Study Pays Off

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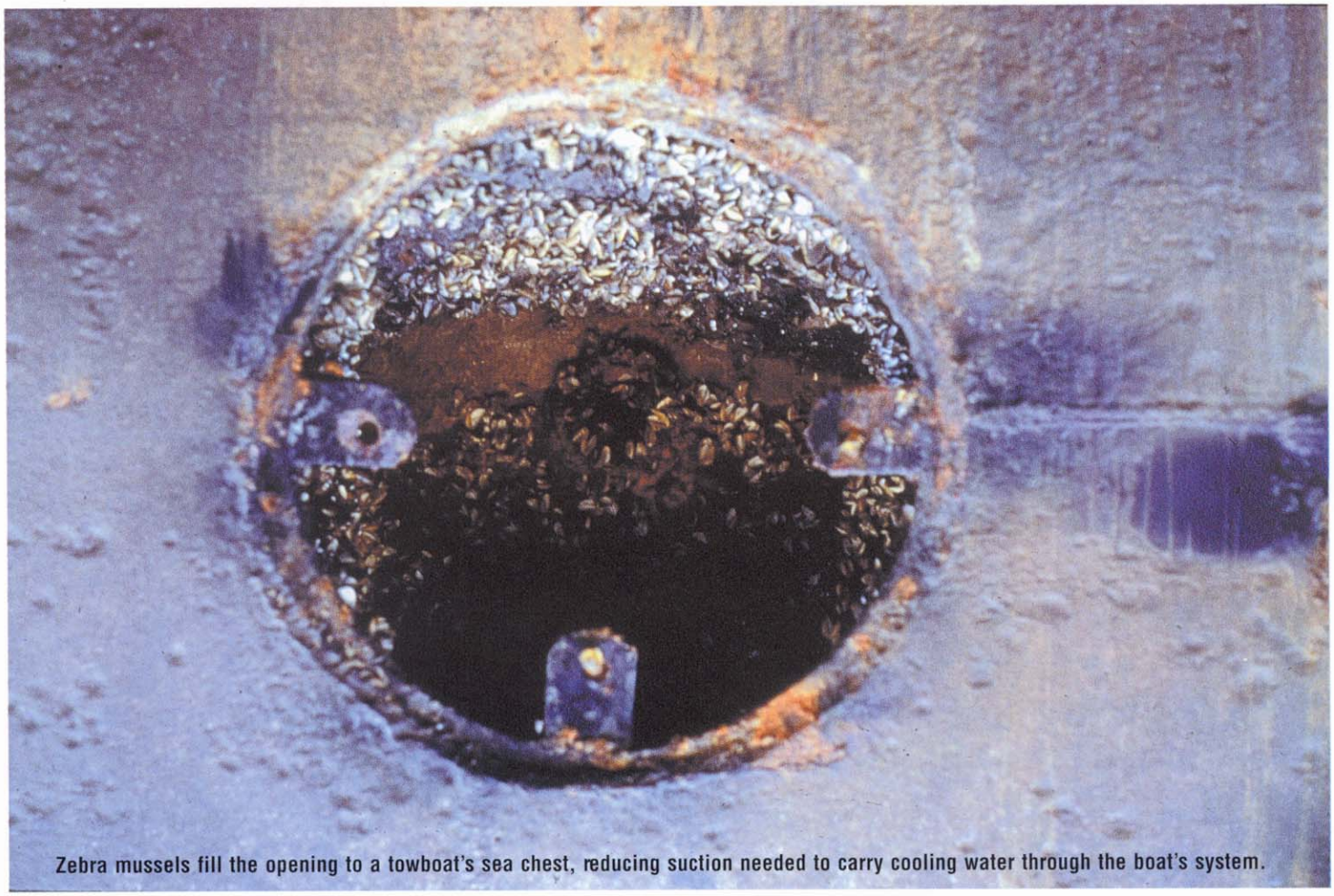
Photos by Charles Ramcharan

Yvonne Allen checks the growth of zebra mussels in a research cage at the Argosy Casino Dock in Baton Rouge.

Study sometimes pays off in unexpected ways. Scientists study an animal or plant for many years, accumulating reams of data on growth, reproduction, and other life systems and then share these with colleagues. Besides improving knowledge in a specific field of science, information resulting from such studies can be useful to people in business or industry. Such is the case with the zebra mussel. After accumulating much data on this nonindigenous species to share with other scientists, Yvonne Allen of Louisiana State University's Coastal Fisheries Institute was able to help some river-based industries help themselves.

Nonindigenous species may be troublesome when introduced into a new ecosystem. Because nonindigenous species like zebra mussels have no natural predators, they are able to multiply without any other animals to control their numbers. Those with a tolerance for a broad range of environments or with few food preferences or high food processing abilities are often able to out-compete native species for living space and food. The zebra mussel, for example, was brought to the US from the Black Sea area of Eastern Europe in the ballast water of an ocean-going cargo vessel, and it became a problem when it settled and multiplied in the Great Lakes. These mussels formed colonies in the raw water intakes of many industrial plants, sometimes multiplying until the colonies clogged the intakes and affected operations. They are expensive to clear or control. Nonindigenous species currently cost the US an estimated $3 billion per year for monitoring as well as chemical and mechanical control, according to the Department of the Interior. Zebra mussels subsequently spread to waters throughout the northern states and the interior just east of the Mississippi River as well as throughout the Mississippi River Basin to the Gulf of Mexico. Allen was part of a team that began to



Zebra mussels fill the opening to a towboat's sea chest, reducing suction needed to carry cooling water through the boat's system.

study them in the Lower Mississippi Region to help river-using power companies control mussel infestations. This early study helped surface water using industries like power companies develop a monitoring protocol and learn about alternative control measures.

Allen's work expanded to towboats plying the Mississippi when these pesky critters also began to settle in the boats' sea chests and raw water intakes. These vessels operate continuously, carrying US products to various river ports along the Mississippi River Waterway System. They may travel between various river ports on the Ohio, Monongahela, Tennessee and other Mississippi tributaries while carrying cargo to and from the nation's heartland and major Gulf of Mexico ports. Vessel operators want to avoid operations emergencies or unexpected work stoppages resulting from zebra mussel infestations. These can reduce suction, increase sedimentation, and/or reduce the efficiency of heat exchangers on a towboat's raw water system.

Through responses to a questionnaire and to telephone interviews, Allen gathered data specific to the towboats and their mussel infestations, and, as she accumulated data, noticed that infestations were not consistent among the boats. Upon further study, she noted that the frequency of mussel settlement appeared to correlate with the rivers in which the boat operated.

Zebra mussel infestation was a particular problem for boats operating in the Upper Mississippi, the Illinois and the Ohio rivers, but was less of a problem for boats operating on the Lower Mississippi. Boats operating solely on uninfested rivers such as the Missouri, Red, Ouachita, White, Black Warrior, Tombigbee, or Alabama rivers likewise had no problem with zebra mussel infestation. Using these data, Allen developed a risk characterization process that boat maintenance and operations managers now use to control zebra mussels. The process was published in a fact sheet with some alternative treatment methods that can be used during scheduled maintenance, such as flushing or scraping to remove attached mussels or coating the intake system to discourage mussels from settling.

One study leads to another. Allen compared her data on zebra mussels in the Lower Mississippi River (LMR) with similar data from the Upper Mississippi River (UMR) collected by Rick Hart of North Dakota State University, Jennifer Sauer of the US Geological Survey and Andrew Miller of the US Army Corps of Engineers Waterways Experiment Station. These data helped to identify some of the factors affecting zebra mussel growth rates under different physical conditions of the Mississippi River.

Specifically, the best conditions for zebra mussel growth are moderate temperatures of 15-25°C (59-77°F) with low suspended sediment and moderately high food (algae) concentrations. However, these animals can survive and maintain themselves in poorer environments.

"In the UMR, water temperature is generally in the ideal range for most of the spring, summer and into the fall, providing conditions for a prolonged period of good growth. Zebra mussels will survive cold winter temperatures although they do not grow," Allen said. "But they cannot survive freezing.

"Suspended sediment levels are also relatively low in the UMR, and food levels variable but quite adequate throughout most of the summer. Under these excellent growing conditions, few zebra mussels die naturally from year to year, resulting in the formation of thick mats or "reefs" of zebra mussel colonies."

Temperature plays a larger role in the seasonal dynamics of growth and death in the LMR than in the UMR. "In the LMR, the ideal temperature range generally occurs only in the spring and fall. During the summer, water temperatures in the LMR are very high, 28-30°C (82-86°F). In these temperatures, zebra mussel shell growth stops and the mussels begin to lose soft tissue weight," Allen said. "High temperature is particularly stressful for larger (greater than 15mm or 0.59 in.), older mussels which have higher metabolic demands." In extremely warm water, their energetic demands exceed their ability to gather energy, resulting in slow or no reserves left for growth.

"Suspended sediment concentrations in the LMR are also very high relative to the UMR. High suspended sediment causes

stress to zebra mussels in two ways. First, zebra mussels are filter feeders, constantly sieving water to get food. If suspended sediment levels are high, the mussel has to use extra energy to sort through and get rid of all the particles that are not food," Allen explained. "Second, high suspended sediment in the water reduces the light penetration, thus limiting the growth of algae which zebra mussels eat. When periods of high temperatures coincide with periods of high suspended sediment (for example, when river levels rise during August and September), mortality of the larger mussels can be 90 percent or greater."

Allen, Hart, Sauer and Miller concluded that total observed infestation is generally lower on the LMR than on the UMR, and "reefs" of zebra mussels more than two layers thick are not generally found in the southern reaches of the river. The largest live mussels on the LMR are generally less than about an inch long because many of them die at the end of their second year. Mussels live longer and grow larger on the UMR. By publishing this information, the scientists are providing towing companies and other river-using industries with useful information to incorporate zebra mussel control into operations as well as maintenance planning.

For Mississippi River using industries trying to control zebra mussels, this means that those on the UMR must control mussels that grow fairly steadily for most of each year. Nature provides little help except occasional very low temperatures in winter that might freeze a few zebra mussels. However, industries on the LMR can use nature's help from regular summer heat to stress most mussels and reduce infestations. Time will tell if this help from nature reduces the effort southern industries must exert to control zebra mussels.

These studies continue. Allen and other scientists are currently looking at the water chemistry in these rivers to determine possible effects on zebra mussel growth. Study pays off again, and again and again.

Yvonne Allen and an unidentified shipyard worker examine zebra mussels infesting recesses on a towboat's keel coolers.