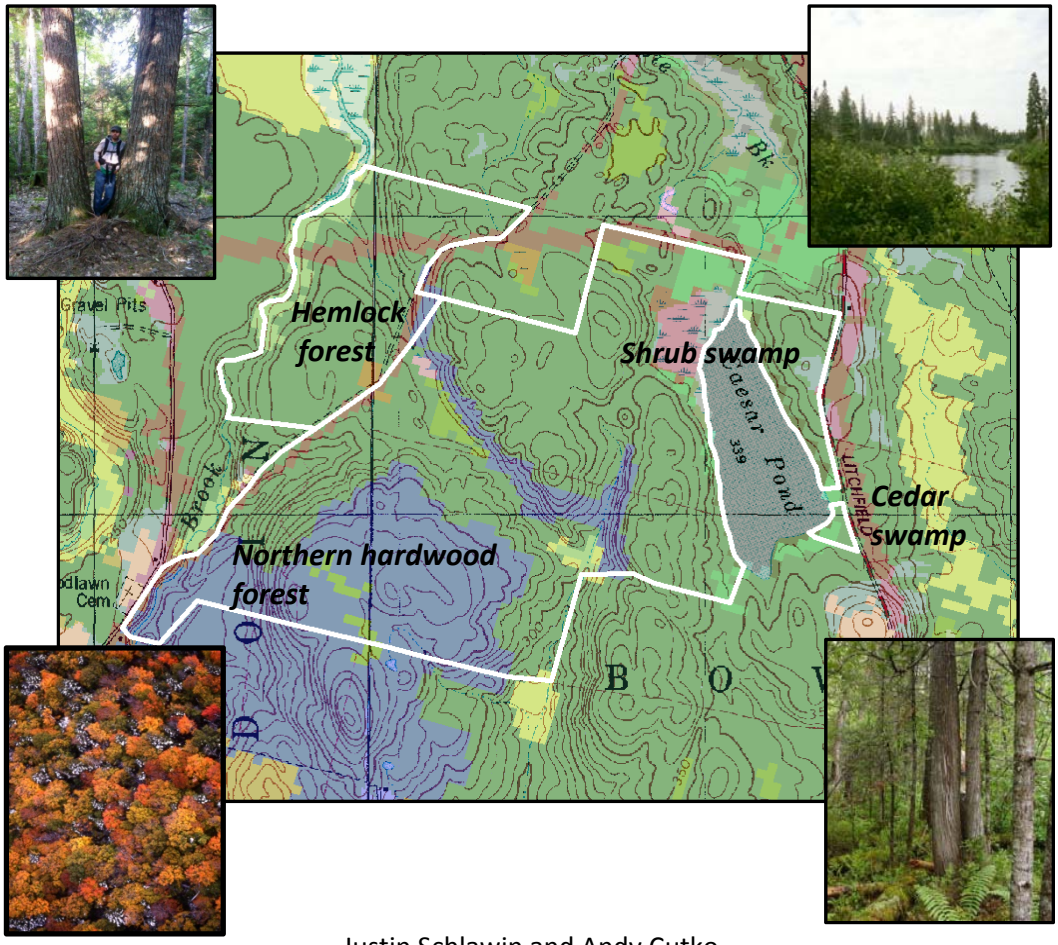
A Conservation Vision for Maine

Using Ecological Systems



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Contents

Summary

Maine has added nearly one million acres of conservation land in the last decade, and close to 20% of Maine's land is now in some form of permanent conservation. From a biodiversity standpoint, a region's portfolio of conserved land should ideally represent the full variety of habitat types present in that region. We used a regional GIS habitat layer, known as Ecological Systems, to determine how well Maine's conserved lands include the variety of habitats that occur in the state. We assessed all conserved lands as well as the subset of conserved lands that are 'reserved' from forest management, and we conducted the analysis statewide as well as within each of seven geographic regions. This effort updates a previous assessment by the Maine Natural Areas Program nearly a decade ago (Cutko and Frisina 2005).

Key findings of the assessment include:

- Maine's amount of conserved lands varies significantly by region, from 38% in northwest Maine to 5% in central Maine. Generally, southern and central Maine have the least amount of conserved lands, and these lands are in comparatively small parcels.
- Less than 4% of Maine is in 'reserve' status (i.e., off limits to forest management). Proportions of reserved lands also vary considerably, from 9% in Downeast Maine to less than 2% in the southern Maine. Nationally, 16% of the United States is in 'reserve' status.
- Wetlands are comparatively well represented within conserved lands throughout the state. In four of Maine's seven biophysical sections, wetlands are more than twice as abundant on reserve lands as on the landscape as a whole.
- Mountaintops (lands over 2700' in elevation) are twice as abundant within conserved lands and almost eight times as abundant within 'reserved' lands.
- Each of 29 ecological system groups occurs at least once within conserved lands in Maine. However, representation is poorer at the scale of seven biophysical sections. None of Maine's biophysical sections had adequate representation of 'reserved' examples of all the ecological systems that occur in that section. Many upland forest types are under-represented on conserved lands in various parts of the state, and no common forest types are adequately represented in 'reserved' lands in southern Maine.

Our intent with this analysis is not to propose a single habitat-based solution for land conservation. Rather, we hope this information will complement existing natural resource data and add to the growing set of GIS-based tools that may help conservation groups, state agencies, and others increase their effectiveness at safeguarding biodiversity from a statewide perspective.

Introduction:

Many factors are considered in evaluating where to purchase conservation land, including scenic and recreational features, cost of land, availability of funding and potential partners, adjacency to other conserved lands, habitat values, and others. From a biodiversity standpoint, a region's portfolio of conserved land should ideally represent the full variety of habitat types present within that region. Ecological representation may be approached in a variety of ways. *A Conservation Vision for Maine Using Ecological Land Units* (Cutko and Frisina 2005) examined the representation of Ecological Land Units (ELUs) on conservation land in Maine. ELUs are enduring physical features of landform, surficial and bedrock geology, and elevation. To conduct the 2005 analysis, Cutko and Frisina merged ELUs into ecologically relevant groups and overlaid the most up-to-date conserved lands GIS layer. Since 2005 nearly one million acres of additional land have been conserved or digitized in a GIS environment in Maine and new, more accurate GIS land cover layers have been made available. Consequently, we sought to update and improve the 2005 analysis with the most recent information and tools.

Using a GIS landcover layer created by The Nature Conservancy in 2011, we have filtered for 'quality' occurrences of ecological systems statewide using a patch-mosaic model. Using this model, we have examined the representation of these occurrences found in ecological reserve (Gap 1 & 2) lands as well as all conserved lands.

Maine's Conservation Lands:

Over one million acres of Maine land have been conserved since 2000, bringing the total conserved land in the state to almost four million acres. Nearly 20% of Maine is now held in some form of conservation, with 757,449.8 acres or 3.85% of the state off limits to timber harvesting (i.e., US Fish and Wildlife Service Gap 1 or Gap 2 status; see sidebar at right).

The conserved lands layer used in this study was developed collaboratively by the Department of Agriculture, Conservation and Forestry (ACF), the Department of Inland Fisheries and Wildlife (IFW) and The Nature Conservancy (TNC). Prior to analysis, the Maine Natural Areas Program collaborated with land trusts around the state to include their most recent

Definitions for Gap Status are as follows (from the USGS National Gap Analysis Program):

***GAP Status 1**: Permanent protection from conversion of natural land cover and a mandated management plan to maintain a natural state within which disturbance events or are allowed to proceed without interference or are mimicked through management.*

***GAP Status 2**: Permanent protection from conversion of natural land cover and a mandated management plan to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.*

***GAP Status 3**: Permanent protection from conversion of natural land cover for the majority of area. Subject to extractive uses of either broad, low-intensity type (e.g. logging) or localized intense type (e.g.mining).*

***GAP Status 4**: No known public/private institutional mandates/legally recognized easements.*

conserved lands data in our GIS layer. We obtained new data from over 70 organizations around the state, many of which did not have parcel data digitized for the 2005 study. Collaborating with The Nature Conservancy of Maine, Gap Status was classified for each parcel, and additional conserved lands data was obtained.

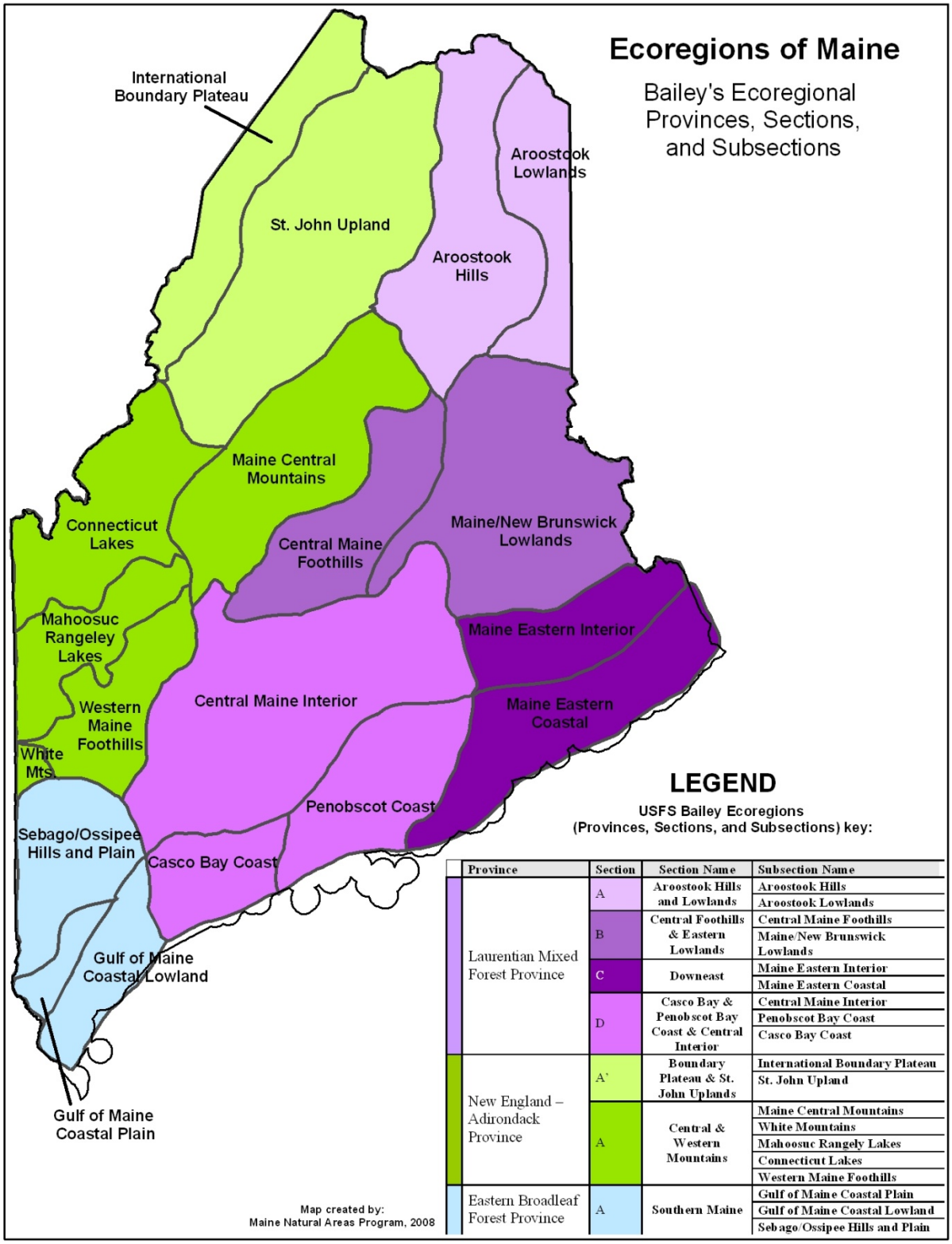
In this study **'Type 1'** Conservation Lands include all conserved lands, GAP Status 1, 2 and 3. '**Type 2**' Conservation Lands are only conservation lands with GAP status 1 & 2, sometimes termed 'forever wild' or 'reserve' lands. These lands include places such as Acadia National Park, the National Park Service's Appalachian Trail, federal Wilderness Areas in the White Mountain National Forest and Moosehorn Wildlife Refuge, State Ecological Reserves, land trust ownerships, and much of Baxter State Park. Overlay analysis was performed independently for Type 1 and Type 2 Conservation lands.

Ecological Sections:

Analyzing the representation of ecological systems solely at a statewide scale undervalues the state's regional variation. For example, spruce-fir forest is very common in the northern part of the state, while in southern Maine it is uncommon. To examine the representation of ecological systems within conserved lands more finely, we examined regions of the state independently.

There are many ways of segmenting Maine, including political divisions such as township or county lines, as well as ecological divisions that split the state into unique units defined by climate and geography or by watershed. For this study, we use the biophysical sections from McMahon (1990) to isolate regions of the state with similar landforms, climate, and vegetation. These sections correspond roughly to a hierarchical system of ecoregions used by the US Forest Service (Bailey 1995). Provinces are most general, sections are intermediate and subsections are the finest level of division (Figure 1).

We performed overlay analysis at the biophysical 'section' level, dividing Maine into seven geographic units. This scale is consistent with that used for assessing the ecological representation of Maine's Ecological Reserves by the Ecological Reserves Scientific Advisory Committee, and it is also compatible with The Nature Conservancy's ecoregions, which form the outline for each group of mapped ecological systems (Appendix 1) used in analysis.



Province	Section	Section Name	Subsection Name
Laurentian Mixed Forest Province	A	Aroostook Hills and Lowlands	Aroostook Hills
			Aroostook Lowlands
	B	Central Foothills & Eastern Lowlands	Central Maine Foothills
			Maine/New Brunswick Lowlands
	C	Downeast	Maine Eastern Interior
			Maine Eastern Coastal
	D	Casco Bay & Penobscot Bay Coast & Central Interior	Central Maine Interior
			Penobscot Bay Coast
			Casco Bay Coast
New England – Adirondack Province	A'	Boundary Plateau & St. John Uplands	International Boundary Plateau
			St. John Upland
	A	Central & Western Mountains	Maine Central Mountains
			White Mountains
			Mahoosuc Rangely Lakes
			Connecticut Lakes
			Western Maine Foothills
Eastern Broadleaf Forest Province	A	Southern Maine	Gulf of Maine Coastal Plain
			Gulf of Maine Coastal Lowland
			Sebago/Ossipee Hills and Plain

Figure 1. Hierarchy of USFS Bailey Ecoregions in Maine.

Ecological Systems GIS Layer:

In the 2005 study, analyses were performed using a GIS layer of Ecological Land Units (ELUs). This layer classified Maine's landscape into units categorized by landform, geology and elevation. Similar combinations of ELUs were grouped for analysis purposes. However, no land cover datasets were incorporated into the 2005 analysis, and systematic ground truthing was not performed. As a result, the 2005 analysis describes landform types well but does not describe the vegetation represented by ecological systems.

The Ecological Systems GIS layer, published in 2011, classifies terrestrial ecological systems across the northeast by combining landform, geology, elevation, land cover data, USFS Forest Inventory and Analysis (FIA) plot data, vegetation mapping data, and Natural Heritage community element occurrences. The layer is a 30-meter resolution raster dataset that covers Maine to Virginia. Ecological systems were mapped independently in the three Nature Conservancy ecoregions (Appendix 1) and merged. This layer classifies Maine into 72 land cover classes. For more information about the origin of this layer, see Ferree (2011).

Generally speaking, ecological systems in this layer are coarsely defined, and they correlate with natural communities described by the Maine Natural Areas Program (Gawler and Cutko 2010) on a one-to-many basis. This layer has become an important tool to help Natural Areas Program staff identify target areas for ecological inventory and model potential occurrences of uncommon or rare natural community types. This layer is also the best available resource for representational analysis work. Full descriptions of the ecological systems used in this study are in Appendix 2.

Consolidating Comparable Ecological Systems:

Though the Ecological Systems GIS layer classifies Maine's landscape into 72 unique types, many of these types are too similar to be differentiated for purposes of this analysis. These systems were aggregated for the following reasons:

1. Ecological systems were mapped separately in the Northern Appalachian – Boreal Forest, North Atlantic Coast and Lower New England – Northern Piedmont TNC ecoregions (See Appendix 1), and otherwise ecologically similar systems were given different names depending on the ecoregion in which they occur;
2. Many wetland types were differentiated based on the type of water body to which they were proximal (e.g., large river, smaller river). While this distinction is meaningful for some types of wetlands in Maine, the scale of the layer is too coarse to determine adequate representation of these differences; and
3. We are not confident in the differentiation of some of the small patch types that often co-occur on the ground. For example, Acidic Cliff, Acidic Talus, and Acidic Rocky Outcrop are differentiated as three independent layers in the ecological systems layer.

Following a thorough examination, elements in the Ecological Systems were layer consolidated. Ultimately, 32 combined units were used for further analysis including developed, open water and agricultural land cover classes. (See Table 1 for original and grouped ecological systems.)

Requirements for Representation

We used two rules to determine adequate representation of each ecological system in conservation lands:

1. *Proportional Representation*
   Ecological Systems representation relative to each biophysical section was analyzed to determine if ecological systems on conserved lands reflected their natural abundance on the landscape. Following the methodology of Cutko and Frisina (2005), an ecological system is considered to be ***adequately represented*** if it is ***at least half as abundant*** on conservation lands as in the biophysical section as a whole. An ecological system is considered to be ***under represented*** if it is less than half as abundant on conservation land as in the section. An ecological section is considered to be ***not represented*** if the group does not occur in conserved lands but does occur in the ecological section. Differing from Cutko and Frisina (2005), we first isolated 'quality' ecological systems based on the patch type for each system (see following discussion on methods for isolating 'quality' patches). Next we examined the total acreage of each ecological system within conserved lands, within each ecological section. If the minimum patch size acreage was not met for a given patch, then it was not considered conserved and was omitted from analysis.

2. *Plurality*
   To account for adequate representation of diversity within each ecological system type, we examined whether ***at least two unique patches*** over 1 kilometer apart were conserved in each biophysical section. To isolate unique patches, all occurrences of a particular ecological section occurring within 1 kilometer of another were aggregated and assigned a unique identifier (see following section on methodology for aggregation). An ecological system was determined to be ***plural*** if two or more system aggregates were conserved within a biophysical section and ***not plural*** if less than two examples were conserved within a biophysical section.

All analyses were performed for Type 1 (all conserved land) and Type 2 (GAP 1 and 2) conservation lands within each biophysical section. Ecological systems that did not occur within a biophysical section were not analyzed.

Table 1. *Original and merged ecological systems, from the Ecological Systems GIS layer. Descriptions of each ecological system are in Appendix 2.*

Ecological System Name	Merged Ecological System Name
Acadian Low Elevation Spruce-Fir-Hardwood Forest	Acadian Low Elevation Spruce-Fir-Hardwood Forest
Acadian Maritime Bog	Acadian Maritime Bog
Acadian Sub-boreal Spruce Flat	Acadian Sub-boreal Spruce Flat
Acadian-Appalachian Alpine Tundra	Acadian-Appalachian Alpine Tundra
Acadian-Appalachian Montane Spr-Fir-Hwd Forest	Acadian-Appalachian Montane Spr-Fir-Hwd Forest
Acadian-North Atlantic Rocky Coast	Acadian-North Atlantic Rocky Coast
Laurentian-Acadian Acidic Cliff and Talus	Acidic Cliff, Talus and Rocky Outcrop
N. Appalachian-Acadian Rocky Heath Outcrop	
North-Central Appalachian Acidic Cliff and Talus	
NLCD agricultural classes 81-82	Agricultural
NLCD 52/71: shrublands/grasslands	
Laurentian-Acadian Alkaline Fen	Alkaline Conifer-Hardwood Swamp
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp: Isolated	
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp: Lake/pond: any size	
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp: Smaller river riparian	
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp: Larger river floodplain	
North-Central Interior and Appalachian Rich Swamp: Isolated	
North-Central Interior and Appalachian Rich Swamp: Lake/pond: any size	
North-Central Interior and Appalachian Rich Swamp: Smaller river riparian	
Laurentian-Acadian Pine-Hemlock-Hardwood Forest: typic	Appalachian-Acadian Pine-Hemlock-Hardwood Forest
Laurentian-Acadian Pine-Hemlock-Hardwood Forest: moist-cool	
Appalachian (Hemlock)-Northern Hardwood Forest: typic	
Appalachian (Hemlock)-Northern Hardwood Forest: drier	
Appalachian (Hemlock)-Northern Hardwood Forest: moist-cool	
Laurentian-Acadian Calcareous Cliff and Talus	Calcareous Cliff, Talus and Rocky Outcrop
Laurentian-Acadian Calcareous Rocky Outcrop	
North-Central Appalachian Circumneutral Cliff and Talus	
Central Appalachian Alkaline Glade and Woodland	Central Appalachian Alkaline Glade and Woodland

Central Appalachian Dry Oak-Pine Forest Central Appalachian Pine-Oak Rocky Woodland	Central Appalachian Dry Oak-Pine Forest
North-Central Appalachian Acidic Swamp: Larger river floodplain North-Central Interior and Appalachian Rich Swamp: Larger river floodplain	Central Appalachian Floodplain Forest
NLCD developed classes 21-24 & 31	Developed
Boreal-Laurentian Bog Boreal-Laurentian-Acadian Acidic Basin Fen North-Central Interior and Appalachian Acidic Peatland: Isolated/headwater streams North-Central Interior and Appalachian Acidic Peatland: Undifferentiated North-Central Interior and Appalachian Acidic Peatland: Lake/pond: any size North-Central Interior and Appalachian Acidic Peatland: Smaller river riparian	Laurentian- N. Appalachian-Boreal Peatland
Laurentian-Acadian Floodplain Forest Eastern Boreal Floodplain	Laurentian-Acadian Floodplain Forest
Laurentian-Acadian Freshwater Marsh: Isolated Laurentian-Acadian Freshwater Marsh: Lake/pond: any size Laurentian-Acadian Freshwater Marsh: Smaller river riparian Laurentian-Acadian Freshwater Marsh: Larger river floodplain	Laurentian-Acadian Freshwater Marsh
Laurentian-Acadian Northern Hardwood Forest: typic Laurentian-Acadian Northern Hardwoods Forest: moist-cool	Laurentian-Acadian Northern Hardwood Forest
Laurentian-Acadian Northern Hardwood Forest, high conifer	Laurentian-Acadian Northern Hardwood Forest, high conifer
Laurentian-Acadian Red Oak-Northern Hardwood Forest	Laurentian-Acadian Red Oak-Northern Hardwood Forest
Laurentian-Acadian Wet Meadow-Shrub Swamp: Isolated Laurentian-Acadian Wet Meadow-Shrub Swamp: Lake/pond: any size Laurentian-Acadian Wet Meadow-Shrub Swamp: Smaller river riparian Laurentian-Acadian Wet Meadow-Shrub Swamp: Larger river floodplain	Laurentian-Acadian Wet Meadow-Shrub Swamp
North Atlantic Coastal Plain Basin Peat Swamp: Isolated/headwater streams North Atlantic Coastal Plain Basin Peat Swamp: Smaller river riparian	North Atlantic Coastal Plain Basin Peat Swamp
North Atlantic Coastal Plain Hardwood Forest	North Atlantic Coastal Plain Hardwood Forest
North Atlantic Coastal Plain Maritime Forest	North Atlantic Coastal Plain Maritime Forest

North-Central Appalachian Pine Barrens	North-Central Appalachian Pine Barrens
North-Central Interior Wet Flatwoods	North-Central Interior Wet Flatwoods
Northeastern Coastal and Interior Pine-Oak Forest	Northeastern Coastal and Interior Pine-Oak Forest
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp: Isolated	Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp: Lake/pond: any size	
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp: Smaller river riparian	
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp: Larger river floodplain	
North-Central Appalachian Acidic Swamp: Isolated	
North-Central Appalachian Acidic Swamp: Lake/pond: any size	
North-Central Appalachian Acidic Swamp: Smaller river riparian	
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach
NLCD-NHD open water	Open Water
North Atlantic Coastal Plain Tidal Salt Marsh: salt/brackish/oligohaline	Tidal Marsh
Acadian Coastal Salt Marsh, Acadian Estuary Marsh	
Acadian Estuary Marsh	

Isolating 'quality' patches for each ecological system type

In the 2005 study, only proportional representation of ELU groups in conserved lands was analyzed. In other words, representation of ELU groups occurring on conserved land was analyzed relative to total area of ELU groups occurring within a geographic area. However, the size of ELU patches and adequate *protection* of ELU groups was not analyzed. In this analysis, we attempt to take a step further than the previous study and isolate 'quality' (minimum size) patches of each ecological system type for representational analysis.

Habitat or ecological system 'Patches' are relatively unique, dynamic homogenous units, occurring naturally or as a result of human activity at various sizes and in various shapes (Forman 1995). The scale of these patches differs based on the factors that influence their composition and structure, including climate, topography, geology and disturbance. Patches are typically categorized into a series of unique units which are then classified as small/large patch and matrix types.

The size at which these patches occur is relevant to their conservation value. For example, an isolated three-acre patch of *Acadian Low Elevation Spruce-Fir Hardwood Forest* (a common, matrix – forming ecological system) cannot be expected to contain the full range of ecological diversity inherent in this natural community type. The scale of this small example of spruce-fir forest is not representative for its type, and would have a much lower conservation value than a large, representative example. Conversely, a three acre patch of *Calcareous Cliff, Talus and Rocky Outcrop* (a small patch type) may support the full range of ecological diversity expected for this system in Maine.

We chose to filter the ecological systems layer to remove examples below a minimum size threshold prior to analysis, thereby removing 'low quality' examples of each type. We classified all ecological systems as either small, medium, large patch or matrix types, based on the ecology of each type and the average patch size within the ecological systems layer (See Table 2). The minimum size threshold was set at 3 acres for small patch; 10 acres for medium patch; 50 acres for large patch; and 250 acres for matrix systems. All features that were below the minimum threshold for their type were removed from the dataset. We define patches as being 'quality examples' for their type if they are above this minimum size threshold.

For 'quality' ecological system patches to be captured in conserved lands in our analysis, the above minimum patch size thresholds must be captured within the conserved lands boundary. If partially conserved ecological system patches were below these size thresholds, they were not considered captured within conservation lands.

Table 2. Grouped ecological systems, with patch size and minimum acreage classified for each type.

Merged Ecological Systems	Patch size	Minimum Acreage
Acadian Low Elevation Spruce-Fir-Hardwood Forest	matrix	250
Acadian Maritime Bog	large	50
Acadian Sub-boreal Spruce Flat	large	50
Acadian-Appalachian Alpine Tundra	small	3
Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest	matrix	250
Acadian-North Atlantic Rocky Coast	small	3
Acidic Cliff, Talus and Rocky Outcrop	small	3
Agricultural	N/A	N/A
Alkaline Conifer-Hardwood Swamp	small	3
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	matrix	250
Calcareous Cliff, Talus and Rocky Outcrop	small	3
Central Appalachian Alkaline Glade and Woodland	small	3
Central Appalachian Dry Oak-Pine Forest	medium	10
Central Appalachian Floodplain Forest	medium	10
Developed	N/A	N/A
Laurentian- N. Appalachian-Boreal Peatland	large	50
Laurentian-Acadian Floodplain Forest	medium	10
Laurentian-Acadian Freshwater Marsh	medium	10
Laurentian-Acadian Northern Hardwood Forest	matrix	250
Laurentian-Acadian Northern Hardwood Forest, high conifer	matrix	250
Laurentian-Acadian Red Oak-Northern Hardwood Forest	matrix	250
Laurentian-Acadian Wet Meadow-Shrub Swamp	medium	10
North Atlantic Coastal Plain Basin Peat Swamp	large	50
North Atlantic Coastal Plain Hardwood Forest	matrix	250
North Atlantic Coastal Plain Maritime Forest	large	50
North-Central Appalachian Pine Barrens	large	50
North-Central Interior Wet Flatwoods	medium	10
Northeastern Coastal and Interior Pine-Oak Forest	matrix	250
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	large	50
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	small	3
Open Water	N/A	N/A
Tidal Marsh	medium	10

Aggregation

To test the plurality of ecological systems conserved in each biophysical section, each unique ecological system occurrence was assigned an identifier. 'Unique' systems were defined as groups of features over one kilometer from another feature of the same type. This aggregate dataset provided the base for each feature's unique 'aggregate id'. The 'aggregate id' was then spatially joined back to the original feature without affecting the geometry of the original feature (e.g. Figure 2). Within each ecological section, at least two examples of an ecological system had to occur within conserved lands for that system type to be represented.

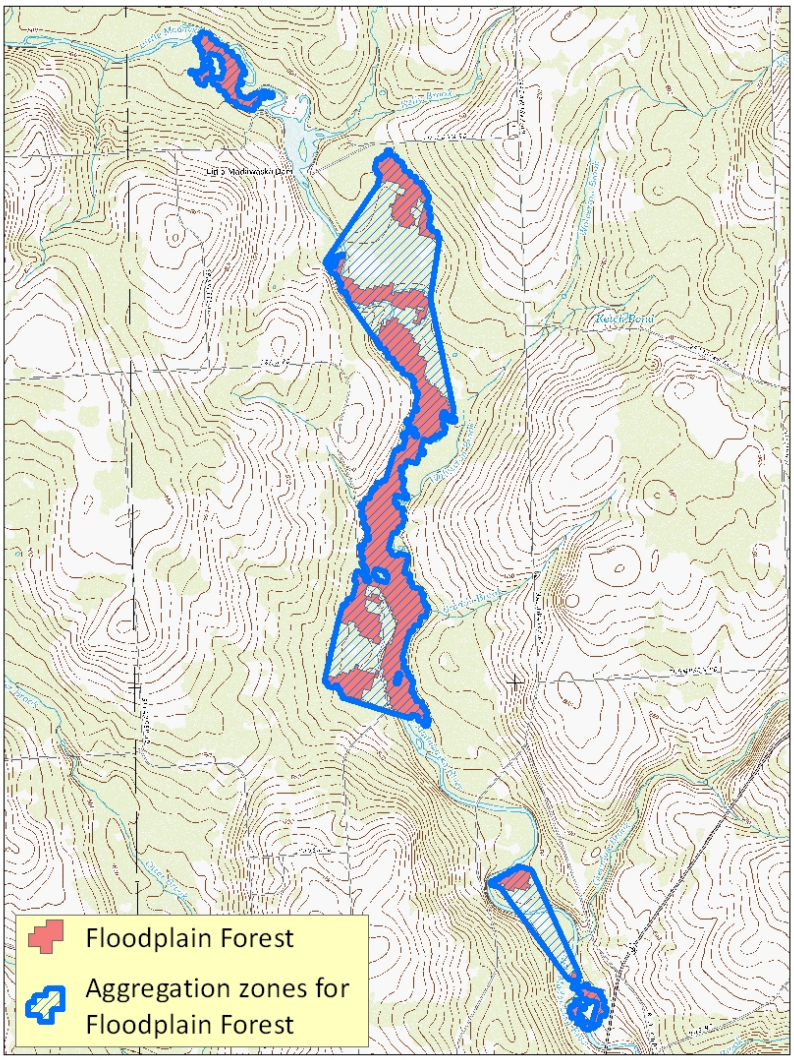


Figure 2. Floodplain Forest occurrences from the Ecological Systems GIS layer, overlaid by 1 kilometer Floodplain Forest aggregation zones. Each feature is assigned the ID of the aggregation zone in which it falls. For an ecological system to be adequately represented, sufficient acreage of features from at least two unique aggregates zones must occur in Type 1 and Type 2 conserved lands.

Results

Conserved Land

The distribution of Type 1 and Type 2 conserved lands in the biophysical sections of Maine is shown in Figure 3 and Table 3.

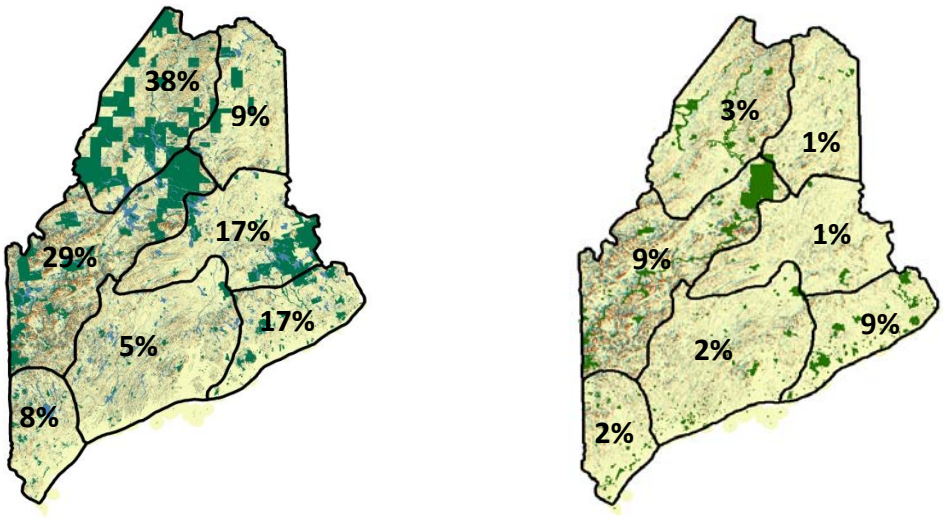


Figure 3. Proportions of Type 1, or all conserved land in Maine, by biophysical section (left) and proportions of Type 2, or 'reserved,' land (right).

Table 3. Distribution of conserved land in Maine's seven biophysical sections. Values are represented in acres and as a percentage of total land area. Open water was excluded from analysis.

Biophysical section	Type 1 Cons. Land Acres (% of section)	Type 2 Cons. Land Acres (% of section)	Total Land Area Acres
Aroostook Hills and Lowlands	210,728 (8.8%)	20,067 (0.8%)	2,382,758
Boundary Plateau and St. John Uplands	1,318,743 (37.5%)	95,507 (2.7%)	3,512,934
Casco Bay - Penobscot Bay - Central Interior	184,386 (5.1%)	80,458 (2.2%)	3,646,120
Central - Western - White Mountains	1,242,366 (29.4%)	365,540 (8.6%)	4,232,247
Eastern Interior - East Coast	253,913 (17.3%)	129,798 (8.9%)	1,464,628
Eastern Lowlands - Central Foothills	509,104 (16.7%)	36,265 (1.2%)	3,042,033
Seacoast Plain – Ossipee	105,601 (7.6%)	29,814 (2.2%)	1,384,041
Total	3,824,842 (19.5%)	757,450 (3.9%)	19,664,758

Overlay analysis indicates that conserved lands, and especially Type 2 conserved lands, contain considerably higher proportions of wetlands than occur on the landscape as a whole (Table 4). Wetlands are generally well represented in conserved lands in all biophysical sections. In four of Maine's seven biophysical regions, wetlands are more than twice as abundant in Type 2 conserved lands as on the landscape as a whole.

Table 4. *Percentage of each biophysical section covered by wetlands, as mapped by the National Wetlands Inventory. Open water wetlands including lakes and rivers were removed from analysis.*

Section Name	% of section	Conserved Land	
		% Type 1	% Type 2
Aroostook Hills and Lowlands	11.18%	12.51%	17.71%
Boundary Plateau and St. John Uplands	7.97%	8.72%	19.17%
Casco Bay - Penobscot Bay - Central Interior	13.55%	22.28%	26.93%
Central - Western - White Mountains	5.52%	6.32%	5.72%
Eastern Interior - East Coast	15.37%	14.57%	17.49%
Eastern Lowlands - Central Foothills	14.40%	18.09%	36.54%
Seacoast Plain – Ossipee	12.69%	21.76%	28.86%
All Maine	**10.74%**	**10.80%**	**14.39%**

Simillarly, high elevation areas (lands above 2700' elevation) are well represented in conserved land -- more than twice as abundant in conserved lands on the whole, and nearly eight times as abundant within 'reserved' lands.

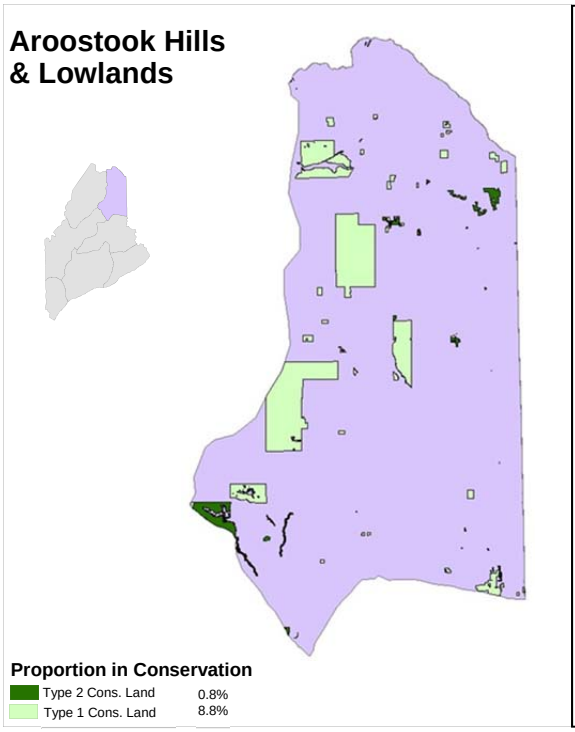
Each of 29 ecological system groups occurs at least once within conserved lands in Maine. Of the ecological systems occurring in more than one biophysical section, only *Appalachian-Acadian Pine-Hemlock-Hardwood Forest* is under-represented statewide in Type 2 conservation lands, and none were under-represented in Type 1 conservation land. There are 2,450,235 'quality' patch acres statewide of *Appalachian-Acadian Pine-Hemlock-Hardwood Forest*, accounting for 12.5% of the state. The distribution of this ecological system is largely within southern and central portions of the state. 24,762 acres are captured in Type 2 conservation lands, accounting for 3.3% of all Type 2 lands. All other systems are adequately represented on Type 2 conserved lands statewide or occur in only one biophysical section.

While most ecological systems are adequately represented for each biophysical section within Type 1 conservation land, representation is poorer within Type 2 conservation land. None of Maine's seven biophysical sections had adequate representation of all the ecological systems that occur in that section within Type 2 conservation lands. The number of ecological systems varies among biophysical sections, with biophysical sections in southern Maine (**Casco Bay, Penobscot Bay and Central Interior** and **Seacoast Plain-Ossipee)** containing the most systems. In every biophysical section, some ecological systems are not adequately represented in either Type 1 or Type 2 conserved lands, or both types (Figures 4-10). Under-represented systems can be classified into three distinct categories:

1. Uncommon ecological systems, forming < 0.5% of a biophysical section, that are under-represented or not represented at all.
2. Common, matrix forest systems forming > 10% of the landscape that are abundant in conserved lands, but not in proportion to the occurrence of the system on the landscape.
3. Common patch or matrix systems that are geographically distinct from the conserved lands in the biophysical section (i.e. most of the conserved land is in the north of a biophysical section, while the ecological system primarily occurs in the south).

Full acreage and relative percent occurrence in Type 1 and Type 2 conserved lands is included in Appendix 3.

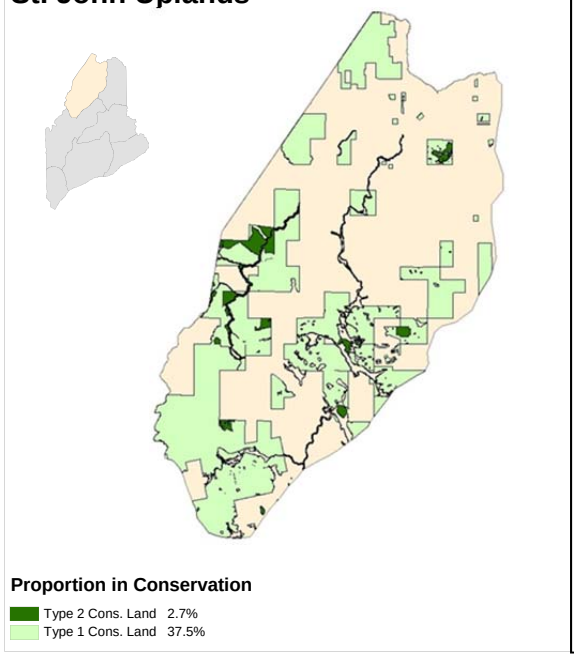
Figure 4. Aroostook Hills and Lowlands—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian Low Elevation Spruce-Fir-Hardwood Forest	27.40%		
Acadian Sub-boreal Spruce Flat	3.94%		
Acidic Cliff, Talus and Rocky Outcrop	0.08%		AR-NP
Alkaline Conifer-Hardwood Swamp	3.73%	UR-P	
Calcareous Cliff, Talus and Rocky Outcrop	0.07%		
Laurentian- N. Appalachian-Boreal Peatland	0.92%		
Laurentian-Acadian Floodplain Forest	0.10%		
Laurentian-Acadian Freshwater Marsh	0.27%		
Laurentian-Acadian Northern Hardwood Forest	12.83%		UR-NP
Laurentian-Acadian Northern Hardwood Forest, high conifer	3.03%		
Laurentian-Acadian Red Oak-Northern Hardwood Forest	0.07%	NR	NR
Laurentian-Acadian Wet Meadow-Shrub Swamp	0.77%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	2.18%		AR-NP

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

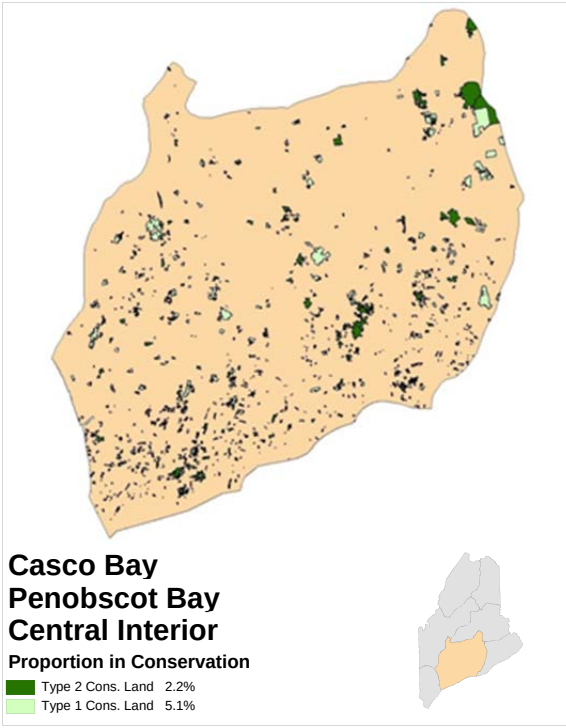
Figure 5. Boundary Plateau – St. John Uplands—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian Low Elevation Spruce-Fir-Hardwood Forest	29.71%		
Acadian Sub-boreal Spruce Flat	5.45%		
Acadian-Appalachian Montane Spr-Fir-Hwd Forest	0.01%	NR	NR
Acidic Cliff, Talus and Rocky Outcrop	0.36%		
Alkaline Conifer-Hardwood Swamp	1.01%		UR-P
Calcareous Cliff, Talus and Rocky Outcrop	0.08%		UR-P
Laurentian- N. Appalachian-Boreal Peatland	0.89%		
Laurentian-Acadian Floodplain Forest	0.02%		
Laurentian-Acadian Freshwater Marsh	0.32%		
Laurentian-Acadian Northern Hardwood Forest	25.63%		UR-P
Laurentian-Acadian Northern Hardwood Forest, high conifer	6.33%		UR-P
Laurentian-Acadian Wet Meadow-Shrub Swamp	0.54%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	1.96%		

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

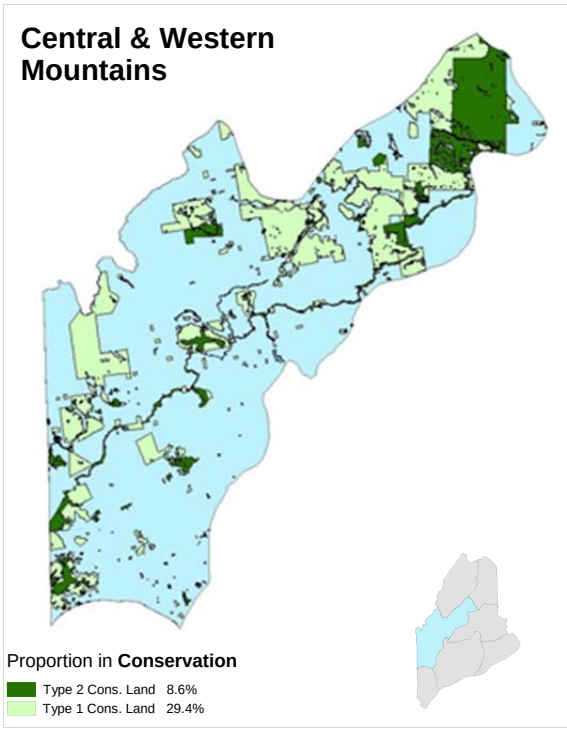
Figure 6. Casco Bay, Penobscot Bay and Central Interior—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian Low Elevation Spruce-Fir-Hardwood Forest	4.05%		
Acadian Maritime Bog	0.01%	NR	NR
Acadian Sub-boreal Spruce Flat	0.56%		
Acadian-North Atlantic Rocky Coast	0.06%		
Acidic Cliff, Talus and Rocky Outcrop	0.05%		
Alkaline Conifer-Hardwood Swamp	4.05%		
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	30.80%		UR-NP
Calcareous Cliff, Talus and Rocky Outcrop	0.02%		
Central Appalachian Dry Oak-Pine Forest	0.03%		
Laurentian- N. Appalachian-Boreal Peatland	1.65%		
Laurentian-Acadian Floodplain Forest	0.21%		UR-P
Laurentian-Acadian Freshwater Marsh	1.23%		
Laurentian-Acadian Northern Hardwood Forest	2.55%		
Laurentian-Acadian Northern Hardwood Forest, high conifer	0.08%	NR	NR
Laurentian-Acadian Red Oak-Northern Hardwood Forest	4.39%		
Laurentian-Acadian Wet Meadow-Shrub Swamp	1.22%		
North Atlantic Coastal Plain Maritime Forest	0.46%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	0.59%		
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	0.03%		
Tidal Marsh	0.25%		

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

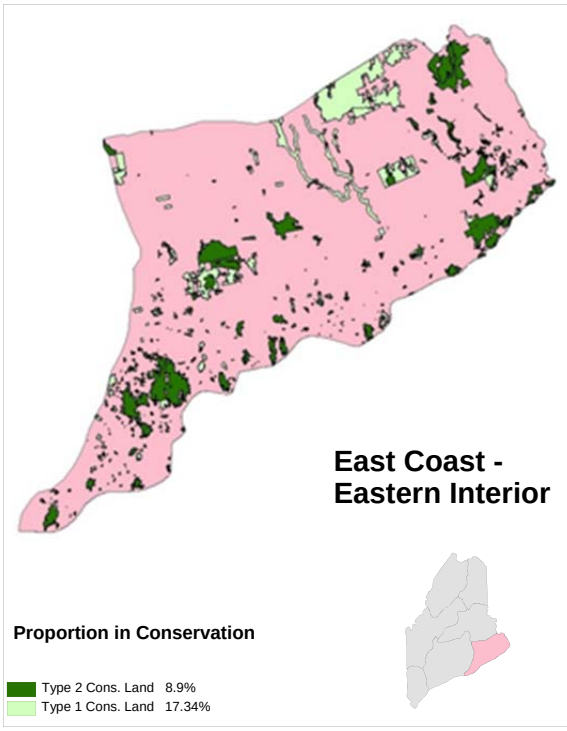
Figure 7. Central and Western Mountains—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian Low Elevation Spruce-Fir-Hardwood Forest	16.07%		
Acadian Sub-boreal Spruce Flat	1.85%		
Acadian-Appalachian Alpine Tundra	0.09%		
Acadian-Appalachian Montane Spr-Fir-Hwd Forest	9.31%		
Acidic Cliff, Talus and Rocky Outcrop	1.37%		
Alkaline Conifer-Hardwood Swamp	0.79%		UR-P
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	4.80%	UR-P	UR-NP
Calcareous Cliff, Talus and Rocky Outcrop	0.27%		
Central Appalachian Dry Oak-Pine Forest	0.01%		NR
Laurentian- N. Appalachian-Boreal Peatland	0.42%		
Laurentian-Acadian Floodplain Forest	0.07%		
Laurentian-Acadian Freshwater Marsh	0.22%		
Laurentian-Acadian Northern Hardwood Forest	26.53%		
Laurentian-Acadian Northern Hardwood Forest, high conifer	4.62%		
Laurentian-Acadian Red Oak-Northern Hardwood Forest	3.61%	UR-P	UR-P
Laurentian-Acadian Wet Meadow-Shrub Swamp	0.63%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	0.76%		

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

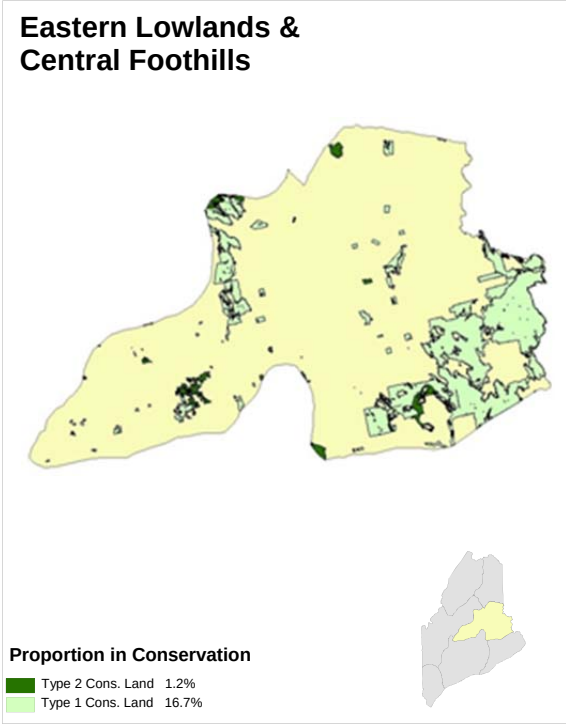
Figure 8. East Coast- Eastern Interior—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian Low Elevation Spruce-Fir-Hardwood Forest	35.03%		
Acadian Maritime Bog	0.25%		
Acadian Sub-boreal Spruce Flat	3.55%		
Acidic Cliff, Talus and Rocky Outcrop	0.29%		
Alkaline Conifer-Hardwood Swamp	3.25%		
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	5.92%		UR-P
Calcareous Cliff, Talus and Rocky Outcrop	0.01%		
Central Appalachian Dry Oak-Pine Forest	0.01%		
Laurentian- N. Appalachian-Boreal Peatland	1.75%		
Laurentian-Acadian Floodplain Forest	0.06%		
Laurentian-Acadian Freshwater Marsh	1.17%		
Laurentian-Acadian Northern Hardwood Forest	2.15%	UR-P	UR-P
Laurentian-Acadian Northern Hardwood Forest, high conifer	0.09%	AR-NP	NR
Laurentian-Acadian Red Oak-Northern Hardwood Forest	2.52%		
Laurentian-Acadian Wet Meadow-Shrub Swamp	1.43%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	1.15%		
Tidal Marsh	0.18%		

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

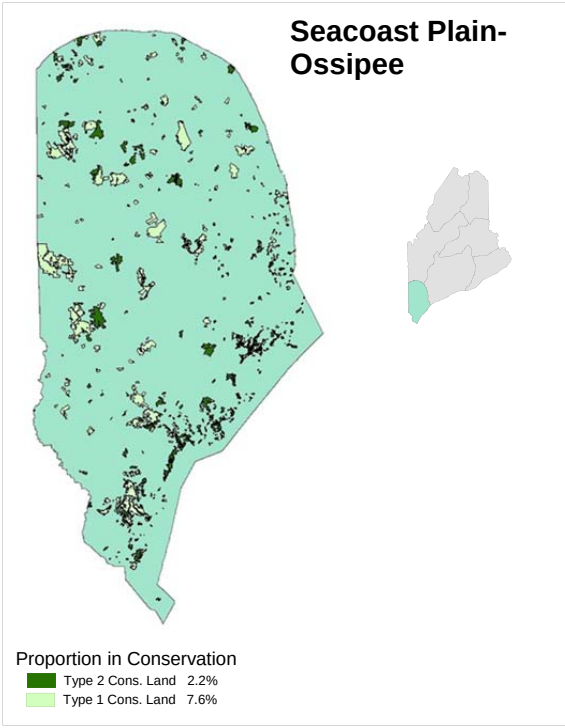
Figure 9. Eastern Lowlands & Central Foothills—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian Low Elevation Spruce-Fir-Hardwood Forest	13.16%	UR-P	UR-P
Acadian Sub-boreal Spruce Flat	2.11%		UR-P
Acidic Cliff, Talus and Rocky Outcrop	0.07%		
Alkaline Conifer-Hardwood Swamp	4.65%		
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	22.45%		
Calcareous Cliff, Talus and Rocky Outcrop	0.02%	UR-P	NR
Laurentian- N. Appalachian-Boreal Peatland	2.16%		
Laurentian-Acadian Floodplain Forest	0.17%		
Laurentian-Acadian Freshwater Marsh	0.78%		
Laurentian-Acadian Northern Hardwood Forest	10.87%		UR-NP
Laurentian-Acadian Northern Hardwood Forest, high conifer	1.63%		AR-NP
Laurentian-Acadian Red Oak-Northern Hardwood Forest	0.72%		NR
Laurentian-Acadian Wet Meadow-Shrub Swamp	1.49%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	1.57%		

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

Figure 10. South Coastal & South West Interior—representation of ecological systems in Type 1 (GAP types 1,2 and 3) and Type 2 (GAP types 1 and 2 only) conserved lands. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no value is given, the system is adequately represented (proportionally) and occurs plurally.



		Cons. Lands Rep.	
	% of section	Type 1	Type 2
Acadian-North Atlantic Rocky Coast	0.05%		
Acidic Cliff, Talus and Rocky Outcrop	0.10%		
Alkaline Conifer-Hardwood Swamp	3.30%		
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	25.59%		UR-NP
Calcareous Cliff, Talus and Rocky Outcrop	0.06%		
Central Appalachian Alkaline Glade and Woodland	0.01%		NR
Central Appalachian Dry Oak-Pine Forest	0.17%		
Central Appalachian Floodplain Forest	0.55%		
Laurentian- N. Appalachian-Boreal Peatland	0.17%		
Laurentian-Acadian Freshwater Marsh	0.93%		
Laurentian-Acadian Wet Meadow-Shrub Swamp	1.18%		
North Atlantic Coastal Plain Basin Peat Swamp	0.04%	AR-NP	NR
North Atlantic Coastal Plain Hardwood Forest	0.95%		NR
North Atlantic Coastal Plain Maritime Forest	0.13%		
North-Central Appalachian Pine Barrens	0.37%		AR-NP
North-Central Interior Wet Flatwoods	0.13%	UR-NP	UR-NP
Northeastern Coastal and Interior Pine-Oak Forest	13.00%		UR-NP
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	1.77%		
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	0.17%		
Tidal Marsh	0.54%		

Remaining % of section = agriculture, water, developed areas and small and fragmented ecological systems.

Discussion

This relative preponderance of wetlands and mountaintops within Maine's conserved lands is not surprising, given their high ecological and scenic importance, low development and forestry potential, regulatory constraints, and inexpensive land values. An estimated 85% of Maine's vertebrate species use wetlands or riparian areas at some point during their life cycles (Boone and Krohn 1998). Mountaintops provide habitat for a variety of rare plants and animals and may serve as important refugia in a changing climate. As a result, the abundance of wetlands and high elevation areas in Maine's conservation lands has likely paid strong dividends for biodiversity.

In the following section, we examine under-represented ecological systems in each biophysical section to discern trends and limitations in the data, as well as identify anomalies resulting from our rules for representation.

Aroostook Hills and Lowland

The **Aroostook Hills and Lowland** biophysical section has the least Type 2 conserved land in Maine. Most of the conserved land is working forest fee and easement lands, with the exception of a small section of Baxter State Park and a small handful of properties in the northeast of the section. The distribution and low acreage of Type 2 conserved land accounts for the under-representation of several ecological systems.

Laurentian Acadian Northern Hardwood Forest

Laurentian Acadian Northern Hardwood Forest is the second most common ecological system in this section (Figure 4). It occupies many of the small ridges and hills that pepper the landscape, and it is under-represented because of the scarcity and patchiness of Type 2 conserved land. Only one example is conserved in Type 2 conserved land (in Baxter State Park). In Type 1 conserved land, *Laurentian Acadian Northern Hardwood Forest* is conserved on working forest easement land and in the Scopan Unit (Maine BP&L). *Laurentian Acadian Northern Hardwood Forest – High Conifer*, a variant that may occur on northerly aspects and has roughly 25% or more conifers in the overstory, is conserved in Baxter State Park and in Aroostook State Park, both Type 2 conserved land.

Alkaline Conifer-Hardwood Swamp

It is unusual that an ecological system would be adequately represented on Type 2 conserved land but not on Type 1 conserved land. In the **Aroostook Hills and Lowland** biophysical section, *Alkaline Conifer-Hardwood Swamp* (roughly analogous to Northern White Cedar Swamp or Cedar-Spruce Seepage Forest and classified as a small patch type, following Gawler and Cutko 2010) is conserved in Marble Fen and Woodland Bog (TNC), Baxter State Park, and Aroostook National Wildlife Refuge. Due to the relatively low acreage of Type 2 conserved land in this biophysical section, these examples of *Alkaline Conifer-Hardwood Swamp* (764 total acres, Appendix 3) constitute 3.8% of Type 2 conserved land area, while 'quality' examples of this system type only account for 3.7% of the total landscape.

The distribution of Type 1 conserved land accounts for the under-representation of *Alkaline Conifer-Hardwood Swamp*. Large blocks of working forest easements occur on the western side of the

Aroostook Hills and Lowlands biophysical section. Because most of the *Alkaline Conifer-Hardwood Swamp* occurs on the lowlands in the eastern side of the section, it is not captured in Type 1 conserved land.

Other Ecological Systems

Several ecological systems are adequately represented in Type 2 conserved land in terms of acreage, but do not occur plurally. These included *Acidic Cliff, Talus and Rocky Outcrop* and *Northern Appalachian-Acadian Conifer Hardwood Acidic Swamp*. The under representation of these systems is largely a result of the relatively low amount of Type 2 conserved land in the **Aroostook Hills and Lowland**. Additionally, for open upland types such as *Acidic Cliff, Talus and Rocky Outcrop*, representation in Type 2 conservation lands is somewhat irrelevant—this system may be equally well protected in Type 1 conserved lands as Type 2 conserved lands, unless the potential for mining exists.

Laurentian-Acadian Red Oak- Northern Hardwood Forest is very rare in this region, and is, as a result, not represented in conserved lands. Representation of rare or uncommon systems is better described through analysis of Natural Areas Program element occurrence data, because the Ecological Systems GIS layer is more likely to be inaccurate a fine scale.

Boundary Plateau and St. John Uplands

There is more Type 1 conserved land in the **Boundary Plateau and St. John Uplands** than any of the other biophysical sections, in terms of both total acreage and as a percentage of the biophysical section (Table 3). Type 1 conserved land includes several large working forest easements and land owned in fee by the state and private conservation groups. Type 2 conservation land is not nearly as common and includes lands owned by The Nature Conservancy and ecoreserves owned and managed by the Division of Parks and Public Lands. No systems are under-represented in Type 1 conservation land, but several systems are under-represented in Type 2 conserved land.

Alkaline Conifer-Hardwood Swamp

Most of the *Alkaline Conifer-Hardwood Swamp* that occurs in Type 2 conserved land is in the Division of Parks and Public Lands Chamberlain Lake Unit. Most of the examples of this system occur along the east and southeast of the unit but do not intersect the largest piece of Type 2 conserved land: The Nature Conservancy's Upper St. John River Watershed Reserve. *Alkaline Conifer-Hardwood Swamp* is largely missing from the Type 2 conserved lands portfolio, but is captured numerous times in working forest easements (Type 1).

Laurentian-Acadian Northern Hardwood Forest

Laurentian-Acadian Northern Hardwood Forest and *Laurentian-Acadian Northern Hardwood Forest, High Conifer* are the second and third most dominant systems on the landscape. Their combined acreage is actually higher than *Acadian Low Elevation Spruce-Fir-Hardwood Forest*. These types are under-represented because, though they occurred scattered throughout the smaller blocks of Type 2 conserved lands around the section, they are very scarce in TNC's Upper St. John River Watershed

Reserve (~56,000 acres), the largest block of Type 2 conserved land in the **Boundary Plateau and St. John Uplands** biophysical section. These systems are adequately represented in Type 1 conservation lands.

Other Ecological Systems

Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest is not represented in either conserved land type. The only occurrence of this system in the **Boundary Plateau and St. John Uplands** is on Russell Mountain in Russell Pond Township. It is not clear whether this occurrence should be distinct from the surrounding *Acadian Low Elevation Spruce- Fir Hardwood Forest*. This can only be assessed through field examination.

Differentiated between Type 1 and Type 2 conserved land for non-forested upland types such as *Calcareous Cliff, Talus and Rocky Outcrop* may be irrelevant. GAP 3 status is an equivalent level of protection for these sites as GAP 1 or GAP 2, unless the potential for mining exists.

Casco Bay – Penobscot Bay – Central Interior

The **Casco Bay – Penobscot Bay – Central Interior** has the least Type 1 conserved land proportionally of any of the biophysical sections, but is roughly average for Type 2 conserved land. Because this biophysical section contains the greatest number of ecological systems (tied with **Seacoast Plain – Ossipee**), it is somewhat surprising that very few systems are under-represented. This reason for this has likely to do with the distribution of conserved lands: unlike northern and eastern sections, there are no large (> 10,000 acres) blocks of conservation land. Rather, conserved lands are distributed more evenly across the landscape. Because of this even distribution, ecological systems are not isolated geographically from conserved lands. However, because parcel sizes are small for Type 2 conserved lands, large 'quality examples' of matrix forest are not as well captured.

Appalachian-Acadian Pine-Hemlock-Hardwood Forest

Appalachian-Acadian Pine-Hemlock-Hardwood Forest is the most common ecological system within the section (30.8%, Appendix 3) and one of the most common in the state. Though this system is the most common type conserved in Type 2 conserved land (11,762 acres, or 14.6%), this system is under-represented because it is proportionally far more common on the landscape as a whole, and because parcel size of many Type 2 conserved lands was too small to capture contiguous blocks of this type more than 250 acres, the minimum threshold. Additional Type 2 conservation of roughly 1,700 acres would be sufficient to achieve adequate proportional representation.

The reason that this system failed the plurality test was an anomaly of how our analysis was structured. Because *Appalachian-Acadian Pine-Hemlock-Hardwood Forest* is so abundant on the landscape, a single 'occurrence' of this ecological system stretches from the western to eastern borders of the state with no breaks of over 1 kilometer. Just one huge occurrence of *Appalachian-Acadian Pine-Hemlock-Hardwood Forest* is captured in conservation lands in parcels from the western to eastern ends of the **Casco Bay – Penobscot Bay –Central Interior** biophysical section.

Laurentian Acadian Floodplain Forest

Hardwood floodplain forests are rare in Maine, in part because they occur on fertile alluvial soils that have a high value for agriculture. As a result, floodplain forests have been greatly diminished from their historic abundance. Alluvial wetlands have the highest rate of land conversion of any wetland type in the northeast (Anderson and Sheldon 2011). Our analysis may over-estimate the representation of floodplain forest because we evaluate representation relative to current *land cover* rather than underlying *landforms*. If analyzed with respect to its historic range in Maine, *Laurentian Acadian Floodplain Forest* could potentially be under-represented in all biophysical sections.

Laurentian Acadian Floodplain Forest is under-represented within Type 2 conserved lands in the **Casco Bay- Penobscot Bay- Central Interior** biophysical section, occurring on only a handful of conserved rivershore wetlands. However, some GAP 3 (Type 1 conserved lands) occurrences of Laurentian Acadian Floodplain Forest are on riparian islands where timber harvesting or other resource extraction activities seem highly unlikely.

Other Ecological Systems

A few small patches of *Acadian Maritime Bog*, an ecological system that is primarily restricted in range to Downeast Maine and the Canadian Maritimes, occur near the easternmost edge of the **Casco Bay- Penobscot Bay- Central Interior** biophysical section. The *Acadian Maritime Bog* ecological system is closely associated with three rare (S3) Natural Areas Program community types: *Maritime Slope Bog*, *Maritime Huckleberry Bog* and *Deer-Hair Sedge Bog Lawn*. The patches of *Acadian Maritime Bog* in this biophysical section are not mapped occurrences of any of these types and may be inaccurately mapped.

The *Laurentian-Acadian Northern Hardwood Forest, high conifer* ecological system is uncommon because it is at the southern end of its mapped range in this biophysical section. Most occurrences are smaller than 250 acres and were therefore dropped from analysis. Though statewide this ecological system is classified a matrix forest type, its distribution within the **Casco Bay-Penobscot Bay-Central Interior** is more similar to large patch ecological systems.

Central- Western- White Mountains

Relative to other parts of Maine, the **Central-Western-White Mountains** has the largest amount of Type 2 conserved land by acreage. Nearly all of the Type 2 conserved land statewide is in the Maine Central Mountains subsection, including the White Mountain National Forest, Baxter State Park, the Debsconeag Matrix (TNC) lands, and the Nahmakanta Ecological Reserve (BP&L). Much of the GAP 3 conservation land statewide is also here, including the Plum Creek and Katahdin Forest Project Easements. Within the **Central- Western- White Mountains ecoregion** conservation land has a northerly distribution, and ecological systems that primarily occur in the southern foothills are under-represented.

Southern Maine Ecological Systems

Appalachian- Acadian Pine-Hemlock-Hardwood Forest and *Laurentian-Acadian Red Oak-Northern Hardwood Forest* are both under- represented in the **Central-Western-White Mountains** biophysical section. Both of these systems occurred exclusively in the White Mountains and Western Maine Foothills subsections (See Fig. 1), where there is relatively less conserved land. Further analysis should be performed within these two sub-sections to determine adequate representation at a finer scale.

Other Ecological Systems

Alkaline – Conifer Hardwood Swamp is relatively uncommon in the **Central- Western – White Mountains.** Though there are some small occurrences in several locations of Type 2 conserved lands, including lands owned by the Appalachian Mountain Club, the state of Maine and The Nature Conservancy, *Alkaline – Conifer Hardwood Swamp* is under-represented. However, the Northern White Cedar Woodland Fen Fringing the Moose River (and conserved by TNC) may be incorrectly mapped within the ecological systems layer as *Laurentian N. Appalachian Boreal Peatland*. If this natural community occurrence is included in the acreage for *Alkaline – Conifer Hardwood Swamp*, this system would no longer be under- represented.

Additionally, some large examples of *Alkaline – Conifer Hardwood Swamp* do occur within the Moosehead Forest Easement (GAP 3), and Plum Creek (the land manager/owner) is already collaborating with the Maine Natural Areas Program and the Maine Department of Inland Fisheries and Wildlife to manage appropriately for these features.

Central Appalachian Dry Oak- Pine Forest is rare in the **Central – Western and White Mountains** and in Maine. This system is a matrix forest type in the mid-Atlantic. It appears that for Maine, occurrences of this system were mapped with a heavy reliance on enduring features of the landscape (landform) rather than land cover. This system generally describes sites with good drainage; better data needs to be collected before examining how this ecological system might influence conservation planning.

Eastern Interior- East Coast

Although the **Eastern Interior- East Coast** has an intermediate amount of Type 1 conservation land compared to the other biophysical sections, it has the second highest amount of Type 2 conservation land in acres and the highest amount of Type 2 conservation land by percentage of the section as a whole. Fully half of the conservation land in the **Eastern Interior- East Coast** is Type 2 conservation land, driven by Acadia National Park, the Cutler Coast (BP&L), Moosehorn National Wildlife Refuge, and the Spring River/ Donnell Pond matrix (TNC, BP&L). Under-represented systems occur primarily in central and northwestern portions of the section, outside of the large blocks of conservation lands.

Appalachian- Acadian Pine-Hemlock-Hardwood Forest

Appalachian- Acadian Pine-Hemlock-Hardwood Forest occurs in The Nature Conservancy's Lower Penobscot Forest Conservation Easement and in a few other scattered conserved lands. However, this system is under-represented because it occurs primarily in the northwestern corner of the **Eastern Interior- East Coast** section (where there are no large blocks of Type 2 conservation land). Immediately across the northern border in the **Eastern Lowlands – Central Foothills,** this system is adequately represented in Type 2 conservation lands. Thus, under-representation may be a result of the somewhat coarse location of the ecoregion boundary.

Laurentian Acadian Northern Hardwood Forest

Laurentian Acadian Northern Hardwood Forest and *Laurentian Acadian Northern Hardwood Forest, high conifer* are mesic upland ecological systems that typically occur in areas with more fertile soils, although they do have a broad range of tolerances. Northern hardwood forest is relatively uncommon in the Eastern Interior- East Coast, due to the acidic soils and cool coastal influence that favor spruce and fir. Within this section, this system occurs on upland ridges in the central and northwestern areas where there is less conservation land.

Among GAP 1 and GAP 2 lands, *Laurentian Acadian Northern Hardwood Forest* is represented in Acadia National Park, Spring River Matrix/Donnell Pond, and privately conserved land along the coast. It is also conserved in GAP 3 lands in the New England Forestry Foundation's Downeast Lakes easements.

Eastern Lowlands- Central Foothills

Several large conservation projects in the last few years have added considerably to the total acreage conserved in the **Eastern Lowlands- Central Foothills.** However, only 7.1% of this conserved land and 1.2% of the biophysical section is in 'ecological reserve'. Conservation lands are also highly concentrated, with most conservation lands in the southeastern third of the section. These factors account for the under-representation of ecological systems in Type 1 and Type 2 conserved lands in this biophysical section.

Acadian Low Elevation Spruce-Fir-Hardwood Forest and *Acadian Sub-Boreal Spruce Flat*

Acadian Low Elevation Spruce-Fir-Hardwood Forest is under-represented because of the uneven distribution of Type 1 and Type 2 conservation land. In the southeastern corner of the section, the large blocks of conserved lands are dominated by *Appalachian-Acadian Pine-Hemlock-Hardwood Forest* (which is very well represented), and have relatively few examples of *Acadian Low Elevation Spruce-Fir-Hardwood Forest*. Under the thresholds established in this study, approximately 3,000 additional acres would have to be conserved for this type to be adequately represented (Type 1 conservation land only).

Acadian Low Elevation Spruce-Fir-Hardwood Forest and *Acadian Sub-Boreal Spruce Flat* are also under-represented in Type 2 conservation land. Most of the Type 2 conserved land is in southern parts of the section, where these two ecological systems are less common.

Laurentian Acadian Northern Hardwood Forest

Significant Type 1 conservation lands in this biophysical section are: Atkinson Fee and Easement Lands, Penobscot Forest Easement Lands, Downeast Lakes Land Trust lands, the Crystal Bog Preserve and scattered small parcels and conservation lands that fringe the edge of the section. These properties do not overlap with significant bands of *Laurentian Acadian Northern Hardwood Forest*, which occurs scattered throughout the **Eastern Lowlands- Central Interior** section. The only places where this system is captured in Type 2 Conservation Lands are the Debsconeag and Trout Mountain Preserves (TNC) in the northwest corner of the section.

Other Ecological Systems

Calcareous Cliff, Talus and Rocky Outcrop is scattered across the **Lowlands- Central Interior** section and is indicative of exposed, circumneutral bedrock. In a couple of instances, this system overlaps with MNAP mapped occurrences of moderately rich forest types. However, the inaccuracy and scale at which this ecological system is mapped make it challenging for informing conservation decisions. Natural Areas Program mapped exemplary natural communities are likely a better resource for tracking conservation of calcareous outcrop natural communities.

Laurentian- Acadian Red Oak- Northern Hardwood Forest (A close associate of *Laurentian Acadian Northern Hardwood Forest*) is not represented at all. This is a result of the sparseness of this type in the region and the relatively low acreage of Type 2 conservation lands.

Seacoast Plain- Ossipee

The **Seacoast Plain- Ossipee** biophysical section is the smallest in physical area and has the least Type 1 conserved land by acres and the second least Type 1 lands by percentage. This section has relatively more Type 2 conserved land (Table 3). Larger parcels of GAP 3 conserved lands include working forest easements, MDIFW Wildlife Management Areas and Water District and other lands on Mount Agamenticus. Large parcels of Type 2 lands include The Nature Conservancy's Waterboro Barrens Preserve, Saco Heath (also TNC), Rachel Carson National Wildlife Refuge, Loon Echo Land Trust's Pleasant Mountain property and Sebago Lake State Park. Conservation lands are reasonably well distributed geographically.

The ecological systems GIS layer for the **Seacoast Plain- Ossipee** biophysical section was developed separately from the rest of Maine because occurs in the a different TNC ecoregion: the Lower- New England- Northern Piedmont. Though we merged many of the ecological systems within this section with their northern counterparts, a number of unique systems in this section could not be merged. Some unique systems, like *North-Central Appalachian Pine Barrens,* accurately represent features that occur exclusively in this biophysical section. Other ecological systems mapped here, such as *North-Central Interior Wet Flatwoods* (a seasonal wetland type from southern Appalachia dominated by swamp white oak, bur oak and pin oak), do not occur in Maine, but mapped occurrences may describe natural communities that are similar to their southern counterparts and contain plants with more northern distribution. The *North-Central Interior Wet Flatwoods* likely describes variants of red

maple swamps in southern Maine (for full system descriptions, see Appendix 2). This added degree of regional variation adds uncertainty about representation, which is discussed further on a system-by-system basis.

Several general and important trends are apparent from the results. Nearly all systems are adequately represented in Type 1 conserved lands. A very high percentage of Type 1 and Type 2 conserved lands are wetlands (Table 3), driven by conservation of wetlands in the Saco River floodplain, coastal saltmarshes, and other sites; nearly all wetland types are well represented. Conversely, *all* matrix forest types are under-represented in Type 2 conserved lands.

Appalachian-Acadian Pine-Hemlock-Hardwood Forest

In southern Maine, this system differs from *Northeastern Coastal and Interior Pine-Oak Forest* by being primarily deciduous (differing slightly from northern biophysical sections because of how original ecological systems were merged). Additionally, because of how systems were derived within the layer, there is an artificial boundary line ~12 miles from the coast where this system is no longer mapped (coastal hardwoods are mapped as *North Atlantic Coastal Plain Hardwood Forest*), which could potentially skew results.

Though this is the best-conserved ecological system in Type 2 conserved land, it is still under represented because it is not conserved proportionally to its occurrence on the landscape as a whole. This system is captured in Type 2 conserved lands on Pleasant Mountain (Loon Echo Land Trust), the Heald and Bradley Pond Reserve (Greater Lovell Land Trust), the Sawyer Mountain Highlands (Francis Small Heritage Trust), Perly Mills Community Forest and Bald Pate Mountain (both Loon Echo Land Trust). Though it is the dominant ecological system in many other conserved land parcels, it is not considered captured for representation due to small parcel size. To meet the minimum threshold for representation, at least 250 contiguous acres of a matrix ecological system would have to be conserved. Parcels of 500 acres or over had much better chances for capturing matrix ecological systems, because ecological systems will rarely conform to a parcel's boundary.

North Atlantic Coastal Plain Hardwood Forest

North Atlantic Coastal Plain Hardwood Forest is mapped in an inverse distribution from *Appalachian-Acadian Pine-Hemlock-Hardwood Forest*: it is mapped only within ~12 miles of the coast (this ecological system comes from TNC's **North Atlantic Coast** ecoregion). According to the description (Appendix 2), this system is not known to occur in Maine. However, mapped occurrences in Maine correspond to site conditions and land cover comparable to where this system occurs farther south. This system appears to differ from *Northeastern Coastal and Interior Pine-Oak Forest* in that it is almost entirely deciduous.

This forest type occurs on Type 1 conserved lands on Mount Agamenticus (conserved by various organizations), The Kennebunk Plains (MDIFW), and Blackstrap Hill Matrix (Falmouth Land Trust). There is nearly enough contiguous Type 2 conserved land acreage at Blackstrap Hill for *North Atlantic Coastal Plain Hardwood Forest* to be captured in Type 2 conserved land. Elsewhere, Type 2 conserved land parcels are too small to capture this matrix system.

Northeastern Coastal and Interior Pine-Oak Forest

This is an ecological system that bridges both TNC's 'North Atlantic Coast' and 'Lower New England-Northern Piedmont' ecoregions. It represents sites with higher cover of conifers than either *Appalachian-Acadian Pine-Hemlock-Hardwood Forest* or *North Atlantic Coastal Plain Hardwood Forest*. This system is conserved in Type 2 conserved lands only in TNC's Bull Ring Preserve, but is captured in many parcels of Type 1 conservation land, including the Massabesic Experimental Forest (USFWS), Mount Agamenticus (multiple conservation organizations), the Pine River conservation easement (BP&L) and others. Though this ecological system forms significant coverage of many Type 1 conservation land parcels, most are too small to capture contiguous forest blocks > 250 acres.

Other Ecological Systems

Three other ecological systems are underrepresented or not represented proportionally (*Central Appalachian Alkaline Glade and Woodland*, *North Atlantic Coastal Plain Basin Peat Swamp*, *North-Central Interior Wet Flatwoods*) and one additional system does not occur plurally (*North-Central Appalachian Pine Barrens*). *Appalachian Alkaline Glade and Woodland* describes woodlands over calcareous bedrock and is associated in Maine with **Ironwood-Oak-Ash Woodland** (Gawler and Cutko 2010). *North Atlantic Coastal Plain Basin Peat Swamp* is associated with **Atlantic White Cedar Swamp** (Gawler and Cutko 2010). Both of these natural communities are tracked by the Maine Natural Areas Program; for these systems, representational analysis of MNAP natural community data would be more accurate.

North Central Interior Wet Flatwoods, as mentioned above, is an ecological system from southern New England and extending to the Midwest. The mapped locations of this system in Maine are uncommon and could represent a range of areas where this community could potentially occur under scenarios of climate change. Because of uncertainty in the data, it is unclear what recommendations should be made regarding representation of this type.

Although only one contiguous example of *North-Central Appalachian Pine Barrens* is conserved in Type 2 conserved lands, this system is well represented proportionally. 9.3% of all examples of this system are conserved in Type 2 lands, and 44.4% of all examples are conserved in Type 1 conservation lands. Because *North-Central Appalachian Pine Barrens* is a system that requires disturbance to persist, some management and harvesting may be in concert with the conservation of this system. GAP 3 lands may conserve this system as equally as GAP 1 or GAP 2 lands as long as a proper disturbance regime is established.

Conclusions

Representational analysis using ecological systems may be the best resource for examining representation of common habitats within conservation lands. Data for rare ecological systems is likely to be less accurate than Maine Natural Areas Program natural community data; Natural Areas Program data for rare natural communities should drive management recommendations for the associated rare ecological systems.

Nearly 20% of Maine is now in some form of conservation, and less than 4% is reserved from timber harvesting. Wetlands and mountaintops are comparatively well represented in the state's conserved lands. Many forested ecological systems are well represented statewide, but multiple systems are under-represented within each biophysical section. According to our criteria, no biophysical section has all of its ecological systems adequately represented. Statewide, *Appalachian-Acadian Pine-Hemlock Hardwood Forest*, a common forest type occurring in southern and central areas of the state, is under represented in GAP 1 and 2 (Type 2) conservation lands. Similarly, in the **Seacoast Plain-Ossipee** and **Casco Bay- Penobscot Bay- Central Interior** sections, all common upland forest types are under-represented in GAP 1 and 2 lands. Under representation of these systems occurs primarily because parcels of conservation lands are generally too small to capture 250 acre blocks of this ecological system in southern Maine. This result corroborates findings for the entire northeast U.S. (Virginia to Maine), where oak-pine forests are less well conserved than other forest types (Anderson and Sheldon 2011).

In the **Aroostook Hills and Lowlands**, **Boundary Plateau and St. John Uplands, Eastern Interior-East Coast** and **Eastern Lowlands, Central Foothills**, *Laurentian Acadian Northern Hardwood Forest* is under represented in GAP 1 and 2 (Type 2) conserved lands. However, because this system is adequately represented in the **Central, Western and White Mountains**, largely in Baxter State Park, *Laurentian Acadian Northern Hardwood Forest* is adequately represented statewide. In the northeast region (Virginia-Maine), 8% of northern hardwood forests are in GAP 1 and GAP 2 lands, a result of large areas of 'reserved' land in the White Mountains National Forest and in the Adirondack State Park, a relatively high amount (Anderson and Sheldon 2011). However, conservation of northern hardwood forest in low elevation settings has not been separately examined, and is likely similar to Maine. In another analysis, rich site geophysical setting types at low elevations (often characteristic of northern hardwoods) were under-represented on the Northern Appalachian Region (Coker 2013).

Representational analysis using the ecological systems layer, and using rules established in this study, allows us to optimize patterns of conservation that yield the best representation of natural systems. If the rules of this study are to be followed, a theoretical landscape for optimal representation would contain conserved land that is well distributed and a high percentage of conserved land in contiguous units 500 acres or more. Future efforts should focus on identification of large occurrences of under-represented ecological systems to assist conservation organizations to strengthen their portfolio of conserved land.

Bibliography

Anderson, M.G. and A. Olivero Sheldon. 2011. Conservation Status of Fish, Wildlife, and Natural Habitats in the Northeast Landscape: Implementation of the Northeast Monitoring Framework. The Nature Conservancy, Eastern Conservation Science. 289 pp.

Bailey, Robert. 1995 Description of the Ecoregions of the United States. 2d ed. Rev. and expanded 1st ed. 1980). Misc. Publ. No. 1391 (rev.) Washington DC: USDA Forest Service. 108p. with separate map at 1:7,500,000.

Boone, R.B. and W.B. Krohn. 1998. Maine Gap Analysis vertebrate data - Part I: distribution, habitat relations, and status of amphibians, reptiles, and mammals in Maine. Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, Maine, USA. 175 pp. + appendices.

Coker, Dan. 2013. Representation of geophysical settings in conserved lands in the Northern Appalachian Region. Unpublished data.

Cutko, Andrew and Rick Frisina. 2005. "A Conservation Vision Using Ecological Land Units." Maine Natural Areas Program, Department of Conservation. http://www.maine.gov/doc/nrimc/mnap/about/publications/elu.htm. Accessed 5/3/13.

Feree, Charles. 2011. NE Terrestrial Habitat Mapping Project. http://conserveonline.org/workspaces/ecs/documents/ne-terrestrial-habitat-mapping-project. Accessed 5/3/13.

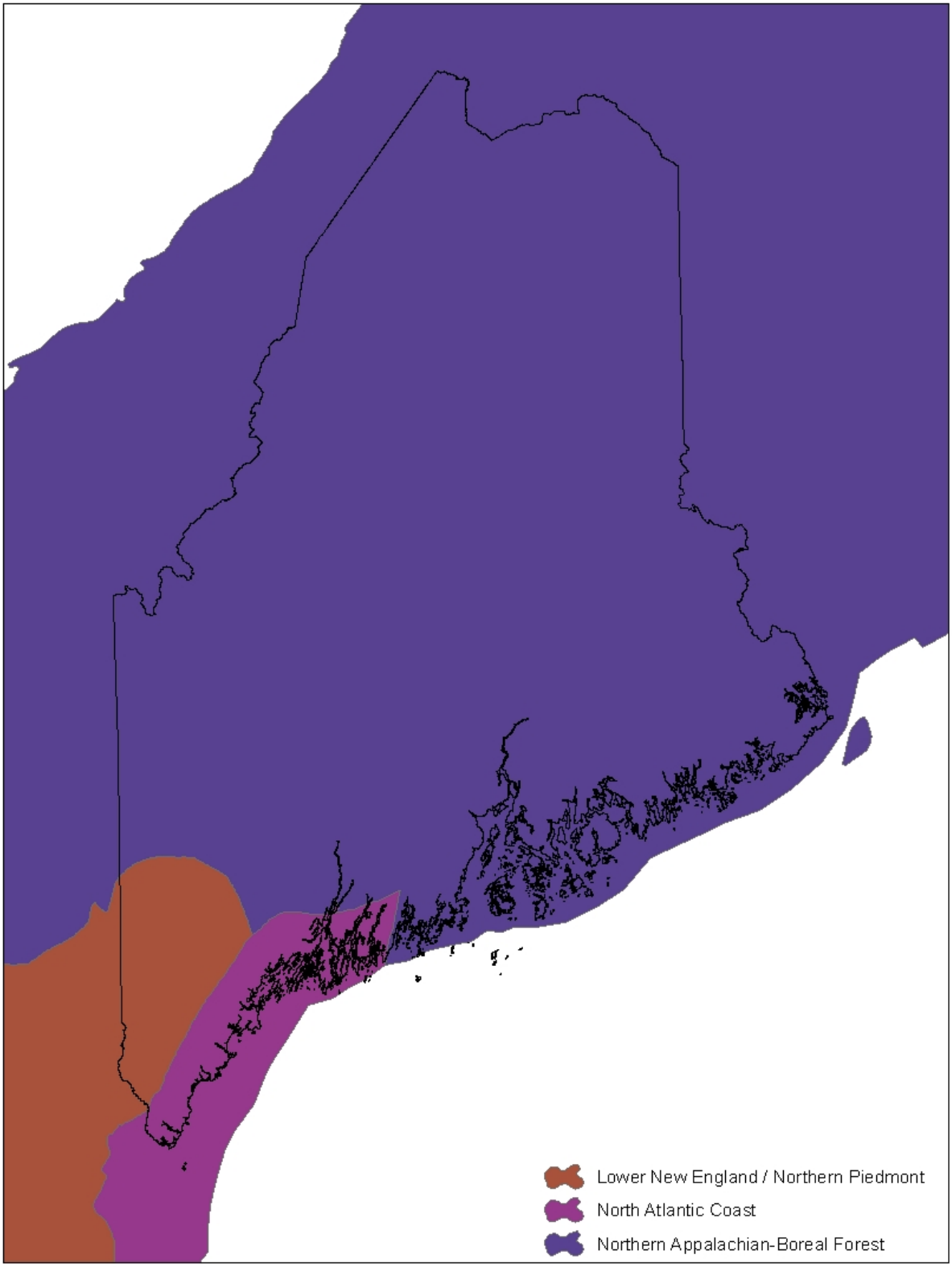
Forman, Richard. 1995. Land Mosaics: the ecology of landscapes and regions. Cambridge University Press, Cambridge, U.K.

Gawler, Susan and Andrew Cutko. 2010. Natural Landscapes of Maine: A Guide to Natural Communities and Ecosystems. Maine Natural Areas Program, Maine Department of Conservation, Augusta Maine.

McMahon, J.S. 1990. The biophysical regions of Maine: patterns in the landscape and vegetation. M.S. Thesis, University of Maine, Orono. 120 pp.

Appendix 1. The Nature Conservancy's ecoregions occurring in the state of Maine.

Ecological Systems were mapped independently in each of the three ecoregions.



Appendix 2. Description of Ecological Systems layer.

Descriptions are from companion materials to the Ecological Systems GIS layer (Feree 2011).

Merged System Type	Original System Type (if different)	Description
Acadian Low Elevation Spruce-Fir-Hardwood Forest & Acadian Sub-boreal Spruce Flat		This system represents the Acadian and northern Appalachian red spruce-fir forest. The low- to mid-elevation matrix forests are dominated by red spruce and balsam fir; black and white spruce are sometimes associates. Yellow birch is a typical hardwood associate; paper birch, beech, and red or sugar maple are often present. The soils are acidic and usually rocky, mostly well- to moderately well-drained but with some somewhat poorly drained patches at the slope bottoms. This habitat includes both uplands and seasonally wet areas (flats), but not saturated conifer swamps. In earlier successional patches, paper birch, aspen, and larch are mixed in with the spruce and fir. Blowdowns with subsequent gap regeneration are the most frequent form of natural disturbance, with large-scale fires important at longer return intervals.
Acadian Maritime Bog		These acidic peatlands occur along the north Atlantic Coast from downeast Maine east into the Canadian Maritimes. When these form in basins, they develop raised plateaus with undulating sedge and dwarf-shrub vegetation. They may also occur as "blanket bogs" over a sloping rocky substrate in extreme maritime settings; here, dwarf-shrubs and peat-mosses are the dominant cover. Species characteristic of this maritime setting include crowberry and baked-apple berry. Typical bog heaths such as sheep laurel, bog laurel, huckleberry, and Labrador tea are also present. Peatland morphology and certain coastal species distinguish these from more inland raised bogs. The distribution is primarily Canadian, and these peatlands are rare in the U.S.

Acadian-Appalachian Alpine Tundra	This system encompasses vegetation above treeline on northeastern mountains. Wind, snow, and cloud-cover fog are prominent environmental factors. Most of the cover is dwarf-shrubland, lichen, or sparse vegetation; islands of taller shrubs may occur in protected spots. The dominant plants are dwarf heaths (bilberry is diagnostic and often dominant) and cushion-plants such as diapensia. Bigelow's sedge is a characteristic and, in some places, locally dominant herb. This system includes wetland depressions, such as small alpine bogs, within the surrounding upland matrix.
Acadian-Appalachian Montane Spr-Fir-Hwd Forest	This is the matrix forest system in the spruce-fir region of the northern Appalachian Mountains. It occurs mostly upwards of 1500' elevation and is restricted to progressively higher elevations southward. Northward, it is often contiguous with Acadian Low-Elevation Spruce-Fir Forest. It often forms a mosaic of strongly coniferous patches and mixed patches, with occasional smaller inclusions of northern hardwoods or stands of paper birch, but is overall more than 50% coniferous. Red spruce and balsam fir are the dominant conifers. Gaps formed by wind, snow, ice, and harvesting are the major replacement agents; fires may be important but only over a long return interval.
Acadian-North Atlantic Rocky Coast	This system encompasses non-forested uplands along the immediate Atlantic Coast, from north of Cape Cod to the Canadian Maritimes. It is often a narrow zone between the high tide line and the upland forest; this zone becomes wider with increasing maritime influence. The substrate is rock, sometimes with a shallow soil layer, and tree growth is prevented by extreme exposure to wind, salt spray, and fog. Slope varies from flat rock to cliffs. Cover is patchy shrubs, dwarf-shrubs and sparse vascular vegetation, sometimes with a few stunted trees. Many coastal islands have graminoid-shrub areas that were maintained by sheep grazing and now persist even after grazing has ceased.

Acidic Cliff, Talus and Rocky Outcrop	North-Central Appalachian Acidic Cliff and Talus	These sparsely vegetated to partially wooded cliffs and talus slopes in the Central Appalachians occur at low to mid elevations from central New England south to Virginia, and up to 4500’ in West Virginia. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. In some cases, especially in periglacial areas, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action on the bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present.. The vegetation is patchy and often sparse, punctuated with patches of small trees. Red-cedar is a characteristic tree species, poison ivy a characteristic woody vine, and rock polypody a characteristic fern. Virginia pine is often present (within its range).
Acidic Cliff, Talus and Rocky Outcrop	Laurentian-Acadian Acidic Cliff and Talus	This acidic cliff system occurs at low to mid elevations, well below treeline, from New England west to the Great Lakes. It consists of near-vertical cliffs and the talus slopes below, formed on hills of granitic or otherwise acidic bedrock. Most of the substrate is dry and exposed, but small areas of seepage are often present and vegetation tends to be more well developed there. The vegetation is patchy and often sparse, punctuated with patches of small birch or spruce. In north-facing or other sheltered settings where cold air accumulates at the bottom of slopes, a distinctive shrubland of heaths and reindeer lichens can develop. This system differs from the more southerly North-Central Appalachian Acidic Cliff and Talus in the more boreal affinities of its flora (spruce rather than red-cedar).

Acidic Cliff, Talus and Rocky Outcrop	Northern Appalachian-Acadian Rocky Heath Outcrop	This semi-treed system ranges across New England and adjacent Canada, and southward at higher elevations to northern Pennsylvania, on ridges or summits of resistant acidic bedrock. It occurs primarily at low to mid elevations up to about 2500'. It often occurs as a mosaic of woodlands and open glades. Red oak and various conifers, including white pine and red spruce, are characteristic trees, and are often stunted in form. Low heath shrubs, including sheep laurel, lowbush blueberry, huckleberry, and chokeberry, are typically present. Exposure and occasional fire are the major factors in keeping the vegetation relatively open.
Alkaline Conifer-Hardwood Swamp	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp	These forested wetlands are uncommon in the glaciated northeast except in areas with extensive limestone or similar substrate. The higher pH and nutrient level are associated with a rich flora. The substrate is typically mineral soil, but there may be some peat. Northern white cedar is a diagnostic tree and may dominate the canopy or be mixed with other conifers or with deciduous trees, most commonly red maple or black ash. Some examples can be almost entirely deciduous and dominated by black ash. Red-osier dogwood is a common shrub. The moss layer is often extensive.
Alkaline Conifer-Hardwood Swamp	Laurentian-Acadian Alkaline Fen	These fens, distributed across glaciated Northeast, develop in open basins where bedrock or other substrate influence creates circumneutral to calcareous conditions. They are most abundant in areas of limestone bedrock, and widely scattered in areas where calcareous substrates are scarce. Shore fens, which are peatlands that are occasionally flooded along stream and lakeshores, are also included here because flooding tends to create moderately alkaline conditions. The vegetation may be graminoid-dominated, shrub-dominated, or a patchwork of the two; shrubby cinquefoil is a common and diagnostic shrub. The herbaceous flora is usually species-rich. Peat moss dominates the substrate, but certain other mosses are indicator bryophytes.

Alkaline Conifer-Hardwood Swamp	North-Central Interior and Appalachian Rich Swamp	These forested wetlands are scattered throughout the Northeast from southern New England south, at low to mid elevations. They are found in basins where higher pH and/or nutrient levels are associated with a rich flora. Species include red maple and black ash, as well as calciphilic herbs. Conifers may include larch, but typically not northern white cedar, which is characteristic of more northern wetlands. There may be shrubby or herbaceous openings within the swamp. The substrate is primarily mineral soil, but there may be some peat development.
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	Laurentian-Acadian Pine-Hemlock-Hardwood Forest	This conifer forest system ranges from the northeastern U.S. and adjacent Canada west to the Great Lakes and upper Midwest. The dryish forests usually occur on low-nutrient soils at low elevations, mostly less than 2000'. White pine, hemlock, and red oak are typical canopy dominants. Red maple (or black birch at the southern periphery of the range) is also common. (Oaks besides red oak are essentially absent from this system, being more representative of systems in the Central Interior-Appalachian Division to the south.) This is a widespread, matrix forest type in the glaciated northeast. Gap replacement and infrequent fire are the major natural regeneration modes.
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	Appalachian (Hemlock)-Northern Hardwood Forest	This forested system is one of the matrix forest types of the northeast, ranging from central New England west to Lake Erie and south to the higher elevations of Virginia and West Virginia. Northern hardwoods such as sugar maple, yellow birch, and beech are characteristic, either forming a deciduous canopy or mixed with hemlock (or in some cases white pine). Other common and sometimes dominant trees include red oak, tuliptree, black cherry, and black birch. It is of more limited extent and more ecologically constrained in the southern part of its range. Fire suppression appears to have increased the extent of this system.

Calcareous Cliff, Talus and Rocky Outcrop	Laurentian-Acadian Calcareous Cliff and Talus	This calcareous cliff system occurs at low to mid elevations, well below treeline, from New England west to the Great Lakes. It consists of near-vertical cliffs and the talus slopes below, where weathering and/or bedrock chemistry produce circumneutral to calcareous pH and enriched nutrient availability. The vegetation is often sparse, but may include patches of small trees. Northern white cedar may dominate on some cliffs (and reach very old ages, upwards of 1000 years). Ash and basswood are other woody indicators of the enriched setting.
Calcareous Cliff, Talus and Rocky Outcrop	Laurentian-Acadian Calcareous Rocky Outcrop	This outcrop system occurs in scattered locations from New England west to the Great Lakes. It occurs on ridges or summits of circumneutral to calcareous bedrock. Sites are often exposed and dry; however, there may be local areas of more moist conditions. The vegetation is often a mosaic of woodlands and open glades; northern white cedar is a characteristic tree although it rarely forms extensive cover.
Calcareous Cliff, Talus and Rocky Outcrop	North-Central Appalachian Circumneutral Cliff and Talus	This cliff system occurs at low to mid elevations from central New England south to Virginia and West Virginia. It consists of vertical or near-vertical cliffs and steep talus slopes where weathering and/or bedrock lithology produce circumneutral to calcareous pH and enriched nutrient availability. Substrates include limestone, dolomite and other rocks. The vegetation varies from sparse to patches of small trees, in places forming woodland or even forest vegetation. Basswood, ash, and bladdernut are woody indicators of the enriched setting; northern white cedar is sometimes present. The herb layer is typically not extensive but includes at least some species that are indicators of enriched conditions.

Central Appalachian Alkaline Glade and Woodland		This system occurs at low to moderate elevations from the Central Appalachians down into the Ridge and Valley. It consists of woodlands and open glades on thin soils over limestone, dolostone or similar calcareous rock. In some cases, the woodlands grade into closed-canopy forests. Red-cedar is a common tree, filling in in the absence of fire, and chinquapin oak is indicative of the limestone substrate. Prairie grasses are the dominant herbs (big bluestem, Indian grass, little bluestem, grama); forb richness is often high. Fire is sometimes an important natural disturbance vector, but open physiognomies may also be maintained by drought and landslides.
Central Appalachian Dry Oak-Pine Forest	Central Appalachian Dry Oak-Pine Forest	These oak and oak-pine forests cover large areas in the Central Appalachians and northern Piedmont, with a more limited range in New England and north to the Champlain Valley. The low- to mid-elevation setting ranges from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. The soils are coarse and infertile; they may be deep (on glacial deposits in the northern part of the system's range), or more commonly shallow, on rocky slopes of acidic rock. The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but can include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species such as chestnut oak, white oak, red oak, black oak, scarlet oak, pitch pine, and white pine. The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. A heath shrub layer (hillside blueberry, huckleberry, and mountain laurel, etc.), often dense, is characteristic. Small hillslope pockets with impeded drainage may support small isolated wetlands with red maple and black gum characteristic. Disturbance agents include fire, windthrow, and ice damage. Increased site disturbance generally leads to secondary forest vegetation with a greater proportion of Virginia pine and weedy hardwoods such as red maple. In the absence of fire, this system is believed to succeed to northern hardwood and hemlock forests.

Central Appalachian Dry Oak-Pine Forest	Central Appalachian Pine-Oak Rocky Woodland	This system of the Central Appalachians encompasses open or sparsely wooded hilltops and outcrops or rocky slopes, mostly at lower elevations, but occasionally up to 4000 feet in West Virginia. The substrate rock is granitic or of other acidic lithology, including traprock in New England. The vegetation is patchy, with woodland as well as open portions. Pitch and/or Virginia pines are diagnostic and often are mixed with dry-site oaks (including black oak and scarlet oak) and sprouts of chestnut. Some areas have a fairly well-developed heath shrub layer, others a graminoid layer. Conditions are dry and nutrient-poor, and at many, if not most, sites, a history of fire is evident.
Central Appalachian Floodplain Forest		This system encompasses floodplains of rivers in Atlantic drainages from southern New England to Virginia. It is most common on medium to large rivers, but can occur on smaller rivers where the stream gradient is low and a broad floodplain develops. It can include a complex of wetland and upland vegetation on deep alluvial deposits, on depositional bars, and (rarely) on bedrock where rivers cut through resistant geology. This complex includes floodplain forests in which silver maple, sycamore, and cottonwood are characteristic, as well as herbaceous sloughs, shrub wetlands, riverside prairies and woodlands. Most areas are underwater each spring; microtopography determining how long the various habitats are inundated. Depositional and erosional features may both be present depending on the particular floodplain.
Laurentian- N. Appalachian-Boreal Peatland	Boreal-Laurentian Bog	These raised peatlands are found at the near-boreal latitudes of glaciated northeastern and north-central United States and adjacent Canada, where climate allows the rate of peat accumulation to exceed its decomposition, resulting in acidic peatlands. The surface of the bog typically is over the water table (ombrotrophic). Peat mosses form the substrate. Black spruce and larch are the characteristic trees; they are sparse to patchy, with the vegetation dominated by low heath shrubs (sheep laurel, bog laurel, Labrador tea, leatherleaf) and patches of sedge and bryophyte lawns. Typical forbs include sundews, pitcher plants, and several orchids. While the raised portion defines these bogs, fen vegetation is often present along

		the wetter perimeter.
Laurentian- N. Appalachian-Boreal Peatland	Boreal-Laurentian-Acadian Acidic Basin Fen	Almost intermediate between a marsh and a bog, these fens develop in relatively shallow basins with nutrient-poor and acidic conditions. They are common across the glaciated Northeast. Many occur in association with lakes or streams; some occur as kettlehole fens (usually called kettlehole "bogs") associated with eskers or other glacial deposits. These fens often form a floating peat-based mat over water. The substrate is peat moss, and vegetation typically includes patches of grass/sedge and dwarf-shrub dominance. Leatherleaf is usually present and often dominant. North of 46 N latitude, distinctive ribbed fens may be found in which a pattern of narrow low ridges are oriented at right angles to the direction of the drainage, with wetter pools or depressions between the ridges.

Laurentian- N. Appalachian-Boreal Peatland	North-Central Interior and Appalachian Acidic Peatland	These open “bogs” occur in basins south of the coldest regions of the Northeast down to near the glacial boundary. They are found mostly in areas where glacial stagnation left coarse deposits and glacial depressions (many are "kettleholes"). The basins are generally closed, i.e., without inlets or outlets of surface water. The nutrient-poor substrate and the reduced throughflow of water create conditions fostering the development of peat and peatland vegetation. In deeper basins, the vascular vegetation grows on a peat mat over water, with no mineral soil development. Heath shrubs and dwarf-shrubs (e.g., leatherleaf) dominate, with patches of sedges and forbs. Some peatlands may have a sparse tree layer. Although these are often called bogs, in most cases they are technically fens (albeit nutrient-poor ones), as the vegetation remains in contact with the groundwater.
Laurentian-Acadian Floodplain Forest	Laurentian-Acadian Floodplain Forest & Eastern Boreal Floodplain	These floodplains occur in the northeastern U.S. north of the range of sycamore. Most occur along medium to large rivers where topography and process have resulted in the development of a complex of upland and wetland, temperate, alluvial vegetation. This complex includes silver maple floodplain forests as well as herbaceous sloughs and shrub wetlands. Most areas are underwater each spring, the length of inundation dependent on both overall water level and local microtopography. Associated trees include red maple and musclewood, the latter frequent but never abundant. On terraces or in higher-pH areas, sugar maple or red oak may be locally prominent, with yellow birch and ash associates. Black willow is characteristic of the levees adjacent to the channel. The herb layer often features abundant spring ephemerals, giving way to fern dominance in many areas by mid-summer. Non-forested wetlands associated with these systems include shrubby or sedge/grass vegetation. Two uncommon expressions occur along sub-boreal rivers in northernmost New England, north of the range of silver maple: ice-scour rivershores dominated by diverse herb and shrub associations, and boreal floodplain forests characterized by balsam poplar.

Laurentian-Acadian Freshwater Marsh	These freshwater emergent and/or submergent marshes are dominated by herbaceous vegetation. They are common throughout the Northeastern United States. Freshwater marshes occur in basins that are most often flat-bottomed and shallow, or forming a ring around the periphery of deeper basins. They are associated with lakes, ponds, slow-moving streams, impoundments or ditches. The herbaceous vegetation does not persist through the winter. Scattered shrubs are often present and usually total less than 25% cover. Trees are generally absent and, if present, are scattered. The substrate is typically muck over mineral soil. Typical plants include cattails, marsh fern, touch-me-not, pondweeds, water lilies, pickerelweed, and tall rushes.
Laurentian-Acadian Northern Hardwood Forest, Laurentian-Acadian Northern Hardwood Forest, high conifer, & Laurentian-Acadian Red Oak-Northern Hardwood Forest	These northern hardwood forests range across New England and adjacent Canada west to Minnesota. They occur in various upland settings at low to moderate elevations (generally <2000') across the glaciated northeast. Sugar maple, beech, and yellow birch are the dominant trees; hemlock and red spruce are frequent but minor canopy associates. Paper birch and aspen, along with white pine, are common in successional stands. This system can include large expanses of rich forest in areas of limestone or similar bedrock, as well as forests that are relatively poor floristically in areas of granitic (or similar) bedrock or acidic till. Blowdowns or snow and ice loading, with subsequent gap regeneration, are the most frequent form of natural disturbance.
Laurentian-Acadian Wet Meadow-Shrub Swamp	This system encompasses shrub swamps and wet meadows on mineral soils of the Northeast. They are most characteristic of the glaciated regions, but can be found in more scattered areas southward. They are often associated with lakes and ponds, but are also found along streams, where the water level does not fluctuate greatly. They are commonly flooded for part of the growing season but generally do not have standing water throughout the season. The size of occurrences ranges from small pockets to extensive acreages. The system can have a patchwork of shrub and graminoid dominance; typical species include willow, red-osier dogwood, alder, meadowsweet, bluejoint grass, tall sedges, and rushes. Trees are generally absent

and, if present, are scattered.

North Atlantic Coastal Plain Basin Peat Swamp

This system of the coastal plain from Massachusetts south to Virginia is comprised of acidic peat swamps formed in basins of various sizes. Atlantic white cedar is characteristic and often dominant; red maple may also be an important species, especially after logging. The saturated hydrology is evidenced by Sphagnum-based hummock-and-hollow microtopography.

North Atlantic Coastal Plain Hardwood Forest

This system is comprised of dry hardwood forests largely dominated by oaks, ranging from sandy glacial and outwash deposits of Cape Cod and Long Island south through the coastal plain of Maryland and Virginia (to about the James River). White, red, chestnut, and scarlet oaks are typical, and holly is sometimes present. Sassafras, birch, aspen, and hazelnut are common associates in earlier-successional areas. In the northern half of the range, conditions can grade to dry-mesic, reflected in the local abundance of beech . These forests occur on acidic, sandy to gravelly soils with a thick duff layer, often with a heath shrub layer.

North Atlantic Coastal Plain Maritime Forest	This system encompasses a range of woody vegetation present on barrier islands and near-coastal strands, from southeastern Virginia (Virginia Beach) northward along the extent of the Atlantic Coastal Plain. It includes forests and shrublands whose structure and composition are influenced by proximity to marine environments, including both upland and wetlands. Vegetation includes narrow bands of forests, often featuring stunted trees with contorted branches and dense vine layers. A range of trees may be present depending upon actual location and degree of protection from most extreme maritime influences.
North-Central Appalachian Pine Barrens	These pine barrens occur on glacial sandplains of inland regions of New England and New York, as well as some occurrences in the coastal plain north of Cape Cod and a disjunct area in the Poconos. Substrates include outwash plains, stabilized sand dunes, and glacial till. The soils are consequently coarse-textured, acidic, well-drained to xeric, and low in nutrients. Pitch pine is the usual dominant; open woodland is the typical cover but some include patches of closed-canopy forest. Red oak, white pine, and gray birch are common associates. A tall-shrub layer of scrub oak or dwarf chinkapin oak is commonly present. A well-developed low-shrub layer is typical, with lowbush blueberry, huckleberry, and sweetfern characteristic. The barrens are often a physiognomic patchwork, ranging from nearly closed-canopy forest to open pine woodlands, to scrub oak shrublands, to herbaceous/dwarf-shrub frost pockets. Small changes in elevation can create pockets with saturated soil, where shrubs such as hazelnut, buttonbush, highbush blueberry, and alder can form dense cover. Grassy areas dominated by little bluestem with native wild lupine, bushclover, and other forbs provide habitat for several rare invertebrates including the Karner blue butterfly and frosted elfin. Important vertebrate species include the hognose snake, whippoorwill, nighthawk, pine barrens treefrog, and others. These barrens always have a history of recurrent fires, and fire is required to maintain them.

North-Central Interior Wet Flatwoods	This small-patch system is found throughout the northern glaciated Midwest ranging east into Lower New England and the Champlain Valley. It usually occurs on poorly drained uplands or in depressions associated with glacial features such as tillplains, lakeplains or outwash plains. Soils often have an impermeable clay layer that can create a shallow, perched water table. Saturation can vary, with ponding common during wetter seasons, and drought possible during the summer and autumn months. These fluctuating moisture levels can lead to complexes of forest upland and wetland species occurring within this system. Pin oak dominates in many areas; other common trees (sometimes dominant) include swamp white oak, bur oak, and/or red maple. Areas with more dense tree cover have less shrub and herbaceous cover, while those with moderate tree canopy cover tend to have a dense understory. Some common species include buttonbush, winterberry, alder, and sedges. Flooding, drought and fire can influence this system.

Northeastern Coastal and Interior Pine-Oak Forest	(Same description as Central Appalachian Dry Oak-Pine Forest)	These oak and oak-pine forests cover large areas in the Central Appalachians and northern Piedmont, with a more limited range in New England and north to the Champlain Valley. The low- to mid-elevation setting ranges from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. The soils are coarse and infertile; they may be deep (on glacial deposits in the northern part of the system's range), or more commonly shallow, on rocky slopes of acidic rock. The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but can include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species such as chestnut oak, white oak, red oak, black oak, scarlet oak, pitch pine, and white pine. The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. A heath shrub layer (hillside blueberry, huckleberry, and mountain laurel, etc.), often dense, is characteristic. Small hillslope pockets with impeded drainage may support small isolated wetlands with red maple and black gum characteristic. Disturbance agents include fire, windthrow, and ice damage. Increased site disturbance generally leads to secondary forest vegetation with a greater proportion of Virginia pine and weedy hardwoods such as red maple. In the absence of fire, this system is believed to succeed to northern hardwood and hemlock forests.
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	These forested wetlands are common in the glaciated Northeast. They occur on mineral soils (sometimes with a thin to moderate upper layer of peat) that are nutrient-poor. These basin wetlands remain saturated for all or nearly all of the growing season, and may have standing water seasonally. Red maple, red spruce, and balsam fir are the most typical trees; ash may be common in some locations. The herbaceous and shrub layers tend to be fairly species-poor; catberry, tall ferns (cinnamon, interrupted, sensitive), and wetland sedges are typical and may be extensive.

Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	North-Central Appalachian Acidic Swamp	These swamps are distributed from central New England through the Central Appalachians south to Virginia and west to Ohio. They are found at low to mid elevations (generally <2000') in poorly drained depressions. The acidic substrate is mineral soil, often with a component of organic muck; if peat is present, it usually forms a thin layer over the mineral soil rather than a true peat substrate. Hemlock is usually present and may be dominant. It is often mixed with deciduous wetland trees such as red maple or black gum. Basin swamps tend to be more nutrient-poor than seepage swamps; in some settings, the two occur adjacent to each other with the basin swamp vegetation surrounded by seepage swamp vegetation on its upland periphery.
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach		This system includes sparsely vegetated sand beaches along the northeast coast. They generally extend seaward from foredunes but may include flats behind breached foredunes. Although these habitats are situated just above the mean high tide limit, they are constantly impacted by waves and may be flooded by high spring tides and storm surges. Constant salt spray and rainwater maintain generally moist conditions. Substrates consist of unconsolidated sand and shell sediments that are constantly shifted by winds and floods. Dynamic disturbance regimes largely limit vegetation to pioneering, salt-tolerant, succulent annuals. Sea-rocket and Russian thistle are usually most numerous and characteristic, with other scattered maritime environment associates.

Tidal Marsh	North Atlantic Coastal Plain Tidal Salt Marsh: salt/brackish/oligohaline	This system encompasses the intertidal marshes of the North Atlantic Coastal Plain from Chesapeake Bay north to Cape Cod, and sporadically to the southern Maine coast. It includes a number of different broad vegetation types including salt pannes, salt marshes, and salt shrublands. This system occurs on the bay side of barrier beaches and the outer mouth of tidal rivers where salinity is not much diluted by freshwater input. The typical salt marsh profile, from sea to land, features a low regularly flooded marsh strongly dominated by salt marsh cordgrass; a higher irregularly flooded marsh dominated by saltmeadow cordgrass and saltgrass; low hypersaline pannes characterized by saltwort; and a salt scrub ecotone characterized by marsh elder, groundsel-tree, and switchgrass. Salt marsh "islands" of slightly higher elevation also support red-cedar. For the purposes of this classification, these include the uncommon salt ponds sometimes found behind barrier beaches, which are treated elsewhere as a separate system (Northern Atlantic Coastal Plain Salt Pond Marsh).
Tidal Marsh	Acadian Coastal Salt Marsh, Acadian Estuary Marsh	This system covers saltwater marshes of the Gulf of Maine along the immediate ocean shore and near estuary mouths. Sometimes called "salt meadows," these marshes display strong graminoid dominance, with patchy forbs. Salt hay and smooth cordgrass are the major dominants. These marshes may be extensive where the local topography allows; however, they are generally not associated with sand beach and dune systems, being more characteristic of the primarily rocky portions of the Gulf of Maine coast. Where the coastal topography becomes more dissected, they are commonly seen as a fairly narrow fringe along tidal shorelines. For the purposes of this classification, these include the uncommon salt ponds sometimes found behind barrier beaches, which are treated elsewhere as a separate system (Northern Atlantic Coastal Plain Salt Pond Marsh).

Tidal Marsh	Acadian Estuary Marsh	These marshes are found along brackish estuaries of the Gulf of Maine, and include both emergent and submergent vegetation. Dominance ranges from extensive bulrush beds and tall grasses and sedges to sparsely vegetated mudflats, all tidally influenced. These marshes grade into the salt marsh system at the mouth of estuaries.

Appendix 3. Details of Ecological System Representation per Ecological Section

A. Number of unique patches of each ecological system, over 1km apart from a similar system of the same type; B. total acres of each ecological system and acres and percent of each ecological system conserved; C. Proportion of conserved lands and all lands occupied by each ecological system [(acres of each ecological system)/(total acres conserved or total acres)]; and D. Representation of ecological systems in conserved land. Both proportional [AR = adequately represented; UR = under represented; and NR = not represented] and plurality [P = occurs plurally; NP = does not occur plurally, i.e. only one example has been conserved within the biophysical section] analyses are described. Where no description is given, the system is adequately represented (proportionally) and occurs plurally. All analyses were done by first filtering 'quality' examples of ecological systems based on acreage, and were performed for both Type 1 (Gap status 1,2 and3) and Type 2 (Gap status 1 and 2 only).

	A. # unique patches			B. Acres			C. relative % of total area			D. Cons. Lands Rep.	
	Type 1 Cons. Land	Type 2 Cons. Land	All land area	Type 1 Cons. Land (%)	Type 2 Cons. Land (%)	All land area	Type 1 Cons. Land	Type 2 Cons. Land	All land area	Type 1	Type 2
Aroostook Hills and Lowlands	**206**	**38**	**1641**	**137,850 (10.45%)**	**10,777 (0.82%)**	**1,319,475**	**65.4%**	**53.7%**	**55.4%**		
Acadian Low Elevation Spruce-Fir-Hardwood Forest	3	2	51	72,727 (11.14%)	4,516 (0.69%)	652,825	34.5%	22.5%	27.4%		
Acadian Sub-boreal Spruce Flat	25	3	190	18,648 (19.86%)	1,328 (1.41%)	93,880	8.8%	6.6%	3.9%		
Acidic Cliff, Talus and Rocky Outcrop	7	1	69	162 (8.51%)	129 (6.77%)	1,905	0.1%	0.6%	0.1%		AR-NP
Alkaline Conifer-Hardwood Swamp	26	6	154	3,036 (3.42%)	764 (0.86%)	88,790	1.4%	3.8%	3.7%	UR-P	
Calcareous Cliff, Talus and Rocky Outcrop	7	2	60	237 (14.06%)	36 (2.11%)	1,685	0.1%	0.2%	0.1%		
Laurentian- N. Appalachian-Boreal Peatland	23	3	106	3,229 (14.74%)	553 (2.52%)	21,902	1.5%	2.8%	0.9%		
Laurentian-Acadian Floodplain Forest	4	2	47	298 (12.65%)	256 (10.88%)	2,355	0.1%	1.3%	0.1%		
Laurentian-Acadian Freshwater Marsh	21	7	216	840 (12.86%)	343 (5.25%)	6,530	0.4%	1.7%	0.3%		
Laurentian-Acadian Northern Hardwood Forest	10	1	92	20,267 (6.63%)	306 (0.1%)	305,630	9.6%	1.5%	12.8%		UR-NP

Laurentian-Acadian Northern Hardwood Forest, high conifer	16	2	117	9,995 (13.85%)	1,769 (2.45%)	72,151	4.7%	8.8%	3.0%		
Laurentian-Acadian Red Oak-Northern Hardwood Forest			3	0 (0%)	0 (0%)	1,553			0.1%	NR	NR
Laurentian-Acadian Wet Meadow-Shrub Swamp	37	8	348	2,102 (11.48%)	515 (2.81%)	18,310	1.0%	2.6%	0.8%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	27	1	188	6309 (12.14%)	263 (0.51%)	51,960	3.0%	1.3%	2.2%		AR-NP
Boundary Plateau and St. John Uplands	**1036**	**142**	**2638**	**917,478 (36.12%)**	**47,769 (1.88%)**	**2,540,260**	**69.6%**	**50.0%**	**72.3%**		
Acadian Low Elevation Spruce-Fir-Hardwood Forest	14	2	33	415,089 (39.77%)	23,558 (2.26%)	1,043,676	31.5%	24.7%	29.7%		
Acadian Sub-boreal Spruce Flat	156	23	345	86,643 (45.26%)	6,418 (3.35%)	191,438	6.6%	6.7%	5.4%		
Acadian-Appalachian Montane Spr-Fir-Hwd Forest			1	0 (0%)	0 (0%)	304			0.0%	NR	NR
Acidic Cliff, Talus and Rocky Outcrop	117	6	517	3,126 (25%)	748 (5.98%)	12,503	0.2%	0.8%	0.4%		
Alkaline Conifer-Hardwood Swamp	76	10	157	12,274 (34.61%)	477 (1.35%)	35,463	0.9%	0.5%	1.0%		UR-P
Calcareous Cliff, Talus and Rocky Outcrop	63	2	142	1,024 (37.44%)	25 (0.91%)	2,734	0.1%	0.0%	0.1%		UR-P
Laurentian- N. Appalachian-Boreal Peatland	67	9	138	14,469 (46.38%)	2,115 (6.78%)	31,201	1.1%	2.2%	0.9%		
Laurentian-Acadian Floodplain Forest	14	4	21	445 (56.19%)	135 (17.05%)	792	0.0%	0.1%	0.0%		
Laurentian-Acadian Freshwater Marsh	93	30	214	4,943 (43.41%)	1,532 (13.45%)	11,387	0.4%	1.6%	0.3%		

Laurentian-Acadian Northern Hardwood Forest	53	4	113	297,450 (33.04%)	5,018 (0.56%)	900,392	22.6%	5.3%	25.6%		UR-P
Laurentian-Acadian Northern Hardwood Forest, high conifer	84	4	245	46,348 (20.85%)	1,973 (0.89%)	222,318	3.5%	2.1%	6.3%		UR-P
Laurentian-Acadian Wet Meadow-Shrub Swamp	160	34	362	7,356 (38.46%)	1,652 (8.64%)	19,127	0.6%	1.7%	0.5%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	139	14	350	28,312 (41.08%)	4,118 (5.97%)	68,926	2.1%	4.3%	2.0%		
Casco Bay - Penobscot Bay - Central Interior	**372**	**183**	**3381**	**84,705 (4.44%)**	**39,485 (2.07%)**	**1,906,300**	**45.9%**	**49.1%**	**52.3%**		
Acadian Low Elevation Spruce-Fir-Hardwood Forest	6	4	74	3,767 (2.55%)	2,339 (1.59%)	147,503	2.0%	2.9%	4.0%		
Acadian Maritime Bog			3	0 (0%)	0 (0%)	280			0.0%	NR	NR
Acadian Sub-boreal Spruce Flat	9	7	125	782 (3.83%)	594 (2.9%)	20,436	0.4%	0.7%	0.6%		
Acadian-North Atlantic Rocky Coast	23	10	60	324 (15.16%)	133 (6.23%)	2,140	0.2%	0.2%	0.1%		
Acidic Cliff, Talus and Rocky Outcrop	23	12	82	441 (25.84%)	351 (20.58%)	1,706	0.2%	0.4%	0.0%		
Alkaline Conifer-Hardwood Swamp	81	38	524	10,329 (6.99%)	5,386 (3.65%)	147,704	5.6%	6.7%	4.1%		
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	2	1	47	31,916 (2.84%)	11,762 (1.05%)	1,123,013	17.3%	14.6%	30.8%		UR-NP
Calcareous Cliff, Talus and Rocky Outcrop	6	2	52	38 (6.67%)	13 (2.33%)	565	0.0%	0.0%	0.0%		
Central Appalachian Dry Oak-Pine Forest	2	1	45	25 (2.7%)	12 (1.27%)	931	0.0%	0.0%	0.0%		

Laurentian- N. Appalachian-Boreal Peatland	23	12	122	11,957 (19.87%)	8,599 (14.29%)	60,165	6.5%	10.7%	1.7%		
Laurentian-Acadian Floodplain Forest	10	3	105	298 (3.87%)	44 (0.58%)	7,705	0.2%	0.1%	0.2%		UR-P
Laurentian-Acadian Freshwater Marsh	79	33	876	3,156 (7.03%)	1,346 (3%)	44,893	1.7%	1.7%	1.2%		
Laurentian-Acadian Northern Hardwood Forest	4	3	113	3,506 (3.77%)	1,136 (1.22%)	92,972	1.9%	1.4%	2.5%		
Laurentian-Acadian Northern Hardwood Forest, high conifer			7	0 (0%)	0 (0%)	2,849			0.1%	NR	NR
Laurentian-Acadian Red Oak-Northern Hardwood Forest	8	2	96	10,646 (6.65%)	4,399 (2.75%)	160,191	5.8%	5.5%	4.4%		
Laurentian-Acadian Wet Meadow-Shrub Swamp	55	25	772	2,771 (6.22%)	872 (1.96%)	44,579	1.5%	1.1%	1.2%		
North Atlantic Coastal Plain Maritime Forest	10	10	26	1,558 (9.21%)	961 (5.68%)	16,923	0.8%	1.2%	0.5%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	7	5	136	851 (3.97%)	596 (2.78%)	21,434	0.5%	0.7%	0.6%		
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	8	6	46	205 (18.64%)	177 (16.06%)	1,102	0.1%	0.2%	0.0%		
Tidal Marsh	16	9	70	2,134 (23.18%)	765 (8.31%)	9,206	1.2%	1.0%	0.3%		
Central - Western - White Mountains	**1158**	**354**	**3683**	**883,761 (29.24%)**	**266,953 (8.83%)**	**3,022,392**	**71.1%**	**73.0%**	**71.4%**		
Acadian Low Elevation Spruce-Fir-Hardwood Forest	35	10	118	277,152 (40.75%)	79,800 (11.73%)	680,108	22.3%	21.8%	16.1%		
Acadian Sub-boreal Spruce Flat	140	32	347	30,337 (38.78%)	5,999 (7.67%)	78,226	2.4%	1.6%	1.8%		

Acadian-Appalachian Alpine Tundra	9	6	9	3,550 (99.04%)	2,472 (68.94%)	3,585	0.3%	0.7%	0.1%		
Acadian-Appalachian Montane Spr-Fir-Hwd Forest	38	26	67	143,846 (36.52%)	61,491 (15.61%)	393,850	11.6%	16.8%	9.3%		
Acidic Cliff, Talus and Rocky Outcrop	267	97	821	26,401 (45.55%)	17,047 (29.41%)	57,966	2.1%	4.7%	1.4%		
Alkaline Conifer-Hardwood Swamp	93	18	387	9,019 (26.97%)	882 (2.64%)	33,444	0.7%	0.2%	0.8%		UR-P
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	5	1	32	9,680 (4.76%)	954 (0.47%)	203,295	0.8%	0.3%	4.8%	UR-P	UR-P
Calcareous Cliff, Talus and Rocky Outcrop	72	24	271	3,720 (33%)	1,756 (15.58%)	11,272	0.3%	0.5%	0.3%		
Central Appalachian Dry Oak-Pine Forest	4		24	72 (19.54%)	0 (0%)	370	0.0%		0.0%		NR
Laurentian- N. Appalachian-Boreal Peatland	32	5	83	10,014 (56.61%)	4,241 (23.97%)	17,689	0.8%	1.2%	0.4%		
Laurentian-Acadian Floodplain Forest	9	5	46	494 (17.51%)	242 (8.58%)	2,819	0.0%	0.1%	0.1%		
Laurentian-Acadian Freshwater Marsh	98	28	337	2,606 (28.63%)	651 (7.15%)	9,105	0.2%	0.2%	0.2%		
Laurentian-Acadian Northern Hardwood Forest	47	17	115	259,621 (23.12%)	55,864 (4.97%)	1,122,975	20.9%	15.3%	26.5%		
Laurentian-Acadian Northern Hardwood Forest, high conifer	83	20	246	73,369 (37.49%)	27,567 (14.09%)	195,704	5.9%	7.5%	4.6%		
Laurentian-Acadian Red Oak-Northern Hardwood Forest	10	3	54	15,776 (10.32%)	2,172 (1.42%)	152,872	1.3%	0.6%	3.6%	UR-P	UR-P

Laurentian-Acadian Wet Meadow-Shrub Swamp	158	47	549	7,035 (26.25%)	2,008 (7.49%)	26,802	0.6%	0.5%	0.6%	
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	58	15	177	11,068 (34.25%)	3,808 (11.78%)	32,310	0.9%	1.0%	0.8%	
Eastern Interior - East Coast	**353**	**194**	**1502**	**128,279 (14.89%)**	**67,480 (7.83%)**	**861,306**	**50.5%**	**52.0%**	**58.8%**	
Acadian Low Elevation Spruce-Fir-Hardwood Forest	7	5	29	70,887 (13.82%)	39,834 (7.76%)	513,010	27.9%	30.7%	35.0%	
Acadian Maritime Bog	8	7	33	780 (21.02%)	725 (19.54%)	3,712	0.3%	0.6%	0.3%	
Acadian Sub-boreal Spruce Flat	39	17	184	6,886 (13.23%)	3,149 (6.05%)	52,029	2.7%	2.4%	3.6%	
Acidic Cliff, Talus and Rocky Outcrop	14	9	52	3,597 (85.38%)	3,358 (79.69%)	4,213	1.4%	2.6%	0.3%	
Alkaline Conifer-Hardwood Swamp	47	29	146	7,740 (16.26%)	3,934 (8.27%)	47,591	3.0%	3.0%	3.2%	
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	4	3	40	10,107 (11.65%)	1,159 (1.34%)	86,756	4.0%	0.9%	5.9%	UR-P
Calcareous Cliff, Talus and Rocky Outcrop	3	2	13	14 (20.45%)	11 (15.58%)	68	0.0%	0.0%	0.0%	
Central Appalachian Dry Oak-Pine Forest	5	4	5	147 (95.78%)	137 (88.9%)	154	0.1%	0.1%	0.0%	
Laurentian- N. Appalachian-Boreal Peatland	20	12	87	6,247 (24.37%)	5,397 (21.06%)	25,629	2.5%	4.2%	1.7%	
Laurentian-Acadian Floodplain Forest	6	2	21	169 (19.21%)	49 (5.54%)	879	0.1%	0.0%	0.1%	

Laurentian-Acadian Freshwater Marsh	89	48	354	4,423 (25.72%)	2,982 (17.34%)	17,195	1.7%	2.3%	1.2%		
Laurentian-Acadian Northern Hardwood Forest	7	3	41	2,720 (8.65%)	1,188 (3.78%)	31,449	1.1%	0.9%	2.1%	UR-P	UR-P
Laurentian-Acadian Northern Hardwood Forest, high conifer	1		5	341 (25.07%)	0 (0%)	1,359	0.1%		0.1%	AR-NP	NR
Laurentian-Acadian Red Oak-Northern Hardwood Forest	10	3	48	7,705 (20.91%)	2,679 (7.27%)	36,844	3.0%	2.1%	2.5%		
Laurentian-Acadian Wet Meadow-Shrub Swamp	67	34	305	4611 (22.01%)	1,584 (7.56%)	20,945	1.8%	1.2%	1.4%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	15	9	102	1,608 (9.58%)	1,103 (6.57%)	16,780	0.6%	0.8%	1.1%		
Tidal Marsh	11	7	37	298 (11.08%)	192 (7.13%)	2,692	0.1%	0.1%	0.2%		
Eastern Lowlands - Central Foothills	**533**	**64**	**2884**	**337,765 (17.95%)**	**19,870 (1.06%)**	**1,881,200**	**66.3%**	**54.8%**	**61.8%**		
Acadian Low Elevation Spruce-Fir-Hardwood Forest	21	3	113	30,831 (7.7%)	1,596 (0.4%)	400,190	6.1%	4.4%	13.2%	UR-P	UR-P
Acadian Sub-boreal Spruce Flat	44	3	311	8,188 (12.74%)	248 (0.39%)	64,246	1.6%	0.7%	2.1%		UR-P
Acidic Cliff, Talus and Rocky Outcrop	38	4	118	659 (32.86%)	103 (5.12%)	2,007	0.1%	0.3%	0.1%		
Alkaline Conifer-Hardwood Swamp	31	7	219	33,587 (23.75%)	3,056 (2.16%)	141,400	6.6%	8.4%	4.6%		
Appalachian-Acadian Pine-Hemlock-Hardwood Forest	22	3	114	179,616 (26.3%)	6,861 (1%)	683,002	35.3%	18.9%	22.5%		

Calcareous Cliff, Talus and Rocky Outcrop	5		46	27 (5.61%)	0 (0%)	476	0.0%		0.0%	UR-P	NR
Laurentian- N. Appalachian-Boreal Peatland	53	8	222	15,328 (23.38%)	2,885 (4.4%)	65,558	3.0%	8.0%	2.2%		
Laurentian-Acadian Floodplain Forest	16	4	61	976 (19.01%)	178 (3.47%)	5,132	0.2%	0.5%	0.2%		
Laurentian-Acadian Freshwater Marsh	92	7	529	5,650 (23.89%)	1,231 (5.2%)	23,656	1.1%	3.4%	0.8%		
Laurentian-Acadian Northern Hardwood Forest	33	1	170	37,583 (11.36%)	349 (0.11%)	330,797	7.4%	1.0%	10.9%		UR-NP
Laurentian-Acadian Northern Hardwood Forest, high conifer	11	1	104	4,702 (9.48%)	349 (0.7%)	49,620	0.9%	1.0%	1.6%		
Laurentian-Acadian Red Oak-Northern Hardwood Forest	7		42	3,905 (17.81%)	0 (0%)	21,923	0.8%		0.7%		NR
Laurentian-Acadian Wet Meadow-Shrub Swamp	124	18	656	11,720 (25.78%)	1,136 (2.5%)	45,458	2.3%	3.1%	1.5%		
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	36	5	179	4,993 (10.46%)	1,879 (3.94%)	47,735	1.0%	5.2%	1.6%		
Seacoast Plain - Ossipee	**201**	**90**	**1334**	**47,984 (7.05%)**	**11,423 (1.68%)**	**681,037**	**45.4%**	**38.3%**	**49.2%**		
Acadian-North Atlantic Rocky Coast	8	6	22	117 (15.92%)	101 (13.82%)	733	0.1%	0.3%	0.1%		
Acidic Cliff, Talus and Rocky Outcrop	8	5	49	245 (17.89%)	140 (10.23%)	1,372	0.2%	0.5%	0.1%		
Alkaline Conifer-Hardwood Swamp	22	15	131	3,854 (8.45%)	1,478 (3.24%)	45,620	3.7%	5.0%	3.3%		

Appalachian-Acadian Pine-Hemlock-Hardwood Forest	2	1	23	16,794 (4.74%)	3,207 (0.91%)	354,166	15.9%	10.8%	25.6%		UR-NP
Calcareous Cliff, Talus and Rocky Outcrop	5	2	29	400 (47.29%)	331 (39.17%)	846	0.4%	1.1%	0.1%		
Central Appalachian Alkaline Glade and Woodland	2		13	27 (14.83%)	0 (0%)	181	0.0%		0.0%		NR
Central Appalachian Dry Oak-Pine Forest	13	5	65	411 (17.51%)	174 (7.43%)	2,348	0.4%	0.6%	0.2%		
Central Appalachian Floodplain Forest	8	5	36	2,074 (27.3%)	466 (6.13%)	7,596	2.0%	1.6%	0.5%		
Laurentian- N. Appalachian-Boreal Peatland	3	1	12	965 (40.94%)	845 (35.86%)	2,356	0.9%	2.8%	0.2%		
Laurentian-Acadian Freshwater Marsh	36	13	291	1,520 (11.81%)	555 (4.31%)	12,874	1.4%	1.9%	0.9%		
Laurentian-Acadian Wet Meadow-Shrub Swamp	34	11	362	1,323 (8.13%)	254 (1.56%)	16,281	1.3%	0.9%	1.2%		
North Atlantic Coastal Plain Basin Peat Swamp	1		3	102 (18.77%)	0 (0%)	544	0.1%		0.0%	AR-NP	NR
North Atlantic Coastal Plain Hardwood Forest	3		16	2,889 (21.95%)	0 (0%)	13,163	2.7%		1.0%		NR
North Atlantic Coastal Plain Maritime Forest	2	2	15	128 (7.05%)	128 (7.05%)	1,822	0.1%	0.4%	0.1%		
North-Central Appalachian Pine Barrens	6	1	16	2,282 (44.37%)	480 (9.33%)	5,142	2.2%	1.6%	0.4%		AR-NP
North-Central Interior Wet Flatwoods	1	1	39	16 (0.89%)	16 (0.89%)	1,812	0.0%	0.1%	0.1%	UR-NP	UR-NP
Northeastern Coastal and Interior Pine-Oak Forest	10	1	68	8,278 (4.6%)	318 (0.18%)	179,918	7.8%	1.1%	13.0%		UR-NP

Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	17	6	99	2,302 (9.39%)	598 (2.44%)	24,512	2.2%	2.0%	1.8%
Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	8	5	19	160 (6.94%)	115 (5%)	2,300	0.2%	0.4%	0.2%
Tidal Marsh	12	10	26	4,096 (54.96%)	2,216 (29.74%)	7,453	3.9%	7.4%	0.5%