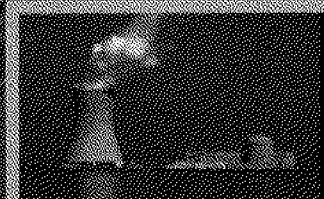
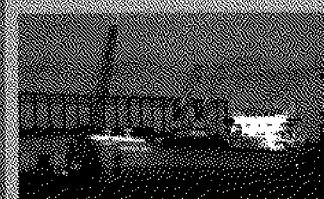


ZEBRA MUSSEL:

Present Threat, Future Danger?

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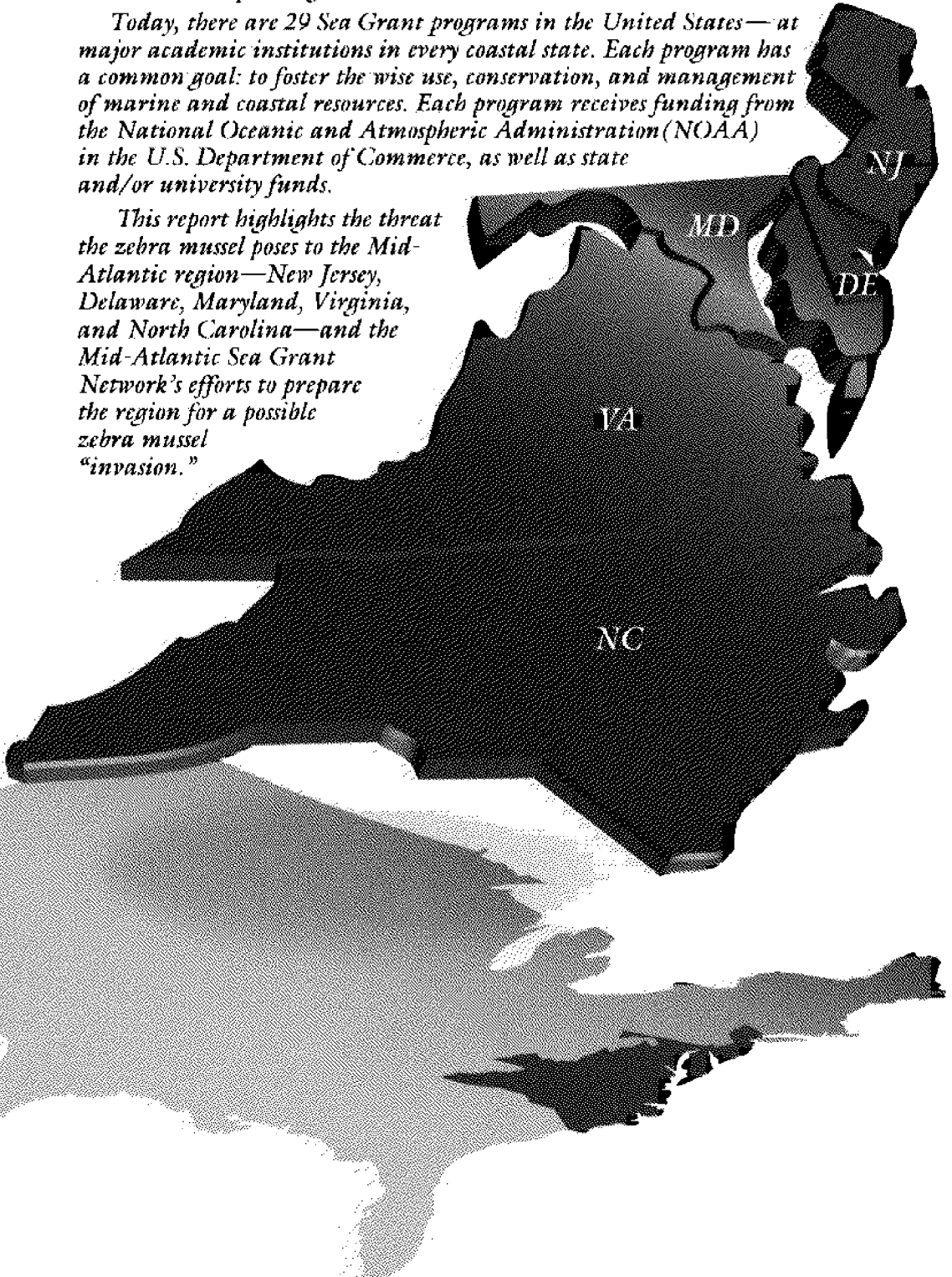
A REPORT FROM THE MID-ATLANTIC SEA GRANT NETWORK
— 1992-1993 —

The MID-ATLANTIC SEA GRANT NETWORK

In 1966, Congress established the National Sea Grant College Program to conduct research, education, and public service in support of the nation's ocean, coastal, and Great Lakes resources. The name "Sea Grant" was chosen to emphasize the parallel between this program focusing on the sea, and the Land Grant program created more than a century earlier to develop our agricultural resources.

Today, there are 29 Sea Grant programs in the United States—at major academic institutions in every coastal state. Each program has a common goal: to foster the wise use, conservation, and management of marine and coastal resources. Each program receives funding from the National Oceanic and Atmospheric Administration (NOAA) in the U.S. Department of Commerce, as well as state and/or university funds.

This report highlights the threat the zebra mussel poses to the Mid-Atlantic region—New Jersey, Delaware, Maryland, Virginia, and North Carolina—and the Mid-Atlantic Sea Grant Network's efforts to prepare the region for a possible zebra mussel "invasion."



In July 1988, the zebra mussel (*Dreissena polymorpha*)—a creature new to North American waters—was sighted in Lake St. Clair, near Detroit, Michigan. A native of the Black Sea, the small black-and-white striped mussel apparently hitched a ride to the United States in the ballast water of Eurasian tankers bound for the Great Lakes.

Soon after it arrived in the Great Lakes, the zebra mussel began wreaking havoc, for the tiny mollusk (average size: 1½ inches) can attach itself firmly to virtually any solid object in fresh or slightly brackish water, with often disastrous results.

In the Great Lakes region, the zebra mussel has clogged the intake pipes of municipal water plants and power companies and even the water systems of golf courses. It has glued itself to the shells of other freshwater mollusks, including several species of endangered clams, effectively smothering them.

The zebra mussel's sheer numbers combined with its method of feeding—filtering tiny plants and other organic matter from the water—have caused a reduction in the food supply needed by other shellfish and the larval stages of some finfish in the Great Lakes.

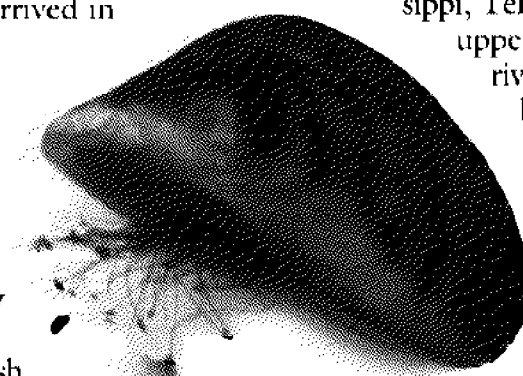
In addition to changing the aquatic ecosystem, the zebra mussel's impact on fishing, boating, and beach use also has been

significant—and costly. The costs associated with zebra mussel control in the Great Lakes are expected to approach \$5 billion by the end of this decade.

And now the zebra mussel may be headed our way. Since the first sighting in Lake St. Clair in 1988, the zebra mussel has spread beyond the Great Lakes to the Hudson, Mohawk, Illinois, Ohio, Mississippi, Tennessee, and upper Susquehanna rivers. Biologists believe it ultimately will infest most North American waters south of central Canada and north of the Florida Panhandle.

The National Sea Grant College Program has launched major initiatives focusing on research to determine better methods to control the zebra mussel and on outreach efforts to assist water users affected or threatened by the pest.

In the Mid-Atlantic region, Sea Grant programs in New Jersey, Delaware, Maryland, Virginia, and North Carolina are working to alert the public we serve about the mussel and its threat to our fresh and brackish waters. Combining a strong program of applied research and public outreach, and coordinating with partners at agencies and industries throughout the region, our goal is to prepare the region to respond effectively to the zebra mussel if the pest sets foot in our waters.



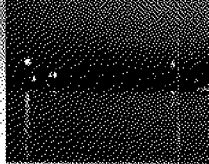
ASSESSING THE MID-ATLANTIC THREAT

In June 1993, a boater spotted an unfamiliar mollusk on the hull of his boat docked at a marina along the Chesapeake and Delaware Canal. He had heard of the zebra mussel and contacted the Sea Grant program at the University of Delaware for assistance. Fortunately, the tiny shellfish was not the destructive foreign

The zebra mussel was identified in the headquarters of the Susquehanna River in New York in 1991, but so far it has not been found farther downstream. However, it has infested several neighboring waterways, including the Hudson River and Ohio River. The proximity of these waterways to the region lends even more strength to scientists'

accidentally shuttle the zebra mussel to new waters. Eurasian tankers introduced the zebra mussel to the Great Lakes when these vessels discharged their infested ballast water.

In the Mississippi and Ohio rivers, zebra mussels may attach to the hulls of barges and thus travel to new territory.



invader, *Dreissena polymorpha*, more commonly known as the zebra mussel. For the Mid-Atlantic region, however, the zebra mussel's arrival may only be a matter of time.

So far, the zebra mussel has not been discovered in the waters of New Jersey, Delaware, Maryland, Virginia, and North Carolina. But it is moving closer to us.

predictions that a zebra mussel infestation in the Mid-Atlantic is no longer a question of "if" but "when."

How Will the Zebra Mussel Get Here? While it is possible that waterfowl, turtles, and other animals could help disperse the zebra mussel to new areas, human activity will be the most likely means of transport.

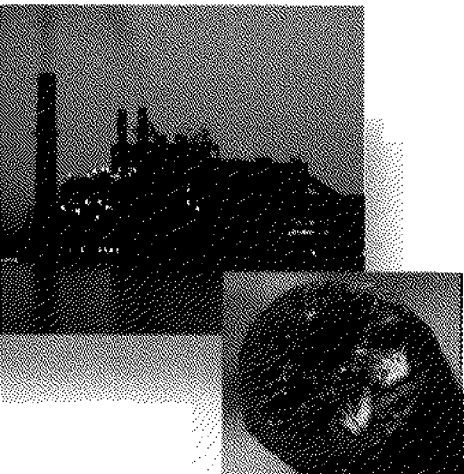
Ships, barges, and boats may all

Even the recreational boater or angler may unknowingly transport the zebra mussel to a new home. Boats and boat trailers, bait buckets, and bait may harbor the mussel or its microscopic larvae, called *veligers*.

Yet a water body's susceptibility to zebra mussel infestation depends primarily on its chemistry and certain environmental parameters.

What Does the Zebra Mussel Need to Survive?

What makes the zebra mussel such a formidable pest is its resilience. It can survive as long as a week out of water. It can also tolerate a fairly wide range of environmental conditions. It can withstand salinities as high as 12 parts per thousand, a pH range from 7.0 to 9.0, and water temperatures from just above freezing to 91° F (33° C).



Given such conditions, the zebra mussel could survive in a variety of aquatic areas in the Mid-Atlantic region, from freshwater ponds, reservoirs, and lakes to the less salty, upper reaches of such expansive estuaries as the Delaware Bay and the Chesapeake Bay.

Many of the water bodies that are at risk of zebra mussel infestation in the Mid-Atlantic are

Research Puts Muscle into Mussel Control

Combating the zebra mussel requires a coordinated program of research and outreach—Sea Grant scientists focus on learning more about the mussel's biology to devise better methods to control the pest; Sea Grant outreach specialists then relay the results to water users.

Several zebra mussel research projects are under way in the Mid-Atlantic region:

- ◆ At New Jersey Sea Grant, Dr. Dimitri Donskoy is examining the use of acoustic, vibrational, and hydrodynamic techniques to control zebra mussel infestation in water intake systems.
- ◆ At Maryland Sea Grant, Dr. David Wright is investigating the temperature and salinity tolerance of zebra mussel larvae under conditions common to northern Chesapeake Bay during spawning season. Results of survival and growth observations will aid scientists in further predicting the mussel's potential behavior and impact on the estuary.
- ◆ At Delaware Sea Grant, Dr. Herbert Waite (above) is examining the zebra mussel's foot, the muscular appendage that produces the glue that enables the animal to bond to surfaces underwater. If he can decode the gluey foot's chemistry, a chemical control could be developed to "shoot the mussel in the foot" and prevent it from attaching to intake pipes and other objects. Scientists would also have the chemical recipe needed to create a synthetic mussel glue for use in dentistry and other fields where strong adhesion is needed on wet surfaces.



The Zebra Mussel: Are We Crying Wolf?

How do you educate people about a creature that threatens the region but has not yet arrived here? That's the challenge facing the Mid-Atlantic Sea Grant Network.

In the Great Lakes region, many residents have had to learn the hard way about the zebra mussel. For example, the water treatment plant in Monroe, Michigan, was shut down by zebra mussels clogging the plant's intakes. "All the people who thought zebra mussels were not their problem

woke up one morning and found they couldn't make coffee, they couldn't flush the toilet," said Fred Snyder, an extension specialist at Ohio Sea Grant. "All of a sudden, the zebra mussel was their problem."

The Great Lakes region had no advance warning of the zebra mussel's arrival in 1988. To deal with the invasion, Sea Grant staff needed to quickly become experts on the mussel. It is these colleagues—from Sea Grant programs in New York, Ohio, Illinois, Indiana, Michigan, Wisconsin, and Minnesota—who have helped train Sea Grant outreach staff in the Mid-Atlantic region, as well as in New England and the Southeast.

In 1990, a key resource was established at New York Sea Grant with funding from electric utilities, public water authorities, industry, and the National Sea Grant College Program: the Zebra Mussel Information Clearinghouse. This public, non-profit organization maintains an extensive library of publications and audiovisuals on the zebra mussel and related biofoulers, publishes the bimonthly *Dreissena polymorpha Information Review*, and offers print and electronic data bases of its Technical Collection Bibliography. The Mid-Atlantic Sea Grant Network routinely refers clients to the clearinghouse. For more information, please contact the clearinghouse at (716) 395-2516 or (800) 285-2285.



the same waterways that provide us with drinking water, and supply such major industries as electric and nuclear power, farming, shipping, oil refining, pulp and paper manufacturing, aquaculture, and recreational fishing and boating.

How Could the Zebra Mussel Affect These Operations? At a municipal water plant, for example, the mussel colonizes the intake pipes because they offer exceptionally good habitat: the water flow provides a continuous source of food (plankton) and oxygen and carries away the mussel's wastes, while the structures protect the mussel from predators, such as ducks and some species of fish.

The zebra mussel responds to these optimum conditions by extensively colonizing the pipes, leading to severely reduced water supplies and many other problems.

Ridding a facility of the zebra mussel is often an expensive proposition since industries in the United States have not encountered the pest before and coping with it requires new control strategies, ranging from chlorine dosing to hydroblasting and often costly retrofitting.



ASSISTING MID-ATLANTIC WATER USERS

In 1992, Sea Grant outreach specialists from New Jersey, Delaware, Maryland, Virginia, and North Carolina were awarded a federal grant to increase public awareness of the zebra mussel and begin preparing the Mid-Atlantic region for a possible invasion.

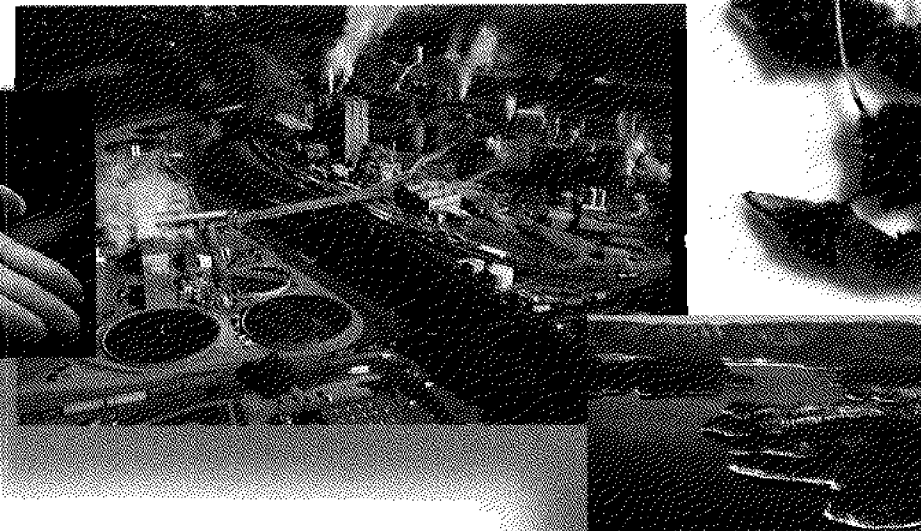
From hands-on zebra mussel identification programs to radio public service announcements, the

mussel were to appear in local waters. The Mid-Atlantic Sea Grant Network continues to inform more than 500 industries of the mussel's status and control methods and is helping many develop monitoring programs.

For example, Maryland Sea Grant hosted the region's first Mid-Atlantic Zebra Mussel Conference in March 1993 in Baltimore.

The event included a hands-on training session to help 80 participants identify zebra mussels at various life stages.

Working with local power companies, North Carolina Sea Grant produced a Geographical Information System (GIS) map of all sites currently being monitored for zebra mussels in the state and nearby areas of Virginia and South Carolina.



Mid-Atlantic Sea Grant Network has developed a variety of approaches to reach water users who could be seriously affected by the zebra mussel. The following are selected highlights.

Industry Assistance.

Power companies, water treatment facilities, manufacturing plants, and other industries in the Mid-Atlantic region could be faced with significant risks if the zebra

The conference provided timely information to 115 representatives from regional industries and other groups. Several local power companies helped sponsor the event.

The North Carolina and Virginia Sea Grant staffs hosted a conference for industrial water users, resource agency personnel, and others in June 1993 in Greensboro, North Carolina.

Delaware Sea Grant surveyed every industrial water user in the state to learn what water-quality parameters each facility monitors. This information is being used to establish a zebra mussel monitoring program in the Delaware River and other watersheds.

Agency Partnerships.

Forming partnerships with resource management agencies and other groups maximizes

Sea Grant's zebra mussel awareness efforts. The following are just a few of the ties that have been developed between Sea Grant and neighboring agencies in the region.

Virginia Sea Grant joined with a host of agencies and industries to co-sponsor the Virginia Water Resources Conference presented by the Virginia Water Resources Research

members from private industry, state and federal agencies, and natural resource groups. The task force later hosted a regional meeting of governmental agencies and other groups that are monitoring for zebra mussels in Pennsylvania, New Jersey, and New York.

In conjunction with the North Carolina Department of Environment, Health, and

Legislative and Policy-making Activities. The Mid-Atlantic Sea Grant Network is keeping decision makers abreast of the zebra mussel's status and laying the groundwork for future management strategies.

In June 1993, Delaware Sea Grant briefed the House Committee on the Environment and Natural Resources of the Delaware General Assembly about the



Center and Virginia Lakes Association in April 1993 in Richmond. During the conference, Virginia Sea Grant presented a special seminar, "Zebra Mussels Update for Virginia," for an audience of 80 representatives from natural resource agencies, industry, and local government.

New Jersey Sea Grant was appointed chair of the state's Zebra Mussel Task Force, comprising

Natural Resources, North Carolina Sea Grant organized a 17-member Zebra Mussel Task Force comprising representatives from power companies and government agencies such as the U.S. Army Corps of Engineers and the North Carolina Department of Agriculture. The task force designated North Carolina Sea Grant as chair and center for reporting monitoring results and for obtaining updated information.

zebra mussel and distributed information packets to committee members, natural resource agency staff, and legislative aides. The committee sought Sea Grant's advice in determining if legislative action needed to be taken immediately to minimize the state's risk of infestation.

The Exotic Species Work Group (of the Living Resources Subcommittee of the Chesapeake Bay Program) chaired by

Maryland Sea Grant, produced "Chesapeake Bay Policy for the Introduction of Non-Indigenous Aquatic Species," which will help guide management strategies for the zebra mussel and other potential invaders.

Education. The Mid-Atlantic Sea Grant Network has also informed other educators about the zebra mussel.



For example, New Jersey Sea Grant helped the Pocono Environmental Education Center in Pennsylvania initiate a zebra mussel monitoring program in four water bodies in the Poconos as part of the center's public education program.

Virginia Sea Grant has developed an educational resource packet, "Invasion of an Exotic Species: Stop the Zebra Mussel," to guide students and teachers in grades 8-12.

Network Activities Prep Region for Zebra Mussel

A major goal of the Mid-Atlantic Sea Grant programs is to work cooperatively to reach water users with zebra mussel information in an efficient and cost-effective manner. The following are examples of individual state efforts that serve the entire region:

- ◆ New Jersey Sea Grant produced a Geographical Information System (GIS) map of the Mid-Atlantic region depicting potential zebra mussel infestation areas. The map will be used to help water users assess their risk of infestation.
- ◆ Delaware Sea Grant developed a decal for boaters and anglers to alert them about the zebra mussel and how to lessen their odds of transporting it into the Mid-Atlantic region.
- ◆ Maryland Sea Grant hosted the first Mid-Atlantic Zebra Mussel Conference on March 10-12, 1993, in Baltimore. The conference brought together 115 representatives from academia, industry, resource management, government, and the media to learn more about the mussel's history, biology, method of transport, and status in the region. A trade show featuring 11 vendors highlighted zebra mussel control and monitoring devices and services.
- ◆ Virginia Sea Grant scientists compiled *Criteria for Predicting Zebra Mussel Invasions in the Mid-Atlantic Region*, an 11-page review of the region's probability and susceptibility of invasion by *Dreissena polymorpha*.
- ◆ North Carolina Sea Grant produced the *Mid-Atlantic Zebra Mussel Fact Sheet*, which has been used throughout the region to introduce readers to the mussel and its potential impacts.



Mid-Atlantic Sea Grant Publications

The Mid-Atlantic Sea Grant Network published the following zebra mussel information in 1992-1993.

For a list of all Sea Grant publications on the zebra mussel, call the Zebra Mussel Information Clearinghouse at (716) 395-2516 or (800) 285-2285.



- ◆ "Can the Pesky Zebra Mussel Change Its Stripes?" *University of Delaware Sea Grant Reporter* (winter 1993). Highlights research on the glue the zebra mussel produces to attach to objects underwater. By Delaware Sea Grant.
- ◆ *Citizens Alert: Zebra Mussels Pose a Threat to Virginia's Waters*. This brochure alerts residents about the mussel, its potential economic impacts, and control. By Virginia Sea Grant, Virginia Coop. Extension, Virginia Water Resources Research Center, and Virginia Dept. of Game and Inland Fisheries.
- ◆ *Criteria for Predicting Zebra Mussel Invasions in the Mid-Atlantic Region and Potential Range of the Zebra Mussel In and Near Virginia*. These reports review the region's and Virginia's risk of mussel invasion. By Virginia Sea Grant.
- ◆ "Don't Pick Up Hitchhikers!" *The Jersey Shoreline* (summer 1992). Outlines precautions to take to help prevent the mussel from invading state waters. By New Jersey Sea Grant.
- ◆ "Exotic Species Introductions: Devastation or Deliverance?" *Marine Notes* (spring 1992). Reviews the impact of zebra mussels and other non-native species on U.S. waters. By Maryland Sea Grant.
- ◆ *Mid-Atlantic Zebra Mussel Fact Sheet*. Provides an overview of the mussel and its threat to the region. By North Carolina Sea Grant.
- ◆ "Mid-Atlantic Zebra Mussel Outreach Plan." *Tideline* (summer 1992). Reviews Sea Grant's planned effort and Virginia's contribution to it. By Virginia Sea Grant.
- ◆ "Musseling into Carolina Waters." *Coastwatch* (May/June 1992). Describes zebra mussel preparedness efforts and prevention tips. By North Carolina Sea Grant.
- ◆ *Zebra Mussel Decal*. This 3 1/2 x 7-inch decal alerts boaters and anglers about the zebra mussel and the steps they can take to thwart the hitchhiker. By Delaware Sea Grant and Delaware Dept. of Natural Resources and Environmental Control.
- ◆ *Zebra Mussel Identification Card*. This wallet-sized card tells how to identify the mussel and what to do if you find one. Created by Wisconsin Sea Grant, the card is tailored to each state in the Mid-Atlantic region.
- ◆ *Zebra Mussels: A Costly Threat to North Carolina*. This brochure describes the mussel and what citizens can do to keep it out of the state. By North Carolina Sea Grant.
- ◆ *Zebra Mussels: A Threat to Maryland Waters*. This brochure identifies the mussel and steps to take to stop its spread. By Maryland Sea Grant and Maryland Dept. of Natural Resources.
- ◆ "Zebra Mussels Head for the Bays." *Marine Notes* (Dec. 1991-Jan. 1992). Recounts the mussel's history in the U.S. and provides tips for mussel prevention. By Maryland Sea Grant.

Media Awareness and Public Information. Sea Grant's outreach team also has targeted the news media and the general public for zebra mussel information. So far, the network has distributed more than 100,000 publications to industry representatives, boaters, anglers, resource managers, teachers, and other Mid-Atlantic residents. The following are other high-impact efforts.

New Jersey Sea Grant produced a series of customized radio public service announcements for broadcast in New Jersey, Delaware, Maryland, Virginia, and North Carolina, reaching a potential listening audience of 20 million.

News releases and articles have resulted in coverage by a variety of newspapers, from the *Philadelphia Inquirer* to the *Delmarva Farmer*, and magazines such as *Wildlife in North Carolina*, *New Jersey Fish and Wildlife Digest*, and *Outdoor Delaware*.

All programs in the network have been developing audiovisuals to use at workshops and meetings. Maryland Sea Grant's "Zebra Mussels: A Threat to Maryland Waters," has been used to train Maryland park managers, state natural resource managers, engineering companies, and private citizens in fishing and hunting clubs and other groups.

Future Efforts. In 1992-1993, the Mid-Atlantic Sea Grant Network played a key role in alerting the region's water users of the zebra mussel's threat.

During the next year, the network's goal is to continue delivering timely, accurate information to prepare the region for the zebra mussel's eventual arrival.

MID-ATLANTIC SEA GRANT CONTACTS

The following programs are members of the Mid-Atlantic Sea Grant Network. Please contact the program in your state for more zebra mussel information:

University of Delaware
Sea Grant College Program
Marine Advisory Service
700 Pilottown Road
Lewes, DE 19958
Contact: James Falk
(302) 645-4235

University of Maryland
Sea Grant College Program
Sea Grant Extension/NOAA
410 Severn Avenue
Annapolis, MD 21403
Contact: Dan Terlizzi
(410) 267-5660

New Jersey Sea Grant
College Program
Rutgers Coop. Extension
1623 Whitesville Road
Toms River, NJ 08755
Contact: Eleanor Bochenek
(908) 349-1152

North Carolina
Sea Grant College Program
North Carolina State Univ.
1130 Jordan Hall, Box 8208
Raleigh, NC 27695-8208
Contact: Barbara Doll
(919) 515-5287

Virginia Sea Grant
College Program
Marine Advisory Program
Virginia Institute of
Marine Science
Gloucester Point, VA 23062
Contact: William DuPaul or
Vicki Clark
(804) 642-7164

This report was written by Tracey L. Bryant and James M. Falk of the University of Delaware Sea Grant College Program, a member of a national network of universities committed to research, education, and technology transfer designed to meet the changing needs of our ocean, coastal, and Great Lakes regions. The program is financially supported by the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, the State of Delaware, and the university. This publication was produced by Tracey Bryant, editor; David Barczak, art director; and Pamela Donnelly, production manager. For more information, contact the University of Delaware Marine Communications Office, Newark, DE 19716-3530. Phone: (302) 831-8083.

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