IIB. Large Scale Ecosystems in the North Atlantic Coast Ecoregion

The highly fragmented and developed landscape of the North Atlantic Coast Ecoregion (NAC) poses challenges for conservation. Protecting rare species and exemplary natural communities alone will not result in conservation success. The remaining lands that provide natural cover and intact ecological processes which support species, habitats, and ecosystems must also be a conservation priority. Thus, even more than in other ecoregions, defining and identifying landscape-scale conservation targets was a goal for this plan.

Landscape-scale ecosystem functions, such as nutrient cycling, disturbance regimes, source breeding areas for wildlife, and watershed integrity, are critical to supporting and preserving biodiversity. The dominant threats associated with development (habitat loss and fragmentation) require us to protect remaining natural landscapes. These landscapes:

1) provide critical ecosystem services such as clean water, clean air, and compatible recreation areas and green space for people;
2) support wildlife habitat associated with human managed landscapes, such as agricultural areas, grassland habitat, early successional forest and shrublands;
3) serve a critical buffer function and provide supporting ecological processes for rare and exemplary examples of species and natural communities;
4) provide habitat connections and movement areas for wildlife, including pathways for range expansions of species responding to climate change;
5) stabilize and moderate change in regional-scale factors such as solar reflectance and evapotranspiration that determine local climatic conditions.

To ensure conservation of the remaining natural land cover, common natural communities, and wildlife habitat, we identified several scales of intact landscapes. As in other ecoregion assessments in the Northeast, **matrix forest blocks** at least 10,000 acres in size,[1] were identified based on the area requirements of interior forest breeding species and historical disturbance patterns. These landscapes will ensure the protection of the common and dominant forest natural communities indicative of the ecoregion. In most sections of the region, site options for matrix forest conservation were few, the exception being the New Jersey pine barrens.

In addition to matrix forest blocks, we examined and mapped all relatively unfragmented landscapes greater than 1,000 acres in size based on the patterns of roads, railroads, power lines, development, and other edge-features. Our goal for these **coastal unfragmented blocks (CUBs)** was to identify and prioritize the remaining functional habitat, managed landscapes, and/or natural land cover in the NAC Ecoregion.

Species, upland communities, wetlands, and river features embedded within CUBs have a much greater chance of long-term viability if the supporting processes and natural land cover in the CUBs are protected and allowed to persist. For example natural communities embedded within matrix forest blocks and CUBs are more likely to have functional hydrology, natural fire regimes, operative wind disturbance responses that support the ecosystem and their constituent species. Conversely, species or natural community occurrences not within or abutting larger intact landscapes may have higher threat from human encroachment. Conservation area planning, target goal setting, and conservation strategies for finer scale targets should take into consideration how the given target sits within, abuts, or is isolated from matrix forests or CUBs.

[1] In Lower New England-Northern Piedmont and Northern Appalachian Ecoregions, the minimum size for matrix forest blocks was 15,000 and 25,000 acres, respectively.

Protection of multiple examples and scales of these landscape units will provide, for example, ecosystem services, buffers, and connectivity functions for these finer scale conservation targets.

Matrix Forest Blocks

The conservation target within matrix forest blocks is primarily the natural forest communities that cover the majority of the landscape and serve as the dominant supporting habitat for embedded terrestrial and aquatic conservation targets. Individually dominant forest species may be common, such as the oak and pine species that form the large forest swaths of this ecoregion but intact patches of interior forest are rare.

Our size criteria for matrix forest blocks was set at 10,000 acres in order to ensure resilience by providing adequate area (1) to withstand and recover from dominant natural disturbances (e.g. fire, hurricane, insect outbreaks), and (2) to support viable populations of the suite of interior bird species that occur in the Ecoregion (Table 1). Matrix forest block boundaries were defined by large fragmenting features such as roads, power lines, railroad lines, and large coasts or shorelines.

To ensure representation of dominant ecological processes across the geographic range of the Ecoregion we examined how embedded physical landscape features distinguish ecological settings among blocks, and, we classified them using an ecological land units analysis employed in other TNC ecoregional plans (Anderson 1999). Ecological land units (ELUs) are unique combinations of: (1) elevation; (2) bedrock and surficial geology; and (3) landform classes. In brief, ELUs are generated using GIS at the 30m pixel scale across the ecoregion, and the unique combination of within-block ELUs are classified using standard multivariate software. This allowed us to identify unique forest-landscape combinations and locate at least one example of each combination in each sub-region within NAC.

There were so few qualifying matrix blocks across NAC, prioritization was only required for large blocks occurring in the pine barrens ecosystems in New Jersey. For these, we assigned two levels of priority to each selected block based on local expert opinion. Tier 1 blocks were in relatively higher ecological condition and are those where the basic conservation strategies would include protecting or maintaining core forests and the processes that sustain them (e.g. fire). Tier 2 blocks are intended to be alternate blocks that may be substituted for Tier 1 blocks if forests were designated to be non-viable in those blocks.

Coastal Unfragmented Blocks

The fragmented landscape is a dominant feature of the North Atlantic Coast Ecoregion. Partners engaged in NAC ecoregional planning exercises repeatedly recommended that conservation efforts focus on "protecting what is left," ostensibly because there is so little intact habitat remaining. While CUBs in and of themselves are not the standard type of conservation targets in the strict sense that matrix forest blocks are, they represent the best remaining, unfragmented natural land cover. Thus they are vital to conserving the functions and processes that maintain biodiversity and represent a new type of target relevant to a "crisis ecoregion" such as the North Atlantic Coast. These areas support and buffer other kinds of conservation targets, including rare species, natural communities, and portfolio rivers. They also provide critical ecosystem functions, such as wetland and shoreline buffers, connectivity for local and wide-ranging species, nutrient cycling, and a full range of ecosystem services important to species and humans alike.

Table 1. Bird, area requirements and forest type relationships for the North Atlantic Coast. Data on mean female territory size (columns 3 & 4) from Poole and Gill (2002). Forest type associations (columns 5-9) show the strength of the relationship based on expert opinion and basic references. Column 10 give the partner in flight score, from 1-5, for this species in the ecoregion. The highest score (5) indicates a high regional responsibility.

		Area needed		Forest Types					PIF Score
GROUP	SPECIES	Mean Territory Size (acres)	Territory times 25	White Pine-Red Oak Forest	Oak-Hickory	Oak-ericad Forest	Eastern Hemlock-White Pine Forest	Pitch Pine-Scrub Oak Barren	PIF score for region 9 (NAC)
Pine-Oak	Red-tailed Hawk	960	24000	3	2	2	1		2
	Broad-winged Hawk	569	14225	3	2	2			3
	Cooper's Hawk	500	12500	3	2	2	1		2
	Pileated Woodpecker	100	2500	3	3	2	2		2
	Black-and-white Warbler	88	2200	3	1	1	1		4
	White-breasted Nuthatch	35	875	3	4	1	1		5
	Wild Turkey	32	800	3	2	2	1		3
	Black-billed Cuckoo	15	375	3	1	2	1		4
	Yellow-billed Cuckoo	15	375	3	2	2			2
	Red-bellied Woodpecker	12	300	3	4		1		2
	Tufted Titmouse	11.8	295	3	5	1	1		5
	Scarlet Tanager	9.6	240	3	3	2	1		4
	Yellow-throated Vireo	7.4	185	3	2	2			3
	Northern Flicker	5	125	3		1	2		4
	Hermit Thrush	5	125	3		1	2	3	2
	Worm-eating Warbler	4	100	3	3	1			3
	Wood Thrush	3.6	90	3	1	2	1		4
	Rose-breasted Grosbeak	2.5	62.5	3	2	2	1		4
	Downy Woodpecker	2	50	3	5	1	1		5
	Ovenbird	2	50	3	5	2	1		4
	American Crow	0	0	3	2	1	2		5
	Blue Jay			3	2	2	1		5
	Barred Owl	1638	40950	2	1	1	1		2
	Sharp-shinned Hawk	1416	35400	2	1	1	1		3
	Red-headed Woodpecker	14	350	2	3	1			2
	Eastern Wood-Pewee	12	300	2	1	2	1		4
	Cerulean Warbler	2.6	65	2	2				2
	Pine Warbler	2.5	62.5	2			2	3	3
	Blue-gray Gnatcatcher	1.7	42.5	2	2	2			2
	Chipping Sparrow	1.5	37.5	2	1	1	2	1	5
	Red-eyed Vireo	1.5	37.5	2	2	2			3
	Cedar Waxwing	0.5	12.5	2	1	1	2		4
	Least Flycatcher	0.5	12.5	2	1	1			2
	Mourning Dove	0.25	6.25	2	2	1	1		4
	Yellow-bellied Sapsucker	0	0	2	2	1	1		2
Pine Barren	Nashville Warbler	51	1275	1		1	1	3	2
	Common Nighthawk	40	1000	1		1	1	3	2
	Ruffed Grouse	5.4	200	1	1	1	1	3	2
	Whip-poor-will	16	400		2	1	2	3	2
	Eastern Bluebird	13	325		3	1	1	3	2
	Eastern Towhee	2.5	62.5					3	3
	Prairie Warbler	2	50		3	1	1	3	4
	Brown Thrasher	2	50		5	1	1	3	2
Non-forest:									
PIF 5	Salt Marsh Sharp-tailed Sparrow								5
	Mute Swan	8	200						5
	Herring Gull	0	0						5
	Gray Catbird	1	25		3	1	1		5
	Eastern Phoebe	3	75	1	1	1	1		5
	Common Yellowthroat	1.5	37.5		4	1	1		5
	Canada Goose	0.5	12.5						5
	Blue-winged Warbler	2	50		1	1			5
	Black-capped Chickadee	10	250			1	1		5
	Baltimore Oriole	3	75		1	1			5
	American Robin	0.3	7.5		1	1	1		5

To begin, we identified remaining patches of natural land cover, defined by fragmenting features such as roads, power lines, railroads and other edge features. Patches at least 1,000 acres in size were identified on maps, and each state identified patches, or groups of patches as target areas. The 1,000 acre minimum was used to ensure half of each CUB's area was minimally influenced by edge effect. Edge effects range widely, from influencing the movement, predation, and habitat use by animals, to changes in the amount of light and wind penetrating the edge, to seed germination and survival success in plants.

To understand our size minimum, imagine a perfectly round, 1,000 acre patch with a radius of 1,135 meters. (Conversely, a perfectly round patch with a 1,000 meter radius will produce a 776 acre patch). The most conservative estimates suggest that detectable edge effects penetrate up to 900 meters from a boundary (Zankel 2005). A 1,000 acre, round patch with a 900 meter edge influence results in only 43 acres of un-influenced core area. However, most empirically derived estimates of edge effects in northeastern U.S. suggest that effects typically do not penetrate beyond 300 meters. Using this estimate results in about half (540 acres) of a 1,000 acre area free from edge effects.

We compiled all the selected CUBs for the ecoregion and grouped them based on an ecological land unit analysis, allowing us to set stratification and distribution goals. That is, we identified different CUB types, based on their combination of geology, landscape position, and elevation (Table 2, Figure 1). Prioritization among CUBs was based on expert opinion, known embedded conservation targets, and to some extent, feasibility or current conservation activity. We also distributed the selected CUBs to ensure that they represented the full spectrum of ELU types across the sub-sections of the ecoregion.

We assigned two levels of priority for conservation action, based on our knowledge of the landscape, embedded features, current conservation activity, etc. Tier 1 CUBs are those where a high level of protection (i.e. GAP 1-3) is warranted, and where land protection would aid in conserving embedded rare or exemplary occurrences of biodiversity, intact landscape functions, ecological processes, and connectivity. Tier 2 CUBs are those where at least natural land cover should be protected over the long term in order to protect ecosystem functions and provide connectivity. *Note that this is a different use of Tier 1 and Tier 2 labeling then used for matrix forest blocks where tier 2 blocks are not in the portfolio, but can be exchanged for Tier 1 sites if for some reason a Tier 1 site becomes non-viable.*

CUBs, like other conservation targets, require local conservation area planning to identify site-scale threats and strategies, and to fine-tune mapping and extent of the CUB. Local scale planning ensures that conservation targets (i.e. primary and secondary species targets, exemplary natural communities, and aquatic targets) are assessed and planned through a 5-S (or equivalent) adaptive management plan. Within TNC, state programs are responsible for site-based planning efforts for ecoregionally determined targets.

We identified 351 unfragmented landscape areas within NAC, including 11 Tier 1 Matrix forest blocks and 116 Coastal unfragmented blocks (Table 3; Figure 2). In total, the acres captured in both Matrix forest blocks and CUBs accounts for just over 14% of the Ecoregion. For Tier 1 landscape targets, matrix forest blocks and CUBs account for 709,846 acres, or 6% of the Ecoregion. Currently 38% of the areas are secured against conversion to development. We hope to focus land protection and other strategies within these areas to maintain relatively intact natural cover and the processes they support.

Table 2. TWINSPAN partitioning of the unfragmented blocks into three broad groups: A1, A2, and B. The partitioning corresponds with the coding shown on map 1. The term maritime = 0-20 feet, and low = 20-800 ft

Major Block Groups and Distinguishing Characteristics
A1: Blocks on fine sediment deposits, mixed bedrocks (mostly sedimentary and granites) but moderately calcareous is common and diagnostic. *Blocks mostly north of the Merrimack river in New Hampshire and Maine, a few in Pawtucket RI and Foxboro MA region.*
A1a: Blocks with maritime sedimentary and low elevation sedimentary: no moderately calcareous rock. *Maine Boothbay harbor region and area directly north*
A1b: Blocks lacking maritime/low sedimentary rock. With moderately calcareous bedrock and some granite: *Pawtucket RI, Foxboro MA, Great Bay NH (A1b1) up the coast to about Newcastle Main (excluding boothbay)*
A2: Blocks not on fine sediment except along certain streams, mixed bedrocks with high proportions of maritime zone granites and mafic rocks. Very little moderately calcareous bedrock. High proportions of coarse sed (sands) along major rivers. *Blocks mostly south of the Merrimack river to southern Connecticut: Massachusetts (except Cape Cod & Islands), Rhode Island, Connecticut*
A2a: Mostly on granite bedrock with patches of coarse outwash and fine sediment (plum island tidal flats): *Plum island/Parker river MA, Plymouth to Taunton region MA, Coastal RI about great swamp-wood river, continuing to the east side of the mouth of the Connecticut river CT.*
A2b. Mostly on mafic bedrock, some sedimentary: *Mouth of the Connecticut river on the west side southward in CT , a few scattered blocks in RI, and Attleboro MA.*
B: Blocks entirely on coastal outwash sands: *New Jersey, Long Island, Cape Cod, Massachusetts Islands.*
B1: Very wet estuarine marsh complexes directly on the ocean: *Southern New Jersey tidal flats and S. Long island barrier islands*
B2: Slightly higher (above 20 meters) shoreline and inland blocks
B2a: Maritime slopes, hills, steep areas. *North shoreline of Long Island, Shoreline blocks on Cape Cod & MA Islands*
B2b: Not as above, mostly very flat: *NJ Pine Barrens: Central, inland Long Island, Cape and MA island blocks*

Figure 1. Ecological Land Unit Grouping of Coastal Unfragmented Blocks and Matrix Forest Blocks. Legend corresponds to groupings in Table 2. Full size map in appendix.

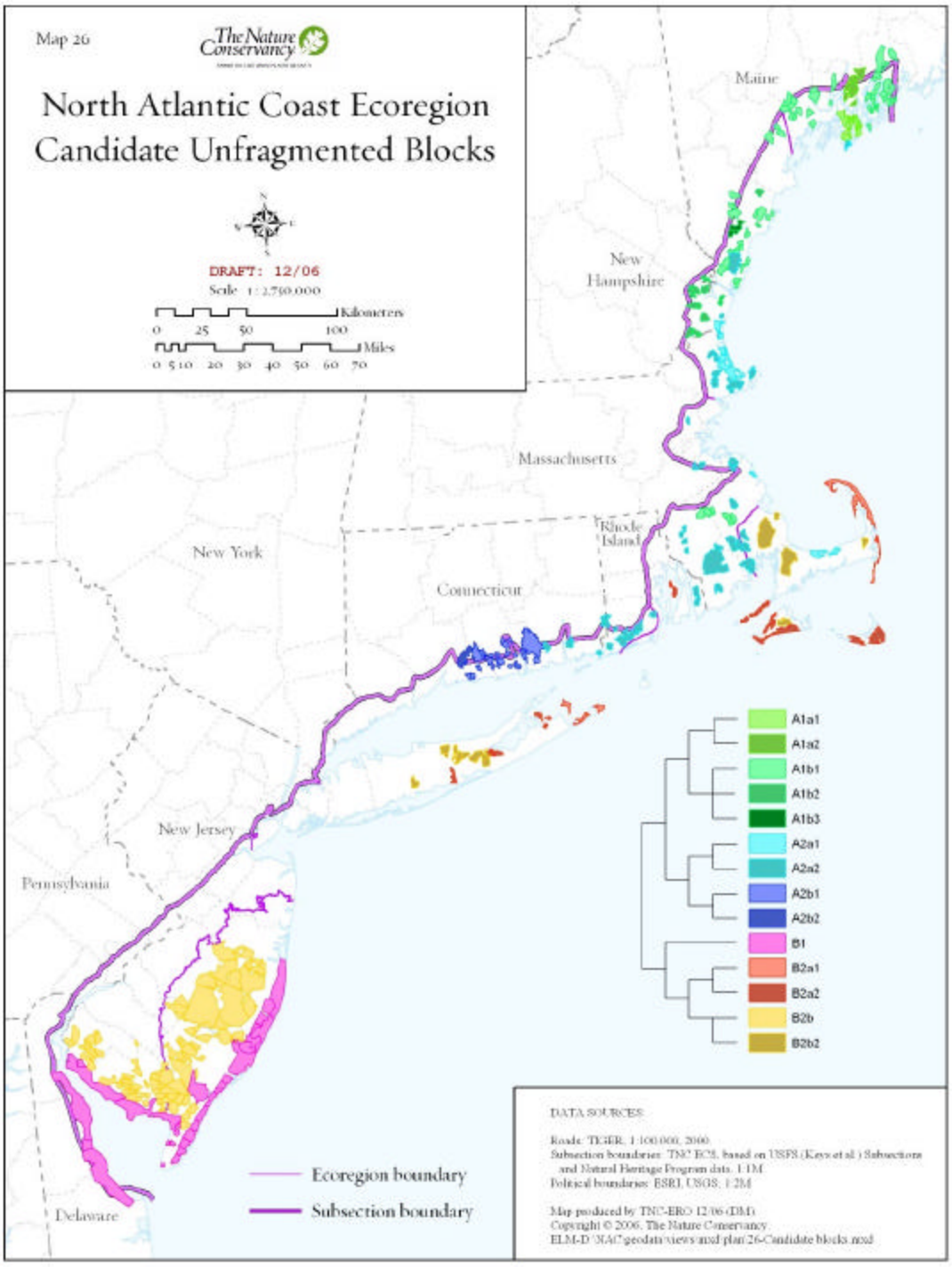

Table 3. Total counts (with averages in parentheses) for landscape target areas, separated by priority level (Tiers). The Acres row is total acres in the ecoregion, with Average referring to the average acres per block or CUB. GAP Status reflects conservation lands within each landscape area, with GAP 1&2 reflecting preserve-level status, and GAP 3 reflecting lands protected from development.

	Tier one			**Tier 2**			**TOTAL**
	Matrix Blocks	**CUBs**	**Subtotal**	**Matrix Blocks**	**CUBs**	**Subtotal**	
Count	11	116	127	4	220	224	351
Acres	322,065	387,780	709,846	107,996	1,005,235	1,113,231	1,823,077
Average	29,279	3,343		26,999	4,569		
Embedded EOs (Average)	710 (65)	1,687 (18)	2,397	95 (32)	713 (6)	808	3,205
GAP 1&2 Acres	24,089	72,444	96,560	4,664	72,986	77,650	174,179 (10%)
GAP 3 Acres	160,023	61,223	221,246	35,820	257,625	296,446	514,692 (28%)

The 351 CUBs represent a new kind of conservation target. Their combined acreage, across both Tiers (over 1 million acres) represents nearly 11% of the ecoregion. However, they are smaller landscape units, and are not always in close proximity to one another. These are landscape patches, within which remain natural land cover of various types, including forests, shrublands, other early successional habitats, wetlands, and aquatic features (lakes, ponds, and rivers). Given their small size and their road-bounded edges, they are more susceptible to edge effects and invasive species establishment and spread. They likely offer less resilience and resistance to both human and natural disturbances. In short, they are vulnerable to degradation. However, in most cases, they support the remaining wildlife habitat, rare species, natural communities, and aquatic buffers in the Ecoregion. They provide many of the aesthetic benefits and ecosystem services for their coastal communities. They represent a high priority for conservation, particularly due to the highly fragmented and rapidly developing nature in the Ecoregion.

On the other hand, the 15 Matrix Forest Blocks in the Ecoregion (430,000 acres) represent only three percent of the Ecoregion. There are several concentrations of these across NAC, mostly on the New Jersey coastal plain where pine barrens and forests are dominant and widespread. Otherwise, the matrix blocks are relatively unusual because they have escaped the effects of human development so far. Like other matrix forest planning efforts in forest ecoregions, these deserve conservation area planning to: (1) identify core areas where preserve level conservation (GAP 1 & 2) is warranted; and (2) to identify sufficient buffer lands to ensure ecosystem processes are maintained.

Figure 2. Ecological Land Unit Grouping of Coastal Unfragmented Blocks and Matrix Forest Blocks. Legend corresponds to groupings in Table 2.