

## COASTAL HABITAT PROTECTION PLAN 2021

### CHAPTER 2. IMPLEMENTATION PROGRESS ON PRIORITY HABITAT ISSUES:

Over the past four years, implementation of the 2016 CHPP focused on four identified priority issues:

- Restoring oyster reef habitat
- Encouraging use of living shorelines
- Reducing sedimentation impacts in estuarine creeks
- Developing metrics on habitat trends and management effectiveness

The primary divisions responsible for implementing CHPP recommended actions are the Division of Marine Fisheries (DMF), Division of Coastal Management (DCM), Division of Water Resources (DWR), and the Division of Energy, Minerals, and Land Resources (DEMLR). Progress on these actions to address priorities are summarized below.

#### 2.1 Oyster Reef Habitat Restoration

The 2016 Coastal Habitat Protection Plan included Oyster Reef Habitat Restoration as a priority habitat issue. The participating DEQ divisions and partners made substantial progress towards achieving and implementing the 2016 recommended actions. Progress was strengthened by DMF partnering with others on the N.C. Oyster Steering Committee. The committee consists of a diverse group of state and federal agencies, including DMF, as well as researchers, nongovernmental organizations (NGOs), and shellfish lease growers with the common goal of restoring and protecting oyster habitat through multiple strategies. The N.C. Coastal Federation (NCCF) serves as the lead organization for the steering committee and production of the Oyster Restoration and Protection Plan: A Blueprint for Action, that is updated on five year cycles. The 2015-2020 Blueprint summarizes work being done in North Carolina related to oysters, and builds on progress accomplished through the 1995 Blue Ribbon Advisory Council for Oysters and the CHPP. Many of the goals in the Blueprint closely align to recommendations and implementation actions of the CHPP, including creating additional acreage of oyster sanctuaries, planting cultch for sustainable harvest, protecting and improving water quality in priority shellfish growing areas, and documenting oyster population status and trends ([http://www.nccoast.org/wp-content/uploads/2015/03/Oyster-Restoration-Blueprint-2015-2020\\_FINAL.pdf](http://www.nccoast.org/wp-content/uploads/2015/03/Oyster-Restoration-Blueprint-2015-2020_FINAL.pdf)). Through collaboration with partners, and support from the N.C. General Assembly, progress on oyster restoration has been tremendous over the past five years.

The 2016 CHPP recommended actions were presented for three categories: Cultch Planting, Oyster Sanctuaries, and Hatchery and Oyster Seed Production.

#### ***Cultch Planting***

The 2016 CHPP recommended actions for cultch planting were:

1. Increase spending limit per bushel of shell to compete with other states
2. Develop a cooperative public/private, self-sustaining shell recycling program by providing financial incentives in exchange for recycled shell
3. Work with the shellfish industry to institute an “oyster use fee” to help support the cultch planting program
4. Identify alternative substrates for larval settlement in intertidal and subtidal reefs, including a cost-benefit analysis
5. Establish long term monitoring program to support future decision-making

6. Utilize new siting tools and monitoring protocols to maximize reef success

Since 2016, several actions have been taken to advance the success of cultch planting. In early 2019, the DMFs' special delegation for the purchase and transport of oyster shell was increased to account for inflation of transportation costs. The allowed price per bushel remains at \$2, though that may be revised again in 2021. In 2018, due to lack of funding DMF formally terminated the oyster shell recycling program. However, the NCCF has continued recycling across the state. Recycled shell used for DMF cultch planting is either donated or available for purchase under the shell delegation. No progress has been made toward establishing incentives or funding mechanisms such as oyster use fees (tax on sale of oysters with revenue allocated for cultch planting) to acquire shell for the program. As described in the 2016 CHPP, DMF recently reallocated a position to establish a new cultch planting biologist. This position will focus on providing scientific support to the cultch planting decision-making process including: identifying alternative substrates for larval settlement in intertidal and subtidal reefs, establishing a long term monitoring program and using new siting tools and monitoring protocols to maximize reef success. Of note, the newly redefined CRFL RFP process has afforded the cultch planting program an opportunity to request focused university research to inform decisions. Also, DMF recently repurposed another position to create a dedicated side-scan mapping role. This position will be tasked with mapping hard bottom areas, with particular attention paid to cultch planting reefs, oyster sanctuaries, artificial reefs, and natural oyster reefs. Data will provide spatial context for public consumption, reference tools for other division programs (Leases, CHPP, etc.), and a baseline for future monitoring of habitat performance over time. An example of backscatter data (derived from side-scan mapping surveys) from a cultch planting site is presented in Figure 2.1.

While not listed under any recommended actions, it is important to note the substantial accomplishments of DMF in pursuit of the cultch planting objective. Since 2016, staff have built a total of 261 acres of oyster habitat using 1,266,815 bushels of material, without assistance from marine contractors.

**Oyster Sanctuaries**

The 2016 CHPP recommended actions for Oyster Sanctuaries were:

1. Identify alternative substrates for larval settlement in intertidal and subtidal reefs, including a cost-benefit analysis
2. Identify the size and number of sanctuaries needed
3. Develop reefs that are resistant to poaching
4. Utilize new siting tools to maximize reef success
5. Explore actions for in-situ sampling protocol to incorporate alternative construction materials
6. Expand oyster sanctuary network to include intertidal reefs in euhaline waters

Since 2016, substantial progress has been made toward achieving and implementing the Oyster Sanctuary recommended action. Between 2016 (CY) and 2019 (CY), the DMF protected approximately 80.7 acres of bottom and, with partners, developed approximately 51.15 acres of oyster habitat within that area. Two independent sanctuaries were constructed, Little Creek (20.7 acres) and Swan Island Sanctuary (60 acres). The Swan Island project was the most notable accomplishment involving a public-private partnership with the NCCF and funding from both the N.C. General Assembly and the National Oceanic and Atmospheric Administration (NOAA). The project was completed in 2019 using a combined total of 80,600 tons of granite and marine limestone marl. Rigorous sampling of oyster sanctuaries,

including Swan Island, resumed in 2019 after a short hiatus. Monitoring will provide size structure and population density information to inform recommendations for identifying alternative substrates for larval settlement in intertidal and subtidal reefs, identifying the size and number of sanctuaries needed, and new siting tools to maximize reef success. Presently, these data are undergoing analysis to compare 2019 results to published literature. The primary objective of this analysis is to evaluate trends in population and size structure over a long time series and potentially develop predictive tools for future management. Preliminary results and analysis of the 2019 data are presented in Figures 2.2-2.3. Under the recommended action to develop reefs that are resistant to poaching, it is now speculated that poaching occurs mostly on low-relief reef sites in bays where mechanical harvest is allowed nearby. Construction options for deterring poaching may also involve the use of less suitable materials (precast concrete) or other methods not currently allowed under the existing permits. Since altering construction methods is typically not feasible, the most successful deterrent may be increasing enforcement through stricter penalties. Finally, with respect to recommended action 6, no intertidal oyster sanctuaries were developed in euhaline waters.

### Hatchery Oyster Seed Production

The 2016 CHPP recommended actions for hatchery oyster seed production were:

1. Explore options for increasing funds to support University of North Carolina–Wilmington (UNC-W) oyster hatchery
2. Identify regional genetic variability within North Carolina
3. Improve availability of seed oysters genetically suited to respective regions

Since 2016, the University of North Carolina–Wilmington (UNC-W) has been making progress on the recommended actions for hatchery oyster seed production. Based on legislative reports provided by UNC-W, the university has successfully and progressively increased viable spawns and provided broodstock from multiple lines to commercial hatcheries and community colleges statewide. The Shellfish Research Hatchery Breeding Program was substantially compromised during Hurricane Florence, which identified a need for storm resilience through industry/community/academic partnerships. Funding has been budgeted for genetics and additional staff to presumably address recommended actions to identify regional genetic variability within North Carolina and improve availability of seed oysters genetically suited to respective regions.

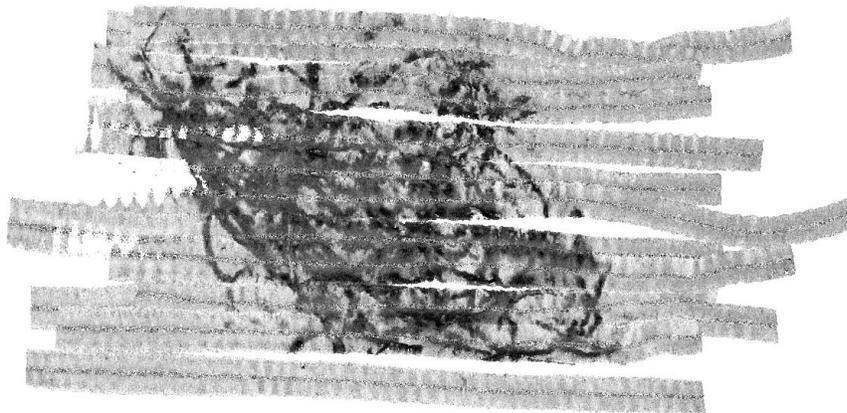


Figure 2.1. Backscatter imagery from a high resolution survey conducted at a cultch planting site in Bonner Bay on 6/9/2016. The darker colors indicate hard bottom habitat created by the NCDMF cultch planting vessel, RV Shell Point. The lighter colors indicate softer sand/mud bottom.

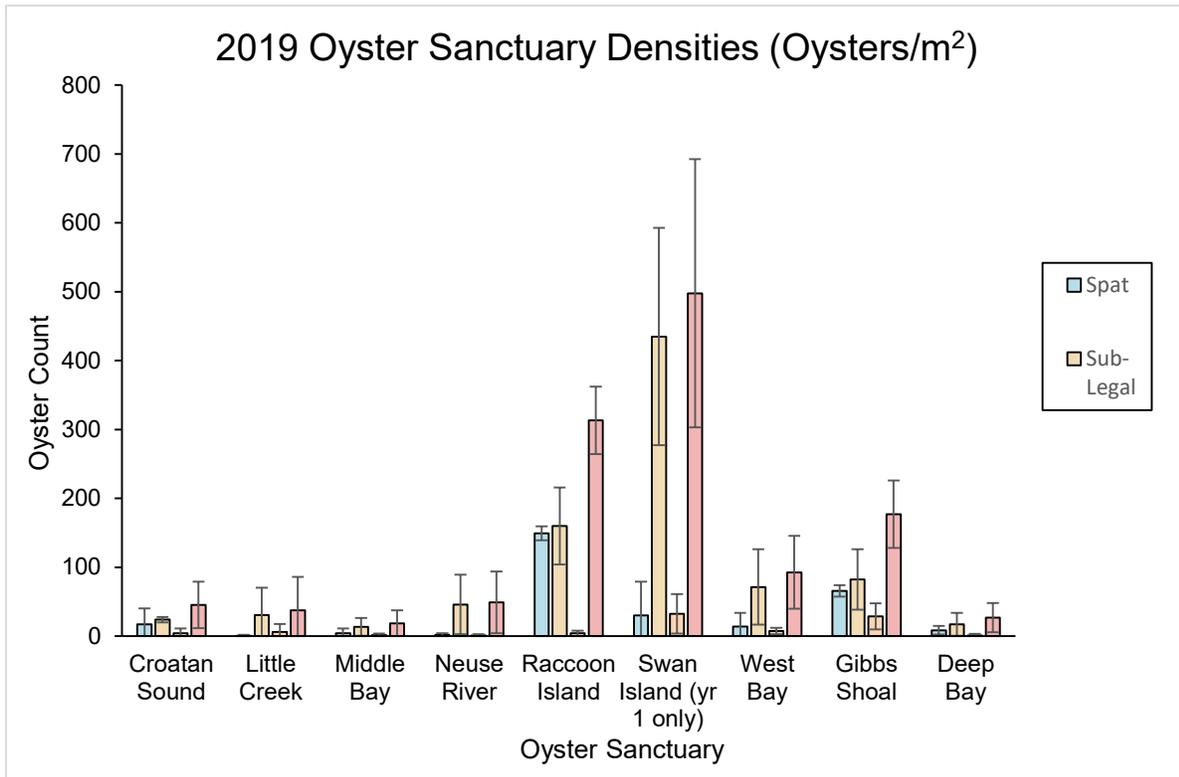


Figure 2.2. Preliminary population density data for 13 oyster sanctuary sites in Pamlico Sound. Size class densities (oysters/m<sup>2</sup>) are presented with error bars for each sanctuary, along with the total mean density at each.

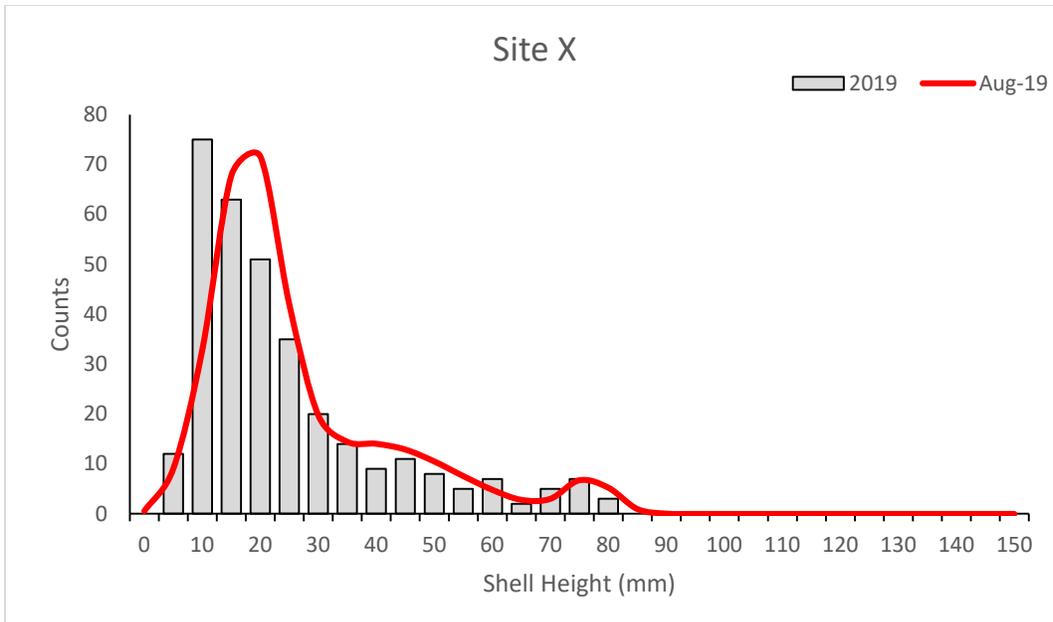


Figure 2.3a. Preliminary length frequency data for one sanctuary site in Pamlico Sound, as compared to data collected by Puckett and Eggleston 2012. Figure a. Length frequency at one sanctuary site in 2019. The data in these figures is in preparation for publication, so site name has been removed.

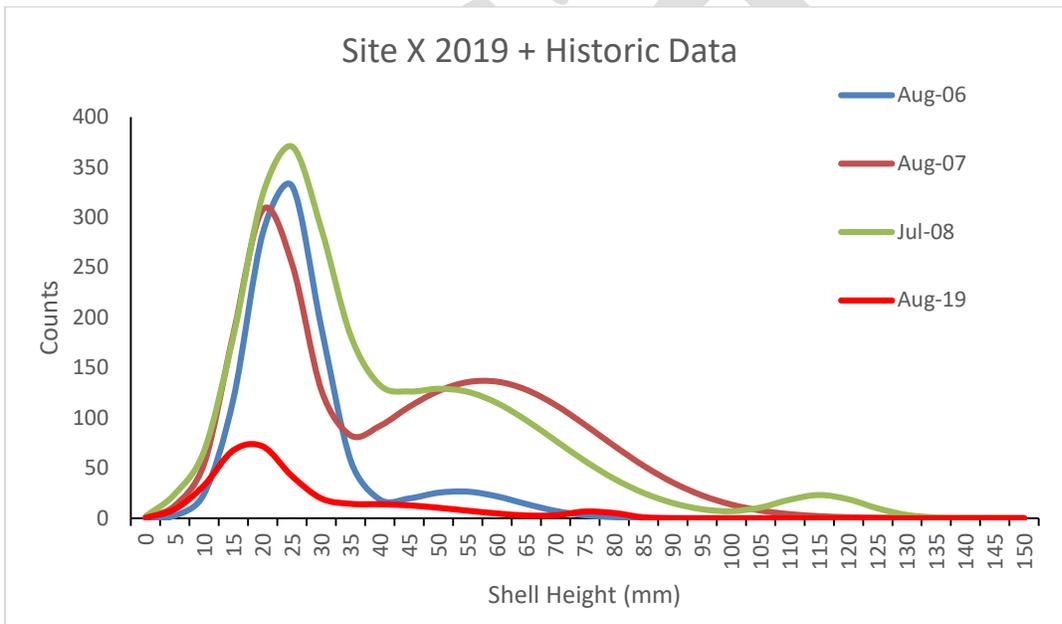


Figure 2.3b. Comparison of length frequency plot in 2.3a compared to data published by Puckett and Eggleston (2012).

## 2.2 Encourage Use of Living Shorelines

The 2016 Coastal Habitat Protection Plan directs agencies to continue focusing efforts on encouraging living shorelines to protect property, restore shoreline habitat, and improve water quality. Starting in 2018, a Living Shoreline Steering Committee (LSSC) was established through a partnership with Albemarle-Pamlico National Estuary Partnership (APNEP) and the NCCF. Member partners include DEQ staff from DMF, DWR, DCM and its N.C. Coastal Reserve and National Estuarine Research Reserve (N.C. Coastal Reserve) as well as research scientists from National Oceanic and Atmospheric Administration (NOAA), UNC-W, UNC-Chapel Hill (UNC-CH), East Carolina University (ECU), Duke University and N.C. Sea Grant. Two NGOs, NCCF and The Nature Conservancy (TNC) are also members. The goals and objectives of the LSSC and the CHPP Living Shoreline Priority Issue Paper closely align. Through the steering committee, there has been a dramatic increase in communication, collaboration and significant progress in advancing the recommended actions in the 2016 CHPP Living Shoreline priority issue paper, including:

1. Continuing to **educate** the public and waterfront property owners regarding the benefits of living shorelines.
2. Promoting additional **research** and monitoring of living shorelines
3. Continuing to simplify the federal and state **permitting** process for living shorelines.
4. Promote the appropriate **use of oyster shells** to facilitate habitat enhancement and availability for incorporation into living shorelines.

Much of the progress described below was associated with members of the LSSC and CHPP Team.

### ***Permitting***

The most notable accomplishment toward CHPP implementation is the simplification of permit requirements, specifically the changes to the General Permit (GP) for marsh sills. In 2017, the N.C. Division of Coastal Management worked with a stakeholder group that included the U.S. Army Corps of Engineers (USACE), marine science community, DMF, DWR, NCCF, N.C. Sea Grant, and NOAA to determine how best to move forward with creating a more streamlined permitting process for marsh sills. For there to be an efficient streamlined general permit, all federal and state agency concerns must be addressed with permit conditions. In early 2017, DCM compiled all of the comments and recommendations from the stakeholder group and drafted an amended general permit 15A NCAC 7H .2700. In 2018, the USACE used the draft amended GP .2700 as guidance in the development of a Regional General Permit (RGP) for Marsh Sills that would allow DCM to issue GPs for marsh sills without a case-by-case federal review prior to issuance.

On September 5, 2018 the USACE issued a public notice proposing to authorize a RGP for the construction, maintenance, and repair of marsh sills. As proposed, the RGP for the construction and maintenance of marsh sills included all conditions that were agreed upon at the stakeholder meetings. On March 26, 2019 the USACE issued the RGP (RGP 20181536) that authorizes the construction, maintenance and repair of marsh sills for shoreline stabilization.

The CRC adopted amendments to 15A NCAC 7H .2700 that was consistent with the USACE RGP and the Temporary Rule became effective on April 1, 2019 and the Permanent Rule became effective on July 1, 2019. This general permit does not require any coordination with state and federal agencies as long as the permit conditions are met; therefore, creating a streamlined general permit process that is consistent with other Coastal Area Management Act (CAMA) general permits. Since the effective date of this general permit, there has been an increase in 15A NCAC 7H .2700 applications and to date there

have been approximately 14 General Permits issued for the construction of marsh sills.

Another permit related activity underway is exploring the possibility of living shorelines being constructed for mitigation credits. The NCCF is currently looking into the feasibility of this with environmental consulting companies. Similar crediting is being used in the Chesapeake Bay. Living shorelines are one type of shoreline Best Management Practice (BMP) that can be used for Total Maximum Daily Load or Limit (TMDL) or shoreline management BMP credits to reduce nutrients and sediment. Virginia offers a residential cost-share program (Virginia Conservation Assistance Program), an agricultural cost-share program, and low interest loans as incentives.

### ***Education***

Since 2017, the N.C. Coastal Reserve has conducted nine living shoreline training events throughout the coast to promote the use of living shorelines as a preferred erosion control method where appropriate. These training events were conducted in three coastal regions and attendees included real estate professionals, marine contractors, land use planners, landscape architects, property owners, and homeowner associations. The NEERs will continue to conduct these training events as well as begin development of a marine contractor training adapted from a Florida training with the intent to host the workshop in 2021. DCM regulatory staff and the NCCF presented at most of the Coastal Reserve workshops, providing valuable technical expertise. The workshops have been effective in increasing understanding on not only the benefits of living shorelines, but where and how to construct them. A contractor that attended training has independently built several living shorelines, a sign that the workshops are effective.

The NCCF has played a major role in encouraging property owners to consider living shorelines to stabilize their shorelines. They provided shoreline consultations to 55 waterfront property owners coast wide in 2019 alone. The NCCF also engaged with multiple homeowner associations, providing presentations and guidance on living shoreline implementation, as well as to town planners and during town meetings. By utilizing community volunteers to construct living shorelines, the value, applicability, and effectiveness of living shorelines reaches large numbers of people from a diversity of backgrounds, including students, church members, environmental groups, and private businesses.

### ***Research***

There are several research projects that are ongoing and include monitoring of salt marsh surface elevation tables (SET) and vegetation in natural marshes and nearby living shorelines in Carteret County. A study that surveyed coastal property owners after Hurricanes Irene (2011) and Arthur (2014) found that most homeowners believed that bulkheads were the most effective way to prevent erosion from hurricanes. However, the study also showed that the majority of damage by hurricanes was to bulkheads. Cost for repairs of these bulkheads was double the price and four times the cost of annual maintenance of natural or living shorelines. But during the same timeframe, shoreline hardening increased by 3.5% from along the Outer Banks (Smith et al. 2017). Recent work by Smith et al. (2018) demonstrated the resilience of living shorelines to hurricanes and that living shorelines had better resistance to erosion than bulkheads and natural marshes. They also found that no repairs were required during the two-year study period. Post-Hurricane Florence monitoring of several living shorelines throughout the state showed minimal signs of damage to both rock and oyster sills. Some marsh shoreline erosion was observed but only an average loss of 14 percent of marsh vegetation, suggesting that marsh was protected and retained after the storm. What structural damage was observed was some displacement of oyster bags from the main sill (Taggart and Puckett 2019). There

are several other studies that are completed or are close to completion that demonstrate 1) that bulkheads reduce salt marsh extent, 2) how wave energy is attenuated by natural marshes, reducing erosion of uplands, and 3) how waves are transformed across living shorelines. A new online tool was developed by NOAA and The Nature Conservancy incorporating recent research and the relationship between salt marsh distribution, shoreline wave energy, and suitability for living shorelines (<https://coastalresilience.org/new-north-carolinas-living-shorelines-application/>).

Several presentations were given at various scientific conferences. Beaufort, NC was also the site of Restore America's Estuaries' Third National Living Shoreline Technology Transfer Workshop in October 2019. The workshop, locally hosted by NCCF was attended by approximately 250 professionals. Field trips showcased local living shorelines projects at Piver Island, Carrot Island, Trinity Center, the N.C. Aquarium at Pine Knoll Shores and Hammocks Beach State Park's Jones Island.

Work on testing alternative construction materials has also been ongoing. A 185 ft. living shoreline was constructed in Bogue Sound at the N.C. Aquarium at Pine Knoll Shores using Sandbar Oyster Company's Oyster Catcher™ material. Oyster shell and rock gabions developed by the Tensar International Corporation and JLS Contracting Services, LLC, are being tested at Jones Island and at a shoreline along the Intracoastal Waterway in Swansboro. The federation is working with Green Recycling Solutions to develop a degradable alternative to the traditional plastic mesh bags. The company is in the process of developing a jute mesh bag that can be used to fill oyster shells. This will be tested for living shoreline construction. The use of their degradable erosion control sock may also be explored.

#### ***Living Shorelines with Oyster Habitat***

Using oyster shell as substrate to create a living shoreline doubles the habitat benefits by enhancing wetland and oyster habitat. While oyster shell is limited in supply, other hard substrate can be used that oysters can recruit onto. Environmental conditions, primarily salinity, limits oyster habitat on all living shorelines. Living shorelines incorporating oysters therefore represents a subset of all living shorelines. The Oyster Blueprint, prepared by the NCCF in partnership with multiple organizations, is a plan for oyster restoration and protection. The Blueprint will be updated in 2021 and plans to include a new goal to expand the use of living shorelines in areas that support oyster habitat, and make them the most commonly used stabilization method in those areas. Living shorelines located in areas that support oysters will provide benefits to oyster rehabilitation efforts by potentially providing another source for oyster larvae. Living shorelines provide another opportunity to supplement oyster rehabilitation efforts, and improve water quality. Living shorelines are one strategy to protect and restore wetlands, and in some cases oysters.

Living shorelines remain a priority in the 2021 CHPP for the benefits they provide as fish habitat, wetland restoration, oyster restoration, water quality improvement, and enhancing coastal resilience (Figure 2.4). Recognition of the benefits of living shorelines has greatly increased in the past five years. To this point, the General Assembly in 2019 (Session Law 2019-251) allocated \$2 million to the N.C. Department of Transportation (DOT) to construct living shorelines in areas close to vulnerable infrastructure.

The 2021 CHPP priority habitat issue paper **Wetland Protection and Enhancement, with Focus on Nature-Based Methods** will provide additional information.

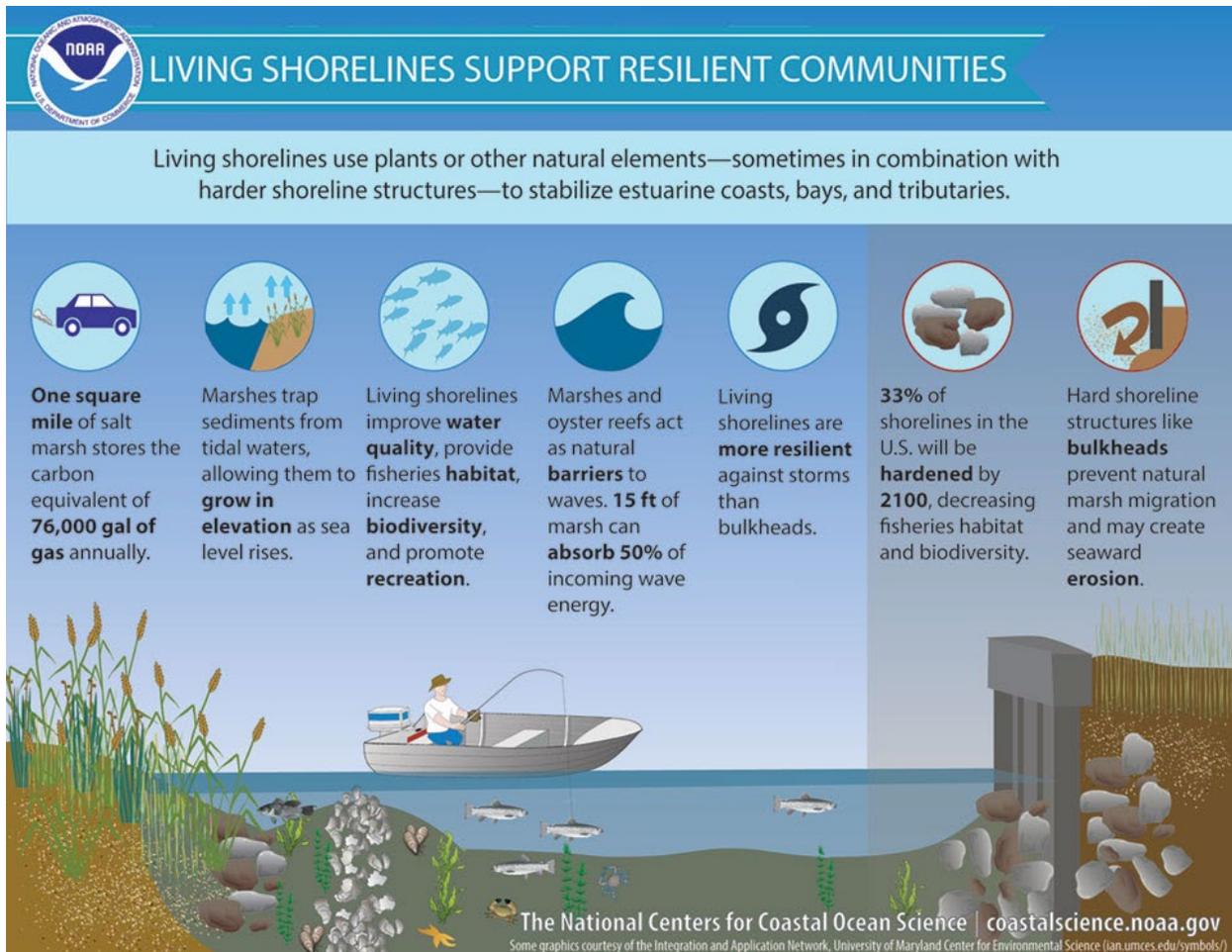


Figure 2.4. The ecosystem benefits of living shorelines for shoreline stabilization. Graphic source: National Centers for Coastal Ocean Science.

### 2.3 Sedimentation in Estuarine Creeks

Tidal creeks are a gateway between uplands and larger estuarine waters, but many have been overloaded by influx of sediment and pollutants (Freeman et al., in press). Reducing sedimentation in tidal creeks was a priority issue in the 2016 CHPP due to concerns that sedimentation was causing upper creeks to fill in, reducing habitat availability for juvenile fish, smothering oyster reefs, and degrading water quality, particularly shellfish harvest waters. Review of literature concluded that the negative impacts of sedimentation are fairly well understood and a few studies were done in North Carolina to look at sedimentation rates and sources. However, more assessments of tidal creeks across a continuum of anthropogenic disturbance were needed to determine prevalence of high sedimentation, major land use activities contributing to it, and the effects of sedimentation on nursery area function. While more research was needed, there were management and outreach actions that could advance. The research and management actions included:

1. Determine magnitude and change in sedimentation rates and sources over time at sufficiently representative waterbodies and regions.
2. Determine the effect of sedimentation in the upper estuaries on primary and secondary productivity and juvenile nursery function.
3. Encourage research for innovative and effective sediment control methods in coastal areas.
4. Encourage expanded use of stormwater Best Management Practices (BMPs) and low impact development (LID) to reduce sediment loading into estuarine creeks.
5. Improve effectiveness of sediment and erosion control programs.

#### ***Research Actions***

Two studies done since 2015 examined sedimentation rates and sources in North Carolina and both found that sedimentation rates in tidal creeks were exceeding local sea level rise. One study examined the relationship of land use, shoreline change, and sedimentation rates in three creeks in Onslow and Carteret counties (Corbett et al. 2017). Sediment composition and profiles indicated sediment in the upper creeks originated from land runoff and an increased flux of organic carbon and nitrogen over time. There was not a clear relationship between sedimentation, shoreline change, and land use. However timing of the measured change in sediment accumulation rates in Oyster and Broad creeks coincided with periods of development and land use change in the surrounding areas (Corbett et al. 2017). Another study examined sedimentation rates and resulting impacts to fishery production in nursery areas. This study, funded by the Coastal Recreational Fishing License Fund (CRFL), began in 2016 and is in the final stages of completion. The first part of the study assessed the relationship of land use change and tidal creek infilling by calculating sedimentation rates from twelve tidal creeks in Carteret and New Hanover counties (Deaton 2018). Sedimentation rates were compared to changes in watershed land use from 1959 to 2010. Sedimentation rates experienced notable increases through time as developed land area increased and the sedimentation in all creeks was greater than the relative sea level rise rates. The results of the study indicated that land-use change, particularly increasing development, leads to higher sedimentation rates with the potential to drive infilling and shallowing of tidal creeks. However, Deaton (2018) noted that hydrological conditions influence whether sediment loads are deposited in the upper creeks or exported downstream to larger estuaries.

The second part of the study conducted extensive spring, summer, and fall nekton sampling in the same 12 creeks, from 2017 to 2019. Preliminary results indicated that for 11 of the tidal creeks, there appeared to be a negative relationship between sedimentation rate (integrated over the last 50 years) and catch rate of nekton (fish and decapod crustaceans) (Figure 2.5) (J. Fodrie, UNC-CH, personal

communication). The investigators continue to explore whether the mechanism for this negative relationship include changes in habitat amount (i.e., higher sedimentation = smaller creeks), changes in water quality (i.e., turbidity), and/or changes in benthic habitat quality (i.e. altered sediment characteristics and/or burial of biogenic habitat).

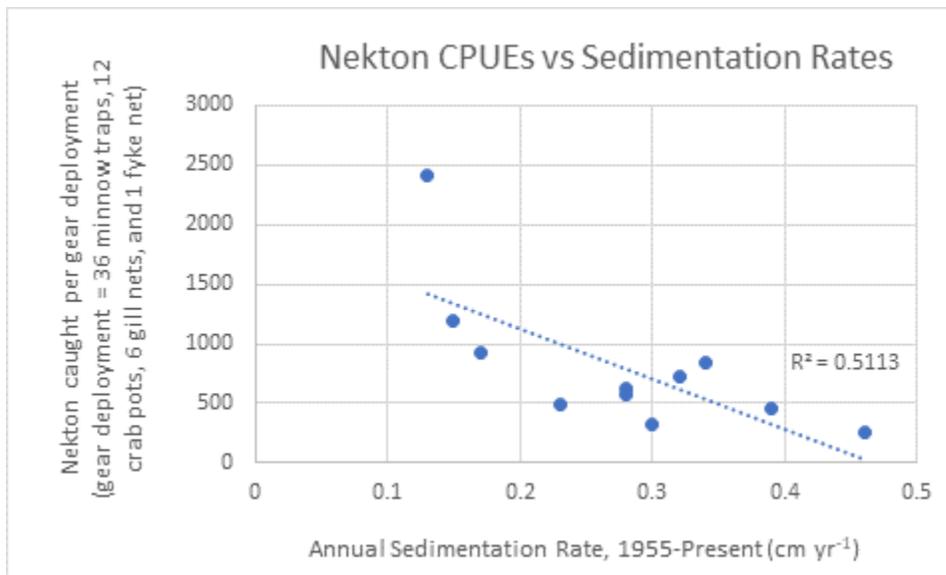


Figure 2.5. Abundance of nekton collected with multiple gears

Another research action in the 2016 CHPP issue paper was the need for more research on innovative and effective sediment control measures in coastal areas . Changes to coastal stormwater rules in 2016 made this even more critical than in the past. With less emphasis on built-upon limits and stormwater ponds, research on innovative and effective infiltration systems continued to be a high priority. Significant research has been conducted in the past five years, primarily through collaboration among NCSU, DEQ, and DOT. Some examples of research projects in coastal counties include:

- Rain garden and permeable pavement Wilmington YMCA (2010)
- Stormwater wetlands at Stonestrow Condos, Wilmington (2010)
- Drainage and stormwater improvements at Towns Creek, Greenville (2019)
- Stormwater wetlands project, Jacks Creek, New Bern (2013)

Through Section 319(h) of the Clean Water Act, the U.S. Environmental Protection Agency (EPA) provides states with funding to reduce nonpoint source pollution. North Carolina typically receives around \$1 million for competitive funding of watershed restoration projects. Section 319 grant projects must be used to help restore waterbodies currently impaired by nonpoint source pollution in areas with approved watershed restoration plans. Since 2015 several projects occurred in coastal watersheds (Table 2.1).

Table 2.1. Partial list of 319 projects approved since 2015 in coastal counties.

Year	Project Name	Sponsor	River Basin	Impairment
2016	Implementing the Bradley and Hewletts Creeks Watershed Restoration Plan	North Carolina Coastal Federation	Cape Fear	bacteria, stormwater

**DRAFT FOR MAY 11, 2020 CHPP STEERING COMMITTEE MEETING**

2018	Reducing Stormwater Runoff Volume on the UNC Wilmington Campus	North Carolina Coastal Federation	Cape Fear	bacteria
2019	Reduction of Nutrient Loading to Greenfield Lake from Jumping Run Branch, Wilmington	Cape Fear River Watch	Cape Fear	
2017	Little River Restoration Phase II In-Stream Wetland	Albemarle Resource Conservation and Development Council	Pasquotank	sediment, chl. <i>a</i> , TSS, nutrients
2015	Mattamuskeet Drainage Association: Implementing the Watershed Restoration Plan	North Carolina Coastal Federation	Tar-Pamlico	
2017	Jaycee Park Forested Stormwater Wetland	Sound Rivers, Inc.	Tar-Pamlico	
2016	Brynn Marr Watershed Water Quality Improvement	North Carolina State University	White Oak	bacteria, turbidity, nutrients
2018	Carteret and Onslow Soil and Water Conservation District Stormwater Retrofit Projects	N.C. Division of Soil and Water Conservation	White Oak	stormwater

A major source of impervious surfaces in coastal North Carolina is DOT roadways. Consequently, they have several programs to research and implement innovative techniques to reduce stormwater runoff. Although not within DEQ, the magnitude of their potential impact on sedimentation and progress they are taking to minimize adverse impacts is worth noting.

Through the DOT Research Program the agency explores new and innovative technologies that may be suitable for use with the linear nature of most DOT activities. DOT actively funds university research to investigate and evaluate suitable methods for treating pollutants associated with DOT activities. Active research programs involving detailed analytical monitoring have been established to investigate and document the impacts of stormwater runoff from highways as well as the effectiveness of BMPs. This has included research on performance of dry swales, wet swales, permeable pavement, and bioswales. Research publications sponsored by the program are listed on their website

<https://connect.ncdot.gov/projects/research/Pages/ProjectSearch.aspx#InplviewHashd751ee3e-09a3-45cd-ab7b-a04df60cd8af=FilterFields1%3DTopic%255F%255FTitle-FilterValues1%3DStormwater%253B%2523Water%2520Quality%2520and%2520Pollutant%2520Discharge%253B%2523Erosion%2520and%2520Turbidity%2520Control>

***Management Actions***

DEMLR Coastal Stormwater and Erosion and Sedimentation Control Programs

The Sedimentation Pollution Control Act (SPCA) addresses sedimentation impacts in surface waters. The law requires an erosion and sedimentation control plan for any land-disturbing activity if more than one acre is to be disturbed. The law is primarily implemented by the Sediment Control Commission (SCC) and two programs in DEMLR - Stormwater Program and Erosion and Sedimentation Control Program (E&S). The SCC and DEQ are charged with enforcement of the SPCA and educating the regulated community and general public about erosion and sedimentation control. Agriculture, forestry, mining, and

emergency situations are exemption from the law. Coastal counties that are subject to NPDES Phase II MS4 post-construction requirements (15A NCAC 02H .1016) such as Brunswick, New Hanover, Onslow, Pitt, and Wayne counties, must have their own stormwater programs. Additionally, some local municipalities have elected to implement their own stormwater and E&S programs.

The Coastal Stormwater Program has undergone several rule changes from its inception in the late 1980's. The rules of 1995 were updated in 2008 and again in 2017 due to legislation. In 2008, coastal stormwater rules were modified, reducing the percent impervious cover limits for low density development from 24% to 12% adjacent to Outstanding Resource Waters (ORW), SA waters, and areas with 0.5 mi and draining to SA waters. This change was based on research that showed fecal coliform bacteria increased directly with increasing runoff from impervious surface and shellfish harvest closures were continually increasing (Street et al. 2005; DEMLR 2016). In 2016, legislation required the coastal stormwater rules to be modified, returning the impervious surface/built upon areas back to their 1995 requirements, along with several other changes (<http://reports.oah.state.nc.us/ncac/title%2015a%20-%20environmental%20quality/chapter%2002%20-%20environmental%20management/subchapter%20h/15a%20ncac%2002h%20.1019.pdf>). A DEQ report on the existing coastal stormwater program stated that “any direct discharge of stormwater to a coastal water can compromise its quality” and that the solution for controlling fecal coliform contamination is incorporation of Stormwater Control Measures (SCMs) in developments to infiltrate stormwater onsite (DEMLR 2016). Recommended SCMs includes but are not limited to infiltration systems (basins and aggregate-filled trenches designed to soak stormwater into the ground), permeable pavement, and disconnected impervious surface (direct rainwater from roofs and pavement to vegetated areas with gutters, etc.). Where high water tables make infiltration systems ineffective, wet ponds and stormwater wetlands are considered a more effective technique. Due to the revised rules, greater use of stormwater BMPs and low impact development are encouraged (Action #4). The DEQ also updated their Stormwater Design Manual in 2017 to be consistent with the rules. <https://deq.nc.gov/sw-bmp-manual>

The latest stormwater rules have created new flexibility in the stormwater approach that reduces costs, while still protecting water quality. The flexibility and reduction in cost comes from reduction in size of some of the SCM's (eg. wet pond's vegetative shelf reduced from 10' to 6'). More flexibility was given in the design of infiltration systems, disconnecting built-upon area, use of smaller SCMs, as well as use of other innovative systems. The new set of rules favors use of infiltration systems over the traditional “store and release” approach. It is important to mention that despite agency efforts to step away from the wet pond approach in stormwater treatment, a large percentage of developers and consultants continue proposing these systems. The stormwater permitting process is being streamlined by implementation of the new “Fast Track” permitting option by scanning of all stormwater files and switching to electronic permitting.

The financial support for the local and state programs to better manage sediment control measures from all land disturbing activities has stayed at about the same level. Several coastal municipalities and counties have their own Stormwater or E&S programs, or both, and are inspected annually. Examples include Goldsboro, Greenville, Pitt County, Nags Head, and Kill Devil Hills. Although Greenville was non-compliant in 2014-2015 and minor non-compliances were noted during annual inspections, the overall efficiency of local programs is high because non-compliances in the field can be monitored regularly (daily/weekly) until corrected. In contrast, the state programs have much higher number of projects per staff and cannot monitor as frequently.

While agricultural activities are exempt from the SPCA, farmers must address erosion and sedimentation control through other means such as reduced tillage, vegetative filter strips/buffers, cover crops and

other conservation practices. Farmer education and BMP implementation is addressed by the Department of Agriculture Division of Soil and Water Conservation, and local Soil and Water Conservation Districts.

#### DOT Post Construction Stormwater Program and BMP Retrofit Program

DOT is required by its National Pollutant Discharge Elimination System (NPDES) permit to implement a Post-Construction Stormwater Program (PCSP). The primary objective of the PCSP is to manage stormwater runoff from DOT projects by requiring structural and non-structural best management practices (BMPs) to protect water quality. The requirements described in the PCSP apply to DOT projects which increase built-upon area. DOT implements structural BMPs described in the BMP Toolbox and/or non-structural pollution minimization measures described both in the PCSP and the BMP Tool Box ([https://connect.ncdot.gov/resources/hydro/HSPDocuments/2014\\_BMP\\_Toolbox.pdf](https://connect.ncdot.gov/resources/hydro/HSPDocuments/2014_BMP_Toolbox.pdf))

The NPDES Retrofit Program designs and constructs BMPs retrofitted into existing DOT roadways and facilities. While effective SCMs for new construction minimizes water quality impacts, retrofitting is a means of potentially improving water quality. The program is required by the NPDES permit to implement a minimum of 70 retrofits over the course of the five year NPDES permit term. In most cases, the stormwater discharge cannot be eliminated due to space constrictions, therefore the goal is to reduce the volume and increase the quality of the stormwater. Criteria for selecting retrofit projects include water quality improvement and the need for stormwater conveyance maintenance. Collaboration with another organization, such as when a watershed restoration plan has already been developed, will increase project priority. Another role of the Retrofit Program is to test new BMPs or design criteria prior to inclusion in the BMP Toolbox. DOT maintains a geospatial inventory of its roadway system and stormwater outfall assets within priority watersheds. The outfall inventory is used to support the BMP Retrofit Program. There are over 20 different types of BMPs used for stormwater outfall retrofits (Figure 2.6.)

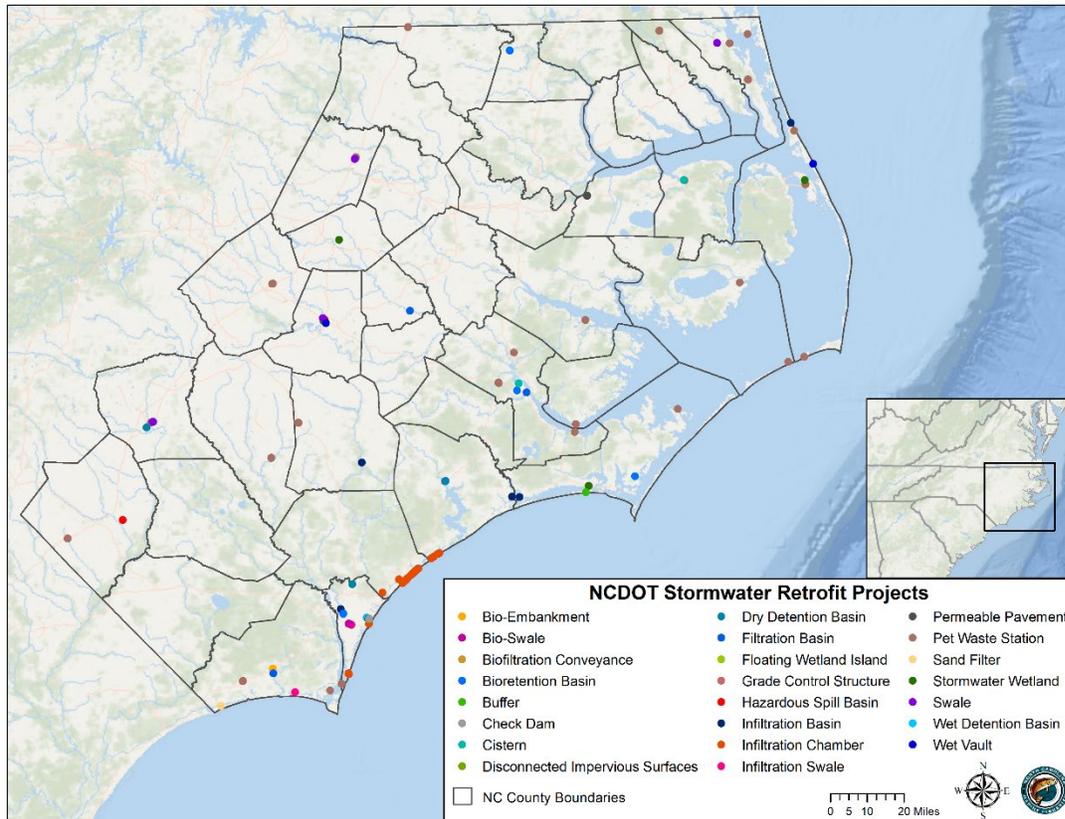


Figure 2.6. DOT stormwater retrofit projects completed 2018-2019. Data source: A. McDaniel, DOT.

### Outreach

Outreach on sedimentation control occurs in several ways within DEMLR, starting at the Regional Office during daily interactions, inspections, and meetings with interested parties, as well as the DEQ website. A 319(h) grant provides funding for one Sediment Education Specialist, for the education and training program mandated by the Sedimentation Pollution Control Act. Outreach is used as a tool to encourage use and proper construction of SCMs in both the Stormwater and E&S programs.

Technical assistance is offered through the Sedimentation and Erosion Control Planning and Design Manual, the companion Field Manual and the Inspectors Guide, and annual workshops for design professionals and local government programs. Another objective of the program is to provide education on erosion and sedimentation control to the general public. Technical expertise has been and will continue to be provided to education professionals to help implement sedimentation pollution awareness in public schools and colleges.

In 2019 two Erosion and Sedimentation Control Design Workshops were conducted for design professionals, with a total of 255 participants. A wide range of experts presented on common erosion and sedimentation issues and solutions based on innovative design and solid research. Additionally, an annual training workshop was conducted for local government staff with delegated local erosion and sediment control programs. Representatives from 45 of the 54 local governments participated in the workshop with a total of 102 participants. State representatives provided updates on the latest regulatory changes, various experts presented on related erosion and sedimentation control topics including planting native, beneficial fill, forestry inspections and research updates from N.C. State

University's (NCSU) Erosion Field Lab. The workshop also provides an opportunity for local programs to connect, learn from each other, and share challenges, strategies and successes of managing erosion and sediment throughout the state.

In 2019 the Sediment Education Specialist exhibited at and distributed educational materials at the N.C. Association of Soil and Water Conservation Districts annual meeting, two conferences, and made numerous school visits. One tool often brought to these education outreach events is the Enviroscape, a watershed model that is used to demonstrate point and non-point source pollution.

In 2020, training includes:

- Stormwater Inspection & Maintenance Certification – September 17-18, 2020 Raleigh
- Level I and II E&S/Stormwater Inspector/Installer – Raleigh
- Level II – Design of E&S Control Plans – Raleigh, June 9, 2020, December 2, 2020
- Stormwater SCM Inspection & Maintenance Certification – Raleigh January 22-23, 2020
- Welcome to the MDC (Minimum Design Criteria) – Raleigh, March 10-11, 2020
- Rain Garden and Water Quality Certification – Brevard March 6, 2020
- Permeable Pavement Maintenance – Raleigh April 16, 2020 – postponed Covid-19

#### Stormwater and Erosion Control programs limitations

While progress has been made with controlling sedimentation by DEMLR, more resources are needed to run these programs effectively. The current compliance programs are insufficient to address the large percentage of noncompliant sites and complaints, reducing program efficiency (see Compliance Issue Paper for more information). There is interest in the programs becoming more “user-friendly” for the developing community, yet the impact of sedimentation on the state’s estuarine resources continues. In 2020, DEMLR is going through a program evaluation of the E&S, Post-Construction Program with the Stormwater Program to address legislative complaints. Resulting program changes that are implemented will likely affect both programs in a negative way since a goal is to reduce costs of running these programs. To the contrary, more resources are needed to improve compliance and monitoring capabilities of both local and state sediment control programs. Purchasing of new equipment to enhance the monitoring and appropriate training of program staff can be only achieved by increased funding.

#### **2.4 Generating Metrics on Management Success and Habitat Trends**

The 2016 Coastal Habitat Protection Plan included Generating Metrics on Management Success and Habitat Trends as a priority habitat issue. The participating DEQ divisions have made substantial progress has towards achieving and implementing the identified proposed management options. These options included:

1. Develop indicator metrics for monitoring the status and trends of each of the six habitat types within North Carolina’s coastal ecosystem (water column, shell bottom, SAV, wetlands, soft bottom, hard bottom)
2. Establish thresholds of habitat quality, quantity, or extent, similar to limit reference points (LRPs) or traffic lights, which would initiate pre-determined management actions
3. Develop indicators for assessing fish utilization of strategic coastal habitats
4. Develop performance criteria for measuring success of management decisions
5. Include specific performance criteria in CHPP management actions where possible

### ***Submerged Aquatic Vegetation***

Some of the most notable progress has occurred in regards to the monitoring and status of SAV. The 2021 CHPP priority habitat issue, **Protecting SAV with a Focus on Water Quality**, will cover this topic thoroughly, but a brief overview will be provided here. APNEP has published a revised coastwide map from the 2006-2008 SAV mapping cycle (<https://www.nconemap.gov/datasets/ncdenr::sav-2006-2008-mapping-revised>) and a new map of the high-salinity zone of the Albemarle Pamlico estuary for the 2012-2014 mapping cycle (<https://www.nconemap.gov/datasets/ncdenr::sav-2012-2014-mapping>). The DMF revised and finalized 2015 SAV mapping data for coastal waters south of Bogue Inlet (<https://ncdenr.maps.arcgis.com/home/item.html?id=303e73f25bd94c47bbf051caca503645>). APNEP and NCDMF conducted a coastwide aerial survey in 2019, but will re-survey in 2020 to improve image quality for interpretation. Funding for the 2019/2020 efforts was supplied by APNEP and DEQ. However, long-term funding to sustain this monitoring is still being sought. APNEP is currently developing a monitoring plan focused initially on the ecosystem components of coastal water quality and SAV. This monitoring plan is scheduled to be adopted in 2020.

APNEP established low salinity SAV sentinel sites for monitoring in Neuse (10) and Pamlico rivers (6), and Albemarle Sound (10), and work is being done to establish a site in Currituck Sound. The protocol used to monitor these sites was developed through CRFL grant funding and employs sonar methodology. These sites have been established and monitored over the last five years. Methods for sentinel site monitoring of the high-salinity zone SAV are being developed through a pilot project. The results will be used to establish a long-term high-salinity SAV monitoring protocol. Several CRFL funded research projects are examining the use of remote sensing technology, such as sonar and drones, to develop repeatable protocols for mapping and monitoring multiple coastal habitats including SAV, intertidal and subtidal oysters, and salt marsh and wetlands.

### ***Shell bottom***

In 2019 DMF began a pilot study to explore the use of remote sensing technology, such as drones and sonar, as alternative means of mapping shell bottom. The Estuarine Bottom Habitat Mapping program is using drones to map intertidal oysters and modifying parameters to establish sentinel sites for more frequent and rapid mapping and monitoring. These changes will greatly increase the efficacy of the Estuarine Bottom Habitat Mapping program and allow more timely trend assessments of the intertidal oyster population. To enhance subtidal oyster habitat mapping, a vacant position in the Habitat and Enhancement section was repurposed to focus on using side scan sonar to map priority subtidal areas for the Oyster Sanctuary and Clutch planting programs with primary focus in Pamlico Sound. These advances along with additional information on the status and trends of North Carolina's coastal habitats is discussed in more detail in the 2021 CHPP priority habitat issue, **Habitat Monitoring to Assess Status and Regulatory Effectiveness**.

### ***Wetlands***

Most of the progress in wetlands mapping and monitoring within DEQ has been undertaken by DWR. In 2016, DWR participated in the EPA's National Wetland Condition Assessment (NWCA). As part of this national wetland assessment, 21 wetland sites were surveyed (and two sites twice). The DWR plans on participating in the 2021 NWCA. In 2021, DWR will begin sampling for an EPA grant called "The Assessment of Change in North Carolina Coastal Plain Wetlands". This assessment will be looking at new wetland sites as well as known sites surveyed five, 10, and 30 years ago. In addition, NCSU continued the long-term monitoring of a few sites previously monitored by DWR from 2014 through 2018/2019. The DWR is currently awaiting funds from the EPA to initiate a statewide wetland mapping project, a more accurate, publicly available wetland mapping tool for North Carolina.

In addition to the wetlands mapping and monitoring conducted by DWR, other agencies and academics have also attributed. DOT developed a LiDAR-based GIS wetland prediction model to update wetland mapping as part of a pilot project. DOT has been working with researchers at UNC-C to automate the modeling process which has resulted in GIS tools that can rapidly predict wetland locations. Ultimately, DOT will use these tools to update wetland mapping across the state which will be accessible in the DOT ATLAS web-based applications. In the northern region of the coast, the Virginia Institute of Marine Science is discussing extending their Wetland Condition Assessment Tool (WetCAT) into the northeastern region of North Carolina as part of an agreement between the governors. In Back and Bogue sounds, and parts of the Newport and New river, some site specific monitoring has been conducted. Using remotely sensed imagery, rates of salt-marsh shoreline erosion and upland transgression with and without the presence of bulkheads were quantified over a ~ 30 yr period (Burdick et al., in review). The 2021 CHPP priority habitat issue, **Wetland Protection and Enhancement, with Focus on Nature-Based Methods**, provides more detail on shoreline erosion, wetlands loss, and potential mitigating techniques. Other studies have used multiple metrics (elevation, accretion, sediment supply, sea level rise (SLR), etc.) to assess the vulnerability of salt marshes to SLR at NERRs across the country. In North Carolina, Masonboro Island Reserve near Wilmington was assessed and found to have very low resilience to SLR (Raposa et al. 2016). The potential effects of climate change on North Carolina's coastal habitats and how to create a more resilient coastal ecosystem and community is discussed in the Update to Climate Change and Coastal Habitat Resiliency section.

### ***Strategic Habitat Areas***

Since the 2016 CHPP, the nomination of Strategic Habitats Areas (SHAs) was completed for all four CHPP regions, with Region 4 (The Cape Fear River Basin) nominations being approved by the Marine Fisheries Commission at the May 2018 business meeting (NCDMF 2018). The same year, a CRFL grant provided funding to begin the validation of the fish use and habitat condition of the nominated SHAs. The first two years of the study focused on CHPP Region 3 (The White Oak River Basin; NCDMF 2014). Multiple sampling gears are used to collect various fish and habitat metrics to compare fish abundance and diversity and habitat condition between SHA nominations and areas not nominated as SHAs. Sampling in CHPP Region 3 was completed in the fall of 2019 with a total of 252 sampling events (126 SHAs and 126 Non-SHAs). In the spring of 2020, the study expanded into CHPP Region 4 and analysis of the CHPP Region 3 data is underway. The expansion of the study into the larger waters of CHPP Region 1 (Albemarle Sound) and Region 2 (Pamlico Sound) is also being examined (NCDMF 2011a and NCDMF 2011b). The results of this study will be used to validate or modify the existing SHA nominations and provides a foundation for the ecological evaluation of management areas such as designated nursery and spawning areas.

The progress made towards establishing baseline habitat conditions through sentinel sites and long-term monitoring of coastal habitats, and the validation and verification of SHAs in all CHPP regions is the foundation for establishing management thresholds for coastal habitats. The quality, quantity, and extent of the coastal habitats in North Carolina must be identified before management thresholds can be applied. This was recognized by the CHPP steering committee during the selection of priority habitat issues for this update. The 2021 CHPP priority habitat issues, **Submerged Aquatic Vegetation Protection and Restoration, with Focus on Water Quality Improvements and Habitat Monitoring to Assess Status and Regulatory Effectiveness** will continue to address these needs.

### **2.4. Implementation progress on other CHPP recommendations**

In addition to the priority habitat issues, progress has occurred with other recommendations from the

2016 CHPP. One implementation action to aid in compliance with existing rules and permits (Recommendation 1.1) was to “cross train Marine Patrol officers to take note of and report violations of CRC and EMC rules and permits in coastal waters to appropriate agencies”. The DCM staff conducted training in 2019 to DMF’s Marine Patrol staff in the Northern and Central districts and over 60 officers attended. Background on CAMA jurisdictional areas and rules was provided. They were shown how to look for unusual activity such as heavy equipment on the shoreline, projects that stand out like excessively longer pier than surrounding areas, fresh dirt piled on vegetation or without a silt fence, new looking boatlifts or docks in very shallow primary nursery areas (PNAs), and bulkheads unusually far distance from shoreline. The officers were receptive to assisting when out in the field and provide flights to assess potential violations periodically.

Considerable work continues to be done by DEQ regarding expanding outreach on fish habitat value, threats, and explanations of management measures (Recommendation 1.3). One implementation action was to provide educational information to school children (K-12) regarding biodiversity and value of estuaries. Towards this, APNEP has an ongoing Shad in the Classroom program. An educational specialist position with DWR was filled in 2017. Through that, staff conduct live workshops and online modules. The primary programs are Project WET (reached 500-3780 students/ year 2017-2020; Its Our Water Online Module (reached 80-680 students/yr 2017-2020), and NC Stream Watch. Other smaller programs and school visits are also done. Project WET, SeaGrant, NC Water Resources Research Institute (WRI), and NC Watershed Stewardship Network partnered to create a new PBS online program called Watershed Wisdom that includes interactive lessons/videos. The Soil and Water Conservation Districts continue with Envirothon training and competition, Resource Conservation workshops, school field days, and Poster and essay contests.

One implementation action to Restore fish passage for migratory fishes through elimination or modification of stream obstructions (CHPP 2016 Recommendation 3.5b) was “the DEQ, through the DWR and Division of Mitigation Services (DMS) will pursue dam removal projects where appropriate”. Staff from DWR participate in the N.C. Aquatic Connectivity Team, a group of experts that manage dam removal projects within the state of North Carolina. American Rivers and Southeast Aquatic Resources Partnership (SARP) provide technical support on barrier identification, inventory, and prioritizations. Several projects were completed 2018-2020 in the coastal draining river basins by DWR and DMS (Table 2.2). Additionally, Milburnie Dam on the Neuse River was removed by a restoration company for mitigation bank credits.

Table 2.2. Barrier removals or modifications completed by DWR, DMS, and partners in coastal river basins, 2018-2020 (Source: F. Shepard, DWR, personal communication).

River Basin	Dam removal	Culvert, ditch, or pond modifications
Chowan	-	3
Neuse	4	5
Cape Fear	-	4
Lumber	-	2

Managing stormwater benefits not only sediment loading as discussed earlier in the chapter, but also nutrient and bacteria loading. The revised stormwater rules, stormwater design manual, and minimum design criteria support the CHPP 2016 Recommendations 4.5, to improve strategies to reduce nonpoint

pollution and minimize cumulative losses of fish habitat through voluntary actions, assistance, and incentives, including a) improved methods to reduce pollution from construction, agriculture, and forestry; and b) increased on-site infiltration of stormwater; and c) encouraging and providing incentives for implementation of Low Impact Development practices.” Additionally, the recently readopted Neuse and Tar-Pamlico nutrient stormwater rules require implementation of the Division’s Stormwater Nitrogen And Phosphorus (SNAP) calculator for new development activity subject to those rules. The rules also require annual electronic reporting from local governments, which will include exported SNAP data from developments within their jurisdictions. Taken together, the rules provide the division data to maintain effective regulatory strategies for water quality (CHPP 2016 Recommendation 4.6). The DWR, through the Nutrient Criteria Development Program (NCDP), is evaluating water quality data in the Albemarle Sound system to evaluate existing nutrient criteria and changes needed to support use support and biological endpoints. The 2021 CHPP priority habitat issues, **Submerged Aquatic Vegetation Protection and Restoration** will provide more details.

### Literature Cited

Burdick et al. (in prep)

Corbett, D.R., J.P. Walsh, and Y. Zhao. 2017. Impacts of land use change on sedimentation in tidal creeks of North Carolina, USA. *Journal of Geography and Earth Sciences*. 5(1):1-25.

Davis, J., C. Currin, L. Eddy. 2018. Living Shoreline Explorer Summary. [https://media.coastalresilience.org/NC/Carteret\\_LivingShoreline\\_Summary.pdf](https://media.coastalresilience.org/NC/Carteret_LivingShoreline_Summary.pdf). Last accessed September 29, 2018.

Deaton, C.D. 2018. Land-use change and tidal creek sedimentation in coastal watersheds on North Carolina. MS Thesis. UNC-Chapel Hill. 33 p.

Freeman et al. in press

Luck, C., B. Puckett, et al. (in prep). NCDMF Oyster Sanctuary 2019 Data Analysis – Comparative Population demographics

NCDMF (in prep) Sidescan and Bathymetric Surveys 2016 Final Report. *Prepared by Z. Harrison and N. Hendrix*.

NCDMF. 2011. Strategic Habitat Area Nominations for Region 1: Albemarle Sound to Northeastern Coastal Ocean of North Carolina, North Carolina Division of Marine Fisheries. Morehead City, North Carolina.

NCDMF. 2011. Strategic Habitat Area Nominations for Region 2: The Pamlico Sound System in North Carolina, North Carolina Division of Marine Fisheries. Morehead City, North Carolina.

NCDMF. 2014. Strategic Habitat Area Nominations for Region 3: The White Oak River Basin in North Carolina, North Carolina Division of Marine Fisheries. Morehead City, North Carolina.

NCDMF. 2018. Strategic Habitat Area Nominations for Region 4: The Cape Fear River Basin in North Carolina, North Carolina Division of Marine Fisheries. Morehead City, North Carolina.

Puckett, B. and D. Eggleston. 2012. Oyster Demographics in a Network of No-Take Reserves: Recruitment, Growth, Survival, and Density Dependence. *Marine and Coastal Fisheries*. 4. 605-627. 10.1080/19425120.2012.713892.

Raposa K.B., K. Wasson, E. Smith, J.A. Crooks, P. Delgado, S.H. Fernald, M.C. Ferner, A. Helms, L.A. Hice,

- J.W. Mora, and B. Puckett. 2016. Assessing tidal marsh resilience to sea-level rise at broad geographic scales with multi-metric indices. *Biological Conservation*. 204:263-75.
- Smith, C.S., Puckett, B., Gittman, R.K. and C.H.Peterson. 2018. Living shorelines enhanced the resilience of saltmarshes to Hurricane Matthew (2016). *Ecological Applications* 28: 871-877. doi:10.1002/eap.1722
- Smith, C.S., R.K. Gittman, I.P. Neylan, S.B. Scyphers, J.P. Morton, F.J. Fodrie, J.H. Grabowski, and C.H. Peterson. 2017. Hurricane damage along natural and hardened estuarine shorelines: Using homeowner experiences to promote nature-based coastal protection. *Marine Policy* 81:350-358.
- Taggart, M. and Puckett, B. 2019. Part II: Measuring the performance and resilience of marsh and living shorelines. <https://apnep.nc.gov/blog/2019/02/14/living-storm-protections-part-ii>

Draft