Picea glauca Floodplain Old-growth Forest Biophysical Setting

White Spruce Floodplain Old-growth Forest Biophysical Setting

Interior Alaska

Conservation Status Rank: S4 (apparently secure)

Introduction

The *Picea glauca* (white spruce) Floodplain Old-growth Forest biophysical setting is characterized by a closed canopy of mature *Picea glauca* and an abundance of snags and downed wood in a floodplain environment (Figure 1). Definitions of old growth forests vary as they reflect the inherent patterns and dynamics of the regional forest (USFS 2003). On floodplains in boreal Alaska *Picea glauca* tree age averages 150 years but may be less as some stands of old growth contain patches of younger growth (Juday et al. 2015). Old-growth forests are valued as unique habitats in North America that function to filter sediment and nutrient-laden floodwaters, stabilize bank sediments and regulate temperature through shading (Waring and Franklin 1979, Juday and Zasada 1984, Alaback 1991). In Alaska, mature *Picea glauca* forests also provide important habitat to a variety of bird and mammal species, particularly cavity nesters such as the boreal owl, hawk owl, northern flying squirrel and hairy woodpecker (Scott et al. 1977). Marten utilize large tree cavities for denning and resting and thus reach peak abundance in old-growth forests (Bailey 1981). Old growth systems are dynamic with disturbance affecting their growth, amount of large woody debris, and landscape patch mosaic The spruce bark beetle (*Dendroctonus rufipennis*) has killed large areas of mature *Picea glauca* and forests were widely exploited during the gold rush and settlement periods of the early 1900s (USFS 2003).

Figure 1. Small patches of *Picea glauca* forests on floodplains of the Yukon River in Yukon-Charley Rivers National Preserve, Alaska.

Distribution

Old-growth *Picea glauca* floodplain forests occur on moderate to large floodplains in interior Alaska flanking the Yukon, Kuskokwim, Koyukuk, and Tanana Rivers. These forests have not been mapped as a distinct class in most of Alaska, however a small portion of the total 45,900,000 ha of boreal forest in interior Alaska occurs on interior Alaskan floodplains (Yarie et al. 1998). A distribution map for the Old-growth *Picea glauca* Floodplain Forest biophysical setting was developed from sampling locations targeting floodplain old growth *Picea glauca* stands collected by Juday and others (2015), *Picea glauca*-dominated landcover classes from the Alaska Vegetation Map (Boggs et al. 2015) and floodplains delineated within the State Surficial Geology Map of Alaska (USGS 1999). The final distribution map represents closed to open canopy spruce forests occurring on floodplains (Figure 2).

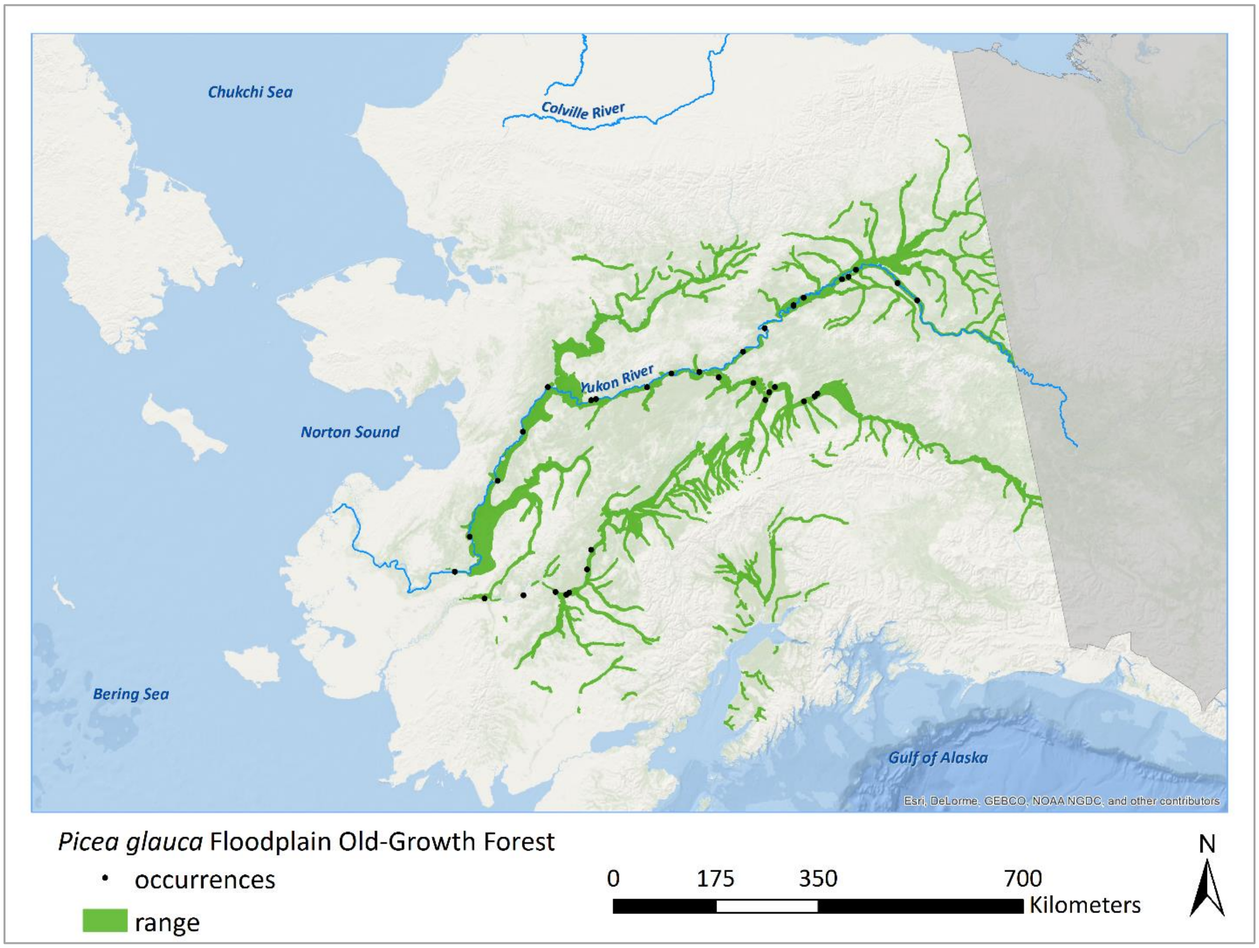

Figure 2. Distribution of the *Picea glauca* Floodplain Old-growth Forests Biophysical Setting. Note areas of occurrence are buffered for better visibility.

Climate

Short, warm summers and long, very cold winters characterize the subarctic continental climate of the area (NRCS 2006). The average annual precipitation ranges from 25 to 38 cm in the east and north and 38 to 51 cm in the south and west. Maximum precipitation occurs in the late summer, mainly as a result of thunderstorms. The average annual snowfall ranges from 76 to 203 cm. The average annual temperature ranges from -5.5 ºC in the east to -4 ºC in the west. The average frost-free period ranges from 70 to 120 days. The temperature usually remains above freezing from June through mid-September.

Environmental Characteristics

In interior Alaska, mature *Picea glauca* occur on both floodplains and south facing uplands. Upland stands are thought to burn more frequently, and as a result, individual upland trees older than 200 years are rare (Van Cleve and Viereck 1981). Trees over 200 years, however, are known from floodplain sites, which are thought to contain the oldest stands of *Picea glauca* in Alaska. Here, *Picea glauca* trees have ranged from over 300 years on the Tanana River floodplain (Farr 1967, Juday and Zasada 1984), to 250 on the Chena River floodplain (Viereck 1970, Viereck 1989, Juday and Zasada 1984, Boggs and Sturdy 2005, Yarie 1983).

The formation of new land and the initiation of primary successional processes in floodplain ecosystems is well documented (Leopold et al. 1964). Along a meandering river, alluvium typically is deposited on the inner, point bank the river channel. The opposing bank is cut, providing sediment for downstream deposition and creating a series of similar bands of alluvial deposits. The channel thus meanders laterally across the floodplain. Vegetation growing on new deposits near the river may be contrasted with that on older deposits inland to recognize and measure successional processes. Alluvium also is deposited on the soil surface during flooding, further raising the soil surface height.

Soils are mostly comprised of well-drained alluvial sand and gravel deposited during flooding events. Due to frequent alluvial disturbance, soils in the active floodplain show little development and are often classified as inceptisols or entisols (Martin et al. 1995); older sites elevated above the active floodplain may support spodisols.

Water availability plays a major role in plant community structure and composition on floodplain terraces. Water is input from overbank flow (flooding), groundwater and precipitation, with terraces becoming progressively drier with increasing vertical and horizontal distance from the active channels. Within the stands, soil and air moisture are high, and as a result, fires are rare. When they do occur, fires burn out in the humid understory and rarely reach the spruce canopy.

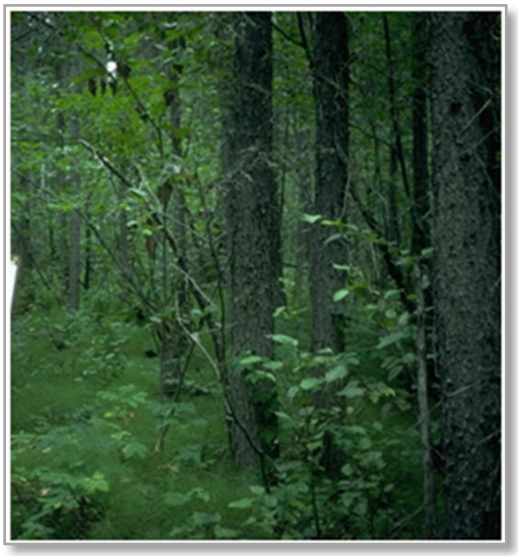

Figure 3. The *Picea glauca/Alnus viridis* ssp. *crispa/Rosa acicularis/Arctostaphylos rubra* Plant Association on the Yukon River, Alaska (Boggs and Sturdy 2005).

Vegetation and Succession

In boreal Alaska, old-growth floodplain forests are dominated by uneven-aged stands of *Picea glauca*, which ranges in age from 130 to 350 years, in height from 30 to 34 m, and in canopy cover from 30 to 50%. The tall shrub, *Alnus viridis* ssp. *crispa* dominates or codominates with *Alnus incana* ssp. *tenuifolia* in the tall shrub layer with 25 to 90% cover (Figure 3). These alder species are commonly over 3 m tall. Low shrubs include, *Ledum groenlandicum*, *Rosa acicularis*, *Vaccinium vitis-idaea* and *Viburnum edule*. *Arctostaphylos rubra* and *Linnaea borealis* are common dwarf shrubs. Common herbaceous species include *Cornus canadensis*, *Equisetum arvense*, *E. pratense*, and *Geocaulon lividum*. The feather mosses, *Hylocomium splendens* and *Rhytidiadelphus triquetrus* are the dominant species and often blanket the ground. Lichen cover is low.

In some old-growth *Picea glauca* stands, alder cover is less than 25% cover and the understory is instead dominated by the shrub *Rosa acicularis* with *Ledum palustre* ssp. *decumbens*, *Vaccinium vitis-idaea* and *Viburnum edule* occurring at lower cover (Boggs and Sturdy 2005). Common herbaceous species are the grass *Calamagrostis canadensis* and the forb *Mertensia paniculata*. Similar to the alder-dominated understories, the feather moss, *Hylocomium splendens* often blankets the ground and lichen cover is low.

Floodplain succession in interior Alaska has been well documented. Across these chronosequences, newly-formed gravel bars are colonized by light-seeded herbs and shrubs in the *Salix* genus (Viereck 1970). Within five years, willow saplings and *Populus balsamifera* (balsam poplar) seedlings and are abundant (Walker et al. 1986, Boggs and Sturdy 2005). During this stage, *Alnus incana* ssp. *tenuifolia* and *Picea glauca* seedlings are often present but less abundant. Under conditions of low sedimentation, and good soil aeration, *Alnus incana* ssp. *tenuifolia* may be an important pioneer shrub. Within 10 to 15 years, the *Populus balsamifera* saplings are able to overtop the *Salix* species, which are gradually replaced by *Rosa acicularis* and *Viburnum edule* shrubs in the understory (Figure 4). *Equisetum* species become nearly continuous on the forest floor.

In mid-seral stages *Picea glauca* trees codominate with *Populus balsamifera*. Because *Populus balsamifera* are short-lived (100 to 150 years), poorly-recruited, and subject to felling by beaver, *Picea glauca* eventually dominate the forest canopy (Viereck et al. 1983, Walker et al. 1986, Oechel and Van Cleve 1986). Initially, stands of *Picea glauca* are relatively evenly aged due to similar time of establishment; however, variable recruitment eventually produces multi-aged stands with the oldest individuals more than 300 years old (Chapin et al. 2006). The dominance of alder species (*Alnus incana* ssp. *tenuifolia* and *Alnus viridis* ssp. *sinuata*) in the understory, and feather mosses (*Hylocomium* spp. and *Pleurozioum schreberi*) on the forest floor may persist.

Figure 4. The *Picea glauca/Rosa acicularis* Plant Association on the Yukon River in Yukon-Charley Rivers National Preserve, Alaska (Boggs and Sturdy 2005).

In late-seral stages, the closed *Picea glauca* canopy reduces light infiltration to the forest floor, slowing soil thaw in the spring and summer. A combination of low soil temperature, acidification, and other factors reduces the rate of decomposition and thus nutrient cycling (Flanagan and Van Cleve 1983, Van Cleve et al. 1983, Van Cleve et al. 1993), leading to the accumulation of organic material on the forest floor, which further reduces soil temperatures. While permafrost may underlie *Picea glauca* stands, it is more common *Picea mariana*-dominated plant associations due to their higher soil moisture contents (Boggs and Sturdy 2005).

Common disturbances to stands of *Picea glauca* include flooding, browsing by snowshoe hares, and winter ice storms (Viereck et al. 1993). *Picea glauca* is attacked by a number of bark beetles in the genera *Dendroctonus, Ips, Trypodendron, Dryocoetes, Scolytus, Polygraphus* and others (USDA, Forest Service Research and Development, 2014). Although most of these species attack trees of low vigor, the spruce bark beetle (*Dendroctonus rufipennis*) attacks trees of normal vigor and has killed large areas of mature and old-growth *Picea glauca*.

Conservation Status

Rarity: In interior Alaska, stands of old-growth *Picea glauca* growing on well-drained alluvial and riparian soils are relatively rare; 35 locations have been documented (Juday et al. 2015).

Threats: Old-growth *Picea glauca* forests on floodplains are susceptible to damage from timber harvest, forest fire, spruce bark beetle *(Dendroctonus rufipennis)* infestation, and climate change. A westward shift of the *Picea glauca* range appears to be driven by increasing summer temperatures in interior Alaska, which can exceed the physiological tolerances of *Picea glauca* (Juday et al. 2015).

Trend: Floodplain forests were exploited during the gold rush and settlement period of the early 1900s but current logging is small scale and localized near remote villages (Zasada et al. 1987). However, short-term declines are predicted due to an intensified disturbance regime (insects and fire). Long-term declines are predicted to account for *Picea glauca* mortality in lowland interior sites where future warming is expected to be most intense (Juday et al. 2015).

Species of Conservation Concern

The bird and plant species listed below are designated critically imperiled or vulnerable either globally (G1-G3) or within Alaska (S1-S3) and are known or suspected to occur in this biophysical setting (Table 1, Table 2). While just a few species of conservation concern have been documented for this biophysical setting, old-growth canopy structure may be vital to cavity-nesting species such as the boreal owl (*Aegolius funereus*), hawk owl (*Surnia ulula*), northern flying squirrel (*Glaucomys sabrinus*), and hairy woodpecker (*Picoides villosus*). In Alaska, American marten (*Martes americana*) utilize large tree cavities for denning and resting and thus reach each peak abundance in mature conifer forests and are generally absent from extensive tracts of secondary successional vegetation (Bailey 1981). Please visit the Alaska Center for Conservation Science website for species descriptions (ACCS 2016).

Table 1. Bird species of conservation concern within the *Picea glauca* Floodplain Old-growth Forest Biophysical Setting.

Common Name	Scientific Name	Global Rank	State Rank	Habitat Description
Birds				
Black Scoter	*Melanitta americana*	G5	S3S4B, S3N	Could use river habitat during nonbreeding seasons.
Osprey	*Pandion haliaetus*	G5	S3S4B	Known to use mature spruce tree habitat along major river systems in Interior Alaska (Hughes 1990).

Table 2. Plant species of conservation concern within the *Picea glauca* Floodplain Old-Growth Forest Biophysical Setting.

Scientific Name	Global Rank	State Rank	Habitat Description
Carex eburnea	G5	S3	Moist *Picea glauca* woods on river terrace
Festuca occidentalis	G5	S1	Upper terrace of Takhin River floodplain

Plant Associations of Conservation Concern

The plant associations listed below are designated critically imperiled or vulnerable either globally (G1-G3) or within Alaska (S1-S3) and are known or suspected to occur in this biophysical setting (Table 3).

Table 3. Plant associations of conservation concern within the *Picea glauca* Old-Growth Forest Biophysical Setting.

Name	Global Rank	State Rank	Concept Source
Open *Picea glauca/Alnus crispa*-Alnus tenuifolia*/Vaccinium vitis-idaea/Hylocomium splendens*	G3	S3	Viereck 1989
Picea glauca/Alnus crispa/Rosa acicularis/Arctostaphylos rubra*	G3	S3	Yarie 1983

*2016 taxonomy is *Alnus viridis* ssp. *crispa* and *Alnus incana* ssp. *tenuifolia*

Classification Concept Source

The classification concept for this Biophysical Setting is based on Viereck (1970) and Juday and Zasada (1984).

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