HABITAT HOTLINE *Atlantic*

2014 Annual Issue

HEALTHY FISHERIES NEED HEALTHY HABITAT

Climate Change Impacts on Fish Habitats

As the Chair of the Atlantic States Marine Fisheries Commission's Habitat Committee, it is my pleasure to present the ***2014 Habitat Hotline Atlantic***. This year's issue explores some of the processes and impacts of climate change on marine and estuarine fish habitats along the United States' East Coast. According to EPA's Climate Change Indicators in the United States, 2014, climate change refers to "any substantial change in measure of climate lasting for an extended period (decades or longer) that may result from natural factors and process from human activities." Some of these changes consist of increased ocean and sea surface temperatures, sea level rise, and increasing ocean acidity. Coupled with other factors, climate change can significantly affect fish habitats and the behavior and geographic distribution of our fishery resources.

Habitat Hotline Atlantic 2014 also features examples of the commitment of the Habitat Committee and affiliated partners in improving fisheries habitat conservation through scientific research, restoration activities, partnerships, policy development, and education. It demonstrates the creative approaches to the challenges of understanding the dynamics of marine and coastal fish habitats in a changing climate. I invite you to enjoy reading about the various fish habitat related conservation issues and projects happening along our coast.

KENT SMITH
Habitat Committee Chair

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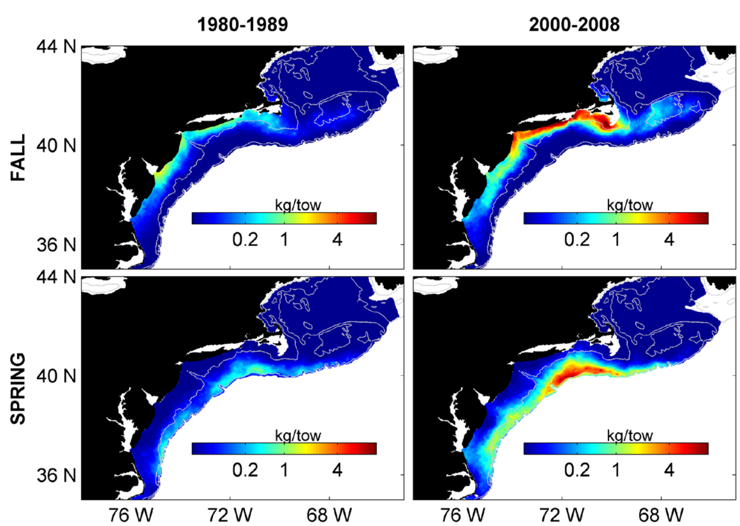
How Climate Change Affects Species Range and Habitats

Cheri Patterson, New Hampshire Fish and Game Department

The effects of climate change impact the performance of fish stocks at various stages in their life history cycle through changes in physiology, morphology, behavior, and habitat. Climate change conditions can affect ocean circulation, which drives larval transport and can have important consequences for population dynamics. Marine systems, which are often dominated by organisms with planktonic life history stages, are sensitive to alteration in coastal oceanographic patterns such as upwelling and shoreside advection patterns can be strong determinants of dispersal and recruitment. Changes in transport processes can influence dispersal and recruitment. Community-level effects are mediated by interacting species (e.g., predators, competitors, etc.), and include climate-driven changes in the abundance of interacting species. The combination of these impacts results in emergent ecological responses, such as alterations in species distributions, biodiversity, productivity and microevolutionary processes.

Rising temperatures in coastal and ocean water is a major driver of shifting species ranges. A 2009 study by Janet Nye (Stony Brook University) and her colleagues examined the relationship between the species' spatial distribution and abundance with the changes in temperature regime using a 40-year trawl survey time series (1968 to 2007). They found that 24 out of 36 fish stocks from the Northeast continental shelf exhibited clear shifts in spatial distribution associated with large-scale warming. Another study, published in *Science* by Malin Pinsky and his colleagues in 2013, looked at 43 years of survey data on 360 species, including commercial species such as lobster, shrimp, and cod, living in North American waters. Findings suggest that climate velocity (speed and direction that climate shifts in a particular region or landscape) may explain observed shifts in distribution far better than biological or species characteristics. Shifts in the species depth and latitude correlated with regional-scale fluctuations in ocean temperature. On average, changes in temperature moved north at 4.5 miles per decade and species shifted an average of 5 miles north per decade, however species-specific movements varied greatly. For example, lobster in the northeastern United States moved north at a pace of 43 miles per decade, while nearly half of the studied species moved south. A video of lobster movement north from 1968-2008 by L. Lewis and D. Richardson, NOAA, can be seen at: *http://www.princeton.edu/main/news/archive/S37/89/16S66/index.xml?section=topstories*.

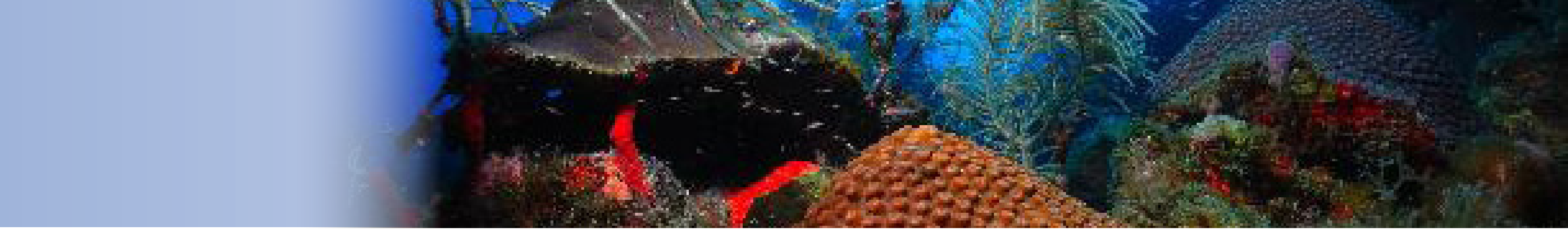


Rising water temperatures are causing some species of fish in the New England and Mid-Atlantic region to shift northward. Source: NOAA Fisheries

The Virginia Institute of Marine Science studied the impacts on submerged aquatic vegetation (SAV) through increases in temperature, atmospheric and weather changes, and sea level rise. A projected 1°C (1.8 °F) increase in average temperature has been associated with short-term pulses of high water temperatures and low oxygen levels, which can adversely affect seagrass survival. Climate change is predicted to increase the frequency and intensity of storms and rainfall over the next 30 to 100 years. Increased rainfall will likely result in added sediment and nutrient loading, further decreasing light availability for SAV populations in the Chesapeake Bay and estuaries along the coast. As shorelines in Chesapeake Bay and elsewhere are hardened for anthropogenic reasons (ie. developed land), landward migration of intertidal and shallow subtidal regions will likely be reduced, further limiting SAV, saltmarsh, and other nearshore habitats. SAV reduction or loss may have serious consequences for both water quality and important organisms such as fish and invertebrates that use them.

Additionally, coral reefs, which are important structures for fish habitats, are commonly considered very effective indicators of sea level because reef-building corals occupy a narrow vertical depth range and have good geological preservation potential. If sea level rises more rapidly than the reef can accrete, they may drown as the coral communities will experience progressively deeper water until light levels prevent photosynthesis. Read more about how ocean acidification effects coral reefs on page 4 of this issue.

The Atlantic States Marine Fisheries Commission's (ASMFC) Management and Science Committee collaborated with scientists at the Northeast Fisheries Science Center to determine the state of knowledge for select focal species and to demonstrate distribution shifts for fish stocks. Using the NOAA Northeast Fisheries Science Center's trawl survey data, the work determined if the center of biomass along the



Mid-Atlantic and Southern New England coast changed over time for four managed species: black sea bass, scup, summer flounder, and winter flounder. If a species demonstrated a change in center of biomass, the shifts were then attributed to changes in temperature, fishing pressure, stock rebuilding, or a combination of factors. The results of the investigation found that black sea bass, scup, and summer flounder exhibited a significant shift in distribution while the winter flounder stock did not. The poleward shift for black sea bass and scup in the spring season was attributed to increasing water temperatures. However, the poleward shift of summer flounder was largely attributed to the stock's increase in total abundance and expansion of size structure. This is most likely due to a decrease in fishing pressure since length structure and abundance are largely controlled by fishing. The summer flounder center of biomass will most likely continue to move north with the increase in the abundance of older fish and continued warming.

Fisheries managers must consider climate change when determining fishery management plans. In anticipation of future climate impacts to fish stocks, ASMFC is adding climate evaluations to upcoming benchmark stock assessments, including the lobster, red drum, and black sea bass assessments to be completed in the next few years. ASMFC is also incorporating the latest science and analytical tools to evaluate climate impacts to fish habitat through ASMFC's Habitat Program and the Atlantic Coastal Fish Habitat Partnership. The Management and Science Committee will continue to track developing scientific tools and management issues related to climate and fisheries, including a new fish stock climate vulnerability tool being developed by NOAA Fisheries. To learn more about these tools, visit *http://www.st.nmfs.noaa.gov/ecosystems/climate/activities/assessing-vulnerability-of-fish-stocks.*

Climate Data Collection Efforts Supporting Fisheries Management in the Northeast

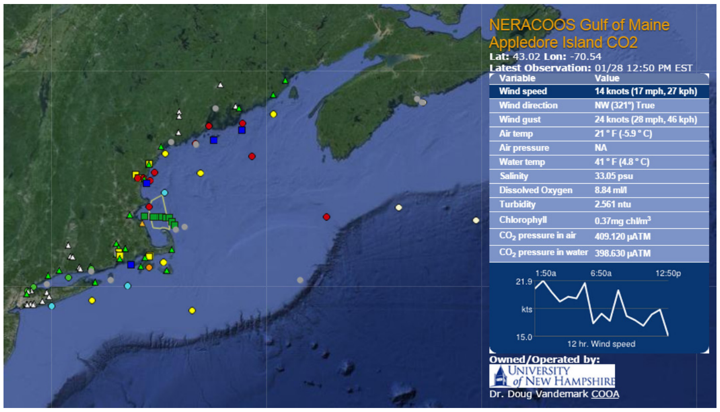
Mark Rousseau, Massachusetts Division of Marine Fisheries

The Northeast Regional Association for Coastal Ocean Observing Systems (NERACOOS) and Northeast Regional Ocean Council (NROC) are working toward establishing an integrated regional sentinel-monitoring network to collect environmental data in the Northeast. The network is designed to inform researchers, managers, and the public about ecosystem vulnerabilities and impacts, and supports an ecosystem-approach to management framework that promotes human and ecosystem resiliency from climate change and related stressors.

NERACOOS houses an array of data and products that can be used in support of fisheries management and ecosystem based management efforts in the Northeast. These include:

- Real-time buoy data and ocean forecasts to support safety and efficiency of fisheries operations *(http://www.neracoos.org/realtime_mapand http://www.neracoos.org/datatools/forecast)*
- 12+ years of hourly data from buoys, including deep water, on ocean and weather conditions to provide context for understanding the dynamics of northeastern fisheries *(http://www.neracoos.org/erddap/index.html)*
- Climate information tools comparing specific ocean conditions to the average conditions over the past decade *(http://www.neracoos.org/datatools/climatologies)*
- 30-year model hindcast provides an extensive climatology for ocean and weather conditions in the Northeast *(http://www.neracoos.org/datatools/forecast/oceanforecasts)*
- Satellite imagery of chlorophyll concentration to help track the timing and intensity of algal blooms *(http://www.neracoos.org/datatools/historical/satellite).*

One of NERACOOS' missions is to advocate for a regional ocean observing system and the application of scientific assessments using environmental data to meet societal needs. A Northeast Sentinel Monitoring Steering Committee has developed a framework for implementation of this goal. Regional pelagic, benthic and estuarine habitat work groups have been formed and tasked with identifying a suite of sentinel ecosystem variables from existing observing activities, identifying gaps in the present observing system and contributing to the synthesis of an integrated regional plan. A key outcome will be to procure funding to fill monitoring and data gaps that establish a self-sustaining, integrated sentinel monitoring program for the Northeast. Participation from qualified professionals in this collaborative effort is encouraged. Please contact Jackie Ball at *jball@neracoos.org* for details or visit the NERACOOS website at *www.neracoos.org.*



A screen shot of NERACOOS' data portal demonstrates real-time observations from buoys and monitoring systems in the northeast Atlantic. Source: NERACOOS

Ocean Acidification

Effects on Atlantic Coral Reefs

Kent Smith, Florida Fish and Wildlife Conservation Commission

Carbon dioxide (CO_2) absorbed into the ocean from the atmosphere increases acidity of oceanic waters. The oceans of the world absorb approximately 25% of CO_2 generated by human activities every year, and over the past century (mostly during the last 30 years), the acidity of the world's oceans has increased by 30%. Increased acidity in ocean waters affects reef building corals in a number of ways, including inhibiting the production of their calcium carbonate ($CaCO_3$) support structures and reducing growth, reproduction, and survival – effects that are exacerbated by other human disturbances and ocean warming.

The Southeast Atlantic's shallow-water (0-20 m) reef-building coral ecosystems encompass an estimated 30,801 km^2 and extend from the Dry Tortugas in the Florida Keys to St Lucie Inlet on the Atlantic Ocean coast and Tarpon Springs on the Gulf of Mexico Coast. Deeper water corals along the western Atlantic, such as Oculina, build complex structures supporting diverse and abundant fish and invertebrate communities. Such vibrant reefs provide important recreational and commercial reef fish fisheries. Acidification of ocean waters from increasing levels of atmospheric CO_2, particularly when combined with warming ocean waters, is a substantive threat to shallow and deep-water coral reef communities, particularly to the reef building corals themselves.

Increased ocean acidity reduces the ability of coral polyps to create their calcium carbonate calyces. Slight increases in ocean acidity that have been documented have resulted in a reduction of available $CaCO_3$, and coral reef accretion rates have already begun to decline. When combined with increasing ocean temperatures, even marginally higher acidity reduces the growth and survival of primary coral polyps after planulae larval settlement for some species. Live reef-building coral coverage on Caribbean coral reefs have declined from 50% in the 1970s to as little as 8% today, with especially low live coral coverage on U.S. East Coast reefs in Florida.

The combined effects of ocean acidification and warming reduces coral reef resilience to storm damage and sea level rise. Reef community composition is also affected, and when these physical effects are coupled with overfishing and other human disturbances, phase shifts in coral-algal community balances result. Reduced growth rates and survivorship of coral polyps provide competitive advantages to calcareous and fleshy algae settling in available space opened by disturbance events. When herbivore populations are reduced or direct coral consumers are more abundant, algae can come to dominate coral reef systems. Such species composition shifts could lead to functional collapse in coral reef systems, which lead to reef fishery resource collapse.

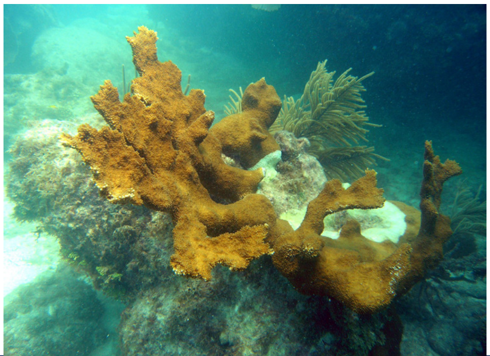
Source: Florida Fish and Wildlife Commission Florida Wildlife Research Institute

Solutions to addressing increased ocean acidity related to CO_2 absorption range from the use of technical physio-chemical processes to the sequestration of CO_2 through restoration and protection of natural plant communities, such as saltmarsh and seagrass habitats. Such solutions are monumentally expensive to achieve and must be completed on a global scale to effectively sequester quantities of CO_2 currently produced by the burning of fossil fuels and related human activities.

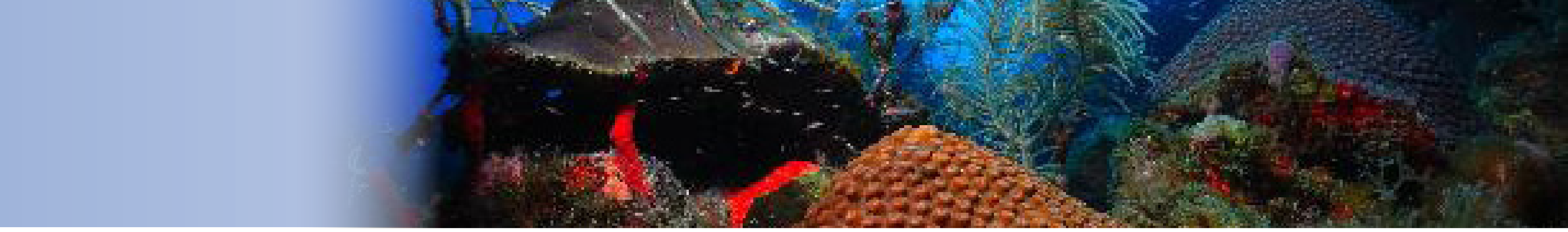
NOAA's Ocean Acidification Program has created ecosystem-based and economic forecast models in an attempt to predict how ecosystems will respond to shifts in ocean acidification and other factors. Often these models are used to inform fisheries management, and management of other important natural resources. However, analyzing how the change in ocean chemistry will affect an ecosystem is extremely complex as many ecosystem aspects are intertwined. Scientists are studying ocean acidification impacts to calcifying organisms, how ocean acidification may affect fish behavior (i.e., predator-prey interactions), the nutritional content of non-calcifying phytoplankton, and impacts further up the food web.

Staghorn coral (Acropora cervicornis) colony fully bleached on a Florida Keys reef system, Monroe County, Florida. Source: Florida Fish and Wildlife

Staghorn coral (Acropora cervicornis) colony on the Gulf Stream Reef in Palm Beach County, Florida. Source: Florida Fish and Wildlife Commission



Elkhorn Coral with evident bleaching at base on Looe Key, Monroe County, Florida. Source: Florida Fish and Wildlife Commission Florida Wildlife Research Institute



Slowly Dissolving Shellfish (and its Industry)

Russell Babb, New Jersey Dept. of Environmental Protection
Jamie Taylor, New Jersey Dept. of Environmental Protection

Water bodies around the world are experiencing the impacts of ocean acidification, the process of increased acidity as our oceans absorb atmospheric CO_2. Recently, an increased amount of atmospheric CO_2 has been escalating ocean acidification. Scientists have estimated that the world's oceans have become 30% more acidic since the boom of the Industrial Revolution and the use of fossil fuels. Even if current CO_2 levels decrease, acidity levels are still predicted to increase since much of the atmospheric CO_2 has already been dissolved into deeper waters which will eventually circulate to the coasts. While the U.S. West Coast has been experiencing ocean acidification due to the upwelling of waters with higher concentrations of CO_2, the U.S. East Coast waters are dealing with upwells of acidic waters as well as other factors. Along the East Coast, the main contributor is excess nutrients, including runoff from agricultural fertilizers, sewage, and other nutrient-rich wastes carried throughout the coast's highly inhabited estuaries. Runoff introduces carbon into coastal waters, increases acidity and leads to eutrophication and hypoxic "dead zones." The decomposition chemistry of these zones releases additional CO_2 into the water column, further increasing acidity.

Shellfish have recently been referred to as the "canary in the coal mine" of this new ocean acidification problem. While many shellfish farmers have been suspicious of viruses or diseases causing their most current crop decline, recent studies have shown increased acidity levels to be the culprit. Shellfish, particularly larvae, depend on materials like calcium carbonate and aragonite suspended in the water column to build their shells. But with more corrosive waters, these materials are breaking down more easily and shell creation and repair is often inhibited. Field studies and laboratory experiments alike have demonstrated the escalated struggles shellfish species face as they try to construct their shells in acidic waters. When exposed to increased acidity, the larvae, which need to form their shells in those first important days of development, simply cannot collect the essential materials needed. Larvae that do indeed survive often yield adult shells that are not as thick and robust as shells grown in less acidic waters.

Throughout the U.S., wild shellfish harvest and shellfish aquaculture industries are valued at $740 million dollars and many species have already endured many years of decline. The industry has already been beset by numerous problems throughout the past century, including overfishing and severe disease-induced mortalities. Adding ocean acidification to the equation complicates the effort to conserve these environmentally and economically important species. The National Marine Fisheries Service stated that U.S. shellfish producers harvested 72 million pounds of eastern oysters (*Crassostrea virginica*) in 1952, but in 2012 the harvest yielded only 23.8 million pounds. Once a booming industry, this harvest has not been over 30 million pounds per year since 1996. On the Northwest Pacific coast, it is estimated that shellfish seed production dropped by 80% - between 2005 and 2009 primarily due to impacts of increased acidification on larvae production. Farmers on the East Coast are now starting to see declines as well. The Chesapeake Bay, famous for its shellfish industry, has shown signs of acidifying three times faster than any of the oceans. Scientists from Woods Hole Oceanographic Institute in Massachusetts have predicted that U.S. shellfish harvests may decrease by 25% over the next 50 years due to acidification. Experimentation and observation on species such as the eastern oyster, the hard clam (*Mercenaria mercenaria*), the bay scallop (*Argopecten irradians*) and several others important to the industry have all revealed a decrease in survival when exposed to increased acidity. While these shellfish species are known for their evolutionary skills, many are concerned that the current rate of ocean acidification may be too rapid for adaptation.

Effects on Planktonic Resources

Dr. Jon Hare, Northeast Fisheries Science Center

Ocean acidification poses a significant threat to marine resources. However, identifying impacts on specific species in a given region is limited by the lack of species-specific information. Ocean acidification describes the increasing acidity of the ocean through the adsorption of atmospheric CO_2. As atmospheric CO_2 has risen, dissolved CO_2 in the ocean has risen, leading to an increase in ocean acidity. There are significant regional and local scale processes that effect the carbonate cycle making the regional expression of ocean acidification complicated. Along the East Coast of the United States there are strong seasonal cycles in CO_2 concentrations, as well as regional differences. In nearshore areas, sediment-water column interactions and freshwater runoff also affect carbonate chemistry.

Information regarding the effects of ocean acidification is limited, but the increase in ocean CO_2 concentrations have biological impacts that will vary by species groups and by species. The most extreme effects have been identified for mollusks, which form calcium carbonate shells. The planktonic early life stages of many benthic molluscs are particularly vulnerable. Shell formation and shell growth are negatively impacted by ocean acidification. Pelagic mollusks (e.g., pteropods) are also vulnerable. Some studies have reported negative impacts on the planktonic stages of marine fish but other studies have found minimal effects. Part of the difference may represent species-specific differences, part may be attributable to the levels of CO_2 concentration used in experiments, and part may reflect the traits that are studied. Effects of ocean acidification on crustaceans are also variable. The early life stages of benthic crustaceans may experience

See OCEAN ACIDIFICATION continued on page 6

OCEAN ACIDIFICATION continued from page 5

decreased survival, but negative effects have not been identified on planktonic crustaceans (e.g., copepods), which form an important part of marine food webs. Phytoplankton, which form the base of planktonic food webs, may be positively affected as carbon becomes more available for photosynthesis.

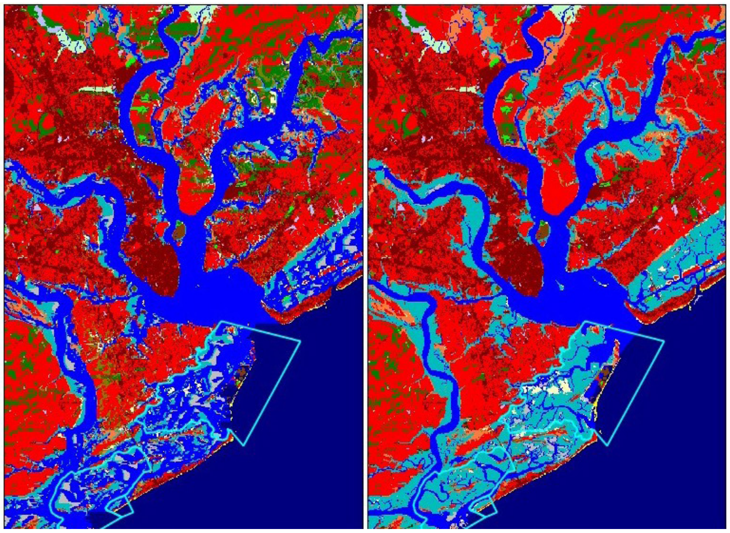
Direct and indirect effects of ocean acidification need to be considered. Direct effects include reduced survival resulting from interference with the formation of calcium carbonate shell (e.g., mollusks) or increased growth resulting from the increase availability of CO2 (e.g., diatoms). Modeling studies of direct effects have shown that reductions in larval survival can reduce population productivity. Indirect effects include changes in species interactions and changes in biogenic habitats. These effects are harder to study, but modeling studies have shown that ocean acidification can affect planktonic and benthic food-web structure and ultimately, important resource species. There is still a lot of work needed to understand the effect of ocean acidification on planktonic systems and how these apply to marine resource management. NOAA is funding a number of projects in the region to address these needs, including ocean observing, process-oriented research, and modeling activities. Other federal and state agencies, such as National Science Foundation, Environmental Protection Agency, and states of Maine and Maryland are working to understand the risks of ocean acidification effects and developing strategies to address its effects.

Sea Level Rise Effects on Coastal Salt Marshes

Dr. Robert Van Dolah (retired),
South Carolina Department of Natural Resources

Averaged over all the world's oceans, sea level has risen at a rate of approximately 0.60 inches per decade since 1880. In recent years, the rate has accelerated to more than an inch per decade. Areas characterized by low elevations, faster rates of sea level rise, and low tidal amplitudes will or already have experienced greatest losses in wetland habitat. Where marshes are drowning, increases in nutrient inputs and sediment enhancements may be effective and beneficial. Stresses to plant systems, either due to natural or anthropogenic effects, can exacerbate wetland losses. Regions that have or will experience the greatest wetland losses include areas with accelerated subsidence rates and/or decreased sediment delivery rates. These rates are affected by ground water extraction or artificial drainage of wetlands, construction of dams and/or reservoirs, and agricultural/ upland land management practices that control or limit sediment yields to the coastal marshes.

Combined with tidal creeks and other adjacent estuarine waters, coastal salt marshes represent critical nursery habitat for many commercially and recreationally important finfish

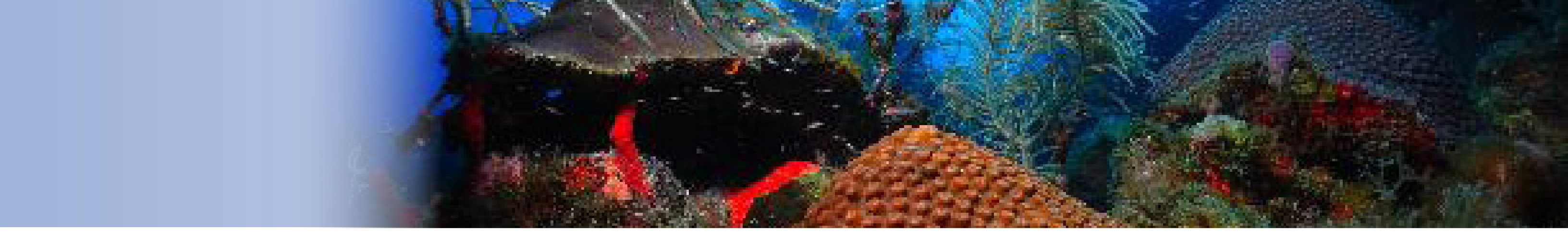


Example of SLAMM output for projected 0.7 m sea level rise in the area of Charleston, South Carolina. Source: Dr. Robert Van Dolah via www.SLAMMview.org

and crustacean species. The loss of salt marsh habitat resulting from sea level rise could have devastating effects on these resources and many of the prey species that they rely on. Regional assessments predict that conversion of tidal wetlands to open water due to sea level rise will result in a 20-45% loss of salt marsh during the current century. However, not all marsh systems will be affected equally by sea level rise, with some areas being more stable than others and able to build vertically at rates equal to or greater than sea level rise.

Factors important to the maintenance of salt marsh habitats as sea level rises include land elevation, primary production rates, and sediment accretion. In fact, several studies and models have shown that the relative elevation of the sediment surface controls marsh plant productivity and that productivity has a positive feedback on the rate of accretion on the marsh surface. These studies indicate that marsh systems will be stable against changes in relative sea level rise when surface elevations are higher than the elevation that is optimal for primary production of a species. When sea level rises, the portions of a salt marsh system that were above the optimal growing elevation will experience increased plant productivity that will increase mineral sedimentation and organic matter accumulation. Instability results when rising sea level decreases primary productivity (e.g. in areas currently optimal for plant growth or areas lower than the optimal growth areas) which, in turn, decreases mineral sedimentation and organic matter accumulation.

State and federal agencies monitor coastal wetlands to track sea level rise. Protection of current upland areas where coastal wetlands or beaches can develop or "migrate" as the sea level rises will be needed if commercial and recreational fisheries are to be retained at close to current levels. The National Wildlife Federation's Sea-Level Rise and Coastal Habitats in



the Chesapeake Bay Region Technical Report estimates 66% of commercial fishes in the Chesapeake Bay region are dependent on coastal marshes for nursery and spawning grounds, including Atlantic menhaden, bluefish, flounder, spot, mullet, croaker, and rockfish. In addition to providing food, nesting and rearing habitat, tidal marshes play an important role in maintaining water quality in the bay by taking up excess nutrients that contribute to hypoxia events and dead zones. Beaches are also important spawning habitat for horseshoe crab, and fish species such as killifish, rockfish, perch, herring, silversides, and bay anchovy. Additionally, tidal flats support worms, clams, snails, and other species that are critical food sources for fish and wildlife.

The United States Fish and Wildlife Service (USFWS), The Nature Conservancy (TNC), Warren Pinnacle Consulting Inc., Image Matters LLC, and the National Wildlife Federation developed a "Sea Level Affecting Marshes Model (SLAMM)" that incorporate data on inundation, erosion, overwash, accretion, saturation and salinity. This interactive web-based tool allows users to search an area of interest and simulate potential marsh losses based on a selection of scenarios *(www.slammview.org)*.

An oyster reef exposed during mid-tide at Hunting Island State Park in South Carolina. Source: James Stuby

How Will Sea Level Rise Impact Oyster Reefs?

January Murray, Georgia Department of Natural Resources

Sea level rise has the potential to impact shell bottom habitats along the Atlantic coast. SLR is dependent upon atmospheric temperature and the dynamics of polar ice masses. Globally, 85 percent of oyster reefs that once dominated the bays and estuaries of the world have disappeared. Eastern oyster (*Crassostrea virginica*) populations have declined along the Atlantic Coast due to habitat loss, predation, disease, pollution, and harvest pressure. Environmental stressors such as extended changes to temperature regimes, precipitation, and stream flow patterns may also play a role in oyster distributions, growth, reproduction, and survival. Does the eastern oyster possess sufficient resilience to survive ecological and environmental stressors as well as impacts from SLR?

The effects of globally increased water temperatures may initially provide a handful of benefits to oysters and other shellfish. These benefits include 1) increased filtration and growth rates; 2) a longer spawning season; 3) a shorter duration of the planktonic larval phase; 4) range expansion of lower latitude species; and 5) increased subaqueous space allowing for extended vertical accretion. These benefits to oysters and other shellfish may be short lived as warming water temperatures can 1) increase susceptibility to environmental stressors; 2) increase rates of infection from oyster parasites; 3) alter environmental cues for reproduction; and 4) temporal mismatches between larval production and food supply.

Changes in precipitation may influence fresh water inflow, nutrient delivery systems, and salinity regimes. Increased precipitation will decrease salinity in estuarine systems. Nutrient delivery systems may be disrupted as increased precipitation and fresh water inflow cause water column stratification and nutrient enrichment from increased runoff. Oysters are physiologically stressed at salinities less than 10 ppt resulting in reduced rates of filtration and respiration. This stressor can also cause declines in larval oyster production and larval survivorship. Direct effects of physical stress on oysters can result in mortality. Oysters have the potential to freeze to death during the winter season if exposed above the waterline during low tide. In addition, the physiological stress of hypoxic or anoxic aerial exposure can result in mortality.

SLR has the potential to create fundamental shifts in habitat availability, coastal and freshwater wetland distributions, intertidal movements of oysters, and shoreline stabilization. Intertidal oyster reefs may be able to persist sub-tidally if submerged by SLR but increased rates of predation by boring sponges, oyster drills, and blue crabs may limit ability. Rising tidal elevations may potentially effect growth and / or drown sub-tidal reefs. Coastal development may also impede oyster movements landward. Corridor functions between reefs and adjacent tidal marsh may be disconnected as a result of SLR. This in turn will decrease habitat quality for fish and macro-invertebrates that use intertidal reefs.

As global CO_2 concentrations increase ocean acidification can occur, a reduction in ocean pH, which is an additional environmental stressor to oyster reefs. Oysters experience dissolution of adult calcareous shells, decreases in 1) growth rates; 2) calcification; and 3) larval development and settlement when pH levels are less than 7.5. Reef development and maturation will slow in these conditions and mature oysters will face increased predation pressure. Decreases in available shell bottom will lead to reduced habitat complexity and biodiversity. Coastal managers have cause for concern in regards to SLR but adaptive management, coastal planning, and modeling may provide hope for the oyster yet.

Salt Marshes and Mangroves: A Fine Line Between Acidification and Climate Change Resiliency

Melissa Yuen, Atlantic States Marine Fisheries Commission

Among the many ecological benefits of salt marshes and mangroves, they serve as "carbon sinks" that capture and store organic and atmospheric carbon. However, there is a fine line between benefit and potential threat when it comes to maintaining acidity of marine coastal ecosystems. When healthy and intact, these sensitive habitats play a critical role in enhancing resiliency of coastal fish habitats from the negative impacts of ocean acidification. Conversely, climate change impacts and anthropogenic activities can compromise the beneficial properties of salt marshes and mangrove systems and cause them to release acidic water into marine habitats.

Coastal marshes and mangroves transition between terrestrial and marine environments. These systems typically are highly efficient at storing carbon (and metal pollution) through accumulation of mostly anaerobic sediment. In fact, some of these carbon-stocked soils have been preserved for a millennia. The carbon-storing processes make the soils naturally acidic. Under stable conditions, the acidity is controlled by physical, chemical, and biological processes that create equilibrium.

Climate change impacts such as sea level rise and increasingly frequent and intense tropical storms are a concern to marshes and mangroves because of their ability to disrupt the stabilizing processes that contain acidity. When the sediments and natural water flows are disturbed by climate-induced wet and dry periods, the soils oxidize and release acidity into surrounding environments. With sea level rise, hydrogen sulfide-rich pore water in marshes and mangroves can be transported out of the soil layers and into adjacent water bodies. Such acidification events by marshes and mangrove ecosystems have been linked to fish and shellfish kills, outbreaks of diseases in aquatic species, algal blooms, and loss of native vegetation and biodiversity.

Anthropogenic activities such as urban development and tidewater control also can weaken the coastal marsh and mangrove systems' ability to withstand climate-related impacts, and could result in release of acidic water into marine fish habitats. Salt marshes in densely populated coastal communities have been known to cause acidification events when natural water flow is restricted.

Through recent studies and initiatives, state and local agencies, academia, and non-profit organizations are working to promote the benefits of salt marshes and mangroves as a solution to ocean acidification and climate change impacts. By adequately protecting or restoring these ecosystems, we can maintain their beneficial processes of erosion control and blue carbon storage that enhance resiliency of marine habitats. Learn more about the benefits of mangroves and salt marsh habitats by visiting NOAA Fisheries Habitat Division's website: *http://www.habitat.noaa.gov/coastalbluecarbon.html*. An example of a multi-national effort to advance the conservation and restoration of estuarine blue carbon habitats is the Commission for Environmental Cooperation's (CEC's) North America Blue Carbon Project. Read about the CEC's efforts at *http://www.cec.org*.

Salt marshes comprised of plants such as smooth cordgrass (Spartina alterniflora) capture and store atmospheric carbon. Source: USDA

Habitat Management: Considerations and Tools for Adaptation to Climate Change

Cheri Patterson, New Hampshire Fish and Game Department

Healthy marine habitats that can adapt to and withstand an ever-changing climate are critical for long-term productive fisheries, good water quality, coastal infrastructure, and the health and economic well-being of coastal communities. As a result, fisheries managers need to consider habitats and their contribution to the productivity of our nation's fisheries, and how that productivity may be changing and impacting stocks and fishing communities. Climate change parameters should be incorporated into stock evaluations and assessments to inform decision-making processes.

The 1996 Sustainable Fisheries Act amendment to the Magnuson-Stevens Fishery Conservation and Management Act Section required that federal fishery management plans (FMPs) describe and identify those habitats necessary to fish for spawning, breeding, feeding, and growth to maturity as Essential Fish Habitat (EFH). Federal Rule 50 CFR Part 600.815(a)(1)(i)) further established guidelines for describing EFH that clearly states the critical habitats or habitat types for each life stage of managed species. FMPs should explain the physical, biological, and chemical characteristics of an EFH and, if known, how these

characteristics influence the species' life stages and processes. They also must identify the specific geographic location (e.g., maps, boundaries, etc.) and extent as described as EFH for each species and life stage. This information, along with climate change monitoring, will be critical in helping scientists and fishery managers plan and develop climate change adaptation management strategies.

A well-designed adaptation plan should reduce the negative impacts of potential climate effects through reducing exposure, promoting resilience, and accommodating adaptation of ecosystems, species, communities, and infrastructure to changing conditions. To assist with planning, a variety of tools have been developed for conceptualizing current and future conditions; improving the understanding of biological, geophysical, and socioeconomic processes; and simulating a variety of scenarios to understand risks. Many state, federal, local, and non-governmental organizations have strategies, plans, and tools to protect and manage the oceans' habitats and fisheries in light of climate change, such as:

- On a national level, the National Fish, Wildlife and Plants Climate Adaptation Strategy is a unified response by a partnership of the USFWS; NOAA Fisheries; and the New York State Department of Environmental Conservation for a coordinated, nationwide fish, wildlife and plant climate adaptation strategy. This document defines seven goals to help fish, wildlife, plants, and ecosystems adapt to a changing climate, and provides a list of practical actions that can be taken in the next five to ten years.
- NOAA Fisheries partnered with the Office of Ocean and Atmospheric Research (OAR) to create the Ocean Climate Chance Web Portal, an on-line tool that depicts projected changes in the marine ecosystem (temperature, salinity, precipitation, pH, etc.) on a global scale. Please see *http://research.noaa.gov/News/NewsArchive/LatestNews/TabId/684/ArtMID/1768/ArticleID/10457/Mapping-climate-change-in-the-oceans.aspx*
- NOAA Fisheries partnered with OAR to create a methodology which uses existing information on climate and ocean conditions, species distributions, and species life history characteristics to estimate the relative vulnerability of fish stocks to potential changes in climate. The first implementation of the methodology was on 82 species from the Northeast and Mid-Atlantic. Results should be available in 2015. For more information, see *http://www.st.nmfs.noaa.gov/ecosystems/climate/activities/assessing-vulnerability-of-fish-stocks* or contact Mark Nelson (*mark.nelson@noaa.gov*).
- On a regional level, various fishery management councils are updating or developing essential fish habitat amendments to identify and address fish habitat requirements for fishery management plans that include climate change parameters, conservation measures, and best management practices to mitigate climate change effects (e.g., New England Fishery Management Council's Omnibus Habitat Amendment 2). Additionally, adding climate change parameters while modelling for species stock assessments will provide a more comprehensive view of climate impacts. ASMFC is already incorporating the latest science and analytical tools to evaluate climate impacts to fish habitat through the Commission's Habitat Program and the Atlantic Coastal Fish Habitat Partnership (ACFHP).
- On a state level, most eastern seaboard states have developed plans to address climate change and some local communities are conducting formal planning and developing actions as they recognize the importance of pre-emptive action to address their vulnerabilities to climate change impacts. The Georgetown Climate Center has a map that highlights the status of state adaptation efforts as well as NOAA's Coastal Climate Adaptation website (*http://collaborate.coast.noaa.gov/climateadaptation/default.aspx*). Additionally, states are updating climate change aspects to their Wildlife Action Plans.

Current data on the various changing elements, such as sea surface temperature and sea level rise, and tools to evaluate those changes are critical to helping fisheries scientists and managers prepare for climate change impacts. There are many data monitoring stations globally, nationally, regionally, and locally providing real-time information on sea surface temperature, sea level rise, etc. Coastal observing systems along the east coast are situated to provide the necessary ocean observing, data management, and forecasting capacity to address prioritized regional themes. These regional systems are the Mid-Atlantic Regional Association of Coastal Ocean Observing System, (MARACOOS), NERACOOS, and the Southeast Coastal Ocean Observing Regional Association. These are all integrated into the U.S. Integrated Ocean Observing System which contribute to global observing activities including the Global Ocean Observing System (GOOS, *http://ioc-goos-oopc.org*) and the Global Earth Observation System of Systems (GEOSS, *http://www.earthobservations.org*). On a more local level, many states have a National Estuarine Research Reserve System-wide Monitoring Program (SWMP) located in their estuaries and are conducting surveys and utilizing tools to assist with ecosystem-based climate planning.

Many factors can make it difficult for practitioners to select the best tools for assessing climate change needs and capacities. Some of these difficulties include the wide range of available tools, the difficulty of determining the various tool functions, location-specific data needs and requirements, training requirements, and modeling strengths and limitations. To address this, NatureServe's Ecosystem-Based Management Tools Network's "A Guide for Selecting Tools to Assist with Ecosystem-Based Climate Planning" (*https://connect.natureserve.org/sites/default/files/documents/EBM-ClimateToolsGuide-FINAL.pdf*) provides processes and approaches that benefit from the use of geospatial analyses and tools that will provide information necessary for coastal natural resource managers and community planners to make better informed decisions pertinent to their particular needs. Other climate change adaption tools can be found at the US Environmental Protection Agency's website, *http://www.epa.gov/climatechange/impacts-adaptation/adapt-tools.html*, and on the U.S. Climate Resilience Toolkit website (*toolkit.climate.gov*) developed by the NOAA and other federal agencies.

Addressing Climate Change Impacts with Fish Passage Adaptations

Jake Kritzer (Environmental Defense Fund), Stephen Gephard (Connecticut Dept. of Energy and Environmental Protection), and Adrian Jordaan (Dept. of Environmental Conservation, University of Massachusetts)

Diadromous fishes are species that migrate between freshwater and the sea for feeding and breeding, and they provide a wide variety of ecosystem services. Unfortunately, many of these services have been lost or compromised by multiple ecosystem stressors. Perhaps most significant among these has been centuries of construction of dams and other barriers to migration across their native range. Those barriers have resulted in tremendous loss of spawning and nursery grounds, and therefore a drastic reduction in carrying capacity and the ecosystem benefits of these species .

Recent decades have seen increasing efforts to provide fish passage at these barriers by either removing them or building fishways. In addition to the high profile efforts like the removal of dams on the Penobscot River or re-opening of fishways on St. Croix River, both in Maine, there have been numerous small-scale fish passage projects along the Atlantic coast. In Connecticut alone, approximately 55 fish passage projects over the past 25 years have made approximately 520 miles of freshwater habitat accessible to anadromous fish once again.

A new challenge to restoring fish passage has emerged in recent decades: sea-level and variability in precipitation have steadily increased. The average precipitation over the course of each decade has not changed, but the frequency of extreme events (i.e., flood years and drought years) has increased. The timing and success of outmigration of juvenile river herring is strongly dependent upon river flow. Thus, extremes in flow can exacerbate any fluctuations in population size, which can have both demographic and ecological implications. Furthermore, high flow can create velocity barriers preventing successful upstream passages, which can compromise reproductive output even before outmigration becomes an issue.

Further complicating these concerns is the fact that many fish passage structures were designed to function within a certain set of flow conditions, conditions that might become less frequent as extreme events become more common. For example, engineers design the size of the fishway based partially on the amount of water in a stream during the fish migration season. The goal is to have 2-3% of the stream discharge pass through the fishway to allow migrants to effectively locate the fishway entrance. As

The Vargas Pond fishway on Stony Brook in Stonington, CT, illustrating the very different passage conditions that can exist under both low flow (top) and high flow (bottom) conditions. Source: CT Dept. of Energy and Environmental Protection, Inland Fisheries Division

stream flow increases, fishways may need to add supplemental attraction water to meet this criterion.

Another design issue is the elevation of fishway entrances. To provide an attractive plume of water, fishway entrances must not be submerged. However, present day fishways were designed for stream levels experienced during the latter half of the 20th Century. As climate change results in new river flow rates, the elevation of the fishway entrances could become ill-suited. In the Northeast, as water levels increase, entrances could be submerged and migrants unable to locate them. In the Southeast, if river flows decrease, entrances could be too high and migrants might not be able to enter them. At all tidal locations, as sea level rises, fishway entrances could become submerged. This could require retrofitting with wall extensions and other engineered adaptations. In future fishway designs, entrance elevations need to consider current and long-term projected water surface elevations.

The challenges will not be limited to design, but will also include changes in operations. Many fishways operate on established annual time tables to accommodate targeted species. Climate change can cause the timing of migrations to change. Managers will need to research, document, and adapt the operational schedule to these changes in migration patterns. Moreover, the suite of targeted species may change over the lifetime of a fishway and these must be considered for both existing fishways and those being planned.

Fortunately, there is a rich and productive history of biologists and engineers working to monitor and improve the performance of fishways. These collaborations must now confront new challenges in developing designs that are flood and drought-resistant, responsive to sea-level rise, and attentive to changes in the timing of different species' migrations. The Northeast is well positioned to meet these challenges: since the 1970s, there have been extensive collaborations on fish passage design involving hydraulic engineers, biologists, and managers in federal and state agencies, NGOs, academic institutions, and private consulting firms.

Atlantic Coastal Fish Habitat Partnership Update

The Atlantic Coastal Fish Habitat Partnership (ACFHP) has been actively restoring and protecting fish habitat through new funding and collaboration opportunities, and consistently contributed to established science and data initiatives this year. Additionally, the partnership welcomed Lisa Havel as the new ACFHP Coordinator in September, joining us from the University of Texas at Austin. She is enthusiastically continuing to promote ACFHP's mission following Emily Greene's departure after six years of building ACFHP into the productive and valuable partnership it is today. The skills and expertise Lisa developed through her graduate work focusing on red drum early life history stages and habitat associations will be a tremendous asset to the Partnership and we're very excited to have her onboard.

Project Funding

ACFHP has partnered with the USFWS for the fifth consecutive year to fund two new on-the-ground restoration projects in 2014. The first focuses on Eastern oyster (*Crassostrea virginica*) reef and salt marsh habitat (*Spartina alterniflora*) restoration along 200 feet of estuarine shoreline in Stump Sound, Holly Ridge, North Carolina, and is led by the North Carolina Coastal Federation (Figure 1). The second, led by the New Hampshire Chapter of TNC, will restore two acres of oyster (*C. virginica* spat on *Spisula solidissima* shells, Figure 2) reef in Great Bay Estuary, Rockingham County, New Hampshire (Figure 3). Both projects will increase the extent of living shoreline, which in turn will augment resiliency to climate change-induced sea level rise. Oyster reefs not only stabilize vulnerable sediments, but continue to shift and expand over time in response to changes in water level. This is because oyster spat settle and grow on established oyster shells, vertically building up from the seafloor over time. Restoring oyster reefs will also help mitigate the effects of ocean acidification, another byproduct of climate change. Since the calcium carbonate in shells alters the chemical composition of the surrounding water, shellfish are capable of buffering against increasingly acidic estuarine conditions. For more information on these and other ACFHP-USFWS funded projects, please visit: *www.atlanticfishhabitat.org/projects/fundedprojects/.*

Figure 1: Oyster reef and salt marsh habitat restoration project area, Stump Sound, Holly Ridge, North Carolina. Source: North Carolina Coastal Federation

Figure 2: Eastern oyster (Crassostrea virginica) recruited on surf clam (Spisula solidissima) shells. Source: The Nature Conservancy

Figure 3: Reef barge clamshell construction in Great Bay Estuary, New Hampshire. Source: The Nature Conservancy

ACFHP expanded the implementation of conservation moorings to Jamestown, Rhode Island this year thanks to funding provided by the NOAA and support from the Rhode Island Division of Fish and Wildlife, Town of Jamestown Conservation Commission, Clarks Boat Yard, Conanicut Marine Services Inc., and Rhode Island Marine Trades Association. Conservation moorings use a buoyant bungee-like cord to minimize contact with the seafloor. This eliminates "chain sweeping" and subsequent damage to submerged aquatic vegetation that occurs around traditional mooring systems. Area mapping and pre-monitoring are underway, and the moorings will be fitted in place next spring. To learn more about conservation moorings, please read about our eelgrass restoration efforts at: *www.atlanticfishhabitat.org/projects/fundedprojects/.*

Collaboration Opportunities

For the past year ACFHP has partnered with TNC and other partners to prioritize, plan, and strategize river herring needs in the Southern New England, Mid-Atlantic, and Southeast regions of the United States. This work is funded by the National Fish and Wildlife Foundation River Herring Initiative. The project involves collaboration with state and federal agencies and non-governmental organizations via in-person workshops and webinars. This project will result in multiple reports on river herring

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habitat needs for each geographic focal area, as well as advance the cooperation among stakeholders in each region, and aid ACFHP in prioritizing river herring restoration needs for future USFWS project funding. Check back early next year for an update on our findings.

ACFHP has continued its Whitewater to Bluewater *(www.easternbrooktrout.org/groups/whitewater-to-bluewater/)* project this year with its Fish Habitat Partnership neighbors, the Southeast Aquatic Resources Partnership (SARP) and the Eastern Brook Trout Joint Venture (EBTJV). This initiative promotes a collaborative approach to implementing their respective goals and the National Fish Habitat Action Plan. Currently, we are working on a Fish Passage Barrier Removal Fact Sheet that allows for conservation groups and agencies to easily modify the content in order to reach target audiences. The fact sheet will be available in the spring of 2015.

Significant progress has been made in the development of a Decision Support Tool to Assess Aquatic Habitats & Threats in North Atlantic Watersheds & Estuaries. ACFHP and its partners are working with Downstream Strategies, LLC to compile and analyze the threats to inland, estuarine, and coastal aquatic species across the Northeast Atlantic. These data are then used to model species distributions, which will provide information to produce both distribution maps and a multi-criteria decision support tool for resource managers. This work is funded by the North Atlantic Landscape Conservation Cooperative. Eastern brook trout and winter flounder models are close to completion, and data is currently being compiled to begin analyses on river herring by the end of the year. For more information on this project and the North Atlantic Landscape Conservation Cooperative, please visit *www.northatlanticlcc.org*.

In early November, ACFHP attended the 7th National Summit on Coastal and Estuarine Restoration in National Harbor, Maryland. ACFHP not only had an exhibit in the Exposition Hall that reached over 1000 participants, but presented at the conference during the Coastal Fish Habitat Partnership session. This session included presentations from Coastal Fish Habitat Partnerships spanning the national coastline: ACFHP (Atlantic region), SARP (Gulf coast), and Western Native Trout Initiative (Pacific region), as well as a panel discussion focused on aiding Coastal Fish Habitat Partnership coordination efforts. For more information on the summit, please visit the Restore America's Estuaries website at *www.estuaries.org*.

Emily Greene Receives 2014 Melissa Laser Fish Habitat Conservation Award

In November, the 2014 Melissa Laser Fish Habitat Conservation Award was presented by ACFHP to Emily Greene at the Coastal Fish Habitat Partnership session of the Restore America's Estuaries Summit in Washington, DC. Emily was the former ACFHP Coordinator and is currently working at NOAA Fisheries as the Marine Habitat Program Outreach Specialist. As ACFHP's first Coordinator, Emily worked tirelessly to guide the Partnership and Steering Committee in developing its reputation as a successful fish habitat conservation and restoration organization. Her personality and enthusiasm have been major factors in guiding the Partnership to where it is today. She has been integral in managing the Steering Committee, establishing the operational framework for the Partnership, developing the first Conservation Strategic Plan, collaborating with the USFWS and NOAA to secure funding for restoration projects, coordinating the development of multiple scientific products, securing operational funding, and disseminating information via numerous outreach opportunities. Emily has contributed significantly to the improvement of fish habitat along the Atlantic coast through her tremendous work with the Partnership. Her contributions and talent for building successful collaborations embody Melissa's own dedicated approach towards fish habitat conservation.

L to R: Bill Goldsborough, Emily Greene and Kent Smith, Habitat Committee Chair

The Melissa Laser Award was established in 2012 in memory of Dr. Melissa Laser, a biologist with the Maine Department of Marine Resources and active member of the ACFHP Steering Committee. Melissa dedicated her career to protecting, improving, and restoring aquatic ecosystems both locally in Maine and along the entire Atlantic coast. For more information on the Melissa Laser Award, please visit: www.atlanticfishhabitat.org/opportunities/awards/.

Maine

Gail Wippelhauser, Maine Department of Marine Resources

The State of Maine continues to restore rivers to their natural flow by removing dams when safety and economic concerns necessitate demolition, or installing fish passages to increase upstream access for diadromous fish. Maine has had many successes with wildlife recovery along rivers where dams have been removed.

In July of 2013, the Penobscot River Restoration Trust partnered with the State of Maine, Penobscot Indian Nation, US Fish and Wildlife Service, NOAA Fisheries, and NGOs such as The Nature Conservancy to remove the Veazie Dam (located at river kilometer (rkm) 47) on the Penobscot River. In 2014, a newly constructed fishlift began operating at Milford Dam, which is now the first barrier on the (located at rkm 63) on the Penobscot River. In its first year of operation, the fishlift passed 187,429 river herring and 805 American shad. Elsewhere, another 2,378,906 river herring used a fishlift at the Benton Falls Hydropower Project in 2014 to reach upstream spawning habitat in the Sebasticook River.

Pursuant to its Low Impact Hydropower Institute certification, Messalonskee Stream Hydro L.L.C., began installing upstream eel passage on a two-year schedule on five projects located on Messalonskee Stream. Upstream eel passage was installed at the lowermost dam (Union Gas) in 2012, and passed 20,169 yellow eels. In 2014, upstream eel passage was installed at the next upstream dam (M4), and passed 46,473 yellow eels.

In addition to fish passage issues, the State of Maine created a commission to study the effects of coastal and ocean acidification on commercially harvest and cultured species. Membership includes Senate and House representatives appointed by the President; a panel of scientists with expertise of ocean acidification and oceanography; and representatives of commercial fishing and aquaculture industries. Learn more by visiting *http://www.maine.gov/legis/opla/oceanacidificationagendas.htm.*

New Hampshire

Cheri Patterson, New Hampshire Fish and Game Department

The New Hampshire (NH) River Restoration Task Force continue to work with state, federal, non-governmental organizations, individual dam owners, and municipalities on dam removal projects by providing technical advice. Many dams under consideration for removal are due to safety concerns investigated by the NH Department of Environmental Services (NHDES), Dam Safety Section. Letters of Deficiency (LOD) have been issued and the dam owners are navigating through various studies to determine available options such as removal, repair, or modification to meet dam safety standards. These options consider many aspects such as public input, long- and short-term environmental and financial concerns, recreational impacts, etc. Below is an update of the dams affecting NH coastal watersheds and diadromous fish passage and habitats currently being considered for removal.

Great Dam (*Exeter, NH, Exeter/Squamscott River – Owner, Town of Exeter*) is the first dam above head of tide. While it does have a fish ladder and associated weir (to help direct fish towards fish ladder entrance) the Town must address safety issues concerning the dam. A decision by the Town was made in early 2014 to remove the dam and funding options for dam removal are currently being explored.

Taylor River Dam *(Hampton, NH, Taylor River – Owner, State of New Hampshire)* is a head-of-tide dam with an associated Denil fish ladder to pass anadromous fish. Both the dam, fish ladder, and the nearby I-95 bridge are in need of repair and the dam has a NHDES LOD to address safety issues. The NH Department of Transportation conducted a dam removal feasibility study in 2010 and is moving forward with replacing the I-95 Bridge within the next two years, but is still determining whether to remove or replace the attached dam. For more information, visit *http://www.nh.gov/dot/projects/hampton13408b/index.htm.*

Old Mill Pond Dam *(Hampton, NH, Nilus Brook – Owner, Town of Hampton)* was voted for decommissioning after the Town of Hampton completed an Initial Study of Alternatives to address safety. A warrant article was approved by the voters in March 2014 to provide some funding for the decommissioning, with additional funding being sought.

Macallen Dam, Newmarket *(NH, Lamprey River – Owner, Town of Newmarket)* is a head-of-tide dam with an associated fish ladder - one of the most productive diadromous fish passage facilities in NH coastal rivers. The Town of Newmarket finalized a Phase 1 dam removal feasibility study to define alternative options to meet a safety LOD from the NHDES. A dam committee will consider the next steps for evaluating the feasibility study results and addressing the LOD.

Gonic Dam (*privately owned*) and **Sawmill Dam** (*abandoned*) (*Gonic, NH, Cocheco River*) are the third and fourth dams on the mainstem of the Cocheco River. The City of Rochester and the NHDES continue to pursue removal of both dams (feasibility study conducted in 2005); however, the unresolved ownership status of the GSD and its adjacent 8.3 acre parcel continue to delay the project. In 2014, the City of Rochester with funding from DES and USFWS finalized a sediment management plan for the 3,000 cubic yards of impounded contaminated sediment that need to be removed from the river in conjunction with the removal of the GSD.

McLane Dam *(owner, Town of Milford)* and **Goldman Dam** *(privately owned) (Milford NH, Souhegan River, tributary of Merrimack River)* are now the first two dams on the Souhegan River which are currently being evaluated for removal. A feasibility study was completed in September 2014 and the Town is seeking funds for dam removal which will open an additional seven miles of the Souhegan River.

Sawyer Mill Dams (*Dover, NH – Owner, private*) at the Sawyer Mill complex represent the first diadromous fish passage barriers on the Bellamy River, a major tributary river to the Great Bay estuary. The dams lack any fish passage structures. Removal of the two dams at Sawyer Mills would reconnect 11.2 miles of upstream unobstructed stream habitat to the estuary, which represents restoring diadromous fish access to 34% of the total stream habitat in the Bellamy River system. A feasibility study was completed in March 2014 and presented to the public. Funds are currently being sought for dam removal.

Oyster Restoration in Great Bay Estuary *(Ray Konisky, The Nature Conservancy, New Hampshire)*
In 2014, TNC, the University of New Hampshire, and independent oyster growers worked together to construct an additional 4.5 acres of oyster reef in the Great Bay Estuary of NH. This was the 6th consecutive year of construction and one of the largest annual projects to date, bringing the total to 18 acres of restored oyster reef since 2009. In addition, TNC's Oyster Conservationist Program engaged 75 families across the Seacoast Region of NH and Southern Maine to grow oysters on their private docks for the restoration effort – the highest participation in the program's nine year history.

The New Hampshire Estuary Spatial Planning Project *(Kirsten Howard, NOAA Coastal Management Fellow, New Hampshire Coastal Program)*
The New Hampshire Estuary Spatial Planning Project (NH ESP) is a two-year effort to better understand the ways people benefit from Great Bay estuary ecosystems and inform decisions to sustainably maximize those benefits while reducing conflict. The project is using spatial modeling tools to understand current and future risks to Great Bay estuary habitats as well as the quantity, value, and spatial distribution of ecosystem services provided by those habitats. Ecosystem services provided by eelgrass, salt marshes, and oyster beds in the Great Bay estuary include recreation, water filtration, coastal protection, and fisheries production supported by nursery habitat. NH ESP launched in September 2013 and is coordinated by the New Hampshire Coastal Program's NOAA Coastal Management Fellow, Kirsten Howard. The project is supported by the NHDES Coastal Program and NOAA's Coastal Services Center as well as TNC, the Piscataqua Region Estuaries Partnership and the Natural Capital Project as well as multiple partner organizations that serve on the project Advisory Committee.

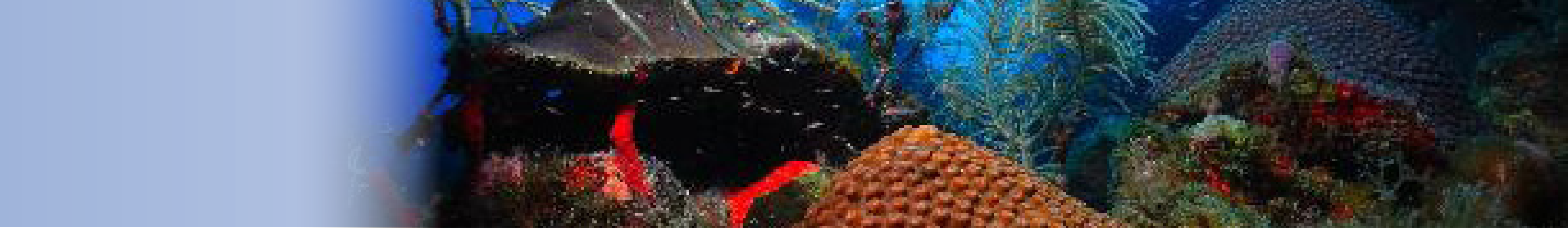
DMF volunteer Charlie Markos recording dock measurements at a dock site. Grass clippings were collected from random locations under and adjacent to docks Control location in foreground. Source: Marine Fisheries Habitat Program

Massachusetts

Mark Rousseau, Massachusetts Division of Marine Fisheries

Marine Fisheries Habitat Program Receives Hurricane Sandy Grant to Examine the Use of Dredged Rock Material for Shoreline Protection and Fisheries Habitat Enhancement
In the face of rising sea levels and more frequent and intense storms, there is interest among regulators and NGOs in developing infrastructure solutions for Massachusetts that can demonstrate both aquatic habitat benefits and shoreline protection. The MarineFisheries Fisheries Habitat Program received $240 thousand in coastal resilience funding from the U.S. Department of Interior (DOI) to consider how to combine the dual purposes of shoreline protection and enhancing marine fisheries resources. This is a collaborative effort led by MarineFisheries that includes TNC, the Massachusetts Office of Coastal Zone Management, the City of Boston, Northeastern University, and the U.S. Army Corps of Engineers. With this grant, partners will select a nearshore site and secure permitting for a designed structure that will maximize wave attenuation for protecting vulnerable shoreline while maintaining and enhancing biological function and diversity. The goal of the project is to examine the feasibility of utilizing rock taken from a dredging project for the Boston Harbor federal navigational project and repurposing material on a project to reduce wave energy and protect transplanted eelgrass. The hard bottom habitat and restored eel grass beds will benefit many finfish and shellfish native to the area while protecting vulnerable urban shorelines. For more information, please contact Mark Rousseau at *mark.rousseau@state.ma.us.*

Shading Impacts of Docks and Piers on Salt Marsh
In 2013, MarineFisheries initiated a field study examining shading impacts of docks and piers on salt marsh vegetation by installing a network of experimental docks set at different heights over a salt marsh in Marshfield, Massachusetts. In 2014, this study was repeated for a second field season and a new complementary study of existing docks and piers was conducted throughout the Massachusetts coast. In this new study, over 200 dock sites were sampled, with marsh vegetation collected under and adjacent to docks to assess any relative changes in marsh grass stem density, biomass, or height in relation to dock characteristics (e.g., dock height, width, orientation, decking type). Marsh clip plot samples collected in 2014 for the two studies will be processed this fall and winter. These experimental data will provide information for regulatory agencies to better inform dock design and regional planning. For more information, please contact John Logan at *john.logan@state.ma.us.*



MarineFisheries examines the impacts of conventional vs. conservation moorings on eelgrass habitat

The MarineFisheries Habitat Program continued work on a project funded by the ACFHP to study the impact of conventional chain moorings on eelgrass meadows versus that of "conservation moorings" in West Falmouth Harbor. "Conservation moorings" are designed to minimize impacts to eelgrass meadows by utilizing a floating flexible rode which replaces the traditional mooring chain that drags on the seafloor and causes direct scour of eelgrass beds. In 2013, eight traditional moorings were replaced with "conservation moorings." Additionally, three of the converted mooring sites were augmented with eelgrass transplants, while the remaining five were left to fill in naturally. In 2014, diver monitoring along with aerial surveys provided by Lighthawk, has shown that the mooring scars are beginning to decrease in size and some filling in of eelgrass is evident in both planted and unplanted scars where "conservation moorings" were installed. Further monitoring is scheduled for next year. For more information, please contact Tay Evans at *tay.evans@state.ma.us*.

Rhode Island

Eric Schneider, Rhode Island Department of Environmental Management

Cultured oysters (Crassostrea virginica) from a farm in Ninigret Pond, Charlestown, RI Source: Rhode Island Dept. of Environmental Management

A State-Wide Collaboration to Improve Shellfish Management and Research

Over the last two years, experts from across Rhode Island have been developing the first comprehensive management plan for shellfish in the state's history. Facilitated by the Coastal Resources Center/ Rhode Island Sea Grant at the University of Rhode Island, this two year effort serves to highlight and honor the value of shellfish to the state's economy, environment, and culture. In collaboration with the RI Department of Environmental Management and the state's Coastal Resources Management Council (the two agencies charged to set policy and regulate shellfish resources and industries in the state), a series of stakeholder meetings and public events have brought participation from the wild harvest shellfish community, the aquaculture industry, universities, non-profits, and federal agencies to discuss issues related to shellfish and pave a path for improved future management efforts.
The Shellfish Management Plan (SMP) process marks several important accomplishments including crafting the state's first Vibrio Control Plan for oysters, enacting a noon-time reopening for water quality closures, collecting GPS coordinates for signs delineating open and closed shellfishing grounds, and evaluating the effectiveness of current quahog spawner sanctuary locations. The SMP will culminate in a detailed description of shellfish resources and industries alongside various management and research recommendations. A first draft is available online through Nov. 1st for public comments. See *www.rismp.org* for more information.

Connecticut

Penny Howell, Connecticut Department of Energy and Environmental Protection

The impacts of increased precipitation and flooding, both inland and coastal, on Connecticut communities was the focus of a University of Connecticut Climate Adaptation Academy (CAA) workshop held on October 10, 2014. Over 70 attendees representing municipalities and companies across Connecticut learned about precipitation forecasts and what they mean for existing infrastructure and natural resources. Workshop sessions included a Connecticut Department of Transportation case study looking at impacts of increased precipitation on roadways and culverts on a watershed in northwestern Connecticut, information and resources from the Unites States Geological Survey on flood frequency analysis and real-time stream gauging networks, and floodplain management and policies. The CAA is a new NOAA program at the University of Connecticut Avery Point (Groton, CT) designed to work with municipalities and relevant professionals on current climate change related issues and climate change adaptation. Through feedback from municipalities and other constituents, CAA is prioritizing the needs of municipal officials and other professionals concerning climate adaptation, and is organizing workshops around these priorities. Topics under consideration for future workshops include the logistics of green infrastructure and developing living shorelines.

Connecticut completed eight fish passage projects, with three dams removed and five fishways installed, restoring access to 18.3 miles of riverine habitat. One tidal wetland project restored 1.7 acres of salt marsh.

New York

Dawn McReynolds, New York State Department of Environmental Conservation

Sunken Meadow State Park's Comprehensive Resiliency and Restoration

In many ways, Hurricane Sandy jump-started the restoration process when it removed the earthen dike which restricted the connection between the 132 acres of coastal habitats within Sunken Meadow Creek and Long Island Sound. Since Hurricane Sandy, bank improvements and the installation of a footbridge have been completed, but additional restoration and green infrastructure are needed to further improve the ecological integrity of the Creek. NYS Office of Parks, Recreation and Historic Preservation (NYSOPRHP) and partners (Connecticut Fund for the Environment (CFE)/Save the Sound, NOAA Restoration Center, The Nature Conservancy, United States Fish and Wildlife Service, and New York State Department of Environmental Conservation (NYSDEC) are planning and implementing the next steps in a comprehensive resiliency and restoration plan that will focus on additional habitat restoration, improved stormwater detention, green infrastructure, and fish passage feasibility. The Plan was recently funded by the Hurricane Sandy Coastal Resiliency Competitive Grant Program, a disaster relief appropriation through the Department of the Interior (DOI), and administered by National Fish & Wildlife Foundation (NFWF).

Marsh restoration includes soil removal and plantings to restore ecological services. Source: New York Dept. of Environmental Conservation

To reduce stormwater discharge quantity and improve stormwater and groundwater discharge quality to Sunken Meadow Creek and Long Island Sound, approximately 12-acres of impervious asphalt parking will be replaced with a structurally supported grass multipurpose area. This redesigned area will accommodate vegetated open space, picnicking, and play areas while integrating low-impact materials such as grass supported with structural soil and/or pervious pavement for overflow parking. A series of interpretive signs will be placed along the Creek corridor to highlight changes that have occurred and will be occurring within the Creek. An educational program funded through this grant will provide environmental interpretation and stewardship for park visitors and school groups.

The western headwaters of Sunken Meadow Creek have been heavily modified over the last hundred years. There are seven dams along Sunken Meadow Creek, consisting of earthen berms with concrete structures fitted with wooden weir boards. A feasibility study will assess fish passage restoration opportunities within and adjacent to the park. Certain dams have potential for passage of alewife and American eel. Additional green infrastructure alternatives will be explored to restore marsh ecological services through soil removal and marsh plantings to create almost five acres of salt marsh.

New Jersey

Russell Babb, New Jersey Department of Environmental Protection

Living Shorelines Encouraged in New Jersey

Following Superstorm Sandy, the New Jersey Department of Environmental Protection (DEP) initiated changes to the State's Coastal Permit Program Rules and the Coastal Zone Management Rules to encourage and facilitate living shorelines and habitat restoration projects in an effort to create more resilient coastal areas in New Jersey. The DEP formed a Living Shorelines Workgroup to serve as the primary point of contact to bring together the internal offices and programs to coordinate, promote and explore opportunities to restore habitat and natural shorelines, evaluate and refine practices that work best in coastal areas, and use the findings to refine coastal policy and regulations moving forward.

To date, the Workgroup has provided guidance on living shorelines projects for single family homes, county, and State facilities, as well as saltmarsh restoration projects. On the horizon, the Workgroup will be involved with a large number of projects to receive Hurricane Sandy Coastal Resiliency Competitive Grants from the DOI. The DEP is also working with the Stevens Institute of Technology's Center for Maritime Systems to develop a living shorelines guidance document for the engineering and regulatory community, with a focus on the engineering components of living shorelines project design and identifying the critical site-specific parameters.

NJDEP Superstorm Sandy Blue Acres Acquisition and Conservation Program

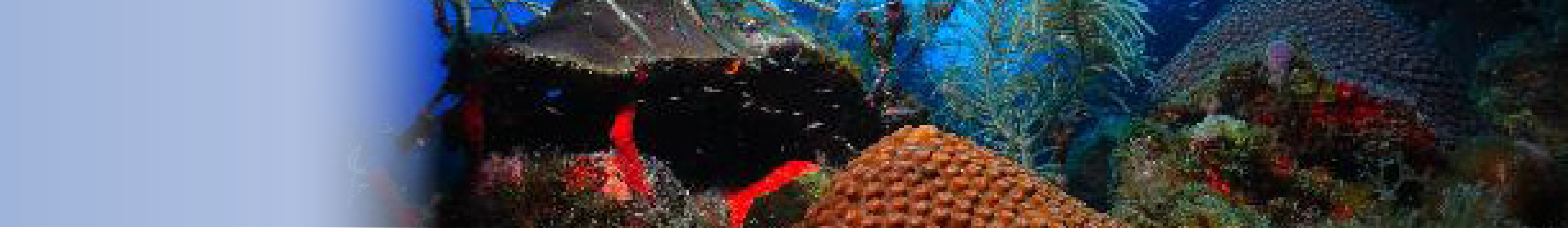
The Blue Acres Program is part of New Jersey's Green Acres Program that purchases and converts flood-prone properties and restores them to natural area buffers. Its goal is to dramatically reduce the risk of future catastrophic flood damage and to help families to move out of harm's way. Through the Program, the State will spend $300 million in federal disaster recovery funds to give homeowners the option to sell Sandy-damaged homes at pre-storm value in flood-prone areas. These homes will be demolished, and the land will be permanently preserved as open space, accessible to the public, for recreation or conservation purposes.

Shellfish and Submerged Aquatic Vegetation Surveys

The NJ Division of Fish and Wildlife (DFW) has ramped up its shellfish and SAV assessment program. Over the past three years, shellfish and SAV surveys have been conducted in Little Egg Harbor Bay, Barnegat Bay (both pre and post Superstorm Sandy) and work is being completed in Raritan and Sandy Hook bays. The assessments enable biologists to estimate the number of hard clams present, to identify sensitive areas for future coastal development projects, and to identify areas suitable for restoration and enhancement efforts.

Partnership to Identify Historical Oyster Habitat for Restoration Work

DFW partnered with the Richard Stockton College Marine Science Field Station to monitor the Mullica River-Great Bay Estuary's oyster population to assess sites where historical habitat can be enhanced and new habitat created. DFW intends to build on previous enhancement and restoration work in the estuary. The overall goal of this project is to establish a long-



term program to monitor the seasonal recruitment of young oysters in the Mullica River-Great Bay system, which holds the last two viable natural oyster seed beds on New Jersey's coast. The team will use multibeam sonar to map the seafloor and identify sites with the greatest restoration potential to enhance oyster reefs. Bathymetric (depth) data will be collected to avoid steep, unstable slopes and classify the potential suitability of substrate for oyster settlement. New oyster habitat can improve water quality and provide essential fish habitat and can provide opportunities for recreational and commercial oyster harvesting.

Barnegat Bay Initiative Continues

Since late 2010, the Christie Administration has continued to make progress on a comprehensive action plan to address the health of Barnegat Bay. Its 660-square-mile watershed with its 75-square-mile estuarine system encompasses most of the 33 municipalities in Ocean and Monmouth counties, The entire watershed has undergone dramatic growth since 1950, resulting in land use changing from principally undeveloped or agricultural to suburban, leading to surface and groundwater quality issues with negative impacts on the estuary's fisheries and other biological resources.

Addressing these issues requires a complex approach. The Bay cannot be restored to a pristine condition, but further degradation can be prevented and some restoration is possible. Input from extensive stakeholder involvement complemented by scientific data and research conducted by the NJ DEP and other researchers provided the basis for the Administration's action plan for Barnegat Bay. The plan includes a negotiated agreement with Exelon Corporation to cease electric generation operations at the Oyster Creek Generating Station, funding stormwater mitigations projects, new rules reducing nutrient pollution and standards for post-construction soil restoration, land acquisition, special or sensitive area plans, shellfish enhancement, increased water quality standards and reducing the impacts of personal watercrafts on sensitive habitats.

Pennsylvania

Benjamin D. Lorson, Pennsylvania Fish and Boat Commission

Fish Passage Restoration: Pennypack Creek

The City of Philadelphia and project partners are working to acquire funding to continue restoration efforts on Pennypack Creek in the lower Delaware River basin. To date, four dams have been removed and a rock ramp fishway has been constructed over a sewer line crossing. Project partners are designing plans to remove a large portion of the Roosevelt Boulevard Dam (RM 5.8) and construct a rock ramp fishway over the remaining structure. This project would remove the last major blockage and restore migratory and resident fish passage to the entire mainstem of Pennypack Creek. Verree Road Dam (RM 9.2) is still intact but is breached around the left abutment and likely passes fish under certain conditions.

Atlas Dam Removal

Local partners have acquired the necessary funding and have begun the removal of Atlas Dam on Hokendauqua Creek, Northampton County, PA. The dam is located approximately one mile upstream of Hokendauqua Creek's confluence with the Lehigh River. There are three dams on the Lehigh River with fish passage facilities. The project will benefit migratory and resident fish passage in Hokendauqua Creek.

Heistand Sawmill Dam Removal

Heistand Sawmill Dam is located on Chiques Creek approximately 150 meters upstream from its' confluence with the Susquehanna River near Marietta, Lancaster County, PA. The project will restore unimpeded fish passage to approximately 13 miles of Chiques Creek to benefit resident and migratory fishes. Project partners have acquired all necessary funding and the project is scheduled to go to construction in the Spring of 2015.

Downing Ridge Dam

Downing Ridge Dam impounds East Branch Brandywine Creek near Downingtown, Chester County, PA. Project partners are advancing the removal of the dam to benefit resident fish passage and eliminate a threat to public safety. This project could benefit migratory fishes if additional fish passage improvements are advanced downstream.

Darby Creek Dam removals

The Darby Creek Restoration Project restored fish passage to 9.7 miles of Darby Creek in Delaware County, PA. Three dams and bridge pier remnants were removed in 2012. Darby Creek flows into the lower Delaware River and the project aimed to benefit migratory and resident fish species. Fishery surveys conducted September

Kent Park Dam before removal of stone structures (left) and after (right). Source: PA Fish and Boat Commission

2014 in the tidal portion of Darby Creek revealed the presence of young of year river herring. Fishery and habitat assessments will be conducted through 2018 to monitor the physical and biological response to the dam removals.

PFBC to receive funding dedicated to Habitat Restoration

The PA Fish and Boat Commission will be receiving $150,000 annually through 2030 to be directed at aquatic habitat restoration in York and Lancaster Counties in the Lower Susquehanna River Drainage. At least $50,000 will be dedicated to dam removals in those two counties. This funding will be provided to PFBC by Exelon Generation Company, LLC as specified in the Section 401 Water Quality Certification for the operation of the Muddy Run Pumped Storage Project and the Peach Bottom Atomic Power Station. PFBC will work with willing dam owners to restore migratory and resident fish passage, restore natural stream function, improve water quality and remove hazards to public safety.

Delaware

Jeffrey Tinsman, Delaware Division of Fish and Wildlife

The Delaware Division of Fish and Wildlife recently promulgated regulations covering shellfish aquaculture activities in Rehoboth, Indian River, and Little Assawoman Bays. Delaware is now seeking permission from the United States Army Corps of Engineers to use Nationwide Permit 48, which authorizes discharge of dredged or fill material used for commercial shellfish aquaculture activities. When aquaculture leases are granted, Delaware will become the last state along the Atlantic coast to allow shellfish aquaculture.

A bay-wide survey of the wild hard clam population in Indian River and Rehoboth Bays was concluded in 2012. This survey shows that Delaware has a robust clam population, unchanged from the earlier survey conducted in 1976. Many Atlantic coast states have documented significant declines in native hard clam populations over this period. In order to protect Delaware's native hard clam and oyster populations, aquaculture regulations will require disease testing of any shellfish imported into the state. Probably the most important measure will be the geographic separation of wild and aquaculture stocks to reduce disease transfer and genetic mixing. Delaware's oyster beds and fishery are in Delaware Bay, while oyster aquaculture will be limited to the three coastal bays. Delaware's wild hard clam stock and fishery are in Indian River and Rehoboth Bays. Hard clam aquaculture will be limited to Little Assawoman Bay, an isolated system which will support hard clams but has no native population. More information on these regulations can be found at *http://www.dnrec.delaware.gov/Info/Documents/Secretarys%20Order%20No.%202014-F-0013.pdf*

Information on Nationwide Permit 48 (USACE): *http://www.usace.army.mil/Portals/2/docs/civilworks/nwp/2012/NWP2012_corrections_21-sep-2012.pdf*

Maryland

Marek Topolski, Maryland Department of Natural Resources

The Maryland Department of Natural Resources Fish Passage Program works to ensure anadromous species such as shad and river herring have access to spawning habitats. In 2014, Bloede Dam removal project has completed the 60% design phase and is awaiting public comment. Relocation of an upstream sewer line is scheduled for 2015 and dam removal is scheduled for 2016. Read more about fish passage and the DNR's activities on *http://dnr2.maryland.gov/fisheries/Pages/fishpassage/index.aspx.*

Oyster restoration in Chesapeake Bay has focused on a 377 acre portion of Harris Creek, a tributary of the Choptank River. To date, 189 acres of the site have been constructed or planted. Two additional oyster sanctuary sites are under development in Little Choptank River and Tred Avon River. Construction is scheduled to begin in December 2014. Read more about MD DNR's oyster restoration activities by visiting *http://dnr2.maryland.gov/fisheries/Pages/oysters/eco-restoration.aspx.*

In 2014, the Maryland General Assembly passed a bill to create an Ocean Acidification Task Force, the members of which include the Chesapeake Bay Foundation, National Aquarium, University of Maryland's Center for Environmental Science, Maryland Watermen's Association, and Hollywood Oyster Company. The mission of the task force is to analyze the best available science on ocean acidification and its potential effects on the ecology of State waters and on fisheries, and to recommend potential strategies to mitigate those effects. The Task Force is scheduled to release a report in January 2015 detailing what is known about ocean acidification impacts to coastal and estuarine ecosystems, and to provide recommendations for how to address those impacts. Particular attention will be paid to effects on shellfish and finfish and the implications of those effects for related industries. For more information on the Task Force and its accomplishments, visit *http://mddnr.chesapeakebay.net/mdoatf/index.cfm.*

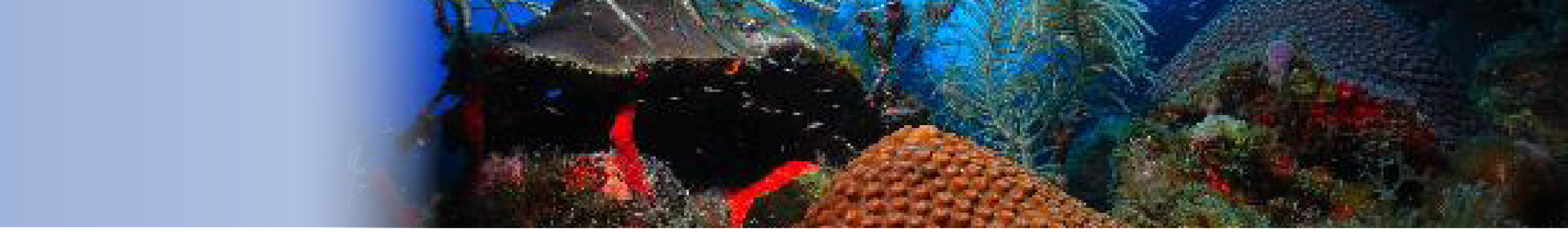
The Department of Natural Resources also developed an interactive web map titled "Restoration Print" which allows for the general public to see how and where Chesapeake and Atlantic Coastal Bays Trust Fund resources are being used *(http://www.dnr.maryland.gov/ccs/funding/trust_fund.asp)*. Smart phone users can download MD DNR's Mobile Restoration App, available on iTunes and Google Play stores *(http://www.dnr.maryland.gov/ccs/restoration.asp).*

Virginia

Tony Watkinson, Virginia Marine Resource Commission

Virginia Seaside Restoration

Restoring the health of the Seaside has been one of the Virginia Coastal Zone Management (CZM) Program's largest financial investments ($4.69 M) and longest running efforts (1999 to present).



The shallow waters and barrier islands of Virginia's Eastern Shore form a rich and dynamic ecosystem protecting the mainland from storms and erosion. Over the last century, this area has suffered substantial economic and ecological losses to the barrier Islands surrounding marine habitats and resources from hurricanes and disease. Since 1999, the CZM Program has worked with the Virginia Institute of Marine Science (VIMS), the Virginia Marine Resources Commission (MRC), TNC, and many others to bring back eelgrass, bay scallops, oysters and shore birds. 380 acres of eelgrass planted with 51 million seeds over the past 11 years has now spread to over 4,700 acres, making this the largest and most successful eelgrass restoration project on the planet. Efforts by Dr. Mark Luckenbach of VIMS and others to reintroduce the bay scallop into the eelgrass beds saw the number of scallops found within 4500 m2 (~ 1 acre) at 90 sites jump from 25 to 99 between 2013 and 2014. Success to date has been encouraging and the goal is to once again have a bay scallop fishery.

This year, the US Army Corps of Engineers will be providing about $646k to VIMS over the next 6 years matched with CZM dollars and the Saltwater Recreational Fishing Funds. VA CZM funded VIMS, TNC, the Accomack-Northampton Planning District Commission (ANPDC) and Accomack County to analyze habitat and human uses and develop new policies for better management of Seaside. Through this effort Accomack County adopted the Chesapeake Bay Preservation Act provisions on the Seaside

Along with the eelgrass success, Dr. Mark Luckenbach of VIMS is using CZM and other funds to reintroduce the bay scallop into the eelgrass beds. Between 2013 and 2014 the number of scallops found within 4500 m2 (~ 1 acre) at 90 sites jumped from 25 to 99. Bay scallops can be ephemeral. They live for only about 2 years and their populations can fluctuate dramatically depending on growth conditions.

In addition, spatial analysis of public oyster grounds (Baylor Grounds), shellfish private leases, and eelgrass restoration areas illustrated the need for more flexible policies to manage this diverse and dynamic system and protect public resources. For example, within the current boundaries for public oyster grounds (established in the 1980's), only 56% of the underwater habitat is now suitable for oysters and only 43% of natural oyster reefs are still within the public grounds.

Private shellfish growers expressed concern that eelgrass restoration and proliferation could continue to the point of precluding other uses. The CZM Program staff led a mapping exercise in which VIMS scientists and MRC staff collaboratively mapped all the potential eelgrass expansion areas on the Seaside. Currently SAV covers about 4.7% of underwater land on the Seaside. According to VIMS, it only has the potential to spread naturally to another 5% and only in a few, specific areas. This analysis was presented to the MRC Commissioners at the January 2014 monthly meeting resulting in the Commissioner requesting recommendations for new SAV set aside areas on the Seaside. Work will continue in collaboration with VIMS scientists, MRC and A-N PDC staff, watermen and shellfish growers to identify the best areas for the Commission's consideration.

Constructed Spawning Reefs as a Possible Recovery Strategy for Endangered Atlantic Sturgeon in the James River, Virginia

The Atlantic sturgeon once supported a major Chesapeake Bay fishery and was among the oldest, largest, and most iconic species along the Atlantic coast. In response to habitat loss, pollution, and over-fishing, Atlantic sturgeon abundance declined dramatically and, as recently as the early 1990s, some biologists believed that the species was extirpated from Chesapeake Bay. However, small numbers of sturgeon did persist in a few coastal rivers, including the James River of Virginia. Most U.S. populations were listed by NOAA as federally endangered in 2012. As part of ongoing research and recovery efforts for James River Atlantic sturgeon, three spawning reefs were constructed in the James during the period 2010-2013 by the James River Association (JRA) and Virginia Commonwealth University (VCU), with support from USFWS, National Fish and Wildlife Foundation, The Nature Conservancy, Luck Stone, and Vulcan Materials. Each reef is about one-half hectare in size and site selection was based on a number of criteria, including river depth, salinity, and proximity to known migration corridors. Habitat mapping by VCU, USGS, and NOAA suggested that the availability of clean, hard substrate may limit recovery in the James, which experiences high rates of sedimentation from watershed sources. Post-construction monitoring of reefs employed a wide array of gears, including egg mats, nets, and acoustic telemetry, and reef utilization has been documented for several migratory and semi-migratory fishes, including white perch and Alosa spp. To date, no eggs of Atlantic sturgeon have yet been recovered from the reefs but monitoring will continue, as resources permit. For more information on this program, contact Greg Garman, *ggarman@vcu.edu.*

Construction of a spawning reef for Atlantic Sturgeon in the tidal James River, Virginia near Jones Neck. Source: G. Garman

Updates from Around the Coast

North Carolina

Jimmy Johnson, North Carolina Department of Environment and Natural Resources

The 2013-2014 reporting year was a time of transition for North Carolina's Coastal Habitat Protection Plan (CHPP) process due to the reorganization of several North Carolina Department of Environment and Natural Resources (DENR) divisions and the restructuring of the associated commissions. DENR requested the CHPP process and direction be re-evaluated and modified if necessary so that the plan remains vital and relevant in sustaining our state's natural resources, and that it supports the department's priorities and mission statement. CHPP Steering Committee will meet to discuss habitat and water quality issues of concern to the DENR divisions and provide input on the 2015 CHPP update. Significant work has occurred this past year with regard to the identification of Strategic Habitat Areas in the White Oak River Basin (SHA Region 3). The lead agency for this work is the NC Division of Marine Fisheries (DMF), with significant assistance from the Albemarle-Pamlico National Estuary Partnership (APNEP), other DENR divisions, and universities. The identification of a subset of strategically located, high quality coastal habitats is an important non-regulatory planning tool for resource managers, local government, and conservation groups.

During the 2013-2014 year, APNEP, DMF, National Oceanic and Atmospheric Administration (NOAA), and the Division of Transportation (DOT) worked together to photograph the extent of Submerged Aquatic Vegetation (SAV) in eastern portions of Albemarle-Pamlico National Estuary. These images will be compared to previous images taken in 2008 and 2009 to review the extent of change in SAV habitat.

A Low Impact Development (LID) Summit was held in Raleigh, attended by close to 300 people. The Summit was led by the Division of Water Resources (DWR) in conjunction with the NC Coastal Federation (NCCF) and NC State University. Funding and staff for the Summit were provided by APNEP. The Summit promoted LID as an environmentally sound way to develop, and presented a new computer model, Stormwater EZ, which can be used state-wide to help design LID projects and help secure the necessary permits.

To encourage alternatives to vertical shoreline stabilization, Division of Coastal Management (DCM) staff drafted a Living Shoreline Strategy with input from other DENR division representatives. The strategy identifies six short-term and four long-term actions for Department consideration. The document summarizes previous and ongoing estuarine shoreline stabilization research in the state, identifies information gaps, highlights the need for continued staff engagement and public awareness, and investigates potential grant programs or cost reductions. The strategy also recognizes the need to promote other living shoreline strategies (other than riprap sills), to develop training programs/certification for marine contractors, and to partner with groups such as the military to increase the number of demonstration sites. The draft will be presented to the CHPP Steering Committee and DCM will continue working on specifications within the strategy.

A 5-year review and revision, required under the 1997 Fisheries Reform Act, is underway. The current plan is to streamline the document to reduce redundancy, and focus on priority issues, as directed by DENR and the CHPP Steering Committee. DMF staff has been working on draft edits for several months, and anticipates that staff from other agencies will be actively involved in the final update.

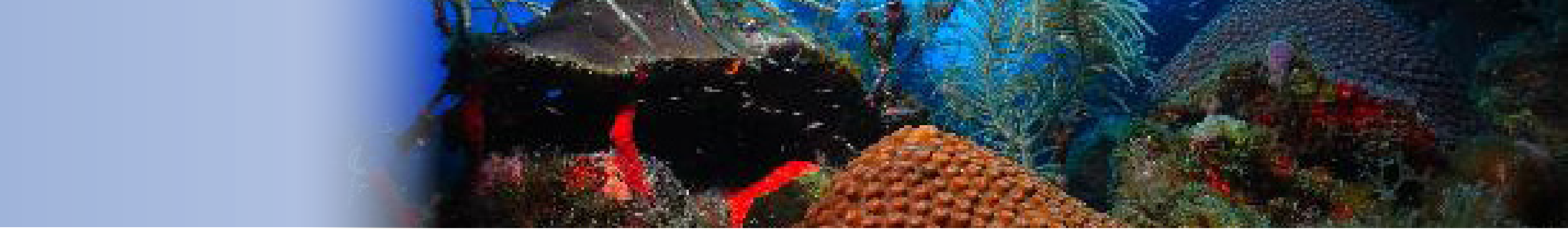
South Carolina

Dr. Robert VanDolah, (retired), South Carolina Department of Natural Resources

The South Carolina Department of Natural Resources (SCDNR) continued its development of living shorelines using a variety of materials including oyster shell, experimental crab trap reefs and oyster castles. A number of projects are being conducted in South Carolina which have the potential to alter habitats including dredging, beach renourishment, and harbor deepening.

The South Island Dredging Association (SIDA) conducted one of the largest open water disposal projects ever conducted in South Carolina waters this past year. The disposal operation removed 240,000 yd3 of predominantly fine grained sediments from intertidal and shallow subtidal creek bottoms, approach channels and marina basins. The sediments were pumped to an open water site near the entrance of Calibogue Sound. Disposal occurred near the bottom over a period of 96 days. A monitoring study of the project impacts is being conducted. The Charleston Harbor Deepening Project (Post 45) Study is continuing on an accelerated schedule. The planned project will both widen and deepen existing channels to a minimum of 45' maintained. Environmental assessments (of interest to habitat effects and protection) include assessments of hard bottom habitats, benthic surveys, wetland assessments habitat suitability indices, sediment testing, and air quality analysis. Updates on the Charleston Harbor Post 45 Project are provided at *http://www.sac.usace.army.mil/Missions/CivilWorks/CharlestonHarborPost45.aspx*

The U.S. Army Corps of Engineers completed a major beach renourishment project at Folly Beach. This project pumped sand onto approximately 4.9 miles of shoreline along the majority of the island, excluding undeveloped portions on the north and south ends of the island. Approximately 1.4 million yd3 of sand were pumped from four offshore borrow sites. The borrow areas will be monitored for one year to assess potential impacts including sediment composition changes and macrobenthic community changes. Previous monitoring of two of the borrow sites for Folly Beach showed an accumulation of muddier



sediments in the borrow site holes, thereby making them unsuitable for use in subsequent projects. Two of the borrow sites will be mined for sand to a lesser depth below grade, which will hopefully reduce the accumulation of muddier sediments. SCDNR and the Bureau of Ocean Energy Management (BOEM), as part of a two-year cooperative agreement, will undertake an effort to compile, collect, and reassess old and new data on sand resources in the Outer Continental Shelf area (OCS) of South Carolina. The goal of this project is to develop a framework for locating OCS sand resources offshore of South Carolina by improving our knowledge of existing data. Previously assembled data sets will be expanded with additional data to develop an inventory of sand resources. The purpose of the inventory is to provide a data framework that can be evaluated for data gaps, so that future data collection can be directed towards areas needing information of any particular type.

A permit is being sought for the processing of cannonball jellyfish in South Carolina. Potential water quality concerns from discharge, currently proposed in a tidal creek, are being evaluated through chemical and toxicity testing.

Georgia

January Murray, Georgia Department of Natural Resources

Management of Artificial Reefs

Georgia Department of Natural Resources (GADNR) annually deploys donated materials of opportunity to enhance both offshore and inshore artificial reef sites. Offshore enhancements consist of two reef sites deployed by a hopper barge loaded with 330 metal chicken transport cages, a steel deck barge, and other materials of opportunity. Inshore enhancements at two reef sites included the deployments of: 49 concrete transmission line poles and 13 steel drum frames. Reef project goals include obtaining donations of materials and funding, maintaining permits and partnerships, and annual material inspection surveys via side scan sonar, aerial reef flyovers, and SCUBA diving. GADNR also consults with the Department of Defense and US. Army Corps of Engineers (USACE) on the decommissioning of eight offshore Tactical Aircrew Training System Towers to create fish habitat located in federal waters along the Georgia coast. Regional Permit 36 (RP 36) authorizes the deployment and maintenance of materials at Georgia's 30 offshore artificial reef sites. GADNR also maintained a State Coastal Marshland Protection Act permit (CMPA 682) and a federal USACE Programmatic General Permit (PGP 37) for the enhancement of fifteen inshore artificial reefs at multiple locations throughout coastal Georgia.

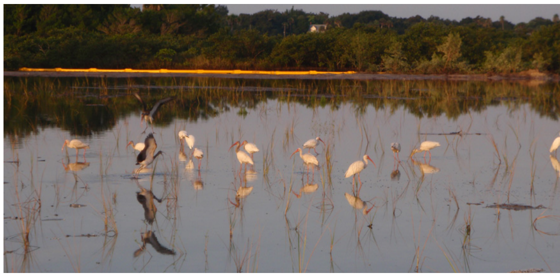
GADNR oyster test plot area where 90 bags of recycled oyster shells, 48 bamboo spat sticks, and one oyster ball were deployed within a 60′ l x 30′ w footprint. Source: January Murray

Oyster Reef Restoration

In spring of 2014, GADNR in partnership with the Coastal Conservation Association of Georgia, Oatland Island Wildlife Center, and the Surf Rider Foundation planted natural cultch materials at two sites and five test plot areas to enhance substrate for oyster restoration. Funds donated from the Georgia Natural Resources Foundation were used to assist with costs associated with shellfish restoration projects. Through GADNR's Oyster Shell Recycling Program, the local community provided 24 tons of shells (cured three to six months). 10.6 tons of donated shells were used to in two 2014 restoration projects, including a 14-ton reserve. A third restoration project utilized wire bundles and bamboo spat sticks. Approximately seven tons of recycled oyster shells were planted to restore 0.017 acres of oyster reef. An additional 3.6 tons of recycled oyster shells, 240 bamboo spat sticks, and five oyster balls were planted at five test plot areas (0.018 total acres) to verify the viability of each location. Each test plot was monitored to document changes in larval recruitment and sedimentation rates by observing variations in recruitment in relation to: 1) material type; 2) distance from marsh edge; and 3) distance from mean low water. GADNR conducts monitoring at all oyster restoration and test plot sites to ensure project objectives are achieved. In addition to providing bank stabilization, essential fish habitat, and improved water quality, these oyster restoration sites serve as excellent locations for education and outreach projects showcasing restoration of shellfish in Georgia's estuarine waters.

Florida

Kent Smith, Florida Fish and Wildlife Conservation Commission



Florida's Northeast Estaurine Restoration Team secured $1.5 million to restore marsh habitats. Source: Florida Fish and Wildlife Commission

Expansion of ports in Florida continues to be a focus of activities affecting fish habitats. The Port of Miami dredging project has begun, and sedimentation resulting from this activity is affecting coral habitats along the channel dredging and access path. Mitigation of fish habitat damage associated with the Port of Jacksonville channel deepening is currently being assessed through the ACOE's EIS process. Ports up and down the east coast of Florida are pursuing deepening in anticipation of the post-Panamax era, and resource managers are working to address mitigating the adverse effects to marine and estuarine habitats.

Top: Smooth cord grass is planted for a salt marsh restoration project. Bottom: Smyrna Beach with new plantings. Source: Florida Wildlife Commission

Regional estuarine habitat restoration efforts have been advanced through the development and implementation of the Northeast Estuarine Restoration Team's (NERT) Northeast Florida Estuarine Habitat Restoration Priority Plan. A confederation of regional federal, state, NGO, and local estuarine habitat managers, NERT has collaborated to secure a $1.5 million NOAA community restoration grant to restore subsided marsh, dragline ditched coastal marsh, filled saltmarsh, and a black mangrove/smooth cordgrass marsh. The latter project is a 4-acre saltmarsh restoration project that was recently completed at the Florida Wildlife Commission's New Smyrna Beach ecocenter, and will provide up to 50,000 smooth cord grass and black mangrove out-planting units annually for regional restoration projects. This project also includes a series of shoreline demonstration projects ranging from traditional seawall to full living shoreline installations complete with informational signs providing private property owners with the tools to make decisions on use of living shoreline alternatives for their coastal property.

The Southeast Coral Reef Initiative, addressing coral habitats from St. Lucie County south to Miami, has initiated a conservation initiative called Our Florida Reefs. This stakeholder process, led by the Florida Department of Environmental Protection and NOAA, seeks to develop coral habitat conservation strategies from the perspective of local stakeholder interests. The conservation measures could take varied forms from non-regulatory to regulatory actions. This process will continue through 2015 with recommendations from the regional OFR teams expected early in 2016.

New England Fishery Management Council

Michelle Bachman, NEFMC

During 2014, the New England Fishery Management Council has focused on finalizing management alternatives to protect essential fish habitats throughout the New England region. These alternatives have been developed and analyzed as part of Omnibus Essential Fish Habitat Amendment 2, which was published in draft form in October. The public comment period on the amendment closes in January 2015, and the Council plans to make final decisions on which measures to recommend during spring 2015. The new measures would go into effect as early as December 2015.

The measures include management areas in the Gulf of Maine, on Georges Bank, and in Southern New England where mobile bottom-tending gear use would be limited or prohibited entirely. The management areas generally contain habitat types that are highly structured and therefore more susceptible to fishery impacts. Some of the areas were specifically chosen because they contain large number of juvenile groundfish that associate with structured habitats. The Council is also considering new spawning protection areas as well as dedicated habitat research areas. In addition, the amendment will update essential fish habitat designations for the 28 species of finfish and shellfish managed by the Council, and also includes designated habitat areas of particular concern, which are subsets of essential fish habitat deemed to have special significance.

NMFS Southeast Regional Office

Dr. Pace Wilber, NOAA Fisheries

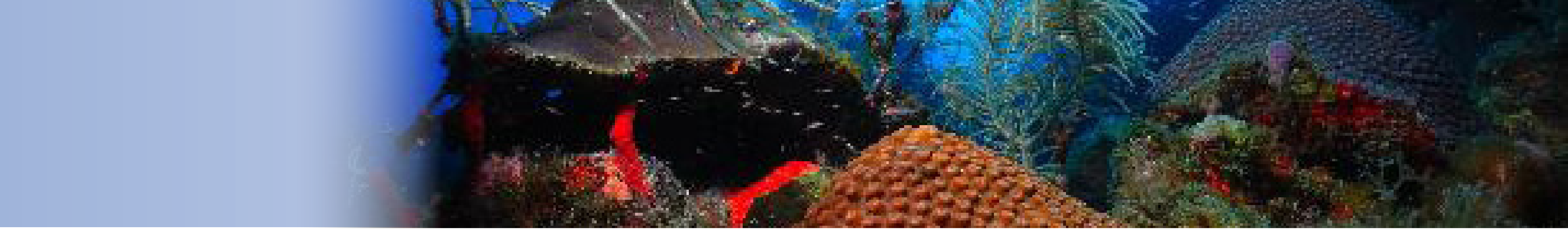
During fiscal year 2014, the NMFS Southeast Regional Office received 615 essential fish habitat (EFH) consultation requests from federal agencies, mostly the U.S. Army Corps of Engineers, for projects in North Carolina, South Carolina, Georgia, and the Atlantic coast of Florida. Conservation recommendations were provided for 136 projects, NMFS offered no objection to 119, and NMFS had insufficient staff to review 360 of the consultation requests. Major coastal projects during the past year included deepening of the Ports of Miami, Everglades, Jacksonville, and Charleston, and each of these projects is expected to remain a high priority for the coming year. A major milestone was the successful use by sturgeon and American shad of a rock-arch ramp on the Cape Fear River to access upriver spawning grounds. Construction of the ramp at the lowermost dam on the Cape Fear River was completed in 2012 as mitigation for dredging shallow-water nursery habitat downstream in the Port of Wilmington.

U.S. Fish and Wildlife Service Updates

Dr. Wilson Laney, Aranzazu Lascurain, Krishna Gifford, Steven Shepard, John Gill, and Gerard McMahan

American Eel

The USFWS held a webinar on the American eel status review for state partners and FWS staff on October 16, 2014. A presentation summarizing new information since the 2007 "not warranted" ESA listing decision was given by FWS Northeast Region staff and questions from webinar participants, which included a number of ASMFC Commissioners, were answered. The FWS has compiled an American Eel Species Biological Report, which reviews and summarizes the science on American Eel and will inform the FWS 12-month finding, along with applicable ESA policies, on the listing petition. The Biological



Report was peer reviewed by numerous reviewers, including the ASMFC American Eel Technical Committee, and will be released to the public concurrent with publication of the 12-month finding The Service is required to make a determination on whether the American eel warrants ESA listing by September 30, 2015. For more information see: *http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E0AG and http://www.fws.gov/northeast/newsroom/eels.html).*

Red Knot

On December 9, 2014, FWS listed the *rufa* subspecies of the red knot, a migratory bird, as threatened throughout its entire range under the Endangered Species Act (ESA). A "threatened" designation means a species is at risk of becoming endangered throughout all or a significant portion of its range. Service Director Dan Ashe noted that "the red knot is a remarkable and resilient bird known to migrate thousands of miles a year from the Canadian Arctic to the southern tip of South America… Unfortunately, this hearty shorebird is no match for the widespread effects of emerging challenges like climate change and coastal development, coupled with the historic impacts of horseshoe crab overharvesting, which have sharply reduced its population in recent decades." The knot's population has fallen by about 75 percent in some key migration and wintering areas. The primary threats to the red knot are habitat loss across its range due to sea level rise, some coastal alteration projects and Arctic warming; reduced food availability and timing mismatches (asynchronies) throughout the birds' annual migratory cycle; and potential increases in predation by birds and mammals in the knot's Arctic breeding grounds.

In making its decision, the FWS analyzed the best available data in more than 1,700 scientific documents, and considered more than 17,400 public comments. The listing will become effective on January 12, 2015, As required by the ESA, the FWS is also reviewing the U.S. range of the rufa red knot to identify areas that are essential for its conservation. The FWS expects to propose critical habitat for the rufa red know for public review and comment in 2015 after completing the required review of economic considerations. For more information visit: *http://www.fws.gov/northeast/redknot/, under Docket Number FWS-R5-ES-2013-0097.*

U.S. Department of the Interior Climate Science Centers

(Excerpted from O'Malley, R. USDOI, 2012. Fact Sheet 2012-3048. U.S. DOI, U.S. Geological Survey, Reston, VA

The United States East Coast face myriad challenges from invasive species, effects of changing land and water use, habitat fragmentation and degradation, and other influences. All of these challenges are compounded by increasing influences from a changing climate - temperature variations, increasing droughts, floods and wildfires, and overall increasing variability in weather and climate.

The U.S. Department of the Interior (USDOI) has established eight regional Climate Science Centers (CSCs) that provide scientific information and tools to natural and cultural resource managers as they plan for conserving natural resources in a changing world. Natural and cultural resources managers will help identify CSC science priorities. USDOI Landscape Conservation Cooperatives (LCCs) are primary sources of science needs, along with other management entities and stakeholders in a CSC region. Scientists will work cooperatively with managers who identify results that can be applied directly to real-world problems. In addition to the strong ties with LCCs, the CSCs will seek input from a wide variety of regional partners. Each CSC will convene a Stakeholder Advisory Committee with representation from federal, state and tribal management agencies, in addition to formal membership from each LCC in the region (for ASMFC, the two primary LCCs are the North Atlantic LCC and South Atlantic LCC). Coordination across CSC regions will ensure that issues are addressed on an ecological basis, and are not limited by regional or administrative boundaries. CSC's will do research to determine the impacts of climate change on key natural and cultural resources in their regions. CSC scientists will:

- Predict how fish, wildlife, habitats, water, cultural, and other resources will change in response to climate change,
- Assess the vulnerability of these resources to climate change,
- Link projections of climate change (such as expected alterations in temperature and precipitation) with models that predict how climate will affect resources,
- Work with partners to develop standardized approaches to monitoring and link existing monitoring efforts to models of climate and resource response and,
- Ensure that data generated at NCCWSC and the CSCs are shared and can be combined with other data sets.

Learn more about the Climate Science Center by visiting *https://necsc.umass.edu/ and http://globalchange.ncsu.edu/secsc*. The Northeast and Southeast CSCs will address ASMFC member states: (*http://www.doi.gov/csc/northeast*) is hosted at the University of Massachusetts, Amherst. The Southeast CSC (*http://www.doi.gov/csc/southeast*) is hosted by North Carolina State University (*http://globalchange.ncsu.edu/secsc*). For additional information contact: Director, National Climate Change and Wildlife Science Center, USGS, 12201 Sunrise Valley Drive, Reston, VA 20192. Telephone: 703-648-6016; also see: *http://nccwsc.usgs.gov.*

NMFS Greater Atlantic Region Fisheries Office

Lou Chiarella, Terra Lederhouse, Christopher Boelke

Fiscal Year 2014 was very busy for the NMFS Greater Atlantic Region Fisheries Office (GARFO) extending from Maine to

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Virginia. The Habitat Conservation Division (HCD) received 713 requests for essential fish habitat (EFH) consultations and was able to complete consultation on 521 of them. Consultations were conducted on various federal actions including US Army Corps of Engineers permit and civil works actions, Federal Highway Administration/State DOT transportation projects, and Nuclear Regulatory Commission and Federal Energy Regulatory Commission licensing actions. Due to HCD involvement on these activities, 94% of the completed actions have resulted in project modifications/improvements aimed at avoiding, minimizing, and mitigating for adverse impacts to fishery habitats. In addition to these activities, the regional hydro team has been very active in hydro dam relicensing activities on the Susquehanna River, MD/PA; Hudson River, NY; Connecticut River, MA; and the Saco, Kennebec, Penobscot, Union, and St. Croix Rivers in Maine.

NOAA also completed the selection of two Habitat Focus Areas for the North Atlantic which include the Choptank River Complex in MD and DE and the Penobscot River in Maine. The goal of the Habitat Focus Areas is to direct NOAA's expertise, resources for science, and on-the-ground conservation efforts in targeted areas to maximize our investments and the benefits to marine resources and coastal communities.

Lastly, the GARFO has greatly increased its presence in the Mid-Atlantic by hiring two Marine Habitat Resource Specialists and one Protected Species Biologist for our new Annapolis, MD Field Office and increased the habitat staff in our Sandy Hook, NJ office to two. We are now able to service the habitat needs of the Mid-Atlantic States with a complement of six biologists spread over three field offices.

HABITAT PROGRAM MISSION

To work through the Commission, in cooperation with appropriate agencies and organizations, to enhance and cooperatively manage vital fish habitat for conservation, restoration, and protection, and to support the cooperative management of Commission managed species.

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HABITAT HOTLINE Atlantic

2014 Annual Issue

RESOURCE LINKS AND REFERENCES

LINKS

Shifting Ranges

http://www.epa.gov/climatechange/pdfs/climateindicators-full-2014.pdf

Ocean Acidification: Effects on Atlantic Coral Reefs

http://www.coralreef.noaa.gov/threats/climate/
http://www.iucn.org/?10903/Crunch-time-for-Caribbean-corals
http://coralreef.noaa.gov/education/oa/

Effects of Ocean Acidification

http://www.oceanacidification.noaa.gov/ http://www.epa.gov/climatechange/science/indicators/oceans/acidity.html
http://www.maine.gov/legis/opla/oceanacidificationstaff.htm
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http://www.whoi.edu/main/topic/ocean-acidification
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