



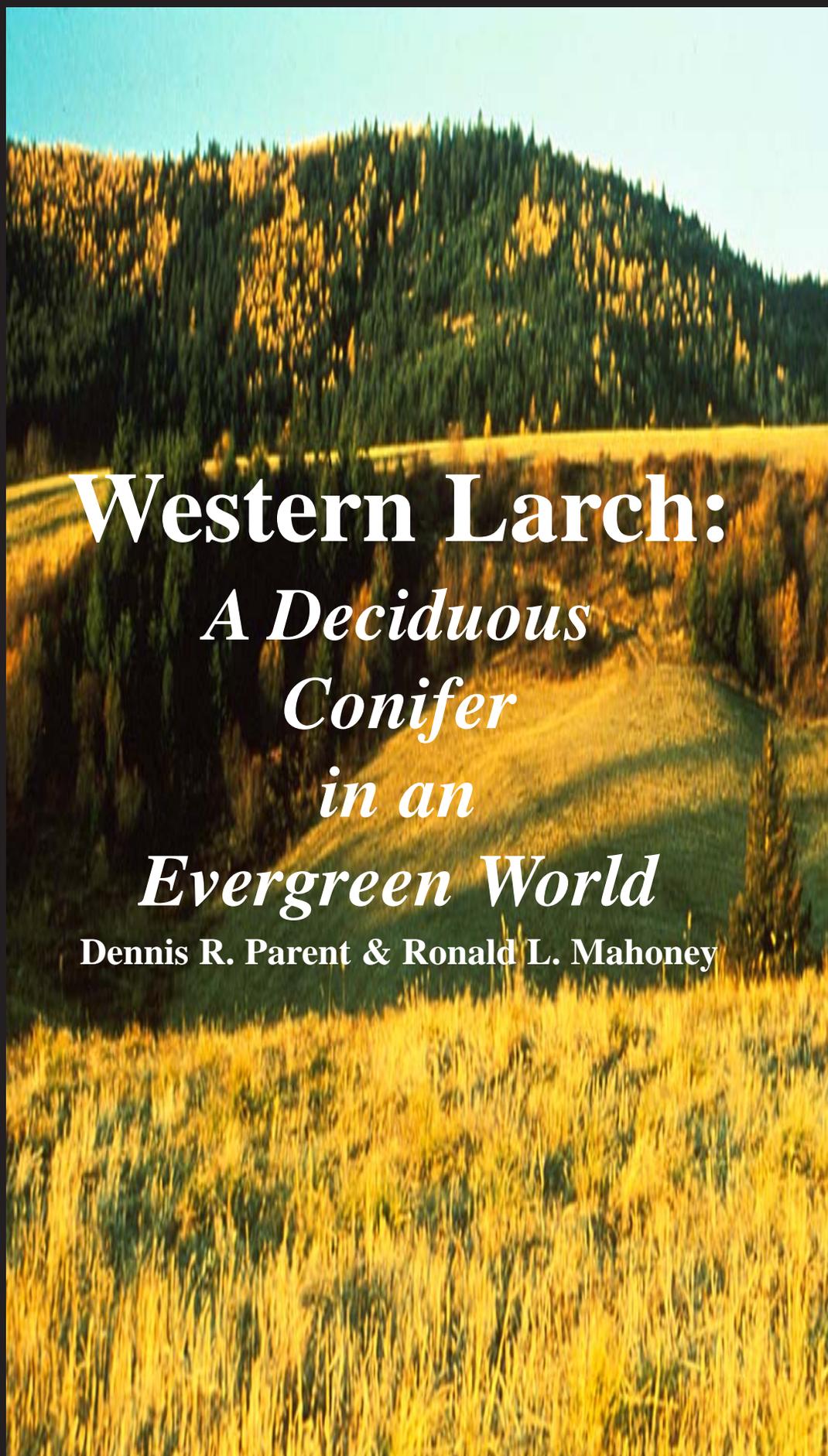
Station Bulletin No. 90
October, 2008

An electronic
publication
available at:
[www.cnr.uidaho.edu/
extforest/Larch.htm](http://www.cnr.uidaho.edu/extforest/Larch.htm)

Idaho Forest, Wildlife and
Range Experiment Station,
Moscow, Idaho.

Director
William J. McLaughlin

University of Idaho
Extension



Western Larch: *A Deciduous Conifer in an Evergreen World*

Dennis R. Parent & Ronald L. Mahoney

About the Authors:

Dennis R. Parent, Silviculturist, Inland Empire Paper Company, Spokane, WA.

Ronald L. Mahoney, Extension Forester and Professor, University of Idaho, Moscow, ID.

Special thanks to the following people for their critical review of this publication:

Yvonne C. Barkley, Associate Extension Forester, University of Idaho, Moscow, ID.

John Mandzak, Forester, Potlatch Corporation, Lewiston, ID.

Chris Schnepf, Area Extension Educator - Forestry, Coeur d'Alene, ID.

Mike Wolcott, Consulting Forester, Inland Forest Management, Sandpoint, ID.

Production:

Yvonne C. Barkley, Associate Extension Forester, University of Idaho Extension.

Notes to the reader:

- This publication contains some technical terminology, without which we would have to provide much explanation. If any of the terminology here is unfamiliar to you, please refer to *Terminology for Forest Landowners*, Extension Bulletin 1353, Washington State University. That publication is available from any Cooperative Extension office in WA, OR, or ID, many libraries, and online at <http://cru84.cahe.wsu.edu/cgi-bin/pubs/EB1353.html?id=bEpI8KGe> (read and print a PDF file, or purchase it for \$4.00).
- **Herbicide Use.** Herbicide recommendations in this publication are generalized information. Any herbicide planning and application must comply with herbicide labels and other regulatory requirements.

This publication is issued as
contribution No. 1018
of the Idaho Forest, Wildlife and Range
Experiment Station, College of Natural
Resources, University of Idaho, Moscow, ID
83844-1130



Western Larch: *A Deciduous Conifer in an Evergreen World*

Dennis R. Parent & Ronald L. Mahoney

Western larch is unique. Instead of maintaining their needles throughout the winter as other conifers do, larches are deciduous and drop their foliage and grow new needles every year. This physiological difference make the larch distinct among the world's conifer tree species. Few other conifers are deciduous, namely bald cypress and dawn redwood. Western larch (*Larix occidentalis*) is a familiar tree in the Inland Northwest, especially when its fall foliage turns a brilliant yellow. Many people also refer to this tree as *tamarack*, particularly when used as firewood. Western larch and subalpine larch (*Larix lyallii*) are the only larches native to the Inland Northwest. Subalpine larch exists in small populations in high altitude locations in Idaho, Washington, and Montana, and is not sufficiently represented across the landscape to differentiate it from western larch in this publication. Consequently, we will only consider western larch and refer to this tree species as larch through the rest of the publication.

Larch is well-adapted to nutrient-poor soils and burned sites. This shade-intolerant pioneer species has adapted well to the fire cycles of its home range. Larch is also relatively resistant to many insects and diseases common to the region. This is partly due to its ability to produce new foliage each year. In addition, the wood itself is high in extractives, chemicals that help it to resist root-rot and many wood-rotting organisms.

Not only is larch exceptionally adaptable as a species and resistant to many pests, but it also has excellent wood qualities that make it an outstanding choice whenever strength and consistency are desired. Larch wood is strong, hard, and dense, making it ideal for wood products such as laminated beams, poles, trusses, joists and rafters, and even flooring and firewood. Larch wood fibers produce good yields for kraft paper. Larch has many qualities that make it an ideal wood producer for the intensive forest management regimes of the future, and well-suited to a

variety of other ecosystem management objectives. Its unique qualities among conifers contribute strongly to biodiversity as well.

The Characteristics & Ecology of Western Larch

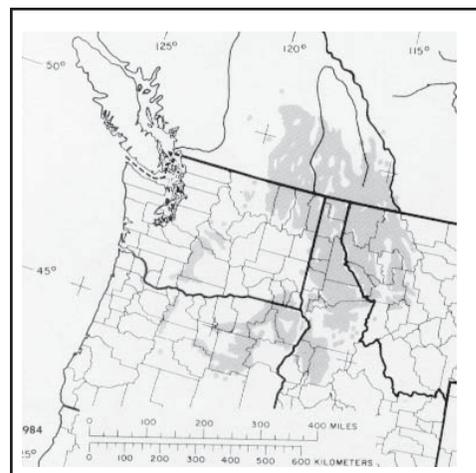
Range. Western larch has a relatively limited natural range: southeastern British Columbia, central to northern Idaho, western Montana, and northeastern Washington (Figure 1). It also is found throughout the northern Cascade mountain range and in the Blue Mountains of northeastern Oregon. There are 11 species of larch throughout the world. Three are native

to the United States: western larch, subalpine larch found at the higher elevations of the northern Rockies, and eastern larch (*Larix laricina*) a smaller tree in the northeastern United States, Alaska, and

Canada that frequents poorly-drained areas. Western larch is the tallest and largest of the world's larches.

Growth. Western larch is the fastest growing conifer species in the Inland Northwest. Larch effectively competes with other species by rapid juvenile height growth. It is common to observe annual height growth of three to four feet on young plantations with occasional observations of up to five feet. However, larch diameter growth is very sensitive to stand

Figure 1. Native range of western larch.



density, and if crowded, it loses crown rapidly because its needles function poorly without full sunlight. This property of larch is called “intolerance”. Due to its shade intolerance, larch usually develops into even-aged stands.

Larch height growth is peculiar compared to other conifers. It exhibits both predetermined and free (indeterminate) growth. Predetermined height growth consists of the portion of potential shoot growth for which stem units were initiated the previous growing season and enclosed in the over-wintering bud. Free growth consists of the portion of the shoot that is initiated and expanded during the growing season beyond what was predetermined. In most conifers, free growth is a juvenile trait that lasts up to 20 years for most species; in larch, free growth continues beyond the juvenile phase. This has important ramifications for long-term height growth.

Environmental Tolerances. Larch is considered a “seral” species meaning the tree is very intolerant to low light levels, and is adapted to open, disturbed sites. Larch is also a “pioneer species” in that it is one of the first species to come in after disturbances, such as fire, landslide, flood, or clearcut harvest. Compared to the other conifers in its range, many of which tolerate partial shade, larch survives and grows only in conditions of high light levels. Whereas all conifers do best in open sunlight, larch can survive only in open sunlight. If larch is overtopped by other species its crown rapidly deteriorates, and its vigor declines severely. Larch is the most shade-intolerant conifer in the Northern Rockies. This characteristic has many implications for management.

Larch is “mid-range” in drought tolerance, requiring more moisture than Douglas-fir and less than western redcedar, for instance.

Reproductive Biology and Seed Transfer. Western larch flowers very early. A warm spell in early- to mid-March can stimulate flowering. Unfortunately, this peculiar phenology makes the flowers susceptible to later spring frosts.

Western larch is known to be one of the best seed producers in northwestern Montana, but it is regarded as an unreliable seed producer in northern Idaho and other parts of its range. The reasons for this



*Female,
cone-producing flowers of
western larch in mid-season.*

discrepancy are still somewhat of a mystery, although late spring frosts appear to be the main factor. Consequently, outside of Montana, natural regeneration of larch is considered risky in most situations and planting is preferred.

Tree improvement and tree breeding applies genetic principles to develop “better” trees. One of the tools of tree improvement is seed transfer.

Guidelines have been developed for each western conifer species to determine how far seed can be transferred from the seed collection site to the planting location. These environmental requirements differ between species. The seed transfer rules for western larch are relatively broad, meaning seed and seedlings can be spread further from the source compared to other species. Larch’s adaptation to natural environments with three seed zones is intermediate between white pine, which has one seed zone and ponderosa pine, which has six seed zones across the Inland Northwest.

Nutrition. Little research-based information is available about larch nutritional characteristics, particularly its response to fertilizer, but growth response to fertilization is commonly reported. We also know that larch uses nitrogen more efficiently than other conifers. Larch effectively translocates nitrogen from the foliage back into the tree tissues before dropping its needles in the fall and it does this more efficiently than any other tree genus. For example, the needle litter of most other regional conifers has about 1 part nitrogen per 16 parts of carbon, whereas larch has only 1 part nitrogen per 50 parts carbon in its needle litter.

Water Use. Larch is very water efficient. It has a higher wood production rate per unit of water used than other western conifers. However, it can also be considered less water efficient in that it has only

moderate drought tolerance. Larch compensates for this inefficiency by shedding its needles during the winter, thus not transpiring during its dormant months. This could be the reason larch is generally not found until we reach the mid-moisture habitats characterized by grand fir, and larch is most productive on high-moisture cedar-hemlock habitats. This could also be the reason that larch seedlings seem to be sensitive to moisture, especially in the first two to three years of growth and development.

Photosynthesis and carbon fixation. One of the jobs that trees do well is to remove carbon from the atmosphere and store it as wood and other biomass for long periods. The photosynthetic rate of larch is similar to other conifers on a leaf area basis, but on a leaf weight basis, larch’s net photosynthetic rates are often twice that of other evergreen conifers. In other words, western larch has a low-carbon-cost, well-illuminated, nitrogen-efficient canopy that allocates carbon at higher rates than other western conifers. This information is

more easily understood if one pictures the crown architecture of the larch tree. Larch has a large tree height per crown width ratio, which enables the tree to capture higher levels of solar radiation. Its small, short branches allow more of the tree’s photosynthate to be allocated to bolewood rather than limbs or needles. As a result, larch can fix the same or more carbon during its shorter growing season as other evergreen conifers during the entire year. This species is comparably efficient in converting light energy to cellulose and other forms of carbon.



Larch produces new, highly productive needles each year. The characteristic “tuft” appearance makes larch easy to identify.

Watershed values. One of the lesser appreciated values of trees is watershed protection. A well-managed forest protects the land much as a rug protects a floor. Forests are the best land use to protect a watershed. The deciduous nature of larch provides

some unique characteristics to the hydrology of a watershed. A forest dominated by larch has less snow interception than other species due to its open crown architecture and deciduous foliage. Therefore, larch should produce a higher water yield due to less winter interception and less evaporation loss from the tree crowns. Larch forests should also experience higher snowmelt rates because of increased wind penetration during winter under a bare larch canopy, and more sunlight during the early spring before larch leaves out. These characteristics can be an advantage or disadvantage depending on the goals of the forest manager and a diverse array of other watershed variables.

Aesthetics. There is no argument about the stunning aesthetic beauty of larch trees. Larch adds a measure of color and textural diversity to the viewshed that no other conifer can match. Starting in spring with soft, delicate green foliage which becomes darker green in the summer, larch really shines in the fall, turning brilliant yellow, that in combination with neighboring dark green conifers, makes a uniquely striking landscape. The grays of winter completes the seasonal color contrasts in larch forests.

Special Attributes of Larch

Fire resistant. Larch is the most fire resistant species in the Inland Northwest (Table 1). Its thick bark resists ground fires, and its open crown architecture allows the heat of a fire to pass through rather than ignite the

Table 1. Fire resistance of Inland Northwest conifer species.

Species	Rank
western larch	1
ponderosa pine	2
Douglas-fir	3
western white pine	4
lodgepole pine	5
grand fir	6
western redcedar	7
western hemlock	8
Engelmann spruce	9

foliage. Also, if damaged, larch's deciduous needles are replaced the following season. Wildfire may actually favor larch because the species may still produce a viable seed crop even after the crown is killed by fire, and fire, whether wild or prescribed, will likely reduce the competition of other tree species and understory vegetation.

Root rot resistant. Larch is relatively root rot resistant. This may be due to a number of factors including a high level of extractives in the wood and bark, high phenol/sugar ratios, and low nutrient demands, which together increase disease resistance (Table 2).

Table 2. Susceptibility of Inland Northwest conifers to root disease (1= highest; 4 = lowest)

Species	Armillaria	Laminated
western larch	3	2
ponderosa pine	2	4
lodgepole pine	2	3
western white pine	2	3
western hemlock	2	2
Engelmann spruce	2	2
western redcedar	2	4
Douglas-fir	1	1
grand fir	1	1

Genetic adaptability. Larch has a high potential for genetic improvement and seed orchard development for the following reasons:

- Of the five commercially important Inland Northwest conifer species, larch has a one of the highest potential volume gains of 20 to 40 percent according to measurements by the Inland Empire Tree Improvement Cooperative from progeny tests in northern Idaho and northwestern Montana.
- Larch is also one of the higher-value species and has held its value over a long period.
- Larch exhibits one of the fastest growth rates of conifers, especially during the juvenile stages, thus recovering investment in genetic improvement sooner.

- Larch seed is in high demand because it tends to have poor natural seed yields, especially in northern Idaho. Consequently, this may help fund its genetic improvement through sales from seed orchards.
- Larch is easy to graft, which improves the economics of seed orchards.
- Larch seed transfer is relatively broad, which reduces the cost of seed orchards.
- Finally, larch responds positively to intensive forest management, a trait that gives it an advantage for capturing the potential genetic improvement.

Wood strength. Larch has strong wood compared to other Inland Northwest conifers. The specific gravity of wood is highly correlated with strength. Larch has one of the highest specific gravities of all conifers in this region (Table 3) and larch also has a high BTU content, especially if there is a lot of pitch in the wood. Both of these characteristics make larch a preferred species for firewood as well as material for laminated beams, flooring, and power poles (where ice loading may be encountered).

Table 3: Specific gravity of Inland Northwest woods.

Species	Specific Gravity
western larch	0.48
Douglas-fir	0.46
western hemlock	0.42
ponderosa pine	0.38
lodgepole pine	0.38
western white pine	0.36
grand fir	0.35
Engelmann spruce	0.33
western redcedar	0.30

Height growth. One of larch's greatest attributes is its rapid juvenile (i.e.: first 20 years) height growth. This rapid growth quickly gets the seedling above competing brush and other associated tree species so it can take control of the site. While sufficient upper-soil moisture is necessary to enable this growth, its fast growth enables its roots to penetrate lower water

levels, sustaining it during drought periods once it is established.

Windthrow resistance. Larch's deep and extensive root system enables it to withstand high winds. Also, the lack of foliage and light branching causes winter gusts to filter through the crown, further reducing the chance of wind breakage or uprooting.

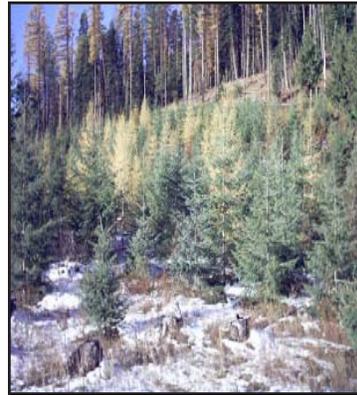
Low weather damage risk. Larch is able to withstand ice and snow loading during the long Inland Northwest winters. This characteristic is mostly due to lack of winter foliage, but a narrow, well-balanced crown with short branches and strong wood adds to the ability. Ice and snow loading, especially in the early spring, may bend the trees, but they usually recover.

Wildlife habitat. Larch snags are long-lived, which makes it one of the best snag species in the west. The sapwood is slow to decay and often surrounds the decaying heartwood in older trees with a durable ring of solid wood. This provides excellent habitat for all kinds of cavity nesting birds and mammals. Even after the tree falls to the ground its importance to forest growth remains high as it slowly decomposes into long-lasting nutrient and water conserving soil organic matter, which is so vital to forest sustainability.

Chemical value. Larch wood contains many extractive chemicals, some of which have marketable value. For example, arabinogalactan is a water-soluble gum high in sugars that can be extracted from larch. Though present throughout larch wood, it tends to concentrate in the butt of the tree, especially old ones. In the Libby, Montana, area, many stumps and "long butts" remaining from earlier old-growth harvests have been removed and undergone chemical extraction. Arabinogalactan, a high-value alternative forest product, is used as a binder in the food, pharmaceutical, cosmetic, and bio-tech industries.

Special Problems of Larch

Although western larch has some unique properties that make it one of the most valuable species of the Inland Northwest, it also has some characteristics that can be a challenge to its effective management.



Larch does well in a mix with western white pine and other conifers, but density management is necessary to avoid excessive competition for this intolerant species.

Regeneration. In order to thrive, larch needs adequate site preparation. Regeneration is very sensitive to competition and soil moisture the first few years, so control of competing vegetation and exposure of mineral soil for natural seedlings are essential.

Crowding. Larch's seral, shade-intolerant nature causes rapid crown loss if overtopped or crowded by competing trees or

other vegetation. This has implications for the timing of precommercial and commercial thinning, and mixed species management. High tree density can also cause physical crown loss in windy conditions because of limb breakage from contact with nearby trees.

Herbicides. Larch is very susceptible to herbicide damage. Its non-waxy needles and continuous growth with late bud set keeps its tissues susceptible until late fall, whereas other associated conifers begin to set bud and go into dormancy during August. Once dormant, conifers are very tolerant of many commonly used forest herbicides. The exceptions: larch is quite tolerant to sulfometuron (Oust®), atrazine (Atrax®) and chlopyralid, effective herbicides for grass and forbs.

Seed Yield. Larch has sporadic cone crops in the wild, especially in northeastern Washington and northern Idaho. As previously mentioned, the main reason for poor cone crops is considered to be frost damage to flowers. Frost does not affect the buds, in fact larch buds are very tolerant to frosts; it is the flowers that are sensitive. Even in years of



Larch seed is light in weight with a large "wing" that enables it to travel and fall over large areas when winds are favorable.

good cone crops, seed and cone insects can dramatically reduce viable seed yields.

Mismanagement. One of the biggest threats to the sustainable management of western larch is the forester manager. Larch has difficulty regenerating under the shade of a partial cutting system. Furthermore, if established, larch has even more difficulty growing under the partial shade left after this type of harvest. Continued high-grade logging, partial cutting, public resistance to clearcutting and lack of prescribed fire may relegate western larch to nothing more than an occasional tree in our forests within another rotation. In fact, the biggest threat to western larch may not come from the natural processes operating in the ecosystem, but from human actions and inactions that disrupt natural events. We personally believe that the biggest impact on the future of larch is from poor forest management decisions, often driven by “kinder and gentler” sentiments that particularly effect management of public lands. These concerns could be moot, however, if recent research on the relationship between the range of larch and climate change proves true. One model predicts that the present trends in climate change could result in a large portion of larch’s current range becoming unsuitable over the next 30 to 90 years. We don’t want larch to eventually become a threatened species simply due to poor forest management, but we also need to be thinking of how we respond to changing environments and habitats for this and other forest tree species.

Insects and Disease. Western larch is relatively free of damage from most insects, diseases, and other problems. However, larch is susceptible to some pathogens and insects. The important ones are listed in Table 4 and are addressed below.

Mistletoe. Dwarf mistletoe is probably the most damaging pathogen of larch. Mistletoe is a parasitic plant that grows on the tree, removing sap for its sustenance. Swellings on the limbs and dense branching that later become visible as “witches’ brooms” are the visible effects of mistletoe.

Dwarf mistletoes are species specific; the same species of mistletoe cannot infect different species of trees. It is easy to deal with silviculturally because the parasite dies when the infected plant dies; thus, cutting the tree controls the mistletoe. Mistletoe is a slow spreading disease, so early detection and sanitation - cutting infected branches or removing entire trees - is the most effective treatment. Mistletoe rarely kills large trees, but once established, can kill or disfigure seedlings and saplings. Consequently, regeneration may be limited unless infected overstory trees are removed, and because larch regeneration is limited, species composition may change radically in areas of advanced mistletoe.

Casebearer. Larch casebearer get its name from the way the larvae carries its cocoon-like case constructed out of a larch needle as it seeks new foliage to mine. Casebearer was accidentally introduced into the U.S. in the 1950’s. It spread rapidly and reduced larch growth dramatically during the 1970’s and early 1980’s. Introduced and native parasites, plus adverse weather conditions, appear to be reducing the casebearer problem. Spotty outbreaks still occur in certain areas, but the insect pest is now generally “endemic” (it maintains a small, incidental population).



Once a plague on Inland Northwest larch, the casebearer damage shown here has become rare due to parasites of this introduced insect.

Table 4: Western larch insect, disease, and other problems

Name	Species	Relative Importance
dwarf mistletoe	<i>Arceuthobium laricis</i>	1
larch casebearer	<i>Coleophora laricella</i>	2
needle cast	<i>Meria laricinis</i>	3
bears	<i>Ursus americanus</i>	4
spruce budworm	<i>Choristoneura occidentalis</i>	5
root and butt rot	<i>Phaeolus schweinitzii</i>	6
laminated root rot	<i>Phellinus weirii</i>	7
flatheaded fir borer	<i>Melanophila drummondi</i>	8

Silvicultural Treatments for Western Larch

Needle Cast. Larch needle cast (*Meria laricinis*) and needle blight (*Hypodermella concolor*) are caused by naturally occurring fungi. They can cover large areas after warm, wet winter weather conditions. Although the impacts may appear serious and from a distance are easily confused with casebearer, these pests have minor impacts under normal conditions.

Budworm. Western spruce budworm will damage larch only if there is no other nutrition available and the population is epidemic.

Root Rot. Although rare, larch will occasionally become infected with root rot, but even when infected, the disease usually manifests as butt rot and the tree is rarely killed. When root rot centers develop for other conifer species, planting larch is often recommended where conifer regeneration is desired.

Bark Beetles. Historically, bark beetles have not been a problem for western larch. However, the first known instance of bark beetle-caused mortality was recently discovered in Montana. Although trees were killed, foresters believe the outbreak was indirectly caused by recent droughts and wildfire.

Animal Damage. One of the more serious problems of larch is the stripping of bark by bears. During spring, when other food is scarce, the bears strip pole-sized trees to get at the succulent inner bark. Some feel that this is a learned response and animal control can be effective, while other forest owners have tried feeding stations at critical times with mixed results. For some unknown reason, the bears seem to prefer larch over other tree species. It has been speculated that this is due to the additional sugars contained in larch trees.



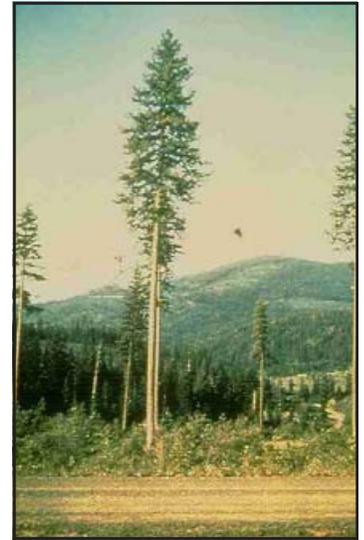
Bear damage is a localized, but sometimes severe, problem for pole-sized larch.

The silvicultural treatments for western larch are fairly straightforward if the forester recalls the previous ecological requirements and characteristics of larch and uses them to fine tune the prescription.

Natural Regeneration. Natural regeneration can be successful for larch, but it is not easy, free, or cheap. In addition, natural regeneration is usually a higher financial and biological risk than planting. For the greatest chance of success, it requires a broadcast burn or intense site preparation, which can include either mechanical or herbicide methods, or both. The

highly periodic cone crops require a method of prediction. In Montana, researchers found that the probability of natural stocking for any species is less than 50 percent. Even with scarification you must be willing to accept this risk, and understand that for full stocking at least some spot planting is nearly always required. Furthermore, pre-commercial thinning of naturally overstocked areas may be necessary to secure the investment and capture the full growth potential of larch.

There is a technique to enhance cone production in natural stands. Research at the USDA Forest Service Rocky Mountain Research Station developed a method of partial girdling that increased larch cone crops significantly. The dominant trees in a stand must be partially girdled in March before flowering occurs. Make two saw cuts three-quarters of the way around the tree opposite each other and spaced apart about equal to its diameter on the tree bole. This wounding has little effect on the health of the tree, and will not kill it or attract bark beetles or other insects, as it



Leaving well-formed, dominant larch for natural seeding is a common and effective regeneration method.

might in other species. This tactic can be applied in seed tree systems where these “parent” trees would be removed within 10 years after seedling establishment.

Planting. Artificial regeneration provides a much higher guarantee of success if good seedlings are available from proper seed zones. Site preparation is just as important as with natural regeneration. Prescribed fire, mechanical treatment, herbicides or a combination of these can be used. The most important thing to remember - if good survival is desired, there must be adequate site preparation that removes or reduces competing vegetation. Plant as large a seedling as you can afford. Many people are changing to bigger seedlings with Styro-8 container-grown seedlings currently the most popular. Larger seedlings have higher survival and are better able to withstand animal damage and the other hazards of nature. Bigger seedlings cost more, but remember, the issue is not planting cost but cost per survived seedling. The higher cost of bigger seedlings is generally offset by better survival, reducing the need for subsequent re-treatment of the site and re-planting.

Fall planting may be preferable to spring, but only if container stock is planted early enough in the fall to allow significant root growth. Root growth during fall predisposes the seedling to start crown expansion immediately when the weather warms the following spring. However, do not fall plant larch on frost-prone sites, especially those with fine-textured silt and clay soils, due to the danger of frost heaving. Avoid sites exposed to strong winds and areas with a traditional lack of winter snow, because soil moisture is critical in winter as well as summer. Fall planting is best when there is sufficient available moisture on higher elevations and northerly aspects.

Since larch is very sensitive to any amount of competition, vegetation control is a vital ingredient for regeneration success. The best advice is to get it done before planting the seedlings. Due to larch’s sensitivity to most herbicides, it is very difficult to treat seedlings after planting. Use contact herbicides such as glyphosate (Roundup®, Accord®, Foresters®) and imazapyr (Arsenal®, Chopper®) prior to planting. Atrazine (Atrex®), acting as a preemergent herbicide, can help hold sites after contact herbicide treatment. Chlopyralid, a relatively new herbicide, can control thistles that tend to seed into sites about a year after



The absence or control of competition is essential for successful larch regeneration.

treatment with the above herbicides. Sulfometuron (Oust®) herbicide may work but be mindful of soil pH. The solubility of Oust® increases rapidly once the pH is above 6.0. As solubility increases, so does the chance for damage. Oust® herbicide works well on established grasses, and most of our forest soils are sufficiently acidic to avoid the solubility problem. Fire, or planting on formerly

farmed land, may raise soil pH. In these situations, it is better to apply Oust® 6 months or so in advance of planting to allow its activity to degrade.

Thinning. Thinning can favor the best species, optimize biological growth, increase future income, and provide many other benefits. Considering the recent emphasis on smaller stems (with minimum sawlog diameter at the small end approaching four inches) thinning is less important, especially since small tree harvests mean shorter rotations, earlier monetary returns, and higher net present values.

Precommercial thinning. Precommercial thinning can be an effective silvicultural treatment for larch with the following considerations:

- Thin early - at 10 to 15 years old and 15 to 20 feet tall, before significant crown loss occurs. This results in lower cost, larger crowns, and better growth response. It also produces less slash and lower fire hazard than later thinning of larger trees.
- Thin from below to leave the best crop trees. The key is to look for the trees you want to leave at the desired spacing, then cut the rest.
- Select the spacing carefully to get a diameter growth rate that will allow merchantable trees to be cut in the next entry.

- Remember, the greatest volume growth is found at medium to high tree densities. In other words, you may sacrifice maximum diameter trees to achieve the highest volume per acre at the next harvest.
- Too high a thinning cost can result in a poor investment. For example, a \$150/acre thinning job today invested at a four percent real interest rate must generate an additional two to three MBF per acre in 30 to 40 years in order to recoup the initial investment.
- Leaving too wide a spacing wastes growing space, with trees eventually getting too big by the time they can economically utilize the area. Keep in mind that big trees are no longer more valuable than several small trees of equal volume.
- Thinning too late can result in poor response because crown loss from early crowding leads to growth loss. Sometimes, the crown can eventually rebuild, but the best thinning is one that occurs before the trees lose any growth potential. Thinning must be completed before the tree crowns are reduced to less than 40 percent of the total height to maintain optimum growth.

But, the landowner may have other objectives that can be met using commercial thinning:

- Favoring larch in a mixed composition stand, where other species such as grand fir may be less desirable.
- Minimizing losses to insects or disease.
- Growing desired diameter trees in a shorter amount of time.
- Opening up the stand for additional structural and vegetation diversity.
- The aesthetics of a more open-grown stand.
- Earlier income generation.
- Increasing maximum harvest yield.



The short growth internodes show the effects of competing vegetation of this tree.

Thinning and wood quality. There is some recent good news about the effects of thinning on wood strength, especially in western larch. Wood strength (as measured by density or specific gravity) is affected more by the ratio of summerwood to springwood, not merely by ring width. Thinning often increases the summerwood to springwood ratio because the trees have more adequate moisture through the drier part of the summer season. Thus, you can have wider growth rings and stronger wood, or

more volume and better wood quality.

In 2004, research on the Coram Experimental Forest in Montana found no significant differences in average wood density between a wide range of thinning densities (110 to 680 trees per acre). In addition, there was strong evidence that managed larch stands will produce a relatively high proportion of mature wood (vs. the higher proportion of juvenile, weaker wood associated with young or thinned trees of other conifer species) with relative density levels similar to natural forests. This wood density effect is unique to larch; other western conifers do not grow this way. Another wood quality characteristic which is unique to larch is the ring density variation within the tree bole. Larch

Commercial thinning. Commercial thinning in pure larch stands can be questioned from either economic or biologic terms:

- It can open up the stand to brush competition.
- It can result in loss of total stand growth.
- It may encourage larger trees that are worth less in today's log market.



Vegetation management helped this 8-year old larch reach its growth potential.

Harvest Systems for Western Larch

ring density increases uniformly from pith to bark, whereas other conifers decrease at first, then increase. This has positive implications for wood quality, especially wood quality in managed stands with smaller diameters. Not only do these characteristics make larch wood stronger overall; it is also less prone to warping, and shrinking erratically than other species.

Pruning. Due to larch tree biology, wood quality characteristics, and log market specifications, there is little need to prune western larch for the following reasons:

- Larch self-prunes well, especially if kept dense at young ages.
- Larch tends to produce epicormic branches from dormant buds on the bole. These buds respond to the increased light after pruning.
- Larch is primarily used for construction and dimension lumber. The grading rules for construction lumber allow up to two-inch green knots without large decreases in grade or strength. Therefore, reduction in knots or knot size is less important than with lumber used for appearance grades (ponderosa pine and white pine).

However, there may be some economic and health reasons to prune larch along roads and other possible fire ignition zones, to reduce the chances of a ground fire “climbing” into the crowns of younger larch stands.

Fertilization. There is limited information on larch nutrition and fertilization. One recent study of the ten-year effect of fertilization on tree growth and mortality found no significant fertilizer effects on western larch. Another fertilization project resulted in a large early growth response, but there was a rapid falloff the next year. This does not mean that fertilization may not be a viable option for larch in the future, as new formulations are tested and field trials are expanded to more sites. Properly prescribed fertilization can also stimulate and enhance flowering and cone production.

Selecting the correct harvesting system for a species is more than just the most economical method of getting the trees to the sawmill. It is also a silvicultural system designed to regenerate the species. Understanding the silvics and biology of larch helps design successful harvest systems that simultaneously complete the growth of one stand and begin that of another. Consider larch and the four main timber harvest systems:

Selection. Selection cutting is a misunderstood and often misused term. The term selection cutting is often used interchangeably with “selective” cutting. Silviculturally, the two terms are very different.

The goal of the selection harvest system is to produce or maintain an uneven-aged stand. This is a difficult challenge, especially if the stand is currently even-aged as many of our Inland Northwest forest stands are. Selective cutting, on the other hand, is a general term used by people who hope to legitimize a partial harvest that may or may not be best for the stand. A thinning is a selective cut that can be very appropriate and beneficial, or detrimental as in a diameter-limit or high-grade harvest. A main difference in a thinning compared to a selection harvest system, is that thinning is not intended to induce regeneration, whereas the selection system has that as a necessary objective.

Often, individuals use diameter as a surrogate for age, since diameter is easier to measure. However, larger diameter does not always indicate increased age, particularly in a multi-species stand where the diameter variability is usually a result of species, competition, or genetic differences, not age. Cutting only the larger trees in hopes of developing an uneven-aged stand usually results in a degraded stand with large amounts of smaller trees that grow more slowly. Even in single species stands, this is an equally detrimental practice, since diameter size is greatly effected by proximity to competing trees regardless of species.

After reviewing the silvics of larch, it should be apparent that an uneven-aged stand of this species would be extremely rare, if it exists at all. Since larch has great difficulty regenerating and growing under conditions of low light, a selection harvest system will most likely end in failure. It is possible to manage larch under the group selection system, IF the gaps for groups of regeneration are large enough. For instance, gaps an acre or more in size, would leave an uneven-aged stand across a large area, but there is little reason to do this with larch, and many would consider this a series of small clearcuts rather than a “selection” system. Nonetheless, this type of group selection system may be the best choice when visual or political factors favor a more complex, costly management regime.

Shelterwood. Regenerating larch using the shelterwood harvesting system can work if the tree crowns are opened up sufficiently. This means leaving less than 40 square feet of basal area for the shelterwood. Of course, one must consider the risk of wind damage before using this system, and at this density, many would just consider it a seed tree system.



Where larch has become rare, individuals with good crown characteristics can be left as seed trees.

Seed tree. The seed tree harvesting system works quite well for larch, especially if the site is prepared using prescribed fire after harvest. A good cone crop and adequate site preparation allows natural regeneration to prosper. If natural regeneration fails, the planting option can be used but would likely require additional site preparation.

Clearcut. The clearcutting harvest system is favorable for larch because it creates conditions that are closely aligned with its silvicultural requirements. A large clearcut is not necessary; neither is complete tree removal or intense site preparation. But overhead shade and plant competition must be minimized using an appropriate silvicultural technique. A clearcut size of 15 to 20 acres or more with the amount of edge minimized by a square or circle shape will regenerate larch effectively.

If landowners desire to regenerate larch, the harvest must allow large amounts of light to reach the ground surface. Also, adequate site preparation and control of competing vegetation is critical. One must cut hard and plan well to regenerate larch. It will be difficult to maintain a significant western larch component in our Inland Northwest forests if there are no fires or clearcuts. Additionally, site preparation and post-establishment control of competition using appropriate herbicides and/or prescribed fire and mechanical methods need to remain acceptable options on many sites, or larch will simply be overwhelmed by other tree and plant species.

The “Secrets” of Growing Western Larch

There is really no secret in growing a successful larch forest, which may be a pure larch stand or a mix with adapted associates such as western white pine and ponderosa pine. But there are many things to consider.

The following mnemonic may help to recall the main principles:

- Look for Seed.
- Adequate Site Preparation.
- Realize the Importance of Planting.
- Control Density.
- Heavy Harvest

Look for Seed. Plan for seed needs in advance. Look for seed crops in seed production areas. Girdle individual trees for cone production in March of the previous year. Find good sources of seed for nursery seedlings such as your own elite trees, logging jobs, or by purchase. The Inland Empire Tree Improvement Cooperative (IETIC) has signed a contract for the development of a larch seed orchard at Vernon, British Columbia. Improved seed should be available within 10 years to IETIC members, private nurseries, and the general public.

Adequate Site Preparation. This step is very important for initial success of planted or natural seedlings. Site preparation can be accomplished using prescribed fire (broadcast or underburn), careful mechanical scarification with minimal soil compaction and displacement, or herbicide treatments. Select an

herbicide with no residual soil activity; an Accord®/ Arsenal® herbicide mixture may work best. Herbicides can be applied using broadcast, strip, or spot methods.

Realize the Importance of Planting. Larger seedlings such as Styro-8's (8 cubic inch container) seem to work well. Also, copper treated containers are a definite advantage for rapid root egress once planted and adequate first season moisture is essential. Good site preparation should exclude the need for further herbicide treatment but spot treatment with Oust® can be used if the soil pH is less than about 6.0. Consider planting in the fall rather than spring to take advantage of increased soil moisture availability and early root growth. Generally, fall planting requires soil temperatures at or above 40 degrees F for successful root growth. With fall planting avoid early frost zones to reduce frost heaving of seedlings.

Control Tree Density. The best time to control density is at planting time. In the Inland Northwest, it is not usually necessary to plant more than 200 to 350 trees per acre. On difficult sites, many will plant more trees per acre. However, this often produces overstocked patches and still leaves open areas. It may be better to plant again the following year in unstocked gaps to get the best distribution of established larch seedlings. Precommercial thin if density is over 1,000 trees per acre. When thinning, don't forget today's value of small logs. Remember, you are making an investment that has to return a profit 20 to 40 years in the future. Do not plan on commercial thinning in larch stands, except where other objectives compliment or replace timber objectives. Keep stand density high enough to suppress undergrowth but low enough to develop healthy crowns and merchantable sizes.

Heavy Harvest. To obtain successful regeneration, a heavy harvest will help to produce the ecological conditions which set the stage for adequate larch regeneration and growth. That usually means a seed tree or clearcut harvesting system. Remember, if you cannot cut hard, you cannot manage for maximum production of pure larch stands. Larch can be combined with other compatible species, usually western white pine and/or ponderosa pine, and even

cedar in some cases, where a more mixed species composition is desired. However, the larch in these situations will not thrive unless specific light and moisture requirements are met.

Summary

Western larch is a tough tree that is resistant to insects and diseases. Its excellent high density, straight-grained character produces wood that is hard, strong, and durable. Its deciduous foliage protects it against many of winter's onslaughts. Larch grows rapidly, and as a long-lived seral tree, dominates many fire-climax landscapes. Its unique qualities suggest that it can do very well under the intensive management regimes of a future where we grow more wood on fewer acres. A little care during planting and early growth will pay big dividends as the tree matures. Larch is truly a tree that deserves our attention, for it presents opportunities for the future unlike any other Inland Northwest conifer.