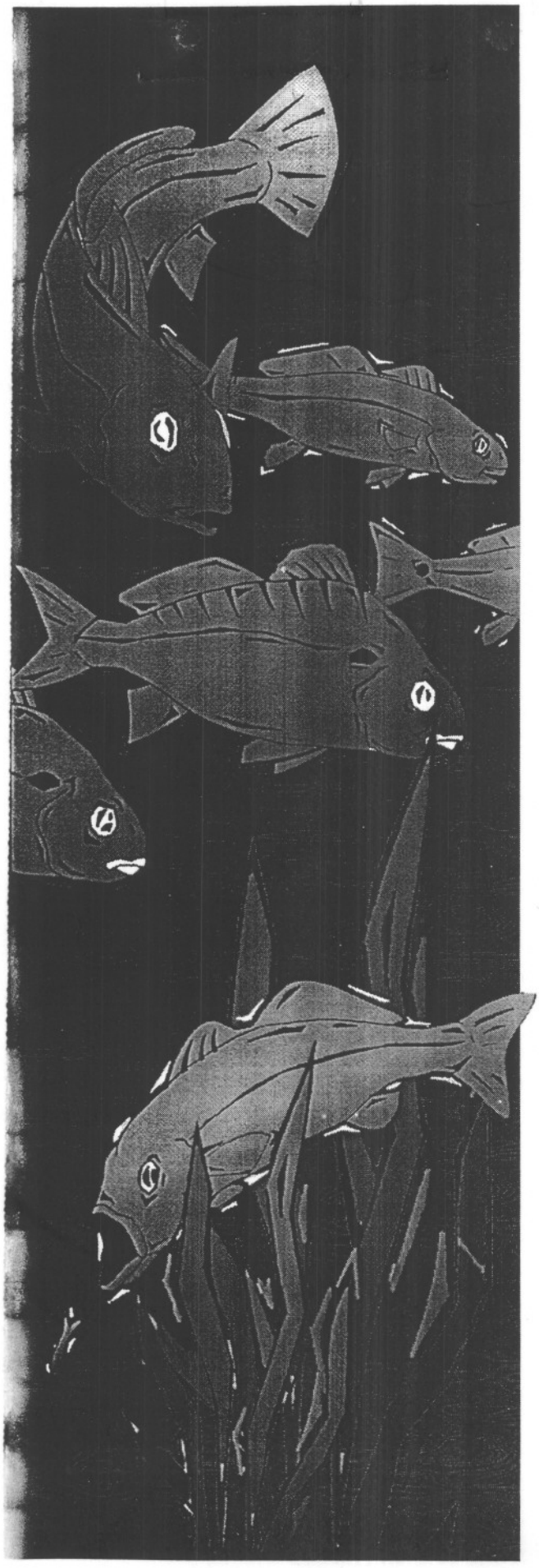

Management of Atlantic Coastal Marine Fish Habitat:

Proceedings of a Workshop for Habitat Managers

June 3 - 6, 1996
Philadelphia, Pennsylvania

ASMFC Habitat Management Series #2

April 1997

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Preface

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This document is a collection of papers presented at a workshop entitled *Management of Atlantic Coastal Fish Habitat: A Workshop for Habitat Managers,* held June 3-6, 1996 in Philadelphia, Pennsylvania. The workshop gave state and federal fish and habitat managers an opportunity to expand their chest of tools for the protection of fish habitat. Formal presentations covered topics from identifying the links between habitat and fisheries impacts to a review of existing/creative tools for habitat management; and, as with any workshop or conference, significant utility surfaced in the form of informal interaction between managers, research scientists and others concerned about protecting fish habitat.

The three primary areas of focus covered by the workshop included: 1) a review of innovative management tools used for fish habitat conservation, 2) the scientific research necessary for management decision making and research application; and 3) communication and coordination. Innovative management tools discussed which inspired considerable enthusiasm among managers included the use of water quality standards to protect the biotic integrity of fish habitat, and fisheries habitat restoration or enhancement projects, including the development of regional restoration plans. A process for the consideration of fisheries impacts in the development of dredging windows for Long Island Sound was discussed, with coastwide implications. Finally, the concept of essential fish habitat as included in Magnuson Act reauthorization language was reviewed. An open ended evening discussion session provided lively debate and insights from managers as well as the fishermen and environmentalists in attendance.

A number of papers outlining the results of applicable recent scientific research were presented, and included the effects of pollution on fish behavior and reproduction, the effects of the application of agricultural best management practices on estuarine fated polluted runoff, and the effects of pier shading on fish populations, among others. These research results were identified as examples of the kind of information habitat managers require to assist in the decision making process for the permitting of habitat affecting activities; although managers commented that even with clear linkages, habitat protection is not necessarily guaranteed. In addition, a plan reviewing habitat related research for the National Marine Fisheries Service was presented.

Of the take home messages, the one most emphasized was the need for frequent communication between and among those with habitat related concerns. In order to be at all effective, the fragmented nature of habitat management requires communication between the factions of managers including coastal zone, water quality, wetlands, local land-use, fisheries, and researchers and the general public. This proceedings was developed in order to facilitate communication, and provide habitat managers with a valuable reference tool to assist in future management decisions.

Chapter 1

Overview of the Fisheries Management Process

Introduction

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Purpose

The purpose of this brief introduction to the fisheries management process is to give a quick overview of how fisheries management, especially management of interjurisdictional species, works in the United States. I want to briefly cover the "whos"–the players in the process; the "wheres" – where the jurisdictional boundaries are; the "whats" – the major federal legislative underpinnings of the fisheries management process; and the "hows" – the processes that result in Fishery Management Plans (FMPs). I admit to a bias towards anadromous, estuarine and marine interjurisdictional species, since those are the ones with which I am most familiar (but the process is similar for inland freshwater species, albeit usually less complex). I will provide a skeleton to which our speakers during this session are going to attach the muscles, organs, nerves, connective tissues, and epidermis. This 10-minute presentation is condensed from a lecture that normally occupies at least an hour of class time, so fasten your seat belts! Several good references which give a more complete account are Fowle 1993, Hamer et al. 1991, Kilczewski 1992, and Wallace et al. 1994.

There are a number of reasons why it is important for fish habitat managers to understand the fisheries management process. **First and foremost, habitat managers need to understand the linkages between fisheries productivity and the habitat's fish use.** Habitat managers need this information in order to strengthen the justification for actions that they take to protect aquatic habitats. To the extent they are known, these linkages are recorded, in many cases along with recommendations for protection, restoration or enhancement of the habitats, in Fishery Management Plans. Obtaining copies of plans requires knowledge of who is preparing them and where to obtain them. **Second, habitat managers can help fisheries managers to refine habitat components of FMPs.** Habitat managers may have direct knowledge of which habitat protection, restoration and/or enhancement measures work and which ones don't. They also will generally have knowledge of how to most effectively implement measures administratively. For example, from past experience they can assess whether performance bonds should be required for restoration projects, what monitoring measures should be required, and for how long monitoring should be conducted. To effectively integrate their concerns into the process at the appropriate time, habitat managers must be aware of the plan development process and the points at which their input will be most effective. **Third and perhaps most important, fish habitat managers need to know the process in order to establish an effective dialogue with fisheries managers.** A dialogue between these two groups is critical to creating a working relationship which will result in better protection for aquatic habitats. Better communication will result in fish habitat managers obtaining the answers to questions about the impact of regulatory action on fish and their habitats, and fish managers obtaining answers regarding improving the effectiveness of their participation in the

regulatory review process and developing better recommendations. Establishment of an ongoing dialogue between fisheries managers and fish habitat managers is one of the key reasons for holding this workshop.

Who Are the Participants?

Participants in the fisheries management process consist of **fish catchers and harvesters**, from both the commercial and recreational sectors; groups which I call **fish watchers**, in both a figurative and literal sense; indirect fish managers including **fish consumers** and those who **affect fish habitats** through practices that result in fish habitat degradation; the **fish managers**, including those in fishery management agencies who directly manage fisheries resources; and those who in this workshop we have termed "**fish habitat managers**", who indirectly manage fish through manipulating or regulating their habitats.

Perhaps the most important of these are the **fish catchers/harvesters**, the commercial and recreational fishermen (the term "fishermen" as used here means people regardless of gender, who fish for profit, subsistence or recreation; a "fisher" is a North American carnivorous mammal of the family Mustelidae). Fishing in the United States is big business. Commercial and recreational fishing in the U.S. annually generates $111 billion and employs one and one-half million people (Kier 1994). Commercial fishing interests have organized such groups as the Alaska Longline Fishermen's Association, Maine Lobsterman's Association, National Fisheries Institute and many more. Recreational fishing has spawned such organizations as Trout Unlimited, Bass Anglers Sportsman's Society, and the Coastal Conservation Association, among others. As the coastal population of the eastern U.S. continues to swell, it is anticipated that more and more individuals will participate in fishing activity, and fish consumption will continue to increase.

Fish watchers, both figurative and literal, are beginning to rival the catchers and harvesters in terms of both economic and political power. Organizations such as the Center for Marine Conservation, National Audubon Society (through its Living Oceans program), National Coalition for Marine Conservation, National Wildlife Federation, and World Wildlife Fund all actively promote conservation of fish resources and lobby for strengthening existing federal legislation. Many of these organizations belong to the umbrella organization, the Marine Fish Conservation Network, based in Washington, D.C., which formed in 1992 to work to strengthen the Magnuson Act. As of November 1995, the network had 100 member organizations representing over 5 million individuals. In addition to these emerging organizations which figuratively "watch" fish from a conservation perspective, there are millions of additional citizens who are literally watching fish from above and beneath the waters through ecotourism, snorkeling and scuba diving activities. Ecotourists travel to the Pacific Northwest of Canada and the U.S. to observe salmon migrations and the brown bears and bald eagles that feed annually upon them. If you don't believe that fish watching is now extremely big business, pick up the May, 1996 issue of Skin Diver magazine from your local library and read the editorial page (Gleason 1996). The U.S. has tens of thousands of certified divers, and more are taking classes all the time. In 1995, 7,442 of them participated in a national Underwater Cleanup day, indicative of the level of interest in maintaining fish habitats.

Certainly not least among fish users are the **fish consumers** and **habitat affecters**. There are many members of the public who do not fish, but enjoy consuming fish. If you believe they have little impact on the fishery resource and its management, consider the case of blackened redfish, invented by Chef Paul Prudhomme of Louisiana. The demand that this gastronomical delight created for redfish, a.k.a. red drum or channel bass here on the East Coast, almost resulted in the demise of the fishery. Another group of fish consumers are those who purchase fish for personal or public display in aquariums. The proliferation of magazines that relate to aquarium keeping and fish husbandry is a testament to the popularity of this widespread hobby. There is also a host of individuals who affect fish habitat indirectly through land management or other activities that are not regulated but have significant impacts on the quality of fish habitat. Irrigation withdrawals, which typically occur during periods of low streamflow, can devastate instream flows in small stream systems and can potentially cause local extinctions.

Next are the **fish and fish habitat managers**, federal, state, tribal and local. These include the professional fisheries biologists who monitor fish populations, assess their health, produce and enforce regulations, and write fishery management plans. Plans may be written at the federal level (such as Recovery Plans for federally-listed endangered or threatened species and Fishery Management Council plans), at the state level, or through cooperative multi-agency efforts (Atlantic States Marine Fisheries Commission, Chesapeake Bay Program, National Estuary Program Comprehensive Conservation and Management Plans). I also include in this group other professionals who establish and enforce water quality standards, designate primary nursery areas, establish instream flow releases, and many other activities that directly or indirectly affect fish and their habitats. Not to be overlooked are the legislators, both federal and state, who pass the laws which provide the mandate for regulation and management of fish and their supporting habitats; and the judges who interpret the laws and can have a significant influence on fishery management as issues are litigated.

At the federal level, the United States Congress has committees in both the Senate (Commerce Committee and Environment and Public Works Committee) and House (House Resources Committee) which are currently considering the reauthorization of significant national fisheries legislation (the Magnuson Act, Striped Bass Conservation Act, Atlantic Coastal Fisheries Cooperative Management Act, and others). There are two federal agencies, the Fish and Wildlife Service in the U.S. Department of the Interior and the National Marine Fisheries Service in the U.S. Department of Commerce, which have primary responsibility for managing interjurisdictional fish and fisheries in the U.S. Marine fisheries (including estuarine and anadromous species) in state waters are managed through interstate commissions, such as the Atlantic States Marine Fisheries Commission, while Fishery Management Councils manage fisheries in federal waters. On the East Coast, there are three councils, the New England, Mid-Atlantic and South Atlantic Fishery Management Councils. The two federal fisheries management agencies and state marine fisheries programs participate as members of the commission and the councils and are mandated to assist them in implementation and adminstration of the fisheries management planning process. Other federal agencies also have direct or indirect fish management authority through managing public land (U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, National Park Service; Fish and Wildlife Service, National Wildlife Refuge System; Bureau of Reclamation; Tennessee Valley Authority) or through establishing conditions under which federally permitted or

licensed projects must operate (U.S. Department of Defense, Army Corps of Engineers; U.S. Environmental Protection Agency; Federal Energy Regulatory Commission).

This entire fish management structure is replicated at the state level, usually in duplicate on the East Coast as most coastal states have both inland and marine fish management agencies. Each state also has a legislature, habitat management agencies, and judicial system that affect fish and their habitats within state boundaries, in addition to county and local governments which have considerable authority to regulate fish habitat both directly and indirectly.

Where Do the Fisheries Managers Exercise Their Authority?

In federal marine waters, from 3 to 200 miles off the Atlantic Coast, the New England, Mid-Atlantic and South Atlantic Fishery Management Councils have jurisdiction, unless there is no council plan, in which case the National Marine Fisheries Service has jurisdiction, unless there is no federal plan, in which case the adjacent state can exercise jurisdiction. In state waters, from 0 to 3 miles seaward, the Atlantic States Marine Fisheries Commission has jurisdiction. Within state boundaries, most coastal states have a marine fisheries agency that has jurisdiction in coastal waters, and an inland fisheries agency that has jurisdiction in inland waters. Some states have designated joint waters where both agencies have jurisdiction. Beneath this hierarchy of broad federal and state fishery regulatory authority is a host of smaller, more localized entities such as National Wildlife Refuges, National Parks, National Forests, state and city parks, towns, cities and many others in which local regulations are paramount. A striped bass which migrates from the Atlantic Ocean off North Carolina to the Roanoke Rapids Dam to spawn passes through all these jurisdictions and probably a few more which I haven't listed.

What Are the Legislative Mandates?

At the federal level, the Fishery Management Councils were established by the Magnuson Fishery Conservation and Management Act. The powers of the Atlantic States Marine Fisheries Commission were recently strengthened through passage of the Atlantic Coastal Fisheries Cooperative Management Act. Other acts that provide a federal legislative basis for fish and fish habitat management include:

- Anadromous Fish Conservation Act
- Atlantic Striped Bass Conservation Act
- Endangered Species Act
- Estuary Protection Act
- Federal Power Act
- Federal Water Pollution Control Act (also known as the Clean Water Act)
- Fish and Wildlife Act of 1956
- Fish and Wildlife Coordination Act
- Nonindigenous Aquatic Nuisance Prevention and Control Act
- Sikes Act

At the state level, specific state statutes too numerous to list provide a foundation for the regulatory authority of the fishery management agencies to regulate harvest, collect data and enforce the regulations.

How Does the Process Work?

In general, all fisheries management planning processes involve public citizens, interested organizations, and federal and state agency personnel working together to produce fishery management plans. When a need arises for a formal, written plan for a species, group of species, or perhaps a geographic area, planning occurs. During initial planning, input is solicted from the public and interested organizations. More planning occurs and a draft plan is usually produced. The draft is then circulated for review and public meetings or hearings are held. The draft is revised based on comments from the public, interested organizations and the fishery management agencies and is released as the final plan. Final plans are implemented by the appropriate jurisdiction and are periodically reviewed and revised as appropriate, based on monitoring and evaluation of the fisheries. Papers following this one will address more details of the Atlantic States Marine Fisheries Commission and South Atlantic Fishery Management Council processes as examples.

This gives the bare bones of the fishery management process on the East Coast of the U.S. Our subsequent speakers will begin to flesh these out for you and provide additional details about how the system works, and how you as fish habitat managers can become more involved in the process.

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The ASMFC's Fishery Management Process

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Introduction

The Atlantic States Marine Fisheries Commission was formed by the fifteen Atlantic coast states (Maine through Florida, including Pennsylvania) in 1942 to assist in managing and conserving their shared coastal fishery resources. The states have found that their mutual interest in sustaining healthy coastal fishery resources is best achieved by working together cooperatively, and collaboratively with the federal government. Through this approach, the states uphold their collective fisheries management responsibilities in a cost-effective, timely, and responsive fashion.

Each of the fifteen states is represented on the Commission by three Commissioners, including the director for the state's marine fisheries management agency, a state legislator, and an individual representing fishery interests, appointed by the state governor. These Commissioners participate in deliberations in the Commission's five main policy arenas: interstate fisheries management; research and statistics; habitat conservation; sport fish restoration; and law enforcement.

Interstate Fisheries Management Program

The Commission's Interstate Fisheries Management Program (ISFMP) promotes the cooperative management of marine, estuarine and anadromous fisheries in state waters of the east coast through the development of interstate fishery management plans. The major components of the program are to: (1) determine priorities for the management of fisheries in state waters; (2) develop, monitor and review fishery management plans for high priority fisheries; (3) recommend to states, regional fishery management councils and the federal government management measures to benefit such fisheries; and (4) provide a means of conducting short-term research essential to preparation or revision of fishery management plans.

In December 1993, the actions of the ISFMP were expanded further with the passage of the **Atlantic Coastal Fisheries Cooperative Management Act**, which provides a mechanism to ensure state compliance with mandated conservation measures in the Commission-approved fishery management plans. Prior to the passage of this Act, state implementation of a Commission fishery management plan was voluntary, with the exception of the *Fishery Management Plan for Atlantic Striped Bass*. Today, all member states that have a declared interest in a fishery, must comply with certain conservation provisions of the plan, or the Secretary of Commerce may impose a moratorium in that state's waters for the harvest of the species in question.

The ISFMP operates under the direction of the ISFMP Policy Board and species management boards. The ISFMP Policy Board, comprised of one Commissioner from each of the fifteen member states and representatives of the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, oversees the program and meets at least bi-annually to establish and monitor the direction of the program. The species management boards consider and approve the development and implementation of fishery management plans, including the integration of scientific information, proposed management measures, and considerations for habitat conservation and the management of protected species/fishery interactions. The ISFMP Policy Board is also responsible for ensuring that adequate opportunity for public input is provided during the plan development or amendment process.

The species managed under this program are: American lobster, Atlantic croaker, Atlantic herring, Atlantic menhaden, Atlantic sturgeon, bluefish, northern shrimp, red drum, shad and river herring, Spanish mackerel, spot, spotted seatrout, striped bass, summer flounder, weakfish, winter flounder, scup and black sea bass. A fishery management plan is currently under development for American eel.

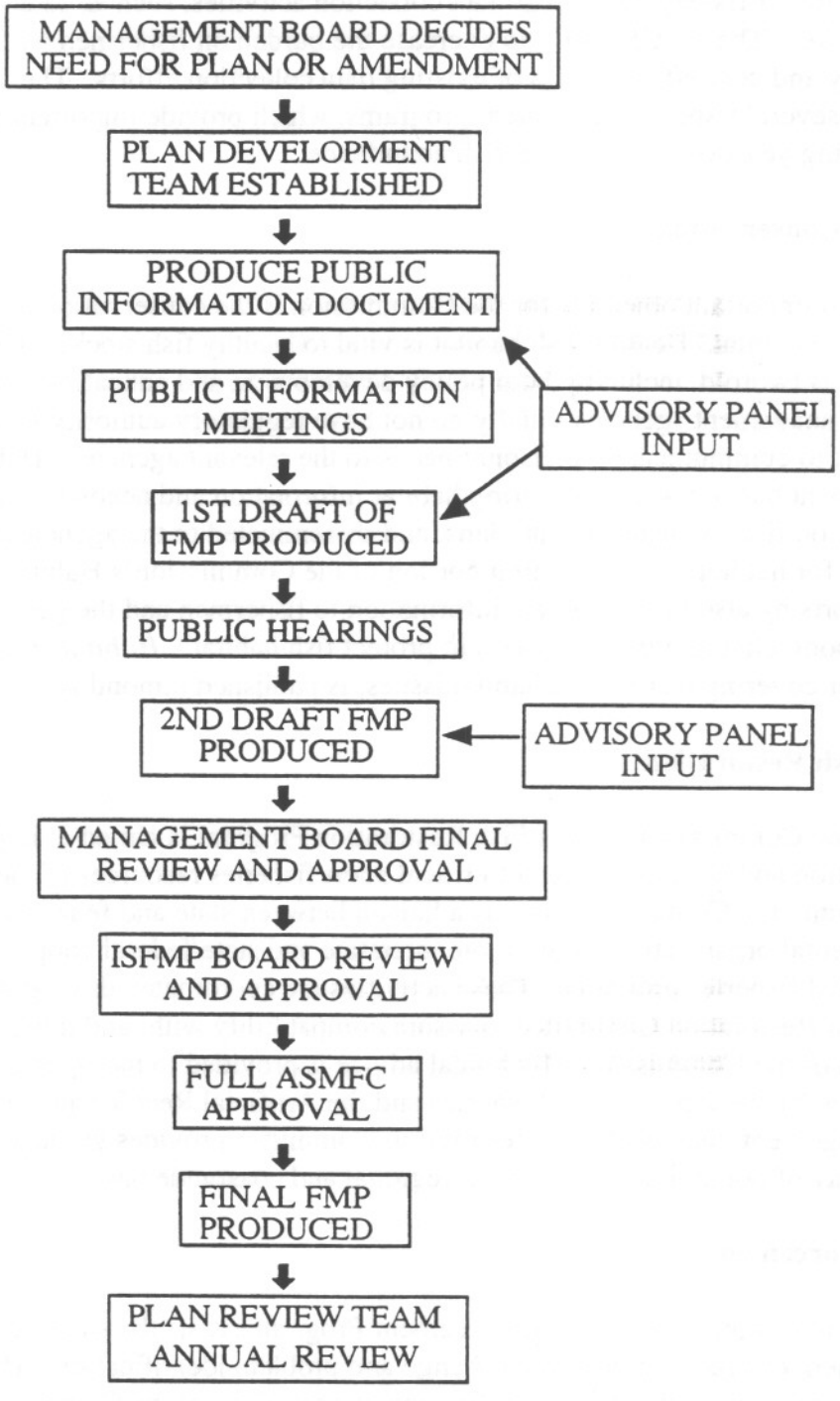
Public Participation

The accompanying figure traces the path of the Commission's fishery management planning process, from its inception to the final outcome (Figure 1-1). The public plays an important role in the Commission's fisheries management planning process, from advisory panel input to general public information meetings and hearings. The Commission's Advisory Panels are comprised of representatives from the commercial, charterboat, and recreational fishing industries, as well as conservation interests, from coastal states participating in the management of a given species. The role of the advisors is to provide input throughout the fishery management planning process. The Advisory Panel process arose in part as a result of the Commission's increasing responsibilities under the Atlantic Coastal Fisheries Cooperative Management Act, which mandates that the Commission provide adequate public participation in its fishery management planning process, including at least four public hearings and procedures for submission of written comments to the Commission. Additionally, the Commission has established an Advisory Committee, comprised of the chairs of the various species advisory panels, in order to provide general input on issues, including fisheries management and habitat conservation.

Research & Statistics

The overall process of fisheries management relies heavily on scientific research and data collection activities for providing accurate and timely information to managers in support of effective federal, state, and interjurisdictional fisheries management. The Commission's Research and Statistics Program works to ensure that the best scientific information – biological, social and economic – is incorporated into the Commission's fishery management plans. The Management and Science Committee is the scientific advisory body for the Commission and provides information and advice on broad scientific issues, including aquaculture and stocking activities, fish health advisories, metadata information, and protected species.

Figure 1-1. ASMFC FMP Development



The Commission has coordinated commercial and recreational fisheries data collection programs for several years. Recently, the Commission played an active role in the development and implementation of the **Atlantic Coastal Cooperative Statistics Program** (ACCSP). Program partners, including federal and state fisheries agencies, will initially focus efforts on coordination of fishery-dependent data collection activities, such as catch, landings, effort and participation. The ACCSP aims to decrease the burden on fishermen while increasing the efficiency and cost-effectiveness of existing data collection efforts. The Commission also supports several fishery-independent programs, which provide important information in determining year-to-year trends in fish abundance

Habitat Conservation

An important objective for the Commission is the conservation and improvement of marine fish habitat. Healthy fish habitat is vital to healthy fish stocks. The Commission's approach is twofold, including both policy development and education. Since member state fishery management agencies usually do not have regulatory authority for fish habitat, it is important to communicate fish habitat needs to the relevant agencies. Habitat policy development has focused on ensuring habitat information and needs are clearly outlined in Commission fishery management plans, and disseminated to the agencies with regulatory authority for habitat. The education portion of the Commission's Habitat Program complements these efforts by also providing this information to fishermen and the general public, along with advice about what individuals can do to protect fish habitat. *Habitat Hotline Atlantic,* a newsletter covering marine fish habitat issues, is published bimonthly.

Sport Fish Restoration

The Commission's Sport Fish Restoration Program is aimed at improving fishery conservation and wise utilization of critical sport fisheries resources of the Atlantic. Through this program, the Commission acts as a liaison between state and federal agencies and non-governmental organizations to promote interstate and state/federal cooperation on marine recreational fisheries programs. These activities are coordinated through the Commission's Sport Fish Restoration Committee to assure compatibility with, and integration into other programs of the Commission. Technical advice is provided to the Sport Fish Restoration Committee by the Recreational Fisheries and the Artificial Reef Technical Committees. Through this arrangement, the Sport Fish Restoration Committee provides guidance to the Commission on broad array of policy issues on a local, regional and coastwide basis.

Law Enforcement

The Commission's Law Enforcement Program assists the states in coordinating their law enforcement efforts through data exchange and problem identification. The program's primary objective is to ensure that the law enforcement provisions of the Commission's fishery management plans are adequate.

Conclusion

The Interstate Fisheries Management Program, run under the auspices of the Atlantic States marine Fisheries Commission, is a cooperative effort by the states to address fisheries conservation and management concerns that affect the Atlantic Coast states. The Commission addresses not only regulatory requirements, but the whole range of fisheries disciplines that are necessary to make a conservation and management program effective. These include research statistics, law enforcement, and, significantly, habitat. Through its Habitat Program, the Commission will continue to provide fisheries and habitat managers with the focus needed to emphasize the critical link between healthy fisheries habitat and productive marine fishery resources.

Integration of State Fisheries and Habitat Management with ASMFC and Fishery Management Councils

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Historically, management of marine fisheries habitat has been a secondary concern of state and federal fisheries councils and commissions. This certainly does not imply that habitat issues have been ignored or that actions to conserve habitats have not been implemented. However, we have been losing fish habitats at an alarming rate, and fisheries managers have given the issue little more than lip service. Habitat management and fisheries management at both state and federal levels have traditionally been decoupled for several reasons:

1. Regulatory authority: Fisheries managers' authority to regulate habitats is often unclear – and more importantly, untested – in the legal arena. Quite often the regulatory aspects of commissions and councils focus on fisheries, although in some cases, the implementing language could encompass a greater scope of marine resources in the regulatory process. Commissions and councils, by choice or by authority, usually only comment on issues concerning fisheries habitat.

2. No clear mandate: Fisheries councils and commissions at state and federal levels are first and foremost charged with managing harvested species, and priorities relative to other fisheries issues, such as habitat, are vague.

3. Low priority mandate: Even when fisheries managers have a clear mandate concerning habitat or when they implement habitat initiatives, fisheries habitat is still a low priority in the scope of activities.

4. Too much to handle: Because of the tremendous informational needs and controversies of managing species harvest, there is often neither the resources nor the organizational energy to bring habitat issues to the forefront. In recent years, both state and federal fisheries regulators have been addressing habitat issues, but the methods and results are somewhat difficult to measure.

The integration of fisheries and habitat management has been occurring, albeit slowly. There are several reasons for the increasing attention to this integration:

1. Ecosystem management has become a growing and accepted concept. Agencies are officially acknowledging the benefit of better integrating solutions to multiple resource issues. The Florida Department of Environmental Protection (FDEP) is

an example of an agency that is beginning to implement new management concepts through an ecosystem management approach and that recognizes a much better link is needed between the management of individual species and the management of the ecosystems that support each of these species.

2. We have a growing body of scientific evidence defining the critical links between a habitat and fisheries.

3. Habitat is being recognized as a limiting factor in species population management.

Live Rock

A look at the chronology of live rock management gives a sense of where fisheries and habitat management begin to integrate. Live rock is a broad term used to describe several types of sea floor structure colonized by marine organisms. It can be composed of reef framework, hard bottom, and rubble. It is usually colonized by algae, worms, corals, and sponges. Live rock harvest has been a growing industry that supplies colorful habitat for the saltwater aquarium trade. Unregulated, this industry was creating a fishery based on the exploitation of prime fish habitat.

Management Chronology:

1982: Live rock was not an issue in the South Atlantic Fishery Management Council's (SAFMC's) Coral Fishery Management Plan (FMP).
1989: The harvest of live rock becomes a growing issue in Florida.
1989: Florida DEP uses illegal-mining rules to halt collection in state waters.
1989: Harvest shifts to federal waters.
1991: Florida Marine Fisheries Commission (FMFC) initiates rule-making to phase out harvest and allow aquaculture.
1992: FMFC reiterates prohibition of harvest in state waters.
1992: FMFC establishes State Landing Quotas for wild live rock landed in Florida but harvested outside state waters.
1992: FMFC determined that no wild live rock landings would be permitted after July 1, 1995.
1992: FDEP modifies submerged land rules to regulate live rock aquaculture.
1993: Landings closed in Florida after eight months harvest, when the 225-ton annual quota was reached four months early.
1993: Marine Life Fishermen file injunction to allow landings, and it was upheld.
1993: Gulf and South Atlantic Fishery Management Councils (FMCs) begin exercising options for regulating under Coral FMP.
1994: SAFMC closes wild harvest by January 1996 with provisions for aquaculture.
1994: GMFMC implemented phase-out of wild harvest by 1997.

To summarize the above, in 1989, Florida took initial action to regulate live rock harvest by enforcing mining and submerged lands rules. This was an immediate but temporary solution to the problem. Florida's MFC took action in 1991-92 to regulate harvest by prohibiting harvest

in Florida waters and setting landing (live rock harvested outside state boundaries) quotas and eliminating landings of wild live rock by 1995. In 1993, the Gulf and South Atlantic FMCs began exercising options for regulating harvest in federal waters, and the SAFMC set closure for wild harvest in 1996. Gulf closure is supposed to occur after December 1996. The conclusion is that the State of Florida took immediate action that was effective, but used mining rather than fishery regulations. Fishery regulations took up to six years for full implementation. In fact, these fisheries-based closures may still be challenged and overturned.

Florida Shrimp Management Plans

Since 1987, the FMFC has been developing statewide shrimp management plans with the following goals: maintaining healthy stocks, ensuring fair and optimal distribution among user groups, protecting habitat, minimizing by-catch, standardizing regulations, minimizing conflict with other fisheries, and ensuring a high-quality product. The shrimp fishery was divided into three user groups: recreational, live-bait, and food production. To account for habitat and gear differences, five contiguous management regions in Florida were designated: the northeast, Big Bend, southwest, southeast, and northwest regions. Recognizing that seagrass habitats are a primary fish nursery area and that shrimping can impact seagrass habitat and the nursery species (by-catch) supported by the habitat, plans have been developed that integrate shrimp distribution, seagrass habitat location, and other biological and sociological information to determine the geographic boundaries within which certain types of shrimping gear and certain types of user groups should be excluded.

The Florida Department of Environmental Protection, focusing on seagrass protection as part of its ecosystem management initiative, worked closely with the FMFC to provide the habitat data and the Geographic Information System (GIS) technology to integrate the many biological and social factors necessary in formulating the plans efficiently and effectively. The use of GIS in public meetings promoted consensus and interactive solutions that were quantifiable and not perceived as "smoke and mirrors." The important point is that the state agency concerned with and responsible for habitat protection teamed with the FMFC to develop a plan to better protect seagrass habitat and the nursery species using that habitat. In addition, both the SAFMC and Atlantic States Marine Fisheries Commission (ASMFC) have identified seagrass protection as a significant fisheries habitat protection issue; thus, the linkage of habitat protection and fisheries management is made stronger – and this time outside Florida. The concept of regions, zones, and marine reserves or special management areas has also become prominent when habitat impacts are part of the concern.

Oculina Banks

A final example of the progress fisheries managers are making in protecting habitat concerns the Oculina banks of the east coast of Florida. Oculina is a deep-water, bush-like coral that forms dense thickets up to 1.5 meters high. It is a fragile coral that is critically important as nursery habitat and spawning habitat. Oculina banks are found primarily in federal waters. The SAFMC has reacted to this critical habitat's destruction by fishing gear, by implementing geographic and gear restrictions. This approach was familiar to managers in Florida because of the shrimp management plans, and once again promoted the concept of zones and reserves.

Conclusions

Although slowly, fisheries managers are beginning to better focus on fisheries habitat issues. We are beginning to see fisheries management authority being more effectively used to conserve fish habitat. The mandate to conserve habitat is becoming clearer as the concepts of ecosystem management are brought to action. However, fisheries habitat issues are still relegated to lower priority by fishery managers. Councils and commissions provide a forum for better interstate and federal management of habitat for fisheries, and through their habitat committees and panels, should raise the stakes in fisheries habitat conservation.

This is easier said than done. As pressures on marine resources have continued to grow, it has become increasingly evident that the data needed to make informed management decisions are either lacking or are inaccessible. Gathering this needed information through monitoring and research is an important step towards better informed management; however, simply gathering this information will not solve the problems associated with managing that information and making it readily available. Unless advanced information management technologies are instituted in resource management agencies, the information necessary to better manage our resources will not be effectively utilized. GIS technologies are providing the tools needed to translate and synthesize geographically-oriented marine resources information in Florida. Unfortunately, much information is yet to be gathered. Commission and council activities such as the bottom mapping effort of SEAMAP are beginning to help gather the information that will allow full integration of habitat and fisheries management. This trend must continue and grow.

Discussion

The following question was asked by a workshop participant at the conclusion of Mr. Haddad's presentation:

Question: How much respect is given to these plans, for example, the response of other offices within Florida DEP that certify federal dredging permits to a shrimp plan that says sea grass is very important to Florida?

Response: A growing respect. The reason that it's growing is because of the merger of the authorities. The management side of DEP, which has had input into the regulatory process of fisheries, is now connected with those responsible for water quality, dredge and fill, etc. The connection is growing. The regulatory side may still permit activities that cause a loss of sea grass; however, our input into the decision has changed from the role of a casual observer making comments to someone who is actually involved in the upfront compromise process from a fisheries perspective.

Habitat Information and Habitat Management Recommendations in ASMFC Fishery Management Plans

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The Atlantic States Marine Fisheries Commission (ASMFC) currently manages 17 species or species groups by means of fishery management plans and amendments that have been developed during the last 19 years by the Commission on its own or jointly with the Mid-Atlantic and/or South Atlantic Fishery Management Councils (Table 1-2). This review of habitat information and habitat management recommendations focuses on 12 FMPs and amendments developed exclusively by the Commission (excluding lobster). The four joint FMPs (for bluefish, summer flounder, red drum, and scup/black sea bass) were written in accordance with federal guidelines and practices followed by the two Councils.

Table 1-2. ASMFC Fishery Management Plans and Amendments

Species	FMP Date	Latest Amendments
American lobster	1978	1990(1)
Striped bass	1981	1995(5)
Atlantic menhaden	1981	1992
Summer flounder *	1982	1992(2)
Spotted sea trout	1984	
Red drum **	1984	1991(1)
Weakfish	1985	1996(3)
Shad and River herring	1985	
Northern shrimp	1986	
Atlantic croaker	1987	
Spot	1987	
Bluefish *	1989	
Atlantic sturgeon	1990	
Spanish mackerel	1990	
Winter flounder	1992	
Atlantic herring	1994	
Scup and black sea bass *	1995	

* Managed jointly by ASMFC and MAFMC
** Managed jointly by ASMFC and SAFMC

Most of the "early" ASMFC fishery management plans (those completed and approved prior to 1990) were prepared following the same outline. These FMPs included a section devoted to a description of the habitat(s) utilized by the species, which was further broken down into sub-sections describing the condition of the habitat(s), habitat areas of particular concern, and existing habitat protection programs for the managed species. Additional sub-headings under different biological and ecological sections dealt with determinants of distribution, contaminants, ecological relationships, and community ecology. In general, these early FMPs emphasized biological and life history characteristics, with considerable habitat-related background information on spawning behavior and habitat, juvenile nursery areas, and a summary of known environmental requirements for different life history stages. Good examples of such early management plans are spot, croaker, spotted sea trout, weakfish, red drum and menhaden.

Although these early FMPs contained a lot of useful biological information, they were notably lacking in specific habitat information and contained no habitat management recommendations whatsoever. In fact, in many cases the descriptive habitat information in these FMPs was very brief (one or two pages) and merely copied from one document into another. Areas of particular concern were not specified (there are references, for example, to estuaries in general, but not to any specific estuarine systems), essential habitats and life history stages were not identified, there were very few details relating to habitat quality, and no information on the biological consequences of habitat loss or degradation. In short, whatever habitat-related information there was in these early management plans seems to have been included strictly as "boiler-plate." This is not surprising since fisheries management during the 1980's was viewed, with a few exceptions, as an exercise in controlling or reducing exploitation rates, not protecting or restoring habitat.

Two of the early ASMFC FMPs that did address habitat issues were the 1981 striped bass and the 1985 river herring management plans (more about striped bass later). The river herring FMP included a number of habitat-related management objectives and recommendations for improving water quality and maintaining minimum flow rates in rivers that support spawning runs. This FMP, however, did not require that the states take any action (a set of guidelines was issued instead) and the recommendations were largely ignored. An amendment (in progress) to this FMP will include habitat restoration measures that may require state action in much the same way as the 1987 Chesapeake Bay agreement to restore natural passage for migratory anadromous fish species (Chesapeake Bay Program 1988).

With one exception, all the ASMFC management plans that have been developed since 1990 contain more specific habitat-related information and management recommendations. The Spanish mackerel FMP is an exception: the descriptive habitat information in this document is not specific and there are no recommended habitat protection measures. Summaries of post-1990 ASMFC FMPs that address habitat to any significant degree follow.

Atlantic sturgeon is an anadromous species and the FMP for this species includes descriptive habitat and related biological information. It defines essential habitat as deep, upstream river channels (which are utilized for spawning), lists principal threats to survival, and defines habitat suitability in terms of several different environmental variables. Despite the

importance of habitat to this species, the FMP does not identify any habitat protection measures as management objectives or make any recommendations regarding habitat management.

Perhaps the most notable example of an Atlantic coast fishery management plan, state or federal, that incorporates habitat protection measures is the 1992 ASMFC Winter Flounder FMP. This plan goes well beyond the usual physical description of habitat(s) to include a thorough summary of environmental requirements of the species, an evaluation of the status of habitat quality and alteration, an analysis of the relationship between habitat area and the size of individual stocks, a summary of the effects of power plant entrainment and impingement, and finally (and, perhaps, most significantly), an analysis of the relative effects of habitat loss or restoration versus changes in fishing mortality on young-of-the-year survival and egg production. A major conclusion of this last analysis was that coastal habitat restoration which increases juvenile production "would result in longer-term benefits [than reducing fishing mortality] and allow managers to gradually increase fishery yield from these populations." This plan goes on to identify seven recommended habitat management measures (Table 1-3) and research needs. One of the four objectives of the winter flounder FMP is "to preserve, maintain, and enhance habitat and environmental quality necessary for the optimal growth and reproduction of winter flounder."

The Commission has not had, until recently, the authority to require the states to take any particular action to manage interjurisdictional fishery resources or conserve marine fishery habitat, and had to rely chiefly on the power of persuasion to achieve coordinated and effective management among the states. The Commission took a significant step forward, however, in 1990, when it passed a resolution to actively implement a unified habitat policy that was presented at the May 1990 ASMFC meeting. This policy statement committed the member states "to use available mandates and to expand interagency efforts to minimize adverse effects of human activities on marine, estuarine, and riverine species and their habitats . . . by offering general guidance to states, federal agencies and regional bodies that share responsibility for fish habitats through their respective roles in decisions on research, management, and specific human activities." The stated objectives and actions of this policy are summarized in Table 1-4.

The passage of the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) in 1993 gave the Commission new authority to require individual states to comply with fishery management plans approved by the Commission. This Act requires that the Secretary of Commerce, in cooperation with the Secretary of the Interior, "implement a program to support the interstate fishery management efforts of the Commission," including activities to support, among other things, state cooperation in habitat conservation. As required by this new law, states participating in an ASMFC management program must comply with any recommendations that are specifically identified as requirements. As with management actions aimed at reducing fishing effort on over-exploited resources, the new law provides the Commission with the authority to implement and enforce habitat management measures. Under the authority of the ACFCMA, the Commission required all of the states participating in the management program for winter flounder to report to the Commission concerning habitat protection efforts within each state (Table 1-5). All of the states successfully complied with these criteria by the January 1 1995 deadline (ASMFC 1996).

Table 1-3. Winter Flounder Habitat Management Recommendations

1. Assure that Clean Water Act (Section 319) Non-Point Source Plans and Coastal Non-Point Pollution Control Plans are developed and implemented such that adverse impacts of non-point source pollutants on winter flounder are minimized. These plans should include measures such as:

   a) protective land use practices (e.g. establishment of substantial buffer zones around productive coastal nursery grounds);

   b) reduction of non-point toxic contamination of ground water and nearshore coastal habitats by redirecting stormwater runoff into catch basins;

   c) evaluation of the cumulative effects of in-water structures on habitat quality;

2. Strengthen enforcement of sewage discharge, or NPDES (National Pollution Discharge Elimination System), permit effluent limits from centralized treatment plants, and ensure proper maintenance and operation of domestic septic systems.

3. Implement effective oil and toxic chemical spill prevention and control programs to prevent accidental release, and prioritize cleanup plans to protect areas where winter flounder are known to concentrate for spawning.

4. Establish and enforce no-vessel-discharge zones, and promote education of recreational boaters to reduce their contamination of inshore waters from chronic vessel fuel spills and waste disposal.

5. Establish time frames when sediment dredge activities should be prohibited or minimized in areas where winter flounder are known to concentrate for spawning.

6. Assist industrial siting councils in siting new power plants so that areas where winter flounder are known to concentrate for spawning are avoided, and assess cooling water entrainment mortality from existing plants (Clean Water Act, Section 316) on a stage-specific basis for both local and regional flounder populations.

7. Identify sediments sufficiently contaminated to impose documentable acute or chronic impacts on winter flounder resources including the benthic communities upon which they depend, and develop remediation plans or active sediment pollution prevention programs for such areas.

Table 1-4. Joint Statement to Conserve Marine, Estuarine and Riverine Habitat (Abridged Summary)

Presented at ASMFC Meeting
Washington, DC
May 16 1990
Final Revision November 7, 1990

Statement:

The undersigned parties agree to use available mandates and to expand interagency efforts to minimize adverse effects of human activities on marine, estuarine, and riverine species and their habitats. This statement offers general guidance to states, federal agencies and regional bodies that share responsibility for fish habitats through their respective roles in decisions on research, management, and specific human activities.

Objectives:

1. To minimize avoidable adverse impacts on fish stocks and their habitat.

2. To conserve, restore, and enhance fish habitats for the long-term benefit of all users.

3. To promote innovative programs that will increase our knowledge of management strategies that may reduce habitat loss or augment fish stocks.

4. To improve our use of existing authorities and adopt new interagency procedures that will improve our habitat management efforts.

5. To foster greater interagency cooperation and collaboration.

Recommended actions:

1. Share general information, recommendations, and decisions for other important living resources that relate to habitats or related resources.

2. Collaborate with other parties on actions that relate to habitat or living resources.

3. Initiate new agreements to improve our efforts to conserve and manage living resources and their habitat.

Table 1-5. Winter Flounder Habitat Protection Requirements

1. Each state participating in the ASMFC Winter Flounder Fishery Management Program (via the ASMFC agency commissioner) shall develop a Winter Flounder Habitat Protection Strategy and initiate discussions with the applicable habitat enforcement and environmental quality programs in its state to explain the importance of the nearshore aquatic environment as spawning and nursery habitat for winter flounder production. These discussions should be consistent with the Habitat Management Strategy and Measures found on pages 90-92 of the Winter Flounder Plan and in Section I.B.2 of the May 1992 Implementation Strategy. By January 1, 1995, each state shall have concluded these discussions and shall report to the Commission at the May meeting regarding any improvements to in-state procedures which have resulted from the discussions.

2. Each agency participating in the ASMFC Winter Flounder Fishery Management Program shall initiate discussions with permitting authorities regarding the effects of dredging, dredge spoil disposal, industrial facility siting, and other human uses of the coastal environment to ensure that impacts associated with such uses are clearly understood, so that avoidable impacts are eliminated, and so that unavoidable impacts are minimized or mitigated. By January 1, 1995, each state shall have concluded these discussions and shall report to the Commission at the May meeting regarding any improvements to in-state procedures which have resulted from the discussions.

3. Each state participating in the ASMFC Winter Flounder Fishery Management Program shall initiate discussions with the applicable information and education units of the Department to ensure that public communications include reference to the importance of maintaining a high quality nearshore environment for the benefit of the winter flounder resource.

The 1992 amendment to the Atlantic menhaden FMP includes some relevant biological and ecological information, including feeding habit and diet information and discussions of why natural mortality rates for this species are so high, its ecological importance, and the critical nature of the juvenile life history stage. Lacking is specific information on the relative importance of different predators on juvenile and adult menhaden in different habitats and times of year. Some of the environmental requirements for this species are noted, but they are not summarized concisely. This FMP does include an adequate description of the continental shelf habitat for adults, but descriptive information for the major estuarine systems along the Atlantic coast that provide critical habitat for juvenile habitat was not included, nor is there any information relating to the condition or quality of coastal habitats important to this species. There is some reference in the executive summary to critical areas and problems, but more detail is needed for individual estuaries and watersheds.

No habitat management measures are recommended in the menhaden FMP despite the fact that estuarine and nearshore coastal habitats in the mid-Atlantic region are critical for this

species (and for lots of other estuarine-dependent species), and the fact that these habitats in this part of the coast have been severely affected by increasing population density, urbanization, and industrialization. An evaluation of what is known concerning the extent of coastal habitat loss and degradation and their effect on this and other nearshore species is badly needed, as is a prognosis for the future. Will coastal habitats continue to be lost and degraded, and if so, what biological impact can be expected and what can be done to prevent any negative consequences? Answers to these questions may not be easy to come by, but the questions are important and need to be addressed in a systematic manner for a whole host of coastal species, not just menhaden.

The Atlantic herring FMP, in contrast to the Atlantic menhaden FMP, includes a general assessment of coastal environmental quality along the Atlantic coast and a detailed summary of known environmental requirements for herring eggs, larvae, juveniles and adults. The habitat quality information in the herring FMP was extracted from a number of published sources, including preliminary results of a four-year Environmetal Monitoring and Assessment Program (EMAP) in the mid-Atlantic region, which was conducted recently by the U.S. Environmental Protection Agency and included Atlantic coastal sampling sites from Cape Cod to the mouth of the Chesapeake Bay (Weisberg et al. 1992). The Atlantic herring FMP also included one management objective that partially addressed a habitat issue and seven habitat management recommendations. All but one of these were "borrowed" from the winter flounder FMP and modified somewhat to relate to herring. There was not much thought given, however, to how applicable or important these habitat management measures were to Atlantic herring, and, in contrast to winter flounder, there has been no attempt by the Commission or any of the states affected by this management plan to implement any of these measures.

One additional habitat management recommendation that is specific to this species (which, like winter flounder, produces demersal eggs at specific locations in coastal waters) is to "establish critical spawning habitat areas or special management zones to protect spawning aggregations of herring and/or demersal egg masses." This was, in part, the intent of spawning closure regulations that were implemented by the states of Maine, New Hampshire, Massachusetts, and Rhode Island in 1982 and incorporated into the 1994 FMP. The ASMFC FMP goes further, however, and recommends under "other management measures" that "the use of bottom-tending gear (e.g., otter trawls and dredges) be prohibited in designated spawning areas during spawning closures." Implementation of this recommendation would require that bottom trawling and scallop dredging be banned in areas where herring spawn for three or four weeks at a time in the late summer and early fall. Such action would not be reasonable unless the exact locations of herring egg beds were known with more certainty.

The original 1981 striped bass FMP has been amended five times, most recently in 1995 (Table 1-2). Amendment #4 (1989) recognizes the importance of adequate habitat and water quality on the health of coastal striped bass stocks and contains an entire section devoted to "habitat and water quality requirements." There are five recommendations, each of which describes actions that the states "should" take in order to provide necessary habitat protection for this species. One of the three management objectives of this early FMP was to "adopt standards of environmental quality necessary for the maximum natural production of striped bass and for the utilization of allowable harvest." As a companion to this amendment, the Commission

published a source document (ASMFC 1990) that provided evidence of the possible effects of degraded water quality on striped bass reproductive success in Chesapeake Bay and information on PCB contamination in striped bass from the Hudson River and the threat posed to human health. This document contains over 50 pages of detailed information on prey species, competitors, predators, habitat requirements of different life history stages, and information on habitat condition, modes of habitat alteration (physical and chemical), effects of individual contaminants, etc. Some of this information is specific to particular estuarine systems along the Atlantic coast.

Amendment #5 to the striped bass FMP was adopted in 1995. This most recent amendment completely replaced the original FMP and all subsequent amendments and addenda. The goal of the 1995 amendment refers to the need to "provide for the restoration and maintenance of [their] critical habitat." Two of the seven management objectives addressed habitat issues: 1) "to identify critical habitats and environmental factors necessary to the long term maintenance and productivity of east coast migratory striped bass," and 2) "to adopt and promote standards of environmental quality necessary to the long term maintenance and productivity of east coast migratory striped bass throughout their range." In addition, this amendment describes six actions that the states should take to preserve existing striped bass habitat and four things to do to avoid incompatible activities (Table 1-6). There is also a recommendation relating to the prohibition of certain fishing practices that would have an unacceptable impact on essential striped bass habitat and three recommendations relating to habitat restoration, improvement, and enhancement.

Comparison of the degree to which habitat issues are addressed in Amendments #4 and #5 and the way in which some of the recommendations describe exactly what actions are expected (rather than referring only to actions that "should" be taken) underscores the increased significance that is being afforded to habitat issues for this species and the fact that passage of the Atlantic Coastal Fisheries Cooperative Management Act ensures that the states will be held accountable for implementing certain management actions. For this reason, Amendment #5 describes procedures that will be followed for determining compliance with management measures included in the plan. It is also significant that this amendment cites the identification of "critical" habitat as a management objective. The concept of critical (or essential) habitat has been elevated by increasing public attention to habitat issues in marine fisheries management and has been inserted into proposed amendments to the Magnuson Fishery Conservation and Management Act, which is expected to be re-authorized in 1996. The striped bass habitat management "requirements" in Amendment #5 are listed as "recommended" management measures, not "mandatory" measures, and are therefore <u>not</u> subject to approval for determining compliance when states submit their annual reports to the Management Board.

At the same time that Amendment #5 to the striped bass FMP was being developed, a group of scientists was formed by the ASMFC Habitat Committee and Management and Science Committee and asked to develop a new outline for habitat-related information that would be required in future ASMFC management plans and amendments. The outline, which eventually was approved by the ISFMP Policy Board in October 1994 (Table 1-7) was incorporated into Amendment #5 of the striped bass FMP.

Table 1-6. Striped Bass Habitat Management Recommendations Amendment #5 to ASMFC Striped Bass FMP

Habitat Conservation and Restoration

Each State should implement protection for striped bass habitat within its jurisdiction in order to ensure the sustainability of that portion of the migratory stock which either is produced or resides within its boundaries. Such a program should inventory historical habitats, identify habitats presently used and specify those which are targeted for restoration, and impose or encourage measures to retain or increase the quantity and quality of striped bass essential habitats.

Preservation of Existing Habitat

1) States in which striped bass spawning occurs should notify in writing the appropriate federal and state regulatory agencies of the locations of habitats used by striped bass. Regulatory agencies should be advised of the types of threats to striped bass populations and recommended measures which should be employed to avoid, minimize or eliminate any threat to current habitat quantity or quality.
2) Where available, States should seek to designate striped bass essential habitats for special protection. Tools available include High Quality Waters or Outstanding Resource Waters designations. Designations should, where possible, be accompanied by requirements of nondegradation of habitat quality, including minimization of nonpoint source runoff, prevention of significant increases in contaminant loadings, and prevention of the introduction of any new categories of contaminants into the area (via restrictions on National Pollutant Discharge Elimination System (NPDES) discharge permits for facilities in those areas).
3) State fishery regulatory agencies should develop protocols and schedules for providing input on water quality regulations to the responsible agency, to ensure that water quality needs for striped bass are met.
4) State fishery regulatory agencies should develop protocols and schedules for providing input on Federal permits and licenses required by the Clean Water Act, Federal Power Act, and other appropriate vehicles, to ensure that striped bass habitats are protected.
5) Water quality criteria for striped bass spawning and nursery areas should be established or existing criteria should be upgraded to levels which are sufficient to ensure successful reproduction. Any action taken should be consistent with Federal Clean Water Act guidelines and specifications.
6) All State and Federal agencies responsible for reviewing impact statements and permit applications for projects or facilities proposed for striped bass spawning and nursery areas shall ensure that those projects will have no or only minimal impact on local stocks. Natal rivers of stocks considered depressed or undergoing restorations are of special concern. Any project which would result in the elimination of essential habitat should be avoided.

Table 1-6. Continued

Avoidance of Incompatible Activities

1) Federal and State fishery management agencies should take steps to limit the introduction of compounds which are known to be accumulated in striped bass tissues and which pose a threat to human health or striped bass
2) Each State should establish windows of compatibility for activities known or suspected to adversely affect striped bass such as navigational dredging, bridge construction, and dredged material disposal, and notify the appropriate construction or regulatory agencies in writing.
3) Projects involving water withdrawal (e.g. power plants, irrigation, water supply projects) should be scrutinized to ensure that adverse impacts resulting from impingements, entrainment, and/or modification of flow and salinity regimes due to water removal will not adversely impact on striped bass stocks.
4) Each State which encompasses spawning rivers and/or producer areas within its jurisdiction should develop water use and flow regime guidelines which are protective of striped bass spawning and nursery areas and which will ensure the long-term health and sustainability of the stock.

Fisheries Practices

1) The use of any fishing gear which is deemed by management agencies to have an unacceptable impact on striped bass essential habitat should be prohibited within appropriate essential habitats (e.g. trawling in spawning areas or primary nursery areas should be prohibited).

Habitat Restoration, Improvement and Enhancement

1) Each State should survey existing literature and data to determine the historical extent of striped bass occurrence and use within its jurisdiction. An assessment should be conducted of those areas not presently used for which restoration is feasible.
2) Every effort should be made to eliminate existing contaminants from striped bass habitats where a documented adverse impact occurs.
3) States should work in concert with the USFWS and NMFS, Office of Habitat Protection, to identify hydropower dams which pose significant impediment to striped bass migration and target them for appropriate recommendations during Federal Energy Regulatory Commission relicensing.

Table 1-7. Outline for Habitat Sections of ASMFC FMPs

1. Description of habitat

    Habitats classified functionally (e.g., spawning, nursery, etc.)
    Physical and non-physical aspects (e.g., associated biological community)
    Differences in habitat characteristics over geographic range of species
    Seasonal timeframes for habitat use
    Range maps and maps of migratory pathways
    If possible, linkages between habitat protection and species production

2. Identification and Distribution of Essential Habitats

    Essential habitat defined as:
        habitat required for successful reproduction and survival, and/or
        the amount of habitat necessary to support the population
    Maps of present location and extent of all and essential habitat
    If known, historical extent of essential habitat

3. Present Condition of Habitats and Essential Habitats

    Quantity and quality of habitat presently available
    Explanation for reductions in habitat quantity and quality
    All current habitat-related threats to species
    Assessment of effects of habitat loss or degradation on ability to harvest, consume and market the species

4. Recommendations and/or Requirements for Habitat Conservation/Restoration

    Formulate management measures for implementation

5. Information Needs/Recommendations for Future Research

The new habitat outline for ASMFC management plans and amendments is much more specific than the general guidelines that were followed previously. The explanatory narrative that accompanies the outline is also very useful. It defines in more detail what kind of habitat information is needed and exactly what is meant by terms such as "essential habitat," and what are the differences among habitat restoration, improvement, and enhancement. At the time this outline was developed, it was recognized that it might not be universally applicable to all species and that habitat information for many species would be incomplete. Thus, this outline serves primarily as a guide to assist plan development teams in the collection and presentation of relevant habitat-related information so that critical information needs are not overlooked and appropriate habitat managment and research recommendations are identified.

The most recent ASMFC management plan to be amended is the 1985 weakfish FMP. This amendment, like the winter flounder and striped bass plans, seeks to identify and conserve habitat "essential for the long term stability in the population of weakfish." There is a complete section devoted to habitat conservation and restoration that repeats, almost verbatim, the same statement of purpose, list of actions needed to preserve existing habitat, prohibition on certain fishing practices, and steps to restore, improve and enhance habitat as appear in Amendment #5 to the striped bass FMP. Important weakfish habitat and distribution information was identified in this amendment using a method recently introduced in a prototype by the National Marine Fisheries Service for identifying summer flounder habitat (NMFS 1995). In this method, quantitative trawl survey data from state and federal monitoring programs and qualitative interpretations provided by the National Ocean Services's Estuarine Living Marine Resources Program were displayed graphically using Geographic Information Systems (GIS) technology. These relative abundance data indicating weakfish distribution were assumed to represent weakfish habitat preferences. Another addition to the weakfish FMP, which was updated and improved from the Atlantic Menhaden FMP, is a table listing state habitat management agencies and authorities. By including this information, state fishery managers and fishermen will know whom to contact in cases of habitat loss or degradation. The amended weakfish FMP also specifies the minimum compliance requirements and the procedures for determining compliance, but like the amended striped bass FMP, does not require the states to take any action to conserve or protect habitat.

That takes us all the way back to winter flounder as the only species with any required habitat management actions (Table 1-5). The purpose of these required actions was to motivate the states to begin discussions among all the relevant agencies in order to increase the awareness of all parties to the importance of nearshore winter flounder spawning habitat and to begin the process of improving procedures designed to eliminate or minimize impacts to this habitat. The intention of the winter flounder habitat management effort may seem trivial, but it is a logical first step that must be taken for any species with clearly defined habitat management needs. Habitat management will never be fully integrated with more traditional fisheries management that focuses on controlling fishing mortality and harvest practices until the various state and federal agencies that administer regulations on such diverse activities as land use, environmental quality, and living resource management begin to coordinate their efforts more effectively. It is not surprising, therefore, that the first thing that is required is more communication. Hopefully, this workshop will contribute to that process.

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Linking Habitat Considerations with Fishery Management in the Chesapeake Bay

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In 1975, the Environmental Protection Agency (EPA) conducted a comprehensive study of the Chesapeake Bay and its tributaries. The task of this 5-year study was to assess water quality problems, establish a data collection and analysis program, coordinate research activities, and make recommendations for improving Chesapeake Bay management. Results of the study were transformed into an action phase with the 1987 Chesapeake Bay Agreement. The development of fishery management plans (FMPs) began with the signing of the Agreement. To date, 13 FMPs have been adopted by the Executive Council of the Chesapeake Bay Program (CBP). The FMPs encompass 19 finfish and shellfish species and contain over 200 commitments for action. Each FMP serves as a framework for conserving and wisely using a fishery resource. The main purpose of the FMPs has been to manage commercial and recreational harvest to prevent overfishing and, in many instances, to reduce exploitation. The FMPs consist of a biological background section and a management section. The biological background section includes information on life history, stock status, Chesapeake Bay fisheries, an economic perspective, the results of fishery independent monitoring programs, research needs, habitat requirements, and current regulations. The management section identifies and defines problems and/or potential problems and recommends management strategies and actions. Originally, fishery managers focused on just fishery issues, since habitat implementation was out of their control. Management recommendations for habitat were usually generic. For example, a habitat recommendation would refer to the broad objectives of the CBP concerning a 40 percent reduction in nutrient loading by the year 2000 and/or a general reference to other CBP plans like fish passage and aquatic reef goals. These references to other programs was a beginning in integrating habitat concerns. However, stronger habitat strategies were needed.

A reoccurring issue during discussions on how to improve the habitat actions was that the fishery managers didn't feel qualified to develop and implement habitat policies and that the habitat managers didn't feel qualified to deal with fishery requirements. The FMP workgroup and the Living Resources Subcommittee (LRSc) decided to take two approaches: 1) improve and enhance habitat strategies and actions within the FMPs as new plans are developed and adopted plans are reviewed and amended, and 2) develop a FMP/habitat document which links human activities on land and water and their affects on fish and shellfish.

The groups decided on four steps for improving habitat within the existing structure of the CBP:

1) The FMP workgroup would identify and define habitat requirements for a particular species. This information would include the types of habitats utilized, the distribution of habitat and species within the Bay and tributaries, water quality requirements, and any other available data. It would then be sent to the appropriate habitat workgroups.

2) The LRSc workgroups specializing in those habitats would formulate specific habitat strategies and actions that protect habitat.

3) The specific habitat strategies developed by the habitat workgroups would then be incorporated into the FMPs.

4) The FMP with the new habitat strategies and actions would be sent through the CBP adoption process and signed by members of the Executive Council.

A working example of this process is the current revision of the 1989 Blue Crab FMP. Depending on life stage and sex, blue crabs can be found throughout the entire Chesapeake Bay. To avoid the development of a "generic" habitat statement, the FMP workgroup identified two main habitat issues for blue crabs, submerged aquatic vegetation (SAV) and dissolved oxygen. Submerged aquatic vegetation was designated as vital for juveniles and post-molt crabs and specific seagrass areas were delineated because of their potential importance to postlarval settlement. The information was given to the SAV workgroup. They used the information to develop a decision matrix for recommending actions that could potentially increase blue crab settlement. The SAV workgroup first identified which segments of the Chesapeake Bay were within the range of postlarval blue crab settlement. The segments were than evaluated based on current SAV distribution (mapped from 1978 to 1991), potential SAV distribution (based on SAV Tier II goals), and water quality parameters (median concentrations that support SAV growth in different salinity zones) (Table 1-8). The matrix was turned into a GIS map (Figure 1-9) for easy reference. Recommendations for SAV actions based on potential blue crab larval settlement would apply only to shallow water portions of each segment (2 meters deep or less). Recommendations for the protection of SAV refer to preventing physical disruption of SAV. Recommendations for maintaining or improving water quality refer to implementing the tributary strategies for nutrient reduction. More actions to reduce runoff are needed in areas that do not currently meet SAV habitat requirements. Recommendations to restore SAV where feasible involve SAV planting. Guidelines for planting projects are in the process of being refined and will be included in the FMP when they are available.

Similarly, bottom DO data from June through September for all areas of the Bay and tributaries were examined and a GIS map generated. Areas were identified for chronic DO or areas below 3 mg/L. The development of specific habitat actions have not been completed yet but will be added to the FMP.

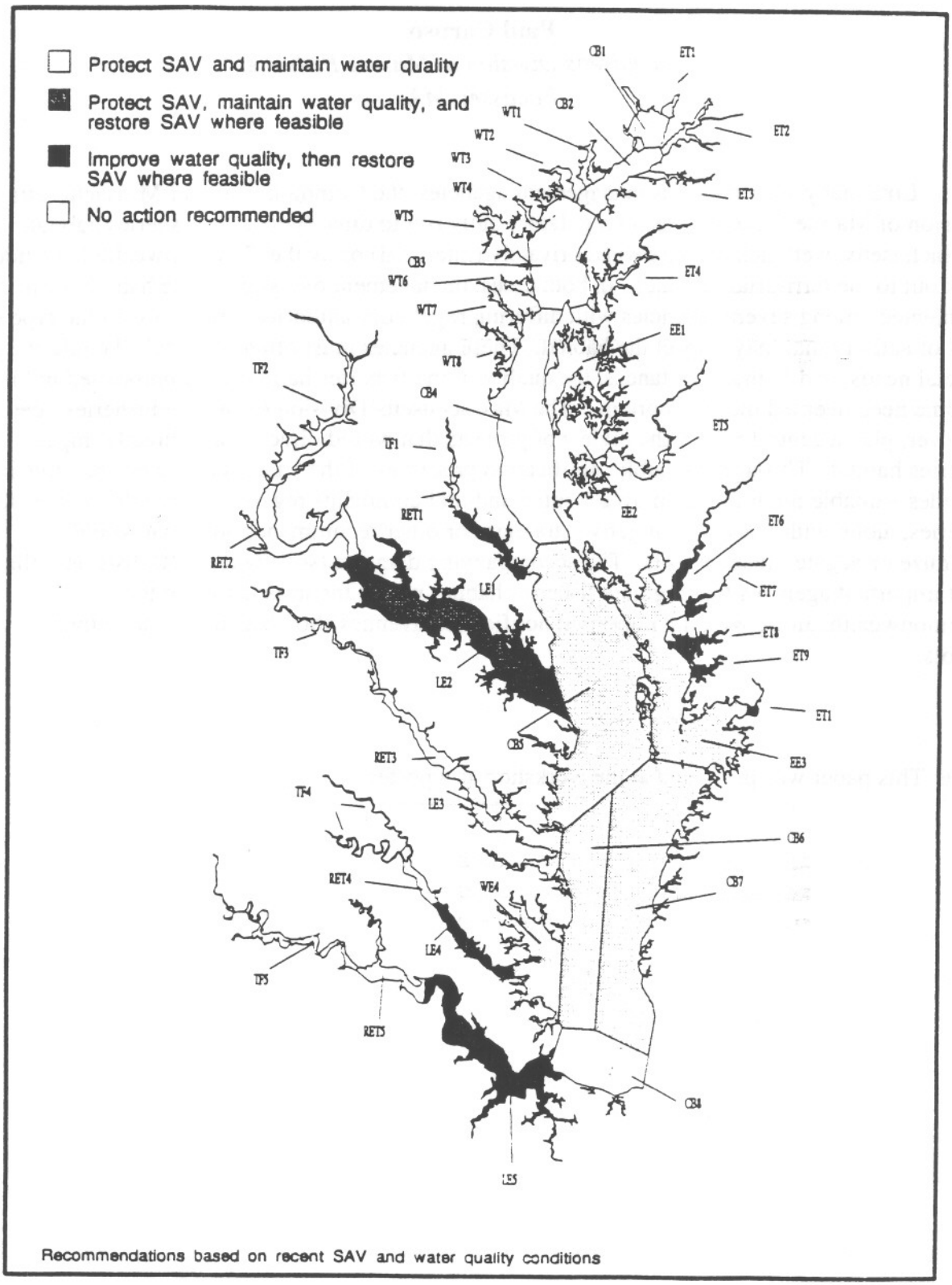
Table 1-8. Decision Matrix for SAV Recommendations and Postlarval Blue Crab Settlement (SAV Workgroup Recommendations).

Category	Recent SAV Area	Potential SAV Area	Water Quality	Recommended Action
A	Moderate to high	Moderate to high	Adequate	Protect SAV. Maintain water quality.
B	Low	Moderate to high	Adequate	Protect SAV. Maintain water quality. Restore SAV where feasible.
C	Low	Moderate to high	Inadequate	Improve water quality. Restore SAV where feasible.
D	Low	Low	Adequate or inadequate	No action.

The second approach to integrating habitat and fishery management is the development of a habitat linkage document. The goal of this document is to provide Federal and state agencies, land developers, stakeholders, and the general public with the incentive, information, and tools to make decisions and take actions which promote environmental protection and land stewardship for the benefit of fishery resources of the Chesapeake Bay. Objectives of the document include the establishment of a unified policy for integrating fisheries habitat when assessing environmental impacts of human activities; the documentation of social, economic, and ecological values of fishery resources; the documentation of important fisheries habitat; the identification of land use activities that impact fishery resources; and the recommendation of methods to avoid or minimize human impacts to fishery resources. The FMP/habitat document will consist of three parts. The first section will be an educational/reference document which consolidates the known scientific and ecological linkages between habitat and fish. The second section will be a compilation of existing Federal, state and local laws and regulations that protect habitat (e.g., floodplain regulations, forest conservation act, critical areas regulations, etc.). This section would need to be evaluated annually and updated as necessary. The last section will be a compendium of specific habitat strategies and actions that are developed for each of the FMPs.

The CBP has taken the first steps in developing specific habitat strategies and actions that relate to fishery resources. Linking habitat and fishery resources is an important activity for successful ecosystem management.

Figure 1-9. SAV Recommendations to Benefit Blue Crab Postlarval Settlement



A Diagrammatic View of Marine Fish Habitat Management in Massachusetts

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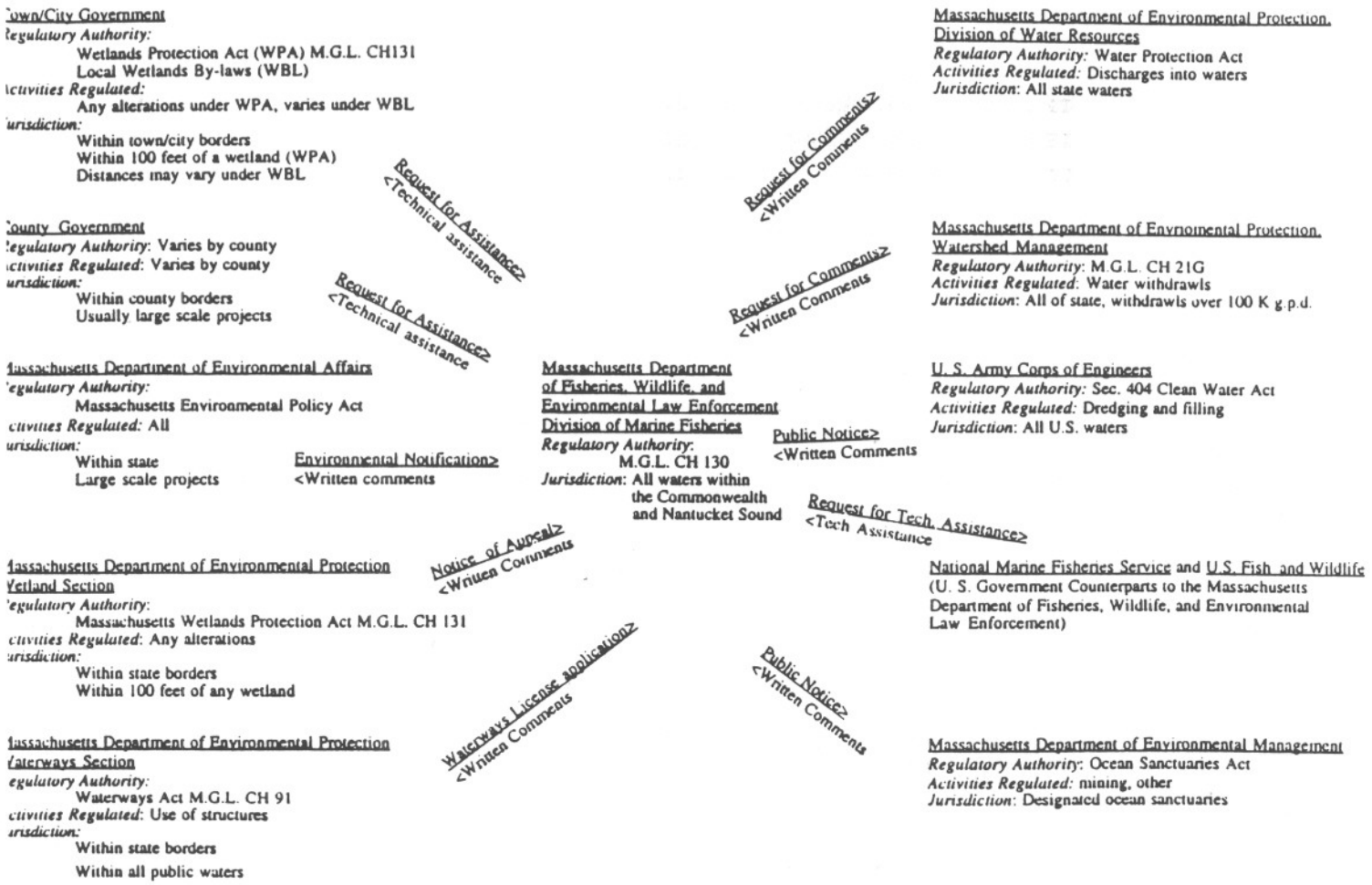
Like many state fisheries management agencies, the Commonwealth of Massachusetts Division of Marine Fisheries has no regulatory authority to directly manage fisheries habitat. In Massachusetts, wetlands can be owned privately (intertidal) or by the Commonwealth (low tide mark out to the territorial sea line). In both cases, management oversight of the habitat itself is fragmented among several agencies with differing regulatory authority, depending on the type or level of activity that may impact the habitat. These agencies must often try to fulfill conflicting societal needs, and in many instances, the quality of the fisheries habitat is compromised in favor of some need deemed more important. The Massachusetts Division of Marine Fisheries does, however, play a central role in the review of projects that would directly or indirectly impact fisheries habitat. Through the public notification processes of the various agencies, the Division provides valuable input by submitting written and oral comments regarding possible impacts to fisheries, along with possible mitigative strategies or other recommendations that would minimize or negate those impacts. The accompanying diagram (see Figure 1-10) lists only the most important agencies that regulate fisheries habitat within the jurisdiction of the Commonwealth, along with the important notification avenues shown as input and output vectors.

(Note: This paper was presented at the workshop as a poster)

Figure 1-10. A Diagrammatic View of Marine Fish Habitat Management in Massachusetts



Chapter 2

Existing/Creative Tools for Habitat Management

Introduction

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Our existing/creative tools consist of state and Federal laws that give us the authority to manage habitat, research being conducted to help us manage habitat, tools to create habitat, conserve habitat, enhance habitat, and mitigate for habitat losses and impacts. We have tools to identify critical habitat, and recently, the ability to identify the changes that are occurring in these habitats. Yet, our tools are limited, since we do not fully understand many of the relationships of the fisheries to their habitat, the importance of various habitats to the resources utilizing them, or the interactions between one type habitat and another type habitat. We are also limited in our ability to conserve these habitats due to the tremendous pressure for coastal development and habitat encroachment and our limited ability to get the message of habitat importance out to citizens and legislators. We must be creative in our use of these tools, and we must work together as managers of a most valuable resource.

First, let's look at what is mandated. Existing laws that require some form of fisheries habitat management come in the form of Federal laws, state laws, Presidential and Gubernatorial policies, governmental guidelines and regulations, and local statutes and rules. Following is a list of the most commonly used Federal laws that either mandate or allow for fishery habitat management. They consist of a combination of regulatory authority, enforcement authority, as well as, conservation and preservation authority.

- **The Rivers and Harbors Act -** The oldest of the bunch. Passed in 1899, it made it unlawful to dredge, fill, or construct in navigable waters of the United States without a permit from the U. S. Army Corps of Engineers (COE).

- **The Fish and Wildlife Coordination Act -** This is the basic legislation stating that fish and wildlife conservation shall receive equal consideration in water resources development.

- **The Marine Protection, Research, and Sanctuaries Act -** This Act regulates the ocean dumping of waste, provides for a research program on ocean dumping, and provides for the designation and regulation of marine sanctuaries.

- **The Clean Water Act -** When originally passed, this was The Federal Water Pollution Control Act, but since being amended in 1977, it has been commonly referred to as the Clean Water Act. This Act established the National Pollutant Discharge Elimination System, which gives the Environmental Protection Agency (EPA) the authority to control the discharge of effluent into the waters of the United States and authorizes the

COE to issue permits for the discharge of dredged and fill material into the navigable waters and waters of the United States.

- **Endangered Species Act -** This Act provides for the conservation of endangered and threatened species of fish, wildlife, and plants.

- **National Environmental Policy Act -** Commonly referred to as NEPA, this Act directs all agencies of the Federal government to include environmental considerations in planning and decision making which may have an impact on man's environment. It also requires the preparation of an Environmental Impact Statement for activities that could significantly affect the quality of man's environment.

- **Magnuson Fishery Conservation and Management Act -** This Act established a Fishery Conservation Zone, established the Fishery Management Councils and their Habitat Advisory Panels, and required the preparation of fishery management plans when applicable. The proposed re-authorization of this Act will increase the Council's authority to review wetland alteration proposals and will require the identification of essential fishery habitat.

- **Water Resources Development Act -** This Act authorized the construction of over 270 COE projects and 33 generic studies along with requirements for mitigation activities for these projects. It also identified a list of "species of national importance", which has allowed increased protection, enhancement, and mitigation for these species when they are impacted.

- **Federal Power Act -** This Act gives the Federal Energy Regulatory Commission the authority to require a license to construct, maintain, and operate such fishways associated with power producing facilities as may be prescribed by the Secretaries of the Interior and Commerce.

- **Coastal Zone Management Act -** This Act initiates a national program to encourage state planning for the management, beneficial use, protection and development of the Nation's coastal zones.

- **Outer Continental Shelf Lands Act -** This Act gives the Federal government the authority to lease offshore lands for the exploration and production of oil and gas.

The tools of habitat management stemming from laws passed by Federal, state, and local legislatures fall into two major categories: regulatory and enforcement.

Regulatory programs having major impacts, both positive and negative, on fishery habitats and their management are those of the COE, EPA, Multi-state Fishery Councils and Commissions, State permitting programs, and local zoning and development regulations. Whereas these tools are existing, they are also creative as demonstrated by the recent development of Programmatic

General Permits which will reduce and simplify the regulatory processes and make wise use of limited resources while continuing to protect the aquatic environment. These permits will authorize certain types of projects that are regulated by more than one agency. In this time of fiscal pressure, all levels of management must be creative in the use of their resources as efficiently as possible.

Enforcement programs impacting fishery habitat management include, but are not limited to: the COE's enforcement of its permits issued under the Rivers & Harbors Act and the Clean Water Act; EPA's enforcement of water quality standards under the Clean Water Act, as well as its authority to veto actions by the COE pursuant to Section 404c of the Clean Water Act; and state and local enforcement of their own issued permits and authorizations.

Also available as tools to habitat managers are different types of data monitoring programs including aerial photography, wetland inventory maps, satellite imagery, regional mapping efforts, and change analysis programs, which assist in habitat management. The U.S. Fish & Wildlife Service (FWS) started its wetland inventory mapping program in 1975, and it, along with aerial photography, has long been one of the most highly utilized tools for habitat managers. Our jump into the space age has brought us satellite imagery that has greatly increased our ability to accurately identify wetlands and vital fishery habitat over large areas but still on a useable scale. The EPA's Advanced Identification of Wetlands Program is a creative tool that is developing regional and local wetland mapping that gives local governments valuable tools for dealing with coastal development and habitat encroachment. The National Oceanic and Atmospheric Administration's Coastal Change Analysis Program gives us the capability to classify types of land cover, analyze and monitor changes in coastal submersed habitats, wetland habitats, and adjacent uplands using remote sensing.

Water quality standards are a vital tool in dealing with the management of fishery habitat. The EPA, in its establishment of water quality standards and its enforcement authority to control these standards, gives us an invaluable tool in maintaining the quality of the habitat of all United States fishery resources.

Mitigation has become an important buzzword in habitat management for the 1990's. We are still very much on the learning curve as to how to use this management tool successfully at all levels. Mitigation spans from creation/restoration of wetlands and habitat in-kind and on-site, to the establishment of off-site mitigation banks used for many projects of varying types and sizes. Mitigation covers the restoration of spawning habitat through the removal of migration blockages, the creation, restoration, or enhancement of coastal marshes, riverine wetlands, hardwood wetlands, seagrasses and open water habitats. One piece of recently passed Federal legislation is the "Coastal Wetlands Planning, Protection, & Restoration Act". This Act, though primarily aimed at the State of Louisiana, does provide for matching grants to any coastal state to implement wetland conservation projects. Recently, a partnership of Federal agencies developed a creative habitat management tool titled "Mitigation Banking Guidelines". This document is the culmination of cooperation between five Federal agencies and will be used as a creative tool in the establishment, use, and operation of mitigation banks.

Research is an invaluable tool that provides information that we, as managers, must have to manage fishery habitat. Throughout many of the Federal and state environmental agencies and academic institutions, both in the United States and abroad, studies that are necessary for us to understand the processes and relationships of fishery resources to their habitats are being conducted. We need to know how estuaries work. What are the management problems associated with different habitat types, and what is needed to successfully manage these habitats? The interaction and cooperation between research and management is necessary for successful habitat management. Recently the researchers in the Southeast Region hosted a workshop for the managers in the same area with one of the primary aims being the exchange of information and needs. Cooperative efforts such as this are both an existing and creative tool available to us.

These cooperative efforts have led to the development of probably the most recent creative management tool in the idea of ecosystem management. This is an approach to habitat management involving the management of an entire ecosystem within a geographical area rather than the individual management of habitats within a particular ecosystem. An excellent example of this initiative is the creation of the National Estuary Program, a comprehensive, multi-agency evaluation, planning, and action-oriented initiative for preserving, protecting, and restoring aquatic resources within an estuarine system. The EPA is the lead Federal agency in this endeavor, but participation from other state and Federal agencies is requested and encouraged. This approach has demonstrated success by the signing of an interagency agreement aimed at the restoration of Florida Bay and South Florida Ecosystem, the continuing efforts to implement management plans developed for the Albemarle/Pamlico Estuaries in North Carolina, the Narragansett Bay in Rhode Island, and the Great Bay Estuary Project just getting underway in New Hampshire and Maine.

Partnerships between agencies, interactions between researchers and managers, cooperation between managers, law makers, and the general public are creative tools that need to be expanded if we are going to improve our management abilities and successes. These efforts cannot be just on the Federal or State level, but must reach down to local zoning and planning agencies. These interactions will lead to our ability to not only manage fishery habitat within an ecosystem, but also contribute factors such as point and non-point source discharges and other developmental pressures that impact fishery habitat. Without the capability of controlling an entire ecosystem including land-based influences, ecosystem management will be extremely difficult and possibly unsuccessful.

I've covered some of the important tools, both existing and creative, we presently have for the management of fishery habitat. This list is by no means complete since there are many other laws, programs, and research activities that are vital for habitat management. I did not cover any specific state or local laws and regulations since they vary considerably from state to state and locality to locality. These differences show the need to tailor regulations to fit the needs of regional and local managers. This also demonstrates the need for all of us to work together as a team in the management of these habitats. Perhaps, the best and strongest tool we have today is our ability and desire to work together with the one goal of protection, enhancement, and an increase in high quality fishery habitat.

Using Water Quality Standards to Protect Fish Habitat

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Water Quality Standards have for over 30 years provided an important, but often underutilized, mechanism to protect fish and fish habitat. At the time of the Clean Water Act's passage in 1972, pollutant discharge was an obvious source of environmental degradation. Throughout the 1970's and 1980's, implementation of the Act focused on regulating point source dischargers of pollutants using technology-based controls. As water quality improves from the implementation of programs to reduce effluent discharges, the impacts on water quality from habitat degradation and loss are increasingly apparent. Water Quality Standards continue to be an important technique for protecting aquatic habitat.

The purpose of this paper is to examine the aspects of standards that can best be utilized to protect habitat, and identify opportunities for fish and wildlife professionals and concerned citizens to participate in the development and review of standards.

Background and Basis for Water Quality Standards

Section 101(a) of the Clean Water Act states: "The objective of the Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Congress intended that the word integrity refer "to a condition in which the natural structure and function of ecosystems in maintained." The interim goal of section 101(a)(2) is water quality that provides for the protection and propagation of fish, shellfish and wildlife.

EPA-approved State standards are critical to protecting the "goal uses" of the Clean Water Act which include, "the protection and propagation of fish, shellfish and wildlife." Designation of waters as fish habitat directly reflects the 101(a) goals of maintaining the "chemical, physical and biological integrity of the nation's waters."

Standards serve the dual function of establishing goals for a water body and providing the basis for regulatory controls. The Clean Water Act requires States to review and revise, if necessary, their water quality standards every three years incorporating a formal public participation process.

Water Quality Standards are applicable to all waters, including rivers, lakes, streams, natural ponds, wetlands and tidal waters, which lie within a state/tribal boundary and which meet the definition of "waters of the United States." They are applicable in all situations, regardless of activity or source of degradation.

[1] This paper represents the opinions of the author and does not necessarily constitute the opinion of the U.S. Fish and Wildlife Service.

They set the "performance standards" for a variety of Federal permits (CWA Section 402, 404), State permits or certificates (CWA Section 401, 402, water diversion permits, stream alteration permits, state wetland permits etc.) and in some cases local regulations (local BMPs necessary to meet the performance standards).

EPA has, since its inception, directed the states to adopt water quality standards which protect aquatic habitat and the designated and existing uses of its waterways. It has done so through regulations and policy guidance.

Important Elements of Water Quality Standards

Three essential elements of water quality standards are discussed below; **designated uses**, **criteria** and **antidegradation** (protection of existing uses). The discussion focuses on aspects of each of these most useful for protecting fish and wildlife habitat.

Designated Uses

Designated uses are uses specified in Water Quality Standards for each water body or segment whether or not they are being attained and are often referred to in shorthand as "goal of fishable, swimmable water." States are required to designate at a minimum the following uses; propagation of fish and wildlife and recreation. Waste transport and assimilation is not an acceptable use in any case.

Special use designation is an important way to protect particularly unique, sensitive, or valuable aquatic species, communities or habitats. Subcategories may also be developed (migratory fish pathway, spawning areas etc.) or to reflect differing ecosystems etc. States vary in their approach to doing this both in terms of specificity of use (fishable vs. cold water spawning habitat) and the way uses are mapped or listed.

Several examples of descriptive designated uses follow:

California Water Quality Standards

- **Cold Freshwater Habitat** - Provides a cold water habitat to sustain aquatic resources associated with a cold water environment.
- **Fish Migration** - Provides a migration route and temporary aquatic environment for anadromous or other fish species.
- **Fish Spawning** - Provides a high quality aquatic habitat especially suitable for fish spawning.
- **Wildlife Habitat** - Provides a water supply and vegetative habitat for the maintenance of wildlife.

Wisconsin Wetland Water Quality Standards

. . .(1) To protect, preserve, restore and enhance the quality of waters in wetlands and other waters of the state influenced by wetlands, the following water quality related functional values or uses of wetlands, within the range of natural variation of the affected wetland, shall be protected: . . .

(e) Habitat for aquatic organisms in the food web including, but not limited to fish, crustaceans, mollusks, insects, annelids, planktonic organisms and the plants and animals upon which these aquatic organisms feed and depend upon for their needs in all life stages;

(f) Habitat for resident and transient wildlife species, including mammals, birds, reptiles and amphibians for breeding, resting, nesting, escape cover, travel corridors and food; and . . . .

Not having a detailed designated use is not wrong; however, it makes protection more difficult. Detailed designated uses may be a problem where a use is missed or poorly described. The important thing is to maintain a proper balance in describing uses.

Criteria

States are required to adopt water criteria that will protect the designated use(s) of a water body. The criteria must be based on scientific rationale and contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria must support the most sensitive use.

There are several forms of criteria: numeric, narrative, biological, sediment and wildlife. Numeric criteria (e.g. dieldrin or mercury) are particularly important where the cause of toxicity is known or there is bioaccumulation potential. Numeric criteria should address acute and chronic effects.

Narrative criteria typically consist of the "free forms" (free from oil and grease etc.) and other statements that describe the desired water quality goal. An example of narrative biological criteria from the Wisconsin Wetland Water Standards follows:

. . . (2) The following criteria shall be used to assure the maintenance or enhancement of the functional values identified in sub. (1): . . .

(e) Hydrological conditions necessary to support the biological and physical characteristics naturally present in wetlands shall be protected to prevent significant adverse impact on: . . .

4. The movement of aquatic fauna . . .

(3) Existing habitats and the populations of wetland animals and vegetation shall be maintained by:

1. Protecting food supplies for fish and wildlife
2. Protecting reproductive and nursery areas

When criteria are met, water quality will generally protect the designated use; however, EPA regulations recognize that in some circumstances, criteria alone are insufficient to protect a designated use.

In the PUD No. 1 case, the State of Washington placed minimum flow requirements on a Federal Energy Regulatory Commission (FERC) license in order to protect a designated use of salmonid and other fish migration, rearing and spawning. While the Washington standards contained no specific "flow criterion", the Supreme Court found that the State "may include minimum stream flow requirements . . . to enforce a designated use." In other words, the minimum flow is based on a State's interpretation of its narrative criteria.

Antidegradation

EPA regulations require that States adopt antidegradation policies providing for the protection of existing uses and the level of water quality necessary to protect those uses. (An existing use is a use which has actually occurred since November 28, 1975.) This is known as the base level or tier 1 of antidegradation. No activity is allowable (with limited exception for variances and mixing zones) which could partially or completely eliminate an existing use.

This can be a powerful tool to protect fishery habitat. In the PUD No. 1 case, for example, the State also justified its minimum stream flow as necessary to meet its antidegradation policy. The Supreme Court agreed stating, ". . . in many cases water quantity is closely related to water quality; a sufficient lowering of the water quantity in a body of water could destroy all of its designated use . . . as a fishery."

Tier Two of antidegradation affects high quality waters whose quality exceeds that necessary to protect 101(a) goals. A lowering of water quality is possible in these waters only after an antidegradation review finds that all existing uses will be protected, there is adequate public review, and that the degradation is necessary to accommodate important economic and social development in the area in which the waters are located.

The third tier of antidegradation applies to waters of outstanding character designated by the States for heightened protection. This can include waters of National Wildlife Refuges and waters of exceptional recreational or ecological significance. These waters typically have a no discharge or no change in measurable water standard associated with them.

Potential for Greater Fishery Agency Involvement

There are a number of aspects of standard development and triennial review in which fishery professionals could participate to better protect fish habitat:

1. Development of biological criteria to protect biological integrity of aquatic ecological resources.

2. Development of flow/hydrological criteria to insure physical integrity of habitats.

3. Development of more descriptive designated uses and antidegradation policies for waters and wetlands that include habitat and ecological characteristics.

4. Integration of fishery management/restoration plans into standards. For example, few elements of the State/Federal restoration plans for the Susquehanna, Connecticut, Merrimack or Penobscot Rivers can be found in respective state standards.

5. Incorporation of fish habitat data collected and mapped in planning processes such as the Conte National Fish and Wildlife Refuge into State standards.

6. Identification of areas of outstanding ecological significance suitable for designation as Tier 3 (ONRW) waters.

7. Getting involved in permit/ license review to insure that the above points are being implemented.

Discussion

The following question was asked by a workshop participant at the conclusion of Mr. Abele's presentation:

Question: What impact will uncertainty have on the Clean Water Act; e.g., the effect of state water quality standards on habitat?

Response: It's hard to answer that. One of the bills that passed the House has broad-based goals. The EPA right now is looking at all of their water quality standards. How long that will take is uncertain. The States will have to look for positives although the landscape may change.

Conserving Coastal Habitats With the Wetlands Conservation Grants Program of the U.S. Fish and Wildlife Service

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The National Coastal Wetlands Conservation Grants Program (Coastal Grants Program) is administered by the Fish and Wildlife Service under the authority of the Coastal Wetlands Planning, Protection, and Restoration Act of 1990 (CWPPRA). This program provides matching Federal funds to coastal states for projects that will restore, acquire, manage, or enhance coastal lands and waters in perpetuity (except for Louisiana, which has its own coastal conservation project funding under the CWPPRA).

All coastal states, including the Great Lakes States, Trust Territories and Commonwealths, are invited annually to submit project proposals to the Fish and Wildlife Service Regional Office covering their state. Because of limited Federal funding for the Coastal Grants Program and considerable demand, project proposals are selected competitively. Although only states may apply for grants under this program, other public agencies and private groups are encouraged to work with the states to develop project partnerships.

Funding for the Fish and Wildlife Service's CWPPRA programs comes from the Sport Fish Restoration Account of the Aquatic Resources Trust Fund. The Trust Fund is derived from an excise tax on sportfishing equipment, trolling motors, sonar fish finders, small engine fuel, and a portion of the taxes on motorboat fuel. Import duties on sportfishing equipment and pleasure boats also are deposited. The CWPPRA program funds obtained from the Sport Fish Restoration Account are determined by the annual allocation of either 18 percent of the excise taxes and import duties on fishing equipment, or 100 percent of the excise tax on small engine fuel, whichever is greater. Of this amount, 15 percent (not to exceed $15 million) is provided for the Coastal Grants Program, 70 percent (not to exceed $70 million) is provided for the development and implementation of projects for the coastal Louisiana Restoration and Conservation Plan, and 15 percent (not to exceed $15 million) is provided for coastal activities authorized by the North American Wetlands Conservation Act.

On average, about $7 million is available each year for the Coastal Grants Program. Funds will continue to accrue through Fiscal Year 1997 and will be available for spending on approved projects through Fiscal Year 1999. Between 1992 and 1996, the Fish and Wildlife Service has awarded over $34 million in 78 matching grants to 23 coastal states and one territory. Over 16,200 hectares (40,000 acres) have benefited from the program; 14,580 hectares (36,000 acres) through acquisition and over 1,620 hectares (4,000 acres) through restoration. The Fish and Wildlife Service reviews an average of 35 Coastal Grants Program proposals each year. Table 2-1 shows the breakdown by year of the number of proposals selected, the Federal share, and the total area benefited. States contributed a total of $31.4 million.

Table 2-1. Summary of Annual Coastal Grants Proposals, Cost Share, and Area of Habitats Restored or Acquired

FY	Proposals Selected	Federal Share ($ millions)	Hectares	Acres
1992	13	$5.7	1,941	4,793
1993	10	$5.9	1,587	3,918
1994	19	$7.6	7,695	19,000
1995	22	$7.0	3,938	9,723
1996	14	$8.0	1,219	3,009
TOTAL	78	$34.2	16,380	40,443
Total State Contribution: $31.4 million for 1992 through 1996 ($14.5 million in Fiscal Year 1996 alone).				

Of the total grant expenses, the state's share is 50 percent. It may be decreased to 25 percent if the state has established a trust fund for acquiring coastal wetlands, natural areas, or open spaces, or if the state has a dedicated recurring fund for acquiring natural areas such as a tax check-off or a license plate fee.

Application For Grants

The timetable for each year's program is as follows: state proposals must be received in Fish and Wildlife Service Regional Offices by September 1. After review and regional ranking, the proposals are sent to Washington, D.C., by October 15. A national review team in Washington, D.C., scores and ranks the proposals by December 15. The Fish and Wildlife Service Director makes the final selection of proposals by January 15.

Grant Eligibility

Eligible purposes of Coastal Grants Program proposals include acquisition, restoration, management or enhancement of coastal wetland ecosystems if they are protected for the long-term conservation of their lands and waters, the hydrology, water quality, and fish and wildlife dependent on them. Ineligible activities include navigation, irrigation, flood control, mariculture, mitigation of habitat losses resulting from the actions of other agencies, creation of artificial wetlands, law enforcement, research, operations and maintenance, and proposals outside the defined coastal wetlands ecosystem boundary.

Only proposals for projects that are on or near the coastline are considered eligible (including the Great Lakes). Eligible coastal wetland ecosystems are made up of multiple, interrelated coastal wetlands in drainage basins of estuaries or coastal waters that contain saline, brackish and nearshore waters; adjacent freshwater and intermediate wetlands that interact as

an ecological unit; river mouths and river systems affected by tidal influence; and associated shorelands, dunes, barrier islands, and uplands.

Criteria for Grant Scoring and Selection

The Coastal Grants Program was designed to include 13 criteria which are assigned points. Proposals that have the highest scores are placed highest in the ranking. These criteria were developed to favor proposals designed (1) within an ecosystem management framework, (2) to ensure long-term protection of specific habitat and adversely affected indigenous fish, wildlife, and plant resource values, and (3) to leverage additional funds by fostering partnerships with Federal, state and local governments, and private organizations. The 13 criteria are:

1. Does the proposal benefit coastal, barrier island, or maritime forest habitats?

2. Will the proposal address the Wetlands No-Net-Loss concept by reversing coastal wetland loss or habitat degradation in decreasing or stable coastal wetland habitats?

3. Will the proposal have a positive effect on federally listed endangered or threatened species, on species proposed for Federal listing, or on designated or proposed critical habitat for listed species in coastal wetlands?

4. Does the proposal further the natural resource goals and objective of a formal, ongoing coastal ecosystem or coastal watershed management effort?

5. Will the proposal provide documented present or future benefits to anadromous and other coastal interjurisdictional fish species and their habitats?

6. Will the proposal prevent or reduce input of contaminants to the coastal wetlands and associated coastal waters, or restore those coastal wetlands and associated coastal waters already impacted by contaminants?

7. Will the proposal receive financial support, including in-kind match, from partnerships with private, local, or other Federal interests?

8. Does the state applicant have financial support from sources other than the state that exceeds, by 10 percent or more, the state matching requirement?

9. Is the combination of acquisition (e.g., use of long-term conservation easements, fee title ownership, etc.), protection strategy (e.g., reference a long-term plan), and restoration/management project design (e.g., life of structures, or duration of effectiveness of the management technique) sufficient to ensure long-term conservation of coastal wetlands values up to 25 years or more?

10. Is the proposal designed to increase environmental awareness and to foster, promote, and develop a more informed and involved citizenry to support coastal wetlands conservation?

11. Is the proposal designed to leverage other ongoing coastal wetlands protection projects in the area, such as acquisition of areas to add to already acquired coastal lands, or to provide impetus for additional restoration?

12. Does the State have and use one of the following for the purpose of acquiring coastal wetlands, other natural areas, or open spaces: (a) a trust fund from which the principal is not spent, or (b) a fund derived from a dedicated recurring source of money, including but not limited to real estate transfer fees, taxes, cigarette taxes, tax check-offs, or motor vehicle license plate fees?

13. Factors not addressed in the above criteria that should be considered, such as: What makes the coastal area project site unique or special? What are the threats to the coastal area project site? Are there extenuating circumstances? Does the site have significant biological diversity?

Additional Considerations for Selecting Grant Proposals

Additional considerations are used to rank proposals that are otherwise equal. These factors favor projects that can be done in the most cost-efficient manner as follows: (1) projects that can be completed in one year are preferable; (2) proposals that do not require significant portions (10% or more) of the total available program funds may fare better because expensive proposals may price themselves out of competition; (3) restoration projects that can be completed with the least amount of funds, $1 - 2 thousand per acre, are preferable; and, (4) funds requested are less than what the state is eligible for. Higher priority will be given to proposals in which the state or third party provides additional funds, lands, or services as opposed to only using lands already owned as the total state matching share.

Project Examples

Examples of significant projects that have been funded under the Fish and Wildlife Service Coastal Grants Program include the following:

- Escondido Creek, California – The State of California received a Coastal Grant in 1992 to acquire a key 43-acre tract of land along Escondido Creek near San Diego. This riparian habitat and brackish and freshwater marsh is located upstream from the San Elijo Lagoon and is one of the few free-flowing streams remaining in southern California. This habitat is a pocket of high species diversity and is important to migratory species and several endangered species.

- Cana Wetlands, Wisconsin – The State of Wisconsin received a Coastal Grant in 1994 to help acquire 220 acres of wetlands in Wisconsin's largest remaining tract of

undeveloped Lake Michigan shoreline. The Cana Wetlands are important habitat for migratory and resident birds, and are virtually the only spawning habitat for whitefish in Lake Michigan. The endangered Hine's emerald dragonfly and the threatened dwarf lake iris are members of this wetland community.

- Cape May, New Jersey – The New Jersey Department of Environmental Protection acquired 153 acres of coastal wetlands, beachfront dunes, and maritime forest on Cape May with its 1995 Coastal Grant. This acquisition is a critical habitat link to adjacent wildlife areas that are part of a world-renowned stopover for neotropical migratory songbirds, raptors, and shorebirds.

For More Information:

Contact the U.S. Fish and Wildlife Service, Division of Habitat Conservation, Branch of Habitat Restoration, Washington, D.C., (703) 358-2201.

Natural Resource Trusteeship and Fish Habitat Protection

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Introduction

In an August 28, 1995 press release, U.S. Environmental Protection Agency Administrator Carol Browner announced that "Contaminated fish are bad for the economy. Public health is at risk – the health of Americans who depend on fishing to put food on the table for their families. I can think of nothing that demonstrates more clearly the need for strong, effective protection of our nation's water bodies."

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, but better known as Superfund), the Clean Water Act, and the Oil Pollution Act (OPA) recognize the need to protect and restore natural resources such as the nation's fisheries from chemical contaminants. All three Acts recognize fisheries, shellfisheries, and their habitats as elements of the public welfare. All three Acts mandate natural resource trustees to represent the public's interest when chemical contaminants degrade natural resources. These Acts empower the trustees to initiate actions to restore, rehabilitate, replace, or acquire the equivalent of the resources injured or impacted by the release of chemical contaminants. While not within the focus of this presentation, the Marine Protection, Research, and Sanctuaries Act authorizes the recovery of damages for habitats injured in Marine Sanctuaries due to physical impacts, such as a vessel grounding.

Natural resource trustees are the heads of various Federal land and natural resource managing agencies, including the Secretaries of the Departments of Commerce and Interior, and State agency officials delegated by State Governors. Within the Federal system, these trustees may delegate the authorities to enforce the mandates of CERCLA and OPA to other agency officials. Within Commerce, for example, the Secretary has delegated the trustee authority to the Administrator of the National Oceanic and Atmospheric Administration (NOAA). NOAA has delegated various aspects of this authority (e.g., the authorized official, legal, response, damage assessment, and restoration) to other agency officials.

Under Federal law, natural resource trusteeship in navigable waters is shared between the appropriate States and the Federal Government. NOAA, as one Federal natural resource trustee, has jurisdiction over all estuarine and marine fishery natural resources, including their supporting habitats. The jurisdiction applies to all anadromous and catadromous fishes throughout their ranges. This jurisdiction is shared with the state or states in which these resources lie.

Trustee Protection

A branch of the Hazardous Materials Response and Assessment Division, NOAA's Coastal Resource Coordinator (CRC) Program has representatives (CRCs) within each EPA regional office. The CRCs work with EPA, the Coast Guard, and some States on cleanup actions at more than 200 sites within the Atlantic States Marine Fisheries Commission's area of interest. CRCs exercise NOAA's natural resource trustee authority to redress adverse effects of uncontrolled releases of hazardous substances from coastal industrial facilities and waste sites. Being involved in cleanup response helps NOAA achieve one of its primary objectives: to protect and restore fishery health, habitats, and biodiversity.

Paradigm: New Bedford Harbor

For example, PCB contamination from the New Bedford Harbor Superfund site in Massachusetts has closed several areas to fishing activity. Area I is closed to the taking of all fish and shellfish. Area II is closed to the taking of eel, lobster, flounder, scup, and tautog, and Area III is closed to the taking of lobsters only.

The upper harbor is a major sink for PCB contamination. Consequently, it acts as a major source for widespread dispersion of contamination. More than 200 pounds of PCBs per year are estimated to migrate out of the harbor and into Buzzards Bay. The natural resource trustees are working with EPA to design cleanup strategies that improve habitat quality and potential biodiversity. However, the enormous costs associated with cleaning up such widespread contamination may preclude the lifting of any of the three fishery area bans any time soon. Regardless, protective strategies should enhance the recovery and trustee restoration efforts by significantly reducing the further spread of contamination.

A Proactive Stance

Occasionally, the CRC discovers a potential threat to trust resources and requests a lead agency to initiate investigations leading to the removal of those hazardous substances threatening or impacting trust resources including fisheries and their habitats.

For example, the M/V *Empire Knight* sank during a storm in 1944, 7 miles off the southeast coast of Maine in approximately 250 ft. of water. Allegedly on board were 221 steel vials of mercury amounting to approximately 16,000 pounds. The States of Maine and New Hampshire expressed concern over the potential mercury contamination of seafood if salvers inadvertently released the mercury into the surrounding environs. Federal and state trustees submitted a request to the US Coast Guard, which has jurisdiction as a lead Federal response agency, to investigate and potentially arrange for the removal of the mercury threat. Subsequent investigations did reveal a release of mercury from the vessel.

A Coast Guard-lead removal action located and removed the 221 mercury vials which, for the most part, had corroded and voided their mercury contents. However, further

investigations by Federal and state agencies determined that seafood quality and marine life in general was not compromised by the release.

In another instance, the hopper barge Patricia Sheridan grounded outside the mouth of Charleston Harbor, South Carolina entrance channel on October 12, 1995. The barge contained 12,000 tons of dioxin contaminated dredge spoils from Staten Island, New York. The material was in transit to Texas for offloading and rail transport to Utah for final disposal. The grounding dislodged two hatch covers over hopper (hold) # 2, thereby allowing approximately 2,500 tons to be washed into the sea.

State and Federal trustees became concerned over the potential threat to fisheries and their habitats, including the public confidence in the recreational fish stocks, and a threat to compromising the integrity of clean sediments in the nearby Federal navigation channel. The trustees requested the Coast Guard to investigate and abate the potential threats if necessary. Investigations verified a release of dioxin-contaminated spoils. The Coast Guard ordered the removal of contaminated spoils over approximately 4 acres of seafloor. Subsequent dredging removed approximately 5,500 cubic yards of material from the seafloor. Dioxin analyses of spider crabs, the species of opportunity, did demonstrate elevated concentrations at the grounding site in comparison to reference stations. The Coast Guard has ordered additional sampling to verify the effectiveness of the removal action.

Conclusion

In conclusion, those Federal and state natural resource trustees having the authority to claim for natural resource damages also have the authority to protect and restore marine resources, including fisheries and their habitats, from releases of chemical contaminants.

Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Lindsay's presentation:

Question: How much is natural resource damage assessment being done; i.e., is it being done for all of the Superfund sites or is there some sort of prioritization scheme to decide which ones get addressed first?

Response: Damage assessment is the "last straw" at sites where you have a recalcitrant responsible party or have a significant impact on natural resources with potentially large damages. Bringing in an economist and preparing to go to litigation to recover these large sums of money is very important to the agencies involved. Fortunately, these instances are relatively few to date.

Also, there are two arenas involved: oil spills and chemicals. The oil spill arena is much more damage assessment-prone, with a high media profile, involvement by different parties, and

immediate negotiations. With hazardous waste sites, most damage assessment-related activity pursued by NOAA and the Department of Interior is associated with EPA cleanup actions. Most of the damage assessment elements within this process take place during the negotiations for cleanup and the consent decree. And most of injuries that occur are not so large that they cannot be negotiated equitably with the responsible parties. This results in many "covenants-not-to-sue" issued under Section 122 of CERCLA when the responsible party takes action adequate to protect and restore the resources that have been injured. Sometimes this involves restoration actions or the parties may want to "cash-out" by paying an appropriate settlement determined by the natural resource trustees. The parties may also declare bankruptcy resulting in limited resources that must be allocated to cleanup or restoration by the U.S. government and the states. But by and large, most of the damage assessments are done behind closed doors in negotiated settlements during the cleanup process, then lodged in court and subject to a public review period. This does not mean that everyone is aware of these settlements; typically the bigger cases have higher visibility but are much fewer in number. For information about our program, you can call me at 206/526-4560, or if you want information on a particular site, call Bill Connor at the Damage Assessment Center in Silver Spring, MD (telephone number unavailable).

Question: Are the trustees from the natural resource agencies in the states involved in the negotiations and the covenants-not-to-sue?

Response: I can't speak for all sites, only those at which NOAA has considerable interest. For these sites, the answer is yes. By law, the trustees must be invited to be involved, but because of bureaucracy, sometimes we are not always notified, notifications are issued at the last minute, or the responsible parties want to settle and request release from further liability for natural resource damages from the Department of Justice. It is a very complicated process.

Comment: Final regulations will be published in January or December of this year to address problems states have had with the inadequacy of funds for small spills. This regulation will allow a lot of settlements to be lumped together in a fund that can be applied to a regional plan. Establishment of regional plans (e.g., the Delaware Bay) will create opportunities for restoration projects.

Local Government Role in Habitat Protection

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Introduction

Since 1994, the U.S. Environmental Protection Agency (EPA) has funded the National Association of Counties' (NACo) Coastal Watershed Management Project. This presentation will provide an overview of NACo, the Coastal Watershed Management Project, and the role of local officials in watershed management and protection. A brief discussion of the efforts of local officials in Carroll County, Maryland, to protect water resources illustrates how fisheries managers can access local officials to protect and restore habitat. Finally, NACo resources available to assist fisheries managers and others working to protect and restore watersheds, will be described.

National Association of Counties

NACo represents approximately two-thirds of the more than 3,100 county governments across the United States. The 1,800 member counties comprise over 90 percent of the US population. NACo's primary objectives are to:

- Act as a liaison with other levels of government,
- Improve public understanding of counties,
- Serve as a national advocate for counties, and
- Provide a resource for counties to help them find innovative methods to meet the challenges they face.

Member counties direct NACo policy and activities through steering committees, the Board of Directors, elected leadership and affiliate organizations. Member counties also vote on the American County Platform and Resolutions at the annual conference.

NACo's Community Services Division provides assistance to county officials to improve community infrastructure and the environment. Community Services Division projects with EPA funding include:

- Sustainable Communities Initiative,
- Radon/Indoor Air Project,
- Pollution Prevention Project,
- Solid Waste Management Project,
- Source Water Protection Project, and
- Coastal Watershed Management Project.

The Importance of Coastal Watersheds to Counties

Coastal counties are home to over half of the US population and natural resources vital to local economies. County governments are responsible for providing a wide range of services that can affect habitat protection and restoration. County officials play an integral decision-making role that balances the needs of economic development and environmental health in coastal watershed communities. Tools such as planning and zoning are used by local officials to manage growth and protect public health in their counties. Often, concerns cross geographic and political boundaries.

NACo's Coastal Watershed Management Project began in 1994 with funding from the US EPA's National Estuary Program. The goals of the project are to:

- Develop a communication network that promotes local government coastal initiatives,
- Provide technical assistance, such as coastal protection training,
- Develop in partnership tools needed by public and private leaders to sustain coastal communities, and
- Produce publications, fact sheets and articles on coastal issues and programs.

To facilitate these goals, NACo established the Coastal Watershed Advisory Committee (CWAC). The CWAC is comprised of elected and appointed officials from NACo's Environment, Energy and Land Use Steering Committee and representatives from state associations of counties. Currently the CWAC has 28 members representing coastal counties across the country.

In January 1996, the CWAC produced its first report, "Watershed Management and Sustainable Development in Coastal Counties." Part of the CWAC's mission is to increase the NACo membership's awareness of coastal watershed issues. The CWAC will propose incorporating a coastal watershed management section as official NACo policy at NACo's Annual Meeting in July 1996.

Accessing Local Officials to Assist Habitat Protection and Restoration: Lessons Learned from Carroll County, Maryland

Carroll County is a rural agricultural community in north central Maryland. The watersheds of Piney and Alloway Creeks begin in Adams County, Pennsylvania and flow through the northwest corner of Carroll County. The County is participating in the Piney and Alloway Creek Targeted Watershed Project, a Maryland statewide initiative to facilitate multi-agency watershed efforts. Declining water quality resulting from treated sewage and rainfall runoff containing sediments, fertilizers, manure and other substances, is the primary concern. The Piney and Alloway Creek project will restore riparian habitats and stream channels and serve as a demonstration for other restoration efforts. The project was primarily funded by a Nonpoint Source grant under Section 319 of the Clean Water Act with matching funds from partner organizations.

Public drinking water is a priority issue for Carroll County. The County Division of Water Resource Management has completed a draft wellhead protection plan and will finish a Water Resource Management ordinance by the end of the year. Restoration efforts completed under the Piney and Alloway Creek project would assist in attaining improved water quality for one municipal groundwater supply in Carroll County. The Division of Water Resources worked with the Carroll Soil Conservation District to coordinate county-level activities to achieve multiple benefits. For instance, the Division assisted the Soil Conservation District in establishing a data base and geographic information system mapping land use activities, management practices, and conservation planning within the watershed. County staff also assisted State and Federal agencies in restoring riparian habitat on private land.

Priority issues for local governments often focus on public health, safety and economic stability. Habitat issues may be related to these concerns, but these connections may not be readily apparent to local officials. Fisheries managers can help educate elected and appointed officials and citizens on the interrelationship of fisheries and watershed issues. As shown in Carroll County, habitat protection and restoration may be achieved as a secondary benefit to initiatives or ordinances to protect drinking water. Collaborative solutions, such as multi-agency efforts, also benefit local governments by saving money and other resources.

Local government can be a valuable partner in efforts to protect and restore fish habitat. Fisheries managers and others working to protect and restore fish habitat can take proactive steps towards working with local government. Suggestions from county staff include:

- Meet with elected and appointed officials,
- Learn the priority issues for local government; e.g. water quality, water supply, or growth management concerns,
- Work with an existing framework; e.g. local comprehensive plan, permit review, ordinance development, local or state watershed plan,
- Educate local officials and citizens on the interrelationship of fisheries habitat and watershed issues,
- Remember habitat protection and restoration may be a secondary benefit to initiatives or ordinances to protect public health and safety; e.g. drinking water, and
- Focus on opportunities and collaborative solutions.

NACo is a Resource

As a direct link to county governments across the country, NACo is a resource for fisheries managers and others working to protect and restore fish habitat. There are a number of avenues to publicize or facilitate different aspects of local government involvement with fish habitat efforts. First, articles may be submitted for publication in the *County News*, a biweekly newspaper with 30,000 subscribers or the *County Environmental Quarterly*, which has a smaller, but more specialized readership. Second, NACo hosts three major conferences per year (a Legislative Conference in March, the Western Interstate Regional Conference in May, and an Annual Conference in July), with at least one workshop focusing on watershed management issues. In addition, NACo's Coastal Watershed Advisory Committee is comprised of elected and

appointed county officials with expertise in watershed concerns. The members are excellent resource people.

State Associations of Counties also have annual meetings with workshops focusing on county issues, such as water quality. Most State Associations have an environmental specialist or staff contact. NACo also has numerous affiliate organizations, such as the National Association of County Planners and the National Association of County and City Health Officials. State Associations and NACo affiliates can provide linkages to networks of county officials and staff.

Conclusion

The goal of this presentation was to discuss how local government can be a valuable partner to protect and restore fish habitat and related watershed efforts. NACo's Coastal Watershed Management Project was established to raise local officials' awareness of coastal watershed issues. NACo and the Coastal Watershed project are resources for fisheries managers to facilitate or publicize local government involvement in habitat protection and restoration. The experience of Carroll County, Maryland, shows that by acting upon the priority issue of groundwater protection, riparian habitat restoration was achieved as a secondary benefit. For more information, please contact Abby Friedman: at NACo, (202) 942-4225, 440 First Street, NW, Washington, DC 20001 or email at: afriedma@naco.org.

Chapter 3

Implications of Identifying Essential Fish Habitat

Essential Fish Habitat: Considerations for the ASMFC

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Introduction

The term "essential habitat" first came to my attention in 1993 when I became involved with the Atlantic States Marine Fisheries Commission's (hereafter ASMFC or Commission) Habitat Committee's efforts to prepare a generic habitat section outline for use in the preparation of Fishery Management Plans (FMPs). Since that time, especially since incorporation of the term into the language of the various versions of the Magnuson Act during its reauthorization journey, the term has been and continues to be the subject of much discussion among professional fishery biologists and others interested in fishery conservation. In this presentation, I will review the background considerations which led to the development of the ASMFC definition of essential habitat, as well as speculate on future considerations for the ASMFC as it strives to deal with the integration of essential habitat into the fishery management planning process. Preparation of this presentation has benefitted greatly from professional interactions with: my colleagues in the U.S. Fish and Wildlife Service, especially Bill Cole and Connie Young-Dubovsky; Dianne Stephan, Habitat Coordinator for the ASMFC; Roger Pugliese, Fishery Biologist with the South Atlantic Fishery Management Council; and David K. Stevenson, Bureau of Marine Sciences, Maine Department of Marine Resources.

Background Considerations

The ASMFC Habitat Committee (Committee) was created in 1991. The Statement of Policy and Activities in which the Committee outlined its charge specified that the program goal was (ASMFC 1992):

> To bring the unique capabilities of the ASMFC to bear in order to stimulate activities to conserve and restore coastal and estuarine habitat.

Under its Policy Formulation and Analysis program area, the Committee furthered the Habitat Program's charge to:

1. Evaluate legislation and institutional mechanisms that result in public policy decisions affecting fisheries habitat, and make recommendations as appropriate.

2. Review and evaluate state and federal agency programs that affect fisheries habitat; and make recommendations as appropriate.

3. Review and evaluate agency implementation of the Joint Statement to Conserve Marine, Estuarine and Riverine Habitat.

4. Review and evaluate the habitat sections of Commission Fishery Management Plans and provide advice to the relevant Management Board, as appropriate.

At its July 1993 meeting, the ASMFC Management and Science Committee formed an ad-hoc committee to draft a set of recommendations on what kind of habitat information to include in ASMFC FMPs and how to proceed with the job. The very first item that the committee recommended (as developed by Dave Stevenson, Bruce Halgren (NJ), Tom Fote (NJ and Chair of the Habitat Committee), Susan Shipman (GA), Bonnie Brown (VA) and Dianne Stephan) was (ASMFC 1993a):

> ASMFC should adopt a working definition of habitat. Critical questions are whether the definition should be limited strictly to the physical habitat or whether it should be broadened to include other species (prey, predators, competitors) in the ecosystem. Even if restricted to a physical definition, should it include water quality (and therefore embrace nutrient loading, land use and watershed management practices)?

The suggested definition that the committee ultimately recommended was:

> The physical environment(s) inhabited by any life stage of the species of interest and the ecological/biological factors that affect populations of the species such as forage, predators, and co-existing competing species.

The subject of fish habitat was much discussed at the November 1993, ASMFC Annual Meeting. A roundtable discussion, entitled "How Can the ASMFC Best Affect Fish Habitat Protection?" was held during the meeting. Participants in the discussion determined (ASMFC 1993b) that "ideally, mapping of all required habitat [emphasis added] for species under management should be included in FMPs" and that " ... it is extremely important to document the habitat needs of each species under management."

At the November 1993 Habitat Committee meeting, the Management Information Document for Amendment #5 of the Interstate FMP for Atlantic Striped Bass was distributed for review by the Plan Development Team (PDT). The PDT had been asked by the Management and Science Committee to integrate habitat considerations into this major amendment, and I was asked, as principal plan writer, to use the amendment as a vehicle for developing a generic habitat outline for use in it and future FMPs. A subsequent motion to this effect was approved by the committee and recommended to the Commission's Interstate Fishery Management Policy Board. The day after the meeting, I scribbled the first draft of that outline, on which I noted Roman numeral I as: "Description of Essential Habitats (avoid use of term 'critical habitats' which has a legal implication under the Endangered Species Act)".

The outline that was produced drew heavily on the first ASMFC plan to contain a significant habitat section, the Fishery Management Plan for Inshore Stocks of Winter Flounder (Howell et al. 1992). This plan was the first to contain extensive specific recommendations for management of habitat, but did not consider the issue of what constituted essential habitat for the species.

The initial version of the outline, distributed for review in January 1994, continued use of the term "essential habitats" without the benefit of a definition. As review of the outline proceeded and comments began to trickle in, it became evident that the term would have to be defined. In August 1994, in response to a request from Dianne Stephan, I prepared a memo discussing options for the definition of essential habitat, the partial contents of which follow:

> The current [July 14, 1994] staff discussion draft of the proposed amendments to the Magnuson Fishery Conservation and Management Act defines "essential fishery habitat" as " . . . those areas necessary to fish for spawning, breeding, or growth to maturity". It appears that under this definition, any habitat used by any species, at any time, for the defined functions would be considered "essential". As you and I discussed, the area of "habitat" (which we defined as any conceivable area that any life stage of a given species would ever use) which a given fish species would use would always be greater than the amount considered "essential".

However, when we try to determine what specific habitat types or areas are "essential" or "necessary", based on the above definition or on one which we formulate for ASMFC purposes, we encounter some difficulties. We can define "essential" habitat area in several different ways. One approach is to base our definition on habitats that may constitute a vital step in the species' life history and are important functionally as some sort of gateway or pathway (e.g., Oregon Inlet would thereby be "essential" and "necessary" habitat for a host of species spawned offshore in the Atlantic Ocean, and which must immigrate through it to reach their estuarine nursery areas, and for which it is the only available inlet to Albemarle Sound; the same would be true for all anadromous species' adults which must travel from the ocean, through Oregon Inlet, to reach spawning grounds on the Roanoke, Chowan and all other tributaries of Albemarle Sound). We could therefore say that all inlet habitat on the Atlantic Coast is "essential" and "necessary", since if the larval and postlarval stages and spawning adults can't get through, there is no growth to maturity and all these fisheries would ultimately collapse. Since many of the species spawning offshore produce literally millions of offspring, usually far in excess of what could occupy the available nursery area habitat, then maybe under this approach their spawning habitats would not be considered "essential", or perhaps not <u>all</u> of the spawning habitat (i.e., you only need enough spawning area to produce sufficient amounts of recruits to fill the available nursery area habitat). For other species that spawn in very small areas (striped bass?), spawning habitat would be considered "essential".

This approach works fine for inlets and for discrete spawning areas, but is not so clean and neat for other habitats that we might consider "essential" because of the role they perform as spawning, nursery or adult resident habitats. The reason it isn't so clear is because we have to consider the size of the population we want to produce before we can determine how much of the habitat that they occupy at various life stages is "essential". For example, one subset of "essential" habitats is legally defined, under the Endangered Species Act of 1973, as amended, as "critical" habitats. These "critical" habitats are reserved for designation for those listed species for which such habitat represents the last remaining vestige of formerly more widespread distributions. In most cases, these populations are on their last legs, and everyone would agree that these habitats are "essential" as well as "critical" for the survival of the species. In many cases, the amount of "critical" habitat

designated is not adequate for ensuring the survival of the species in question, and the Recovery Plan will indicate that establishment of additional populations (and supporting habitat) is necessary (i.e., "essential") to enable the recovery of the species. For many of these species, geneticists have determined what the minimum population level is for maintaining a viable population, and it may be a relatively simple task to determine how much area is needed by that population size, thereby enabling us to estimate how much habitat is needed for maintaining a viable population in a biological sense.

I think that everyone who is in the fishery management business would agree that restricting our definition of "essential" habitat to that area necessary for sustaining a viable population of a given species is not sufficient, since the whole rationale behind fisheries management is to produce/maintain a population size which will allow for harvest. So, I think we can all agree that "essential" area is larger than "critical", and smaller than "habitat".

The question is, how much larger? The answer lies in how many individuals we want to produce beyond the population level at which the species can sustain itself. Here we begin to re-enter territory which is familiar to those of us who have been dealing with striped bass. In establishing parameters for the level of striped bass spawning stock biomass (SSB) that you need, do you run your model of the historical fishery with the harvest rates present during the years the stock was at a peak, and take those SSB values as representative of the amount you need to sustain harvest, or do you run the model with more conservative harvest levels and allow SSB to climb even higher? If you select the latter course, then more habitat is "essential", because it is necessary for supporting a larger population size (at least this is true if you believe that at some point, density dependence comes into play).

So, if you accept the above logic, "essential" habitat becomes that amount of all functional habitat categories (spawning, nursery, juvenile, adult resident, etc.) which is necessary to support the desired population size. It may be that individual management boards will be able to make some guesses about what kind of area might be needed for their species. The larger the target population size for a given species, the greater the quantity of "essential" habitat required. If we are satisfied with striped bass population levels that will allow harvest levels equivalent to those observed during peak harvest years, then probably all the habitat presently occupied by Atlantic Coast migratory striped bass is "essential". If we're not satisfied with those levels, and we want to achieve population levels more akin to what they were at or before European colonization of North America, then we have to start restoring access to blocked spawning areas and reestablishing spawning runs, and we have to expand our definition of "essential" to include areas not used presently, but which were used historically.

But, to throw in one more complicating factor, habitat is not only the physical space that a species occupies throughout its life cycle, but also includes other biological components, such as prey. If we preserve "essential" habitats without considering the need to preserve/restore the community also, then we may not get very far with restoration of the target species, or, we may have some unintended impacts on other species (is there more

than coincidence to the concurrent upsurge in striped bass and declines in bluefish and weakfish?). Some fishery biologists believe that we need to move away from the single species approach to management toward more of a community approach that considers management of at least guilds of fishes, if not community management.

This string of reasoning resulted in the definition that I included in a narrative attached to the memorandum, and led to the following draft definition of essential habitat in January 1994:

> For the purposes of the ASMFC, "essential" habitat means that amount of habitat and the associated biological community which is necessary to support the population of the particular species (or guild of species) at a level determined appropriate by the ASMFC Management Board responsible for that species (or species guild).

After review by the members of the Habitat Outline Working Group, the definition was revised to delete the reference to stock level being determined by the Management Board, to read as follows in August 1994:

> For the purposes of the ASMFC, "essential" habitat means that amount of habitat and the associated biological community which is necessary to support the population of the particular species (or guild of species) at a predetermined level.

Further refinements were made as the review process continued, with comments received from Habitat and Management and Science Committee reviewers. All reviewers recommended specifying in the narrative, either in the definition of essential habitat or within the descriptions of what should be contained in an FMP, that essential habitat goes beyond the physical and encompasses the ecological aspects of a species' relationship with its habitat. One reviewer provided a copy of a paper prepared a decade earlier that addressed the subject of "critical habitats" for fish (Odum 1984). Odum (1984) defined "critical habitat" as " ... locations such as marshes, mangrove swamps, seagrass beds, kelp forests, and coral reefs which are indispensable to a fisheries organism during at least a portion of its life history" [p. 1]. Odum's definition was clearly less all-encompassing than the definition proposed for ASMFC or those proposed for use in the Magnuson Act.

The Magnuson Act proposed definition was also in the process of undergoing change, or at least had several permutations. One sent in by one of the reviewers in September 1994, read as follows:

> The term "essential fishery habitat" means an area which includes physical or biological features which (i) are essential to the conservation and management of a fishery and (ii) may require special management considerations or protection.

After further discussion and review, the Habitat Committee formally adopted the following definition and forwarded it to the Interstate Fishery Management Program Policy Board as follows in October 1994:

> For the purposes of the ASMFC, "essential habitat" refers to the habitat that is known to be required for the successful reproduction and survival of the managed species. Since different life history stages of a species often utilize different habitats, the identification of essential habitat requires knowledge of the life history stages during which the production of the species is most directly affected, and the habitats that support those essential life history stages. For some species for which the required information is available, "essential habitat" could alternatively mean that amount of habitat which is necessary to support the population of the managed species.

The definition of essential habitat was adopted by the ISFMP Policy Board at its October 1994, meeting, along with the outline and narrative for FMP habitat sections, for use as guidance in the preparation of all ASFMC FMPs.

Future Considerations

Clearly, the constituents of those of us who are privileged to serve as fish and fish habitat managers are demanding that more attention be paid to habitats, regardless of how they are specifically defined. Adoption and use of the essential habitat concept has a number of implications for the ASMFC and the Magnuson Act Fishery Management Councils.

First, while we may be expected to address essential habitat for each species in the FMPs that we prepare, we frequently don't have a complete understanding of what is essential to a given species. This lack of understanding requires a great deal of research to elucidate the linkages between the life history of a species and its habitat requirements, not just in terms of the physical, but also the ecological. I am aware at present of only a few species for which quantitative relationships between habitat and production have been demonstrated (penaeid shrimp, see Turner 1977, and winter flounder, see Gibson 1991), and these consider only the nursery area component of these species' essential habitats. Far less is known and understood about how anthropogenic activities affect habitat use, and about how these induced impacts may be mitigated, if at all. Much work remains to be done before what is clearly essential is understood. The ASMFC can act in this arena by identifying research needs related to habitat in the published FMPs, supporting specific proposals for research that investigate species/habitat relationships, and lobbying for additional funding for fish habitat related research.

Once we do possess a thorough understanding of what is essential for a given species, our constituents must be educated. The ASMFC is already playing this role through incorporating habitat information into FMPs, providing a portable fish habitat exhibit to fishery-related trade shows and meetings, publishing the Habitat Hotline Atlantic newsletter, reaching out to habitat managers, and planning, hosting and conducting workshops such as the present one. Future transfer of habitat information on species under ASMFC management will be greatly facilitated by use of electronic media such as the Internet to literally bring current habitat information to the users' fingertips, and by the use of Geographic Information Systems (GIS) to store and display information on the spatial and temporal distribution of species. Combining these two powerful tools can result in future generations of biologists literally viewing the essential habitats for a given species on the screens at their desks.

As more is understood about a species' life history, the information must be incorporated into ASMFC FMPs, along with appropriate management recommendations for implementation by fishery management agencies and habitat management agencies. Much debate has occurred, and undoubtedly will continue to occur, regarding whether such habitat measures should be voluntary or mandatory (under the Atlantic Coastal Fisheries Cooperative Management Act). Some fish managers argue that measures should not be mandatory for compliance to the FMP, noting that their agencies are usually not granted the authority needed to promulgate and enforce habitat provisions. It would be unfair, they contend, to find a state out of compliance with required FMP habitat provisions and close a fishery because the habitat management agency with such authority was unable to or refused to implement the required measure. On the other hand, fishery management agencies typically have limited influence over habitat management agencies, and the inclusion of mandatory provisions in FMPs would give them considerable leverage to influence the habitat management process; e.g., "if you don't provide the instream flows necessary for this species to spawn, our state will be determined out of compliance and the fishery closed."

Where this dialogue will lead, only the future will reveal. I do note for the record, however, that current ASMFC success regarding restoration of the Atlantic migratory stock of striped bass was achieved only after the fishery management provisions of that FMP were made mandatory for compliance. That success led to passage of the Atlantic Coastal Fisheries Cooperative Management Act, which will replicate the striped bass model for many other species. Perhaps it is time for us to make as serious a commitment to habitat management as we have to the fish stocks which are dependent upon us to exercise habitat stewardship for future generations of both fish and their users.

Regardless of whether habitat management measures are voluntary or mandatory, the final point to be made is that action is required. Habitat measures developed by the Plan Development Teams, Advisory Panels, and Technical Committees and approved by the Management Boards and Commission for implementation by the member states are meaningless if they are allowed to sit on the shelf and gather dust. Habitat management measures in the plans must be conveyed to the appropriate agencies, both state and federal, for implementation. This, of necessity, requires more dialogue between the fishery management agencies and the habitat managers. That is the purpose of the present workshop, to establish such a dialogue, which I hope will lead to better implementation of habitat management measures and the ultimate recovery and sustainability of fish stocks in the United States.

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Laney's presentation:

Question: How do we assess the overlap of uses by the different targeted species in terms of available forage, etc.? We can determine what we need for weakfish and we can determine what we need for the bluefish, but how do we determine what we need for the coexistence of weakfish, bluefish, and rockfish?

Response: The short answer is that I don't know. The long answer is that conceptually I can envision some point in the future looking at the historical landings data that we have to make some sort of assessment to address a question raised earlier today as to what constitutes a healthy community. Can you look at historical data as snapshots in time of when striped bass, bluefish and weakfish were at levels that would be considered optimum from a fisheries perspective and therefore assume that there was a sufficient forage base to support all three species given inter-specific competition? I don't know. This embodies the concept of multi-species management plans, which gets more towards a community approach. Some people at the National Marine Fisheries Service on the west coast have developed multi-species management plans.

This is the direction where I would ultimately like to see us go – managing whole communities instead of individual species. But from a practical standpoint, this is difficult to do because the requirements are so different for many species. For example, anadromous fishes may spawn relatively far inland, including those that migrate from several different systems and collectively gather offshore somewhere to overwinter. For these species, it makes more sense to have a plan that addresses the whole species as a unit because it is easier from administrative and political standpoints to reach consensus on a species-specific, as opposed to habitat-specific, basis.

Question: But as your database needs to be increased, ultimately you're going towards a community management approach anyway.

Response: Yes. The other thing that occurred to me is that you could conceivably set minimum thresholds using all of the mapping tools that are available (e.g., if the habitat is not used by 15-20 species, it will not be considered essential). All data could be put into a GIS system and anything with an "n" of greater than 15 would be considered essential habitat. Of course, this is strictly an anthropogenic standpoint and is probably not a good idea. I'm of the mindset that just because a habitat is contaminated does not mean that it should be excluded; it should be cleaned up.

Planning to Meet the Challenge: A Process to Implement "Essential Fish Habitat"

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[*Note to the reader*: The Magnuson-Stevens Fisheries Conservation and Management Act amended by the Sustainable Fisheries Act was signed into law by the President on October 11, 1996.]

Implementation of the essential fish habitat concept into living marine resource management is of great importance to the National Marine Fisheries Service (NMFS) habitat mission. Essential fish habitat (EFH) is a tool that NMFS will utilize to move forward with its habitat conservation mandate.

NMFS is charged to protect and conserve the habitat of living marine resources to help ensure the sustainability of the Nation's fishery stocks. Under current methods of habitat conservation, this responsibility has been difficult to implement effectively. Requirements of the Fish and Wildlife Coordination Act (FWCA) provide NMFS with the opportunity to comment on activities that may impact living marine and anadromous resource habitat. Historic methods have been reactive, untimely, and only partially effective. The number of project applications actually reviewed is small compared to the number received over the course of the year, and the process is in need of a prioritization mechanism. The proposed habitat provisions included in the Magnuson Act reauthorization present a potential to more effectively protect habitat for trust resources.

We in the Office of Habitat Conservation recognize the need for an integrated tool to manage and protect trust resources and their habitat. The Office must take an active role in addressing the cumulative impacts of development projects and be involved in all phases of the project; early planning, permitting and construction, and follow-up actions. There is a need for an integrated approach to addressing habitat issues, including advance planning using watershed management and priority assessment of human impacts. NMFS supports the Administration's new wetlands policies by working towards no-net-loss of wetlands and improving the efficiency of the permit review process. New authorities of the Magnuson Act will feed into the comment process associated with the established FWCA process, expanding NMFS coverage of projects and proposed actions that may affect trust resources. Implementation of this tool provides four benefits. It 1) supports priority-setting by identification of essential habitat and major threats, 2) relates directly to our policy movement to ecosystem approaches, 3) establishes a public review process for identification of threats and recommended management actions that will increase the public awareness for our habitat issues, and 4) provides us with an additional tool to address these issues.

The Office took action early in 1995 to examine the potential application as well as implications of the implementation of EFH. A cooperative project was established with the

National Ocean Service (NOS) Office of Ocean Resources Conservation and Assessment. A demonstration project was developed using summer flounder as a test case. Species life history and habitat information was collected, assessed, and mapped, and a summary report of the project was produced.

The demonstration project used national databases that were available from within NOAA. Data resources included species distribution and relative abundance data from the NOS Estuarine Living Marine Resources Program, distribution data from the NMFS Northeast Fishery Science Center trawl surveys, National Coastal Wetlands Inventory data, and physical data from the NOS National Estuarine Inventory. The demonstration project accomplished several objectives, namely 1) mapping capability was introduced into the Office of Habitat Conservation, 2) methods and maps were developed for identifying habitats and species distributions, and 3) several recommendations were made for future work on EFH.

Given the outcomes of the demonstration project, NMFS elected to expand the prototype in FY1996 using a second species. The Atlantic States Marine Fisheries Commission (ASMFC) was concurrently developing Amendment 3 to their weakfish fishery management plan (FMP), so the coordinated efforts of NMFS and ASMFC benefitted both organizations. NMFS benefited through the Commission's access to state fishery-independent trawl survey data, and the Commission received a set of distribution and relative abundance maps that were used to improve the habitat section of this FMP amendment.

With the completion of two demonstration projects within the headquarters office, the next step in the process was the expansion of the EFH model to involve a broader group within the agency. A NMFS EFH working group was established with diverse representation from the science centers, regions and headquarters offices. The group's expertise includes fisheries management, habitat conservation, and research science. The role of the group is to develop guidance for implementation of any EFH mandate, expansion and improvement of a standard methodology, and coordination in final implementation. Likewise, the group will also provide important connections to Council representatives in the field.

Many questions exist around the implementation of the final habitat provisions. These concepts initially will be addressed through the working group. NMFS will develop a standard interpretation of the concise legal definition provided in the final legislation. For instance, the levels to which habitat should be restored (i.e., maintenance of 1996 levels, return to historic conditions, etc.) must be determined. The working group will develop guidelines for the implementation of the final provisions, to assist the Councils in their requirements to amend each of their FMPs.

The House and Senate bills provided relatively similar habitat provisions, with a few variations primarily centered around the schedule for implementation. Both bills call for the identification of threats to habitat as well as conservation and management measures to address threats. NMFS agrees with both of these areas and plans to address them regardless of the final legislation. Current FMPs are inconsistent in their coverage of threats and management measures. With this legislation, a standard methodology will be developed so that all FMPs provide an adequate and useful assessment of impacts to the habitat.

The Senate draft envisions a concise implementation schedule. If this schedule continues through the final legislation, NMFS will be required to complete guidelines for the description and identification of EFH within 6 months from the date of enactment. The Councils will also be held to a compressed schedule, as amendments to all management plans submitted to the Secretary will be required within 24 months from the date of enactment. In order to meet this schedule, NMFS has been proactive in its tasks. This advance work will reduce the number of tasks that will be required immediately following enactment of the amendments.

The EFH initiative represents a significant change to the current role of habitat in fisheries management. While the early stages of the initiative were completed largely within NMFS headquarters, in the past year it has involved many more NMFS players from around the country, all of whom will have a role in or will be affected by the final outcomes. This conference is an indication of the cooperative nature of the initiative. NMFS is working with ASMFC with the common desire to improve habitat sections in both Federal and interstate commission FMPs. As development continues, commissions, councils, academia and others will have a role in the implementation of the habitat provisions.

EFH is moving forward within NMFS. It has garnered the support of the agencies' leadership and is likely to be passed by Congress. The challenges facing NMFS are many and exhaustive, however the end result will be the enhancement of habitat conservation. Implementation of the amendments challenges the agency to identify and support the importance of habitat conservation to the sustainability of healthy fisheries.

Concerns and Implications for Essential Habitat Identification

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This presentation will present a different perspective: I am not a habitat manager; I do not work for the federal government; and I study an organism that does not have a backbone nor go to sea, namely the blue crab. In fact, I look at many fish as food for the crabs or I look at the crabs as prey for a number of different fish species. But, this somewhat odd perspective has certainly brought me into contact with a lot of habitats that are essential for marine fish. Some of these, such as the bays and estuaries of southern New Jersey quickly come to mind as essential habitat. Others such as Raritan Bay, the Anchorage, or Governor's Island in lower New York Harbor are interesting habitats but do not come to mind as readily, if at all (e.g., Bayonne or Newark Bay). These areas, however, cannot be neglected. This is because across the nation, we have spent a lot of time developing many of the large estuaries that are important for fish habitat into large areas that are also important for commercial and industrial uses. Very often, these two activities could be perceived as being at odds with one another.

My approach is based on whole community interactions. We all know that a relatively stable and healthy community of species is needed in order to support the fish populations that we are interested in maintaining. So I took a trophic approach to determine who is the bait, where does it live, and what keeps it healthy. We know the most with respect to the first question. As to where the bait lives, various studies have taken different approaches to get a handle on the distribution of organisms. For an EPA study on water quality indicators in 1991, I mapped the distribution of species that might be important as fish food in the hopes that maybe the results would be related to known water quality parameters. I think that these kind of data might be helpful when taking a community approach to essential habitat identification. These pieces of information are available from other studies, can be mapped using GIS, and might be added as an additional data layer to understand where the bait lives.

Regarding health of the bait, we need to consider water and sediment quality issues. Because several others have already addressed water quality, and, given my professional background, I will restrict my remarks to sediment quality. Sediments for many urban estuarine systems are contaminated with a whole suite of chemicals, from heavy metals to organics. While my recent research has focused on dioxin, I do not want to leave the impression that this is the only chemical that warrants concern. Many of the sediments in the Hudson-Raritan Bay complex cause direct mortality to a number of species in a 96-hour bioassay. Severely toxic sediments are found in Newark Bay, through parts of the Raritan River and Bay, up into the Hudson, and out towards Long Island Sound. There are also toxic sediments near the Mud Dump site.

Several years ago, we examined dioxin contamination in blue crabs for the State of New Jersey. Results from this study as well as another study for EPA on lobsters demonstrate how materials in the sediment are being taken up by these animals, which can be considered as fish

under Congress' definition. These results are very disturbing given that the Food and Drug Administration issues warnings for dioxin concentrations of 25 ppt and animals were found to be heavily contaminated (e.g., 40 ppt in muscle tissue; 155-235 in the hepatopancreas). This situation is serious; the fishery is already impacted, resulting in consumption bans and health advisories.

In addition to crabs and lobsters, we studied worms as part of an overall trophic approach. Based on an examination of sediment values and levels in worms, we can show that organisms are accumulating dioxin through the food chain. A few years ago, NMFS studied fish near the Mud Dump site but unfortunately was not able to report data on dioxin due to poor analytical techniques. So while we do not know what is being taken up by the "real" fish in this area, we do know what is being accumulated by the "lobster fish".

What are the implications for essential habitat? EPA is interested in expanding the dredged materials dump site and is in the process of beginning an environmental impact statement (some public hearings have already been held). Two expansion options have been proposed. The first will allow expansion only for Category 1 sediments, which are clean sediments. It is believed that this option would help in remediating the existing problem. This is because dredging of the Category 3 materials currently found there would fail marine dumping criteria, which means that the sediments could not be placed back in the ocean. This proposal would essentially use clean sand as a cap. The second proposal would allow dumping of some Category 2 sediments prior to covering with Category 1 materials. Category 2 sediments are not acutely biotoxic (i.e., animals survive a 96-hour bioassay), but they do bioaccumulate in a 28-day test.

I believe this area is essential fish habitat, so the question involves concern over bioaccumulation of toxic chemicals. Also, when materials are dumped, the Corps of Engineers estimates that 5 percent of the material is lost. Where does this material go? It probably settles in normal depositional zones. Will these areas be capped? There is already contamination in these locations in the sediments, worms, and lobsters. This is one of my concerns and it relates to the abilities of the Fisheries Management Councils and NMFS to provide comment on a proposal that might affect essential habitat.

In addition to concerns over the existence of toxic chemicals and bioaccumulation, I am concerned over the fact that there are many animals that still live there. We are degrading the habitat, but delineation of essential fish habitat should not leave out this area because it is too degraded. It is essential; there are animals that live there. In any population, there are individuals that are better genetically able to withstand certain conditions. Even if they do not live in this area as juveniles, I know that they live there as adults. For example, during a 10-minute trawl in this area, we collected 80 blue crabs. Once this area is designated as nonessential, certain regulators may believe that it is acceptable to do whatever they want.

We have to do our best to protect all of the habitat we have, even if it is presently degraded. We have to try to figure out ways to communicate, not only among different agencies, but also among stakeholders that might want to have a subsistence fishery, the local government, and people that need to use these areas as a port or industrial area. There are ways for all parties to arrive at compromises in order to maintain the habitat and use of the port.

Finally, I am interested in education. I just received a grant to involve the public as well as school children in the process. The grant is aimed at bringing GIS technology into the middle schools. This grant will enable us to teach 6th, 7th, and 8th grade students to use GIS technology to understand their watershed. We will begin with the Passaic and Hackensack watersheds, which form Newark Bay. These kinds of efforts require input from everyone, because the children need to learn not only how to manipulate the technology, but how to use the technology to create a generation of people with a greater understanding of habitats, watersheds, and how the whole system fits together.

Discussion

The following comment was made by a workshop participant at the conclusion of Dr. Cristini's presentation:

Comment: From a water quality standards context, a contaminated shellfish bed gets whole protection as a use. If it's not contaminated (e.g., recreational shellfishing), you sort of have two uses and the full protection of the Act is afforded. I think you can translate this to some of your concerns about essential fish habitat as an issue that can be dealt with fairly squarely.

Discussion Session: Essential Fish Habitat

Scott Burns, Facilitator
World Wildlife Federation

To begin the discussion, Mr. Burns noted that one issue that had arisen in many of the day's presentations concerned the extent to which the habitat identification process is about setting priorities. This was particularly an issue in the last presentation; i.e., the notion that degraded habitat shouldn't necessarily be excluded from the identification process. If the concept is examined in the broadest possible sense, resulting in the identification of any habitat that at one time may have been suitable for species managed under the Magnuson Act, then everything will be mapped and provide little help in setting priorities. Therefore, how do we go about setting priorities, given the fact that we all have limited resources? How do we make sure that those resources are spent in the way that is most likely to have a positive result on the fish populations? Participants responded with the following comments:

- In terms of identifying essential habitat, I suspect you'll start at the other end and define nonessential habitat; everything else is essential. I don't know what nonessential habitat is, much less essential habitat. It's almost what you've admitted you can do without. This raises the question of a migratory species whose range has been degraded and therefore contracted. Where do you start? I think you'll always have to start with nonessential habitat, but critical habitat has to be your first priority.

- Essentially you need to start out with a range of species and identify various levels of production, even in areas that aren't degraded. Then you need to develop a formula to estimate the amount of species/population that is produced by a given amount of habitat. This is all very idealistic – attempting to quantify the amounts produced by different locations – but then you can just decide how much you want. I'm not saying that this is what we'll try to do, but the concept of essential habitat almost forces you into this kind of thinking.

- The Magnuson Act takes non-managed species out of essential habitat considerations. Other questions, e.g., how much do we want, are not relevant for these species. I'm not sure we should ignore this.

- During Superfund Reauthorization, they tried to change the cleanup criteria to account for the importance of the ecosystem in maintaining a viable population. It could then be argued, for example, that compromising Newark Bay would not affect the Blue Crab population because they are found everywhere. This is ludicrous. We need to be building on the strengths of the different mandates so that they all support each other. A lot of words from the Superfund Act have an effect on the Magnuson Act. For example, NOAA uses the definition of "fish" from the Superfund Act, i.e., any living thing, to justify habitat protection.

- In terms of implementing what might happen under the Magnuson Act, the Fisheries Service needs to recognize that the way the Council works now is species by species. If we don't break this mold, then we will continue to work in this vein instead of looking at habitat issues in a broader context. If we are not made to document an entire habitat, then we'll be forced by the system to work plan-by-plan. The management system has to be designed to examine issues on a broader scale or we won't come up with the priorities that we hope to see.

- FMPs should include a restoration component and therefore will identify opportunities. It will then come down to an evaluation of costs and benefits. Another reason for focusing on GIS systems is in recognition of the Council's species-by-species approach. GIS allows us to sort through the vast amount of data to specify a particular ecosystem and identify essential habitats for the species in that ecosystem and potential threats. The database can then be used for management purposes. Another important issue concerning priority setting is permitting. Various categories of activity and types of habitat get treated differently (e.g., Categories I, II and III are subject to different types and levels of review). We need to incorporate not just the geographic area, but the degree of the threat.

Mr. Burns then asked participants to describe how they believe the results of the essential habitat identification process will affect the way the NMFS's habitat program works. Specifically, will the process influence the level of attention given to different types of regulatory activities? Participants answered as follows:

- It could definitely do that. For example, there's no reason why one letter couldn't suffice for comments on a particular project that pertain to different acts. One of the biggest changes, however, is the ability to have all of the data in GIS. For example, the Corps of Engineers needs to meet certain standards for substantial impacts. A lot of little projects don't meet the standard individually, but the cumulative impacts may. This will also help in prioritizing.

- It's also important that the process will force the Agency to place habitat at a higher level of priority. About 80 percent of the Agency's efforts is now directed towards management of fish stocks. Essential fish habitat will now be on an equal level with protecting individual species. This is an opportunity. We really have to start by identifying the various life stages and their habitat requirements. Without this information, you can't define essential fish habitat. But we need to be careful, because the areas that aren't designated then get developed.

- The difficulty is that in trying to do everything, you're not setting priorities. Part of the impetus for identifying essential fish habitat was the recognition that problems can't be solved in the current piece-meal manner.

- Another important component of essential fish habitat is a threat analysis of the areas that have been mapped. Then it becomes clearer that a particular habitat that is important as a nursery for a particular species is also subject to a number of short-term stresses. In effect, the threat analysis is another GIS overlay. The essential habitat may not itself be determined by the threats, but the analysis can help in setting priorities.

- Several years ago, a stretch of the Delaware River had very low dissolved oxygen. After spending a lot of money and effort to clean it up, the fish came back. A few years later, a high concentration of PCBs was discovered in the fish. Where do you start drawing the line in determining priorities? What is non-essential?

- The terms "essential" and "non-essential" are problematic. To a particular species, everything that is used is essential. Trying to put bounds on what is essential gets back to the question of what stock size do you want to manage to. And still this won't answer the question because populations fluctuate, even when anthropogenic effects are low. A good example is striped bass. Everyone believed that part of the problem was habitat degradation, and although several studies found some habitat impacts, the big factor was controlling harvests. Not only did the striped bass rebound, but in 1994 throughout most of the nursery areas on the East Coast for all of the different stocks, they produced record year classes. We still don't know exactly why. Although some cleanup measures had been taken, natural variations must be taken into consideration when trying to define the stock size, which in turn, would define the essential habitat.

  In terms of setting priorities, it is almost preferential to define priorities in terms of what habitats need to be cleaned up first, because if the habitat or access to the habitat is cleaned up, the species will take care of themselves. But if we keep with the species-by-species approach, at least in the short term, there are some obvious candidates that are in worse condition than others. For example, from a generic standpoint, the anadromous group has more problems than pelagic species simply because they require access to the spawning habitats that have been blocked off or altered.

To follow up with the last comment, Mr. Burns noted the time constraints facing managers and asked participants for feedback on the merits of a species-by-species approach versus a group approach (e.g., anadromous species). Does the latter save time and energy? Is it realistic? Participants provided the following input:

- This is sort of "déja vu" all over again; i.e., partly biological and partly regulatory issues. During the wetlands categorization process, which entailed a ranking process, people were concerned about the lack of upfront knowledge (e.g., unknown threats) to determine which wetlands were the most important. One of the ways this concern was dealt with involved the development of a screening mechanism with ranges. This approach helped mesh biological characteristics with a regulatory program. The National Academy of Sciences report that was released last May on wetlands categorization could probably provide some worthwhile information.

- We need to consider how economics fits into prioritization. For example, how do we account for species with greater economic value or those that may respond more quickly?

- The biology of the species may be another criterion that should be considered in setting priorities. For example, weakfish mature at an early age and have a relatively high fecundity, so they will respond more quickly to measures to protect habitat or reduce harvests than a sturgeon (long-lived, high fecundity) or a shark (long-lived, low fecundity). Maybe it would be best to develop a matrix for prioritization. Again, using biological criteria is suitable for a species-by-species approach, but different criteria would be needed for habitat or watershed approaches. Also, relative to restoration of anadromous species, it would be relatively easy to review the FERC re-licensing schedules for dams. A lot of the dams are up for re-licensing, and using this information in conjunction with knowledge of historical ranges and current flow data, would make it possible to develop priorities for restoration of river systems. For example, a system with 17 dams and no spawning habitat left would be a low priority.

- It seems like we're trying to equate the essential habitat identification process with the land use planning process; i.e., certain land is set aside for development and other land is set aside for protection. I don't foresee us approaching water use at the same level — we're not going to start zoning waters (although dams do this to a certain extent). Instead, in the future, we may change how we use a waterway. We have to try and maximize the compatibility of human use with fish use. The information that is collected during the identification process will show that certain areas are important for any kind of creature. What is more important is determining the impacts of human use for any given project. General water quality standards may work for a lot of species, but maybe not for certain ones. Similarly, maybe certain physical actions will affect one species more than another. So I don't envision that certain areas will be "written off", instead we have to be more sensitive to the compatibility of particular uses with natural resources. Knowledge of essential habitats will help in tailoring a particular project.

- In order to make the consultation process effective among and between agencies, there have to be some sort of conditions.

- If an area becomes contaminated (e.g., cadmium from the Marathon Battery site in the Hudson River) and is unsuitable for commercial fishing, recreational fishing, etc., is there some way of integrating a public welfare component so that the habitat becomes essential?

- There has to be some connection between management of the fisheries and management of sources of pollution.

- As much as we attempt to define habitat, it's more and more in a state of flux. Everything is dynamic in terms of habitat and species flux (e.g., the Outer Continental

Shelf). We need to determine what is being maximized (e.g., restoration or sanctuary preservation).

- It's not just the degree of threat, but our ability to do something about that threat and the cost of the actions. For example, dams present very real opportunities to open up thousands of stream miles.

- There appear to be two themes. First, prioritizing habitats should be part of the identification process and will help with workloads. However, we need to be careful and begin with a biological basis before moving onto threats and priorities. Second, in the Chesapeake Bay, water quality is considered as one piece of the habitat, and SAV is treated similarly. This approach is useful.

- The issue of food chain productivity hasn't been mentioned yet. The question becomes "essential for what?" and problems arise with quantification and the degree of precision. We can make estimates of how important something is to a certain stock level as well as estimates of productivity. It's where the studies come together that is important.

Mr. Burns then asked participants to consider the fact that different viewpoints need to be taken into account to set priorities. How does this get put into operation? There has been frequent criticism of the Fishery Management Councils regarding their openness to differing viewpoints. How do we create a process that is accessible? Participants shared the following comments:

- We may be focusing too much on defining what essential habitat is rather than what we should be doing. We need to identify what's important and then assess the threats that come along.

- We already know what a lot of the threats are. Managers can use some of the information that has been gathered over the past 30 years.

- The assumption is that we will be able to identify habitats and then develop priorities. The belief that we already know what can't be done in certain habitats is not correct. We need data to back up the designations.

- We don't have to look very far to see that the hand that is being dealt by Congress has a lot of pitfalls. It's very difficult to justify the establishment of priorities when you don't have the data. For example, certain sediment characterization data was found to be wrong in significant ways through the application of GIS. Also, the concept of "living" documents hasn't been too successful.

- Regarding the earlier comment concerning the differences between water/aquatic resources planning and land use planning, another distinction is that the former is viewed as a public trust resource, not a private property issue. Also, we seem to be talking about essential habitat identification from two different perspectives: the species

and the watershed. From a watershed perspective, the entire habitat is essential. Lastly, we can define what constitutes essential habitat under the Hutchinsonian concept of the niche in a hypervolume. To do this, we need to measure enough variables associated with a given species to produce a 3-dimensional response surface that will define the limitations of that species. The problem is determining how big the volume becomes in terms of stock size, because the area occupied by a particular organism can still expand and diminish due to modification of just one variable. You could never have enough resources to make all the measurements.

- We have to be realistic about the process. The process will likely be decided at the outset over the next year and a half, and will rely on density or abundance. It will not get to the level where the difference between critical habitat and total habitat can be defined relative to some stock size. We just don't have the information. Falling back on density, however, will still lead to difficulties; e.g., it doesn't predict relative abundance well. Also, other habitats, such as emergent marshes, will be ignored.

- Another important concept is patch size; the contrast is elusive and that's where fisheries accumulate. For example, reefs would be a spike. Biodiversity is enabled by habitat diversity. Sometimes the greatest productivity occurs after a storm event. We saw this happen with lobsters in expanding their territory. There have been major ecological shifts in 30 years.

- Do we have an option? If we're being forced into identifying essential habitat then we have to do the best we can.

- Edges are important. Another important point concerns migratory species. It's easy for the public to see the importance of spawning and wintering grounds, but more difficult to understand that these species need migratory corridors. Fish may only use them for two days per year, but they are just as essential as other habitats.

- A better approach might be starting off by stating that everything that's left is essential. The burden of proof would then be on determining what is nonessential.

- This exercise of drawing definitive lines is not comfortable; there's a huge error rate. Also, we shouldn't put a lot of resources into this that would be diverted from identification and mapping exercises.

- EPA wants to expand the dump site from 2-23 miles. Everyone knows there are a lot of fisheries out there. It's a big bay and some will say the fish can forage elsewhere. These are the decisions that get made on a daily basis. Identification of essential habitat is great for regulators; it allows them to justify actions and not accept generic statements.

- This is one reason the South Atlantic Council has adopted fairly generic criteria. Two issues are involved: identification of baseline habitat and identification of migratory habitat. Getting the information is the first step.

Finally, Mr. Burns asked participants to consider that one of the issues under the Magnuson Act is the habitat impacts of fishing. Participants closed the discussion session with the following comments:

- The South Atlantic Council falls back on best available information. Some of this information is gathered pro-actively; i.e., the Council was challenged and upheld in Court.

- There is a private group that is meeting on this issue in June. This issue has to be brought up more in the Northeast.

- Regarding lessons learned, we had a full-blown research plan for the Amendment 7 process. We learned that it has to be a collaborative process and get people on board, especially from the fishing community. We found out that their area was little used, in spite of what people said. Things are changing, but livelihood issues are important. More literature exists than previously thought and it's very compelling. For example, various sanctuary areas are now dominated by other species; i.e., a monoculture. We can't definitely say it's happening, but we see the trends.

- We need to consider the implications of a bill on dragging. Clams are surface mined under certain systems. This is a very critical issue and more data on the impact of dragging on bottom grasses is emerging.

- All gear, anchoring and fishing is being prohibited in the first closed area in the South Atlantic (in the Keys). This program was developed in conjunction with the Marine Reserve Program.

Chapter 4

Restoration or Enhancement Projects to Benefit Fisheries

Ecological Processes and Parameters for Restoration Planning

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Introduction

Environmental restoration is an area of increased emphasis within the Civil Works Program of the U.S. Army Corps of Engineers. New Congressional authorities and policy changes are providing more opportunities to pursue environmental initiatives, and to develop improved techniques for the evaluation and comparison of environmental restoration projects and programs in coastal and inland waters. The Evaluation of Environmental Investments Research Program (EEIRP) was initiated in order to provide an evaluation framework, techniques, and planning procedures to assist resource managers and regulators in addressing two questions: 1) *How can we determine whether the recommended action from a range of alternatives is the most desirable in terms of the environmental objective being addressed?,* and 2) *How can we allocate limited resources among many "most desirable" environmental investment decisions?* The EEIRP has been divided into ten specific work units, each of which is developing procedures manuals, analytical tools, and other products to address individual components of the restoration planning, evaluation, and prioritization process.

Approach

Estuaries and near-coastal habitats are often particularly susceptible to environmental degradation due to their hydrologic and geomorphic characteristics and proximity to population centers. However, restoration activities in the coastal zone and elsewhere are often conducted in the absence of adequate planning guidelines, and may lack clearly stated project objectives and technically sound monitoring protocols. A technical working group with representatives from government, academia and the private sector was convened in 1994 to identify and prioritize the environmental parameters that should guide restoration projects, and to summarize information on the use of ecosystem models and other analytical techniques used to develop restoration objectives and compare alternative approaches. Collectively, this group had experience in restoring a diversity of inland and coastal habitat types in the continental United States. The working group toured and met with participants of several ongoing restoration projects in New England, the Pacific Northwest, and central Florida in an effort to accurately convey regional and interdisciplinary concerns in their final report, entitled "Ecological Processes and Parameters for Restoration Planning". A companion report, entitled " Restoration Analysis: Use of Models to Predict Restoration Success" has recently been completed and contains an indexed bibliography of over 400 literature citations on conceptual and quantitative ecological models and their role in environmental restoration decision making.

The working group selected three general concepts to convey in their report. An *Adaptive Management Approach* was deemed necessary in most cases to avoid project pitfalls and ensure design flexibility. Likewise, a *Systems Perspective* and the explicit recognition of *Ecosystem Spatial and Temporal Heterogeneity* should be incorporated in the planning and design of habitat restoration projects. Watershed or bioregional project scales are recommended, where feasible, and the ability to make modifications to the project based on outputs from ecological models, bench/field-scale experimentation, and long-term monitoring are critical attributes. These concepts distinguish restoration project planning and implementation from traditional Corps civil works projects. The "safe-fail" philosophy of adaptive management and the incorporation of uncertainty analysis and flexibility in restoration project planning counters traditional linear engineering approaches, but is considered necessary to ensure the long-term success of a habitat restoration project.

Estuarine and near-coastal habitats profiled by the technical working group in their report include intertidal wetlands (salt, brackish, and tidal freshwater marshes, mangrove forests), vegetated and non-vegetated shallow subtidal habitats (including temperate and subtropical seagrass beds), and live-bottom/reef habitats. Inland habitats profiled include lakes and reservoirs, rivers and streams, and freshwater (non-tidal) wetlands). Performance indicators (i.e., the structural or functional elements of the habitat that are to be measured/monitored) are presented in detail for each habitat type, along with a discussion of key ecological processes (ecosystem succession, disturbance, competition, etc.) to be addressed in restoration project planning and implementation.

Detailed case studies for each habitat category are presented in the report and are intended to illustrate the application of adaptive management, ecosystem-level planning, and the recognition of spatial and temporal habitat heterogeneity in restoration project design and evaluation. Many of the restoration case studies reflect a growing concern over the decline of regional fisheries resources and target the restoration of a specific biological component of an ecosystem (i.e., anadromous clupeid fisheries in the James River, Virginia) or the restoration of nursery habitat (i.e., salt marsh and seagrass beds in Tampa Bay, Florida).

Products

Future products that will be available to restoration planners, scientists, and engineers include "E^3", an environmental restoration Decision Support System (DSS) intended to reside on the World Wide Web, and a video documentary on environmental restoration concepts and applications. The technical reports and other products are targeted towards planners, project engineers, and resource managers at Corps districts and other agencies/institutions who may not have particular expertise in ecology, or those new to restoration who may require habitat-specific guidance in determining objectives, implementation, and evaluating the results of restoration projects in coastal and inland waters.

Panel Discussion: Requirements for a Successful Enhancement or Restoration Project

Seagrasses

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Introduction

The basic principles involved in seagrass restoration are the same, regardless of species. The examples discussed in this presentation draw on my experience in South Florida, but the principles are the same. In general, it's important to think about restoration in two contexts. The first context is regulatory; i.e., mitigation. This occurs when there is some forced legal requirement to perform restoration. The second context is when restoration is done because it should be. The requirements and the way we treat these two processes should be different. In reality, both processes are treated more or less the same in the United States today. For example, we place the same regulatory requirements on both of them. Being subject to the same permitting process wastes a lot of time and money for the "pure" restoration projects. While I am not advocating that the permit requirements be dropped for these types of projects, the process should be expedited.

It is also important to note that the technology to restore all types of wetland habitats in the United States is available. Most of you have probably heard horror stories about wetland restoration, which reflects the fact that most wetland restoration projects do not work. The failure rate is extremely high. A few years ago, I reviewed several case studies and found a failure rate of over 90 percent. Interestingly, roughly half of these projects were required by law but never done. This was possible because of the lax enforcement and compliance system within the wetlands regulations of the United States. So many of the failures are due to institutional issues in addition to the fact that there are a lot of amateurs in the business. There are no requirements that practitioners demonstrate a certain level of expertise. Overall, there are a lot of problems in applying appropriate technology. Therefore, it is important to approach wetland restoration from the perspective of what do we need to do to rectify the process.

A final introductory point is that there are literally tens of millions of dollars available for restoration every year. Most of this money is associated with private development projects or public works projects that are required to perform restoration. These dollars could be much better spent instead of wasting them on these little projects that are required for regulatory purposes. Promising options include mitigation banking and pooling the money for use by government or private sector professionals. We are missing a lot of opportunities under the current system.

Restoration Requirements

When dealing with seagrasses in any context, it is essential to understand the water quality parameters needed for restoration. Seagrasses are underwater flowering plants, but they are not algae. They have very high light requirements. There has been a tendency in the scientific community to treat seagrasses similarly to algae in terms of their light requirements, but we now know that this is not correct. Seagrasses typically occur in shelf, estuarine, or open ocean areas with limited depth. This is because as the water gets deeper, less light reaches the seagrasses.

In terms of competition with other aquatic plants, seagrasses compete well with algae. Seagrasses do well in oligotrophic/low nutrient situations because their nutrient requirements are primarily from the soil. They recycle material in the sediments and take up nutrients through an elaborate root system. Algae, however, take nutrients out of the water column as do phytoplankton and epiphytes that live on the seagrass leaves. When nutrients are increased in an ecosystem as is the case worldwide, the seagrasses do not compete as well. The algal species that do well with nutrients in the water column, increase in quantity and begin to intercept light. Comparison of aerial photographs taken 50 years apart in Tampa Bay show that seagrasses have moved inshore and are confined to a very narrow area and can no longer grow in deeper water. This is because of increased algae due to nutrient inputs and higher baseline turbidity levels due to dredging.

Restoration will therefore be unsuccessful as nutrients levels increase. Most projects fail because people fail to question why seagrasses are not found in the first place at the proposed site. If this question cannot be answered and the impact is not removed, the project will fail. For the past 25 years, people have been proposing projects based on the existence of bare spots without considering why this situation exists. For example, placing seagrasses in a boat channel with visible prop scars will not work.

So where do you plant seagrasses? Mother Nature plants them quite well. Seagrasses produce asexually and sexually via fruits, seeds, and asexual propagules. In many cases, they will repopulate an area if given the opportunity. Chronic impacts such as high turbidity, however, must be overcome if seagrasses have been lost in a particular area. In other situations, seagrasses may have been dredged out with the bottoms removed from the euphotic zone, leaving a hole that does not receive enough light. In this type of situation, we can raise the bottom to the photic zone and plant seagrasses. Alternatively, we can look for areas where seagrasses are being planted naturally. All we are really trying to do with seagrass restoration is help those natural processes along. To the extent that we fight these processes, we fail. In most cases, seagrass failure is due to inappropriate water quality parameters, unsuitable water velocities, boat propeller damage, and possibly sediment problems (the literature seems to suggest that the type of sediment is not a factor; the depth of the sediments, however, is important in accommodating root systems).

But there are successes. For the Florida Department of Transportation, for example, we removed a road and planted seagrasses that were well-established one year later. Our control areas, however, had the same results one year later without being planted. So we need to distinguish the circumstances where manual planting is appropriate as opposed to a waste of time. In another project for the Department of Transportation north of Key West, we worked to restore a lagoon

system where the normal tidal connections were blocked. At the start of the project, only algae existed. Ten years later following the construction of several culvert openings to allow for sea water exchange to improve mangrove growth (which was the intent of the project), approximately 60 acres of seagrasses had been inadvertently established. None of the seagrasses had been planted, this was simply a hydrologic restoration.

For those situations where planting is appropriate, we have a variety of plant materials to use including bare root materials and plugs. The older literature recommended taking plugs from natural seagrass beds. The question that was never really addressed was what happens to the sites after the plugs are removed? A bed can be heavily damaged by several people just walking around it to obtain plugs. We examined the recovery process and found that a typical 8-inch square hole takes roughly 5 years to recover on its own. Recovery was much more rapid when plugs were taken from submerged beds that do not have to be walked through. Another option is salvage. Until recently, seagrasses that were dug up during dredging projects were thrown out. Today, we look for opportunities to salvage seagrass, and if the plugs are large enough, they will send out rhizomes.

In conjunction with the National Marine Fisheries Service, we have also looked at nondestructive methods of seagrass propagule establishment (i.e., locating materials that do not require digging up of other seagrasses). One method involves the use of drift material; we have used this successfully in small projects. Also, in submerged sites and some other areas, the seagrasses produce asexual propagules. The propagules are produced in the water column during periods of rapid growth and basically consist of an underground rhizome establishment with small roots and a break point. These propagules break away naturally and establish a bed at another location. These can be harvested fairly easily at the right time of the year. Unfortunately, these materials are of limited availability. It is important, however, to find opportunities for use of nondestructive sources of seagrasses. We have also had success in growing seagrasses using floating collars, and others are continuing similar experiments.

In closing, I want to note that physical disruption of seagrasses is a major problem. As boating and commercial activity increases, we are seeing significant damage due to prop cuts. Federal and state agencies should have policies concerning destruction of submerged aquatic vegetation by commercial and recreational boating activities. If this is not a problem today in other areas, it will be in the future. Boating activities are increasing and there is no training or licensing requirements when it comes to habitat destruction. And educational programs will not work in protecting the seagrass beds because most people do not care or do not understand. Unfortunately, the most effective means of protection is to safely mark channels, enforce the regulations, and fine violators in amounts similar to speeding tickets. Without this type of system, there will be a lot more loss of seagrasses.

Discussion

The following questions were asked by workshop participants following the conclusion of Dr. Lewis' presentation:

Question: Regarding general overall enhancement, light sensitivity or turbidity is a major controlling factor for restoration projects as well as natural environments. Do we need to re-visit some of the state water quality standards from a turbidity standpoint, taking into consideration survival of sea grasses as opposed to phytoplankton?

Response: There is absolutely a need. We have been attempting to do this in Florida for over 10 years with no success. We'll continue to try; it's the one glaring error in the way we manage water quality standards. For those of you who are not aware of this issue, sea grasses require 20-25 percent of the incoming light that strikes the surface of the water to survive. Most biologists learn about the compensation point for algae, which is 1 percent of the incoming light. Unfortunately, all biological criteria have historically been developed using this 1 percent. This situation needs to be applied to real-world water quality criteria.

Question: As a scientist, habitat manager, and a user in terms of being a consultant, what's your position relative to the general statement concerning sea grasses that "if you build it, they will come"?

Response: I would agree. We do know that there are project sites where sea grasses may not colonize but the parameters may be correct. We refer to these as propagule-limited sites. These sites can be identified fairly quickly after you do your work, and restoration by planting or providing seeds might be appropriate. Ninety percent of the job is site preparation – identification of where your local propagules might come from and how far away are the sea grass beds that might contribute. You may be able to identify sites fairly easily that are simply too far away from adjacent sea grass beds. Basically it's a question of providing the right parameters.

Question: Can you elaborate in terms of a more holistic aspect beyond the plant community itself (e.g., the faunal communities)? Would you consider this an important aspect of developing sea grasses?

Response: Absolutely. I'd like to reinforce the point that everyone is making in that monitoring is essential; we need to learn from our mistakes and successes.

Question: In propagule-limited sites where it may be appropriate to do some planting, has it been easier to plant pioneer species (e.g., *Halodule*) and let them succeed naturally (e.g., to *Thalassia*), or does it depend on the situation as to whether it's more beneficial to directly plant *Thalassia*?

Response: It's primarily a question of the availability of plant materials. *Halodule* is readily available, colonizes quickly, and as far as we know, provides appropriate conditions for other species to come in. We've observed this naturally. We call it crest succession when you try to provide those extra propagules after the initial ones are started, but more work needs to be done in this area.

Panel Discussion
Requirements for Successful Projects, Cont'd.

Oyster Reef Habitat Restoration: Examining Structural and Functional Relationships

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Few would dispute the premise that oyster reefs throughout the Mid-Atlantic are highly degraded habitats, or the assertion that restoration of some of the ecological functions associated with those habitats (including fisheries production, if possible) would be a desirable endpoint. To date, however, most of the attention paid to declining oyster stocks in the region has centered on the direct impacts to the oyster fishery (e.g., Hargis and Haven, 1988). In this paper, I seek to examine issues related to restoration of oyster reef habitat by first summarizing what we know of reef habitat function, then asking what more do we need to know to couple habitat structure and function.

As with any restoration effort, for these habitats it is important that we (*i*) develop the rationale for restoration, (*ii*) identify specific functional components of interest, and (*iii*) define the relationships between structure and function. It is particularly important in this context that clear, realistic desired endpoints be established at the outset.

Unfortunately, in the Mid-Atlantic we have lost most of the opportunity to directly examine pristine reefs to determine the ecological roles which they historically played. We must, therefore, infer function from historical records and experimental investigations. My objective here is to summarize recent and ongoing work related to effects of oyster reefs on water quality and the provision of habitat for other organisms, and to ask how these functions may be related to the structure of the habitat.

In 1988 Roger Newell published the now widely cited estimate that at the end of the 19th century oysters within Chesapeake Bay were capable of filtering the entire bay volume in three to six days. This assertion was based upon estimates of historical standing stocks and laboratory-derived filtration rates for oysters. While this type of information may be illustrative of the ecological importance of oysters, it is quite obvious that it cannot serve as a basis for specific restoration projects. Refinements of oyster filtration and growth rates in natural environments on appropriate scales are needed to guide restoration efforts.

Harsh and Luckenbach (in press) have investigated the effects of current speed, seston composition, turbulent redistribution of particles, and oyster health on filtration rates in a series

of flume experiments. They found that the effect of oyster reefs on exchange of materials between the water column and benthos is a function of each of these factors. Further, current speed and seston quantity and composition have been shown to affect oyster growth in field experiments (Luckenbach and Mann, 1995). In a series of experiments on artificially constructed reefs, Lenihan and Peterson (unpubl. data) have demonstrated that reef morphology affects current speeds across the reef surface, which in turn influences oyster growth rates. At larger spatial scales, it may be important to determine how the size and spacing of reefs within a region affect flow structures and particle exchange between the water column and the benthos (Newell and Sanford, unpubl. data).

Though it has long been recognized that oyster reefs serve as habitats for a variety of resident and transient estuarine species (Bahr and Lanier, 1981; Zimmerman et al., 1988), experimental evidence is just beginning to emerge which relates some aspects of structure and habitat value for oysters and other reef residents. At an experimental reef site in the Piankatank River, Virginia, Roger Mann and colleagues have been investigating the development and utilization of a constructed intertidal reef. In one component of this work they have clearly demonstrated the importance of interstitial space, located with the fabric of the reef, to the recruitment, growth and survival of oysters (Bartol and Mann, in press). Their data reveal that the availability of space below the surface of the reef extends the vertical range over which oysters survive on the reef. This has implications not only for our choice of materials and design criteria for restoring oyster reef habitat, but also for how we view the role of dead oysters (or the shell they leave behind) on the reef. On a related matter, Denise Breitburg (in press) has shown that the availability of recently dead, still articulated shells within an oyster reef may be important in determining the reproductive success of blennies and gobies. Structural complexity of the habitat would appear to be a key feature affecting ecological function.

Experimental evidence that oyster reef habitat provides a refuge from fish predation for grass shrimp has recently been presented by Posey and colleagues (in press). Their work has demonstrated in laboratory mesocosms that shrimp move into areas with oyster shell in the presence of fish. Further research is needed to determine how the physical structure of a reef relates to its utilization by mobile fauna and the provision of refugia.

The relationship between habitat size and biodiversity has been a matter of concern to conservation biologists for some time. Often referred to as SLOSS (Single Large or Several Small), the issue of the most appropriate size for bio-reserves has received considerable attention in terrestrial systems. David Eggleston and colleagues have investigated this issue for patches of oyster shell ranging from 0.25 - 4.0 m^2 and found greater biodiversity of macrofauna in small reefs (unpubl. data). Additionally, Eggleston et al. found that patches of oyster shell contained as many first instar blue crabs as similar-sized experimental plots of seagrass, a habitat widely recognized as a blue crab nursery.

Larger-scale experiments using reef-sized structures up to 2 acres in size are underway in South Carolina (Coen et al., in press), North Carolina (Peterson et al.) and Virginia (Luckenbach and Mann). In each case, efforts are being made to relate the development of reef assemblages to the structure and location of experimental reefs. Few data are available from these studies yet; I

expect that over the next few years they will reveal much about the factors which affect the development of communities on restored reefs.

In the interim, there are basically two things that we can do to facilitate oyster reef habitat restoration: (1) put out substrate and (2) limit harvest. Numerous questions remain: What type of substrate should be used? Where do we put the substrate? How much substrate should be used? What configurations work best? Precisely what are the functional outcomes which we hope to achieve?

For the time being, I suggest that the following principles should guide oyster reef habitat restoration efforts. First, select areas with good recruitment potential and which support good growth. Second, use materials which provide sufficient interstitial habitat of varying sizes. Clean oyster shell is likely the best substrate, but, since availability is often limited, other materials such as pelletized coal combustion by-products and some other mollusk shells will suffice. Thin shells, like those of the surf clam *Spisula solidissima* which easily break into fine pieces, are less desirable. Next, it is necessary to plant sufficient substrate to provide 3-dimensional relief to avoid high sedimentation and low dissolved oxygen in bottom waters. Fourth, and perhaps most controversial, I recommend that diseases should play only a minor role in the placement and management of restored reef habitat. Despite the wide distribution throughout the Mid-Atlantic of *Haplosporidium nelsoni* and *Perkinsus marinus* (the causative agents of MSX and Dermo, respectively), there remains little that resource managers can do to control the diseases. Moreover, though the diseases have had devastating consequences for oyster fisheries in the region, significant numbers of oysters survive to reproduce in disease endemic areas. Thus, while the demographics of oyster populations and the absolute densities of oysters on a reef are clearly affected by disease, disease is unlikely to result in the elimination of oysters from a reef. Fifthly, in lieu of additional information on the scale dependence of the ecological functions of reef (e.g., water quality effects and species-specific habitat needs), reefs should be constructed as large as is practical. Finally, it is crucially important that monitoring programs be in place to evaluate the outcome of restoration projects. Well defined, specific restoration goals followed by appropriate monitoring programs are the only means of judging success or failure of environmental restoration projects.

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Luckenbach's presentation:

Question: Concerning the data on the higher survival rate of oysters in the interstices of the reef rather than the outside, has there been any follow up to determine whether the growth of these oysters is inhibited by being surrounded by other hard structures?

Response: Absolutely. I used data from Young, Barthall, and Mann concerning growth in the interstices. At some heights on the reef, the rates are significantly lower in the interstices. But when you sum it all together across the reef, the net effect of having a 3-dimensional complex structure, as opposed to a flat surface, is that it clearly expands the vertical range in which oysters survive and grow to maturity. The most striking effects are well in the subtidal range where predation and competition exclude animals. Higher in the intertidal range is where desiccation and winter ice kill animals.

Question: Could you elaborate briefly on your earlier remarks concerning the misconception of the effects of disease on oysters in the Chesapeake Bay?

Response: There are two reasons: 1) you can't do anything about it anyway, and; 2) what is it going to do? In the mid-Atlantic, the salinity is above 10 parts per thousand and you find 80-100 percent prevalence of the organism that causes the disease. It is there and eventually causes mortality in 90 percent of the population. A lot of other things cause mortality at earlier stages in life (e.g., blue crabs and mud crabs). In a sense, the more common disease is a lot spottier and tends to be variable year to year, and maybe cause 30-70 percent mortality. So you can't do anything about the disease, and while the type of mortality can be devastating to a local fishery (e.g., affecting up to 90% of the market-size oysters), the remaining oysters are probably adequate brood stock and the mortality is mostly occurring after the reproductive stage. Therefore, the effects are just not as devastating on a population as they are on a fishery. For example, there are many areas where you can establish a healthy reef populated by 2 1/2-inch oysters that are reproductively active, but these are useless to a fishery that wants 3-inch oysters.

Question: What is your view concerning a "quick fix" with exotic oyster species?

Response: The "quick fix" potential does not exist. There is very much the assumption by some members of traditional fisheries, and certainly in the political arena, that there is a quick fix to the demise of our historical wild fishery that can be realized from the importation of non-native species. I can't figure out how this might happen. The assumption is that we can find a species that is more resistant to the two diseases than the one we've presently got. Given that there are only two diseases and a whole range of mortality causes, I don't think this approach will be that useful. Also, it was the fishing practices that were fundamentally unsustainable. In this case, fishing the animal means destroying its habitat by mining the reefs. There is some thought that bringing in another species will have some benefit for shellfish aquaculture, and indeed it might. However, aquaculture with the native species is perfectly feasible and little benefit would seem to accrue from using another species. Finally, there is interest in non-native species due to habitat and water filtration capabilities. But if we can manage and restore the existing species, we'll be decades ahead on the time curve.

Panel Discussion
Requirements for Successful Projects, Cont'd.

The Restoration of Migratory Fishes to the Susquehanna River Basin

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American shad, *Alosa sapidissima*, hickory shad, *A. mediocris,* and river herring, *A. aestivalis*, *A. pseudoharengus,* once dominated Pennsylvania streams and rivers each spring. Their annual spawning migrations supported huge commercial and subsistence fishing. During the industrial revolution, construction of dams, water pollution and overfishing reduced migratory fish numbers. Spawning and rearing habitat were reduced by 99 percent when 4 hydro-electric dams were constructed in the lower Susquehanna River between 1904 and 1932. Migratory fish were virtually eliminated from the Susquehanna River and tributaries.

During the last three decades, the Pennsylvania Fish and Boat Commission (PFBC), along with other Federal and state resource agencies and private interests, has worked cooperatively with several utility companies – PECO Energy, Pennsylvania Power and Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company – to restore American shad and other migratory fishes to the Susquehanna. This unique partnership resulted in cooperative agreements that provided vital funding for a long-term restoration program to re-establish a population of shad and herring imprinted to the Susquehanna River.

The restoration is currently managed under the auspices of The Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) whose membership includes the PFBC, Maryland Department of Natural Resources, New York Department of Environmental Conservation, U. S. Fish and Wildlife Service, National Marine Fisheries Service (NMFS), and Susquehanna River Basin Commission.

Restoration has four major components: 1) development of fish passage and/or removal of blockages to fish migration; 2) capture and transport of target species to spawning areas in the upper Susquehanna Basin; 3) hatchery culture and stocking of uniquely marked American shad fry; and 4) evaluation of restoration effort.

Restoration is working. Numbers of shad and herring returning to the Susquehanna to spawn has increased dramatically. In the early 1970's, fish lift(s) operating at Conowingo Dam in Maryland captured fewer than 150 American shad per year. In recent years, numbers have increased to a record high of over 61,000 in 1995. Since 1976, the PFBC's Van Dyke Research Station for Anadromous fishes has produced and stocked an average of 10 million American shad fry per year. Since 1985, otoliths of all American shad fry stocked in the basin have been marked by immersion in tetracycline antibiotics. Analysis of otoliths of both out-migrating juveniles and

returning adults has demonstrated that hatchery contribution to the overall population ranges from 75 to 90 percent. In future years, expectations are that the percentage of "wild" fish in the population will increase to the level that continued hatchery operations are unnecessary and no longer required to sustain the fishery.

In June 1993, the governors of Pennsylvania and Maryland, along with utilities, fisheries agencies and public fishing interests signed the historical agreement to provide permanent fish passage facilities at the three hydro-dams located in Pennsylvania. The agreement calls for fish passage at Holtwood and Safe Harbor Dams by 1997 and York Haven Dam by 2000. Fish passage facilities at Conowingo Dam began operation in 1991 under a separate agreement. These agreements and others with owners of dams further upstream on the Susquehanna will re-open over 450 miles of large river habitat to shad and other migratory fishes.

With fish passage secured on the Susquehanna, the PFBC in conjunction with the EPA Chesapeake Bay Program has begun efforts to re-open spawning and rearing habitat for migratory fish by providing passage at blockages on Susquehanna tributaries. Species for tributary restoration focus on river herring, although in larger drainage systems American and hickory shad are also targeted.

With a grant provided by the EPA Chesapeake Bay Program, the PFBC has contracted the Pennsylvania State University (PSU) Cooperative Fish and Wildlife Research Unit to inventory blockages to fish migrations on selected Susquehanna tributaries and identify the quantity and quality of habitat that could be made available to various anadromous fish species, if fish passage were provided at these blockages. Blockages encountered during the inventory include road culverts, low-head dams, weirs, debris dams, water falls and other natural barriers. Blockages were identified from records provided by state and Federal resource agencies, aerial photographs and on-ground visual surveys.

A set of criteria developed by the EPA Chesapeake Bay Program, Living Resources Subcommittee's Fish Passage Work Group is being used by all jurisdictions in the Chesapeake Bay drainage to characterize and assemble blockages in a common electronic data base. Upon completion, the inventory in Pennsylvania will have identified and characterized blockages in eighteen watersheds and surveyed over 740 miles of tributaries, third order or larger, to the Susquehanna River.

Chesapeake Bay Funding is also being used to provide fish passage at blockages in Pennsylvania and other states in the Chesapeake Bay drainage. Funding for fish passage projects requires a 1:1, Federal:nonfederal, contribution. Since the funding for fish passage is limited, specific criteria is evaluated to prioritize blockages for the implementation of fish passage. To assist in this endeavor, attempts were made to identify the quantity and quality of habitat for blueback herring and alewife reproduction located above identified tributary blockages. Researchers from PSU developed Habitat Suitability Indices (HSIs) for adult spawning and juvenile rearing life stages for alewife and blueback herring. HSI curves were developed for six variables including substrate, velocity, depth, turbidity, pH, and dissolved oxygen, for riffle and

pool habitats based on mean HSI curves supplied by scientists that have worked extensively with these two species. Usefulness of the HSIs for spawning and rearing habitats was limited by the information available on the life history of these species as well as difficulties in predicting habitat impacts due to periodic changes in stream morphology and changes that occur in a given stream reach as a result of breaching and removing dams. Criteria for fish passage projects using Chesapeake Bay Program funding is as follows:

1) Relative location of blockage within Chesapeake Bay drainage and local watershed. Blockages located in tributaries closest to the Chesapeake Bay and with fewest blockages downstream are considered priority;

2) Quantity and quality of habitat available above blockage. Blockages that have the greatest number of miles of free flowing river habitat upstream on tributaries with good water quality (gross measurements) are considered priority;

3) Dams that can be breached and removed. Removal is cheapest in long-term because no annual maintenance or operational cost required as with a structural fishway. Breaching and removing dams restores the riverine ecosystem and eliminates potential public safety hazard;

4) Blockage ownership. Ability of owner to contribute nonfederal match for Bay Program grants.

Various avenues are being utilized to achieve compliance for provisions for fish passage at man-made blockages. These include:

1) Federal Energy Regulatory Commission re-licensing requirements.

2) PFBC state permit review requirements.

3) 30 PA Consolidated Statues, section 3501(a) which grants the PFBC authority to mandate fish passage at dams and other impediments.

4) PFBC/EPA Chesapeake Bay Program fish passage and habitat restoration projects.

Numerous tributary fish passage projects are underway throughout the Susquehanna Basin (Table 4-1). These will result in hundreds of additional miles of spawning and rearing habitat for migratory fishes. With more habitat becoming accessible, the abundance of migratory fishes should increase dramatically. Ultimately, the goal is to restore annual migrations of 2 million American shad and 15 million river herring to the Susquehanna Basin to spawn. At those levels, hundreds of thousands of angling trips are predicted for Pennsylvania's citizens and visitors.

The multi-million dollar program to restore migratory fishes to the Susquehanna Basin is one of the largest restoration efforts of its type ever undertaken and is a model of persistent, cooperation and long-term commitment.

Table 4-1. Pennsylvania 1995 Fish Passage Projects Completed, In Progress, or Planned for the Susquehanna River Basin

Project (Stream & River Drainage)	Passage Type	Habitat Opened (miles)	Funding Source	Status
Holtwood Dam, Susquehanna R.	Lift	9.0	PP&L	Construction ongoing
Safe Harbor Dam, Susquehanna R.	Lift	23.0	Safe Harbor Water Power Corp.	Construction ongoing
York Haven Dam, Susquehanna R.	Gated open channel	169.3	MET.ED.	Design complete
Fibre Dam, Susquehanna R.	Vertical slot	310.0	PA Dept. Cons. & Natural Res.	Design ongoing
Rock Hill Dam, Conestoga R.	Breach	18.5	EPA/NMFS/PFBC	Construction summer, 1996
Castle Fin Dam, Muddy Ck.	Breach	4.3	EPA/NMFS/PECO Energy	Construction summer, 1996
Williamsburg Station Dam, Frankstown Br. Juniata R.	Breach	19.3	PENELEC	Construction summer, 1996
Huntingdon Water Authority Dam, Standing Stone Ck.; Raystown Br. Juniata R.	Denil	22.0	Borough of Huntingdon	Construction ongoing
Lancaster Water Authority Dam, Conestoga River	Gated open channel?	11.0	Lancaster Water Authority	Negotiations
American Paper Products Co. Dam, Conestoga River	Breach?	2.5	EPA/NMFS/?	Negotiations
Lapp's Dam, Conestoga R.	Breach?	4.3	EPA/NMFS/PFBC	Negotiations
Marietta Gravity Water Co. Dam, Chickies Ck.	Breach?	1.8	EPA/NMFS/?	Negotiations

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American Paper Products Co. Dam, Conestoga River	Breach?	2.5	EPA/NMFS/?	Negotiations
Lapp's Dam, Conestoga R.	Breach?	4.3	EPA/NMFS/PFBC	Negotiations
Marietta Gravity Water Co. Dam, Chickies Ck.	Breach?	1.8	EPA/NMFS/?	Negotiations

Discussion

The following questions were asked by workshop participants at the conclusion of Mr. Carney's presentation:

Question: You've invested a lot of effort in getting the adult fish back up the rivers. In the Pacific Northwest, we're finding that getting the young ones back down can be even more of a problem. What consideration is being given to getting young fish back down the rivers given that they don't follow the fish passages?

Response: Studies have determined that about 5 percent mortality occurs to juveniles at each hydrodam. We can live with this, at least initially. At the one dam where the percentage is slightly higher, we are studying whether a bypass system will significantly reduce mortality. It's a problem, but not a major one. Our opinion is that if you get the stocks to the point where there is enough reproduction, this will be just another segment of mortality.

Question: That's what we initially thought in the Northwest too. But the overall juvenile mortality is not just a factor of passing through each dam, there is reduced fitness and an overall weakening of the stock.

Response: This may be so. We really haven't done studies to address this issue at this point. We were concerned about getting fish up there first and then we'll negotiate, especially given the heavy costs borne by utilities.

Use and Management of Artificial Reefs

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Introduction

For over a century, artificial reefs have been used to enhance fisheries in coastal and marine waters of the United States. Their primary use has been to address growing demands for saltwater fishing opportunity by increasing availability of habitat for target species. National support for, and concern with the proper planning and management of these dynamic systems has been demonstrated by three significant Congressional actions. The first of these was the Maritime Programs Appropriations/Authorizations Act of 1972 (P.L. 98-402). A section of this law authorized the transfer to coastal states of surplus World War II "Liberty" class war vessels designated by the Secretary of Commerce as scrap if states would sink them for artificial reefs. The National Fishing Enhancement Act (PL 98-623, Title II) was enacted in 1984 establishing a framework for a national artificial reef program. That same year, the Wallop-Breaux Amendment (contained in the Deficit Reduction Act: PL 98-369) to the Federal Aid in Sport Fish Restoration Act of 1950 (Dingell-Johnson Act aka: D-J) became law. The Wallop-Breaux amendment greatly expanded the amount of money states received in federal assist and to develop sport fish restoration projects. Availability of this new source of financial assistance to the states lead to dramatic increase in construction of artificial reefs in coastal and marine waters.

Today, there are more than 600 state-permitted artificial reef sites in U.S. marine and estuarine waters. Approximately half of these have been developed within the last 10 years. These artificial reefs have become popular destinations for saltwater anglers and divers, providing angling and diving opportunities that otherwise would not exist. Significant incentives to continue reef construction have been created in particular by the significant positive impacts on local and regional economies from these activities.

In spite of the significant support for reef development, full potential of artificial reefs as a fishery management tool and for habitat enhancement and conservation has never come to full fruition. The National Artificial Reef Plan originally addressed the idea of artificial reefs being an attractive nuisance and overcame the stigma of ocean disposal of derelict materials. However, the idea of integrating artificial reefs into fisheries management and habitat programs has gone no further than using these structures to increase access to fisheries resources and enhance fishing opportunities.

Liberty Ship Reef Program

Materials used to construct artificial reefs have dictated the direction in which U.S. artificial reef development has gone. The majority of reefs have been, and continue to be constructed with materials of opportunity. Such development has served a dual purpose. By

utilizing derelict materials, reef developers have been able to acquire the essential large size and volume of materials necessary to construct effective marine reefs. Such projects would otherwise prove cost prohibitive. At the same time, secondary use of such materials for productive fisheries applications has solved many disposal problems. The Liberty Ship Reef Program developed as a result of P.L. 98-402 emphasized this aspect of reef development. These ships ended up providing the bulk of the U.S. Naval "moth ball" fleet after World War II. In cleaning up the "moth ball" fleet, it was realized that the life expectancy, size, weight and bottom relief provided by these vessels fulfilled most of the essential criteria for marine artificial reef materials. These vessels were slowly being removed from the "moth ball" fleet through sales to salvers. However, the legislation allowed for immediate removal with transfer of these vessels to the states for artificial reef program.

Many of the states such as Texas, also were able to establish and fund a reef program with the profits realized through salvage of portions of each vessel in preparation for deployment as artificial reefs. With availability of such materials, a renewed emphasis on artificial reefs as a means of beneficial use for derelict materials was spawned.

National Fishing Enhancement Act

The National Fishing Enhancement Act (Act) likewise found its genesis in a derelict materials issue. Requirements of the Minerals Management Service to remove offshore oil field structures once production ceased represented a significant financial disincentive to many of the oil companies exploiting rich oil reserves in the Gulf of Mexico and in certain regions of the California coast. Creating incentives for continued develop lead to what then Secretary of Interior Jim Watt termed the national "Rigs-to-Reefs" program in which oil companies could donate their derelict structures to permitted artificial reef sites. This program also re-introduced the concept of using artificial reefs in mitigation banking for inevitable destruction of critical habitat by oil field activities. The need to define roles and responsibilities of federal, state, and private entities in such a program lead to development and enactment of the National Fishing Enhancement Act. The Act spawned a renewed emphasis in the role of artificial reefs for marine fisheries enhancement, and recognized that ". . .properly designed, constructed, and located, artificial reefs...can enhance the habitat and diversity of fishery resources; increase the production of fishery products in the United States; increase the energy efficiency of recreational and commercial fisheries; and contribute to the United States and coastal economies."

The Act establishes national standards for artificial reef development in the EEZ. These standards formed the basis for development of the National Artificial Reef Plan by the Secretary of Commerce as mandated by the Act. The plan provides guidance for state programs through a plan framework, and provides recommendations on siting as well as on the types of materials used in the construction of artificial reefs. Implementation of the Plan over the past 10 years has effectively placed development and monitoring responsibilities of almost all marine artificial reefs under the auspices of coastal state marine fishery programs. However, this role of the states is not specified in the Plan; rather it has occurred by default. The Secretary of the Army, through the Corps of Engineers permitting program, has the designated primary responsibility under the Plan.

Sport Fish Restoration Program

The Wallop-Breaux Amendment significantly enhanced the "user-pay-user-benefit" aspects of the Federal Aid in Sport Fish Restoration Program of the U.S. Fish and Wildlife Service. This program invests angler and boater taxes in state and national projects to improve angling success and boating access. With the increased financial assistance from Wallop-Breaux has come dramatic expansion in artificial reef site development by coastal state agencies. This occurred in part due to a provision of the amendment that "new" money collected was to go toward new projects, and was to be split equitably between fresh and saltwater projects within the state agencies.

Since the initiation of Wallop-Breaux funding in 1985, Atlantic coastal states have deployed over 180 new artificial reefs. These projects include a wide variety of fishery development partnerships involving fishing clubs, tackle manufacturers, large corporations, and state resource agencies. Many successful projects have resulted from technical expertise, knowledge of the marine environment, and an understanding of local community needs coordinated through the Interstate Marine Fisheries Commissions' Artificial Reef Technical Committees established under a cooperative agreement with the U.S. Fish and Wildlife Service Federal Aid in Sport Fish Restoration Administrative Program. Wallop-Breaux funding has provided, and continues to provide the financial support for nearly all reef development in the U.S. under the auspices of state and interstate programs. Managers of those programs participate in the collective bodies of the Commission reef committees to exchange ideas and experiences, and to coordinate development of coastwide policies. As such, these groups provide the basis for a truly national program.

Conclusions

Marine artificial reef development in the U.S. has been driven by two critical elements: 1) availability of suitable materials; and 2) availability of a steady funding source. The coincidence in passage of the National Fishing Enhancement Act and the Wallop-Breaux Amendment fulfilled these requirements and established a new era in artificial reef development. These acts have encouraged development of a cooperative national program between the coastal states, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. Due in part to the availability of funding for development of artificial reefs, the priority for these structures has been heavily biased toward enhancing fishing opportunity for sport fishermen.

Although a framework for national policy guidance on artificial reef development is provided in the 1984 Plan, the plan has failed to meet the challenge to realize the full potential for application of artificial reefs to a variety of fishery management issues and habitat enhancement and conservation projects. The Plan was intended to be a dynamic, working document which would be revised as new information became available. In the nearly eleven years since adoption of the Plan, much has changed regarding artificial reefs and coastal marine fisheries in general. Most states now have state- and some site-specific plans. Many states and federal fisheries management agencies are beginning to recognize the possible fishery management implications of artificial reefs. Experiences shared by coastal state agencies in their respective reef programs have revealed strengths and weaknesses as well as deficits in the Plan.

These and other important developments indicate that a thorough review and revision of the Plan and possibly its enabling legislation, is overdue.

To date, approximately half of the U.S. coastal states have developed state artificial reef plans based on the National Artificial Reef Plan of 1985. The states have worked cooperatively to identify and resolve national issues such as standardized criteria for materials used to build artificial reefs. Under an inherent, shared responsibility to a national reef program, the Commissions' Artificial Reef Committees are seeking a national effort to review of the National Plan and its enabling legislation. It is hoped that this effort will produce a blueprint for marine artificial reef development and research into the next decade with improvements in regional and national management and planning for reef programs and activities, under the authority of the National Fishing Enhancement Act of 1984 and the Commerce Secretary's National Artificial Reef Plan.

The current Congress is poised to make major decisions regarding the future of environmental programs in this country, and few programs will be more effected than aquatic habitat programs. Given that the trend within the states is to place more reefs on federally permitted sites, there is a need to establish better coordination and communication among the various public and private entities effected by these endeavors, and to reaffirm the roles of these groups as set forth in the National Plan. This is particularly important with regard to the various federal permit programs. In addition, new information acquired in the past ten years should be used to reexamine these roles as well as the criteria established in the Plan for materials used in marine fisheries enhancement projects. The Interstate Marine Fisheries Commissions provide a critical focal point in coordinating these activities. The Commissions have a proven record in their ability to assure a national approach in coordination among state, federal, public and private partners.

Discussion

The following questions were asked by workshop participants at the conclusion of Mr. Christian's presentation:

Question: One of the concerns frequently raised concerning artificial reefs is whether they act purely as fish aggregators for recreational needs or do they really provide habitat. What kind of research and monitoring has been done to answer a question like this?

Response: Aggregation vs. production is an old question. A lot of people implementing the programs believe it's a moot point and that the reefs do both. There is a recent study (conducted in Georgia, I believe) that has positive data indicating that artificial reefs produce biomass. For example, certain species such as black sea bass are resident species that spawn and feed off of the ecosystem created by the reefs. It's also an ongoing question in that as more money becomes available, more studies will be conducted that prove biomass production. But it's true that reefs draw fishermen and create a management problem where there is a potential to outstrip the resources that may be adjacent to those areas and drawn to the reefs.

Question: South Carolina has spent $500,000 per year on reefs over the past 20 years. So we think it's important or the state wouldn't have put up that much money. The issues we hear are twofold and must be addressed on a national level. First, putting out an artificial reef gives you a false sense of solving the problem. The problem is overfishing and putting out more habitat isn't going to solve the problem, unless the habitat is limited. Secondly, it's recruitment failure because the juveniles aren't surviving in their habitat and the reefs don't help. This is what the scientific issue boils down to: a false sense of solving the problem.

From an economic point of view, we hear that we're creating fishing places for wealthy people using large boats with blue collar tax dollars. You need to resolve this in two ways: we need to put our artificial reef efforts in the context of marine reserves and research tools. This makes a lot more sense. This is a comment, not a question.

Response: I appreciate the comment because this is one of the more salient issues right now. Within the plan there was never any mechanism or language that allows for designation of use. It's pretty vague and open. One of the mechanisms that has been utilized came out of the South Atlantic Fishery Management Council and involves the designation of special management zones. This language was developed over a 5-year period concerning a reef that went down off of the permitted site and interfered with some fisheries. A mechanism was developed to designate use for these reefs, and set up a board for people to provide comment on these designations.

Question: There needs to be a national plan with a rational understanding of where reefs are useful and where they aren't. For example, in New England, the Corps of Engineer created a rock reef on some material that was known to be critical habitat for cod and haddock. We're spending all of this money on bringing back a species by building artificial reefs, but they can't tell us what effects this will have on fish aggregation, dispersion patterns, etc. I think we need to be more sure about what we're doing before we do it. No pre-survey was done in our area. Maybe this is just a regional problem.

Response: No, it's a national problem associated with the national Artificial Reef Plan. That type of guidance should be in the national Plan, but it's not there. The other problem is that NMFS does not have a strong role in a national program. They had one employee who was the author of the Plan, but now there is no one to talk to concerning artificial reefs regulations on a national scale. One of the things that's important about the new Recreational Fisheries Resources Conservation Plan is that NMFS has a new directive to build a recreational fisheries program. This Plan will be the baseline and it mentions the use of artificial reefs to achieve Plan objectives. So there is more utility in reefs, and it was also intended to include commercial interests. NMFS needs to get involved soon. Most of the states are left to go it alone. States will keep implementing their programs because most people are happy with what they're doing. However, we may reach a saturation point. There is a definite need for monitoring and evaluation of impacts.

Question: What are the publications that you referred to?

Response: The first one is the *Recreational Fisheries Resources Conservation Plan.* This is a new publication and is available by contacting Bob Batky of the U.S. Fish and Wildlife Service at 703/358-1715. The Commission will get approximately 200 copies of this publication and will send them first to our respective committees (e.g., habitat, recreational fisheries, artificial reefs, etc.). But we won't use all 200 copies, so extra copies will be available through our office in one or two months. The other document is a companion publication by the Departments of Commerce and Interior called *A Policy for Conserving Species Listed or Proposed for Listing Under the Endangered Species Act While Providing and Enhancing Recreational Fishing Opportunities*. There are two councils involved in this effort. The Sport Fishing and Boating Partnership Council, which is the industry, is the review group for what happens nationally in this plan. There was another council developed by an Executive Order that's co-chaired by the Departments of the Interior and Commerce. This group is responsible developing and implementing the plan, and will report back to the Sport Fishing and Boating Partnership Council. Any comments you may have on the plan should be addressed to these two groups.

Question: When was the Executive Order for the recreational fishing restoration plan issued?

Response: It was signed on July 15, 1995 and allowed one year to produce this plan, which was made public this past Monday. Individual agencies have to develop their own plans by December 31, 1997.

Chapter 5

Linking Habitat Loss to Fisheries Impacts

Assessment of the Impact of Watershed Development on the Nursery Functions of Tidal Creek Habitats

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Background Information and Problem Definition

Meandering shallow tidal creeks and the associated intertidal salt marshes are dominant features of Southeastern estuaries and provide critical nursery habitat for many species of fish, crabs, and shrimp. These shallow tidal creeks are also conduits through which many pollutants enter estuaries with creek sediments serving as a repository for toxic chemicals and other contaminants discharged into estuarine environments.

Resource management and regulatory agencies responsible for protecting estuarine environments do not know if the policies and programs they have implemented are adequately protecting tidal creek habitats. These agencies also lack the knowledge required to restore degraded creek habitats.

Objectives

In 1994, the South Carolina Marine Resources Research Institute initiated a study, called the Tidal Creek Project (TCP), to develop the information needed to: (1) characterize and define the ecological values of tidal creeks and associated marsh habitats;(2) identify the major pollution threats to tidal creeks associated with watershed development; (3) assess the cumulative impacts of watershed development on tidal creek habitats including the living resources that use them as nurseries; and (4) develop environmental quality criteria for sustaining tidal creek nursery functions. This study was funded jointly by the Charleston Harbor Project (1994-1996) and the Marine Recreational Fisheries Advisory Board (1995-1996).

Approach

The general study approach used was to sample and contrast the physical, chemical, and ecological characteristics of tidal creeks draining relatively pristine, undeveloped watersheds (called reference creeks) and creeks draining highly developed watersheds (called developed creeks). Associations between physical, chemical, and ecological characteristics of creeks and the various types of human development and land cover that occurred were also evaluated. This sampling approach is generally referred to as the comparative watershed assessment approach.

Creeks in the developed watershed class were selected to represent the major types of development that occur in the South Carolina coastal zone including: (1) industrial development, (2) urban development, (3) suburban development, and (4) agriculture. Crecks in the reference

class were either predominately forested and/or salt marsh. Watersheds of similar sizes and physical characteristics were evaluated from both the reference and developed classes. The tidal creeks sampled included representatives of the major salinity zones (brackish water to near full strength sea water) and sediment types (sand, mixed, and mud sediments) that occur in SC.

The accuracy, precision, representativeness, completeness, and comparability of the information produced by the TCP were evaluated through a formal Quality Assurance (QA) Program. This QA program was designed to ensure the information produced by the TCP was adequate for addressing study objectives and developing environmental policy. A computerized relational data base system was also established to facilitate efficient storage, retrieval, and analysis of the data produced. This data base provides a means through which the data can be accessed by other researchers or regulatory and resource management agencies. A copy of the TCP data base will be provided to state and federal agencies upon request.

Findings

Salinity was identified as the major factor controlling the distribution and abundance of living resources in shallow tidal creeks. Salinity fluctuated over greater ranges and was generally more variable in creeks with developed watersheds than in reference creeks. The increased variability and extreme fluctuations in the salinity of developed creeks appeared to be related to the "flashier" runoff associated with the increased amount of impervious surface in developed watersheds (e.g., roofs, roads, parking lots). Creeks that were dominated by salt marshes and limited freshwater inputs had relatively stable salinity distributions.

Dissolved oxygen concentration (DO) is a fundamental requirement for maintaining balanced, indigenous populations of fish, shellfish, and other aquatic biota in shallow tidal creeks. Pollution related decreases in DO is generally considered to be the greatest threat to the environmental quality of estuaries. DO in tidal creeks fluctuated with phase of the moon, time of day, and stage of the tide. DO in both reference and developed creeks frequently did not meet state water quality standards (4 mg/l)with the lowest and most stressful DO to living aquatic resources occurring during early morning and night-time low tides. DO in developed creeks was less predictable and had larger amounts of unexplained variance than DO in reference creeks. About 68 percent of the variance in the DO of reference creeks was associated with natural cycles. Only about 20 percent of the variance in DO of developed creeks could be attributed to natural cycles. Living resources inhabiting developed creeks were exposed to stressful low DO more frequently than living resources inhabiting reference creeks. Tidal creek ecosystems in both reference and developed watersheds appeared to consume more DO than they produced. Point-in-time measurements of tidal creek DO does not adequately represent the exposure of living resources to stressful low DO events.

Sediment characteristics were also identified as an important environmental factor influencing the distribution of the living resources in shallow tidal creeks. Sediments in developed creeks were generally composed of more sand and had larger site-to-site variation in physical characteristics than reference creeks. The greater sand content and more variable sediment characteristics in creeks located on developed watersheds were probably associated with alterations in erosion and deposition processes associated with watershed development.

Tidal creek sediments are repositories for pollutants. Trace metal and organic contaminant concentrations in sediments of the upper reaches of developed creeks, particularly those with industrialized watersheds or long histories of high density urban and suburban development, were enriched with chemicals to levels known to adversely affect living resources. Enrichment levels ranged from 2-10,000 times the values observed in reference creeks or deeper areas of South Carolina estuaries. Contaminants of particular concern were copper, lead, chromium, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and the pesticides of antiquity, including DDT and chlordane. Low density suburban development did not result in sediment contaminant levels that were of concern. The single agriculture watershed sampled did not provide an adequate representation of sediment contaminants in agricultural watersheds because pollution inputs, mainly pesticides, are episodic and do not persist in sediments.

The distribution of contaminants in tidal creeks varied with the type of development and kind of contaminant. For example, PAHs which are mainly derived from street runoff and specific point sources generally had the highest concentrations in sedimentary environments of upper reaches of creeks. Pesticide concentration in at least one suburban watershed was frequently highest in the salt marsh adjacent to houses.

Sediment bioassays indicated that the cumulative amounts of chemicals in sediments of the upper reaches of developed creeks, particularly industrialized creeks, were adversely affecting key biological processes. Sediment bioassays from reference creeks did not suggest that exposure to these sediments resulted in acute or chronic impacts on living resources.

The kind of benthic prey available to fish, crabs, and shrimp using tidal creeks as nurseries varied with salinity and sediment characteristics. Human activities associated with watershed development did not adversely affect the biodiversity of benthic organisms in creeks. Long-term salinity distributions and estuary-wide water quality were more important in controlling biodiversity of benthos in tidal creeks than were the local processes occurring within creeks.

The abundance of benthic organisms in tidal creek habitats was mainly controlled by salinity, sediment characteristics, and location within tidal creeks. These three factors accounted for between 7 and 84 percent of the variance in the abundance of benthic populations. After accounting for the effects of salinity, sediment characteristics, and location within creek on benthic distributions, both increases and decreases in the abundance of benthic populations were found in developed watersheds. The greatest differences occurred in the upper regions of developed creeks where benthic population abundances were generally reduced, particularly at sites with a long history of industrial or urban development.

Results of a benthic recruitment experiment demonstrated that benthic resources maintained high population levels in creeks by continually recruiting to bottom sediments over the summer. This continual recruitment over the summer provided a renewable source of food for fish, shrimp, and crabs using tidal creeks as nurseries. Salinity, sediment characteristics, location within creeks (upper or lower reaches), and predation by fish and shrimp all had large

influences on benthic recruitment success and colonization processes. After accounting for the variation in recruitment due to these natural factors, human alterations of tidal creek watersheds were found to adversely affect the recruitment processes for the numerically dominant benthic organism reproducing during the summer. Recruitment of this organism was greatly reduced in developed creeks.

Mummichogs and grass shrimp, the preferred prey of many species of recreationally important fish including juvenile red drum, spotted seatrout and flounder, were the dominant fish and crustaceans collected in seine samples from tidal creeks during the summer. Penaeid shrimp and spot were the dominant recreationally important living resources that were found in tidal creeks. Much of the variation in the abundance of fish and crustaceans that occurred from creek-to-creek was associated with variation in sediment characteristics and salinity distributions. After accounting for creek-to-creek variation due to salinity and sediment distributions, no differences in abundance of the numerically dominant species of fish and crustaceans and the kinds/diversity of the fish and crustaceans were found between developed and reference creeks. The abundance of selected key species were, however, reduced in specific creeks with long histories of industrial and urban development.

Although no differences in abundance of numerically abundant fish were observed between creeks located in developed watersheds and reference creeks, the numerically dominant resident fish (i.e., mummichogs) collected from creeks with developed watersheds generally were characterized by poorer physiological condition (i.e., skinnier) and had blood that was not as vigorous as fish from reference creeks. The differences in the blood vigor between developed and reference creeks was most pronounced in male fish and suggest that immune system of resident fish is compromised in developed watersheds.

Fish and crustaceans in size ranges sought by fishermen were rarely collected from tidal creeks. These biota are apparently not be able to tolerate the low DO and other environmental conditions that occur in tidal creeks during summer.

Conclusions and Recommendations

The cumulative impact of development has adversely affected the health of individual resident fish and altered distributions of the type of prey available to fish, shrimp, and crabs that use shallow tidal creeks as nurseries. These alterations, however, do not appear to be substantial enough to adversely affect the populations of recreationally and commercially important living resources that use creeks as nurseries. The number of creeks that are affected in SC is small and the regions of creeks that are the most severely affected is confined to the headwaters which is not the preferred nursery habitat for living resources. Living resources from adjacent habitats continually repopulate impacted regions of creeks.

We believe the alterations to tidal creeks identified above are "early warnings" of more widespread degradation that will occur if the pollution inputs are not reduced. It is interesting that these are the same symptoms that were identified for Chesapeake Bay and other Northeastern estuaries in the early to mid 1970s before it became obvious that the living resource populations of the Bay were declining.

The data base that has been created for primary tidal creeks provide critical baseline information for a broad range of tidal creeks located in developed and undeveloped watersheds. This data base is a research platform for designing and conducting a broad array of future environmental research. Scientists from other institutions and geographical areas are being encouraged to use these data as part of their assessment and research programs.

Because tidal creek ecosystems are consumers of DO, they require adequate amounts of DO to sustain their functions. Water quality management agencies should ensure that DO allocation schemes provide sufficient DO to tidal creeks.

Factors that contribute to low DO in tidal creeks have not been identified or evaluated. Currently, we do not know if the observed alterations to DO dynamics in developed tidal creeks is associated with increased loadings of oxygen consuming pollutants, increased loadings of nutrients (nitrogen and phosphorous) that stimulate excessive growth of primary producers, modifications to the hydrodynamics of tidal creeks from development of the watershed, and/or some other unidentified cause. Until the low DO in tidal creeks can be linked to contributing factors, it is unlikely that policies which prevent DO problems can be developed. A DO budget for tidal creeks and the associated salt marshes to define their relative importance as consumers and identify the major factors controlling low DO conditions needs to be developed. Development of a DO budget is a critical step in the development of DO standards that will ensure that nursery functions provided by tidal creeks are sustained as South Carolina's coastal watersheds are developed.

Additional research on the chronic, sublethal effects of chemical contamination to the health of individual organisms in tidal creeks needs to be conducted. Priority research topics include evaluation of the effects of contamination on immune systems, genetic adaptations of resident living resources to chronic exposure of high levels of chemical contaminants, bioaccumulation/trophic transfer of contaminants as a means of export, and *in situ* effects of contaminant exposure on survivorship, growth, and production of valued living resources (e.g., juvenile red drum).

Based on the data collected to date, status and trends monitoring efforts for tidal creeks should focus on the upper reaches of primary tidal creeks and should include measures of the health of resident organisms, water and sediment quality, and selected population and community parameters of resident living resources. The objective of tidal creek monitoring programs should be to assess the proportion of creeks that have degraded characteristics.

Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Holland's presentation:

Question: This is a very impressive data set. Was it collected over the course of one year and at what cost?

Response: The project cost approximately $200,000 to $300,000. The work was performed by two graduate students, one technician, and myself, as well as 4-5 people working full-time on the chemistry data. Geoff Scott believes that this is probably the most extensive small-scale chemistry data that he knows of in existence. The project was done in two years. It's a targeted study; the dissolved oxygen sampling was performed throughout the year and all creeks were sampled randomly in time over an index period (July 1 to September 15). The creeks were ordered so that each week we sampled one good, one bad, and collected samples for a separate validation data set that I haven't mentioned. The validation data set included repeat samples of some of the good and bad creeks, as well as independent creeks, for use in validating whatever models are developed. We're in the process of doing this now. We've held the validation set back because of the way we prioritized processing data. This set will allow us to validate the models with a sample totally different from the repeat samples to determine if the processes worked. We are now also working statewide – sampling selected creeks from the north inland and national estuarine research reserve to the Savannah River – and we're seeing the same results.

Question: How much of the patterns showing low dissolved oxygen do you think are due to fact that we now have the ability to measure continuous records of dissolved oxygen? We're finding the same thing in a variety of habitats, for example, sea grasses.

Response: I don't think it's abnormal, necessarily, but I don't know the answer. There are probably ways to deal with it, for example, by relating dissolved oxygen dynamics to something that we can historically measure such as total nitrogen in sediment cores. This relationship could provide a partial answer. Also, the dissolved oxygen budget should identify the consumers – e.g., the sediment, a bad reaeration process, or the organisms. But a more important question is whether we want to fix the problem. I think it's an invisible barrier to large predators preventing them from moving into the creeks and consuming the juveniles. The organisms clearly do adapt, but the question is how low can you let the levels go. We sampled two creeks at a naval air station where aerators were installed to meet mandated levels (4 mg/l), and they don't have any shrimp. Another inlet was redesigned by the Corps to meet the standard and the creeks don't have as many shrimp. So I'm not sure we want to change it, but we do need to know how low it can go and at what exposure these organisms can't adapt.

Question: This is more of a comment. I think the same thing happens in very clean marsh creeks in New Jersey where we find low dissolved oxygen in the summer. These effects disappear in the fall and winter. Tagging of summer flounder has shown that they stay at the mouth during the day and move up the creeks and feed heavily at night.

Response: One message is that even the worst creeks function, just at a different level. Another message is that quality counts, not the amount. We have a vast supply of creeks in South Carolina; the question is do they work, not how many you have. We keep asking the wrong questions.

Determining the Effects of Habitat Impacts on Fish Populations

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Until recently, human-induced perturbations other than fishing have received little attention in the stock assessment literature. Beginning in the late 1960's, environmental legislation in the U.S. has directed attention toward assessing the mortality of fish and other living aquatic resources caused by observed (or anticipated) changes in water quality or other habitat features that are related to ongoing (or proposed) human activity. Scientists are not only being requested to devise means to estimate the extent of aquatic impacts related to the causes, but also means to reduce or avoid them. The challenge to fishery scientists is to develop a robust method to evaluate impacts that is easily applied with available data and gives results that are readily understood by fishery managers. Here I describe four methods that can be used to determine the population-level effects of habitat impacts.

The equivalent adult method was introduced by Horst (1975) as a means of assessing the population-level impact of entrainment mortality of ichthyoplankton by power plants. Entrainment mortality is caused by mechanical abrasion and changes in temperature and pressure as organisms are drawn through the cooling water systems. It usually affects only the youngest life stages in a fish population, when natural mortality rates are generally highest and most variable (Houde 1987). The equivalent adult method translates losses in younger age groups due to entrainment (or other identified sources, such as pollution) directly into equivalent numbers lost in older age groups had the younger fish been allowed to survive. The method uses age- or stage-specific survival rates between the age group being impacted and the age group when the fish would have been recruited to the spawning stock or fishery. The equivalent adult approach has been used recently by Public Service Electric and Gas to determine the population-level impacts of entrainment mortality of weakfish (*Cynoscion regalis*), spot (*Leiostomus xanthurus*), and white perch (*Morone americana*) caused by operation of the Salem Generating Station in Delaware Bay (PSE&G 1993).

An elaboration of the equivalent adult approach translates losses in younger fish into subsequent lost production to the ecosystem, termed "production forgone" (Rago 1984). This measure uses a biological production model to project future impacts to available biomass in a system that are associated with current losses. Production forgone is a more relevant measure of ecosystem impact than losses in numbers or biomass alone, since it includes biomass which would have been transferred to other trophic levels through either consumption or decomposition (Rago 1984). Estimates derived from the production forgone method are generally much higher than the actual biomass killed. The method is currently being used to estimate the number of acres of wetland habitat bordering Delaware Bay that would need to be restored to offset the loss

in productivity of the bay caused by operation of the Salem Nuclear Generating Station (PSE&G 1993).

Although the equivalent adult method and its elaborations provide some insight into potential impacts of losses due to pollution or other sources of habitat-induced mortality, fishery managers may be more interested in the impacts on the reproductive potential of a fish population. Reproductive potential can be measured as the potential lifetime contribution of a recruit to population fecundity (eggs per recruit, EPR) or to spawning stock biomass (spawning stock biomass per recruit, SSBR) under conditions of optimum growth and natural mortality. For both the EPR and SSBR measures, mortality caused by pollution (or other events) is expressed as the fractional reduction in the number of recruits caused by the pollution event under the assumption that only density independent mortality occurs between the age being impacted and the age of recruitment. The fractional reduction in recruits translates directly to the fractional reduction in reproductive potential (EPR or SSBR), which can then be compared to the level of change in fishing mortality that would result in an equivalent reduction in reproductive potential of the population. Goodyear (1988) determined that a conditional power plant mortality of 0.2 for age 0 striped bass in the Hudson River was equivalent to an increase in 14 percent in the number of striped bass fishermen of average efficiency; thus, a 14 percent reduction in allowable fishing mortality was required to offset the power plant losses. Boreman et al. (1993) found that the effects of percentage reductions in reproductive potential of winter flounder in Cape Cod Bay caused by decreased age 0 survival can be offset by relatively equivalent percentage reductions in the fishing mortality rate.

A relatively new method of tracking mortality in early life stages of fishes is the individual-based modeling (IBM) approach. The IBM follows individuals on a short time step (usually daily) as they develop until they die. The approach enables tracking of individuals with respect to their initial attributes (e.g., spawning date, parentage, egg size, growth rate) as they are exposed to events that may affect the size distribution of the population and magnitude of recruitment. Although the IBM approach has not yet been applied to translate added mortality due to pollution or fishing into population-level impacts, it has the capacity to do so. However, the IBM method is heavily reliant on data that accurately characterizes the relationships between environmental variables and age 0 growth and survival, more so than the equivalent adult or reproductive potential methods.

All of the methods described in this paper that are currently being used or potentially could be used to compare population-level effects of pollution and fishing share several common limitations. Probably foremost is the inherent difficulty in estimating survival rates for early life stages. As noted by Horst (1977) and others, early life stages of fishes experience high variability in spatial and temporal distributions and survival. Attempts to relate the high variabilities in early life stages to environmental parameters are often stymied by the lack of corresponding spatial and temporal resolutions of data sets containing physical and chemical variables. Variability is also introduced by difficulties in sampling early life stages, due to factors such as gear avoidance, net extrusion, gear-induced mortality, site-specific limitations for using particular gear types, and misidentification (Bowles et al. 1978). Protracted spawning

periods, which can result in the simultaneous presence of a number of early life stages and ages within the life stages at any given time during the development season, further complicate analyses. The high variability in abundance and distributions of early life stages, combined with variability in the environment from which the organisms are sampled and variability imposed by the sampling process itself, leads to estimates of natural mortality rates for early life stages based on field sampling that are dubious, at best.

Because fishery managers can reduce fishing mortality much easier than they can eliminate pollution from fish habitats, imposing additional harvest restrictions is usually an effective short-term strategy for rebuilding fish stocks while their habitats are being restored. The Atlantic States Marine Fisheries Commission adopted such a strategy in the early 1980s to rebuild the coastal migratory stock of striped bass (Versar, Inc. 1990). After the action was taken by the coastal states to reduce fishing mortality, the estimated annual survival rate of the coastal migratory stock doubled (Sprankle 1994), followed by increased recruitment in the major spawning rivers (NMFS 1993). However, if an underlying cause for the decline in striped bass is a decreasing trend in survival rate induced by pollution or another form of habitat degradation, then the gain in abundance of striped bass spawners and recruits resulting from the additional harvest restrictions will only be temporary. Managers should not use imposition of additional harvest restrictions as an excuse to abandon their efforts to maintain or enhance fish habitats.

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Boreman's presentation:

Question: You show loss as mortality; how about converting that into a positive such as gain in fish?

Response: We showed this for winter flounder. You can look at it both ways. You can lose fishing opportunity by pollution, but if you can clean up habitat, you gain fishing opportunity. This gives the fishery manager the option of increasing fishing limits. It depends on what the management objective is; if the objective is to maintain some level of reproductive output in the population, you consider all of these options. But they're only as good as the underlying data, which I don't have to worry about. I just work with the numbers. The problem is the risks involved with the numbers.

Question: Regarding the problems with mortality at the early life stages, rather than looking at eggs per recruit, I was wondering if you plotted recruits per egg against biomass, whether the point where the curve breaks would indicate capacity.

Response: This is dangerous because you're looking at the system in two dimensions. While it may work for the particular time you're collecting the data, we're working in an "n"-dimensional system. It may work for the first approximation, but I wouldn't put a lot of faith in it because the systems are so variable and the recruit per egg relationship is controlled by different things every year.

Question: One of the ways to increase the public's attention, including politicians, is to present good examples of things that have worked. Is this (i.e., habitat improvement) what happened with the striped bass and are there any other success stories?

Response: I don't think habitat improvement had any effect on recovery; I think what we've seen is the result of releasing an incredible amount of fishing pressure on the stock. What we found is that watermen were removing 70-80 percent of the year class among young striped bass. When this is stopped, survival increases 3 to 4 times. We warned Maryland that they would start to see a lot more small fish, but not to yield to pressure because these age classes have to reach spawning age, as does the next generation, and so on.

Question: Let me add to that; one of our concerns is that the striped bass has been declared recovered, but habitat loss may still be a problem.

Response: I agree. My last message is that we may be giving ourselves false hope. For striped bass, it worked because they're so vulnerable to fishing, but habitat loss may still be a problem. So don't use reducing the fishing mortality rate as an excuse not to improve habitat. For winter flounder, it's more evident that habitat improvement is very important for restoring their stocks. It's a much more effective management tool for flounder because the striped bass were so vulnerable to fishing. So don't give up on one option just because something else seems to work.

Question: Is any effort being spent on determining the cause of the loss of younger juveniles and early life stages instead of just assuming that there is a mortality rate? What are the habitat impacts (e.g., wetlands loss or increased turbidity)? One of the questions we're always asked is what effects does the mud dump site have on fish stocks, and it's very difficult to answer.

Response: There has been a lot of effort in this area. Over-fishing was one of nine hypotheses developed for the striped bass. No "smoking gun" has been found other than fishing, but there is a lot of evidence to show that there are habitat problems, especially in the Eastern Shore rivers of Maryland (e.g., low pH episodes during rainstorms and operation of the C&D canal). There are a lot of possible suspects out there.

Question: Is it not possible that we could become euphoric over the abundance of the striped bass and start increasing fishing pressure?

Response: I haven't been involved with striped bass since 1985, so please keep this in mind. Some striped bass modelers want to start re-introducing more fishing pressure on the stock. Some people think this may be going overboard by trying to do too much too soon. The bottom line is that the modelers are believing the models, which is very dangerous. My feeling is that it's worked so why mess with it?

Approaches for Determining Effects of Pollution on Fish Populations in Puget Sound

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Puget Sound is a large marine and estuarine ecosystem in Washington which serves as the habitat for a number of recreationally and commercially important species of groundfish and Pacific salmon. Over the past several decades, the human population of the Puget Sound drainage basin has increased substantially, resulting in increased habitat degradation and chemical pollution. There is now a body of evidence showing that groundfish and salmon in Puget Sound are experiencing a range of biological effects due to chemical contaminant exposure, including impairment of several stages in the reproductive process, increased susceptibility to pathogens resulting from altered immune competence (Arkoosh et al. 1994, 1996), and development of toxicopathic diseases (e.g., Myers et al. 1990, Varanasi et al. 1992; Johnson et al. 1994; Stein et al. 1995).

The question which now must be addressed is whether contaminant-related reduction in reproductive and survival rates are sufficient to affect fish abundance. Currently we are investigating the potential impact of contaminant-related mortality and reproductive impairment on the population growth rate of English sole (*Pleuronectes vetulus*) using techniques of simulation modeling. An initial Leslie matrix population model (Caswell 1989) was constructed for investigation of contaminant effects using the adult mortality rate for English sole in Puget Sound, WA, estimated from recent historical data (Johnson and Landahl 1994). Age-specific fecundity was determined from previously collected English sole ovary samples (Johnson et al. 1996). Existing data on the effects of contaminants on reproduction, including impaired gonadal development, reduced spawning ability, and decreased egg and larval viability (Johnson et al. 1988; Casillas et al. 1991; Collier et al. 1992), were incorporated into the fecundity component of the model. The influence of density-dependent population regulation on model results was also examined.

Resulting model projections indicate that contaminant effects, particularly on reproductive capacity, could substantially reduce the intrinsic rate of increase (r) of English sole populations from contaminated sites in Puget Sound if density-dependence is weak or moderate. This could be a cause for concern, especially if fish inhabiting contaminated estuaries or embayments have historically contributed a significant proportion of recruits to the English sole population of Puget Sound.

Geographically, contaminant "hot spots" constitute a relatively small percentage of the sea floor of Puget Sound, and hence on this basis would not appear to be a major influence on the English sole population. However, from the perspective of habitat suitable for English sole, the

assessment may be different, as this species occurs mainly in a relatively narrow band of shallow to moderate water depth nearshore (Lassuy 1989, Toole et al. 1987) where contaminant "hot spots" generally occur (PSWQA 1987). Presently we have only qualitative estimates of the proportion of the total Puget Sound sole population that resides at urban sites and thus would be susceptible to contaminant-associated declines in survival or reproductive rates. A more quantitative assessment can be made by using data from reproductive surveys in Puget Sound to estimate the threshold sediment concentrations of contaminants such as PAHs and PCBs at which decreased reproductive success is first observed. Such an approach would provide an estimate of the geographic area over which animals are at risk, and thus identify the proportion of English Sole habitat that is functionally impacted and requires remediation.

In contrast to reproductive rates, total mortality rates in sole from heavily contaminated sites were generally similar or slightly lower than those for English sole from the Port Susan reference site and for Puget Sound as a whole (Johnson and Landahl 1994), and did not substantially affect population trajectories of sole subpopulations from contaminated sites. When estimated differences in fishing mortality were taken into account, however, non-fishing mortality appeared to be substantially higher at the urban sites than at the Port Susan reference area (Johnson et al. 1995, Landahl et al. 1996). Historically, the lack of fishing in urban bays of central Puget Sound appears to have mitigated the impact of this increased mortality on sole populations. These findings highlight the linkage between human activities and fishery productivity, and point out the need to consider the cumulative impacts of multiple stressors on fish populations.

While our initial model provides insight into the potential effects of chemical contaminants on English sole populations, a number of refinements are needed to increase the model's ecological relevance, and usefulness in decision-making. These include better estimates of 0-3 age survival and improved data on fishing and natural mortality in Puget Sound English sole. Perhaps most critical, however, is the need to consider the contribution of recruits from urban sites to the central Puget Sound English sole population, as well as the possibility that immigration into contaminated areas by offspring of fish from other sites could compensate for recruitment declines associated with contaminant exposure in localized areas. Because English sole have planktonic eggs and larvae that are transported by tidal currents from spawning sites to nursery grounds (Lassuy 1989), some movement of eggs and larvae from non-urban to urban areas is a possibility. Metapopulation analyses would be useful to address this issue; however, there is a need for better field data on actual recruitment and migration patterns in English sole to develop a metapopulation model that would accurately reflect the population biology of this species. We are also exploring the use of a stage-based rather than age-based model to more effectively simulate the distinctive processes affecting the larval, juvenile, and adult life stages of English sole. Developing better information on immigration among habitat types will provide data necessary for improved science-based decisions on conservation of productive English sole habitat.

Similarly, the information from such studies provides a baseline for evaluating the efficacy of remediation efforts at polluted sites in Puget Sound. The monitoring of such projects is

crucial in evaluating the benefit of the remediation to the functional properties of the habitat. We have recently worked cooperatively with the Region 10 US EPA office to assess the effect of a sediment capping project in reducing exposure and effects by polycyclic aromatic hydrocarbons in the benthic flatfish assemblage from a site heavily contaminated by creosote. The initial phase of the monitoring is completed and has demonstrated the importance of: 1) studies on indigenous species in assessing the effectiveness of the remediation; 2) sufficient monitoring, both spatially and temporally, prior to the remediation efforts; and 3) sustained monitoring following completion of the project for an objective assessment of changes in the biological community at the site. Without such information, the efficacy of the project cannot be evaluated and the need for additional action cannot be objectively determined.

A final consideration is the applicability of the present findings to effective management of marine fish stocks. Effects of contaminants on fecundity, as presented here, when viewed as a form of "population stress" can be expressed in terms related to spawning per recruit, making it possible to use techniques for stock assessment to estimate the decrease in commercial and recreational fishing that would be needed to offset the stress from pollution (Sissenwine and Sheperd 1987, Fogarty et al. 1991). For example, a spawner-recruit model can be used to express contaminant effects and fishing pressure in a common currency. Using a "common" currency has the clear advantage of allowing an assessment of the both the relative and cumulative contributions of multiple stressors (fishing, loss of habitat, and chemical substances) to declines in commercially and recreationally important fisheries, and thereby contributes to improved assessment and management of fisheries resources and their habitat by identifying the major stresses on a population. Such an approach should be more effective, therefore, in managing for the cumulative effects of human-induced stresses on fish populations.

In summary, our studies with English sole substantiate that through multidisciplinary studies that combine field and laboratory experiments with modeling techniques, substantive progress can be made to distinguish quantitatively the effect of chemical pollution on fish stocks and the quality of their habitat. It is also noteworthy that recent studies with juvenile salmon show that even relatively brief exposure of an anadromous species to chemical contaminants can lead to biological effects (immunodysfunction, increased disease susceptibility) that may increase mortality (Arkoosh et al. 1994, 1996). Overall, our findings indicate that chemical contaminants can have an impact on fish populations in nearshore coastal areas, and the effective regulation of pollution and related anthropogenic impacts may be a factor in the maintenance of healthy fish stocks in such environments.

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Stein's presentation:

Question: How much of an effect is predation having on those stocks?

Response: There are two answers. The hypothesis is that predation is probably pretty important but we don't understand it very well. For example, a study during an episodic event in Barclay Sound in Canada found it to be very important. But identification of the real contribution and the partition among predators (e.g., fish, birds) is unclear.

Question: What percentage of habitat loss is due to hydro development?

Response: I don't know the answer, but it's high. Clearly on the Columbia River, hydro development has altered it dramatically. However, there have also been changes in practices that have been implemented leading to some improvements in survival to offset some of the habitat loss. But the results have not been evident and it's a huge management issue. State and federal agencies, and private landowners are involved.

Question: But prior to the decline, the dams were there and production (or harvest) was still very high.

Response: It depends on where you start from. It's been a fairly steady decline; it just got more precipitous.

Question: What about the role of genetics?

Response: Certainly there's much concern about the genetic component. There's a very large debate over whether hatcheries are good or bad.

Effects of Pollution on the Behavior and Subsequent Fitness of Salt Marsh Killifish

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Among the features of habitat that are critical for success of fish populations is the quality of the environment. Pollution can have major consequences on the survival, growth and reproduction of fish. One of the most sensitive responses to contaminants, and one with obvious consequences for survival, is that of behavior. Impaired feeding behavior has been noted in many laboratory experiments in response to exposure to a variety of contaminants. Another behavior with obvious ecological consequences is predator avoidance, which has also been observed in organisms exposed in the laboratory to various contaminants.

The mummichog, *Fundulus heteroclitus*, is a very abundant fish which plays an intermediate role in the trophic structure of East Coast marshes. Adults consume primarily crustaceans and annelids, and feed on the marsh surface at high tide. Adults are significant predators on the grass shrimp, *Palaemonetes pugio (*Knieb, 1988). They also consume detritus, which is of very little nutritional value to them (Prinslow et al., 1974). They are consumed by migratory fishes such as white perch and striped bass. However, these are rare in tidal creeks which are the principal habitat of mummichogs, where its principal predator is probably the blue crab, *Callinectes sapidus* (Knieb, 1987).

Previous studies (reviewed in Weis and Weis, 1989) demonstrated differences between populations from clean reference areas and fish inhabiting Piles Creek (PC) a polluted tributary of the Arthur Kill in Linden, NJ. Surrounded by industrial sites, a sewage treatment plant, a power plant, and a major highway, the sediments and biota of this creek have elevated contaminants, including mercury (Khan and Weis, 1987). We have found that the fish have increased embryonic tolerance to methylmercury. Adults do not show this tolerance, but rather show reduced growth and condition and a shorter lifespan, compared with those from cleaner sites in eastern Long Island (EH) and Tuckerton NJ (TK). Nevertheless, the population persists due to compensation via increased reproduction, an adaptation noted in stressed populations of other organisms.

Recent work has led to an understanding of behavioral modifications leading to the decreased condition and growth in the PC population: impaired prey capture ability. Laboratory studies comparing the rate at which PC and EH adults captured food (baby guppies) demonstrated that PC fish were slower to capture the prey (Weis and Khan, 1991). Impaired feeding behavior was also seen in fish that had been exposed in the lab to mercury for a week (Weis and Khan, 1990). When experiments were performed using a more appropriate prey

species, the grass shrimp, *Palaemonetes pugio*, a similar result was obtained: PC fish were poor predators compared to fish from TK (Smith et al., 1995). The poor predation was correlated with elevated brain mercury and lowered levels of the neurotransmitter, serotonin, in the brains of the PC fish. When TK fish were maintained in an aquarium with PC sediments and water and fed PC shrimp, their prey capture ability declined to that of PC fish by one month. Analysis of the brains of these fish revealed that they had increased their level of brain mercury to that of PC fish. When PC fish were maintained in clean water for over two months, there was only a very slight improvement in their prey capture ability, and brain mercury did not decrease. This correlation of behavior with brain mercury does not necessarily mean that this pollutant is the cause of the altered behavior; other contaminants may contribute as well. Analysis of videotapes showed that the reduced prey capture was primarily due to fewer attempts to capture prey, rather than to poor coordination (Smith and Weis, in press). PC fish, being generally "slow" had lower spontaneous activity and were more vulnerable to predation by blue crabs in laboratory experiments. On the other hand, the predator-avoidance abilities of the grass shrimp at PC did not appear to be significantly impaired compared to conspecifics from clean sites. Analysis of gut contents of field-caught mummichogs revealed that PC fish were eating primarily detritus and sediment, and far less live food than the fish from TK. Since detritus has been shown to have little nutritional value, this may be largely responsible for the poorer growth and condition previously observed. Studies on early larvae demonstrated that PC larvae are not poor predators, but rather can capture prey (*Artemia*) faster than EH larvae. However by the time they are one year old, the impaired behavior is manifested (Zhou and Weis, 1995).

Most studies of pollution effects focus on one level of organization - biochemical, cellular, organismal, population, or community. Our studies demonstrate the links between the different levels of organization: the biochemical - neurotransmitter alterations - leading to the organismal - altered feeding behavior - leading to the population level, as seen in the reduced size structure, condition, and longevity of the population at Piles Creek.

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Weis' presentation:

Question: Did you look at prey densities at the different sites?

Response: We're looking at this right now. It's very easy to get grass shrimp in both places, so it's not a scarcity issue. The shrimp in Pyle's Creek tend to be larger and we have studies underway to examine the possibility that they're bigger because they're preyed on less. It's possible that the shrimp are showing us a link from the population to the community level in that reduced predation due to impaired feeding of the fish may allow shrimp to live longer.

Question: Do you have any water or sediment chemistry data for mercury?

Response: We have that data on metals; we're going to be getting data for organics. All of the metals are much higher in Pyle's Creek. Pyle's Creek has had several oil spills and probably has most common contaminants in it.

Question: Are the EPA water quality criteria exceeded?

Response: I'm not sure; I would imagine they might be for certain contaminants. We've been focusing on sediment levels rather than water levels.

Question: Do the sediment levels for mercury exceed standards?

Response: Sediment levels for mercury and other contaminants are very patchy. Levels are generally in the 10-20 ppm range for mercury, but we have a hot spot where it's 200 ppm. I'm sure it's patchy for other things as well, so it's very hard to draw conclusions.

Question: It would be interesting to determine if effects are seen at levels below criteria levels.

Response: There's a lot of data in the research literature showing that some of the criteria levels are, in fact, higher than what causes some effects in certain organisms. I don't think these levels are meant to protect everything; they're meant to protect 95 percent of things.

Question: There's a lot of evidence to show that sediments are packed with microflora. Have you done any stable isotope studies to show that organisms are not extracting beneficial material from microflora in detritus or sediments?

Response: We have some samples being analyzed right now for stable isotopes. My comments were based on previous work that looked at the value of sediment in the diet of *fungilus* and concluded that it didn't have any.

Chapter 6

Review of Regional Habitat Issues

Introduction

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I want to provide a brief overview of issues, processes, and habitat types to serve as a point of reference for the presentations that follow. This session will focus on two specific issues: dredging windows on Long Island Sound and agricultural runoff in a southeast estuary. Relative to habitat, we need to acknowledge the regional variables that are involved. Obviously, from Florida to Maine, we are dealing with numerous habitats and the issues change from state to state.

When we convened this workshop, we recognized that hard work would be required to arrive at a common goal beyond the protection and enhancement of habitat in general. The geographical differences that need to be acknowledged include morphology, climate, development pressures, and the fishery resources present. And we need to keep in mind habitat functions such as nursery, spawning, forage, refuge, ingress, and egress areas. We also need to acknowledge the different types of aquatic habitats including coastal wetlands, marshes, mangroves, forested floodplains, submerged aquatic vegetation, unvegetated bottoms, tidal flats, shallows, hard bottoms, inshore estuarine, and offshore pelagic, shellfish reefs and beds, the water column, and shoreline (vegetated or unvegetated, and structural features such as cobble, rock, mud or sand composition). In addition, impacts can be classified as to whether they are physical (e.g., dredging, excavation, erosion, discharges, hydrologic modifications, and boating and fishing activities) or chemical (e.g., point source and nonpoint source discharges).

Finally, the management of impacts can be categorized by type of activity. In a perfect world, we could avoid most impacts through communication of needs and compromise; however, we typically fall back on regulation to control or influence modifications to natural systems. So we need to consider how the process of regulation can be enhanced in protecting habitat when considering regional issues. Mechanisms available to enhance the function of the process include communication, coordination, education, and technical information.

Dredging: What is the Best Approach for New Jersey?

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The sediments in the Port of New York and New Jersey are contaminated with high levels dioxin. The dioxin came from the Diamond Shamrock Plant, which manufactured Agent Orange during the Vietnam War. The dioxin was released to the Passaic River and has worked its way down to various areas in the Port. Businesses that depend on the Port, however, need to dredge the Port in order to function. In order to look for solutions for the handling of this contaminated material, New Jersey Governor Christine Whitman formed the Dredged Materials Management Team. The purpose of this Team was to develop alternatives to ocean dumping of the contaminated dredged material. The Team was given six months to develop alternatives acceptable to the environmental, business, and scientific communities.

For many years, dredged spoils from the Port were disposed of at the Mud Dump Site. The Mud Dump is approximately 5.5 miles from Sandy Hook, NJ. So, in addition to the concern of Port businesses, there's also concern from shore residents and the tourism industry. A few years ago, a group called Clean Ocean Action sued to stop the dumping of contaminated dredged spoils at the Mud Dump. They were successful to a certain extent: while the courts decided that the imminent dredging projects would go forward, other projects were held up due to uncertainty in the testing protocols for the dumping of dredged materials at that site.

What is at stake are jobs and the environment. It is estimated that the Port of New York and New Jersey is responsible for 432,000 indirect jobs and 117,000 direct jobs. We have a unique situation in that the materials that have been found have been classified into three categories. The first category is considered clean, which means it meets federal ocean dumping criteria and can continue to be disposed of at the Mud Dump. Category 2 material has been deemed safe for ocean disposal under federal regulations, but it must be capped with clean material after dumping. Category 3 material fails all ocean dumping criteria and cannot be disposed of at the Mud Dump at all. Consequently, in New Jersey, we had to develop alternatives for Category 3 material, as well as Category 2 material because Governor Whitman did not want it disposed of in the ocean.

Some of the dredging alternatives examined included: subaqueous borrow pits (also known as confined disposal facilities); containment islands; geotextile bags; land disposal; decontamination technology; and various combinations of these. The recommendation of the Team was to create subaqueous borrow pits in Newark Bay. Specifically, the Team proposed to dig subaqueous pits adjacent to Port Authority property down to an 80' depth. The pits would then be filled with contaminated dredged spoils and capped with clean materials. The rationale for selecting this alternative is that the contaminated sediments would be kept where they originated rather than moving them out to the Mud Dump, a relatively clean area. This alternative would also

prevent the spread of contaminants any further. Other sites that were considered were also relatively clean.

This became quite a project — in New Jersey, approximately 66 percent of the dredged spoils are contaminated (i.e., Category 3 material). This is much higher than had been anticipated. Among the issues studied by the Team were testing protocols, which are currently under review by the federal government. Fisheries managers should examine the changes to these protocols to determine whether the criteria for ocean dumping are being weakened. The Team also reviewed information on various methods of testing the Harbor to identify areas with the most concentrated sediments for potential disposal in containment islands, upland brownfield sites, or other suitable locations. In addition, the Team looked at a myriad of decontamination technologies, ranging from bioremediation to photocatalytic degradation. While some pilot projects are underway, actual use of decontamination technologies is still 5-10 years away.

With respect to immediate disposal needs, permits are pending to place Category 3 material at an upland site adjacent to the Port Authority property. The material will be solidified with lime and used to stabilize a parking area for a new mall and at a landfill. But a lot of the solidification technology is in the early development stages, and there has been some public opposition. So currently we intend to proceed with the subaqueous pits. EPA, the Army Corps of Engineers, and the Port Authority are preparing an Environmental Impact Statement. All of the environmental groups, scientists, agencies, and local organizations are part of the process. This seems to be the best solution at this time. In terms of actual implementation, the 80' pits will be filled with contaminated sediments and covered with clean material. The pits will first be tried in Newark Bay, and if successful, perhaps used in other areas of the Port.

Concerning the alternatives, the use of geotextile bags involves loading a plastic material with contaminated sediments, sewing the bags shut, and depositing them at various sites. The bags have been tried in Texas and have also been used as landfill liner. Tests performed by the Port Authority, however, were unsuccessful because the bags ripped. Additional tests are planned because the ideal situation would be to place the material in these bags for dumping without decomposition.

Most recently, the Governor's Team has been examining longer-term solutions including:

- Containment islands — Environmentalists, however, are concerned over potential loss of habitat when the islands are built

- Decontamination — The most promising is the development of a treatment regime involving a combination of bioremediation, heat, and metals removal

- Habitat creation — A Seattle-based company has placed contaminated dredge material within contaminated, unused berth areas, and added plants to develop habitat. This technique has been quite successful.

One of the greatest advantages of the subaqueous pits is habitat restoration. Currently, fishing advisories restrict catching and consumption. The subaqueous pits would actually clean up the area by capping it over and restoring the bay bottom to its natural conditions. Also, in the long-run, other actions such as upgrading of sewage treatment plants and discharges, and seeking natural resource damages from past violators, will contribute to improved conditions. One of the Team members estimates that within a 5-year timeframe, if contaminant loadings are reduced, there will be a quick turnaround in the levels of contaminants in the sediments and marine life. This will result in reduced food chain effects, and hopefully, diminish some of the current fishing advisories.

Discussion

The following questions were asked by workshop participants at the conclusion of Ms. DiLorenzo's presentation:

Question: Have any ship berths already been identified for possible long-term disposal?

Response: Yes. An area called the Long Slip Canal is a very fouled location near the train station in Newark and will be filled with contaminated material. Wetlands will also be established.

Question: Regarding the use of contaminated sediments to create wetlands, are the plans to fill an area with contaminated sediments and then put clean material on top, or will the contaminated mud somehow be decontaminated and used as the official substrate?

Response: The clean material could be either Category I material, for example, from the passenger ship terminal in New York, or it could be sand. But it will be capped.

Question: Next week the Corps of Engineers will be conducting a geotextile bag demonstration at the Mud Dump. One bag will be dropped next week and another will be dropped the following week. They tried this last year and had some problems. Assuming these bags work (i.e., they don't fall apart and they have been placed properly), what do you think could be put in them and how could they be used out in the ocean?

Response: There's a proposal now to fill the bags with sediment from the Port and re-dredge the mud dump site for clean sand for construction purposes. The bags would be filled with this material and placed in the pits that are created from the sand mining project.

Question: What is the capacity of the bags?

Response: The capacity of the bags is approximately one barge load of material.

Question: Was the five-year prediction based on natural attenuation, sedimentation or something else?

Response: It was based on natural attenuation.

Question: What is the volume cost?

Response: The original estimate was for 150 million cubic yards in the subaqueous borrow pit. But since this time, it was decided to begin with a smaller pilot project with three smaller pits of about 1 million cubic yards each.

Question: Could you comment on the status of capping technology? I remember seeing a map of contaminants at the Mud Dump site and some were dispersed outside of the dumping area.

Response: That's a good question — there's quite a controversy over the status of capping. Although the Corps of Engineers' predictions indicate that the capping remains in place, it actually hasn't. Angela Cristini has found that the capped and uncapped areas have the same levels of contamination in the worms, which leads her to believe that although capping may be somewhat effective, the worms are affected through finer particulates.

Question: What is found in the material excavated from the pits?

Response: The material that's removed from the pits is contaminated for about the first foot and a half. This material will be placed at the new Metro Mall site near the airport. The rest of the material underneath is clean and can be placed at the Mud Dump.

Question: At the beginning of your talk you mentioned that the sediments are contaminated with dioxin. I'm always floored that people working on this project keep forgetting the fact that there are many orders of magnitude higher concentrations of heavy metals, such as mercury, in the sediments. There seems to be a myopia. I know dioxin is what triggered everything, but dioxin is found in parts per trillion, while mercury is found in parts per million. When people are talking about decontamination and other actions, the sole focus on dioxin is a very dangerous approach.

Response: That's a good point. I think in terms of what the Governor's team has been looking at, there's a number of different decontamination technologies to handle a whole realm of contaminants and dredged spoils rather than just focus on the dioxin. But this clearly points out the need to assess the impact of the mud dump on marine life. So far only the bioaccumulation of dioxin has been tested, but all of the other contaminants really haven't been looked at.

Question: The toxicity that they find is categorized as Category 3, which is due to other toxicants. So they are looking at it.

Response: (Note: the first part of the response was provided by an audience member.) Most of the Category 3 sediment is put into that category because of the failure of a test. But dioxin is the only bioaccumable contaminant for which there is also a criterion to put it into Category 3. So there are some sediments in the New York-New Jersey Harbor that cause accumulation between 1 and 10 parts per trillion, which is Category 2. Above 10 parts per trillion is considered

Category 3. Most recently, around the Diamond Shamrock plant, sediments were found with 900 ppt, which is the highest level of dioxin found in sediments in the country.

Question: What's going on with the Diamond Shamrock site?

Response: This is a federal Superfund site and they are pursuing cleanup, albeit slowly.

Question: Do you have a breakdown by volume of the category of materials?

Response: All 3 million cubic yards will be Category 3 material. We're not going to fill up the pits with uncontaminated material; we're going to specifically dredge those areas that have Category 3 material to start. Over the next 10 years, it's anticipated that about 10 million cubic yards of material needs to be dredged and disposed of in the Port.

Question: Do you have a start date for dredging?

Response: The start date is dependent on completion of the Environmental Impact Statement, which should be finished by the end of September 1996. The Port Authority has projected that work would start sometime next Spring.

Question: What kind of longevity testing is proposed to test the integrity of the geotextile fabrics, e.g., 10 years, 20 years?

Response: That's a good question. I think the Waterways Experiment Station at the Corps of Engineers in Vicksburg has been looking at this. One of the companies that makes geotextile bags has said that they will last over 100 years on land. In water, they're supposed to last indefinitely.

Question: Is there any consideration or plan to account for continuing sources of contamination that will re-contaminate areas that have been dredged?

Response: The intent of the New York-New Jersey Harbor Estuary Program, an EPA-funded program in cooperation with the states and the City of New York, is to reduce contaminant loadings. A lot of the re-contamination is from other sources rather than continued contamination from the Diamond Shamrock plant.

Question: Do you have any estimates of the cost per yard of these different options?

Response: The cost for the subaqueous pits is estimated at about $10 per cubic yard, which is higher than the $5 per cubic yard that was associated with unrestricted dumping at the Mud Dump. However, to date, the Port Authority and the City of New York paid for transport of contaminated sediments from a local facility to a landfill in Utah that cost approximately $118 per cubic yard. So this spurred a lot of interest in the vendor market. I think most estimates for decontamination technologies have been around $60 per cubic yard.

Question: What category of material will be placed in the bags?

Response: We'll be starting with the Category 3 material first.

Question: How does this reconcile with EPA regulations for the bags?

Response: This hasn't been resolved. Supposedly, once the material is placed in the geotextile bags, there's no leaching. So it should be contained and can still be placed out there.

Summary of Long Island Sound Dredging Windows Strategy Workshop

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Purposes

One of the actions committed to in the Long Island Sound Study Comprehensive Conservation and Management Plan is to define, revise, and coordinate the establishment of seasonal restrictions for dredging that minimize adverse effects on aquatic organisms, especially finfish and shellfish and their habitats. Towards that end, the purposes of a workshop to realize this action, which was attended by individuals employed by government, universities, and industry, were:

- To reach an agreement on what dredging windows (when dredging/disposal may or may not occur) should exist and why;
- To define impacts of dredging/disposal of dredge spoil and determine priority impacts on a scientific basis;
- To define resources at risk;
- To design the dredging windows;
- To create policies on implementation of dredging windows;
- To determine what actions should follow this workshop.

Among the major concerns expressed by participants was that dredging windows should be:

- Flexible, subject to other conditions, "one size fits many";
- The product of an interstate agreement when dredging takes place in Long Island Sound proper;
- Divided into four zones: Long Island Sound proper, Connecticut rivers, coastal tributaries, and harbors; and,
- An interim agreement, to be tested and refined over time as additional information becomes available.

Impacts of Dredging/Disposal of Dredge Material

During dredging operations, bottom sediments are removed, disturbed, and resuspended. Historically, dredged material was disposed of by being discharged into designated open-water disposal areas near the dredging site. Because of concern about environmental damage, disposal of dredged material has been tightly regulated.

Initially, in establishing dredging windows, impacts must be considered with respect to:

Environmental

- Direct removal/burial of organisms as a result of dredging and placement of dredged material;
- Turbidity/siltation effects, including increased light attenuation from turbidity, alteration of bottom type, and physical effects of suspended sediments on organisms;
- Contaminant release and uptake, including nutrients, metals, and organics from interstitial water and the resuspended sediments; and,
- Release of oxygen-consuming substances, sulfides, for example;
- Release of excess nutrients;
- Noise/disturbance to terrestrial organisms.

Other

- Wear-and-tear on equipment;
- Cost considerations;
- Vessel and human safety;
- Type of dredging/disposal equipment;
- Funding cycles;
- Project feasibility.

Additional factors were enumerated at the workshop:

- The protected resource and industry;
- Natural turbidity events;

- Socioeconomic impacts from commercial and recreational fisheries;
- User group impacts (e.g., delays to navigational improvements, beach nourishment, etc.);
- Time of dredging versus time of disposal;
- Project practicality and availability of dredging equipment;
- Mandates from specific fisheries management plans/agencies;
- Impacts to non-fisheries resources (e.g., birds, wildlife, etc.) from noise and disturbances; and,
- Temporal issues.

The size of the project must be considered. It must also be remembered that impacts from dredging can be cumulative. A number of small projects, particularly in an embayment with poor flushing characteristics can have as severe environmental consequences as a major project in the same area.

Although it was agreed that alteration to hydrodynamic regimes and physical habitat alterations were impacts associated with dredging, it was agreed that they are not generally seasonal (with the exception of beach nourishment, with respect to endangered shorebird species) and therefore not within the scope of the conference.

Priorities should be site-specific, therefore there should not be a generic prioritization where one species or one impact is automatically given the greatest consideration. In addition, there are places in Long Island Sound that may be dredged year-round. It was recommended that areas defined by NYSDOS and NYSDEC as Significant Coastal Fish and Wildlife Habitats can be used as a basis for developing a regional dredging window for New York State.

Organisms at Risk

In assessing biological impacts from dredge and disposal operations, it is necessary to consider impacts to individual species, as well as responses at the community level. Not only organisms of different species but also organisms of the same species at different stages in their life history vary in their ability to tolerate or avoid stressful conditions produced by dredging and disposal. Because estuaries such as Long Island Sound are diverse and dynamic, the interactions of living marine resources with their environment are complex and not always readily discernible.

Scope and Basis

The workshop was asked the question of how are organisms at risk determined. Below are highlights of the ensuing discussion.

All species of concern may be affected by dredging. It is necessary to consider site-specific utilization of an area by a species of concern. The life stage of the species of concern must also be a part of the dredging window formulation. It was agreed that there is a general lack of site-specific data. It was also agreed that local data can be reasonably used to make generalizations.

An organism's ability to adapt to turbidity and sedimentation must be considered. Some organisms have the ability to incur an oxygen debt during times of high turbidity or sedimentation, and thereby survive the associated impacts. Viability of eggs is effected by sediment deposition and suspension. This can be the result of burial, as a direct result of disposal or siltation, or by the physical or chemical effects of the resuspended sediments.

Whether or not an organism is mobile or sessile must be considered. Also, is the species a year-round resident, or is it transient to the area? Because mobile species can avoid areas that they find unsuitable, they are less likely than sessile organisms to suffer the impacts of dredging and disposal. If an organism spends only part of the year in Long Island Sound, then that is the only time that the impacts of dredging disposal in the Sound must be considered for that organism. A listing of critical life stages of local marine organisms and time of year that they utilize different waterways has been attached.

Shellfish beds also deserve consideration in establishing dredging windows. Oysters, clams and scallops are relatively sessile, and therefore unable to relocate themselves to avoid dredging impacts. Furthermore, they have economic importance and frequently a monetary investment has been made in harvesting them. Dredging windows designed to protect shellfish beds must consider preventing impacts during the set stage as well as providing protection against disease organisms. In New York, in the case of surf clam beds, transplanting is done to remove organisms from the areas where dredging impacts would occur, if practical. If transplanting is not practical, then the shellfishers are compensated for monetary loss due to dredging impacts. Therefore, transplant potential must be considered.

There is evidence that only spawning areas are impacted for anadromous fish. This would principally apply to the rivers in Connecticut. Species affected would be shad, alewife, blueback herring, Atlantic sturgeon and shortnose sturgeon.

Western Long Island Sound may be viewed homogeneously as a winter flounder nursery area. Typically small winter flounder occupy shallow, inshore habitats and move to progressively deeper and more open water as they grow larger. Historically, winter flounder have been widely distributed throughout the Sound.

With regard to threatened and endangered species, dredging windows should be used to comply with the Endangered Species Act. In dealing with endangered species, there are two approaches: (1) a process basis, or (2) a general *a priori* agreement. The process basis is good for agency consensus, but creates a more difficult situation for the dredging permit applicant.

Seagrass beds, although they are a resource that would be subject to dredging impacts, are not truly within the scope of a dredging windows discussion. This is because the impacts of dredging to seagrass beds are present year-round, thus they need to be protected year-round. Typically, this is done with dredging setbacks to seagrass beds.

The states of New York and Connecticut, and the National Marine Fisheries Service have species of concern for dredging windows. Table 6-1 lists these species. From the species listed by these governmental agencies, a guild list was formed. Species were then, as appropriate, added or deleted to the guild list. For example, Atlantic tomcod was added to the list, due to its importance as a food source for juvenile striped bass. The critical life stages that require protection from a dredging window were determined for each organism. Table 6-2 shows the guild list and critical life stages. The State of Connecticut has a two-tiered list of species to be protected by dredging windows. The first tier, consists of the winter flounder, anadromous species and shellfish. They are focused upon due to the tendency of individuals to spawn at natal sites. The second tier consists of all other species listed in Table 6-1 for Connecticut.

Table 6-1. Long Island Sound Species of Concern for Dredging Windows by Government Agency

Connecticut	New York
River Herring (Blueback, Alewife)	Winter Flounder
Atlantic Salmon	Eelgrass
Shad	Striped Bass (overwintering)
Winter Flounder	Tautog
Shellfish (Oysters)	Weakfish
Lobster	Scup
Shortnose Sturgeon	Hard Clams
Kemp's Ridley Turtle	Oysters
Waterfowl	Scallops
Bald Eagle	
Piping Plover	Spoil Disposal Only:
Puritan Tiger Beetle	Osprey
	Least Tern
NMFS	Piping Plover
Sea Turtles	Roseate Tern
Marine Mammals	Common Tern
Shortnose Sturgeon	Herons-Egrets (rookeries)

Table 6-2. Guild List of Species of Concern and Critical Life Stages

Organism	Critical Life Stage(s)
Anadromous Species	
Atlantic Salmon	upstream migrating adults/juveniles
Shad	upstream migrating adults/juveniles
River Herring (blueback, alewife)	upstream migrating adults/juveniles
Shortnose Sturgeon[a]	adults
Atlantic Tomcod	juveniles
Striped Bass	juveniles/spawning adults
Shellfish and Crustaceans	
Oysters	adults during pre-spawn/larvae
Scallops	larvae/adult
Hard Clams	larvae
Lobsters	larvae
Other Finfish	
American Eel	elvers
Tautog	eggs/larvae/juveniles
Winter Flounder	juveniles/spawning adults
Birds	
Osprey[a]	nesting to fledgling
Piping Plover[a]	nesting to fledgling
Least Tern[a]	nesting to fledgling
Common Tern	nesting to fledgling
Roseate Tern[a]	nesting to fledgling
Wading Birds	nesting to fledgling
Bald Eagle[a]	wintering
a = Indicates protected species	

Connecticut does not have any dredging restrictions because of birds; New York does. New York's restrictions are primarily based on shorebird (e.g., piping plover) utilization of an area and placement of dredged material.

It is important that all agencies are aware of other agencies' concerns. Agencies should start reviews with the same list of concerns. The State of Connecticut currently coordinates its dredging windows with NMFS.

Other topics raised by participants, although there was no general consensus on them, relative to "Organisms at Risk" were:

- Burying of overwintering lobsters;
- Future aquaculture concerns, particularly shellfish;

- Marine mammals – harbor seals and porpoises, mostly a NMFS concern;
- Sea turtles that use Long Island Sound for their migration routes (e.g., Kemp's Ridley);
- Benthic fauna and the effects of resuspension and siltation; and,

Beneficial effects from dredging, primarily habitat alterations that favor species of concern.

Designing Long Island Sound Dredging Windows

It was pointed out that over 90 percent of the material dredged from the embayments of the Sound is disposed of in the open waters of the Sound. Hence, the dredging impacts are in the embayments, whereas the disposal impacts are in the open Sound. This amounts to 300,000 cu. yd./yr. of dredge spoil.

Dredging windows should depend upon:

- Site-specific species to protect;
- Identification of factors specific to the project (sediment type, volume, duration);
- Management concerns, priorities (e.g., time sensitivity, equipment availability, etc.); and
- Risk assessment, particularly in the case of sites where contaminated sediments are present and there is a potential danger to human health.

If an extension to a dredging window is sought, considerations include what resource impacts are to be negotiated and which end of the window is more critical. Often an extension request occurs when a project is delayed, rather than by initial design.

Therefore, dredging windows must be coordinated for dredging and disposal/capping.

Hypothetical Case

A hypothetical dredging project was conceived at the workshop. It probably would not have received regulatory approval, but it served for the purposes of demonstration. It called for removal of 25,000 cu. yds. of material for a boat channel off Centre Island, NY, in Turtle Cove.

Items to be considered in formulating the dredging window were:

- Fisheries resources;

- Management objectives; and,
- Operational specifics.

Known factors were:

- The area is known to be a winter flounder spawning/nursery area;
- There is an important shellfish aquaculture facility and productive shellfish beds in the vicinity of the project;
- There are nursery areas for several species of fish, based on data from the 1930's;
- The project would be located within or adjacent to the most important waterfowl overwintering area on the North Shore of Long Island;
- Osprey nesting areas are located near the project;
- The winter flounder population has been in decline over the past several years; and,
- The bottom sediments are mostly sandy, although some muddy areas exist inshore.

Incomplete knowledge includes:

- The size of the turbidity plume;
- The type of dredging equipment to be used;
- Impact of placement of dredge spoil on beach;
- Species that will be impacted

  - shellfish
  - osprey
  - winter flounder (eggs, larvae, juveniles)
  - waterfowl.

The known factors as well as the areas of incomplete knowledge comprise items that should be included in an application. An applicant should be responsible for supplying this information.

Based on this hypothetical project, the group was asked to play out the application process, including the need for information. From this information, it was determined that dredging at the site should be restricted between 15 December to 30 September. This will protect shellfish and finfish, including winter flounder. It will also benefit waterfowl that use Turtle Cove for an overwintering area.

Conclusions

Preliminary conclusions drawn by the workshop participants include:

1) It is necessary to focus on the process by which dredging windows are determined, not on a general strategy.

2) A concept of separate windows for individual embayments, based on site-specific information, should be considered.

3) Dialogue between regulatory agencies, scientists, and regulated dredging industries should be improved.

4) Windows for specific embayments should be based on consistent standards.

Next Steps

- Produce a final document;
  - Itemize species-specific impacts;
  - Share information amongst all agencies.

- Produce public document(s) for applicants:

  - Significant habitat literature;
  - Documents must be flexible;
  - Includes rationales, scientific backing;
  - Interagency cooperation of documentation.

- Solicit comments on Connecticut's existing draft policy.

- Meet in the future to compare notes and agree on an approach.

Priority Research Needs to Support Dredging Window Decisions:

- Distribution and presence of Winter flounder eggs and larvae in embayments;

- Anadromous fish impacts.

Discussion

The following questions were asked by workshop participants at the conclusion of Ms. Chytalo's presentation:

Question: Are you familiar with a document developed in the west a few years ago that involved a process very similar to what you discussed to determine dredging windows?

Response: Yes, we're familiar with it. We examined the report for information on some of the latest tools that can be used as well as habitat suitability indices. This is an approach that we want to be going towards, but we're not totally there yet.

Question: Has anything been done to determine the turbidity levels that anadromous fish can accept? Can some species tolerate excessive turbidity levels?

Response: These were some of the research needs that were identified, especially for anadromous fish. Some of that work has been done, e.g., for striped bass, but I'm not sure what other species have been involved. This is the direction we're moving towards.

Results of Managing Agricultural Nonpoint Source Pollution in a Southeastern Estuary

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Introduction

Since 1985, we have been conducting a long-term study to evaluate the impacts of agricultural nonpoint source runoff on estuarine ecosystems. This talk will focus on some of the outputs of this research, which do not necessarily reflect the way the study was designed but rather are the result of being able to evaluate certain management options that were implemented.

Today, there are approximately 960 pesticides that are registered for use in the United States. This includes 240 herbicides, 225 insecticides, 170 fungicides and menticides, 35 rodenticides, and 210 disinfectants. These 960 active ingredient pesticides are sold in roughly 25,000 different formulations. The bulk of pesticide use, approximately 77 percent, is for agriculture. When pesticides are used near aquatic bodies, fishkills can result. The national fishkill database for coastal areas shows that 5 percent of all fishkills are caused by pesticides.

In South Carolina, vegetable farming (tomatoes, snap beans, cucumbers, and squash) is the predominant form of agriculture. Tomatoes are the largest cash crop, approximately $13-14 million annually, with 80 percent of the total production in Charleston County. Approximately 90 percent of all of the agriculture in coastal areas drains into estuarine surface waters, making appropriate runoff management strategies especially important.

A review of fishkill statistics by two graduate students revealed that approximately 43 percent of all fishkills in the State occurred in coastal waters. Thirty-five percent of all fishkills had anthropogenic causes, and of this portion, 53 percent were due to pesticides, 19.8 percent were due to agriculture, 13.2 percent were due to vector control, and 20.9 were due to aquatic weed control. The real problem is that small nursery grounds for finfish and shellfish are adjacent to agricultural areas.

Tomatoes are grown using a modified no-till method with black plastic covers that render half of the field impermeable. This accelerates runoff. There are three primary insecticides found in the runoff: azinphosmethyl, endosulfan, and fenvalerate. Endosulfan, an organochloride, has been responsible for more coastal fishkills than all other pesticides combined. In addition to chemical stressors, other concomitant factors must be considered when examining agricultural runoff. These include low salinity (fresh water washes the pesticide out of the field), low pH (which may change the chemistry or uptake of the pesticide by the organism), increased ammonia levels (due to washing off of fertilizers), and lower dissolved oxygen levels (which may cause animals to increase their exposure by moving more contaminated water across gills).

Approach

We began the study by planting our own tomato fields to examine the effects of the plastic cover. The pesticides are usually applied at 18 pounds of active ingredient per acre, with 14 pounds of herbicide, fungicide, and menticide under the plastic, and 4 pounds of insecticide above the plastic. This is the second highest pesticide application rate in the State (only peaches are higher). We put in a conventional tillage field for comparative purposes and then installed rainmakers and collected runoff.

We found a 70 percent increase in runoff volume from the field topped with plastic. However, the farmer gets 25 percent more production when using the plastic and soil loss is retarded. A surprising finding was that pesticide levels were lower in the runoff from the fields with plastic. This is because the higher volume of runoff dilutes the pesticides to lower levels. Even the lowest concentration (2-3 ppb), however, is 20-30 times the 96-hour LC-50 for grass shrimp (.05 ppb). The bottom line, therefore, is that if this runoff reaches a tidal creek, it will have an impact. Using the plastic cover basically increases the frequency with which rain events will have contact with tidal creeks.

We took a three-tiered approach to assessing the impacts of agricultural runoff on estuarine organisms. First, we started off with sound laboratory toxicity data. We use an institute bioassay approach involving the caging of animals in the field coupled with block seining and push netting techniques to assess population effects. The main organism used in the lab bioassays is the grass shrimp, which is the dominant macrophylagic fauna in these tidal creeks (56 percent). Within the bioassay scheme, we may test a number of intrinsic and extrinsic factors that we believe are important for risk assessment, including the effects of low salinity, pulse exposures, and mixture exposures, as well as intrinsic factors such as sex and life history stage.

In addition to the lab approach, we used an *in situ* approach for the grass shrimp. Shrimp were placed in the field in cages for a 96-hour exposure before and during rain events. Hydrolabs are used to measure the continuous change in the dynamics of this environment. We also measure pesticide levels.

The study sites were located just south of Charleston, SC, and included a reference site, a managed agricultural site, and an unmanaged agricultural site. At the managed agricultural site, we have data from 1985-1987 when there were no retention ponds and very active integrated pest management practices in place. Beginning in 1988, the farmer constructed a series of retention ponds leading to the control of up to 80 percent of the runoff on his property. So we can now look at the before and after effects of management at the same site. The reference site is an area characterized primarily by rural single-family dwellings and deciduous pine/hardwood forest. At the unmanaged site, calendar day application is still in use; i.e., the farmer applies pesticides once every five days (as opposed to the managed site, where the farmer uses integrated pest management to apply pesticides only after scouting the field and when insect pests are present).

In addition to the *in situ* approach, we also used a block seining technique. This involved placing a series of 4 nets in the creeks at 50 meter intervals and collecting all organisms greater than 15 mm in size.

Results

The acute toxicity data show that the grass shrimp are more sensitive to azinphosmethyl and fenvalerate than the mummichug. Both organisms are equivalently sensitive to endosulfan. This was an important find — if a fishkill affects both fish and crustaceans, endosulfan is involved. A fishkill that involves only crustaceans most likely involves azinphosmethyl or fenvalerate. With azinphosmethyl, if the organisms are not already dead, there is usually neurological poisoning and the animals will be swimming erratically. These effects are not necessarily seen with fenvalerate. This basic set of laboratory data is essential in starting a good database to interpret field effects.

With respect to the field toxicity data, we first compared survival of grass shrimp at the managed agricultural site in two time periods, 1985-1987 and 1988-1990. From 1985-1987, there were two fishkills with significant mortality from all three pesticides for the grass shrimp and some mummichugs. After the management practices were implemented in 1988, there were no fishkills, with some grass shrimp mortality (primarily from one pesticide) and no mummichug mortality. This shows that retention ponds really work. We found an approximately 90 percent reduction in instream pesticide levels following the implementation of the better management strategies.

Grass shrimp survival at the reference site was 95-100 percent in all the bioassays. Block seining confirmed at least 90-95 percent mortality in field populations prior to the implementation of the management practices. Post-1988 data is characterized by high survival with the exception of one tropical storm event that brought 13" of rain and caused the ponds to overflow and discharge 100 ppt fenvalerate (this is double the LC-50 value). In 1990, there was also some fenvalerate but no mortality. This was because we asked the farmer to use a different isomeric ratio that is 10 times less toxic. Survival data from the unmanaged site looks just like the managed site prior to implementation of the management techniques.

In addition to the *in situ* mortality data, we looked at results from the field population. One of the artifacts of caging animals is the removal of one of their primary adaptations, i.e., avoidance. We therefore wanted to examine the transient nature of exposure in these systems. These exposures are very compressed. We found almost one more meter of water in a low tide system following a storm event. The signals for freshwater runoff in a hydrograph are high elevation at low tide, low salinity, and the presence of pesticides. But this is only a 3-6 hour window of exposure. So if monitoring isn't continuous, the exposure window may be missed. This is the real reason nonpoint source pollution is hard to measure — it's a moving target.

With respect to ecotoxicology, we looked at block seining data for two sites in the Spring of 1995 that were comparable in terms of total biomass. A fishkill due to endosulfan killed approximately 90 percent of the biomass. Eventually the biomass recovered. Another fishkill in the next growing season due to azinphosmethyl caused a 70 percent drop in biomass. The site recovered in approximately two months. These impacts from two different pesticides on total

abundance in a tidal creek were due to just a 6-hour exposure. This is a profound take-home message in terms of management.

With respect to the main organisms that made up the difference in biomass, we compared densities at the two sites. After the fishkill, we found approximately 9,000 more grass shrimp in a 50 m stream segment at the control site than at the agricultural site. Using partial life tables, we found that the highest mortality rates occurred with the youngest and oldest individuals in the population. Over three years of data, we were able to track the impacts of three different classes of pesticides on grass shrimp abundance. Each event caused approximately a 90 percent mortality rate. We also found delayed effects after the initial exposure. Ninety days later, larvae that were present would be adults in the population. We tracked this by examining recruitment. So these effects can be persistent in headwater streams for quite a long time.

Besides the grass shrimp, we also have to be concerned about other organisms. While the grass shrimp really integrate aquatic exposure, the blue crab integrates food chain exposure. An examination of blue crab abundance at the sites shows major differences in the years which had fishkills. The blue crabs survive the acute exposure, but eat the dead animals, resulting in reduced populations 30 days later.

One of the things we have been trying to do is develop better predictors of field effects. Currently, we're working on the development of a salt marsh mesocosm system, with high-, mid-, and low-marsh tidal creek channels replicated. One of the advantages we have is knowing the field impacts of these pesticides. So we can stock these mesocosms based on densities from our field data and assess the impacts on 27 macrofaunal species with 1 set of analytical chemistry data. We're also trying to determine some of the secondary and tertiary effects of pesticides in these systems. To date, we've found a fairly good correlation between laboratory, field, and mesocosm data.

Recommendations

To help mitigate agricultural pesticide impacts, the most important action to take is to form a coastal pesticide advisory committee. These groups work proactively to solve pesticide issues and are comprised of federal, state, and local government representatives; academia; farmers; environmental groups; and pesticide manufacturers. We learned early on that collective input is needed; e.g., a solution proposed by a toxicologist may be problematic to an entomologist. This group also makes an independent determination concerning the causes of fishkills. Most of the cases we have examined have not been due to misapplication by the farmer, which leads to the question of who is really at fault. Because of some of the input we have provided, labels have been changed for endosulfan and fenvalerate.

The second action is integrated pest management. When we began this program, very few farmers were involved. Clemson, however, has been very active in supplying farmers with graduate students for a fee to assess the presence of insects. Overall, we have seen a reduction of roughly 60 percent in the amount of pesticide applied. The farmers are also in favor of this approach because it saves them money.

Thirdly, the selection of less toxic pesticides must be encouraged. For example, orthene is 140,000 to 1,800,000 times less toxic to aquatic life than the three pesticides we examined. The only drawback is some incremental increase (1:1,000,000) in risk to human consumers who eat snap beans, cucumbers, and tomatoes all treated with the pesticide (very few tomatoes are treated with this). We received a waiver from EPA to do this.

Finally, retention ponds are the one technique that readily demonstrate direct benefits to water quality. We found approximately an 89-90 percent reduction in entering pesticide levels with 75 percent retention control. Use of all of these methods together results in an integrated risk reduction strategy. While the risk will not be reduced to zero, this type of strategy will better protect natural resources.

Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Scott's presentation:

Question: The farmer has the motivation to use IPM because he'll save money, but what motivation does a farmer have to build a retention pond that will cost money and not do anything in terms of financial savings or improving crops?

Response: There was actually funding available for innovative environmental controls from the Farm Home Administration. We need legislation that will do this. The farmer I mentioned has a dual distinction: he's the only farmer ever fined by the State of South Carolina for a fish kill, and he was also EPA's national environmental conservation farmer of the year.

Question: NOAA has a nonpoint source pollution control program that is currently administered with EPA under section 317. The State of South Carolina along with other coastal states is supposed to require these kinds of management practices. Is there any discussion at the state level to require retention ponds for certain levels of agriculture?

Response: Currently, applications come to the Coastal Pesticides Advisory Committee because no one else knows how to administer them. We're just an advisory committee, not regulatory per se. I have a graduate student who is currently studying how to design the optimum-size retention pond from a modeling perspective. This is a real issue. For example, the South Florida Water Management District is the ultimate runoff control program and controls much of the runoff in the area, including regulation of agriculture by and large. They have real concerns over vegetable farming due to the wide use of pesticides in that area. Some of the work that we're doing with Gordon Thayer at the Beaufort lab is looking into this. It is a fundamental question that no one can answer definitively.

Question: What about pesticide concentrations in retention ponds? Aren't we just shifting the problem?

Response: The ponds function with approximately 3 million gallons of irrigated water per day and there's no net discharge. The water is filtered, fertilizer is added, and then the water is circulated back to the plant roots via drip irrigation. We're also encouraging use of organophosphates. Pesticides found off-property are detected near retention ponds, which I believe is due to the high volume of water being pumped. Farmers are also interested in retention ponds as a buffer against drought situations. So this concept can be sold to farmers in a number of different ways as a means to stabilize uncertainty in production.

Question: Is the 25 percent increase in productivity that was found just because of the plastic, or are different pesticides being used?

Response: Yes, the plastic creates a heat sink that causes faster growth rates and less loss of water from the roots. Compared to conventional tillage per acre, use of plastic mulch results in approximately a 25 percent increase in production. (Note: an audience member also commented that the vegetables grown in mulch go to market about one month earlier, which is a big difference.)

Question: Have they looked at alternative mulch fabrics? Some are more permeable than plastic.

Response: I think this is something that should be looked at. If you want to figure out risk, all you need is rainfall data. Any time there is one-half inch of rainfall, you're going to have loss into tidal creeks. While drainage depends primarily on the surface area to volume ratio, I would wager that use of plastic mulch would result in connectivity off site. With a conventional tillage plot, you need one inch of rainfall to have the same effect. So you can almost use your meteorological data to predict the frequency on an annual basis. A more porous fiber would work much better.

Regional Breakout Sessions

Mid-Atlantic Region

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Issues

The following issues were identified by Mid-Atlantic fishery and habitat mangers as being of significant concern in the region:

- Dredging – Especially small channels which are more likely to be in close proximity to fish habitat
- Dredge Spoil Placement – Impacts range from burial of fisheries habitat to increased turbidity
    - Beneficial Use of Dredged Material – Proponents of beneficial use projects often don't completely weight the adverse impacts against anticipated benefits
- Coastal Development – Increased urbanization of the coastal zone
- Sand Mining
- Clean Water Act Sec 316 – Regulation of thermal discharges from point sources to protect indigenous populations of fish, shellfish, and wildlife
- Land Management Generally – Need for better consideration of fisheries habitat impacts in land use planning/decision making
- Aquaculture – Adverse impacts on water quality, conflicts with other aquatic uses
- Shoreline Hardening – Impacts on beach and shallow water habitats
- Fishing Gear Impacts – Impacts of dredges, bottom trawls, and other gear on bottom habitat
- Habitat Restoration – Need to target on a watershed basis; relationship to mitigation
- Eutrophication – Excessive nutrients from point and nonpoint sources

- Toxics – Contaminated sediments
- Boating Impacts – Petroleum and sewage discharges, prop scarring, garbage, and propeller/impeller damage to fish eggs and larvae
- Water Withdrawal, Diversion, and Channelization
- Fish Blockages
- Invasive/Exotic Species – *Phragmites*

Mid-Atlantic Region Solutions

The following solutions were identified by Mid-Atlantic fishery and habitat mangers:

- Tertiary Treatment Innovations – Costs of going to tertiary treatment in Long Island Sound were reduced from $6B to $1B
- Simulation Models – Allows for evaluations of toxics and water quality control methodologies; targeting of habitat restoration and protection efforts for maximum benefit
- Monitoring and Assessment of Restoration/Mitigation Projects – Allows for refinement of restoration/mitigation projects to maximize fisheries benefits; ensures that mitigation projects are conducted as designed
- Integrate Existing Fisheries Habitat Data into One Data Base – Will allow for identification of data gaps and facilitate information transfer
- Regional/Federal Oversight of Fisheries Habitat Protection – Need a Regional/Federal authority to force states into protecting fish habitat similar to the role of ASMFC and NMFS with fisheries management (currently the Atlantic Coastal Act and the Magnuson Act do not convey this authority)
- Status and Trends of Fisheries Habitat – Would allow for better targeting of protection and restoration efforts
- Education and Outreach – Target the general public and politicians, increase awareness of how land use decisions impact fisheries habitat

- Promote Non-structural Shoreline Erosion Control – Look for opportunities to enhance fisheries habitat
- Construct Fish Passages
- Control Exotic/Invasive Species.

Regional Breakout Sessions, Cont'd.

New England Region

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The New England regional working group considered three related topics: 1) habitat characteristics in the New England region, 2) actual and potential threats to habitat quality, and 3) high priority habitat issues and information needs. The New England region was defined as including the Gulf of Maine (U.S. and Canadian waters), offshore banks (e.g., Georges Bank), and southern New England and Long Island Sound.

Habitat Characteristics

This region is very diverse since it includes highly populated and industrialized coastal areas (New York, CT and RI shorelines, Cape Cod, Boston, Portland) as well as large stretches of undeveloped coastline (most of the Maine coast, Bay of Fundy). The physical characteristics of the coast also change north of Portland where the lower profile, sandy shoreline gives way to a rocky coastline with numerous islands and muddy intertidal areas. Salt marsh habitat is more common south of Portland, but is also found in places along the Maine coast and in the Bay of Fundy. The Gulf of Maine is unique in terms of its physical characteristics (broad continental shelf, offshore banks, irregular bottom topography, cold water, extreme tidal mixing, and high primary productivity). Offshore banks like Georges and Browns Banks support important commercial fisheries, as do the coastal waters and estuaries. Reduced human population along the Maine and New Brunswick coast and the absence of heavy industry have, in general, resulted in reduced contamination of coastal waters and sediments in the Gulf of Maine, but more urbanized "hot spots" and airborne contaminants have had effects on environmental quality (acid rain, heavy metals in offshore sediments) which belie the common perception that the gulf is a pristine environment. The heavily populated and industrialized southern New England coast and Long Island Sound area have severe contamination and habitat degradation problems and have more in common with the mid-Atlantic region.

List of Habitat Characteristics:

Important offshore commercial fishery
Reduced recreational fishing
Reduced human population (north of Portland ME)
Reduced pollution, habitat loss/alteration
Rocky coastline, irregular bottom topography, numerous islands (north of Portland)
Broad continental shelf, large offshore banks
Large tides, mixed water column

Extensive intertidal (mud) habitat, reduced marsh habitat
High primary productivity
Cold water temperatures
Shorter watersheds

An issue that was raised was the importance of offshore commercial fisheries and the degree to which offshore fishery resources depend on coastal habitats: what are the links, given fact that anthropogenic effects are mostly confined to coastal area?

Threats to Habitat Quality (not ranked)

Inshore:

Nutrient loading (hypoxia in LIS)
Non-point-source pollution
Boating impacts, including marinas
Contaminants (sediments in city harbors)
Population growth in coastal zone
Oil spills
Introduction of exotic species
Barriers to fish passage up rivers
Dragging, other fishing impacts on benthic habitat
Impacts of aquaculture (benthos, use conflicts)
Reduced fresh-water flow rates
Entrainment, increased temperature in power plants
Coastal alteration (filling wetlands, construction)
Sewage outfalls (e.g., Boston)

Offshore:

Dragging (complex issue, no clear facts)
Oil/gas drilling, transport (future)
Ocean mining (future)
Ocean dumping, including fish waste
Ocean incineration
Contamination of sediments (airborne)

"Risk" should be defined by how populations respond to habitat loss/degradation, not by physical or chemical alterations of habitat alone. For that reason, it is important to understand the biological consequences of habitat loss or alteration before any damage is done.

Winter flounder provide a good example of how coastal habitat alteration and contamination, by reducing the quantity and quality of available nearshore spawning ground, can affect the size of a fish population and why habitat protection measures must be factored into fishery management plans along with measures to control fishing mortality.

Institutional impediments to implementing habitat management measures (i.e., delays, cumbersome and complicated regulatory process) also constitute a "threat." Inadequate funding and political pressure from "user groups" to take or not take certain actions are also problems. Finally, there is seldom enough information available to adequately evaluate and prioritize threats to environmental quality, yet management measures often must be taken anyway.

Some High Priority Issues and Information Needs:

Dealing with reduced fresh-water flow, e.g., in estuaries
Removal or passage around dams, access to fresh-water spawning areas
Nutrient/organic enrichment of coastal/estuarine waters, including sewage outfalls
Understanding/dealing with ecosystem effects of fishing (physical and biological)
Capability to respond to specific events like oil spills, clean-up efforts (e.g., Empire Knight, New Bedford harbor)
Understanding sub-lethal effects of habitat degradation (e.g., mummichog research in NJ)
Building a stronger constituency with public as a means of accomplishing goals
Getting NMFS/NEFMC to devote more time and effort to habitat management (reduction of fishing mortality has been the major objective)

For More Information, Consult the Following Recent Publications:

Gulf of Maine Habitat: Workshop Proceedings, RARGOM Report No. 94-2, D. Stevenson and E. Braasch (eds.). Proceedings of a workshop convened on April 12-13, 1994 at the Maine Dept. of Marine Resources Laboratory, W. Boothbay Harbor, ME by the Regional Marine Research Program for the Gulf of Maine and the Regional Association for Research on the Gulf of Maine (RARGOM), Dartmouth College, Hanover, NH.

The Health of the Gulf of Maine Ecosystem: Cumulative Impacts of Multiple Stressors, RARGOM Report No. 96-1, D. Dow and E. Braasch (eds.). Proceedings of a workshop convened on September 18-20 1995 at Dartmouth College by the Regional Association for Research on the Gulf of Maine (RARGOM), Dartmouth College, Hanover, NH.

New England Fisheries: Planning for the Future, New England Aquarium Aquatic Forum Series Report 96-2, M.L. Mooney-Seus, H.C. Tausig, and G.S. Stone (eds.). Proceedings of a forum held January 12 1996 at the New England Aquarium, Boston, MA.

Regional Breakout Sessions, Cont'd.

South Atlantic Region

Rob Dunlap
South Carolina Department of Natural Resources
Charleston, SC

The South Atlantic group's discussion centered around the issue of facilitating the communication of available scientific information that could help state habitat managers better manage marine fish habitat. A recurring theme was that while science is able to provide some answers, habitat managers (and resource managers in general) should not hang their hat exclusively on scientific (e.g., biological, ecological, chemical) information. Habitat managers might do well to understand the sociological, economic, and political aspects of marine fish habitat conservation. An example was given where officials from one state's coastal zone management program questioned whether they might use biological/ecological information to limit the length of private docks. Scientists responded that there might be no ecological reason to limit dock length, but that citizen preferences might lead to limiting dock length to 500-600 feet. This is the case where hard science might have few answers, but socio-economic considerations might be brought to bear on management decisions.

Representatives from the region expressed how beneficial the information and exchanges of the workshop had been, and reinforced the need to communicate specific needs and requirements to all state and local planning and regulatory authorities. Coastal management agencies were emphasized as one of the primary state agencies that influence habitat protection. ASMFC was encouraged to reach out to these agencies and enlist them in future coastwide habitat protection programs.

Chapter 7

What Kind of Information Do Habitat Managers Need?

Introduction

Chris Mantzaris
National Marine Fisheries Service
NER Habitat & Protected Species Program
Gloucester, MA

First of all, I want to thank you for inviting me to kick off what I hope to be a very interactive and interesting panel discussion on the information needs of habitat managers. Following my overview, each of the six panelists will provide a brief statement and then the panel will accept questions and comments from the audience for discussion.

We have spent the last three days discussing habitat and the challenges we all face as habitat managers. I think it is fitting that we end the workshop with identification and discussion of the information needs we all have and hopefully will identify some common approaches and strategies to acquiring and applying information to make better decisions.

As I contemplated the question of "What types of information do habitat managers need?," I began a very long grocery list of what, ideally, I would like to know before making decisions affecting habitat. Before getting into the specifics of that list I would like to share with you some recent developments and philosophical changes in approach that the NMFS Northeast Region Habitat Program is initiating. Approximately two years ago I appointed a team of individuals within the Region to review the Habitat Program and make suggestions for improvement in what we do and how we do it. The recommendations of that team focus on more tightly integrating the work of habitat managers and fishery managers. This is not a new concept but is just recently reaching the mainstream as evidenced by amendments to the Magnuson Fishery Management and Conservation Act which include a provision for identifying "essential fish habitat."

Habitat managers do not manage habitat any more than fishery managers manage fish. We attempt to manage portions of the human component of the equation. The status of a fish stock is affected by a great number of factors. In a very simplistic model, the "target fish stock," whether it is cod or flounder, is affected by the availability of prey and predators and the health of the habitat it depends on. Man enters into the equation by directly removing fish from the stock (harvest) or adding fish through supplementation/stocking programs. This describes traditional fish management. Secondly, man influences stock abundance as he manages activities and actions that could impact the availability or suitability of habitat that species utilizes. This is where we as habitat managers fit into the equation. Fishery management and habitat management need to be intertwined as they are both forces acting on the fish stock. This realization has lead my Division to the conclusion that habitat needs to be more fully integrated into the process of fishery management – including fishery management plans – so that the connections between commercial fish stocks and habitat are clearly identified, and the need to

protect that habitat is part of the overall strategy to manage the impact of humans on the fish stock.

The NMFS is charged as steward of living marine resources with the goal of providing stocks in a sustainable manner with a harvestable surplus. Fishery management regulations for harvest of commercial stocks have a direct and very visible impact on the status of those stocks. Actions of habitat managers to protect or restore habitat have a more indirect, less immediate and less visible benefit to the fish stock. Consequently, these actions do not always get integrated into the equation. Failure to consider the intimate tie between species and the health of their habitat can result in inaccurate estimates of stock abundance in reaction to harvest restrictions. The road to species recovery can be improved when habitat protection is coupled with harvest restrictions.

To have a better understanding of the relationship between habitat and stock abundance, in my Division, we are designating a team to evaluate the habitat needs of a commercial fish stock throughout its entire life cycle and identify potential impacts to that habitat both temporally and spatially. That habitat information will then be fully integrated into a fishery management plan so that the human impacts to a fish stock will be addressed in one document in a comprehensive manner. We believe that the end product - a habitat-fortified fishery management plan - will be a very useable document for habitat managers, fishery managers and a wide range of regulatory agencies. For instance, the summer flounder fishery management plan may contain an identification of nearshore spawning habitat. If an applicant proposed dredging in such an area the resource and regulatory agencies could refer to the FMP to see if dredging was identified as an activity that could degrade that nearshore habitat for summer flounder spawning. The description and delineation of such habitat in a FMP and the identification of potential impacts to that habitat provides information to a wide audience for consideration during the early planning stages for a wide range of activities. Fishery management plans are consulted by local conservation commissions, town planning boards, state resource agencies and Federal agencies. Consequently they are a far-reaching and powerful vehicle for convening habitat information.

While I am advocating that consideration of habitat become an integral component in the effort to achieve sustainable stocks, I am not saying this is an easy matter. We do not have all the information we need to be able to clearly define cause and effect relationships and cannot always make the connection between the presence of habitat and its functions and values as they relate to commercial fish stock abundance. This leads us into what types of information we need as habitat managers.

In order to make informed decisions in the habitat arena, managers need up-to-date surveys and assessments to delineate habitat. In addition to this quantitative information on habitat, managers need qualitative information. What functions is that habitat providing to what species? What about that particular area makes it attractive and useful? What would be the tangible impact of the alteration, degradation or loss of that habitat? Both fishery and habitat managers need a complete picture of species life cycle - where it spends its time, when it can be found in certain places and what components of that habitat are most critical. As I stated

previously, what we are attempting to do is to manage the impact of activities on habitat. Consequently, we need better information on the direct and indirect impacts of activities. This would take the guesswork out of habitat management and improve our ability to predict the consequences of actions. As habitat managers, we are being pushed to provide better documentation and scientific justification for our recommendations. This push comes from regulatory agencies who are under increased scrutiny and operate in fear of legal challenge – either from developers or environmental groups – and more recently, take issue.

Identifying ways to access or obtain information is just as important as identifying what types of information you need. In these times of limited staff and shrinking budgets, we need to be more and more creative in finding ways to combine resources and share information. We need to document our experiences in a more formal manner and find a way to make that information accessible to others so that we are not reinventing the wheel. Collectively we can advance knowledge in the habitat field much quicker than if we are all proceeding along separate paths. In addition, we need to take advantage of new tools that allow us to be more efficient and effective in our jobs including the Internet and GIS (geographical information systems) technology.

The final and very critical step is that we need to be more proactive and creative in how we apply the information we obtain. I believe we need to attack issues head-on and seek comprehensive solutions to reoccurring problems. While such approaches may initially be more time-intensive than a simple project specific solution, they save time and effort in the long run and make the process more predictable and consistent. It is no longer enough to say "we don't know" what the impact of a proposed action will be. We are forced to devise, implement and monitor experimental projects or acquire information to make assessments. These approaches are risky and we must ensure that any unanticipated impacts are reversible.

So, now that we have identified the types of information habitat managers want and how they might use that information once they get it, let's leave the ideal world and take a look at a couple of real-world examples. As I stated previously, creating the laundry list of information needs is relatively straightforward. The real challenge for habitat managers is deciding what to do in the absence of conclusive information.

Swampscott Harbor, Massachusetts

In 1992, the Town of Swampscott and the Massachusetts Department of Environmental Management submitted an application to "maintenance dredge" two areas in Swampscott Harbor. The areas had last been dredged in 1958, nearly 35 years before. The harbormaster reported that there were no shellfish or shellfish beds present in the project area, and the Corps of Engineers project managers saw no resources of concern from shore on a brief site visit. Based on this information, the NMFS did not object to the issuance of a permit for this project.

The dredging contractor began work and discovered that he was dredging through eelgrass and that his work orders specified dredging outside the area depicted in the 1958 plans. The contractor was concerned with what was being characterized as "maintenance dredging" and disturbed by the obvious habitat destruction taking place. The contractor alerted the Corps of

Engineers and a subsequent dive survey revealed eelgrass to be present throughout the project area.

This dredging project resulted in the loss of approximately two acres of eelgrass and, even more significantly, exposed flaws in the permit review process. Subtidal habitats were not afforded the same level of review that typically is given to terrestrial habitats. The value of salt marsh is generally recognized and consequently steps are taken to avoid impacts to this habitat before project plans make it to the resource and regulatory agencies. In contrast, eelgrass and other submerged aquatic vegetation beds are still generally thought of as "weeds" that interfere with swimmers and boaters, and mudflats are still considered stinky and smelly.

The Swampscott case is one where the impact of an activity on habitat, (dredging in eelgrass beds) was clearly known. The failure in this situation was simply the lack of identifying the resource. This project illustrated the need for a consistent process for the delineation of resources in shallow marine and estuarine habitats. The NMFS and the New England Division of the US Army Corps of Engineers have cooperated in the development of a two-tier resource assessment policy to address this need. All projects extending seaward of mean high water require a Tier One resource identification. Tier One requires applicants to query existing sources to determine what resources are present in the project area. Projects proceed to Tier Two if dredging is involved or if tier one is found to be insufficient to determine the extent of existing resources. The need for a Tier Two assessment will be determined on a case-by-case basis but generally it is required for projects that could have considerable impact on marine resources based on the type, size and location of the proposed activity. The Tier Two assessment is more detailed and requires actual surveys of shellfish and seagrass. This new process ensures that all marine resources are identified early in the project planning process to prevent surprises at a later date when the time and financial investment in the project is greater.

The Swampscott Harbor case study is instructive in that it clearly demonstrates how the failure to fully identify resources during the planning of a project can result in the loss of significant habitat. The Tier One and Tier Two resource identification process for living marine resources in tidal waters is a success story of a cooperative effort at devising a preventative solution. While the lesson learned in this case came at the expense of two acres of eelgrass, the regional solution will prevent the problem from repeating itself. We see a great benefit in working with regulatory agencies to integrate our information needs into their standard permit application process. Including resource information needs along with public access, navigation, and design information sends a clear message to applicants as to what factors are important to those reviewing their application. Soliciting and receiving **all** project related information at one time also allows resource and regulatory agencies to conduct a comprehensive review at the initial stages and, in turn, be more responsive to the applicant.

Sears Island, Maine

The second case study I would like to briefly present is the Sears Island project in Searsport, Maine. The proposed project was the construction of a cargo terminal project on an

undeveloped island in Penobscot Bay. A permit was issued for the project in the late 1980's by the Army Corps of Engineers despite objections from the resource agencies and acknowledgment that impacts to marine habitat were "considerable." The project did not go forward due to legal challenge. Field work in 1992 revealed the presence of extensive forested wetlands and eelgrass meadows. With this new information, the resource agencies determined that the proposed project would result in the loss of approximately 12 acres of intertidal habitat and 18 acres of subtidal habitat, including productive eelgrass beds. In addition, estimates of intertidal and subtidal habitat that would be degraded ranged from 80 to 250 acres. With this new resource information the resource agencies could take a strong stand against the project as proposed and present a case for denial so strong that the applicant withdrew the permit application. The position of the agencies was also based on their determination that the proposed mitigation did not offset project impacts and that a less environmentally damaging alternative existed. Even with the quantitative habitat information (acres that would be lost) many questions remain surrounding the more qualitative attributes of that habitat - specifically what functions and values is it providing to species using the project area such as winter flounder, pollack, menhaden, mackerel, herring, smelt, soft shell clams, lobsters and scallops. Specific questions such as how would the loss of this habitat impact the herring population remain difficult, if not impossible, to answer definitively. However, this is exactly the type of information sought by those in the position to issue or deny permits. This is a critical question. If we could have provided that information, I believe the project would have been denied well before 1992.

What do these "war stories" tell us? Clearly, habitat information needs to be a critical consideration during the planning stage of development projects. The inclusion of that information into the decision framework increases the potential for activities to be conducted in a manner that minimizes impacts to species and their habitat. Likewise, habitat information should be integrated into the fishery management planning process early on so that the human-related impacts to species and their habitats can be evaluated in a comprehensive manner.

As I stated previously, I believe there is no mystery as to the types of information habitat managers need or would like to have. Ideally, we would have all species distributions and habitat types delineated on GIS at each manager's and decision maker's desktop. We would have a complete understanding as to how species utilized habitats - what functions and values are being provided and relied upon. In addition, we would have a clear understanding of the effect of **all** activities on habitats so as to be able to predict the ramifications of actions. I believe we are making progress in identifying collectively what our information needs are and devising strategies for acquiring such data. However, we cannot avoid the reality that as habitat managers we are forced daily to make decisions and recommendations in the absence of conclusive information.

In order to do our job better, habitat managers need more complete life history and habitat requirements of species, a better understanding of habitat functions and values, and more conclusive data linking actions with impacts. The existence of data and facts is critical; however **access** to this information and effective **methods of applying** this knowledge are equally important. Access can be improved through more coordination and collaboration on mutually

agreed upon objectives and needs and the use of new technologies. The most effective methods of habitat protection are those aimed at avoiding problems - our experience clearly demonstrates that it is easier to prevent impacts than it is to undo them. One of the greatest tools we have at our disposal as habitat managers is our ability to educate the public.

Panel Discussion: Information Needs of Habitat Managers

Art Newell
New York Department of Environmental Conservation
East Setauket, NY

The NY DEC's Division of Marine Resources is both a fisheries management and habitat protection/management office. Most of my substantive work is related to habitat management. My initial approach to this discussion was to develop a list of questions concerning essential habitat. Instead, I decided to focus on whether fishery management plans contain the information needed for managers to protect the habitat of a particular species. To do this, I reviewed the FMP for winter flounder, which has been characterized as one of the better plans developed to date. Specifically, I wanted to determine if the plan's information and recommendations were useful to me as a habitat manager.

The FMP for winter flounder basically has two sections that cover the status of winter flounder habitat and recommended actions for management of the habitat. The first section has very specific information concerning area and population size, and how changes in area for small populations have greater impacts than in other areas. This information provides good support for protecting all winter flounder habitat, even small areas. What the FMP does not do is tell you where the habitat is, so communication would be needed between the habitat managers and fisheries biologists. Even in our office which covers both areas, we do not frequently have this type of communication.

The next discussion covered dredging and provided descriptions of the adverse effects as well as recommendations. The descriptions were useful, especially those pertaining to effects on winter flounder spawning. Again, I would need to obtain information from others concerning when and where the essential life stages occur and dredging schedules. This is exactly the type of work that NY DEC is currently undertaking in the development of a dredging windows plan by embayment, as described yesterday.

The next aspect of the FMP discusses contaminants and recommended actions related to water pollution. The FMP contains a lot of good information in this area, but it would not enable me to take actions specifically related to winter flounder. Generally, we rely heavily on water and sediment quality criteria because it is difficult to perform case-specific studies. Some of the information in the FMP could be used in conjunction with knowledge of flounder habits (e.g., bottom dwelling) to predict adverse reactions, but the existing water quality, effluent, ambient water toxicity, and sediment criteria generally integrate this type of information fairly well. So I am not sure how to use the information in the FMP, but will continue to work to ensure that the criteria are not exceeded.

The last discussion addresses entrainment and impingement. The discussion documents mortality quite well, but is less clear concerning the significance of larval mortality to adult populations. Without these linkages, it may be hard to defend the recommendations for winter flounder that are contained in the plan. A typical habitat manager reviewing a permit would need much more support from other experts and a significant amount of modeling. So while the plan is useful in identifying other information that is needed, it probably cannot be relied on as the sole guidance for making permit decisions.

Panel Discussion
Information Needs, Cont'd.

Mike Street
North Carolina Division of Marine Fisheries
Morehead City, NC

My training is in fisheries, I am not a habitat expert. I was in the field for a number of years, but have been an administrator for approximately 20 years (I currently serve as Chief of Analysis and Planning). In December 1984, my office began commenting on permits and needed to develop a system without the benefit of additional money or staff. Part of my current responsibilities is to oversee this "system". While we have a few written procedures, mostly we just "do".

In North Carolina, a major evaluation of the entire coastal fisheries management process, the Fisheries Moratorium, is underway. This study includes an evaluation of habitat. As with most systems, habitat regulation in North Carolina is designed to issue permits; it is not intended to protect habitat. Protection does occur when permits are denied or modified, but the intention is to issue permits. This process has been described by some as an orderly system to destroy habitat.

By the end of the century, the Division of Marine Fisheries will probably prepare roughly 30 state fishery management plans as a result of the Moratorium process. Habitat issues will be a very important part of these management plans. The estuarine habitat of North Carolina is of overwhelming importance for us. Over 90 percent of the landings of our commercial fisheries are estuarine-dependent species. Roughly two-thirds of the catch of our recreational fisheries is estuarine-dependent. In fact, in the 1980-1981 reorganization, we discontinued our offshore research vessel. We work in the estuary.

In terms of habitat, based on fish usage, North Carolina has nursery areas that are utilized during the initial growing season. The primary nursery areas are generally the upper areas of the estuarine creeks, which are populated by uniformly sized juveniles and larvae. Secondary nursery areas are downstream and contain juveniles of varying ages and sizes. One issue that I have not heard mentioned during this workshop is feeding areas. Distribution of fish and food is patchy; it is not random. There are reasons why fish are in any given area at a given time, whether it is for feeding, spawning, etc. We know this instinctively, but it is rarely stated. Only random surveys can locate fish. For example, feeding areas are occupied by immature and mature fish because that is where the food is; it is not in another location. Migration routes, which are occupied by fish enroute to feeding, spawning or nursery areas, are particularly important for anadromous fish and are easily blocked. Spawning areas, of course, are also a concern in North Carolina and include riverine wetlands, open ocean, and shoal areas. These areas frequently have strong currents where fish eggs must be suspended to develop or less swift currents with specific bottom types for egg attachment. While it varies with the species, again, there is a reason for fish utilizing a specific area and it is mostly related to habitat.

In terms of physical characteristics, coastal wetlands provide protection, food, and basic primary productivity. Riverine and wooded wetlands are areas that are often ignored during discussions of fish of coastal importance. But these areas, especially for anadromous fish, provide spawning areas. They also provide primary productivity and food production as well, similar to a coastal marsh. The estuarine system differs from the oceanic system in that its basic energy input is from marsh and woodland/wetland systems; it does not result from plankton productivity. This is a fact that needs to be emphasized. Submerged aquatic vegetation in nursery and spawning areas does provide primary productivity, but generally, the amount of area in an estuary is quite small relative to the overall system. Shellfish beds contain concentrations of oysters, clams, scallops, and mussels, and are conducive areas for these species by virtue of bottom type, depth, current, salinity, and other habitat characteristics.

North Carolina has a 26-year history of performing habitat surveys by the Division of Marine Fisheries, NMFS, and graduate students in various programs. There is a need to coordinate communication among these groups. The Division delineates and maps habitat areas using GIS. These maps are publicly available. Based on the surveys, the Division recommends rules to the Marine Fisheries Commission, which has the authority to designate important habitat areas (e.g., primary and secondary nurseries, shellfish beds, anadromous fish spawning and nursery areas, and submerged aquatic vegetation). The areas are described as they are delineated. Because the Commission's authority is limited to fishing, once an area is described, they determine any restrictions on fishing. After the rules are published and implemented, we notify other agencies of the designations in the hopes that they will enact protections under their authorities. Unfortunately, because of the moratorium, we have had no new designations since 1994. We do have a number of areas to recommend to the Commission, however, when the moratorium ends.

North Carolina's total estuarine system is approximately 2.3 million acres, mostly in open water. Roughly 140,000 acres are designated as primary and secondary nurseries. Some areas have not yet been designated pending completion of detailed surveys. Other agencies do recognize and protect the primary nursery areas in rules and policies, but not the remaining areas. We are in the process of designating some of these areas; approximately 40 percent of the coastal region has been mapped for shellfish during an ongoing survey that will probably require another 10 years to complete. NMFS and other agencies are also doing some mapping. To date, SAV, high salinity, and anadromous fish spawning areas are completed; low salinity areas are underway. Nursery areas are generally delineated, but not on GIS.

With regard to the roles of different agencies in habitat protection, the Division of Marine Fisheries is a fisheries management agency. We are not a habitat/permit agency; we comment on permits. The Coastal Resources Commission and the Division of Coastal Management have rules to prohibit new dredging in primary nurseries and restrict trawling in secondary nurseries. Seasonal restrictions are placed on maintenance dredging via dredging windows. The Coastal Resources Commission also severely restricts any work in coastal marshes. The Environmental Management Commission and its water quality agency have rules that classify all primary nursery areas as either outstanding resource waters (the highest classification) or high quality waters. Unfortunately, protection of riverine wetlands under 401 certification is not very good. Dams have been constructed in locations that we had demonstrated were spawning areas.

The Marine Fisheries Commission prohibits bull rakes and mechanical shellfish harvesting in SAV, and the Coastal Resources Commission does not allow new channel dredging in SAV. The Marine Fisheries Commission also restricts harvests from shellfish beds. Oyster rocks are fairly well protected from channel dredging by the Coastal Resources Commission. Unfortunately, because clam beds cannot be seen in the substrate, they are not well protected. For example, channels have been permitted through the middle of beds. In addition, no estuarine spawning areas have been delineated yet. We are hoping to begin research to delineate areas for weakfish and red drum.

One of the problems we have is that interagency communication and coordination is not very good overall. At the local level, people communicate fairly well, but at the Commission level, communication ranges from poor to nonexistent. This is partly due to institutional barriers. A new concept that appears to have a lot of promise is habitat management plans. Among other things, they will require interagency coordination because the plans will be developed by interagency teams, including the Department of Transportation, the Department of Agriculture, and citizens. Only six to eight plans will be developed, but once approved, implementation will be required and all regulatory Commissions will have to amend their rules to protect and define habitats. This process will most likely be at the center of any future efforts for habitat protection, and will hopefully enable us to move away from a system of organized destruction.

Panel Discussion
Information Needs, Cont'd.

Ed Bonner
U.S. Army Corps of Engineers
Philadelphia, PA

I work in the regulatory branch of the Philadelphia District. At this workshop, I represent the regulatory perspective. While I do not have much to say, the overall flow of the workshop is appropriate. Several technical experts have presented information that will flow to the regulator, in this case the Corps, who will then make a final determination. In theory, this is how the program is supposed to work from the Corps' perspective: regulators use the technical information to control the regulated public. For example, during this workshop, I have heard several interesting presentations including one by Ken Able concerning the impacts of piers on winter flounder. I can assure you that if the Corps of Engineers were to deny a permit application in the City of New York for a new pier based upon this research, it would send reverberations far beyond the State of New York.

The problem we face in the regulatory community is that we have to take this technical information and try to use it in the daily operating context of a permit application. We need to know your concerns, and more importantly, how to address these concerns in a permit action. Our regulations are designed to issue permits, not to deny them. So the actual endpoint is further along, at the time when we say "yes" to the public, which we do hundreds of times per year. It becomes very difficult to take these general arguments and make sense from them. My needs are to have as much information as possible and as quickly as possible. I need this information to make decisions.

One recent example highlighting the need for information involved an application for a replacement of an intake structure for a water treatment plant on the Delaware River. This structure was located in the middle of short-nosed sturgeon spawning grounds. NMFS recommended the use of intake screens with 1 mm openings and a maximum intake velocity of .5 ft./sec. While this recommendation sounds simple, when the applicant was informed that the agency had requested these actions, they became upset over costs. We then had to go back to NMFS and begin questioning the rationale for each part of the recommendation. We kept discussions to an informal Section 7 consultative process involving several exchanges before we arrived at the answer. The bottom line is that, as a regulator, I need the "whys" behind the recommendations. I need this information to defend my decision. So while the research described at this workshop is good, experts need to make sure that they create channels to feed the information being generated to the regulators who are making the day-to-day permit decisions.

Panel Discussion
Information Needs, Cont'd.

Rob Dunlap
South Carolina Department of Natural Resources
Charleston, SC

I am not a regulator; I am with a state agency that often finds itself having to react to the regulatory process. We do the best we can to convey our perspective, educate, and work within the strengths of the federal and state regulatory processes. In South Carolina, it's a joint process; we interact with the state regulatory agency on coastal zone management and water quality programs, and with the federal government on Corps' programs.

After listening to the presentations and dialogue during this workshop, I see a need to use this process that we are somewhat stuck with. We need to bring all of these different interests and requirements together. We have learned this lesson painfully over the past 15-20 years in South Carolina during the evolution of our coastal zone management program. Their needs were certainly re-iterated yesterday during the southeast regional breakout session. Participants from Georgia, which just started a coastal zone management program, were clamoring for information. We do not always have the answers, but we need to continue to promote and focus research. In South Carolina, we are fortunate to have a research facility that is part of the Marine Resources Division. Without access to such a convenient mechanism, there are other alternatives including universities, NMFS, and other federal research programs. If necessary, we need to utilize these other entities to the extent possible. Again, communication and coordination are essential.

Some of the information mechanisms that have evolved in South Carolina include monthly interagency meetings involving the Corps and all of the participants in the state and federal regulatory process. These regularly scheduled meetings are held to discuss specific permit applications, including pre-application issues for major projects. This process enables applicants, who are allowed to attend, to receive feedback from all of the players involved in the process including the regulators and resource agencies. Exchanges of technical information are not always involved, but at least everyone understands the needs of the other players. The meetings also provide a mechanism for the agencies to share information among themselves in a predictable forum.

We also have several specific task forces and committees that have been established to address issues. For example, the Coastal Pesticides Advisory Committee has been very helpful in helping to promote integrated pest management and exchange information. The information is out there; sometimes we just need to coordinate within our own organization. To address this problem, within the Marine Resources Division, we have intra-Divisional committees that meet periodically to share information pertaining to research and management issues. These committees provide a means to minimize the information gap and identify new issues.

Case Study Of How Habitat Information Can Be Used To Site Alternative Dredged Material Disposal Sites in Charleston Harbor

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Background Information and Problem Definition

Charleston Harbor is one of the most valuable economic resources in South Carolina and has a major role in national defense as a Navy home port. Large numbers of jobs and tax revenues result from the investments made in port facilities. The Harbor is also a valuable environmental resource providing spawning and nursery habitat for recreationally and commercially important fish and shellfish. The Harbor is used extensively for recreational fishing, shrimping, and boating.

The maintenance and development of navigational channels in Charleston Harbor is critical to the regional economy and national security. Annually, more than five million cubic yards of material must be removed from channels to maintain water depths required by shipping traffic. Construction of planned new port facilities and deepening of the Harbor to support a broader range of vessels will require more than twelve million cubic yards of additional dredged material disposal capacity. Activities associated with dredging, particularly the disposal of dredged material, may have substantial adverse impacts upon environmental resources.

Currently, the majority of material dredged from Charleston Harbor is deposited at a site located on the southern portion of Daniel Island which has large capacity, low environmental impact, and is economical to use. Unfortunately, the lease agreement for the use of Daniel Island expired in 1992, and the owner plans to develop the site into a community including residential housing, light industry, a shipping terminal, recreational space, and associated support services (e.g., schools).

Due to the impending loss of Daniel Island as a dredged material disposal site, the U.S. Army Corps of Engineers (USACOE) working with the South Carolina Coastal Council, the State Ports Authority (SPA), the U.S. Navy, and the City of Charleston initiated a study to identify alternatives to Daniel Island that have acceptable economic costs and environmental impacts. The USACOE was lead agency for conduct of the study and was responsible for the conduct of economic and engineering studies. The S.C. Wildlife and Marine Resources Department, Marine Resources Division (MRD), was contracted to conduct analyses to identify alternatives to Daniel Island that could sustain acceptable levels of environmental impacts. The alternative of not dredging the Harbor was not considered because the resultant economic and national security impacts were considered unacceptable.

Approach

MRD worked with the USACOE, other state and federal agencies, and the public, to identify alternative dredged material disposal sites that could be used *in lieu* of Daniel Island. Twenty prospective sites that had disposal capacities ranging from about one million cubic yards to 120 million cubic yards were identified. The areal extent of these sites ranged from 49 acres to over 9,800 acres. Sixteen were diked upland sites, two were diked estuarine sites, and two were uncontained ocean disposal sites. Six of the sites were existing dredged material disposal areas. The complete range of environmental conditions that exists in Charleston Harbor was represented by the alternative sites included in the evaluation. Multiple engineering configurations were evaluated for several sites.

MRD convened a workshop to define environmental concerns associated with construction and operations of dredged material disposal facilities in Charleston Harbor. Participants at the workshop included representatives of state and federal regulatory and resource management agencies, academic institutions, environmental advocacy groups, and cultural resource agencies. Environmental concerns associated with dredged material disposal facilities identified by participants at the workshop included:

- Impacts on existing environmental quality
- Impacts on water quality
- Critical habitat losses
- Impacts on environments adjacent to candidate sites
- Impacts on material cycles
- Impacts on migration and movement patterns
- Impacts on groundwater resources
- Impacts on cultural resources
- Impacts on human uses.

Projecting and contrasting the environmental consequences associated with siting of dredged material disposal facilities at the alternative sites required data collected in a standardized manner for all sites. MRD's review of the ecological literature for these sites found it to be fragmented, incomplete, and limited in spatial and temporal coverage. To overcome this problem, MRD developed a standardized data base of habitat types for the sites that provided data which could be used as a basis for projecting and evaluating environmental impacts for each of the environmental concerns identified. The habitat-cover data were developed using post-Hugo color infrared photography obtained by the National Aerial Photography Program (NAPP), existing nautical charts, and coastal bottom mapping data collected by the United States Environmental Protection Agency (EPA).

MRD developed quantitative measures (i.e., indicators) for projecting impacts associated with the environmental concerns identified at the workshop except impacts on groundwater and cultural resources. The South Carolina Water Resources Commission (WRC) was responsible for projecting impacts on groundwater resources, and Brockington and Associates, Inc., a Charleston based archaeological consulting firm, was responsible for projecting impacts on cultural resources.

The indicators developed by MRD incorporated habitat-cover data and scientific knowledge about the sensitivity and vulnerability of habitats to estimate the relative magnitude of impacts associated with development of dredged material disposal facilities. The MRD analytical approach was also designed to allow the results obtained from WRC and Brockington and Associates, Inc. to be incorporated into the final assessment. Cumulative impacts were assessed by summing impacts across all environmental concerns. Environmental concerns were weighted equally for the cumulative impact assessment. Estimates of the degree of impact were adjusted for among-site differences in capacity to facilitate comparison of the alternatives. The final assessment we developed identified alternatives that had both small cumulative environmental impact and small environmental costs per cubic yard.

None of the alternative sites were preferred habitat for threatened or endangered species or blocked migrational routes for recreationally and commercially important species.

Existing diked dredged material disposal facilities at Yellow House Creek, Naval Weapons Station, Drum Island, and Clouter Creek were projected to represent the least threat to environmental resources and were the most acceptable alternatives to Daniel Island. These sites generally have large capacity and are located in regions of the Harbor where impacts on ecologically valuable resources are low. The smaller of two Ocean Dredged Material Disposal Site was also determined to be an acceptable alternative to Daniel Island for disposal of uncontaminated dredged material. The combined capacity of these existing disposal sites is about 240 million cubic yards. In combination, they provide most of the dredged material disposal capacity required for Charleston Harbor for the next 50 years.

The most acceptable "new" site identified was Upper Thomas Island. Development of this site would provide about 25 million cubic yards of additional disposal capacity.

Most of the potential sites do not warrant further evaluation as alternatives to Daniel Island because of the high environmental impact which would be associated with their development and use. Included in this group are the proposed Folly Beach Berm, modifications to the existing Morris Island disposal site, Patriots Point, Middle Shoal, Rodent Island alternatives, Lower Thomas Island, Fort Johnson, Cainhoy Road alternatives, Point Hope Island alternatives, and Parkers Island alternatives.

Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Holland's presentation:

Question: I was struck by how the first example, in effect, quantified scientific judgment. Were there no surprises?

Response: There were two surprises. The first was that one of the sites we were using was not a good place for disposal. We had not thought this at first. Second, coming from the private sector, I had never been told to get a certain answer. My first assignment at marine resources was

to demonstrate that upland sites are a bad place to put dredge for disposal. This was the answer that was wanted. But the upland sites were sort of in the middle. Some were more unsuitable, but others might be acceptable over the longer term. Another major surprise was that we already have enough capacity to get us through 20 years. In 20 years, science and engineering technology may advance to the point where we won't have to make a decision about using one of these upland sites. In general, this project concerned trying to make a judgment up front before spending a lot of money. The Corps was prepared to spend a lot of money to characterize these upland sites. Now they don't have to spend money on this activity. Instead they're focusing on how to make the current capacity work until we can look at the situation in a more logical way.

Question: We basically did the same thing in the Chesapeake Bay with Baltimore. But the process was run by the Port. They had a screening system set up with roughly 16 criteria, but didn't do any weighting. So everything was weighted equally. There were about four environmental categories, four engineering categories, and 4 cost categories. We at NMFS were never happy with the product. We felt we were always at loggerheads with cost and environmental impact, because the cheapest sites were in the best part of the Bay. After a few years, our office put together a group of environmental representatives from the states, fishing groups, the Fish and Wildlife Service, and NMFS to develop a list of criteria that would be used to disqualify a site. We examined known fishing areas, spawning areas, and other criteria, and then entered the results into a GIS. We overlaid this on a NOAA chart to view the navigation channels and other features. This became a first-tier screen to disqualify certain areas. We originally thought the entire upper Bay would be covered, but found some open areas to our surprise. We took this product back to the Port and got the ball rolling. We now have a 20-year plan and some of the areas that were identified from our screening process are part of the plan. This hasn't gone out to the public yet and no particular site has been proposed, but it got the process going again. You might have to tweak our process for your particular situation, but it basically works.

Response: Yes it does, and that was the point I was trying to make. We needed to make a decision in an objective way so we got all of our management and scientific personnel to agree on an approach. Then we went out and did the assessment, and brought everyone back together to examine the conclusions. They had a lot of questions about sensitivity and weighting, but it turns out that weighting didn't have much of an effect until higher up the scale.

Question: Regarding the treated wood study, the work we had done in the Gulf and in the Northeast involved bulkheads, rather than docks, where you have a much greater surface area for leaching. Dock piles are scattered here and there versus the solid wall of a bulkhead. There is much more leaching from a bulkhead than a dock. Leaching from docks, even in the Northeast, don't seem to have significant impacts.

Response: We were being forced to deal with the data that said docks were bad; i.e., copper and arsenic was leaching from treated wood. This was the way we decided to deal with it. Environmental impacts from leachate are not a concern, maybe other things are. Another message is that when you're dealing with data from regions with different tides, things will change.

The Distribution and Growth of Shallow Water Juvenile Fishes in an Urban Estuary: A Preliminary Report on the Effects of Manmade Structures in the Hudson River Estuary

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A variety of techniques have been used in preliminary and ongoing studies to assess the quality of urban estuarine habitats in the Hudson River estuary. Trapping and caging techniques were used in 1993 and 1994 to determine the relative abundance and growth of juvenile fishes in underpier, pile field and open water habitat types in nearshore areas (1.0 - 5.0 m depth) on both the New York and New Jersey sides of the estuary where salinities ranged from 13.5 - 28.0 ppt. Piers ranged from a large platform (351 x 255 m) to a smaller commercial pier (213 x 100 m). Pile fields were rectangular arrays (270 x 50 m to 242 x 25 m) of pile supports (pilings) that remain after the platforms have been removed from piers. Nearly 1,500 mostly juvenile fishes representing 24 species were collected in 1,865 trap days conducted from May through October in the two years. In each year, fish abundance increased throughout the summer with highest catches in late summer. Abundance decreased beginning in September. Two seasonal assemblages of fishes were apparent in both years. Young-of-the-year (YOY) Atlantic tomcod and winter flounder dominated an early summer assemblage (May-July) while large numbers of YOY striped bass were collected in a late summer assemblage (August -September). Among the other species making up more than 5 percent of the catch in both years were American eel and cunner. Seaboard goby was an important constituent of the fauna in 1993, while black sea bass contributed significantly to the total number of fishes collected in 1994. The presence of relatively large numbers of young-of-the-year during 1993 and 1994 lends support to the idea that nearshore areas in the Hudson River estuary function as nursery habitats for a variety of fishes. While the importance of the entire New York Harbor estuary has been previously suggested, previous surveys of the pier and interpier areas have only rarely demonstrated their use by young-of-the-year fishes.

The effects of habitat type on fish assemblage structure were evident during both years. Fish abundance and species richness were typically low at underpier stations, where YOY fishes were rare and larger juvenile American eels accounted for nearly 80 percent of the total catch. In contrast, YOY fishes dominated collections at pile field and open water stations where fish abundance and species richness were high compared with the underpiers. Despite the generally consistent patterns observed for many species, there were important differences between years. These observations support the need for multiple year studies to determine how fish use different habitats. This may be especially true in estuaries in the Middle Atlantic Bight where the fish fauna is highly migratory (Able and Fahay, in press).

In 10-day caging experiments conducted with recently settled winter flounder (June-July, 1993 and 1994; 3 experiments yr^{-1}, N = 522 ; 14-90 mm TL) and tautog (July - August, 1993 and 1994; 3 experiments yr^{-1}, N = 489 ; 21-76 mm TL), instantaneous growth rates in weight (G_w $\%d^{-1}$) were significantly higher in pile field and open water habitat types than in the underpiers where both species lost weight in all of the experiments. Growth rates for individual winter flounder and tautog were much higher in open water and pile field habitats. These same patterns were evident when growth was analyzed for instantaneous growth in length.

The results of both the trapping and caging studies indicate that habitat quality under the platforms and large piers (> 20,000 m^2) is poor for YOY fishes when compared with nearby pile field and open water habitat types. These studies (Able and Studholme, 1994; Able et al., 1995) have provided specific answers to questions of habitat value for the Hudson River estuary and have implications for other urban estuaries as well. The studies are continuing in order to further define pier impacts, especially relative to edge effects for these structures.

Literature Cited

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Able's presentation:

Question: Does the aggregate data for the Hudson River include the caged fish under the piers?

Response: Yes.

Question: Those species aren't normally living under piers. What would happen if you removed these results from the data and looked at the growth of the Hudson River fish that were not caged under piers?

Response: We thought about this, but if I remove this data, I also want to remove the data for marsh creeks from Great Bay because, in effect, the growth rate is very slow in marsh creeks.

Question: But do you find the species naturally there?

Response: They are there in the spring, but when the temperature rises and dissolved oxygen drops, the creeks become a negative habitat. But also remember, there are artifacts associated with these results. We are caging these animals so their movement is restricted. The technique is not perfect. So if both of these negative habitats were removed from the data, it would look the same.

Question: Is there a size threshold for structures that would influence the impacts you identified?

Response: The two piers are very large; the second pier is approximately the size of an average commercial pier. We've been asked this question several times and we don't have a very good answer. There was no difference in the size of the two piers that we used. In an attempt to address this issue, we're doing studies over the next two summers to examine edge effects. People have suggested that the edges are where production is really going on. If we could find an edge effect, this would help answer the question. Because the piers we used are typical commercial-sized piers, I believe you'd have to use something smaller to get a response.

Question: What do you think of doing caging experiments with eels, because they normally live under the piers and perhaps find it a more suitable place to grow?

Response: These are bigger individuals and would result in a lot of biomass in the cage, so they're probably not an appropriate animal.

Question: What may be an appropriate animal to look at for a positive impact under the piers, i.e., those that are benefitting from them?

Response: I think it's simpler than that. Eels are fairly ubiquitous and are found in a lot of habitats. Perhaps one of the reasons they are surviving well under the piers relative to other animals is that they do well in the dark because they're nocturnal. They have other sensory modalities besides vision that they use to find their prey. But I think this is working pretty hard to find a positive effect of the piers.

Question: But the striped bass don't like the dock and the striped bass like the eel, so we're kind of separating the predator from the prey, which is benefitting the eel also.

Response: But the abundance of eels is still not that great under the piers. They are more abundant there than in other habitats but the actual abundance in terms of biomass is not that great. So it's not a resource for striped bass.

Question: Is the growth data for both years the same for both species?

Response: The trends are the same. In 1993, we were learning the system, so the data aren't as good (e.g., we lost cages, etc.) and are difficult to analyze. But the trends are the same.

Question: What do you find, in general, under the piers?

Response: In terms of species composition, it's 80% eels. Then there's *Microgadus (*tomcod; this is apparently another nocturnal species). Those are the two major components. You find little else.

Question: One of your early slides showed environmental parameters in the three habitats. Wasn't dissolved oxygen much lower under the piers?

Response: If I remember correctly, it was actually lower in one of the pile field sites on the New Jersey side. This seemed to be a localized effect and we don't really know why. It was a little bit lower, but when we looked at the dissolved oxygen trends and the growth data or distribution of abundance, it wasn't a consistent factor.

Question: Concerning your trap studies, are you reasonably confident that you were trapping everything that was there?

Response: I am confident that we are not. For example, we're not collecting anchovies or silversides, so we're missing the pelagic component completely. Are we missing bottom-oriented things? Perhaps so. It depends on how fish respond to that structure, which is a trap. We did get 24 species, which is much more diverse that anyone would have thought occurred in the Hudson there. I cannot think of an obvious benthic or demersal fish that is probably there, but we missed. Pelagic species we clearly don't catch.

Question: So you haven't looked at catchability in terms of a specific species with that particular trap?

Response: We have in the Great Bay system. We found that it does give you a representative measure of fish species composition with the exception of pelagic species.

Question: Relative to why the growth rate was lower under the piers, do you think that this is a light phenomenon? For example, is it a function of the prey density relationship inside the cages or preying in the dark? Are both tautog and flounder diurnal visual predators that are impaired by the light levels?

Response: This is the simplest interpretation; it's so dark under the piers that they can't see to feed. The light levels are extremely low when working under the piers – we often need lights of some sort.

Question: Is there any consideration of sampling the edges of pilings underneath the dock to see, for example, how much barnacle growth is on the pilings underneath the docks versus how much growth is in the open pile field? Or you could even sample the mud to see what type of worm exists. This wouldn't be affected as much by the cages. For one thing, the tautog obviously like to feed off the pilings where the winter flounder focus more on organisms in the mud.

Response: I think these are all good suggestions; all it takes is time and money to address them. That's why we used abundance and growth; we thought they were pretty good indices.

National Habitat Research Needs

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In 1991, Dr. Nancy Foster, currently the Deputy Director of NOAA's National Marine Fisheries Service (NMFS), asked me to develop a research plan for the NMFS Habitat Program. To help insure that the plan would not be regional in scope and included a perspective from NMFS Headquarters, I asked Dr. James P. Thomas with the NMFS Habitat Program in Silver Spring (MD) and Dr. K. V. Koski with the NMFS Auk Bay (AK) Laboratory to join me. This presentation and brief paper summarize that plan and some specific research and information needs as seen by the NMFS Regional Offices and Science Centers and is based on a May 1996 Fisheries publication (Thayer et al. 1996). However, after having sat through the presentations at this workshop, I believe that this presentation can serve to summarize a great deal of the information needs that were expressed by fishery managers, habitat managers and research individuals who attended.

We began the development of the plan with the knowledge that NMFS had ongoing, well-recognized, albeit scattered and unstructured on a national basis, habitat research in most of its regions. We also knew that there is a relation between landings of estuarine-dependent fishes and the extent of estuarine and coastal habitats, and that on a national basis about 70 percent of the landings are of estuarine-dependent fish. Available data also provide information demonstrating that emergent and submergent wetlands and their associated shallow habitats provide food for growth, refuge from predation, and export of organic material to other parts of the system and to the offshore environment. However, linkages between organisms and habitats and movements between habitats are not well understood, and in many instances not sufficient to provide the data relevant to determinations of critical and essential habitats. We knew as well that there are priority threats not only to living marine resources (LMRs) but also to habitats (e.g., physical habitat degradation, contaminants, freshwater inflow alteration [quality, quantity and timing], and nutrient over-enrichment), the degree of importance of any one of which varies regionally. These priority threats are most in evidence at the estuarine-nearshore region.

A major purpose behind development of this plan was to provide an umbrella to organize and optimize ongoing and future habitat research in NMFS to protect LMR habitats and enhance fisheries and protected resources. We asked designated habitat managers and scientists in each of the NMFS regions to provide lists of what information was needed to fulfill this goal. While the responses understandably fell into different regional priorities, they also fell into five categories: Structure and Function of Habitats, Responses of LMR and Habitats to Habitat Alterations, Habitat Restoration, Indicators of Impact and Recovery, and Synthesis and Transfer of Information. As noted earlier, these are the general areas that have been evident at this workshop as needing information.

Examples of research/information under each area are listed below.

Area 1: Habitat Structure and Function

Knowledge of the structure and function of natural ecosystems, linkages between and among habitats, and the role they play in supporting LMR's is fundamental to the program, and forms the underpinning of data bases necessary to establish critical and essential fish habitat. Ken Able presented some data on research not only on distribution of fishery organisms but also on rates of growth in different habitat types at this workshop that provide examples of some of the research information that is required by habitat managers. Other examples of research include:

- Recruitment to and use of coastal and estuarine habitats such as salt marshes, seagrasses, mangroves, oyster reefs, coral reefs, and tidal flats.
- Comparisons of similar habitats in terms of fishery use, for example (1) as a function of landscape or location within a system and (2) as a function of geographic region.
- Comparison of functional processes within similar and different habitats with tools such as experimental evaluations of growth rates in different habitats or use of multiple stable isotopes to trace food web linkages.
- Evaluations of movements between habitats.
- Development of simulation models to estimate value of wetland habitats in terms of fishery yield.
- Inventory of coastal habitats on watershed and regional bases with remote sensing and ground truthing for assessment of habitat quantity, change and health status.

Area 2: Responses to Habitat Alterations

Quantifying responses of habitats and LMR's to natural and anthropogenic alterations is not only requisite to determining the degree of impact, predicting recovery rates and recommending effective restoration procedures, but it also is knowledge needed to establish protection measures.

Research is required on:

- Responses to physical and chemical alterations.
- Responses to watershed management practices such as regional comparisons of system (habitat and biota) responses to silvaculture, agriculture, urbanization.
- Development of simulation models to predict responses.
- Use of coastal change analyses to document habitat change.

- Evaluations of gear impact on fish habitat.

Area 3: Restoration

The need for, and approaches to, restoration of coastal wetlands have been an important focus of this workshop and the NMFS Habitat Program. While many techniques do exist for several habitat types, most have not been applied at large scales that we are now faced with. Robin Lewis provided an overview of seagrass restoration approaches at this workshop and the need for monitoring of the success of restoration actions if we are to get a handle on recovery trajectories. In addition to research on techniques to enhance rates of habitat use by fauna and institutionalizing the need for scientific monitoring, efforts are needed to:

- Develop regional and national databases on restored and created coastal wetlands.

- Develop design criteria. Simulation modeling could be useful to vary design aspects for evaluation of temporal and spatial success rates.

- Develop success criteria that account for success and fishery value.

Area 4: Indicators of Impact and Recovery

Our survey of Science Center and Regional habitat managers in NMFS revealed there is a need to develop good indicators that can be used in determining whether an ecosystem, habitat, or LMR is affected or is recovering. Information presented by John Stein at this workshop, for example, is providing evidence that incidence of lesions may in fact provide evidence of impacts at the population level. Advisories on blue crabs because of heavy metal contamination are based on human health concerns and evidence of shell disease reduces their marketability. While both may be indicators of potentially stressed systems there is no evidence indicating that there are concomitant impacts at the population level (Engel and Thayer, In Press).

Information is needed on;

- Potential factors to indicate system health, rates of degradation and habitat recovery.

- Tools that can be used include experimental transplant studies; comparative analyses of fishing reserves and non-reserve areas.

Area 5: Information Synthesis and Transfer

The synthesis and transfer of scientific data are major components of the NMFS Habitat Program and the Plan, and it was a major discussion area at this ASMFC workshop. The NMFS Habitat Research Plan, for example:

- Encourages greater level of interaction between fishery and habitat managers and the scientific community to facilitate a two-way flow of information and needs.

- Promotes the use simulation models and GIS as tools.

- Recommends development of non-technical but scientifically based syntheses.

- Encourages integration of information and needs not on a site by site basis but on a watershed basis, including the development of watershed-based restoration plans.

The NMFS Habitat Program, while having had credible and both nationally and internationally recognized in-house research on habitats, has never had a research-management plan to organize its habitat research activities. I hope that pulling together our present and future research activities under this umbrella will not only help the agency to identify research information gaps and organize much-needed budget initiatives that link science and management, but also provide a vehicle to enhance the development of mutually beneficial partnerships. The plan must be used to provide a greater level of integration between habitat, fishery management and protected resources as well.

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Discussion

The following questions were asked by workshop participants at the conclusion of Dr. Thayer's presentation:

Question: This is presented as a national plan, but there is a tremendous focus on coastal and estuarine habitats, and hardly any mention at all of offshore habitats. From the perspectives of the Pacific Northwest, California, and New England, these offshore habitats are critically important for commercial species.

Response: I don't disagree with you at all. When the plan was initially conceived and put together, it was totally based on the Habitat Office's sphere of activities. Since then, we've agreed that the plan contains a lot of general information and can be "torqued" to pull in other oceanographic information. I hope this is a living document that will change with time. I'm not going to publish it again, but there's no question about bringing in some of these aspects during the next round. Particularly within the Service, we need to link the offshore management issues with the habitat issues. I'll admit that we didn't do a good job of this.

Question: I guess I'm frustrated because I attended the meetings in New England during the formation of this plan, and provided written and oral comments about the importance of this issue (i.e., offshore habitats) and other people echoed that. The fact that it didn't make it into the plan is incredibly frustrating.

Response: This is the 52nd version of the plan, which is about 13 pages. I'll give you a copy of an earlier version (e.g., the 25th version) that was about 50 pages. These ideas were there, but the emphasis is definitely inshore. I think, however, that the information pertaining to processes, areas of research, information needs, and the linkages between them, is not just restricted to inshore issues, and that we can readily incorporate information on the Pacific Northwest islands.

Question: Is there a companion strategy for producing the tools from all of this research for the habitat manager, and similarly, a strategy for making that available to the habitat manager?

Response: This is point #5 concerning synthesis and information transfer. Besides publishing synthesis documents on subjects, efforts are underway to provide this information on-line and to develop GIS systems. Another more subtle mechanism is that periodically we are involved in presenting information like this to the fishery management councils, as well as translating and transferring some of our information into management needs for the NMFS habitat managers. We have a problem just internally communicating back and forth between our own managers and scientific community. But the information is coming.

Chapter 8

Wrap-Up

Introduction

This chapter of the proceedings includes a report from the Steering Committee and summary papers prepared by six workshop participants. The Steering Committee's report includes a summary of responses to a workshop evaluation survey, as well as recommendations for future work to the ASMFC Habitat Committee.

The individuals asked to provide participant reports were chosen in order to represent the wide range of participants attending the workshop. These individuals were from habitat regulatory agencies, habitat commenting agencies, university/research organizations, and conservation organizations. In the reports, participants were asked to give their impressions of the workshop, including identifying issues of great concern and important take home messages.

Workshop Evaluation and Recommendations for Future Work

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In order to determine how well the objectives of the workshop were met, and develop recommendations for further ASMFC action, the Workshop Steering Committee requested feedback from the participants in the form of a written survey and the Habitat Managers Workshop Steering Committee. This information was then integrated into the final recommendations, which were forwarded to the ASMFC Habitat Committee for possible inclusion in the Habitat Program.

Participant Evaluation and Recommendations

An evaluation form was distributed to the workshop participants in order to identify the ways in which the workshop was useful to them, and how it assisted in achieving the ultimate goal of fish habitat conservation. The evaluation was also used to solicit feedback on possible ASMFC Habitat Program activities. The following three questions were posed to address the workshop's usefulness, and develop recommendations for ASMFC action:

1. What portions of this workshop were the most useful for you?

2. What contacts and/or information will you put to use as a result of this workshop?

3. What kind of follow-up from ASMFC would you like to see?

Responses ranged in level of detail. Not all participants were sampled since the evaluation forms were distributed on the final day of the workshop. Comments of the fourteen respondents are summarized below. A brief review of applicable, planned ASMFC activities are also provided in the section outlining recommendations for ASMFC follow-up.

Workshop Utility

The workshop respondents identified the opportunity to gain knowledge through information sharing as the most useful part of the workshop. Technical issues were highlighted, and included research results of habitat impacts, case studies on habitat assessment techniques, and the identification of fishery impacts from habitat loss. Less technical issues were also mentioned, and included regional habitat issues, identification of habitat manager information needs, and examples of proactive approaches to habitat protection and improvement.

A number of respondents considered the discussion on how to incorporate habitat into the fishery management process very useful. Finally, the opportunity to network and make contacts was identified as a very important part of the workshop.

Application of Workshop Findings

Three distinct categories were obvious in the responses, including the application of technical information; policy development and interagency coordination; and habitat research. Technical information gained from the workshop, which respondents reported they intend to apply, includes the use of Susquehanna fish passage experience for the improvement of fish passage in South Carolina; habitat restoration information for seagrasses and shellfish; and the use of oyster reefs as important fish habitat. Respondents also mentioned that they would use the proceedings and other technical information identified during the workshop, and the habitat sections in relevant fishery management plans (FMPs), as reference tools when making habitat related permit decisions or comments.

In the policy arena, a number of respondents stated that they would encourage the review of state water quality standards for applicable watersheds, and the adoption of water quality designations and minimum stream flow standards in order to protect fisheries resources. Improved coordination between state and federal habitat and fisheries management agencies on habitat issues was predicted to be an outcome of the workshop. Continued collaboration between the National Marine Fisheries Service and ASMFC on issues such as essential fish habitat was suggested and has been planned. Increased participation in habitat protection by the Mid-Atlantic and New England Fishery Management Councils was encouraged. Respondents also mentioned that the research findings which were presented would be shared with other researchers, and used to plan future research.

Recommendations for ASMFC Follow-up

The most common recommendation for ASMFC follow-up was the publication and distribution of a workshop proceedings, including a summary of comments and evaluations. Other recommendations fell into one of three categories: *Information Development and Distribution; Future Workshops;* and *Interagency Coordination.* The recommendations are given below, along with comments on relative ASMFC activities in progress.

Information Development and Distribution – Two respondents suggested the production of documents containing habitat needs for species under management, that could be used by project/permit reviewers when making habitat impacting decisions. One respondent suggested that such documents be produced regionally, with species specific habitat sections and matrices containing habitat parameter thresholds for each species under management. A multi-species matrix was also suggested. ASMFC is currently planning on developing similar documents which are species specific. These documents will be based on the habitat sections for FMPs as they are developed. Work is currently underway for striped bass and weakfish, and will be undertaken for winter flounder in the near future.

The development of status reports on the incorporation of habitat sections into ASMFC FMPs, the NMFS research plan, and state progress in implementing habitat protection recommendations in ASMFC FMPs was also suggested. Finally, it was proposed that ASMFC serve as a clearinghouse for applied research on fishery habitat, such as the works of Geoff Scott and Ken Able which were presented at the workshop. Currently, none of these projects are being addressed by ASMFC, although *Habitat Hotline Atlantic* gives updates on FMP habitat section development.

Future Workshops – Eight respondents suggested planning future workshops. ASMFC does not have any habitat related workshops under consideration at this time. Proposed program content for possible future workshops identified by the respondents included:

1) A program focused on a single, priority issue common to most Atlantic coast managers; identification of habitat threats, resource impacts, and methods to alleviate impacts; development of scientifically supportable recommendations that can be adopted by ASMFC and regional fishery management councils, which can then be used by habitat managers in support of their positions to regulators;

2) A program to educate ASMFC Commissioners and Advisors on general habitat issues;

3) A workshop to disseminate information on essential fish habitat delineation and general implementation of the habitat provisions, pending Magnuson Act reauthorization;

4) A program that supports collaboration and cooperation between fishery managers and habitat managers and develops an agenda for action, possibly in regional groups;

5) A program to identify research needs by habitat managers for habitat researchers, and presents options for applying habitat research to habitat managers;

6) A program which periodically assembles regional programs (i.e. permitting, research, fisheries, etc.) to address habitat impacts.

Coordination – It was suggested that ASMFC be used as a contact for information exchange between state and federal agencies on habitat issues. To a large extent ASMFC is fulfilling this role of facilitating the exchange of habitat information between and among fishery management agencies. *Habitat Hotline Atlantic* covers issues relevant to both state and federal agencies, the Management and Science Committee discusses important habitat issues state by state twice per year; and the Habitat Committee deals with overall Commission policy. ASMFC is still at the very beginning stages of getting involved with other state, federal and local agencies, including those responsible for coastal zone management, water quality, and land use planning. A database of these agencies and other habitat related organizations has been compiled, and will be used for distribution of FMP habitat sections developed by ASMFC. Other direction for ASMFC in this area is unclear.

Consistency in the identification of essential fish habitat, as described in current Magnuson Act reauthorization, between NMFS, regional fishery management councils, and ASMFC was suggested by one of the respondents. ASMFC has a definition of essential fish habitat, although it has not developed any policies on EFH identification in FMPs.

Finally, it was suggested that ASMFC be used as a forum for the development of position/policy statements about recommendations for protection of various important habitat types. The ASMFC Habitat Committee has discussed this option, which is similar to the approach that the South Atlantic Fishery Management Council employs. The Habitat Committee has not planned any action beyond the development of a subcommittee to educate Commissioners on the importance of Submerged Aquatic Vegetation at the October 1996 Annual Meeting.

General Comments

More than half of the respondents stated that the program content was excellent. A number of respondents mentioned that a greater diversity of participants including stock assessment biologists and more habitat regulators and researchers, and a greater amount of time for discussion would have added to the workshop. Requests for additional information on habitat manager needs and how agencies can work together were also posted.

The comment which was probably heard most frequently during discussion periods and coffee breaks was the need for better coordination and communication between federal and state habitat and fishery managers. This sentiment was also echoed in the editorial reports prepared by select participants, which follow this summary.

Steering Committee Recommendations

The Steering Committee is forwarding four recommendations to the ASMFC Habitat Committee as a result of the workshop. The first recommendation addresses the widespread sentiment that events such as the Habitat Managers Workshop are extremely important in facilitating communication between and among fishery and habitat managers and researchers. The Steering Committee recommends that a recurrent conference be planned to provide for information exchange and improved communication. Current for a such as the biennial Coastal Zone meeting or the Shallow Water Research and Management Conference were suggested, but may not appeal as much to fishery managers. Additional ASMFC sponsored workshops such as the Habitat Managers Workshop would also provide this function.

The second recommendation is the preparation of a single ASMFC habitat document, in addition to the improved FMP habitat sections currently being developed for FMPs. Habitat managers are in need of a comprehensive document which describes important fishery habitat and the habitat needs of fish under management, describes and/or establishes conservation policies, and gives concrete examples of conservation, mitigation and restoration options. As a part of this recommendation, the Steering Committee encourages ASMFC to ensure that any habitat related documents produced include input from habitat managers, in order to firmly establish the utility of the documents to habitat managers.

The third recommendation is the establishment or identification and advertisement of a World Wide Web site to facilitate information exchange and communication between habitat and fishery managers. Whether established through ASMFC, the Coastal Services Center, or another organization, this site could assist managers in identifying information, and sharing experience when addressing habitat/fishery management issues.

The fourth and final recommendation from the Steering Committee is the development and adoption of policies by ASMFC which address the conservation of specific habitat types. These policies could include model recommendations or regulations which states may implement. The Chesapeake Bay Program has instituted this approach for issues such as protecting submerged aquatic vegetation from physical disturbance. The information being prepared by the Submerged Aquatic Vegetation Subcommittee of the Habitat Committee could serve as a basis for this type of policy development.

Participant Reports

Jim Gilmore
New York Department of Environmental Conservation
New York, NY

What Did I Expect?

I spent the first 11 years of my career working at a consulting firm assessing impacts to fishery resources and habitats from power generation projects. I also obtained a graduate degree in fisheries management toward the end of my consulting years and then began employment with New York State in habitat management and protection focusing on three areas: 1) regulatory programs/habitat protection; 2) habitat restoration; and 3) state land (wetland) management. Therefore, I originally worked in fisheries management but more recently have been a habitat manager. Coincidentally, one of my first tasks with the state 10 years ago was to evaluate critical finfish habitats. The effort was not completed due to "higher" priorities.

My expectations for the workshop were:

- I hoped to gain some new tools and insights in helping with habitat management and protection. Fishery Management Plan habitat evaluations are critical for making more defensible regulatory decisions. There are many changes currently occurring in Federal and state laws that have made protection of these areas more difficult. I wanted to see if the same problems we deal with in New York are occurring elsewhere in the country. (Misery loves company.)

- I always thought it was important to have closer coordination of habitat and fisheries management efforts, but limited resources made this more of a luxury in the past. I hoped this conference would begin this coordination and identify this as more of an essential requirement.

- Lastly, as always at workshops, to improve networking with other resources managers.

What Happened?

The presentations were very informative and I picked up quite a lot of useful information. There were good concepts and themes suggested including:

- Partnering and communication

- Habitat advisory panels

- The Commissions and Councils need to "raise the stakes"

- Winter flounder – good start with habitat component in FMP. However, I am concerned that there are no regulatory "teeth" to make the plan effective.

- Geographic information systems are being widely used and suggested. A cautionary note here since I heard of differing GIS formats. We must standardize efforts if we are to be effective.

- Essential habitats – concern; don't repeat mistakes of the past. Supported idea that degraded habitats should not be written off in prioritization of habitats. If we identify poorly functioning habitats, it may be their death knell. Degraded habitats have been restored to fully functioning systems. It is a safer approach to say we have lost a great deal of habitat already and remaining percentage is all critical.

- I had the impression there were more fish managers than habitat managers.

- I learned some interesting things. I never knew they had inflatable dams! What a great concept. Just think, we could deflate Grand Cooley or Hoover Dam every year to allow for the salmon run!

I also decided to present my personal awards for specific presentations:

- Fred Holland gets the "Energy award"

- Karen Chytalo gets the "On-time award"

- Ken Able gets "My favorite talk award"

- John Boreman gets the "Golden memory award" (I haven't seen him since I was in graduate school and he is still talking about striped bass)

- Gordon Thayer gets the "Excellent summation award." He did a good job in synthesizing where we are.

- Dianne Stephan and the Steering Committee get the "Honorable mention award" for doing a terrific job in putting the workshop together.

What Will I Take Home?

Some new ideas, some new approaches, a revived old idea, but most of all, some hope. The following are just some of the things I left with:

- New contacts and data support

- Coastal Service Center – Margaret Davidson's presentation and efforts are exciting. Information from her shop is available on CD with soundtrack!

- I have a sense we are all speaking with one voice.

- Fred Holland's presentation on the dredge disposal process is very applicable to issues we are currently dealing with in New York Harbor.

- Learned how to properly pronounce Glouster, MA (Glosster); Beaufort, NC (Bowfort); and Beaufort, SC (Bewfort).

What Suggestions For The Future

The workshop was very good although at times it was more like a conference than a workshop. The following are my summary comments:

- Good start. We have to do this again very soon and regularly thereafter.

- Presentations were helpful but we need a "working" workshop. At times, I was experiencing information overload. I believe we should have professionally-facilitated sessions with clear questions and issues formulated prior to the workshop.

- Need regular dialogue between fisheries and habitat managers if we are to effectively manage our natural resources.

- Need to focus our energies.

- I still am unclear as to how we would enforce the requirements under the habitat components of the management plans. We need to focus on this issue.

- If there were more fish managers than habitat managers in attendance at the workshop, I suggest trying to have a more even balance at future workshops.

- Having more people involved with dual backgrounds of fisheries and habitat management would be beneficial.

In summary, I thought it was a successful workshop that provided a good start for addressing a long-needed issue; specifically, bringing fisheries and habitat managers together. I believe we have to do this again very soon as a professionally-facilitated workshop, where we can role up our sleeves and produce some useable products.

Participant Reports, Cont'd.

Steve Gilbert
U.S. Fish and Wildlife Service
Charleston, SC

Sessions 1 and 2 - Overview of the Fisheries Management Process and Existing/Creative Tools for Fisheries Habitat Management.

A central and important issue that arose during these sessions is the challenge of getting the state *regulatory* agencies the message that habitat recommendations in FMPs are required implementation for the state. In the context of Magnuson, the "states" = the state fish and game agencies. Often these are not the state agencies with the authority or jurisdiction to implement these recommendations through state regulatory programs. This issue is also critical to protecting "essential habitat" once its designated.

In Session 2, Ralph Abele suggested a means to resolve the above problem. Agencies can push to get "essential habitat" and/or migration routes, and important spawning, nursery and feeding habitats recognized as an "existing use" or adopted as a "designated use" in their state's Water Quality Standards. Under the antidegradation clause of Section 401 of the Clean Water Act, the state regulatory agency charged with 401 Certification cannot certify a project that would degrade existing or designated uses.

Session 3 - Implications of Identifying Essential Fish Habitat

There was a lot of animated discussion surrounding this topic. One concern was that if we designate certain habitats as essential, do we run the risk of the remainder being *de facto* considered as "non-essential" and therefore subject to greater development pressure?

An interesting option is to attempt implementing a generic FMP for habitat in lieu of designating essential habitat species-by-species in a variety of plans. It is anticipated that there will be a good deal of overlap in species utilization of essential habitats even though they may be partitioned temporally. However, there may be technical limitations imposed by Magnuson which would preclude major transgressions from the species by species approach.

Considerable presentation time and discussion revolved around the definition of essential habitat. The existing Congressional definition, while containing some technical flaws, would allow substantial flexibility in what may be included. What are the benefits of limiting ourselves upfront with a more restrictive definition? In a parallel, the Congressional definition of "fish" always gets some chuckles. However, this broad definition allows FMPs for corals, seagrasses, and even prescription of necessary fishways for passage of migratory shrimp in Puerto Rico.

Essential habitat can be designated for certain functions, thereby not totally excluding alterations which are compatible with the function. For example, if a migratory corridor is designated as essential, temporally-controlled deepening may be performed without degrading the essential habitat function.

Session 4 - Restoration or Enhancement Projects to Benefit Fisheries

Important messages/lessons from this session included:

- Develop regional restoration plans - list of opportunities and needs prioritized upfront. This theme was repeated by several of the speakers.

- Pre-determination of suitable conditions prior to restoration attempts. This theme was reiterated by every speaker.

- Monitor the outcome of the restoration/enhancement action.

Session 5 - Linking Habitat Loss to Fisheries Impacts

Intuitively, we all know that loss of important habitats may be directly related to fisheries losses. However, this session highlighted the extent of research necessary to document the relationship.

John Boreman noted the complexity of showing the link to populations through developing scenarios which involve projecting survival probabilities of young life stages. Fred Holland's research in small tidal creeks highlighted how little we really know – still getting surprises researching basic systems we've worked on for years.

Several examples of how non-physical habitat degradation can create fishery impacts, some of which can be fairly subtle, but important relative to interaction of biological and ecological factors (i.e., Judy Weis' work on feeding behavior of *Fundulus*, John Stein's work on immune system and growth responses in salmon, also Geoff Scott's work - see below).

Session 6 - Review of Regional Habitat Issues

Geoff Scott showed massive effects on biota from non-point source events. On a positive note, Geoff demonstrated that good hard data can be extremely valuable in developing and implementing real, workable solutions.

Breakout session lists appeared to overlap in several areas while distinct regionally-limited concerns were also there. This highlights the need for identifying mutual generic issues that apply to all areas and separating them from more regionally-oriented issues. Also highlighted from the Southeastern breakout was the need for better communication with regulatory folks (e.g., Coastal Zone Management agencies).

Session 7 - What Kind of Information do Habitat Managers Need?

Ken Able's presentation on habitat utilization in inter-pier, open, and under-structure habitats seemed to epitomize the type of information that is valuable to habitat managers (i.e., information sufficiently detailed and documented to make management decisions that are supportable).

Gordon Thayer's list of research needs was inclusive and would undeniably provide much needed information. Habitat managers have always needed much of the information; the list looks much like many that have been seen in the past.

The Corps of Engineers perspective was enlightening. This primary regulatory agency would have difficulty denying authorization of an activity even with recommendations supported by the level of study representative of Ken Able's work. This really raises questions about how we get the habitat protected even if we do all the research necessary to document the importance of various habitats.

Remarks From a Regulatory-Dependent Habitat Manager

Issue: Getting the Habitat Protected

Once important and/or critical habitats are identified, and optimistically, appropriately documented, there is still the issue of getting the regulatory agencies to listen. Strategies to accomplish this were fairly absent from the workshop. While we did have a session on Habitat Manager's Needs, the agencies with regulatory authority are not necessarily comprised of habitat managers; yet they are the agencies with the power to effect the most change in habitat protection or alteration.

The front-line troops dealing with the regulators on fish habitat are the state and Federal resource agencies (state fish and game departments, NMFS Habitat Conservation Division, and USFWS Ecological Services). Operating primarily under the authority of the Fish and Wildlife Coordination Act (FWCA), these are the parties that review and comment on environmental assessments, environmental impact statements, Corps of Engineer's projects, permits under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, and FERC licenses under the Federal Power Act. While Magnuson FMP's and their habitat recommendations will give these agencies additional ammunition, success in getting appropriate protection is far from guaranteed.

Like the FWCA, Magnuson itself is not a sufficiently strong regulatory hammer to protect habitat. The required regulatory agency response to comments guarantees a letter, not habitat protection. While closing of a fishery could be argued as a strong tool, the state fish and game agencies it's aimed at are often not the agencies with the regulatory authority to effect habitat protection. From years of frustrating experience in this arena, I would recommend concentration on the following strategies to effect regulatory control over protecting important habitats:

1. Make all efforts to get the State 401 Certification Agency to include important fish habitats in their water quality standards. Recognition of essential spawning, nursery, feeding and migratory habitats as an existing use of specified state waters or adoption of such habitats as a designated use would protect these habitats under the antidegradation policy of the Clean Water Act. Narrative water quality standards for these habitats should also be developed and adopted.

2. Use existing regulatory tools to the extent possible. The existing Memorandum of Agreement between the Corps and the Federal resource agencies under Section 404(q) of the Clean Water Act allows for elevation of Corps' permitting decisions to higher-level review if there is a significant impact to an aquatic resource of national importance (ARNI). If designated essential habitat is not an ARNI, I don't know what is. Permit decisions adverse to designated essential habitat or contrary to FMP habitat recommendations should be elevated for higher-level review. Section 404(c) of the Clean Water Act authorizes EPA to preclude the use of any site as a disposal site based on unacceptable adverse effects on, among other things, ". . . fishery areas (including spawning and breeding areas". If this authority survives the next Congressional go-round of the Clean Water Act, we should be petitioning EPA to use it on threatened important and essential fishery habitat. Contrary to popular misconception, this authority does not have to be used solely as a "veto" to a Corps permit, but can be used prophylactically in advance of any specific proposed activity.

3. Give high priority as a research need to conducting estuary-by-estuary cumulative impact analyses utilizing the methodology of Leibowitz et al, 1992, or comparable. We will always be facing the piecemeal loss of small, but important parcels of habitat unless we can make a documentable cumulative impact case. Unfortunately, this requires lots of upfront work.

4. Public outreach should also be given a high priority effort. Getting the public as advocates of habitat protection even when it means trading off some short-term economic gains is critical to turning the tide on habitat loss. An important concept to get into the common vernacular is "public trust". State and Federal agencies have a responsibility to protect fish habitats under the public trust doctrine. This doctrine, which dates back to the Roman Empire, has substantial case law development in state and Federal courts which supports this thesis. Under the public trust doctrine, authorizations to alter these habitats should not be granted unless there is an overriding public interest.

Literature Cited

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Participant Reports, Cont'd.

Ken Hinman
National Coalition for Marine Conservation
Leesburg, VA

The theme of this Habitat Managers Workshop, "Fish Need Habitat," may seem obvious to the participants. But the fact is, management of marine fisheries has long focused on regulating the activities of fishermen while largely neglecting other human-caused impacts on fish and their environment. If not entirely absent from the rhetoric of fishery management, habitat conservation certainly has been missing in action.

If fish need habitat, what does habitat need? The answer is fishery managers and fishermen working together to preserve it. Significantly, this workshop featured a discussion of pending changes to the Magnuson Fishery Conservation and Management Act, the 1976 Federal law intended to conserve the nation's marine fisheries which, in its present form, gives little more than lip service to habitat protection. The law empowers neither the National Marine Fisheries Service (NMFS) nor the Regional Fishery Management Councils to control activities which degrade or destroy the habitat of the very fish populations they are responsible for conserving.

But that seems about to change. The Magnuson Act is being reauthorized by Congress this year, and new amendments in both the House and Senate bills introduce the concept of "essential fish habitat." For starters, the Councils would be required to identify essential habitats for each fishery under management and require measures to minimize the adverse impacts on habitat due to fishing (e.g., bottom trawls). In addition, and most importantly, the bills expand the authority of the Councils and NMFS to influence decisions by other non-fisheries agencies which affect habitat. The result of these changes will be to elevate the role of fishery managers, as well as fishermen, conservationists and others involved in marine fisheries management, to that of designated advocates for fish habitat conservation within the Federal government.

Each Federal fishery management plan (FMP) will identify habitat "essential" to the growth and/or reproduction of managed species. The intent seems to be to have fishery managers focus onto something less than every piece of water or substrate related to each phase of a species' life cycle, but more than the Endangered Species Act concept of "critical habitat", i.e., areas vital for species survival. Within the context of the Magnuson Act, essential habitat presumably will be what is needed to maintain fish populations at levels capable of producing the "optimum yield" to the nation.

How it will be defined in practice is uncertain. The definition of essential must be qualitative as well as quantitative. An acre of restored wetlands, for example, does not serve all the biological functions of an acre of natural wetlands. Will areas whose value as fish habitat has

already been degraded be allowed to be further abused, or will they be targeted for restoration? And how will so-called "non-essential" habitats be treated? As one workshop participant noted, "without preserving all kinds of habitat, one with a great but undefined value for some important fishery could easily be lost."

Nonetheless, incorporating the concept of essential habitat into each FMP will enable fishery managers to better make the fish/habitat connection, both in the public mind and in Federal policy, thus providing an undeniably stronger foundation for political action. And that's where the "rubber meets the road."

The Regional Council system is the public's pipeline into fishery management. Whereas the direct involvement of affected fishermen has hindered action to prevent overfishing in many instances, this setup can work to strengthen habitat management. The new Magnuson Act amendments will empower fishermen on habitat matters by getting them into the decision-making process – from the beginning.

But they must choose to take advantage of their new power. It will not be enough for fishery managers to put the spotlight on threats to fish habitat. It will not be enough even for them to submit comments on threatening projects and require a detailed response, as the new law will authorize them to do. They must have the active support of the fishermen whose fishing hangs in the balance.

In the increasing competition for limited coastal resources, government must of necessity limit certain uses at the expense of others. The difficult question is, whose use will prevail? When unwise or unrestrained development in the coastal zone wins out, it directly or indirectly reduces the capacity of the coastal environment to support fish populations in their historic abundance, exacerbating the already severe impacts of overfishing in many regions. Fishermen are the losers.

Fishery managers need their constituents – commercial and sport fishermen and fish conservationists – to be there with them. Otherwise they won't have the political will to aggressively pursue their mutual interests in the Federal arena.

Tying the value of habitat directly to individual species or fisheries of value to fishermen may not be ecologically correct, but it will actually strengthen the cause of habitat protection *politically*. Maintaining coastal rivers, estuaries and offshore habitats, such as coral reefs, for spawning and nursery grounds for fish (and other wildlife) will make better sense to politicians when they see – and hear from! – the fishermen whose livelihoods and recreation depend on them, and that dependency is documented (in each FMP) as thousands of jobs and millions of dollars in revenues to seaside economies.

Finally, the greatest challenge to habitat managers, fishery managers, fishermen and conservationists is striking the right balance. Between actions to prevent overfishing and habitat loss. Between immediate and long-range threats. One example cited during the workshop was striped bass.

The ASMFC has declared striped bass "fully recovered" and is relaxing fishing restrictions. The welcome resurgence of the spawning stock after years of a virtual moratorium on fishing has persuaded many fishery managers that overfishing was the primary culprit, not habitat degradation in Chesapeake Bay, the Atlantic striper's principal spawning ground. But as Dr. John Boreman pointed out, there is another, more cautious view. By reducing fishing pressure, the population is better able to cope with habitat-related limitations. However, if we don't continue efforts to restore the striper's habitat, we may not be able to approach, much less return to, historic catch levels without stressing the resource again and triggering another collapse in reproduction.

What it all means is that integrating fishery management and habitat management is essential to the success of both. And success will require all those with habitat-related concerns, including fishermen and conservationists, working together.

Participant Reports, Cont'd.

Robert Boyles
South Carolina Sea Grant Consortium
Charlestown, SC

The agenda for this meeting covered a range of issues, from an introduction to governance of fisheries to specific research projects aimed at addressing particular habitat needs. These presentations served as the foundation for breakout sessions where managers and scientists discussed specific issues and problems related to managing marine fish habitat.

Tuesday afternoon's facilitated discussion on Essential Fish Habitat spawned vigorous debate concerning several issues. Perhaps the most lively discussion concerned the central question of "what is essential fish habitat?" Participants debated issues of "habitat" (given one interpretation of "fish habitat" [i.e., those areas where fish are found], isn't then all habitat "essential?"); what constituted "essential," and how state marine fisheries agencies might identify, protect, and enhance that "essential habitat." There was little resolution of these issues – while the participants did not believe that "all habitats are created equal," neither did they seem willing to "sacrifice" habitats by having certain habitats designated as anything less than "essential."

Wednesday afternoon's breakout sessions were organized by region. The south Atlantic group's discussion centered around the issue of what scientific information could help state habitat managers better manage marine fish habitat. A recurring theme was that while science is able to provide some answers, habitat managers (and resource managers in general) should not hang their hat exclusively on scientific (e.g., biological, ecological, chemical) information. Habitat managers might do well to understand the sociological, economic, and political aspects of marine fish habitat conservation. An example was given where officials from one state questioned whether they might use biological/ecological information to limit the length of private docks. Scientists responded that there might be no ecological reason to limit dock length, but that citizen's preferences might lead to limiting dock length to 500-600 feet. This is the case where hard science might have few answers, but socio-economic considerations might be brought to bear on management decisions.

Representatives from the region also suggested that while the workshop was helpful in allowing them to exchange information on common issues, perhaps ASMFC's resources should target representatives from the Coastal States Organization and state coastal zone management agencies. These coastal zone managers typically have better ability to regulate activities that may be detrimental to fish habitat. Participants pointed out that several states did not have representatives from their coastal zone management programs, a shortcoming that should be overcome in future habitat workshops.

Participant Reports, Cont'd.

Andrew Jones
Montauk, NY

Introduction

There is usually some degree of political difficulty in directing human resources toward improvement and protection of wild resource habitat and ecology. Prioritization of attention to fisheries habitat is too often entirely ignored. That wild fisheries production is dependent on habitat quality and quantity is recognized by anyone who thinks about it. It is not commonly recognized that, for long-range improvement and maintenance of production, attention to habitat is as vital as attention to fishing effort. It became clear at the ASMFC June '96 Habitat Workshop, that the importance of fishery habitat and the need for action is well understood, that practical expertise in the many aspects of the field is available and the will for effective planning is strong

Reasons why fisheries management has been lacking in effective habitat policy include:

1) The immediate limiting factor of stock level is assumed to be egg supply. When this is true, initial and relatively rapid results are to be obtained by regulating fishing effort.

2) It is easier politically to regulate fishing effort than impingements on habitat

3) Difficulty exists in the many habitat variables and the lack of data.

4) A self-reinforcing situation exists in that the lack of quantified information permits the policy that keeps that information from being obtained.

An area of constraint to comprehensive generic planning for fisheries habitat management is seen in the gap between the quantitative methodology of fishing effort management and the more qualitative methodology of fisheries ecology. It is suggested that the same order of expertise in population dynamics that has been applied to effort management be applied to the "natural" or wild side of fisheries production. The following may be of use in approach and definition in planning a comprehensive generic program.

Need for Quantitative Integration

The absolute productivity of a fishery depends first on the number of fish recruited to the fishery and secondarily, on the yield per recruit. The potential level of recruitment to a fishery is primarily dependent on the amount and condition of essential habitat and supportive ecology required by the early life stages. Secondarily, enough eggs must be provided from the adult stock for the habitat to operate at capacity.

Present fishery recruitment-management controls the supply of eggs by controlling fishing effort. Fishing mortality rates (catch fraction of stock per time) are calculated and set to allow enough eggs to be spawned for stocks to increase and/or stabilize at some previous or unspecified level. These calculations depend on assumed pre- and post-recruit natural mortality rates, which are dependent on habitat quantity and condition in addition to seasonally varying environmental and ecological parameters.

Restoration of net yields to economic levels of social benefit requires the quantified integration of habitat and effort management. Reasons include:

1) Presently, the assumption is made that actual pre-recruit mortality rates are density independent; that there is enough essential habitat and food for additional eggs to grow without significant increase in competition and thus, increase in their mortality rate. For specific cases, this assumption may or may not be true.

2) Potential recruitment is effectively deemed by effort-management to be dependent solely on the supply of eggs, that the amount and condition of essential habitat and pre-recruit mortality rates, past, present and future, are immutable. This is obviously untrue.

3) Quantification in hierarchical, relative or absolute terms of potential change in net yields through changes in habitat quantity and condition is required for prioritization in funding and efficient planning. As these potential changes are not presently quantified, they are effectively ignored.

4) Environmental impact and cost/benefit considerations require quantified fishery input for cumulative ecosystem protection.

Challenges and Approaches

Accuracy and Precision of Estimates Incorporating Habitat Parameters - The dynamic complexity of ecosystems is well appreciated. Quantifying rates is fraught with peril. The attraction of precision must give way to the need for working estimates and improving accuracy, i.e., minimizing bias. It is to be expected that both accuracy and precision of estimates derived to quantify environmental variables and habitat productivity, would improve with time and effort applied to data collection.

Quantitative estimates based on narrow assumptions have been used with high precision and questionable accuracy in setting limits for fishing mortality and thus, for setting catch quotas. Increased data sources and analytical methodology (e.g. mandatory logbooks and virtual population analysis) have been initiated to (hopefully) bring accuracy within the range of precision of the estimates on which quotas for fishermen have been based. It is not unreasonable nor far-fetched to expect the same effective effort to be applied to habitat considerations and for valuable results to ensue.

Prioritization of Approaches - A constraint to the formation of a comprehensive and integrated program was seen in the recurring apparent need for choice of approach, between species habitat and area ecosystem. It is suggested that both should be used simultaneously and in convergence. Fish production requires both successful reproduction and adequate food-chain productivity; these share requirements of both specific habitat and area ecology.

Prioritization for species habitat should be for the essential requirements of early life stages (the most vulnerable). Area ecology should prioritize food-chain productivity. The watershed approach to area ecology is of obvious merit.

As the need of a program is for the long term, resource inventory is required. Such would include destructive and degrading vectors, chemical and physical. Prioritization for remediation would depend on estimates of quantified specific and ecological value and requirements.

Proposed Definitions - Assuming that reproduction, survival and growth requires specific types of protective habitat and food supply ecology, we may apply the word *Essential* to these habitat and ecosystem types.

Condition (rather than quality) may be applied to a quantification or ranking of the potential productive value per unit of essential habitat or system. This would reflect physical and chemical factors, wild and anthropogenic, which would directly affect growth and density-independent mortality rates.

Necessary, then, may be applied to the minimum area and condition of essential habitat and to the minimum food density required to produce a specified number of individuals of a specific life stage per time or season.

Habitat species *Capacity*, may be expressed in terms of the number of individuals at an entering stage (e.g. eggs, larvae, juveniles) that a given habitat and ecosystem will support at a specified maximum mortality rate. It is an ecological function of the quantity and condition of the essential habitat and ecology available. It is limited by high density-dependent mortality rates due to crowding and competition. Estimates of capacity would indicate the maximum number of eggs effective in maximizing recruitment and thus, provide more rational in determining catch quotas.

The apparent need to group qualities for evaluation within defined *boundaries* (such as "essential" habitat as required for species' life stages) may detract from realistic methodology. It is suggested that in such cases, quality (or value) gradients may be more useful. Thus an essential type of habitat would be graded as to it's condition.

Need for Integration: Long Island Winter Flounder (*Pleuronectes americanus*)

An array of elements relevant to the need for integrated action in fishery and habitat management are present in the inshore winter flounder fishery of Long Island, New York, and probably elsewhere along the coast. Briefly, these elements are:

1. The Winter Flounder has been a vital component of the inshore trawl fishery. It has been a mainstay of the near-shore recreational fishery.

2. Stocks are low and fishing effort regulation is quite restrictive, particularly inshore, in State waters.

3. Regulation is based on allowing an adequate egg supply for the stock to increase. Regulations are derived from analysis of data from miscellaneous sources of the coastal region, from Cape Cod to Delaware Bay.

4. Tagging data indicate that populations are predominantly local, with short, seasonal offshore migrations. These populations are subject to pre-recruit mortality rates that are dependent on the limitations of local habitat area and condition.

5. Enclosed embayments are essential for flounder spawning success. Smaller embayments are more productive per unit of area than larger ones (ASMFC 1992).

6. These same embayments and the fish larvae and food chain production dependent on their condition, are the most subject, vulnerable and sensitive to degradation from the full array of anthropogenic physical and chemical vectors, including: bulkheading, silting, toxics and excess nutrients.

7. Because of relative early maturity and limited time in the fishery, increase in flounder recruitment through habitat improvement is more effective proportionate to fishing effort reduction, than it is for other species such as striped bass and shortnose sturgeon. (Boreman in press)

8. Two local National Estuary Programs; Suffolk County Office of Ecology; NY Department of State, Division of Coastal Resources; NY Department of Environmental Conservation (DEC), and many local environmental groups are mandated or professed custodians of natural resource habitat in this area.

9. National Estuary Program guidelines provide for prioritization of attention to the requirements of valued resources (EPA 1994).

10. No action has been taken to address the Winter Flounder habitat situation. Fishing effort restriction has been the only specific action taken to realize recruitment potential.

Clearly, action to protect and improve flounder reproductive habitat is warranted and better understanding of local pre-recruit dynamics is necessary for more effective management of the fishery.

Conclusions

The need is obvious for an entity of authority (both in knowledge and executive power) to be charged with the responsibility for the planning of a fishery habitat program and for the encouragement of State and local agencies and organizations in implementation.

While the political field is different for habitat management than for fishing effort control, as the inter-state agency of coastal fishery management, the ASMFC is the logical entity to take this responsibility for the Atlantic Coast. It is essential that States, with the help of Federal agencies, be required to care for the habitats on which marine fisheries depend, as they presently are for ensuring adequate brood stocks.

It should be formally emphasized that habitat management is an inherent and integral part of fisheries management.

Literature Cited

ASMFC. 1992. Fishery management plan for inshore stocks of winter flounder. Fisheries Management Report No. 21 of the Atlantic States Marine Fishery Commission. Washington, DC. 138 p.

Boreman, J. In press. Sensitivity of North American sturgeon and paddlefish to fishing mortality. Env. Biol. Fish.

EPA. 1994. National Estuary Program Guidance: Technical Characterization in the National Estuary Program. EPA-842-B-94-006. June 1994. 46 p.

Habitat Managers Workshop

Ramada Inn - Philadelphia International Airport
June 3-6, 1996

MONDAY JUNE 3, 1996

4 p.m. - 6 p.m. **Poster Set-up**
7 p.m. - 9 p.m. **Social and Poster Viewing**

TUESDAY JUNE 4, 1996

8:30 a.m. **General Introduction**

Session 1 Overview of the Fisheries Management Process, Moderator: *Wilson Laney, USFWS*

8:45 Introduction - *Wilson Laney, USFWS*
9:00 The ASMFC Process - *John H. Dunnigan, ASMFC*
9:20 The Federal Fishery Management Council Process - *Roger Pugliese, SAFMC.*
9:40 Integration of State Fisheries and Habitat Management with the ASMFC and Fishery Management Councils - *Ken Haddad, Florida DEP Marine Research Institute*
10:00 BREAK
10:15 Review of ASMFC FMPs and their Habitat Recommendations - *Dave Stevenson, Maine DMR.*
10:35 Chesapeake Bay Program - *Nancy Butowski, Maryland DNR.*

Session 2 Existing/Creative Tools for Fisheries Habitat Management, Moderator: *Larry Hardy, NMFS*

11:00 Introduction - *Larry Hardy, NMFS.*
11:20 Use of Water Quality Standards to Protect Fish Habitat - *Ralph Abele, USFWS*
11:40 U.S. Fish and Wildlife Service - Conserving Coastal Habitats with the Coastal Wetlands Conservation Grants Program- *Keith Taniguchi, USFWS*
12:00 LUNCH
1:10 Natural Resources Damage Assessment Process and Fish Habitat Protection - *John Lindsay, NOAA*
1:30 Local Governments and Fish Habitat Protection - *Abigail Friedman, National Assoc. of Counties*

Session 3. Implications of Identifying Essential Fish Habitat, Moderator: *Lee Crockett, NOAA*

1:55 Introduction: Why Essential Habitat? - *Scott Burns, World Wildlife Fund*
2:15 Considerations for the ASMFC - *Wilson Laney, USFWS*
2:35 *BREAK*
2:50 NMFS Planning to Meet the Challenge - *Jim Burgess, NMFS*
3:10 Concerns and Implications for Essential Habitat Identification - *Angela Cristini, Ramapo College.*
4:00 - 5:30 **Social and Poster Viewing**
5:30 - 7:00 **Discussion:** Essential Fish Habitat Facilitator: *Scott Burns, WWF*

WEDNESDAY JUNE 5, 1996

Session 4 Restoration or Enhancement Projects to Benefit Fisheries, Moderator: *Ben Anderson, Delaware DNREC*

8:30 Introduction - *Garry Mayer, NMFS*
8:50 Ecological Processes and Parameters for Restoration Planning - *David J. Yozzo, US ACoE Waterways Experiment Station*
9:10 Panel: Requirements for a Successful Enhancement or Restoration Project
Seagrasses - *Robin Lewis, Lewis Environmental Services, Inc.*
9:25 Shellfish - *Mark Luckenbach, Virginia Inst. of Marine Sciences*
9:40 Anadromous Fish Habitat - *Scott Carney, PA Fish and Boat Commission*
9:55 Discussion
10:15 BREAK
10:30 Use and Management of Artificial Reefs - *Richard Christian, ASMFC*

Session 5 Linking Habitat Loss to Fisheries Impacts, Moderator: *Jennifer DiLorenzo, Office of NJ State Assemblyman Steve Corodemus*

10:50 Introduction - *Jennifer DiLorenzo, Office of NJ State Assemblyman Steve Corodemus*
11:10 Impacts to the Quantity and Quality of Fish Habitat Along the Atlantic Coast - *Fred Holland, SC DNR*
11:30 **LUNCH** — Dredging: What is the Best Approach for New Jersey? - *Steve Corodemus, New Jersey State Assemblyman*
1:00 Determining the Effects of Habitat Impacts on Fish Populations - *John Boreman, Univ of Massachusetts*
1:20 Approaches for Determining Effects of Pollution on Fish Populations in Puget Sound - *John Stein, NMFS*
1:40 Effects of Pollution on the Behavior and Subsequent Fitness of Salt Marsh Killifish - *Judith Weis, Rutgers University*
2:00 BREAK

Session 6 Review of Regional Habitat Issues Moderator: *Rob Dunlap, SC DNR*

2:15 Introduction - *Rob Dunlap, SC DNR*
2:35 Dredging Windows for Long Island Sound - *Karen Chytalo, NY DEC*
2:55 Results of Managing Agricultural Nonpoint Source Pollution in a Southeastern Estuary - *Geoff Scott, NMFS*
3:15 Regional Breakout Sessions
4:00 Development of Coastwide Priorities and Discussion of Novel Approaches

THURSDAY JUNE 6, 1996

Session 7 What Kind of Information do Habitat Managers Need? Moderator: *Chris Mantzaris, NMFS*

8:30 a.m. Introduction - *Chris Mantzaris, NMFS*
8:50 Panel: Information Needs of Habitat Managers

Art Newell, NY DEC	*Rob Dunlap, SC DNR*
Ed Bonner, US ACoE	*Dave Stevenson, Maine DMR*
Mike Street, NC DEHNR	*TBA, NMFS*

10:00 Providing Managers with the Information They Need - *Margaret Davidson, NOAA Coastal Services Center*
10:35 Overview of Habitat Assessment Techniques - *Fred Holland, SC DNR*
10:55 BREAK
11:10 Integrating Research and Management: An Example from New York - *Ken Able, Rutgers University*
11:30 National Habitat Research Needs - *Gordon Thayer, NMFS*

Session 8 Wrap-Up, Moderator: *Dianne Stephan, ASMFC*

11:50 Report of Rovers, Development of Recommendations and Future Planning

1:00 p.m. **ADJOURN**

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