Improving the Health and Balance of New York's Waters

In February 2002, New York Sea Grant began conducting the majority of its core research projects funded with $1.15 million in NYSG's federal resources. These projects will prove critical to the health and well-being of the state's fresh and saltwater systems. The articles on pages 4 through 11 describe in some detail many of these innovative projects.

Striking a balance: managing and evaluating vitality of fisheries

Commercial production of flame retardants has increased globally over the past 20 years as has global environmental contamination by the polybrominated diphenyl ethers or PBDEs that compose them. Disposal of flame retardants through incineration and leaching gets PBDEs into soil sediments and waterways. And like PCBs to which PBDEs bear a structural resemblance, PBDEs exhibit a bioaccumulative effect in food chains of many ecosystems. In the Great Lakes, recreational and commercial fisheries could potentially transfer the neuro- and endocrine-toxic effects of PBDEs to humans. However, potential health risk assessment is hindered by limited research data on PBDEs. SUNY College at Buffalo investigators **Harish Sikka** and **Subodh Kumar** will be the first to fill this critical data gap by investigating the absorption, tissue distribution and biotransformation of metabolites in the rainbow trout. This risk assessment of PBDEs to fish will be useful to regulatory agencies in the NYS Department of Environmental Conservation and Department of Health that develop health advisories regarding human consumption of contaminated fish.

rainbow trout

Insight into how aquatic organisms are affected by estrogenic compounds that accumulate in urban waterways is critical to managers who plan remediation of such resources. Expanding from previous unique NYSG research that developed ultra-sensitive analytical techniques to directly determine estrogen mimics in sewage effluents, surface waters and sediments, this team led by **Anne McElroy** of

MSRC at Stony Brook University and **Martin Schreibman** of CUNY Brooklyn College will take some bold new steps. The team will study the effects of chronic exposure to environmental estrogen mimics using resident bottom-dwelling fish, winter flounder (*Pleuronectes americanus*) of Jamaica Bay as a model species of exposure in the field. In addition to conventional measures of endocrine disruption, this team will break new ground by also examining higher neural and endocrine centers that regulate reproductive system development in indigenous fish and their offspring. McElroy says, "This study will provide information that wastewater treatment and fisheries resources managers can use to better protect ecosystem health."

Winter flounder

Salmon sportfishing is of economic importance to communities surrounding Lake Ontario. As native salmonid populations in the lake declined, stocking programs were used to maintain the fishery. Recently, however, there are indications that the wild populations may be showing increased reproduction. A new project led by **Patrick Sullivan** and **Lars Rudstam** of Cornell will examine Chinook salmon returning to the Salmon River to spawn in order to determine the survivorship of hatchery-reared vs. wild salmon. Using otoliths (ear stones) to determine fish age, class, and origin, the team will compare the proportion of returning adults with those migrating out to see if increases in releases from hydropower dams on the river are benefiting the wild Chinook populations. The results of this research will be valuable to fisheries managers, anglers, and ultimately the economies of the Lake Ontario region.

This same team with the addition of **John Horne** of the University of Washington, will conduct a separate project related to hydroacoustics, a tool often used by managers to assess fish populations. The researchers will measure and
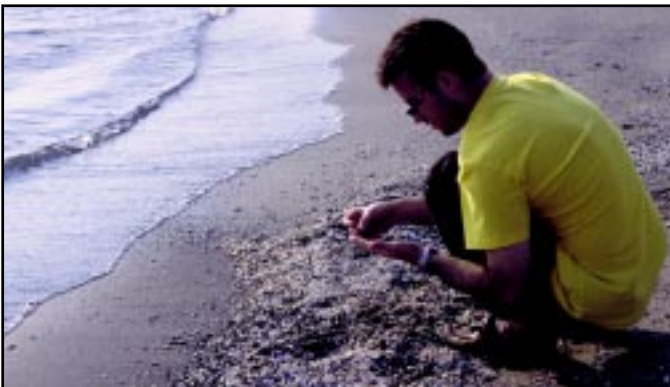
analyze different sources of bias such as those associated with acoustics of different fish species, extrapolation to whole lake estimates, and variations in field measurements. The results will place hydroacoustically-based forage fish population estimates into a more accurate context which should help improve fisheries management in Lake Ontario and elsewhere.

Over the last 20 years, Great Lakes ecosystems have experienced improved water quality due primarily to concerted efforts to reduce phosphorus, a nutrient known to promote the growth of nuisance algae. The reduction in algae allowed for increased light penetration and water clarity. Then along came the invasion of the zebra mussel. Filter-feeder activities of the exotic mussel further increased the Lakes' water clarity. Cornell University researcher **Ed Mills** says these factors are acting synergistically to redirect energy production from near the lake surface to the bottom or benthic zone. Mills, along with **Christine Mayer** (Syracuse University) and **Dean Fitzgerald** (Cornell University), is conducting a project to improve understanding of this process of "benthification" by examining the consequences of such changes on benthification on fish communities and populations, the extent of submerged aquatic vegetation, and production dynamics of benthic habitats. The team will develop GIS models to help predict changes in fish communities. "This information will then be available to Great Lakes user groups and managers to support long-term planning for fisheries management," says Mills.

SBU researcher **Duane Waliser** and Fred Hall, VP and General Manager of the Bridgeport & Port Jefferson Steamboat Company, examine the acoustic doppler current profiler about to be installed beneath the *PT Barnum*.

Underwater exploration: tracking ecosystem health and public safety

With millions of people living in its watershed, economic and recreational activities place many demands on the Long Island Sound ecosystem. One major concern is the condition of low dissolved oxygen or hypoxia that is stressful to a wide range of aquatic organisms. Hypoxia usually occurs when large amounts of decaying organic matter consume dissolved oxygen over the course of the summer. To deal with hypoxia, management plans have focused on reducing nutrient input into the Sound. However, not all hypoxia can be correlated to nutrient loading. Deficiencies exist in understanding the impacts of summertime water stratification and their influence on the Sound's hypoxia. In their current research project, SBU's **Duane Waliser** and **Robert Wilson** are looking to fill in the gaps. By using a specially-equipped commuter ferry in conjunction with a moored data profiler, the team is developing a unique comprehensive real-time observation program to measure environmental variables such as near-surface water temperature, salinity, and dissolved oxygen. Year-round sampling along the Bridgeport-Port Jefferson Steamboat Company's ferry track as well as on-board meteorological data will be used to update hydrodynamic models of Long Island Sound. "The Bridgeport-Port Jefferson Steamboat Company is providing an extremely valuable resource by letting us

Aquatic invaders such as these exotic mussels along Lake Erie's shoreline have played a role in the improved water clarity of the Great Lakes. Cornell University's **Ed Mills** will now examine the trend toward the benthification of the Great Lakes.

Experienced diver Dick Smith prepares to dive beneath the *PT Barnum* where he will attach the profiler that will record conditions in Long Island Sound for the Waliser-Wilson project.

sample the Sound from their vessel," says Waliser. "Up until now, there have been no long-term measurements of such data over the central Sound. These data are crucial for understanding the development and demise of summertime water column stratification, and thus the indirect impact of atmospheric forcing on hypoxia."

Many bacterial nonpoint source pollution (NPS) problems in coastal communities are attributable to people, pets, livestock and waterfowl. Fecal coliform bacteria (*Escherichia coli*) as an indicator of contaminated surface water leads to the closure of shellfish harvest areas and recreational beaches. Says lead PI **Emerson Hasbrouck** from Cornell Cooperative Extension of Suffolk County, "Evidence shows that *E. coli* found in the gastrointestinal systems of different animal species or groups varies in genetic identity and these genetic differences can be used to identify the source of specific strains of *E. coli*." The team will develop and modify novel molecular methodologies using Pulsed Field Gel Electrophoresis. This technology will help establish and validate DNA bacterial libraries that will pinpoint sources of coliform bacteria. Ultimately these libraries will help managers in targeting specific best management practices to the actual source of contamination.

Botulism, an emerging issue in Lake Erie, is a bacterial disease that can wipe out entire flocks of waterfowl. The role of fish in the recent botulism-induced waterfowl mortalities, however, is unknown. Cornell University investigators **Paul Bowser** and **Rod Getchell** will sample fish in their natural habitats for the gene coding of the botulism toxin produced by the causative agent, *Clostridium botulinum*. (*See related article, pages 12-13.*)

Healthy shellfish: hard clam and oyster research

Scientific tools for industry, government, and agencies do not exist for rapidly and reliably differentiating virulent from non-pathogenic *Vibrio parahaemolyticus* strains that can potentially compromise safety of shellfish harvested in NY's waters. This pathogen, most often transmitted by oyster consumption, is responsible for about 5,000 illnesses annually nationwide. Standard detection methods of the pathogen are expensive and tedious. They do not allow rapid screening of either seafood or seawater samples. Current methods require time-consuming culturing of the bacteria and may not detect emergent pathogenic strains. Cornell University's **Kathryn Boor** and **Martin Wiedmann** will develop new and novel tissue culture-based assays for distinguishing *V. parahaemolyticus* that have the actual ability to cause pathogenic effects from those bacteria that merely exhibit the genetic characteristics that are associated with virulence. Says Boor, "Our results will allow regulatory, public health, and seafood industry laboratories to acquire more rapid and reliable data reflecting the pathogen status of oyster harvest areas."

In a study that will help scientists and managers rigorously test techniques for stocking young hard clams in Long Island waters, Cornell Cooperative Extension of Suffolk County's **Gregg Rivara,** Stony Brook University's **Robert Cerrato** and NYSDEC's

What are some ways to make hard clam populations recover in Long Island's waters? Stony Brook University's Robert Cerrato (pictured) and Cornell Extension's Gregg Rivara will investigate with the help of six Suffolk County towns.

Debra Barnes will work cooperatively with six different Suffolk County towns led by **John Aldred** of East Hampton. The unique research team will examine the survivability of early small vs. later larger seed clams in a variety of environments and whether either method provides a good means to help the recovery of hard clam stocks. Hard clam harvests from Long Island's south shore waters are at an all time low, dropping consistently since a record 700,000 bushels were yielded just 25 years ago. "If we can demonstrate similar survival rates, then public shellfish enhancement programs and commercial clam farms can modify their practices to plant smaller seed beginning earlier in the season" says Rivara. This technique would increase output of hatcheries and nurseries and lead to a possible overall increase in yield at harvest.

Understanding the why: environmental analysis and response

Climate change with attendant rising sea levels and intense storms will put extremely valuable real estate and environments in lower Manhattan and adjacent areas in New Jersey at an even higher risk for serious flooding. SBU researchers **Malcolm Bowman**, **Roger Flood**, **Douglas Hill,** and **Robert Wilson** are exploring the feasibility of using storm surge barriers to protect these densely populated coastal areas. With co-funding from the City of New York, the team will establish if placing such barriers across the Verrazano Narrows, Upper East River and entrance to Arthur Kill could protect the region without undue adverse effects on the coastal environment outside or behind the barriers. "The Europeans have protected their low-lying cities from North Sea storm surges quite effectively," says Bowman. "Using various storm-surge numerical

Malcolm Bowman will investigate ways to mitigate flooding of New York's urban coastlines. Photo by Barbara Branca

models and high resolution elevation-bathymetry databases, our study will provide planners with the information needed to see if similar engineering structures would work this side of the Atlantic."

SBU investigator **Robert Cerrato** will develop a revolutionary technique for benthic habitat identification and mapping. This innovative method will help replace the fairly standard approaches benthic ecologists have used over the past several decades for underwater community structure analysis and habitat identification. Cerrato's multi-stage approach incorporates the use of side-scan sonar, multi-beam acoustics, sediment grain size analysis, and other geophysical survey tools with data about the living community. Using an integrated approach to differentiate among various benthic habitats will benefit the design and power of scientific research and monitoring projects, and environmental impact studies that are vitally important to resource managers.

Salt marshes are inherently ephemeral coastal habitats sensitive to changes in their physical environment. Management strategies seek to address the loss of wetlands, but lack an understanding of how marshes are likely to respond to environmental changes caused by growing coastal urbanization. In a newly funded project, SBU's **Steven Goodbred** and **J. Kirk Cochran** will evaluate the physical characteristics of several wetlands in the diverse coastal areas of Long Island. As a function of physical regime, some marshes may show markedly different sensitivities to environmental change. Keystones identifying the most significant and robust factors that contribute to marsh stability, and lynchpin factors sensitive to change, will be defined to create a framework for making educated decisions between conservation, development, and remediation.

— Barbara Branca, Patrick Dooley, Paul C. Focazio, Cornelia Schlenk and Lane Smith
contributed to this article

Photo by Anita Kusick

Wetlands that fringe Long Island's shorelines are the focus of **Steve Goodbred's research.**