



Picea sitchensis
Sitka Spruce

Sitka spruce (*Picea sitchensis*) is a coastal tree restricted to a relatively narrow band that occurs on sea-facing slopes and valley bottoms (Harris 1978). It is located mostly from sea level to an elevation of 1000 feet (O'Driscoll 1977). Research by Sara Lipow (personal communication, August 2000) and field observations in Olympia National Park (Ed Schreiner, personal communication, August 2000) suggest that the range of this species extends further up the west side of the Olympic Mountains than Little's (1971) range maps indicate. The Sitka spruce zone is the mildest forest zone in Washington, with few extremes of moisture or temperature (Franklin and Dyrness 1973). The climate is uniformly wet and mild, usually without a pronounced summer drought (Farr and Harris 1979). For example, there are only six days difference in the number of frost free days between Otis, Oregon and Sitka, Alaska, a distance of over 1000 miles (Farr and Harris, 1979). Precipitation is also similar for the two locations, with 250 inches at Otis and 214 at Sitka. Common companion species include western hemlock, western redcedar, and Douglas-fir.

Like most other conifers, over 90 percent of the total genetic diversity of Sitka spruce resides within (rather than between) populations (Yeh and El-Kassaby 1980). However, Sitka spruce is like Douglas-fir, in that a much higher proportion of its total genetic variation tends to be apportioned among populations than is typical for most other western conifers (Ager *et al.*, 1993). Variation among families within a location was relatively consistent from one location to another (Campbell *et al.*, 1989). Trees from stands that were geographically close had more similar isoenzyme patterns than trees from stands that were geographically separated (Copes and Beckwith, 1977). Sitka spruce was not strongly geographically differentiated for the loci evaluated by Yeh and El-Kassaby (1980). They reported that, on the average, there was little difference among Oregon, Washington, and British Columbia populations, and they all demonstrated similar divergence from Alaskan populations.

Southern sources entered dormancy much later than northern sources, and had more fall frost damage (O'Driscoll 1977, and Birot and Christophe 1983). This north-to-south pattern is also seen in earlier spring bud flushing in the north than in the south (Magnesen 1976, and Falkenhagen 1977). Altitude had less influence than latitude on the timing of fall bud set (Falkenhagen 1977).

Sources north of 46° latitude showed little difference in frost damage when tested in Germany (Kleinschmit and Sauer, 1976), but southern sources flushed before northern ones when tested in Ireland (O'Driscoll 1976). Date of bud set varied by 49 days among provenances when grown in the Netherlands and was highly correlated with latitude, with northern provenances setting bud earlier (Kriek 1976).

There was a north-to-south trend for growth and growing period which increased with decreasing latitude (O'Driscoll 1977, and Birot and Christophe 1983). Among wide-ranging Sitka spruce provenances grown in Denmark, there was little difference in time of bud burst, but large differences in time of growth

cessation. This resulted in higher mortality for southern sources than northern ones (Nielsen 1994). Southern sources grew faster than northern ones in France (Biro 1976).

Campbell and others (1989) found that elevation explained bud burst and bud set better than other environmental factors for an Alaskan island population of Sitka spruce. Seedlings that burst bud late tended to be from low elevations, flat slopes, eastern parts of the island, and eastern sides of mountains. Campbell and Ying (Cheng Ying, personal communication, August 2000) found that transfer of seed between the coast and inland areas can decrease growth or increase frost damage. Others have found that southern sources entered dormancy much later than northern ones and were more subject to fall frosts (O'Driscoll 1977, and Falkenhagen 1977). Magnesen (1976) found that northern sources flushed earlier than those from the south.

Campbell and others (1989) stated that transfer from the center to the edge of an island may have more risk than transfer between edges of widely scattered islands. Regulations in British Columbia allow Sitka spruce to be transferred freely throughout the Georgia lowlands; but restricts transfers in elevation to 980 feet up or 650 feet down, and transfers in latitude to one degree south or 4 degrees north in the maritime area (British Columbia Ministry of Forests, 1995). Nielsen (1994) divided Sitka spruce into nine provenance zones, with the two Washington zones separated at about 47.2° north latitude (Pacific Beach at the coast). There was one Oregon zone, and the southern British Columbia zone extended north to about the southern tip of the Queen Charlotte Islands.

New recommendations for seed transfer zone boundaries

HOH (Zone 1): The western half of the Olympic Peninsula. Consists of old seed zones 011 and most of 012, and the portion of old seed zone 221 that is west of Angeles Point.

TWIN HARBORS (Zone 2): Coastal areas south of the Olympic Peninsula. Northern boundary is the northern edge of the old 030 seed zone. The eastern boundary is the eastern edge of the old 030 seed zone from near Capitol Peak in the Olympic Mountains to near Pe Ell and then south to Cathlamet on the Columbia River. Consists of old seed zone 030 and the western tip of 041.

NORTH PUGET (Zone 3): The northern part of the Puget Trough. The eastern boundary follows the eastern edge of the species range from the Canadian border to near the confluence of the White and Clearwater Rivers. The southern boundary starts on the eastern edge of the species range near the confluence of the White and Clearwater Rivers and goes west to Buckley, Sumner, a point north of Tacoma, north to Quilcene, and west to the edge of the gap in the species range in the Olympic Mountains near Mount Constance. The western boundary follows along the edge of the gap in the species range to near Elwha and north to Port Angeles. Consists of old seed zones 201, 202, 211, and 212, the western parts of 412, 411, 403, and 401, and the eastern 3/4 of 221.

SOUTH PUGET (Zone 4): The southern part of the Puget Trough. The northern boundary starts at the eastern edge of the gap in the species range in the Olympic Mountains near Mount Constance and goes east to Quilcene, then south to a point north of Tacoma, and east to Sumner, Buckley and the edge of the species range near the confluence of the White and Clearwater Rivers. The eastern and southern boundaries follow the edge of the species range to near Pe Ell. The western boundary is the eastern edge of the old 030 seed zone and

the eastern edge of the gap in the species range in the Olympic Mountains. Consists of old seed zones 231, 232, 421, 422, the eastern portion of 222, and the northern portions of 241 and 242 within the range of Sitka spruce.

LOWER COLUMBIA (Zone 5): Areas within the range of Sitka spruce along the lower Columbia River, but to the east of Cathlamet. Consists of old seed zone 042, the eastern half of 041, and portions of 241, 430 and 440.

Elevation bands within geographic seed transfer zones

These five geographic seed zones generally cover areas less than 1000 feet in elevation. Therefore, a single elevation band is recommended for all Sitka spruce.