ZEBRA MUSSELS IN COMMERCIAL VESSELS ON INLAND WATERWAYS

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WHAT PROBLEMS DO ZEBRA MUSSELS CAUSE ON VESSELS?

- **reduced suction**
- **sedimentation**
- **pitting**

Zebra mussels attach primarily to the sea chest, and in piping leading from the sea chest. Their attachment not only reduces suction, but can also cause increased siltation in the sea chest by blocking drainage and creating a rough surface for silt to collect. Zebra mussels have been found attached in the area of the keel coolers and occasionally attached to the hull. It is suspected that dense colonies in these areas can accelerate damage due to pitting.

HOW DO THEY GROW AND SURVIVE?

- **microscopic, free-floating larvae**

Zebra mussels reproduce by sending microscopic, free-floating larvae into the water. In a river, a colony of zebra mussels produces a batch of larvae. These larvae float down river and grow for 7-30 days. In cooler water, they grow more slowly, in warmer water, they grow more quickly. The larvae are most abundant in the water from the beginning of May through the end of October.

When they have grown enough, the larvae settle onto something with a hard surface and attach themselves – in a sea chest, for example. Because their growth depends on temperature, and the river temperature changes so much as the larvae ride downstream, it is hard to predict where and when they will settle. Some vessels may have the bad luck to be in the "wrong place at the wrong time". When zebra mussels settle, they are smaller than the head of a pin, and they can settle by the hundreds of thousands. They grow rapidly. After one year of growth, they will be about $^1/_2$ - $^3/_4$". They attach quite strongly to a surface with a bundle of threads. The maximum size for zebra mussels after several years growth is about 1".

- **moderate temperatures**

Settled zebra mussels like moderate water temperatures and do well in 55-85^{0}F. When water temperatures are lower than this, they survive well but stop growing. When water temperatures are higher than 85^{0}F for an extended period of time, they will stop growing, start to lose weight, and eventually die because the temperature is too high.

- **when they die**

When they die, the body inside the shell disintegrates and the shell falls off. The shell will float down river or it can be sucked further into a piping system. The bundle of attachment threads remain fastened to the surface. A large die off of mussels can result in a large accumulation of shells in a strainer.

WHERE IN THE U.S. ARE THEY KNOWN TO LIVE?

Zebra mussels are now distributed throughout the major inland navigable waterways (See map). However, they do not live in all of the rivers on these waterways.

- **favorable river conditions**

Vessels operating primarily on the Illinois, Ohio, and Upper Mississippi rivers are at the greatest risk for rapid zebra mussels infestation. The water conditions on these rivers are ideal for zebra mussel growth and survival, and the lock and dam system may offer greater opportunities for vessel infestation. Vessels operating primarily on the lower Mississippi will also suffer some infestation, but levels are likely to be much lower because of reduced opportunity for infestation and periodic summer die-offs due to high temperature.

WHERE WON'T THEY LIVE?

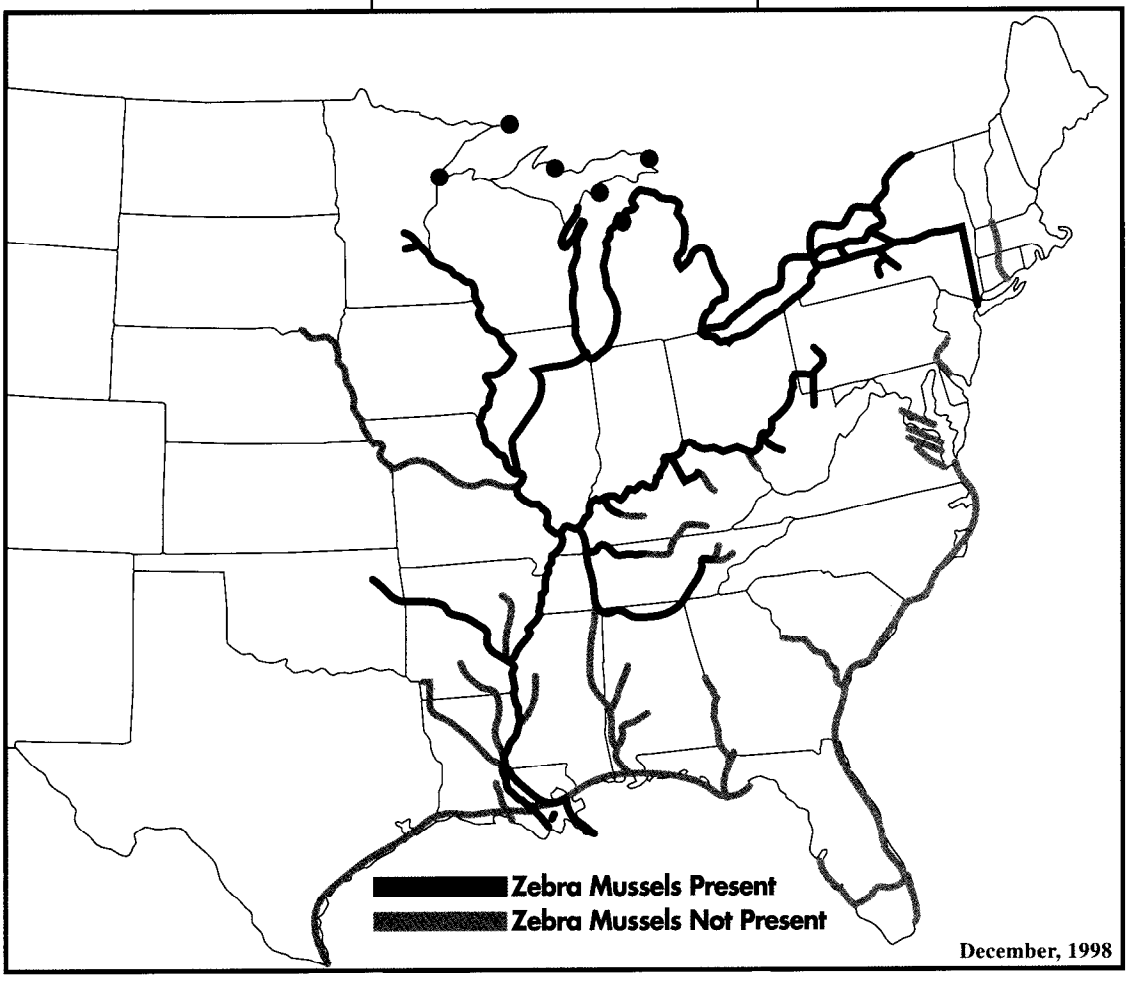
Like most animals, zebra mussels tend to be found in the areas which are better for growth. They are more abundant in areas with much better growing conditions. However, zebra mussels are seldom found in certain types of water.

- **salt water**

Their bodies cannot handle salt water, so they have not been found on vessels which normally operate or make frequent trips through salt water.

- **soft water**

They are also generally not found in very soft waters (those without magnesium or calcium).



This may be the reason that zebra mussels have not colonized the Tenn-Tom Waterway or the Ouachita River.

• low oxygen

They also tend not to be found in very stagnant waters which lack oxygen for long periods of time.

• upstream spawning source

They have not been reported within the navigable reach of the Missouri River, possibly because there are no dams to create a stable, upstream source of new population.

WHERE DO THEY LIVE INSIDE THE BOAT?

• sea chest, piping systems, recessed keel cooler box

The most common place for zebra mussels to attach to commercial vessels is on the sea chest. They can also be found inside suction piping leading from the sea chest and attached in the recessed areas around the keel coolers. They tend not to be abundant on hulls which are in service. If a vessel or barge is tied up for any length of time before it is put back into service, zebra mussels can build up on the hull.

WHAT CAN BE USED TO CONTROL THEM?

• pressure wash

For most towboats, zebra mussel infestation does not interfere with vessel operation between maintenance periods. Mussels can then be removed at dry dock by blasting with a pressure washer. Pressure washing with hot water or after allowing the mussels to desiccate may be most effective.

If dry docking is infrequent or the boat has critical areas which must be maintained free of zebra mussel buildup, there are several alternatives for proactive control:

• antifoulant paint

Coat the sea chest and the covering on the sea chest with antifoulant paint. The most effective anti-foulant paints either (1) contain copper or zinc which are toxic to zebra mussels, or (2) contain silicone which discourages attachment. If a vessel has had zebra mussel build up in the recesses around the keel cooler, it is advisable to paint the area with antifoulant paint as well. The results from this treatment have been very encouraging, and there have been very few or no mussels found attached to areas treated with antifoulant paint. It is unclear whether zebra mussels are still able to attach to untreated piping leading from a treated sea chest.

• heat

Another alternative is treatment with heat. If the temperature of all the water in the sea chest is raised to 100^{0}F for at least one continuous hour, all zebra mussels directly affected by this water should be killed. In order for this treatment to be effective, it is important that the heated water affect the covering on the sea chest as well as the area inside the sea chest. This treatment has not been installed on any vessels yet, but it has been recommended by several experts on zebra mussel fouling. The advantage to this type of control is that the piping system can also be treated without risk of increased corrosion.

It has been noted, however, that zebra mussels are able to attach to areas around the skin keel coolers despite the high temperature of the engine coolant. It is possible that raw river water moving past may offer the mussels enough relief from the high temperatures of the coolers. This area, however, needs further study.

• chlorine

Recent experiences have shown that regular applications of chlorine can be effective in controlling zebra mussels on vessels operating on the upper rivers. Vessels using this method of control reported no mussels infestations in the sea chests although mussels are still found attached to their keel coolers if not treated with antifoulant paint. To get effective control, one chlorine puck (like those used in swimming pool strainers) is introduced into the sea chest once a month. This form of chlorine is easy to handle and requires minimal retrofit. This disadvantage of using chlorine is the increased risk of corrosion to the sea chest and piping.

Regardless of whether heat or chlorine treatment is used, it is not necessary to treat every month of the year. Abundances of larvae are very low form 1 November to 30 April and treatment during this time is unnecessary. From 1 May to 30 October, treatment should be done monthly to keep new larvae from becoming established. In this way, zebra mussels are eliminated from the system when they are very small, and no problems are caused by the release of larger shells form dead animals. We strongly recommend that the treatment water be discharged while the rest of the vessel is underway to minimize the effects of very hot water or chlorine on the animals and plants living at dockside.

Risk Evaluation for Boats Operating on Inland Waterways

	Range of operation includes the Ohio, Illinois, or Upper Mississippi River	Operation exclusively on the Lower Mississippi River or Tennessee River	Operation on non-infested waters and/or salt water
	Extensive raw water usage for critical systems		Raw water usage not in critical systems/back up systems available
	Small sea chest	Medium sea chest	Large sea chest
	Narrow diameter piping, low flow rate		High flow rate (>6 ft/sec), copper piping
	Infrequent dry dock schedule (less than once a year)	Dry dock once a year	Dry dock every six months
	No zebra mussel control in place	Antifoulant paint only inside sea chest	Antifoulant and/or heat treatment in place

Treatments recommended in this fact sheet do not exclude or supercede other methods maintenance managers might choose.

The information reported in this flyer is based on interviews with port engineers from several major towing companies operating on the inland waterways.

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