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KEY FISH AND WILDLIFE HABITATS

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NORTHEAST REGIONAL CONTEXT

The Northeast is highly diverse and home to a wide variety of plant and animal communities. More than 60 percent of the landscape is forested and contains more than 200,000 miles of rivers and streams, 34,000 bodies of water, and more than six million acres of wetlands. Because of this variation in landscape structure, a high degree of biodiversity thrives throughout the region, including 2,700 restricted rare species (TCI and NFWDTC 2013).

Both terrestrial and aquatic habitats are subject to fragmentation in the Northeast due to roads and waterway barriers. They generally occur in blocks of 5,000 acres or less at an average of 100 acres (Anderson and Olivero Sheldon 2011; Butler et al. 2007); this exemplifies the continuous threat of habitat fragmentation for the region.

In addition to fragmentation, land conversion also has a significant impact on the landscape. Public and private land ownership plays a pivotal role in conservation in the Northeast. Land easements and fee ownership protect 16 percent of the region's land against conversion to development, with five percent preserved specifically for natural purposes (TCI and NFWDTC 2013). The largest proportion of conservation land is owned by state governments (12 million acres), followed by the federal government at six million, and municipalities at 900,000 acres (Anderson and Olivero Sheldon 2011). Unfortunately, the conversion of land in the region still exceeds land conservation rates by a 2 to 1 ratio (TCI and NFWDTC 2013).

Wetlands are one of the most unique habitat types and have the ability to support a large number of wildlife species. Unfortunately, buffer zones for most wetlands adjacent to paved roads, agricultural properties, or development are insufficient, resulting in a severe loss of—and impact on—biodiversity (Butler et al. 2007; Anderson and Olivero Sheldon 2011). Similarly, many lakes and ponds have high levels of disturbance along their coastlines and in buffer zones, which is likely due to the ease of access to these bodies of water. Riparian areas along rivers and streams also have conversion rates that exceed conservation rates, at a ratio of 2 to 1 (Anderson and Olivero Sheldon 2011), threatening their water quality and ability to support biodiversity.

The Northeast is also home to 11 unique habitats, three of which have significant densities of rare species. Limestone bedrock, fine-grained silts, and coarse-grained sands are not only three of the most biologically important habitats for rare species, but also the three most converted, least conserved, and most fragmented habitat types in the region (Anderson and Olivero Sheldon 2011).

Ecological Regions

Several ecosystem classification systems apply to the Connecticut landscape. These regional classifications place Connecticut and its fish and wildlife resources within a national context. An ecosystem approach to conservation planning and implementation allows Connecticut to participate in and benefit from regional and national conservation efforts with a variety of partner agencies and organizations.

The Nature Conservancy's Ecoregions: The majority of Connecticut falls within two of The Nature Conservancy's ecoregions: Lower New England – Northern Piedmont and North Atlantic Coast (Figure 2.1). The Lower New England – Northern Piedmont region is one of the most highly populated ecoregions, and therefore one of the most fragmented (LandScope America 2014a). The North Atlantic Coast Ecoregion spans nine states (DE, PA, NJ, NY, CT, RI, MA, NH, ME), and is highly diverse and unique due to the influence of marine waters on both the climate and landscape (LandScope America 2014b). This region supports a multitude of rare and threatened species through its varied habitats, such as beaches and dunes, maritime grasslands and heathlands, brackish and freshwater tidal rivers, coastal plain ponds, and pine barrens.

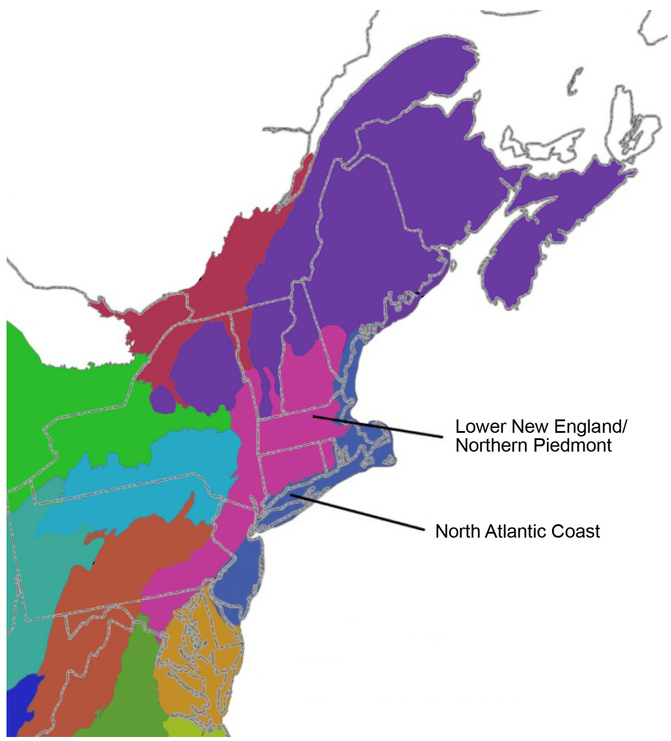


FIGURE 2.1: THE NATURE CONSERVANCY ECOREGIONS OF THE NORTHEASTERN UNITED STATES (SOURCE TNC 2015)

Partners in Flight Bird Conservation Regions: Partners in Flight (PIF) identifies bird habitats using unique categorical systems called Avifaunal Biomes and Bird Conservation Regions (BCR). The Northern Forest Avifaunal Biome contains 44 species of continental importance, with 29 of these occurring in Connecticut, while the Eastern Avifaunal Biome contains 38 species, 30 of which occur in Connecticut (Rich et al. 2004). Connecticut falls within three Bird Conservation Regions: the New England/Mid-Atlantic Coast, the Atlantic Northern Forest, and the

Appalachian Mountains (Figure 2.2). These BCRs are part of two areas for which PIF has identified priority species for conservation: Physiographic Area 9 (Southern New England) and Physiographic Area 27 (Northern New England). The conservation plans for the three BCRs and two physiographic areas examine the regional status of species and identify conservation issues and opportunities at the planning unit and habitat level. Rosenberg has used these plans to define state-level conservation actions for Connecticut's birds (Hodgman and Rosenberg 2000; Dettmers and Rosenberg 2000).

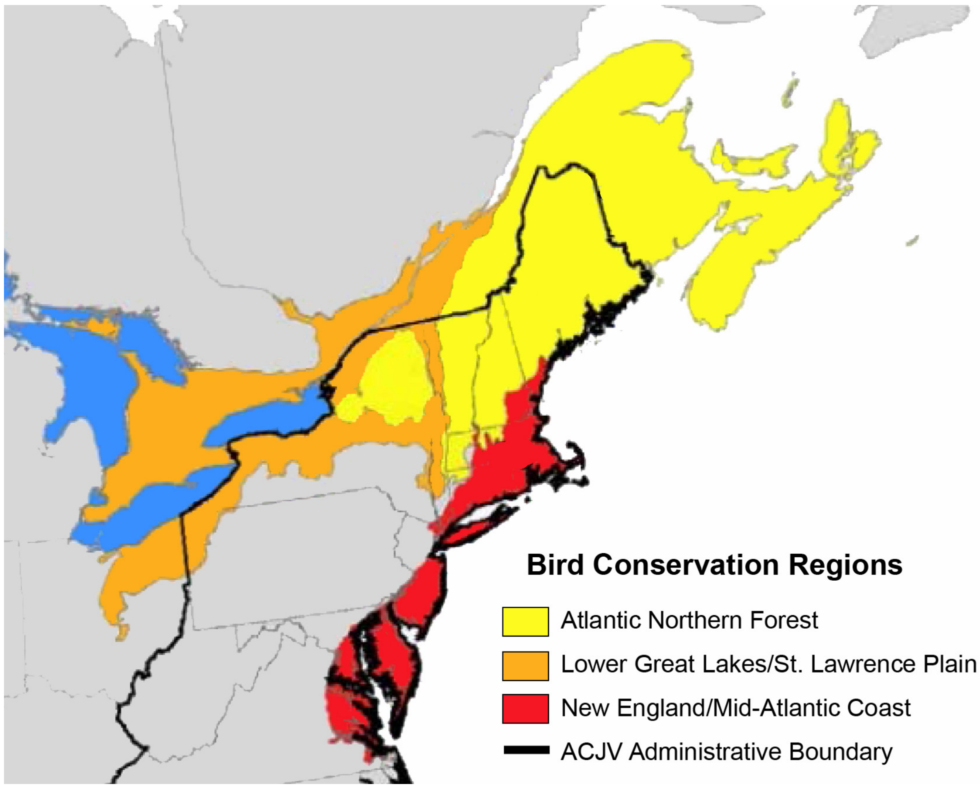


FIGURE 2.2: NORTH AMERICAN BIRD CONSERVATION INITIATIVE BIRD CONSERVATION REGIONS. (SOURCE: NABCI 2000)

Regional Habitat Conservation Planning and Management

Landscape-level conservation requires regional cooperation and communication. There is a need for a regional strategic approach to conservation actions in the Northeast, which the Regional Planning Association has recently examined (Pirani et al. 2012). A survey identified current regional conservation efforts and related obstacles (e.g., climate change, land use, funding, transportation, water and energy infrastructure). The report offered recommendations for approaching conservation in ways that promote the improvement of landscape-scale practices. It also described and summarized work being done by various landscape conservation initiatives within the Northeast region. Conservation Opportunity Areas (COAs) are priority areas that that have the greatest potential for GCN species conservation on the state-level. Similarly, Regional Conservation Opportunity Areas (RCOAs) are priority areas at the regional scale. The North Atlantic Landscape Conservation Cooperative (NALCC) is a regional partnership whose vision is to sustain natural resources and cultural heritage through collaborative conservation in the North Atlantic region. The NALCC is developing RCOAs, based on information provided from many regional projects, to address high priority regional species, habitats, and issues.

A recent analysis provides specific information on condition metrics for both terrestrial and aquatic habitat types of the Northeast (Anderson et al. 2013). Metrics used for both terrestrial and aquatic habitats include secured land, local connectedness, landscape context index, and predicted development. Metrics used solely for terrestrial habitat analysis consist of patch size, core area, forest stand age, and landscape complexity. Metrics used solely to determine the condition of aquatic habitats consist of impervious surfaces, riparian land cover, dam type and density, risk of flow alteration from dam water storage, network size, and road-stream crossings. In addition to habitat condition the report identified several other habitat characteristics, including species and biodiversity, anadromous fish linkages to habitats, terrestrial resilience to climate impacts, and freshwater resilience to climate change.

The fourth *National Coastal Condition Report* (EPA 2012) rated the overall condition of the coastal areas in the Northeast as “fair” on a scale from poor to good. This rating was based on an assessment of the region’s overall ranks for several indices including water quality, sediment quality, benthic habitat, coastal habitat, and fish tissue contamination. Detailed information on the condition of the nation’s estuaries and coastal bays and lagoons, based on data collected between 2003 and 2006, is included in the report. The assessment also uses information for monitoring coastal conditions, offshore fisheries, and advisory data. The report provided information on the Northeast region overall, as well as specific information on the condition of Long Island Sound.

The Long Island Sound Stewardship Initiative (LISSI) identified areas of the Sound with significant recreational and ecological value. A guidebook was created, including 33 areas identified by maps and descriptions of their recreational and ecological resources and significance (RPA 2006). The Long Island Sound Study also has a Comprehensive Conservation and Management Plan for the Sound (http://longislandsoundstudy.net/wp-content/uploads/2011/10/management_plan.pdf) (LISS 1994), which includes information on Connecticut’s coast. This plan, which is currently being updated (LISS 2014), addresses species and habitat management issues, as well as conservation strategies. In addition to an updated conservation and management plan, the Long Island Sound Study has also developed an Action Agenda (LISS 2011) that describes specific action items for Long Island Sound between 2011 and 2013.

The Stedman and Dahl (2008) report on the status and trends of wetlands in coastal watersheds in the eastern United States described erosion, coastal subsidence, and sea-level rise as contributing factors to the loss of wetlands. Freshwater wetland loss along the Atlantic was greatly affected by development. Coastal wetlands are also vulnerable to saltwater inundation, especially in the north to mid-Atlantic region. Also, coastal wetland restoration was seen as significantly more difficult and more expensive to accomplish than inland wetland restoration. A net loss of 361,000 acres of wetlands occurred in the United States from 1998 to 2004 (Stedman and Dahl 2008).

A more recent report (Dahl and Stedman 2013) describes the status and trends of wetlands in the conterminous United States. The goal of this document was to provide agencies, policy makers, and decision makers with updated information on the status of wetlands between 2004 and 2009, to assist in prioritization of conservation planning efforts. Dahl and Stedman (2013) found that between 2004 and 2009 there was also a net loss of wetlands in coastal areas, which creates a long-term resource challenge for fish and wildlife species. During this period, the coastal wetlands on the Atlantic coast declined by approximately 112,000 acres. An important step to counter this loss is to enhance the opportunity for wetland reestablishment (Dahl and Stedman 2013).

The Atlantic Coastal Fish Habitat Partnership (ACFHP) developed a Conservation Strategic Plan for 2012-2016, which proposes key conservation strategies to address serious threats to fish habitats along the Atlantic coast (ACFHP 2012a). ACFHP also developed an accompanying 2012-2013 Implementation Plan, a subset of the Conservation Strategic Plan, which described specific objectives and actions to be accomplished during the 2012-2013 period (ACFHP 2012b).

The Association of Fish and Wildlife Agencies (AFWA) published a National Fish Habitat Action Plan (AFWA 2006), which detailed specific actions for the restoration and conservation of fish habitat across the U.S. The National Fish Habitat Partnership (NFHP) recently published a second edition of the habitat action plan (NFHB 2012) with new conservation and management actions and updates on progress since the first edition in 2006. In 2010 NFHP conducted the first national assessment of fish habitat, *Through a Fish's Eye: The Status of Fish Habitats in the United States* (NFHB 2010), which detailed the status of fish habitats across the country and served to accomplish one of the major goals of AFWA's 2006 Action Plan.

Regional Habitat Projects

Numerous regional projects have been identified and implemented to improve regional habitats through cooperative conservation and restoration. Projects were completed to further enhance the understanding and use of the regional classification systems, resulting in the following:

- Terrestrial habitat cover maps via the creation of a GIS database of upland and wetland wildlife habitats (Ferree and Anderson 2013);
- An extension of the Northeast terrestrial habitat map to include Atlantic Canada (Anderson 2014a);
- A guidance document for understanding and use of terrestrial and aquatic habitat maps (Anderson et al. 2013);
- Geospatial habitat condition analysis based on Northeast SGCN habitat maps (Anderson 2014b);
- Evaluation of permeable landscapes across the Northeast (Anderson 2014c);
- Updates to the National Wetlands Inventory for selected areas of intertidal wetlands in the North Atlantic Landscape Conservation Cooperative (Klopfer 2013); and,
- The application of Coastal and Marine Ecological Classification Standards (CMECS) in the Northeast (Weaver et al. 2013).

Additional information on these projects can be found in the Northeast Regional Wildlife Conservation Project Summaries (Terwilliger and NEFWDTC 2013).

In 2011, Martin and Apse completed a Northeast Aquatic Connectivity (NAC) project, which provides Northeast states with the necessary tools, data, and resources to encourage connectivity between fragmented aquatic habitats throughout the region. The project resulted in a regional network of professionals, a comprehensive database, guidance for decision-making processes, dam ranking parameters, and extensive data on the relative ecological benefits to anadromous and resident fish from barrier mitigation.

Vermont, New Hampshire, Massachusetts, and Connecticut were part of a regional effort to develop an interactive, GIS-based application to estimate continuous, unrestricted daily streamflow in the Connecticut River Basin (Archfield et al. 2013). The software builds on previous work in Massachusetts, and allows users to operate a point-and-click application to estimate natural streamflow at ungauged locations within the Connecticut River Basin.

Multiple projects and programs have focused specifically on the assessment of the likely impacts of climate change on northeastern fish and wildlife species and habitats. After Hurricane Sandy hit the east coast in 2011, coastal planning for climate adaptation became increasingly important. The Regional Planning Association and the Lincoln Institute for Land Policy published a report (Pirani and Tolkoff 2013) that discussed coastal resiliency and climate adaptation planning in New York, New Jersey, and Connecticut.

Manomet Center for Conservation Sciences (MCCS) and the National Wildlife Federation (NWF) have identified specific species and habitats that are likely to be most vulnerable to climate change. They also predicted how these species and habitats might adapt under various climate scenarios. Information on adaptation alternatives was also examined and described. As an expansion of MCCS and NWF's efforts, another study provided predictions for ten additional habitat types and included information on tidally-influenced habitat vulnerability (Galbraith 2014). A database (www.NEclimateUS.org) for coastal climate change projects and tools was developed as well (Galbraith 2014).

GIS decision support tools, including habitat assessment models, were developed to enhance resource planning decisions at site-specific, state, and regional scales. Fish distribution, habitat, and threats for aquatic species in the North Atlantic Landscape Conservation Cooperative were used to define the system. The user-friendly system can be used by managers to prioritize conservation areas in a changing landscape and climate (Boettner 2014). A similar project developed a web-based decision support system for the evaluation of alternative management effects on local populations of brook trout under various climate change scenarios. This system used a hierarchical modeling framework and statistical modeling, and incorporates climate change forecasts to account for variations in scale, landscape changes, and more (Letcher 2014).

CONNECTICUT'S LANDSCAPE

Connecticut's landscape ranges from coastal plains in the south to mountain ridges and valleys in the northwest and northeast corners of the state, separated by the broad Central Valley and Metacomet Ridge (Dowhan and Craig 1976). The distribution and abundance of Connecticut's wildlife are directly related to the condition and location of wildlife habitats. In the 1800's, European settlement changed Connecticut's landscape dramatically. Forested lands were converted to farmland, and keystone wildlife species such as mountain lion, elk, wild turkey, beaver, and timber wolves disappeared (Hochholzer 2010). Despite these, Connecticut's current varied climate, geology, soil types, topography, and watersheds continue to support a range of vegetative communities that provide diverse habitats for its wildlife.

Physiography

The state's irregular shoreline includes rocky headlands, pocket beaches, barrier spits, coves, bays, and islands (Bell 1985, Patton and Kent 1992). The Central Valley is divided by the north-south Metacomet volcanic traprock ridge and talus slopes, rising 1,000 feet or more above the valley floor, creating a unique habitat for plant and animal communities.

Connecticut is naturally separated into four physiographic sections: Western Uplands, Central Valley, Eastern Uplands, and Coastal Slope (Figure 2.3). Within the Piedmont physiographic province, the Southwest and Windham Hills are areas have rolling topography shaped by Connecticut's glacial history. The Coastal Plain forms a relatively narrow band along Long Island Sound in the southern portion of the state. The Appalachian Mountains extend through the Northwest Highlands of Connecticut, connecting to the Berkshire Mountains in Massachusetts and the Taconic Mountains in New York. This area includes Connecticut's highest point, which is on the southern slope of Mount Frissell (2,380 ft.), and nearby Bear Mountain (2,316 ft.), which is the highest mountain completely within state borders (Bell 1985, Patton and Kent 1992). The Northeast Highland's ridge and valley topography includes the north-south Bolton and Tolland Mountain Ranges, as well as the Mohegan Range, the only east-west range in southern New England. These higher elevations slope into rolling areas, such as Windham Hills, generally grading from 1,100 to 500 feet toward the southeast region of the state (Bell 1985) (Figure 2.3).

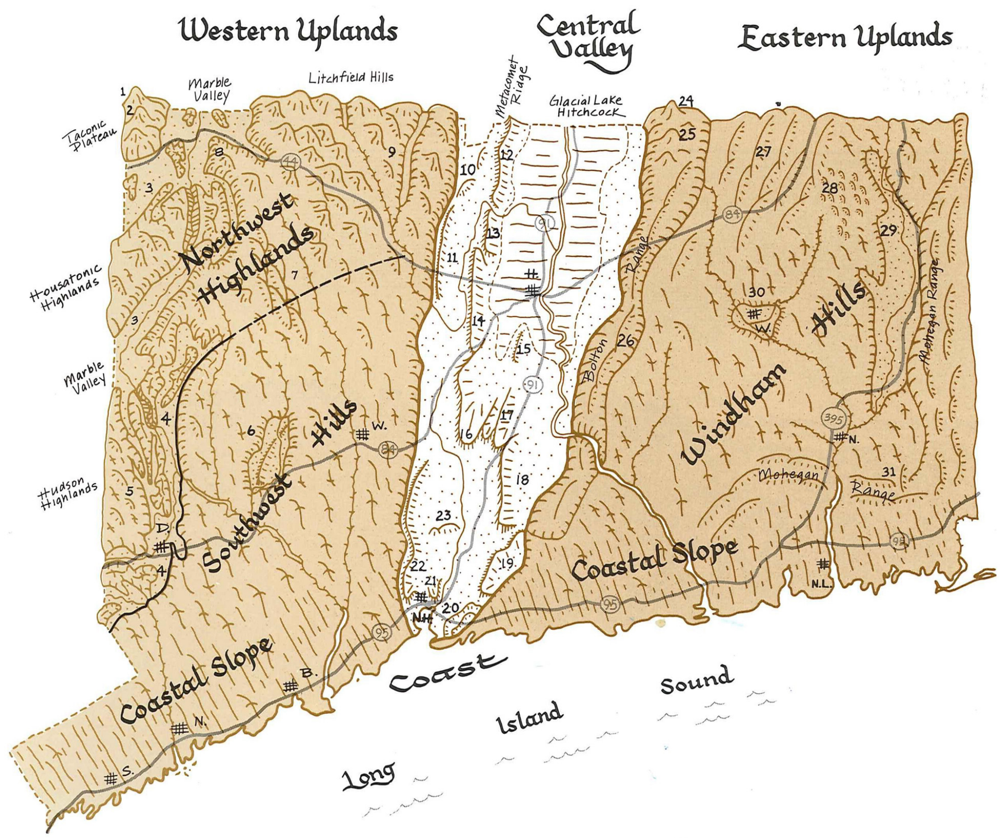


FIGURE 2.3: PHYSIOGRAPHY OF CONNECTICUT. (SOURCE: BELL 1985)

Geology

The subsurface geology of the Coastal Slope was created by glacial erosion and outwash from underlying bedrock. Bedrock of the Western and Eastern Highlands includes Paleozoic Era igneous granites, gneisses, and metamorphic schists formed into north-south belts. Metamorphosed limestone of Paleozoic age underlies Marble Valley and other areas in the west. The Central Valley has considerably younger bedrock of Triassic/Jurassic age, sedimentary brownstone, and shale with intrusive, erosion-resistant igneous basalts forming the distinctive Metacomet Ridge (Metzler and Barrett 2006) (Figure 2.4).

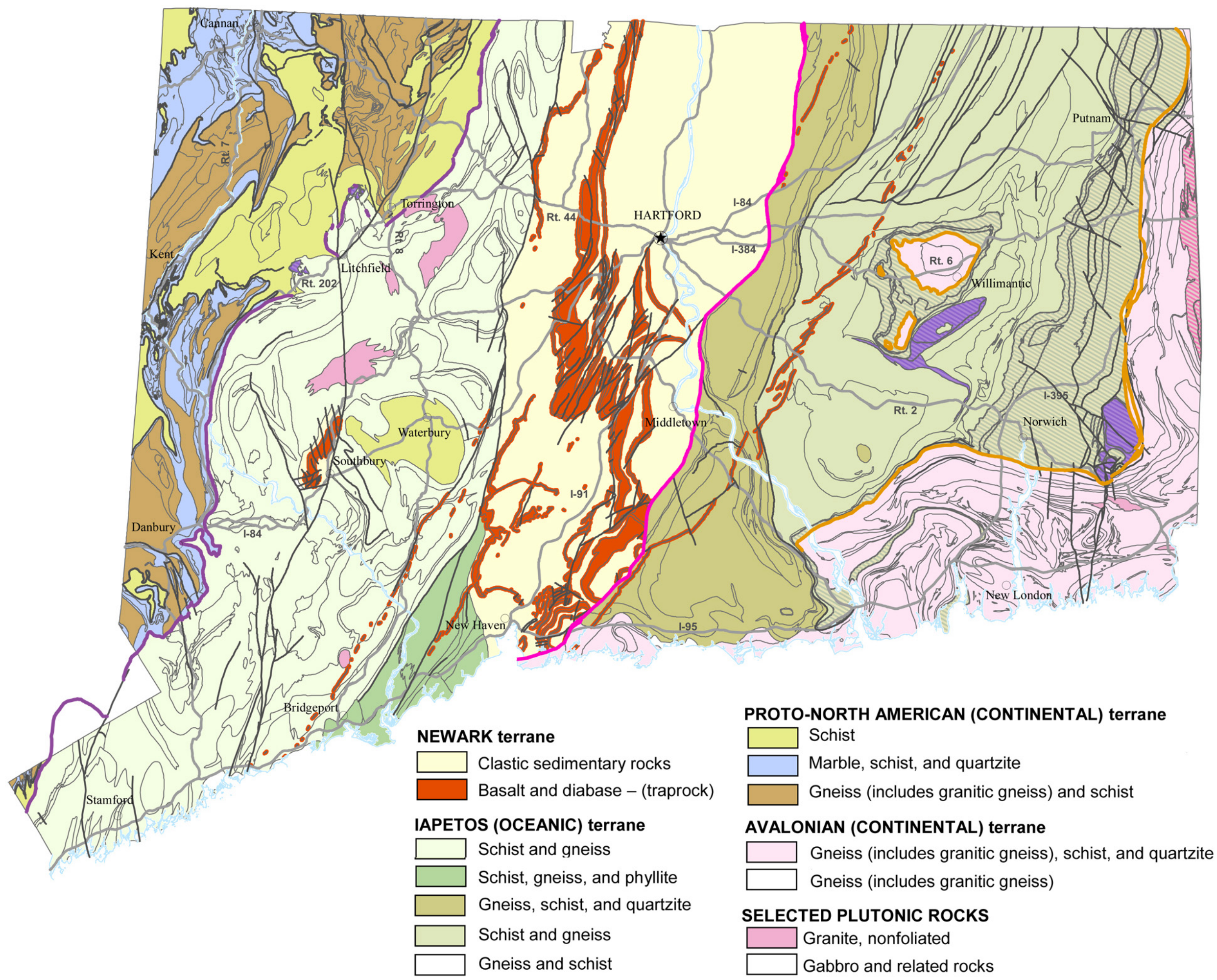


FIGURE 2.4: GENERALIZED BEDROCK GEOLOGIC MAP OF CONNECTICUT.

Soils

Soil types vary with geology, being derived primarily from the underlying bedrock of the region. The fertile soils of the Central Valley were formed through a combination of fine-grained glacial lake sediments and loamy or sandy alluvial deposits. Glacial till soils in the Western and Eastern Highlands are derived from crystalline rocks and tend to be rocky, with little organic accumulation. Most soils are geologically young, having formed either during the Wisconsin age or more recently under hardwood forests. Organic soils are common throughout Connecticut, formed in depressions and basins where surface peats and mucks accumulate in a microtopography of hummocks and swales (Metzler and Barrett 2006) (Figure 2.5). This information is shown in the Connecticut Critical Habitat mapper (CTEco): http://ctecoapp1.uconn.edu/advancedviewer/.

The Soil Survey of the State of Connecticut (NRCS 2008) provides detailed descriptions of every soil type found within state borders. The report includes general and detailed information on soil classifications, locations, characteristics, and more. The report can be accessed at: http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/connecticut/CT600/0/connecticut.pdf.

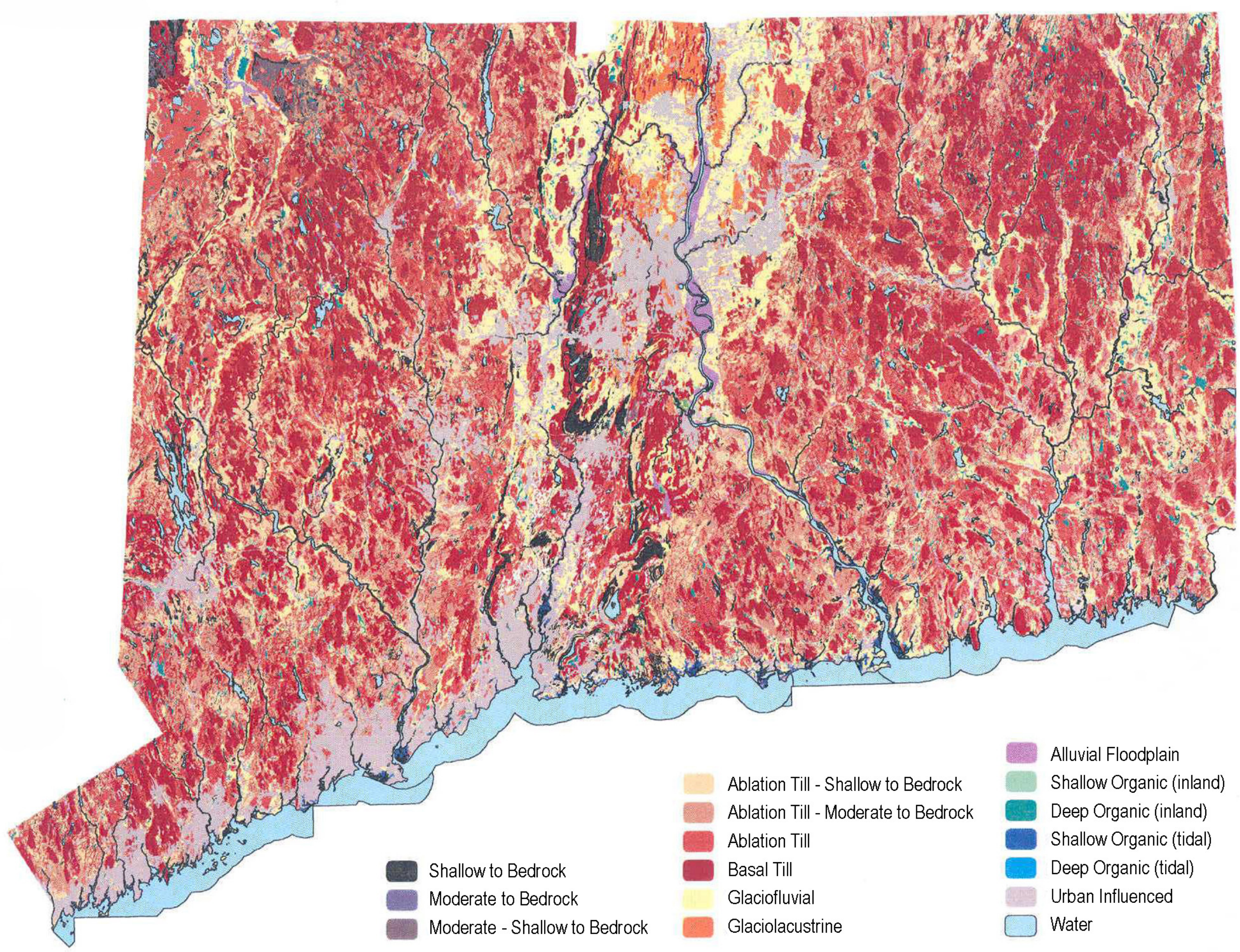


FIGURE 2.5: SOILS OF CONNECTICUT-PARENT MATERIAL. (SOURCE USDA NRCS)

Climate

Connecticut generally has a large temperature range, both daily and seasonally. Precipitation is equally distributed throughout the year and across the state, and the growing season extends from mid-April to mid-October. Gradual differences in climate, such as temperature, snowfall, and length of frost-free season, correspond to distance from the coast and rise in elevation (Metzler and Tiner 1992). Climatic extremes, such as hurricanes, tornadoes, droughts, and ice storms, occasionally occur (Metzler and Barrett 2006).

The local climate varies with topography, resulting in climate-related habitat types throughout the state. Cool stream temperatures in the upland regions are related to air temperatures and elevation, while warm systems in coastal areas are moderated only by groundwater from glacial deposits (N. Hagstrom, CT DEEP, pers. com., 2014).

The global climate is changing rapidly, and the primary drivers of that change appear to be human in origin. Evidence for climate change abounds, from the atmosphere to the depths of the oceans (Kennedy et al. 2010). The planet is warming as indicated by increased temperatures at the surface, in the troposphere, and in the oceans. Snow and ice cover have decreased in most areas. Atmospheric water vapor due to increased evaporation from the warmer surface has been increasing in the lower atmosphere. Sea levels are rising. Changes in other climate-relevant indicators such as length of growing season have been observed in many areas. Worldwide, the observed changes in average conditions have been accompanied by trends toward extremes of heat, cold, drought, and heavy precipitation events (Alexander et al. 2006).

Connecticut has been growing warmer and wetter since 1895, with the annual precipitation increasing at a rate of approximately one inch per decade and the mean annual temperature rising at 0.2 ^{o}F per decade (NOAA 2014). The threat of climate change is given special consideration in the Connecticut Wildlife Action Plan (WAP) because climate change exacerbates many other threats to wildlife and affects each species differently. Thus, incorporating climate change into the plan is vital for the development and implementation of effective conservation actions. A more detailed review of the climate change, including threats to specific Connecticut habitats, is presented in Chapter 3.

Connecticut's Waters

Connecticut is home to a varied waterscape from mountain streams, tidal creeks, lakes, and Long Island Sound. These aquatic landscapes support a variety of wildlife resources, including freshwater, estuarine, and marine species. Diverse hydrology influences the distribution and abundance of Connecticut's fish and wildlife species (Metzler and Tiner 1992).

Many of Connecticut's waters have received state, national, and international recognition for their importance to fish, wildlife, and the public. The lower tidelands of the Connecticut River have been designated by The Nature Conservancy as one of the Western Hemisphere's 40 "Last Great Places." In 1999, President Clinton proclaimed the Connecticut River an American Heritage River. In May 2012, the Connecticut River was designated as the first National Blueway by President Obama. The U.S. Department of Interior has identified it as one of the most important ecological landscapes in the country. In 1994, the Ramsar Convention designated it one of 18 wetlands of international importance. The U.S. Congress and National Park Service (NPS) designated the Quinebaug and Shetucket River valleys in northeastern Connecticut as National Heritage Corridors and the West Branch of the Farmington River (in 1994) and the Eight Mile River (in 2008) as "Wild and Scenic Rivers."

P.J. Fusco

The lower tidelands of the Connecticut River have been designated by The Nature Conservancy as one of the Western Hemisphere's 40 "Last Great Places."

Since the early 1970's, protective water quality laws, remediation efforts, and wastewater treatment investments have resulted in increased health and overall water quality of Connecticut's water systems. Water Quality Standards set an overarching policy for the management of Connecticut's surface and groundwaters. The Connecticut Water Quality Standards and Classifications document takes into account mandates and policy standards set forth in the Connecticut General Status and the federal Clean Water Act (CWA). The document can be viewed at: http://www.ct.gov/deep/lib/deep/regulations/22a/22a-426-1through9.pdf (CT DEEP 2013). Additional information regarding classifications can be found at: http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325620&deepNav_GID=1654 (CT DEEP 2014a). A triennial review of state Water Quality Standards, mandated by federal regulations, was completed in 2013 and submitted to the U.S. Environmental Protection Agency (EPA) for final review.

Non-point source stormwater management and infrastructure improvement still needs refinement. The 2012 Integrated Water Quality Report provides further detail (http://www.ct.gov/deep/lib/deep/water/water_quality_management/305b/2012_iwqr_final.pdf) (CT DEEP 2012). A statewide nonpoint source pollution management plan is underway for the state of Connecticut. The plan will be consistent with planning requirements stated in the EPA's nonpoint source program and grants guidelines for states and territories. For more information, visit http://www.ct.gov/deep/cwp/view.asp?a=2719&q=526576&deepNav_GID=1654. (CT DEEP 2014b)

Watersheds

DEEP's Watershed Management Program (WMP) uses an integrated perspective to address watershed quality issues throughout the state. Watershed management plans are developed for active maintenance of Connecticut's water systems by providing guidance on the conservation of water resources, assessing water quality, enhancing pollution management techniques, and protecting and restoring water quality.

The WMP approved 28 watershed-based plans between 2006 and 2014. For further details and access to all watershed based plans for the state of Connecticut, visit http://www.ct.gov/deep/cwp/view.asp?a=2719&q=379296&deepNav_GID=1654.

Rivers, Streams and Drainage Basins

There are approximately 5,830 miles of rivers and streams in Connecticut (CT DEP 2004). The state has three major drainage basins (Figure 2.6), all of which drain into Long Island Sound: the Housatonic Basin, the Connecticut Basin, and the Thames Basin. In addition, there are four minor coastal drainage basins that drain into Long Island Sound: the Southwest Coast Basin, the South Central Coast Basin, the Southeast Coast Basin, and the Pawcatuck Basin. The Hudson River drainage basin is restricted to a small area in the southwest corner of the state and is an important drainage basin in adjacent New York. A Fisheries Guide to Wadeable Streams and Rivers of Connecticut (N. Hagstrom, CT DEEP, in prep.) provides detailed descriptions of these basins and their associated rivers and streams. Summary descriptions from this publication follow.

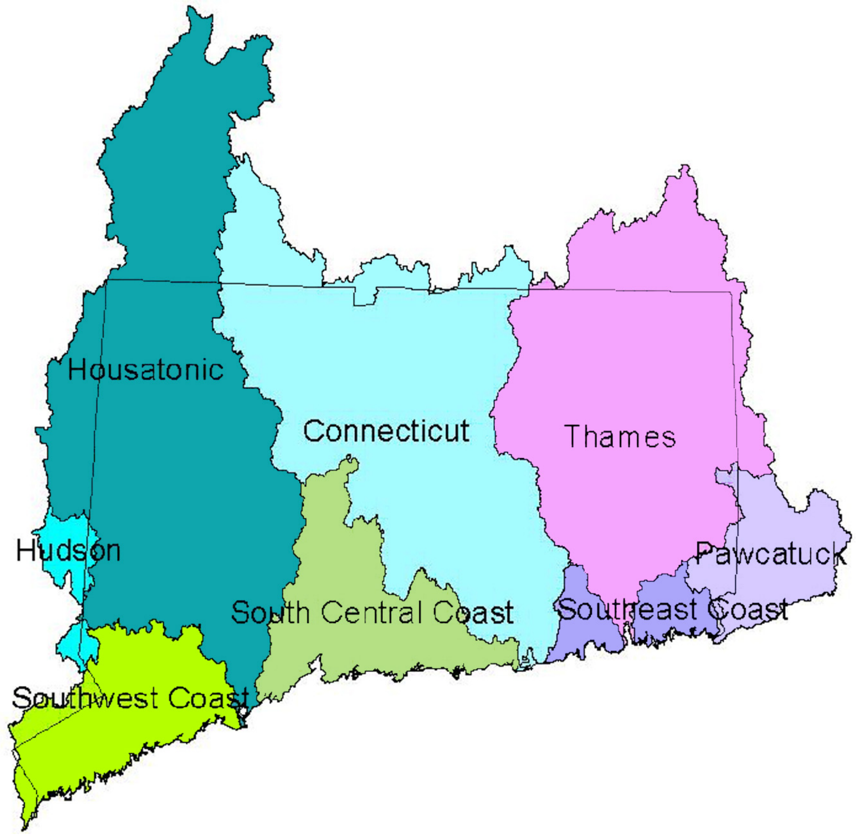


FIGURE 2.6: MAJOR AND MINOR DRAINAGE BASINS OF CONNECTICUT. (SOURCE: CT DEP WATER BUREAU, WATERSHED COORDINATION PROGRAM 2004a)

Housatonic River Basin: The Housatonic River Basin occupies much of the western third of Connecticut and extends from its headwaters in the Berkshire Mountains of Massachusetts south to Long Island Sound. The system drains approximately 1,946 sq. miles with 1,233 sq. miles in Connecticut. About seven miles of the Housatonic River are navigable below Lake Housatonic Dam (Derby Dam).

This basin has a long history of industrial development. In the 1800's, the Naugatuck and lower Housatonic River valleys became known worldwide as a center of brass machining. Candlewood Lake was created in 1928 as a pump storage reservoir for power generation. Additional hydropower facilities divide the lower Housatonic River into a series of three reservoirs (Lake Lillinonah, Lake Zoar, and Lake Housatonic).

The Still River in Danbury flows south and is one of the few rivers in Connecticut not redirected by the glaciers to flow southward. While the bedrock of the Housatonic basin is predominately granite, schists and gneiss, there are underlying layers of marble in the western edge of the basin. In most cases, the erosion of the river channel has exposed these underlying marble layers. The minerals that leach from the marble greatly increase the ability of these rivers to support large numbers of fish and invertebrates.

Connecticut River Basin: The Connecticut River Basin occupies the middle third of Connecticut and extends north to its headwaters along the Canadian border. The system drains approximately 114,000 sq. miles including 1,477 sq. miles in Connecticut. The Connecticut River valley is the site of the earliest European settlements in the state, dating to the 1630's. The wide flat river allowed easy passage of ships through Wethersfield. Nearly 45 miles of the Connecticut River are navigable from Long Island Sound to Hartford. The basin consists of the Connecticut River that bisects the state and numerous large tributary rivers. The Scantic River system drains a portion of the Eastern Highlands, and the Farmington River system drains a large portion of the Western Highlands.

The north-central portion of the Connecticut Basin is roughly split in half by a combination of basaltic and slate bedrock. The rest of the basin has mostly granite-schist bedrock. The streams flowing over granite bedrock tend to have lower productivity, often with lower pH's and tannic waters.

Thames River Basin: The Thames River Basin occupies the eastern third of Connecticut and part of south-central Massachusetts. The system drains approximately 1,463 sq. miles with 1,300 sq. miles in Connecticut. It is an area rich in historical mill sites with many dams still in operation (American Thread, Willimantic; Wauregan Mills, Killingly). Nearly 15 miles of the Thames River are navigable from Long Island Sound to Norwich Harbor (Norwich). Above Norwich the drainage is divided into (1) the Shetucket River Regional Basin and (2) the Quinebaug River Regional Basin along the state's eastern border. Most of Connecticut's Eastern Highlands are drained by the upper Shetucket River system with a small portion of the runoff going eastward into the Quinebaug River. The eastern edge of the Quinebaug drainage includes some low productivity (low nutrient levels) coastal pine barrens habitat. Most of the Thames basin is composed of granite-schist bedrock. As a result, some streams in the Thames Basin tend to have tannic waters and lower pH and productivity than other Connecticut drainages.

Southwest Coastal Basin: The Southwest Coastal Basin is not a true basin, but a cluster of similar coastal streams. It consists of a series of small to moderate sized drainages (1.2-93 sq. miles) situated on the state's southwest coastal plain, most of them flowing directly into Long Island Sound. The entire basin drains approximately 406 sq. miles of southwestern Connecticut.

Most of these streams cross the heavily developed I-95 corridor. A series of large water supply reservoirs and diversions influence almost every major stream. There is a band of urban development between the coast and I-95 and most of the area north of I-95 that is not protected as a source of water supply has undergone heavy residential development. Nearly all streams in this basin have been altered by dams, ponds, diversions or channeling.

The bedrock of this basin is predominately granite, gneiss, and schists, with localized deposits of glacial sand and gravel that provide a good source of groundwater for some watersheds. The valleys within the basin run in a north-south direction with mostly gradual slopes and headwaters that start at less than 200 ft above sea level.

South Central Coastal Basin: The South Central Coastal Basin is situated between the lower half of the Housatonic Basin and the Connecticut River Basin along the middle of the Connecticut Coastline. It consists of a series of small to moderately large streams and rivers that drain approximately 482 sq. miles of Connecticut and flow directly into Long Island Sound. The Quinnipiac River forms the center of the basin, with four small drainages to the west and nine smaller drainages to the east.

The bedrock consists of mostly schists and granites to the west of New Haven and in the eastern third of the basin. The central area, consisting of the Quinnipiac and West Rivers, has mostly arkose (a sedimentary sandstone) and basalt bedrock. The Farm River, which is unique among rivers in Connecticut, has a long narrow shale valley surrounded by arkose ridges.

The majority of the basin is low in elevation, with forested hills and only a few steep basalt ridges at the northern end of drainage. Along the coast are significant areas of salt marsh and a small section of coastal pine barrens habitat along the Quinnipiac River.

Southeast Coastal Basin: The Southeast Coastal Basin consists of similar streams having small to moderate size drainages (0.7-31 sq. miles) situated on the coastal plain and flowing generally south, directly into Long Island Sound. About half of these streams are located to the east of the Thames River and about half are between the Connecticut and the Thames River Basins. Of the 341 sq. miles in this basin, the streams east of the Thames River drain 135 square miles and streams west of the Thames River drain about 206 square miles.

Most of these streams cross the heavily developed I-95 corridor and many are part of water supply systems or are subject to adjacent groundwater withdrawals and diversions. With the exception of the heavily populated shoreline and highway corridor, much of this basin remains forested or in use as farmland; however, this is rapidly changing due to recent increases in development pressure.

As in the Southwest, the bedrock of this basin is predominately granite, gneiss, and schists. In addition, there are thick deposits of glacial sand and gravel that serve as a good source of groundwater. Valleys run in a north-south direction with generally gradual slopes and headwater sections that start at less than 200 ft above sea level. A significant portion of this basin consists of coastal sand barren habitat that has generally tea stained, slightly acidic waters.

Pawcatuck River Basin: Connecticut contains about 60 sq. miles of the 305 sq. mile Pawcatuck River Basin. The majority of this drainage basin is in Rhode Island as is its largest tributary, the Wood River. The lower ten miles of the Pawcatuck forms the Connecticut-Rhode Island border. The lower Pawcatuck River is navigable for about three miles, up as far as the Town of Westerly, Rhode Island, which historically had many mills and associated dams. The Pawcatuck River Basin is located on a broad gradually sloping geological region called the Coastal or Avaloniane Terrane.

Lakes and Ponds

Connecticut has approximately 2,300 lakes, ponds, and reservoirs. Most of the lakes and ponds were created during the last glacial retreat, but many man-made reservoirs also provide potable public water, energy production, and flood control (Jacobs and O'Donnell 2002). Of the 2,100 lakes and ponds available for public recreational activities, 116 have been classified as "significant" for their recreational opportunities and/or their outstanding aquatic habitat and fisheries. Some of the smaller lakes and ponds, such as Honey Hill in New Hartford and Trail Wood in Hampton, have been preserved by non-governmental organizations and local governments for their value to fish and wildlife and to local residents (CT DEP 2004b). Detailed information on the distribution and relative condition of lakes and ponds in Connecticut is found in the annual DEEP Water Bureau 305d Report and other water quality assessment documents (CT DEP 2004a).

The mission of DEEP's Lake Management Program is to protect and restore the ecological health and integrity of Connecticut's lakes and ponds. Baseline monitoring, diagnostic studies, watershed assessments, management plans and implementation are used to address major concerns, including non-native invasive plants, eutrophication, and more. This program also provides local lake communities and private pond owners with technical and financial assistance for aquatic plant management.

Caring for Our Lakes (CT DEP 1996) is an informational booklet that discusses the general background of lake ecology and problems faced by lake users and residents; watershed management activities that protect lake water quality from pollution sources; and in-lake management methods that relieve aquatic weed and algal bloom problems. The document focuses solely on watershed and in-lake management for Connecticut lakes, and is available at http://www.ct.gov/deep/lib/deep/water/lakes/Caring_for_Our_Lakes.pdf.

In 2002, *A Fisheries Guide to Lakes and Ponds* was revised and updated (Jacobs and O'Donnell 2002). The book includes information on habitat characteristics, aquatic vegetation, and fish diversity. It also contains full-page color depth maps of popular fishing sites in the state, including 113 of Connecticut's major public lakes and ponds and the Connecticut River main stem and adjoining coves.

Estuaries: Long Island Sound

Estuaries are biodiversity hotspots due to the mixing of freshwater and saltwater. Long Island Sound (LIS), which is the largest and most important estuary for the state, was created by retreating glaciers and forms the southern boundary of Connecticut. Long Island Sound encompasses 612 square miles. Its watershed covers 16,820 square miles in Connecticut and New York, receiving 90 percent of its freshwater from the three major Connecticut rivers. LIS is unique among estuaries in that it has two connections to the Atlantic Ocean: to the east through the Race and Rhode Island's Block Island Sound, and to the west through the East River and New York Harbor. The estuary is approximately 110 miles long east-to-west, and 21 miles wide at its broadest part, covering 1,320 square miles (LISS 2014), and it supports an array of ecologically important areas (Figure 2.7).

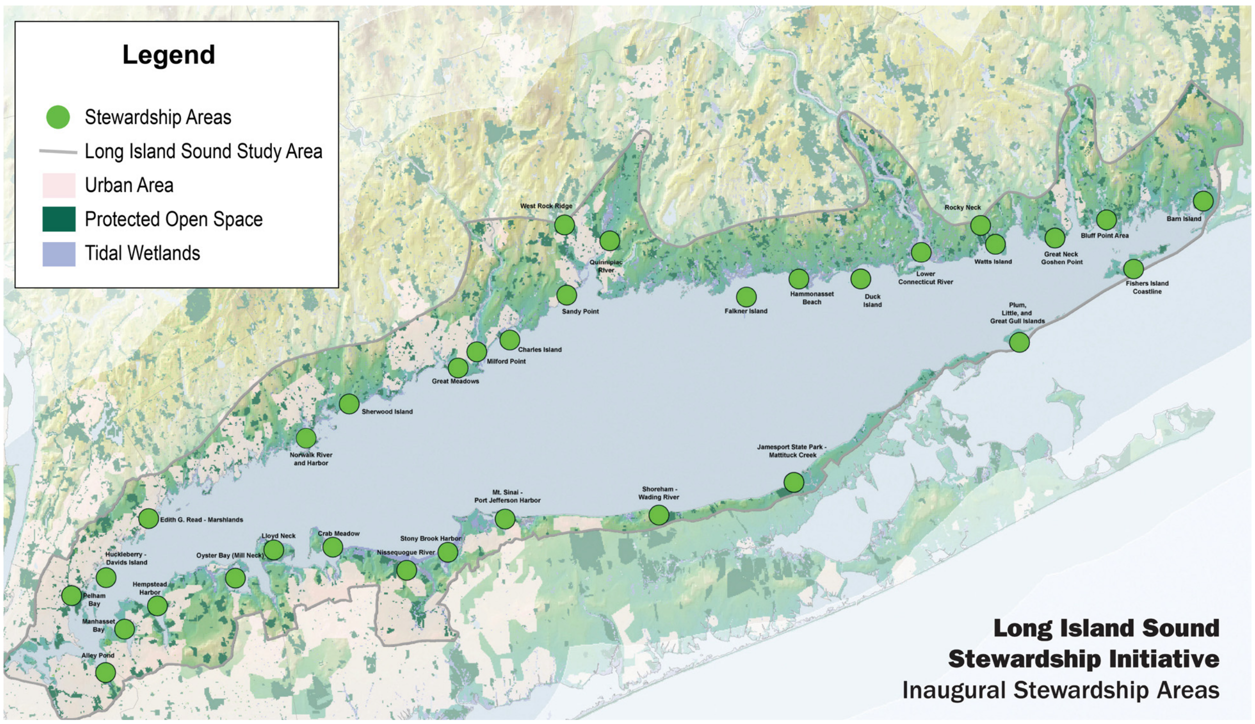


FIGURE 2.7: LONG ISLAND SOUND STEWARDSHIP INITIATIVE: INAUGURAL STEWARDSHIP AREAS. (SOURCE: LISS 2006)

The Long Island Sound Study (LISS), www.longislandsoundstudy.net, examines water quality, climate change effects, and condition of watershed basins, as well as the condition of shellfish, finfish, coastal birds, habitats, and altered landscapes (LISS 2008). It has identified hypoxia, toxic substances, and land-use changes as three major environmental concerns for LIS. A 2008 report (LISS 2008) rated the overall condition of LIS as poor, based on rankings of water quality, benthic, fish tissue contamination, and sediment quality indices (Figure 2.8). This overall condition score was not derived using the presence of estuarine and marine fish species, as was as was the case for the sub-habitats that make up larger Estuarine Aquatic Habitat encompassing Long Island Sound.

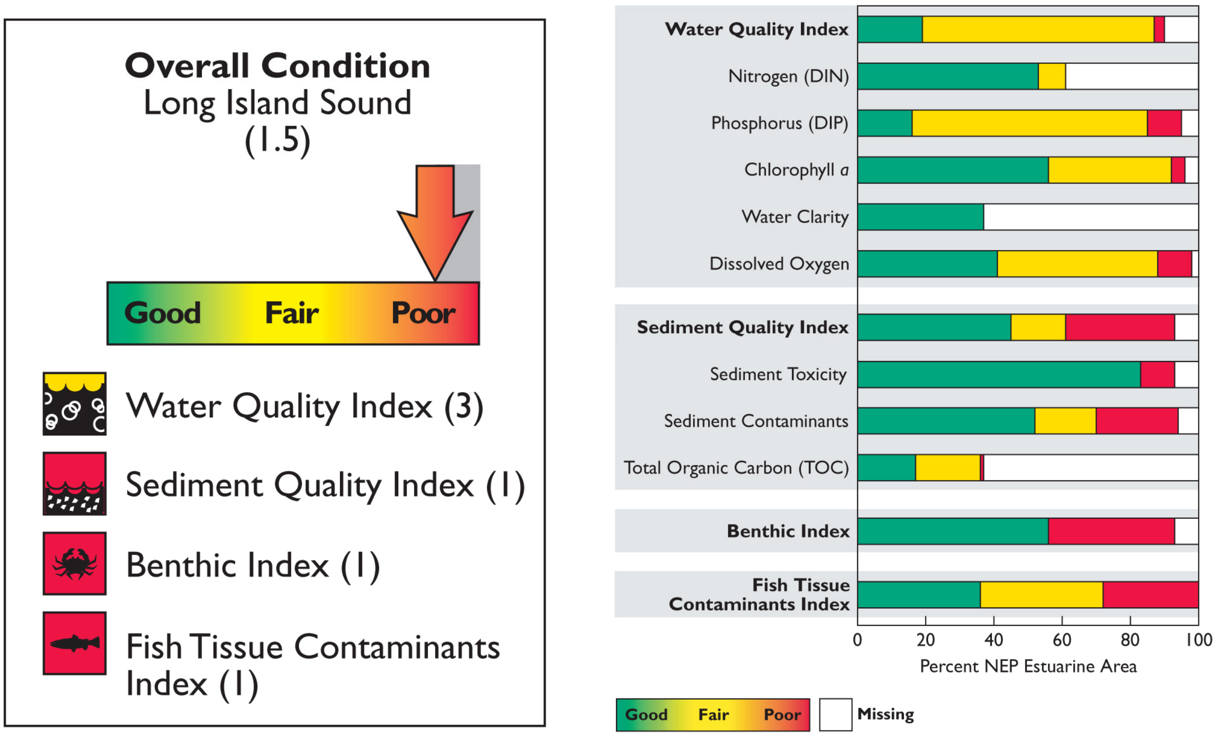


FIGURE 2.8: OVERALL CONDITION OF LONG ISLAND SOUND AND PERCENTAGE OF AREA ACHIEVING EACH RATING. (SOURCE: ADAPTED FROM EPA 2007)

Water quality is monitored through assessment of hypoxia, toxic contaminants, and pathogens within the Sound. The LISS has found high levels and occurrence of hypoxia in western Long Island Sound (Figure 2.9). Contaminants such as PCBs continue to decrease, while levels of pathogens have increased. Pathogens affect the overall health and productivity of shellfish beds.

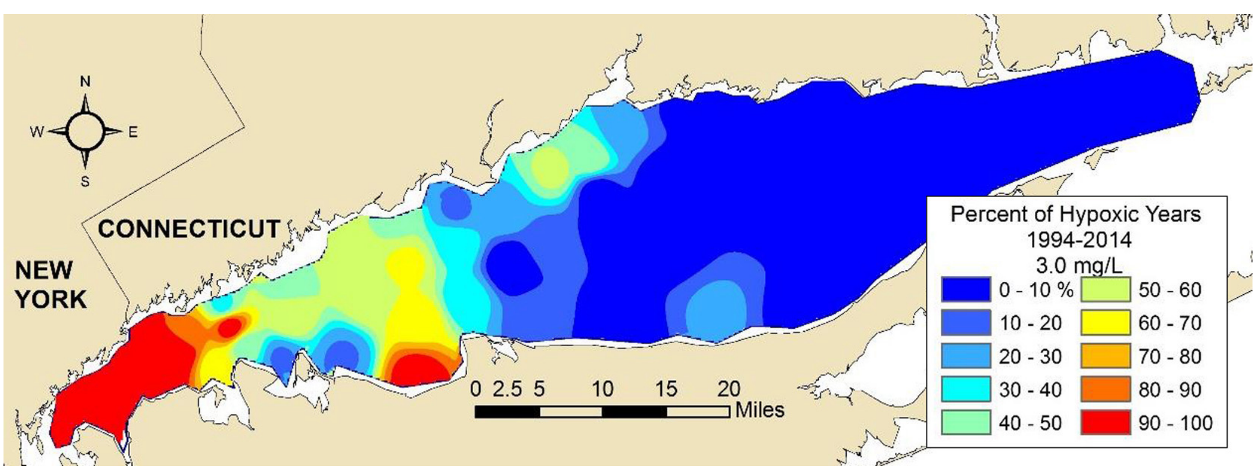


FIGURE 2.9: PERCENT YEARS OF HYPOXIA (< 3 PPM DO) WITHIN LONG ISLAND SOUND. (SOURCE: ADAPTED FROM LISS 2015a)

The 2008 report examined the potential effects of climate change relative to fisheries, wildlife, and habitats, with predictions of notable decreases in cold-water fish species and increases in warm-water fish populations due to increased water temperatures. It predicted sea-level rise negatively impacting the nesting and breeding success of many coastal birds (LISS 2008). In addition to increased nest flooding, habitat loss was also seen as an issue for coastal bird populations.

Tidal marsh losses will also increase in magnitude and distribution, according to recent predictions, especially in the western portion of the Sound. Tidal marshes are important to many coastal bird, fish, and invertebrate populations. An array of scientific studies and new research has focused on the effects of marsh loss on habitats and species, as well as on the possible causes of these losses (EPA 2007). According to LISS (2008), habitat conservation efforts have helped populations of piping plover and osprey. Colonial waterbirds such as night herons and great egrets have shown stable populations in the Sound in recent years. New York's population of least terns has recently increased, while Connecticut's population has continued to decrease since the 1980's (LISS 2008). As the pace of habitat loss accelerates, these populations continue to face many challenges.

A major priority for the Sound is conservation and protection of oyster beds and lobster populations (EPA 2007). Oyster populations have shown signs of slow recovery in recent years, while lobster stocks have continued to decline. Clam harvests have steadily increased over the last two decades. Finfish populations also remain stable in Long Island Sound, with year-to-year species variation (LISS 2008).

The EPA's National Coastal Assessment (NCA) index has been used to evaluate water quality trends in Long Island Sound over the past two decades (LISS 2015). The NCA index is based on five chemical and biological measures:

- Nitrogen (Dissolved inorganic nitrogen in surface waters)
- Phosphorus (Phosphate, or PO4, in surface waters)
- Chlorophyll a (in surface waters)
- Dissolved Oxygen (in bottom waters)
- Water Clarity (Secchi disk depth)

Good water quality is defined as water containing low concentrations of nitrogen, phosphorus and chlorophyll, high concentrations of dissolved oxygen, and high water clarity. Figure 2.10 depicts the relative condition of the western, central, and eastern basins found in Long Island Sound. The western basin is under the most environmental stress, with the poorest water quality overall, while the eastern watershed has the best water quality.

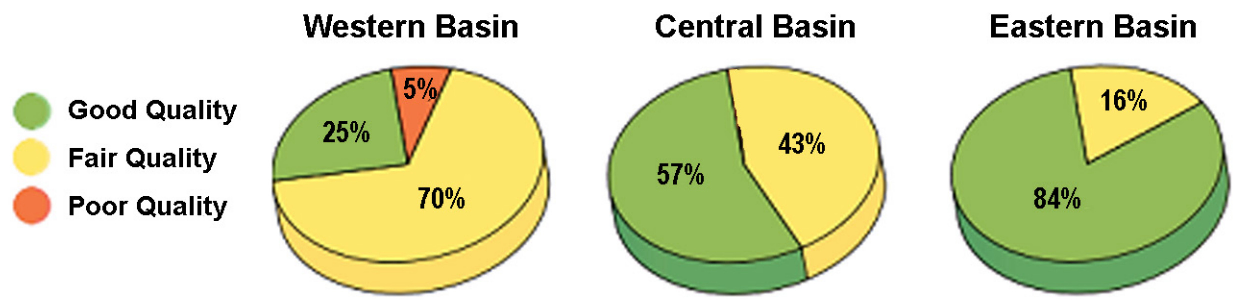


FIGURE 2.10: LONG ISLAND SOUND WATER QUALITY INDEX AVERAGES FROM 1991 TO 2010. (SOURCE: ADAPTED FROM LISS 2015b)

Significant conservation efforts and programs have focused on LIS. Their goals are to assess, protect, conserve and restore coastal resources and provide detailed information on the relative condition of this important estuary. The Comprehensive Conservation and Management Plan (LISS 1994) includes examples of organizations focused on the health, restoration, and protection of LIS including the LIS Stewardship Initiative, Coastal and Estuarine Land Conservation Program (CELCP), Long Island Sound Study (LISS), DEEP Office of Long Island Sound Programs, and Long Island Sound Conservation Society, among others.

HABITAT CONSERVATION FOR CONNECTICUT'S WILDLIFE

A key link exists between wildlife diversity, abundance, adaptability, and the overall condition, quality, and extent of habitats. Connecticut has been involved with numerous projects to address the general health and rehabilitation of the state's ecosystems by recognizing this crucial link.

Landowner Incentive Program: Connecticut's Landowner Incentive Program (LIP) has been providing technical and cost share assistance to landowners for habitat management since 2004. The purpose of this program is to protect, restore, enhance, and manage early successional and wetland habitats that support fish, wildlife, and plant species considered at risk. The program was funded for three years through grants from the U.S. Fish and Wildlife Service. Projects included creation of young forest habitat, reverting field restoration, warm season grass planting, invasive species control, and wetlands restoration. The Wildlife Division partnered with an array of conservation groups such as Connecticut Audubon, Audubon Connecticut, the Connecticut Chapter of the Nature Conservancy, various sportsmen's groups, land trusts, nature centers, private landowners, and landowner associations to accomplish projects. This program gave the Wildlife Division an opportunity to build enduring relationships with private landowners. These relationships have supported subsequent habitat initiatives such as Connecticut's Shrubland Habitat Enhancement Initiative, which continues to provide technical assistance to private landowners to develop habitat for the New England cottontail and other young-forest-dependent species. When the LIP projects are complete in 2016, 46 projects will have been accomplished and more than 2,000 acres will have been enhanced, restored and placed under management.

Wildlife Habitat Incentives Program: Beginning in 1998, the Wildlife Division secured funding through the Wildlife Habitat Incentives Program (WHIP) that enabled the Division to establish a highly successful wildlife management program on state lands. WHIP was established in 1996 as one of several conservation programs incorporated into the Federal Farm Bill to promote wildlife habitat management. Its purpose was to create, restore and maintain upland and wetland wildlife habitat, with a priority of conserving habitats of threatened, endangered, or other wildlife in need of conservation action. More than $1.7 million was appropriated to manage approximately 1,650 acres on state properties throughout Connecticut. The report entitled "Wildlife Habitat Incentives Program (WHIP) Implementation on Lands Owned by the Connecticut Department of Environmental Protection A Twelve-Year Summary April 1998-October 15, 2009" documents the accomplishments over that period.

The majority of funds were used to manage critical early successional habitats including warm and cool season grasslands, meadows, old fields, and shrublands. These habitats are declining because of development and intensive farming practices that result in multiple hay harvests throughout the growing season and elimination of fallow, brushy areas. Absent natural disturbances or management, these areas often grow up into forestland and no longer support species that depend on early successional habitat. Quality early successional habitats and the wildlife species they support are in serious decline in Connecticut and throughout the Northeast. Practices implemented to restore, create and manage these habitats included mowing, planting of warm and cool-season grasses, creation of seedling sapling stands using forestry harvesting equipment, and planting native trees and shrubs.

Wetland habitats were also targeted for management using WHIP funds because about half of Connecticut's state-listed species are dependent on wetlands. These important habitats have been reduced between 30 and 50 percent since colonial times and continue to be impacted indirectly by development and directly by invasive species. Many state-owned wetlands have been severely degraded due to infestation by non-native species, especially common reed (*Phragmites australis*). Funding under WHIP was used to control non-native species and replace water control structures that created vital wetland wildlife habitat.

With passage of the 2008 Farm Bill, state and municipal lands were no longer eligible for Farm Bill funding. Except for a handful of existing contracts yet to be completed, the WHIP Program is no longer available to support work on state lands. When the last WHIP contract expires in 2016, more than 4,000 acres of treatments will have been completed under 80 WHIP contracts at 45 areas, resulting in the enhancement of 1,650 acres of crucial wildlife habitat statewide.

WHIP funding provided a dependable source of revenue to pay for quality habitat management. Absent this funding stream, the Wildlife Division continues to seek an alternative, secure source for support of annual large scale habitat management projects on state lands, which are vital to conserving Connecticut's wildlife.

Grassland Habitat Initiative: Grasslands were identified as a priority habitat in the 2005 WAP. In response, a Grassland Habitat Initiative was developed, through DEEP, focusing on restoration and preservation of grassland habitats throughout the state. This initiative was designed to identify and establish potential grassland habitats, with a target of 800 sites. Surveys and monitoring efforts revealed that these grasslands are prime habitat for grassland birds, resulting in the identification of several new breeding records for threatened or endangered species, including American kestrel, eastern meadowlark, and horned lark. These sites continue to serve as crucial habitats for grassland species (CT DEEP 2009a). DEEP utilized State Wildlife Grant funds to conduct Environmental Site Assessments for various parcels of land being considered for acquisition by the state, including the General Cigar Property in Suffield (CT DEEP 2009b).

Forest Management: The Wildlife Division makes recommendations for forest management statewide. For example, the Centennial Watershed State Forest recommends that the primary emphasis be age class management for forest interior birds with a special emphasis on large interior cuts to provide fledging habitat. In the Mountain Block of Meshomasic State Forest, continued shrubland management is important. In 2011, more and larger even-aged management cuts were recommended for early successional birds at the Goodwin State Forest. DEEP recommended larger, even-aged management cuts for early successional birds in the Cockaponsett State Forest and Wyassup State Forest management plans in 2012. Bird summary assessments were provided to aid in the development of ten year plans for the Nassahegon State Forest, Natchaug State Forest, Nipmuck State Forest, and Shenipsit State Forest. The Wildlife Division also worked with the Forestry Division to distribute a brochure describing the benefits of clearcutting for forest and wildlife health (CT DEEP 2012).

In 2012, the Forestry Division's Forest Legacy Program helped to secure 73 acres in the town of Simsbury through a working forest conservation easement. This parcel connects 730 acres of protected land to the south and 5,300 acres of protected land to the north (Martin 2013), providing important continuity of habitat for many wildlife species.

The 2004-2013 Connecticut Statewide Forest Resource Plan provides an overview of recommendations for planning activities within the state's forests. The plan outlines DEEP's vision for the future of Connecticut's forests and provides an overall description of the state's forests and associated ecosystem health. It also identifies forest health related to fish and wildlife species; addresses outdoor recreation, policy, and planning; and describes public and private forest stewardship. Finally, the plan identifies specific areas of conservation and management concern and provides recommendations for the implementation of specific actions (Flounders 2004). The plan is currently being updated to addresses concerns for Connecticut's forests in the next decade.

Wetland Management: From 2005 through 2015 DEEP's Wetland Habitat and Mosquito Management Program completed 113 projects through Integrated Marsh Management systems. Actions included cleaning ditches, creating new channels and shallow pools, and enhancing local habitats by the creation of shallow, open water areas that reintroduce tidal flow and fish access to mosquito breeding sites. At certain locations DEEP and UConn monitor the results of restoration activities. They also monitor mosquito breeding and conduct studies on bird populations and other environmental factors (Capotosto and Wolfe 2014).

With the advent of sea level rise, salt marsh conservation efforts must include upland, non-wetland habitat to provide for marsh migration opportunities. A federal grant through the North American Wetlands Conservation Act (NAWCA) allowed Connecticut to obtain three parcels totaling 82 acres of critical coastal and salt marsh habitats. Through this project, DEEP, along with seven major partner organizations, restored vital habitats for an estimated 20 percent of Connecticut's wintering waterfowl.

Coastal Connecticut is an area recognized for having one of only 35 RAMSAR Convention Wetlands of International Importance in the United States, and one of only nine RAMSAR wetlands on the East Coast. Despite intense development, the coast of Connecticut is globally significant for many wetland-dependent breeding and wintering birds, such as the saltmarsh sparrow, roseate tern, and American black duck. It also provides habitat for more than 60 GCN migratory bird species.

Habitat Mapping: From 2008 to 2010, DEEP worked to map habitats and develop geospatial databases for GCN species (CT DEEP 2010). A total of 36,000 acres were mapped representing 110 sites throughout the state. Data are available on the *Connecticut Environmental Conditions Online* website (http://www.cteco.uconn.edu/). An important finding from this project attributed the decline of New England cottontail populations to habitat loss and degradation, and to increased competition with the more abundant eastern cottontail. Spatial and temporal movement patterns were monitored using live traps and fecal pellets, harvest, and road mortality collections.

A statewide assessment of grassland habitat was also conducted that used known grassland habitat characteristics to define and identify additional new sites throughout the state. As a result, several new breeding and nesting sites for many of Connecticut's threatened birds were identified. The project also produced a web page on grasslands and grassland management.

A third component of this project examined forest stands. Maps were digitized and a web-based geospatial tool was developed for DEEP employees (CT DEEP 2010).

DEEP also developed and implemented a Statewide Instream Flow Management Plan to evaluate ecological effects of water withdrawals and impoundments in small streams on fish grouping and population structure. Thirty-three streams were examined, including streams with dams and associated impoundments as well as unimpounded streams with pumping wells. Results indicated that alteration of natural flow regimes do impact stream biota (CT DEEP 2009a).

Long Island Sound Blue Plan: The Connecticut Chapter of The Nature Conservancy initiated Long Island Sound Blue Plan legislation, which was passed in May 2015. The Blue Plan will allow Connecticut to comprehensively plan for multiple future uses of Long Island Sound. Once the planning process is complete and approved by the legislature, it will become part of the Connecticut Coastal Management Program and will officially guide DEEP and the Department of Agriculture's Division of Aquaculture in the review of permit applications for activities in coastal areas.

IDENTIFYING CONNECTICUT'S KEY HABITATS

A combination of the following sources provides the best available information on the types, relative condition, and location of fish and wildlife habitats in Connecticut. Due to the lack of distribution and abundance information for many wildlife species, especially invertebrates, information on key habitats and associated sub-habitats is used for conservation planning and research activities.

Six recognized, standardized classification systems have been used to describe Connecticut's vegetated landscape and were used in developing the key wildlife habitats described in this plan.

1. The National Vegetation Classification Standard (NVCS) was established in 1997 and revised in 2008, as the standard vegetation classification system for federal agencies (FGDC 1997, 2008). The NVCS uses a hierarchy of nine levels, including seven levels of physiognomic factors (such as climatic, environmental, and structural characteristics) at the coarse scale and two levels of floristic factors (such as dominant and indicator species) at the fine scale (FGDC 1997, 2008; Comer et al. 2003).
2. NatureServe was developed from a consortium of state natural heritage programs and conservation agencies and organizations. The classification was established as a database system for natural heritage data in the United States (Comer et al. 2003) and uses the fine-scale floristic levels of the NVCS system to categorize land cover.
3. The UConn's Center for Land Use Education and Research (CLEAR) uses satellite imagery to map the Connecticut landscape. The project uses a vegetation-based classification system for Connecticut's landscape, defining 12 land use/land cover categories. Periodic updates allow patterns and trends in the state's changing landscape to be identified (http://clear.uconn.edu).
4. Metzler and Barrett (2006) developed an updated Vegetation Classification for Connecticut. This classification system uses the regional landscape approaches of Bailey (1995) and Dowhan and Craig (1976). However, it is tailored less to climate and more to the localized influences of Connecticut's topographical features and major drainage patterns on vegetation community distribution.
5. The Northeast Terrestrial Habitat Classification System (NETHCS) (Gawler 2008) was developed as a comprehensive and standardized representation of habitats for wildlife that would be consistent with other regional classification and mapping efforts. This classification formed the basis for a GIS map of ecological systems. Approximately 70,000 inventory points were contributed by state natural heritage programs and the U.S. Forest Service's Forest Inventory and Analysis Program to create an accurate model of where these habitats occur. In addition, the *Northeast Habitat Guide: A Companion to the Terrestrial and Aquatic Maps* (Anderson et al. 2013), published by The Nature Conservancy, presents profiles of each habitat type in the Northeast with distribution maps, state acreage figures, identification of species of conservation concern, and assessment of overall condition in the region.

NETWHCS defines ecological systems as recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. They are intended to provide a classification unit that can be easily mapped, often from remote imagery, and is readily identifiable by conservation and resource managers in the field. They are defined based on biogeographic region, landscape scale, dominant cover type, and disturbance regime. Examples in Connecticut include Central Appalachian Dry Oak-Pine Forest and Northern Atlantic Coastal Plain Sandy Beach.

6. In concert with NETWHCS, Olivero and Anderson (2008) developed the Northeast Aquatic Habitat Classification System (NEAHCS), which provides a standardized classification and GIS dataset for stream systems by addressing natural flowing-water habitat types throughout the region. For marine systems, DEEP's Office of Long Island Sound Programs' marine categories and the Coastal and Marine Ecological Classification Standards (NOAA 2012) were referenced and compared.

One of the most prominent regional efforts completed since the 2005 WAP is the development of regional terrestrial and aquatic habitat classification systems. The Northeast Terrestrial Wildlife Habitat Classification System (NETWHCS) (Gawler 2008) uses habitat systems and structural modifiers to describe and classify wildlife habitat in the Northeast. This flexible framework was the first step in a regional effort to identify and define habitats in the Northeast, and was designed to incorporate compatibility with current classification systems such as LANDFIRE and USGS Geographic Analysis Program (GAP). Final reports and additional information can be found at http://rcngrants.org/content/northeastern-terrestrial-wildlife-habitat-classification (Gawler 2008).

An extension of the Terrestrial Wildlife Habitat Classifications project led to the development of the Northeast Aquatic Habitat Classification System (NEAHCS) (Olivero and Anderson (2008). This effort created a standardized classification system and GIS dataset for stream systems across the Northeast. The project addressed natural flowing-water habitat types throughout the region, and unified state classification systems to promote a broader understanding of aquatic biodiversity throughout the region. Additional details can be viewed at: http://rcngrants.org/content/northeastern-aquatic-habitat-classification-project . The system was revised, adding lake classification maps and a tidal component to the classification of streams and rivers (Anderson 2014). Additional information on the revision can be found at: http://www.northatlanticlcc.org/projects/aquatic-classification-revisions/revisions-to-the-northeastern-aquatic-habitat-classification.

In Connecticut, the identification of key habitats essential to GCN species involved input and analysis by DEEP staff, the Endangered Species Scientific Advisory Committee (ESSAC), and key partners and stakeholders. Using information from existing ecoregion and vegetative classification systems, an initial list of habitats important to wildlife in Connecticut was developed and continually refined by input from these groups.

The list was then compared and cross-referenced by the National Vegetation Classification Standard (NVCS), NatureServe, NETWHCS, and NEAHCS for regional and national consistency. DEEP staff used these data to identify ten key habitat classifications and 46 sub-habitats (Table

2.1). Each habitat may contain multiple natural vegetative sub-habitat that are similar in vegetative structure and characteristics. Each of these sub-habitats has been referenced to Metzler and Barrett's ecoregions.

TABLE 2.1: KEY HABITATS AND ASSOCIATED SUB-HABITATS.

Key Habitat	Sub-habitat
1) Upland Forest	a.) Oak Forests b.) Calcareous Forests c.) Coniferous Forests d.) Old Growth Forests e.) Northern Hardwood Forests f.) Mixed Hardwood Forests g.) Young Forests h.) Maritime Forests
2) Upland Woodland and Shrub	a.) Red Cedar Glades b.) Pitch Pine - Scrub Oak Woodlands c.) Maritime Shrublands d.) Reverting Field and Early Successional Shrubland
3) Upland Herbaceous	a.) Coastal Beaches and Dunes b.) Grassy Glades and Balds c.) Sand Barrens and Sparsely Vegetated Sand and Gravel d.) Warm Season Grasslands e.) Cool Season Grasslands
4) Forested Inland Wetland	a.) Atlantic White Cedar Swamps b.) Red/Black Spruce Swamps c.) Northern White Cedar Swamps d.) Floodplain Forests e.) Red Maple Swamps
5) Shrub Inland Wetland	a.) Bogs and Fens b.) Shrub Swamps
6) Herbaceous Inland Wetland	a.) Calcareous Spring Fens b.) Freshwater Marshes c.) Wet Meadows
7) Tidal Wetland	a.) Salt and Brackish Marshes b.) Intertidal Beaches, Flats and Rocky Shores
8) Freshwater Aquatic	a.) Large Rivers and their Associated Riparian Zones b.) Unrestricted, Free-Flowing Streams c.) Cold Water Streams d.) Head-of-Tide and Coastal Streams e.) Lakes and their Shorelines f.) Coastal Plain Ponds

Key Habitat	Sub-habitat
9) Estuarine Aquatic	a.) Coastal Rivers, Coves, and Embayments b.) Vegetation Beds c.) Hard Bottoms d.) Sponge Beds e.) Shellfish Reefs/Beds f.) Sedimentary Bottoms g.) Open Water h.) Algal Beds
10) Unique; Natural or Man-made	a.) Traprock Ridges b.) Offshore Islands c.) Coastal Bluffs and Headlands d.) Caves and Other Subterranean Habitats e.) Urban and Man-made Features f.) Cliffs and Talus Slopes g.) Surface Springs and Seeps h.) Vernal Pools i.) Agricultural Lands j.) Navigational Channels, Breakwaters, Jetties, and Piers k.) Public Utility Transmission Corridors

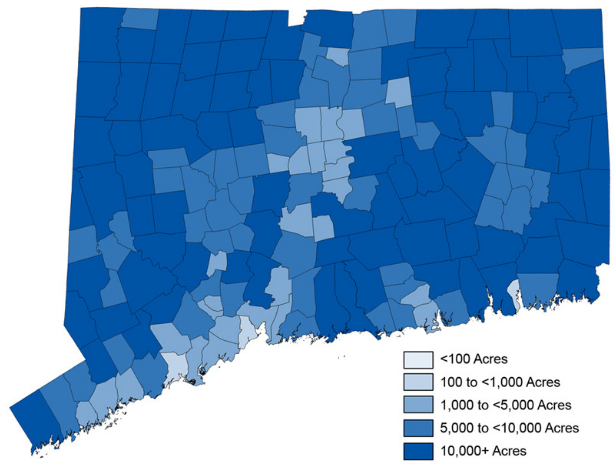
Most key habitats and their associated sub-habitats are described in greater detail in Metzler and Barrett (2006). Summary tables of associated wildlife species, arranged by taxon, are presented for each of the ten key habitat and their respective sub-habitats (Chapter 4). These tables were produced from the database developed by staff, expert advisors, and stakeholders following the same process used to identify GCN species, as outlined in Chapter 1.

The best available information and expert opinion on the location and relative ecological condition of each of the ten key habitat types, as well as the status of inventory and mapping data for each habitat within Connecticut, are presented in Appendix 2. Representative sites and priority areas within the habitats have also been identified. Primary sources of information used in developing this list of habitats were Metzler and Barrett (2006) and Metzler and Wagner (1998). In general, habitat location and relative condition of habitats are sufficient to determine what conservation action should take place for most GCN species.

Connecticut's Key Habitats

This section provides general descriptions of each of Connecticut's ten key habitats and summarizes their relative condition and extent. Chapter 4 provides additional detail for key habitats, including information on each of their associated sub-habitats. A partnership with the University of Connecticut (UConn) has provided additional mapping of key habitats for this WAP revision. Mapping rare natural communities also guides collection of baseline information on invertebrates and other less studied communities and GCN species.

Upland Forest



Upland forests are habitats characterized by more than 60 percent canopy cover of deciduous, coniferous, or mixed deciduous/coniferous trees. In mature forests there is a well-developed understory shrub layer and a ground layer of herbaceous plants, although these layers may be sparse in closed canopy forests, especially those dominated by conifers.

Situated in the southern New England portion of the Appalachian Forest, Connecticut was naturally forested. It is estimated that prior to European settlement more than 90 percent of the state was forested by deciduous trees, primarily oaks and red maple. Coniferous forests constituted about 15 percent of the state's forest land with white pine, pitch pine, and hemlock being the primary naturally-occurring upland species. Mature forests supported a high diversity of wildlife species in an array of canopy, sub-canopy, shrub, and ground vegetation layers, and there was strong evidence that the largest forest tracts, ranging up to thousands of hectares, supported the highest diversity of forest species.

In addition to spatial characteristics, the structure of forest vegetation was an important attribute determining the diversity of forest species. Historically, forests of interior New England have undergone frequent, small-scale natural disturbances in the form of tree windthrows that removed individual trees or groups of trees, resulting in canopy breaks. Major catastrophic disturbances from hurricanes and wild fires occurred less frequently. Natural disturbances created forests that were structurally diverse, with dense nesting cover at the shrub and ground levels that supported a high diversity of forest-nesting birds.

European colonists cleared nearly all of Connecticut's original deciduous, hardwood forest, converting about two-thirds of its acreage for agriculture. By the mid-19th century, industry had replaced agriculture as the region's dominant employment and many farm fields were abandoned. An estimated 30 percent of the lost woodlands were restored through natural succession in these abandoned fields.

Although there is more forest acreage in Connecticut today than there was 100 years ago, almost all is second-growth. Few areas are large enough habitats to support the full complement of expected species and natural ecosystem processes inherent in mature, unfragmented forest systems. For example, key characteristics that determine a forest's value for breeding bird habitat are its size and shape, nearness to other forest tracts, and surrounding land use. Forest patches are becoming smaller and more isolated in Connecticut, primarily due to fragmentation caused by housing, roads, and other developments.

The age and structure of forests influence the composition of the plant and animal communities that occupy these habitats. In Connecticut forests there has been a reduction in understory vegetation which is a critical habitat characteristic for ground-nesting birds, mostly as the result of over-browsing by white-tailed deer. Moreover, forests continue to undergo declines in understory and ground layer plant diversity because recolonization of some species is prevented by the creation of dispersal barriers such as roads, development, and invasive plant and animal species. In such cases, even mature forests are paying an "extinction debt" as small populations of plants and other biota decline and disappear due to fragmentation (Vellend et al. 2007).

The relative condition of forest habitat in Connecticut is fair to good, varying widely across the state depending on location, forest type, localized threats, and other factors. Upland forests are the primary habitat throughout Connecticut. This key habitat classification includes eight sub-habitats determined to be most important to wildlife (Table 2.2).

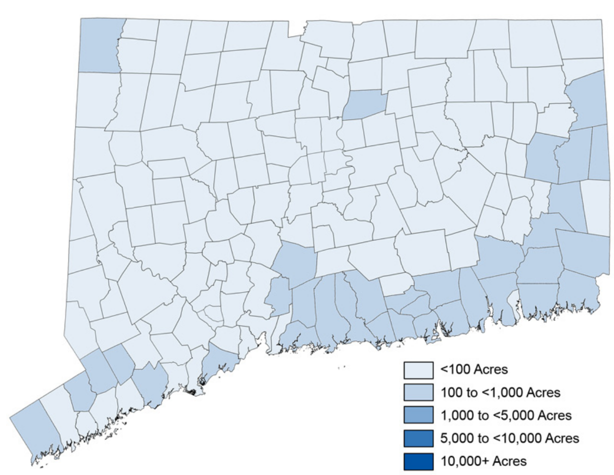
TABLE 2.2: SUB-HABITATS OF THE UPLAND FOREST KEY HABITAT GROUP.

Sub-habitat	Condition
Oak Forests	Good–Fair
Calcareous Forests	Fair
Coniferous Forests	Fair
Old Growth Forests	Fair
Northern Hardwood Forests	Fair
Mixed Hardwood Forests	Fair
Young Forests	Poor
Maritime Forests	Poor

Often over looked are the small tracts of forest that remain within the most heavily developed sections of the state in municipal parks, cemeteries, hospital grounds, schools, and other marginally protected sites. In these areas, the composition of plant species has been altered by the replacement of native species with invasive and exotic species. As a result, the sub-habitat is not recognizable as any naturally-occurring forest type in Connecticut. Despite changes in species composition, these areas can support canopy and cavity nesting birds and can also serve as valuable resting and feeding areas for migrating songbirds.

Upland Woodland and Shrub

Upland woodland and shrub habitats are characterized by trees and tall shrubs, deciduous, coniferous, or mixed, where tree crowns are widely separated (25-60% canopy cover).



Early successional habitats are defined as uplands where natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs. Historically, these habitats would have developed in openings within the predominantly forested landscape. These openings were created by natural disturbance, primarily severe storms and fires. Today, the majority of these habitats are anthropogenic in origin. The widespread clearing of the forest for wood and farmland provided a large amount of potential early successional habitat that developed to its maximum extent during the post-Civil War era, when large tracts of farmland were abandoned. Today, abandonment of farmland has stabilized and most old field habitat is created and maintained on State management areas, conservation properties, and other private lands under management agreements. Other places where early successional habitats are fostered include logging sites and utility rights-of-way (e.g., electric power lines and gas pipelines).

Assessing the amount of shrubland habitat in Connecticut depends on the historic reference point used. During the pre-settlement era, when natural disturbances governed the amount and distribution of shrublands, this habitat comprised an estimated three percent of Connecticut's inland area. Near the coast, where there was constant impact from maritime winds and higher storm frequencies, shrublands were more extensive and comprised more than 15 percent of the landscape. Populations of shrubland animals probably reached their greatest densities in these habitats (Litvaitis 2003).

Shrubland wildlife significantly benefited from the increase of old field habitat that reached its peak circa 1870 when less than 30 percent of the state was forested. Since that time there has been a steady decline in shrubland habitat as old fields succeed to forest and former farms are converted to residential and commercial developments.

The occurrence of natural disturbances are not sufficient to maintain or create enough shrubland to support those GCN species identified with this habitat. As a result, anthropogenic methods are used to augment the creation of natural shrublands. Litvaitis (2003) argues that such an approach should avoid actions that jeopardize the survival of species affiliated with other habitats, especially mature forests. Rather, efforts to provide shrubland habitats in human-dominated landscapes should incorporate existing modified lands to avoid concerns of additional habitat fragmentation. Large, clustered patches of shrubland habitat may be more practical and beneficial, especially in coastal areas where the creation and maintenance of shrublands can augment naturally-maintained shrubland habitats.

This key habitat classification includes four sub-habitats determined to be most important to wildlife (Table 2.3).

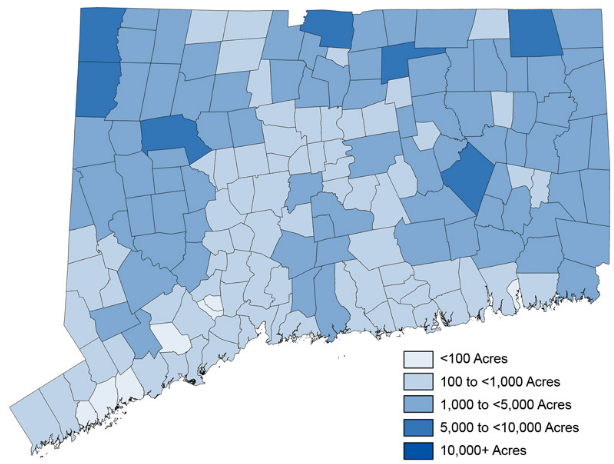
TABLE 2.3: SUB-HABITATS OF THE UPLAND WOODLAND AND SHRUB KEY HABITAT GROUP.

Sub-habitat	Condition
Red Cedar Glades	Fair
Pitch Pine and Scrub Oak Woodlands	Poor
Maritime Shrublands	Poor
Reverting Field and Early Successional Shrubland	Fair

Examples of Upland Woodland and Shrub communities in Connecticut include West Rock Ridge State Park in Hamden (Red Cedar Glade), Hopeville Pond Natural Area Preserve in Griswold (Pitch Pine and Scrub Oak Woodland), and Hammonasset Natural Area Preserve in Madison

(Maritime Shrubland). The overall distribution of upland woodlands and shrub habitats in Connecticut is not well known at this time; the relative condition of this key habitat is fair-to-poor. Priority areas for this habitat type include all publicly owned and managed lands where these types are found.

Upland Herbaceous



Upland herbaceous habitats are characterized by herbaceous plants (sedges, grasses, herbs, forbs, and ferns) forming more than 25 percent of the cover. Areas with scattered trees, shrubs, and dwarf-shrubs with more than 25 percent cover are included in this classification.

Grassland habitats provided by hayfields and pastures support a distinct assemblage of nesting birds and invertebrates. Although the origin and history of this fauna in southern New England is conjectural, the conversion of much of the Connecticut landscape to agriculture by 1850 created significant acreages of grassland habitat and consequent increases in grassland species.

However, unlike the naturally-maintained grasslands of the Midwest, grassland habitats in Connecticut are typically ephemeral and depend on semi-regular management to prevent encroachment from woody species. State-listed grassland birds, including barn owl, northern harrier, and grasshopper sparrow are found in the largest patches of grassland habitat, and where there is also a lack of mammalian predators.

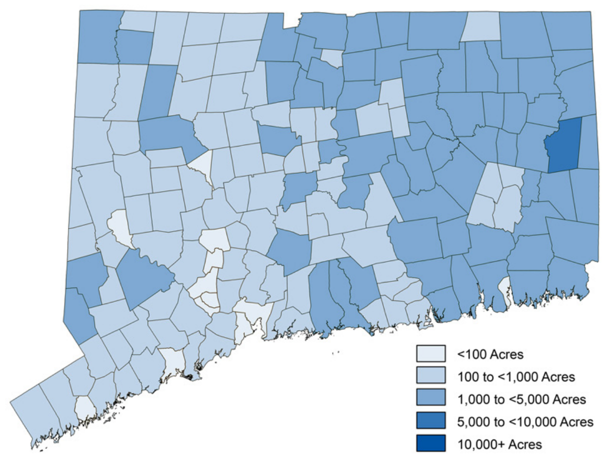
Grassland species have declined because much of the original farmland was abandoned or more recently sold and converted to other uses. In addition, farmland is managed more intensively today to maximize production, with more frequent haying schedules often coinciding with nesting periods of grassland birds. Also, the amount of grassland in contiguous blocks is critical to determining the value of a specific tract of land for grassland birds. For example, upland sandpiper and grasshopper sparrow generally do not inhabit grasslands less than 50 acres in size, and today this size restriction limits the distribution of these birds to the larger non-agricultural, but otherwise heavily managed, grasslands found at airports and military reservations.

The Upland Herbaceous key habitat includes several sub-habitats (Table 2.4). Examples of Upland Herbaceous habitats include Bushy Point at Bluff Point State Park and Coastal Reserve in Groton (Coastal Dunes), Talcott Mountain State Park in Simsbury (Grassy Glades and Balds), and Clarkhurst Wildlife Management Area in Haddam (Warm Season Grassland). Upland Herbaceous habitats are scarce and declining in Connecticut. The relative condition of this habitat type is fair, with Higganum Meadows identified as a priority area.

TABLE 2.4: SUB-HABITATS OF THE UPLAND HERBACEOUS KEY HABITAT GROUP.

Sub-habitat	Condition
Coastal Beaches and Dunes	Good-Fair
Grassy Glades and Balds	Fair-Poor
Sand Barrens and Sparsely Vegetated Sand and Gravel	Fair-Poor
Warm Season Grasslands	Poor
Cool Season Grasslands	Good

Forested Inland Wetlands



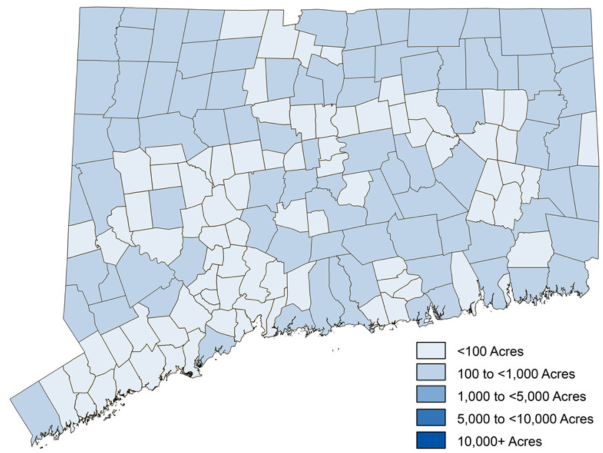
Forested inland wetland habitats are characterized by hydric soils with evergreen and/or deciduous trees forming 60 to 100 percent of the canopy cover. Forested swamps are topographical basins that contain deposits of decomposed peats and mucks and slow-moving or stagnant water. Floodplain forests are more dynamic systems governed by annual flooding regimes along major rivers. Connecticut has approximately 100,000 acres of forested wetlands, with red maple forests being the most common.

There are five sub-habitats of the Forested Inland Wetland Key Habitat group (Table 2.5) ranging in condition rank from poor to good. Examples of Forested Wetlands include Chester Cedar Swamp National Natural Landmark in Chester (Atlantic White Cedar Swamp), Holleran Swamp in Colebrook (Red Spruce Swamp), and Wangunk Meadows Wildlife Management Area in Portland (Floodplain Forest).

TABLE 2.5: SUB-HABITATS OF THE FORESTED INLAND WETLAND KEY HABITAT GROUP.

Sub-habitat	Condition
Red Maple Swamps	Good
Atlantic White Cedar Swamps	Poor
Northern White Cedar Swamps	Poor
Red/Black Spruce Swamps	Unknown
Floodplain Forests	Fair-Good

Shrub Inland Wetland



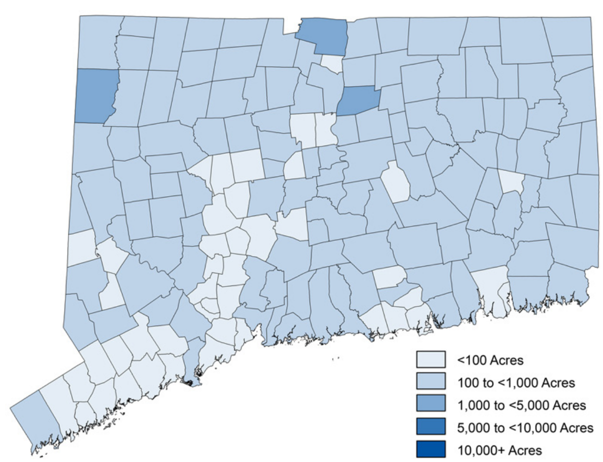
Shrub inland wetland habitats are characterized by hydric soils and more than than 25 percent cover of shrubs generally taller than 1.5 feet. Trees may also be present, but forming less than 25 percent of the canopy. This habitat type is found throughout Connecticut. The overall status and distribution of shrub freshwater wetland habitats in Connecticut is not well known at this time. There are no identified priority areas, and the relative condition is currently unrated.

This key habitat classification includes two sub-habitats determined to be most important to wildlife: (a) Bogs and Fens and (b) Shrub Swamps (Table 2.6). Shrub Swamps are variable in composition and include red maple sapling swamps, willow and alder thickets, and highbush blueberry/swamp azalea swamps. Bogs and Fens are natural peatlands that occur in topographic basins influenced by groundwater. Examples of Shrub Inland Wetlands include Mohawk Mountain Black Spruce Bog in Cornwall and Pachaug State Forest in Voluntown.

TABLE 2.6: SUB-HABITATS OF THE SHRUB INLAND WETLAND KEY HABITAT GROUP.

Sub-habitat	Condition
Bogs and Fens	Fair
Shrub Swamps	Unknown

Herbaceous Inland Wetland



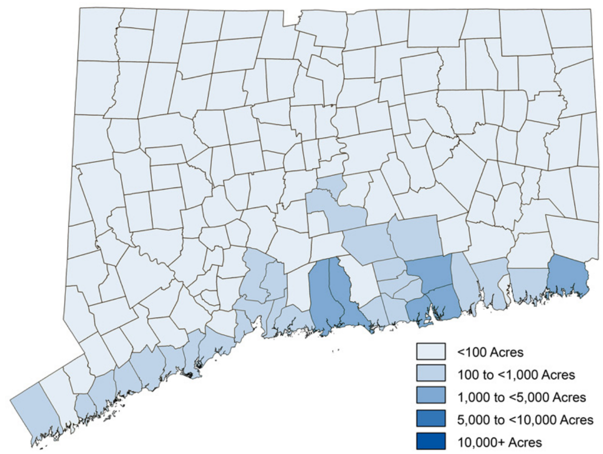
Herbaceous inland wetland habitats are wetlands dominated by herbaceous plants (grasses, sedges, forbs, and ferns) with less than 25 percent of woody plant (tree, shrub, and dwarf-shrub) cover. The extent and distribution of herbaceous inland wetlands is not well known at this time, but all state-owned marshes are identified as priority areas.

This key habitat classification includes three sub-habitats determined to be most important to wildlife (Table 2.7), including the freshwater marsh sub-habitats that are tidally influenced. Examples include Beeslick Pond in Salisbury (Calcareous Spring Fen) and Charter Marsh in Tolland (Freshwater Marsh).

TABLE 2.7: SUB-HABITATS OF THE HERBACEOUS INLAND WETLAND KEY HABITAT GROUP.

Sub-habitat	Condition
Calcareous Spring Fens	Poor
Freshwater Marshes	Unknown
Wet Meadows	Fair

Tidal Wetland



Tidal wetlands are coastal lowlands, typically dominated by herbaceous plants, that are diurnally flooded by saline or brackish tidal waters. In southern New England tidal wetlands have been reduced by approximately 50 percent since 1900 through filling, dredging, and ditching activities (Rozsa 1995). Today there are approximately 19,300 acres of tidal wetlands distributed along the shoreline of Connecticut. The relative condition of tidal wetlands in Connecticut ranges from poor to good. Three priority areas have been identified: Oyster River and lower Connecticut River marshes (Old Saybrook), lower Quinnipiac River/Mill River marshes (New Haven), and Great Meadow Marsh/Long Beach (Stratford). These three wetlands are at or near the mouths of major rivers flowing into the Long Island Sound (Housatonic, Quinnipiac, and Connecticut). They are also located in urban/suburban areas where their integrity is threatened by development or alteration.

This key habitat includes two sub-habitats determined to be important to wildlife: (a) Salt and Brackish Marshes and (b) Intertidal Beaches, Flats, and Shores (Table 2.8). The statewide condition of these sub-habitats is not well studied, but there are examples of each sub-habitat that are ranked as good. Examples of Tidal Wetlands include the Great Meadow Salt Marsh in Stratford and the Charles E. Wheeler Wildlife Management Area in Milford.

Estuarine habitats are primarily governed by the degree of daily tidal exchange and consequent water salinity. The predominant estuarine habitat in Connecticut is salt marsh. A salt marsh is a mosaic of communities dominated by plants adapted to varying salinity levels, determined by the degree of daily inundation of salt water. The largest salt marsh complexes develop within protected coves, bays, and salt ponds, but about ten percent are fringe marshes of less than five yards width. These are mostly found along the upper portions of tidal rivers. Salt marshes are universally considered to be among the most important wildlife habitats in North America, and Connecticut's contribution to the regional distribution and conservation of this habitat type is significant.

Brackish marshes occur where fresh and salt water mix. These marshes support a graminoid plant community and a high diversity of plants. Because of their rarity and limited extent, brackish marsh communities are extremely vulnerable to the impacts of climate change, especially rising sea level. Recently, application of SLAMM (Sea Level Affecting Marshes Model) modeling at several Northeast Federal Wildlife Refuges has projected that the initial impact of sea level rise will be an increase in salt marsh (saline) habitats at the expense of brackish habitats (MCCS and NWF 2012). SLAMM modeling is currently being applied to the Connecticut-Rhode Island coast (Boyd and Rubinoff 2014), and preliminary results indicate that the degree of brackish marsh loss is dependent on the accessibility of adjacent upland and/or freshwater wetland sites for inland marsh migration. DEEP recently partnered with the EPA's Long Island Sound Study and the New England Interstate Water Pollution Control Commission to apply SLAMM modeling to Connecticut's coast. The goal was to identify adaptive actions in response to such anticipated change. While there are many uncertainties resulting from limited date, the study concludes that 50 to 97 percent of high marsh or irregularly flooded marsh will be lost by 2100. Many factors may change before that time, but models like this can be useful to help direct habitat and species conservation.

Subtidal estuarine aquatic eelgrass beds are also a valuable habitat in Connecticut. Eelgrass plays a crucial role in the health of coastal systems because it provides critical habitat for juvenile marine life, stabilizes sediments, and aids in filtering particles from the water column. Eelgrass was once common along the entire Connecticut coastline, but at least 90 percent of eelgrass beds disappeared in the 1930’s due to an eelgrass wasting disease along the Atlantic Ocean in Europe and North America. An estimated two thirds of the original eelgrass beds in central and western Long Island Sound were lost; but eelgrass has since returned to eastern Long Island Sound. The U.S. Fish and Wildlife Service’s National Wetlands Inventory Program (NWI) has conducted eelgrass inventories for the eastern end of Long Island Sound since 2002.The 2012 survey located 240 eelgrass beds in eastern Long Island Sound totaling 2,061 acres with seven areas totaling over 100 acres. An additional 80 beds of undetermined submerged aquatic vegetation, totaling approximately 584 acres, were also identified (Tiner et al. 2013).

More than 50 percent of the estuarine marshes present in Connecticut at the time of European settlement have been lost (Cowardin et. al. 1979), primarily by draining or filling to provide sites for coastal development, including docks, marinas, petroleum storage facilities, industrial parks, and landfills. Moreover, most currently existing estuarine marshes have been ditched and sprayed for mosquito control. Most of these impacts have been reduced or eliminated, at least to some degree, but estuarine habitats face newer threats from the impacts of climate change, especially sea level rise. Climate change vulnerability assessments, including those prepared by the Manomet Center for Conservation Sciences (MCCS and NWF 2012), consistently identify brackish marshes as the most vulnerable to these impacts.

TABLE 2.8: SUB-HABITATS OF THE TIDAL WETLAND KEY HABITAT GROUP.

Sub-habitat	Condition
Salt and Brackish Marsh	Fair
Intertidal Beaches, Flats and Rocky Shores	Fair

Freshwater Aquatic

Freshwater aquatic habitats in Connecticut include large rivers, streams, lakes, and ponds, as well as vegetated and non-vegetated habitats. When present, vegetation may be emergent or submerged. Dams, diversions, culverts, and other man-made structures greatly affect the quality of these habitats. In many cases, they represent significant threats to GCN species that rely on these habitats. There are approximately 15,000 miles of rivers and streams and 6,000 lakes and ponds in Connecticut. Many of Connecticut's aquatic habitats are in fair condition depending on the level of development or modification of adjoining riparian zones and terrestrial habitats. No priority areas are identified at this time.

This key habitat classification includes six sub-habitats determined to be most important to wildlife (Table 2.9). Examples of freshwater aquatic habitats include the Connecticut and Housatonic Rivers and tributaries.

TABLE 2.9: SUB-HABITATS OF THE FRESHWATER AQUATIC KEY HABITAT GROUP.

Sub-habitat	Condition
Large Rivers and their Associated Riparian Zones	Fair
Unrestricted Free-flowing Streams	Fair
Cold Water Streams	Fair
Head-of-Tide and Coastal Streams	Fair
Lakes and their Shorelines	Fair
Coastal Plain Ponds	Poor

Estuarine Aquatic

Estuarine aquatic habitats in Connecticut include coastal and tidal waters of varying salinity and substrates associated with Long Island Sound. Among these are the aquatic zones of Long Island Sound and upstream areas influenced by tides with intermediate salinity levels (at least 0.5 ppt). Indicators used to determine the relative condition of the sub-habitats include all resident estuarine and marine species, such as striped bass, bluefish, winter flounder, sea robins, killifish, tomcod, and hogchokers, as well as diadromous species, such as American shad, blueback herring, alewife, sea lamprey, smelt, and American eel. More than 120 species of finfish have been recorded as resident or migratory species in this habitat.

The Long Island Sound estuary includes 3,370 sq. km (1,301 sq. miles) forming approximately 655 km (253 miles) of coastline in Connecticut. Estuarine aquatic habitats extend from the open water of Long Island Sound, with various submerged substrates, to intertidal coves, bays, and the head-of-tide of major rivers flowing into the Sound (west to east, principally the Housatonic, Quninnipiac, Connecticut, and Thames Rivers). The relative condition of estuarine aquatic habitats varies. The lower Connecticut River, Thames River (New London), Black Rock and Bridgeport Harbor (including Lewis Gut), and the New Haven Harbor are all identified as priority areas.

This key habitat classification includes eight sub-habitats determined to be most important to wildlife (Table 2.10). Examples of Estuarine Aquatic habitats include the Lower Connecticut River (Coastal River), Bluff Point State Park in Groton (Vegetation Bed), and Falkner Island (Sponge Bed).

TABLE 2.10: SUB-HABITATS OF THE ESTUARINE AQUATIC KEY HABITAT GROUP.

Sub-habitat	Condition
Coastal Rivers, Coves and Embayments	Variable
Vegetation Beds	Variable
Hard Bottoms	Variable
Sponge Beds	Variable
Shellfish Reefs and Beds	Variable
Sedimentary Bottoms	Variable
Open Water	Good-Excellent
Algal Beds	Variable

Unique; Natural or Man-made

This last category includes: (1) unique landscape features that may support one or more key habitats, (2) small-scale habitat features that occur within multiple key habitats, and (3) anthropogenic features, including manmade structures, that used by wildlife. Relative condition, extent/distribution, and identified priority areas vary based on the sub-habitat being described. This key habitat group includes 11 sub-habitats determined to be most important to wildlife (Table 2.11).

TABLE 2.11: SUB-HABITATS OF THE UNIQUE; NATURAL OR MAN-MADE KEY HABITAT GROUP.

Sub-habitat	Condition
Traprock Ridges	Good
Offshore Islands	Variable
Coastal Bluffs and Headlands	Unknown
Caves and other Subterranean Habitats	Fair
Urban and Man-made Features	Poor
Cliffs and Talus Slopes	Good
Surface Springs and Seeps	Variable
Vernal Pools	Unknown
Agricultural Lands	Good
Navigational Channels, Breakwaters, Jetties and Piers	Variable
Public Utility Transmission Corridors	Good-Poor

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