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ZEBRA MUSSELS (*DREISSENIDAE*) : REVIEW OF PARASITIC AND OTHER SYMBIOTIC ORGANISMS ASSOCIATED WITH THESE EUROPEAN BIOFOULING BIVALVES

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Because zebra mussels, *Dreissena polymorpha,* are capable of attaching to hard surfaces by byssal threads, they can cause serious economic impacts as biofoulers in pipes drawing water from infested areas. Described from the Caspian Sea over 200 years ago, they spread through Western Europe in the 19th century. Likely carried from European freshwaters in the ballast water of transoceanic vessels, they were first discovered in North America in 1988. Relatively few studies have attempted to document the existence of dreissenid parasites.

Protozoans

In Europe, ciliates living on the exterior of the visceral mass and gills have been reported, including *Conchophthirus acuminatus, Ancistrumina limnica, Hypocomagalma dreissenae, Sphenophrya dreissenae* and *Ancistrina sp.* Although these ciliates have been referred to as "parasitic" by some workers, no conclusive evidence of pathology has ever been offered to substantiate use of this term. In recent surveys of Russian mussels, ciliates which are morphologically distinguishable from the above-mentioned ectosymbiotic forms have been frequently observed living inside the digestive gland. When the epidermis covering the digestive gland of an infested specimen is teased open, these ciliates can be seen slowly moving about in the fluid between the lobes of this organ as well as inside them. As with the ectosymbiotic species, the nature of the association between these latter endosymbiotic ciliates and zebra mussels is unknown. In North America, the only ciliates thus far reported from zebra mussels are ophryoglenids observed inside the shells (but not organs) of living and dead specimens. Other than ciliates, the only other protozoan recorded from zebra mussels is a

sporozoan, tentatively identified as a ascetosporan, which causes apparently lethal infections in The Netherlands.

Trematodes

Five genera of flatworms have been recorded from European zebra mussels : *Sanguinicola sp., Bucephalus polymorphus, Echinoparyphium recurvatum, Phyllodistomum folium, P. macrocotyle, P. dogieli ; Aspidogaster conchicola* and *A. limacoides.* To date, North American trematode records include only *Aspidogaster conchicola* and plagiorchiids. Although trematode infection is generally debilitating, it appears to be severe only with *B. polymorphus,* whose sporocyst growth can completely destroy gonadal tissue. The bionomics and distribution of each of trematode species will be reviewed.