Spruce Tree Challenge Guide

1. What's the difference between white and black spruce trees?

To tell a black spruce from a white spruce, examine the small branchlets, the cones and the habitat. **We mainly have white spruce in the DVC area**, but there are some black spruce around the area in wet places and low lying areas.

Black spruce

- has tiny reddish hairs on the outermost branchlets and short needles (to 1.5 cm)
- **Black spruce cones** are smaller (to a maximum of 3 cm) and rounder
- black spruce usually grows in low lying areas (bogs or edges of wetlands),
- Black spruce will often grow in association with other moisture preferring species like tamarack, white cedar (*Thuja occidentalis*) and paper birch (*Betula papyrifera*),

White spruce

- has no hairs and has longer needles (to 2.5 cm).
- **white spruce cones** (to 5 cm long).
- white spruce prefers upland sites.
- white spruce is more often found with jack pine (*Pinus banksiana*), balsam fir and aspen (*Populus tremuloides*). Source

Comparison of black and white spruce twigs and cones. Black Spruce to the bottom and left, White Spruce to the top and right.

http://www.naturenorth.com/winter/blspruce/Fblsprce_3.html

2. Animals and Plants that rely on spruce (focusing on white spruce)

Common animals signs around spruce trees might include

- Squirrel middens and nests in trees, squirrels caching mushrooms in tree branches
- Moose rubbing antlers on trees (bark and branches get rubbed off)
- Bear hair or claw marks on bear rub trees
- Porcupine or beaver chewing on spruce trees

Ephiphytic Lichen on spruce

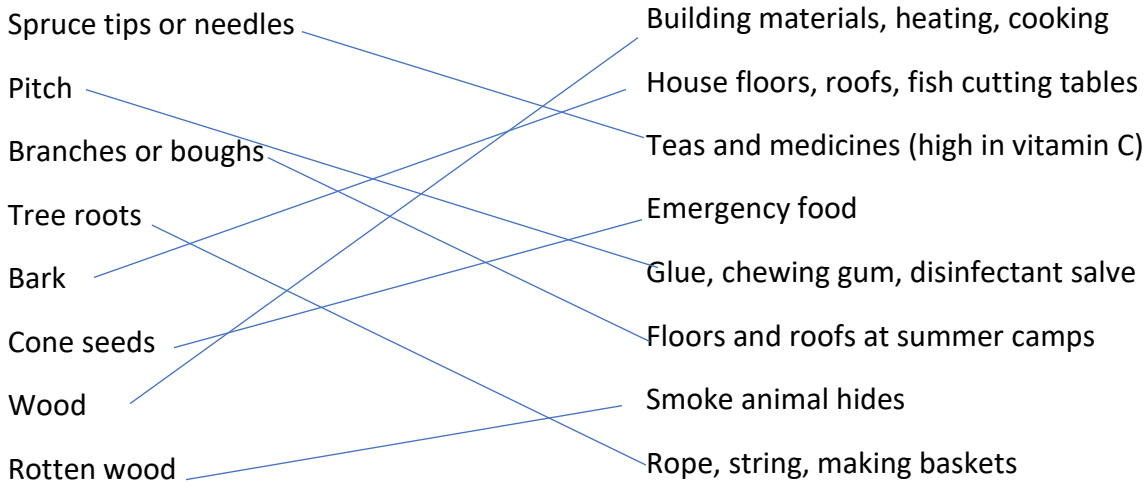
- An epiphyte is an organism that grows on the surface of a plant and takes in its moisture and nutrients from the air, rain, water, or debris accumulating around it.
- Lichen growing on spruce do not harm the tree in any way.
- Lichen grow on and prefer branches that are already dead because more light can reach the lichen. The branches are usually dead because a tree has "self-pruned" or focused its energy on the branches higher up that are still getting sun, especially in a more closed canopy forest.

Mushrooms

- Many mushrooms growing around spruce may be mycorrhizal with trees; the fungus has a symbiotic relationship with the spruce roots.
- Other mushrooms can be saprophytic and help in the process of decay, such as mushrooms growing overtop of a dead tree.
- Some mushrooms do cause rot on spruce trees and their roots.

Traditional Cultural Uses

Information comes from a subsistence unit created with Telida Village Council:
http://ukpreservation.com/wp-content/uploads/2012/10/Gathering-Section2-Lessons.pdf



Athabaskan Utilization of the

WHITE SPRUCE

BARK

Outer

Shelter
Roofing and flooring
Fish cutting table
Dye

Inner

Bandages:
Sores, cuts, burns
Medicinal tea:
Heart problems, kidney trouble, ulcers, stomach sicknesses, weak blood, colds, sore throat, sores, tuberculosis

BOUGHS

Insulation
Shelter
Fish hooks

SAP

Spring tonic
Medicinal use:
Burns, tuberculosis

NEEDLES

Medicinal tea:
Cough medicine, cathartic

DEAD WOOD

Tanning smoke
Smudge fire
Firewood
Dye for moosehide

TOP OF SPRUCE

Used by shaman to get rid of bad spirits.
Medicinal tea:
Bone aches, colds, tuberculosis
Juice:
Sore eyes

CONES

Cone dust:
Dry up runny ears

TRUNK

Firewood
Logs and planks
Poles
Canoes
Rafts
Fishwheels
Beluga hunting stand
Tent frames
Drying racks
Beaver snare toggles

CARVING

Utensils
Tools
Toys
Weapons
Fish traps

PITCH

Adhesive
Antiseptic
Waterproofing
Religious ritual
Hair dressing
Chewing gum
Medicine:
Heart trouble, tuberculosis, stop bleeding, remove cataracts

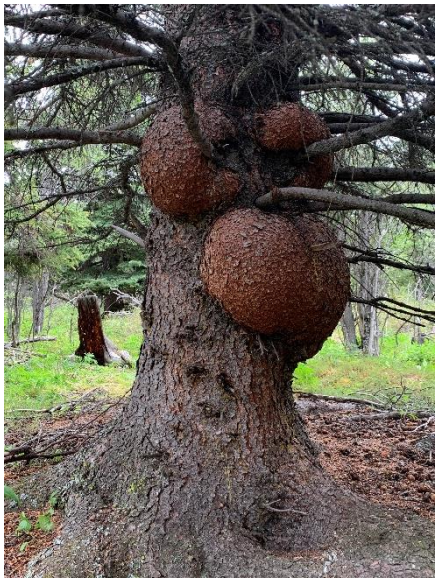
ROOTS

Lashing:
Baskets, fish traps, snares, fishnets
Juice:
Eye medicine
Tea

Traditional uses of the white spruce by Interior Athabaskans.

Sources: Ella Jones and Dena'ina K'et'una: Tanaina Plantlore, compiled by Priscilla Kari, 1977, Anchorage: Adult Literacy Laboratory, University of Alaska

3. Tree Health



Burl – large round growth on the trunk; burls are like a non-cancerous tumor. Burls grow quickly and may weaken trees but do not kill them.

Spruce Bark Beetle Sign small holes in the lower trunk or piles of "sawdust" like wood at the tree base may indicate spruce bark beetles.

Trees react to beetles by releasing pitch, which results in small white or reddish-brown pitch tubes on the bark of the trunk. If the pitch tube is mostly reddish it likely means the beetle was able to bore into the tree. If the tube is mainly white (tube on right), the tree may have been successful in "pitching" out the beetle. Trees also react to branch cutting by releasing pitch or sap so not all trees with sap on the bark have bark beetles.

Sometimes there may be a bluish tint to beetle infested trees due to a blue stain fungus that travels in beetles' mouths.

Spruce Rust infections do not kill a tree, but can weaken it. Also known as witches' broom. fungus (*Chrysomyxa arctostaphyli*,) *Arctostaphylos uva-ursi* is the secondary host for this fungus (required to complete its life cycle). Although broom rust doesn't kill the tree, it can weaken it and could serve as an entrance for other decay fungi to infect the tree. Brooms are important nesting sites for wildlife including red and flying squirrels (Holsten et al. 2001). Spruce needle rust (*Chrysomyxa ledicola*) is a similar fungal disease that affects new needle growth of *P. glauca*. Labrador tea is the secondary host for this fungus.

Read more about Forest Health and Boreal Blights in the Denali area at:

https://www.nps.gov/articles/000/dena-boreal-forest-blights.htm

Some more notes about Spruce Bark Beetles

FROM: https://www.nps.gov/articles/assessing-the-risk-of-denali-forests-to-spruce-beetles.htm

Climate Change Connections

Spruce beetles are a native insect, and their dispersal is a natural process. They already call Denali home, but a few variables will affect whether their populations reach outbreak levels. For instance, researchers have linked the start of past outbreaks to a series of warmer and drier than normal summers (Werner et al. 2006). Observed climatic warming is thought to increase the number of beetles that complete their life cycle in one year instead of two (Bentz et al. 2010). Additionally, random events such as windstorms that produce many fallen trees are thought to boost local spruce beetle populations, creating host sites for larger-scale outbreaks.

Between these scenarios, and perhaps the most likely, a moderate level of spruce beetle infestation may kill local populations of spruce in Denali. Human use of beetle-killed areas may change, at least temporarily, as standing dead trees become a fall hazard. A change in understory plant cover may occur in newly opened spaces, but regional forest composition will remain relatively unchanged. Depending on the extent of spruce die-off, an increased fire risk may be of concern. A particularly cold winter, or a series of late springs, may keep the length or magnitude of the outbreak relatively short.

Current Denali Status (2020)

Widespread spruce death has already occurred throughout much of southern Denali National Park and Preserve, primarily in the large river valleys draining the Alaska Range. The U.S. Forest Service's forest health protection program maps forest health condition throughout the state annually. Their 2019 aerial detection survey mapped spruce beetle activity and damage to mile 199 of the Parks Highway, 25 miles farther north than in 2018, indicating continued expansion of the southcentral Alaska outbreak

In June 2020, Denali botany staff surveyed trails in the park entrance area (at mile 231 and 237 of the Parks Highway), finding occasional sign of spruce beetle activity. Groups of dead or damaged trees were detected but remained interspersed with healthy forest. Some trees exhibiting needle discoloration did not show other signs of beetle activity, such as obvious entry holes or pitch tubes. Other factors such as drought stress could be contributing to local declines in forest health (Dubois and Charnon 2019). Localized outbreaks of other forest insects, such as the Northern Spruce Engraver (Ips perturbatus), may also contribute to spruce death in Interior Alaska.

4. Science of Spruce https://www.nps.gov/articles/denali-crp-spruce-cone-production.htm

Animals that use white spruce seeds for food - red squirrels, spruce grouse, white-winged crossbills, chickadees, and pine grosbeaks.

Every year since 1992, botany program staff has carefully observed trends in white spruce (*Picea glauca*) reproduction both at treeline and in lower elevation forest of the Rock Creek drainage near Park Headquarters in Denali's oldest continuously monitored vegetation plots.

For each of 30 monitored trees, staff document yearly growth by measuring tree diameter and estimate overall cone production by counting cones produced in the current year (Figure 1). For each of 6 plots (3 replicates at treeline and 3 in the forest), staff track seed production by setting out six 1 m2 sampling frames to capture and count seedfall (Figure 2), and seed viability by taking captured seeds (Figure 3) into the lab to undergo germination trials. Data collected is compared to local and regional climatic trends to aid our understanding of what factors contribute to high or low white spruce seed production, and thus the variability we might expect in this important food source. Additionally, data collected provides insight as to the reproduction potential of this ecosystem defining species at critical landscape positions such as treeline.

Results from this study indicate that spruce cone production occurs on approximately 3 year cycles, with climate conditions of the preceding years being the deciding factors in both seedfall and seed viability. For example, recent research from these plots suggests that an optimal cone production year will arise after two wet summers and low snow winters (during which reserves for cone growth are stored), followed by a warm and dry early summer (during which cones are initiated), and capped with a wet, cool summer just before seed dispersal (as cone maturation is complete).

However, high cone and seed production does not necessarily mean high seed viability since slightly different climatic factors control success of the two processes. Overall, the long-term mean annual germination percentage is only around 8% in the forest, and 5% at the treeline, indicating that it takes a white spruce tree quite a bit of energy, and perhaps luck, to successfully reproduce.

Spring of 2020 appears to have been kind to Denali's flowering plants – including spruce trees! Beginning in mid-May, the lower branches of many spruce were laden with male pollen cones. These cones are bright reddish at first, then elongate and turn yellow as they release their pollen in early June. Beginning in late June, one could observe the development of female seed cones, primarily found on the ends of white spruce's upper branches. They start out light green, and will turn to purplish-brown by fall.

The last notable cone production year occurred in 2016, and **cone production occurs in approximately 3 year cycles** (Figure 4). As of late June 2020, the number of purplish cones visible indicates that Denali's spruce are on track for another high cone production year, referred to as a 'mast year.' The highest cone production years remain 1998 and 2000, with an average of 390 and 251 cones per tree.