



Picea engelmannii
Engelmann Spruce

Engelmann spruce (*Picea engelmannii*) has an impressive latitudinal range, extending from near the Mexican border to near the Alaskan panhandle. It is most common in the northern Rocky Mountains, where it occupies some of the coldest, highest, forested areas. It is found in cold humid environments, and in spite of its large range appears to be limited to a relatively narrow range of temperatures and precipitation. In Washington it is common in the Okanogan Highlands, but also occurs along the crest and east side of the Cascades, in a small population in the Blue Mountains, and in a very small, isolated population on the Olympic Peninsula (Alexander and Shepperd 1990, Ed Schreiner, personal communication, August 2000).

Most of the genetic studies of Engelmann spruce have focused on the relationships between this species and white spruce, Sitka spruce, and blue spruce. Most of these studies have attempted to determine whether natural interspecific hybrids exist, often with inconclusive results (Daubenmire 1974, La Roi and Dugle 1968, Mitton and Andalora 1981, and Roche 1969). If such hybridization exists, introgression rather than adaptation to environmental factors could be responsible for at least a portion of the genetic variation in this species.

Rehfeldt (1994) conducted the only study designed to develop seed transfer guidelines for this species. This study did not include any samples from Washington, but its conclusions can provide general concepts. He found genetic variation tended to occur along elevational and latitudinal clines. He found that within an area, elevation changes of about 1400 feet were associated with measurable genetic differences between populations. The latitudinal distance associated with genetic differences varied from several hundred miles in parts of the Southwest to 60 or 70 miles in central Idaho. Because risk of seed movement can vary from place to place within the range of a species and because we have very little information for the state of Washington for this species, it would be prudent to be somewhat more conservative than Rehfeldt recommends. In a review paper, Rehfeldt (1993) indicated that genetic variation in Engelmann spruce is similar to ponderosa pine and that both can be moved similar distances both elevationally and climatically. Within the state of Washington the natural distribution of these two species is similar, except that Engelmann spruce occurs on both sides of the Cascades while ponderosa pine is generally restricted to the east side (Alexander and Shepperd 1990).

Shepperd *et al.* (1981) conducted a typical provenance trial of Engelmann spruce in Colorado that included collections from Washington and nearby parts of Oregon, Idaho and British Columbia. They found huge differences between populations from southwest Idaho and east-central Idaho, the same area where Rehfeldt (1994) found very steep genetic differences. However, the differences they found within the state of Washington were much smaller. They speculated that the excellent growth of northern sources, particularly from parts of British Columbia may have been due to introgression from white spruce. Lester *et al.* (1990) recommended that Engelmann spruce seed not be moved from wet to dry or dry to wet bioclimatic zones.

New recommendations for seed transfer zone boundaries

ELWHA (Zone 1): This isolated population on the Olympic Peninsula will make up one seed zone to conserve any unique genes it may possess. Local land managers may want to stockpile a genetically diverse, local collection of this seed in case the population is destroyed.

SKAGIT (Zone 2): Areas within the Engelmann spruce range that are west of the crest of the Cascades and north of the Suiattle River. Consists primarily of the old 402 seed zone and the part of 401 where Engelmann spruce occurs.

GREEN (Zone 3): Areas within the Engelmann spruce range that are west of the crest of the Cascades between the Tieton and Skagit seed transfer zones, including portions of the old 403, 411 and 412 seed zones.

TIETON (Zone 4): High elevation areas along the east side of the Cascades south of the Yakima River, and along the west side of the Cascades south of the Green River. Consists of the western portions of the old 641 and 651 seed zones and the eastern portions of the old 412, 430 and 440 seed zones, as well as the old 652 seed zone and the southern portion of the 631 seed zone.

TWISP (Zone 5): Areas east of the crest of the Cascades, west of the Okanogan River, and north of the Methow River and Early Winters Creek. Consists primarily of the northern 2/3 of the old 600 seed zone and western portions of the old 611 seed zone.

CHELAN (Zone 6): Areas within the Engelmann spruce range that are east of the crest of the Cascades between the Twisp and the Tieton seed transfer zones. When practical, seed for the isolated population within this zone should be locally obtained. Consists primarily of the portions of the old 621, 622 and 631 seed zones where Engelmann spruce occurs.

UPPER COLUMBIA (Zone 7): Areas within the natural range of Engelmann spruce that are east of the Okanogan River and west of the Columbia River. Consists primarily of portions of the old 612, 614, 801, and 802 seed zones where Engelmann spruce occurs.

PEND OREILLE (Zone 8): Areas within the natural range of Engelmann spruce that are east of the Columbia River. Seed for the small areas near Spokane can be obtained from nearby parts of Idaho if desired. Consists primarily of portions of the old 811, 812, 813, 821, 822 and 830 seed zones where Engelmann spruce occurs.

GRANDE RONDE (Zone 9): Areas within the Washington portion of the Blue Mountains. Consisting of old Washington seed zones 851 and 861. Can be combined with old Oregon seed zones 852 and 861.

Elevation bands within geographic seed transfer zones

Within each seed movement zone, 1200-foot elevation bands should be established.