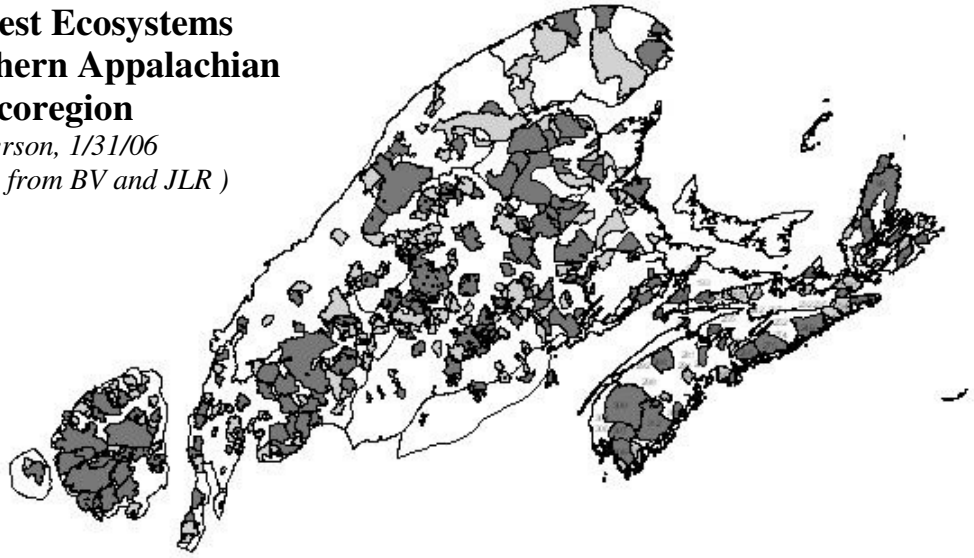
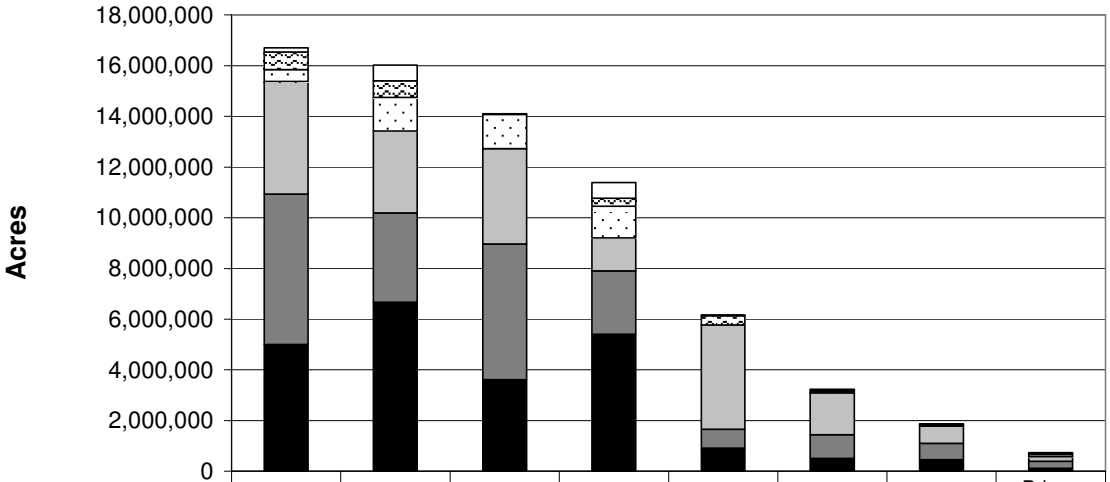
Matrix Forest Ecosystems in the Northern Appalachian /Acadian Ecoregion

(3rd draft Anderson, 1/31/06 including edits from BV and JLR)



The Northern Appalachian /Acadian ecoregion is a predominantly forested, rugged landscape clad in spruce, maple, beech, birch, pine, fir, hemlock, and oak. Eighty-two percent of the region's 82 million acres are covered by roughly equal amounts of conifer (28 percent), deciduous (24 percent) and mixed (24 percent) forest types. Presently, about 6 percent (4 million acres) of the forest is in an early successional state, most of that being "working forest" harvested in the last five years. The western and more southerly parts of the ecoregion in New York and Vermont are considerably more deciduous in nature than the large northeastern provinces New Brunswick, Nova Scotia and eastern Quebec which are chiefly coniferous (Figure 1).

Figure 1. Forest cover-types by state and province.



	Maine	New Brunswick	Quebec	Nova Scotia	New York	Vermont	New Hampshire	Prince Edward Island
Emerg. Wetland	161,391	620,640	1,331	616,134	26,065	46,161	24,875	20,941
Forested Wetland	690,113	663,461	18,912	315,703	365,101	64,133	42,073	53,551
Regen. or Barren	470,041	1,313,206	1,352,080	1,255,114	9,034	28,671	19,466	84,733
Deciduous Forest	4,440,433	3,237,340	3,758,050	1,296,036	4,108,182	1,652,717	677,180	178,507
Mixed Forest	5,932,374	3,525,839	5,357,761	2,500,443	747,896	939,105	646,355	282,989
Conifer Forest	5,006,211	6,665,508	3,614,662	5,403,863	910,665	506,134	461,097	112,942

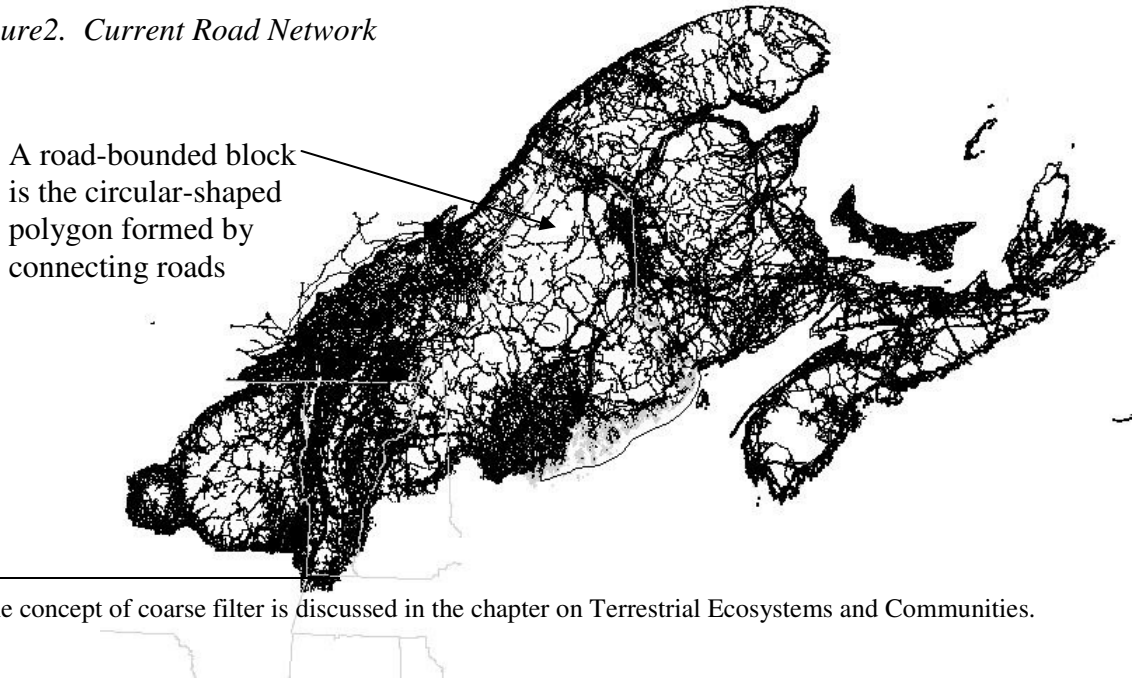
Dominant and contiguous ecosystems, referred to here as "matrix-forming" are singularly important for conservation as they define the fundamental ecological characteristics of a region such as total solar reflectance, evapotranspiration rates and regional responses to large-scale disturbances. Additionally, matrix-forming forests are important as "coarse filters"[1] for the conservation of most common species, from soil invertebrates and little known fungi to forest interior birds, large herbivores and wide-ranging predators.

Such large, contiguous systems pose an ironic challenge to conservation because it is unlikely that forest integrity and connective landscape can be protected throughout the entire ecoregion. Alternatively, we developed a five-step strategy to assess and protect the matrix forest system:

- Subdivide the entire forest into smaller semi-discrete "forest blocks.".
- Classify all forest blocks into representative forest landscape types.
- Screen each forest block, using indicators of biodiversity value and resilience, size, condition and landcover in the surrounding landscape context criteria
- Identify for conservation action, a network of functional forest blocks representative of the diversity of forest types and landscape elements of the ecoregion
- Advocate for management practices to retain forest cover and functional connectivity between the blocks

We used roads and other fragmenting features to subdivide the larger forested landscape into semi-discrete units (road-bounded blocks). Roads are an appropriate choice for this task as they disrupt the movement of some organisms and ecological processes and increase the level of threats associated with access into interior forest regions. Additionally the location of roads, powerlines, logging trails, housing developments, agricultural lands and mining operations are highly correlated with human extractive activities such as logging. These features have increased dramatically as the present forest redeveloped after being cleared for agriculture in the 1800s (Figure 2).

Figure2. Current Road Network



[1] The concept of coarse filter is discussed in the chapter on Terrestrial Ecosystems and Communities.

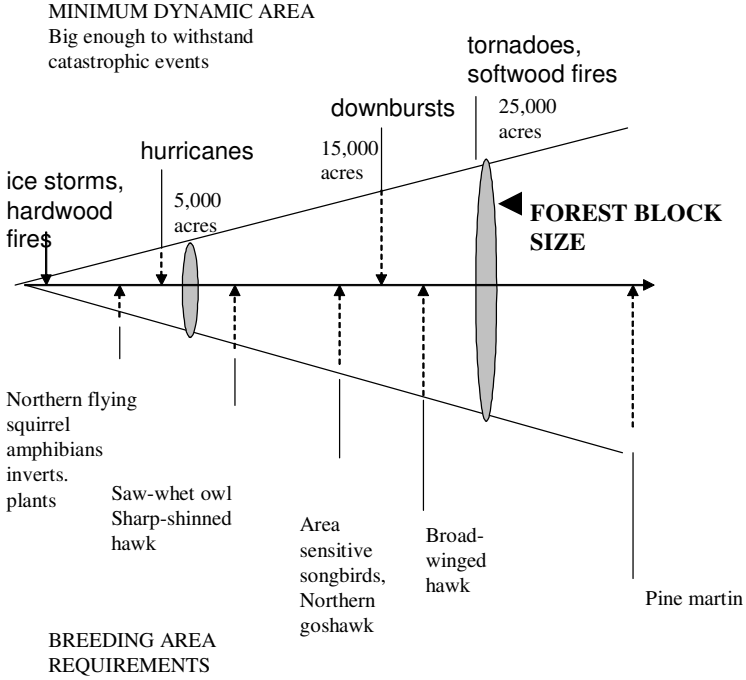
Using road-bounded blocks to tessellate the region creates thousands of potential forest blocks, most of them very small (Figure 2). Although large roadless regions are known to contain the most pristine and viable examples of forest ecosystems, many smaller examples in relatively good condition may be found scattered throughout the region. We developed screening criteria to define the characteristic of a functional forest block and then applied the criteria to the potential blocks to identify the best places for forest conservation.

The screening criteria had three dimensions:

- **Size**: Minimum of 25,000 acres (10,000 ha) based on the key factors of minimum dynamic area and species area requirements discussed below.
- **Condition:** Little internal fragmentation and at least 50 acres of old growth of mature forest with structural legacies. Confirmed evidence of high quality headwaters, high condition forest, or many examples of smaller scale ecosystems and species.
- **Landscape context:** Block surrounded on 75% of its boundary by natural or semi-natural land cover in a 10 mile radius

We determined the 25,000 acre critical size minimum for a forest block by examining the historic size ranges of documented catastrophic disturbance events along with the area requirements of forest-interior breeding species (Figure 3 –details in Anderson 1999)

Figure 3. 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

Representing forest blocks across all landscape types

Our goal was to identify for conservation forest ecosystems across all of the ecoregion's characteristic landscape types. Ecoregion-wide representation is a crucial part of our forest conservation strategy as it distributes risk in the face of severe region-wide threats such as climate change or acid deposition.

Stratifying forest block selection across all forest-landscape types maximizes the inclusion of different communities and species within the blocks. For example, some forest blocks encompass spruce forests on high-elevation granitic mountains. These blocks are likely to include acidic cliffs, alpine meadows, rocky summits and Bicknell's thrush populations. In contrast, other blocks encompassing deciduous forests in lowland valley settings underlain by rich calcareous and sedimentary soils may include rich fens, floodplain forests, rivershore grasslands and rare freshwater mussels. Even in blocks that share the same dominant forest type, one set may be situated so as to include extensive steeply cut rivers, while another set might occur within a landscape of moist flats with low rolling hills.

To assess the ecological characteristics of each potential forest area and determine which blocks could be considered interchangeable replicates of the same forested landscape, we developed a comprehensive region-wide data layer of physical features. We termed these *ecological land units* (ELUs). Technical details on the development of the ELUs are in the appendix. In brief, every 30 square meters of the ecoregion was classified[2] by its topographic position, its geology and its elevation zone (Table 1.), allowing us to identify discrete units such as "cliff on granite in the alpine zone" or "north facing sideslope on sedimentary rock at low elevations."

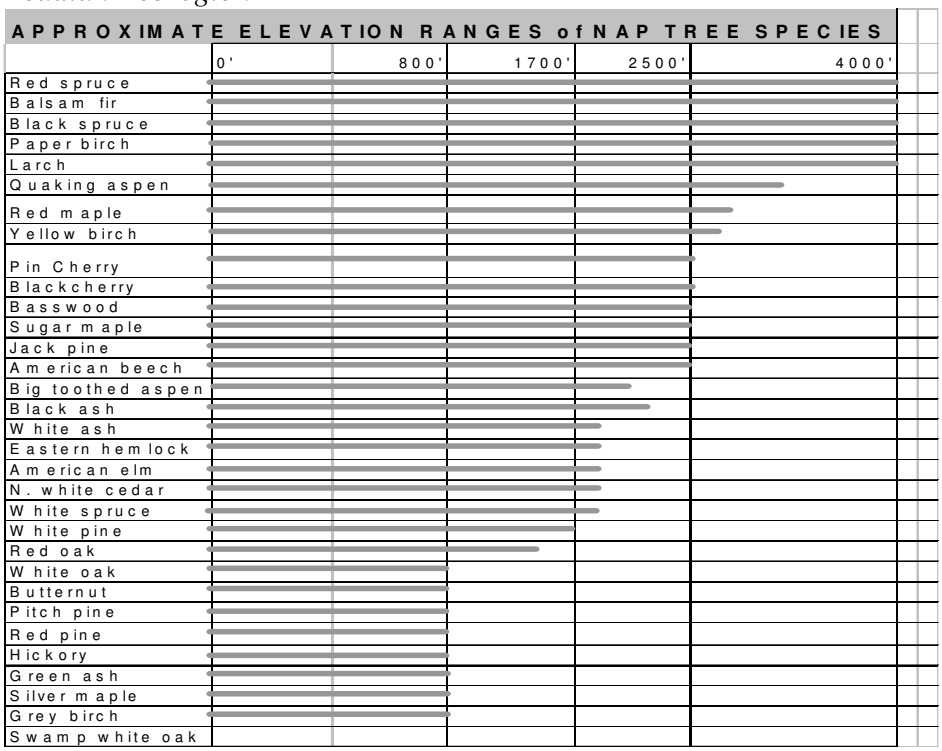
Table 1. Ecological Land Unit variables

ECOLOGICAL LAND UNITS: generalized example. An ELU is any combination of these three variables			
TOPOGRAPHY		GEOLOGY	ELEVATION ZONE
Cliff	Hill / gentle slope	Acidic sedimentary	Very Low (0-800')
Steep slope	Valley bottom or gentle toeslope	Acidic shale	Low (800-1700')
Flat summit or ridgetop	Dry flat	Calcareous	Medium (1700-2500')
Slope crest	Wet flat	Moderately Calcareous	High (2500-4000')
Sideslope –N facing	Flat at bottom of steep slope	Acidic granitic	Alpine (4000+'}
Sideslope – S facing	Stream	Intermediate or mafic	
Cove or footslope-N facing	River	Ultra mafic	
Cove or footslope–S facing	Lake or pond	Deep fine-grained sediments	
Hilltop flat		Deep coarse-grained sediments	

[2] While the variables that we used are physical ones, the classes were based on biological considerations (e.g., tree distribution for Elevation Zone).

The choice of elevation zones, bedrock types and topographic features used to develop the ELUs was determined by ecological considerations backed up by data. For example, elevation thresholds were based on tree distribution patterns (Figure 4)

Figure 4. Approximate elevation ranges for tree species in the Northern Appalachian / Acadian Ecoregion



By overlaying the boundaries of the potential forest blocks on the ecological land unit data layer, and tabulating the area of each ELU within the block, we summarized the types and amounts of physical features contained within each forest block. Subsequently we used standard quantitative classification, ordination, and cluster analysis programs to aggregate the forest matrix blocks into groups that shared a similar combination of physical features. The resulting groups consist for the most part of readily recognizable *forest-landscape combinations*, which we termed "ELU-groups."

We corroborated the differences between ELU-groups using expert review by state and provincial scientists and by examining the distribution patterns of over 10,000 ground inventory points provided by Canadian Conservation Data Centers and US Natural Heritage programs. Both sources indicated that smaller scale ecosystems, communities and species locations were highly correlated with the types and diversity of the ELUs. Thus, we assumed that the forest-landscape groups were a useful surrogate for both the current and potential biodiversity contained within each matrix block.

Selection Process

Identification of the Tier 1 blocks was done by local experts based on biodiversity values, forest condition, feasibility of protection, landscape context and complementarities to the other blocks. Materials provided included quantitative summaries of ELUs, current landcover, hydrologic features, element occurrences and protected lands as well as air photos and satellite imagery to assess forest condition

The section that follows describes the development and characteristic of specific Ecological Land Unit (ELU) groups. After the blocks within each ELU group were identified as potential conservation targets we reviewed them in detail with state, provincial and local experts. At each review session the participants were charged with examining a set of blocks within an ELU-group, and identifying the best and fewest blocks needed to fully represent the group. At a minimum this meant identifying a single block if the set was extremely homogeneous, but it ranged up to 9 if the set was heterogeneous or, especially, if there were blocks that clearly met the selection criteria and were already protected. It was felt that having several clusters of adjacent matrix blocks adding up to much larger areas of protected contiguous forest was not "redundant," but would make the resulting portfolio much more robust.

On average the experts identified 2 or 3 "Tier 1" blocks per ELU-group. Note that in some ELU groups there were few alternatives and perhaps no "Tier 2" alternates, whereas in some subregions and ELU groups there are alternatives that were designated Tier 2 to indicate they met the criteria, but, based on current condition or feasibility or overall portfolio efficiency, did not seem as good candidates. In practice it is recognized that both current condition and practical considerations of feasibility will change and the conservation importance of any given block will also change as the status of protected land changes.

Results: Ecological Land Unit Groups for the Northern Apps/Acadian Ecoregion

Through a combination of quantitative analysis and expert review we identified 71 distinct ELU-Groups, the basic template for representing all forest-landscape types occurring in the ecoregion. Preliminary groups were identified using Two-way Indicator Species Analysis or TWINSPAN (Hill 1979). A TWINSPAN analysis partitions a complete set of samples into increasingly smaller and more similar subsets based on dominant ecological gradients found in the data. Beginning with one undifferentiated set the partitioning proceeded as follows:

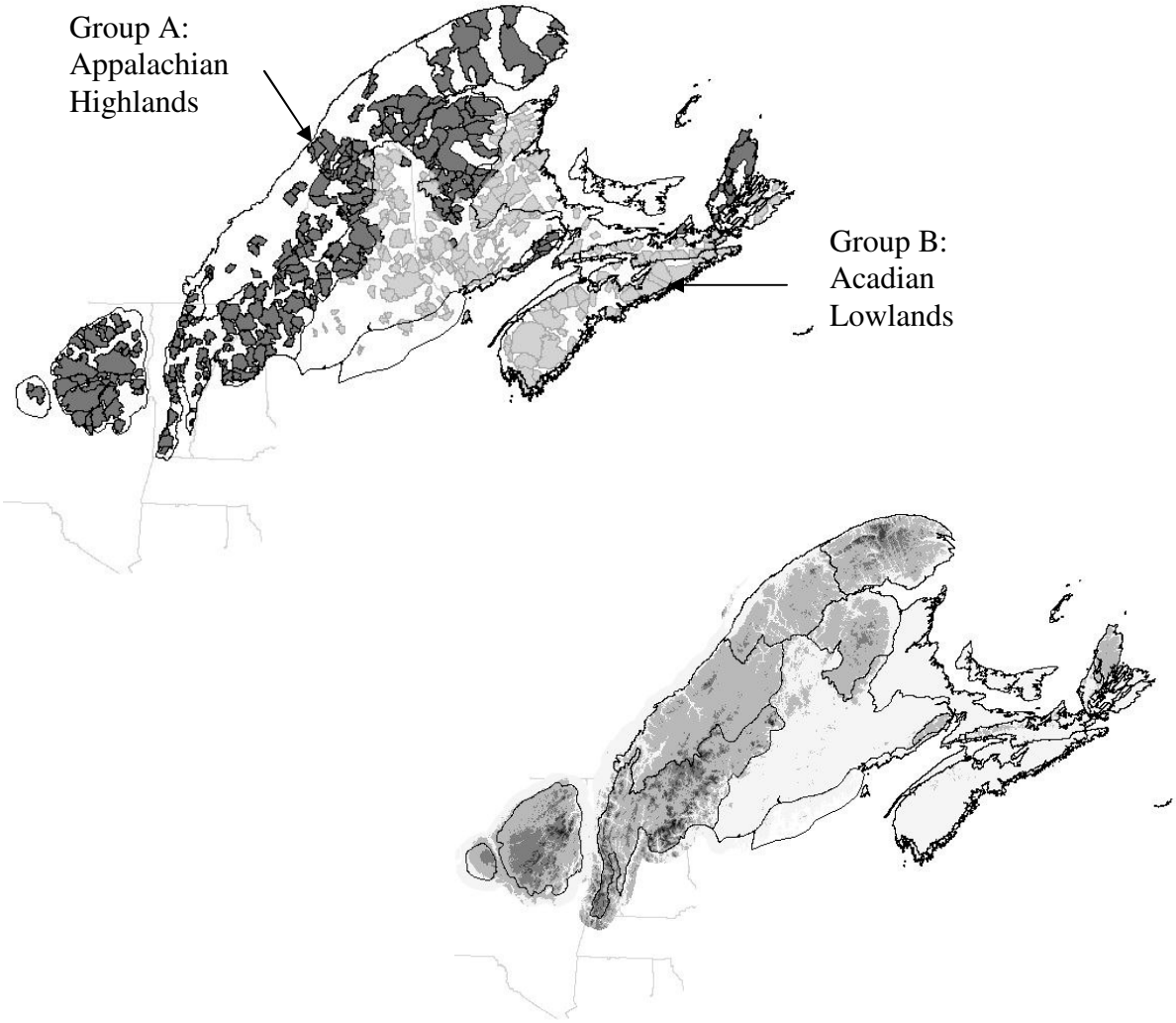
- 2 groups that corresponded with elevation
- 4 groups that corresponded with bedrock and elevation
- 17 groups that corresponded with bedrock, elevation, geography and climate
- 71 groups that corresponded with all of the above plus local landform differences

It is worth noting that ecologists across the ecoregion were agreed that the separations into the 17 groups (3 divisions) seemed to correspond to observable differences in natural species composition. They were not unanimous about the additional split into the finer set of ELU groups yielding a total of 72 groups. These seem

meaningfully different in some cases, less clearly so in others. Tier 1 blocks for conservation priority were identified within each interchangeable set.

Examining each successive division and identifying the corresponding gradients will elucidate the logic behind the final set of ELU-groups. The initial division, for instance, corresponded with elevation (Figure 5).

Figure 5. The first TWINSPAN division (top left) corresponded directly to elevation zones (bottom right). The "A" group in dark grey was associated with elevations from 800-4000' while the "B" group was composed of blocks under 800' in elevation.



The result of the first division was a split of the blocks into those from the Appalachian highland region (A) and those from the Acadian lowland region (B). These two regions are dominated by different forest types and exhibit many other consistent ecological differences. To quantify the differences we examined the species, communities and ecosystems contained within the matrix blocks corresponding to the two groups.

The high elevation Appalachian region block contained 723 communities/species that were only recorded from this region. Very characteristic were mountain red spruce-balsam fir forests, balsam fir forests, transitional spruce-hardwood forests and a number of alpine communities such as krumholtz and alpine meadow. These blocks also contained much of the rich hardwood forests associated with coves, the bulk of the summit ecosystems, and all the cold-air talus slope communities. Preferential rare fauna included the rock vole, long-tailed shrew, northern bog lemming, Bicknell's thrush and three-toed woodpecker. Restricted plants in this region included dwarf white birch, bearberry willow, lance-leafed arnica, diapensia, Bigelow's sedge, alpine sweetbroom, boreal bentgrass, arctic rush and more than 400 additional species, most of them alpine.

The low elevation Acadian lowlands blocks contained a set of 334 communities/species found only in this half of the ecoregion. The lowland region coincides with the distribution of red oak- white pine forests, oak woodlands, pitch pine summits, large silver maple floodplain forests, hemlock-pine conifer forests and red maple swamps, although small examples of these communities may sometimes be found in low elevation pockets in the highland region. Birds partial to open woodlands or grasslands such as Baltimore oriole, great-crested flycatcher, indigo bunting, eastern phoebe, whip-poor-will, black-billed cuckoo, purple martin, upland sandpiper and eastern meadowlark are known only from this portion of the ecoregion. Marsh birds such as Virginia rail, yellow rail, black tern and marsh wren are much more common in this wetter lowland region as are greater scaups, brants and other lake associated waterfowl. Herptiles such as the grey treefrog, Blanding's turtle and the eastern ribbon snake are also restricted, within the ecoregion, to these warmer lowland settings.

Over 200 plant species show up only in these lower elevation blocks including a few tracked tree species such as butternut and bur oak. Other species included four types of goldenrod, brookside alder, zigzag bladderwort, buttonbush, netted chainfern and coastal plain endemics like Virginia meadow-beauty, Plymouth gentian and twigrush.

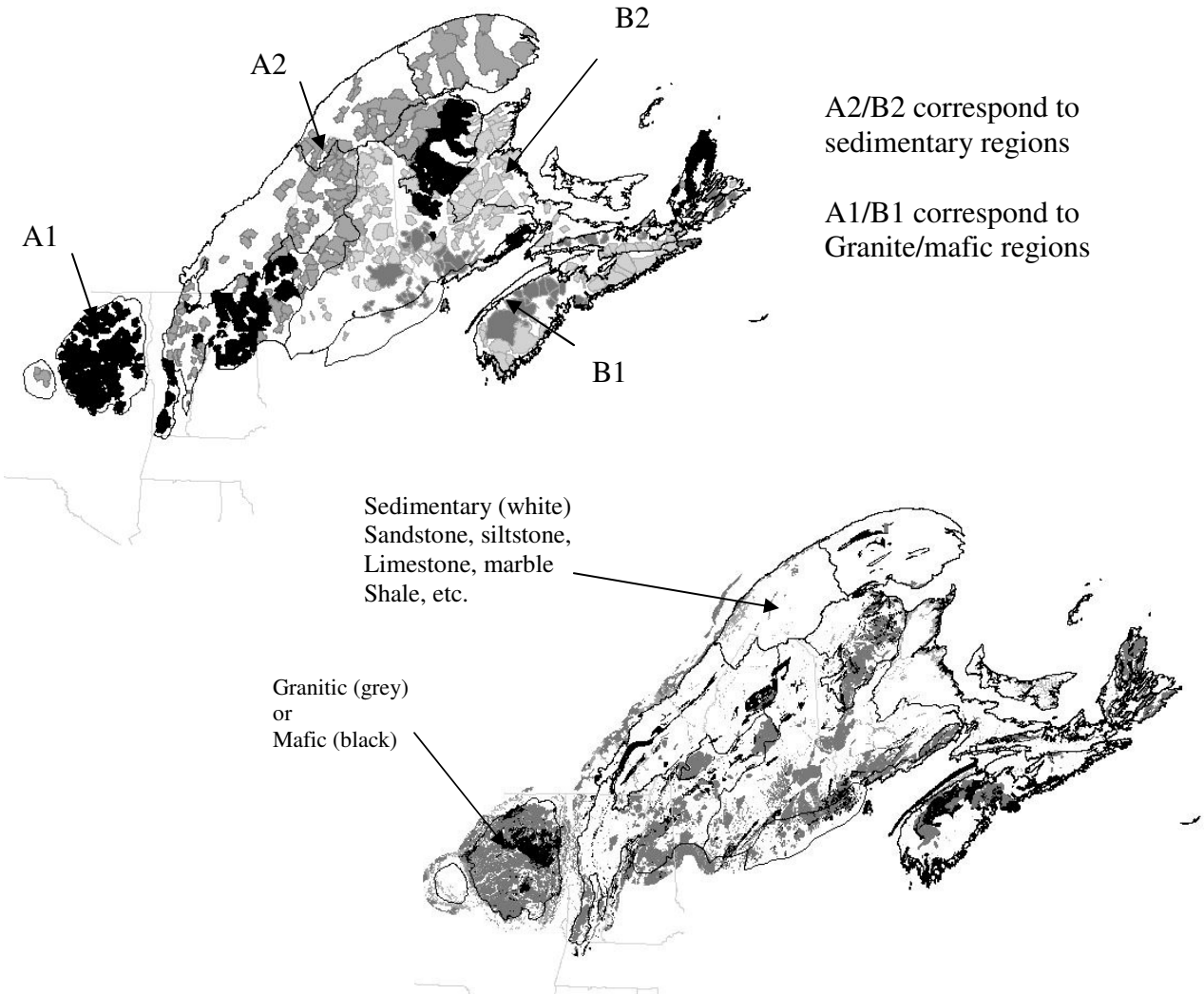
The second TWINSPAN division further subdivided the two elevation groups into four sets based primarily on bedrock geology. Blocks falling chiefly on granite and mafic bedrock were separated form those occurring on sandstone, siltstone, limestone, dolomite, shale or other sedimentary bedrocks (Figure 6).

The bedrock groups have corresponding species and community differences with about 545 types showing a preference for blocks in granitic or mafic settings. These included breeding sites for peregrine falcon, northern goshawk, and black guillemot, most alpine species and much of the jack pine, pitch pine or maritime spruce forests. Granite favoring plants included White Mountain saxifrage, twining baronial, and Pickering's reed bent-grass.

A set of 306 species and communities favored blocks in sedimentary settings. Examples included hardwood floodplains, riverside seeps, circumneutral and calcareous fens, shoreline outcrops and Atlantic white cedar bogs. Corresponding rare plants

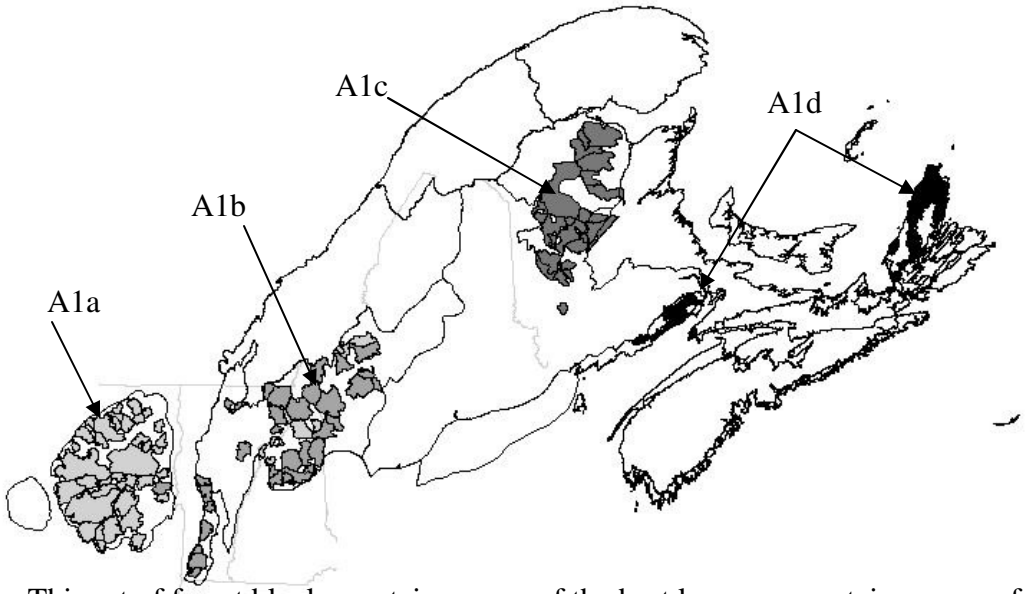
included the calcareous-favoring dioecious sedge and prairie sedge and others like Orono sedge, northern bog sedge, soft-leaved muhly, Gaspe shadbush and eastern blue-eyed grass. A majority of fish, mussel and bat hibernacula occur in matrix forest blocks in sedimentary regions.

Figure 6 The second TWINSPAN divisions (below left) were driven by bedrock differences. Both elevation groups split into a granitic/mafic set (A1, B1) and a sedimentary set (A2, B2). The overlay of the patterns is easy to see on the simplified geology map (below right).



In summary, the result of the first two divisions was a partitioning of the forest blocks into four basic block groups: A1 - Appalachian highland on granite or mafic bedrock, A2 -Appalachian highland on sedimentary bedrock, B1 - Acadian lowland on granite or mafic bedrock, B2- Acadian lowland on sedimentary bedrock. The next few pages examine each of the four groups more closely and present the results of the block selection process in detail. The expert review process and selection criteria were described on page 6

Appalachian Highland Blocks on Granitic or Mafic Bedrock (Block Group A1): Adirondacks, Southern Green Mountains, White Mountains, Mt Megantic, Mt Carlton Highlands, Fundy Highlands and Cape Breton Highlands



This set of forest blocks contains many of the best known mountain ranges of the ecoregion. Forests in these mountains stand on hard acidic granite or anorthosite, representing the plutonic cores of ancient mountains. In some areas the granites are intermixed with extremely resistant quartzite.

The Adirondack blocks (A1a) were the most unique group, being developed on magnesium and iron (mafic) rich anorthosites with origins and weathering properties quite different from the textbook granites of the other mountains. The forests in these mountains are also strongly deciduous in character and contain the best developed and most functional examples of old-growth northern hardwoods in the northeastern US.

The Fundy and Cape Breton Highland blocks (A1d) separated from the other based on their relatively lower elevations, warmer climate zone and maritime influences. Never-the-less they exhibit alpine like features similar to parts of the White Mts. and High Peaks of the Adirondacks. They further differentiate from each other based on the high proportion mafic soils of the Fundy region.

The White/Green mountains (A1b) separated from the New Brunswick highlands (A1c) based mostly on elevation with the former having strong gradients ranging from northern hardwoods at the lower elevations up to extensive spruce-fir forests well over 2500 ft and significant numbers of alpine peaks over 4000 ft in elevation. Although Mt Carleton, the highest point in the Maritimes, reaches 2690 ft., the New Brunswick highlands are mostly in the 800 – 1700 ft range, in a warmer climate zone, less dramatically sloped and more strongly coniferous than the White/Green mountain region.

The White/Green mountain blocks further separate into a southern Green mountain set on metamorphosed gneiss that is warmer and more deciduous than the White Mountain set. The New Brunswick uplands further separate on landform qualities with the flatter wetland regions separating from the steep mountainous blocks.

Each group was separated once more into a finer set of ELU-groups within which the blocks were judged to be most certainly interchangeable.

The final results of the selection process for group A1 are given in tables 2 and 3. The tables list the blocks by name, state or province, and provide the current protection status. Protection status is by GAP code as explained in the managed and protected lands section. Generally GAP 1 or 2 indicates a conservation reserve with no extraction and a management plan aimed at conserving biodiversity. GAP 3 refers to an area with extractive management (generally logging) but with easements or other legal restrictions to prevent conversion of the land from forest into agriculture, developed lands or other non-forested uses.

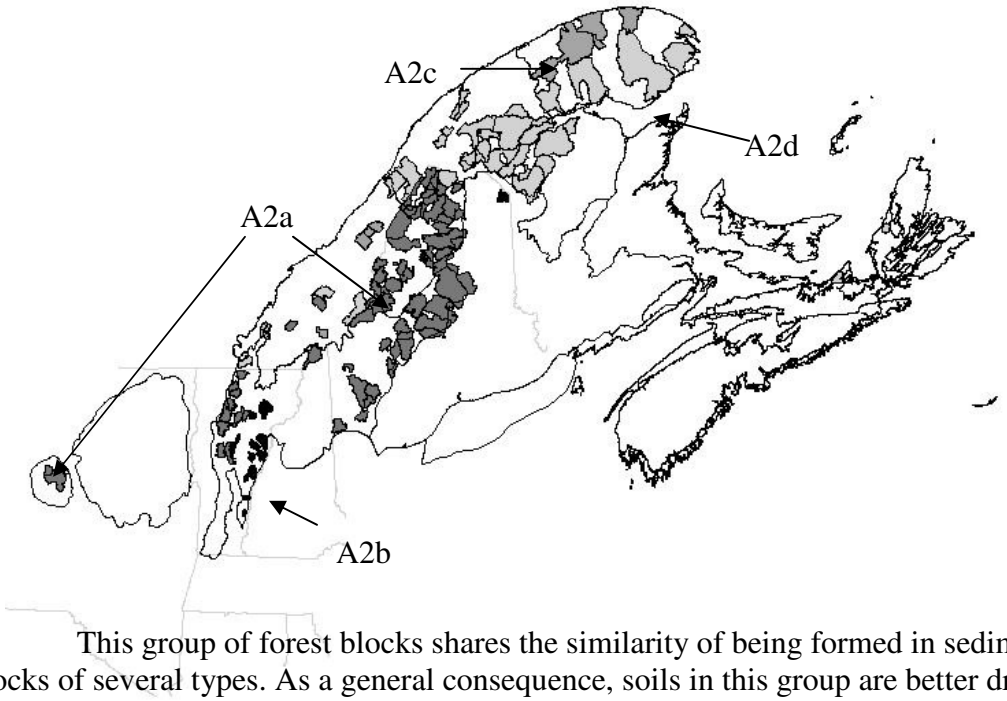
Table 2: Northern Appalachian Granite Highlands: Adirondacks Region (A1a)

HIER4	ELU_GROUP	Block Name	S/P	%GP1	%GP2	%GP3
A1a1	Adirondack Central Mt	Ferris Lake	NY	0	85.1	
		Hudson River Gorge	NY	0	61.9	0.8
		Pigeon Lake	NY	54.1	21.9	0.5
		Sargent Ponds	NY	0	67.1	2.4
		Siamese Ponds	NY	69.7	4	2.3
		Silver Lake	NY	67.2	17.8	0
		Wakely Mountain	NY	55.4	36.4	0.8
		West Canada Lakes	NY	33.4	38.2	2.7
		Wilcox Lake	NY	0	69.6	
A1a2	Granite Highlands	Coburn Gore	ME			26.7
		Lyon Mountain	NY		0.6	4
		Sable Mountains	NY		55.5	1.8
A1a3	Adirondack SW foothill	Five Ponds	NY	34	20.2	13.2
		Independence River	NY	14.1	35.6	4
		Jerseyfield Lake	NY		56.7	
A1a4	Adirondack Highlands	Giant Mountain	NY	71.4	2.7	0.1
		High Peaks	NY	49	9.2	4
		Hoffman Notch	NY	50.5	31.7	
		Jay Range	NY	18.9	4.1	0.2
		White Face	NY	66.5	11.9	6.6
A1a5	Adirondack NW flow	Jordan River	NY	1.1	22.3	40
		St Regis	NY	11.4	3.5	41.6
		Whitehill	NY		31.3	17.8
A1a8	Adirondack SE foothill	Jabe Pond	NY	0	68.7	3.3
		Pharoah Lake	NY	63.2	2.3	2.4
A1a9	Mafic Whites	Kilkenny	NH	0.1	29	39
		Number 5 Bog	ME		1.1	21.9

Table 3: Northern Appalachian Highlands: White and Green Mountain region (A1b)

HIER4	ELU_GROUP	Block Name	S/P	%GP1	%GP2	%GP3
A1b	Whie/Green Mts					
A1b1	Eastern whites	Bigelow	ME		1.9	67.1
		Mahoosucs	ME	0	4.1	15.4
		Mt. Abram	ME	1.7	4	9.3
A1b2	S .greens	The Burning	VT	49.8	3	33.8
		White Rocks	VT	15.9	30.9	30.1
A1b3	NE .kingdom	Nulhegan	VT	0		65.3
		Victory Basin	VT		0.4	31.6
		West Mountain	VT	0.9	19.7	31.8
A1b4	White Mountains	Baldpate	ME		3.8	18.3
		Bunnell/Nash Stream	NH	6	0.1	28.7
		Dead Diamond River	NH		0.7	21.1
		Monastery Mt	VT		10	59.9
		Pemigewasset	NH	31.7	41.1	22.7
		Presidentials/Dry River	NH	38.4	32.8	20.6
		Sandwich	NH	22	28.6	37.4
		Upper Magalloway	ME	13.9	1.5	29.6
		Wild River	NH	0.5	39.2	46.2
A1c	NB Mountains					
A1c1	Nb calcmafic	Jacquet River PA 1	NB	22.3		61.1
A1c2	Nb mount	Brighton Moutain	NB			49.1
		Gilman Peak	NB	0		14.3
		Mount Carleton region	NB	11.6		36.8
		NBCA118	NB			12.7
A1c3	Nb mod calc	Dungarven Lake	NB			94
		Kennedy Lakes PA	NB	46.2		49.8
		Mularchy Peak	NB			13.6
A1d	Cape Breton/Fundy					
A1d1	NS capebreton	Bornish Hills	NS	7.6		28.2
		Cape Breton High	NS	76.1		5.1
		Pollets Cove-Asp	NS	52.2	0.2	34.7
		Trout Brook	NS	5.5		54.8
A1d2	Nb coastmafic	Caledonia Gorge PA	NB	11.8		60
		Cape Chignecto	NS	32.7	0.1	13.2
		Donnegal	NB			42.1
		Fundy National Park PA	NB	64.2		28.7
		Ross Corner	NB			41.5

Appalachian Highland Blocks on Sedimentary Bedrock (Block group A2) Gaspe highlands, Northwest Maine, Northern Green Mountains, Vermont Piedmont and the Tughill plateau.



This group of forest blocks shares the similarity of being formed in sedimentary rocks of several types. As a general consequence, soils in this group are better drained and richer in nutrients than the granite-formed soils of group A1 and many of the rich hardwoods forests communities are found in this set. This group also tends towards more developed and deeply cut stream networks.

Mostly the forests are on resistant quartzite, conglomerate, metamorphosed sandstone, siltstone, hornfell and schist, with almost all bedrocks exhibiting some form of alteration due to heat and pressure. The Vermont piedmont region is dominated by calcareous marbles and altered limestone while the Tug Hill region has the only extensive shales of the ecoregion.

The blocks differentiate cleanly along some natural gradients. Blocks of the northernmost Mont Chic-Chocs region of the Gaspe highlands are the most different having strong elevation gradients with much of the area being over 2500 ft and containing extensive sections of alpine over 4000 ft.

The next most different set in this group is on the Vermont piedmont where there is richer calcareous bedrock, mixed forests, and broader valleys. A number of interesting small- patch communities like calcareous cliffs and outcrops occur here. One apparent outlier of this set, the Caswell block, shows up in far northeastern Maine were it remains as a large intact forested wetland complex sitting alone in a primarily agricultural setting.

The Tughill block is also somewhat of an outlier, being a high flat sedimentary plateau with deciduous forests and extensive wetlands. Its proximity to the Great Lakes gives it one of the highest snowfall accumulation areas in the US and the boundary area of this block exhibits shale cliffs and talus slopes which are unique for this ecoregion.

The remaining sedimentary expanse in this group differentiates based on landform properties. The northern section reaching to the tip of the Gaspe is strongly dissected with deeply cut stream channels and include extensive coves, confined floodplains and steep

slopes. The southern set of sedimentary blocks is flatter with extensive wetlands and numerous hill complexes.

The results of the expert selection process for Tier 1 blocks are given in tables 4 and 5. Details on the selection process were given on page 10.

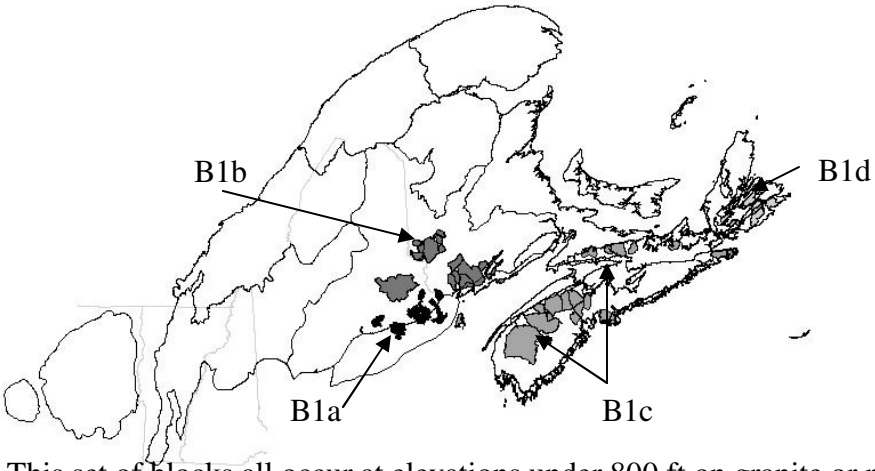
Table 4. Appalachian Sedimentary Highlands: Northern US and Southern Quebec sedimentary highlands (A2a&b)

HIER4	ELU_GROUP	NAME	S/P	%GP1	%GP2	%GP3
A2a	White/Green Mts					
A2a1	Qumaficflat	QCCA259	QC			
		QCCA222	QC	45.8		
A2a2	N. Greenmts	QCCA289	QC	7.4		
		Bone Mt	VT	1.4	0.4	41.1
		Breadloaf	VT	42.9	4	37.4
		Camels Hump	VT	3.7	0.3	38.9
		Indian Stream	NH	0.1	6.8	74.3
A2a3	Northernsedflat	QCCA213	QC			25.7
		Depot Lake-29 west	ME	14.6	1.3	33.5
		Tug Hill	NY	11.7		35.1
A2a4	(blank)	East Lake	ME			26
		Upper St. John Ponds	ME	4.3		58.5
A2a5	(blank)	Caribou/Speckled	ME	18.7	8.2	40.6
		Mt. Blue	ME		10.7	5.5
A2a6	(blank)	Deboulle	ME			21.9
		Little Black River	ME			63.9
A2a7	(blank)	Big Spencer	ME	2.7	1	9.5
A2a8	(blank)	Nahmakanta	ME	15.9	3.8	38.2
A2a9	(blank)	Big Reed	ME	8.2		57.2
		Chamberlain	ME		19.3	60
A2a10	(blank)	Baxter	ME	32.1	0.7	21
A2b	VT Piedmont					
A2b1	(blank)	Steam Mill Brook	VT			16
		Taylor Valley	VT			3.9
A2b2	(blank)	Pine Mountain	VT			5.6
A2b3	(blank)	Caswell	ME		0.4	5.2

Table 5. Appalachian Sedimentary Highlands: Quebec Highlands (A2c&d)

HIER4	ELU_GROUP	NAME	S/P	%GP1	%GP2	%GP3
A2c	Gaspe-N. coast					
A2c1	Qbsmount	QCCA136	QC			27.2
		QCCA146	QC		1.7	29.2
		QCCA267	QC	43.6	0.1	1.7
A2c2	Qusedmount	QCCA15	QC	17.6	44.4	38
		QCCA9	QC	17.6	2.1	58.5
A2c3	Qusednravines	QCCA1	QC	0.7	4.1	81.9
		QCCA6	QC	30.9	0.7	61.4
A2d	Gaspe – S. coast					
A2d1	Nbcalc	Forbes Gulch	NB			3.4
		Popelogan Depot	NB			97.2
A2d10	NSCBsedslope	Eigg Mountain	NS			27.7
		Mason's Mountain	NS			36.3
A2d12	Qbsedwet	QCCA199	QC	15.2		
A2d14	Qusedravines	QCCA52	QC		4.4	95.6
A2d2	Qbsedhills	QCCA64	QC		22	42.8
A2d3	Qbsedlflats	NBCA89c	NB	0.1		22.5
		QCCA89a	QC		0.2	73.7
		QCCA89b	QC			46.9
A2d4	Qbsslopes	Halfway Depot	NB			38.3
	Qusedtightslopes	Green River	QC	0	2.6	82.6
		Kedgwick	NB		1.5	97.3
		Restigouche	NB		3.1	65
A2d5	Qunlowslopes	QCCA37	QC		30.2	41.3
		QCCA50	QC		20.2	27
		QCCA51	QC		6.2	78.3
A2d6	Qusedncoast	QCCA10	QC	86.5	0	
		QCCA12	QC		5.2	76.4
A2d7	Qusedslopes	QCCA24	QC	0.2	1.8	79.7
		QCCA35	QC		1.4	74.9
A2d8	Quserpflat	QCCA262	QC			
		QCCA270	QC	0		

Acadian Lowland Blocks on Granite or Mafic Bedrock (Block Group B1): N. coastal Maine, Mouth of the St Croix, Minas Basin, Kejimkujik region, Bras'd'Or lake region.



This set of blocks all occur at elevations under 800 ft on granite or mafic bedrocks. Most are near the Bay of Fundy and have maritime influences.

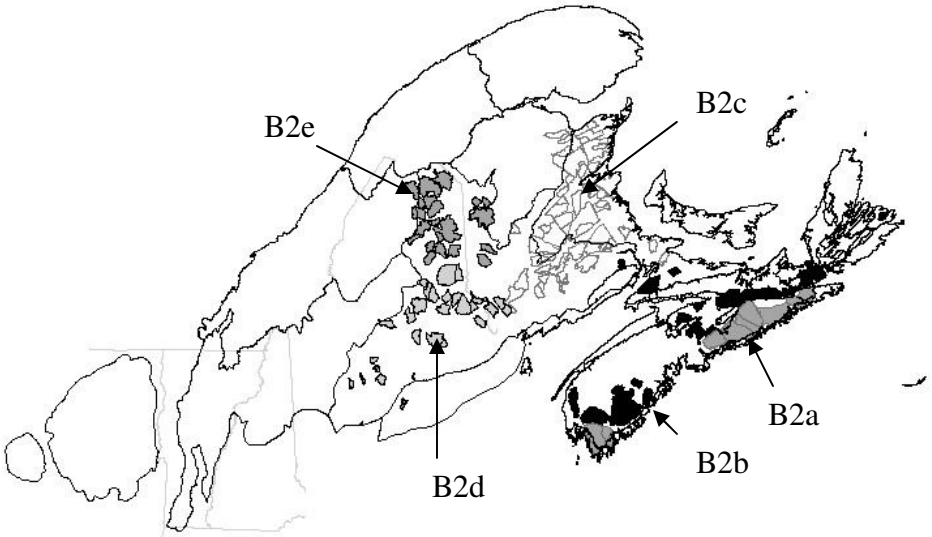
The first group (B1a) begins just north of Acadia National Park in the US and represents a set of rocky coniferous or mixed forests and islands, some with extensive coastal bogs and maritime spruce-fir woods. The second group (B1b) clusters around the mouth of the St Croix River, and are mainly granitic basins with large deposits of fine surficial sediment and extensive lakes and wetlands. The third group (B1c) consists of granite and mafic flats in the southern inland region of Nova Scotia, which contains the Kejimkujik National Park, and the ridge of hills just north of the Minas Basin. The final group (B1d) are a set of granite lowland blocks around Bras d'Or lake on Cape Breton.

The Tier 1 blocks identified by expert review are given in Table 6.

Table 6 Acadian lowland blocks: Granite and mafic coastal region (B1a-d)

B1	ELU_GROUP	Block Name	S/P	%GP1	%GP2	%GP3
B1a1	NB:Island	Grand Manan	NB			
	ME: acidicflatshills	Spring River Lake	ME		0.1	17.9
B1b1	NBcoastfs&g	Loch Alva PA 1	NB	22.9		62.2
		Oak Ridge	NB	0		2.8
B1b2	Nbfs&gf	Spednic Lake PA	NB	89.8		8.5
B1b3	ME: mixedflatslakes	Downeast Lakes	ME			9
B1c1	Nsgranmaficflat	Cloud Lake	NS	15.6		47.6
		Kejimkujik with redesign	NS	48.6		7.9
		Panuke Lake	NS	0.4		30.4
B1c2	Nsmaficcoast	Bonnet Lake Barrens	NS	42.8		11
		Canso Coastal Barrens	NS	72.9		5.1
		Terrance Bay	NS	48.8		13.3
B1c3	Nsmaficridge	Economy	NS	15.7		12.5
B1c4	Outlier	Cape Split	NS	8		0.5
B1d1	NSCBflats	Boisdale Hills	NS		0.4	30.4
		Marble Mountain	NS			32.8
B1d2	NSCBgranflats	Framboise-Middle River	NS	16.2		54.8
		Louisbourgh/Mira	NS			50.9

Acadian Lowland Blocks on Sedimentary Bedrock (Group B2): Northern Acadian uplands region (B2e), Central Acadian uplands, Northumberland lowlands, Nova Scotia Atlantic lowlands,



This group shares the similarity of sedimentary derived soils varying from metamorphosed or carboniferous sandstone and siltstone, and moderately calcareous mixtures of the same, to calcareous deposits of marble or limestone, A few areas are mélanges of sedimentary rock with inclusions of mafic granite. Almost all the blocks have large surficial deposits of coarse sandy outwash or fine-grained lake sediment. As a whole this is the wettest of the forest block group with extensive marshes, bogs and soggy forested basins are common in many of the groups.

Working from east to west, the first group (B2a) flanks the Atlantic-facing coastline of Nova Scotia and included two separate regions: a broad sedimentary lowland running from Halifax eastward to Chedabucto bay, and the eastern tip of the province around Cape Sable. Bedrock in both of these areas includes a significant component of mafic bedrock scrambled in with the primarily sedimentary environment. Group B2b captures a set of interesting inland forest regions in the central and southeast coast region including the Flintstone barrens.

Group B2c corresponds with the extensive Northumberland lowlands and the eastern edge of the Acadian upland section. This area is the wetland nucleus of the ecoregion having almost three times the amount of swamps, lakes, marshes and bogs than any other portion of the region. Group B2d consists of the southwestern portion of the Acadian uplands this region has moderately calcareous soils and extensive deposits of fine-grained lake sediments and coarse-grained glacial or river outwash. It is known for some large wetland complexes. Notably some of the blocks on the far western end are rather small and isolated occurring in one of the more developed sections of the region. The final Group, B2e, is a somewhat drier and more acidic flatland. The area is shared by Maine and New Brunswick and has a rich calcareous farmland in its center where there were no qualifying forest blocks.

The Tier 1 blocks identified by the expert review process (see page 10) are given in Table 7 below.

Table 7 Acadian lowlands on Sedimentary bedrock (B2 a-e)

HIER4	ELU_GROUP	NAME	S/P	%GP1	%GP2	%GP3
B2a	NS south coast					
B2a1	Nsscoastmafic	Quinan Lake	NS		0.8	71.6
B2a2	NSmidcoastsed	Liscomb River	NS	9.2		73.1
		Tangier	NS	22.6		38.7
		Waverly	NS	20.8		27.7
B2b	NS sed. lowland					
B2b1	Nsssedflat	Clare	NS			5.9
		Flintstone Barrens	NS	2.3		69.7
		Lake Rossignol	NS	17.7		29.5
B2b2	Nscentralsed	Long Lake	NS			21.7
	Nssedcoast	Cogmagun River	NS			62
B2b3	Nssedhills	Ogden	NS	36.1	0.5	9.5
B2b4	Nbsed	Nixon	NB			54.3
		River Hebert	NS		0	71.9
B2c	Northumberland					
B2c1	NBls&cf&wet	Bartholomew	NB			72
		Carr Barren	NB			44.5
		Dufferin	NB	0.1		88.1
		Hartts Island	NB			63.9
		Lavina Settlement	NB			
		North Bartibog River	NB			94.3
B2c2	NBlsf&wet	Amherst Bog	NS		2.5	16.2
		Caanan Bog PA	NB	39		60.5
		Jehu Lake	NB			95.8
B2c3	Nbfinesed	Gagetown	NB	0.9		0
		Portobello Creek	NB	4.8	25.9	0
B2c4	NBls&cf&wet	Miscou Island	NB			
	Nboutcoast	Point Escuminac	NB	26.5		46.4
B2d	S. Acadian Upland					
B2d1	NBmc&fs	Canoose Flowage PA	NB	19.6		69.2
		Magundy	NB			82.9
		Tyron Settlement	NB			80.6
B2d2	(blank)	Baskahegan	ME			0.5
		Bowerbank	ME			
B2d3	(blank)	Mattawamkeag Lake	ME			3.3
B2d4	(blank)	Amherst Matrix Block	ME		9.9	13.1
		Atkinson Block	ME	4.1	12.3	13.7
		Unity All	ME		0.2	
B2d5	(blank)	Camden / Lincolnville S.	ME	0.6	57.5	
B2d6	(blank)	Kennebec Highlands	ME		0.3	40.6
B2e	N. Acadian Upland					
B2e1	Nbsed*	Dow Settlement	NB			28.7
		Lampedo	NB			47.4
		Plaster Rock	NB	1.3		
B2e2	(blank)	Eagle Lake	ME	0.1		18.2
		Squa Pan	ME		0.3	6.9

Goals and Current status

The portfolio identifies 175 Tier 1 matrix blocks recommended by scientists through the review process described above. The minimum goal for the ecoregion was to identify one block for each of the 71 ELU-groups. If each group had been extremely homogeneous, the number of blocks identified would have been 71 in actuality experts identified from 1 to 9 blocks per ELU group, averaging 2.5 per group. Surpluses occurred especially were blocks were already protected

In the US, a Nature Conservancy based team agreed on a variation of the full ecoregional goal – that of representing blocks from each of the 17 ELU groupings (the next level up from the 71 ELU types) in each of the subregions in which it occurs at least twice, where there are the opportunities that meet landscape viability standards. This goal is slightly lower than the ecoregion goals, totaling to a minimum of 48 blocks based on how the 17 ELU groups distribute themselves across subregions. The goal may need to be confirmed or revised for the ecoregion as a whole by a wider team discussion.. (Aspects of the goals are still under discussion by the team)

Goal issues to resolve:

- Appropriate level of stratification by ELU group(i.e. third level split which breaks into 17 ELU groups vs. 4th level split which breaks into 72 groups.)
- Appropriate levels of replication and where (i.e. a more consistent application of large clusters of multiple blocks principle)
- Numeric Goals for buffer or permanently assured forested landscape context (e.g. Gap 3) as well as "core reserves" for forest blocks
- The need for a sliding scale for goal and "protection" such that blocks surrounded by very large areas of forest that will not be converted may be considered "adequately protected" with less than 25,000 acres in Gap 1 or 2; whereas, blocks in fragmented landscapes with lower surrounding forest cover may need much more than 25,000 core acres in Gap 1 or 2 to be adequately protected.
- How to account for additional forest protection in areas that were not selected as Tier 1 blocks in assessing progress towards overall forest goals.(the equivalent of "De facto" occurrences of matrix forest blocks)

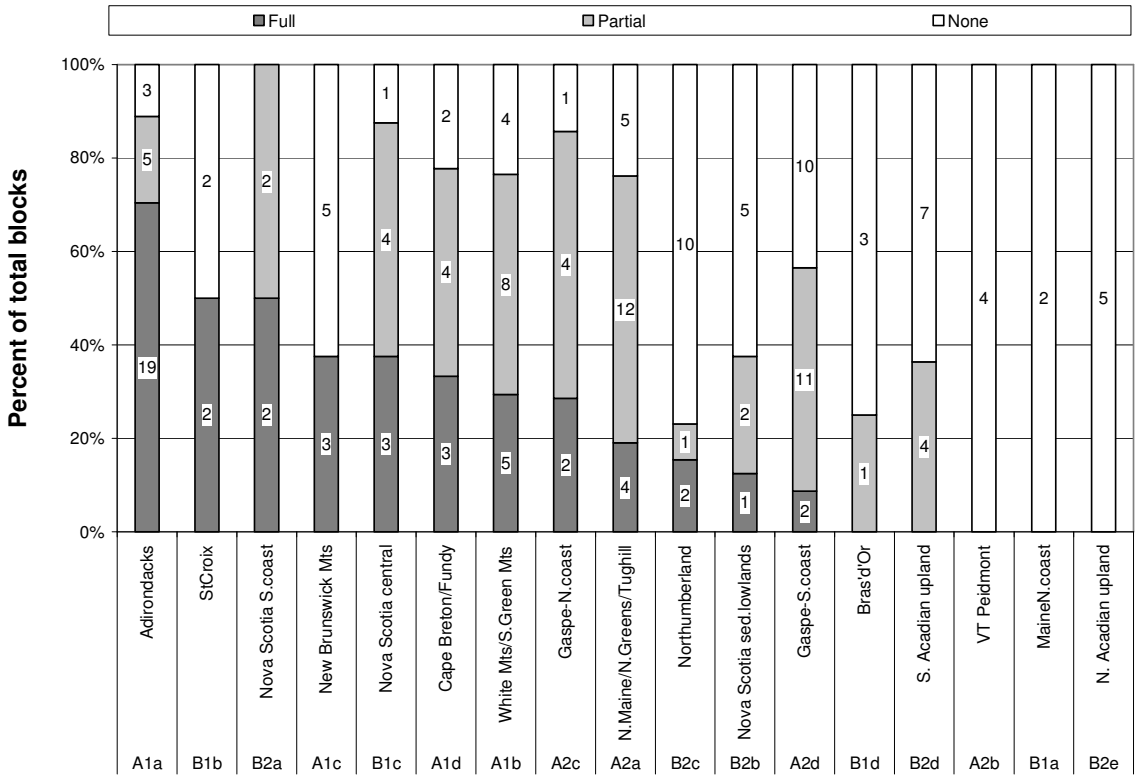
Evaluating Current Protection Levels

To assess initial protection levels we determined which of the blocks already contained at least a 25,000 acre core protected area in GAP status 1 or 2. This standard is a major component of our protection goals for each forest blocks. All blocks were categorized as ;

F = fully meets the minimum of 25,000 acres in GAP 1 or 2 protection
P = partially meets the minimum of 25,000 acres in GAP 1 or 2 protection.
N = no permanently assured Gap 1 or 2 protection

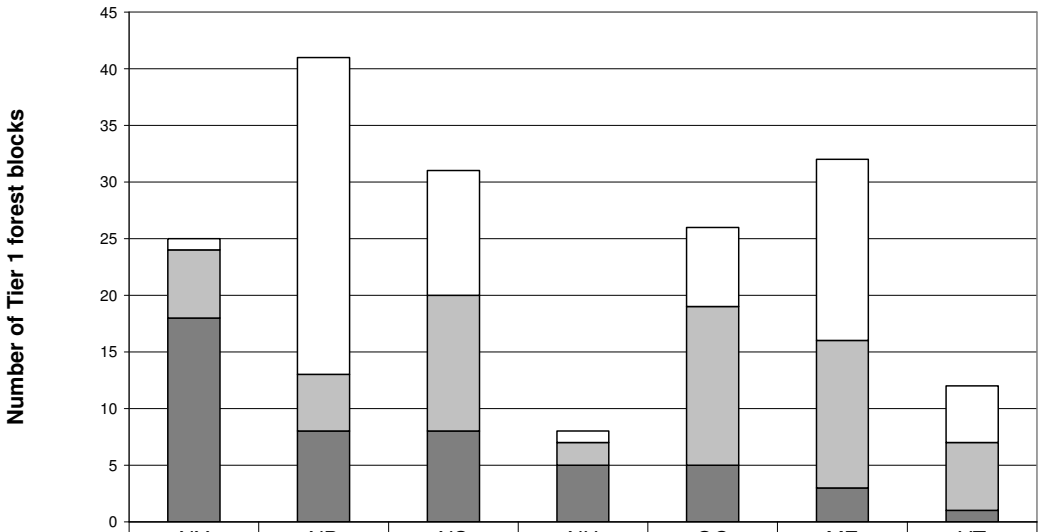
Results were summed across ELU groups (Figures x) and across states /provinces (Figure y). With respect to ELU groups higher elevation A groups were considerably more protected than lower elevation B groups and granite (1) groups were significantly higher than sedimentary (2) groups. There were notable exceptions to this generalization .

Figure x. Protection summary of Tier 1 blocks by ELU groups at third split. Percentages refer to the percent of the total blocks identified by the expert selection process. The percentages do not related to the "goal" at this stage. The chart simply reposts information across the 17 ELU group catagories.



Summed across states, New York had the most blocks that fully met the 25,000 acre core criteria (13) reflecting the advanced state of forest protection in the Adirondacks. New Brunswick and Nova Scotia both had (8) blocks fully meeting the criteria. At the other end of the scale was Vermont with 1 block and Maine with 3 blocks.

Figure y. Protection summary by province and state. The legend indicates the number of blocks that 1) fully meet the criteria, that is have >25,000 acres in Gap 1 or 2 protection; 2) partially meet the criteria, 1000-24,000 acres in Gap 1 or 2; or 3) do not meet the criteria for core regions in Gap 1 or 2 level protection.



	NY	NB	NS	NH	QC	ME	VT
None	1	28	11	1	7	16	5
Partial	6	5	12	2	14	13	6
Full	18	8	8	5	5	3	1

Note, we should also include a table or additional bar to above that indicates blocks with substantial acreage in Gap 3.

Table 8. Number of blocks with core protected areas of 25,000 acres or more: Group A

H1	H2	H3	ELUGROUP	Goal	Y	P	N	%Y
A	A1	A1a	A1a1	9	8	1		89%
		70%	A1a2	3	1		2	33%
			A1a3	3	3			100%
			A1a4	5	4	1		80%
			A1a5	3	1	2		33%
			A1a8	2	1	1		50%
			A1a9	2	1		1	50%
		A1b	A1b1	3		2	1	0%
		29%	A1b2	2	1	1		50%
			A1b3	3		1	2	0%
			A1b4	9	4	4	1	44%
		A1c	A1c1	1	1			100%
		38%	A1c2	4	1		3	25%
			A1c3	3	1		2	33%
		A1d	A1d1	4	2	2		50%
		33%	A1d2	5	1	2	2	20%
	A1 Total			61	30	17	14	49%
	A2	A2a	A2a1	2	1		1	50%
		19%	A2a10	1	1			100%
			A2a2	5		5		0%
			A2a3	3	1	1	1	33%
			A2a4	2		1	1	0%
			A2a5	2		2		0%
			A2a6	2			2	0%
			A2a7	1		1		0%
			A2a8	1	1			100%
			A2a9	2		2		0%
		A2b	A2b1	2			2	0%
		0%	A2b2	1			1	0%
			A2b3	1			1	0%
		A2c	A2c1	3		2	1	0%
		29%	A2c2	2	1	1		50%
			A2c3	2	1	1		50%
		A2d	A2d1	2			2	0%
		9%	A2d10	2			2	0%
			A2d12	1		1		0%
			A2d14	1		1		0%
			A2d2	1		1		0%
			A2d3	3			3	0%
			A2d4	4		3	1	0%
			A2d5	3		3		0%
			A2d6	2	2			100%
			A2d7	2		2		0%
			A2d8	2			2	0%
	A2 Total			55	8	27	20	15%
A Total				116	38	44	34	33%

Table 9. Number of blocks with core protected regions of 25,000 acres or more: Group B

H1	H2	H3	ELUGROUP	GOAL	Y	P	N	%Y
B	B1	B1a	B1a1	2			2	0%
		B1a Total		2			2	0%
		B1b	B1b1	2	1		1	50%
			B1b2	1	1			100%
			B1b3	1			1	0%
		B1b Total		4	2		2	50%
		B1c	B1c1	3	2		1	67%
			B1c2	3	1	2		33%
			B1c3	1		1		0%
			B1c4	1		1		0%
		B1c Total		8	3	4	1	38%
		B1d	B1d1	2			2	0%
			B1d2	2		1	1	0%
		B1d Total		4		1	3	0%
	B1 Total			18	5	5	8	28%
	B2	B2a	B2a1	1		1		0%
			B2a2	3	2	1		67%
		B2a Total		4	2	2		50%
		B2b	B2b1	3	1	1	1	33%
			B2b2	2			2	0%
			B2b3	1		1		0%
			B2b4	2			2	0%
		B2b Total		8	1	2	5	13%
		B2c	B2c1	6			6	0%
			B2c2	3	1		2	33%
			B2c3	2		1	1	0%
			B2c4	2	1		1	50%
		B2c Total		13	2	1	10	15%
		B2d	B2d1	3		1	2	0%
			B2d2	2			2	0%
			B2d3	1			1	0%
			B2d4	3		2	1	0%
			B2d5	1		1		0%
			B2d6	1			1	0%
		B2d Total		11		4	7	0%
		B2e	B2e1	3			3	0%
			B2e2	2			2	0%
		B2e Total		5			5	0%
	B2 Total			41	5	9	27	12%
B Total				59	10	14	35	17%
Grand Total				175	48	58	69	27%

H = Hierarchy level. Goal = the number of blocks identified in the ELU group.
Y = the number of blocks with 25, 000 acres protected in GAP 1 or 2
P = the number of blocks with 1,000 - 24, 999 acres protected in GAP 1 or 2
N = the number of blocks with less than 1000 acres protected in GAP 1 or 2
%Y = the percent of blocks with 25000 protected cores.

Table 10. Full hierarchy and 72 ELU groups

Appalachian Highlands			ELU Group	Example Block	Acadian Lowlands			ELU Group	Example Block
A	A1	A1a	A1a1	Ferris Lake	B	B1	B1a	B1a1	Grand Manan
			A1a2	Coburn Gore			B1b	B1b1	Loch Alva PA 1
			A1a3	Five Ponds				B1b2	Spednic Lake PA
			A1a4	Giant Mountain				B1b3	Downeast Lakes
			A1a5	Jordan River			B1c	B1c1	Cloud Lake
			A1a8	Jabe Pond				B1c2	Bonnet Lake Barrens
			A1a9	Kilkenny				B1c3	Economy
		A1b	A1b1	Bigelow				B1c4	Cape Split
			A1b2	The Burning			B1d	B1d1	Boisdale Hills
			A1b3	Nulhegan				B1d2	Framboise-Middle River
			A1b4	Baldpate		B2	B2a	B2a1	Quinan Lake
		A1c	A1c1	Jacquet River PA 1				B2a2	Liscomb River
			A1c2	Brighton Moutain			B2b	B2b1	Clare
			A1c3	Dungarven Lake				B2b2	Long Lake
		A1d	A1d1	Bornish Hills				B2b3	Ogden
			A1d2	Caledonia Gorge PA				B2b4	Nixon
	A2	A2a	A2a1	QCCA259			B2c	B2c1	Bartholomew
			A2a10	Baxter				B2c2	Amherst Bog
			A2a2	QCCA289				B2c3	Gagetown
			A2a3	QCCA213				B2c4	Miscou Island
			A2a4	East Lake			B2d	B2d1	Canoose Flowage PA
			A2a5	Caribou/Speckled				B2d2	Baskahegan
			A2a6	Deboullie				B2d3	Mattawamkeag Lake
			A2a7	Big Spencer				B2d4	Amherst Matrix Block
			A2a8	Nahmakanta				B2d5	Camden / Lincolnville S
			A2a9	Big Reed				B2d6	Kennebec Highlands
		A2b	A2b1	Steam Mill Brook			B2e	B2e1	Dow Settlement
			A2b2	Pine Mountain				B2e2	Eagle Lake
			A2b3	Caswell					
		A2c	A2c1	QCCA136					
			A2c2	QCCA15					
			A2c3	QCCA1					
		A2d	A2d1	Forbes Gulch					
			A2d10	Eigg Mountain					
			A2d12	QCCA199					
			A2d14	QCCA52					
			A2d2	QCCA64					
			A2d3	NBCA89c					
			A2d4	Halfway Depot					
			A2d5	QCCA37					
			A2d6	QCCA10					
			A2d7	QCCA24					
			A2d8	QCCA262					