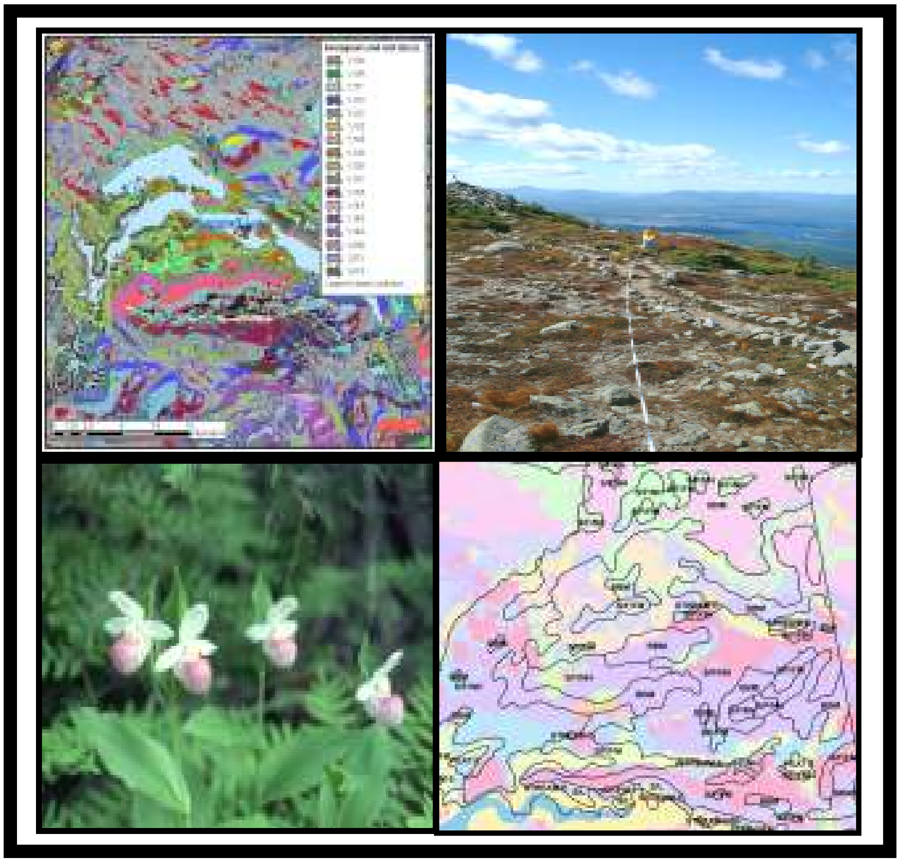
# Saving all the Parts: A Conservation Vision for Maine Using Ecological Land Units



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# Executive Summary

The pace and scale of Maine's land conservation projects have grown dramatically in recent years, with more than 1.5 million acres protected in the last decade. While conservation strategies have been guided by the current condition of forests and wetlands, less attention has been directed to protecting the "enduring features" of landform, geology, and elevation. By incorporating patterns of these enduring features, depicted as Ecological Land Units (ELUs), into conservation planning, we can more fully account for the variability inherent in the underlying landscape and the biodiversity it supports.

This project explores the relationship between Maine's biotic landscape, in the form of natural communities, and the physical landscape, in form of ELUs. It also examines how well natural communities and ELUs are represented in Maine's current conservation lands. Specifically, this project has three objectives:

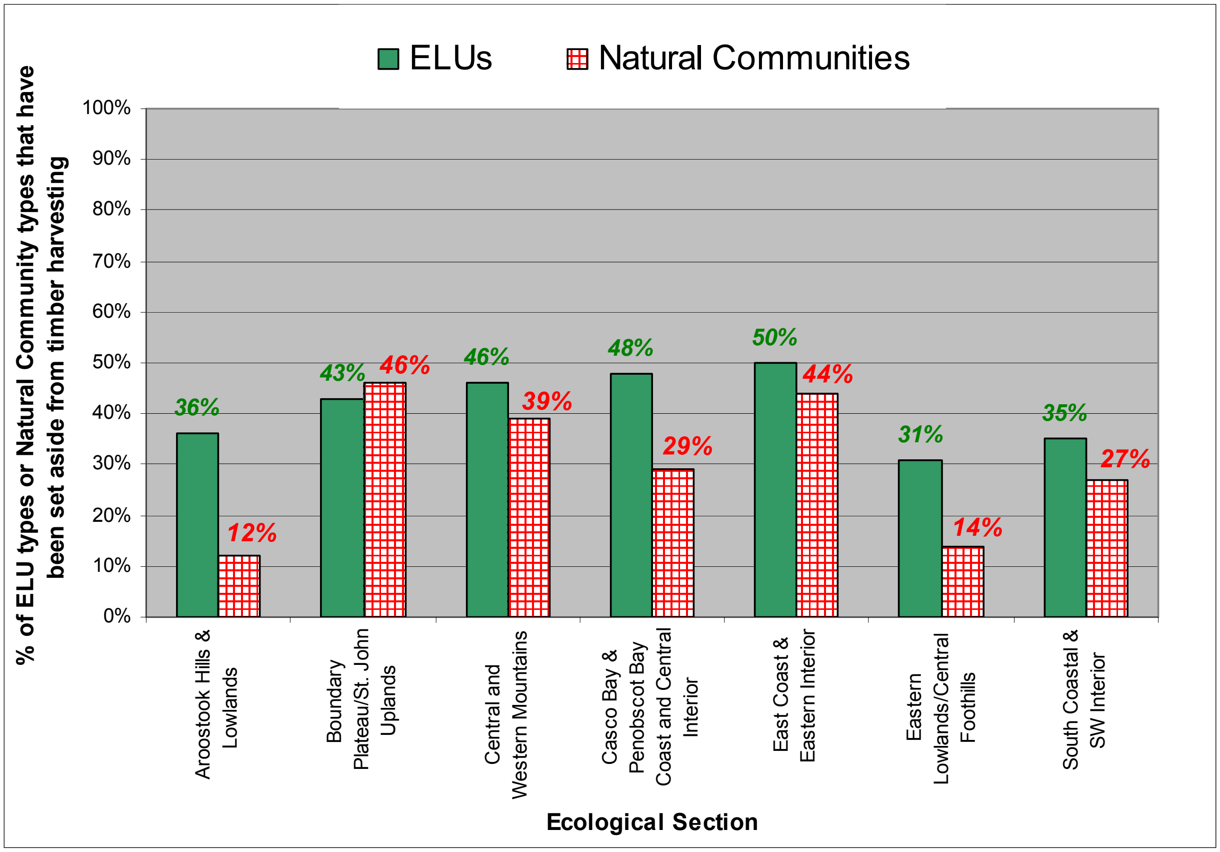
1. Assess the current representation of Ecological Land Units (abiotic factors) and natural communities (biotic factors) on conserved land in Maine, including Maine's Ecological Reserves.

2. Identify landscape features (both biotic and abiotic) in Maine that are under-represented on Maine's protected lands.

3. Investigate relationships between ELUs and natural communities, and test the utility of ELUs for identifying and predicting natural communities.

While 15% of Maine's lands are in some form of conservation (ownership or easement), only 3% are restricted from timber harvesting. Our results indicate that viable examples of 79 of the state's 98 natural community types (81%) are represented on conserved lands that have been set aside from timber harvesting. Of the nineteen types *not* represented, twelve are rare (i.e., ranked S1, S2, or S3), and only two are forested (Balsam Poplar Floodplain Forest and Hardwood Seepage Forest).

Natural community representation is poorer when geographic representation is considered. Dividing the state into seven geographic "sections," only 31% of the natural community types are represented on lands restricted from timber harvesting. Not surprisingly, portions of the state with the largest amount of conservation land, such as northwest Maine, have the best representation of natural communities. Conversely, regions with comparatively less conservation land, such as the Aroostook Hills and Lowlands, Eastern Lowlands, and South Coastal and Southern Interior sections, have poorer protection of natural communities (see figure below).




Representation of ELUs may be assessed through individual ELUs or ELU groups (ELUs clustered into more broadly defined units). Representation of ELUs and ELU groups is higher statewide than representation of natural communities. Of the 368 ELUs found across Maine, 336 (91%) are represented on conservation land as a whole, and 294 (80%) are represented on the subset of conserved land that is restricted from timber harvesting. Within each of Maine's seven geographic sections, an average of 41% of the ELU types are captured within the subset of conservation lands restricted from timber harvesting (see figure above).

Each of Maine's 25 ELU *groups* are represented on conservation lands statewide, and conservation lands within each of the state's seven geographic sections contain an average of 78% of the ELU groups known to occur in those respective regions. Most ELU groups that are inadequately represented on conservation lands are rare in each geographic section and account for less than 1% of each section's landscape.

In comparison to natural communities, the higher representation of ELUs and ELU groups on conservation land may be explained by at least two factors. First, natural community representation is limited by the incompleteness of our inventory efforts; ELU data, in contrast, is available as a "wall to wall" coverage of the state. Moreover, our analysis of ELU representation considers only *presence/absence* and *relative proportions*, while natural community representation includes considerations of minimum size and condition (i.e., viability or ecological integrity).

The ELU components of geology, slope, and landform may be highly effective at predicting natural community occurrence on the landscape. Using over 1,000 mapped natural communities, ELU components predicted the correct natural communities more than 80% of the time. The success of ELU groups at predicting natural communities varied by group. In a case study of the Bigelow Reserve, the "Alpine" ELU group was mapped with the appropriate natural communities 96% of the time, but the correlation between other ELU groups and natural communities at Bigelow was not as strong, in part due to issues of scale. Most of the "Acidic Cliff/Outcrop/Talus" ELU group, for example, is mapped as Fir – Heartleaf Birch Sub-alpine Forest, likely because the acidic cliffs portrayed by ELU groups occur at too fine a scale to be depicted on natural community maps derived from air photos.

The results of this study indicate that ELUs may serve several important roles in conservation planning:

1) Identifying specific areas of the state that could fill ecological gaps in the state's portfolio of conservation lands, such as the Aroostook Hills and Lowlands, Eastern Lowlands, and South Coastal Plain.

2) Serving as an effective surrogate for approximating natural community diversity in cases where natural community information is lacking; and

3) Incorporating a representative diversity of enduring features and conserving their associated biodiversity over the long term.

The creation and application of ELUs are relatively recent additions to the state's conservation toolbox. Additional work would be useful at improving the utility of ELUs for the purposes noted above. Some of these "next steps" are noted below:

- Natural community representation on conservation lands is limited by the incompleteness of natural community data. MNAP efforts to complete an initial broad-brush inventory of the state are currently scheduled to finish within the next five years, but this effort is contingent on funding.

- This type of analysis points to the need for a complete, unified, accessible database of conservation lands in the state. Currently this information is held by numerous parties with no protocol for acquiring or sharing data.

- Minimum area thresholds are needed to approximate the size required for an ELU or ELU group to support viable natural communities. This minimum area would relate to the natural patch size (small patch, large patch, matrix) of the ELUs or ELU groups and associated natural communities.

- Further work is needed to describe, quantify, and map larger landscape units (i.e. at the scale of township or larger) that capture specific repeated patterns and orientations of ELUs and ELU groups.

# Acknowledgements

Staff at The Nature Conservancy created the bulk of the underlying data for Ecological Land Units beginning in the late 1990s. Mark Anderson provided the initial inspiration and creative thinking behind this concept, and he pioneered the original data development. Specialists Charles Ferree and Greg Kehm further developed Mark's original work by collecting and processing volumes of data throughout the region. Here in Maine, Dan Coker has loaned his GIS expertise and patience to the development of ELUs for Maine application.

An ecological team of Josh Royte, Sue Gawler, and Janet McMahon participated in exhaustive discussions about the meaning, application, and utility of Ecological Land Units, and the team reviewed several versions of cross-walks between ELUs and natural communities. Josh in particular has been pivotal in moving this project forward as an avenue to assess representation and gaps in Maine's conservation lands. Barbara Vickery provided timely and useful "reality checks" to keep the balance from tipping from the practical to the theoretical. Roger Milliken gamely offered Baskahegan lands as a testing ground for applying our methodologies.

Within the Maine Natural Areas Program, Brooke Wilkerson drafted an initial crosswalk of ELU components to natural communities and provided valuable feedback on the report. Stephanie Gregoire entered data and created spreadsheets for our analysis. Emily Pinkham provided useful financial and administrative oversight. Molly Docherty offered support, oversight, and (most importantly) patience throughout the process!

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# 1.0 Introduction

Traditionally many conservation planning efforts have focused on assessing ecological information such as rare species, important habitats, and forest conditions, within the context of surrounding land uses and land protection. Many of these analyses disproportionately weight the current condition of the landscape and are consequently affected by relatively short-term influences, such as timber harvesting. Even the Maine Natural Areas Program's own "landscape analysis" is heavily focused on evaluating current conditions, such as forest stand types depicted in air photos and remote sensing imagery, and presence or absence of rare species. In the long term, however, the current biological conditions of the landscape are dynamic, and the underlying "enduring physical features" are likely to be a dominant influence on why and where certain habitats occur.

This project looks beyond the current condition of Maine's landscape and focuses instead on the variation of Maine's Ecological Land Units as an indication of how effective conservation actions are at protecting biological diversity of Maine. Ecological Land Units are unique combinations of geology, landform, and elevation that may be used to model how natural communities occur on the landscape. The results of the project will enable the people of Maine to make more informed long-term decisions about land acquisition and will provide large landowners with a better ecological framework for managing and conserving their lands.

The urgency for this project stems from multiple requests the Maine Natural Areas Program has received over recent years from public and corporate landowners and conservation groups regarding lands available for acquisition. The question constantly arises about how unique an area is, beyond the standing timber, and whether it merits consideration for acquisition or special management. In this report, the Maine Natural Areas Program begins to answer these questions by conducting a statewide analysis of:

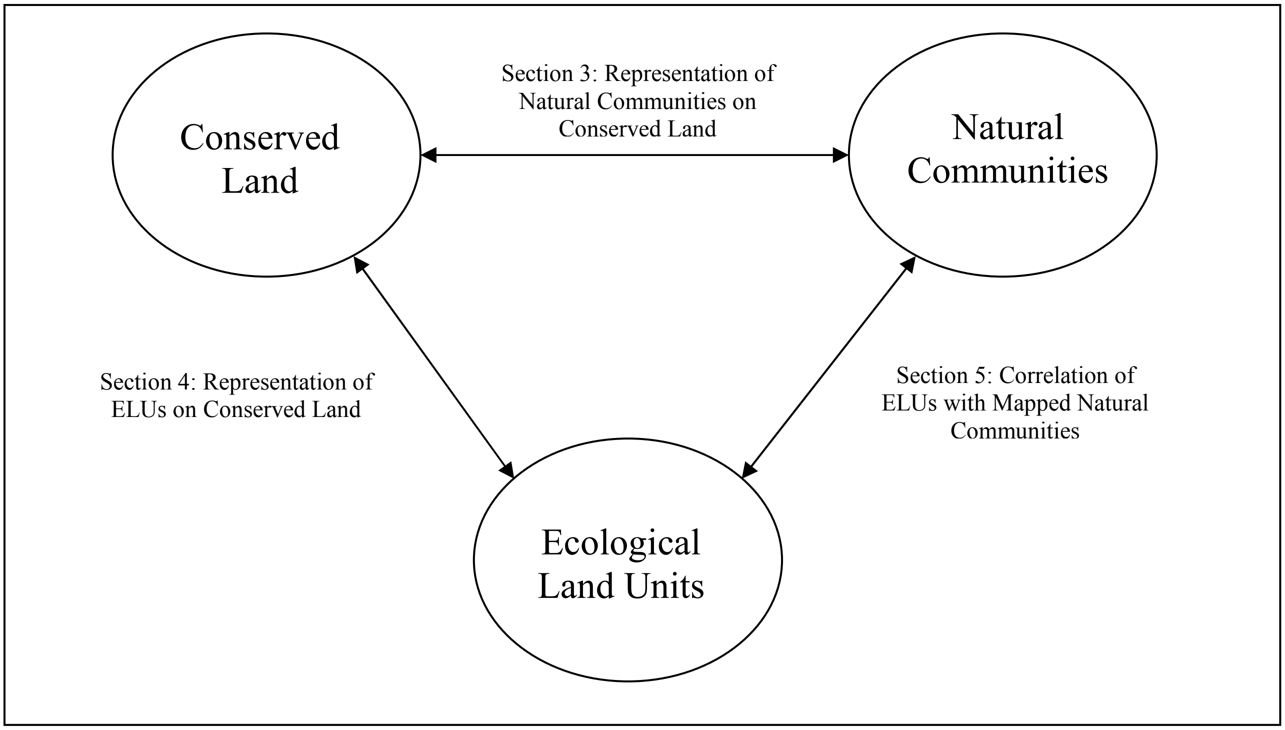
1) the degree to which conservation lands currently incorporate natural community diversity in Maine;

2) the degree to which conservation lands incorporate diversity in Ecological Land Units; and

3) the relationships between natural communities and Ecological Land Units.

These topics and relationships are depicted in Figure 1. The results of our study will provide a scorecard of how Maine is doing at protecting the diversity of Maine's biological and physical features.

*Figure 1: Representation Analysis and links between ELU and Natural Communities*




## 1.1 Conservation Land in Maine

Using the best available data, there are currently 3,087,100 acres of "conservation land" in Maine, accounting for just under 15% of the state. (The state's database of conservation lands is not complete, omitting numerous small land trust parcels, municipal lots, and some privately held conservation lands.) This conservation land includes parcels with a variety of restrictions, including "working forest" conservation easements, public lands managed for multiple uses, private conservation lands, state Ecological Reserves, and others (Table 1).

***Table 1: Conservation Lands in Maine (not all categories are included in sub-totals)***

| | Acres | Composition |
|---|---|---|
| **Total Area under Broad Form of Conservation** | 3,087,100 | Conservation easements and fee ownership. Excludes pending easements and acquisitions. |
| State Owned Land | 944,050 | State owned lands (multiple Gap classes) |
| TNC Owned Land | 257,200 | TNC owned lands (multiple Gap classes) |
| Land Under Conservation Easement | 1,463,200 | Conservation easements only. |
| Lands Restricted from Harvesting (includes some federal, state, and TNC lands) | 679,150 | Gap 1 and 2 Lands and Ecological Reserves |

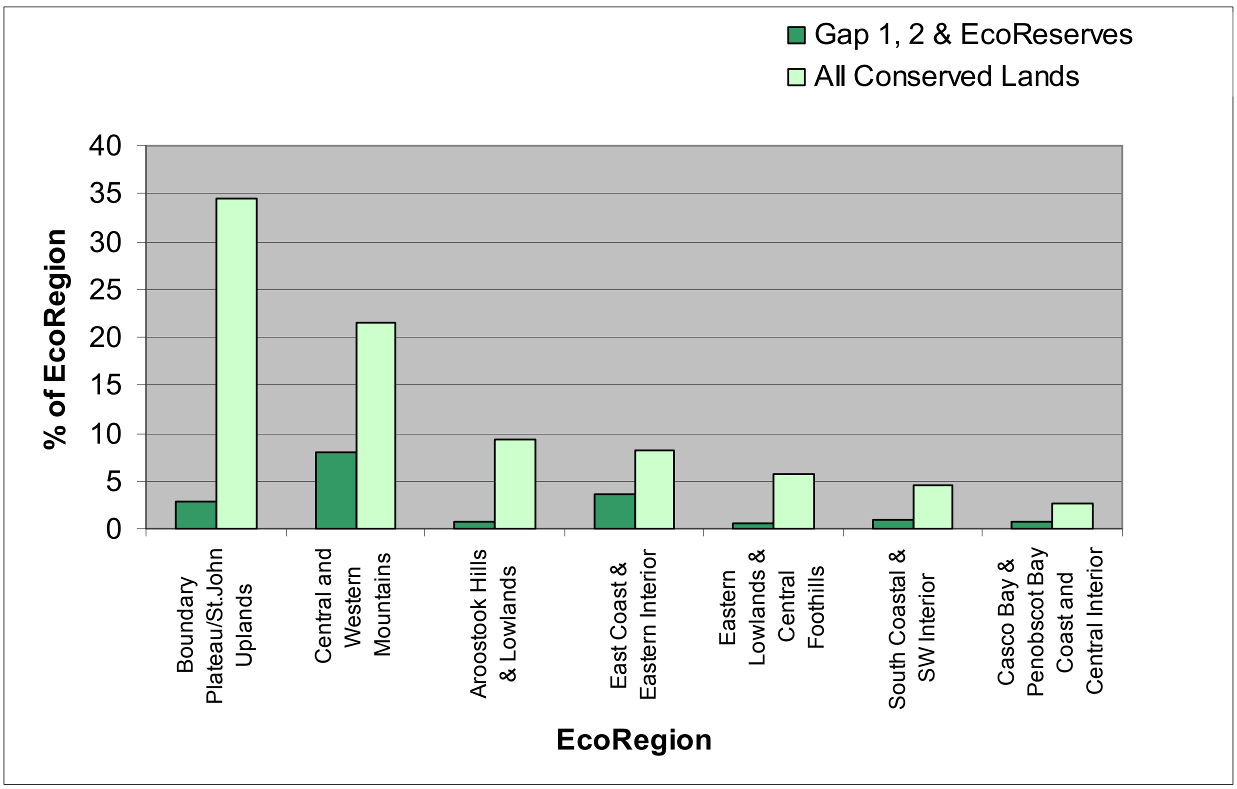
Source: Managed Areas shape file provided by the Maine Field Office of The Nature Conservancy, 2005.

To more accurately characterize these lands, a Gap Status (Crist 2000) has been assigned to each parcel. Gap Status is a national classification system that uses four classes to denote the level of permanent land use restrictions on each parcel. Among other distinctions, Gap 1 and 2 lands are off-limits to timber harvesting, while Gap 3 and 4 lands are not. In this project we distinguished two types of conservation land:

1. Gap 1 and 2 lands (Maine's Ecological Reserves have been added to this group even though they are not permanently designated), and
2. Gap 3 and 4 lands, which represent conserved lands where timber harvesting is permitted

Figure 2 indicates the amount of each type of conservation land (in proportions, not absolute acres) in seven different biophysical sections of Maine, with northern and western Maine exhibiting substantially higher proportions of conservation lands.

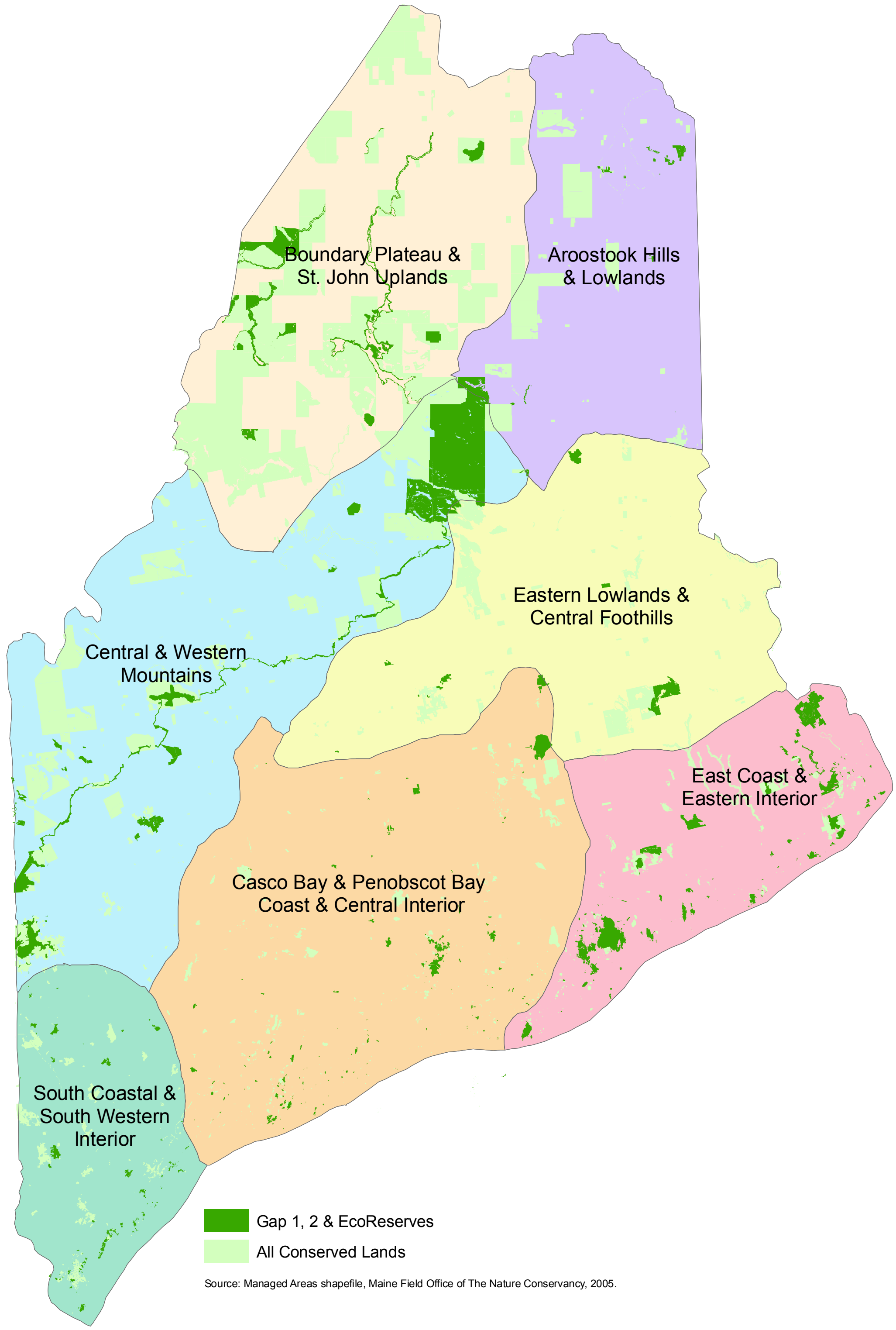
***Figure 2: Conservation Lands in Maine by Biophysical Section (Ecoregion)***




Source: Managed Areas shape file, provided by the Maine Field Office of The Nature Conservancy, 2005.

Figure 3 depicts the location of these conservation lands. Notably, less than 600,000 acres, or 3% of Maine, is statutorily off-limits to timber harvesting. Over one-third of this acreage is within Baxter State Park and the adjacent TNC Debsconeag Reserve.

*Figure 3: Conservation Lands in Maine*



## 1.2 What are Ecological Land Units?

Ecological Land Units (ELUs) are a GIS-generated data set that represents a combination of three landscape components: elevation, geology and landform. “The data set was developed as a tool for assessing the biophysical character of landscapes and for modeling the community assemblages that might potentially occur across those landscapes” (*The Nature Conservancy, 2003*). The premise behind modeling natural communities is that their occurrence may be predicted by mapping the biophysical variables that influence their distribution (see further discussion in Section 1.3).

Despite their broad scope, elevation, geology and landform are often indicators of finer environmental gradients that are more closely tied to vegetation distribution, such as nutrient availability, moisture and temperature. Several abiotic data layers are used to derive the three ELU components. Landform is derived from a number of digital elevation model (DEM) generated products including slope, landscape position and moisture index. Geology is a combination of bedrock and surficial geology layers, while elevation is also a derivation of DEM.

By allocating a unique code to each of the three component categories, a distinct ELU number can be constructed that directly indicates the unique combination of the three components (Figure 4).

***Figure 4: Ecological Land Unit Components***

***Elevation***

| Code | Range (ft) |
|---|---|
| 1000 | 0 – 800 |
| 2000 | 800 – 1700 |
| 3000 | 1700 – 2500 |
| 4000 | 2500 – 4000 |

***Geology***

| Code | Type |
|---|---|
| 100 | Acidic Sedamentary/Metased. |
| 200 | Acidic Shale |
| 300 | Calcareous Sedamentary/Metased. |
| 400 | Moderately Calc. Sed/Metased. |
| 500 | Acidic/Granitic |
| 600 | Mafic/Intermediate Granitic |
| 700 | Ultramafic |
| 800 | Outwash forest/wetland |
| 900 | Fine Sediments |

***Landform***

| Code | Type |
|---|---|
| 4 | Steep Slope |
| 5 | Cliff |
| 11 | Flat Summit/Ridge top |
| 13 | Slope Crest |
| 21 | Low Hilltop (flat) |
| 22 | Low Hill (gentle slope) |
| 23 | N-Facing Side slope |
| 24 | S-Facing Side slope |
| 30 | Dry Flat |
| 31 | Wet Flat |
| 32 | Valley/Toe Slope |
| 41 | Bottom of Steep Slope |
| 43 | N-Facing Cove/Draw |
| 44 | S-Facing Cove/Draw |

**ELU = Elevation Code + Geology Code + Landform Code**

Using this numbering schema, there are potentially 504 unique ELU types that may describe different combinations of the three component biophysical characteristics. Not all of the possible combinations occur in Maine.

## 1.3 Why are Ecological Land Units Important to Conservation?

Concepts of how to conserve biodiversity have evolved in recent decades, motivated by the experience of conservation practitioners and by applied and theoretical research in conservation biology. This evolution has resulted in an increased emphasis on the conservation of species, ecological communities, and landscapes at larger scales (Noss and Peters 1995). Coupled with this emphasis has been an increased appreciation for natural ecological processes and landscape-level factors that sustain these communities and ecosystems (Anderson 1999).

These developments have led federal, state, and private organizations to develop new scales and strategies for conservation planning. Foremost among these developments is the comprehensive design of reserve systems – networks of private conservation and public conservation lands that collectively conserve the full biological diversity of a given region as well as the landscape level processes that sustain them. By incorporating ELUs into conservation planning, we can more fully account for the variability inherent in the underlying landscape. The arguments for using ELUs are worth elucidating further:

- **ELUs are a key influence on biotic communities.**

Despite centuries of alteration by humans and thousands of years of disturbance by natural processes, there remains an obvious link between the physical attributes of a particular landscape (substrate, topography, climate) and what grows there. A hike up any one of Maine's 4000' foot peaks illustrates this connection. As one traverses through forests that transition from moist, lowland conifers to well-drained mid-slope hardwoods and then to higher elevation conifers, it is apparent that climate, slope, drainage, and aspect are all key determinants of vegetation. These vegetation communities are, in turn, associated with particular suites of animal species.

These links are well established in ecological literature. According to Franklin (1995), modeling of potential natural vegetation communities "rests on the premise that vegetation distribution can be predicted from the spatial distribution of environmental variables that correlate with or control plant distributions." Leak and Riddle (1979) focused on soil and geology as a link to tree species and composition: "The type and arrangement of plants would always serve as a mirror for the mixture of clay, silt, sand, and rock lying beneath them…. Knowing that trees differ in their requirements for nutrients and moisture, and that sites differ in their ability to supply these needs, we can correlate species to habitat and produce descriptions of typical combinations." Anderson et al (1998) summarized the importance of Ecological Land Units as follows: "Potential natural vegetation is determined directly by environmental gradients such as nutrient availability, moisture, and temperature. These environmental gradients are driven by broader determinants such as geology, climate, and topography. Therefore, in order to produce predictive vegetation maps the gradients thought to drive vegetation must be mapped or modeled themselves." In assessing vegetation as habitat for wildlife DeGraaf and Yamasaki (2001) composed a matrix that associates New England wildlife species with specific vegetation types and seral stages.

The connection between Ecological Land Units and associated vegetation is examined for Maine in this report, and is described further in Section 5.

- **In comparison to the current composition of the land, ELUs likely serve as better long term indicators, or predictors, of the future ecological composition of natural areas.**

As "enduring features" of the land, ELUs are much more permanent than the biotic communities they support. ELUs were determined by geologic and glacial processes initiated millions of years ago and culminating with the end of glacial activity ~11,000 years ago. In contrast, biotic communities exist in a dynamic state, responding on a much shorter time frame to both natural and human stresses. Silvicultural activities, for example, may shift the composition of a forest stand from mixed-wood to softwood-dominated, or an ice storm may convert a dense forest canopy into an open woodland with profuse seedling regeneration of shade-intolerant species. In the longer term, warming climate may shift Maine's spruce – northern hardwood forests toward oak-pine stands more characteristic of the Central Appalachian region.

Despite these stresses, underlying ELUs will remain largely unchanged, and given appropriate seed sources (and barring major invasions from non-native species), protected areas with little human intervention should gravitate over time to reflect the given subset of vegetation types associated with those particular ELUs. Consequently, ELUs may be a better tool for long term conservation planning than the existing vegetation. Accordingly, ELUs may serve as a surrogate for biological diversity at the landscape level where specific localized biological data proves inadequate or is absent. For conservation planning to be most effective, analysis of ELUs should complement rather than replace the biotic/land cover based landscape assessment approach.

- **Allowing for representation of ELUs in conservation planning will provide the best "coarse filter" approach for capturing biodiversity in a dynamic landscape.**

An emerging recognition of many large-scale conservation efforts is that some conservation targets (i.e., species, natural community types) may be merely ephemeral indicators, or placeholders, for conserving functional landscapes. These placeholders may serve as "focal species," "umbrella species," or "keystone species" – that is, coarse filters to capture the current wildlife assemblages, vegetation structure, composition, and landscape integrity of a particular place. These conservation targets, however, may be subject to degradation, elimination, transition, or even enhancement as a result of unforeseen natural stresses. For example, if conservation efforts for pine marten or Furbish's lousewort fail to sustain these species despite conserving enough land and abating perceived threats, have the efforts completely failed? By one very visible measure they have, but countless other species and communities adapted to that landscape may still be sustained, including a potentially very different suite of communities a century or two from now. Similarly, it may not be critical or even realistic to expect that each of the component plant species of an Eccentric Bog is forever protected. It is important, however, that the bog is allowed to adapt to natural fluctuations in climate, hydrology, and succession, so that whatever biotic communities would naturally accompany these changes are permitted to flourish without human alteration. In such a case, it is not the biotic communities that are the ultimate target of conservation, but the underlying landscape of abiotic features.

### 1.4 Project Objectives

The following objectives were presented to the Maine Outdoor Heritage Fund:

1. Assess the current representation of Ecological Land Units (abiotic factors) and natural communities (biotic factors) on conserved land in Maine, including Maine's Ecological Reserves.

2. Identify landscape features (both biotic and abiotic) in Maine that are under-represented on Maine's protected lands.

3. Investigate relationships between ELUs and natural communities, and test the utility of ELUs for identifying and predicting natural communities.

These project objectives are key precursors to designing a conservation strategy built on ELUs. Such a strategy is based on achieving adequate representation of ELUs within protected lands, and it has two logical criteria:

- ***Representation Criterion: The*** *ELU composition within conserved lands should be proportional to the ELU composition in the broader region.*

- ***Noah's Ark Criterion:*** *All ELUs that occur in the region should be represented in conservation lands*.

A notable limitation of the Representation Criterion is that it is relative rather than absolute. In other words, as long as the ELU *proportions* on conservation land are similar to those in the region as a whole, this criterion will be met. For example, if there were only 100 acres of conservation land in a two million acre region, all ELUs might still appear well represented if they occur in the same proportions within those 100 acres as they do in the larger region. In reality, many ELUs support natural communities that must have a minimum size to be viable. This minimum size concept varies however, depending on the natural patch size of the community and/or ELU (e.g., calcareous cliffs occur as small patches of an acre or less, while hardwood forests occur as matrix-forming stands of thousands of acres.) To sufficiently account for these issues of scale and viability, ELUs and ELU groups would need to be segregated into small patch, large patch, and matrix types, and minimum acreages applied for each type.

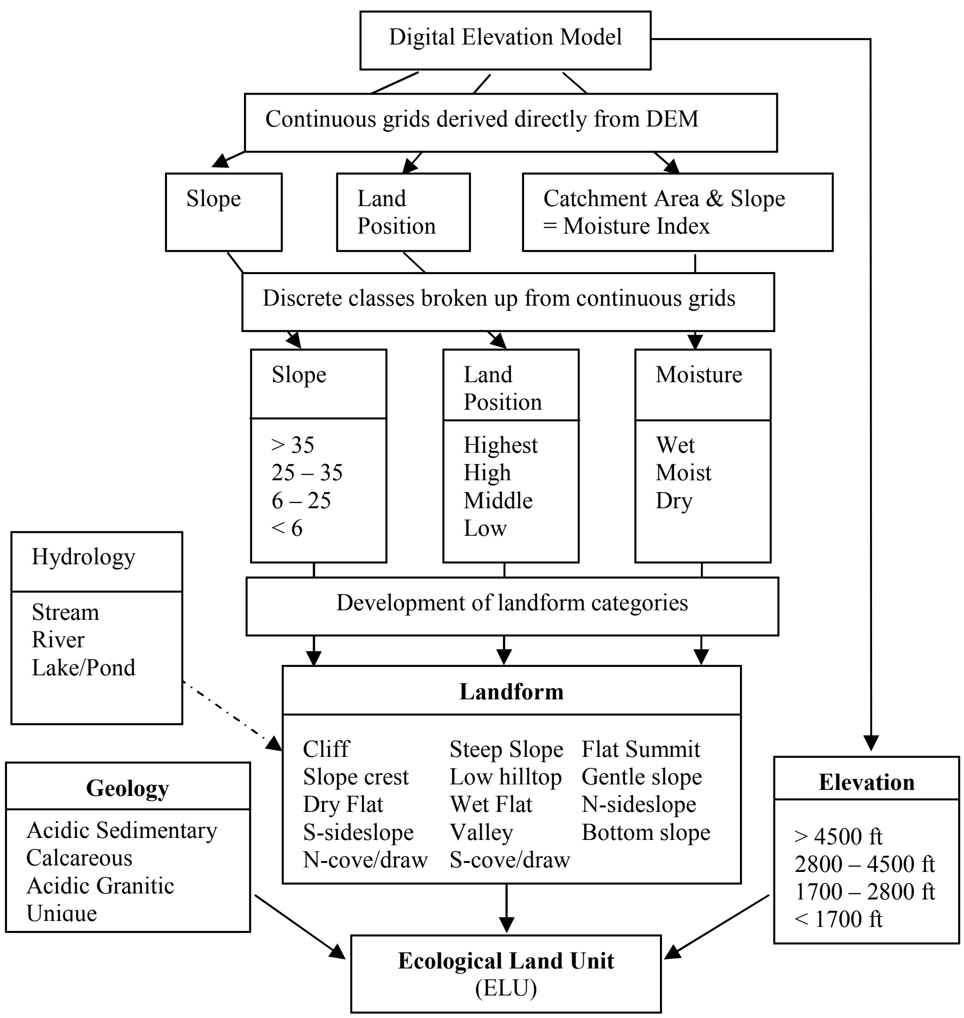
Another issue related to scale is the question of how large an area should be considered in a representational analysis: the ecological Province (e.g., Northern Appalachian – Boreal), the Section (Aroostook Hills and Lowlands), or the Subsection (e.g., Aroostook Hills). For the purposes of this report, we have chosen to conduct representational analysis at the intermediate level of "Section" (Figure 3) because it provides the most practical, robust scale for conservation planning.

# 2.0 Working with ELUs

## 2.1 Development of Ecological Land Units for Maine

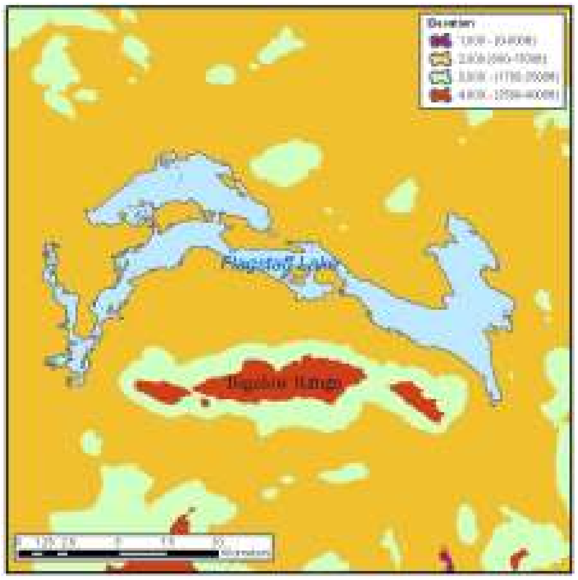
The Nature Conservancy's Eastern Conservation Science office in Boston developed ELUs for three ecoregional project areas that together cover the State of Maine. ELU data sets were generated for the Northern Appalachian, Lower New England – Northern Piedmont, and North Atlantic Coast regions in 2003. ELUs are raster GIS data sets. The ELUs developed by TNC were based on 30m digital elevation models (DEMs) available at that time. With 10m DEMs becoming available over the next two years in Maine, the Landform and Elevation components of the ELU data sets may be further improved.

***Figure 5: Flow Diagram of ELU development*** ***(Anderson, Merrill and Biasi, 1998)***



The ELU data set is modular by design so that additional component information may be added at any time. For example, hydrologic data can be added to expand the number of landform categories. Soils data may be added to complement geology, and current land cover condition may be added to better describe the biotic systems. Figure 6 indicates how the ELU components are combined to form ELUs for the region around Flagstaff Lake.

***Figure 6: Assembly of ELU Components***

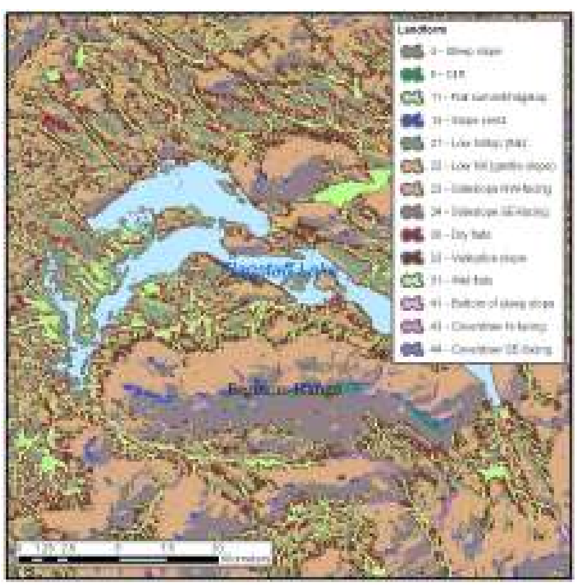



**Elevation**

+

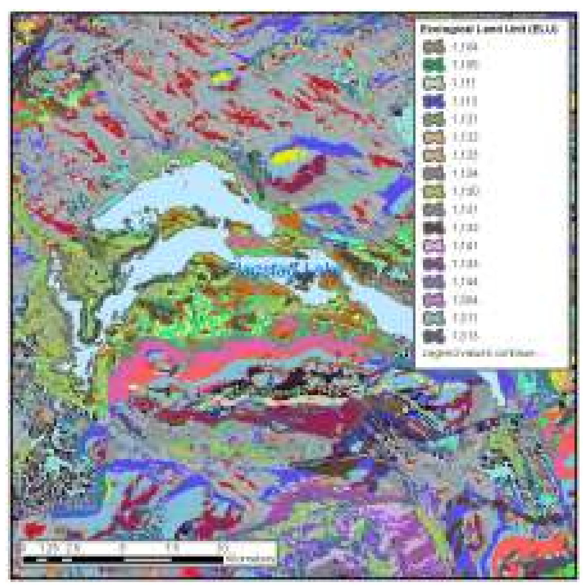

**Geology**

+




**Landform**

=




**ELU**

| **ELU = Elevation Code + Geology Code + Landform Code** |
|---|

### 2.2 Advantages of Ecological Land Units Model

1. The ELU is modular in design allowing easy manipulation including addition, separation and update of ELU components. For example, National Wetland Inventory data may be added to improve the "Wet Flats" category of Landform, which is very broad and includes multiple wetland natural community types.

2. The raster GIS data type makes analyses with ELUs in combination with other data layers easy to perform.

3. The ELU data set provides sufficient detail to allow investigation of their utility for modeling natural communities.

### 2.3 Limitations of the Ecological Land Unit Model

1. The ties between ELUs and on-the-ground vegetation have not been fully tested in a variety of conditions throughout the state.

2. The large number of different ELUs across Maine make it difficult to synthesize meaningful results from statewide analyses. There are many more ELUs in Maine than natural community types, suggesting that some ELU distinctions may not be ecologically meaningful. For instance, does the vegetation in Maine now, or will it in the future, reflect differences between "acidic sedimentary/meta sedimentary" bedrock and "acidic-granitic" bedrock? Which ELUs or ELU components are redundant? How can ELUs be best grouped for meaningful analysis?

3. Each ELU component carries some measure of mapping inaccuracy that is compounded when added with other ELU components. These types of inaccuracies are usually characterized as contextual inconsistencies (e.g., a pixel of flat summit surrounded by pixels of steep slopes) that can best be observed by visual inspection of the data, but may easily be missed in tabular summary figures.

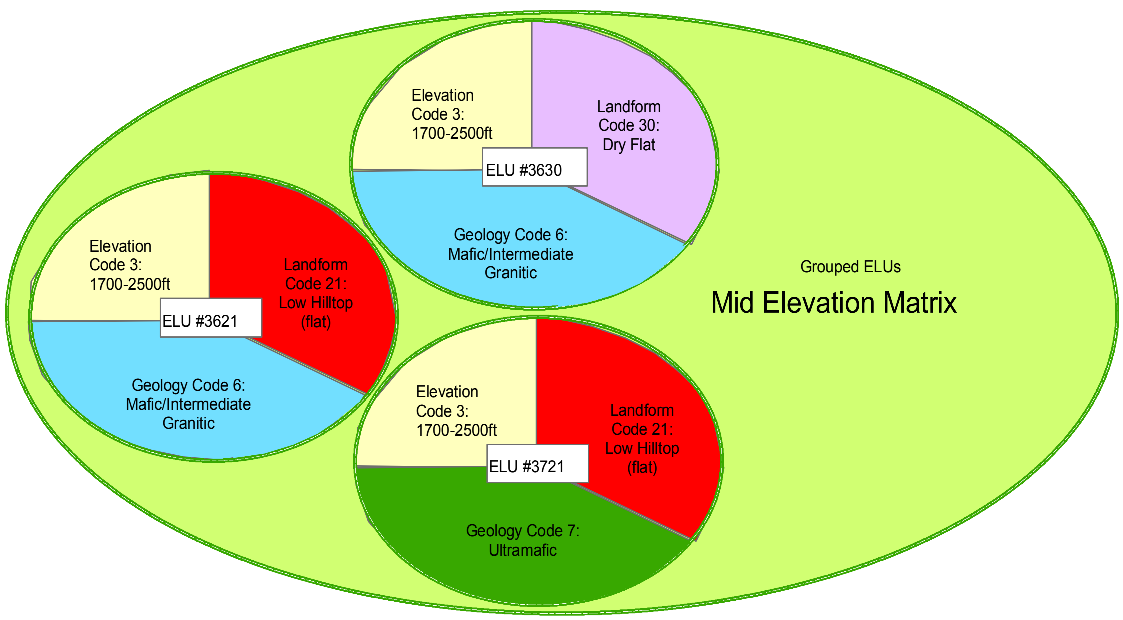
4. The scale of ELUs is mis-matched with the typical scale of conservation planning. The issue of how ELUs and ELU groups aggregate into larger landscape units that might correlate more closely with the scale of conservation planning remains largely unexplored. While distinct landscape patterns are often discernable as repeated ELUs or ELU groups, they have not yet been described or quantified, and current conservation planning efforts rely on subjective ways to assess them.

### 2.4 Isolating ELU *Components* versus ELUs

Along with the representation of natural communities on conserved lands, one of the objectives of this study is to test the utilization of ELUs for identifying landscapes that may potentially carry ecologically important, rare or under represented natural communities. With the ELU model, this type of testing may be undertaken by considering ELUs in any of three ways (Figure 7):

i. As individual ELU components (i.e., elevation, landform & geology), such as "all lands below 800' in elevation";
ii. As ELUs (i.e., combinations of elevation, landform & geology) such as "low elevation dry flats on mafic/intermediate granite";
iii. As "Grouped" ELUs (i.e., combinations of assembled ELUs), such as the subset of ELUs that are low and mid elevation slopes on till.

***Figure 7: Nesting of ELU Components, ELUs, and Grouped ELUs***




In this model, each of the three ELU components (Elevation, Landform, Geology) is weighted equally. A number of questions arise. For example, which ELU components are the most meaningful and which are the least? Moreover, do ELUs (or even grouped ELUs) represent a sufficiently complex combination of landscape features for identifying or predicting the occurrence of natural communities and ecosystems?

- **Which ELU components are most meaningful, and which are least?**

The importance of each ELU component depends on the physical setting. As noted in Section 2.3 above, it is questionable that a low-elevation dry flat on "acidic sedimentary-metasedimentary" bedrock would produce different vegetation cover than a low-elevation dry flat on "acidic granitic" bedrock. In either case, the dry flat is the key feature driving the natural community type; the bedrock is likely to be buried beneath tens or hundreds of feet of glacial outwash or till. Consequently, bedrock is important only where it is either (a) exposed, such as cliffs, or (b) influences groundwater discharge, such as a seepage forest or headwater stream. Other "splits" in ELU components present similar challenges. For instance, does the

1700’ elevation cutoff represent a meaningful distinction for Maine’s vegetation? (Elevation was incorporated into ELUs as a surrogate for climate.) Our testing of a cross-walk between ELU components and known natural communities (Appendix 8.1) indicates that in many cases it is not. Recognition of the varying degrees to which ELU components are meaningful is a key factor in grouping ELUs and ELU components for further analysis.

### 2.5 ELUs versus Grouped ELUs

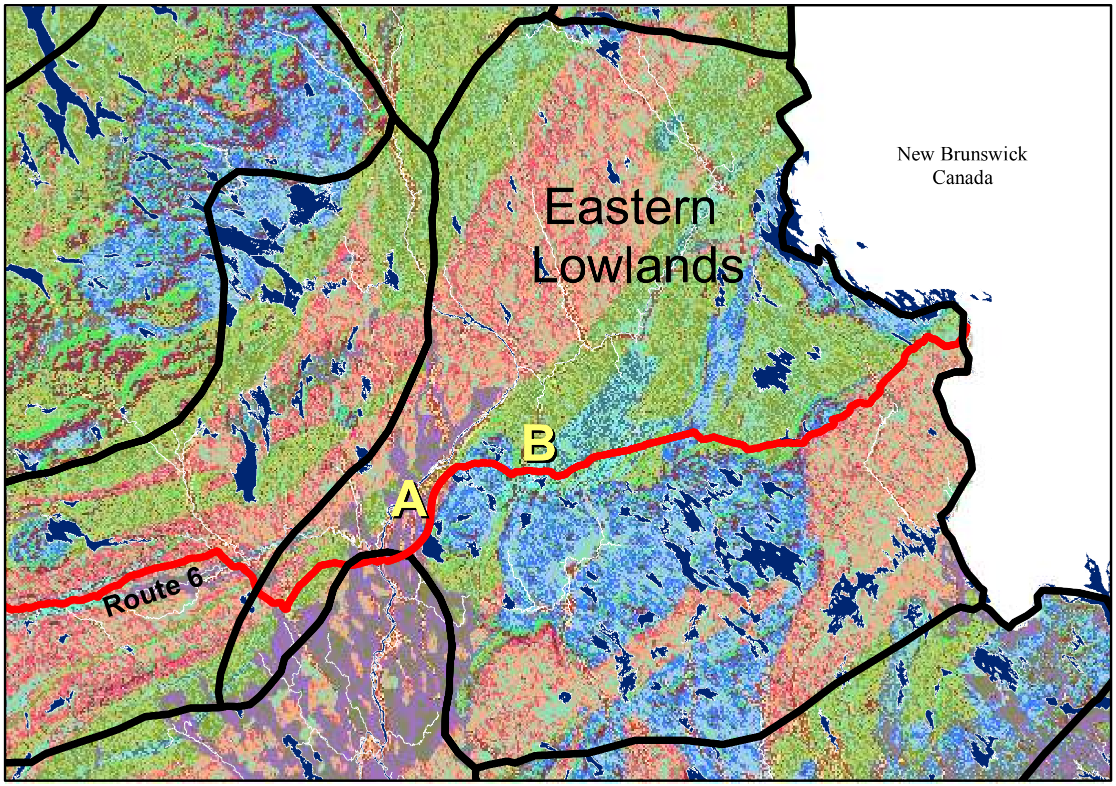
A total of 504 unique ELUs could theoretically be generated by the multiple combinations of elevation, slope, and geology that occur in Maine. On the ground, there are 368 distinct ELUs that occur. This is more than *three times* the number of natural community types in the state, according to Gawler and Cutko (in press), and more than six times the number of Systems in the National Vegetation Classification. This comparative complexity and fine scale of ELUs suggests that many of these ELUs may not be meaningfully different from one another, as noted previously. It is also possible, on the other hand, that some ELUs may represent distinct or characteristic factors not currently expressed on the landscape because of past land uses (i.e., the landscape has been “homogenized” by past land uses, possibly obscuring differences in potential vegetation ).

Nonetheless, some aggregation of ELUs or ELU components is likely necessary to make ELUs more relevant. The utility of grouping becomes apparent through a few exercises. First, in the matrix constructed to associate ELU components with natural communities (Appendix 8.1) most natural communities are predicted to occur across several different geology types. A Beech Birch Maple Forest, for instance, may occur on seven types of surficial or bedrock geology.

A visual image illustrates this issue on a larger scale. A map of Ecological Land Units on Maine’s 2.2 million-acre Eastern Lowlands region (Figure 8) indicates pronounced differences within the region. Driving eastward across Route 6, for instance (shown on the map), one would expect to encounter distinct changes as multiple ELUs were crossed. In reality, while some changes are noticeable (e.g., softwood forest on lowland glacial-marine soils at point “A” versus hardwood soils on upland till at point “B”), the landscape is not as distinctly varied as Figure 8 suggests.

Much of the underlying data that drives the colors in Figure 8 relates to bedrock geology – more specifically, differences in calcareous vs. acidic bedrock. However, most of this region is covered by glacial till that may obscure or eliminate any influence of bedrock geology. Therefore, ELUs composed of different bedrock geologic types can be grouped for analytical purposes. Individual polygons of grouped ELUs tend to be much larger than polygons of individual ELUs.

***Figure 8: ELUs within Maine's Eastern Lowlands Section***



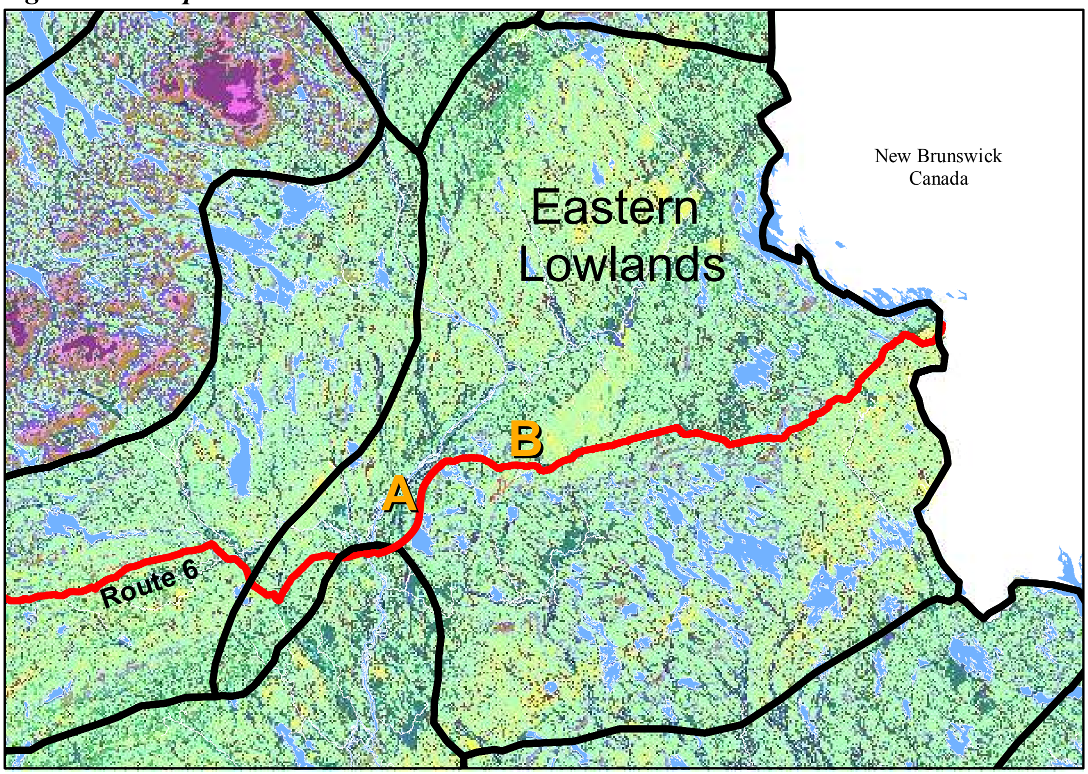

A lengthy exercise was undertaken to collapse the 368 ELUs that occur in Maine into a much smaller subset, based on our knowledge of the physical conditions on which Maine's natural communities occur. Grouping occurred for all factors – elevation, geology, and landform. Spearheaded by Josh Royte of TNC, this effort involved Andy Cutko, Sue Gawler, and Janet McMahon, with GIS services from Dan Coker and Rick Frisina. As a result of this analysis, 25 ELU "groups" were derived (Appendix 8.2).

This number is smaller than both the 368 ELU types and 98 natural community types in Maine. Accordingly, the 25 ELU groups may fail to represent the full diversity of Maine's landscape, but are likely a more realistic portrayal than the 368 ELUs.

The contrast in classification of wetlands by ELU methods and natural community methods explains much of this difference. Over half (51 of 98) of Maine's natural community types are wetlands, and these 51 wetland types fall within 10 ELU groups. This is in part because ELUs (and ELU groups) do not sufficiently capture the broad variation in form and function of Maine's wetlands. Only one landform class (wet flats) applies to all wetland types; therefore, wetland ELUs are distinguished primarily by substrate and elevation. In contrast, wetland natural communities are distinguished by subtle variations in vegetation composition (e.g., low sedges vs. tall sedges) which are influenced by biotic factors including nutrient availability, beaver activity, and seed sources.

As manifested on the landscape, ELU grouping results in a more homogenous landscape. Figure 9 illustrates these grouped ELUs for the Eastern Lowlands. The drive across Route 6 now appears to traverse a landscape of subdued variation that is more reflective of the actual landscape.

***Figure 9: Grouped ELUs within Maine's Eastern Lowlands Section***




**Which is most appropriate – an analysis of ELU components, ELUs, or grouped ELUs?**

A representational analysis using ELUs can occur at multiple levels:

i. ELU components in isolation (e.g., what proportion of calcareous bedrock is captured in conservation lands?)
ii. ELUs (e.g., what proportion of high elevation acidic hilltops is captured in conservation lands?)
iii. Grouped ELUs (e.g., what proportion of the group of ELUs that typically underlie spruce flats is captured in conservation lands?)

As noted above, in most cases certain ELU components, such as landform, are likely better predictors of natural vegetation than others, such as bedrock. Similarly, some ELUs impart more meaning than others. A high elevation calcareous cliff is expected to support a distinct natural community type, while a mid-elevation, mid-slope acidic till site might support the same vegetation as numerous other ELUs. These factors were taken into consideration in the process of grouping ELUs. Because ELUs were grouped to reflect the expected natural vegetation on the landscape, an analysis of ELU groups is likely to be the most useful. The bulk of analyses in this report focus on ELU groups rather than ELUs or ELU components.

# 3.0 Natural Community Representation on Conserved Lands

MNAP has classified and distinguished 98 different natural communities and 24 broader ecosystems that collectively cover the state's landscape (Gawler and Cutko *in press*). The range of occurrence of each of these has also been mapped in terms of seven ecological sections across Maine (McMahon, 1990). For any given section, a known suite of communities and ecosystems is expected to occur. To date, MNAP has collected a database of over 1,200 records of exemplary or rare natural communities.

This representational analysis identifies the number of natural community types that occur on conserved land out of the total number of types expected to occur in each of the seven ecological sections. In other words, of the known number of types expected to occur, we identify the proportion that are adequately represented on conserved land.

## 3.1 Methodology

The analysis is a sequence of simple GIS overlay processes that combines, then summarizes, three data sets:

1. Natural Communities
2. Conserved Lands
3. Ecological Sections

To ensure that only viable examples of natural communities were used, a selection of 'A' or 'B' Rank community records was made ("Excellent" or "Good" Estimated Viability). This selection produced approximately 750 examples of natural community occurrences across Maine.

For the purpose of this representational analysis, two 'Types' of conserved land were identified:

**Type 1: All conserved land**. This is land under any broad form of conservation including all fee owned lands and lands under conservation easement. This selection totaled approximately 3,087,000 acres, or 15% of the area of Maine.

**Type 2: Land restricted from timber harvesting**. This includes lands designated as Ecological Reserves and lands classified as biodiversity management status GAP 1 or GAP 2 (Crist, 2000). This selection totaled approximately 679,000 acres, or 3% of the area of Maine.

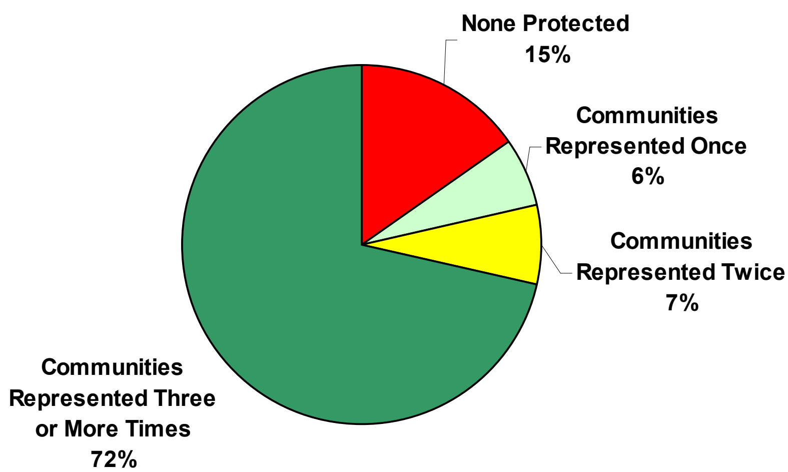
If any part of an "A" or "B" ranked natural community intersected with conservation land, that natural community was considered "adequately represented." This is a low threshold for representation and does not incorporate redundancy of natural communities (i.e., two or more examples), which may be desirable from a conservation standpoint. Moreover, it only indirectly incorporates buffering (surrounding landscape context), as a factor in the occurrence rank.

### 3.2 Results

***Statewide:***

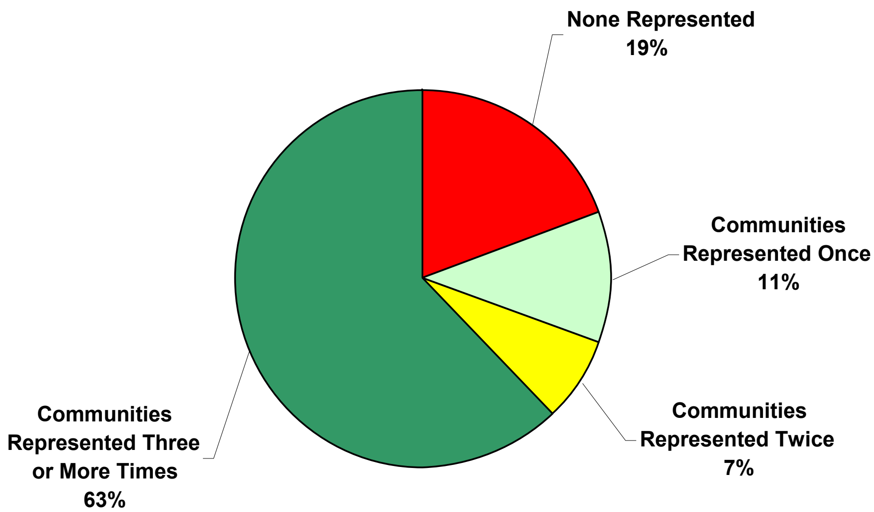
For the state as a whole, only 15 of 98 natural community types have NO protected 'A' or 'B' ranked examples on Type 1 conservation lands, and the overwhelming majority of natural community types have multiple examples (Figure 10). Only two of the fifteen natural community types with no representation (Balsam Poplar Floodplain Forest, Hardwood Seepage Forest) are forested types. The former occurs on a few limited rivers in northern Maine, and the latter is likely under-surveyed and may indeed occur on conservation lands. Not surprisingly, the representation of natural communities on conserved land within each region is directly related to the amount of land in conservation.

***Figure 10: Proportions of the State's 98 Natural Community Types with Good Examples on Type 1 Conserved Lands (All Conserved Lands)***




Representation and redundancy are more lacking on Type 2 conservation lands (Figure 11). Nearly one-fifth (19 of 98) of the state's natural community types have no protected A or B ranked examples on Gap 1, Gap 2 or Ecological Reserve lands. Four forested types are included in this "non-protected" list: Balsam Poplar Floodplain Forest, Hardwood Seepage Forest, Jack Pine Forest, and Pitch Pine Heath Barren. Jack Pine Forest occurs on protected (Gap 3) lands near No. 5 Bog, and Pitch Pine Heath Barrens occurs on protected (Gap 3) lands in the town of Brunswick.

***Figure 11: Proportions of the State's 98 Natural Community Types with Good Examples on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)***




***By Geographic Section:***

A more meaningful measure of natural community representation involves geographic representation within each of Maine's seven ecological sections (Figure 3). For example, if Beech – Birch – Maple Forest occurs in each of the seven sections, how many of these sections have protected examples within conservation lands? Geographic representation offers a measure of redundancy and also accounts for geographic variation within natural community types (and associated variation in animal assemblages) across the state.

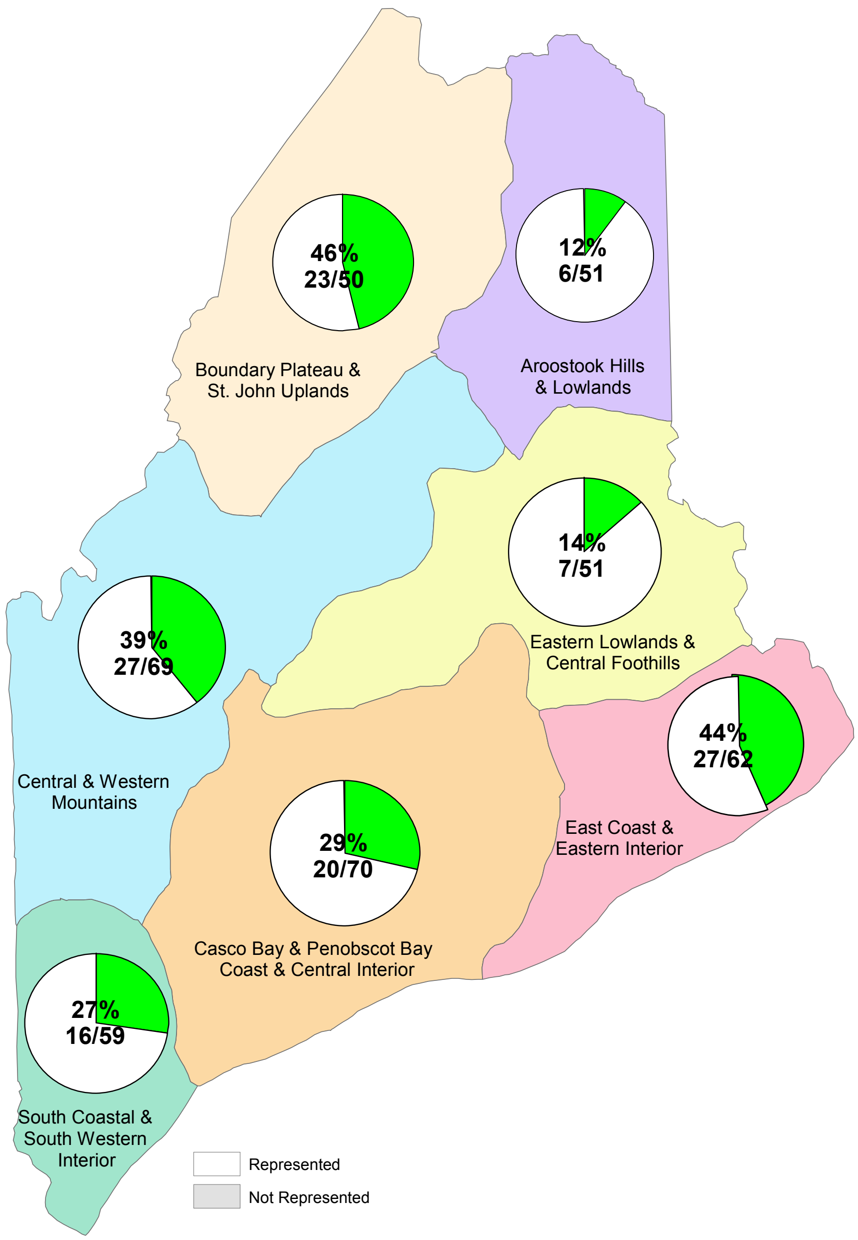
The combination of natural community types and ecological sections where they occur results in 412 possible natural community types occurring across all sections (i.e., by this method of accounting, a Beech – Birch – Maple Forest counts for seven sections because it occurs in all seven sections; Northern White Cedar Swamp would count for five sections if it occurs in five, etc.). For the state as a whole, 126 of 412 (31%) natural communities are represented on Type 2 conserved lands in the sections where they occur. A breakdown of natural communities into four broad types is listed in Table 2.

***Table 2: Statewide Community Representation on Type 2 Conserved Lands***

| **Broad Community Type** | **Number Represented on Type 2 Conserved Lands** | **Communities known to Occur in all Sections** | **Representation** |
|---|---|---|---|
| Forested Uplands | 51 | 135 | 38% |
| Forested Wetlands | 23 | 77 | 30% |
| Non Forested Uplands | 17 | 48 | 35% |
| Non Forested Wetlands | 35 | 152 | 23% |

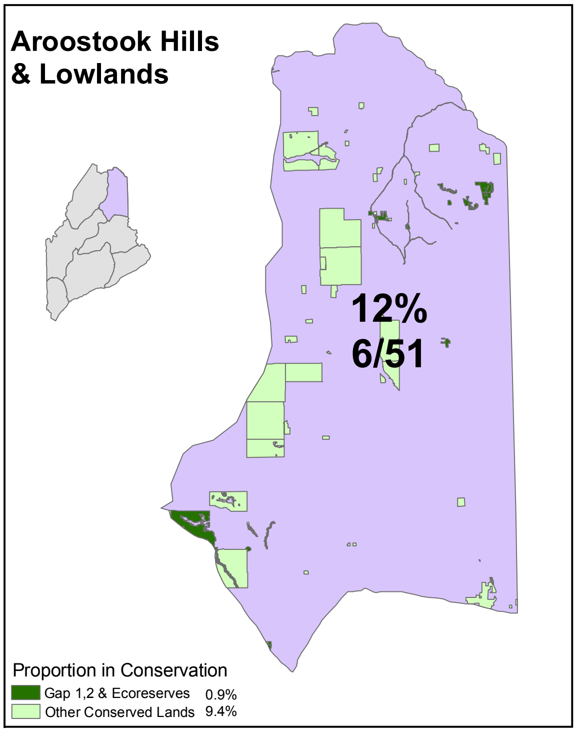
Figure 12 indicates the number of natural community types represented on Type 2 conserved lands for each ecological section. The figures are presented as a proportion of the number of communities known to occur throughout the section. For example, in the Aroostook Hills and Lowlands section, 6 of 51 community types known to occur are represented on Gap 1 or Gap 2 lands or Ecological Reserves.

***Figure 12: Representation of Natural Communities on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)***




The following figures show the proportional representation broken down into the four broad community types for each section.

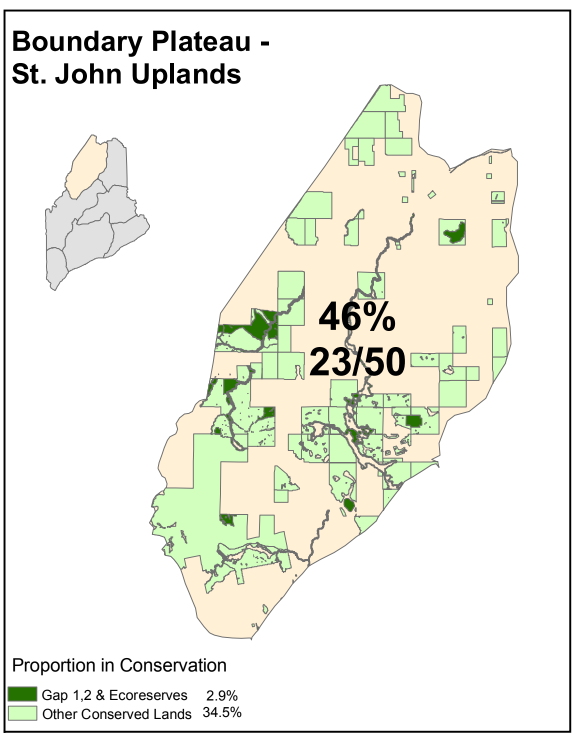
*Figure 13: Aroostook Hills & Lowlands – Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | 0/16 | | | |
| **Forested Wetlands** | | | 4/10 | |
| **Non Forested Uplands** | 0/3 | | | |
| **Non Forested Wetlands** | | 2/22 | | |

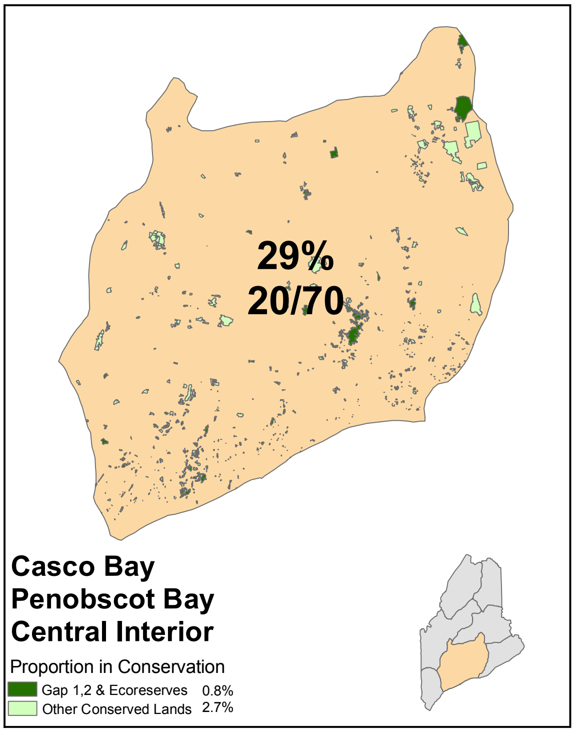
*Figure 14: Boundary Plateau / St.John Uplands – Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | | | | 11/15 |
| **Forested Wetlands** | | | 2/8 | |
| **Non Forested Uplands** | | | | 4/5 |
| **Non Forested Wetlands** | | 6/22 | | |

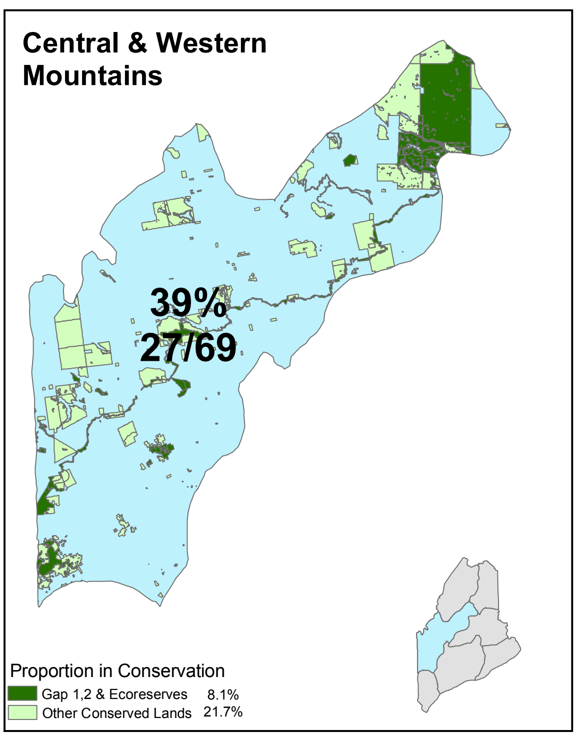
*Figure 15 : Casco Bay / Penobscot Bay / Central Interior - Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | | | 6/24 | |
| **Forested Wetlands** | | | 6/14 | |
| **Non Forested Uplands** | | | 2/8 | |
| **Non Forested Wetlands** | | | 6/24 | |

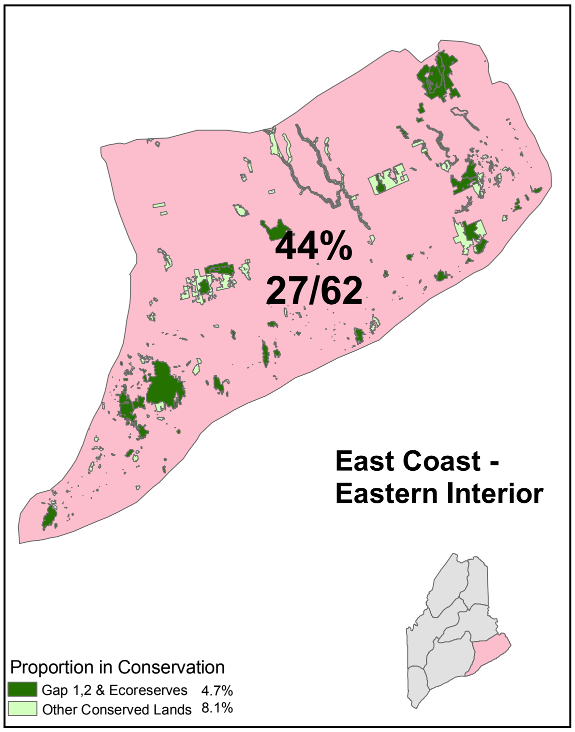
*Figure 16 : Central & Western Mountains – Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | | | | 13/23 |
| **Forested Wetlands** | | | 3/12 | |
| **Non Forested Uplands** | | | | 7/13 |
| **Non Forested Wetlands** | | 4/21 | | |

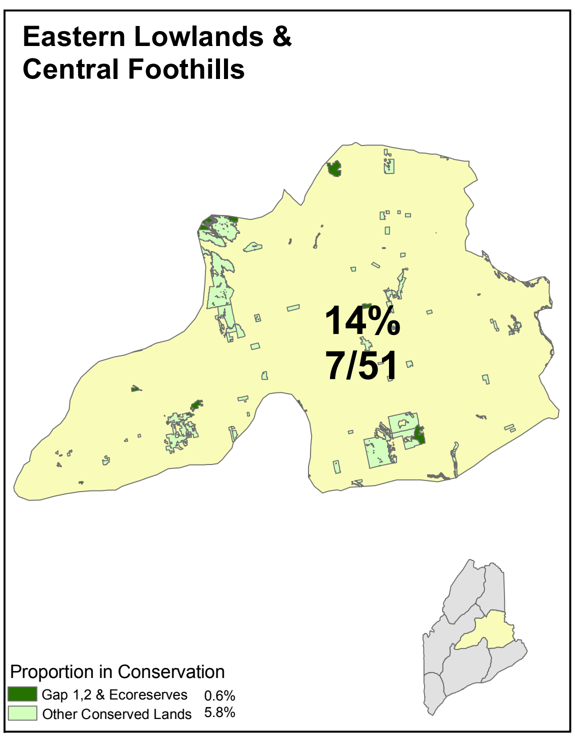
*Figure 17: East Coast / Eastern Interior - Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | | | | 12/20 |
| **Forested Wetlands** | | 1/9 | | |
| **Non Forested Uplands** | | | 3/10 | |
| **Non Forested Wetlands** | | | 11/23 | |

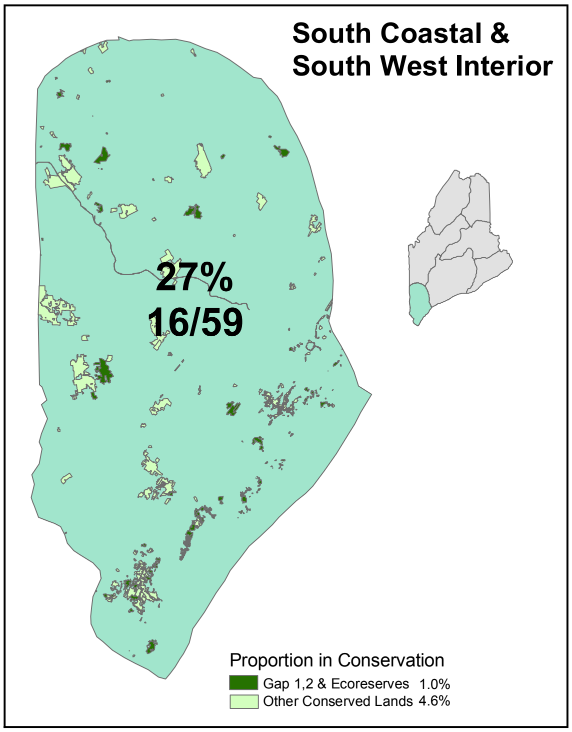
*Figure 18: Eastern Lowlands & Central Foothills - Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | | 2/18 | | |
| **Forested Wetlands** | | 3/11 | | |
| **Non Forested Uplands** | 0/3 | | | |
| **Non Forested Wetlands** | | 2/19 | | |

*Figure 19: South Coastal & South West Interior - Community Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




**Community Representation Breakdown**

| | None | < 25% | 25 - 50% | > 50% |
|---|---|---|---|---|
| **Forested Uplands** | | | 7/19 | |
| **Forested Wetlands** | | 4/13 | | |
| **Non Forested Uplands** | | 1/6 | | |
| **Non Forested Wetlands** | | 4/21 | | |

### 3.3 Discussion

The regional maps indicate that forested uplands show the highest proportion of community types in Type 2 land protection (38%), while non-forested wetlands show the lowest (23%). This is encouraging from a conservation perspective, since forested uplands are probably more threatened than are open wetlands.

As the figures above indicate, geographic representation by section closely mirrors the amount of protected land in each section. Sections with comparatively high proportions of conservation land, such as the Boundary Plateau – St. John Uplands and Central – Western Mountains (northwest Maine), have comparatively higher representation of natural communities. Moreover, more than half the upland forest types are represented in these two regions.

In contrast, three sections with comparatively little acreage of Gap 1 and 2 conservation land or Ecological Reserves (Aroostook Hills and Lowlands, Eastern Lowlands, South Coast – South Western Interior) have the poorest representation of natural communities. Forested uplands are particularly under-represented in these protected lands, with 0%, 11%, and 37% of the community types represented, respectively.

The data used to generate these tables and figures also allow us to generate specific lists of natural communities not adequately protected in each region. These underlying data may be used as a “wish list” when evaluating future conservation options to add missing natural communities to the state’s portfolio of conservation lands.

# 4.0 ELU Representation on Conserved Lands

Representation of ELUs on conserved lands was conducted for each of:

i. Individual ELU components
ii. Individual ELUs
iii. Grouped ELUs

As noted in the Project Objectives, there are two key criteria of a conservation strategy built on adequate representation of ELUs:

- *ELU components, ELUs, or grouped ELUs should occur in the same proportion on conserved lands as they do in the broader region* **(*Representation Criterion)***

- *At least one of each ELU (or ELU component or grouped ELU) that occurs in the region should be captured in conservation land* ***(Noah's Ark Criterion)***

We approached the concept of ELU "representation" relative to each biophysical section. To determine what is adequately captured ("represented") within conservation lands, we selected a cut-off of 50% representation; that is, a particular ELU should be at least half as common on conservation lands as it is in the region as a whole. For example, if a particular ELU component, ELU, or ELU group comprises 20% of the biophysical region, in order for it to be adequately represented, it should comprise *at least* 10% of conservation lands. As noted previously, this concept of representation does not factor in a minimum acreage considered necessary for a particular ELU or ELU group to support a viable natural community. (This issue is discussed further in Section 4.3, "Adequate Representation vs. Adequate Protection.")

## 4.1 Methodology

The GIS approach was similar to that employed in the natural community representation analysis: a sequence of overlaying and then summarizing three data sets:

1. ELUs
2. Conserved Lands
3. Ecological Sections

In contrast to the natural community representation, all processing was performed in a raster environment.

By design, the ELU data set contains both ELUs and ELU components, so the analysis of both of these was achieved through one combination of the data sets listed above. The analysis of grouped ELUs required the extra step of remapping the 368 ELUs into 25 groups (Appendix 8.2) and then performing the overlays. ELUs under agricultural or developed land were not considered in this analysis.

## 4.2 Results

In the same fashion as the representational analysis of natural communities, this analysis was also conducted on two types of conserved land:

> **Type 1: All conservation lands**. Land under any broad form of conservation including all fee owned lands and lands under conservation easement.
>
> **Type 2: Land restricted from timber harvesting**. Lands designated as GAP 1 or GAP 2 and Ecological Reserves.

However, in contrast to the analysis of natural communities, the analysis of ELUs involved three different levels of investigation and produced a considerably higher volume of results to examine.

For the purpose of brevity, results for ELUs and Grouped ELUs on Type 1 conserved lands have not been summarized in this section while their results on Type 2 conserved lands have been summarized in maps. Full details of all analysis results are provided in Appendices 8.3, 8.4 and 8.5. Table 3 indicates how all ELU representation analysis results are presented in this report.

***Table 3: Presentation of ELU Representational Analysis Results***

| | Appendix | (Type 1) All Conservation Lands | (Type 2) Gap 1, 2 & EcoReserves |
|---|---|---|---|
| **ELU Components** | 8.3 | Summarized Below | Summarized Below |
| **ELUs** | 8.4 | Appendices only | Table 4, Figure 20 |
| **Grouped ELUs** | 8.5 | Appendices only | Figures 21 - 28 |

### *ELU Components: What's Missing?*

The list below is a sample (not all inclusive) of physical features that are *not* captured within Maine's conservation lands.

*Aroostook Hills and Lowlands*

- There is NO conservation land over 1700' elevation (661 acres in the region).
- There are NO lands with fine sediment in conservation land (6,634 acres in the region)

*Boundary Plateau / St. John Uplands*

- There are NO lands with fine sediment in conservation (21,239 acres in the region)

- There are NO lands with calcareous bedrock in Gap 1 or 2 conservation (20,620 acres in the region).

*Central and Western Mountains*

- In comparison to its proportion of the region as a whole, there is five times more high elevation (>4000') terrain in conservation land, and thirteen times more in Gap 1 or Gap 2 land. Conversely, there is about half as much low elevation terrain (<800') in conservation land as in the region as a whole.
- Lands with fine sediment are significantly under-represented on conservation land and do not occur at all on Gap 1 or Gap 2 conservation land.

*East Coast & Eastern Interior*

- Lands with moderately calcareous or calcareous bedrock are significantly under-represented on conservation land and do not occur at all on Gap 1 or Gap 2 conservation land.

*Eastern Lowlands & Central Foothills*

- There are NO cliffs in conservation (only 16 acres in the region).
- There are NO lands with mafic or ultramafic bedrock in Gap 1 or Gap 2 conservation (51,356 acres in the region).

## *ELUs*

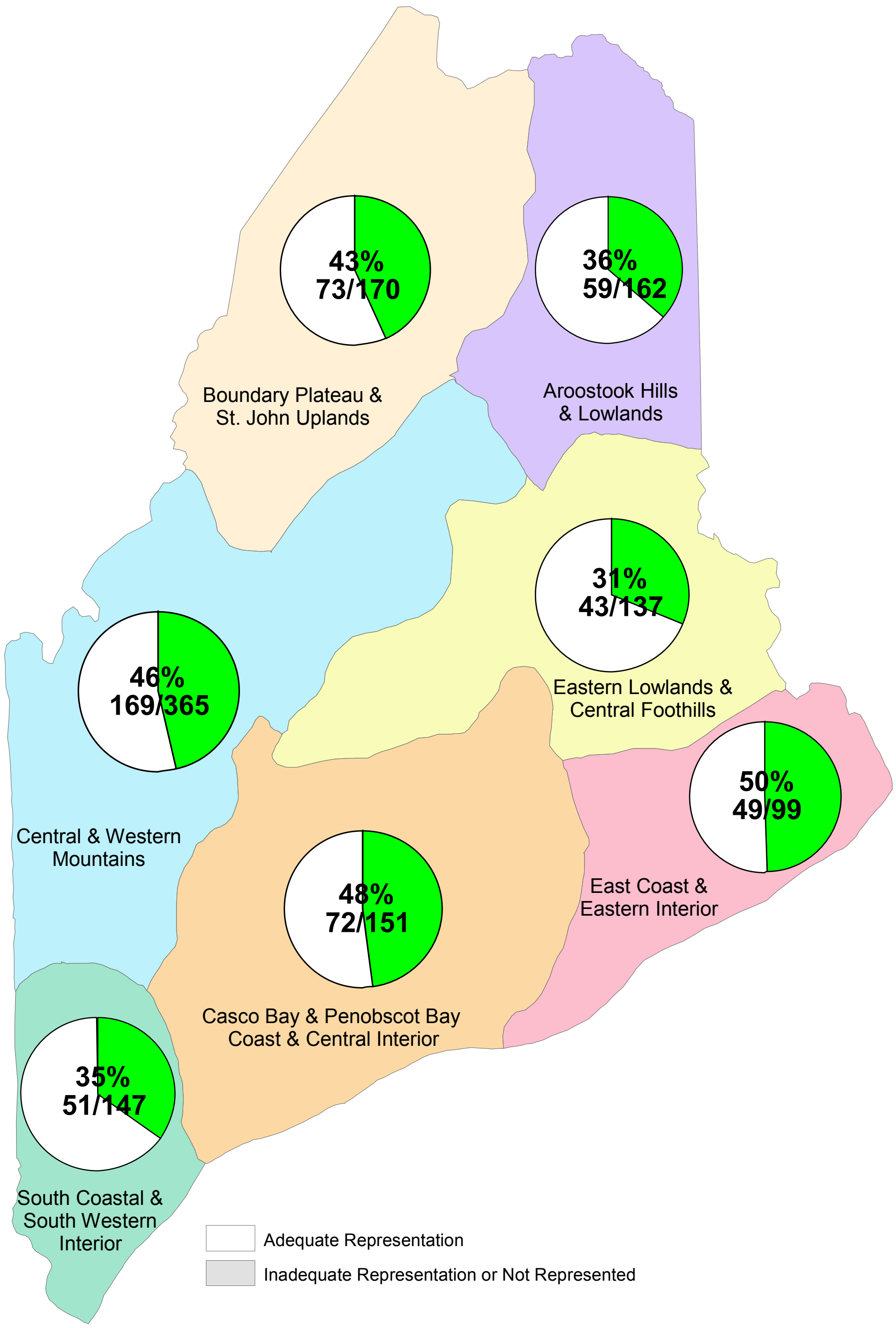
Of the 368 ELUs found across Maine, 74 (20%) are not represented on any Type 2 conserved land and 32 (9%) are not represented on any Type 1 conserved lands. Table 4 and Figure 20 indicate the number of ELUs adequately represented on Type 2 conserved land for each ecological section according to the *50% representation criterion* described above.

***Table 4: Representation of ELUs on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)***

| | **Aroostook Hills & Lowlands** | **Boundary Plateau / St.John Uplands** | **Casco Bay-Penobscot Bay** | **Central & Western Mountains** | **Eastern Lowlands & Central foothills** | **East Coast & Eastern Interior** | **South Coast & Southern Interior** |
|---|---|---|---|---|---|---|---|
| Adequately[1] Represented | 59 | 73 | 72 | 169 | 43 | 49 | 51 |
| NOT Adequately[2] Represented | 35 | 17 | 25 | 101 | 12 | 13 | 27 |
| NOT Represented | 68 | 80 | 54 | 95 | 82 | 37 | 69 |
| **Total ELUs** | **162** | **170** | **151** | **365** | **137** | **99** | **147** |

[1] At least 50% as common on Type 2 conservation lands as it is in the region.
[2] Between 0 and 50% as common on Type 2 conservation lands as it is in the region.

*Figure 20: Adequate ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*



### *Grouped ELUs*

When the 368 ELUs have been collapsed into 25 more meaningful "groups" (named according to associated vegetation types and/or landscape positions) representation increases (Figure 21). In the South Coastal and South Western Interior region for example, 51 of 147 (35%) of *ELUs* are adequately represented on Type 2 conservation land, but almost all (18 of 19) of ELU *groups* are adequately represented. In fact, each of the 25 ELU groups is represented on Type 2 conservation lands across Maine, and most of the ELU groups are adequately represented (*Representational Criteria*) in each of the seven regions. Statewide, 79% (99 of 126) ELU groups are adequately represented in regions where they occur. ELU groups that are inadequately represented are generally uncommon in each region, typically accounting for less than 1% of the landscape. Figure 21 indicates the proportion of grouped ELUs represented on Type 2 lands. Figures 22 – 28 indicate the representation of ELU groups within each region. The associated lists distinguish which of the ELU groups are not represented, inadequately represented or adequately represented for each region.

***Figure 21: Adequate Grouped ELU Representation on Type 2 Conserved Lands***

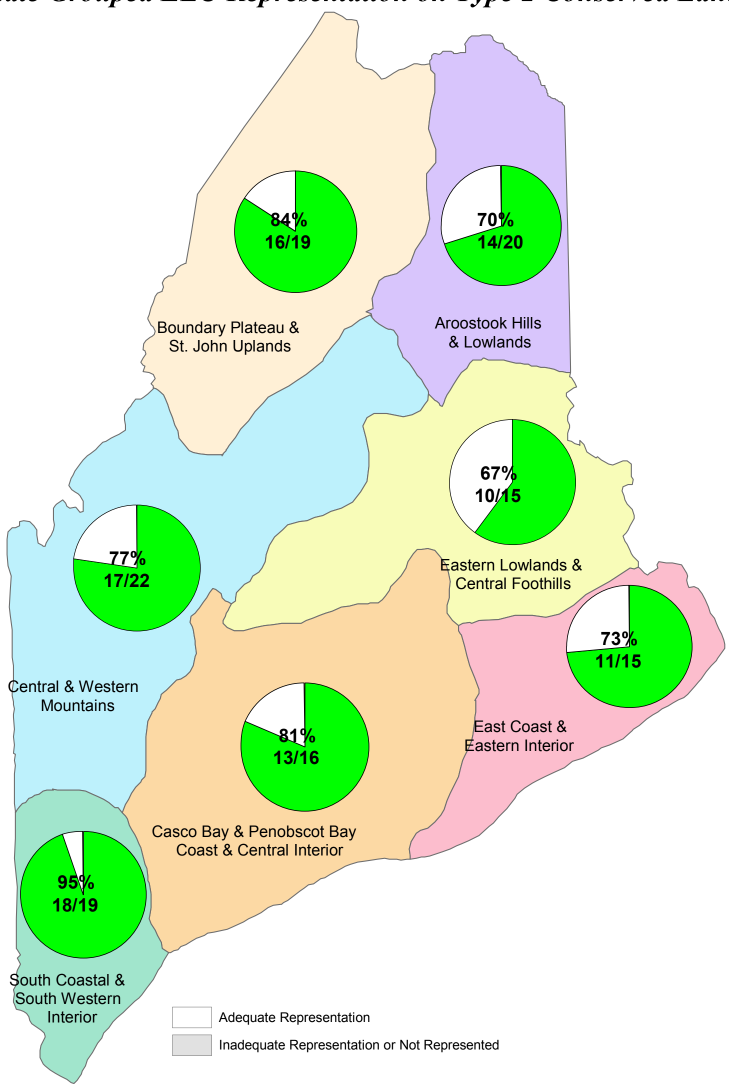
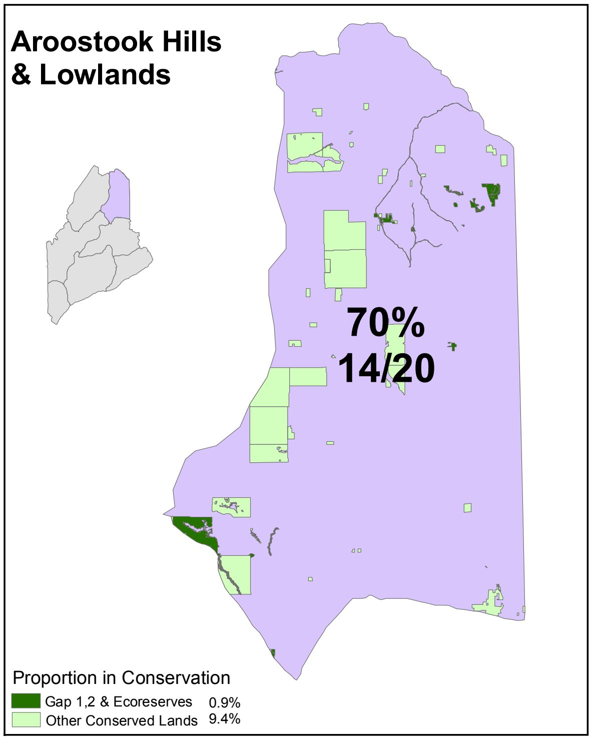


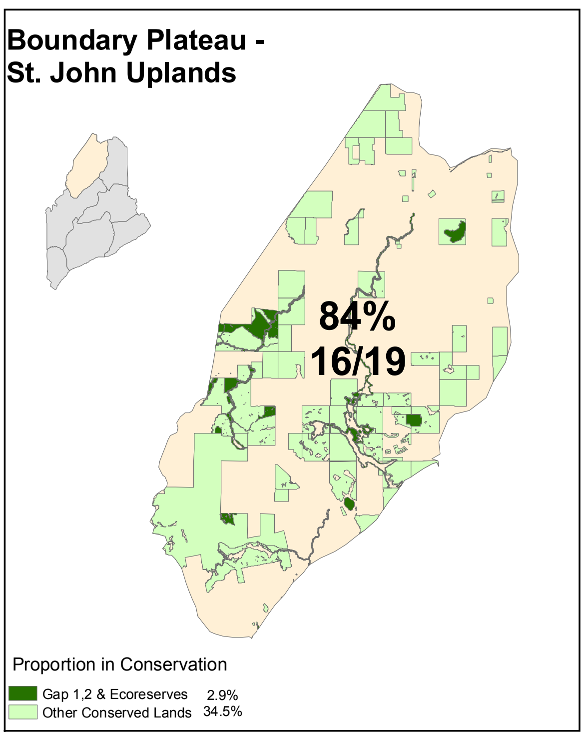
*Figure 22: Aroostook Hills & Lowlands - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




| Not Represented | % of Section |
|---|---|
| Montane spruce-fir forest | <1 |
| Sub-alpine woodlands/barrens | <1 |
| N. hdwd/pine-hemlock-hdwd | <1 |
| Spruce - n. hardwood (mid elev) | <1 |
| Serpentine hillcrest | <1 |
| **Under Represented** | **% of Section** |
| Northern hardwood | <1 |
| **Adequately Represented** | **% of Section** |
| Acidic cliff/outcrop/talus | <1 |
| Calcareous cliff/outcrop/talus | <1 |
| Calcareous swamp/bog | 4.1 |
| Outwash forest/wetland | <1 |
| Spruce flat/swamp | 5.8 |
| Emergent wetland | <1 |
| Enriched northern hardwood | <1 |
| Red maple or mixed swamp | 9.3 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | 5.3 |
| Pine - hemlock - hardwood | 1.2 |
| Oak - northern hardwood | 2.0 |
| Shrub swamp | <1 |

Remaining % of Section = Agriculture, Water & Development

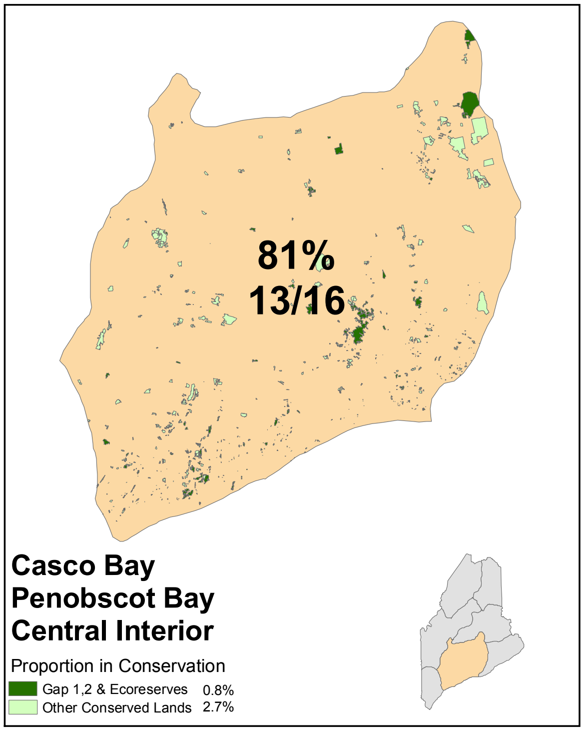
*Figure 23: Boundary Plateau / St.John Uplands - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




| Under Represented | % of Section |
|---|---|
| Calcareous cliff/outcrop/talus | <1 |
| Calcareous swamp/bog | <1 |
| Shrub swamp | <1 |
| **Adequately Represented** | **% of Section** |
| Acidic cliff/outcrop/talus | <1 |
| Outwash forest/wetland | 1.2 |
| Spruce flat/swamp | 8.4 |
| Enriched northern hardwood | <1 |
| Emergent wetland | <1 |
| Red maple or mixed swamp | 7.9 |
| Montane spruce-fir forest | <1 |
| Sub-alpine woodlands/barrens | <1 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | 19.3 |
| Pine - hemlock - hardwood | 45.8 |
| Pine - oak forest | <1 |
| N. hdwd/pine-hemlock-hdwd | <1 |
| Northern hardwood | 2.1 |
| Spruce - n. hardwood (mid elev) | <1 |
| Oak - northern hardwood | 7.1 |

Remaining % of Section = Agriculture, Water & Development

*Figure 24: Casco Bay / Penobscot Bay / Central Interior - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*



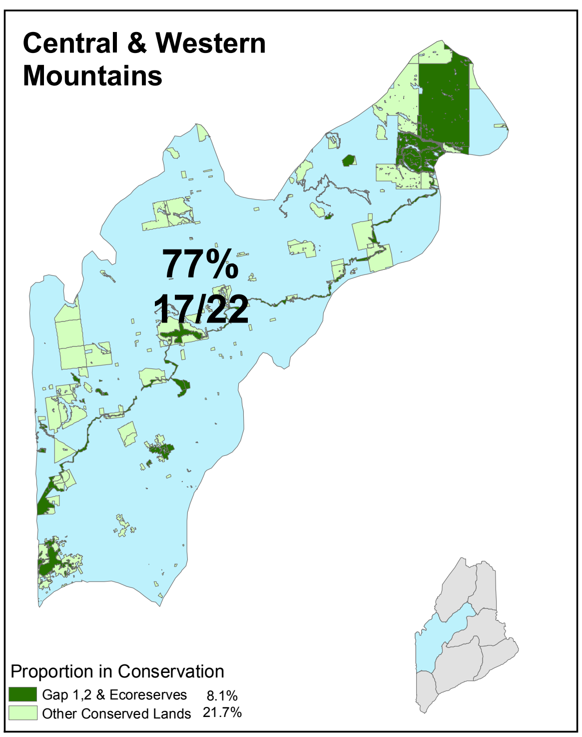

| Not Represented | % of Section |
|---|---|
| Northern hardwood | <1 |

| Under Represented | % of Section |
|---|---|
| Outwash forest/wetland | 1.1 |
| Shrub swamp | <1 |

| Adequately Represented | % of Section |
|---|---|
| Acidic cliff/outcrop/talus | <1 |
| Calcareous cliff/outcrop/talus | <1 |
| Calcareous swamp/bog | 3.0 |
| Spruce flat/swamp | 4.3 |
| Emergent wetland | <1 |
| Enriched northern hardwood | <1 |
| Red maple or mixed swamp | 7.7 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | <1 |
| Pine - hemlock - hardwood | 50.3 |
| Pine - oak forest | 4.4 |
| Oak - northern hardwood | <1 |
| Serpentine hillcrest | <1 |

Remaining % of Section = Agriculture, Water & Development

*Figure 25: Central & Western Mountains - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*



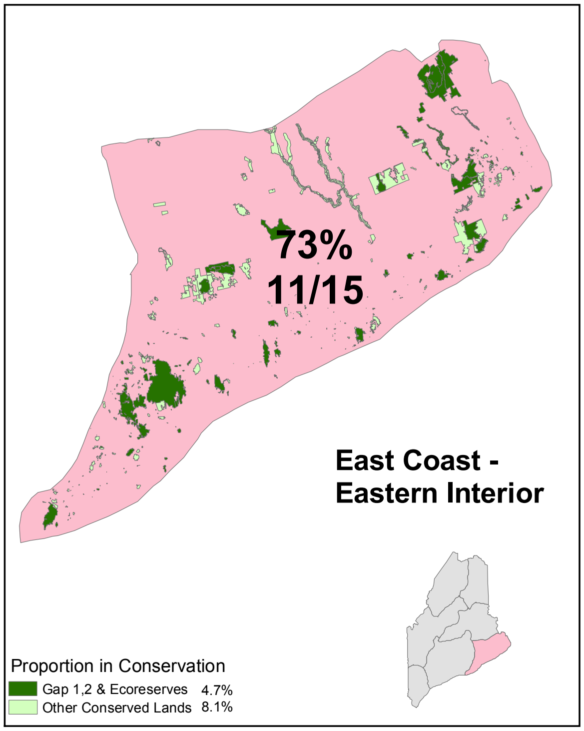

| Not Represented | % of Section |
|---|---|
| Serpentine hillcrest | <1 |

| Under Represented | % of Section |
|---|---|
| Calcareous swamp/bog | <1 |
| Emergent wetland | <1 |
| N. hdwd/pine-hemlock-hdwd | 2.4 |
| Shrub swamp | <1 |

| Adequately Represented | % of Section |
|---|---|
| Alpine | <1 |
| Acidic cliff/outcrop/talus | <1 |
| Calcareous cliff/outcrop/talus | <1 |
| Outwash forest/wetland | 1.2 |
| Spruce flat/swamp | 3.8 |
| Enriched northern hardwood | <1 |
| Red maple or mixed swamp | 6.4 |
| Montane spruce-fir forest | 6.8 |
| Sub-alpine woodlands/barrens | 4.7 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | 13.7 |
| Pine - hemlock - hardwood | 30.0 |
| Pine - oak forest | 1.9 |
| Spruce - n. hardwood (mid elev) | 5.4 |
| Northern hardwood | 4.5 |
| Oak - northern hardwood | 9.4 |
| Sub-alpine wetland | <1 |

Remaining % of Section = Agriculture, Water & Development

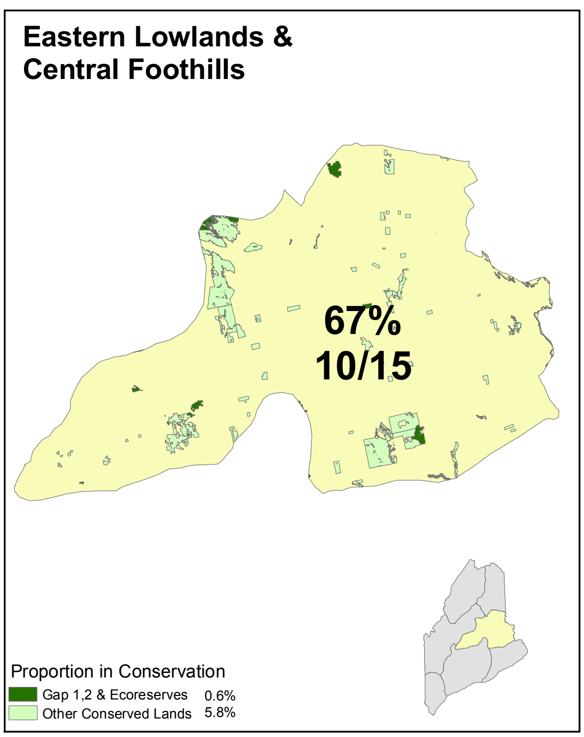
*Figure 26: East Coast / Eastern Interior - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




| Not Represented | % of Section |
|---|---|
| Calcareous swamp/bog | <1 |
| Northern hardwood | <1 |
| **Under Represented** | **% of Section** |
| Calcareous cliff/outcrop/talus | <1 |
| Outwash forest/wetland | 2.3 |
| **Adequately Represented** | **% of Section** |
| Acidic cliff/outcrop/talus | <1 |
| Spruce flat/swamp | 5.3 |
| Emergent wetland | 1.3 |
| Enriched northern hardwood | <1 |
| Red maple or mixed swamp | 11.9 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | <1 |
| Pine - hemlock - hardwood | 54.0 |
| Pine - oak forest | 4.0 |
| Oak - northern hardwood | <1 |
| Shrub swamp | <1 |

Remaining % of Section = Agriculture, Water & Development

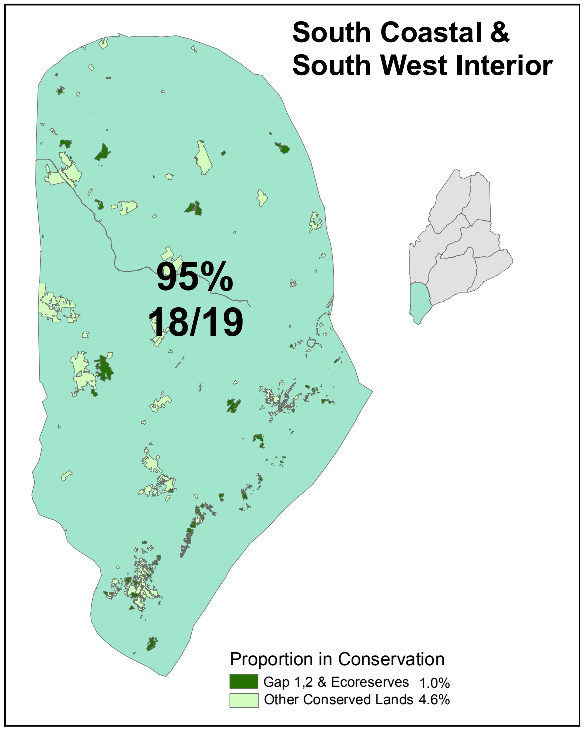
*Figure 27: Eastern Lowlands & Central Foothills - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




| Not Represented | % of Section |
|---|---|
| Acidic cliff/outcrop/talus | <1 |
| Calcareous cliff/outcrop/talus | <1 |
| Northern hardwood | <1 |
| **Under Represented** | **% of Section** |
| Enriched northern hardwood | <1 |
| Shrub swamp | <1 |
| **Adequately Represented** | **% of Section** |
| Calcareous swamp/bog | 6.4 |
| Outwash forest/wetland | 1.1 |
| Spruce flat/swamp | 7.0 |
| Emergent wetland | <1 |
| Red maple or mixed swamp | 7.9 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | <1 |
| Pine - hemlock - hardwood | 62.4 |
| Pine - oak forest | 3.0 |
| Oak - northern hardwood | <1 |

Remaining % of Section = Agriculture, Water & Development

*Figure 28: South Coastal & South West Interior - Grouped ELU Representation on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)*




| Not Represented | % of Section |
|---|---|
| Shrub swamp | <1 |
| **Under Represented** | **% of Section** |
| **Adequately Represented** | **% of Section** |
| Acidic cliff/outcrop/talus | <1 |
| Calcareous cliff/outcrop/talus | <1 |
| Calcareous swamp/bog | 1.7 |
| Outwash forest/wetland | 5.2 |
| Spruce flat/swamp | 4.9 |
| Emergent wetland | 1.4 |
| Enriched northern hardwood | <1 |
| Red maple or mixed swamp | 11.6 |
| Montane spruce-fir forest | <1 |
| Sub-alpine woodlands/barrens | <1 |
| Dry pine - oak woodland | <1 |
| Lowland spruce - fir - hdwd | <1 |
| Pine - hemlock - hardwood | 46.9 |
| Pine - oak forest | 5.2 |
| N. hdwd/pine-hemlock-hdwd | <1 |
| Spruce - n. hardwood (mid elev) | <1 |
| Northern hardwood | <1 |
| Oak - northern hardwood | <1 |

Remaining % of Section = Agriculture, Water & Development

## 4.3 Discussion

### ELUs vs. Grouped ELUs

Grouped ELUs are better represented because they "homogenize" numerous ELUs into spatially larger units, and it is more likely that some part of these larger, homogenized units will be captured in conservation land. Conversely, because ELUs are much larger in number and smaller in scale, and conservation lands account for only a small fraction of any given region, individual ELUs are more likely to be omitted from conservation lands.

### Adequate Representation vs. Adequate Protection

The fact that 18 of 19 ELU groups are "adequately" represented in the South Coastal and Southwest Interior Region (southern Maine) appears to challenge the common perception that conservation lands are lacking in that part of the state. Moreover, it contrasts with our earlier finding that natural communities are poorly represented (27%) on conservation lands in that same region.

This apparent difference is explained by our methodology and by inherent differences between ELUs and natural communities. Our ELU analysis indicates that conservation lands have successfully captured the diversity of landscape types in that region, ranging from coastal marshes to hilly terrain to sand flats, *in similar proportions as they occur in the region*. As noted previously, this analysis is *relative* rather than *absolute*, providing information on only presence/absence and relative proportions of ELUs. These data lack important information about the size and viability of the habitats that are protected. In contrast, size and viability have been accounted for in our natural community analysis by factoring in only A and B ranked examples of natural communities. As a result, the ELU and ELU group *representation* figures should not be construed to indicate adequate *protection*. To sufficiently capture the viability/functionality of ELUs and ELU groups, one would need to assess the size of each grouped ELU polygon (or polygon cluster) relative to its natural patch size (i.e., small patch, large patch, matrix) and appropriate targets for acreage and number of occurrences (e.g. TNC methodology) for those types in the state or region. This task is beyond the scope of this initial investigation but is listed in Section 6.4, "Additional Research Needs and Questions."

# 5.0 Correlation of ELUs with Mapped Natural Communities: Testing the Predictive Power of ELU Components

A key underlying question related to ELUs is the degree to which they predict natural vegetation. Can ELUs potentially be used as surrogate for ecosystems and communities when the relationship between biotic factors and ELUs is better understood? More specifically, can the relationships be used to evaluate the potential distinctiveness or rarity of a given landscape or to identify priorities for future inventory or conservation planning efforts?

**Cross-walking ELUs to Natural Communities**

Results obtained from comparing ELUs and ELU components with existing mapped natural community data were used to develop several versions of "crosswalks" that link ELUs and natural communities. These crosswalks were in turn used to group ELUs for representational analyses in Section 4.

Appendices 8.1 and 8.6 show some examples of such crosswalks. Appendix 8.1 is a cross-walk between ELU *components* and natural communities, and Appendix 8.6 is a cross-walk between ELUs and natural communities (according to Maine's classification). Linkages between ELU components, ELUs, and natural communities were used to direct the process of collapsing of 368 ELUs into 25 ELU groups.

## 5.1 Methodology

To attempt a preliminary assessment of the correlation between individual ELU components and natural communities, a matrix was constructed (Appendix 8.1) to predict the elevation, landform, and geologic type with which each natural community type would "naturally" be associated. For instance, we predicted that a Brackish Tidal Marsh would occur on only one type of landform (wet flats), one elevation classes (less than 800'), and multiple geologic types (since bedrock geology is not strongly correlated with the formation of tidal marshes). Similarly, a wide-ranging natural community such as a Beech Birch Maple Forest could occur on eleven different landforms, three elevation classes, and seven geologic types.

To account for some uncertainty, we created three categories of prediction. One category indicted that a natural community was *likely* to occur on a particular ELU component. A second category indicated that a natural community *was likely to or could possibly* occur on a particular ELU component. A third category indicated that a natural community was *unlikely* to occur on a particular ELU component.

A key difference between this approach and others undertaken elsewhere in New England is that we assumed a particular ELU type could be associated with one *or more* natural community types. This "one-to-many" approach is a reflection of two factors. First, we recognize the dynamic character of natural communities, as they are influenced by natural disturbances at varying geographic and temporal scales, differing seed sources, and other biological factors not explained by ELUs alone. Second, we recognize some uncertainty (or perhaps lack of confidence!) in assigning a specific natural community for each location on the ground. Other ELU analyses have assumed a one-to-one relationship; that is, for each location on the ground, only one natural community could occur under natural conditions.

This difference in approaches dissolves as ELUs and ELU *components* are collapsed into larger groups. As discussed above, our predictions of correlations between natural community groups and ELU groups assume a one to one relationship; that is, one distinct set of natural communities is associated with only one ELU group.

Next, a GIS analysis was conducted to test the "precision" of our predictions. ELUs (and their underlying components) were matched with nearly 1,000 mapped natural communities. Within each natural community polygon, the largest portion of any particular ELU component (e.g., the most abundant bedrock type within the polygon) was compared to the "predicted" ELU component (e.g., acidic-granitic bedrock).

## 5.2 Results

### *ELU Components and Natural Communities*

Based on this analysis, each of the three ELU components (slope, elevation, geology) was associated with the appropriate natural communities at least 80% of the time. Figures 29, 30, and 31 illustrate these relationships.

- Elevation had the strongest correlation. As Figure 29 indicates, 97.2% of natural community occurrences fell within the "likely" elevation category, and 98.8% fell within the "possible" category.

- Landform and geology had similar correlations to natural communities (Figures 30 and 31).

*Figure 29: Precision of Elevation in predicting Natural Community Type*

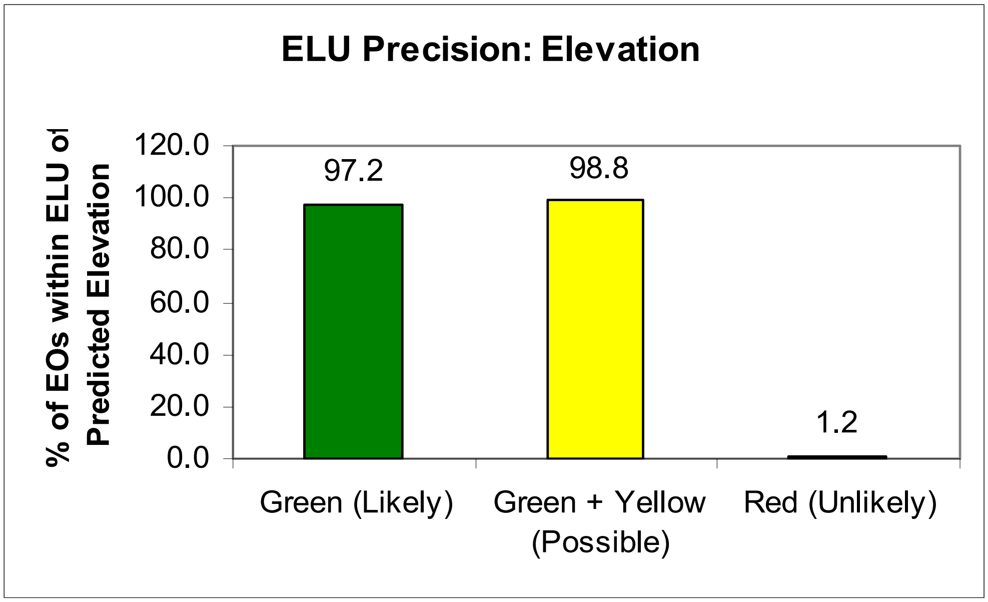



*Figure 30: Precision of Landform in predicting Natural Community Type*

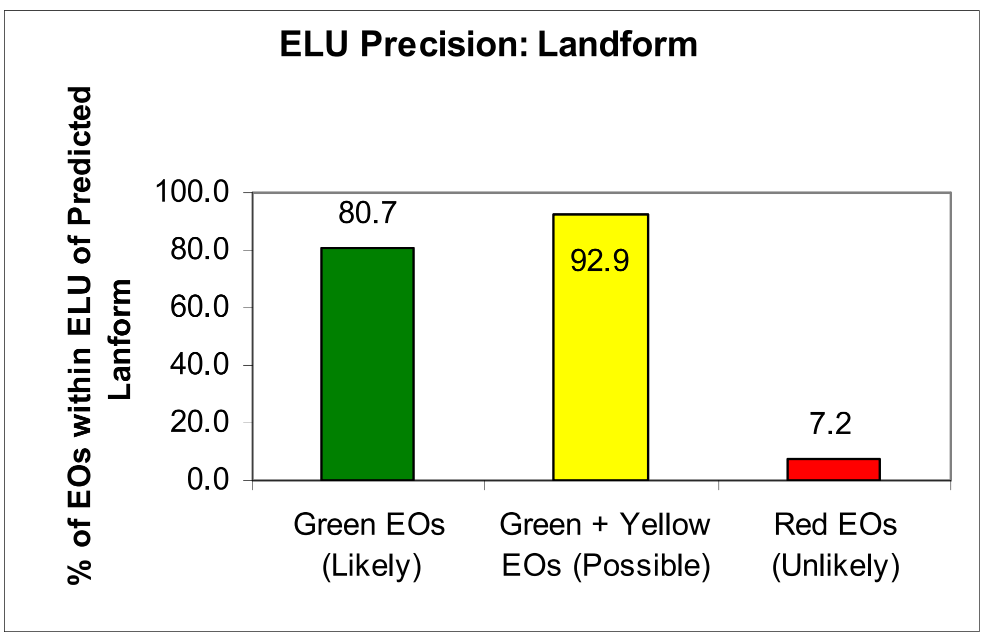
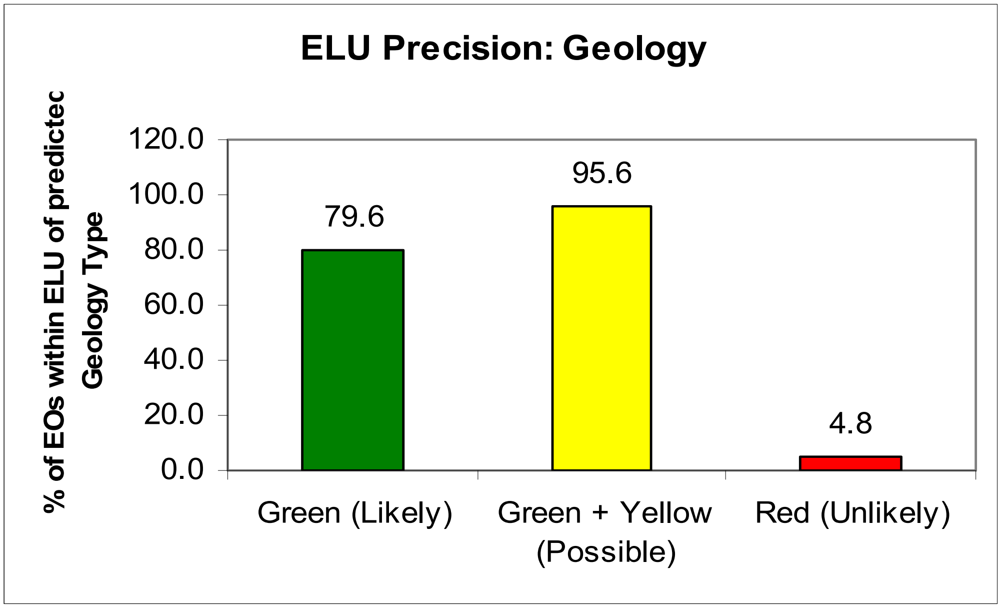
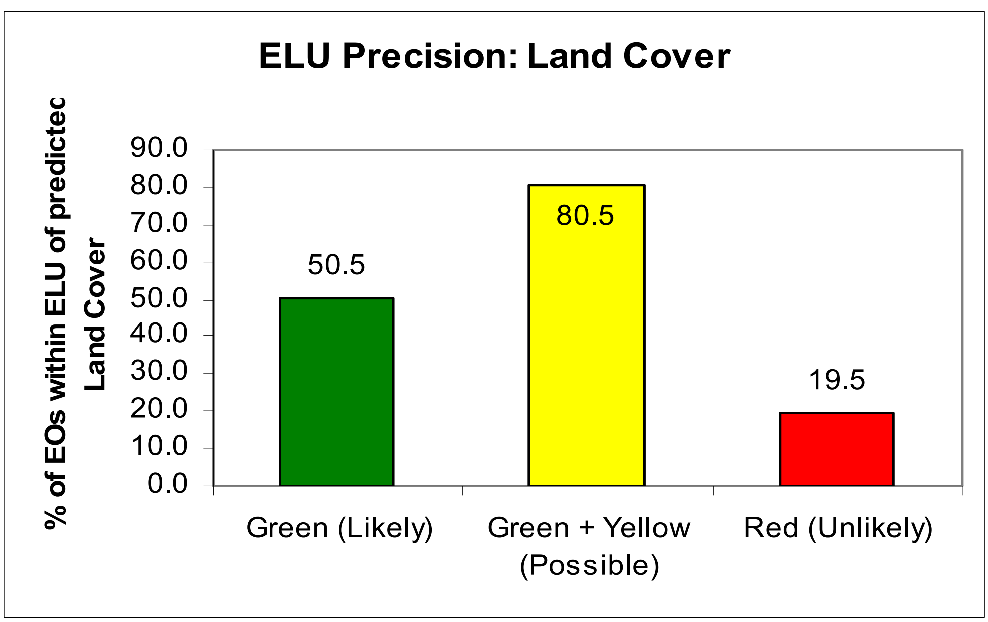


*Figure 31: Precision of Geology in predicting Natural Community Type*




A prediction was also made between the national Medium Resolution Land Cover (MRLC) data set and natural communities (land cover is an add-on component to ELU where ELU + Land Cover = "Systems"). MRLC land cover is based on satellite imagery from the early 1990s and includes approximately 12 categories in Maine. Interestingly, this feature was far less precise than the three physical components of ELUs. Only half of the natural communities fell within a land cover type in which they were predicted to occur (Figure 32). This is likely caused by the transitional character of the state's land cover, particularly in the northern tier of the state, coupled with the out-dated source of the information.

*Figure 32: Precision of Satellite-based Land Cover (MRLC) in predicting Natural Community Type*



***ELU Groups and Natural Communities: A Case Study of the Bigelow Reserve***

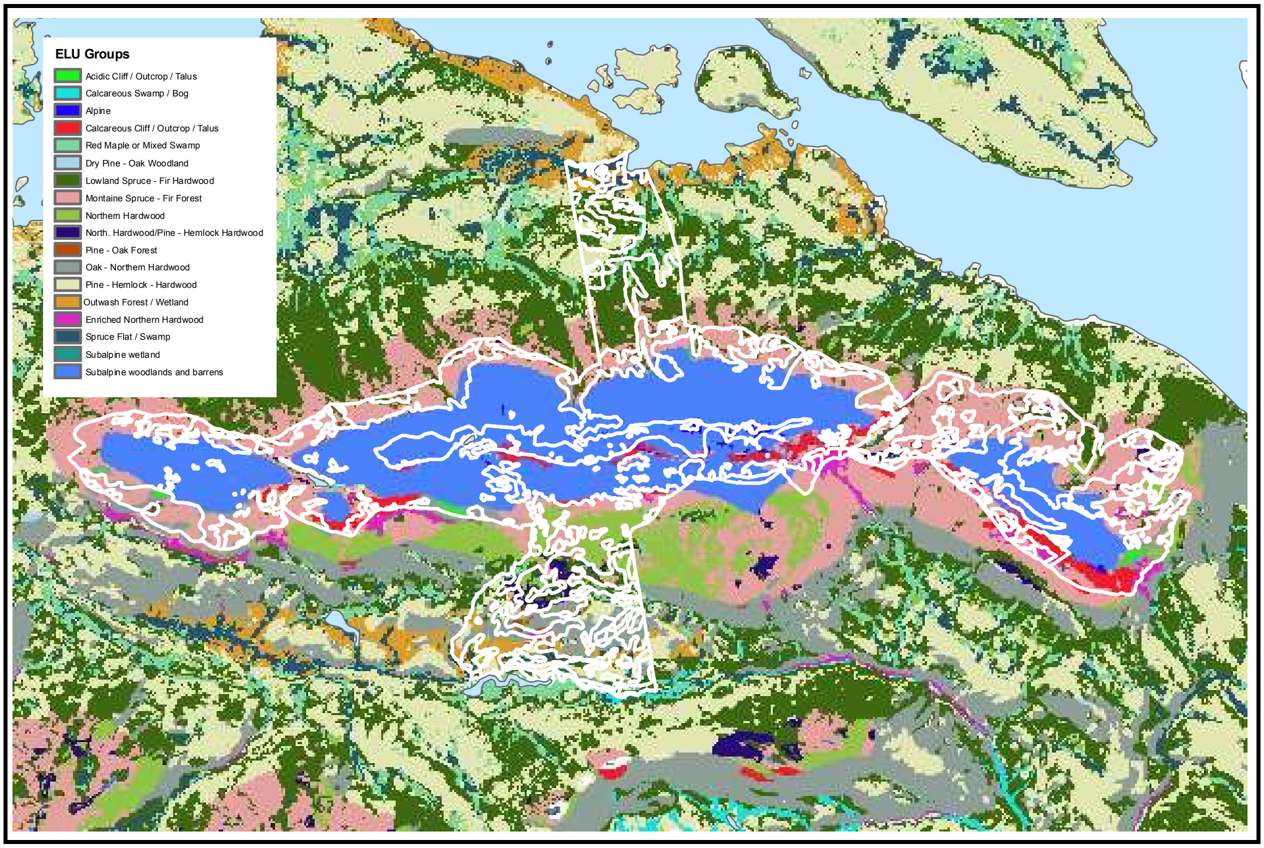
As noted previously, we collapsed 368 ELUs into 25 ELU groups to depict a more workable (and potentially more meaningful) correlation between physical features and natural communities. To test this correlation, we overlaid ELU groups and natural communities on the Bigelow Ecological Reserve, a 10,000+ acre tract that has two desirable features for this type of analysis: (1) natural communities have been mapped in “wall to wall” fashion from air photos, and (2) the Bigelow Reserve exhibits a range of landform and elevation that creates a wide variety of ELUs. Figure 33 depicts the results of this overlay, and Appendix 8.7 indicates how successfully ELU groups predict natural communities for the Bigelow Ecological Reserve.

A true 1:1 correspondence would not be expected because of the different scales of classifications used (25 ELU groups vs. 98 natural community types). It is likely one ELU group would be associated with two or more natural community types. For groups and natural communities clearly defined by landform or elevation, the association is strong. For example, 96% of the “Alpine” ELU group is associated with one of three appropriate natural communities: Crowberry – Bilberry Open Summit Bald (24%), and Spruce – Fir – Birch Krummholz (27%), and Fir – Heartleaf Birch Sub-alpine Forest (45%). Similarly, 89% of the “Sub-alpine Woodlands and Barrens” ELU group is associated with one of two appropriate natural communities: Fir – Heartleaf Birch Sub-alpine Forest (79%) and Spruce – Fir – Birch – Krummholz (10%). Two-thirds (66%) of the “Northern Hardwood” ELU group is associated with Northern Hardwood Forest, and one quarter (23%) is associated with “Spruce – Northern Hardwood Forest.”

Other associations are not as strong for a variety of reasons, including scale and geographic specificity. The “Calcareous Swamp/Bog” ELU group, for example, accounts for a very small portion of the Bigelow Reserve (12 acres total), where it is associated mostly with two upland natural community types. A closer inspection of this ELU group reveals that it is mapped as a series of linear pixels, a few acres in size, along stream drainages. At this small scale, these locations are not large or distinct enough to support wetland natural communities mappable from air photos, although there may be subtle distinctions or transitions on the ground. Similarly, most of the “Acidic Cliff/Outcrop/Talus” ELU group is associated with Fir – Heartleaf Birch Sub-alpine Forest, likely because the acidic cliffs portrayed by ELU groups are scattered pixels too small (0.16 acre) to be captured by natural community maps, which had a minimum mapping size of 1 acre.

Another explanation for poor correlations is that the ELU groups were created as a statewide layer. When applied to a particular location on the ground, geographic differences between northern and southern Maine may not be adequately reflected. A modification of the ELU groups has been made to account for these regional differences, as well as aspect (northwest vs. southeast) and is expressed by a further splitting of ELU types, as shown in Appendix 8.2. For example, the “Low Elevation – Cool” ELU group is predicted to support Lowland Spruce – Fir – Hardwood Forest across all aspects in northern Maine and Northern Hardwood Forests on northwest facing slopes in Southern Maine.

*Figure 33: ELU Groups and Natural Communities on the Bigelow Ecological Reserve*




## 5.3 Discussion

The strong correlation between ELU components and natural communities attests to the predictive capacity of ELUs. It also reflects the conservative "one to many" approach we took, assuming that one ELU component might be associated with several natural community types, depending on other ELU components, natural disturbance history, and other factors. Not surprisingly, elevation had the strongest correlation, since many communities (coastal marshes, alpine areas) are easily predicted to occur in distinct elevation zones.

There are several possible reasons for cases in which natural communities are NOT associated with the correct ELU component. First, the natural community might not be mapped accurately (many of the polygons were mapped prior to GPS technology). Second, where a natural community polygon crossed several ELUs, only the majority ELU within that polygon was used for analysis. As a result, a polygon crossing five ELUs might be linked to an ELU that accounts for only 30% of that polygon.

The poor correlation of the land cover data set to natural communities is likely caused by the above factors but is enhanced by the transitional character of the state's land cover, particularly in the northern tier of the state.

# 6.0 Conclusions

## 6.1 What is lacking from Maine's Conservation Portfolio?

### Natural Communities

As noted in Section 3.2, fifteen of the state's 98 natural community types are not adequately represented (no A or B examples) on any conservation lands, and nineteen are not represented on Gap 1 or 2 lands. Table 5 lists these nineteen types; twelve of the nineteen types are rare (S1 – S3) and are listed in bold. It is also important to note that some of the common types (e.g., Open Water Marsh, Pickerelweed Marsh, Bulrush Marsh) likely occur on conservation lands but have not been documented as A or B ranked examples.

***Table 5: Community Types not represented on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)***

| | |
|---|---|
| ***1*** | **Balsam Poplar Floodplain Forest** |
| ***2*** | **Blueberry Barren** |
| 3 | Bulrush Marsh |
| 4 | Cattail Marsh |
| ***5*** | **Circumneutral Pond** |
| 6 | Coastal Beach |
| ***7*** | **Coastal Sedge Bog** |
| ***8*** | **Dune Grassland** |
| ***9*** | **Hardwood Seepage Forest** |
| ***10*** | **Jack Pine Forest** |
| ***11*** | **Maritime Slope Bog** |
| ***12*** | **Mid-elevation Bald** |
| 13 | Open Cedar Fen |
| 14 | Open Water Marsh |
| 15 | Pickerelweed Marsh |
| ***16*** | **Pitch Pine - Heath Barren** |
| ***17*** | **Rivershore Shrub Thicket** |
| ***18*** | **Riverwash Sand Barren** |
| 19 | Tall Shrub Fen |

Only two forested types (Balsam Poplar Floodplain Forest and Hardwood Seepage Forest) are not represented on any type of conservation land, and four forested types (the two listed above plus Pitch Pine – Heath Barren and Jack Pine Forest) are not represented on Gap 1 or 2 conservation lands.

A more meaningful assessment of natural community protection incorporates geographic representation. For the state as a whole, good examples of only 126 of 412 (31%) of natural communities or ecosystems are represented in sections where they occur. Not surprisingly, regions of the state with comparatively less conservation land exhibit poorer representation of natural communities.

## Grouped ELUs

Using the grouped ELU representation (Figure 21) as an indication, Maine's limited conservation lands have been very successful at capturing landscape diversity. Each of the 25 ELU groups is captured at least once on conservation lands somewhere in Maine, and conservation lands adequately capture an average of 78% of the ELU groups expected to occur within each region. Moreover, each region has at least 2/3 of the expected ELUs represented on Type 2 conservation lands. ELU groups that are under-represented vary by region but are typically uncommon types, accounting for less than 1% of each region's landscape.

As discussed previously, however, the relative/proportional nature of these ELU figures and our assumptions for "adequate representation" do not allow full assessment of the question 'how much is enough'? For example, if the composition of the protected lands is entirely reflective of the surrounding landscape, but only 3% of the land is protected, is that enough? For small and large patch natural communities (e.g., calcareous cliffs, red maple swamps), perhaps it is enough, but the scale necessary to protect matrix forming natural communities is not accommodated by this representational strategy.

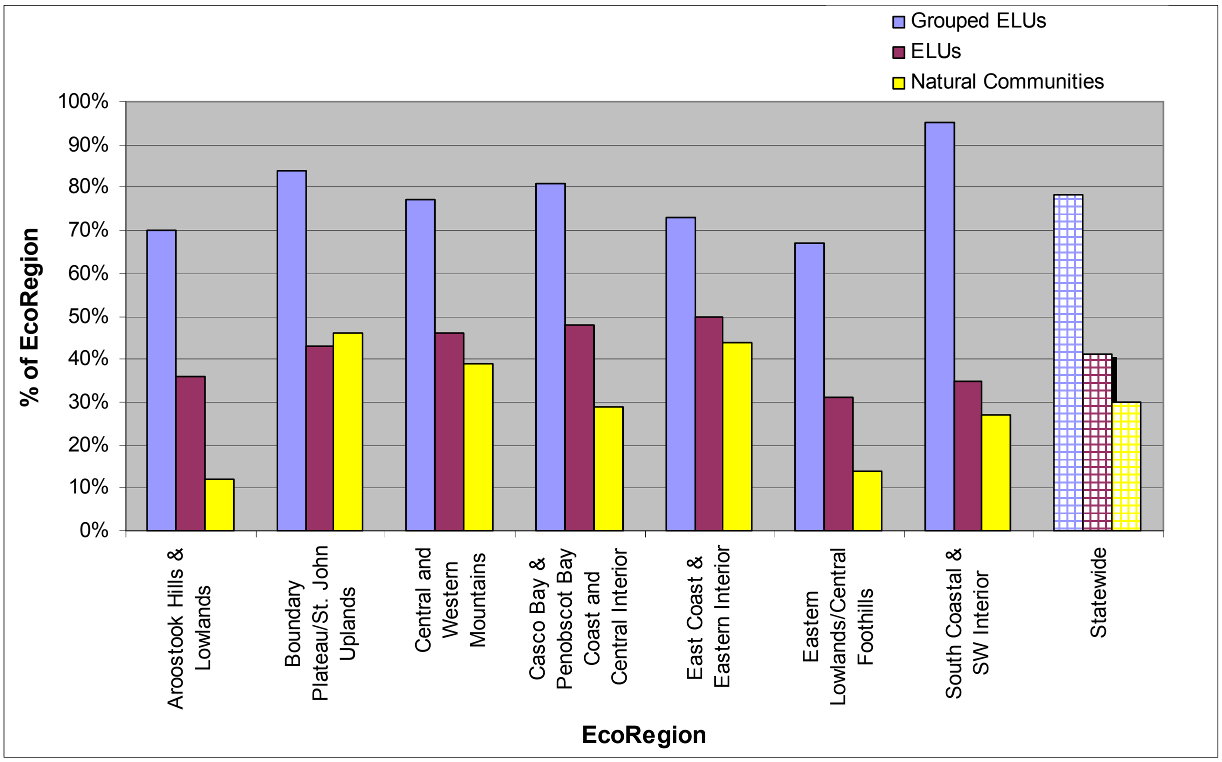
## A Geographic Perspective

Not surprisingly, natural communities are most poorly represented in regions with the lowest amount of conservation lands – Southern Maine, the Aroostook Hills and Lowlands, and the Eastern Lowlands and Foothills. Conversely, natural communities are comparatively well represented in the St. John Uplands and Central and Western Mountains, regions with the most conservation land. This pattern of conservation ownership holds true for both conservation lands as a whole and the restricted subset of conservation lands set aside from timber harvesting.

## 6.2 Comparing Representation of ELUs and Natural Communities

Figure 34 compares the effectiveness of land conservation at protecting representative ELUs (both individual and grouped) and natural communities. The advantage of the natural community approach is that it is direct: while ELUs may be considered surrogates for representing biodiversity, natural communities are often targets in themselves.

***Figure 34: A Comparison of Representational Analyses on Type 2 Conserved Lands (Gap 1, Gap 2 & Ecoreserves)***




Why are the representation figures so different for ELUs, grouped ELUs, and natural communities? The differences between representation of ELUs and grouped ELUs are discussed in Section 4.3 ("homogenized" ELU groups are larger in scale and therefore more likely to be captured within conservation lands). The disparity between ELU representation and natural community representation may be explained by several factors.

- First, as noted in Section 4.3, ELU representation involves relative proportions rather than absolute sizes, so only presence/absence and proportions of ELUs are sufficient to be considered "represented."

- Natural community representation, on the other hand, is based on "exemplary" natural communities documented by MNAP. To be considered "viable" (A or B ranked) these mapped communities exceed minimum thresholds of size, condition, and landscape context. In this regard, natural community representation may be a more accurate means of evaluating biodiversity protection.

- Natural community representation is based on inventory data, which is not uniform and far from complete statewide. ELUs, in comparison, have been mapped in “wall-to-wall” coverage for the state. A different measure of natural community representation, parallel to ELU representation, would involve presence/absence and proportions of ALL natural communities. This method would not capture the viability thresholds noted above. In addition, this type of natural community representation is not feasible because “wall-to-wall” natural community information on all protected lands is not available for comparison.

### 6.3 Applying ELUs to Conservation Planning

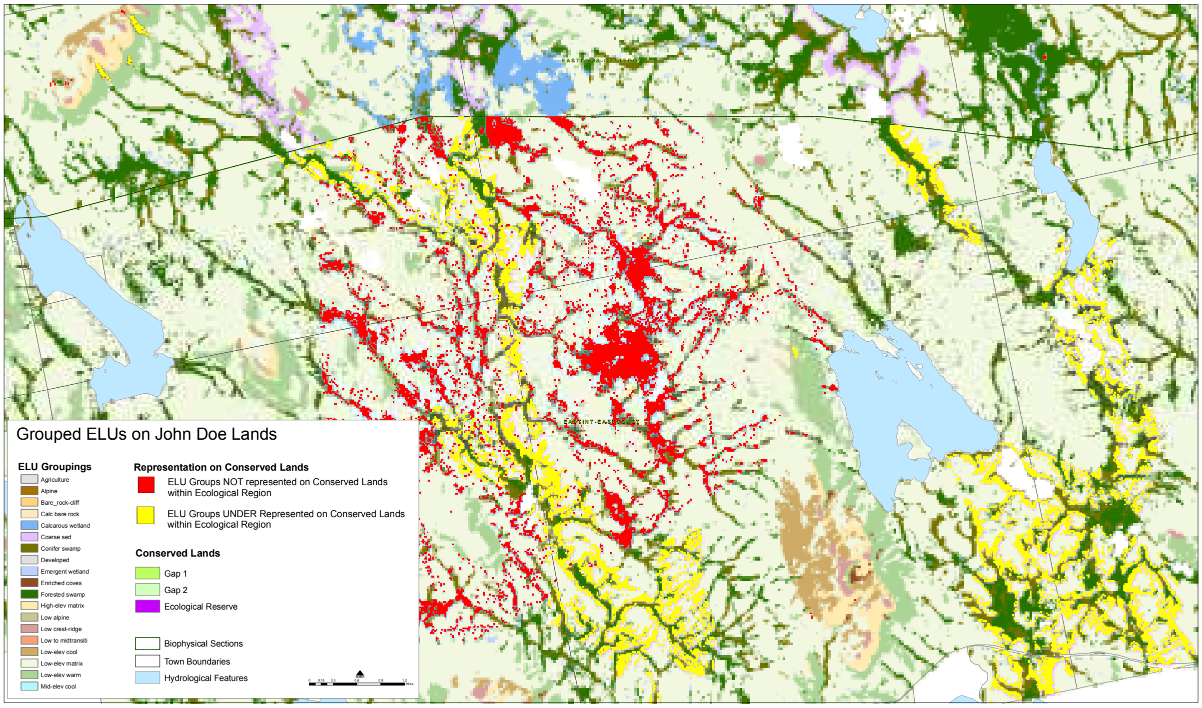
Ecologists are often asked to evaluate proposed land protection projects with regard to what ecological values they might add to the state’s portfolio of conservation lands. The data developed for this project now enable us to create maps and lists of natural communities and ELUs that both (a) occur on a subject property, and (b) are under-represented in Maine or in a particular region.

This capability is currently being used to evaluate hypothetical conservation options on two large ownerships in Maine. For conservation options on a hypothetical ownership that covers five ecological Sections of Maine, for example, we have generated both a map and table (Table 6 and Figure 35) that indicate ELU groups that occur on those lands and are not sufficiently protected in the region. This information may be used in conjunction with natural community data (from ground-truthing or air photo interpretation) to guide conservation and acquisition strategies.

***Table 6: Acreages of Under-Represented ELU groups (yellow) and Non-Represented groups (red) on a hypothetical ownership in Maine***

| ***ELU Group*** | Aroostook Hills & Lowlands- | Casco Bay-Penobscot Bay Coast & Central Interior | Central & Western Mountains | East Coast & Eastern Interior | Eastern Lowlands & Central Foothills |
|---|---|---|---|---|---|
| Bare rock/cliff | | | | | 12.23 |
| Calc bare rock | | | | 4.23 | 422.91 |
| Calcareous swamp/bog | | | 4153.79 | 475.47 | |
| Outwash forest/wetland | | 1927.16 | | 1112.65 | |
| Emergent wetland | | | 618.93 | | |
| Enriched northern hardwood | | | | | 141.00 |
| N. hdwd/pine-hemlock-hdwd forest | | | 1468.91 | | |
| Mid-elev matrix | 198.52 | | | 1.33 | 5829.58 |
| Serpentine hillcrest | | | 47.37 | | |
| Shrub swamp | | 15.56 | 80.95 | | 88.29 |

*Figure 35: Sample map indicating Under -Represented ELU groups (yellow) and Non -Represented groups (red) on part of a hypothetical ownership in Maine*




## 6.4 Next Steps: Additional Research and Application Needs

The creation and application of ELUs are a relatively recent addition to the conservation toolbox. This study has brought to light many of the strengths of ELUs and highlighted some potential applications. However, additional work is necessary to address some of the weaknesses. Some of these needs are noted below:

- Natural community representation on conservation lands is limited by the incompleteness of our natural community data. MNAP efforts to complete an initial broad-brush inventory of the state are currently scheduled to finish within the next five years, but this effort is contingent on funding.

- This scale of analysis points to the need for a complete, unified, accessible database of conservation lands in the state. Currently this information is held by numerous parties with no protocol for acquiring or sharing data.

- Finer definition is needed for the ELU “wet flats” category, which is currently so broad that it includes many types of wetlands and poorly drained uplands. One way to address this deficiency is to embed National Wetland Inventory (NWI) data into ELUs to develop new wetland ELU classes.

- Use of more current and higher resolution land cover data (to be available in a year or two) is needed to test the correlation between mapped land cover, ELUs and ELU groups.

- Ground truthing is needed in different regions of Maine to match ELUs and ELU groups to predicted natural communities.

- Continued reiteration and re-testing of regionalized ELU groupings is needed to more closely predict the natural communities found on different parts of Maine's landscape.

- Defining a minimum area threshold (i.e., number of pixels) is necessary to approximate the minimum number of acres required for an ELU or ELU group to support viable (current or future) natural communities. This minimum area would relate to the natural patch size (small patch, large patch, matrix) of the ELUs or ELU groups and associated natural communities.

- Further work is needed to describe and quantify larger landscape units (i.e. at the scale of 1,000 acres or larger) that capture specific repeated patterns and orientations of ELUs and ELU groups. These landscape units are often visually discernable, but efforts to incorporate them into conservation planning in a quantifiable way remain subjective and largely untested.

# 7.0 Literature Cited


Anderson, M.G., Comer, P., Grossman, D., Groves, C., Poiani, K., Reid, M., Schneider, R., Vickery, B., and A. Weakley. 1999. ***Guidelines for representing ecological communities in ecoregional conservation plans***. The Nature Conservancy. 74 pp.

Anderson, Mark. G., Merrill, Michael. D and Biasi Frank. B. 1998. ***Connecticut River Watershed: Ecological Communities and Neotropical Migrant Birds: Final Report Summary***.

DeGraaf, R., and M. Yamasaki. 2001. New England Wildlife: Habitat, Natural History, and Distribution. University Press of New England. Hanover, NH.

Crist, Patrick. J. 2000 ***Mapping and Categorizing Land Stewardship***. University of Idaho, Moscow, Idaho (http://www.gap.uidaho.edu/handbook/pdf/stewardship.pdf)

Franklin, J., 1995. ***Predictive vegetation mapping: geographic modeling of biospatial patterns in relation to environmental gradients***. Progress in Physical Geography 19(4):474-499.

Gawler, S and Cutko, A. (In Press). ***Natural Landscapes of Maine***. Maine. Natural Areas Program, Augusta, Maine.

Leak, William B., and Jane R. Riddle, 1979. ***Why trees grow where they do in New Hampshire forests***. US Forest Service, NE Forest Experiment Station. NE-INF-37-79.

McMahon, J. S. 1990. ***The Biophysical Regions of Maine: Patterns in the Landscape and Vegetation***. M.S Thesis, University of Maine, Orono.

Noss, R., and Robert L. Peters, 1995. ***Endangered Ecosystems: A Status Report on America's Vanishing Habitat and Wildlife***. Washington, D.C.: Defenders of Wildlife.

Orndorff, Stephanie. 1996. ***Representational Analyses of Conservation Lands in Maine***. M.S Thesis, University of Florida.

The Nature Conservancy, New England Office. 2003. ***Supplementary Metadata for Systems30 Raster Data***. Unpublished White Notes.

# 8.0 Appendices

## Appendix 8.2 ELU Groups for Maine

| Short Description | ELU Group | Regional Variants |
|---|---|---|
| Agriculture | Agriculture | Agriculture |
| Alpine | Alpine | Alpine barrens |
| Bare_rock-cliff | Acidic cliff/outcrop/talus | Acidic cliff and talus |
| Bare_rock-cliff | Acidic cliff/outcrop/talus | Acidic outcrop and talus/rocky outcrop |
| Bare_rock-cliff | Acidic cliff/outcrop/talus | Acidic rocky outcrop |
| Calc bare rock | Calcarous cliff/outcrop/talus | Calcareous cliff and talus |
| Calc bare rock | Calcarous cliff/outcrop/talus | Calcareous rocky outcrop |
| Calcarous wetland | Calcarous swamp/bog | Calcareous emergent wetland |
| Calcarous wetland | Calcarous swamp/bog | Calcareous emergent wetland |
| Calcarous wetland | Calcarous swamp/bog | Conifer seepage forest |
| Calcarous wetland | Calcarous swamp/bog | Alkaline conifer-hardwood swamp |
| Coarse sed | Outwash forest/wetland | Pine-oak forest on outwash |
| Coarse sed | Outwash forest/wetland | Emergent wetland on outwash |
| Conifer swamp | Spruce flat/swamp | Spruce Flat |
| Developed | Developed | Developed |
| Emergent wetland | Emergent wetland | Emergent wetland |
| Enriched coves | Enriched northern hardwood | Rich northern hardwood |
| Forested swamp | Red maple or mixed swamp | Conifer-hardwood acidic swamp |
| Forested swamp | Red maple or mixed swamp | Red maple swamp |
| High-elev matrix | Montane spruce-fir forest | Montane spruce-fir/Northern hardwood forest |
| High-elev matrix | Montane spruce-fir forest | Montane spruce-fir hardwood forest |
| Low alpine | Sub-alpine woodlands/barrens | Spruce-fir hardwoods/subalpine woodlands |
| Low alpine | Sub-alpine woodlands/barrens | Subalpine woodlands and barrens |
| Low crest-ridge | Dry pine - oak woodland | Dry acidic woodland |
| Low crest-ridge | Dry pine - oak woodland | Dry calcareous woodland |
| Low crest-ridge | Dry pine - oak woodland | Northern pine-oak forest |
| Low crest-ridge | Dry pine - oak woodland | Oak-pine-hardwood-hemlock forest |
| Low to midtransitional | N. hdwd/pine-hemlock-hdwd | Northern hardwood/Pine-hemlock-hardwood forest |
| Low-elev cool | Lowland spruce - fir - hdwd | Pine-hemlock-hardwood northslope |
| Low-elev cool | Lowland spruce - fir - hdwd | Northern hardwood forest |
| Low-elev cool | Lowland spruce - fir - hdwd | Lowland spruce-fir hardwood forest |
| Low-elev cool | Lowland spruce - fir - hdwd | Northern hardwood forest northslope |
| Low-elev matrix | Pine - hemlock - hardwood | Pine-hemlock-hardwood forest |
| Low-elev matrix | Pine - hemlock - hardwood | Pine-hemlock-hardwood northslope |
| Low-elev matrix | Pine - hemlock - hardwood | Pine-oak/Pine-hemlock-hardwood forest |
| Low-elev matrix | Pine - hemlock - hardwood | Spruce-fir-hemlock-hardwood |
| Low-elev warm | Pine - oak forest | Northern pine-oak forest |
| Mid-elev cool | Spruce - n. hardwood (mid elev) | Northern hardwood forest |
| Mid-elev cool | Spruce - n. hardwood (mid elev) | Lowland spruce-fir hardwood forest |
| Mid-elev cool | Spruce - n. hardwood (mid elev) | Northern hardwood forest northslope |
| Mid-elev matrix | Northern hardwood | Northern hardwood forest |
| Mid-elev warm | Oak - northern hardwood | Oak-northern hardwood forest |
| Serpentine hillcrest | Serpentine hillcrest | Serpentine hilltop/crest |
| Shrub swamp | Shrub swamp | Shrub swamp |
| Shrub swamp | Shrub swamp | Wet meadow-shrub swamp |
| Subalpine wetland | Subalpine wetland | Subalpine wetland |
| Water | Water | Water |

# Appendix 8.3: ELU Components x Conserved Lands x Ecological Sections

**Elevation X Section X All Conservation (Type 1)**

| Sum of Acres | Elevzone | | | | | |
|---|---|---|---|---|---|---|
| Section Name | **0 - 800'** | **800 - 1700'** | **1700 - 2500'** | **2500 - 4000'** | **> 4000'** | **Grand Total** |
| ARHILLS-ARLOWS | 167406 | 62905 | | | | 230311 |
| BP-STJUPS | 22287 | 1163742 | 67184 | | | 1253213 |
| CASCO-PENOB-CENTINT | 106673 | 6207 | | | | 112880 |
| CENTRAL-WESTMTNS | 50833 | 562159 | 197779 | 80586 | 2650 | 894007 |
| EASTINT-EASTCOAST | 159459 | 3286 | | | | 162745 |
| EASTLOWS-CENTFOOT | 182878 | 5737 | | | | 188615 |
| SCST-SW INT | 70167 | 3801 | 257 | | | 74225 |
| **Grand Total** | **759703** | **1807838** | **265221** | **80586** | **2650** | **2915997** |

**Elevation X Section X GAP1, 2 & EcoReserves (Type 2)**

| Sum of Acres | Elevzone | | | | | |
|---|---|---|---|---|---|---|
| Section Name | **0 - 800'** | **800 - 1700'** | **1700 - 2500'** | **2500 - 4000'** | **> 4000'** | **Grand Total** |
| ARHILLS-ARLOWS | 17536 | 3834 | | | | 21369 |
| BP-STJUPS | 5401 | 98703 | 3623 | | | 107727 |
| CASCO-PENOB-CENTINT | 33562 | 1197 | | | | 34759 |
| CENTRAL-WESTMTNS | 29014 | 168465 | 69330 | 46376 | 2650 | 315834 |
| EASTINT-EASTCOAST | 91170 | 3108 | | | | 94278 |
| EASTLOWS-CENTFOOT | 15999 | 943 | | | | 16942 |
| SCST-SW INT | 14993 | 955 | 257 | | | 16205 |
| **Grand Total** | **207674** | **277203** | **73210** | **46376** | **2650** | **607113** |

**Geology X Section X All Conservation (Type 1)**

| Sum of Acres | Geology | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Section Name | **Acidic granitic** | **Acidic sed / metased** | **Calcareo us sed / metased** | **Coarse sediments** | **Fine sediments** | **Mafic/interme diate granitic** | **Mod calcareous sed / metased** | **Ultramafic** | **Grand Total** |
| ARHILLS-ARLOWS | 1619 | 180476 | 13576 | 2257 | | 24189 | 8194 | | 230311 |
| BP-STJUPS | 42784 | 970585 | 4054 | 35405 | 3757 | 177459 | 19171 | | 1253213 |
| CASCO-PENOB-CENTINT | 22069 | 23143 | 1321 | 1543 | 37845 | 2940 | 23604 | 415 | 112880 |
| CENTRAL-WESTMTNS | 409522 | 385090 | 2153 | 15469 | 221 | 59692 | 19119 | 2741 | 894007 |
| EASTINT-EASTCOAST | 71865 | 6550 | | 5541 | 40287 | 38273 | 230 | | 162745 |
| EASTLOWS-CENTFOOT | 57322 | 41289 | 5884 | 5342 | 5023 | 4216 | 69539 | | 188615 |
| SCST-SW INT | 37035 | 1693 | 737 | 13988 | 8911 | 427 | 11434 | | 74225 |
| **Grand Total** | **642216** | **1608826** | **27723** | **79545** | **96044** | **307196** | **151291** | **3157** | **2915997** |

**Geology X Section X Gap1, 2 & EcoReserves (Type 2)**

| Sum of Acres | Geology | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Section Name | **Acidic granitic** | **Acidic sed / metased** | **Calcareo us sed / metased** | **Coarse sediments** | **Fine sediments** | **Mafic/interme diate granitic** | **Mod calcareous sed / metased** | **Ultramafic** | **Grand Total** |
| ARHILLS-ARLOWS | 1531 | 12015 | 5601 | 674 | | 316 | 1233 | | 21369 |
| BP-STJUPS | 6417 | 74322 | | 12406 | | 14413 | 168 | | 107727 |
| CASCO-PENOB-CENTINT | 3925 | 10519 | 35 | 403 | 15319 | 548 | 3595 | 415 | 34759 |
| CENTRAL-WESTMTNS | 209757 | 84890 | 228 | 3897 | 15 | 8013 | 7636 | 1398 | 315834 |
| EASTINT-EASTCOAST | 51624 | 462 | | 389 | 19588 | 22214 | | | 94278 |
| EASTLOWS-CENTFOOT | 5098 | 6007 | 247 | 814 | 1413 | | 3364 | | 16942 |
| SCST-SW INT | 6154 | 219 | 144 | 2709 | 3833 | 215 | 2931 | | 16205 |
| **Grand Total** | **284507** | **188433** | **6255** | **21291** | **40168** | **45719** | **18927** | **1814** | **607113** |

### Landform X Section X All Conservation (Type 1)

| Sum of Acres | Landform | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section Name | Bottom of steep slope | Cliff | Cove/draw NW-facing | Cove/draw SE-facing | Dry flats | Flat summit / ridgetop | Low hill (gentle slope) | Low hilltop (flat) | Sideslope NW-facing | Sideslope SE-facing | Slope crest | Steep slope | Valley/toe slope | Wet flats | Grand Total |
| ARHILLS-ARLOWS | 68 | 26 | 56 | 78 | 40612 | 115 | 35817 | 45606 | 11725 | 8509 | 416 | 203 | 35206 | 51875 | 230311 |
| BP-STJUPS | 719 | 116 | 363 | 614 | 189731 | 1361 | 212107 | 223153 | 77182 | 76125 | 4004 | 1529 | 224756 | 241454 | 1253213 |
| CASCO-PENOB-CENTINT | 180 | 56 | 154 | 222 | 12432 | 145 | 16086 | 16332 | 8829 | 10038 | 302 | 373 | 13388 | 34343 | 112880 |
| CENTRAL-WESTMTNS | 3806 | 4126 | 7437 | 9603 | 52957 | 3133 | 112270 | 60740 | 182664 | 176544 | 20910 | 26608 | 129199 | 104011 | 894007 |
| EASTINT-EASTCOAST | 789 | 303 | 880 | 1233 | 15876 | 59 | 23798 | 22660 | 16784 | 14846 | 149 | 2347 | 21072 | 41949 | 162745 |
| EASTLOWS-CENTFOOT | 63 | | 39 | 39 | 25844 | 99 | 31550 | 34574 | 8381 | 8379 | 225 | 43 | 27417 | 51960 | 188615 |
| SCST-SW INT | 52 | 29 | 32 | 89 | 7178 | 86 | 9189 | 11524 | 5939 | 5473 | 356 | 312 | 8026 | 25939 | 74225 |
| **Grand Total** | **5676** | **4655** | **8962** | **11877** | **344631** | **4998** | **440817** | **414590** | **311504** | **299915** | **26363** | **31414** | **459065** | **551531** | **2915997** |

### Landform X Section X Gap 1, Gap 2 & EcoReserves (Type 2)

| Sum of Acres | Landform | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section Name | Bottom of steep slope | Cliff | Cove/draw NW-facing | Cove/draw SE-facing | Dry flats | Flat summit / ridgetop | Low hill (gentle slope) | Low hilltop (flat) | Sideslope NW-facing | Sideslope SE-facing | Slope crest | Steep slope | Valley/toe slope | Wet flats | Grand Total |
| ARHILLS-ARLOWS | 59 | 26 | 25 | 76 | 2640 | 18 | 2961 | 3007 | 2123 | 1472 | 150 | 113 | 3202 | 5498 | 21369 |
| BP-STJUPS | 155 | 61 | 81 | 176 | 18742 | 147 | 9818 | 22837 | 4597 | 4875 | 554 | 378 | 14185 | 31121 | 107727 |
| CASCO-PENOB-CENTINT | 72 | 22 | 102 | 94 | 2979 | 44 | 4234 | 4057 | 3337 | 3123 | 74 | 170 | 3417 | 13035 | 34759 |
| CENTRAL-WESTMTNS | 1894 | 3671 | 4787 | 5669 | 12675 | 1692 | 32445 | 13579 | 71972 | 72522 | 12888 | 20297 | 36393 | 25350 | 315834 |
| EASTINT-EASTCOAST | 709 | 298 | 801 | 1136 | 8248 | 56 | 13075 | 11032 | 11984 | 10973 | 144 | 2270 | 11040 | 22511 | 94278 |
| EASTLOWS-CENTFOOT | 4 | | 8 | 17 | 2101 | 29 | 1661 | 2893 | 974 | 1053 | 96 | 37 | 1423 | 6647 | 16942 |
| SCST-SW INT | 0 | 22 | 3 | 38 | 1368 | 12 | 1307 | 2473 | 623 | 1074 | 141 | 250 | 1041 | 7853 | 16205 |
| **Grand Total** | **2892** | **4101** | **5808** | **7206** | **48752** | **1998** | **65500** | **59877** | **95611** | **95093** | **14047** | **23515** | **70700** | **112015** | **607113** |

# Appendix 8.4: ELUs x Conserved Lands x Ecological Sections

**All Conservation Lands (Type 1)**

| Sum of Acres | Section Name | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Elu30** | **AHILLS-ARLOWS** | **BP-STJUPS** | **CASCO-PENOB-CENTINT** | **CENTRAL-WESTMTNS** | **EASTINT-EASTCOAST** | **EASTLOWS-CENTFOOT** | **SCST-SW INT** | **Grand Total** |
| 1104 | 12.01 | 2.00 | 121.43 | 35.36 | 0.22 | | | 171.02 |
| 1105 | | | 21.57 | 1.33 | | | | 22.91 |
| 1111 | 3.34 | | 34.69 | 0.67 | | | | 38.70 |
| 1113 | 1.11 | | 39.36 | 10.45 | | | | 50.93 |
| 1121 | 27262.45 | 745.91 | 1792.94 | 352.72 | 1248.52 | 8410.96 | 413.21 | 40226.72 |
| 1122 | 15918.11 | 1345.49 | 3288.33 | 437.23 | 1045.92 | 5260.74 | 117.87 | 27413.68 |
| 1123 | 3947.95 | 1493.16 | 2874.67 | 1068.83 | 257.09 | 865.34 | 8.23 | 10515.26 |
| 1124 | 2949.62 | 1220.95 | 3543.19 | 1269.65 | 216.39 | 942.51 | 11.34 | 10153.64 |
| 1130 | 27386.99 | 1192.26 | 1330.14 | 845.77 | 604.69 | 6197.69 | 202.38 | 37759.92 |
| 1131 | 36029.47 | 3540.30 | 3323.91 | 1819.63 | 2480.14 | 11498.02 | 903.59 | 59595.05 |
| 1132 | 19237.12 | 2615.36 | 3475.14 | 1237.40 | 690.09 | 5332.13 | 36.25 | 32623.49 |
| 1141 | 43.59 | 32.02 | 82.51 | 221.73 | 1.11 | 0.89 | | 381.85 |
| 1143 | 18.68 | 28.02 | 94.96 | 148.34 | 3.78 | 2.22 | | 296.01 |
| 1144 | 53.37 | 10.90 | 82.73 | 240.19 | 1.56 | | | 388.75 |
| 1304 | | | | 10.23 | | | | 10.23 |
| 1311 | | | 0.22 | 0.22 | | | | 0.44 |
| 1313 | | | 0.44 | 1.33 | | | | 1.78 |
| 1321 | 2764.36 | 1129.10 | 160.12 | 53.82 | | 961.63 | 31.36 | 5100.40 |
| 1322 | 1662.18 | 217.28 | 285.55 | 95.85 | | 279.77 | 49.59 | 2590.23 |
| 1323 | 172.58 | 0.22 | 96.07 | 137.44 | | 16.23 | 78.51 | 501.05 |
| 1324 | 109.86 | 4.00 | 257.98 | 98.74 | | 3.78 | 57.60 | 531.97 |
| 1330 | 2281.10 | 861.33 | 110.97 | 23.13 | | 786.39 | 17.35 | 4080.27 |
| 1331 | 3629.03 | 1631.04 | 177.69 | 37.81 | | 3609.02 | 39.36 | 9123.96 |
| 1332 | 1926.83 | 209.27 | 229.96 | 70.94 | | 226.84 | 40.25 | 2704.09 |
| 1341 | | | 0.89 | 13.34 | | | 0.22 | 14.46 |
| 1343 | | | | 16.68 | | | 0.67 | 17.35 |
| 1344 | | | 1.11 | 12.23 | | | 0.44 | 13.79 |
| 1404 | 0.89 | | 5.12 | 3.78 | | | 0.22 | 10.01 |
| 1405 | | | | | | | | |
| 1411 | | | 9.12 | 0.89 | | 2.89 | 2.89 | 15.79 |
| 1413 | | | 15.35 | 0.89 | | 6.45 | 10.90 | 33.58 |
| 1421 | 1052.59 | | 4850.20 | 66.05 | 53.37 | 14129.61 | 2200.59 | 22352.43 |
| 1422 | 677.64 | | 2510.39 | 130.32 | 24.69 | 10881.99 | 1628.15 | 15853.17 |
| 1423 | 243.52 | | 692.09 | 338.48 | 67.16 | 2579.33 | 1659.73 | 5580.32 |
| 1424 | 183.92 | | 964.97 | 242.19 | 6.23 | 1573.89 | 1028.35 | 3999.54 |
| 1430 | 1172.91 | | 3655.72 | 28.47 | 5.56 | 10483.90 | 255.09 | 15601.64 |
| 1431 | 1892.58 | | 7562.52 | 157.46 | 38.03 | 20202.54 | 2706.10 | 32559.22 |
| 1432 | 966.75 | | 1978.42 | 177.69 | 35.36 | 9132.63 | 773.27 | 13064.12 |
| 1441 | 16.23 | | 21.57 | 21.13 | | 29.36 | 6.89 | 95.18 |
| 1443 | 4.23 | | 10.23 | 19.79 | | 10.45 | 6.00 | 50.71 |
| 1444 | 12.23 | | 15.57 | 26.46 | | 5.78 | 1.33 | 61.38 |
| 1504 | | | 137.44 | 43.14 | 1867.00 | 26.46 | 27.35 | 2101.41 |
| 1505 | | | 30.02 | | 273.10 | | 6.23 | 309.35 |
| 1511 | | | 46.93 | 4.00 | 40.25 | 17.57 | 30.91 | 139.66 |
| 1513 | | | 127.65 | 5.34 | 90.51 | 18.01 | 62.94 | 304.46 |
| 1521 | 1.11 | 2.67 | 1981.98 | 2975.64 | 6668.94 | 9039.22 | 7200.24 | 27869.81 |
| 1522 | 16.46 | 2.22 | 3955.51 | 5955.72 | 9991.74 | 12106.93 | 6285.09 | 38313.68 |
| 1523 | 5.34 | | 2401.64 | 5381.06 | 12225.25 | 3206.71 | 2695.42 | 25915.41 |
| 1524 | 24.91 | | 2708.10 | 6730.77 | 10822.83 | 4001.10 | 3248.52 | 27536.22 |
| 1530 | 3.34 | 50.48 | 1528.07 | 2944.73 | 4018.45 | 5933.04 | 2605.13 | 17083.23 |
| 1531 | 14.46 | 49.59 | 3970.85 | 5489.36 | 11368.14 | 10434.08 | 8589.10 | 39915.59 |
| 1532 | 26.69 | 24.69 | 3249.63 | 7548.96 | 8489.24 | 9994.85 | 3703.54 | 33037.59 |
| 1541 | | | 59.38 | 257.53 | 735.46 | 32.25 | 41.59 | 1126.21 |
| 1543 | | | 28.91 | 168.13 | 814.63 | 22.68 | 19.79 | 1054.15 |
| 1544 | | | 85.84 | 244.86 | 1172.91 | 30.25 | 37.36 | 1571.22 |
| 1604 | 4.00 | | | 6.89 | 4.23 | | | 15.12 |
| 1611 | 7.12 | | 6.45 | 0.67 | 13.57 | 2.45 | 0.22 | 30.47 |
| 1613 | 6.89 | | 4.45 | 0.22 | 16.23 | 6.23 | 0.44 | 34.47 |
| 1621 | 1752.47 | 111.20 | 268.87 | 108.31 | 6752.79 | 517.07 | 93.18 | 9603.88 |
| 1622 | 1603.02 | 235.29 | 423.88 | 287.56 | 6303.10 | 1057.71 | 32.47 | 9943.04 |
| 1623 | 1125.09 | 62.49 | 521.07 | 311.57 | 2285.77 | 435.23 | 30.25 | 4771.47 |
| 1624 | 325.14 | 15.79 | 410.76 | 304.90 | 2193.25 | 378.52 | 4.89 | 3633.26 |
| 1630 | 2390.52 | 404.98 | 184.37 | 97.63 | 4632.03 | 417.21 | 67.39 | 8194.13 |
| 1644 | | | 1.11 | 21.79 | 22.02 | | | 44.92 |
| 1721 | | | 3.11 | | | | | 3.11 |
| 1722 | | | 26.02 | | | | | 26.02 |
| 1723 | | | 165.02 | | | | | 165.02 |
| 1724 | | | 67.39 | | | | | 67.39 |

**…Continued**

| Elu30 | AHILLS-ARLOWS | BP-STJUPS | CASCO-PENOB-CENTINT | CENTRAL-WESTMTNS | EASTINT-EASTCOAST | EASTLOWS-CENTFOOT | SCST-SW INT | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 1730 | | | 5.34 | | | | | 5.34 |
| 1731 | | | 26.69 | | | | | 26.69 |
| 1732 | | | 56.04 | | | | | 56.04 |
| 1741 | | | 0.22 | | | | | 0.22 |
| 1743 | | | 4.45 | | | | | 4.45 |
| 1744 | | | 0.22 | | | | | 0.22 |
| 1830 | 638.05 | 642.50 | 336.26 | 342.04 | 1191.81 | 1076.61 | 3088.39 | 7315.67 |
| 1831 | 1220.95 | 1662.62 | 961.86 | 720.78 | 3065.71 | 3256.52 | 8215.25 | 19103.69 |
| 1832 | 392.75 | 897.36 | 244.86 | 694.98 | 1283.44 | 1009.00 | 2684.75 | 7207.14 |
| 1921 | | 44.92 | 7007.65 | 2.00 | 7910.79 | 1261.20 | 1495.83 | 17722.40 |
| 1922 | | 20.02 | 4294.88 | 6.45 | 6241.28 | 288.00 | 633.60 | 11484.23 |
| 1923 | | 50.71 | 550.87 | 4.23 | 675.63 | 2.00 | 93.41 | 1376.84 |
| 1924 | | 13.34 | 478.59 | | 480.37 | 0.22 | 56.27 | 1028.80 |
| 1930 | | 147.00 | 5107.73 | 4.45 | 5419.31 | 873.79 | 921.16 | 12473.44 |
| 1931 | | 205.49 | 17243.36 | 20.91 | 14236.81 | 2368.50 | 5194.47 | 39269.53 |
| 1932 | | 149.23 | 3162.01 | 4.45 | 5322.35 | 229.51 | 516.40 | 9383.94 |
| 2104 | 34.69 | 493.72 | 81.40 | 1578.56 | | 2.22 | | 2190.59 |
| 2105 | 4.45 | 41.81 | 1.56 | 178.81 | | | | 226.62 |
| 2111 | 37.58 | 414.54 | 24.69 | 217.50 | | 2.22 | | 696.54 |
| 2113 | 83.62 | 990.99 | 59.16 | 1072.16 | | 19.35 | | 2225.28 |
| 2121 | 10988.51 | 182613.02 | 122.32 | 32278.12 | | 138.11 | | 226140.07 |
| 2122 | 12129.62 | 155894.76 | 694.54 | 39862.66 | | 1011.67 | | 209593.25 |
| 2123 | 3303.89 | 43837.51 | 940.73 | 32286.57 | | 558.88 | | 80927.58 |
| 2124 | 3249.18 | 40362.82 | 896.25 | 31375.42 | | 538.86 | | 76422.53 |
| 2130 | 5840.30 | 143130.88 | 10.67 | 25289.81 | | 51.60 | | 174323.26 |
| 2131 | 4940.49 | 168867.48 | 28.91 | 40100.84 | | 74.28 | | 214012.01 |
| 2132 | 6996.31 | 156170.09 | 136.77 | 43253.73 | | 381.63 | | 206938.53 |
| 2141 | | 418.55 | 2.00 | 766.37 | | | | 1186.92 |
| 2143 | | 200.16 | 12.90 | 1392.63 | | | | 1605.69 |
| 2144 | 3.78 | 282.22 | 25.58 | 1827.19 | | | | 2138.77 |
| 2304 | | | | 0.22 | | | 1.33 | 1.56 |
| 2305 | | | | | | | | |
| 2311 | 1.78 | | | 3.11 | | | 4.67 | 9.56 |
| 2313 | 0.22 | | | 4.89 | | | 4.45 | 9.56 |
| 2321 | 316.91 | | | 260.42 | | | 10.23 | 587.57 |
| 2322 | 363.62 | 0.89 | | 326.70 | | | 54.26 | 745.47 |
| 2323 | 33.80 | | | 212.61 | | | 202.16 | 448.57 |
| 2324 | 15.57 | | | 60.94 | | | 76.95 | 153.45 |
| 2330 | 86.51 | | | 272.43 | | | 2.67 | 361.61 |
| 2331 | 114.53 | | | 203.71 | | | 11.79 | 330.03 |
| 2332 | 96.96 | 0.44 | | 235.96 | | | 42.92 | 376.29 |
| 2341 | | | | | | | 3.11 | 3.11 |
| 2343 | | | | | | | 2.45 | 2.45 |
| 2344 | | | | | | | 4.23 | 4.23 |
| 2404 | | 2.22 | 3.11 | 92.96 | | | 2.22 | 100.52 |
| 2405 | | | | 6.00 | | | | 6.00 |
| 2411 | 1.11 | 37.36 | 6.23 | 16.68 | | 3.78 | 8.01 | 73.17 |
| 2413 | 1.11 | 71.61 | 10.01 | 66.94 | | 7.78 | 26.91 | 184.37 |
| 2421 | 331.15 | 2986.54 | 72.06 | 635.16 | | 59.16 | 61.83 | 4145.88 |
| 2422 | 597.80 | 3647.27 | 264.20 | 1289.22 | | 215.72 | 243.30 | 6257.51 |
| 2423 | 130.99 | 1013.01 | 131.88 | 1528.07 | | 73.61 | 425.66 | 3303.23 |
| 2424 | 117.20 | 1530.30 | 269.32 | 2436.78 | | 54.71 | 198.60 | 4606.90 |
| 2430 | 210.16 | 2611.80 | 112.53 | 625.15 | | 18.46 | 11.79 | 3589.89 |
| 2431 | 214.39 | 3591.89 | 175.91 | 1120.20 | | 19.35 | 64.94 | 5186.68 |
| 2432 | 366.28 | 3676.85 | 267.32 | 1884.57 | | 47.15 | 111.42 | 6353.59 |
| 2441 | | 1.33 | | 74.28 | | | | 75.61 |
| 2443 | | | | 80.51 | | | | 80.51 |
| 2444 | | 0.89 | | 187.48 | | | | 188.37 |
| 2504 | 65.83 | 344.49 | 21.35 | 2828.19 | 475.92 | 14.01 | 257.76 | 4007.55 |
| 2505 | 21.35 | 39.14 | 2.89 | 342.93 | 29.58 | | 22.91 | 458.80 |
| 2511 | 12.01 | 160.57 | 17.12 | 515.07 | 5.34 | 70.50 | 32.91 | 813.52 |
| 2513 | 110.97 | 578.00 | 45.81 | 1921.49 | 42.25 | 167.46 | 186.81 | 3052.81 |
| 2521 | 12.23 | 3025.23 | 68.94 | 16158.07 | 25.80 | 57.16 | 14.46 | 19361.89 |
| 2522 | 65.16 | 5636.59 | 320.69 | 36254.75 | 190.81 | 447.90 | 124.32 | 43040.23 |
| 2523 | 762.37 | 5743.78 | 408.54 | 46562.96 | 1272.76 | 643.39 | 673.63 | 56067.43 |
| 2524 | 317.80 | 7139.98 | 416.32 | 50317.42 | 1126.65 | 885.57 | 725.23 | 60928.98 |
| 2530 | 15.12 | 3283.65 | 50.48 | 13033.87 | 4.45 | 5.56 | 7.12 | 16400.26 |
| 2531 | 43.81 | 5528.95 | 132.99 | 30773.39 | 21.57 | 35.36 | 38.47 | 36574.55 |
| 2532 | 82.95 | 8578.65 | 254.42 | 39333.58 | 18.68 | 124.32 | 92.52 | 48485.11 |
| 2541 | 4.45 | 163.24 | 7.78 | 1186.03 | 4.89 | 0.89 | 0.22 | 1367.50 |
| 2543 | 4.45 | 85.18 | | 1408.65 | 31.36 | 3.56 | 3.34 | 1536.52 |
| 2544 | 8.67 | 222.39 | 9.79 | 1983.98 | 36.25 | 2.67 | 45.15 | 2308.90 |
| 2604 | 86.07 | 259.09 | | 219.73 | | | | 564.88 |
| 2605 | | 17.12 | | 11.34 | | | | 28.47 |
| 2611 | 51.60 | 374.96 | | 56.04 | | | | 482.60 |
| 2613 | 211.72 | 1108.64 | | 186.81 | | | | 1507.17 |

**…Continued**

| Elu30 | AHILLS-ARLOWS | BP-STJUPS | CASCO-PENOB-CENTINT | CENTRAL-WESTMTNS | EASTINT-EASTCOAST | EASTLOWS-CENTFOOT | SCST-SW INT | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 2621 | 1124.20 | 22720.49 | 4.00 | 3543.63 | | | | 27392.33 |
| 2622 | 2783.04 | 25931.87 | 20.68 | 5302.33 | | | | 34037.92 |
| 2623 | 1999.77 | 16866.40 | | 8345.80 | | | | 27211.97 |
| 2624 | 1215.83 | 17915.43 | 14.90 | 6791.26 | | | | 25937.43 |
| 2630 | 586.01 | 22827.02 | | 3161.56 | | | | 26574.59 |
| 2631 | 610.92 | 32195.38 | | 6423.20 | | | | 39229.50 |
| 2632 | 2087.84 | 34594.13 | | 7450.66 | | | | 44132.63 |
| 2641 | 1.78 | 78.51 | | 164.35 | | | | 244.63 |
| 2643 | 1.33 | 34.25 | | 165.46 | | | | 201.04 |
| 2644 | | 70.05 | | 227.29 | | | | 297.34 |
| 2704 | | | 2.67 | | | | | 2.67 |
| 2705 | | | | | | | | |
| 2711 | | | | | | | | |
| 2713 | | | | | | | | |
| 2721 | | | | 80.28 | | | | 80.28 |
| 2722 | | | 1.78 | 191.26 | | | | 193.04 |
| 2723 | | | 46.04 | 104.30 | | | | 150.34 |
| 2724 | | | 10.23 | 48.70 | | | | 58.93 |
| 2730 | | | | 67.61 | | | | 67.61 |
| 2731 | | | | 104.97 | | | | 104.97 |
| 2732 | | | | 244.19 | | | | 244.19 |
| 2741 | | | | | | | | |
| 2743 | | | | | | | | |
| 2744 | | | | | | | | |
| 2830 | 0.67 | 9294.53 | | 3203.37 | | | | 12498.57 |
| 2831 | 0.22 | 16517.46 | | 6120.52 | | | | 22638.20 |
| 2832 | 4.67 | 6390.06 | | 4040.24 | | | | 10434.97 |
| 2921 | | 412.10 | | 31.80 | | | | 443.90 |
| 2922 | | 188.59 | | 7.12 | | | | 195.71 |
| 2923 | | 23.57 | | | | | | 23.57 |
| 2924 | | 7.78 | | 0.22 | | | | 8.01 |
| 2930 | | 422.99 | | 12.68 | | | | 435.67 |
| 2931 | | 1818.30 | | 124.10 | | | | 1942.39 |
| 2932 | | 252.64 | | 2.67 | | | | 255.31 |
| 3104 | | 113.64 | | 3465.13 | | | | 3578.77 |
| 3105 | | 15.57 | | 382.52 | | | | 398.09 |
| 3111 | | 250.64 | | 637.16 | | | | 887.80 |
| 3113 | | 643.16 | | 3699.75 | | | | 4342.92 |
| 3121 | | 9347.24 | | 1882.79 | | | | 11230.03 |
| 3122 | | 18885.96 | | 9621.45 | | | | 28507.42 |
| 3123 | | 7257.62 | | 28846.57 | | | | 36104.19 |
| 3124 | | 7430.42 | | 25164.38 | | | | 32594.81 |
| 3130 | | 4859.54 | | 1240.74 | | | | 6100.28 |
| 3131 | | 5166.00 | | 4972.52 | | | | 10138.52 |
| 3132 | | 10627.57 | | 11443.31 | | | | 22070.87 |
| 3141 | | 23.57 | | 260.42 | | | | 284.00 |
| 3143 | | 3.11 | | 1019.01 | | | | 1022.13 |
| 3144 | | 15.57 | | 1273.21 | | | | 1288.78 |
| 3304 | | | | | | | | |
| 3311 | | | | | | | | |
| 3313 | | | | | | | | |
| 3321 | | | | | | | | |
| 3322 | | | | | | | | |
| 3323 | | | | | | | | |
| 3324 | | | | | | | | |
| 3330 | | | | | | | | |
| 3331 | | | | | | | | |
| 3332 | | | | | | | | |
| 3341 | | | | | | | | |
| 3344 | | | | | | | | |
| 3404 | | | | 384.96 | | | | 384.96 |
| 3405 | | | | 50.04 | | | | 50.04 |
| 3411 | | | | 27.35 | | | | 27.35 |
| 3413 | | | | 140.11 | | | | 140.11 |
| 3421 | | | | 25.80 | | | | 25.80 |
| 3422 | | | | 211.05 | | | | 211.05 |
| 3423 | | | | 898.92 | | | | 898.92 |
| 3424 | | | | 1937.28 | | | | 1937.28 |
| 3430 | | | | 9.34 | | | | 9.34 |
| 3431 | | | | 128.77 | | | | 128.77 |
| 3432 | | | | 231.29 | | | | 231.29 |
| 3441 | | | | 21.57 | | | | 21.57 |
| 3443 | | | | 56.71 | | | | 56.71 |
| 3444 | | | | 365.84 | | | | 365.84 |
| 3504 | | 306.90 | | 5934.15 | | | 22.68 | 6263.74 |
| 3505 | | 1.56 | | 919.60 | | | | 921.16 |

**…Continued**

| Elu30 | AHILLS-ARLOWS | BP-STJUPS | CASCO-PENOB-CENTINT | CENTRAL-WESTMTNS | EASTINT-EASTCOAST | EASTLOWS-CENTFOOT | SCST-SW INT | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 3511 | | 100.74 | | 438.56 | | | 6.45 | 545.76 |
| 3513 | | 473.48 | | 3199.59 | | | 64.05 | 3737.12 |
| 3521 | | 10.90 | | 1502.72 | | | 3.56 | 1517.18 |
| 3522 | | 83.18 | | 7855.86 | | | 20.46 | 7959.50 |
| 3523 | | 628.26 | | 26103.33 | | | 72.28 | 26803.87 |
| 3524 | | 459.69 | | 24152.93 | | | 65.38 | 24678.01 |
| 3530 | | 1.78 | | 959.63 | | | | 961.41 |
| 3531 | | 5.12 | | 3356.82 | | | 0.67 | 3362.60 |
| 3532 | | 26.46 | | 6378.27 | | | 1.33 | 6406.07 |
| 3541 | | 1.33 | | 541.53 | | | | 542.86 |
| 3543 | | 12.45 | | 1567.21 | | | | 1579.67 |
| 3544 | | 12.45 | | 1624.59 | | | | 1637.05 |
| 3604 | | 6.45 | | 430.11 | | | | 436.56 |
| 3605 | | 0.44 | | 9.79 | | | | 10.23 |
| 3611 | | 21.79 | | 87.62 | | | | 109.42 |
| 3613 | | 138.33 | | 509.06 | | | | 647.39 |
| 3621 | | 3.56 | | 170.58 | | | | 174.13 |
| 3622 | | 17.12 | | 1146.44 | | | | 1163.57 |
| 3623 | | 205.05 | | 5490.92 | | | | 5695.97 |
| 3624 | | 24.91 | | 3885.90 | | | | 3910.81 |
| 3630 | | | | 154.34 | | | | 154.34 |
| 3631 | | | | 502.83 | | | | 502.83 |
| 3632 | | 2.89 | | 1377.51 | | | | 1380.40 |
| 3641 | | | | 21.35 | | | | 21.35 |
| 3643 | | | | 44.48 | | | | 44.48 |
| 3644 | | | | 118.98 | | | | 118.98 |
| 3704 | | | | 11.56 | | | | 11.56 |
| 3705 | | | | | | | | |
| 3711 | | | | 2.67 | | | | 2.67 |
| 3713 | | | | 6.45 | | | | 6.45 |
| 3721 | | | | 2.00 | | | | 2.00 |
| 3722 | | | | 8.45 | | | | 8.45 |
| 3723 | | | | 368.95 | | | | 368.95 |
| 3724 | | | | 66.27 | | | | 66.27 |
| 3730 | | | | | | | | |
| 3731 | | | | 4.45 | | | | 4.45 |
| 3732 | | | | 8.01 | | | | 8.01 |
| 3741 | | | | 13.12 | | | | 13.12 |
| 3743 | | | | 37.36 | | | | 37.36 |
| 3744 | | | | 20.24 | | | | 20.24 |
| 3830 | | | | 72.28 | | | | 72.28 |
| 3831 | | | | 104.08 | | | | 104.08 |
| 3832 | | | | 170.58 | | | | 170.58 |
| 4104 | | | | 3534.96 | | | | 3534.96 |
| 4105 | | | | 349.60 | | | | 349.60 |
| 4111 | | | | 515.29 | | | | 515.29 |
| 4113 | | | | 4244.40 | | | | 4244.40 |
| 4121 | | | | 284.22 | | | | 284.22 |
| 4122 | | | | 1604.35 | | | | 1604.35 |
| 4123 | | | | 9833.40 | | | | 9833.40 |
| 4124 | | | | 8791.92 | | | | 8791.92 |
| 4130 | | | | 119.65 | | | | 119.65 |
| 4131 | | | | 477.70 | | | | 477.70 |
| 4132 | | | | 1488.71 | | | | 1488.71 |
| 4141 | | | | 42.03 | | | | 42.03 |
| 4143 | | | | 286.67 | | | | 286.67 |
| 4144 | | | | 403.65 | | | | 403.65 |
| 4304 | | | | | | | | |
| 4311 | | | | | | | | |
| 4313 | | | | | | | | |
| 4321 | | | | | | | | |
| 4322 | | | | | | | | |
| 4323 | | | | | | | | |
| 4324 | | | | | | | | |
| 4330 | | | | | | | | |
| 4331 | | | | | | | | |
| 4332 | | | | | | | | |
| 4404 | | | | 839.09 | | | | 839.09 |
| 4405 | | | | 155.23 | | | | 155.23 |
| 4411 | | | | 41.37 | | | | 41.37 |
| 4413 | | | | 436.34 | | | | 436.34 |
| 4421 | | | | 18.68 | | | | 18.68 |
| 4422 | | | | 137.00 | | | | 137.00 |
| 4423 | | | | 536.64 | | | | 536.64 |
| 4424 | | | | 958.97 | | | | 958.97 |
| 4430 | | | | 1.33 | | | | 1.33 |

**…Continued**

| Elu30 | AHILLS-ARLOWS | BP-STJUPS | CASCO-PENOB-CENTINT | CENTRAL-WESTMTNS | EASTINT-EASTCOAST | EASTLOWS-CENTFOOT | SCST-SW INT | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 4431 | | | | 58.27 | | | | 58.27 |
| 4432 | | | | 46.04 | | | | 46.04 |
| 4441 | | | | 2.45 | | | | 2.45 |
| 4443 | | | | 49.82 | | | | 49.82 |
| 4444 | | | | 90.96 | | | | 90.96 |
| 4504 | | | | 6270.86 | | | | 6270.86 |
| 4505 | | | | 1131.99 | | | | 1131.99 |
| 4511 | | | | 448.57 | | | | 448.57 |
| 4513 | | | | 4565.76 | | | | 4565.76 |
| 4521 | | | | 290.00 | | | | 290.00 |
| 4522 | | | | 1350.16 | | | | 1350.16 |
| 4523 | | | | 12436.97 | | | | 12436.97 |
| 4524 | | | | 10840.18 | | | | 10840.18 |
| 4530 | | | | 442.57 | | | | 442.57 |
| 4531 | | | | 898.47 | | | | 898.47 |
| 4532 | | | | 1486.04 | | | | 1486.04 |
| 4541 | | | | 151.45 | | | | 151.45 |
| 4543 | | | | 867.34 | | | | 867.34 |
| 4544 | | | | 894.92 | | | | 894.92 |
| 4604 | | | | 261.31 | | | | 261.31 |
| 4605 | | | | 5.56 | | | | 5.56 |
| 4611 | | | | 34.25 | | | | 34.25 |
| 4613 | | | | 231.51 | | | | 231.51 |
| 4621 | | | | 6.23 | | | | 6.23 |
| 4622 | | | | 41.14 | | | | 41.14 |
| 4623 | | | | 489.94 | | | | 489.94 |
| 4624 | | | | 723.89 | | | | 723.89 |
| 4630 | | | | 3.78 | | | | 3.78 |
| 4631 | | | | 8.90 | | | | 8.90 |
| 4632 | | | | 39.14 | | | | 39.14 |
| 4641 | | | | 2.67 | | | | 2.67 |
| 4643 | | | | 25.58 | | | | 25.58 |
| 4644 | | | | 9.79 | | | | 9.79 |
| 4704 | | | | 165.91 | | | | 165.91 |
| 4705 | | | | 74.72 | | | | 74.72 |
| 4711 | | | | 3.34 | | | | 3.34 |
| 4713 | | | | 143.22 | | | | 143.22 |
| 4721 | | | | 8.45 | | | | 8.45 |
| 4722 | | | | 33.36 | | | | 33.36 |
| 4723 | | | | 468.81 | | | | 468.81 |
| 4724 | | | | 264.65 | | | | 264.65 |
| 4730 | | | | 1.11 | | | | 1.11 |
| 4731 | | | | 10.01 | | | | 10.01 |
| 4732 | | | | 27.35 | | | | 27.35 |
| 4741 | | | | 12.68 | | | | 12.68 |
| 4743 | | | | 36.03 | | | | 36.03 |
| 4744 | | | | 28.69 | | | | 28.69 |
| 5104 | | | | 6.23 | | | | 6.23 |
| 5105 | | | | 0.22 | | | | 0.22 |
| 5111 | | | | 1.56 | | | | 1.56 |
| 5113 | | | | 26.91 | | | | 26.91 |
| 5504 | | | | 483.04 | | | | 483.04 |
| 5505 | | | | 505.95 | | | | 505.95 |
| 5511 | | | | 75.17 | | | | 75.17 |
| 5513 | | | | 386.52 | | | | 386.52 |
| 5521 | | | | 2.22 | | | | 2.22 |
| 5522 | | | | 113.87 | | | | 113.87 |
| 5523 | | | | 893.80 | | | | 893.80 |
| 5524 | | | | 78.28 | | | | 78.28 |
| 5531 | | | | 0.67 | | | | 0.67 |
| 5532 | | | | 1.11 | | | | 1.11 |
| 5543 | | | | 1.56 | | | | 1.56 |
| 5544 | | | | 0.22 | | | | 0.22 |
| 5704 | | | | 1.11 | | | | 1.11 |
| 5711 | | | | 5.12 | | | | 5.12 |
| 5713 | | | | 49.59 | | | | 49.59 |
| 5723 | | | | 14.01 | | | | 14.01 |
| 5724 | | | | 2.45 | | | | 2.45 |
| Grand | **230311.30** | **1253213.25** | **112880.11** | **894007.21** | **162745.18** | **188614.78** | **74225.05** | **2915996.88** |

# Appendix 8.5: ELU Groups x Conserved Lands x Ecological Sections

## All Conserved Lands (Type 1)

| ELU Group | ARHILLS-ARLOWS | | | | BP-JTJUPS | | | | CASCO-PENOB-CENTINT | | | | CENTRAL-WESTMTNS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | |
| | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation |
| Agriculture | 294880.0 | 12.0 | 0.4 | 0.5 | 7483.1 | 0.2 | 7.0 | 0.0 | 406372.6 | 9.7 | 1.0 | 3.5 | 71955.7 | 1.6 | 1.3 | 0.1 |
| Alpine | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | 6461.9 | 0.1 | 68.7 | 0.5 |
| Bare_rock-cliff | 284.2 | 0.0 | 15.1 | 0.0 | 383.6 | 0.0 | 47.1 | 0.0 | 1141.1 | 0.0 | 6.9 | 0.1 | 4006.7 | 0.1 | 51.1 | 0.2 |
| Calc bare rock | 233.7 | 0.0 | 2.7 | 0.0 | 240.9 | 0.0 | 31.1 | 0.0 | 592.0 | 0.0 | 1.7 | 0.0 | 3261.0 | 0.1 | 28.7 | 0.1 |
| Calcarous wetland | 99674.5 | 4.1 | 4.5 | 1.9 | 8402.8 | 0.2 | 35.7 | 0.2 | 126814.7 | 3.0 | 4.2 | 4.7 | 25808.9 | 0.6 | 3.7 | 0.1 |
| Coarse sed | 18347.8 | 0.7 | 5.5 | 0.4 | 44960.0 | 1.2 | 38.9 | 1.4 | 47164.9 | 1.1 | 1.2 | 0.5 | 54404.7 | 1.2 | 15.2 | 0.9 |
| Conifer swamp | 142854.3 | 5.8 | 14.1 | 8.7 | 311751.5 | 8.4 | 40.2 | 10.0 | 179310.0 | 4.3 | 4.0 | 6.3 | 168833.4 | 3.8 | 21.8 | 4.1 |
| Developed | 34577.8 | 1.4 | 1.9 | 0.3 | 1644.6 | 0.0 | 18.4 | 0.0 | 163265.1 | 3.9 | 1.1 | 1.6 | 15569.4 | 0.3 | 2.9 | 0.1 |
| Emergent wetland | 8876.9 | 0.4 | 12.3 | 0.5 | 12284.2 | 0.3 | 32.7 | 0.3 | 38014.2 | 0.9 | 5.3 | 1.8 | 14284.9 | 0.3 | 16.7 | 0.3 |
| Enriched coves | 6230.4 | 0.3 | 2.7 | 0.1 | 2931.2 | 0.1 | 21.0 | 0.0 | 9207.8 | 0.2 | 4.2 | 0.3 | 31044.1 | 0.7 | 23.9 | 0.8 |
| Forested swamp | 228224.6 | 9.3 | 10.4 | 10.3 | 291650.8 | 7.9 | 33.6 | 7.8 | 322136.3 | 7.7 | 4.9 | 14.1 | 285887.0 | 6.4 | 19.5 | 6.2 |
| High-elev matrix | 537.1 | 0.0 | 0.0 | 0.0 | 15960.4 | 0.4 | 44.6 | 0.6 | | 0.0 | | 0.0 | 302907.8 | 6.8 | 25.9 | 8.8 |
| Low alpine | 6.0 | 0.0 | 0.0 | 0.0 | 485.0 | 0.0 | 35.9 | 0.0 | | 0.0 | | 0.0 | 211756.7 | 4.7 | 37.1 | 8.8 |
| Low crest-ridge | 6577.1 | 0.3 | 15.9 | 0.5 | 13944.4 | 0.4 | 27.0 | 0.3 | 12997.0 | 0.3 | 3.9 | 0.4 | 21234.3 | 0.5 | 19.4 | 0.5 |

| ELU Group | EASTINT-EASTCOAST | | | | EASTLOWS-CENTFOOT | | | | SCST-SW INT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | |
| | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation |
| Agriculture | 9040.4 | 0.5 | 4.1 | 0.2 | 76350.4 | 2.3 | 0.9 | 0.4 | 115105.4 | 7.9 | 1.4 | 2.2 |
| Alpine | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 |
| Bare_rock-cliff | 1002.1 | 0.1 | 48.8 | 0.3 | 86.7 | 0.0 | 5.9 | 0.0 | 621.6 | 0.0 | 8.7 | 0.1 |
| Calc bare rock | 14.5 | 0.0 | 3.1 | 0.0 | 139.2 | 0.0 | 3.2 | 0.0 | 598.5 | 0.0 | 4.9 | 0.0 |
| Calcarous wetland | 5819.9 | 0.3 | 0.4 | 0.0 | 209028.2 | 6.4 | 6.8 | 7.5 | 24448.3 | 1.7 | 8.6 | 2.8 |
| Coarse sed | 39985.1 | 2.3 | 6.3 | 1.5 | 37380.8 | 1.1 | 5.8 | 1.1 | 76460.1 | 5.2 | 7.6 | 7.8 |
| Conifer swamp | 91896.3 | 5.3 | 9.9 | 5.6 | 228843.1 | 7.0 | 7.7 | 9.3 | 71401.7 | 4.9 | 6.4 | 6.1 |
| Developed | 13755.1 | 0.8 | 3.8 | 0.3 | 19094.2 | 0.6 | 1.7 | 0.2 | 103944.8 | 7.1 | 1.6 | 2.2 |
| Emergent wetland | 22024.7 | 1.3 | 11.1 | 1.5 | 13734.2 | 0.4 | 6.3 | 0.5 | 20221.0 | 1.4 | 13.4 | 3.7 |
| Enriched coves | 1036.8 | 0.1 | 67.0 | 0.4 | 3675.5 | 0.1 | 0.6 | 0.0 | 3058.2 | 0.2 | 7.1 | 0.3 |
| Forested swamp | 207969.1 | 11.9 | 12.3 | 15.7 | 256925.2 | 7.9 | 5.8 | 7.9 | 170158.2 | 11.6 | 8.3 | 19.0 |
| High-elev matrix | | 0.0 | | 0.0 | | 0.0 | | 0.0 | 237.3 | 0.0 | 48.2 | 0.2 |
| Low alpine | | 0.0 | | 0.0 | | 0.0 | | 0.0 | 9.6 | 0.0 | 58.1 | 0.0 |
| Low crest-ridge | 14707.0 | 0.8 | 12.4 | 1.1 | 5852.3 | 0.2 | 7.7 | 0.2 | 3877.9 | 0.3 | 9.4 | 0.5 |

## …Continued

| | ARHILLS-ARLOWS | | | | BP-JTJUPS | | | | CASCO-PENOB-CENTINT | | | | CENTRAL-WESTMTNS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | |
| **ELU Group** | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation |
| Low to midtransiti | 23.1 | 0.0 | 0.0 | 0.0 | 31113.5 | 0.8 | 61.0 | 1.5 | | 0.0 | | 0.0 | 106010.8 | 2.4 | 17.8 | 2.1 |
| Low-elev cool | 129559.5 | 5.3 | 9.0 | 5.1 | 714856.5 | 19.3 | 31.6 | 18.0 | 7342.6 | 0.2 | 18.4 | 1.2 | 613255.1 | 13.7 | 21.3 | 14.6 |
| Low-elev matrix | 1311452.2 | 53.5 | 11.6 | 66.4 | 1692159.7 | 45.8 | 36.3 | 49.0 | 2097178.6 | 50.3 | 2.9 | 53.9 | 1339494.9 | 30.0 | 19.4 | 29.1 |
| Low-elev warm | 30131.9 | 1.2 | 11.9 | 1.6 | 12899.8 | 0.3 | 14.5 | 0.1 | 183255.9 | 4.4 | 4.3 | 6.9 | 83614.5 | 1.9 | 13.8 | 1.3 |
| Mid-elev cool | 24.9 | 0.0 | 0.0 | 0.0 | 27612.3 | 0.7 | 62.3 | 1.4 | | 0.0 | | 0.0 | 241563.9 | 5.4 | 20.0 | 5.4 |
| Mid-elev matrix | 10080.7 | 0.4 | 11.4 | 0.5 | 76320.4 | 2.1 | 45.9 | 2.8 | 141.0 | 0.0 | 26.7 | 0.0 | 201682.0 | 4.5 | 18.4 | 4.2 |
| Mid-elev warm | 48367.6 | 2.0 | 10.1 | 2.1 | 264057.4 | 7.1 | 25.5 | 5.4 | 6702.5 | 0.2 | 21.0 | 1.2 | 422085.2 | 9.4 | 22.9 | 10.8 |
| Serpentine hillcre | 5.3 | 0.0 | 0.0 | 0.0 | | 0.0 | | 0.0 | 8.5 | 0.0 | 10.5 | 0.0 | 871.6 | 0.0 | 3.7 | 0.0 |
| Shrub swamp | 268.7 | 0.0 | 12.7 | 0.0 | 3501.6 | 0.1 | 28.9 | 0.1 | 1229.0 | 0.0 | 2.3 | 0.0 | 882.7 | 0.0 | 15.1 | 0.0 |
| Subalpine wetland | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | 478.1 | 0.0 | 45.1 | 0.0 |
| Water | 82022.2 | 3.3 | 3.3 | 1.2 | 161571.5 | 4.4 | 7.0 | 0.9 | 567456.2 | 13.6 | 0.7 | 3.4 | 241981.6 | 5.4 | 3.6 | 1.0 |
| **Grand Total** | **2453240.6** | **100.0** | | **100.0** | **3696215.4** | **100.0** | | **100.0** | **4170329.9** | **100.0** | | **100.0** | **4469336.9** | **100.0** | | **100.0** |

| | EASTINT-EASTCOAST | | | | EASTLOWS-CENTFOOT | | | | SCST-SW INT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | | Region-wide Figures | | Conserved Figures | |
| **ELU Group** | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation | Acres | % of Total Area | % in Conservation | % of Total in Conservation |
| Low to midtransiti | | 0.0 | | 0.0 | | 0.0 | | 0.0 | 26.0 | 0.0 | 79.5 | 0.0 |
| Low-elev cool | 2449.5 | 0.1 | 57.2 | 0.9 | 20652.7 | 0.6 | 4.9 | 0.5 | 11800.5 | 0.8 | 7.9 | 1.3 |
| Low-elev matrix | 941200.8 | 54.0 | 10.2 | 58.7 | 2035440.4 | 62.4 | 6.0 | 65.0 | 684879.4 | 46.9 | 4.8 | 44.3 |
| Low-elev warm | 70541.5 | 4.0 | 21.0 | 9.1 | 96685.3 | 3.0 | 7.1 | 3.7 | 75910.1 | 5.2 | 6.0 | 6.1 |
| Mid-elev cool | | 0.0 | | 0.0 | | 0.0 | | 0.0 | 54.0 | 0.0 | 78.2 | 0.1 |
| Mid-elev matrix | 1.3 | 0.0 | 0.0 | 0.0 | 1144.0 | 0.0 | 1.0 | 0.0 | 262.0 | 0.0 | 27.5 | 0.1 |
| Mid-elev warm | 2047.1 | 0.1 | 53.9 | 0.7 | 15308.3 | 0.5 | 9.7 | 0.8 | 13680.4 | 0.9 | 6.8 | 1.2 |
| Serpentine hillcre | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 |
| Shrub swamp | 4865.3 | 0.3 | 3.9 | 0.1 | 415.2 | 0.0 | 4.9 | 0.0 | 93.6 | 0.0 | 7.1 | 0.0 |
| Subalpine wetland | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 |
| Water | 314858.8 | 18.1 | 2.0 | 3.8 | 241556.3 | 7.4 | 2.2 | 2.9 | 84833.7 | 5.8 | 1.7 | 1.9 |
| **Grand Total** | **1743215.2** | **100.0** | | **100.0** | **3262312.3** | **100.0** | | **100.0** | **1461682.2** | **100.0** | | **100.0** |

## Appendix 8.6: ELUs and Predicted Natural Community Types

(Sample; pp. 1-3 of 61)

| Landform, Substrate | | Elevation | | | | |
|---|---|---|---|---|---|---|
| | | 1000 | 2000 | 3000 | 4000 | 5000 |
| **Description** | **Code** | **0-800'** | **800-1700'** | **1700-2500'** | **2500-4000'** | **>4000'** |
| | | | | | | |
| Steep Slope: Acidic Sed/metased | 104 | Acidic Cliff Gorge | Acidic Cliff Gorge | Acidic Cliff Gorge | Bilberry - Mountain-Heath Alpine Snowbank | Bilberry - Mountain-Heath Alpine Snowbank |
| | | Aspen-Birch Woodland/Forest Complex | Aspen-Birch Woodland/Forest Complex | Aspen-Birch Woodland/Forest Complex | Dwarf Heath - Graminoid Alpine Ridge | Diapensia Alpine Ridge |
| | | Beech - Birch - Maple Forest | Beech - Birch - Maple Forest | Beech - Birch - Maple Forest | Fir - Heartleaved Birch - Subalpine Forest | Dwarf Heath - Graminoid Alpine Ridge |
| | | Birch - Oak Talus Woodland | Birch - Oak Talus Woodland | Labrador Tea Talus Dwarf-Shrubland | Heath - Lichen Subalpine Slope Bog | Fir - Heartleaved Birch - Subalpine Forest |
| | | Black Spruce Woodland | Black Spruce Woodland | Rock Outcrop Ecosystem | Labrador Tea Talus Dwarf-Shrubland | Heath - Lichen Subalpine Slope Bog |
| | | Chestnut Oak Woodland | Chestnut Oak Woodland | Spruce - Fir - Broom-moss Forest | Rock Outcrop Ecosystem | Labrador Tea Talus Dwarf-Shrubland |
| | | Coastal Headland Ecosystem | Hemlock Forest | Spruce - Fir - Northern Hardwoods Forest | Spruce - Fir - Birch Krummholz | Spruce - Fir - Birch Krummholz |
| | | Crowberry - Bayberry Headland | Labrador Tea Talus Dwarf-Shrubland | Spruce - Fir - Wood Sorrel - Feather-Moss Forest | Spruce - Fir - Northern Hardwoods Forest | Subalpine Heath - Krummholz |
| | | Hemlock Forest | Red Oak - Northern Hardwoods - White Pine Forest | Spruce - Northern Hardwoods Forest | Spruce Talus Woodland | |
| | | Red Oak - Northern Hardwoods - White Pine Forest | Rock Outcrop Ecosystem | Spruce Talus Woodland | Subalpine Heath - Krummholz | |
| | | Seaside Goldenrod - Goosetongue Open Headland | Spruce - Fir - Broom-moss Forest | Subalpine Heath - Krummholz | | |
| | | Spruce - Fir - Broom-moss Forest | Spruce - Fir - Northern Hardwoods Forest | Three-toothed Cinquefoil - Blueberry Low Summit Bald | | |
| | | Spruce - Fir - Northern Hardwoods Forest | Spruce - Fir - Wood Sorrel - Feather-Moss Forest | | | |
| | | Spruce - Fir - Wood Sorrel - Feather-Moss Forest | Spruce - Northern Hardwoods Forest | | | |

**…Continued**

| Landform, Substrate | | Elevation | | | | |
|---|---|---|---|---|---|---|
| | | 1000 | 2000 | 3000 | 4000 | 5000 |
| **Description** | **Code** | **0-800'** | **800-1700'** | **1700-2500'** | **2500-4000'** | **>4000'** |
| | | | | | | |
| | | Spruce - Northern Hardwoods Forest | Spruce Talus Woodland | | | |
| | | White Oak - Red Oak Forest | Three-toothed Cinquefoil - Blueberry Low Summit Bald | | | |
| | | | | | | |
| Cliff: Acidic Sed/metased | 105 | Acidic Cliff Gorge | Acidic Cliff Gorge | Acidic Cliff Gorge | Rock Outcrop Ecosystem | |
| | | Coastal Headland Ecosystem | Pitch Pine Woodland | Rock Outcrop Ecosystem | Spruce Talus Woodland | |
| | | Pitch Pine Woodland | Rock Outcrop Ecosystem | Spruce Talus Woodland | | |
| | | Seaside Goldenrod - Goosetongue Open Headland | Spruce Talus Woodland | | | |
| | | | | | | |
| Flat Summit/Ridgetop: Acidic Sed/metased | 111 | Aspen-Birch Woodland/Forest Complex | Aspen-Birch Woodland/Forest Complex | Aspen-Birch Woodland/Forest Complex | Crowberry - Bilberry Summit Bald | Crowberry - Bilberry Summit Bald |
| | | Beech - Birch - Maple Forest | Beech - Birch - Maple Forest | Beech - Birch - Maple Forest | Dwarf Heath - Graminoid Alpine Ridge | Diapensia Alpine Ridge |
| | | Black Spruce Woodland | Black Spruce Woodland | Crowberry - Bilberry Summit Bald | Fir - Heartleaved Birch - Subalpine Forest | Dwarf Heath - Graminoid Alpine Ridge |
| | | Chestnut Oak Woodland | Chestnut Oak Woodland | Red Pine Woodland | Rock Outcrop Ecosystem | Fir - Heartleaved Birch - Subalpine Forest |
| | | Crowberry - Bilberry Summit Bald | Crowberry - Bilberry Summit Bald | Red Spruce - Mixed Conifer Woodland | Spruce - Fir - Northern Hardwoods Forest | Subalpine Heath - Krummholz |
| | | Jack Pine Woodland | Oak - Pine Forest | Rock Outcrop Ecosystem | Subalpine Heath - Krummholz | |
| | | Oak - Pine Forest | Oak - Pine Woodland | Spruce - Fir - Northern Hardwoods Forest | | |
| | | Oak - Pine Woodland | Pitch Pine Woodland | Spruce - Heath Barren | | |
| | | Pitch Pine Woodland | Red Pine - White Pine Forest | Spruce - Northern Hardwoods Forest | | |

## …Continued

| Landform, Substrate | | Elevation | | | | |
|---|---|---|---|---|---|---|
| | | 1000 | 2000 | 3000 | 4000 | 5000 |
| **Description** | **Code** | **0-800'** | **800-1700'** | **1700-2500'** | **2500-4000'** | **>4000'** |
| | | | | | | |
| | | Red Pine - White Pine Forest | Red Pine Woodland | Subalpine Heath - Krummholz | | |
| | | Red Pine Woodland | Red Spruce - Mixed Conifer Woodland | Three-toothed Cinquefoil - Blueberry Low Summit Bald | | |
| | | Red Spruce - Mixed Conifer Woodland | Rock Outcrop Ecosystem | White Pine - Mixed Conifer Forest | | |
| | | Spruce - Fir - Northern Hardwoods Forest | Spruce - Fir - Northern Hardwoods Forest | | | |
| | | Spruce - Heath Barren | Spruce - Heath Barren | | | |
| | | Spruce - Northern Hardwoods Forest | Spruce - Northern Hardwoods Forest | | | |
| | | White Pine - Mixed Conifer Forest | Three-toothed Cinquefoil - Blueberry Low Summit Bald | | | |
| | | | White Pine - Mixed Conifer Forest | | | |
| | | | | | | |
| Slope Crest: Acidic Sed/metased | 113 | Aspen-Birch Woodland/Forest Complex | Aspen-Birch Woodland/Forest Complex | Aspen-Birch Woodland/Forest Complex | Bilberry - Mountain-Heath Alpine Snowbank | Bilberry - Mountain-Heath Alpine Snowbank |
| | | Beech - Birch - Maple Forest | Beech - Birch - Maple Forest | Beech - Birch - Maple Forest | Crowberry - Bilberry Summit Bald | Crowberry - Bilberry Summit Bald |
| | | Black Spruce Woodland | Black Spruce Woodland | Crowberry - Bilberry Summit Bald | Dwarf Heath - Graminoid Alpine Ridge | Diapensia Alpine Ridge |
| | | Chestnut Oak Woodland | Chestnut Oak Woodland | Red Spruce - Mixed Conifer Woodland | Fir - Heartleaved Birch - Subalpine Forest | Dwarf Heath - Graminoid Alpine Ridge |
| | | Coastal Headland Ecosystem | Crowberry - Bilberry Summit Bald | Rock Outcrop Ecosystem | Rock Outcrop Ecosystem | Fir - Heartleaved Birch - Subalpine Forest |
| | | Crowberry - Bayberry Headland | Oak - Pine Forest | Spruce - Fir - Northern Hardwoods Forest | Spruce - Fir - Birch Krummholz | Spruce - Fir - Birch Krummholz |
| | | Crowberry - Bilberry Summit Bald | Oak - Pine Woodland | Spruce - Heath Barren | Spruce - Fir - Northern Hardwoods Forest | Subalpine Heath - Krummholz |
| | | Jack Pine Woodland | Pitch Pine Woodland | Spruce - Northern Hardwoods Forest | Subalpine Heath - Krummholz | |

## Appendix 8.7: Correlation of Natural Communities and Grouped ELUs on the Bigelow Preserve (numbers indicate acres)

| Natural Communities | Percentage of ELU Group | ELU Groups | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alpine | Acidc cliff/outcrop/talus | Calcarous cliff/outcrop/talus | Calcarous swamp/bog | Outwash forest/wetland | Spuce flat/swamp | Enriched northern hardwood | Red maple or mixed swamp | Montane spruce-fir forest | Sub-alpine woodlands/barrens | Dry pine - oak woodland | N. hdwd/pine-hemlock-hdwd | Lowland spruce - fir - hdwd | Pine - hemlock - hardwood | Pine - oak forest | Spruce - n. hardwood (mid elev) | Northern hardwood | Oak - northern hardwood | Subalpine wetland |
| Natural Communities | Acidic Cliff | 2 | 2 | 1 | | | | | | | 1 | | | | | | | | | |
| | Alpine Ecosystem | | | | | | | | | | | | | | | | | | | 19 |
| | Aspen-Birch Forest-Woodland Complex | | | 3 | | | | 13 | | 2 | 1 | | | | | | | 2 | | |
| | Beech - Birch Maple Forest | | 1 | 6 | 6 | 3 | 5 | 38 | 24 | 10 | | 15 | 10 | 45 | 15 | 19 | 43 | 66 | 23 | |
| | Crowberry - Bilberry Open Summit Bald | 24 | | 2 | | | | | | | | 8 | | | | | | | | |
| | Fir - Heartleaf Birch Sub-alpine Forest | 45 | 75 | 73 | 36 | | | 23 | | 35 | 79 | 8 | 8 | | 6 | | 10 | 7 | 22 | 75 |
| | Peatland Ecosystem | | | | | 2 | 1 | | 2 | | | | | | | | | | | |
| | Red Spruce Mixed Conifer Woodland | 2 | | | | | | | | | 1 | | | | | | | | | |
| | Spruce - Fir Birch Krummholz | 27 | | 3 | | | | | | | 10 | | | | | | | | | 6 |
| | Spruce - Larch Forested Bog | | | | | 1 | 1 | | | | | | | | | | | | | |
| | Spruce - Northern Hardwood Forest | | 20 | 11 | 33 | 64 | 44 | 23 | 41 | 44 | 6 | 69 | 68 | 46 | 64 | 81 | 41 | 23 | 48 | |
| | Spruce-Fir Feathermoss / Broommoss Forest | | | 2 | 5 | 27 | 37 | 2 | 6 | 7 | | | 14 | 5 | 13 | | 5 | 1 | 5 | |
| | Spruce-Larch Forested Bog | | | | 16 | | 1 | | 6 | | | | | 2 | | | | | 1 | |
| | Streamshore Ecosystem | | | | 4 | 4 | 13 | | 20 | | | | | 1 | 1 | | | | | |
| | Tarn | | | | | | | 1 | | | | | | | 1 | | | | | |
| | **Total Acreage** | **54** | **35** | **376** | **12** | **180** | **176** | **108** | **153** | **2754** | **4000** | **2** | **108** | **456** | **399** | **10** | **562** | **348** | **517** | **2** |

< 25%   25-49%   50-75%   >75%