the lake. These specimens have been re-examined, and we can confirm Greeley's (1940) assessment. Smith (1985) likewise showed records of this species across the watershed. In several bays of Lake Ontario, both Johnny and Tessellated darters were found sympatrically, but Tessellated Darter abundance and frequency of occurrence was greatest in the northeastern-most part of the watershed in Jefferson County. It is in Jefferson County that the Tessellated Darter replaces the Johnny Darter as the dominant stream darter. In tributaries of the lake in Oswego County, Johnny Darters were found in upstream rocky areas, and Tessellated Darters were found in downstream sandy areas (S. Coglan SUNY ESF, unpubl. data). Chaupleau and Pageau (1985) reported the same results for tributaries of the Saint Lawrence River in Quebec. Because we expected that the Johnny Darter would predominate in the western portion of this watershed, records from the three westernmost counties were only retained for mapping if the specimens were examined by C.L. Smith of the AMNH or by R.S. Morse or B.R. Weatherwax of the NYSM. This resulted in the exclusion of 33 unconfirmed collections from 1960–2011 from our maps.

Genesee (2,3). According to Smith (1985) and Stillman (1984), this species is only found in the lower part of the watershed downstream of Portageville. Some earlier authors like Greeley (1927) and Lee et al. (1981) did not report Tessellated Darters from this watershed. The 16 records from this watershed that were retained for mapping were examined by C.L. Smith of

Species continued on next page

the AMNH or by R.S. Morse or B.R. Weatherwax of the NYSM and included collections from 1962 (NYSM 43311), 1982 (e.g., AMNH 223377), and 2000-2003 (e.g., NYSM 52300). Fifteen unconfirmed records from 1951-2001 are not included on our map. Additional museum specimens exist that need to be re-examined; these records were also not included on the map.

Oswego (1,2,3). Greeley (1928) noted that this darter was abundant and was found in all but the coldest of waters. It was commonly caught and widely distributed in surveys conducted between 1996 and 2010, where its frequency of occurrence in streams was 48%.

Black (1,2,3). During the 1931 survey, this species was abundant and was found in most of the lowland streams and lakes. Although it was absent from the Adirondacks, it was found at sites at up to 485 m in elevation (Greeley and Bishop 1932). It is currently widespread in streams at lower elevations and is present in a few impoundments.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that this darter was common and found throughout lowland sites but was not found at any Adirondack site, although populations were present several kilometers upriver in both the Grass and Saint Regis rivers. The species remains common and is present at both low-elevation and upland sites throughout the watershed.

Oswegatchie (1,2,3). This species was present in most of the lowland streams and lakes and was absent from Adirondack sites during the 1931 survey (Greeley and Bishop 1932). It is common and widespread today.

Raquette (1,2,3). Tessellated Darters were common during the 1933 survey but were restricted to areas downstream of Hannawa Falls (Greeley 1934). The species remains common and widespread and has increased its range to include sites above the falls.

Champlain (1,2,3). Greeley (1930) reported that this darter was common in Lake Champlain, Lake George, and in the lower courses of tributaries but was also found well upstream in the Great Chazy and Mettawee rivers. It remains common and occurs throughout the watershed. Although the Johnny Darter has not been reported from Lake Champlain, it is widely distributed in the Richelieu River system in Canada (Bernatchez and Giroux 2000; April et al. 2013). Stillman (1984) noted that hybrids or intergrades, based on characteristics of the infraorbital canals, were present in the watershed. Although the results of April et al. (2013) suggest that eastern New York specimens are Tessellated Darters, a zone of hybridization that includes the northern part of Lake Champlain may exist and further study is needed.

Chemung (1,2,3). This species was found at 51% of the watershed survey sample sites and was present in streams and some lakes (Greeley 1938). Its status is unchanged.

Susquehanna (1,2,3). This darter was abundant, present in 48% of the watershed survey samples, and taken in almost all streams and some lakes butabsent from headwater areas (Greeley 1936). In recent surveys, Tessellated Darters occurred at about 65% of stream sample sites.

Delaware (1,2,3). Greeley (1936) reported that this species was collected at 26% of the sample sites during the 1935 survey, including in streams and lakes. It remains common and widespread.

Upper Hudson (1,2,3). Greeley and Bishop (1933) listed the Tessellated Darter as common and present in the Sacandaga River basin as well as the Hudson River and its tributaries downstream of the confluence with the Sacandaga River. It was also abundant in Saratoga Lake. Recent records show that the species continues to inhabit these waters and that it has expanded its range upriver into the Hudson River above Glens Falls as well as the Schroon River.

Mohawk (1,2,3). During the 1934 survey, Tessellated Darters were abundant at low-elevation sites, including the main channel, tributaries, and lakes, but were rare at upland sites (Greeley 1935). The species continues to be found at these sites and has increased its range to include many sites in the Catskills and Adirondacks.

Lower Hudson (1,2,3). Tessellated Darters were present in 38% of the samples from the 1936 survey and were taken from the main channel, streams, lakes, and reservoirs. Although typically found in the shallows, individuals were also present in deep water in the Hudson River (Greeley 1937). The species is common and widespread today.

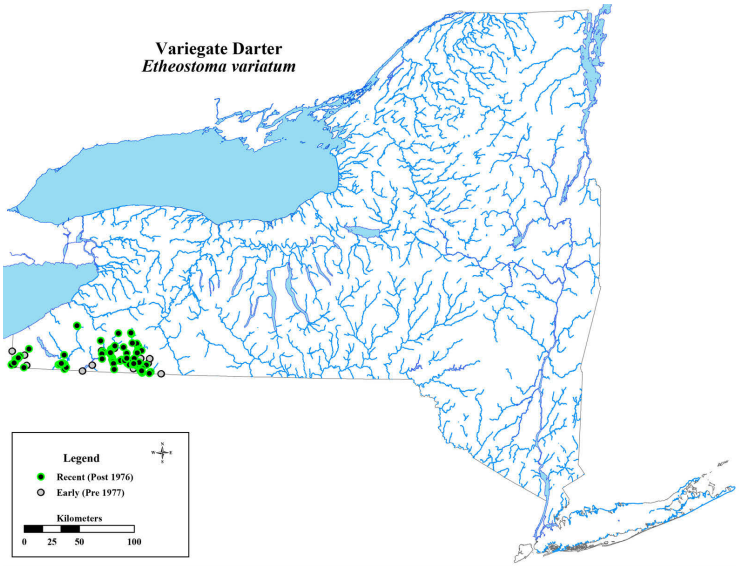
Newark Bay (1,2,3). Greeley (1937) noted that this darter occurred in 32% of the samples collected in the 1936 survey. It is common and widespread today.

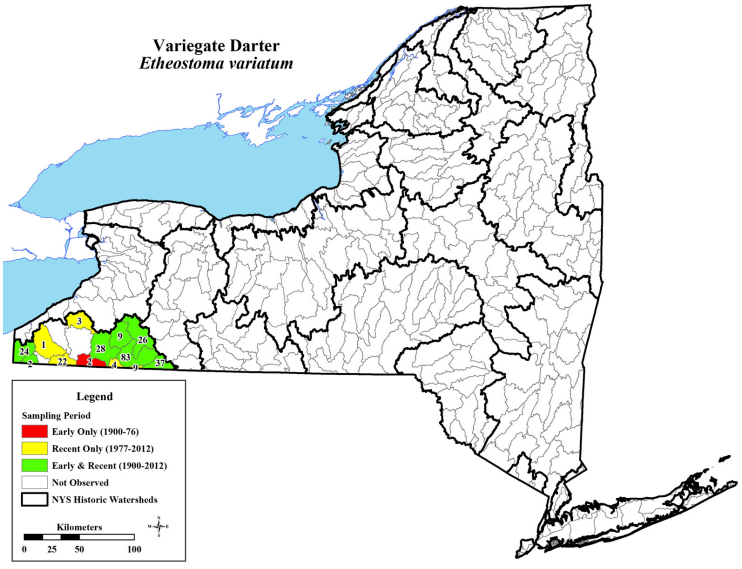
Long Island (1,2,3). This was a common species in streams and many ponds in both Nassau and Suffolk counties (Greeley 1939a). In Westchester County streams, it was collected at 36% of the watershed survey sites (Greeley 1937). Although there are few if any recent records from Nassau County, the Tessellated Darter remains ubiquitous in Suffolk and Westchester counties.

Etheostoma variatum, Variegate Darter

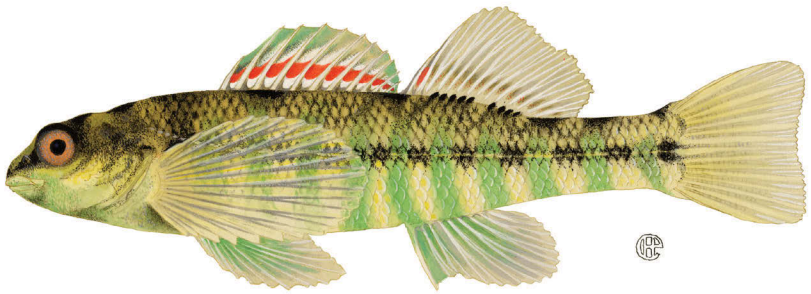
This brightly-colored darter lives in riffles of medium-sized streams. In New York, it is only present in the Allegheny watershed, where it is native. Although widespread in the western and eastern basins in early surveys, the species was not found in the central basin until 1989.

Allegheny (1,2,3). Variegate Darters were caught at 7% of the sites sampled during the 1937 survey. The species was abundant in French Creek, absent from the central basin, and scarce in the eastern basin (Greeley 1938). In recent decades, its status has become more secure, with increased abundance and a wider distribution. More recently, individuals were found in riffles and runs of the Allegheny River (Yochim 1981). This darter occurs in larger tributaries, including Red House Brook, Great Valley, Olean, Dodge, and Tunungwant creeks in the eastern basin and remains common in French Creek. In the central basin, it began to be found in Conewango and Stillwater creeks in the 1980s (e.g., NYSM 16573). During a 2004-05 survey of the central basin, individuals were found at 5% of the sample sites, but the species has continued to expand its range. In 2009, a specimen was taken at the current northernmost site for this species in the central basin at West Branch Conewango Creek (NYSM 64774).

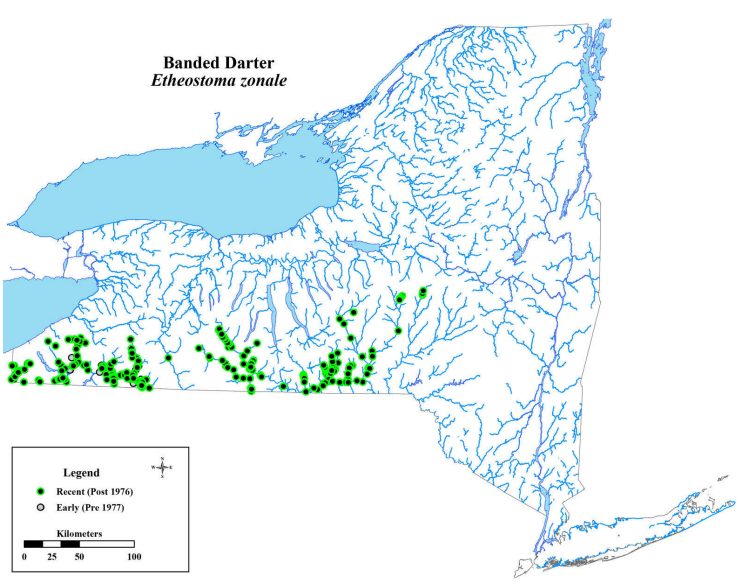




Etheostoma zonale, Banded Darter

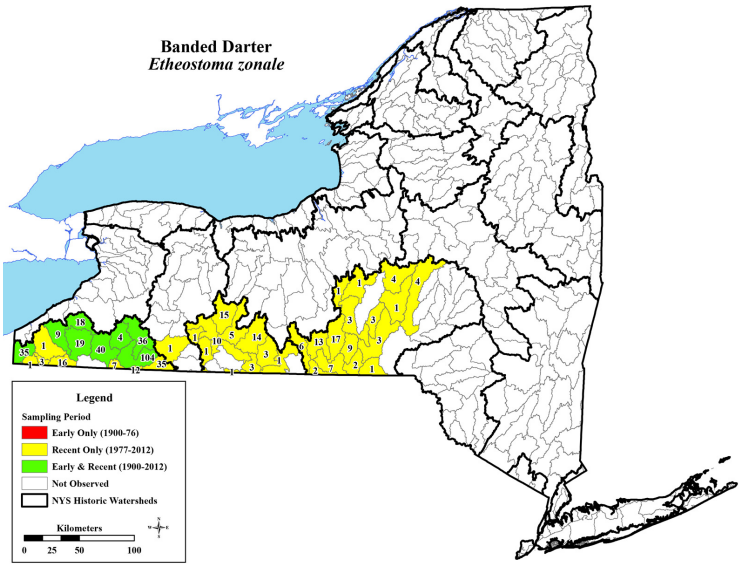


This darter occurs in medium-sized streams and depends on clean gravel areas for spawning. In New York, it is only native to the Allegheny watershed but has also become widespread in the Susquehanna and Chemung watersheds.



Allegheny (1,2,3). Banded Darters were found in 11% of the watershed survey samples and typically inhabited the swift, shallow riffles of the Allegheny River and large and medium-sized tributaries in all three basins (Greeley 1938). Recent stream survey work recorded the species in about a quarter of the samples collected, again from large and medium-sized streams.

Genesee (**2**). Only one authenticated sample exists for this watershed, from the Genesee River near Angelica in 1981 (AMNH 224501). Additional unvouchered records from the Genesee River at Belvidere in 1978 and Canaseraga Creek in 2002 are suspicious and were not included on our map. Based on surveys conducted in the last three decades, the Banded Darter does not appear to have become established in this watershed.

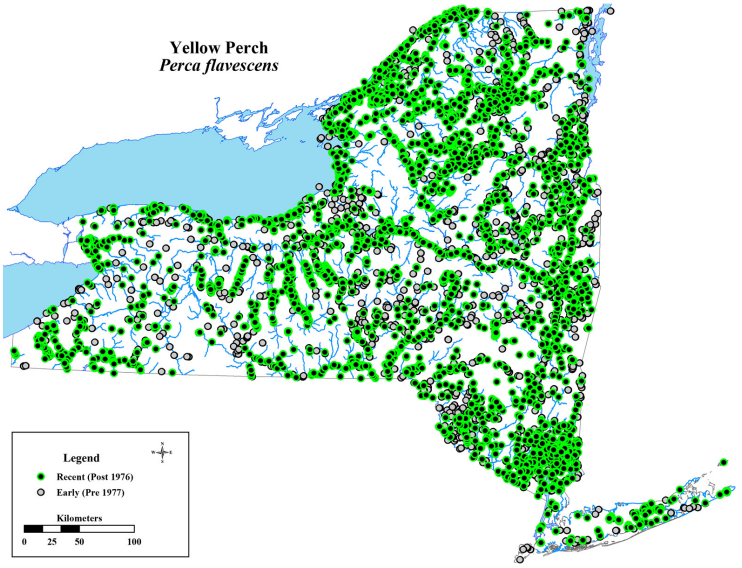


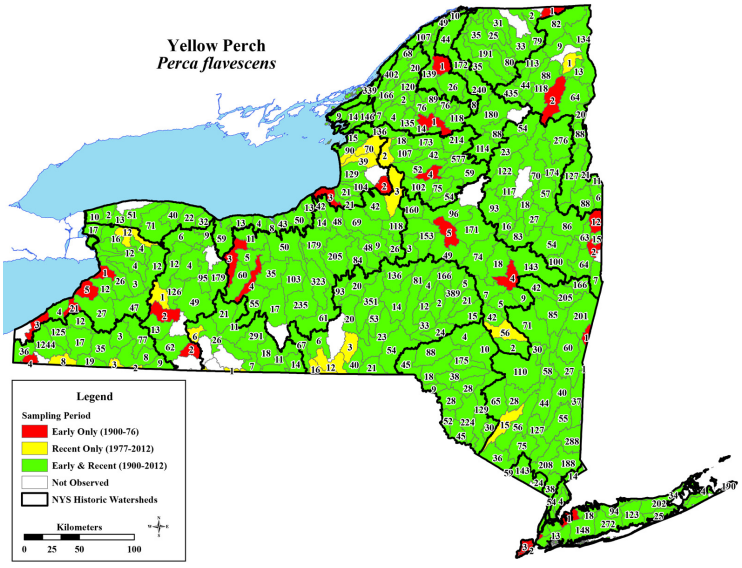
Chemung (**2,3**). This darter was first recorded in the watershed in 1982 and has become common and widespread in larger streams. According to studies by Gray et al. (2005), the aggressive behavior of this species has caused Tessellated Darters to move to other habitats.

Susquehanna (**2,3**). The first record in this watershed is from Catatonk Creek in 1980 (CUMV 65037). The species was repeatedly collected in subsequent years and appeared to have been extending its range north from Pennsylvania since 1971 (Denoncourt et al. 1975). It has since spread eastward to Chenango River tributaries, including the Sangerfield River in 1994, Genegantslet Creek in 2001, and the Tioughnioga River in 2004. Further east, this darter was found in the Unadilla River in 1991. In surveys conducted between 1996 and 2010, Banded Darters were found at over 10% of the stream sites.

Perca flavescens, Yellow Perch

The Yellow Perch is among the most frequently caught lake fishes in the state. This ubiquitous sport fish occurs in a variety of habitats in addition to lakes, including streams. It is native to all 18 of the state's watersheds but historically was absent from the Adirondacks. Because this species is a popular target for anglers, it has been introduced into many waters.





Allegheny (1,2,3). Yellow Perch were present in 21% of the watershed survey samples taken and were largely confined to lakes, although the species was also present in the Allegheny River and large streams (Greeley 1938). The population in Chautauqua Lake was so abundant that most individuals were stunted. This fish continues to be a major component of nearly all of the watershed's lakes and the Allegheny Reservoir as well as most of the larger streams, including the Allegheny River. It has been collected from Ischua, Olean, Great Valley, Haskell, Tunungwant, and Conewango creeks. Yellow Perch have been found in Findley Lake in the western basin but are rarely caught in streams in this basin, although reports exist from West Branch French Creek in 1972 and 2010.

Erie-Niagara (1,2,3). This species was abundant and commercially important in Lake Erie and the Niagara River at the time of the 1928 survey (Greeley 1929). Greeley (1929) also noted that it was present in large streams and had been introduced into smaller lakes (such as Lime Lake). Currently, almost every body of water in this system, with the exception of headwater streams, contains this species.

Ontario (1,2,3). Greeley (1940) noted that more Yellow Perch were caught than any other species in Lake Ontario and that populations were also abundant in the other lakes and streams in the watershed. The status of this species is unchanged.

Genesee (1,2,3). During the 1926 survey, Yellow Perch were common in lakes and large streams but were absent from smaller streams. Individuals were caught in Silver, Conesus, Hemlock, and Honeoye lakes, Black Creek, and from several sites on the Genesee River (Greeley 1927). The species continues to be common and widespread.

Species continued on next page

Oswego (1,2,3). Greeley (1928) described this species as abundant and present in all major lakes and rivers in the watershed as well as in smaller ponds and warm streams; it was only absent from high-velocity waters. Yellow Perch are now commonly caught and widely distributed, with a frequency of occurrence in streams of 32% in surveys conducted between 1996 and 2010.

Black (1,2,3). Greeley and Bishop (1932) noted that the native range of this species included the lower reaches of the main channel of the Black River and its tributaries but that it was introduced at all upland sites. Mather (1886) categorically identified the Yellow Perch as introduced and described the mid-19th century point introduction in the Black River system and its rapid dispersal from that site. By the 1931 survey, populations were well established in most upland lakes, including the Fulton Chain, Pleasant, Long, Crystal, Stony, Otter, and White lakes. The species remains common at lowland sites and is among the most frequently caught fish in Adirondack lakes (Gallagher and Baker 1990).

Saint Lawrence (1,2,3). Yellow Perch are native in the main channel and lower areas of tributary creeks but introduced in the Adirondacks. The species was abundant throughout the watershed and an important game fish at the time of the 1930 survey (Greeley and Greene 1931). Its status is unchanged.

Oswegatchie (1,2,3). The native range of this species includes the lower Oswegatchie River, its tributaries, and the lowland lakes, but it had also been introduced into the Adirondack lakes by the time of the 1931 watershed survey (Greeley and Bishop 1932). It is common and widespread.

Raquette (1,2,3). Yellow Perch were abundant in 1933 and present throughout the watershed (Greeley 1934). Greeley (1934) wrote: “Although native to the St. Lawrence River, the perch did not naturally occur above the impassable waterfalls which protected the extensive Adirondack section of the Raquette River from invasion by various fishes of the lowland region. Considering the short period of time that it has been present in the extensive lake areas of the upper Raquette region…this fish has become exceedingly abundant. Unfortunately, it continues to spread.” Despite Greeley’s (1934) warnings about the potential harmful impacts of introducing this fish, it is the rare body of water that does not support the species today.

Champlain (1,2,3). During the 1929 survey, this species was very common in Lake Champlain, Lake George, the Saranac lakes, Loon Lake, and many of the ponds in the southern part of the watershed as well as in the Adirondacks, where it was introduced (Greeley 1930). Today it is common and widespread.

Chemung (1,2,3). Yellow Perch were present in 25% of the samples taken in 1937 and were abundant in lakes and large streams (Greeley 1938). The species continues to be found throughout the watershed in lakes and large to medium-sized streams.

Susquehanna (1,2,3). This was the dominant game fish in the watershed and was caught at 34% of the sample sites in the 1935 survey; it was abundant at all of these sites, except for those in swift water or at headwaters (Greeley 1936). Yellow Perch have been found at over 15% of the stream sites sampled in recent surveys.

Delaware (1,2,3). Greeley (1936) identified this species at 23% of the watershed survey sample sites and noted its importance as a game fish. As was true for the Adirondack lakes, isolated lakes in this watershed did not have Yellow Perch until they were introduced (Greeley 1936). The species is widespread today.

Upper Hudson (1,2,3). Although Greeley and Bishop (1933) noted that there were no records that identified this species as native to the watershed, they conceded that it was abundant throughout. The main channel of the Hudson River probably supported native populations of this species because there were no barriers to migration from the lower river, but it was introduced into the upland lakes as was true for all other Adirondack watersheds (George 1981a). The earliest record from the watershed is a report from Sanford Lake near Tahawus in 1863 (Burroughs 1871). Recent records show no substantial changes in this species’ range or abundance.

Mohawk (1,2,3). During the 1934 survey, this species was abundant in the main channel, streams, and lakes in the watershed, where it was an important game fish (Greeley 1935). Greeley (1935) also noted that the Yellow Perch was native in the Mohawk River and lowland sites and introduced at upland Catskill and Adirondack sites. In recent surveys, the species continues to be abundant and present throughout the watershed.

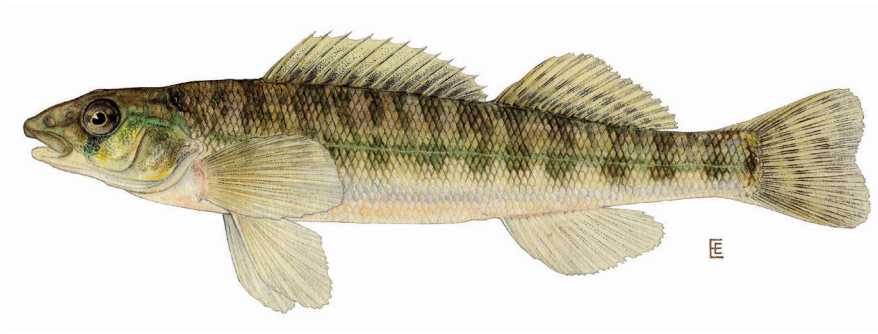
Lower Hudson (1,2,3). Mearns (1898) reported that this was the most abundant game fish in the main channel of the river. Greeley (1937) reported that populations were scattered in the streams of the watershed and scarce in the main channel, although most of the lakes contained Yellow Perch. The species continues to be found throughout the watershed and its numbers in the main channel have rebounded.

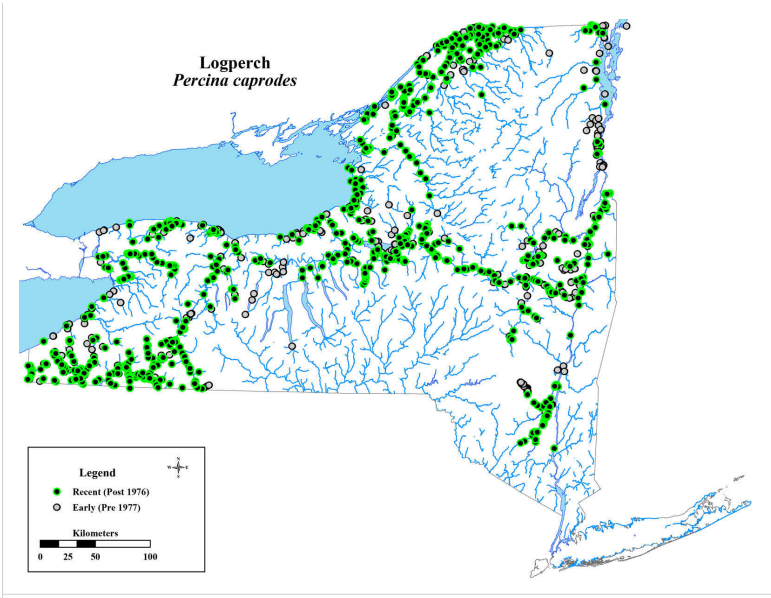
Species continued on next page

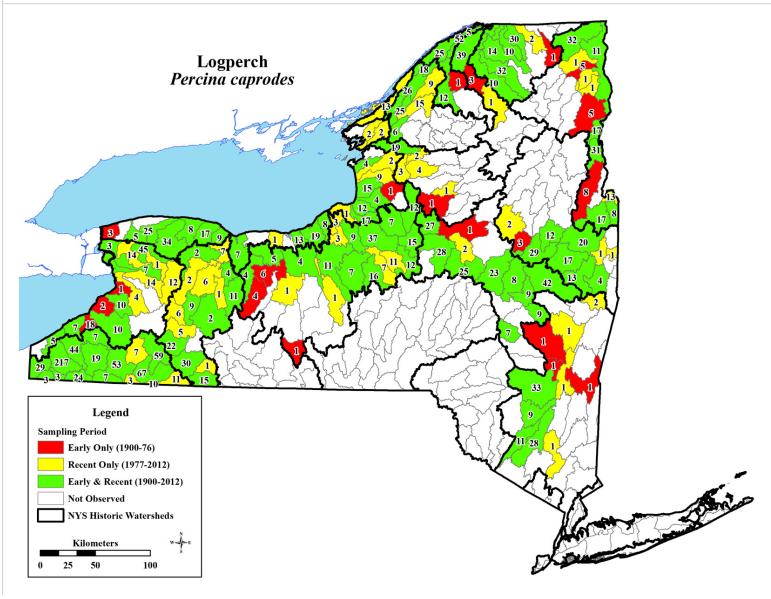
Newark Bay (1,2,3). Yellow Perch were present at 32% of the sample sites during the 1936 survey (Greeley 1937) and the species remains common and widespread in this watershed.

Long Island (1,2,3). This species was present in “lakes, ponds and the larger rivers” of the watershed and moderately abundant on Long Island but was only found in lakes on Staten Island (Greeley 1939a). It was present in 38% of the samples taken from Westchester County streams that flow into Long Island Sound (Greeley 1937). The range and abundance of Yellow Perch in this watershed have changed little in the intervening decades.

Percina caprodes, Logperch







This relatively large darter lives in the slower portions of streams and lakes and spawns on gravel. The Saint Lawrence River Drainage and Allegheny watersheds comprise the ten New York watersheds where it is native. Logperch are not native to Atlantic slope watersheds (Schmidt 1986, Mills et al. 1997), but populations have become established in the Mohawk, Upper Hudson, and Lower Hudson watersheds, including parts of the Adirondacks. Since the 1970s, this species has expanded its range in most of the watersheds where it is found.

Allegheny (1,2,3). Logperch were found in the main channel, many streams, and the larger lakes of the central basin and were represented in 18% of the watershed survey samples (Greeley 1938). In later surveys, this species was commonly taken from the Allegheny River, Five Mile Creek, Olean Creek, Great Valley Creek, an oxbow lake at South Vandalia, and the Allegheny Reservoir. The riffles closest to the Allegheny Reservoir contained more Logperch than other areas farther upstream (Yochim 1981). This darter was also caught in about 25% of the samples from French Creek between 1979 and 1996. In the central sub-basin, populations still inhabit Chautauqua and Cassadaga lakes, and individuals were taken in 19% of stream samples from 2004–2005.

Erie-Niagara (1,2,3). Greeley (1929) described this species as very common in Lake Erie, the Niagara River, and the lower courses of streams. Its range and abundance remain unchanged in recent decades.

Ontario (1,2,3). During the 1939 survey, Logperch were taken at 72 sites in bays and streams across the entire shoreline of Lake Ontario to an elevation of 150 m, which was at a site on the Erie Canal (Greeley 1940). Recent records show that the species still occurs in many of these same waters.

Genesee (1,2,3). The 1926 survey found that this species was widely distributed but rare when it was found (Greeley 1927). Recent records show that it remains widely distributed but has become less rare.

Oswego (1,2,3). During the 1927 survey, Logperch were common in the shallow waters of lakes, particularly Oneida Lake, and large, warm streams, usually in moderate to strong current (Greeley 1928). The species' frequency of occurrence in streams was 16% in surveys conducted from 1996-2010.

Species continued on next page

Black (1,2,3). The Logperch is a rare species in this watershed. In 1931, it was collected from the Black River east of Watertown (NYSM 21380). In the 1970s, it was reported at nearby Delano Island and from much farther upstream at Kent Creek near Boonville. In 1993, a specimen was collected from the Black River (NYSM 43003), and additional collections from the mouth of the Deer River occurred in 1991 (NYSM 41582) and 1995 (NYSM 44501). In 2005, Logperch were reported in the middle section of the Black River as part of a fish kill assessment (McCullough and Hart 2010). Although the species remains rare, it has been collected more frequently in the last two decades, which suggests that it is becoming more abundant.

Saint Lawrence (1,2,3). Greeley and Greene (1931) noted that this darter was present in the main channel and all lowland streams but was absent from upland sites except for in the Grass River, where it was found as far upstream as Tracy Brook. In recent surveys, it has continued to be present in lowland areas and rare at upstream sites.

Oswegatchie (1,2,3). Greeley and Bishop (1932) reported the presence of this species in the lower reaches of the Oswegatchie and Indian rivers and in lowland lakes. It continues to be found at these lowland sites.

Raquette (1,2,3). During the 1933 watershed survey, Logperch were common at sites between Potsdam and Hannawa Falls. The falls served as a barrier to upstream movement, and the river downstream of Potsdam was polluted (Greeley 1934). Recent records are from these same waters, although the species now occurs at sites farther upstream, such as the Stark Falls Reservoir, where individuals were collected in 2008.

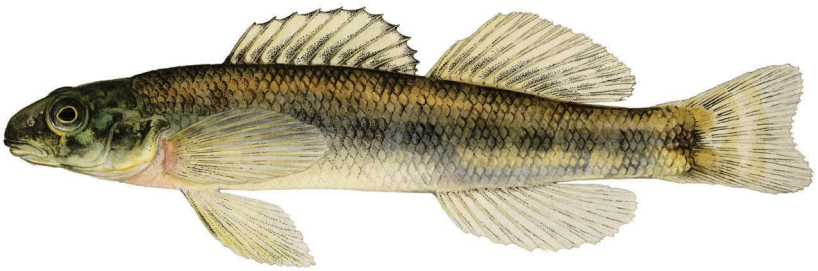
Champlain (1,2,3). Greeley (1930) noted that this species was common in Lake Champlain and its tributaries to the first barrier except in the Great Chazy River, where it was also found above the first falls. It remains common in the lake and lowland sites but rare upstream of barriers.

Upper Hudson (**1,2,3**). Logperch were collected from the Hudson River and its tributaries downstream of Hudson Falls during the 1932 watershed survey (Greeley and Bishop 1933). In recent decades, individuals have been collected from the Hudson River downstream of its confluence with the Sacandaga River, the Sacandaga River itself, and the Sacandaga Reservoir. The species also was reported upstream of the reservoir in the West Branch Sacandaga River in 2002.

Mohawk (**1,2,3**). This darter was moderately common in the Mohawk River and other low-elevation sites during the 1934 survey (Greeley 1935). In recent collections, it has been found along the entire course of the Mohawk River and Erie Canal but remains rare at higher-elevation sites. The exception is the Schoharie Creek basin, where specimens have been collected at upland sites in the Gilboa Blenheim Reservoir (NYSM 43790) and in the Helderbergs (NYSM 68747).

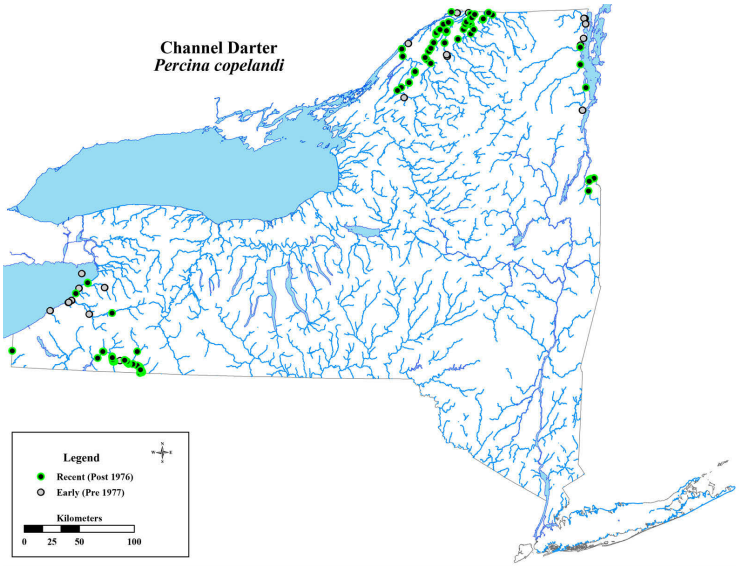
Lower Hudson (**1,2,3**). Greeley (1937) listed this species as scarce in the watershed, where it was collected at just under 2% of the watershed survey sites sampled, including collections from the Hudson River, Kaaterskill, Catskill, and Rondout creeks, the Wallkill River, and the Rifton Reservoir. Recent collections include several from the Hudson River, Esopus and Rondout creeks, and the Wallkill River. In 2009, a specimen was collected from the Poesten Kill (NYSM 64894). Logperch are still infrequently collected in this watershed's streams. In surveys conducted from 1996-2010, the species was present in 5% of the samples taken.

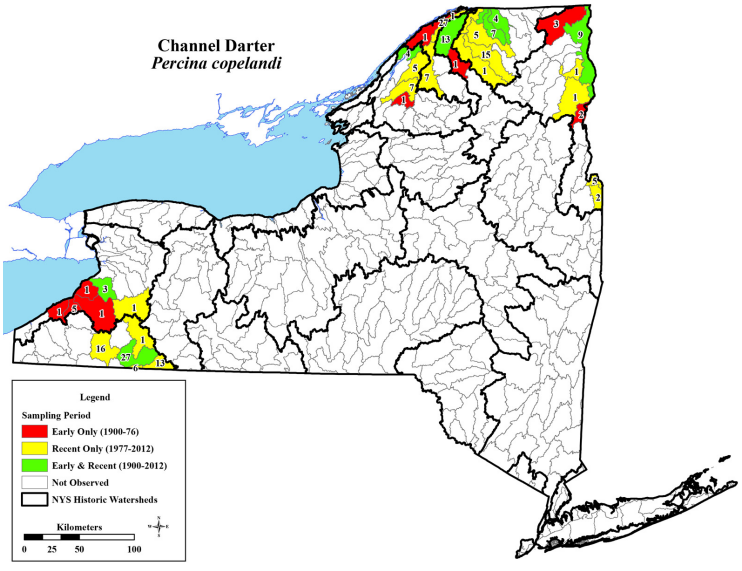
Percina copelandi, Channel Darter



This darter lives in streams and large lakes, off sand and gravel shoals. It is widespread in the lowland areas of the northern and western watersheds.

Allegheny (2,3). The Channel Darter was first collected from the New York portion of the Allegheny River in 1975 (Eaton et al. 1982), where it was caught during several later studies (Becker 1982; Smith 1985; Daniels 1989, 1998). Because this species was present in earlier collections from upstream areas in Pennsylvania (Cooper 1983) but was not found during the 1937 survey of the watershed (Greeley 1938), its presence is likely a downstream range expansion. It has been collected throughout the course of the main channel and from two of the larger tributaries of the eastern basin (Oswayo (NYSM 58603) and Ischua (Morse et al. 2009) creeks) in recent years. The species remains relatively rare in the western and central basins, where it is contiguous with downstream Pennsylvania populations. There is a single record from the western basin at West Branch French Creek in 1998 (NYSM 51458).





Erie-Niagara (1,2,3). Greeley (1929) identified this species as common in Lake Erie and in the lower courses of several tributaries. In the 1890s, it was collected from Cattaraugus Creek (USNM 62851, 125339) and Canadaway Creek near Dunkirk (USNM 69964, 69965). Specimens have also been collected from Eighteenmile Creek in 1951 (CUMV 20038) and 2003 (NYSM 55132). More recently, individuals have been reported from the mouths of Eighteenmile and Silver creeks, and from Cattaraugus Creek near Springville in 2006. The species is no longer common in this watershed despite these recent records.

Saint Lawrence (1,3). This darter was uncommon during the 1930 survey, with Greeley and Greene (1931) reporting: “Rocky shoals along the St. Lawrence River and shallows near the foot of rapids in the lower parts of tributaries are places where this small darter was collected. This species was found near the mouth of the Salmon and Little Salmon Rivers and the St. Regis River.” It remains an uncommon catch, and its current range in this watershed is similar, with the addition of the Grass River (NYSM 62532).

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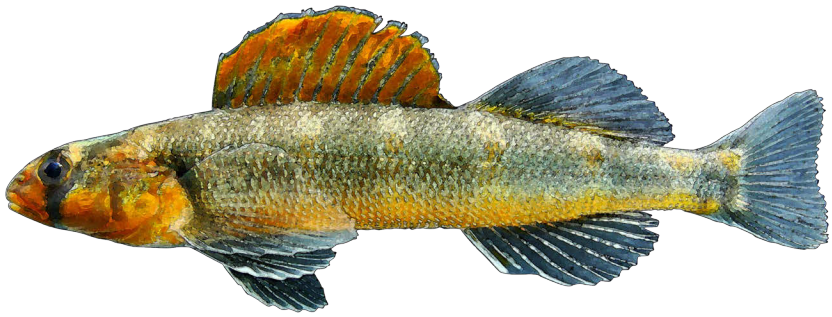
Oswegatchie (1,3). Greeley and Bishop (1932) reported that three individuals were caught in the shallows of the Oswegatchie River near Ogdensburg, and a single adult male in breeding condition was collected from the lower part of Sawyer Creek at an elevation of 130 m. Since 1999, this species has been taken from the main channel near Richville (NYSM 51388, 57483), Elmdale (NYSM 70156), and Gouverneur (NYSM 64284).

Raquette (1,3). Like other lowland species, this darter was not found upstream of the barrier at Hannawa Falls, nor was it found in the polluted river stretch below Potsdam (Greeley 1934). Everman and Kendall (1902b) reported it at Norfolk, however, about 6 km downstream of Potsdam, presumably from a time when environmental conditions were suitable for this species. There are relatively few recent records, but Channel Darters have returned to the river downstream of Potsdam, with a 2007 catch near Norwood (NYSM 62847) and one in 2012 below Raymondville (NYSM 67903).

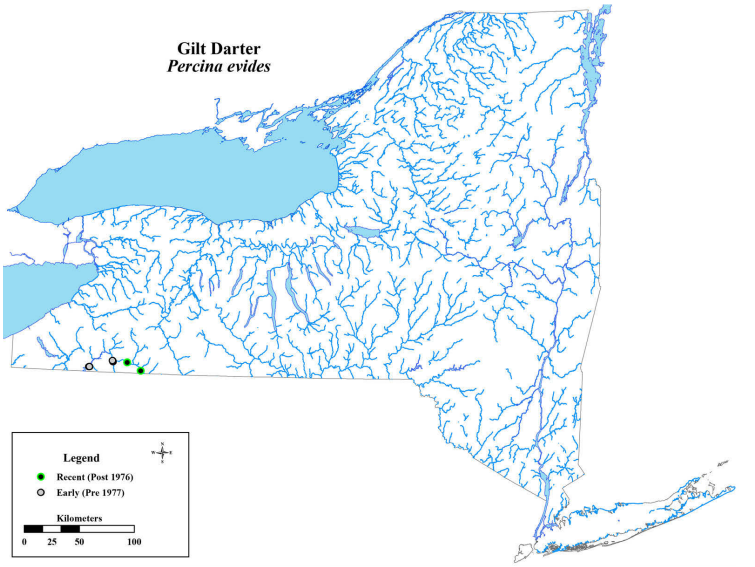
Champlain (1,2,3). In 1853, specimens were collected from Westport Brook (MCZ 148, CAS 3953). Greeley (1930) reported this species to be uncommon but widely distributed; it was present in both the lake itself and the lower reaches of some tributaries. Between 1982 and 1995, Channel Darters were collected at several sites in the Mettawee and Poultney rivers, both of which are southern tributaries. In 2013, specimens were collected at two sites in the lower Saranac River (NYSM 69527, 69582).

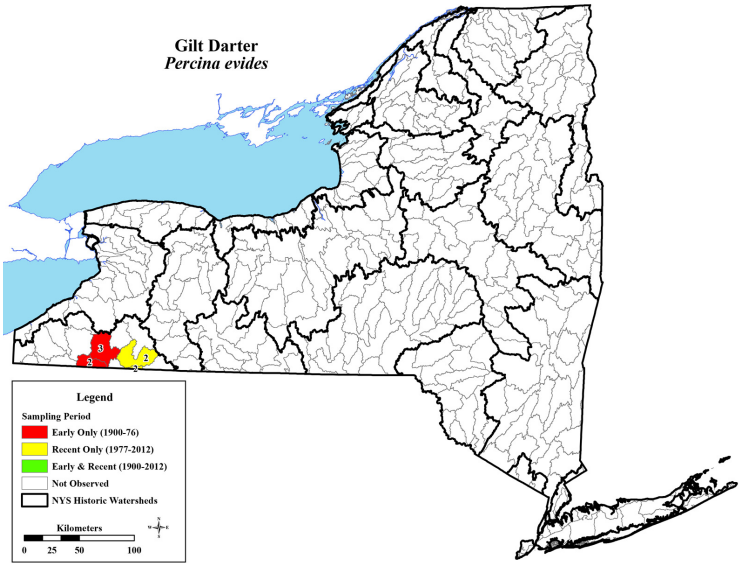
Percina evides, Gilt Darter



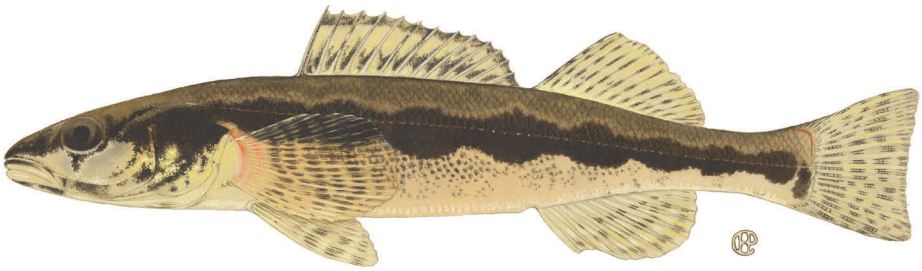
In New York, this species was historically only found in the main channel of the Allegheny River, where there are deep riffles and swiftly moving water. It was only collected at three sites in the 1937 watershed survey. Despite intensive survey work, no specimens have been collected since 1937, although the species is present in the Allegheny River in Pennsylvania downstream of the Kinzua Dam. In New York, the Gilt Darter is classified as an Endangered Species. A program to reintroduce this species was begun in 2012 (Foster 2014), when individuals were stocked in areas where specimens had historically been collected.

Allegheny (1,3). Greeley (1938) reported that this "rare and beautiful" species was collected at three sites in the Allegheny River: downstream of the confluence of Quaker Run (NYSM 12705) and two sites near South Carrollton. In 1931, several specimens were collected at Carrollton (CUMV 27042). The site near the mouth of Quaker Run is now inundated by the Allegheny Reservoir. Despite extensive efforts to recapture this species at various sites in the Allegheny River during low-flow conditions from 1951-2008, no specimens have been taken. From 2012-2013, hatchery-reared fingerlings and juveniles were stocked at South Carrollton, Olean, and Oswayo Creek. Individuals have been caught in 2013 and 2014 during sampling to evaluate the project. Documented survival of introduced individuals offers hope that the overall project will be successful.



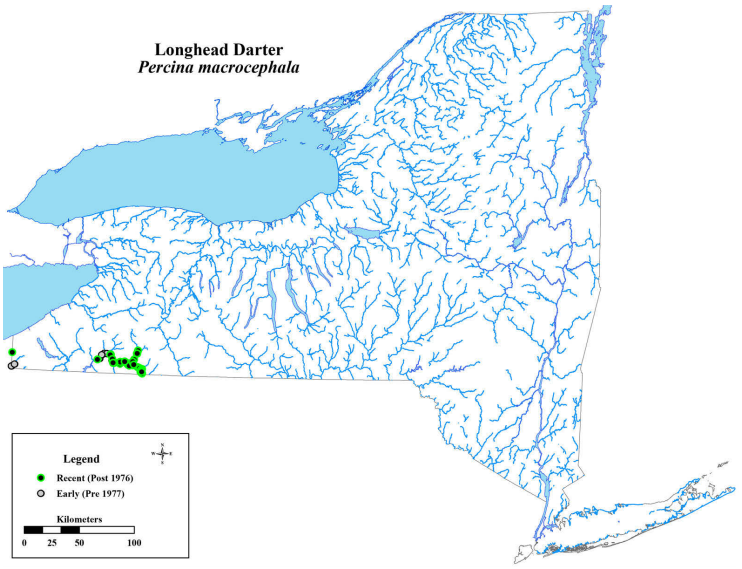


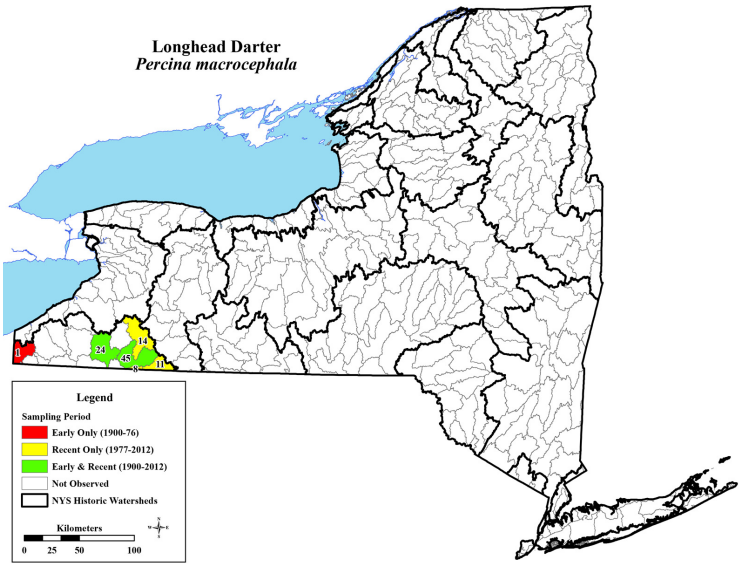
Percina macrocephala, Longhead Darter



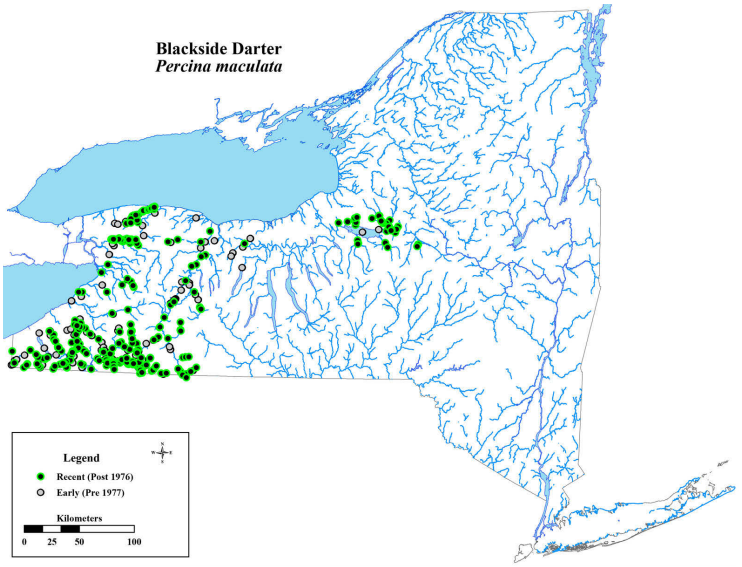
The Longhead Darter occurs in runs and riffles in medium-sized and larger streams and, in our state, is only native to the Allegheny watershed. Its range has increased over the last 20 years, and the species seems secure, although it is still classified as Threatened in New York.

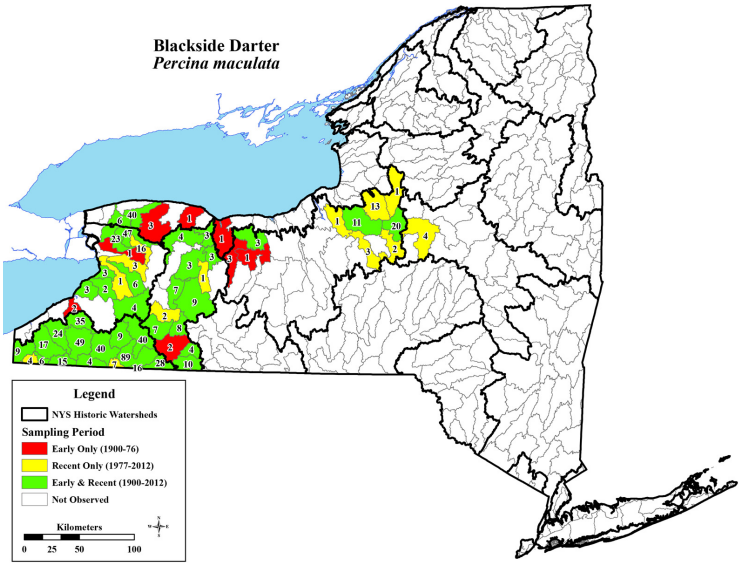
Allegheny (1,2,3). Greeley (1938) was the first to report the presence of this darter in the state, when it was collected at eight sites in French Creek and the Allegheny River. In recent years, Longhead Darters have been taken from the Allegheny River at the riffles at Weston Mills, Olean, and near Salamanca. The species has also been found in the lower reaches of Great Valley, Dodge, and Oswayo creeks. Despite extensive efforts in the 1960s, individuals were only found near the mouth of Olean Creek; in 1999, however, several specimens were found 2 km above the mouth (NYSM 51126). Even more recently, collections have been made up to 13 km above the mouth in 2001, 2007 (NYSM 62375), and 2008. In French Creek, this darter was collected near the state line in 1937, near Cutting in 1972-1973 (W. Hadley, SUNY, Buffalo, pers. comm.), and at sites near Marks Corners and Sherman in 1994. In 1998, a specimen was caught in the West Branch of French Creek (NYSM 51456). This species is relatively common in the areas where it is caught.





Percina maculata, Blackside Darter





This darter lives in shallow, cool streams with rubble substrates. It is widespread in the Allegheny, Erie-Niagara, and Genesee watersheds. In the Ontario watershed, its range extends only as far east as Rochester. There is a disjunct population in and around Oneida Lake. The species is also present in the Utica area of the Mohawk watershed, where it is exotic.

Allegheny (1,2,3). Blackside Darters were present in 16% of the watershed survey samples taken in 1937 (Greeley 1938). In recent years, individuals were taken at numerous sites in riffles of medium-sized and larger streams in all three basins of the watershed. This species moves from riffles to deeper pools in the spring and summer (Yochim 1981).

Erie-Niagara (1,2,3). Greeley (1929) reported that this species was uncommon but present in the warm streams emptying into Lake Erie and absent from headwaters. It remains uncommon but has subsequently been reported from a tributary south of Springville in 1952 (Smith 1985), Elton Creek in 2001, and Cattaraugus Creek in 2006.

Ontario (1,2,3). This species was rare during the 1939 survey and was collected at only nine stream sites from Oak Orchard, Johnson, Eighteenmile, and Irondequoit creeks (Greeley 1940). The easternmost collection in 1939 was from Allen Creek, which flows into Irondequoit Bay (NYSM 13556). In recent decades, individuals have been found in the lower reaches of streams, but recent collections do not extend farther east than Johnson Creek. This species has thus suffered a range reduction and has also declined in abundance.

Genesee (1,2,3). Greeley (1927) reported that Blackside Darters were rare but widely distributed in the watershed. Recent records show that the species has become more widespread.

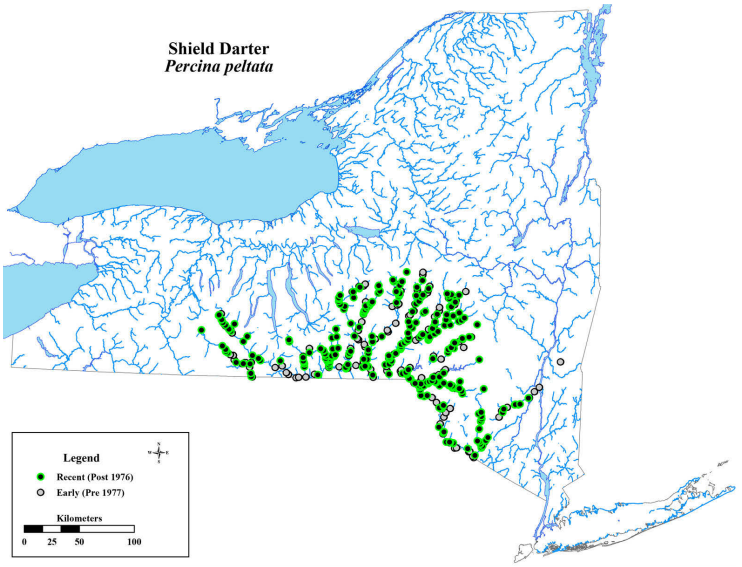
Oswego (1,2,3). During the watershed survey, this species was present in Oneida Lake and the Clyde River as well as their tributaries (Greeley 1928). After the 1927 survey, it was collected from a Seneca River tributary in 1953 (CUMV 23044) and Canandaigua Outlet in 1948 (CUMV 25471), 1951 (CUMV 25480), and 1954 (CUMV 33646). In 1978, a specimen was taken from nearby Red Creek (AMNH 41680). This darter did not occur in samples taken during a 2004 survey of the western portion of

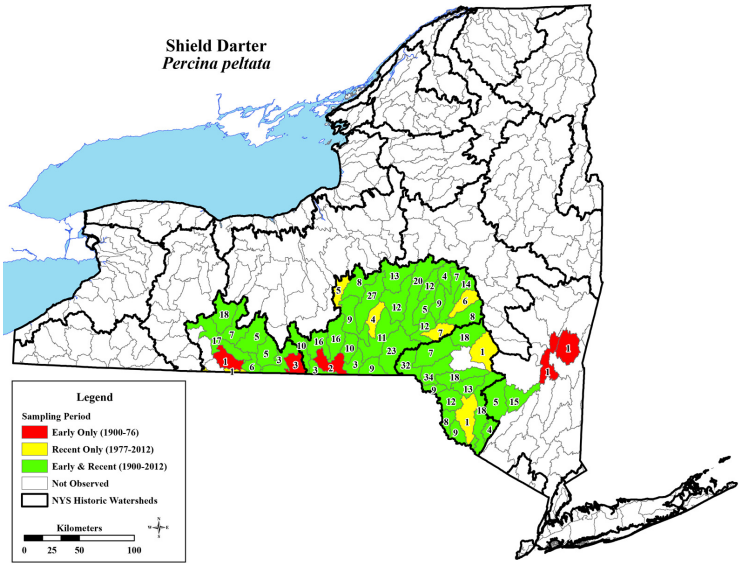
Species continued on next page

the watershed. Despite an earlier collection from the Seneca River, an unvouchered record from a tributary of Seneca Lake in 1977 was not included on our map. Tributaries of Oneida Lake still support this species; it has been taken as far east as Wood Creek and its tributaries (e.g., AMNH 42712). Two specimens were also collected from the Erie Canal in 1983 (NYSM 50605).

Mohawk (**3**). In 2013, Blackside Darters were collected near Utica from both Sauquoit Creek and its tributary, Mud Creek (NYSM 68760, 69814).

Percina peltata, Shield Darter





This southern darter reaches its northern limit in New York and lives in medium-sized streams with clean gravel. It is native to the Chemung, Susquehanna, and Delaware watersheds. It is a non-native species in the adjacent Lower Hudson watershed.

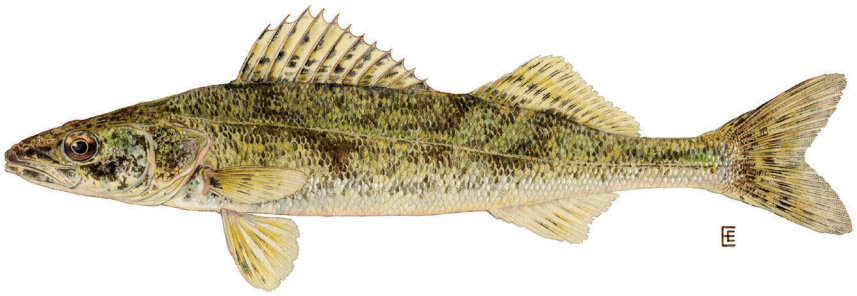
Chemung (1,2,3). Shield Darters were present in 9% of the samples taken in the 1937 survey of this watershed (Greeley 1938). The species remains common and widespread.

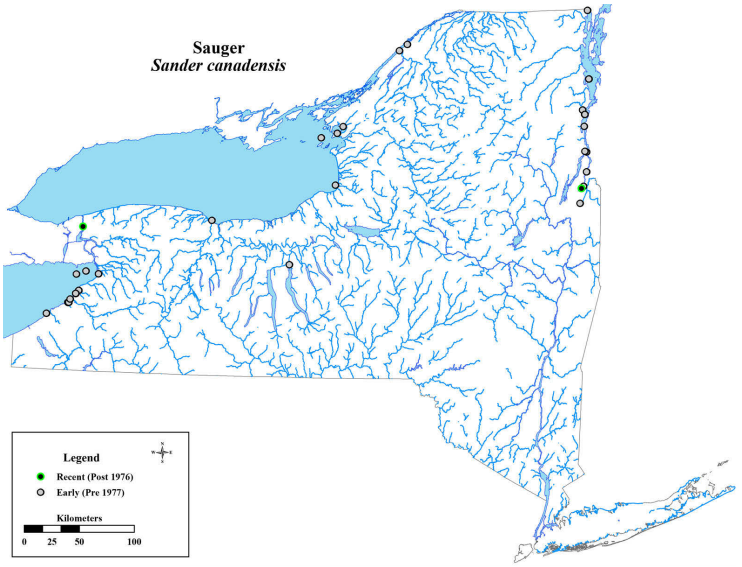
Susquehanna (1,2,3). Greeley (1936) reported that this darter was very common in the swift-water areas of larger streams and was present in 11% of the watershed survey samples taken. He (Greeley 1936) also noted that it was very agile and difficult to catch with seines, the only device used in these early stream surveys. Individuals were found at over 15% of the stream sites sampled in later surveys, with this slight increase in frequency of occurrence likely being attributable to different sampling devices, such as electrofishing units.

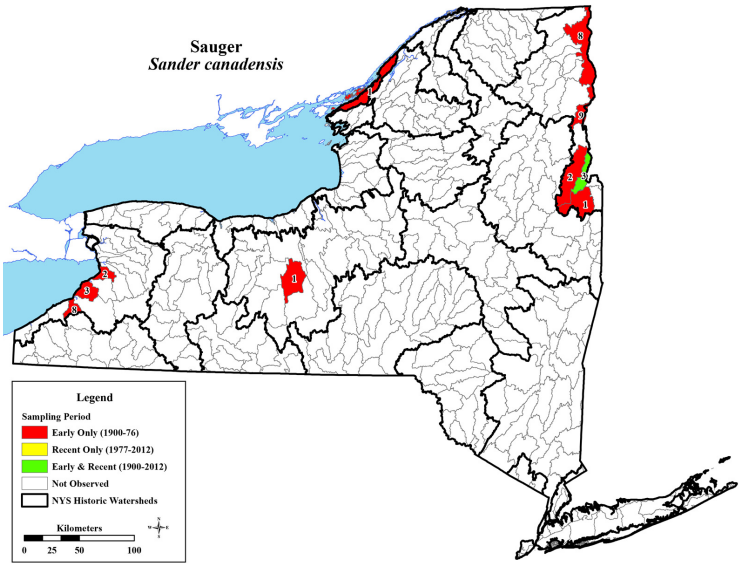
Delaware (1,2,3). This darter was present in 7% of the samples taken in the 1935 survey and was only found in swiftly flowing streams (Greeley 1936). The species is widespread today.

Lower Hudson (**1,2,3**). Shield Darters were collected once in the Hudson River and seven times in the Rondout Creek system or in 1% of the watershed survey samples taken in 1936 (Greeley 1937). Collections in recent years are mostly from the Rondout Creek system (e.g., NYSM 66090 in 2010). There is a 1972 report from Taghkanic Creek, an east-bank tributary of the Hudson River, but there is no voucher specimen and this record cannot be verified. Because all but one sample are from one small basin, Carlson and Daniels (2004) treat this species as exotic to this watershed.

Sander canadensis, Sauger







This increasingly rare member of New York's fish fauna lives in low-gradient streams and large lakes. It is native to five watersheds. The Sauger appears to be extirpated from the Erie-Niagara, Ontario, Oswego, and Saint Lawrence watersheds. Since 1978, the species has been documented from Lake Champlain twice. It has become critically imperiled in the state, and a recovery plan has been developed.

Allegheny (3). Saugers were historically present in the Allegheny River of Pennsylvania as far upstream as Warren (Fowler 1909, 1919), which is now the site of the Kinzua Dam. In 2014, fingerlings were stocked in the Allegheny Reservoir, and evaluation efforts documented survival through the first summer. Because the first record is from 2014, just a few months after stocking, it is not shown on our map.

Erie-Niagara (1,2). During the 1928 survey, this species was common in the shallow waters of Lake Erie, avoided the deeper parts of the lake, and was only a rare visitor to the tributary streams (Greeley 1929). It began its decline after the 1930s and was last reported from the watershed in 1977. The late catches were probably from fish stocked in Ohio (Rawson and Scholl 1978). The species is assumed to be extirpated from this watershed.

Ontario (1,2,3). Smith (1892) reported that this species was occasionally taken from Chaumont Bay. Evermann and Kendall (1901) collected it from Chaumont Bay as well. In the nineteenth century, Saugers were also present in Lake Ontario on the Canadian side of the lake (Crossman and VanMeter 1979). There were reports of occasional gill net catches near Oswego and Chaumont Bay in the eastern part of Lake Ontario in 1942, although no specimens were collected during the watershed survey several years before (Greeley 1940). In 1990, an individual was taken from Lake Ontario near the mouth of the Niagara River at Lewiston, which was verified by NYSDEC as an angling state record. The species is now presumed to be extirpated from the lake, however.

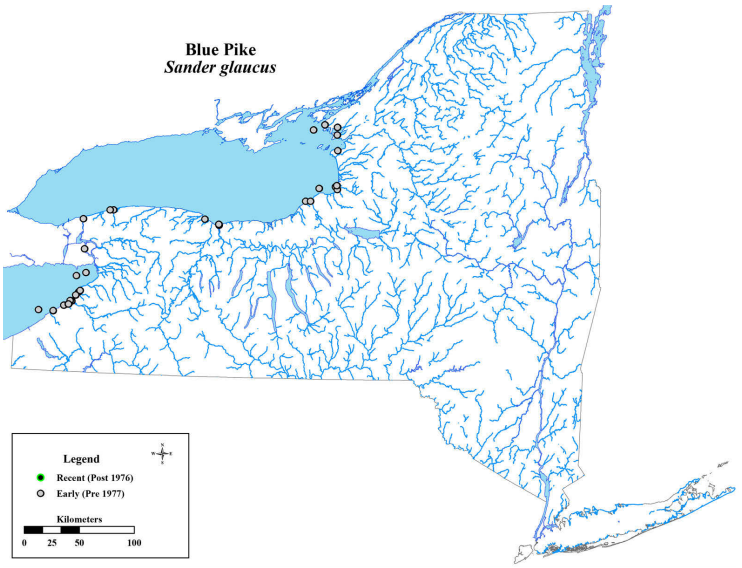
Oswego (1). Greeley (1928) reported no catches during the 1927 survey but did note that a specimen (CUMV 1587) was listed from Cayuga Lake and speculated that Saugers might occur along the Seneca River. None has been collected since the Cayuga Lake specimen, and this species is thus presumed to be extirpated from the watershed.

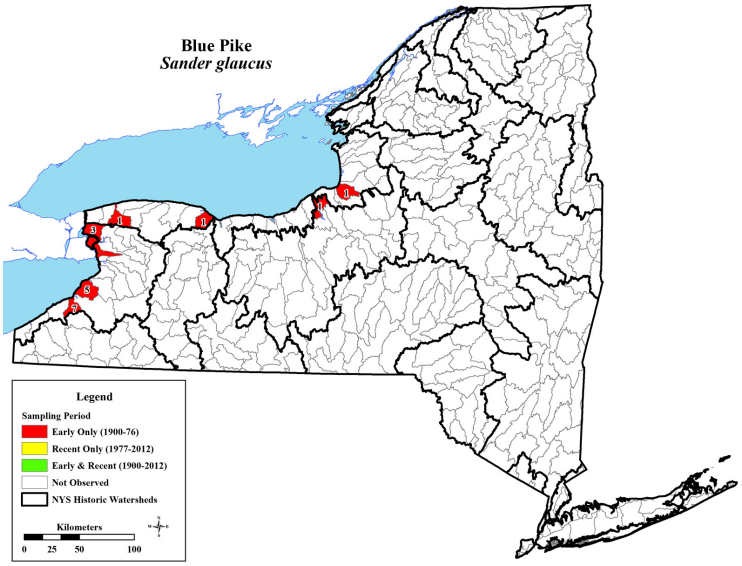
Species continued on next page

Saint Lawrence (1). This species was reported from the river near Ogdensburg by Evermann and Kendall (1902b). Greeley and Greene (1931) reported no catches. With the absence of any recent records, the Sauger is presumed to be extirpated from the New York portion of this watershed, even though individuals are still caught downstream in Quebec.

Champlain (1,2,3). Greeley (1930) reported that Saugers were moderately common in Lake Champlain, were found throughout the lake in shallow and deep water and ascended the lower reaches of streams to spawn. The abundance of this species declined severely in the 1980s. There have been few reports of catches in the last several decades (Nettles et al. 2005), but Loukmas (2013) did report a catch in 2010.

Sander glaucus, Blue Pike





This species is probably extinct. It has previously been considered a subspecies of Walleye (Smith 1985), but, in this atlas, we follow Smith (2004), who treated this fish as a distinct taxon at the species level. Populations were once found in Lake Erie and the Niagara River and were commercially important. By 1964, the species had declined in numbers and was no longer caught. Blue Pike once spawned in tributaries but otherwise lived in deeper offshore areas. Individuals were also occasionally caught in Lake Ontario and the mouth of the Oswego River. Haponski and Stepien (2014) treat this taxon as a color morph of the Walleye. There are recognized morphometric characteristics that distinguish Blue Pike from Walleye, however (Smith 1985). Until its status is fully resolved, we continue to treat the Blue Pike as a distinct taxon until additional information is obtained.

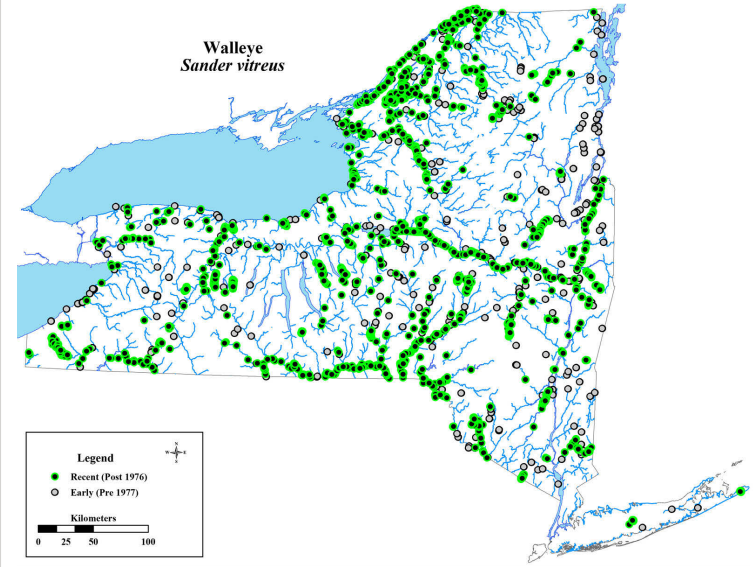
Erie-Niagara (1,2). Greeley (1929) noted that Blue Pike were very common in Lake Erie and the Niagara River and that the species supported an important commercial fishery. The vast majority of individuals were found off shore in deeper water, although a few were found inshore. None have been caught since 1964.

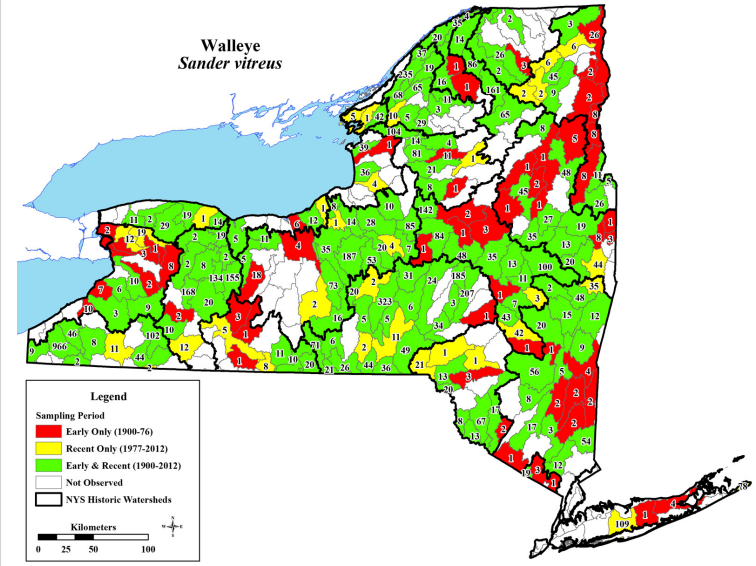
Ontario (1,2). A spawning run of Blue Pike was recorded in the mouth of the Oswego River in 1891 (Smith 1892) suggesting that, at one time, this species was an important component of the lake fish assemblage. Surveyors did not catch any specimens in the lake in 1939, however (Greeley 1940). Greeley (1940) did note that "small blue pike pass through into the Barge Canal system from the upper Niagara River. Specimens were seen and one was captured at the Lockport intake [NYSM 37642] and they also occurred in collections made in the canal." Stone (1943) reported captures from the area between Wilson Bay and Cape Vincent, and Stone (1948) was also the last to report captures in this watershed. Christie (1973) found no morphological difference between individuals from Lake Erie and Lake Ontario and suggested that Lake Ontario fish were strays from the upstream Lake Erie. Greeley (1940), however, noted morphological differences between fish from the two lakes and suggested that some Lake Ontario fish may have been intergrades.

Oswego (1). Greeley (1928) reported that Blue Pike occurred in the Oswego River at its mouth but that they were not found upstream of the first dam in Oswego. Greeley (1940) and Smith (1985) noted the possibility of interbreeding between this species and the Walleye, which makes these early records questionable at best.

Sander vitreus, Walleye

This extremely popular game fish lives in lowland streams and lakes and spawns on gravel. It is found in all of New York's watersheds but is only native to the Allegheny and Saint Lawrence River drainage watersheds. The species has been introduced to many lakes, where annual stocking continues to supplement poor natural reproduction.





Allegheny (1,2,3). Walleyes were rare during the 1937 survey, being present at less than 1% of the sites sampled (Greeley 1938). More recently, the species has become fairly common in the Allegheny River, Olean Creek, Cassadaga Creek, Conewango Creek, and lakes of the area, including Findley Lake to the west. It was introduced into Chautauqua Lake in the 1960s (McKeown 2000).

Erie-Niagara (1,2,3). This species was listed as common in Lake Erie and the Niagara River; it had also been introduced into smaller lakes in the watershed, like Java Lake (Greeley 1929). Greeley (1929) also noted that this was a popular fish for anglers but that it did not support an important commercial fishery. Walleyes are abundant in Lake Erie and continue to support a popular fishery, even though there has been a decline in catch rates since the late 1980s (Einhouse et al. 2005).

Ontario (1,2,3). This species is present in the lake, but most individuals live in the bays and lower reaches of tributaries. It was also present in lowland lakes during the 1939 survey (Greeley 1940). In recent years, a thriving fishery has developed in eastern Lake Ontario, which appears to be largely supported by recruitment from four regions in the northeast corner of the lake (Wilson and Farrell 2010).

Genesee (1,2,3). Greeley (1927) reported that this fish was "moderately common in the Genesee River from Mt. Morris to Rochester and in some of the lakes. Has been introduced into the Genesee river above Portageville Falls and at the Belmont Dam, but is rare in the river above these falls." Today this species is widespread and relatively common in larger streams and lakes of the watershed.

Oswego (1,2,3). During the 1927 survey, Walleyes were common in "certain lakes and all the rivers of the region." (Greeley 1928). The species continues to be common in these areas today.

Species continued on next page

Black (1,2,3). This species is probably only native to the lowest part of this watershed, next to Lake Ontario. The 1931 watershed survey found Walleyes in Brantingham Lake, where the species was introduced (Greeley and Bishop 1932). Recollections of long-term residents about their childhoods in the 1920s included seeing large Northern Pike among the springtime frenzy of fish using the flooded river flats for feeding near Greig, but they had no memories of Walleyes until the late 1930s and early 1940s. Greene et al. (1932) recommended the stocking of fry in the watershed. It is likely that a population became established in the middle section of the Black River after the 1930s. The earliest record from surveys in this area came in 1951 from the Beaver River at Beaver Falls. Special harvest regulations were imposed in 1978 because the quality of the fishery had declined; this decline and the implementation of regulations coincided with a major fish survey of the river. Presently, Walleye populations support a significant fishery in the Black River from the mouth to as far upstream as Lyons Falls. Spawning areas in parts of the middle and lower river are described by Carlson (1993) and Acres International Corporation (1989).

Saint Lawrence (1,2,3). Greeley and Greene (1931) stated: "It is native in the river and ascends tributaries for a short distance. One of the most important spawning creeks for it is Brandy Brook (near Waddington)." The area where Brandy Brook joins the Saint Lawrence River has been inundated by the Moses Saunders Dam and the abundance of Walleyes in that section of the river has declined substantially (Patch et al. 1984). The species remains relatively common in other parts of the river.

Oswegatchie (1,2,3). Greeley and Bishop (1932) noted that fish in the lowland lakes and large rivers were native but that specimens taken from Lake Bonaparte were undoubtedly from an introduced population. Walleyes have been introduced into other lakes in the intervening years, and, in several of these lakes, populations have not been able to maintain themselves for long periods (Schiavone 1985) despite supplemental stocking. The farthest upstream native population in the Oswegatchie River would probably be at Natural Dam, even though individuals were also present at Emeryville in the 1931 survey. Other collections exist from as far upstream as Browns Falls Reservoir in 1982 and Flat Rock Reservoir in 1991.

Raquette (1,2,3). Walleyes are native to the lowland reaches of this watershed, but populations had become established upstream of Hannawa Falls a few years before the 1933 survey was conducted (Greeley 1934). Greeley (1934) noted that the species was not yet in Long Lake but had become established in the Tupper Lake Chain and along the Raquette River, referring to these introductions as a "*dangerous experiment* [his italics]." In recent years, the Walleye fishery has become prominent in the impoundments from the Carry Falls Reservoir downstream (Gordon and Richardson 1995). The species continues to inhabit Tupper Lake in low numbers but has not been found much farther upstream in the lakes of the upper watershed nor has it been stocked there.

Champlain (1,2,3). This species is native to Lake Champlain and was relatively common during the 1929 survey. It had also been introduced to and was established in many other lakes, such as Lincoln Pond and Silver and Glen lakes, and had also been planted in other lakes where populations failed to establish themselves, such as Lake George (Greeley 1930). Today, Walleyes remain common in the lake and are well established in many of the lakes where the species has been introduced.

Chemung (**1,2,3**). Individuals were collected at just over 2% of the watershed survey sample sites, including localities on Loon Lake and the Chemung and Tioga rivers (Greeley 1938). The presence of Walleyes in the Canisteo River was first noted in 1970. The species has become fairly common in large streams throughout the watershed.

Susquehanna (**1,2,3**). At the time of the 1935 survey, Walleyes had become established through stocking in many of the lakes and larger streams, with representatives being present in 6% of the watershed survey samples (Greeley 1936). Odell and Senning (1936) noted that the species occurred in, or had been reported from, 15 lakes or reservoirs and was ranked from rare to common in these waters. This suggests that stocking was widespread in the watershed and that it had begun early enough to enable this species to establish itself. Although established in lakes and reservoirs in this watershed, the presence of Walleyes in several rivers was first noted during a 1962 survey, so the populations in the Tioughnioga, Chenango, Otselic, and Unadilla rivers might have resulted from a later stocking event or outmigration from the lakes. The species is now widespread in the watershed.

Delaware (**1,2,3**). By the time of the 1935 survey, populations had become established in both streams and lakes as a result of stocking, with individuals being present at 2% of the sites sampled (Greeley 1936). Walleyes were only reported from three lakes or reservoirs in 1935 (Odell and Senning 1936). From there, the species has continued to expand its range in the watershed, having become established in the Pepacton and Cannonsville reservoirs over the last few decades. The only stream fishery in the watershed has developed in the downstream stretches of the East Branch, West Branch, and mainstem of the Delaware River.

Species continued on next page

Upper Hudson (**1,2,3**). Greeley and Bishop (1933) reported that this species has been stocked into several lakes just prior to the 1932 survey, and Odell (1933) listed it from 16 lakes or reservoirs. It is now widespread in lakes, streams, and the main channel (Markarowitz 1983).

Mohawk (**1,2,3**). Greeley (1934) reported that there were "considerable numbers" in Schoharie Creek and the Mohawk River, and Odell (1935) ranked this species from rare to common in 13 lakes or reservoirs. Recent records exist from the Mohawk River (NYSM 70702 in 2014), Delta Lake, Schoharie Creek (NYSM 64961 in 2009), and the Schoharie Reservoir.

Lower Hudson (**1,2,3**). Walleyes were present at 1% of the watershed survey sites sampled and were taken in all basins of the watershed, except for the Croton River system (Greeley 1937). Odell and Senning (1937) corroborated the relative scarcity of this species in the watershed by noting that it was fairly common only in the Ashokan Reservoir. It remains relatively rare in this watershed, but self-sustaining populations have been established. Spawning has been observed at the Troy Dam and the mouth of the Poesten Kill.

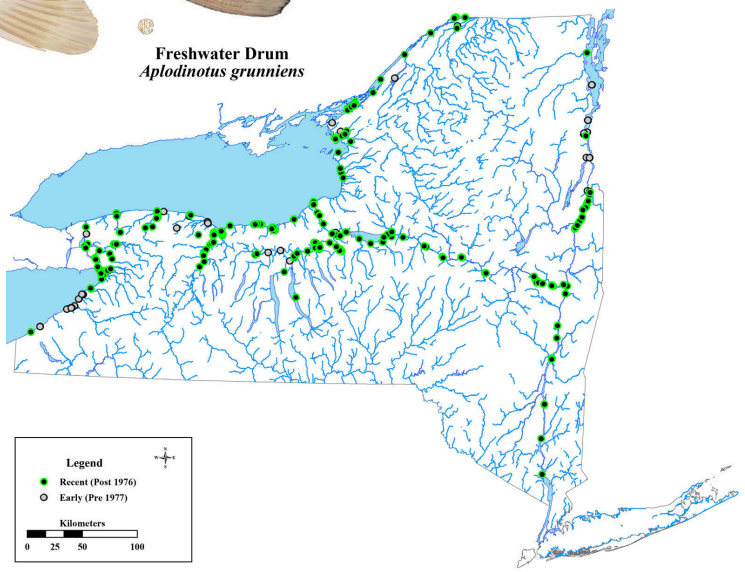
Newark Bay (**1,3**). Odell and Senning (1937) listed this species as rare in Greenwood Lake. It remains rare but has been reported in the lake in recent surveys.

Long Island (**1,2,3**). Senning (1939) listed this fish as rare in Fresh Pond (Suffolk County). Greeley (1939a) reported that the species had been stocked in many waters but opined that it "apparently does not have a favorable habitat here for the development of a permanent population." More recently, Walleyes were stocked in Lake Ronkonkoma and in Fort Pond, but there have been no reports of natural recruitment, which supports Greeley's (1939a) assessment.

Sciaenidae, Drums

Only two species in this large, mostly marine family exclusively inhabit freshwater, although many species stray into estuaries. One of the freshwater forms occurs in New York. In addition, several coastal species enter the lower Hudson River and other coastal streams. Occasionally, these species will remain in the river for extended periods. Frequent strays include the Spot (*Leistomus xanthus*) and the Weakfish (*Cynoscion regalis*). On rarer occasions, Silver Perch (*Bairdiella chrysoura*), Northern Kingfish (*Menticirrhus saxatilis*), and Atlantic Croaker (*Micropogonias undulatus*) enter the estuary. Recently, the Red Drum (*Sciaenops ocellatus*) has been reported from the Hudson River. Further treatment of these marine strays is outside the scope of this atlas.

Aplodinotus grunniens, Freshwater Drum



This fish occurs in large lowland streams and lakes. It favors near-shore areas and is tolerant of high turbidity and salinity. The species is native in eight Saint Lawrence River drainage watersheds and is now found in all three watersheds of the Hudson River drainage. The Freshwater Drum has become more widespread in the Erie Canal and Saint Lawrence River drainage, which coincides with the invasion of the Zebra Mussel (*Dreissena polymorpha*), a favored food item, that began in the 1990s. Because this species is tolerant of salt water, it is possible that it used two routes to gain access to the Hudson River, where we currently treat it as an exotic. It seems clear that migration occurred through the Erie Canal from the Great Lakes. It is possible, however, that the early individuals captured in the Lower Hudson watershed migrated along the coast from more southern populations, in which case, these fish would be considered to be native. Further genetic research would be necessary to determine the source(s) of these Hudson River populations.

Erie-Niagara (1,2,3). Specimens were collected in the 1890s from Cattaraugus Creek (USNM 69960) and Fish Creek near Buffalo (USNM 69961). Greeley (1929) noted that Freshwater Drum were common in Lake Erie and also present in the Niagara River and the mouths of larger creeks. In recent years, reports exist from most of these same areas as well as Cazenovia Creek and the Erie Canal at Pendleton.

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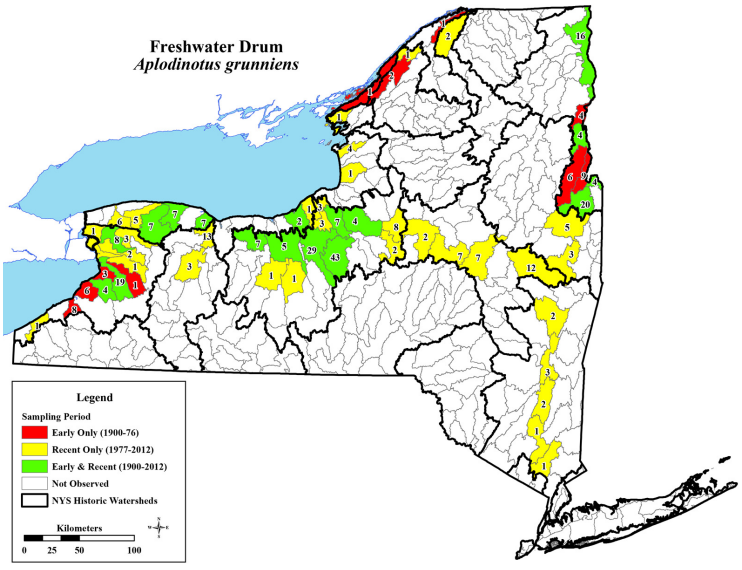


Ontario (1,2,3). The 1939 survey collected specimens from the bays of Lake Ontario, lowland ponds, and stream mouths (Greeley 1940). Since 1994, this species has been caught more frequently east of Oswego, including in Chaumont and Black River bays. It continues to be found in the western part of the watershed, with records from two impoundments on Oak Orchard Creek since 1991. This pattern of eastward expansion in the watershed is similar to that observed for the White Perch.

Genesee (1,2,3). No specimens were caught during the 1926 survey, but Greeley (1927) did report that an individual was caught at Rochester although it was not vouchered. He (Greeley 1927) also noted that the Erie Canal could serve as a conduit for fish migration from the Great Lakes to the upper part of this watershed, which was previously isolated by the Rochester Falls. The first verified record from upstream of Rochester was in 1977, and Freshwater Drum are occasionally caught in the Genesee River as far upstream as Avon.

Oswego (1,2,3). Surface (1899) found Freshwater Drum in the Clyde River and Cayuga Lake (CUMV 3711) in 1898. Greeley (1928) listed this species as uncommon during the 1927 survey. The survey crews caught a lone specimen in the Clyde River (NYSM 23868) and reported catches from the Clyde, Seneca, and Oswego rivers, as well as the Erie Canal. The presence of Freshwater Drum in Oneida Lake was first reported in 1959 (CUMV 41644), and individuals continue to be caught episodically in the larger rivers of the watershed. Catches in the Erie Canal have increased recently, which Goehle and Clay (2013) attributed to increases in Zebra Mussel abundance.

Saint Lawrence (1,2,3). No specimens were collected during the synoptic survey of this watershed (Greeley and Greene 1931), but a specimen was taken from the Grass River at Massena in 1931 (NYSM 15281). The next verified record is from the Saint Lawrence River at Cape Vincent in 1976. Since 2004, this species has been frequently caught in the Saint Lawrence River and the extreme lower portions of its tributaries.

Oswegatchie (1). Greeley and Bishop (1932) included this species in their watershed survey report because of anecdotal reports of its presence in Black Lake. It has not been reported in recent decades.

Raquette (3). A Freshwater Drum was caught in 1991 near Massena. There are no additional records from this watershed.

Champlain (1,2,3). Greeley (1930) listed the Freshwater Drum as moderately common and widely distributed in the lake although its population density was greatest in the South Bay. Individuals were also taken from the lower reaches of tributaries, such as Ticonderoga Creek (NYSM 23846). Dudones (1977) reported the species from South Bay during a 1976 survey, and specimens were collected farther north, from Bulwagga Bay, in the 1980s (AMNH 43867). More recently, Freshwater Drum have been collected from the Champlain Canal in 2008 and Lake Champlain in 2009.

Upper Hudson (**2,3**). In 1983, this species was reported from the Champlain Canal at its southern terminus. It was caught in the main channel just upstream of the confluence with the Mohawk River in 1988 and at Fort Edward in 2008 (C. Millard, USEPA, National Rivers Study, unpubl. records).

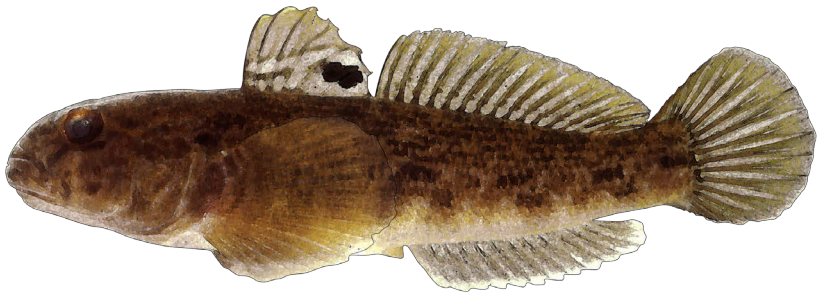
Mohawk (**3**). This species was first reported from this watershed in 1991 near Schenectady (NYSM 41483). More recent reports are from the Mohawk River, most recently in 2014 (NYSM 70705), and the Erie Canal, which provides access to this watershed for out-migrating fish from Oneida Lake.

Lower Hudson (**2,3**). Freshwater Drum were first reported from the lower Hudson River in 1989 (AMNH 59035, NYSM 39600). In later collections, individuals have been taken farther upriver in Greene County in 2005 (NYSM 59196) and 2010 (NYSM 65852), Dutchess County in 2006 (NYSM 60397), and Rensselaer County in 2013 (NYSM 69048). This species occurs throughout the main channel but has not been reported from any tributary.

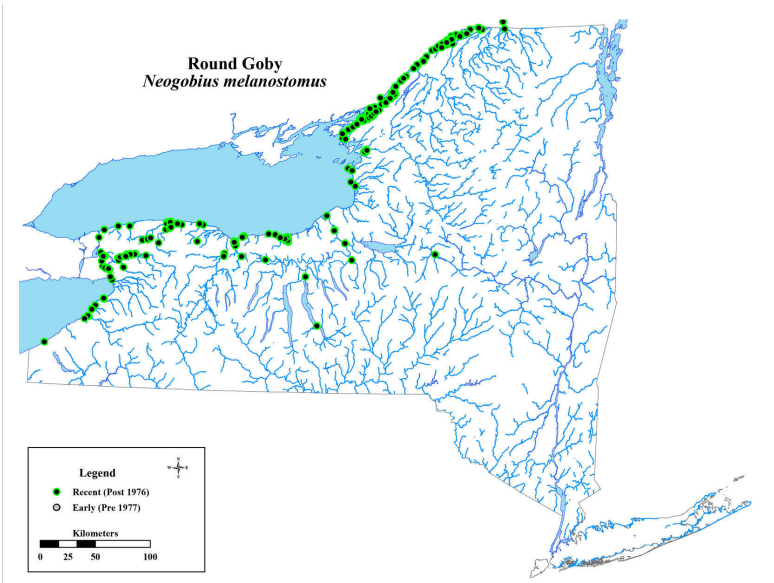
Gobiidae, Gobies

This is a speciose family of fishes, and, while most are obligate marine species, some are tolerant of freshwater, and a few species are freshwater residents. Recently, two species of Eurasian gobies have gained access to the Great Lakes. The Round Goby is now established in New York waters. The second species, the Tubenose Goby (*Proterorhinus marmoratus*), has been reported from neighboring states and provinces but has not yet been taken in New York.

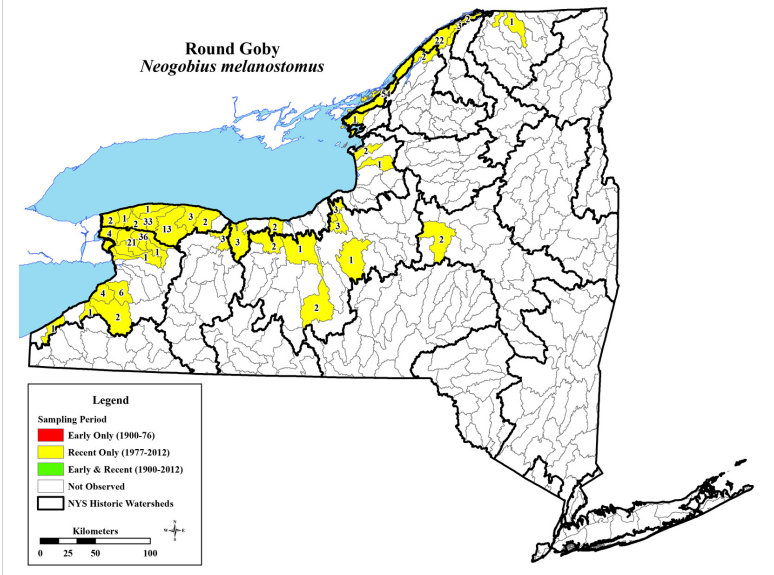
Neogobius melanostomus, Round Goby



This Eurasian species lives in streams, lakes, and canals with rocky bottoms. It was first discovered in Lake Saint Clair in 1990 and has since expanded its North American range to include most of the Great Lakes states and provinces. It is likely that its range will continue to expand into all waters with continuous connections to the Saint Lawrence River drainage. The species has been slower to colonize northern tributaries, however, than those in western New York. Increases in range and abundance of this species have coincided with the invasion of the Zebra Mussel (*Dreissena polymorpha*), a favored prey item, that began in the early 1990s.



Erie-Niagara (**3**). This species was first reported from the New York waters of Lake Erie and the Niagara River in 2000. Collections from some tributaries, such as Tonawanda Creek (NYSM 54405), and the Erie Canal soon followed. In 2001, Round Gobies were collected in 7% of samples taken in the Niagara River (New York Power Authority, unpubl. field notes). This goby is now an abundant species in the near-shore waters of Lake Erie (Einhouse et al. 2014) and was ranked highest in trawl catches from 2003-2009 (Einhouse et al. 2014). It has displaced some darter species in Lake Erie tributaries like Ellicott Creek (Pennuto et al. 2010). Poos et al. (2010) detailed the potential impacts of this species on a suite of benthic fishes, including madtoms, darters, and sculpins, and argued that goby-associated competition and predation led to a decrease in overall biodiversity.



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Ontario (**3**). This species was first seen in western Lake Ontario in 1998 and in the Bay of Quinte in 1999, which suggests that it was in the upstream Erie-Niagara watershed earlier than it was first reported. It is now widespread in the lake, the Erie Canal, and lower reaches of tributaries, like Johnson Creek (NYSM 62913). The species was caught in the Rochester segment of the Erie Canal in 2007. Even though the canal is drained during the winter, this goby can overwinter in areas where water remains. This is particularly true east of Rochester, where the canal is not drawn down completely (Clay 2010). In 2009, individuals were caught near Macedon (Trometer et al. 2010), Oak Orchard Creek, and the Waterport Reservoir, which is linked to the canal by overflow channels.

Genesee (**3**). Round Gobies were first reported from Rochester at the junction of the Erie Canal in 2007 (Young et al. 2009) and from Red Creek in 2011.

Oswego (**3**). In 2010, Round Gobies were reported from the Seneca River portion of the Erie Canal at Port Byron, Onondaga Lake, and the Oswego River at Fulton. In 2011, the species was reported from the Oswego River at Phoenix. In 2013, a specimen was taken from Cayuga Lake (CUMV 97647). This species has established itself in the canal system since its initial invasion, and, in 2014, it was found in the Erie Canal 38 km east of Oneida Lake.

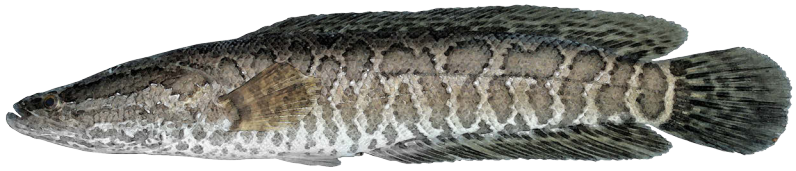
Saint Lawrence (**3**). This goby was reported from the Saint Lawrence River near Massena in 2004 and from the Thousand Islands region in 2006. It is now widespread in the main channel and the lower reaches of tributaries, such as the Salmon River at Fort Covington and at the mouth of the Grass River (NYSM 66389). The records from tributaries are all downstream of the first riffle or within a few kilometers of the mouth. Carlson and McKenna (2014) reported that this species displaced the dominant darter species, the Tessellated Darter, in the Saint Lawrence River, and Abbett et al. (2013) also reported declines in native species resulting from the Round Goby invasion.

Oswegatchie (**3**). This species was reported from the mouth of the Oswegatchie River at Ogdensburg, downstream of the first dam, in 2011.

Channidae, Snakeheads

This family of predatory fishes is native to south and east Asia and tropical Africa. Certain species can grow to over 1 m in length, a relatively large size for a freshwater fish. Some species are obligate air breathers as adults, and some are capable of over-land migrations under certain environmental and weather conditions. This set of characteristics makes these fish formidable dispersers and dominant components of any fish assemblage of which they are a part.

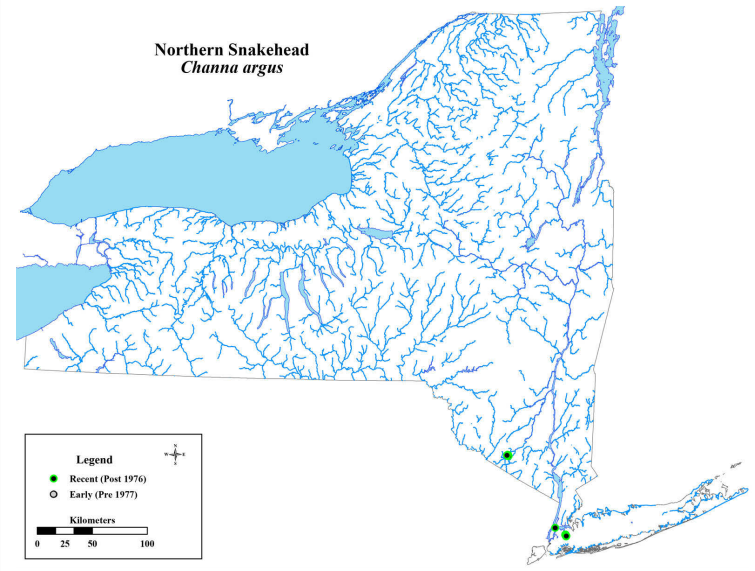
Channa argus, Northern Snakehead

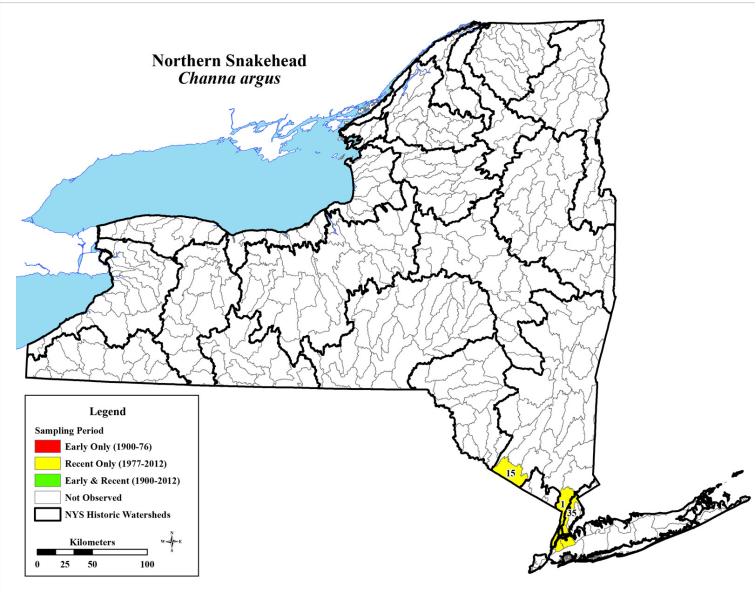


This large piscivore is native to northeast Asia. It inhabits standing water or sluggish streams and is often associated with abundant aquatic vegetation. It is tolerant of low-oxygen conditions but is intolerant of even low salinity. The Northern Snakehead is an obligate air breather and is, therefore, tolerant of low and even no-water conditions. This species was first reported in North America at a pond in Maryland in 2002, and, from there, it subsequently escaped into the Potomac River. The species has gained access to other areas by point introductions. It is possible that individuals have been released as part of a Buddhist rite, but this is also a popular food fish in its native range, and its release might be explained as a simple but illegal stocking activity.

Lower Hudson (**3**). In 2008, an established population was documented in Ridgebury Lake and its outflow, Catlin Creek, a tributary to the Wallkill River. In August 2008, NYSDEC mounted an eradication effort, during which over 200 Northern Snakeheads were poisoned. A follow-up treatment was conducted in 2009, and the effort appears to have succeeded in eliminating this exotic species from the watershed. Records also exist from a pond in Central Park on Manhattan Island in 2008.

Long Island (**3**). This species was first reported from Willow and Meadow lakes in Flushing Meadows, Queens, in 2005. These lakes are isolated, and the only outlet is into Long Island Sound, which prevents out-migration by this species. Monitoring of these populations in subsequent years has yielded additional specimens (e.g., NYSM 60526), but in four years of monitoring, the fish assemblage in these ponds has not dramatically changed (Cohen et al. 2011).





Literature Cited

Abbett, R., E.M. Waldt, J.H. Johnson, J.E. McKenna, Jr. and D.E. Dittman. 2013. Interactions between invasive Round Gobies (*Neogobius melanostomus*) and Fantail Darters (*Etheostoma flabellare*) in a tributary of the St. Lawrence River, New York, USA. *Journal of Freshwater Ecology* 28:529-537.

Acres International Corporation. 1989. Niagara Mohawk Power Corporation Walleye spawning surveys, Black River Project FERC no. 2569. Acres International Corporation. Amherst, NY. 75 p.

Adams, C.C. and T.L. Hankinson. 1916. Notes on Oneida Lake fish and fisheries. Transactions of the American Fisheries Society 45:154-169.

Adirondack Lake Survey Corporation. 2014. Historic 1984-87 Data. http://www.adirondacklakessurvey.org/historic.php. Adirondack Lakes Survey Corporation, Ray Brook, NY.

Anderson, J.K. 1978. Lake Champlain fish population inventory 1971 to 1977. Federal Aid Project F-12-R, Job No. II-1. Vermont Fish and Game Department. Montpelier, VT. 118 p.

April, J., R.H. Hanner, A.M. Dion-Cote and L. Bernatchez. 2013. Glacial cycles as an allopatric speciation pump in north-eastern American freshwater fishes. *Molecular Ecology* 22:409-422.

Argent, D.G., R.F. Carline and J.R. Stauffer, Jr. 1997a. Changes in the distribution of Pennsylvania fishes: the last 100 years. *Journal of the Pennsylvania Academy of Science* 72:32-37.

Argent, D.G., R.F. Carline and J.R. Stauffer Jr. 1997b. Historical and contemporary distribution of fishes of Pennsylvania. Final report, Research work order no. 47. Pennsylvania State University. University Park, PA. 278 p.

Arndt, R.G. 2004. Annotated checklist and distribution of New Jersey freshwater fishes, with comments on abundance. *Bulletin of the New Jersey Academy of Science* 49:1-33.

ASAAC (ASA Analysis and Communication) 2013. 2013 Annual year class report for the Hudson River Estuary Monitoring Program. Prepared on behalf of Entergy Nuclear Indian Point 2 LLC, Entergy Nuclear Indian Point 3 LLC, Entergy Nuclear Operations and NRG Bowline LLC. Washingtonville, NY.

Atlantic States Marine Fisheries Commission. 2012. River herring benchmark stock assessment Volume 1. Stock Assessment Report No. 12-02 of the Atlantic States Marine Fisheries Commission. Washington, DC. 36 p.

Bain, M.B. 1997. Atlantic and Shortnose Sturgeons of the Hudson River: Common and divergent life history attributes. *Environmental Biology of Fishes* 48:347-358.

Bart, H.L., Jr., M.D. Clements, R.E. Blanton, K.R. Piller and D.L. Hurley. 2010. Discordant molecular and morphological evolution in buffalofishes (Actinopterygii: Catostomidae). *Molecular Phylogenetics and Evolution* 56:808-820.

Beak Consultants, Incorporated. 1986. Somerset aquatic monitoring program, summer data report 1986. New York State Electric and Gas Corporation. Binghamton, NY.

Beak Consultants Incorporated. 1994. Black River supplemental fisheries studies, FERC no. 2569-004-NY. Niagara Mohawk Power Corporation. Syracuse, NY. 170 p.

Bean, T.H. 1902. Catalogue of the fishes of Long Island. pp. 373-478. *In*: Annual Report of the Forest, Fish and Game Commissioners for the State of New York (1901). Albany, NY.

Bean, T.H. 1903. Catalogue of the Fishes of New York. New York State Museum Bulletin 60. 784 p.

Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press. Madison, WI. 1052 p.

Becker, L. R., Jr. 1982. Fishes of the Allegheny River and its tributaries between Salamanca and Allegany, Cattaraugus County, New York. M.S. Thesis. Saint Bonaventure University. Saint Bonaventure, NY. 132 p.

Bernatchez, L. and M. Giroux. 2000. Les poisons d'eau douce du Quebec. Broquet. 350 p.

Bishop, S.C. 1936. Fisheries investigations in the Delaware and Susquehanna Rivers. pp. 122-139. *In*: E. Moore (ed.). A Biological Survey of the Delaware and Susquehanna watersheds. Supplemental to the Twenty-fifth Annual Report New York State Conservation Department (1935). Albany, NY.

Black, S.R. 1944. Seth Green father of fish culture. *Rochester History* 6(3):1-24.

Bouton, D.J. 1986. Survey for the Eastern Sand Darter, *Ammocrypta pellucida*, in nine major New York State tributaries and in five delta areas of Lake Champlain. New York State Department of Environmental Conservation. Albany, NY. 15 p.

Bouton, D.J. 1991. A summary of 1987-91 survey data collected on the Eastern Sand Darter, *Ammocrypta pellucida*, in the Mettawee River, Poultney River and Little Salmon-Salmon River systems. New York State Department of Environmental Conservation. Albany, NY. 19 p.

Bowers, N.J., J.R. Stauffer and J.R. Pratt. 1992. The distribution, population and ecology of *Etheostoma maculatum* Kirtland in upper French Creek, New York. Pennsylvania State University. University Park, PA. 43 p.

Boyle, R.H. 1969. *The Hudson River, A natural and unnatural history*. W.W. Norton and Company. New York. 304 p.

Brazner, J.C., N.P. Danz, G.J. Niemi, R.R. Regal, A.S. Trebitz, R.W. Howe, J.M. Hanowski, L.B. Johnson, J.J.H. Ciborowski, C.A. Johnston, E.D. Reavie and G.V. Sgro. 2007. Evaluation of geographic, geomorphic, and human influences on Great Lakes wetland indicators: a multi-assemblage approach. *Ecological Indicators* 7:610-635.

Brewer, J. and M. Clancy 2015. Assessment of Paddlefish (*Polyodon spathula*) restoration in the Allegheny River system. New York State Department of Environmental Conservation. Allegany, NY. 23p.

Brewer, J. 2015. 2012-2013 Allegheny River fish community assessment. New York State Department of Environmental Conservation. Albany, NY. 34 p.

Brumbach, H.J. and S.J. Bender. 1986. Anadromous fish and fishing: a synthesis of data from the Hudson River drainage. *Man of the Northeast* 32:35-63.

Brussard, P.F., M.C. Hall and J. Wright. 1981. Structure and affinities of freshwater Sea Lamprey (*Petromyzon marinus*) populations. *Canadian Journal of Fisheries and Aquatic Sciences* 38:1708-1714.

Bryan, M.B., D. Zalinski, K.B. Filcek, S. Libants, W. Li and K.T. Scribner. 2005. Patterns of invasion and colonization of the Sea Lamprey (*Petromyzon marinus*) in North America as revealed by microsatellite genotypes. *Molecular Ecology* 14:3757-3773.

Buckingham, N., R. Mullholland and D. Dubois. 1977. Niagara district bait fish study, summer 1977. Ontario Ministry of Natural Resources. Peterborough, ON. 19 p.

Budnik, R.R., M. Clancy, J.G. Miner and W.D. Brown. 2014. Assessment of Paddlefish reintroduction into Allegheny Reservoir. *Journal of North American Fisheries Management* 34:1055-1062.

Burroughs, J. 1871. Wake-robin. Houghton, Mifflin and Co. Boston, MA and New York. 256 p.

Carlson, D.M. 1986. Fish and their habitats in the Hudson estuary. New York State Department of Environmental Conservation. Stamford, NY. 30 p.

Carlson, D.M. 1992a. 1992 Lower Oswegatchie River: a warmwater fish survey. New York State Department of Environmental Conservation. Watertown, NY. 27 p.

Carlson, D.M. 1992b. A fisheries management survey of the middle Oswegatchie River (Gouverneur to Cranberry Lake). New York State Department of Environmental Conservation. Watertown, NY. 45 p.

Carlson, D.M. 1993. 1992-93 Black River fisheries survey: Carthage to Lyons Falls. New York State Department Environmental Conservation. Watertown, NY. 38 p.

Carlson, D.M. 1995. Lake Sturgeon waters and fisheries in New York State. *Journal of Great Lakes Research* 21:35-41.

Carlson, D.M. 1996. Black River fisheries survey, 1992-93. New York State Department Environmental Conservation. Watertown, NY. 77 p.

Carlson, D.M. 1997. Status of Pugnose and Blackchin Shiners in the Saint Lawrence River in New York. pp. 15-1 to 15-10. *In*: Annual Report of the Saint Lawrence River Subcommittee to the Lake Ontario Committee and the Great Lakes Fishery Commission (1996). Saint Lawrence River Unit, New York State Department of Environmental Conservation. Cape Vincent, NY.

Carlson, D.M., R. Colesante, J. S. Hayes and S.L. Schlueter. 2002. Lake Sturgeon (*Acipenser fulvescens*) and its recovery programs in New York State. p. 1-13. *In*: Technical Compendium to the Proceedings of the Fourth International Symposium on Sturgeon, Oskosh WI, July 8-13, 2001. Report #102. 13 p.

Carlson, D.M. and R.A. Daniels. 2004. Status of fishes in New York: increases, declines and homogenization of watersheds. *American Midland Naturalist* 152:104-139.

Carlson, D.M., R.A. Daniels and S.W. Eaton. 1999. Status of fishes of the Allegheny River watershed of New York State. *Northeastern Naturalist* 6:305-326.

Carlson, D.M., J. Homa and A. Carlson. 2000. Freshwater fishes of New York: Map Series by Edward Raney (Abstract). New York State Museum Circular 62:56.

Carlson, D.M.and S.L. LaPan. 1997. Fish species inhabiting the international portion of the St. Lawrence River. New York State Department of Environmental Conservation. Watertown, NY. 11 p.

Carlson, D.M. and J.E. McKenna. 2014. Comparison of fishes in near shore areas of the St. Lawrence River, New York, over 35 years. pp. 21-1 to 21-5. *In*: Lake Ontario Annual Report 2013. New York State Department of Environmental Conservation. Albany, NY.

Carlson, D., R. Morse and E. Hekkala. 2015. Late spawning suckers of New York's Adirondack Mountains. *American Currents* 40(4):10-14.

Carmignani, J. 2012. The distribution and abundance of the "of special concern" freshwater fish Bridle Shiner, *Notropis bifrenatus*, in the Housatonic River Basin with emphasis on physical habitat patterns at multiple spatial scales. MA thesis. Clark University. Worchester, MA. 144 p.

Caron, F., G. Verreault and E. Rochard. 2003. Estimation of the population size, exploitation rate and escapement of silver-phase American Eels in the St. Lawrence Watershed. pp. 235-242. *In*: D.A. Dixon (ed.). Biology, management and protection of catadromous eels. American Fisheries Society Symposium 33. Bethesda, MD.

Cervone, T.H., R.M. Langianese and S.M. Stayer. 1985. The fishes of Tunungwant Creek drainage. Proceedings of the Pennsylvania Academy of Science 59:138-146.

Chaupleau, F. and G. Pageau. 1985. Morphological differentiation of *Etheostoma olmstedi* and *E. nigrum* (Pices: Percidae) in Canada. *Copeia* 1985:855-862.

Cheney, A.N. 1897. Black Bass and their distribution in the waters of New York State. pp. 176-184. *In*: Annual Report of the Forest, Fish and Game Commissioners of the State of New York (1896). Albany, NY.

Christie, W.J., 1973. A review of the changes in the fish species composition of Lake Ontario. Great Lakes Fisheries Commission Technical Report 23. 65 p.

Christie, W.J. and N.A. Thomas. 1981. Biology. pp. 327-340. *In*: E.J. Aubert and T.L Richards (eds.). The International Field Year for the Great Lakes. US National Oceanic and Atmospheric Adminstration, Great Lakes Environmental Research Laboratory. Ann Arbor, MI.

Clay, D.L. 2010. Effects of semi-annual water-level fluctuation on fish and macroinvertebrate communities in the Niagara Region of the Erie Canal. MA Thesis. State University of New York Buffalo State College. Buffalo, NY. 69 p.

Cohen, M.K., J.A. MacDonald and A.M. Brinton. 2011. Northern Snakeheads in two New York City lakes over four years. New York State Department of Environmental Conservation. Long Island City, NY. 16 p.

Coldwater Task Group. 2014. Report of the Lake Erie Coldwater Task Group, March 2014, Presented to the Standing Technical Committee. Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, MI. 72 p.

Cornwell, M. 1994. Characterization of Atlantic Salmon reproduction in the upper Susquehanna River. pp. 186-191. *In*: Twenty-sixth Annual Report of the Oneonta Biological Field Station (1993). State University of New York Oneonta. Oneonta, NY.

Connerton, M.J., B.A. Murry, N.H. Ringler and D.J. Stewart. 2009. Majority of age-3 Chinook Salmon (*Oncorhynchus tshawytscha*) in Lake Ontario were wild from 1992 to 2005, based on scale pattern analysis. *Journal of Great Lakes Research* 35:419-429.

Connerton, M.J. and D.J. Stewart. 2013. A strategic plan for the establishment of native deepwater ciscoes in Lake Ontario. New York State Department of Environmental Conservation. *Cape Vincent, N.Y. 42* p.

Cooper, E.L. 1983. Fishes of Pennsylvania and the Northeastern United States. Pennsylvania State University Press. University Park, PA. 243 p.

Cooper, E.L. 1985. Fishes. pp. 169-256. *In*: H.H. Genoways and F.J.Brenner (eds.). Species of Special Concern in Pennsylvania. Carnegie Museum of Natural History Special Publication 11. 41 p.

Cooper, E.L. and C.C. Wagner. 1980. Evaluation of post-impoundment fishery resources of Allegheny Reservoir in 1979-80. Contract no. DACW-31-79-C-0005 (3). Sport Fishing Institute. Washington, DC. 39 p.

Cooper, S. F. 1851. *Rural hours/By a lady*. George P. Putnam, New York. 528 p.

COSEWIC. 2005. COSEWIC assessment and update status report on the Shortnose Cisco *Coregonus reighardi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vi + 14 p.

COSEWIC. 2006. COSEWIC assessment and update status report on the Deepwater Sculpin *Myoxocephalus thompsonii* (Western and Great Lakes-Western St. Lawrence populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. 39 p. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2009. COSEWIC assessment and update status report on the Bigmouth Buffalo *Ictiobus cyprinellus*, Great Lakes – Upper St. Lawrence populations and Saskatchewan - Nelson River populations, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 40 p. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2012. COSEWIC assessment and status report on the Silver Chub *Macrhybopsis storeriana* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xiii + 34 p. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

Criswell, R.W. and J.R. Stauffer, Jr. 2011. The distribution and status of Pennsylvania's lampreys. Pennsylvania Fish and Boat Commission. Harrisburg, PA. 14 p.

Crossman, E. J. and H.D. Van Meter, 1979. Annotated list of the fishes of the Lake Ontario watershed. Great Lakes Fish Commission Technical Report 26. 25 p.

Culligan, W.J., J.L. Markham, D.W. Einhouse, D.L. Zeller, R.C. Zimar, B.J. Beckwith. 2005. New York State Department of Environmental Conservation Lake Erie Annual Report to the Lake Erie Commission and the Great Lakes Fishery Commission (2004). New York State Department of Environmental Conservation. Albany, NY. 67 p.

Curran, H.W. and D.T. Ries. 1937. Fisheries Investigations in the lower Hudson River. pp. 124-145. *In*: E. Moore (ed.). A Biological Survey of the Lower Hudson watershed. Supplemental to the Twenty-sixth Annual Report New York State Conservation Department (1936). Albany, NY.

Daniels, R.A. 1989. Preliminary report, Allegheny River fish survey, 1989. New York State Museum. Albany, NY. 9 p. + maps

Daniels, R.A. 1993. Habitat of the Eastern Sand Darter, *Ammocrypta pellucida*. *Journal of Freshwater Ecology* 8:287-295.

Daniels, R. A. 1995. Nearshore fish assemblage of the tidal Hudson River. pp. 260-263. *In*: E. T. LaRoe, G. S. Farris, C. E. Puckett, D. P. Doran, and M. J. Mac (eds.). *Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems*. U.S. Department of the Interior. Washington, D.C.

Daniels, R.A. 1998. Fishes of Allegheny State Park. New York State Museum, Albany, NY.

Daniels, R.A. 2001. Untested assumptions: the role of canals in the dispersal of Sea Lamprey, Alewife and other fishes in the eastern United States. *Environmental Biology of Fishes* 60:309-329.

Daniels, R. A. 2011. Legacy of New York State's watershed surveys, 1926-1939. *Fisheries* 36(4):179-189.

Daniels, R.A., R.T. Bombard, J.W. Sutherland and C.W. Boylen. 2011a. Status of fishes in selected Adirondack lakes: eight decades of changing assemblage composition. *The Open Fish Science Journal* 4:21-39.

Daniels, R.A., D.M. Carlson, R.S. Morse and B.R. Weatherwax. 2006a. Fish, *Ichthyomyzon bdellium, Ichthyomyzon greeleyi, Norturus flavus, Moxostoma breviceps, Lythrurus umbratilis, Notropis buccatus, Misgurnus anguillicaudatus, Morone americana, Lepomis cyanellus, Ammocrypta pellucida*: distribution extensions. Check List 2:10-13.

Daniels, R. A., K. E. Limburg, R. E. Schmidt, D. L. Strayer and R. C. Chambers. 2005. Changes in fish assemblages in the tidal Hudson River, New York. pp. 471-503. *In*: J.N. Rinne, R. M. Hughes and B. Calamusso (eds.). Historical changes in large river fish assemblages of America. American Fisheries Society. Bethesda, MD.

Daniels, R.A., R.S. Morse, R.T. Bombard, J.W. Sutherland, C.W. Boylen. 2008. Fish movement among lakes: Are lakes isolated? *Northeastern Naturalist* 15:577-588.

Daniels, R.A., R.S. Morse and B.R. Weatherwax. 2006b. Fish, Conewango Creek, Allegheny River drainage, New York, USA. Check List 2:14-19.

Daniels, R.A., R.E. Schmidt and K.E. Limburg. 2011b. Hudson River Fisheries: Once robust, now reduced. pp. 27-40. *In*: R.E. Henshaw (ed.). *Environmental History of the Hudson River*. State University of New York Press, Albany, NY.

Daniels, R.A. and S.J. Wisniewski. 1994. Feeding ecology of Reside Dace, *Clinostomus elongatus. Ecology of Freshwater Fish* 3:176-183.

Dawley, R.M., R.J. Schultz and K.A. Goodard. 1987. Clonal reproduction and polyploidy in unisexual hybrids of *Phoxinus eos* and *Phoxinus neogaeus*. (Pisces; Cyprinidae). *Copeia* 1987:275-283.

DeKay, J.E. 1842. Zoology of New York or the New York fauna; Part IV. Fishes. W. and A. White and J. Visscher. Albany, NY. 415 p. + 79 pls.

Demong, L. 1995. Summary of the Great Chazy River Muskellunge Survey, June 26 and 28, 1994. New York State Department of Environmental Conservation. Ray Brook, NY. 6 p.

Dence, W. A. 1928. A preliminary report on the trout streams of south-western Cattaraugus County, New York. Roosevelt Wildlife Bulletin 5:145-210.

Denoncourt, R.F., W.A. Potter and J.R. Stauffer, Jr. 1977. Records of the Greenside Darter, *Etheostoma blennioides*, from the Susquehanna River drainage in Pennsylvania. *Ohio Journal of Science* 77:38-42.

Dermott, R.M. and C.A. Timmins. 1986. Occurrence and spawning of Pink Salmon, *Oncorhynchus gorbuscha*, in Lake Ontario tributaries. *Canadian Field-Naturalist* 100:131-133.

Dittman, D.E., L.S. Machut and J.H. Johnson 2009a. Lake Champlain drainage: American Eel history, status, and management options. State Wildlife Grant New York State Department of Environmental Conservation Final Report. US Geological Survey. Cortland, NY. 115 p.

Dittman, D.E., L.S. Machut, and J.H. Johnson. 2009b. Susquehanna River drainage: American Eel history, status, and management options. State Wildlife Grant Final Report. Bureau of Wildlife, New York State Department of Environmental Conservation. Albany, NY. 96 p.

Dittman, D.E., L.S. Machut and J.H. Johnson 2009c. Hudson River drainage: American eel history, status, and management options. SWG project for New York State Department of Environmental Conservation. USGS, Cortland, NY. 130 p.

Dittman, D.E., L.S. Machut, and J.H. Johnson. 2009d. Long Island drainage: American eel history, status, and management options, Final Report for State Wildlife Grant C005548, Comprehensive study of the American eel. Bureau Wildlife, New York State Department of Environmental Conservation. Albany, NY. 107 p.

Dittman, D.E., J.H. Johnson, M. Chalupnicki and J. Snyder. 2010a. Evaluation of Lake Sturgeon recovery efforts in the Saint Regis River. GLNPO Project DW-14-94806801-0. US Geological Survey. Cortland, NY. 44 p.

Dittman, D.E., L.S. Machut, and J.H. Johnson. 2010b. Overview: American Eel history, status, and management options, Final Report for State Wildlife Grant C005548, Comprehensive Study of the American Eel. Bureau of Wildlife, New York State Department of Environmental Conservation. Albany, NY. 36 p.

Dittman, D.E., L.S. Machut, and J.H. Johnson. 2010c. Lake Ontario/Saint Lawrence River drainage: American Eel history, status, and management options, Final Report for State Wildlife Grant C005548, Comprehensive Study of the American Eel. Bureau of Wildlife, New York State Department of Environmental Conservation. Albany, NY. 122 p.

Docker, M.F. 2009. A review of the evolution of nonparasitism in lampreys and an update of the paired species concept. American Fisheries Society Symposium 72:71-114.

Docker, M.F., N. E. Mandrak and D.D. Heath. 2012 Contemporary gene flow between “paired” Silver (*Ichtyhmyzon unicuspis*) and Northern Brook (*I. fossor*) Lampreys: Implications for conservation. *Conservation Genetics* 13:823-835. (DOI 10.1007/s10592-012-0332-3.)

Dovel, W.L., A.W. Pekovitch and T.J. Bergren. 1992. Biology of the Shortnose Sturgeon (*Acipenser brevirostrum*) in the Hudson River estuary, New York. pp. 187-216. *In*: C.L. Smith (ed.). *Estuarine Research in the 1980s*. State University of New York Press. Albany, NY.

Driscoll, C.T., R.M. Newton, C.P. Gubala, J.P. Baker and S.W. Christensen. 1991. Adirondack Mountains. pp. 133-202. *In*: D.F Charles and S. Christie (eds.). Acidic deposition and aquatic ecosystems regional case studies. Springer-Verlag, New York.

Dudones, T.R. 1977. 1976 Lake Champlain New York International Joint Commission Fisheries Investigations, 1-April to 29-October. New York State Department of Environmental Conservation/Adirondack Lake Survey Corporation. Ray Brook, NY. 52 p.

Deuel, C.R. 1958. Splake in New York. *New York Conservationist* 12(6):13.

Dunning, D.J., J.T. Evans and M.J. Tarby. 1978. Baseline biological studies preparatory to the assessment of winter navigation: Fisheries data base on the St. Lawrence River. New York State Department Environmental Conservation. Watertown, NY. 144 p.

Dymond, J. R. 1922. A provisional list of the fishes of Lake Erie. University of Toronto Studies in Biology Series 20, Publications of the Ontario Fisheries Research Laboratory 4:57-73.

Dymond, J. R., J. L. Hart and A. L. Pritchard. 1929. The fishes of the Canadian waters of Lake Ontario. University of Toronto Studies Biological Series 33 Publication Ontario Fisheries Research Laboratory 37:1-35.

Eaton, E.H. 1928. The Finger Lakes fish problem. pp. 40-66. *In*: E. Moore (ed.). A Biological Survey of the Oswego River System. Supplemental to the Seventeenth Annual Report New York State Conservation Department (1927). Albany, NY.

Eaton, S.W. and L.P. Kardos. 1972. The fishes of Canandaigua Lake, 1971. Science Studies Saint Bonaventure University. Saint Bonaventure, NY.

Eaton, S.W., R.J. Nemecek and M.M. Kozubowski. 1982. Fishes of the Allegheny River above Kinzua Dam. *New York Fish and Game Journal* 29:189-198.

Edmunds, M.C. 1874. Obstructions in the tributaries of Lake Champlain. pp. 622-629. *In*: Report of the US Fish and Fisheries Commission (1872-73). Washington, DC.

Edwards, A.L. and S.K. Staton. 2009. Management plan for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker and Warmouth in Canada. Species at Risk Act Management Plan Series. Fisheries and Oceans Canada. Ottawa, ON. 43 p.

Einhouse, D.W., J.L. Markham, D.L. Zeller, R.C. Zimar, B.J. Beckwith and M.L. Wilkinson. 2005. Lake Erie Unit Annual Report (2004). New York State Department of Environmental Conservation. Albany, NY. 135 p.

Einhouse, D.W., J.L. Markham, D.L. Zeller, R.C. Zimar, B.J. Beckwith, M.L. Wilkinson. 2014. New York State Department of Environmental Conservation Lake Erie Unit 2013 Annual Report. New York State Department of Environmental Conservation. Albany, NY. 72 p.

Ellrott, B.J. and J.E. Marsden. 2004. Lake Trout reproduction in Lake Champlain. Transactions of the American Fisheries Society 133:252-264.

Eshenroder, R.L. 2009. Comment: Mitochondrial DNA analysis indicates Sea Lampreys are indigenous to Lake Ontario. Transactions of the American Fisheries Society 138:1178-1189.

Evans, T. E. and K. E. Limburg. 2014. The distribution of larval lamprey and their potential diet overlap with mayflies in the Hudson River. Section IX, pp. 1-53. *In*: S. H. Fernald, D. J. Yozzo and H. Andreyko (eds.). Final reports of the Tibor T. Polgar Fellowship Program, 2013. Hudson River Foundation. New York, NY.

Evermann, B.W. and E.E. Goldsborough. 1902. Notes on the fishes and mollusks of Lake Chautauqua, New York. pp. 169-175. *In*: United States Commission of Fish and Fisheries, Report for the Commissioner (1901).

Evermann, B. W. and W. C. Kendall. 1896. An annotated catalogue of the fishes known from the State of Vermont. pp. 579-604. *In*: United States Commission of Fish and Fisheries, Report for the Commissioner (1894).

Evermann, B.W. and W.C. Kendall. 1901. Notes on the fishes of Lake Ontario. pp. 479-488. *In*: Annual Report of the Forest Fish and Game Commission (1900). Albany, NY.

Evermann, B. W. and W. C. Kendall. 1902a. An annotated list of fishes known to occur in Lake Champlain and its tributaries. pp. 217-225. *In*: United States Commission of Fish and Fisheries, Report for the Commissioner (1901).

Evermann, B. W. and W. C. Kendall. 1902b. An annotated list of fishes known to occur in the Saint Lawrence River. pp. 227-240. *In*: United States Commission of Fish and Fisheries, Report for the Commissioner (1901).

Facey, D.E. 1998. Status of the Eastern Sand Darter (*Ammocrypta pellucida*) in Vermont. *Canadian Field Naturalist* 112:596-601.

Facey, D.E. and G.W. LaBar. 1989. A survey of the fishes of Vermont waters of the southern Lake Champlain basin. Technical Report 7. Vermont Fish and Wildlife Department. Waterbury, VT. 60 p.

Festa, P.J. 1989. Tiger Muskellunge catch reporting system, final report. New York State Department of Environmental Conservation. Albany, NY. 20 p.

Fetzner, J.W., Jr. and F.E. Rawlins. 2007. Molecular resolution of conservation challenges involving rare Pennsylvania fishes. Project No. T-32 Submitted to the Pennsylvania Fish and Boat Commission. Carnegie Museum of Natural History. Pittsburgh, PA. 65 p.

Fish, M.P. 1929. Contributions to the early life histories of Lake Erie fishes. pp. 76-95. *In*: E. Moore (ed.). A Biological Survey of the Erie-Niagara System. Supplemental to the Eighteenth Annual Report New York State Conservation Department (1928). Albany, NY.

Fish, M.P. 1932. Contributions to the early life histories of sixty-two species of fishes from Lake Erie and its tributary waters. Fisheries Bulletin 67:293-308.

Fischer, D.P. 2011. Life history aspects of the Burbot *Lota lota* (Linnaeus) in the upper Allegheny River. MS Thesis. Pennsylvania State University. University Park, PA. 114 p.

Fisher, J.P., J.D. Fitzsimons, G.F. Combs, Jr. and J.M. Spitsbergen. 1996. Naturally occurring thiamine deficiency causing reproductive failure in Finger Lakes Atlantic Salmon and Great Lakes Lake Trout. Transactions of the American Fisheries Society 125:167-178.

Fisheries Technical Committee Lake Champlain Fish and Wildlife Management Cooperative. 1999. A comprehensive evaluation of an eight year program of Sea Lamprey control in Lake Champlain. New York State Department of Environmental Conservation. Ray Brook, NY. 209 p.

Foster, J.R. 2014. Restoration of the Gilt Darter (*Percina evides*) in the lotic-benthic community of the Allegheny River, New York. Final report for State Wildlife Grant T-14-3, MOU – AMO7248. New York State Department of Environmental Conservation. Albany, NY. 84 p.

Fowler, H.W. 1907. Records of Pennsylvania fishes. *American Naturalist* 41:5-21.

Fowler, H.W. 1919. A list of fishes of Pennsylvania. Proceedings of the Biological Society of Washington 32:49-74.

Fowler, H.W. and J.G. Carlson. 1927. Fishes of McKean, Potter and Cameron Counties, Pennsylvania. Proceedings of the Biological Society of Washington 40:65-74.

Fraser, B.A., N.E. Mandrak and R.L. McLaughlin. 2005. Lack of morphological differentiation in Eastern (*Rhinichthys atratulus*) and Western (*Rhinichthys obtusus*) Blacknose Dace in Canada. *Canadian Journal of Zoology* 83:1502-1509.

Frisa, C.N. 1977 A strategic plan for an urban fishing program for Buffalo, New York. New York State Department of Environmental Conservation. Buffalo, NY. 43 p.

Gage, S.H. 1893. The Lake and Brook Lampreys of New York, especially those of Cayuga and Seneca Lakes. pp. 421-493 *In*: Some Former Students (eds.). *The Wilder Quarter-Century Book*. A collection of original papers dedicated to Professor Burt Green Wilder. Comstock Publishing Co. Ithaca, NY.

Gage, S.H. 1928. The lamprey of New York State – life history and economics, pp. 158-191 *In*: E. Moore (ed.). A Biological Survey of the Oswego River system. Supplemental to the Seventeenth Annual Report New York State Conservation Department (1927). Albany, NY.

Gallagher, J. and J. Baker. 1990. Current status of fish communities in Adirondack lakes. pp 3-11 to 3-44. *In*: Adirondack lakes survey: an interpretive analysis of fish communities and water chemistry, 1984-87. Adirondack Lakes Survey Corporation. Ray Brook, NY.

George, C.J. 1981a. The fishes of the Adirondack Park. New York State Department of Environmental Conservation. Albany, NY. 93 p.

George, C.J. 1981b. The fishes of the Lake George watershed. pp. 257-284. *In*: C. Boylen (ed.). The Lake George Ecosystem. Proceedings of the Lake George Research Symposium and Contributed Papers. Lake George Association. Lake George, NY.

George, C.J., R.A. Daniels and T.J. Sinnot. 1986. The importance of archives: fish illustrations of the 1926-39 watershed survey in New York State. *Fisheries* 11(6):2-11.

Gerstell, R. 1998. *American Shad in the Susquehanna River Basin*. Penn State University Press, University Park, PA. 217 p.

Gibbs, R.H. 1963. Cyprinid fishes of the subgenus *Cyprinella* of *Notropis*. The *Notropis whipplei-analostanus-chloristius* complex. *Copeia* 1963:511-528.

Gimenez Dixon, M. 1996. *Coregonus reighardi*. The IUCN Red List of Threatened Species. Version 2015.2. www.iucnredlist.org. http://www.iucnredlist.org/details/summary/5376/0

Goforth, R.R. and M.B. Bain. 1997. French Creek watershed aquatic biodiversity project, final report. Department of Natural Resources, Cornell University. Ithaca, NY. 302 p.

Gordon, W.H. and D. Richardson. 1995. Upper Raquette River impoundments, assessment and management of coolwater fish stocked, 1990-1994. New York State Department of Environmental Conservation. Watertown, NY. 69 p.

Gorsky, D., E. Trometer, G.R. Jacobs, J.A. Sweka, M.A. Webb and M. Talbott. 2013. Population assessment of Lake Sturgeon in the lower Niagara River, Lake Ontario Annual Report (2012). New York State Department of Environmental Conservation. Albany, NY. 9 p.

Gray, E.S.S., E.A. Kellogg and J.R. Stauffer, Jr. 2005. Habitat shift of a native darter *Etheostoma olmestedi* (Teleostei: Percidae) in sympatry with a non-native darter *Etheostoma zonale*. American Midland Naturalist 154:166-177.

Greeley, J.R. 1927. Fishes of the Genesee region with annotated list. pp. 47-66. *In*: E. Moore (ed.). A Biological Survey of the Genesee River system. Supplemental to the Sixteenth Annual Report New York State Conservation Department (1926). Albany, NY.

Greeley, J.R. 1928. A biological survey of the Oswego River system. pp. 84-107. *In*: E. Moore (ed.). A Biological Survey of the Oswego River System. Supplemental to the Seventeenth Annual Report New York State Conservation Department (1927). Albany, NY.

Greeley, J.R. 1929. Fishes of the Erie Niagara Watershed. pp. 150-179. *In*: E. Moore (ed.). A Biological Survey of the Erie-Niagara System. Supplemental to the Eighteenth Annual Report New York State Conservation Department (1928). Albany, NY.

Greeley, J. R. 1930. Fishes of the Lake Champlain watershed. pp. 48-87. *In*: E. Moore (ed.). A Biological Survey of the Champlain watershed. Supplemental to the Nineteenth Annual Report New York State Conservation Department (1929). Albany, NY.

Greeley, J.R. 1934. Fishes of the Raquette watershed with annotated list. pp. 53-108. *In*: E. Moore (ed.). A Biological Survey of the Raquette Watershed. Supplemental to the Twenty-third Annual Report New York State Conservation Department (1933). Albany, NY.

Greeley, J.R. 1935. Fishes of the watershed, with annotated list. pp. 63-159. *In*: E. Moore (ed.). A Biological Survey of Mohawk-Hudson watershed. Supplemental to the Twenty-fourth Annual Report New York State Conservation Department (1934). Albany, NY.

Greeley, J.R. 1936. Fishes of the area with annotated lists. pp. 45-88. *In*: E. Moore (ed.). A Biological Survey of the Delaware and Susquehanna watersheds. Supplemental to the Twenty-fifth Annual Report New York State Conservation Department (1935). Albany, NY.

Greeley, J.R. 1937. Fishes of the area with annotated list. pp. 45-103. *In*: E. Moore (ed.). A Biological Survey of the Lower Hudson watershed. Supplemental to the Twenty-sixth Annual Report New York State Conservation Department (1936). Albany, NY.

Greeley, J.R. 1938. Fishes of the area with annotated list. pp. 47-73. *In*: E. Moore (ed.). A Biological Survey of the Allegheny and Chemung Watersheds. Supplemental to the Twenty-seventh Annual Report New York State Conservation Department (1937). Albany, NY.

Greeley, J.R. 1939a. The freshwater fishes of Long Island and Staten Island with annotated list. pp. 29-44. *In*: E. Moore (ed.). A Biological Survey of the Freshwaters of Long Island. Supplemental to the Twenty-eighth Annual Report New York State Conservation Department (1938). Albany, NY.

Greeley, J.R. 1939b. Fishes and habitat conditions of the shore zone based on July and August seining investigations. pp 72-91. *In*: E. Moore (ed.). A Biological Survey of the Salt Waters of Long Island, 1938 Part II. Supplemental to the Twenty-eighth Annual Report New York State Conservation Department (1938). Albany, NY.

Greeley, J.R. 1940. Fishes of the watershed with annotated list. pp. 42-81. *In*: E. Moore (ed.). A Biological Survey of the Lake Ontario watershed. Supplemental to the Twenty-ninth Annual Report New York State Conservation Department (1939). Albany, NY.

Greeley, J.R. and C.W. Greene. 1931. Fishes of the St. Lawrence watershed, with annotated list. pp. 44-94. *In*: E. Moore (ed.). A Biological Survey of the St. Lawrence watershed. Supplemental to the Twentieth Annual Report New York State Conservation Department (1930). Albany, NY.

Greeley, J.R. and S.H. Bishop 1932. Fishes of the watershed with annotated list. pp. 54-92. *In*: E. Moore (ed.). A Biological Survey of the Oswegatchie and Black Rivers. Supplemental to the Twenty-first Annual Report New York State Conservation Department (1931). Albany, NY.

Greeley, J.R. and S.H. Bishop. 1933. Fishes of the upper Hudson watershed with annotated list. pp. 54-92. *In*: E. Moore (ed.). A Biological Survey of the Upper Hudson watershed. Supplemental to the Twenty-second Annual Report New York State Conservation Department (1931). Albany, NY.

Green, D. and S. Smith. 1976. Zooplankton, zoobenthos and fish populations in Canadarago Lake during initial stages of nutrient control. Technical Paper 48. New York State Department of Environmental Conservation. Albany, NY. 105 p.

Greene, C. W. 1930. The smelts of Lake Champlain. pp. 105-129. *In*: E. Moore (ed.) A biological survey of the Champlain watershed. Supplemental to the Nineteenth Annual Report New York State Conservation Department (1929). Albany, NY.

Greene, C.W., R.P. Hunter and W.C. Senning. 1931. Stocking policy for streams, lakes and ponds of the St. Lawrence systems. pp. 18-53. *In*: E. Moore (ed.) A biological survey of the Champlain watershed. Supplemental to the Nineteenth Annual Report New York State Conservation Department (1929). Albany, NY.

Greene, C.W., R.P. Hunter and W.C. Senning. 1932. Stocking policy for streams, lakes and ponds of the Oswegatchie and Black watershed. pp. 20-52. *In*: E. Moore (ed.). A Biological Survey of the Oswegatchie and Black Rivers. Supplemental to the Twenty-first Annual Report New York State Conservation Department (1931). Albany, NY.

Halnon, L. C. 1963. Historical survey of Lake Champlain's fishery. Vermont Fish and Game Job Completion Report F-1-R-10 Job 6. Essex Junction, VT. 96 p.

Hankinson, T. L. 1927. A preliminary survey of the fish life of Allegany State Park in 1921. Roosevelt Wildlife Bulletin 4:483-490.

Hankinson, T.L. 1923. The creek fish of western New York. *Copeia* 1923:29-33.

Hankinson, T.L. 1924. A preliminary report on a fish survey in western New York. Bulletin of the Buffalo Society of Natural Sciences 13:57-87.

Hansen, M.J. and C.W. Ramm. 1994. Persistence and stability of fish community structure in a southwest New York stream. *American Midland Naturalist* 132:52-67.

Haponski, A.E. and C.E. Stepien. 2014. A population genetic window into the past and future of the walleye *Sander vitreus*: relation to historic walleye and the extinct "blue pike" *S. v.* "*glaucus*". *BMC Evolutionary Biology* 14(133):1-21.

Haro, A., W. Richkas, K, Whalen, A. Hoar, W.-D. Busch, S. Lary, T. Brush and D. Dixon. 2000. Population decline of the American Eel: Implications for research and management. *Fisheries* 25(9):7-16.

Hartel, K.E., D.B. Halliwell and A.E. Launer. 2002. Inland Fishes of Massachusetts. Massachusetts Audubon Society. Lincoln, MA. 328 p.

Hayes, J. 2000. Summary of Lake Sturgeon research efforts in the Saint Lawrence and Grass River systems. p. 9-10. *In*: T. Brooking (ed.). Update of Lake Sturgeon in New York State Waters 2000, Workshop Abstracts and Meeting Summary. Bridgeport, NY.

HDT/DTA 2010. Oswegatchie River hydroelectric project (FERC no. 2713). Draft Fisheries Study. Erie Boulevard Hydropower LP. Potsdam NY. 153 p.

Heard, R.M., W.E. Sharpe, R.F. Carline and W.G. Kimmel. 1997. Episodic Acidification and Changes in Fish Diversity in Pennsylvania Headwater Streams. Transactions of the American Fisheries Society 126:977-984.

Herbert, P.J. 2010. Walleye (*Sander vitreus*) stock assessment (2006-2007) in the Buffalo River, NY, USA. MS Thesis, State University of New York Brockport, Brockport, NY. 82 p.

Herbst, S.J. and J.E. Marsden. 2011. Lake Whitefish in Lake Champlain after commercial fishery closure and ecosystem changes. *North American Journal of Fisheries Management* 31:1106-1115.

Hocutt, C.H., R.E. Jenkins and J.R. Stauffer, Jr. 1986. Zoogeography of the fishes of the central Appalachians and central Atlantic coastal plain. pp. 161-211. *In*: C.H. Hocutt and E.O. Wiley (eds.). *The zoogeography of North American Freshwater Fishes*. John Wiley and Sons, New York.

Hoyle, J.A., 2005. Status of Lake Whitefish (*Coregonus clupeaformis*) in Lake Ontario and the response to the disappearance of *Diporeia* spp. pp 47-66. *In*: Mohr, L.C. and T.F. Nalepa (eds.). Proceedings of a workshop on the dynamics of Lake Whitefish (*Coregonus clupeaformis*) and the amphipod *Diporeia* spp. in the Great Lakes: Great Lakes Fishery Commission Technical Report 66. Ann Arbor, MI.

Hubbs, C.L 1919. Nomenclatural notes on the cottoid fishes of Michigan. Occasional Papers of the University of Michigan 65:1-9.

Hubbs, C.L. 1926. A checklist of the fishes of the Great Lakes and tributary waters, with nomenclatorial notes and analytical keys. Miscellaneous Publications of the University of Michigan Museum of Zoology 15. 77 p.

Hubbs, C.L. 1931. *Parexoglossum laurae*, a new cyprinid fish from the upper Kanawha River system. Occasional Papers of the Museum of Zoology University of Michigan 234:1-12.

Hubbs, C.L. and T.E.B. Pope. 1937. The spread of Sea Lamprey through the Great Lakes. Transactions of the American Fisheries Society 66:172-176.

Hughes, T.C. 2002. Population characteristics, habitats and movements of Lake Sturgeon (*Acipenser fulvescens*) in the lower Niagara River. MS Thesis, State University of New York Brockport, NY. 175 p.

Hulbert, P.J. 1987. Secondary TFM application report for Cayuga Inlet treatment in 1986. Bureau of Fisheries, New York State Department of Environmental Conservation. Albany, NY. 13 p.

Jackson, J.R., D.M. Carlson and R.A Daniels. 2014. Distribution of stream fishes in New York: a comparison of historic and modern surveys, Draft Report. Cornell University. Ithaca, NY.

Jackson, J.R., A. J. Van DeValk, J. L. Forney, B.F. Lantry, T.E. Brooking and L. G. Rudstam. 2008. Long-term trends in Burbot abundance in Oneida Lake, New York: life at the southern edge of the range in an era of climate change. American Fisheries Society Symposium 59: 131-152.

Jacobs, R.P. and E.B. O'Donnell. 2009. A pictorial guide to freshwater fishes of Connecticut. Connecticut Department of Environmental Protection Bulletin 42. 242 p.

Jenkins, R.E. 1970. Systematic studies of the catostomid fish tribe Moxostomatini. PhD Dissertation. Cornell University. Ithaca, NY. 800 p.

Johnson, J.H., C.C. Nack and J.E. McKenna Jr. 2010. Migratory salmonid redd habitat characteristics in the Salmon River, New York. *Journal of Great Lakes Research* 36:387-392.

Jolliff, T.M. and T.H.Eckert. 1971. Evaluation of present and potential sturgeon fisheries of the Saint Lawrence River and adjacent waters. New York State Department of Environmental Conservation. Cape Vincent, NY. 108 p.

Jordan, D.S. 1929. Manual of the vertebrate animals of the northeastern United States, inclusive of marine species. 13th Ed. World Book Co. New York, NY. xxxi + 446 p.

Jordan, S.M., R.M. Neumann and E.T. Schultz. 2004. Distribution, habitat use, growth and condition of a native and an introduced catfish species in the Hudson River estuary. *Journal of Freshwater Ecology* 19:59-67.

Juet, R. 1909. From "The Third Voyage of Master Henry Hudson," by Robert Juet, 1609. pp. 16-29. *In*: J.F. Jameson (ed.). *Narratives of New Netherland, 1609-1664*. Charles Scribner's Sons, New York.

Kahnle, A. W., K. A. Hattala and K. McKown. 2007. Status of Atlantic Sturgeon of the Hudson River estuary, New York, USA. pp. 347-363. *In*: J. Munro, D. Hatin, K. McKown, J. Hightower, K. Sulak, A. Kahnle and F. Caron (eds.). Proceedings of the symposium on anadromous sturgeon: Status and trend, anthropogenic impact, and essential habitat. American Fisheries Society Symposium 56.

Kapuscinski, K.L. and J.M. Farrell. 2012. First record of abundant Rudd populations in North America. *North American Journal of Fisheries Management* 32:82-86.

Kasper, J.B. 1994. The Delaware River and its Fisheries. J.B. Kasper, Morrisville, PA. 151 p.

Keller, D.H. 2011. Population characteristics of White Catfish and Channel Catfish in the Delaware River estuary. pp. 423-436. *In*: P.H. Michaletz and V.H. Travnichek (eds.). *Conservation, ecology, and management of catfish: The second international symposium*. American Fisheries Society Symposium 77. Bethesda, MD.

Keller, W.T. 1979. Management of wild and hybrid Brook Trout in New York lakes, ponds and coastal streams. New York State Department of Environmental Conservation. Albany, NY. 45 p.

Kendall, W.C. 1924. The status of fish culture in our inland public waters and the role of investigations in the maintenance of fish resources. Roosevelt Wildlife Bulletin 2:205-351.

Kendall, W.C. and W.A. Dence. 1929. The fishes of the Cranberry Lake Region. Roosevelt Wildlife Bulletin 5:219-309.

Kleinschmidt. 2007. Saint Lawrence—FDR Power Project, FERC no. 2000. 2007 Survey of American Eel in the tailwater of the International Saint Lawrence Power Project, Final Report. New York Power Authority, White Plains, NY.

Klindt, R.M. 2007. 2006 Lake St. Lawrence warmwater fisheries assessment. pp. 7-1 to 7-11. *In*: 2006 Annual Report of the Lake Ontario Committee and the Great Lakes Fishery Commission. New York State Department of Environmental Conservation. Albany, NY.

Klindt, R.M. and R. Adams. 2006. 2005 Lake sturgeon spawning activity in the lower Black River. pp. 21-1 – 21-5. *In*: 2005 Annual Report of the Lake Ontario Committee and the Great Lakes Fishery Commission. New York State Department of Environmental Conservation. Albany, NY.

Koelz, W. 1929. Coregonid fishes of the Great Lakes. Bulletin of the U.S. Bureau of Fisheries 43(2):297-643.

Kozlowski, G. 2001. Mud Creek brook trout. New York State Department of Environmental Conservation. Stony Brook, NY. 4 p.

Kraczkowski, M.L. and B. Chernoff. 2014. Molecular phylogenetics of the Eastern and Western Blacknose Dace, *Rhinichthys atratulus* and *R. obtusus* (Teleostei: Cyprinidae). *Copeia* 2014:325-338.

Lachance, S. 2001. Rapport sur la situation du brochet d'amerique *Esox americanus americanus*, au Canada. *Canadian Field-Naturalist*. 115:597-607.

Lake Erie Standing Technical Committee and Task Group Chairmen. 1990. Lake Erie State of the Lake Report. New York State Department of Environmental Conservation, Albany, NY. 18 p.

Langdon, R. W., M. T. Ferguson, and K. M. Cox. 2006. Fishes of Vermont. Vermont Department of Fish and Wildlife. Waterbury, VT. 320 p.

Lange, R.E. 1983. Fishing in the Big Apple: A demonstration program for New York City. pp. 263-274. *In*: L.J. Allen (ed.). Urban Fishing Symposium Proceedings. American Fisheries Society, Bethesda, MD.

Lange, R.E. 1984. Fisheries management plan for New York waters of Lake Erie, 1984-1990. New York State Department of Environmental Conservation. Albany, NY. 105 p.

Lantry, B.F., R. O'Gorman, M.G. Walsh, J.M. Casselman, J.A Hoyle, M.J. Keir and J.R. Lantry. 2007. Reappearance of Deepwater Sculpin in Lake Ontario: Resurgence or last gasp of a doomed population? *Journal of Great Lakes Research* 33. Supplement 1:34-45.

Lantry, J.R. 2012. Eastern basin of Lake Ontario warmwater fisheries assessment, 1976-2011. pp. 4-1 – 4-24. *In*: 2011 Annual Report of the Lake Ontario Committee and the Great Lakes Fishery Commission. New York State Department of Environmental Conservation. Albany, NY.

Lark, J.G.F. 1973. An early record of the Sea Lamprey *Petromyzon marinus* from Lake Ontario. *Journal of the Fisheries Research Board of Canada*. 30:131-133.

Larson, G.L., G.C. Christie, D. A. Johnson, J. F. Koonce, K. M. Mullett, and W.P. Sullivan. 2003. The history of Sea Lamprey control in Lake Ontario and updated estimates of suppression targets: Sea Lamprey International Symposium. *Journal of Great Lakes Research* 29: 637-654.

La Violette, N., D. Fournier, P. Dumont and Y. Mailhot. 2003. Caracterisation des communautes de posssons et developpement d'un indices d'integrite biotique pour le Fleuve Saint-Laurent, 1995-1997. Societe de al faune et des parcs du Quebec, Direction de la recherché sur la faune. 237 p.

Lawrie, A.H. 1970. The Sea Lamprey in the Great Lakes. Transactions of the American Fisheries Society 99:766-775.

Leckvarcik, L.G. 2001. Life history of the Ironcolor Shiner, *Notropis chalybaeus* (Cope), in Marshalls Creek, Monroe County, Pennsylvania. MS Thesis, Pennsylvania State University. University Park, PA.

Leckvarcik, L.G. 2006. Restoration of the Pennsylvania-endangered Bridle Shiner *Notropis bifrenatus* (Cope) and Ironcolor Shiner *Notropis chalybaeus* (Cope) in Brodhead Creek watershed, Monroe County. PhD Dissertation. Pennsylvania State University. University Park, PA. 133 p.

Lee, D.S., C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister and J.R. Stauffer, Jr. 1980. *Atlas of North American freshwater fishes*. North Carolina State Museum of Natural History. Raleigh, NC. 854 p.

Lesueur, C.A. 1817. Description of a new species of the genus *Cyprinus*. Journal of the Academy of Natural Science, Philadelphia. 1(1):85-86.

Liegey, F., E.H. Donahun and S.W. Eaton. 1955. The fishes of Olean Creek, Cattaraugus County, New York. Science Studies Saint Bonaventure University 17:5-25.

Limburg, K.E., K.A. Hattala, A.W. Kahnle and J.R. Waldman. 2006. Fisheries of the Hudson River. pp. 189-204. *In*: J.S. Levinton and J.R. Waldman (eds.). *Hudson River Estuary*. Cambridge University Press. Cambridge.

Limburg, K.E., K.M. Stainbrook, J.D. Erickson and J.M. Gowdy. 2005. Urbanization consequences: case studies in the Hudson Valley. pp. 23-37. *In*: L.R. Brown, R.H. Gray, R.M. Hughes and M. Meador (eds.). The effects of urbanization on stream ecosystems. American Fisheries Society Symposium 47. Bethesda, MD.

Limburg, K.E. and J.R. Waldman. 2009. Dramatic declines in North Atlantic diadromous fishes. BioScience 59: 955-965.

Loukmas, J. 2013. New York State Sauger Management Plan. New York State Department of Environmental Conservation. Albany, NY. 23 p.

Machut, L.S., K.E. Limburg, R.E. Schmidt and D.E. Dittman. 2007. Anthropogenic impacts on American Eel demographics in Hudson River tributaries, New York. Transactions of the American Fisheries Society 136:1699-1713.

Machut, L.S., D.E. Dittman and J.H. Johnson. 2009. Hudson River drainage: American Eel history, status, and management options. State Wildlife Grant Project. US Geological Survey. Cortland, NY. 128 p.

MacKenzie, C. 2008. Restoration of Lake Sturgeon, Lake Champlain fisheries restoration management. Federal Aid Report F-35-R-10 July 1, 2003 to June 30, 2008. Vermont Fisheries and Wildlife Department, Annual Report. Montpelier, VT. 8 p.

Makarewicz J.C. 1983. Champlain Canal fish survey, New York State Barge Canal—Data Report to Malcolm Pirnie, Inc. Department of Biological Sciences, State University of New York Brockport. Brockport, NY. 242 p.

Malaty, P. 2014. A comparison of historic (1938) and current (2010) Long Island nearshore estuarine fish communities. MA Thesis. Queens College of City University of New York. Flushing, NY. 95 p.

Malick, R.W., Jr. 1978. The Mimic Shiner, *Notropis volucellus* (Cope), in the Susquehanna River drainage of Pennsylvania. Proceedings of the Pennsylvania Academy of Science 52:199-200.

Mandrak, N.E., and E.J. Crossman. 1992. Postglacial dispersal of freshwater fishes into Ontario. *Canadian Journal of Zoology* 70:2247-2259.

Mandrak, N.E. and E.J. Crossman. 1996. The status of the Lake Chubsucker, *Erimyzon succeta*, in Canada. *Canadian Field Naturalist* 110:478-482.

Marsden, J.E, R.W. Langdon and S.P. Good. 2000. First occurrence of the Brook Silverside, *Labidesthes sicculus* (Cope), in New England. *Northeastern Naturalist* 7:248-254.

Marsden, J.E. and M. Hauser. 2009. Exotic species in Lake Champlain. *Journal of Great Lakes Research* 35:250-265.

Marsden, J.E. and R.W. Langdon. 2012. The history and future of Lake Champlain's fishes and fisheries. *Journal of Great Lakes Research* 38:19-34.

Marson, D., N.E. Mandrak and D.A.R. Drake. 2009. Targeted sampling of fish species at risk in Lyons and Tea Creeks, 2004. Canadian Manuscript Report of Fisheries and Aquatic Sciences. 2910: iv + 18 p.

Mather, F. 1886. Memoranda relating to Adirondack fishes with descriptions of new species from researches made in 1882. State of New York Adirondack Survey Appendix to the Twelfth Report (Zoology) 1886. 56 p.

McBride, N.D. 2002. Radiotelemetry study of trout movements in the Delaware tailwaters and the Beaver Kill: 1995-1997. New York State Department of Environmental Conservation. Stamford, NY. 43 p. + tables, figures and appendix.

McBride, N.D. and D.K. Sanford. 1997. An interim fish management plan for Otsego Lake. New York State Department of Environmental Conservation. Stamford, NY.

McCullough, R.D. and J.J Hart. 2007. 2006 Lake St. Lawrence warmwarter fisheries assessment. pp. 6-1 to 6-12. *In*: 2006 Annual Report of the Lake Ontario Committee and the Great Lakes Fishery Commission. Watertown, NY.

McCullough, R.D. and J.J. Hart. 2010. Evaluation of Black River fish kill and recovery. New York State Department of Environmental Conservation. Watertown, NY. 14 p.

McCusker, M.R and N.E. Mandrak. 2014. Population structure and conservation genetic assessment of the endangered Pugnose Shiner, *Notropis anogenus*. *Conservation Genetic*s 15:343-353.

McCusker, M.R., N.E. Mandrak, S. Doka, E.L. Gertzen, J.F. van Wieren, J.E. McKenna, D.M. Carlson and N.R. Lovejoy. 2014. Estimating the distribution of the imperiled Pugnose Shiner (*Notropis anogenus*) in the Saint Lawrence River using a habitat model. *Journal of Great Lakes Research* 40:980-988. http://dx.doi.org/10.1016/j.jglr.2014.09.014

McKenna, J.E. 2003. Biological structure and dynamics of the fish assemblages in the tributaries of eastern Lake Ontario. pp. 443-473. *In*: M. Munawar (ed.). *State of Lake Ontario (SOLO): Past, present and future*. Backhuys Publishers, The Netherlands.

McKeown, P. 1984. Additions to ichthyofauna of the Susquehanna River with a checklist of fishes of the Susquehanna River drainage below Conowingo Dam. Proceedings of the Pennsylvania Academy of Sciences 58:187-192.

McKeown, P. 2000. Fisheries. pp. 12-1 to 12-41. *In*: M.P. Wilson, K.D. Riforgiat and W.T. Boria (eds.). Chautauqua Lake—Entering the 21st Century: State of the Lake Report. Chautauqua County Department of Planning and Development. Jamestown, NY.

McKinley, D.L. 2005. James Eights (1798-1882): Antarctic Explorer, Albany Naturalist, His Life, His Times, His Works. New York State Museum Bulletin 505. Albany, NY. 455 p.

Mearns, E.A. 1898. A study of the vertebrate fauna of the Hudson Highlands, with observations on the Mollusca, Crustacea, Lepidoptera, and the flora of the region. Bulletin of the American Museum of Natural History 10:303–352.

Meek, S.E. 1889. Notes on fishes of Cayuga Lake basin. Annals of the New York Academy of Sciences 4:297-316.

Mikol, G.F. and W.F. Hadley. 1979. Evidence of successful reproduction of Coho Salmon in a New York tributary of Lake Erie. *New York Fish and Game Journal* 26:97-98.

Miller, R.R. 1957. Origin and dispersal of the Alewife, *Alosa pseudoharengus*, and Gizzard Shad, *Dorosoma cepedianum*, in the Great Lakes. Transactions of the American Fisheries Society 86:97-111.

Mills, E.L., J.M. Casselman, R. Dermott, J.D. Fitzsimons, G. Gal, K.T. Holeck, J.A. Hoyle, O.E. Johannsson, B.F. Lantry, J.C. Makarewicz, E.S. Millard, I.F. Munawar, M. Munawar, R. O'Gorman, R.W. Owens, L.G. Rudstam, T. Schaner and T.J. Stewart. 2003. Lake Ontario: food web dynamics in a changing ecosystem (1970-2000). *Canadian Journal of Fisheries and Aquatic Sciences* 60:471-490.

Mills, E.L., M.D. Scheuerell, J.T. Carlton and D.L. Strayer. 1997. Biological invasions in the Hudson River basin. New York State Museum Circular 57. Albany, NY. 51 p.

Mongeau, J.R. 1979. Lake Saint Francis fish survey in Huntington and Vaudreaul-Soulanges Counties, sport and commercial fishing, Muskellunge stocking 1963-1977. Quebec Ministry of Tourism and Fisheries Technical Report 06-25. 120 p.

Moore, E. (editor). 1927. A biological survey of the Genesee River system. Supplemental to the Sixteenth Annual Report of the New York State Conservation Department (1926). Albany, NY.

Moore, E. (editor). 1928. A biological survey of the Oswego River system. Supplemental to the Seventeenth Annual Report of the New York State Conservation Department (1927). Albany, NY.

Moore, E. (editor). 1929. A biological survey of the Erie-Niagara system. Supplemental to the Eighteenth Annual Report of the New York State Conservation Department (1928). Albany, NY.

Moore, E. (editor). 1930. A biological survey of the Champlain watershed. Supplemental to the Nineteenth Annual Report of the New York State Conservation Department (1929). Albany, NY.

Moore, E. (editor). 1931. A biological survey of the Saint Lawrence watershed. Supplemental to the Twentieth Annual Report of the New York State Conservation Department (1930). Albany, NY.

Moore, E. (editor). 1932. A biological survey of the Oswegatchie and Black river systems. Supplemental to the Twenty-first Annual Report of the New York State Conservation Department (1931). Albany, NY.

Moore, E. (editor). 1933. A biological survey of the upper Hudson watershed. Supplemental to the Twenty-second Annual Report of the New York State Conservation Department (1932). Albany, NY.

Moore, E. (editor). 1934. A biological survey of the Raquette watershed. Supplemental to the Twenty-third Annual Report of the New York State Conservation Department (1923). Albany, NY.

Moore, E. (editor). 1935. A biological survey of the Mohawk-Hudson watershed. Supplemental to the Twenty-fourth Annual Report of the New York State Conservation Department (1934). Albany, NY.

Moore, E. (editor). 1936. A biological survey of the Delaware and Susquehanna watersheds. Supplemental to the Twenty-fifth Annual Report of the New York State Conservation Department (1935). Albany, NY.

Moore, E. (editor). 1937. A biological survey of the lower Hudson watershed. Supplemental to the Twenty-sixth Annual Report of the New York State Conservation Department (1936). Albany, NY.

Moore, E. (editor). 1938. A biological survey of the Allegheny and Chemung watersheds. Supplemental to the Twenty-seventh Annual Report of the New York State Conservation Department (1937). Albany, NY.

Moore, E. (editor). 1939a. A biological survey of the fresh waters of Long Island. Supplemental to the Twenty-eighth Annual Report of the New York State Conservation Department (1938). Albany, NY.

Moore, E. (editor). 1939b. A biological survey of the salt waters of Long Island, Parts I and II. Supplemental to the Twenty-eighth Annual Report of the New York State Conservation Department (1938). Albany, NY.

Moore, E. (editor). 1940. A biological survey of the Lake Ontario watershed. Supplemental to the Twenty-ninth Annual Report of the New York State Conservation Department (1939). Albany, NY.

Moreau, D.A., D.L. Parrish and T. Wiggins. 1993. Lake Champlain Lake Sturgeon restoration study. Vermont Cooperative Fish and Wildlife Research Unit, University of Vermont. Burlington, VT. 123 p.

Morse, R.S. 2007. The rediscovery of a species: The redescription, biogeography, and ecology of the Summer Sucker, *Catostomus utawana*. PhD Dissertation. State University of New York, College of Environmental Science and Forestry. Syracuse, NY. 103 pp.

Morse, R.S. and R.A. Daniels. 2009. A Redescription of *Catostomus utawana* (Cyrpiniformes: Catostomidae). *Copeia* 2009:214-220.

Morse, R.S., B.R. Weatherwax and R.A. Daniels. 2009. Rare fishes of the Allegheny River and Oswayo Creek. Final report to New York State Wildlife Grants, Grant T-5, Study 2. New York State Museum. Albany, NY. 30 p.

Needham, J. G., C. Juday, E. Moore, C. Sibley and J. Titcomb. 1922. Biological survey of Lake George, N.Y. New York State Conservation Department. J. B. Long Co., Printers. Albany, NY. 78 pp.

Neely, D.A. and A. L. George. 2006. Range extensions and rapid dispersal of *Etheostoma blennioides* (Teleostei: Percidae) in the Susquehanna River drainage. *Northeastern Naturalist* 13:391-402.

Nelson, J. 1890. Descriptive catalogue of the vertebrates of New Jersey. Final Report of the State Geologist 2:489-824.

Nemecek, R.J. 1980. Comparative ecology of three species of darters in the genus *Etheostoma: Etheostoma variatum* (Kirtland), *Etheostoma caeruleum* (Storer) and *Etheostoma zonale* (Cope) in the Allegheny River drainage of western New York. PhD Dissertation. Saint Bonaventure University. Saint Bonaventure, NY. 153 p.

Nepszy, S.J. 1999. The changing fishery regime in Lake Erie. pp. 233-239. *In*: M. Munawar and T. Edsall (eds.). State of Lake Erie (SOLE) – past, present and future. Ecovision World Monograph Series. Backhuys, The Netherlands.

Neth, P.C. 1955. Assessment of a control program for Common Whitefish (*Coregonus clupeaformis*) and Round Whitefish (*Prosopium quadrilaterale*) in Little Moose Lake, New York. MS Thesis. Cornell University. Ithaca, NY. 101 p.

Neth, P.C. and G. Barnhart 1983. Landlocked salmon, its life cycle, its history, its management. *New York Conservationist* 38:24-35.

Nettles, D.C., C.D. Martin and N.R. Staats. 2005. South Bay, Lake Champlain Walleye and Sauger assessments, 2003-2004 (draft). US Fish and Wildlife Service, New York State Department of Environmental Conservation. Ray Brook, NY. 22 p.

New York Power Authority. 2001. Summary report for the fish survey conducted in the upper and lower Niagara River during the year 2001. New York Power Authority. New York. 40 p. + tables

Niagara Mohawk Power Corporation. 1991a. Black River Hydroelectric Project. Application for Major License FERC Project No. 2569. Syracuse, NY.

Niagara Mohawk Power Corporation. 1991b. Lower Raquette River Hydroelectric Project. Application for Major License FERC Project No. 2330. Syracuse, NY.

Niagara Mohawk Power Corporation. 1991c. Middle Raquette River Hydroelectric Project. Application for Major License FERC Project No. 2320. Syracuse, NY.

Niagara Mohawk Power Corporation. 1999. Upper Raquette River Hydroelectric Project. Application for Major License FERC Project No. 2084. Syracuse, NY.

Normandeau Associates, Inc. 1995. St. Lawrence-FDR Power Project, 1994 fishery survey. New York Power Authority. White Plains, NY.

Normandeau Associates, Inc. 2007. A general fish community study of the Grass River near Massena, NY in 2007. Town of Massena Electric Department, Massena NY.

Odell, T.T. 1932. Lakes of the Oswegatchie and Black River systems. pp. 94-119. *In*: E. Moore (ed.). A Biological Survey of the Oswegatchie and Black Rivers. Supplemental to the Twenty-first Annual Report New York State Conservation Department (1931). Albany, NY.

Odell, T.T. 1933. Lakes of the upper Hudson watershed. pp. 102-129. *In*: E. Moore (ed.). A Biological Survey of the Upper Hudson watershed. Supplemental to the Twenty-second Annual Report New York State Conservation Department (1931). Albany, NY.

Odell, T.T. 1935. The lakes of the Mohawk River drainage basin. pp. 102-137. *In*: E. Moore (ed.). A Biological Survey of Mohawk-Hudson watershed. Supplemental to the Twenty-fourth Annual Report New York State Conservation Department (1934). Albany, NY.

Odell, T.T. 1940. Bays and ponds of the shore area. pp. 82-97. *In*: E. Moore (ed.). A Biological Survey of the Lake Ontario watershed. Supplemental to the Twenty-ninth Annual Report New York State Conservation Department (1939). Albany, NY.

Odell, T.T. and W.C. Senning. 1936. Lakes and ponds of the Delaware and Susquehanna watersheds. pp. 89-121. *In*: E. Moore (ed.). A Biological Survey of the Delaware and Susquehanna watersheds. Supplemental to the Twenty-fifth Annual Report New York State Conservation Department (1935). Albany, NY.

Odell, T.T. and W.C. Senning. 1937. Lakes and ponds of the Lower Hudson area. pp. 104-123. *In*: E. Moore (ed.). A Biological Survey of the Lower Hudson watershed. Supplemental to the Twenty-sixth Annual Report New York State Conservation Department (1936). Albany, NY.

Odell, T.T. and W.C. Senning. 1938. Lakes and ponds of the Allegheny and Chemung watersheds. pp. 74-101. *In*: E. Moore (ed.). A Biological Survey of the Allegheny and Chemung Watersheds. Supplemental to the Twenty-seventh Annual Report New York State Conservation Department (1937). Albany, NY.

Oglesby, R. T. 1978. The Limnology of Cayuga Lake. pp. 1-120. *In*: J.A. Bloomfield (ed.). *Lakes of New York State*. Volume 1 Ecology of the Finger Lakes. Academic Press, New York.

O'Gorman, R. and J.A. Burnett. 2001. Fish community dynamics in northeastern Lake Ontario, with emphasis on growth and reproductive success of Yellow Perch (*Perca flavescens*) and White Perch (*Morone americana*) 1978 to 1997. *Journal of Great Lakes Research* 27:367-383.

O'Gorman, R., J.H. Elrod and C.P. Schenider. 1998. Reproductive potential and fecundity of Lake Trout strains in southern and eastern waters of Lake Ontario, 1977-92. *Journal of Great Lakes Research* 24:131-144.

Oldenburg, K., M.A. Stapanian, P.A. Ryan and E. Holm. 2007. Potential strategies for recovery of Lake Whitefish and Lake Herring stocks in Eastern Lake Erie. *Journal of Great Lakes Research* 33 (Supplement 1):46-58. http://dx.doi.org/10.3394/0380-1330(2007)33[46:PSFROL]2.0.CO;2

Ontario Ministry of Natural Resources. 2004. Lake Ontario fish communities and fisheries: 2003. Annual report of the Lake Ontario Management Unit. Ontario Ministry of Natural Resources, Picton, Ontario. 114 p.

Owens, R.W. and R.A. Bergstedt. 1994. Response of Slimy Sculpins to predation by juvenile Lake Trout in southern Lake Ontario. Transactions of the American Fisheries Society 123:28-36.

Owens, R.W., R. O'Gorman, E.L. Mills, L.G. Rudstam, J.J. Hassee, B.H. Kulik and D.B. MacNeill. 1998. Blueback Herring (*Alosa aestivalis*) in Lake Ontario: First record, entry route and colonization potential. *Journal of Great Lakes Research* 24:723-730.

Owens, R.W., R. O'Gorman, T.H. Eckert and B.F. Lantry. 2003. The offshore fish community in southern Lake Ontario, 1972-1998. pp. 407-442. *In*: M. Munawar (ed.). *State of Lake Ontario (SOLO): Past, present and future*. Backhuys Publishers, The Netherlands.

Page, L.M. and B.M. Burr. 1991. *A field guide to freshwater fishes: North America north of Mexico*. Houghton Mifflin Harcourt. Boston, MA. 432 p.

Page, L.M., H. Espinosa-Perez, L.T. Findley, C.R. Gilbert, R.N. Lea, N.E. Mandrak, R.L. Mayden and J.S. Nelson. 2013. Common and scientific names of fishes from the United States, Canada and Mexico, Seventh Edition. American Fisheries Society Special Publication 34. Bethesda, MD.

Panek, F.M. 1978. Summary of 1976-77 biological surveys and cooperative angler census of the Black River (Draft Report). New York State Department of Environmental Conservation. Watertown, NY. 14 p.

Parsons, J.W. 1973. History of salmon in the Great Lakes 1850-1970. US Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife Technical Paper 68. 80 p.

Pasko, D.G. 1957. Carry Falls Reservoir investigation. *New York Fish and Game Journal* 4:1-31.

Patch, S.P., D.N. Busch, T.D. Schwartz and T.H. McCartney. 1984. The Saint Lawrence River–past and present, a review of historical natural resource information and habitat changes in the International Section of the Saint Lawrence River. US Army Corps of Engineers. Buffalo, NY.

Pennuto, C.M., P.J. Krakowiak and C.E. Janik. 2010. Seasonal abundance, diet and energy consumption of Round Gobies (*Neogobius melanostomus*) in Lake Erie tributary streams. *Ecology of Freshwater Fish* 19:1-10.

Perkins, D.L., C. Krueger and B. May. 1993. Heritage Brook Trout in Northeastern USA: genetic variability within and among populations Transactions of the American Fisheries Society. 122:515-532.

Perkins, D.L., J.D. Fitzsimons, J.E. Marsden, C.C. Krueger and B. May. 1995. Differentiation in reproduction among hatchery strains of Lake Trout at eight spawning areas in Lake Ontario: Genetic evidence for mixed-stock analysis. *Journal of Great Lakes Research* 21 (Supplement 1):364-374.

Perlmutter, A. 1939. An ecological survey of young fish and eggs identified from tow-net collections. pp. 11-91. *In*: E. Moore (ed.). A Biological Survey of the Salt Waters of Long Island, 1938 Part II. Supplemental to the Twenty-eighth Annual Report New York State Conservation Department (1938). Albany, NY.

Pfeiffer, M.H. 1979. Comprehensive plan for fish resource management within the Adirondack zone. New York State Department of Environmental Conservation. Albany, NY. 207 p.

Pfeiffer, R.A. 1942. Some observations on the spawning habits of the Western Blacknose Dace. Science Studies Saint Bonaventure University 10:17.

Pfeiffer, R.A. 1955. Studies on the life history of the Rosyface Shiner *Notropis rubellus*. *Copeia* 1955: 95-104.

Plosila, D.S. 1977a. A lake trout management plan for New York State. New York State Department of Environmental Conservation. Albany, NY. 68 p.

Plosila, D.S. 1977b. Relationship of strain and size at stocking to survival of Lake Trout in Adirondack lakes. *New York Fish and Game Journal* 24:1-24.

Plosila, D.S. and J. Anderson. 1985. Lake Champlain salmonid assessment report. Technical report prepared for Lake Champlain Fish and Wildlife Management Cooperative. New York State Department of Environmental Conservation, Vermont Agency for Environmental Conservation. Albany, NY 126 p.

Plosila, D.S. and G.W. LaBar. 1981. Occurrence of juvenile Blueback Herring in Lake Champlain. *New York Fish and Game Journal* 28:118.

Plosila, D. S. and L. Nashett. 1987. Occurrence of White Perch in Lake Champlain. New York State Department of Environmental Conservation. Ray Brook, NY.

Plosila, D.S., T.M. Jolliff, J. Gersmehl and P.C. Neth. 1986. Draft environmental impact statement on use of lampricide in a temporary program of Sea Lamprey control in Lake Champlain with an assessment of effects on certain fish populations and sportfisheries. New York State Department of Environmental Conservation. Albany, NY. 372 p.

Pomeroy, J.K. 1995. The 1993 fisheries study of Conewango Creek. New York State Department of Environmental Conservation. Olean, NY. 35 p.

Poos, M., A.J. Dextrase, A.N. Schwalb and J.D. Ackerman. 2010. Secondary invasion of the Round Goby into high diversity Great Lakes tributaries and species at risk hotspots: Potential new concerns for endangered freshwater species. *Biological Invasions* 12:1269-1284.

Preall, R.J. 1997. Schroon Lake (UH-P374) management report (1997). New York State Department of Environmental Conservation. Ray Brook, NY. 47 p.

Preist S.J.L., C. Lowie, E. Kozuchowski and E.A. Poole. 1994. Fisheries enhancement plan for the Raquette River, New York, tributary to the St. Lawrence River. US Fish and Wildlife Service. Amherst, NY. 58 p.

Prindle, S.E. and D.L. Bishop. 2012. Fall 2011 Lake Ontario tributary angler survey. pp. 11-1 – 11-19. *In*: 2011 Annual Report of the Lake Ontario Committee and the Great Lakes Fishery Commission. New York State Department of Environmental Conservation. Albany, NY.

Prindle, S.E. and D.L. Bishop. 2013. Lake Ontario tributary creel survey Fall 2011-Spring 2012. pp. 11-1 to 11-51. *In*: New York State Department of Environmental Conservation Lake Ontario Annual Report (2012). New York State Department of Environmental Conservation. Albany, NY.

Rachlin, J.W, B.E. Warkentine and A. Pappantoniou. 2007. An evaluation of the ichthyofauna of the Bronx River, a resilient urban waterway. *Northeastern Naturalist* 14:531-544.

Raney, E.C. 1938. The distribution of the fishes of the Ohio drainage basin of western Pennsylvania. PhD Dissertation. Cornell University. Ithaca, NY. 102p.

Raney, E.C. 1969. Minnows of New York. Part 2. The shiners. *New York Conservationist* 23(6):21-29.

Rawson, M.R. and R.L. Scholl. 1978. Reestablishment of Sauger in western Lake Erie. American Fisheries Society Special Publication. 11:261-265.

Reed, H.D. and A.H. Wright. 1909. The vertebrates of the Cayuga Lake basin, New York. Proceedings of the American Philosophical Society 48:370-459.

Renaud, C.B., M.F. Docker and N.E. Mandrak. 2009. Taxonomy, distribution and conservation of lampreys in Canada. American Fisheries Society Symposium 72:293-309.

Renaud, C. B., A.M. Naseka and N.R. Alfonso. 2016. Description of the larval stage of the Alaskan Brook Lamprey, *Lethenteron alaskense* Vladykov and Kott 1978. pp. 231-250. *In*: A.M. Orlov and R.J. Beamish (eds.). *Jawless Fishes of the World*. Cambridge Scholars Publishing. Newcastle upon Tyne, UK.

Ribey, S.C. 1997. Characterization of littoral fish assemblages and their habitat in the St. Lawrence River near Cornwall, Ontario. MS Thesis. University of Ottawa. Ottawa, ON. 80 p.

Ricciardi, A. 2006. Patterns of invasion in the Laurentian Great Lakes in relation to changes in vector activity. *Diversity and Distributions* 12:425–433.

Richardson, J. 1836. Fauna boreali—Americana, or the Zoology of the Northern parts of British America, part third. The Fish. Richard Bently. London. 327 p., 93 pls.

Roseman, E.F., D.J. Jude, M.K. Raths, T.G. Coon and W.W. Taylor. 1998. Occurrence of the Deepwater Sculpin (*Myoxocephalus thompsoni*) in western Lake Erie. *Journal of Great Lakes Research* 24:479-483

Ryan, P.A., R. Knight, R. MacGregor, G. Towns, R. Hoopes, and W. Culligan. 2003. Fish-community goals and objectives for Lake Erie. Great Lakes Fisheries Commission Special Publication 03-02. 56 p.

Ryan, P.A., L.D. Witzel, J. Paine, M. Freeman, M. Hardy, S. Scholten, L. Sztramko and R. MacGregor. 1999. Recent trends in fish populations in eastern Lake Erie in relation to changing lake trophic state and food web. pp. 241-289. *In*: M. Munawar, T. Edsall and I.F. Munawar (eds.). *State of Lake Erie (SOLE) –Past, Present and Future*. Ecovision World Monograph Series. Backhuys Publishers. Leiden, The Netherlands.

Sabaj Pérez, M.H. (ed.). 2014. Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an Online Reference. Version 5.0 (22 September 2014). Electronically accessible at http://www.asih.org/, American Society of Ichthyologists and Herpetologists, Washington, DC.

Samaritan, J.M. and R.E.Schmidt. 1982. Aspects of life history of a freshwater population of the Mummichog, *Fundulus heteroclitus* (Pisces: Cyprinodontidae), Bronx River, New York, USA. *Hydrobiologia* 94:149-154.

Sanford, K.D. 1984. Otsego Lake Lake Trout Study 1968-81. New York State Department of Environmental Conservation. Stamford, NY. 33 p.

Schaffner, W.R. and R.T. Ogelsby 1978. Limnology of eight Finger Lakes: Hemlock, Canadice, Honeoye, Keuka, Seneca, Owasco, Skaneateles and Otisco. pp 313-470. *In*: J.A. Bloomfield (ed.). *Lakes of New York State*. Volume 1. Ecology of the Finger Lakes. Academic Press, New York.

Schiavone, A., Jr. 1983. The Black Lake fish community: 1931 to1979. *New York Fish and Game Journal* 30:78-90.

Schiavone, A., Jr. 1985. Response of Walleye populations to the introduction of Black Crappie in the Indian River Lakes. *New York Fish and Game Journal* 32:114-140.

Schiavone, A., Jr. and R.D. Adams 1995. Movements of Sea Lamprey past the Dexter Dam complex on the Black River, New York. New York State Department of Environmental Conservation. Watertown, NY. 18 p.

Schmidt, R.E. 1986. Zoogeography of the northern Appalachians. pp. 106-136. *In*: C.H. Hocutt and E.O. Wiley (eds.). The zoogeography of North American freshwater fishes. John Wiley and Sons, New York.

Schmidt, R.E. 1992.Temporal and spatial distribution of bay anchovy eggs through adults in the Hudson River. pp. 228-241. *In*: C.L. Smith (ed.). *Estuarine Research in the 1980s, the Hudson River Environmental Society Seventh Symposium on Hudson River Ecology*. State University of New York Press, Albany, NY.

Schmidt, R.E. and R.A. Daniels. 2006. Hybridization in Umbridae in the Hudson River, New York, with Designation of Neotypes for *Umbra limi* and *Umbra pygmaea*. *Zootaxa* 1113:1-20.

Schmidt, R.E., B.M. Jessop, and J.E. Hightower. 2003. Status of river herring stocks in large rivers. pp. 171–182. In: K.E. Limburg and J.R. Waldman (eds.). Biodiversity, status, and conservation of the world's shads. American Fisheries Society Symposium 35. Bethesda, MD.

Schmidt, R. E. and R.S. Morse 2011. An historical record of Alewife (*Alosa pseudoharengus*) in Lake Champlain. *Northeastern Naturalist* 18:229-235.

Schmidt, R.E., R.S. Morse and B.R. Weatherwax. 2007. First record of Central Stoneroller (*Campostoma anomalum*) in the tidal Hudson River. *Northeastern Naturalist* 14:492-494.

Schmidt, R.E. and A.J. Schmidt. 2014. Observations on Oriental Weatherfish (*Misgurnus anguillicaudatus*), an Exotic Species in the Hudson River Valley, New York. *Northeastern Naturalist* 21:134-145.

Schneider, C.P., R.W. Owens, R.A. Bergstedt and R. O'Gorman. 1996. Predation by Sea Lamprey (*Petromyzon marinus*) on Lake Trout (*Salvelinus namaycush*) in southern Lake Ontario, 1982-1992. *Canadian Journal of Fisheries and Aquatic Sciences* 53:1921-1932.

Schwartz, F.J. 1954. Variations in the growth rates, densities and meristic characters of four species of darters (Etheostomatinae) from the upper Allegheny River and its tributaries. PhD Dissertation. University of Pittsburgh. Pittsburgh, PA. 232 p.

Schwartz, F.J. 1965. Densities and ecology of the darters of the upper Allegheny River watershed. pp. 95-103. *In*: C.A. Tyron, Jr, R.T. Hartmen and K.W. Cummins (eds.). Studies on the Aquatic Ecology of the Upper Ohio River System. Pymatuning Laboratory of Ecology. Special Publication 3. University of Pittsburgh. Pittsburgh, PA.

Scott, W.B. and E.J. Crossman. 1979. Freshwater Fishes of Canada. Fisheries Research Board of Canada. Bulletin 184. Ottawa, ON. 966 p.

Shultz E.T., K.M.M. Lwiza, J.R. Young, K.J. Hartman and R.C. Tipton. 2006. The dynamics of Bay Anchovy in the Hudson River Estuary: Process-oriented studies and long-term changes. American Fisheries Society Symposium 51:197-213.

Senning, W.C. 1939. The freshwater lakes and ponds of Long and Staten Islands. pp. 45-63. *In*: E. Moore (ed.). A Biological Survey of the Freshwaters of Long Island. Supplemental to the Twenty-eighth Annual Report New York State Conservation Department (1938). Albany, NY.

Senning, W.C. 1940. Lakes and ponds above the Lake Ontario Lake level. pp. 98-116. *In*: E. Moore (ed.). A Biological Survey of the Lake Ontario watershed. Supplemental to the Twenty-ninth Annual Report New York State Conservation Department (1939). Albany, NY. Albany.

Sharpe, L.B. 1909. *History of Greenwich, New York*. Commonweal Press, Greenwich, NY. 58 p.

Sheldon, A.L. 1968. Species diversity and longitudinal succession in stream fishes. *Ecology* 49:193-198.

Shupp, B.S. 1976. Predicted effects of the fish and wildlife resources based on proposed water level re-regulation plans for Great Sacandaga Lake (P-127-UH) and Indian Lake (P597-UH). New York State Department of Environmental Conservation. Albany, NY. 38 p.

Sibley, C.K. Notes on the adult fishes of Lake George and their feeding habits. pp. 64-68. *In*: J.G. Needham, C. Juday, E. Moore, C.K. Sibley and J.W. Titcomb (eds.). *A biological survey of Lake George, NY*. State of New York Conservation Department. J.B. Lyons Company, Albany, NY.

Simon, P.W., K.E. Limburg and L.S. Machut. 2007. Bridging the energy gap: anadromous Blueback Herring feeding in the Hudson and Mohawk Rivers, New York. Transactions of the American Fisheries Society 136:1614-1621.

Sloan, R.J. and K. Jock. 1990. Chemical contaminants in fish from the St. Lawrence River drainage on lands of the Mohawk Nation at Akwesasne and near the General Motors Corporation/Central Foundary Division, Massena, New York Plant. New York State Department of Environmental Conservation. Albany, NY. 94 p.

Smallwood, W.M. and P.H. Struthers 1928. Carp control studies in Oneida Lake. pp. 67-83. *In*: E. Moore (ed.). A Biological Survey of the Oswego River System. Supplemental to the Seventeenth Annual Report New York State Conservation Department (1927). Albany, NY.

Smith, C.L. 1985. The inland fishes of New York State, New York State Department Environmental Conservation. Albany, NY. 522 p.

Smith, C.L. and T.R. Lake 1990. Documentation of the Hudson River fish fauna. American Museum Novitates 2981. 17 p.

Smith, G.R. 2004. Carl L. Hubbs and K. F. *Lagler's fishes of the Great Lakes region*.

Revised edition. University Michigan Press. Ann Arbor. 276 pp.

Smith, H.M. 1892. Report on an investigation of the fisheries of Lake Ontario. Bulletin of US Fish Commission 18:177-215.

Smith, H.M. and M.M. Snell 1891. Review of the fisheries of the Great Lakes in 1885. pp. 3-334. *In*: Report of the United States Commissioner of Fish and Fisheries for 1887. Washington, DC.

Smith, S.H. 1968. That little pest the Alewife. Limnos 1:12-20.

Smith, S.H. 1970. Species interactions of the Alewife in the Great Lakes. Transactions of the American Fisheries Society 99:754-765.

Snelson, F.F. 1968. Systematics of the cyprinid fish *Notropis amoenus*, with comments on the subgenus *Notropis*. *Copeia* 1968:776-802.

Springer, J.E. and T.M Groutage. 1963. The tri-state fishery study: A cooperative investigation of the Delaware River Fishery 1959-1962. New Jersey Division of Fish and Game, New York State Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, U.S. Bureau of Sport Fisheries and Wildlife. Annapolis, MD. 31 p.

Staats, N.R. and B. Peintka. 2012. Lake Champlain fisheries restoration and management, forage fish monitoring. Federal Aid project F-35-R-14. Annual report July 2011-June 2012. Vermont Fish and Wildlife Department. Montpelier, VT. 33 p.

Stapanin, M.A., C.P. Madenjian, C.R. Boronte, M.P. Ebener, B.F. Lantry, and J. D. Stockwell. 2008. Status of Burbot populations in the Laurentian Great Lakes. American Fisheries Society Symposium 59:111-130.

Starnes, W.C., J. Odenkirk, and M.J. Ashton. 2011. Update and analysis of fish occurrences in the lower Potomac River drainage in the vicinity of Plummers Island, Maryland-Contribution XXXI to the natural history of Plummers Island, Maryland. Proceedings of the Biological Society of Washington 124:280-309.

Steinhart, G.B., M. Mineau and C.E. Kraft. 2007. Status and recovery of Round Whitefish, *Prosopium cylindraceum*, in New York, USA. Final Report, SWG T-3, Project 1. New York State Department of Environmental Conservation. Albany, NY. 61 p.

Stevens, G.R. and R.E. Schmidt. 1993. Preliminary ecological assessment of Sparkill Creek, Town of Orangetown, Rockland County, New York. Final Report to the Hudson River Defense League by Hudsonia Limited. Annandale, NY. 19 p.

Stewart, D.J., A. Sheldon, S. Coglan and D. Carlson. 2005. Changes in fish community of Owego Creek (Abstract). Program and Abstracts, American Fisheries Society, Tri-Society Meeting, Syracuse, NY. 1 p.

Stillman, L. 1984. Morphological comparisons of *Etheostoma olmstedi* Storer and *Etheostoma nigrum* Rafinesque inside and outside a zone of secondary contact. MS Thesis. City College of City University of New York. New York. 123 p.

Stone, F.L. 1948. A study of the taxonomy of the blue and the yellow pikeperches (*Stizostedion*) of Lake Erie and Lake Ontario. PhD Dissertation. University of Rochester. Rochester, NY. 164 p.

Stone, U.B. 1940. Studies on the biology of the Satinfin Minnows, *Notropis analostanus* and *Notropis spilopterus*. PhD Dissertation. Cornell University. Ithaca, NY. 98 p.

Stone, U.B. 1943. Summary of the results of experimental netting and recommendations for changes in regulations for Lake Ontario based on field work done during the season of 1943. New York State Conservation Department. Albany, NY. 24 p.

Stone, U. B. 1947. A study of the deep-water cisco fishery of Lake Ontario with particular reference to the Bloater *Leucichthys hoyi* (Gill). Transactions of the American Fisheries Society 74:230-249.

Stone, W. and J. Okoniewski. 2002. Botulism in Lake Erie. *New York Conservationist* 56(6):12-14.

Strayer, D.L., K.A. Hatala and A.W. Kahnle. 2004. Effects of an invasive bivalve (*Dressena polymorpha*) on fish in the Hudson River estuary. *Canadian Journal of Fisheries and Aquatic Sciences* 61:924-941.

Sullivan, W. P. and R. Adair. 2010. Integrated management of Sea Lampreys in the Great Lakes 2009. Annual Report to the Great Lakes Fishery Commission. Ann Arbor, MI.

Sullivan, W.P., G.C. Christie, F.C. Cornelius, M.F. Fodale, D.A. Johnson, J.F. Koonce, G.L. Larson, R.B. McDonald, K.M. Mullett, C.K. Murray and P.A. Ryan. 2003. The Sea Lamprey in Lake Erie: A case history. *Journal of Great Lakes Research* 29:615-636.

Surface, H.A. 1899. Removal of lampreys from the interior waters of New York. pp. 191-245. *In*: Annual Report of the Forest, Fish and Game Commissioners of the State of New York (1898). Albany, NY.

Thompson, Z. 1842. *History of Vermont, natural, civil and statistical*. Chauncey Goodrich. Burlington, VT. 200 p.

Tibbits, W.T. 2005. Further evaluation of the Lake Trout (*Salvelinus namaycush*) spawning habitat in Otsego Lake. pp. 92-100. *In*: Thirty-seventh Annual Report of Oneonta Biological Field Station (2004). State University of New York, Oneonta. Oneonta, NY.

Tipton, M. 2013. Phylogeography of the Eastern Blacknose Dace, *Rhinichthys atratulus*, and systematics of the *R. atratulus* complex. PhD Dissertation, Wesleyan University. Middletown, CT. 250 p.

Trautman, M. B. 1981. *The fishes of Ohio with illustrated keys*. Revised Edition. Ohio State University Press. Columbus, OH. 782 p.

Trembley, F.J. 1930. The gar-pike of Lake Champlain watershed. pp. 139-145. *In*: E. Moore (ed.). A Biological Survey of the Champlain watershed. Supplemental to the Nineteenth Annual Report New York State Conservation Department (1929). Albany, NY.

Trested, D.G. 2010. Biology and ecology of Lake Sturgeon (*Acipenser fulvescens*) in the Grass River, New York. Ph.D. Dissertation. Clemson University. Clemson, SC. 98 p.

Trometer, E., B. Cotton, D. Clay and M. Goehle. 2010. Aquatic invasive species monitoring and fish survey of the New York State Canal System, 2009. Administrative Report 2010-01. US Fish and Wildlife Service. Amherst, NY. 26 p.

Turner, O. 1851. *History of pioneer settlement of Phelps and Gorham's purchase, and Morris's Reserve*. To which is added a supplement or continuation of the pioneer history of Ontario, Wayne, Livingston, Yates and Allegany. William Alling, Rochester, NY. 588 p.

Underhill, J.C. 1986. The fish fauna of the Laurentian Great Lakes, the Saint Lawrence lowlands, Newfoundland and Labrador. pp. 105-136. *In*: C.H. Hocutt and E.O. Wiley (eds.). *The zoogeography of North American freshwater fishes*. John Wiley and Sons, New York.

USFWS. 2008. Strategic plan for Lake Champlain fisheries (Draft). Fisheries Technical Committee, Lake Champlain Fish and Wildlife Management Cooperative. US Fish and Wildlife Service. Essex Junction, VT. 37 p.

Waldman, J.R., R.A. Daniels, M. Hickerson and I. Wirkin. 2009. Mitochondrial DNA analysis indicates Sea Lampreys are indigenous to Lake Ontario: response to comment. Transactions of the American Fisheries Society 138:1190-1197.

Waldman, J. R., C. Grunwald, and I. Wirgin. 2006. Evaluation of the native status of Sea Lamprey *Petromyzon marinus* in Lake Champlain based on mitochondrial DNA sequencing analysis. Transactions of the American Fisheries Society 135:1076–1085.

Waldman, J.R., C. Grunwald, N.K. Roy and I.I. Wirgin. 2004. Mitochondrial DNA analysis indicates Sea Lampreys are indigenous to Lake Ontario. Transactions of the American Fisheries Society 133:950-960.

Waldman, J.R. and I.I. Wirgin. 1994. Origin of the present Delaware River Striped Bass population as shown by analysis of mitochondrial-DNA. Transactions of the American Fisheries Society 123:15-21.

Watson, W.C. 1876. The salmon of Lake Champlain and its tributaries. pp. 531-540. *In*: US Commissioners of Fish and Fisheries Report (1874-75). Washington, DC.

Webb, S.A. and T.N. Todd. 1995. Biology and status of the Shortnose Cisco *Coregonus reighardi* Koelz in the Laurentian Great Lakes. Archiv für Hydrobiologie Special Issues Advanced Limnology 46: 71-77.

Webster, D.A. 1973. Life history, ecology and population dynamics of suckers. Annual job progress report April 1, 1972 to March 31, 1973. Federal Aid Project no. F-28-R-8, Job 8-C. Cornell University. Ithaca, NY.

Webster, D.A. 1982. Early history of the Atlantic Salmon in New York. *New York Fish Game Journal* 29: 26-44.

Weidel, B.C., M.G. Walsh and M.J. Connerton. 2013. Sculpin and Round Goby assessment, Lake Ontario 2012. pp. 15-24. *In*: 2012 Annual Report, Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee. New York State Department of Environmental Conservation. Albany, NY

Wells, L. 1969. Fishery survey of the U.S. waters of Lake Ontario. Limnological Survey of Lake Ontario, 1964. Great Lakes Fisheries Commission Technical Report 14:51-57.

Wells, S. 2014. Monitoring feral Oriental Weatherfish infestations in New York State. *American Currents* 39(3):18-21.

Welsh, A. and B. May 2007. Genetics characteristics of spawning Lake Sturgeon at the Grass River. State University of New York Oswego. Oswego, NY. 11 p.

Welsh, A., T. Hill, H. Quinlan, C. Robinson and B. May. 2008. Genetic assessment of Lake Sturgeon population structure in the Laurentian Great Lakes. *North American Journal of Fisheries Management* 28: 572-591.

Werner 1972. Bluespotted Sunfish, *Enneacanthus gloriosus*, in Lake Ontario drainage. *Copeia* 1972:878-879.

Whittier, T.R. and T.M. Kincaid. 1999. Introduced fish in northeastern USA lakes: Regional extent, dominance, and effect on native species richness. Transactions of the American Fisheries Society 128:769-783.

Wilkinson, M.A. 1993. Summary of Upper Niagara River Muskellunge angler cooperator activities from 1979 to 1985. New York State Department of Environmental Conservation. Buffalo, NY. 31 p.

Wilson, C., and J. Farrell. 2011. Genetic analysis of population structure in Lake Ontario and the St. Lawrence River and adjoining waters of New York. Fed. Aid F-55-R, study 3, Job 3-3 final report. New York State Department of Environmental Conservation. Albany, NY. 23 p.

Wilson, W. H. 1955. Lampreys in the Lake Champlain Basin. *American Midland Naturalist* 54:168-172.

Woltmann, E. 1989. An evaluation of aquatic vegetation control with sterile Grass Carp. New York State Department of Environmental Conservation. Albany, NY. 55 p.

Woodland, R.J. and D.H. Secor. 2007. Year-class strength and recovery of endangered Shortnose Sturgeon in the Hudson River, New York. Transactions of the American Fisheries Society 136:72-81.

Wright, A.H. 2006. The fishes of the vicinity of Rochester, New York. Guelph Ichthyology Reviews 6. 99 p.

Wright, J., C.C. Krueger, P.F. Brussard and M.C. Hail. 1985. Sea Lamprey (*Petromyzon marinus*) populations in northeastern North America: Genetic differentiation and affinities. *Canadian Journal of Fisheries and Aquatic Science* 42:776-784.

Yochim, W.D. 1981. Distribution of darters (*Etheostoma* and *Percina*) in the major riffles of the Allegheny River upstream of the Allegheny Reservoir. MS Thesis. Saint Bonaventure University. Saint Bonaventure, NY. 86 p.

Young, B.T., B. McDonald, E. Trometer, D. Clay and M. Goehle. 2009. Invasive species monitoring and biological survey of the New York State canal system, 2007-2008. Administrative Report 2009-01. U.S. Department of Interior, Fish and Wildlife Service, Lower Great Lakes Fish and Wildlife Conservation Office. Amherst, NY. 27 p.

Youngs, W.D. and R.T. Ogelsby. 1972. Cayuga Lake: effects of exploitation and introductions on the salmonid community. *Journal of the Fisheries Research Board of Canada* 29:787-794.

Appendix

Appendix Table 1. Distribution of fishes in New York watersheds and period of capture

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Ichthyomyzon bdellium	Ohio Lamprey	23																		1
Ichthyomyzon fossor	Northern Brook Lamprey		123					23	3		3									4
Ichthyomyzon greeleyi	Mountain Brook Lamprey	123																		1
Ichthyomyzon unicuspis	Silver Lamprey		13	13				13	3	1	123				**12**		**2**			8
Lethenteron appendix	American Brook Lamprey	123	123	23	23	123		23		3	123			123			12		23	11
Petromyzon marinus	Sea Lamprey		**23**	123		123	23	123	1	3	123	1	1	123	2		123		123	14
Acipenser brevirostrum	Shortnose Sturgeon														1		123			2
Acipenser fulvescens	Lake Sturgeon		123	123	13	123	23	123	123	13	13					**3**				10
Acipenser oxyrinchus	Atlantic Sturgeon													1			123			2
Polyodon spathula	Paddlefish	13																		1
Lepisosteus platostomus	Shortnose Gar	1																		1
Lepisosteus osseus	Longnose Gar	123	123	123	23	123	13	123	123	13	123						**3**			11
Amia calva	Bowfin		23	123	23	123	3	123	123	1	123			**23**	**3**		**23**		**2**	13
Hiodon tergisus	Mooneye	1	13	13				123	123	3	123									7
Anguilla rostrata	American Eel	12	**123**	123	123	123	123	123	123	123	123	12	123	123	123	123	123	123	123	18
Anchoa mitchilli	Bay Anchovy																123		123	2
Alosa aestivalis	Blueback Herring			**3**		**3**		**3**			**23**				123	**123**	123		123	8
Alosa mediocris	Hickory Shad																123		1	2
Alosa pseudoharengus	Alewife		**123**	123	**123**	**123**		123			**123**	123	123	123	123	**123**	123	**123**	123	14
Alosa sapidissima	American Shad			**13**								1	13	123	12	12	123		1	8
Dorosoma cepedianum	Gizzard Shad	**3**	123	123	**23**	123	3	23			**3**	**3**	**3**	**23**	**23**	**23**	**23**		**123**	15
Campostoma anomalum	Central Stoneroller	123	123	123	123	123	3	23		3		123	123	23	23	23	23			14
Carassius auratus	Goldfish	123	123	123	123	123		2			23	123	13	3	123	123	123	12	123	15
Chrosomus eos	Northern Redbelly Dace	123	12	123	2	123	123	123	123	123	123		3		123	123	123			14

Numbers after the fish name show periods of records for: before 1940=1, 1940-1987=2, and 1988-present=3. Bold designates "introduced".

Appendix Table 1. Distribution of fishes in New York watersheds and period of capture (cont.)

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Chrosomus neogaeus	Finescale Dace	12		1			12	123	123	123	123				123					8
Clinostomus elongatus	Redside Dace	123	123	123	123	123	123		123			123	123			123				10
Couesius plumbeus	Lake Chub			12		1	123	123	123	123	123			123	123	123	1			11
Ctenopharyngodon idella	Grass Carp		**3**				**3**										**3**		**23**	4
Cyprinella analostana	Satinfin Shiner			**23**		**123**	**13**	**13**	**3**			123	123	123	123	123	123	23	**13**	13
Cyprinella spiloptera	Spotfin Shiner	123	123	123	123	123	123	13	123	123	123	123	123	23	123	123	123			16
Cyprinus carpio	Common Carp	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**23**	**13**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Erimystax dissimilis	Streamline Chub	123																		1
Erimystax x-punctatus	Gravel Chub	12																		1
Exoglossum laurae	Tonguetied Minnow	123			123															2
Exoglossum maxillingua	Cutlip Minnow			123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	3	16
Hybognathus hankinsoni	Brassy Minnow	**3**	1	13	2	23	123	123	123	123	123		**2**		123	13	123			14
Hybognathus regis	Eastern Silvery Minnow			123	12	123	3	3	3		123	12	12	13	123	123	123		1	14
Hybopsis amblops	Bigeye Chub	123	123	12		1														4
Luxilus chrysocephalus	Striped Shiner	123	123	123	123	123					13									6
Luxilus cornutus	Common Shiner	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Lythrurus umbratilis	Redfin Shiner	3	123	13		1														4
Macrhybopsis storeriana	Silver Chub		1	1																2
Margariscus margarita	Allegheny Pearl Dace	123	123	123	123	123	3	3			123	123	123		123	123	123			13
Margariscus nachtreibi	Northern Pearl Dace			13	12	12	123	123	123	123	123									8
Nocomis biguttatus	Hornyhead Chub	123	123	123	123	123	**3**		**3**				**23**			**123**				9
Nocomis micropogon	River Chub	123	123	123	2	**123**						123	123							7
Notemigonus crysoleucas	Golden Shiner	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Notropis amoenus	Comely Shiner					**123**						12	123	123		**1**	**123**	**1**		7

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Appendix Table 1. Distribution of fishes in New York watersheds and period of capture (cont.)

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Notropis anogenus	Pugnose Shiner			13		1		123												3
Notropis atherinoides	Emerald Shiner	123	123	123	123	123		123	23	3	123	**23**	**123**	**23**	**123**	**123**	**123**			15
Notropis bifrenatus	Bridle Shiner		12	123	23	123		123	123	123	123	123	123	123	123	123	123	123	123	16
Notropis buccatus	Silverjaw Minnow	23																		1
Notropis chalybaeus	Ironcolor Shiner													123				1		2
Notropis dorsalis	Bigmouth Shiner	123	123	2	123	1						**23**								6
Notropis heterodon	Blackchin Shiner	12	12	123	123	12		123	13		123		123		12					10
Notropis heterolepis	Blacknose Shiner	123	123	123	1	123	13	123	123	23	123	123	12		123	12				14
Notropis hudsonius	Spottail Shiner	**123**	123	123	123	123	123	123	123	13	123	123	123	123	123	123	123	23	**12**	18
Notropis photogenis	Silver Shiner	123																		1
Notropis procne	Swallowtail Shiner					**12**						123	123	123			**1**			5
Notorpis rubellus	Rosyface Shiner	123	123	123	123	123		123	123	123	123	123	123		123	123	123			14
Notropis stramineus	Sand Shiner	123	123	123	123	3		123	3	3	123	**3**	**3**				**23**			12
Notropis volucellus	Mimic Shiner	123	123	123	123	123	13	123	23	13	123	**3**	**3**		3					13
Pimephales notatus	Bluntnose Minnow	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	**3**	**3**	18
Pimephales promelas	Fathead Minnow	123	123	123	123	123	123	123	123	13	123	**123**	**123**	**23**	**123**	**123**	**123**		**13**	17
Rhinichthys atratulus	Eastern Blacknose Dace			123		123	123	123	123	123	123	123	123	123	123	123	123	123	123	15
Rhinichthys cataractae	Longnose Dace	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Rhinichthys obtusus	Western Blacknose Dace	123	123	123	123															4
Rhodeus sericeus	Bitterling																**12**	**12**		2
Scardinius erythrophthalmus	Rudd	**3**	**3**	**3**	**3**	**3**		**3**	**3**		**3**	**3**	**3**		**3**	**3**	**123**	**3**		14
Semotilus atromaculatus	Creek Chub	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Semotilus corporalis	Fallfish		**23**	123	**2**	123	**23**	123	123	123	123	123	123	123	123	123	123	123	13	17
Tinca tinca	Tench										**3**									1

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Appendix Table 1. Distribution of fishes in New York watersheds and period of capture (cont.)

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Carpiodes cyprinus	Quillback	123	123	23	23	23	3	23			1	123	23							10
Catostomus catostomus	Longnose Sucker			12	123	123	123	123	12	123	123		123	123	123	123	123			13
Catostomus commersonii	White Sucker	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Catostomus utawana	Summer Sucker						123		13							123				3
Catostomus sp. cf. *utawana*	undescribed sucker							3		3	3				23					4
Erimyzon oblongus	Eastern Creek Chubsucker		123		123			23				123	123	123	23	123	123	123	123	11
Erimyzon sucetta	Lake Chubsucker		1	1																2
Hypentelium nigricans	Northern Hog Sucker	123	123	123	123	123	**23**					123	123	23	123	123	123			12
Ictiobus bubalus	Smallmouth Buffalo		3	3																2
Ictiobus cyprinellus	Bigmouth Buffalo		3	3													**3**			3
Minytrema melanops	Spotted Sucker		3	3																2
Moxostoma anisurum	Silver Redhorse	123	123	123	123	123		123	13	123	123									9
Moxostoma breviceps	Smallmouth Redhorse	123																		1
Moxostoma carinatum	River Redhorse	23																		1
Moxostoma duquesnei	Black Redhorse	123	123		1															3
Moxostoma erythrurum	Golden Redhorse	123	123	123	123	12														5
Moxostoma macrolepidotum	Shorthead Redhorse		123	123	123	123		123	123	123	123	23	123		23	123	23			13
Moxostoma valenciennesi	Greater Redhorse	3	123	123	3	123		13	23	13	13									9
Misgurnus anguillicaudatus	Oriental Weatherfish	3											**3**	**3**		**3**	**3**		**3**	6
Ameiurus catus	White Catfish													23	23	2	123	123		5
Ameiurus melas	Black Bullhead	1	123	123	123	12			13		123									8
Ameiurus natalis	Yellow Bullhead	123	123	123	23	123	1	23	123	**3**	23	**3**	**23**	**23**	123	123	123	123	3	17
Ameiurus nebulosus	Brown Bullhead	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Ictalurus punctatus	Channel Catfish	**23**	123	123	23	123	23	123	123	13	123	**23**	**23**	**23**	**23**	**23**	**23**	**3**	**3**	18

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Appendix Table 1. Distribution of fishes in New York watersheds and period of capture (cont.)

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Noturus flavus	Stonecat	123	123	123	123	123	123	123	3	123	123				123	123	12			13
Noturus gyrinus	Tadpole Madtom		123	123	12	123	12	123	13	3	23	12	123	123	12	123	123	1	**1**	17
Noturus insignis	Margined Madtom			**12**	**2**	**123**	**23**		**23**	**23**		123	123	123	**23**	**123**	**123**			12
Noturus miurus	Brindled Madtom	123	23	123	2	123										**23**	**3**			6
Osmerus mordax	Rainbow Smelt		**123**	**123**	**23**	**123**	**123**	**123**	**123**	**123**	123		**23**	**123**	**123**	**3**	123	13	1	16
Coregonus artedi	Cisco	12	123	123	12	123	**2**	123	123	**123**	123	**2**	**23**	**2**	123	23	23			16
Coregonus clupeaformis	Lake Whitefish		123	123	123	123	**123**	123	123	**123**	123		123	**2**	**123**	**123**	**123**			14
Coregonus hoyi	Bloater			12																1
Coregonus kiyi	Kiyi			12																1
Coregonus reighardi	Shortnose Cisco			12																1
Oncorhynchus gorbuscha	Pink Salmon		**23**	**23**																2
Oncorhynchus kisutch	Coho Salmon		**23**	**23**	**3**			**2**						**3**						5
Oncorhynchus mykiss	Rainbow Trout	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Oncorhynchus nerka	Sockeye Salmon					**2**	**23**	**3**	**23**		**23**		**2**	**2**	**23**		**23**			9
Oncorhynchus tshawytscha	Chinook Salmon		**23**	**123**	**23**	**3**	**3**	**23**		**3**							**3**		**1**	9
Prosopium cylindraceum	Round Whitefish			12			123	123	**12**	123	123				123	12				8
Salmo salar	Atlantic Salmon			123	13	123	123	1	123	123	123		**23**	**23**	**123**	**23**	**123**	**1**		14
Salmo trutta	Brown Trout	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Salvelinus fontinalis	Brook Trout	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
S. fontinalis x S. namaycush	Splake			**2**	**2**		**23**	**23**	**23**	**23**	**23**	**2**	**2**		**23**	**23**	**2**			12
Salvelinus namaycush	Lake Trout		123	123	123	123	123	123	123	123	123		123	123	**123**	123	**123**	**13**	**123**	16
Esox americanus americanus	Redfin Pickerel										**123**	23	123	123	123	123	123	123	123	9
Esox americanus vermiculatus	Grass Pickerel	23	123	123	12	123	123	123	23	3										9
Esox lucius	Northern Pike	**23**	123	123	123	123	123	123	123	123	123	**123**	**23**	**12**	**123**	**123**	**123**			16
E. lucius x E. masquinongy	Tiger Muskellunge	**23**	**23**	**3**	**3**	**23**	**3**	**3**	**3**	**3**	**23**	**3**	**23**	**2**	**3**	**23**	**23**	**3**	**23**	18
Esox masquinongy	Muskellunge	123	123	13	1			123	123	123	123	**23**	**23**	**13**	**1**	**2**		**3**		14
Esox niger	Chain Pickerel	**3**	**123**	123	123	123	123	**123**	**123**	**3**	123	123	123	123	123	123	123	123	123	18

Numbers after the fish name show periods of records for: before 1940=1, 1940-1987=2, and 1988-present=3. Bold designates "introduced".

Appendix Table 1. Distribution of fishes in New York watersheds and period of capture (cont.)

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Umbra limi	Central Mudminnow	123	123	123	123	123	**23**	123	123	123	123	**23**	**23**		**23**	**123**	**23**			15
Umbra pygmaea	Eastern Mudminnow													3			123	123	123	4
Percopsis omiscomaycus	Trout-perch	123	123	123	123	123		123	23		123				123	123	123			11
Aphredoderus sayanus	Pirate Perch		1	123															123	3
Lota lota	Burbot	123	123	123		123	123	123	123	123	123		123							10
Microgadus tomcod	Atlantic Tomcod																123		12	2
Labidesthes sicculus	Brook Silverside	123	123	123	23	123		123	13	3	**3**				**3**	**13**	**23**			12
Fundulus diaphanus	Banded Killifish	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Fundulus heteroclitus	Mummichog																123	**1**	123	3
Gambusia affinis	Western Mosquitofish																**3**		**23**	2
Apeltes quadracus	Fourspine Stickleback														1		123		123	3
Culaea inconstans	Brook Stickleback	123	123	123	123	123	123	123	123	123	123	123	123		123	123	123			15
Gasterosteus aculeatus	Threespine Stickleback			123	1	12		123									123		23	6
Pungitius pungitius	Ninespine Stickleback			12		12											2	1	123	5
Cottus bairdii	Mottled Sculpin	123	123	123	123	123		123			123	123	123	**3**						10
Cottus cognatus	Slimy Sculpin		12	123	123	123	123	123	123	123	123	123	123	123	123	123	123	23		16
Cottus ricei	Spoonhead Sculpin		1	2																2
Myoxocehaplus thompsonii	Deepwater Sculpin		1	123																2
Morone americana	White Perch	**3**	**23**	**23**	**23**	**23**	**3**	**123**		**3**	**23**		**3**	**3**	123	**123**	123	123	123	16
Morone chrysops	White Bass	23	123	123	23	123		23								**23**	**23**			8
Morone saxatilis	Striped Bass													3	123	12	123		23	5
Acantharchus pomotis	Mud Sunfish																	1		1
Ambloplites rupestris	Rock Bass	123	123	123	123	123	123	123	123	123	123	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Enneacanthus gloriosus	Bluespotted Sunfish					23								123			123	123		4
Enneacanthus obesus	Banded Sunfish																	1	123	2

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Appendix Table 1. Distribution of fishes in New York watersheds and period of capture (cont.)

		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Lepomis auritus	Redbreast Sunfish							**2**		**123**	123	123	123	123	123	123	123	123	123	11
Lepomis cyanellus	Green Sunfish	**3**	**23**	**23**	**3**	**3**	**3**	**3**				**123**	**23**	**23**		**23**	**123**	**3**	**3**	14
Lepomis gibbosus	Pumpkinseed	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Lepomis gulosus	Warmouth																123			1
Lepomis macrochirus	Bluegill	123	123	123	123	123	**23**	23	123	**123**	123	**123**	**123**	**123**	**123**	**23**	**123**	**123**	**123**	18
Lepomis peltastes	Northern Sunfish		23	123		12														3
Micropterus dolomieu	Smallmouth Bass	123	123	123	123	123	123	123	123	123	123	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Micropterus salmoides	Largemouth Bass	123	123	123	123	123	123	123	123	123	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Pomoxis annularis	White Crappie	123	123	123	23	123					**3**	**23**	**23**	**23**	**23**	**123**	**123**	**3**	**1**	14
Pomoxis nigromaculatus	Black Crappie	123	123	123	123	123	23	123	123	**23**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**	18
Ammocrypta pellucida	Eastern Sand Darter	3	13					3	3		23									5
Etheostoma blennioides	Greenside Darter	123	123	123	123	123						**3**	**3**			123	2			9
Etheostoma caeruleum	Rainbow Darter	123	123	123	**23**											**3**				5
Etheostoma camurum	Bluebreast Darter	23																		1
Etheostoma exile	Iowa Darter	1	123	123	123	123		123	123	3	13									9
Etheostoma flabellare	Fantail Darter	123	123	123	123	123	123	123	123	123	123	123	23		23	123	23			15
Etheostoma fusiforme	Swamp Darter																		123	1
Etheostoma maculatum	Spotted Darter	123																		1
Etheostoma nigrum	Johnny Darter	123	123	123	123	3	3	123	123	13		**123**								10
Etheostoma olmstedi	Tessellated Darter			123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	16
Etheostoma variatum	Variegate Darter	123																		1
Etheostoma zonale	Banded Darter	123			**2**							**23**	**23**							4
Perca flavescens	Yellow Perch	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	18
Percina caprodes	Logperch	123	123	123	123	123	123	123	123	123	123				**123**	**123**	**123**			13
Percina copelandi	Channel Darter	23	123					13	13	13	123									6
Percina evides	Gilt Darter	13																		1
Percina macrocephala	Longhead Darter	123																		1

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		Allegheny	Erie-Niagara	Ontario	Genesee	Oswego	Black	Saint Lawrence	Oswegatchie	Raquette	Champlain	Chemung	Susquehanna	Delaware	Upper Hudson	Mohawk	Lower Hudson	Newark Bay	Long Island	Watersheds Count
Percina maculata	Blackside Darter	123	123	123	123	123										**3**				6
Percina peltata	Shield Darter											123	123	123			**123**			4
Sander canadensis	Sauger	1	12	123		1		1			123									5
Sander glaucus	Blue Pike		12	12		1														3
Sander vitreum	Walleye	123	123	123	123	123	123	123	123	123	123	**123**	**123**	**123**	**123**	**123**	**123**	**13**	**123**	18
Aplodinotus grunniens	Freshwater Drum		123	123	123	123		123	1	3	123				**23**	**3**	**23**			11
Neogobius melanostomus	Round Goby		**3**	**3**	**3**	**3**		**3**	**3**							**3**				7
Channa argus	Northern Snakehead																**3**		**3**	2
	number of taxa	109	119	136	108	119	83	108	95	88	103	81	92	81	94	96	113	62	72	
	number of taxa pre2003	97	108	126	101	111	77	97	84	76	91	76	87	74	87	90	101	58	66	

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Appendix Table 2. Credits for art work and photographs. Photographs were modified with Photoshop tools. Thanks to all of them.

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