Ecosystem Targets
Northern Appalachian – Acadian Ecoregion

(final draft, Anderson 3/16/2006)

Coarse-filter and fine-filter targets

Conservation of biodiversity encompasses all aspects of nature from a single rare species to a complete ecosystem with all its associated species, structural components and ecosystem functions. This comprehensive protection approach is referred to as "coarse-filter / fine-filter" strategy where the coarse-filter targets are the ecosystems that characterize an region and define its landscapes. Coarse-filter targets not only implicitly conserve up to 99% of the species present in an ecoregion but also maintain the larger ecological context and processes. "Fine-filter" targets are the relatively few species that can not be adequately conserved by protecting ecosystems only but require individualized and direct conservation attention.

Ecosystem definitions

Ecosystem: an ecological community, together with its environment, functioning as a unit.

An ecosystem is defined by having a distinctive biota and physical setting but the term is scale-less and does not imply any particular size of feature. Floodplain forests, freshwater marshes, and peat-forming bogs are examples of moderately sized ecosystems. At smaller scales ecologists recognize cliff/talus slope ecosystems, rocky summit ecosystems and bowl/ravine ecosystems. These relatively discrete systems are associated with a discernable topographic setting, geologic situation or a dominant process and occur across the landscape in distinct patches. We named these *patch-forming ecosystems*. In contrast, a few ecosystem types dominate the natural land area in and around the patch systems forming a background matrix. We called these *matrix-forming ecosystems* and in eastern North America they are all forest types.

This way of scaling ecosystems recognizes an explicit spatial hierarchy. For example, a large area dominated by lowland conifer forest (a matrix-forming system) may, on close examination, reveal a network of bogs, swamps and marshes (large patch systems) and even smaller settings of cliffs, outcrops and shores (small patch systems). Patch-forming ecosystems are often richer in species diversity than the matrix-forming ecosystems that surround them and are of great interest to conservationists as "special habitats" or "biotic hotspots." Regardless of scale, ecosystems are still coarse-filter targets as they are composed of many individual species populations and conservation activity is best directed at maintaining the entire system.

Not every landscape feature, geologic formation or natural process forms a distinct ecosystem. It was the task of the ecology team to name and describe those settings that do and, by default, those that do not. Toward this end a list of all potential ecosystems was compiled for the ecoregion based on the U.S. National Vegetation Classification (NVC[1]) and the Acadian Forest Taxonomy[2], which are hierarchical classifications organized by vegetation structure and hydrologic regime. Preliminary units for ecoregional targets were identified at the taxonomic scale of the *association* defined by the full floristic composition of the unit. Descriptions of the species

[1] Grossman et al. 1998; Anderson et al. 1998; Maybury 1999. The NVC itself was developed from the classification work of state ecologists that has been reviewed and compiled into a single overarching framework. The framework is based on a modified version of the UNESCO world vegetation classification.

[2] Basquill 2003. Acadian Forest Association Taxonomy

composition, the physical setting, the typical size range of an occurrence and its distribution in the ecoregion were assembled.

Defining and Delineating the Ecosystem Targets

The classification work supplied a vision and understanding of the types of ecosystems that occurred in the ecoregion. However the taxonomies had been created primarily for the purpose of cataloging ground inventory data collected in the field. To comprehensively locate, identify and assess examples of each ecosystem type across the huge 84 million acre region we developed new ecosystem mapping and modeling techniques consistent with the classification systems.

Ecosystem Models

Ecosystem models were created based on a landform/topographic feature data layer available for the entire ecoregion (detail on the derivation of the landform coverage from a 90 meter digital elevation model are documented in Anderson 1999[3]). The landform coverage classified and mapped the ecoregion into 14 topographic settings that collectively covered 100% of the landscape:

- *Flat summit*
- *Slope crest*
- *Upper slope*
- *Cliffs and steep slopes*
- *NE facing side slope*
- *SW facing side slopes*
- *NE facing bowls & ravines*
- *SW facing bowls & ravines*
- *Gently sloping hills*
- *Dry flats and valley bottoms*
- *Wet flats and wetlands*
- *Slope bottom flats*
- *Lakes and ponds*
- *Rivers and streams*

Data on wet flats and wetlands were supplemented and enhanced by detailed digital maps of wetlands delineated from airphoto analysis and compiled from several sources:

National wetlands inventory (US, scale 1:24000)

Maritimes wetland inventory (Maritime Canada, scale 1:24000)

Quebec wetland mapping (Quebec, scale ?)

Relationships between the mapped landform units and the NVC/Natureserve community classification units were studied and made explicit through the overlay of over 8,000 ground inventory points for community types available in the U.S. and forest stand data points available in maritime Canada. Some relationships were directly synonymous (e.g. cliff and steep slope landform = Natureserve cliff and talus ecological system) others were more complex and we characterized them quantitatively (e.g. 80% of the rich northern hardwood forests occurred on bowl/ravine landforms, while 20% were on steep slopes). These relationships are discussed in detail in the individual ecosystem chapters.

After examining the relationships to the Heritage and CDC element occurrences we simplified the landform models to encompass six key settings that were highly correlated with, and logical surrogates for, patch-forming ecosystems. When tested against the US Heritage program element occurrences that included natural community types, **these six features collectively**

[3] Anderson 1999. Viability and spatial assessment of ecological communities in the Northern Appalachians ecoregion.

contained almost 81% of the 8554 compiled element occurrences although the systems themselves covered only 15% of the ecoregion[4]. The final set included:

- Summits and hilltops
- Cliffs and steep slopes
- Bowls, hollows and ravine networks
- Freshwater wetlands
- Riparian and floodplains networks
- Coastal shores and wetlands

Other topographic settings, particularly side-slopes, gently sloping hills, dry flats and valley bottoms were associated with matrix-forming forest. Matrix was treated in a customized way described in the matrix-forming forest chapter.

To develop conservation targets for patch forming ecosystems the six landform models were stratified across a spectrum of biophysical settings encompassing the important ecological gradients identified for the ecoregion. To allow for this, consistent ecoregion-wide data layers were compiled for 5 physical factors (state, provincial and national data sets provided the data sources).

- Bedrock and surficial geology
- Elevation zones
- Ecological subregions
- Climatic zones
- Current landcover

Geologic and land cover units were simplified from more detailed local taxonomies to single regionally uniform units judged to have meaningful expressions for biodiversity. For instance all types of calcium-bearing rocks (limestone, dolomite, dolostone, marble etc) were mapped as "calcareous bedrock" and its presence coincides with fertile agricultural soils. State and provincial unit equivalences are given in the appendix. The compiled maps of each factor are presented in the map atlas section of this document.

Bedrock dependent models such as summits were stratified across bedrock types and elevation zones, whereas coastal wetlands were stratified geographically. The stratification scheme used for each model is described in the corresponding ecosystem section. In all cases the decisions on stratification were guided by the community classifications to insure that important biotic variation was captured by the ecosystem models.

Our goal was to closely approximate true taxonomically defined ecosystem targets. An ecosystem target was thus defined as an landform model in a specific biophysical and geographic setting (Table 1 and 2). For example the target defined as:

Cliffs and steep slopes on acidic sedimentary bedrock at low elevation

was considered roughly equivalent to the NVC association type (Table 2).

Sandstone dry cliff with sparse vegetation

[4] Note that adding lake and pond features would have boosted the EO capture to 84%

Table 1. Relationship between ecosystem models and their biophysical settings with Natureserve ecological system taxonomy and NVC associations. Further detail in Table 2

Final Ecosystem Models	# Set-tings.	Ecological Systems (Natureserve)	# NVC Assoc
Bowls and ravines	24	Sugar Maple – Hardwoods Forest (rich)	2
Cliffs and steep slopes	19	Acidic Cliff & Talus	12
		Alpine Mosaic	1
		Circumneutral Cliff & Talus	5
Coastal shores and wetlands	40	Atlantic Rocky Coast	6
		Coastal Raised Bog	5
		Estuary Marsh	3
		Saltmarsh	5
		Spruce-Larch Peatland	1
Freshwater wetlands	29	Acidic Open Fen	12
		Acidic Swamp	9
		Alkaline Open Fen	13
		Circumneutral Swamp	2
		Coastal Raised Bog	1
		Enriched Seepage Forest	3
		Forested Fen	5
		Inland Raised Bog	11
		Kettlehole Fen	9
		Patterned Acid Fen	6
		Patterned Alkaline Fen	3
		Shoreline Marsh	3
		Spruce-Larch Peatland	1
		Subalpine Fen	2
		Wet Meadow	4
Matrix forest	72	Lowland Spruce – Fir – Hardwood Forest	8
		Montane Spruce – Fir – Hardwood Forest	4
		Near-Boreal Spruce Flats	1
		Oak-Pine-Hemlock Forest	16
		Sugar Maple – Hardwoods Forest	4
Matrix forest (barrens & early successional)		Spruce Barrens	2
Riparian and floodplain	29	Ice-Scour Rivershore	4
		Inland Rocky Shore	2
		Near-Boreal Floodplain	5
		Temperate Floodplain	17
Summits and hilltops	22	Acidic Rocky Outcrop	16
		Alpine Mosaic	10
		Circumneutral Rocky Outcrop	5
		Oak-Pine-Hemlock Forest (woodland)	1
		Subalpine	7
Grand Total			250

Table 2 . The relationship between the ecosystem model stratification and the Natureserve and NVC classification. Targets were identified as a landform model (column 1) stratified across elevation and bedrock (column 2 and 3). Columns 4-7 provide information on the number of occurrences in the ecoregion, the conservation goal set and the total selected for the portfolio. Columns 5-6 show the equivalent ecological system type and corresponding association(s).

Cliff, Talus and Steepslope Ecosystems

LAND FORM	ELEV.	BEDROCK	Total in Region	% in Region	Goal	Total Selected	Nature serve System	NVC association: most likely type or types
Cliff and Steep slopes	0-800'	Sedimentary	424	10%	37	100	Acidic cliff/talus	Sandstone Dry Cliff Sparse Vegetation
		Granites	223	5%	19	41		Q. rubra – B. alleghaniensis / P. virginianum Woodland
		Mod Calc/ Mafic	168	4%	14	12		Igneous - Metamorphic Northern Dry Cliff Sparse Vegetation
		Calcareous	27	1%	2	14	Calcareous cliff/talus	Thuja occidentalis Cliff Woodland
	800-2500'	Sedimentary	1399	32%	121	268	Acidic cliff/talus	Sandstone Dry Cliff Sparse Vegetation
		Granites	717	16%	62	78		Granite - Metamorphic Talus Northern Sparse Vegetation
		Ultramafic	9	0%	2	4		Serpentine Cliff Sparse Vegetation?
		Mod Calc/ Mafic	428	10%	37	98		Igneous - Metamorphic Northern Dry Cliff Sparse Vegetation
		Calcareous	96	2%	8	32	Calcareous cliff/talus	Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation
	2500-4000'	Sedimentary	255	6%	22	46	Acidic cliff/talus	Sandstone Dry (or Moist) Cliff Sparse Vegetation
		Granites	376	9%	32	67		B. papyrifera – P. glauca / A. spicatum/ P. virginianum Talus
		Ultramafic	24	1%	2	17		Serpentine Cliff Sparse Vegetation?
		Mod Calc/ Mafic	244	6%	21	39		Igneous - Metamorphic Northern Dry Cliff Sparse Vegetation
	4000+	Sedimentary	11	0%	1	8	Alpine cliff	Lichen Fellfield Sparse Vegetation
		Granites	1	0%	1	1		Lichen Fellfield Sparse Vegetation
		Mod Calc/ Mafic	5	0%	2	4		Lichen Fellfield Sparse Vegetation
			4407	100%	380	829		
Stratification							**Classification**	

After mapping the ecosystems, individual examples of each ecosystem type were converted to discrete polygons or "modeled occurrences" ("MO"s, here after referred to as "occurrences") using GIS region-group techniques allowing for assessment of each target across the ecoregion. Subsequently 20,000 to 120,000 examples of each described ecosystem were located and extensive information was assembled for each example relative to condition, landscape context and verification by other data sources (e.g. Natural Heritage or CDC element occurrences – Table 3). Each occurrence was individually screened as to its potential contribution towards conserving biodiversity using methods described below. The best examples were selected for the portfolio using representation goals to ensure that the selected examples were located across a spectrum of environmental settings.

Table 3: Example of a data compiled for one modeled occurrence of a low elevation bog

Wetland id#	**125078**	**Block size**	832 acres
Target type	Low elevation bog in coarse sediments	**Block size class**	4 (500-1000 acres)
Size in Acres	328.7	**# of Dams**	0
Size class	2	**Housing density pressure**	0.0012
State or Province	NB	**Land cover index**	19
Subregion	Acadian Uplands	**% in GAP 1 or 2**	28
Adjacency	Adj. to Size 4 river	**% in GAP 3**	45
Geology	Coarse sediments	**Distance to road: min**	0
% Deciduous	2.4	**Distance to road: mean**	343
% Conifer or Mixed	0.6	**Nearest road class**	4 – local road
% Swamp	61.4	**Site name**	
% Emergent	35.6	**EO communities**	1: Bog
Elevation Zone	Very low 20'-800'	**EO species**	0
Aquatic targets	Size 4 river	**EO rank**	A

During the screening process described below, quantitative methods were used to maximize the stacking of fine-scale targets within larger scale targets, but the co-occurrence of targets was not a requirement for inclusion in the portfolio. A key tenet of this effort was to maximize the utility of our data products to others by providing a comprehensive, transparent and objective analysis of the biodiversity targets in the ecoregion. We expect that other organizations will access the data, study the analysis and draw their own conclusions.

Identifying Critical Examples: Screening occurrences and determining their relative importance

Is it possible to permanently conserve all the biodiversity of an ecoregion using only a small proportion of the landscape? The answer to this question has not been scientifically established. While the Nature Conservancy, and many of its partners, recognizes the futility of trying to protect every acre of land or body of water, current research offers convincing evidence that certain places, and particular occurrences of key features, play a more important role in maintaining regional biodiversity than other places and features. Thus the question driving this analysis was - *which sites are the most critical to protect to insure the conservation of all biodiversity across the ecoregion.*

The influence of a particular ecosystem example on maintaining regional biodiversity may be due to its being particularly complete with respect to its component species or the occurrence may serve as source habitat for characteristic species and thus play a pivotal role in exporting individuals to the larger landscape. Ecologically complete occurrences contain all necessary parts of the ecosystem such as a full complement of associated species, key structural components and functioning processes that maintain dynamics. High quality examples contain habitat, in which the component species thrive because the habitat provides adequate resources, minimizes mortality and facilitates reproduction. Source areas consistently produce surplus individuals (juveniles or propagules) that emigrate to the larger landscape. The antithesis of source habitat, sink areas, are habitat patches where species subsist but are not reproducing or where mortality rates are very high. Populations in sink areas may persist over time but they are generally subsidized from the source habitats. High quality habitat may also serve as refugia or strongholds of rare or uncommon species that have already disappeared from much of the surrounding.

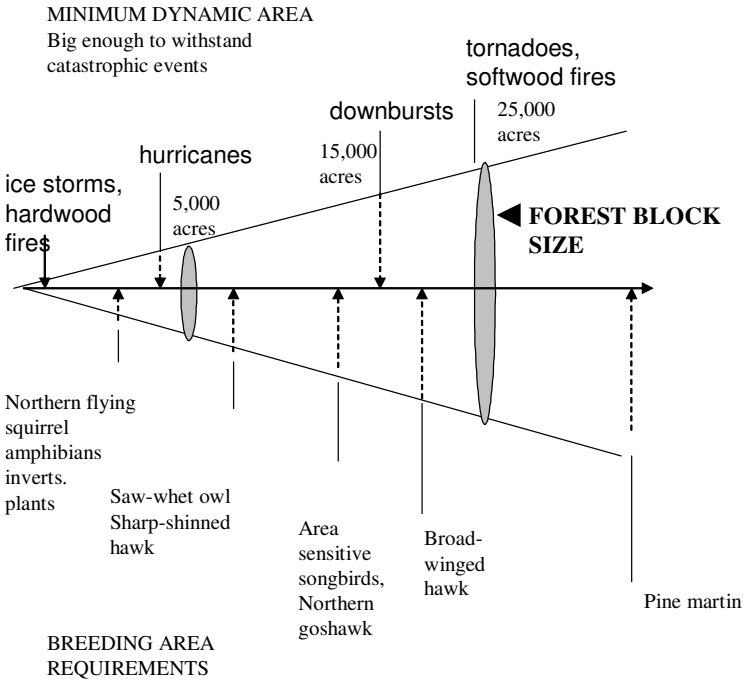
We established and applied **screening criteria** to every ecosystem example to determine if it was likely to be a **critical** occurrence and qualify for the portfolio. Those that did not meet the criteria were classified as **supporting** occurrences – important but not crucial to the conservation of biodiversity in the ecoregion. The criteria we used to separate the critical occurrences from the supporting ones were:

- Size of the occurrence.
- Landscape context surrounding the occurrence.
- Condition of the occurrence.

Criterion 1. Size of the occurrence: Acreage thresholds for ecosystems were based on the minimum dynamic area needed for an occurrence to absorb and recover from typical disturbances. Additionally we used the minimum area requirements of associated species and the average territory size of breeding females. The latter allowed us to estimate whether a given species would likely be present and whether there was physical space for at least 25 breeding territories to allow the population to persist (Figure 1 and 2.) Details on this approach may be found in Anderson (1999)[5]

[5] Anderson 1999. Viability and spatial assessment of ecological communities in the Northern Appalachian ecoregion.

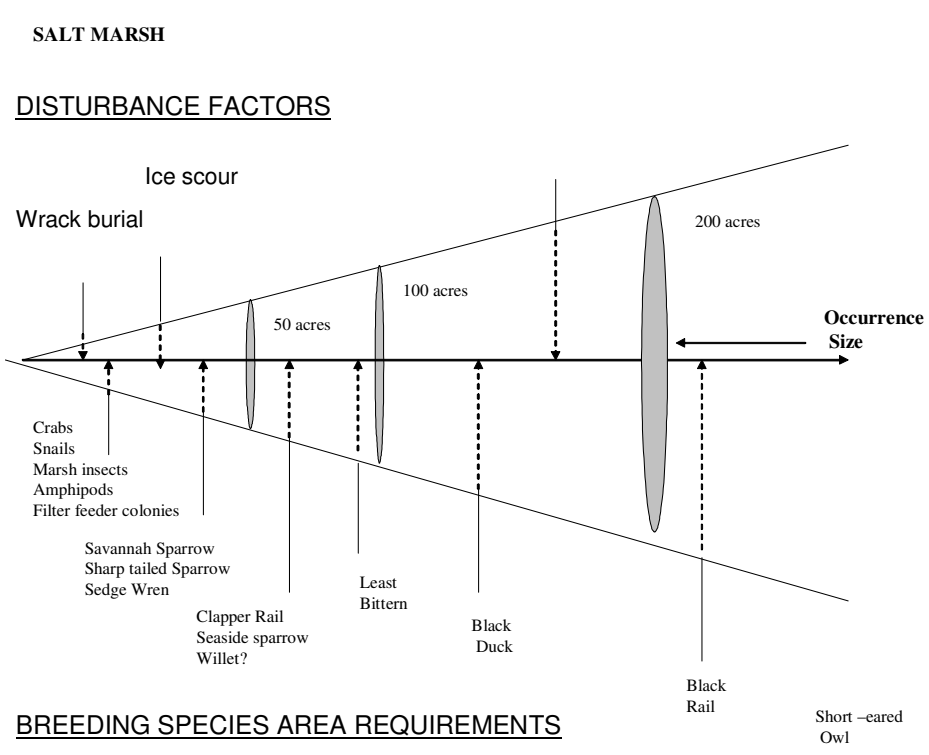
Figure 1. Scaling factors for matrix forming forest in the Northern Appalachian / Acadian ecoregion. A 25,000 area forest block, represented by the larger grey circle, should be accommodating of all the factors to its left.



Disturbance sizes are based the severe disturbance patch size as determined from published literature and air photo analysis

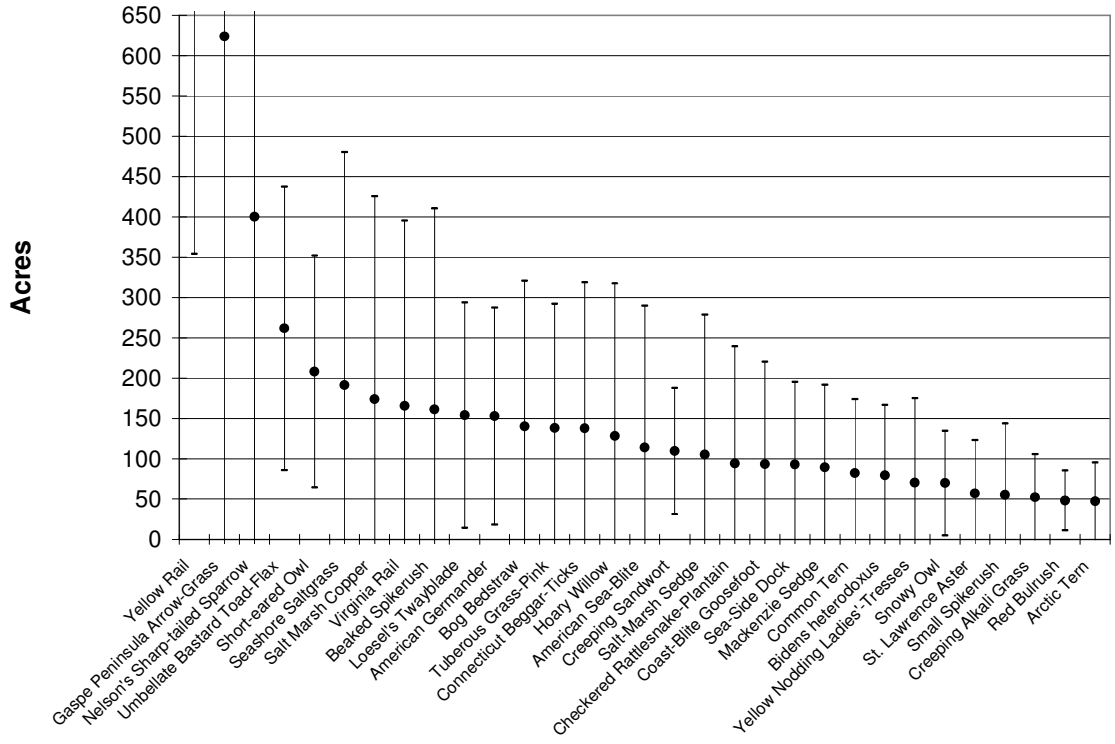
Female breeding area requirements are from Birds of North America (Poole and Gill eds.) and DeGraaf and Yamasaki 2000 New England Wildlife

Figure 2. Minimum dynamic area and breeding territory sizes for Northern Appalachian salt marshes.



Using ground survey information we assembled evidence on the relationship between occurrence size and species presence by calculating the average size of an ecosystem occurrence in which a particular species, or group of species had been found (Figure 3).

Figure 3. The average size and size range of coastal bogs and salt marshes where confirmed occurrences of characteristic species were found. Data from Canadian CDC programs and Maine Natural Heritage program, restricted to species with 3 or more occurrence and a location precision of 0 to 3. The grand average was 188 acres.



Criterion 2. Landscape context. This measure refers to the relative amount of development, agriculture, quarries, roads or other fragmenting features within an area directly surrounding a specific ecosystem occurrence. It provided an estimate of the isolation of the occurrence as well estimates of future encroachments on the occurrence. To assess landscape context we developed a landscape context index (LCI) based on these features within a 1 kilometer radius surrounding the occurrence (Figure 4). Base data layers included roads, high intensity developed lands, low intensity developed lands, agriculture, quarries and natural cover.

Figure 4. Schematic of Land Cover Index (LCI). An LCI below 20 indicated that the occurrence was surrounded primarily by natural cover. Higher LCIs indicated increasing amounts of roads, development and agriculture, Occurrences with LCIs above 50 were usually rejected as critical occurrences.

LCI < 20 Occurrence is surrounded by primarily natural land cover

LCI > 50 Occurrence is surrounded by roads, development and agriculture

Criterion 3. Condition.

This measure refers to the internal state of the occurrence. Had the example been ditched, dredged, mined, clear-cut, toxified, or otherwise degraded? Was it loaded with exotic pest species? We evaluated condition by requiring that every selected occurrence be corroborated by an independent source such as a US. Natural Heritage or Canadian Conservation Data Center ground inventory point. Other acceptable evidence was if the occurrence was coincidence with a described Audubon or Fish and Game important bird area or if it received expert confirmation by a recognized authority. For this verification we are greatly in debt to the US Natural Heritage programs and Canadian Conservation Data Centers who contributed over 29,000 ground inventory points and to the Provincial governments who contributed thousands of forest inventory points.

Our screening process filtered out many examples that may be capable of persisting through time, particularly if augmented by management, but our intent was to identify the most crucial examples of each target necessary to protect to maintain biodiversity across the ecoregion. Selected examples were judged to be extremely significant and vital to the resolution of the biodiversity crisis in this region. To avoid confusion we opted not to use the term *viable,* in reference to these examples instead referring to them as *qualifying* and to those selected for the portfolio as *critical occurrences*.

Setting Numeric Goals

Minimum numeric and distribution goals were set for each target based on the factors of representation and replication. Goals were used primarily to identify and measure gaps in portfolio sufficiency, however *the numeric goal also represents the smallest number of examples we think are needed to represent the target across all important gradients with a minimal degree of redundancy*. Minimum acreage goals were calculated by multiplying the numeric goals times the

minimum size criteria. For instance, if ecosystem "A" had a goal of 100 examples and if each example had to be at least 50 acres than the minimum area needed is 5,000 acres.

Representation: The objective of the representation goal was to insure that we captured all the compositional variability inherent in the ecosystem. Some systems vary in their species composition across elevation zones, bedrock types, climatic regions and soil moisture levels. Our solution was to protect a set of examples selected from across the various gradients using the customized stratification schemes described in the ecosystem sections.

Replication and Redundancy: The objective of the replication goal was to minimize the risk of a given target disappearing by insuring that we had more than one example in the portfolio. Like back-up engines on an airplane, reliability theory suggests that many moderate quality/small examples might have the same probability of persisting over a century as fewer high quality/large examples. Thus we adjusted the numeric goal according to the scale of the target. For matrix forest blocks, which are huge in size, we required only 2 or 3 replicates whereas small features like cliffs needed 20 to 30 replicates.

Portfolio Status: Definitions and Codes:

Every occurrence of each ecosystem was assigned a final portfolio status and given a portfolio code based on the definitions given below. Only those examples termed "critical occurrences" were considered to be included in the portfolio and only those examples were used to calculate progress towards ecoregional goals.

1) Critical occurrence: an occurrence crucial to the conservation of biodiversity in the eocoregion. The occurrence met all screening criteria for size, landscape quality and verification. Critical occurrences are the only type counted towards meeting portfolio goals.

2) Candidate occurrence: an occurrence that met the size and landscape context criteria but was not corroborated or verified by an expert or ground inventory point. These occurrences were not considered part of the portfolio or used to meet goals. They are a priority for further inventory work to verify their condition and importance.

3) Supporting occurrence: an occurrence that is below the screening criteria for size or landscape context or has poor condition as verified by a third party. These occurrences are not considered part of the portfolio although they may contribute towards biodiversity in the ecoregion.

Ecosystem Criteria Summary

Summits and hilltops: 30 acres, LCI2<20
Cliffs and steep slopes: 25 acres, LCI2<20
Bowls, hollows and ravines (Coves): 25 acres, LCI2<20
Freshwater wetlands 50 acres, LCI2<20
Riparian and floodplains communities 100acres, LCI2<20
Coastal shores and wetlands:
- Beach: 20 acres, LCI2<30
- Rocky shore/Cliff: 10 aces, LCI2<30
- Salt marsh: 60 acres, LCI2<30

Tidal flat: 100 acres, LCI2<30
Coastal bog: 75 acres, LCI2<30

Technical Definitions

Candidate = Larger than the size criteria and below LCI 20 (30 for coastal)
Provisional Candidate= Larger than the size criteria and above 20 but below 50 LCI
Supporting = Smaller than the size criteria and any LCI or any size but greater than 50 LCI
Critical = Candidate and provisional candidate occurrences that had their significance corroborated and verified with appropriate ground inventory information (EO point) or expert knowledge.
Protected = Term applied if 50% or greater of the occurrence area was found on land with a GAP status 1 or 2.

Identifying the critical occurrences was a relatively straightforward process except for those occurrences in the "zone of indecision", the grey area where borderline occurrences were sorted through on a case-by-case basis with more subjectivity than at the two ends (Table 4). Adjustments to the final selection of occurrences were made via expert caveats based on knowledge of the site. Expert opinion generally overrode the assigned category and this came into play for approximately 5-10% of the selected critical occurrences.

Table 4: Screening Criteria Decision Rules for Freshwater Wetlands: Examples had to meet 3-way criteria of Size, Landscape Context and Confirmation by Element occurrences. The bottom row indicates the subset of the occurrences that needed case by case attention to determine the portfolio status.

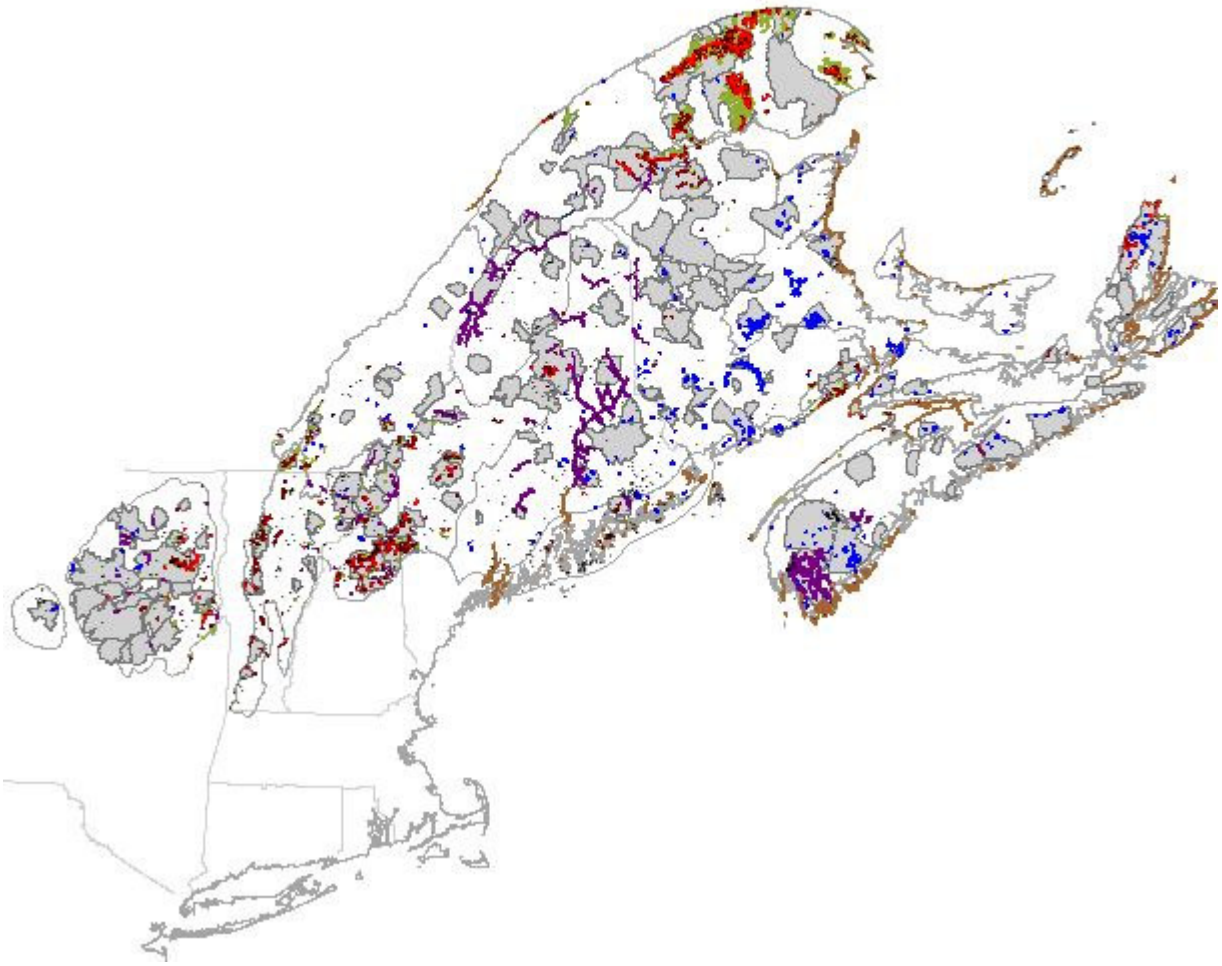
DECISION RULES	SIZE	LCI	Element Occurrences	Decision
Critical Occurrences	Greater than 1000 Acres	Less Than 20	EO verification or expert confirmation. Largest in ecoregion	**High confidence**
Critical Occurrences	Greater Than 50 Acres	Less Than 20	A-B quality communities or species OR many unranked occurrences	**High confidence**
Candidate Occurrences	Greater than 50 Acres	Less than 20	No verification	**Moderate confidence**
Provisional Candidate Occurrences	Greater than 50 acres	20 – 50	No verification	**Moderate confidence**
Supporting Occurrences	Less Than 20 acres	Greater than 50	No verification or D ranked or Historic Occurrences	**High confidence**
Various	20-50 Acres	20-50	C quality communities or species OR single unranked occurrence	**Case-by case decisions**

IV. Results: Our results suggest that about 29% of the ecoregion is critical for maintaining biodiversity of ecosystems in region (Table 5). Of that 27% was focused on matrix-forming forest and 2% on patch-forming ecosystems. When examined from the perspective of ecosystem types our results suggest that from 9% to 44 % (average 24%) of all possible examples were selected depending on the ecosystem type. Detailed results are included in each ecosystem chapter. Below are summaries and examples for all of the ecosystem types and a few illustrative species targets.

Table 5. Summary of Acreage Recommendations for the Northern Appalachians/Acadian region

ECOSYSTEM TYPE	GOAL % of all possible examples	GOAL % of the Ecoregion	% portfolio protected GAP 1/2	Total Acreage in the region	% System in the Region
Coastal (excl. tidal flat)	44%	0.01%	18%	926,644	1%
Steep slopes	27%	0.00%	13%	488,011	>1%
Freshwater wetlands	24%	0.05%	26%	1,273,517	2%
Riparian	18%	1.00%	3%	4,282,458	5%
Bowls/ravines	14%	0.50%	76%	3,889,864	5%
Summits	9%	0.03%	35%	2,758,928	3%
Total Non Forest		1.59%		13,619,422	15%
Matrix Forest Blocks	29%	27.00%	27%	67,724,133	82%
Subset for restoration cores		*5.00%*			
TOTAL PORTFOLIO		**28.59%**		**82,590,406**	**23,612,597**

Figure 5. The Northern Appalachian/Acadian Ecoregional Portfolio. This map does not show the background forest in order to emphasize the sites.



Ecosystem Summaries and Chapters

A) One-Page Summaries

Upland Ecosystems

Matrix-forming forest
Summits
Cliffs and steep slopes
Bowls, hollows and ravine networks

Wetland Ecosystems

Freshwater basin wetlands
Riparian and floodplain networks
Coastal shores and marshes

B) Ecosystem Chapters

Upland Ecosystems

Matrix-forming forest
Summits
Cliffs and steep slopes
Bowls, hollows and ravine networks

Wetland Ecosystems

Freshwater basin wetlands
Riparian and floodplain networks
Coastal shores and marshes

UPLAND ECOSYSTEMS

Matrix-forming Forest:

Red Spruce- Balsam fir, Beech-Birch-Maple Northern hardwoods, Red spruce-hardwoods, Others.

Forest comprises 84 percent of the ecoregion, most of it recovering from almost two centuries of logging. Now in its 3 or 4th rotation, forestry is less profitable and the land base is being sold for other uses. Forest ecosystems have lost their legacies of large coarse woody debris and they are presently crisscrossed by a vast network of roads and highways serving as both barriers between interior patches and conduits into once inaccessible places.

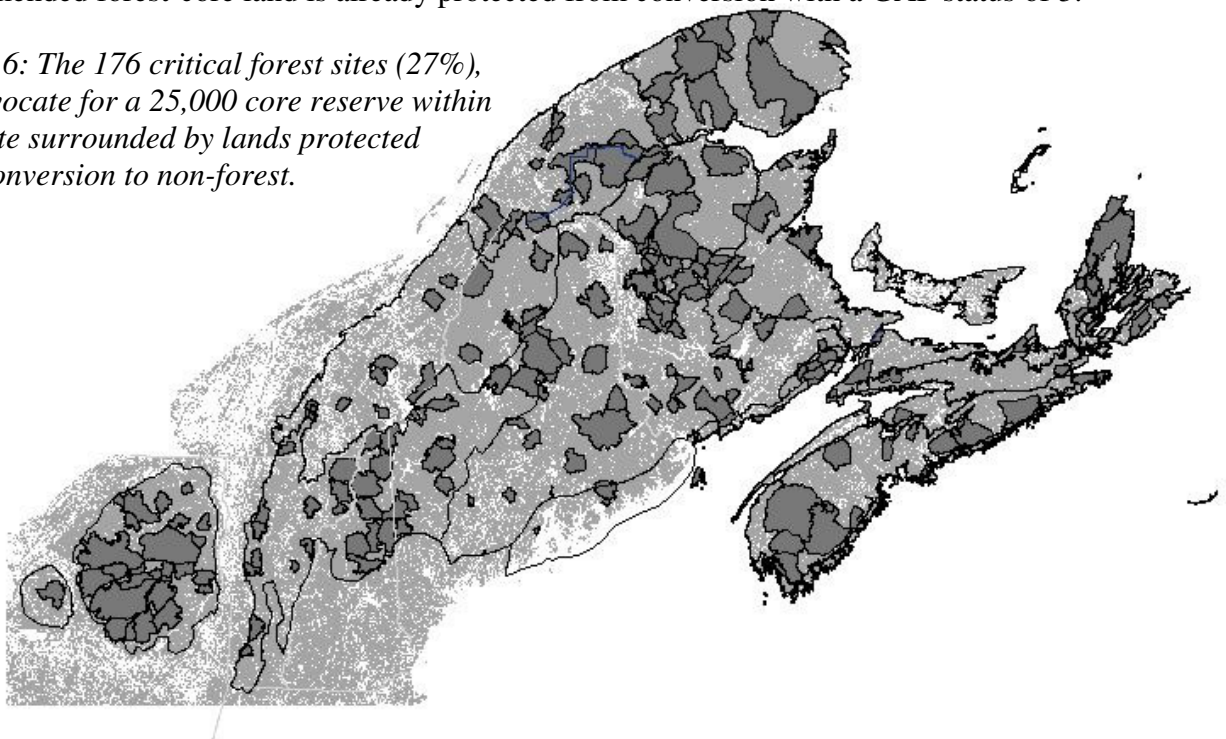
Acreage: 67,724,133 (82% of the ecoregion)
Portfolio goal: 1 site minimum per 72 ecological groups
Portfolio sites identified: 176 sites, each over 25,000 acres
Portfolio %: 27% with 5% subset for restoration of complete ecosystems with "old growth" characteristics
Protection: 27% have 25K cores in GAP 1or 2.
33% have1-24K cores in GAP 1 or 2
29% have less than 1K cores in GAP 1or 2

Key conclusions for forest

Based on our results we recommend that a minimum of 27% of the forest be conserved and restored in a series of 176 forest reserves, each comprised of 25,000 acres or more contiguous forest. Further we advocate that a subset of 5% (25,000 acres per block) be devoted to the restoration of complete forest ecosystems with biological legacies and "old-growth" characteristics. Outside of the core restoration areas, forest-cover and biodiversity should be maintained through methods that prevent conversion to non-forest cover and insure "well managed forest".

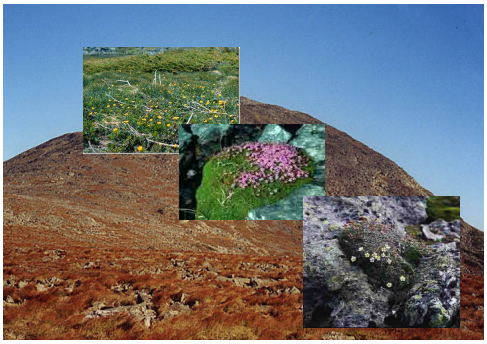
We are already more than one-third of the way towards meeting this goal. As of November 2005, almost one-third the 176 matrix forest areas have established 25,000 acre core areas and another third have established cores within a 5000 to 24,000 size range. Additionally 11% of the recommended forest-core land is already protected from conversion with a GAP status of 3.

Figure 6: The 176 critical forest sites (27%), We advocate for a 25,000 core reserve within each site surrounded by lands protected from conversion to non-forest.



Summits:
Mountain peaks, hilltops, ridgelines, knolls

Ranging from alpine summits with a unique gem-like flora to the fog-shrouded granite domes of coastal islands - mountain top and hill crest features are some of the most characteristic and beloved features of the ecoregion. Their biodiversity contributions are well documented. The immense open barrens on serpentine rock or the smaller mid-elevation outcrops on calcareous rocks abound with plant rarities. Rocky pine/oak woodlands predominate at low elevation punctuated by open sparse grasslands and heath communities. Among the high spruce and fir, the stunted krummholz, open meadows and the rare Bicknell's thrush have brought them to global attention. .

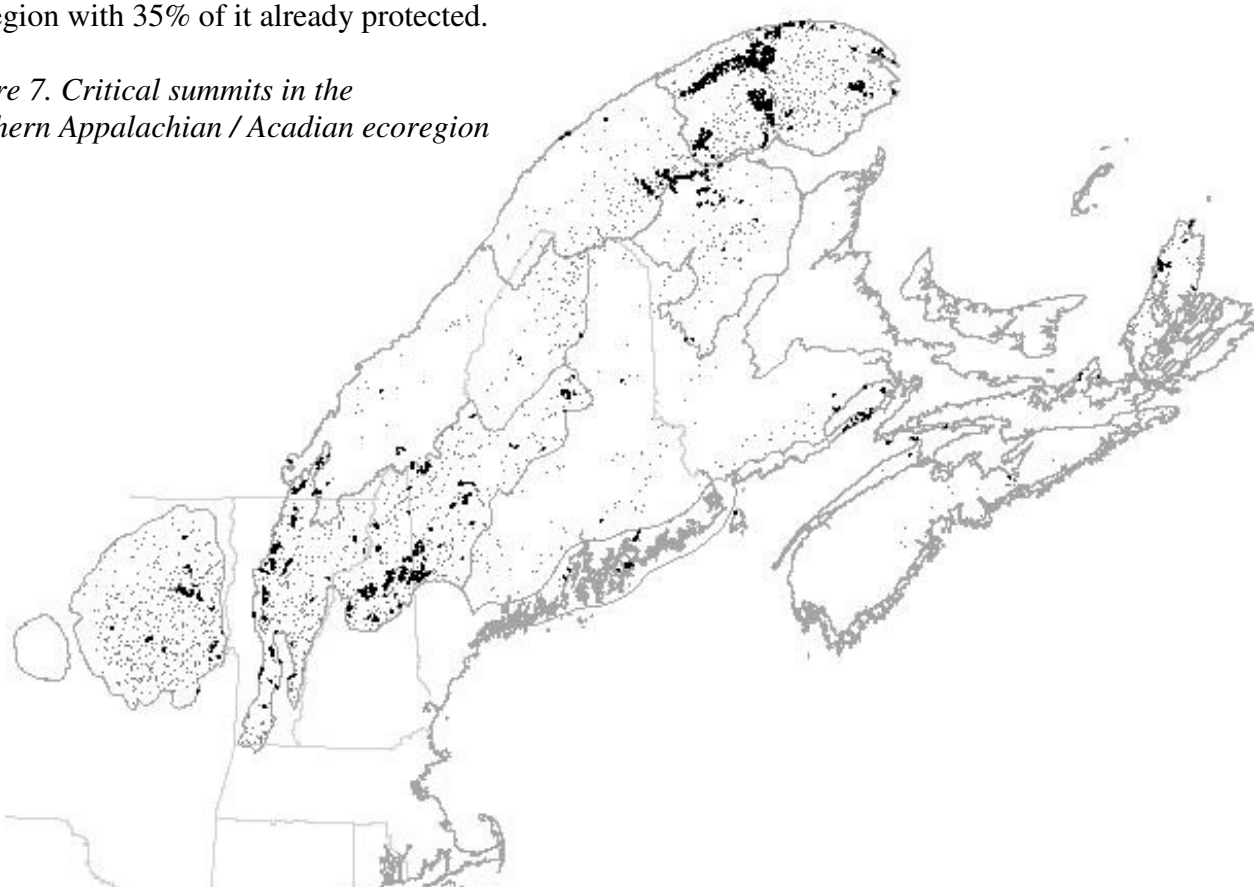


Acreage: 2,758,928 (3% of the ecoregion)
Count: 104,745 (over 2 acres)
Average Size of Feature: 26 acres
Screening Criteria
Size: 30 acre minimum, LCI <20, Corroboration
Portfolio goal: 453 (20 examples * 22 "types")
Portfolio sites identified: 393 (1,938 occurrences)
Portfolio acreage: 9% of summits, 0.03% of Ecoregion
Portfolio Protection by area: 35% on GAP 1 or 2

Key conclusions for summits and mountains:

Summits comprise about 3 percent of the whole region. We recommend a minimum of 9% of all summits them be protected in a set of 393 key sites that concentrate almost 2000 of our most critical summit ecosystems. This is a very achievable goal amounting to less than 1 % of the whole ecoregion with 35% of it already protected.

Figure 7. Critical summits in the Northern Appalachian / Acadian ecoregion



Steep slopes:
Cliffs, talus slopes, crags, bluffs, outcrops

Remote cliffs, rocky crags, landslide scars, river bluffs and talus slopes contribute unmistakable character to the rugged landscapes of the Northern Appalachian - Acadian region. Unique biodiversity and ecosystems are associated with these features throughout the region, differing substantially with bedrock types. Vertical cliff faces are choice settings for peregrine falcons and golden eagles. Wiry, tenacious herbs like birds-eye primrose, slender cliff brake and fragrant cliff fern root in minute crevices. Accumulating talus at cliff basses creates a structure preferred by timber rattlesnake, rock vole and Gaspe shrew.

Acreage: 488,011 (<1% of the ecoregion)
Count: 16,392 (over 2 acres)
Average Size: 27 acres
Screening Criteria
Size: 25 acre minimum, LCI <20, Corroboration
Portfolio goal: 380 (20 * 19 "types")
Portfolio sites: 346 sites (829 occurrences)
Portfolio acreage: 27% of steep slopes, 0.003% of region
Portfolio Protection by area: 13% on GAP 1 or 2 (3% by c

Key recommendations for steep slopes

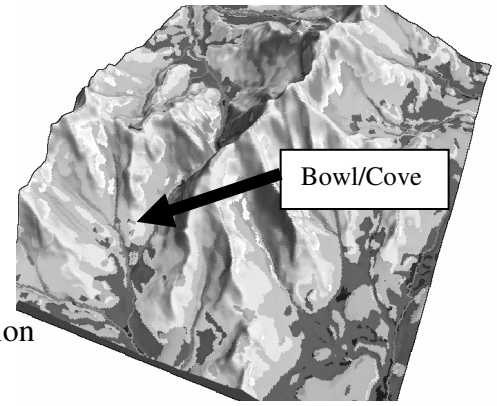
Over 15,000 examples of these features occur in the region totaling almost a half a million acres. Based on our analysis we recommend that 27% of the half million acres be protected in 346 critical sites. This amounts to less than a 1 percent of the ecoregion but includes over 800 of the most critical occurrences. As of this year, 13% of this set is already in a GAP 1 or 2 reserve status

Figure 8. Critical steep slopes in the Northern Appalachian / Acadian ecoregion

Bowls, Hollows and Ravine Networks:
Rich forests, moist draws, ravines, toe slopes, hillside benches

Moist draws, wooded ravines, enriched forests in bowls and hollows provide some of the most fertile settings in the region. Over 200,000 of these features occur, covering 5% of the ecoregion, although like streams, these systems form interconnected networks and it can be hard to determine where one occurrence ends and another begins.

The lush patches of forest that develop in these settings are known colloquially as "rich northern hardwood forests", "rich mesic forest", "maple-ash-basswood forest" or "cove hardwoods" and they are often sought out by botanists for their unique flora. The fertile damp soils that develop in these shallow bowls are local repositories of nutrients and support a variety of nutrient-loving plants such as ginseng or Goldie's fern, and trees like basswood, white ash and sugar maple. Calcareous soils accentuate the fertility of rich hardwood forests and remarkable understories of maidenhair fern, trilliums and impatience may result. Seventy-eight percent of the inventoried rich hardwood forests occurred in this setting.

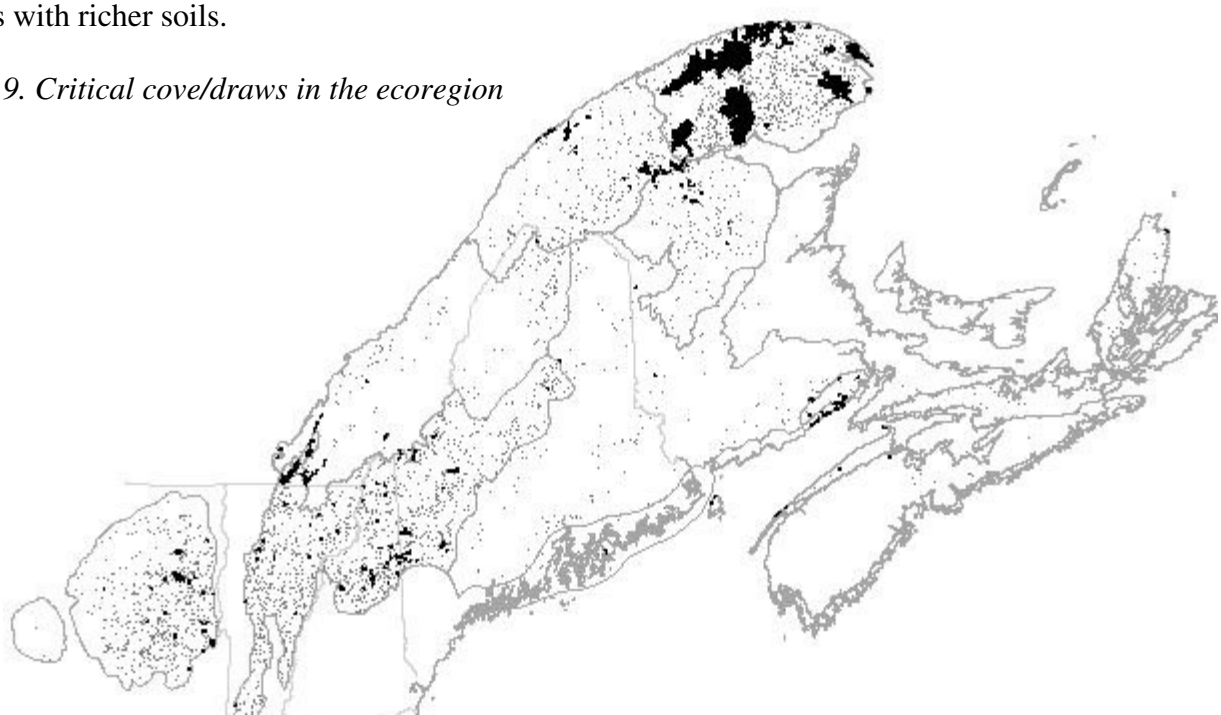


Acreage: 3,889,364 (5% of ecoregion)
Count: 216,272 (over 2 acres)
Average Size: 18 acres
Screening Criteria
Size: 25 acre minimum, LCI <20, Corroboration
Portfolio goal: 20 * 44 "types" = 480 (499)
Portfolio sites: 340-380 sites (roughly 1269 occurrences)
Portfolio acreage: 14% of all coves/draws, <1% of Ecoregion
Portfolio Protection by area: 76% on GAP 1 or 2
11% on GAP3

Key recommendations for cove forest and wooded ravines

We recommend that protection be established for 14 percent of these features in a set of 360 sites that contain a remarkable 1200 of our most critical occurrences. This goal is highly achievable as currently 76% of the critical examples identified in this portfolio are already protected in GAP 1 or 2 reserves. The final 24% may be a challenge however as they tend to occur in low elevation settings with richer soils.

Figure 9. Critical cove/draws in the ecoregion



WETLAND ECOSYSTEMS

Freshwater Basin Wetlands

Bogs, marshes, fens, wet meadows

Much of the Northern Appalachian / Acadian region is soggy. Massive Holocene glaciers left behind a legacy of deranged drainage patterns forming over a million acres of marshes, mudflats, seeps, swamps and spongy bogs. These features are unevenly distributed across all subregions with the easternmost Acadian uplands and the Bras D'Or lowlands having more than the rest of the subregions combined.

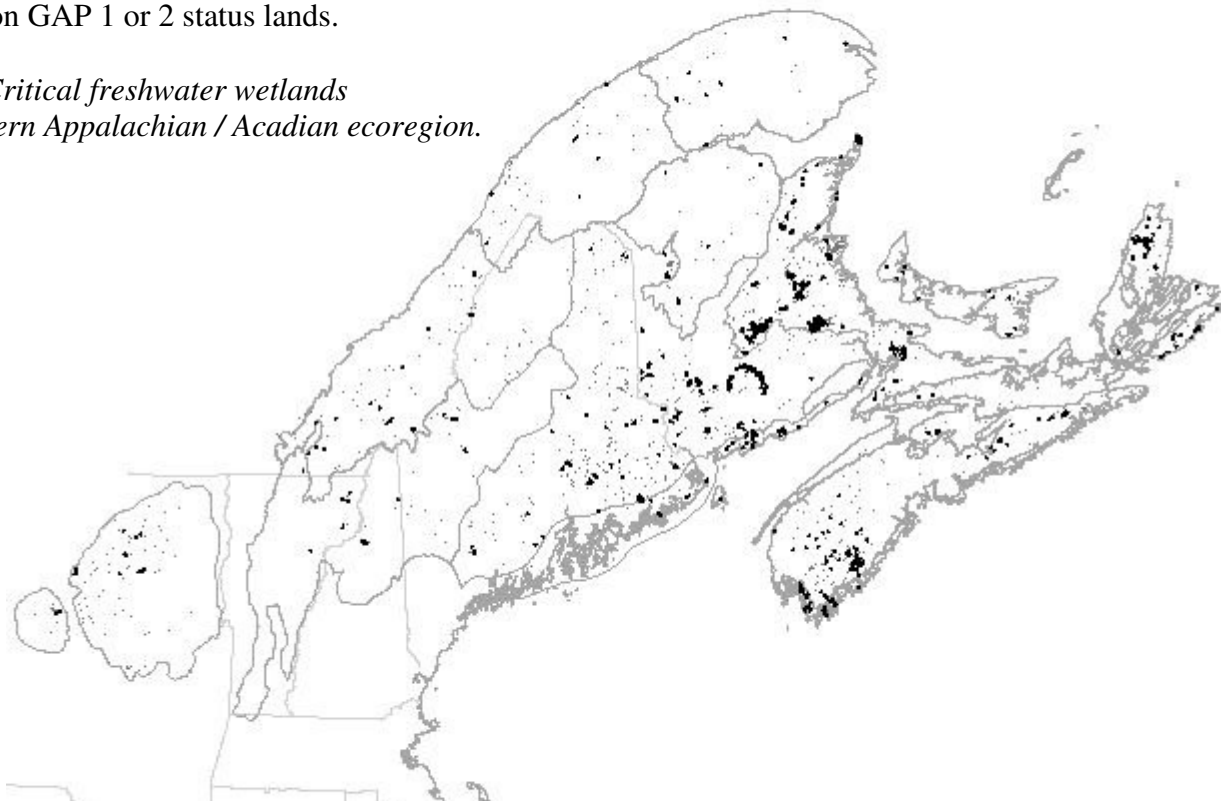
Breeding populations of birds such as Virginia rail, yellow rail, American bittern, marsh wrens, black-crowned night heron and ring-necked duck, herptiles such as pickerel frog, northern dusky salamander and Blanding's turtle, a myriad of sedges, rushes, bladderworts, orchids, water-lilies, pondweeds and insects from darners to dusky-wings depend on these wetlands.

Acreage: 1,273,517 (2% of the ecoregion)
Count: 29,312 (over 2 acres)
Average Size: 43 acres
Screening Criteria
Size: 50 acre minimum, LCI <20, Corroboration
Portfolio goal: 20 * 29 "types" = 580 occurrences
Portfolio sites: 568 critical occurrences
Portfolio acreage: 24% area of wetland, 0.05% of region
Portfolio Protection by area: 26% on GAP 1 or 2,
30% on GAP 3

Key Results for Freshwater Wetlands

Based on the results of this analysis we recommend that 24% of the 1.3 million acres of wetlands be protected for biodiversity in a set of 568 critical wetland complexes. About ¼ of these are already on GAP 1 or 2 status lands.

Figure 10. Critical freshwater wetlands in the Northern Appalachian / Acadian ecoregion.



Riparian wetlands

Floodplains, alluvial marshes, riverside seeps

Riversides and floodplains are some of the most dynamic areas of the landscape. During spring runoff, submerged floodplains provide critical feeding and spawning areas for fish and other aquatic species. In drier seasons, the water recedes to reveal a myriad of geomorphic features, each with its own characteristic flora and fauna. Fresh silt deposits, scoured riverbanks, sand bars, alluvial meadows, depression marshes, oxbow lakes, braided stream channels and lush floodplain forests interact to form a complex system rich in biodiversity.

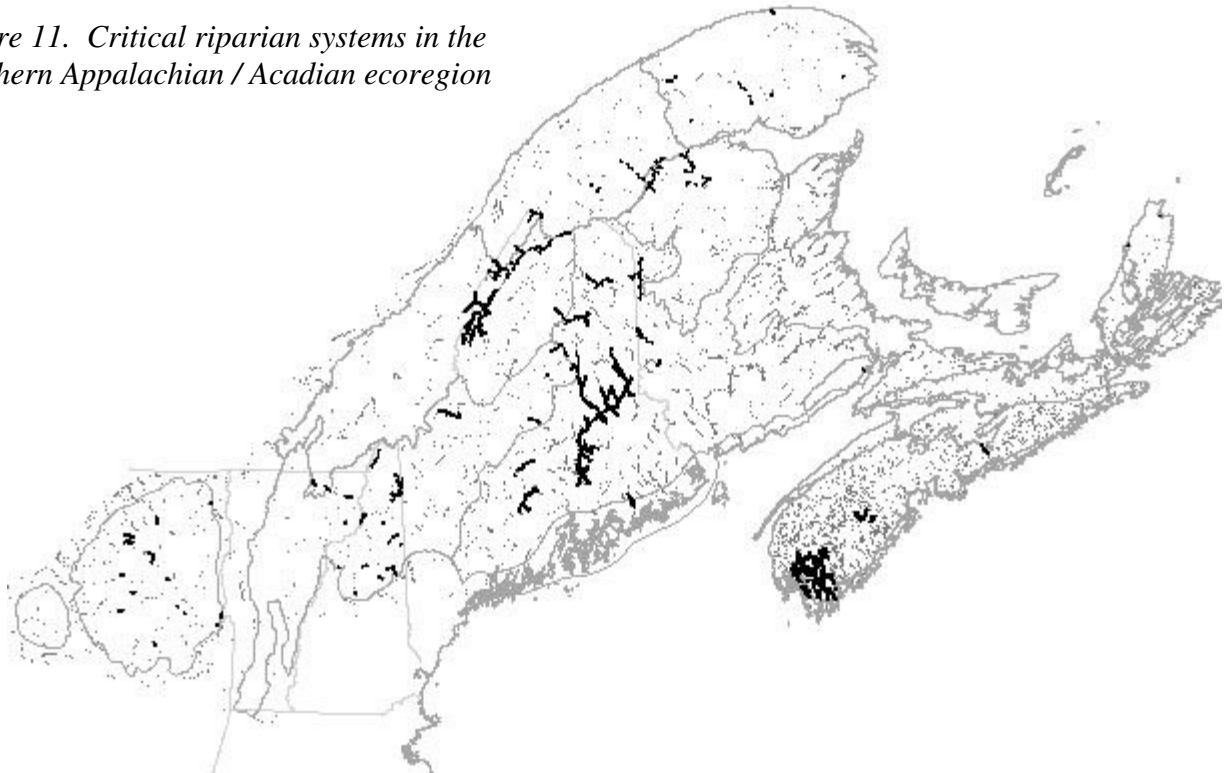
Intact riparian corridors and floodplains are linear features, averaging about 200 acres in the Northern Apps. They provide critical habitat for flood tolerant trees like silver maple, green ash, American elm and box elder as well as ideal conditions for many native ferns and herbs, such as ostrich fern, sensitive fern, wood nettle, tall meadow rue, jack-in-the-pulpit, riverbank grape and poison ivy. Wood turtles, fowler's toad, and many other frogs, turtles and salamanders depend on riparian systems as do brook trout, salmon and other native fish.

Acreage: 4,282,458 (5% of ecoregion)
Count: 21,834 (over 2 acres)
Average Size: 201 acres
Screening Criteria
Size: 100 acre minimum,
LCI <20, Corroboration.
Portfolio goal: 295 (10 * 29 "types")
Portfolio sites = 240 occurrences
Portfolio acreage: 18% of riparian features,
1% of ecoregion
Portfolio Protection by area: 3% on GAP 1 or 2

Key recommendations for Riparian systems

We recommend a minimum of 18% of all the intact riparian systems be protected for biodiversity in a network of 240 critical riparian systems.

Figure 11. Critical riparian systems in the Northern Appalachian / Acadian ecoregion



Coastal Shores and Wetlands

Salt marshes, beach/dunes, tidal flats, rocky shore, sea cliff, coastal bogs

The Northern Appalachian / Acadian ecoregion is rich with coastal features hosting almost 24,000 examples of beaches, salt marshes, tidal flats and rocky shores in a narrow zone tracking the continental shoreline. Although most features are relatively small (ave. 39 acres) and collectively they cover only 1% of the ecoregion it is remarkable how much biodiversity is concentrated at the coastal edge.

Tidal flats and marshes of this region are important to many of our rarest birds such as the salt marsh sparrow, roseate tern, arctic tern, willet and black-legged kittiwake. Specialized organisms, as exemplified by the dominant spartina grasses, have evolved mechanisms to resist desiccation and maintain salt balance in this dynamic setting. Rare or declining species include seaside dock, saltmarsh sedge, seashore saltgrass, creeping alkali grass, American sea-blite, and small spikerush are abundant in this setting

Acreage: 926,644, <1% of the ecoregion
Count: 23,950
Average Size: 39 acres
Screening Criteria
Size: Salt marsh 60, Beach 20,
Rocky shore 10, Bog 75,
Tidal flat 100 acres
LCI <30, Corroboration
Portfolio goal: 1440 occurrences (40 * 8 subregions)
Portfolio sites: 2311 features in 90 key sites
Portfolio acres: 44% of coastal features (- tidal flat)
1% of the Ecoregion
Protection: 18% protected with GAP 1-2 lands.

Key recommendations for coastal wetlands
We recommend that 44 % of all the tidal marsh, beaches, coastal bogs and salt ponds be conserved for biodiversity. This amounts to 423,052 acres in 90 critical marsh complexes.

Figure 12. Critical coastal wetlands and dunes in the Northern Appalachian / Acadian ecoregion

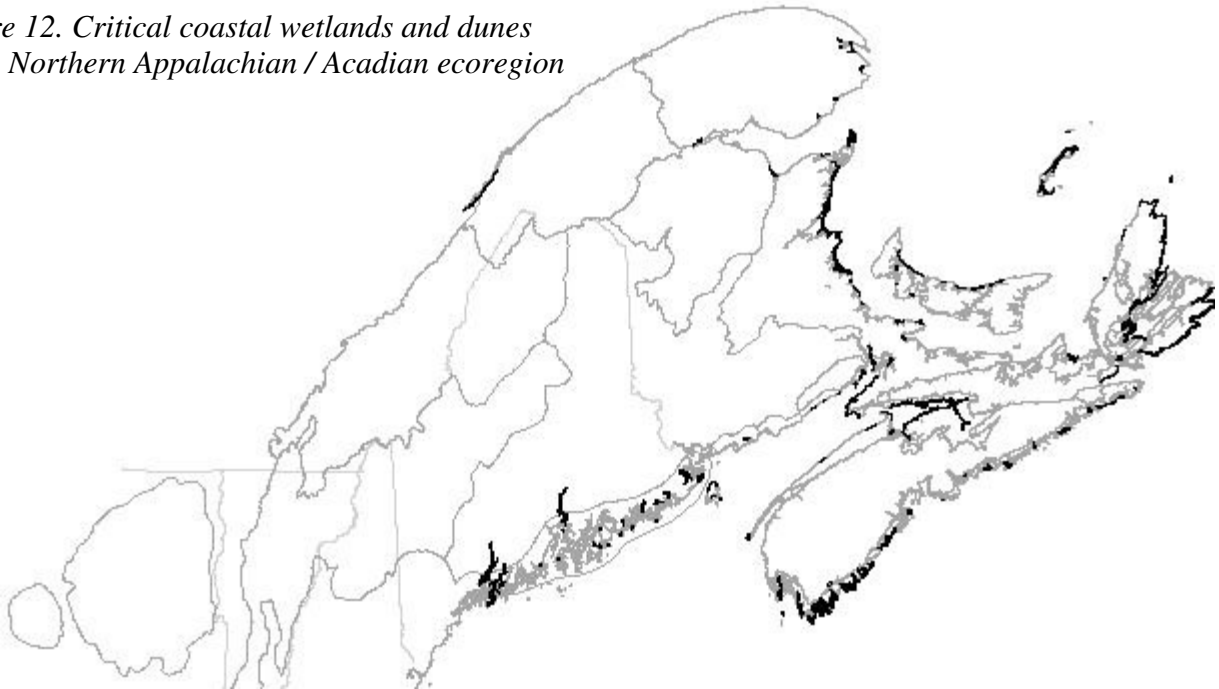


Table 2 Zoom in of cliff and steep slope

Ecological System (Natureserve)	Dominant ELU Feature	NVC Association
Acidic Cliff & Talus	Granite	Acer spicatum - Thuja occidentalis - Betula papyrifera / Taxus canadensis Shrubland Betula papyrifera - Picea glauca / Acer spicatum - Alnus viridis / Polypodium virginianum Talus Shrubland[Provisional] Granite - Metamorphic Talus Northern Sparse Vegetation Lichen spp. Nonvascular Vegetation Picea mariana / Ledum groenlandicum - Empetrum nigrum / Cladina spp. Dwarf-shrubland Picea rubens / Ribes glandulosum Woodland
	Low Elevation	Quercus rubra - Betula alleghaniensis / Polypodium virginianum Woodland
	Mafic	Basalt - Diabase Northern Open Talus Sparse Vegetation Igneous - Metamorphic Northern Dry Cliff Sparse Vegetation
	Sedimentary	Epilobium glandulosum - Viola spp. Cliff Sparse Vegetation[Provisional] Sandstone Dry Cliff Sparse Vegetation Sandstone Midwest Moist Cliff Sparse Vegetation
Alpine Mosaic	Alpine	Lichen Fellfield Sparse Vegetation [Provisional]
Circumneutral Cliff & Talus	Calcareous	Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation Limestone - Dolostone Midwest Moist Cliff Sparse Vegetation Thuja occidentalis Carbonate Talus Woodland Thuja occidentalis Cliff Woodland Tilia americana - Fraxinus americana - (Acer saccharum) / Geranium robertianum Woodland