Research Priorities from the
NC Coastal Habitat Protection Plan

NC Coastal Habitat Protection Plan Team
NC Department of Environmental Quality

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The Marine Fisheries Commission and DMF have authority within its jurisdiction to adopt rules for the management, protection, preservation, and enhancement of marine and estuarine resources, which includes all fish, shellfish, crustaceans and plant life found in the waters under MFC jurisdiction (G.S. 143B-289.52, G.S.143B-10). The DMF and other DEQ divisions with authority over habitat and water quality are required to draft and update a Coastal Habitat Protection Plan every five years (G.S. 143B-279.8). The plan includes management recommendations for the purpose of long-term enhancement of coastal fisheries through habitat protection and enhancement. Habitat-related information gaps and research needs are identified through the plan update process. These may relate to habitat function, condition, distribution change, linkages between habitats and specific fish species, or the effect of factors influencing habitat condition, including hydrological or physical alterations, or water quality degradation.

The 2016 Coastal Habitat Protection Plan selected four priority issues to focus efforts over the next five years. Research related to furthering progress in these issues are the highest current priorities. However, there are also research needs on different topics.

Priority: Oyster Restoration

Due to habitat loss over time, there is a need to increase oyster habitat through restoration. Oyster restoration through creation of Oyster Sanctuaries, Shellfish Management Areas, and Estuarine Artificial Reefs by the division, and environmental organizations has been ongoing, but funding, and gaps in information have limited progress.

Cultch Planting

1. Identify alternative substrates for larval settlement in intertidal and subtidal reefs, including a cost-benefit analysis
2. Develop and utilize new siting tools and monitoring protocols to maximize reef success

Hatchery Oyster Seed Production

1. Identify regional genetic variability within NC

Oyster Sanctuaries

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. Utilize new siting tools to maximize reef success
4. Explore options for in-situ sampling protocol to incorporate alternative construction materials

Priority: Living Shorelines

The shoreline edge is critical to both estuarine species and property owners. Wetland vegetation and nearshore oyster reefs reduce wave energy and shoreline erosion, while providing critical shallow water habitat for juvenile fish and invertebrates. Valuable research on living shorelines has been done recently in NC, but more work is needed to advance the use of living shorelines by waterfront property owners rather than selecting hardened vertical structures for erosion control.

1. Examine the effectiveness of natural and other structural materials for erosion control and ecosystem enhancement.
2. Examine the long-term stability of living shorelines and vertical structures, particularly after storm events.
3. Map areas where living shorelines would be suitable for erosion control.
4. Investigate use of living shorelines as a Best Management Practice or mitigation option.

Priority: Sedimentation

The upper portions of some estuarine creeks are filling in from sedimentation at an increasing rate, with a variety of potential adverse effects on habitats and fish. There are multiple non-point sources of sedimentation. The magnitude and extent of sedimentation and the effect of that on fish habitat is largely unknown.

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.
   a. Enhancing monitoring capabilities for local and state sediment control programs (e.g. purchase turbidity meters for testing turbidity coming off site and train staff to use).
   b. Work with NCDOT to identify road ditches that drain to estuarine waters. Prioritize those that are contributing significant amounts of sediment to waterbodies with sensitive resources, such as designated nursery areas, oyster reefs, or submerged aquatic vegetation.

Priority: Generating Metrics

Without quantified data on trends in habitat condition and effectiveness of management actions, it is difficult to successfully manage for a healthy and productive coastal ecosystem.

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 or Traffic Light triggers, which would initiate pre-determined management actions.
4. Develop performance criteria for measuring success of habitat and water quality management decisions.

Other Research Needs

While there is numerous specific research needed regarding the health of North Carolina’s coastal fish habitats, and how human activities are influencing the integrity of the coastal system, certain data gaps where identified during the updating of this plan. These are listed below but are not in order of importance.

Habitat Status

- Develop methods to map intertidal and subtidal oyster reefs and shell hash using remote sensing or other rapid assessment techniques, in combination with field verification.
- Determine if decline and lack of substantial natural recovery of oysters is due to spawner limitations, stress and mortality from infectious diseases affecting primarily larger, more fecund adults, or to physical damage from mechanical oyster harvesting.
- Update estuarine bathymetry maps to a finer contour resolution.
- Collect data on fish and habitat condition within identified coastal strategic habitats to verify condition of SHAs and relative impact of known alterations.
- Conduct spawning area surveys to identify new and monitor existing areas for species such as river herring, sturgeon, striped bass, red drum, blue crab.
- Develop an estuarine index of biotic integrity for estuarine habitat.

**Ecological Role and Value**
- Research how reef characteristics influence detrital delivery, water clarity, anoxia, and fish use to aid in managing shell bottom habitat, and enhancing adjacent habitats.
- Conduct a comprehensive economic valuation study for all North Carolina habitats, including value from fish production and ecosystem services.
- Assess fish use (abundance, diversity, seasonality) in low-salinity SAV habitat (native and non-native) in North Carolina to better understand the importance of this habitat in oligohaline systems, and how fish respond to inter-annual fluctuations.
- Evaluate the effect of habitat change on fish abundance and richness.

**Habitat Restoration**
- Assess the role of shell matrix to aid in restoration design planning (size, shape and arrangement, corridors) to optimize recruitment, retention, and dispersion of larvae, as well as adult oyster survival and growth.
- Develop effective techniques for SAV restoration.
- Assess the effect of dam removal on upstream and downstream habitat and fish migration.
- Assess culvert criteria needed for river herring to successfully migrate to spawning grounds.
- Assess composition and extent of benthic plant and invertebrate colonization on artificial reef structures, and the habitat value provided to fish.

**Habitat Threats**

**Physical Alterations**
- Quantify the extent and frequency that bottom in Pamlico Sound is trawled and the effect on benthos.
- Assess the overall effect of oyster and crab dredging on shell bottom habitat and restoration efforts.
- Assess the effect of 2014 wetland statute changes on wetland abundance, flood control, water quality, and fish.
- Assess the effect that beach nourishment has had on hard bottom condition within state waters.
- Assess the impact of shading from fixed and floating structures on productivity of shallow soft bottom habitat.
- Assess the cumulative impact of boat wakes on wetlands.

**Hydrological Alterations**
- Identify obstructions to diadromous fish spawning migration routes, including dams, culverts, or water flow conditions.
- Assess the long term consequences of hardened structures on larval transport and recruitment.
- Assess the impact of water withdrawals on water column parameters that could influence fish movement and survival.
• Assess effect of agricultural flood control (diking, drainage canals, and active pumping of stormwater) on the condition of designated Primary Nursery Areas in Hyde County; whether conditions in the creeks and upper ditched waterbodies are still suitable and being utilized as nursery areas.
• Assess the effect of mine dewatering (associated with mines or rapid infiltration systems) on estuarine nursery area habitat and floodplain wetlands.

**Water quality impacts**
• Evaluate the effectiveness of coastal stormwater rules in maintaining water quality and preventing further shellfish closures.
• Determine the level of Total Suspended Solids, chlorophyll a, and other parameters needed to achieve acceptable water clarity for sustained habitat health, particularly SAV.
• Research the effectiveness of current vegetated buffers in the coastal plain and the design needed to adequately limit sediment and nutrient inputs into estuarine waters.
• Develop a network of continuous water quality monitoring stations within the Pamlico Sound system to better evaluate long-term water quality conditions in this critical estuarine system.
• Conduct research on low-impact development, best management practices, and other strategies to reduce nonpoint runoff to shellfish waters.
• Assess concentration, and prevalence of endocrine disrupting chemicals in estuarine waters, fishery species, particularly blue crab and oysters.
• Assess the extent that hypoxia is impacting benthic habitat and fish species and identify the waters most vulnerable to repeated hypoxic events.
• Examine the ecological effect of declining ocean pH on shell bottom and ocean hard bottom habitats.
• Investigate the source(s) contributing to increased occurrence of algal blooms in coastal river systems, particularly the Chowan, Tar-Pamlico, and Cape Fear rivers and means of reducing prevalence and severity of such blooms in the future.
• Conduct research to determine the effect of acoustic sounds (airguns) associated with seismic surveys on fish behavior and hearing.

**Invasive Species**
• Determine the fish habitat value of non-native aquatic vegetation and invertebrates, such as Eurasian milfoil and animal grass.
• Assess the long-term impact of *Phragmites australis* on estuarine fish use.
• Assess the effect of lionfish on snapper and grouper species in NC, and the best means of controlling their expansion.