



# MAINE'S WILDLIFE ACTION PLAN

## Element 2: Key Habitats and Natural Communities

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Prepared by

**Maine Department of Inland  
Fisheries and Wildlife**

In collaboration with

**Maine's Conservation Partners**

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**KEY TO ACRONYMS**

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GIS	Geographic Information System
MCP	Maine Coastal Program
MDIFW	Maine Dept. of Inland Fisheries and Wildlife
MDMR	Maine Dept. of Marine Resources
MNAP	Maine Natural Areas Program
NALCC	North Atlantic Landscape Conservation Cooperative
NETHCS	Northeast Terrestrial Habitat Classification System
SGCN	Species of Greatest Conservation Need
SWAP	State Wildlife Action Plan
TNC	The Nature Conservancy
USFWS	U.S. Fish and Wildlife Service
WMA	Wildlife Management Area

*What is most striking in the Maine wilderness is the continuousness of the forest, with fewer open intervals of glades than you had imagined. Except the few burnt lands, the narrow intervals on the rivers, the bare tops of the high mountains, and the lakes and streams...the forest is uninterrupted.*

Henry David Thoreau, 1846: *The Maine Woods*

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## 2.0 ABSTRACT

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Element 2 identifies the extent and condition of wildlife habitats and community types essential to the conservation of Species of Greatest Conservation Need (SGCN). Maine's Wildlife Action Plan employs The Northeast Terrestrial Habitat Classification System (NETHCS) to identify the extent of habitats and community types essential to the conservation of SGCN. Federal and state agencies in the Northeast have endorsed the NETHCS as a tool for assessing habitat distribution and composition on a regional scale. The specific version of the NETHCS used in Maine includes a number of modifications made by the Maine Department of Marine Resources (MDMR) and the Maine Department of Inland Fisheries and Wildlife (MDIFW) to reflect Maine's landscape and coastal features. The basic layer within NETHCS is the habitat 'system', which corresponds to the national Ecological Systems classification. There are approximately 150 Ecological Systems in Maine. MDIFW and conservation partners used the more general 'Macrogroup' level of this hierarchical system for assigning stressors (Element 3) and some analyses; there are 42 habitat macrogroups in Maine.

Maine further consolidated the macrogroups into three broad habitat categories to facilitate development of conservation actions and ease of Plan use by conservation partners. The broad categories are Coastal and Marine, Terrestrial (including Freshwater Wetlands) and Freshwater Aquatic (Rivers, Lakes, and Ponds). The importance of various habitats to SGCN is not directly correlated to their statewide abundance; habitats such as pine barrens, open freshwater wetlands, and rivers and streams are dis-proportionately important compared to many other habitat types. It is estimated that there are presently 3,824,842 acres of conservation land in Maine, accounting for nearly 20% of the State. Much of this conserved land lies within Focus Areas of Statewide Ecological Significance, which have been identified to help prioritize conservation of Maine's landscape for SGCN and other habitat values (Element 4).

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## 2.1 SIGNIFICANT CHANGES FROM MAINE'S 2005 PLAN

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Drawing from several sources, Maine's 2005 Plan highlighted 21 habitat types and provided overviews (by ecoregions) across the State (<http://www.maine.gov/ifw/wildlife/reports/wap.html>). This Plan does not attempt to replicate that detailed narrative. Important changes in Element 2 of the 2015 Wildlife Action Plan include:

- Standard habitat classification: This Plan employs the NETHCS developed by The Nature Conservancy (TNC) in collaboration with fish and wildlife agencies. Habitat associations for SGCN are made with 'systems,' the finest resolution of this hierarchical system. Federal and state programs in the Northeast have endorsed the NETHCS as a standard that is compatible with nationwide classifications (<http://www.landfire.gov/>).

- Standard habitat mapping: NatureServe and TNC developed seamless GIS coverage to assess habitat distribution and composition terrestrial and freshwater systems in the Northeast. The specific version of the NETHCS used in Maine includes a number of minor alterations and additions made by the University of Massachusetts, as well as minor modifications made by the MDMR and MDIFW to improve resolution on some Maine's landscape and coastal features.
- SGCN - habitat associations: We evaluated SGCN occurrences at two different scales of habitat classification: approximately 150 'systems' grouped within 42 'macrogroups'. The results demonstrate that Maine's current assemblage of 378 SGCN occur disproportionately relative to the extent of habitat types within the State.
- Broad habitat groupings: We further consolidated the macrogroups into three broad ecosystem categories to facilitate discussion among conservation partners during the consideration of the extent and condition of SGCN habitats and during the development of conservation actions. The broad categories are Marine; Terrestrial, including Freshwater Wetlands; and Freshwater Rivers, Streams, Lakes, and Ponds.
- State Wildlife Action Plan database: As elsewhere in this Plan, the tabular compilation of SGCN associations in each of 42 'macrogroups' (Table 2-3) also functions as a gateway to more detailed reports. Each macrogroup summary reports compiles associated SGCN and major stressors for that system. Such information can be readily updated in the 10-year horizon of the Plan.

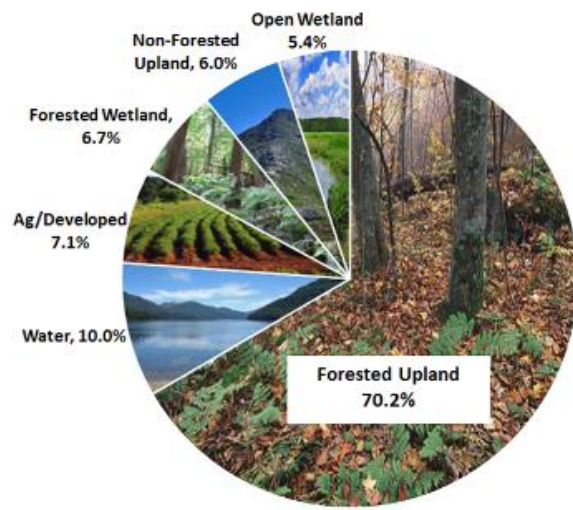
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## 2.2 LANDSCAPE OVERVIEW OF MAINE

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Maine encompasses approximately 21 million acres of lands and waters, from the dramatic coastline to the heights of Mount Katahdin. Maine is as large as the remaining New England states combined, and more than 31,800 miles of streams and rivers and 5,600 lakes and ponds dot the landscape. Maine's scenic, rock-bound coast is 4,100 miles long and embraces 4,613 islands between Kittery and Eastport. Roughly one quarter of the state consists of freshwater wetlands, including hardwood floodplains, freshwater marshes, and dense assemblages of vernal pools. At nearly 90% forest cover, Maine is the most heavily forested state in the United States, but it also contains some of the most significant grassland and farmlands in the Northeast. Maine's broad habitat types are shown in Figure 2-1.

**Figure 2-1.** Broad breakdown of habitat types in Maine (Source: NatureServe Ecological Systems GIS layer, 2012).




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### 2.2.1 CLIMATE

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Maine's climate plays a major role in determining the plant and animal assemblages within the State. The National Weather Service separates Maine into three distinct climatological divisions – coastal, southern interior, and northern interior (Brandes 2001). The coastal division runs from Kittery to Eastport and about 20 miles inland. Here the ocean moderates the climate, making coastal winters warmer and summers cooler than the interior. The southern interior division, covering the bottom one-third of the state, has the warmest summer weather and the highest numbers of clear days, whereas the northern interior (upper two-thirds of the state) boasts a mixed bag of snowy winters, warm summers, and the state's lowest rainfall.

Potential changes to Maine's climate, and their subsequent impacts on Maine's habitats and wildlife, have been the focus of recent studies by the University of Maine, conservation groups, and state agencies (Whitman et al. 2013, Fernandez et al. 2015). These changes include rising seas, altered natural disturbance processes (e.g., increased fire), changes in hydrology of wetlands and waterways, and transitions in forest composition. Despite uncertainties regarding the magnitude and timing of future changes in Maine's climate, there is a general understanding that high elevation habitats, boreal forests and peatlands, tidal marshes, and cold water fisheries are among Maine's vulnerable habitats (Whitman et al. 2013). Potential climate change impacts on SGCN are discussed in Element 3, and associated conservation actions are addressed in Element 4.

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### 2.2.2 PHYSIOGRAPHY

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Maine's western border adjoining New Hampshire and Quebec is characterized by rugged terrain with numerous glacier-scoured peaks, lakes, and valleys. The Appalachian Mountain chain, formed nearly 500 million years ago, extends into Maine from New Hampshire,

terminating at the 5,268-foot Mount Katahdin. South and east of mountain areas lie rolling hills, smaller mountains, and broad river valleys. Maine's coastline consists of long sand beaches interrupted intermittently by rocky promontories in the southwest, and a series of peninsulas, narrow estuaries, bays, and coves north and east of Portland. Tides along Maine's coast are among the highest in the world, running between 12 and 24 feet. More than 4,600 islands dot the coast, some no more than rock ledges; others are vegetated and home to fulltime and seasonal residents.

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## 2.3 HABITAT CLASSIFICATIONS

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Fish and Wildlife Agencies in the Northeast have agreed to a regional standard for evaluating habitats within each State (Terwilliger and NEFWDC 2013). This commitment not only eliminates the >900 classifications used individually by 13 northeastern states in 2005 plans, it aids regional conservation strategies across boundaries. In fact the North Atlantic Landscape Conservation Cooperative (NALCC; Anderson et al. 2015) recently extended this NETHCS coverage into the Canadian Maritime provinces and southern Quebec. Maine shares a longer border with both New Brunswick and Quebec than it does with the continental U.S. Therefore, many landscape analyses, SGCN assessments, and conservation efforts in Maine benefit from an international perspective with Atlantic Canada.

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### 2.3.1 NORTHEAST TERRESTRIAL HABITAT CLASSIFICATION SYSTEM

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The NETHCS, initially developed by NatureServe and TNC, is a hierarchical framework for characterizing ecological systems and mapping habitats in the region (TNC and NatureServe 2011). TNC subsequently refined the classification system with collaboration and funding from the Regional Conservation Needs Grants administered by the Northeast Association of Fish and Wildlife Agencies and U.S. Fish and Wildlife Service (USFWS). NETHCS serves as a standard for assessing habitat distribution and composition across the Northeast. The mapping effort is augmented by profiles of many common habitat systems (Anderson et al. 2013a), extent and condition analyses (Anderson et al. 2013b), and an evaluation of site resiliency (Anderson et al. 2011). Details of the NETHCS methodology are available at a TNC website: <https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/dc/reportsdata/terrestrial/habitatmap/Pages/default.aspx>.

The specific version of the NETHCS used for Maine's State Wildlife Action Plan (SWAP) includes a number of minor alterations and additions made by the University of Massachusetts (digital 'ESM Plus' layer available from NALCC), with additional minor modifications by the MDMR and MDIFW to reflect Maine's landscape and coastal features. State-based modifications include incorporation of a geographic information system (GIS) layer of impermeable surfaces by MDIFW, and finer-scaled marine classes identified by MDMR that reflect underlying substrate and biotic composition in the intertidal and subtidal areas.

The basic layer within NETHCS is the habitat 'system', which corresponds to the Ecological Systems classification. There are approximately 150 Ecological Systems in Maine, and all have been entered into the SWAP database. These include natural vegetated habitats ('Boreal Laurentian Bog'), freshwater aquatic systems ('Headwaters and Creeks'), marine systems ('Gastropod Reef'), and human-modified habitats ('Powerline Right of Way').



It is important to note that only about 50 of the 150 ecological systems are reflected in the GIS map layer because of scale limitations or difficulty of distinguishing tidal and subtidal habitats.

It should also be noted that although the classification system can accommodate structural modifiers (e.g., early successional forest), the GIS layer upon which our analyses are based does not generally distinguish between successional stages of forest. Therefore, the 'Northern Hardwood and Conifer' macrogroup, for example, includes forest stands of all successional stages. Forest condition and structure (e.g., canopy closure, vertical layering) are important habitat characteristics for many SGCN. However, the NETHCS GIS habitat layer is not an effective source for this spatial information. Other sources of information on forest condition include the U.S. Forest Service's Inventory and Analysis Program and various remote sensing data sources such as the Global Forest Change 2000-2014 project ([http://earthenginepartners.appspot.com/science-2013-global-forest/download\\_v1.2.html](http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.2.html)).

The more general 'Macrogroup' level was used for several of our analyses. There are 42 habitat macrogroups in Maine, though not all of these are mapped (e.g., intertidal mollusc reef). Acreages for terrestrial, wetland, and freshwater macrogroups mapped in Maine are shown in Table 2-1 (shown in descending order of statewide acreage). Spatial mapping of marine habitats is particularly challenging and has not occurred.

**Table 2-1.** Acreages of habitat macrogroups and proportions conserved in Maine. Sources: NatureServe Ecological Systems GIS map (2012) and Maine Conserved Lands Database (2015). Extent of marine habitat macrogroups cannot be determined.

Habitat Macrogroup	Acres in state	% of State	% Conserved
Northern Hardwood & Conifer	8,787,683	39.87%	17.1%
Boreal Upland Forest	6,560,611	29.77%	26.0%
Open Water	2,206,392	10.01%	1.9%
Northern Swamp	1,435,003	6.51%	18.9%
Agricultural	802,154	3.64%	1.2%
Urban/Suburban Built	765,055	3.47%	4.6%
Emergent Marsh	438,838	1.99%	52.2%
Northern Peatland	362,022	1.64%	27.9%
Wet Meadow / Shrub Marsh	354,013	1.61%	19.4%
Central Oak-Pine	126,500	0.57%	13.3%
Outcrop & Summit Scrub	64,435	0.29%	33.5%
Cliff and Talus	43,774	0.20%	49.4%
Northeastern Floodplain Forest	29,135	0.13%	13.8%
Salt Marsh	26,213	0.12%	30.2%
Ruderal Shrubland & Grassland	22,632	0.10%	7.1%
Alpine	3,624	0.02%	99.1%
Coastal Grassland & Shrubland	4,443	0.02%	11.0%
Central Hardwood Swamp	2,790	0.01%	1.8%
Rocky Coast	3,146	0.01%	18.7%
Coastal Plain Swamp	654	0.00%	18.9%
Glade and Savanna	183	0.00%	16.4%

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### 2.3.2 COASTAL AND MARINE CLASSIFICATION SYSTEM

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Since the NETHCS focuses on habitats vegetated with vascular plants, the NETHCS marine and coastal habitat components had poor accuracy and low specificity, especially for intertidal and subtidal habitats. “Rocky coast,” “coastal,” and “tidal marsh” habitat macrogroups were retained from the NETHCS scheme because they have associated vegetation, but all intertidal and subtidal habitats were reclassified to increase the specificity and accuracy for these ecologically, culturally, and economically important habitats. Staff from MDMR and the Maine Coastal Program (MCP) worked with other SWAP partners to generate a coastal and marine habitat classification scheme for Maine’s marine and coastal environment (Table 2-2) that encompasses all areas from the high tide line to the boundary of state waters, which extend three nautical miles offshore.

This habitat scheme was based on several existing classification systems that were either too detailed for our intended purpose or did not encompass the diverse breadth of habitats found in the coastal and marine regions in Maine (Coastal and Marine Ecological Classification Standard 2012; Brown 1993). Although this scheme was adapted to fit the particular needs of the Maine SWAP, it is written in generalized terms, where possible, in order to fit the needs of surrounding New England states. Additionally, it is possible to crosswalk this scheme with the other classification schemes listed above in order to compare existing habitat classification and maps for the limited regions where these data exist. During the development of this habitat scheme, several gaps in knowledge were identified, including the geographic locations and spatial extents of most marine and coastal habitats, the health and resiliency of these habitats, and past and projected ecosystem changes over time. Thus, mapping marine and coastal habitats and monitoring their changes over time have been highlighted as priorities for the conservation of marine SGCN over the next 10 years.

There are five broad coastal and marine habitat *formations* associated with conservation actions (tidal marsh, rocky coast, coastal, intertidal, and subtidal). The tidal marsh formation includes all peat-forming tidal marshes. The rocky coast formation encompasses rocky habitats above the high tide line. The coastal formation encompasses coastal grasslands and shrublands. The intertidal and sub-tidal formations encompass all of the benthic and pelagic (water column) habitats from the littoral zone to the open ocean. These broad habitat groups were subdivided into 15 *macrogroups* based on wave energy and the resulting physical composition of the substrate for benthic habitats (e.g. tidal marsh, mud, sand, rock, etc.); pelagic habitats are classified separately (e.g. water column).

At the more specific habitat *system* level, additional biological and physical drivers that shape the ecosystem were incorporated into the classification scheme (e.g. presence of fauna and flora, relative nutrient concentration, desiccation and temperature stressors, etc.). In Maine, certain kinds of flora and fauna, such as eelgrass, kelp beds, and soft corals, form ecologically important habitats by creating a three-dimensional structure that rises above the substrate and serves as a nursery ground or can be used for protection by fishes and invertebrates. These habitats also tend to be vulnerable to environmental stressors. To highlight the importance and relative vulnerability of these habitats, the classification scheme lists these individually at the habitat system level. The language has been generalized to “submerged aquatic vegetation,” “kelp bed,” and “erect epifauna” to encompass additional flora and fauna that may exist throughout the northeast region in case other New England states elect to adopt this classification scheme.

**Table 2-2.** Coastal / marine habitat classification developed for the Maine Wildlife Action Plan.

Formation	Macrogroup	Habitat System	
Tidal Marsh	Intertidal Tidal Marsh (peat-forming)	Acadian Coastal Salt Marsh	
		Coastal Plain Tidal Marsh	
Rocky Coast	Rocky Coast	Acadian-North Atlantic Rocky Coast	
		North Atlantic Cobble Shore	
Coastal	Coastal Grassland & Shrubland	Northern Atlantic Coastal Plain Dune and Maritime Grassland	
		Northern Atlantic Coastal Plain Sandy Beach	
Intertidal	Intertidal Mudflat	Non-Vascular Mudflat	
		Freshwater Tidal Marsh	
		Submerged Aquatic Vegetation	
	Intertidal Sandy Shore		Sand Flat
			Submerged Aquatic Vegetation
			Sand Beach
	Intertidal Mollusc Reefs		Oyster Reef
			Gastropod Reef
			Mussel Reef
	Intertidal Bedrock		High Intertidal
			Mid-Intertidal
			Low-Intertidal
	Intertidal Gravel Shore		High Intertidal
			Mid-Intertidal
			Lower Intertidal
	Intertidal Water Column		Confined Channel
			Embayment
			Exposed Shore
Subtidal	Subtidal Mud Bottom	Unvegetated	
		Submerged Aquatic Vegetation	
	Subtidal Sand Bottom		Unvegetated
			Submerged Aquatic Vegetation
	Subtidal Mollusc Reefs		Oyster Reef
			Gastropod Reef
			Mussel Reef
	Subtidal Bedrock Bottom		Bedrock
			Kelp Bed
			Erect Epifauna
	Subtidal Coarse Gravel Bottom		Coarse Gravel
			Kelp Bed
Erect Epifauna			
Subtidal Pelagic (Water Column)		Nearshore	
		Offshore	
		Upwelling Zones	
		Confined Channel	

## 2.4 COASTAL AND MARINE ECOSYSTEMS

The Gulf of Maine watershed encompasses 69,115 square miles adjacent to Nova Scotia, New Brunswick, Maine, New Hampshire, Massachusetts, and Quebec. Maine is the only state or provincial jurisdiction located entirely within the watershed. The Gulf of Maine, largely created by glaciers 10,000 to 20,000 years ago, is a semi-enclosed sea bounded to the south and east by Browns Bank and Georges Bank, and includes the Bay of Fundy. Underwater valleys plunge to depths of 1,500 feet.

### Tidal Marshes and Estuaries

Gulf of Maine intertidal areas include salt marsh, rocky intertidal, and mudflat. The location and extent of these habitats are influenced by substrate, wave and tidal energy, tidal range, and slope. These habitats support several commercially important species as well as numerous SGCN.

*“Tidal marshes are among the most productive ecosystems on earth.”*

Tidal marshes occur throughout the Gulf of Maine as large estuarine complexes or small fringe marshes. Of more than 5 million acres of wetlands in the state, approximately 157,500 acres are tidal (tidal flats, salt marsh, brackish marsh, aquatic beds, beach bars and reefs), including roughly 22,000 acres of salt marsh (MDEP 1996, MEPC 1998, MNAP 2014). In fact, there are more tidal wetlands in Maine than in any state north of New Jersey (MEPC 1998).

Despite harsh growing conditions and low plant diversity, tidal marshes are among the most productive ecosystems on earth. They provide food, shelter, spawning, and nursery areas for Striped Bass (*Morone saxatilis*), Winter Flounder (*Pseudopleuronectes americanus*), and Mummichogs (*Fundulus heteroclitus*). Clams and Ribbed Mussels (*Geukensia granosissima*) inhabit tidal marshes and adjacent tidal flats, and birds rely on the rich food webs of tidal marshes for breeding and during migration.



A tidal marsh estuary in Sagadahoc County, Maine. © Maine Natural Areas Program

Estuaries, places where freshwater rivers meet the ocean, receive high concentrations of nutrients that are exported from watersheds, particularly during late winter and early spring snowmelt. Land-derived nutrients combine with nutrients from tidal marshes, rockweeds, and oceanic sources to stimulate phytoplankton growth throughout the year. Eelgrass and other submerged aquatic vegetation sometimes grow in estuaries and provide a three-dimensional habitat that serve as critically important nurseries for larval and juvenile invertebrates and fish, and feeding and nesting areas for migratory fish and birds. In addition, these areas serve as coastal storm buffers and filter sediments and pollutants before they reach coastal waters. Despite their

importance, up to 50% of the region's original estuarine marshes have been lost through various human activities (MEPC 1998), and many eelgrass meadows have receded dramatically over the last few years due to a myriad of known and unknown causes.

### Islands, Beaches, and Dunes

Roughly 500 Maine islands support nesting wading birds, seabirds, and Common Eiders. Islands cause upwelling of deep, nutrient-rich water to the sea surface, enriching nearby waters. Currents driven by tidal action swirl around islands and surge through passages, “creating a funnel effect that increases the volume of feed available to filter feeders, as well as those species that prey on the filter feeders” (Conkling 1995).

Nearly all of Maine's larger islands were cleared in the past, primarily for sheep or cattle pasture. Many islands were burned repeatedly to remove trees and increase hay production. Human use of the islands peaked roughly 100 years ago, and since early in this century, gradual abandonment of many islands has resulted in their reforestation. In the last few decades, recreational use and construction of seasonal homes have limited the ecological recovery of some islands.

Beaches, pounded by an average 8,000 waves a day, are high-energy, climatically extreme environments. They vary from long shorelines of fine-grained silt or sand to cobbleshores and boulders. Because of geological differences between western and Downeast Maine, large sand beaches are mostly limited to southern Maine. Sand dunes, often located upslope of sand beaches, are hillocks of wind-blown sand originally brought to the rear of beaches by ocean waves and stabilized by beach grasses. Major dune systems in Maine are located at Scarborough Beach and Popham and Reid State Parks.

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## 2.5 FRESHWATER AQUATIC ECOSYSTEMS

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Maine has more than 5,000 rivers and streams, encompassing 31,800 miles of flowing waters that cover nearly half of the watershed for the Gulf of Maine. These waterways and their riparian borders are important for Maine's fisheries and wildlife, and they also serve as an important recreational resource for anglers, canoers, and rafters. More of Maine's rivers and streams are undeveloped and free-flowing than any other state in the northeastern U.S. (Bennett 1988). The state's major rivers include the Penobscot (350 mi), the St. John (211 mi), the Androscoggin (175 mi), the Kennebec (150 mi), the Saco (104 mi), and the St. Croix (75 mi).



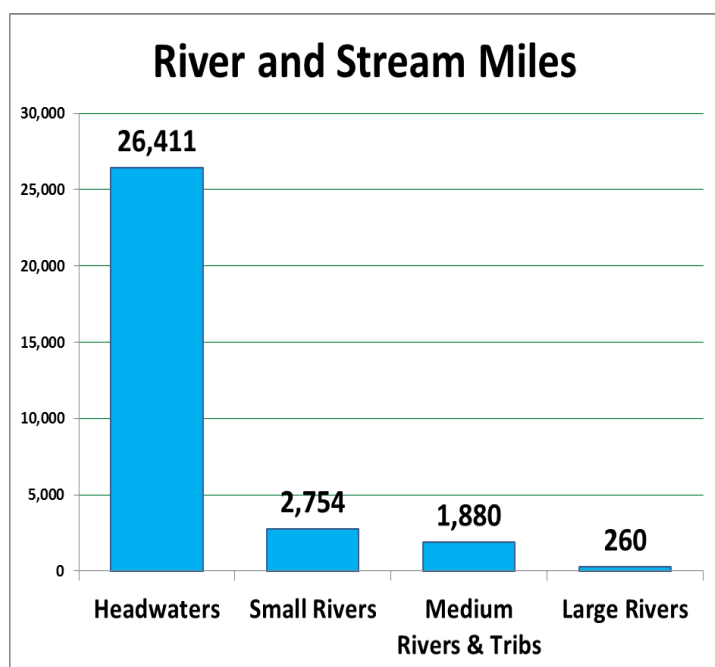
An oligotrophic lake in Somerset County, Maine. © Charlie Todd

However, the overwhelming majority of flowing water mileage in Maine is in headwater streams (Figure 2-2). Cold headwater streams and small rivers are vital habitat for Maine's brook trout, among other species, and Maine has the most extensive distribution and abundance of brook trout (*Salvelinus fontinalis*) throughout their native range in the U.S.

Maine also boasts more than 5,600 lakes and ponds, more than any other state in the Northeast. Moosehead Lake, covering about 117 mi<sup>2</sup>, is the state's largest lake, and Sebago Lake is the deepest at 316 ft (40 ft below sea level). The availability of nutrients and oxygen at different lake depths have important implications for fish habitat, and for the purposes of this

Action Plan, Maine’s lakes have been classified according to their nutrient and oxygen availability: oligotrophic (low nutrients, high oxygen), mesotrophic (intermediate nutrients and oxygen), eutrophic (nutrient-rich, low oxygen), and dystrophic (low oxygen, acidic/tannic waters). Maine also has a small number of fishless ponds, considered important for a variety of invertebrate and amphibian species.

**Figure 2-2.** River and stream mileage in Maine.




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## 2.6 TERRESTRIAL AND WETLAND ECOSYSTEMS

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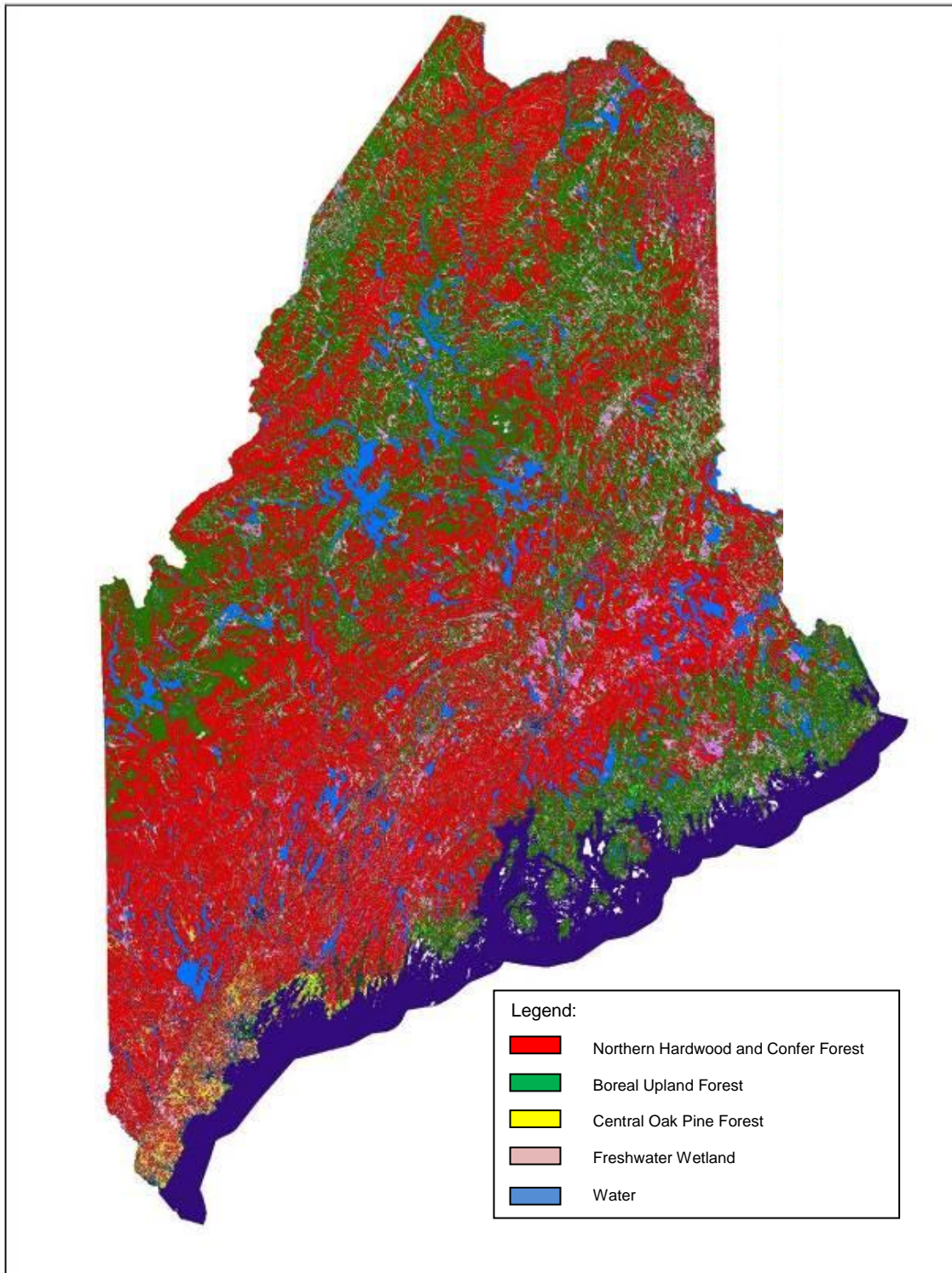
### Upland Forests

Maine falls in the transition between the deciduous forest region to the south and the boreal forest region to the north. Maine’s forests cover more than 17 million acres, making Maine the most heavily forested state in the nation. Unlike other regions where forest cover has been almost completely lost due to conversion to agriculture or other uses, Maine retains or has regrown much of its forest cover. Sixty-seven woody plant species reach their range limits in south-central Maine, and an additional 44 woody plant species define a coastal-inland transition zone, reaching their western range limits in a southwest-northeast belt bisecting the state (McMahon 1990). *Natural Landscapes of Maine* (Gawler and Cutko, 2010) describes 104 Natural Community types that are linked to the NatureServe’s National Vegetation Classification and the Ecological Systems.

*“Maine’s forests cover more than 17 million acres, making Maine the most heavily forested state in the nation.”*

At the macrogroup level, Maine’s most abundant forest type is Northern Hardwood and Conifer, which accounts for approximately 40% of the state and extends from York to Aroostook County (Figure 2-3). This macrogroup consists of a mosaic of northern hardwood, spruce-fir, and mixed

**Figure 2-3.** Generalized map of Maine habitat types, from the Northeastern Habitat Classification System.





forest types featuring Sugar Maple, American Beech, Yellow, Red Spruce, Balsam Fir, and Eastern Hemlock. Boreal Forest, which accounts for 30% of the state, is dominated by spruce-fir types and is most common in northern Maine and along the Downeast Coast. The Central Oak Pine macrogroup, characterized by White Pine and Red Oak, occurs in southernmost Maine and accounts for less than 1% of the state.

Forest structure and condition are important attributes for many wildlife species. Both early- (young) and late-successional (old) forests are uncommon in parts of Maine. Statewide, Maine's older forests (stand age of more than 120 years) account for less than 3% of the state (U.S. Forest Service 2014), and true old growth may be as little as 0.1% of the state (Barton et al. 2012). Maine's conserved lands, in particular those classified as Gap 1 and 2, are an important resource for older forest.

### Early Successional Habitats

In southern Maine, young forest is also uncommon. In York and Cumberland counties, forest younger than 40 years old accounts for less than 8% of the landscape, compared to more than 28% statewide (U.S. Forest Service 2014). In the Northeast U.S., and especially in Maine, terrestrial openings are most often the result of disturbances, whether by human activity or, historically, by wildfires (Askins et al. 2007). Open habitats increased greatly in the 18<sup>th</sup> and 19<sup>th</sup> centuries as settlers converted forests for agriculture (Todd 1940). By 1880, approximately 34% of Maine was cleared for farming (Day 1954), but that pattern reversed dramatically via reforestation during the 1900s (Powell and Dickson 1984). By 1997, only 6% of the state's land area was in agricultural use (National Agricultural Statistics 2009). That proportion has changed little during the past 30 years, but remaining farms are often row-crop agriculture. Pastures decline by 97% in the past 135 years as former pastures have re-grown. Wildfire suppression and reversion of fallow fields to forests have further reduced grasslands and shrublands.

### Freshwater Wetland Ecosystems

Freshwater wetlands account for roughly one quarter of the surface area of Maine (Calhoun 2001), four times the wetland area of the other New England States combined. Forested wetlands include red maple swamps, spruce flats, and cedar swamps, while non-forested wetlands range from large peatlands to emergent meadows created by beavers. In particular, Maine's diversity of peatland types is unequalled in the United States (Davis et al. 1983). The state's latitudinal, altitudinal, and coastal-inland gradients are all reflected in the varying peatland morphologies and vegetation composition. Some Maine peatland types are rare in the state (maritime slope bogs, coastal plateau bogs, circumneutral fens, patterned fens, and eccentric bogs), while others are more common (unpatterned fens, level bogs, kettlehole bogs and ponds, and some streamshore ecosystems).

*“Freshwater wetlands account for roughly one quarter of the surface of Maine, four times the wetland area of the other New England states combined.”*

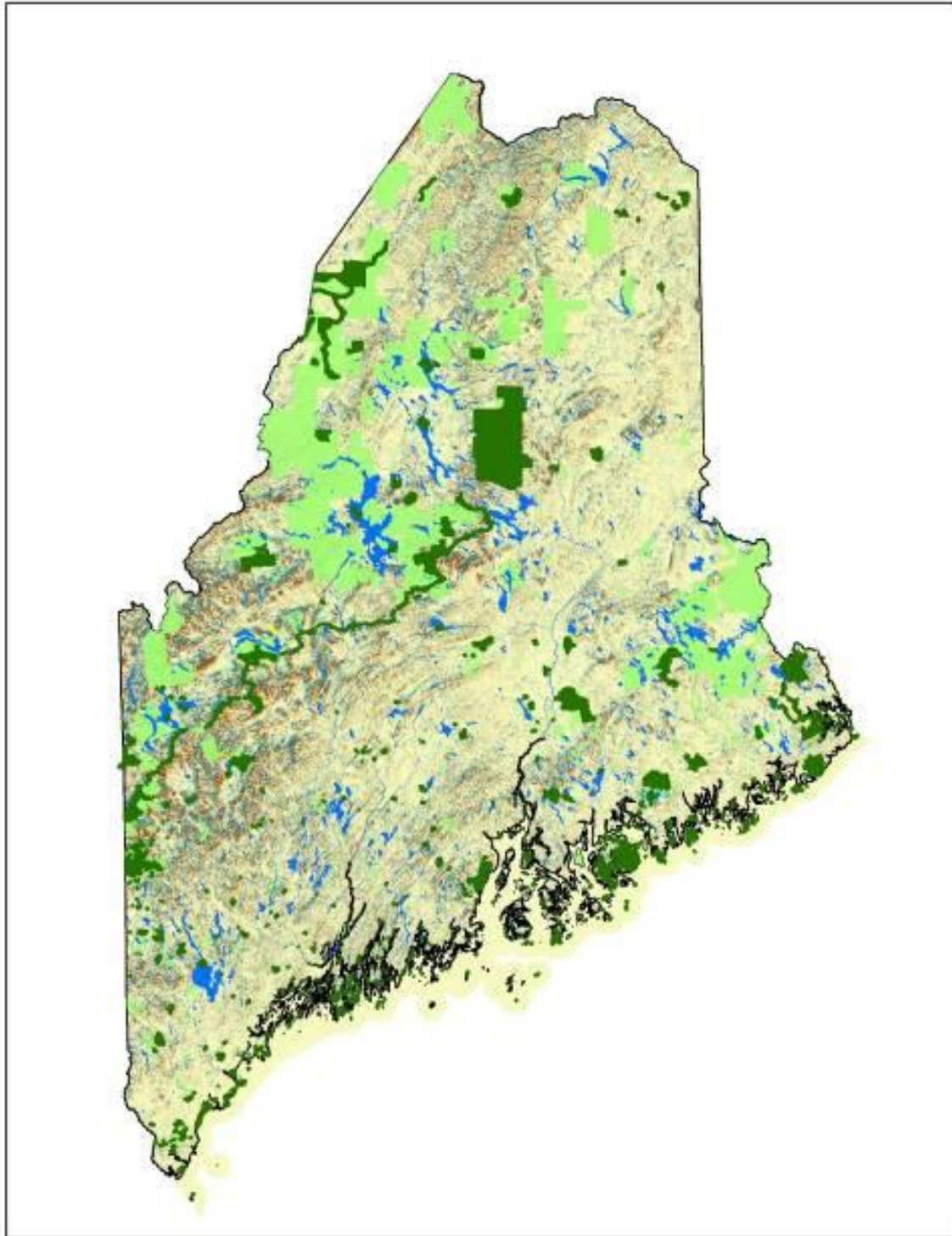
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## 2.7 CONSERVATION LAND IN MAINE

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According to the best available data, there are 3,824,842 acres of conservation land statewide, accounting for nearly 20% of Maine (Schlawin and Cutko 2014; Figure 2-4). This conservation land includes parcels with a variety of restrictions, including “working forest” conservation

**Figure 2-4.** Conserved lands in Maine. Dark green lands are Gap 2 (off limits to extractive uses) and light green lands are considered Gap 3 (fee lands and conservation easements managed for forest products).



easements, public lands managed for multiple uses, private conservation lands, state Ecological Reserves, and others. There are 757,450 acres of land that are considered 'Gap 1 or Gap 2' according to the USFWS classification of conserved lands. These Gap 1 and Gap 2 lands are managed for non-extractive uses (i.e., off limits to timber harvesting, gravel extraction, etc.) and account for just under 4% of Maine's conservation land.

*"There are 3,824,842 acres of conservation land in Maine, accounting for nearly 20% of the state."*

MDIFW holds title to approximately 106,000 acres on more than 50 Wildlife Management Areas (WMAs). Most of these lands were purchased with federal Pittman-Robertson funds, other federal matching funds, Maine citizen approved bond monies, gifts, Maine State Lottery Outdoor Heritage funds, and North Atlantic Wetland Conservation Act grants. Holdings include forested uplands, grasslands, freshwater and tidal wetlands, and seabird nesting islands. Wetlands account for more than 37% of WMAs, and several wetland types (emergent marsh, northern peatland, northern swamp, wet meadow/shrub marsh) are more than twice as well represented in WMAs than in the landscape as a whole.

For each WMA, MDIFW develops a management plan that describes the natural resources occurring on the property, history of past uses, wildlife management objectives, and future plans for additional acquisitions, habitat maintenance, and development activities. Management plans are updated every five years to reflect new land acquisitions and any changes in management objectives. WMA information and map are available at <http://www.maine.gov/ifw/wildlife/land/index.html>.

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## 2.8 IMPORTANCE OF HABITATS TO SGCN

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Maine identified 378 SGCN in this Plan. MDIFW and MDMR staff, in consultation with species experts and stakeholders, identified the primary and secondary habitats important to the lifecycle of each of Maine's SGCN when known. However, habitat requirements for some SGCN, especially invertebrates, are not well understood; in those cases, staff used professional knowledge to identify habitat. All Priority 1 and Priority 2 SGCN were associated with the finest scale 'habitat systems' in the hierarchical classification. Habitat assignments for Priority 3 SGCN were at the mid-scale 'habitat macrogroup' since many of the fauna in that category are poorly studied and/or handicapped by scant information.

The importance of each habitat type to SGCN varies and is not proportional to their statewide acreage. Figure 2-5 indicates that while the vast majority of the state is forested uplands, those habitats provide habitat to fewer than 35% of the state's SGCN. Conversely, open freshwater wetlands account for only 5% of Maine's area but support more than 21% of the state's SGCN.

**Figure 2-5.** Proportions of habitat types expressed as percentages of all state habitats and as value to SGCN.

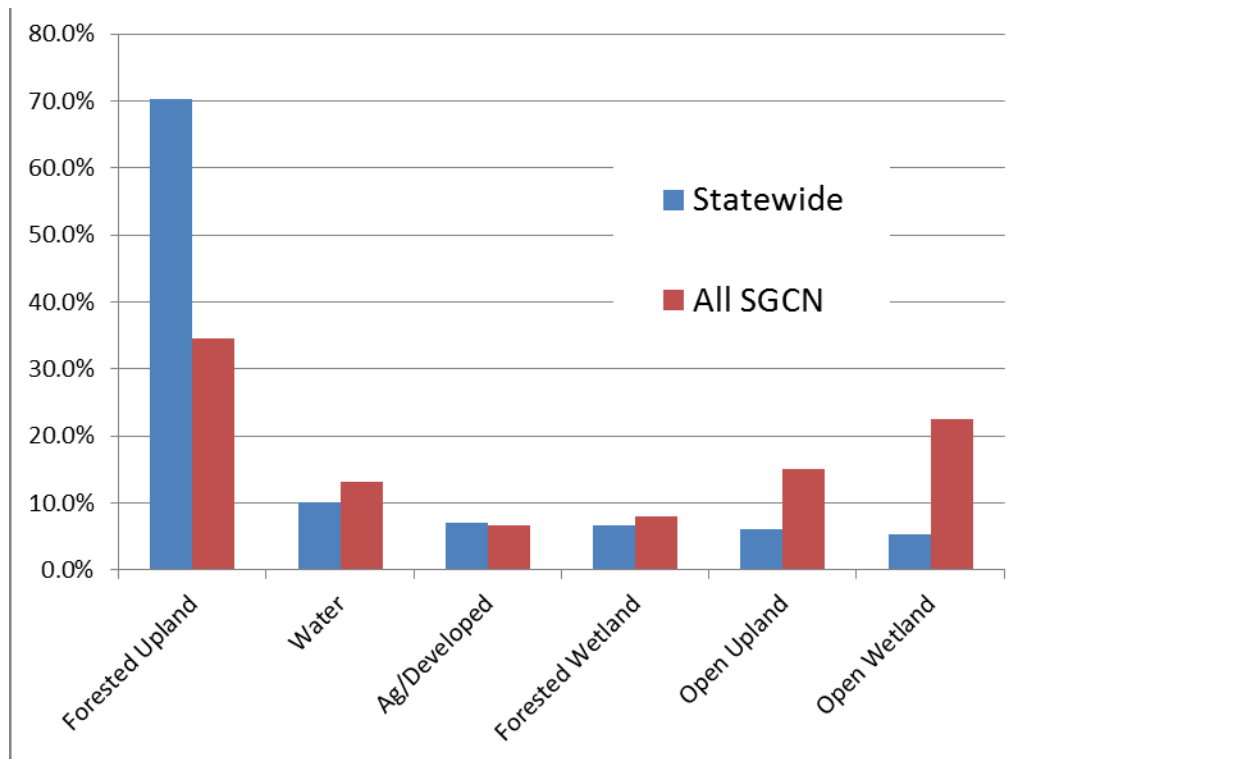


Table 2-3 summarizes the importance of various habitat macrogroups to SGCN. Northern Hardwood and Conifer Forests support 153 SGCN: more than any other type. This is not surprising, given that this habitat type is the most abundant in the state, covering nearly 40% of Maine. However, Central Oak Pine Forests provide habitat for 127 SGCN but covers less than 1% of the state. The importance of the Central Oak Pine Type is largely driven by the value of the Northeastern Interior Pine Barrens ecological system, which itself is home to 42 SGCN and covers less than 9,000 acres statewide, only 0.04% of Maine.

*“Central Oak-Pine Forest provides habitat for 127 Species of Greatest Conservation Need but covers less than 1% of the state.”*

All 14 of the Marine and Coastal Macrogroups support multiple SGCN, with the sub-tidal pelagic group is home to the most Priority 1 SGCN as well as total SGCN. Many marine fauna have complex life histories with varying habitat affinities at different stages of development.

Notably, habitats that are moderately to significantly altered by humans provide habitat for numerous SGCN. In particular, agricultural areas support 40 SGCN, and significant numbers of SGCN are also supported by Ruderal Grasslands and Shrublands, Urban/Suburban – Built, and Modified – Managed Marshes. Reforestation of former agricultural lands and the near demise of some types (e.g., old fields and pastures) has become a critical limitation for many SGCN.

**Table 2-3.** SGCN associations with NETHCS habitat macrogroups. Click on a macrogroup name to launch a full summary report of associated SGCN and for each habitat macrogroup.

Macrogroup Name	Priority 1 SGCN	Priority 2 SGCN	Priority 3 SGCN	Total # SGCN
<b>Coastal/Marine</b>				
<a href="#">Intertidal Bedrock</a>	3	10	6	19
<a href="#">Intertidal Gravel Shore</a>	1	19	15	35
<a href="#">Intertidal Mollusc Reefs</a>	3	1	5	9
<a href="#">Intertidal Mudflat</a>	7	13	16	36
<a href="#">Intertidal Sandy Shore</a>	7	10	9	26
<a href="#">Intertidal Tidal Marsh (peat-forming)</a>	6	14	16	36
<a href="#">Intertidal Water Column</a>	8	4	10	22
<a href="#">Rocky Coast</a>	6	10	14	30
<a href="#">Subtidal Bedrock Bottom</a>	2	12	2	16
<a href="#">Subtidal Coarse Gravel Bottom</a>	5	28	9	42
<a href="#">Subtidal Mollusc Reefs</a>	2	3	3	8
<a href="#">Subtidal Mud Bottom</a>	6	17	7	30
<a href="#">Subtidal Pelagic (Water Column)</a>	17	38	25	80
<a href="#">Subtidal Sand Bottom</a>	7	18	4	29
<b>Freshwater/Aquatic</b>				
<a href="#">Coastal Plain Pond</a>	4	9	9	22
<a href="#">Lake &amp; River Shore</a>	2	3	5	10
<a href="#">Lakes and Ponds</a>	10	21	43	74
<a href="#">Rivers and Streams</a>	18	19	49	86
<b>Terrestrial</b>				
<a href="#">Agricultural</a>	10	17	14	41
<a href="#">Alpine</a>	3	3	13	19
<a href="#">Boreal Upland Forest</a>	11	29	82	122
<a href="#">Central Oak-Pine</a>	9	40	62	111
<a href="#">Cliff and Talus</a>	3	3	2	8
<a href="#">Coastal Grassland &amp; Shrubland</a>	1	8	10	19
<a href="#">Exotic Upland Forest</a>	4	6	3	13
<a href="#">Extractive</a>	7	4	3	14
<a href="#">Glade, Barren and Savanna</a>	1	7	1	9
<a href="#">Maintained Grasses and Mixed Cover</a>	4	6	10	20
<a href="#">Northern Hardwood &amp; Conifer</a>	12	43	99	154
<a href="#">Outcrop &amp; Summit Scrub</a>	5	6	6	17
<a href="#">Plantation and Ruderal Forest</a>	4	19	12	35
<a href="#">Ruderal Shrubland &amp; Grassland</a>	9	27	34	70
<a href="#">Urban-Suburban Built</a>	3	15	15	33

**Table 2-3.** *continued: page 2 of 2.* Click on a macrogroup name to launch a full summary report of associated SGCN and for each habitat macrogroup.

Macrogroup Name	Priority 1 SGCN	Priority 2 SGCN	Priority 3 SGCN	Total # SGCN
<b>Wetlands</b>				
<a href="#">Boreal Forested Peatland</a>	1	9	20	30
<a href="#">Central Hardwood Swamp</a>	3	5	1	9
<a href="#">Coastal Plain Peat Swamp</a>	1	2		3
<a href="#">Emergent Marsh</a>	7	18	26	51
<a href="#">Modified-Managed Marsh</a>	6	12	12	30
<a href="#">Northeastern Floodplain Forest</a>	5	9	21	35
<a href="#">Northern Peatland &amp; Fens</a>	7	15	33	55
<a href="#">Northern Swamp</a>	6	20	26	52
<a href="#">Wet Meadow-Shrub Marsh</a>	11	23	27	61

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## 2.9 ASSESSING HABITAT CONDITION AT MULTIPLE SCALES

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In addition to exploring the configuration and amount of conserved habitats in Maine as well as their relative importance to SGCN, we also assessed habitat condition at multiple scales using several approaches. At the statewide scale, we assessed habitat condition for each macrogroup during our stressor analysis described in Element 3. We evaluated seven stressor characteristics (severity, actionability, reversibility, immediacy, spatial extent, certainty, and likelihood) for each habitat-stressor combination. Much of this information is contained in the linked macrogroup reports in Table 2-3 above. Additional macrogroup information is available in Maine's Wildlife Action Plan database, including all stressor characteristic values and additional notes. These notes often contain valuable regional information on where habitat condition is most affected by a given threat. Additional database information can be obtained by contacting MDIFW; online users will soon be able to access database information directly through Maine's Wildlife Action Plan Database Web Tool (available Winter 2018).

Our habitat stressor assessment describes habitat condition for individual macrogroups at the statewide scale; we employ two additional methods to examine spatially explicit habitat conditions pooled across multiple SGCN and habitat types. The first approach, Focus Areas of Statewide Ecological Significance, identifies locations containing the highest quality habitats across Maine. The second approach, co-occurrence mapping, can be applied at multiple scales to identify the highest quality habitats at the local or regional level. Both techniques are described in more detail below.

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## 2.9.1 HABITAT CONDITION AT THE STATE SCALE: FOCUS AREAS OF STATEWIDE ECOLOGICAL SIGNIFICANCE

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### Background

Over the last decade, MDIFW partnered with MNAP, MDMR, USFWS and TNC to identify concentrations of rare species, including many SGCN, and high quality habitats across Maine. Using confirmed survey data, rarity indicators, and landscape condition (size and integrity), this effort resulted in a mapped suite of nearly 140 species-at-risk Focus Areas of Statewide Ecological Significance ('Focus Areas') across Maine (Figure 2-6).

These areas include assemblages of some of the best examples of rare wildlife and plant populations and high quality natural habitats in Maine. For each species-at-risk Focus Area, there is a basic conservation plan that includes descriptions of significant features, voluntary recommendations for how best to conserve those resources and a map that delimits the area. Maps and descriptions of Focus Areas that occur in Maine's organized towns are available at:

<http://www.maine.gov/dacf/mnap/focusarea/>.

### Criteria, Delineation, and Application

Criteria used to delineate Focus Areas include multiple locations of rare plants, animals, and natural communities; locations of the best examples of common natural communities; locations of significant wildlife habitats; and, locations where these features overlap with larger undeveloped blocks. Focus Area boundaries are based on sub-watersheds and major fragmenting features such as roads. The boundaries are strictly non-regulatory and are neither firm nor always field-delineated; rather, they are meant to indicate the general location of high value areas where voluntary land conservation and outreach measures are likely to have disproportionate benefit to Maine's vulnerable species and habitats.

Focus Areas have become integrated into a number of land conservation programs such as the Maine Natural Resources Conservation Program and the Forest Legacy Program. Focus Areas have been recognized by the land trust community and others as important indicators of ecological significance.

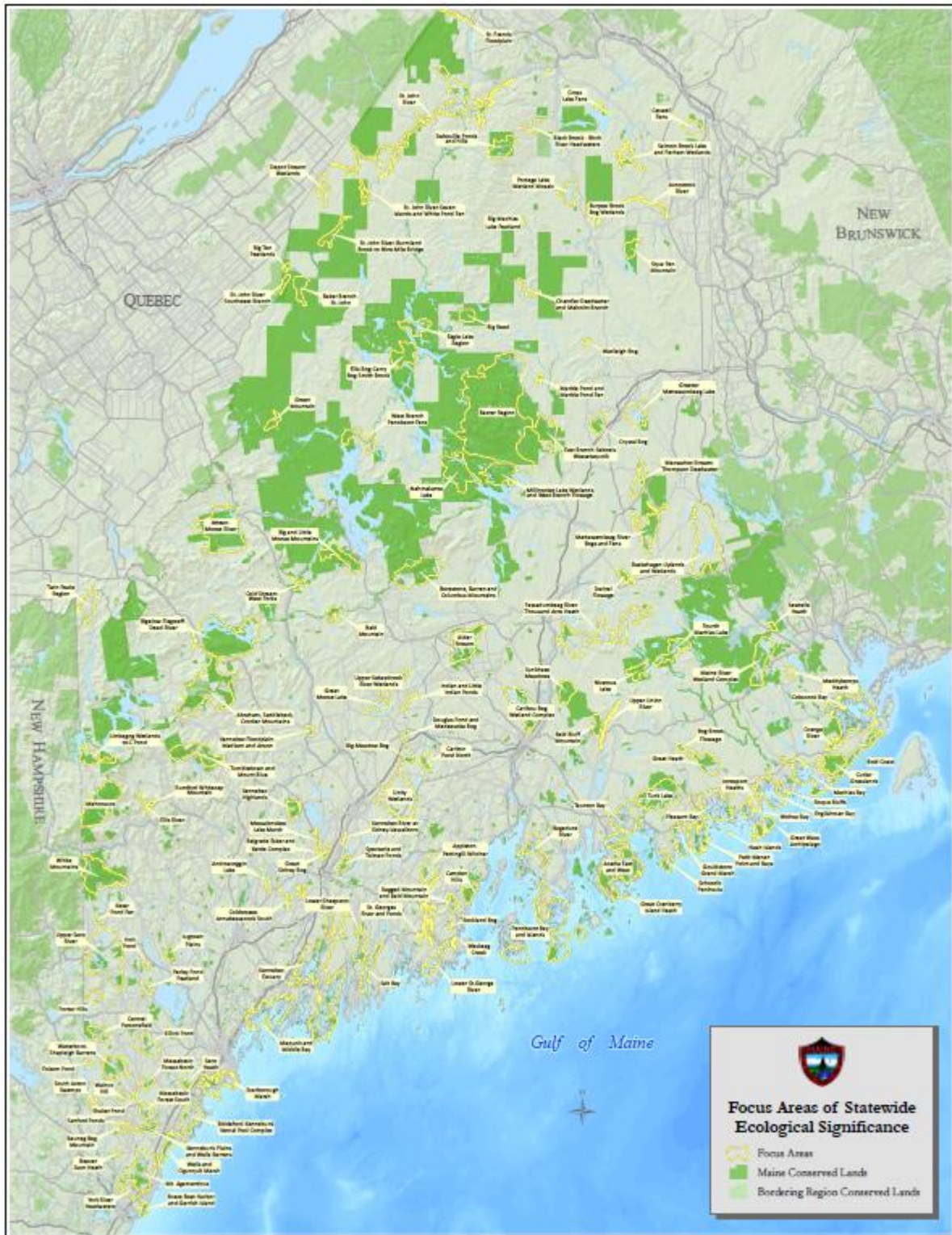
Since completion of Maine's 2005 Wildlife Action Plan, MDIFW and conservation partners (including MNAP, MDMR, USFWS, TNC, Maine Audubon, and Maine Coast Heritage Trust) developed fact sheets for most Focus Areas, which can be found at:

<http://www.maine.gov/DACF/mnap/focusarea/factsheets.htm>

Each factsheet contains a map of the Focus Area; a statewide map showing the location within the State; information on habitats, plants and animals likely to be present; conservation opportunities for the Focus Area; and an assessment of habitat condition. Fact sheets are updated periodically, with the last comprehensive review completed in 2011. Over the next few years, MDIFW and conservation partners will complete fact sheets for all Focus Areas (see Element 4, Table 4-21, Program 10). Beginning in August 2017, online users will be able to view Focus Area locations and access fact sheets directly using MDIFW's online Habitat MapViewer:

<http://webapps2.cgis-solutions.com/beginningwithhabitat/>

Figure 2-6. Distribution of Maine's Focus Areas of Statewide Ecological Significance.





**Habitat Condition within Focus Areas and WMAs**

In 2014, an assessment of Maine's Focus Areas and WMAs was initiated to determine their effectiveness at conserving the variety of SGCN and habitats across the state, including considerations for a changing climate. While this assessment is ongoing, a few key findings include:

- Nearly all Focus Areas meet multiple criteria; that is, most Focus Areas support a combination of rare species and important wildlife habitats.
- Almost all habitat macrogroups are well represented in Focus Areas and WMAs, and several macrogroups (e.g. alpine) are more than four times as abundant in Focus Areas relative to their overall statewide coverage.
- The network of Focus Areas generally indicates a high resilience to climate change, reflecting both high habitat connectivity and representing nearly the full variety of Maine's geophysical settings.
- In general, landscape connectivity is higher within Focus Areas than outside and is generally higher in northern than in southern or coastal Maine.

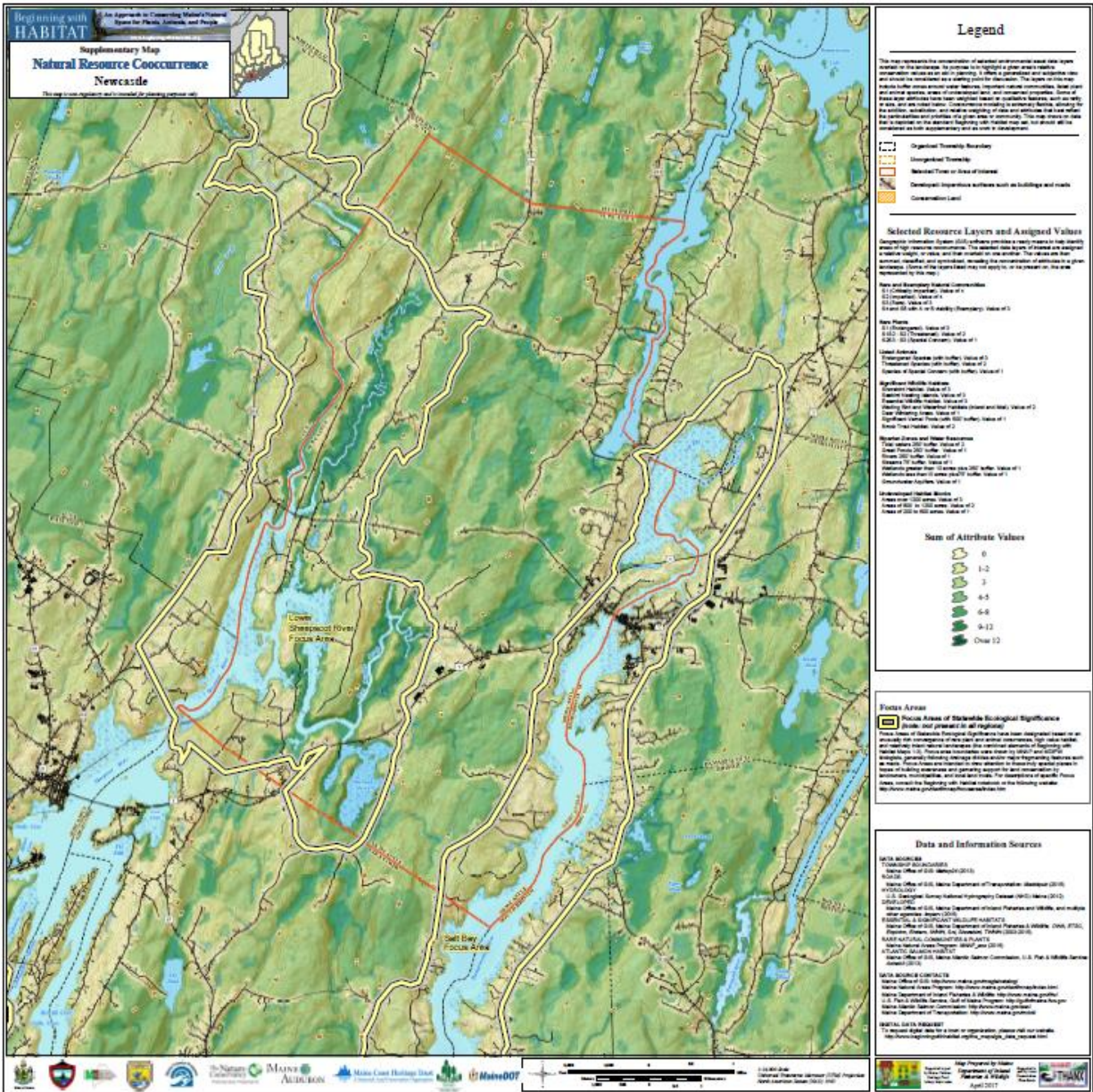
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**2.9.2 HABITAT CONDITION AT LOCAL AND REGIONAL SCALES: CO-OCCURRENCE MAPS**

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While Focus Areas highlight the highest value habitats at the statewide scale, conservation efforts often occur locally. In order to provide municipalities and other conservation partners with habitat information at scales relevant to their service areas, MDIFW and partners are developing GIS co-occurrence maps for every incorporated Maine municipality (see Figure 2-7 for an example co-occurrence map for the midcoast Maine town of Newcastle) and regional service areas (see Figure 2-8 for an example co-occurrence map for the Georges River Land Trust service area in midcoast Maine). A co-occurrence map highlights concentrations of selected data layers overlaid on the landscape. The selected data layers of interest are assigned a relative weight, or value, and then overlaid on one another. The values are then summed, classified, and symbolized, revealing the concentration of attributes in a given landscape. Its purpose is to highlight key local, high quality habitats based on the sum of relative values in a given area. Intended as an aid in planning, it provides a generalized and subjective view and should be considered as a starting point for discussion.

**Figure 2-7.** Example co-occurrence map for the town of Newcastle; the highest value habitats are depicted in dark green.



**Figure 2-8.** Example co-occurrence map for the Georges River Land Trust service area; the highest value habitats are depicted in dark green.



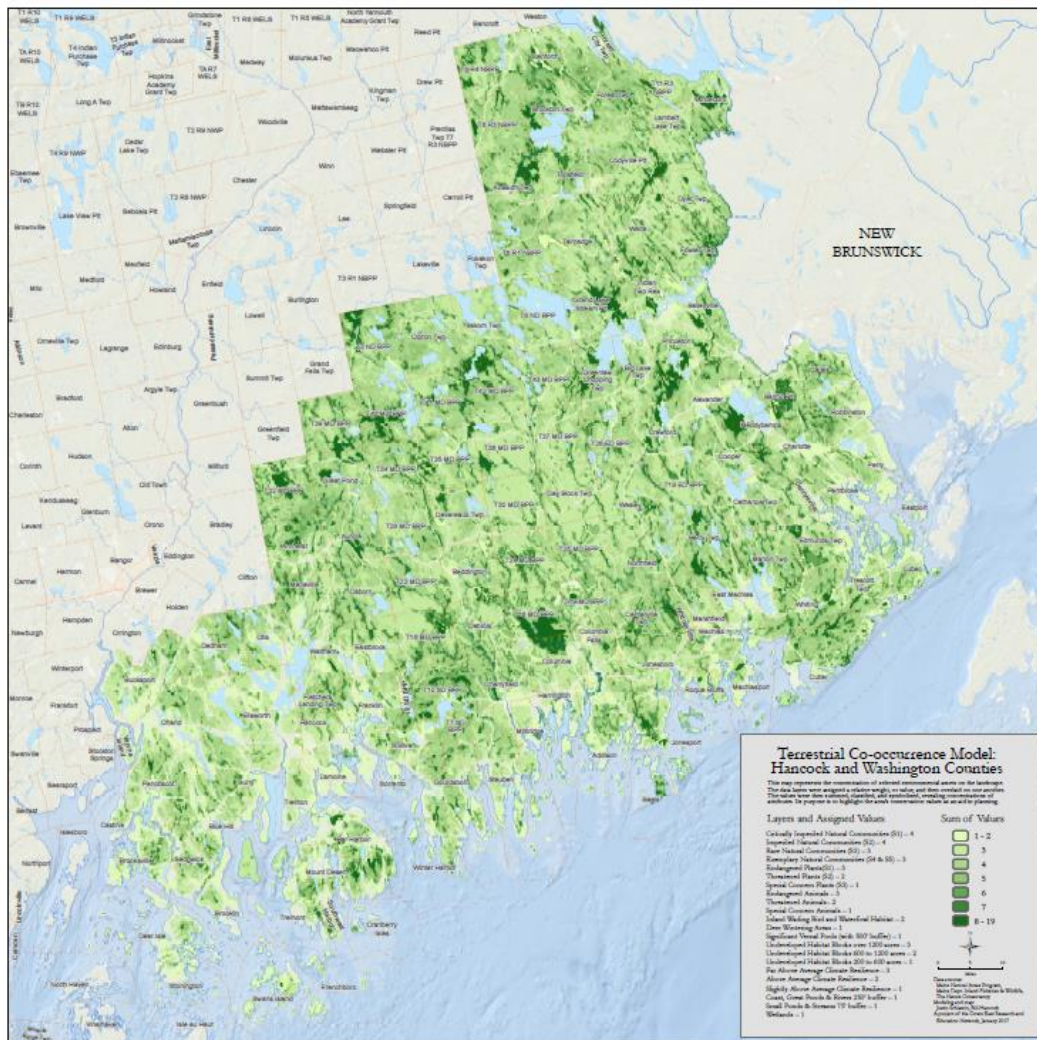
The data layers included in co-occurrence maps include buffer zones around water features, important natural communities, listed plant and animal species, areas of undeveloped land, and conserved properties. Some of these layer attributes have been weighted based on qualitative features, such as rarity or size, and are noted in Table 2-4. Co-occurrence modeling is extremely flexible, allowing for the addition, substitution, and relative weighting of data and attributes that best reflect the particularities and priorities of a given area or community.

**Table 2-4.** Data layers and typical values used to develop co-occurrence maps.

<b>Data Layer</b>	<b>Value</b>
<b>Rare and Exemplary Natural Communities</b>	
S1 (Critically Imperiled)	4
S2 (Imperiled)	4
S3 (Rare)	3
S4 and S5 with A or B viability (Exemplary)	3
<b>Rare Plants</b>	
S1 (Endangered)	3
S1S2 - S2 (Threatened)	2
S2S3 - S3 (Special Concern)	1
<b>Listed Animals</b>	
Endangered Species (with buffer)	3
Threatened Species (with buffer)	2
Species of Special Concern (with buffer)	1
<b>Significant Wildlife Habitats</b>	
Shorebird Habitat	3
Seabird Nesting Islands	3
Essential Wildlife Habitat	3
Wading Bird and Waterfowl Habitats (inland and tidal)	2
Atlantic Salmon Habitat	2
Heritage Brook Trout Waters	2
Shellfish Beds	1
Significant Vernal Pools (with 500' buffer)	1
Deer Wintering Areas	1
<b>Riparian Zones and Water Resources</b>	
Tidal Waters 250' buffer	2
Great Ponds 250' buffer	1
Rivers 250' buffer	1
Streams 75' buffer	1
Wetlands greater than 10 acres plus 250' buffer	1
Wetlands less than 10 acres plus 75' buffer	1
Groundwater Aquifers	1
<b>Undeveloped Habitat Blocks</b>	
Areas over 1200 acres	3
Areas of 600 to 1200 acres	2
Areas of 200 to 600 acres	1

The flexibility of co-occurrence modeling extends to the regional scale as well. In 2016, the Down East Research and Education Network (DEREN), a collaborative effort to encourage and facilitate land and resource conservation and management in Hancock and Washington Counties, partnered with MNAP and MDIFW to develop several GIS tools to aid its analysis and decision-making. Among those tools is a co-occurrence map (Figure 2-9) highlighting concentrations of conservation attributes based on two dozen terrestrial feature layers. In addition to most of the layers listed in Table 2-4, the DEREN map includes data layers representing the landscape's climate resiliency based on Anderson et al. (2011). The relative values of these resilient sites are categorized and summed in the co-occurrence map: Far Above Average Resiliency with a value of 3; Above Average Resiliency with a value of 2; and Slightly Above Average Resiliency with a value of 1. The resulting co-occurrence map identifies areas estimated as being the most resilient to climate-induced changes and disruptions by the end of the century, thereby providing the highest habitat quality for species to persist. This same modeling approach is being applied to other regions in Maine, including southern and coastal towns.

**Figure 2-9.** Example co-occurrence map for Washington and Hancock Counties incorporating climate change resiliency; the highest value habitats are depicted in dark green.



## 2.10 MAINE FLORA AND EXEMPLARY NATURAL COMMUNITIES

### Rare Plant Data

There are approximately 1,443 native and 653 introduced species of vascular plants in Maine (Gawler et al. 1996). The state's vascular plants include species at the northern edge of their range and boreal representatives at their southern limit. The Official List of Endangered and Threatened Plants in Maine is a list of native vascular plant species whose populations within the state are highly vulnerable to loss. Species on the list are typically known from a very small number of sites within the state, and many require unique habitat for survival. Roughly one third are considered vulnerable to climate change. The list is used to assist scientific research, environmental assessment, permit review, land management, and for educational purposes. Nearly one quarter of Maine's native flora (340 species) is considered possibly extirpated, rare, Threatened, or Endangered in the State, and 15 species, or fewer than two percent, of the plants native to Maine are rare throughout their worldwide range (e.g., ranked G1 or G2). The list is managed by the Maine Natural Areas Program (MNAP) and is under the jurisdiction of the Commissioner of the Department of Agriculture, Conservation and Forestry. Section 6 funding under the U.S. Endangered Species Act supports conservation of federally listed plants in Maine.



Small Round-leaved Orchid (*Amerorchis rotundifolia*): an orchid state-listed as a Threatened Species. © Maine Natural Areas Program

No plant species are included as Maine SGCN taxa because SWG funds are restricted to fauna only. There is presently no statutory protection for native plants in Maine, though natural community and landscape level conservation of SGCN and their habitats will provide secondary benefits to many rare and vulnerable plants. Informational summaries of SGCN in habitat macrogroups (Table 2-3) include E/T flora of Maine.

### MNAP Rare or Exemplary Natural

**Communities** are two broad classes of natural communities recognized as important for conservation: those that are rare and those that are common but in exemplary condition. A natural community is a system of interacting plants and their common environment, recurring across the landscape, where the effects of human intervention are minimal. There are currently 104 natural communities known in Maine, examples of which include Pitch Pine/Scrub Oak barrens, Atlantic White cedar bog, and



A Pitch Pine/Scrub Oak barrens in York County, Maine. © Maine Natural Areas Program

*Spartina* tidal marsh. Examples of common community types include oak/pine forest, Red Maple swamp, and cattail marsh. Most upland natural communities have been impacted by land use practices, and it is unusual to find relatively large, undisturbed examples of them. Size, disturbance, and condition are all considered when assessing the quality of common natural communities.

**MNAP Rare Plant Locations** designate specific points where populations of Rare, Threatened, and Endangered plants have been documented and, for some species, MNAP has identified habitat for the respective plants. Rare plants have no formal protection in Maine (rare plant legislation is for informational purposes only), thus the habitat in which these plants occur is important for their survival. Rare Plant Locations may occur outside of, or within documented MNAP Rare and Exemplary Natural Communities. Rare plants are often components of documented natural communities and can be conserved in the context of these larger systems. Populations of rare plants outside of documented natural communities will require separate conservation actions.

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## 2.11 LITERATURE CITED AND REFERENCES

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- Anderson, M. G., M. Clark, and A. Olivero Sheldon. 2011. Resilient sites for species conservation in the Northeast and mid-Atlantic region. The Nature Conservancy, Eastern Conservation Science. Boston, MA. 122pp. Available online at [http://static.rcngrants.org/sites/default/files/final\\_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf](http://static.rcngrants.org/sites/default/files/final_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf)
- Anderson, M. G., M. Clark, C. E. Ferree, A. Jospe, A. Olivero Sheldon and K. J. Weaver. 2013a. Northeast habitat guides: a companion to the terrestrial and aquatic habitat maps. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. 394pp. Available online at [http://rcngrants.org/sites/default/files/news\\_files/Northeast%20Aquatic%20and%20Terrestrial%20Habitat%20Guide.pdf](http://rcngrants.org/sites/default/files/news_files/Northeast%20Aquatic%20and%20Terrestrial%20Habitat%20Guide.pdf).
- Anderson, M. G., M. Clark, C.E. Ferree, A. Jospe, and A. Olivero Sheldon. 2013b. Condition of the Northeast terrestrial and aquatic habitats: a geospatial analysis and tool set. The Nature Conservancy, Eastern Conservation Science. Boston, MA. 171pp. Available online at <http://easterndivision.s3.amazonaws.com/Geospatial/ConditionoftheNortheastTerrestrialandAquaticHabitats.pdf>
- Anderson, M. G., C. Ferree, and K. McGargial. 2015. Extending the Northeast terrestrial habitat map to Atlantic Canada. Report to North Atlantic Landscape Conservation Cooperative, Hadley, MA. 23pp. Available online at <http://northatlanticlcc.org/projects/habitat-map-to-atlantic-canada/canada-map-final-report/index.html>
- Askins, R. A., F. Chavez-Ramirez, B. C. Dale, C. A Haas, J. R. Herkert, F. L. Knopf, and P. D. Vickery. 2007. Conservation of grassland birds in North America: understanding ecological processes in different regions. Ornithological Monographs No. 64. 46pp.

- Barton, A.M, White, A.S., and C.V Cogobill. 2012. The Changing Nature of the Maine Woods. University of New England Press. 304pp.
- Bennett, D. B. 1988. Maine's natural heritage. For the Maine Critical Areas Program, State Planning Office, Augusta, ME. 285pp.
- Brandes, K. M. 2001. Moon handbooks: Maine. Avalon Travel Publishing, CA. 651pp.
- Brown, B. 1993. A classification system of marine and estuarine habitats in Maine: An ecosystem approach to habitats. Maine Natural Areas Program, Department of Economic and Community Development.
- Calhoun, A. 2001. Vernal pool assessment. Maine Department of Inland Fisheries and Wildlife, 284 State Street, State House Station 41, Augusta, Maine, 04333-0041. 70pp.
- Coastal and Marine Ecological Classification Standard (CMECS). 2012. Marine and Coastal Spatial Data Subcommittee, Federal Geographic Data Committee.
- Conkling, P. W. (ed.). 1995. From Cape Cod to the Bay of Fundy: An environmental atlas of the Gulf of Maine. The MIT Press, Cambridge, MA.
- Davis, R. B., G. L. Jacobson, Jr., L. S. Widoff, and A. Zlotsky. 1983. Evaluation of Maine peatlands for their unique and exemplary qualities. Maine Department of Conservation, Augusta, ME.
- Day, C. A. 1954. A history of Maine agriculture, 1604-1860. University Press, Orono, ME. 318pp.
- Fernandez, I.J., C.V. Schmitt, S.D. Birkel, E. Stancioff, A.J. Pershing, J.T. Kelley, G.L. Jacobson, and P.A. Mayewvski. 2015. Maine's Climate Future: 2015 Update. Orono, ME. University of Maine. 24pp.
- Gawler, S. C., J. J. Albright, P. D. Vickery, and F. C. Smith. 1996. Biological diversity in Maine – an assessment of status and trends in the terrestrial and freshwater landscape. Maine Natural Areas Program, Department of Conservation, Augusta, Maine. 80pp plus appendices.
- Gawler, S., and A. Cutko. 2010. Natural Landscapes of Maine: A Guide to Natural Communities and Ecosystems. Maine Natural Areas Program, Augusta.
- Maine Department of Environmental Protection (MDEP). 1996. Issue profile Maine's wetlands: their functions and values. DEP, Augusta, ME.
- Maine Environmental Priorities Council (MEPC). 1998. An assessment of the quality of Maine's environment 1998. Augusta, ME. 28pp.
- Maine Natural Areas Program (MNAP). 2014. Analysis of tidal marsh acreage in Maine, based on digitized air imagery and National Wetlands Inventory maps. Unpublished data from Don Cameron.



- McMahon, J. S. 1990. The biophysical regions of Maine: patterns in the landscape and vegetation. M.S. Thesis, Univ. of Maine, Orono. 120pp.
- National Agricultural Statistics Service. 2009. The 2007 census of agriculture: table of 2007 statistics and earlier census years. Volume I, Chapter 1: Maine state level data. Available online at [http://www.agcensus.usda.gov/Publications/2007/Full\\_Report/Volume\\_1,\\_Chapter\\_1\\_State\\_Level/Maine/st23\\_1\\_001\\_001.pdf](http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/Maine/st23_1_001_001.pdf)
- Powell, D. S. and D. R. Dickson. 1984. Forest statistics for Maine, 1971 and 1982. U. S. Department of Agriculture, Forest Service Bulletin. NE-81, Broomall, PA. 194pp.
- Schlawin, J., and A. Cutko. 2014. A Conservation Vision for Maine Using Ecological Systems. Maine Natural Areas Program, Augusta ME.
- Terwilliger Consulting, Inc. and the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC). 2013. Taking action together: Northeast regional synthesis for state wildlife action plans. A report submitted to the Northeast Association of Fish and Wildlife Agencies. Locustville, VA. 291pp.
- The Nature Conservancy and NatureServe. 2011. Northeast Terrestrial Habitat Classification System. Available online at <https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap>.
- Todd, W. E. C. 1940. Birds of western Pennsylvania. University of Pittsburgh Press, Pittsburgh, PA. 710pp.
- U.S. Forest Service (2014). Inventory and Analysis Project, e-validator on-line data tool. Available online at <http://apps.fs.fed.us/Evalidator/evaluator.jsp>. Last accessed - November 5, 2014.
- Whitman, A., A. Cutko, P. deMaynadier, S. Walker, B. Vickery, S. Stockwell, and R. Houston. 2013. Climate change and biodiversity in Maine: vulnerability of habitats and priority species. Manomet Center for Conservation Sciences (in collaboration with Maine Beginning with Habitat Climate Change Working Group) Report NCI-2013-03. Brunswick, ME. 105pp. Available online at [https://www.manomet.org/sites/default/files/publications\\_and\\_tools/BwHSummary\\_021914.pdf](https://www.manomet.org/sites/default/files/publications_and_tools/BwHSummary_021914.pdf)