SPECIES PROFILE

Non-Breeding Birds

Federal Listing: Not listed
State Listing: Not listed
Global Rank: Not ranked
State Rank: Not ranked
Authors: Pamela D. Hunt, Rebecca W. Suomala, and Carol R. Foss, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Habitat for non-breeding birds includes nearly all habitats in the state, from offshore waters to high elevation conifer forests. For this document, 11 focal areas where birds tend to concentrate have been identified (see section 1.4). In general, birds use critical habitats within focal areas in the following ways:

- Grasslands and agricultural areas are used extensively by waterfowl, seed-eating passerines, and some raptors during spring and fall migration. Depending on location and snow cover, these areas may also be used by a reduced set of species during the winter. Flooded fields are particularly important to waterfowl during spring and to a lesser extent to shorebirds during spring and fall. A few shorebirds (plovers, upland sandpiper) also congregate in dry fields in the fall.
- Early successional, scrub-shrub, and edge habitats—including forest-agricultural boundaries—often leaf-out earlier in the season and often retain both foliage and fruit later into the fall. They are important to early spring and late fall migrant land birds, as well as to frugivores in fall (Parrish 1997, 2000; Suthers et al. 2000, Rodewald and Brittingham 2004).
- Riparian forests provide important stopover habitat to migrating land birds and waterfowl (e.g., wood duck. Such areas tend to be phenologically ahead of upland forests, and thus provide a more reliable food supply—particularly for insectivorous birds—during the early phase of spring migration (mid-April through mid-May).
- Open water is important for waterfowl and waterbirds, as well as for some shorebirds, at all times of year. Some species seek open water during winter and spring migration, including by non-breeding bald eagles. Offshore salt water remains open year round, and habitat suitability here probably depends more on currents, water depth, degree of shelter, and substrate. Among passerines, swallows are particularly dependant on open water—and its associated flying insects—in spring and fall.
- Fresh-water wetlands (ponds, emergent marshes, etc.) are used by waterfowl and some waterbirds (coots, grebes, herons) primarily during spring and fall migration. Rails, bitterns, and snipe may also use marshes during migration.
- Salt marshes and tidal flats are critical feeding and roosting habitats for migrating shorebirds. Marshes and flats are also used extensively by non-breeding herons from April through October, and by post-breeding terns, gulls, and cormorants in late summer and early fall. Large numbers of salt marsh sparrows use salt marshes during migration, particularly in the fall.
- Coastal dunes habitats serve a similar function to some grasslands. These habitats are used by several species of seed-eating passerines during fall and winter, and occasionally raptors. Some shorebirds roost in dunes or on adjacent beaches at high tide.
- Rocky shorelines are used by shorebirds, gulls, cormorants, and some waterfowl throughout the year.

1.2 Justification

Birds are most vulnerable during the non-breeding

season, when the stresses of migration and weather are added to the need to find food and avoid predators. Because migratory birds often spend much time away from breeding grounds, the conservation of non-breeding individuals and their habitats is critical. Conversely, if factors limit a species during winter or migration, then management on breeding grounds may not have the desired effect. Migrating birds need places to feed, rest, reorient, avoid adverse weather, and minimize other stress (predation, dehydration, etc.). Some migrant taxa, particularly shorebirds and waterfowl, regularly use the same staging areas each year, and alteration of these sites may have significant effects on populations (Moore et al. 1995, Brown et al. 2001). Even in passerines and other species with limited stopover site fidelity, broad alteration of stopover habitat may have similar effects (Sherry and Holmes 1995, Hutto 2000). Similarly, use of wintering grounds may ultimately affect breeding success (Norris et al. 2004). Non-breeding and breeding habitats are often different, forcing managers to consider multiple habitats to protect a species.

Additional threats covered in this profile include climate change, cat predation, collisions with man-made structures, and effects of pesticides and other contaminants. Their effects on migrant bird populations remain largely unknown and thus warrant future study.

1.3 Protection and Regulatory Status

There are no provisions to protect non-breeding bird habitat, except when the bird is federally listed. However, some protection is offered by many existing statutes, including the Shoreland Protection Act, conservation of agricultural lands, and wetland protection measures.

1.4 Population and Habitat Distribution

Although non-breeding habitat is distributed across the state, birds are known to concentrate in certain areas. These 11 focal areas, and the reasons for their selection, are as follows (see also table 1).

Connecticut River Valley
The open water and agricultural lands along the Connecticut River provide stopover habitat for several species of waterfowl. The north-south orientation of the valley and the presence of extensive areas of edge or early successional habitat make it an important flyway for southbound fall migrants and for northbound land birds in spring. Shorebirds comprise a minor component of the area's migrant pool, but some species may reach high densities at larger reservoirs or agricultural fields. Finally, open water provides winter habitat for bald eagles and several species of waterfowl.

Merrimack River Valley
This valley is important for the same reasons as the Connecticut River, although waterfowl and shorebird diversity is somewhat lower.

Contoocook River Valley
Because of its north-south orientation, the Contoocook may be valuable to passerines in much the same way as are the Connecticut and Merrimack valley. Yet the relative narrowness of this valley and lack of extensive farmland preclude large concentrations of migratory waterfowl, and the absence of open water precludes wintering eagles and waterfowl.

Bowman Notch
This low saddle that follows part of the Israel River valley marks one of the few east-west routes through the mountainous areas of northern New Hampshire. Some data suggest that birds moving north up the Connecticut use this gap to reach breeding areas in the Androscoggin River watershed.

Lake Umbagog/Pontook Reservoir
The extensive marshes and open water in this area attract some of the largest concentrations of loons and diving ducks in the state, as well as lower numbers of dabbling ducks. Large concentrations of shorebirds have been reported in this area. Many species of land birds use shoreline habitats, primarily in spring, and swallows often concentrate over open water. Bald eagles are attracted to open water in the winter and during fall migration.

Lakes Region
This region is similarly important, although there is less evidence of its importance to migrating land birds. Larger areas of open water make it attractive to wintering waterfowl, and many species of diving ducks reach their highest winter densities here.

Powwow River
This small area, consisting primarily of Powwow Pond, regularly hosts the state's largest spring and fall concentrations of ring-necked ducks, ruddy ducks, pied-billed grebes, and American coots.

Great Bay
Great Bay is valuable to many species throughout the non-breeding period. It supports most of New Hampshire's wintering American black ducks, Canada geese, and greater scaup. Many other waterfowl species use the Bay during spring and fall. Some species rely on nearby agricultural lands or grasslands at Pease Air Force Base for foraging. Herons, gulls, cormorants, some shorebirds, and perhaps rails use the extensive wetlands that border the bay. The extensive shoreline is important to wintering bald eagles.

Coast
Salt marshes, mudflats, dunes, and coastal thickets support significant numbers of non-breeding birds. Salt marshes and mudflats provide the most important stopover habitat in the state for shorebirds. Herons, gulls, cormorants, and terns forage in coastal wetlands from spring to early winter, and salt marsh sparrows rely on salt marshes in the fall. Sparrows and other seed-eating passerines also congregate in coastal dunes and similar open habitats.

Many species of migrant land birds congregate along coastlines, and in this heavily developed area of New Hampshire, suitable stopover habitat is limited. Habitats with fruit-bearing shrubs may be particularly important in fall, whereas forests and early successional habitats are important in spring. Large, forested wetlands are roost sites for blackbirds and other flocking species. Several species of waterfowl and waterbirds—many of which do not breed in New Hampshire—use nearshore waters, include sea ducks, gulls, terns, loons, grebes, and cormorants.

Isles of Shoals
In some ways, the Isles of Shoals are similar to the mainland coast. They are used by various migrant land birds, non-breeding or post-breeding waterbirds (cormorants, gulls, terns), and some species of shorebirds and waterfowl. A few species are far more common there than on the mainland, including common eider, purple sandpiper, and ruddy turnstone.

Offshore Waters
Offshore waters support several species not covered by any other part of this Strategy. These deeper waters between the mainland and Isles of Shoals, or beyond the islands, are used by several species of alcids and pelagic seabirds (shearwaters, storm-petrels, phalaropes, northern gannet, jaegers) that are rarely seen from land. There are also smaller numbers of gulls, loons, grebes, and sea ducks. This habitat has been included in this profile because state bird conservation needs to consider offshore species.

1.5 Town Distribution Map

Not completed for these species.

1.6 Habitat Map

The non-breeding focal areas mapped for this profile are based on focal areas originally identified for New Hampshire in the late 1990s for Partners in Flight and the Atlantic Coast Joint Venture. These areas were chosen based on bird sighting data and personal experience. The original focal areas were delimited independently for waterfowl, shorebirds, waterbirds, and land birds, and the current areas have been modified to incorporate overlap between the 4 sets where appropriate. All areas of the state support birds during migration or winter, and only areas of high concentrations or significance are addressed in this profile. Explanations of how each focal area was mapped are included in table 1.

1.7 Sources of Information

Focal areas were based on those created in the late 1990s as discussed above. Data on habitat use by non-breeding birds in New Hampshire were compiled from New Hampshire Bird Records and the authors' personal experiences. Many of these data were originally summarized under the auspices of the New Hampshire Important Bird Area program. General information on the importance of certain habitat types was obtained from the scientific literature. Many proposed research or monitoring actions are based on projects previously identified through regional bird conservation planning.

1.8 Extent and Quality of Data

Extensive data are available for some parts of the identified focal areas, but very few areas have data for the entire geographic scope, the full complement of species, or for all times of year. In many cases, the mapped focal area reflects an extrapolation of available data on species behavior to the broader landscape.

1.9 Distribution Research

Detailed research on non-breeding bird habitat is extremely limited in New Hampshire. The research projects below have been identified by in-state interests or through broader regional conservation planning (BCR 14, BCR 30).

- Conservation of habitat for wintering bald eagles will be aided by mapping (or otherwise modeling) the distribution of open water along river corridors. Habitat conservation projects could then focus on areas that are most likely to support wintering eagles. Such a project would also potentially benefit wintering waterfowl.
- In the Mid-Atlantic States, there is increasing interest in the use of RADAR to identify important stopover habitat for migrating passerines. Little is known about the factors that govern the distribution and abundance of non-breeding sea ducks and other marine species in the Northeast. Such data will be extremely valuable in the event of offshore oil spills or wind farm developments.
- There has been no consistent effort to quantify the seasonal and spatial distribution of New Hampshire's shorebirds. New Hampshire could adopt proven techniques for measuring shorebird concentrations (e.g., PRISM).
- Non-breeding distributions of many species are largely unknown, including rails, bitterns, nightjars, and owls that tend to be highly secretive or nocturnal. New Hampshire should participate in regional migration monitoring projects. Current efforts include northern saw-whet owl banding (e.g., Clayton 2004) and common nighthawk migration monitoring (Robinson and Robinson 2001).

Element 2: Species/Habitat Condition

2.1 Scale

Non-breeding bird habitat will be treated in this Strategy at the level of habitat types within focal areas.

2.2 Relative Health of Populations

Given the many habitats and species treated in this profile, and the complexities inherent to studies of bird migration, assessing the health of non-breeding birds and their habitats is beyond the scope of this profile.

2.3 Population Management Status

Only game birds—particularly waterfowl—are specifically managed during the non-breeding season in New Hampshire. Refer to state waterfowl regulations and data for more information on this subject. Management of wintering eagle populations—largely through protection of critical roosting areas—has been implemented in the Great Bay and Merrimack River areas.

2.4 Relative Quality of Habitat Patches

Non-breeding habitat can vary in mortality risk, food resources, protection from weather, and degree of human disturbance. These factors are often correlated with habitat type or extent of anthropogenic alteration. Given the complexities involved in assessing habitat quality, and the broad scale chosen for this profile, it is impossible to discuss habitat quality at the scale of individual patches. Within a given focal area, any activity that influences non-breeding birds or their habitat should be viewed in the context of migrant needs and threats on a case-by-case basis.

2.5 Habitat Patch Protection Status

Table 1 shows the percentage of each focal area that is protected by fee-simple or conservation easement. This does not include open ocean and "great ponds" which are not subject to private or public ownership in the traditional sense.

2.6 Habitat Management Status

It is not feasible to address management status at the level of either focal areas or habitat patches within them. See section 2.4 above. See also form 3 for an overview of which threats are most important in each focal area.

2.7 Sources of Information

General information on the importance of certain habitat types was obtained from the scientific literature. Many proposed research or monitoring actions are based on projects previously identified through regional bird conservation planning.

2.8 Extent and Quality of Data

Given the broad scale of the areas treated in this profile, the quality of data supporting any particular assessment of varies. For this reason, most discussion of habitat condition is highly generalized.

2.9 Condition Ranking

2.10 Condition Assessment Research

Several projects to determine the quality of non-breeding habitat have been proposed at the regional level, and the following are applicable to New Hampshire.

- **Research the effects of impoundment management on shorebirds, waterfowl, and waterbirds:** Depending on when these drawdowns occur, they can be beneficial to shorebirds or detrimental to species that require deeper or more extensive water bodies. Research could provide information about how birds use impoundments and how management could improve stopover habitat for multiple species.
- **Shorebird stopover monitoring:** Research is needed on how resource levels vary among shorebird stopover sites during the migration season. This may allow biologists and land planners to identify, protect, or restore critical areas.
- **Offshore food resource levels:** Non-breeding seabird distribution in the Gulf of Maine (and other marine areas) is greatly influenced by the abundance of plankton and baitfish (Callaghan 2003). Participation in a regional research effort may inform conservation of priority breeding species such as terns.
- **Effects of invasive plants on non-breeding songbirds:** Non-native fruiting shrubs may provide less valuable food than do native species. Habitats that appear to contain abundant food may in fact be sub-optimal habitat for migratory birds. Research on energy content and use of these species by songbirds might support programs that encourage native fruit-bearing plants in landscaping and increase support for removal of invasive plants.
- **Passerine stopover habitat:** Not all stopover habitat are equally valuable to migratory birds (Duncan et al. 2002), largely because of variability in food resources, shelter, or predation risk. Measurable indicators of habitat value for birds include mass gain, residency time, and physiological condition.

Element 3: Species and Habitat Threat Assessment

3.1.1 Unsustainable Harvest (Forestry Operations and Management), Development (Habitat Loss and Conversion), Unregulated Take, Non-Point Source Pollution (Chemical Contaminants), Agriculture

A) Exposure Pathway
Because bird migration occurs on a hemispheric scale, the birds we protect during the breeding season may face their greatest threats well beyond New Hampshire, the United States, or even the Northern Hemisphere. Three broad classes of threats that occur outside New Hampshire are identified below.

1. Deforestation and habitat conversion in Latin America and the Caribbean have long been suspected in declines of many North American land birds that migrate to the tropics. Current declines of many species that winter on the eastern slope of the Andes (Canada warbler, cerulean warbler, olive-sided flycatcher, etc.) may be partially the result of deforestation in this region (Robbins et al. 1992). As in the United States, habitat conversion, fire suppression, intensive agriculture,

pine monocultures, and development can have deleterious effects on bird populations elsewhere on their migratory route.

2. Over-harvesting. Species that occur in high concentrations, including shorebirds, terns, waterfowl, and flocking passerines (e.g., bobolink) are particularly susceptible to human consumption in parts of the developing world. Birds are particularly vulnerable at key staging or wintering areas. The extinction of formerly abundant species like the passenger pigeon and Eskimo curlew is testament to the effects of unregulated hunting on populations of migratory birds.
3. Poisoning. In many areas south of the United States, chemicals such as DDT are still in use for agriculture or mosquito control. There is increasing evidence that many chemicals used in Latin America can cause high levels of direct mortality (e.g., Swainson's hawk, Goldstein et al. 1996), and they may cause population decline in species that winter in south-temperate agricultural areas. Although the threat is probably greater in the developing world, agricultural activities in the southern United States—particularly blackbird control—may harm populations of birds that winter in these habitats, including rusty blackbird, swallows, and several sparrow species.

B) Evidence
There is an extensive literature on non-breeding season limitations on migratory birds, and only a few references have been included in this profile to illustrate specific points.

3.1.2 Development (Habitat Loss and Conversion)

A) Exposure Pathway
During migration, birds require habitat where they can rest and feed after strenuous periods of sustained flight. When such habitat is limited, as in heavily urbanized areas, birds are forced into smaller patches, which may be further compromised by predators, light pollution, contaminants, and human disturbance. Many migratory species are affected by loss or degradation of river valleys, coastal areas, and even ridgelines (used by migrating hawks). In addition, some migrants are known to be area sensitive during migration and may suffer reduced fitness in heavily fragmented landscapes.

B) Evidence
There is an extensive literature documenting the importance of stopover habitat to migrating birds. Much of the recent research on this topic has been summarized in Moore 2000 and the references therein.

3.1.3 Predation and Herbivory (Subsidized or Introduced Predators)

A) Exposure Pathway
As landscapes become more urbanized, birds are threatened by domestic or feral cats. Birds in a weakened condition, or otherwise disoriented by windows or lights, may be especially vulnerable.

B) Evidence
Evidence suggests that cats kill several hundred million birds each year in the United States (American Bird Conservancy). The indirect effects of cat predation on migratory birds are poorly understood, and there are few data on how predation varies seasonally. Nonetheless, when combined with other sources of mortality caused by human activity (window and tower kills), cat predation could be a significant drain on breeding populations.

3.1.4 Agriculture (Land/Crop Conversion)

Not all agricultural areas are equally suitable for migrating birds. Broad types are arranged from most to least suitable as follows: grains, row crops, hayfields, fallow fields, and sod farms. Economic pressures often result in farmland conversion from more suitable to less suitable types, and this conversion may have immediate detrimental effects on local congregations of birds (especially waterfowl) that rely on waste grain during migration.

3.1.5 Recreation (Boats and Jet Skis)

Extensive use of boats and jet skis on water bodies used by migrating birds may cause repeated flushing or may otherwise reduce the time birds spend resting or foraging. Increased energy use and decreased food intake may affect seasonal migration, and thus have indirect effects on individual fitness and population health.

3.1.6 Recreation

The effects of human foot traffic on migrating birds are similar to those discussed above. The best examples are disturbance of bald eagles at winter roost sites and shorebirds at beach roosts. For example, repeated disturbance of roosting shorebirds has been shown to reduce the birds' ability to put on fat and concomitantly reduce their chances of surviving migration (Pfister et al. 1998).

3.1.7 Energy and Communication Infrastructure

There is extensive evidence that birds experience large mortality events at television and radio towers (Shire et al. 2000, www.towerkill.com), and all such structures cause regular low levels of mortality. Nocturnal birds tend to be attracted to lights on such towers, and sometimes they become disoriented and crash into the towers or their associated guy wires. The proliferation of towers for cellular communication will increase this risk, and towers located near migration routes may be particularly dangerous. As of 1999, there were roughly 60 towers in New Hampshire over 200 feet tall, the height at which towers start posing a greater threat (Braile 1999). Although large mortality events have not been recorded in New Hampshire (but see Sawyer 1961), the issue has received little study, and its overall magnitude remains unknown.

Although there are no wind power facilities in New Hampshire, evidence from elsewhere suggests that they can sometimes cause high levels of avian mortality (Birdlife International 2003, Schwartz 2004). Mortality appears important in raptors in the West, whereas limited data from the East suggest that migrating bats may be more at risk than birds (Kerns and Kerlinger 2004). Offshore wind power may pose a threat to waterfowl or waterbirds depending on location, and may include direct mortality and behavioral modification (Yulp et al. 1999).

3.1.8 Climate Change, Altered Natural Disturbance

Although the habitat-level effects of climate change (sea level rise being the exception for shorebirds and other coastal taxa, Galbraith et al. 2002) are not likely to influence migrating birds (they are adapted to using multiple habitats), disruption of seasonal patterns may be detrimental. Many species of migratory birds have shifted their arrival dates as much as 3 weeks earlier over the last several decades (Price and Root 2002). Such shifts in migration phenology can decouple bird migration peaks from peaks in food supply (e.g., McCarthy 2004), though effects on migrants' survival and ability to put on fat are unknown. Similarly, shifts in weather patterns may influence migratory behavior.

3.1.9 Development (Light Pollution)

Heavily lit urban areas can attract nocturnal migrants (many songbirds, cuckoos, owls, rails) that become disoriented and may die in collisions with structures. Disoriented birds, in turn, may be more susceptible to predation, or may find themselves in inhospitable environments with limited foraging opportunities. Some researchers estimate that upwards of 100 million birds are killed annually in this manner in North America (FLAP).

3.2 Sources of Information

Information on habitat-based threats was obtained largely from the scientific literature and summaries thereof. For broad-based but still poorly understood threats such as collisions and cat predation, most information came from reports written by bird conservation organizations available on the web.

3.3 Extent and Quality of Data

Effects of habitat loss and alteration on the winter grounds are well documented in scientific literature. Stopover habitat issues are also becoming better understood, although there are fewer direct connections between stopover events and population dynamics. Data on mortality (cats and towers), effects of climate change, and light pollution are rarely collected in a consistent manner across numerous locations, and extrapolations of these data to the broader scale are necessarily rough.

3.4 Threat Assessment Research

For some of the "low" threats discussed above (particularly climate change, cats, towers, wind power,

and light pollution), one of the main reasons for their low rank is a lack of information on the timing and severity of the threat. New Hampshire could participate in ongoing monitoring occurring elsewhere in the region.

There are also very few data with which to evaluate the effects of habitat loss or fragmentation on birds that migrate through New Hampshire. RADAR, in conjunction with data on landscape characteristics, can determine whether fragmented or degraded areas are used to the same degree as more intact habitats.

Other research would focus on the effects of human disturbance on non-breeding birds. Some such studies are planned or underway (bald eagles) or are already completed (shorebirds), but they lack for small land birds and aquatic birds.

It is critical to identify and research potential threats to priority species on their winter grounds (in Latin America, the Caribbean, and the southern United States). Research may include the effects of habitat conversion, pesticides, and agricultural practices.

Element 4: Conservation Actions

4.1.1 Outreach on cross-border and diffuse effects (coffee, pesticides, PIF, etc.), Education and Outreach

Threat addressed: Out-of-state Activities

In the early 1990s, Partners in Flight (PIF) and its partner organizations raised awareness of the effects of extra-national activities on North America's breeding birds. In the decade since, initiatives such as the promotion of shade-grown coffee have been relatively successful in 'bringing home" the connections between breeding and wintering areas, but more work needs to be done. Important issues that may be particularly suitable for grassroots activism include pesticide use in South America, climate change, and mortality associated with towers and lighted structures. At stopover sites, initiatives such as the Important Bird Area program, Western Hemisphere Shorebird Reserve Network, and others can galvanize local support for land conservation, which in turn can increase local awareness of other issues affecting migrant birds.

4.1.2 Land Conservation in Priority Corridors, Habitat Protection

Threats addressed: Loss of stopover habitat

Available research indicates that migrants need multiple stopover sites and a wide variety of habitats (Petit 2000, R. Suomala unpubl. data). For many land birds, important habitat features include fruit-bearing shrubs and large enough habitat patches to attract area-sensitive species. Edge habitats should be maintained or enhanced to manage or restore habitat for migratory songbirds (Suthers et al. 2000). Habitat protection (or management/restoration) at this scale will require more baseline data on the primary species or species groups that use the landscape.

4.1. 3 Local Stopover Habitat Education, Education, and Outreach (with potential to include Regulation and Policy)

Threats addressed: Loss of stopover habitat

Local communities can encourage or implement land use policies that benefit migratory birds (Mabey and Watts 2000). Such policies could include landscaping with fruit-bearing shrubs or shelter-providing conifers (C. Foss, personal observation), bird-friendly zoning, and tax incentives to maintain critical habitats. Attempt to influence local land use should be combined with outreach pertaining to an area's value to migratory birds (along lines of 4.1.1) and, where appropriate, discussion of the potential "nature tourism" value of maintaining migrant habitats.

4.1.4 Cats Indoors Campaign, Education and Outreach

Threats addressed: Cat predation

The American Bird Conservancy has initiated an outreach campaign directed toward minimizing the hazards posed by cats to native wildlife. To be broadly successful, such an effort should be supported by multiple conservation organizations and pet-advocacy groups (Humane Societies, SPCA). There may be considerable resistance to control of feral cats by some parties, which only a concerted outreach campaign is likely to overcome. In addition, state and

local governments should consider the feasibility of legislation prohibiting cats outdoor without a leash, much as with current leash laws for dogs.

4.1.5 Management agreements with farmers, Restoration and Management OR Education and Outreach

Threats addressed: Change in crops

The Farm Bill, Current Use, and the Conservation Reserve Program encourage existing agricultural practices (or discourage conversion of agricultural lands). These tools should be applied in situations where there is greatest risk of farmland conversion to less suitable land use as described in section 3.1.4. In situations where income is not the primary purpose of agricultural land (e.g., "gentleman farmers"), there is an opportunity to encourage land use compatible with the needs of migratory birds.

4.1.6 Outreach on (or regulation of) impacts of human disturbance (especially on eagles and shorebirds), Education and Outreach OR Regulation and Policy

Threats addressed: Human disturbance (both aquatic and terrestrial)

Changing human behavior will benefit non-breeding birds during important resting or feeding periods. These include:

- Limiting access to critical roosting (shorebirds, eagles) and feeding (shorebirds) areas
- Providing "limited disturbance areas" at major waterfowl concentration areas (this may need to be implemented in the context of existing hunting regulations)

4.1.7 Adopt bird-friendly tower siting and design policies, Regulation and Policy

Threats addressed: Mortality at communication towers

FCC regulations require that all towers over 199 feet tall be lighted, as well as those near airports or along major highways. Provisions guiding tower placement and lighting that would reduce their threat to migrating birds need to be addressed, especially in areas where migrants are known to be relatively concentrated (e.g., focal areas). Shire et al. (2000) list several recommendations that would help minimize bird mortality at communications towers, including:

- When possible, use existing towers or structures for placement of new antennae
- Make new towers under 200 feet tall so lighting is not required
- If lighting is necessary, use the minimum amount and intensity allowed under FCC regulations
- Dismantle inactive towers as soon as possible
- Minimize lighting for on-ground facilities associated with towers
- Existing evidence suggests that use of white strobes may result in less circling behavior by nocturnal migrants and thus cause fewer mortalities than red pulsating lights. However, additional research is needed before implementing this recommendation

4.1.8 Establish Wind Power Facility Site Review Regulations, Regulation and Policy

Threats addressed: Mortality at wind farms

Data on the effects of wind power are limited (but see section 3.1.7), so first steps in addressing this threat should include consideration of siting regulations. Wind farms should not be built in areas where they will pose a high risk to birds, and proposals should thus include provision for detailed pre-construction assessment of bird use. When possible, facilities should follow any "best design practices" that may be developed as research progresses on the effects of wind farm affects on birds and bats. In the event that any wind farms are constructed, it is imperative that provisions be included for monitoring of bird and bat mortality for comparison to pre-construction use patterns.

4.1.9 Reduce light pollution, Education and Outreach OR Regulation and Policy

Threats addressed: Light pollution

Some North American cities (Toronto, Chicago) have implemented "lights out" programs during peak migration periods. Under these programs, cooperating building owners and managers agree to turn out decorative lights or draw blinds during the evening hours. The overall degree of light pollution can be markedly reduced if buildings comply (see www.lightsout.audubon.org/). In addition, there is growing interest in many municipalities to reorient street lighting so that it is more directed toward the ground and thus less disorienting to birds. All such measures have the benefit of reducing energy use.

4.1.10 Advise Inter-agency Risk Assessment Teams about Risks to Non-breeding Birds, Policy and Regulation

Threats addressed: Wind energy, climate change

NHFG will develop a strategy to initiate Interagency Wildlife Risk Assessments for several broad-based threats that affect the state's wildlife and their habitats. When these Assessments are implemented, it is critical that issues related to non-breeding birds and their habitats are included in discussions of the effects of these threats and the actions that may be needed to address them.

Element 5: References

5.1 Literature

American Bird Conservancy. Cats Indoors Campaign. www.abcbirds.org/cats (February 16. 2005)

Barrow, W.C. Jr., C. Chen, R.B. Hamilton, K. Ouchley, and T.J. Spengler. 2000. Disruption and restoration of en route habitat, a case study: the Chenier Plain. Pages 71-87 *in* Stopover ecology of Nearctic-neotropical landbird migrants: habitat relations and conservation implications (F. R. Moore, ed.). Studies in Avian Biology 20.

Birdlife International. 2003. Windfarms and birds: an analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. Convention on the conservation of European Wildlife and Natural Habitats, Strasbourg, France, 1-4 December 2003.

Braile, R. 1999. Proliferation of cell towers poses threat to birds. The Boston Globe. May 23, 1999 New Hampshire Weekly, p. 1.

Brown, S., C. Hickey, B. Harriington, and R. Gill, eds. 2001. The U.S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, MA.

Callaghan, C. 2003. Fundy's phalaropes. Passages: the Long and Brier Island News, October 2003. (www.bofep.org/phalaropes.htm).

Clayton, K. 2004. Banding northern saw-whet owls in the Blackstone River valley. Bird Observer 32: 287-297.

Cox, J. 1988. The influence of forest size on transient and resident bird species occupying maritime hammocks of northeastern Florida. Florida Field Naturalist 16(2): 25-34.

Duncan, C., B. Abel, D. Ewert, M.L. Ford, S. Mabey, D. Mehlman, P. Paterson, R. Sutter, and M. Woodrey. 2002. Protecting stopover sites for forest-dwelling migratory landbirds. The Nature Conservancy, Arlington, VA. Unpublished report.

Fiore, C.A., and K.B. Sullivan. 2000. Domestic cat (*Felis catus*) predation of birds in an urban environment. Wichita State University. Unpublished report. www.geocities.com/the_srco/Article.html (February 16, 2005).

FLAP. Fatal Light Awareness Program (www.flap.org).

Galbraith, H., R. Jones, R. Park. J. Clough, S. Herrod-Julius, B. Harrington, and G. Page. Global climate change and sea level rise: potential losses of intertidal habitat for shorebirds. Waterbirds 25: 173-183.

Gildstein, M.I., B. Woodbridge, M.E. Zaccagnini, and S.B. Canavelli. 1996. An assessment of mortality of Swainson's hawk on wintering grounds in Argentina. Journal of Raptor Research 30: 106-107.

Hutto, R.L. 2000. On the importance of en route periods to the conservation of migratory landbirds. Pages 109-114 *in* Stopover ecology of Nearctic-neotropical landbird migrants: habitat relations and conservation implications (F. R. Moore, ed.). Studies in Avian Biology 20.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Report to FPL Energy and Mountaineer Wind Energy Center Technical Review Committee, Curry and Kerlinger, LLC.

Langston, R.H.W., and J.D. Pullan. 2003. Wind-

farms and birds: An analysis of the effects of windfarms on birds, and guidelines on environmental assessment criteria and site selection issues. Report written by Birdlife International for the Bern convention (www.birdlife.org/)

Mabey, S.E., and B.D. Watts. 2000. Conservation of landbird migrants: addressing local policy. Pages 99-108 *in* Stopover ecology of Nearctic-neotropical landbird migrants: habitat relations and conservation implications (F. R. Moore, ed.). Studies in Avian Biology 20.

McCarthy, M. 2004. Disaster at sea: global warming hits UK birds. The Independent (UK) 30 July 2004 (news.independent.co.uk/uk/environment/story.jsp?story=546138).

Moore, F.M. 2000. Stopover ecology of Nearctic-neotropical landbird migrants: habitat relations and conservation implications. Studies in Avian Biology 20.

Moore, F.R., S.A. Gauthreaux, Jr., P. Kerlinger, and T.R. Simons. 1995. Habitat requirements during migration: important link in conservation. Pages 121-144 *in* Ecology and Management of Neotropical Migratory Birds: A Synthesis and Review of Critical Issues (T.E. Martin and D.M. Finch eds.), Oxford University Press, New York.

Norris, D.R., P.P. Marra, T.K. Kyser, T.W. Sherry, and L.M. Ratcliffe. 2004. Tropical winter habitat limits reproductive success on the temperate breeding grounds in a migratory bird. Proceedings of the Royal Society of London (Biology) 271:59–64.

Parrish, J.D. 1997. Patterns of frugivory and energetic condition in Nearctic landbirds during autumn migration. Condor 99: 681-697.

Parrish, J.D. 2000. Behavioral, energetic, and conservation implications of foraging plasticity during migration. Pages 53-70 i*n* Stopover ecology of Nearctic-neotropical landbird migrants: habitat relations and conservation implications (F. R. Moore, ed.). Studies in Avian Biology 20.

Petit, D.R. 2000. Habitat use by landbirds along nearctic-neotropicl migration routes: implications for conservation of stopover habitat. Pages 15-33 *in* Stopover ecology of Nearctic-neotropical landbird migrants: habitat relations and conservation implications (F. R. Moore, ed.). Studies in Avian Biology 20.

Pfister, C., M.J. Kasprzyk, and B.A. Harrington. 1998. Body-fat levels and annual return in migrating semipalmated sandpipers. Auk 115: 904-915.

Price, J.T., and T.L. Root. 2002. No orioles in Baltimore? Climate change and Neotropical migrants. Bird Conservation 16:12.

Robbins, C.S., J.W. Fitzpatrick, and P.B. Hamel. 1992. A warbler in trouble: *Dendroica cerulea*. Pages 549-562 *in* Ecology and Conservation of Neotropical Migrant Landbirds (J. M. Hagan and D. W. Johnston, eds.), Smithsonian Institution Press.

Robinson, S., and J. Robinson. 2001. The Pittsfield nighthawk watch: 1993-2001. Bird Observer 29: 446-447.

Rodewald, P.G., and M.C. Brittingham. 2004. Stopover habitats of landbirds during fall: use of edge-dominated and early-successional forests. Auk 121: 1040-1055.

Sawyer, P.J. 1961. Bird mortality at the WENH-TV tower in Deerfield, New Hampshire. New Hampshire Audubon Quarterly 14(2); 46-49.

Schwartz, S.S. (ed.). 2004. Proceedings of the Wind Energy and Birds/Bats Workshop: Understanding and Resolving Bird and Bat Impacts (Washington, DC. May 18-19, 2004). RESOLVE Inc., Washington, D.C.

Sherry, T.W. and R.T. Holmes. 1995. Summer versus winter limitation of populations: what are the issues and what is the evidence. Pages 85-120 i*n* Ecology and Management of Neotropical Migratory Birds: A Synthesis and Review of Critical Issues. (T.E. Martin and D.M. Finch eds.). Oxford University Press, New York.

Shire, G.G., K. Brown, and G. Winegard. 2000. Communication towers: A deadly hazard to birds. American Bird Conservancy. www.abcbirds.org/Towerkills.htm.

Somershoe, S.C., and C.R. Chandler. 2004. Use of oak hammocks by Neotropical migrant songbirds: the role of area and habitat. Wilson Bulletin 116: 56-53.

Suthers, H.B., J.M. Bickal, and P.G. Rodewald. 2000. Use of successional habitat and fruit resources by songbirds during autumn migration in New Jersey. Wilson Bulletin 112: 249-260.

5.2 Data Sources

National Audubon Society (2002). The Christmas Bird Count Historical Results [Online]. Available at http://www.audubon.org/bird/cbc.

NHBR. New Hampshire Bird Records, New Hampshire Audubon, Concord, NH.

Element 6: List of Figures

Focal Area	% protected	includes:
Connecticut River Valley	7.57	
Merrimack River Valley	9.85	
Contoocook River Valley	27.33	
Bowman Notch	22.85	
Lake Umbagog/Pontook Reservoir	12.23	
Lakes Region	0.09	
Powwow River	15.25	
Great Bay Grasslands	32.83	Great Bay
Great Bay Wetlands	54.91	Great Bay
Saltmarsh and intertidal flats	6.93	Great Bay, Coast
Coastal shoreline and nearshore waters	1.34	Coast
10 miles inland	11.65	Coast
Combined Great Bay/Coast	11.73	
Offshore Waters	0	Isles of Shoals

Table 1. Percentage conserved land in non-breeding bird focal areas and habitats. Because of the way the Great Bay and Coastal focal areas were created in the GIS process, the areas listed below do not necessarily correspond with those listed in Section 1.4. The appropriate focal areas from Section 1.4 are listed for reference in Table 1.