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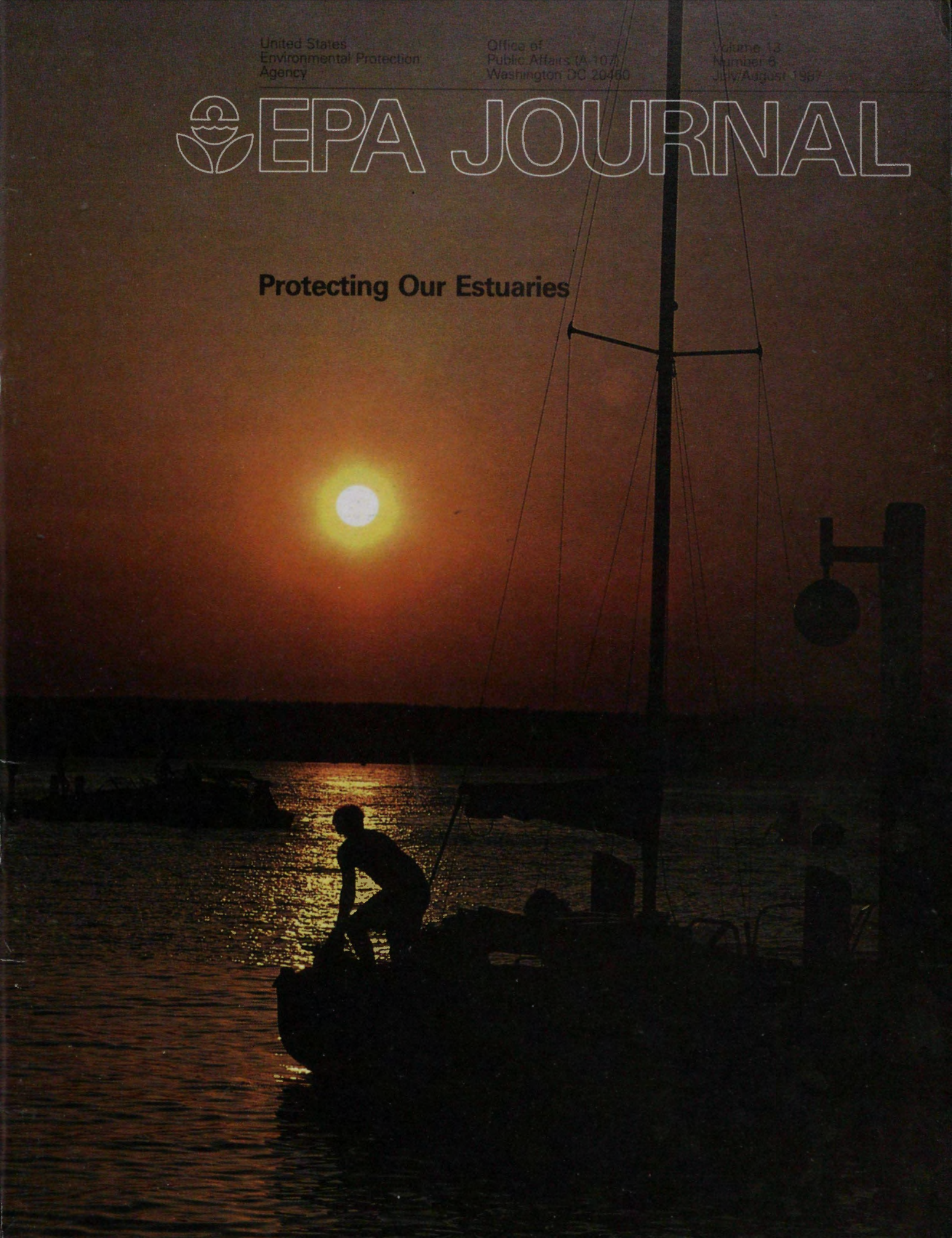
## Protecting Our Estuaries



Save the Bay, Inc.

Preparing for the annual Swim the Bay fundraiser sponsored by Save the Bay, a group that is concerned with protecting Narragansett Bay in Rhode Island.

# Protecting Our Estuaries

Estuaries—where rivers mix with the sea. The definition of these waters may not be widely known, but they are one of the most popular natural features on earth. This issue of the *EPA Journal* focuses on estuaries, beginning with an excerpt from *Beautiful Swimmers*, a book which describes the chain of life in the Chesapeake Bay.

Setting a perspective for the issue is an article by Lawrence J. Jensen, EPA's Assistant Administrator for Water. An interview with Tudor T. Davies answers questions about EPA's role in protecting estuaries. Davies is Director of the Agency's Office of Marine and Estuarine Protection.

Then a series of articles discusses the benefits of estuaries, the environmental problems they face, recent Congressional action to protect them, and EPA's National Estuary Program. Changing the pace, another article takes a look back from an imaginary point in the future on the outcome if we don't act to protect our estuaries.

Next are status reports on environmental protection efforts in four major U.S. estuaries: Narragansett Bay in Rhode Island, Puget Sound in Washington State, Albemarle-Pamlico Sounds in North Carolina, and Chesapeake Bay.

Finally, an article reports on the condition and status of pollution control efforts in estuarine systems internationally, from the Inland Sea of Japan to the Baltic Sea.

Two articles follow on related subjects: EPA's wetlands protection program, including wetlands in estuaries, and an initiative to control pollution in the Gulf of Mexico, another coastal water body confronted with environmental problems.

Update and Appointments—two regular features—conclude the issue. □

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EPA is charged by Congress to protect the nation's land, air, and water systems. Under a mandate of national environmental laws, the agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.

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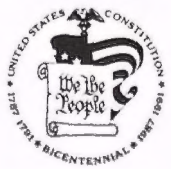


Front Cover: Ending the day. *Scene is in Puget Sound, Washington State. Photo by Gary Greene.*

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# The Treasure of an Estuary

## An Excerpt from *Beautiful Swimmers*

*William Warner's* Beautiful Swimmers *is much more than a study of the life and habitat of the blue crab. Published in 1976 and winner of a 1977 Pulitzer Prize, the book is also a warm tribute to the astounding richness and diversity of the Chesapeake Bay and the people who make their living from it.*

*The following excerpt from* Beautiful Swimmers *describes the harvest of a day spent "scraping" for crabs in the eelgrass in the shallow marshes near Smith Island.*

One aspect of the work was a constant pleasure, an unsuspected bonus. Bending closely over the grass, one became increasingly aware of the richness of marine life it harbored. To understand fully this richness and the unique manner in which it was displayed, it is first necessary to picture what a three or four foot cube of eelgrass forest must look like underwater. The forest will teem with life at all levels: sluggish predators on the floor, maturing fish fry and hiding crustaceans in the luxuriant midsections, and darting minnows in the canopy. The scrape then comes along, lifts it all in place and deposits it on the washboard for convenient inspection.

The opportunities for observing this normally hidden community were unparalleled, in fact, in my experience. I had to think how we listen so patiently to the biologists' sermons on the value of nutrient-loaded wetlands or the high productivity of marsh and rooted aquatic plants in general. Most of us, I suspect, take the scientist's word on faith. Here on a scrape boat you could *see* it. The evidence was all there, palpably and beautifully presented in each gleaming fresh-green roll of grass. With each lick there came dozens of fish species—both minnows and the fry of larger fish—trapped in grass filaments or wriggling madly for freedom down the race of water leading to the scuppers. There were perfectly formed baby bluefish, already possessed of pin-sharp teeth and murderous little underslung jaws. One somehow did not expect them to look so much like adults. But they did, unmistakably, at one or two inches. The same was largely true of other species. Here was a tiny bottom flatfish with a blunt head and almost completely encircling dorsal and ventral fins. A hog choker, most likely. If there was any doubt, you could try pushing him backward along the washboard. If he was a flounder, he would glide smoothly. If the underside scales dug firmly into the grain of the wood and you couldn't budge him, you knew he was a hog choker and that's how he got his name. Find a silvery little fish with a gasping mouth right under its nose and you could almost be sure it was a hardhead or a croaker. Confirm it, if necessary, by listening. Put the little fellow off by himself and wait. In time he might croak or at least oblige with a nursery-sounding squeak before you returned him to the water. Baby spots, close relatives to the channel bass, already had their single and highly distinctive dark patches behind the eye. The sea trout might grow to greater beauty. But even as infants they honored their name, proudly speckled and iridescent.

Even more interesting to the lay observer were the "trash" or inedible species, many of them adults. Toadfish, the plague of the Chesapeake, were present in all sizes and shapes. Much rarer were the bizarre species variously known as burrfishes or spiny boxfishes. Known as "thorn toads" among watermen, these little fish have been described in scientific literature as "a solid bony box with holes for the mouth, eyes, fins and vent, more or less inflatable." I held one in gloved hands and saw that it had handsome dark green and yellow stripes running between the spines on its back and a tiny, almost vestigial-looking tail which was all but lost inside the fish when it puffed up. Its pectoral and dorsal fins were also ridiculously small. Top swimming speed, one imagined, could scarcely surpass one knot. Still, the fish undoubtedly gets along very well in whatever company it keeps. Top and bottom it is encased in sharp spines, rendering it safe from anything but the most foolish predator, and its bony, beak-like mouth crushes tiny mollusks and crustaceans with ease. It thus has both good protection and an ample, easily captured food supply. I doubt that a spiny boxfish wants any more from life.

Numerous elongate fishes, easy to identify by their movements, added further variety. Small eels writhed furiously and without cease in the scuppers. In sharp contrast were the curious pipefish that looked like little sticks caught in the grass, utterly unable to snap themselves free. Stiff, brittle and with a mouth identical to the closely related seahorse, the pipefish immediately suggests an evolutionary prank. Ichthyologists agree, or at least speak of it and the seahorse as "lower order" or primitive, both having such crude anatomical unnecessaries as bony exterior skeletons formed from fused scales and brood pouches carried by the males. Between the extremes of the pipefishes' creaky motion and the eels' squirming were the gars and half bills, which flapped more or less as you would expect from a fish out of water. The baby gars already had toothy, well-developed snouts and the little half bills, or balaos as they are called in the tropics, gave off the bright silver sheen that makes them prized in their adult form for swordfish bait in deep sea sport fishing.

Sea worms without number, unknown legions of minnows and puzzling egg cases rounded out the nursery fauna. □

# Having the Vision to Save Our Estuaries

by Lawrence J. Jensen

Steve Delaney

Estuaries can offer quiet scenes; they can be treasures of diverse life forms; they can be busy with human activity.

One day, not too far in the future, while I'm traveling along the Chesapeake, admiring Puget Sound in Washington State, enjoying inlets along the Gulf Coast, or otherwise relishing the beauties of bays, estuaries, and sounds wherever they are found, I hope to hear a news report that starts like this: "Flash: The Bay is Back! Flash: The Sound is Once Again Sound!" Actually, my hope is much more than a hope. It is a goal that EPA has been working toward with varying degrees of success since 1972. And it is a goal well worth working for.

With their rolling dunes, unique wildlife, and abundant fish, estuaries and their surroundings provide us with valuable economic, recreational, and aesthetic resources. Additionally, for countless living things, only the estuary's unique melding of land and sea provides an environment suitable for existence. All this together lends estuaries a magnetism that is difficult to describe and even more difficult to resist.

But this very magnetism has multiplied the number of people who call the seaside fringes of our nation home. And with population pressure come all the by-products of modern living—industry and sewage effluent, grimy runoff from roads and parking lots, fertilizers and pesticides. These pollutants and others find their way daily into our vital and scenic estuaries.

It's clear that estuaries cannot long withstand such an onslaught. But what's even more clear is that the loss of these

***We are now better armed than ever before to bring about headlines that proudly proclaim the comeback of our estuaries.***

unique coastal resources, so valuable to man and nature alike, would be a loss. we could not easily stand, either.

The good news is that winning the battle against destructive pressures is possible. In different parts of the country, estuary management programs have been in place for several years. These programs have put in place institutions to deal with pollution challenges, but an even more important outcome has been the mobilization of citizen concern. In fact, where I live in Virginia, it is not uncommon to see bumper stickers and advertisements challenging us in bold lettering to Save the Bay. In similar settings all around the country, we have made progress.

To understand both the progess we've made and the magnitude of what remains to be done, it's important to recognize that estuaries are imperiled not only by nearby pollution sources but also by pollution washed down from streams and rivers far inland. Estuaries literally are the sinks at the end of the system where water cannot be washed any further downstream. This means that anything we do to control pollution inland does help save the bay or restore the sound.

Point source pollution permitting is a good example. EPA and the states have 65,000 permits in place for point source dischargers, specifying exactly how much pollution can be discharged in their wastewater. As we learn more about various pollutants and become better able to remove them from wastewaters, pollution limits in these permits are becoming more and more strict. In fact, the Water Quality Act of 1987 places new requirements on states that will take us far toward the elimination of toxic point source pollution. Such progress in point source permitting has and will continue to benefit our estuaries.

But even if we entirely eliminated pollution from direct discharge points across the country, the health and vigor of our estuaries would not be completely restored. Non-point source pollution, consisting mainly of rural and urban runoff, carries in it the components of pollution problems ranging from nutrient buildup to sedimentation. Because of its diverse and scattered nature, however, non-point pollution is much more difficult to control. Nevertheless, we must deal with non-point source pollution as quickly and efficiently as possible if the headlines are to one day announce that our estuaries are once again healthy.

The Water Quality Act of 1987 provides useful instruments for helping us. For instance, EPA's Great Lakes and Chesapeake Bay programs, which have been in place for some time, have encouraged development of basin-wide management. The success of these programs led Congress to call for an Estuary Program in 1985 that widened our focus to four additional estuaries. The Water Quality Act of 1987 expands on this program. It suggests that basin-wide management focusing on both point and non-point pollution sources is the only way to restore and protect our estuaries. To encourage a comprehensive, watershed-based approach, the Act calls for estuary-specific management conferences consisting of federal, state, and local agencies. These conferences will analyze water quality trends and particular pollution sources, both point and non-point, and develop comprehensive management plans. (See article on page 16 for additional details.)

These efforts are augmented by at least two additional factors. First, the Water Quality Act's new non-point source provisions require states to address and control non-point source problems within their boundaries. Second, the Agency is stepping up its efforts in wetlands protection through research, education, and enforcement initiatives.

With better tools in the toxics, non-point source, wetlands, and estuaries areas, we are now better armed than ever before to bring about headlines that proudly proclaim the comeback of our estuaries. But even the finest tools are but crude instruments in the hands of the uninterested or unskilled. In other words, people will have to make the difference. Unless all of us who share in the benefits of our estuaries are willing to share the responsibility for their welfare, better tools will not be enough. Governments can provide information on best management practices for homeowners or farmers, but they cannot put them in place and maintain them. But you and I can.

That leads to the bottom line. You and I in our roles as homeowners, farmers, businessmen, regulators, and citizens must make the difference. Through our mutual efforts, programs will work, pollution will be controlled, and our estuaries will be restored and revived. □

*(Jensen is EPA's Assistant Administrator for Water.)*

# Answering Questions about a Key Resource:

## An Interview with Tudor T. Davies

*What are the answers to questions that people ask about estuaries and EPA's program to protect them? EPA Journal asked Tudor Davies, Director of the Agency's Office of Marine and Estuarine Protection. The text of the interview follows:*

**Q What are estuaries and why are they in trouble?**

A In the classical sense, estuaries are where a river mixes with the sea. They are also very desirable places to live, and they are in trouble because so many people are moving there.

**Q Why should we care?**

A From a strictly biological point of view, estuaries are very important areas for the ocean because they are nurseries for many oceanic animals that breed and carry out their initial life stages there. If estuaries are significantly degraded, this essential function is lost. We see fundamental impacts on fisheries and on the ecology of the ocean. Estuaries are very difficult environments anyway, and we are making it significantly more difficult for animals to live there if we add pollution to the natural variability in these areas.

**Q But say I live in a little town off Delaware Bay. Why should I care what happens to the vegetation there?**

A I could return your question and ask you why you chose to live there. I would guess that you chose to live there because you have some aesthetic sense that this is a very beautiful environment, because you can enjoy the water, the fishing, the scenery. You have a sense of well-being from being around the sea. I also suspect that you feel your property values are going to increase steadily because other people feel as you do about the water and want to live there, too. However, if you degrade the essential features of an estuary, if you can no longer fish, swim, or enjoy the aesthetics of that environment, then the area will no longer be so desirable. Your property values are going to decline.

**Q We already have a coastal zone management program as well as national pollution controls. Why do we need a program specifically for estuarine protection?**

A Yes, we do have a system of managing sources of pollution through technological controls—that is, we require certain specific types of technologies to treat municipal and industrial wastewater discharges. But in some areas, particularly coastal areas, we've found that this approach is inadequate to protect the natural resources. The estuary program is a way of figuring out what we need to protect these resources to the levels we want, and trading off among alternative management levels to achieve that protection. Now, that may mean different approaches in terms of point and non-point pollution controls, different levels of industrial controls, and management of historic loads of pollutants entering the system. What I am saying is that the current, technology-based system treats every source the same way. But that approach may no longer be adequate to protect coastal resources, given the number of people moving to those areas. So what we are looking for is a rational plan for deciding the level of resource protection that all the stake-holders—the people who have a vested interest in the system—can participate in.

**Q How does such an approach fit in with EPA's traditional research and/or regulatory focus?**

A Well, it combines aspects of both. We depend on the base regulations developed by the Agency to give us a protection "floor" in the coastal areas. Where our research and monitoring activities show us that the resources are declining, however, or the water quality standards are not being met—in other words, that the regulatory approach is inadequate—then we want to develop a consensus among the stake-holders to go to different levels of protection. That may mean new regulations, but not necessarily.

It may mean looking beyond regulations, beyond research and monitoring, so that we can develop agreement among the parties—federal, state, and local—as to the objectives we want to achieve, and the system and resource management we are willing to undertake.

**Q So in some instances, you are talking about going beyond what is in place?**

A Yes. For example, I think the Chesapeake Bay Program showed that even with secondary wastewater treatment programs in place, the resource wasn't being protected. And the people and the state regulatory agencies have agreed that we need something beyond what we had because the resource is too precious to lose. They've agreed that we need to take very special steps to manage the pollution around the bay so that we *do* protect it.

In practical terms, that has meant the evolution of a consensus on what needs to be done. The political will is really there to institute controls that will protect the Chesapeake.

**Q Given this complexity, where do you see the focus of estuarine protection? What are your greatest concerns—toxics, habitat preservation, or information exchange?**

A Each estuary is different. There are some common, recurring problems, of course, but there are site-specific problems, too. In North Carolina's Albemarle-Pamlico Sounds, for instance, the focus has been on how excess nutrients are changing the system's ecology, while in Washington State's Puget Sound, the emphasis has been toxic substances. So the strategies that need to be adopted are different in each case. The management solutions have to be related to the particular problems.

**Q What's the major impediment, then? Are the problems scientific or institutional?**

A What is standing in our way, I think, is the fact that we are seeing significant demographic change around the coasts. We have people moving rapidly and in great numbers to those areas, and many of the pollution-control agencies find it difficult to keep pace with the level of control needed to manage the new load, not only of

people, but of industry. It's also hard for them to come to grips with the fact that as the population densities increase, we may need to take more stringent measures if we want to protect the water resources, the wetlands, and the whole ecology of the system.

**Q It's an institutional problem, then?**

A I think you have an institutional problem in managing growth, accommodating increased loads, and then developing infrastructures to deal with them. This is not to say that we don't still need basic information. We still need to understand the dynamics of estuaries, their ecologies. But the whole emphasis that we are trying to develop is that there are indeed common problems with common solutions. You might say we are trying to create a tool kit so that as we see similar problems around the coast, we can pull out effective solutions. We will still require a certain base level of site-specific data, but we will have the common tools.

**Q A lot of federal agencies have oversight roles in marine and coastal issues. How are these overlapping responsibilities coordinated?**

A There are overlapping responsibilities and there are also gaps. In some cases, the issue is only that responsibilities are not well coordinated. One of our goals is to get these responsibilities fully realized, get people working together, and make sure that things work. I am confident there are adequate tools out there to manage problems. What we need to do is develop the institutional will, particularly at the local level, to address them.

**Q In terms of structures, how did the recent Water Quality Act amendments enhance protection of estuaries?**

A It was a recognition by Congress that there are serious problems with our estuaries. The amendments formally set up the National Estuaries Program, recognizing certain estuaries for special attention and calling for new management plans between the states and the federal government for threatened resources in those estuaries. These efforts would then provide a model for other estuaries in the country.

But there are other provisions in the act that are equally valuable, to my mind. For instance, the new act begins to address formally the problems of non-point pollution. It talks about focusing on specific problem areas, and it also talks about dealing with toxic hot spots around the country. All those have very specific application and are very important to estuaries. I think they will help the states deal with developing problems around the coast in a more systematic way. So I am very pleased with the new provisions.

**Q Does this mean that the non-point source problem is finally being recognized in legislation?**

A I think we've recognized it for years as the real culprit for many bodies of water that don't meet their water-quality goals. What I think the new act recognizes is that we need a balance between point and non-point controls in some areas. In the Chesapeake Bay and Great Lakes, for example, we've learned that to get nutrient levels down, we need both point and non-point controls to achieve a cost-effective reduction in nutrients and sediments coming into those waterways.

**Q You've mentioned coastal demographics as one of the great pressure factors on estuaries. Do you really think we can protect estuaries in the face of such pressures?**

A Yes, I think we can. It is going to need great cooperation and very careful balancing of conflicting uses, but with careful management, I think it is possible to do the job.

Now, that type of management will have to be on a higher level than we've had before, and people will have to develop a somewhat different ethic about these bodies of water. But it's already developing in places like Puget Sound and Chesapeake Bay and the Great Lakes. There is an understanding that individuals can actually have an impact—first, by paying taxes that pay for pollution controls and by supporting the necessary zoning laws, and second, by reducing their own polluting activities, such as not using too much lawn fertilizer and being careful about the waste they generate.

But as you say, the higher population densities are going to require greater levels of control to keep pollutants at a level estuarine systems can handle.

**Q Population densities are one new factor hurting estuaries, but what else is new? What's the difference from 50 years ago?**

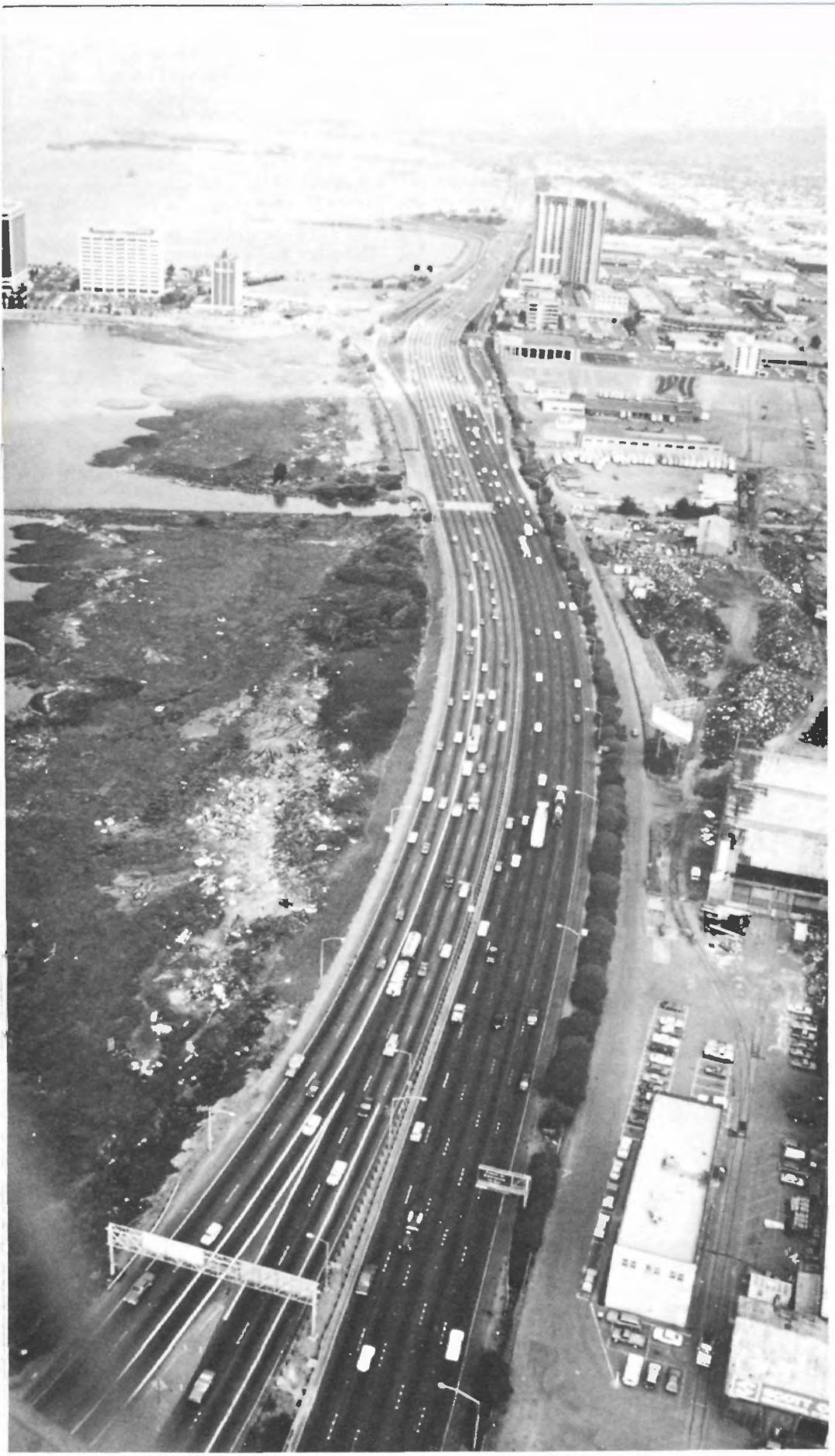
A I think the difference is the sort of society we've become. We've increased our consumption of materials, our generation of waste, and our uses of bodies of water. For example, we use estuaries much more for recreational fishing, recreational boating, and water contact activities. Our ports are very different from what they used to be. We have waterfront home developments that we didn't have in the past. The whole access is different, and so are the expectations.

**Q Obviously, state and local governments will have to play a major role in protecting estuaries.**

A The major role *is* state and local; our role—the federal role—should be to coordinate, to offer technical assistance, perhaps help with technology transfer. But when it comes to implementing the management controls that are needed, it's the state and local authorities who will have to do it. It's a local responsibility.

What we need to get at here is a true sense of ownership of a water body by the people who use it, live around it, pollute it, enjoy it. That's what has to be developed. The federal government is not going to be the primary actor in managing that resource, in dealing with the issues of permitting, zoning, and paying.

Will people living 25 miles away, or further, feel a responsibility, too? I think so. The Chesapeake Bay program shows that public education can change attitudes so that even people outside the immediate benefits of the bay—farmers in Pennsylvania, for example—can understand its importance and act to protect its value. But it takes a strong education campaign to make clear how lack of action in one area can cause problems somewhere else.



**Q So you see the development of individual awareness?**

A Yes, but you have to *build* that ethic. The citizens program for Chesapeake Bay has put out handbooks, particularly for school children, which talk about individual actions that are appropriate or inappropriate in terms of protecting the bay. There has been enormous response to that, and it's a very important contribution.

**Q Can an estuary protection program succeed without heavy public participation?**

A No, it's absolutely essential if you are going to build any will to go to higher levels of management and control. Without that will, we can maintain management at a technology-based level which will perhaps meet the law, but won't protect the resource. Of course, developing that will means that there be recognition that estuaries are, in fact, important and worth protecting.

**Q You've spoken a little bit about the unprecedented levels of cooperation we're going to need, actions that 10 years ago would never have been contemplated. Can you give some specific examples?**

A One example we talk about constantly is the Critical Areas Commission in Maryland. The job of the Commission is to agree on levels of future development that will be allowed within 1,000 feet of the Chesapeake Bay shoreline—and that's not just the actual bay, but the creeks and rivers and inlets flowing into it.

This is very different from land-use decision-making up to now. Locally, it could mean limitations on how many houses get built, or on how undeveloped areas are managed. It also means a significant impact on future water use and development of coastal areas. And that's the sort of thing that may have to happen in other water bodies if we decide that we want to protect them to a very high level, and maintain or restore the resources.

*Continued to next page*

Urban development along an estuary. Pictured is San Francisco Bay.

**Q** **Land-use controls have always been a touchy issue. Considering the political controversy that often surrounds them, are we going to be able to accomplish the sort of broad-scale planning that you're talking about?**

**A** That is a question state and local authorities will have to face when they look at protecting their resources, decide what their management alternatives are, and take some action. They represent the people who use the resource and want to preserve it.

I think that is what happened in Maryland with the Critical Areas Commission. The initial proposal to manage a 1,000 foot-wide swath of land around the bay was followed by many public hearings on the potential problems and benefits, and only then was it taken to the State House to see if there was the political will to carry it out.

But this was not a federal action, nor was it imposed by the federal government. It was an action taken by the state government through a political process that showed that this was indeed something that the state and local people wanted to see happen to protect the Chesapeake Bay.

**Q** **Are there incentives, though, that the federal government can offer to encourage this sort of action?**

**A** I think the federal government's role is to provide technical support and assistance, to offer research and information from other places. However, the people who benefit are the local people, so it is very important that they take the necessary actions. Our role is to facilitate that, but not necessarily to provide the financing and the backbone to do it.

What we are seeing in Puget Sound, in the Great Lakes, in the Chesapeake Bay, is that the protective ethic does develop—if the problems are clearly understood and goals are set for what needs to be done. I do believe there is a strong public ethic that says that we want to protect our natural resources, and that we will pay the costs and change our attitudes to do this.

**Q** **As you noted, the water quality amendments endorsed a stronger estuarine effort. Now what? What will EPA do with that endorsement?**

**A** We've been working with the states and citizens and scientists in a number of the named estuaries to this point. We will also be working with the states to designate other estuaries of national significance that will fit within the program. That will be our first step. We need to develop guidance on such questions as how to define estuaries of national significance, how governments should nominate, and what should be included in comprehensive management plans.

Then, we will be working in a number of estuaries around the country which we feel can be models for other communities in terms of processes, or application of scientific principles, or implementation of management plans. That's where we would like to be going over the next few years.

**Q** **What is your long-range direction? Where will the estuarine program be in the year 2000?**

**A** Given the population projections we see, we're going to lose resources in some areas, and some of these losses will be reversible, some not. We're going to have to get very serious about our coastal waters. I think our direction is to develop and implement management plans that could cost-effectively control pollutants coming into estuary systems. At the least, that means managing multi-media sources.

**Q** **What happens if we don't implement estuary protection, if we let things continue as they are now?**

**A** We've documented the declines in places over the last 15 to 20 years, and I think those declines will continue and be significant in many cases.

Once you have significant increases in population, there are so many pressures that develop. You have the pollution effects, you have the fisheries impacts, you have the habitat loss and ecological changes and everything that those lead to. And it's probably fair to say that at a certain point, the losses and declines start to accelerate.

John Costlow of Duke University gave a talk about Albemarle Sound that illustrates these points. Like many estuarine systems, Albemarle Sound is beset by waste management problems, indiscriminate building and development, overfishing, nitrification, and ecological damage. If conditions stay as they are, the sound will be ruined.

So Costlow asked his audience: "Are you going to allow development to kill off the whole reason people want to live here? Are you going to contaminate your drinking water? Are you going to rule out farming because you've ruined the soil or caused salt water to intrude into the fresh water aquifers? Or are you going to manage the sound properly so that you protect all these resources?"

The point is that the loss of ecological viability in an estuary in many ways is just a symptom of all the other things you have not done right.

**Q** **Have we lost some estuaries already? Are some beyond help?**

**A** Well, I can think of specific examples where recovery time using natural processes will be a long-term process, certainly in the order of 10 years and more. I can't answer on whether we've lost any. That's too categorical.

**Q** **Is it a crisis?**

**A** In my eyes, yes; in a lot of other people's, probably not. It depends on your value judgments and how important these things are to you. There are places around the country where people are not concerned that they are losing natural resources, perhaps because they do not appreciate them, or don't yet recognize their importance and the consequences of losing them.

On the other hand, we are talking really about where people live. If I live next to a hazardous waste site, that's my particular crisis. If I'm a city person, perhaps I'm more concerned about the air I breathe and vehicles around. Perhaps I never see or use a bay.

But to me, the decline of a bay is a symptom of all the other things in the coastal environment. If the estuaries are going downhill, then there are lots of other things that are not working, too.

I think it is very important that we establish a baseline and do not go below it, that we say we are not going to allow any further degradation of these systems. We need them too much to lose them. □

# Defining the Estuary

by Anthony J. Calio

Judging by a number of demographic and commercial indicators (population relocation trends, real estate values, tourist revenues, and commercial interest in waterfront locations), coastal areas are our preferred settings for living, vacationing, and working. As an example of the significance of recreational uses of our coasts, in 1982, almost $5 billion was spent by federal, state, and local agencies to provide recreational opportunities in coastal areas. The 1985 National Park Service records show over 60 million visits to lands adjacent to marine waters, including 22 million visits to national seashores.

Few can dispute that our coastal areas are of immense value to society, providing invaluable resources to tens of millions of Americans and contributing billions of dollars of revenue to the economy each year. Ironically, however—despite wide acclaim and appreciation for our shores, coasts, bays, beaches, and harbors—we have done too little to safeguard the value of our estuaries. Yet these uniquely productive coastal waters provide us with a truly remarkable variety of benefits. In terms of biological productivity alone, these portions of the coast far surpass any comparable ecosystem—aquatic or terrestrial. Salt marshes, for example, produce ten tons of organic material per acre per year, compared to only four tons per acre per year produced by fertile hay fields. Clearly, a reappraisal of estuarine values is in order so that we can continue to enjoy these coastal areas and make more productive use of their resources.

Estuaries are generally defined as those parts of rivers or streams that connect with the open sea, where land-derived fresh water intermixes with salt water. This saline mixture, saturated by sunlight and continually stirred by currents and tides, folds humus, topsoil, and other organic material from the land into the ocean's minerals and organic products of underwater decay. The resulting brew feeds a chain of life from protozoa, plankton, small fish, shrimp, oysters, and larger fish, to the fish-eating mammals, including man.

In many ways, estuaries serve as the cradles of the ocean's harvest. In addition to being important sources of

Menhaden harvested in Chesapeake Bay.

Steve Delaney

nutrients for fisheries, estuaries provide spawning and nursery grounds for at least two-thirds of our commercial fisheries. Shrimp, salmon, oysters, menhaden, crabs, lobster, clams, and haddock: all of these species depend on estuaries for their survival. The estuarine ecosystem also supports additional species of value to the recreational fishing industry.

While estuaries are critical for most important fisheries, they also provide essential breeding grounds and habitat for waterfowl and other wildlife, including a large number of endangered species. This wildlife also draws millions of people annually to estuarine areas for bird or whale watching, waterfowl hunting, or other recreational purposes.

Estuaries serve additional valuable functions apart from the living resources they support. For example, estuarine vegetation helps protect adjacent waters from upland sediments and waterborne pollutants by holding, filtering, or eventually breaking down this material before it silts into the open water. In much the same way, the marsh-like vegetation mitigates the erosion of upland areas by reducing the impacts of flood waters, storm tides, and wave surges before they reach the land.

For these and other reasons, increasing numbers of residents and visitors are attracted to our coasts. As a result, not only are estuaries among our most productive natural systems, but they are also among our most intensely populated, heavily used, and highly stressed systems. As a society, we ask that estuaries provide cooling waters for industry and energy production, accommodate the needs of large ships and tanker traffic, and accept pollutant loads from pipelines, rivers, streams, land drainage, and runoff. In addition, we have sacrificed wetlands and bottom habitat to make space for coastal development.

Because estuaries support so many different uses—many of which tend to exclude other uses—and because the demands on estuaries have increased along with human coastal populations, there has been a significant decline in the quality of estuarine waters and their resources. For example, the dramatic increase in population and development around the Chesapeake Bay has drastically affected the bay's water and sediment quality and resulted in significant declines in submerged aquatic vegetation and estuarine-dependent fisheries. The value of estuaries as transportation corridors, as receptacles for waste, and as places to live cannot be overestimated. However, these uses have profoundly affected the integrity of our estuarine ecosystems, often resulting in long-term environmental degradation, fisheries loss, property value declines, and public health and safety threats.

To meet our irrigation, energy, and flood control needs, most of the nation's major rivers have been diverted or dammed, changing the flow of fresh water into estuaries and fundamentally modifying the estuarine ecosystem structure. Many of our most valuable anadromous fish are now prevented from returning upstream to spawn, and critical habitat has been irreversibly altered. As an example, the Northwest salmon fishery has suffered a severe decline in the aftermath of large-scale construction of hydroelectric dams in the Columbia River combined with intensive logging practices.

***In 1982, almost $5 billion was spent by federal, state, and local agencies to provide recreational opportunities in coastal areas.***

The use of our estuaries to dispose of society's wastes has also led to significant degradation of our estuarine resources and benefits. New York City and Los Angeles release 1.5 billion and 900 million gallons of sewage effluent per day, respectively, into coastal waters. Boston discharges 500 million gallons per day, along with a half million gallons of raw sludge per year. These discharges include thousands of tons of nutrients that disrupt inshore ecosystems that sustain fish and shellfish. Sewage pollution has led to closure of one third of the 4,000 acres of clam flats in the vicinity of Boston Harbor, while nutrient-induced oxygen depletion has triggered massive fish kills off the New Jersey coast. As a result, there has been a $60 million loss to the commercial clam fishery alone. Sewage disposal has also affected the shrimp catch in Pensacola/Escambia Bay, Florida, which declined dramatically from 902,000 pounds in 1968 to 17,000 pounds in 1971.

Industrial waste discharges may have an even more unsettling outcome. The effects of industrial pollution have been strongly felt in New Bedford Harbor, Massachusetts, a major center for the American fishing industry. Historically, lobsters have been a lucrative component of the New Bedford catch, yet lobsters are no longer taken from the harbor's waters. Years of dumping wastes from neighboring electrical industries have raised the level of PCBs in the harbor sediments to over 200 parts per million, leading to closure of 28 square miles of commercial lobster grounds. The National Oceanic and Atmospheric Administration (NOAA) has conservatively estimated that the resulting loss to commercial lobstermen is $2.1 million and to recreational fishermen, $1.9 million. Beaches in the area have also been closed, resulting in revenue losses estimated at $14.7 million, and residential property values in the New Bedford area have declined more than $30 million.

Wetlands loss is another significant factor affecting the vitality of estuarine and coastal resources. Research has established that over 120,000 juvenile shrimp per acre are sustained by Louisiana's shallow marsh regions. However, that state is losing 50 square miles of coastal wetlands per year, and it is possible that there is a corresponding loss in shrimp productivity. In San Francisco Bay, diking and filling have reduced the original 300 square miles of wetlands to fewer than 75 square miles. Corresponding to these California wetland losses has been a decline of fish and shellfish harvests. The salmon population in the Sacramento River, for instance, has been reduced by over 50 percent.

The evidence clearly indicates that the health of our estuaries is declining. While the complex food webs of estuaries are known to provide a degree of resiliency to cope with these stresses, they alone cannot restore and maintain high levels of desirable biological productivity. It is time to re-examine what can and should be done to conserve our nation's estuaries.

Unfortunately, the effects of human activities and natural changes on our estuarine and coastal environment are not well understood. We do not know how to predict reliably the fate and transport of effluent from sewage treatment plants in Boston Harbor or Chesapeake Bay, to determine what organisms are exposed to its toxic chemicals, or to anticipate where nutrient-induced anoxia will lead to more fish kills. We have yet to discern

how PCBs are transported from New Bedford, Raritan Bay, or Elliott Bay to other areas via the food chain. We know that Gulf shrimp require wetlands for survival, but we do not know precisely how many shrimp will be lost with the loss of each acre of wetland.

If we are to halt the deterioration of our nation's estuaries and adjacent coastal waters, it is essential that we act now to correct the causes of such deterioration and protect these valuable bodies of water. The crucial first step is to understand better the estuarine ecosystem in order to predict the effects of human activities on estuarine resources and coastal ocean systems. This is NOAA's role: to increase our understanding of how estuarine ecosystems work and improve our predictive capabilities in order to support the wise use and management of the nation's estuarine resources and coastal ocean systems. Over the years, NOAA has built upon its base of scientific expertise and capabilities in estuarine assessment, research, and management to achieve this goal.

To provide internal leadership and coordination for its estuarine programs, NOAA established the Estuarine Programs Office (EPO) in 1984. Two years later, Congress specified EPO's responsibilities: (1) develop and implement a national estuarine strategy for NOAA; (2) coordinate NOAA's various estuarine activities, including estuarine research and assessment, fisheries research, coastal management, and habitat conservation; (3) coordinate these activities with other agencies; and (4) provide technical assistance to NOAA, other federal agencies, and state and local governments in estuarine assessment, and identification and monitoring of estuarine management programs. In response to this mandate, EPO has developed NOAA's *Estuarine and Coastal Ocean Science Framework*, a strategy that will guide and coordinate the agency's estuarine science programs into the next decade. NOAA is committed to its task of improving our understanding of the estuarine ecosystem. With the cooperation of other agencies that are integral to improving and maintaining the health of our estuaries, we can build on this knowledge towards wiser use and management of these valuable resources. □

*(Calio is the Under Secretary for Oceans and Atmosphere in the U.S. Department of Commerce.)*

# The Threat to Estuaries

by Howard Levenson

Most Americans love the ocean. We swim in it, sail on it, view its waves, and eat its seafood. Yet few of us realize the extent to which, or for how long, coastal communities and industries have used the nation's marine waters as an answer to their waste disposal needs.

Estuaries and coastal waters, in particular, have borne the brunt of marine waste disposal activities, and many now exhibit a variety of adverse effects. Unless additional protective measures are taken, the Office of Technology Assessment (OTA) has concluded, many estuaries and some coastal waters will deteriorate further or begin to do so during the next few decades, even in areas that previously were improving. OTA is a non-partisan, analytical arm of the U.S. Congress, and it released a report on *Wastes in Marine Environments* in April 1987 that discusses the effects of waste disposal on the environment.

This deterioration is of great concern because these waters support commercial and recreational fishing, swimming and boating, and other activities generated by the tourist trade. They also provide critical habitat for numerous plants and animals, including some endangered species and many important commercial species. For example, commercial landings of fish and shellfish from U.S. marine waters had a dockside value in 1985 of $2.3 billion and a retail value several times greater; fish and shellfish harvested within three miles of shore accounted for roughly half of these revenues.

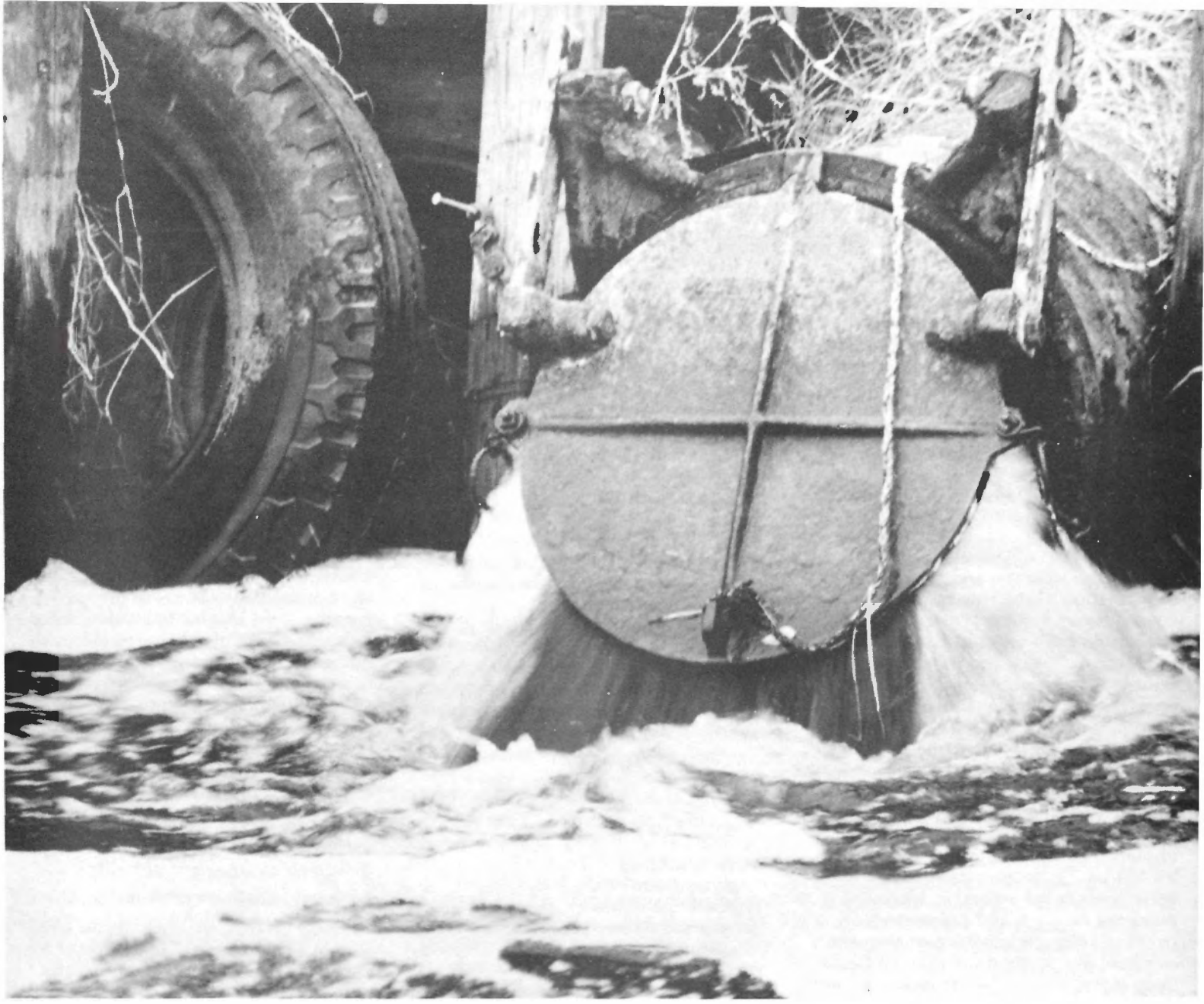
The extent of coastal degradation varies greatly around the country. Some areas that once exhibited severe effects have improved, but noticeable deterioration continues to occur or is accelerating in others. Most public attention has focused on well-documented problems in areas such as the Chesapeake Bay, the New York Bight, southern California, and Puget Sound, but serious, less-publicized effects are also showing up in the Gulf of Mexico and along the southern Atlantic coast.

The importance of any one pollution source varies greatly from area to area. Among disposal activities, wastewater discharges from industrial and municipal pipelines are at least as culpable in causing effects as the dumping of sewage sludge and dredged material. Almost 2,000 major industrial and municipal facilities discharge wastewater directly into estuaries and coastal waters, and thousands more discharge into rivers that eventually flow into estuaries. Thousands of industries also discharge wastes into the sewers of municipal treatment facilities that later discharge into marine waters. Large volumes of dredged material and smaller volumes of sewage sludge and some industrial wastes are dumped at specific sites. In addition, runoff from urban and agricultural areas, although not classed as disposal, is a significant source of pollution. Other activities such as filling of wetlands and channelling of rivers, as well as excess commercial harvesting, also affect marine waters and resources.

The range of adverse effects includes:

- Changes in water quality, such as excess levels of nutrients, low levels of dissolved oxygen, and turbidity.
- Loss of aquatic vegetation.
- Effects on fish, shellfish, birds, and mammals, such as accumulation of toxic chemicals, disease and abnormalities, reproductive failure, and mortality.
- Changes in entire marine communities, such as population declines, and impacts on species diversity.
- Closures of beaches and shellfish grounds due to contamination with microorganisms or toxic chemicals.
- Rising incidence of reported human disease from consuming contaminated shellfish or swimming in contaminated marine waters.
- Accumulation of toxic pollutants in sediments.

For example, one conspicuous and widespread effect is eutrophication, a process associated with excess amounts of nutrients such as nitrogen and phosphorus. Excess nutrients can contribute to massive population



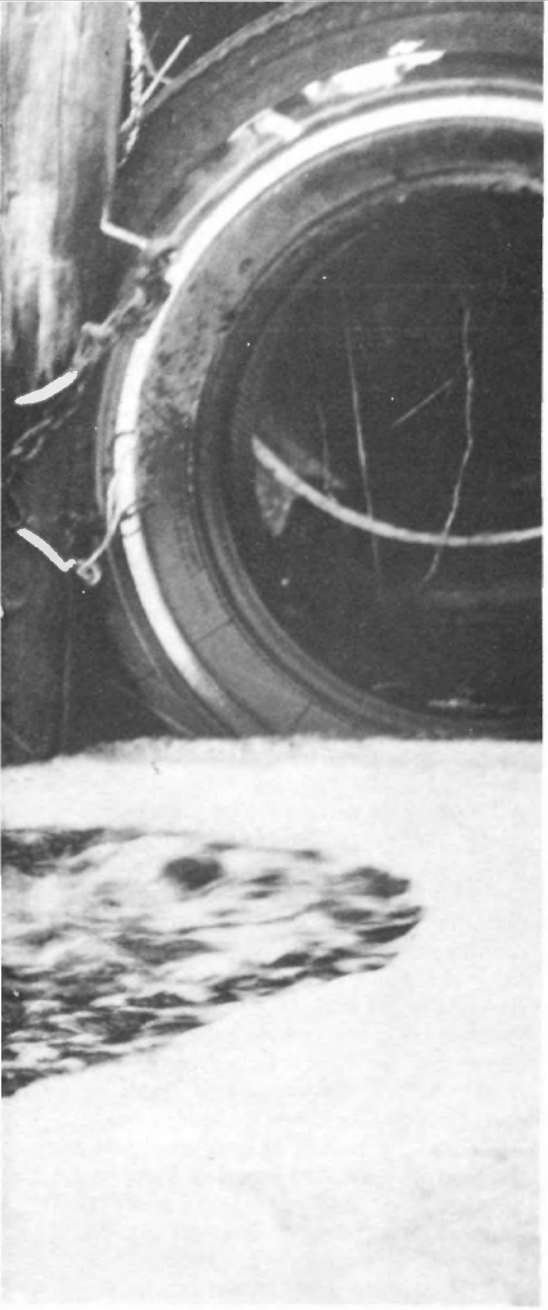
A "point source" of waste discharge, one of the pollution inputs into estuaries that cleanup efforts are facing.

explosions (sometimes called "blooms") of tiny microorganisms. Under extreme conditions, these microorganisms can deplete the level of dissolved oxygen in the water, resulting in massive fish kills. Seasonally low oxygen levels occur regularly in the Chesapeake Bay and the New York Bight; the affected area in the Chesapeake Bay has increased significantly during the last 30 years. Recent research has revealed an even larger area off the coast of Louisiana that is subject to seasonal oxygen depletion.

Another widespread effect is contamination of shellfish with disease-causing microorganisms. In 1985, commercial harvests from about one-third of our productive shellfish areas were restricted because of such contamination, and the problem is increasing in rapidly developing areas such as the Gulf of Mexico and southeast Atlantic coast. Some areas are improving, however. For example, near Savannah and in San Francisco Bay, contamination with microorganisms has declined, and shellfishing has been allowed for the first time in decades.

Nevertheless, contamination and the reported incidence of some human diseases caused by microorganisms appears to be rising. In New York, consumption of contaminated shellfish caused over 100 reported outbreaks of viral gastroenteritis in 1982. Bathing in contaminated waters has been linked with increases in viral gastroenteritis and hepatitis, particularly in New York and Louisiana.

Another major problem in recent years is the contamination of fish and shellfish with toxic metals and organic chemicals; in some areas, the contamination is severe enough to prompt government warnings or restrictions on fishing or consumption. The most widely publicized problems have been linked with pipeline discharges of long-lasting, toxic chemicals that accumulate in fish tissues. Commercial striped bass fishing in New York State, for example, has been banned because of contamination with polychlorinated biphenyls (or PCBs), causing an estimated economic impact of over $15 million annually. Signs in Santa Monica Bay in southern California warn against eating some fish



because of contamination with DDT.

Finally, toxic pollutants have been linked with conspicuous problems in fish and shellfish themselves. These effects occur around the country; examples include fin erosion and cancerous lesions in winter flounder from Boston Harbor, impaired reproduction in striped bass and starry flounder from San Francisco Bay, and liver tumors in English sole from Puget Sound.

To combat these and other problems, the federal government has concentrated on regulating dumping activities and municipal and industrial pipeline discharges; it has not been very involved in managing runoff. Two statutes form the basis of most federal regulatory efforts: the Marine Protection, Research, and Sanctuaries Act, and the Clean Water Act.

The programs and procedures established under these acts have significantly reduced the quantities of pollutants entering marine waters. For example, the Marine Protection, Research, and Sanctuaries Act has been relatively successful in controlling the dumping of sewage sludge and industrial wastes. Under the Clean Water Act, the construction or upgrading of municipal sewage treatment plants has improved some aspects of water quality in some estuaries and coastal waters, particularly with respect to levels of oxygen and nutrients. Moreover, reducing pollutants in industrial discharges into sewers has improved the quality of some municipal sludge, enhancing its potential for beneficial uses such as fertilizer and compost.

***Another major problem in recent years is the contamination of fish and shellfish with toxic metals and organic chemicals.***

Unfortunately, however, these programs will not be sufficient partly because discharges and runoff (particularly from urban areas) will increase greatly as population and industrial development expand in coastal areas. In addition, numerous obstacles including insufficient financial resources already hinder full implementation and enforcement of current programs.

Finally, even total compliance with today's regulations will still allow new or continued degradation to occur; current programs do not adequately address all important toxic pollutants or industries, nor do they adequately address runoff. In addition, federal resources for municipal treatment plants are declining, and it is unclear whether sufficient alternative funding mechanisms will be developed.

Some of these problems—for example, weak enforcement and deficiencies in the coverage of toxic pollutants—could be addressed within the structure of existing Clean Water Act programs. But other issues, particularly the management of runoff, simply do not fit well within these programs and call for additional, site-specific management efforts. These efforts will require a great deal of cooperation among the many responsible local, state, and federal agencies, as well as the intimate involvement of the public. Recognizing the need for more coordinated management, the federal government and some states have developed what OTA calls "waterbody management" programs. Two prominent examples are the Chesapeake Bay Program and the Puget Sound Water Quality Authority. Waterbody management programs attempt to bring together all appropriate parties, identify the most important problems and their causes, and devise management plans to alleviate the problems. These efforts appear promising, although most are only in the early stages.

However, such programs have been established for only a few of the many estuaries and coastal waters in need of additional management. Furthermore, no systematic framework exists yet for deciding which estuaries and coastal waters need help, either to reverse current degradation or to prevent significant degradation from occurring.

Yet many major components for such a framework do exist in numerous institutional guises. At the federal level, for example, these include:

- Section 320 of the 1987 Water Quality Act, which authorizes EPA to convene management conferences for individual estuaries.
- The Coastal Zone Management Act.
- EPA's initiative on near-coastal waters.
- Areawide and watershed plans under Sections 208 and 303(e) of the Clean Water Act.

The big issue is whether these and other existing mechanisms at all governmental levels will be used effectively. Will enough waterbody management programs be developed and implemented? The answer will depend to a great extent on our ability to achieve cooperation among responsible agencies, to involve the public, to provide sufficient funding, and to make difficult decisions about land-use issues and coastal development practices. More than anything else, in fact, a systematic framework may require consolidation and integration of sometimes disparate existing efforts. It will also call for a great deal of oversight. Without such efforts, however, our estuaries and coastal waters will continue to decline. □

*(Levenson is an analyst and project director for the Office of Technology Assessment in the U.S. Congress.)*

# What Congress Has Done

by Walter B. Jones

In 1970, with the release of a report by the U.S. Department of the Interior, the nation discovered that many estuaries were degraded or threatened with degradation. *The National Estuary Study* presented an awesome picture of the ongoing destruction of the nation's estuaries. The summation was concise and painfully clear: "Estuaries are in jeopardy. They are being damaged, destroyed, and reduced in size at an accelerating rate by physical alteration and by pollution."

In response to the discovery of this and other environmental problems, the Congress enacted a suite of statutory tools, including the Federal Water Pollution Control Act, the Coastal Zone Management Act, and the Marine Protection, Research, and Sanctuaries Act. However, nearly 20 years later, the Congressional Office of Technology Assessment (OTA) has found that our estuaries are still in jeopardy.

On April 28, 1987, the OTA released a comprehensive report entitled *Wastes in Marine Environments*, which presents the results of two years of investigation. As explained in the previous article, the report clearly constitutes an indictment of our efforts since 1970 to understand and protect these crucial coastal ecosystems: "Many of these waters have exhibited a variety of adverse impacts, and their overall health is declining or threatened. Even with total compliance, which is unlikely, existing regulations will not be sufficient to maintain or improve the health of all estuaries or coastal waters."

Thus, 17 years after *The National Estuary Study*, the OTA report has helped us, or perhaps *forced* us, to rediscover our estuaries. Once again, it is not a pleasant or gratifying discovery. It is, plainly and simply, a tragic discovery.

OTA's recent findings are especially disconcerting given the increasingly documented importance of estuaries. Estuaries are the undisputed workhorses of the marine environment, constituting its biological foundation. The majority of our highly valued fisheries are sustained by estuaries during their most vulnerable life stages. In fact, estuarine-dependent species comprise about 70 percent of the total U.S. commercial catch.

The problems facing our estuaries are the problems of our people and our communities. This is evident upon examination of demographic trends. Today, over 70 percent of our population lives in coastal states, and it is predicted that by 1990, over 75 percent of the entire population will live within 50 miles of the nation's coasts. It has never been more obvious that we are both the *cause* of and the *solution* to estuarine degradation.

We have been warned a second time that our estuaries, both great and small, are in deep trouble. These warnings must be heeded. The work to save them must begin now.

We need only look to the Chesapeake Bay to see the costs of waiting too long. In the Chesapeake, the warning signals were heard *almost* too late. Now, federal and state governments are engaged in a massive project to determine what went wrong and to begin to correct the damage. Because people waited until the problems were critical, the costs—in both dollars and intrusive regulation—are staggering; the results are only speculative at this point.

However, the Chesapeake Bay effort does provide a template for action in other estuaries. In fact, the OTA report calls this site-specific, waterbody management approach "very promising," but also urges a more "systematic" national framework.

The Water Quality Act of 1987 provides this national framework. In particular, section 320 of the new statute establishes a National Estuaries Program within the Environmental Protection Agency. Through this EPA-coordinated program, federal, state, and local governments are now joining forces in a common effort to explore, understand, and manage estuaries.

Section 320 of the Water Quality Act specifically calls for the development of comprehensive conservation and management plans that recommend actions to restore and maintain individual estuaries and assure that designated uses of these estuaries are protected. At the completion of each project, the communities surrounding the estuaries will have a blueprint for action. They will be armed with knowledge about how the estuaries work and with alternative solutions to problems.

People want solutions to estuarine degradation. Recently, on February 14, 1987, I witnessed a compelling demonstration of public commitment to our estuarine resources in my own Congressional District. It was Valentine's Day, a warm and sunny Saturday offering a temporary respite from winter. Although the outdoors beckoned, nearly 600 citizens attended a day-long workshop concerning the Albemarle-Pamlico estuary, recently designated as part of the National Estuaries Program.

As I addressed this gathering, I was encouraged. I saw some scientists, some regulators, some managers. Mostly, however, I saw just people: people who live and work on the Albemarle-Pamlico estuary; people who use it and who are affected by its use; people whose quality of life, and sometimes their very livelihood, is linked to the health of that great estuary (the nation's second largest). They came because they wanted to learn what is being done, and more importantly, to learn what they could contribute.

This was not a contrived political event. It had been conceived and announced only a few weeks beforehand. It was a spontaneous and genuine expression of public enthusiasm and conviction. On that Saturday in February, a government project was transformed into a people's initiative. However, it was also clear that these same people realized that government action is both necessary and proper.

In my area of the country, people are often wary of government intervention—especially when it involves the federal government. In this instance, however, there was an overriding sense of mutual interest and shared responsibility that suppressed institutional and political suspicions, at

On Albemarle-Pamlico Sounds, an estuary system on the North Carolina coast.

least momentarily. During such moments, there is opportunity. The bottom line is that government—federal, state, and local—must provide the conduit for citizen community action.

A program of active cooperation among governments at the federal, state, and local levels is government at its very best. That is the kind of program in progress for the Chesapeake Bay and the kind of program we are trying to

***Let's hope that this is the last time we will need to rediscover our estuaries. We have been offered a rare second chance.***

accomplish for the Albemarle-Pamlico estuary. It is difficult work, but if it can be done, the benefits are enormous. If it can be done for the Chesapeake and for Albemarle-Pamlico, it can be done elsewhere, and there is hope for all of our estuaries.

The time has come to determine exactly what forces are crippling our estuarine resources and then to make the difficult choices necessary to reverse the trends. With an ounce of prevention we can avoid repeating the tragedy of the Chesapeake Bay in other areas of the country. At stake is not just our estuaries but our way of life.

Let's hope that this is the last time we will need to rediscover our estuaries. We have been offered a rare second chance. We have new and improved statutory tools, such as the National Estuaries Program. We have a public that is interested in innovative solutions and is willing to make personal sacrifices to guarantee protection of estuaries. We recognize shared governmental responsibilities. What is required now is effort and commitment; we must all be willing to work, to learn and to teach. Surely it is worth the effort. □

*(Jones, D-NC, is Chairman of the Committee on Merchant Marine and Fisheries in the U.S. House of Representatives.)*

# EPA's National Estuary Program

by Mary Lou Soscia
and Karen Flagstad

In 1985, Congress appropriated $4 million to EPA for study and assessment of four major estuaries around the country: Narragansett Bay in Rhode Island, Buzzards Bay in Massachusetts, Long Island Sound in New York and Connecticut, and Puget Sound in Washington. This was the *de facto* beginning of the National Estuary Program, initiated by EPA as a framework for addressing pollution problems and the effects of overuse and development in and around these and other estuarine systems. To date—with the additions in 1986 of Albemarle-Pamlico Sounds in North Carolina and the San Francisco Bay/Sacramento-San Joaquin Delta system in California—the program is at work in six estuary sites.

From 1985 through 1986, the National Estuary Program was administered, through EPA's Office of Marine and Estuarine Protection, under existing authorities of several federal statutes including the Clean Water Act, and state legislative authorities. This operating context, and the "informal" status of the program, changed earlier this year when Congress passed the Water Quality Act of 1987.

The Water Quality Act of 1987 formally establishes the National Estuary Program with the goal of identifying nationally significant estuaries, protecting and improving their water quality, and enhancing their living resources. It also identifies 11 estuaries for "priority consideration" by EPA under the national program. These 11 priority estuary systems include the six sites where the National Estuary Program is already active and, in addition, five other potential program sites: Delaware Bay in Delaware and New Jersey; Delaware Inland Bays in Delaware; New York-New Jersey Harbor in New York and New Jersey; Sarasota Bay in Florida; and Galveston Bay in Texas.

From EPA's standpoint, the new law is particularly important because it embodies a new level of national concern for estuaries while recognizing that there can be no single solution for problems linked tightly to specific environmental, demographic, and socio-economic considerations. Instead, the act calls for EPA to develop a framework within which local estuarine "constituencies" can cooperate to develop long-term protection and management plans. The Agency will provide the technical expertise and the organizational umbrella for working partnerships among state, local, and federal interests. But the programs to manage estuarine resources—and the political will to protect them—must come from the local users.

This recognition of the necessity for local input and responsibility has grown out of EPA's experience with the Great Lakes and Chesapeake Bay programs. Both of these pioneering efforts demonstrated that complex estuarine systems can be successfully managed by collecting scientific data about specific problems and their solutions and by developing the political partnerships to put that scientific knowledge to use.

Now, in the 1987 Water Quality Act, these key principles of problem-solving and partnership, which work through site-specific management coalitions ("management conferences," under the new law), have formally become part of the National Estuary Program. The goal is not to provide blanket solutions to the problems of our nation's estuaries, but rather a framework for the development and implementation of long-term estuarine management plans for particular estuaries. You might say that the National Estuary Program is not really *one* program, but several different programs for the several estuaries where estuarine resource management efforts are underway.

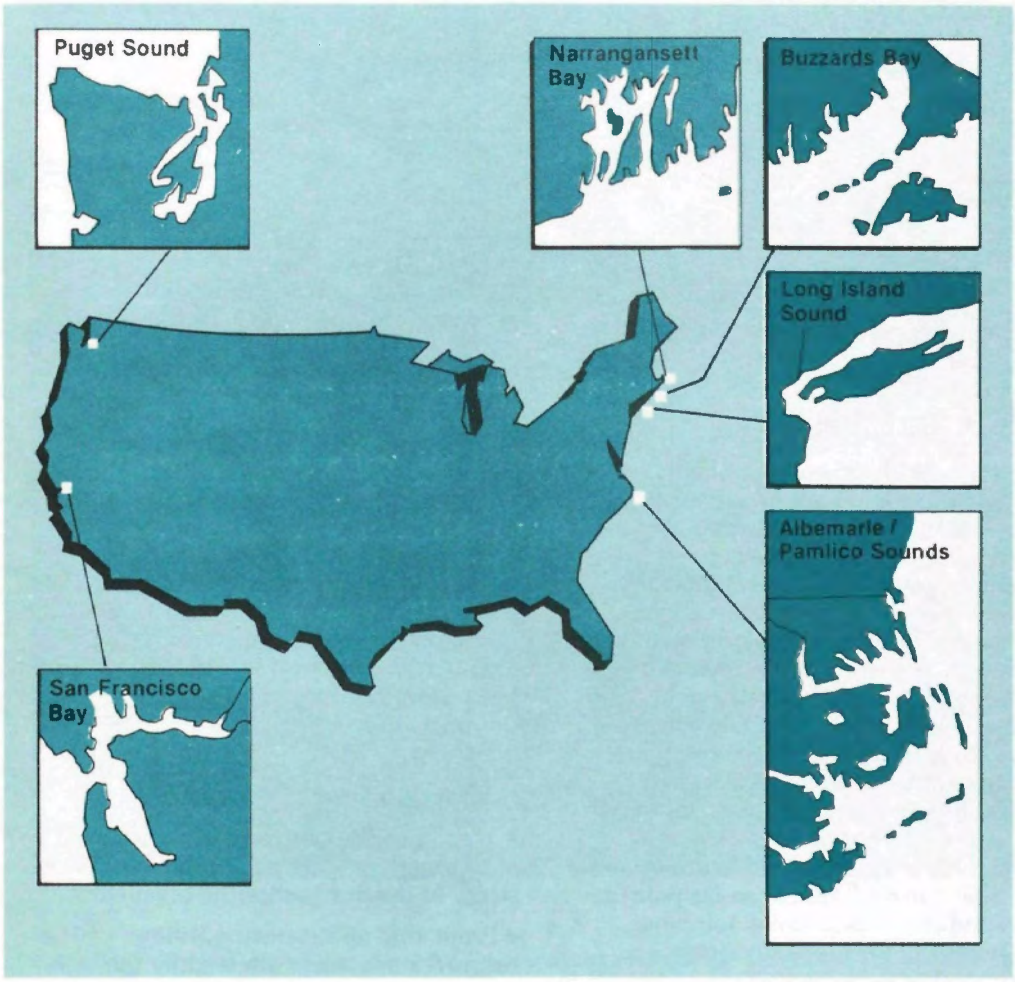
The following summations give a flavor for the National Estuary Program's ongoing work at six current program sites: Narragansett Bay, Buzzards Bay, Long Island Sound, and Puget Sound, which have been part of the national program since its inception in 1985; and Albemarle-Pamlico Sounds and the San Francisco Bay/Sacramento-San Joaquin Delta system, added to the program in 1986.

**Narragansett Bay**

The Narragansett Bay Project is jointly administered by EPA's Region 1 office in Boston and the Rhode Island Department of Environmental Management. In 1986, the state's citizens voted to pass the Rhode Island

## Management Conferer

One of the key aspects of the new law is the requirement for "management conferences" for each specific estuary in the program. These management conferences are responsible for the development and implementation of site-specific "Comprehensive Conservation and Management Plans," and must include representatives of such critical constituencies as local research institutions engaged in scientific investigations of an estuary and its resources; local, state, and federal governments (including the Administrator of EPA); and business, agriculture, specific municipalities, and the general public. Management conferences are convened for a period not to exceed five years but may be extended, or reconvened, as determined appropriate by the Administrator of EPA.




Map showing current areas of focus under EPA's National Estuary Program.

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Under the law, the management plans developed by each conference must:

- Assess trends in water quality, natural resources, and uses of the estuary.
- Collect, characterize, and assess data on toxics, nutrients, and natural resources within the estuarine zone to identify the causes of environmental problems.
- Develop the relationship between the inplace loads and point and nonpoint loadings of pollutants to the estuarine zone and the potential uses of the zone, water quality, and natural resources.
- Develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and non-point sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected.
- Develop plans for the coordinated implementation of the plan by the states as well as federal and local agencies participating in the conference.
- Monitor the effectiveness of actions taken pursuant to the plan.
- Review all federal financial assistance programs and federal development projects . . . to determine whether such assistance program or project would be consistent with and further the purposes of the plan prepared under this section.

Clean Water Act Trust Fund, which contains provisions for $500,000, allocated over two years, to help support the development of a Comprehensive Conservation and Management Plan for Narragansett Bay.

A preliminary trend assessment of estuarine resources in Narragansett Bay has found dramatic declines in its living resources over the last several decades. For example, oysters have disappeared altogether; and crab, scallop, and fish populations are significantly diminished. A number of formerly profitable quahog (hand clam) beds have been closed as a consequence of bacterial pollution. Recently, during the summer of 1986, a "brown tide" (microscopic algae bloom) reduced water visibility to inches and killed 30 percent of the bay's cultured mussels.

To date, the Narragansett Bay Project has identified the following conservation and management objectives:

- Protecting and restoring finfish resources.
- Restoring quahog fishery resources.
- Development of a long-term monitoring program.

The Narragansett Bay Project will achieve these goals through definition of status and trends of living resources and water/sediment quality, and development of control strategies for point and non-point pollution sources and resource management plans.

The Narragansett Bay Project has begun this work. For example, ongoing initiatives include the development of computer models to relate nutrient inputs from sewage treatment plants to water-quality trends in the bay. A project is also underway to complete a detailed, scientific trend characterization of the overall ecology of the bay, and in particular its quahog

Houseboats and other craft at a marina in the San Francisco Bay area. The outlook is for increasing "people pressure" on estuaries.

population. In addition, the National Oceanic and Atmospheric Administration (NOAA) has been commissioned to develop a detailed "atlas" of Narragansett Bay, charting transportation routes of oil and hazardous materials, including pollution response strategies and recommendations for contingency planning.

**Buzzards Bay**

The Buzzards Bay Project is jointly administered under the leadership of EPA's Region 1 (Boston) office and the Massachussetts Executive Office of Environmental Affairs.

Trends in and around Buzzards Bay include rapid development—particularly in Barnstable County on the Eastern shore, which is the fastest growing county in New England—accompanied by increased pollution pressures on the estuary. In addition, the western shores of the bay have had a long history of industrial discharges, resulting in contaminated sediments along the shoreline. One of the most disturbing trends in Buzzards Bay is the closure of increasing numbers of shellfish beds, due to coliform (fecal bacteria) contamination. In 1986 alone, 11,500 acres of previously productive shellfish beds in Buzzards Bay were closed to harvesting.

The Buzzards Bay Project has targeted three problem areas as immediate priorities:

- Shellfish bed closures resulting from pathogen contamination.
- Contamination of fish and shellfish with residues of toxic metals and organic compounds.
- Abnormally high nutrient levels in the bay.

One interesting component of the Buzzards Bay Project is an evaluation of coliform contamination of shellfish in Buttermilk Bay, an embayment at the northern end of Buzzards Bay, to identify the sources and pathways of coliform and other bacteriological contamination of local shellfish. Preliminary data from this study indicate that (1) coliform counts tend to increase immediately following storm events, (2) coliform levels in shellfish appear to relate primarily to coliform counts in surrounding sediments rather than in the water, and (3) waterfowl and recreational boating may be ruled out as primary sources of coliform contamination in Buttermilk Bay.

The study's findings so far point to ground water as a major source of waterborne nutrients, probably originating from septic tanks adjacent to Buttermilk Bay. This conclusion is supported by recorded variations in nitrogen levels, which are higher near the shoreline than offshore, and higher in summer than in winter, probably due to increased septic flow during the summer tourist season.

By tracing and explaining the causes of shellfish contamination, the Buttermilk Bay study will be in a position to recommend specific management initiatives to restore this important and profitable resource in Buzzards Bay. The study is a useful model for other estuary systems.

**Long Island Sound**

The Long Island Sound Study is unique within the National Estuary Program in that two EPA regions, Region 1 (Boston office) and Region 2 (New York City office), and two states, New York and Connecticut, share leadership responsibility in the Long Island Sound management coalition. The Interstate Sanitation Commission and NOAA are also key participants.

Five states contribute to the drainage basin of Long Island Sound, including New Hampshire, Vermont, and Massachussetts as well as the key states of New York and Connecticut. The sound's 577 miles of coastline are heavily populated: five million people live with five miles of the shoreline, and 14.6 million within the drainage basin. For these reasons, Long Island Sound presents unusually complex estuarine management problems.

The following priority problem areas have been identified by the Long Island Sound Study:

- Controlling toxic contamination of Long Island Sound.
- Targeting the causes of low dissolved oxygen concentrations, which can cause stress or death to estuarine organisms.
- Protecting and restoring living resources adversely affected by the presence of toxic contaminants and an absence of sufficient available oxygen.

Toxic contaminants of concern in Long Island Sound include metals such as copper, cadmium, and mercury, as well as organic compounds such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Through ongoing research efforts, the Long Island Sound Study is working to determine (1) the scope of the sound's toxic contamination problems, (2) the year-to-year trends of toxic pollution, and (3) the specific effects of these toxic contaminants on the living resources of the sound, including fish and shellfish destined for human consumption.

The Connecticut Department of Agriculture, the New York State Department of Environmental Conservation, the Interstate Sanitation Commission, and NOAA—which sponsors the "Mussel Watch Program"—are actively involved in data collection and analysis efforts focusing on toxic contaminant problems in Long Island Sound.

In addition, work is underway concerning patterns of oxygen depletion

in the sound and the impact of low dissolved oxygen levels on the sound's living resources. The Interstate Sanitation Commission and NOAA have been extensively involved in these efforts.

### Puget Sound

The Puget Sound Estuary Program is run by EPA's Region 10 office in Seattle, Washington, in cooperation with several Washington state agencies and other participants in the program's management coalition, including Indian tribal governments. The program works very closely, in particular, with the Puget Sound Water Quality Authority (created in 1985) and the Washington State Department of Ecology.

The Puget Sound Estuary Program has identified three pragmatic management objectives for the purpose of focusing its resources:

- Prompt action to address presently known, acute environmental problems associated with chemical contamination in the sound.
- A decision base that incorporates scientific data on estuarine processes, current environmental conditions, and spatial and temporal changes in those conditions.
- A coordinated approach to estuarine management for the effective and timely resolution of environmental problems.

The first objective (prompt action on known environmental problems) has come to fruition in the Urban Bay Toxics Control Program, which currently involves "action programs" in three urban, or industrialized, bays of Puget Sound: Elliott Bay, Commencement Bay, and Everett Harbor.

For example, in Elliott Bay, an interim pollution source control plan has been developed by EPA and the Washington Department of Ecology with assistance from an interagency technical work group and a citizens' advisory committee. Since 1985, the Elliott Bay "action team" has conducted 221 on-site investigation of known or suspected pollution source sites; identified 42 unpermitted discharges of pollutants; initiated 86 enforcement actions; and issued two National Pollutant Discharge and Elimination System (NPDES) permits with effluent limitations and monitoring requirements.

Major accomplishments directly related to the second objective (a comprehensive decision base) include the Puget Sound Environmental Atlas: a series of approximately 500 maps with up-to-date information on pollution sources, resource distribution within the estuary, and current environmental conditions. Another significant accomplishment has been the Puget Sound Pollutant Loading Study, which uses historical and current data to characterize trends in contaminant "loading" from both point and non-point sources to the estuary.

The third objective (a coordinated approach to estuarine management) is reflected in the Puget Sound Estuary Program's ongoing emphasis on interagency coordination. For example, the *Puget Sound Estuary Program Protocols Manual*, developed with the assistance of the United States Army Corps of Engineers, details recommended techniques for the sampling and analysis of physical, chemical, and biological variables in the sound. This manual is just one example of a number of coordination efforts of the Puget Sound Estuary Program, and it will also be of practical use for estuarine research elsewhere.

### Albemarle-Pamlico

The Albemarle-Pamlico Estuarine Study is a joint effort between EPA's Region 4

office in Atlanta, Georgia, and the North Carolina Department of Natural Resources and Community Development. Since its inception in 1986, the Albemarle-Pamlico management coalition has made outreach to the public one of its top priorities. This has included a number of public education initiatives, designed to bring home the point that successful management of estuarine resources in the Albemarle-Pamlico system will depend on the active cooperation of citizens and local governments. A public meeting held in February of this year succeeded in drawing internationally known speakers and over 600 participants to define the problems in the sound and the role of the public in resolving them.

The management coalition of the Albemarle-Pamlico Estuarine Study has adopted two pragmatic principles to direct its work:

- The environmental problems of the Albemarle-Pamlico system result directly and indirectly from human activities.
- Estuarine management initiatives should be focused on management problems that are likely to be solved.

Current work in Albemarle-Pamlico is centered around 10 conflicting uses of this estuary system. Six of these uses directly or indirectly affect the ecology of Albemarle-Pamlico: waste disposal, agriculture, forestry, residential and commercial development, mining, and national defense. Four of these uses are primarily affected by the health of the estuary system: commercial fishing, wildlife, natural resources, and tourism and recreation. All work planned for Albemarle-Pamlico is directed toward management objectives that are specifically action-oriented. A draft five-year workplan for the Albemarle-Pamlico Estuarine Study has recently been completed.

Steve Delaney

An egret. EPA's National Estuary Program recognizes the value to the nation of the estuarine environment.

**San Francisco Bay/Sacramento-San Joaquin Delta**

The San Francisco Bay/Sacramento-San Joaquin Delta Project is managed through EPA's Region 9 office in San Francisco, California. In convening a management coalition for the bay/delta project, the Region has involved the state of California, local government, and other federal agencies. The Region has also brought together representatives of diverse user groups that have strong and often conflicting interests in relation to the bay/delta system. The user groups encompass the interests of the urban communities of San Francisco Bay as well as the agricultural communities of the Sacramento-San Joaquin Delta region.

Trends in the bay/delta system include increasing diversion of water flow for municipal, industrial, and agricultural uses—so that nearly 65 percent of the system's freshwater inflow is now diverted before it reaches San Francisco Bay—and a progressive deterioration in the bay's water quality since the early 1900s. Both agricultural drainage and urban runoff contribute to pollution in the bay/delta system. Industrial and municipal wastes currently enter San Francisco Bay from over 100 locations. The effects of these pollutants on the estuary's living resources are just beginning to be understood.

During initial planning stages for the bay/delta project, there has been a strong emphasis on consensus-building. This consensus process has enabled the bay/delta management coalition to agree on four estuarine management issues for priority consideration:

- Land uses that affect the resources of the estuary, including wetlands.
- Waterway and channel modification, dredging, and levees.
- Existing point and non-point sources of pollutant loading into the estuary system.
- Freshwater inflow and salinity.

The particular issue of freshwater inflow and salinity will be addressed by the California State Water Resources Control Board through an existing Bay-Delta Hearing System. The objective of this process will be to achieve revised standards to protect beneficial uses of the estuary system. The San Francisco Bay/Sacramento-San Joaquin Delta Project is currently developing an information management system for technical information that will be needed during the hearing process. This is a vital first step in integrating the bay/delta project into state and local government in California. ▫

*(Soscia is in EPA's Office of Marine and Estuarine Protection. Flagstad is writing for the Journal on detail from the Agency's Office of Pesticide Programs.)*

# Looking Back from the Future

by John D. Costlow

Levi was uncomfortable, and it wasn't just his 65 plus years. Maybe it was the strong breeze with its hints of fall. He had lived on the abundance from the shores and marshes of the sound for his entire life, and in the good old days, such a breeze would have been called a "mullet blow." But those days were long gone. True, mullets or other sport fish would occasionally break the surface of the waves, but it had been years since there were enough to justify taking out the boats or even repairing the fishing nets.

Other riches of the sound, including shrimp, scallops, and crabs, had disappeared, too. The decline had been so gradual, though, that Levi couldn't fix any particular time or cause. It would have been easy to blame the same old scapegoats—industry, corporate farms, sewage treatment plants, and, of course, the state and federal bureaucracies—but in reality, just about everyone was at fault.

He remembered how his neighbors had reacted to the passage of the Coastal Area Management Act. The public meeting explaining the regulations had almost degenerated into a riot; some folks even seemed convinced that the rules were a communist plot to keep those who owned the land from doing what they wanted with it. Lots of shore residents could trace their ownership back to land grants from King George I; how could the bureaucrats from the capital assume they knew better than the locals? Why should they have to get a permit to dredge or fill the marshes? There were thousands of acres of salt marshes, and losing a few acres here or there wouldn't make any difference.

It was the same when the developers came in. He remembered the discussion with his brother Billy over the sale of a sizable stretch of waterfront property. The offer seemed reasonable, and they had been assured that a few condominiums wouldn't hurt the local fishing; they had been promised that the shellfish beds wouldn't be affected, either. But the sewage treatment facilities built for the condos turned out to be inadequate. Under strong pressure from developers, the legislature passed a special act to relax the water-quality standards, allowing something called "fecal coliform bacteria" to enter the sound untreated. The result was that the

area was permanently closed to shellfishing for miles around.

For a while, as part of a national estuarine study, a few local citizens, scientists, and politicians had actually tried to develop a long-range management plan. The enthusiasm was short-lived, though, and as far as Levi was concerned, the whole thing was just one of those expensive studies that never led to anything but talk and more studies.

Levi had to admit, however, that some of the problems came from the old-time commercial fishermen who couldn't seem to bury past squabbles and stick together. More than once, he had been involved in arguments with his neighors over clam sites, and of course, everyone remembered the local "shrimp wars," complete with shooting sprees.

As for fishing, Levi's other brother still maintained that the shrimp trawlers had destroyed most of the young fish with their endless sweeps. With hindsight, Levi admitted that they probably should have supported the efforts of the Marine Fisheries Commission to start a limited entry program. Back then, though, the idea that he and his family could somehow be excluded from fishing in their "traditional" waters was just something he couldn't go along with.

Levi sighed as he tried to catch a glimpse of one of the few mallard ducks he had seen this fall. When his son was small, there had been thousands at a time in the marshes, feeding on eel grass and the organisms that the grass sheltered. Even that was gone now. In the face of public opposition, the Commission had given up trying to prohibit the use of clamming devices that chewed up the eel grass, and once the grassbeds were destroyed, all the birds and sea animals it supported went, too.

In fact, the whole estuary had begun to deteriorate badly with the loss of the marshes and their root systems. Despite this, the commercial shippers and recreational boaters had successfully pressed for regular dredging to maintain the ship channels. In the old days, dredge spoil could not have been dumped on prime oyster beds, but the few left were dwindling so rapidly from the smothering effects of the dredging that it hardly seemed worth worrying about them. The clams were still there, of course, but they were so tainted from the oil spill of a few years ago that they could not be sold.

***Some people claimed there was no difference between real crab cakes and those made of processed fish and flavorings.***

Some of Levi's neighbors, on the other hand, blamed the oyster losses on the large mining operation up the creek. No one could understand why the mine was allowed to discharge millions of gallons of fresh water every day, especially when it was being rationed for residential and commercial users. Others argued that agricultural runoff and pesticides were responsible for the shellfish decline.

If he really wanted to blame someone, Levi figured that the recreational boat users and the tourists were as responsible as anyone. He smiled as he remembered the face of the so-called "captain" who had run into a net stake left in the water after the regular fishing season. The man could easily have repaired the hole, Levi was sure, but he had political connections and managed to get a bill passed that banned the use of nets and stakes in any of the state's estuarine waters. By that time, it didn't matter so much anyway. Most of Levi's friends and neighbors had already given up trying to replace nets damaged by fleets of overpowered, badly piloted boats.

The hurricane of "07" had settled a few scores, though; just as one of the geologists at the university had predicted, many of the summer residences and condos had washed into the sound with the first major storm. Still, lobbyists for just about everybody with money had inspired new regulations to allow the area to be built up again. Reflecting that it was now October and a good month for hurricanes, Levi almost wished that Mother Nature would conjure up another storm to teach this new bunch a lesson they wouldn't forget.

The screen door slammed and his grandson emerged with that expression on his face that could mean only one thing: he wanted to hear stories of the "old days" when the sound had produced bountiful harvests and a distinct way of life. He wondered if he should take his grandson out to lunch, maybe even try some surimi. Some people claimed there was no difference between real crab cakes and those made of processed fish and flavorings. Levi knew better, but he also knew there were no crabs left. After lunch, perhaps he would take his grandson over to the Maritime Museum. The plastic models of fish and other sea life as well as the models and photos of old fishing gear were all that was left of the good old days. □

*(Costlow is Professor and Director of the Duke University Marine Laboratory in Beaufort, North Carolina.)*

# Narragansett Bay

by Trudy Coxe

Save the Bay, Inc

On the Warren River at Barrington, R.I. The river is a tributary of Narragansett Bay.

One hundred and twenty years ago, a journalist from the *Chicago Tribune* who had visited Rhode Island wrote in his newspaper:

> Rhode Island—land and water combined—is not quite so large as Cook County, and contains little more than one half the population, yet without consultation with any person, I can name 15 summer resorts within its boundaries, and nearly all of them on the shores of Narragansett Bay. At this moment, these 15 places are lodging and feeding nearly 5,000 summer guests. This is simply owing to the fact that this bay, which swallows nearly half the state, is, probably, take it all in all, the most magnificent sheet of water in the western world.

Now, more than a century later, Rhode Islanders would still agree with that Windy City newsman.

Narragansett Bay is Rhode Island's greatest natural resource. One of the most fertile estuaries in the world, the bay literally teems with marine life; it is a feeding ground for schools of fighting bluefish and striped bass during the summer, the source of one quarter of the shellfish eaten each year in the United States, and a home for several months each fall to tropical fish swept north by the Gulf Stream.

***The biggest problem now facing Narragansett Bay is an ongoing boom in development.***

Narragansett Bay is also the state's most valuable economic asset. The tourist industry alone is valued at $1 billion annually, while the fishing and marine trades industries also benefit to the tune of millions of dollars each year.

Yet Narragansett Bay is under attack from a variety of pollution sources. Although 10 Rhode Island and Massachusetts sewage treatment plants that affect the bay are now in compliance with their discharge permits year-round, another 14 are still allowing excess sewage to enter the bay and its tributaries. In addition, with Providence, the state's capital, serving as one of the nation's chief jewelry manufacturing centers, the discharge of heavy metals and toxic chemicals has also weighed heavily upon the bay. As a result, tens of thousands of acres of prime shellfishing beds are off-limits to the 3,200 quahoggers who depend on the clams for their livelihoods. Other areas along the coastline are closed permanently to shellfishing as a direct result of failed septic systems, a consequence of ill-considered development.

In fact, the biggest problem now facing Narragansett Bay is an ongoing boom in development that has recently hit Rhode Island, exacerbating our pollution problems. State planners estimate that one quarter more of the state will be developed within the next 10 years. They also estimate that at the current rate of growth, farmland will no longer exist in Rhode Island by the year 2000.

This recent development boom has outstripped the state's environmental defenses. The Pawtuxet River, one of the bay's largest tributaries and the state's dirtiest river, suffers from runoff pollution from two large shopping malls. In fact, the mall's parking lots contribute greater quantities of toxic pollutants to the river than do the three sewage plants and one pharmaceutical company that also discharge into the Pawtuxet.

On the water-quality front, the state lags behind its New England counterparts in per capita expenditure for water quality protection. Until a $35 million Rhode Island Clean Water Act bond was passed in November 1986, the budget of "Save the Bay," the state's bay advocacy organization, was larger than the state's water resources division budget—the first line of defense for the bay.

In terms of coastal protection, the Rhode Island Coastal Resources Management Council (CRMC) remains understaffed and nearly powerless in its ability to stop developers from ravaging the coastline. The state's ability to deal with the current building boom is further hampered by statewide zoning

laws that date back to 1921, and the lack of a long-range plan for land use.

However, with growing public support, Rhode Island is beginning to fend off environmental threats. As just one indication of public commitment, "Save the Bay" continues to grow in membership and political strength. Labeled by the *Providence Journal* as the "state's conscience," our organization now boasts a roll of 10,000 family members.

We are beginning to see some measurable results. The state's sewage treatment plants are becoming much more efficient at treating wastewater, and local communities have voted to augment federal and state funds for plant improvements with local bonds. "Save the Bay's" annual performance review of the facilities, titled "The Good, the Bad, and the Ugly," has helped focus public attention on the issue with positive results. But vigilance by regulatory agencies will still be necessary to keep the recent record of improvements moving forward.

Inroads have also been made in dealing with toxic discharges. "Save the Bay" recently joined with the Boston-based Conservation Law Foundation to file a citizens' suit against two of the worst polluters in the Providence metropolitan region. Government and environmentalists are now working hand in hand to bring home the message that anyone not obeying the requirements of the Clean Water Act will have to pay the price.

The issue of proper land use is also being tackled head-on at national and local levels. Speaking in January at "Save the Bay's" second statewide land use conference, U.S. Senator John Chafee revealed his plans to propose a $1 billion per year federal land transfer fee program, which would provide funds to help preserve open space. Meanwhile, "Save the Bay" launched a campaign to put a $65 million "open space preservation" bond issue before Rhode Island voters in November 1987. If this bond is passed, it will undertake the purchase and preservation of critical lands in urban and rural communities.

Narragansett Bay continues to be a big cause in a small state, and a great deal of work is still needed to protect the bay. But with growing public concern and increased activity from the grassroots to the halls of government, there is a cautious optimism about the future of "the most magnificent sheet of water in the western world." □

*(Coxe is Executive Director of Save the Bay, Inc.)*

# Puget Sound

by Katherine Fletcher and Annette Frahm

Puget Sound. This beautiful estuary in the far Northwest corner of the United States is home to orca whales and seals, salmon and steelhead, great blue herons—and almost three million people. While it is well loved by the people of Washington, Puget Sound has suffered from the activities of its human residents.

For example, "toxic hot spots" have been found in the sound's urban bays. Important commercial shellfish harvest areas have been closed because of bacterial pollution. Over half of the sound's original wetlands have been filled, drained, or developed.

Responding to growing public concern about the sound's health, the Washington State Legislature created the Puget Sound Water Quality Authority in 1985. The seven members of the Authority, appointed by Governor Booth Gardner in July 1985, were charged with developing a comprehensive plan for Puget Sound water quality and overseeing its implementation. The initial plan was to be adopted by January 1, 1987, followed by revised plans in 1989 and 1991.

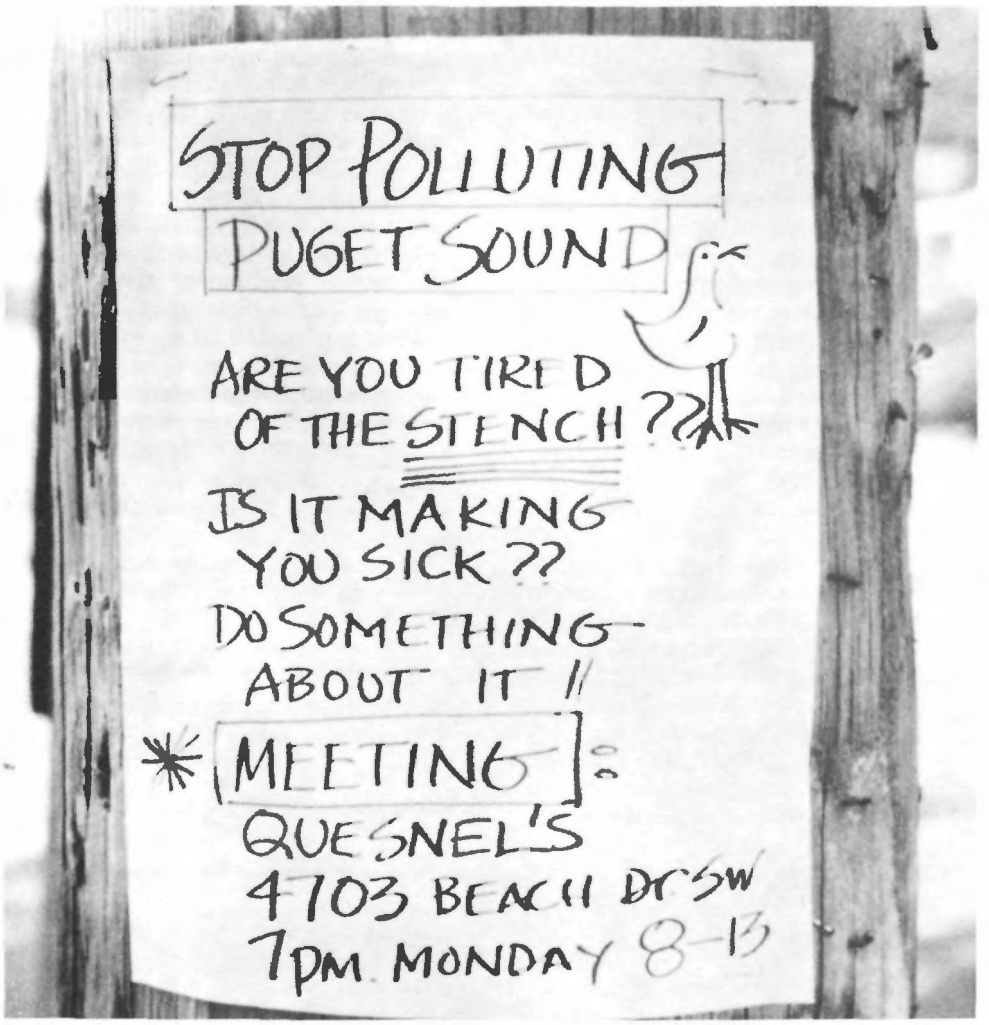
The task was daunting. More than 450 governmental bodies are responsible for some aspect of the sound's water quality. About 400 industries and sewage treatment plants have permits to discharge into Puget Sound. And the routine activities of nearly three million people contribute to pollution through contamination in surface runoff, or "non-point" source pollution.

During its first 18 months of existence, the new Water Quality Authority held dozens of public meetings to listen to people's concerns and ideas. The Authority also issued nine major background reports on Puget Sound water quality issues, a "State of the Sound" report, and draft and final management plans.

***"Toxic hot spots" have been found in the sound's urban bays.***

The Authority reached several conclusions about the state of Puget Sound:

- Contrary to previous assumptions, water and pollutants recirculate within the sound and are not easily flushed to the ocean.
- Most toxic contaminants bind to particles and settle out in the bottom of the sound. This is especially serious in urban bays, where high levels of toxicants are associated with diseases in bottom fish.
- Toxicants pose the greatest long-term threat to the sound, yet none of the known sources of toxicants is adequately controlled.
- Pathogens pose a threat to human health through shellfish consumption or swimming in water contaminated with pathogens. None of the sources of pathogens is adequately controlled.
- The population of the Puget Sound basin is expected to increase by 700,000 to one million people by the year 2000, dramatically increasing the potential for pollution.
- Even though regulations have slowed the rate of loss of the sound's wetlands, some shoreline wetlands are still being lost, and many inland wetlands are not protected by any regulations.
- Existing water quality programs are inadequately funded to accomplish legislated goals.




John Armstrong

A sign of citizen concern about environmental problems in Puget Sound.

These findings shaped the first Puget Sound Water Quality Management Plan, which was unanimously adopted by the Authority in December 1986. Some major elements of the plan include:

- Better control of toxic pollutants through more stringent discharge permits and increased inspection and enforcement.
- Local government actions to control nonpoint source pollution from farms, failing septic systems, and other sources. Planning will focus on selecting priority watersheds and controlling all sources of pollution within these watersheds.
- Efforts to reopen closed shellfish beds and protect existing beds from bacterial pollution from nonpoint sources.
- Improved control of the quality and quantity of stormwater in the sound's cities and areas that are becoming urbanized.
- Acquisition of high priority wetlands and more effective regulation to protect other wetlands.
- Support for education on the sound and public involvement in water quality policy-making.

The overall plan is based on the concept of prevention and the premise that it is cheaper to prevent pollution now than to clean it up after the sound is more severely damaged. Under state law, state and local agencies must abide by the plan.

In its first biennium, the Authority was funded at $2.7 million to develop the Puget Sound plan. Federal, state, and local governments will require about $120 million to carry out the plan during fiscal years 1987-1992, excluding the costs of upgrading primary sewage treatment plants and other ongoing water quality-related costs.

One source of funding is an increased tax on tobacco products. The tax was passed by the state legislature in 1986 to provide funds for water quality programs statewide and generates $40 million per year. However, an additional source of revenue, a proposed increase in permit fees for dischargers, failed to pass the 1987 legislature. The Authority also proposed bills related to septic systems and to criminal penalties that were considered but not passed. The legislature will undoubtedly take up the failed bills and funding issues in future sessions. Meanwhile, some parts of the plan will be delayed to reflect the legislature's actions.

The Authority is currently working with federal, state, and local governments to forge partnerships to carry out the Puget Sound plan. The Authority is also working with EPA to coordinate Washington State's initiative in Puget Sound with the National Estuary Program. In addition, EPA's assistance will be crucial in carrying out activities ranging from control of pollution from military bases to putting in place a sound-wide water quality monitoring program.

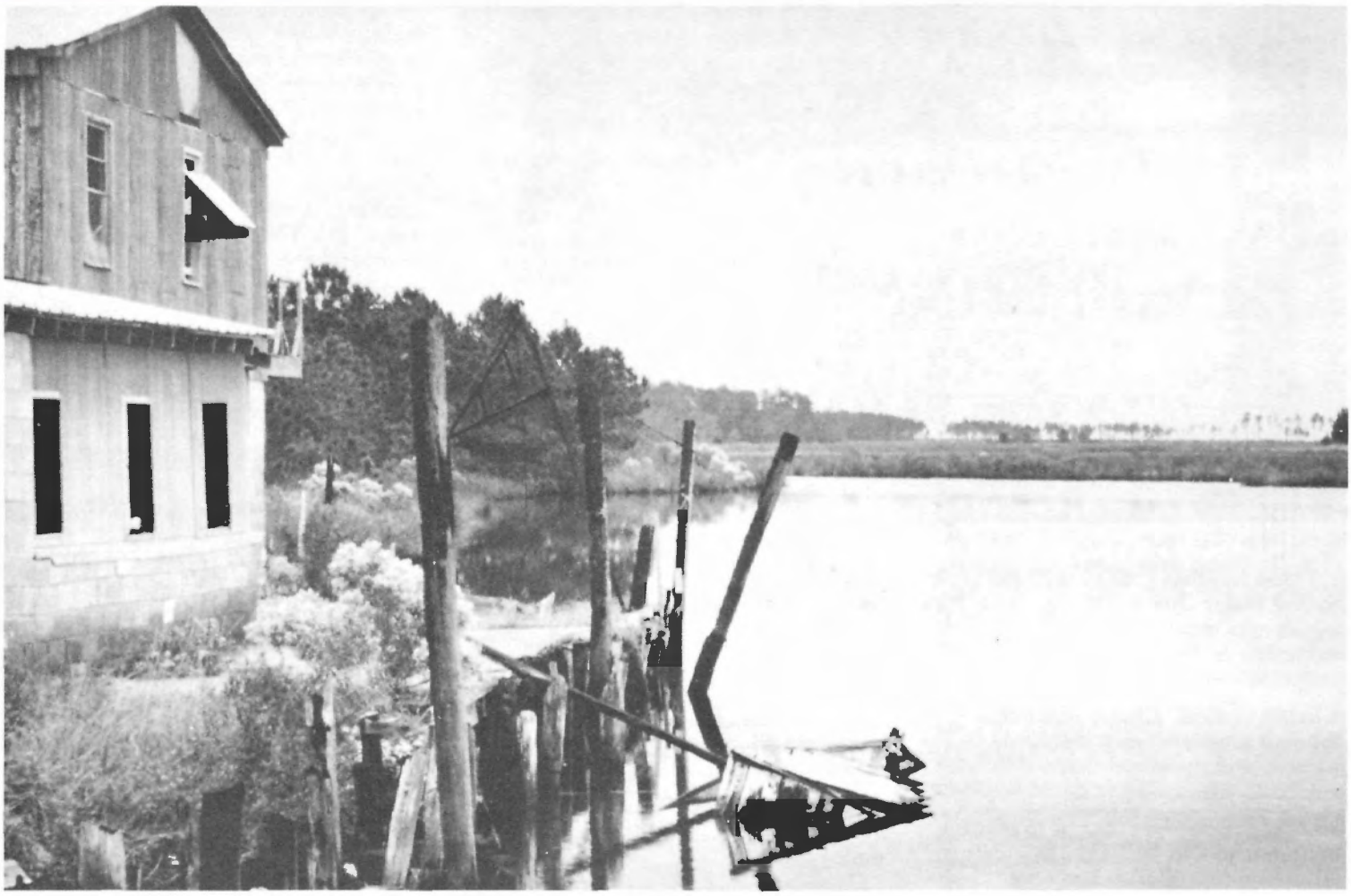
Since the Authority is scheduled to exist only until 1991, it is important to institutionalize what needs to be done to protect Puget Sound. Management of the sound must be an ongoing task if we are to ensure the health and vitality of Puget Sound for future generations. □

*(Fletcher is Chair of the Puget Sound Water Quality Authority. Frahm is Publications Manager for the Authority.)*

# Albemarle-Pamlico Sounds

by David W. Owens

A scene in Albemarle-Pamlico Sounds.



Dominating eastern North Carolina, the Albemarle and Pamlico Sounds comprise a huge complex of shallow sounds, rivers, and wetlands. With a total water area that exceeds 2,900 square miles (an area larger than the state of Delaware), Albemarle-Pamlico is the second largest estuary system in the United States.

The system supports many extremely rich and diverse uses. It produces over 90 percent of the state's fishing catch. It is also a major nursery area for fish caught along the entire Atlantic coast. Shellfishing, recreational boating, waterfowl hunting, and tourism in the Albemarle-Pamlico area are critical to traditional life styles and a growing coastal economy, and all depend on a clean and healthy estuary.

Unlike many other major estuarine systems in the United States, the Albemarle-Pamlico area remains largely rural. Although some of its major rivers drain through the more populous Piedmont region of the state, most of the area's immediate watershed is farmland, forest, and freshwater wetlands interspersed with small towns and resort development along the Outer Banks.

While the area does not have graphic environmental problems such as the toxic wastes in Boston Harbor or Puget Sound, there are disturbing trends. Fish landings are declining, particularly for

anadromous fish like striped bass, shad, and river herring. Fish diseases are far more common than in the past. For example, disease affected 90 percent of the menhaden caught in the Pamlico River last year. Algae blooms have become regular events in some of the area's rivers. Bacterial pollution is causing the closure of important shellfish beds. Alterations in drainage patterns are reducing salinity levels in vital nursery areas. Submerged grass beds that are critical for many fisheries are disappearing. These are the early symptoms of an estuarine system in trouble. These symptoms tell us that without action now to improve how we manage the use of the Albemarle-Pamlico system, we may soon do irreparable harm to one of the country's most important natural resources.

***Clearly what is needed is a systematically integrated approach to the area as a complete physical system and all its uses.***

Concern about these problems is not new. Over the past 20 years, there have been significant efforts to protect these resources. Dredge and fill laws and a coastal management program have virtually halted the loss of salt marshes and alteration of shallow bottom habitats. The state has adopted permit standards for all development along the water's edge, and the area's local governments are required to prepare land use plans that meet state standards. Controls placed on waste discharges, the construction of municipal waste treatment plants, and tighter regulation of septic tanks have improved the quality of much of the region's water. In addition, a new $6 million-per-year program is underway to promote agricultural practices designed to reduce runoff water pollution.

Despite these very substantial efforts, the problems remain. Our combined efforts, although extensive and well intentioned, may only be slowing the rate of decline—giving us a few more years of productivity and enjoyment before the natural health of the Albemarle-Pamlico estuary gives out.

What must be done to halt this decline and coming crisis? Simply doing more of the same—more research, planning, regulation, and enforcement—will only buy a little more time.

Clearly what is needed is a systematically integrated approach to the area as a complete physical system and all its uses. Otherwise, we cannot even begin to answer such basic management questions as whether we would be better off spending our next $1,000,000 of management funds on improving municipal wastewater treatment plants, increasing enforcement of regulation of fishing practices, or reducing runoff from farmlands. If we make such management choices as isolated, *ad hoc* decisions, our success at long-term resource management will depend more on luck than rational thought and action.

Now that there is an umbrella management structure for Albemarle-Pamlico being developed under the National Estuary Program, several key factors will be critical to our success in designing and implementing a systematic estuarine management program. In this difficult undertaking, failure to consider these factors could result in millions of dollars expended in a futile effort that only adds to the considerable litter of past failed initiatives and noble experiments at basin-wide water quality management.

The first basic need is for better understanding of the sounds' resources, their uses, and the environmental impacts of these uses. This includes the complex scientific questions of what is happening, why, and how it is all related. But the question of civic understanding is also critical—how much the public understands these uses, their interrelationships, and the implications of management options. Completing scientific studies will not, in itself, lead to any better management, as there are many fine studies gathering dust on bookshelves. Nor will increased public awareness of existing problems be successful in the absence of adequate technical information, since loud public outcries to do something, anything, without any notion of what actually needs to be done are rarely fruitful. Therefore, it is necessary to develop technical knowledge in concert with public understanding if the Albemarle-Pamlico program is to be successful.

Second, we need to recognize and use existing management tools. Just as the estuarine area is a complex, interrelated physical web, so also is its existing management context. Numerous federal, state, and local agencies are already at work with plans, studies, regulations, investments, and acquisitions. It is no more practical to build a new management system and institutions from scratch than it would be to completely rebuild the estuary's physical environment. This is not to say that new tools will not be helpful or that existing tools do not need considerable refinement. But using the tools we have, making them work to maximum effect, and coordinating them better should be the primary focus of this program, given the physical, cultural, and political realities in the Albemarle-Pamlico area. A five-year work plan has now been drafted for the Albemarle-Pamlico program, which attempts to address these realities.

A final need is a commitment to action. We cannot afford to wait three to five years before moving to "implementation." Some of our information needs are complex and will require years of study and analysis. However, there are immediate management needs, and there are strategic questions that can be answered with six months of study; we must act swiftly in these areas. We also can move now to implement and evaluate previously devised solutions. It is critical to establish the credibility of this effort as a *management improvement* program, as distinguished from just another study or research effort. It is critical to achieve some immediate near-term results. The long-run success of the program must begin with a series of smaller successes.

It is the charge of the Albemarle-Pamlico Estuarine Study to achieve, through a comprehensive conservation plan, an effective management improvement program for the sounds. This will be done in part through the provision of money, making the needed research and action possible. Part will be done through initiatives to improve public awareness of the management needs. But the greatest contribution, and the greatest challenge, will be to accomplish a fully integrated system for our various management initiatives. For it is only by looking at the entire Albemarle-Pamlico system and all its uses as an integrated whole that we will be able to protect its future. □

*(Owens is the Director of the Division of Coastal Management in the North Carolina Department of Natural Resources and Community Development.)*

# Chesapeake Bay

by William M. Eichbaum

Unloading oysters in Kent Narrows, Chesapeake Bay.

The Chesapeake Bay is one of the largest and most bountiful estuaries in North America. Its 4,400 square miles include more than 50 rivers and a shoreline of over 4,000 miles in Maryland alone. Its fisheries provide 95 percent of the nation's blue crabs and over 50 percent of its oysters.

Over 13 million people live in the Chesapeake watershed, and that number is growing every day. Like many estuaries in urbanized areas of North America, the Chesapeake must assimilate huge pollutant loads from both point and non-point sources daily while serving innumerable commercial, recreational, and aesthetic uses.

Concerns about the health of the Bay began to translate into action in the late 1970s, when a comprehensive six-year study of the Chesapeake was undertaken by EPA. The Agency's findings, released in 1983, identified significant areas of decline, including depleted fisheries and seagrasses, excess phosphorus and nitrogen levels, and inadequate oxygen for healthy aquatic life. Maryland leaders responded vigorously to the challenge presented by EPA's findings, which sparked a regional cooperative effort that has been historic in its dimensions.

In December 1983, the Chesapeake Bay Conference brought together leaders from every level of government throughout the region, and the resulting agreement began a new era of federal and interstate cooperation to "Save the Bay." Cooperative efforts continue among EPA and the member states—Maryland, Virginia, and Pennsylvania, as well as the District of Columbia—in the ongoing Chesapeake Bay Program.

Maryland responded to the Chesapeake challenge by creating a sweeping package of initiatives in 1984 that both enhanced its existing Bay protection programs and created new ones. In addition, we organized environmental education programs and set up a comprehensive monitoring and research program encompassing the Bay's main stem, tributaries, and fall-line.

Our point source pollution control efforts have been remarkably successful due chiefly to upgrades at Maryland's sewage treatment plants, a strong enforcement posture in implementing the National Pollutant Discharge Elimination System (NPDES) program, and an effective industrial pretreatment program requiring industries to "pretreat" their wastewaters before discharging them into municipal systems. Our nonpoint source control efforts are focused primarily on storm-water management, sediment and erosion control, and agricultural and urban "best management practices."

***Concerns about the health of the bay began to translate into action in the late 1970s.***

Maryland's resource restoration efforts have put priority on aquatic grasses and "living resources," especially oysters and striped bass. In addition to our restoration efforts where harm has been done, we have also taken a preventive approach through land resource protection initiatives focusing on conservation easements, nontidal wetlands, and forestry efforts.

The centerpiece of Maryland's land resource protection efforts has been the "Critical Area Program," designed to protect water quality and wildlife habitat in the Chesapeake by regulating the uses of the 1,000 foot strip of land around the Bay and its tidal marshes, known as the "Critical Area." The program represents a breakthrough in state and local land-use partnership.

What lessons can we draw from our participation in the Chesapeake Bay effort that others might find useful?

- Build a broad-based, cooperative effort from the outset, when you are just beginning to define problems and articulate possible solutions. Bring together the full range of players, including state legislators, local officials, and citizen groups such as farmers, businessmen, and developers. Drive home the fact that problems of estuary management are everyone's responsibility. Hold seminars for these groups, attend and contribute to their meetings, and schedule private briefings where you can communicate your message. For this effort, find technical people who can make the scientific issues comprehensible to these groups.

- Determine what level of effort can be sustained over the long haul. Build the expectation of a long-term effort into your program. Plan realistic, affordable solutions, and then prepare for progress to be slow and not readily apparent. In the Chesapeake Program, our watchword has been that centuries of abuse to the Chesapeake cannot be reversed in three years—or even 10 or 20.

- Take the time to create a strong scientific basis for the management actions you undertake. Collect, organize, and analyze the existing data before spending time and funds on new data collection efforts. Missing this step runs the risk of setting priorities too early and wasting valuable resources. On the other hand, don't allow scientific uncertainties to be used as an excuse for inaction. In Maryland, we have undertaken a number of initiatives in light of this balance, such as a phosphorus ban in the Upper Bay and a moratorium on the taking of striped bass.

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- Concentrate your limited resources where they can do the most good. For example, the Chesapeake experience has shown that tributaries—where the direct stresses of pollution are concentrated and where the key life stages of fisheries take place—are where significant research and management resources need to be targeted. Avoid the temptation to single out a perceived technical problem—such as toxics—too early in the effort. Before defining your technical problems, give pragmatic consideration to intended uses and expectations of users, and frame your programs accordingly.

- Fiscal incentives and technical assistance for local governments and special groups such as farmers are crucial, not just from a technical pollution control standpoint, but also for generating momentum in public education and involvement. Maryland's stormwater management, industrial pretreatment, and agricultural cost-share programs have all been particularly effective in this regard. By finding new ways to "sell" pollution control, we have helped farmers to see nutrient management as good economics, business to see that resource recovery can be affordable and cost-effective, and local governments to begin to accept water quality as an important target of their stormwater management efforts.

These are some of the most important lessons we have learned so far in our effort to restore the Chesapeake Bay. Our successful beginning—and it is only a beginning—stems from effectively balancing the range of issues we face. We built strong political momentum while carefully defining problems and planning programs. Even now, we constantly weigh our management objectives against our ongoing scientific and technical efforts. The true basis of our success, however, is the enormous—and growing—number of people in the region who are willing to work for the survival of the Chesapeake Bay. □

*(Eichbaum is a staff member of the Department of the Environment of the State of Maryland.)*

# An International Perspective

by Clifton Curtis

The Inland Sea of Japan.

"Conflicting uses and competing users" summarizes the problems facing those charged with the preservation and wise management of the world's estuarine resources. The interests of maritime commerce, coastal fisheries, commercial coastal development, recreation, and special sanctuaries often appear too divergent to reconcile. The problems are further complicated by multi-jurisdictional governance of coastal resources—from local to international levels.

To study these problems and recommend workable solutions, a project called "Coastal Seas Governance" is underway as a cooperative effort of the Oceanic Society, the University of Maryland's Center for Environmental and Estuarine Studies, Washington College, and the Chesapeake Publishing Corporation. This three-year project is international in scope and concerns the fate of estuarine systems in developing nations as well as developed, industrialized countries. Research conducted by project participants has included visits in the past year to seven countries and four estuarine systems—the Chesapeake Bay, Baltic Sea, North Sea, and Inland Sea of Japan—to meet with senior policy makers and leading coastal scientists. This fall, we will release a report presenting our preliminary findings and recommendations. All of us involved in the project hope that the forthcoming report will stimulate scientists, managers, and policy-makers to better understand and govern the world's "coastal seas" in the face of competing demands on estuarine resources.

The ongoing decline in the environmental health of estuaries, one of humankind's most important environmental assets, is indeed a worldwide problem. Throughout the world, estuaries are being forced to assimilate growing amounts of pollution from offshore activity; from onshore industry, residences, and farms; and from rapidly increasing populations in coastal areas. These kinds of pressures are not restricted to estuaries in industrialized nations.

In much of the Third World, overfishing threatens the major supply of protein for people. At the same time, fish resources depend on healthy estuaries. In Third World countries, development centers on coastal harbors and surrounding environments—placing new demands on previously unstressed coastal seas as they become waste disposal and petroleum trans-shipment sites, and cruise ship ports. As one example, there are coastal areas in Ghana where entire fisheries have been lost mainly as a result of human waste disposal. The plight of fish resources in Ghana is typical of problems elsewhere in West and Central Africa.

***In Japan, that pressure came from fishermen who took dead fish to government offices.***

As marine scientists now recognize, estuaries are complex ecological systems that are significantly different from ecologies in the open ocean. Compared to ocean depths, the majority of estuaries are shallow—both the Chesapeake and the Inland Sea, for example, average less than 30 feet—and the bottom has a tremendous influence on the biological processes taking place in the waters. Estuaries act as filters that trap plant nutrients, toxic wastes, pesticides, and other pollutants; conserve them in bottom sediments; and release them at a later time—often in chemically altered states. In other words, estuaries do not transport pollutants rapidly to the open sea but tend to retain and concentrate them. As a result, living resources are exposed to increasing levels of contamination.

But pollution isn't the only hazard. Changes in the physical character of an estuary can cause significant problems. Shipping, more often than not, demands that mud and sand be dredged to form the deep channels required for large vessels to maneuver—as in the approach to the Netherland's Port of Rotterdam. Such dredging destroys bottom habitat needed for feeding and laying eggs.

Marshes are filled in to make way for homes and factories—as in the case of the Inland Sea of Japan, where less than 23 percent of the 6,000-plus kilometers of coastline remains in its natural state. Marshes and mangroves are also converted to ponds for aquaculture, again reducing the naturally functioning ecosystem. Construction on high surrounding land results in large amounts of soil washing into the water. Add natural catastrophes such as floods and hurricanes to the scenario, and it is easy to understand the concern of many communities for the health of their local estuaries.

The complex environment of estuaries can be understood only by taking a multidisciplinary approach, and the regulatory problems that estuaries pose will be solved only through multidisciplinary solutions. Whenever one listens to the diverse array of experts discussing estuaries, this message comes through loud and clear. However, it is also clear that scientific and technical considerations are not being effectively translated into policy decisions. This is partly an issue of communication—or the lack thereof—and it has been one of the more disturbing findings that is emerging from the Coastal Seas Governance project.

Many estuary managers are challenged by the unknown socio-economic consequences of their decisions. Unfortunately, these decisions are typically made in a crisis-response atmosphere without adequate input from the "human" sciences like economics, sociology, and demography. This is often the case in developing nations, where coastal fisheries alone may account for significant portions of their gross national product. But there is also compelling evidence that the human sciences are not being given adequate attention in the estuaries of developed nations. If socio-economic issues are not adequately addressed and communicated—as is all too often the case—managers are far more likely to be faced with irreversible degradation of estuarine assets.

Even when significant ecosystem alterations occur in estuarine systems—like the red tides that caused large fish kills in the Inland Sea in the early 1970s or the loss of submerged aquatic vegetation in the Chesapeake—corrective action is unlikely unless there is substantial pressure from individuals, user groups, or the public for changes. In Japan, that pressure came from fishermen who took dead fish to government offices. In Holland, it came from conservationists determined to ensure that the last large remaining nature preserve in their country—the Wadden Sea—would not be destroyed by yet another set of dikes and landfills. But where there is no concerted pressure on government to address marine ecosystem degradation, as is true in Poland, action in response to the serious problem of municipal waste discharge is not receiving the attention it deserves.

Where estuaries link several nation states, regional transnational entities like the Helsinki Commission (for the Baltic Sea) and the Oslo or Rhine Commissions (for the North Sea) take on particular importance. Despite the lingering view that transnational bodies typically reflect a "lowest common denominator" of agreement, this skepticism is giving way to a growing belief that these types of decision-making bodies need to be used more rather than less. In part, this new sense derives from successes achieved under the United Nations Environment Programme's "Regional Seas" management structures, which now involve over 120 countries in 11 regions of the globe.

In addition, less formal mechanisms are gaining prominence and hold promise for the future. In the North Sea region, for example, a series of informal regional meetings occurred in 1984, and a second round began late last year. To begin with, environmental and other citizen group leaders meet to articulate their concerns for the North Sea. Subsequently, there is a special gathering of scientists, most of whom work for governments of the nation states in the region. Finally, high-level ministers meet on both science and policy issues to hammer out agreements for future action. There have been few tangible results so far, but these efforts have received high marks for substantially increasing the dialogue among key participants in the North Sea decision-making process.

In the United States, and in other developed and developing countries, there is now a near consensus that estuaries are facing serious problems—problems that, with few exceptions, are getting worse rather than better. We've reached the stage of grappling with decisions on what strategies can best protect these precious resources, and of exercising the political will to commit the resources (money, time, and energy) to reverse their decline. Other problems may seem more immediate, but few are as pervasive in their implications for the future quality of life on our "blue planet."□

*(Curtis is President of the Oceanic Society in Washington, DC)*

Marshlands in Chesapeake Bay.

# Wetlands: A Growing Concern

by David G. Davis

*Editor's note: The following article explains EPA's wetlands program, which is concerned with wetlands in estuaries, along coastlines, and also, with those that are inland.*

Wetlands, one of this nation's most valuable and perhaps irreplaceable resources, are rapidly disappearing. This natural heritage of marshes, swamps, bogs, and other wetland types once covered 215 million acres in the lower 48 states; today only 95 million acres remain. In the three decades between 1950 and 1980, over 11 million acres were lost entirely, and additional acres have been degraded by pollution to the point where they cannot fulfill their individual functions. National figures mask much greater losses of particular wetland types in specific regions. In Iowa, for example, conversion of wetlands to agricultural use has destroyed 99 percent of the marshes. Bottomland hardwood forests in the lower Mississippi Valley decreased by more than 50 percent between 1950 and 1977; the loss continues at a rate of about 100,000 acres per year.

EPA has been involved in efforts to protect wetlands since the passage in 1972 of Section 404 of the Clean Water Act, which regulates the discharge of dredged and fill material into waters of the United States, including most wetlands. In October 1986, after a major strategic study of wetlands protection, EPA Administrator Lee Thomas increased and underscored the Agency's commitment by creating a new Office of Wetlands Protection (OWP). The Office reports directly to Lawrence Jensen, EPA Assistant Administrator for Water. The goals of OWP will be to mobilize resources needed to save existing wetlands for the future and to retrieve some of the areas from their degraded states.

Wetlands destruction or degradation means the loss of those plants and animals that have evolved over geologic time to live in these specialized habitats. When we lose wetlands, we also lose one of the most productive of all ecosystems. Wetland plants convert sunlight into plant material or biomass which serves as food for many types of aquatic and terrestrial animals. The major food value of wetland plants occurs as they break down into small organic particles that form the base of an aquatic food chain that supports

higher consumers like commercial and recreational fisheries.

Wetlands also help to improve and maintain water quality in adjacent water bodies. In effect, wetlands serve as natural treatment plants by improving the quality of the waters that pass through them. They remove nutrients such as nitrogen and phosphorus, thus helping to prevent eutrophication or overenrichment of natural waters, they filter harmful chemicals such as pesticides and heavy metals, and they trap suspended sediments that produce turbidity.

Moreover, wetlands have socioeconomic values. They play an important role in flood control by absorbing peak flows and releasing water slowly. Along the coast, they buffer land from storm surges resulting from hurricanes and tropical storms. Wetlands vegetation can reduce shoreline erosion by absorbing and dissipating wave energy, binding the soil, and encouraging the deposition of suspended sediments. In addition, they contribute $20 billion to $40 billion annually to the nation's economy.

The new OWP will pursue a number of opportunities for protecting our wetland resources. The most important regulatory mechanism is the dredge and fill permit program implemented jointly by EPA and the U.S. Army Corps of Engineers. Other federal programs that help to protect wetlands include: permitting of effluent discharges into wetlands under CWA Section 402; withholding, under the "Swampbuster" provision of the 1985 Farm Bill, various agricultural benefits to farmers who convert wetlands to cropland; and federal land management and acquisition programs.

Many state legislatures have enacted wetland acquisition or protective statutes that complement federal programs. States also administer a variety of land use and water quality management programs that can serve to protect wetlands. Local zoning and land use planning, if done wisely, can also be an important protection mechanism. Also, private organizations, industry, and landowners contribute in significant ways through education, acquisition, and wise resource management.

With the creation of OWP, EPA's wetlands program will benefit from the technical expertise, permitting strengths, enforcement capabilities, and state program development experience existing in other Agency water programs. Emphasis is being placed on integrating EPA's wetland efforts into the Agency's overall water resource protection activities, such as ground-water protection, estuaries and near coastal waters, and non-point source management. An integrated "Clean Water Strategy" is being emphasized by the Office of Water in its implementation of the Water Quality Act Amendments of 1987. For wetlands, such integration can mean:

- Enhanced protection of wetlands due to increased recognition of their important role in improving water quality.
- Enhanced protection of wetlands from water pollution impacts other than discharges of fill.
- Encouraging a reorientation of Clean Water Act programs from a discharge-site or discharge-type basis toward a larger landscape basis such as a watershed.

The new Office is expanding EPA's wetland activities beyond the traditional Clean Water Act Section 404 authorities with six areas of emphasis:

- Vigorous implementation of the Section 404 responsibilities.
- Assistance to states and localities to strengthen existing wetland protection programs or, where lacking, to create new programs.
- Anticipatory approaches to wetlands protection such as the Advanced Identification process under Section 230.80 of the EPA Section 404(b)(1) guidelines.
- Increased coordination with and consistency of federal and state policies.
- Enhanced public awareness of wetland values.
- Expanded scientific knowledge of wetland functions.

The Section 404 regulatory responsibilities will continue to serve as the cornerstone for EPA's wetland protection activities. In particular, OWP will concentrate on expediting related policy development in such areas as mitigation, enforcement, and delineation of wetland boundaries.

At the same time, OWP will be looking beyond the Section 404 program to a variety of regulatory and nonregulatory protective approaches aimed at increasing public understanding of and support for wetlands protection and enhancing complementary or related nonregulatory programs. One approach to increased public awareness is through a National Wetlands Policy Forum, convened by the Conservation Foundation at the request of the EPA Administrator and chaired by Governor Thomas Kean of New Jersey. The Forum is bringing together leaders representing federal, state, and local governments, industry and agriculture, environmental and public interest groups, and academia to identify and analyze major issues confronting wetlands protection and make recommendations in the spring of 1988.

EPA also recognizes the importance of the state and local government role in wetlands protection. In the context of the Section 404 program, OWP expects final promulgation of the revised state program regulations in the near future. These regulations will streamline the requirements for state assumption of the Section 404 program. Also, in conjunction with other EPA offices, OWP will begin to work with the states to strengthen the existing water quality certification process under Section 401 of the Clean Water Act to protect wetlands. Beyond Section 404, OWP will strengthen communications and technical assistance to state wetland programs through a more active EPA role as an information clearinghouse on state initiatives.

Since wetlands ecology is a relatively young science with major information gaps, another area of emphasis will be expanding scientific knowledge of wetland systems. EPA's Office of Research and Development, in conjunction with OWP, is implementing a Wetlands Research Plan, which was adopted in 1986 and addresses three key topics: the contribution of wetlands to water quality; prediction of the cumulative impacts of wetlands loss and the relation of individual permit decisions to that loss; and techniques for creating and restoring wetlands.

However, with such actions as a starting point, OWP is committed to expanding its focus beyond the regulatory program and towards state and local regulatory efforts as well as nonregulatory protection initiatives involving the public and private sectors. In the final analysis, better protection of our vulnerable wetlands requires employing a variety of approaches in a coordinated, thoughtful, and effective manner. □

*(Davis is the Director of the Office of Wetlands Protection in EPA's Office of Water.)*

# Taking the Initiative for the Gulf of Mexico

by Hagan Thompson

*Editor's note: The following article reports on the status of efforts to protect another coastal water body, the Gulf of Mexico.*

It's easy to get saturated by statistics when discussing the Gulf of Mexico. The gulf generates some 2.5 billion pounds of harvested fish and shellfish annually. Most of the nation's offshore gas comes from the area, and substantial supplies remain in the Outer Continental Shelf. Nearly half of the United States' export and import tonnage passes through gulf ports. And one-sixth of the United States' population now lives in states bordering the gulf.

By any standard, the gulf is remarkable for its fish, wildlife, energy resources, ports, and shoreline. The gulf's coastal estuaries, wetlands, and barrier islands provide important habitat for large populations of wildlife, including waterfowl, shorebirds, and colonies of nesting seabirds. In fact, it provides habitat for most of the migratory waterfowl traversing the United States.

That's the good news. The bad news is that the Gulf of Mexico is affected adversely by the rest of the nation, with a continent's nutrients, wastes, and soils eventually washing down to it.

In short, the Gulf of Mexico provides an impressive wealth of resources, but it also presents great responsibilities. The continued health and productivity of the gulf should be a national priority.

During the past few decades, the gulf has begun to show signs of deteriorating environmental quality, with serious deterioration already apparent in some places.

Gulf estuaries, and the gulf itself, are becoming enriched with plant nutrients in the form of nitrogen and phosphorus. Enrichment results from agricultural runoff and waste contributions to the vast drainage network feeding the gulf, as well as direct discharges from coastal population centers. Although local nutrient discharges from wastewater treatment plants and industrial sources are significant throughout the gulf, nearly 10 times more nutrients come into the region from upstream sources. Although the contribution of river-borne nutrients is partly responsible for the gulf's exceptionally high productivity, excess nutrients cause blooms of microscopic plant life that then decompose and deplete dissolved oxygen levels. Marine organisms may be killed if the dissolved oxygen supply is inadequate to sustain them. Excess nutrients may also cause blooms of noxious phytoplankton that have toxic effects on other marine organisms or humans consuming tainted seafood.

***Today, serious conflicts are emerging among users of the gulf, its coastal environments, and its resources.***

Oxygen depletion is an increasing problem for many gulf estuaries, including Sarasota Bay, Tampa Bay, Pensacola Bay, Mobile Bay, Lake Pontchartrain, Barataria Bay, Calcasieu Lake, Galveston Bay, and Corpus Christi Bay. In addition, nitrogen concentrations in the Mississippi River have apparently increased twofold, probably as a result of fertilizer runoff from the nation's farm belt.

The economy of the gulf coast states depends heavily on agriculture and the petroleum and chemical industries. With these activities, however, comes an increase in toxic materials that are products or byproducts. Approximately 48 percent of the total wastewater discharged to the gulf from point sources is from petrochemical and chemical facilities.

For example, the extraction and transport of oil from coastal and offshore regions of Louisiana and Texas introduce large quantities of petroleum hydrocarbons and other organic and inorganic contaminants resulting from drilling and production. The use of pesticides and herbicides in agriculture also produces lingering contamination. Twenty-two million pounds of pesticides were applied in gulf coastal counties in 1978. A dramatic effect of previous, careless release of large quantities of pesticides was the local extinction of the brown pelican—the symbol of Louisiana—from the northern gulf coast as a result of pesticide-related reproductive failures.

There have been rapid losses of marine habitats such as marshes, mangroves, and seagrass beds. In Louisiana, coastal wetlands are being lost at a rate of approximately 50 square miles per year as a result of canal dredging and reduction of the sediment supply to wetlands from the Mississippi River. In Florida, which has 96 percent of the nation's mangroves, approximately 22,000 acres have been lost to urban and residential development, and more than 75,000 acres of submerged lands have been filled with dredged materials in Texas, Louisiana, and Florida.

The Gulf of Mexico produces more than half of this country's oyster harvest. With this bounty, though, comes the risk of disease from eating raw or poorly cooked shellfish. Compounding the risk is the nature of the gulf estuaries where oysters are produced. Typically, these estuaries are confined, shallow waters with small tidal ranges and warm temperatures, and the low flushing rates and warm temperatures are ideal for incubating human pathogens from sewage treatment plants or malfunctioning septic systems.

Not surprisingly, then, the incidence of gastroenteritis, hepatitis, and cholera contracted by consuming shellfish is higher on the gulf coast than elsewhere in the nation. Precautions taken to minimize the risk of these diseases have resulted in the permanent or conditional closure of 1.6 million acres of shellfish growing areas along the gulf coast.

For a long time, the Gulf of Mexico was perceived as having boundless resources. There was as much there for the taking as one wanted. But increased seafood consumption and the startling statistics concerning the rate of loss of natural habitats have finally combined to produce the stark realization that what the gulf can supply us is indeed finite. Today, serious conflicts are

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Processing the shrimp harvest in the Gulf of Mexico.

emerging among users of the gulf, its coastal environments, and its resources.

A notable example is the conflict over fish and shellfish resources between recreational and commercial fishermen. These conflicts began to develop in Texas and Florida a decade ago and now have converged in Louisiana, where the philosophy of boundless resources is perhaps most prevalent. There, the conflict is over the commercial harvest of redfish (or red drum). The nationwide craze for Cajun blackened redfish greatly increased the demand for it while reducing its availability to sport fishermen.

However, many other conflicts among users of the gulf are apparent: between land developers and conservationists; between oil and gas extractors and fishermen; between those who use coastal waters to disperse wastes and those downstream or lower in the estuary who use those waters for other purposes, such as drinking water or oyster production.

Perhaps eclipsing all of these conflicts is the one between the users within the drainage system (two-thirds of the contiguous United States) and those who are directly affected by these upstream contributions as they reach the gulf estuarine system and the gulf itself.

Clearly, the health and ecological integrity of the Gulf of Mexico are threatened. The time is now for concerted action to stop the deterioration of the gulf and its coastal areas and, where possible, to restore damaged environments.

Recognizing the need for immediate action, Region 4 is developing an institutional structure that will provide a comprehensive, systematic approach to assessing and implementing regionally based solutions to these problems. This effort is called "the Gulf Initiative."

The overall approach embodied in the Gulf Initiative is similar to those conceived and successfully implemented in other areas where regional solutions were sought (i.e., the Great Lakes and Chesapeake Bay programs). Although the geographic scale of the Gulf Initiative is larger than that of any single estuarine program, the institutional scale (five participating states and the Republic of Mexico) is not so large that the problem of scale becomes intractable.

Already there has been a considerable amount of activity. An initial workshop held in Gulf Shores, Alabama, last summer attracted over 60 people—representing federal, state, and local organizations, industry and citizen associations, and academia—to discuss means of pursuing the initiative.

Obviously, a program of this size and range goes far beyond the ability or the mandate of EPA. Since the initial workshop, two Task Force meetings have been held in Atlanta, Georgia, with participation from state regulating agencies, other federal regulators active in the Gulf of Mexico, and other interested parties. And, while there is a predictable degree of skepticism, virtually all agree that the initiative is an idea whose time has come. This support comes from EPA's Region 6 and the gulf states of Louisiana and Texas; and numerous resolutions of support have been received from state legislators, governors, and other important players necessary to bring about a national appreciation of the importance of the Gulf of Mexico as a vital, valuable resource. The ultimate goal of the Gulf Initiative is to provide a comprehensive strategy for managing and protecting this valuable resource. □

*(Thompson is Chief of the Public Affairs Branch in EPA's Region 4 office.)*

# Update

A review of recent major EPA activities and developments in the pollution control program areas

## HAZARDOUS WASTE

**Land Disposal Restricted**

EPA completed the second step in its ban on the land disposal of untreated hazardous waste. The Agency is prohibiting the land disposal of 12 classes of hazardous wastes, including liquid wastes containing cyanides, metals, polychlorinated biphenyls (PCBS), liquid and solid wastes containing halogenated organic compounds (HOCs), and all corrosive wastes.

J. Winston Porter, EPA's Assistant Administrator for Solid Waste and Emergency Response, stated, "This is the second group of chemicals prohibited in our five-year program to end the land disposal of untreated hazardous wastes. Last year we prohibited the land disposal of untreated dioxin and solvent wastes."

The prohibition on land disposal for these wastes is effective immediately. However, as provided for under RCRA, certain HOCs are being given a two-year extension due to lack of incineration capacity. Liquid PCB wastes are not being granted an extension, as was initially proposed, since most PCB wastes are already being incinerated.

## WATER

**Carcinogens in Drinking Water**

The Agency has adopted final national drinking-water standards for eight volatile synthetic organic chemicals, most of which are probable human carcinogens.

This rule applies to both: 1) community water-supply systems serving at least 15 connections used by year-round residents or regularly serving at least 25 year-around residents and 2) to a new category of water supplier: non-transient, non-community systems. These are suppliers that regularly serve at least 25 of the same persons over six months per year, such as at rural schools and factories with their own water supplies.

Volatile synthetic organic chemicals (VOCs) are man-made carbon-based chemicals that vaporize when they come in contact with air.

## AIR

**Clean Air Plans**

EPA Administrator Lee M. Thomas announced proposals to disapprove state clean air plans for 14 metropolitan areas that have not shown they can achieve EPA's ozone or carbon monoxide air quality standards by the end of this year or in the near term. The Agency is also proposing bans on construction in those 14 areas.

The construction bans would go into effect upon a final determination by EPA and would prevent the approval of permits for building major new sources or modifications of existing sources of volatile organic compounds (VOC) or carbon monoxide (CO), depending on the pollutant for which the area is not attaining the standard.

A few of the major metropolitan areas affected are: Chicago, IL; Cleveland, OH; and Denver, CO, for carbon monoxide; and Atlanta, GA; and Dallas-Ft. Worth, TX, for ozone.

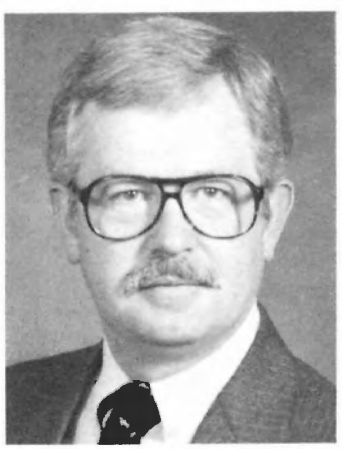
**Municipal Waste Incinerators**

EPA announced that it is requiring controls on air emissions from municipal waste incinerators in light of findings that show that available technologies can substantially reduce risks associated with such emissions.

The Agency reported that existing facilities can emit dioxins and other organic chemicals, metals, and acid gases, which, if left unregulated, could pose health and environmental risks, based on lifetime exposure.

The findings came in a report to Congress on municipal waste combustion and in an advance notice of proposed rulemaking for new facilities under the federal Clean Air Act.

# Appointments

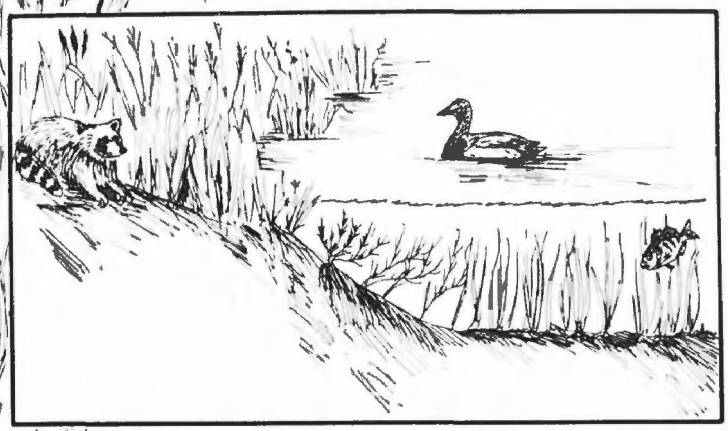


**Paul R. Thomson, Jr.** has been appointed as EPA's first Senior Enforcement Counsel for managing criminal enforcement in the Office of Enforcement and Compliance Monitoring (OECM).

Thomson brings to this position a broad background in criminal enforcement. He has served as General Counsel for Natural Resources for Pittston Coal Company in Lebanon, Virginia, and Assistant U.S. Attorney, First Assistant U.S. Attorney, and U.S. Attorney for the Western District of Virginia. He has also worked in private practice with the Clement and Wheatley firm of Danville, Virginia.

Thomson received his bachelor's degree in history from the Virginia Military Institute and his LLB from Washington and Lee University.

Back Cover: Aerial view of Chesapeake Bay. Photo by Cameron A. Davidson, Folio, Inc.



An insider's look at life in an estuary.