



United States Department of Agriculture



ALASKA

Natural  
Resources  
Conservation  
Service



# BASIC FOREST ECOLOGY

## AND MANAGEMENT CONCEPTS

Prepared by Wasilla Soil and Water Conservation District

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# Alaska's Forest Types



Photo Credit: Molly Gillespie

## Boreal Forest



Photo Credit: Craig Flatten, ADF&G



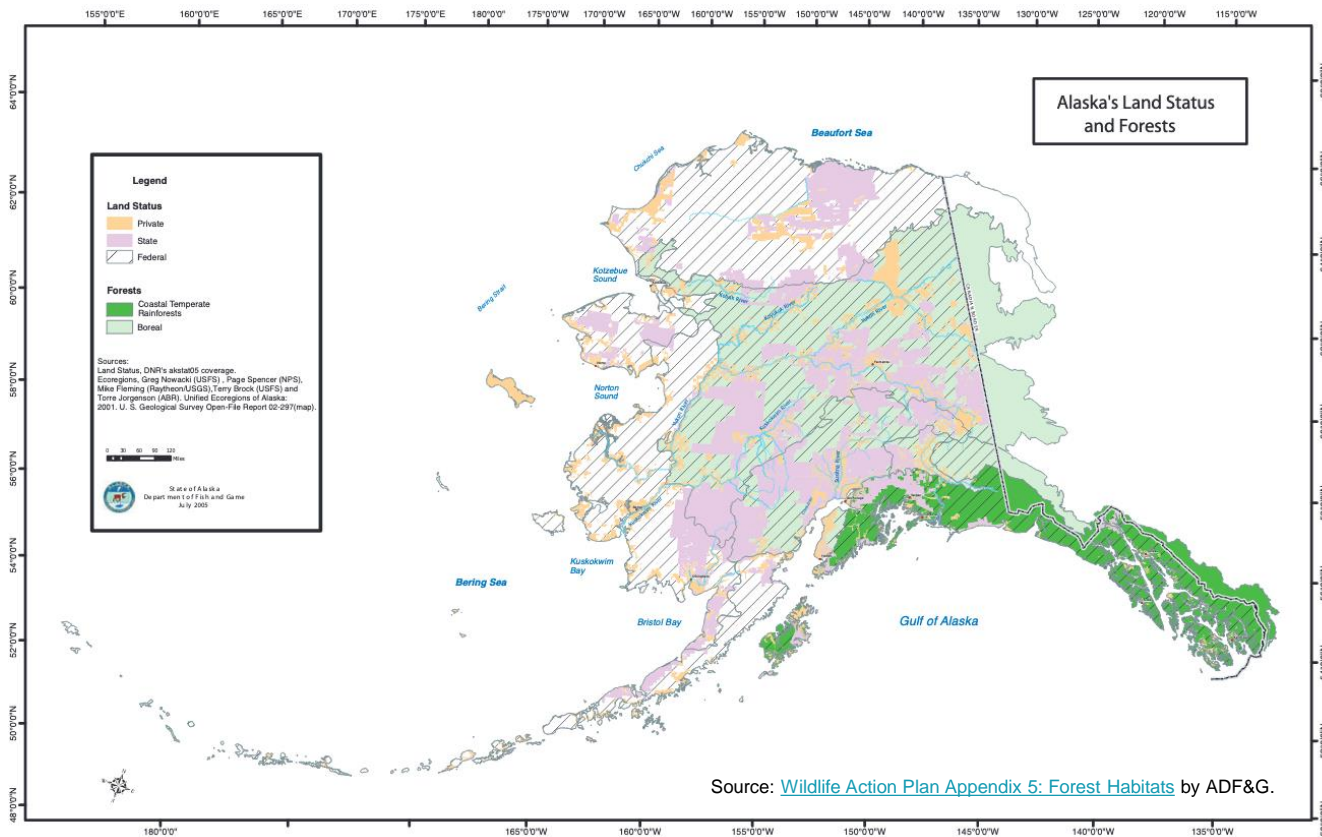
Photo Credit: Norio Matsumoto

## Coastal Temperate Rainforest

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# Alaska's Land Status and Forests



Source: [Wildlife Action Plan Appendix 5: Forest Habitats](#) by ADF&G.

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# Alaska's Boreal Forest

The Boreal Forest, found between 50°N-60°N, is the world's largest terrestrial biome and accounts for approximately one third of Earth's total forested area. In Alaska, it covers 60-70% of the land area, and is mostly made up of Black Spruce and White Spruce, with some populations of broadleaf deciduous trees, such as Aspen, Balsam Poplar and Birch. Smaller populations of Tamarack (Larch) and Black Poplar can also be found, and some localized areas host Lutz, a hybrid of Sitka Spruce and White Spruce.

Many freshwater bodies in the form of rivers, lakes, bogs, fens and marshes are found in the boreal forest. Overall, the soil has relatively low fertility. Most of the nutrients occur in the upper layer of the soil where organic matter is found. The soil also tends to be slightly acidic because of the breakdown of evergreen needles when they fall to the ground and decompose.

The boreal forest has cold winters and generally cool summers. The interior boreal forest is largely sheltered from maritime moisture by mountain ranges, so the climate is typically dry.

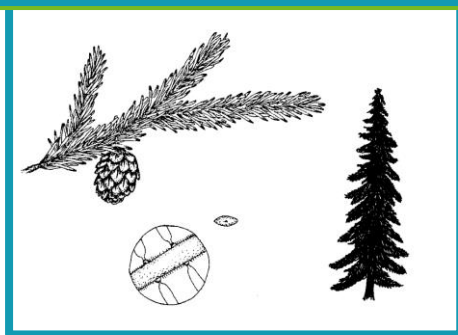


# Common Tree Species of Alaska's Boreal Forest

White Spruce (*Picea glauca*)



Black Spruce (*Picea mariana*)



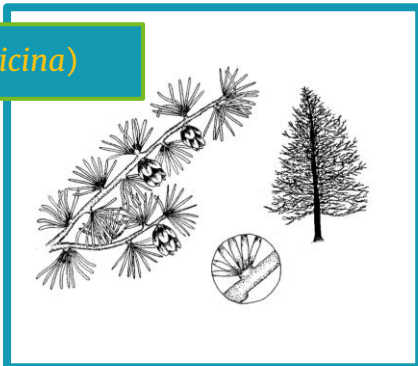
Balsam Poplar  
(*Populus balsamifera*)



Paper Birch  
(*Betula papyrifera*)



Tamarack (*Larix laricina*)

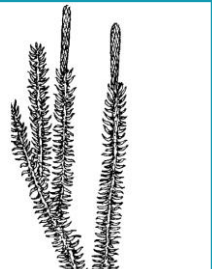


Aspen (*Populus tremuloides*)

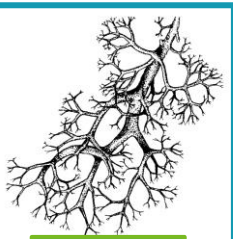
Source: Alaska Ecology Cards, illustrated by  
Conrad Field



# Common Shrub and Understory Species of Alaska's Boreal Forest



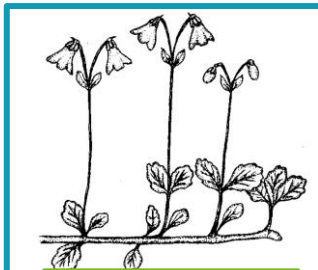
Clubmosses  
(Genus: *Lycopodium*)



Lichens



Fireweed  
(*Epilobium angustifolium*)



Twin Flower  
(*Linnaea borealis*)



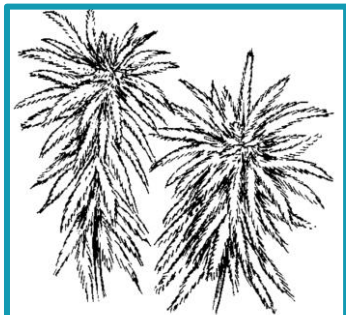
Willows (Genus: *Salix*)



Dwarf Birch  
(*Betula nana*)

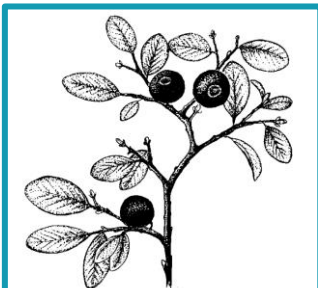


Horsetail Fern  
(Genus: *Equisetum*)



Sphagnum Moss

Source: Alaska Ecology Cards, illustrated by Conrad Field



Blueberry  
(Genus: *Vaccinium*)



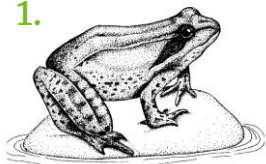
Prickly Rose  
(*Rosa acicularis*)



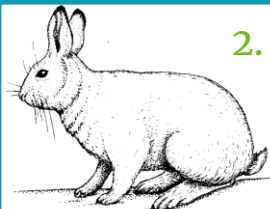
Labrador Tea (*Ledum groenlandicum*)

# Common Wildlife Species of Alaska's Boreal Forest

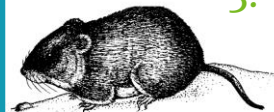
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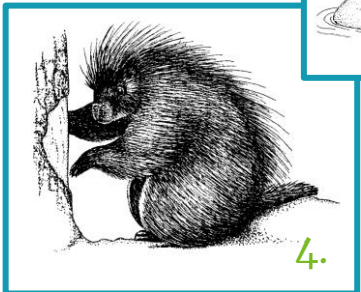
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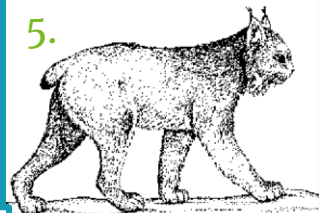
1. Wood Frog (*Rana sylvatica*)
2. Showshoe Hare (*Lepus americanus*)
3. Voles (Genus: *Microtus*)
4. Porcupine (*Erethizon dorsatum*)
5. Lynx (*Lynx Canadensis*)
6. Grizzly Bear (*Ursus arctos*)
7. Red Squirrel (*Tamiasciurus hudsonicus*)
8. Marten (*Martes americana*)
9. Moose (*Alces alces*)
10. Wolf (*Canis lupus*)
11. Caribou (*Rangifer tarandus*)
12. Beaver (*Castor canadensis*)

Illustrations from [Alaska Ecology Cards](#), illustrated by Conrad Field.

4.



5.



6.



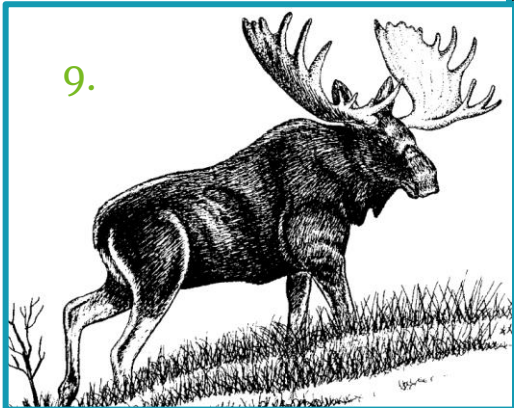
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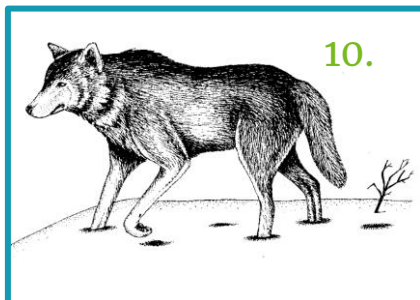
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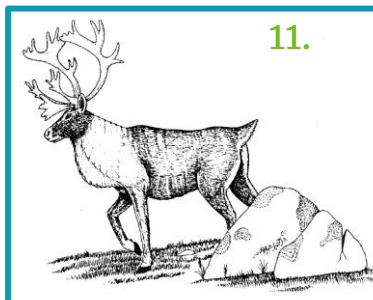
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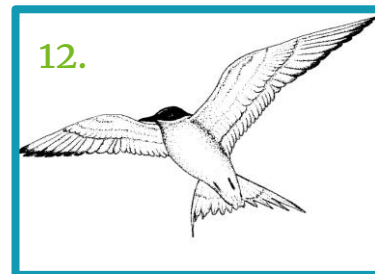
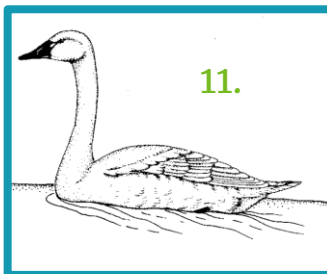
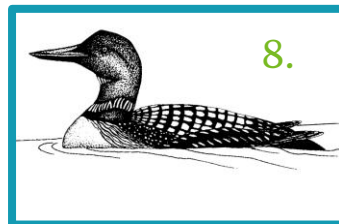
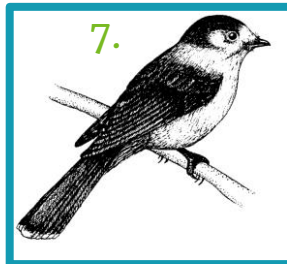
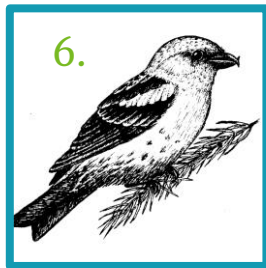
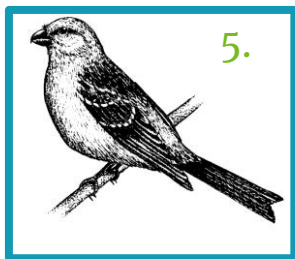
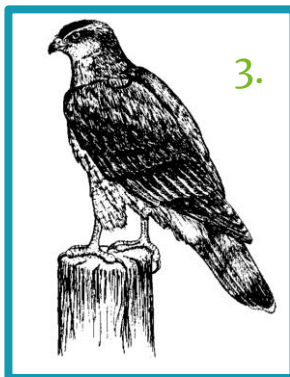
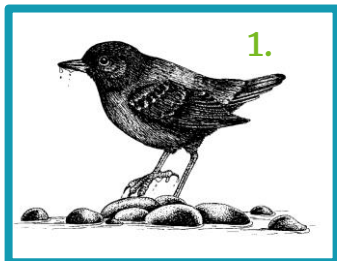
11.



12.



# Boreal Birds



1. American Dipper (*Cinclus mexicanus*)
2. Boreal Owl (*Aegolius funereus*)
3. Golden Eagle (*Aquila chrysaetos*)
4. Three-toed woodpecker (*Picoides triactylus*)
5. Pine Grosbeak (*Pinicola enucleator*)
6. White-winged Crossbill (*Loxia leucoptera*)
7. Gray Jay (*Perisoreus canadensis*)
8. Common Loon (*Gavia immer*)
9. Common Raven (*Corvus corax*)
10. Spruce Grouse (*Dendragapus canadensis*)
11. Trumpeter Swan (*Cygnus columbianus*)
12. Arctic Tern (*Sterna paradisaea*)

Illustrations from [Alaska Ecology Cards](#), illustrated by Conrad Field.





# Alaska's Coastal Temperate Rainforest

Coastal temperate rainforests are rare, covering just 1% of the earth's surface.

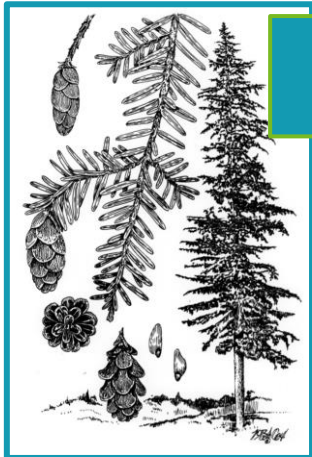
Defined by the proximity to ocean, a presence of mountains and over 80" of rainfall, this forest biome is found along Alaska's southern coast, from the Kodiak archipelago to the islands and mainland of southeast Alaska.

Much of Alaska's coastal temperate rainforests are old-growth forests which host **Western hemlock, Sitka spruce, mountain hemlock, and Alaska yellow cedar**. Mature coastal temperate rainforests support an abundant and diverse understory of plants, fungi and lichens that contribute to a complex web of life

The coastal temperate rainforest has well-drained soils and is dominated by conifers due to the relatively cool summers, warm winters, low angle sun, and short summer growing season.



# Common Tree Species of Alaska's Coastal Temperate Rainforest



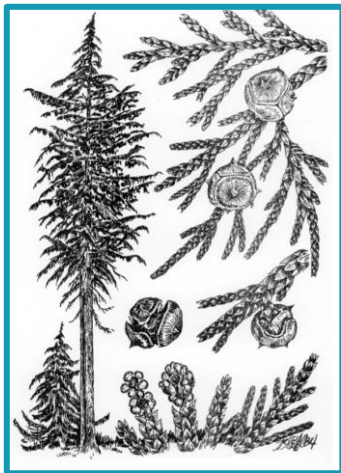
Western Hemlock  
(*Tsuga heterophylla*)  
Most abundant species



Mountain Hemlock  
(*Tsuga mertensiana*)



Sitka Spruce  
(*Picea sitchensis*)



Alaskan Yellow Cedar  
(*Chamaecyparis nootkatensis*)



Western Red Cedar  
(*Thuja plicata*)



Red Alder  
(*Alnus rubra*)

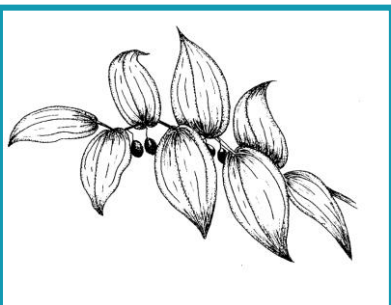


Shore Pine  
(*Pinus contorta* var. *contorta*)



Black Cottonwood  
(*Populus balsamifera* sub. *tricarpa*)

# Common Shrubs and Understory Species of the Coastal Temperate Rainforest



Twisted Stalk  
(*Streptopus amplexifolius*)



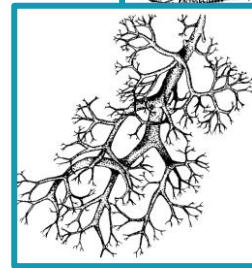
Devil's Club  
(*Oplopanax horridus*)



Western Skunk Cabbage  
(*Lysichiton americanus*)



Lichens



Salmonberry  
(*Rubus spectabilis*)



Mosses  
(620 species of moss in AK)



Sphagnum Moss



Ferns

# Common Wildlife Species of Alaska's Coastal Temperate Rainforest

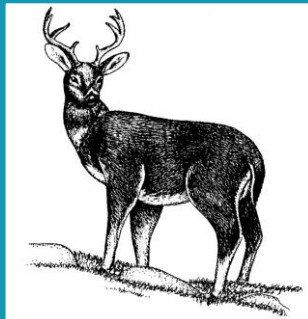
Stellar's Jay  
(*Cyanocitta stelleri*)



Bald Eagle  
(*Haliaeetus leucocephalus*)

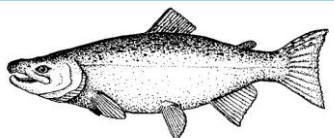
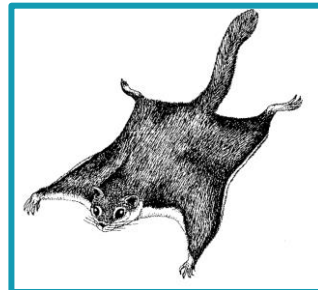


Great Horned Owl  
(*Bubo virginianus*)

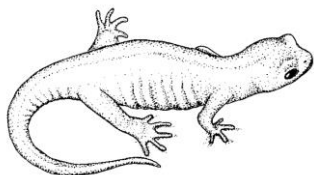


Sitka Black-tailed Deer  
(*Odocoileus hemionus*)

Northern Flying Squirrel  
(*Glaucomys sabrinus*)



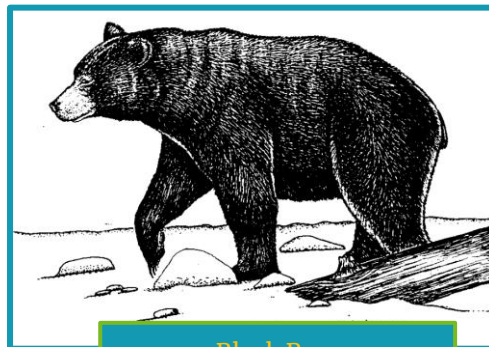
Pacific Salmon  
All 5 species



Rough Skinned Newt  
(*Taricha granulosa*)



Mink  
(*Mustela vison*)



Black Bear  
(*Ursus americanus*)



# Forest Stand Development: Major Disturbance Regimes



**Coastal  
Rainforest:**  
Wind and  
insect  
outbreaks

“Wind is a common and important disturbance in Alaskan forests, contributing to stem breakage (wind/bole snap) or complete uprooting of trees. In the coastal rainforest of Southeast Alaska, where wildfire is rare, blowdown is an important stand renewal process. Small canopy gaps facilitate the development of uneven-aged forests and increased growth of understory vegetation, while large canopy gaps create even-aged forest stands.” [USFS Alaska Region, Forest and Grassland Health.](#)



**Boreal Forest:**  
Wildfire  
(primary), wind,  
flooding, insect  
outbreaks, and  
permafrost thaw



Black spruce forests are the most flammable vegetation types in interior Alaska. Because black spruce needles and branches are highly resinous and usually distributed continuously from ground to treetop, they ignite and burn easily. Black spruce/feather moss and mixed conifer-hardwood stands are usually moister than black spruce-lichen stands, so they are less likely to burn in most years. Since lichens dry more quickly than mosses, they are more likely than mosses to promote fire spread. During extreme drought, all strata (ground to canopy) of a black spruce community become highly flammable and burn readily. ([Fryer](#))



## Forest Structure: Coastal Temperate Rainforest

One key characteristic of old-growth stands is that they include trees of multiple (“uneven”) ages and sizes, from seedlings and saplings to pole-sized trees (30–80 years) to trees many centuries old. This forest structure is the cumulative result of many single tree or small tree-group mortality events caused by disease or wind opening gaps in the canopy and creating the space for a rich understory of herbs, ferns, and shrubs, as well as the next generation of trees vying for dominance. ([Albert, et al](#))

“Clearcuts (0 to 30 years old) produce the most shrubby vegetation of any age class in the forest succession. Even-aged forests (30 to 150 years old) produce the least understory vegetation. Uneven aged, old-growth forests sustain the most structurally diverse understory vegetation. Forests with open, patchy canopies tend to produce the most understory vegetation.”([Alaback](#))

# Forest Structure: Boreal Forest



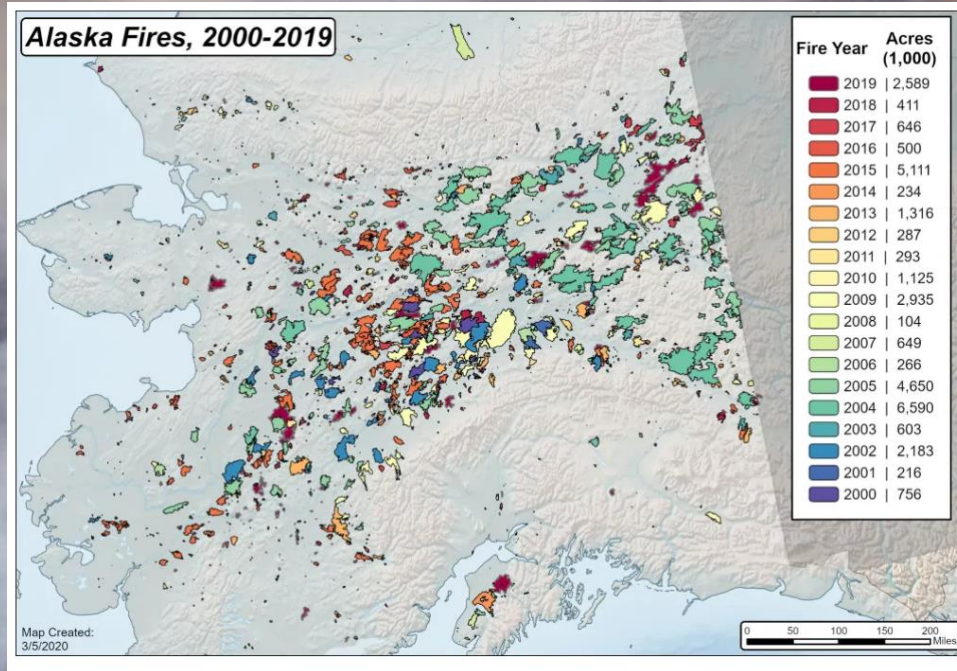
“The boreal forest is a mosaic of species and stands. It ranges in composition from pure deciduous and mixed deciduous-coniferous to pure coniferous stands.

The diversity of the forest mosaic is largely the result of many fires occurring on the landscape over a long period of time. These fires have varied in frequency, intensity, severity, size, shape and season of burn.” ([Natural Resources Canada](#))

“Due to intensifying forest utilization, and in certain areas due to increasing natural disturbances, boreal forest age-class structures have changed rapidly, so that the proportion of old forest has substantially declined, while that of young post-harvest and post-natural-disturbance forest proportions have increased.” ([Kuuluvainen and Gauthier](#))

Wildfires play an important role in shaping the structure and composition of boreal forests. Stand replacing and mixed fire regimes are possible. Stand-replacing fires can burn large areas, initiating new stands containing seral species, whereas the mixed fire regimes include both stand-replacing fires and low-intensity surface fires. These fire regimes create a mosaic of conditions that allow a mixture of early-, mid-, and late-seral species to thrive. ([Graham and Jain](#))

# Natural and Human History of Forests in Alaska: Fire as Major Disturbance in South-central and Interior AK



“During the 2000s, an average of 767,000 acres burned, 50% higher than in any previous decade since the 1940s. Over the past 60 years, there was a decrease in the number of lightning-ignited fires, an increase in extreme lightning-ignited fire events, an increase in human-ignited fires, and a decrease in the number of extreme human-ignited fire events. The fraction of area burned from human-ignited fires fell from 26% for the 1950s and 1965 to 5% for the 1998 and 2000s, a result from the change in fire policy that gave the highest suppression priorities to fire events that occurred near human settlements.” (Kasischke, et al)

The 2004 fire season, Alaska’s largest to date [as of 2019], burned more than 6.6 million acres. Since then, four seasons have exceeded 2 million acres, including 2019. (Liao)



# Natural and Human History of Forests in Alaska: General Harvest History

“Alaska has a long and varied forest products industry from local production for Russian settlements, to the basis for a year-round economy in southeast Alaska, to a vibrant but high-cost producer of high-quality softwood lumber for global markets.

From an economic perspective, many of these changes have been driven by shifts in competitive costs and the array of forest products produced in southeast Alaska. From a policy perspective, timber ownerships and federal forest management policy changes have been determinants of change. In spite of these often countervailing changes, there has been an evolution in the past decade of various products where Alaska producers using unique species or grades have found successful niche markets.”  
(Brackley, et al)

## Harvest in Alaska. (Brackley, et al)

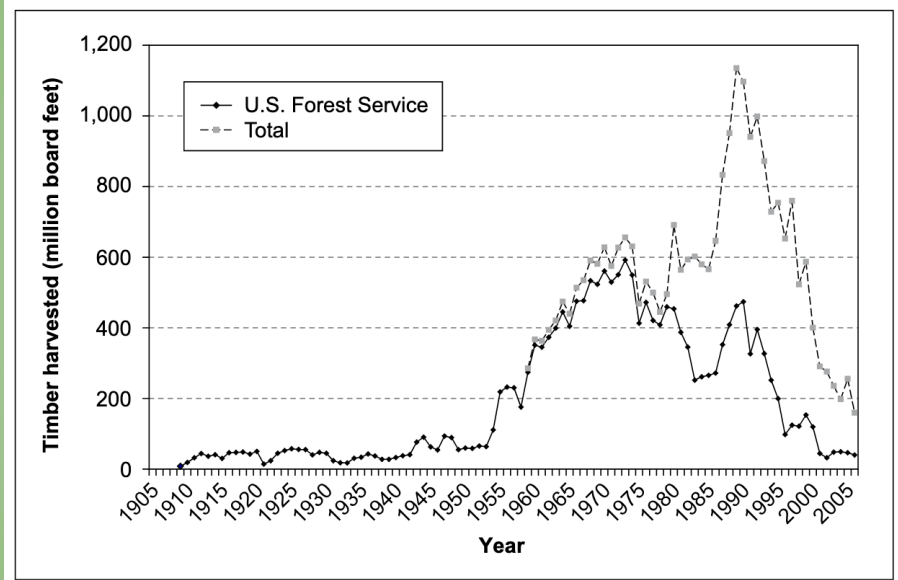
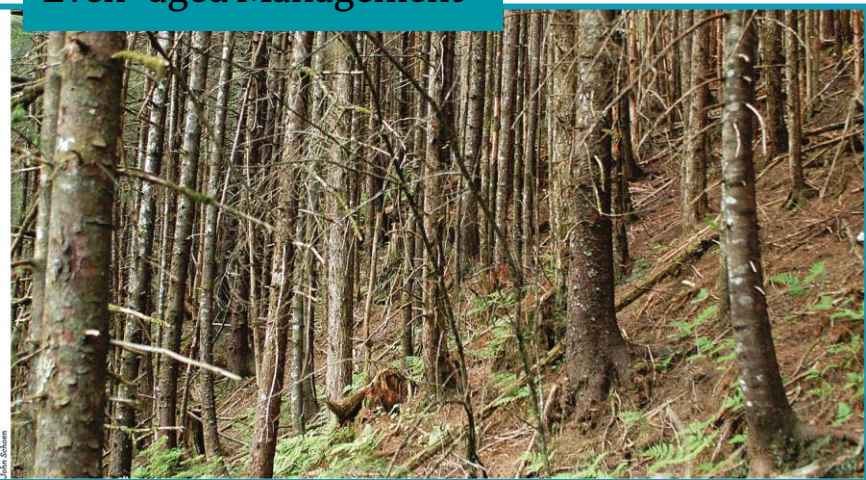


Figure 1—Harvest in Alaska. (Source: 1909-1958 compiled from U.S. Department of Agriculture, Forest Service, Alaska Region, regional summaries of timber sold and harvested; 1959-2006 and total from Ruderman 1975; USDA Forest Service, n.d.; Warren 1987, 1996, 2007)

# Management Implications on Ecology

Even-aged Management



Fire Breaks



Pest Management



# Even Aged Management



For the most part, the interior boreal forests are functional in the fire ecology and form an even-aged response to fire in the ecosystem. Tree species like aspen, poplar and birch regenerate well in the conditions created by heavy fire (exposed mineral soil). White spruce can regenerate on mineral soils, but like many shade tolerant species, it regenerates well on a duff layer, moss or under a forest canopy of less shade tolerant trees. The spruce then can form a new canopy layer and slowly grow until it penetrates the deciduous cover. This successional trend is common in fire ecologies. The pattern of reforestation many vary depending on the number of residual trees and the amount of residual duff or organic material left after a fire.

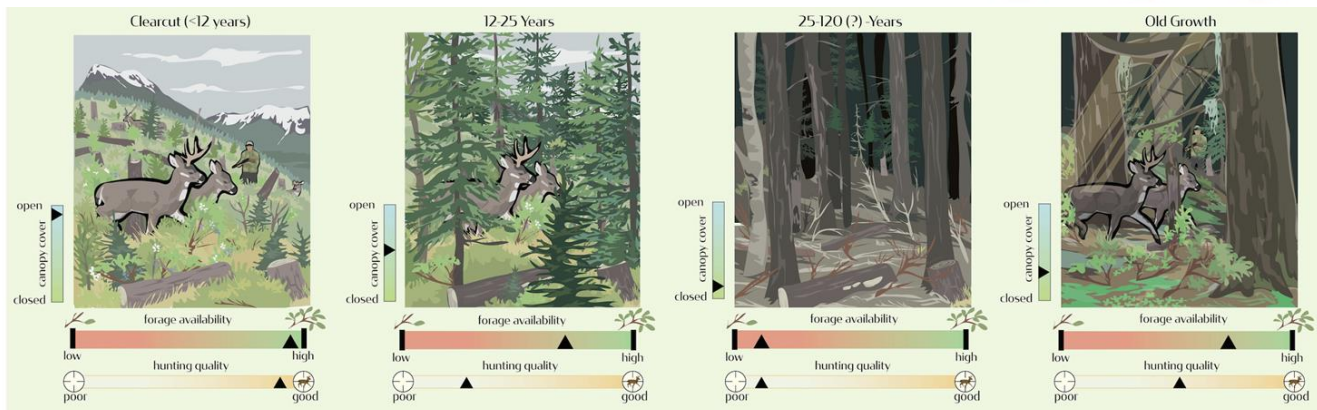
In contrast, the coastal temperate forest, in their natural state, are a result of succession away from young, even-aged stands to complex, multi-strata, uneven-aged stands. This development is the result of mortality events that result in various age groups, vegetation layers and greater diversity than what occurs after even-aged management that results from clearcuts.



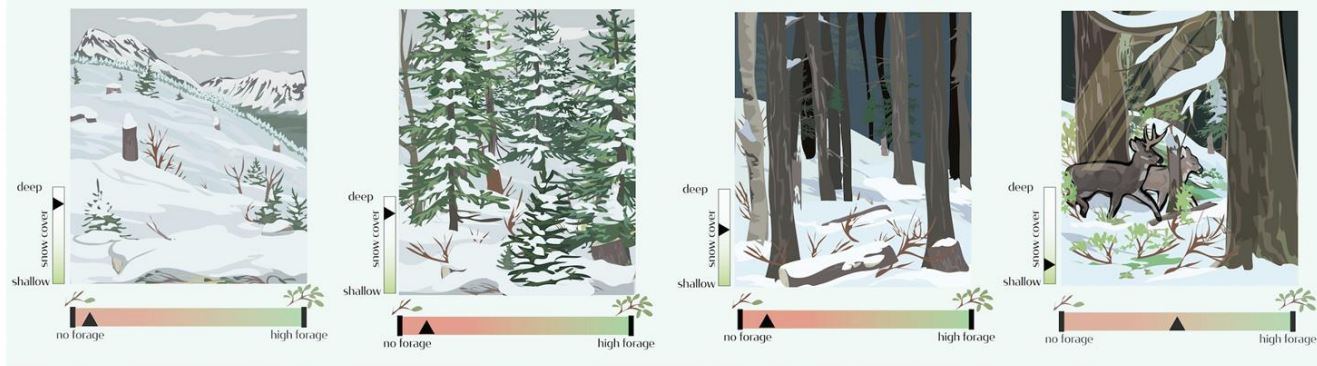
# Even Aged Management



Summer



Winter



In the boreal forests, the early successional cover that results after disturbance like fire in the boreal forest can be directly attributed to increase browse for animals like deer and moose. However, this same stand development that results from clearcutting in the coastal temperate forests results in ecological issues as the forest shifts from even-aged to old growth, uneven-aged forests.

Natural Resources Conservation Service



# Even Aged Management



Unlike the boreal forest, the **coastal temperate rainforests** are devoid of fire and large-scale disturbances that create conditions favorable to even-aged forests. Instead, the southeast Alaskan forests respond to openings resulting from disturbances like windthrow, insect mortality, and mass wasting. These smaller scale events create openings in the forest canopy large enough for small regeneration events, similar to those found in the uneven-aged management, single-tree selection, group selection or patch selection.

The conversion of SE old growth forests to second growth, even-aged forests has ecologic impacts. Old growth forest support more vertical structure or a development of layers of forest canopies. This results in a forb layer, a brush layer, and trees of various sizes. This also results in browse and cover for animals that use the forest. Stands that develop from clearcuts can result in tree densities that exclude many terrestrial forms of wildlife and exclusion of brush species like blueberry, huckleberry, and various rubus species.

“Initially young seedlings and saplings generate an abundance of new forage (i.e. herbs, ferns, and shrubs) for some species, including deer, during snow-free months. Conifer seedlings grow abundantly and peak at approximately 15 to 20 years. At about 20 to 30 years, young conifers begin to overtop shrubs and dominate the second-growth stand. After 35 years, stands move into the “stem-exclusion” phase where pole-sized trees grow so tightly packed that light does not reach the forest floor. In this stage, conifers completely dominate second growth, the forest floor is continually shaded, and the under-story (including forbs, shrubs, and lichens) largely disappears from the even-aged, second-growth stand.” (Albert, et al)

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# Fuel Breaks

## Forest Treatments to Reduce Fire Hazard in Alaska:

### A Compilation of Case Studies

Special Report from JFSP Project 14-4-01-27



UNIVERSITY OF ALASKA FAIRBANKS



Alaska Fire Science Consortium

A JFSP FIRE SCIENCE EXCHANGE NETWORK

R.R. Jandt, S.A. Drury, J.M. Little, A. Molina and B. Lane

April 1, 2019

To understand the science, history, and affects of fuel breaks in Alaska, this guide should be consulted:

“This compilation is intended to provide an illustrated overview of the **current science of fuel breaks in Alaska boreal forest, with citations and links to additional reference material for practitioners and the public.** Research on fuel breaks in the high northern latitudes is scarce, yet there is a pressing need for strategies to improve infrastructure and public protection from wildfires which are intensifying as the climate warms. This guide is a follow-on product of the Joint Fire Science funded project: [Evaluating the Effectiveness of Fuel Treatments in Alaska \(Little, et al. 2018\)](#)”

Authors: Joseph Little, PhD<sup>1</sup>, Randi Jandt, M.S.<sup>2</sup>, Stacy Drury, PhD<sup>3</sup>, Allen Molina, PhD Candidate<sup>1</sup>, Brock Lane

Natural Resources Conservation Service

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# Pest Management

## Pocket Guide for the Identification of Common Forest Diseases and Insects in Alaska



Diseases and insects cause enormous volume loss and tree mortality to the forests of Alaska. They also play vital ecological roles by cycling nutrients, providing wildlife habitat, and enhancing forest diversity. (USFS Pocket Guide)



“Alaska has nearly 130 million acres of forest lands. Approximately 77 million acres are federally owned, 22 million acres are owned by the state, and 30 million acres are privately owned (Alaska Department of Commerce). There are few planted stands, forest nurseries, or tree farms in Alaska. Pest management in natural (unmanaged) forests is not commonly conducted except in the case of serious outbreaks or infestations. Direct control of pests is limited by the vast areas involved, the inaccessibility of many forested areas, and the long life cycle of trees. In cases where controls must be applied, understanding the life-cycle of the pest is essential for success. The goals of forests managed for habitat are significantly different than those managed for timber harvest. Forests managed for habitat can benefit from pests and diseases that contribute to structural and biological diversity. In areas where timber production is important, there is less tolerance for pests and diseases.” [DEC Alaska Forest Pest Control Manual](#)

### Integrated Pest Management UAF Cooperative Extension Service

[Online Courses](#) available for CEU's including:

Spruce Beetle in Trees and Forest, Exotic Forest Insect Pests, and more

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# Pest Management



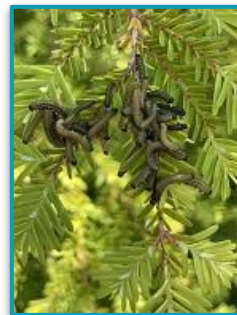
Since 2017, USFS Region 10 Alaska, has created story maps and interactive survey maps. Story maps, such as above, highlight key forest health topics and provide basic user instructions for interactive maps. ([Forest Health Conditions in Alaska Reports & Damage Maps \(2002-2019\)](#))



**Spruce Bark Beetle**  
[Video: Spruce Beetle, what they are and what you can do about them.](#)

## [ALASKASPRUCEBEETLE.ORG](http://ALASKASPRUCEBEETLE.ORG)

For photos, current data, information about spruce beetle ID, biology, management and other resources.



Pest of the Coastal Temperate Forest:

**Hemlock Sawfly**  
[USFS Video](#)

Natural Resources Conservation Service

[nrcs.usda.gov/](http://nrcs.usda.gov/)





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