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Zebra Mussels in Virginia's Future

VIRGINIA SEA GRANT PROGRAM

VIRGINIA INSTITUTE OF MARINE SCIENCE

INTRODUCTION

The zebra mussel, *Dreissena polymorpha*, is an alien species introduced to the Great Lakes in the 1980s, via ballast water from Europe. It has since invaded all of the Great Lakes, and the Hudson, Ohio, and Mississippi Rivers. The zebra mussel is also in the upper Susquehanna River, and is expected to appear in other mid-Atlantic drainages. As a consequence of their ability to heavily foul submerged surfaces, zebra mussel populations have had severe ecological and economic impacts in areas in which they have become established.

This report summarizes the physiological requirements, dispersal mechanisms, and potential range in Virginia, of zebra mussels. Critical physiological parameters are temperature, salinity, pH, and calcium. Dispersal mechanisms discussed include both natural and human-mediated vectors. Water quality and vectors of introduction are used to predict whether zebra mussels are likely to become established in specific bodies of water in and near Virginia.

REQUIREMENTS

Optimum temperatures for growth and reproduction of zebra mussels are between 12 and 26°C, so temperatures in the mid-Atlantic region are unlikely to be limiting. While zebra mussels are found primarily in freshwater, they can persist in slightly brackish water (0.5‰), and tolerate salinities of up to 12‰ for a few days. Zebra mussels can survive short periods of acidity, but require relatively alkaline water (above pH 7.5) to reproduce. Calcium, required for shell growth, may be limiting in some bodies of water.

DISPERSAL

Zebra mussel adults and juveniles can crawl short distances, but the primary means of natural dispersal is by planktonic larvae and postlarvae. Zebra mussels are more likely to become initially established in lakes or estuaries, than in rivers where the



Zebra Mussels, *Dreissena polymorpha*

dispersing forms would be swept away. Zebra mussels may reach high densities in rivers, however, if there are lakes or reservoirs upstream which have reproducing populations. Once zebra mussels are established in a lake, all lakes and estuaries downstream are subject to invasion by drifting larvae. Most mid-Atlantic estuaries have large freshwater portions, many with nearly ideal water chemistry, in which zebra mussels can become established.

Zebra mussels can be introduced to bodies of water by several human-mediated means. Larvae and postlarvae may be transported long distances in the ballast water of commercial ships, and it was by this means that they were introduced to the Great Lakes. The hulls of commercial vessels also represent a means of transport. Adults and juveniles attach to the hulls of vessels which may subsequently move upstream or across salinity barriers. At the new location, the zebra mussels can detach and reattach to a nearby substrate, or adults may reproduce and release larvae at the new location. Barges are an important example of this, because they remain in one place for long periods of time and are infrequently cleaned of fouling organisms, but any vessel could serve as a vector. Zebra mussels can survive several days out of water and can be introduced via the hulls of recreational craft trailered between watersheds. Alternately, larvae or postlarvae could inadvertently be trans-

ported in the bilge or bait wells of recreational vessels. The possibility also exists that zebra mussels may be deliberately introduced by landowners to increase water clarity of ponds or lakes.

POTENTIAL RANGE: ESTUARIES

POTOMAC RIVER

The freshwater portion of the Potomac estuary stretches from Washington, to near Quantico, Virginia. Zebra mussels are most likely to be introduced to the Potomac River by vessels traveling from nearby estuaries or the Great Lakes, either attached to hulls or in ballast water. Water quality in the Potomac is suitable for zebra mussel reproduction. The risk of invasion is high and, once established, zebra mussels would rapidly attain pest proportions.

RAPPAHANNOCK RIVER

The tidal freshwater portion of the Rappahannock estuary extends from Fredricksburg to near Tappahannock. Invasion of the Rappahannock could occur from upstream reservoirs, or vessels from other estuaries could bring in zebra mussels attached to their hulls. Water quality is not conducive to reproductive success of zebra mussels. Invasion risk and establishment potential are moderate for the Rappahannock.

PIANKATANK RIVER

The Piank tank and the adjoining freshwater tidal portion, Dragon Swamp, have no major upstream reservoirs, and limited vessel traffic. The water has low pH and calcium, and is unlikely to support zebra mussels. Risk of invasion and establishment is low compared to other estuaries.

MATTAPONI AND PAMUNKEY RIVERS

The Mattaponi and Pamunkey Rivers unite at West Point to form the York River estuary; however, the freshwater portions remain separate. The Mattaponi River has several upstream reservoirs which are at risk of introduction via recreational vessels. Traffic from other estuaries is moderate. Water chemistry is unlikely to support large populations of zebra mussels. Risk of introduction is moderate but reproductive success would be low.

JAMES RIVER

The freshwater tidal portion of the James River extends from Richmond to Jamestown, Virginia, and includes portions of the Chickahominy and Appomattox Rivers. The James River drainage has many large reservoirs with heavy recreational use. Zebra mussels may be introduced to these lakes via trailered pleasure craft. The James River is industrialized and traffic from other estuaries is heavy. Large vessels carrying ballast water visit the Port of Richmond from freshwater European ports. Conditions favorable for zebra mussel reproduction are found throughout the estuary, and zebra mussels will attain pest populations if introduced. Risk of invasion and establishment are high for the James River.

ELIZABETH RIVER/ALBEMARLE SOUND

The South Branch Elizabeth River in Chesapeake, Virginia, is Albemarle Sound in North Carolina via the Chesapeake and Albemarle Canal and the Dismal Swamp Canal. Back Bay, in Virginia, is the northernmost portion of Albemarle Sound, and is usually fresh. These bodies of water are interconnected by an intricate network of canals and ditches. If zebra mussels become established in any part of the system they will spread to all other portions that have adequate water chemistry. They are most likely to be introduced to the system by the heavy vessel traffic from other estuaries. Water chemistry is sufficient for zebra mussels throughout much of the system although populations in Back Bay would

be limited in some years by salinity, and the Dismal Swamp Canal is too acidic for zebra mussel survival. In general, however, invasion risk and establishment potential are high for these bodies of water.

POTENTIAL RANGE: LAKES

CLAYTOR LAKE

Claytor Lake is a multi-purpose reservoir on the New River (Kanawha River), a tributary of the Ohio. Recreational use is heavy and zebra mussels are likely to be introduced via recreational vessels. Risk of invasion is high but water chemistry varies, making establishment potential moderate.

FLANNAGAN RESERVOIR

John W. Flannagan Reservoir is on the Pound River, a tributary of the Ohio via the Big Sandy River. Opportunities for introduction by the hulls of small recreational vessels are high. The water is alkaline but calcium varies; zebra mussels will survive but reproduction may be calcium-limited in some years.

KERR RESERVOIR AND LAKE GASTON

John H. Kerr Reservoir and Lake Gaston, just downstream, are large multi-use impoundments on the Roanoke River, which ends in the Albemarle Sound. The lakes are heavily used by recreational boaters and fishermen and are downstream of a variety of public-access reservoirs. Kerr Reservoir and Lake Gaston are, therefore, at higher risk of invasion by zebra mussels via recreational vessels than any other lakes in Virginia. Water chemistry is optimal for reproduction in portions of both lakes and, once introduced, zebra mussels will rapidly become established.

LAKE ANNA

Lake Anna, on the North Anna River, is the largest reservoir in the Pamunkey River drainage. Recreational boaters use Lake Anna as well as two other lakes upstream, thus, opportunities for introduction are high. Water chemistry is not favorable for zebra mussels, however; the chance that they will become established is low.

LAKE CHESDIN

Lake Chesdin, on the Appomattox River, receives heavy recreational use but water chemistry is unsuited for zebra mussels. Therefore, risk of invasion is high but establishment potential is low.

PHILPOTT RESERVOIR

Philpott Reservoir is on the Smith River, a tributary of the Roanoke River via Dan River. Opportunities for introduction via recreational vessels is high. The water is generally alkaline but calcium levels are low making zebra mussel reproduction unlikely and establishment success low. If zebra mussels did become established in Philpott Reservoir, they would spread downstream to Kerr Reservoir and Lake Gaston.

SMITH MTN. LAKE AND LEESVILLE LAKE

Smith Mountain Lake is a large reservoir on the headwaters of the Roanoke River, and Leesville Lake is directly below it. Smith Mountain Lake is heavily used by boaters and fishermen and opportunities for introduction are numerous. Water chemistry conditions will support zebra mussels but in some years population levels may be limited by calcium.

WESTERN BRANCH RESERVOIR

Western Branch Reservoir is one of many similar lakes in the Nansemond River drainage. Recreational use, and therefore risk of introduction, is moderate. Water chemistry is favorable for zebra mussels so once introduced, they would reach high population levels.

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