

Grasslands

Associated Species: Northern Harrier (*Circus cyaneus*), Upland Sandpiper (*Bartramia longicauda*), Purple Martin (*Progne subis*), Eastern Meadowlark (*Sturnella magna*), Horned Lark (*Eremophila alpestris*), Grasshopper Sparrow (*Ammodramus savannarum*), Vesper Sparrow (*Poocetes gramineus*), northern leopard frog (*Rana pipiens*), and Wood Turtle (*Glyptemys insculpta*).

Federal Listing: Not listed

State Listing: Not listed

Global Rank: Not ranked

State Rank: Not ranked

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ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

Extensive grasslands are defined as areas greater than 10 ha that are dominated by grasses, forbs, and sedges with little shrub or tree cover (generally less than 10%) (Vickery and Dunwiddie 1997, DeGraaf and Yamasaki 2001). Grasslands include hayfields and pastures, fallow fields, cropland (cornfields and other row crops), airports, military installations, landfills, forb, and sedge-dominated meadows, heathlands, and similar non-alpine areas (Vickery and Dunwiddie 1997, Mitchell et al. 2000). Native plant species typical of northeastern grassland include goldenrod (*Solidago* spp.), aster (*Aster* spp.), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and meadowsweet (*Spiraea alba*) (Mehrhoff 1997). Rare plant species found in New England grassland include wild lupine (*Lupinus perennis*), butterfly weed (*Asclepias tuberosa*), and northern blazing star (*Liatris scariosa* var. *novae-angliae*) (Mehrhoff 1997).

1.2 Justification

Native grasslands were once the most widely distributed vegetative cover in North America (Knopf 1995). A decline in this habitat type in the Northeast has led to a precipitous decline in grassland bird populations, which are disappearing faster than any other group of birds in this region (Sauer et al. 2003). Seven grassland birds are listed as endangered or threatened in at least 1 state in the region (Mitchell et al. 2000). In New Hampshire, grasslands serve as primary breeding and nesting grounds for several avian species of conservation concern including the state endangered northern harrier (*Circus cyaneus*), state endangered upland sandpiper (*Bartramia longicauda*), state threatened grasshopper sparrow (*Ammodramus savannarum*), eastern meadowlark (*Sturnella magna*), horned lark (*Eremophila alpestris*), and vesper sparrow (*Poocetes gramineus*).

Large (>10 ha) grasslands are important because many grassland birds require large areas. For instance, eastern meadowlarks require at least 6 ha, grasshopper sparrows at least 12 ha, savannah sparrows 8 to 16 ha, and upland sandpipers 40 to 80 ha (Jones and Vickery 1997).

Other species of conservation concern that would benefit from the conservation of grasslands include black racer, smooth green snake, northern leopard frog, wood turtle, and others. Grassland invertebrates include a host of grasshoppers, butterflies, moths, and spiders (Vickery and Dunwiddie 1997).

1.3 Protection and Regulatory Status

Grasslands have no special regulatory status. Grasslands that are habitat for endangered or threatened species are protected under RSA 212 if modifying the habitat would result in those species' inability to use the habitat.

A number of programs exist that protect critical grasslands and farmland from development. LCHIP provides fee simple or conservation easement grants to communities, land trusts, and others to help protect priority lands. Since 1979, the State Department of Agriculture has administered an Agricultural Land Preservation Program, which was created under RSA 432:18-31a for the sole purpose of protecting prime farmland through conservation easements. In addition, the program works with land trusts, conservation organizations, and municipalities to protect important farm resources. The state, through the Current Use Advisory Board within the Department of Revenue Administration, administers the Current Use Taxation program, which was created via RSA 79-A to encourage, among other things, the protection of agriculture and wildlife resources. The program reduces state property taxes by 20 percent for lands of at least 4 ha that are open year-round to public recreational use.

At the federal level, the NRCS administers the Farmland Protection Program through the USDA. The Farmland Protection Program provides funds to help purchase development rights to keep farmland in agriculture. The program provides up to 50 percent of the fair market easement value (NRCS 2005a).

At the local level, many municipalities have passed open space bonds to help protect natural resources of local and statewide importance. Since 2000, municipalities have invested over \$125 million in land protection (SPNHF 2005). It is unknown how many hectares of grassland or farmland have been protected through these investments.

1.4 Population and Habitat Distribution

Grasslands in New Hampshire are largely restricted to hay fields, cropland, airports, capped landfills, and military installations. According to the grassland habitat mapping completed by NHFG, there are 94,578 ha of grassland complexes at least 10 ha in size. Most of these grasslands occur in Grafton county (18,937 ha: 20%) followed by Merrimack and Coos counties [12,139 (13%) and 11,635 (12%) ha, respectively]. Cheshire, Hillsborough, Rockingham, Strafford, and Sullivan counties contain 7,300 to 9,600 ha of extensive grassland each, whereas Carroll and Belknap counties contain the least amount of grassland at approximately 4,700 ha each.

1.5 Town Distribution Map

At least one grassland complex larger than 10 ha occurs in nearly every town in New Hampshire. The exceptions are 20 towns and territories in Coos County, 3 towns in Carroll County, 4 towns in Grafton County, and 2 towns in each of Cheshire, Hillsborough, and Rockingham Counties (figure 1).

1.6 Habitat Map

The New Hampshire Landcover Assessment (Complex Systems Research Center 2002) was used to map extensive grassland larger than 10 ha. Much habitat for rare grassland birds is classified as disturbed or cleared. Where such areas abutted active agricultural plots, the two were joined. In this way, areas greater than 10 ha were isolated and converted to a separate shape file.

Polygons were then overlaid atop 1998 Digital Orthophotos and the entire state was scanned at a scale of 1:50,000 to identify areas erroneously mapped as grassland. Invalid polygons were deleted from the data layer, and if only a portion of the polygon was misclassified, the polygon boundary was edited. Polygons that were misclassified were often shrub swamps, wet meadow, developed areas, or timber harvest areas reverting to forest. Only those polygons that were significantly misclassified were edited.

1.7 Sources of Information

Sources of information for this element included technical reports, Breeding Bird Survey data, and peer reviewed journal articles. The New Hampshire Landcover Assessment (CSRC 2002) was used to map grassland habitat. 1998 digital orthophotos were used to check the accuracy of the grassland habitat data layer.

1.8 Extent and Quality of Data

Data for mapping grasslands were obtained from the New Hampshire Landcover Assessment (CSRC 2002). The assessment was obtained from interpretation of satellite imagery (pixel size = 30 m) using standard digital image processing techniques. Because the satellites used cannot capture items on the ground less than 30 m in size, many hedgerows and tree lines that

typically separate fields were not delineated. Thus, this data layer really depicts grassland complexes and not individual grassland patches. The coarse scale of the satellite imagery caused some imprecision in the delineation of boundaries, which may be offset when laid over an aerial photograph.

Because the entire state was scanned to identify misclassification errors, errors of commission (classifying an area as grassland when it is really some other land cover type) should be relatively few. Even so, it is possible that some errors were missed during the scanning. Similarly, it is possible that some true grassland areas were omitted.

1.9 Distribution Research

Research is needed to clarify the complex relationships between land use, natural disturbance, and biogeography of rare wildlife. Historically, many Native American and European land uses imitated natural disturbance regimes capable of maintaining grasslands. These land uses included firewood and timber harvesting, controlled burning, and clearing for year-round or seasonal settlements and agriculture. Some of the natural disturbances these land uses may imitate include fire, extreme weather, herbivory, extensive colonial nesting (passenger pigeons), and sand plain terracing resulting from alluvial denudation and deposition.

Native grasslands and heathlands are recognized as fine-scale, fire-driven structural features of pitch pine and scrub oak woodlands (NHNHB). However, more inclusive land use and biogeographic data suggest a broader historic extent of native grasslands and heathlands. Other research should determine causes of grassland wildlife declines, explore the relationship between invertebrates and grassland, and improve techniques for grassland mapping.

ELEMENT 2: SPECIES/HABITAT CONDITION

2.1 Scale

Counties will be used as the conservation-planning units for this habitat. The majority of grassland habitats in New Hampshire are related to agricultural activity. Most technical and financial assistance is provided to farmers on a county-basis by the Farm Services Agency, Natural Resources Conservation

Service, University of New Hampshire Cooperative Extension, Conservation Districts, and others.

2.2 Relative Health of Populations:

Although the amount of grassland habitat in New Hampshire has been declining over numerous decades, it is difficult to determine the extent of grasslands in New Hampshire prior to European settlement. The creation and maintenance of grasslands prior to European settlement are ascribed to beavers and Native American use of fire.

Numerous reports, largely based on historic accounts, suggest that Native Americans in coastal regions and river valleys used fire to create and maintain agricultural fields and to improve hunting grounds and travel corridors (Day 1953, Harris 1972, Cronon 1983, Whitney 1994). The resulting mosaic included habitat, including grassland, in different states of succession. However, archaeological data are equivocal, and the effect that Native American fires had on vegetation composition and distribution in the region is unclear.

Beavers likely contributed to the creation of open areas (Askins 1997). After a beaver dam is abandoned, the previously dammed area succeeds to a meadow dominated by sedges, grasses, and forbs. Though no empirical data exist to elucidate the extent of beaver activity in New Hampshire or the region, it is known that beaver activity may influence 20 to 40% of the total length of second- to fifth-order streams (Naiman et al. 1988). Additionally, a study in the Adirondack Mountains found that beaver dams created patches of disturbance that covered, on average, 6.7 to 12 ha (Remillard et al. 1987). Given their habitat requirements, it is plausible that many grassland endemic species could have used beaver meadows during pre-settlement times (e.g., grasshopper sparrow, savannah sparrow).

An analysis of wet flats in New Hampshire (the flat floodplain area adjacent to streams and rivers that would be affected by beavers) shows that nearly 30% (267 out of 961) of the wet flats 7 to 12 ha in size are affected by agriculture and likely no longer serve as grassland habitat because of current management practices (e.g., repeated mowing during the breeding season or planting to crops). Another 17% (165 out of 961) are affected by development (CSRC 2001, TNC 2003).

Native sand plain grasslands may have been more common in New Hampshire prior to European settlement, especially in coastal lowlands and along the Merrimack and Connecticut Rivers in southern New Hampshire. However, only small remnants occur within historic and current pitch pine areas (see the Pine Barren habitat profile).

Despite local losses of specific grassland types (e.g., sand plain grassland) the amount of grassland in New Hampshire increased dramatically after European settlement. Much land was cleared for farmland in the eighteenth and nineteenth centuries, and grasslands abounded at that time (Askins 1997). In 1850 there were over 910,000 ha of improved farmland (hayfields and cropland) in New Hampshire (Silver 1957). However, when agricultural practices were abandoned and fields reverted to woodland or became developed during the twentieth century, grasslands and the species associated with them began their slow decline. Currently, there are approximately 101,175 ha of farmland in New Hampshire, and most of it is intensively managed so as not to be suitable for wildlife (Jones and Vickery 1997, USDA 2004).

2.3 Population Management Status

N/A

2.4 Relative Quality of Habitat Patches

Most of New Hampshire's grasslands are cultivated fields and are thus ill suited to most wildlife. Farm fields are either in a row crop (e.g., corn) or are used for hay or pasture. Hayed fields are typically mowed more than once during the breeding bird season, which likely destroys bird nests (Bollinger et al. 1990). Mowing more than once a season also harms grassland reptiles like black racers, smooth green snakes, and eastern garter snakes (Mitchell 2003). Roads and development fragment fields into patches that may not be big enough to sustain grassland-nesting birds. It also introduces more predators (e.g., cats, raccoons, foxes, crows, blue jays, etc.).

In a study of land use change in Rockingham and Strafford Counties, the University of New Hampshire CSRC documented a roughly 50% decline in active agricultural land from 1962 to 1998. Of the increase in developed land in Strafford County from 15,155 acres (1962) to 33,616 acres (1998), 3,487 acres were converted from active agriculture. In Rocking-

ham County, of the increase in developed land from 36,519 acres (1962) to 98,417 acres (1998), 11,685 acres were converted from active agriculture (Fay Rubin, Complex Systems Research Center, unpublished report). In northern Coos County, where northern harriers breed in large grasslands, the amount of hayfield declined from 54% to 44% from 1982 to 1993 (Serrentino 1988).

2.5 Habitat Patch Protection Status

Only 8% of the grasslands larger than 10 ha are conserved in New Hampshire. The percentage of conserved grasslands by county ranges from 4 to 11% with the most area conserved in Merrimack and Strafford counties (11% each) and the least in Belknap county (4%).

2.6 Habitat Management Status

Financial & Technical Assistance Programs:

Several programs provide financial and technical assistance to farmers for managing and preserving agriculture fields for wildlife. These include the USDA's Conservation Reserve Program (CRP), Environmental Quality Incentive Program (EQIP), and Wildlife Habitat Incentives Program (WHIP), as well as the USFWS's Partners for Fish & Wildlife Program (Partners Program), and the NHFG Small Grants Program. University of New Hampshire Cooperative Extension Wildlife Specialists also provide technical assistance to farmers and other landowners on wildlife habitat management issues.

The Conservation Reserve Program provides financial incentives to landowners in the form of annual rent payments to encourage them to take highly erodible cropland out of production (FSA 2005). Financial assistance may also be provided to help establish a suitable cover crop or to restore habitats that were lost during agriculture conversion (e.g., floodplain forest).

The Conservation Research Program is not much used in New Hampshire. On average, only 85.5 ha were enrolled under this program between 2001 and 2003 (FSA 2002, FSA 2003a, FSA 2004). A major reason for this is that the rental rates paid to farmers are based on soil productivity and local dry land cash rates, and priority is given to projects with low costs (FSA 2003b). Since, on a nationwide scale, soil pro-

ductivity is relatively low and the local cash rates are high in New Hampshire and the northeast in general, CRP projects in this region are not often chosen for funding (figure 2). The Conservation Research Program would perhaps become a more viable option for farmers in this state if CRP acreage enrollment goals were established by region (e.g., Midwest, Northeast, etc.) (Oehler 2003).

The Environmental Quality Incentives Program offers financial and technical assistance to help agricultural producers install or implement structural and management practices on eligible agricultural land (NRCS 2005b). An EQIP Technical Committee in each state sets eligible habitat improvement practices, of which there are nearly 70 in New Hampshire. These include such things as nutrient management, installation of manure storage facilities, and restoration of declining habitats. Eligible EQIP practices that would benefit grasslands include brush management, pasture and hay planting, prescribed grazing, restoration and management of declining habitats (New Hampshire NRCS 2005a). Statistics are currently unavailable to determine how many ha have been treated with each of these practices. In 2005, New Hampshire received nearly \$8 million for EQIP.

The Wildlife Habitat Incentives Program encourages the creation of quality wildlife habitat on private land through technical and financial assistance (NRCS 2005c). Like EQIP, a WHIP Technical Committee in each state sets eligible habitat improvement practices. Like many states in the northeast, New Hampshire's list of eligible practices includes such things as brush management, prescribed burning, grass planting, and other practices applicable to grasslands (New Hampshire NRCS 2005b). Statistics are currently unavailable to determine how many ha have been treated with each of these practices. In 2005, New Hampshire received over \$1,000,000 for WHIP.

Since 1990, the USFWS's Partners for Fish & Wildlife Program in New Hampshire has provided technical and financial assistance to landowners, state agencies, many organizations and individuals to restore fish and wildlife habitat such as coastal wetlands, riparian habitats, and grasslands (USFWS 2001). Since its inception, the Partners Program has restored over 40.5 ha of upland habitat (USFWS 2001).

New Hampshire Fish and Game administers the

Small Grants Program that was established to fund all or part of the cost of small-scale habitat restoration and enhancement projects on privately owned lands. Up to \$50,000 per year is committed to the Small Grants Program. The funds are obtained via a \$2.50 habitat fee required of all who purchase a New Hampshire hunting license. Twelve habitat management practices are eligible for funding, of which three are relevant to grasslands. These include mowing to maintain grasslands and shrublands, establishment and maintenance of cool season grasses and clovers, and establishment and maintenance of warm season grasses (NHFG undated). Since 2000, 400 ha have been mowed, 31 ha have been planted to cool season grasses or maintained via soil amendments, and 3.5 ha have been planted to warm-season grasses or maintained via soil amendments (NHFG unpublished data).

Management on State Lands

The NHFG owns in fee-simple or under conservation easement just over 334 ha of fields (NHFG unpublished data). One-hundred-and-seventy-three ha are maintained in active agriculture (either hay or cropland), and the remainder is maintained via brush hog mower with mowing occurring every 1 to 3 years after the bird nesting season.

Few of the NHFG fields are greater than 10 ha. The Osborne Wildlife Management Area (WMA) in Belknap County is an easement owned property with a complex of fields totaling 64 ha. The property owner actively farms these fields. The Lime Pond conservation easement in Coos County has an 11 ha field that is currently not maintained. The Fort Hill WMA in Coos County has the largest complex of fields on NHFG property, totaling 153 ha. Forty-two ha are owned under a conservation easement and are actively farmed by the property owner, a dairy farmer. An additional 74 ha of fields are owned in fee simple status by the department and leased to the same dairy farmer. Thirty-seven ha are owned in fee simple status, but the previous landowner retained the agriculture rights.

The Department of Resources and Economic Development (DRED) owns in fee-simple or under conservation easement approximately 543 ha of fields and other early-successional openings (DRED unpublished data). Forty ha are maintained in active

agriculture (either hay or cropland). One-hundred-and-thirty-seven ha are maintained via mowing by State Parks or NHFG. The remainder is not maintained on a regular basis.

Like NHFG, DRED owns or manages few fields greater than 10 ha. Specifically, 9 properties may provide opportunities for grassland. These, along with the NHFG owned or managed fields, should be evaluated for their potential to provide grassland habitat.

Management on Other Lands

All other grassland complexes greater than 10 ha occur on private land and, to a much lesser extent, on land of private land trusts, municipalities, and other conservation organizations/agencies. It is not known to what extent grasslands on other conservation lands are maintained. Grasslands on private lands are typically owned by farmers and are therefore maintained as cropland or pastureland.

2.7 Sources of Information

Sources of information for element 2 include journal articles, websites, GIS data, and white papers.

2.8 Extent and Quality of Data

It is difficult to ascertain how suitable the mapped grassland complexes are for grassland-related wildlife species. The minimum mapping unit for the New Hampshire Landcover Assessment was 30 square meters (CRSC 2001). This resolution is often too coarse to pick up hedgerows and tree lines that may separate fields and render them useless to area-dependent grassland birds. Higher resolution satellite imagery would be needed to adequately map and evaluate grassland complexes in an efficient manner. The alternative would be field ground truthing of mapped complexes to determine their suitability, but that would be extremely time consuming. Concentrating on larger complexes, especially those on state land, would be more manageable. Although Farm Bill and other financial assistance programs are used in New Hampshire and elsewhere in the country, little has been done to evaluate wildlife species' response to the management.

2.9 Condition Assessment Research

- Assess the availability of higher resolution satellite imagery to use to better map grassland complexes and their condition
- Assess the number of farmers currently more than once per season from the highest priority grasslands. Such an assessment could be used as an indicator of grassland health and could be monitored to track grassland health through time.
- Assess in more detail the rate of loss of open space to development and the attendant effects on grasslands
- Assess effectiveness of Farm Bill programs by implementing monitoring programs on lands where Farm Bill monies have been applied

ELEMENT 5: REFERENCES

5.1 Literature

- Askins, R.A. 1997. History of grasslands in the northeastern United States: implications for bird conservation. Pages 119-136 *in* Grasslands of northeastern North America: ecology and conservation of native and agricultural landscapes, P. D. Vickery and P. W. Dunwiddie, editors. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.
- Askins, R., and D. Thompson. 2003. Assessment of the importance of grasslands in the central Connecticut River Valley for conservation of grassland birds.
- Bollinger, E.K., P.B. Bollinger, and T.A. Gavin. 1990. Effects of hay-cropping on eastern populations of the bobolink. *Wildlife Society Bulletin* 18:142-150.
- Complex Systems Research Center. 2002. Landcover assessment - 2001. University of New Hampshire, Durham. <http://www.granit.sr.unh.edu/data/datacat/pages/nhlc01.pdf>. Accessed 8 February 2002.
- Cronan, W. 1983. Changes in the land: Indians, colonists, and ecology of New England. Hill and Wang, New York, New York, USA.
- Day, G. 1953. The Indian as ecological factor in the northeastern forests. *Ecology* 34:329-346.
- DeGraaf, R.M., and M. Yamasaki. 2001. New Eng-

- land wildlife: habitat, natural history, and distribution. University Press of New England, Hanover, New Hampshire, USA.
- Denny, R.N. 1974. The impact of uncontrolled dogs on wildlife and livestock. Transactions of the North American Wildlife and Natural Resources Conference 39: 257-291.
- Farm Service Agency. 2005. Conservation Reserve Program. U.S. Department of Agriculture. <http://www.fsa.usda.gov/dafp/cepd/crp.htm>.
- Farm Service Agency. 2004. Conservation Reserve Program fiscal year summary: FY 2003. U.S. Department of Agriculture. 14pp.
- Farm Service Agency. 2003a. Conservation Reserve Program fiscal year summary: FY 2002. U.S. Department of Agriculture. 14pp.
- Farm Service Agency. 2003b. Conservation Reserve Program: fact sheet. U.S. Department of Agriculture. <http://www.fsa.usda.gov/pas/publications/facts/html/crp03.htm>.
- Farm Service Agency. 2002. Conservation Reserve Program fiscal year summary: FY 2001. U.S. Department of Agriculture. 14pp.
- Hoopes, E.M. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. Thesis, University of Massachusetts, Amherst, Massachusetts, USA.
- Jones, A., and P.D. Vickery. 1997. Conserving grassland birds: managing agricultural lands including hayfields, cropfields, and pastures for grassland birds. Grassland Conservation Program, Center for Biological Conservation, Massachusetts Audubon Society, Lincoln, Massachusetts, USA.
- Jones, A., and P.D. Vickery. 1997. Distribution and population status of grassland birds in Massachusetts. Pp. 187-199 *in* Grasslands of northeastern North America: Ecology and conservation of native and agricultural landscapes, P.D. Vickery and P. W. Dunwiddie, editors. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.
- Knopf, R.L. 1995. Declining grassland birds. Pages 296-298 *in* Our living resources: a report to the nation on the distribution, abundance and health of U.S. plants, animals, and ecosystems, E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, editors. U. S. Department of the Interior, National Biological Service, Washington, D.C., USA.
- Mehrhoft, L.L. 1997. Thoughts on the biogeography of grassland plants in New England. Pages 15-23 *in* Grasslands of northeastern North America: ecology and conservation of native and agricultural landscapes, P.D. Vickery and P.W. Dunwiddie, editors. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.
- Mitchell, J.C. 2003. DRAFT Habitat management guidelines for amphibians and reptiles of the northeastern United States. Partners in Amphibian and Reptile Conservation. 57pp.
- Mitchell, L.R., C.R. Smith, and R.A. Malecki. 2000. Ecology of grassland breeding birds in the northeastern United States: a literature review with recommendations for management. U.S. Geological Survey, Biological Resources Division, New York Cooperative Fish and Wildlife Research Unit, Department of Natural Resources, Cornell University, Ithaca, New York, USA.
- Naiman, R.J., J.M. Melillo, and J.E. Hobbie. 1988. Ecosystem alteration of boreal forest streams by beaver (*Castor canadensis*). Ecology 67:1254-1269.
- New Hampshire Office of the Natural Resources Conservation Service. 2005a. New Hampshire EQIP approved practice list. U.S. Department of Agriculture. http://www.nh.nrcs.usda.gov/programs/program_documents/EQIP/2004_EQIP_Practice_List.pdf
- New Hampshire Office of the Natural Resources Conservation Service. 2005b. New Hampshire WHIP approved practice list. U.S. Department of Agriculture. [http://www.nh.nrcs.usda.gov/programs/WHIP 2005 Practice List 1-28.pdf](http://www.nh.nrcs.usda.gov/programs/WHIP%202005%20Practice%20List%201-28.pdf).
- Natural Resources Conservation Service. 2005a. Farmland Protection Program. U.S. Department of Agriculture. <http://www.nrcs.usda.gov/programs/eqip/>.
- Natural Resources Conservation Service. 2005b. Environmental Quality Incentives Program. U.S. Department of Agriculture. <http://www.info.usda.gov/nrcs/fpcp/fpp.htm>.
- Natural Resources Conservation Service. 2005b. Wildlife Habitat Incentives Program. U.S. Department of Agriculture. <http://www.nrcs.usda.gov/programs/whip/>.
- New Hampshire Fish & Game Department. Undated. Private lands habitat conservation – Small Grants Program: program overview. New Hampshire Fish & Game Department. 11pp.
- Norment, C. 2002. On grassland bird conservation

- in the northeast. *The Auk* 119: 27-279.
- Serrentino, P. 1998. A survey and habitat evaluation of northern harriers (*Circus cyaneus*) in northwest Coos County, New Hampshire. Report to Silvio O. Conte National Fish and Wildlife Refuge (U.S. Fish and Wildlife Service).
- Simes, C.A. 1999. Domestic dogs in wildlife habitats. *In* Effects of recreation on Rocky Mountain wildlife: a review for Montana, G. Joslin and H. Youmans, coordinators, Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society.
- Society for the Protection of New Hampshire Forests. 2005. Press release: town meeting voters approve \$23 million for conservation. Concord, New Hampshire, USA.
- Oehler, J.D. 2003. State efforts to promote early-successional habitats on public and private lands in the northeastern United States. *Forest Ecology and Management* 185:169-177.
- Parshall, T., and D.R. Foster. 2002. Fire on the New England landscape: regional and temporal variation, cultural and environmental controls. *Journal of Biogeography* 29:1305-1317.
- Patterson, W.A. III, and K.E. Sassaman. 1988. Indian fires in the prehistory of New England. Pages 107-135 *in* Holocene human ecology in northeastern North America, G.P. Nichols, editor. Plenum Publishing Corporation, New York, New York, USA.
- Remillard, M.M., G.K. Gruending, and D.J. Bogucki. 1987. Disturbance by beaver (*Castor canadensis* Kuhl) and increased landscape heterogeneity. Pages 103-122 *in* Landscape heterogeneity and disturbance, M.G. Turner, editor. Springer Verlag, New York, New York, USA.
- Sauer, J.R., J.E. Hines, and J. Fallon. 2004. *The North American breeding bird survey, results and analysis 1966 - 2003. Version 2004.1. United States Geological Service Patuxent Wildlife Research Center, Laurel, Maryland, USA.*
- Silver, H. 1957. New Hampshire game and furbearers. New Hampshire Fish & Game Department, Concord, New Hampshire, USA.
- Swain, P.C., and J.B. Kearsely. 2001. Classification of the natural communities of Massachusetts. Natural Heritage & Endangered Species Program Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts, USA.
- The Nature Conservancy. 2003. Ecological landunit data layer. Conservation Science Support Program, Eastern Resource Office of The Nature Conservancy, Boston, Massachusetts, USA.
- United States Department of Agriculture. 2004. 2002 census of agriculture. National Agricultural Statistics Service, U.S. Department of Agriculture, Washington, D.C. <http://www.nass.usda.gov/census/>.
- United States Fish and Wildlife Service. 2001. Partners for Fish and Wildlife Program: New Hampshire. <http://northeast.fws.gov/partners/Documents/State Summaries/NH-needs.pdf>
- Vickery, P.D., J.R. Herkert, F.L. Knopf, J. Ruth, and C.E. Keller. 2005. Grassland birds: an overview of threats and recommended management strategies. *In* Strategies for bird conservation: The Partners in Flight planning process, R. Bonney, D.N. Pashley, R.J. Cooper, and L. Niles, editors. Cornell Lab of Ornithology. <http://birds.cornell.edu/pifcapemay>
- Vickery, P.D., and P.W. Dunwiddie, editors. 1997. Grasslands of northeastern North America: ecology and conservation of native and agricultural landscapes. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.
- Whitney, G. 1994. From coastal wilderness to fruited plain: a history of environmental change in temperate North America from 1500 to present. Cambridge University Press, Cambridge, Massachusetts.
- Yalden, P.E., and D. Yalden. 1990. Recreational disturbance of breeding golden plovers *Pluvialis aprincarius*. *Biological conservation* 51: 243-262.

ELEMENT 6: LIST OF FIGURES

Figure 1. Distribution of extensive grasslands in New Hampshire.

Distribution of Extensive Grasslands in New Hampshire

Distribution
■ Known



0 10 20 40 Miles

