

Pinus contorta

Lodgepole Pine and Shore Pine

Lodgepole pine (*Pinus contorta*) has a large natural distribution which extends from Mexico to the Yukon, and from the Pacific Ocean to Alberta and Colorado. Within this area, the species occurs from sea level to 12,000 feet. The species is extremely intolerant of shade, but tolerates low temperatures. It is tolerant of infertile soils and grows on a variety of soils, but they are usually moist. Lodgepole pine has a number of characteristics that can make it an extremely aggressive pioneer species; it has large and frequent seed crops, it has small, widely distributed seed, and the cones are often serotinous (Lotan and Critchfield, 1990).

There is considerable variation within lodgepole pine. It is divided geographically into four subspecies, three of which are found in Washington. Shore pine (*P. contorta* var. *contorta*) is found along the coast and around the Puget Trough. Shore pine has rapid juvenile growth, but tends to be short-lived and small, with large branches. Sometimes it is susceptible to poor form and frost damage. Rocky Mountain lodgepole pine (*P. contorta* var. *latifolia*) is found in most of the inland parts of the state. Rocky Mountain lodgepole pine tends to live longer, grow larger, have better form, and have serotinous cones. Sierra lodgepole pine (*P. contorta* var. *murrayana*) is found mainly in the Sierras and Oregon Cascades, but exists as a few scattered populations on the west side of the southern Washington Cascades. Sierra lodgepole pine tends to be slower growing than either of the other subspecies, have large diameters for its height, and have cones that are not serotinous (Lotan and Critchfield, 1990).

No seed movement studies have been conducted with lodgepole pine in Washington. However, excellent seed movement studies have been conducted with this species in Oregon, Idaho, and British Columbia, and the findings from these projects can be generalized to this state. In addition, many seed source trials, some of which included collections from Washington, have been conducted in Europe with this species.

Rocky Mountain lodgepole pine occupies almost any type of site and Rehfeldt (1983, 1985 and 1988) found that in the Inland Empire this variety of the species must balance the need to grow rapidly in mild environments with the need to become frost hardy early in the year in severe environments. The species accommodates this environmental variation by adapting very specifically to various sites. He found that populations from sites that differ by as little as 650 feet in elevation are likely to be genetically different and should not be interchanged. Populations can be moved relatively long distances geographically, but any movement that results in a change in more than 24 frost free days should be avoided. In a later paper that analyzed plantation data, Rehfeldt *et al.* (1999) recommended that seed movement be limited to 500 feet in elevation at low elevation, and 660 feet at high elevation in southern British Columbia. Ying *et al.* (1989) found that for Rocky Mountain lodgepole pine, elevation movements as large as 1150 feet were acceptable in British Columbia. However, they found that the coastal influence in British Columbia extended

well past the Coast Range (which is comparable to the Cascades in much of Washington) and recommended using extreme caution in moving material from the east side of the range to the interior.

Ying and Liang (1994) evaluated all 4 varieties of lodgepole pine on a test site in the rain shadow of southern Vancouver Island. They found that shore pine outperformed the other three varieties in this environment. For shore pine, they found seed should not be transferred more than 500 feet in elevation. They found seed could be moved 1.5° north or south, but only a short distance east and west. In fact, seed for this site should be obtained only from other sites within the relatively narrow rain shadow of Vancouver Island. They also found that it took as long as 20 years before the problems associated with non-local seed sources became obvious.

Yang and Yeh (1995) looked at genetic differences at the molecular level in lodgepole pine. They concluded that populations of Rocky Mountain lodgepole pine were large and continuous enough so that genetic differences between populations represented adaptational differences due to strong selection pressure. They also concluded that, because shore pine tends to be less common and the populations smaller, the opportunity exists for random differences to develop between populations. Thus, some of the genetic differences among shore pine populations may not be adaptational differences.

There is very little Sierra lodgepole pine in Washington. Sorensen (1992) and Stoneman (1984) investigated Oregon sources of this variety and reached conclusions similar to those found for other varieties. Both determined that broad geographical movement of lodgepole pine was acceptable, but recommended relatively narrow elevation movements.

New recommendations for seed transfer zone boundaries for Shore Pine

HOH (Zone 1): Coastal areas along the Olympic Peninsula. Consists of those parts of the old 012 and 011 seed zones that are within the natural range of shore pine.

TWIN HARBORS (Zone 2): Coastal areas south of the Olympic Peninsula. Consists of parts of the old 030 seed zone that are within the natural range of shore pine, as well as the portion of the old 041 seed zone west of Grays Bay.

ELWHA (Zone 3): East side of the Olympic Mountains. The western boundary consists of the edge of the species range in the Olympic Mountains. The northern, eastern, and southern boundaries start at the edge of the species range near Olympic Hot Springs and go east to Hurricane Hill and Mount Angeles, south to Mount Townsend, The Brothers, and west to the edge of the species range west of Capitol Peak in the Olympic Mountains. Consists primarily of higher elevation parts of old seed zones 221 and 222.

LOWER COLUMBIA (Zone 4): Inland areas within the natural range of shore pine on both sides of the Columbia River. The northern and eastern boundaries consist of the edge of the species range. The southern boundary is the Columbia River. The western boundary consists of the western edge of Wahkiakum County north to where it intersects the old 041 seed zone line. Consists primarily of the old 041 seed zone east of Grays Bay and adjacent parts of Oregon.

ISLANDS (Zone 5): Low elevation areas along the coast to the east of Vancouver Island including Whidbey, Camano, and the San Juan Islands. Eastern boundary is the eastern boundary of the old 201 and 202 seed zones. Southern boundary is the southern edge of the old 202 seed zone and the southern edge

of Island County. Consists primarily of old seed zones 201, 202, 211 and the northern part of 212.

KITSAP (Zone 6): Low elevation areas along the Puget Sound not including Whidbey Island. The northern boundary starts on the coast at the northern edge of the Tulalip Indian Reservation and proceeds west along the northern boundary of the old 212 and 411 seed zones to a point west of Silverton. The eastern boundary starts at a point west of Silverton and goes south through Goldbar, Ragnar and the Three Sisters to the edge of the species range near Ashford. The southern and western boundaries follow the edge of the species range from near Ashford west to near Capitol Peak in the Olympic Mountains. Consists primarily of old seed zone 231, the part of 212 south of Whidbey Island, those parts of 232 within the natural range of shore pine, and lower elevation areas of the old 221, 222, 411, 412, and 421 seed zones.

Elevation bands within geographic seed transfer zones for Shore Pine

For Shore pine (zones 1-6), 1000-foot elevation bands should be established within each zone.

New recommendations for seed transfer zone boundaries for Lodgepole Pine

WASHOUGAL (Zone 7): Isolated populations of *P. contorta* thought to be var. *murrayana* on the west side of the southern Washington Cascades. Whenever practical, seed from these isolated populations should be planted in this seed zone. Where that is not possible, seed from the northern part of Oregon's lodgepole pine seed zone 1 may be used. Local land managers may want to stockpile genetically diverse seed collections from these stands in case they are destroyed by fire.

SKAGIT (Zone 8): The west side of the Cascades in the northern part of the state. The northern boundary is the Canadian border from a point west of Black Mountain to the Cascade Crest. The eastern boundary is the Cascade Crest south to Dome Peak. The southern boundary is the line between Skagit and Snohomish Counties. The western boundary follows the western edge of the old 403 and 401 seed zones from the county line north through Little Deer Peak, Lyman, Saxton, and Deming, to a point on the Canadian border west of Black Mountain. Consists primarily of old seed zones 401 and 402, and northern portions of 403.

SNOQUALMIE (Zone 9): The west side of the Cascades in the central part of the state. The northern border is the line between Skagit and Snohomish Counties. The eastern boundary is the Cascade Crest from the county line south to Snoqualmie Pass (Interstate 90). The southern boundary is Interstate 90 west to Ragnar. The western boundary goes north from Ragnar through Goldbar to a point west of Silverton, then west and north along the old 403 seed zone boundary to the Skagit / Snohomish County lines. Consists primarily of high elevation portions of the old 411 and 412 seed zones, and southern portions of the old 403 seed zone.

COWLITZ (Zone 10): The west side of the Cascades in the southern part of the state. The northern boundary is Interstate 90 from Ragnar to the Cascade Crest. The eastern and southern boundaries follow the crest of the Cascades from Interstate 90 (Snoqualmie Pass) south to Mount Adams, Steamboat Mountain and south to the edge of the range near Burnt Peak. The western

boundary follows the edge of the species range from Burnt Peak to a point near Ashford and continues from that point north to the Three Sisters and Ragnar. Consists primarily of high elevation portions of the old 421, 422, 430, and 440 seed zones, and southeastern portions of the old 412 seed zone.

TWISP (Zone 11): The east side of the Cascades in the northern part of the state. Northern boundary is the Canadian border. The eastern boundary follows the edge of the interrupted species range to the west of the Okanogan River. The southern boundary follows the edge of the interruption in the species range along the Methow River and along Early Winters Creek to the Cascade Crest. The western boundary is the Cascade Crest. Consists primarily of portions of the old 600 seed zone.

CHELAN (Zone 12): The east side of the Cascades in the central part of the state. The northern boundary goes from the Cascade Crest east along Early Winters Creek to the edge of the species range. The eastern boundary follows the edge of the interrupted species range south along the Methow and Columbia Rivers. The southern boundary is Interstate 90. The western boundary is the Cascade Crest. Consists primarily of the old 621, 622, and 631 seed zones, and the southwestern part of the old 600 seed zone.

TIETON (Zone 13): The east side of the Cascades in the southern part of the state. Includes areas within the natural range of lodgepole pine that are east of the crest of the Cascades and south of Interstate 90. Consists primarily of those parts of the old 632, 641, 651, and 652 seed zones that are within the natural range of lodgepole pine.

KETTLE (Zone 14): Areas within the natural range of lodgepole pine that are east of the Okanogan River and west of the Columbia River. Consists primarily of those parts of the old 614, 612, 801, 802, 803 and 804 seed zones that are west of the Columbia River and within the natural range of lodgepole pine.

PEND OREILLE (Zone 15): Areas in the northeast part of the state that are within the natural range of lodgepole pine and east of the Columbia River. Consists primarily of the old 811, 812, 813, 821 and 822 seed zones, and 804 east of the Columbia River.

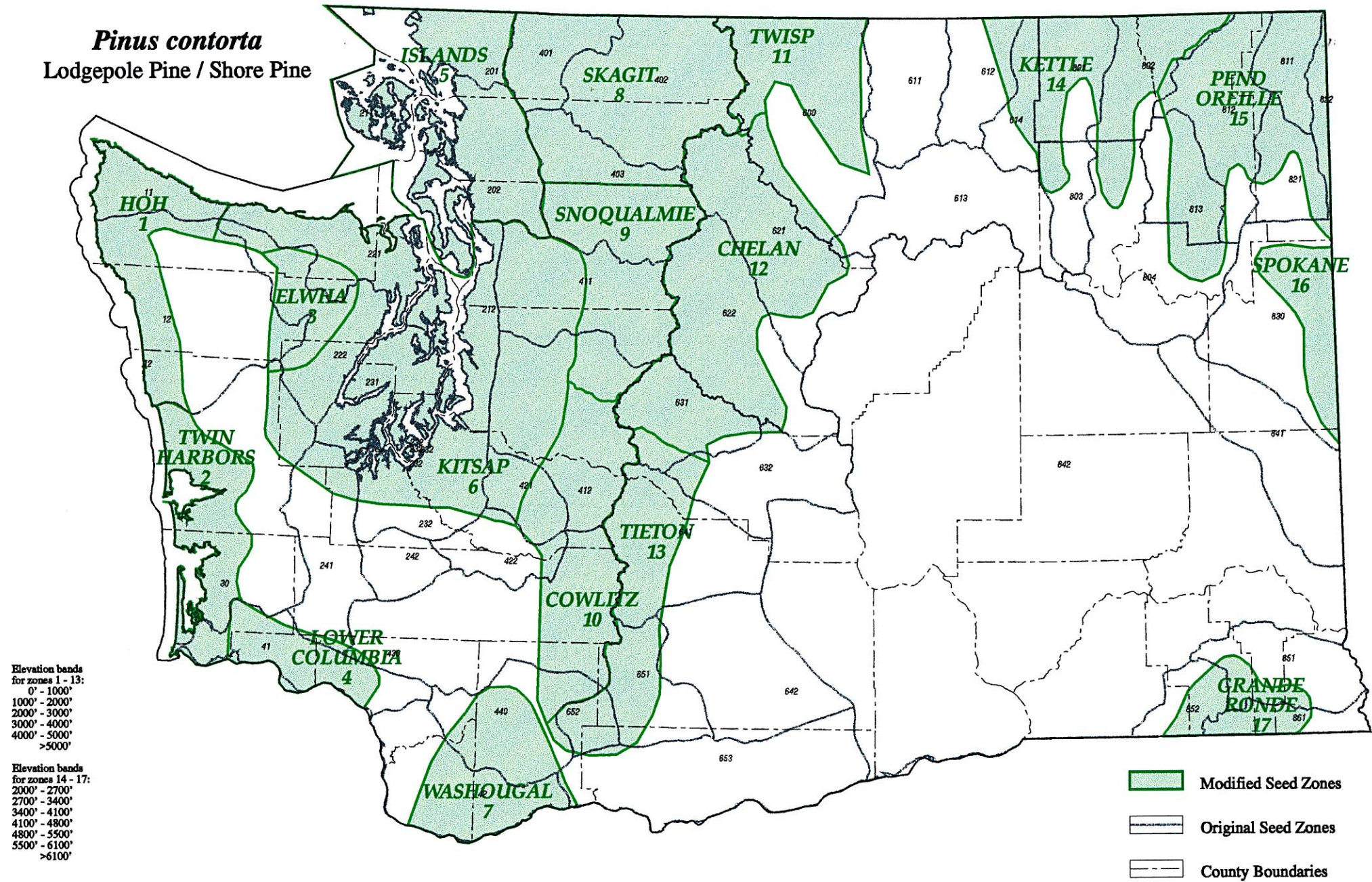
SPOKANE (Zone 16): Areas within the natural range of lodgepole pine on the east side of Spokane County and nearby parts of Idaho. Consists of the old 830 seed zone and nearby parts of Idaho, particularly Kootenai County.

GRANDE RONDE (Zone 17): Areas within the natural range of lodgepole pine in the Washington portion of the Blue Mountains and nearby portions of Oregon. Consists primarily of portions of the old Washington/Oregon seed zones 851, 852, and 861.

Elevation bands within geographic seed transfer zones for Lodgepole Pine




In the Cascades (zones 7-13), 1000-foot elevation bands should be established within each seed transfer zone. In the Okanogan Highlands and the Blue Mountains (zones 14-17), 700-foot elevation bands should be established within each seed transfer zone.

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Lodgepole Pine / Shore Pine



Elevation bands
for zones 1 - 13:
0' - 1000'
1000' - 2000'
2000' - 3000'
3000' - 4000'
4000' - 5000'
>5000'

Elevation bands
for zones 14 - 17:
2000' - 2700'
2700' - 3400'
3400' - 4100'
4100' - 4800'
4800' - 5500'
5500' - 6100'
>6100'

-  Modified Seed Zones
-  Original Seed Zones
-  County Boundaries

Modified Seed Zones