

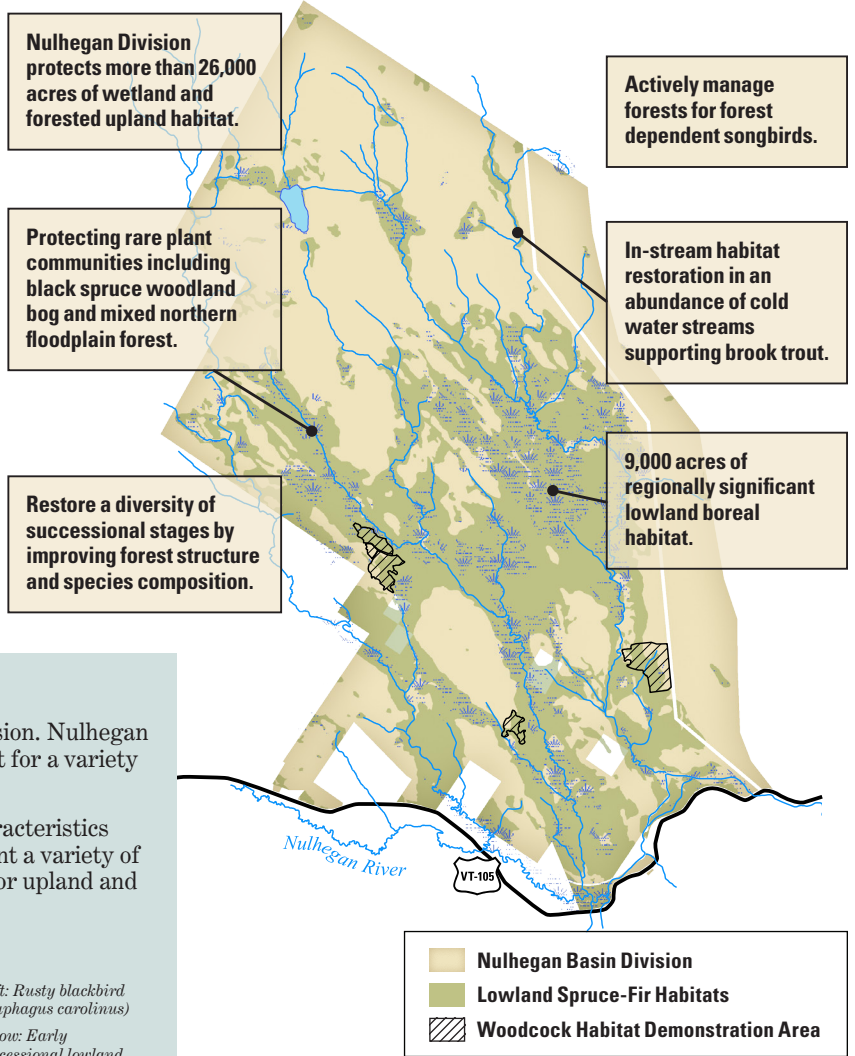
# Applied Silviculture for Climate Change

*Nulhegan Basin Division of Silvio O. Conte National Fish and Wildlife Refuge*



## About The Refuge

The Nulhegan Basin Division, located in northeastern Vermont, represents the largest forested tract managed by the Conte Refuge. The Division occurs at the intersection of the Connecticut River Watershed (i.e., Conte Refuge's legislated boundary) and the Northern Forest. The Nulhegan River and three of its four tributaries—the North, Yellow, and Black Branches – exert a strong influence over the Basin's habitats. Bogs, fens, shrub-dominated wetlands, and swamps, as well as, lowland conifer, montane, and hardwood forests support a diversity of plants and animals.



## Conservation Designed To Make a Difference

Wildlife conservation is a top priority at Nulhegan Basin Division. Nulhegan provides regionally significant breeding and migratory habitat for a variety of bird species.

Active forest management is designed to improve habitat characteristics essential for “focal species.” Focal species are used to represent a variety of wildlife and plants that utilize similar habitats. Focal species for upland and lowland forests include:

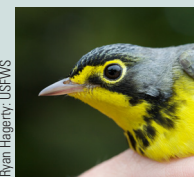
- Rusty blackbird
- Canada warbler
- Blackburnian warbler
- Black-throated blue warbler
- American woodcock

Nulhegan contains a mosaic of spruce-fir, northern hardwood, and northern hardwood-conifer forest communities that provide habitat for these species.



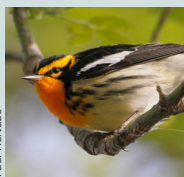
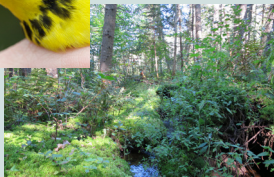
Left: Rusty blackbird (*Euphagus carolinus*)

Below: Early successional lowland spruce-fir habitat



Left: Canada warbler (*Cardellina canadensis*)

Below: Lowland northern hardwood-conifer habitat



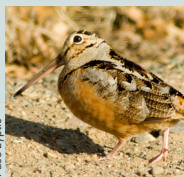
Left: Blackburnian warbler (*Setophaga fusca*)

Below: Late successional spruce-fir habitat



Left: Black-throated blue warbler (*Dendroica caerulescens*)

Below: Northern hardwood habitat



Left: American woodcock (*Scolopax minor*)

Below: Early successional northern hardwood habitat



*Improve the diversity of seral stages, rehabilitate composition and structure, and improve landscape connectivity of spruce-fir habitat to support species of conservation concern and aid in climate change adaptation.*

## Strategic Habitat Management

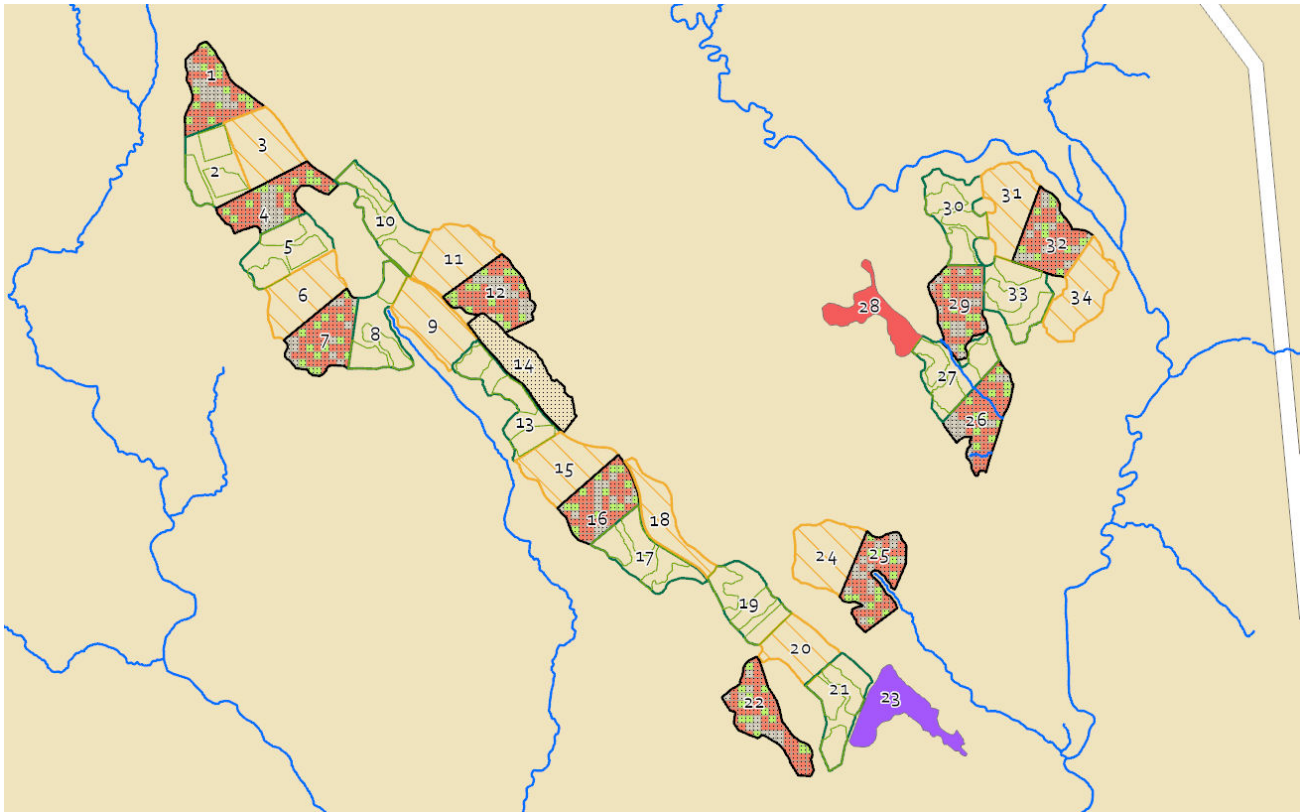
Guided by our vision for the refuge's future, we've developed a strategic approach to maintaining and enhancing wildlife habitat while protecting sensitive resources. To be strategic, landscape scale planning guides stand level decisions. Refuge plans include:



**Comprehensive Conservation Plan**  
Landscape Scale Planning

**Habitat Management Plan**  
Biological Strategies

**Site Specific Management Prescriptions**  
On-the-ground Application



## Focal Species, Climate Change Adaptation and Forest Management

### *Adaptive Silviculture for Climate Change - A collaborative effort to establish a series of experimental silvicultural trials across a network of different forest types.*

Resource managers need robust examples of how to integrate climate change adaptation into silvicultural planning and on-the-ground actions. Scientists, resource managers, and a variety of partners have developed a 550 acre trial site to research long-term ecosystem responses to a range of climate change adaptation actions within a lowland mixed conifer forest. Partners include the University of Vermont, University of New Hampshire, Dartmouth, US Forest Service, and the Northern Institute of Applied Climate Science.

### *Climate change is expected to impact forest ecosystems in Vermont into the future.*

Projected impacts include:

- Warming of 5.3 to 9.1 degree F by late century
- Fewer days below freezing
- Increase in length of growing season
- More frequent, damaging storms
- Decline of balsam fir, red spruce
- Increased impacts from pests



Canada warbler (*Cardellina canadensis*)

### Current Forest Conditions

Forests in the Division have a long history of logging. In developing climate adaptation strategies coupled with focal species habitat needs, it is helpful to identify the specific structural and functional changes that have led to current conditions. The project area is largely even-aged and dominated by balsam fir following a salvage harvest in the late 1970s. This has given rise to the following broad conditions:

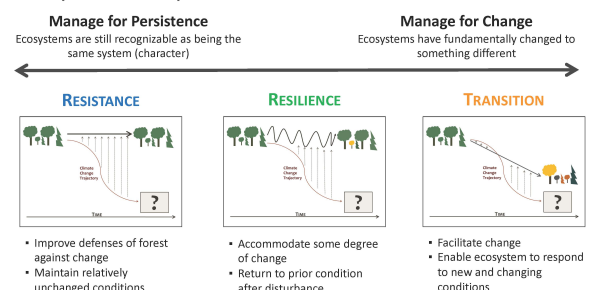
- Old forests have been replaced by younger forests
- Structurally complex forests of all ages have been replaced by simplified stands
- Species compositions at a given site have shifted from long-lived species (e.g., red spruce, black spruce, yellow birch) to short-lived species (e.g., balsam fir, aspen, red maple)
- Forest communities now contain a mix of species other than what occurred through natural processes in the absence of management

### Forest Adaptation Actions - Experimental Design

The Refuge and collaborators developed several adaptation actions for this project, including:

- Research treatments (15 acre replicates):
  - Patch clearcuts with reserves
    - Promote diverse age classes
      - Retain 10% overstory
    - Maintain and restore species diversity of native species
      - Plant seedlings of historically-important species
    - Retain biological legacies
      - Fell or tip 8-10 trees per acre for downed dead wood
  - Variable density thinning
    - Promote diverse age classes
      - 20% of area in 1/2 acre gaps
      - 20% of area in 1/2 acre patch reserves
      - 60% of area thinned to 110 ft<sup>2</sup>/acre
    - Maintain and restore diversity of native species
      - Favor retention of red spruce and white pine
      - Plant seedlings of historically-important species
    - Retain biological legacies
      - Fell or tip 8-10 trees per acre for downed dead wood
    - Promote diverse age structure
  - All treatments
    - Reduce impacts to soils and nutrient cycling
    - Maintain or restore hydrology
    - Retain biological legacies
    - Favor or restore native species that are expected to be adapted to future conditions
    - Protect future-adapted seedlings and saplings

### Adaptation Options



For more information on Strategic Habitat Management at Nulhegan, visit:  
[http://www.fws.gov/refuge/Silvio\\_O\\_Conte/about/vt.html#nulhegan](http://www.fws.gov/refuge/Silvio_O_Conte/about/vt.html#nulhegan)