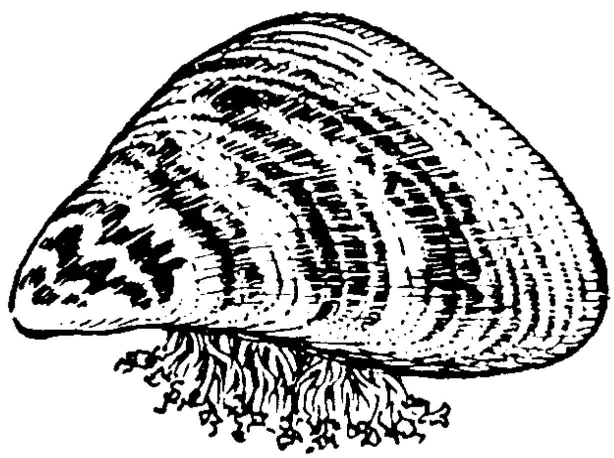
ZEBRA MUSSEL

(Dreissena polymorpha)



by

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Introduction

The first confirmed Oklahoma sightings of Zebra Mussels (ZM), Dreissena polymorpha, were made on the Arkansas River, 20 - 22 Jan 1993, inside locks 14 (W.D. Mayo), 15 (R.S. Kerr), and 16 (Webbers Falls). They were found in the Verdigris River at lock 17 (Chouteau) on 10 June 1993 and at lock 18 (Newt Graham) in mid January 1994. The first inland lake confirmation was not until 30 May 2003 at Oologah Lake. The first inland lake in Kansas was at El Dorado Lake in August 2003. Veligers were washed down the Arkansas River from El Dorado and were first discovered in Kaw Lake in July 2004, but settled adults were not found until February 2005. Settlement from this continued downstream flow was found in Keystone Lake on 31 October 2005 and Sooner Lake on 3 May 2006.

Zebra mussels were accidentally transported from Europe to North America in the 1980's and were first found in the United States in St. Clair Lake, Michigan in 1986. Researchers believe that the mussels were accidentally transported to North America by trans-Atlantic ships. They are expected to spread across the majority of the U.S. within a decade.

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 established a National Aquatic Nuisance Species Program to control and reduce the risk of further introductions of aquatic nuisance species. It specifically addressed the zebra mussel, which is expected to impact over two-thirds of the Nation's waterways. It was renewed as the National Invasive Species Act of 1996 P.L. (101-636).

Biology and Ecology

Biological characteristics of the ZM must be considered when developing control strategies for a facility. It is important to be able to identify the mussel and to understand basic aspects of its life history and ecological requirements. Two important aspects of the life history of ZM are their strong byssal attachment to any firm substrate and the occurrence of ZM as microscopic, planktonic veliger larvae in their early life history.

Spawning occurs between 12C (54F) and 27C (80F). The eggs develop in 7 days and larval life is 7 - 30 days. The eggs and larvae are easily transported by water currents; therefore, facilities upstream of known populations are at less immediate risk. Veligers may be abundant in water when temperature exceeds 12C and can settle at any water velocity less than 1.5 mps. They prefer flows of 1.5 to 2.0 mps. (4.8 to 6.6 fps). If faster flows slow down they can attach and stay when velocity picks back up.

Most adults live two to three years. Adults are intolerant of low dissolved oxygen (less than 50% air saturation), high water temperature (30C)(86F) is stressful, 32.5C (90F) will cause mortality in 5 hours, 34C (93F) is lethal), acidic (pH less than 7), low calcium conditions (less than 15 mg/L as divalent cation), brackish water (greater than 5 ppt), turbidity over 50 TDU, and salinity above 4.5.ppt. Biochemical indicators show ZM to be their weakest in the spring and fall.

Monitoring

Monitoring for presence/absence of ZM is best accomplished by periodically inspecting substrate surfaces. Tests show that preference was given to upper over lower surfaces, textures over smooth surfaces, horizontal over vertical surfaces and prefer to settle near crevices and surface irregularities. There was no preference to light and dark substrates or among various substrate materials such as wood, steel, aluminum, plexiglas, glass, PVC, fiberglass, concrete, and limestone. Adults have substrate preferences similar to those of the juveniles. Adults can readily detach from a substrate and move .5 meter per hour, for over 24 hours. Light, in particular, appears to stimulate movement.

Artificial monitoring stations may be set out in hard to observe areas, natural waterways, or if you want data for impact analysis and ecological studies. They should not be used for plankton studies.

Control Measures

ZM are hard to control because of their high reproduction rate, rapid growth, microscopic larval stage which can be rapidly dispersed in moving water, and their ability to attach firmly to most hard substrates. Some of the more promising control measures are chlorine application, thermal treatment, surface coating, cathodic protection, mechanical filtration, and acoustics. The most popular and proven to date is chlorine application and thermal flushing, or a combination of the two.

Chlorination is popular method of ZM control. Many factors can influence the effectiveness of chlorine, such as temperature, pH, chlorine concentration, exposure time, type and quantity of chlorine compounds formed, and the size and physiological state of the ZM treated. For best results 0.5ppm total residual chlorine (TRC) is desired, 2.5ppm will kill adults in 10 - 15 days. Treatments can be end of season, periodic, intermittent, continuous, or semi-continuous. Managers must be aware of potential effects of chlorine to their facilities. Caution must be taken to insure acceptable temperature and chlorine levels in wastewater and effluent. Control measures may require an EA, EIS, or NPDES. Other chemicals and biocides are being used, however, not all EPA regions have approved uses other than chlorine for ZM control.

Thermal treatment has proven successful in many situations. Mortality can be near 100% if exposed to water temperatures of 36C (97F). Consideration should be given to the effects of thermal treatment on lubricating oil, turbine oil, hydraulic temperatures, etc. In long pipe systems the water temperature may be hard to maintain. Once the ZM have been killed most will fall off into the pipe system and must be removed. They may be found throughout the piping system, up to hydrants and nozzles. If ZM are clustered very thick on pipe walls the bottom layer of ZM may not be exposed enough to kill them. Therefore another treatment may be needed. Large powerplants, with heavy infestations, recommend conducting a thermal treatment in the Fall, to kill that seasons ZM, and another in the Spring, to kill what was not killed in the Fall.

Where the opportunity exists, freezing ZM have proven to work. They will die when exposed to -1.5C (23F) for long periods of time. At -3C (27F) mortality will be 100% in 12 hours. If the ZM are clustered very thick in may take 3 times as long.

Surface coatings are effective to some extent and may be the only alternative in some situations, such as on vessels or buoys. Any toxic metal-based surface coating will deter Zebra Mussels, also silicone based paints. The preferred coating by the U.S. Coast Guard is a water-base inorganic Zinc paint. Zinc is toxic to ZM. They have had no reoccurring infestation after 12 months.

Cathodic protection, mechanical filtration, and acoustics have shown some promise, but not enough research has been conducted to make many recommendations yet. An alternative to direct treatments is to use toxic metals such as copper, bronze, and galvanized steel. ZM avoid the toxic metals and the Zinc from galvanized steel will kill them. Many facilities are redesigning structures to be removable for easier cleanup.

Summary

The infestation of Zebra Mussels in the Arkansas and Verdigris Rivers appears to have been from a commercial vessel in late 1992. Some U.S. waterways report that once the adults have been introduced into their area they began to see substantial populations in about the third year. Other areas have taken longer to see significant populations. The rate of spread and the extent of their impact in Oklahoma waterways will depend on many factors. If conditions are right for the Zebra Mussel, once they are introduced, we will be forced to initiate control measures and change our operational procedures.