Current Projects in Aquatic Nuisance Species

Impacts of Aquatic Nuisance Species within New York State

Although New York Sea Grant addresses a variety of aquatic nuisance species issues, of greatest concern are the effects of the zebra mussel on the state's public and private infrastructure. Over the last decade, combating these exotics has cost the state at least $28 million, impacting electric power generation, drinking water facilities and residential water supplies, food processing, automotive parts manufacturing, photographic products manufacturing as well as other industries which rely heavily on raw surface water for cooling, flushing or processing of water.

The zebra mussel–a genus including zebra mussels, *Dreissena polymorpha*, and quagga mussels, *Dreissena bugensis*–contributes to the fouling of raw water intakes which results in the loss of pumping ability, clogged pipes, obstructed valves, obnoxious smells from decayed mussel flesh, increased corrosion of cast iron pipes and safety hazards if sprinkler systems fail to deliver fire fighting water. As documented in research papers published in New York Sea Grant's National Aquatic Nuisance Species Clearinghouse's publication ***Dreissena!*** since mid-1997, these organisms have also been shown to impact such ecological facets of the Lake Erie and Lake Ontario systems as habitat, food web and biodiversity. For example, because zebra mussels feed on phytoplankton and detritus, it is likely that they have helped clear the lakes of food sources for tiny zooplankton.

New York is also experiencing ecological impacts on native species caused by the recent invasions of several other species into its waters: the blueback herring in the Erie Canal and Lake Ontario, the round goby in the eastern basin of Lake Erie, the New Zealand mud snail in Lake Ontario and the "fishhook water flea," *Circopagis pengoi*, in Lake Ontario and the Finger Lakes. Another growing problem has been the impacts on fishery resources by cormorants. The recent invasion of Cayuga Lake by the Asian clam may also cause infrastructure and ecological impacts. Other problems facing New York are the food web, bioenergetic, biodiversity and other long-term ecological impacts of such well-established nonindigenous fishes as the alewife. From the Great Lakes region to the Hudson Valley and the marine district there is concern for the potential habitat and biodiversity issues related to such nonindigenous plants as purple loosestrife, *Phragmites*, waterchestnut, and the Eurasian water milfoil.

Research Emphasis on Zebra Mussels and Fisheries

New York Sea Grant's outreach efforts are partnered with a strong research component with a focus on zebra mussel studies and ecological effects of other nonindigenous species on fisheries. While zebra mussels are ubiquitous and abundant in many major freshwater ecosystems in New York and elsewhere, very little is known about their influence on the biogeochemical cycling of metals. By evaluating the daily processes and functions of zebra mussels, **Nicholas Fisher** assessed the role of zebra mussels in influencing metal cycling in freshwater ecosystems, with a focus on the upper Hudson River region. Fisher's intent in the NYSG study, which was completed in January 1998, was also to evaluate the prospect that these organisms might hold great promise as bioindicators for the presence of toxic metals in freshwater systems.

Overall, Fisher reported assimilation efficiencies of chromium (2%), silver (4%), selenium (approximately 70%) and cadmium (72%) measured from numerous algal and particle types. "We observed that assimilation efficiency varies greatly between elements and varies significantly within elements depending on food type acting as the source of the trace element," he said. Additional experiments included a measure of zebra mussel absorption efficiencies of metals from the dissolved phase as well as analyses to determine both short-term efflux rates of metals out of zebra mussel tissues as well as long-term efflux of metals which have entered slowly-exchanging pools within the organisms.

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 veligers without the requirement of being taken to the laboratory for identification. An important objective and extension of the project is to cooperate with industrial user groups that are concerned with the colonization of their facilities by zebra mussels.

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Current Projects in Aquatic Nuisance Species

In a 1998 *New York Times* interview, 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 **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 as well as those of other Great Lakes areas. 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."

In an effort to determine how changes in nutrient levels and exotic mussels are affecting the Lake Erie food web and the future of the fish community, **Edward L. Mills** initiated a multi-agency study in February 1998 entitled "Sustaining Fisheries in a Changing Environment: The Effects of Oligotrophication and Invasion of Dreissenids in Eastern Lake Erie." The two-year NYSG study involves a collaborative effort by researchers to specifically study the interactions between the number of smelt produced by the lake, growth rates of predatory fish such as smallmouth bass, walleye and lake trout and changes in the lake's ability to support fish. "I believe that this approach will help us understand how lowered nutrient levels from phosphorous reductions and zebra mussel activities will aid in the prediction of future fish production to make necessary management actions," Mills said. As such findings continue to unfold, a greater emphasis is placed on plans to expand studies on Lake Erie so as to better manage its fisheries resources.

Setting his study sights in another part of the state, **Stuart Findlay**, a scientist at the Institute of Ecosystem Studies, is working closely with the Habitat Restoration Project and in particular with the Hudson River National Estuarine Research Reserve. In Tivoli Bay North, one of four nationally-designated estuarine reserves along the Hudson, Findlay's NYSG-funded project, begun in 1998, is to compare the dynamics of decomposition for both invasive reeds (*Phragmites*) and the native cattails (*Typha*). According to Findlay, "Reeds stay standing long after they die compared to cattails which soon fall over. Thus the rates at which the plant matter decays differ as do the nutrient loads added to the water and the dynamics of populations of bacteria and fungi that decay the plants." Findlay's documentation will be used to determine the benefit of restoration efforts made in coastal areas that focus on removing invasive reeds. According to Findlay, "Reed invasion and potential reed removal are central issues on the Hudson and our documentation of important marsh functions related to specific plant communities will contribute to overall tidal wetland management."

Looking to the Future

Overall, more than 145 established exotic species have successfully invaded the Great Lakes, with 15 fish species having found their way into Lake Ontario so far. It has been documented that about one out of every ten established exotics has had serious impacts on Great Lakes ecosystems. Recent reports confirm that many exotic species have been found to potentially cause genetic alterations in native populations as well as compete for and succeed in obtaining food and nesting sites. Exotic species introductions are unpredictable and more likely to cause permanent changes. Some consider invasive species to represent the single greatest threat to the Great Lakes ecosystem. Invasive nuisance species will continue to be an issue in the Great Lakes into the 21st century, an area where Mills cites, "The significance of the problem will present a challenge to managers and stakeholders alike," emphasizing the need for prevention and control action. Providing aquatic nuisance species research and outreach to legislators, resource agencies, scientists, the media and the general public will continue to be an important mission of New York Sea Grant.

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New York, with 3,400 miles of widely varied coastline, is the only state in the country bordering both the Great Lakes and the ocean. More than 85% of the state's 15 million people live along its coastlines. New York Sea Grant is currently supporting 60 projects in research, extension and education. The projects described here reflect some of the research priorities of NYSG's 1998-1999 omnibus. For more detailed information about NYSG's research projects, call the Institute office at (516) 632-6905 or visit us on the World Wide Web, <www.seagrant.sunysb.edu>

Current Projects in Fisheries & Seafood Safety

Empirical Simulation of the Effects of Size-Selective Natural and Fishing Mortality on the Evolution of Growth Rate in Fish Stocks

David O. Conover, Marine Sciences Research Center, SUNY Stony Brook

Natural populations of fishes are subject to many sources of natural and fishing mortality that act in a size-dependent manner. Natural mortality typically selects for larger fish (bigger is better) while fishing mortality does the opposite (smaller is better from the fishes' point of view). Evidence is accumulating that both forms of size-selective mortality influence the evolution of growth rate, but in opposite directions. In response, this project will utilize captive populations to experimentally evaluate the level of growth rate evolution in response to size-selective mortality, using a model species (the Atlantic silverside, *Menidia menidia*) that appears to be ideally suited for this purpose. If this initial project is successful, the system can then be exploited to pursue more complex questions such as the influence of size selective harvest in variable environments, for populations with overlapping generations, other forms of selective harvest (e.g., slot length), and changes in other life history traits (e.g., age at maturity).

Preventing Scombrotoxin Formation: Developing More Refined Data for an On-Board and In-Plant HACCP Plan

Joe M. Regenstein, Department of Food Science, Cornell University (CU)

In order to develop an appropriate HACCP plan for both processors and the catching sector when handling fish that are subject to scombrotoxin formation, it is necessary to determine the impact of various time/temperature handling regimes on scombrotoxin formation in mackerel, bluefish and herring. The impact of handling practices, e.g., fecal contamination of fish not naturally containing bacteria with high levels of histamine decarboxylase or short-term exposure to abuse temperatures, on the process needs to be further elucidated.

Stock Identification and Mixed Stock Analyses of Winter Flounder (*Pleuronectes americanus*)

Isaac I. Wirgin, Institute of Environmental Medicine, NYU Medical Center

Winter flounder is a highly-sought groundfish which is subject to a wide variety of competing fisheries. Currently, stocks of winter flounder are severely depleted throughout much of its range, although not everywhere. Winter flounder are managed as three stocks by ASMFC, although biological evidence supporting this approach is minimal. This study will sensitively determine the genetic stock structure of winter flounder and estimate the relative contributions of defined stocks to mixed fisheries in New York and federal waters. These results can be used by ASMFC and state agencies to support current management paradigms or more effectively manage this resource.

Specific Detection and Tracking of Pathogenic *Listeria monocytogenes* in Smoked Salmon and in Processing Plants

Martin Wiedmann, Department of Food Science, CU

Compliance with zero-tolerance for *L. monocytogenes* in ready-to-eat seafoods represents a significant challenge for the smoked fish industry. This project will determine the relative frequency and characteristics of *L. monocytogenes* with attenuated virulence or avirulence in cold-smoked salmon products. These data will provide the basis for proposing a new non-pathogenic or less pathogenic *Listeria* subset to the FDA. Regulatory recognition of avirulent *Listeria* spp., coupled with application of new technology for their rapid detection, may reduce the incidence of costly product recalls. This project, conducted in close collaboration with the New York Sea Grant extension program and with New York State salmon processors, will also propose development, validation and application of a molecular detection and tracking system for *L. monocytogenes*, followed by incorporation of this strategy into HACCP plans.

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Construction and Testing of an Inexpensive PSP Toxin Analyzer

Gregory L. Boyer, SUNY College of Environmental Science and Forestry (ESF)

Paralytic Shellfish Poisoning (PSP) is a major economic problem for the shellfish industry. To prevent toxic shellfish from reaching consumers, PSP toxins are currently analyzed in the laboratory using either the mouse bioassay or by HPLC coupled with post-column oxidation. Both have drawbacks: The mouse bioassay is facing considerable opposition due to the animal rights lobby and the current HPLC technique is too complex for regulatory use. In this project, two PSP analyzers will be constructed: one for use in a regulatory lab and another for shellfish growers/harvesters and aquaculturists.

Shell Beds as Hot Spots for Increasing Hard Clam Production

Robert M. Cerrato, Marine Sciences Research Center, SUNY Stony Brook

The hard clam (*Mercenaria mercenaria*) is an important economic and ecological species that has declined dramatically in abundance in Great South Bay. This study will use both laboratory and field research to examine the population dynamics of juvenile hard clams in order to identify time periods, life stages, and physical processes critical to year class success and relate these to habitat characteristics. Our recent side-scan sonar mapping has provided us with the ability to focus for the first time on the most productive areas of the bay, and the proposed study will give us a new understanding of habitat characteristics critical to young hard clams. Results will provide resource managers with a detailed blueprint for implementing full-scale hard clam habitat creation/enhancement operations.

Contributions of Fish Production from Coastal Wetlands and Nearshore Areas to Great Lakes Pelagic Habitats

Neil H. Ringler, Department of Environmental and Forest Biology (EFB), SUNY College of ESF

This project will evaluate the importance of coastal wetlands and littoral habitats as young fish nursery areas and measure the extent to which this production contributes to the open water system of Lake Ontario. We hypothesize that these nearshore areas function like marine estuaries, providing unique habitats for young fish. We expect to observe differences in young fish production or growth between nearshore habitats (e.g., between wetland and other vegetated shoreline). Further, if this production plays a role in the life histories of pelagic species, we should be able to estimate the extent to which this energy is exported from nearshore to open waters.

Population Dynamics of Naturally Spawning Salmonine in Lake Ontario

Donald J. Stewart, Department of EFB, SUNY College of ESF

After more than 30 years effort, the dynamics of naturally spawning lake trout has become an emerging issue for sustaining their recovery and for future management of the salmonine fishery. Commonly used fish bioenergetic models do not have explicit treatments of reproduction and mortality. In contrast, most traditional fishery models emphasize individual numbers and lack considerations of energy demand and supply. In order to manage natural spawning populations of salmonines, new techniques for evaluating metabolic states in the field and a bioenergetics-based population dynamic model are badly needed.

Walleye Restocking and Production by Using Indoor Systems

Michael B. Timmons, Department of Agriculture & Bio. Engineering, CU

Sport fishing is one of the major contributors to the tourist industry in NY State with walleyes being considered one of the premium sport fishes. Severe shortages of walleyes for stocking currently exist, primarily due to *Columnaris* bacteria-induced high mortality rates (>90%) during the fry to dry feed fingerling stage. In attempts to best combat this prevailing problem, the Oneida Hatchery practicing extensive sterilization techniques on incoming water used for its aquaculture procedures—which result in over 300 million eggs for other hatcheries as well as 1.5 million eggs for its own efforts to produce fingerlings for live stocking in the Finger Lakes regions.

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