
Habitat Hotline Atlantic

Issues of Concern for Atlantic Marine Fish Habitat

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Endocrine-Disrupting Chemicals In Marine and Estuarine Systems: *Should We Be Concerned?*

by

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One of the major environmental issues facing us today is the potential ecological and human health impacts of chemicals which disrupt the endocrine system, a network of glands and organs that regulates many bodily functions, including growth, metabolism, reproduction, and immune function, through chemical messengers known as hormones. Endocrine-disrupting chemicals include a broad range of compounds, such as aromatic hydrocarbons derived from fossil fuel products, PCBs, DDTs and other pesticides, surfactants present in detergents, phthalates present in plastic products, and food preservatives. Most of them interfere with endocrine function by either mimicking or blocking the effects of naturally occurring hormones.

Contaminants that mimic the female reproductive hormone, estrogen, and are called eco-estrogens or xenoestrogens, are probably the best-known of the endocrine-disrupting compounds. Environmental estrogens and their effects have been publicized in the popular press in reports of feminized male fish in England, reproductive problems in Florida alligators, and declining sperm counts in men. However, xenoestrogens are not the only types of endocrine-disrupting chemicals found in the environment. There are also a number of other types of hormone-disrupting chemicals, which may have anti-estrogenic effects, or may interfere with the functioning of other hormones, such as androgens, the male reproductive hormones, or thyroid hormone, which regulates growth and metabolism.

Effects on Freshwater Fish - There are several well-known examples of the effects of endocrine-disrupting chemicals on freshwater fish. One of the most dramatic is the discovery of feminized male fish in rivers in England. The concern began when unusually high numbers of hermaphroditic fish were observed in rivers near sewage outfalls. Further investigation revealed that a number of male trout and carp were producing vitellogenin, the egg yolk protein that is normally produced only by female fish during reproductive development. Because vitellogenin production can also be induced in male fish exposed to estrogen or estrogen-like substances from outside sources, investigators suspected that the abnormalities in male fish were caused by exposure to synthetic estrogens or estrogen-like substances in the water. Currently, it is thought that synthetic estrogens from birth control pills or related medications are the main source of estrogen exposure in these fish, although other estrogenic compounds, such as surfactants in detergents or industrial pollutants, may also contribute to the problem.

Reproductive problems in fish from the Great Lakes have been a concern since the 1950s. Subsequent research has implicated dioxins and dioxin-like compounds, including certain PCBs, as causative agents for recruitment failure of lake trout and other fish species from this area. Larvae of fish exposed to



dioxins and related compounds cause growth retardation and various types of malformations which lead to high rates of early-life stage mortality.

Exposure to pulp and paper mill effluent also leads to alterations in endocrine and reproductive function in fish. In Lake Superior and other sites around the Great Lakes in Canada, for example, white sucker, longnose sucker, and lake whitefish exposed to bleached kraft pulp mill effluent exhibit a wide range of altered reproductive responses including reductions in depressed sex steroid hormone levels, reduced gonad size, delayed sexual maturation and reduced expression of secondary sexual characteristics.

Dioxins and related compounds which are formed during the bleaching process are possible causative agents, but are unlikely to be the sole source of the problem, as alterations in the bleaching process which removes these chemicals has failed to eliminate reproductive problems in fish exposed to effluents from Canadian mills. It is now thought that estrogenic chemicals derived from the wood products themselves, such as beta-sitosterol, may be responsible for some of the effects associated with pulp mill effluents.

Marine and Estuarine Systems - In comparison, we have heard less about effects of endocrine-disrupting compounds on marine life. Are endocrine disrupting chemicals a cause for concern in the marine environment? To determine this, we must answer several key questions. Are marine fish and shellfish exposed to endocrine-disrupting chemicals? If so, are the exposures sufficient to affect critical processes such as growth, development, disease resistance, and reproduction? How widespread is the problem? What might be the overall effect on fisheries resources?

Data from large-scale monitoring studies throughout the world show clearly that marine organisms are exposed to compounds with known effect on endocrine function. For example, in NOAA's National Benthic Surveillance Program, it was found that bottom-dwelling fish from a number of urban areas along the east and west coasts of the United States had elevated concentrations of pesticides, PCBs, and DDTs in their tissues, and were also exposed to aromatic hydrocarbons and heavy metals. The types of PCBs found in tissues included both dioxin-like congeners, which tend to have anti-estrogenic and adverse developmental effects, and congeners which tend to mimic estrogen or thyroid hormone.

Exposure to chemicals is in fact linked to a variety of reproductive and development abnormalities in marine fish and shellfish, a number of which may be mediated through the endocrine system. Like trout and carp, some marine bottom fish in Great Britain are affected by environmental estrogens. Some very recent studies have shown that male plaice from estuaries in England and Scotland where there are a large number of sewage outfalls also show abnormal vitellogenin production and a high proportion of hermaphroditic fish. The extent of this problem in estuarine and marine areas in the United States is not clear, but surveys are underway by scientists in various parts of the country.

An equally serious concern for marine fish populations are the effects of compounds with anti-estrogenic effects. These include substances such as aromatic hydrocarbons derived from petroleum products and fossil fuel combustion, dioxins, and certain types of PCBs which have dioxin-like actions. Exposure to these types of compounds tends to suppress vitellogenin production, and wild female fish from sites where these compounds are present often show reproductive abnormalities. For example, NOAA Fisheries scientists in Seattle, Washington have found that English sole exhibit various types of reproductive dysfunction, including depressed sex hormone levels, altered or inhibited reproductive development, and reduced egg and larval viability at sites within Puget Sound where high concentrations of such compounds are found. Similarly, NOAA Fisheries researchers on the East coast have seen suppressed vitellogenin production and resorption of developing eggs in winter flounder from contaminated sites such as Boston Harbor. Winter flounder from these areas also show declines in egg and larval quality.

Similar types of abnormalities have been found in marine fish from other urban areas in both the United States and Europe. Reductions in gonadal growth, egg quality, and other indicators of reproductive function have been observed in field populations of starry flounder from San Francisco Bay, white croaker from the Los Angeles area, and Atlantic croaker from the Houston Ship Canal in Texas. Alterations in the timing of vitellogenesis have been observed in flounder from polluted sites in the North Sea, and reductions in egg and larval viability have been reported in dab, European and Baltic flounder, cod, and plaice from polluted waters in Europe.

In most of these studies, reproductive abnormalities were correlated with elevated body burdens of organochlorine compounds, such as PCBs, DDTs and various pesticides, in affected fish, or with exposure to aromatic hydrocarbons from petroleum products of fossil fuel combustion. These studies suggest that there may be widespread impacts of chemical contaminants on the reproductive capacity of marine fish.

In addition to reproduction and early development, endocrine disrupting chemicals may interfere with growth, metabolic function, and disease resistance. For example, studies in Puget Sound show potential endocrine-disrupting impacts of contaminants on juvenile salmon which pass through urban estuaries on their way to the ocean. In these fish, exposure to chemicals, particularly PCBs, appears to reduce growth and suppress immune function. Although these fish are typically exposed to contaminants only for a few days or weeks while they pass through polluted estuaries on their way to the ocean, these transient exposures can trigger effects on growth or disease resistance which may linger for several months after exposure ceases.

Other Marine Species - Fish are not the only marine animals affected by endocrine-disrupting chemicals. Exposure to tributyltin (TBT), which until recently was a common agent in anti-fouling paints, causes the masculinization of female gastropods. This condition, known as imposex, has been observed in

over 40 species of marine gastropods in contaminated coastal areas throughout Europe and the United States and Canada, in New Zealand and Australia, and in Japan. Imposex is thought to be caused by disrupted metabolism of sex hormones.

TBT appears to interfere with the metabolism and excretion of the male hormone, testosterone, and the resulting build-up of this hormone in the tissues "masculinizes" female gastropods. Insect growth regulators such as diflubenzuron and methoprene, which are used as insecticides, may also pose a threat to marine crustaceans. Adverse effects on crustacean growth, survival, reproduction, and behavior have been found in laboratory exposures in mysids, prawns, shrimp, crab, and crayfish, but the impacts of these chemicals in the natural environment are not well known.

Are endocrine-disrupting contaminants contributing to declines in fish stocks? This is an important question, but one that is not easy to answer. Fish abundance is affected by a number of factors, so it is difficult to confirm that endocrine-disrupting chemicals are directly responsible for

declines in specific fisheries. However, there is little doubt that exposure to certain classes of contaminants can reduce growth, survival, and reproductive rates in marine fish. Consequently, they are capable of decreasing fisheries productivity, and of reducing the capacity of fish populations to withstand the additional stresses associated with overharvest, habitat destruction, and changes in climatic conditions.

Exposure to endocrine-disrupting chemicals is associated with adverse health effects in marine fish and shellfish throughout the world, and their potential impact on fisheries productivity should be taken into account in our management of marine resources.

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NACo Implements Nonpoint Source Pollution Program

Belching smokestacks and leaking effluent pipes describe the image most of us probably have of environmental pollution. However, in many counties, nonpoint sources of pollution represent more of a threat to environmental resources.

Nonpoint, or diffuse, sources of pollution include runoff from agricultural lands and urban areas, construction sites, forestry and mining wastes, lawn chemicals, animal feed lots, leaking septic systems, marinas and recreational boating. While the impact from individual nonpoint sources may be small, the cumulative effect from numerous activities significantly degrades water quality.

Water flowing over land from natural precipitation or from irrigation picks up pollutants, including chemical fertilizers, sediment, animal wastes, oil, road salt, and toxic chemicals, and carries them into rivers, lakes, and aquifers. In urban areas, paved surfaces prevent precipitation from being absorbed and filtered by the ground. In this circumstance, water often travels a considerable distance to areas where it is absorbed back in to the ground or deposited into lakes or streams. This can cause accumulation of large volumes of water, and with it, pollution and siltation. Porous soils, grass lands, and wetlands can help filter and cleanse water, and allow for more gradual recharge of surface and ground water.

According to the U.S. EPA, nonpoint source pollution is the most widespread and significant source of pollution to our nation's rivers, lakes and estuaries. Agricultural pollutants are

the number one source of pollution to rivers and lakes, affecting 60% of the impaired river miles and 50% of impaired lake acres. Urban runoff and storm sewer effluent is the primary contaminant in estuaries, which are waterways of varying salinity where a river meets the sea (U.S. EPA, *The Quality of Our Nation's Water: 1994*).

Because nonpoint source pollution is so pervasive, solutions to this problem involve a broad range of players and activities. From local planners and environmental specialists, to farmers and developers, nonpoint source pollution prevention cannot move forward without the concerted effort of multiple parties.

Under a grant from EPA's Office of Water, the National Association of Counties will be providing county officials information on how they can help reduce the ill effects of nonpoint source pollution in their communities. A special focus of this project will be on land-use practices, including techniques for maximizing the environmental capability of new development. Please look for future articles and publication.

For more information, contact Naomi Friedman at NACo, 202/942-4262 or David George, 202/942-4243. For information on NACo's Coastal Watershed Protection Project, contact Abby Friedman at 202/9942-4225. You may access EPA's homepage on nonpoint source pollution at www.epa.gov/owow/nps/index.html. Adapted from *County Environment Quarterly, Spring 1997*.

MAINE

Removal of the Edward's Dam -The Federal Energy Regulatory Commission (FERC) has released its final Environmental Impact Statement (EIS) for the re-licensing of 11 hydroelectric projects on the Kennebec River in Maine. In a surprising reversal from the draft EIS, FERC staff endorsed the retirement and removal of the Edward's Dam project, thereby supporting the recommendations of National Marine Fisheries Service (NMFS), the Department of the Interior (DOI), the State of Maine, and a coalition of regional and national environmental groups.

FERC staff found that the fishways prescribed by NMFS and DOI are needed and appropriate, but the \$10 million cost of installing them makes licensing the project about 1.7 times more expensive than retiring the project and removing the dam. FERC staff also agreed with NMFS and others that dam removal is the only option that would restore shortnose sturgeon, Atlantic sturgeon, rainbow smelt, and striped bass to their historic spawning habitat above the dam, and found that dam removal would result in a net increase in wetland habitat, recreational boating, and fishing benefits. NMFS Habitat Program staff worked with other parties over the past six years to convince FERC of the severe adverse impacts of the Edward's Dam on anadromous fish, and to persuade FERC that the benefits of restoring a 15 mile reach of riverine spawning habitat outweighed the costs of removing the dam. FERC must now vote on whether to accept, modify, or reject the conclusions in the final EIS. If approved, this would be the first case nationally where FERC has ordered the decommissioning and removal of an operational hydropower dam. For more information, please contact Jon Kurland at NMFS, 508/281-9204.

NEW HAMPSHIRE

New Hampshire towns, USFWS collaborate on Great Bay salt marsh restoration - Twenty-five acres of degraded salt marshes in the Great Bay National Wildlife Refuge are the target of a restoration project begun last November by the US Fish and Wildlife Service (USFWS), neighboring towns, and a Maine-based contractor.

The joint efforts are meant to provide

habitat for invertebrates and migratory birds; reestablish normal tidal flow; restore water levels; reestablish native vegetation; and halt costly mosquito spray programs by restoring mosquito-eating fish in four environmentally important coastal marshes.

Restoration work under way at Herods Cove, Stubbs Salt Marsh, Woodman Point, and Welsh Cove is funded by a USFWS Challenge Grant, the North American Waterfowl Management Plan, and matching contributions from the towns of Greenland, Hampton, Newmarket, and Newington.

The USFWS provided a trained equipment operator and specialized lightweight equipment designed for use in fragile salt marshes, and developed the projects jointly with SWAMP Inc., a Maine-based contractor.

According to USFWS biologist Jan Taylor, drainage ditches constructed in the past to remove mosquito breeding areas often improved mosquito habitat instead. Draining of marshes also ruined habitat that had supported mummichogs, leading to a noticeable increase in the marsh mosquito population. Draining of coastal marshes for mosquito control, salt hay production and other kinds of development also led to a decline in wildlife dependent on wetlands for breeding, migration, and wintering habitat, Taylor noted.

According to USFWS, the methods being used to reverse these effects have proven successful in other southern New Hampshire coastal communities, as well as Massachusetts and Connecticut. *Adapted from Gulf of Maine Times, Spring 1997.*

Governor Shaheen Serves on NGA Natural Resources Committee - The National Governors' Association recently appointed new members to their Natural Resources Committee. The Committee has recently focused on clean water issues, Superfund and electricity restructuring. Governor Shaheen has served on the Committee since her election in 1996. Nevada Governor E. Benjamin Nelson is the new Chair, and Montana Governor Marc Racicot serves as the Vice Chair. The remainder of the Committee members are: Gov. Tony Knowles, AK; Gov. Philip E. Batt, ID; Gov. Kirk Fordice, MS; Gov. Frank Keating, OK; Gov. John Kitzhaber, OR; Gov. George W. Bush, TX; Gov. Michael O. Leavitt, UT; Gov. Howard Dean, M.D., VT; Gov. Roy L. Schneider, M.D., VI; Gov. Cecil H. Underwood, WV. *For further information, contact the NGA at 202/624-5300.*

RHODE ISLAND

Marina Pollution Control Methods Now On-line - The control of pollution from marina-related activities has become an increasingly pressing concern over recent years. To comply with federal and state regulations, operators of recreational boating facilities find themselves searching for ways to manage sewage and solid waste, to prevent oil and gasoline spills, and to minimize the impact of boat maintenance activities.

Until now, there has been a lack of practical, widely applicable approaches to controlling these diffuse and often

elusive nonpoint sources of pollution. But a new on-line document, the result of six years of experimental work in Rhode Island, recommends actions that marina operators can take to reduce this pollution.

Best Management Practices for Clean Marinas: Lessons Learned presents nine case studies that describe methods developed through testing at five pilot marinas in Rhode Island. The project — funded by the Environmental Protection Agency, and carried out by RI Sea Grant, the URI Coastal Resources Management Council, and the RI Marine Trades Association — addressed a variety of nonpoint source pollution problems common to marinas nationwide. Solutions to these problems range from the use of vacuum sanders, to improved liquid waste containment and disposal methods, to boater education efforts. The document provides general descriptions of each best management practices (BMP), evaluating costs, pollutants collected, and overall effectiveness, and gives recommendations for the future use of the practice.

The BMP guide joins several other RI Sea Grant marina-related publications already available on the World Wide Web. Selected sections from *Environmental Guide for Marinas: Controlling Nonpoint Pollution and Storm Water Pollution in Rhode Island* provide detailed technical guidance to help recreational facilities comply with state and federal regulations. A series of one-page fact sheets helps boaters reduce nonpoint pollution from all activities, from fueling to sanding and painting.

All of the documents are accessible through the RI Sea Grant home page, <http://seagrants.gso.uri.edu/riseagrants/marina.html>. Adapted from *Nor'easter, Spring/Summer 1997*.

NEW YORK

Southampton Considers Legislation to Regulate Coastal Development - The Town of Southampton, NY Board of Trustees has drafted a proposal to establish a strategy and management plan for the Town's coastal and waterfront areas. They hope to initiate and enact local legislation that will both protect Southampton's natural resources and maintain citizens and property owners' rights. The National Marine Fisheries Service has reviewed the draft legislation and hopes to provide comments to the Board of Trustees by the end of August. Information from a pier monitoring study conducted in eelgrass habitat will be included. For more information, please contact Diane Rusanowsky at NMFS, 203/783-4228.

NEW JERSEY

Mud Dump Site Closure - As of September 1, the Mud Dump Site will be closed to all but uncontaminated dredged material. The site, located six miles east of Sea Bright, New Jersey, has been the major depository of all federal and private dredging in the New York Harbor since the turn of the century. Recent public controversy over the impact of disposing dredged material slightly contaminated with an assortment of organic fractions has lead the White House Administration to order the Environmental

Protection Agency to close the Mud Dump Site. For further information, contact Stan Gorski, National Marine Fisheries Service, 732/872-3037.

MARYLAND

Maryland Water Monitoring Council - The Maryland Water Monitoring Council was formed in November 1995 to promote cooperation and communication among water monitoring groups, and to help effectively collect, analyze, interpret, and share monitoring data needed for regulations, policies, and management issues related to state water resources. The council addresses a range of aquatic resources, including groundwater, surface waters, and associated watershed-landscape relationships. It operates by building consensus among Maryland groups involved in water monitoring.

The council is patterned after the Federal Intergovernmental Task Force on Monitoring Water Quality (ITFM) formed in 1992 to support the establishment of federal, state, and tribal organizations to coordinate water monitoring activities. The ITFM recently released a report recommending that a nationwide strategy for water-quality monitoring be established to support sound aquatic resource management decisions at all levels of government and also in the private sector.

The MWMC is serving as a model for several states that are at various stages in the formation of water monitoring coordination bodies. These states include Florida and New Jersey. Maryland will provide information on forming a water monitoring council to any state agencies that ask.

Creation of the Maryland council was spearheaded by federal, state, and local governments as well as academia, volunteer organizations, and environmental consultants. The MWMC is governed by a 21 member board of directors that established five standing committees to carry out the council's goals and objectives. The committees are: the Planning Committee, the Assessment and Reporting Committee, the Monitoring Methods Committee, the Environmental Indicators Committee, and the Data Management Committee.

Membership in the council is free and its activities are funded by the Environmental Protection Agency, US Geological Survey, and the Maryland Department of Natural Resources. Future activities include publishing a quarterly newsletter, creating an MWMC home page, and coordinating various workshops to pursue topics of interest to members.

For more information or to receive copies of the proceedings from the 1995 and 1996 annual conferences, contact Ron Klauda at 410/974-3782. Adapted from *Fisheries, June 1997*.

GEORGIA

Georgia Coastal Management Program Draft Environmental Impact Statement available for public review - In accordance with the National Environmental Policy Act, the Georgia Coastal Management Program Document/Draft Environmental Impact

Statement is available for public review. This document is required for the approval of the Georgia Coastal Management Program by the National Oceanic and Atmospheric Administration pursuant to the Federal Coastal Zone Management Act.

Document Distribution: Interested parties may review the document at public libraries through Georgia's eleven county coastal area. Individuals may also call Mr. Joshua Lott (NOAA) at 301/713-3117x178 or Ms. Kathryn Zagzebski (Georgia DNR) at 912/264-7218 to receive a copy.

Written Comments: Written comments on the document should be submitted to: Mr. Joseph A. Uravitch, Chief, Coastal Program Division, SSMC4, Room 11537, 1305 East-West Highway, Silver Spring, MD 20910, 301/713-3155, x195. Comments must be received by Monday, October 20.

Georgia Coastal Management Program Issues Request for Proposals - The Georgia Department of Natural Resources, Coastal Resources Division, is soliciting proposals for Coastal Incentive Grants awarded under the Georgia Coastal Management Program. The theme of the 1997-1998 Coastal Incentive Grant cycle is "*Coastal Water-Related Resources*." The purpose of this theme is to promote projects of local and regional significance that enhance the knowledge of and improve the quality of coastal water-related resources.

The Federal Coastal Zone Management Act provides funding assistance to states with approved Coastal Management Programs for the purpose of program implementation and administration. As part of the Georgia Coastal Management Program, the Department of Natural Resources, Coastal Resources Division contributes approximately 60% of Georgia's administrative allocation to eligible entities as "Coastal Incentive Grants." Designed to fund projects that further the mission of the Coastal Management Program, Coastal Incentive Grants allow regional and local coastal issues to be defined and addressed creatively and proactively at the grass-roots level. Eligible grant applicants include county and municipal governments, state agencies, and educational and research institutions. Annual themes and funding criteria are established by the Coastal Advisory Committee. Projects are evaluated by the Coastal Resources Division staff according to specified criteria. The application deadline is January 1, 1998.

For further information, contact the Georgia Coastal Management Program, Department of Natural Resources, Coastal Resources Division, One Conservation Way, Suite 300, Brunswick, GA 31520-8687, 912/264-7218 (phone), kaz@dnrcrd.dnr.state.ga.us (email).

FLORIDA

Clean Marinas Help Keep Florida Waters Clean - In fall of 1997, the Florida Department of Environmental Protection (DEP) plans to initiate the Clean Marina Program. The Department started development of the program a little over 12 months ago to give marina operators a set of tools and incentives to reduce marina and boater impacts on Florida's waters. Modeled after

DEP's successful Clean Vessel Act Program, the development plan has four components: education and awareness, award recognition, incentive grants, and "Clean Marina" designation.

The education and awareness component will involve a series of community-based strategies promoting the other program components and will include an informational "clearing-house" of the latest pollution prevention technologies for easy access by marina and agency staff.

The award recognition component will provide a public forum for recognition of marinas that adopt program criteria and best management practices (BMP) which are over and above the minimum and provide a net positive environmental impact. This recognition can be used by the marina to its economic advantage.

Marinas will be encouraged with incentive grants to adopt best management practices which may be financially difficult in the short run. Under this program component, a series of strategies combining technical assistance, loans and grants will be developed to assist and encourage marinas in developing and implementing a BMP plan of action.

"Clean Marina" designation will provide a voluntary means by which marinas and boatyards will actively adopt a set of criteria important to boaters and the environment. One of the more important criteria is a set of activity-driven, ecosystem-based, multimedia BMPs. This designation will provide boaters with an assurance that marinas and boatyards are meeting program criteria. The Department's strategies will include technical assistance with the development and implementation of criteria and marina BMP action plans.

The DEP has traced the remarkable growth of boating in Florida and the statistics are impressive. Florida has 8,426 miles of shoreline, over 2,200 marinas, over 771,000 registered boaters, and almost 300,000 visiting vessels. Eighty percent of Florida's population lives on the coast, and more move in at a rate of 5,000 per month. The dramatic growth of boating makes it imperative that Florida minimize the environmental impacts associated with marina activity.

Public participation in the development of this program has been encouraged through the DEP's informative and interactive Clean Marina website at www.dep.state.fl.us/law/clean-marina. Each component of the proposed program includes a link to allow users to provide input in the form of comments, suggestions, or questions. For those who prefer face to face interaction, the department holds public forums throughout the state each quarter.

For more information, please contact Bonny King at 850/488-5600 x35. *Adapted from Coastal Currents, Summer 1997.*



Linking Town Hall to Technology and Land Use to Water Quality in Connecticut

The Waterford Town Hall in southeastern Connecticut is not a place most people would go to see a lively futuristic picture show, but town officials experienced a gripping, colorful, real-life drama on the screen when they invited the NEMO team to town. NEMO stands for Nonpoint Education for Municipal Officials and is a program developed as a collaboration between the University of Connecticut Cooperative Extension System and Connecticut Sea Grant. The program educates town decisions makers about the effects of nonpoint pollution by relating land use to water quality.

NEMO uses high-tech GIS map graphics and remote sensing images to show the town officials the town and its watersheds. GIS stands for "geographic information system," and means that any data that can be referenced to a location can be assembled into a digitized map, stored, and subsequently manipulated with computer software. Different types of information about the same geographical location can be overlain on a base map as a series of layers, making it easy to analyze and compare situations. Statistical programs can also be used with the data displayed to create predictive models.

The computer program can show how the original map of the town changes if all of the development that the town's current zoning regulations allow actually occur. Different colors on the map indicate areas that are aquatic, forested, cultivated, or impervious. Impervious areas are surfaces that water cannot penetrate, such as asphalt paving, roofs, and concrete. With traditional development, the percentage of land covered with impervious surfaces increases dramatically. If too great an increase occurs in a watershed, water quality inevitably suffers. Recent research shows that when the total area of impervious surface in a watershed exceeds 25 percent, serious degradation of water quality has already occurred.

The colors shown on the impervious cover maps are like the colors of traffic lights. Green areas designate environmentally healthy resource situations with less than 10 percent impervious surface, while yellow areas imply a need for caution (10 to 25 percent impervious cover). Red zones (greater than 25 percent) indicate danger — danger that serious degradation to water quality has occurred, requiring remedial action.

Accommodating Compatible Growth - NEMO's message is not that all large-scale development must be prohibited, but rather that municipalities can preserve and protect water resources and community character while accommodating compatible economic growth, provided appropriate planning is done. The challenge is to devise a development strategy that fits in with the surrounding community, minimizes negative environmental impact, and does not degrade groundwater and surrounding lakes and estuaries. The team advises a three-tiered strategy to accomplish these goals: natural resource-based planning, innovative site design, and the use of best management practices.

One recurring problem in town planning and resource use is that officials on planning boards and wetlands commissions are volunteers, either elected or appointed. Problems sometimes arise because members may lack sufficient technical knowledge and support. They also tend to have busy schedules, a narrow legal purview, and a rapid turnover rate. Given these constraints, board members, however dedicated and qualified, have a hard time tracking the cumulative impacts of proposed developments to the environment, economy, and quality of life. That's where NEMO lends a hand.

For example, in Waterford, commercial and industrial storm water runoff and improved site design are addressed by zoning commissions, and water resource protection goals are added

to development plans. As part of an effort involving the Environmental Protection Agency (EPA) the town is using NEMO concepts to experiment with two different housing subdivisions designs and a control site to determine the effects of the two designs on water quality downstream, using new monitoring technologies.

Sea Grant has historical connections with the NEMO project that led to the original concept. The land use cover maps that NEMO uses so effectively were compiled for the entire state of Connecticut by Dan Civco, natural resources management associate professor at the University of Connecticut's remote sensing laboratory in Storrs. The project was partly sponsored by Connecticut's Sea Grant development funds, with the intent of estimating major nitrogen sources that contribute to eutrophication in Long Island Sound. While reviewing the maps, the creators of NEMO identified ways to expand the educational value of the data and bring the towns and municipalities directly into the pollution battle.

Expanding NEMO's Influence - Planners are enthusiastically embracing the NEMO program as a guiding light to help them devise environmentally sound projects. In other towns influenced by NEMO presentations, such as Chester, open space planning and natural resource inventories have been initiated by conservation commissions. In Old Saybrook, NEMO information was incorporated into landscaping and parking regulations. For example, shopping centers can try including storm water catch basins in their parking lot designs. Sunken islands of vegetation placed within asphalt parking lots can be attractive features that help to mitigate the problem of polluted runoff.

While it is easy to blame industrialization and urbanization for water quality problems, these are not the only causes of the problem. Housing patterns that developed after World War II, based

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on individual automobile use, have led to large-scale suburban sprawl and very consumptive patterns. The traditional square or rectangular housing subdivision, for example, incorporates a lot of impervious surface in the blocks of straight roads. A more environmentally sound arrangement would be a cluster of houses surrounded by open space.

Support from Environmentalists -

Connecticut's NEMO fans also include The Nature Conservancy. Since 1993, the NEMO project has worked the Conservancy on two watershed projects in the lower Connecticut River valley, Chester

Creek, and Eight-mile River. The Conservancy designated the areas as one of the 40 "Last Great Places" in the world. With additional support from the U. S. Department of Agriculture, the Environmental Protection Agency, and the U.S. Fish and Wildlife Service, NEMO has been able to develop stewardship programs for private woodlot and streamside property owners, in addition to land use programs for town officials.

The NEMO concept is not limited to Connecticut; it's traveling rapidly, as other Sea Grant and extension programs and water districts all over the nation leap to adopt programs like NEMO.

It makes sense to export NEMO concepts, since towns in other states face the same or similar problems.

As resources dwindle and population grows, NEMO-like programs offer a new way of looking at community land use, from a larger, watershed perspective that relates both surface and groundwater quality to impervious surfaces. The difficult portion is imparting new perspectives, and translating new perspectives into actions that improve resource management and community planning.

Adapted from Nor 'Easter, Spring/Summer 1997

Settlement Speeds Puerto Rico Coral Reef Repair

Repair and restoration of a coral reef damaged by a freighter that ran aground off Mona Island in Puerto Rico are now underway, thanks to a \$1,250,000 settlement between a shipping company, the Commonwealth of Puerto Rico, and the National Oceanic and Atmospheric Administration (NOAA).

Rama Shipping Company of Thailand agreed to pay \$1,250,000 to the Commonwealth and NOAA for natural resource damages caused by the July 24 grounding of the *MN Fortuna Reefer*. The government agencies, acting as trustees for the injured natural resources, will use the settlement funds for restoration projects and damage assessment costs.

The settlement, reached on September 11, provides \$650,000 for emergency restoration of broken corals that is being conducted under NOAA leadership, and \$400,000 for compensatory restoration under the leadership of the Commonwealth, plus reimbursement of trustee costs. Emergency restoration of some 400 pieces of elkhorn coral was initiated on September 20, 1997 by NOAA's Damage Assessment and Restoration Program in cooperation with the Commonwealth of Puerto Rico.

Quick settlement between the natural resource trustees and the responsible party makes it possible to reattach the still living pieces of elkhorn coral broken off of the reef.

"The prompt recovery of restoration funds for the damage demonstrates the tremendous benefits that accrue to the nation's natural resources when responsible parties and trustees cooperate to quickly restore injuries," said Terry Garcia, Commerce Acting Assistant Secretary for Oceans and Atmosphere.

"The Department's main goal is the conservation and restoration of natural resources and to that end, the state and federal trustees managed this case on a fast track basis," said Daniel Pagan Rosa, Secretary for the Puerto Rico Department of Natural and Environmental Resources. "We are pleased with the outcome and are eager to commence the restoration work and the project with the funds secured through the settlement for compensatory damages," he said.

Experts plan to remove the largest broken pieces of branching elkhorn coral from the sea floor and reattach them before they succumb to winter storm damage. Emergency restoration will reverse the major impacts of the grounding by reestablishing the physical structure of the coral reef community and reducing coral mortality.

The 326-foot *Fortuna Reefer* grounded near a Commonwealth of Puerto Rico Natural Reserve off the west coast of Mona Island. The vessel injured a barrier reef that extends approximately 10 miles from the eastern end of the island along the southern coast and around to the northwest. The reef is populated with large, branching "old growth" elkhorn corals (*Acropora palmata*), which were injured by the grounding.

The remoteness of the grounding site hampered salvage efforts and the vessel remained aground for eight days. Most of the 100,000 gallons of heavy fuel oil and 33,000 gallons of marine diesel fuel aboard the *Fortuna Reefer* were removed before extracting the vessel from the reef. While no significant amount of oil was released, the grounding and subsequent salvage activities caused a swath of physical damage to the reef surface, measuring approximately 900 feet in length by 50 to 100 feet wide.

Calendar

Minding the Coast: It's Everybody's Business — The Coastal Society (TCS) invites papers, posters and proposals for concurrent topical or panel session and special programs for its 16th International Conference in Williamsburg, Virginia, July 12-15, 1998. The conference will highlight the need for all interests to work together on the complex issues involving the coastal ocean and coastal zones of various nations. 1998 is the International Year of the Ocean. Papers that present successful case histories where disparate commercial and environmental interests have been able to work together on key coastal issues or problems are encouraged. The Coastal Society was chartered in 1975 to serve as a forum for coastal resource professionals and other individuals interested in coastal issues to come together to promote the better understanding and sustainable use of our coastal resources. A website for the conference has been established at www.vims.edu/TCS16. For further information, please send email to tcs16@vims.edu or call 804/684-7151.

Fisheries, Habitat and Pollution 1997 - This conference, held November 6-8 in Charleston, SC, will explore population and ecosystem level effects of pollution and environmental degradation in the following areas: pollution, habitat quality and ecological issues associated with fisheries; watershed and coastal management; restoring degraded environments; and policy, management, and communication. Sponsors include National Marine Fisheries Service, Coastal Services Center, South

Carolina Department of Natural Resources, TerraAqua Environmental Science and Policy, and the Atlantic States Marine Fisheries Commission, among others. For additional information, please contact Elaine L. Knight, Conference Coordinator, at the South Carolina Sea Grant Consortium, 803/727-2078 or knighotel@musc.edu.

Fourth Marine and Estuarine Shallow Water Conference - Users and Regulators Seeking Consensus - For the past several years, scientists and regulators from around the world have met at the Marine and Estuarine Shallow Water Conferences to discuss the multiple issues surrounding this important ecological region which they have previously defined as the shallow water zone - the zone of maximum interaction between human activities and biological resources: the intertidal zone to four meters below mean low water. The conference, to be held in Atlantic City, NJ from March 15-19, 1998, continues the dialog and seeks to raise and discuss the issues, noting the conflicts between and pursuing consensus among the varied users and regulators. Abstracts should be tailored so they are relevant to a diverse group of users and should include a discussion of one of the following: critical habitats, scientific research, users' needs, policies and regulations, and management practices. For further information, contact: Ralph Spagnolo, 215/566-2718 (spagnolo.ralph@epamail.epa.gov) or Ed Ambrogio, 215/566-2758 (ambrogio.edward@epamail.epa.gov).

Profile: The EPA Office of Sustainable Ecosystems and Communities

The mission of the Environmental Protection Agency's Office of Sustainable Ecosystems and Communities (OSEC) is to foster the implementation of integrated, geographic approaches to environmental protection that emphasizes ecological integrity and the associated improvement in economic sustainability and quality of life. Here are just a few of the many tools OSEC offers to communities promoting sustainability.

The Sustainable Ecosystems and Community Clearinghouse works to make EPA's Community-Based Environmental Protection (CBEP) information and publications easily accessible to communities working on effective solutions to their local environmental issues. Clearinghouse information is available through:

A world wide web site (www.epa.gov/ecocommunity) that provides direct access to information about the economics of sustainability and community involvement.

A fax-on-demand systems (202/260-5339) that allows callers to select documents from a menu and then have them automatically faxed or mailed.

A bi-weekly newsletter that contains information of interest to CBEP practitioners; it is available through the web address, the fax-on-demand system or e-mail by sending a request to harris.lisaa@epamail.epa.gov.

A Guide to Sustainable Community Indicators describes the step-by-step process of developing, evaluating and using indicators at the community level. It also contains more than 400 indicators used by 11 different communities in defining and measuring community sustainability. For a copy of this report, send \$12.50 to QLF/Atlantic Center for The Environment, 55 Main St., Ipswich, MA 01935.

"Communicating with the Public on Environmental Issues" is a new brochure outlining five principles for effective communication. A short bibliography and checklist accompany the brochure, which can be obtained by calling 1-800-490-9198. Use document reference number EPA236F96.001. *From Joint Center Report, Publication of the Joint Center for Sustainable Communities, Volume 1, Number 1 Summer 1997*



Resources

Municipal Nonpoint Source Pollution Guidebook by Jennifer M. Pultz and Robert K. Williams. This guidebook is designed to assist local government in the prevention of water resources deterioration through nonpoint source pollution management by providing a common and basic understanding of the dynamics and management of this type of pollution. It offers information regarding common sources of pollution that can be effectively prevented through municipal intervention. (NYSGI-H-94-001) To order a copy for \$2.50, write to Communicator, New York Sea Grant Institute, 117 Nassau Hall, SUNY at Stony Brook, Stony Brook, NY 11794-5001.

Methods to Evaluate Constructed and Restored Wetlands as Finfish Nursery Habitats by Mark Malchoff. This report was compiled to facilitate such evaluation by reviewing the available information pertinent to this goal. The report offers a review and synthesis of methods useful in determining the habitat usage, density, and abundance of fishes associated with intertidal wetland environments. This information can serve as a useful tool for those businesses, organizations, and agencies currently planning or likely to plan for the creation or restoration of estuarine wetlands, with the objective of providing or enhancing finfish nursery habitat. The South Shore Estuary Reserve Council provided funding support for the development of this publication. (NYSGI-T-986-001) To order a copy for \$1, write to Communicator, New York Sea Grant Institute, 117 Nassau Hall, SUNY at Stony Brook, Stony Brook, NY 11794-5001.

Boater Fact Sheets by Jared Rhodes and Malia Schwartz. This monthly series of one-page fact sheets is designed to help recreational boaters reduce pollution associated with everyday activities on the water and at the dock. Each fact sheet presents tips and clear steps for boaters to follow. Topics include: sanding and painting; vessel cleaning and fish wastes; engine maintenance; vessel sewage; bilges, fueling, and spill response; and solid waste disposal. Fact sheets can be bought individually for \$.50 or the full set is available for \$2. To order, write to Publications, Rhode Island Sea Grant, University of Rhode Island Bay Campus, Narragansett, RI 02882-1197.

Environmental Guide for Marinas: Controlling Nonpoint Source and Storm Water Pollution in Rhode Island — Revised by Mark Amaral and Virginia Lee. Now revised and updated, this manual provides a “bible” for operations and management plans that can help marina operators reduce nonpoint source pollution. The guide is designed to help recreational boating facilities meet federal and state water quality regulations and reduce pollution from routine activities, such as hull maintenance, fuel spillage, and sewage disposal. Included are example best management practices that have been designed and tested at model marinas. To order a copy for \$10, write to Publications, Rhode Island Sea Grant, University of Rhode Island Bay Campus, Narragansett, RI 02882-1197.

A Spring 1997 Snapshot of Ecosystem Management Activities in Florida This is a preliminary report on Ecosystem Management activities in Florida containing thumbnail sketches of their activities. Activities cover the four “Cornerstones” of Ecosystem Management — place-based management, common-sense regulation, cultural change, and foundations. The finished report is in progress. There are a limited number of copies available. To order a copy, write to Office of Ecosystem Management, 3900 Commonwealth Blvd., Tallahassee, FL 32399-3000.

Ocean Pollution: Effects on Living Resources and Humans, by Carl J. Sindermann. This book provides a unique look at the effects of estuarine and coastal pollution on resource species. It gives an accurate assessment of the state of the inshore marine environment and its inhabitants. \$89.95 To order, call Lewis Publishers at 1-800-272-7737, email orders@crcpress.com, or visit the website at www.crcpress.com.

Pollution Impacts on Marine Biotic Communities by Michael Kennish. This book features a basic introduction to pollution-related issues in coastal regions, detailed case histories of well known, highly contaminated systems in the U.S. and Europe, specific coverage of marine pollutants, and broad coverage that includes use and management of coastal resources. \$89.95. To order, call CRC Press at 1-800-272-7737, email orders@crcpress.com, or visit the website at www.crcpress.com.

New Wetlands Loss Study - A study released in mid-September by the U.S. Fish and Wildlife Service shows that America is losing 117,000 acres of wetlands each year. The report indicated that the rate of wetlands loss from 1985 to 1995 has slowed from the rate of loss in the previous decade. According to the report, 79% of the wetlands lost in the study period were due to upland agricultural activities while urban development was responsible for 6% and other types of land use 15%. For a copy of the report contact Merritt Frey at mfrey@nrhc.org or 202/289-2421.

Florida's Statewide Ocean Resource Inventory Project

Many decision-makers recognize that a great portion of Florida's culture and economy is rooted in the state's valuable marine resource assets. Because diverse pressures are being placed on many of these resources, managers need accurate and timely information upon which to base decisions and formulate recommendations. To help meet this need, the Florida Marine Research Institute (FMRI) is conducting a project known as the Statewide Ocean Resource Inventory (SORI), which focuses on inventorying, acquiring, and formatting existing marine resource data relevant to coastal and ocean management concerns. The FMRI project team has based SORI on a modified version of ArcView II software designed to make ocean resource data from around that state readily available to users equipped with a personal computer, CD-ROM, and Internet access.

SORI partners include the Florida Coastal Management Program, which is funding the project, and a range of other state and regional level planners, local and non-governmental organization staff, and academic policy analysts. The SORI partners assisted the FMRI project team with identification of management issues and prioritization of data themes necessary to address these issues. In addition, they provided descriptions of data viewing and querying needs to help the FMRI project team customize the software interface. SORI partners have evaluated how a prototype application performs as a decision support system for coastal and ocean resource managers and are returning structured comments for incorporation into the final application.

The software interface of the prototype application is structured around six priority management issues that the SORI partners identified. They are emergency response, pollution prevention, fisheries management, protected areas, habitats of protected species, and coastal infrastructure. The FMRI project

team took the data themes associated with these management issues and translated them into actual datasets that were incorporated into the prototype application.

While ArcView II is considered to be the best suited software to view and query Florida's marine resource data, the default interface may appear too cryptic for the average coastal/ocean manager. Therefore, the FMRI project team asked SORI partners to describe the "look" that they would like to be presented with when viewing these data. In addition, the FMRI project team programmed special functions in the application to assist users while navigating the application.

The results from the evaluation of the prototype application will guide the development of the final system. The application evaluation began with a workshop in October 1996 and ended in January 1997. In addition, the project team from FMRI conducted site visits to each partner's location to understand how a desktop information system like this can be used in a management or planning environment. This feedback is vital to the success of the project and subsequent utilization of the application for marine resource management. The comments expressed throughout the entire development process and the future recommendations of the partners should help generate a useful tool for coastal/ocean managers across the state.

Once complete, the SORI project should prove to be a great tool for ocean managers and planners. SORI will provide these professionals with data and information to be used as a basis for decision-making regarding ocean rules, policies, and regulations. As the issues are refined and the information base to address these issues grows, computer applications such as SORI can become even more useful to managers and planners across the state. *Adapted from Coastal Currents, Winter 1997.*

National Estuary Program Bill Reintroduced in House

On August 1, Representatives Lowey (D-NY), DeLauro (D-CT) and Shays (R-CT) introduced the Water Pollution Control and Estuary Restoration Act of 1997 (H.R. 2374). The bill reauthorizes the National Estuary Program of the Clean Water Act and extends the state water pollution control revolving loan fund (SRF).

The bill requires implementation of EPA-approved estuary management plans crafted by community stakeholders, devotes SRF funds for implementation, and includes programmatic reforms to improve citizen participation during plan development and implementation. Finally, H.R. 2374 increases federal contributions to the SRF to \$2.5 billion in FY 1998, gradually increasing to \$4 billion in FY 2003 and 2004.

A letter in support of the bill was signed by 78 environmental and conservation organizations and was delivered to each

U.S. Representative's office in mid-September. The letter urges Representative s to cosponsor and support H.R. 2374. For copies of the letter and more information, contact Ted Morton of American Ocean Campaign at 202/544-3526 or aocm@wizard.net. *Adapted from Clean Water Network Status Report, September 1997.*

Poll Shows Americans Support Environmental Protection

Greenwire reports a recent survey revealed that 60% of US adults say environmental protection is "so important that requirements and standards cannot be too high, and continuing environmental improvements must be made, regardless of cost." The poll was taken by Public Opinion Strategies between August 16th and 19th from 800 registered voters. The 60% figure is up from a low of 52% in 1992. *Adapted from Clean Water Network Status Report, September 1997.*

Conference

Global Climate Change: *What Does it Mean for the Mid-Atlantic States?*

On Tuesday, November 18, 1997, the United States Environmental Protection Agency (EPA), Region III in cooperation with EPA's Office of Policy Planning and Evaluation, will host a one-day conference on global climate change at the Holiday Inn, 1800 Market Street, Philadelphia, Pennsylvania.

The purpose of the conference is to increase awareness and understanding of climate change among leaders from business, industry, state and local government, the health field, academia, and other concerned individuals. It will facilitate discussion among stakeholder groups regarding not only the potential effects of climate change, but also policy options to address these impacts.

At this conference, national and regional experts in the field of global climate change will provide the most current scientific information concerning climate change and the potential impacts on the Mid-Atlantic region. Topics will include the potential effects of climate change on water resources, forests, recreational fisheries and business. It will also address human health issues related to heat waves, air quality and infectious diseases.

To register for the conference contact Monica Duda at 703/247-2410, or register on-line at <http://eis.wpi.org/epaworkshop/midatlantic>. The registration deadline is November 4th, and the fee is \$30.

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Editor

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