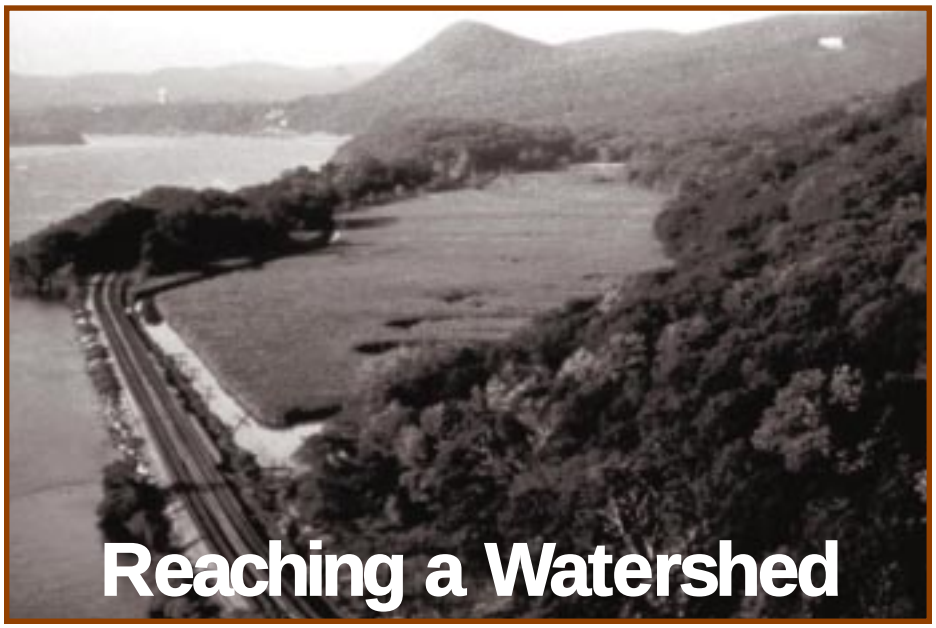
Sea Grant
New York

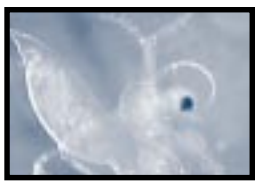
Hudson Valley Photo by NY Dept. of State



Reaching a Watershed

What is a watershed? Simply put, a watershed is the entire area of land that drains into a single stream or water body. It is the land that water, sediment and dissolved materials flow over or under on their way to a stream, river, lake, estuary or wetland. Think of the hills in your neighborhood— a drop of water falling on one side of a hill flows into one watershed, and a drop falling on the other side may roll to another watershed. Since a watershed encompasses all the areas that would contribute pollution to a particular body of water they are good focal points for managing coastal resources. Watershed management transcends social and political boundaries to take into account the geology, topography, hydrology and pollution impacts of a particular area on a coastal water body.

Continued on page 4



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From the Director

Watersheds have recently become a major focus of aquatic resource management. Before the 1960's, watershed management by groups like the Delaware River Basin Commission was concerned primarily with "crisis management"— preventing disasters due to floods or ensuring equitable supplies during droughts.

In the 1960's and 70's, the Clean Water Act Amendments ushered in a more extensive watershed management approach. For example, efforts were made to ensure that the natural processes that maintain a stream's oxygen levels exceeded the oxygen demands made by sewage or chemical effluents that reduce oxygen and negatively impact life in the stream. However, these efforts were aimed toward studying the matrix of processes within the stream itself.

In contrast, current watershed management takes an ecosystem approach. This approach recognizes that processes and activities in the terrestrial portion of the watershed influence water quality and quantity in downstream— sometimes far downstream— lakes, streams and estuaries. An example of the application of this concept is the Sound Gardening program (reported in the Fall 1998 *Coastlines,* Vol. 27, #1), which teaches gardening techniques that protect the watershed by preventing the release of nutrients from fertilizers that could pollute local water bodies. Such releases have been identified as critical contributors to the nutrient levels in such New York waters as the Peconic Estuary.

Resource management at the watershed level appears sure to increase in the future. The US Environmental Protection Agency is increasing its watershed focus in regulating contaminants. And the NYS Department of Environmental Conservation is organizing consideration of non-point source pollution around the state's watersheds. Although not a panacea, the watershed seems to be a logical framework on which to make decisions about pollutant releases.

This issue of *Coastlines* documents some of the work that NYSG is doing that relates to watersheds (page 1). Research is being conducted on Long Island Sound, a major resource that is impacted by watershed activities in both New York and Connecticut (pages 6-9). Extension specialists are educating students, teachers and the general public about both watershed concepts (pages 3, 5 and 13) and non-indigenous species that have invaded many of New York's key watersheds (pages 10-11).

Also in this issue is a one-page budgetary annual report. With special help from both the New York Senate and Assembly, 1998 marked the first time New York Sea Grant's budget passed $4 million. Even in a single table, it is easy to recognize the application of research, extension and education toward development and protection of New York's coastal resources.

New York Sea Grant Director Jack Mattice (left) and Associate Director Dale Baker confer at the NYSG display table during the biennial Sea Grant Week held in Portland, Oregon in June.

In this fall Coastlines, we educate our readers about watersheds — what they are and the issues that affect the quality of our precious water resources.

Says **EPA Administrator Carol Browner**, "Water quality restoration across the country over the past 25 years has had dramatic environmental, recreational and economic benefits. Despite this progress, serious water pollution problems persist." Therefore, the EPA has scheduled a National Watershed Outreach Conference in San Diego next April to further address the matter.

In doing its part, **New York Sea Grant** supports a wide range of research and outreach education that, as featured inside, deals with such related concerns as aquatic contaminants, hypoxia and invasive species. In addition, several NYSG extension specialists integrate water resource education into their individual program efforts, including this issue's feature writer, **Kimberly Zimmer**.

Photo courtesy of Nordica Holochuck

Suited up and ready to board

Nordica Holochuck, NYSG Hudson Valley Specialist (kneeling at left), instructed nine K-12 teachers during a City University of New York Hudson River Ecology summer course that she developed. The educational forum, a partnership between Rockland County Teachers Center and Rockland County Cornell Cooperative Extension, included field explorations aboard a research vessel.

Photo by Lauren Makeyenko

Students Pledge Stewardship

Helen Domske, NYSG coastal education specialist, helped plan and host the NYSG-co-sponsored Third Biennial Great Lakes Student Summit held in Buffalo this past May. Isaac Hunter (pictured), a Detroit student in attendance who read the Summit's "Statement of Stewardship," is flanked by fellow students, East Aurora teacher John Newton (at back), and Harvey Shear of Environmental Canada (far right). See story on p. 13.

Statement of Stewardship

I am proud to take stewardship of the water, land, and air in any way that I can. As I return to my home, I pledge to:

1. *Study the ecology of my area*
2. *Teach others about my area's ecology*
3. *Increase my own awareness of the effects that I have on the environment*
4. *Promote wise use of products and packaging*
5. *Devote time every year to group community service to benefit and beautify the environment*
6. *Participate in the conservation of water, energy, and natural resources*
7. *Get involved in local decision-making*
8. *Invite scientists and others to help us*
9. *Do what I know is right*

Where's Your Watershed?

The map names the major drainage basins in New York State. Each basin in comprised of smaller local watersheds. Map courtesy of NYSDEC

"Watershed," continued from front cover

Streams and rivers pick up pollutants from human activities that occur in the watershed as they flow down to the coast. Pollution associated with human activities such as farming, gardening, boating, building, driving and even walking the dog or washing the car may ultimately impact the quality of coastal waters. For example, as a river or stream flows through an urbanized or rural area it can gather various contaminants, including fertilizers that wash off lawns or fields, untreated sewage from failing septic tanks, wastewater discharges from treatment plants or industries and sediment from construction sites or agricultural fields. Wherever you are, you are in a watershed. It is important to remember that what happens on land can affect the water.

> *"Wherever you are, you are in a watershed. It is important to remember that what happens on land can affect the water."*
>
> *—Kimberly Zimmer*

Pollution from these sources on land may have many impacts on the nearby water— loss of habitat, loss of recreational opportunities and loss of economic resources. For example, sewage treatment plants and stormwater runoff can contribute excessive amounts of nitrogen to the watershed. This nitrogen stimulates the growth of algae, blocking light that would normally reach aquatic vegetation. When the algae dies off, the decay process uses up the oxygen in the water, leaving virtually no oxygen for fish and other organisms. This condition, known as hypoxia, may occur with some regularity and may have other contributing factors (see "Sponsoring Sound Research," page 6).

During storm events, sediments wash off into streams and rivers of the watershed. Sediments cloud or muddy the water, smothering organisms living on the bottom, preventing light from reaching aquatic vegetation, making the water unappealing to swimmers and increasing the need for dredging. Sediments can also carry toxic substances. These toxic substances, such as pesticides, metals, polycyclic aromatic hydrocarbons (PAHs)

Photo by John Hood

Participants of the Great Lakes Student Summit explored one of the most recognizable waterfalls in the world — Niagara Falls, where the Niagara River plunges over this precipitous drop (see page 13). Water reaches the Niagara River from Lakes Superior, Huron, Michigan and Erie. Further downriver, well below the falls, water drains into Lake Ontario.

and polychlorinated biphenyls (PCBs), can accumulate in sediments and aquatic organisms. Toxic materials can also enter through storm drains, industrial and sewage treatment plant discharges and automobile, factory and power plant emissions.

Pathogens, disease-causing microorganisms such as bacteria and viruses, are also present in watersheds and can be carried by runoff. Some sources of pathogens are untreated or poorly treated sewage, combined sewer overflows and animal waste. In elevated amounts, waterborne pathogens often result in beach and shellfish bed closures.

A heron wades in Downs Creek which drains into Great Peconic Bay. The watershed for the Peconic Bays is comprised of the five east end townships of Long Island.

Photo by Ken Rubino

Litter or debris, washing in from both storm drains and the tide, is one of the more widespread pollution problems found in coastal ecosystems. Debris comes from many sources, including improper disposal of trash on land, stormwater runoff and combined sewer overflows and seagoing vessels. Once litter gets into coastal waters, it can adversely affect wildlife, the environment, humans and our economy.

Today there are many watershed management efforts underway in New York State (see map on page 4 for locations) which strive to understand the cumulative environmental impacts on our coastal waters and ways to mitigate these impacts. This watershed management approach provides an opportunity for municipalities and non-governmental organizations to work together within a defined geographical area to consider the relationship between land use and the impacts to surface and ground water during the decision-making process. Watersheds transcend political, social and economic boundaries and therefore, it is important to include all interests when designing and implementing a watershed plan. As our population grows, the demands imposed on our natural resources increase, and protecting these resources for all their natural, economic, and aesthetic values becomes even more important.

—Kimberly Zimmer

New York Sea Grant Extension Support Specialist

The lower Hudson River is the site of current Sea Grant research and extension efforts. Hudson Valley specialist Nordica Holochuck's activities include outreach for a submerged aquatic vegetation workshop at the Institute for Ecological Studies sponsored by NYSDEC, Cornell University and NYSG.

Photo by Hudson Roditi

Watershed Tips

What happens in your watershed can affect another, sometimes hundreds of miles away. Help protect your watershed and coastal waters by becoming informed and getting involved.

- **Follow proper lawn care and waste disposal practices. Use pesticides and fertilizers sparingly and correctly. Compost organic waste.**
- **Learn how to properly dispose of toxic substances. Many areas have hazardous waste collection days or sites for disposing paint, automotive fluids and cleaning products.**
- **Curb your dog and properly dispose of pet waste by placing it in the trash. Do not leave it on the ground or throw it down a storm drain. Pet waste contains bacteria and viruses that can contaminate shellfish and cause the closing of bathing areas.**
- **Inspect your septic tank annually if you have one. Pump it out every 3 to 5 years. Proper maintenance and careful waste disposal will prolong the life of your system and prevent discharge of untreated sewage to ground and surface waters.**
- **Pick up litter when you see it. Make sure to properly dispose of your own trash and remember to recycle.**

Sponsoring Sound Research

Monitoring station E10 in western Long Island Sound has been the site of hypoxia studies by NYSG-funded researchers Swanson and Wilson.

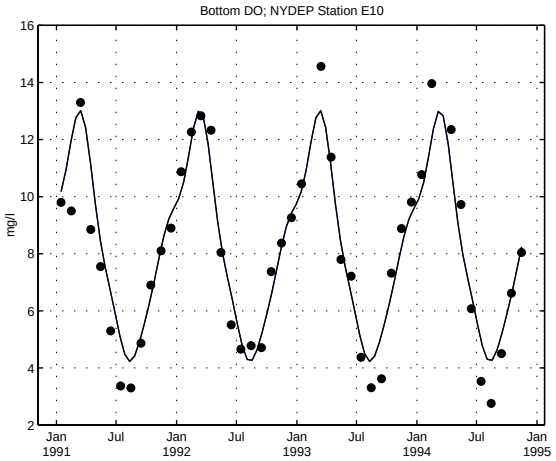
Since 1914, scientists have been keeping track of water temperature and other physical and chemical properties from monitoring station E10 near Hart Island, a tiny teardrop island in western Long Island Sound. That's one of the reasons why **Larry Swanson** and **Robert Wilson** began their current NYSG-funded project to create a useful model to explain the annual condition of hypoxia in western Long Island Sound. By examining the historical data, these two faculty researchers from the Marine Sciences Research Center (MSRC) at SUNY Stony Brook can look at long-term cycles that affect hypoxia. Wilson, a physical oceanographer, and Swanson, director of the Waste Reduction and Management Institute (WRMI) at MSRC, say that their findings will be used to evaluate the benefits of future management proposals such as the costly upgrade of sewage treatment plants to remove nutrients from waste effluent.

> *"Wind stirring, heating, and freshwater inflow contribute to hypoxia in western Long Island Sound."*
> *—Dr. Robert Wilson*

Using the data of half a century, Wilson and Swanson have defined precisely the annual hypoxia cycle (see graph below), creating a model that shows the strong roles the physical and climatological factors play as they bring about summertime water stratification and then hypoxia. According to them, much of the yearly cycle and a portion of variation from that cycle can be explained by the physics of the site.

Location makes Hart Island a likely hotspot for hypoxia. To the southwest is one of the mouths of the East River where outflow from many New York City sewage treatment plants enters the Sound. To the northeast is the Hempstead sill, a region of relatively shallow depths which serves to isolate the deeper waters of the western Sound. According to Wilson, three factors contribute to the evolution of annual hypoxia conditions. First, there are the winds which cause stirring of the water. Secondly, there is heating, especially of surface waters, and finally, the inflow of freshwater from both the East and Hudson rivers. "These physical factors have a controlling role in the onset, severity and duration of hypoxia," says Swanson. He continues, "This precise analysis of hypoxia's cause is of great importance especially when municipalities and managers propose upgrades from secondary to tertiary sewage treatment." If climatological factors contribute to the loss of oxygen, upgrading sewage treatment at great cost will not necessarily relieve hypoxic conditions.

The graph's solid circles show monthly averaged values for dissolved oxygen on the bottom of western Long Island Sound over four years. The solid line represents the annual hypoxia cycle based on historical data.
Graph courtesy of Robert Wilson



Because the graph is based on averages, there are differences or anomalies from year to year or between individual observations. Wilson and Swanson are determining what fraction of the variance in these anomalies is associated with physical forcing—changes in surface heating, wind stirring and freshwater inflow that affect stratification and ultimately oxygen content on the bottom.

"Musseling" in on Heavy Metal

Also at the Marine Sciences Research Center's WRMI, **Vincent Breslin** has been studying another aspect of Long Island Sound—its metal content. Within the Sound's sediments, metal content measures higher than in many other comparable US coastal waters. Western Long Island Sound is especially enriched in contaminant metals that come from treated sewage discharges, industrial wastewater and particles from the atmosphere. Recently, there has been concern about the potential toxic effects on fish, crabs and algae from metals leaching from the treated wood used to construct docks and bulkheads. NYSG research has been conducted to scientifically test this.

> *"The experiment showed few differences between blue mussels exposed to treated wood and the control mussels."*
> *—Dr. Vincent Breslin*

Low tide along this dock on Long Island's north shore reveals the structure made of treated wood.

Photos by Vincent Breslin

In a NYSG-funded research project conducted between 1997-1998, Breslin and then Sea Grant Scholar **Leslie Adler-Ivanbrook** conducted laboratory and field experiments to examine the effects of treated wood that is commonly used in piers and pilings on the mortality and growth of a common invertebrate—the blue mussel. The construction material of choice is often southern yellow pine treated with chromated copper arsenate type C. In Breslin's experiment, blue mussels were exposed to treated wood and sampled regularly to measure how much copper, chromium and arsenic had been taken up by the mussels. Just how much of these metal contaminants had leached out of the wood and been ingested by the filter-feeding mollusks? The experiment showed few differences between the exposed and control mussels. The results are attributed to the low rate of release of these elements from the treated wood and the continuous flushing which prohibits the accumulation of these elements surrounding the mussels.

In other related work with MSRC/WRMI's **Sergio Sañudo-Wilhelmy,** Breslin has sampled sediments from Port Jefferson Harbor to find the spatial distribution of metals and find the sources of contaminants into the harbor. Metals such as silver, copper, iron, nickel, lead, vanadium and zinc vary widely in concentration. One thing appears certain. The higher metal concentrations are located in the fine-grained inner harbor sediments and in the water column, metal concentrations was increased 1.2 to 10 fold in the inner harbor surface water in comparison to Long Island Sound water collected outside the mouth of the harbor.

—Barbara A. Branca

Top: Leslie Adler-Ivanbrook using a perforated tube to distribute water evenly over a submerged treated wood sample.

Right: Collecting blue mussels.

Within sight of the Throgs Neck Bridge, REU Fellows Gretchen Flack (left) and Anne Prusak cruise western Long Island Sound aboard the ***RV/Onrust.*** **Prusak was sponsored by NYSG for the eight-week program.**

Coast

A Sound Summer

"No one came as an observer on any cruise …"

—Dr. Josephine Aller REU Program Coordinator

Summer cruises, beautiful views, and of course, lots of tiring work aboard research vessels filled the days and nights for eight students chosen for the Research Experience for Undergraduates (REU) program this summer at the Marine Sciences Research Center (MSRC) at SUNY Stony Brook. A diverse group of academically talented undergraduates from a wide variety of universities was selected to participate in this highly prestigious program. New York Sea Grant sponsored one of the students and the other seven were funded by the National Science Foundation. According to **Dr. Josephine Aller,** associate professor at MSRC and program coordinator, the focus of the summer program was to study the causes and impacts of summertime hypoxia development in Long Island Sound. To do so, the REU program's fellows and mentors established stations along the west-east axis of Long Island Sound extending from the Hart Island/Execution Rocks vicinity in the western Sound to Port Jefferson Harbor. "We centered our seabed and water column sampling around a main study site near Execution Rocks," said Aller. "A wide variety of atmospheric, physical, geological, chemical, biogeochemical and biological data was collected at these stations during three cruises on the *RV/Onrust* and three aboard the *RV/Privateer* throughout the eight weeks."

"…Everyone pitched in and helped collect samples and data…"

According to MSRC's **Robert Wilson,** mentor to Fellow **Darren Robinson,** "By starting the sampling in early June then continuing into mid-July, students could see the evolution of hypoxia this summer." They were able to experience first hand the three most important factors which contribute to the Sound's hypoxia: surface heating, wind stirring and freshwater inputs such as outfall from sewage treatment plants in the East River and freshwater from the Hudson.

Prusak (left) and Flack collect water samples from a Niskin bottle.

Watch

> *“…even if it meant worms, clams and staining, smelly mud.”*

Darren Robinson (left) and MSRC graduate student, Angelos Hannides, retrieve a box core. Its contents will be used to analyze the oxygen and nutrients immediately overlying the sediment.

Each student contributed to the interdisciplinary study of the site, whether scanning the seabed topography, measuring phytoplankton productivity or collecting meteorological data. New York Sea Grant-funded Fellow **Anne Prusak,** a Stony Brook undergraduate who hails from a town within the Adirondack Park in upstate New York, worked with mentor **Mary Scranton** to measure methane production in the water column and seabed as influenced by the development of hypoxia. “Normally there are up to two centimeters of oxygenated surface sediment in the Sound,” reported Prusak. “As hypoxic conditions set in, the oxygen decreases and we would expect the methane concentrations to increase throughout the water column and within the sediment. Through a series of chemical reactions, oxygen, nitrogen, magnesium and iron are depleted. Then several terminal reactions are likely to produce the methane you see in the sediment.”

Says Aller, mentor to Fellow **Chun-Der Li** who studied changes in bacteria in the Sound’s water column and sediments, “No one came as an observer on any cruise. Everyone pitched in and helped collect samples and data, even if it meant worms, clams and staining, smelly mud.”

—Barbara A. Branca

Above photo: (left to right) Chun-Der Li and Josephine Aller realign a VanVeen grab sampler. The sampler’s contents, emptied into the pan, will be used to enumerate bottom-dwelling animals and analyze grain size.

Bottom right photo: All hands on the deck of *RV/ Onrust.* Standing from left: Liz Scordato (a non-REU summer research fellow), Darren Robinson, Chun-Der Li, Grace Tan (MIT undergrad) and Carrie Loughlin. Seated (left to right): Kate Rodriguez, Gretchen Flack, Anne Prusak, Anthony Richey and Josephine Aller, REU coordinator. Missing is Alison Sweeney whose project entailed measuring trace metals in the Sound that result from human activity.

Photos courtesy of Josephine Aller

Aliens *in Our Watersheds*

Cercopagis pengoi
Photo by Joseph Makarewicz

Another Exotic Invades Lake Ontario

As of August 1998, several independent reports, including those conducted by NYSG-funded researcher Joseph Makarewicz and the Environmental Protection Agency, confirm the existence of *Cercopagis pengoi* in Lake Ontario. Based on recent findings, Makarewicz says it is likely that this deepwater zooplankter, a native to the Caspian and Aral Seas that has invaded salt and fresh water environments in Russia, Bulgaria and Ukraine, will make its way into other Great Lakes. In early September, the "fishhook water flea" was reported in Lake Michigan. Makarewicz is conducting research to develop a fundamental understanding of this microscopic alien: what it eats, how it behaves, how it reproduces and how it will impact the Lake Ontario food web.

Continued opposite page

Aquatic nuisance species. Just what are they and why should New Yorkers be concerned? When these non-native animals or plants enter our waterways, they often compete with native species, sometimes with devastating effects.

Of greatest concern is the effect of the zebra mussel, *Dreissena polymorpha,* and its relative, the quagga mussel, *Dreissena bugensis.* These nuisance mollusks have been shown to impact the habitat, food web and biodiversity of both Lake Erie and Lake Ontario. Because zebra mussels feed on phytoplankton and detritus, it is likely that they have helped clear the lakes of food sources normally used by tiny zooplankton. In turn, the decline of zooplankton populations could alter natural food webs and result in fewer fish of all kinds, particularly predatory sportfish such as trout, salmon and bass.

According to NYSG's **Chuck O'Neill,** combating the zebra mussel has cost New York State's public and private infrastructure at least $28 million over the last decade. The impacts have affected electric power generation, food processing, drinking water facilities and residential water supplies as well as other industries that rely on surface water for cooling or flushing. Much of this financial jolt is the result of the fouling of raw water intakes by the zebra mussel, which translates to the loss of pumping ability, clogged and corroded pipes, obstructed valves, obnoxious smells from decayed mussels and inoperable sprinkler systems.

New York is also experiencing ecological impacts on native species caused by the recent invasions of several other species like the blueback herring in the Erie Canal and Lake Ontario, the round goby in the eastern basin of Lake Erie and the New Zealand mud snail in Lake Ontario. Raising concern, too, is the introduction of the "fishhook water flea," *Cercopagis pengoi,* into Lake Ontario, which Brockport-based NYSG-funded researcher **Joseph Makarewicz** is addressing along with Edward Mills and Lars Rudstam (both Cornell University affiliates) and University of Windsor's Hugh MacIsaac (see sidebar). The recent invasion of Cayuga Lake by the Asian clam may also cause infrastructure and ecological impacts. And from the Great Lakes region to the Hudson Valley and Long Island, there is concern for changing habitat and biodiversity caused by nonindigenous plants such as purple loosestrife, *Phragmites,* waterchestnut, and the Eurasian water milfoil.

As zebra mussels are ubiquitous and abundant in many major freshwater ecosystems in New York and elsewhere, New York Sea Grant devotes a portion of its research efforts to studying the ecological effects of these aliens in our watersheds. Very little is known about their influence on the biogeochemical cycling of metals, for example. In response, NYSG-funded researcher **Nicholas Fisher** has evaluated the daily processes and functions of zebra mussels to assess the role they play in influencing metal cycling in freshwater ecosystems. Fisher's intent in the Hudson River region study, which was completed in January 1998, was also to evaluate the use of these organisms as bioindicators for the presence of toxic metals in fresh water.

Sea Grant Scholar Hudson Roditi, based at SUNY Stony Brook, with zebra mussels in a depuration chamber.

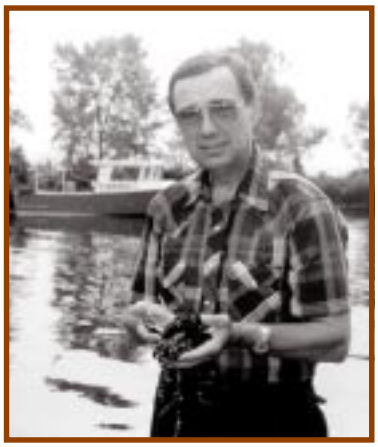
Photo by Ian Stupakoff

During the study, zebra mussels were placed in a "depuration chamber," a purification chamber that mimics their natural environment. NYSG Scholar on Fisher's project, **Hudson Roditi** (pictured illustrating the concept), explains that these mussels were initially exposed to food contaminated with radioisotopes of metals such as silver, cadmium, chromium or mercury. The mussels were then placed in the aquarium, each in its own small cup, and fed suspended algal food from filtered Hudson River water. Periodically the mussels were removed from the water and placed in a gamma

radiation counter, where their radioactivity was measured. Then the mussels were returned to the aquarium and allowed to further depurate. Says Roditi, "The measurements make it possible to calculate how long it takes for the zebra mussels to be free of the metal contaminants."

Sandra Nierzwicki-Bauer, Director of Rennselaer Polytechnic Institute's Darrin Fresh Water Institute on Lake George, is currently developing a genetic probing method whereby water samples can be quickly and simply screened for zebra mussel young without going to the laboratory for identification. An important objective and extension of the project is to cooperate with industries that are concerned with the colonization of their facilities by zebra mussels. In a 1998 *New York Times* article, Nierzwicki-Bauer was referred to as one of the few biologists who has gained "a toehold against the pesky mussel." Her NYSG-funded work also explores the possibility of developing a commercial product based on the probe technology that may be of interest to other agencies for use with numerous molluscan species.

On Lake Ontario, where Cornell affiliate **Lars C. Rudstam** completed his NYSG-funded study on "The Role of Embayments and Inshore Areas as Nursery Grounds for Young-of-Year (YOY) Alewife and Other Species" in early 1999, nonindigenous species such as alewife and rainbow smelt have had a significant impact on its ecosystem. Overall, Rudstam said, "This research will help management agencies designate appropriate locations for monitoring zooplankton in Lake Ontario and will provide basic information for the continuing efforts to model the dynamics of the lake's alewife populations."



According to NYSG-funded researcher Ed Mills, "The significance of the problem incurred by aquatic nuisance species will present a challenge to managers and stakeholders alike," emphasizing the need for prevention and control action.

Photo by Cornell University Photography

Lake George, site of Darrin Fresh Water Institute

Photo by Sharon O'Donovan

To determine how changes in nutrient levels and exotic mussels are affecting the Lake Erie food web and the future of the fish community, Cornell affiliate **Edward L. Mills** initiated a multi-agency fisheries effort in February 1998. He is studying the interactions among the number of smelt produced by eastern Lake Erie, growth rates of predatory fish such as smallmouth bass, walleye and lake trout and changes in the lake's ability to support fish. "This will help us understand how lowered nutrient levels from phosphorous reductions and zebra mussel infestations will aid in the prediction of future fish production," Mills said. As such findings unfold, plans can be made to better manage Lake Erie's fisheries resources.

More than 145 exotic species have successfully invaded the Great Lakes, with 15 fish species having found their way into Lake Ontario. Over the last two decades, it is estimated that one out of every 10 exotics has had serious impacts on Great Lakes ecosystems. As this alien invasion continues to be an issue into the 21st century, providing aquatic nuisance species research and outreach to legislators, agencies, scientists, the media and the public will continue to be a mission of New York Sea Grant.

— Paul C. Focazio

Continued from opposite page

Finding the Corridor

"Our results will help us predict the geographic and ecological impacts of this species in the Great Lakes, pointing us in the direction of potential mechanisms of control," Makarewicz says. "In addition, these findings will provide the scientific background information needed for the development of informed management policies of important Great Lakes fisheries that may be impacted."

Makarewicz, based near the shore of Lake Ontario at SUNY Brockport, places much importance on determining the "invasion corridors" of the species. "Because *Cercopagis* has a much more confined distribution in Eurasia than most other exotic species that have established in the Great Lakes, the opportunity to identify its invasion corridor is very good. By identifying the invasion route of the species, we can pinpoint the location of its introduction, thereby preventing new introductions and perhaps providing an understanding in how to reduce the spread of established populations."

ANS Conference a Success

Photos courtesy of Minnesota Sea Grant

With a backdrop of Lake Superior, the 9th International Zebra Mussel and Aquatic Nuisance Species Conference was held in April in Duluth, Minnesota and hosted by Minnesota Sea Grant. New York Sea Grant specialist **Chuck O'Neill** was a featured presenter. During his presentation, "The National Aquatic Nuisance Species Clearinghouse: A New Vision for the New Millennium," O'Neill addressed the history and successes of the Clearinghouse, as well as the directions the aquatic nuisance species library project is expected to take in the coming years. The conference was also the venue for the official "roll out" of Sea Grant's National Aquatic Nuisance Species Clearinghouse's new searchable bibliographic database on the Clearinghouse's World Wide Web site, <*www.cce.cornell.edu/seagrant/nansc*>.

In a presentation entitled "The Impact of Nationwide Zebra Mussel Outreach Programming," O'Neill outlined the activities and accomplishments of the four-year project which saw Sea Grant educators from six programs (NY, MN, NC, CT, LA and IL-IN) plan and implement zebra mussel outreach programs. The varied programs ranged from satellite teleconferences to multiday, multistate workshops across the US and from the production of information bulletins on zebra mussel impacts and control to public service TV commercials. This nationwide initiative, the brainchild of NYSG specialist O'Neill, is credited with the start-up of the Western Zebra Mussel Task Force, 17 state and provincial zebra mussel task forces and work groups, and helped in the development of the Western Regional Panel on Aquatic Nuisance Species.

In a related presentation, NYSG specialist **Helen Domske** recounted the successes of the award-winning Great Lakes Sea Grant Network Exotic Species Day Camp Teacher Training Initiative that introduced more than 125 teachers from throughout the Great Lakes Basin to an array of educational resources on exotic aquatic species, much of it developed by Sea Grant programs.

New York Sea Grant researchers **Marc Frischer** of the Skidaway Institute of Oceanography, and **Sandra Nierzwicki-Bauer** of the Rensselaer Polytechnic Institute, presented their research on zebra mussels as possible biomonitors or filters of the protozoan pathogens *Cryptosporidium* and *Giardia*. They also presented research on the differential survival of zebra mussel veligers and juveniles in Lake George. **Daniel Molloy,** of the Biological Survey of the New York State Museum, presented his research on the natural enemies of zebra mussels and the use of bacteria for zebra mussel control. Molloy is soon to be engaged in a NYSG-funded research project.

A high point of the conference came when the Federal Aquatic Nuisance Species Task Force presented long-time NYSG supporter **Dr. James Carlton** of the Williams College, Mystic Seaport Maritime Studies Program with an award for his ceaseless efforts to combat the serious global problem of nonindigenous organism introduction.

In addition to presenting at the conference, O'Neill's coastal resource expertise was also recently showcased on "Aquatic Invaders," a 30-minute television special that premeired on CNBC in August. See NYSG's website for more details.

—Chuck O'Neill
Coastal Resources Specialist

Dr. James Carlton (center), who received an award from the ANS Task Force, is flanked by (left to right) Minnesota Sea Grant's Jeff Gunderson, Congressman James Oberstar and Gary Edwards, co-chair of the ANS Task Force.

Students test water quality aboard the *Niagara Clipper* with help from Mike Goehle, assistant manager of the BSC Great Lakes Center Field Station (seated) and Buffalo teacher Karen Arnold (center).

Students Keep the Lakes Great

CURRENTS

New York Sea Grant and the Great Lakes Program at the University at Buffalo were proud to help sponsor the third Biennial Great Lakes Student Summit (GLSS). The event brought over 260 students, volunteers and teachers together in Buffalo, New York, from May 12-14, 1999. Participants, representing 17 schools, 6 counties, 3 states and 2 countries, came together to learn about the Great Lakes and share their research and environmental awareness. The theme for 1999, "The Great Lakes: Your Concerns, Our Concerns, Areas of Concern," encouraged students to examine their local environmental concerns while learning about the International Joint Commission's Areas of Concern (AOC).

Helen Domske, NYSG coastal education specialist and associate director of the Great Lakes Program, has been part of the planning teams and has served as a co-host and workshop presenter for each of the Student Summits since their inception six years ago. According to Domske, " Every GLSS gets better and better. I am truly amazed by the knowledge, interest and environmental savvy of these students. They are the best and brightest, and they will go on to be formidable stewards of the Great Lakes."

During the event, students were involved in workshops, field experiences and sharing sessions, learning from agency representatives, other outside experts and each other about the Great Lakes and AOC. One evening was spent exploring Niagara Falls, from the thundering waters of the cataract to the deserted quiet of the former Love Canal site. A visit to the Aquarium of Niagara brought them eye-to-eye with Great Lakes fishes, including sturgeon, trout, salmon and catfish.

The final day found the participants getting to know the biology, geology or chemistry of the Great Lakes through trips to Tifft Nature Preserve, Penn Dixie Paleontological Outdoor Education Center, a water pumping station and local wastewater treatment plant. Then students boarded ship to cruise the Buffalo River, a local AOC, where they learned about the river from experts. The highlight of the cruise was a rendezvous with an electro-shocking boat of the U.S. Fish and Wildlife Service. The fishery biologists provided living proof of the biological diversity of the river, a sign that the ecosystem is improving. Students were amazed by the sight of a huge carp, a large northern pike and several common goldfish which had been identified as exotic invaders during one of the student workshops.

The most memorable experience of the entire event was the creation and delivery of the Statement of Stewardship that was presented to a panel of representatives from local, state and U.S. and Canadian federal governments (see page 3). The students' commitment, determination and genuine concern for the Great Lakes expressed by that statement impressed the distinguished panel. When the event was over and students exchanged mementos and hugs, they left with a pledge to continue their stewardship efforts for the Great Lakes. Event organizers left with a feeling of hope for the future, knowing that these students are better prepared for their stewardship roles. Sponsors knew that they should begin at once to plan the Fourth Biennial to keep this environmental momentum going. Government and agency representatives left knowing that the next generation is preparing to take over where they leave off and will continue to work to keep the lakes GREAT!

—Helen Domske
Coastal Education Specialist

Annual Report

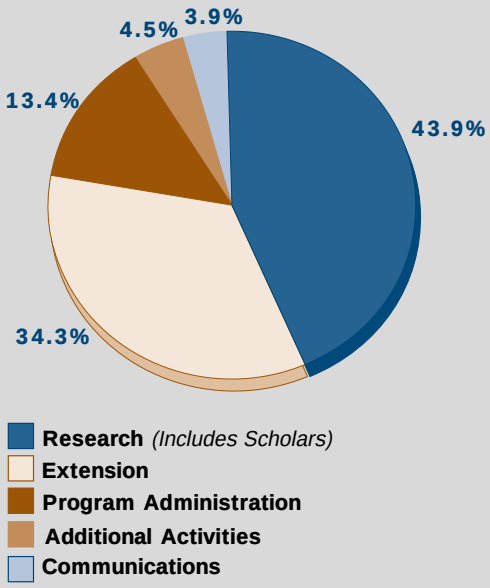
New York Sea Grant Institute Funding 1998

(State, Federal, and Other Funds Allocated in Calendar Year 1998)

Program Administration	$585,015
Communications	$171,010
Extension	$1,500,726
Research and Scholars	
Economic Leadership	$629,663
Coastal Ecosystem Health and Public Safety	$463,259
Initiatives and National Investments	
NOAA Partnership Investment	$61,773
Non-Indigenous Species Investment	$100,858
Marine Biotechnology Investment	$181,100
Brown Tide Research Initiative (BTRI)	$479,275
Percent of Above Research Funds Allocated to Scholars	13.3%
Total Research and Scholars	$1,915,928
Additional Activities	
Fellowships	$82,363
Conferences/Workshops/Special Projects	$14,906
Regional Activities	$35,421
SSER Technical Advisory Committee Administration	$30,202
BTRI Administration and Outreach	$32,949
Total Additional Activities	$195,841
Total Funds Allocated	**$4,368,520**
Unallocated/Pending Committed Carryover Funds*	$935,040
Additional Non-Federal Cost-Sharing or In-Kind Support	$1,174,866

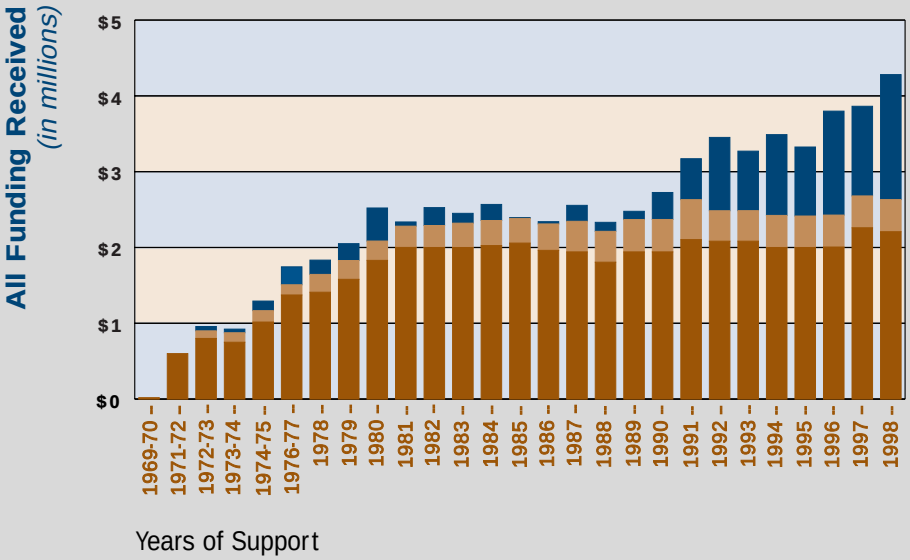
**Includes funds committed to continuation of specific projects/activities, and projects slated to begin in 1999*

Distribution of All Funding Among Program Elements



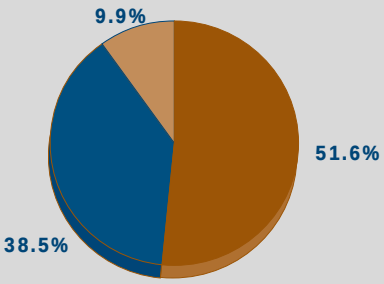
New York Sea Grant Funding

(Since Inception)



Funding Sources

(1998)



Note: "Other" includes additional state, federal, Cornell, SUNY and private funds received by NYSG program.

—Stefanie Massucci
Fiscal Officer

LastWave

Ordering Publications

Please send requests for the following recent publications along with a self-addressed label and check payable to:

New York Sea Grant Institute Communications
121 Discovery Hall
SUNY at Stony Brook
Stony Brook, NY 11794-5001
(516) 632-9124

Marine Mammals & Turtles of the U.S. Atlantic & Gulf of Mexico

A full-color 130-page field guide featuring descriptions, photographs, illustrations and distribution maps of the region's whales, dolphins, seals, manatees and sea turtles. *$25.*

Surf this fall with Sea Grant

In addition to being the focus of a forthcoming redesign plan, www.seagrant.sunysb.edu, New York Sea Grant's web site, features a variety of additional nuances this season, including:

- Revised "Publications & Public Relations"pages, including a current list of NYSG's available publications as well as a Sea Grant timeline providing dozens of media releases and articles that highlight the program's extension, research and education efforts
- The latest on NYSG's newly- added, eighth extension office at Plattsburgh SUNY, a Lake Champlain initiative
- *Soon-to-be added:* Coastlines, *Fall 1999;* BTRI #4, Fall 1999; and Seafood Technology pages

Journal Reprints

Accumulation of copper, chromium, and arsenic in blue mussels *(Mytilus edulis)* from laboratory and field exposures to wood treated with chromated copper arsenate type C. Leslie Adler-Ivanbrook and Vincent T. Breslin. 1999. *Environmental Toxicology and Chemistry* 18(2):213-221. $1.00

Occurrence of *Bythotrephes cederstroemi* in Lake Ontario offshore waters. Joseph C. Makarewicz and H. Douglas Jones. 1990. *Journal Great Lakes Research* 16(1):143-147. $1.00

Occurrence of macrophytes in the nearshore waters of Lake Ontario. Joseph C. Makarewicz and R. C. Dilcher. 1988. *Journal of Great Lakes Research* 14(4):405-410. $1.00

Rates and routes of trace element uptake in zebra mussels. Hudson A. Roditi and Nicholas S. Fisher. 1999. *Limnology and Oceanography* 44(7):1730-1749. $1.00

Release of copper, chromium and arsenic from CCA-C treated lumber in estuaries. V. T. Breslin and L. Adler-Ivanbrook. 1997. *Estuarine, Coastal and Shelf Science* 46:111-125. $1.00

New York Sea Grant Publications

Brown Tide Research Initiative Report #3. Patrick Dooley. 1999. Free.

Coastal Educators News. H. David Greene, Editor. Bi-monthly. Free

Dreissena! Charles R. O'Neill, Editor. Bi-monthly. $30 for 1-Year Subscription

National Aquatic Nuisance Species Clearinghouse Brochure. Charles R. O'Neill, Editor. Free

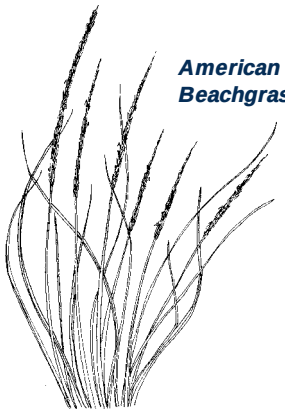
Oceans: Into the Next Millennium of Oceanographic Research. National Oceanographic Administration. 1998. Free

Watershed Sciences for Educators. Karen Edelstein, Nancy Trautmann, and Marianne Krasny. 1999. $39.99 payable to Cornell. (To order: Cornell University Media and Technology Services Resource Center, 7 Business and Technology Park, Ithaca, NY, 14850)

Planting Guide

Planting Guides

A series of three fact sheets, each spotlighting different plant species indigenous to New York State's Marine District. Complied by NYSG extension specialist Bob Kent, the set includes information on the ecological importance of native coastal grasses, including American beach grass, smooth cord grass, seaside goldenrod and Indiangrass. Free.



American Beachgrass

Monkfish

Monkfish is found in deep ocean waters all along the Atlantic coast and as far north as the Grand Banks off the coast of Newfoundland. Its alias, Anglerfish, was coined due to its use of a "fishing or angling" technique to feed, in which it erects the first of three spines atop its head and rapidly moves this "bait" back and forth to attract smaller fish. In New York, where the lean, white-fleshed fish is available in markets year-round, fishermen harvest along the south shore of Long Island and from the ports of Montauk and Shinnecock from November to June with peak landings in the spring. With its firm texture, monkfish is a great choice for moist heat cooking methods like baking, steaming, poaching, grilling, frying or in seafood soups and stews. For more information on the monkfish and other species, check out New York Seafood Council's web site, www.nyseafood.org, which will be complemented by NYSG's own World Wide Web "Seafood Technology" pages this winter.

—Paul C. Focazio

Monkfish with Zucchini and Yogurt

Ingredients

1 lb. monkfish fillets
2 zucchini, medium
1/4 cup water
2 tbsp. margarine
1/2 cup white wine, dry
1 tbsp. shallots, minced
1 tbsp. butter (optional)
1 cup yogurt, plain, low fat
1 egg

Method

Trim the monkfish and cut at an angle in 1 1/2-inch slices. Wash zucchini and cut into 2 to 3 inch long wedges. Put water, 1 tbsp. margarine, and zucchini in saucepan. Cover and cook 5 minutes. Remove from heat and keep warm. Grease a baking dish. Place monkfish slices in one layer and add the wine. Cover dish loosely and bake for 8 to 10 minutes at 375°. Drain pan liquids into a skillet. Add minced shallots and optional tbsp. of butter. Reduce liquid over high heat to less than 1/2 cup. Add yogurt, stirring constantly with a wire whisk. Beat egg in a small bowl. Stir some of the hot liquid into the egg to warm, and then add to the hot liquid. Cook, stirring constantly, until the sauce is thickened, about 2 or 3 minutes. Do not boil. Spoon the sauce onto a warm plate. Arrange the fish slices and zucchini wedges on the sauce.

Recipe developed by the Food and Nutrition Committee of Massachusetts Cooperative Extension.

Sea Grant New York

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