Summer | 10

POLICY ANALYSIS OF H.R. 4715, THE CLEAN ESTUARIES ACT OF 2010

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CONTENTS

THE CLEAN ESTUARIES ACT OF 2010

EXECUTIVE SUMMARY

The Clean Estuaries Act of 2010, H.R. 4715, reauthorizes the National Estuary Program (NEP) of 1987 (Section 320), which is an amendment to the Clean Water Act of 1977. The purpose of the Clean Water Act is to protect the integrity of the nation's water bodies. The Clean Estuaries Act extends this statute to estuaries. The NEP is comprised of 28 member estuaries that are deemed to be nationally significant.

An estuary is an area where fresh surface water or groundwater meets and combines with salt water from the ocean. Estuaries are an important breeding ground for countless species of marine life and are fundamental to the fishing industry. Historically, humans have settled around estuaries, adding to their cultural significance. Human activities have affected the health of our national estuaries through pollution, overdevelopment, and overuse. The NEP is designed to restore and sustain these important ecosystems.

HR 4715 passed in the US House of Representatives on April 15, 2010. The Act included a substantial funding increase from $35 million to $50 million annually for the NEP. Five days later, an explosion on the Deepwater Horizon oil rig marked the beginning of the disastrous oil spill in the Gulf of Mexico, affecting several of our nation's estuaries, including the Barataria-Terrebonne estuarine complex. Since the spill, The Clean Estuaries Act has been read twice and referred to committee in the US Senate. The Senate Committee on Environment and Public Works amended the bill with a funding increase to $75 million annually (SachemPatch).

This report will address the importance of estuaries, how the Act supports sustainable management of estuaries, and the challenges to implementation. The report illustrates these key points with examples from two member estuaries of the NEP – the New York-New Jersey Harbor Estuary and the Barataria-Terrebonne estuarine complex located on the Gulf of Mexico.

Photo Credit: Barataria-Terrebonne National Estuary Program

IMPORTANCE OF ESTUARIES

ECOLOGIC

Estuaries are highly productive ecosystems. The combination of fresh water and saltwater creates a unique habitat for diverse terrestrial and aquatic organisms. Estuaries function as water filtration systems, coastal buffers against storms, and prevent flooding and erosion. Degradation of estuaries negatively affects all species within them, and the economic, social, and cultural assets of the estuary are dependent on its ecological state.

ECONOMIC

Estuarine ecosystems have significant commercial value. They provide habitat for 75% of American commercial fish and shellfish catch. The annual revenue of the fishing industry is $185 billion. (U.S. House Committee on Transportation and Infrastructure). Although estuarine counties occupy only 13% of the US land area, they account for 49% of the Gross Domestic Product and support roughly 28 million jobs (U.S. House Committee on Transportation and Infrastructure). Estuaries also house ports and marinas that serve as hubs for shipping and industry. Recreational fishing generates up to $26 billion annually and estuaries provide up to 90% of the recreational fish catch (U.S. House Committee on Transportation and Infrastructure).

SOCIAL AND CULTURAL

Estuaries are centers for important leisure outlets such as boating, swimming, bird watching and recreational fishing. They provide staple foods in regional diet and are also important hubs for many Native American communities.

Photo Credit: Coastal Conservation Association (US EPA, Office of Wetlands, Oceans and Watersheds,Coastal Management Branch)

SUMMARY OF THE CLEAN ESTUARIES ACT OF 2010

OVERVIEW

The Clean Estuaries Act of 2010:

- Extends the National Estuaries Program until 2016 ;
- Increases funding for the program from $38 to $75 million annually;
- Outlines a new process for evaluation, response, and approval of each member estuary's Comprehensive Conservation and Management Plan (CCMP) ;
- Increases collaboration between federal agencies, management conferences, and stakeholders;
- Requires the Environmental Protection Agency to evaluate the National Estuaries Program; and
- Redefines the term "estuary" within the scope of this legislation to include near coastal waters within the Great Lakes and other water bodies that have a similar function to marine estuaries (The Clean Estuaries Act of 2010).

FUNDING

The proposed legislation includes a significant annual funding increase from $35 million to a recently amended amount of $75 million. The allocations of annual funding are illustrated below in Table 1.

TABLE 1: ALLOCATIONS OF THE CLEAN ESTUARIES ACT OF 2010

Up to 10% for administration of the National Estuaries Program	$7.5 million
At least $1,875,000/yr to each Management Conference for development, implementation, and monitoring of their CCMP (28 Estuaries * $1,875,000)	$52.5 million
Research	$ 5 million
EPA Monitoring/Implementation, and Discretionary Grants	$10 million
Total	**$75 million**

COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN (CCMP)

PURPOSE

Each Management Conference in the National Estuaries Program must develop and submit a CCMP to the EPA that identifies the estuary's watershed boundaries and recommends corrective actions for environmental problems. The goal of the CCMP is to "restore and maintain chemical, physical, and biological integrity of the estuary (The Clean Estuaries Act of 2010)." The Clean Estuaries Act of 2010 requires that each CCMP include plans for sustainable commercial activities, mitigation of the impacts of climate change, and public education initiatives. The Act requires that Management Conferences have measurable restoration goals and monitor the effectiveness of the CCMP in achieving these goals.

EVALUATION OF THE CCMP

The Act outlines new measures for evaluating each estuary's CCMP. Every four years after this law goes into effect, the EPA must evaluate each CCMP and submit the evaluation to the Management Conference for review. Each evaluation must be available to the public. The Management Conference must submit an update of the plan in response to the evaluation within eighteen months. The EPA determines whether to reapprove the plan within 120 days of this submission. If the updated plan is not approved by the deadline (three years from the date the EPA makes the evaluation available to the public for review and comment), the EPA has the authority to place the Management Conference on probation. If the program is on probation for two consecutive years, the EPA can terminate the Management Conference, at which point the EPA would take control.

COLLABORATION OF STAKEHOLDERS

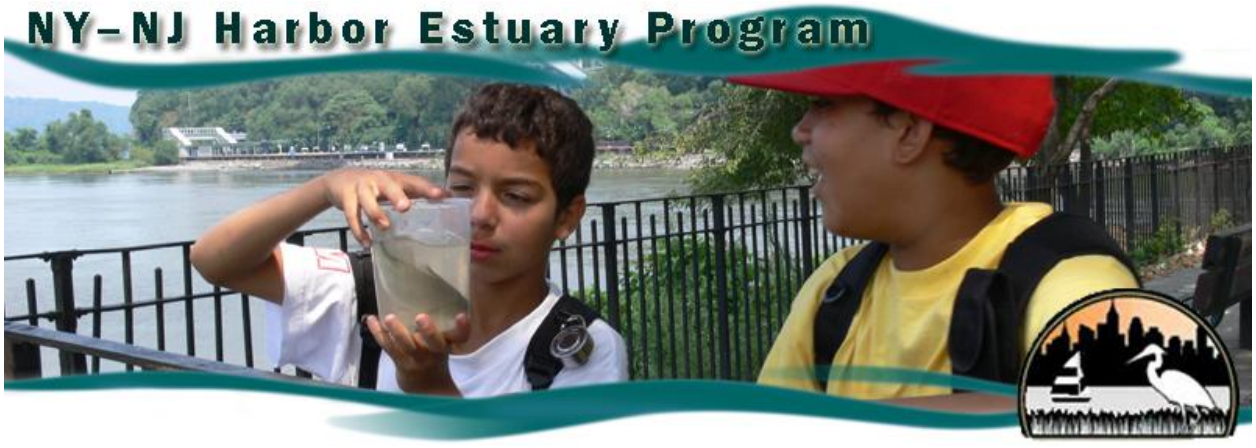
The Clean Estuaries Act of 2010 promotes collaboration between management conferences, government agencies, nonprofit organizations, watershed stakeholders, and the general public. H.R. 4715:

- Includes nonprofit organizations as eligible members of management conferences;
- Requires that data related to the member estuary are made available to all involved parties;
- Requires federal agencies to cooperate with the Management Conference in any activities affecting the estuary and consider the CCMP in their annual budgets; and
- Mandates collaboration between federal agencies and the Management Conference in developing tools and methods to improve the ecological health and water quality of each estuary.

EVALUATION OF THE NATIONAL ESTUARIES PROGRAM (NEP)

The EPA Administrator is required to issue a publicly accessible report evaluating the effectiveness of the NEP and identify best management practices for in improving water quality, natural resources, and sustainable use of the estuaries.

Pictured: Children with a striped bass benefit from the New-York New-Jersey Harbor Estuary public education program (New York-New Jersey Harbor Estuary Program) http://www.harborestuary.org/resources.htmhttp://www.harborestuary.org/resources.htm



ENVIRONMENTAL PROBLEMS FACING ESTUARIES

In order to sustainably manage estuaries, it is necessary to understand the complex problems that develop in these unique ecosystems. The principal environmental problems facing the nation's estuaries are:

- **Water quality degradation;**
- **Biodiversity loss; and**
- **Impacts of global climate change.**

Each of these problems will be discussed in further detail in the following sections.

WATER QUALITY DEGRADATION

Estuaries act as water filters between the land and ocean; when they are overloaded with contaminants, water quality declines. Specialized estuarine plants filter pollutants from the water and store them in their roots, which improves water quality. However, the pollutants may reenter the water or food chain when the plant's leaves are ingested or biodegrade (Oberrecht).

Pollutants can enter the ecosystem in two ways: through point source or nonpoint source pollution. Point source pollution comes from a single identifiable source: usually a drainage pipe or sewer line. Nonpoint source pollution comes from contaminants that are widely distributed throughout the environment. Improper training, poor maintenance, or inadequate storage often results in discharge of pollutants into the waterway.

The three main types of pollutants that affect estuaries are excess nutrients, pathogens, and toxic chemicals. Though all of these components exist in nature to some degree, human activity has greatly increased their occurrence and concentration.

NUTRIENT OVERLOAD

One of the most common problems associated with nutrient overload in estuaries is eutrophication, the process by which excessive nutrients, especially nitrogen and phosphorus, inundate bodies of water (Groffman). Humans can cause eutrophication through sewage discharge and runoff from agricultural fertilizer (Manahan). This results in an overgrowth of plants, phytoplankton, and algae that inhibits the penetration of sunlight. The overgrowth depletes oxygen levels, resulting in dead zones, where other marine species are unable to survive. In 2007, scientists from the National Oceanic and Atmospheric Administration (NOAA) determined that 65% of the estuaries observed in the U.S. showed moderate to high-levels of eutrophication (Bricker).

PATHOGENS

Pathogens are bacteria, viruses, or other disease-causing microorganisms found in the fecal waste of humans and animals. Pathogens typically enter waterways from public sewage or livestock runoff. Common pathogens found in contaminated waters include Escherichia coli, Cryptosporidium species, and Giardia species. Their presence in drinking water and recreational swimming areas can lead to public health concerns, closures of commercial fisheries, and decreased recreational activities.

TOXIC CHEMICALS

Toxic contaminants present serious threats to human and ecological health. They come from a variety of sources: hazardous waste sites, illegal dumping of commercial or industrial waste, pesticide and herbicide runoff, petroleum release, and airborne particles. Many toxic substances, such as polychlorinated biphenyls (PCBs), are suspected of causing cancer (ToxFAQs. Polychlorinated Biphenyls (PCBs)). Others may affect reproduction rates in both humans and animals. Toxic chemicals that bioaccumulate in the food chain are a risk for human consumption. Toxic chemicals also poison plants, fish, and other wildlife. Cleanup efforts are often extremely difficult and costly.

BIODIVERSITY LOSS

Estuaries are home to a vast array of birds, mammals, fish, reptiles, insects and plants. Many are specialized for a particular level of salinity and placement within the estuary. Slight changes in the ecosystem can have substantial consequences. When invasive species are introduced to a new area, they often thrive unchecked and can outcompete native species, leading to population decline or even extinction.

IMPACTS OF CLIMATE CHANGE

The Clean Estuaries Act of 2010 specifically addresses the importance of preparing for the effects of climate change in the CCMPs. According to the Climate Change Science Program, sea level is projected to rise between 0.18–0.59 meters by 2100 (Julius). (These estimates do not take changes in the Greenland and Antarctic ice shelves into account, which could lead to rises of up to 1 meter.) Sea level increases could lead to land loss by inundation and erosion, removal of natural material from beaches, and increased flood events. Increased temperatures may lead to altered species distributions and interactions, increased microbial metabolic rates, and alternative reproductive and migration timing (Julius). Increases in atmospheric CO_2 will lead to acidification of the oceans and waterways, reduced photosynthesis rates, and changes in water chemistry.

FIGURE 1: CHANGES IN SEA LEVEL, BATTERY TIDE GAUGE, NEW YORK, NY

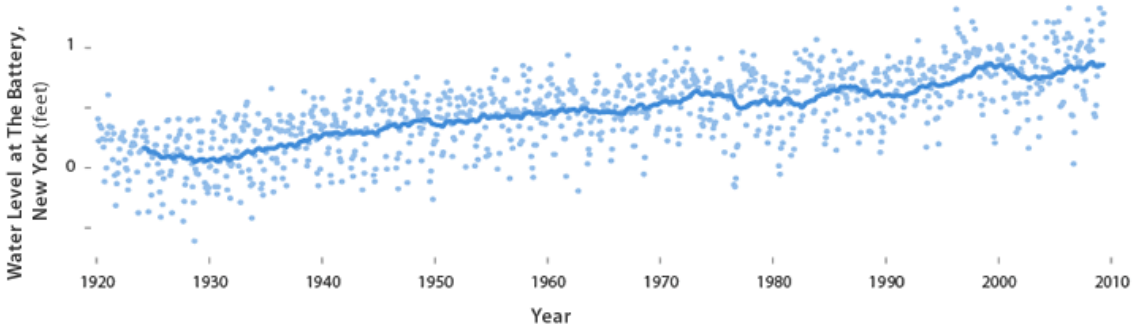


Figure 1: Sea level has exhibited a positive trend during the twentieth century in the New York Harbor, NOAA Climate Services. Each dot represents a monthly average while the solid line shows the overall trend (Dahlem).

A TALE OF TWO ESTUARIES

CASE STUDY

The New York-New Jersey Harbor Estuary and the Barataria-Terrebonne Estuary are both members of the National Estuaries Program. However, they are in two very different environments: the New York-New Jersey is in a metropolitan area on the Atlantic coast, while the Barataria-Terrebonne is a complex salt-marsh wetland off the Gulf of Mexico. Both member estuaries are led by a Management Conference responsible for maintaining and restoring the estuary through the development of a Comprehensive Conservation and Management Plan. This case study gives examples of environmental problems for each.

Photo Courtesy of Clayton Winter

NEW YORK –NEW JERSEY HARBOR

- Combined sewer overflow (CSO) occurs when public water systems are inundated during heavy rains. Waste management officials have no choice but to allow the combined untreated sewage and rain flow directly into the harbor (NYC Environmental Protection).
- Floatable debris, including waste material, threatens indigenous species, causing habitat degradation (New York-New Jersey Harbor Estuary Program).
- Management of fisheries is a priority due to reduced commercial landings from 317,000 metric tons in 1957, to 72,600 metric tons in 1987 (New York-New Jersey Harbor National Estuary Program).
- Diking, impoundment, and channelization are key threats (New York-New Jersey Harbor Estuary Program).

Photo Courtesy of Wetland Wiki
www.wetlandresearch.com/wiki/index.php?title=Louisiana

BARATARIA-TERREBONNE

- Land subsidence and salt water intrusion resulting in the loss of 25 square miles of wetlands per year (Schultz).
- Fecal coliform is a human health threat in 18 out of 27 assessed water bodies in the Barataria basin and in 33 out of 55 in the Terrebonne basin (The Estuary Compact).
- Agricultural runoff causes eutrophication and dead zones where no life can be sustained. The dead zone in the Gulf of Mexico is now estimated to be between 6,500 and 7,800 square miles, roughly the size of New Jersey (Flesher).
- Levees and dams build along the Mississippi have altered the flow and deposition of sediment, resulting in declining wetlands and habitat loss (Issues facing the Barataria-Terrebonne).

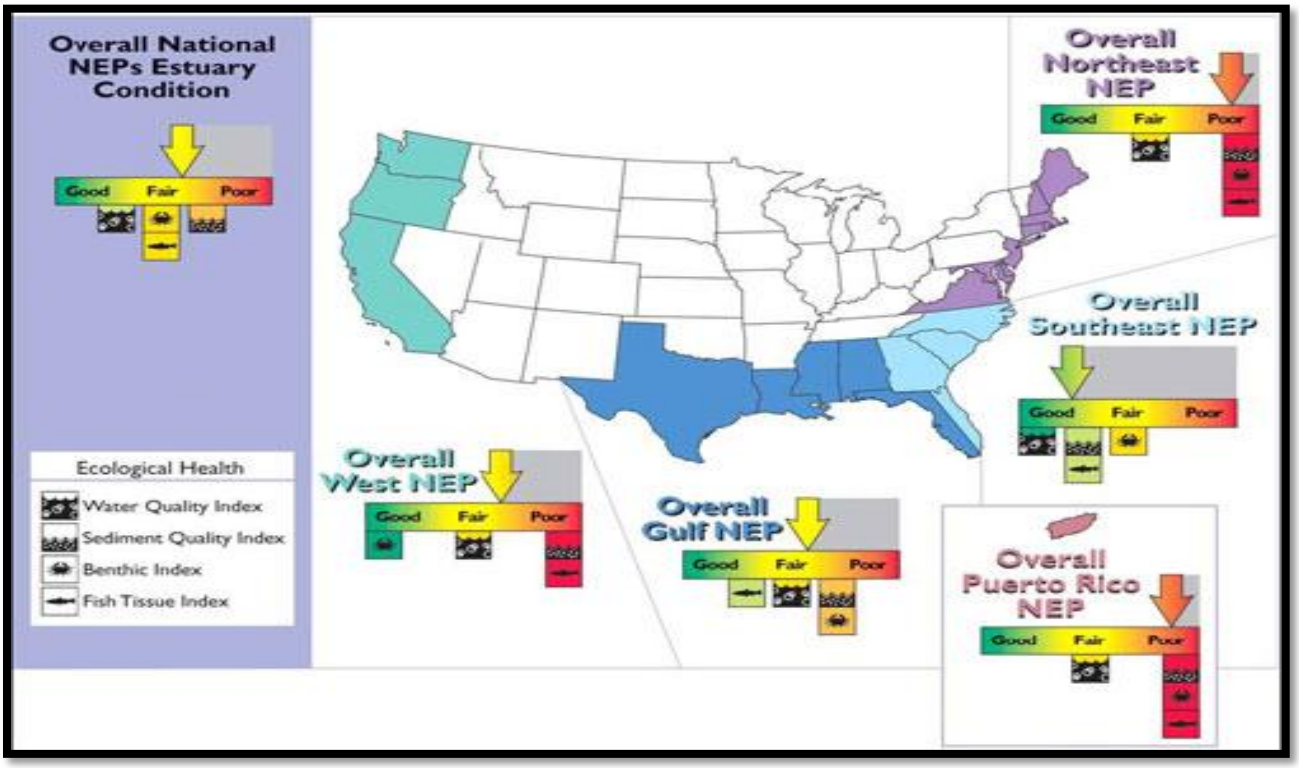
NEED FOR GOVERNMENT ACTION

The National Coastal Condition Report III of 2008 concluded that 30% of U.S. coastal areas are in poor condition (U.S. House Committee on Transportation and Infrastructure). The National Estuary Program has promoted restoration and maintenance of estuaries since its inception in 1987. The Clean Estuaries Act of 2010 builds upon the success of the National Estuary Program, and addresses the perceived weaknesses in the current law by requiring enhanced monitoring and evaluation of progress. This Act seeks to upgrade conservation strategies and improve program management.

From 2003 through 2009, estuaries in the program leveraged $1.98 billion through multi-sectoral funding and contributions from only $140 million in grants (Estuaries.Gov). With the increased funding package in the legislation, estuaries will have increased leveraging power, enhancing their capacity to implement costly, large-scale restoration strategies.

Finally, 38 additional estuaries have expressed interest in being included in the National Estuary Program. Increasing funding from $35 million to $75 million annually will enable the Environmental Protection Agency to add 12 new estuaries to the program, expanding the scope of estuary protection across the country (Estuaries.Gov).

Figure 2: Overall NEP Estuary Condition. Refer to the Target Ecosystems Case Study for more information on the estuaries' ecological health indices (United States Environmental Protection Agency) http://water.epa.gov/type/oceb/nep/nepccr-factsheet.cfm .



POLITICAL DEBATE SURROUNDING THE ENVIRONMENTAL PROBLEM

Rep. Timothy Bishop (D-NY) co-sponsored the Clean Estuaries Act of 2010 with Frank LoBiondo, (R-NJ). Proponents of the Act relied on economic considerations as evidence of the need for an extension of the Program and an increase in funding. They also emphasized the success of the multi-stakeholder framework that guides the Program, and championed the locally-based program management.

There was a general consensus on the nature of the environmental problem, but political debate focused on the appropriate response. Virginia Foxx (R-NC) argued that the 43% increase in funding that this act would bring is inappropriate given the current national deficit of $12.8 trillion. Foxx also cited a watchdog for federal government program performance, ExpectMore.gov, which describes the National Estuary Program's performance as merely 'adequate' (H.R. 4715). She criticizes the Act's strategy, unconvinced that increased funding will improve the Program's performance. Instead, Foxx argues for structural reform and more ambitious goals, without the dramatic increase in funding.

H.R. 4715 passed in the House of Representatives on April 15, 2010 with 278 votes for and 128 against.

SUPPORTING SUSTAINABLE MANAGEMENT

The Clean Estuaries Act of 2010 will support sustainable management of the existing National Estuaries Program primarily by improving the effectiveness of the CCMPs. The Act supports Management Conferences by requiring that federal agencies adhere to the goals of the CCMP in any actions affecting the estuary. In addition, the Act:

- Expands the implementation requirements of the CCMP;
- Increases collaborative processes and stakeholder participation ;
- Increases accountability;
- Requires measurable goals; and
- Increases funding.

EXPANDING IMPLEMENTATION OF THE CCMP

This solution is designed to expand the scope of CCMPs in the program. If the Act passes, updated CCMPs must:

- Identify the estuary boundaries and associated upstream waters ;
- Recommend and prioritize corrective actions and compliance schedules;
- Consider sustainable commercial activities;
- Address the impacts of climate change;
- Increase public education and awareness;
- Identify and assess upstream impairments;
- Include performance measures and goals;
- Include a coordinated monitoring strategy;
- Monitor and make results available to the public; and
- Track the introduction of non-native species.

COLLABORATIVE PROCESSES

The Act opens membership in the Management Conferences to non-profit organizations, and increased inclusion in the restoration plans will encourage participation from all stakeholders. Increased collaboration among stakeholders ensures that the management conferences are effective and inclusive. The Act encourages the participation of multi-level stakeholders in estuary management through:

- Equal access to information;
- Consensus-based rules and assistance from impartial facilitators;
- Promotion of accountability and transparency;
- Identification of roles and responsibilities of members ; and
- Conflict resolution.

INCREASED ACCOUNTABILITY

Increased accountability of the program at the national and regional level is one of the strengths of the legislation. The Act establishes a continuous four-year evaluation cycle by the EPA that will ensure that Management Conferences take a goal-oriented approach to implementing the CCMPs.

MEASURABLE GOALS

The National Estuaries Program currently includes monitoring requirements for CCMPs, but The Clean Estuaries Act of 2010 requires measurable performance goals. Setting specific measurable goals ensures that Management Conferences are focused on both quantitative and qualitative improvements to their estuaries.

INCREASED FUNDING

The increase of funding from $35 to $75 million enhances the Management Conferences' ability to meet specified requirements and achieve desired habitat and water quality goals. While Estuary's budgets have remained unchanged, the costs of materials and labor have risen. This new legislation attempts to provide adequate financial resources. In 1996, the estimated cost of the core program of the HEP management conference was $690,000 annually, but commitments to the program only reached $300,000 (New York-New Jersey Harbor National Estuary Program). The increase in funding will allow for $1.875 million for each estuary if the authorized funds are appropriated and distributed evenly. However, there are often discrepancies between the authorization and the distribution of funds in Congress.

THE NEW YORK-NEW JERSEY HARBOR ESTUARY PROGRAM (HEP)

A CASE STUDY

The Hudson Estuary Program is best described as an umbrella organization that plans, manages, and guides diverse groups from the New York Harbor region toward the common goal of estuarine health and improvement (New York-New Jersey Harbor Estuary Program). With a full-time staff of only three members, the HEP is run by a part-time Management Conference that generally meets on a quarterly basis. This conference is composed of individuals from a wide variety of federal, state, and local agencies, as well as private and non-profit organizations. Each brings a unique viewpoint and set of interests. Through collaboration, the committee builds a consensus on appropriate priorities, initiatives, and expenditures.

The HEP receives input from various sub-committees, including the Restoration, Nutrients, Pathogens, Toxics, Oversight, Public Access, Harbor Herons, Regional Sediment Management, and Citizens Advisory Committees. All actions of the program are overseen and approved by the HEP Policy Committee. This executive committee is chaired by the regional director of the EPA, and includes the directors or administrators from involved federal, state, and local agencies. Recent actions and collaborations include:

- Restoration work on the Saw Mill River , in collaboration with Groundwork Hudson Valley and the Saw Miller River Coalition;
- Identifying water quality degradation issues from tributaries feeding the estuary, in collaboration with the New Jersey Harbor Dischargers Group, NYCDEP, and the New England Interstate Water Pollution Commission; and
- A public access initiative for kayaking and canoeing in the estuary, in collaboration with the Sebago Canoe Club and the Citizens for Jamaica Bay.

The Clean Estuaries Act of 2010 may increase regulation of the NY/NJ HEP, but it does not indicate any major changes to current practices. The current CCMP (from 1996) will now be updated and evaluated every four years, and the effects of climate change are an emerging issue that the management committee will have to consider. However, due to the HEP's historically proactive nature, the primary benefit of the Act appears to be a much-needed increase in funding.

MEMBERS OF THE HEP MANAGEMENT CONFERENCE

THE ENVIRONMENTAL PROTECTION AGENCY

THE DEPARTMENT OF THE INTERIOR

THE ARMY CORPS OF ENGINEERS

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION AND DEPARTMENT OF STATE

NEW JERSEY AND NEW YORK CITY DEPARTMENTS OF ENVIRONMENTAL PROTECTION AND HARBOR DISCHARGERS GROUP

THE NEW YORK-NEW JERSEY PORT AUTHORITY

THE CITIZENS ADVISORY COMMITTEE

THE SCIENCE AND TECHNOLOGY COMMITTEE

PRIORITIES OF THE NY/NJ HEP ACTION PLAN OF 2008

Clean up pollution in the estuary

Improve habitat and ecological health

Improve public access to the estuary

Support an economically and ecologically viable estuary and port

Public education and community involvement

THE SCIENCE BEHIND ESTUARY MANAGEMENT

The proposed solutions for restoration and remediation of US estuaries are multi-faceted. This section gives specific examples of remediation approaches, with an emphasis on the New York-New Jersey Harbor Estuary.

MANAGEMENT OF WASTEWATER POLLUTION

The two primary sources of wastewater pollution in estuaries are point sources of untreated municipal sewage and combined sewage overflow (CSO). New York City addressed the problem of untreated municipal sewage by building sewage treatment facilities (Brosnan and O'Shea). Dissolved oxygen content at the New-York New-Jersey Estuary increased substantially as sewage treatment became effective (See "Measuring the Program's Success" for more information on dissolved oxygen content.) One possible solution for CSO is the construction of overflow storage units that hold combined flow until treatment facilities are ready to treat the water stored in the tanks. Small-scale projects—e.g., maintaining green spaces and green rooftops, and increasing porous paving materials in urban environments—may also alleviate the CSO issue (Montalto, Behr and Alfredo).

DREDGING HEAVY METALS AND PCBS

Dredging is a possible solution for removing pollutants from an estuary. Sediment is treated and then relocated to a disposal site. Dredging the Hudson River reduced cadmium levels at a site upriver of the New York-New Jersey Estuary (Mackie, Natali and Levinton). Unfortunately, after dredging the Hudson River to remove heavy metals and polychlorinated biphenyls (PCBs), increased contamination levels were reported in fish around the site of dredging (Richter, Kane and Skinner). This issue is discussed in more detail in "Controversies within the Science of Problems and Solutions."

TRACKING INVASIVE SPECIES

The estuaries in the program are home to a great number of invasive species that compete with native plants and animals for resources. The New York-New Jersey Estuary is home to dozens of problematic non-native plant species including: *Trapa natans* (water chestnut), *Phragmites australis* (common reed), *Lythrum salicaria* (purple loosestrife) (Laba, Downs and Smith). It is also home to many non-native animal species such as: *Dreissena polymorpha* (zebra mussel), various *Orconectes* species (crayfish), and *Oncorhynchus mykiss* (rainbow trout) (Mills, Scheuerell and Strayer). Recent research in the estuary has focused on using satellite imagery to map the invasive species (Laba, Downs and Smith). Mapping reveals the species location and allows managers to examine distribution patterns that provide more information about their behavior, enhancing their ability to control the species (Laba, Downs and Smith).

NON-POINT SOURCE AGRICULTURAL POLLUTION REDUCTION

Several sustainable farming practices have been shown to reduce pesticide and nutrient runoff (Kay, Edwards and Foulger). One example is the practice of Integrated Pest Management (IPM) which has shown potential to reduce the need for pesticide-intensive farming. Another example is the establishment and maintenance of ecological buffer strips can provide protection from the effects of pollutants. Buffer strips are either naturally or artificially maintained ecosystems that absorb pollutants from runoff and act as a buffer between the agricultural system and the natural environment.

CONTROVERSY WITHIN THE SCIENCE OF PROBLEMS AND SOLUTIONS

Controversies related to the science of solutions in the National Estuaries Program can be illustrated by three examples from the New York-New Jersey Harbor Estuary Program: nutrient removal in wastewater treatment, dredging, and the reestablishment of oyster populations.

The effects of climate change are also briefly addressed in this section; however, it is difficult to predict how Management Conferences will plan for these effects because this is a new addition to the Clean Estuaries Act.

NUTRIENT REMOVAL FROM WASTEWATER

Nutrient removal would result in greater dissolved oxygen content in the water, increased biodiversity, and better water quality. However, the processes used for nutrient removal could increase greenhouse gas emissions and have a negative impact on climate change. The challenge of nutrient removal is deciding whether the economic and environmental costs are worth the gains.

Two nutrients of concern in wastewater are nitrogen and carbon. Upgrading current infrastructure for the removal of carbon and nitrogen is associated with increased fossil-fuel based energy consumption (Metcalf and Eddy (AECOM)). A study at New Jersey Harbor Discharge Group Plants showed that removing high levels of nitrogen would result in an aggregate emission of 247 million pounds of carbon dioxide per year (Metcalf and Eddy (AECOM)). High levels of carbon removal would result in an aggregate emission of approximately 272 million pounds of carbon dioxide per year (Metcalf and Eddy (AECOM)). Corresponding oil consumption would be approximately 332,000 barrels per year for nitrogen removal and 374,000 barrels per year for carbon removal (Metcalf and Eddy (AECOM)).

DREDGING THE HUDSON RIVER FOR PCBS

Polychlorinated biphenyls (PCBs) were discharged as waste from General Electric Corporation's manufacturing plants on the Hudson River from the late 1940s to 1977, when the practice ended (Baker). In December 2000, the EPA mandated dredging 2.65 million cubic yards of PCB contaminated sediments out of the Upper Hudson River (Baker). Dredging is a controversial method for removing contaminants because it may expose highly contaminated deep sediment through an expensive and intensive procedure, leading to increased transport of these sediments downstream (Baker).

However, if the water is not dredged and no alternate method for removing contaminants is proposed, then PCBs will continue to be a significant source of contamination to the lower Hudson River under average stream flow conditions. For example, the Thompson Island Pool has no point source of PCBs, but they are still present as a result of sediment disruption via normal stream flow (Baker). Overall findings show that the best dredging techniques only release a small fraction of PCBs to the water, probably smaller than 2% of the total dredged (Baker). This short-term reintroduction of PCBs is similar to the current rate at which PCBs are currently being released from sediments (Baker). Successful remediation depends on effective management of the stream of dredged materials. The scientific consensus is that removing contaminated sediments will accelerate the recovery of the river ecosystem (Baker).

REESTABLISHMENT OF OYSTER POPULATIONS

Oysters are an important species in the New York-New Jersey estuary. They filter water, removing nutrients, plankton, and pollutants. Adult oysters can filter as much as 50 gallons of water each day (NY-NJ Baykeeper.org). Oysters are also a keystone species that build reefs, which become a habitat for many small organisms such as fish, crabs, snails, and anemones (NY-NJ Baykeeper.org).

Historically, oysters have been a significant part of the New York-New Jersey Estuary. In 1609 oyster reefs covered 350 square miles of the area (O'Neill). Oyster populations were nearly extinct by the 1960s, a direct result of human harvest and consumption (State of New York Hudson River Valley Commission).

In 1997, a coalition of non-profit organizations, the New York-New Jersey Hudson Harbor Estuary Program and the NY/NJ Baykeepers, in conjunction with Rutgers University, began an oyster cultivation program in the Hudson Estuary. This has had variable success but there has been evidence of oyster spawning (State of New York Hudson River Valley Commission). On June 7, 2010, the New Jersey Department of Environmental Protection (NJDEP) banned this program, ordering the removal of one-quarter mile of the site in Raritan Bay. The NJDEP states that it does not have adequate resources to patrol the area for illegal activity and the Food and Drug Administration (FDA) will not allow monitoring by volunteers. Illegal poaching and sale could lead to human health risks and threaten the New Jersey shellfish industry, worth $790 million annually (Hester). Proponents of the restoration project view the prohibition as favoring of the shellfish industry over environmental and water quality (Hester).

CLIMATE CHANGE AND SEA LEVEL RISE

At this point, there is a strong consensus among the scientific community that anthropogenic climate change is occurring and will have significant impacts the environment, including sea level rise. Despite this, there are individuals that disagree with various parts of the climate change science. The inclusion of preparation for climate change in The Clean Estuaries Act of 2010 implies that there is at least some level of consensus about climate change science in the U.S. House of Representatives.

Photo Courtesy of Hudson Valley Magazine http://www.hvmag.com/Hudson-Valley-Magazine/September-2009/Moving-Back-Home/

MEASURING THE PROGRAM'S SUCCESS

SCIENTIFIC INDICATORS OF SUCCESS

Monitoring the status of an estuary is a complex undertaking. Measuring water and living resource quality at all times, locations, and depths would be prohibitively expensive (Bain). Scientific indicators provide a means to measure existing and future environmental conditions. Environmental indicators are specific, measurable markers that can provide cost- effective information on a system. They can express complex information as simple and useful measures of status and trends, and can be used to inform diverse audiences.

Generally, scientifically acceptable measures used to evaluate estuarine health are related to water quality, but biodiversity loss is also an indicator. The following are examples of common indicators:

- **Fecal Coliform:** widely used as indicator organisms of the presence of sewage-related wastes and pathogenic bacteria in water.

- **Dissolved Oxygen:** one of the most universal indicators of overall water quality, habitat and ecosystem conditions because it is critical for respiration of most aquatic life forms (Bain).

- **Chlorophyll 'a':** a green pigment found in most macro-algae and phytoplankton that is vital for photosynthesis. Chlorophyll 'a' found in phytoplankton can be used as an indicator of primary productivity - the base of the food chain in the water. Overgrowth of primary producers can cause eutrophication.

- **Secchi Transparency:** a Secchi disk is used to estimate the clarity of surface waters. High Secchi transparency (greater than 5.0 feet) is indicative of clear water, with declines in transparency typically due to high-suspended solids concentrations or plankton blooms. Low Secchi readings (less than 3.0 feet) are typically associated with degraded waters and indicate limited light, which in turn affect primary productivity and nutrient cycling (New York-New Jersey Harbor Estuary Program).

- **Nutrient overload:** includes nitrogen, phosphorous, ammonia and nitrite-nitrate concentrations from sources including agricultural runoff, stormwater runoff, wastewater discharge, atmospheric deposition, and other anthropogenic inputs. Data collection involves sampling standard limnological and water quality parameters, as well as conducting algal and bacterial dilution bioassays to identify limiting nutrients (New York-New Jersey Harbor National Estuary Program).

- **Toxic chemicals:** predictions of the fate of specific chemicals can, to some extent, be modeled from chemical properties and laboratory test. In real aquatic ecosystems, accurate predictions of eventual sinks, trends and concentrations in biota and response to remedial measures are site specific (Adams and Benyi). Individual toxins can be identified using unique analytical techniques such as gas chromatography for the determination of pesticides in aquatic ecosystems (Edinger).

- **Biodiversity loss:** Invasive species are identified via a variety of manual field sampling techniques. Empirical studies of patterns in biodiversity and other ecological phenomena require field measurements.

USING TARGET ECOSYSTEM CHARACTERISTICS TO MEASURE RESTORATION SUCCESS

A CASE STUDY

The overall condition of the New York-New Jersey Harbor Estuary is rated poor based on indices of water quality, sediment quality, fish tissue contaminants, and the benthic index. This assessment is based on data from 32 sites sampled in the area in 2000 and 2001 (New York-New Jersey Harbor Estuary Program). The CCMP proposed a series of critical actions to address the poor condition of the estuary, recommending the development of a comprehensive regional plan to restore and protect habitat within the estuary. Existing datasets and GIS analyses were used to identify habitat suitability and constraints to ecological restoration.

The restoration study was initiated by the US Army Corps of Engineers in partnership with The Port Authority of New York & New Jersey and Cornell University and the Hudson River Foundation (HRF) have also provided support. The team conducting the study held periodic consultations with implementing agency representatives. Team deliberations defined the properties of the restoration problem, the approach for solutions, a program goal, and specific measurable objectives, termed target ecosystem characteristics (TEC). A TEC is a specific ecosystem property or feature related to the restoration that can be expressed as a quantifiable goal. A workshop was held to develop candidate ecosystem targets for restoration planning. The project scientific team selected 11 TECs for the agenda. While both natural and public gains were the aim, the TECs differed substantially from one another in scope and justification.

Oysters and oyster reefs

Eelgrass beds

Coastal wetlands

Shorelines and shallows

Habitat for fish, crabs, and lobsters

Enclosed and confined waters

Sediment quality

Tributary connections

Waterbirds

Maritime forest

Public access

Each target has near-term (2012) and long-term (2050) statements followed by background, technical merit, policy and management relevance, implementation information, and performance measures. This approach to restoration links human and environmental benefits of the estuary (New York-New Jersey Harbor Estuary Program). The “public access” and “shorelines and shallows” TECs aim to provide highly visible sites that can be visited, appreciated as a complex combination of conditions, and experienced as a contrast to the built shorelines. TECs were developed with some of the following outcomes in mind: replicating restoration projects and sites, reversing loss rates, developing unique ecosystem attributes, and eliminating problems. This approach for restoration planning, combined with quantitative ecosystem target statements, succeeded in forming a clear and powerful argument for estuary restoration.

CHALLENGES TO MEASURING SUCCESS

INADEQUATE DATA

Some indicators that were once used are no longer monitored. Data gaps and inconsistencies exist among available spatial and temporal monitoring data. In the New York-New Jersey Harbor Estuary, comprehensive monitoring of water quality on the New York side of the Harbor has produced data for nearly 100 years. Although the New Jersey Department of Environmental Protection has a system for reporting closures and beach conditions, collection of comprehensive water quality data on the New Jersey side of the Harbor has begun only recently.

PROJECTED COST

In the New York-New Jersey Harbor Estuary, the projected cost to achieve the Coastal Wetlands TEC objectives (for information about TECs, see the case study) range between $262 and $856 million for the short-term objective, and $3.3 to $10.8 billion for the long-term objective. These are the costs associated with one of the 11 TECs; funding to implement all the targets will be difficult to secure (Niedowski).

JURISDICTIONAL BOUNDARIES

Resource management agencies are tasked with balancing multiple, often conflicting, goals of resource conservation while providing for compatible uses of the environment. Examples of policy issues that should be addressed include:

- Habitat exchange issues;
- Placement of fill in water;
- Beneficial use of dredged material for habitat restoration;
- Attractive nuisance issues; and
- Issues affecting management of contaminated sediments (Reilly, Spagnolo and Ambrogio).

LOOKING AHEAD

Future research efforts are warranted in several areas. Interpretation of the science behind estuary management is limited by a lack of understanding of global climate change processes. Until more is known, estuary managers would be wise to prepare for would be wise to prepare for several possible scenarios including sea level rise, increased intensity of hurricanes and extreme storm events, and increased acidification of ocean and estuarine waters. Future research efforts should focus on all aspects of climate change as they relate to estuarine health.

Limitations on the contaminant filtering and storing capacity of estuaries are not yet fully understood. Although estuaries can be used for this type of mitigation, there is clearly a limit to the capability of these systems to deal with pollutants. Understanding these limitations would help estuary managers properly prepare for safe disposal of contaminants in estuarine systems. Identification of point and nonpoint source pollution sites is essential in reducing contamination. Increased regulation of offshore oil drilling is an ongoing area of concern that has been highlighted by the Deepwater Horizon oil spill.

OUR ESTUARIES AND THE DEEPWATER HORIZON OIL SPILL

On April 20, 2010, an explosion on the Deepwater Horizon oil rig in the Gulf of Mexico marked the beginning of one of the largest petroleum spills in recent history. Approximately 4.9 million barrels of oil (205.8 million gallons) were released, according to the latest estimates (Achenbach). By early August, the White House claimed that only 26% of the oil remains in the gulf, although scientific experts are skeptical of these findings (Zabarenko).

In the coming years, members of the National Estuaries Program on the gulf will need to decide how to deal with the remaining pollution. There are 8 members of the NEP in the Gulf of Mexico, including the Barataria-Terrebonne National Estuaries Program (BTNEP). The BTNEP is determining the appropriate method for oil spill cleanups. Techniques commonly utilized in cleaning up a marsh environment include natural degradation/no response, vacuum, skimming, low pressure flushing, and cutting vegetation (Barataria-Terrebonne National Estuary Program). Currently, the federally mandated response is natural degradation/no response (Huus). The natural degradation/no response technique is used when quick biodegradation is expected to occur in the natural environment, and when cleanup efforts may cause more harm than good. Federal and local experts on salt marsh cleanup fear that volunteer efforts may disturb the marsh grass and the eggs of nesting birds. Until plans can be made for organized and strategic cleanup, the experts say "hands-off" (Huus). However, it is probable that BTNEP and the other estuaries on the gulf will be dealing with the effects of the spill for years to come.

The Gulf of Mexico: The oil spill can be seen in the picture below as a silver swirl off the coast of Louisiana.

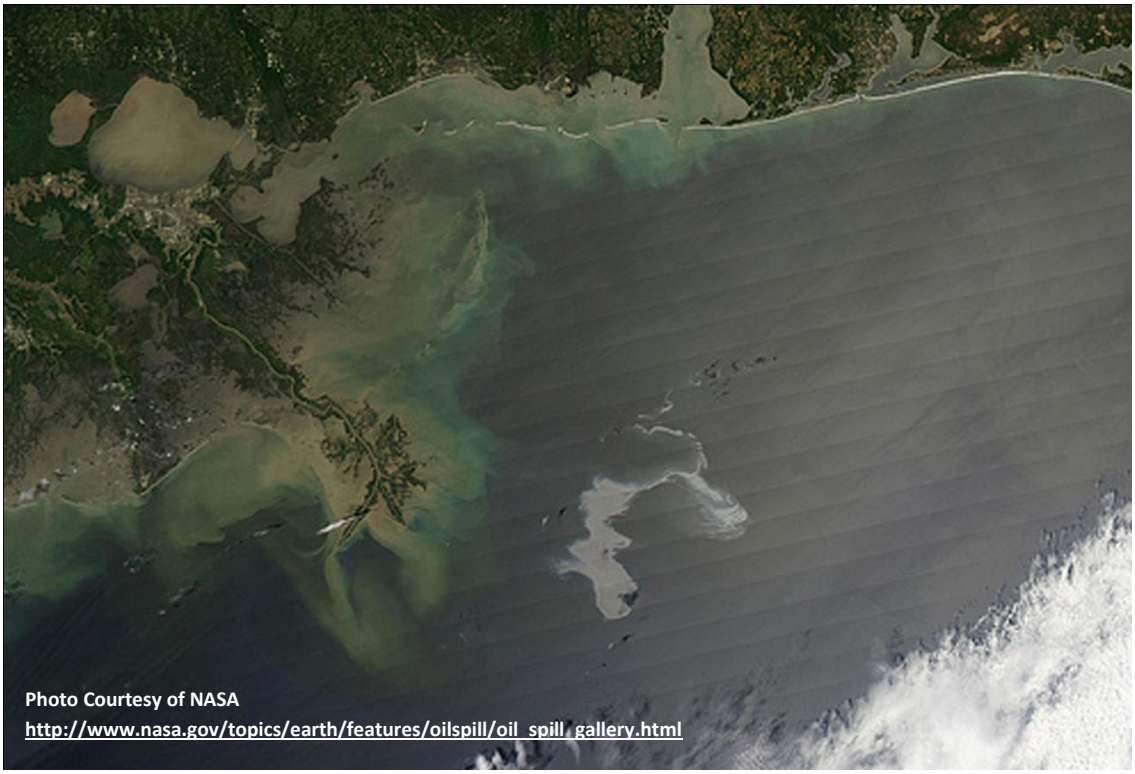


Photo Courtesy of NASA
http://www.nasa.gov/topics/earth/features/oilspill/oil_spill_gallery.html

CONCLUSION

Managing estuaries is a challenge due to their complexity. Human activities have had a critical impact on estuaries. Any approach to sustainable management must balance ecological, economical and societal values. The solution must include the formation of solid institutional frameworks that are able to tackle the uncertainties and the complexity of the system. The Clean Estuaries Act of 2010 is an institutional response to enhance the management of estuaries on the local and national level. Many of the challenges facing estuaries - e.g., climate change, polluted agricultural runoff, and the Gulf oil spill - are beyond the scope of this legislation. However, the achievements of the National Estuaries Program merit increased funding and support that this legislation provides.

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