HABITAT PROFILE

Lowland Spruce-Fir Forest

Associated Species: spruce grouse, Northern Goshawk, three-toed woodpecker, bay-breasted warbler, purple finch, rusty blackbird, hoary bat, Canadian lynx, American marten, northern bog lemming
Global Rank: Not ranked
State Rank: Not ranked
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Element 1: Distribution and Habitat

1.1 Habitat description

This system is a mosaic of lowland spruce - fir forest and red spruce swamp communities that occur on mineral soils. In northern New Hampshire, these range from well or moderately well drained upland forests to poorly or very poorly drained swamps. Somewhat poorly drained soils are intermediate and very common. The average condition for red spruce swamps is acidic and poorly drained, with shallow, well decomposed organic soils (10 – 40 cm) over sandy to silty mineral soil. When soils are very poorly drained, these systems tend toward black spruce peat swamps. In steeper areas at moderate elevation, such as the White Mountains, swampland may be dominated by red spruce. These areas may border areas of narrow spruce fir, hardwood forest, or high elevation spruce fir. Lowland spruce fir is more minerotrophic than black spruce peat swamps, but less so than northern white cedar or near-boreal hardwood-conifer minerotrophic swamp systems. Diagnostic natural communities:

- Red spruce swamp (S3)
- Lowland spruce - fir forest (S3)
- Montane black spruce - red spruce forest (S1)

Associated natural community systems: Black spruce peat swamp systems occur on adjacent very poorly drained peat soils. In more minerotrophic settings this system can be adjacent and transition into northern white cedar or near-boreal hardwood-conifer minerotrophic swamp systems. Upslope, lowland spruce – fir forest/swamps typically transition to northern hardwood – conifer systems.

1.2 Justification

Lowland spruce-fir forest covers approximately 10% of New Hampshire. This forest type supports 101 vertebrate species in the state, including 9 amphibians, 2 reptiles, 53 birds, and 37 mammals. Of the bird species, 15 are essentially restricted to or heavily dependent on spruce-fir forest, and 7 require mature age classes. Threatened and endangered wildlife species occurring in this forest type include Canadian Lynx, eastern small-footed bat, marten, osprey, Peregrine falcon, Bald Eagle, and three-toed woodpecker. Extensive heavy cutting in recent decades has substantially reduced the distribution of mature spruce-fir forest in New Hampshire. Recent forest inventory data (Miles 2005) suggest that 71% of live spruce and fir trees are in the 2-inch diameter class and less than 1.5% are in diameter classes of 10 inches and above. Soil and other environmental conditions over extensive acreage in northern New Hampshire create the potential to support either spruce-fir or northern hardwood-conifer forest. Past harvesting in some of these areas have resulted in conversion of former spruce-fir sites to northern hardwood-conifer forest.

2.3 Protection and Regulatory Status

Much of New Hampshire's lowland spruce-fir occurs on private industrial land; approximately 30% of this forest type occurs on conservation lands. Areas of

public ownership include the White Mountain National Forest, Nash Stream Forest, Lake Umbagog National Wildlife Refuge, Pondicherry Refuge, and Randolph Community Forest.

Forestry on state lands is covered by RSAs 216, 217, and 218. RSA 227 stipulates requirements for residual basal area in riparian areas. The manuals "Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire" (Cullen 1996) and "Good Forestry in the Granite State" (FSSWT 1996) provide recommended management practices for sustainable forestry in New Hampshire.

2.4 Distribution

Lowland Spruce-Fir forest occurs primarily in northern New Hampshire, with approximately 45% by area in Coos County and approximately 20% in Grafton County.

2.5 Town Distribution Map

See attached.

1.6 Habitat Mapping

To develop a map of lowland spruce-fir forest in New Hampshire a model was developed for each ecoregion subsection of the state based on the 2001 New Hampshire Land Cover Assessment, elevation, landform, and soils (Keys and Carpenter 1995, Sperduto and Zankel 2005). The model was developed by experts from TNC and NHNHB.

First, 2001 New Hampshire Land Cover Assessment grid value 422 (spruce-fir) was selected and combined with elevations from 1,000 to 2,500 feet extracted from the USGS National Elevation Dataset. Only spruce-fir occurring in that elevation range was included (CSRC 2001, USGS 2003). Ecological Land Units (ELU), created by TNC's Conservation Science Support, were then added to capture additional areas likely to have geo-physical conditions favorable to lowland spruce-fir, or remove areas likely to have geophysical conditions unfavorable to lowland spruce-fir (TNC 2003). Specifically, acidic granitic dry flats, acidic sedimentary/metasedimentary dry flats, acidic shale dry flats, mafic/intermediate granitic dry flats, moderately calcareous sedimentary/metasedimentary dry flats, and wet flats were included. Water bodies were used to erase wet flats in the ELU layer that were actually open water.

To further refine the model, soil types associated with lowland spruce-fir were identified by NHNHB scientists and selected from digitized county soil data, where available (NRCS 2002). The soils data added areas that, while not captured as spruce-fir in the New Hampshire Land Cover Assessment, had requisite features for spruce-fir habitat.

NHFG had previously completed a model to map high-elevation spruce fir in New Hampshire, based on a Vermont Institute of Natural Science (VINS: Lambert et al. 2005) elevation threshold, which depicts the lower elevation limit of Bicknell's Thrush habitat, Hale's (in press) Bicknell's Thrush probability surface, and New Hampshire Natural Heritage Bureau (NHB) exemplary high-elevation spruce-fir natural communities. This layer was used to erase features in the lowland spruce-fir layer to ensure that there was no overlap between the two. However, overlap is unlikely because of the different elevation ranges that were used. NHFG then applied a filter to determine the majority forest type between neighboring polygons in TNC's model, and smoothed the boundaries to generalize the transition between matrix forest types.

Model results were reviewed by experts from TNC, NHFG, and NHNHB, who agreed that the broad patterns depicted by the model align with reasonable expectations. No ground truthing was conducted. This is a first version of the model, and further refinements may be developed in the future.

1.7 Sources of Information

The lowland spruce-fir map was developed based on expert input from scientists from NHNHB and the New Hampshire Chapter of TNC. The results were reviewed by additional scientists from NHFG and ASNH. A variety of GIS data was used to generate the map including USGS elevation data, landform data from TNC's eastern regional office, landcover data from the New Hampshire Landcover Assessment, among others, and soils as outlined by NHNHB scientists based on extensive fieldwork in lowland spruce-fir areas.

1.8 Extent and Quality of Data

The habitat map is considered a first version but is thought to provide a useful depiction of broad landscape patterns. Additional refinements will likely be necessary based on ground truthing of the existing map. Soils information gathered during extensive NHNHB fieldwork in spruce-fir areas was used instead of those outlined by the NRCS. NRCS provided a table of soil series that were believed to be strongly correlated with lowland spruce-fir and other forest types (Homer 2005). Soil series were provided by ecoregional subsection and elevation ranges. There was considerable overlap between series outlined for lowland spruce-fir and some of the other forest types. Thus, additional review and refinement are necessary prior to incorporating the NRCS listed soils into a lowland spruce-fir model. This was not possible for this initial version.

1.9 Distribution Research

Fieldwork is needed to evaluate correlations between soil series and forest type as outlined in Homer (2005). County soil surveys outline soils suitable for forestry from an economic perspective. However, little has been done to evaluate soils from an ecological perspective (e.g., if left unmanaged, an area with a particular soil would eventually succeed to lowland spruce-fir forest). Fieldwork is also needed to ground truth the lowland spruce-fir map to assist with refining it.

Element 2: Species/Habitat Condition

2.1 Scale: County

2.2 Relative Health of Populations

An approximately 3% decrease in forest area occurred between 1992 and 1993 and 2001 in the two-county area where approximately 95% of New Hampshire's potential Lowland Spruce-Fir forest occurs. An additional approximately 1% decrease is projected to occur between 2001 and 2025 (Calculated from data in SPNHF 2005).

2.4 Relative Quality of Habitat Patches: Analysis pending.

2.5 Habitat Patch Protection Status

Approximately 30% of potential Lowland Spruce-Fir forest in the two-county area where approximately 80% of this forest type occurs is in conservation ownership (calculated from TNC data).

2.6 Habitat Management Status

Certified Tree Farms cover approximately 55% of the two-county area in which approximately 80% of New Hampshire's potential Lowland Spruce-Fir forest area occurs (calculated from data in Thorne and Sundquist 2001 and TNC data).

2.7 Sources of Information

See 1.7

2.8 Extent and Quality of Data

See 1.8 regarding extent and quality of data associated with the TNC matrix forest map. Tree farm data from Thorne and Sundquist 2001 are based on a New Hampshire Tree Farm program database issued in August 2000. Data regarding changes in forest area from SPNHF 2005 include information from the New Hampshire Land Cover Assessment, 2001 and results of predictive modeling.

2.9 Condition Assessment Research

Research is needed:

- to determine the age class distribution of this forest type on the landscape;
- to determine locations and sizes of remaining mature patches and identify stands that will reach maturity in the near term;
- to determine the extent of this forest type that occurs in large un-fragmented blocks;
- to determine presence and breeding status of spruce-fir dependent species in remaining mature patches;
- to ground-truth Capen et al.'s remote-sensing based habitat models for priority spruce-fir bird species

Element 3: Species and Habitat Threat Assessment

3.1.1. Unsustainable Harvest (Forestry Operations and Management)

(A) Exposure Pathway: Extensive, heavy cutting in recent decades has substantially reduced the distribution of mature spruce-fir forest in New Hampshire. Soil and other environmental conditions over extensive acreage in northern New Hampshire create the potential to support either spruce-fir or northern hardwood-conifer forest. See also 3.1.2.

(B) Direct Evidence: Recent forest inventory data (Miles 2005) suggest that 71% of live spruce and fir trees are in the 2-inch diameter class and less than 1.5% of these trees are in diameter classes of 10 inches and above. Historical harvesting practices in some areas have resulted in conversion of former spruce-fir sites to northern hardwood-conifer forest.

3.1.2. Non-Point Source Pollution

(A) Exposure Pathway: Use of DDT and related pesticides to control forest pests during the mid twentieth century resulted in dramatic population declines of raptors and other wildlife species (Cade et al. 1971, Ogden 1977, Bednarz et al. 1990). More recent pest management strategies have included shorter rotations and pre-salvage harvesting, which may create extensive even-aged stands that are increasingly vulnerable to future outbreaks.

(B) Direct Evidence: The Osprey population in northern New Hampshire included only 3 to 4 known nesting pairs by 1977 (Smith 1979). After DDT was banned in 1976, this population gradually increased to 21 pairs by 1989 (Evans in Foss 1994). Recent forest inventory data (Miles 2005) suggest that 71% of live spruce and fir trees are in the 2-inch diameter class and less than 1.5% of these trees are in diameter classes of 10 inches and above.

3.1.4. Altered Natural Disturbance

(A) Exposure Pathway: Short rotations on managed spruce-fir forests prevent much of the forest from reaching sufficient age for bark beetles and, more recently, spruce budworm, to create natural stand mortality and to provide prey for species that depend heavily on these resources (e.g., three-toed woodpecker, Bay-breasted Warbler, Cape May Warbler).

(B) Direct Evidence: Recent forest inventory data (Miles 2005) suggest that 71% of live spruce and fir trees are in the 2-inch diameter class and less than 1.5% of these trees are in diameter classes of 10 inches and above.

3.2 Sources of Information

Threat information was derived from a work session with forestry professionals and stakeholders, available data, published literature, and personal experience.
3.3 Extent and Quality of Data: Threat pathways are well documented. Spatially explicit data regarding areas affected by threats are inadequate or lacking.

3.4 Threat Assessment Research

Comprehensive analysis of the current age-class distribution of lowland spruce fir forest across the landscape, including patch sizes, is needed.

Identification of areas that historically supported lowland spruce-fir forest but have been converted to northern hardwood-conifer forest as a result of past management practices is needed.

Element 4: Conservation Actions

4.1.1. Protect un-fragmented blocks and other key wildlife habitats.

See Strategies: Land Protection

4.1.2. Develop a comprehensive land protection support program.

See Strategies: Land Protection

4.1.3. Advocate adoption of sustainable forestry.

See Strategies: Education and Outreach

4.1.4. Restore and maintain late successional habitats.

See Strategies: Habitat management

4.1.5. Establish IRAT for Forestry

See Strategies: Interagency Regulation and Policy

4.2 Conservation Action Research

Identify existing unprotected patches of late successional lowland spruce-fir forest. Determine patch sizes of late successional lowland spruce-fir forest needed to support species dependent on that habitat type.

Element 5: References

5.1 Literature

Complex Systems Research Center. 2001. New Hampshire land cover assessment – 2001. 30m raster data. Available from GRANIT, University of New Hampshire.

Homer, J. 2005. Soil types corresponding to the NH Natural Heritage Bureau forest systems classification. U.S. Department of Agriculture, Natural Resource Conservation Service, Lancaster, NH, U.S.A., Unpublished Report to New Hampshire Fish and Game Department.

Keys, J.E. and C.A. Carpenter. 1995. Ecological units of the eastern United States: first approximation. U.S. Department of Agriculture, Forest Service.

Lambert, J. D., K. P. McFarland, C. C. Rimmer, S. D. Faccio, and J. L. Atwood. 2005. A practical model of Bicknell's Thrush distribution in the northeastern United States. Wilson Bulletin 117:1-11.

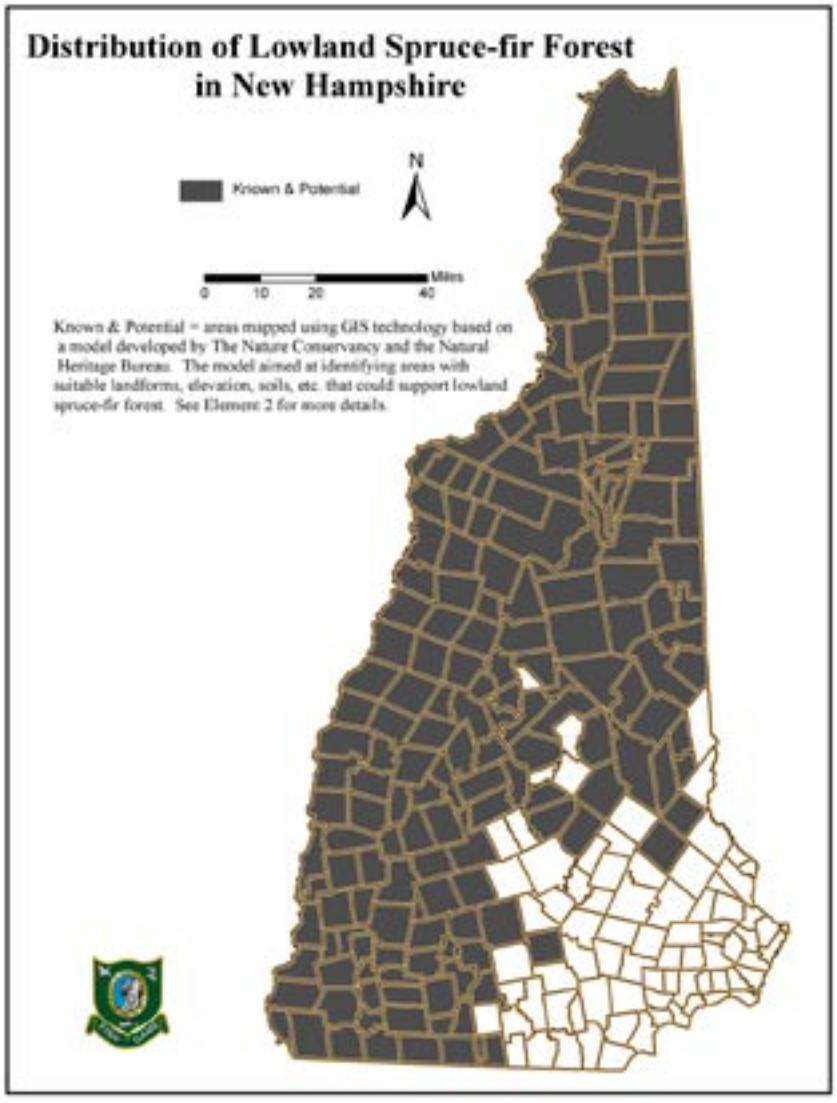
Natural Resources Conservation Service. Date varies, in progress with last revision in 2002. Soil Units of Rockingham, Sullivan, Cheshire, and Strafford Counties. Automated by and available from GRANIT, University of New Hampshire.

Sperduto, D, and M. Zankel. 2005. Distribution of matrix forest systems in New Hampshire by subsection, elevation, slope, and aspect. NH Department of Resources and Economic Development, Division of Forests and Lands, Natural Heritage Bureau, and The Nature Conservancy, Concord, NH, U.S.A. Unpublished Report to New Hampshire Fish and Game Department.

The Nature Conservancy, Conservation Science Support. 2003. Ecological Land Units. 30m raster data. Available from TNC, Eastern Resource Office, Boston, MA.

United States Geological Survey. Date varies, complete by 2003. National Elevation Dataset. 30m raster data. Projected by Complex Systems Research Center in January 2005, available from GRANIT, University of New Hampshire.Twith most of New Hampshire's potential lowland spruce-fir forest area.

Distribution of Lowland Spruce-fir Forest in New Hampshire



Known & Potential = areas mapped using GIS technology based on a model developed by The Nature Conservancy and the Natural Heritage Bureau. The model aimed at identifying areas with suitable landforms, elevation, soils, etc. that could support lowland spruce-fir forest. See Element 2 for more details.