HABITAT HOTLINE Atlantic

2020 Annual Issue

HEALTHY FISHERIES NEED HEALTHY HABITAT

Fish and Habitat Assessments Along the Atlantic Coast

As I begin my first year as Chair of the Atlantic State Marine Fisheries Commission's (ASMFC) Habitat Committee, it is my privilege to present to you the *2020 Habitat Hotline Atlantic*. With Covid-19 and the challenges it has brought to all of us, nothing about this year has been easy and I marvel at all that has been accomplished even in the face of such adverse conditions. I also want to express my appreciation to all of those who have contributed articles to this issue of the *Habitat Hotline Atlantic*.

The focus of this *Hotline* is habitat assessments and the importance of understanding how these habitats and their conditions affect the fisheries that are so dependent on them. It is critically important for fisheries managers to be able to monitor the long-term status and trends of these habitats to determine the cause of their waxing and waning. From the effects of sea level rise on these marine and estuarine habitats, to the need for comprehensive mapping and monitoring of significant habitat resources, to the changes being caused by an ever changing climate, the members of the ASMFC's Habitat Committee and their respective institutions are rising to the many challenges of assessing and monitoring our important fishery habitats. This in turn will allow decision makers to be able to make better informed decisions regarding the management of our fish stocks.

The articles in this year's *Habitat Hotline Atlantic* demonstrate the commitment of Habitat Committee members and our affiliated members of assessing and monitoring critical fish habitats with some novel and creative approaches. I hope you will enjoy reading the *2020 Habitat Hotline Atlantic.*

Jimmy Johnson
Habitat Committee Chair

In This Issue

Atlantic Coastal Fish Habitat Partnership

Lisa Havel, ACFHP

This summer, the Atlantic Coastal Fish Habitat Partnership (ACFHP or Partnership) released the Fish Habitat Conservation Area Mapping and Prioritization Project, a prioritization of Atlantic coastal, estuarine, and diadromous fish habitats for conservation. This multi-year effort was funded by the National Oceanic and Atmospheric Administration (NOAA) Southeast Regional Office and Greater Atlantic Regional Fisheries Office. ACFHP partnered with the Southeast Aquatic Resources Partnership for the Southeast Mapping Project, and with The Nature Conservancy (TNC) for the Northeast Mapping Project.

Geographic regions and ACFHP priority habits covered by the eight spatial analyses.

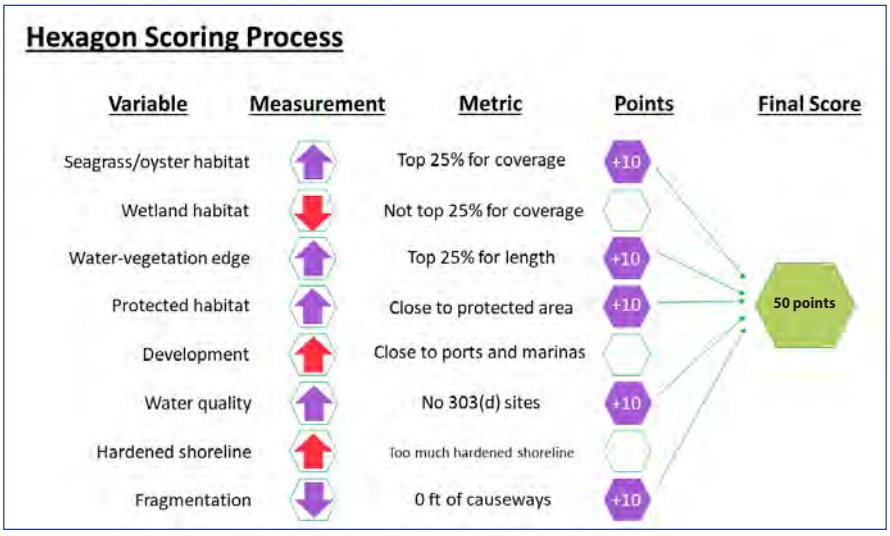
Mapping Project	ACFHP subregion	ACFHP Priority Habitat	Analysis
Northeast	North Atlantic	Riverine bottom	North Atlantic Diadromous
		SAV	North Atlantic Estuarine
		Marine and estuarine shellfish beds	
	Mid-Atlantic (Cape Cod to NC drainages)	Riverine bottom	Mid-Atlantic Diadromous
		SAV	Mid-Atlantic Estuarine
		Marine and estuarine shellfish beds	
		Tidal vegetation	
Southeast	Mid-Atlantic (NC-drainages to Cape Hatteras) and South Atlantic	Riverine bottom	South Atlantic Diadromous
		SAV	South Atlantic Estuarine
		Marine and estuarine shellfish beds	
		Tidal vegetation	
	South Florida	SAV	South Florida Estuarine
		Tidal vegetation	
		Coral and live/hard bottom	South Florida Coastal

Results will help ACFHP, our partners, and various stakeholders better identify locations in need of habitat conservation – both "Areas of Excellent Fish Habitat" that could benefit from land and watershed protection and expansion by restoring adjacent areas, and "Restoration Opportunity Areas" that would most benefit from restoration.

We conducted eight separate analyses to address ACFHP's priority habitats within each of our four subregions (table above right). For both the diadromous and estuarine analyses, eight metrics which describe some aspect of the suitability or condition of the diadromous or estuarine habitat were calculated. Impervious surface, point and non-point source pollution, potential for species access, fragmentation, riparian buffer extent, and more were included in the diadromous analyses, and habitat coverage, proximity to development and protected habitat, water quality, and hardened shorelines were some of the variables included in the estuarine analyses. For a full list of variables included, see the final report.

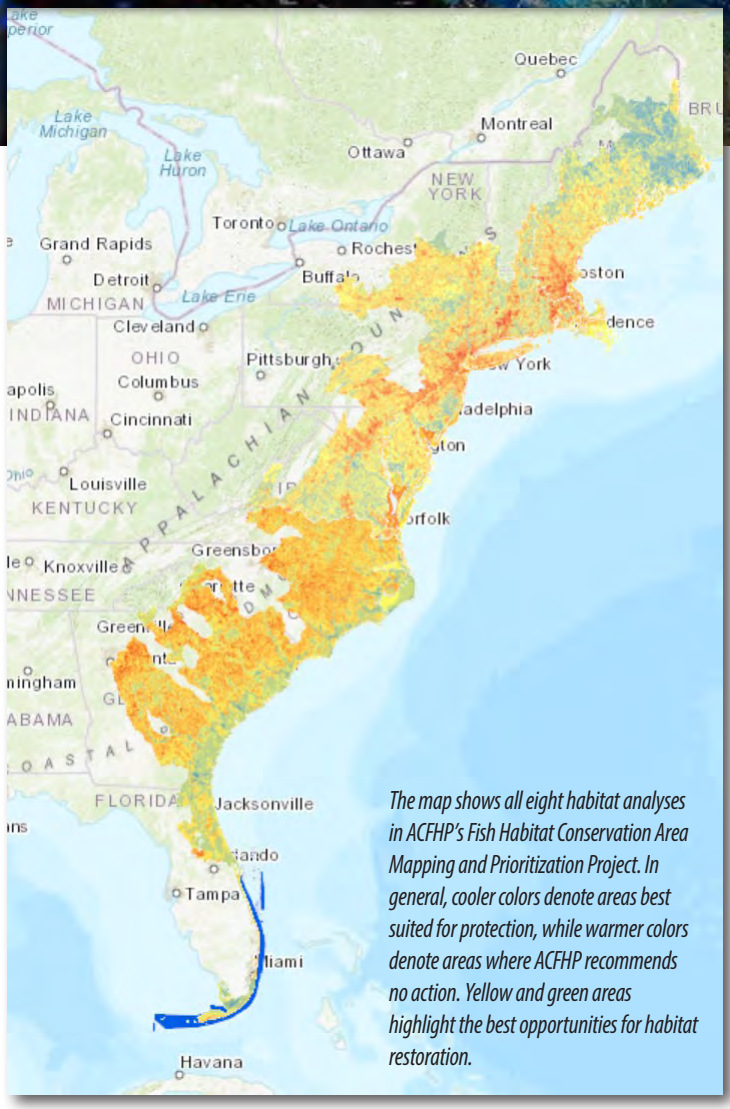
To score each catchment, we awarded 10 points for each variable if it met the criterion for that metric (for a full list of variables and their associated metrics, see the final report or user guide). For all diadromous and estuarine analyses, we calculated scores by adding up all the points each catchment (diadromous) or hexagon (estuarine) received. Except for the South Florida estuarine analysis (maximum possible score = 70), each analysis had a maximum possible score of 80. The higher the score the better the habitat quality.

Example of how an estuarine hexagon was scored.



Results of the North and Mid-Atlantic diadromous analyses show that highly urbanized areas, especially the 'Bo-Wash Corridor' from Boston to Washington, DC, have some of the lowest scores, while undeveloped Northeastern Maine has some

of the highest scores. The results of the South Atlantic diadromous analysis show that larger mainstem rivers having little development, and often protected lands, are also high scoring. Results of the estuarine analyses highlighted many high scoring areas that were already protected, such as Roanoke Island and the Elizabeth River, both in North Carolina. However, other clusters of hexagons that are not protected also fell into the top tier of scores (arguably more 'pristine' areas based on our metrics), emphasizing the need to further protect high scoring areas along the coast.



The map shows all eight habitat analyses in ACFHP's Fish Habitat Conservation Area Mapping and Prioritization Project. In general, cooler colors denote areas best suited for protection, while warmer colors denote areas where ACFHP recommends no action. Yellow and green areas highlight the best opportunities for habitat restoration.

We designated catchments or hexagons with higher scores (>60) as "Areas of Excellent Fish Habitat." It is unlikely that much improvement is needed to ensure availability or quality of fish habitat at these sites because they are in good condition and face few threats. Therefore, maintaining the current condition is the primary conservation action. These areas might be a good candidate for protection. "Restoration Opportunity Areas" fall in the middle of the score range (20 - 60) – these are areas that are doing well in some respects, but the sites can be improved upon. It is likely that a restoration project, especially one that targets the variables that did not contribute points towards the final score, would have a significant impact here. If, for example, an estuarine marsh hexagon scores fairly well, but does not receive points for wetland habitats, then wetland restoration activities could be undertaken to improve its overall score and, by extension, increase available fish habitat. "Degraded Areas of Opportunity" received few points (<20), and face many challenges to fish habitat conservation based on the variables included in the analysis. A restoration project, unless it is large in scale or targets many of the variables in the analysis (e.g. reduction of impervious surface or sewage system infrastructure), will not likely increase availability or quality of fish habitat as much as one in a restoration opportunity area. ACFHP does not, however, intend for readers to interpret a grade <20 as an ACFHP recommendation that no action(s) should ever be taken in these areas.

The South Florida coastal analysis was not scored like the diadromous and estuarine analyses; instead, coral extent and Habitat Area of Particular Concern (HAPC) designations were mapped. The goal of the South Florida coastal analysis was to identify coastal areas south of Cape Canaveral that contained shallow coral habitat, a priority habitat for ACFHP's South Florida subregion. The Partnership decided that all coral habitat was in need of conservation, regardless of quality, due to the slow growth and immediate threats to South Florida reefs (including bleaching, pollution, and disease).

This work is not intended to be used as guidance for regulatory purposes. We encourage you to review the caveats in the final report for details on how best to interpret and use the results of this project.

For more information and to access the maps, visit the ACFHP website, at *https://www.atlanticfishhabitat.org/science-and-data-projects/*, or contact Lisa Havel, ACFHP Coordinator, at *LHavel@asmfc.org*.

Northeast Regional Habitat Assessment Update

Jessica Coakley, MAFMC, and Michelle Bachman, NEFMC

Regional fishery management councils (Councils) are charged with designating essential fish habitat (EFH) for all managed species and minimizing the impacts of fishing on those habitats. Understanding which fish habitat attributes are important to managed species, and where those attributes occur throughout the region, is important for generating useful EFH designations and designing beneficial habitat management strategies.

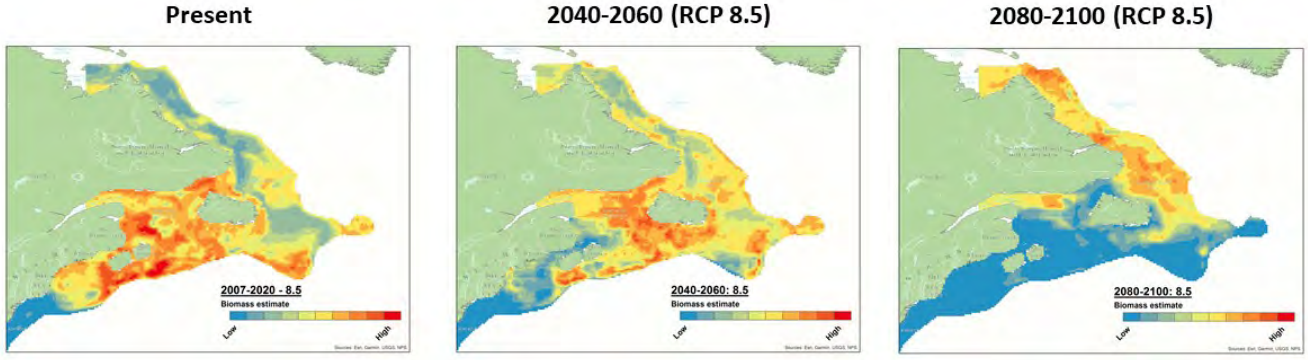
The Mid-Atlantic Fishery Management Council (MAMFC) and New England Fishery Management Council (NEFMC) are one year into a three-year habitat assessment, referred to as the Northeast Regional Habitat Assessment, or NRHA, that is designed to answer these questions. The assessment team includes partners from ASMFC, NOAA Fisheries, TNC, the U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (Service), state fisheries agencies, and others. Contributors participate in assessment activities via inshore and offshore-focused work teams, chaired by Council and NOAA Fisheries staff. The Councils partnered with NOAA Fisheries and Monmouth University to hire a contractor and post-doctoral associate to take the lead on data assembly and modeling efforts.

During year one, the team developed a spatial data inventory, assembling habitat and fishery-independent resource survey data for an area spanning the Northeast U.S. shelf ecosystem from eastern Maine to the South Carolina border. The team is also conducting literature reviews to summarize habitat use, life history, and management of the 65+ focus fish species in the assessment. These species include all the stocks managed by NEFMC and MAFMC, respectively, as well as all species managed by ASFMC and others that are common within the ecosystem but for which there is no fishery management plan (e.g. cusk).

Species habitat modeling (e.g. individual and joint species distribution models) will be a focus of the assessment, particularly for offshore areas, helping the teams to understand which environmental variables govern species distribution. In addition to determining existing spatial patterns in habitat use, the team will use climate forecasts to project how habitat distributions may change in the future. This will allow the Councils, ASMFC, and NOAA Fisheries to manage these species with likely future scenarios in mind. Initial modeling work is already underway, and the teams will review and begin to develop information products with the results during year two of the assessment.

Another aspect of the assessment is a review of information on inshore habitats, such as marshes, submerged aquatic vegetation, and oyster reefs. A challenge here will be considering how best to characterize status and trends for these habitat types, since data collection efforts vary by state and are collected at varying time intervals.

Year three will focus on reporting out the results of the assessment to fishery managers. At present, the team envisions providing spatial information via regional data portals and developing reports to share the modeling and literature review results. For more information visit *https://www.mafmc.org/nrha*.



Species distribution model for Atlantic cod under different climate scenarios (preliminary). Figure credit: Victoria Kentner, Integrated Statistics/NOAA Fisheries.

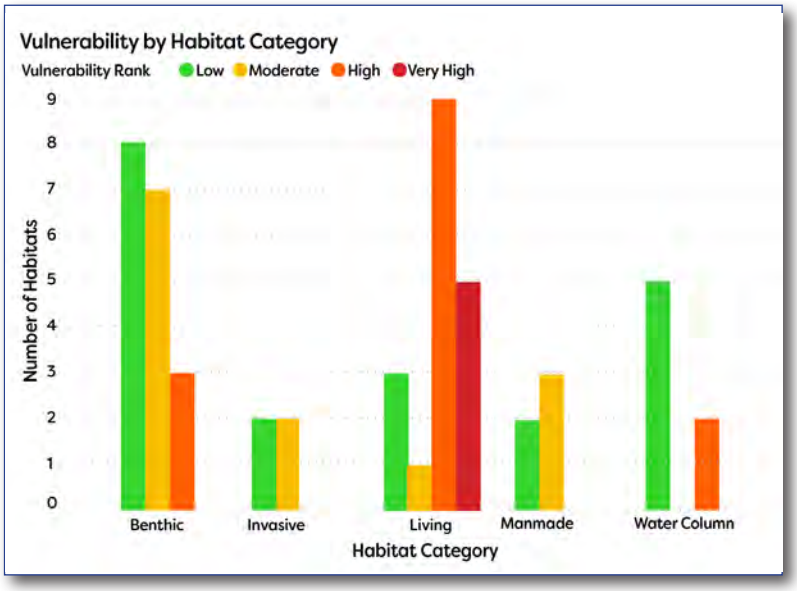
Northeast Habitat Climate Vulnerability Assessment Summary

Emily Farr, NOAA Fisheries

NOAA Fisheries and its partners are responsible for managing fisheries, protected species, and the habitats that support them. In the context of climate change, this includes increasing our understanding of how climate impacts species and their habitats, and identifying strategies to reduce those impacts and increase the resilience of living marine resources and the communities that depend on them.

Oysters are a living habitat in the HCVA. Image credit: Shutterstock/AG Technology Solutions.

To address this need, NOAA Fisheries assessed the vulnerability of 52 marine, estuarine, and riverine habitats in the Northeast U.S. to climate change. This Northeast Habitat Climate Vulnerability Assessment (HCVA) will be used to improve EFH designations and aid in EFH consultations, set habitat conservation priorities, understand cumulative impacts of fishery management actions, and provide long-term context for the management of protected and fishery species. The assessment builds on the Northeast Fish and Shellfish Climate Vulnerability Assessment completed in 2016, and uses a similar framework. The northern and southern boundaries of the study area are the U.S./Canadian border and Cape Hatteras, North Carolina, respectively, and the study includes habitats out to the U.S. exclusive economic zone (EEZ) and up-river to capture the full range of diadromous species. Habitats were identified as benthic, invasive, living, manmade, or water column, and the assessment results are presented for individual habitats and by category.



Vulnerability rankings for benthic, invasive, living, manmade, and water column habitats. Benthic habitats include sand, mud, and rocky bottom; invasive habitats include invasive riverine and estuarine wetlands; living habitats include wetlands, submerged aquatic vegetation, deep-sea coral and sponge, and shellfish reefs; man-made habitats include hard structures like jetties, artificial reefs, and wrecks; and water column encompasses marine, estuarine, and riverine water column habitats. Figure credit: NOAA Fisheries.

The Northeast HCVA considers the overall vulnerability of habitat to climate change to be a function of two main components: exposure and sensitivity. The exposure component considers the magnitude and overlap of projected changes in climate with the distribution of each habitat. Climate exposure is assessed using end-of-century climate projections based on the Intergovernmental Panel on Climate Change (IPCC) RCP 8.5 emissions scenario. The sensitivity component includes nine habitat attributes, or traits, that are believed to be indicative of the response of a habitat to potential changes in climate.

The assessment methodology relies on expert elicitation, where habitat experts score the exposure and sensitivity of each habitat based on defined criteria, using their expert opinion to account for the complexities of these habitats and their responses to changes in climate. The assessment team included partners from multiple NOAA offices, the Service, USGS, Bureau of Ocean and Energy Management (BOEM), Environmental Protection Agency (EPA), and several academic institutions.

The resulting vulnerability rankings (see figure) show that living habitats are expected to be most vulnerable to climate change, with implications for the many species that rely on these habitats

for nursery, food, and shelter. Juvenile and adult blue crab, for example, are highly dependent on salt marsh habitat[1], which scored as very highly vulnerable in this assessment. These vulnerability rankings are accompanied by a detailed narrative for each habitat that describes its key drivers of vulnerability, specific climate effects on habitat condition and distribution, and any data gaps. The next step in this effort will be to link the habitat climate vulnerability results to the vulnerability of the species and human communities that depend on them.

[1] Atlantic Coastal Fish Habitat Partnership. 2009. Species-Habitat Matrix. *https://www.atlanticfishhabitat.org/species-habitat-matrix/*

Habitats that scored as highly or very highly vulnerable to climate change (draft results, in review)

Highly and Very Highly Vulnerable Habitats

Habitat	Sensitivity	Exposure	Vulnerability
Mid-Atlantic native salt marsh	High	Very High	Very High
New England native salt marsh	High	Very High	Very High
Marine intertidal shellfish reef	High	Very High	Very High
Estuarine intertidal shellfish reef	High	Very High	Very High
Deep sea coral and sponge: seamounts and canyons	Very High	High	Very High
Deep sea coral and sponge: Gulf of Mexico	Very High	Moderate	High
Marine intertidal mud	Moderate	Very High	High
Marine intertidal sand	Moderate	Very High	High
Marine intertidal rocky bottom	Moderate	Very High	High
Marine submerged aquatic vegetation	High	High	High
Estuarine submerged aquatic vegetation	High	High	High
Marine kelp	High	High	High
Estuarine kelp	High	High	High
Marine subtidal shellfish reef	High	High	High
Estuarine subtidal shellfish reef	High	High	High
Estuarine water column	High	High	High
Riverine non-tidal native wetland	High	High	High
Riverine submerged aquatic vegetation	High	High	High
Riverine water column	High	High	High

PROJECT SPOTLIGHTS

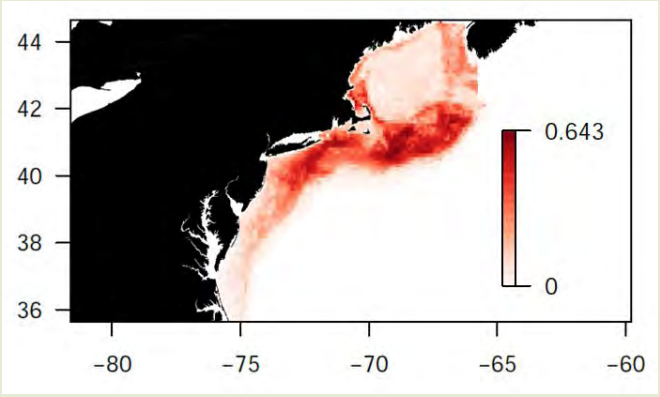
Several scientists in the Northeast are all working on separate, but complementary research projects that will contribute to the NRHA, improving our understanding of how fish use habitat and how that may change as the climate changes.

One of the projects is led by Rich Bell and Brian Grieve of TNC, who are using fish abundance, temperature, and benthic data from a slew of sources to add a dynamic dimension to traditional habitat mapping. Like many projects, they utilize water temperature as a niche parameter, but combine that with habitat patch dynamics derived from high resolution benthic structure and sediment data to provide a spatially explicit, biological rendering of thermal-benthic habitat suitability. These indices can be implemented over a variety of time scales and will help incorporate physiological and biological elements into stock assessments, allowing basic habitat variability and climate change to be empirically considered in fisheries management decisions. -- Kate Wilke, TNC

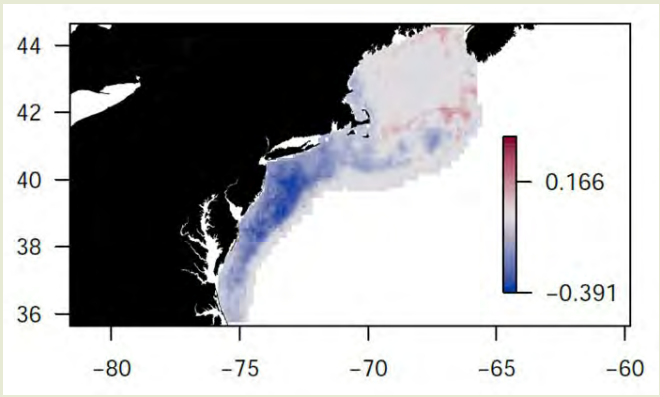
Linking Life History in Habitat Models to Understand Historical Change in Habitat for Groundfish Distribution on the U.S. Northeast Shelf

Ryan Morse, NOAA NEFSC, Narragansett, RI; Kevin Friedland, NOAA NEFSC, Narragansett, RI; Vincent Guida, NOAA NEFSC, Sandy Hook, NJ; Vincent Saba, NOAA NEFSC, Princeton, NJ

Species distribution models were developed for U.S. Northeast groundfish using a hierarchical approach linking life history stages. First, a multi-model approach was used to identify primary covariates in order to build parsimonious models. Then, hierarchical generalized additive species distribution models were built for adult, juvenile, and ichthyoplankton life stages based on spring and fall trawl survey data. Groundfish abundance and biomass, and relevant physical and biological data were obtained from Northeast Fisheries Science Center (NEFSC) bottom trawl surveys, and



Mean habitat area in spring from 1977-2019 for cod ichthyoplankton. Figure credit: NOAA NEFSC.



Change in habitat area in spring from 1977-2019 for cod ichthyoplankton. Figure credit: NOAA NEFSC.

ichthyoplankton and lower trophic level data were obtained from NEFSC EcoMon surveys. Hindcasts of habitat using optimally interpolated surface and bottom temperature data were produced from 1977-2019 for the spring and fall seasons. Preliminary results from this analysis address changes in habitat availability for groundfish species over time, as well as ecosystem level influences on groundfish distribution. Changes in habitat availability over time for ichthyoplankton, and the temporal and spatial relations between ichthyoplankton and juvenile habitats, may play a critical role in recruitment processes. For more information, please contact Ryan Morse at *ryan.morse@noaa.gov*.

Incorporating Lower Trophic Level Variables in Habitat Models for Fish and Invertebrates on the U.S. Northeast Shelf

Kevin Friedland, NOAA NEFSC, Narragansett, RI

Fish habitat has been traditionally defined by thermal tolerances, with temperature variables serving as the principal explanatory factors in habitat models. Kevin Friedland, of the NEFSC, has developed habitat models for fish and macroinvertebrate species of the Northeast Shelf that draw on a range of lower trophic level explanatory variables including chlorophyll concentration and zooplankton abundance. These models suggest that habitat for fish and macroinvertebrates have expanded in recent decades, which is seen as a sign of ecosystem tropicalization and the result of the expansion of species interactions and diversification of resource utilization (Friedland et al. 2020). These models are also being used to put into perspective the range of habitat impacts associated with the planned development of offshore wind energy.

Larger zooplankton species such as this euphausiid (krill) are vital links in the food web on the Northeast US continental shelf. Image credit: Uwe Kills, Rutgers University.

For additional information see: *https://www.fisheries.noaa.gov/new-england-mid-atlantic/ecosystems/fisheries-habitat-northeast-us-shelf-ecosystem*.

Friedland, K. D., Langan, J. A., Large, S. I., Selden, R. L., Link, J. S., Watson, R. A., & Collie, J. S. (2020). Changes in higher trophic level productivity, diversity and niche space in a rapidly warming continental shelf ecosystem. Science of the Total Environment, 704, 135270. https://doi.org/10.1016/j.scitotenv.2019.135270

NEW HAMPSHIRE

Are New England Marshes Drowning?

Christopher Peter, Great Bay NERR

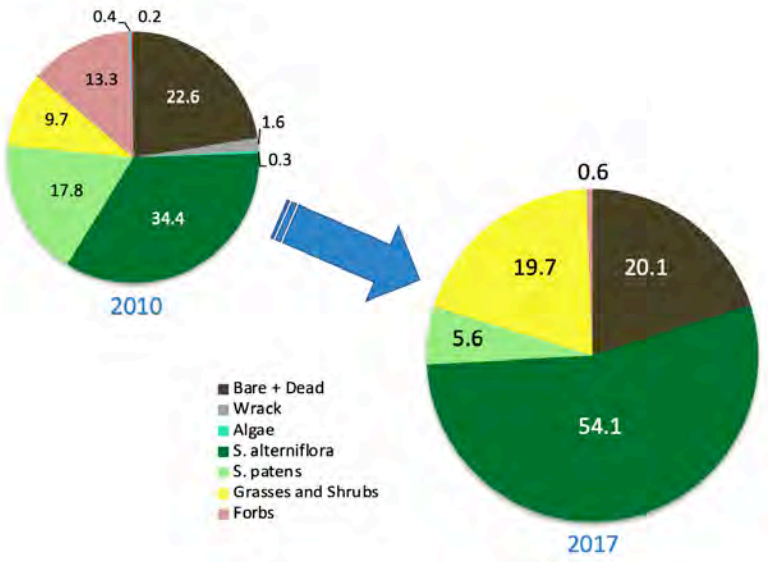
Oceans are rising at an alarming rate with future predictions almost impossible to comprehend, let alone plan for. Rising seas have and will further impact coastal communities in multiple ways, including flooding to homes and businesses and salt infiltration into our drinking water, but also can have large impacts on natural ecosystems. Salt marshes in particular are at great risk of 'drowning' from sea level rise. While these saline grasslands naturally build with rising seas by trapping sediments from the tides and adding a matrix of roots and rhizomes to the soil, also referred to as peat, they may not be able to keep pace. Coincidentally, the building of peat is also the main mechanism of carbon storage in marshes, which along with other coastal wetlands (mangroves and seagrasses) account for more carbon sequestration than any other ecosystem in the world. If these valuable coastal marshes are further diminished, you can imagine how this could amplify carbon dioxide levels in our atmosphere, further warming the planet and increasing sea levels.

Researchers and volunteers monitor long-term salt marsh plots in Great Bay, NH. Image credit: Christopher Peter, Great Bay NERR.

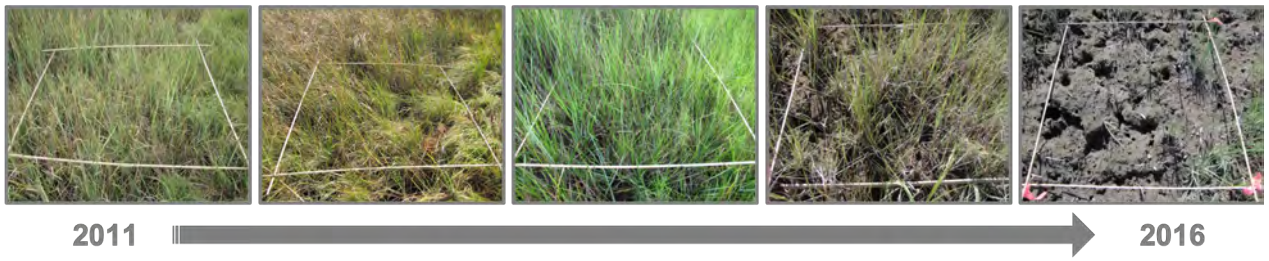
Over the past decade, scientists have been tracking the effects of rapidly rising oceans on salt marshes. Great Bay National Estuarine Research Reserve (NERR), along with many of the other 28 reserves around the country, has been monitoring impacts to salt marshes since 2010. This wealth of data along with increasing concern over the persistence of our marshes led the Great Bay NERR and David Burdick - a research professor at the University of New Hampshire who has been studying marshes for several decades, to ponder what the data were reporting. Have salt marshes been able to keep pace with rising seas? Are we seeing differences in marsh response across New England?

From these concerns and our long-term monitoring, a project was born examining salt marsh trends at Great Bay and other nearby reserves, ranging from Rhode Island to Maine. Our team, which included researchers and collaborators from all four New England reserves primarily focused our research on how plant communities are responding to rising seas over the past decade. We employed tiers of increasing complexity to analyze potential change in plants using graphical visualizations, univariate and multivariate statistics, and inundation modeling. In all cases, significant trends were found showing salt marshes have been shifting throughout New England indicating greater flooding and overall a wetter environment.

Shifts in plant communities become clearer when analyzing by marsh zone. In the low marsh, where tides typically flood twice daily, the dominant plant (*Spartina alterniflora*, smooth cordgrass) is dying off, leaving bare soils and standing water. The



Percent cover of plant species from low to high marsh transition plots Great Bay, New Hampshire showing an increase of the flood-tolerant S.alterniflora at the expense of less flood tolerant S.patens. Figure credit: Christopher Peter, Great Bay NERR.



Time-series tracking a single plot in the low marsh at Narragansett Bay, Rhode Island showing a drastic loss of plants in only five years. Image credit: Kenny Raposa, Narragansett Bay NERR.

time series photos above show how one monitoring location in Narragansett Bay, Rhode Island went from being dominated by *S. alterniflora* to being almost entirely barren in just five years. Immediately upslope in the high marsh, which is flooded only a handful times a month during spring (moon) tides, plant communities are also showing signs of increased flood stress. High marshes are dominated by thinner perennial grasses, and are giving way to the more flood tolerant smooth cordgrass. Essentially, the entire marsh is migrating upslope to find refuge from rising oceans.

Southern New England marshes in Rhode Island and on Cape Cod, Massachusetts, have experienced the most dramatic changes in marsh plants. Our team suspects southern marshes are more sensitive to rising seas, not because of their latitude, but because of their relatively small tidal ranges. If a marsh has only a couple feet of tidal water fluctuation, then an increase in water levels is proportionally much larger compared to marshes with over 10 feet of tidal range. Data from our northern marshes in Maine and New Hampshire support this hypothesis, by showing less dramatic changes to the plant communities while exhibiting tidal ranges over twice as large as southern marshes.

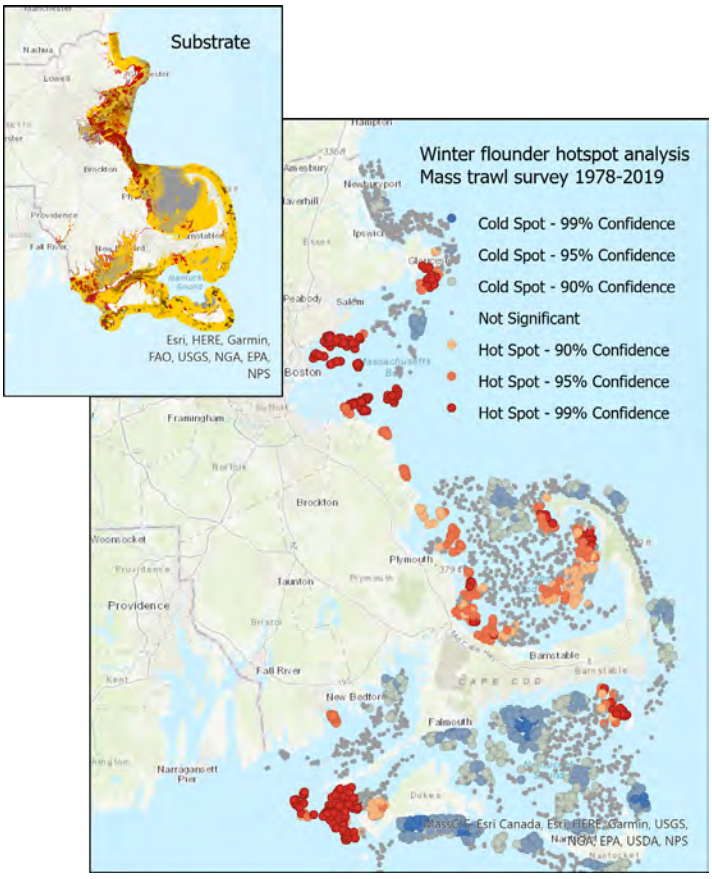
This study is a first, using on-the-ground monitoring across New England, to show the vulnerability of salt marshes to sea level rise in both microtidal (more vulnerable) and mesotidal (less vulnerable) estuaries. Our results serve as a call to action by coastal resource managers and decision makers, especially those who might be uncertain whether marshes are truly at risk. In anticipation of much greater salt marsh loss in the near future, managers should consider helping these systems cope with unprecedented increases in sea levels. Some tools at their disposal include experimental restoration within the marsh, including boosting elevation with thin layers of sediment applied directly to the marsh or reducing the number of historical ditches that prevents marshes from building naturally. Other tools may be aimed at allowing salt marshes to naturally migrate landward into what is now upland areas, by removing barriers and protecting these lands. Overall, our results highlight how salt marshes are being transformed and lost, and provide a strong case for continued monitoring, research, and management to prevent further loss.

MASSACHUSETTS

Mark Rousseau, MA DMF

Assessing Important Fish Resource Areas

The Massachusetts Ocean Plan (*https://www.mass.gov/service-details/2015-massachusetts-ocean-management-plan*) was developed to outline siting and performance criteria for offshore construction projects including sand mining, cables, pipelines, and renewable energy in Massachusetts. As part of the ocean planning process, maps of special, sensitive, or unique features were generated and used in compatibility analyses for the different types of construction. One of these layers was the Important Fish Resource Areas map. The mapping effort relied on the only statewide dataset in offshore waters: the Massachusetts Division of Marine Fisheries (MA DMF) trawl survey. The trawl survey has consistently sampled state waters in a stratified-random otter trawl survey in May and September since 1978. For the ocean plan map, the average biomass of 22 species of commercial, recreational, and ecological importance in Massachusetts was determined and the top 25% of biomass values were mapped. There are shortcomings of combining a broad spectrum of species caught in a survey that is conducted in two seasons. Namely, the trawl survey only represents two seasons a year, each species may not be vulnerable



Substrate/winter flounder DMF trawl survey data (1978-2019) hotspot analysis. Figure credit: MA DMF.

to the impacts or equally vulnerable to the trawl survey, and higher biomass areas may not necessarily be the most special, sensitive, or unique areas for fish. Therefore, there is interest in mapping fish habitats. As a step toward developing fish habitat maps, we examined the relationships between individual fish species, sediment type, temperature, and depth using the trawl survey data. We found that the trawl survey did not sample in enough sediment types to distinguish relationships between species biomass and sediment type, and we found strong relationships between species biomass, temperature, and depth. Further work is focusing on limiting our analyses to species vulnerable to each construction activity and exploring relationships between fish communities across state waters. Details of the ocean plan analysis are outlined in the MOP Fisheries Workgroup Report (*https://www.mass.gov/files/documents/2016/08/rg/fisheries.pdf*). For more information about this work please contact John Logan, *john.logan@mass.gov,* or Kathryn Ford, *Kathryn.ford@mass.gov.*

Duxbury 2020: Massachusetts Citizens and Scientists Collaborate by Air and by Sea to Assess and Manage Eelgrass

In Massachusetts, eelgrass (*Zostera marina*) is threatened by habitat degradation, climate change, and direct physical impact. In the Duxbury-Kingston-Plymouth (DKP) embayment eelgrass beds have experienced severe declines over several decades, and there is a need and local interest in tracking these changes. The low temporal resolution of existing aerial surveys (flown once every five years) was identified as a major limitation in understanding natural and anthropogenic influences on eelgrass. Since 2018, the MassBays National Estuary Program, MA DMF, and North and South Rivers Watershed Association have joined with citizen scientists on the water to monitor eelgrass extent and condition in DKP on an annual basis with underwater video monitors (UVM). However, these UVM surveys alone were unable to replicate the spatial coverage of the infrequent aerial surveys. To address this shortcoming, the annual UVM eelgrass assessment was combined for the first time in 2020 with aerial imagery taken by volunteer pilots coordinated through the LightHawk Conservation Flying organization. The resulting high resolution spatial and temporal assessment of eelgrass in DKP will be paired with water quality data to investigate connections between eelgrass losses and hypothesized stressors

Aerial image of an oyster aquaculture lease abutting an eelgrass meadow and a nearby recreational boater in DKP. Aquaculture leases are prohibited from overlap with existing Eelgrass at the time of siting suggesting eelgrass has expanded into this lease simultaneous to the aquaculture. Massachusetts bays and estuaries experience high volumes of recreational boat traffic during the summer months and propeller grounding and boat wakes can damage eelgrass. Image credit: Arlene Myers, LightHawk.

such as eutrophication, temperature, and sedimentation. Assessments of spatial trends in eelgrass losses will also be compared against maps of aquaculture lease sites in order to assess the potential for direct impacts of aquaculture, a growing industry in DKP, on eelgrass. In addition, this two-pronged citizen-science-based eelgrass monitoring approach is being curated with the goal of expanding the program to other estuaries in Massachusetts in the coming years. Contact Forest Schenck at *Forest.schenck@mass.gov* for additional information.

RHODE ISLAND

Patrick Barrett and Eric Schneider, RI DEM DMF

In Rhode Island, more than 70% of recreationally and commercially important finfish spend part of their lives in coastal waters (Meng and Powell 1999). From newly settled juveniles to spawning adults, the production of sportfish is directly linked to the ecosystem functions of estuarine and nearshore marine habitats (Beck et al. 2001, O'Connor et al. 2017). In particular, habitats such as eelgrass, oyster reefs, kelp beds, and artificial reefs provide ecosystem services that are critical to sportfish like tautog, striped bass, and black sea bass. Not only do these biogenic, habitat-forming species provide both provisions and shelter for sportfish, but they simultaneously serve as the foundation of some of the most biologically diverse and productive habitats in temperate coastal ecosystems (Stenek 2002, Peterson et al. 2003, Blandon et al. 2014, Zu Ermgassen et al. 2016, Howleg et al. 2020). For decades, researchers have documented the decline in the abundance and stability of seagrass, oyster reef, and kelp forest systems due to climate and land-use change, disease, and over-harvest (Waycot et al. 2009, Orth et al. 2006, Beck et al. 2011, Zu Ermgassen et al. 2012, Wernberg et al. 2011, Krumhansl et al. 2016, Wernberg et al. 2019). In an ever-changing global environment, monitoring the health of our local biogenic habitats is essential for sustaining healthy finfish populations and associated recreational opportunities.

Diver conducting quadrant sampling during a fish habitat productivity survey of kelp. Image credit: RI DMF.

Diver conducting a uniform point count during a fish habitat productivity survey of kelp. Image credit: RI DMF.

Diver preparing to conduct fish counts during a fish habitat productivity survey of eelgrass. Image credit: RI DMF.

Image of an oyster reef, with juvenile black seabass, included in the fish habitat productivity assessment. Image credit: Heather Kinney, TNC.

Rhode Island Department of Environmental Management Division of Marine Fisheries (RI DEM DMF) Habitat Program is committed to assessing all habitats known to support recreationally and commercially important species in Rhode Island waters. However, quantifying the relative contribution of enhanced finfish production has been challenging to assess across habitat types. To address this need, the Habitat Program in partnership with TNC, Northeastern University, and University of Rhode Island have developed new projects that aim to use standardized surveys and analytical approaches to holistically assess the function of fish habitat and the production of associated species. Results are expected to provide new insights into the relative contributions and enhancement potential of coastal habitats to sustaining local fish populations, and thereby informing future priorities for conserving and restoring certain habitat types.

The standardized survey approach utilizes a dive transect monitoring protocol that is designed to sample common algae, invertebrates, and fish species, and monitor changes to the selected habitats over time. Survey results will allow us to establish fish habitat linkages by comparing estimates of fish biomass associated with targeted habitats (e.g., oyster reefs, kelp, eelgrass, and artificial reefs) to control sites (sand flats and natural rocky subtidal habitats). In addition, results from this research will support aspects of marine habitat and fisheries management, as well as guide future habitat enhancement projects.

For more information, and full list of works cited, contact Pat Barrett, RI DEM DMF, at *Patrick.Barrett@dem.ri.gov.*

NEW YORK

Julia Socrates, NYSDEC

New York's coastal waters provide extraordinary and abundant habitat for a variety of culturally and commercially valuable marine life. From crustaceans and shellfish in local bays to migratory fish and marine mammals that thrive in the open ocean, maintaining healthy and balanced habitats is what continues to support thriving fisheries and communities along New York's shores. New York State Department of Environmental Conservation (NYSDEC) and partners conduct numerous fisheries and habitat monitoring programs that help to ensure New York is maintaining a productive and resilient ecosystem for generations to come.

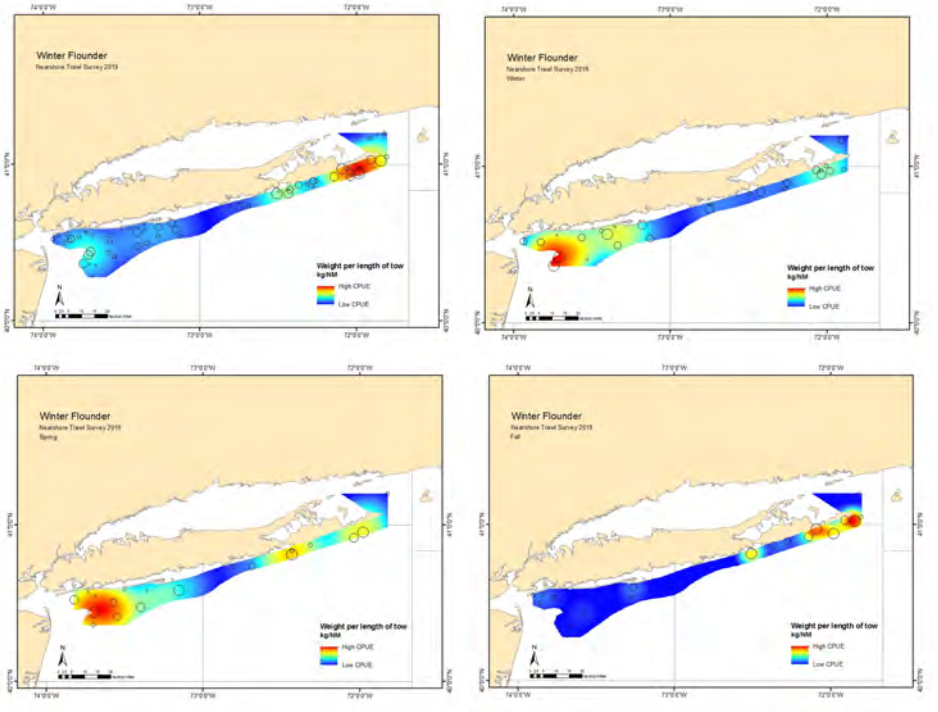
Nearshore Ocean Trawl

Since 2017, NYSDEC has been working cooperatively with Stony Brook University School of Marine and Atmospheric Sciences (SoMAS) on a ten-year trawl survey of New York's nearshore Atlantic Ocean waters from Breezy Point, Queens to Block Island Sound at the easternmost point of New York State on the R/V Seawolf. The trawl survey is conducted five times a year, encompassing all four seasons, and samples 30 stations on each survey. An 80-foot otter trawl is lowered to the ocean floor and towed for 20 minutes to collect marine life found along the sea floor. A CTD profile, which is a method of measuring conductivity and temperature, throughout the entire water column from the surface to the bottom, is taken for environmental data at each station. Researchers collect biological data from adult and subadult finfish and macro invertebrates that exist in the nearshore waters to better understand their distribution, relative abundances and life history. Fish collected during the survey are counted, weighed, and returned to the water with minimal handing and disturbance unless further biological sampling is required. Clearnose skate, winter skate and smooth dogfish have been consistently some of the top species captured since the survey's inception. The survey has also collected data on commercially and recreationally valuable species including striped bass, winter and summer flounder, black sea bass, and scup. During the fall, migratory striped bass are tagged as part of the coastwide ASMFC striped bass tagging program to help determine survival rates. In addition, Atlantic sturgeon, sharks and several marine finfish species are tagged with acoustic tags as part of a collaborative acoustic gate survey with NYSDEC and SoMAS that provides information on nearshore ocean habitat use.

Ocean Ecosystem Health Indicators

In addition to the trawl survey, the R/V Seawolf also collects numerous sets of biological, physical, and chemical data from New York's shores to the continental shelf. These data help to establish a baseline assessment of ocean conditions that will be analyzed against subsequent seasonal and annual conditions in order to develop a long-term interdisciplinary, multi-trophic level ocean monitoring program in the New York Bight.

Biological data, along with additional physical and chemical data, provides researchers and managers a holistic understanding of long-term trends and indicators of the health of our ocean ecosystem that will help support existing and future monitoring programs. Beginning in 2018, measurements of carbonate chemistry, biological productivity, fisheries acoustics, and shipboard marine

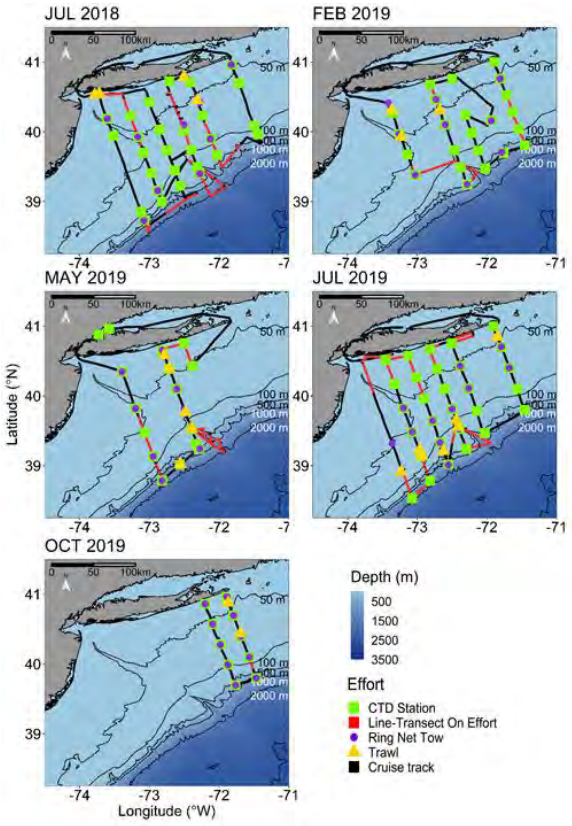


2019 Nearshore survey winter flounder abundance (CPUE) map. Image credit: NYSDEC.

mammal observations have been collected and will continue seasonally over the next ten years. In 2019, an underwater glider was deployed as part of this monitoring project to characterize the physical and chemical profile of the New York Bight in defining the seasonal formation, migration, and degradation of the 'Mid-Atlantic Cold Pool,' which is an area of cold near-bottom water that is essential thermal habitat for many regulated fish and shellfish species. This work in New York will provide a template for monitoring to be conducted more broadly in the Mid-Atlantic region, and its methods are designed to be consistent with and comparable to existing monitoring programs in the region.

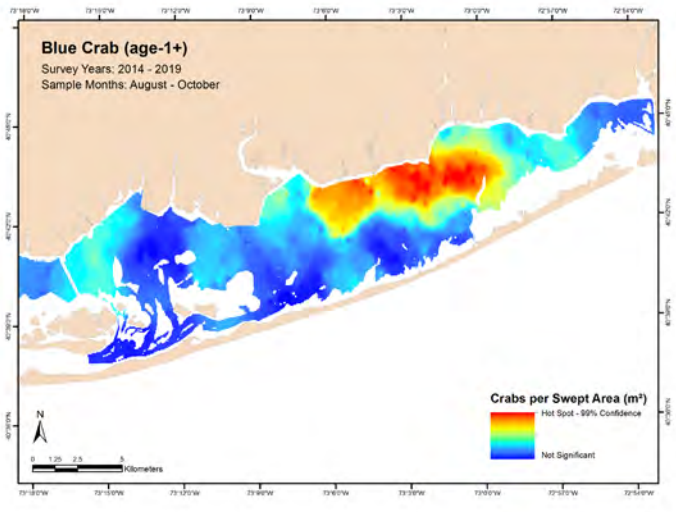
This project has completed a desktop study of available datasets of federal, state, and local partners as outlined in the New York State Ocean Action Plan and a set of indicators of ocean health has been established. These were chosen based on stakeholder feedback from a 2016 workshop, the quality of existing data, and topics of interest to state resource managers. The research conducted on the R/V Seawolf will contribute to the data being analyzed to track trends in various ecosystem processes in the New York Bight over the next ten years.

Great South Bay (GSB) Beam Trawl NYSDEC also has dedicated fisheries-independent monitoring programs for nearshore bays including the GSB, Western Long Island Bays, Hudson River, and Peconic Bays. Many NYSDEC monitoring programs have been operating for decades, while the moderately new GSB beam trawl survey was developed in 2014, with the aid of SoMAS, to monitor the relative abundance of blue crab and other commercially and recreationally important finfish and invertebrate species. NYSDEC has continued this survey to help monitor species diversity in the bay. Researchers have documented improvements in water quality, returning eelgrass habitat, and an increase in the abundance and diversity of finfish and invertebrates in GSB since the formation of an 'Old Inlet' breach on the Bay's barrier island that occurred during Super Storm Sandy in 2012. Monitoring the shifts in the GSB ecosystem in relation to physical changes in the bay assists researchers and managers in prioritizing future projects and potential management plans.



Cruise tracks and locations of various sampling efforts (red: line-transect survey effort; green: ring net tow locations; yellow: trawling locations) for all offshore monitoring cruises that have been completed in 2018-2019. Image credit: NYSDEC.

Blue crab has been the most abundant species captured in the survey. Data collected from the survey suggests that juvenile blue crabs (age-0), adult crabs, (age-1+), and mature females without eggs have all shown increases in abundance, or catch per unit effort (CPUE), over recent years. The high CPUE of blue crab captured in this survey may be a result of a combination of more crabs surviving the warmer winters, and warmer and longer growing seasons that have been observed during the last few years.



GSB Survey Crab Abundance (CPUE). Figure credit: NYSDEC.

Comprehensive sampling of New York's marine waters

Blue crabs collected during a single five-minute tow during the GSB beam trawl survey. Image credit: NYSDEC.

assists state and federal managers monitor sustainable, highly valued, fisheries that rely on New York's diverse marine habitats. Baseline ecosystem health and fisheries assessments combined with long-term data series can help provide a better understanding of distribution, abundance and basic demographic metrics for many important fish species. As a result of the decades of dedication from federal, state, and local agencies and organizations, water quality improvement and habitat protection initiatives and regulations have significantly improved the integrity of local marine habitats. New York continues to monitor and assess the impacts of these ground-breaking and influential actions, while considering potential contemporary shifts from the effects of climate change. Consistent and dedicated monitoring of our dynamic marine ecosystems is essential to make use of valuable historic data, establish the current status of the health of the ecosystem, and most importantly, determine the future management goals in relation to emerging threats.

NEW JERSEY

Russ Babb, NJDEP

New Jersey Artificial Reef and Monitoring Program

Over the past year, New Jersey Division of Fish and Wildlife's Marine Fisheries Administration (MFA) has continued to develop its artificial reef program. This work aimed to develop and monitor the 17 artificial reef sites off the coast of New Jersey. In addition, New Jersey's two newest reef sites - Manasquan Inlet and Delaware Bay - both have received reef deployments. The Manasquan site is monitored for successional development through the MFA's Ventless Trap Survey.

During the past year, reef building and maintenance consisted primarily of five deployments equating to approximately 14,000 cubic yards of material, consisting of reef balls, one barge, two caisson gates, along with bridge "rubble." These deployments took place across four of the 17 reef sites including Townsends Inlet, Cape May, Atlantic City, and Ocean City reefs.

A large portion of our work this past year focused on continuing a reef-centric Ventless Trap Survey. Dividing the state into a northern and southern region at the Barnegat Inlet, the survey aims to characterize the seasonal and spatial changes in reef community composition and relative abundance of structure-associated species. Traps are hauled four times per season at 22 fixed locations at two reef sites. The survey focuses on several species of recreational and commercial importance in New Jersey, including black sea bass, tautog (i.e. blackfish), Jonah crab, and lobster, while also providing data on other significant species occurring on the reefs. Results from this project are valuable for improving our ecological understanding of New Jersey's artificial reefs, which is useful for consideration in the development of fishery management plans and informing ongoing projects as part of the New Jersey Department of Environmental Protection's (NJDEP) artificial reef program. Results from the survey have been interesting to date with significant variation being observed between the northern and southern sites. For example, staff found slightly higher amounts of black sea bass in the north than the south. However, when comparing on reef to off reef sand sites, the highest abundance of black sea bass at our northern site was off the reef while the highest abundance of sea bass in our southern location was on the reef. One of the contributing factors as measured in the survey is the density of natural structure surrounding the two reef sites. Measured in a 20 square mile area around both sites, the northern site has 30 prime fishing areas and four additional reef sites. The southern area has four prime fishing areas and three additional reef sites. This suggests that sea bass are utilizing both reef locations but prefer the northern locations because of the surrounding adjacent structure provided when comparing the two survey areas. This survey will continue for the next several years at minimum focusing on the already established study areas

around these three reef sites with expectations to expand to an additional two sites in the future.

As part of our new monitoring initiative, staff are updating the 2008 New Jersey Artificial Reef Guide. We have been working with several organizations to digitize all of New Jersey's reef bathymetry charts to provide public users access to an electronic GIS version that is on a searchable platform on our website. This product includes not only reef site-specific depth information but accompanying deployment information on the material types and species associated with those reefs and materials.

Tug boat sunk on the Sandy Hook Reef off of New Jersey's coast. Image credit: New Jersey MFA.

MFA staff deployed a 150-foot long caisson gate on the Deepwater Reef site, which now rests in 125 feet of water and rises off the bottom 30 feet. Image credit: New Jersey MFA.

NJDEP Has $8 Million in Ecological Restoration Grants Available for Two Northwestern New Jersey River Systems

Using funds recovered from polluters, NJDEP made $8 million in competitive grants available for ecological restoration and enhancement projects along two northwestern New Jersey river systems. The grants were open to governmental agencies and nonprofit groups that are interested in developing and implementing projects along the Paulins Kill and Pequest River, important tributaries of the Delaware River that flow through Warren and Sussex counties.

The monies from the grant program will fund projects to restore and enhance river habitats, improve water quality, or create fish passage for these two scenic and ecologically important river systems in the Skylands region of the state. The Paulins Kill and Pequest river systems support a great diversity of wildlife, are among the most important trout production streams in the state, and provide an important habitat for migratory fish.

The grant program is funded by Natural Resource Damage settlements the state has secured over the years with polluters who have caused past harm to natural resources such as ground water, wetlands, and waterways. The Murphy Administration is committed to aggressively pursuing Natural Resource Damage actions, enforcement and other litigation against polluters, including prioritizing actions in the state's environmental justice communities. Applications were due in late September 2020.

As part of its broader mission of restoring natural resources statewide, the NJDEP for years has been focusing on projects to restore the Paulins Kill and Pequest River systems, including projects to remove obsolete dams to make them flow freely again. These projects have opened spawning habitat for migratory fish species and improved water quality. NJDEP joined other partners, including

Crews remove an obsolete dam within the Columbia Wildlife Management Area to restore access for migrating fish to their historic spawning grounds. Image credit: NJDEP.

Block Island Offshore Wind Farm, Rhode Island (Deepwater Wind). Image credit: American Wind Energy Association.

TNC, on a $7 million project to remove the Columbia Lake Dam in Knowlton Township, Warren County, making a large stretch of the Paulins Kill free flowing again. The project restored important habitat for migratory fish, primarily American shad and American eel, and enhanced the public's recreational enjoyment of this critical Delaware River tributary.

NJDEP Establishes Environmental Resources Working Group to Achieve Offshore Wind Energy Goals for New Jersey

As part of Governor Murphy's expanded goal of reaching 7,500 megawatts of offshore wind generation by 2035, NJDEP will lead a newly established working group of fishing and conservation groups to provide guidance to the Administration's overall strategy and approach to achieving its offshore wind goals.

The New Jersey Environmental Resources Offshore Wind Working Group will draw representatives from commercial and recreational fishing industries, conservation and environmental organizations, maritime industry, and FMCs. The Working Group will ensure that interested parties have a seat at the table with government officials to help shape the state's offshore wind strategy and implementation. The establishment of the Working Group recognizes that engagement is critical to the success of the Murphy Administration's clean energy, economic development and natural resource preservation goals.

The group has five objectives:

- Enhancing communication and coordination between fishing and conservation communities and state and federal agencies;
- Providing a platform for the fishing and conservation communities to have meaningful input to assist the state with its decision making as New Jersey moves forward with its clean energy goals;
- Sharing existing data, research and information sources with fishing and environmental groups;
- Providing information on current uses of proposed offshore wind areas in order to allow NJDEP and other agencies to better address, and potentially mitigate, any potential resource or fishing or habitat conflicts;
- Supporting scientific and technical research at state and regional levels to address issues related to offshore wind energy project planning, siting, construction, operation and monitoring.

To learn more about New Jersey's clean energy efforts including offshore wind energy, visit www.nj.gov/dep/aqes/opea-clean-energy.html.

New Jersey Shell Recycling and Oyster Reef Enhancement Program

MFA staff continued developing and acting as the primary coordinator for the NJ Shell Recycling Program (SRP) in partnership with Rutgers University New Jersey Agricultural Experiment Station, Stockton University Marine Field Station, and the Jetty Rock Foundation.

The program collects shell from one casino and two local restaurants in Atlantic City and is currently in discussions with three additional casinos. Prior to this program, clam and oyster shell from these establishments was being hauled to an area landfill. Through the SRP, the shell will now be beneficially used as cultch material to be planted on the Mullica River oyster reefs, located in Atlantic County, which are one of the last self-sustaining oyster reef systems on the Atlantic coast of New Jersey. The planted shell

will allow for the expansion and continued growth of this resilient oyster population.

Staff currently collects shell from participating locations once per week on a mutually agreed upon schedule. Staff is also working with partners to compete for grant funding to further expand the overall program including additional casinos, restaurants and participants, increased outreach opportunities with the public and area schools as well as public shell drop off sites. The SRP provides the MFA, Division of Fish and Wildlife and the NJDEP with an outstanding educational, marine environmental and ecological stewardship-public engagement platform.

MARYLAND

Marek Topolski, MD DNR

Maryland Department of Natural Resources' Fisheries Habitat and Ecosystem Program (MD DNR FHEP) is focused on understanding the dynamics of how habitat changes impact Maryland's Chesapeake Bay fisheries. A primary focal issue has been how land use limits habitat for fish.

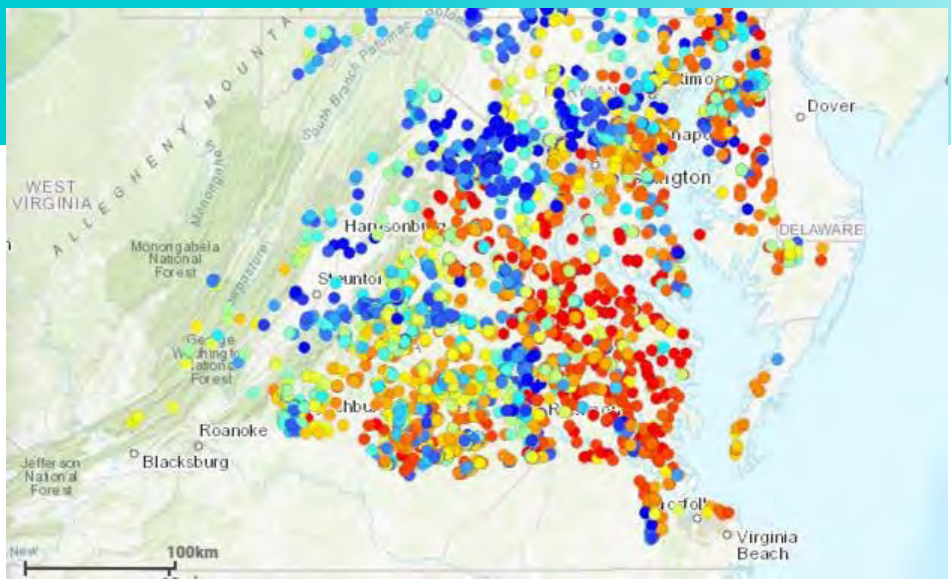
Flanked by metropolitan areas including the nation's capital, Maryland's portion of the Chesapeake Bay watershed is a desirable location for outdoor activities and the landscape is rapidly developing. Agriculture continues to account for a large portion of Maryland's Bay watershed and management of farming practices has become more intense in recent decades in response to eutrophication. Fisheries researchers and managers are increasingly aware of the effects of land use change and development on the living resources of the Bay including the small rivers and streams that flow into the Bay. Particular attention is paid to anadromous spawning habitat and the application of impervious surface (measure of development) thresholds and targets as a management tool.

Anadromous fishes in the Bay include striped bass, hickory and American shad, blueback herring, alewife, white perch, and yellow perch. Biological sampling of adults, egg, and larvae was conducted in the 1970's and 1980's in order to document spawning streams and nursery areas of anadromous finfish species in Maryland. Years of FHEP research (*dnr.maryland.gov/fisheries/pages/fhep/pubs.aspx*) has identified numerous negative consequences of suburban and urban watershed development on spawning and nursery habitat of anadromous fish. Consequences for streams and tributaries include increases to multiple factors such as runoff volume and intensity; physical instability, erosion, and sedimentation; thermal pollution; contaminant loads including endocrine disruptors; road salt; nutrients through direct discharges, sewage leaks and spills, and stormwater runoff; and disruption of organic matter dynamics (a food source for zooplankton that feed larval fishes and a mediator of contaminants and nutrients). Additionally, these direct effects to stream condition and availability of organic matter reverberate through alteration of natural food webs. These factors erode the underlying productivity of fish habitat that supports fisheries. Fisheries managers need to take these changes into account to manage realistically.

FHEP has advanced the use of "indicators of development" as a fishery management tool within the land use planning process. Impervious surface is a commonly used metric to measure the extent of suburban and urban development, however, the data are not generated annually. FHEP developed a surrogate index of development based on counts of structures per hectare from Maryland tax data, which are collected annually. These indices are applied as target and threshold reference points for development, similar to reference points for exploitation, that provide general guidance for common management activities (harvest restrictions, stocking, and habitat activities). For example, in Maryland a target impervious surface of 5% (a rural watershed comprised of a mix of forest, wetlands, agriculture, and low density residential) is equivalent to 0.37 structures per hectare, a threshold of 10% impervious surface is equivalent to 0.86 structures per hectare, and 15% is equivalent to 1.35 structures per hectare. Below the target of ≤ 5%, harvest management and stocking should offset habitat degradation; conserving a watershed at or below the target would be a top priority. By the time the 10% threshold is breached, traditional tools of fisheries management are increasingly unlikely to offset degradation. Conservation of remaining natural lands and habitat revitalization are the primary tools for fishery sustainability, but some loss of productivity is likely. At 15%, serious habitat problems make fish habitat revitalization very difficult and managers must deal with substantially less productive fisheries. Local land planners and fishery managers are able to use this information to evaluate likely outcomes for fisheries resources under different development density scenarios. Fisheries managers are engaging in land use decisions in Maryland by participating in counties' comprehensive growth planning.

VIRGINIA

Tony Watkinson, VMRC



Map of known fish migration impediments in the Chesapeake Bay watershed of Virginia. Figure credit: Erik Martin, TNC. For more details, visit https://maps.freshwaternetwork.org/chesapeake/.

Fishery Habitat Assessment as Permit Mitigation

Virginia Marine Resources Commission (VMRC) this year completed its review of the Hampton Roads Bridge Tunnel (HRBT) expansion project. This much needed $3.8B transportation project will add two new tunnels and expand the existing bridge trestles in Hampton Roads at the mouth of the James River. The HRBT currently carries more than 100,000 vehicles a day during the tourist season. As a part of the permit approval, the mitigation package included a requirement to assess fishery habitat and implement restoration efforts. The fishery mitigation habitat assessment plan* described here was submitted by the Hampton Roads Crossing Partners (HRCP) and selected as the HRBT project design build team by the Virginia Department of Transportation (VDOT).

Many Virginia coastal streams with historic runs of anadromous fishes, including blueback herring and alewife (collectively known as river herring), have been impacted by anthropogenic migration impediments, including poorly installed stream crossings or low-head dams. In recent years, the Virginia Department of Wildlife Resources (VDWR), Virginia Service office, and TNC have inventoried hundreds of migration impediments that disrupt ecological connectivity and block access to historic spawning and rearing habits in tidal and nontidal streams.

Although there has been a good start to assessing road crossings and other anthropogenic impediments in some segments of the James River watershed (e.g. Chickahominy drainage for river herring) there is still a lot of fieldwork necessary to prioritize sites for migratory fish passage. As a condition of permit approval, HRCP will conduct intensive assessments of candidate streams using protocols established by the North Atlantic Aquatic Connectivity Collaborative (NAACC) for impediment evaluations and U.S. Department of Agriculture Forest Service Stream Simulation Design protocols for designing fish passage enhancements. The proposed project team for the effort (VDWR, the Service, and Virginia Commonwealth University [VCU]) will leverage existing data and resources and build new capacity to conduct targeted assessments of in-stream habitat and to determine which streams still support river herring populations and are, therefore, good candidates for enhancement.

Streams with good habitat, but no river herring may be candidates for hatchery-based propagation and introduction of marked river herring larvae in order to re-establish some populations. This approach is currently being used successfully to help restore river herring populations in Virginia and will be applied, where appropriate, in support of this project's objectives. The team will also use relatively new environmental DNA (eDNA) technology, in conjunction with conventional electrofishing, to document the presence or absence of alosine fishes in selected streams within the lower James River watershed (Turner et al. 2015). Genomic analysis of surface water and sediment is a rapid and cost-effective screening tool; a positive eDNA 'hit' will trigger conventional sampling to confirm the presence of herring species in a stream. To support the scale of the proposed sampling for this project and to facilitate future sampling projects, VCU will partner with the Service to conduct NAACC-sponsored training activities to increase the number of certified stream assessors in Virginia natural resource agencies that can conduct sampling.

Only streams with appropriate habitat and, ideally, with extant runs of river herring should be considered for impediment removal or habitat improvement. The agencies are very keen to have both habitat and fisheries field assessments conducted in the vicinity of documented migration impediments, thereby leveraging the existing

surveys by the Service and other groups. Data from this study will be used to rank and prioritize a small subset of impediment locations for removal or remediation, as part of a broader recovery plan for declining river herring populations in the James River watershed. This work could also leverage an ongoing partnership between Harrison Lake National Fish Hatchery, VDWR, and VCU to use hatchery propagation methods to re-introduce river herring into viable historic habitats. This effort is currently used by VMRC as fisheries mitigation for approved permits.

When priority sites are determined from crossing assessments, eDNA sampling, and ground-truthing, VCU, VDWR, and VDOT will jointly review the prioritized inventory of potential fish impediment removal projects and select projects that will be implemented.

*Text from: Hampton Roads Bridge Tunnel (HRBT) Expansion Proposed Fisheries and SAV Mitigation Plan, available at: *https://webapps.mrc.virginia.gov/public/habitat/ enter project number 20191577*

NORTH CAROLINA

Jimmy Johnson and Trish Murphey, APNEP

Dealing with the pandemic of 2020 has certainly made field work and habitat assessments very challenging this year. After almost a full shut down of effort in the early spring, adjustments were made and most work was able to continue. Dr. Carolyn Currin, with NOAA's National Centers for Coastal Ocean Science (NCCOS) based in Beaufort, North Carolina, reported to the Coastal Habitat Protection Plan Virtual Wetlands Workshop regarding a long-term monitoring effort (2009-2019) of fringing marshes. At that meeting, Dr. Currin reported that natural marshes are losing elevation and vegetation at the shoreline. Stabilized fringing marshes (living shorelines) accrete more sediment and show little loss of shoreline vegetation. Analysis of marsh surface elevation at many locations in central North Carolina showed that salt marsh surface elevation is not keeping up with sea level rise, and that low-lying salt marshes (below mean sea level) are in danger of drowning in future decades. Field-collected data show that landward migration of marshes is occurring, and agree with model predictions that upland migration is the primary way that salt marsh habitat extent will be preserved in the coming decades.

Dr. Brian Boutin, Director of TNC's Albemarle-Pamlico Sounds Program, reported that with funding from NOAA's Habitat Program and in partnership with the Wildlife Resources Commission and the Service, TNC has been working with Kris Bass Engineering to assess barriers to fish passage and floodplain connectivity on conservation lands in the Roanoke River floodplain. Using a previous GIS analysis of potential barriers completed by a Duke University intern as a guide, they worked with conservation land management partners to ground truth and prioritize top ranking barriers from that assessment, using a modified Southeast Aquatic Resource Partnership methodology to assess them on-the-ground. In total, 30 barriers have been assessed and they will be restoring the top ranking barrier by modifying or removing it.

The Albemarle-Pamlico National Estuary Partnership (APNEP) continues to lead the state's SAV Partnership, which is made up of agency staff from North Carolina's Department of Environmental Quality as well as scientists from several state universities and NCCOS. During this past spring and fall, aircraft were able to fly and provide aerial photographic images for delineation of SAV abundance in

Students measuring marsh accretion, diversity, and density. Image credits: Trish Murphey, APNEP.

the northern and central regions of coastal North Carolina. This same group is also currently working on monitoring plans for both high and low salinity SAV. In conjunction with the state's SAV Partnership, Dr. Joe Luczkovich with East Carolina University (ECU) has been using side scan sonar in sentinel sites and along the 1-m isobath in the Neuse, Pamlico, and Albemarle River sub-estuaries to determine quantity and extent of low salinity SAV.

ECU's Stacey Trackenberg, a PhD student studying under Dr. Rachel Gittman, is looking at fish communities across seagrass beds in Back Sound to see if the fish communities differ across seagrass species. From the data that were gathered in 2019 it appears that faunal abundances are driven by seasonal effects of temperature and seagrass species composition. It also appears that an increased canopy height is correlated with increased fish species richness and abundances. This relationship persists when the summer is broken up into two month samples (April/May, June/July, August/September) as both the grass composition and fish communities in North Carolina are highly seasonal. The presence and metrics associated with each seagrass species may also be correlated with faunal abundances and species composition, however most of the sampled beds were dominated with shoalgrass (Halodule wrightii) in 2019. Ms. Trackenberg hopes to have updated results from 2020 sampling where they were able to sample beds that had a more mixed distribution of seagrass species. The physical metrics of the seagrass may be more important in determining fish communities than the seagrass species composition. Therefore, there is the potential that shoal grass replacing eelgrass (*Zostera marina*), which is at its southern extent in North Carolina, will not be as detrimental as previously thought.

At North Carolina State University (NCSU), Dr. David Eggleston's lab has been working on several different initiatives. One has to do with designing a fishery independent oyster population survey methodology quantifying oyster distribution and abundance on varying types of reefs throughout North Carolina (sub-tidal natural reefs, inter-tidal natural reefs, sub-tidal cultch reefs, and sub-tidal sanctuary reefs) through the use of diver excavations, dredging, drones, and hand-excavation of intertidal reefs. This is being done in cooperation with TNC and the Division of Marine Fisheries *https://ncoysters.org/2018/09/stock-assessment-on-the-horizon/*. NCSU is also working to quantify bay scallop distribution and abundance in seagrass beds in Core Sound via diver surveys and scallop dredge.

SOUTH CAROLINA

*Evaluating Spawning Activity of Horseshoe Crabs in Salt Marshes and Beaches, and Comparing Embryonic Development Between Habitat Type*s

Daniel Sasson, SCDNR Marine Resources Research Institute

Sandy beaches are considered ideal spawning habitat for horseshoe crabs because the environmental conditions in their sediments are thought to be optimal for embryonic development. For this reason, surveys of spawning horseshoe crabs used in population assessments are conducted almost exclusively on sandy beaches. While horseshoe crabs are known to spawn in alternative habitat types, the extent to which they are used and the effects of their environmental conditions on horseshoe crab embryonic development need further study. To address this gap in knowledge, biologists at South Carolina Department of Natural Resources (SCDNR) are conducting surveys to document horseshoe crab spawning in salt marshes and to compare embryonic development of horseshoe crab eggs laid in salt marshes and sandy beaches. In 2019, the team searched for eggs in both habitats and brought them back to SCDNR's Marine Resources Research Institute in Charleston, South Carolina where they categorized the developmental stages of the eggs. They found embryonic development was occurring in both habitats, but eggs collected from beaches were generally at a later developmental stage than those collected from marshes. Additionally, a higher proportion of eggs collected from marshes were discolored, which a pilot rearing experiment found correlated with lower viability. These results suggest the environmental conditions in salt marshes may slow the development of horseshoe crab embryos and impact their viability. Whether spawning in marshes negatively impacts overall population health may depend on the extent to which that habitat is used.

In 2020, the SCDNR team set out to assess the extent to which horseshoe crabs spawn in marshes compared to sandy beaches. The team selected 20 random sites (ten beach and ten marsh) in each of five regions around Saint Helena Sound, South Carolina. At each site they searched the habitat for horseshoe crab eggs.

For marsh sites, the team found eggs in three of the five regions surveyed, while for beach sites only one of the five regions yielded eggs, suggesting that horseshoe crabs are likely spawning extensively in the marshes. The low

Biologists from SCDNR locate horseshoe crab eggs in salt marsh near Edisto Island, South Carolina. Image credit: SCDNR.

number of sites with eggs overall (marsh = four, beach = two) and the fact that sampling occurred after the peak horseshoe crab spawning season (primarily due to COVID-19 restrictions on field activities earlier in the year), make any conclusions tentative. Future research is planned to more extensively survey horseshoe crab spawning in marsh habitat, to compare environmental conditions (e.g., temperature, salinity, oxygen levels) in marsh and beach habitats used for spawning, and to experimentally test the impact of habitat type on embryonic development. These projects will provide much needed information about the use of alternative spawning habitats and the effects of the natal environment on the earliest life history stages of horseshoe crabs, which will allow for more accurate modeling of population dynamics.

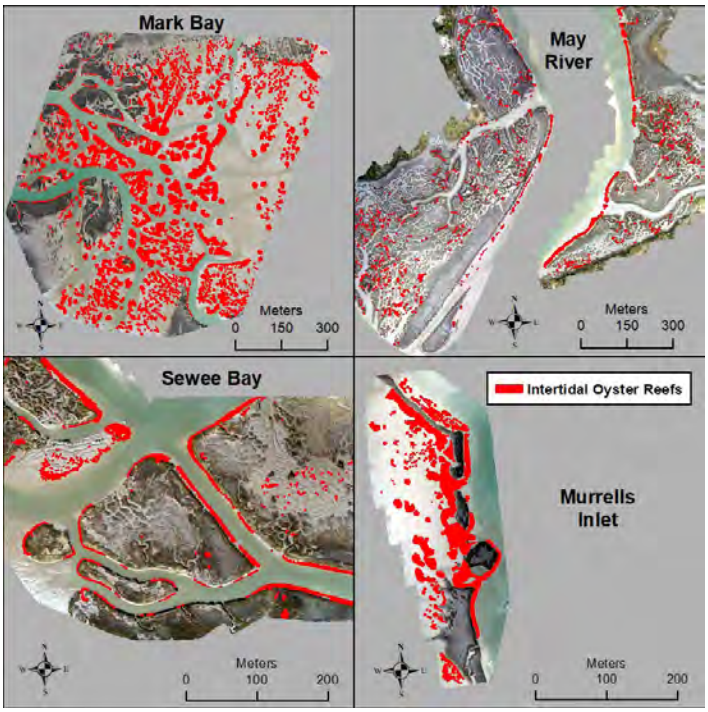
Mapping Intertidal Oyster Reefs Using Small, Unoccupied Aerial Systems

Gary Sundin, SCDNR Marine Resources Research Institute

SCDNR is using small, unoccupied aerial systems (sUAS) to map intertidal oyster (*Crassostrea virginica*) reefs in South Carolina estuaries, both as a potential resource management tool and as a monitoring platform for restoration and living shoreline projects. SCDNR first began using this approach in 2018, in part to replace the use of low-altitude helicopter flights to update oyster reef maps. These sUAS platforms provide researchers with the flexibility to control the timing and location of flights, improving their ability to capture data from ephemerally exposed intertidal habitats that are not reliably captured in larger-scale remote sensing datasets. Researchers are using sUAS imagery to update portions of SCDNR's existing intertidal oyster reef GIS layer. This GIS product is used to inform management decisions and is periodically made available to the public. *https://www.dnr.sc.gov/GIS/descoysterbed.html*

SCDNR is also exploring the utility of sUAS-based approaches to assess the performance of shellfish habitat restoration and enhancement actions and to monitor oyster reef extent and condition (e.g. vertical relief and rugosity). The high-resolution digital surface models generated with structure-from-motion photogrammetry techniques from sUAS imagery provide researchers detailed reef texture data that are useful for detecting habitat changes and for assessing oyster reef health. A pilot project recently used sUAS to map the intertidal habitats surrounding SCDNR long-term trammel net sampling sites around Charleston Harbor. These data are being prepared for use in analyses of habitat use by key finfish species, particularly those of recreational importance.

Investigating Relationships Between Changing



Intertidal oyster reefs mapped in South Carolina using sUAS technology. Figure credit: SCDNR.

Land Use, Climate, and Estuarine Habitat Quality in South Carolina

Andrew Tweel, SCDNR Marine Resources Research Institute

Land use in coastal South Carolina is changing rapidly as the region continues to experience high rates of population growth and coastal development. Many of these coastal areas have also experienced increases in temperature

Eric Montie (left, USCB Associate Professor) and Bradshaw McKinney (right, USCB student) deploy a passive acoustic recorder in front of the South Carolina Aquarium, Charleston Harbor, South Carolina. Image credit: USCB.

and precipitation intensity, and these trends are forecasted to continue. Estuarine environmental quality may be affected by these changes in land use and subsequent storm water runoff, and these impacts may be exacerbated by a changing climate. SCDNR is exploring these relationships as part of a project funded by the South Carolina Sea Grant Consortium. Since 1999, SCDNR's South Carolina Estuarine and Coastal Assessment Program has conducted annual holistic estuarine ecosystem assessments along South Carolina's entire coastline, collecting habitat data on a range of parameters ranging from water and sediment quality to benthic macroinvertebrate infauna community and nekton community (including juvenile spot, Atlantic croaker, and weakfish). During this time, the coastal population has increased by 46% and the region has experienced periods of varying temperature and precipitation. These datasets are being re-analyzed to better understand how adjacent land uses, as well as seasonal and short-term temperature and precipitation patterns, relate to metrics of habitat quality over the last 20 years. Early results suggest that some metrics, such as bacterial contamination, are primarily influenced by local land use and short-term precipitation, while others such as the chemical contamination of sediments and integrity of biological communities are more influenced by changes at larger spatial and temporal scales. Predictive models are being developed to help identify potential changes to estuarine habitats under different scenarios of development and climate.

Tracking Courtship Behavior of Estuarine Fishes with Passive Acoustic Recorders to Estimate Reproductive Potential and Comparisons to Young-of-the-Year Abundance

Eric Montie, USCB Department of Natural Sciences

The Estuarine Soundscape Observatory Network in the Southeast (ESONS) monitors underwater sounds using passive acoustic recorders in four estuaries of South Carolina. Soundscape data are used to monitor animal behavior at multiple levels of biological complexity (i.e. from snapping shrimp to fish to marine mammals) and at time scales ranging from minutes to years. The soundscape approach allows the ability to 'eavesdrop' on key behaviors of marine animals that can change rapidly or gradually in response to environmental changes and human impacts, thus providing a measure of resilience or shifting baselines for economically important or protected species. Passive acoustic platforms provide sound files at a high temporal resolution of two minutes every hour along with water temperature and depth data.

The University of South Carolina Department of Natural Resources (USCB) Marine Sensory and Neurobiology Lab (supervised by Montie) has been collecting estuarine soundscape data in the May River estuary since 2013 and Charleston Harbor since 2017. In 2019, the Montie Lab expanded their array to Chechessee Creek/Colleton River and the North Inlet-Winyah Bay NERR. Acoustic records from this network assist in tracking courtship behavior of sound-producing fish including such species as silver perch, black drum, oyster toadfish, spotted seatrout, and red drum. Fish calling intensity provides a relative measure of spawning potential. In a recent study, the team

USCB undergraduate students Bradshaw McKinney and Shaneel Bivek seine an intertidal creek to quantify YOY fish species to correlate with fish chorusing aggregations. Image credit: USCB.

analyzed soundscape data from 2013 to 2018 obtained in the May River estuary. Their objectives were to investigate long-term patterns of calling, shifts in the calling season, and determine the relationship between fish calling intensity and young-of-the-year (YOY) abundance collected through haul seines. The team found in years with warmer springs, fish began chorusing earlier and had longer calling seasons than in the years with cooler water temperatures. Additionally, the Team found positive correlations between sound production and YOY abundance. In years with higher acoustic activity, they detected higher abundance of silver perch, spotted seatrout, and red drum than in the years with lower acoustic activity. The team detected the appearance of YOY in the estuary approximately one month after initiation of the chorusing season. These patterns provide support that passive acoustics can aid in monitoring reproductive output of an estuary and can assist in studying the impacts of climate change on fish spawning. In the future, expansion of the network to Chechessee Creek/Colleton River and the North-Inlet Winyah Bay NERR will allow comparisons to year class sizes using trammel net survey data provided by SCDNR Inshore Fisheries (in collaboration with Dr. Joey Ballenger).

A list of publications incorporating ESONS data can be found at the bottom of Eric Montie's faculty page: *https://www.uscb.edu/academics/academic_departments/school-of-science-and-mathematics/natural_sciences/research/emontie.html.*

FLORIDA

Kent Smith, FL FWC

The State of Florida has the longest coastline in the contiguous United States (1,348 miles). The coastal zone is heavily populated (76% of the state population lives in coastal counties) and contains 1,180 miles of sandy beaches that support economically important recreation and tourism. Florida's coastal waters are among the most valuable coastal zones in the nation generating over $30 billion in revenue per year, and host the largest number of recreational boats and saltwater fishermen in the country. Florida has been collaborating across agencies and partnerships to generate priority assessments of aquatic habitat that benefit fish species for a number of years. These efforts involve local, regional, state and federal agencies, along with numerous non-governmental organizations (NGOs), such as TNC and Bonefish and Tarpon Trust. Priority assessments are generally geared to help direct limited funding for habitat conservation efforts in areas of the greatest need and opportunity. Although there are many such efforts either completed or underway, prioritization is an on-going process, so the list below should be viewed as a current partial list of relevant efforts only.

FL FWC Aquatic Habitat Conservation Priority Assessment

Florida Fish and Wildlife Conservation Commission (FL FWC) assimilated current geographical and geospatial information on Florida's aquatic habitats and associated fish and wildlife species that depend on these resources. Focusing on socio-economic, feasibility of conservation, and fish and wildlife resources as dataset categories, a prioritization analysis was conducted to identify, locate, and prioritize publicly-owned aquatic resources in need of restoration or enhancement across the landscape and into the marine system. This information will help guide future management considerations that will provide the greatest conservation benefit for management, restoration, and enhancement of fish habitat in Florida using limited legislatively appropriated and grant-based funding. Currently available story maps and reports focus on freshwater aquatic habitats, but the FL FWC is completing an update in 2020 that will include estuarine and marine habitats as well. All pertinent information and publicly accessible products can be found at: *https://myfwc.com/wildlifehabitats/habitat/ahcr/.*

Statewide Ecosystem Assessment of Coastal and Aquatic Resources

The Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR) is a collaborative process with the goal of aggregating existing data on priority habitats around the state. While freshwater aquatic preserves and areas outside the Office of Resilience and Coastal Protection managed areas are not included in the current phase of the SEACAR project, they do include estuarine and marine systems. Objectives include identifying long-term ecosystem conditions of specific submerged habitats within the Resource Conservation Priority managed areas; identifying ecological indicators allowing for future expansion and use of existing data; identifying data gaps; determining the frequency of habitat

index assessment to allow for adaptive management; and incorporating assessment information into a decision support tool/system to provide the best available science to managers and policy makers. Since 2016, partners from over 75 organizations have contributed their time and expertise to select the priority habitats and the indicators; identify product formats for deliverables; identify and provide data files on the chosen indicators for inclusion in an online database; and analyze the available indicator data to produce scientifically defensible status and trends evaluations for each habitat.

The foundation of the products is the SEACAR Database and Discovery Interface which includes project data for all five habitats (coastal wetlands, coral/coral reef, oyster/oyster reefs, water column, and SAV) in one database and it is available online at: *https://dev.seacar.waterinstitute.usf.edu/.*

Florida Coastal Mapping Program Prioritization Process

To address the increasing need for coastal seafloor mapping data, the USGS and the Florida Institute of Oceanography, in 2017, spearheaded the creation of the Florida Coastal Mapping Program, which is an initiative between federal and Florida State agencies and institutions to assess existing data, and develop a prioritization and strategy for filling gaps with high resolution data for all of Florida's coastal waters from the shore to the continental shelf edge. To accomplish this goal, a steering committee composed of four federal and four state agencies are working together closely to coordinate ongoing and future planned mapping efforts, and engage with stakeholders through workshops and other communications to prioritize new data collection and set consistent mapping standards. The goal is to implement a strategy to have complete, consistent, high resolution data for all of Florida's coastal waters by 2028.

https://www.usgs.gov/centers/spcmsc/science/florida-coastal-mapping-program?qt-science_center_objects=0#qt-science_center_objects

Research Prioritization to address Stony Coral Tissue Loss Disease

A multi-agency partnership addressing Stony Coral Tissue Loss Disease (SCTLD) is underway in the wake of its effects on corals starting off Miami in 2016, advancing north and then south along the Florida Reef Tract (FRT). Ongoing randomized surveys conducted FRT-wide assessing disease prevalence by species are used to determine spread and extent as well as intervention strategies. The consortium of agencies, universities, and NGOs are focusing on determining modes of transmission (likely water-borne), causative microbes, and intervention strategies. Strategies have included cutting 'firebreaks' along disease margins to isolate apparently healthy tissues. The team has also experimented with chlorine-laced epoxy and amoxicillin-laced Base 2 medical media along the disease margin. To date, the amoxicillin treatments have been most effective at reducing disease margin advance; however, treated colonies sometimes show re-infection at the margin or elsewhere on the colony. The treatment success and histological examinations strongly suggest that SCTLD has bacterial origins. Recently, the Smithsonian Institution has been testing pro-biotics (certain 'defensive' bacteria) as a potential prophylactic measure. In addition, colonies of keystone coral species are being collected and housed in aquaria nationwide as part of a gene banking program. The studies conducted thus far are key to future planning efforts in order to best use limited resources along the FRT, the third largest coral reef tract on Earth.

East Coast Living Shoreline Prioritization and Mangrove Restoration Suitability Modeling Assessment

A team of researchers from the University of Central Florida (UCF) led by Dr. Kelly Kibler produced two new models to help restoration practitioners plan for more effective living shoreline restoration. The first, a restoration prioritization model, utilizes characteristics of the shoreline to classify segments as 'Urgent', 'Priority', 'Vulnerable', 'Wetland' and 'Hardened.' This can help direct efforts to the most urgent needs in a region, or toward areas that may soon progress into a more severe category without prompt attention. The second component is a mangrove habitat suitability model. The team was able to determine hydrodynamic habitat thresholds for mangroves, information that could be applied to areas outside of the Indian River Lagoon. Using data about the wind-wave climate along a shoreline, the hydrodynamic thresholds, and existing shoreline characteristics, the model shows the probability of mangrove persistence throughout the project area. The modeling efforts both cover 180 miles of estuarine shorelines in Mosquito Lagoon and northern Indian River. This work is a second phase to the shoreline characterization that was completed throughout Northeast Florida supported by the St. Johns River Water Management District, Florida Department of

Environmental Protection, UCF, the Indian River Lagoon National Estuary Program, and FWC. Shoreline model data are available for direct download as a spatial dataset, or for online viewing in a *GIS storymap*.

US EPA REGION I

Phil Colarusso, EPA

Due to COVID-19, much of the Environmental Protection Agency's (EPA) field work has been curtailed this season. Continuing work on the use of high-resolution satellite imagery to estimate eelgrass abundance has been deferred to 2021. Initial results on the use of this technology in New England have been promising, and our team has been able to get reasonable estimates of shoot density, aboveground biomass and leaf area from these images. Repeated satellite images within a season can then be used to estimate eelgrass primary production.

A wayward striped burrfish in Rhode Island, at the northern extreme of its range.

The buildup of organic material and carbon below a typical eelgrass meadow. Top/Bottom image credit: Phil Colarusso, EPA.

Our team did get out to do some fine scale sampling of sediment carbon in an eelgrass meadow. This a blue carbon project being done in conjunction with partners at Massachusetts Institute of Technology, Boston University, and the University of Barcelona. We are examining the variation of carbon sequestration rates within a single meadow.

Our team was pleased to have our study on carbon sequestration in New England eelgrass meadows published this spring. This paper looks at the variation of carbon sequestration rates between meadows and the factors that might be responsible for that variation. The link to the paper is: *https://link.springer.com/article/10.1007/s12237-020-00754-9*. Since its first publication, one of the figures in this paper has been revised; the published update can be found here: *https://link.springer.com/article/10.1007%2Fs12237-020-00815-z*.

North Carolina Coastal Federation

Erin Fleckenstein, Michael Flynn, Wilson Laney, and Todd Miller, NCCF

The North Carolina Coastal Federation (NCCF or Federation) is a member-supported 501(c)(3) non-profit organization that focuses on protecting and restoring the North Carolina coast. Since 1982, the Federation has been in the field restoring miles of coastline; training and educating students, adults (including engineers, landscape architects, and scientists), and community leaders to take actions that result in cleaner coastal waters; and advocating for an accessible, healthy, productive coast.

One important aspect of the Federation's mission is to assess and restore coastal watersheds. Lake Mattamuskeet, historically the largest natural lake in North Carolina, is a vital part of the state's and Hyde County's amazing natural and cultural heritage. Established as a National Wildlife Refuge in 1934 and promoted by no less a personage than Rachel Carson (see Carson, 1947), the Refuge was renowned for waterfowl hunting and viewing, and fishing. It historically and currently provides spawning and nursery habitat for anadromous alewife, and catadromous American eel. Coastal residents and visitors alike value this national treasure.

Mattamuskeet Lodge at the Mattamuskeet National Wildlife Refuge in Hyde County. Image credit: Michael Flynn, NCCF.

Partners meeting on a cold day in January for Lake Mattamuskeet Watershed Restoration planning. Image credit: Todd Miller, NCCF.

Declining water quality, elevated water levels and invasive species (e.g. common carp) threaten the future of this natural wonder as well as the residents and farmers that surround it. The lake, once dominated by SAV, has shifted to a phytoplankton-dominated system (Moorman et al. 2017). In 2017, Hyde County, the North Carolina Wildlife Resources Commission, and the Service formed a partnership and contracted the Federation to develop a watershed restoration plan. This plan aims to address both poor water quality within the Lake as well as chronic and persistent flooding on the surrounding landscape.

The partners embarked on an 18-month planning process that involved stakeholder and public engagement, and on August 7, 2019 the Lake Mattamuskeet Watershed Restoration Plan was officially approved by the North Carolina Department of Environmental Quality. The goals of the plan are to: (1) protect the way of life in Hyde County; (2) actively manage the lake water level; and 3) restore water quality and clarity. For more information regarding the plan and its development, visit: *https://www.nccoast.org/protect-the-coast/stormwater/lake-mattamuskeet-watershed-restoration/.*

Since then, the partners transitioned from plan development to implementation. In 2020, three grants were awarded from state and national funders to advance the implementation of the Lake Mattamuskeet Watershed Restoration Plan. To learn more about the grants, visit: *https://www.nccoast.org/2020/04/three-grants-awarded-to-advance-the-lake-mattamuskeet-watershed-restoration-plan/.*

The grant awards allow the partners to advance several of the priority management actions for the watershed. Throughout 2020 and 2021, the partners will host a series of public meetings and seek input on different implementation ideas.

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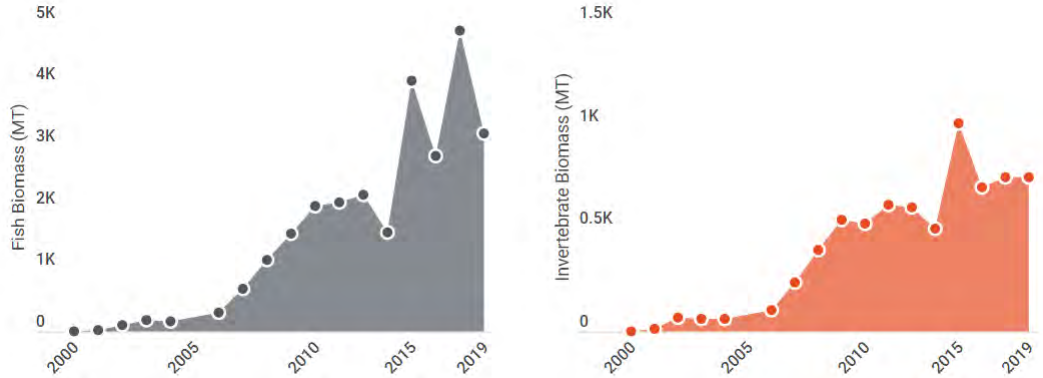
THE NATURE CONSERVANCY

Kate Wilke, TNC Virginia

VIRGINIA

Eelgrass Resurgence Nurtures Invertebrates and Fish

Virginia's coastal bays are home to the largest eelgrass restoration and recovery projects in the world. Seeding of nearly 600 acres has spurred natural growth and recovery in over 9,000 acres. The Virginia Institute of Marine Science, with help from TNC, have been monitoring fish and invertebrate biomass in these restored eelgrass meadows



The estimated biomass of invertebrates (crabs, small shrimps, etc.) and fishes in metric tons (MT) supported by restored eelgrass beds in Virginia's coastal bays. See research articles for confidence intervals and other details. Figure credit: VIMS.

for nearly 20 years. Fish biomass is now about 172 times what it was in the early days of the restoration back in 2001 and invertebrate biomass is over 50 times larger.

"The abundance and diversity of fishes, crabs, and other small shrimps and snails have exploded in response to restoration of their eelgrass habitat. This vibrant food web is key in supporting the fish and fowl that make up the recreational industry of this region." —Dr. Jon Lefcheck, Smithsonian Environmental Research Center

Check out the whole comeback story of the benefits of eelgrass in this eye-catching *infogram* from VIMS.

PENNSYLVANIA
Improving Spawning and Rearing Habitat for Alosines in the Delaware River Basin (DE, NJ, NY, PA)

TNC is creating a Restoration Roadmap for American shad and river herring within the Delaware River basin. This two-year effort is laying out a basin wide set of priority actions to improve access to high-quality spawning and rearing habitat for American shad and river herring in the Delaware basin, once home to some of the largest runs of these species on the East Coast. With its free-flowing mainstem, the Delaware River holds enormous potential for the recovery of migratory fish, but fragmentation caused by more than 1,500 dams and other barriers, on priority tributaries, still impacts migratory fish throughout the basin.

The project team, which includes the Academy of Natural Sciences and Wildlands Conservancy (with funding from the National Fish and Wildlife Foundation), will focus on a select number of priority tributaries with the greatest potential for restoration, and identify key barriers on these tributaries and next steps towards removal and/or mitigation – including recommendations on funding needs, ownership, feasibility, potential for phasing projects, and possible partners. The Academy of Natural Sciences will be further assessing these sites for habitat suitability. Ultimately, the roadmap will advance a targeted aquatic connectivity strategy within the Delaware River Basin that seeks to galvanize partners and align funding resources behind a shared set of goals.

Black Rock Dam on the Schuylkill River, in southeastern Pennsylvania. Image credit: TNC.

ACRONYMS

ACFHP or Partnership - Atlantic Coastal Fish Habitat Partnership
APNEP – Albemarle-Pamlico National Estuary Partnership
ASMFC – Atlantic States Marine Fisheries Commission
BOEM - Bureau of Ocean and Energy Management
Council – Fishery Management Council
CPUE – catch per unit effort
DKP – Duxbury-Kingston-Plymouth
ECU – East Carolina University
eDNA – environmental DNA
EEZ – Exclusive Economic Zone
EFH – Essential Fish Habitat
EPA - Environmental Protection Agency
ESONS – Estuarine Soundscape Observatory Network in the Southeast
FHEP – Fisheries Habitat and Ecosystem Program
FRT – Florida Reef Tract
FWC – Florida Fish and Wildlife Conservation Commission
GSB – Great South Bay
HAPC – Habitat Area of Particular Concern
HCVA – Habitat Climate Vulnerability Assessment
HRBT – Hampton Roads Bridge Tunnel
HRCP – Hampton Roads Crossing Partners
IPCC – Intergovernmental Panel on Climate Change
MA DMF – Massachusetts Division of Marine Fisheries
MAMFC - Mid-Atlantic Fishery Management Council
MD DNR – Maryland DNR
MFA – Marine Fisheries Administration
NAACC – North Atlantic Aquatic Connectivity Collaborative
NCCF – North Carolina Coastal Federation
NCCOS - National Centers for Coastal Ocean Science
NCSU – North Carolina State University
NEFMC - New England Fishery Management Council
NEFSC – Northeast Fishery Science Center
NERR or Reserve – National Estuarine Research Reserve
NGO – non-governmental organization
NJDEP – New Jersey Department of Environmental Protection
NOAA – National Oceanic and Atmospheric Administration
NRHA – Northeast Regional Habitat Assessment
NYSDEC – New York State Department of Environmental Conservation
RI DEM – Rhode Island Department of Environmental Management
RI DMF – Rhode Island Division of Marine Fisheries
SAV – submerged aquatic vegetation
SCDNR – South Carolina Department of Natural Resources
SCTLD – Stony Coral Tissue Loss Disease
SEACAR – Statewide Ecosystem Assessment of Coastal and Aquatic Resources
Service - U.S. Fish and Wildlife Service
SoMAS - Stony Brook University School of Marine and Atmospheric Sciences
SRP – Shell Recycling Program
sUAS – small, unoccupied aerial system
TNC – The Nature Conservancy
USCB – University of South Carolina Beaufort
USGS - U.S. Geological Survey
UVM – underwater video monitors
VDOT – Virginia Department of Transportation
VDWR – Virginia Department of Wildlife Resources
VMRC – Virginia Marine Resources Commission
YOY – young of year

ACKNOWLEDGEMENTS

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.

REPRODUCTIONS

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