Partners in Flight
Bird Conservation Plan
for
Eastern Spruce-Hardwood Forest
(Physiographic Area 28)

American Bird Conservancy

Partners In Flight
Landbird Conservation Plan:

Physiographic Area 28:
Eastern Spruce-Hardwood Forest

(DRAFT 1.0: 10 June 2000)

Kenneth V. Rosenberg
PIF Northeast Regional Coordinator

And

Thomas P. Hodgman
Maine Dept. Inland Fisheries and Wildlife

Address comments to:

Kenneth V. Rosenberg
Cornell Lab of Ornithology
159 Sapsucker Woods Rd.
Ithaca, NY 14850
607-254-2412
kvr2@cornell.edu

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Description - The Eastern Spruce-Hardwood Forest is the largest physiographic area in the Northeast region. Landforms within the unit range from low coastal plains (including offshore islands) in Maine and the Maritime provinces to high Appalachian peaks (4,000-6,000 ft.) in the White Mountains and Green Mountains. Virtually the entire planning unit is dominated by either sugar maple-beech-birch forest, red spruce-balsam fir forest, or a combination of the two in various proportions. Other important vegetation types include alpine stunted spruce-fir communities, coastal saltmarsh and estuaries, and numerous peatlands, bogs, and other wetlands. Human populations are relatively sparse throughout the physiographic area and are largely confined to coastal regions, and major river valleys. A few areas, such as Prince Edward Island, the Connecticut and St. John River valleys, and extreme northeastern Maine remain as pockets of active agricultural production. The most pervasive human influence on the natural landscape has been through commercial timber harvest and production. The cumulative effects of timber harvesting in the region has been a change in the age structure of the forest and a gradual shift towards greater dominance by northern hardwoods. A large proportion of this commercial forestry in the U.S. takes place on private lands; for example, nearly half of the forested land in Maine is owned by the forest industry. In Canada, private companies hold long-term leases, but lands remain in public (crown) ownership. In general, over a century of timber harvesting in this region has not resulted in the significant loss of species or populations of forest birds. Avifaunal changes have mostly been in the form of changes in local composition and relative abundances, as the mix of successional stages and conifer vs. hardwood forests shifted across the landscape.

Priority bird populations and habitats -

Coastal saltmarsh -

Nelson's Sharp-tailed Sparrow – Nearly entire range of *subvirgatus* race occurs here; status and habitat requirements poorly known.

American Black duck – Very important breeding and wintering populations; declining.

Objective: Numerical population objectives and acreage requirements not yet established.

Mountaintop-conifer woodland -

Bicknell's Thrush -- This region supports more than 50% of the world's breeding population of this species. A monitoring program for this species and its habitat is urgently needed.

Objective: Ensure the protection of all sites that support populations of Bicknell's Thrush "large enough to be considered source populations for other sites," and as many additional high-elevation habitat patches with smaller populations as possible.

Coniferous forest -

Bay-breasted Warbler -- Populations cycle with spruce-budworm outbreaks.

Cape May Warbler -- Nests in stands > 50 years old, > 15 m tall, with will-developed crowns

Spruce Grouse – Requires mixture of age classes and ericaceous ground cover.

Blackburnian Warbler – Roughy 25% of global population breeds here; increasing in numbers since 1966.

Red Crossbill -- Eastern spruce-fir population reduced greatly from historic numbers; current status poorly known.

Objective: Roughly 400,000 ha of mature coniferous and mixed forest is required to support 330,000 pairs of Blackburnian Warblers, with sufficient habitat to support xxx pairs of Spruce Grouse and other boreal species.

Northern hardwood forest -

Canada Warbler -- Declining nearly throughout its range, this species favors dense understory, especially in wet areas.

Black-throated Blue Warbler -- Large and apparently stable population; requires dense deciduous understory, especially hobblebush.

Veery – Nearly 20% of global population; declining. Favors dense understory

Objective: Roughly 2 million ha of northern hardwood forest is required to support the entire habitat suite of species, with 520,000 ha suitable to support 250,000 pairs of Black-throated Blue Warblers and 200,000 pairs of Canada Warblers

Boreal peatland/edge/shrub -

American Woodcock – Large, declining population. Requires mix of age classes, wet ground.

Chestnut-sided Warbler – Generalist in disturbed and regenerating forest.

Olive-sided Flycatcher -- This bird is experiencing a mysterious and precipitous population decline nearly throughout its range. Uses isolated large trees, snags for feeding.

Objective: Roughly 1 million ha of disturbed and successional habitats are required to support 940,000 pairs of Chestnut-sided Warblers; this should be adequate to maintain entire habitat-species suite.

Conservation recommendations and needs -

Clearly, any successful landbird conservation plan in this region must reconcile the needs of long-term, sustainable timber production and the habitat needs of high-priority bird species. Loss of the economic sustainability of commercial forestry could result in conversion of forest habitats to urban development or other less bird-friendly landscapes. The primary goal of this bird conservation plan is to ensure the long-term maintenance of all important forest types in the future landscape mosaic. This must be achieved through careful forest planning on both private and public lands. Commitments by several large timber companies would ensure that conservation objectives are met over vast areas. In addition, protection and monitoring of coastal salt marshes and boreal mountaintop habitats are high priorities. Specific recommendations and needs include:

- Apply GIS-based spatial monitoring protocol to survey and monitor high-elevation habitats for Bicknell's Thrush
- maintain a "shifting mosaic" of forest-age structures, including adequate amounts of mid-successional as well as late-successional forest (both coniferous and northern hardwood)
- ensure that a minimum of 10%-20% of sub-regional planning units (commercial licenses, townships, etc.) involved in timber production be maintained as mature or overmature coniferous forest.
- identify and designate Bird Conservation Areas (BCA), within which long-term sustainability of priority bird populations is a primary management objective
- determine specific habitat needs (and causes of declines) for Canada Warbler; why, for example, is Canada Warbler declining while Black-throated Blue Warbler is stable, if both require shrubby understory of mature forest?

INTRODUCTION

Continental and local declines in numerous bird populations have led to concern for the future of migratory and resident landbirds. Reasons for declines are complex. Habitat loss, degradation, and fragmentation on breeding and wintering grounds and along migratory routes have been implicated for many species. Additional factors may include reproductive problems associated with brood parasitism, nest predation, and competition with exotic species. Scientists and the concerned public agreed that a coordinated, cooperative, conservation initiative focusing on nongame landbirds was needed to address the problem of declining species. In 1990, Partners in Flight (PIF) was conceived as a voluntary, international coalition of government agencies, conservation organizations, academic institutions, private industry, and other citizens dedicated to "keeping common birds common" and reversing the downward trends of declining species.

PIF functions to direct resources for the conservation of landbirds and their habitats through cooperative efforts in the areas of monitoring, research, management, and education, both nationally and internationally. The foundation for PIF's long-term strategy for bird conservation is a series of scientifically based Landbird Conservation Plans, of which this document is one. The geographical context of these plans are physiographic areas, modified from original strata devised by the Breeding Bird Survey (Robbins et al. 1986). Twelve physiographic areas overlap the northeastern United States (USFWS Region-5). Although priorities and biological objectives are identified at the physiographic area level, implementation of PIF objectives will take place at different scales, including individual states, federal agency regions, and joint ventures.

A. Goal

The goal of PIF Landbird Conservation Planning is to ensure long-term maintenance of healthy populations of native landbirds. This document was prepared to facilitate that goal by stimulating a proactive approach to landbird conservation. The conservation plan primary addresses nongame landbirds, which have been vastly underrepresented in conservation efforts, and many of which are exhibiting significant declines that may be arrested or reversed if appropriate management actions are taken. The PIF approach differs from many existing federal and state-level listing processes in that it (1) is voluntary and nonregulatory, (2) focuses proactively on relatively common species in areas where conservation actions can be most effective, rather than the frequent local emphasis on rare and peripheral populations. PIF Landbird Conservation Planning therefore provides the framework to develop and implement habitat conservation actions on the ground that may prevent the need for future species listings.

B. Process

PIF Landbird Conservation Planning emphasizes effective and efficient management through a four-step process designed to identify and achieve necessary actions for bird conservation:

(1) identify species and habitats most in need of conservation; i.e. prioritization
(2) describe desired conditions for these habitats based on knowledge of species life history and habitat requirements
(3) develop biological objectives that can be used as management targets or goals to achieve desired conditions
(4) recommend conservation actions that can be implemented by various entities at multiple scales to achieve biological objectives.

Throughout the planning process and during the implementation phase, this strategy emphasizes partnerships and actions over large geographic scales. Information and recommendations in the plans are based on sound science and consensus among interested groups and knowledgeable individuals. Specific methods used to complete this process are described within the plan or in its appendices. Additional details on PIF history, structure, and methodology can be found in Finch and Stangel (1993) and Bonney et al. (1999).

C. Implementation

This landbird conservation strategy is one of many recent efforts to address conservation of natural resources and ecosystems in the Northeast. It is intended to supplement and support other planning and conservation processes (e.g. The Nature Conservancy Ecoregion Plans, USFWS Ecosystem Plans, Atlantic Coast Joint Venture, Important Bird Areas initiatives) by describing a conservation strategy for nongame landbirds that are often not addressed or only incidentally addressed in other plans.

PIF strategies for landbird conservation are one of several existing and developing planning efforts for bird conservation. PIF Landbird Conservation Plans are intended to compliment other initiatives such as the North American Waterfowl Management Plan, National Shorebird Conservation Plan, and North American Colonial Waterbird Plan. Ongoing efforts to integrate with these initiatives during objective setting and implementation will help ensure that healthy populations of native bird species continue to exist, and that all of our native ecosystems have complete and functional avifaunal communities. In particular, the emerging North American Bird Conservation Initiative (NABCI) will provide a geographical and political framework for achieving these ambitious goals across Canada, Mexico, and The United States.

SECTION 1: THE PLANNING UNIT

A. Physical Features

The Eastern Spruce-Hardwood Forest is the largest physiographic area in the Northeast region, encompassing roughly the northern two-thirds of the states of Maine, New Hampshire, and Vermont, plus an even larger area in the Canadian Maritime provinces, and southern Quebec (including the Gaspé Peninsula). The total area under consideration is roughly 353,538 km^2 (136,500 square miles).

Within the U.S. portion of the planning unit are 30 Ecological Units (Keys et al. 1995), all within the Laurentian Mixed-Forest and New England - Adirondack provinces (Appendix 1). A few Ecological Units extend into adjacent physiographic area 27 (N. New England).

Landforms within the unit range from low coastal plains (including offshore islands) in Maine and the Maritime provinces to high Appalachian peaks (4,000-6,000 ft.) in the White Mountains and Green Mountains. The northeastern terminus of the Appalachian Mountains is in northern New Brunswick, with only a few peaks reaching 750 m. Most of Area 28, however, is low-mountainous or open hilly country, interspersed with valleys and plains. Highlands within this area constitute the headwaters of nearly every major river in New England and the Maritimes, including the Connecticut and much of the St. Lawrence drainages. Highlands also contain numerous lake and pond systems with associated forested wetland habitats. The U.S. portion of the planning unit contains over 65,000 miles of rivers and streams and over 7,700 lakes totaling an area of over 1 million acres (Harper et. al. (1990).

Average annual precipitation [U.S. only] ranges from 36 inches in northern, interior Maine to 49 inches in the northern Green Mountains. Growing season ranges from 98 days on the high peaks to 152 days in coastal Maine (climate data from Keys et. al. 1995).

B. Potential and Present-day Vegetation

Virtually the entire planning unit is dominated by either sugar maple-beech-birch forest (TNC Alliance = I.B.2.a.i), red spruce-balsam fir forest (I.A.8.c.2), or a combination of the two in various proportions (Appendix 1). The maple-beech-birch (northern hardwood) forests are associated with lower elevations, more southern sections, and well-drained soils, whereas the spruce-fir forests dominate at higher elevations, especially in more northern sections, along the immediate coast, and on shallow, acidic soils.

A number of minor forest-types are represented (Appendix 1), including various mesic and dry oak-pine forests, mesic red oak hardwood forest (I.B.2.a.v.), oak-hickory-ash dry forest (I.B.2.a.vi.), and various forested wetlands such as red spruce-balsam fir swamps (I.A.8.f.ii.), black spruce bogs (I.A.8.f.iii.), and northern white cedar swamps (I.A.8.f.iv.).

Nonforest alliances include pitch pine-scrub oak woodlands (II.A.2.a.i.), northern white cedar limestone woodland (II.A.2.b.ii.), freshwater tidal marsh (VIII.A.2.f.i.), and various open bogs, fens, and meadows. In addition several distinct and very important alpine communities occur on mountain peaks, including rocky summit spruce woodlands (II.A.2.b.i.), black spruce-dominated boreal heathland (III.A.3.b.i.), and subalpine heath/ krummholtz (IV.A.2.i.).

U.S. Forest Service FIA and Canadian CCRS data indicate that roughly 29.5 million ha throughout the physiographic area (84%) are covered with forest today (Table 1.1; Fig. 1.2). Differences in the way U.S. and Canada classify forest cover prevents exact comparisons or combinations between the two countries. Present day forests are dominated by various mixed hardwood forest types (maple-beech-birch in U.S.; various mixed forests in Canada), with roughly 19% of the forest classified as spruce-fir or evergreen needleleaf. The latter forests dominate in mountainous areas of Maine and New Brunswick, southern and coastal Nova Scotia, and the central Gaspé Peninsula. U.S. FIA data also identify roughly 630,000 ha of white-red-jack pine forest, primarily in VT, NH, and eastern Maine, and 260,000 ha of Aspen-birch forest, primarily in northwestern Maine.

Table 1.1. Natural vegetation cover-types in the Eastern Spruce-hardwood Forest physiographic area. Forest types are taken from USFS FIA data; non-forest types are from USGS data. Canadian cover types from CCRS. See Fig. 2 for map of current vegetation cover types.

Vegetation type	Area (ha)	Area (ac)	% of area
United States portion			
Spruce-fir forest	3,467,400	8,567,950	9.8
Maple-beech-birch forest	2,629,500	6,497,500	7.5
White-red-jack pine forest	628,400	1,552,776	1.8
Oak-hickory forest	175,000	433,000	0.5
Canadian portion			
Evergreen needleleaf forests [1]	3,269,400	8,078,700	9.3
Mixed deciduous and intermediate forest	18,962,700	46,856,800	53.7

[1] includes "high-density evergreen needleleaf," "medium-density evergreen needleleaf," and "mixed evergreen" forests.

C. Natural disturbances

[from Erskine 1992, so far -- will expand] Probably the entire physiographic area was covered with glacial ice during the last ice age; therefore the extensive forests are relatively young (< 15,000 yr.). More recently, the region experienced a cooling period during the "Little Ice Age" (1300-1800), and has probably been experiencing a warming trend during the past 200 years. These climatic trends undoubtedly influenced the nature and distribution of forest types covering the landscape, and therefore the distribution and population levels of many bird species. Erskine (1992) makes frequent reference to the expansion of certain southern and hardwood-associated species into the Maritimes during historic times. For such Neotropical migrant species as Wood Thrush, he speculates that in the absence of major anthropogenic habitat changes, global warming will continue to favor these species in the future.

In the extensive forests that existed before European settlement, fire was a primary disturbance factor, although the cool, wet climate limited the extent and frequency of lightning-caused fires. Wind, too, is a major factor affecting the structure of forests in many areas, especially on mountaintops and along the immediate coast. Evidence of tornado or microburst swaths are evident throughout northern Maine (L. Alverson, in litt.). With a few local exceptions, it is unlikely that hurricanes and other major storms, even those that reached southern New England, have had a major influence on vegetation in this region. However, treefall gaps created by windthrown trees on shallow soils created a mosaic of habitats for a variety of understory-dependent birds.

D. History and land use

Human populations are relatively sparse throughout the physiographic area and are largely confined to coastal regions, and major river valleys. Vast areas in northwestern Maine, northern New Brunswick, and Quebec are largely uninhabited, and only recently have been roaded. Initial exploitation of forest resources were close to coastal habitations, opening a strip along the Maritime and Maine coasts. Settlement, and farming, in the regions away from the coast generally began after 1750. Agriculture was never a major land-use in the region, amounting to roughly 10% -15% of the land being cleared during its maximum extent in the early 1900s. A few areas, such as Prince Edward Island, the Connecticut and St. John River valleys, and extreme northeastern Maine remain as pockets of active agricultural production.

By far, the most pervasive human influence on the natural landscape has been through commercial timber harvest and production. The first cutting largely supplied the worldwide ship-building industry for much of the 19th century. In the 1900s, pulp and paper production became the primary use of commercial forests. Large pine and mature spruce were the primary species of interest to early timber operators, and transport to mills occurred along rivers. Log driving on rivers persisted until the 1970s, after which roads were built to facilitate transport. A large proportion of this commercial forestry in the U.S. takes place on private lands; for example, nearly half of the forested land in Maine is owned by the forest industry. In Canada, private companies hold long-term leases, but lands remain in public (crown) ownership (Seymour and Hunter 1992).

In general, intensive, high-yield silvicultural practices, such as planting to replace hardwood species with commercially valuable softwoods, are relatively uncommon in the region, except on crown lands in the Maritime provinces (Seymour and Hunter 1992). In northern New England and Maine, commercial forestry is dominated by low-intensity, industrial timber management, with herbicide release being the most common silvicultural practice. Rotation intervals range from 20 to 60 years (Seymour and Hunter

1992). Clearcutting of spruce-fir forests, and associated road-building became more intensive after the late 1960s, at least in part because of salvaging trees killed during a spruce-budworm epidemic (Seymour and Hunter 1992). Since then, many landowners have reduced the area harvested by clearcutting and have returned to partial harvesting methods. The practice of conversion forestry remains on sites with the best soils. Currently, advances in machinery seem to be directing harvest strategies toward leaving as much residual material (tops and limbs) in the forest as opposed to the whole tree removal and roadside delimbing. This technology may reduce the amount of time needed for regenerating forests to regain mature structure.

The cumulative effects of timber harvesting in the region has been to change the age structure of the forest, increasing the acres of early succesional stands and decreasing the acres of mature stands. A tendency towards even-aged forest structure, resulting from pre-settlement spruce-budworm epidemics, is perpetuated through modern forestry, thus enhancing the opportunities for future budworm epidemics in some areas (see below).

Besides commercial timber production, recreation is probably the second-most important human use of the region today, especially on public lands. National Forests in Vermont and New Hampshire represent heavily used recreational lands close to populated centers in New England. Currently, 102,000 acres on the White Mt. National Forest are designated as Wilderness, and 200,000-acre Baxter State Park, in Maine, is managed in an essentially wilderness character (Harper et al. 1990). There is also a long tradition of public recreational use of private lands, through open access and leased rights. Development of high-elevation sites for ski resorts is a recent factor, with potential impacts on high-priority bird habitats and species (see below).

Table 1.2. Current land-use and ownership patterns in portions of the Eastern Spruce-Hardwood physiographic area. (based on USFS FIA and Canadian CCRS cover-type data)

Land classification	Area (ha)	Area (ac)	Percent of total
Forested land	29,494,500	72,880,900	83.5
Public ownership			
National Forest (U.S.)			
National Park			
State or province managed			
other public			
Private industrial			
Private industrial (leased)			
Private non-industrial			
Agricultural land	3,087,800	7,6629,950	8.7
Urban/ developed	104,200	257,478	0.3
Wetlands/fresh-water	728,900	1,801,100	2.1

SECTION 2: PRIORITY BIRD SPECIES

A. General avifauna

Roughly 196 bird species (Appendix 2) have been documented as breeding within physiographic area 28 (Peterson 1980, various atlases). Of the nongame landbirds (135 species), the majority are migratory; these include 99 Neotropical migratory species. The landbird avifauna is typical of northern

or boreal portions of North America, but includes many species of more southern affinity that are at the northern limits of their range. An analysis of all Neotropical migratory species in the Northeast U.S. (Rosenberg and Wells 1995) found the composition of breeding species in this area (along with the Adirondack Mountains) to be distinct from all other physiographic regions. From a global perspective, this region ranks among the highest priorities for long-term bird conservation in eastern North America.

Fifteen species were estimated to have 15% of their total population breeding in the planning unit (Appendix 2). This area supports the highest relative abundance (of any physiographic area) for American Woodcock, (eastern) Red Crossbill, American Black Duck, American Redstart, Magnolia Warbler, Evening Grosbeak, and Northern Parula. In addition, a large proportion of the global population of Bicknell's Thrush, as well as nearly a quarter of the world's Black-throated Blue Warblers, are estimated to breed here.

Our primary measure of population trend at present is the Breeding Bird Survey (BBS), which provides data on roughly 160 of the 196 species breeding within Area-28 (N = 160 routes). For many species in this region, however, especially those of boreal or high-elevation habitats, BBS coverage is poor, and reported trends often lack statistical significance. In addition, a sub-regional bias in BBS route placement may also exaggerate trends that are occurring only in more accessible portions of the planning unit (L. Alverson, in litt.). Nevertheless, a significant declining trend for a species on existing BBS routes may be reason enough to examine the population trend more closely, and to initiate measures to halt or reverse this trend.

Of the 160 species sampled by BBS, 42 have declined significantly ($P < 0.10$) since 1966, and 17 additional species have declined since 1980 (Appendix 2). These include nearly all species associated with grasslands and other early successional habitats, as well as many species associated with riverine or other freshwater wetlands (e.g., Belted Kingfisher, Bank Swallow, Common Snipe) or mature conifer forests (e.g. Pine Grosbeak, Boreal Chickadee). Taxonomic groups with disproportionate numbers of declining species include thrushes, large flycatchers, icterids, and sparrows. Of the 10 forest species that declined only since 1980, nearly all had increased significantly in the previous period (1966-1979), indicating a probable tracking of regional spruce budworm populations.

In contrast, 37 species exhibit significantly increasing population trends (Appendix 2). A majority of these are associated with urban or other human-altered habitats, including those that use bird feeders or are abundant in managed coniferous forests (e.g. Red-breasted Nuthatch, Golden-crowned Kinglet, Yellow-rumped (Myrtle) Warbler, Hermit Thrush). In addition, a disproportionate number of woodpeckers and vireos are among the increasing species in this region.

B. Priority species pool

From among the breeding avifauna, a pool of species may be derived that represents priorities for conservation action within the physiographic area (Table 2.1). Note that a species may be considered a priority for several different reasons, including global threats to the species, high concern for regional or local populations, or responsibility for conserving large or important populations of the species. The different reasons for priority status are represented by levels or tiers in Table 2.1. Our primary means of prioritizing species is through the PIF prioritization scores generated by Colorado Bird Observatory (Hunter et al. 1993, Carter et al. in press). This system ranks species according to seven measures of conservation vulnerability. These include four global measures (i.e., they do not change from area to area), as well as threats to breeding populations (TB), area importance (AI), and population trend (PT), which are specific to each physiographic area. A total rank score is then derived, which is a measure of

overall conservation priority; scores for all breeding species in the Eastern Spruce-Hardwood region are found in Appendix 2.

Explanations of the tiers, or entry levels into the priority species pool (Table 2.1) are as follows:

I. *High overall (global) priority* -- species scoring 22 in the PIF prioritization system. Indicates high vulnerability of populations throughout the species range, irrespective of specific status in this physiographic area. Species without manageable populations in the area (peripheral) are omitted.

II. *High physiographic area priority* -- species scoring 19-21 in the PIF system, with either (IIa) AI + PT 8 or (IIb) a high percentage of the global population breeding in the physiographic area. Tier IIa indicates species that are of moderately high global vulnerability, and with relatively high abundance and/or declining or uncertain population trend in the physiographic area. Tier IIb signifies that the area shares in responsibility for long-term conservation of those species, even if they are not currently threatened. Percent of population is calculated from percent of range area, weighted by BBS relative abundance (see Rosenberg and Wells 1999). A disproportionately high percentage of global population is determined by considering the size of each physiographic area relative to the total land area of North America, south of the open boreal forest (see Appendix 3).

III. *Additional Watch List* -- species on PIF's national Watch List that did not already meet criteria I or II. Watch List species score 20 (global scores only), or 18-19 with PT = 5. These species are considered to be of high conservation concern throughout their range, even in areas where local populations may be stable or not severely threatened.

IV. *Additional listed* -- species on federal or state endangered, threatened, or special concern lists that did not meet any of above criteria. These are often rare or peripheral populations.

V. *Local concern* -- species of justifiable local concern or interest. May represent a geographically variable population or be representative of a specific habitat of conservation concern.

Table 2.1. Priority species pool for Area 28. Percent of population calculated from percent of range area, weighted by BBS relative abundance (see Rosenberg and Wells 1999). PIF scores from CBO (Carter et al.2000).

Entry level	Species	Total score	% of pop.	AI	PT	Local status
I						
	Nelson's Sharp-tailed Sparrow	27	9.5	4	3	B
	Bicknell's Thrush	26	90+?	5	3	B
	Canada Warbler	25	15.9	5	5	B
	Piping Plover (US-FT, CA-E)	25	??	2	3	B
	Bay-breasted Warbler	25	11.7	5	3	B
	Cape May Warbler	24	9.1	5	4	B
	American Woodcock	22	29.8	5	3	B
	Wood Thrush	22	4.0	3	5	B
II						
a.	Veery	21	19.0	5	5	B
	Purple Finch	21	12.9	5	5	R
	Bobolink	21	9.6	3	5	B

	Blackpoll Warbler	21	<1	3	5	B
	Spruce Grouse (VT-E)	21	??	5	3	R
	Yellow-bellied Sapsucker	20	9.3	4	5	B
	Nashville Warbler	20	6.8	4	4	B
	Black-billed Cuckoo	20	2.5	3	5	B
	Boreal Chickadee	20	2.3	4	5	R
	Least Flycatcher	19	5.7	4	5	B
	Belted Kingfisher	19	4.7	5	5	B
	Ruffed Grouse	19	3.6	3	5	R
	Eastern Wood-pewee	19	2.6	3	5	B
	Olive-sided Flycatcher	19	1.5	3	5	B
	Pine Grosbeak	19	<1	3	5	R
b.	Common Eider (eastern pop.)	19	30.0 [a]	5	2	R
	American Black Duck	19	26.5	5	2	B
	Northern Parula	19	26.2	5	1	B
	Black-throated Blue Warbler	21	23.8	4	1	B
	Black-throated Green Warbler	20	18.4	5	2	B
	Blackburnian Warbler	19	16.2	4	1	B
III						
	none					
IV						
	Harlequin Duck (ME-SC)	19	<1	2	3	R
	Roseate Tern (US,CA-FE)	18	< 1	2	3	B
	Upland Sandpiper (NH-E; VT-T)	18	< 1	2	2	B
	Common Tern (ME-SC, NH,VT-E)	17	5.7	4	5	B
	Northern Harrier (NH-T)	17	1.3	3	3	B
	Peregrine Falcon (US,CA-FE)	17	< 1?	2	3	B
	Common Loon (NH-T; VT-E)	16	5.2	4	1	B
	Golden Eagle (ME-E; NH-E)	16	< 1	2	3	B
	Bald Eagle (US-FT)	16	< 1	2	3	R
	Osprey (NH-T; VT-E)	14	6.3	3	1	B
	Arctic Tern (ME-SC; NH-T)	14	< 1?	2	3	B
	Common Nighthawk (NH-T)	12	< 1	2	2	B
	American Pipit (ME-SC)	?	< 1	1	3	B

[a] numbers derived from Gauthier and Aubry (1996)

Eight species scored at least 22 in the PIF prioritization system and are considered to be high overall or global priority (Table 2.1). Nelson's Sharp-tailed Sparrow and Bicknell's Thrush score the highest, largely because of their very restricted range and small total populations. A vast majority of the world's Bicknell's Thrushes breed on mountaintops in this physiographic area, making this species perhaps the highest priority for conservation planning. Similarly, of the three distinct races that now make up Nelson's Sharp-tailed Sparrow, *A. n. subvirgatus*, breeds almost entirely in coastal and estuarine marshes within this area. Piping Plover is listed as an endangered species in Canada and threatended in the U.S.; although this species is near the edge of its range, important populations still nest in coastal areas from the Gaspé Peninsula to Maine. The remaining species in this tier are more common and widespread, but are among the most vulnerable or declining species of mature and successional forests in the region.

Priority level IIa includes 15 species with relatively high total scores and with either relatively large or declining populations in the physiographic area. A majority of these are in two groups -- species associated with mid-successional hardwood forests, or boreal species associated with mature conifers. Both of the region's forest grouse are in this priority tier. Five additional species in IIb have significant proportions (>15%) of their North American or global populations in this physiographic area (see Appendix 3), but show stable or increasing population trends at present. These along with other species listed in Appendix 2 (e.g. Blue-headed Vireo, American Redstart, Magnolia Warbler, Black-and-white Warbler) indicate that this physiographic areas shares a large responsibility for the long-term conservation of spruce-fir and northern hardwood forest bird communities, as well as the world breeding population of American Black Duck. In addition, coastal populations of Common Eider represent roughly 30% of the eastern North American population and 80% of the American race *S. m. dresseri* (numbers derived from Gauthier and Aubry 1996).

No additional Watch List species are represented in the priority species pool. Thirteen species are listed as endangered, threatened or special concern federally or by U.S. states. These are primarily wetland, grassland, or raptor species that are represented by peripheral, although in some cases locally high, populations. Among the listed species, Harlequin Duck, Upland Sandpiper, and Roseate Tern score highest in the PIF system, but regional breeding populations of these species are very low. Common Tern is the only species in this tier that is common enough to show a significantly declining trend in the physiographic area, according to the BBS.

The overall priority pool of 42 species (21% of the breeding avifauna) consists of representatives of virtually all the major habitat types of this large physiographic area. Considering all priority categories, the species of highest conservation concern include Bicknell's Thrush, Nelson's Sharp-tailed Sparrow, Canada Warbler, and a suite of boreal-coniferous forest breeders. These may represent focal species that help define conservation actions in their respective habitats.

SECTION 3: BIRD CONSERVATION ISSUES AND OPPORTUNITIES

A. Early vs. late-successional habitats and species -- historical baselines

Because most of the Northeast region has undergone major changes in forest cover during the past two centuries, the relative importance placed on early- versus late-successional species and their habitats today depends in large part on the historical baseline chosen for comparison. This issue, which permeates bird-conservation planning throughout the Northeast, must be resolved before priority species and habitats are determined. As elsewhere in the region, species with large proportions of their total population in the planning unit are mostly associated with mature forest habitats, and most show stable or increasing population trends. In contrast, the list of species with significant declining trends is dominated by early successional species. Although early successional (especially grassland) birds have arguably been shown to be part of the original avifauna in many parts of the Northeast, and therefore worthy of conservation concern (refs, Wells and Rosenberg, in press), this is less true within Area-28. Many of these species invaded the spruce-hardwood region during clearing in the late 1800s, and have declined steadily as forests regenerated. A few areas, such as the barrens of Washington county, ME and the agricultural land of Aroostook County, ME, are of local significance for their populations of grassland birds.

To some extent, deciding on the "value" of early-successional bird populations is subjective; for example, the fact that two of the most numerous species with the steepest, significant declining trends in

the region are Brown-headed Cowbird and House Sparrow is hardly reason for concern. Other species such as Chestnut-sided Warbler, however, rank high in regional importance and have undoubtedly benefited from forest regeneration following harvesting.

This plan recognizes the overriding importance of mature-forest species in long-term conservation planning, based on three lines of reasoning:

(1) The planning unit supports a major portion of the global population for many northern-forest species;

(2) Current and future land use ensures the maintenance of some early successional habitats throughout the region, although probably never to the extent that existed during colonial times or at the height of the spruce-budworm epidemic of the 1970s and 1980s.

(3) The "unequal trading" principle (Dan Brauning): any critical need for early successional habitats in the future can be easily and quickly reconciled through increased harvesting, whereas creating mature forest requires much more time.

B. Regional economics of commercial timber production

Clearly, any successful landbird conservation plan in this region must reconcile the needs of long-term, sustainable timber production and the habitat needs of high-priority bird species. Loss of the economic sustainability of commercial forestry could result in conversion of forest habitats to urban development or other less bird-friendly landscapes. In general, over a century of timber harvesting in this region has not resulted in the significant loss of species or populations of forest birds. Avifaunal changes have mostly been in the form of changes in local composition and relative abundances, as the mix of successional stages and conifer vs. hardwood forest types shifted across the landscape.

The primary goal of this bird conservation plan is to ensure the long-term maintenance of all important forest types in the future landscape mosaic. This must be achieved through careful forest-planning on both private and public lands, with the goals of economic gains and sustainability balanced with the needs of birds and other wildlife. This balance will likely differ in different geographic areas (see below). By taking a global perspective, we can take advantage of the opportunities in each area, such that the cumulative result will be to maintain healthy bird populations into the future.

C. Changing age structure of the forest and spruce-budworm outbreaks

A number of forestry practice issues are particularly relevant to bird conservation planning. These generally involve changes in age structure of the forest, suppression of hardwood understory regrowth, loss of mature spruce component of conifer stands, cycles of spruce-budworm outbreaks and associated harvest, as well as controversial issues such as clear-cut size limits and designation of wilderness. Much research has been directed at the effects of forestry practices on bird populations -- Hagan refs., DeGraaf refs., etc [need to flesh all this out]

The relationship between forestry practices and outbreaks of spruce budworm has particulary important implications for bird populations. Natural cycles in spruce budworm populations and an accumulation of volume in mature age classes set the stage for the most recent epidemic (Irland et al. 1988). The latter of these two conditions is not likely to recur as rotation length overall is shorter (Irland et al. 1988). However, largescale presalvage harvesting as well as targeting both spruce and fir may aggravate future outbreak at the stand level Local experts are predicting future budworm outbreaks and the need for

future salvage efforts -- timing will vary in different areas. Although many bird populations benefit temporarily from regional outbreaks, the danger is loss of mature spruce-fir habitat over vast areas during interim periods (see New Brunswick plan, below). As vast acreages that were salvaged after the last major epidemic continue to mature, predictable changes in bird populations will occur. Planning for sustainable bird populations over the entire planning unit must take into account these regional changes and must emphasize the importance of maintaing a balance of age classes across the forested landscape. [need to figure this out in more detail, add refs., etc.]

D. Mountaintop development

Perhaps the most immediate threat to important bird populations in the planning unit is the loss of boreal-mountaintop habitats that are critical for Bicknell's Thrush. Recent expansion of ski resort developments in northern New England and New York, plus the potential development of wind-power stations, threaten several known Bicknell's sites. Until detailed population surveys throughout the range are complete (Rimmer, refs), the extent of this threat remains unknown. An important component of the regional bird conservation plan will be the identification of all suitable sites for Bicknell's Thrush and associated species, as well as any potential threats to those sites. Evaluation of habitat quality at existing developed sites will also be important to determine how much disturbance is tolerated by Bicknell's Thrush and other high-elevation species.

E. U.S. and Canadian planning efforts

Coordination of U.S. and Canadian conservation planning has just begun in the northern forest region. Because of the vast portions of the planning unit within Canada, such coordinated efforts are vital for the success of any conservation plan. recent contacts were made between Maine's PIF working group and habitat managers in New Brunswick. Several large private timber companies have holdings on both sides of the border. Additional cooperation needs to be sought, at the level of the USFWS regional office and in the private sector, as well as in similar jurisdictions within Canada.

F. Bird conservation opportunities and solutions

Although this planning unit is large and spans portions of four states and four Canadian provinces, several factors contribute to an optimistic assessment of future bird conservation planning: (1) most priority bird species are still abundant and widespread, exemplifying the PIF objective of "keeping common birds common;" (2) The economic base of the region is in commercial forestry and recreation, so it is unlikely that habitats for forest birds will be severely threatened in the near future; (3) a dedicated team of land managers, representing the diverse geographical and jurisdictional areas within the planning unit, has already begun to coordinate efforts towards long-term landbird conservation planning.

Large portions of the region are under single ownership or agency control, and thus simplify the implementation of conservation planning. For example, commitments by several large timber companies would ensure that conservation objectives are met over vast acreages in the U. S. and Canada. Similarly, large National Forests protect much of the Vermont and New Hampshire portions of the planning unit.

Ultimately, a combination of legal mandates and voluntary private incentives may be necessary to acheive largescale planning objectives. Degree of public control of land practices on private lands differs between the U.S. and Canada. In New Brunswick,(at least,) the Crown Lands and Forest Act (1980) allows the provincial agency to mandate quotas of forest types and age classes on lands leased

to private companies; such mandates do not exist in the U.S. Because sustainability and the maintenance of a mosaic of forest habitats are the primary objectives of this conservation plan, strong opposition from the private sector is not anticipated.

Identification of *Important Bird Areas* in the planning unit has recently begun, at least in Vermont and Maine. Although most of these sites will probably be based on concentrations of seabirds or migratory shorebirds or waterfowl, at least some are expected to identify critical habitats for Bicknell's Thrush and associated mountaintop species, or representative forest tracts that are unusually diverse or pristine (e.g. Baxter State Park). A series of mountaintop sites will most likely constitute one or more Bird Conservation Areas in Maine and New England. The greatest influence on landbird populations regionwide, however, will be through the identification and adoption of forest-management practices (i.e., best management practices) that meet the habitat objectives of high-priority bird species.

SECTION 4: PRIORITY HABITATS AND SUITES OF SPECIES

When species in the priority pool (Table 2.1) are sorted by habitat, the highest priority habitats and associated species can be identified (Table 4.1). These represent the habitats that are either in need of critical conservation attention or are critical for long-term planning to conserve regionally important bird populations. The highest priority species do not form a cohesive habitat group, but rather divide among nine different forest, early successional, and wetland habitats. The species of greatest concern, however, is Bicknell's Thrush, and by association, the conifer habitats of mountaintops and windsept coastlines rank first in regional priority. Other habitats may be loosely ranked according to the highest-scoring species in the habitat suites. Within each habitat-species suite, certain species that represent particular limiting requirements (e.g., area sensitivity, snags) are considered focal species for setting population-habitat objectives and determining conservation actions.

Table 4.1. Priority habitat-species suites for Area 28. TB (threats breeding), AI (area importance), PT (population trend), and total PIF scores from CBO prioritization database (Carter et al.2000). Focal species for each habitat are in boldface.

Habitat	Species	Total score	TB	AI	PT	Action level [a]
Mountaintop-conifer woodland						
	Bicknell's Thrush	26	2	5	3	II
	Blackpoll Warbler	21	2	3	5	III
	American Pipit	?	?	?	?	IV
Maritime saltmarsh and estuary						
	Nelson's Sharp-tail. Sparrow	27	3	4	3	II
	American Black Duck	19	2	5	2	III
	Northern Harrier	17	3	3	3	IV
	Osprey?	14	2	3	1	VI

Mature conifer (spruce-fir) forest

Bay-breasted Warbler	25	3	5	3	IV
Cape May Warbler	24	3	5	4	IV
Spruce Grouse	21	4	5	3	III
Boreal Chickadee	20	3	4	5	III
Black-throated Green Warbler	20	2	5	2	VI
Pine Grosbeak	19	3	3	5	III
Olive-sided Flycatcher	19	2	3	5	III
Northern Parula	19	3	5	1	VI
Blackburnian Warbler	19	3	4	1	VI
Red Crossbill (eastern)	15+	3	5	1	III

Northern hardwood-mixed forest

Canada Warbler	25	3	5	5	III
Wood Thrush	22	2	3	5	III
Black-throated Blue Warbler	21	2	4	1	IV
Veery	21	2	5	5	III
Purple Finch	21	2	5	5	III
Yellow-bellied Sapsucker	20	2	4	5	III
Black-billed Cuckoo	20	2	3	5	III
Least Flycatcher	19	2	4	5	III
Eastern Wood-Pewee	19	2	3	5	III
Ruffed Grouse	19	2	3	5	III

Coastal beach/dune/island/shoreline

Piping Plover	25	4	2	3	I
Common Eider	19	4	5	2	III
Harlequin Duck (winter?)	19	3	2	3	IV
Roseate Tern	18	3	2	3	III
Common Tern	17	2	4	5	III
Arctic Tern	14	2	2	3	IV
Osprey	14	2	3	1	IV
Savannah (Ipswich) Sparrow	??	??	??	??	IV?

Early successional forest/edge

American Woodcock	22	3	5	3	III
Nashville Warbler	20	2	4	4	IV
Olive-sided Flycatcher	19	3	3	5	III
Ruffed Grouse	19	2	3	5	III
Common Nighthawk	12	3	2	2	VI

Grassland/agricultural

Bobolink	21	3	3	5	III

Upland Sandpiper	18	4	2	2	III
Northern Harrier	17	3	3	3	IV
Boreal peatland					
Spruce Grouse	21	4	5	3	III
Blackpoll Warbler	21	2	3	5	IV
Olive-sided Flycatcher	19	2	3	5	IV
Freshwater wetland -- river/lake					
American Black Duck	19	3	5	2	III, V?
Belted Kingfisher	19	2	5	5	IV
Common Tern	17	2	4	5	III
Northern Harrier	17	3	2	3	IV
Bald Eagle	16	2	2	3	III
Common Loon	16	3	4	1	IV
Osprey	14	2	3	1	IV

[a] Action levels: I = crisis; recovery needed; II = immediate management or policy needed rangewide; III = management to reverse or stabilize populations; IV = long-term planning to ensure stable populations; V = research needed to better define threats; VI = monitor population changes only.

A. Mountaintop-conifer woodland

Importance and conservation status: The recognition of Bicknell's Thrush as a separate species (Ouellet 1993, AOU 1995) has elevated the importance of its primary habitat, high-elevation conifers, to a top regional conservation priority (Rosenberg and Wells 1995). This habitat type occurs naturally at high elevations (approximately >900m in U.S.; >500m in Canada) from the Adirondack Mountains (and Catskill Mts) of New York, northeastward through northern New England, western New Brunswick to the Gaspé Peninsula of Quebec. Its distribution is therefore naturally fragmented at the landscape level, with most patches (N = 251 sites, in the U.S.) estimated to be < 1000 ha in extent (Atwood et al. 1996). The total areal extent of this habitat type has been estimated at 100,000 to 150,000 ha in the U.S. (Atwood et al. 1996), plus ???? in Canada.

Current threats to the habitat fall into three categories: (1) global climate change; (2) atmospheric deposition (including acid precipitation); and (3) recreational and other development. The first factor, a global warming trend resulting in the shrinking or retraction of cool-temperate forests regionwide, has been postulated to influence bird distribution and abundance (Erskine 1992, Atwood et al 1996). Indeed, recent models for change in CO_2 indicate that high elevation conifer habitat will eventually disappear from the region (http://www.fs.fed.us/ne/delaware/atlas/ for fir). Although such an effect cannot be controlled by bird-conservation efforts alone, we must make every effort to influence the larger factors that ultimately may determine the fate of this entire habitat-species suite. Atmospheric pollution in the form of acid rain has been shown to adversely influence the health of balsam fir and spruce-dominated communities in New York and New England, resulting in heavy mortality in some areas (Miller-Weeks and Smoronk 1993). Although studies of the effects of acid rain on bird communities in these areas have just begun, a likely factor is the reduction of available calcium in the soil, ultimately reducing egg production and egg-shell thickness in nesting birds (ref). Recreational development, primarily for ski resorts is a growing threat, especially in New York and New England.

Direct elimination of vegetation for building construction is the primary threat, although fragmentation of habitats for the creation of ski slopes, and increased vehicular traffic may also have impacts on the bird community.

Associated priority species: BICKNELL'S THRUSH, Blackpoll Warbler. Bicknell's Thrush appears to be the only species that is restricted to this habitat nearly throughout its range. A
In Canada, additional populations of this species occur locally in habitats of similar structure along the windswept coasts of the Maritime provinces and Quebec, and in some second-growth industrial forest habitats at lower elevations inland(Ouellet 1993, Erskine 1992, Gauthier and Aubry 1996, Nixon 1999). Thrushes were present on mountaintop islands as small as 1.5 ha (Atwood et al 1996), and area of available habitat was not a significant predictor of occupancy (Atwood et al 1996). Preferred habitat has been described as dense, stunted stands dominated by balsam fir, with varying amounts of white birch, mountain ash and sometimes red spruce and other species (Wallace 1939, Atwood et al 1996). The other species associated with Bicknell's Thrush tend to be species of open coniferous and disturbed forests in the more northern portions of their range, but are specialists on mountaintop conifers in New England and New York. The American Pipit is a tundra species that breeds on only a few barren mountaintops in the region. Its status of *special concern* in Maine is intended to protect it's fragile alpine tundra habitat.

Habitat and population objectives: Despite the small size of most available habitat patches, Bicknell's Thrush and other associated species occur there in high densities. Recent estimates of Bicknell's Thrush densities on Mt. Mansfield in Vermont range from about 40 to 60 pairs per 40 ha of continuous habitat (Rimmer et al. 1996), but these do not take into account more recent discoveries of highly skewed sex ratios (1.8 males:1 female) and very patchy distributions within suitable habitat. Using the most up-to-date GIS data available, K. McFarland (unpubl. data) estimates a maximum 53,000 breeding Bicknell's Thrush occurring within the U.S. portion of the range. The actual number may be closer to 15,000-30,000 individuals. The breeding bird atlas estimated an additional 1000 pairs breeding in the Maritime provinces (Erskine 1992), although the number of birds in Canada remains highly uncertain (Nixon 1999).

Sample densities of other associated species are also high. For example, territory size of Blackpoll Warblers decreases with elevation, with densities of up to 100 pairs per 40 ha on some mountaintops (Morse 1979, Sabo 1980, K. McFarland and C. Rimmer unpub. data). Similarly, White-throated Sparrow density was estimated at 25 pairs per 40 ha (Sabo 1980). Population trends for species in this habitat are difficult to assess, because BBS routes do not sample such high-elevation sites. Trend estimates for the planning unit as a whole, however, show that most species associated with this habitat have declined significantly since 1966 (see Table 2). Estimates of declines range from 2.3% per year for White-throated Sparrow, to 5.8% per year in Blackpoll Warbler. Trend estimates for Bicknell's Thrush are more problematical; the steep decline reported by BBS (-10.9% per yr) is based on only six routes, presumably away from mountaintop areas. Nonetheless, the disappearance of this species from some mountains in New England has been documented (Atwood et al 1996), and they have presumably vanished from some coastal and offshore-island locations in recent decades (Erskine 1992). Ouellet (in Gauthier and Aubry 1996) offers a more optimistic view for the species in Quebec, noting its recent colonization of disturbed habitats at lower elevations. The bird is most likely a natural disturbance specialist that utulized areas created by fires and hurricanes in the past and may benefit temporarily from some forestry practices. Data on differential reproductive success and source-sink dynamics of Bicknell's Thrush populations in relation to habitat-patch size or quality are much needed and will be difficult to obtain.

OBJECTIVE 1. Ensure the protection of 100% of sites that support populations of Bicknell's Thrush "large enough to be considered source populations for other sites," and as many additional high-elevation habitat patches with smaller populations as possible. Maintain a regional population of 50,000 breeding individuals (30,000 individuals in U.S.).

Implementation strategy: A strategy for protecting high-elevation habitats and ensuring a stable population of Bicknell's Thrush and associated species should include the following elements (not necessarily sequential):

- identification and characterization (habitat size, quality, land ownership) of all potential habitat patches, using GIS (now complete for Vermont; K. McFarland unpubl. data)
- completion of on-the-ground inventories to determine numbers of breeding Bicknell's Thrushes at all sites
- identification and designation of most important sites, perhaps through state or provincial Important Bird Area programs
- identification of specific threats to particularly important sites
- incorporation of research on reproductive success of Bicknell's Thrush and other species into ongoing studies of forest health, in relation to pollution and development
- explicit and "official" recognition of Bicknell's Thrush and its associated habitat as a high conservation priority in public agency and private land-use planning efforts
- if future declines in habitat availability or Bicknell's Thrush populations warrant, legal mandates for implementation of habitat-protection objectives.

High elevation habitats are currently protected to some extent by existing laws in each state and province **(Table 3).** Potential for strict protection of important habitat patches is highest on publicly owned lands, particularly on National Forests (Vermont, New Hampshire), state lands (e.g., Baxter State Park, ME), and several national and provincial parks in Canada (e.g. Cape Breton Highlands National Park, NS; Mt. Carleton Provincial Park, NB, and Laurentides Reserve and Gaspésie Provincial Park, QE). An immediate priority is the determination of how much habitat (acreage and proportion of Bicknell's Thrush population) is already protected, as well as a review of agency policies potentially affecting these habitat patches.

Implementation of habitat objectives on private lands will be voluntary, except to the extent that Canadian law dictates land-use policies to private lease-holders. Inaccessibility of most sites on private land, as well as the minimal commercial value of stunted conifers that dominate this habitat, should offer a moderate level of protection in the near future. Explicit recognition of important sites should be sought, however, with the goal of incorporating their protection, where possible, into timber-harvest and other land-use plans. Designation within the Important Bird Areas program, if carried out properly and with great sensitivity to private landowners' concerns, could aid in meeting objectives on private lands.

Potential conflicts or threats at specific, important sites should be identified quickly and cooperative agreements sought. These threats may include ski-resort developments, inclusion in commercial timber sales, or agency policies that neglect or inadvertently threaten mountaintop sites. Ultimately, long-term protection of this habitat type and its associated bird species may depend on a multilateral, international effort to halt or reverse the effects of acid precipitation and global climate change in the Northeast.

Management recommendations: xxxxx

Research and monitoring needs: Several ongoing research efforts are now focusing on mountaintop bird communities and the breeding biology of Bicknell's Thrush, Blackpoll Warbler, and other species. These and additional studies should be supported at the highest level of conservation priority. Specific research and monitoring needs that are most relevant to implementation of this conservation plan include the following:

- application of GIS and GAP analyses to determine distribution and conservation status of all habitat patches in the U.S. and Canada.
- continued censuses of Bicknell's Thrush and other species at all sites
- studies of Bicknell's Thrush demography, to be applied to source-sink dynamics modeling and metapopulation analysis throughout this species' range
- studies of calcium availability in relation to acid precipitation and avian reproductive success at high elevation sites
- thorough surveys for breeding Bicknell's Thrush away from mountaintop habitats; in particular in disturbed habitats and along the Atlantic Coast
- determination of potential limiting factors affecting Bicknell's Thrush on its nonbreeding grounds, in winter and at migration-stopover sites
- development of efficient monitoring protocols for evaluating Bicknell's Thrush population trends

Recommended protocols for surveying breeding Bicknell's Thrushes are now available (Rimmer et al. 1996). A potential technique for monitoring this species along its migration routes may employ the recording of distinct nocturnal flight calls (Evans 1993). Studies of Bicknell's Thrush on its wintering grounds and development of a conservation plan for this species in the Dominican Republic are also ongoing (Rimmer).

Outreach: Increased public awareness of the uniqueness and vulnerability of mountaintop coniferous woodland will be necessary for full implementation of the conservation plan. This can be achieved through PIF state working groups throughout the planning unit, as well as programs by NGOs such as VINS and Manomet Observatory. **[add stuff]**

B. Maritime marsh and estuary

Importance and conservation status: Relative to the entire physiographic region, only a small portion of this habitat type occurs in the U.S. The eastern Maine coast has several small rivers and estuaries. The salt marshes there tend to be smaller than in other regions of the Atlantic coast. North of the border, however, this habitat is more prevalent. The largest river system in the Maritimes, the St. John River, and the largest estuary in eastern Canada, the St. Lawrence, are dominant influences on the landscape, and as a result, on the bird communities in this region. Extensive marshes once occurred in the lowlands between New Brunswick and Nova Scotia near Sackville, N.B. Historically this probably held the largest single population of Nelson's Sharp-tailed Sparrow on the east coast. This area has largely been altered through dyking for waterfowl production and by draining for agriculture.

Associated priority species: NELSON'S SHARP-TAILED SPARROW, AMERICAN BLACK DUCK, Northern Harrier. With the recent taxonomic split of Sharp-tailed Sparrow into two species, the priority status of each new, geographically restricted form is increased. Furthermore, the race *A. n. subvirgatus* is nearly endemic to the coastal marshes of physiographic area. Intensive studies of this species on the Maine coast are ongoing (Hodgman and Shriver). Recent surveys for this and other

saltmarsh species resulted in 25 occupied marshes along the eastern Maine coast in this physiographic region (Hodgman and Wilson 2000). American Black Duck is a globally vulnerable Watch List species with a large proportion of its population in this region. It is considered one of the highest priority species according to the Atlantic Coast and Eastern Habitat Joint Ventures and among the state and provincial agencies where this species is abundant. Coastal Marshes are especially important to wintering black ducks as are estuaries and sheltered coves along the coast of this region. Saltmarshes undoubtedly contribute breeding habitat for this species wherever it occurs in the region.

Population and habitat objectives: Although the BBS was not designed to sample coastal or wetland habitats, average relative abundances throughout the area allow VERY ROUGH population estimates (see Appendix 3) of priority species (Table 4.2).

Table 4.2. Population estimates for priority species of maritime marsh and estuary habitat in the Eastern Spruce-Hardwood physiographic area. Percent of Atlas blocks based on number of 5-km blocks in which the species was reported (from Rosenberg and Wells 1995, Appendix 4; Erskine 1992, Gauthier and Aubry 1996).

Species	BBS	% Atlas blocks				
	population	VT	NH	ME	QE	MAR
Nelson's Sharp-t. Sparrow	10,200	0	0	?	(31)	12
American Black Duck	46,500	48	46	81	63	55
Northern Harrier	2,100	11	20	36	(540)	38
Osprey	4,500	0	15	67	(299)	39

These crude estimates are most useful in illustrating the relative population sizes of various species and, perhaps, giving order-of-magnitude figures for setting population objectives for the region. Note that the relative abundances used to for these estimates are averages across all BBS routes in the physiographic area using data from 1990-1998. Somewhat independent estimates of population sizes for the maritime provinces (37% of the total physiographic area) are available from Erskine (1992), based on abundance estimates in breeding bird atlas blocks during 1986-1990.

Independent estimates of population levels are needed, especially for the Nelson's Sharp-tailed Sparrow. An estimate of 2,500 breeding pairs in the Maritimes is based on abundance estimates in breeding bird atlas blocks during 1986-1990 (Erskine 1992). An additional 1,000 pairs were estimated to breed in southern Quebec (Gauthier and Aubry 1996), and about 250 pairs along the Area 28 portion of the Maine coast (Hodgman). BBS data do not permit estimates of population trends for the sparrow in this region. American Black Duck and Northern Harrier populations appear to be stable over the past 30 years, whereas Ospreys have increased significantly at 7.3% per year (see Appendix 2). Erskine (1992) estimated a breeding populations in the Maritimes of 30,000 pairs of Am. Black Ducks, 5,200 pairs of Northern Harriers, and 900 pairs of Osprey.

OBJECTIVE 1. Maintain a stable population of roughly 8,000 [??] Nelson's Sharp-tailed Sparrows throughout the physiographic area.

OBJECTIVE 2. Maintain a stable population of roughly [??] American Black Ducks throughout the physiographic area; roughly xx% of these to be supported in coastal salt marsh and estuary habitats. [Incorporate objectives of Atlantic Coast JV].

Implementation strategy: For Nelson's sharp-tailed sparrows, a combination of habitat protection and increased awareness (outreach) about the importance of these species in the region is needed. Habitat conservation for Black Ducks is likely the most effective strategy at maintaining stable numbers of both wintering and breeding birds across the region. Further reductions in the harvest, at least in U.S., are unlikely given the harvest level has been so low for several years.

Management guidelines: Little of the occupied saltmarsh habitat in eastern Maine is in conservation ownership, yet, a protection initiative is underway which will target some of the most significant sites identified by Hodgman and Wilson (2000). Because many of the sites in this portion of the region are small, the degree of saltmarsh ditching is minimal compared to sites in other regions. At least in the U.S., threats to habitat quality via invasive plants such as Phragmites is minimal. Opportunities may exist in New Brunswick for conservation easement or acquisition of former marsh habitat and for restoration of ditched marshes.

Black Duck management in the northeast (chiefly harvest reductions) has managed to stem the decline in the species. A variety of harvest reductions including reducing daily bag limits (1 bird per day in Maine), reducing season length and delaying opening for this species appear to have been effective. The beginning of a recovery may be evident from midwinter waterfowl survey in the Atlantic Flyway, where 1999 data were at a 23 year high (Serie et al. 1999). Longcore et al. (2000) called for an improved strategy for harvesting black ducks throughout northeastern North America. Such a revised plan would require strong cooperation between Canadian and American biologists and hunters. Despite the importance of coastal habitats, American Black Ducks present in tidal marsh and estuary habitats in winter may not have been produced in these same marshes, so wintering numbers of this species may have much to do with production and harvest in interior habitats of Area 28.

Research and monitoring needs:

- Complete inventory for Nelson's Sharp-tailed Sparrow in Atlantic Canada and along the St. Lawrence (Maine surveys completed in 1999); develop methods appropriate for estimating population size; develop program (perhaps using volunteers) to monitor populations of sharp-tailed sparrows and other saltmarsh birds at key sites in Area 28.

- Determine factors that influence habitat suitability and quality for Nelson’s Sharp-tailed Sparrow; identify threats to the most important sites and develop ways to diminish these threats; examine nesting success in areas with extreme tidal ranges; identify limiting factors other than or that interact with tidal flooding of nests.

- Examine feasibility of marsh restoration for sharp-tailed sparrows, specifically effects of ditch plugging on nesting success.

- Support efforts to monitor wintering American Black Ducks in coastal habitats in Area 28; develop methods for stratifying state- or province-wide survey data to be specific to Area 28.

- Identify factors that affect habitat quality for breeding Black Ducks in coastal versus inland habitats; improve monitoring of Black Duck productivity in coastal habitats.

Outreach: Increase awareness among the public and among conservationists of the importance of Sharp-tailed Sparrows (nearly endemic to region) among the Area 28 avifauna. Because people have difficulty getting excited about a species that is difficult to identify, encourage identification workshops at

bird festivals, national wildlife refuges, and presentations to local Audubon chapters and birding clubs. These should target the intermediate birder and encourage both sight and sound identification. Whenever possible, emphasize the dependence of sharp-tailed sparrows on saltmarsh habitats for all aspects of their life history.

Continue to encourage hunters to learn to identify the Black Duck, through distribution of color posters at sporting goods stores, municipal offices, wildlife refuges, etc.

C. Mature conifer (spruce-fir) forest

Importance and conservation status: Cool coniferous forests, dominated by balsam fir and red spruce, represent one of two major forest types (along with northern hardwoods) that occur in a mosaic throughout the planning unit. Largest continuous areas of coniferous forest exist in the northern sections (Laurentian Highlands, Gaspé Peninsula), along the immediate coast in the Maritime provinces and Maine, and on slopes of Appalachian mountains from northern New Brunswick to the Adirondacks. Stands dominated by spruces or firs also occur as islands throughout the mixed and hardwood-dominated forests further south and at lower elevations, depending on drainage and disturbance regimes. Total area of this forest type is on the order of millions of ha.

Coniferous (i.e. softwood) tree species are currently preferred for commercial timber production (pulp and paper) in this region, and vast acreages of coniferous forest are under management for commercial forestry. Total area of coniferous forest has increased in the region as mature hardwood and mixed forests were initially logged and replaced by regenerating softwoods. Because of shorter rotation cycles, however, age-class distribution of conifer forest is favoring younger and more even-aged stands. A 1995 forest-management plan for New Brunswick (NB Dept. of Natural Resources and Energy 1995) projected that mature and overmature classes of spruce-dominated coniferous forest will decline more rapidly over the next 40 years (from 46% of land area to 8%) than any other habitat-community type. This projection may also apply to large portions of Nova Scotia, Quebec, and the industrial forests of northern Maine [check this]. It is these mature coniferous forests that support a large number of high priority bird species, and if projections are accurate these species may decline throughout the region. Unlike the patchily distributed mountaintop communities, where protection of specific sites is critical, conservation strategies for mature coniferous forest will need to focus on maintenance of minimum percentages of the landscape mosaic to prevent local loss of this habitat type and its associated dependent species. This goal may best be achieved through cooperative agreements with large landowners.

Associated priority species: BAY-BREASTED WARBLER, CAPE MAY WARBLER, SPRUCE GROUSE, RED CROSSBILL (?). The total habitat suite of 10 priority species represents a cross-section of the breeding bird community and is composed primarily of two groups of species. The first are widespread, but low-density, species that are more typical of the boreal forests further north. These include the largely resident Spruce Grouse, Boreal Chickadee, and Pine Grosbeak, as well as the Neotropical migrant Olive-sided Flycatcher. The second group consists of several "spruce-woods warblers" and the Red Crossbill, which are more restricted to and reach high densities in the taller spruce-fir forests of this physiographic area.
[ecological information, microhabitat requirements, population trends]

Habitat and population objectives: Based on extrapolations from BBS relative abundances (assuming each route samples approximately 2.5 km2 of forest habitat; see Appendix 3), VERY ROUGH estimates of population size for priority species in this habitat suite can be derived (Table 4.3).

Table 4.3. Population estimates for priority species of mature conifer forest habitat in the Eastern Spruce-Hardwood physiographic area.. Percent of Atlas blocks based on number of 5-km blocks in which the species was reported (from Rosenberg and Wells 1995, Appendix 4; Erskine 1992, Gauthier and Aubry 1996).

Species	BBS	% Atlas blocks				
	population	VT	NH	ME	QE	MAR
Bay-breasted Warbler	136,600	6	39	78	61	39
Cape May Warbler	84,000	17	33	76	46	25
Spruce Grouse	???	2	15	43	5	14
Boreal Chickadee	76,500	23	45	60	42	44
Black-thr. Green Warbler	735,000	100	98	94	87	57
Pine Grosbeak	12,000	1	0	12	15	20
Olive-sided Flycatcher	103,000	81	34	76	57	40
Northern Parula	763,000	65	67	97	53	61
Blackburnian Warbler	328,000	87	98	93	87	49
Red Crossbill	24,000	1	0	6	(37)	9

These crude estimates are most useful in illustrating the relative population sizes of various species and, perhaps, giving order-of-magnitude figures for setting population objectives for the region. Note that the relative abundances used to for these estimates are averages across all BBS routes in the physiographic area using data from 1990-1998. Somewhat independent estimates of population sizes for the maritime provinces (37% of the total physiographic area) are available from Erskine (1992), based on abundance estimates in breeding bird atlas blocks during 1986-1990.

BBS data also indicate that populations of Boreal Chickadee and Olive-sided Flycatcher have declined by roughly 5% per year since 1966, and Pine Grosbeaks may have declined by as much as 14% per year. In contrast, Blackburnian Warbler, Hermit Thrush, Winter Wren, and possibly Black-backed Woodpecker and Red Crossbill, have increased significantly over this period. It is noteworthy that several of the species in this suite undergo marked population fluctuations in response to spruce-budworm outbreaks; these species exhibited large increases during the period 1966-1979 and then subsequent declines during the following decades. Setting population objectives for such species is extremely difficult.

OBJECTIVE 1. Maintain sustainable populations of priority spruce-fir warbler community, within limits of natural fluctuations or cycles (no net loss). In northern portions of the phsysiographic area, Bay-breasted and Cape May warblers will be focal species; in Nova Scotia and northern New England states, Black-throated Green, Northern Parula, and Blackburnian warblers will be focal species. Population estimates listed in Table 4.2 may be used as preliminary numerical goals.

OBJECTIVE 2. Maintain sustainable regional population of 5,000-10,000 [??] Spruce Grouse, within natural population cycles. Assumption: sufficient habitat for Spruce Grouse will also be sufficient for other boreal-conifer bird species.

OBJECTIVE 3. Stabilize or reverse declining population trends for Olive-sided Flycatcher, Boreal Chickadee, and Pine Grosbeak, over next 20 years.

OBJECTIVE 4. Detemine conservation status and maintain sustainable populations of eastern Red Crossbill.

Based on published average density estimates of 4-5 pairs of Blackburnian Warblers and 10 pairs of Black-throated Green Warblers (Gauthier and Aubry 1996), an estimated 730,000 ha (1.8 million acres) of mature conifer habitat is required to support the suite of spruce-woods warblers in this physiographic area. Roughly 120,000 ha (300,000 acres) of this land should be maintained or managed in stands older than 50 yr to support breeding Cape May Warblers. In addition, xxx ha are required in a mosaic of stand ages to support a regional population of Spruce Grouse.

Implemention strategy: A strategy for supplying adequate habitat for species requiring mature coniferous forest over large regions is proposed in the New Brunswick forest management plan (New Brunswick Department of Natural Resources and Energy 1995). This plan ensures that a minimum of 10%-20% of sub-regional planning units (commercial licenses, townships, etc.) involved in timber production be maintained as mature or overmature coniferous forest. This value is derived from estimates of minimum areas required by viable populations of American marten and adequate wintering habitat for white-tailed deer, and is assumed to be adequate for populations of forest landbirds. Interestingly, if applied over the entire physiographic area, the amount of mature conifer habitat estimated to meet priority bird population objectives above is roughly 11% of the total extent of land classified as coniferous forest.

For conservation lands that support coniferous forest, maintenance of considerably larger percentages of land area in mature or overmature age classes is desirable to offset potential shortfalls or temporal bottlenecks. This model is similar to the concept forwarded by ecologists at Manomet (Hagan et al.), often referred to as the shifting mosaic. The shifting mosaic paradigm requires that no species be lost from a landscape unit over time. To meet this seemingly simplistic objective requires maintenance of all habitat types in that landscape unit for a specified period. The region is largely managed *de facto* in this manner already, and as a result, populations of most species that breed in this habitat type are not in decline.

Management recommendations: Cooperative relationships with industrial forest landowners seems to be the best approach in the U.S. and is being adopted for deer wintering area management in the region. Acquisition of scenic and sensitive natural areas continues but the extent to which these will contribute to regional bird conservation remains unclear. Clearly, the dominant impact on the landscape is timber management. Fortunately forest types in this region are self regenerating and a variety of bird species benefit from each stage of stand development. Keeping the region's conifer forest as conifer forests should be a high priority, and keeping land in timber management may be the simplest way of achieving this. Issues that are especially problematic will be related to species needs for narrow habitat conditions such as minimum stand age and/or certain structural conditions.

Research and monitoring needs:

- complete inventory of Spruce Grouse populations and habitats; determine conservation status and threats.
- better understanding of role of stand age and stand structure on habitat quality and ultimately survival and reproductive success.
- better methods for monitoring species that use patchily distributed components of the forest, such as treefall gaps, small wetlands, snags.

• determine possible causes of population declines of Olive-sided Flycatcher; explore management practices that might enhance populations of this species

Outreach: Develop full color posters which give identification types for distinguishing Spruce Grouse from Ruffed Grouse and the protected status of Spruce Grouse and post these at convenience stores, municipal offices, roadside checkpoints, etc. Encourage adult education courses in the identification of bird species, perhaps at the beginning, intermediate and advanced level, for the purpose of recruiting future volunteers for BBS and other monitoring programs in the planning unit.

D. Northern hardwood and mixed forests

Importance and conservation status: Northern hardwood and mixed forests, usually dominated by sugar maple, beech, and birch, represent the most widely distributed habitat-community within the planning unit. Although mature hardwoods (and associated white pine) were extensively harvested in the past century, these forests have largely regenerated over most of the region during the past 50 years. In the Canadian provinces and northern Maine, however, where commercial timber production is the dominant land use, regenerating conifer stands have replaced the original hardwood forest over vast areas. Today, hardwood and mixed forest types dominate in the southern portions of the planning unit (New England) and at lower elevations in southern Quebec and southern New Brunswick. Throughout this recent history of widely fluctuating availability in the region, few if any bird species dependent on northern hardwood forests have been lost or severely reduced in abundance.

The importance of this habitat type is great, because of the number of associated bird species with high proportions of their total population in the planning unit. In general, these species are relatively abundant throughout the region, and many show stable or even increasing population trends. Setting habitat and population objectives is therefore not as straightforward as in the mountaintop or mature conifer habitat types. Conservation planning should focus on extensive tracts of representative forest types, and should address the microhabitat needs of species showing regional or local declines. A majority of high-priority species in this habitat are dependent on particular characteristics of the forest understory.

Associated priority species: CANADA WARBLER, BLACK-THROATED BLUE WARBLER, Wood Thrush, Yellow-bellied Sapsucker, Veery, Black-billed Cuckoo, Ruffed Grouse, etc. The total suite of 17 priority species in this habitat represents a cross section of the entire diverse breeding bird community. Unlike the coniferous forest species suite, most species in the northern hardwood suite are near the northern limit of their range; for 5 species, however, more than a quarter of the world population is estimated to breed in this physiographic area. Also unlike in the coniferous forest suite, a majority of the priority species in northern hardwood forest habitat are exhibiting population declines.

[ecological information, microhabitats]

Habitat and population objectives: Based on extrapolations from BBS relative abundances (assuming each route samples approximately 2.5 km^2 of forest habitat; see Appendix 3), VERY ROUGH estimates of population size for priority species in this habitat suite can be derived (Table 4.4).

Table 4.4. Population estimates for priority species of northern hardwood and mixed forest habitat in the Eastern Spruce-Hardwood physiographic area. Percent of Atlas blocks based on number of 5-km blocks in which the species was reported (from Rosenberg and Wells 1995, Appendix 4; Erskine 1992, Gauthier and Aubry 1996).

Species	BBS	% Atlas blocks				
	population	VT	NH	ME	QE	MAR
Canada Warbler	200,000	98	98	94	91	46
Black-throated Blue Warbler	250,000	91	96	85	84	24
Wood Thrush	303,000	98	98	80	58	11
Yellow-bellied Sapsucker	377,500	94	92	92	85	43
Purple Finch	405,000	100	96	99	97	65
Veery	1,420,000	97	98	96	97	49
Black-billed Cuckoo	24,500	57	60	47	19	10
Least Flycatcher	663,000	96	91	93	96	49
Eastern Wood-pewee	165,000	96	96	91	81	47
Ruffed Grouse	37,500	94	86	91	83	48

These crude estimates are most useful in illustrating the relative population sizes of various species and, perhaps, giving order-of-magnitude figures for setting population objectives for the region. Note that the relative abundances used to for these estimates are averages across all BBS routes in the physiographic area using data from 1990-1998. Somewhat independent estimates of population sizes for the maritime provinces (37% of the total physiographic area) are available from Erskine (1992), based on abundance estimates in breeding bird atlas blocks during 1986-1990.

OBJECTIVE 1. Stabilize or reverse declining population trend for Canada Warbler; maintaining long-term population of (200,000) breeding pairs.

OBJECTIVE 2. Maintain stable population of (250,000) Black-throated Blue Warblers throughout the physiographic area.

Assumption: maintaining suitable habitat for Canada and Black-throated Blue warblers will be sufficient to support sustainable populations of most other birds in this habitat suite.

Based on published average density estimates of 4-5 pairs of Canada Warblers and Black-throated Blue Warblers (Gauthier and Aubry 1996), an estimated 500,000 ha (1.25 million acres) of suitable northern hardwood and mixed forest habitat is required to support the highest-priority species in this physiographic area. A total of 1.9 million ha (4.75 million acres) is required to support the entire habitat-species suite, based on a density estimate for Veery of 7-8 pairs per 10 ha.

Implementation strategy: Implementing the broad objectives for this habitat-species suite will require a comprehensive forest management plan for the entire Eastern Spruce-hardwood forest region, that acknowledges the long-term importance of maintaining large source populations of priority forest birds. Elements of such a plan that are most relevant to the high-priority birds include:

- maintaining a balance of forest-age structures, including adequate amounts of mid-successional as well as late-successional forest

- ensuring long-term tree-species composition; i.e. prevent loss of particular species, such as hemlock, white pine, or beech, through disease or selective harvest
- ensuring adequate structural diversity, especially regarding understory components (shrubs, treefalls); monitor effects of natural disturbances (e.g. wind storms) as well as deer browsing and forestry practices
- setting maximum allowable levels of forest fragmentation due to forestry practices or planned development; e.g. do not allow any 10,000 km^2 landscape to fall below 70% forest cover
- identify and designate Bird Conservation Areas (BCA), within which long-term sustainability of priority bird populations is a primary management objective

An as yet untested approach to the long-term conservation of forest birds is the establishment of Bird Conservation Areas (BCA) within the forested landscape that maximize the chances of sustaining source populations of priority species. Such an approach would essentially superimpose an island or patch model onto a seemingly continuous landscape. Identification of potential BCAs would take into account present-day local distributions of priority species, specific habitat relationships that optimize density or reproductive success, land ownership status, and prospects for long-term maintenance of desired habitat conditions. Land-management goals within BCAs would explicitly include sustainability of priority bird populations; i.e., these areas would be responsible for sustaining these populations for the phsyiographic area. Areas outside of designated BCAs might support similar habitats and bird populations, and might contribute substantially to the overall bird community, but they would not be *essential* to meeting specific population objectives for priority species. This basic approach is being developed and tested in patchily distributed grassland habitats in the Midwestern U.S. (refs).

A procedure for designating Bird Conservation Areas for forest birds in a region such as the Eastern Spruce-hardwood forest would involve the following steps:

- determine local optimum densities of priority species in suitable habitats
- determine area required to support source population (e.g. 500 pairs) of priority species, assuming optimum habitat conditions
- determine present distribution of priority species; e.g. using Breeding Bird Atlas or similar occurrence data
- identify potential patches of suitable or optimal habitat, using GIS, that meet requirements of habitat type (e.g. forest type, elevation), minimum size, and known or suspected occupancy for each priority (focal) species.
- superimpose suitable habitat patches identified for multiple priority species to identify patches capable of supporting entire habitat-species suite
- overlay land-ownership, conservation status, and other relevant features (e.g. using GAP analysis) to identify potential BCAs

This basic procedure is similar to that used for GAP Analysis, identification of focal areas within TNC's Ecoregions, and probably other conservation planning processes, but it has not been applied previously to PIF planning for forest birds. Note that if similar initiatives to identify conservation focus areas are ongoing within a physiographic area, then a modified approach could begin with already-identified areas, assessing their potential for supporting priority bird populations, and then following the above procedure to identify any additional areas that are needed to meet population objectives.

If BCAs are being identified in another forest habitat type, then these processes should be coordinated, or perhaps combined. For example, in the Eastern Spruce-hardwood forest, BCAs can be identified for species of both northern hardwood and spruce-fir forests. If these forest types occur as distinct,

large patches, then BCAs for each habitat-species suite could be distinct. If, however, forest types occur primarily as a mosaic over large landscapes (more likely), then particular BCAs might be selected that are large enough to meet the needs of species in both habitats.

Management guidelines: Most of the priority species in northern hardwood forest habitat have been shown to respond positively to various silvicultural practices, and only one species (Northern Goshawk) may require very large blocks of mature forest. In particular, Canada and Black-throated Blue Warbler populations were enhanced by modest timber harvesting in Maine (Hagan and Grove, ms). **EXPAND**

Research and monitoring needs: xxxxxxx

- GIS analysis of public and private lands to identify, catalog, and prioritize forest stands in terms of species composition, age structure, and amount of understory;
- verify population declines of forest birds through independent measures; establish general causes of declines if possible (e.g., habitat loss? changing forest structure?)
- determine specific habitat needs (and causes of declines) for Canada Warbler; why, for example, is Canada Warbler declining while Black-throated Blue Warbler is stable, if both require shrubby understory of mature forest?
- better understanding of landscape-level effects of land-use practices on forest bird populations
- better understanding of role of stand age and stand structure on habitat quality and ultimately survival and reproductive success of priority species.
- better methods for monitoring species that use patchily distributed components of the forest, such as treefall gaps, wetlands, peatlands, snags.

Outreach:: Involvement of private timber companies is essential; they should be invited to participate in forest stand prioritization analysis and discuss optimum practices for meeting priority bird population objectives. Outreach is needed also to state and provincial agencies to help guide the development of forest management plans on public lands, as well as for prioritizing areas for possible purchase or conservation easement.

E. Coastal beach/dune/shoreline

Importance and conservation status: xxxx

Associated priority species: PIPING PLOVER, SAVANNAH (IPSWICH) SPARROW, Common Eider, terns, etc.

Habitat and population objectives: xxxxxxxx

Implementation strategy: xxxxx

Research and monitoring: needs xxxxxxxx

Outreach: xxxxxxxx

F. Early successional forest/edge

Importance and conservation status: Early successional habitats within this region can be of three types, distinguished by their origins. Natural disturbance was undoubtedly responsible for maintaining local areas of successional habitat, following severe storms, landslides, beaver activity, or fire. These areas probably were important in sustaining populations of priority bird species, and they remain important today, especially in portions of physiographic area that are exempt from timber harvest. Other early successional habitats are created or maintained through the processes of agricultural abandonment and silviculture. Regenerating forests through silvicultural practices are an important component of the landscape on extensive areas owned by private timber companies.

Associated priority species: AMERICAN WOODCOCK, OLIVE-SIDED FLYCATCHER, Nashville Warbler, Ruffed Grouse, Chestnut-sided Warbler, etc.

American Woodcock was found to be distributed rather uniformly within the physiographic area, according to regional breeding bird atlas projects. Although the BBS does not adequately sample this largely nocturnal species, singing-route surveys indicate a significant decline of 2-3% per year since 1968 in most of the region, except for southern Quebec (Bruggink 1996). Woodcocks require a mix of habitats, including forest openings or clearings for singing displays in spring, alder or other young hardwoods on moist soils for feeding and daytime cover, young second-growth hardwoods for nesting, and large fields for night-time roosts (Mendall and Aldous 1943; Connor, in Andrle and Carroll 1988). Although there have been many studies of seasonal habitat use, the relationship between specific habitat features and population demography remain unknown (Keppie and Whiting 1994). Silvicultural practices can enhance habitat available for woodcocks (Sepik et al. 1981), although a shift away from even-aged management (creating large areas of uniform shrub cover) may be detrimental to populations (Keppie and Whiting 1994).

Olive-sided Flycatcher is listed here as a forest-edge species, although it also occurs in mature coniferous forest with natural openings, such as peatlands. Primary habitats in the Adirondack Mountains of New York were described as “small boggy ponds, swampy ends of lakes, marshy streams, wet backwaters of rivers, quaking bogs, and old beaver meadows.” (Peterson, in Andrle and Carroll 1988). A common element of these habitats was the presence of dead standing trees (snags), which the birds used as singing and feeding perches. This species was apparently more abundant following widespread clearing and burning of forests in the last century. **[add stuff on other species]**

Because of their diverse habitat requirements, these species probably do not constitute a "habitat-species suite" per se. In fact, there is overlap in habitat use with species in the mature forest suites, with a continuum of tolerance levels to disturbance and intensive management. Listing them together, however, highlights the need to include early successional habitats in the conservation plan, where doing so is not in conflict with higher-priority mature-forest-bird objectives.

Habitat and population objectives: Based on extrapolations from BBS relative abundances (assuming each route samples approximately 2.5-6.3 km^2 of appropriate habitat; see Appendix 3), VERY ROUGH estimates of population size for priority species in this habitat suite can be derived (Table 4.6).

Table 4.6. Population estimates for priority species of early successional and edge habitats in the Eastern Spruce-hardwood physiographic area. Percent of Atlas blocks based on number of 5-km blocks in which the species was reported (from Rosenberg and Wells 1995, Appendix 4; Erskine 1992, Gauthier and Aubry 1996).

Species	BBS	% Atlas blocks				
	population	VT	NH	ME	QE	MAR
American Woodcock	12,300	60	56	76	52	32
Nashville Warbler	858,400					
Olive-sided Flycatcher	103,000	81	34	76	57	40
Ruffed Grouse	37,500	94	86	91	83	48
Common Nighthawk	27,000					
(Chestnut-sided Warbler)	941,300	100		97		45

These crude estimates are most useful in illustrating the relative population sizes of various species and, perhaps, giving order-of-magnitude figures for setting population objectives for the region. Note that the relative abundances used to for these estimates are averages across all BBS routes in the physiographic area using data from 1990-1998.

OBJECTIVE 1. Maintain stable breeding population of ????? American Woodcocks throughout the physiographic area.

OBJECTIVE 2. Stabilize or reverse declining population trend for Olive-sided Flycatcher; maintaining long-term population of 100,000 breeding pairs.

OBJECTIVE 3. Maintain sustainable population of 800,000-1,000,000 pairs of Nashville and Chestnut-sided Warblers, distributed throughout the physiographic area.

Setting habitat objectives for American Woodcock (or Ruffed Grouse) is difficult at present, because of poor estimates of numerical population objectives. Overall objectives for early-successional forest may be set, however, based on desired populations of the more common warbler species, with the assumption that adequate habitat for those species would also support woodcock and grouse. One caution that must be applied with this assumption is that woodcock habitat selection may be closely tied to soil moisture and earthworm densities wheras shrub- and ground-nesting wrblers may not be.

Based on published average densities of roughly 5 pairs of Chestnut-sided Warblers and Nashville Warblers per 10 ha (Gauthier and Aubry 1996), an estimated 1.8 million ha (4.7 million acres) of successional (regenerating) forest is required to maintain this habitat suite throughout the physiographic area. Note that this is roughly equal to the amount of forest in older age-classes needed to support the mature forest habitat suite (see above), implying that a shifting mosaic of age classes will be adequate to maintain all the forest-breeding species of this region (Hagan refs.)

Implementation strategy: It is unlikely that Bird Conservation Areas (BCA) need to be established specifically for early successional species in this physiographic area. Rather the needs of these species will most likely be met outside of forest-based BCAs, where a variety of land-use processes will continue to generate suitable habitat. In addition, protection of existing snags and policies directed at retaining standing dead trees after harvesting may favor Olive-sided Flycatcher.

Implementing objectives for birds of successional habitats will require working with private landowners as well as public land management agencies. [apply shifting mosaic model -- Hagan] In particular, management strategies for American Woodcock may be suitable for maintaining populations of other priority species. Elements of implementation could include:

- mapping and tracking of suitable disturbance regimes on public lands;
- partnership with private timber companies to map and track early successional stands;
- mapping and tracking beaver activity; monitor for associated priority birds;
- snag retention and protection to enhance Olive-sided Flycatcher populations;
- integration of traditional woodcock and other game species management (especially Ruffed Grouse, deer) with songbird objectives.

Research and monitoring needs:

- compare early successional habitats resulting from natural disturbances vs. forestry practices with regard to suitability for high-priority species
- determine effects of woodcock habitat management techniques on other priority, early-successional bird species
- determine possible causes of population declines of Olive-sided Flycatcher; explore management practices that might enhance populations of this species
- study impacts of human development on early successional bird species

Outreach: Information on the importance and conservation status of early successional bird species should be disseminated to private landowners, as well as public agencies. In particular, outreach to private timber companies will be important for meeting habitat objectives for this habitat suite. Partnerships should be built with the Ruffed Grouse Society and Cooperative Extension to further awareness of parallel needs of Ruffed Grouse, American Woodcock and many songbird species. Republish Sepik et al. (1981) (..Landowner's Guide to Woodcock Management....) with broader species scope and incorporating recent findings in both the woodcock and songbird literature.

G. Grassland (barrens) and agricultural land

Importance and conservation status: Natural grasslands were not a major feature of the presettlement landscape of this region, and it is unlikely that other natural openings, such as bogs or wet meadows, supported many grassland birds (except possibly Northern Harrier). Today, agricultural land represents a minor and declining feature of the landscape. Primary areas with local concentrations of grassland species include Aroostook County, in northeastern Maine, blueberry barrens of eastern Maine, St. John River Valley in New Brunswick, and Prince Edward Island.

Other than maintaining overall avian richness in the region, grassland birds are a relatively low priority in this physiographic area. Large geographic ranges and larger populations in other parts of North America greatly contributes to their lower priority. Where land is in active agricultural production, however, efforts to maintain populations of priority bird species will contribute to conservation objectives for these species throughout the Northeast.

Associated priority species: BOBOLINK, UPLAND SANDPIPER, Northern Harrier, (Vesper Sparrow, Eastern Meadowlark). The Bobolink is a (U.S.) national Watch List species (Moderate priority), and thus all populations of this species may be considered important. In addition, Upland

Sandpiper and Northern Harrier were identified by Schneider and Pence (1992) as nongame species of management concern in the Northeast U.S..

Habitat and population objectives: Based on extrapolations from BBS relative abundances (assuming each route samples approximately 6.3 km^2 of appropriate habitat; see Appendix 3), VERY ROUGH estimates of population size for priority species in this habitat suite can be derived (Table 4.7).

Table 4.7. Population estimates for priority species of freshwater wetland habitats in the Eastern Spruce-hardwood physiographic area. Percent of Atlas blocks based on number of 5-km blocks in which the species was reported (from Rosenberg and Wells 1995, Appendix 4; Erskine 1992, Gauthier and Aubry 1996).

Species	BBS	% Atlas blocks				
	population	VT	NH	ME	QE	MAR
Bobolink	420,900	83	54	72	(610)	47
Upland Sandpiper	2,300	2	1	7	(129)	1
Northern Harrier	2,100	11	20	36	(540)	38

These crude estimates are most useful in illustrating the relative population sizes of various species and, perhaps, giving order-of-magnitude figures for setting population objectives for the region. Note that the relative abundances used to for these estimates are averages across all BBS routes in the physiographic area using data from 1990-1998.

Bobolink is the most abundant and widespread species and also the least area sensitive. Roughly 10% of the global population of Bobolinks breeds in this region, and this population is declining significantly at roughly 3% per year throughout the physiographic area. In the Maritime provinces, Erskine (1992) estimated 76,000 breeding pairs; this species is patchily distributed, with concentrations in the St. Johns valley, eastern New Brunswick, and Prince Edward Island -- on PEI they were rare before the 1960s, however (Erskine 1992). In Quebec, the distribution closely parallels the extent of agricultural development, primarily in the Eastern Townships and coastal Gaspé Peninsula.

Upland Sandpipers are probably the most specialized and area sensitive species in this suite. Many sites supporting this species would likely support populations of one or more other priority species. In the Maritime provinces, roughly 50 pairs are estimated to occur in grasslands > 20 ha, primarily in eastern New Brunswick and Prince Edward Island; surprisingly, none were found in the agricultural St. Johns river valley (Erskine 1992). Weik (2000) estimates 15-20 pairs in northern Maine and 140-160 pairs in eastern Maine. In the Quebec portion of the physiograpic area, this species was found breeding in 129 Atlas blocks, primarily in the extreme southeast near the Maine border (Eastern Townships). Population trend estimates for Upland Sandpipers from the BBS indicate a stable population over the last 32 years.

OBJECTIVE 1: Maintain stable population of 450,000+ pairs of Bobolinks (averaging 7-8 per BBS route) on lands in active agriculture (including pastureland) with no reduction in the number of BBS routes reporting this species (approximately 50 routes).

OBJECTIVE 2: Maintain sustainable population of 2500 Upland Sandpipers, ensuring the long-term representation of the full habitat/species suite in this region.

Based on published density estimates of 9.1 Bobolinks per 10 ha, an estimated 468,000 ha (1,170,000 acres) of suitable habitat is required to support the grassland bird suite in this physiographic area. Roughly 30,700 ha (76,800 acres) of this land should be maintained or managed in suitable condition to support breeding Upland Sandpipers and Northern Harriers.

Implementation strategy: Maintaining existing populations of any grassland bird species in Northern New England is closely associated with human use of their habitats. Most of the grasslands in the region are of agricultural origin, yet, many modern agricultural practices can be detrimental to successful reproduction of these species. This contradiction needs to be considered in any implementation strategy. If farmers are unable to "earn a living", these lands will be converted to other uses such as home developments and surrounding land will revert to forest. In northern areas with damp climates, early haying practices are not possible, and conditions are more favorable for breeding Bobolinks.

Management recommendations: In addition to broad outreach efforts targeted specifically for agricultural lands, the many small native grasslands also need attention. Many of these sites are formed on natural sandplains and need periodic burning to remain suitable for grassland birds. Sandplain grasslands are a fairly rare community in the northeast and support other rare species of plants and animals. Ensuring that grassland bird issues are incorporated into management plans for protected natural grasslands is an obvious first step. Protection of these sites may be easier if justification can be based on priority birds as well as rare plants and invertebrates.

Research and monitoring needs: Bobolinks have been well studied in other parts of the northeast region, yet have not been the focus of investigations within this physiographic area. A variety of methods, centered largely around haying practices, have been proposed to minimize losses of nests and nestlings during typical agricultural activities (Bollinger and Gavin 1992, Jones and Vickery 1997). However, little is known about relative reproductive success following these practices. For example, would leaving unmowed sections or strips increase fledging success or focus predation on nests later in the season when females are less likely to renest? Furthermore, lifetime reproductive output is not known for individuals in agricultural ecosystems in this region.

Monitoring of grassland birds like other species with patchy distributions will require special efforts targeted toward appropriate habitats. The Grassland Bird Working Group (Northeast U.S. PIF) could be used to nominate sites (given statistical considerations) based on results of the regional grassland bird surveys conducted by Massachusetts Audubon in 1997 and 1998. State working groups could assist with identifying qualified volunteers to perform the actual counts.

Outreach: xxxxxxxx

H. Boreal peatlands

Importance and conservation status: xxxx

Associated priority species: SPRUCE GROUSE, Blackpoll Warbler, Palm Warbler, Olive-sided Flycatcher.

Habitat and population objectives: xxxxxxxx

Implementation strategy: xxxxx

Research and monitoring: needs xxxxxxxx

Outreach: xxxxxxxx

I. Freshwater wetlands

Importance and conservation status: This Physiographic Area supports thousands of lakes and ponds and tens of thousands perhaps hundreds of thousands of wetlands. This area is not unlike others in the northeast having lost large portions of the wetland resource. The greatest losses occurred in floodplain wetlands (including forested wetlands and vernal pools) following hydropower development along major rivers. Over time, agriculture also has contributed heavily to losses (and conversion) of wetland habitat especially in northeastern Maine, western and extreme eastern New Brunswick, along the south shore of the St. Lawrence, and on Prince Edward Island.

American Black Ducks are synonymous with beaver flowages, ponds and marshes in the Northeast. Despite long-term declines they remain a common if not the most abundant breeder in the region. The wetland habitats used by black ducks and other associated species are protected by both state and federal laws. However, small incremental losses continue to occur across the region.

Associated priority species: AMERICAN BLACK DUCK, BELTED KINGFISHER, Common Tern, etc.

Habitat and population objectives: Based on extrapolations from BBS relative abundances (assuming each route samples approximately 6.3 -25 km^2 of appropriate habitat; see Appendix 3), VERY ROUGH estimates of population size for priority species in this habitat suite can be derived (Table 4.8).

Table 4.8. Population estimates for priority species of freshwater wetland habitats in the Eastern Spruce-hardwood physiographic area. Percent of Atlas blocks based on number of 5-km blocks in which the species was reported (from Rosenberg and Wells 1995, Appendix 4; Erskine 1992, Gauthier and Aubry 1996).

Species	BBS	% Atlas blocks				
	population	VT	NH	ME	QE	MAR
American Black Duck		48	46	81	63	55
Belted Kingfisher						
Common Tern						
Northern Harrier		11	20	36	(540)	38
Bald Eagle						
Common Loon						
Osprey		0	15	67	(299)	39

These crude estimates are most useful in illustrating the relative population sizes of various species and, perhaps, giving order-of-magnitude figures for setting population objectives for the region. Note that the

relative abundances used to for these estimates are averages across all BBS routes in the physiographic area using data from 1990-1998.

OBJECTIVE 1. Increase numbers of American Black Duck broods to ____ in interior wetland habitats of Area 28.

Implementation strategy: Habitat protection for Black Ducks is likely the most effective strategy at maintaining stable number of both wintering and breeding birds. Further reductions in the harvest, at least in the U.S. are unlikely, given the long period in which harvests have been low

Management recommendations: Black Duck management in northeast states (chiefly through harvest restrictions) has managed to stem the decline in the species. A variety of harvest reductions including reducing daily bag limits (1 bird per day), reducing season length and delaying opening for this species appear to have been effective at stopping declines. Very conservative harvest measures have been adopted through the U.S. portion of this physiographic area while less conservative measure have been used in neighboring provinces **[Harvest in Canada??]**. The beginning of a recovery may be evident from midwinter waterfowl survey in the Atlantic Flyway, where 1999 U.S. data were at a 23 year high (Serie et al. 1999). Longcore et al. (2000) called for an improved strategy for harvesting black ducks throughout northeastern North America. Such a revised plan would require a unified approach among Canadian and American biologists.

Research and monitoring needs:

- Support efforts to monitor American Black Ducks via aerial surveys in cooperation with federal biologists;
- identify factors that affect habitat quality for breeding Black Ducks in coastal versus inland habitats (why disturbance is important during pairing, but not during the rest of the year).

Outreach: Continue to encourage hunters to learn to identify and refrain from harvesting the Black Duck, through distribution of color posters at sporting goods stores, municipal offices, wildlife refuges, etc.

LITERATURE CITED

American Ornithologists Union. 1995. Fortieth supplement to the American Ornithologists Union checklist of North American birds. Auk 112:819-830.

Andrle, R. F., and J. R. Carroll. 1988. The Atlas of breeding birds in New York State. Cornell University Press, Ithaca, NY.

Atwood, J. L., C. C. Rimmer, K. P. McFarland, S. H. Tsai, and L. R. Nagy. 1996. Distribution of Bicknell's Thrush in New England and New York. Wildon Bull: 108:650-661.

Bollinger, E. K. and T. A. Gavin. 1992. Eastern Bobolink populations: ecology and conservation in an agricultural landscape. Pages 497-506 *in* J. M. Hagan III and D. W. Johnston, eds. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Bonney,R. E., D. Pashley, R. J. Cooper, and L. Niles (Eds.). Strategies for bird conservation: The Partners in Flight planning process. Cornell Lab of Ornithology.

Bruggink, J. G. 1996. American Woodcock harvest and breeding population status, 1996. U.S. Fish and Wildlife Service Report, Patuxent Wildlife Research Center, Laurel, MD.

Carter, M. F., W. C. Hunter, D. N. Pashley, and K. V. Rosenberg. (in press). Setting conservation priorities for landbirds in the united states: the partners in flight approach. Auk.

Emlen, J. T., and M. J. DeJong. 1981. The application of song detection threshold distance to census operations. Pp. 346-352 in Ralph, C. J., and J. M. Scott (Eds.), Estimating numbers of terrestrial birds. Studies in Avian Biology 6.

Erskine, A. J. 1992. Atlas of breeding birds of the Maritime Provinces. Nova Scotia Museum.

Evans, W. R. 1994. Nocturnal flight call of the Bicknell's Thrush. Wilson Bull: 106:55-61.

Finch, D. and P Stangel (eds.). 1993. Status and management of Neotropical migratory birds. U.S.D.A. General Technical Report RM-229, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Gauthier and Aubry (1996)

Harper et. al. (1990)

Hodgman, T. P. and P. U. Wilson. 2000. Saltmarsh Birds. Pages xx to xx in A. P. Weik, P. deMaynadier and T. P. hodgman, compilers. A survey of rare, threatened, and endangered fauna in Maine: eastern coastal and eatern interior regions (1999). Maine Dept. of Inland Fisheries and Wildlife, Bangor, ME.

Hunter, W. C., M. F. Carter, D. N. Pashley, and K. Barker. 1993. The Partners In Flight prioritization scheme. Pp. 109-119 in D. Finch and P Stangel (eds.), Status and management of Neotropical migratory birds. U.S.D.A. General Technical Report RM-229, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Irland, L. C., J. B. Dimond, J. L. Stone, J. Falk, and E. Baum. 1988. The spruce budworm outbreak in Maine in the 1970's - assessment and future directions in research. Bulletin 819, Maine Agricultural Experiment Station, University of Maine, Orono, ME. 119pp.

Jones, A. L. and P. D. Vickery. 1997. Conserving grassland birds: managing agricultural lands including hayfields, crop fields, and pastures for grassland birds. Massachusetts Audubon Society and U.S. Fish and wildlife Service. 17pp.

Keys, Jr., J., C. Carpenter, S Hooks, F. Koenig, W.H. McNab, W. Russell, and M. L. Smith. 1995. Ecological units of the Eastern United States - first approximation, Atlanta, GA: U.S. Department of Agriculture, Forest Service.

Keppie, D. M. and R. M. Whiting, Jr. 1994. American Woodcock. The Birds of North America, No. 100. A. Poole and F. Gill Eds.

Lambeck, R. J. 1997. Focal species: a multi-species umbrella for nature conservation. Conservation Biology 11:849-856.

Maine Department of Inland Fisheries and Wildlife. 1994. Piping Plover Management System and Database. MDIFW, Wildlife Resource Assessment Section, Endangered and Threatened Wildlife Group. 32pp.

Mendall, H. L. and C. M. Aldous. 1943. The ecology and Management of the American woodcock. Maine Cooperative Wildlife Research Unit, University of Maine, Orono, ME. 201pp.

Miller-Weeks, M. and D. Smoronk. 1993. Aerial assessment of red spruce and balsam fir condition in the Adirondack region of New York, the Green Mountains of Vermont,the White Mountains of New Hampshire, and the mountains of western Maine 1985-1986. Forest Service Northeastern Region. U.S. Department of Agriculture NA-TP-16-93.

New Brunswick Department of Natural Resources and Energy. 1995. Management of forest habitat in New Brunswick. Forest Habitat Program, Fish and Wildlofe Branch, Fredricton, NB.

Nixon 1999. Status report on Bicknell's Thrush in Canada. Unpublished report to COSEWIC.

Ouellet, H. 1993. Bicknell's Thrush: taxonomic status and distribution. Wilson Bull. 105:545-572.

Peterson, R. T. 1980. A field guide to the birds. 4th Edition. Houghton Mifflin Co., Boston.

Rimmer, C. C., J. L. Atwood, K. P. McFarland, and L. R. Nagy. 1996. Population density, vocal behavior, and recommended survey methods for Bicknell's Thrush. Wilson Bull. 108:639-649.

Robbins, C. S., D. Bystrak, and P. H. Geissler. 1986. The Breeding Bird Survey: its first fifteen years, 1965-1979. U.S. Fish and Wildlife Service Resource Publication 157, Washington, D.C.

Rosenberg, K. V., and J. V. Wells. 1995. Final Report: importance of geographic areas to Neotropical migrants in the Northeast. Prepared for U.S. Fish and Wildlife Service, Region-5; July 1995.

Rosenberg, K. V. and J. V. Wells. 1999. Global perspectives on Neotropical migrant conservation in the Northeast: Long-term responsibility vs. immediate concern. *In* R. E. Bonney, D. Pashley, R. J. Cooper, and L. Niles (Eds.). Strategies for bird conservation: The Partners in Flight planning process. Cornell Lab of Ornithology.

Sabo 1980

Sauer, J. R., J. E. Hines, I. Thomas, J. Fallon, and G. Gough. 1999. The North American Breeding Bird Survey, Results and Analysis 1966 - 1998. Version 98.1, USGS Patuxent Wildlife Research Center, Laurel, MD

Schneider, K. J. and D. M. Pence, eds. 1992. Migratory nongame birds of management concern in the northeast. U. S. Dept. of the Interior, Fish and wildlife Service, Newton Corner, Massachusetts. 400pp.

Sepik, G. F., R. B. Owen, Jr., and M. W. Coulter. 1981. A landowner's guide to woodcock management in the northeast. Life Sciences and Agriculture Experiment Station Miscellaneous Report 253. USFWS Moosehorn National Wildlife Refuge and University of Maine, Orono, ME. 23pp.

Serie, J., J. Peterson, and A. Vecchio. 1999. Atlantic Flyway: waterfowl harvest and population survey data, July 1999. USFWS Office of Migratory Bird Management. 90pp.

Seymour and Hunter 1992

U.S. Fish and Wildlife Service report. 1994. Status and biology of Bicknell's Thrush in the Northeastern U.S. Manomet Observatory for Conservation Sciences and Vermont Institute of Natural Science.

Wallace, G. H. 1939 Bicknell's Thrush, its taxonomy, distribution, and life history. Proc. Boston Soc. Nat. Hist. 41:211-402.

Wells, J. V. 1998. Important Bird Areas in New York State. National Audubon Society, New York.

American Bird Conservancy
P.O. Box 249
The Plains, VA 20198
(540) 253 5780

Front cover illustration from 'All the Birds of North America'
by Jack Griggs, courtesy of HarperCollins publishers.

APPENDIX 1

Ecological Units and associated vegetation alliances within the Eastern Spruce-Hardwood PIF planning unit (physiographic area 28). Modified from Keys et al. (1995). SM-B-B = Sugar Maple-beech-birch forest; RS-BF = red spruce-balsam fir forest. Human use categories: F = forestry, A = agriculture,

Subunit (state)	Description	Vegetation	Human use
212Aa (ME)	Aroostook Hills and Lowlands	SM-B-B; RS-BF; pine heath woodland	F,A
212Ab (ME)	Aroostook Lowlands	SM-B-B; RS-BF; n. red oak-white pine forest	F,A
212Ba (ME)	Central Maine Foothills	SM-B-B; RS-BF (and wetlands); n. red-oak-white pine forest	F,A
212Bb (ME)	Maine/ New Brunswick Lowlands	SM-B-B; RS-BF; n. red oak-white pine forest; n. cedar limestone woodland	F,A
212Ca (ME)	Maine Eastern Interior	SM-B-B; RS-BF; n. red oak-white pine forest; n. red oak summit woodland	F,A,rural
212Cb (ME)	Maine Eastern Coastal	SM-B-B; RS-BF; n. red oak-white pine forest; freshwater tidal marsh	rural, A, R
M212Aa (ME)	International Boundary Plateau	RS-BF; SM-B-B; n. white cedar swamp; black spruce open bog	F,A
M212Ab (ME)	St. John Upland	RS-BF; SM-B-B; n. white cedar swamp; alpine communities, blk spruce barren	F, A, rural
M212Ac (ME)	Maine Central Mountains	RS-BF; SM-B-B; alpine communities; pine heath woodlands	F, rural, R
M212Ad (ME,NH)	White Mountains	RS-BF; SM-B-B; alpine communities;	F, R, D
M212Ae (ME,NH)	Mahoosuc Rangely Lakes	RS-BF; SM-B-B; alpine communities;	F, R
M212Af (ME,NH)	Connecticut Lakes	RS-BF; SM-B-B; alpine communities; calcareous fens	F, A, R
M212Ag (ME)	Western Maine Foothills	RS-BF; SM-B-B; alpine communities;	F, rural, R
M212Ba (NH,VT)	Vermont Piedmont (part)	SM-B-B; n. red oak-hardwood mesic forest; RS-BF; n. white cedar limestone woodland	A, F, Q, R
M212Bb (NH,VT)	N. Connecticut River Valley	SM-B-B; oak-pine dry forest; silver maple floodplain forest	A, U
M212Bc (NH)	Sunapee Uplands (part)	SM-B-B; n. red oak-hardwood mesic forest; RS-BF	F, A, R
M212Ca (VT)	Northern Green Mountains	RS-BF; SM-B-B; alpine communities	F, R
M212Cb (VT)	Taconic Mountains (part)	RS-BF; SM-B-B; oak-hickory dry forest	F, R, Q
M212Cc (VT)	Berkshire/ Vermont Upland (part)	SM-B-B; RS-BF; oak-hickory dry forest	F, A, R
M212Cd (VT)	Southern Green Mountains (part)	RS-BF; SM-B-B; oak-hickory dry forest	F, R

APPENDIX 2: AVIFAUNAL ANALYSIS

In this section we provide additional details on the status of the roughly 196 species known to breed in the physiographic area. Global and area scores for all species from the PIF prioritization database (Carter et al. 2000) are provided in Table A2.1.

Species may be ranked according to the importance of this planning unit to their total species population (Table A2.2). Species with high proportions of their total populations in this region are considered of greatest importance for long-term conservation planning; ie., this region has the greatest responsibility for the long-term maintenance of their populations (Rosenberg and Wells 1995, 1999). Because of the large size of this planning unit, we consider a species to be of regional importance if 15% of its population occurs in the unit (see Rosenberg and Wells 1995, Appendix 3 for methods).

Table A2.2. Species with high proportions of their total population in Area-28. Percent of population calculated from percent of range area, weighted by BBS relative abundance (see Rosenberg and Wells, in press). Population trend from BBS data (% change per year from 1966-1998). Area Importance (AI) from CBO/PIF prioritization database (Carter et al.2000). [all BBS data and % pop. updated through 1998]

Species	% of pop.	rel. abun.	Pop. trend		N
Bicknell's Thrush	75+?	na	na	na	na
Red Crossbill (eastern)	52.0	0.17 [a]	6.8	0.08	22
American Woodcock	29.8	0.09 [a]	-3.2	ns	24
American Black Duck	27.7	0.82 [a]	0.1	ns	75
Northern Parula	26.2	5.50 [a]	1.8	0.04	132
Black-throated Blue Warbler	23.8	1.78	4.4	0.00	118
Blue-headed Vireo	23.6	3.97	6.9	0.00	136
Veery	19.0	10.21	-1.4	0.00	144
Black-throated Green Warbler	18.4	5.30	-0.5	ns	149
American Redstart	17.7	12.39 [a]	-0.5	ns	150
Blackburnian Warbler	16.2	2.35	3.5	0.00	125
Magnolia Warbler	16.0	11.22 [a]	0.9	ns	150
Canada Warbler	15.9	1.45	-2.4	0.01	131
Herring Gull	15.7	14.53	-3.2	0.00	71
Black-and-white Warbler	15.0	4.75	1.0	ns	143

[a] Relative abundance is the highest recorded for any physiographic area

Declining species

Of the 15 species (or subspecies) with 15% of their total population in the planning unit, only Canada Warbler, Veery, and Herring Gull have declined significantly ($P < 0.10$) since 1966 (Table A2.2). A majority of species with proportionally high regional populations are exhibiting stable or increasing population trends. Other declining species may be of local or regional concern, even if they don't rank highly in regional importance (Table A2.3). In addition, suites of declining species may signal added regional concern for a habitat type that also supports high-priority species.

Increasing species

It is informative to also examine the species that are increasing significantly in a physiographic area. In the Eastern Spruce-Hardwood Forest, 38 species show significantly increasing population trends (Table A2.3). A majority of these are species that have adapted particularly well to human activities or development. Species associated with human activities include those using bird feeders or nest boxes (e.g. Mourning Dove, Black-capped Chickadee), as well as those that breed in urban wetlands (e.g. Mallard). Several species, such as House Finch and Northern Cardinal have experienced widespread population increases throughout the Northeast. Another group of species that has benefited from human activities are those associated with regenerating conifer forests and plantations; these include Red-breasted Nuthatch , Golden-crowned Kinglet, Blackburnian Warbler, Myrtle Warbler, Pine Warbler, and Hermit Thrush.

Table A2.3. Species showing large or significant population declines within Physiographic Area 28, based on Breeding Bird Survey, 1966-1998 trends (N = 158 routes). BM = boreal-mountaintop forests; CF = conifer forests; HF = hardwood or mixed forests; ES = early successional; GR = grassland; W = wetlands; MA = maritime; UR = urban areas

Species	Trend (% per year)	N	Significance	Relative abundance	Primary habitat
Horned Lark	-15.5	30	0.00	0.36	GR
Black-crowned Night-Heron	-14.8	7	0.02	0.05	W
Green Heron	-12.2	6	0.00	0.02	W
Pine Grosbeak	-11.0	21	0.09	0.29	CF
Common Tern	-10.3	20	0.04	1.11	W, MA
Purple Martin	-9.7 a	9	0.02	1.20	ES,W
Bank Swallow	-7.7 a	85	0.00	10.59	W
Common Nighthawk	-7.2 a	24	0.02	0.19	ES
Rose-breasted Grosbeak	-7.0 a	128	0.00	4.72	HF
House Wren	-6.8 a	31	0.01	0.25	ES
Ruffed Grouse	-6.5	77	0.03	0.20	HF
Blackpoll Warbler	-6.4	37	0.06	0.93	BM
Olive-sided Flycatcher	-6.3	112	0.07	1.07	CF, ES
Great Crested Flycatcher	-6.1 a	69	0.00	0.64	HF
House Sparrow	-5.8	116	0.00	9.49	ES, UR
Boreal Chickadee	-5.7	78	0.00	0.68	CF
Brown-headed Cowbird	-5.7	127	0.00	5.62	GR
Wilson's Warbler	-5.6 a	42	0.01	0.43	ES?
Field Sparrow	-5.4	27	0.01	0.16	ES
Chimney Swift	-5.2	105	0.00	1.50	ES?
Eastern Towhee	-5.1	18	0.09	0.13	ES
Bay-breasted Warbler	-5.1 a	85	0.01	1.54	CF
Tennessee Warbler	-5.1 a	91	0.02	3.72	CF
Eastern Meadowlark	-4.7	50	0.00	0.76	GR
Vesper Sparrow	-4.6	48	0.06	0.68	GR
Black-billed Cuckoo	-4.6	73	0.00	0.43	HF

Cape May Warbler	-4.3 [a]	84	0.09	0.68	CF
Barn Swallow	-4.2	139	0.00	16.49	GR
Brown Thrasher	-3.9 [a]	42	0.02	1.43	ES
Lincoln's Sparrow	-3.5 [a]	71	0.03	2.21	ES
Bobolink	-3.5	122	0.00	13.81	ES
Baltimore Oriole	-3.3	67	0.03	0.52	HF
Herring Gull	-3.2	71	0.00	22.21	W, MA
Red-winged Blackbird	-3.0	146	0.00	20.67	ES
Eastern Wood Pewee	-3.0	131	0.00	1.55	HF
Spotted Sandpiper	-3.0 [a]	66	0.09	0.61	W
Yellow-bellied Sapsucker	-2.6	129	0.00	3.79	HF,CF
Common Snipe	-2.6	124	0.00	2.86	W
Wood Thrush	-2.6	89	0.00	3.35	HF
Cliff Swallow	-2.6 [a]	89	0.09	0.71	ES.W
Belted Kingfisher	-2.5	116	0.07	0.61	W
Gray Catbird	-2.5	124	0.00	2.33	ES
Canada Warbler	-2.4	131	0.01	2.40	HF,CF
Purple Finch	-2.3	149	0.00	5.41	CF,HF
Slate-colored Junco	-2.3	141	0.00	7.44	CF,HF,ES
Blue-winged Teal	-2.2	9	0.02	0.05	W
Tree Swallow	-2.2 [a]	140	0.01	10.59	ES. W
American Redstart	-2.1 [a]	146	0.00	14.28	HF
White-throated Sparrow	-1.9	153	0.00	40.58	ES?
Least Flycatcher	-1.9	150	0.01	5.44	HF
Killdeer	-1.9	114	0.04	3.08	GR
European Starling	-1.8	141	0.00	42.05	ES
Savannah Sparrow	-1.6	126	0.00	13.19	GR
Eastern Kingbird	-1.5	116	0.05	1.65	GR
Ruby-crowned Kinglet	-1.5	137	0.02	6.54	CF,BM
Veery	-1.4	144	0.00	13.46	CF, HF
Swainson's Thrush	-1.3	139	0.02	13.24	CF
Song Sparrow	-1.3	150	0.00	24.44	ES
Common Yellowthroat	-1.1 [a]	147	0.02	19.47	ES, W

[a] Significant increasing trend for period 1980-1996 only.

Table A2.3. Species showing large or significant population increases within Physiographic Area 28, based on Breeding Bird Survey, 1966-1996 trends (N = 160 routes). CF = conifer forests; HF = hardwood or mixed forests; ES = early successional; GR = grassland; W = wetland; MA = maritime; UR = urban.

Species	Trend (% per year)	N	Significance	Relative abundance	Primary habitat
Northern Cardinal	28.4	11	0.00	0.01	UR
Mallard	24.7	28	0.00	0.07	W, UR
Ring-billed Gull	17.9	36	0.06	1.49	W, UR
Mourning Dove	13.7	121	0.00	2.02	ES,UR
House Finch	13.2	23	0.05	0.11	UR
White-winged Crossbill	10.6 [a]	40	0.02	0.69	CF
Pine Warbler	11.6	20	0.09	0.29	CF
Merlin	11.1	12	0.04	0.03	CF?
Ring-necked Pheasant	11.0	22	0.00	0.40	GR
Sora	8.2	13	0.02	0.02	W
Wood Duck	7.6	15	0.01	0.04	W
Golden-crowned Kinglet	7.4	111	0.04	1.23	CF
American Wigeon	6.9	7	0.04	0.21	W
Blue-headed Vireo	6.9	136	0.00	2.88	HF,CF
Barred Owl	6.8	23	0.01	0.03	HF,CF
Red Crossbill	6.8	22	0.08	0.11	CF
Osprey	6.6	45	0.01	0.19	W
Red-breasted Nuthatch	5.7	136	0.00	2.13	CF
Northern Mockingbird	5.3	11	0.00	0.02	ES, UR
Double-crested Cormorant	5.3	38	0.01	3.86	W
Palm Warbler	5.1 [a]	28	0.09	0.23	CF
Pileated Woodpecker	5.1	91	0.00	0.50	HF
Philadelphia Vireo	4.7	52	0.03	0.81	HF
Black-throated Blue Warbler	4.4	118	0.00	1.39	HF
Black-capped Chickadee	4.3	151	0.00	6.19	HF, UR
Hairy Woodpecker	4.3	126	0.02	0.74	HF
Common Loon	3.8	95	0.00	0.89	W
Blackburnian Warbler	3.5	125	0.00	2.19	CF, HF
Winter Wren	3.4	145	0.00	7.00	CF
Yellow-r.(Myrtle) Warbler	3.0	148	0.00	5.13	CF
Cedar Waxwing	3.0	146	0.00	9.24	ES, UR
Downy Woodpecker	2.9	132	0.00	0.86	HF, UR
Eastern Phoebe	2.5	90	0.05	1.40	ES, UR
Red-eyed Vireo	2.5	149	0.00	21.81	HF
American Crow	2.0	150	0.00	35.62	ES, UR
Northern Parula	1.8	132	0.04		CF
Common Raven	1.7	146	0.03	7.15	CF?
Hermit Thrush	1.5	147	0.08	7.47	CF

[a] Significant increasing trend for period 1980-1996 only.

Appendix 3: Population estimates and assumptions

In this PIF bird conservation plan, several estimates are presented of relative or absolute bird population sizes. Relative population size (percent of global population) is used to illustrate the importance of a given geographic area to priority bird species, whereas estimates of absolute population size are used to set numerical population objectives for habitat-species suites within a physiographic area. Both types of estimates are derived using Relative Abundance values from the Breeding Bird Survey (BBS). These values represent the average number of birds per BBS route, across all routes in a physiographic area, for the period 1990 through 1998 (J.R. Sauer, pers. com.). These same Relative Abundance values are used to calculate Area Importance (AI) scores in the PIF species prioritization database (see Carter et al. in press). Note that prior to July, 1999 BBS Relative Abundance was calculated differently; so any previously presented or published population estimates using these values will differ from those calculated after July 1999 (J.R. Sauer, pers. com.).

Percent of Population

The percent of total or global population (% pop) for a species is calculated according to the methods originally described by Rosenberg and Wells (1999). For species sampled by the BBS, the Relative Abundance value for each physiographic area is multiplied by the size of that area (km^2) and then summed across all the physiographic areas in which the species occurred to yield a total "BBS population." The area-weighted value for each physiographic area is then divided by this total to yield the proportion of the total population in that area. Thus:

$$\% \text{ Pop} = \frac{\text{Relative Abundance (area)}}{\text{(Relative Abundance) (area)}}$$

Estimates of % Pop are relative values and are not dependent on the "correctness" of Relative Abundance values for individual routes; i.e., even if BBS greatly underestimates absolute abundance of "poorly sampled" species, such as nightjars and raptors, Relative Abundance values and % pop estimates should be valid, *as long as the detectability of a species on BBS routes is relatively constant across the range of the species*. These estimates are more questionable for species occupying very patchy habitats (e.g. wetlands) in regions where BBS routes do not adequately sample these habitats.

In cases where additional survey data for groups of species are available (e.g. waterfowl, colonial waterbirds), relative abundance and % pop estimates should be calculated with these data to compare with or replace BBS data. For some species (e.g. Piping Plover), direct censuses of populations exist and should be used to calculate the percentage of the total population in each region. Wherever supplemental data exist, these new estimates should be entered into the PIF prioritization database at Colorado Bird Observatory.

Within PIF plans, a threshold of % Pop has been determined that signifies a disproportionate abundance of a priority species in a physiographic area, or that an area shares a disproportionate responsibility for the long-term conservation of that species. This threshold is based on the size of a physiographic area relative to the total area of North America south of the open boreal forest (roughly 12 million km^2). An analysis of North American bird species' distribution and abundance (K. V. Rosenberg, unpublished data) resulted in the % Pop thresholds listed in Table A3.1.

Table A3.1. Percent of Population thresholds, signifying disproportionate population size, relative to size of physiographic area.

Physiographic area size (km^2)	Proportion of North America	Percent of population threshold
< 57,000	< 0.50	2
57,000 - 80,000	0.51 - 0.69	3
81,000 - 100,000	0.70 - 0.89	4
101,000 - 125,000	0.90 - 1.09	5
126,000 - 153,000	1.10 - 1.30	6
154,000 - 173,000	1.31 - 1.49	7
174,000 - 191,000	1.50 - 1.69	8
192,000 - 222,500	1.70 - 1.89	9
223,000 - 246,000	1.90 - 2.10	10
300,000 - 500,000	2.60 - 3.50	15
> 600,000	> 5.0	25

Absolute population estimates

In order to set appropriate and justifiable habitat goals within physiographic areas, it is usually necessary to first set numerical population objectives for priority bird species. Population estimates rarely exist, however, for most nongame bird species. For relatively widespread and common species of forest, shrub, and some grassland habitats, the BBS may provide a landscape-level density estimates that can be converted into regional population estimates if the following assumptions are made:
(1) BBS routes constitute a random sample of the landscape;
(2) habitats in question are fairly evenly distributed across the region; and
(3) each bird species has a relatively fixed average detection distance at BBS stops, within which a reasonable estimate of the number of individuals present may be obtained.

Because BBS route locations are selected at random (ref), the first assumption is reasonable. Furthermore, several studies have shown that common habitat types are represented along secondary roads used as BBS routes in roughly the same proportions as in the overall landscape (refs). The third assumption is the most problematic; although most species probably do have a fairly constant average detection distance, selecting that distance is difficult and has a large effect on total population estimates. For example, an entire BBS route composed of 50 stops, each consisting of a 0.25 mi. (400 m)-radius circular count, potentially surveys roughly 25 km^2 of heterogeneous landscape. For a species that is detected routinely only out to 200 m at each stop, the effective area surveyed is reduced to 6.3 km^2; for a species detected only out to a distance of 100 m, the BBS route surveys 1.6 km^2. A simple method of extrapolating avian density from counts of singing males using detection threshold distances was proposed by Emlen and DeJong (1981), who also provided average maximum detection distances for 11 species of common forest birds. These distances ranged from 72 m (Blue-gray Gnatcatcher) to 186 m (Wood Thrush) and averaged 128 m for the 11 species. Emlen and DeJong (1981) further proposed that numbers of singing males be doubled to obtain a total population estimate and that a correction factor be applied to account for variable singing rate (i.e. birds that were missed because they didn't sing during the survey period).

In the absence of additional empirical data on species-specific detection distances and singing frequencies, we may take a simple and conservative approach to estimating regional population sizes from BBS relative abundance data. Species were initially placed in three categories, according to their

presumed detection-threshold distances. A majority of forest-breeding songbirds and similar species of scrubby and open habitats were assigned a detection distance of 125 m (close to the average distance for forest birds in Emlen and DeJong's study) -- for these species a BBS route samples an effective area of 2.5 km^2. A second group of species that are detected primarily visually or have unusually far-carrying vocalizations in open habitats were assigned detection distances of 400 m; i.e., they are detected out to the limit of each BBS circular stop (e.g. raptors, Upland Sandpiper). For these species the BBS samples roughly 25 km^2. A third group of species is considered to be intermediate and was assigned a detection distance of 200 m (effective sampling area = 6.3 km^2). These include species, such as Bobolink and Eastern Meadowlark, that are detected by a combination of song and visual observations in open habitats.

Population estimates for a physiographic area are then calculated as the average landscape-level density (number of birds per route * effective area sampled by each route) multiplied by the size (km^2) of the physiographic area. Note that landscape-level densities are not assumed to be similar to species densities in uniform optimum habitats, but rather reflect habitat heterogeneity at larger scales as sampled by BBS routes. Because the great majority of detections on typical BBS routes are of singing or displaying males, the population estimate derived from this method is assumed to represent number of breeding pairs, unless specifically noted otherwise.

Clearly, much additional research and analysis is necessary to (1) test assumptions of this approach, (2) provide refined empirical estimates of detection distances and frequencies that can be applied to density estimation, and (3) to develop independent means of estimating population size in order refine or calibrate estimates derived from BBS data. The crude population estimates provided in this PIF plan are a reasonable starting point, however, that are based on the best information yet available, and that can serve as preliminary population objectives for priority species in each physiographic area. These population objectives can then be translated into habitat objectives, with the goal of assuring the long-term sustainability of priority species in each region. As better population data become available, these should be incorporated into later versions of the PIF conservation plans.