

Oregon Department of Forestry  
**FOREST TREE SEED ZONES  
FOR WESTERN OREGON**  
(1996)

Commercially planted forest tree species  
and other species commonly used in  
wildlife and riparian planting



*"Stewardship In Forestry"*



# FOREST TREE SEED ZONES FOR WESTERN OREGON (1996)

## ACKNOWLEDGMENTS

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## INTRODUCTION

The purpose of this document is to provide information to forest land managers and others about the level of risk associated with moving forest tree seed from a collection (source) environment to another location where it will be grown. The guidelines and recommendations provided in this document, apply to natural populations of indigenous forest tree species unless otherwise noted.

Genetic variation is evident in all biological organisms including forest trees. The differences we observe among trees are determined by genetic differences and environmental influences. In the Pacific Northwest, forest tree species exhibit large genetic differences in survival, growth rate, frost hardiness and other important traits. For several decades, genetic differences among populations of a species have been recognized as an important consideration when selecting appropriate seed sources for regeneration programs. There are numerous examples around the Pacific Northwest of "off site" plantations where survival and growth of planted stands are less than optimum due to poor selection of seed source.

During the last 20 years, research into genetic variation of growth and other adaptive traits has helped define the risks of seed movement for forest tree species. This guide summarizes current research knowledge, published seed zone literature, seed transfer rules and information about genetic variation for tree species used in reforestation, wildlife, and riparian planting. Specific guidelines are given for each species. If no published information is available, general guidelines are given for that species and geographic area based upon known patterns of genetic variation or on general rules of seed transfer.

The Guidelines provided in this document apply to Western Oregon from the Pacific Coast to the crest of the Cascade Mountains. In addition, seed zones for ponderosa pine and lodgepole pine are also provided for eastern Oregon since available genetic information on these species was currently available.

To determine the appropriate seed source for planting in an area of interest, locate the page reference from the table of contents for the specific species, then refer to the species map for seed zones and elevations. Elevation bands are not mapped but are described in the seed transfer guidelines.

For purposes of identifying a seedlot using these guidelines a suggested identification code is, species name (code), geographic zone (code), and elevation band (code).

Conifer forest tree species of the Pacific Northwest have the highest levels of genetic variation found in plants (Hamrick et al. 1992). Therefore, these guidelines are for forest tree species and should not be used for other plants. However, seed zones for Douglas-fir encompass areas where environmental variation is generally fairly uniform and can serve as guidelines for other species where no guidelines currently exist.

## HISTORY OF SEED ZONES

Foresters in western Oregon gained an early appreciation for the importance of seed source through large scale tree planting projects in the Coast Range (1920's-1940's) following major forest fires. For plantations that were most maladapted, seedlings survived poorly or grew slowly, suggesting a poor match of seed origin with planting environment. By 1962 a system to certify forest tree seed to stand origin was established in Oregon under the guidance of the Northwest Forest Tree Seed Certifiers and administrated by the Crop Improvement Association, Oregon State University Extension Service. Four years later, in April 1966, a statewide seed zone map was developed by individuals, primarily local foresters, who were knowledgeable in topography, weather, climate, and tree growth (based primarily upon Douglas-fir). The map was revised in July 1973. Since then, the Seed Zone Map has been used to guide seed and seedling transfer for forest tree species.

The range of each species generally embraces a broad set of environmental conditions. Within that range there are specific ecological niches for which a species is better suited.

A geographic zone with generally uniform environment may cover just a few thousand acres in the mountains of western United States while a similar uniform range of environment may occupy an entire state in the gentler topography of the southern or mid-western portion of the USA. Mountainous topography with small areas of uniform environment usually dictates small seed zones where seed should not be transferred very far from its origin.

Most climatic information is gathered for agriculture use from weather stations at low elevation. In the mountainous forested regions few weather stations exist. Therefore, researchers in the western United States have based seed zones, or more specifically seed transfer rules, on geographic-genetic variation. Patterns of geographic genetic variation are determined from seedlings grown



from seed collected in specific natural stands and evaluated in nursery and field tests. These natural genetic patterns of variation form the basis for maps and seed transfer guidelines that are published in this report. Unfortunately, genetic mapping of only a portion of Oregon and a few species have been completed leaving large gaps of knowledge for some species. To fill these voids, genetic information, geographic patterns, climatic data, and persons with local species knowledge were also used as sources for information upon which guidelines for seed movement were based.

To illustrate major differences among species in genetic patterns of geographic variation an example from the interior west is used. Gerald Rehfeldt (1994a) found that populations of Douglas-fir occurring in habitats that differed by at least 18 days in the mean frost-free period were genetically differentiated. For ponderosa pine the interval required to delineate population differences was 35 days, for western red cedar 55 days, and for western white pine no genetic differentiation was found in 80 days of frost free period.

Since geographic-genetic variation is a continuous variable, a mathematical model is an effective method to evaluate risks when transferring seed. For many species, the larger the environmental difference between the planting location and the origin of the seed, the greater the risk of seed transfer. The "modeling" approach, while providing more accuracy, does not offer the practicality of map-based seed transfer guidelines. For this report, maps are used as the primary information tool and seed transfer models, when available are referenced.

## DEVELOPING SEED ZONES

Ideally seed transfer guidelines result from evaluation of long-term field tests of several populations collected across the species range and planted across a variety of environmental conditions. Long-term Douglas-fir evaluation, in western Oregon, has shown that growth rate progresses at a steady state and can be determined at an early age. Determining adaptation, however, requires longer term testing, perhaps 50 years, to provide time for the environment to eliminate non-adapted populations (Roy Silen, personal communication March, 1995). Another valuable approach, when results from long-term tests are not available, is to map genetic patterns of geographic variation from nursery tests. In concept, the larger the genetic difference observed in nursery seedlings the greater the presumed adaptive difference between populations. The assumption is that genetic differences are largely adaptive and a map of genetic variation is also a map of the environment that shaped natural selection.

Genetic mapping and long term testing are initiated by selecting many parent trees across a geographic range, collecting seed from each parent, and growing the seedlings in nursery environments. Long-term tests are planted, with nursery seedlings, at several locations to reflect the range of environments, in the region under study. Seed transfer recommendations are made after assessing survival, growth, and tree development for many years. The genetic mapping approach utilizes the seedlings at the nursery (more than one nursery environment). Growth and phenology are measured to determine patterns of geographic-genetic variation. Geographic areas and/or distance that seed can be transferred, without undue risk of maladaptation, are estimated from observed genetic patterns. Seedling tests, however, do not evaluate all risks, and are thus provisional until long-term field results become available.

Patterns of variation for different species are sometimes, but not always, similar within the same region. When environmental gradients and related genetic clines are steep (such as with rapid elevational change), seed transfer may be possible for only very short distances.

Temperature and precipitation are major climatic factors responsible for genetic selection. Climatic factors that determine growing season length are influenced by elevation, mountain profile, latitude, and distance from the ocean. By matching the latitude, longitude, and elevation of both the source of seed and the planting location, the relative risk of seed transfer can be assessed. The most suitable method to determine risk of maladaptation when transferring seed is to calculate projected risk by using mathematical models developed through genetic studies. Unfortunately, only a few areas of Oregon have been "genetically mapped" using these techniques.

Risk of seed transfer should be assessed upon environmental distance, not geographic distance, and should consider the species sensitivity or "plasticity" to seed movement. A change in precipitation, temperature, elevation, climate, etc. from one location to another is termed an environmental gradient. When major environmental changes occur in a short geographic distance, the genetic gradient may be steep and seed transferred across that gradient could have a high probability of maladaptation.

A common approach is to delineate areas in which geographic-genetic variation is small. This is the typical seed zone approach or classification model. Unfortunately, tree variation is usually continuous (clinal variation) with no distinct lines on the landscape. Even so, seed zones are the most practical approach and easily located on the ground and on maps. Classification zones based upon soils, vegetation type, slope and aspect, and watersheds do not accurately explain patterns of genetic variation, and, as such, cannot replace the testing process to determine the species variation across the landscape. The three geographic coordinates of latitude, longitude,

and elevation, which are easily measured and located on maps and the ground, have become most useful in the development of seed transfer rules and seed zone maps. The 1966 version of seed zones appears to be suitable for some species in certain areas (Campbell and Sugano 1993). For other species, 1966 seed zones do not accurately predict a risk of seed movement.

Seed zones provided in this report are elongated north and south following temperature and precipitation zones. Seed zones are similar to plant hardiness zones which are based upon a 10 degree F difference in average annual minimum temperature (Cathey 1990).

Both procedures reflect the goal of matching the length of season when temperature and soil moisture permit risk free growth.

Attempts to classify seed movement based upon watersheds, elevational bands (Campbell and Sugano 1993), soils and seed zones (Campbell 1991) vegetation type (Campbell and Franklin 1981), and slope and aspect (Sorensen 1983), have generally not been very successful. Most genetic variation for Oregon forest trees can be explained by elevation, latitude, and longitude (Campbell 1991).

For some species and zones seed transfer models are available. If land ownership is split by a seed zone boundary, boundary adjustments are possible after accessing transfer risk with the appropriate seed transfer model (see specific species zone description suitable for your area).

## GENERAL SEED TRANSFER GUIDELINES

### Introduction:

The following general guidelines are intended to be used for species where specific information about risks of seed movement is not currently available. These guidelines only apply when planting on sites where the species naturally occurs.

1. The level of risk for seed transfer within a zone and elevation band assumes using a zone-wide seed mix collected at several random locations within the same zone and elevation band. If localized collections are made at the edge of a zone or limit of an elevation band, safe transfer would be about half a band width. This restriction usually would be more important for elevational and longitudinal than for latitudinal transfers (Frank Sorensen personal communication, March 1995).

2. Seed transfer to a higher elevation usually increases the risk of maladaptation, e.g. the potential for climatic damage. A transfer to a lower elevation probably will not increase survival risk, but may decrease productivity. If wood production is important and geographically localized collections are made, seed should probably not be transferred down over 500 feet.

3. Risk from equivalent seed transfer distance is greater with elevational transfers in the Cascades than in the Coast Ranges of Oregon (Campbell and Sorensen 1978). At locations more distant from the coast, elevation is not as great an influence as is longitude. Latitude has less influence on seed transfer than does longitude (Campbell and Sugano 1993, Campbell 1986, Sorensen 1983, and Campbell 1991).

4. A 300-meter (1000 feet) elevation transfer is considered to be about maximum in western Oregon for Douglas-fir (Sorensen 1979).

5. Local populations are generally well adapted to local environments and are the safest to use until long-term provenance tests locate better adapted or better growing sources (Namkoong 1969).

6. Seed transfer across any environmental gradient imposes the same relative risk regardless of whether transfer is to a milder or to a harsher condition (Campbell 1986).

7. Environmentally uniform zones are generally smaller at high elevation than at low elevation (Campbell and Sorensen 1978). Size of planting zone decreases as site severity increases (Adams and Campbell 1982, Sorensen 1979). Therefore, less seed movement is possible at higher elevation Cascades sites. The steeper the genetic gradient, and the harsher the planting site involved, the greater the risk of seed transfer (Adams and Campbell 1981). High elevations and harsh climates dictate that seed must be planted fairly close to its origin. However, closer to the ocean, at low elevation, seed movement becomes much less restrictive. Coastal climate permits most seed sources to survive, but those from harsher environments may grow less than those from favorable environments which are better able to utilize the site potential.

8. When planting a species near its biological limits, a higher planting density is recommended and early thinning should be delayed to compensate for higher than normal mortality due to fewer seedlings being genetically adapted (Campbell 1975 and 1987). Shorter rotations would also reduce risk.

9. Risk of maladaptation is greatly increased when transferring seed across more than one environmental condition; for example, when transfer is from west to east and also from lower to higher elevation (Adams and Campbell 1982).

10. At higher elevations the rate of adaptional change is greater than at lower elevation, and if a zone includes the upper elevational distribution of a species, the elevational bands are narrower at the top. [At the species margins, natural regeneration should probably be strongly encouraged (Personal communication, Frank Sorensen March 1995).]

11. If ownership or management would benefit by "floating" the zone boundaries north or south, that usually can be done. Sorensen (1994) stresses that seed zones are not major divisions between populations; zone locations result in least risk for seed transfers. The same applies for elevation (a 1000-foot band can be between 1700 and 2700 feet as well as between 2000 and 3000 feet if the former fits the species distribution better) with the exception that the bands at higher elevation are often narrower. In this context, zone lines should be considered as flexible boundaries.

12. Local site conditions may also effect inherent growth potential. If wood production is important, seed from a lower quality site should not be used on more productive sites even if they are within the same zone and elevation. By example in western Oregon there are many local areas on the east side of high ridges that receive less precipitation (rain shadow). Tree growth in these rain shadow areas may be inherently less than the growth in the surrounding higher precipitation areas. Transferring seed from lower to higher precipitation areas may result in reduced growth.

13. Relative humidity may be important; for example transferring seed from a warm dry area to a cool moist area may increase the incidence of foliage disease (Squillace et al. 1975 and Nelsen et al. 1989).

14. Seed orchard seed is most safely used in the breeding zone of the parents or in breeding zones where the parents have been tested (Campbell 1992). (See reference to Seed Orchard Seed below.)

15. Recommended number of seed parents in a seed lot ranges from 15 to 30. If there is equal representation from each seed parent, then the smaller number is suitable; if unequal representation, then the larger number is appropriate (Adams et al. 1992). Regardless of the number, the parents should represent a seed zone wide mix, unless genetic information is available to demonstrate the desirability of single stand collections.

## SEED ORCHARD SEED

Since the late 1960's, most forestry organizations in the Pacific Northwest were participating in large-scale genetic tree improvement programs. The purpose of these programs is to increase growth, yield and wood quality, of planted forests, while maintaining long-term adaptability. Currently a larger amount of the Douglas-fir planting stock in Western Oregon originates from tree improvement programs.

Tree improvement activities involve the selection of genetically improved trees and the production of improved seed. Genetic selection involves the field testing of numerous progeny from each selected tree and the measurement and evaluation of the progeny trees over time. Tree selections which test-out to be better than average are included in seed orchards. Seed produced from orchards is sometimes made available for



sale to other parties (as seed or seedlings). Prior to purchasing and using orchard seed or seedlings, the purchaser may want to ask the following questions, to assess the desirability of using genetically improved seed/seedlings from a specific seed orchard.

1. What is the origin (geographic location and elevation) of the seed parent trees in relation to the location and elevation of the intended planting site(s)?
2. Are there genetic (progeny) tests of the seed producing parents or field tests demonstrating the performance and adaptability of the orchard seed?
3. What geographic area do the tests encompass? How do test locations relate to the location of the intended planting site(s)?
4. What are the results of the tests? How much better or worse than average is the orchard seed predicted to be for the survival, growth, disease resistance, frost susceptibility and other adaptive traits?
5. How many seed parents are represented in the seed/seedling mix? (See General Seed Transfer guideline 15.)
6. What is the risk of pollen contamination in the seed orchard? Pollen drifting into the orchard blocks from outside stands or geographically different orchard blocks may reduce genetic gain or increase the risk of maladaptation (Stoehr et al. 1994).
7. What percent of the trees in the orchard produced seed? Better adaptation is obtained when there are a large number of parents, both male and female, represented in the seed lot. (See General Seed Transfer guideline 15.)

## GUIDELINES FOR INDIVIDUAL SPECIES

### Douglas-fir:

Douglas-fir (*Pseudotsuga menziesii* var *menziesii* (Mirb.) Franco) seed transfer was extensively evaluated for southwestern Oregon. Seed transfer guidelines for Douglas-fir, in other westside areas, are based primarily on an extensive system of progeny tests, climatic patterns, patterns of genetic variation, and general seed transfer rules. Western Forest Tree Seed Council present seed zones, after some modification, will alleviate the risk of maladaptation during seed transfer (Campbell and Sugano 1993). However, soil series and seed zone maps do not provide a good representation of geographic-genetic variation of Douglas-fir in Southwestern Oregon (Campbell 1991).

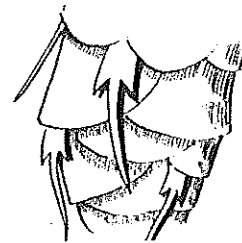


For southwestern Oregon, in an area 100 miles north from the California border and 115 miles east from the coast, Hamlin (1993) hypothesized that Douglas-fir has adapted to three major macro-climatic regions where selection has significantly influenced the present growth and phenology patterns. Hamlin's zones were coastal, lower elevation inland, and high elevation. The coast zone has a single elevation and the inland zones are divided into low and high elevation zones. The genetic structure within each of these zones is relatively homogenous and much more similar within than between adjacent zones. Within this same area Campbell (1986) stated that the risk of maladaptation was greatest when transferring seed either east-west along the southern boundary or north-south along the western boundary. This area of southwestern Oregon may appear to have less environmental change than the higher elevations of the Cascades but the east-west gradients are just as steep. Sorensen (1983) suggested a subzone to separate the west side of the coastal ridge from the rest of the southwest coastal region. Seed transfer across the Coast Range crest is not recommended as Sorensen (1983) found greater differences in phenology between the two sides than between east and west aspects further inland.

Campbell and Sugano (1993) proposed blocking southwestern Oregon into three geographic areas with different numbers of elevation bands in each block: 0 to 610 meters, from 611 to 838 meters, and then a series of bands 152 meters wide at higher elevations. The coastal breeding block generally follows the western edge of the Kalmiopsis Wilderness north to Heywood Peak and the Josephine-Curry county line and northward along the Illinois River. The central block starting at Little Grayback Mountain at the Oregon-California line north to Cave Junction and north-westward to Onion Mountain. The third area extends eastward to the crest of the Cascade Range. The coastal area is the Powers and Gold Beach Cooperative tree improvement area. Cooperative tree improvement data on file at U.S. Forest Service Genetics project, Corvallis, OR. Present seed zones with their 500 foot elevation bands account for nearly two-thirds of the genetic variation among locations (Adams and Campbell 1982). Campbell (1991) states that reconfiguring present seed zones based upon a physiographic model provides the least amount of risk.

#### South Coast

Sorensen (1983) recommended that a narrow coastal strip zone be established which is separate from the present coastal zone. Sorensen's coastal zone starts from the California border and extends northward to about 43 degrees where it joins the Coast Range crest. Further north from 43 to 45 degrees the crest of the Coast Range is nearer to the ocean and there probably is no need for a division of the present zones (071, 062, 061, and 053). Then further north from 45 degrees to the Columbia River another zone is again needed. In southern Oregon there are greater temperature differences near the coast than there are further inland and thus the genetic gradients are also steeper.

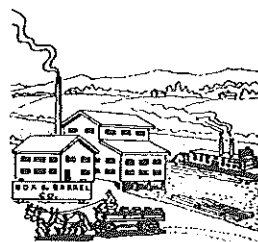


For the Western Siskiyou, the seed zone map designates a Coastal region extending from the ocean to a set of ridges approximately 60 km inland (seed zone 081). Generally this line runs along the main eastern ridges of the Coast Ranges. Sorensen (1983) reported that his results are preliminary, but they indicate that a

subzone should be considered to separate the coastal ridge and perhaps even the west side of the coastal ridge from the rest of the Coastal Region. The Gold Beach Cooperative makes this breakdown for their applied tree improvement program. (Cooperative tree improvement data on file at U.S. Forest Service Genetics project, Corvallis, OR.) Seedlings from the North Umpqua area have different growth patterns than seedlings from the South Umpqua area (Loopstra and Adams 1989).

#### Central Coast

Common garden studies of Douglas-fir from the central coastal area have shown that sources west of the Coast Range crest break bud in the spring 10 to 14 days later than sources east of the crest. This change appears to be more abrupt north of a line from Newport to Hoskins than south (Sorensen personal communication). Elevations within the west slope of the central Coast Range are similar but not as pronounced where low elevation sources flush later than higher elevation sources (personal communication Lisa Balduman OSU Dept. Of Forest Science, January 1995). Genetic maps from the Mapleton and Tillamook areas show depressed growth rate of young trees from the fog-zone along the coast, with later bud bursting (data on file at U.S. Forest Service Genetics Research Project, Corvallis, OR). Elevational seed transfer for the north and central coast area should be fairly restricted. Douglas-fir from the lower elevations is less susceptible to Swiss needlecast than are higher elevation sources (Nelson et al. 1989). Cooperative programs for the coast area at Reedsport and Mapleton have shown major growth differences between the east and west side of the Coast Range. This growth pattern is comparable to the better growth seen for parents from the coast side of the Coast Range for the Siuslaw National Forest which extends along the coast from Reedsport to Hebo (data on file at Siuslaw National Forest Supervisors Office Corvallis).

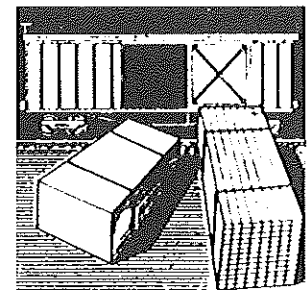


## Cascades

Moving seed from the east side of the Coast Range to the west side of the Cascades is one of the poorest seed transfers that can be made (Silen 1964). The Dallas Valley cooperative separated poor growth on the east side of a line from better growth from Pedee-Fall City-Dallas-Willamina-Sheridan-McMinnville (Silen and Mandel 1983). That line is approximately the boundary between old seed zones 251 and 261 which separates the east slopes of the Coast Ranges from the Willamette Valley. Because of tree growth differences and major precipitation changes, a separate Willamette Valley seed zone is recommended which has as a boundary corresponding to approximately the 600 foot elevation and the 50 inch rainfall line. Precipitation being not generally different, old seed zones 261 and 262 have been combined into a single zone. Spring frost is a major weather factor that influences seed movement. A general area of major spring frost was identified by Timmis et al. (1994) as occurring along the flanks of the Cascades in central and southern Oregon as well as for the area from Corvallis northwest towards Grand Ronde. New seed zones for the Umpqua and South Cascades seed zones reflect the eastern spring frost area and the separation of the Willamette Valley from the east slope of the Coast Range, the other frost area.

## North Coast

Vernonia cooperative parents with slowest growth are from the rain shadows that fringe the Willamette Valley and extended northward into the upper Nehalem drainage to Vernonia (Silen and Mandel 1983). Better growth was recorded from parents nearer the Columbia River (Silen and Mandel 1983). A seed zone division can be along a line from St. Helens to Vernonia to Jewell. The major influence on growth was latitude as is reported for Douglas-fir and other species in western Oregon. Height growth patterns followed the general landform in many instances and is related to growing season length (Silen and Mandel 1983). Best growth is found in areas of deep soil, or on broad ridgetops also with heavy rainfall and deep soils.



Douglas-fir seed zones:

1. South Coast: From the coast eastward to the first major ridges, following a line of ridges halfway between Bandon and Coos Bay eastward to Coquille then south on Hwy 42 to Powers, Barklow Mt., Iron Mt., Agness, Raspberry Mt., Buzzards Roost, Saddle Mt., Collier Butte then south along the Kalmiopsis Wilderness to the California border. (Western half of old seed zones 072, 081, 082, and 090.)
2. South Coast Inland: East from Summer, Coos Mt. Bear Mt. at the Coast Range crest; south from Bear Mt. along the Coast crest to Taylor Mt., Onion Mt., Squaw Mt., southeast to Hwy 199 and south to the California border; southern boundary is Oregon-California border; western boundary is from the California border, Chetco Pk., Big Craggies, Collier Butte, Saddle Mt., Buzzards Roots, Raspberry Mt., Agness, Iron Mt., Barklow Mt., Powers, Hwy 42 to Coquille, then Summer. (Eastern half of old seed zones 072, 081, 082, 090, and western half of 512.)

These divide the old coast seed zones into eastern and western zones.

3. South Interior: Northern boundary is the Josephine County line from Coast Range crest east to I-5; eastern boundary is I-5 south to Medford then east to Grizzly Pk., southeastward to Soda Mt. and the California border; southern boundary is the Oregon border; western boundary is north along Hwy 199 to Squaw Mt., Onion Mt., Taylor Mt. at the Coast Range crest, north along the crest to the Josephine County line. (Eastern portion of old seed zone 512 and old seed zones 511 and 321.)

Elevation bands for the above three zones are 0 to 2000 feet, 2001 to 2750 feet then a series of bands each 500 feet wide.

4. Central Coast: From the coast east to the Coast Range crest; northern boundary is east from Cape Foulweather to Siletz, to the ridge slightly north of Nashville; eastern boundary is the Coast Range crest; southern boundary is Bear Mt. at the Coast Range crest west to Coos Mt., Summer, Coquille, and approximately half-way between Bandon and Coos Bay. (Old seed zones 061, 062, and 071.)

Elevation bands are: 0-1,000' then a series of bands each 500 feet wide.

5. North Coast: From the coast east along the Columbia River to St. Helens; eastern boundary is south from St. Helens, Bunker Hill, Vernonia, Round Top and south along the Coast Range crest to slightly north of Nashville; southern boundary from Nashville west to Siletz, and Cape Foulweather. (Old seed zone 041, 051, and 053; western portion of 052.)

Elevation bands for the North Coast seed zone are 0 to 500 feet and continuing upward with 500 foot bands.

6. East Slope of Coast Range (north): Northern boundary is from Round Top on the Coast Range crest to Vernonia, and Bunker Hill; eastern boundary from Bunker Hill, North Plains, Gaston, Yamhill, Bellevue, Alpine, Franklin, Veneta, Crow, Gillespie Corners, Divide, Anlauf, and Rice Hill; southern side is from Rice Hill west to Yellow Butte, to three miles north of Old Blue on the Coast Range crest; western boundary is north of Old Blue along the Coast Range crest to Round Top. (Old seed zones 251 and 252; southern portion of 052 which reflects growth from Vernonia Cooperative.)
7. East Slope of Coast Range (south): Northern boundary is an east-west line from three miles north of Old Blue Mt. to Rice Hill; eastern boundary is I-5 south from Rice Hill to Josephine County; south boundary is Josephine county line to Coast Range crest; western boundary is crest of the Coast Range. (Old seed zone 270.)

8. Willamette Valley: Northern boundary is the Columbia River from St. Helens east to Corbelt; eastern boundary is south from Corbelt, Orient, Colton, Sweet Springs Mt., Lyons, Lacombe, Coburg Hills, Marcola, Deerhorn, Lowell, Hardesty Mt., Holland Pk., and Fairview Pk.; southern boundary west from Fairview Pk., Huckleberry Mt., Elkhead, and Rice Hill; western edge is from Rice Hill north to Anlauf, Divide, Gillespie Corners, Crow, Veneta, Franklin, Alpine, Bellevue, Yamhill, Gaston, North Plains, Bunker Hill, and St. Helens. (Combine old seed zones 261, 262, 481, and a portion of 042 as far north as St. Helens and Bunker Hill. Eastern boundary reflects growth pattern of Molalla Cooperative.)

A single elevation zone for the Willamette Valley.

9. Willamette Valley (east): Northern side is the Columbia River from Corbelt east to Bonneville Dam; eastern boundary is from Bonneville Dam southwest to upper end of Bull Run Reservoir, Cherryville, Goat Mt., Soosap Pk., Table Rock, Niagra, Monument Pk., Moose Ridge, Green Mt., Vida, McKenzie River to Deerhorn; south and west boundary is from the McKenzie River at Deerhorn northward Marcola, Coburg Hills, Lacombe, Lyons, Sweet Springs Mt., Colton, Orient, and Corbelt. (Combine old seed zone 471 and 461; and western half of 451 and 452; and portion of 042.)
10. North Umpqua: Northern boundary is eastward from Rice Hill to Huckleberry Mt., Fairview Pk., Calapooya Ridge to Cowhorn Mt. at the Cascade crest; east boundary Cowhorn Mt., Elephant Mt., Mt. Bailey; southern boundary Mt. Bailey, Fish Mt., Quartz Mt., White Rock, Lane Mt., Dodson Butte, and I-5 half-way between Roseburg and Myrtle Creek; western boundary is I-5 north to Rice Hill. (Old seed zone 491.)



11. South Umpqua: Northern boundary is I-5 half-way between Roseburg and Myrtle Creek to Dodson Butte, Lane Mt., White Rock, Quartz Mt., upper end of Black Rock Fork, and Fish Mt.; eastern and southern boundary from Fish Mt., Abbott Butte, Josephine County and Jackson County lines to I-5 at Wolf Creek; western boundary is I-5. (Old seed zone 492.)
12. North Cascades: Northern boundary is the Columbia River from Bonneville Dam to the Cascade crest; eastern side is from the Columbia River south along the Cascade crest to the North Fork of the Breitenbush River, to Marion Forks and old Cascade crest to the McKenzie River; southern boundary is the McKenzie River west to Deerhorn; western side is from Deerhorn, Vida, Green Mt., Moose Ridge, Monument Pk., Niagra, Table Rock, Soosap Pk., Goat Mt., Cherryville, upper end of Bull Run Reservoir and northward to Bonneville Dam. (Eastern corner of old seed zone 042, combine old seed zones 462 and east half of 451 and 452. (Move southern boundary of 462 to McKenzie River.)
13. Old Cascades: Area between the old and new Cascade crests; follow new Cascade crest south from the upper end of the North Fork of the Breitenbush to Pengra Pass; western boundary is old Cascades north from Salt Creek to the upper end of the North Fork of the Breitenbush. (Combine old seed zones 463, 473, and 483.)
14. Central Cascades: Northern boundary is the McKenzie River from Leaburg to the Cascade crest; eastern boundary is the crest of the old Cascades from the McKenzie River to Pengra Pass then the new Cascade crest to Cowhorn Mt.; south and west boundary is Cowhorn Mt., Calapooya Mts. Holland Point, Hardesty Mt., Lowell, and McKenzie River at Leaburg. (Combine old seed zones 482 and southern half of 472 north to the McKenzie River.)

15. South Cascades: Eastern boundary is the Cascade crest from Cownhorn Mt. south to Mt. McLoughlin; south and western boundary is from McLoughlin, Russler Pk., Olson Mt., Cascade Gorge, Whetstone Pk., to Jackson County line three miles SW of Abbott Butte, Fish Mt., Mt. Bailey, Elephant Mt., and Cowhorn Mt. (Combine old seed zones 493 and 501.)
16. Eagle Point: Northern boundary is I-5 at Josephine County line east along Josephine and then Jackson County to near Abbott Butte; eastern boundary is south to Whetstone Pk., Cascade Gorge, Olson Mt., Russler Pk., Mt. McLoughlin and Cascade crest to California border; western boundary is a line at the California border SE of Soda Mt, then Soda Mt., Grizzly Pk., Medford, I-5 north to Josephine county. (Old seed zone 502.)

For all the zones (except those otherwise marked) use 0 to 1000 feet and thereafter 500 foot elevation bands.

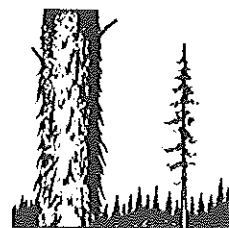
#### Alaska Yellow Cedar:

Alaska yellow cedar (*Chamaecyparis nootkatensis* [D.Don] Spach.) is a tree of the northern and central Oregon Cascades found on cold sites at mid to high elevations. The northern Cascades seed zone, which extends south to the McKenzie River, covers most of the commercial area for western Oregon. There are a few scattered trees south of the McKenzie River but probably none south of the Calapooya Divide.



#### Alaska yellow cedar seed zones:

1. North Cascades: Northern edge is the Columbia River; east side is the Cascade crest; south boundary is west of the Cascade crest along the McKenzie River-White Branch; west side is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton,



Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordsville, along Coburg Hills, Marcola, and Walterville at McKenzie River. (Old seed zones 451, 452, 461, 462, 463, 471, and north half of 472 and 473.)

2. Central Cascades: North side is the McKenzie River-White Branch; east edge is the crest of the Cascades; southern boundary is the Calapooya Divide; western edge follows a line from Walterville, Lowell, Hardesty Mt, Holland Pk., then along ridge of Calapooya Mts., to Cowhorn Pk. at the Cascade crest. (Old seed zones 482, 483, and south half of 472.)

Elevation zones are from its lower elevation limit to 4000 feet and 1000 foot bands above 4000 feet.

### Incense Cedar:

Incense cedar (*Calocedrus decurrens* [Torr.] Florin) is found on dry sites in the central and southern Cascades but more commonly in the Siskiyou Mts. of southwestern Oregon. It does not occur on the coast; its western boundary is along the first major ridges inland in Coos and Curry counties.

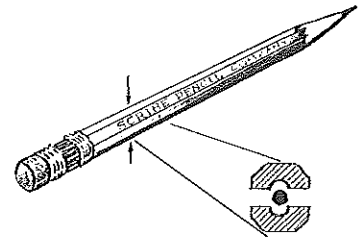


Rogers et al. (1994) found in a 12 year common garden test that the majority of genetic variation in incense cedar from California is within local stands with little among-region differentiation. Their evaluation of six geographic sources also indicated that longitude was not a significant factor for height, volume, diameter, or crown form. Latitude was a little more important accounting for one to ten percent of the total variation depending on the variable. The southern California source (Los Angeles County) was significantly different from the other five sources. Their recommendation was that the present California seed transfer guidelines already in use for other conifers should be applied to incense cedar.

Since there were no growth differences detected among the five northern seed sources in the Rogers et al. Study, which spanned an area from Klamath Falls, Oregon to Greenhorn Summit, California, nearly eight degrees of latitude, the proposed zones of one and one-half degrees of latitude should be suitable.

Incense cedar seed zones:

1. South coast inland: Starting at the species northern margin near Coquille, east to Fairview, McKinley, Dora, Sitkum, Bear Mt; eastern boundary is the Coast Range crest south to Onion Mt., Squaw Mt., Hwy 199 to Oregon border; western side is from Oregon border north to Chetco Pk., Big Craggies, Collier, Mt., Saddle Mt., Agness, Iron Mt., Powers, Broadbent, Coquille. (Eastern half of old seed zones 072, 081, 082, and 090; and western half of seed zone 512.)
2. East slope of Coast Range (south): Northern boundary is Hwy 38 from Coast Range crest to Drain; eastern border is Drain to Rice Hill, I-5 to Grants Pass, Roundtop Mt., Mungers Butte, Clayback Mt., Craggy Mt., Oregon border; western boundary is north from the Oregon border on Hwy 199 Cave Junction, Squaw Mt., Onion Pk., Mt. Peavine and Coast crest to Hwy 38. (Old seed zones 270, northwest portion of 511, eastern half of 512.)
3. Southern Interior: Northern boundary is Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., and Lowell; eastern boundary is Lowell, Hardesty Mt., Holland Pk., Harding, Quartz Mt., Grasshopper Mt., Abbott Butte, then Douglas-Jackson County line, Hwy 62 to Medford, Grizzly Pk., Soda Mt., Oregon border; western side is north from the Oregon border, Craggy Mt., Clayback Mt., Mungers Butte, Roundtop Mt., Grants Pass and I-5 to Divide. The few scattered incense cedar populations of the Willamette Valley found in Southern Linn County are considered part of this zone. (Old seed zones 481, 492, 321, west three-quarters of 491, west half of 502, and east one-half of 511.)



4. Cascades: North side is the McKenzie River from Deerhorn to the crest of the Cascades; east edge is the Cascade crest to the California border; western edge follows a line from Oregon border to Soda Mt., Grizzly Pk., Medford, Hwy 62 to Douglas-Jackson County line, Abbott Butte, Grasshopper Mt., Quartz Mt., Harding, Holland Pk., Hardesty Mt., Lowell, Deerhorn. (Old seed zones 482, 483, 493, 501, south half of 472 and 473; east half of 491, and eastern fringe of 492.)

Elevation Bands: Elevation bands are 1000 to 2000 feet and 1000 foot intervals thereafter.

#### Port Orford Cedar:

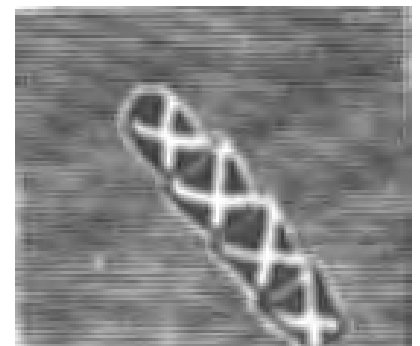


Port Orford cedar (*Chamaecyparis lawsoniana* A. Murr.) occurs as small scattered populations in the coastal fog belts of SW Oregon and southwest California. It is primarily in Coos and Curry counties but also found in a few small areas in western Lane and Douglas counties. Many horticultural varieties are planted.

Variability of California populations of Port Orford cedar is considerably lower than that of other conifers of the same region (Millar and Marshall 1991). But there is more variability than found in western red cedar (Copes 1981) and less variability than in incense cedar (Millar and Libby 1991). Millar and Marshall found that inland populations were distinguished from coastal populations by allele frequencies and were more variable than the coastal populations.

#### Port Orford cedar seed zones:

1. Central Coast: Coast to the crest of the Coast Range, Newport (Yaquina River) south to Bandon, east along the Coquille River to the crest of the Coast Range. (Old seed zones 061, 062, and 071.)

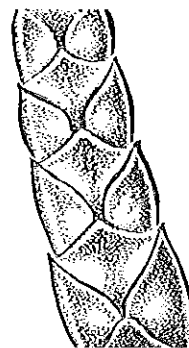


2. South coast: Bandon south to California-Oregon border, east along Coquille River to Coast Range crest, following a line Bandon, Coquille, Fairview, McKinley, Dora, Sitkum to near Reston (old seed zones 072, 081, 082, and 090.)

Elevation Bands: From sea level to 1500 feet and from 1500 to 2500 feet.

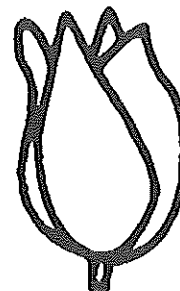
Western red cedar:

Western red cedar (*Thuja plicata* Donn ex D.Don) occurs throughout western Oregon, along streams and on moist flats and mountain slopes. This species is unique among western conifers since it appears to have very little genetic variation (Copes 1981). Seed collections from western Oregon, as far south as Eugene, from western, central and northeastern Washington were evaluated chemically. No genetic variation was detected, every seedling produced the same 19 isozyme bands that are common in other conifers (Copes 1981). Growth of western red cedar seedlings was much less variable than growth of seedlings of six other northwestern forest tree species (Minore 1969). This lack of isozyme variation and growth uniformity implies that the species is genetically uniform. However, western red cedar may be more variable in other portions of its range as some variation was detected in northern California (Millar and Libby 1991) and in the inland west where population differences were found when length of the growing season differed by more than 55 days (Rehfeldt 1994a). Nursery evaluation of seedlings from British Columbia, Montana, and Idaho indicated that populations must be separated by at least 600 meters elevation or two degrees of latitude before differences in growth or phenology are apparent (Rehfeldt 1994a). Clearly western red cedar seed can be transferred long environmental distances. While isozyme results suggest a single zone, growth evaluation places some restriction on transfer.



Western red cedar seed zones:

1. North Coast and Willamette Valley: Western red cedar zones for the Coast Range, Willamette Valley, and central valley to the western edge of the Cascades below elevations of 2000 feet which is approximately a line southward from the Columbia River at Bridal Veil, Lenhart Butte, Colton, Mill City, Cascadia, and Nimrod at the McKenzie River; southern boundary is a line from Florence (Siuslaw River), Knowles Creek, to Bailey Ridge, Wildcat Creek, Veneta, Eugene, McKenzie River to Nimrod.
2. South Coast and Interior valley: Northern boundary is from Florence, Knowles Creek, Bailey Ridge, Wildcat Creek, Veneta, Eugene, McKenzie River to Nimrod; east side is from Nimrod, southward to Oakridge, Steamboat, Tiller, Eagle Point, Medford, I-5 to the California border.



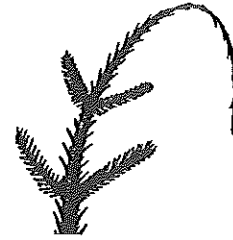
The above two large coast zones have no elevation restriction.

3. North Cascade: Western slopes of the Cascades from the Columbia River south to the McKenzie River; north side is the Columbia River; eastern side is the crest of the Cascades; southern side is the McKenzie River west to Nimrod; western boundary is Nimrod, Cascadia, Mill City, Colton, Lenhart Butte, and Bridal Veil. All above 2000 feet in elevation.
4. South Cascades: Western slopes of the Cascades from the McKenzie River to the Oregon border; north side is the McKenzie River from Nimrod to the Cascade crest; east side is the crest of the Cascades; southern boundary is the Oregon border; western boundary is I-5 north to Medford, Eagle Point, Tiller, Steamboat, Oakridge, and Ninrod. All above 2000 feet in elevation.

Elevations for the Cascade Zones are; low elevation 2000 –3500 feet and high elevation which is above 3500 feet.

### Western Hemlock:

Best development of western hemlock (*Tsuga heterophylla* [Raf.] Sarg.) is along the coast from sea level to 2000 feet. This species occurs throughout western Oregon but away from the coast. It is more common on northern slopes and moist creek bottoms.



Based on seedling growth and phenology data, it has been recommended that seed movement should not exceed 2 degrees north nor more than 400 meters in elevation above the origin of the seed source. (Kuser and Ching 1981). Others have looked at early growth, in a smaller geographic area, and found no evidence to contradict Kuser's and Ching's recommendation (Piesch 1976; Pollard and Porlock 1986.)

Based on early height growth, Foster and Lester (1983) suggested a Coast Range hemlock breeding zone from Clallam Bay, Washington (48 -1/4 degrees) southward to Tillamook, Oregon (45-1/2 degrees). Elevation transfer can be from sea level to 300 meters. Southern, lowland, and coastal provenances grew the fastest (Kuser and Ching 1981).

No evidence of genotype x environment interaction for height growth was found except when populations represented large geographic areas (King 1990). Even in a large geographic area there was no evidence that elevation is an important factor (King 1990). Foster and Lester (1983) found that family performance was stable along the Washington Coast. However, growth performance was not consistent within the geographic area from Lincoln City north to the Columbia River and 40 km eastward from the coast (Roberds et al. in press). They found that populations from the central portion, Tillamook Bay area, performed better when planted at locations where hemlock site index was lower, while populations from either further north or south grew better when planted on the best hemlock producing sites.

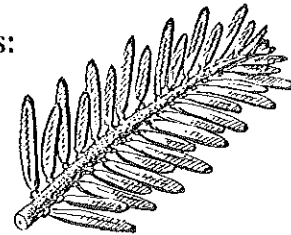


Growth patterns, phenology and cold hardiness were generally similar along the west coast from California to British Columbia (Kuser and Ching 1980; Kuser and Ching 1981). They found that bud set was 4 days later per degree latitude southward and 2 days later per degree latitude for bud burst. Seed germination followed the same pattern as bud burst where northern populations were earlier by 4 days per degree of latitude (Campbell and Ritland 1982). Provenance variation was twice as large as family variation within provenance for most responses (Kuser and Ching 1981).

Cascade populations at the same latitude as Coast populations set bud earlier (Kuser and Ching 1980). It is recommended that seed not be interchanged between the Cascade Range and the Coast Range.

Western hemlock seed zones:

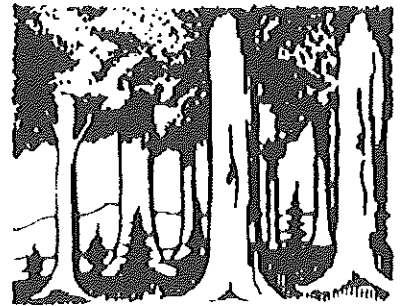
1. Northern Coast: Astoria to Prescott at the north; eastern boundary is Prescott, then south along the Coast Range crest to the Siuslaw River; west to Florence (Siuslaw River, Knowels Creek, to Bailey Ridge) from the coast to the Coast Range crest (Old seed zones 052, 051, 053, 061, 041, and north half of 062). Better overall growth may be obtained if hemlock seed from the coast area from Nehalem Bay to Cape Lookout is planted on low productivity hemlock sites and hemlock seed from the remaining area of the north coast seed zone is used on average and above average hemlock sites.
2. Southern Coast: From Florence along the Siuslaw River to the Coast Range crest and south to the California Oregon border. (Old seed zones 071, 072, 081, 082, 090, and south half of 062.)



Elevation for both zones is sea level to 1500 feet and continuing upwards with 1000 foot bands.

3. East Slope of Coast Range (north): Northern boundary is from Prescott to St. Helens along the Columbia River; eastern boundary is from St. Helens, Bunker Hill, North Plains, Gaston, Yamhill, Bellevue,

Alpine, Franklin, Veneta, Crow, Gillespie Corners, Divide, Anlauf, and Rice Hill; southern side is from Rice Hill west to Yellow Butte, to three miles north of Old Blue on the Coast Range crest; western boundary is three miles north of Old Blue along the Coast Range crest to Round Top. (Old seed zones 251 and 252.)



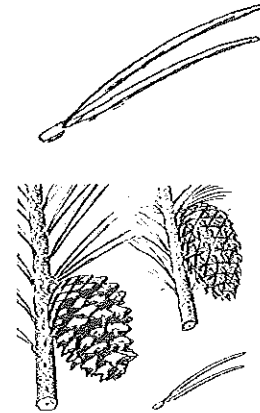
4. East Slope of Coast Range (South): Northern boundary is an east-west line from Rice Hill to three miles north of Old Blue Mt.; eastern boundary is I-5 from Rice Hill to Grants Pass then south to Murphy, Roundtop Mt., Mungers Butte, Grayback Mt., Craggy Mt., and California border; western boundary is the crest of the Coast Range south to the California border. (Old seed zones 270 and 512; northwestern portion of 511.)
5. Willamette Valley: Northern side is the Columbia River from St. Helens to Corbelt; east and south boundary is Corbelt, Orient, Colton, Sweet Springs Mt., Lyonds, Lacombe, Coburg Hills, Marcola, Deerhour, Lowell, Blue Mt., upper end of Cottage Grove Reservoir, Divide; western edge is from Divide, Gillespie Corners, Crow, Veneta, Franklin, Alpine, Bellevue, Yamhill, Gaston, North Plains, and St. Helens. (Old seed zones 261, 262, 461, and 471; western portion of 042.)
6. Southern Valley: Northern edge is from Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., to three miles south of Lowell; eastern side follows from three miles south of Lowell to Hardesty Mt., Holland Pk., Harding Butte, Quartz Mt., Grasshopper Mt., Abbott Butte, Whetstone Pk., Cascade Gorge, Olson Mt. Russler Pk., Mt McLoughlin, Cascade from crest to the California border; western boundary is Oregon border, Craggy Mt., Grayback Mt., Mungers Butte, Roundtop Mt., Grants Pass, I-5 to Divide. (Old seed zones 481, west half of 491, most of 492, 502, eastern one-half of 511, and 321.)

7. West Slope of Cascades (north): Northern edge is the Columbia River; eastern boundary is the Cascade crest south to the high ground west of Cultis Lake; southern boundary is from the Cascade crest to Sardine Butte, Pernot Mt., near Deerhorn; western boundary is three miles south of Deerhorn, Moose Ridge, Monument Pk., Marion Co. line, and the confluence of Molalla and Table Rock Fork Rivers, Colton, Orient, and Corbalt. (Old seed zones 451, 452, 462, 463, 472, and 473, eastern one-half of 042.)
8. West Slope of Cascades (south): Northern boundary is from near Deerhorn east to Pernot Mt., Sardine Butte, half-way between Chucksney and Moolack Mts. and then east to the Cascade crest; eastern boundary is the crest of the Cascades; western boundary is Mt. McLoughlin, Russler Pk., Olson Pk., Cascade Gorge, Whetstone Pk., Abbott Butte, Grasshopper Mt., Quartz Mt., Harding Butte, Holland Pk., Hardesty Mt., Lowell, three miles south of Deerhorn. (Old seed zones 482, 483, 493, 501; east half 491, and western portion of 492.)

Elevation bands are 1000 feet for all zones except for the two low elevation coast zones which have a 1500 foot low elevation band.

### Lodgepole Pine and Shore Pine:

*Pinus contorta* Dougl. ex Loud occurring in a narrow band along the coast is called shore pine (*Pinus contorta* var. *contorta*). There are two varieties of lodgepole pine: the variety found in the Cascades is var. *murrayana* while elsewhere in eastern Oregon the var. *latifolia* is found. These three varieties have different physical characteristics and distinct genetic patterns. Seed transfer rules for shore pine are more restrictive than for either lodgepole variety.



DNA analysis separated shore pine populations from lodgepole pine populations and showed that lodgepole pine from Santiam Pass, Oregon (var. *murrayana*) was more closely related to var. *latifolia* than to var. *contorta* (Dong and Wagner 1993). Shore pine provenances have more genetic variation than lodgepole pine provenances (Ying and Liang 1994).

Widely separated shore pine provenances grown on Vancouver Island were similar in growth traits; however, large survival differences were evident among the populations. The narrow shore pine zone in this region had close local adaption and was sensitive to elevational transfer as well as transfer across climatic zones (Ying and Liang 1994). They recommended that safe seed transfer for the coast should be limited to 150 meters of elevation and 1.5 degrees of latitude and must avoid transfer across major climatic zones.

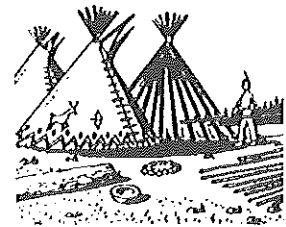
Seed transfer recommendations for interior populations are less restrictive (Rehfeldt 1987, Sorensen 1992, and Ying et al. 1989). Low to mid elevation transfers of 400 meters and three degrees of latitude have succeeded for ten years in British Columbia. (Ying et al. 1989).

In south central Oregon, Stoneman (1984) found elevation of seed source to have a much greater influence on genetic variation than latitude or longitude. This result led Stoneman to suggest that seed transfer in this region can be over fairly broad geographic areas as long as elevations are similar. His

most conservative estimate for the width of the elevational band was 235 meters. Sorensen (1992) recommended broad seed zones for most of the east slopes of the Cascades and for the Warner Mountains and suggested an elevation band width of 300 meters. He stressed that at upper elevations the environmental gradient is steeper and that elevation bands should be narrower. Sorensen also stressed that the use of his regression equations are a better approach to seed transfer than relying on seed zones.

Shore pine seed zones for the coast:

1. North Coast: The coastal fringe from the Columbia River south along coast to Newport (Yaquina River). (Old seed zones 051 and 053.)
2. Central Coast: The coastal fringe from Newport (Yaquina River) south to Bandon (Coquille River). (Old seed zones 061, 062, and 071.)
3. South coast: Coastal fringe from Bandon (Coquille River) south to California-Oregon border. (Old seed zones 072, 081, 082, and 090.)

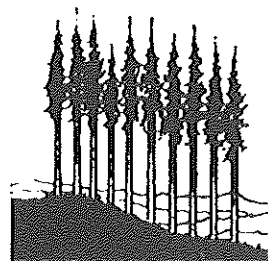


Since shore pine is only found at low elevation a single elevation band from 0 to 500 feet is recommended.

Lodgepole pine seed zones for the Cascades and central Oregon:

1. North Cascades: This zone straddles the Cascades. Northern boundary is the Columbia River from Bonneville Dam to Sherman-Gilliam County line; eastern side follows the Sherman-Gilliam then Jefferson-Wheeler County lines south to Hwy 26; southern boundary Hwy 26 to Juniper Butte, Round Butte, Metolius Bench, Cascade crest at North Fork of Breitenbush River, and Battle Ax; western boundary is north from Battle Ax to Silver King Mt., Squaw Mt., Big Bend Mt. and Bonneville. (Old west side seed zones 451 and 452; old east side zones 661, 662, and 671.)

2. Central Cascades: Northern boundary from Battle Ax east to Cascade crest along Whitewater River to Green Ridge; eastern boundary south along Green Ridge to Squaw Back Ridge, Sisters, six miles west of Bend, LaPine, Walker Rim, and Walker Mt.; southern boundary Walker Mt., six miles south of Cappy Mt. on the Cascade crest, then north to Cowhorn Mt., west along Calapooya Ridge; western boundary is generally along the old Cascade crest north to Juniper Ridge, Koch Mt., Chucksney Mt., Belknap Springs, Batchelor Mt., and Battle Ax. (Old west side zones 463, 473, and 483; old east side zones 675 and 681).
3. Paulina: North and east boundary six miles SW of Bend at Hwy 97, east 12 miles to Hwy 26, Millican, SE 22 miles to the Deschutes-Lake County line, southward to 10 miles east of Fort Rock, Picture Rock Pass, south along Winter Ridge to west side of Summer Lake; south boundary Winter Ridge west to Sycan Butte, Yamsay Mt., Walker Mt.; western side is Walker Mt., Walker Rim, La Pine, six miles south of Bend. (Old seed zones 682, 690, 711, and 713.)
4. Crater Lake: Covering both sides of the Cascades with the northern boundary along the Calapooya Divide to crest of Cascades, to three miles south of Cappy Mt., and Walker Rim; eastern boundary Hwy 97 from near Walker Mt., south to Oregon border; southern boundary is Oregon border; western boundary north from Oregon border, Siskiyou Pass, Grizzly Pk., Olson Mt., Abbott Butte, Fish Mt., Mt. Bailey, Calapooya Divide. (Old west side zones 493, 501, and 502; east side zones 701 and 721.)
5. Klamath: North and east boundary Walker Mt., Slide Mt., Yamsay Mt., Sycan Butte, east to Winter Ridge, Dead Horse Rim, Gearhart Mt., Quartz Mt., Barnes Rim, Yocum Valley at Oregon border; south side is the Oregon border; western boundary is Hwy 97 north to near Walker Mt. (Old seed zones 702, 703, and 722.)



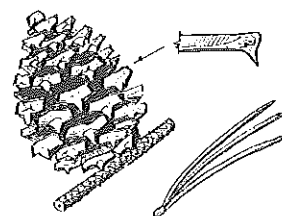
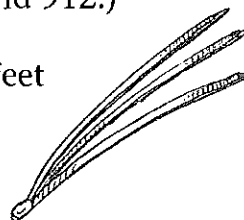
6. Lakeview: North and eastern boundary Picture Rock Pass, SE to Paisley, Valley Falls, Plush, Adel, follow ridge to Oregon border; south side is the Oregon border; western boundary north from the Oregon border Yocum Valley, Barnes Rim, Quartz Mt., Gearhart Mt., Dead Horse Rim, Slide Mt., Walker Rim, Picture Rock Pass. (Old seed zones 712, 731, and 751.)
7. Prineville: North and east boundary Green Ridge and Matolius Bench east to Round Butte, Juniper Butte, Grizzly Mt., Hask Rock, Spanish Pk., Wolf Mt., Suplee; southern boundary Suplee, Paulina, Alkali Butte, Millican, six miles south of Bend; western boundary six miles south of Bend to Sisters, Squaw Back Ridge, junction of Green Ridge and Metolius Bench. (Old east side zones 674, 673, 911, and 912.)

Elevation bands for lodgepole pine are 1000 feet beginning at the lower limit of 2500 feet.

### Ponderosa Pine:

Ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) is a species usually considered as occurring only east of the Cascades. There are, however, several locations where it is found naturally in the western part of the state. Because of its economic importance and available genetic data, east of the Cascades, seed transfer guidelines are provided for central and eastern Oregon. West side seed transfer guidelines are based upon natural occurrence of ponderosa pine and general climatic patterns. For assessing seed transfer risks east of the Cascades, Sorensen and Weber (1994) have developed a computer program which requires knowing only elevation, latitude, longitude, slope, and aspect of the planting site and the potential seed collection site.

Sorensen and Weber (1994) compared genetic patterns of Douglas-fir and ponderosa pine from central Oregon and found that differences due to elevation were similar for both species. However, longitudinal patterns were not similar. Douglas-fir from the Cascades was quite different from Ochoco Douglas-fir, whereas ponderosa pine exhibited no difference between those



same two geographic regions. For whatever factor that guided selection, it resulted in much greater east-west differentiation in Douglas-fir than for ponderosa pine. Even though geographic variation was small for ponderosa pine, its much larger local genetic variation was controlled by slope and aspect, completely unlike other western conifers (Sorensen and Weber 1994) where elevation, latitude, and distance from the ocean or longitude explained most of the local genetic variation for other western conifers.



East of the Cascades, Sorensen and Weber (1994) subdivide the Ochoco and Malheur area into two blocks, one east and one west of longitude 120 degrees west. This longitude is approximated by a north-south line following Baldy, Paulina Butte, and Maupin Butte. Their recommendation is no transfer between the east slopes of the Cascades and the Ochoco and Malheur National Forests. They recommend the establishment of two elevation bands, 4200 to 5200 feet and 5200 to 5900 feet. There are very few Ponderosa pine sites below 4200 feet or above 6000 feet. Seed transfers above 6000 feet should be limited to 500 foot elevation changes. They further recommend that any seed transfers below 4200 feet be based on their seed transfer equation. Their guidelines apply only to ponderosa pine sites within the range covered by these seed zones.

Seed zones for ponderosa pine west of the Cascades are based upon discussions with individuals knowledgeable about the occurrence of this species and patterns of rainfall distribution in this region.

Sorensen (1994) and Sorensen and Weber (1994) recommended ten eastern Oregon seed zones as follows:

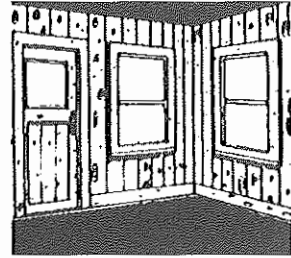
Ponderosa pine seed zones:

1. Hood River: North boundary is the Columbia River; eastern boundary is Hood River-Sherman County line at the Columbia River south along Summit Ridge to Tygh Ridge, Maupin, Mutton Mt.,



Eagle Butte at Jefferson-Wasco County line; south boundary is Jefferson-Wasco County line; western side is the Cascade crest. (Old seed zone 661, west half of 662 and 671.)

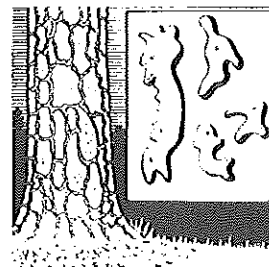
2. Sisters: North boundary is Jefferson-Wasco County line; eastern boundary is Eagle Butte, Round Butte, Lower Bridge, Cline Buttes, Tumalo, LaPine, Walker Mt.; southern boundary Cappy Mt. at Cascade crest east to Walker Mt. then intersecting a N-S line from Spring Butte to Yamsay Mt.; western side is the Cascade crest. (Old seed zones 675 and 681; small area at Marion Forks east of Detroit and Big Pine Meadows area south-east of Oakridge.)
3. Crater Lake: Northern boundary Cappy Mt. at Cascade crest east to Walker Mt. then intersecting a north-south line from Spring Butte to Yamsay Mt.; eastern boundary south from Spring Butte to six miles west of Yamsay Mt. to Hamelton Butte; south boundary is Union Pk. on Cascade crest; west to Hampton Butte; western boundary is the Cascade crest. (Old seed zones north half of 701 and 702.)
4. Pelican Butte: North boundary Union Peak at Cascade crest east to Hamelton Butte; east side is Hamelton Butte to six miles west of Yainax Butte; south boundary Surveyor Mt. on Cascade crest to Klamath Falls, six miles west of Yainax Butte; western boundary is the Cascade crest from Union Pk. to Surveyor Mt. (Old seed zones south half of 701 and 702.)
5. Paulina: Northern boundary is Bend eastward to Millican; eastern boundary Millican to county road and Deschutes-Lake County line, SW to Township 25 and Range 15; southern boundary Township 25 and Range 15, Fort Rock, Hole-in-the-ground, Spring Butte; western boundary Bend, LaPine, Spring Butte. (Old seed zones 681 and 690.)



6. Gearhart Mt: Northern boundary Township 25 and Range 15, Fort Rock, Hole-in-the-ground, Spring Butte; eastern boundary township 25 and Range 15 south to Table rock, Picture Rock Pass, Paisley, Valley Falls, Lakeview, and New Pine Creek; southern boundary Oregon-California border; western boundary Yocum Valley, north to Barnes Rim, Horsefly Mt., to six miles west of Yainax Butte, north to Fuego Mt., Hamilton Butte, Yamsay Mt., County line north of Spring Butte. (Old seed zones 711, 703, and 731.)
7. Lakeview: North and eastern boundary is from Valley Falls, south along Hwy 395 to Oregon border at New Pine creek; south and western boundary is the Oregon border then north to Adel, Drake Pk., Plush, and Valley Falls. (Old seed zones. 751, 712, and 713.)
8. Klamath: North and east sides from Surveyor Mt. on Cascade crest east to six miles west of Yainax Butte, SE to the south end of Gerber Reservoir and the Oregon border six miles east to Willow Valley reservoir; west side is the Cascade crest. (Old seed zones 721 and 722.)
9. Madras: Northern boundary is Columbia River; eastern boundary John Day Dam, Klondike, DeMoss then south on Hwy 97 to Shaniko, east to Corral Mt., south along Township 22 to Maupin Butte (the eastern boundary is 120 degrees west longitude); southern boundary Maupin Butte west to Hwy 27 south to Hwy 20, west to Bend; western boundary Hood River-Sherman County line south along Summit Ridge to Tygh Ridge, Maupin, Mutton Mt., Eagle Butte at Jefferson-Wasco County line, Round Butte, Lower Bridge, Cline Buttes, Tumalo, Bend. (Old seed zones 672, 674, 673, 902, 901, 921, 911, and 912; plus eastern half of 662.)

For the above nine zones use 1000 foot elevation bands.

10. John Day: Northern boundary east-west line from Baldy to Whitney; eastern boundary north-south line from Whitney to Hwy 20 at Harney-Malheur County line; southern boundary is Hwy 20 from Lake-Harney County line east to Harney-Malheur line; western boundary is north-south line from Baldy to near Glass Buttes. (From Burns to north of John Day (44 degrees 30 minutes north latitude), old seed zones 921, 943, 942, 922, 941, 930, south half of 892 and eastern quarter of 916.)



For zone 10 seed transfers should be limited to 1000 foot elevation change, when above 5000 feet limit transfer to 700 feet.

11. Willamette Valley: North side is along the Columbia River from Prescott to Corbett; east and south boundary is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton, Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordville, along Coburg Hills, Marcola, Deerhorn, Lowell, upper end of Cottage Grove Reservoir, and Divide; west side Divide, then north along the Willamette River to Newberg, Beaverton and north to the Columbia. (Old seed zones 261, 262, and west half of 042.)
12. Umpqua: Northern boundary Rice Hill east toward Huckleberry Mt., Fairview Peak., SE to Calapooya Divide to Cowhorn Mt.; eastern and southern boundary Cowhorn Mt., SW to Mt. Bailey, Fish Mt., Abbott Butte, then along Jackson and then Josephine County lines to Wolf Creek Pass; western boundary Rice Hill south on I-5 to Josephine County line. (Old seed zones 481, 491, and 492.)
13. Siskiyou: North boundary from Iron Mt. east along Curry County line to Coast Range crest, Josephine County line east to Wolf Creek Pass; eastern and southern boundary Wolf Creek Pass, I-5 to Grants

Pass, Onion Mt., Pearsoll Pk., Collier Butte; west boundary Collier Butte, Saddle Butte, Agness, Iron Mt. (Old seed zones Eastern half of 081, first major ridge from coast, and the northern portion of 511.)

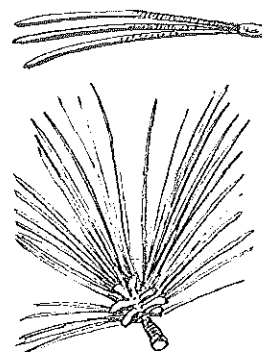
14. Eagle Point: North boundary Wolf Creek Pass, then along Jackson and Josephine County lines, Abbott Butte, Fish Mt., Mt. Bailey, and Cowhorn Mt.; eastern side is Cascade crest, western boundary Oregon-California border, Soda Mt., Grizzly Pk., Medford, I-5 to Wolf Creek Pass. (Old seed zones 501, 502, and 493.)

15. South Interior: North and east sides are from Onion Mt. to Grants Pass, I-5 to Medford, then east to Grizzly Pk., Soda Mt., and Oregon-California border; south and western boundary is along the border to Hwy 199, north to Squaw Mt., then Onion Mt. (Old seed zones 511 and 321.)

Elevations: a single elevation for the Willamette Valley; for the other three westside zones use elevation bands suggested by Sorensen (1994) for the eastside, that is limit transfer to 1000 feet of elevation.

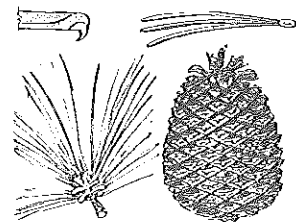
### Jeffrey Pine:

Jeffrey pine (*Pinus jeffreyi* Grev. and Balf.) is found primarily in the western half of Josephine County and in small isolated patches in southern Douglas County. Generally it occurs in mixed stands with ponderosa pine, lodgepole pine, sugar pine, white and Shasta fir, and incense cedar. Some low elevation Jeffrey pine, near Myrtle Creek, are found at 600 feet elevation but most occur above 3000 feet in elevation. Jeffrey pine will occur at elevations above ponderosa pine and appears to be more frost resistant than ponderosa pine.



Jeffrey pine seed zones:

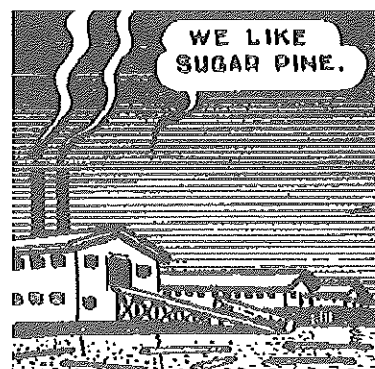
Northern boundary is from Iron Mt. at the Coos and Curry County line east toward Mt. Boulvar, along the Curry and Josephine County line to Mt. Reuben; east boundary Mt. Reuben, Galice, Onion Mt., Squaw Mt., and Hwy 199 to the Oregon border; western boundary is Packsaddle Mt. near the Oregon-California border north toward Big Craggies, and Iron Mt.



Elevations within this seed zone are the same as for Ponderosa pine. Seed transfer should be limited to 1000 foot elevation.

Sugar Pine:

Sugar pine (*Pinus lambertiana* Dougl.) is a species of low to mid elevation in the southern and central Cascades, the extreme southern Coast Range, and the adjacent Siskiyou Mountains. Scattered sugar pine is generally found on dry sites throughout its Oregon range. Like western white pine and noble fir, seedling studies indicate that sugar pine has an apparent genetic structure that permits larger seed zones than those for Douglas-fir in the same geographic area.



Seed zones recommended, for sugar pine by Campbell and Sugano (1987) differ greatly from the standard zones of the Forest Tree Seed Council map. Their evaluation covered most of the important range of sugar pine for western Oregon (coast to Cascade crest and 160 km northward from the California border). Genetic differences from location to location are greater in sugar pine than for western white pine. This genetic arrangement apparently results in local populations that vary genetically in complex patterns in the complex environment of Southwest Oregon (Campbell and Sugano 1987).

Based on Campbell and Sugano's (1987) work, the boundary between the Coast and Cascade zones was defined as the 152 cm annual precipitation line. For practical purposes that is along Hwy 199 from the California-Oregon border north to Grants Pass and then north along I-5 to Roseburg. Information for the central

Cascade sugar pine zone, an area where sugar pine is only an occasional scattered tree, was developed by the U.S. Forest Service Region Six after consultation with Dr. Robert Campbell (1987).

Sugar pine seed zones:

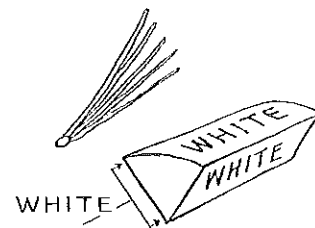
Sugar pine seed zones have different geographic areas for the three elevation bands.

Low elevation 0 to 2500 feet.

1. South Coast Low Elevation: Northern boundary is from Coquille River to Coquille, Fairview, Summer, Coos Mt., Tioga, Bear Mt. on Coast Range crest; east boundary follows crest south to Dutchman Butte, Mt. Peavine, Onion Mt., Squaw Mt., and Hwy 199 to California border. (Old seed zones 072, 081, 082, 090 and all west of Hwy 199 and I-5 in seed zones 511 and 512.)
2. South Cascade Low Elevation: Northern boundary is Hwy 38 at Coast Range crest, Elkton, Drain, Anlauf, Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., Lowell, Hardesty Mt., Holland Pk., Calapooya Ridge to Cowhorn Mt.; eastern side is the Cascade crest; southern side is Oregon border; western boundary is Hwy 199 at the Oregon border to Grants Pass and I-5 to Divide. (Old seed zones 270, 321, 481, 491, 492, 493, 501, and 502 and all east of Hwy 199 and I-5 in zones 511 and 512.)

Low elevation 0 to 3000 feet.

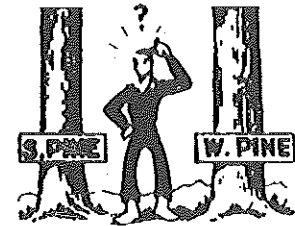
3. Central Cascade Zone: Northern side is from the confluence of Molalla and Table Rock Fork Rivers, Silver King Mt., Battle Ax, following the high ground to the headwaters of the North Fork of the Breitenbush at the Cascade crest; eastern side is the Cascade crest; southern boundary is Cowhorn Mt., Calapooya Ridge, Holland Pk., Hardesty Mt., and Lowell; western boundary is Lowell, Vida, three miles south of Deerhorn, Moose Ridge, Monument



Pk., Marion Co. line, and the confluence of Molalla and Table Rock Fork Rivers. (Old seed zones 462, 463, 472, 473, 482, and 483.) Only a single elevation is recommended for the Central Cascade zone.

Mid elevation 2500 to 4000 feet.

4. South Coast Mid Elevation: Northern boundary is from Coquille River to Coquille, Fairview, Summer, Coos Mt., Tioga, Bear Mt. on Coast Range crest, north along crest to Hwy 38 Elkton, Drain, Anlauf, Divide; eastern boundary is I-5 to Grants Pass, Hwy 199 to California-Oregon border.
5. South Cascades Mid Elevation: Northern boundary is from Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., Lowell, Hardesty Mt., Holland Pk., Calapooya Ridge to Cowhorn Mt.; eastern side is the Cascade crest; southern side is Oregon border; western boundary is Hwy 199 at the Oregon border to Grants Pass, and I-5 to Divide. (Old seed zones 270, 321, 481, 491, 492, 493, 501, and 502 and all east of Hwy 199 and I-5 in zones 511 and 512.)

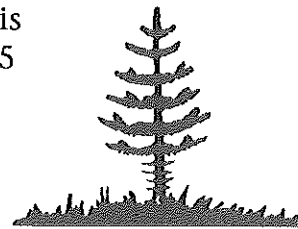


High elevation above 4000 feet.

6. South Coast High Elevation: Northern boundary is from Port Orford on the coast northeast to Edson Butte, Myrtle Point, Hwy 42 to Roseburg; eastern boundary is I-5 from Roseburg to Grants Pass, then Hwy 199 to California-Oregon border.
7. South Central High Elevation: North and east boundary is from I-5 from Grants Pass to the California-Oregon border; southern and western boundary is from I-5 along the California-Oregon line west to the Hwy 199 then north to Grants Pass.

8. Central High Elevation: Northern boundary is from Roseburg to Steamboat along Hwy 138, then north to Lowell, Willamette River to Emigrant Pass on the Cascade Crest south to Timber Crater, West along Douglas County line to Hwy 230, Union Creek, Hwy 62 to Medford; south and west boundary is I-5 from Medford to Roseburg.
9. South Cascades High Elevation: Northern side is from Medford to Union Creek on Hwy 62, Hwy 230 to northwest corner of Klamath County, east to Timber Crater; eastern side is the Cascade crest south to the California-Oregon border; south boundary is the California-Oregon border to I-5; west side is I-5 to Medford.

Western White Pine:



In Oregon, western white pine (*Pinus monticola* Dougl. ex D. Don) is found on the west side of the Cascades above 3000 feet and in the Siskiyou Mountains slightly north of the California border. Throughout its range in western Oregon, the elevational zone where most western white pine occurs is narrow. The genetic structure of western white pine is unlike that of Douglas-fir in that there is very little genetic difference from one population to another (Rehfeldt 1979, Campbell and Sugano 1989). The distribution of genetic variation is as differences among trees within the local stand with very little genetic difference from one location to another. There is even less geographic variation in white pine than there is in noble fir and genetic differences from one elevation to the next have not been detected (Campbell and Sugano 1989). Since western white pine occurs on both sides of the Cascade crest, see Campbell and Sugano (1989) for details on assessing risk when transferring seed to areas not covered by the seed zones listed for western Oregon. Seed transfer guidelines were based on growth and phenology research conducted by Campbell and Sugano (1989). Genetic patterns found by them for trees from the Cascades are similar to those reported by Rehfeldt et al. (1984). Most observed variation among parent tree locations reflected a combined effect of latitude and distance west to east across the crest of the



Cascades. Even though elevation differed among parent trees, it had an extremely small influence on seed transfer. Thus there are no elevation bands within any of the new seed zones.

A very important seed transfer caution is that these seed zones have meaning only for areas presently occupied by western white pine (Campbell and Sugano 1989). A large coastal zone is also outlined since a few scattered natural white pines have been found in the Coast Range.

Western white pine seed zones:

1. Washington Cascades:
2. North Cascades: Columbia River south to North Fork of the Breitenbush River on the west side of the Cascades. North side is the Columbia River from Corbelt to the Cascade crest; eastern boundary is the Cascade crest; south boundary is from the Cascade crest at the headwaters of the North Fork of the Breitenbush westward following the high ground to Battle Ax, Silver King Mt. to the confluence of Molalla and Table Rock Fork Rivers; western boundary follows a line north from the confluence of Molalla and Table Rock Fork Rivers, Colton, Orient, and Corbelt. (Old seed zones 451, and 452 and east half of 042. This seed zone is most of Clackamas County and the eastern half of Multnomah County.)
3. Central Cascades: Northern side is from the confluence of Molalla and Table Rock Fork Rivers, Silver King Mt. Battle Ax, the Cascade crest at the headwaters of the North Fork of the Breitenbush River; eastern boundary is the Cascade crest; west and south boundary is from Cowhorn Mt., Calapooya Ridge, Holland Pk., Hardesty Mt., Lowell, Deerhorn, Coburg Hills, Lacombe, the confluence of Molalla and Table Rock Fork Rivers. (Old seed zones 461, 462, 463, 471, 472, 473, 482, and 483.)



4. South Cascades: That area on the west side of the Cascades from the Calapooya Divide to the California border. North boundary is Lowell, Hardesty Mt., Holland Pk., Calapooya Ridge to Cowhorn Mt.; east boundary is the Cascade crest; western boundary is California border, northwest to Soda Mt., Grizzley Pk., Medford, I-5 to Divide, upper end of Cottage Grove Reservoir, Blue Mt., and Lowell. (Old seed zones 481, 491, 492, 493, 501, and 502.)
5. Siskiyou: Northern boundary is from mouth of Coquille River to Coquille, Fairview, Summer, Coos Mt., Tioga, Bear Mt. on Coast Range crest, follow crest north to three miles north of Old Blue then east to Kellogg, Yellow Butte, and I-5 at Rice Hill; eastern side follows crest to Josephine County line, I-5 to Medford, Grizzley Pk., Soda Mt., and southeast to the California border. (Old seed zones 072, 081, 082, 090, 270, 321, and 512).
6. Coast: That area extending south from the Columbia River to Coquille River and from the coast to the Willamette Valley. Eastern edge is from Astoria, North Plains, Gaston, Yamhill, Bellevue, Alpine, Franklin, Veneta, Crow, Gillespie Corners, Divide, Rice Hill, Yellow Butte, three miles north of Old Blue, Coast Range crest south to Bear Mt. (Old seed zones 051, 052, 053, 061, 062, 071, 251, and 252.)

An important note is that there are no elevation bands or elevation restrictions when transferring western white pine seeds.

### Engelmann Spruce and Pacific Silver Fir:

In western Oregon both Engelmann spruce (*Picea engelmannii* Parry) and Pacific silver fir (*Abies amabilis* (Dougl.) Forbes) are species at high elevations in the Cascades; probably neither occurs below an elevation of 3500 feet.



For the Intermountain west, Engelmann spruce populations appear to be genetically similar if they are not separated by more than 420 meters in elevation (Rehfeldt 1994b). Genetic differentiation associated with this much elevation change amounts to a difference of 38 days in the length of the frost free period (Rehfeldt 1994b). A seed zone elevation band of 420 meters is quite generous, being about twice as broad as the elevation band width recommended for Douglas-fir, in this region, and half as liberal as for western white pine.

Engelmann spruce occupies a very cold damp habitat which appears to be quite climatically uniform throughout its range in Oregon. Recommendation is for a single seed zone with single elevation band for this species in western Oregon.

Pacific silver fir occupies nearly the same geographic area as Engelmann spruce. No seed transfer information is currently available. Recommendation is two geographic areas each with two elevation bands.

Engelmann spruce seed zone:

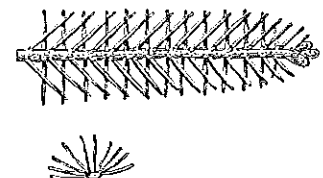
1. The geographic area for this single seed zone is the Columbia River on the north and the Cascade crest on the east; the southern side is the Oregon border; and the western boundary is a line that follows the 3500 foot elevation contour along the west slopes of the Cascades. There is only one elevation zone.



**PEW! (Englemann)**

Pacific silver fir seed zones:

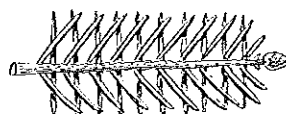
1. North Cascades: From the Columbia River at the north to the McKenzie River at the south; eastern boundary is the Cascade crest; the western boundary is the 3500 foot elevation along the west slope of the Cascades.



2. South Cascades: From the McKenzie River south to the California-Oregon border. The west slope of the Cascades above 3500 feet in elevation to the limit of Pacific fir at the crest of the Cascades.

There are two elevations bands for Pacific silver fir as follows: Low elevation below 5000 feet and high elevation above 5000 feet.

### Sitka Spruce:



Sitka spruce (*Picea sitchensis* (Bong.) Carr.) occurs along the western coast on moist well drained sites, generally at low elevation and usually is restricted to the coastal fogbelt which is within two or three miles of the coast. In river basins its inland penetration may be up to 25 miles. For Oregon, since Sitka spruce occupies a narrow coastal fogbelt band, elevation and east-west movement are not factors in seed transfer. The only question is how far seed can be safely transferred north or south of its origin. A single study in Alaska looked directly at seed transfer (Campbell et al., 1989), while other studies evaluated differences among several populations in coastal Alaska and British Columbia. No seed transfer research was conducted for Oregon populations of Sitka spruce.



Sitka spruce has a much higher proportion of its genetic variance at the population level than at the family level when compared to the average for most other western conifers (Ager et al. 1993). Contrasted to growth differences, an isoenzyme evaluation of six Alaskan populations of Sitka spruce showed them to be similar (Copes and Beckwith 1977). Isoenzyme patterns have not been very useful for outlining seed zones in western Oregon (Merkle et al., 1988). Others reporting on phenotypic traits found genetic variation with latitude and elevation (Roche and Fowler 1975, Falkenhagen 1977).

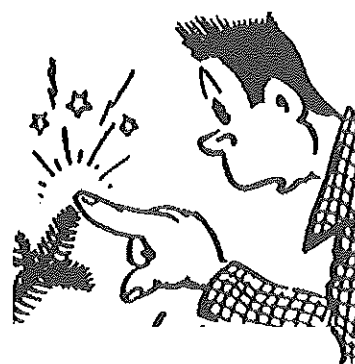
Provenance tests throughout Europe have shown differences in growth with taller plants produced from Oregon seed and shorter plants from Alaska seed. The taller plants of southern provenances also suffered the

most winter damage in these tests. There was very little difference in time of flushing (northern sources slightly earlier) even though provenances extended from Alaska to Brookings, Oregon (Magnesen 1976.) Campbell et al. (1989) concluded, however, that seed transfers, even at constant elevation, on a small coastal Alaskan island may introduce risk in reforestation. Campbell's findings indicated that small seed zones, however, may not be necessary in coastal Alaska since there is far greater genetic differentiation between the edge and center of an island than between edges of widely scattered islands. Common environmental indexes were longitude, latitude and elevation. Even other environmental factors such as slope, aspect, and position on an island were associated with genetic variation. Factors which influence the length of the growing season also influence seedling performance (Campbell et al. 1989).

Since patterns of genetic variation are not greatly different than for Douglas-fir and since no specific Sitka spruce transfer guidelines are available, recommendation is to follow the general requirement of keeping the donor and recipient areas within the same ten day length of growing season. One degree of latitude and 1000 feet of elevation changes length of growing season by ten days, thus seed zones are about 60 miles north-south and span 1000 feet of elevation.

Sitka spruce seed zones:

1. North coast: Coastal fringe from Columbia River south along coast to Cape Foulweather; inland toward Siletz (coastal fringe of old seed zones 051 and 053).
2. North central: Cape Foulweather to Reedsport, follow Umpqua River inland (coastal fringe of old seed zones 061 and 062).
3. South central: Reedsport to Port Orford inland toward Barklow Mt. and headwaters of South Fork of Coquille River (coastal fringe of old seed zones 071 and 072).

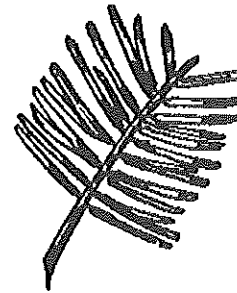


4. South coast: Port Orford to California- Oregon border (coastal fringe of old seed zones 081, 082, and 090).

Elevation is sea level to 1000 feet. One elevation band (sea level to species limit).

#### Grand Fir, White Fir, and Interspecific Hybrids:

Grand fir (*Abies grandis* (Dougl.) Lindl.) is the only true fir found in the lowlands at sea level in Oregon, its range extends eastward from the coast to the crest of the Cascades north of the Calapooya Divide. It is absent from the southern central valleys. Throughout the southern half of the state, west of the Cascades, grand fir and white fir (*Abies concolor* Gord. and Glend.) occur together and there may be natural hybrids between them. Hamrick and Libby (1972) speculated that *A. grandis* and *A. concolor* are both part of a large species complex and that they evolved from some ancestral taxon. Grand fir became adapted to a moist cool climate and white fir became adapted to a drier warmer climate.



Provenance testing of grand fir has been extensively conducted in Europe, and there has been a limited effort in British Columbia. No information is available on provenance testing in Oregon west of the Cascades.

After ten years, mortality in British Columbia plantings was highest for two seed sources from the southern Oregon coast, but the remaining other sources performed similarly with very little mortality. Major differences were seen between fast growing, low elevation, coastal provenances, from the rain shadow zone of eastern Vancouver Island and northeastern Olympia Peninsula, and slow growing high elevation inland provenances (Xie and Ying 1993). Latitude and longitude of the seed source did not influence growth in the first few years but became important as the trees became older (Xie and Ying 1993).

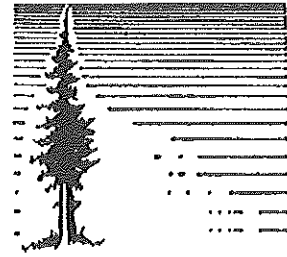
Xie and Ying (1993) recommend that seed sources from high elevations are not suitable for reforestation at lower elevations because of poor growth and susceptibility to needle diseases. Sources far south of the planting site are likewise not suitable because they are not cold hardy when moved into harsher environments. Effect of elevation and latitude and longitude dictate that seed zones not be too large and that elevation bands also be utilized.

Grand fir, white fir, and interspecific hybrids seed zones:

1. Coast North: From the coast east along the Columbia River to Prescott; eastern boundary is south from Prescott, Bunker Hill, Vernonia, Round Top and south along the Coast Range crest to slightly north of Nashville; southern boundary from Nashville west to Siletz, and Cape Foulweather. (Old seed zone 041, 051, and 053; western portion of 052.)
2. Central Coast: From the coast east to the Coast Range crest; northern boundary is east from Cape Foulweather to Siletz, to the ridge slightly north of Nashville; eastern boundary is the Coast Range crest; southern boundary is Bear Mt. at the Coast Range crest west to Coos Mt., Summer, Coquille, and approximately half-way between Bandon and Coos Bay. (Old seed zones 061, 062, and 071.)
3. South coast: North side is between Bandon and Coos Bay east to Coquille, Summer, Coos Mt., at the Coast Range crest; east boundary is the crest of the Coast Range south to the Oregon border. (Old seed zones 072, 081, 082, and 090.)
4. East Slope of Coast Range (north): Northern boundary is from Round Top on the Coast Range crest to Vernonia, and Bunker Hill; eastern boundary from Bunker Hill, North Plains, Gaston, Yamhill, Bellevue, Alpine, Franklin, Veneta, Crow, Gillespie Corners, Divide, Anlauf, and Rice Hill; southern side is from Rice Hill west to Yellow Butte, to three miles north of Old Blue on the Coast Range crest; western



boundary is north of Old Blue along the Coast Range crest to Bunker Hill. (Old seed zones 251 and 252; southern portion of 052 which reflects growth from Vernonia Cooperative.)



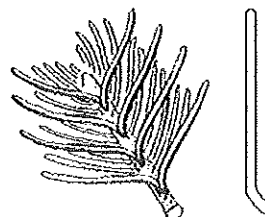
5. East slope of Coast Range (South): Northern boundary is at the Coast crest three miles north of Old Blue, east to Yellow Butte, and Rice Hill; eastern boundary is I-5 to Grants Pass, then Hwy 199 to the Oregon border; western boundary is the Coast Range crest. (Old seed zones 270, northwest portion of 511 and west half of 512.)
6. Willamette Valley: North side is along the Columbia River from Prescott to Corbett; east and south boundary is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton, Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordsville, along Coburg Hills, Marcola, Deerhorn, Lowell, upper end of Cottage Grove Reservoir, and Divide; west side from Divide, Gillespie Corners, Crow, Elmira, Cheshire, Alpine, Philomath, Falls City, Bellevue, McMinnville, Carlton, Yamhill, Forest Grove, North Plains, Bunker Hill, Prescott. (Old seed zones 261, 262, and west half of 042.)
7. Southern Interior: Northern boundary is Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., and Lowell; eastern boundary is Lowell, Hardesty Mt., Holland Pk., four miles east of Fairview Pk., west end of Calapooya Ridge, then southward to Quartz Mt., Grasshopper Mt., Abbott Butte, then Douglas-Jackson County line to Hwy 227 to Hwy 62 to Medford then I-5 to California border; south side is the Oregon border; western boundary is Hwy 199 from Oregon border to Grants Pass, I-5 to Divide. (Old seed zones 481, 492, 321, west three-quarters of 491, west half of 502, and east one-half of 511.)



8. North Cascades: Northern edge is the Columbia River; east edge is the Cascade crest; south boundary is the McKenzie River; west side is along the Willamette Valley as follows: from Deerhorn, Marcola, Coburg Hills, Crawfordsville, Sweet Home, Lacombe, Lyons, Sweet Spring Mt., Colton, Highland Butte, Barton, Boring, Orient, and Corbalt. (Old seed zones 451, 452, 461, 462, 463, 471, and north half of 472 and 473.)
9. Central Cascades: North side is the McKenzie River; east edge is the crest of the Cascades south to Cowhorn Mt.; southern and western boundary is the Calapooya Divide, Holland Pk., Hardesty Mt., Lowell, Leaburg. (Old seed zones 482, 483, and south half of 472.)
10. South Cascades: Northern edge is the Calapooya Divide; eastern side is the crest of the Cascades; southern edge is the border with California; western boundary is I-5 from the California to Medford, Hwy 62, Hwy 227 to Jackson County line, Abbott Butte, Grasshopper Mt., Quartz Mt., Calapooya Ridge, four miles south of Holland Pk., west end of Calapooya Ridge, then southward to Quartz Mt., Grasshopper Mt., Abbott Butte, then Douglas-Jackson County line to Hwy 227 to Hwy 62 to Medford then I-5 to California border. The western edge is the boundary with Grand fir seed zone seven, Southern Interior Zone. (Old seed zones 501, 493, and eastern half of 491 and 502.)

Elevation Bands: Since grand fir begins at sea level, elevation bands are 0 to 1000 feet and 1000 foot intervals thereafter.

Noble Fir / Shasta Fir:



Noble fir (*Abies procera* Rehd.) occurs as a mid to high elevation species on the west side of the Cascade Range. In addition a few of the highest Coast Range peaks have a scattering of noble fir at their tops. Franklin et al. (1978) classified noble fir as extending from its northern limit, 48 degrees north latitude, southward to the McKenzie River Valley (44 degrees latitude).

Southward from there the variable fir population was referred to as Shasta red fir. In southwest Oregon, in the Siskiyou Mts., Shasta red fir (*Abies magnifica shastensis* Lemm.) dominates. Sorensen et al. (1990) determined a steep genetic gradient with its mid point at 44 degrees latitude which is just south of the McKenzie River. This area of transition is consistent with a chemical change found for the same location (Zavarin et al. 1978).

Progeny from parent trees located between McKenzie Bridge and Detroit were taller than progeny from parents near Oakridge when grown at 17 sites ranging from Detroit to Oakridge (Willamette National Forest Tree Improvement Program 1992). In a ten year old field test of Oregon and Washington noble fir in Germany, provenances from the north were taller and provenances from south of Oakridge were 15 percent shorter than the average (Ruetz et al. 1990). The German tests recorded higher mortality and less height growth for coastal provenances (Mary's Peak and Grass Mt) than for Cascade provenances. However, Laurel Mt. provenance west of Salem gave above average growth. Nearly identical results were obtained when the same noble fir provenances were planted in British Columbia (Xie & Ying 1994). This line of inherent growth transition in Oregon starts at the Cascade crest at Elk Mountain and extends westward to Rebel Rock, between Lookout and Sardine Butte, then to Gilbert Mountain and to Mt. Pisgah.

The McKenzie River is a major division where there is more precipitation north than south. Noble fir seed from north of the river grows faster than noble fir from south of the McKenzie Valley. Soils of the north are mostly glacial till; in the central and southern portion extensive areas are covered with volcanic pumice,

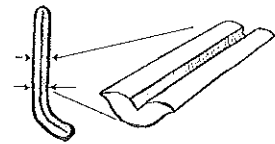
cinders, and ash (Franklin and Dyrness 1973). Seed transfer north or south across this zone is not recommended. Within each of these two zones wide seed transfer north or south is possible with little risk (Sorensen et al. 1990). Midpoint of the elevation band for the southern zone was 1770 meters and for the northern band 1350 meters. Each of the two zones have a high and a low elevation band; for the north divide at 4500 feet and for the south separate at 5500 feet.

Latitude explained most of the genetic variation in growth and phenology but elevation and distance from the crest also made minor contributions (Sorensen et al. 1990). They did not evaluate a number of important geographic variables, such as slope, aspect, landform, shade profile of nearby mountains, and soil characteristics.

Compared to other western conifers the amount of variation associated with source is smaller for noble fir and about the same as for sugar pine in southwest Oregon (Campbell 1987). The genetic arrangement of noble fir is such that seed zones can be larger than for Douglas-fir. Noble fir is successfully grown for Christmas trees or as ornamental plantings at elevations much below its natural occurrence.

Noble fir seed zones:

1. North Cascades: West slopes of the Cascades from the Columbia River south to the McKenzie River-White River branch at the Cascade crest. The western boundary follows the natural range of noble fir at about 3000 feet in elevation. Two elevation bands for this zone, divided above and below 4500 feet.
2. Coast Range Peaks: The few scattered noble fir populations that occur at the tops of the Coast Range peaks are located north of 44 degrees latitude and are considered a separate seed zone with a single elevation.



Shasta fir seed zones:

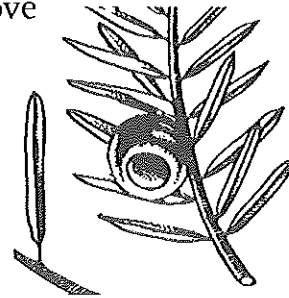
3. South Cascades: West slope of the Cascades south of the McKenzie River to the California border. The western boundary follows the natural range of Shasta-noble fir at about 4000 elevation. Two elevation bands within this zone, divided above and below 5500 feet.
4. South coast inland: Southwestern Oregon area is a separate seed zone. Northern boundary is from Coos Mt. east to Bear Mt.; eastern side is south from Bear Mt. along Coast crest to Taylor Mt., Onion Mt., Squaw Mt., southeast to Hwy 199 and south to the California border; western boundary is south from Coos Mt. Bridge, Bald Knob, Saddle Mt., Chetco Pk., California border. (Eastern half of old seed zones 072, 081, 082, 090, and western half of 512.)

There are two elevations within the south coast inland zone: low from 3000 to 4500 feet and high above 4500 feet.

Pacific Yew:

Pacific yew (*Taxus brevifolia* Nutt.) is a common understory tree throughout western Oregon. It is relatively more common in the Cascades than in the Coast Ranges. Collections from throughout the Oregon Cascades, Willamette Valley, and the Coast Ranges were grown in nursery beds at Corvallis, Oregon (Nan Vance, personal communication, Forest Service Research, Corvallis, Oregon, December 6, 1994). Major differences in growth, time of flowering, and bud flushing were seen between Coast and Cascade populations. High elevation Cascade sources had different growth patterns than low elevation Cascade sources.

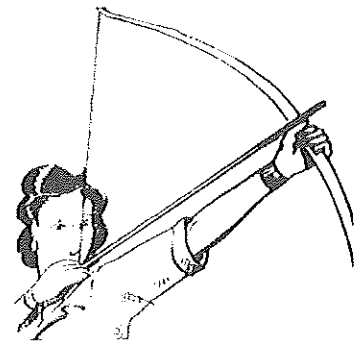
Allozyme evaluation of 54 Pacific yew populations from 174 geographic areas indicated that Sierra Nevada sources were not the same as sources from Idaho, Montana and northeastern Oregon. Populations from the Oregon and Washington Cascades, northwestern California, and the Siskiyou Mts. were quite genetically



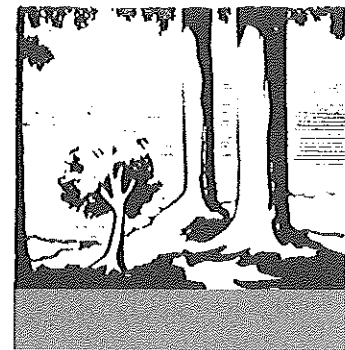
similar (Forest Service Allozyme analysis of Pacific yew, 1992. Data on file at National Isozyme Lab. Placerville, Calif.). Pacific yew has a moderate amount of genetic variation with most of the variation falling within populations and little variation from one population to another. This indicates that most of the variation is among individuals within populations and among local populations. Similar findings were reported by El-Kassaby and Yanchuk (1994) for allozymes of British Columbia Pacific yew; 92 percent of the variation is within a region and genetic diversity levels are not as high as its temperate-zone associates. Low elevation Willamette Valley seed is about one-third larger than high elevation Cascade seed (Steve Difazio, personal communication, Oregon State University, December 13, 1994).

Pacific yew seed zones:

1. North Coast: Columbia River to Prescott; eastern side is the edge of the Willamette Valley from Prescott, Bunker Hill, North Plains, Forest Grove, Yamhill, Carlton, McMinnville, Bellevue, Falls City, Hwy 223 to Philomath, Alpine, Cheshire, Elmira, Crow, Gillespie Corners, and Cottage Grove; Divide I-5 to Rice Hill; southern boundary Rice Hill, Yellow Butte, Kellogg, Coast crest, four miles north of Hwy 38, west to Reedsport.
2. South Coast: The coast area is south from the Umpqua River to the California border. North boundary is Reedsport to four miles north of Hwy 38 on the Coast Range crest, south to near Old Blue, Yellow Butte, and Rice Hill; eastern boundary is I-5 to Grants Pass then Hwy 199 to Oregon border.
3. Willamette Valley: North side is along the Columbia River from Prescott to Corbett; east and south boundary is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton, Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordsville, along Coburg Hills, Marcola, Deerhorn, Lowell, upper end of Cottage Grove



Reservoir, and Divide; west side Divide, Gillespie Corners, Crow, Elmira, Cheshire, Alpine, Philomath, Falls City, Bellevue, McMinnville, Carlton, Yamhill, Forest Grove, North Plains, Bunker Hill, Prescott. (Old seed zones 261, 262, and west half of 042.)



4. Southern Valley: Northern edge is from Divide on the Douglas County line south to the upper end of Cottage Grove Reservoir, Blue Mt., to three miles south of Lowell; eastern boundary follows from three miles south of Lowell to Hardesty Mt., Holland Pk., Harding Butte, Quartz Mt., Grasshopper Mt., Abbott Butte, Whetstone Pk., Cascade Gorge, Olson Mt., Butte Falls, Grizzly Pk., Soda Mt., south to California border; southern boundary is Oregon border; western edge follows Hwy 199 north to Grants Pass, I-5 to Divide. (Old seed zones 270 and 512; northwestern portion of 511.)
5. North Cascades: From the Willamette Valley to the crest of the Cascades and north of the Calapooya Divide. Northern boundary is the Columbia from Corbelt to the Cascade crest; east boundary is the Cascade crest south to Cowhorn Mt.; southern boundary is from Cowhorn Mt., Calapooya Divide, Holland Pt., Hardesty Mt., and Lowell; western boundary is Lowell, Deerhorn, Marcola, Coburg Hills, Crawfordsville, Sweet Home, Lacombe, Lyons, Sweet Spring Mt., Colton, Highland Butte, Barton, Boring, Orient, and Corbelt. (Old seed zones 451, 452, 461, 462, 463, 471, 472, 473, 482, and 483.)
6. South Cascades: Western slopes of the Cascades south of the Calapooya Ridge to the Oregon California border. North side is from near Holland Pk. east along the Calapooya Divide to Cowhorn Mt.; eastern boundary is the Cascade crest south to the Oregon border; western boundary is California border, Soda Mt., Grizzly Pk., Butte Falls, Olson Mt., Cascade Gorge, Whetstone Pk., Abbott Butte, Grasshopper Mt., Quartz Mt., Harding Butte, and Holland Pk. (Old seed zones 493, 501, eastern part of 491, and 502.)

### Elevation Bands:

There are no elevation bands in the two coast and the two valley zones. Within the two Cascade zones there is a low elevation which is below 2500 feet and a high elevation covering all elevations above 2500 feet.

### Red Alder:

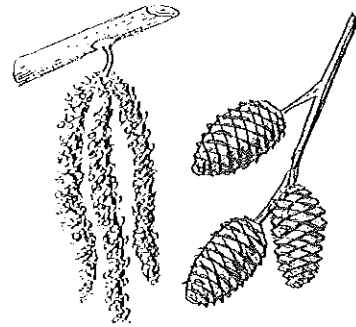
Red alder (*Alnus rubra* Bong.) generally is found at elevations less than 2500 feet and within 100 miles of the Pacific Ocean. Commercial sized alder is generally restricted to a very narrow band along stream bottoms. On upland sites seldom will alder attain adequate size without intense management. Information to guide red alder seed transfer is limited. There are no published seed transfer rules. Presented in this manual are seed use guidelines based on patterns of genetic variation and comparison to other species.



Genetic information for red alder comes from published reports of populations along the coast, generally from Washington and Alaska, or from populations from four river drainages; the Santiam in Oregon, the Nisqually, Hoh, and Nooksack in Washington.

Ager et al. (1993) compared patterns of genetic variation of red alder to conifers that occupy the same geographic area. Overall patterns of genetic variation were very similar for red alder and conifers. But Ager et al. observed an unusual amount of genetic uniformity within red alder populations. This unusual genetic uniformity may result because of strong selection pressure that stands undergo during early development and the patchy distribution of red alder results from aggressive colonization of disturbed sites which generally are small and have small population sizes. This strong early selections and patchy distribution combine to reduce within population variation. Only red pine of the Lake States Region of the U.S. showed less within population variation (Ager et al. 1993).

Patterns of geographic variation in growth show many similarities to Douglas-fir, western hemlock, and black cottonwood. East-west variation in red alder was not the same at all latitudes, a finding that is similar to Douglas-fir (Ager et al. 1993). In other words when comparing one river system to another the genetic change along the rivers are not the same.



Spring bud burst was about the same for all provenances along the west coast from 46 to 58 degrees north latitude (Cannell et al. 1987). Timing of bud flush was only very weakly associated with elevation of origin and bud flush could mostly be explained by mean July temperature and frost free growing season (Ager et al. 1993). The two northern drainages which flushed early are from an area with low frequency of late spring frosts. The southern drainages which flushed later are from an area with high frequency of late spring frosts (Ager et al. 1993). Bud set occurred two days earlier for each degree of latitude northward and elevation had little influence over a range from 15 to 521 meters (Cannell et al. 1987).

When planted inland at Olympia, Washington, early fall frost killed most seedlings except for those from Juneau, Alaska and Sand Point Idaho; while at Cascade Head, at the Oregon coast, where early fall frost is limited, there was no frost damage even for seedlings from sources as far south as Port Orford (DeBell and Wilson 1978). Use northern sources from areas subject to early fall frost; but spring frosts should have the same effect on all provenances.

Best performance, in growth tests, are sources from warmer areas with low moisture demands. These are low coastal zones such as northwestern Washington. Santiam River seed sources were poorest at all test sites (Hibbs et al. 1994). Elevation within a river drainage had very little influence on growth. Best growth will be on well drained soils free of early fall and late spring frosts.



Red alder seed zones:

1. North Coast: North boundary is the Columbia River east to Prescott; eastern boundary is south from Prescott to Bunker Hill, and along Coast crest to Hwy 38 (Umpqua River); south side is along Hwy 38 to Reedsport. (Old seed zones 051, 052, 053, 061, 062, and western portion of 041.)
2. South Coast: North boundary is the Umpqua River from Reedsport to the Coast crest; eastern side is the Coast crest south to the Oregon border. (Old seed zones 071, 072, 081, 082, and 090.)
3. East slope of Coast Range (North): North and eastern boundary is the edge of the Willamette Valley which follows a line south from Bunker Hill, North Plains, Forest Grove, Yamhill, Carlton, McMinnville, Bellevue, Falls City, Hwy 223 to Philomath, Alpine, Cheshire, Elmira, Crow, Gillespie Corners, and Cottage Grove; south boundary is Hwy 99 from Cottage Grove to Drain, then Hwy 38 west to crest of Coast Range; western boundary is crest of Coast Range from Hwy 38 to Bunker Hill. (Old seed zones 251 and 252.)
4. East slope of Coast Range (south): West boundary is the crest of the Coast Range to the California-Oregon border; eastern border is from California to Grants Pass along the Jackson-Josephine county line, I-5 to Rice Hill, Hwy 99 to Drain; northern boundary is Hwy 38 from Drain west to crest of Coast Range. (Old seed zones 270, northwest portion of 511, eastern half of 512.)
5. Willamette Valley: North side is along the Columbia River from Prescott to Corbett; east and south boundary is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton, Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordville, along Coburg Hills, Marcola, Deerhorn, Lowell, upper end of Cottage Grove Reservoir, and Divide; west side Divide, Gillespie



**Water Loving**

## *Tree Seed Zones for Western Oregon*

Corners, Crow, Elmira, Cheshire, Alpine, Philomath, Falls City, Bellevue, McMinnville, Carlton, Yamhill, Forest Grove, North Plains, Bunker Hill, Prescott. (Old seed zones 261, 262, and west half of 042.)



6. North Cascades: Northern edge is the Columbia River from Corbelt to the Cascade crest; eastern boundary is the Cascade crest south to six miles NW of Cultis Lake; southern boundary is from the Cascade crest to Chucksney Mt., Sardine Butte, Pernot Mt., and Deerhorn; west side is from Deerhorn, Marcola, Coburg Hills, Crawfordsville, Sweet Home, Lacombe, Lyons, Sweet Spring Mt., Colton, Highland Butte, Barton, Boring, Orient, and Corbelt. (Old seed zones 451, 452, 461, 462, 463, 471, and north half of 472 and 473, east half of 042.)
7. West Slope of Cascades (south): Northern boundary is from near Deerhorn east to Pernot Mt., Sardine Butte, half-way between Chucksney and Moolack Mts. and then east to the Cascade crest; eastern boundary is the crest of the Cascades; western boundary is Mt. McLoughlin, Russler Pk., Olson Pk., Cascade Gorge, Whetstone Pk., Abbott Butte, Grasshopper Mt., Quartz Mt., Harding Butte, Holland Pk., Hardesty Mt., Lowell, three miles south of Deerhorn. (Old seed zones 482, 483, 493, 501; east half 491, and western portion of 492.)
8. Southern Valley: Northern edge is from Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., to three miles south of Lowell; eastern side follows from three miles south of Lowell to Hardesty Mt., Holland Pk., Harding Butte, Quartz Mt., Grasshopper Mt., Abbott Butte, Whetstone Pk., Cascade Gorge, Olson Mt., Russler Pk., Mt. McLoughlin, Cascade crest to the California border; western boundary is Oregon border, Craggy Mt., Grayback Mt., Mungers Butte, Roundtop Mt., Murphy, Grants Pass, I-5 to Divide. (Old seed zones 481, west half of 491, most of 492, 502, eastern one-half of 511, and 321.)

Elevation Bands:

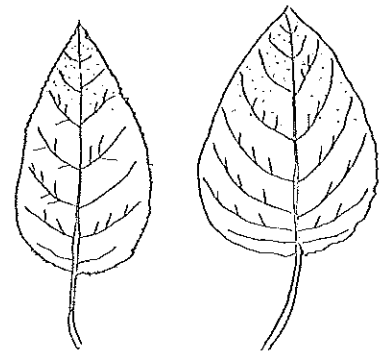
Coast Range (Zones 1-4) a high and low elevation separated at 1500 feet.

Willamette Valley (Zone 5) a single elevation.

Cascade (Zones 6-8) low elevation is below 1500 feet, mid elevation is 1500-2500 feet, and high elevation is above 2500 feet.

Black Cottonwood and Hybrid Poplars:

Black cottonwood (*Populus trichocarpa* Torr. and Gray) is found throughout Oregon; it is a tree of moist sites occurring along streams, lowland areas, and in wet spots at high elevation. At higher elevations growth slows and the species often is seen as bushy and not tree like. Best development is on moist loamy but well drained sites, at low elevation in western Oregon. Cottonwood hybrids (*Populus trichocarpa* x *P. deltoides*) developed by Washington State University and University of Washington grow successfully in western Oregon. Other cottonwood hybrids commonly grown throughout Oregon are Lombardy poplar (*Populus nigra* L. cv. 'italica'), the straight boled tree with vertical branches used as windbreaks, and Carolina poplar (*P. deltoides* X *nigra* cv. 'Carolinensis'), a large branched big-leaved cottonwood common around abandoned homesteads.



Abundant genetic variation for native black cottonwood populations was reported by Weber et al. (1985). Black cottonwood and Douglas-fir were found to have very similar within population and family coefficients of variation; both are higher than the common hardwood red alder (Ager et al. 1993). Most studies of western black cottonwood have evaluated populations along east-west rivers. In these studies longitude was found to be a better predictor of growth than latitude (Stettler et al. 1993). Some Oregon rivers flow from cool moist upper elevation reaches into warm dry low lands. More genetic variation exists in the

upper reaches than in the lower sections of these streams (R. Stettler personal communication May, 1995). Stettler advised that black cottonwood should not be exchanged between these two regions of a stream.

Black cottonwood populations, from east and west of the Cascades, were different in their water use and photosynthetic traits (Dunlap et al. 1993). Differences among trees within a river system were not as large as were the differences between trees from east side versus west-side rivers (Dunlap et al. 1993). Stettler et al. (1993) also found stronger genetic differentiation across the mountains ranges than parallel to them.

Growth cessation and bud set occur earlier in eastern and northern sources. Moving genetic material from low elevation to high elevation or from southern to northern location may result in early fall frost damage as the low elevation southern material does not stop growth as soon. The abundant genetic variation within a population may be a selective response to the extremely variable environments black cottonwood inhabit (Weber et al. 1985). Movement in latitude from one river drainage to another is preferable to moving elevationally within a river system. Cottonwood plantings for conservation and restoration of riparian ecosystems must use material from the general area to safeguard local genetic diversity (Stettler et al. 1993). Moving a Roseburg provenance north to Corvallis will provide increased growth but there is much greater risk of frost damage (Stine et al. 1981).

Hybrids most susceptible to cold injury come from crosses with southern sources of eastern cottonwood. These hybrids should be used only west of the Cascades at low elevations. If planting east of the Cascades, be sure that the eastern cottonwood parent used in the cross originated from a source in the mid or northern United States (Heilman et al. 1990). Hybrid material that survived and grew best at a Pack Forest, Washington plantation was also the best at Westport, Oregon 70 miles to the southwest (Stettler, et al. 1988).



The Oregon State Forestry Nursery at Elkton produces two different cottonwoods. One is a rooted cutting that probably is a hybrid between eastern cottonwood (*Populus deltoides* and European black cottonwood (*Populus nigra*) commonly referred to as the Euramericana hybrid. This material has been grown and distributed for 70 years by the state nursery. Its survival is very high and growth satisfactory when planted throughout Oregon. Oregon State Forest Nursery's other cottonwood material is a mixture of hybrid clones from the WSU and UW cottonwood program. These clones grow much faster than the old Euramericana material, but should only be planted in western Oregon and at elevations less than 1500 feet.

Black cottonwood and hybrid poplar seed zones:

Native Black Cottonwood:

1. North Coast: From the Columbia River south to Reedsport and the ocean to the Willamette Valley. The northern boundary is along the Columbia River east to Prescott; eastern boundary is from Prescott, Bunker Hill, North Plains, Gaston, Yamhill, Bellevue, Alpine, Franklin, Veneta, Crow, Gillespie Corners, Divide, Anlauf, and Rice Hill; southern side is from Rice Hill west to Yellow Butte, to three miles north of Old Blue on the Coast Range crest to three miles north of the Umpqua River; western side is the ocean. (Old seed zones 051, 052, 053, 061, 062, 252, and 252.)
2. South Coast: From Reedsport south to the Oregon border and east to I-5. North side is Reedsport east to three miles north of the Umpqua River, at the Coast Range crest, to three miles north of Old Blue Yellow Butte, and Rice Hill; eastern boundary is I-5 from Rice Hill to Jackson-Josephine County line south to the California-Oregon border; south side is Oregon border; west side is the ocean. (Old seed zones 071, 072, 081, 082, 090, 270 part of 512 and 511.)



3. Willamette Valley: Northern boundary is the Columbia River from Prescott east to Corbett; eastern boundary is south from Corbett, Orient, Colton, Sweet Springs Mt., Lyons, Lacombe, Coburg Hills, Marcola, Deerhorn, Lowell, Hardesty Mt., Holland Pk., and Fairview Pk.; southern boundary west from Fairview Pk., Huckleberry Mt., Elkhead, and Rice Hill; western edge is from Rice Hill north to Anlauf, Divide, Gillespie Corners, Crow, Veneta, Franklin, Alpine, Bellevue, Yamhill, Gaston, North Plains, Bunker Hill, and St. Helens. (Combine old seed zones 261, 262, 481, and a portion of 042.)
4. Southern Interior: Northern boundary is Rice Hill, Elkhead, Huckleberry Mt., and Fairview Pk.; eastern boundary is from Fairview Pk., southward to Harding Butte, to Quartz Mt., Grasshopper Mt., Abbott Butte, then Douglas-Jackson County line to Hwy 227 to Hwy 62 to Medford then I-5 to California border; south side Oregon border; western boundary is Josephine-Jackson county line to I-5 to Rice Hill. (Most of 491, 492, 502, 511, and 321.)
5. North Cascades: Northern edge is the Columbia River; east side is the Cascade crest; south boundary is the McKenzie River-White Branch; west side is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton, Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordsville, along Coburg Hills, Marcola, and Walterville at McKenzie River. (Old seed zones 451, 452, 461, 462, 463, 471, and north half of 472 and 473, east half of 042.)
6. South Cascades: North side is the McKenzie River; eastern edge is the Cascade crest south to the Oregon border; western boundary from the south is an approximate north line from Soda Mt., Grizzly Pk., Olson Mt. Abbott Butte, Grasshopper Mt., Harding Butte, Holland Pk., Hardesty Mt., Harding Mt., Quartz Mt., Lowell, and Deerhorn. (Old seed zone 472 and 473 south through 482, 483, 493, and 501; east half of 491, and 502.)

These zones limit north south movement to two degrees of latitude. Elevation transfer should not exceed 2000 feet. For experimental use or when planting only a few trees, latitude movement of up to four degrees often is successful (R.Stettler personal communication May, 1995).

Euramericana hybrids: A single zone for the entire state.

*P. trichocarpa* x *deltoides* hybrids from Oregon State Nursery: Use native black cottonwood seed zones.

### OTHER WESTERN OREGON SPECIES

Broadleaf riparian zone and adjacent upland species —

Oregon ash (*Fraxinus latifolia* Benth.)

Oregon white oak (*Quercus garryana* Dougl.)

Willow spp. (*Salix* spp.)

Bigleaf maple (*Acer macrophylla* Pursh)

These four broadleaf species occur in seasonally flooded, swampy interior valleys and adjacent higher elevations. Little, if any, is known about the effects of seed transfer in these species. Several species of willow are present in western Oregon and some are grown in forest nurseries. Weeping willow, an exotic species, is sometimes available. It should only be planted at low elevation and is subject to damage by late spring frosts.

These hardwoods, as well as all species not listed in this seed transfer guide, should be planted only in areas where they naturally occur. Use as a guide for seed transfer the following basic westside zones.



**What a big leaf!**

## TEN BASIC WESTSIDE SEED ZONES

These zones represent geographic areas where climate and growing conditions are more similar within a zone than they are between zones. When transferring seed of a species not listed, these zones and elevation bands are a general recommendation.

1. North Coast: Columbia River near Prescott south along coast to Newport, east along Yaquina River to the Coast Range crest near Nashville then north along crest to Monmouth Pk., Saddleback Mt., Mt. Nebo, Bell Mt., Trask Mt., Saddle Mt., Round Top, Timber, Nehalem River to Vernonia and Bunker Hill (old seed zones 051 and 053).

2. Central Coast: Newport (Yaquina River) south to Bandon, east along the Coquille River to the crest of the Coast Range following a line northeast from Coquille, Fairview, McKinley, Dora, Sitkum to near Reston, eastern boundary is Coast Range crest (old seed zones 061, 062, and 071).

3. South coast: Bandon south to California-Oregon border, east along Coquille River to Coast Range crest, following a line Bandon, Coquille, Fairview, McKinley, Dora, Sitkum to near Reston, eastern boundary is the Coast Range crest (old seed zones 072, 081, 082, and 090).

4. East slope of Coast Range (North): Western boundary is crest of Coast Range starting at Bunker Hill, south boundary is Hwy 99 from Cottage Grove to Drain, then Hwy 38 west to crest of Coast Range, eastern boundary is the edge of the Willamette Valley which follows a line south from Bunker Hill, North Plains, Forest Grove, Yamhill, Carlton, McMinnville, Bellevue, Falls City, Hwy 223 to Philomath, Alpine, Cheshire, Elmira, Crow, Gillespie Corners, and Cottage Grove (old seed zones 251 and 252).



5. East slope of Coast Range (South): west boundary is the crest of the Coast Range, southern boundary is the California-Oregon border, eastern boundary is Hwy 199 from California-Oregon border; eastern side follows red alder zone seven and the Cascade Crest; Southern Interior: Old seed zones 481, 491, 492, 502, 321, and east half of 511.

6. Willamette Valley: North side is along the Columbia River from Prescott to Corbett; east and south boundary is along the Willamette Valley as follows: south from the Columbia River at Corbett, Orient, Boring, Barton, Highland Butte, Colton, Sweet Spring Mt., Lyons, Lacombe, Sweet Home, Crawfordsville, along Coburg Hills, Marcola, Deerhorn, Lowell, upper end of Cottage Grove Reservoir, and Divide; west side Divide, Gillespie Corners, Crow, Elmira, Cheshire, Alpine, Philomath, Falls City, Bellevue, McMinnville, Carlton, Yamhill, Forest Grove, North Plains, Bunker Hill, Prescott. (Old seed zones 261, 262, and west half of 042.)

7. Southern Interior: Northern boundary is Divide on the Douglas County line southeast to the upper end of Cottage Grove Reservoir, Blue Mt., and Lowell; eastern boundary is Lowell, Hardesty Mt., Holland Pk., four miles east of Fairview Pk., west end of Calapooya Ridge, then southward to Quartz Mt., Grasshopper Mt., Abbott Butte, then Douglas-Jackson County line to Hwy 227 to Hwy 62 to Medford then I-5 to California border; south side is the Oregon border; western boundary is Hwy 199 from Oregon border to Grants Pass, I-5 to Divide. (Old seed zones 481, 492, 321, west three-quarters of 491, west half of 502, and east one-half of 511.)

8. North Cascades: Northern edge is the Columbia River; east edge is the Cascade crest; south boundary is the McKenzie River; west side is along the Willamette Valley as follows: from Deerhorn, Marcola, Coburg Hills, Crawfordsville, Sweet Home, Lacombe, Lyons, Sweet Spring Mt., Colton, Highland Butte, Barton, Boring, Orient, and Corbelt. (Old seed zones 451, 452, 461, 462, 463, 471, and north half of 472 and 473.)

9. Central Cascades: North side is the McKenzie River; east edge is the crest of the Cascades south to Cowhorn Mt.; southern and western boundary is the Calapooya Divide, Holland Pk., Hardesty Mt., Lowell, Leaburg. (Old seed zones 482, 483, and south half of 472.)

10. South Cascades: Northern edge is the Calapooya Divide; eastern side is the crest of the Cascades; southern edge is the border with California; western boundary four miles south of Holland Pk., west end of Calapooya Ridge then Douglas-Jackson County line to Hwy 227 to Hwy 62 to Medford then I-5 to California border the western edge is the I-5 from California to Medford, Hwy 62, Hwy 227 to Jackson County line, Abbott Butte, Grasshopper Mt., Quartz Mt., Harding Butte, Calapooya Ridge, four miles south of Holland Pk. (Old seed zones 501, 493, and eastern half of 491 and 502.)

Elevation Bands: Elevation bands 0 to 1000 feet and 1000 foot intervals to 3000 feet and thereafter 500 foot bands.

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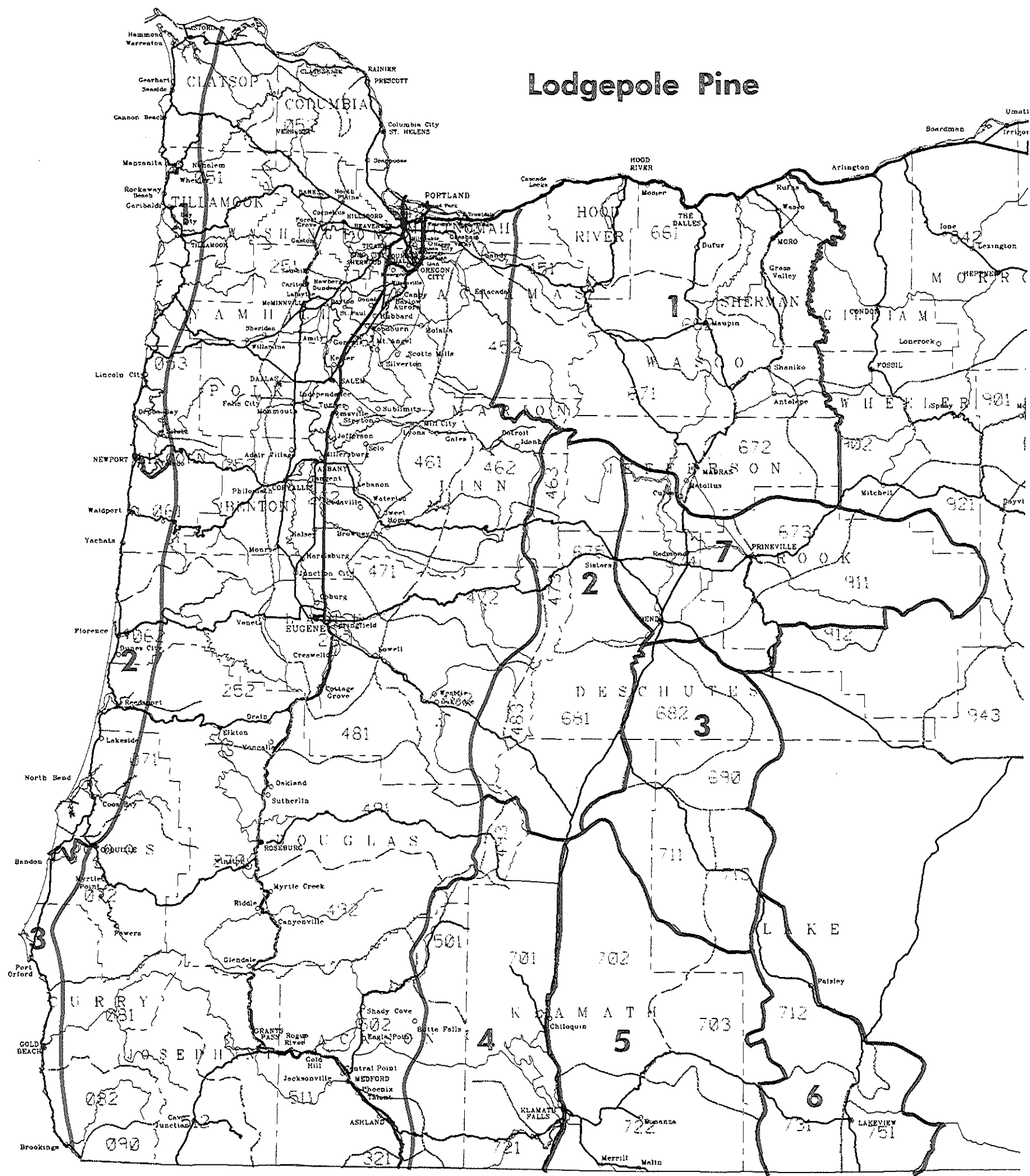
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Shore Pine

Lodgepole Pine



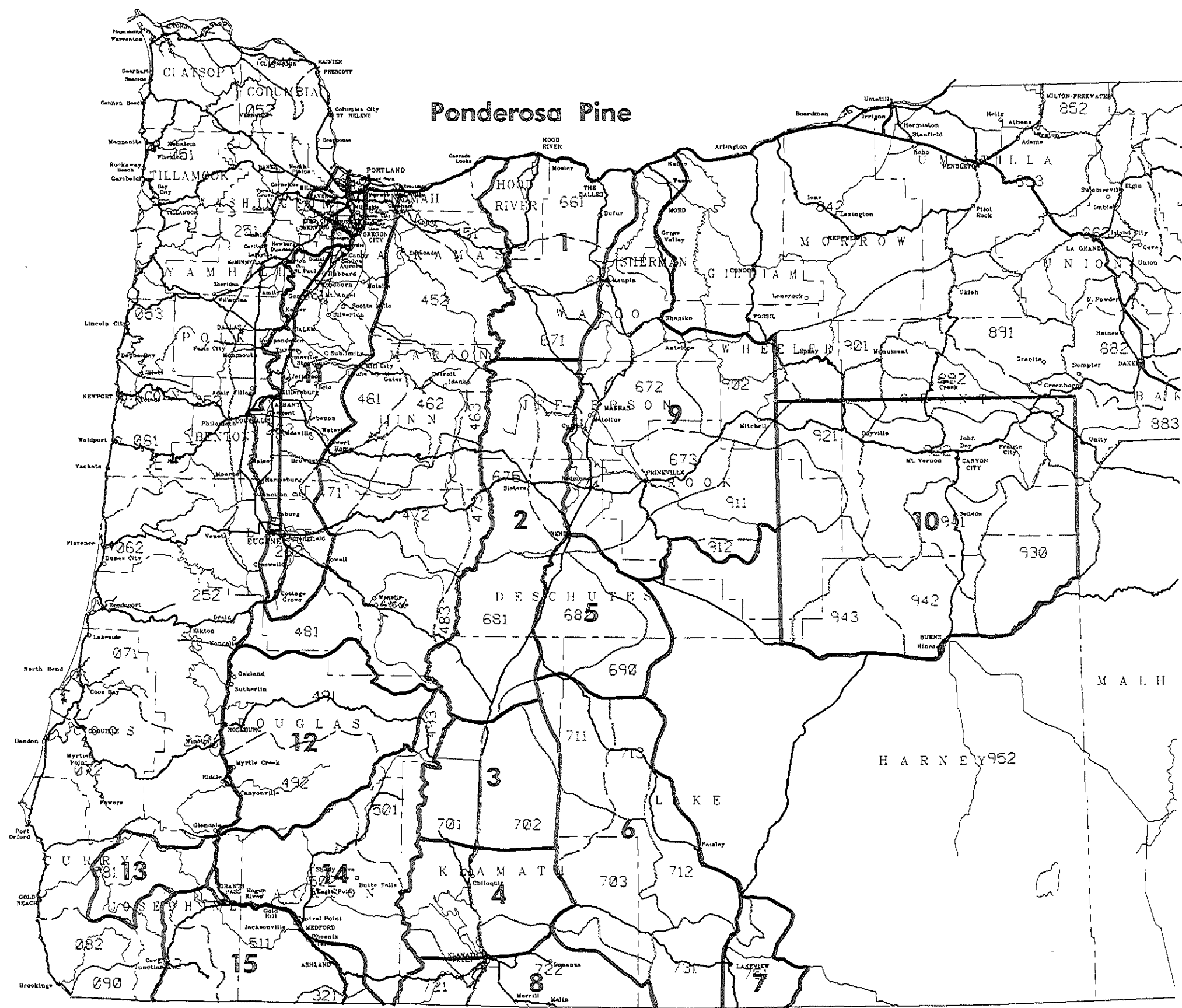
Shore Pine  
Zones 1-3  
0 = 500'

Lodgepole Pine  
Zones 1-7  
1000' elevation bands



TREE SEED ZONES FOR WESTERN OREGON  
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995

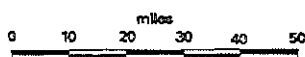




Zone 1-9,12-15  
1000' elevation

Zone 10  
<5000' = 1000' elevation bands  
>5000' = 700' elevation bands

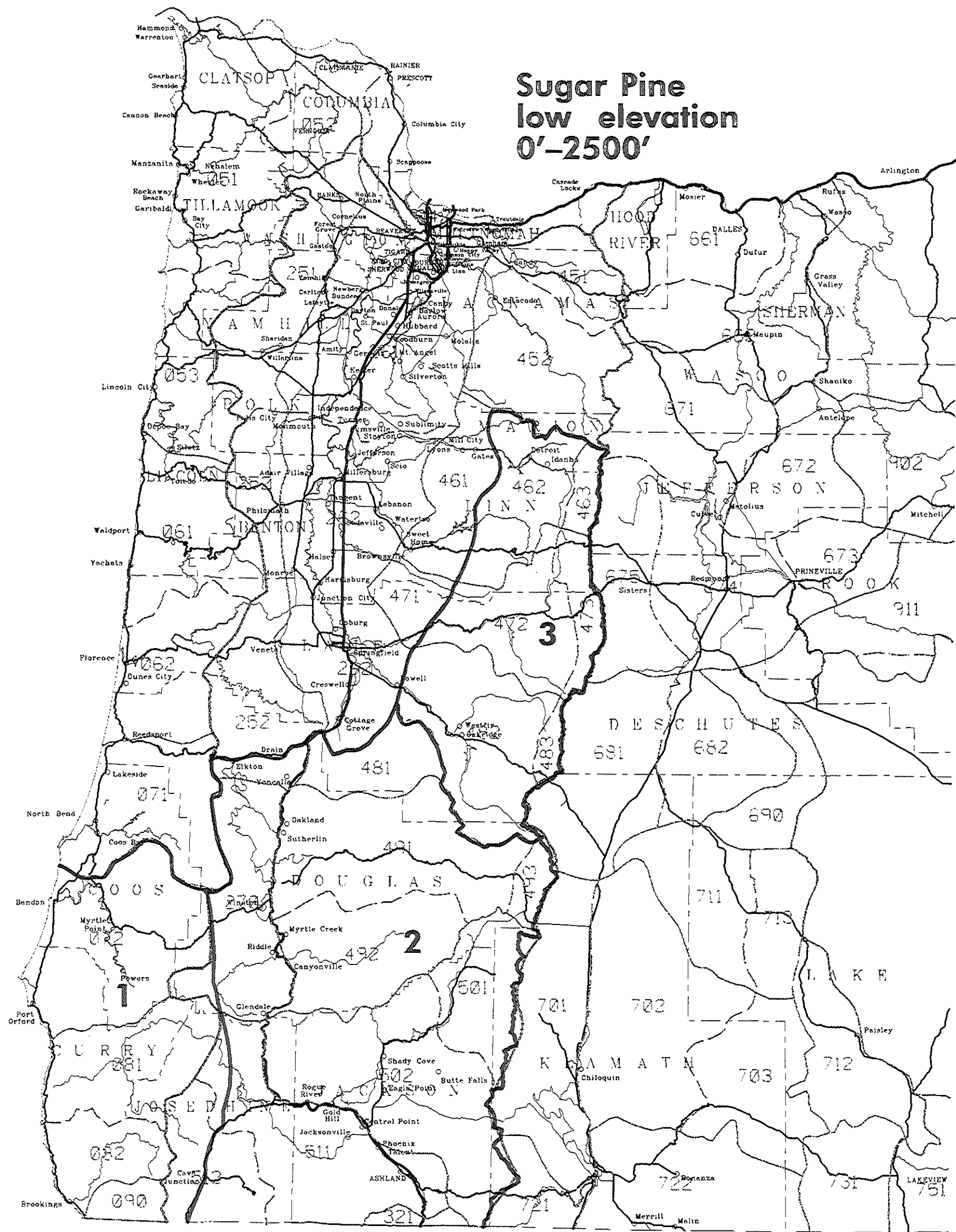
Zone 11  
single elevation band



TREE SEED ZONES FOR WESTERN OREGON  
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995



Sugar Pine  
low elevation  
0'-2500'



Zone 1,2  
0-2500' (one elevation band)

Zone 3  
0-3000' (one elevation band)



TREE SEED ZONES FOR WESTERN OREGON  
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995

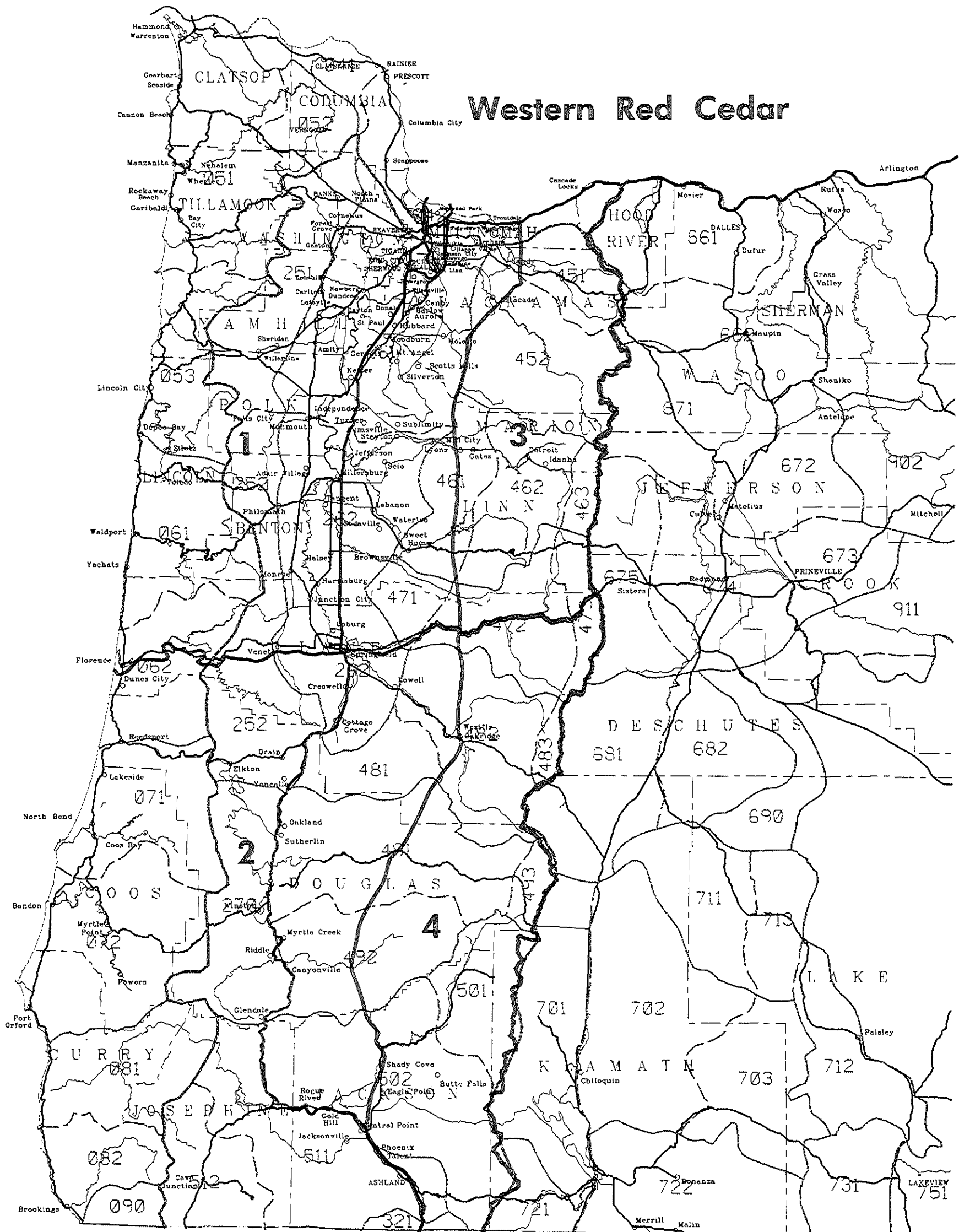








# Western Red Cedar



Zones 1,2  
no elevational sub zones

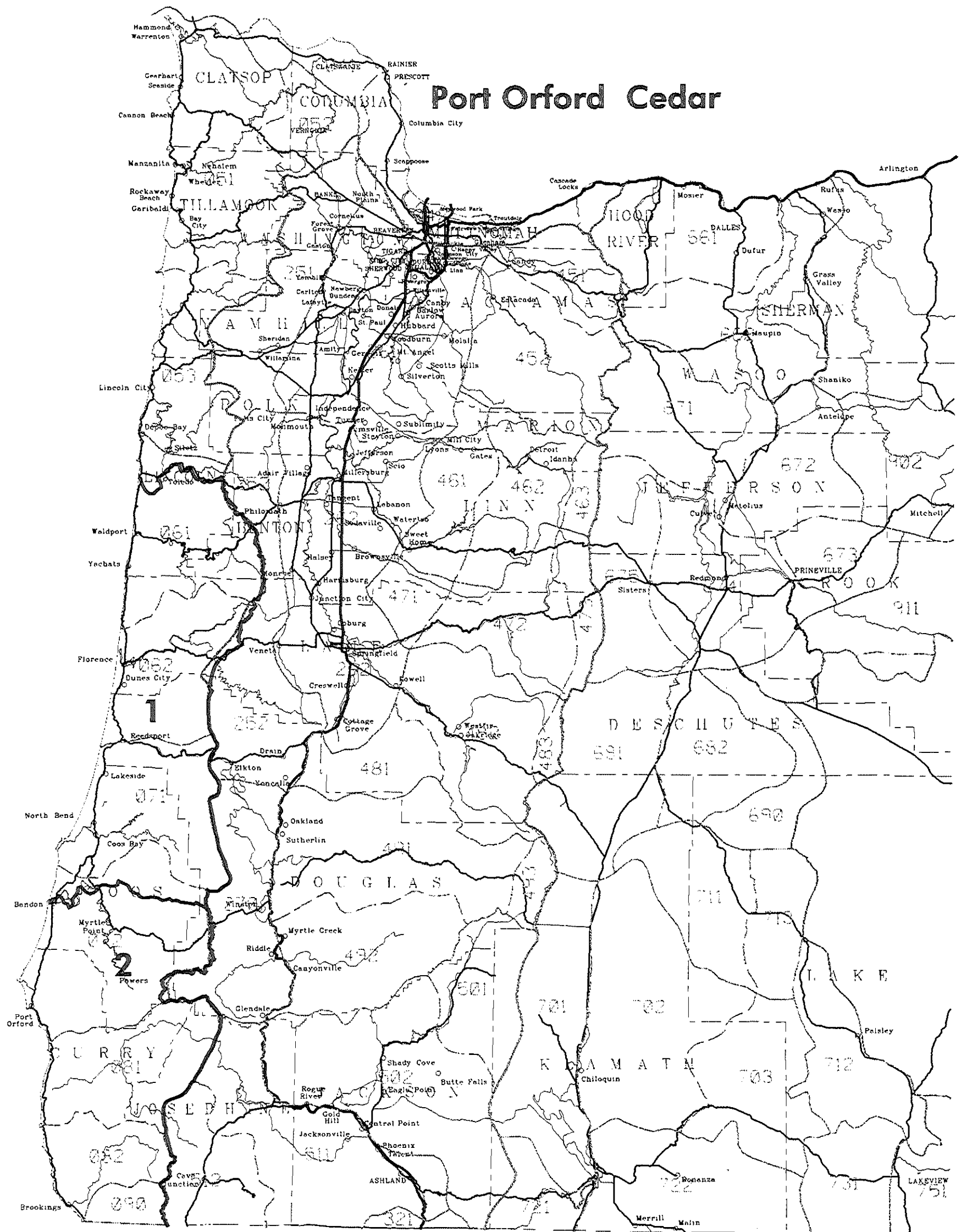
Zones 3,4  
2000'-3500'  
>3500'



TREE SEED ZONES FOR WESTERN OREGON

Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995





Zones 1,2  
0-1500'  
1500'-2500'

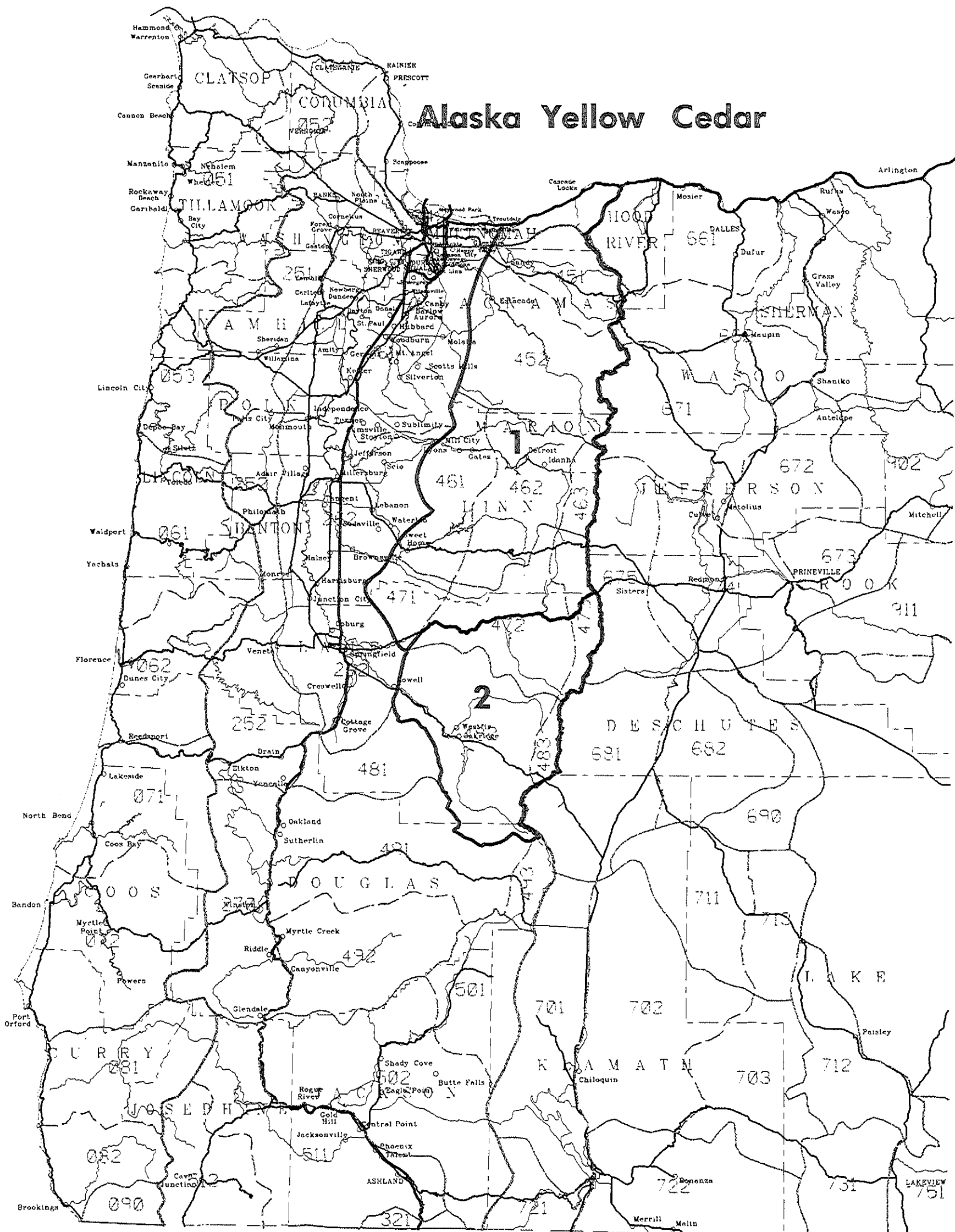


TREE SEED ZONES FOR WESTERN OREGON

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September 1995



# Alaska Yellow Cedar



Zones 1,2

0-4000'

>4000' = 1,000' bands

0 10 20 30 40 50  
miles

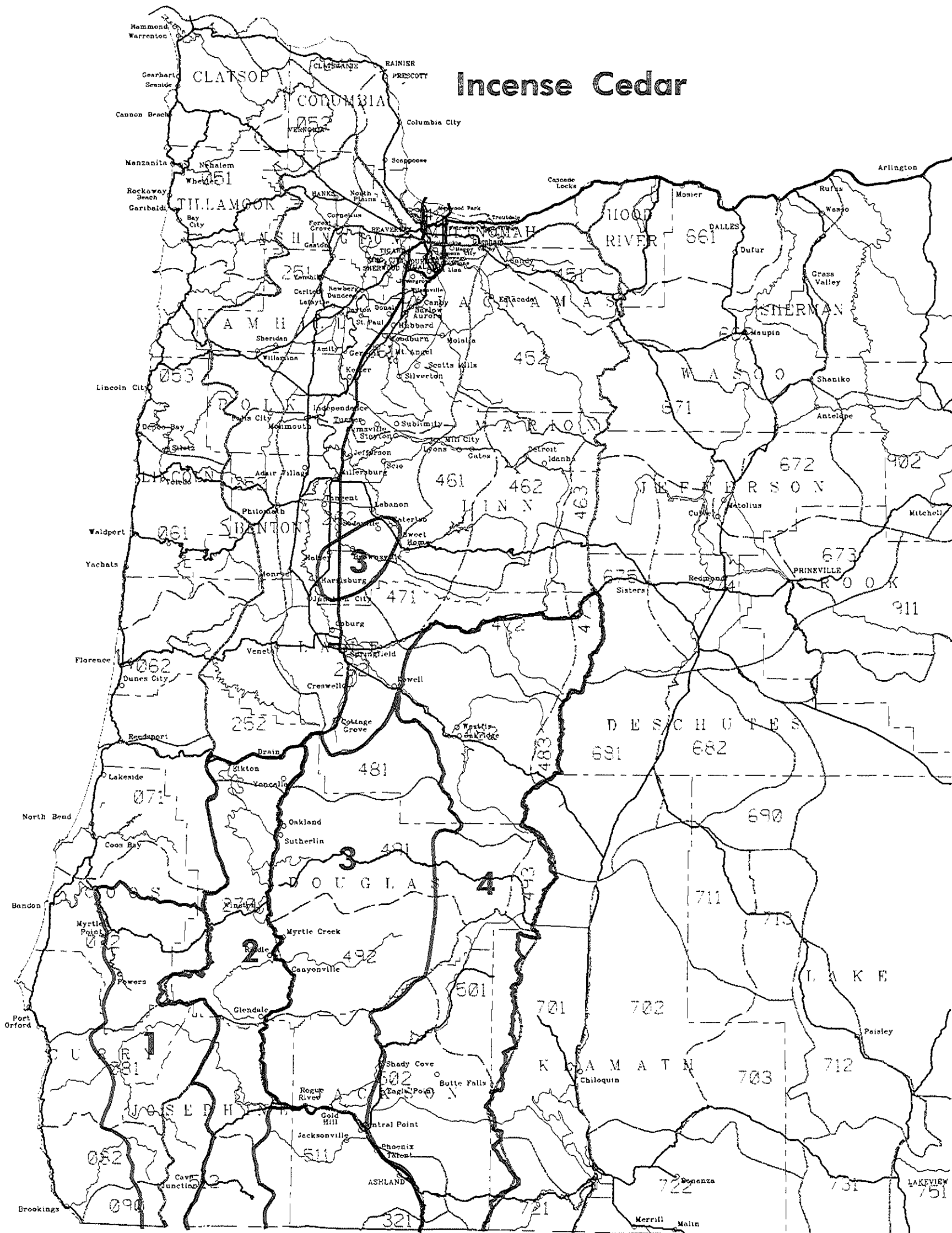
TREE SEED ZONES FOR WESTERN OREGON

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September 1995





## Incense Cedar



Zone 1-4  
1000'-2000'  
> 2000' = 1000' bands

A scale bar labeled "miles" with markings at 0, 10, 20, 30, 40, and 50.

## TREE SEED ZONES FOR WESTERN OREGON

Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995











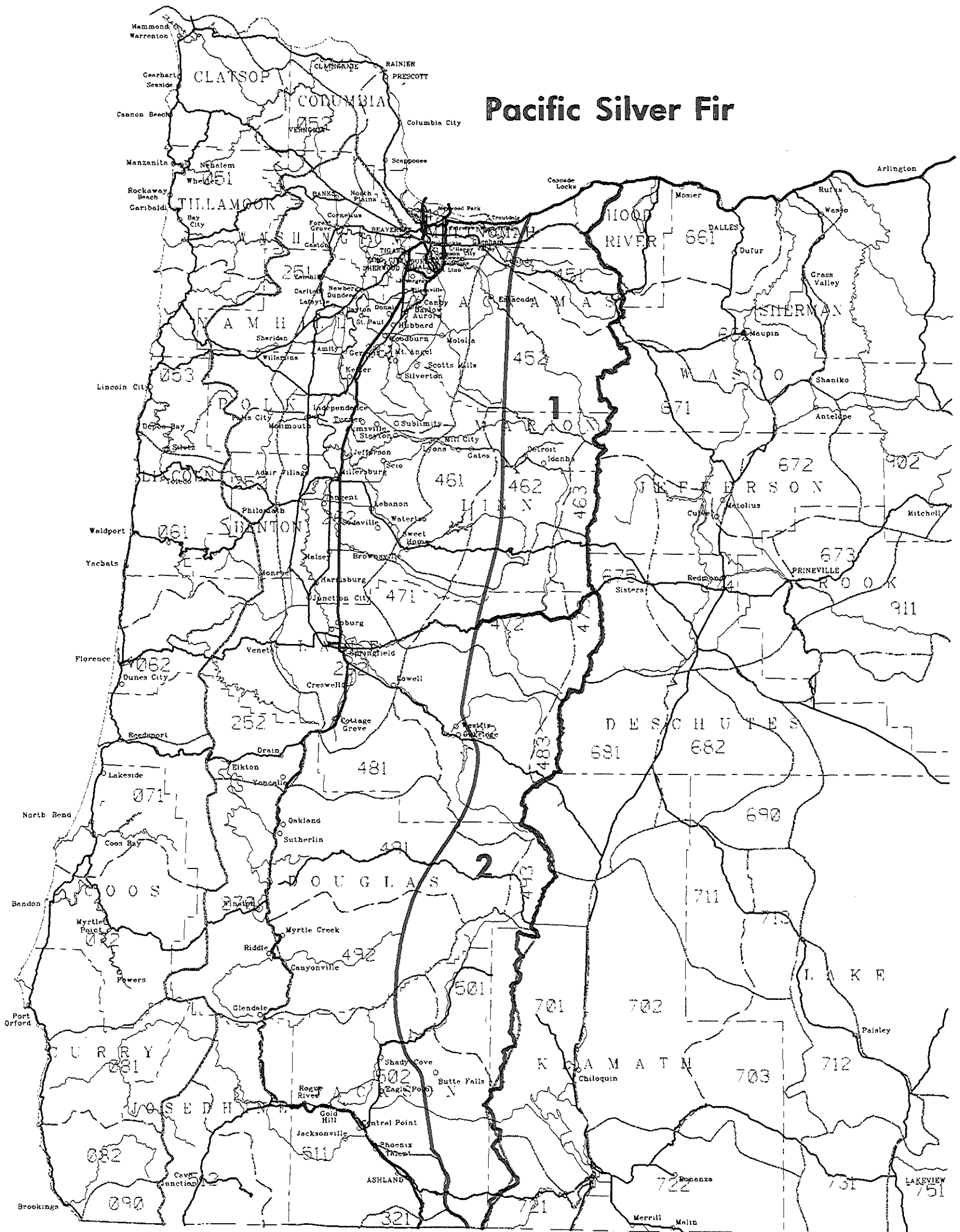
**Red Alder**

The map displays the distribution of Red Alder across Oregon, with county boundaries and major cities labeled. The distribution is marked by a thick black line and various numbers (e.g., 051, 053, 054, 055, 056, 057, 058, 059, 060, 061, 062, 063, 064, 065, 066, 067, 068, 069, 070, 071, 072, 073, 074, 075, 076, 077, 078, 079, 080, 081, 082, 083, 084, 085, 086, 087, 088, 089, 090, 091, 092, 093, 094, 095, 096, 097, 098, 099, 100) scattered across the map.

Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995







Zones 1,2

< 5000'

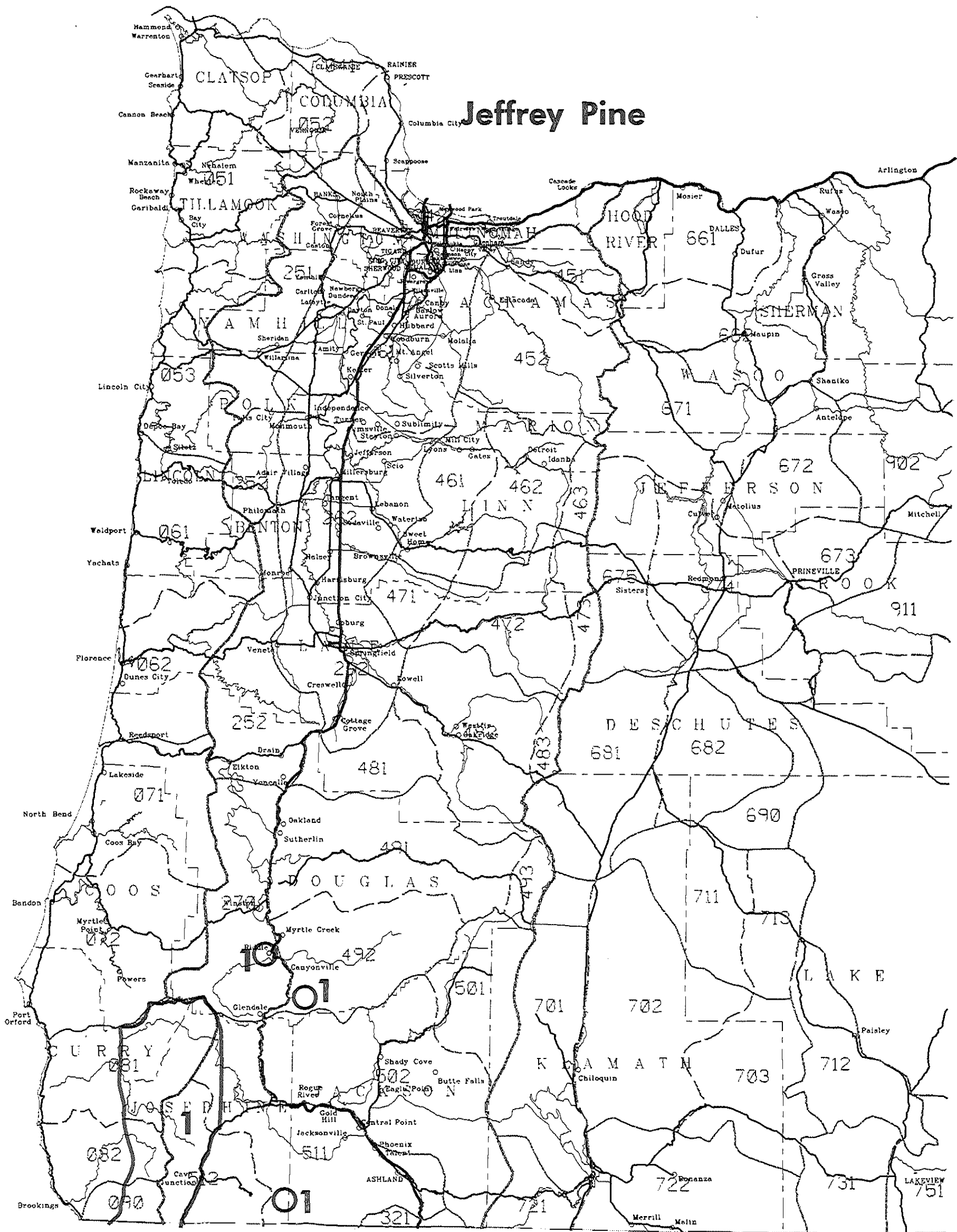
> 5000'

0 10 20 30 40 50  
miles

TREE SEED ZONES FOR WESTERN OREGON

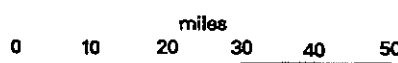
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September 1995





Zone 1 (all)

1000' elevation bands



TREE SEED ZONES FOR WESTERN OREGON

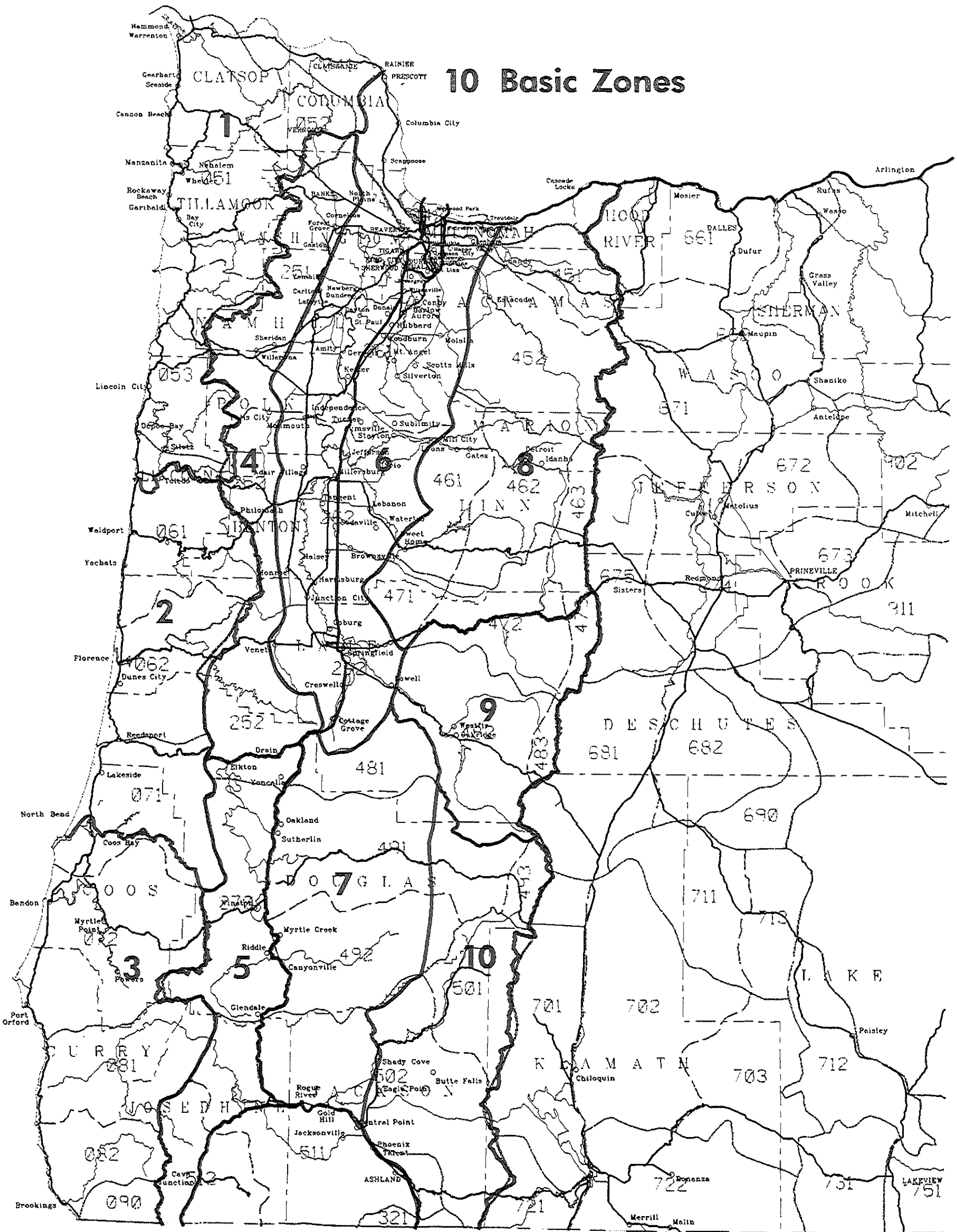
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995



## A detailed map of Oregon showing the distribution of Douglas-fir across various counties. The map includes county names such as Clatsop, Tillamook, Multnomah, Washington, Hood River, Deschutes, Klamath, Josephine, Curry, Lincoln, Marion, Polk, Lane, and Ashland. Major cities like Portland, Medford, Eugene, and Salem are marked. The Douglas-fir range is indicated by a thick black outline, encompassing areas from the coast near Cannon Beach down to the southern border near Jacksonville. Numbered regions (1-16) are shown within the distribution area. Topographic features like Mt. Hood and Mt. St. Helens are also labeled.

Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995





#### All Zones

0 - 1000  
1000 - 2000  
2000 - 3000  
> 3000 = 500'

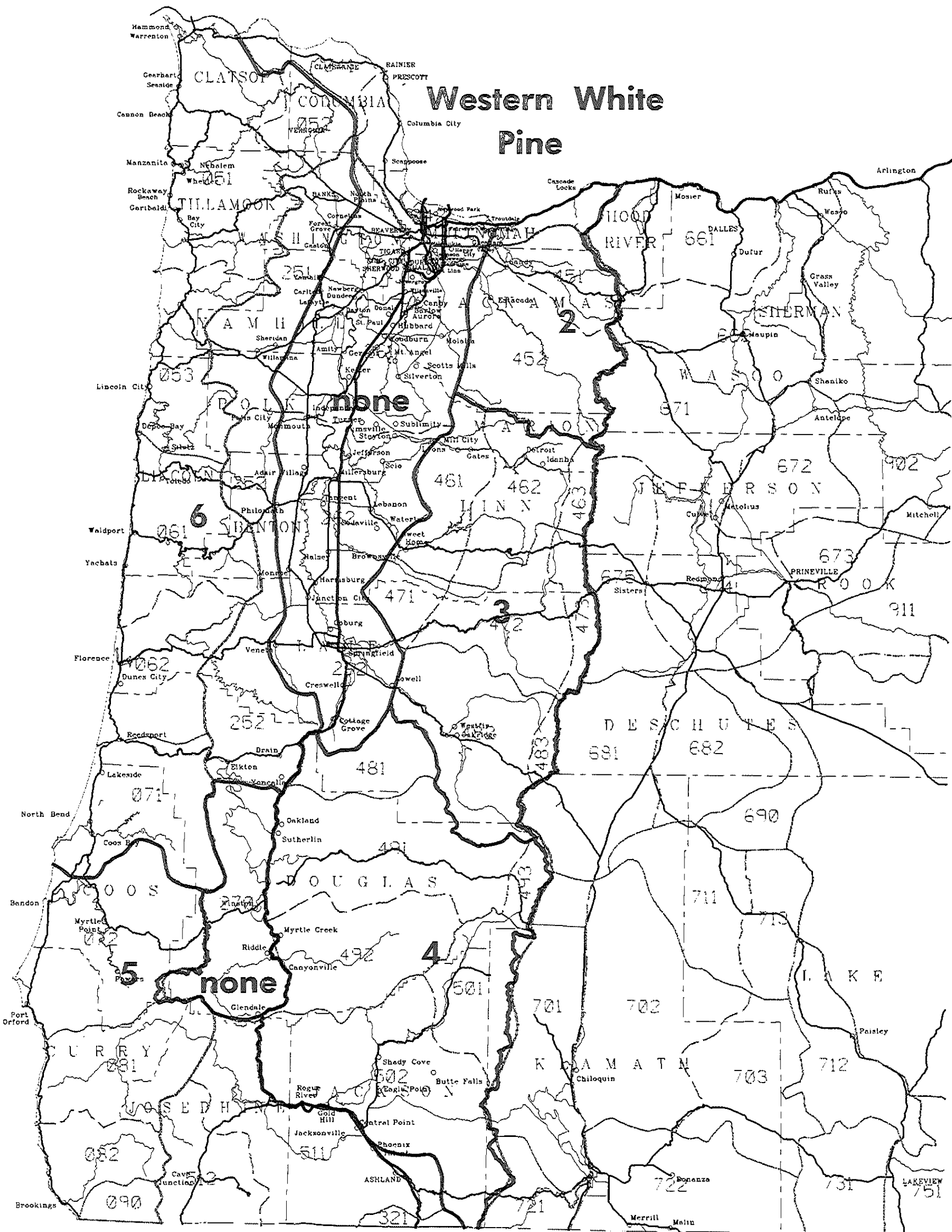
0 10 20 30 40 50  
miles

TREE SEED ZONES FOR WESTERN OREGON

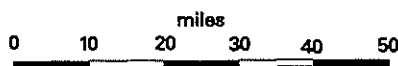
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995







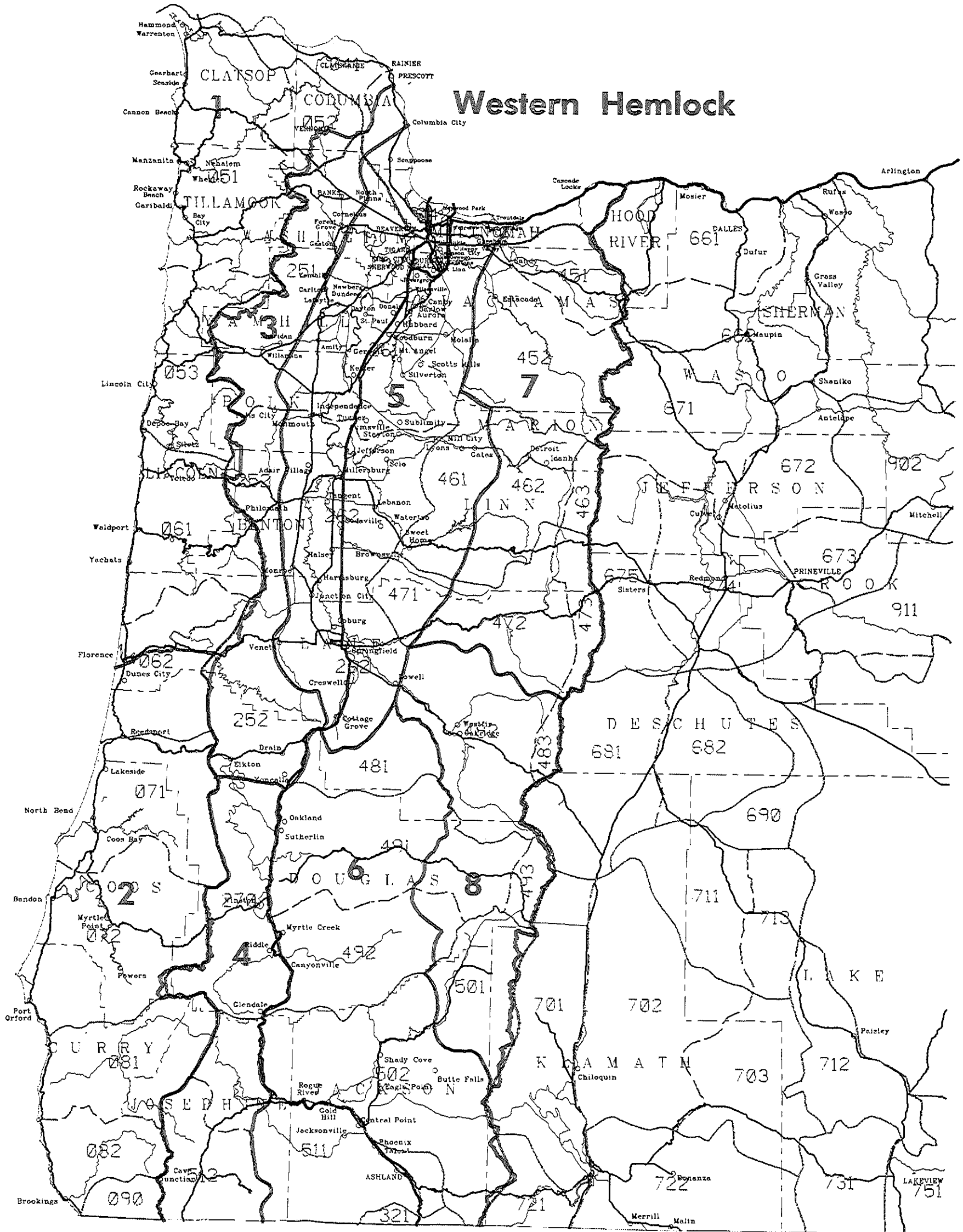
All Zones  
One elevation band



TREE SEED ZONES FOR WESTERN OREGON  
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995

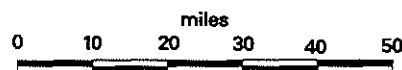


# Western Hemlock



Zones 1,2  
0-1500'  
> 1500' = 1000' bands

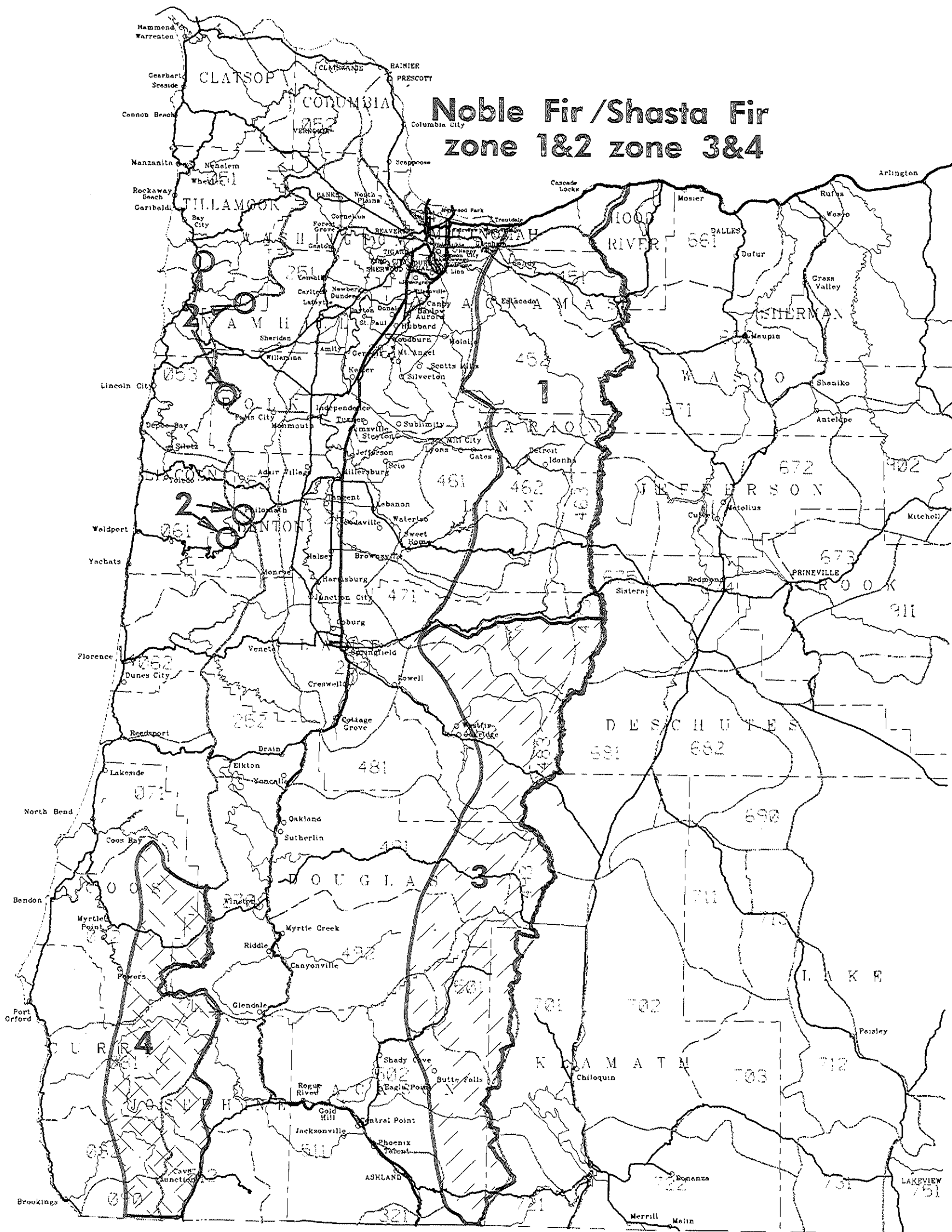
Zones 3-8  
1000' bands



TREE SEED ZONES FOR WESTERN OREGON

Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995





# Noble Fir /Shasta Fir zone 1&2 zone 3&4

Noble Fir



Zone 1  
<4500'  
>4500'

Zone 2

Single elevation band

Noble /Shasta



Zone 3  
<5500'  
>5500'

Shasta Fir



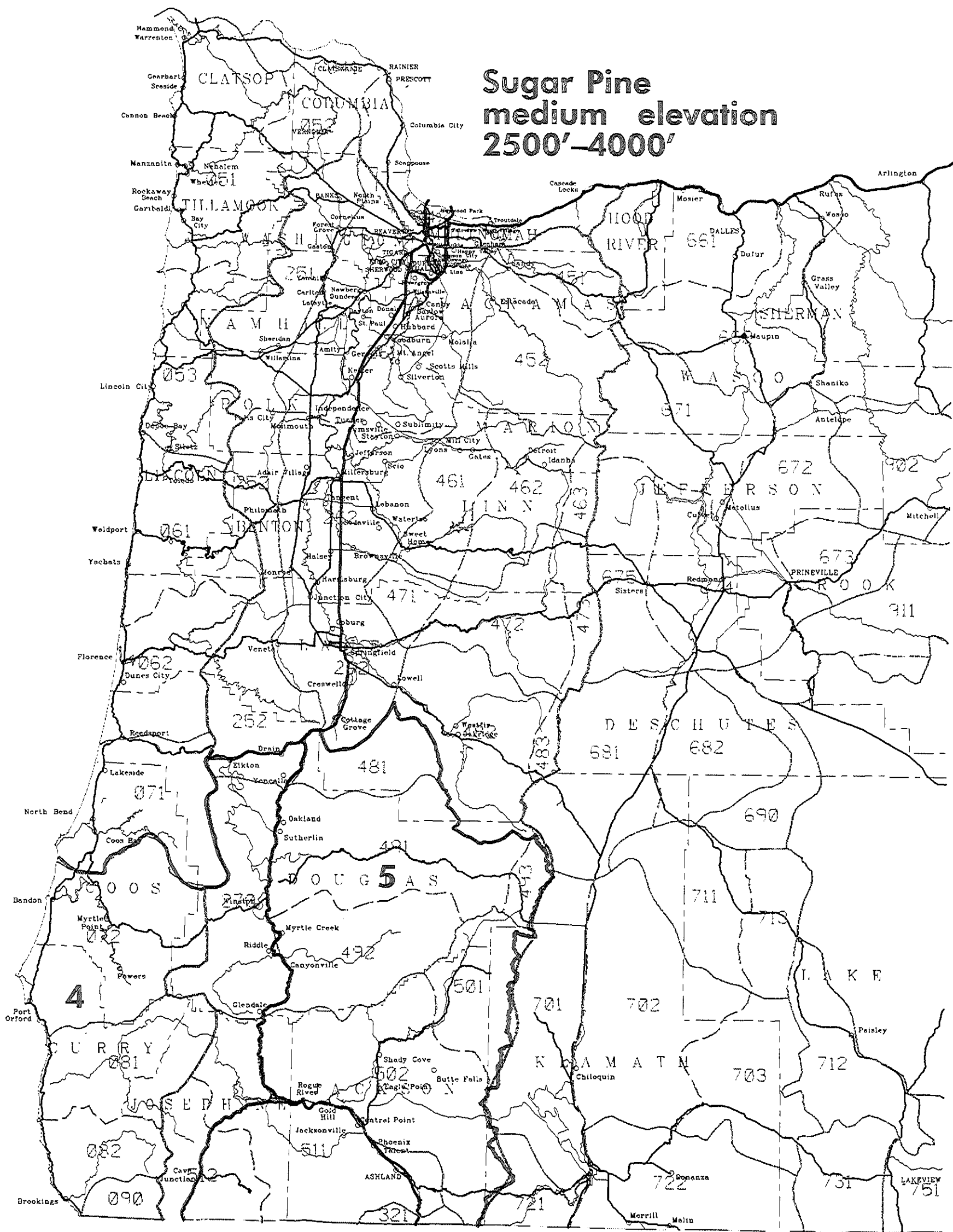
Zone 4  
3000'-4500'  
>4500'



TREE SEED ZONES FOR WESTERN OREGON

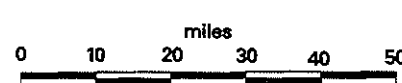
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995





# Sugar Pine medium elevation 2500'-4000'

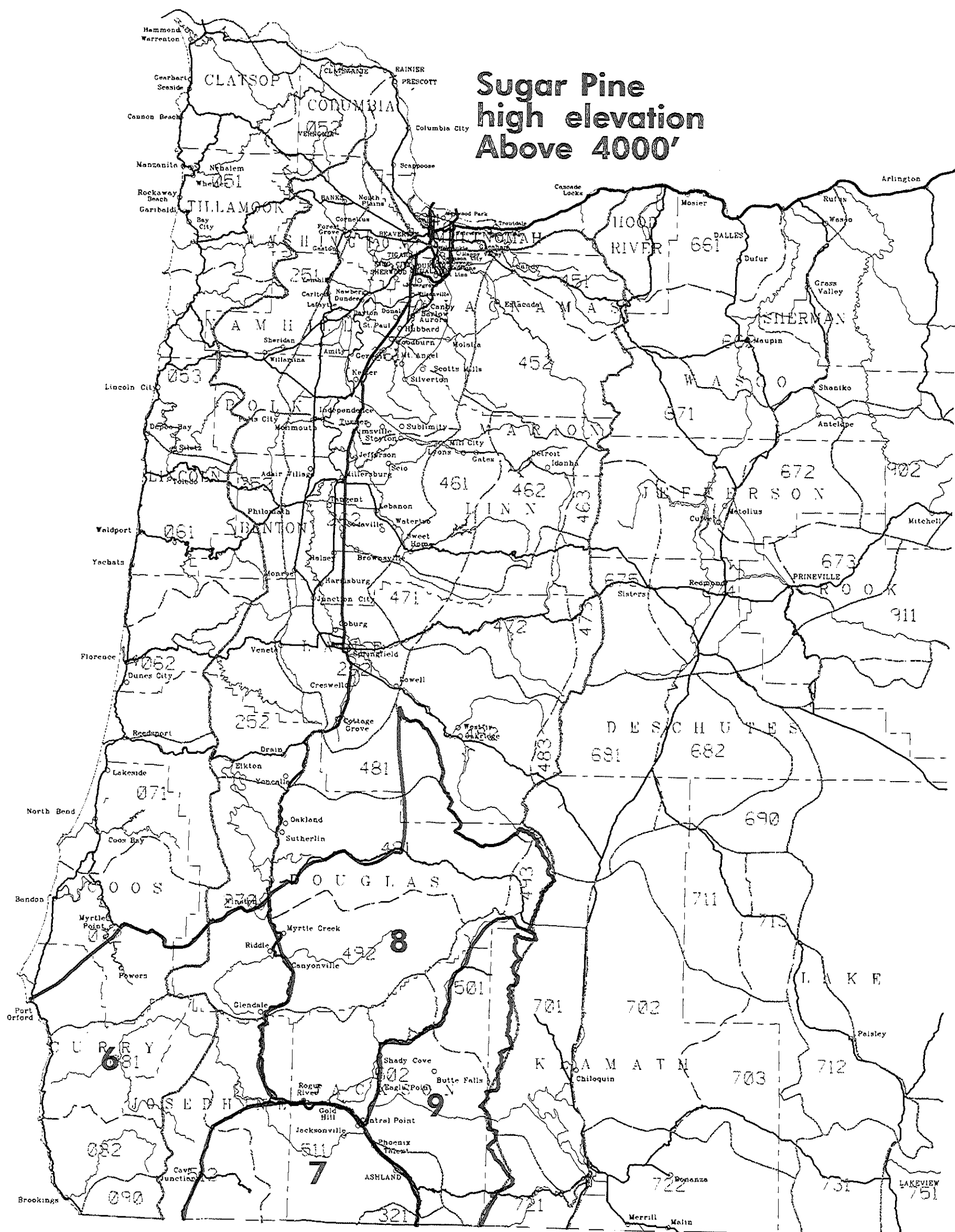
Zone 4,5  
2500'-4000' (one elevational band)



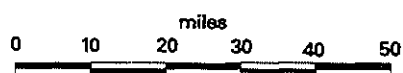
TREE SEED ZONES FOR WESTERN OREGON  
Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995







Zone 6-9  
> 4000' (one elevation)



Produced by Oregon Department of Forestry in cooperation with U.S. Forest Service Cooperative Forestry  
September 1995

