HABITAT PROFILE

Tidal Coastal Watersheds

Associated Species: Alewife (Alosa pseudoharengus), American Brook Lamprey (Lampetra appendix), American Eel (Anguilla rostrata), American Shad (Alosa sapidissima), Atlantic Salmon (Salmo salar), Atlantic Sturgeon (Acipenser oxyrhynchus), Banded Sunfish (Enneacanthus obesus), Blueback Herring (Alosa aestivalis), Bridle Shiner (Notropis bifrenatus), Burbot (Lota lota), Brook Trout (Salvelinus fontinalis), Rainbow Smelt (Osmerus mordax), Redfin Pickerel (Esox americanus americanus), Sea Lamprey (Petromyzon marinus), Shortnose Sturgeon (Acipenser brevirostrum), Swamp Darter (Etheostoma fusiforme)

Federal Listing: Not listed
State Listing: Not listed
Global Rank: Not ranked
State Rank: Not ranked
Author: New Hampshire Fish and Game and The Nature Conservancy

Element 1: Distribution and Habitat

1.1 Habitat Description

Tidal coastal watersheds include tidal rivers and their watersheds. These rivers support runs of diadromous fish, such as American shad, alewife, American eel, Atlantic salmon, and blueback herring. These basins are dominated by abundant tributaries that are at low and very low elevations, are connected to larger meandering mainstem rivers, flow over acidic bedrock, and have extensive areas of deep and coarse sediment. There are a few moderate gradient tributaries in the upper headwaters of some of these watersheds, but the majority are low-gradient rivers. Most of these low-gradient tributaries have warmwater fish communities. Colder, groundwater-fed systems rarely occur. Instream habitats are dominated by riffle-pool habitats in the low gradient and unconfined valleys. In the low or very low gradient and highly sinuous channels with coarse sediments and sands, dune-ripple habitats may also occur. Dune-ripple habitats are dominated by sand-sized substrates and lack riffle-pool structure (Kline 2005).

The tributaries and mainstems in the lowest portions of these watersheds occur in areas of deep and extensive fine marine clay, which provides additional buffering capacity. Finer streambed substrates and connected wetland and floodplain communities are common in these areas of deep, fine surficial geological deposits. Low tidal watersheds are unique with tidal marsh/estuary ecosystems and small tidal tributaries at their mouth, in addition to the abundant freshwater stream and river habitats.

Fine scale system 13 was the only fine scale system in this analysis that was so ecologically distinct as to merit its own major watershed group. Although low gradient streams and mainstem tidal rivers dominate this watershed group, there is some variation with the two northernmost watersheds encompassing more moderate elevations and substantial amounts of moderate and a few high gradient streams along side slopes and summits.

1.2 Justification

Tidal aquatic ecosystems and their tributaries offer unique habitats for New Hampshire's wildlife. They are relatively uncommon in New Hampshire, and the rivers and estuary system at Great Bay are unique in the Northeast. Many rare species congregate in these coastal areas and may occur nowhere else in New Hampshire. In addition to the estuarine and diadromous fish species listed in section 1.1, species such as bald eagle, osprey, common tern, American black duck, saltmarsh specialist songbirds (e.g. saltmarsh sparrow, marsh wren, Nelson's sharp-tailed sparrow), and congregatory species groups such as waterfowl, wading birds, and shorebirds use Great Bay and other coastal waters throughout the breeding and migratory seasons.

The gradients between salt, brackish, and fresh water occur uniquely within this watershed group. Restoring or enhancing marine and aquatic connectivity is paramount to ensuring stable and viable populations of riverine, estuarine, diadromous, and many marine species.

1.3 Protection and Regulatory Status

1.4 Habitat Distribution

Low tidal watersheds occur in seven watersheds in New Hampshire's coastal region, including all of the watersheds draining into Great Bay Estuary and New Hampshire's Atlantic Ocean coastline. They extend west of TNC's North Atlantic Coast Ecoregion, and into the Southern New England Coastal Hills and Plains subsections of southeastern and south-central New Hampshire. They sit entirely within the Merrimack-Saco-Charles River Ecological Drainage Unit (EDUs)[1]. The southeastern-most watershed contains rivers draining into the mouth of the Merrimack River, including the Powwow River. The rivers in this watershed are not tidally influenced, but represent the headwaters of these southern Merrimack River tributaries.

1.5 Town Distribution Map

See attached.

1.6 Habitat Map

1.7 Sources of Information

1.8 Extent and quality of data

This pattern sometimes caused these watersheds to group with fine scale system 14 in some of the underlying TWINSPAN runs. Although the critical tidal connection and low gradient systems of their lower mainstems were felt to be overriding factors to keep these watersheds ultimately included in this Group, future research could examine whether certain watersheds should group with more northern system Groups (such as Salmon Falls River, for example). Overall, this system has one of the strongest ecological signatures of any in this analysis. TWINSPAN identified this area early in the splitting as a unique type, no matter what combination of variables were used. The strength of this type is further supported by its overlap with other regional land and water classifications (e.g. Ecoregions, EDUs, etc.).

Element 2: Species/Habitat Condition

2.1 Scale

Due to the large land area covered by the major watershed groups (Figure 3), a fine scale classification (Figure 4) was used, when possible, to assess the relative condition of aquatic habitats across the state. The low tidal watershed group is fine scale system 13 for this comparison.

2.2 Relative Quality

The total area of the low tidal watershed group is 2918.9 km^2. Approximately 103.5 km^2 of this area is surface water. Headwater streams (watershed area <48.28 km^2) are the most dominant stream/river type, comprising 84% of the total riverine habitat. Small rivers (watershed area of 77.70-518.00 km^2), medium rivers (watershed area of 518.00-2589.99 km^2), and large rivers (watershed area >2589.99 km^2) comprise 12%, 1%, and 2%, respectively, of riverine habitats.

There are 137 lakes greater than 10 acres in the low tidal watershed group. Most of these lakes (109 lakes) are less than 100 acres in size. Only two lakes, Pawtuckaway Lake and Bow Lake, are greater than 1000 acres, and the size of both of these lakes was increased by the creation of dams. There are over 2,455 small ponds less than 10 acres, ranging from shallow wetland systems with less than one acre of open water to relatively deep ponds with rocky or sandy shorelines. Where the coastal watersheds meet the Atlantic Ocean, New Hampshire contains approximately 354 km of tidal shoreline and 46 km^2 of estuary at high tide (Jones 2000).

The coastline of New Hampshire, though small, has a surprising diversity of habitats. Various combinations of rock, sand, and mud substrates along the coast support different communities of marine species. Salt marshes, tidal flats, shellfish beds, and submerged aquatic vegetation in the estuaries of Great Bay and Hampton Harbor are essential to countless species of fish, birds, and invertebrates.

Freshwater habitats in the coastal watersheds are equally diverse. The Lamprey River watershed is perhaps the best example, with at least 25 different habitat characteristics required by New Hampshire wildlife species of concern (SPNHF 2002). A survey by the National Park Service found the Lamprey River contains 6 of 9 mussel species known to New Hampshire, including the state-endangered brook floater (*Alasmidonta varicosa*) (LRAC 1990).

Although freshwater and marine ecosystems are often considered separately, coastal watersheds are better viewed as a complex network of interdependent habitats. Many species move between marine, estuarine, and freshwater ecosystems at different stages of their life cycles. Submerged aquatic vegetation, such as the eelgrass beds (*Zostera marina*) in the Great Bay estuary, is an important nursery habitat for many species of invertebrates and juvenile fish (ASMFC 1997). Some of these species, such as Atlantic menhaden (*Brevoortia tyrannus*) and American lobster (*Homarus americanus*), will spend most of their adult lives in coastal waters, while others, such as alewives (*Alosa pseudoharengus*) and juvenile American eels (*Anguilla rostrata*), will migrate upriver and contribute nutrients to freshwater rivers (MacAvoy et al. 2000). The water quality of these rivers is critical to the health of shellfish beds and submerged aquatic vegetation in the estuaries. Protecting wildlife in the coastal watersheds will require maintaining and restoring continuity between freshwater, estuarine, and marine habitats.

2.3 Population Management Status

N/A

2.4 Relative Health

Land Use

Despite a rapidly increasing population, much of the land in low tidal watersheds remains natural. Approximately 69% of the land cover is unfragmented natural land, 5% is agricultural land, and 8% has been developed. In 2001, there were 282 blocks of unfragmented land greater than 250 acres, although only 15 of these blocks were greater than 2,500 acres (New Hampshire Estuaries Project (NHEP) 2003). Impervious surfaces are increasing rapidly in southeastern New Hampshire. In 43 towns in the coastal watersheds, impervious surface area increased from 4.3% to 6.3% between 1990 and 2000 (Justice and Rubin 2002). During this period, the average amount of impervious surface area per person increased from 1.5 acres to 2 acres, which suggests a growth pattern typical of urban sprawl (NHEP 2003).

Hydrology and Connectivity

There are approximately 514 active dams in the coastal watersheds. Dams range from hydroelectric facilities to small earthen dams used to create wildlife habitat. The number of dams per total river length in the low tidal watershed group is 0.065 dams/km, which is the third highest in the state.

There are 8 fishways (one on the Salmon Falls, Cocheco, Oyster, Lamprey, Winnicut, and Taylor Rivers and two on the Squamscott River) designed to provide access to spawning habitats used by anadromous fish in coastal rivers. While these fishways have helped restore populations of river herring and sea lampreys, they have been less effective for other species (Trowbridge 2003a). The coastal fishways are typically open only during spring spawning runs. For most of the year, dams at the head of tide act as barriers between freshwater and estuarine systems. Restoring connectivity by removing dams and installing more effective fishways will benefit many species.

Poorly designed culverts and stream crossings result in the fragmentation of freshwater ecosystems (Warren and Pardew 1999). The density of maintained and unmaintained roads (1.67 and 0.67 km/km^2, respectively) is second only to low nontidal watersheds where Interstate 93 crosses into New Hampshire.

Invasive Species

The Piscataqua River and Great Bay are at a high risk of invasive species invasion from the release of ballast water by foreign ships transporting oil, coal, and other commercial goods to the shipping ports along the Piscataqua River (Buck 2004). Invasive species have caused a number of major community shifts in the coastal ecosystem (Harris and Tyrell 2001). The green crab (*Carcinus maenas*), the common periwinkle (*Littorina littorea*), and, most recently, the Japanese shore crab (*Hemigrapsis sanguineus*), are just a few examples of non-native species that have become abundant in coastal waters.

There are 4 infestations of freshwater invasive aquatic plants in low tidal watersheds, a number that is surprisingly low compared to other watersheds with high population density. This number does not include wetland and shoreline species such as purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*), which may have an indirect effect on aquatic ecosystems. There are many non-native fish species that have become naturalized in the rivers, lakes, and streams of low tidal watersheds, including black crappie (*Pomoxis nigromaculatus*) and smallmouth bass (*Micropterus dolomieu*). The impact of these species on native freshwater communities is poorly understood.

Water Quality

Water quality data collected by Great Bay Watch from 1990 to 2000 indicate good overall water quality in Great Bay and its tributaries (Konisky et al. 2000). Fecal coliform levels show a decreasing trend at most sites and dissolved oxygen levels generally exceed class B standards of 75% saturation (Konisky et al. 2000, NHDES 2000). Stormwater runoff remains a problem as elevated fecal coliform levels are correlated to rainfall (Konisky et al. 2000). The elevated levels of bacteria in shellfish following heavy rains provide further evidence for nonpoint source pollution (Konisky et al. 2000). Approximately 63% of shellfish beds in New Hampshire are permanently closed due to bacterial contamination (Jones 2000). An overall increase in water quality between 1990 and 2000 suggests a decrease in point source pollution from industrial sources and wastewater treatment facilities (Konisky et al. 2000). However, an increase in polyaromatic hydrocarbons (PAH) in shellfish tissue is evidence that oil and gasoline is entering coastal waters through stormwater runoff and/or boat spills (NHEP 2003).

2.5 Habitat Patch Protection Status

Only 9.7% of the total land in low tidal watersheds is conserved. Of the 355,406 acres of unfragmented land in these watersheds, 12.7% is protected. A greater proportion of tidal shorelines is protected (21%) compared to freshwater shorelines (14%), but tidal shorelines are more developed (Trowbridge 2003a). It is difficult to purchase large pieces of property in the coastal watersheds because of rapidly increasing property values.

2.6 Habitat Management Status

There is an incredible amount of funding for the restoration of coastal ecosystems, yet there is surprisingly little monitoring to determine whether restoration projects have achieved their goals (Cornelison 1998). Most work in New Hampshire has focused on marine and estuarine habitats. Over 176 acres of salt marsh have been restored since 2000 (NHEP 2003). The University of New Hampshire's Seagrass Ecology Group has been mapping eelgrass beds in the Great Bay since 1986. There are at least 35 ongoing coastal water quality and biological monitoring programs in New Hampshire (NHEP 2003).

Land protection is the main strategy for conserving coastal watersheds. The Great Bay Resource Protection Partnership has protected 4,100 acres of land as of 2003 (NHEP 2003). Restoration efforts on coastal rivers have recently focused on dam removal. A timber crib dam was removed on the Bellamy River in 2004, providing access to more freshwater spawning habitat for anadromous fish. A nature-like fishway has been proposed to improve fish passage at the Wiswall Dam on the Lamprey River. An inactive dam on the Winnicut River is also under review for removal. Comparatively little work has been done to identify and restore degraded headwater streams.

2.7 Sources of Information

The relative quality of watershed groups was assessed using GIS data from various sources, including NHDES, TNC, and The New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT), as well as reports and management plans from both private and government organizations.

2.8 Extent and Quality of Data

While useful for assessing general trends, GIS data may not be completely accurate at finer scales. Much detail is lost with such a broad scale approach. Information on long-term trends is scarce. Most of the indicator data used in the status reports produced by

NHEP has only been collected in the last 10 to 20 years (NHEP 2003).

2.9 Condition Assessment Research

The NHEP developed a number of indicators for ecosystem health in coastal watersheds. Their work has developed a baseline upon which to compare the future health of low tidal watersheds in New Hampshire. Refining and expanding the data used as environmental indicators will allow for a better assessment of future trends. Additional indicators should incorporate data on the status of headwaters and other underrepresented areas in coastal watersheds.

There should also be an effort to identify natural processes needed by the species in coastal watersheds. Certain variations in seasonal flows, nutrient concentrations, or sediment transport may be critical for these species. Understanding these connections will help preserve the natural processes needed by many species, rather than taking a reactive approach to the declines of individual species.

Element 3: Species and Habitat Threat Assessment

The effects of rapid development, including habitat conversion, non-point source pollution, and altered hydrology, are the most pressing threats to coastal watersheds. Fragmentation due to dams and stream crossings restricts the amount of habitat available to many species and could have a negative impact on their genetic integrity. Restoring connectivity between marine, estuarine, and freshwater habitats will have a positive, long-term effect on the health of the coastal ecosystem. While the entire coastal watershed is at risk of future invasive species introductions, the greatest risk is from foreign ships that enter the Piscataqua River. Heavy ship traffic in the Piscataqua River also puts the Great Bay and coastal areas at risk from oil spills. In 1979 an oil spill from the tanker *New Concord* during an incoming tide contaminated sites in the Piscataqua River, the Bellamy River, and the Great Bay (NHFG 1979). Oil and toxic chemical spills will continue to threaten the coastal ecosystem, although oil containment technology has improved significantly over the past 10 years (UNH 2004).

Refer to the general threats section for: Transportation Infrastructure, Development (Fragmentation and indirect effects), Non-Point Source Pollution (Runoff and Sedimentation), Acid Deposition, Introduced Species, Altered Hydrology, Recreation, Unsustainable Harvest (Forestry Operations and Management), Oil Spills, and Agriculture.

Element 4: Conservation Actions

Salt marsh and river restoration will largely continue through a cooperative process with the New Hampshire Natural Resource Conservation Service (NHNRCS), which coordinates efforts to restore coastal salt marshes, and the NHDES, which has a River Restoration Coordinator (focused largely on removing dams).

The NHFG purchases property and assists with conservation easements throughout the state as opportunities arise. The NHFG is also part of the CORD review process, and thus can acquire land for little or no fee. Much of the land obtained through the CORD process was originally acquired by the New Hampshire Department of Transportation for road or road infrastructure projects.

Refer to general strategies for: Transportation Infrastructure, Development (indirect effects), Fragmentation, Pollutants (Acid Deposition), Invasive Species, Altered Hydrology, Sedimentation, Recreation, Forestry, Pollutants (Stormwater runoff and oil spills), and Agriculture.

Element 5: References

5.1 Literature

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[1] EDUs in New England were qualitatively delineated by the TNC Freshwater Initiative program in 1999 using USFS Fish Zoogeographic Subregions, USFS Ecoregions and Subsections, and major drainage divisions (Bryer and Smith 2001). The EDUs were defined by grouping 8-digit US Geological Survey Hydrologic Units watersheds into units that were thought to contain aquatic systems with similar patterns of physiography, drainage density, hydrologic characteristics, connectivity, and zoogeography (Bryer and Smith 2001).


Watershed Groupings:
TIDAL
COASTAL
N
0 15 30
Miles