HABITAT PROFILE

Salt Marshes

Associated Species: American Bittern, American Black Duck, Common Tern, Nelson's Sharp Tailed Sparrow, Salt Marsh Sharp Tailed Sparrow, Seaside Sparrow, Semipalmated Sandpiper, Willet

State Ranks: Salt marsh system: Low salt marsh (S3), High salt marsh (S3), Salt pannes and pools (S3), Brackish marsh (S2S3), Coastal salt pond marsh (S1); Brackish tidal riverbank marsh system: Low brackish tidal riverbank marsh (S1S2), High brackish tidal riverbank marsh (S1S2), Brackish marsh (S2S3); Sparsely vegetated intertidal system: Coastal shoreline strand/swale (S2), Intertidal rocky shore (S3), Saline/brackish intertidal flat (S3).

Authors: Megan J. McElroy and Kimberly J. Babbitt, University of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

Salt marshes are grass-dominated tidal wetlands existing in the transition zone between ocean and upland (Niering and Warren 1980). These marshes are among the most productive ecosystems in the world and are dominated by detritus-based food chains (Mitsch and Gosselink 2000).

Salt marsh plants are salt-tolerant and adapted to fluctuating water levels. Salt marshes are composed of 3 distinct vegetative zones in response to tidal regime: low marsh, high marsh, and marsh border. The low marsh, occurring as a narrow band along the seaward edge of the marsh, and along creeks and ditches, becomes flooded during most tides, but is exposed during low tide. Tall-form smooth cordgrass (*Spartina alterniflora*) is the predominant plant species found in the low marsh and can grow up to 2 meters.

The high marsh occurs between the low marsh and the marsh border. The high marsh becomes flooded usually only during extreme high tides, such as the new-moon and full-moon tides. Throughout the high marsh, grasses and rushes dominate. Species such as salt hay grass (*Spartina patens*), spike grass (*Distichlis spicata*), black grass (*Juncus gerardii*), short-form smooth cordgrass (*Spartina alterniflora*), salt marsh aster (*Aster tenufolius*), and sea lavender (*Limonium nashii*) are common. Pannes and pools found in the high marsh zone are also important salt marsh components. Pannes are shallow depressions of standing water that typically dry out during long, dry periods (e.g., end of summer). Only the most salt-tolerant plant species can occur at panne edges, such as common glasswort (*Salicornia europaea*), seaside plantain (*Plantago maritima*), and short-form smooth cordgrass. Pools are larger and deeper than pannes and hold submerged aquatic vegetation, such as widgeon grass (*Ruppia maritima*).

The marsh border is located at the upland edge of a salt marsh but can also be found in pockets of the marsh where elevation level is higher than that of the high marsh. The marsh border has the highest plant diversity in a salt marsh, with the following dominant species: marsh elder (*Iva frutescens*), sweet gale (*Myrica gale*), seaside goldenrod (*Solidago sempervirens*), and switchgrass (*Panicum virgatum*).

Frequency and duration of tidal flooding are key environmental factors that create and influence salt marsh vegetative patterns (Niering and Warren 1980, Mitsch and Gosselink 2000). In addition, salinity, substrate, fine-scale topography, availability of nutrients and oxygen, and human modifications influence vegetative patterns (Niering and Warren 1980). Nutrients that stimulate marsh plant growth are carried in with the tides, and organic matter that feeds fish and other organisms is carried out by the tides. Over time, organic matter accumulates on the marsh and forms peat. By building up more peat, salt marsh elevation can keep apace with rising sea level, unless the rate of sea-level rise becomes too great.

1.2 Justification

More than 50% of coastal and estuarine marshes in the United States have been lost, and the Northeast region is one of four "hotspots" with the most significant loss (Benoit and Askins 1999). In addition, by the 1930s, about 90% of salt marshes from Maine to Virginia were ditched for mosquito control (Clarke et al. 1984, Post and Greenlaw 1994). An estimated 30-50% of New Hampshire's original salt marsh habitat has been lost to development (New Hampshire Coastal Program (NHCP). Therefore, protecting and restoring remaining salt marsh habitat has become a high priority for New Hampshire.

Salt marsh habitat is an important conservation concern because it has many important values and functions, such as supporting biodiversity, scenic, and recreational values and serving as an upland buffer for storms (Mitsch and Gosselink 2000). Salt marshes provide habitat and food for small fish, crustaceans, and insects, as well as larger fish that are important to the New England fishing industry. Moreover, salt marshes provide breeding, foraging, and migratory stopover habitat for many species of birds (Mitsch and Gosselink 2000), including several species of special concern in New Hampshire, such as saltmarsh sharp-tailed sparrow, Nelson's sharp-tailed sparrow, and willet.

1.3 Protection and Regulatory Status

Salt marshes are regulated by NHDES. Activities that may involve filling, dredging, or destroying wetlands in any way are subject to strict guidelines, and approved permits must be obtained before work can commence (RSA 482-A).

1.4 Population and Habitat Distribution

Most of New Hampshire's salt marsh habitat is located along the open coast, with only 10% located in and around Great Bay (NHCP). Salt marshes are found in New Hampshire's coastal zone, which encompasses the following towns: Seabrook, Hampton, Hampton Falls, North Hampton, Rye, Portsmouth, New Castle, Newington, Greenland, Stratham, Exeter, Newfields, Newmarket, Durham, Madbury, Dover, and Rollinsford (NHCP).

1.5 Town Distribution Map

See attached.

1.6 Habitat Map

Salt marsh habitat was mapped using National Wetlands Inventory (NWI) data (USFWS 2001). Specifically, those wetlands classified as emergent intertidal estuarine wetlands (code = E2EM) were extracted from the NWI data to represent salt marshes in New Hampshire. Salt marsh habitats were not restricted by size, vegetative structure, or other attributes. Therefore, habitat quality for different species varies among salt marsh polygons. Potential habitat maps for salt marsh species (e.g., salt marsh birds) can be created by querying for specific attributes (e.g., marshes larger than 20 ha).

1.7 Sources of Information

Information on salt marsh habitat ecology, research, management, and restoration was obtained from a literature review. National Wetland Inventory maps were used to identify salt marsh habitat in the state. The New Hampshire Coastal Program's website was used to gather information on salt marsh distribution and abundance in the state, management and restoration projects, and research and conservation issues in the state. Sperduto (2004) was used to crosswalk salt marsh habitat with the New Hampshire Natural Heritage Bureau natural communities and ecological systems (see State Ranks above).

1.8 Extent and Quality of Data

The extent and quality of data on the distribution of salt marsh habitat in New Hampshire are quite good. NHCP monitors habitat changes by regular sampling of soil, fish, vegetation, and birds at select sites that are natural or undisturbed, degraded or restricted, and restored or mitigated. Therefore, any changes in habitat quality or type (e.g., a tidally restricted salt marsh becoming brackish or dominated by invasive species) are well documented and handled by NHCP.

1.9 Distribution Research

Continuation of NHCP's long-term monitoring and surveying efforts of salt marsh habitat is needed so

that information on distribution and loss due to tidal restrictions or degradation is kept current.

Element 2: Species/Habitat Condition

2.1 Scale

The New Hampshire conservation units for salt marsh habitat are Great Bay and Portsmouth and Coast (including Rye, Hampton, and Seabrook).

2.2 Relative Health of Populations

Historically, the introduction of railroads and roads resulted in reduced or no tidal influence to marsh habitat. Currently, negative effects of these transportation systems are still impacting some of New Hampshire's salt marshes. Tidally restricted marshes are less productive than unrestricted marshes (Roman et al. 1984). Burdick et al. (1997) noted that observed trends in marsh degradation indicate that tidal restrictions negatively affect the entire salt marsh ecosystem. For instance, tidal restrictions result in a decrease in flooding frequency and salt and sediment exchange, as well as an increase in freshwater from rain and snowmelt (Burdick et al. 1997). These conditions result in the loss of salt marsh habitat, and typical salt marsh vegetation is replaced with invasive reeds and grasses, such as cattails and common reed (Sinicrope et al. 1990, Burdick et al. 1997, Brawley et al. 1998).

In New Hampshire, there are currently about 2509 ha (6,200 ac) of salt marsh habitat (NHCP). An estimated 30-50% of New Hampshire's original salt marsh habitat has been lost to development. Tidal restrictions and filling have caused most of this historic marsh loss and degradation (NHCP). Residential and commercial development along the entire length of the coast, and the presence of Route 1A, have disrupted and restricted the connection between ocean and the marshes (NHCP).

2.3 Population Management Status

There is no ongoing population management specifically for salt marsh birds in New Hampshire, but inventory work is under way. With historical records from ASNH and the ongoing research being conducted at UNH, potentially important sites for New Hampshire's salt marsh birds are being identified. Lack of data (e.g., habitat suitability and effects of restoration practices) is a significant hurdle in developing effective management guidelines. Currently, researchers at UNH are attempting to answer some of these questions surrounding habitat suitability and effects of restoration practices.

2.4 Relative Quality of Habitat Patches

Salt marsh habitat within New Hampshire's coastal zone can be identified in a geographical information system by using National Wetland Inventory data (NWI code = E2EM1P). Although these habitat patches are all considered salt marsh, they are vastly different in status (i.e., tidally restricted, undisturbed, or restored), size, shape, regime, vegetative structure, location on the landscape relative to human disturbance, elevation, presence of ditches, pools, and pannes, among many other characteristics. Their ability to provide key ecological attributes varies between sites and also depends on the target wildlife species or communities. For example, saltmarsh sharp-tailed sparrow, a salt marsh obligate, typically breeds in large, unrestricted, *Spartina*-dominated marshes with the presence of pannes, pools, and creeks for foraging. However, this is not always the case. Sparrows may occupy marshes that do not fit the above criteria, while marshes that appear to meet all the critical habitat attributes may have an absence of sparrows. Therefore, all New Hampshire's salt marshes potentially have key ecological attributes, but more research is needed to fully understand habitat quality in relation to rare or endangered salt marsh obligates.

2.5 Habitat Patch Protection Status

All salt marshes, regardless of ownership, are protected and regulated by the NHDES through a permitting process. Some marshes are protected further through conservation easements, such as Bay Road marsh in Newmarket, Squamscott River in Newfields, and Chapman's Landing in Stratham. In addition, areas of the Hampton marsh complex are protected through conservation easements held by ASNH, NHFG, and SPNHF.

2.6 Habitat Management Status

The Coastal Zone Management Act of 1972 created the federally consistent formal review process for any federal activities affecting New Hampshire's coastal zone. NHCP, part of the Department of Environmental Services, gained federal approval in 1982 and oversees all protection, mitigation, and restoration efforts surrounding salt marsh habitat in the state. With assistance from the Natural Resource Conservation Service (NRCS), and other partnerships and non-government organizations, NHCP identifies degraded salt marshes, prioritizes sites for restoration, and develops ways to measure the effectiveness of restoration techniques. NHCP is currently forming a comprehensive restoration program that will help coordinate, inventory, and monitor restoration projects in the state.

In a 1994 report, the NRCS identified 31 tidal restriction sites in New Hampshire. Of these, 16 have been rectified, 6 are in the planning stages of restoration, and the remaining restrictions are either infeasible or unnecessary to fix (NHCP). In New Hampshire, restriction removal, fill removal, and open marsh water management are techniques used for restoration. Between 1990 and 2000, removing tidal restrictions restored 236 ha (582 ac), 3 ha (8 ac) of marsh have been restored by fill removal at 2 sites, and the New Hampshire Coastal Program estimates 40 ha (98 ac) have been restored through open marsh water management.

2.7 Sources of Information

Information on salt marsh habitat ecology, research, management, and restoration was obtained from a literature review. The NHCP website was used to gather information on salt marsh condition, health, current management, and restoration efforts.

2.8 Extent and Quality of Data

The extent and quality of data on the condition and management efforts of salt marsh habitat in New Hampshire are quite good. NHCP monitors habitat changes by regular sampling of soil, fish, vegetation, and birds at select sites that are natural or undisturbed, degraded or restricted, and restored or mitigated. Therefore, any changes in habitat quality or type (e.g., a tidally restricted salt marsh becoming brackish or dominated by invasive species) are well documented and handled by NHCP.

2.9 Condition Assessment Research

Continuation of NHCP's long-term monitoring and surveying efforts of salt marsh habitat is needed. This information provides evidence of marsh health at specific sites and can be used to compare different sites. NHCP efforts focus on restricted and restored marshes, but many of New Hampshire's marshes are not monitored. Therefore, extending this effort to unmonitored marshes on an annual basis is recommended.

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
Historically, human activities, such as dredging, filling, and the construction of roads, dikes, bridges, and impoundments, have reduced the amount of salt marsh habitat along the Atlantic coast (Roman et al. 1984). The coastal zone of New Hampshire is a popular location for residential and commercial development because of its flat landscape and proximity to the ocean.

(B) Evidence
More than 50% of coastal and estuarine marshes in the United States have been lost, with the Northeast region being one of the four "hotspots" for the most significant loss (Benoit and Askins 1999). In New England, 80% of the marshes have been lost to human development (Shriver et al. 2004). Habitat loss is a significant factor in the decline of wetland birds, especially species that depend on salt marshes for nesting, such as the saltmarsh sharp-tailed sparrow (Greenlaw and Rising 1994, Benoit and Askins 1999).

3.1.2 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
Coastal development also results in the loss of marsh

border habitat and upland habitat surrounding the marsh, both of which act together as an important buffer zone (NHCP). Many species of birds and mammals use this buffer habitat for breeding, feeding, and other activities (NHCP).

(B) Evidence
The loss of upland buffer habitat and an increase in development surrounding a marsh system may negatively influence the behavior of salt marsh obligate wildlife species. For example, salt marsh nesting birds may nest greater distances from the edge due to the loss of the upland buffer and an increase in noise pollution and therefore be forced to occupy less space (NHCP).

Coastal development combined with an accelerated rate of sea-level rise and loss of upland buffer habitat threatens marsh growth. As sea level rises, marshes will not be able to keep pace with the rising ocean in places where the upland buffer has been lost to development. The result will be smaller and narrower fringe marshes bordering the ocean.

3.1.3 Development (Fragmentation)

(A) Exposure Pathway
Residential and commercial development has fragmented the landscape and created isolated patches of marsh habitat. Historically, the flat, open, and expansive qualities of salt marshes made them ideal locations for the construction of roads and railroads. Ultimately, construction of these transportation systems has left smaller and smaller patches of marsh that consist of more edge habitat and less interior habitat.

(B) Evidence
Fragmented habitats are usually associated with an increase in edge habitat and a decrease in available interior habitat. Area-sensitive species, such as saltmarsh sharp-tailed sparrows (Benoit and Askins 2002), could be negatively impacted by fragmentation and decreasing patch size. In Connecticut, saltmarsh sharp-tailed sparrow densities exhibited a significant positive relationship with marsh area (Benoit and Askins 2002). Moreover, an increase in the amount of edge in many different habitat types can be associated with higher densities of nest predators (Niehaus et al. 2003). Thus, salt marsh nesting birds may be impacted by increased nest predation in fragmented patches. Fragmentation also reduces the amount of suitable nesting habitat. With increasing edge and development pressures surrounding a marsh, many salt marsh nesting birds could lose quality nesting habitat and be forced to move further from the marsh edge or exist at lower densities.

3.1.4 Altered Hydrology (Tidal Restriction), Transportation Infrastructure

(A) Exposure Pathway
Transportation routes (roads and railroads) that have been built on salt marshes since the late 1800s sever the vital connection between the marsh and ocean (NHCP, Roman et al. 1984). Roads built on the marsh often have tide gates or inadequately sized culverts that reduce or eliminate tidal flooding of the marsh system.

(B) Evidence
Without tidal influence, typical salt marsh grasses of tidally restricted marshes are replaced with brackish species and invasive plants (Niering and Warren 1980, Sinicrope et al. 1990, Burdick et al. 1997, Brawley et al. 1998, Benoit and Askins 1999). Tidal restrictions also result in a decrease in salt and sediment exchange and an increase in fresh water from rain and snowmelt (Burdick et al. 1997). Further, tidally restricted marshes are less productive than unrestricted marshes (Roman et al. 1984). Burdick et al. (1997) found that tidal restrictions negatively affect the entire salt marsh ecosystem. Historical degradation of salt marsh habitat quality along the Atlantic coast has contributed to regional declines in the saltmarsh sharp-tailed sparrow population (Greenlaw and Rising 1994, Benoit and Askins 1999) and other salt marsh nesting birds.

3.2 Sources of Information

Information on salt marsh threats was obtained from a literature review and the New Hampshire Coastal Program.

3.3 Extent and Quality of Data

The above threats to salt marsh habitat are well documented and are the focus of many scientific studies in New England.

3.4 Threat Assessment Research

Because past human activities such as road construction continue to negatively affect salt marshes, habitat restoration is a high priority. Pre- and post-restoration research and monitoring of salt marsh structure and function are essential for accurate evaluation of restoration success. For example, open marsh water management for mosquito control may negatively affect the salt marsh ecosystem, but more research is needed (NHCP).

Research is needed to determine the effects of methylmercury on the salt marsh ecosystem in New Hampshire. Methylmercury has become an important regional ecological and human health concern. The Biodiversity Research Institute has started to investigate the effects of mercury on salt marsh birds in New England, but research is needed in New Hampshire. Salt marsh birds are already a regional conservation priority due to habitat loss and degradation, but mercury could pose an increasing threat to these and other salt marsh species. As scientific research assesses mercury's effects, conservation actions can better address the issue.

Element 4: Conservation Actions

4.1.1 Protecting remaining salt marsh habitat and surrounding upland buffer habitat, Habitat Protection

(A) Salt Marsh Loss, Upland Habitat Loss, Habitat Fragmentation, Increased Human and Noise Disturbance, Invasive Plant Species, Increased Deposition of Pollutants, Tidal Restriction, Dredge and Fill, Sea Level Rise

(B) Justification

1) Most of New England's historical salt marsh habitat has been lost to development and other human activities. Therefore, preserving the remaining habitat patches will ensure that no more salt marsh is lost or fragmented in New Hampshire. Protecting quality habitat and the upland buffer will reduce or lessen the threats listed in (A) in measurable ways and benefit the salt marsh community. For example, maintaining the upland buffer surrounding a marsh and protecting it from development will reduce or prevent human and noise disturbance at that site.
2) Many salt marsh nesting birds, such as willet, are area-sensitive and require large, contiguous patches of habitat on a landscape for population colonization and growth. Protecting existing patches will ensure that these and other populations will not decline or become locally extinct due to habitat loss and fragmentation. Protecting existing marshes and upland buffers will benefit New Hampshire's current salt marsh bird populations and allow them to stabilize, grow, or disperse into new protected areas.
3) Habitat protection across the landscape is necessary to maintain current population numbers because salt marshes are threatened by development everywhere.
4) Protection of existing salt marsh habitat structure, function, and value is achievable immediately. Habitat protection has the advantage of being a preventative approach, rather than a reconstructive or restorative approach. For example, sites currently used by salt marsh nesting sparrows likely would continue to be used if the habitat were protected.

(C) Conservation Performance Objective

The performance objective for salt marsh and upland buffer protection is to maintain a tidally influenced, *Spartina*-dominated system with low marsh, high marsh, pannes, pools, and a border of upland habitat. The objective for each conservation unit is to maintain known salt marsh structure, function, and value that can be measured through frequent monitoring. The ultimate goal is to maintain habitat quality within every conservation unit that potentially could support breeding populations of salt marsh obligate birds, which can be used as indicators of habitat health.

(D) Performance Monitoring

Performance monitoring should be conducted at as many salt marshes as possible, or at sites of high priority or concern, on a regular basis (depending on priority, available personnel, funding, and time). Monitoring includes regular sampling of soil salinity, tidal elevations, vegetation structure, and fish and bird communities.

(E) Ecological Response Objective
The desired ecological response to salt marsh protection is persistence of a tidally influenced, *Spartina*-dominated system that could support salt marsh fish populations and potentially support obligate bird populations. This response should be immediate at natural, undisturbed sites that are monitored and protected from further human disturbance and development. For salt marsh protection to be deemed successful, long-term monitoring and research should indicate that fish and bird use stabilizes or increases.

(F) Response Monitoring
Response monitoring should be conducted at as many salt marshes as possible, or at sites of high priority or conservation concern, on a regular basis (depending on priority, available personnel, funding, and time). The response indicator for successful marsh protection is a measured quality of marsh structure and function, in terms of soil salinity, vegetative structure, tidal elevations, and fish and bird communities.

(G) Implementation
NHCP oversees all protection and management of salt marsh habitat within New Hampshire and works with local partners and conservation commissions to ensure protection.

(H) Feasibility:
Although NHCP has successfully protected many hectares of salt marsh habitat in New Hampshire, the pressures of development within the coastal zone are significant. Any impact to wetlands must go through a permitting process before implementation. However, even legally permitted impacts can result in habitat loss. Therefore, reducing or eliminating future disturbance and development is crucial to protecting existing salt marsh systems and communities. The feasibility of intense long-term monitoring at natural sites is limited by personnel and funding.

4.1.2 Restoring degraded salt marshes back to Spartina-dominated systems, Restoration and Management

(A) Salt Marsh Loss, Upland Habitat Loss, Habitat Fragmentation, Invasive Plant Species, Tidal Restriction, Dredge and Fill, Mosquito Ditching

(B) Justification
1) Pre- and post-restoration environmental monitoring has shown that restoring degraded marshes by reintroducing tidal influence can be successful (see Warren et al. 2002, NHCP). Removing or reducing tidal restrictions decreases or eliminates invasive plant species and creates a functioning *Spartina*-dominated system over several years (Niering and Warren 1980, Roman et al. 1984, Warren et al. 2002).
2) Salt marsh restoration has produced a positive ecological response in degraded salt marsh ecosystems (Burdick et al. 1997, Warren et al. 2002). Although more research is needed, restoration is expected to benefit salt marsh obligate bird populations over the long-term. In a 20-year study of salt marsh restoration in Connecticut, abundance and nesting activity of salt marsh specialists were low following restoration, but were comparable to breeding populations of the same species in reference marshes after 15 years (Warren et al. 2002). Restoration may have a near-term negative effect on salt marsh nesting sparrows due to increased flooding, but over time it is possible for restoration to increase bird activity and reproductive success due to an increase in the amount of quality habitat.
3) Salt marsh restoration is critical across the landscape to conserve salt marsh habitat in New Hampshire. Without it, tidal restrictions would continue to degrade and alter these marshes into brackish or freshwater marshes and uplands dominated by common reed and other invasive species. Salt marsh habitat would continue to be lost in the state.
4) Warren et al. (2002) suggest restoration response times for certain ecological parameters to be between 5 and 21 years. Burdick et al. (1997) found significant positive changes to vegetative structure only a few years after restoration, and Warren et al. (2002) found typical salt marsh fish communities present at restoration sites 5 years after restoration. Limited research has been conducted on the timeframe of restoration success in terms of bird use. However, Warren et al. (2002) found salt marsh sharp-tailed sparrow activity at a restored site was similar to activity at reference sites 15 years after restoration.
5) There are many different techniques for restoring

salt marshes, including seeding and replanting *Spartina* grasses, reintroducing tidal flooding to restricted areas by constructing larger culverts under roads, installing self-regulating tide gates to permit water passage, and plugging ditches (see Broome et al. 1988, Sinicrope et al. 1990, Warren et al. 2002). These techniques can be tailored to obtain the desired ecological response depending on a site's specific needs. Ongoing monitoring of salt marsh functions at restored sites provides the necessary ecological information about the outcomes of restoration activities. These data can be used to guide restoration management goals and plans (i.e., adaptive management).

(C) Conservation Performance Objective
The salt marsh restoration performance objective is to create a tidally influenced, *Spartina*-dominated system with low marsh, high marsh, pannes, pools, and a border of upland habitat. The objective for an individual site is to establish marsh structure and function comparable to that of natural, undisturbed systems. Warren et al. (2002) suggests that full restoration of ecological functions, including salt marsh sparrow breeding activity, can occur within 2 decades. Therefore, the ultimate goal for the performance objective is to create habitat with salt marsh structure, function, and value relative to the conservation unit within 20 years of restoration.

(D) Performance Monitoring
Annual performance monitoring should be conducted at all restoration sites, including pre-restoration monitoring, if feasible. If pre-restoration monitoring is not possible due to time constraints and severity of marsh degradation, then monitoring of reference sites is acceptable. All monitoring and research activities should be conducted at reference sites and restoration sites to enable assessment of restoration success. Monitoring should be performed until at least 15-20 years after restoration to determine if desired effects are realized. Restoration is a long-term process and needs to be monitored over a long timeframe. Monitoring should include regular sampling of soil salinity, vegetation structure, tidal elevations, and fish and bird communities.

(E) Ecological Response Objective
The desired ecological response to salt marsh restoration is creating a tidally influenced, *Spartina*-dominated system that could support salt marsh fish populations and potentially support obligate bird populations. This response should be realized approximately 5-20 years after restoration (e.g., 5 years for fish colonization and 20 years for bird colonization) (Warren et al. 2002). For restoration to be deemed successful, long-term monitoring should indicate that soil salinity, vegetative structure, tidal elevations, and fish and bird use at restored sites are comparable to that of similar reference sites.

(F) Response Monitoring
Response monitoring should be conducted at all restoration sites on a regular basis (depending on priority, available personnel, funding, and time). The response indicator for successful marsh restoration is the quality of marsh structure and function measured in terms of soil salinity, vegetative structure, tidal elevations, and fish and bird communities.

(G) Implementation
NHCP oversees all protection, management, and restoration of salt marsh habitat within New Hampshire, often with partners such as Ducks Unlimited, U.S. Fish and Wildlife Service, University of New Hampshire, National Oceanic and Atmospheric Administration, and many local partners, such as town conservation commissions and businesses. Restoration sites are chosen based on degree of degradation, feasibility of proposed restoration activities, and available monetary resources for the project. Once technical support and funding are established for each project, a timeline is created for restoration activities and post-restoration monitoring of habitat functions.

(H) Feasibility
NHCP has successfully implemented salt marsh restoration projects throughout New Hampshire's coastal zone and is planning future restorations. In addition to planning, collaborating with partners, obtaining funding for each project, and carrying out the restoration, NHCP and its partners annually conduct biotic and abiotic sampling to monitor restoration success. The feasibility of intense long-term monitoring of restoration success is limited by personnel and funding.

4.2 Conservation Action Research

More research is needed in New Hampshire to determine the long-term effects of restoration on populations of salt marsh nesting birds, such as saltmarsh sharp-tailed sparrow, Nelson's sharp-tailed sparrow, seaside sparrow, and willet. Salt marsh obligate birds are of special concern in New Hampshire and the impact of restoration on these populations is not well documented. Because these birds may be faithful to breeding sites or territories (see Lowther et al. 2001, Benoit and Askins 2002) and their nests are sensitive to fluctuations in water level, restoration might cause high nest failure rates at a site for several years after restoration. The effects on the small and localized populations of these birds are unknown.

Element 5: References

5.1 Literature

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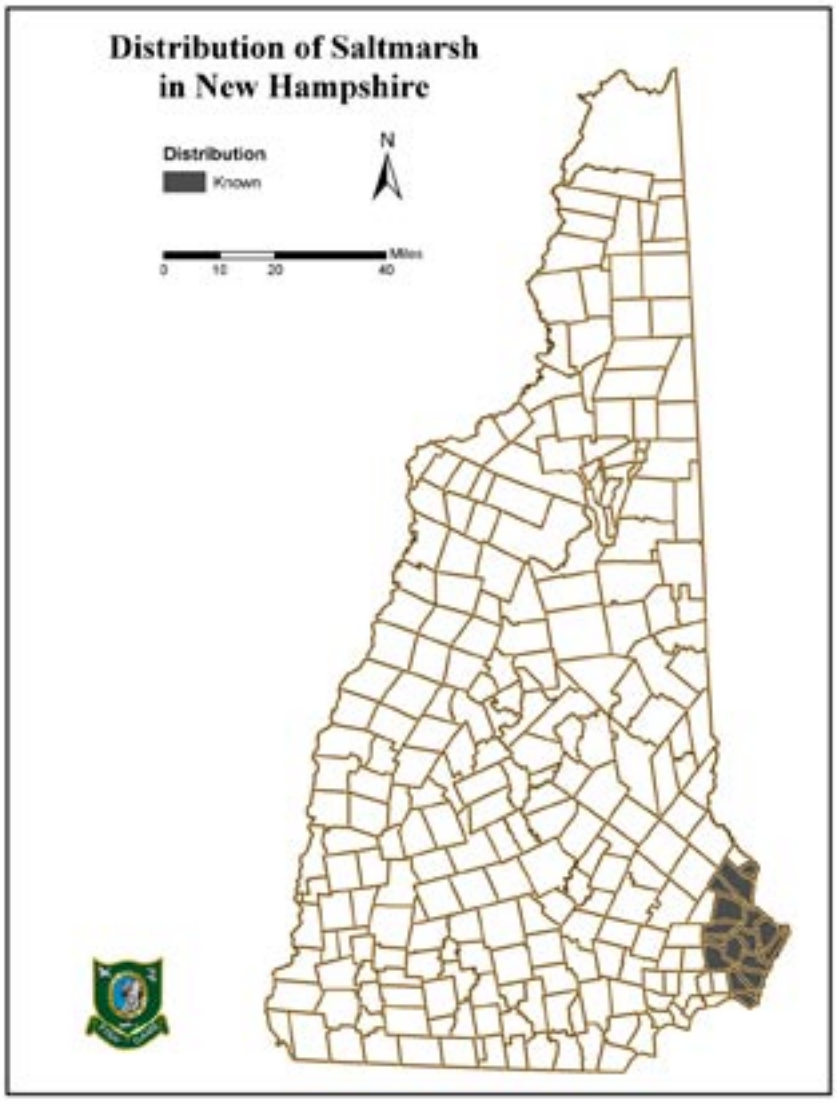
Distribution of Saltmarsh
in New Hampshire
Distribution
Known
N
Miles
0
10
20
40