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Habitat Values of New England Wetlands

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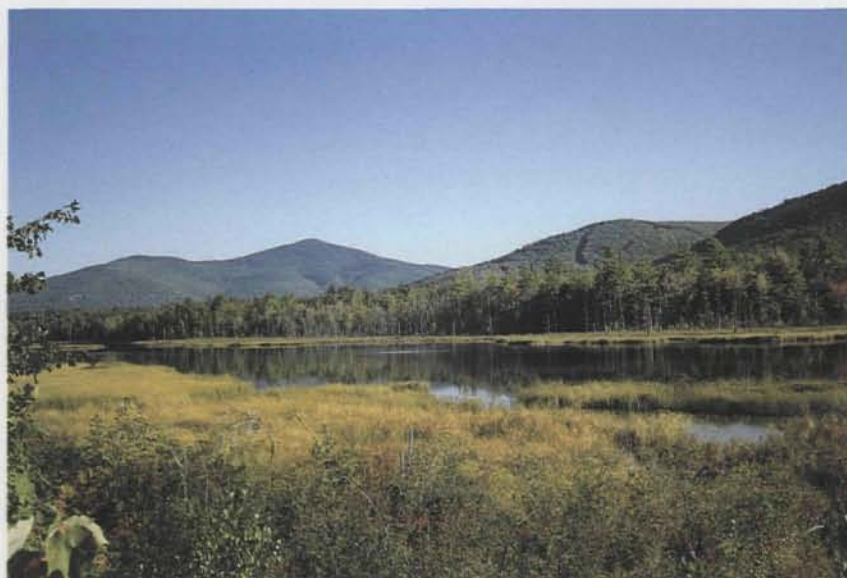
Forested wetland

Cathy Pedevillano

Introduction

New England wetlands are as diverse as the New England landscape. They include red maple swamps, Atlantic white cedar bogs, emergent marshes, kettle holes, barrier beaches, dunes, salt marshes, rivers, lakes, streams and ponds.

Wetlands are just what the name implies, lands that are wet, either inundated or saturated for varying periods during the growing season. The presence of water creates conditions that favor the growth of specially adapted plants called hydrophytes, and promotes the development of characteristic soil properties that comprise these hydric soils. Many factors combined are responsible for the New England wetlands we see today, such as glaciation, climate, agriculture, and hydrological processes. Wetlands, like all natural ecosystems, are



Lacustrine habitat

Cathy Pedevillano

dynamic, ever-changing communities that serve different functions at different points in time. The wetlands we see today with their distinctive flora and fauna may be quite different in ten or twenty years.

There are two major categories of wetlands found in New England: coastal and inland. Coastal wetlands are formed where sea water mixes with fresh

water to produce an environment with varying degrees of salinity. The salt water together with tidal action creates a difficult environment for most plants to grow. Therefore, many coastal wetlands are either unvegetated mud flats or sand flats, or are vegetated with salt-adapted grasses and plants.

Inland wetlands occur most frequently along floodplains of rivers and streams, along the edges of lakes and ponds, and in isolated depressions. They can even be found perched on rock or clay on a hillside. Inland wetlands include marshes and wet meadows dominated by herbaceous vegetation, and shrub swamps and wooded swamps comprised of trees and woody vegetation. Bogs are characterized by a deep layer of organic matter and with either herbaceous or woody vegetation.





Tidal flats

Cathy Pedevillano



Pickerel weed

Cathy Pedevillano

Each type of wetland is a unique ecosystem with its own inherent values and functional processes. The New England Division of the U.S. Army Corps of Engineers has identified twelve different functions and values of wetlands: ground water recharge/discharge, flood storage and desynchronization, sediment/

toxicant retention, nutrient retention/transformation, nutrient export, aquatic diversity/abundance, fish and shellfish habitat, wildlife habitat, endangered species, consumptive recreation, non-consumptive recreation, and uniqueness/heritage.

This narrative focuses on the wildlife habitat values of New England wetlands and describes typical flora and fauna of both inland and coastal systems. The species mentioned in the text may have localized ranges and may be limited to certain portions of New England.



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Beaver flowage

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Inland Wetlands



Forested wetland – early spring

Cathy Pedevillano

Several different types of inland wetlands are found in the Northeast. **Palustrine Forested, Palustrine Scrub-Shrub and Palustrine Emergent** wetlands are the most common. Palustrine is the term used to describe freshwater wetlands dominated by trees, shrubs and persistent emergent vegetation (Cowardin et al. 1979). Palustrine wetlands were traditionally referred to as marshes, swamps, bogs, and fens. **Lacustrine** wetlands are inland systems that include permanently flooded lakes and reservoirs. **Riverine** systems consist of streams and rivers.

Federal, state and local protection for inland wetlands has only recently become a reality. Many of these ecosystems in the Northeast have either been lost to development or fragmented to the point of

much-reduced habitat value. Protection of these valuable systems is important in maintaining regional, national and global biological diversity.



Forested wetland – summer

Cathy Pedevillano

Palustrine Forested Wetlands

A variety of birds, mammals, reptiles, amphibians and invertebrates inhabit palustrine forested wetlands in New England. These areas are characterized by a diversity of plant species and structural features that provide feeding, breeding, nesting, overwintering, and migration habitat for wildlife. Different assemblages of plant species and wildlife species are found within forested wetlands depending on their location in New England.

Palustrine forested wetlands are commonly called “**wooded swamps**” since they are dominated by trees. The **flora** of wooded swamps is varied, yet some plant species are frequently found in



Forested - fall

Cathy Pedevillano

these wetlands. The tree canopy is usually dominated by species such as red maple, white cedar, hemlock, spruce or fir. Others often found associated with these include white pine, yellow birch, elm and ash. Typical shrubs found in forested wetlands include highbush blueberry, sweet pepperbush, swamp azalea, silky dogwood, and common arrowwood. Some herbaceous species that often grow in wooded wetlands are cinnamon fern, sensitive fern, royal fern, skunk cabbage, spotted jewelweed, sphagnum, and goldthread.

A variety of **habitat features** are often found in forested wetlands which add to their overall wildlife value. Snags are dead or dying trees, or portions of trees. They are utilized by various wildlife species for feeding, nesting,



Spotted salamander

David Carroll

denning, roosting or perching. Hilly and hummocky topography within these swamps sometimes creates depressions that seasonally fill with water. Some of these areas, referred to as vernal pools, provide important breeding areas for amphibians such as salamanders and frogs.

Wildlife species utilize wooded swamps according to the habitat characteristics present. Well-developed **tree, shrub, and herbaceous strata** provide feeding and nesting substrates for several



Forested - winter

Cathy Pedevillano

different avian species. The red-eyed vireo and black-throated blue warbler typically feed on insects in the upper canopy; the black and white warbler, veery, yellow warbler and Canada warbler glean insects from the mid to lower canopies; and the wood thrush and hermit thrush forage on insects and fruits in the ground litter. These species all typically nest in the understory. The Northern waterthrush is attracted to wooded swamps with open pools of shallow water.

Snags of various shapes and sizes are often found in forested wetlands. The larger diameter dead trees can serve as dens for the raccoon, Virginia opossum and fisher; or as diurnal roosts for the barred owl, great horned owl and big brown bat. The wood duck, ring-necked duck, common goldeneye and hooded mergan-



Snag

Laura Eaton

ser all nest in large dead tree cavities in wooded swamps. Smaller snags provide feeding and/or nest sites for the black-capped chickadee, white-breasted nuthatch, tufted titmouse, tree swallow, hairy and downy woodpeckers. Brown creepers glean insects from snags with loose bark.

Vernal pools form in topographic depressions found in forested swamps. These areas contain water in spring and fall, and provide extremely important breeding habitat for amphibians. Mole salamanders of the genus *Ambystoma* (spotted, blue-spotted, Jefferson's), as well as the wood frog breed exclusively in vernal pools. These salamanders travel in mass migrations along traditional routes to return to the pools where they were born to breed. Loss of these pools can eliminate

entire breeding populations in localized areas.

Other wildlife species are attracted to vernal pools because of the abundant amphibian prey. These including Blanding's turtles, spotted turtles, great blue herons, green herons and garter snakes. Invertebrates are an essential component of vernal pools and provide food for amphibian larvae. Fairy shrimp only live in vernal pools and lay drought-resistant eggs that hatch when the pool fills with water. Fingernail clams and freshwater snails are often found in the pools as well as a variety of other mollusks, insects, and crustaceans. Vernal pools are extremely productive, valuable ecosystems that are often overlooked and undervalued.





Vernal pool - spring

Cathy Pedevillano

The soft, moist **hydric soils** found in forested wetlands provide a good substrate for tunnelling and burrowing. Small mammals such as the red-backed vole, short-tailed shrew, white-footed mouse, and star-nosed mole feed on the abundant insects and herbaceous vegetation found in wooded swamps and nest either in burrows or in the ground litter.

Other habitat features such as perennial **flowing water** attract additional species to the wetland such as beaver, mink, river otter, Eastern ribbon snake, Eastern painted turtle and green frog. The wood turtle, box turtle, and Eastern garter snake also inhabit wooded swamps.

White-tailed deer are often found in forested wetlands since the microclimate is cooler in summer and there is abundant

herbaceous and woody browse for feeding. In winter, deer in the Northeast often congregate in areas known as **deer yards**. These areas are typically dominated by evergreen trees, including white cedar, hemlock, spruce and fir. Conifers create areas that are warmer due to reduced snow cover and wind, and also provide a source of winter food. Forested wetlands are important to the winter survival of deer in Northern climates.

One consequence of the intense development in the Northeast has been **forest fragmentation**, or breaking up large contiguous tracts of woodland into smaller and smaller pieces. This lessens the overall habitat value of an area by excluding certain species (such as deer, mink, river otter and long-tailed weasel) that have larger home ranges and are more

sensitive to human disturbance. Habitat fragmentation also creates easier access to nests and young by predators such as fox and skunk, and allows nest parasitism by brown-headed cowbirds. The decline of forest interior birds (i.e., warblers, vireos, thrushes) that nest exclusively in large, undisturbed tracts of woodland, has been in part attributed to fragmentation of Northeastern forests.

Palustrine Scrub-shrub Wetlands

Wetlands classified as palustrine scrub-shrub in the Northeast are dominated by **woody species in the sapling and shrub stages**. Vegetation commonly found in these areas includes highbush



Palustrine scrub-shrub

Cathy Pedevillano



blueberry, sweet pepperbush, swamp azalea, spicebush, arrowwood, winterberry, willow, alder, dogwood, common elder, buttonbush and meadowsweet. Associated herbs often include cinnamon fern, sensitive fern, spotted jewelweed, sphagnum, sedges, rushes and hydrophilic grasses. Scrub-shrub wetlands frequently flood in the spring or contain pockets of standing water.

Scrub-shrub wetlands are utilized for **feeding, nesting, breeding, and cover** by a variety of wildlife species. Dense shrubs serve as excellent nesting habitat for songbirds that may also feed on the fruits of berry-producing shrubs or perch on shrubs when catching flying insects. Some birds often found in scrub-shrub wetlands are the common



Scrub-shrub/emergent wetland

Laura Eaton

yellowthroat, alder flycatcher, yellow warbler, chestnut-sided warbler, blue-winged warbler, American redstart, Canada warbler, song sparrow, gray catbird, and American goldfinch.

The American woodcock, a migratory game bird, frequents dense alder thickets where it nests on the ground and feeds on earthworms found in the soft muddy substrate.

Shrub swamps that are flooded in spring are frequently used as **breeding ponds** by the northern spring peeper and gray treefrog. The proliferation of these amphibians attracts predators such as the great blue heron, raccoon, and mink. Shrub swamps that are adjacent to emergent marshes provide shrubby cover for nesting waterfowl. Snowshoe hare, cottontail and white-tailed deer also utilize shrub swamps for food and cover.



Scrub-shrub vegetation

Cathy Pedevillano





White-tailed deer

Gordon Russell

Most freshwater marshes in the Northeast are vegetated with cattails, and may also contain tussock sedge, blue flag, water willow, and other sedges, rushes and grasses. Plants such as pickerelweed, arrow arum, smartweeds, arrowheads, and arrow-leaved tearthumb commonly grow in the mucky marsh soils. Marsh vegetation is often found in and adjacent to open water.

Wet meadows tend to be drier than marshes but many still have a water level close to the surface for much of the year. They are usually vegetated with plants such as bulrush, soft rush, wool grass, spotted jewelweed, joe-pye-weed, sensitive fern, meadowsweet, steeplebush, goldenrod, tussock

Palustrine Emergent Wetlands

Marshes and wet meadows are the most prevalent palustrine emergent wetlands in New England. These are wetlands dominated

by herbaceous or non-woody vegetation and usually have either surface water or saturated soils present year-round.



Eastern garter snake

Cathy Pedevillano



Emergent (cattails) summer

Cathy Pedevillano

sedge, other sedges, rushes and hydrophilic grasses, including bluejoint and reed canary grass.

Purple loosestrife and common reed are two species of non-native vegetation that are often found in palustrine emergent wetlands, especially in disturbed areas. Common reed spreads by underground runners and purple loosestrife reproduces by abundant seed heads. Both are prolific species that have outcompeted

some native wetland vegetation, and once established in an area, they are difficult to remove.

A diversity of wildlife utilize palustrine emergent wetlands. Red-winged blackbirds breed and nest almost exclusively in cattail marshes. Other **songbirds** that nest and/or feed in marshes and wet meadows include the song sparrow, common yellowthroat, swamp sparrow and marsh wren. Some larger species, particularly



Marsh marigolds

Cathy Pedevillano

wading birds, frequent marshes where they find food, nest and brood cover, or escape cover. These include the American bittern, least bittern, Virginia rail, great blue heron, green-backed herons, and common snipe. Emergent vegetation, when interspersed with open water, creates prime **waterfowl** feeding and nesting habitat for such species as the mallard, black duck, and blue-winged teal.



Tadpoles in vernal pond

Cathy Pedevillano



Spotted turtle

David Carroll



Northern leopard frog

Cathy Pedevillano



Beaver

Susi Von Oettingen

Marshes are the preferred habitat of muskrats that feed and build their nests in the herbaceous vegetation. Other **mammals** that hunt or feed in marshes and wet meadows include the raccoon, mink, and cottontail.

Beavers often create open water emergent systems when damming streams.



A variety of **small mammals** tunnel through the soft soils of marshes and wet meadows or feed on the abundant insects and herbaceous vegetation. These include the short-tailed shrew, star-nosed mole, water shrew and meadow jumping mouse. The northern harrier nests on the ground in emergent wetlands and preys upon small mammals, reptiles, amphibians and small birds in the area. Reptiles and amphibians such as the northern

leopard frog, northern spring peeper and eastern American toad feed, breed and overwinter in palustrine emergent wetlands.

Lacustrine Habitat

Lacustrine systems are permanently flooded **lakes and reservoirs, or tidal lakes** with low salinity. They typically lie in a topographic depression or dammed river channel; lack trees, shrubs and persistent emergents; and total area exceeds 8 hectares (Cowardin et al. 1979). Areas of palustrine wetland may lie within the boundaries of the lacustrine system.

The large areas of deep open water characteristic of lacustrine wetlands create habitat for a variety of fish and wildlife species. A major attraction of lacustrine wetlands, to both wildlife and people, is the presence of **fish**. Some fish species commonly



Beaver impoundment (summer)

Cathy Pedevillano



Lake

Army Corps of Engineers



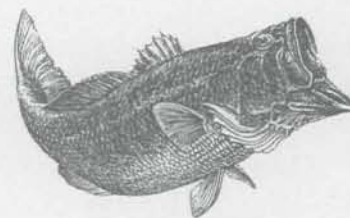
Moose

Gordon Russell

found in New England lakes include the lake trout, Northern pike, yellow perch, pickerel, carp, bass and bluegill. Fish-eating birds such as the belted kingfisher, common merganser, great blue heron, green-backed heron, common loon, pied-billed grebe, osprey and bald eagle utilize lacustrine habitats for feeding and will often nest nearby.

merged and emergent aquatic plants or to rest during migration. **Mink and river otter** will inhabit lakeshores where there are suitable den sites and plentiful fish and other aquatic prey. **Moose** spend their summers near lakes and ponds where they feed on aquatic vegetation. Lacustrine wetlands provide habitat for

amphibians and reptiles such as the bullfrog, green frog, red-spotted newt, Eastern painted turtle and snapping turtle.



Waterfowl, such as the mallard, black duck, gadwall, American widgeon, ring-necked duck, common goldeneye and bufflehead, frequent lakes to feed on sub-



Lacustrine (summer)

Cathy Pedevillano



Mallard and brood

FWS Photo

Riverine Habitat

Riverine habitat refers to **wetlands and deepwater areas with flowing water** within a channel. Typical riverine habitats are streams, rivers, and streamside wetlands and aquatic beds. Riparian areas are the corridors along rivers and streams, including the banks and associated vegetation, which can include both wetland and nonwetland habitats. The waterways may be bordered by palustrine emergent, scrub shrub or forested vegetation and other habitat features that attract certain wildlife species.

Many different aspects of streams and their adjacent corridors provide valuable habitat for wildlife. Cool, fast-flowing streams with **riffle** and **pool complexes** serve as breeding and feeding areas for fish such as the Atlantic

salmon and brook trout, brown trout and rainbow trout. These species lay their eggs in gravelly stream bottoms and may find shade and cover in the submerged, aquatic or emergent vegetation along the edges.

Trees and shrubs along the banks of waterways enhance the habitat value for wildlife. They

provide shade cover which moderates water temperatures; and perching sites for birds that feed on fish, insects or herptiles found along the streams. Vegetation also helps stabilize the banks which reduces soil erosion into the stream. Maintaining clean, clear waters is essential to all species which utilize the streams. Vegetated banks also provide food and cover for animals travelling along the riparian corridor such as fox, rabbit, deer, raccoon, mink, otter and weasel.

Insects such as mayflies, black flies and mosquitoes breed along flowing streams and provide food for fish, songbirds, bats and herptiles. The Northern two-lined salamander and the Northern spring **salamander** require streams for breeding. The green frog and the Eastern ribbon snake are often found in riparian areas. **Birds** such as the common



Riparian (winter). Inset: raccoon tracks

Cathy Pedevillano



Riparian (early spring)

Cathy Pedevillano



Riparian (summer)

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yellowthroat, Eastern phoebe, wood thrush, gray catbird, tree swallow, bank swallow, olive-sided flycatcher, and Eastern kingbird also may feed or nest along riparian corridors.



Otter

Michael Amaral

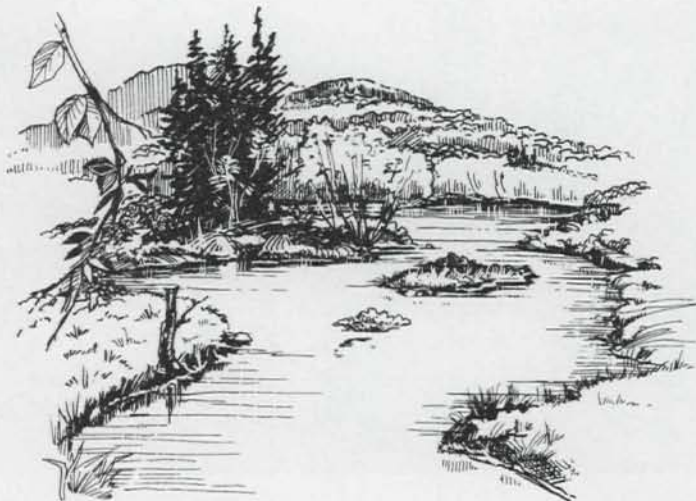
Stream and river banks provide **den sites** for the mink, river otter and long-tailed weasel. They also provide burrowing habitat for small mammals such as the water shrew and star-nosed mole that are often found adjacent to waterways. Frogs, toads, salamanders, snakes and turtles frequently

overwinter in the soft substrate of banks and bottoms of rivers and streams.

Riparian corridors are important in maintaining the ecological integrity of both wetland and the adjacent upland systems. In addition to providing hydrologic connections between different areas, they serve as **habitat linkages**. Many animals travel

along riparian corridors when moving between different habitats or when hunting for food, nest sites or mates. This allows a genetic exchange between populations which increases their overall health and viability. Many birds follow streams and rivers when migrating between summer and winter ranges, and riparian corridors become important feeding and resting areas during these migration periods. Riparian corridors also provide important connections between otherwise fragmented habitats, which expands the amount of available wildlife habitat in the area.

With increasing development in the Northeast, riparian corridors are often the only remaining remnants of former habitats, and they become **refuge areas** for wildlife amidst urbanization. Preserving the biological integrity of these corridors is vital to the continued survival of the species that utilize them.



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Coastal Wetlands

Coastal wetlands occur in both **marine** and **estuarine ecosystems** which include subtidal (continuously submerged) or intertidal (exposed and flooded by tides) areas. Flooding by tidal water is a common characteristic of all coastal wetlands.

The marine system consists of the open ocean overlying the continental shelf and its associated high-energy coastline. This includes beaches, dunes, sandbars, reefs and aquatic beds.

The estuarine system is comprised of deepwater tidal habitats and adjacent tidal wetlands that are semi-enclosed by land but have access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff (Cowardin et. al. 1979). This includes estuaries, saltmarsh, tidal ponds, tidal flats and rocky shores.

Coastal wetlands are extremely valuable systems to fish and wildlife species and to humans. They provide nursery and spawning grounds for many of the recreationally and commercially important marine fish. Many waterfowl and wading birds also utilize these wetlands for feeding, nesting and cover. These systems produce millions of tons of organic matter annually. This provides food for a number of microorganisms and forage fish which in turn feed larger fish and ultimately humans.

The rapid and intense development of coastal areas in southern New England has led to strict state, local, and federal laws regulating these resources. The challenge of protecting coastal wetlands comes in balancing human and economic uses with requirements for the continued survival and viability of existing fish and wildlife populations.



Marine System

Marine habitats are highly productive, diverse ecosystems. The high velocity wave action and the mobility of bottom sediments requires **special adaptations** among both plants and animals to survive in such a dynamic environment. **Algae** are the dominant aquatic flora in marine habitats and range from microscopic diatoms to large seaweeds. Some seaweeds have evolved a root-like structure called a holdfast which allows them to attach to a hard substrate. Free-floating algal beds of rockweeds and kelp are commonly found in the Atlantic Ocean. Marine phytoplankton, tiny plants that are carried along the surf, feed a variety of marine invertebrates that burrow or live on beaches.



Bald eagle

FWS Photo



Eelgrass is an aquatic marine seed plant found along the New England coast. It is an ecologically important plant for several reasons. At full growth, eelgrass may cover acres of shallow bottoms of bays and estuaries stabilizing sediments and eventually participating in the successional development of coastal marshes. It is a principal winter food of the Atlantic brant and it gives shelter to many other small animals. Invertebrates and epiphytic algae grow on the plant; others burrow near the roots. Juvenile fish find cover among the floating leaves. Eelgrass is subject to a blight of unknown causes, the last episode of which began in the

1930s. Eelgrass communities are still absent from some Atlantic coastal regions where recovery from this blight has been slow.

Many species of birds, mammals, fish, shellfish and invertebrates inhabit marine ecosystems. The smaller invertebrate species have evolved mechanisms to survive in the dynamic oceanic environment. Some species are sessile and remain affixed to a firm substrate. These include barnacles, limpets, sea squirts, sea anemones, sponges and corals. Oysters, clams, scallops and other bivalve mollusks have developed shells for protection.

Polychaetes, nematodes and flatworms have evolved forms adapted to burrowing and wriggling into narrow spaces such as crevices between rocks.

Marine invertebrates including surf clams, sand worms, beach hoppers, ghost crabs, and flatworms provide food for migrating shorebirds and for ocean fish. Several species of **shorebirds** stop and feed along coastal mudflats when migrating to and from northern breeding grounds. These include least sandpipers, solitary sandpipers, semi-palmated sandpipers, black-bellied plovers, semi-palmated



Coastal wetland. Inset: roseate tern.

Cathy Pedevillano

plovers and piping plovers, greater yellow-legs, and lesser yellowlegs. Ocean fish such as striped bass, blue fish, flounder, cod, mackerel, herring and smelts, inhabit the Atlantic Ocean and feed on marine invertebrates. These fish provide food for bird species such as the common loon, pied-billed grebe, red-breasted merganser, double-crested cormorant, common tern, herring gull, great black-backed gull, osprey and bald eagle.

A variety of **shellfish** including lobsters, clams, crabs, scallops, oysters, and mussels are found off the New England coast. **Sea ducks** such as eiders, scaup, scoters, goldeneyes, bufflehead and old-squaw feed on mollusks, crustaceans, insects, fish and aquatic plants. Several species of **marine mammals** range within the Atlantic Ocean including the Atlantic bottlenose dolphin, harbor seal, gray seal, humpback whale and right whale.

Several species of **colonial nesting birds** breed along the Atlantic coast. Common terns and least terns nest on gravelly and sandy beaches or on rocky shores of islands. The piping plover, listed as a threatened species by the U. S. Fish & Wildlife Service, and the roseate tern, listed as endangered, both nest in colonies along sandy beaches. Populations of piping plovers have suffered serious declines in recent years



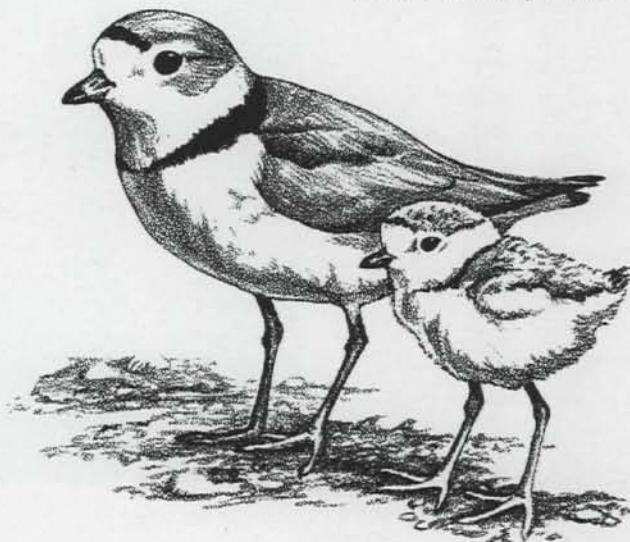
Coastal rocky shore

Cathy Pedevillano

due to increased development and recreational use of beaches. The survival and continued existence of species such as the piping plover and roseate tern depend upon the preservation and wise management of fragile coastal ecosystems.

Estuarine System

The estuarine system is more strongly influenced by its association with land than the marine system, and it is a low-energy system in terms of wave action. Estuarine water regimes and water chemistry are affected by



Julie Zickefoose



Mallard nest

Cathy Pedevillano

oceanic tides, precipitation, freshwater runoff from land areas, evaporation and wind. A range of salinities exists within different estuaries and in part determines the types of plants and animals that can survive there. **Saltmarsh**, **tidal flats** and **rocky shores** are typical estuarine environments in the Northeast.

spike rush, high tide bush, salt-marsh cordgrass, sea lavender, plantain, and glasswort. At the upland edge of saltmarshes, plant diversity is greatest because infrequent tidal flooding and increased freshwater runoff minimize salt stress. Other salt-tolerant species such as salt marsh bulrush, seaside goldenrod, switchgrass, marsh fern, rose mallow and narrow-leaved cattail usually occupy these borders.

The tons of organic matter produced each year by salt marshes originate from the leaves and stems of herbaceous plants which die back each fall and are gradually broken down into small fragments called **detritus**. The detrital fragments are heavily colonized by microorganisms

called **zooplankton**, or are eaten by forage fishes such as mullet, menhaden and alewife. These species in turn provide food for larger fish like striped bass and bluefish which are commercially harvested.

A variety of birds feed and/or nest in salt marshes including the great blue heron, green-backed heron, sora and Virginia rails, American and least bittern, marsh wren, red-winged blackbird, and swamp sparrow. The Northern harrier and short-eared owl are predatory birds that typically nest and hunt in coastal marshes. These wetlands provide valuable feeding and nesting habitat for mammalian species like the least shrew, meadow vole, muskrat, mink and raccoon.

Saltmarsh

Saltmarsh is the **dominant coastal wetland type** along the southern New England coast. It usually occurs behind barrier beaches and at the mouth of tidal rivers where saltwater influence is strongest. Saltmarshes are dominated by self-supporting **herbaceous vegetation** with varying degrees of salt tolerance. The low marsh area is flooded at least once daily by tides and is typically dominated by saltmarsh cordgrass. The high marsh receives less inundation and supports more of a variety of plant species such as saltmeadow cordgrass,



Saltmarsh

Ed Reiner

Tidal flats

Tidal flats appear as large expanses of **mud, sand, gravel**, or various combinations of these at low tide. Depending on salinities, some flats may be covered with algae or low-growing plants. Aquatic bed plants such as eelgrass, widgeon grass and pondweeds may be exposed on tidal flats during the lowest annual tides.

Tidal flats are important habitat for **shorebirds** which depend on these areas for feeding during migration, nesting and breeding. Various species of sandpipers (least, solitary, spotted, semi-palmated), and plovers (black-bellied, golden, semi-palmated, piping) feed on crustaceans, mollusks, snails, insects, and worms found in mud flats and sand flats. Other birds such as the great blue heron, snowy egret, greater and lesser yellowlegs, and black-crowned night heron also feed along tidal flats.



Shorebird

Gordon Russell



Rocky shore

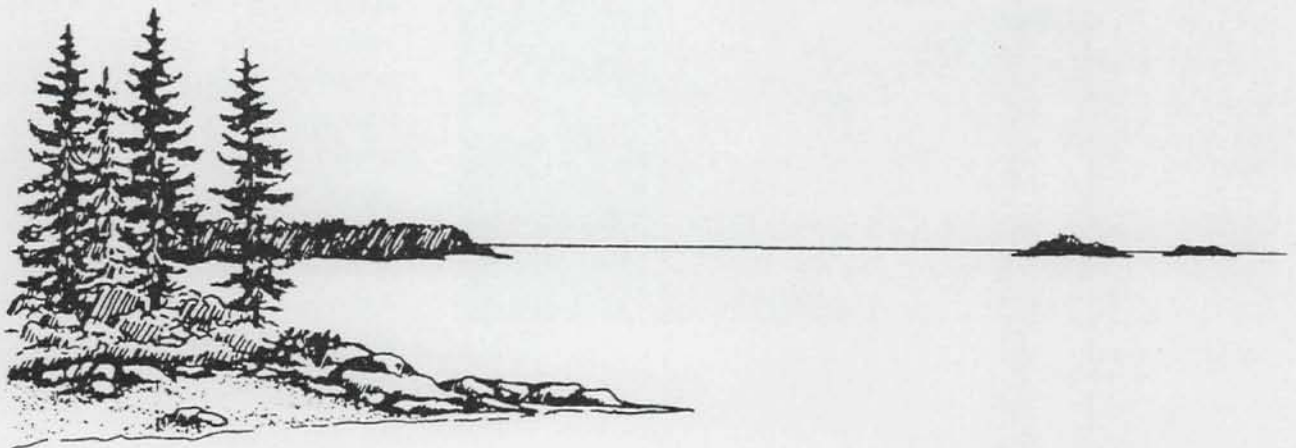
Cathy Pedevillano

Rocky Shores

Rocky shores dominate the northern New England coast and are often characterized by **exposed bedrock cliffs** and outcroppings. These cliffs are commonly inhabited by **sessile organisms** that can survive the constant wave action and high salinity levels. The **intertidal zonation** appears as a succession of colored bands, each comprised of different species. The topmost zone may extend high above sea level and consists of lichens, blue-green algae and periwinkles which are usually only wetted by spring tides and spray. The next lower zone consists mostly of barnacles

and blue mussels. The lowest zone, closest to the ocean, is comprised mostly of rockweed, red seaweeds, and kelp. The seaweeds shelter many different kinds of invertebrates, including sponges, hydroids, bryozoans, small worms, and some fish.

Rocky shores and rocky islands along the northern New England coast are prime nesting habitat for **colonial sea birds** such as the Atlantic puffin, common murre, thick-billed murre, Northern gannet, and black-legged kittiwake. These birds nest in colonies along rock faces and feed on organisms in the adjacent marine and estuarine environments.



Habitat Enhancement

Development pressure in the Northeast continues to intensify. Since wetlands are found interspersed throughout the landscape, they have been subject to direct and indirect effects of development. These impacts include dredging, filling, cutting, fragmentation, degradation from noise, air and water pollution, and human disturbance. There are some steps that may be taken in project planning, construction and monitoring to maintain habitat values of wetlands adjacent to development.

Design Measures

Minimizing the amount of wetland that will be directly impacted is an important measure that can be achieved in several ways. This includes **bridging** over a wetland instead of filling it; efficient design measures (clustering, multiple-story structures) to leave the maximum amount of wetland and open space; and designing a roadway system so it bisects the wetland at the narrowest point in order to minimize habitat fragmentation. **Upland buffer zones** around wetlands also help to limit



Cathy Pedevillano

18' wildlife tunnel

the effects of human encroachment and preserve habitat values. Configuring a project so that wetlands and other open space are left to connect with adjacent natural areas will create **habitat corridors** which are often utilized by wildlife as travel lanes and refuge areas.



Habitat creation

Frank Smigelski

Structural Measures

Structural measures, if properly applied and maintained, can be employed to reduce direct and indirect impacts on wetlands. **Maximizing slope steepness** adjacent to wetlands, and placing retaining walls at the toe of the slope are two ways to reduce the amount of fill in wetlands. **Vegetating slopes** for stabilization instead of riprapping is more beneficial to wildlife. If they must be riprapped, placing soil and vegetation on top of the riprap stones will enhance habitat values.



Wetland creation area

Cathy Pedevillano

Fencing along highway corridors helps to keep animals away from the roadways. **Highway underpasses** have been successfully used in several areas around the country to permit animal passage beneath roadways (built for deer in Pennsylvania, panthers in Florida, mountain goats in Montana, and even salamanders in Massachusetts). **Creative design measures**, such as sectioned culverts installed at the edge of roadways to act as turtle guards to discourage turtles from crossing the road, have been employed to minimize project-related deaths of rare or threatened species.

Routing stormwater drainage that may contain salts, oil, grease, sediments or other contaminants away from wetlands is another means of protecting wetland values.

Habitat Compensation

Wetland restoration, enhancement and creation are sometimes offered to offset wetland values that are lost to development. This exchange process is often called "compensatory mitigation."

Restoration involves removing fill from an area that was previously a wetland and revegetating it to recreate a viable wetland ecosystem.

Enhancement includes measures to improve an existing degraded wetland such as removing weedy exotics (e.g., common reed, purple loosestrife) and revegetating with native vegetation, creating standing or flowing water, and erecting nest boxes or nesting platforms.

Wetland creation attempts to create a wetland on an upland site. This is often a costly and tenuous venture, particularly when trying to create wooded swamps which may take at least fifty years of natural succession to fully provide the range of habitat values that were lost. Wetland creation has been tried throughout New England with varying degrees of success.

If wetland creation is the only option for compensation, there are several steps that may be taken to improve the chances of creating a viable wetland. The first step is setting the goals of the creation project, defining the functions and values of the wetland to be



Concrete animal tunnel

Cathy Pedevillano



Salt marsh creation area

Frank Smigelski



Cathy Pedevillano

Wetland creation area

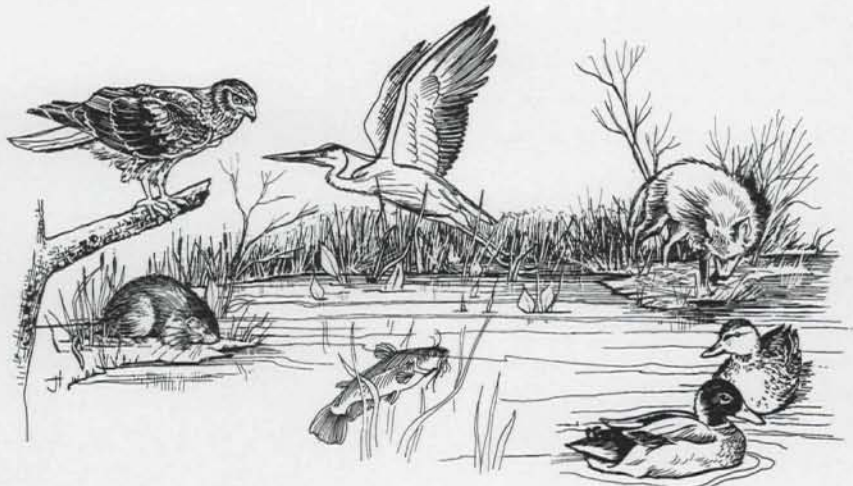
created and how that will be accomplished. A wetland that is created for flood storage adjacent to a highway will not necessarily be able to function also as wildlife habitat. Several factors, including soils, hydrology, proximity to an existing wetland and watershed position, must be evaluated to determine the suitability of a site for wetland creation.

Hydrology is a particularly important factor. Groundwater monitoring data is necessary to determine if there is sufficient moisture to support wetland vegetation. Care must be taken to plant native wetland species and not ornamentals or exotics. Sedimentation and erosion control measures (hay bales, silt fence, hydroseeding) must be properly installed and maintained. Having a wetland scientist on site during the

construction phase is also necessary to insure the correct interpretation of plans and procedures. A comprehensive monitoring plan that includes provisions for replacement of dead or dying plant species and progress reports, must be developed and followed to make sure that the goals of the

wetland creation project are being met. Placing a conservation easement on the wetland creation area is often necessary to ensure that no future development occurs on that site.

The future of New England wetlands depends upon informed decisions at the local, state and federal level. Decision-makers must balance human needs and resource values, and consider not only the quality of the environment for ourselves but for generations to come.



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Species List - Inland Wetlands

PALUSTRINE FORESTED: VEGETATION

red maple	<i>Acer rubrum</i>
northern white cedar	<i>Thuja occidentalis</i>
atlantic white cedar	<i>Chamaecyparis thyoides</i>
eastern white pine	<i>Pinus strobus</i>
eastern hemlock	<i>Tsuga canadensis</i>
green ash	<i>Fraxinus pennsylvanica</i>
American elm	<i>Ulmus americana</i>
tupelo	<i>Nyssa sylvatica</i>
swamp white oak	<i>Quercus bicolor</i>
highbush blueberry	<i>Vaccinium corymbosum</i>
swamp azalea	<i>Rhododendron viscosum</i>
silky dogwood	<i>Cornus amomum</i>
northern arrowwood	<i>Viburnum recognitum</i>
cinnamon fern	<i>Osmunda cinnamomea</i>
sensitive fern	<i>Onoclea sensibilis</i>
royal fern	<i>Osmunda regalis</i>
skunk cabbage	<i>Symplocarpus foetidus</i>
sphagnum	<i>Sphagnum spp.</i>
goldthread	<i>Coptis trifolia</i>
hemlock	<i>Tsuga canadensis</i>

PALUSTRINE FORESTED: BIRDS

red-eyed vireo	<i>Vireo olivaceus</i>
black-throated blue warbler	<i>Dendroica caerulescens</i>
black-and-white warbler	<i>Mniotilta varia</i>
veery	<i>Catharus fuscescens</i>
yellow warbler	<i>Dendroica petechia</i>
Canada warbler	<i>Wilsonia canadensis</i>
wood thrush	<i>Hylocichla mustelina</i>
hermit thrush	<i>Catharus fattatus</i>
northern waterthrush	<i>Seiurus noveboracensis</i>
barred owl	<i>Strix varia</i>
great horned owl	<i>Bubo virginianus</i>
wood duck	<i>Aix sponsa</i>
black-capped chickadee	<i>Parus atricapillus</i>
white-breasted nuthatch	<i>Sitta carolinensis</i>
tufted titmouse	<i>Parus bicolor</i>
tree swallow	<i>Tachycineta bicolor</i>
hairy woodpecker	<i>Picoides villosus</i>
downy woodpecker	<i>Picoides pubescens</i>
ring-necked duck	<i>Aythya collaris</i>
common goldeneye	<i>Bucephala clangula</i>
hooded merganser	<i>Lophodytes cucullatus</i>
brown creeper	<i>Certhia americana</i>

Species List - Inland Wetlands

PALUSTRINE FORESTED: REPTILES AND AMPHIBIANS

spotted salamander	<i>Ambystoma maculatum</i>
blue-spotted salamander	<i>Ambystoma laterale</i>
Jefferson salamander	<i>Ambystoma jeffersonianum</i>
silvery salamander	<i>Ambystoma platineum</i>
wood frog	<i>Rana sylvatica</i>
northern leopard frog	<i>Rana pipiens</i>
gray treefrog	<i>Hyla versicolor</i>
northern spring peeper	<i>Pseudacris crucifer</i>
eastern American toad	<i>Bufo americanus</i>
wood turtle	<i>Clemmys insculpta</i>
eastern box turtle	<i>Terrapene carolina</i>
eastern ribbon snake	<i>Thamnophis sauritus</i>
eastern painted turtle	<i>Chrysemys picta</i>
green frog	<i>Rana clamitans melanota</i>
eastern garter snake	<i>Thamnophis sirtalis</i>

PALUSTRINE FORESTED: MAMMALS

red-backed vole	<i>Clethrionomys gapperi</i>
northern short-tailed shrew	<i>Blarina brevicauda</i>
white-footed mouse	<i>Peromyscus leucopus</i>
star-nosed mole	<i>Condylura cristata</i>
mink	<i>Mustela vison</i>
beaver	<i>Castor canadensis</i>
fisher	<i>Martes pennanti</i>
raccoon	<i>Procyon lotor</i>
Virginia opossum	<i>Didelphis virginiana</i>
big brown bat	<i>Eptesicus fuscus</i>
river otter	<i>Lutra canadensis</i>
white-tailed deer	<i>Odocoileus virginianus</i>
long-tailed weasel	<i>Mustela frenata</i>

PALUSTRINE SCRUB SHRUB: VEGETATION

highbush blueberry	<i>Vaccinium corymbosum</i>
sweet pepperbush	<i>Clethra alnifolia</i>
swamp azalea	<i>Rhododendron viscosum</i>
spicebush	<i>Lindera benzoin</i>
winterberry	<i>Ilex verticillata</i>
arrow-wood	<i>Viburnum recognitum</i>
willow	<i>Salix spp.</i>
speckled alder	<i>Alnus rugosa</i>
silky dogwood	<i>Cornus amomum</i>
red-osier dogwood	<i>Cornus stolonifera</i>
common elder	<i>Sambucus canadensis</i>
buttonbush	<i>Cephalanthus occidentalis</i>

Species List - Inland Wetlands

broadleaf spirea
narrowleaf spirea
steplebush
cinnamon fern
sensitive fern
spotted jewelweed
sphagnum
sedges
rushes
hydrophilic grasses

Spiraea latifolia
Spiraea alba
Spiraea tomentosa
Osmunda cinnamomea
Onoclea sensibilis
Impatiens capensis
Sphagnum spp.
Carex spp.
Juncus spp.
Graminae spp.

PALUSTRINE SCRUB SHRUB: BIRDS

common yellowthroat
alder flycatcher
yellow warbler
chestnut-sided warbler
blue-winged warbler
American redstart
Canada warbler
song sparrow
gray catbird
American goldfinch
American woodcock
great blue heron

Geothlypis trichas
Empidonax aliorum
Dendrolca petechia
Dendrolca pensylvanica
Vermivora pinus
Setophaga ruticilla
Wilsonia canadensis
Melospiza melodia
Dumetella carolinensis
Carduelis tristis
Scolopax minor
Ardea herodias

PALUSTRINE SCRUB SHRUB: REPTILES AND AMPHIBIANS

northern spring peeper
gray treefrog

Pseudacris crucifer
Hyla versicolor

PALUSTRINE SCRUB SHRUB: MAMMALS

raccoon
mink
snowshoe hare
eastern cottontail
white-tailed deer

Procyon lotor
Mustela vison
Lepus americanus
Sylvilagus floridanus
Odocoileus virginianus



PALUSTRINE EMERGENT: VEGETATION

cat-tail
tussock sedge
blue flag
water-willow
rice-cutgrass

Typha spp.
Carex stricta
Iris versicolor
Decadon verticillatus
Leersia oryzoides

Species List - Inland Wetlands

pickerelweed
arrow arum
smartweed
arrowhead
arrow-leaved tearthumb
bulrush
soft rush
wool-grass
spotted jewelweed
joe-pye-weed
sensitive fern
goldenrod
purple loosestrife
common reed

Pontederia cordata
Peltandra virginica
Polygonum spp.
Sagittaria latifolia
Polygonum sagittatum
Scirpus validus
Juncus effusus
Scirpus cyperinus
Impatiens capensis
Eupatorium spp.
Onoclea sensibilis
Solidago spp.
Lythrum salicaria
Phragmites australis

✓ PALUSTRINE EMERGENT: BIRDS

red-winged blackbird
song sparrow
common yellowthroat
swamp sparrow
marsh wren
bobolink
American bittern
least bittern
Virginia rail
great blue heron
green-backed heron
common snipe
mallard
black duck
blue-winged teal
northern harrier

Agelaius phoeniceus
Melospiza melodia
Geothlypis trichas
Melospiza georgiana
Cistothorus palustris
Dolichonyx oryzivorus
Botaurus lentiginosus
Ixobrychus exilis
Rallus limicola
Ardea herodias
Butorides striatus
Gallinago gallinago
Anas platyrhynchos
Anas rubripes
Anas discors
Circus cyaneus

✓ PALUSTRINE EMERGENT: MAMMALS

muskrat
raccoon
mink
eastern cottontail
short-tailed shrew
star-nosed mole
water shrew
meadow jumping mouse

Ondatra zibethicus
Procyon lotor
Mustela vison
Sylvilagus floridanus
Blarina brevicauda
Condylura cristata
Sorex palustris
Zapus hudsonius

Species List - Inland Wetlands



PALUSTRINE EMERGENT: REPTILES AND AMPHIBIANS

northern leopard frog
northern spring peeper
eastern American toad

Rana pipiens
Pseudacris crucifer
Bufo americanus

LACUSTRINE: FISH

lake trout
northern pike
yellow perch
pickerel
carp
bass
bluegill

Salvelinus namaycush
Esox lucius
Perca flavescens
Esox niger
Cyprinus carpio
Micropterus spp.
Lepomis macrochirus

LACUSTRINE: BIRDS

belted kingfisher
common merganser
hooded merganser
red-breasted merganser
great blue heron
green-backed heron
common loon
pied-billed grebe
osprey
bald eagle
mallard
black duck
gadwall
American widgeon
ring-necked duck
common goldeneye
bufflehead

Ceryle alcyon
Mergus merganser
Lophodytes cucullatus
Mergus serrator
Ardea herodias
Butorides striatus
Gavia immer
Podilymbus podiceps
Pandion haliaetus
Haliaeetus leucocephalus
Anas platyhynchos
Anas rubripes
Anas strepera
Anas americana
Aythya collaris
Bucephala clangula
Bucephala albeola

LACUSTRINE: REPTILES AND AMPHIBIANS

bullfrog
green frog
pickerel frog
red-spotted newt
eastern painted turtle
snapping turtle

Rana catesbeiana
Rana clamitans melanota
Rana palustris
Notophthalmus viridescens
Chrysemys picta
Chelydra serpentina

Species List - Inland Wetlands

RIVERINE: FISH

Atlantic salmon
brook trout
brown trout
rainbow trout

Salmo salar
Salvelinus fontinalis
Salmo trutta
Salmo gairdneri

RIVERINE: MAMMALS

red fox
cottontail rabbit
white-tailed deer
raccoon
mink
otter
long-tailed weasel
water shrew
star-nosed mole

Vulpes vulpes
Sylvilagus spp.
Odocoileus virginianus
Procyon lotor
Mustela vison
Lutra canadensis
Mustela frenata
Sorex palustris
Condylura cristata

RIVERINE: REPTILES AND AMPHIBIANS

northern two-lined salamander
northern spring salamander
green frog
eastern ribbon snake

Eurycea bislineata
Gyrinophilus porphyriticus
Rana clamitans melanota
Thamnophis sauritus

RIVERINE: BIRDS

common yellowthroat
eastern phoebe
wood thrush
gray catbird
tree swallow
bank swallow
olive-sided flycatcher
eastern kingbird

Geothlypis trichas
Sayornis phoebe
Hylocichla mustelina
Dumetella carolinensis
Tachycineta bicolor
Riparia riparia
Contopus borealis
Tyrannus tyrannus

Species List - Coastal Wetlands

MARINE SYSTEM: VEGETATION

rockweed
kelp
eelgrass
widgeon grass

Fucus spp.
Laminaria spp.
Zostera marina
Ruppia maritima

MARINE SYSTEM: INVERTEBRATES

northern rock barnacles
limpets
sea squirts
sea anemones
sponges
corals
bay scallops
polychaetes
nematodes
flatworms
northern lobster
surf clam
hermit crab
common oyster
blue mussel

Balanus balanoides
Class Gastropoda
Class Ascidiacea
Class Anthozoa
Phylum porifera
Class Anthozoe
Aequipecten irradians
Class Polychaeta
Phylum aschelminthes
Phylum platyhelminthes
Homarus americanus
Spisula solidissima
Pagurus spp.
Crassostrea virginica
Mytilus edulis

MARINE SYSTEM: BIRDS

least sandpiper
solitary sandpiper
semi-palmated sandpiper
black-bellied plover
semi-palmated plover
piping plover
greater yellow-legs
lesser yellow-legs
common loon
pied-billed grebe
red-breasted merganser
common merganser
hooded merganser
double-crested cormorant
common tern
herring gull
great-black-backed gull
ring-billed gull
osprey

Calidris minutilla
Tringa solitaria
Calidris pusilla
Pluvialis squatarola
Charadrius semipalmatus
Charadrius melodus
Tringa melanoleuca
Tringa flavipes
Gavia immer
Podilymbus podiceps
Mergus serrator
Mergus merganser
Lophodytes cucullatus
Phalacrocorax auritus
Sterna hirundo
Larus argentatus
Larus marinus
Larus delawarensis
Pandion haliaetus

Species List - Coastal Wetlands

bald eagle
common eider
lesser scaup
greater scaup
surf scoter
white winged scoter
common goldeneye
Barrow's goldeneye
bufflehead
oldsquaw
common tern
least tern
roseate tern

Haliaeetus leucocephalus
Somateria mollissima
Aythya affinis
Aythya marila
Melanitta perspicillata
Melanitta fusca
Bucephala clangula
Bucephala islandica
Bucephala albeola
Clangula hyemalis
Sterna hirundo
Sterna antillarum
Sterna dougallii

MARINE SYSTEM: MAMMALS

Atlantic bottlenose dolphin
harbor seal
gray seal
humpback whale
right whale

Tursiops truncatus
Phoca vitulina
Halichoerus grypus
Megaptera novaeangliae
Balaena glacialis

ESTUARINE SYSTEM: VEGETATION

saltmarsh cordgrass
saltmeadow cordgrass
spike grass
black grass
high-tide bush
sea lavender
glasswort
salt marsh bulrush
seaside goldenrod
switchgrass
rose mallow
narrow-leaved cattail

Spartina alterniflora
Spartina patens
Distichlis spicata
Juncus gerardii
Iva frutescens
Limonium nashii
Salicornia spp.
Scirpus robustus
Solidago sempervirens
Panicum virgatum
Hibiscus moscheutos
Typha angustifolia

ESTUARINE SYSTEM: FISH

mullet
menhaden
alewife

Mugil spp.
Brevoortia tyrannus
Alosa pseudoharengus

Species List - Coastal Wetlands

ESTUARINE SYSTEM: BIRDS

great blue heron	<i>Ardea herodias</i>
green-backed heron	<i>Butorides striatus</i>
sora	<i>Porzana carolina</i>
Virginia rail	<i>Rallus limicola</i>
marsh wren	<i>Cistothorus palustris</i>
red-winged blackbird	<i>Agelaius phoeniceus</i>
swamp sparrow	<i>Melospiza georgiana</i>
northern harrier	<i>Circus cyaneus</i>
short-eared owl	<i>Asio flammeus</i>

ESTUARINE SYSTEM: MAMMALS

least shrew	<i>Cryptotis parva</i>
meadow vole	<i>Microtus pennsylvanicus</i>
muskrat	<i>Ondatra zibethicus</i>
mink	<i>Mustela vison</i>
raccoon	<i>Procyon lotor</i>

TIDAL FLATS: VEGETATION

eelgrass	<i>Zostera marina</i>
widgeon grass	<i>Ruppia maritima</i>
pondweeds	<i>Potamogeton</i>

TIDAL FLATS: BIRDS

least sandpiper	<i>Calidris minutilla</i>
solitary sandpiper	<i>Tringa solitaria</i>
spotted sandpiper	<i>Actitis macularia</i>
semi-palmated sandpiper	<i>Calidris pusilla</i>
black-bellied plover	<i>Pluvialis squatarola</i>
golden plover	<i>Pluvialis dominica</i>
semi-palmated plover	<i>Charadrius semipalmatus</i>
piping plover	<i>Charadrius melodus</i>
great blue heron	<i>Ardea herodias</i>
snowy egret	<i>Egretta thula</i>
greater yellowlegs	<i>Tringa melanoleuca</i>
lesser yellowlegs	<i>Tringa flavipes</i>
black-crowned night heron	<i>Nycticorax violaceus</i>

Species List - Coastal Wetlands

ROCKY SHORES: INVERTEBRATES

common periwinkle
northern rock barnacle
blue mussel
rockweed
red seaweeds
kelp
sponges
hydroids
bryozoans

Littorina littorea
Balanus balanoides
Mytilus edulis
Fucus spp.
Phylum Rhodophyta
Laminaria spp.
Phylum Porifera
Phylum Cnidaria
Phylum Bryozoa

ROCKY SHORES: BIRDS

Atlantic puffin
common murre
thick-billed murre
northern gannet
black-legged kittiwake

Fratercula arctica
Uria aalge
Uria lomvia
Sula bassanus
Rissa tridactyla



North American Waterfowl Management Plan

The U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers support the Administration's interim goal of no overall net loss of the Nation's remaining wetlands, and the long-term goal of increasing the quality and quantity of wetland resources. Efforts are underway to ensure that regulatory programs become more efficient, fair, flexible and predictable mechanisms for wetland protection. Non-regulatory programs such as advanced planning, wetlands restoration, inventory and research are being encouraged in order to accomplish long-term wetlands gain and to reduce reliance on Federal regulatory programs as the primary means of wetland partnerships with state, tribal and local agencies, the private sector and individual citizens to approach wetlands protection and restoration in an ecosystem/ watershed context.

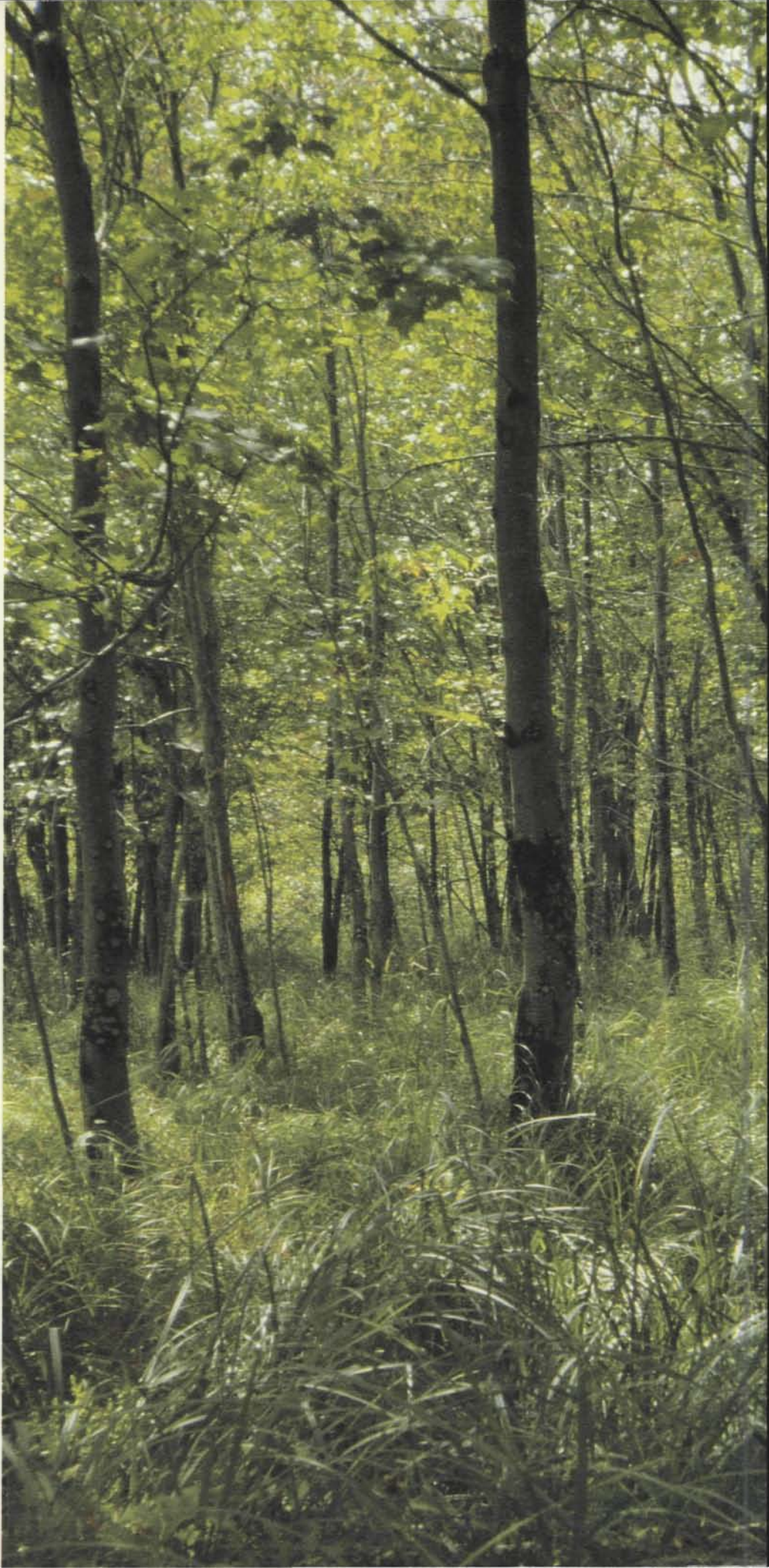
C.J. Rohlf



**US Army Corps
of Engineers**



A combined publication
of the Army Corps of Engineers
and the Department of the Interior,
U.S. Fish and Wildlife Service



The Natural Heritage Program's List of Vernal Pool Animals

Species or Group	Facultative (F) or Obligate (O)	Life Stage(s) Needed for Certification
<u>Amphibians:</u> ↓ yellow spots on black body		
spotted salamander	O	breeding *
blue-spotted salamander	O	breeding *
Jefferson's salamander black	O	breeding *
marbled salamander female guards	O	breeding *
silvery salamander The eggs.	O	breeding *
Tremblay's salamander	O	breeding *
four-toed salamander	F	breeding *
red-spotted newt	F	adults/breeding *
wood frog brownish red with dark brown mask	O	breeding *
spring peeper	F	breeding *
gray tree frog	F	breeding *
green frog	F	breeding *
American toad	F	breeding *
Fowler's toad	F	breeding *
Blue-backed salamander	Terrestrial	N/A
<u>Reptiles:</u>		
painted turtle	F	adults, juveniles
spotted turtle	F	adults, juveniles
snapping turtle	F	adults, juveniles
<u>Crustaceans:</u>		
fairy shrimp	O	any
<u>Molluscs:</u>		
freshwater fingernail clams	F	alive or empty shells
aquatic amphibious snails	F	alive or empty shells
<u>Annelids:</u>		
leeches	F	adults
<u>Insects:</u>		
water scorpions	F	adults/larvae
predaceous diving beetles	F	larvae
whirligig beetles	F	larvae
dobsonflies	F	larvae
caddisflies	F	larvae/cases
dragonflies	F	larvae
damselflies	F	larvae

*Breeding is indicated by chorusing adults, mated pairs, egg masses, tadpoles or larvae, and/or transforming juveniles

THE
MOLE
SALAMANDERS

(timing may vary depending on environmental conditions and location)

(timing may vary depending on environmental conditions and location)

jan feb mar apr may jun jul aug sep oct nov dec

[illegible]

KEY

The diagram illustrates the life cycle of a housefly through five stages, each represented by a box containing a symbol and a label below it:

- breeding or courting adults**: Represented by a box containing four lowercase 'b's (b b b b).
- eggs**: Represented by a box containing three lowercase 'e's (e e e).
- larvae**: Represented by a box containing three vertical bars (| | |).
- transforming juveniles**: Represented by a box containing four lowercase 'j's (j j j j).
- adults**: Represented by a box containing three lowercase 'a's (a a a).

Arrows indicate the progression from breeding adults to eggs, then to larvae, then to transforming juveniles, and finally to adults. A feedback arrow points from the adults back to the breeding adults, completing the cycle.

Labl.
730
University
Pleasant St.

Name Date
by Robert G.
Prepared Speare
Approved

Mass. Audubon Society @ Ipswich Refuge

Vernal Pools Seminar/Workshop 2/1/95

Temporary Pond -

Ephemeral Pond or Pool - short-lived

Vernal Pond or Pool - "Spring" filling but also otherwise

Autumnal Pond or Pool - "fall or winter" filling

Vernal Pool is a functional term (@ least 2 mo. wet)

Astatic Pond or Pool - fluxuates but doesn't dry completely in the summer.

Definition of Vernal Pool:

o Isolated water at least 2 mo. wet *

o Lacks adult fish ← Important characteristic to reduce predation.

o Presence of breeding amphibians & other life (invertebrates) **

* To be absolutely protected (vs. certified less protected)

the vernal pool must be within the 100-yr. flood plain.

** The "Big Night" = $\geq 43^{\circ}\text{F}$ warm front evening following cool to cold spring weather and RAIN happening will trigger a spawning event. To certify, identify presence of (or aftermath of) event and photograph eggs following spawning. Usually between upland and wetland areas - wetland plants not always associated.

Macro-
invertebrate
I.D. Book

A Guide to the Study of freshwater biology by James

G. Needham and Paul R. Needham 5th Ed. 1962

Holden-Day Inc. 4432 Telegraph Ave. Oakland, CA 94609.

Patricia Hedie Bookseller, Inc. 207-336-2778

Certification vs. Protection (Under the Wetlands Protect.)
 (Under NHESP but does not protect pools from
 discharges of fill, stormwater, and other substances.)

Obligate and facultative Vernal Pool Species. SEE LIST

Species that depend on
 vernal pool

no plants are obligates

- (1) ^{Frog} Salamander egg-masses: each egg is covered in gel -
 therefore, masses are 'bumpy' = .
- (2) Salamander egg-masses: the eggs as a group are
 covered in gel - therefore, the mass is 'less bumpy'
 or is smooth = .

The Jefferson salamander can breed with
 the blue-spotted salamander but always produces
 a blue female that is infertile,