Habitat Hotline Atlantic

Issues of Concern for Atlantic Marine Fish Habitat

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How are Cooling Water Intake Structures at Power Plants Impacting Fish?

Introduction

Energy concerns are fueling many issues, including development of our national energy policy, opening areas for oil and gas exploration and drilling, and competing needs for water releases at dams for spawning salmon, agriculture, and power. Energy production is of particular concern as we approach summer, a period of peak demand. In the process of generating electricity, many power plants rely on water for cooling from nearby sources such as lakes, rivers, estuaries and the ocean. Some factories and industrial facilities also withdraw water from these sources. This article focuses on the impacts to fish from cooling water intake structures used by power plants. The primary source for this article is EPA (2002b).

Cooling water intake structures are designed to supply water for a plant's cooling process and extend from the point of surface water withdraw to the intake pump. There are more than 1,200 existing U.S. plants, factories and industrial facilities withdrawing over 279 billion gallons of cooling water per day from U.S. waters (EPA 2002b). Unfortunately, water isn't the only thing that is taken into a plant's cooling water intake system. Fish eggs, larvae and juveniles and other small aquatic life get incorporated into the intake flow. Their fate is one of either impingement on parts of the cooling water intake structure or entrainment in the cooling water system.

Background

Impingement is "the entrapment of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of intake water withdrawal (EPA 2002b, p. 17130)". For example, electric power plants usually have screen meshes installed in the cooling water intake flow to prevent clogging of pumps and condensers in the plant. Fish get trapped on the screens by the force of the water passing through the structure and can suffocate because the water current prevents opening of their gill covers. Impinged fish are also subject to starvation, exhaustion and descaling. A fish impinged for a short period and removed can survive, but its protective slime and scales may be damaged through contact with screen surfaces or high pressure jets used to remove debris from the screens. Consequently, fish can experience high levels of delayed mortality following impingement.

Entrainment is "the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a cooling water system (EPA 2002b, p.17130)." Entrainment usually involves small organisms, including early life stages of fish—eggs, larvae and juveniles—that can pass through mesh screens. The early life stages of fish are particularly vulnerable to damage because of their soft tissues—bones, muscles, skin and scales are soft and offer little protection to their vital organs against thermal and mechanical stresses (EPA 2002). Once entrained, organisms can be subject to physical, thermal and toxicity stresses. Physical damage can occur as the organisms pass through the plant and make contact with internal surfaces of pipes, pumps and condensers. Thermal damage can occur from increased temperatures during passage through condensers and discharge tunnels with evidence that survivability decreases as the discharge temperature increases (EPA 2002). Toxicity damage can occur when antifouling agents such as chlorine are added.

Mortality rates for entrained fish vary by species and life stage. Even though we may not know the exact figure, we do know that mortality is high. Furthermore, organisms that survive passage through a plant can experience delayed mortality after returning to the receiving waters. Although several studies have been conducted to measure entrainment survival at specific plants, differences in sampling and the large number of variables involved make it difficult for comparison and calculation of standard survival rates.

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Fishery Concerns

Cooling water intake structures associated with power plants and other facilities can adversely impact fish and other aquatic organisms through entrainment and impingement. When considering the large amounts of water that are involved in power production (>279 billion gallons per day in the United States), this translates into a lot of fish eggs, larvae and juveniles that can be impinged or entrained.

Numbers of Impinged and Entrained Fish and Mortality Rates

Studies have shown that very large numbers of fish larvae can be entrained through a power plant and that mortality may be high. For example, an estimated 400-800 million fish larvae may have passed through the Detroit Edison plant during a 5-month period from April to August 1974 (EPA 1977). Table 1 shows a summary of impingement and entrainment data from several power plants.

Table 1. Impingement and entrainment annual fish losses at individual power plants expressed as numbers of age 1 equivalents i.e., number of individual fish that would have survived to age 1 if they had not been impinged or entrained (EPA 2002b). Values were calculated by EPA from impingement and entrainment data provided in facility monitoring reports.

Facility	Impingement (# fish/year)	Entrainment (# fish/year)
Pilgrim Nuclear Power Station located on Cape Cod Bay, Massachusetts	52,800	14.4 million
Miami Fort Power Plant located on the Ohio River	298,027	1.52 million
JR Whiting Plant located in Michigan on Lake Erie	21.5 million*	1.8 million

*This was before a deterrent net was installed in 1980 that reduced impingement by almost 90%.

Review of entrainment survival studies from different facilities shows that entrainment mortality of fish varies by species and life stage with a range from 2% (naked goby larvae) to 97% (bay anchovy larvae). Currently, EPA assumes a conservative zero entrainment survival rate with regard to regulations. (EPA 2002).

Another important factor to consider in determining the impact from impingement and entrainment is the relative abundance of species in the water source. For example, low numbers of impinged and entrained fish may reflect low abundance and not necessarily low impact. Conversely, high numbers of fish impinged or entrained could result from increases in fish abundance in the water source or indicate that a species is particularly susceptible to cooling water intake structures effects.

Impacts from impingement and entrainment can result in serious decreases in forage species as well as commercial and recreational landings. An updated analysis of entrainment at three Hudson River power plants during the 1980s "predicted year-class reductions of up to 20 percent for striped bass, 25 percent for bay anchovy, and 43 percent for Atlantic tom cod, even without assuming 100 percent mortality of entrained organisms (EPA 2002b, p. 17138)". In another example at the Brayton Point Generating Station in Massachusetts, an 87 percent reduction in finfish abundance in Mt Hope Bay occurred when the plant converted a closed recirculating cooling water system to a once through cooling system, while at the same time finfish abundance trends in adjacent areas remained stable (EPA 2002b).

Intake Location

Waterbody type is important when considering adverse impacts from cooling water intake structures. Some areas have a higher potential for adverse impacts than others. For example, estuaries and tidal rivers contain essential fish habitat (important spawning and nursery grounds) for many commercial and recreational fish species. As such, these spawning and nursery areas are likely to contain more fish eggs, larvae and juveniles, which are very susceptible to entrainment, compared to other areas i.e., freshwater rivers, lakes or reservoirs and oceans.

Adequate Data

Another concern is over adequate data. Baseline data are needed on the kinds (species), abundance, life stages and duration of all aquatic organisms occurring in areas of intake structures. Data are particularly lacking on impingement and entrainment of protected species and invertebrates (e.g., shrimp, lobsters, crabs, mussels). Additional studies to quantify impingement and entrainment are needed to provide improved mortality and survival conditions and estimates, including for forage species (previous studies have focused on key commercial and recreational species). Multi-year studies are needed to gather adequate information on annual, seasonal, and diel variations in impingement and entrainment that may relate to climate/weather differences, spawning, feeding and water column migration.

EPA relied on facility-provided biological monitoring data in their analyses to estimate impingement and entrainment impacts. Methodology for monitoring impingement and entrainment is often inconsistent among industry studies making comparison of results among facilities very difficult. Furthermore,

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a lot of industry monitoring data were collected 20 or more years ago and may not accurately reflect impingement and entrainment impacts today (both species and abundances may be different). More current studies need to be conducted with consistent methodology.

Cumulative Impacts

Fisheries managers are concerned about how to measure and address the cumulative impact on fishery stocks from multiple cooling water intake structures located on the same water bodies. Table 2 shows estimates of average annual impingement and entrainment impacts of cooling water intake structures calculated in age 1 equivalent fish for a whole waterbody including Delaware Estuary, Tampa Bay, and Brayton Point in Massachusetts. Cumulative impacts can be substantial, even when losses at individual plants seem insignificant. For example in Delaware Estuary, 44,000 age 1 equivalent weakfish were lost through entrainment at the Hope Creek plant, compared to over 2.2 million age 1 equivalents lost through entrainment in all estuarine transition zone facilities in the Delaware Estuary (EPA 2002b). An additional consideration is that some fish may be exposed to multiple impingement and entrainment stresses along their coastal migration routes.

and release program was developed whereby most of the turtles were released alive; however, 160 turtles died (EPA 2002b). Occasionally protected species are impinged at power plants in the Delaware Estuary, e.g., shortnose sturgeon, but lack of impingement and entrainment data prevent an evaluation of the potential impact from cooling water intake structures on them (EPA 2002a).

Ecosystem Impacts

Loss of aquatic organisms can have ecosystem-level effects too. Food webs can be disrupted when some species and/or life stages incur a larger mortality impact from cooling water intake structures than other species. In addition, cooling water intake structures can modify food webs by converting live organisms to organic matter thereby increasing food for scavengers and decomposers and decreasing food for consumers of living organisms. This also can lead to disruption of nutrient, carbon, and energy flows between living organisms and the physical environment. Cooling water intake structures may modify overall aquatic habitat through current modification and water withdrawl and alter species composition and biodiversity.

Table 2. Annual average cumulative impact estimates of Impingement and entrainment for an entire waterbody based on age 1 fish equivalent loss estimates (EPA 2002b).

Waterbody	Impingement (# fish/year)	Entrainment (# fish/year)
Delaware Estuary (includes 4 facilities)	> 14.3 million	> 616 million
Tampa Bay (includes 4 facilities)	> 1 million	> 19 billion
Brayton Point in Mount Hope Bay, Massachusetts	> 69,300	> 3.8 million

EPA estimates that 99% of cooling water intake structures are located within 2 miles of a waterbody that is designated as impaired (problems associated with elevated levels of nutrients, bacteria, metals, and siltation). Thus, many of the aquatic organisms subject to effects from cooling water withdrawals already live in impaired waters and may be more vulnerable to cumulative impacts. Results from an analysis-relationship of the location of cooling water intake structures suggest that intakes potentially contribute to impaired waters.

Protected Species

Some cooling water intake structures are located in areas where threatened or endangered species occur and may have adverse impacts on these protected species. For example, approximately 3,200 protected sea turtles were entrapped in cooling water intake canals at the St. Lucie Nuclear Generating Plant in Florida between 1976 and 1994. In response, a capture

Technologies for Reducing Impingement and Entrainment

Technologies are available that reduce impingement mortality and entrainment of fish life stages. For example, intake screens and passive intake systems (i.e., perforated pipes, porous dikes) work to prevent small organisms from entering the cooling water intake structure. Diversion or avoidance systems include barrier nets, aquatic filter barrier systems and water jet curtains. Fish handling systems, such as fish elevators and spray wash systems, try to maximize survival of impinged organisms by diverting organisms away from impingement or by collecting impinged organisms so they can be returned to the source water. (EPA 2001) Another available technology called dry cooling, uses very little or no cooling water intake. Dry cooling systems consist of towers in which heat from condenser tubes is transferred to air from a natural or mechanical air draft. The benefit of this technology is that it virtually eliminates impingement and entrainment, but it is much more costly than wet cooling and its efficiency may

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vary by climate and region. (EPA 2001). Under the Clean Water Act (Section 316b), EPA must ensure that the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts.

ASMFC Action

The Atlantic States Marine Fisheries Commission (ASMFC) is concerned about the effects of water impingement and entrainment from cooling water intake structures on their managed species. Many of these species, including striped bass, sturgeon, shad and river herring, are anadromous and rely heavily on rivers and estuaries along the Atlantic coast. Specifically, the ASMFC is concerned about the issue of cumulative coastwide impacts of cooling water intake facilities. For most anadromous species, impacts are compounded by multiple facilities along the coast effecting a single population.

As a result, the ASMFC formed a Power Plant Panel to conduct a coastwide assessment of the cumulative impact of power plant impingement and entrainment. The panel is focusing their initial effort as a demonstration project on Atlantic menhaden. Currently the panel has developed the methods to estimate coastwide power plant mortality rates based on coastwide loss estimates and output from coastwide VPA (virtual population analysis). The panel's next step is to determine the availability of power plant data to support the analysis.

Sources:

U.S. Environmental Protection Agency (EPA), 1977. Draft Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment: Section 316 (b) P.L. 92-500, Washington, D.C., 86 pp. [www.epa.gov/waterscience/316b/].

EPA 2001. National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities; Final Rule. Federal Register, December 18, pp. 65-65345 [www.epa.gov/waterscience/316b].

EPA, 2002. Chapter A7: Entrainment Survival In Case Study Analysis for the Proposed Section 316(b) Existing Facilities Rule (EPA-821-R-02-002), Washington, DC. February, pp. A7-1 to A7-14 [www.epa.gov/waterscience/316b].

EPA, 2002a. Chapter B3: Evaluation of I&E Data In Case Study Analysis for the Proposed Section 316(b) Existing Facilities Rule (EPA-821-R-02-002), Washington, DC. February, pp. B3-1 to B3-41 [www.epa.gov/waterscience/316b].

EPA, 2002b. National Pollutant Discharge Elimination System—Proposed Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities. Federal Register, April 9, pp. 17121-17225 [www.epa.gov/waterscience/316b].

Development of Regulations for Cooling Water Intake Structures

As a result of a court settlement, the U.S. Environmental Protection Agency (EPA) is developing regulations under section 316(b) of the Clean Water Act, 33 U.S.C Section 1326(b). Section 316(b) requires EPA to ensure that the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact. The primary impact of cooling water intake is mortality or injury to fish or other aquatic organisms that may be impinged or entrained into cooling systems. There is a great amount of interest and concern over the details of the regulations with regard to the specifics of minimizing impingement and entrainment.

In the past the Section 316(b) provision has been implemented without federal standards in place, on a site-by-site basis. Now the EPA is developing national standards in three phases: Phase I for new facilities, Phase II for existing electric generating plants that use large amounts of cooling water, and Phase III for electric generating plants that use smaller amounts of cooling water and for manufacturers. In November 2001, EPA completed Phase I and published the final rule for cooling water intake structures at new facilities (see EPA 2001). The rule applies to new electric generating plants and manufacturers that withdraw more than 2 million gallons per day (MGD) from U.S. waters, and if they use 25% or more of their intake water for cooling. New facilities with smaller cooling water intakes will continue to be regulated on a site-by-site basis.

Currently the EPA is working on Phase II and on April 9, 2002 the EPA published proposed regulations in the Federal Register (see EPA 2002a) for cooling water intake structures at existing power plant facilities that use the largest amounts of cooling water, i.e., 50 million gallons per day or more. These proposed regulations are required to establish national requirements that reflect the best technology available for minimizing adverse environmental impacts for cooling water intake structures located in distinct water body types.

The Atlantic States Marine Fisheries Commission is monitoring the EPA's development of the Section 316(b) regulations under the Clean Water Act to establish requirements for cooling water intake structures and intends to comment on the proposed Phase II regulations. For those who are interested, comments on the proposed rule for Phase II are due by July 8, 2002 and may be submitted in writing, in person or electronically. The proposed rule as well as supporting documentation and the final rule for new facilities are available at EPA's website www.epa.gov/waterscience/316b. For more technical information contact Deborah G. Nagle at (202) 566-1063. For additional economic information contact Lynne Tudor at (202) 566-1043. For additional biological information contact Dana A. Thomas at (202) 566-1046. The e-mail address for these contacts is rule316b@epa.gov.

Conferences

August 15-20, 2002, Quebec City, Canada. The **Ecological and Evolutionary Ethology of Fishes meeting** (EEEF) will hold four mini-symposiums on "Evolution of alternative reproductive strategies, The role of trophic polymorphism in the evolution of fish populations, The sensory environments and homing behavior of the larvae of coral reef fishes, and Genetic basis, architecture and determinants of fitness-related traits in fishes." Visit their Web site for more information http://www.bio.ulaval.ca/CIRSA/EEEF2002/.

August 18-22, 2002, Baltimore, Maryland. The **Fourth Fisheries Bioengineering Symposium** will be held in conjunction with the 132nd American Fisheries Society (AFS) Annual Meeting. The proceedings of the 2002 Fisheries Bioengineering Symposium will be published and is expected to include the latest research on innovative approaches to addressing issues associated with fish passage, aquaculture, and habitat restoration and enhancement. Symposium sessions include: **Advances In Fish Passage Technologies And Performance Assessment** - Downstream Passage and Water Intake Fish Protection, Biologically-Based Fish Protection: North American And Russian Perspectives, Upstream Passage, and Dam Removal; **Aquaculture** - Facility Design and Operation, Fish Health and Production, Restoration Breeding Programs, Sorting and Handling Systems, Transport Systems, Temporary Facility Design; **Habitat** - Defining Target System, Planning and Construction Processes, Measuring Habitat Restoration and Enhancement Success; and **Innovative Technologies** – Innovative Technologies for use in Fisheries Management and Research. For more information visit the AFS Bioengineering Section Web site at: http://biosys.bre.orst.edu/afseng/bes4.htm.

November 3-7, 2002, Isle of Man, United Kingdom. The **Fifth International Symposium on Flatfish Ecology** will address the role of flatfishes in benthic ecosystems under three themes (Patterns, Processes and Management). The conference sessions will be addressed by keynote speakers and summarized through discussion panels. Sessions will include: Stock structure, Larval supply, Habitat, Trophic interactions, Collapse and recovery, and Stock Enhancement. Registration details for the symposium are available at www.liv.ac.uk/peml/flatfish.

November 12-14, 2002, Tampa, Florida. **The Symposium on Effects of Fishing Activities on Benthic Habitats: Linking Geology, Biology, Socioeconomics, and Management** is being held to help ensure sustainable fisheries and healthy, diverse ecosystems by advancing the scientific knowledge available to resource managers to evaluate and appropriately manage fishing activities that affect benthic habitat. Top researchers and managers have been invited to provide a national/international overview on 14 sub-themes under four major themes of (1) Defining the Issue: Status, Management Needs, and Livelihoods (Fisheries Management Issues and Ecosystem Issues i.e., Effects of Fishing on Benthic Habitat), (2) Characterization and Understanding Natural Change, (3) Understanding the Ecological and Economic Effects of Fishing, and (4) Minimizing the Adverse Effects of Fishing on Benthic Habitat: Lessons Learned (Alternate Fishing Techniques and Policies i.e., Gear Modifications, Rotating Closures, and Marine Protected Areas). The American Fisheries Society, the Ecological Society of America, the National Oceanic and Atmospheric Administration, and the United States Geological Survey are organizing the symposium. Co-sponsors include the National Sea Grant Office and other government agencies. Symposium publications will include the meeting abstracts, and a post-meeting American Fisheries Society volume of peer reviewed papers. More information can be found on the symposium's Web site: http://walrus.wr.usgs.gov/bh2002/index.html.

U.S. Fish Stocks on a Path Toward Recovery

Stock levels for many marine fish managed by the United States are healthy and others are steadily rebuilding, according to a report released by the Commerce Department's National Oceanic and Atmospheric Administration (NOAA) – **Annual Report to Congress on the Status of U.S. Fisheries –2001**.

Fishery programs are designed to allow fishing to continue under strict regulations while the stocks grow to stable levels. The number of stocks with sustainable harvest rates rose by 45 percent between 1999 and 2001 (from 159 to 230), while those with sustainable stocks sizes increased by a third. At the same time, the number of stocks being overharvested has been reduced by 15 percent (from 77 stocks to 65), and the number of stocks deemed as overfished declined by 12 percent in 2001. Out of 959 federally managed fish stocks, there is enough data to determine the abundance of 304 species. The collective landings of the 655 species whose status is unknown represent less than one percent of all fishery landings in the United States.

Depending on the fishery, rebuilding programs may consist of a variety of management regulations that limit fishing effort, set restrictions on allowable gear, or impose minimum size limits to ensure protection of young fish that have not yet contributed to the population. These regulations may also include fishery closures during spawning seasons and in areas that are important havens for juvenile fish. NOAA Fisheries also will focus its resources on reducing harmful fishing activities to fish habitats and continue providing recommendations to other agencies for reducing harmful non-fishing activities that can lead to a decline in fish stocks. An online version of the report is available at http://www.nmfs.noaa.gov/sfa/reports.html.

Source: NOAA press release, May 1, 2002

NRC report on Effects of Trawling and Dredging on Seafloor Habitat

The National Research Council's Ocean Studies Board (OSB) recently completed an 18-month study on the effects of bottom trawling and dredging on seafloor habitats. The OSB study committee consisted of 12 international experts tasked with following: (1) summarize and evaluate existing knowledge on the effects of bottom trawling on the structure of seafloor habitats and the abundance, productivity, and diversity of bottom-dwelling species in relation to gear type and trawling method, frequency of trawling, bottom type, species, and other important characteristics; (2) summarize and evaluate knowledge about changes in seafloor habitats with trawling and cessation of trawling; (3) summarize and evaluate research on the indirect effects of bottom trawling on non-seafloor species; (4) recommend how existing information could be used more effectively in managing trawl fisheries; and (5) recommend research needed to improve understanding of the effects of bottom trawling on seafloor habitats. The National Oceanic and Atmospheric Administration provided funding for the project.

With the expansion of U.S. domestic fishing associated with passage of the Magnuson-Stevens Fishery and Conservation Act in 1976 and technological advances in gear and navigation, concern has increased over the ecological effects of fishing. In addition, overfishing and habitat loss may contribute to slow recovery of marine fish populations. The study committee found that three factors must be considered in order to assess the ecological impact of trawling and dredging: "(1) Gear-specific effects of trawling and dredging on various types of habitats. The extent of the effects depends on gear type, habitat type, depth, and the life-history characteristics of the affected species. Generally, low-mobility, long-lived species are more vulnerable to fishing gear impacts than short-lived species in environments that experience high levels of natural disturbance. (2) Fishing effort data (frequency and geographic distribution of bottom tows). The scale of ecological impacts depends on the level of fishing effort. During this study, the committee collected available effort data for all regions with significant bottom trawl or dredge fisheries. This information is presented in the report as maps and summary tables - the first time that such data has been assembled and analyzed for the entire nation. (3) The physical and biological characteristics of seafloor habitats. The largest information deficit identified by the committee is the distribution of habitat types in trawled or dredged areas. For the most part, only coarse maps are available on habitat distribution."

A major conclusion of the committee is that currently available data can be better used to implement effective fishery management measures that reduce impact to the sea floor. The committee finds no evidence to support that trawling increases the overall productivity of seafloor communities. In addition, the committee finds that analysis of trawling and dredging effort data is currently limited by low spatial resolution and regional variation in reporting methods. Standardization of effort reporting is strongly supported.

The committee affirmed that trawling could be destructive in ecologically vulnerable habitats. However, based on small-scale studies of experimentally trawled sites, they also found that some habitats are resilient to the effects of trawling, e.g., sandy habitats in areas that experience naturally high levels of disturbance. In any case, the committee concludes that evaluation of the potential ecosystem-wide impacts of trawling requires examination of how often and to what geographic extent trawling and dredging occur in different types of marine habitats.

A brief summary of the committee's recommendations are as follows:

- Lack of detailed, location-specific studies should not be used to justify inaction on habitat protection.
- Generalized results of the body of research on the effects of mobile bottom gear should be used to evaluate the potential impacts on fish habitat until more region-specific studies become available.
- Management measures - effort reductions, area closures, and gear modifications - should be tailored to the specific characteristics of the fishery and habitat.
- Comparative risk assessment is an appropriate tool when insufficient information is available for a quantitative analysis.
- Efforts to reduce the impacts of bottom fishing could be facilitated by establishment of guidelines for designating essential fish habitat (EFH) and habitat areas of particular concern (HAPC) based on standardized, ecological criteria and development of a national habitat classification system.

A prepublication version of the report is available for online viewing at http://www.nap.edu/books/0309083400/html. The final version of the report is forthcoming and expected in May 2002.

Source: OSB Web site– see Report Highlights under "publications" at www4.nationalacademies.org/dels/osb.nsf.

Effects of Fishing Gear on Northeast Marine Habitats

The Workshop on the Effects of Fishing Gear on Marine Habitats off the Northeastern United States was held October 23-25, 2001 in Boston, Massachusetts and was sponsored by the National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NMFS), New England Fishery Management Council and Mid-Atlantic Fishery Management Council.

A panel of experts from the fields of fishery ecology, benthic ecology, fishing gear technology, fisheries gear operations, and geology participated in the workshop. The panel's purpose was to "assist the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC) and NMFS with: 1) evaluating the existing scientific research on the effects of fishing gear on benthic habitats; 2) determining the degree of impact from various gear types on benthic habitats in the Northeast; 3) specifying the type of evidence that is available to support the conclusions made about the degree of impact; 4) ranking the relative importance of gear impacts on various habitat types; and 5) providing recommendations on measures to minimize those adverse impacts."

The scope of the workshop covered the geographic area from Maine through North Carolina with a focus on gear types that are federally managed (with the exception that lobster pots were included) and on impacts to benthic habitats. Effects of fishing on exploited populations were not included. Categories of gear types that were evaluated include: (1) Bottom-tending Static Fishing Gear (pots and traps, sink gill nets, bottom long lines), (2) Bottom-tending Mobile Fishing Gear (clam dredges, otter trawls, sea scallop dredges, beam trawls), and (3) Pelagic Fishing Gears (Static and Mobile).

Throughout the workshop, the panel stressed consideration of three management measures to protect habitat from gear impacts: 1) effort reduction, 2) spatial closures, and 3) gear modification.

Panel recommendations include using spatial closures to protect critical and/or vulnerable habitat areas as an important tool to minimize gear impacts on habitat; mapping habitats in the Northeast region beginning with the most critical; collecting and mapping effort data for the various fishing fleets, especially otter trawls and clam dredges; reducing effort for many overexploited species to aid habitat protection; continuing efforts on gear research and modification; improving law enforcement for current and any future closed areas; and providing funding to support additional research that would address information deficiencies identified in this workshop. The workshop report, prepared by the Northeast Region Essential Fish Habitat Steering Committee, is available at http://www.nefsc.nmfs.gov/nefsc/publications/crd/crd0201/.

*Source: Northeast Fisheries Science Center Reference Document 02-01 - **Workshop on the Effects of Fishing Gear on Marine Habitats off the Northeastern United States, October 23-25, 2001, Boston, Massachusetts**. By Northeast Region Essential Fish Habitat Steering Committee. Posted on the web March 22, 2002.*

North Atlantic Food Fish Catches Declined by Half While Fishing Effort Tripled

An international group of leading fisheries scientists released the results of the first ever ocean-wide synthesis of the status of fisheries in the North Atlantic at the February 2002 meeting of the American Association of the Advancement of Science held in Boston. The scientists presented a new portrait of the state of the fisheries which shows that over the last fifty years, the catch of our preferred food fish species such as cod, tuna, haddock, flounder and hake, has decreased by more than half despite a tripling in fishing effort. The researchers' comprehensive analysis of the state of the North Atlantic also examines the gross economic figures as well as the fisheries subsidies and fuel consumed in search of fish. Fishers burn more and more fuel as they increase their efforts competing to capture the last of the dwindling resources.

"The necessary next steps are substantial reduction of fishing fleets, reduction and eventual abolition of subsidies to industrial fisheries, and unavoidably, the establishment of networks of "no-take" marine reserves: to replenish the oceans' depleted resources and to restore productivity," says Pauly. "In order to restore productivity to a fishery, the broader ecosystem with its many parts needs to be conserved."

The study is part of the *Sea Around Us Project*, a two year, $3 million (Canadian dollars), pilot project to evaluate the impact that fisheries have had on the North Atlantic. This represents the first time that detailed studies of this kind have been conducted on an ocean basin scale. The *Sea Around Us Project* is sponsored by the Pew Charitable Trusts, based in Philadelphia, USA and is being conducted by fishery scientists at the University of British Columbia Fisheries Centre in partnership with a global network of scientists providing data, evaluation and peer review. The project aims to collate and analyze catch and ecosystem information using analytical tools being developed at the Fisheries Centre. Specific objectives are to develop a catch and effort information system for each ecosystem, define biological and economic impacts, synthesize results, and draft appropriate management measures to reestablish or sustain a healthy ecosystem. More information about the *Sea Around Us Project* is available at www.fisheries.ubc.ca/Projects/SAUP/index.htm.

Sources: SeaWeb press release Feb 16, 2002 (www.seaweb.org/AAAS2002) and Sea Around Us Project Web site (www.fisheries.ubc.ca/Projects/SAUP/index.htm).

Final Rule for Essential Fish Habitat Published

The National Marine Fisheries Service (NOAA fisheries) published final regulations implementing the essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act, on January 17, 2002 in the Federal Register. The regulations provide guidelines for fishery management councils to identify and conserve necessary habitats for fish as part of federal fishery management plans. The regulations also establish coordination and consultation procedures to be used by NOAA Fisheries and other federal agencies to protect habitats identified as EFH.

The final rule replaces an interim final rule that has been in effect since January 1998. NOAA Fisheries held five separate public comment periods while developing the regulations, and held more than 20 public meetings and workshops.

The revised regulations provide clearer standards for the councils to use in identifying EFH, additional guidance to help councils evaluate whether fishing activities may adversely affect EFH, and clearer procedures for federal agency consultations with NOAA Fisheries on actions that may impact EFH.

Congress added the EFH provisions to the Magnuson-Stevens Act in 1996. The eight regional fishery management councils and NOAA Fisheries subsequently identified EFH using the best scientific information available for each of the species managed under 41 fishery management plans across the nation. The councils and NOAA Fisheries will use the final rule to revise and refine the EFH designations as additional information becomes available regarding the habitat requirements of federally managed fish species. The final rule will also guide the designation of EFH for species managed through any new fishery management plans.

The Magnuson-Stevens Act requires the councils and NOAA Fisheries to minimize to the extent practicable adverse effects of fishing on EFH, and identify other actions to conserve and enhance EFH. Federal agencies that authorize, fund, or undertake actions that may adversely affect EFH must consult with the secretary of commerce, through NOAA Fisheries, regarding potential effects to EFH, and NOAA Fisheries must provide conservation recommendations.

The final rule is available at www.nmfs.noaa.gov/habitat/habitatprotection/essentialfishhabitat.htm.

Source: NOAA press release, January 15, 2002.

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