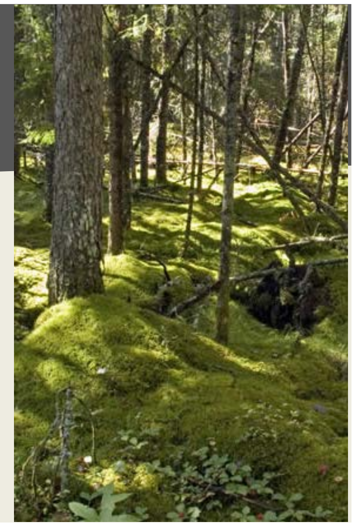
# LOWLAND SPRUCE-FIR FOREST

## CLIMATE ASSESSMENT



Lowland spruce fir is dominated by black spruce in wetlands and red and white spruce and balsam fir in drier areas. The majority is found at elevations between 1000 and 2500 feet and in the bottom of valleys. Most lowland spruce-fir is found in the northern part of the state, but in the south it also occurs in the higher elevations of the western highlands. Spruce-fir forests in general are characterized by poor soils, short growing seasons, and adaptation to cold temperatures (frost free 90-120 days/year).

## POTENTIAL CHANGES TO HABITAT

- As cold adapted species, spruce and fir are likely to experience reduced recruitment and eventually be outcompeted by hardwoods and pines under warming scenarios. The timing of such shifts will vary considerably among species, and any migration is also likely to take place over timeframes longer than the present assessment considers.
- Lowland spruce-fir forests occur on our coldest sites, and tend to have nutrient-poor soils with a high organic content. Under warming conditions, this organic material would break down more rapidly, enriching the soil and making it more suitable to invasion by hardwood species. This phenomenon is more likely on the warmest or driest of lowland spruce-fir sites.
- Drought-induced water shortages may make spruce-fir habitats more susceptible to fire, as well as foster invasion by more drought-tolerant species (e.g., white pine).
- Pressure to develop and distribute alternative energy sources (especially the associated transmission lines) could fragment spruce-fir forest in the lowlands of Coos County or along ridgelines in western New Hampshire. Associated shifts in government policy may open currently protected areas to such development.

## WHAT DOES THIS MEAN?

Predicting the responses of forests to climate change is a complicated endeavor. The response of a particular habitat to climate change is actually comprised of the individual responses of the habitat's component species. As a result, it is unlikely that forest types will simply shift their positions on the landscape. Instead, some species will increase and others decrease depending on specific climate needs and site conditions, resulting in subtly different forest types than those currently described (e.g., Zhu et al.2011). These changes will likely take place over a much longer time frame than the roughly 100 years under consideration for this current assessment, although the rate of change will be heavily influenced by local conditions.

As the most cold-adapted forest type, spruce-fir is the habitat most likely to experience negative effects from climate change. Because lowland spruce-fir occurs near the southern edge of its range in

New Hampshire, it is at the greatest risk of range reduction, including disappearance from isolated and/or peripheral areas to the south. At the same time, it appears that spruce-fir habitats are relatively resilient to many climate change impacts, at least in part because their dominant species outcompete hardwoods and pine on poor soils or in extreme environments (e.g., subalpine zone). However, if current spruce-fir soils warm significantly, they may be enriched by decomposing organic material, and thus be more suspectible to invasion by hardwoods.  Hardwoods more tolerant of poor soils that could invade spruce-fir include American beech and yellow birch.

The effects of altered precipitation patterns on spruce-fir are harder to predict, and are largely tied to the interactions between precipitation and temperature. Higher summer temperatures in combination with more frequent or longer summer droughts will dry out forests, resulting in an increased chance of fire. Although fire has historically been rare in all New Hampshire forests, and spruce-fir is relatively well-adapted to it, such disturbance under a warming climate may facilitate invasion by hardwoods, pines, or non-native invasives. Species particularly adapted to wetter soils - such as black spruce - may disproportionally disappear from this habitat under a warm and dry scenario.

Human response to climate change may affect spruce-fir forests through increased demand for renewable energy. Under this scenario, large areas of lowland spruce-fir could be converted to earlier successional stages as a result of harvesting for biomass fuels. It is important to note, however, that such effects are likely to be limited to relatively small areas of spruce-fir habitat were they to occur. In addition, fragmentation of habitat due to new transmission lines may degrade habitat.

## HOW DOES THIS AFFECT WILDLIFE?

Moose appear to be experiencing extreme stress related to increased infestation of winter tick with a warmer climate. Habitat changes may exacerbate this through altered patterns of herbivory related to snow depth, and migration of deer into moose habitat brings increased exposure to brain worm. Changes in snow depth could impact the ability of marten and small mammals to survive the winter. In general, any loss of spruce-fir forest will reduce habitat availability to an entire suite of boreal wildlife that reach their southern range limits in New Hampshire.

### General Strategies to Address these Vulnerabilities:

*See the full Climate Change Adaptation Plan for strategy descriptions*

S1: Conserve Areas for Habitat Expansion and/or Connectivity
S2: Habitat Restoration and Management
S5: Invasive Species Plan
S6: Comprehensive Planning
S9: State Energy Policy

## Specific Strategies:

1. Develop a model to determine where lowland spruce fir might persist in the landscape. Factors should include where elevation and topography might allow for cold pockets, soil types, geology and other features. Identify areas of spruce forest that have higher existing condition. Identify strategies for corridors/networks between patches. Map areas more likely to persist with climate change based on these factors. Prioritize these for future conservation or management.
2. Determine the soil-water and air-water minimum requirements for lowland spruce fir.
3. Research the impact on winter adapted species such as those who are dependant on snow for shelter or camouflage (small rodents, those that change color) to see which might decline due to climate change, and how that might affect their predators.
4. Encourage timber management for spruce fir in areas identified as likely long-term refuges for this forest type.
5. Limit use of biomass harvesting in this forest type.
6. Protect areas identified in the planning effort as most likely to persist as spruce-fir forests. To this add the conservation of north-south corridors through multiple habitat types to allow migration of tree species and wildlife along riparian corridors and adjacent lowlands. Also protect areas where lowland spruce-fir forests and wetlands are contiguous to help with both wildlife movements and hydrological stability.
7. Find ways to inform and engage foresters in management strategies that encourage the persistence of some spruce and fir despite climate change.

This Climate Assessment is a section of the **Ecosystems and Wildlife Climate Change Adaptation Plan (2013)**, an *Amendment to the NH Wildlife Action Plan*, developed by New Hampshire Fish and Game with the help of many conservation partners. The full plan can be found at http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/climate.html. (Photo by Ben Kimball)