Chapter 3&4 — Affected Environment and Environmental Consequences

Introduction

Chapter 3 (Affected Environment) and Chapter 4 (Environmental Consequences) have been combined in this document to more clearly present information to readers. In the Resource Elements That Address Issues section of the chapter, the description of a resource or environmental component appears just before the description of environmental effects to that resource or component. Most environmental impact statements (EISs) place these sections in separate chapters.

This chapter presents information about those aspects of the environment that are likely to be most directly affected by the management prescribed in the alternatives, those whose ecological, Tribal, or product use or function might be significantly affected by POC management. It also presents the direct and indirect effects (or impacts) of management under the alternatives. This constitutes a presentation of the cumulative impacts of each alternative. Together these form the scientific and analytic basis for the Comparison of the Effects of the Alternatives section in Chapter 2.

Changes Between Draft and Final

The following changes were made to Chapter 3&4 between the draft and final SEIS. Minor corrections, explanations, and edits are not included in this list.

Changes/edits were made to:

- Expand the discussion of what information might be incomplete or unavailable, including a discussion of possible effects of future wildland fire;
- add additional discussion about cumulative effects, including a discussion of past harvest and how large POC numbers might compare with historical levels;
- bring the discussion about reciprocal rights-of-way agreements into this chapter from Chapter 2;
- add analysis assumptions, including a Planting Assumption (found in the Assumptions and Clarifications section of this chapter) describing expectations for performance of outplanted resistant stock;
- remove or modify two references to recent POC mapping because it is not included in the Agencies' geographic information system (GIS) database used for the SEIS (because it did not change);

- add effects for new Alternative 6 for all resource elements, and change the effects for Alternative 2 in response to added emphasis for the 7th field watersheds;
- add supporting data about the effectiveness of PL control measures and describe the basis for the pathology effects for each alternative;
- correct numbers in many of the Ecology section tables;
- consider plant association-specific detail to the Ecology and the Water and Fisheries sections to more precisely predict effects to fish;
- remove the “significant adverse” effect predicted for listed coho in Alternatives 1, 2, 3, (and 6);
- add a discussion of future wildland fire and their likely effect on POC;
- increase discussion of off-highway vehicles;
- add a separate Livestock Grazing section;
- add a separate Mining section;
- fine-tune the effects of the Alternative 3 (and 6) uninfested watersheds on probable sale quantity (PSQ) and the ability to use timber sales to treat fuels in wildland-urban interface;
- show increased costs for sanitation in Alternative 3 (and 6), and long-term cost savings by accelerating the resistance breeding program;
- address Executive Order 13212 and associated BLM direction to address potential effects of the alternatives on locating and transmitting energy.

Incomplete and Unavailable Information

One step in preparing an EIS is to evaluate whether information about effects of a proposed action is incomplete or unavailable and, if so, to disclose that fact and make certain findings about the relevance, importance, and/or costs of acquiring data that could help fill any such gaps.

When encountering a gap in information, the question implicit in the Council on Environmental Quality regulations (40 CFR 1502.22(a)) on incomplete or unavailable information was posed: Is this information

> . . . essential to a reasoned choice among alternatives?

No such information gap is identified.

As noted in the Background section of Chapter 2, Port-Orford-cedar (POC) root disease was introduced to the natural range of POC more than 50 years ago, after raising the concern of nursery pathologists in the Seattle, Washington, area for decades previous to that. Scientific study and management experience by the Agencies and others is considerable. Pathologists with the Forest Service (FS), States of Oregon and California, and Oregon State University, have devoted years to the study and management of POC root disease.

The management practices discussed in the alternatives are generally ones with which the Agencies are well experienced. While conclusive research regarding the effectiveness of each specific practice is sometimes weak or lacking, basic studies of disease indicators have been at least minimally studied for nearly every practice, sufficient to make professional judgments regarding their likely effectiveness. For example, while the effectiveness of washing vehicles on reducing the spread of the disease has not been studied directly (because of the numbers of variables involved), washed vehicles have been reexamined, finding that washing reduced inoculum about 95 percent. A reduction in the risk posed by a washed vehicle traveling through uninfested areas is thus appropriately inferred.

Neither are the observed pathology relationships unique to POC. Where conclusions or inferences must be made without complete POC data, scientists rightfully build on data from similar relationships or results with similar pathogens more thoroughly studied. Subsequent new information about POC root disease has historically supported such inferences, although the new data improves precision.

A source of potential uncertainty arises from both the geographic and temporal scales of this analysis. POC mortality under each of the alternatives is projected for 100 years, and is based on several assumptions founded on the study of the first 50 years of mortality and spread. While these assumptions are reasonable, they are by no means certain to 100 years. Monitoring is prescribed to detect significant departures from predicted disease spread. Departures themselves would trigger further analysis. At this point in time, these predictions provide a sufficient estimate both of the magnitude of effect and the absolute differences between the alternatives and between risk regions to allow a reasonable prediction of indirect environmental effects, and allow the decision-makers to make a reasoned choice from among the alternatives.

Compounding the PL-mortality prediction is the likelihood of future high-intensity fire. In the same 100 years, wildland fire could kill up to 50,000 acres of POC, or up to 35 percent of the combined Inland Siskiyou and Siskiyou Risk Regions in Oregon. These percentages are not additive; some of the future fire mortality is the same as that predicted for *Phytophthora lateralis* (hereafter referred to as PL).

Normally, there is uncertainty when evaluating effects at the programmatic scale (such as this supplemental EIS [SEIS]), because the proposed action neither authorizes nor evaluates any specific management proposal. To the extent such uncertainty might relate to disease spread, it is considered minor. Assumptions in this SEIS about forest management activities, for example, are based in part upon agency experience with POC-related forest management activities that began in earnest in the 1980s. And while the Standards and Guidelines of the various alternatives provide for site-specific application of various management practices based upon consideration of the conditions at each site, both the language of the Standards and Guidelines, and experience with implementation and existing forest conditions, make reasonable predictions about such application possible. Nevertheless, site-specific effects of management can only be known, with any degree of specificity, at subsequent, site-specific levels of analysis and planning. Effects are projected as specifically as possible for purposes of the analysis in this SEIS.

Some scoping comments expressed a belief that POC is on its way to becoming extinct or only minimally represented within its natural range, and that only closing access to the forest will save the cedar. The analysis displayed in the following sections does not support such a position. Because the pathogen virtually requires standing water to infect trees, high-risk areas are limited and definable. POC even a few feet away from water or seasonally saturated soils is at little risk regardless of the management strategy imposed. Further, it is possible to make reasonable predictions about the future spread of PL, the disease-causing pathogen. Other than Pacific yew growing with POC, the pathogen affects only POC and does not have an alternate or hidden host, nor does it travel through the air. PL has very low levels of genetic variation, and so is not likely to adapt to different species or even to resistant POC. Predicting the spread of the disease and the resultant adverse environmental effects is possible, at least to a sufficient degree that the selection of one of the action alternatives will yield a predictable environmental effect.

Considerable precision (and thus, certainty) could be added to this analysis if Agency POC maps were more detailed and then individually analyzed for relevant risk levels and agents. Existing maps are based partly on stand or vegetation-type inventories or stand exam maps and sometimes do not reflect the specific location of included POC. As discussed in the Background section of this chapter, the precise number of acres of POC is unknown, and varies depending upon the mapping criteria used. These details can be correctly relegated to site-specific analysis. The existing information, coupled with existing scientific knowledge of diseases as a whole, is sufficient to establish basic relationships well enough that any new information would not likely reverse or nullify these relationships. There is sufficient information about the pathogen and about the effects of the various alternatives for decision-makers to confidently make a reasoned choice from among the alternatives.

There are other uncertainties. The recently enacted forest health initiative could increase the level of management activity in POC areas, particularly in the wildland-urban interface. The SEIS includes assumptions about levels of forest management and use. Activities under a forest health initiative will likely fall under those activity-level assumptions. If they do not, the "National Environmental Policy Act" (NEPA) analysis for those activities, as well as the monitoring of PL spread required in the alternatives in this SEIS, would help determine if there are (additional) adverse effects.

There is also uncertainty regarding the resistance breeding program. With resistant trees having been exposed to the pathogen for 16 years at the longest, the durability of resistance is unproven. There is also the possibility the pathogen would adapt to the resistant stock. These possibilities are described in detail in the Genetics section and elsewhere. Finally, the SEIS creates uncertainty about the resistance breeding program in its own language by stating the resistance breeding program would, in Alternatives 1, 2, 3, and 6, continue at current levels "per available funding." In light of these uncertainties, the final SEIS places more emphasis on prevention and less emphasis on mitigation, than was the case in the draft SEIS. And in no case is an adverse environmental effect prediction in Chapter 3&4 reduced or softened because of benefits expected from resistant stock, unless that benefit it specifically identified to come from such stock. This separation permits the decision-makers to examine the environmental effects as if the resistance breeding program did not exist at all.

These uncertainties, their limits and their effects, are well addressed in the appropriate effects sections in Chapter 3&4. While additional information would often add precision to effects estimates, the basic data and central relationships are sufficiently well established that any new information would not likely reverse or nullify relationships. Although new information would be welcome, no missing information was identified that is essential to a reasoned choice among the alternatives.

Cumulative Effects

Cumulative impacts (effects) to the environment are defined in the Council on Environmental Quality regulations as those that result from the incremental effects of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes them (40 CFR 1508.7). The alternatives described in Chapter 2 would require that various PL-controlling measures be applied to future agency management activities. The management activities, and the PL-controlling measures proposed to be applied to them under the various alternatives, would affect the environment in the six ways listed below (additional details about each of these effects appear elsewhere in this chapter).

1) *There are effects from the management activities themselves.* The future agency management activities to which the PL-controlling measures would be applied are those occurring near or within stands of POC, and include timber harvest, off-highway vehicle use, special forest product collection, fuels treatment, livestock grazing, and so forth. These activities are described in the Affected Environment portions of the Resource Elements that Address Issues section later in this chapter. These Affected Environment discussions provide the basis for the PL-spread prediction, and the basis for the direct effects of the PL-controlling measures on the management activity, each described separately below. The non-POC related environmental effects of these management activities, such as effects on soils, water, visual quality objectives, and so forth, are already discussed in the EISs for the land and resource management plans being supplemented by this SEIS. This SEIS neither proposes or authorizes these actions.

2) *PL spread prediction.* The future management activities described above themselves affect, or facilitate the spread of PL—this is the major issue for this SEIS. Using probabilities that various activities will transport PL, the Pathology section combines:

- The descriptions of all of the future management activities from the Affected Environment sections described above;
- knowledge of other PL-spread vectors (such as downstream water flow, root grafts, wildlife movement, and other minor human activity);
- the level and nature of management activities on non-Federal lands as described later in this section; and

- the disease controlling measures of the various alternatives described in Chapter 2, into an overall estimate of PL spread over the next 100 years. This estimate of future PL spread on Federal lands in Oregon is described in the Pathology effects section for each alternative, and is expressed both in acres and as a percentage of currently uninfested high-risk sites expected to become infested. In other words, the Pathology section describes the cumulative effect on PL spread on Federal lands in Oregon, of all management activities as affected by the Standards and Guidelines of the various alternatives.

3) *Direct effects of the POC alternatives on management activities.* The Standards and Guidelines of the various (action) alternatives would affect the conduct of future management activities. For example, Alternatives 2, 3, and 6 generally increase costs, reduce road construction, prohibit certain special forest products collections, require Clorox treatment of fire suppression water, and so forth. Some alternatives identify areas where timber harvest and new road construction is prohibited altogether. These effects are described in the effects section for each of the resource elements.

4) *The direct effects of the POC alternatives on resources.* Where the reasonably predictable effects of various Standards and Guidelines are positive to resource elements, such as road closures for Water and Fisheries, or vehicle washing helping reduce the spread of noxious weeds, those effects are identified in various resource element Effects sections as well. Negative effects, to the extent they can be quantified, are also identified. An example is the effect of required roadside sanitation on wildlife habitat. A description of negative resource effects of PL-controlling treatments is limited, however, for two reasons. One is that most PL-controlling measures will be selected from a menu of options that permit managers to tailor the treatment to site-specific conditions. Managers have the opportunity to select the treatment that best fits the site conditions, minimizing adverse effects while securing good PL control. Thus any negative environmental effects will be considered at the site-specific scale before specific disease-controlling practices are selected and implemented. The other reason is the existence of resource-protecting best management practices in the underlying management plans. Sanitation, for example, will not place equipment on steeper slopes than permitted in, the underlying plan, or result in bare soils or soils disturbances beyond existing limits. Projects would be required to meet watershed disturbance limits, if any, and meet relevant visual quality objectives.

5) *The effect of PL-related mortality (or the positive effect of preventing mortality).* The PL-spread predictions made in the Pathology section drive effects predictions for resource elements whose ecological functions are dependent, in part, on POC. For example, since PL kills 90 percent of the POC in stands in infests (and more in the larger size classes), POC mortality along streams in ultramafic soils where few other species are available to replace them, will decrease shading and increase temperatures in these streams. If stream temperatures are already fish-limiting, this POC mortality will adversely affect fish. These effects are described in resource element sections for Ecology and Plant Associations, Wildlife, Water and Fisheries, Botany, and for portions of other resource elements such as Wilderness and Culturally Significant Products for American Indian Tribes. Even benefits not specific to POC are identified. For example, on serpentine soils, POC provides shade for certain rare plants, or provides physical barriers

against the disturbance of such plants by off-highway vehicle travel.

6) *The effects of the various alternatives on POC and related resources off of Federal lands or in California are predicted to the specificity possible.* Because the California NFs are currently implementing PL-controlling management practices for all risk-producing activities, the effects of the Oregon alternatives are very small, but include the possibility of long-distance spread to California. This possibility is discussed in the Pathology section. And because most private forestland management includes only minimal PL-control if any, the effect of the alternatives on PL on private lands is again so slight by comparison that it is not quantifiable. POC, PL, current management practices, and the possibility of spreading PL to or from other Federal or private lands is discussed in more detail below.

The combination of these effects described under the various resource elements in this chapter, coupled with relevant effects in the underlying land and resource management plan EISs, represent the cumulative effects of the alternatives. Given the programmatic nature and scale of this SEIS, most of the environmental consequences discussed represent a general projection of the accumulated effects of management actions that are reasonably assumed to occur under the various alternatives and in the context of other existing Standards and Guidelines and practices on the affected Federal lands, and on other Federal and private lands within the range of POC. In general, estimating more specific effects depends so much on the particulars of each situation and the combination of PL-controlling measures applied, that additional discussion would be speculative. The project analyses where the specific application of one or more of the PL-controlling practices are applied, would be an appropriate place for additional discussions. It can be generalized, however, that the more conservative alternatives in terms of POC protection will have corresponding beneficial effects to unique plants, water, fisheries, and wildlife, at least if they do not increase the level of unusually intense wildfires.

California Portion of the Range

The natural range of POC extends from the planning area into the northwest corner of California. Approximately 10 percent of the POC found on Federal lands is within California, located on the Six Rivers, Klamath, and Shasta-Trinity NFs (and Redwood National Park). These Forests are cooperators in this SEIS, and helped with the analysis. Although the action alternatives do not apply to these Forests, some of the effects sections in this chapter specifically include California because the resource effects could spill into California, or because of the possibility of transporting the disease back and forth across the border. Timber hauling, equipment movement, and other factors are discussed within the Pathology and Timber Harvest sections specifically, and do pose a small but potential risk of cross-state infestation. The Recreation section notes that off-highway vehicles and other recreation equipment (such as boat trailers) drive across the border or are trucked, potentially moving PL across the border or other long distances. The community outreach and other provisions of Alternatives 2, 3, and 6 could help reduce the likelihood of PL spread by these activities, by focusing education efforts specifically on these uses. The Disease Export Standard and Guideline in Alternatives 2, 3 and 6 is specifically designed to reduce movement of PL offsite, including to California.

The existing management direction for the California forests is included in Appendix 3 in this SEIS, and is held constant for the purposes of analyzing the effects of the action alternatives (that apply only to Federal lands in Oregon). As described in the Pathology section, projections for Alternative 1 apply, to the detail of this analysis, to the California forests. Selection for Oregon of an alternative that is more active in restricting spread of the disease would have a slight but corresponding reduction in the spread rate predicted for California, because of changes in the risk of the pathogen being transported to California. Selection of Alternatives 4 or 5, however, could substantially increase the risk of additional disease export events to California. Secondary effects of that changed spread rate, for California, would parallel the effects described for Oregon, but be correspondingly smaller.

Private and Tribal lands account for an estimated 2,000 to 5,000 acres of POC in California. There are no known infestations of PL on California Tribal lands. The Hoopa and Yurok Tribes follow management practices designed to minimize the potential for introduction of PL and to limit its impact if an introduction occurs. Significant populations of POC are present on California State Park land at Jedediah Smith and Castle Crags State Parks. POC along the Sacramento River at Castle Crags State Park is infested with PL where, because of its proximity to Interstate Highway 5, it poses a risk for importation to other parts of the POC range. As discussed later in this chapter, there is POC and PL on Redwood National Park lands in California. Movement of PL between these lands and Federal lands in Oregon is possible, but unlikely. POC is harvested on other private timberlands in California. Movement of PL , with approximately 100 to 200 thousand board feet shipped to Oregon annually for milling or export (see Timber Harvest on Private Land section for further details).

Siuslaw National Forest, Oregon Caves National Monument

Of the 90 or so acres on the Siuslaw NF at the Oregon Dunes, approximately half is along roads and highways and is variously infested with PL in much the same pattern as the private lands that separate the Dunes from other Federal lands in the POC range. The remaining acres are in isolated stands within the sand dunes themselves, in management zones prohibiting off-highway vehicle traffic. Given the isolation, and the presence of PL elsewhere on the Dunes and in surrounding private lands, the likelihood of PL spread from nearby BLM or Siskiyou NF lands is immeasurable under all alternatives.

Oregon Caves National Monument is surrounded by NF, some with PL. There is no PL in the 200+ acres in the Monument with POC and Monument objectives include keeping PL out. Although threats to the Monument come from PL-infested stands along the highway leading into the Monument, hiking trails from the surrounding Siskiyou NF also enter the Monument. Continuation of current or higher levels of PL control (Alternatives 1, 2, 3, and 6) would help achieve Monument objectives. Alternatives 2 and 6 in particular would be most helpful, as the 7th field watershed encompassing the northeastern one-third of the Monument is one identified as being currently uninfested and thus is emphasized in those alternatives.

Port-Orford-Cedar Management on Non-Federal Lands in Oregon

There are no requirements for POC management in the “Oregon Forestry Practices Act.” A few private landowners in the range of POC have requested information on cedar management from local Forestry Assistance foresters. Usually the information provided is of a general nature, and includes management practices such as operating during the dry season, avoiding sites infested with PL, and avoiding roads and skid trails in stands with a POC component. However, little attention is given to POC by most small-tract landowners. Several private landowners have test plantations of resistant stock provided by the FS Dorena Genetic Resource Center. There is interest among private woodland groups in the availability of this resistant stock for future plantings.

Non-Federal lands near Coos Bay contain approximately 8,500 acres of nonroadside infestation (compared with 319 acres on the Coos Bay BLM District) and represent a chronic source of PL for export to other lands throughout the range. An infestation in the Sacramento River Drainage in California is believed to have been transported on logging equipment from the Coos Bay area. The likelihood of such long-distance spread is discussed in the Pathology section and considered in disease projections.

Timber Harvest on Private Lands within the Range of Port-Orford-Cedar

Silvicultural practices on private lands within the range of POC include commercial thinning and regeneration harvesting and their related treatments of burning, planting, spraying of herbicides, pre-commercial thinning, pruning, and fertilization. Recent declines in Federal harvests, economic conditions, and the increase in mills specializing in smaller material has led to shorter rotations and more regeneration harvesting. Rotation ages average 45 years on the coast, and 60 to 90 years in the interior.

Approximately 70 percent of private timber harvest is done with skyline cable-yarding systems and the balance is done with ground-based systems on slopes less than 40 percent. The likelihood of PL spread is substantially reduced with skyline cable-yarding, whether partial- or full-suspension. Ground-based systems have the highest likelihood for spreading PL, assuming they pass through infested areas. These risks would be greatest during wet soil conditions.

Almost no roadside POC sanitation (clearing to prevent infection starts) occurs on private lands within the range, while some large, private, industrial timberland owners are washing heavy logging equipment for noxious weed control. This equipment washing probably has some benefit in slowing the spread of the POC root disease. Small private landowners typically do not wash heavy equipment.

The percent of each county in the POC range that is private, and the annual volume and estimated acres harvested are shown in Table 3&4-1. Private harvest acres have been estimated using the regional average rotation age, total harvest volume, and proportion of volume coming from regeneration or partial cutting and their respective assumed volumes per acre. Table 3&4-1 includes both clear-cut and partial-cut acres.

Within the natural range of POC, the PSQ on Federal lands is 49 million board feet annually for Oregon, and 23 million board feet for California. Thus, on a yearly average basis, and assuming the Agencies cut their full PSQ, the total timber harvested within the range of POC is about 550 million board feet, with private lands representing 87 percent. The estimated acres cut and its potential contribution to the spread of PL are expected to continue at these

Table 3&4-1.—*Average yearly private harvest levels for all species within the natural range of Port-Orford-cedar, 1995–2001*

County	% private lands [1]	Volume harvested in millions of borad feet [1]	Estimated acres harvested
Oregon			
Coos	70	183	6,700
Curry	84	49	1,790
Douglas	12	42	1,550
Josephine	45	12	970
Total	39	286	11,010
California			
Del Norte	74	36	1,310
Humboldt	14	63	2,320
Siskiyou	14	21	2,080
Trinity	62	49	4,930
Shasta	20	20	2,060
Total	20	189	12,700
Total	29	475	23,710

[1] *Source:* Oregon Department of Forestry Annual Timber Harvest Report for Western Oregon by County and California State Board of Equalization Timber Harvest Tax Records from 1995 to 2001.

relative levels into the foreseeable future. The mill capacity is 700 million board feet per year for southwestern Oregon; most mills operate along the Interstate Highway 5 corridor and a few along the coast. Approximately 40 million board feet of logs (not counting POC, discussed below) from private lands are shipped annually to mills in southern Oregon from northern California. This represents about 8,000 truckloads of logs (5,000 board feet per truck). Some of these could come from PL-infested areas..

Management of POC root disease on Federal lands is affected by private land management in several ways. Equipment used to harvest on Federal lands is supplied by private contractors who also work on private lands. This includes logging equipment that moves from sale to sale, and trucks that may haul from different sales in different areas or states from one day to the next. Also, trucks transporting logs from private lands often travel roads through Federal lands, particularly in “checkerboard” ownerships and on reciprocal right-of-way agreement roads. Trucks from various areas or even states are often unloaded at the same locations, often minutes apart; although as noted in the Timber Harvest section, the possibility for spore exchange in this case is very slight. The same possibilities for transport exist from Federal to uninfested private lands, reduced by the PL management requirements implemented on those Federal activities.

Federal administrative units whose POC management practices would be affected most by this level of private timber harvest are Coos Bay, Medford, and Roseburg BLM Districts, located in Coos, Curry, Douglas, and Josephine Counties. The POC lands on these districts are primarily checkerboard, intermixed with private ownership; most of the volume hauled on roads through BLM lands in these areas is from private lands, with little Federal latitude to limit season of use or require vehicle washing. As noted in Chapter 1, many of the PL-controlling management practices the Agencies night use are not available or are less effective on these types of lands, or are not cost-effective given the relatively small gain in protection. Other Federal administrative units with more contiguous land ownership would experience less likelihood of importing PL from private land management activities.

Although harvest of any species within the range of POC (as discussed above) is indicative of a risk of transporting PL, harvest and transport of POC itself is more likely, in a single event comparison, to result in the transport of PL. However, annual harvest of POC on private lands varies widely depending upon market conditions. The harvest levels shown in Table 3&4-2 are probably unusually high, based on a peak in demand that drove the price to a high of $12,000 per thousand board feet for top quality logs in the early 1990s as compared to $2,500 per thousand board feet today.

Most POC harvested in California is transported to mills in Oregon or export facilities in Oregon or Washington. This amounts to about 840 truckloads from Humboldt and Del Norte Counties, based on 4.2 million board feet per year (Waddell and Bassett 1996).

During Fiscal Year 2000 approximately 0.8 million board feet of POC was exported from the northwest to Japan, China, Korea, and Taiwan from the ports of Longview, Coos Bay, Portland, and Seattle. There are no POC export ports in California; all POC harvested for export in California is shipped through Oregon. Recently, POC logs shipped from the Port of Coos Bay in Fiscal Year 2000 averaged 257 thousand board feet (Warren 2002). By 2002, this had dropped to 200 thousand board feet (Green 2003). Overall export trends for POC continue to decline as the overseas demand continues to drop due to economic conditions and the increased production of Hinoki cypress (*Chamaecyparis obtusa*), which is used in Japanese temples.

Several mills in Oregon saw about 4.5 million board feet of POC annually for lumber, paneling, and decking. These mills are located in Bandon, Glide, Myrtle Point, Riddle, and Roseburg. Since the overall export prices for POC have dropped, these mills have been able to purchase more POC. Sources of POC logs include both Oregon and northern California. Approximately 100 to 200 thousand board feet of California POC logs are shipped to Oregon mills annually representing 20 to 40 truckloads of logs. Mill production is limited by the supply of POC logs, as their product demand is strong.

Temporal Effects

The Pathology section predicts mortality percentages at 100 years, and various indirect effects sections address this same time period. As explained in the Pathology section, the spread rate in any one area will not be constant, but will follow an “S” curve typical of similar disease infestations and readily recognizable within POC areas exposed to the pathogen for some time (see Pathology section). Monitoring will continue to validate these assumptions.

Table 3&4-2.—*Port-Orford-cedar standing inventory and harvest volume for private lands*

Counties	Standing inventory [millions of board feet]	Annual harvest [millions of board feet]	Years
Coos, Curry, Douglas, Josephine	94	3.5	1995-97 [1]
Humboldt, Del Norte	23	4.2	1991-94 [2]

[1] Tables 8d and 10d in Azuma et al. [2002].
[2] Tables 9 and 11 in Waddell and Bassett [1996].

Past Harvest and Mortality of Port-Orford-Cedar, All Lands

As noted in the Historical Setting section, A Natural History of Western Trees (1953), cited by Peattie (1991), describes 31 percent of POC "timber" as being on FS and BLM lands, and 69 percent private. Most of the larger POC are assumed to have been harvested or killed by PL on the 69 percent private; the current vegetation survey (CVS) data described later in this chapter shows 103,000 live POC over 20 inches diameter at breast height on private lands, or about 2 POC per acre. Large POC have been harvested from significant areas of Federal lands as well. The CVS data shows approximately 800,000 trees over 20 inches diameter at breast height in Oregon, or about 3 per acre if averaged over the 272,000 POC acres in Oregon. Although original average stocking levels are not known, clearly larger or old-growth POC is a small fraction, perhaps 10 to 20 percent, of what the Oregon distribution was historically. The total acreage itself is likely little changed from historic levels because POC readily reseeds, even if only smaller trees remained after harvest.

Most POC in California is on Federal lands and has not been harvested at nearly the same rate.

Relationship of this Supplemental Environmental Impact Statement to the Northwest Forest Plan

The Northwest Forest Plan was adopted April 13, 1994, as an amendment to land and resource management plans within the range of the northern spotted owl (including the plans that would be amended by the action alternatives in this SEIS). The Northwest Forest Plan added Standards and Guidelines to existing or draft (underlying) management plans for management of habitat of late-successional forest-related species and protection of watersheds. POC was among the species evaluated by the Forest Ecosystem Management Assessment Team and considered to benefit from its provisions, but no specific Northwest Forest Plan Standards and Guidelines are directed at POC. Therefore, no amendment to the Northwest Forest Plan is proposed. Further, none of the alternatives proposed would

> . . . significantly reduce protection for late-successional or old-growth forest related species, or reduce protection for aquatic ecosystems (USDA and USDI 1994b, *p. C-29*).

Therefore, no review by the Regional Interagency Executive Committee is required. Nevertheless, an understanding of the Northwest Forest Plan land allocations is helpful to understanding this analysis.

The Northwest Forest Plan amended the land and resource management plans of the various administrative units, primarily by establishing a system of reserves (certain land allocations), and providing Standards and Guidelines limiting or directing activities within those reserves. Approximately 80 percent of Federal lands were assigned to a reserve land allocation that precludes regularly-scheduled timber harvest. This resulted in a reduction in timber harvest levels of about 80 percent, and a reduction in road construction miles of over 90 percent, when compared to levels in the 1980s. Although there have been more restoration projects, and some reserves permit habitat-improving silvicultural activities including commercial thinning and fuels reduction treatments, there has been a substantial reduction in the level of management activity and heavy equipment use on Federal lands as a result of the Northwest Forest Plan.

A description of the Northwest Forest Plan land allocations found in the planning area is as follows:

Congressionally Reserved—In the planning area this includes designated wilderness.

Late-Successional Reserves—These areas are managed to protect and enhance conditions of late-successional and old-growth forests. Limited stand management is permitted to improve late-successional and old-growth conditions or protect the areas from wildland fire and other large-scale disturbances.

Adaptive Management Areas—These areas are identified, each with an objective to develop and test new management approaches to integrate and achieve ecological and economic health, and other social objectives. Regularly-scheduled timber harvest (those contributing to PSQ) may occur in Adaptive Management Areas.

Administratively Withdrawn Areas—These are areas where the underlying direction in existing land and resource management plans precludes regularly scheduled timber harvest. These areas include recreation and visual areas, back country, administrative sites, research natural areas, and areas of critical environmental concern.

Riparian Reserves—These provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Silvicultural activities are permitted only when watershed analysis shows treatments are needed to achieve watershed objectives.

Matrix—This includes all other lands. Management of these lands is guided by some Northwest Forest Plan direction for Matrix, but primarily by the direction in the underlying land and resource management plans. Approximately 75 percent of the matrix consists of lands suitable for regularly scheduled timber harvest, the remainder being rock, brush, or forestland not suitable for forest management.

In many ways the reserve system of the Northwest Forest Plan created de facto protection areas for POC. Certainly the risk of exposure has been reduced for many POC stands as a result of these allocations. Table 3&4-3 shows gross acres and acres occupied by POC within each of the land allocations of the Northwest Forest Plan for Oregon as of 1994 when the Northwest Forest Plan was adopted. Subsequent land exchanges and corrections may have changed these, probably less than 1 percent.

The Northwest Forest Plan also includes an Aquatic Conservation Strategy. The provisions of the strategy are designed to restore the heath of watersheds and aquatic ecosystems contained within them. The Strategy includes four components: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. The strategy also has nine objectives. In general, the Strategy requires lands within the Northwest Forest Plan areas to be managed to maintain, restore, or not prevent attainment of, the nine ACS objectives.

Table 3&4-3.—*Gross Oregon Federal and presence of Port-Orford-cedar [acres] by Northwest Forest Plan land allocation within the natural range of Port-Orford-cedar in Oregon* [1]

	Congressional/ Administrative Reserve		Late-Successional Reserve		Matrix/Riparian Reserve/Adaptive Management Areas [2]		Total	
Administrative unit/Risk region [3]	Gross [4]	POC [5]	Gross	POC	Gross	POC	Gross	POC
Coos Bay BLM	3,074	229	45,941	18,797	106,101	53,979	155,116	73,005
Powers Ranger District	18,481	1,342	85,841	44,508	20,015	7,393	124,337	53,243
North Coast Risk Region total	21,555	1,571	131,782	63,305	126,116	61,372	279,453	126,248
Roseburg BLM	635	0	45,417	2,056	39,213	2,630	85,265	4,686
Medford BLM	26,829	4,404	119,355	17,277	85,971	2,974	232,155	24,655
Inland Siskiyou Risk Region total	27,464	4,404	164,772	19,333	125,184	5,604	317,420	29,341
Siskiyou Risk Region total [Siskiyou NF, except Powers Ranger District]	256,996	19,735	485,780	71,010	182,332	25,629	925,108	116,374
Grand total	306,015	25,710	782,334	153,648	433,632	92,605	1,521,981	271,963

[1] Data is from 1994 Regional Ecosystem Office GIS mapping and does not reflect subsequent land exchanges or other minor adjustments.
[2] Riparian Reserves are lumped with Matrix because actual Riparian Reserves are mapped onsite during project planning; about 50 percent of the acres shown are Riparian Reserve, with the other 50 percent being Matrix or Adaptive Management Areas.
[3] For "risk regions" see Pathology section.
[4] Gross acres within the range of POC.
[5] Acres with POC present.

Encumbered Forest Roads

The analysis in this chapter indicates roads facilitate the primary PL spread vectors of vehicles and equipment, and suggests some of the biggest gains in reducing PL spread can be made by closing roads, limiting use, sanitizing along them, reshaping them, or otherwise managing road design, location, and use. Several of the alternatives recognize the importance of roads in PL spread and specify, for example, the closure of all discretionary nonmainline roads in POC cores, or specify management practices that include closing roads to reduce unacceptable risk at the project scale. To help understand one of the potential limits to such closures, the following section describes some of the Agencies' legal obligations relative to many forest roads, particularly within checkerboard ownerships.

Bureau of Land Management-administered lands. The BLM entered into hundreds of Reciprocal Right-of-Way Agreements in western Oregon to gain access for forest management activities on the checkerboard lands that the BLM is responsible for managing under the "O&C Act" of August 28, 1937. In the early 1950s, BLM published the O&C Logging Road Right-of-Way regulations, now codified as 43 CFR 2812, initiating the development of Reciprocal Right-of-Way Agreements with most of the private timberland owners within the O&C area of western Oregon. A Reciprocal Rights-of-Way Agreement is a legal exchange of rights between the BLM and a private landowner, called a "permittee." The major benefit and objective of these agreements is the joint use and development of a single, forest road system that serves the needs of the BLM and the intermingled private timberland owner. This arrangement eliminates a potentially duplicative road system and provides guaranteed access for prospective bidders of BLM timber sales. BLM and a permittee share costs in the construction and maintenance of the road network.

To gain access to their respective lands, BLM and the other party have Reciprocal Right-of-Way Agreements to use existing roads and construct new roads across each other's lands. Typically, these agreements are granted in perpetuity to assure long-term access for both parties. The lands that each party can cross are specifically identified in the agreement by legal description and are recorded in the counties where the lands are located. The terms of the agreement are specific and apply to both parties equally. Each party has little discretion in not approving a new road location requested on that party's lands by the other party. In most of the agreements, the only reasons why a proposed road location can be rejected is: (1) the new road location does not constitute the most reasonable direct route; (2) the new road will substantially interfere with existing facilities; (3) the proposed road will cause excessive erosion; or (4) there is already an existing road suitable for the transportation of timber to market. Mitigation measures can be required for new construction, but only if they are to mitigate one of the reasons for rejecting a construction plat in the permit. Because of the reciprocal nature of these agreements, the terms and conditions generally cannot be amended or changed without the approval of both parties.

Reciprocal Rights-of-Way Agreements are considered as legally binding interests on the lands identified in the agreement. Responsibility of the parties for compliance with the environmental laws, including the "Endangered Species Act," have been tested in court and it has been affirmed that the BLM has limited discretion when roads are planned for construction on public lands by a permittee (see Sierra Club v. Babbitt, 65 F3d 1502 [9th Circuit 1995]).

Reciprocal Rights-of-Way Agreements continue to operate as the primary means of obtaining access to intermingled BLM and private timberlands in western Oregon. Nearly 80 percent of the BLM lands in western Oregon are encumbered by one or more agreements.

Although BLM roads are available for use by the public, they are not "public roads" as defined by Oregon Revised Statutes 386.010(2). BLM roads are considered "private government roads" and the Agency retains the authority to control activities on these roads including use by the general public.

In addition to Reciprocal Right-of-Way Agreements for roads, the Bureau has issued right-of-way reservations to the Bonneville Power Administration for utility corridors, pipeline rights-of-way, and numerous rights-of-way grants to private parties for utilities or to access home sites, as well as to numerous users of communication sites located on BLM-managed lands.

Forest Service-administered lands. The FS has the same or similar obligations as the BLM. Several factors affect the level of discretion held by the FS relative to road use and control. Private road use rights are often held on NF System roads and the degree of control the Agency may exercise is dictated by the terms of the document creating the private right. Some private use rights were retained by landowners who conveyed some of their lands to the FS but needed continued road access across the lands to reach other parcels they still owned. Other rights have been granted to private landowners under such authorities as the "Federal Land Policy and Management Act" and the "National Forest Roads and Trails Act." The FS shares ownership in entire road systems where cooperative road construction and use (cost share) agreements have been entered into with large industrial timberland owners. Other authorities have authorized access, such as laws relating to mining on Federal lands. The FS has a statutory requirement to grant reasonable access across NF System lands to landowners within NF boundaries and many different types of access grants have been issued to comply with this mandate.

In general, rights possessed by non-FS entities on NF System roads allow for ingress and egress to private lands subject to traffic regulations, such as speed and weight limits, as well as responsibility for road maintenance commensurate with the use. There are many private use roads, such as private driveways, on which the FS exercises little discretion as to road standards or type of use, since they are not open to the public.

Reservations, outstanding rights, and easement grants all constitute some form of non-Federal interest in the NF road, and each road must be individually assessed to determine the extent of private and Federal rights of use and control.

Assumptions and Clarifications

The effects discussions are based on the Standards and Guidelines of each alternative and any referenced appendices. As indicated by Appendix 2, the Agencies have considerable experience with the management techniques prescribed by the Standards and Guidelines and the effects of POC mortality, and so are able to estimate the future effects of the various alternatives with some degree of certainty. That experience leads to certain underlying assumptions that are stated here for clarity for the reader, and to assure consistency within the analyses. The following assumptions or clarifications are pertinent to the analysis or to the decision to be made. The degree to which any of these assumptions ultimately prove incorrect would be expected to have a corresponding effect on the change in environmental effects attributable to them.

- The analysis assumes the Northwest Forest Plan will be implemented as written and intended. Effects to harvest levels, for example, are based on declared PSQ levels rather than the level experienced in the past 3 years when litigation has limited activities. This potentially conservative assumption assures adequate effects analysis if activity levels return to levels anticipated in the Northwest Forest Plan.

- The analysis only considers effects to POC within its natural range. POC has been planted, both as an ornamental and as a forest tree, throughout the world. Plantations outside the range occur in many areas including (unwanted) in parts of the Redwood National Park. The alternatives are not intended to apply to those areas. The effects of the various alternatives on such plantations is inestimable. Local managers may choose to apply management practices suggested in this SEIS, but no such assumptions are made here.

- Private interest in POC will likely increase if resistant stock is available. The species provides valuable products, may be resistant to *Phytophthora ramorum*, the cause of Sudden Oak Death, may help diversify stands to reduce the effects of Swiss Needle Cast in Douglas-fir, can be grown in very wet areas, and is manageable within a wide range of ecological conditions.

- There will be adequate funding to implement the requirements of the selected alternative. If monitoring is required, for example, it will be funded. Funding is not necessarily expected where the writer provides the caveat "to the extent funding is available", or similar language, although such a case would obviously require funding to achieve the specific effect to which that author refers.

- References to Clorox bleach are to the material registered for control of PL as described in Appendix 4, and, to the extent consistent with effects described in this SEIS, to additional materials registered for such use in the future.

- The resistance breeding program in Alternatives 1, 2, 3, and 6 would be continued essentially at current levels.

- For analysis purposes, areas mapped as 75 percent or greater top-kill in the Biscuit Fire area were removed from acre and map calculations and displays of POC acres in the SEIS, even though there may be live POC on them now or in the future. The Standards and Guidelines of each alternative would apply to these acres of trees. For areas with live trees now, the provisions of Alternatives 3 and 6 for uninfested 6th or 7th field watersheds would apply.

- The ability to restrict traffic on lands in checkerboard ownerships is severely restricted by the terms of the reciprocal right-of-way agreements governing most roads. Written in the 1950s and 1960s to ensure only one set of roads was built to access both private and Federal lands, the agreements provide intermingled owners with a deeded right to use these roads. The results of court challenges to these roads based on the "Endangered Species Act" have affirmed these rights. See the Encumbered Forest Roads section in this chapter for more detail.

- Wildland fire operations will follow the Standards and Guidelines as soon as, and to the extent possible, if they do not jeopardize life and property. This issue is specifically addressed in the Standards and Guidelines of Alternatives 2, 3, and 6, and does not apply to Alternatives 4 and 5. A detailed explanation of wildland fire operations and root disease control considerations on the Biscuit Fire is included in the Fire/Fuels section.

- Facts, analysis, and conclusions displayed in this SEIS may be different than similar data in the Agency's 2003 "Range-Wide Assessment of Port-Orford-Cedar on Federal Lands" (USDA-FS and USDI-BLM 2003a). The Assessment is primarily an internal document that has been several years in the making. Data may be outdated, or analyses not to EIS standards. Generally, where information from the Assessment has been incorporated into this SEIS, it has been incorporated in its entirety with appropriate references, and therefore stands alone.

- Legal compliance by the public, and the effectiveness of Agency law enforcement, will be reasonable, but not absolute. Gates and other area closures will be respected most of the time. Public information efforts will continue to be successful. Firewood and other forest product collectors will stay out of closed areas most of the time, and violators will sometimes, but not always, be caught and cited. Occasional violations of area closures are specifically acknowledged in the Pathology and Botany sections.

Planting Assumption

Introduction. The Agencies' resistance breeding program is described in the Genetics section of this chapter and referred to throughout the SEIS. In particular, most indirect environmental effects are expected to be partially mitigated in the long term (but not in the short term) by the continued development and subsequent outplanting, survival, and growth of POC resistant to PL. Effects mitigations attributable to resistant stock are always identified as such. However, to provide consistency to such discussions, the following assumptions are made about the use and growth of PL-resistant stock.

Assumption. For each alternative, resistant seed is assumed to become available for each breeding zone on the dates projected in the Genetics section. Since resistant seed orchard trees bear cones annually and prolifically if stimulated and carefully managed, enough seed will be available to meet all Federal planting requests. Seedlings will be field planted, generally as part of multi-species mixes, on drier sites within its natural range, and high-risk sites where there is a low probability PL can spread to uninfected POC within, near, or downstream of the site. Planting on infested sites will generally be driven by resource needs like the replacement of stream shading on ultramafic sites where stream temperatures are adversely affecting listed fish species. Such planting would focus on areas where mortality is the most severe and replacement shading is limited. For effects discussions in this SEIS, assume planted resistant trees will eventually mitigate 50 percent of significant environmental loss resulting from PL mortality. For example, assume planting (or other ingrowth) will eventually replace at least 50 percent of shade loss along streams where PL-related mortality is causing temperature increases that threaten listed species. Over-planting will make up for mortality from all factors including PL, and surviving trees will be tended (thinned or released as needed). POC is intermediate in growth; with even moderate stand tending, dominant and codominant trees will exceed 24 inches diameter at breast height and over 100 feet in height in 100 years. See Appendix 6 for additional detail.

Port-Orford-Cedar Background

Port-Orford-cedar (*Chamaecyparis lawsoniana* [A. Murr.] Parl.) is the largest species of its genus and the largest representative of the family Cupressaceae in North America. It is a valued timber tree and is also planted worldwide as an ornamental (USDA-FS 1965).

Species Range

POC is a regional endemic, native only to southwestern Oregon and northwestern California. The range of POC includes portions of the Oregon Coast Range, Siskiyou Mountains, California Coast Range, and Klamath Mountains. The northern limit of the species occurs on coastal dunes north of North Bend. The southern end of the species' range is in Humboldt County. Longitudinal distribution is greatest in California (see Figure 1-1). The range narrows south and north of this area. Range limits in the south and east coincide roughly with the 1,000-mm (39.4 inches) isohyet. Disjunct populations are associated with areas of locally high precipitation about 93 miles inland, near the headwaters of the Trinity and Sacramento Rivers (Hawk 1977).

Autecology

POC has moderately high shade tolerance, and is more tolerant than incense-cedar, sugar pine, Douglas-fir and western white pine, and less tolerant than Shasta red fir, Brewer spruce, white fir, Sitka spruce, grand fir, western red cedar, and western hemlock. Other studies show POC able to reproduce well in all but the darkest microsites, including late-successional stands. Zobel and Hawk (1980) found POC to survive under shade as well or better than all its competitors except western hemlock.

In addition to being shade tolerant, POC is tolerant of repeated fire (Hawk 1977). Even as pole-sized trees, POC has a good chance of surviving fires (Zobel et al. 1985). Fire resistance is less than that of Douglas-fir, but greater than that of the true firs or western hemlock. POC is often the first species to reinvade after fire.

POC occurs over a wide variety of soil types (Hawk 1977). The species outcompetes most of its competitors on ultramafic soils, but is not restricted to these soils and grows better in laboratory studies on other soil types. At low elevations, POC is frequently associated with ultramafic soils. Higher elevation sites occur on a wider array of soil types (Zobel et al. 1985).

POC is characterized as having fairly low drought resistance (Zobel et al. 1985), and its requirements for moisture during the growing season may limit its distribution. POC is considered more drought tolerant than western hemlock and Sitka spruce, but is less tolerant than Douglas-fir, Jeffrey pine, incense cedar, sugar pine, and most other trees found in its range (Zobel et al. 1985).

Geomorphic Position

POC occurs in all physiographic locations from sea level to 6,400 feet elevation on the seaward slopes of the Coast Range and Klamath Mountains (Hayes 1958). POC forests occur most frequently on northwestern aspects; 82 percent of plots collected by Hawk (1977) were on aspects 200 to 45 degrees azimuth (Zobel et al. 1985). Most of the POC communities identified by Hawk (1977) were in midslope landscape positions.

Moisture Regime

Much of the range of POC usually has wet winters, dry summers, relatively uniform temperatures, high relative humidity, and frequent summer fog. Away from the coastal influences, in the south and east portion of its range, rainfall, relative humidity, and summer fog are decreased, while the temperature fluctuations in both the summer and winter are greater (USDA-FS 1965).

Moisture regime strongly influences plant community development within the range of POC. To most populations of POC, a consistent abundance of water seems a critical necessity (Zobel et al. 1985). Where Douglas-fir is present it outcompetes POC for water. Only in the northern part of the range does the ratio of available water to evapotranspiration compensate for this competition (Zobel et al. 1985). POC may outcompete Douglas-fir in areas with low macronutrients, or cold or saturated soils.

Summary of Limitations on Distribution

POC is restricted in geographic range, but has a wide ecological breadth, occurring in many diverse habitats (Zobel et al. 1985). Zobel et al. (1985) suggest limitations on POC distribution acting at four levels: microenvironmental, geomorphic surface, regional, and geographic scales. At the microenvironmental scale, moisture near the surface and high water potential in summer, absence of extreme shade, and mineral soils may be essential to seedling success. At the geomorphic surface-scale, POC seems generally limited to landscape positions that assure a consistent supply of groundwater. These include high water table and seep areas, streams or lakeside areas, slumped areas, and positions with significant watershed area above to maintain soil moisture.

At the regional scale, geology and climate affect distribution. For example, the importance of ultramafic substrates is clear. Higher humidity in coastal zones can compensate for low soil moisture locally. Finally, at the geographic scale, Zobel et al. (1985) suggest changes in precipitation/evapotranspiration ratios and decreases in ultramafic substrates traveling south and east, and increased competition with other conifers in the northern portions of the range.

Several factors mitigate the above-described constraints. North-facing aspects and areas experiencing summer fog also maintain microsite conditions supporting POC in upper slope positions without significant seeps. Also, lithology (bedding tilt) can frequently produce localized wetted soils within meters of local ridgelines. Thus, POC is frequently found in positions at or above midslope, and should not be considered a riparian species, but a mesic-to-moist microclimate-dependent species.

Life History

Some trees start to bear cones within 8 years under natural conditions and earlier in greenhouse conditions. Cone bearing becomes general by 20 years, is best at about 100 years, and continues for the life of the tree. Seed crops are frequent; heavy crops are produced every 4 to 5 years and some seed is usually produced every year. Squirrels do not commonly use POC seeds as food unless other species of seed are scarce. Most seed germinates soon after falling. Seedfall begins in September, reaches a maximum in winter, and continues through spring (USDA-FS 1965).

Natural reproduction is successful if there is a bare, mineral soil seedbed and sufficient moisture. POC survives well in plantations if animal browsing and competition from other vegetation is avoided (USDA-FS 1965).

In the most abundant portion of the range, POC is common in mixed stands up to 20 to 25 years old, after which it is usually overtopped and grows slowly. Once established, the species is relatively shade tolerant and long lived. It retains to an old age the capacity to respond if released from surrounding Douglas-fir and other overstory trees. POC is capable of moderately rapid growth when not overtopped by other trees. Mature trees can reach 4 to 5 feet in diameter and 200 feet tall. Mature trees are generally older than 200 years (USDA-FS 1965).

POC is subject to windthrow. It has no taproot, and the numerous lateral roots are usually of a small diameter. The tree has a tendency to grow multiple stems at any height (USDA-FS 1965).

Historical Setting

Historically, POC was a more prominent component across its natural range. Over the last 150 years the loss of old growth POC due to fire, harvest, land use changes, and root disease has been especially pronounced on the private and county lands along the coastal shelf from Coos Bay to Port Orford. A 1953 description of POC is provided in "A Natural History of Western Trees."

> But from the first discovery of the big stands of timber in 1855, man and fire have assaulted it relentlessly. A disastrous fire in the Coos Bay region at an early date wiped out a vast but undetermined amount. Next, sawmills were at work, and schooner were anchoring off the rocky, haborless coast, to be loaded with Cedar logs carried by high line from the cliffs to the decks.
>
> The demand for Port Orford Cedar, as soon as it became known in eastern and foreign markets, grew swiftly and remained steady.
>
> Today [1953] 69 percent of this precious timber is in private ownership, which means that its destiny is the saw mill . . . while 15 per cent is held on the Oregon and California Railway revested grant lands managed by the Department of

> Interior [BLM]. Only 16 per cent is in the hands of Forest Service.
>
> The best way to see this tree of almost legendary fame is to follow U.S. Highway 101 between Reedsport and Gold Beach, Oregon (Peattie 1991).

Old growth POC that might have survived logging interests on private lands have since been lost to urbanized land use changes and the POC root disease. For the most part, old growth POC along the U.S. Highway 101 corridor does not exist today. Currently, almost all old growth POC is on Federal ownership.

Distribution Across the Range

POC can be found with a variety of species with differing ecological requirements. These species differ across the range of POC. The wide ecological range of POC is reflected in the climatic diversity of the ecoregions and subsections in which it is distributed. These ecological units are defined based on their biotic and environmental factors that directly affect ecosystem function (McNab and Avers 1994). Ecoregions and subsections are used in the Ecology and Botany sections of this SEIS because they directly apply to various POC/other plant relationships. Presence of POC in a stand (as defined in the Glossary) made the stand it was contained in a POC stand and counted as POC acres.

Another approach for conceptualizing the distribution of POC across its range is used in the Pathology section. In this section, the range has been classified into three "risk regions," North Coast, Inland Siskiyou, and Siskiyou, based on the percentage of POC that is on sites at high risk for pathogen spread. While these classifications have some general relationship to the ecoregion and subsection approach, they do not match completely. The relationship between POC acres using the two approaches is shown in Table 3&4-4. Following are basic descriptions of the existing conditions within the risk regions.

North Coast Risk Region

The North Coast Risk Region is part of the Oregon Coast Range. This is an area of low mountains with high rainfall and dense coniferous forests. It has moderately sloping, dissected mountains and sinuous streams. The most important characteristic in terms of species

Table 3&4-4.—*Port-Orford-cedar acres on BLM and FS lands grouped by ecoregion and pathology risk regions, Oregon and California*

	Pathology Risk Regions					
	Oregon			California		
Ecoregions	North Coast Region	Inland Siskiyou Region	Siskiyou Region	Siskiyou Region	Disjunct California	Totals
Northern Coast	124,070	1,543	22,464			148,077
North Inland	291	20,367	17,909	13,724		52,291
Mid-Coast	1,887	5,273	50,120			57,280
Mid-Range		2,158	25,881	16,951		44,990
Southern Range				3,001		3,001
East Disjunct California					1,142	1,142
Totals	126,178	29,341	116,374	33,676	1,142	306,781

composition is the occurrence of western hemlock as a dominant or codominant species. The Federal administrative units that basically cover this region are the Siuslaw NF, Oregon Dunes National Recreation Area; Coos Bay BLM District; and the Siskiyou NF, Powers Ranger District.

Oregon Dunes National Recreation Area (FS)

The natural range of POC extends into the southern end of the Coos Bay dune sheet and the Oregon Dunes National Recreational Area of the Siuslaw NF.

Approximately 50 acres of old-growth POC are isolated by dunes and are managed to maintain, restore, or enhance its condition. These stands are 150 to 350 years old and appear to be healthy and free of PL infection. Off-highway vehicle use and a number of other activities within and adjacent to these POC stands is prohibited.

Approximately 40 additional acres of POC are found on the Oregon Dunes National Recreational Area as generally scattered individual trees or small pockets of younger trees with PL infection known or suspected within the area. Most are adjacent to roads, railroad tracks, or private lands, and about half are in areas open to off-highway vehicle use.

Coos Bay BLM District

Land ownership patterns within the Coos Bay District are checkerboard and scattered parcels of public domain lands interspersed with both private industrial forestlands and private individual landowners. All drainages on the Coos Bay District consist of mixed ownerships.

PL has been present within the Coos Bay BLM District boundary for over 50 years with the first POC trees exhibiting symptoms of PL in 1944 at the Oregon Marine Biological Station in Charleston, Oregon. The first confirmed sites were identified in Coos Bay, Oregon, near Mingus Park, just north of the North Bend McCullough Bridge, and in Charleston, Oregon (Roth et al. 1957).

According to the District's GIS database, there are 82,410 acres of POC on the Coos Bay BLM District with 319 acres of non-roadside PL infestations and 2,391 acres of roadside considered infested. These acres do not include infestations on the private lands intermingled and west of the Coos Bay District lands.

POC grows throughout the forest landscape and is only a minor component of local riparian habitats. Most of the PL infestations within the area occur on private lands from Lakeside, Oregon, to Gold Beach, Oregon, along the coast. Healthy POC is found throughout the landscape away from roads and streams. The vast majority of POC and PL on Coos Bay BLM District lands is in the south half of the district, south of the North Fork Coquille and Coos River drainages. Nearly all drainages within the Coos Bay District are infested with PL. A few uninfested 7th field watersheds are at the northern most end of the natural range. These areas have small scattered populations of POC intermixed with stands of Douglas-fir, western hemlock, and western red cedar.

Planting of nonresistant POC seedlings as part of the species mix has occurred on all regeneration harvest units within the range of POC since Fiscal Year 2000. Planting, annual maintenance, and precommercial thinning of plantations preserve minor species, including POC, in areas away from roads and streams.

Siskiyou National Forest, Powers Ranger District

The Powers Ranger District has the greatest concentration of POC in the world, from the South Fork of Coquille River to Iron Mountain. This district is also unique in having stands with compositions of POC up to 70 to 80 percent. Included within the district are the Port-Orford-cedar Research Natural Area, Big Tree Viewing Area, which includes the largest POC in the world at nearly 12 feet in diameter, and the Coquille River Falls Research Natural Area. The research natural areas are infested with POC root disease.

The district has been active in the inventory of POC through district-wide road surveys in 1964, 1972, 1983, 1992, and 1999. Since 1999, individual road segments connected to project proposals have been surveyed. These surveys, combined with extensive aerial photo and ground verification surveys in 1997, have identified a total of 61,014 acres of POC present on the district, of which 8,138 acres are infested with the PL root disease. Based on survey information and observations, there are few acres of new infestation appearing with each new survey. Most of the roads on the district have been open to the public since their construction and have already become infested.

Coquille Indian Forest

In 1997, Congress granted the Coquille Tribe in Oregon 5,400 acres of public land that had previously been managed by Coos Bay BLM. The lands are generally situated in sections (640 acres) and partial sections northeast of the towns of Myrtle Point and Powers, and are immediately surrounded by private lands although BLM lands are often no more than 1 mile away. The Act (Public Law 104-208) creating the Coquille Indian Forest requires that these Indian lands be managed subject to the Standards and Guidelines of Federal forest plans on adjacent and nearby Federal lands, and consequently the Tribe has been following all elements of the 1994 Northwest Forest Plan. The applicability of the selected alternative from this (POC) SEIS, and the appropriate strategy for POC management on Coquille Forest lands, will be determined by separate action of the Bureau of Indian Affairs and the Coquille Indian Tribe. Analysis in this SEIS assumes the Standards and Guidelines for the selected alternative will not apply.

The annual allowable sale quantity for these lands is about 2 million board feet. Harvest and other activities on these lands have a possibility of spreading PL to Federal lands, with the risk lower than the risk of PL coming from private lands (because of Northwest Forest Plan land allocations). This risk would become equivalent to risk from other Federal lands if the Tribe adopts the Standards and Guidelines of the selected alternative.

Private Lands in the Region

With the prolific seed production of the species and excellent POC growing conditions along the coast, the corridor of lands along U.S. Highway 101 from Lakeside in the north to Port-Orford, Oregon, in the south, is a rich environment for PL infestations. There are approximately 880,000 acres of non-Federal lands within the Coos Bay BLM District boundary within the POC range (see Map 4), with an estimated 50,000 of these acres containing POC. Aerial photography interpretation indicates there are approximately 8,500 acres of non-roadside PL infestations on these lands. The low coastal terraces and abundant standing water in this area result in a high percentage of POC being on sites at high risk for PL infection. The mortality rate calculated from forest inventory plots is consistent with aerial photo disease mapping done by the Coos Bay BLM District.

Inland Siskiyou Risk Region

This risk region has a high diversity of conditions, which is reflected in the vegetation. POC in this region is often associated with ultramafic soils, and codominates the timber stands on these soils with Jeffery pine and incense cedar. The vegetation on other soil types is dominated by the Douglas-fir with scattered POC. POC grows on Federal lands intermingled with private landholdings. It exists as occasional large trees with many seedlings growing underneath. The Federal administrative units that basically cover this region are the Roseburg and Medford BLM Districts.

Roseburg BLM District

Overlapping the northeastern-most portion of the native range of POC, the Roseburg BLM District has approximately 5,000 acres of forestland occupied by this species. The POC on the district grow in the Coast Range west of the Umpqua River, south to the southern area of Camas Valley, then crossing State Highway 42 into the Twelve-Mile drainage. POC grows sporadically along Buck Springs Ridge and Cow Creek and its tributaries, and also in the south fork of Middle Creek.

Less than 100 acres have some level of the root disease, primarily adjacent to highly visible roads. Infestations occur on interspersed private lands as well.

About 63 percent of the trees are less than 80 years of age. POC makes up generally less than 5 percent of the overstory of the stands in which it is found.

PL has probably been present on Roseburg BLM District since the early 1960s. Extensive road construction on both Federal and private lands probably facilitated the introduction of the disease during this period.

Medford BLM District

The natural range of POC extends into the western part of the Medford District. Of the four resource areas on the district, POC is native in the Grants Pass Resource Area and the Glendale Resource Area. The Grants Pass Resource Area contains the majority of POC. Most of the POC on the Medford District is contained in the Williams Creek, Rogue River/Horseshoe Bend, Silver Creek, Rogue River/Hellgate and Deer Creek Watersheds. Surveys in these and other 5th field watersheds show 25,485 acres of healthy POC and 2,340 acres of infested stands.

The habitats in which POC is found are very diverse. POC on the district is often associated with riparian areas, but does occur in the uplands and on ridges. There are inclusions of coastal plant communities associated with POC as well as a high elevation association with Shasta red fir and Alaska yellow cedar. POC can be found on serpentine-influenced (ultramafic) soils that include western white and Jeffrey pine series.

Siskiyou Risk Region

This risk region includes the Coastal Siskiyous, Siskiyou Mountains, and Gasquet Mountain ultramafics located in Oregon and California. In the northwest part of the region, the Coastal Siskiyous have highly dissected mountains and high gradient streams, as well as a few, small, alpine glacial lakes. The climate is wetter with more maritime influence than the Siskiyou and Klamath Mountains to the south. The Coastal Siskiyou area has tanoak, Douglas-fir, and some POC. Western hemlock is present, but not a dominant overstory species. This region has a high diversity of ecological conditions, which is reflected in the vegetation.

In the middle of the region, the Siskiyou Mountains are higher and steeper than the other portions of the cedar's range in Oregon. The vegetation is dominated by Douglas-fir at low elevations, Jeffrey pine on ultramafic soils, and white fir and red fir series at higher elevations.

In the south portion of this region, populations of POC are highly scattered across the landscape and within many vegetation types. Marine air moderates temperatures in the western portion of this area, creating a temperate-to-humid climate near the coast. Douglas-fir and tanoak are the predominate trees in this part of the region. The southern extreme of this region stretches to the southwest edge the Klamath Mountains and into the northern California Coast Range. Many of the isolated populations of POC in this part of the region are often found on ultramafic soils.

The Federal administrative units that basically cover this region within the Siskiyou NF are the Illinois Valley, Galice, Gold Beach, and Brookings Ranger Districts; Six Rivers NF; Klamath NF; Shasta-Trinity NF; Oregon Caves National Monument (FS); and Redwood National Park.

Siskiyou National Forest, Illinois Valley, and Galice Ranger Districts

Many of the POC within the Illinois Valley and Galice Ranger Districts range in age from 200 to 400 years and are 20 to 60 inches in diameter. POC root disease has been present along the Oregon side of the Grayback Road going toward Happy Camp, California, since about 1960. Sanitation removals were implemented on the California side to reduce the potential for further disease introduction. So far, the root disease has not been found on the California side of the Grayback Road. In contrast, there has been considerable spread along this route and subsequent downstream movement in the years following introduction. The disease has spread to many stands, mostly along roads and down streams, east of Highway 199 on the Illinois Valley Ranger District. PL has infested the Grayback/Sucker Creek drainage near the Oregon Caves National Monument. The Wild and Scenic Illinois River and Briggs Valley area have a 6 to 40 percent stand composition of POC and are uninfested. Other major drainages in the Illinois Valley have scattered distributions of uninfected POC amidst steep topography.

POC is most often found in riparian areas within the Illinois Valley and Galice Districts. Generally, POC is within 100 feet of the stream; however, small groves of POC can be found on alluvial fans and benches along these streams. Crown closure in the streamside areas are from 10 to 50 percent.

There are upland populations on the many different soil types, including serpentine. POC is mixed with Douglas-fir, true firs, pines, and incense cedar up to approximately 4,500 feet elevation. In these mixed conifer stands, POC crown closure is generally 5 to 20 percent. Before the Biscuit Fire, POC on serpentine soils could be found from Josephine Mountain south to the Oregon boarder, where POC was scattered with white, knobcone, and lodge pole pines. In other serpentine areas, POC can be found with incense cedar and Douglas-fir. In these areas, POC crown closures are less than 2 percent.

Siskiyou National Forest, Chetco and Gold Beach Ranger Districts

POC can be found from Iron Mountain on the northern boundary of the Gold Beach District south to Mineral Hill. From there south, it is sparsely distributed and found only on the east side of the Chetco Ranger District. POC grows from near sea level up to approximately 4,700 feet at Chetco Peak in the Kalmiopsis Wilderness.

POC is mostly found within 100 feet of the streams, but is also present in upland areas on many different soil types, including serpentine. POC is mixed with Douglas-fir, true firs, pines, and incense cedar. In the mixed conifer stands, POC crown closure is generally 5 to 20 percent, but can be up to 80 percent in small isolated areas. Many of the POC within these districts are 200 to 400 years old and 20 to 60 inches in diameter.

PL has occurred along forest roads since about 1960. The disease has spread to many stands, mostly along roads and streams, and including locations in the Kalmiopsis Wilderness following introduction.

Six Rivers National Forest

The Six Rivers NF includes the greatest extent of POC on Federal and State lands in California. These acres are spread over the northern portion of the forest and decrease in extent toward the south. The Gasquet Ranger District has about 67 percent of the POC on the Forest, primarily in the Smith River drainage. The Orleans Ranger District has about 30 percent of the POC on the forest, all in the Klamath River drainage. The southern-most POC in the natural range is on the Lower Trinity Ranger District. About 77 percent of the POC on the Six Rivers NF is found in riparian landscape positions.

POC root disease was noted on the Gasquet Ranger District by 1980 and has slowly spread to over 2,800 acres. The Orleans Ranger District has 157 infested acres and the Lower Trinity Ranger District has no recorded infestation to date. Most infestations are found in riparian habitats.

Klamath National Forest

There are no known PL infested stands or infected trees on the Klamath NF.

The distribution of POC on the Klamath NF is mostly limited to the Dillon, Clear, and Indian Creek Watersheds within the Siskiyou Mountains. On the Klamath NF, POC stands usually consist of small, isolated pockets or narrow stringers and are nearly always confined to riparian areas. Most acres fall within the Riparian Reserve land allocation. The majority of POC acres are located within the Siskiyou Wilderness. Many of the POC stands in Matrix lands are generally in more accessible areas, but with limited direct road access to stands due to steep topography and riparian position.

Currently, the closest known infested sites are on the Illinois Valley Ranger District of Siskiyou NF and Orleans Ranger District of Six Rivers NF. The Illinois Valley site is close, via the popular Grayback Road, to uninfested sites within the Indian Creek Watershed of Klamath NF.

The 100-acre Sutcliffe Creek Botanical Area, which contains a stand of old POC, is located in the upper Indian Creek drainage of the Happy Camp Ranger District. Many stands of POC on the Klamath NF are greater than 300 years in age, with some individuals reaching ages of over 700 years. There are three locales within the Siskiyou Wilderness where POC and Alaska yellow cedar are found in very close proximity.

Oregon Caves National Monument (FS)

POC is the dominant tree on approximately 40 acres of the 480-acre Monument, and occurs in stands in about half the Monument. There is no PL in the Monument, but it is surrounded by it, even upslope. There are foot trails coming to the Monument from adjacent infested FS lands that are used by people and, illegally, by horses.

Redwood National and State Parks

Of the 110,000 acres in the Park, naturally-occurring POC occupies only about 200 acres at the north end of the Park in the Smith River drainage near Jedediah Smith State Park. POC is found in various pockets, generally as a component of stands, but also within a few POC-dominated stands. There are a few infestations of PL, with one infestation notably along a main trail. There is no formal public access to other infestations, and generally little access to uninfested stands, except at Jedediah Smith State Park Campground.

Biscuit Fire

The Biscuit Fire, located primarily within this region, began on July 13, 2002 and reached 499,965 acres (471,130 acres in Oregon and 28,835 acres in California). One of Oregon's largest fires in recorded history, the Biscuit Fire encompassed most of the Kalmiopsis Wilderness. The boundary of the Biscuit Fire stretches from 10 miles east of the coastal community of Brookings, Oregon, south into northern California, east to the Illinois Valley, and north to within a few miles of the Rogue River. The fire impacted approximately 29 percent of Federal acres with POC and partially occurred on the Medford District BLM, and Six Rivers and Siskiyou NFs.

Private Lands

There are 2,000 to 5,000 acres of non-Federal POC in California (see discussion of California early in this chapter). This includes lands in both the Siskiyou and Disjunct California Risk Regions.

Disjunct California Risk Region

Scattered populations of POC grow in this risk region in the southeastern corner of the Klamath Mountains and Scott Mountains. The primary trees in this part of the region are Jeffrey pine, ponderosa pine, white fir, and Douglas-fir. The Federal administrative unit that covers this region is the Shasta-Trinity NF.

Shasta-Trinity National Forest

Approximately 1,150 acres of POC occur on lands managed by the Shasta-Trinity NF. These are located within portions of the disjunct southeast interior POC population. Occurring as small discontinuous groupings of trees, the POC populations on the Shasta-Trinity NF are almost entirely limited to the riparian zones of the Upper Sacramento and Trinity River drainages. Much of this POC occurs in areas under checkerboard land ownership. There are additional sites with POC on privately-owned land, as well as at Castle Crags State Park. The 1,160-acre Cedar Basin Research Natural Area has isolated patches of large POC as a distinguishing feature.

Although there are several areas of POC root disease infestation along the upper Sacramento River from Shasta Retreat (just north of Dunsmuir) to the mouth of Shotgun Creek, only one infestation is present on the Shasta-Trinity NF. This small infestation was discovered in September, 2001 at Scott Camp Creek, approximately 3 miles upstream from Lake Siskiyou.

Port-Orford-Cedar Acreage Data

Geographic Information System

The geographic information system (GIS)-mapped data for POC and PL infestation was developed over the last decade by the various administrative units (Table 3&4-5). On the Siskiyou NF, roadside survey observations, for both healthy and diseased POC locations, were collected and put into GIS in 1992. Intermittent updates have been made since. The GIS map is composed of aerial photography interpretation, timber cruise data, stand exams, and estimated locations as seen from roads for the presence of any healthy or diseased POC.

On the BLM districts, the FS standards for roadside surveys and aerial photo interpretation with on-the-ground verification sampling were utilized for mapping the presence of POC and the PL infestations. This data was entered into GIS on the three BLM districts in 1998. In 1999, POC and infestation maps for both agencies were consolidated into a common GIS layer covering the range of POC.

On the Roseburg and Medford BLM Districts, only the federally-administered lands were

Table 3&4-5.—*Geographic information system-mapped Port-Orford-cedar and* Phytophthora lateralis *infestation acreage on BLM and FS, post-Biscuit Fire*

	Congressional Reserves/Administratively Withdrawn		Late-Successional Reserves		Matrix/Riparian Reserves/Adaptive Management Areas		Total		
Risk Regions	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested	% Infested
Oregon									
North Coast	1,351	220	57,128	6,177	60,209	1,163	118,688	7,560	6
Inland Siskiyou	4,317	87	18,182	1,151	5,060	544	27,559	1,782	6
Siskiyou	18,829	906	62,474	8,536	22,617	3,012	103,920	12,454	11
Total	24,497	1,213	137,784	15,864	87,886	4,719	250,167	21,796	8
California									
Siskiyou	17,188	1,782	10,641	741	3,013	311	30,842	2,834	8
Disjunct California	371		173		598		1,142		0
Total	17,559	1,782	10,814	741	3,611	311	31,984	2,834	8
Total	42,056	2,995	148,598	16,605	91,497	5,030	282,151	24,630	8

generally mapped for PL infestations. At Coos Bay District BLM, Federal and private lands within the boundary of the district were mapped for PL infestations. However, the PL infestations mapped on private lands do not include roadside surveys and were not field-verified. The private lands are not included on Table 3&4-5. Coos Bay completed an extensive revision of the GIS map for POC presence data in early 2003. A 2002 remapping of PL infestations on the Roseburg BLM District has not yet been incorporated into the common GIS layer used by all administrative units. A SEIS Team-initiated comparison of that data with the GIS data, however, shows only an 18-acre difference, or 0.06 percent of the PL in the Inland Siskiyou Risk Region.

On the Klamath, Shasta-Trinity, and Six Rivers NFs in California, the healthy POC and PL infestations were estimated using detailed ecological mapping and plant association plot information. Some non-Federal lands have also been mapped.

Biscuit Fire Acres. According to canopy fire effects mapping done by the Agencies shortly after the Biscuit Fire, the fire significantly changes the vegetative landscape. Substantial areas of POC were killed in the fire. From this mapping, it is estimated that two-thirds of the fire area had more dead conifers than live. While riparian areas often did not burn as hot as surrounding upland areas, periods of extreme fire behavior also impacted riparian areas, killing many POC trees. Based on overlaying the 75 percent top-kill burn intensity map with the prefire POC GIS maps, it is estimated that 55,400 acres of uninfested POC stands, and 1,400 acres of infested POC stands, were killed out of 95,000 acres within the perimeter of the fire. To provide a description of current conditions, it is assumed these acres experienced complete POC mortality, and hence removed from acres displayed in this analysis.

If POC actually survived, or is reseeded or replanted in burned areas, the Standards and Guidelines of the selected alternative (including those defining uninfested watersheds, if PL was not previously present) would apply. Indeed, 30,000 disease-resistant POC seedlings have been sown for outplanting within the burn. Planting, began in November 2003, is expected to begin restoring the total acres of POC back toward prefire levels.

After the POC SEIS was under way, the Biscuit Fire recovery team remapped burn intensities within the fire area using a vegetation change index, to more accurately display within-stand diversity of fire effects. The earlier canopy fire effects (used in this SEIS) were mapped at the stand scale using stands of 1 to thousands of acres. The vegetation change data used in the Biscuit Fire draft EIS was measured at the 0.222 acre scale. A comparison table in the Biscuit Fire draft EIS shows the landscape-scale differences between the two methods to be small. For example, the portion of the fire area experiencing greater than 75 percent mortality was estimated at 49 percent using canopy fire effects, and 44 percent using the vegetation change approach (USDA-FS 2003d, *p. D-3*) This difference is not considered significant for the programmatic analysis in this SEIS and, if anything, indicates this SEIS is conservative in its estimate of surviving POC. POC acres displayed throughout this SEIS continue to be based on the original canopy fire effects mapping.

The heat from the Biscuit Fire and resultant altered microclimate may have removed PL from some burned areas. Hansen and Hamm (1996) found that after one week, bags of soil and organic matter that had reached temperatures of 104 degrees F for 4 hours each day no longer supported the pathogen. High intensity, stand-destroying fires reach maximum ground temperature of 200 to 300 degrees C (392 to 552 degrees F) at the surface (DeBano et al.

1998). There is good potential for this amount of heat to have negative impacts on PL populations. Questions remain about how deep into the soil profile PL goes (depth of roots) and how deep the pulse of heat extends into the soil.

Port-Orford-cedar Map. Map 3 compiles the GIS maps of POC and PL with the Northwest Forest Plan land allocations. PL infestations are shown in red; POC presence is depicted by all other colors—the colors themselves indicate the underlying Northwest Forest Plan land allocation. Areas not colored do not have POC. The map also shows the FS inventoried roadless areas (cross-hatched) and the Biscuit Fire perimeter (heavy dashed line).

Current Vegetation Survey

The FS maintains a National System of Current Vegetation Survey (CVS) sample plots to acquire basic vegetative resource information triannually at the regional scale. This information allows resource specialists and others to assess the current vegetation condition and assess changes in the ecosystem, spatially and temporally. BLM in western Oregon maintains inventory plots to the same establishment and remeasurement standard as the FS, in order to be able to combine data sets for landscape, provincial, and regional analysis.

In general, the acquired dataset represents a collection of basic, statistically-designed, and quality-assured vegetation resource measurements. The strength of the survey includes: the ability to set a benchmark of the vegetative condition on NF and BLM lands, providing a basis for change estimation (trend analysis, for analysis), and accommodating monitoring through remeasurement.

Data is collected on nested subplot radii within a one hectare (2.47 acres) plot. The plots are located on a 1.7 mile statewide grid and each plot represents approximately 1,750 acres. The plots are divided into 0.2 hectare areas that contain concentric fixed area subplots that vary for each diameter class being sampled. The intensity of 1.7 miles is not usually useful for evaluating minor species such as POC within limited landscapes. In Table 3&4-6, data is compiled only for larger geographic areas. Other survey methods can be used to assess presence of minor species or incidence of forest diseases, and the results of those surveys could be different based on their intensity when compared to CVS.

Similar inventory plots, forest inventory, and analysis (FIA) are maintained on private lands by the research branch of the FS. Forest inventory and analysis inventory data estimates that there are a total of 54,550 acres (standard error 14 percent) of POC on Oregon's private lands with 9,820 acres (standard error 59 percent) of those lands containing dead POC. This estimate is not considered as reliable as the mapping method used for determining infested acreage on Federal lands and shown in Table 3&4-5, but is the only available estimate of Oregon private lands with POC. The inventory plots are considered accurate for displaying individual tree mortality percentages for both Federal and private lands.

Table 3&4-6 provides tree numbers and mortality information from the most current CVS and forest inventory and analysis data in the range of POC. CVS data shows an additional 40 million POC less than 1 inch diameter at breast height on Federal lands in Oregon that are not shown on the table.

Table 3&4-6.—*Current Vegetation Survey: Summary from Forest Inventory Plots of live and dead POC trees*

Area [1]	Diameter group dbh [inches]	Live trees	Dead trees	% live	% dead
Oregon					
Federal:	1-7	7,826,100	1,074,600	88	12
Coos Bay	7-20	1,618,300	436,100	79	21
BLM/Powers	>20	361,600	159,600	69	31
Ranger District [2]					
Federal:	1-7	5,863,900	239,100	96	4
other than above [3]	7-20	1,428,500	417,300	77	23
	>20	435,100	138,200	76	24
Total Federal [4]	1-7	13,690,000	1,313,700	91	9
	7-20	3,046,800	853,400	78	22
	>20	796,700	297,800	73	27
Private [5]	1-7	11,767,200	8,722,200	57	43
	7-20	2,134,400	1,631,000	57	43
	>20	102,900	263,200	28	72
California					
Federal [6]	1-7	4,677,000	23,400	99	1
	7-20	1,096,000	4,800	99	1
	>20	379,600	5,600	99	1

[1] Oregon Federal lands were grouped to match "risk regions" described in the Pathology section and lumped to provide statistically significant results.
[2] Standard error 19-33%.
[3] Standard error 18-41%.
[4] Standard error 13-24%.
[5] Standard error 7-115%; these are from FIA plots [see text].
[6] Standard error not calculated.

Aerial Mortality and Defoliation Surveys — Oregon

The State of Oregon, Department of Forestry, and USDA-FS have been jointly conducting aerial sketch mapping of forest insects and disease pathogens for more than 50 years. The survey protocol identifies clumps of at least five dead trees that have been killed within last year and assigns a causal agent. In 2001, the survey system began using real-time global positioning to digitally construct its electronic maps (USDA-FS and Oregon Department of Forestry 2002). The aerial survey observations for southwestern Oregon contain POC root disease as one of the causal agents in its report. Table 3&4-7 summarizes POC root disease results for 2000 through 2002.

Table 3&4-7.—*Summary of aerial mortality and defoliation survey results for Port-Orford-cedar in Oregon, 2000–2002*

	2000		2001		2002	
Land ownership	Acres	Dead trees	Acres	Dead trees	Acres	Dead trees
Bureau of Land Management	87	64	123	89	169	70
Forest Service	480	239	257	182	213	74
Private	4,615	4,779	5,835	4,882	5,522	6,963
State of Oregon	1	1	64	58	43	43
Wilderness/National Monuments	68	28	0	0	24	5
Total	5,251	5,111	6,279	5,211	5,971	7,155

Resource Elements That Address Issues

Introduction

With the identification of the Purpose and Need in Chapter 1, and following scoping, a list of issues was developed upon which a decision to select one of the alternatives would be based. These issues are addressed in the various resource topic discussions in this chapter. These discussions cover the ecological, Tribal, and product uses or functions potentially affected by POC management, and provide the basis for the Comparison of Alternatives in Chapter 2.

The issues are primarily affected by two distinct kinds of effects. First, to the extent the Standards and Guidelines themselves have a direct effect on access or use of the forest and the harvest of forest products, there is a direct effect. Direct effects include potential reductions in non-POC timber harvest because of direct prohibitions in certain areas or stands; reductions in POC bough harvest because of direct prohibitions, and reductions in recreation opportunities because of road closures or prohibitions on off-highway vehicle use.

Second, to the extent that application of the standards and guideline maintains POC, there is a secondary effect on related resources. Such effects include the degree to which stream shading is maintained or lost, thereby changing temperature, wildlife habitat changes related to the loss of future snags, genetic resources retained, or visual resources affected. Both of these kinds of effects are described in the specific resource Effects of the Alternatives sections.

The keystone for the secondary effects analyses is the Pathology section. The available science and experience has been summarized and synthesized, and brought to bear on the various elements of each alternative. The result is a 100-year infection percentage estimate for each of the alternatives. These percentages, which vary for different "risk regions" within the planning area depending upon various risk factors, are converted to acres and used to predict secondary effects.

Pathology

Introduction

POC root disease is caused by the pathogen *Phytophthora lateralis* (abbreviated in this document as PL). PL is an oomycete belonging to the family Pythiaceae. Formerly considered to be true fungi, it is now generally accepted that oomycetes constitute a separate kingdom from the fungi (Cavalier-Smith 1986; Dick 1995; Erwin and Ribeiro 1996; Parker 1982).

All *Phytophthoras* exist primarily as hyphae, or thin threads of fungus-like material adjacent to and within their host. Aggregations of hyphae are known as mycelia. Mycelia, if fragmented or transported along with pieces of the host plant, can serve to move the pathogen to new locations. Mycelia are somewhat fragile and die when exposed to drying conditions. Several spore types form as specialized structures attached to *Phytophthora* mycelia. Although there are four spore types identified for PL, two are important enough in disease spread to be discussed here.

When PL is mature, and generally in the presence of free water, zoospores are released. Zoospores lack cell walls, are very delicate, and have two flagella. They can swim for several hours before forming cysts, but can only travel an inch or two in standing water (Carlile 1983). Zoospores also have the ability to detect compounds released by a host and swim in the direction of the host. Upon contact with a host rootlet, the zoospore will attach itself and germinate. If a host rootlet is not found, other surfaces are contacted or agitation occurs, and a zoospore will form a cyst. When encysted, it can be carried considerable distances in running water. In contact with a host, the cyst can germinate and form a mycelium that infects the host, or it can form a sporangium and release more zoospores.

Chlamydospores are thick-walled vegetative spores. Chlamydospores are somewhat resistant to drying and temperature extremes. They can germinate directly and form infective mycelia or, in the presence of water, they can form sporangia and release zoospores. Ostrofsky et al. (1977) showed that, under laboratory conditions, PL populations detected by baiting decreased substantially when unfavorably warm, dry conditions typical of summer months in the range of POC occurred. However, the pathogen survived at a reduced level as chlamydospores in organic matter, especially in small roots on infected trees and fragments of roots in the surrounding soil. Hansen and Hamm (1996) have demonstrated that PL can survive in infected POC roots and root fragments for at least 7 years under favorable conditions. PL chlamydospores are incapable of direct movement, but their structure provides protection during passive movement in infected roots or organic material in soil and mud.

Affected Environment

<u>How the Pathogen Spreads</u>

PL spreads in several ways (Hansen et al. 2000; Zobel et al. 1985):

1) Over long distances via resting spores transported in infested plant material or soil;
2) locally via waterborne spores moving in ditches, streams, or overland flow; or
3) via mycelia growing across root contacts and grafts between infected and uninfected POC.

Initiation of infestation into new areas involves 1, above, and is most commonly associated with deposition of infested soil along a road or trail. Vehicles, equipment, animals, or humans on foot transport inoculum from previously infested areas (Hansen et al. 2000; Jules et al. 2002; Kliejunas 1994; Ritts 2003, Roth et al. 1972). A susceptible POC fairly close to the actual site where inoculum is deposited is needed—this is usually a POC growing close to the road (within 10 feet) or a cedar with its roots in the water close to the road-crossing in a case where the introduction involves deposition of inoculum directly in water. Jules et al. (2002) found indications that spores from an introduction into water at a road-crossing can spread to a tree as far downstream as 160 meters, but probability of any single introduction reaching such a distant tree is low. Probability decreases with distance from the point of introduction into the water. In addition to POC, Pacific yew is infected by PL on infrequent occasions (Kliejunas 1994). Observations and laboratory trials show that Pacific yew is much less susceptible than POC. Where it has been found infected, Pacific yew was growing in close association with many previously infected POC (Murray and Hansen 1997).

Once PL is successfully established, subsequent spread mostly involves number 2 listed previously. Under proper environmental conditions for the pathogen, spores produced on the initially infected POC are released and move downslope in overland water flow or streams, infecting additional trees whose roots are within the sphere of influence of the infested water (Hansen et al. 2000; Jules et al. 2002).

Root-to-root spread, number 3 listed previously, occurs in some cases (Gordon and Roth 1976), but is thought to be of much less significance in the epidemiology of the pathogen than spore spread in soil or water. It occurs in heavily-stocked stands with substantial POC components (many POC quite close together).

Infection by PL is greatly favored by cool conditions and requires the presence of water around POC roots for at least several hours (Zobel et al. 1985). Optimal temperatures for infection are between 50 degrees and 68 degrees F (Trione 1974). Most POC are infected by the pathogen in the cool, wet parts of the year. Very little infection occurs in the dry, warm summer months.

Certain kinds of sites and microsites foster conditions especially favorable for spread and infection by PL (Goheen et al. 2000a; Hansen et al. 2000; Roth et al. 1987). These high-risk sites are low-lying wet areas (infested or not) that are located downslope from already infested areas or below likely sites for future introductions, especially roads. They include streams, drainage ditches, gullies, swamps, seeps, ponds, lakes, and concave low-lying areas where water collects during rainy weather. Areas not influenced by the wet conditions or periodic water flow that occurs in high-risk sites are low-risk sites. Cedars near streams or bodies of water whose roots do not extend below the high watermark for flooding are at low risk of infection. Riparian Reserve widths along a stream (as defined in the Northwest Forest Plan by site tree heights) often extend well beyond the high-risk widths for POC.

Probability of Long-Distance Spread and Establishment of *P. lateralis* in New, Previously Uninfested Areas

As already mentioned, long-distance spread of PL involves movement of resting spores. These spores can survive in infected POC roots and root fragments in the soil for at least 7 years after the host POC's death under ideal conditions (Hansen and Hamm 1996). Movement of spores with transport of nursery stock in infested soil was probably how PL was originally introduced into the natural range of POC (Roth et al. 1957). Long-distance spread in the forest today primarily involves movement of resting spores in soil adhering to vehicles or clinging to the feet of humans or animals.

When evaluating the likelihood of long-distance spread to and establishment of PL into a new area, consideration needs to be given to the probabilities that: (1) viable inoculum will be picked up at an infested source; (2) the inoculum will be carried to a particular uninfested area; (3) the inoculum will remain viable during transit; (4) the inoculum will be deposited in the new site; and (5) the inoculum deposited will infect a POC and disease establishment will result. A number of factors influence inoculum accession, spread, and establishment of PL, especially:

- Character of site of origin;
- type of carrier;
- time of year of transport event;
- distance traveled and associated time elapsed;
- effectiveness of management techniques applied to slow or prevent spread or prevent establishment of PL in new areas;
- character of site and stand conditions where the potential introduction occurs; and
- number of potential transport and introduction events.

Exact figures for determining the influence of each factor on the probability of long-distance spread and establishment are available in very few cases. However, relative probabilities between 1 (very low) and 10 (very high) have been determined for each factor. Based on the literature, and the professional judgments of forest pathologists with substantial amounts of experience evaluating PL in the laboratory and the field, it is suggested that probabilities of an event having the result under consideration are as follows.

1 = 0 to 2 percent	6 = 10.1 to 20 percent
2 = 2.1 to 4 percent	7 = 20.1 to 30 percent
3 = 4.1 to 6 percent	8 = 30.1 to 40 percent
4 = 6.1 to 8 percent	9 = 40.1 to 50 percent
5 = 8.1 to 10 percent	10 = 50.1 to 100 percent

The following is a discussion of each of the factors.

Character of site of origin. Potential carriers of PL entering a possible inoculum source area are more likely to pick up soil that contains viable inoculum in some kinds of sites than others. Inoculum clearly will not be available on a site with no infection while areas with obvious infection of POC where certain kinds of wet conditions prevail are the most likely places for inoculum to be acquired. Suggested probability figures for the likelihood of potential carriers picking up viable inoculum on different kinds of sites are:

Site with no evidence of root disease within the local drainage = 1;

site with no evidence of root disease in the area entered by the potential carrier, but evidence of root disease nearby (within 300 feet) in the same drainage = 2;

site with local evidence of root disease where the potential carrier does not enter water = 5;

site with local evidence of root disease where the potential carrier enters flowing water = 7; and

site with local evidence of root disease where the potential carrier enters a swamp, seep, or any-sized body of standing water = 10.

Type of carrier. Vehicles (both motorized and nonmotorized), equipment, humans on foot, and animals (especially cows, horses, and elk) have been implicated in carrying PL. Probability of successful spread is greater with the larger carriers, those that transport greater amounts of soil, those most likely to access infested areas, and those that can rapidly travel to new sites. Suggested figures for the probabilities that different kinds of carriers could pick up and transport infested soil are:

Earth moving equipment = 10;
large transport equipment = 9;
all-terrain vehicles = 8;
passenger vehicles = 7;
humans on foot or using nonmotorized vehicles = 5; and
large animals = 5.

Time of year of transport event. Likelihood of acquiring inoculum, successfully transporting it, and establishing disease at a new site are greatly favored by cool temperatures, and probability of infection is much greater during wet periods than dry ones. Also, inoculum is most likely to be picked up from an infested site during a wet period when infested soil is muddy and prone to adhere to the carrier. Probability of spread and establishment of new infections is greater with soil movement in late fall, winter, and early spring than summer, and is greater in rainy rather than dry weather. Suggested probability figures are:

Movement between October 1 and May 31 during wet weather = 10;

movement between June 1 and September 30 during dry weather = 1;

movement between October 1 and May 31 during a dry period that lasts at least a week before and continues during the time of the movement = 3; and

movement between June 1 and September 30 during a rainy period of sufficient intensity to form puddles on a road or cause roadside ditches to flow = 6.

Distance traveled by carrier. Probability of successful delivery of viable inoculum from one site to another decreases with distance traveled and associated time elapsed since inoculum was picked up. Suggested probability figures are:

For vehicles, less than 0.5 mile = 10;
0.5 to 1 mile = 9;
1 to 5 miles = 8;
5 to 10 miles = 5;
10 to 20 miles = 3;
20 to 50 miles = 2;
greater than 50 miles = 1.

For animals and human foot traffic, less than 0.5 mile = 4;
0.5 to 1 mile = 2;
greater than 1 mile = 1.

Effectiveness of management techniques applied to prevent spread or prevent establishment of *P. lateralis* in new areas. A number of management techniques are recommended for preventing spread of PL or protecting uninfested areas (Betlejewski 1994; Goheen et al. 1997; Goheen et al. 2000a; Hadfield et al. 1986; Hansen et al. 2000; Hansen and Lewis 1997; Kliejunas 1994; Roth et al. 1987). Techniques considered for use in the EIS for managing POC root disease include:

a) Limiting activities to the dry season;
b) ceasing operations during significant rain events that happen during the dry season;
c) planning activities so that uninfested sites are accessed before infested sites;
d) using uninfested or treated water;
e) road management measures, especially improving road surfaces and drainage;

f) featuring POC on low-risk sites;
g) public information efforts;
h) prohibiting or regulating bough collecting and other special forest product harvests;
i) use of lowest risk logging systems in harvest operations;
j) vehicle washing;
k) roadside sanitation treatments;
l) seasonal road closures; and
m) permanent road closures or refraining from building roads into uninfested areas at all.

Virtually all of these techniques were originally suggested by Roth et al. (1957, 1972, 1987). Long-term observations (over 40 years in the case of Roth, a very active Oregon State University professor and PL researcher) suggested that no technique completely eliminated all possibility of PL spread, but that the ones listed did reduce probability of spread to varying degrees depending on how they were applied and what conditions prevailed at the time. It was suggested that most of the techniques should be used with others in integrated disease management strategies for best results. Unfortunately, PL is quite difficult to work with and definitive studies showing exactly how treatments effect actual PL inoculum loads have rarely been done.

Two types of effectiveness monitoring have been conducted with POC root disease: (1) field observations in and around treatment areas, and (2) use of POC seedling baits to determine occurrence and location of PL inoculum.

1) *Field observation over time on sites in and around project areas where treatments have been conducted:* A professional forester or forest technician visits the site several times to determine (a) if the prescription has been correctly implemented and (b) whether or not any evidence of POC mortality/PL infection has developed in or near the project area. Each project is given a rating of 1 to 5 for correct implementation after the project is complete. Each disease management technique is given a rating of 1 to 3 for effectiveness (1= not effective, 2= partially effective, 3= effective) based on combined results of root disease observations for all visits. The data below summarizes the average results for 70 multifaceted projects done on a variety of sites on the Siskiyou NF between 1994 and 1999.

Activity	Average Implementation Rating	Average Effectiveness Rating
Temporary road closures	4.4	2.5
Roadside sanitation	4.7	2.9
Vehicle washing	4.9	2.9
Dry season operations	4.3	2.9
Access avoiding infested areas	4.6	2.9
Entering units in priority	4.4	2.9
Minimizing risk by road location	4.6	2.4
Improving road surfaces	3.9	2.4
Directing water off roads	5.0	2.5
Preventing deposit of soil waste in uninfested areas	4.5	2.3
Dry season road maintenance and construction	4.5	2.9
Avoiding use of infested water sources	3.8	2.4

Results suggest that POC management activities in these prescriptions were usually implemented as planned and were perceived to be effective in many cases based on apparent lack of new infections observed in and around the project areas. Limiting project activities to dry seasons, planning access to avoid infested areas, entering uninfested areas before infested areas, vehicle washing, roadside sanitation, and limiting road construction and maintenance to dry seasons were deemed most effective of the kinds of activities evaluated. In most of the projects, several management techniques were used together. Apparent effectiveness may have been due more to the combined effects of several than to the individual treatments.

2) *More intensive evaluations that monitor actual PL occurrence by use of POC seedling baits to determine presence of the pathogen:* Unfortunately, in spite of considerable research, no accurate, easy, and quick soil assay technique for PL has been devised that can be used in the field. A baiting technique using POC seedlings has been developed and used by the Southwest Oregon Forest Insect and Disease Service Center. The baiting technique is fairly laborious. It takes about a month and a half for each reading and requires access to a laboratory for culturing to confirm presence of the pathogen. The baiting technique is being used to investigate effectiveness of two commonly employed but controversial POC management techniques: washing and roadside sanitation.

Goheen et al. (2000) compared PL inoculum levels on a large piece of equipment, a pickup truck, and a person's boots before and after an operational washing treatment. A road grader, a pickup, and a person wearing boots passed through a muddy PL infested area, were washed, proceeded further up the road, and were washed again. Water from each washing was collected in tubs and was baited with POC seedlings. After 6 weeks exposure, seedlings with their roots in the water from the first wash of the road grader exhibited an average infection level of 27.8 percent, those from the pickup, 41.2 percent, and those from the boots, 65.0 per cent. Seedlings with their roots in the water from the second wash exhibited average infection levels of 2.2 percent for the road grader, 3.7 percent for the pickup, and 2.5 percent for the boots. Decreases in the percent of infected bait seedlings observed in the second wash were attributed to removal of inoculum by the first wash. Based on the results, the investigators suggested that: (a) washing did have the potential to decrease inoculum on contaminated vehicles or boots, (b) washing did not necessarily eliminate all inoculum, suggesting that the treatment should be combined with other treatments in a comprehensive disease management strategy, (c) contrary to a generally held belief at the time, washing boots as well as vehicles might be an important disease management technique in some situations, and (d) the logistics of vehicle washing need to be carefully considered (though potentially effective in reducing inoculum, washing needs to be done in the right places and in the right kind of washing stations, for example). In addition to showing differences associated with washing, this case study demonstrated through actual sampling and pathogen reisolation that PL inoculum can indeed be picked up on vehicles and feet and carried from an infested site to another location. Though this has long been assumed to be true based on numerous observations, it had not been demonstrated conclusively in the past.

Goheen and Marshall (Goheen, D.J., *personal communicaation*) have an evaluation in progress to monitor the effects of operational roadside sanitation treatments on inoculum levels in already infested areas. The evaluation has not yet been completed; it is planned to be continued until all sample units are followed for 10 years, but results so far are illustrative. Twelve PL infested roadside strips that have received sanitation treatments have been monitored by planting 100 POC seedlings in 10 transects as baits at each site. Each spring, seedlings have been planted in the same locations along transects, collected after 6 weeks, and assayed for infection. Preliminary results show the following average percentages of infected bait trees for the 12 sample areas:

Year	0	1	2	3	4	5	6	7	8
% infested	20	13	12	11	6	5	1	3	3

Based on these preliminary results, the investigators suggest that: (a) sanitation treatments in infested areas do cause decreases in roadside inoculum; (b) amount of inoculum decline increases with time after treatment, declining substantially after 4 years; (c) sanitation treatments should be used in integrated strategies with other kinds of disease management techniques; (d) use of roadside sanitation (at least in the case of treatments in already infested areas) should be done strategically. Sanitizing a road into a project area (in already infested stands) where activities are occurring at the same time or immediately after the sanitation treatment are not likely to be valuable. The best approach will involve sanitation treatments on major roads that have the potential to be used in many projects over substantial time periods and that also are frequently traveled by other forest users besides those actually involved in the agency projects, and (e) sanitation treatments need to be kept track of and repeated when new POC regeneration becomes established.

Some estimated probabilities of successful PL spread and establishment when certain management activities have been used include:

Exclusion — This involves protecting uninfested areas by excluding vehicle entry. It can be done by permanently closing existing roads and/or by not building roads into uninfested drainages or upper portions of drainages. Cross-country travel or trail use by animals or humans on foot or in off-highway vehicles can still result in introductions, but probability is low, especially if the distance to the closest infested area is greater than 1 mile. This is believed to be the single most effective treatment, and suggested probability figure if this management approach is used is 1.

Temporary road closure — This involves closing roads with gates or barriers to regulate timing and amount of use. Roads are closed when weather conditions are favorable for PL spread and may be open during other seasons of the year. Gates can be driven around, forced open, or destroyed by vandals, but many remain intact and prevent road use. In a sampling of gated closures done by the Southwest Oregon Forest Insect and Disease Service Center in November of 2000, 90 percent were intact and apparently effective in preventing entry. The suggested probability that a currently uninfested area will be protected if this management approach is used is 2.

Washing — This involves washing vehicles used in projects to remove infested soil before they are moved out of an infested area or before they are moved into an uninfested area. In some instances, tools and boots are also washed. Limitations on washing include the possibility of picking up new inoculum on an infested road after washing, and the inability of the Agencies to require vehicle washing of numerous vehicles that use the roads, but are not controlled by the Agencies. The suggested probability figure if this management approach is used by itself is 4.

Roadside sanitation — This treatment involves removing POC in buffer zones along both sides of roads. Objectives are either to (1) eliminate or minimize the amount of inoculum readily available for vehicle transport from already-infested roadsides, or (2) prevent/reduce new infections along roadsides in currently uninfested areas. The basis for this kind of treatment is the fact that PL only infects living POC roots (Zobel et al. 1985). PL can survive for a time in already infected roots after a POC dies, but it cannot colonize the roots of already dead POC. The objective of the treatment is to create a zone along roads where live POC roots are absent. The suggested probability figure to decrease inoculum if this management approach alone is used on already infested roads is initially 8, dropping to 5 in 4 years after the treatment. Probability can increase again if roadsides are not monitored and treated again when/if POC regenerates on the site. However, if POC exclusion is successfully carried out, the probability drops to 1 after 7 years.

Integrated management — Employing a planned combination of treatments can reduce probability of long-distance spread more than single kinds of treatment. An integrated treatment program that uses a combination of sanitation treatments, vehicle washing treatments, road drainage improvements, timing of activities during dry seasons, using certified clean or Clorox bleach-treated water, scheduling treatments in uninfested before infested areas, regulation of special use activities such as cedar bough collecting, and public education efforts has a suggested probability of 2. If such treatments are combined with road closures, the suggested probability is 1. If combined with permanent road closure, probability by this system is 1, but protection is more effective than if only the closure by itself was used. Probabilities with an integrated management approach would be slightly higher in situations where some of the management techniques could not be used (for example, in a situation where a large wildfire was burning and safety and suppression success considerations prevented use of some of the techniques that might normally be used).

Character of site and stand conditions where the potential introduction event occurs. Introduction of inoculum and establishment of disease in a new, previously uninfested site is influenced by site characteristics as well as occurrence, numbers, and distribution of POC. If carriers deposit viable inoculum on a wet site with POC nearby, and when there are numerous additional cedars downslope in high-risk sites, probability of disease establishment is high. Clearly, depositing inoculum in sites with no POC and no mechanism for moving the inoculum to any POC is low (1). When inoculum is deposited along a road, probability is highest when there are wet conditions and at least some POC within 10 feet (8). When cedars occur more than 10 feet from the road, but less than 50 feet away, predicted probability drops to 4. When inoculum is introduced directly into water at a stream crossing or ditch, probability of establishment is high (8) if there are POC with their roots in water downstream within 50 feet. For similarly situated POC between 50 and 100 feet from the road, probability would be 4. Jules et al. (2002), in their dendrocronological study, indicated that there was evidence of initial infections as far as 525 feet down a stream; however, by the nature of their study, they were unable to evaluate small trees that had died many years before and were no longer detectable on the sites. It is possible that what they viewed as a single spore infection event actually was a several-stage event initially involving small trees closer to the road. Nevertheless, this suggests a probability of 2 for potential introductions in stream crossings if there are no POC in the first 100 feet, but cedars do occur in the subsequent 500 feet.

Number of potential transport and introduction events. The probability figures provided above can be used together to evaluate the relative likelihood of various long-distance PL spread/establishment scenarios involving individual potential carriers. The number of potential transporting events should also be taken into account when evaluating possibility of new introductions. Very low probability events become more likely to occur when they are repeated, and especially so if they are repeated many times.

No formula is suggested here for ranking activities or projects, although the general relationships and relative risks could be used to help guide future site-specific analyses, including use of the POC Risk Key that is a part of Alternatives 2, 3, and 6 in this SEIS. The concepts described above, coupled with known levels of activity (see Background and various Affected Environment sections), conditions on surrounding lands, and other factors described in the SEIS and its references, were designed to serve as part of the analysis needed to make predictions about disease spread for the alternatives considered in this SEIS.

Disease Progression Once the Pathogen is Introduced

Figure 3&4-1 shows the progression of POC root disease within a drainage after PL is introduced and becomes established.

The curve is a disease epidemic curve similar to those of many other plant diseases (Van der Plank 1975). PL is introduced at time 0. At least one POC is infected as a result of the introduction which involves infested soil falling off a vehicle or the feet of an animal or human.

Rate of disease increase is low at first (area *a* on diagram); there are relatively few spores produced because only one or a very few POC close to the site of introduction are infected. Inoculum production increases as more POC are infected (area *b* in diagram). Spore levels in water flowing downslope in drainages during the wet season and in streams increase to high levels. POC trees on high-risk sites downslope from the source of introduction are exposed to this inoculum, are infected, and produce more inoculum in turn. This leads to rapid spread and high levels of mortality of a large proportion of POC growing in the high-risk sites.

Eventually, amount of new mortality and rate of spread within the drainage decreases substantially (area *c* on diagram). Most original POC on the sites with characteristics favorable for the pathogen have been infected and killed by this time. Spread to POC growing on unfavorable sites is very slow and sporadic if it occurs at all (when it does happen it typically involves animals or humans moving infested soil directly onto the roots of individual POC trees during cool, rainy weather). Inoculum levels often remain high on the high-risk sites due to reseeding of POC and chronic infection of small trees.

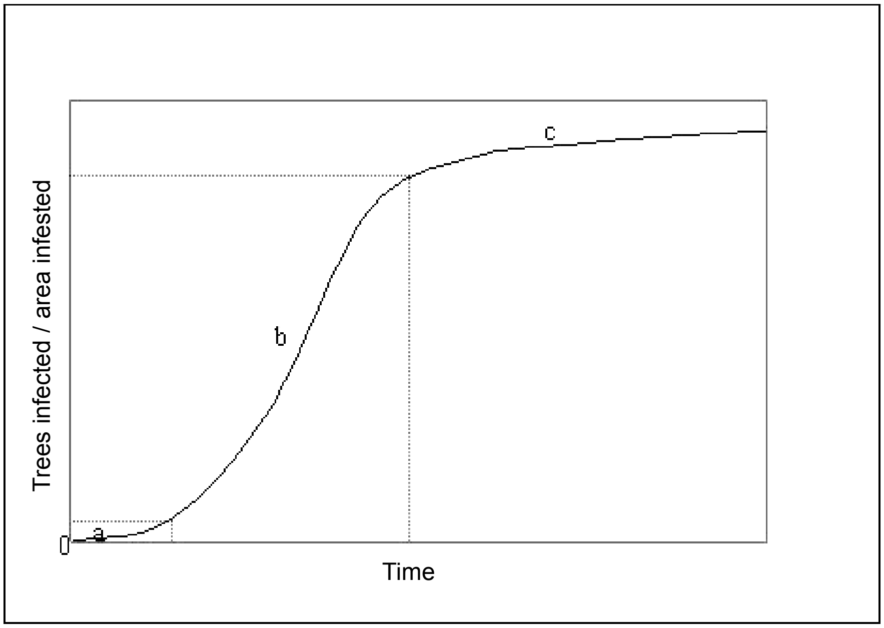

Figure 3&4-1.—*Progression of Port-Orford-cedar root disease within a drainage after* Phytophthera latralis *is introduced and becomes established*

Percent of trees infected at various points in Figure 3&4-1 are:

Stage	Time	% trees infected
a	2–10 years	<0.1
b	5–20 years	90 (high-risk sites)/0.1 per year (low-risk sites)
c	>20 years	Chronic infection/regeneration (high-risk sites)/0.1 per year (low-risk sites)

There are substantial differences in PL spread and impacts within infested drainages in different parts of the range of POC. These mainly reflect (1) different distributions of POC across the landscape in different areas; (2) different proportions of sites in different areas that have conditions favorable for spread and infection by PL (high-risk sites); (3) different histories of PL occurrence; and (4) different positions on the disease progression curve in different areas. Differences by major area or "risk regions" are discussed as follows.

North Coast Risk Region (Northern/Coastal Portion of Range: Siskiyou NF Powers Ranger District, and Coos Bay BLM District). POC is distributed widely across the landscape. On average 20 percent of the area is comprised of high-risk sites. The pathogen has been present in this area for considerable time. Mapping and forest inventories indicate that about 15 percent of the area (or 75 percent of the 20 percent in high-risk sites) is infested, and most drainages are at level *c* on the disease progression curve. Most originally-occurring cedars in infested high-risk sites have been killed (general estimate is 90 percent). There is chronic mortality of small cedars regenerating on high-risk sites that are infested. Low-risk sites (80 percent of the area) are little impacted. Non-Federal lands near Coos Bay contain thousands of roadside infections and approximately 8,500 acres of non-roadside infestation and represent a chronic source of PL for export to Federal and other lands here and throughout the range.

Siskiyou and Disjunct California Risk Regions (Southern Portion of Range on NFs: other districts on Siskiyou NF and districts on the Six Rivers, Klamath, and Shasta-Trinity NFs). POC occurrence is much more tied to riparian zones and wet areas here than is the case in the northern part of the range. On average, about 40 percent of the area is in high-risk sites. PL has not been present in this part of the range for as long as it has been further north. Mapping and forest inventories indicate that about 11 percent of the area (or nearly 28 percent of the 40 percent in high-risk sites) is infested. A substantial number of drainages, or the upper parts of drainages, have not had introductions of the pathogen. Some infested drainages, including major ones in the south, are still at level *b* on the disease progression curve and exhibit high levels of current infection. Ultimately, the amount of mortality in infested high-risk sites is predicted to reach the same levels observed in the northern part of the range. Some drainages are even at area *a* on the disease curve, such as the Lower Sacramento River and Scott Camp Creek drainages where PL infection has only been recently observed. These too will suffer high levels of mortality in high-risk sites unless eradication treatments prove successful.

Inland Siskiyou Risk Region (inland portion of range in Oregon, Medford, and Roseburg BLM Districts). The discussion for this area is similar to that for the southern part of the range on FS land, except that on average about 60 percent of this area is in high-risk sites (the larger number reflects contribution of higher road density to risk, coupled with the occurrence of POC here being mostly tied to creeks and wet areas). Mapping and forest inventories indicate about 9 percent of this area is infested. Position of infested drainages on the disease progress curve are divided between *b* and *c*.

Effects of Alternatives

Introduction

PL does not threaten POC with extirpation. Considerable areas within the range of POC are on low-risk sites or in drainages that presently remain uninfested. Some estimates of current proportion of area within the range of the POC on Federal lands where uninfected POC occur include 91 percent from the mapping exercise done by the FS and BLM for the recent POC range-wide assessment, 89 percent for FS lands in California based on plant association mapping (Jimerson, T.M., *unpublished data*), and the same figure for CVS data, and 76 percent for large trees based on inventory data for Federal lands in Oregon (from Table 3&4-6). Projections later in this section begin with a possibly conservative 87 percent uninfested for Federal POC stands in Oregon.

There is little spread of PL on low-risk sites even when the pathogen is already established nearby. It is estimated that on average, 0.1 percent of the cedars on low-risk sites are infested per year in infested drainages, with much of this likely being offset by regeneration and growth, at least in the smaller size classes. The low level of new infestations on low-risk sites even in the North Coast Risk Region supports this conclusion. About 80 percent of the area in the northern coastal portion of POC range, 60 percent in the southern part of the range, and 40 percent in the inland portion of the range are in low-risk sites.

PL primarily affects high-risk sites, especially in streams and riparian areas. Within these areas that are especially favorable for spread and infestation by PL, it is estimated that on average 90 percent of the POC present before introduction are killed by the pathogen, usually in only a few years after the pathogen is established (5 to 20 years; usually closer to the shorter end of this range). About 20 percent of the area in the northern coastal portion of POC range, 40 percent in the southern part of the range, and 60 percent in the inland portion of the range are in high-risk sites. Large cedars are especially prone to infection and mortality on these sites. Natural reseeding maintains POC at some level on many of these sites, but chronic infestation insures that few if any of the cedars regenerating on an infested high-risk site attain large size.

To maintain POC in high-risk sites requires either:

1) Excluding PL from being introduced into the area in the first place;

2) deployment of disease resistant POC planting stock (assuming that durable resistance can be developed, it will still take many years to replace large trees); or

3) reestablishing cedar after eradicating PL from infested sites (a difficult and problematic approach that also results in the loss of the large cedars at the time of treatment).

Port-Orford-Cedar Root Disease and the Alternatives Considered in the SEIS

Low-risk sites. Low-risk sites are defined for the EIS as those sites that do not fit the criteria for high-risk sites. They are upland sites, sites on convex slopes, sites above the high watermarks of streams, and areas away from roads where topography provides a high degree of protection from a soil- and water-borne pathogen like PL. Many observers have reported that amount of mortality attributed to PL on low-risk sites is very low indeed or sometimes appears to be absent (Goheen et al. 2000a; Hansen et al. 2000; Harvey et al. 1985; Kliejunas 1994; Roth et al. 1987; Zobel et al. 1985). Unfortunately, there are no published studies that have evaluated the amount of POC mortality on low-risk sites. The infestation figure of 0.1 percent per year is based on personal observations of the Agency pathologists, and it is meant to be an average.

There is variation in amount of mortality on low-risk sites. Higher levels of infection occur in the portions of low-risk sites that are close to infested high-risk sites than in low-risk areas at considerable distances from infested areas. SEIS Alternatives 1, 2, 3, and 6 would reduce roadside inoculum to varying degrees and would regulate or curtail human activity associated with bough collecting and harvest of other forest products. Probability of PL-caused mortality in low-risk sites would be slightly less under these alternatives than under Alternatives 4 and 5. Under all alternatives, however, infection levels on low-risk sites would be very low, especially so in comparison with levels on high-risk areas.

High-risk sites. Establishment, spread, and effects of the root disease on the existing POC in high-risk sites that have not yet been infested is likely to differ substantially with the alternative chosen. When PL is established in a formerly uninfested drainage or portion of a drainage, rapid disease spread and 90 percent mortality of the existing POC growing in downslope high-risk sites can be expected in the subsequent 5 to 20 years.

The percentages used in the SEIS to represent impacts over 100 years under the different alternatives (Table 3&4-8) are professional estimates made by FS pathologists with considerable experience with PL and input from forest pathologists from the Oregon Department of

Table 3&4-8.—*Percent of currently healthy drainages [uninfested high-risk areas] predicted to become infested within 100 years by alternative*

Alternative	% uninfested high-risk areas to become infested
1	40
2	30
3	20
4	80
5	80
6	18

Forestry and Oregon State University. As 100-year projections involving consideration of many highly variable factors, no claim is made that they are absolutely precise. They provide, however, a reasonable estimate of the impacts associated with each of the alternatives in terms of ranking and magnitude, and provide a realistic framework for comparing alternatives.

The following assumptions were made in arriving at these estimates:

1) PL will continue to act as it has in the first 50 years of its presence in the range of POC.

2) The same kinds of spread scenarios and the same kinds of associated transport and establishment probabilities will exist in the next 100 years.

3) Overall activity levels in the forest by humans and animals will remain similar to the levels of today. (Though there will probably be offsetting shifts in the relative levels associated with different kinds of activities. Some argue that harvest and other management activities will never begin to match the levels of the 1980s, while others argue that off-highway vehicle technology and other uses will reach levels and areas far beyond previous levels.)

4) The Federal agencies will continue to be involved in a variety of management activities on the lands they administer (though the proportions of Federal projects in different categories may change).

5) The de facto protection provided by reserve and other land allocations on Federal lands will remain in place.

6) Private forest lands within the range of POC will continue to be managed primarily for forest products.

7) Few significant attempts will be made to limit spread and intensification of PL on private lands.

Cumulative Effects

It is important to note that other sections of this chapter describe the nature and extent of forest activities known to contribute to the spread of PL. The Timber Harvest section specifically addresses the general number and origin of log trucks and other equipment, and the movement of logs within the range. Recreation uses, the collection of forest products, and other uses are also described. These and other uses involve people who move from place to place, sometimes over long distances and in a single day. These activities are taken into account in the pathologists' predictions of spread, both spatially and over time. The projections of disease spread for each alternative are the cumulative effect on PL of all expected management activities both on the Agencies' lands and off, as affected by the Standards and Guidelines of the various alternatives.

The individual resource areas discussed in Chapter 3&4 came directly from the Issues identified in Chapter 1, from suggestions received during scoping, and received during the public comment period, and attempt to cover all major forest management activities potentially having a significant influence on the spread of PL. To complete this coverage, a discussion of the potential effects (to POC) of Grazing and of Mining has been added to the final SEIS in response to public comment. The Affected Environment discussions included in the SEIS for various management activities like Timber Harvest, Special Forest Products, and Recreation help provide the setting upon which the 100-year PL spread predictions are based. A multitude of other activities also occur on the federally administered lands within the range of POC that do not rise to the level of individual discussion, but these activities were nonetheless considered in the calculation of 100 year PL spread. These activities would be also subject to the Standards and Guidelines of the selected alternative. Rationale for 100-year infestation predictions made for each alternative follow.

Alternative 1

Alternative 1 retains the current, pre-SEIS management direction for POC. Project-specific analyses are used to determine appropriate treatments or mixes of treatments. Evaluation of this alternative considers: (1) kinds and numbers of projects that are likely to be done within the analysis area in the next 100 years, (2) kinds of POC management treatments and combinations of treatments that would likely be used, (3) how effective these treatments and combinations of treatments are likely to be at decreasing probability of PL spread, and (4) variability in project design and implementation. It is assumed the agencies would continue to carry out projects through the next 100 years (though there probably would be more restoration and forest health projects and fewer and less intensive timber extraction projects) and that the overall level of vehicle use would be about the same as it has been in the first 50 years of PL's occurrence in the native range (though a greater proportion of it would involve vehicles of recreationists and small forest product entrepreneurs rather than timber harvest equipment). Predictions here consider experience working with projects in the last 15 years during which this same POC management direction has been in place. POC management under Alternative 1 would continue to involve use of a number of techniques separately or more often in combinations. Techniques used would be:

a) Limiting activities to the dry season;
b) ceasing operations during significant rain events during the dry season;
c) planning activities so that uninfested sites are accessed before infested sites;
d) using uninfested or treated water;
e) road management measures, especially improving road surfaces and drainage;
f) featuring POC on low-risk sites;
g) public information efforts;
h) prohibiting or regulating bough collecting and other special forest product operations;
i) use of lowest-risk logging systems;

j) vehicle washing;
k) roadside sanitation treatments;
l) seasonal road closures; and
m) permanent road closures or decisions not to build roads at all into uninfested areas.

Though not as consistently effective as total exclusion of vehicles over entire areas, strategies involving the treatments described are effective in decreasing likelihood of spread of PL and are particularly likely to be effective in reducing inoculum and likelihood of spread when used in appropriate combinations. A weak point of Alternative 1 is its lack of a systematic way to evaluate risk and determine where to use mitigation treatments. There is wide variation in how managers approach risk assessment and POC management design in their local projects today, and this would be expected to continue in the future under this alternative. Considering all of the above, Alternative 1 is predicted to result in much better protection for uninfested high-risk sites than if either Alternatives 4 or 5 were in effect, but less protection than would be afforded by Alternatives 2, 3, or 6. It is predicted that under Alternative 1, 40 percent of the currently uninfested high-risk areas would likely be infested in the next 100 years.

Alternative 2

Alternative 2 provides a POC Risk Key for managers to use in determining where risk reduction or mitigation treatments should be applied. Managers are required to go directly to step 2 in the key when planning projects in any of the 162 currently unifested 7th field watersheds with more than 100 acres of POC on Federal land (the same areas with POC cores and buffers identified in Alternative 6). The array of POC management techniques available for use under this alternative is the same as that considered under Alternative 1. The main differences are that under Alternative 2, risk determination would be done in a systematic way by all Federal managers in all areas using the key, and risk reduction in the 162 uninfested 7th field watersheds would receive special emphasis. Use of the key requires the managers to develop a strategy for each project that addresses risk of infection to uninfected POC that are within, near, or downstream from the project area and have important ecological, Tribal, or product use or function, or that if they became infected could spread inoculum to other POC that have important ecological, Tribal, or product use or function. Use of the key would improve protection over that provided under Alternative 1 by providing greater consistency in risk rating and planning and would result in POC management strategies that would include more consistently effective combinations of treatments. It would not provide as effective protection as Alternatives 3 or 6. It is predicted that under Alternative 2, 30 percent of the currently uninfested high-risk areas would likely be infested in the next 100 years.

Alternatives 1, 2, 3, 6, and 4 to a greater degree, and Alternative 5 to a lesser degree, have provisions for deployment of PL-resistant POC planting stock. The first four alternatives also emphasize resistance breeding to varying degrees with Alternative 4, especially stressing an accelerated breeding effort. If POC stock with durable, long-term resistance becomes available, high-risk sites where most of the cedar has been killed in the past, as well as high-risk sites that become infested in the future, can be replanted with resistant trees. Development and deployment of genetically resistant stock has proven successful for maintaining hosts on sites favorable for infestation in cases involving other *Phytophthora*-caused plant diseases (Erwin and Ribeiro 1996; Umaerus et al. 1983). Differences in effects of selecting each of the six alternatives on development and deployment of resistant POC are addressed in the Genetics section of this document.

Alternatives 3 and 6

Selection of either Alternative 3 or 6 would lead to low probability of introduction of PL in a high percentage of large uninfested areas in the next 100 years. The rules for POC core areas identified in these two alternatives (road closures, no vehicles, no timber harvest) would provide effective protection to most of the uninfested areas where they are applied. Furthermore, POC core areas would be surrounded by buffer areas that would have limitations on vehicle entry as well. Among all POC management approaches, the most complete protection of yet uninfested high-risk areas results from exclusion of vehicle entry. Alternatives 3 and 6 would also each have a risk key that would guide management of POC outside of the POC core and buffer areas. This would result in systematic use of combinations of management activities that would reduce the amount of inoculum and probability of spread in these areas. The main difference between the two alternatives is that Alternative 3 has POC cores and buffers in 31 uninfested 6th field watersheds while alternative 6 has POC cores and buffers in 162 uninfested 7th field watersheds. The POC cores represent all POC in watersheds having at least 100 uninfested acres of POC in 6th and 7th field watersheds, respectively, in the overall area covered by the SEIS, except (in Alternative 6) for a very small number that are less than 50 percent on Federal land. Alternative 6 focuses on more and smaller uninfested watersheds than Alternative 3, and has the greatest area in POC core areas. The POC core areas under this alternative have a wider distribution across the range (thus probably incorporating more ecological and genetic diversity). Alternative 3 has a larger acreage of buffer area. Alternative 6 provides more protection for yet uninfested high-risk areas than any of the other alternatives under consideration, but it exceeds Alternative 3 only slightly. Although both of these alternatives would be very effective, no kind of treatment would be 100 percent effective in excluding all introductions of PL into high-risk areas over 100 years. In the past 50 years, there have been cases of PL introductions into remote, apparently unlikely areas. Also, under Alternatives 3 and 6, uninfested high-risk areas that have fewer than 100 acres of POC would not necessarily receive the same level of protection as those with 100 acres or greater. The risk key would be used to determine the management to be used in projects in these areas. Management would involve use of a variety of techniques aimed at decreasing probability of spread. Road closures and exclusion may be used, but would not always be mandated in these areas. Considering all of the above, it is predicted that 20 percent of currently uninfested high-risk areas would likely be infested in the next 100 years under Alternative 3, and 18 percent under Alternative 6.

Alternatives 4 and 5

The lack of protection provided in Alternatives 4 and 5 assures that if either is selected, a very large percentage of the remaining currently uninfested high-risk areas would become infested in the next 100 years. Alternatives 4 and 5 have no provisions for preventing spread of PL into uninfested areas. In the first 50 years of PL's presence in the natural range of POC, the pathogen was introduced into numerous high-risk sites, and all spread was from only one or a very few initial introduction points. In fact, during those first 50 years, PL impacted about 75 percent of the high-risk sites in the North Coast Risk Region, the area closest to where the original introduction or introductions occurred. During the next 100 years, PL would potentially spread from numerous existing infested areas that are now widely distributed through the range of POC in Oregon. A high percentage of the remaining uninfested high-risk sites are predicted to become infested under either Alternative 4 or 5, due to a substantial amount of vehicle activity, no attempts to manage spread, and a timeframe that is twice as long as that for which there is experience. Not all uninfested high-risk areas are predicted to become infested, however, because some are in very remote areas and/or in land allocations that allow little or no vehicle entry. There is, for example, indirect protection provided to uninfested high-risk sites as a result of being remote and in wilderness areas, research natural areas, or roadless Late-Successional Reserves. It is estimated this applies to about 20 percent of the uninfested high-risk areas. Considering all of the above, it is estimated that 80 percent of the currently uninfested high-risk areas in the range of POC in Oregon would likely be infested over the next 100 years under either Alternatives 4 or 5.

Risk of Long-Distance Spread

Even though probabilities are low and it was very unlikely to happen, there is evidence that PL has indeed been transported on occasion over particularly long distances (even over 50 road miles) and into areas that were thought to be unlikely candidates for infestation because of their remoteness. Disease establishment in the Little Chetco River in the Kalmiopsis Wilderness, along the Smith River Drainage, Lower Sacramento River Drainage, Potato Patch Creek, and Fish Lake are known examples. The latter three of these occurrences probably involved inoculum carried on vehicles driving or being transported on roads (in the Lower Sacramento River case, a piece of equipment that had been used in Oregon may have been responsible). The Smith River occurrence is believed to have involved travel by vehicle and on foot by cedar bough collectors, and the Chetco River case remains a mystery though it is next to a mining road and may have been associated with the mining activity (dredging).

There is a possibility that a small number of currently uninfested high-risk sites in California may be infested in the future as the result of inoculum transport from Federal lands in Oregon, even though the probability is much lower than the probability that new infestations in California could result from inoculum transport within California. The probability of spread from Oregon to California would be low under any of the alternatives considered in the SEIS. It would be higher under Alternatives 4 and 5 than under Alternatives 1, 2, 3, and 6. It is impossible to provide exact figures. However, given the fact that there have been four documented cases of long-distance transmission in California in the last 25 years (Smith River, Potato Patch Creek, Fish Lake Creek, and the lower Sacramento River), additional long-distance spreads are likely to happen under any alternative, and each would have the potential to open the disease to a large, currently uninfested area. The Disease Export provision of Alternatives 2, 3, and 6, among others, reduces this likelihood.

Long-Term Mortality

Using the percent mortality predictions shown in Table 3&4-8, and the mortality information in Tables 3&4-5 and 3&4-6 for current POC, the acres and overall percentage of POC expected to survive at the landscape scale can be calculated for each alternative. While the effects of long-term mortality are not evenly distributed over the landscape, and may impact some habitats more than others, it is a useful consideration for some impacted resources. How the calculations are derived from those tables necessitates some explanation. The calculations just include Oregon, since that is the area directly affected by the alternatives.

For comparison of data and further discussion, portions of Table 3&4-5 and Table 3&4-6 have been combined into Table 3&4-9.

In this case, the CVS numbers for trees are considered a more accurate statistical measure of the POC tree population and mortality than GIS. GIS is primarily designed to give spatial representations of data, while CVS is, by design, a population sampling scheme. The GIS maps may have two sources of bias: Smaller (less than 7 inches diameter at breast height) infected trees are difficult to detect on aerial photos in the dense forests on the North Coast; and, mapping in the southeast part of the range is done at stand levels, while POC may be confined to wet areas within the stands. Given some of the inherent overestimates and underestimates of the GIS mapping data, the CVS percent mortality calculation is considered more useful for projecting the long-term POC mortality in each region for each alternative. Using 15 percent mortality for the North Coast Risk Region, 11 percent for the Siskiyou Risk Region, and 9 percent for the Inland Siskiyou Risk Region, assuming this mortality is virtually all on high-risk sites, and applying the pathology predictions contained in Table 3&4-8 to remaining uninfested sites, long-term (100 year) POC infestation rates can be projected for Oregon (Table 3&4-10).

The total area predicted to be infested at 100 years varies between 16 and 30 percent (from 13 percent today) depending upon alternative (Table 3&4-10, shaded column). The percent of high-risk areas predicted to be infested in 100 years is also displayed on Table 3&4-10 because some effects, such as water temperature, are dependent more on the percent of PL infestation near streams than on the percent infestation for the entire landscape. The percent of high-risk areas predicted to be infested in 100 years varies between 50 and 90 percent (from 38 percent today), depending upon the alternative (Table 3&4-10, last column). In both cases, the 100-year infestation percentage varies by risk region.

Ultramafic Soils

Affected Environment

POC in southwest Oregon and northern California is found on soils developed in weathered materials from serpentinite and peridotite, both ultramafic igneous rocks (ultramafic igneous rocks are composed of dark, ferromagnesian minerals and often contain less than 45 percent silica) (Whittaker 1960). Soils of these landscapes are characterized by an abundance of iron, magnesium, chromium, nickel, cobalt, and manganese, relatively low silica and aluminum, and very low calcium that have been weathered from the dark, ferromagnesian minerals of serpentinite and peridotite (serpentinite is a rock consisting almost wholly of serpentine group minerals) (Burt et al. 2001; Proctor and Woodell 1975). Many forest species cannot

Table 3&4-9.—*Infested and infection estimates, Oregon*

	Geographic information system [acres]			Current vegetation survey
Risk regions	Uninfested	Infested	% infested	% infected
North Coast	118,825	7,560	6	15
Inland Siskiyou	27,555	1,782	6	9
Siskiyou	103,787	12,454	11	11
Total	250,167	21,796	8	13

Table 3&4-10.—*100-year infestation prediction for Oregon by alternative* [1]

Alternative	% of risk region high risk	Currently infested high-risk area [as % of risk region] [1]	Uninfested high-risk area [as % of risk region]	% of uninfested high-risk areas predicted to become infested [new] in 100 years [2]	Uninfested high-risk areas predicted to become infested [as % of risk region] [3]	Total [new and current] area to be infested in 100 years [as % of risk region]	Total [new and current] area to be infested in 100 years [in acres] [4]	Total [new and current] area to be infested in 100 years [as % of high-risk areas only]
North Coast Risk Region *[126,248 acres]*								
1	20	15	5	40	2	17	21,500	85
2	20	15	5	30	2	17	20,800	82
3	20	15	5	20	1	16	20,200	80
4 & 5	20	15	5	80	4	19	24,000	95
6	20	15	5	18	1	16	20,100	79
						[Current]	[18,900]	[75]
Siskiyou Risk Region *[116,374 acres]*								
1	40	11	31	40	12	23	27,200	58
2	40	11	31	30	9	20	23,600	51
3	40	11	31	20	6	17	20,000	43
4 & 5	40	11	31	80	25	36	41,700	89
6	40	11	31	18	6	17	19,300	41
						[Current]	[12,800]	[27]
Inland Siskiyou Risk Region *[29,341 acres]*								
1	60	9	51	40	20	29	8,600	49
2	60	9	51	30	15	24	7,100	40
3	60	9	51	20	10	19	5,600	32
4 & 5	60	9	51	80	41	50	14,600	83
6	60	9	51	18	9	18	5,300	30
						[Current]	[2,600]	[15]
Totals *[271,963 acres]*								
1	33	13	21	40	8	21	57,300	64
2	33	13	21	30	6	19	51,600	58
3	33	13	21	20	4	17	45,800	51
4 & 5	33	13	21	80	17	30	80,300	90
6	33	13	21	18	4	16	44,700	50
						[Current]	[34,400]	[38]

[1] Projected infestation is assumed to be within the high-risk areas; does not include estimated 0.1% per year on low-risk sites, much of which is offset by regeneration and growth.
[2] From Table 3&4-6.
[3] Previous two columns multiplied together.
[4] Mortality in infested areas is expected to be about 90%; table does not include replacement with resistant stock.

tolerate the mix of chemicals and clays presented by these soils. Calcium to magnesium ratios that are often less than 1 eliminate or reduce the growth of many plants. Low amounts of phosphorus, potassium and nitrogen are difficult for other species to tolerate. Finally, high amounts of plant-available iron, chromium, nickel, cobalt and manganese have been shown to be toxic to many plants (Kruckeberg 1984; Alexander et al. 1990; Whittaker 1960). Interestingly, there is a suite of endemic and uncommon plants that can grow, some thriving, on the ultramafic mix of soil chemicals (Proctor and Woodell 1975). POC is one of these plants.

While POC tolerates and sometimes thrives on ultramafic soils, it grows far better and larger on adjacent soils, and grows best on soils of sandstones, siltstones, metasediments, and granitics. On the ultramafic soils of southwest Oregon and northwestern California POC is found in riparian areas, near seeps and springs, and on north slopes. On drier sites it is commonly found in the company of Jeffrey pine, western white pine, Brewer's spruce, diminutive tanoak, diminutive Oregon myrtle (California laurel), huckleberry oak, western azalea, California coffeeberry, Saddler's oak, and red huckleberry to name a few trees and shrubs. POC trees larger than 15 to 16 inches diameter are often several hundred years old. While abundant near many seeps, springs, and streams, it is not found everywhere on the ultramafic landscapes.

Soil tests of ultramafic soils often reveal proportionately high calcium and magnesium in the organic (O) horizons. This has led some to speculate that POC has a unique relationship with calcium and in some way enriches the calcium content of the soil (Zobel et al. 1985). Others believe the effect of POC is small (Powers, R., *personal communication*). Data from the Curry County, Oregon, Soil Survey (Burt et al. 2001) suggest that exchangeable calcium and magnesium are high in the organic (O) layers of soils on ultramafic landscapes irrespective of the vegetation cover. Procter and Woodell (1975) have shown the complexities of the exchangeable calcium to magnesium ratio and the need for more research to show if POC and perhaps other plants possess a unique relationship with calcium and magnesium when grown on the ultramafic soils.

Effects of the Alternatives

There would be no known difference between the alternatives upon the status of the ultramafic soils or soil productivity. The range of mortality levels across the range of alternatives is expected to have a small effect on unstable soils, largely mitigated by ingrowth of brushy species and, to some degree, other tree species (see Ecology section). The indirect impact of POC mortality on streambank stability is discussed in the Water and Fisheries section.

Ecology and Plant Associations

Affected Environment

Introduction

POC is found from southwestern Oregon to northwestern California, primarily in the Coast Ranges and Siskiyou and Klamath Mountains, with a small disjunct population in the Scott Mountains of California (Figure 1-1).

The following discussion of the affected environment is organized at two scales: the local scale of plant associations (grouped here for clarity), and the broad landscapes of ecosystems. Organizing affected environments at multiple scales has proven a useful analysis tool, because it more fully captures the range of environmental diversity and ecosystem functions.

Local Scale

Although POC has a narrow geographic range, it occupies many different environments. The species is found at elevations from sea level to 6,400 feet, in glacial basins, along streams, on terraces, and on mountain side-slopes from lower to upper one-third slope positions. POC shows adaptability to a wide range of summer evapotranspiration stress, from very high humidities along the coast to very low summer humidities inland. Soils where POC is found are derived from many parent materials, including sandstone, schist, phyllite, granite, diorite, gabbro, serpentine, peridotite, and volcanics.

Of these, serpentine- and peridotite-generated soils form a distinct group known as ultramafics. Ultramafics are generally droughty environments distinguished by a soil imbalance of the magnesium-to-calcium ratio—an environment associated with rare plant species. POC is among the few tree species that can grow on these soils; in some cases it is the only tree species tolerating this peculiar environment.

POC plant associations, therefore, characterize the broad range of habitats in which POC is found. These plant communities display some of the richest plant species diversity of all forest types in the region (Jimerson and Creasy 1991).

POC can be found among a variety of species with differing ecological requirements. These species differ across the range of POC. For instance, in the northwestern portion of the range, POC is found in association with western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), in the southwest with coastal redwood (*Sequoia sempervirens* (D. Don) Endl.) and tanoak (*Lithocarpus densiflora* (H. & A.) Rehd.), in the central portion with Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco.), and at higher elevations in the eastern portion of its range with white fir (*Abies concolor* (Gord. & Glend.) Lindl.), western white pine (*Pinus monticola* Dougl.), Shasta red fir (*Abies magnifica* var. *shastensis*) and mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.). POC has been noted as a major or prominent component of 90 plant associations in Oregon and California (Atzet et al. 1996; Jimerson and Daniel 1994; Jimerson et al. 1995; Jimerson et al. 1996; Jimerson and Creasy 1997).

The estimate of 306,781 acres of POC occurring throughout its range was derived using GIS mapping of all stands containing POC regardless of stocking level. This section of the SEIS, however, focuses on the 64 plant associations where POC is prominent (*prominent* in this sense means occurring in the name of the plant association) in the overstory (Atzet et al. 1996; Jimerson and Daniel 1994; Jimerson et al. 1995; Jimerson et al. 1996; Jimerson and Creasy 1997; Jimerson 2003). This includes all 59 POC plant associations (those with POC in their name), and as well as five others where POC is common (not occurring in the plant association name, but occurring in the overstory data for a plant association at least 20 percent of the time). The area covered by these plant associations is approximately 104,200 acres, or about 34 percent of the total mapped POC acres. Unless otherwise noted, discussion in this section covers only those acres, a subset of the total range of POC.

Ecoregions/Subsections

The wide ecological amplitude of POC is also reflected in the broad ecoregions and subsections in which it is distributed. At this scale, climate and geomorphology, rather than vegetation or soils, are the primary environmental variables used to delineate ecological units (McNab and Avers 1994; Jimerson 2003; Winthers et al. 2003).

Two types of ecological units were used to describe the distribution of POC, level IV ecoregions in Oregon (USEPA 1998) and subsections in California (USDA 1997). These are the lowest division of regional ecosystems mapped in the two states. Ecoregions and subsections are configured and delineated differently because they are based on two different methods of mapping ecosystems. Land use or human disturbance is used as a factor in separating ecoregions (USEPA 1998), while subsections are separated by differences in attributes of the environment (Winthers et al. 2003). The ecoregions and subsections are shown on Map 4 and characterized in the following section. ***Note:*** In the discussion that follows, the ecoregions/subsections section have been grouped into six larger geographic areas. In the tables used in this section, the North Inland and Mid-Range areas are split into their Oregon and California portions in order to clarify the areas that would be affected by implementation of the alternatives. In these tables, there are therefore eight columns (or rows) for the areas, rather than six.

Northern Coast Geographic Area

Mid-Coastal Sedimentary and Southern Oregon Coastal Mountains Ecoregions. The Northern Coast Geographic Area is composed of the Mid-Coastal Sedimentary and Southern Oregon Coastal Mountains Ecoregions. Part of the Oregon Coast Range, these ecoregions are in low elevation mountains with high rainfall and dense coniferous forests. The area has moderately sloping, dissected mountains and sinuous streams. The most important characteristic in terms of species composition is the occurrence of western hemlock as a dominant or codominant species. Ten plant associations with POC were identified in these ecoregions, and five were found only in these ecoregions.

North Inland Geographic Area

Inland Siskiyous and Siskiyou Mountains Ecoregions. The Inland Siskiyous and Siskiyou Mountains Ecoregions form this geographic area. This area has higher, steeper terrain than the others. The North Inland has a high diversity of conditions, which is reflected in the vegetation. The vegetation is dominated by the Douglas-fir Series at low elevations, Jeffrey Pine Series on ultramafic soils, and White Fir and Shasta Red Fir Series at higher elevations. Sixty-two plant associations with POC were identified in this ecoregion and subsection, and many are exclusive or have their greatest extent here.

Mid-Coast Geographic Area

Coastal Siskiyous Ecoregion. This geographic area is located in Oregon and features highly dissected mountains and high gradient streams, as well as a few, small, alpine glacial lakes. The climate is wetter with more maritime influence than elsewhere in the Klamath Mountains Bioregion, but drier than the Northern Coast. This area has tanoak, Douglas-fir, and some POC. Western hemlock is less well represented here than in the Northern Coast. Nine plant associations that contain POC were identified in this ecoregion, with a high frequency of plant associations on serpentine soils.

Mid-Range Geographic Area

The Serpentine Siskiyous/Gasquet Mountain Ultramafics Ecoregion. This ecoregion is dominated by the Tanoak-Port-Orford-cedar Subseries (POC is codominant with tanoak). In Oregon, the White Fir Series and the Port-Orford-cedar-White Fir Subseries are fairly common and occur at relatively high elevations (up to 4,800 feet) and a long distance inland (up to 45 miles). The Port-Orford-cedar-Douglas-fir and Port-Orford-cedar-Western White Pine Subseries are more common in California, the latter being correlated with ultramafic rock. This ecoregion is highly diverse.

The Western Jurassic Subsection. Marine air moderates temperatures in the western portion of this subsection creating a temperate to humid climate. The Douglas-fir and Tanoak Series dominate this subsection. Twenty-two plant associations with POC are described in this subsection, none are found only here. This subsection has the second highest amount of POC of all subsections in Northern California.

Note: In the discussion and tables presented in this document, the Mid-Range and North Inland Geographic Areas are separated into Oregon and California components so that the effects of the alternatives are more clearly presented.

East Disjunct California Geographic Area

Some of the POC plant associations in East Disjunct California are found nowhere else.

Eastern Klamath Mountains. This subsection is located on the farthest southeastern corner of the Klamath Mountains. It has two plant associations with POC; neither is unique to this subsection.

Lower Scott Mountains. This subsection comprises the low elevation portion of the Eastern Klamath geologic belt of the Klamath Mountains. Ultramafic rocks of the Trinity Terrane and intrusions of granitic rocks dominate the geology of this area. The Jeffrey Pine, Ponderosa Pine, White Fir, and Douglas-fir Series are the dominant vegetation in this subsection. Five POC plant associations are present.

Upper Scott Mountains. This subsection comprises the high elevation portion of the Eastern Klamath geologic belt of the Klamath Mountains. The geology is the same as the Lower Scott Mountains Subsection. Thirteen plant associations with POC are found here, seven are unique to this subsection, and three additional POC plant associations are predominantly found here.

Southern Range Geographic Area

POC occurs only along the border of these subsections with the Mid-Range and North Inland Geographic Areas.

The Eastern Franciscan. The Eastern Franciscan Subsection represents the high elevation portion of the northern California Coast Ranges. There are 16 POC plant associations in this subsection. None of the plant associations are unique to the subsection, and most are extensions of what is found in the Gasquet Mountain Ultramafics, Western Jurassic, and Siskiyou Mountain Ecoregions and Subsections.

Pelletreau Ridge. This subsection is a narrow, arcuate strip of land along the southwest edge of the Klamath Mountains. POC stands here are 20 miles south and 50 miles west of the nearest other stands of POC, although there are no unique plant associations here. The vegetation in this region is dominated by Douglas-fir and Tanoak Series, with White Fir Series at higher elevations (Miles and Goudey 1997).

Rattlesnake Creek. This is an arcuate subsection within the Western Paleozoic and Triassic Belts of the Klamath Mountains. The Douglas-fir, White Fir, and Ponderosa Pine Series dominate this subsection, with Jeffrey Pine Series on serpentinized peridotite (Miles and Goudey 1997). This subsection has a very small amount of POC. There are no POC plant associations that are unique or reach their greatest extent here.

Ecosystem Functions of Port-Orford-Cedar

Biodiversity is the variety of life and its processes. This section discusses these processes; the next section focuses on the diversity of POC ecosystems.

The 64 documented plant associations with POC as a major component can be grouped by key ecosystem processes (Table 3&4-11). The first useful division is ultramafic versus nonultramafic soils. These can be further divided into riparian (adjacent to watercourses, including ephemeral streams) sites and upland sites. A summary of these plant association groups can be found in Table 3&4-11, and their estimated acreages in Table 3&4-12. Note that *plant association group* here is defined somewhat differently than in conventional plant association group maps. In the latter, plant association groups are grouped more as a unit of vegetation classification, and less by landforms/geology. Acreages were estimated overlaying the GIS map of POC locations with the ecoregions/subsections (Map 4), and then subtracting the areas where POC is not prominent in the overstory. The proportion of riparian versus upland plant association areas uses estimates developed by Don Goheen (see Relation of Environmental Processes to *Phytophthora lateralis* Infection section that follows), and the acreage of plant associations for ultramafic versus nonultramafic is based on the number of plant associations tallied.

POC comprises on average 35 to 50 percent of the overstory cover in plant associations where it is prominent in the overstory (Table 3&4-13). Usual cohorts on nonultramafic sites are Douglas-fir and tanoak, although red fir, incense cedar, western hemlock, or other species are also possible. On ultramafic sites, cohorts are usually limited to Jeffrey pine, tanoak, or western white pine. POC trees are very long lived. Jimerson and Daniel (1994) found an average age of 352 years on study plots, with most trees in the 326-to-425-year age-group. Disturbance (other than from PL) is from infrequent fire events, because of the continually wet environment.

Tree understory abundance of POC is generally low in northwestern California (averages 4 percent cover) and greater in southwestern Oregon (averages 31 percent cover). Abundance varies with available moisture, with greater cover in moister environments.

Ultramafic Functions

Ultramafic POC ecosystems make up varying portions of the seven geographic areas, ranging from 10 percent of the major POC plant associations in the Northern Coast Geographic Area to 75 percent of the Mid-Range Geographic Area (the primary ultramafic region) in both Oregon and California; and 76 percent of the Southern Range in California (Table 3&4-12).

Table 3&4-11.—*Average abundance [as indicated by percent cover] of Port-Orford-ceder in plant association groups where POC is prominent in the overstory*

Plant association group	% POC overstory cover	% total overstory cover	POC as % of total overstory cover	% POC understory cover	% total understory cover	POC as % of understory cover
Upland	27	78	27	15	27	56
Ultramafic upland	30	80	38	3	16	19
Riparian	37	87	43	4	14	29
Ultramafic riparian	37	74	50	6	15	40

Table 3&4-12.—*Estimated acreages of stands with Port-Orford-cedar prominent in the overstory and infested acres [in brackets] by geographic area and plant association group*[1]

	Geographic area							
	Oregon				California			
Plant association group	Northern Coast	Mid-Coast	Mid-Range	North Inland	North Inland	Mid-Range	Southern Range	Disjunct California
Upland [2]	26,400 [0]	6,000 [0]	2,300 [0]	6,500 [400]	800 [50]	600 [0]	100 [0]	200 [0]
Ultramafic upland [2]	3,000 [0]	7,300 [0]	7,100 [0]	3,200 [200]	2,500 [200]	2,700 [0]	900 [0]	0 [0]
High-risk riparian	6,600 [5,000]	4,000 [1,100]	1,600 [300]	4,800 [800]	1,150 [200]	1,150 [300]	350 [100]	140 [25]
High-risk ultramafic riparian	700 [500]	4,800 [1,300]	4,700 [1,400]	1,900 [400]	1,150 [150]	1,150 [300]	350 [100]	60 [25]
Total area infected [% infected]	5,500 15	2,400 11	1,700 11	1,800 11	600 11	600 11	200 9	50 9
Areas at high risk [3] [% high risk]	7,300 20	8,800 40	6,300 40	9,900 60	3,400 60	2,300 40	700 40	200 40
Area totals	36,700	22,100	15,700	16,400	5,600	5,600	1,700	400
Grand total								104,200

[1] See text for discussion of how acreages were estimated; grand total estimated area is 104,200 acres [34% of total acres with at least one POC]. Estimated total area at high risk is 38,900 acres [or 13% of the total area with at least one POC].
[2] Includes 4,400 acres high-risk upland in North Inland Geographic area.
[3] Includes infected area.

Table 3&4-13.—*Average abundance [as indicated by percent cover] of Port-Orford-cedar in plant association groups where Port-Orford-cedar is prominent in the ovestory*

Plant association group	% POC overstory cover	% total overstory cover	POC as % of total overstory cover	% POC understory cover	% total understory cover	POC as % of understory cover
Upland	27	78	35	15	27	56
Ultramafic upland	30	80	38	3	16	19
Riparian	37	87	43	4	14	29
Ultramafic riparian	37	74	50	6	15	40

POC on average makes up 38 percent of the overstory on ultramafic upland sites and 50 percent of ultramafic riparian sites (Table 3&4-13).

POC is associated with rare plants of ultramafic systems. Because it is often one of the few, or only tree species that can tolerate these sites, POC probably has a key role in maintaining their function through shading and stabilizing soils. At least one author reports that POC recycles calcium on these sites, making it more available to other species (Zobel et al. 1985).

POC lost to PL in riparian zones would gradually be replaced by those of other conifer species in some riparian areas, and not in others. Down wood recruitment of POC into streams would increase as areas become infested, because tree mortality would accelerate, but eventually be reduced in infested areas because large POC trees would eventually die out. Other species and POC above the high watermark would continue to contribute, however.

Riparian Functions

POC has a keystone role in many riparian ecosystems. Where present, it plays a role in maintenance of water quality. In some cases (particularly on ultramafic sites) it is the only tree species contributing to woody structure in streams; in others it occurs in a mix of species. Large conifer downed wood in the Smith River was found to provide much of the habitat complexity for amphibians and other organisms (Ollivier, L., *personal communication*). Presumably this is also true throughout the range of POC, where the species provides shade (and thereby lowers stream temperatures), and also provides bank stability, and when it dies and falls into the stream, aquatic structure. These factors are key elements of habitat for fish, amphibians, aquatic insects, and other organisms. Since POC is highly resistant to decay, it may be expected to have a longer residence time in streams than other associated conifers. This may be especially important on serpentine soils where POC may be the only, or most abundant, tree species growing on a site.

Fire and Port-Orford-Cedar

Most POC occur in a mixed-severity, moderate-frequency fire regime (USDA-FS 2003c). Over time fire will kill fair amounts of POC trees, such as in the Biscuit Fire of 2002. Although even as a pole-sized tree POC has fire-resistant bark; and Zobel et al. (1985) documented the fire resistance of the tree, recent fuels build-up places this (and other trees) at high risk to mortality from wildfire. Even though POC is often concentrated along streams, POC mortality in Biscuit mirrors the intense fire percentage for the fire area overall. Following fire, POC regenerates well near the coast, but is out-competed by Douglas-fir inland. Post-fire monitoring of the Biscuit Fire area is underway, including investigation of whether fire can sterilize soil sufficiently to kill PL.

Terrestrial Woody Material

In additional to its role in aquatic ecosystems, woody material also has a terrestrial role: it provides habitat for scores of animal species, notably insects; facilitates mycorrhizal development; and serves as a long-term nutrient source for soil development. Standing woody material (snags) provides habitat for some bird and mammal species. Woody material, both standing and down, also moderates the immediate microclimate by serving as a moisture source in warm, dry environments. This is important for the establishment of some species.

Natural (not infected with PL) snag and down wood levels for all species are presented in Table 3&4-14. Ultramafic sites showed the lowest density of snags. Upland nonultramafic sites had the greatest density of down wood. California sites (all associations combined) had the least amount of down wood, but the greatest amount of snags, perhaps because of their recent death from PL infection.

In California, the down wood was composed primarily of Douglas-fir and POC, with 13 additional species represented at low percentages. Oregon species composition is probably similar, except in the Coast Range, where western hemlock snags are prevalent.

Because of their resistance to decay, dead POC would be expected to remain in an ecosystem for a longer period of time than most other conifers when the frequency and extent of wildland fires are controlled. Because the wood is decay-resistant, woody material is expected to

Table 3&4-14.—*Snags and downed woody material by plant association group*[1]

Plant association group	Snags per acre	Woody material: Down wood [tons/acre]	Downed wood [pieces/acre >20" diameter]
Ultramafic upland	6	3	1
Upland cool, dry	26	42	27
Upland moist	23	57	18
California (all associations)	31	40	17

[1] Data are for Oregon unless other noted; data for riparian associations are not available; values are means.
Source: [USDA-FS and USDI-BLM 2003b]

persist longer than that of softer species. This makes their value in riparian zones persist over time, but also means they are less valuable than softer species for wildlife snags, because the harder wood means fewer wildlife cavity excavations.

Relation of Environmental Processes to *Phytophthora lateralis* Infection

Although POC occurs in a wide range of environments, the highest risk of infection is associated with wetlands and riparian zones. PL moves through water easily; on dry sites or in droughty conditions its spores lay dormant. The zone of high risk, however, is restricted to a narrow strip along streams affected by water level in the soil profile. Typically this is 10 to 25 feet on either side of the stream channel (see Pathology section for further discussion) POC growing in upland situations usually escapes infection even when the pathogen is established in nearby drainages or wetlands. In some cases, however, upland sites, when they are in lower or concave slope positions that collect water, can be considered high risk. This has been reflected in the description of effects that follows.

The Pathology section earlier in this chapter describes the percent of POC at high risk, and the 100-year infestation prediction by "risk region." The relationship of the geographic areas and ecoregions used in this section (Table 3&4-12) to the risk regions used in the Pathology section (Table 3&4-5) is shown in Table 3&4-15, by acres. The risk levels can be generally equated to the geographic areas and ecoregions as follows.

Northern Coast: POC is distributed widely across the landscape. High-risk portions of riparian zones comprise 20 percent of the area where POC is prominent. This area was infested beginning about 50 years ago; the pathogen is widespread, and the infestation rate has nearly stabilized. There are pockets of uninfected POC on high-risk sites (Betlejewski, F., *personal communication*; White, D.E., *personal communication*), but it seems only a matter of time before most are infected. Most original cedars in infested high-risk sites have been killed (general estimate is 90 percent). The rest of POC on this landscape (80 percent) can be considered upland, and at low risk.

Mid-Coast, Mid-Range in Oregon and California, Southern Range, and East Disjunct California. PL has not been here as long as in the North/Mid-Coast. Many POC areas, particularly those in the upper part of drainages, have not yet been infested. POC is more closely associated with riparian zones than in the northern part of its range.

North Inland (Siskiyou Mountains). Riparian areas cover about 44 percent of the POC area where POC is prominent in the overstory. A higher portion of this landscape is at risk,

Table 3&4-15.—*Relationship of Port-Orford-cedar geographic areas/ecoregions to risk regions [in acres] where Port-Orford-cedar is prominent in the overstory*

	Risk Regions [1]					
	Oregon			California		
Geographic area/ecoregion	North Coast	Siskiyou	Inland Siskiyou	Siskiyou	Disjunct California	Totals
Northern Coast						
Mid-Coastal Sedimentary	19,700	1,100	400			21,200
Southern Oregon Coastal Mountains	11,100	4,400				15,500
Total	30,800	5,500	400			36,700
North Inland						
Inland Siskiyous	100	4,700	7,400			12,300
Siskiyou Mountains		1,600	200	5,500		7,450
Umpqua Interior Foothills			200			200
Rogue/Illinois Valleys		50	100			200
Red Butte		1,000	800			1,700
Other	50	100		50		250
Total	200	7,450	8,700	5,600		22,000
Mid-Coast						
Coastal Siskiyous	900	18,500	2,700			22,100
Total	900	18,500	2,700			22,100
Mid-Range						
Serpentine Siskiyous		13,500	1,200			14,700
Gasquet Mountain Ultramafic				2,400		2,400
Western Jurassic		1,000		3,200		4,200
Total		14,500	1,200	5,600		21,300
Southern Range						
Eastern Franciscan				1,300		1,300
Pelletreau Ridge				300		300
Rattlesnake Creek				50		50
Total				1,700		1,700
Disjunct California						
Eastern Klamath Mountains						
Lower Scott Mountains					100	100
Upper Scott Mountains					300	300
Total					400	400
Grand totals	31,900	45,950	13,000	12,900	400	104,200

[1] See the Pathology section.
[2] Percent high risk is from the Pathology section.

when compared to other areas. The additional risk comes from the relatively dense road network of this ecoregion. Roads facilitate spread of PL by mud adhering to vehicles, horses, and wildlife.

Diversity

Plant species diversity. As with the classification and mapping of ecosystems, diversity can also be organized at multiple scales. When POC plant association data for the entire range are considered, species diversity within POC stands is exemplified by the high number of species found per layer.

In the overstory tree layer alone, 29 species are identified. The shrub layer included 93 species, and the forb layer 446 species. The total of 568 is considered the rangewide species richness (number of species) in the 90 plant associations in which POC is prominent. Members of the tree and shrub layers are considered indicator species (meaning that they are closely and consistently associated with environmental thresholds where factors such as moisture and elevation changed and were associated with different ecosystems). Species found in the shrub and forb layers help define the major and minor environmental gradients (changes in environmental variables over space) and are used in the plant association classifications.

This high species diversity is typified by the wide ecological gradients in which POC and its associated species are found. Data analysis has shown elevation, ultramafic soils, microposition, moisture, temperature, and solar radiation to all have correlations with distribution of POC.

The wide environmental gradient included within the POC communities is indicated by the work of Millar et al. (1991) (see Genetics section) using allozyme research to represent genetic diversity. The wide range of associated species help to define the major environmental gradients used to describe vegetation series and subseries.

Plant series and plant association diversity. POC has a wide ecological amplitude (that is, it occurs over a wide range of environments). The species overlaps with portions of the ranges of Douglas-fir, White Fir, Jeffrey Pine, and Western White Pine Series and in portions of the environmental range of the Tanoak, Western Hemlock, and Shasta Red Fir Series.

Multivariate statistical analyses of data from plots in Oregon and California from the Port-Orford-cedar Series have resulted in a classification with 64 plant associations with POC as a major overstory species (Atzet et al. 1996; Jimerson and Daniel 1994; Jimerson, et al. 2000).

Vascular plant species richness (number of species) is presented by plant association group and geographic area in Table 3&4-16. The table also shows the within-plant association-group richness as a percentage of regional species richness.

POC plant associations occur in environments where POC is better adapted to survival than other tree species. The overall range of POC, however, includes plant associations from other plant series: Western Hemlock, Douglas-fir, Jeffrey Pine, Tanoak, and White Fir. The species itself is more widely distributed than would be suggested by examining only the series distribution.

Table 3&4-16.—*Species richness of plant associations containing Port-Orford-cedar by geographic area and plant association group [in average number of plant species]*

Plant association group	Geographic Areas [1]						
	Northern Coast	Mid-Coast	Mid-Range Oregon	North Inland	Mid-Range California	Southern Range	Disjunct California
Upland	26.7 [101]	23 [210]	21 [88]	32.0 [480]	22.5 [67]	No data	24.7 [14]
Ultramafic upland	No data	29.0 [93]	22.6 [308]	24.6 [382]	23.4 [248]	23.9 [284]	No data
Riparian	No data	No data	No data	No data	30.7 [17]	24.2 [31]	25.5 [15]
Ultramafic riparian	No data	No data	No data	23.0 [30]	15.3 [169]	20.0 [51]	21.6 [24]

[1] The first four geographic areas listed are in, or partly in, Oregon; the remaining are in California. Riparian zones were not specifically sampled to develop the plant association classification in Oregon; hence, the lack of data for these groups. Brackets show number of samples.

Port-Orford-Cedar Plant Associations with Unique Species and Regional Endemic, Rare, or Sensitive Plants

POC plant associations contain unique species and regional endemic, rare, or sensitive plants. At least 30 plant species considered sensitive in FS Regions 5 and 6, of special status to the BLM, or rare by the California Native Plant Society (Skinner and Pavlik 1994) and the Oregon Natural Heritage Program (2001), are found in plant associations that contain POC. (In addition to the discussion below, sensitive, listed, and other rare species are discussed in the Botany section in this chapter, or in the draft biological evaluations in Appendix 7.) Eleven of these rare or unique plant species are found only within POC plant associations, predominantly on wetland/seep or riparian areas. Plant associations with the highest diversity of rare plants are those that capture microhabitat extremes, from continually wet soils to dry soils in exposed sites. The plant association with the highest number of rare plants is Port-Orford-cedar-California Bay/ Evergreen Huckleberry.

A majority of rare or sensitive plants in POC associations occupy habitats with surface (perennial or intermittent) or subsurface water in the form of spring or seep flow. The unique California pitcher plant (*Darlingtonia californica*) is the most commonly noted hydrophytic species, followed by California lady's slipper (*Cypripedium californicum*). These species are endemic to serpentine wetlands (fens, riparian areas, seeps) and are represented in various associations across the range of POC.

In comparison to the California pitcher plant and California lady's slipper, there are other wetland species associated with POC that are more localized in their distribution. For example, the narrow endemic western bog violet (*Viola primulifolia* var. *occidentalis*) occurs in fens and other serpentine wetland habitats in the Gasquet Mountain Ultramafic Subsection in California and Oregon. The large-flowered rush lily (*Hastingsia bracteosa*) is a narrow endemic found in the Eight Dollar Mountain area of the Siskiyou Mountain Ecoregion of Oregon. It occurs in riparian and wetland settings along with Oregon willow herb (*Epilobium oreganum*) (Kagan 1990a, 1996). Waldo gentian (*Gentiana setigera*) is found in the gently-sloping serpentine wetlands across the Gasquet Mountain Ultramafic Subsection, Coastal Siskiyou Ecoregion of Oregon, and the Siskiyou Mountain Ecoregion of Oregon. Waldo gentian is also found in two, high elevation associations: Port-Orford-cedar-Shasta-Red Fir-Brewer's Spruce/Sadler Oak-Huckleberry Oak and Port-Orford-cedar-Shasta Red Fir/Sitka

Alder-Sadler Oak. This occurrence of Waldo gentian in montane habitats has been noted by Kagan (1990b) in his management guide for this species. POC plant associations in the Lower and Upper Scott Mountain Subsections of eastern California support rare plants distinctive to this area including Scott Mountain phacelia (*Phacelia dalesiana*), showy raillardella (*Raillardella pringlei*), and crested potentilla (*Potentilla cristae*).

Effects of the Alternatives

Because infection with PL eventually leads to death of POC, the reduction of this species will have effects on ecosystems. Overstory trees will be killed in infested areas. Jimerson and Daniel (1994) found the average age of most overstory trees to be 326 to 425 years, so replacement of "in kind" dead overstory will take a long time. Understory POC trees are likely to persist over time, but it is unlikely they will grow into the overstory in infested areas unless they are resistant to PL.

Table 3&4-17 begins with the current estimated acres of POC shown on Table 3&4-12, and illustrates the anticipated infestation, in acres, of POC from ecosystems in each of the six geographic areas for each of the alternatives. Estimates are further segregated by plant association group to illustrate the effects on ultramafic and riparian areas. The acres shown are only for those plant associations where POC is prominent in the overstory. Additional infestation acres (see Pathology section) are not included here.

In this section, the projected acreage losses by alternative are presented, followed by their effects on key ecosystem functions.

Note: Regarding riparian zones—PL has a higher rate of infestation in riparian zones than in other areas. The zone of high risk, however, is restricted to a narrow strip along streams affected by water level in the soil profile. Typically this is 10 to 25 feet on either side of the stream. For all purposes in this effects section, this is the riparian zone referred to, not broader zones as in Northwest Forest Plan documentation. Areas in Table 3&4-17 are also based on this definition. See the Pathology section for further discussion.

Riparian zone acres in Table 3&4-17 are proportional to the estimate of the relative abundance of riparian plant associations in the geographic areas, based on sample sizes of the plant associations in Atzet et al. (1996) and Jimerson and Daniel (1994).

Effects Common to All Alternatives

Because implementation of this SEIS would not directly affect areas in California, for these areas all alternatives are expected to show the same effects as for Alternative 1 (the current course of action). As discussed in the Cumulative Effects section earlier in this chapter, slight increases or decreases from these numbers could be expected if the Oregon units select an alternative substantially different than the current direction in California. Those differences are too small to be reflected in this analysis.

Alternative 1

This alternative is the current course of action under existing Standards and Guidelines. Based on the assumption that 15 percent of the Coos Bay/Powers administrative areas are

Table 3&4-17.—*Predicted infestation acres in 100 years by plant association groups where Port-Orford-cedar is prominent in the overstory* [1]

	Geographic area								
	Oregon				California				
Plant association group	Northern Coast	Mid-Coast	Mid-Range	North Inland	North Inland	Mid-range	Southern Range	Disjunct California	Totals
Current conditions [2]									
Upland [3]	26,400	6,000	2,300	6,500	800	600	100	200	42,900
Ultramafic upland [3]	3,000	7,300	7,100	3,200	2,500	2,700	900	0	26,700
Riparian	6,600	4,000	1,600	4,800	1,150	1,150	350	140	19,790
Ultramafic riparian	700	4,800	4,700	1,900	1,150	1,150	350	60	14,810
Area infested	5,500	2,400	1,700	1,800	600	600	200	50	12,850
[% of area]	[15]	[11]	[11]	[11]	[11]	[11]	[9]	[9]	
Total high risk	7,300	8,800	6,300	9,800	3,400	2,300	700	200	38,800
High risk as % of total	20	40	40	60	60	40	40	40	
Area totals	36,700	22,100	15,700	16,400	5,600	5,600	1,700	400	104,200
Infestation at 100 years									
Alternative 1									
Upland	0	0	0	800	150	0	0	0	950
Ultramafic upland	0	0	0	600	400	0	0	0	1,000
Riparian	5,600	2,300	1,700	1,800	500	400	200	50	12,550
Ultramafic riparian	600	2,700	1,800	1,000	450	900	200	50	7,700
Total infested	6,200	5,000	3,500	4,200	1,500	1,300	400	100	22,200
% of total infested	17	23	22	30	30	23	24	25	21
Alternative 2									
Upland	0	0	0	700	150	0	0	0	850
Ultramafic upland	0	0	0	600	400	0	0	0	1,000
Riparian	5,400	2,000	1,300	1,400	500	400	200	50	11,250
Ultramafic riparian	600	2,300	1,800	1,000	450	900	200	50	7,300
Total infested	6,000	4,300	3,100	3,700	1,500	1,300	400	100	20,400
% of total infested	16	19	20	26	30	23	24	25	20
Alternative 3									
Upland	0	0	0	500	150	0	0	0	650
Ultramafic upland	0	0	0	400	400	0	0	0	800
Riparian	5,300	1,700	1,000	1,400	500	400	200	50	10,550
Ultramafic riparian	600	2,000	1,600	700	450	900	200	50	6,500
Total infested	5,900	3,700	2,600	3,000	1,500	1,300	400	100	18,500
% of total infested	16	15	17	21	30	23	24	25	18
Alternatives 4 & 5									
Upland	0	0	0	1,000	150	0	0	0	1,150
Ultramafic upland	0	0	0	1,300	400	0	0	0	1,700
Riparian	6,300	3,500	3,200	3,100	500	400	200	50	17,250
Ultramafic riparian	600	4,000	2,200	1,500	450	900	200	50	9,900
Total infested	6,900	7,500	5,400	6,900	1,500	1,300	400	100	30,000
% of total infested	19	34	34	51	30	23	24	25	29
Alternative 6									
Upland	0	0	0	500	150	0	0	0	650
Ultramafic upland	0	0	0	400	400	0	0	0	800
Riparian	5,200	1,600	900	1,300	500	400	200	50	10,150
Ultramafic riparian	600	2,000	1,600	700	450	900	200	50	6,500
Total infested	5,800	3,600	2,500	2,900	1,500	1,300	400	100	18,100
% of total infested	16	16	16	20	30	23	24	25	17

[1] Does not include acres restored with resistant stock.
[2] Current condition high risk totals are from Table 3&4-12.
[3] Includes 4,400 acres high-risk upland in North Inland Geographic Area.

currently infested, 9 percent of the Southern Range and East Disjunct areas of California are infested, and 11 percent of all other areas are infested, it is estimated 12,850 acres of stands where POC is prominent are infested within the range of POC. Under Alternative 1, the estimated area infested in 100 years would be 22,200 acres, or 21 percent of the acres where POC is prominent. The estimated acreage for each geographic area under Alternative 1 (as well as the other alternatives) is displayed in Table 3&4-17. Acreage estimates are based on the assumption of moderate to heavy (depending on geographic area) percent of area affected in riparian zones, versus little or no infestation on upland areas (see Pathology section). Infestation estimates are primarily based on the density of streams and roads, and in California, by the closer relationship of POC to riparian zones. The North Coast and Mid-Coast areas have relatively high rainfall and stream densities compared to the other areas. The Mid-Coast, Mid-Range, and North Inland (in Oregon) areas were assumed to have high road densities, and hence, more areas affected by PL.

Alternative 2

This alternative would add a risk key to add more consistency to the application of prescribed mitigation measures, and places emphasis on the 162 uninfested 7th field watersheds. The projection of the infested acres 100 years from now is 20,400 acres, or 20 percent of the acres where POC is prominent, similar to the 21 percent estimated infestation for Alternative 1. Projected acres vary by geographic area, however, with the greatest spread of infestation in the Mid-Range and North Inland areas.

Alternative 3

This alternative includes the Standards and Guidelines from Alternative 2 (except the emphasis on 162 7th field watersheds) and adds additional direction for activities in 31 currently uninfested 6th field watersheds, primarily in the North Inland Geographic Area. The projection of the infested acres 100 years from now is 18,500 acres, or 18 percent of the acres where POC is prominent. This alternative is second only to Alternative 6 in maintaining the diversity and abundance of plant associations of the alternatives considered. Alternative 3 will provide a higher probability of retaining intact POC ecosystems with all ages of trees represented than Alternative 1, 2, 4, or 5.

In Oregon, this alternative would have little additional effect on the Northern Coast Geographic Area (when compared with Alternative 2), because there are no uninfested 6th field watersheds in this area. Throughout the other Oregon geographic areas, reductions in infested areas averaging 3 to 5 percent would be effected (when compared with Alternative 2) if this alternative is adopted.

Alternatives 4 and 5

Alternatives 4 and 5 would remove active POC management measures, and variously rely on the use of genetically-resistant POC stock for restoration planting. These alternatives are projected to lead to the greatest infestation of POC—30,000 acres at 100 years, or 29 percent of the acres where POC is prominent. As with other alternatives, the least effect would be on the Northern Coast, projected to receive a 2 percent decrease in POC, relative to Alternative 1. Effects on the Mid-Coast, Mid-Range, and North Inland would be larger: 11 percent, 12 percent, and 21 percent, respectively, above the amount projected with Alternative 1.

Alternative 6

Alternative 6 is similar to Alternative 3, but extends the POC core area concept to include 162 uninfested 7th field watersheds. Total acres predicted to be infested are virtually the same with either alternative (about 18,000 acres in each, assumed to be whole or predominantly outside of the currently uninfested watersheds), but this alternative has the advantage of protection for additional watersheds.

In general, Alternatives 3 and 6 would lead to the least reduction of POC from ecosystems, Alternatives 4 and 5 the most, and Alternatives 1 and 2 would be in between. This pattern follows for all the effects on ecosystem functions that follow. Some of these effects could be mitigated over time to the extent POC is replaced with resistant stock (see Planting Assumption under the Assumptions and Clarifications section of this chapter).

Effects on Ultramafic Ecosystems

Ultramafic POC ecosystems make up varying portions of the six geographic areas, ranging from 10 percent of the Northern Coast to 77 percent of the plant associations where POC is prominent in the Mid-Range Oregon Geographic Area (the primary ultramafic region). POC on average makes up 38 percent of the overstory on ultramafic upland sites and 50 percent of ultramafic riparian sites (see Table 3&4-13). Alternative 3 and 6 would lead to the most conservation of these areas, Alternatives 4 and 5 the least, and Alternatives 1 and 2 somewhere in between.

Reduction of POC, particularly in riparian zones, would change ecosystems. On ultramafic sites, POC is much less likely to be replaced by other tree species (White, D.E., *personal communication*; Ollivier, L., *personal communication*). Remaining trees of other species could increase, and the shrub layer would be expected to increase. The POC roles of providing shade for understory plants and providing downed wood for a long-term source stream structure would be reduced. Because the species is very long-lived, replacing old trees with seedlings could require hundreds of years to achieve the same level of forest structure where POC is lost from the ecosystem.

Riparian Effects

Loss of POC would affect downed wood structure in streams. As stated in the previous section, other species are not likely to replace all POC, particularly on ultramafic sites, and those that might would be less valuable as riparian downed wood.

Replacement of POC snags and logs by other species depends on the particular POC ecosystem. Long-term effects on large woody debris recruitment (to POC communities that become POC-vacant) would vary according to community tree species diversity. The more predominant the role of POC is in a given vegetation community, the more the potential there is that POC mortality would decrease wood to streams from that community (or site) (described below [McCain, M., *personal communication*]) in the mid and long terms. Loss of POC in the aquatic ecosystem would be greatest in the Mid-Coast, Mid-Range Oregon, and North Inland Oregon Geographic Areas where the highest proportion of riparian areas feature POC. These areas also have a high proportion of ultramafic areas where POC is particularly important because other tree species are often less abundant. Some POC communities in the ultramafic riparian group do not feature other conifer species and may become dominated by shrubs if the POC component is lost, at least along the “high risk” strip. Therefore, the contribution of these communities of wood to streams would be reduced over the long term. Most other POC communities include Douglas-fir, white fir, Jeffrey pine, or other overstory conifers. Where they occur (in the larger size classes), these species could be expected to provide wood to streams, although their wood will not last as long as that of POC.

To better understand these relationships, ultramafic and nonultramafic plant association groups in the southeast portion of the Oregon POC range were analyzed to identify impacts of the loss of POC on stream shade, and to identify the capability of other species to replace the role of POC in providing wood. Data presented in Atzet et al. (1996) were used to develop the summaries that follow. It should be noted however, that the occurrence of plant associations with POC in this landscape is often patchy and discontinuous. It should not be assumed, for example, that stream miles of POC are contiguous. Recovery times listed are rough estimates based on the patchiness and other features of the landscape.

The north to south boundary between the western Coastal Siskiyous Ecoregion and the Serpentine Siskiyous and Inland Siskiyous Ecoregions to the east was used as a divider to separate the southeast portion of the Oregon POC range. West of this line, high rainfall is typical, and POC is widely distributed across the landscape. East of this line, average rainfall is lower, and POC distribution is more restricted to riparian zones.

Recovery of canopy in this analysis area would be affected by rainfall, and in the ultramafic areas, by soil chemistry and the lack of replacement species. A total of 897 stream miles were associated with the ultramafic plant association group. Out of these, 192 miles would be affected by the loss of POC. In the plant associations contained in this plant association group, POC contributes 38 to 50 percent of the overstory cover (ultramafic groups in Table 3&4-11). After loss of the POC component, it would take 40 to 100 years for other species to colonize the canopy gaps or planted resistant stock to make effective contributions.

The nonultramafic group was analyzed as a single group and as three subgroups, in order to contrast ecosystems characterized by POC and those where POC occurs, but is not abundant. Accordingly, the nonultramafic group was further divided into Port-Orford-cedar, Tanoak-Canyon liveoak, Tanoak/Salal, and Tanoak/Evergreen Huckleberry subgroups. In only the Port-Orford-cedar group is POC consistently abundant.

If all nonultramafic associations are analyzed as a group, 37 of 1,474 miles would be affected. Of the nonultramafic subgroups, only the Port-Orford-cedar group has a large proportion of stream miles. An estimated 12 of the 39 stream miles associated with the Port-Orford-cedar Plant Association Group would be affected by loss of POC. In the plant associations contained in this plant association group, POC is the primary component of both the overstory and the understory. After loss of the POC component, it would take less than 30 years for other species to colonize the canopy gaps.

In the Tanoak-Golden Chinquapin Plant Association Group, 19 of 1,333 miles would be affected by the loss of POC. In the plant associations contained in this plant association group, POC contributes 20 percent of the overstory when it is present (in only 14 percent of plots sampled). After loss of the POC component, it would take less than 5 years for other species to colonize the canopy gaps. In two remaining plant association groups, the Tanoak-

Port-Orford-cedar/Salal, and the Tanoak/Evergreen Huckleberry, the miles of stream affected by POC loss were low (5 miles out of 86 miles, and less than 1 mile out of 16 miles, respectively). The POC contribution to overstory was 14 percent and 1 percent, respectively, and colonization by other species was expected to be less than 3 years. All other plant association groups in the analysis either had little or no POC, or had very few potential impacted stream miles.

Based on research and monitoring data, dead POC trees cannot be expected to fall over quickly. Jules et al. (2002) documented uninfected POC snags still standing up to 200 years since their death. Monitoring data from the Agua-Stimpy project area (Medford BLM District, Grants Pass Resource Area) shows no infected POC falling over. This area has been infested since the mid-1970s (Betlejewski, F., *personal communication*).

Snags and Downed Wood

Downed wood has largely been detailed in the previous Riparian Effects section. The value of POC snags for terrestrial wildlife is probably less than other conifer species, because of the hard nature of the wood. Its primary value is in providing downed wood for aquatic systems.

Plant Diversity

Effects on plant diversity are detailed in the Botany section. One note, however, is the presence of the Port-Orford-cedar/Shasta-Red-fir/Brewer's Spruce/Sadler Oak-Huckleberry Oak association in the North Inland Geographic Area. Preliminary tests (stem dip method) have shown the POC in a variant of this association (also including yellow cedar) to have the highest percentage of resistant trees among the communities sampled (Betlejewski, F., *personal communcation*). Conservation of this association, which is known to occur on only a few high elevation sites, would have value as a potential source of material for producing disease-resistant seedlings.

Structural and Landscape Diversity

Species loss is driven by habitat loss. Reduction of POC in high-risk areas across the landscape would reduce diversity at both local and broad scales, leading to a more homogeneous landscape. Such a landscape would be less resilient (if POC were greatly reduced on the landscape, species or ecosystems may be less resilient to change) (Lindenmayer and Franklin 2002). For example, if another conifer species were to replace POC on some sites, and that species itself one day becomes vulnerable to a pathogen, the ecosystem would be more affected than if POC were still present.

Cumulative Effects

The effects of PL-caused mortality on plant associations and their function (described above) also need to be considered in context with other reasonably foreseeable actions or events that could affect these same functions. As noted above, negative effects on the ecological role of POC are most pronounced within riparian areas and on ultramafic soils. Timber harvest or other non-PL related effects to POC in these two areas is expected to be insignificant, particularly in view of the known importance of POC on such sites. The Northwest Forest Plan

Riparian Reserves preclude removal of POC or other species unless they are dead (in which case that removal must be neutral to aquatic objectives) or unless they need thinning in order to improve aquatic conditions. Overall riparian conditions are improving on Federal lands as a result of such measures, and no events other than future fires (discussed under Affected Environment in the Fire and Fuels section and noted under the Cumulative Effects summary earlier in this chapter) is expected to contribute to the adverse effects described above.

Similarly, timber harvest and other management disturbances on ultramafic soils are limited. The ultramafic sites where POC is most important tend to be those whose productivity (fertility) precludes them from being managed for regularly scheduled timber harvest. The maintenance of the existing forests on such landscapes is a primary management objective, and management actions purposely removing POC from these sites are unusual and unquantifiable. Where proposed at all, efforts will be made to avoid or minimize the types of effects described above for PL-related POC mortality.

Timber harvest could temporarily reduce the functional acres in POC plant associations within the Matrix land allocation, but the likelihood of those being the significantly rare associations simultaneously jeopardized by PL is small, either because of the above riparian or ultramafic considerations, or because the site-specific analysis for the timber sale would recognize their uniqueness. Timber sale-related removal of any other, non-rare POC associations would only be done subsequent to analysis indicating such openings, even combined with the mortality described in this SEIS (since those analyses would tier or incorporate this SEIS), were acceptable.

The potential for Sudden Oak Death to cumulatively contribute to the effects above is unknown because its occurrence in the POC range is limited so far, and there is no evidence yet that it affects POC.

Botany

Affected Environment

POC is found from southwestern Oregon to northern California, primarily in the Coast Range, Siskiyou and Klamath Mountains. There is a small disjunct population in the Scott Mountains of California (see Figure 1-1). The following discussion is organized by the same geographic grouping of plant associations as the Ecology section, to capture the range of threatened and endangered species, plant diversity, and ecosystem functions. POC has a narrow geographic range, and occupies variable and different habitats.

Northern Coast comprises the mid-Coastal Sedimentary and Southern Oregon Coastal Mountains Ecoregions. This area has lower elevation, higher rainfall, and dense coniferous forests. *Lilium occidentale* (western lily) is found in openings within stands of POC (Brian 2003; Segotta 2003).

Note: See accompanying biological evaluation for identification of species that are state or federally listed as threatened or endangered (Appendix 7).

North Inland includes the Inland Siskiyou and Siskiyou Mountains Ecoregions. Conditions here are highly varied, and the area has high species diversity. Many rare plants are endemic or have their greatest extension here, such as *Castilleja miniata* ssp. *elata*, *Epilobium oreganum, Darlingtonia californica, Cypripedium californicum, Gentiana setigera, Hastingsia bracteosa* var. *atropurpurea, Hastingsia bracteosa* var. *bracteosa, Viola primulifolia* var. *occidentalis,* and *Smilax jamesii* occur from Smith River to Eight Dollar Mountain with the highest number of rare species along Josephine Creek and Eight Dollar Mountain. ***Note:*** Rare in this context includes unique, locally endemic, narrow ecological amplitude, Agency sensitive, and state or federally listed as threatened or endangered. These sensitive species share *Darlingtonia* fens or streams in ultramafic soils with POC.

Mid-Coast comprises the Coastal Siskiyou located in Oregon; it is an area with rugged mountains and high gradient streams, and a few alpine glacial lakes. This area has higher precipitation rates, with *Darlingtonia californica, Cypripedium californicum,* and *Gentiana setigera* associated with serpentine wetlands from Gasquet Mountain Ultramafics, Serpentine Siskiyous to Coastal Siskiyous.

Mid-Range includes the Serpentine Siskiyou/Gasquet Mountain Ultramafics of California Ecoregions and the Western Jurassic subsection. POC is found at higher elevation in this highly diverse ecoregion. POC here is also found in drier peridotite soils, which is also the preferred habitat of *Arabis macdonaldiana* (Vorobik 2002), endangered rock cress. *Arabis macdonaldiana* grows in the barest unoccupied peridotite rock, at the most sharing these microsites with Roemer's fescue, and sedums. Jeffrey pine does well in this habitat type, and could increase its presence in the absence of POC (Brian 2003). These ecoregions have extensive fens, from very small seeps to hanging fens that run for more than a mile on the side of the mountain, especially on Oregon Mountain and Rough and Ready Creek.

The Western Jurassic subsection is moderated by marine air creating a temperate to humid environment, making this subsection the second highest in POC abundance. *Arabis macdonaldiana* occurs on peridotite in openings within POC stands.

East Disjunct California includes the Eastern Klamath Mountains and Lower Scott Mountains subsections where sensitive species like *Balzamorhiza sericea*, *Chaenactis suffrutescens, Epilobium oreganum, Erythronium citrinum* var. *rodereckii, Ivesia pickeringii, Penstemon filiformis, Phacelia leonis,* and *Smilax jamesii* occur; and the Upper Scott Mountains subsection which is home to *Arctostaphylos klamathensis, Epilobium siskiyouensis*, *Minuartia stolonifera, Phacelia dalesiana*, *Phacelia greenei, Potentilla cristae, Raillardella pringlei,* and *Smilax jamesii* (Nelson 2003). The three areas share the same geologic pattern.

Southern Range includes the Eastern Franciscan, the Pelletreau Ridge, and Rattlesnake Creek subsections. The first represents the higher elevation coastal, the second stands alone, and the third is on peridotite with a small population of POC. The Rattlesnake Creek Terrane is home to *Epilobium oreganum* which here occupies stream areas, meadows, and seeps without *Darlingtonia californica* as an associate species.

There are no federally- or state-listed threatened or endangered plants that occur in the riparian zone. The BLM special status and FS sensitive and other rare plants that occupy and share habitats with POC are generally in good overall condition. Some of them are inadvertently affected by other activities such as mining, recreation (especially off-highway vehicles), wildland fire, noxious weeds, timber harvesting, roads, and wildland fire suppression (Frost 2002).

Because of fire exclusion, open fens and some of the riparian areas have been encroached upon by shrubs and trees that compete with rare vascular plants for space and moisture. This is most evident on the Oregon Mountain and Rough and Ready Creek fens. The upper reaches of Josephine Creek were burned in 1994 by the Mendenhall Fire and back-fired during the 2002 Biscuit Fire. POC's highest benefit to rare vascular plants appears to be providing soil stability and shade. The Days Gulch fen, for example, was affected by the Biscuit Fire and had been burned under prescription twice previously. Erosion was evident because the grass, pitcher plant, and shrubs had been burned without enough time to allow for regrowth between the last prescribed fire, the Mendenhall Fire, and the Biscuit Fire back-firing. Sediment was deposited within the fen, burying a small population of *Epilobium oreganum* where a road culvert slowed runoff.

POC is a prolific seed producer with an estimated 40 million seedlings within the range in both states (Goheen 2003). However, large old POC trees have a higher value than seedlings to the environment in general, and rare plants in particular. Large trees are essential for soil stabilization and microclimate moderation (Nelson 2003). In some areas, POC is a barrier between the recreating public and rare plants, especially off-highway vehicle users. The growth form of POC creates a fence-like barrier with boughs that prevents the public from seeing vulnerable ecosystems like fens or seeps in some areas.

POC forms endomycorrhizae with some fungi (Zobel et al. 1985); most herbaceous plants are endomycorrhizal, but the relationship between POC and vascular plants has not been studied (thus a connection has not been established).

Arabis macdonaldiana occupies peridotite openings in the Gasquet Mountains/Serpentine Siskiyou Ecoregion, sharing similar soil conditions, but separate habitats than POC. A dependent relationship has not yet been studied or established (Hoover 2003).

Effects of the Alternatives

Potential effects to species listed under the "Endangered Species Act" are also discussed in the biological evaluation in Appendix 7.

Alternative 1

This alternative is the current management direction for BLM districts and the Siskiyou NF. It seeks to reduce or prevent introduction of the pathogen into disease-free areas by closing roads into these areas during the rainy season to prevent carrying the spores from infested to uninfested areas, analyzing the risk of introduction to disease-free areas, developing mitigation measures at the project level, informing the public about the reason for these measures (see Appendix 2), and other provisions.

The effects of Alternative 1 to the botanical environment are varied. The areas with the highest presence of rare plants appear to be free of infestation, with the exception of Whiskey Creek, narrow bands on lower Josephine Creek, and Middle Illinois River. Seasonal road closures prevent the introduction of noxious weeds to rare plant areas when soil conditions are optimal for seed germination. Another positive effect from this alternative to rare plant habitats is vehicle and equipment washing. Washing substantially reduces the probability of introducing noxious weeds. Gates help prevent off-highway vehicle recreation, which has a positive effect on rare plants by decreasing soil disturbance at a time when soil moisture is high and vulnerable to erosion and compaction.

Alternative 2

This alternative is similar to Alternative 1, except that practices currently implemented or recently developed are better described, a risk key is included for clarification of the environmental conditions that would trigger additional control or mitigation measures, and the 162 uninfested 7th field watersheds are emphasized. Implementation of disease-mitigating practices is expected to be more consistent because of the key.

The effects of Alternative 2 are similar to Alternative 1. Implementation would reduce the rate of spread of the disease when compared to Alternative 1. Continued development of resistant stock would make stock available for timely replacement in important habitats. Emphasis on 7th field watersheds means 71 sensitive or special status species sites will more likely be protected. Alternative 2 would help maintain a lasting presence of POC in unique plant communities, which seem to be more abundant in high-risk areas.

Alternative 3

Alternative 3 adds additional protection measures to 31 uninfested 6th field watersheds that have at least 100 acres occupied by POC. It divides these watersheds into POC cores and buffers and applies additional Standards and Guidelines to each to lessen introduction of infection to the POC core areas.

The effects of Alternative 3 are the same as Alternative 2, with the exception of effects within the 31 uninfested watersheds. In these watersheds, the prohibition of harvest and discretionary uses in POC cores would increase the probability of a lasting presence of POC in unique plant communities in these areas. Unique plant communities seem to be more abundant in high-risk areas. Alternative 3 has 20 known special status species on BLM lands within 4 POC core areas and 35 known sensitive species on FS lands within 18 POC core areas. Closing roads and lessening off-highway vehicles and other disturbances to rare plant communities would provide other benefits to rare plants through decreased disturbance and decreased weed introductions throughout the watersheds.

Alternatives 4 and 5

Alternative 4 would remove all preventive measures that are currently in place and would speed up the resistance-breeding program to more quickly replace POC killed by the disease with resistant seedlings. Alternative 5 would remove all preventive measures and discontinue development of the resistant-breeding program. Existing resistant seed orchard trees would continue to be used to reforest areas of mortality in breeding zones for which resistant stock is already developed.

The effects of Alternatives 4 and 5 are similar, differing only in the mid and long term where Alternative 4 would deter advancement of the disease by increasing the introduction of resistant stock. Alternative 5 would rely primarily on the natural evolutionary processes involving the very low frequency of resistant POC that are widely scattered in forests.

These alternatives would allow for faster advancement of the disease compared to the current direction in high-risk areas (see Pathology section). The effect of this high mortality on rare plants is unpredictable. POC is a large component of riparian habitats in areas where it is the largest tree species. It would be logical to infer that the loss of shade and stream bank stability that would result from the loss of POC would have a negative effect on the sensitive and rare plants that are adapted to stream microsites.

Alternative 6

Alternative 6 contains all the management elements of Alternative 2, and seeks to slow the spread of PL even more by adding additional protection for 162 currently uninfested 7th field watersheds having at least 100 acres of stands containing POC. This alternative would the most beneficial to unique plant communities. There are 15 known special status species on BLM lands within 4 POC core areas; and 56 known sensitive species on FS lands within 42 POC core areas. Closing roads to most activities at the most critical time would decrease disturbance and possible impacts to Darlingtonia fens, other wetlands, and unique habitats. It would provide indirect benefits to unique species by reducing impacts to highly erodable ultramafic soils and helping prevent the introduction of noxious weeds.

Although there are negative effects to plant communities if POC is killed by PL, negative effects of the loss of POC to threatened, endangered, and Forest Service sensitive and BLM special status plants cannot be determined from the known information.

Cumulative Effects

As noted above, the effect of POC mortality on rare and unique plants is general, and the effect on particular species or sites is unquantifiable and unpredicatable. No listed plants are uniquely linked to POC. Those potentially affected by the alternatives are ones with limited known populations that appear likely to be affected by the loss of shade or physical protection. Even this effect is limited because potentially affected species are generally in good shape. However, such effects would be in addition to those from mining, off-highway vehicles, wildland fire and its suppression, noxious weed encroachment, timber harvesting, road construction, and other activities. Effects of those activities are both so localized, and the subjects of their own analyses and applicable mitigations measures, that cumulative effects predictions would need to be made on a case-by-case basis associated with those activities. That is not possible here because the future PL mortality sites are unknown.

Standards and Guidelines intended to reduce the spread of PL, however, have some direct benefit to rare and unique plants. These are specific to alternatives and are thus described above. They include POC-related road closures preventing foot and off-highway vehicle access to rare plants, thereby reducing injury and soil compaction, and vehicle washing reducing the import of noxious weed seeds which are compete with local endemics.

Water and Fisheries

Affected Environment

The POC range includes southern Oregon coastal watersheds, northern California coastal watersheds, and upper portions of the Umpqua Basin, Rogue Basin, and Klamath Basin.

High-Risk Sites

High-risk sites for transmission of PL infestation include water flowing in linear channel features and direct water influence zones, including connected off-channel areas and flood-plains. Included are road ditches that link with the stream network and gullies formed from cross-drain runoff that continues downslope until a drainageway is met. There are approximately 11,843 stream miles in the Oregon POC range, with 1,510 miles showing presence of POC near streams, and 295 miles infested. The ultramafic geomorphological area has 591 stream miles of POC presence near streams, of which 129 miles are infested. Current POC mapping (Map 4), overlayed with streams, reveals that POC is adjacent to 13 percent of the stream mileage, and current infestation is estimated at 2.5 percent of the mileage. Standing water such as lakes, fens, bogs, and topographic depressions with soils exhibiting persistent high-water tables, may have lower transmission rates, but are in the category as high risk. The high-risk sites are directly associated with water and are almost always much narrower than the Northwest Forest Plan Riparian Reserves.

POC is not normally infected more than 40 feet downslope from roads or trails, except where streams, culverts, wet areas, or other roads are present to facilitate further movement (Goheen et al. 1986b). As was stated in the previous section on Pathology, the probability of infection downstream is highest when PL inoculum is introduced directly into water at a stream crossing or a ditch and POC with their roots in the water are present immediately downstream. Although a recent dendrochronological study provides evidence of infection beyond 160 meters (Jules and Kauffman 1999), limitations to the study make it impossible to ascertain if the transmission was actually over this distance or resulted from several small tree infections between the initial source of inoculum and the large tree that was studied. In any case, the probability of infection at distances greater than 100 feet is very low (2 to 4 percent).

Streams and Flow Paths

Stream densities vary by physiographic provinces. The Coast Range Physiographic Province has total stream densities varying from 5.31 to 12.80 miles per mile square, Franciscan Formation has 6.27 to 9.04 miles per mile square, and Klamath has from 4.63 to 9.76 miles per mile square (USDA-FS et al. 1993). At a planning level, ephemeral and intermittent streams are in headwaters positions and can be classified as 1st and 2nd Order (Strahler 1957). Perennial streams are normally 3rd Order or greater where enough drainage area, soils, relief, and other landscape features interact to form a drainage that can support a year-round flow. Ephemeral/intermittent streams vary from 65 to 80 percent of the stream network, and perennial 20 to 35 percent (USDA-FS et al. 1993).

Stream uppermost surface origin or pourpoints expand further up the drainage with the onset of maritime winter storms. As soils become saturated, further precipitation would runoff into ephemeral/intermittent stream channels, which are above the water table. Overland flow may also appear on compacted areas, including road surfaces, landings, quarries, or soils with high surface rock contents. Although infrequent, rapid melt of shallow snowpacks in the intermittent snow accumulation zone (above 2,000 to 2,500 feet) can lead to overland or concentrated flow in certain areas, increasing stream flow paths. Road-stream connections from roadside ditches, and gullies from ditch relief culverts entering a channel, can substantially boost the drainage density. In one study in the Cascades (Wemple et. al 1996) stream density increased from 21 to 57 percent, depending on dynamic expansion with increasing levels of stormflow.

Assessment of Salmonid Stocks

The assessment by Oregon Department of Fish and Wildlife and California Department of Fish and Game of the status of steelhead in southwest Oregon in 1997 found that the Winchuck River had healthy stocks, but others had depressed winter and/or summer runs (Illinois, Pistol, Chetco, and Rogue Rivers). Oregon Department of Fish and Wildlife determined that trends in the Rogue River were positive and that the steelhead population was stable and not threatened. Winter steelhead spawners roam and will migrate to other areas if conditions to spawn are not good in one stream. As a result, production can vary dramatically from stream-to-stream annually (Rogue Valley Council of Governments 1997). The National Marine Fisheries Service had ruled by 2001 that Klamath Mountain Province steelhead were not warranted for listing as threatened ([online]URL:http://www.nwr.noaa.gov/).

Steelhead habitat is contiguous with that of coho salmon, and 90 percent of the limiting factors for coho salmon are also limiting for steelhead. Similar habitat problems exist for the two species in the Rogue and South Coast Basins. One important distinction is that coho salmon require deeper pools and more side-channel habitat than steelhead for optimal rearing (Rogue Valley Council of Governments 1997).

The wild Southern Oregon/Northern California coho salmon was listed as threatened in May 1997, and the Oregon Coast coho salmon was listed as threatened in August 1998. Southern Oregon Coast/California Coast chinook salmon were not warranted for listing as threatened in September 1999 ([online]URL:http://www.nwr.noaa.gov/).

Current BLM Manual 6840 provides policy and guidance for the conservation of special status species of plants and animals. Oregon/Washington BLM uses three categories for special status species besides endangered, threatened, and candidate designations: Bureau sensitive; Bureau assessment; and Bureau tracking. Classification is dependent upon the different State of Oregon or Oregon Natural Heritage Program designations.

Fall chinook salmon (Bureau sensitive) and spring chinook salmon (Bureau assessment) in the Southern Oregon and Northern California Coastal Evolutionary Significant Unit are on the Oregon/Washington BLM special status species list. Bureau 6840 policy requires that any Bureau action not contribute to the need to list (under the Federal "Endangered Species Act") any species with Bureau sensitive designation (IB-OR-2000-092). The BLM Manual at 6840.01 ([online] URL:http://www.blm.gov/nhp/efoia/wo/manual/6840.pdf) directs the conservation of special status species by the use of all methods and procedures which are necessary to improve the condition of special status species and their habitats to a point where their special status recognition is no longer warranted. A similar FS policy directs the conservation of sensitive species (refer to the Fisheries biological evaluation in Appendix 7).

Salmonid Limiting Factors

Salmonids are frequently used as indicators of watershed health and the impacts of human activities because they have complex life histories and specific environmental requirements. All salmonid species in the project area have similar freshwater requirements. For optimum production, all species require cool flowing waters; free passage through migratory routes; clean gravel substrate for reproduction; water with low turbidity during the growing season for sight feeding; high levels of dissolved oxygen content in streams and within gravel; sufficient instream hiding-cover; and invertebrate organisms for food (USDA-FS and USDI-BLM 1985).

Steelhead, in particular, serve as an indicator species for the fish and aquatic habitats affected by the proposed action because their freshwater requirements are similar to other salmonids and nonsalmonid coldwater species (such as sculpins [*Cottus* spp.] and Pacific lamprey [*Lampetra tridentata*]). In addition, steelhead habitat extends further upstream than that of most fish species within the planning area. In the Rogue and South Coast Basins, which correspond to the Oregon portion of the region and south to the Klamath River in California, there are approximately 6,913 total stream miles of steelhead spawning and rearing habitat. About 1,489 miles, involving 61 total stream miles (about 50 percent Federal ownership), are designated as high-value winter steelhead spawning areas. There is a total of 245 miles (about 27 percent Federal ownership) of summer steelhead streams (Rogue Valley Council of Governments 1997).

Further GIS analysis of the planning area indicates that within the Oregon POC range, there are approximately 2,235 miles of winter and summer steelhead habitat. Steelhead distribution is often used as a conservative estimate of designated Coho critical habitat because the habitat is overlapping and steelhead use extends upstream as far as or further than coho use. This may result in overestimating the effect to coho habitat somewhat, but for the current analysis, it is a useful method. Approximately 301 miles of steelhead habitat within the Oregon POC range have POC present; 168 miles (7.5 percent of the total habitat miles) are in nonultramafic soils, and 133 miles (6.0 percent of the total habitat miles) are in ultramafic soils.

The Southwest Oregon Salmon Restoration Initiative (Rogue Valley Council of Governments 1997) identified the representative priority limiting factors for steelhead streams in the Rogue and South Coast Basins, corresponding to most of the Oregon portions of the Region and south to the Klamath River in California. Low stream flows limit summer rearing habitat, increase water temperatures, and increase competition and the risk of predation. High water temperatures foster disease and diminish food supply. Inadequate riparian habitat was identified because stream canopy over side channels and alcoves provides shade which helps reduce stream temperatures, stabilizes streambanks, serves as holding areas for fry and smolts, and provides a food source for aquatic life. Inadequate levels of instream large woody debris were identified, because large woody debris provides shelter for steelhead, creates pools, collects spawning gravel, helps reduce water velocity, and provides hiding habitat. Sediment and erosion were limiting factors, as they affect spawning areas, fishery health, and water quality. Fish passage at road crossings was identified as needing improvement.

Aquatic Interactions

Habitat characteristics such as channel form, pool riffle sequence, water temperature, water chemistry, water flow depth, velocity, substrate, and cover are linked to the stream adjacent to riparian areas, including large woody debris availability, shading, bank stability, litterfall, and nutrient cycling. Five classes of factors affect aquatic biota; food (energy source), water quality, habitat structure, flow regime, and biotic interactions (Spence et al. 1996).

Soils Limiting Forest Growth

POC in the Inland Siskiyou Region is often associated with dark-colored igneous ultramafic rocks. Ultramafic rocks and soils have higher iron and magnesium nutrient availability that limits tree growth of many species. However, POC tolerates these soils and is sometimes the only tree species supported. The Gasquet Mountain Ultramafics Ecoregion roughly corresponds to this soils area (USDA-FS and USDI-BLM 2003b). There are approximately 10,600 acres of riparian plant associations with a prominence of POC on these soils (Table 3&4-12).

Ultramafic rocks were derived from sections of the seafloor which were produced at spreading centers and then lifted up onto the continental shelf, instead of being subducted. Less than 1 percent of the United States is underlain by ultramafic material ([online] URL: http://jersey.uoregon.edu/~mstrick/AskGeoMan/geoQuerry23.html). These rocks have a relatively low concentration of silica and oxygen, and are enriched in iron and magnesium. They are not stable at surface temperatures and metamorphose into other forms including serpentine ([online] URL:http://jersey.uoregon.edu/~mstrick/GeoTours/Josephine%20Ophiolite/JoOphiolite.html). Because soils produced from ultramafic rocks are rare, plants occurring on them can also be rare.

Headwater Confined Stream Channels

Channel morphology. Headwater confined stream channels in the POC range would be classified as A, or Aa+ (more than 10 percent gradient on bedrock) channels (Rosgen 1996). Characteristics include steep gradients (generally greater than 4 percent), vertically contained, width/depth ratios less than 12, relatively straight, and do not spread on floodplains with incremental increases in winter flow. These channels are generally 1st and 2nd Order, and usually have steep stream-adjacent hillslopes. Substrates vary from bedrock, boulder, and gravels to fine sediments. These channels are above the water table, and based on duration of flow, are either ephemeral (stormflow only when soils are saturated) or intermittent (longer duration, but less than all year). Headwater channels collect from small catchments (normally less than 1 mile per mile square) that feed into drainages.

PL inoculum present in these headwater streams may affect POC on streambanks, but not in upslope positions (Goheen, D.J., *personal communication*).

Bank stability. Bank erosion is caused by stream power from flow and sediment in the channel that can erode channel margins. Bare banks are more susceptible to erosion (soil grain size and ease of detachability become important). Riparian vegetation acts as hydraulic resistance and binds soil particles. Herbaceous vegetation and trees with a matrix of fine and coarse roots that tend to interlock soils counter erosive forces. In headwater channels, banks can be undercut and cause trees to slide into the channel, but this is less frequent because many channels are laterally confined by bedrock. Some sections of the channel are prone to downslope soil creep and delivery of whole trees, debris, and soils. Although tree mortality causes fine roots to decay in a few years, the larger roots last considerably longer (Burroughs and Thomas 1977).

Large woody debris. Large wood accumulates in confined channels to form reservoirs for sediment accumulation and a step-pool system that dissipates stream energies. Many low-order streams accumulate large woody debris and sediment for long periods of time that are removed downstream by episodic transport as debris flows (May and Gresswell 2003).

Stream temperature. These channels do not contribute to stream heating because they are dry during the summer months.

Mid-Drainage-to-Valley Moderately Confined to Unconfined Stream Channels

Channel morphology. Moderately confined to unconfined stream channels in the POC range would be classified as B, C, and D streams (Rosgen 1996). Stream characteristics include gradients less than 4 percent and generally less than 2 percent, width/depth ratios greater than 12, and meandering on a variety of substrates moved and deposited by the river (alluvium). Higher winter flows cause spreading within the floodplain, at least on one side of the stream. The streams have active channel widths of 15 to 30 feet for B streamtypes and greater than 30 feet for C and D streamtypes. Floodprone areas can be narrow to hundreds of feet wide. The F channel type, common in the northern part of the POC range, is a larger stream on a flat gradient that does not have a floodplain. These streams to rivers are 3rd Order and greater and are mostly perennial. Watershed drainage areas would generally be less than 15 miles per mile square for the mid-drainage B channel types, and greater than 15 miles per mile square for the C and D channel type valley streams corresponding to the 7th, 6th, and 5th field hydrologic unit boundaries ([online] URL:http://wwwga.usgs.gov/gis/iag.html).

Aspects of fish habitat that are influenced by channel morphology in these streams include pool frequency, residual pool depth, pool complexity, and the presence of side channels and alcoves.

Stream hydrology. Analysis of stream channel gauging data for southern Oregon shows an approximate 1.5 year bankfull flow would just fill the active channel and not spread laterally, while a 100-year recurrence interval flood would have a depth of 2.0 to 2.2 times the mean depth at bankfull (Fogg, J., *personnel communication*). The actual flooding width during large storms would depend on the runoff and channel geometry, slope, and roughness.

Inoculum present in the water column may affect POC on streambanks, and laterally away from the active channel to the depth of runoff for a particular event. Extensive floods in southwestern Oregon and northern California occurred in 1955, 1964, 1971, and 1996.

Bank stability. Banks in low gradient mid-drainage-to-valley streams can be strengthened by dense root systems from shrubs and trees. However, the streambank can still be easily undercut, particularly on the outside of channel bends, and may reverse the binding effect of roots. Normally, tree roots are wide and spreading and are not more than a few feet deep. Within the ultramafic areas in these streamtypes much of the bank is armored with durable cobble and boulder material. Where POC trees line the banks, their roots are often undercut, providing instream cover for fish. Since dead POC is resistant to decay, there may be little difference in streambank stability compared to living POC when the overriding forces of streamflow are considered.

Large woody debris. Large wood is recruited from streambanks or transported downstream by debris flows or floatation during high flows. Storm events in the moderate-to-high-gradient channels result in large woody debris moving downstream (Mellen, K., *personal communication*). This general down-valley movement is part of the recruitment process, and provides for wood to accumulate in productive gravel-rich low-gradient depositional stream reaches and enhance rearing and spawning habitat (McCain, M., *personal communication*).

Typical studies in western Oregon (McDade et al. 1990) show that riparian stand source distance for old-growth conifer has a median distance of 34 feet, and 87 percent fall within 82 feet of the stream. Maximum source distance was 198 feet. Furthermore, 11 percent of all woody debris originated from 3 feet of the bank. Fluvial erosion and bank undercutting could be responsible for part of this observed supply. Research has shown that for mature and old-growth coniferous forests, wind and tree mortality are the principal agents in initiating treefall (Lienkaemper and Swanson 1987).

POC large woody debris has tremendous longevity. For example, standing dead cedar in a dendrochronology study were routinely over 100 years old and one snag was dated to 264 years old (Jules et al. 2002). Dead wood that is subject to wetting and drying cycles and microbial decay in air, breaks down faster than when buried in streams. In another study in western Washington, 80 percent of coniferous wood added to a channel was depleted within 50 years, although some wood was buried in the floodplain to be exposed centuries later by stream migration and dated at 1,400 years old (Hyatt and Naiman 2001). POC is expected to have long depletion times; much longer than reported for other coniferous species, whether spanning the channel or buried with sediments. This persistence of POC allows the logs to function for decades to centuries as cover; influencing the storage, sorting, and routing of hillslope sediment and channel substrate, and therefore the formation of pools; and to maintain adequate levels of overall stream habitat complexity.

Large woody debris in moderate-width B channels adds important structural elements that erode or protect banks, change flow direction and velocity, influence deposition zones, and scour pools. The debris adds cover and complex habitats for salmon and trout. The large woody debris is normally retained if its length is at least 1.5 times the channel width or includes a rootwad on the bank. In larger C and D channels, large woody debris is floatable and is moved downstream and can become embedded in jams. The debris is lodged near the high waterline on the outside of channel bends or on mid-channel bars and can initiate meander cutoffs. Secondary channel systems formed are primary areas for salmonid rearing because they provide off-channel refuge during high flows.

The link between POC communities, woody debris, and coho habitat is typically indirect.

There can be a considerable distance and time between the point when large woody debris enters a stream and when it functions as a component of coho habitat. Coho generally spawn and rear in low-gradient, gravel-rich, wood-influenced channels that are located downstream from the steeper headwater source streams (including ultramafic POC-dominated channels) that transport and deliver wood. The structural function of large woody debris, as described above, not only creates instream habitat complexity, but also influences macro-invertebrate diversity and productivity. Small woody debris and fine organics are retained in a properly functioning stream and act as substrate and nutrient supply for fish prey species.

Stream temperature. Stream temperature is based on an array of physical and ecological processes. Summer temperatures are of interest because thermal loading can elevate stream temperatures beyond optimum (14.5 degrees C [58 degrees F]) for salmonids and other aquatic life. The desired water temperature for salmonids during spawning is less than 13 degrees C (55 degrees F). Juvenile rearing salmonids can tolerate diurnal fluctuations of 10 degrees C (18 degrees F) without seeking cooler water if the daily minimum temperature is well within the optimum range (Meehan 1991).

Streams with limited canopy that are exposed during the winter months can have energy losses and a decrease in stream temperature. In most of the Oregon and northern California region, except for areas further inland and at high elevations, temperature losses are minor. This is due to nighttime cloud cover and normally moderate air temperatures (Beschta et al. 1987).

Average dry season precipitation (May through September) varies from 7 inches in the Northern Coastal Region, 9 to 18 inches in the Siskiyou Region, and 4 to 5 inches in the Inland Siskiyou Region (Oregon State University 1982). Mid-summer is even drier and streamflows recede in the POC region to about 0.22 cubic feet per second per mile square by July through August. The sun's vertical position (zenith angle) is higher in the summer and its horizontal position (azimuth) is more northerly. These interactions of solar physics result in greater incoming direct-beam solar radiation, the most important factor influencing summer stream temperature change (Brown 1969). Greater available solar radiation, peaking in June–August, coupled with low flows, can result in lesser stream buffering capacity to maintain temperature.

Depending on the sun's path and time of day in summer, trees and shrubs and topography cast shade on streams. When the sun is high, trees closest to the stream provide shade, and as the suns position lowers, vegetation farther from the stream intercepts radiation and casts shadows. Shade is often used as a surrogate for temperature because when shadows block the sun there is much less heat energy gain (Beschta et al. 1987). Depending on the riparian site (including topography, stream orientation, tree height, tree overhang, canopy density, stream width, stand composition, and relative abundance of POC infected with PL) lesser shading may or may not result.

Angular canopy density (a measure of shade quality) can be used to track changes in shade from forest vegetation. Old-growth coniferous stands in western Oregon average 80 to 90 percent angular canopy density (85 to 90 percent shade), and undisturbed riparian coniferous forests in northern California average 75 percent angular canopy density (80 percent shade) (Beschta et al. 1987). Shade greater than about 80 percent may have no further effect on stream temperature decrease (Boyd 1996).

Shade calculation using a shade simulation computer program was used to simulate a general shade scenario for uninfected mid-drainage and valley streams on ultramafic parent material. The north-south, intermediate, and east-west orientations were modeled. Results showed that if POC was the dominant riparian cover present (as may be the case in many ultramafic riparian plant communities), then 86 percent, 88 percent, and 88 percent shade, respectively, would exist along the mid-drainage streams using the three aforementioned stream orientations; and 70 percent, 69 percent, and 49 percent shade, respectively, would exist along the valley streams (Parks 1993). Furthermore, the model predicts a temperature rise of 1.4 to 1.6 degrees C per mile for the mid-drainage streams and 1.8 to 3.0 degrees C per mile for the valley streams with the predicted shade cover (see Appendix 9).

Modeled shade results should be used cautiously. Factors changing shade values or stream temperature effects may include: (1) site factors; each shade reach has its own specific attributes that should be modeled; (2) secondary shade trees of another species, set back from the water's edge, perhaps on stream terraces, can increase shade above the modeled predictions; (3) lateral adjustment of streams by bankcutting can increase or reduce shade; (4) effects of riparian shade on valley streams decrease with increasing distance from the streambank when influenced by channel confinement and floodplain development—this may lead to a natural conditions equilibrium temperature in these streamtypes because vegetation has less control on temperature rise; (5) mixing of bank-stored water in river alluvium with the stream can lower stream temperature; and (6) water withdrawals can increase stream temperatures.

Water Quality Limited 303(d) Streams

Calculations, based on current data, indicate there are approximately 1,020 miles of Oregon Department of Environmental Quality listed 303(d) stream segments listed for temperature within the POC range in Oregon. This represents 8 percent of the total streams in the Oregon portion of the POC range. The listings are generally along valley and some mid-drainage streams. Because of many site variables, including various proportions of different tree species in the overstory, a site-specific analysis of each riparian plant community with an assemblage of POC would be required to determine if, and to what degree, loss of POC canopy density may have on stream temperature.

Effects of the Alternatives

Hydrology/Fisheries Interactions

Inoculum would continue to be introduced into flowing water by spread vectors under all alternatives. The probability, timing, and spatial distribution of the new occurrences vary under the alternatives. Some alternatives apply more stringent control measures in an effort to limit these new occurrences.

North Coast Risk Region (Siskiyou NF Powers Ranger District, and Coos Bay BLM District). POC is a scattered minor component of riparian associations. Since the infestation has been in the north area the longest (more than 50 years), nearly all streams (75 percent) have become infested (refer to Table 3&4-10 in the Pathology section). Approximately 20 percent of known POC distributions are in high-risk sites along streams, floodplains, bogs, fens or other low and depressional areas, or downslope from infected areas. It is estimated that an additional 10 percent of uninfected POC in these high-risk sites would become infected in the next 100 years under Alternative 1, 7 percent under Alternative 2, 5 percent under Alternative 3, 20 percent under Alternatives 4 and 5, and 4 percent under Alternative 6 (Table 3&4-10 in the Pathology section).

The loss of POC under any of the alternatives would not have a detectable effect on fish in this region. POC lost to PL in riparian zones would gradually be replaced by those of other conifer species (refer to the Ecology and Plant Associations section). In this region POC is a scattered component of riparian stands. Gaps in the canopy created by dying crowns are small and spatially distributed so average crown density (one of the factors in a shade analysis) is not reduced at a reach scale of analysis. Spaces in the canopy would typically be filled rapidly by adjacent trees broadening their canopies, release of understory trees, or seeded trees. Summer temperatures and large woody debris recruitment would be maintained within the natural range of variability in headwater streams and mid-drainage and valley streams (see discussion below).

The Siskiyou Risk Region (Siskiyou NF in Oregon and Six Rivers, Klamath, and Shasta-Trinity NFs in California). This region has seen increasing spread of PL in POC along roads and down streams in recent years. Many POC in the valley bottoms are old and range 20 to 60 inches in diameter (refer to Background section). Estimates are that 40 percent of known POC distributions are in high-risk sites along streams, floodplains, bogs, fens, or other low and depressional areas, or downslope from infected sites (refer to Pathology section). It is estimated that 27 percent of the high-risk sites are infested. Infestation predictions for the Oregon portion of the range show that an additional 31 percent of POC areas in these high-risk sites would become infested in the next century under Alternative 1, 24 percent under Alternative 2, 16 percent under Alternative 3, 62 percent under Alternatives 4 and 5, and 14 percent under Alternative 6 (refer to Table 3&4-10).

The loss of POC on headwater streams in this region under any of the alternatives will not have a detectable effect on fish because summer temperatures would not be elevated and the function of large woody debris transport would be maintained. Loss of POC on mid-drainage and valley streams within the nonultramafic portions of this region would not have a detectable effect on fish for the same reasons stated above in the North Coast Risk Region (that is, other conifer species gradually replace POC, and summer temperatures and large woody debris function are maintained). In the lower rainfall ecoregions to the east of the Coastal Siskiyous boundary, species present with POC along creeks in nonultramafic soils would be expected to colonize the canopy gaps left by POC loss, and the miles of stream are discontiguous and dispersed among watersheds (see analysis in the Ecology and Plant Associations section).

Mid-drainage and valley streams within ultramafic areas of this region would be affected by the loss of POC. Because POC mortality on these streams is not predicted to disrupt the recruitment of large woody debris (see following discussion), no effects to fish are anticipated related to its function (such as pool formation, instream complexity, and gravel recruitment). However, the loss of POC stream shade and the associated elevation of summer temperatures on these streams could have an indirect short- and long-term effect on fish. For steelhead and most salmonids this effect would not be significant under any alternative because of the very limited habitat area it involves (6 percent of the total habitat), the small contribution to the population the affected fish make, and the ability of steelhead and resident trout to move and vary their production (see the Cumulative Effects discussion).

Coho also could be affected indirectly in the short and long term by elevated summer temperatures within ultramafic areas of this region. Using steelhead distribution as an estimate of miles of coho habitat, the miles of coho streams affected by the loss of POC in the ultramafic areas would be 6 percent of the total habitat. Within this 6 percent of the miles of coho habitat affected, the impact varies according to the proposed alternatives, which are compared below.

From Alternative 1 to 6, the area affected decreases as the 100-year high-risk riparian infestation prediction decreases to the lowest percentage (41 percent) in Alternative 6 (Table 3&4-10). Under Alternative 1, 58 percent POC infestation would mean that half of the drainages could be affected by elevated temperatures due to shade loss (not that all drainages would lose half of the shade produced by POC). Under Alternative 2, this would be the case also, as 51 percent POC infestation is predicted. The indirect effect to coho from elevated temperatures would be about the same under Alternatives 1 and 2, less under Alternative 6, and the least under Alternative 3 (because of the greater size of POC buffers). Under Alternatives 4 and 5, the 100-year high-risk riparian infestation prediction of 89 percent would mean that most of the drainages in the area would be affected by elevated temperatures, and the effect on coho would be the same under both alternatives.

The indirect effect that elevation of summer temperatures could have on coho in the ultramafic drainages affected by POC mortality would be a decrease in production and survival. However, for the following reasons, this prediction must be qualified. The shade modeling results discussed in this section and given in Appendix 9 are meant to display a worst-case scenario for temperature increase resulting from POC mortality. The modeling was done for ultramafic soils areas and a homogenous stand of POC. However, POC averages less than 50 percent of the overstory in riparian ultramafic plant associations (Table 3&4-11). The current modeling programs predicting shade do not allow variable stand types resulting in variable canopy densities as inputs. Therefore, the predicted loss of shade and stream warming is overestimated. The analysis of the impacts of POC loss on streams using plant association groups indicates that a small percentage of the stream miles in ultramafic soils would be directly affected by the loss of POC. Of the total 897 miles of streams in the Ultramafic Plant Association Groups east of the Coastal Siskiyous, 192 miles (21 percent) would be affected, and within these miles, POC contributes 38 to 50 percent of the overstory. As pointed out in the discussion of this analysis in the Ecology and Plant Associations section, these miles should not be viewed as contiguous, due to the patchy occurrences of the plant associations with POC. Further, the shade modeling is based on the strip of POC up to 25 feet on each side of a stream. Live POC remaining outside of this narrow zone would be able to provide some shade. In some areas, brush species present along creeks would colonize the gaps left by POC loss and recover shade.

The loss of POC on stream segments in the ultramafic areas would not be anticipated to have a significant short- or long-term effect (see the Cumulative Effects discussion) on coho under any alternative because of the very limited habitat area it involves (6 percent of the total habitat), the limited shade loss that could actually result on a given segment of stream, and the relative contribution to the population the affected ultramafic areas make. The significance of the potential for decreased production and survival of coho in the ultramafic areas must be analyzed in the context of the importance of those areas for coho production in the region. The Illinois River anadromous fisheries are a stronghold for wild anadromous fish repopulation in the Rogue Basin. The majority of wild coho in the entire Rogue Basin spawn in the Upper Illinois River. Ultramafic-influenced streams are not characterized as providing optimal salmonid habitat, and less coho production comes from the ultramafic portions of the upper watershed than from the nonultramafic portions (USDA and USDI 1997; Rogue Valley Council of Governments 1996).

The Disjunct California Risk Region has POC in highly scattered drainages in different vegetation types, and often confined to riparian areas. Infection incidence is less than 10 percent. Estimates are that 40 percent of known POC distributions are along streams, floodplains, bogs, fens, or other low and depressional areas, or downslope from infested sites (refer to Pathology section).

Inland Siskiyou Risk Region (Medford and Roseburg BLM Districts). POC is generally scattered on the Roseburg District in the Coast Range of the Umpqua Basin. POC on the Medford District is primarily associated with riparian areas, particularly on the Grants Pass BLM Resource Area (refer to Background section). Estimates are that 60 percent of known POC distributions are in high-risk sites along streams, floodplains, bogs, fens or other low and depressional areas, or downslope from infested sites (Goheen, D.J., *personal communication*). It is estimated that 15 percent of the high-risk sites are infested. Infestation predictions show that an that an additional 34 percent of POC areas in high-risk sites would become infested in the next century under Alternative 1, 25 percent under Alternative 2, 17 percent under Alternative 3, 68 percent under Alternatives 4 and 5, and 15 percent under Alternative 6 (Table 3&4-10 in the Pathology section).

In the Roseburg BLM District portion of the region, the loss of POC under any of the alternatives would not have a detectable effect on fish. POC lost to PL in riparian zones would gradually be replaced by those of other conifer species (see analysis in Ecology and Plant Associations section). Summer temperatures and large woody debris recruitment would be maintained within the natural range of variability in headwater streams and mid-drainage and valley streams (see following discussion).

In the Medford BLM District portion of the region, the loss of POC on headwater streams under any of the proposed alternatives would not have a detectable effect on fish because summer temperatures would not be elevated and the function of large woody debris transport would be maintained. Loss of POC on mid-drainage and valley streams within the nonultramafic portions of this region would not have a detectable effect on fish for the same reasons stated above for the Roseburg BLM District portion.

The loss of POC stream shade and the associated potential elevation of summer temperatures in mid-drainage and valley streams within ultramafic areas of this region would have an indirect short- and long-term effect on fish. The effects are the same as described above for the mid-drainage and valley streams within the ultramafic areas of the Siskiyou Region.

Headwater Confined Stream Channels (1st and 2nd Order Streams)

Channels in these watershed and landform positions, on smooth to steeply dissected descending sideslopes, share several stream and riparian attributes common to all alternatives. These channels are most often intermittent or ephemeral. Since these channel types are laterally constrained by hillslopes and streamflow is vertically contained in the channel, only POC that is not already dead and in or near the water column would be affected. There may be some spatially distributed ongoing declines in root strength with infected POC, which could affect bank stability. However, this effect is localized and is not expected to significantly increase slumps or entry of colluvial material into the channel. Windthrow of dead POC would provide a beneficial effect by increasing the hydraulic roughness and creating a random-to-stepped stream profile. However, POC may persist as standing snags for many years before toppling. Stream large woody debris would have very long persistence and create sediment reservoirs with incorporated organic material. The streamside large woody debris recruitment rate would remain within the range of natural variability. POC overhanging the channels affected by PL would have small pocket areas of an estimated 10 to 15 percent canopy density provided by boles and branches. Winter and spring stream temperatures would remain unchanged. There would essentially be no effect on summer stream temperature relations. This is because these stream types are above the water table and go dry during the warm summer months when stream heating is at a maximum. A summary of riparian and stream attributes in differing morphologies and relationship to PL is shown in Table 3&4-18.

Variable implementation of selected management activities (current direction) under Alternative 1 may have a slight short- and long-term positive effect on lessening the spread of the pathogen through water, when compared to Alternatives 4 and 5. The geographic position of these headwater channels (in many cases in steep topography above roads or greater than 40 feet from roads) would de facto slow pathogen spread to animal or human carriers. Additionally, projects within the Riparian Reserves require Aquatic Conservation Strategy consistency. Current management direction regarding POC would be taken into consideration during these analyses.

Management practices under Alternative 2 are applied in a more structured approach by application of the POC Risk Key. Although the Standards and Guidelines in Alternative 1 use the elements of the risk key, the effects of Alternative 2 may be slightly improved in the short and long term. Systematic planning, direction of limited resources, and operational consistency in avoiding, sanitizing, or eradicating POC may result in lower spread of the pathogen. Management Practice 1 (project scheduling during the dry season) would slow PL resting spore transfer to water because road ditches and 65 to 80 percent of the stream network would be dry. Management Practice 2 (using water from known uninfested sources or treating water) would limit spore dispersal into flowing streams. Management Practice 9 (road management measures with a system of road closures in the wet season and eradication along selected roads) could substantially decrease water entry points particularly into roadside ditches and stream crossings. This would effectively reduce up to 50 percent stream extensions by roads. Management Practice 11 (washing project equipment) when implemented with Management Practices 1 and 9 may be very effective in separating inoculum from watercourses. Within 7th field watersheds, the emphasis in the risk key will provide additional benefits.

Alternatives 3 and 6 (apply mainly to the Siskiyou and Inland Siskiyou Risk Region) are expected to aggressively protect specific headwaters uninfested POC core areas by minimal entry, no timber harvest, and eradication. Since many of the 31 6th field watersheds and 162 7th field drainage core areas are above roads, this would assure that transport of the PL spores would be unlikely to spread by project activities. These alternatives would have a slight beneficial effect on retaining the flow of litter and nutrient inputs, and tree overhang

Table 3&4-18.—*Riparian and stream attributes in differing morphologies and relationships to* Phytophthora lateralis

Riparian zone and stream attributes	Headwater confined stream channels	Relationship to *Phytophthora lateralis*	Mid-drainage to valley moderately confined and unconfined stream channels	Relationship to *Phytophthora lateralis*
Normal water width	In channel	Narrow waterborne infection zone	In channel, connected off channel areas, portions of bars	Somewhat wider area of water infection zone
Flood frequency	Bankfull 100-year return interval	Narrow waterborne infection risk; stream is usually vertically contained by hillslopes	Bankfull 100-year return interval	Overbank flow; leads to wider spreading and [+] PL infection area
Watershed position	1st and 2nd Order channels; generally A+, A, and some B channel types [Rosgen 1996]	[+] Road-stream crossings; but large additive area of unroaded channels above highest crossing, minimizing infection entry, leading to [++] distribution of uninfected POC	3-highest order channels; generally B, and C, with some D and F channel types [Rosgen 1996]	[-] Road-stream crossings; but many parallel roads and roadside ditches connected to streams along infection pathways, [++] probability of infection entry, leadind to [-] distribution of uninfected POC
Dead/dying POC	Base of hillslopes at channel	[0]/[+] large woody debris recruitment; creating hydraulic roughness and stepped channel, sediment storage	Floodplains and terraces within 150 feet of the channel	[0]/[+] large woody debris recruitment; creating pools and complex habitats, portions of jam complexes in larger streams with isolated pieces on the floodplain
		[0]/[-] Bank stability [-] Canopy density		[0]/[-] Bank stability [-] Canopy density leading to [Ñ] shade; wider width on floodplains where more water spreading and POC abundance
		[0]/[-] Nutrient input [0] Winter stream temperatures [0] Diurnal stream temperature change; winter/spring		[-] Nutrient input [0]/[-] Winter stream/spring temperatures
				[0]/[+] Stream temperatures in nonultramafics [++] Summer stream temperatures in ultramafics

[1] [0] = no change expected; [+] = increased; [++] = much increased; [-] = less [Ñ] = much less.

with canopy shading in the short and long term. These conditions should maintain intermittent stream winter and spring water temperatures from being cooler than normal and buffer against higher day/night temperature swings. Furthermore, there would be a better chance of natural large woody debris recruitment over temporal and spatial scales in the range of natural variability within the riparian zone. This in turn would trap sediment and organic material and buffer downstream reaches from sediment pulse inputs from infrequent floods.

Alternatives 4 and 5 are similar to each other in that no specific management measures would be applied, other than a POC resistance breeding program in Alternative 4 and general discontinuance in Alternative 5. Effects on water and aquatic resources, above highest road crossings, would be similar to Alternatives 1 and 2 in the short and long term. Effects to POC mortality below roads would likely be greater in the short and long term because there is no containment strategy for PL spread. Even though seed is available for planting resistant stock in the North Coast Risk Region, many sites are inaccessible, small, and not likely to be replanted. Additionally, edaphic conditions suggest that other tree species can easily occupy the sites in this region. Seed would not be available for planting resistant stock in much of the Siskiyou Region until 2010, and is not planned under Alternative 5. Many sites are inaccessible and not likely to be replanted. Seed would not be available for planting resistant stock in the Inland Siskiyou Risk Region under Alternative 4 until 2010, and would not be planned under Alternative 5.

Several regional differences by stream type and watershed position that could influence hydrologic/aquatic effects from loss of POC are summarized in Table 3&4-19. In headwater channels of the North Coast Risk Region, stream debris flows and torrents occur in the sedimentary formations on steep dissected slopes. Presence of dead POC may or may not increase the rate of debris flows over natural levels, because the tree is a minor species in relative abundance and is not likely to affect the matrix of tree roots that hold the banks together. None of the alternatives should have an effect on the chronic loading with debris and sediments and episodic excavations as debris flows.

In the Siskiyou Risk Region, higher surface rock content may lead to some overland flow and higher drainage densities during storms. Some nonchannel-related POC might be vulnerable to infection, particularly in those areas below roads where drainage relief culverts could spread water on the way downslope to a channel. Furthermore, seasonal intermittent snow accumulation and rapid melt above 2,000 foot elevations could cause some overland flows in this region. In order of protection, Alternatives 6 and 3, and to a lesser extent Alternatives 2, and then Alternative 1, would best protect uninfested POC stands in near channel upslope areas.

Mid-Drainage to Valley Moderately Confined and Unconfined Stream Channels (3rd Order+ Streams)

Several riparian zone and stream attributes are common to all alternatives in these landform and channel types. The streams are mostly perennial and have year-round flow. There is a lower incidence of stream/road crossings, but these are larger streams with many parallel roads and road-ditch stream connections, indicating probable pathogen entry points. Furthermore, these channel types are subject to water-spreading during flooding by overtopping the normal channel. The severity of flooding depends on stochastic precipitation events that would control the widths of the floodprone area where new infestations could occur. De-

Table 3&4-19.—*Regional hydrologic/aquatic differences and effects from Port-Orford-Cedar infection*

Region	Headwater confined stream channels	Effect	Mid-drainage to valley moderately confined and unconfined stream channels	Effect
North Coast Risk Region	[0]/[+] large woody debris channel loading	Episodic debris torrents occurring in headwater channels	Many larger streams do not have floodplain connectivity	[-] Overbank flooding; and [-] risk of spread of PL into the riparian stand
	Mixed riparian stands with [++] hardwood component, exposing open sky in winter/spring	[0] Winter and spring stream temperatures and diurnal fluctuations	Favorable edaphic conditions	Alternative replacement species regeneration
		[0] Nutrient availability		
	Favorable edaphic conditions	Alternative replacement species regeneration		
Siskiyou Risk Region	[+] Surface rock content [0]/[+] Drainage density	[+] Overland flow causing extension of stream network; rapid snowmelt above 2,000 feet may flow overland in certain areas [+] Runoff/unit area	Mid-drainage POC mortality	[0]/[+] Episodic mid-drainage inner gorge slides partly due to loss of root strength
Inland Siskiyou Risk Region	Ultramafic parent material and serpentine soils	Limitation on POC growth, density, and replacement of POC mortality by other species	Ultramafic parent material and serpentine soils	Limitation on POC growth, density, and replacement of POC mortality by other species

[1] [0] = no change expected; [+] = increased; [++] = much increased; [-] = less; [N] = much less.

clines in root strength from standing POC mortality may lead to windthrow or localized undercutting by stream currents, especially on the outside of channel bends. This is expected to have beneficial effects for aquatic habitat by providing increased pool depths, complex habitats, and cover. However, if too wide of an area of dead POC is present, the stream may move laterally across the floodplain, the channel may widen, and may not be in equilibrium. POC trees that topple into the streams would create scour pools in the medium-width channels and become parts of jam complexes or be distributed on the floodplains in wider channels. A summary of riparian and stream attributes in differing morphologies and relationship to PL is shown in Table 3&4-18.

In the North Coast Risk Region POC is a minor species and widely scattered in the riparian area. Many larger streams do not have floodplain connectivity (F type channels), which would limit the waterborne spread of PL into riparian POC. Where floodplains are present, other species of conifers or hardwoods would quickly replace infected POC where there are dead crowns and localized holes in the canopy. Edaphic conditions are generally favorable and there is very high competition for light. Replacement species should phase-in as infected POC diminish. Effects on stream temperature would likely be within the range of natural variability, regardless of alternative selected. Alternatives 3 and 6 would have no effect in this region (over Alternative 2) because there are no uninfested 6th field watersheds.

In the Siskiyou and Inland Siskiyou Risk Regions infected POC with dead crowns may contribute to more expansive holes in the canopy in riparian areas along streams. Infections of POC with PL would result in lesser amounts of shade than a healthy stand. Cedar trees that undergo PL mortality still have branches and boles that remain standing for many years. Field studies show that canopy density for this condition on the Siskiyou NF to be in the range of 10 to 15 percent (Parks, C., *personal communication*). On soils derived from ultramafic materials, shading may be reduced for long time periods. Other tree species have difficulty occupying the site due to waterlogged soils with unfavorable chemistry. Western white pine can occupy these sites, but is susceptible to white pine blister rust (refer to Ecology and Plant Associations section).

A lag time can be expected where alder, tanoak, or other pioneer hardwood species invade openings on many POC riparian sites. Alder and other hardwoods will sometimes provide shade over streams within 3 to 5 years of colonization. Study sites along the Smith River in California showed increased amounts of red alder following the death of POC. This would provide abundant shade in the short term. Alder downed wood, however, decays relatively rapidly and is typically of small diameter. Monitoring data on the Medford BLM District shows a residence time for small (less than 12 inches in diameter) alder logs being in excess of 5 years in a 2nd Order perennial stream. Hardwoods, as they mature, are less desirable as downed material for stream function because they are often of smaller diameter than conifers and do not last as long. Whether conifers eventually become established in these streamside areas depends on site conditions and disturbance history. Planting of resistant POC stock will eventually mitigate some of the effects.

POC mortality causing shade loss would be greater where standing water or wider floodplains are present, inoculum is present, and POC is more open grown with a high relative abundance. Mortality may elevate summer stream water temperatures. The amount of temperature increase would depend on stream and site factors, the extent of POC abundance, whether POC is along the stream (primary shade) or further back on the floodplain (secondary shade), and the severity of the infestation. The north-south, intermediate, and east-west orientations were modeled for shade loss with POC mortality. Assumptions and results are shown in Table A9-2, Appendix 9. Shade modeling suggests that shade in mid-drainage streams may decrease by 9 to 14 percent, and 9 to 19 percent in valley streams. Further, stream temperatures in mid-drainage streams may increase 1.1 to 1.6 degrees C per mile and 0.5 to 1.2 degrees C per mile in the valley streams. The degree of change modeled would be greatest for Alternative 5; the other alternatives would have lesser change. Partial mortality or stands less than 100 percent POC cover would yield a greater shade estimate and lower temperature rise estimate. However, this condition is more difficult to model and data would need to be field collected. Modeled shade results should be used cautiously (refer to the affected environment for further explanation). For comparison, numerous watershed studies in the coast range of Oregon for clearcut harvesting show maximum temperature increases of 3 degrees to 8 degrees C (Bescha et al. 1987).

Alternative 1

Implementation of selected management activities (current direction) under Alternative 1 may have some effect on lessening the spread of the pathogen through water by limiting pathways for entry, or eradicating infestation centers that could reinfect healthy cedars downstream. Most mid-drainage and valley streams have chronic infection, more in the north and less in the south and inland parts of the POC range. This alternative would most likely be more effective than Alternatives 4 and 5, but slightly less effective than Alternatives 6, 3, and 2, in the short and long term.

There is some risk to fish from the use of Clorox bleach. PL-contaminated waters used for washing and firefighting will be disinfected with a 50 parts per million concentration of sodium hypochlorite, the active ingredient in Clorox bleach. Adding Clorox bleach to water after tanks have been filled and away from the fill site can lessen this risk. Wash stations would be located to avoid direct flow of treated water into streams and other bodies of water, so there should be little or no effect to fish from that source. Direct input of chlorinated water could result from wildland fire operations and would be small in scale and of short duration. Sodium hypochlorite, the active ingredient in Clorox bleach, is a strong oxidizing agent and quickly breaks down in the presence of organic matter producing water and chloride ions. See Appendix 4 for additional information about Clorox's chemistry, toxicity, effect on fishes, and other ecological and environmental relationships.

Alternative 2

Management practices under Alternative 2 are applied in a more structured approach by application of the POC Risk Key. Although the Standards and Guidelines in Alternative 1 use the elements of the risk key, the effects of Alternative 2 may be slightly improved in the short and long term in most areas—and substantially improved in the uninfested 7th field watersheds. Systematic planning, direction of limited resources, and operational consistency in avoiding, sanitizing, or eradicating POC may result in lower spread of the pathogen. Management Practice 1 (project scheduling during the dry season) would slow PL resting spore transfer to water because road ditches and 65 to 80 percent of the stream network would be dry. Management Practice 2 (using water from known uninfested sources or treating water) would limit spore dispersal into flowing streams. However, if Clorox is used to treat water and there is an unintentional spill into surface water, there may be harmful effects on fish and aquatic life. Management Practice 9 (road management measures with a system of road closures in the wet season and eradication along selected roads) could substantially decrease water entry points, particularly into roadside ditches and stream crossings. This would effectively reduce up to 50 percent stream extensions by roads. Management Practice 11 (washing project equipment) when implemented with Management Practices 1 and 9 may be very effective in separating inoculum from watercourses. Within uninfested 7th field water-sheds, use of these practices is even more emphasized by reference in the risk key.

The Clorox bleach risk discussed in Alternative 1 applies to Alternative 2 as well.

Alternatives 3 and 6

Alternatives 3 and 6 are similar in that they both involve POC cores and watershed buffers at the larger to smaller 6th and 7th field-sized watersheds. These alternatives incorporate the features of Alternative 2, and add additional measures to control the spread of PL within 31 and 162 currently uninfested subwatersheds (generally 10,000 to 40,000 acres) and catchments (generally 1,000 to 10,000 acres). Alternative 6 watersheds are more widely distributed throughout the POC range, excluding the Coos Bay and Roseburg BLM Districts, and include most of the POC core areas of Alternative 3. Alternative 3 features a larger acreage of watershed buffers (460,500 acres) throughout the POC range, when compared to Alternative 6 watershed buffers (219,000 acres). These POC buffers in Alternative 3 sur-round substantially greater miles of anadromous fish and Oregon Department of Environmen-tal Quality current water quality limited 303(d) streams, when compared to Alternative 6. Alternative 3 and 6 POC cores more frequently occupy higher positions in the watersheds along headwater to mid-drainage streams. Therefore, there should be a lesser probability of downstream spore transport and reinfection to mid-drainage and valley stream segments in these stream systems.

The Alternative 3 design would provide greater protection for fisheries and water resources, when compared to Alternative 6, because of the greater size of the POC buffers, and because multiple 6th field drainages often form contiguous larger areas. Besides limiting the uninfested POC cores to entry by common pathogen vectors, and subsequent waterborne dispersal, Alternative 3 (like Alternative 6) would also require management measures includ-ing transportation analysis, which could lead to road closures or seasonal use. These actions would slow the dispersal of the pathogen, and secondarily improve water quality slightly by reducing road-related sediment delivery, particularly on winter use roads. When comparing Alternatives 1 and 2, the buffer strategy of the POC cores encompassing watersheds may yield a slightly higher protection in the short and long term. Alternative 2 would be similar to Alternative 6, when an analysis area is within an uninfested core, because the risk key would require similar management measures, although with somewhat greater decision-maker flexibility.

POC stands in the valley bottoms on ultramafic soils tend to include larger-diameter trees (greater than 20 inches diameter) in greater abundance (refer to Background section). Where streamside uninfested stands of large trees are present in POC cores, these areas would beneficially maintain water quality; particularly lessening increases in summer stream temperatures, maintaining a continuous supply of large woody debris, and providing bank stability.

In Alternatives 3 and 6, requirements for water sources require mapping and using only untreated water from the uninfested watersheds for wildland fire operations. The risk of the Clorox bleach water treatment additive from being washed into streams from mixing areas or dumping of treated water during wildland fire operations would be essentially eliminated. These water management practices would have a beneficial effect on fishes and biota by preventing spills and short-term water chemistry changes. The Clorox risk discussion in Alternative 1 applies to Alternative 3 and 6 as well, but not particularly in the uninfested POC cores because of the requirements to use local uninfested water where possible.

Alternatives 4 and 5

Alternatives 4 and 5 are similar in that no specific management measures would be applied, other than a POC accelerated resistance breeding program in Alternative 4 and its general discontinuance in Alternative 5. In the North Coast Risk Region effects on water and aquatic resources would also be similar to Alternatives 1 and 2 in the short and long term. This is because POC is a minor riparian species in this region and 75 percent of the riparian areas are already infested in many of the lower drainages. Additionally edaphic conditions suggest that other tree species can easily occupy the sites in this area. Seed is available for this breeding block and could be planted in select areas. The planted POC would be small and not provide effective shade or large woody debris recruitment for many decades. Alte rnative replacement species including hardwoods like red alder or conifers including western red cedar or western hemlock would most likely occupy the site.

In the Siskiyou and Inland Siskiyou Risk Regions, Alternatives 4 and 5 would be less favorable than Alternatives 1, 2, 3, and 6 in the short and long term. Currently about 27 percent and 15 percent respectively of POC of high-risk riparian areas are infested. The Pathology section describes that an additional 62 percent and 68 percent of these regions will become infested in the next 100 years under Alternatives 4 and 5, compared with 16 and 17 percent under Alternative 3 (from Table 3&4-10 in the Pathology section). Seed would not be available for planting resistant stock under Alternative 4 until 2010, and is not planned for some areas under Alternative 5. Using reforestation and growth described in the Planting Assumption (found in the Assumptions and Clarifications section of this chapter), these effects begin to decrease after 100 years, particularly in Alternative 4.

Summaries of several regional differences by stream type and watershed position that can influence hydrologic/aquatic effects from loss of POC are listed in Table 3&4-19.

Effect of Private Intermingled Lands

Reciprocal rights-of-way on the Coos Bay, Roseburg, and Medford BLM Districts limit access control with private landowners and, hence, limit effective control strategies. Some roads will remain open and management direction in Alternatives 1 and 2 cannot always be implemented. Management Practice 11 (vehicle washing) for the portion of vehicles controlled by the government may reduce, but not eliminate, spore transfer to water.

Indirect Benefits of Closing Roads

Primary mechanisms of PL spread include resting spores being transported by vehicles or equipment with adhering organic or soil material, and movement by surface water (refer to the Pathology section). Road closures, particularly during the winter when runoff is the highest, can control the spread of the pathogen. Discontinuance of travel and maintenance on certain winter-use roads to lessen PL spread may also coincidently reduce sediment delivery to stream channels. This effect is variable depending on road location, surface type, adequacy of drainage structures, and closure level. Roads can be a source of chronic surface erosion, as well as occasional failures due to poor road location, construction, or maintenance (Beschta et al. 1995). Some roads, especially on BLM-intermingled lands, are encumbered by private rights, and cannot be closed without permission. Other roads that access predominantly Federal lands could be recommended for permanent or seasonal closures. This process may require an agency or district transportation system analysis and NEPA analysis to define competing needs and uses for a road segment in the short and long term. Permanent road closures normally involve decommissioning to various levels; ranging from gating a road, pulling culverts and reestablishing hydrologic flow paths while leaving the road template in place, and road ripping, reestablishing hydrologic flow paths, and establishing vegetative cover. Management measures in the risk key in Alternative 2, including seasonal and permanent road closures and no vehicle entry in POC cores, and transportation analysis and management objectives for POC buffers in Alternatives 3 and 6, would have an indirect beneficial impact on water quality and salmonids.

Cumulative Effects

POC infestation rates along streams are predicted to range from 30 to 95 percent in 100 years, depending upon risk region and alternative. In the North Coast Risk Region sedimentary-rock-derived soils, the loss of POC influencing shade or large woody debris recruitment on perennial streams is not anticipated to be measurable. Scattered distribution of POC and aggressive naturally-occurring alternative species replacement are expected to continue these processes. A gradual transfer of shading from POC to other conifer and hardwood species would most likely occur as POC trees die. The effect on fish and aquatic resources from the loss of shade or change in large woody debris supply from POC mortality would also be undetectable at multiple-watershed scales (5th to 7th field hydrologic unit codes).

Because the relative importance POC as woody debris for coho habitat depends on the proportion of POC in the headwaters, the potential impacts of the loss of POC will vary by watershed and basin (Hicks et al. 1991; McCain, M., *personal communication;* Swanston 1991). As wood source areas, the ultramafic headwater POC-dominated and sparsely vegetated areas of the North Fork Smith and West Fork Illinois Rivers would likely be the most affected by the loss, while the headwater areas of the Middle and South Forks Smith and East Fork Illinois Rivers that contain denser stands of other conifers will be less affected. Therefore, it is likely that over the long term (centuries) and on a large-basin scale, as the sources of POC decline the subsequent proportion of POC in wood jams that contribute to coho habitat would decrease. Coho habitat in proximity to ultramafic headwater areas will likely be the sites that are affected, while habitat in proximity to the other soil types and vegetation communities where POC is not dominant would not be affected (Hicks et al. 1991; Mazer and Sedell 1994; McCain, M., *personal communication*; Swanston 1991).

In the ultramafic riparian areas of the Siskiyou and Inland Siskiyou Risk Regions, POC comprises on average 50 percent of the overstory cover in plant associations where it is prominent in the overstory (refer to Table 3&4-13). The predicted increase in summer temperatures from the loss of POC stream shade in any one stream may not produce immediate effects on salmonid production. However, the cumulative effects from several tributaries can result in loss of mainstem rearing habitat downstream (USDA-FS and USDI-BLM 1985). Streams on public lands play an important role in the survival of salmonids as they provide cool water to fish habitat lower in the system and provide refugia during summer months when water temperatures are lethal (78.4 degrees F for coho) in the valley segments. The degradation of cold water refugia would have a cumulative effect on salmonid production and survival in the ultramafic portions of these regions because of the current degraded condition of valley segments due to elevated water temperatures, water withdrawals, and natural lack of flow. The magnitude of this impact must be analyzed in the context that it will take place when POC is not replaced by other species. As discussed here and in the Ecology and Plant Associations sections, this is likely on some, but not all ultramafics, or serpentine areas, which are characterized by a lack of many of the attributes of optimal salmonid habitat (USDI-BLM 2003).

Coho would be affected indirectly in the short and long term by elevated summer stream temperatures within ultramafic areas of this region. Out of 220 miles of coho habitat considered to be core areas for production in southwest Oregon, 177 miles (80 percent) are within the Rogue River Basin (Rogue Valley Council of Governments 1996). Coho are an upper tributary spawner and the majority of wild coho in the entire Rogue Basin spawn in the upper Illinois River Watershed. Approximately 40 percent of the area of the upper Illinois River, and perhaps 25 to 30 percent of the stream miles, are on ultramafic soils (USDI-BLM 2003; USDA-FS and USDI-BLM 2000). The area delineated for the analysis of plant association groups in the southeast portion of the Oregon range of POC (Ecology and Plant Associations section) most closely corresponds with the upper Illinois River Watershed. Out of 3,107 total stream miles in this portion of the range, 897 miles (29 percent) were found to be in ultramafic soils. An analysis of the entire POC range in Oregon for the miles of steelhead streams that are ODEQ 303(d) listed for temperature indicated that out of a total of 787 miles, 194 miles (25 percent) were on ultramafic soils. As a conservative estimate, 29 percent is reasonable as the portion of the upper Illinois Watershed coho habitat possibly impacted by cumulative temperature effects.

The elevation of summer temperatures would be likely to decrease reproduction and survival in coho in the drainages affected by POC mortality, due to the cumulative downstream effects of temperature increases. However, it is not possible to discretely quantify the potential decrease in production and survival because: (1) There are limited data to determine baseline juvenile coho production in these tributaries; (2) scarce information for existing summer water temperatures is available (although it is known that summer water temperatures in tributary streams in much of the ultramafic area are at the upper end of the range of temperatures that juvenile coho can tolerate); (3) little information is available describing cold water refuges where fishes can hold during periods of maximum stream heating; and (4) models that predict incremental fish losses from incremental changes in water temperature, short of temperatures predicted to be in the lethal range, have not been found. Given these uncertainties, a qualitative ranking approach to describing the potential effects to coho salmon from the alternatives is warranted.

The trend for cumulative effects under all alternatives is the same as previously stated for the ultramafic areas of the Siskiyou Risk Region, that is, Alternative 3 (due to expanded POC buffer areas) has the least effect; Alternative 6 has slightly more effect; Alternatives 2 and 1 have an increased effect; and Alternatives 4 and 5 have the greatest effect and are equal.

Under Alternatives 3 and 6, approximately 37 percent of the high-risk areas in the affected portion of the upper Illinois Watershed (29 percent) could be impacted by some level of decreased production and survival. This translates to approximately 11 percent of the coho habitat being affected. Since this habitat is within ultramafic areas, which are not characterized as providing optimal conditions for salmonids, this is probably a conservatively high estimate. The cumulative effects under these alternatives would not be significant due to the small percentage of affected area and the disproportionately small contribution the habitat makes to overall production.

Alternatives 1 and 2 differ in the portion of high-risk areas that would be affected (53 percent and 46 percent, respectively), but when applied to the affected portion of the upper Illinois Watershed, account for similar amounts of habitat, 15 percent and 13 percent, respectively. The cumulative effects under Alternatives 1 and 2 would not be significant for the same reasons given for Alternatives 3 and 6, and in addition, a major similarity between the four alternatives tends to decrease the contrast in potential effects. Whiskey Creek and the upper portion of West Fork Illinois are watersheds that, since they are currently infested by PL, would not be designated as POC core watersheds in Alternatives 3 and 6.

Under Alternatives 4 and 5, the portion of high-risk areas that would be affected (85 percent) is the same, and when applied to the affected portion of the upper Illinois Watershed, represents a cumulative effect on 25 percent of habitat in the affected ultramafic area. Alternatives 4 and 5 have intentionally been grouped in this EIS for the likelihood of having similar effects on certain resources. Alternatives 4 and 5 would show a marked difference in their effects from the other alternatives, and it is reasonable to project that their cumulative effect on coho would be significant. This effect would be mitigated somewhat for Alternative 4 in the long term.

A separate biological assessment for effects to coho (presented under separate cover for plan-level consultation) addresses which Federal actions may affect coho and what the likelihood would be of take of a threatened species under the preferred alternative. Through consultation on this plan and any subsequent implementation of it in individual projects, NOAA-Fisheries would consider the Standards and Guidelines and evaluate them for their ability to act as conservation measures in the recovery of coho and critical coho habitat. The result of that consultation will be displayed in the record of decision for the SEIS.

Approximately 25 percent of steelhead habitat would be potentially affected by the cumulative downstream impacts of temperature increases in ultramafic streams. This projection comes from the analysis of the entire POC range in Oregon for the miles of steelhead streams that are Oregon Department of Environmental Quality 303(d) listed for temperature and are in ultramafics (see above for coho). Steelhead production in the region is much more scattered than that of wild coho, and the area analyzed for cumulative effects corresponds to the ultramafic areas within the POC range in Oregon. The qualitative ranking of alternatives is the same as described for coho. The portion of high-risk areas that would be affected when applied to the affected analysis area are approximately 9 percent for Alternatives 3 and 6, 13 and 12 percent for Alternatives 1 and 2, respectively, and 21 percent for Alternatives 4 and 5.

The potential cumulative effects to steelhead would not be significant under Alternatives 1, 2, 3, and 6, for the same reasons given for coho. The cumulative effects potentially would be significant for steelhead under Alternatives 4 and 5. The effects on steelhead might be less than would be expected for coho because steelhead in the region have a stable population and are less vulnerable due to their life history characteristics (scattered distribution, temperature tolerance, variable production, mobility, and resiliency). The effects on steelhead are representative of resident trout as well due to similarity in habitat needs and life history with respect to temperature requirements. Chinook would not be likely to be impacted by indirect temperature effects on rearing habitat due to the timing of their use of the habitat. Juvenile chinook outmigrate from spawning areas during their first spring, so do not typically use tributaries in the upper watersheds that would be affected by elevated temperatures in the summer months.

Aquatic Conservation Strategy

Forest management projects implemented pursuant to selection of one of the alternatives in this SEIS will have to be consistent with all Standards and Guidelines of the applicable land and resource management plans. The Aquatic Conservation Strategy objectives are one of the land and resource management plan objectives to be considered under question 1 in the POC Risk Key in Alternatives 2, 3, and 6. If the proposed management activity is within a Riparian Reserve or Key Watershed, requirements to complete watershed analysis would also apply and provide further information about the role of POC in the potentially affected watersheds. Similarly, a need to improve water temperatures in 303(d)-listed streams would be considered a land and resource management objective under the risk key.

Most vegetation management projects are outside of Riparian Reserves (the location of most high-risk sites). Timber harvest within Riparian Reserves is only done as needed to attain Aquatic Conservation Strategy objectives, and risks of PL introduction would be weighed into that determination. And while various Agency management activities are a primary factor in PL spread, Agency management of PL helps control the potential disease trajectory through the application, depending upon the alternative, of various levels of known techniques for preventing or slowing the disease. These techniques provide considerable disease reduction. With Alternatives 2, 3, and 6, the Agencies would also be proactive in making extra efforts to prevent infestation of currently uninfested watersheds.

The analysis in this SEIS indicates all significant ecological functions for POC, including those relating to aquatic health, will be retained under at least several of the alternatives. In short, the alternatives provide managers with a suite of PL control measures that will provide for the continued ecological function of POC, and for meeting the goals of the Aquatic Conservation Strategy.

Wildlife

Affected Environment

As noted in the Background and other previous sections, POC is found in many different environments, from sea level to 6,400 feet, and is prominent in 64 plant associations. POC is commonly associated with moist areas; usually along riparian areas, but also in wet areas in the uplands. POC typically occurs as single trees or small groups in the uplands; larger groups may be located in riparian areas and alluvial fans. POC can be prominent in stands occurring in administrative units in the central portion of the POC range. POC is capable of growing to a large diameter; in serpentine sites they may be the only source of large diameter trees, snags, and down wood. In plant associations found on ultramafic soils, POC may be a prominent overstory species, especially along riparian zones. In plant associations where POC is prominent, 40 percent are on ultramafic soils, 36 percent within Oregon (derived from Table 3&4-12). High-risk POC areas constitute approximately 38 percent of the POC acres in the planning area where POC is prominent. POC occur on approximately 307,000 acres range-wide. In the 104,200 acres where POC is prominent, POC may comprise 35 to 50 percent of the overstory cover, but is not usually the dominant species (see Table 3&4-11). Within many ultramafic associations that contain POC, approximately 32,700 acres in Oregon and 41,500 acres range-wide (Table 3&4-12), POC is a prominent overstory tree, and its loss could have a negative impact upon the ecological functioning of those stands.

Chappel et al. (2001) identified two major wildlife habitat types within southwest Oregon. The Westside Lowlands Conifer-Hardwood Forest extends across western Oregon, and isolating data specific to southwest Oregon out of the data matrixes would be impossible. Queries of BLM and FS biologists have failed to yield information that would indicate that any species is specifically tied to POC (Dillingham, C., *personal communication*; Miller, R.C., *personal communication*; Webb, L.O., *personal communication*) or would be expected to be uniquely affected by the proposed alternatives. There are no terrestrial wildlife species known to be exclusively linked to POC. In general, the species found in the project area are tied more closely to habitat components. Therefore, species occurrence and habitat association data discussed here are derived based upon the Southwest Oregon Mixed Hardwood-Conifer Forest classification, the dominant type in the affected area. Johnson and O'Neil (2002) identified 226 terrestrial vertebrate species that occur within the Southwest Oregon Mixed Hardwood-Conifer Forest (Table 3&4-20). For many areas, POC has a keystone role in riparian habitats (especially in ultramafic plant associations) and provides long-lasting down wood and snags (standing dead trees) (see the Ecology section for more information).

Snags and down wood of all species are important components of the forest ecosystem. A total of 103 species utilize snags and down wood in the Southwest Oregon Mixed Hardwood-Conifer Forest habitat type (Table 3&4-20) for nesting, feeding, and cover. Ohmann and Waddell (2002) found large snag densities (20+ inches diameter at breast height) varied from 2.6 to 9.5 snags per acre (average for all successional stages equaled 5.1) in the Southwest Oregon Mixed Hardwood-Conifer Forest type. Down wood ranged from 18.3 to 29.6 pieces per acre (average for all successional stages was 21.9 pieces) (Ohmann and Waddell 2002).

Effects of the Alternatives

Potential effects to Agency special status species are discussed in the biological evaluation in Appendix 7.

Alternative 1

Under the current strategy for managing POC and PL, very few activities have effects to wildlife habitat and the associated wildlife species. Roadside sanitation efforts may modifiy and decrease POC in mid- and late-seral stages. There are approximately 9 acres of potential treatment area per 1 mile of road, although this is not all habitat. Much of the roadside sanitation area is within the original clearing limits of the road. The loss of the larger diameter POC would reduce the value of the habitat for species dependent upon large trees,

Table 3&4-20.—*Numbers of wildlife species associated with the Southwest Oregon-Mixed Conifer habitat type* [1]

Group	Number	Down wood associated	Large snag associated [>20" diameter]	Large tree associated [>20 " diameter]	Riparian associated
Amphibian	18	8	0	0	9
Bird	130	17	31	39	32
Mammal	64	32	15	19	27
Reptile	14	5	0	0	4
Total	226	57	46	58	72

[1] Reference Chappell and Kagan [2001]; number of wildlife species based upon data queries of the "Matrixes for Wildlife-Habitat Relationships in Oregon and Washington" [Johnson and O'Neil 2001].

depending on the proportion of such trees in the stand that are POC. Due to the spacing of very large trees it is unlikely that a substantial number of large-diameter trees would be removed by road sanitation in any one stand. The precise level of road treatments to occur is unknown, but it is expected to approximate that described in Appendix 2. Although snags are not removed during sanitation treatments, few snags of any species are left standing next to roads due to safety concerns.

The seasonal restriction/closure of certain roads would benefit wildlife by reducing disturbance to the adjacent habitat. Disturbance affects many species in a wide variety of ways causing them to move away from roads, thereby reducing the available habitat, increasing stress levels, predation, and nest abandonment, and reducing fecundity, depending upon the intensity, frequency, and duration of the disturbance. The closure of local and resource roads is expected to have minor landscape-scale wildlife benefits, but may be important at a local scale. ***Note:*** (1) The rural local system primarily provides access to lands adjacent to the collector network and serves travel over relatively short distances (USDI-BLM 2002); and (2) the resource road system provides access for specific management actions and connects to local or collector road systems (USDI-BLM 2002).

PL-contaminated waters used for washing and firefighting will be disinfected by mixing 1 gallon of Clorox bleach to 1,000 gallons of water. This mixture results in a sodium hypochlorite concentration of 50 parts per million (milligrams per liter) (drinking water is about 2 parts per million). The water quality criteria for total residual chlorine as determined by USEPA for freshwater aquatic species is 0.011 parts per million 4-day average, or 0.019 parts per million for 1 hour (USEPA 1984). Research into the control of zebra mussels (*Dreissena polymorpha*) showed it was an effective biocide at concentrations of 1 milligram per liter (1 parts per million) (Martin et al. 1993). Rainbow trout (*Salmo gairdneri*) exposed to a 30 minute dose showed an LC50 value of 0.43 milligrams per liter at 20 C (0.43 parts per million) while triple exposures (or 5 minutes) resulted in a LC50 of 1.65 milligrams per liter (Brooks and Seegert 1977). Wash stations would be located to avoid direct flow of water into streams and other bodies of water, so there would be little or no effects to aquatic amphibians from those sources. Direct input of chlorinated waters could result from wildland fire operations and would be small in scale and of short duration. Tanker spills and discharges of Clorox bleach-treated water into streams during fire suppression activities have been reported, with documented fish kills. This risk has been reduced in some areas by local requirements to add Clorox bleach to tank trucks after filling, away from the stream. Sodium hypochlorite, the active ingredient in Clorox bleach, is a strong oxidizing agent and quickly breaks down in the presence of organic matter producing water and salt ions. See Appendix 4 for further discussion of Clorox bleach.

Projections by pathologists indicate that 40 percent of the high-risk stands currently un-infested with PL will become infested under Alternative 1 by 2103, and that POC mortality in these infested stands would approximate 90 percent (Table 3&4-10). High-risk stands, as described in the Pathology section, include sites near streams, drainage ditches, gullies, swamps, seeps, ponds, lakes, and concave low-lying areas where water collects during rainy weather, out as far as the periodic high water mark for flooding. Loss of overstory POC could impact from 35 to 50 percent of the overstory cover (Table 3&4-11) in these areas. Fifty-eight wildlife species are associated with large diameter trees and may be negatively impacted by the loss of these structures. Impacts may include loss of forage, foraging substrate, nesting/roosting habitat, and the disruption of travel corridors. Terrestrial species may be impacted by changes to the herbaceous plant biomass in the lower strata and changes in climatic parameters, such as wind speed, relative humidity, and temperature.

Terrestrial species may also be negatively affected by loss of future woody biomass, although this effect is low for POC when compared with other tree species. The same wood chemistry characteristics that make POC a valuable commercial species may negatively impact its value to wildlife as a snag. POC is highly resistant to rot and insects and may remain intact for decades (Jules et al. 2002). Jules et al. (2002) examined increment cores from POC snags that indicated those trees died more than 100 years prior. Increment cores must be intact for accurate dating to occur. Research on yellow-cedar (*Chamaecyparis nootkatensis*), a similar species, has found that cavity nesting is rare in snags, even after they have been dead for 81 years (Hennon et al. 2002). POC snags, like yellow-cedar, possibly contribute very little to wildlife habitat components (DeMeo, T., *personal communication*; Jimerson, T.M., *personal communication*; and Hennon et al. 2002). No work has looked specifically at the wildlife contributions of POC snags/logs, but snags probably provide foraging substrate for bark gleaners and roosting/nesting habitat for those species that utilize sloughing bark. Downed logs provide hiding cover and travel corridors initially. Foraging within the log may occur as they progress into more decayed classes, although their natural resistance to decay makes it more likely that they are consumed by fire first.

POC is a prominent canopy species in 32,700 acres of ultramafic plant associations in Oregon and may be a majority in some riparian plant associations. Infestation rates in 100 years in high-risk ultramafic riparian sites will be about 40 percent (Table 3&4-10), with mortality on these infested sites of about 90 percent. This mortality may cause measurable changes at a site-specific and stand scale (such as changes in micro-climate) due to loss of shading and overstory cover. On the landscape scale, however (5^{th} field watersheds and larger), neither individual species nor guilds should disappear.

Ecosystem recovery, primarily the recovery of the overstory canopy, will be highly dependent upon the ability of the stand to revegetate naturally or upon reforestation efforts as described in the Planting Assumption (found in the Assumptions and Clarifications section of this chapter) and Appendix 6. The development of PL-resistant stock would help to restore the POC losses. Available for deployment in 0 to 40 years depending upon breeding zone (see Table 3&4-21 in the Genetics and Resistance section), larger-diameter POC are expected to be in the landscape again 80 to 100 years later.

Alternative 2

The effects of Alternative 2 are the same as Alternative 1 with the following exception.

Alternative 2 prescribes the use of a risk key for determining when mitigative measures are necessary to prevent/reduce the spread of PL, and places additional emphasis on 162 currently uninfested 7th field watersheds. This risk key would standardize the implementation of mitigative measures, and, it is projected, further reduce the infestation of drainages and the loss of POC.

Projections by pathologists indicate that 30 percent of the high-risk stands currently uninfested with PL will become infested under Alternative 2 in the next 100 years. POC mortality in that 30 percent would approximate 90 percent. Potential effects to wildlife would be less than in Alternative 1, but the overall conclusions remains the same.

As in Alternative 1, ecosystem recovery, primarily the recovery of the overstory canopy, will be highly dependent upon the ability of the stand to revegetate naturally or reforestation efforts described under Planting Assumptions (found in the Assumptions and Clarifications section of this chapter). The development of PL-resistant stock would help to restore the POC losses. Available for deployment in 0 to 40 years depending upon seed zone (see Table 3&4-21 in the Genetics and Resistance section), larger-diameter POC are expected to be in the landscape again 80 to 100 years later.

Alternative 3

The effects of Alternative 3 are the same as Alternative 2 except as follows.

Alternative 3 would provide additional protection for 31 6th field watersheds that are currently identified as being uninfested with PL.

Timber harvests would be prohibited in the 34,000 acres (Table 2-2) in the uninfested watersheds that have POC (POC cores), including 2,260 acres of Matrix and Adaptive Management Area that are currently available for regularly scheduled timber harvest and contribute to PSQ (Table 3&4-24a in the Timber Harvest section). This does not preclude salvage in the case of a stand-replacing event. Additionally, within POC cores, roads will be closed or all POC would be removed along them. This equates to about 9 acres per mile of open road. The loss of the larger-diameter trees could have some effect on ability of the stands to function for species associated with large-diameter trees. Due to the spacing of very large trees it is unlikely that a substantial number of large diameter trees would be remove due to road sanitation in any one stand. There is the potential to restrict the recruitment of large diameter POC, but with the exception of ultramafic plant associations, POC is a minor component of the overstory. The restriction against timber harvest will restrict the ability of Agencies to do commercial thinning on approximately 6,000 acres of 40- to 80-year-old stands of Late-Successional Reserves in those uninfested watersheds in order to accelerate the development of late-successional forests or restore ecological processes. Such thinning is a major strength of the Northwest Forest Plan, but with nearly 2,000,000 acres of thinning needs in the Northwest Forest Plan area, this 6,000 acres is inconsequential (0.3 percent of the Northwest Forest Plan area) to achieving Late-Successional Reserve objectives.

Projections by pathologists indicate 20 percent of the high-risk stands currently uninfested with PL would become infested under Alternative 3 in the next 100 years, and POC mortality in these infested stands would approximate 90 percent. As with Alternatives 1 and 2, loss of overstory POC could impact from 35 to 50 percent of the overstory cover (Table 3&4-11). Fifty-eight wildlife species are associated with large-diameter trees and may be negatively impacted by the loss of these structures. Impacts may include loss of forage, foraging substrate, nesting/roosting habitat, and the disruption of travel corridors. Terrestrial species may be impacted by changes to the herbaceous plant biomass in the lower strata and changes in climatic parameters, such as wind speed, relative humidity, and temperature. Terrestrial species may also be negatively affected by loss of future woody biomass, although this effect is low for POC when compared with other tree species for the reasons described under Alternative 1.

Ecosystem recovery, primarily the recovery of the overstory canopy, will be highly dependent upon the ability of the stand to revegetate naturally or upon reforestation efforts as described in the Planting Assumption (found in the Assumptions and Clarifications section of this chapter). The development of PL-resistant stock would help to restore the POC losses. Available for deployment in 0 to 40 years depending upon breeding zone (see Table 3&4-21 in the Genetics and Resistance section), larger-diameter POC are expected to be in the landscape again 80 to 100 years later.

Alternative 4 and 5

These alternatives remove all mitigation measures currently used by the BLM and FS to limit the spread of PL across the landscape. The alternatives differ from each other only in the level of resistance breeding to continue. Under Alternative 4, the current breeding and testing program for the development of resistant stock would be accelerated. Within 10 years, resistant seed and planting stock will be available for all breeding zones in Oregon. Under Alternative 5, the further identification and testing of new resistant trees would cease, but use of resistant seed from the currently developed breeding zones would continue. These cover approximately 26 percent of the breeding zones.

Projections by pathologists indicate that 80 percent of the high-risk stands currently uninfested would become infested in the next 100 years. Loss of overstory POC could impact from 35 to 50 percent of the overstory cover (Table 3&4-11). Fifty-eight wildlife species are associated with large diameter trees and may be negatively impacted by the loss of these structures. Impacts may include loss of forage, foraging substrate, nesting/roosting habitat, and the disruption of travel corridors. Terrestrial species may be impacted by changes to the herbaceous plant biomass in the lower strata and changes in climatic parameters, such as wind speed, relative humidity, and temperature. Terrestrial species may also be negatively affected by loss of future woody biomass, although this effect is low for POC when compared with other tree species for the reasons described under Alternative 1.

Ecosystem recovery, primarily the recovery of the overstory canopy, will be highly dependent upon the ability of the stand to revegetate, either naturally or under reforestation. The development of PL-resistant stock would help to restore the POC losses—Alternative 4 more than Alternative 5. In Alternative 4, seed will be available for all zones within 10 years (see Table 3&4-21 in the Genetics and Resistance section), and larger-diameter POC are expected to be in the landscape again 80 to 100 years later. Resistant stock would not be developed for some breeding zones under Alternative 5, and replacement of large-diameter trees in infested areas could take centuries or may never be replaced.

Alternative 6

The effects of Alternative 6 are the same as Alternative 3 except as follows.

Alternative 6 would provide additional protection for 162 7th field watersheds that are currently identified as being uninfested with PL (rather than the 6th field watersheds described in Alternative 3). Timber harvest would be prohibited in the 49,675 acres (Table 2-3) that have POC (POC cores), including 3,010 acres of Matrix and Adaptive Management Area that are currently available for regularly scheduled timber harvest and contribute to PSQ (Table 3&4-24b in the Timber Harvest section). This does not preclude salvage in the case of a stand-replacing event. Additionally, within POC cores, roads will be closed or all POC would be removed along them. These equates to about 9 acres per mile of road. The loss of the larger diameter trees could have some effect on ability of the stands to function for species associated with large diameter trees. Due to the spacing of very large trees it is unlikely that a substantial number of large diameter trees would be remove due to road sanitation in any one stand. There is the potential to restrict the recruitment of large diameter POC, but, with the exception of ultramafic plant associations, POC is a minor component of the overstory. The restriction against timber harvest in POC core areas will restrict the ability of Agencies to do manage stands in Late-Successional Reserves to accelerate the development of late-successional forests or restore ecological processes. Such thinning is a major strength of the Northwest Forest Plan, but with nearly 2,000,000 acres of thinning needs in the Northwest Forest Plan area, this amount is inconsequential.

Projections by pathologists indicate 18 percent of the high-risk stands currently uninfested with PL would become infested under Alternative 6 in the next 100 years, and POC mortality in these infested stands would approximate 90 percent. As with Alternatives 1 and 2, loss of overstory POC could impact from 35 to 50 percent of the overstory cover (Table 3&4-11). Fifty-eight wildlife species are associated with large diameter trees and may be negatively impacted by the loss of these structures. Impacts may include loss of forage, foraging substrate, nesting/roosting habitat, and the disruption of travel corridors. Terrestrial species may be impacted by changes to the herbaceous plant biomass in the lower strata and changes in climatic parameters, such as wind speed, relative humidity, and temperature. Terrestrial species may also be negatively affected by loss of future woody biomass, although this effect is low for POC when compared with other tree species for the reasons described under Alternative 1.

Ecosystem recovery, primarily the recovery of the overstory canopy, will be highly dependent upon the ability of the stand to revegetate naturally or upon reforestation efforts as described under Planting Assumptions in the Assumptions and Clarifications section of this chapter. The development of PL-resistant stock would help to restore the POC losses. Available for deployment in 0 to 40 years, depending upon breeding zone (see Table 3&4-21 in the Genetics and Resistance section), larger-diameter POC are expected to return to the landscape in 80 to 100 years.

Cumulative Effects

The effects described above for both PL-caused mortality and for application of various management practices (described above) also need to be considered in context with other reasonably foreseeable actions or events that could affect the same habitat or species. Wildlife habitat could be affected by timber sales or fuel treatment activities, but to a lesser degree other forest management activities.

As noted above, no wildlife species were identified that were exclusively linked to POC. Even POC snags are lesser used than those of other species. Effects to wildlife are thus linked to loss of specific habitat components. Land and resource management plans identify minimum snag and downed log numbers to be maintained during timber sales and other management activities. Since PL increases POC snag and down low components in the short term, but could decrease such features in the long term, only timber sales and other tree-removing activities affecting long-term snag recruitment would have a cumulative detrimental effect. No harvest method reduces long-term snag availability, because trees grow back. Effects of PL-related loss of stands in the Matrix Northwest Forest Plan land allocation would be exacerbated by planned timber harvest, but harvest of Matrix acres is already planned and PL-mortality would only affect timing and arrangement, and then only of the POC portion of the stands, but not the total acres affected.

As noted above, roadside sanitation could adversely affect species associated with late-successional or old-growth habitat (also see biological evaluation, Appendix 7). Such sites are within larger late-successional or old-growth habitat habitats within reserves. No other management activities, except in rare cases the need to remove fire-prone stands, would remove late-successional or old-growth habitat stands in these same areas, so there is no significant cumulative effect on late-successional or old-growth habitat-associated species.

Pacific Yew

Affected Environment

The Pacific yew tree and shrub is unique in western forests, growing inconspicuously either individually or in small groups in the understory of Douglas-fir and other conifer forests. Although important to American Indians and a small contingency of woodworkers, it was overlooked by modern society until taxol, a promising cancer fighting compound extracted from yew, was discovered. Demand soared, and in September 1993, the FS, BLM, and U.S. Food and Drug Administration released the final EIS for the management of Pacific yew. This document provided a comprehensive analysis of Pacific yew including inventories, autecology, occurrence, reproduction and growth forms, effects of management, genetics, ecosystem function, and response to damaging agents including PL. At that time, a total of 19 infected Pacific yew trees had been identified, all in areas with infected POC. Harvest accelerated for a few years, until a synthetic taxol virtually eliminated the need to harvest yew trees. Interest in natural taxol has recently resurfaced, and the future demand is uncertain. However, there are numerous plant communities where Pacific yew grows and POC does not, and from which yew could be collected. For example, Pacific yew is found in 40 plant associations on the Rogue and Umpqua National Forests where POC does not grow.

As noted in the Pathology section, Pacific yew is infected by PL on infrequent occasions (Kliejunas 1994). It has been suggested this is cause for concern, and that this SEIS needs to address Pacific yew in detail, reevaluating the analysis made in the 1993 Pacific yew EIS. However, observations and laboratory trials show that Pacific yew is much less susceptible to PL than POC. Where it has been found infected, yew was growing in close association with many previously infected POC (Murray and Hansen 1997). PL can infect Pacific yew, but rarely.

For the purposes of this analysis, it is concluded there is no evidence that Pacific yew will carry PL on its own, or that PL poses a significant threat to yew.

Effects of the Alternatives

Pacific yew growing in close association with numerous POC will potentially be more susceptible to future PL infections. The potential for incidental Pacific yew growing on high-risk sites to become infected varies by alternative in proportion to the percent of POC predicted to become infected (Table 3&4-8). Within disease-infested areas, yew infections will follow the same infection patterns as those outlined in the Pathology section; that is, they will become infected on infrequent occasions. There are numerous plant communities where Pacific yew grows and POC does not. For example, Pacific yew is found in 40 plant associations on the Rogue and Umpqua NFs where POC does not grow. In all alternatives, overall yew infection rates are expected to be inconsequential.

Genetics and Resistance

Affected Environment

Genetic Variation

Genetic diversity among and within species is the basis for all biological diversity. Most plant species exhibit a large amount of genetic variation, which reflects adaptation to local environmental conditions (Linhart 1995). Paleobotanical evidence indicates that POC formerly occupied a vastly wider range and that restriction to its present distribution left considerable variation intact (Edwards 1985). Such diversity is an asset in allowing a species to survive and adapt to new, changing environments (such as when POC is affected by PL) (Kitzmiller et al. 2003). Knowledge of the patterns of this variability is crucial for successful genetic management, whether in designing elaborate resistance breeding programs, or in developing more passive conservation strategies for natural ecosystems. Recent studies of this genetic variability can be grouped into two major categories: allozyme studies and common garden studies.

Allozyme studies. Electrophoretic analysis of allozymes allows relatively quick, inexpensive quantitative measures of genetic structure, genetic diversity, and mating systems. They are often employed as a first step in describing and understanding the genetic architecture of a species.

In three studies conducted on POC, populations in California were moderately variable in allozymes (comparable to values for other California conifers with small- to moderate-sized distributions, but notably lower than most widespread conifers). Across all stands, 5 percent of total allozyme variation was attributed to differences among stands, and 95 percent to differences among trees within stands (Millar and Marshall 1991). Elevation was the strongest ecological factor associated with genetic differentiation, but at low elevations, soil contrasts (serpentine versus nonserpentine) was nearly as great (Millar et al. 1991). Overall, relationships between ecological habitat, allozyme diversity, and genetic differentiation over short geographic distances were markedly greater for POC than for more widespread Douglas-fir and white fir (Millar et al. 1991). Sampling on a much wider scale showed contrasts between populations from California and Oregon (Millar et al. 1992). For example, while the mean allozyme diversity was slightly greater for Oregon, the range of diversity was greater in California. In addition, the Oregon cline among populations in allozyme variation was strongest along latitudinal, weaker along longitudinal, and weakest along elevational gradients. In California, the cline was strongest along longitudinal strata, although elevation was also a relatively strong determinant of allozyme diversity (Millar et al. 1992).

Collectively, these studies show that a large number of common alleles associated with allozymes reside in any given population. Therefore, even if scattered stands over the species' range were completely lost in the future, common alleles would not be compromised. However, as expected from quantitative genetics theory, these studies have also illustrated that POC does contain rare alleles, especially at the margins of its range (Anonymous 1994; Millar and Marshall 1991). By their paucity, these genes are more likely to be lost (even from stochastic random events), and, although none have yet been documented as lost to PL root disease, such a probability seems almost certain. On the other hand, selection pressure from PL may also increase the frequency of other rare genes, including those exhibiting "major," as well as quantitative, resistance to the disease (see Program to Develop Genetic Resistance and Gene Conservation discussions). Actual expiration of any population of POC by PL has yet to be documented (Anonymous 1994), nor is it predicted to be by this analysis.

While allozyme studies are useful in describing genetic variation in allozymes, they cannot show definitive, adaptive responses to field environments over time. Investigations of these responses are best accomplished by common garden studies.

Common garden studies. As the name implies, common garden tests are often designed to compare variation patterns of a few to relatively large numbers of genetic identities (those may include provenances, open-pollinated, or controlled-pollinated families, and clones), all grown in at least one, but frequently several, test sites, or "gardens." By careful selection of genetic entries, choice of uniform garden(s) representing environmental gradients or extremes, proper experimental design and statistical analyses, and appropriate management, these research sites can yield a wealth of practical information about genetic variation. If maintained judiciously over time they may also allow evaluation of genetic adaptation to infrequent events (such as severe frosts, droughts, and new disease epidemics) or more subtle future changes (such as global cooling or warming).

In 1995 the BLM and FS began to establish range-wide, common garden tests to further evaluate the genetic variability within POC. Seed was collected from 344 healthy parent trees on Federal land between 1991 and 1994. Stands were sampled throughout much of the species' range; their selection assisted by results of the earlier allozyme studies, noted above. Two different hierarchical models were employed to partition the genetic effects: (1) ecological or watershed model with watersheds, stands, and families; and (2) a breeding model with breeding zones, seed zones, and families (Kitzmiller et al. 2003).

Short-term studies of height growth response (Kitzmiller and Sniezko 2000), height growth phenology (Zobel et al. 2002), and water relations of terminal shoots (Zobel et al. 2001) were conducted, utilizing seedlings from families transplanted in raised beds at two nursery sites (Dorena, near Cottage Grove, Oregon, and Humboldt Nursery, McKinleyville, California) in 1996. Seedlots from the extremes (high elevation, southern interior in California and low elevation, coastal stands near Coos Bay) of the species distribution exhibited striking contrasts in all traits. Of more practical adaptive relevance, height growth increased, while the proportion of early-season growth declined and proportion of late-season growth increased with change in source location from (1) high to low elevations, (2) from south to north, and (3) from east to west when populations spanning the range were included. Strong clinal patterns were noted for height potential with source elevation, latitude, and longitude (Kitzmiller and Sniezko 2000). Overall, these data showed population structure and geographic patterns similar to, but much stronger than, the allozyme work noted above (Kitzmiller et al. 2003).

Short-duration tests in low moisture and nutrient-stress nursery environments are not well suited to assess cumulative responses to complex, site-specific environmental stresses. Consequently, five individual common garden sites utilizing 266 of the families included in the nursery tests were planted in 1996 to 1998. Data collected on the Humboldt and Trinity Lake plantations for 3 years showed mean height was inversely related to survival at the inland site. Data collected for 5 years revealed a geographic cline in height growth associated with latitude, longitude, and elevation of seed origin. Northern, low elevation, coastal provenances grew taller than southern, high elevation, interior sources at both plantations. However, these faster growing sources also showed the greatest relative reduction in growth and survival when planted at the inland site.

Growth measurements are scheduled to continue, episodic events will be assessed, and genetic effects evaluated. Even very harsh sites with poor survival have value. For example, Sharpe (2002) assessed drought-prone sites (Althouse and Trinity Lake), as well as greenhouse environments. Her findings generally supported those of Zobel et al. (2001); mid-day field water potentials were correlated with survival of seedlings from different breeding blocks. Root growth and morphology also varied among seed sources, with probable adaptive consequences (Sharpe 2002). These data could be helpful in designing PL resistance mechanism studies.

Overall, these POC genetic variability studies fit with the classical, theoretical population genetics theory of changing responses to mutation and genetic drift, as confounded by various selection pressures (over time and space) and by migration patterns and rates (Namkoong 1979). Practically, the gradual clinal trends collectively imply adaptive changes in gene frequencies across the species' range. These data were all considered in developing geographic subdivisions for POC (see Breeding Block and Zone Designations as follows). They are also fundamental in breeding strategy planning (see Program to Develop Genetic Resistance to *Phytophthera lateralis*: Selection, Testing, and Breeding section), for deployment of resistant seed (see Utilization of Resistance section), and for general genetic and silvicultural management practices.

Breeding Block and Zone Designations

A breeding block designates the geographic area that envelops a number of breeding zones. Preliminary breeding blocks and zones have been delineated on the basis of a short-term genetic common garden study (Kitzmiller and Sniezko 2000) and general knowledge of southwestern Oregon and northern California species genecology (Figure 3&4-2).

Genetic common garden studies are short- and/or long-term tests that are commonly used to assess seed transfer or breeding zones (Westfall 1992). The common garden study noted genetic variation associated with latitude, longitude, and elevation of the seed sources. These macrogeographic variables, in part, imply natural selection to temperature and moisture, which affects growth initiation, growth cessation, and growing season length and climatic gradients over the range of the species. Additional studies (Millar and Marshall 1991; Zobel et al. 2001; Zobel et al. 2002) have also noted differences between the coastal and inland sources of POC in relation to allozyme, phenology, and physiological traits. In addition, a long-term common garden field study was established between 1996 and 1998 to assess

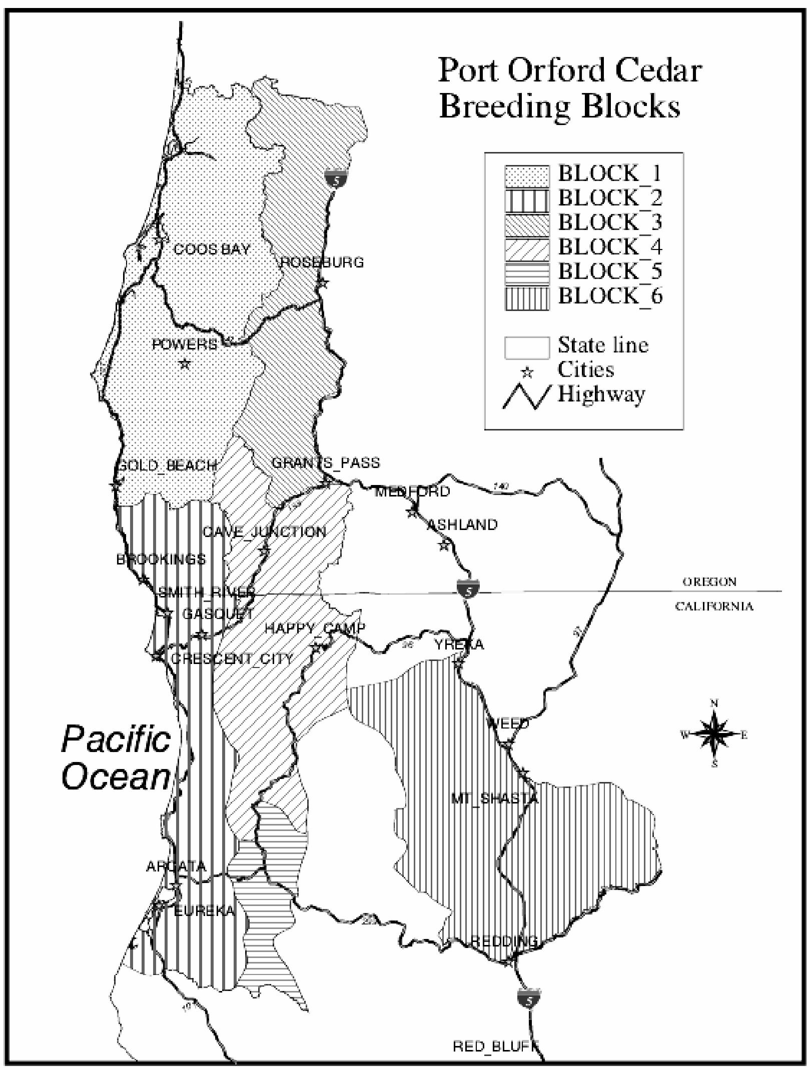

Figure 3&4-2.—*Port-Orford-cedar breeding blocks*

genetic variation patterns over a long timeframe. Future analyses of this study would be used to verify and/or refine the genetic variation patterns inferred from the short-term test.

Breeding blocks and zones represent a geographic area where genetic reproductive materials (such as seed, seedlings, and cuttings) are procured, and then subsequently deployed (seeded or planted). This insures that the seeded or planted stock are adapted to the deployed areas, and also helps conserve the natural genetic structure of the species over the landscape.

The preliminary breeding blocks and zones serve to guide seed transfer and associated breeding activities. Breeding zones are represented by elevation bands within the respective breeding blocks, and designate units of land in which seed transfer and improved populations (resistance breeding) are being developed. The elevation bands are listed in Table 3&4-21 (also see Figure 3&4-2). An elevation band within a breeding block constitutes a single breeding zone; all elevation bands are not represented in every breeding block.

Seedlots may also be delineated in the future within any respective zone on the basis of source soil type. POC occurs on both ultramafic (serpentine) and nonultramafic soil types. A number of plant species have differentially adapted to these distinct soil types (Linhart 1995), but the degree to which POC has specifically adapted is not well known.

Conservation Genetic Considerations

Conservation genetics deals with the inherent genetic diversity of a species, and has been defined as the use of genetics to preserve species as dynamic entities that can evolve to cope with environmental change, and thus minimize their risk of extinction (Frankham et al. 2002, *p. 19*). Conservation genetics is especially relevant to the current POC ecosystem dynamics where populations are being fragmented to varying degrees as the disease spreads through portions of the landscape. The basic principles of genetics can be used to assess the effect on population structure. In addition, current or future conservation measures can be assessed as to their efficacy in conserving genetic diversity. This section will discuss aspects of the following: (1) effect on POC genetic structure where PL is spreading or has been in place; (2) general genetic effects of establishing resistant stock in restoration efforts; and (3) ex situ and in situ genetic conservation measures.

1) Effect on POC genetic structure where PL is spreading or has been in place: Population-level conservation is sufficient for both genetic and species conservation with a simple to very diverse structuring (Namkoong et al. 1988). Population genetic structure refers to the amount and distribution of variation within and among populations. The genetic properties (and structure) are affected by population size, fertility, viability, migration (gene flow), mutation, selection, mating systems, and genetic drift in combination with environments (Falconer 1989).

Many forest species adjust to repeated loss (such as through disease) and subsequent reinvasion (or recolonization) of its range (Stern and Roche 1974, *p. 228*). Change in genetic structure of populations can be summarized by the changes in allele frequencies, heterozygosity, and genetic variances. When populations are completely isolated from others (where there is no gene flow from pollen or seed), fragmentation would typically lead to greater inbreeding (reduced heterozygosity), loss of genetic diversity within fragments, loss of rare alleles, and greater risk of extinction of these populations

Table 3&4-21.—*Projected resistant seed availability per breeding zone by alternative*

Breeding block/ breeding zone	Elevation band	Acres [% serpentine]	Year: Alternatives 1, 2, 3, & 6	Year: Alternative 4	Year: Alternative 5
Breeding Block 1 [Oregon]					
115	< 1,500'	50,083 [5]	2002	2002	2002
130	1,500-3,000'	95,260 [20]	2002	2002	2002
140	3,000-4,000'	20,711 [38]	2010	2010	No seed
150	4,000-5,000'	260 [41]	2030	2010	No seed
Total		166,314			
Breeding Block 2 [Oregon and California]					
215	< 1,500'	817 [16]	2040	2010	No seed
230	1,500-3,000'	1,738 [4]	2035	2010	No seed
240	3,000-4,000'	484 [10]	2020	2010	No seed
250	4,000-5,000'	39 [69]	2040	2010	No seed
Total		3,078			
Breeding Block 3 [Oregon]					
315	< 1,500'	1,902 [3]	2015	2010	No seed
330	1,500-3,000'	6,910 [27]	2010	2010	No seed
340	3,000-4,000'	1,837 [46]	2020	2010	No seed
350	4,000-5,000'	37 [100]	2045	2010	No seed
Total		10,686			
Breeding Block 4 [Oregon and California]					
415	< 1,500'	13,411 [42]	2025	2010	No seed
430	1,500-3,000'	55,919 [57]	2002	2002	2002
440	3,000-4,000'	47,931 [59]	2030	2010	No seed
450	4,000-5,000'	12,423 [13]	2015	2010	No seed
455	5,000-5,500'	1,227 [12]	2015	2010	No seed
460	5,500-6,000'	214 [8]	2025	2010	No seed
465	6,000-6,500'	55 [0]	2035	2010	No seed
Total		131,180			
Breeding Block 5 [California]					
515	< 1,500'	42 [0]	2068	2068	No seed
530	1,500-3,000'	420 [0]	2012	2012	No seed
540	3,000-4,000'	146 [0]	2060	2060	No seed
550	4,000-5,000'	230 [0]	2044	2044	No seed
Total		838			
Breeding Block 6 [California]					
630	1,500-3,000'	96 [0]	2060	2060	No seed
640	3,000-4,000'	154 [0]	2052	2052	No seed
650	4,000-5,000'	269 [0]	2028	2028	No seed
655	5,000-5,500'	453 [0]	2020	2020	No seed
660	5,500-6,000'	289 [0]	2036	2036	No seed
665	6,000-6,500'	30 [0]	2068	2068	No seed
Total		1,291			

Note:
a] See Figure 3&4-3 for geographic areas; breeding zones relate to elevation bands within the respective POC Breeding Block.
b] Some breeding blocks are entirely in either Oregon [OR] or California [CA]; others span both states.
c] Acre figures refer only to Federal land and are based upon geographic information system approximation. Percentage of land that is on serpentine soil is given in parenthesis [%].
d] Breeding Blocks 5 and 6 are in California and not part of the POC-SEIS; Alternative 4 would not apply to these.
e] Projected resistant seed availability assumes 1,250 field selections needed per breeding zone, and assumes all breeding zones would have orchards. Some breeding zones with few acres may be combined.
f] Breeding Zone 130 would be used for Breeding Zones 140 and 150 until seed for those zones were available.
g] 2010 projections under Alternative 4 assumes 20,000 new field selections would be made and tested from 2003 to 2008 [16 breeding zones x 1,250 trees/breeding zone].
h] Priorities for breeding zones are based upon 2003 input from BLM and FS POC program managers.

(Frankham et al. 2002). Since extirpation has not occurred (see Allozyme Studies section) nor is it predicted to in this analysis, the other genetic consequences are applicable in varying degrees across the species range. The most severe consequences would occur in very small, disjunct, inland locales with limited gene flow among stands.

A large segment of POC habitat can be described as a composite of numerous subpopulations (a deme or group of interbreeding individuals) where gene transfer (migration) occurs among subpopulations over time. The main factor relating to change in population structure is the rate of extinction of subpopulations and number and type of founder individuals that colonize the extinct subpopulations (Hedrick and Gilpin 1997). In addition, it is pointed out that the effective population size is increased when the rate of extinctions is reduced, and the number of subpopulations and rate of gene flow are increased. Selection pressures (as an evolutionary force) in any population will ultimately change allele frequencies to some extent. It is the combination of genetic processes that formulate both genetic structure and magnitude to which the structure changes over time.

Even after a severe PL invasion of prolonged duration, surviving natural POC persist and continue to exchange genes (both pollen and seed transfers) with neighboring subpopulations at variable amounts, depending on size, proximity, and number of subpopulations. A very analogous process would likely occur between resistant stock used to rehabilitate PL infestation sites and surviving POC from the same stand and others nearby, although gene flow may be limited and directional until planted trees reach reproductive capacity (see Genetic Resistance Program section) to balance natural trees.

In natural regeneration events, migration from neighboring subpopulations affects the local genetic structure. When small, relatively isolated stands are considered (often referred to as the island or stepping-stone model) only small numbers of immigrants (~ 1; where 1 = [effective population size] x [percent of immigrants from other populations]) in any respective generation are required to prevent loss of alleles (prevent fixation by drift) and differentiation among populations (Falconer 1989, *p. 80*; Namkoong 1979, *p. 308*). When subpopulations are more continuously distributed over the landscape (neighborhood model typical of coastal conditions) and gene frequencies are more similar (among subpopulations), the effective population size must be on the order of 20 or less (circumstances not generally found in coastal subpopulations) for a large amount of local differentiation (Falconer 1989, *p. 80*). Thus, migration helps to maintain genetic variation at the local and larger scale (macrogeographic) level.

The most severe changes in genetic structure and diversity will occur in the high-hazard isolated stands under specific conditions; such as where mortality is high, founders of resistant progeny (via natural regeneration) are minimal in number, and pollen exchange is minimal from surrounding stands. If the number of founding parents that recolonize a site are extremely low (less than three female parent trees), then conditions favorable for reduction in genetic diversity exist (higher inbreeding over shorter period of time, larger population divergence,) as opposed to the original population conditions. If the number of founders are on the order of magnitude of five or more trees in the recolonization event, then the relative impacts on genetic diversity change at the local population level are lessened substantially. Thus, high-risk sites will range in change to genetic diversity from very low to severe over the range of sites throughout the species range. However, over the respective large-scale macrogeographic regions of POC, genetic structure is expected to change little from the sole impact of PL.

Changes in allele frequency, heterozygosity, and genetic variation among and within populations can be expressed at the local population/subpopulation level and at the larger macrogeographic/regional level. As mortality and fragmentation affects a higher percentage of populations/subpopulations across the landscape, the genetic structure will be affected to a greater degree. The local affected populations may experience a reduction in heterozygosity, increased differentiation among populations, a greater loss of rare alleles, and increased differences in allele frequencies. In addition, some populations may experience a severe reduction in genetic diversity (and fitness over time) due to the limited number of founder parents (in natural regeneration) that recolonize sites. The cumulative affects at the larger macrogeographic/regional scale can be generalized in relation to the amount of changes that occur at the local population levels. In general, the cumulative allele frequencies (pooled across all populations) would change little and the common alleles (already present in numerous populations) would not be lost. There would be a loss in rare alleles, commensurate with the accumulative loss at the local population levels. The amount of heterozygosity would decrease across the larger macrogeographic scale, and the amount of genetic variation would decrease by some small degree. The distribution of genetic variation among and within populations would change to some extent, where variation among populations is increased relative to the initiation of mortality and fragmentation events. These same generalizations would apply to other catastrophic events which create similar fragmentation and loss of populations/habitat (such as wildland fires). In general, as the mortality and habitat loss increases, there is an increasing possibility of losing segments of subpopulations over time (assuming no mitigation to reestablish), and some reduction in the natural genetic variation will take place. However, there is expected to be little net effect on the genetic structure in POC over the respective large-scale macrogeographic regions of the species from mortality caused solely by PL.

2) General genetic effects of establishing resistant stock in restoration efforts: Resistant stock can be deployed to various habitats throughout the natural range in order to help restore the habitats where the disease has occurred. Once disease resistance is obtained it can be improved over time in an operational breeding program (Zobel and Talbert 1984). In addition to restoring the habitat, planting would help reestablish gene flow to a degree, enabling pollen flow and migration (seed transfer) of selectively advantageous alleles/genes to be spread to adjacent subpopulations over time (Ledig 1986).

The genetic structure of the local or subpopulations would be dependent on the effective population numbers of the planted stock in addition to the various factors presented earlier (such as gene flow and number of subpopulations). The genetic structure over the species range could be changed to a degree, depending on the scale of plantings and genetic variation of the planting stock. However, the number of plantings would probably not be on a scale sufficient to change effective population sizes over a large continuum of the respective macrogeographic regions.

3) Ex situ and in situ genetic conservation measures: Gene conservation conserves and stores gene pools which in turn helps prevent the loss of genes, gene complexes, and genotypes (Zobel and Talbert 1984, *p. 461*). In practice, application of gene conservation strategies, common genetic conservation measures that are undertaken to conserve genetic variation of a species, can be separated into two broad categories: (1) ex situ (saving genes offsite such as seed banks, clone banks, seed orchards), and (2) in situ (management of populations onsite). Saving genes with efficiency, security, and completeness are the first objectives for conserving biological diversity, and ex situ conserves genes more conveniently (Namkoong et al. 1988, *p. 152*). In situ continues the evolutionary process in the wild, but it may not be practical (Namkoong et al. 1988, *p. 152*), or the natural stands may be vulnerable to damaging agents (such as disease) or catastrophic events (Ledig 1986). Thus, conservation measures are selected and put into place to meet specified conservation objectives.

a) In Situ — Coastal Populations: Millar and Marshall (1991) suggested that in California, because of low allozyme distance among populations and high proportions of variability within stands, a few large (as opposed to many small) natural areas would conserve much of the genetic diversity in POC. The same conclusion should also apply to coastal Oregon populations. Indeed, even in stands that have been severely infested for 30 to 40 years, some seed bearing POC seem to survive, whether by favorable location on microhabitat niches that escape infection, by random chance, or by some combination of heretofore undetected genetic resistance mechanisms. Furthermore, the precocious and prolific seed production of POC (Zobel 1979), its relative shade tolerance, and ability to establish itself on a variety of seedbeds (Zobel et al. 1985) seem to result in continued natural regeneration on these infested sites. On the Oregon coast, it appears that natural conservation areas are presently functionally covered by Reserve and Withdrawn Land Use Allocations (Table 3&4-3).

b) In Situ — Inland populations: Frequently disjunct, inland stands of POC have much smaller preinfection effective population sizes, restricted gene flow with "neighboring" subpopulations, and a higher "average" predicted infection percentage (Table 3&4-10, Pathology section), as well as a likelihood of the occurrence of proportionally more rare alleles. Some notable stands and large acreages are also protected by Reserve or Withdrawn Land Use Allocation (Table 3&4-3). Examples include the Kalmiopsis Wilderness, Brewer Spruce Research Natural Area (RNA) southwest of Grants Pass; Beatty Creek RNA west of Riddle, Oregon; Caves National Monument; and Late-Successional Reserves. Riparian Reserves may be particularly unsuited for protection of POC, since they are often, by definition, high-risk sites.

By their very nature, in situ reserves are exposed to natural selection pressures and catastrophic events. The 2002 Biscuit Fire in southwestern Oregon and northern California provides a dramatic example. If a large number of natural stands are completely consumed, the acreage currently protected and/or as a possible in situ reserve would no longer be available. In any event, in situ reserves may not meet the intended need for the long term, and assessments of their genetic value would need to be made periodically.

c) Ex Situ — Seed Collections: Several authors have noted that ex situ collections can extend the range of genetic protection and reinforce in situ programs (Millar and

Marshall 1991). Ledig (1986) advised that ex situ methods should be used when possible as added insurance against loss. Millar and Marshall (1991) recommended that seeds should be collected as soon as possible from main stands throughout the range, especially in infested areas and from dying trees. These recommendations are especially pertinent to that portion of the POC range in Oregon where infestation is occurring. They further noted that early evidence suggests that POC seeds may retain high viability for more than 50 years under proper cold storage conditions.

A substantial quantity of POC is available in operational reforestation seed lots. Over 120 pounds of seed, representing discrete elevation bands ranging from 1,000 to over 4,000 feet, collected from over 250 wind-pollinated trees from natural stands are in storage at the five administrative units (Coos Bay, Medford, and Roseburg BLM; the Siskiyou NF; and the FS Dorena Genetic Resource Center). This broad-based store from locally well-adapted, but primarily nonresistant parents, all collected since 1989, is available for project work, rehabilitation following catastrophic events, and as operational baseline controls (for contrasts with bred, resistant stock). In some breeding zones, operational seed lots are rapidly being replaced by resistant seed from orchards, although the rate of conversion would vary by alternative (see Table 3&4-21 in Program to Develop Genetic Resistance section).

Open-pollinated cone collections from single trees of precisely known location formed the basis for many past genetics research projects, including the range-wide common garden study (see Genetic Variation discussion). Approximately 500 of these half-sibling families each retain at least 50 seed in storage. While their primary utility may be for additional research projects, they can also serve simultaneously as ex situ genetic reserves. Dorena Genetic Resource Center also maintains an operating, expanding collection of full-sibling families, inbred lines, and a variety of other materials used in their work on breeding PL resistance.

d) Ex Situ — Vegetative Material: There exist a number of ex situ collections of clones/families which are preserved at various locales. Dorena Genetic Resource Center maintains a breeding arboretum of numerous clones, in containers. The BLM Tyrrell Seed Orchard, southwest of Eugene, Oregon, currently contains numerous clones, with 3 ramets per clone, in an “in-ground” clonebank. More room is available for expansion, as an offsite backup and longer-term repository, for material from the Dorena Genetic Resource Center.

The numerous validation plots established in the field (see Genetic Variation subsection at the beginning of this section) also serve as repositories of known identity and pedigree. The range-wide common garden plantations also preserve half-sibling, open-pollinated families, as well as bulked reforestation lots. Finally, although their natural origins are largely unknown, the 50 or more cultivars currently still available commercially (Zobel et al. 1985) could be of interest, especially since their adaptability to a wide range of climatic extremes may be appreciated by horticulturists.

These materials represent a sampling of the gene pool, and preserve both resistant and nonresistant materials from across the species’ range. They would be utilized in the future breeding program to some extent, and help conserve the gene pool on a limited scale.

Program to Develop Genetic Resistance to *Phytophthora lateralis*: Selection, Testing, and Breeding

Nearly all POC seedlings and trees are highly susceptible to PL, which largely explains the very high mortality levels (potentially 90 percent) on infested high-risk sites in natural ecosystems. On these sites, very few, if any, seedlings would ever survive beyond the sapling stage. There appears to be genetic resistance within native POC populations; however, only a very small percentage of trees have complete resistance (probably less than 1 percent of trees) and only a low frequency of trees appear to demonstrate partial resistance or slower rate of mortality (further investigation is underway) (Sniezko, R.A, *personal communication [unpublished data]*). The rare, resistant trees are too scattered to expect natural interbreeding toward resistant stock without severely compromising genetic diversity in the high-risk areas. A resistance program coupled with restoration efforts can overcome this.

Based on initial indications of genetic resistance in the late 1980s (Hansen et al. 1989) and confirmation in cooperative work between the BLM, FS, and Oregon State University in the early 1990s, an operational program to develop resistance was begun in 1997. Over 9,000 prospective resistant trees were selected between 1997 and 2001 on Federal and non-Federal lands (Bower et al. 2000; Sniezko et al. 2003b) funded in part by a special technical development proposal. Until the start of this program, only a handful of trees had been identified with complete resistance. By 2002, more than 100 trees had been identified with complete resistance. Traditional resistance breeding, employed in this program, brings together stock from those parents and allows them to cross-pollinate to generate populations of diverse, adapted, and resistant trees, without having to utilize the recently devised but controversial genetic engineering techniques used in the development of genetically-modified organisms.

The resistance program is based at the FS Dorena Genetic Resource Center and is a cooperative venture between the BLM and FS. Oregon State University provides basic research, disease testing facilities, and further technical pathology input. The primary resistance test is a greenhouse root dip test of seedlings or rooted cuttings (Sniezko et al. 2003a, 2003b). In the greenhouse, rooted cuttings of some field selections consistently show high levels of survival (usually 100 percent), while rooted cuttings of susceptible parents often show 0 percent survival (Sniezko and Hansen 2003b). Seedling survival in greenhouses can vary from 0 to 100 percent 9 months after inoculation depending on the family tested (Sniezko and Hansen 2000; Sniezko and Hansen 2003a; Sniezko et al. 2003a, 2003b).

Field validation plantings have been established at more that 20 sites (Federal, county, and private cooperators), but most tests were established since 2000. The oldest field test (planted in 1989) is at Oregon State University's Botany Farm. Despite some early mortality, the resistant clones (using rooted cuttings of parent trees selected at field sites) and a seedling family have shown good survival and little new mortality in the last 7 years (Sniezko et al. 2000). Nearly all of the susceptible clones died within the first 2 years at this site (Sniezko et al. 2000). Three-year results from one of the 2000 test series involving 26 seedling families showed that short-term greenhouse testing correlated well ($r = 0.65$ to 0.84) with a raised bed test and with tests at two field sites (Sniezko et al. 2004). All four of these tests had moderate to high mortality levels (41 to 69 percent). Analyses of additional tests of this nature are underway, but at this point current data suggest the utility of resistant trees on high-risk areas would be good.

There is difficulty finding good field validation sites on BLM and FS land; however, other interested landowners (county and private) have recently provided sites. These validation tests would be followed over time to determine whether resistance holds up under an array of environments, as well as whether the resistance is durable.

Two of the earliest field selections have survived in high-risk areas infested with PL since the late 1980s. In addition, the earliest confirmed resistant tree (CF1) has survived greater than 20 years in a high-risk area infested with PL at Oregon State University. Progeny and/or rooted cuttings of trees with complete resistance have been repeatedly tested in short-term greenhouse tests and have consistently demonstrated higher survival (50 to 100 percent) than the most susceptible trees (less than 10 percent); they have also shown higher survival in the young field tests (Sniezko and Hansen 2003a; Sniezko et al. 2004). Complete resistance in POC is likely a form of major gene resistance, but it is unknown at this point whether there is more than one resistance mechanism for complete resistance.

Future breeding efforts would focus primarily on improving the levels of partial resistance as these traits are confirmed. Several generations may be needed to increase the levels of partial resistance to levels sufficient for field use. Under natural stand conditions, this process would proceed slowly, if at all, due to the rarity of resistant trees and the pollination by susceptible trees outside the immediate high-risk areas. In a managed greenhouse environment, breeding generations for POC are relatively short (3 to 6 years or more depending on funding). Parents with partial resistance could also be easily added to orchard populations as desired. Resistance from a putative major gene(s) and the affiliated complete resistance already yields moderate to high survival (50 to 75 percent in seedling families in greenhouse testing), and this resistance would generally be incorporated directly into the seed orchard populations. The potential addition of partial resistance would increase the diversity of resistant mechanisms and should bolster the durability of resistance. As feasible, the genetic base for each breeding zone would incorporate selections from throughout the breeding zone. Breeding strategy would be adaptive to take advantage of new findings on inheritance of resistance and to try to keep the genetic base of orchard populations broad. Seed production levels from orchards could easily and inexpensively be increased as needed to meet any Federal or non-Federal needs for resistant seed. Once resistant populations are established in the field it is anticipated that resistance in future generations of natural regeneration would be sufficient to sustain populations in areas of high risk (assuming resistance continues to be durable, which will be monitored in field plantings as described above).

The biology of POC (Elliott and Sniezko 2000; Sniezko et al. 2003b) and high levels of interagency cooperation have allowed very rapid development of resistant populations and orchards for a few breeding zones (Table 3&4-21). Current estimates based on greenhouse and limited field tests indicate that 50 to 75 percent of the seedlings from orchards should survive areas infested with PL versus less than 5 percent of highly susceptible parents. The first resistant seed from seed orchards was available in fall 2002 (Table 3&4-21). If funding is available, selection and testing of additional resistant candidates would help establish seed orchards for additional breeding zones.

Work on the inheritance of resistance and field validation continues, directed by staff at Dorena Genetic Resource Center. With funding and plant materials from the BLM and FS, Oregon State University has undertaken a project to examine the underlying nature of some types of genetic resistance. Results from these projects and trials would help lead to more efficient development of resistant populations of POC. As new information becomes available it would be incorporated. Containerized seed orchard technology developed at the Dorena Genetic Resource Center for POC allows orchards to be updated as frequently as needed to increase genetic diversity or the amount and types of resistance.

Co-evolution of POC and PL. The genetic variability and evolutionary potential of the pathogen can also be important in developing resistance that would be durable. PL appears to have relatively little genetic variability (McWillams 2000a; Goheen et al. 2003). The geographic origin of PL is unknown, but is thought to be outside the range of POC (Goheen et al. 2003), and thus POC and PL have not co-evolved. The low genetic variability suggests the likelihood of a single or limited number of introductions. PL may or may not exhibit greater genetic variability in its sites of native origin. The chance of accidental importation of new strains of PL is very low, but could cause concern if strains with virulence to resistance in POC were introduced. However, the spread of such a strain should be slow, especially if any management measures that slow the spread of PL are in place. The lack of genetic variability in PL in the Pacific Northwest increases the likelihood of developing durable resistance. Pathogens with lower migration rates and relatively low population sizes are hypothesized to have relatively lower evolutionary potential (McDonald and Linde 2002). Thus, there appears to be good likelihood for durability of complete resistance in POC. Even if breakdown of resistance were to occur in one location, the redistribution of any new virulent strain would be slow, or would not occur. An array of management techniques and options are available (Goheen et al. 2000) and can be utilized to increase the potential durability of resistance for POC. Confirmed resistant parent trees in the field can be monitored over time to assay whether a new virulent strain of PL may have arisen.

In summary, the majority of trees in high-risk areas infested with PL would die. Without the use of resistant seedlings there would be little chance of large tree structure developing for POC in these areas. Some of these areas would continue to have large POC on nearby adjacent sites that are low risk (particularly where POC is not confined primarily to riparian areas). Private landowners are unlikely to plant nonresistant POC, decreasing the species diversity on their lands. The continued utility of resistant seed will depend upon its continued effectiveness in providing POC that survives in infested high-risk areas.

Utilization of Resistance

The current anticipated level of resistance from seed orchards to PL (50 to 75 percent survival) is high enough to deploy in those breeding zones for which there is orchard seed. The level and the number of resistant mechanisms should increase in the future. Resistant seed is now the option most likely to be successful in restoring large POC on high-risk sites. Monitoring of existing plantations will continue to update information on durability of resistance. Resistant seed can be used on almost any high-risk site for PL, except in areas where there is a high probability that infection would spread to uninfected POC downstream, or in sanitation areas along roads (because 25 to 50 percent of the seedlings from the first-generation orchards would be susceptible, and that even the resistant seedlings may be host to PL spores [at a reduced level]). Planting guidelines for resistant POC should take account of the current expected levels of resistance.

Vegetative propagation (rooted cuttings for POC) may increase the survival to 75 to 100 percent, while still planting a diverse array of genotypes. However, this may not be the most cost-efficient because of (1) the added cost of rooted cuttings (over seedlings), (2) the potential added selection pressure on the pathogen (if relatively few clones are planted), and (3) the potential of increasing the resistance level available in the near future from seed.

Large amounts (millions) of resistant seed can easily be produced for those breeding zones for which there are containerized seed orchards. Direct seeding may be a viable alternative to planting in some cases.

The ease of seed production for POC also opens an opportunity to supply non-Federal landowners with seed for reforestation or horticultural needs. Estimates from 2000 indicate that the need from these landowners in coastal Oregon would be more than 275,000 seedlings per year. Without resistant seed, most non-Federal landowners would not plant POC (or would plant at much lower levels) and the forest plantations would be less diverse.

Effects of Alternatives — General Discussion

Port-Orford-Cedar Genetic Structure: The most critical variable for determining change in genetic structure of POC over the landscape may pertain to the percent of an area that is of high risk to the disease, and the respective probabilities for infestation and associated mortality over time. This percentage would vary over the next 100 years, depending upon the selected management alternative, over portions of the POC range accordingly: North Coast Risk Region—16 percent to 19 percent; Siskiyou Risk Region—17 percent to 36 percent; and Inland Siskiyou Risk Region—18 percent to 50 percent (Table 3&4-10). On the basis of the affected areas where mortality might progress/occur, and the fact that subpopulations would infrequently be (if ever) entirely extirpated in the POC range, the very localized genetic population structure(s) would be impacted to varying degrees, depending on the degree of isolation, recolonization via natural regeneration events, and/or the amount of mitigation measures taken. The cumulative changes in genetic structure across the respective large-scale macrogeographic risk regions would be impacted to a lesser degree since the overall structure is based on pooling both the affected and unaffected populations across the large regions. The North Coast Risk Region would be changed the least, due to the large number of natural regeneration events, the proximity of neighboring subpopulations or stands, and migration events (gene flow) that occur over time. The Siskiyou and Inland Siskiyou Risk Regions may be impacted to a greater degree due to the isolation, relatively smaller size of POC stands, and potential for more fragmentation on the basis of the projected mortality over time. The degree to which resistant stock is reintroduced into the infested locales would also be a factor in the effects per alternative. The basic causal factors associated with changes in population structure apply to the planted stands as well. Gene exchange continues amongst the neighboring subpopulations, and the genetic structure evolves for the same reasons as stated previously.

Availability of Resistant Seed for Restoration: Although POC is not in danger of extinction, there are some high-risk areas (particularly riparian areas) where 90 percent or more of the POC trees are dead. In these PL infested areas it is not likely that POC would get older and bigger as long as the disease is present and there is no resistant stock planted. If large POC trees in these specific areas are desired, the use of restoration with resistant seedlings may be the most efficient route for accomplishing this (contingent upon the continued effectiveness of resistance). Restoration, either following PL infestation and mortality, or preemptive (on sites anticipated to suffer high mortality in the next 50 or 100 years), would potentially allow for reestablishment of POC as it existed before PL. The use of standard silvicultural tools may be used to promote good growth of POC, thus decreasing the time to develop large POC trees.

Once resistant trees are established in heavily impacted areas, they would serve as parents for future generations, thus allowing for natural regeneration. This would be particularly desirable if there are affected portions of Late-Successional Reserves where large POC is desirable for future generations. In most areas, the genetic base for future generations would be large and would include both surviving POC around the infested riparian area and the resistant POC. Thus, the genetic composition for the future would continue to be broad and help ensure adaptability of POC to changing environments.

In fall 2002, large quantities of resistant seed became available for 3 of the 19 breeding zones that include Oregon (some of these zones also include parts of California). Seed from one of these breeding zones could probably be used for two others without much compromise in either resistance or adaptability. Thus, the option of restoration with resistant seed is now available to land managers, particularly in the coastal Oregon Breeding Block 1 (Table 3&4-21). Under current program levels, it is projected that resistant seed would be available in 2010 to 2045 for other breeding zones (Table 3&4-21)

Since POC readily produces abundant seed in a managed orchard, resistant seed could be made available to non-Federal landowners, although some barriers to this seed transfer need to be overcome. Use of resistant POC by non-Federal landowners would add to the biodiversity on the landscape and potentially boost local economies. This is also important in these areas because of the recent negative impacts of Swiss Needle Cast disease of Douglas-fir as well as the potential impacts of Sudden Oak Death to the diversity of the forests and plantations (POC is thought not to be susceptible to either of the causative pathogens). Management of the seed resource by the BLM and FS would help ensure genetically diverse seed would be used—this should help ensure durability of resistance by limiting the potential for plantations involving only one or a few clones. Guidelines could be developed to help all landowners play a role in maintaining the durability and utility of the resistant POC resource.

There are several options for breeding zones without enough tested selections to find resistant parents to utilize for seed production, including:

1) No mitigation of high-risk PL-infested areas with POC mortality, now or in the future, leaving the process to strictly natural regeneration when only a few rare scattered resistant POC serve as the foundation for future regeneration may severely restrict genetic diversity. Large trees (if they do develop in each local area) would be very limited in their genetic variability (they would probably be the offspring of only a couple resistant trees even if pollen were to come from additional susceptible trees).

2) No current mitigation of high-risk areas due to lack of resistant seed, but proceed with the development of resistant orchards to allow restoration efforts at a future date (2010 to 2045 depending upon breeding zone). The restoration of large POC in the ecosystem would be delayed, but the genetic diversity would be broader when they are established. This would provide for a POC population more likely to persist over generations.

Breeding zones vary dramatically by the acreage of POC on Federal lands (see Table 3&4-

21). However, the breeding zones where resistant seed would be most valuable for restoration may depend on other factors, including the role of POC in the specific ecosystem, the percentage of POC on high-risk sites, and the relative abundance of POC in a area. Prioritization of breeding zones (by managers) would potentially enable earlier resistant seed development in the zones given higher priority. New selections could generally have a resistance evaluation and be producing seed in as little as 5 years of selection in the field—timing of orchard seed availability depends upon level of funding available, and to a lesser extent, limits of facilities and personnel.

Effects of Alternatives — Discussion by Alternative

Alternative 1

Port-Orford-Cedar Genetics Structure: In Alternative 1, the projection of infestation (Table 3&4-10) varies between 17 to 29 percent over the extent of the species' range in Oregon. Changes in genetic structure cannot be given in absolute terms, but can be expressed in relative terms. The North Coast Risk Region (17 percent infestation projection) has larger continuous stands and populations, which should allow both natural regeneration and pollen flow throughout the area. This should create less population-level divergence, and should promote population structure stability over time. Here, both the local and regional genetic structure should be impacted little, and to a lesser degree than the Siskiyou and Inland Siskiyou Risk Regions. The Siskiyou Risk Region (23 percent infestation projection) would likely incur more fragmentation of populations throughout the region than the North Coast Risk Region. However, there would still be survivors within the immediate infested area (about 10 percent), and neighboring uninfested POC (seed trees) reside within the confines of riparian vegetative habitat (outside of, or on microsites within, the highly infested zone). The change in structure in some of the smaller isolated stands may vary from minor to severe, and the cumulative change in structure across the Siskiyou Risk Region may be slightly higher than that of the North Coast Risk Region. Fragmentation would likely be greater in the Inland Siskiyou Risk Region (29 percent infestation projection) in comparison to the other two risk regions. The Inland Siskiyou Risk Region has a greater potential to incur changes in the local population structure, due to the higher percent infestation projected and smaller, more isolated populations. However, this risk region would still have 71 percent (projection) of its habitat not affected by the disease spread, which would tend to buffer against any large-scale change in genetic structure across the region.

Resistant stock would also be planted in varying amounts in infested areas, and this would help conserve the gene pool and structure to a commensurate degree. The planting of resistant stock in those breeding zones with orchard production should enhance genetic diversity in comparison to those breeding zones without. This is a result of the relative difference in gene frequencies (seed orchard population versus local stand population), which creates a more diverse genetic base in this locale after planting.

Availability of Resistant Seed for Restoration: Under Alternative 1, the interagency resistance program would proceed at current levels (assumes funding is stable). No resistant seed was available until fall 2002 (and then only for some breeding zones). Restoration with resistant seedlings can now be considered in project analyses and used as a mitigation technique where relevant, and could supplement the existing efforts to slow or prevent the spread of PL. Monitoring the field trials will continue to update information on durability of resistance.

Seed orchards have been established for a few breeding zones, but for most breeding zones, many more field selections (probably more than 1,250 per breeding zone) are needed to find the low-frequency resistant trees.

The source and timing of funding for additional field selections would determine what other breeding zones resistant orchards are developed as well as the timeline to develop them. Table 3&4-21 displays, by breeding zone, when resistant seed are projected to become available. In order to increase the diversity of resistance and level of resistance, breeding would need to continue after the initial first generation orchards were established.

For planting on low-risk sites, nonresistant or resistant seedlings could be utilized. Under this alternative, restoration on high-risk sites could now begin for only certain breeding zones; other breeding zones would not have resistant seed for another 7 to 42 years (Table 3&4-21) (see the Planting Assumption found in the Assumptions and Clarifications section of this chapter). Without this restoration effort, large POC would likely not develop in many affected areas.

Alternative 2

Port-Orford-Cedar Genetics Structure: The projection of infestation (Table 3&4-10, Pathology section) varies between 17 to 24 percent over the extent of the species' range in Oregon. This is similar to Alternative 1 projections. The emphasis on uninfested 7th field watersheds could help maintain more populations. For the reasons described in Alternative 1 there will be some effects on the local population structure, while the structure across the respective risk regions should not be changed to a great extent. One minor difference pertains to the slightly decreased infestation rates, with obvious, commensurate declines in need for restoration plantings.

Availability of Resistant Seed for Restoration: Alternative 2 would be similar to Alternative 1 (see above) in potential effects of resistant seed. One of the objectives of this alternative is to attempt to reestablish POC in plant communities where it has already been significantly reduced in numbers by root disease. Restoration with resistant seed would best accomplish this. As in Alternative 1, the continued development of resistant stock for various breeding zones would continue at current levels (assuming current funding levels are maintained). A discussion of the assumed reforestation rates under each alternative is described earlier in this chapter. There would be seed available immediately after stand replacement events such as large-scale wildland fires, because a seed bank for each breeding zone that has an orchard for the production of resistant seed would be established.

Alternative 3

Port-Orford-Cedar Genetics Structure: The projection of infestation (Table 3&4-10) is 16 to 19 percent over the extent of the species range in Oregon. In Alternative 3, the relative changes in genetic structure and diversity outside of the POC core areas should be similar to effects stated in Alternatives 1 and 2. Protecting uninfested POC cores and buffers (see Map 1), if successful in preventing infection by PL over a longer period of time, would maintain a greater number of populations in a more natural state. The population structure would be affected less in these areas, where they evolve without PL being present. This alternative has a greater effect in helping to preserve the genetic structure in the Siskiyou and Inland

Siskiyou Risk Regions as opposed to the North Coast Risk Region; in comparison to Alternatives 1 and 2.

Availability of Resistant Seed for Restoration: The use of resistant seed and its effects (increasing the potential of large POC trees in high-risk areas infested with PL in the future) should be similar to Alternatives 1 and 2. Because of the additional protected areas, there should be fewer PL-infested areas that may need restoration with resistant seedlings.

Alternative 4

Port-Orford-Cedar Genetics Structure: The greatest amount of infestation occurs in Alternatives 4 and 5 (Table 3&4-10): North Coast Risk Region—19 percent; Siskiyou Risk Region—36 percent; and Inland Siskiyou Risk Region—50 percent. The effect of this alternative in the North Coast Risk Region would be similar to those stated in Alternatives 1 and 2. Population structure would not change to a great extent in this area, with or without the planting of resistant stock, in consideration of the large amount of natural regeneration, gradual environmental gradients, and more continuous interbreeding populations. The largest amount of fragmentation and effect on population structure would occur in the Siskiyou and Inland Siskiyou Risk Regions. The planting of resistant stock provided in this alternative would be helpful in conserving and/or improving upon the diversity of gene pools. The accelerated level of resistance breeding provided in Alternative 4 should enable resistant stock to be planted at a quicker rate across more breeding zones (see the Planting Assumption found in the Assumptions and Clarifications section of this chapter). Planting programs in the Siskiyou and Inland Siskiyou Breeding Zones would also modify the populations to a greater extent than that for the North Coast Risk Region. Initially, effective population sizes would probably decrease (in numerical number), even more in the Siskiyou and Inland Siskiyou Risk Regions because of high-risk sites (scattered riparian habitats) being spread (with resultant fragmentation) across the landscape. Planting resistant stock in these situations may have the greatest relative genetic benefit (see discussion on migration of genes in Effects on Genetic Structure section). The relative changes in structure across the Siskiyou and Inland Siskiyou regions would be greater than that of the North Coast region. In addition, the change in structure would be greater than those projected in Alternatives 1, 2, 3, and 6. However, the effective population sizes (pooling over all populations) should still be within the orders of magnitude, where it is expected to have little net effect on the genetic structure in POC over the respective macrogeographic risk regions.

Availability of Resistant Seed for Restoration: Alternative 4 would expedite the availability of resistance seed for those priority breeding zones in which seed is not available (Table 3&4-21). More high-risk areas would be expected to experience mortality under Alternative 4 (80,300 acres compared to 45,800 acres under Alternative 3, and 51,600 acres under Alternative 2); more resistant seed would be needed to replace dead POC (however, seed availability is not anticipated to be a limiting factor, once an orchard is operational for a given breeding zone). There are still many areas in all parts of the range of POC that are low risk. In the future as resistant trees develop (and assuming no change in effectiveness of resistance), this alternative should lead to an increase in large POC over the landscape in those high-risk areas that would be PL infested under other alternatives. The sooner the resistant seed is developed the sooner the restoration of large POC can develop.

Alternative 5

Port-Orford-Cedar Genetics Structure: The predicted levels of infestation are the same as in Alternative 4, but resistant stock would be limited primarily to the North Coast Risk Region (about 65 percent of the POC acreage). Population structure would not change to a great extent in this region for the reasons described in Alternative 4. The changes in population structure and probable changes in the gene pool for the Siskiyou and Inland Siskiyou Risk Regions would be greater in this alternative versus Alternative 4. This is due to the minimal opportunities for restoring the impacted habitats with genetically diverse resistant stock. While natural evolution of resistance to PL is theoretically probable, the rate and degree of natural resistance would vary markedly over time and space. Selection pressures in this alternative would have similar effects as in Alternative 4, where allele frequency change over time reflects the high selection pressures within the infested areas. Failure to plant resistant POC in the Siskiyou and Inland Siskiyou breeding zones of highest disease incidence can lead to lesser effective population numbers in localized areas (where disease is present). This could lead to a greater degree of population divergence, a higher rate of inbreeding, and greater loss of rare alleles in a portion of the local populations. The effects of this alternative will be greater than that of Alternative 4, where there will be greater degrees of change in structure over the range of local populations, and the cumulative change in genetic structure across the Siskiyou and Inland Siskiyou Regions will be the highest of any alternative. In general, as the mortality and habitat loss increases, there is an increasing possibility of losing segments of subpopulations over time (assuming no mitigation to reestablish), and some reduction in the natural genetic variation will take place. However, as in Alternative 4, genetic structure is expected to change little from the sole impact of PL over the large-scale macrogeographic regions of POC.

Availability of Resistant Seed for Restoration: Under Alternative 5, only some breeding zones would have resistant seed available (only those for which orchards are currently available) (see Table 3&4-21). For most breeding zones, 85 percent of high-risk areas for PL would seldom achieve large POC, resulting in a loss of large POC across the landscape (in high-risk areas which include many riparian areas). Further development of the resistant program would cease, limiting the diversity of parents represented in current orchards as well as the potential for including other resistance mechanisms. Impacts could be reduction in potential durability of resistance to PL, as well as continued absence of large POC in some areas. Under this alternative, there would be the most acres affected (similar to Alternative 4) and the fewest acres with restoration using resistant seed (few breeding zones would have seed available), resulting in the fewest acres potentially achieving large POC.

Alternative 6

The infestation projections in this alternative are nearly identical to those in Alternative 3; from 16 to 18 percent infestation over the respective risk regions of the species range in Oregon. The effects should be similar to those stated in Alternative 3. Providing additional protection of POC cores and buffers in the uninfested 7th field watersheds would help maintain portions of the populations in their natural state. Alternative 6 protects a greater acreage in the POC cores (49,000 acres) than Alternative 3 (34,000 acres). In addition, the Alternative 6 POC cores are more widely distributed across the POC range. This will protect a larger absolute number of populations in addition to a larger set of peripheral populations across the region. Thus, this alternative would probably have a greater effect in helping to preserve the natural genetic structure across the regions as a whole and to a slightly greater degree than Alternative 3.

Availability of Resistant Seed for Restoration: The use of resistant seed and its effects (increasing the potential of large POC trees in high-risk areas infested with PL in the future) should be similar to Alternatives 1, 2, and 3. Because of the additional protected areas, there should be fewer PL-infested areas that may need restoration with resistant seedlings.

Cumulative Effects

The effects of PL-caused mortality on genetic resources also need to be considered in context with other reasonably foreseeable actions or events that could affect these same resources. For the reasons noted above, particularly that mortality is not 100 percent in any significant area, that mortality is primarily limited to the narrow high-risk area, and that there is considerable genetic variability within POC stands, significant genetic resources are not at risk under any of the alternatives. Other likely management activities or events (except large intense wildfire) will also not remove POC in areas large enough to threaten genetic resources. Timber harvest in the Matrix and other management activities, while potentially affecting a considerable acreage of POC in total, will never remove enough POC in one place to be a genetic concern, even in conjunction with PL-related mortality. This is in part because harvest unit size is limited, seedlings are left or replanted, and Riparian Reserves are typically wider than the high-risk areas, thus leaving uninfested areas between harvest units and PL mortality areas.

Large-scale disturbance events the size and intensity of the Biscuit Fire may remove at least rare alleles from the population. However, because PL-related mortality only affects a percentage of stands in any one area and a large fire may take out a large block, the two events are unrelated as far as gene conservation is concerned. There is no foreseeable activity or event that, along with PL, threatens to significantly affect POC genetic conservation.

Fire and Fuels

There are three aspects of Fire and Fuels potentially affected by POC root disease and the alternatives for its management: (1) the management requirements of the various alternatives can have a direct affect on the Agencies' ability to fight fire successfully or to use wildland fire to meet resouce objectives; (2) the direction in the various alternatives can have a direct affect on the Agencies' ability to reduce forest fuels; and (3) the level of fuel loading created by disease-killed POC. Since POC killed by the root disease contribute directly to forest fuel loading, the success of the alternatives at reducing mortality affects forest fuel-loading levels. Mortality-related fuel-loading differences between the alternatives is much less than 1 percent of the total fuels in the area at any one time, because of the distribution and stocking levels of POC in the landscape, the relatively slow spread of the disease, and the relatively limited difference in annual POC mortality between the alternatives. Hence, this third aspect will not be discussed further in this section.

Affected Environment

Wildland Fire Operations

Wildland fire operationsare common within the range of POC. Southwestern Oregon has a long history of major fire occurrence (Cooper 1939; Haefner 1975; Morris 1934; Pyne 1983). Recent large fires have included the 499,965-acre Biscuit Fire in 2002, the 6,998-acre Mendenhall Fire in 1994, the 2,201-acre Chrome Fire in 1990, and the 9,860-acre Longwood Fire and 96,310-acre Silver Fire in 1987.

Fire occurrence has averaged 35 fires per year on the Siskiyou NF (1970 to 2003), and 34 fires per year on BLM-administered lands (1970 to 2002). A majority of these wildland fires (71 percent) are suppressed at less than 0.25 acres. A little over 1 percent exceeded 100 acres. Most are lightning caused (52 percent), as are nearly all of the large fires (greater than 1,000 acres) (79 percent). The next most common cause of all wildland fires (22 percent) is from recreational users (such as campfires and smoking). Fire season is typically during the drier months with approximately 86 percent of all fires occurring from June 1 through September 30. Fires are generally less frequent from east to west and south to north in the range of POC. The Powers Ranger District, for example, has the greatest concentration of POC in the world, but averages less than three wildland fires per year (1970 to 2003) with the largest fire at 94 acres.

Wildland fire operations include both wildland fire suppression and wildland fire use. Wildland fire suppression is an appropriate management response to a wildland fire that results in curtailment of fire spread and eliminates all identified threats (USDA and USDI 1998). Wildland fire use is the management of naturally ignited wildland fires to accomplish resource objectives within predefined geographic areas. There are currently no approved fire management plans that authorize wildland fire use within the range of POC in Oregon. However, it is reasonably foreseeable that wildland fire use could be authorized within the Kalmiopsis Wilderness and adjacent roadless areas with the completion of fire management plans and/or land and resource management plan revisions. A majority of this area is within the recent Biscuit Fire. The effects of POC management practices on wildland fire use would be similar to wildland fire suppression. Wildland fire use should require fewer resources due to low to moderate burning conditions and preplanning within specific geographic areas.

The objective of initial attack fire suppression is to safely and efficiently suppress unwanted fires in conformance with existing policy and procedures, consistent with approved fire management and land and resource management plans (USDA-FS and USDI-BLM 2003c). The FS has initial attack responsibility for the Siskiyou NF and the BLM has contracted with the Oregon Department of Forestry for its initial attack fire suppression.

All wildland fire suppression Agencies in southwest Oregon have interagency agreements to share suppression resources within preplanned responsibility areas. These areas generally border adjacent Agency jurisdictions, and several Agencies could respond to a wildfire in these mutual aid areas. Resources dispatched to a wildland fire depend on the Agency jurisdiction, values threatened, preplanned dispatch plans, fire danger rating for the day, and resource availability.

All of the wildland fire Agencies rely on similar fire-suppression resources, such as engines, hand crews, tractors, aircraft (including fixed-wing air tankers and helicopters), smoke jumpers, and rappellers. The staffing and availability of these resources are determined by the time of year, available funding, seasonal severity, and minimum fire organization. Engines are typically the primary resource in areas with road access. The use of water can quickly facilitate containment, control, and mop-up of a fire. Hand crews, tractors, and aircraft (helicopters or air tankers) may also be part of the preplanned dispatch or ordered if necessary by the incident commander. Where road access is poor, crews may have to walk long distances to reach a fire. In these cases, aircraft are often used to mobilize hand crews, rappellers, or smoke jumpers. Firefighters in remote locations also utilize portable pumps to access water from sources close to a fire.

Fixed-wing air tankers may deliver fire retardant and helicopters may provide water bucket drops to knock down rapidly initiating fires regardless of ground access. The helicopter buckets are filled from streams, rivers, lakes, or ponds close to the fire that are large enough for the bucket and safe to access by the helicopter. The primary initial attack fire suppression helicopter is a shared-resource, rappel-capable, light helicopter (130 gallons of water per bucket) based in Merlin. The Oregon Department of Forestry also staffs medium helicopters (300 to 700 gallons per bucket) for 60 days at the peak of the fire season in Central Point and Roseburg. In severe fire seasons, a heavy helicopter (1,500 gallons per bucket) has occasionally been staged for initial attack.

A wildland fire that escapes initial attack enters extended attack or the transition phase to a large fire operation. These fires become increasingly complex and large with many resources, logistics needs, and safety concerns. Only a small percentage of all fires enter this phase, but they require the most resources, and aircraft, and affect the largest number of acres.

Firefighter and public safety is the first priority in every fire management activity (USDI et al. 2001). If there is risk to firefighter or public safety, the incident commander would safely and efficiently take appropriate suppression action with available resources without any POC considerations. Equipment could be ordered and used as soon as it was available on the fire, and water could be used from any source.

POC management practices become a concern to fire managers when there is POC near the fire and especially when it is known to be uninfested. Some POC management practices are not a concern during wildland fire operations. Initial attack fire suppression resources, such as engines and crew vehicles, are normally clean and washed on a daily basis, and water in the fire engines is usually from uninfested sources. The fire season is also during the dry season and the warmer times of the year when the risk of spreading POC root disease is the lowest.

Management practices start to effect wildland fire operations when additional water is needed on a fire (such as refill engines, pumping from local sources, and helicopter bucket drops) and/or resources accessing the fire are going through both clean and infested areas. Management practices to reduce the risk of PL spread decrease the efficiency of fire suppression resources and increase the costs of operation. The greatest effect would be on a fire with uninfested POC where the closest available water source is infested. Application of Clorox bleach (see Appendix 4) in engines or water tenders to kill PL spores would be relatively inexpensive and not lose much time. Planning for and installing a pumping station to treat water before pumping it to the fire would require time and additional personnel (if it was feasible). If a helicopter would have to travel 5 minutes longer to a clean source for bucket use it would reduce the number of bucket drops in a day. Helicopter water operations usually attempt to keep the turn time for a bucket load to less than 15 minutes. If the infested source was a 10-minute turn and the clean one was 15 minutes, the effect is a 33 percent reduction in the number of buckets the helicopter can deliver in an hour.

The Biscuit Fire of 2002 is an example of how POC management practices can affect wildland fire operations. Five lightning fires that started in the Kalmiopsis Wilderness and adjacent roadless areas burned together over several months into the 500,000-acre fire (USDA-FS 2002a). These remote fire starts were initially a low priority for suppression resources when many other fires in southwest Oregon and the region were threatening communities. The size of this fire resulted from concerns for firefighter safety, early resource unavailability, poor road access, fire weather conditions, protecting structures and communities at risk, and using available roads and topographic features for control lines. POC management practices probably did not affect the size of this fire, but did affect the cost.

The drainages around the initial fire starts were known to be uninfested and have populations of POC. Management practices in place early on included ensuring contract equipment were clean and inspected before going to the fireline, and locating clean water sources for the few aircraft available. As the fire grew increasingly larger and more complex, the POC mitigations also increased in scale and complexity. None of the mitigations affected firefighter or public safety or property. There were up to four incident management teams at one time on this fire, with thousands of firefighters, hundreds of pieces of equipment, multiple fire camps, incident command posts, and hundreds of miles of fireline and access roads. Management practices for protecting POC included: identification of travel access routes, multiple wash stations, identification and mapping of approved water sources for helicopter and ground resources, and installation of helicopter dip tanks to supply treated water closer to the fire. Wash stations were also installed at the fire camps, spike camps, and equipment staging areas. Many of these stations were staffed 24 hours a day for several months with a minimum of two persons, a water tender, and an engine. All vehicles were washed at least once a shift and sometimes several times depending on their assignment and travel route. If equipment was moved between Divisions on the fire, it was also washed if it was going from an infested area to a clean one. All of these management practices increased the number of personnel on the fire, increased the amount of equipment, increased the time personnel spent washing vehicles or following longer travel routes, reduced the efficiency of helicopter and ground resource water use, and required planning to implement. It is estimated these practices added between $1.5 million and $3 million to the suppression costs of $150 million, or about 1 to 2 percent to the total cost. On smaller fires, the percentage could be higher.

Each wildland fire situation is different and it is impossible to estimate the cost of POC management practices over the entire southwest Oregon area. It should be assumed that implementation of POC management practices would not affect firefighter or public safety or private property, but could increase the acreage burned, damage to natural resources, and cost of operations for wildland fires where POC is found. Severe wildfires can kill POC. Large, severe fires in the range of POC would result in the loss of more POC to wildfire mortality. Small fires on average have lower total fire suppression costs than large fires, but have far higher per acre costs. Additional aircraft time could easily double the cost of a small fire.

Siskiyou NF average costs per acre (1990 to 1999) for fires less than 1 acre is $4,740, and for fires 5,000 to 10,000 acres is $373. The cost of the Biscuit Fire (the most expensive wildfire to suppress in history) was approximately $300 per acre. Costs for wildland fire use would be less than suppression costs due to low to moderate burning conditions and preplanning within specific geographic areas.

Future Wildland Fires: Historic fire regimes describe fire-return intervals and severity (Hardy et al. 1998). The fire regimes in the range of POC are characterized as generally frequent, low- to moderate-severity fires (Fire Regime Working Group 2000). An estimate of annual acreage burned under the historic natural fire regimes was derived using fire-return interval data (USDA-FS 2003a). For the 0 to 35-year fire-return interval, an average fire-return interval of 20 years was used for analysis purposes. A 30-year average was used for the 0 to 50-year fire-return interval; an 80-year average was used for the 30 to 100-year fire-return interval; and an 150-year average was used for the 100 to 200-year interval. Using these factors and estimating fire regimes for BLM lands, an estimated 45,075 acres would be burned annually in the range of POC on Federal lands, for an average across the range of 35 years. Considering the stochastic nature of wildland fire occurrences, this may be better expressed as 450,750 acres per decade historically. Such a figure is not inconsistent with annual wildland fire predictions of 1,130,000 acres per decade appearing in the "Draft SEIS To Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines" (USDA-FS and USDI-BLM 2003c) for the entire range of the northern spotted owl. This figure is useful for comparing the number of acres of wildland fire, hazardous fuels treatments, and other management activities with historical fire patterns.

From 1993 to 2002, approximately 473,618 acres burned in wildland fires in the range of POC in Oregon. The majority of this acreage was in the 2002 Biscuit Fire (462,591 acres). For comparison purposes, in the decade from 1983 to 1992, approximately 149,974 acres burned in wildland fires. The majority of this acreage also burned in one fire year (1987) and one fire event (the 96,310-acre Silver Fire).

Wildland fire will continue to threaten POC. Although POC was adapted to the historic fire regimes in southwest Oregon, years of fire suppression have increased hazardous fuels and potential for severe wildland fires. The recent Biscuit Fire (USDA-FS 2003b) is such an example, where approximately 63 percent of the area burned at a moderate to high intensity (equal to or greater than 50 percent canopy mortality). Small (hundreds to thousands of acres), low-to-moderate severity fires would normally have occurred in the area.

The Biscuit Fire itself, however, changes the likely future burn rate for the POC range because Biscuit Fire burned an estimated 29 percent of the POC range. Because of the intensity of the burn, portions of Biscuit Fire will likely not burn again in the near future. Another third of the range is in coastal areas, much of it checkerboarded with privately managed younger stands. Average fire return interval for mixed-severity fires in most of this area is normally 50 to 100 years. Stand replacing events here could be soon or hundreds of years away, with the roaded intensively managed checkerboard ownerships being the least vulnerable. An area equivalent to the remaining POC area, the third of the Oregon portion of the range outside of the Biscuit Fire area that is in drier vegetation types, could be expected to be exposed to wildland fire within the next 20 to 50 years, but this area too has the advantage of considerable checkerboard ownership with its relatively intensive management and more roads (than the Biscuit Fire). The proportion of a future fire that is high intensity will depend on the fuel conditions in the area of the fires, the level of fuels treatment done between now and when the fires occur, the amount of wildland fire use, and the weather patterns during the events. An order-of-magnitude summary, if one were possible, would thus predict having high-intensity fire to cover another 250,000 acres of the POC range within the next 100 years. Such fires, by proportion, could affect up to half of the POC outside of the Biscuit Fire and the North Coast Risk Region, or up to 50,000 acres of POC.

Fuels Management

The 1995 "Federal Wildland Fire Management Policy" directs Federal land management Agencies to achieve a balance between wildland fire suppression and fuels management to sustain healthy ecosystems. While previous policies emphasized wildland fire suppression, the current policies emphasize fuels management as a part of ecosystem management (USDI et al. 2001). This approach recognizes fire as part of the ecosystem, and focuses on hazardous fuels reduction, integrated vegetation management, and firefighting strategies (USDI et al. 2001). The "Healthy Forests Initiative" (2002) also emphasizes more active forest and rangeland management to reduce the accumulation of fuels and to restore ecosystem health. Attainment of the goals of the 10-year Comprehensive Strategy requires an investment. Market-based approaches (selling by-products) to offset the cost of hazardous fuels reduction are encouraged wherever feasible and cost effective (USDI et al. 2001).

Hazardous fuels treatments should be designed to:

- Reduce the risk of wildand fire to communities and the environment;
- provide safety to firefighters; and
- improve ecosystem health.

The focus is on actively managing acres in the wildland-urban interface, and acres outside of the wildland-urban interface that are in Condition Classes II or III (have missed two or more natural fire cycles) to reduce hazardous fuels and restore fire-adapted ecosystems (USDA and USDI 2003c).

The wildland-urban interface is defined as the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel (USDI et al. 2001). The analysis area used in this document is the area mapped as communities at risk by the Oregon Department of Forestry and a 1.5-mile buffer around them. Communities at risk within the range of POC and near Federal lands include Agness, Cave Junction, Grants Pass, O'Brien, Powers, Selma, Williams, and Wolf Creek. The BLM has the largest percentage of Federal lands in the interface in southwest Oregon. The highest priority treatment areas are generally on the eastern and southern Oregon portions of the range of POC.

Condition class is the degree of departure from historical natural fire regime resulting in changes to key ecosystem components, such as stand structure, age, and degree of canopy closure. Due to fire exclusion policies, grazing, invasive plant species, and insects and disease (1995 "Southwestern Oregon Late-Successional Reserve Assessment") many areas in southwest Oregon are in Condition Class II or III. Fire frequencies have been altered and there is an increase in fire size, frequency, intensity, severity, or landscape pattern. The risk of losing key ecosystem components is also moderate to high. The recent Biscuit Fire is such an example (USDA-FS 2003b). Large areas of Late-Successional Reserves, Riparian Reserves, and uninfested POC were lost.

Federal agencies in southwest Oregon have actively managed hazardous fuels on Federal lands for many years. Treatments were historically linked to timber sale activities, but are becoming more associated with treatment of natural fuels in the wildland-urban interface and areas in Condition Class II and III. These wildland-urban interface areas are the priority areas for hazardous fuels treatment to reduce wildland fire risks to communities and allow wildfire to take a more natural role in the surrounding forest. The Medford BLM District and the Siskiyou NF currently treat the most acres of the administrative units in the planning area. Over the next 5 years, the Grants Pass BLM Resource Area could accomplish 70,000 acres, the Glendale BLM Resource Area 4,200 acres, and the Siskiyou NF 23,000 acres. Most of these treatments are not in stands with POC. The actual acreage treated is highly dependent on funding and is lower than the numbers indicate, because many of these treatments are accomplished on the same acre.

Hazardous fuels treatment objectives are to change fire behavior by reducing its rate of spread or intensity within the wildland-urban interface or other areas that must be protected from fire, and to reduce unwanted fire effects elsewhere. Combinations of treatments are used in southwest Oregon to restore vegetation and historic fire conditions. Most of these treatments are noncommercial, but integrated vegetation management with commercial timber harvesting or producing by-products also occurs. In the high hazard areas next to communities, pretreatment is often needed prior to any prescribed fire use. This is because most areas are well outside the natural fire regime and fire cannot be reintroduced without first modifying the fuels in some way (pretreatment). Dense understory vegetation from years of fire exclusion has resulted in the accumulation of excess down woody fuels that serve as ladder fuels and contribute to crown-fire initiation. Pretreatments include: the cutting, hand piling, and hand pile burning of excess vegetation and fuels; mechanical treatments to masticate or crush fuels and vegetation; and small diameter tree removal for by-products. The usual plan is to underburn within a few years of the pretreatment to reduce vegetation regrowth and maintain desirable fire behavior characteristics.

Hazardous fuels reduction and integrated vegetation management is a potentially large and recurring program in the range of POC (tens of thousands of acres per year). The majority of acres needing treatment would not have POC in the stands, but about 17 percent of the planning area contains stands with POC as a component. Drainages could have POC populations, and access roads could traverse areas with POC. POC management practices could affect wet season (October 1 through May 31) operations, road access, water use, and available treatment options. This in turn would affect the timely implementation, cost, and accomplishment of fuel treatment activities.

Many of these fuel treatments are labor-intensive mechanical or manual treatments. Workers may walk over nearly the entire stand at several different times to cut vegetation with chain saws, lop and scatter slash, hand pile slash, and burn hand piles. Daily production rates are low and large crews and/or a long season is required to accomplish the amount of work. Walk-ins to the work site reduce crew production rates. Mechanical treatments that masticate or crush vegetation have higher production rates, but require access for the machinery and operators, and maintenance and refueling on a daily basis. Seasonal restrictions or road closures limit the amount of time a contractor can work or restrict access. Work in summer is often affected by seasonal industrial fire precaution level restrictions due to fire season severity. Even in the dry season contractors may not be allowed to run saws or motorized equipment.

Road access affects treatment options, access to work areas, travel time to work areas, and access to water sources. Treatments such as small-diameter tree removal and commercial timber harvest require a well-developed road network to be feasible or economically viable. Crews also need some road access to accomplish hand treatments and prescribed burning. Long walk-ins increase costs and risks with prescribed burning, and reduce the feasibility of treatments.

Prescribed fire uses, such as hand pile burning or underburning, are normally accomplished during the wet season to meet burning prescription objectives and reduce fire escape risk. Hand crews and engines usually accomplish the burning. Equipment is washed and cleaned on a daily basis, and water in the engines is from uninfested sources. Unlike wildland fire operations, prescribed fires are preplanned and have a project-specific burn plan. Where POC is a concern, the burn plan specifies mitigation measures that could include: priority of operations, travel routes, water sources that require treatment with Clorox bleach, or additional washing.

The costs of hazardous fuels treatments and the number of acres accomplished are interrelated. High per acre treatment costs result in fewer acres being treated due to funding limitations.

Effects of the Alternatives

Alternative 1

Wildland Fire Operations: POC management practices have the greatest potential effects on wildland fire operations where there is no immediate threat to firefighter safety, public safety, or private property, and the fire is either not suppressed during initial attack by ground-based resources or requires local water use by crews (portable pumps) or helicopter water drops. Larger wildland fires (or wildland fire use) require equipment inspections, travel access management, wash stations, identification of clean water sources, setting up helicopter dip tanks to treat water closer to the fire, and greater use of water tenders. When engines and water tenders need additional water, Clorox bleach is available to treat unknown or infested water sources in the field. To the extent these actions delay suppression action or decrease the efficiency of fire operations, the potential size, cost per acre, and total cost of a fire could be increased.

Approximately 20 percent of all fires on NF lands and 30 percent of all fires on BLM lands receive helicopter water bucket drops. Assuming safety and property are not threatened, delays can occur if POC status and clean water sources are not already known and identified. For example, if there were uninfested POC in the fire area, helicopter water drops would be from the closest clean water source. It could require additional time to find and verify a clean water source. If the clean water source is farther away than an infested source, then the potential efficiency of the helicopter has also been reduced and there could be both a larger fire size and an increased cost per acre. The increased cost is the flight time to deliver the water needed on the fire. One solution when resources are available is to add extra or larger aircraft ($600 to $900 per hour for a light and $1,200 to $1,800 per hour for a medium) to make up for the difference in lost efficiency if multiple water drops are needed. Another is to utilize an air tanker with retardant (approximately $5,000 per load) to hold the fire until other resources can get to the fire. If resources are unavailable or additional time is necessary to acquire them, then the fire could get larger. The use of these additional resources could easily double the cost of a relatively small fire. All of these activities increase the complexity, number of resources, and cost of an incident.

If POC management practices result in larger fires, it increases the areas at risk to PL spread from suppression actions, and could result in the loss of more cedar to fire mortality. These practices could also result in fewer acres of wildland fire use to reduce the risk of PL introduction or fire mortality.

Fuels Management: POC management policies would affect wet season operations. If uninfected POC is within the work area or accessed by roads with seasonal restrictions, activities could be restricted to the dry season. This would contribute to scheduling difficulties to accomplish the work, require hiring more seasonal workers, and provide a less stable local work base. It could also make the purchase and use of specialized small-diameter tree removal or masticating equipment uneconomic by local contractors if it cannot be used for a large part of the year. This would increase the cost and time to accomplish the work, and limit the available treatment options. Mitigations such as daily washing of vehicles and tools, scraping mud off of boots, and priority of operations also have a minor affect on the cost. Prescribed fire burn plans would also include restrictions or mitigation measures that reduce the burning window or increase costs through required mitigation measures.

In general, the larger the potential hazardous fuel treatment program in areas with POC concerns the greater the effect would be on accomplishing the work and the potential for increased costs. Although cost increases may only be in the order of 5 percent to 10 percent for planning, implementation, and monitoring, some areas would probably not be treated due to the difficulty of scheduling treatments around seasonal restrictions or road closures (primarily for prescribed burning). Higher per-acre costs would also reduce the total number of acres treated.

Alternative 2

Wildland Fire Operations: This alternative is similar to Alternative 1, but POC management practices would be simpler to implement due to more consistent policy over multiple-agency jurisdictions. Some preparedness planning would be in place, and the POC Risk Key would facilitate quicker decisions by incident commanders, fire use managers, and resource advisors in the field. This would reduce potential delays in planning and implementing wildland fire suppression tactics and operations in low-risk areas compared to Alternative 1. When wildland fires occur within or could spread into uninfested 7th field watersheds on Federal lands (268,691 acres), there could be an increase in fire size and a higher fire cost. This is due primarily to preparedness planning that may require use of either treated or clean water sources during wildland fire operations within these 7th field watersheds. This could slightly increase the size of an unwanted fire and increase the costs within these 7th field watersheds compared to Alternative 1. Protecting POC could also exclude wildland fire use from uninfested 7th field watersheds to reduce the risk of PL introduction and/or increase costs.

Fuels Management: This alternative is similar to Alternative 1, but POC management practices would be simpler to implement due to consistent policy, and the POC Risk Key would facilitate easier identification of POC areas that do not require management practices. Unlike wildland fire suppression, fuels management activities are preplanned and POC management practices are integrated into those plans. This would be expected to slightly reduce the cost per acre of fuel treatments and increase the acreage treated outside of the uninfested 7th field watersheds compared to Alternative 1. Fuel treatment costs within the uninfested 7th field watersheds would likely increase compared to Alternative 1 due to probable application of measures to reduce the risk of PL introduction. There are about 53,713 acres of wildland-urban interface within these watersheds. POC managment practices could result in fewer acres being treated in these uninfested 7th field watersheds.

Alternative 3

Wildland Fire Operations: This alternative could have the greatest potential effect on wildland fire operations. Reducing road density in POC cores (34,028 acres) and buffers (460,464 acres) would limit access for resources such as engines and hand crews. This could increase the time it takes to respond to an unwanted wildfire and lead to larger fires. Future wildland fire use could be reduced due to poor access to topographic or road-related control features. It could also require the use of more resources and water than if better access allowed prompt and successful initial attack. Many of these POC cores and buffers are adjacent to private property and communities. Additional restrictions on water use within the POC cores and buffers could also reduce helicopter efficiency and could increase fire-suppression costs in extended-attack or large-fire operations. POC management practices may have to be foregone in these areas if fire threatens nearby property.

This alternative could contribute to a larger fire size and higher operation costs than the other alternatives. It would slightly increase the risk of POC fire mortality in the POC cores and buffers due to less efficient initial attack and larger fire size.

Fuels Management: This alternative would have the greatest potential effect on fuels management, especially in the wildland-urban interface. Many of the proposed POC cores and buffer areas are adjacent to or include high priority for treatment of wildland-urban interface areas. Approximately 2,700 POC core and 51,000 POC buffer acres are within the wildland-urban interface. Reducing road density or increasing seasonal road closures in POC cores and buffers would limit access for fuel treatment projects and prescribed burning crews and resources. The prohibition on timber sales would eliminate commercial thinning as a tool for treating overstocked stands in areas. Treatment options may not be feasible or costs would be increased. The result would be the least amount of acres treated because of higher costs, or result in not treating the POC cores and buffers and treating less expensive wildland-urban interface acres elsewhere. The latter could result in larger and more severe wildfires in POC cores and buffers as well as threaten communities.

Alternative 4 and 5

Wildland Fire Operations: These alternatives would have the same effect on wildland fire operations. Resources could be used without any considerations for POC root disease. No restrictions on water use or requirements for Clorox bleach would maintain the effectiveness of helicopter-bucket drops and other water-use operations. Fire operations costs and, potentially, final fire size would be the least of all of the alternatives. This would primarily benefit those few wildfires in areas with uninfested POC that escape initial attack and go to extended-attack or large-fire operations. Future wildland fire use opportunities would also not be reduced by any POC considerations.

Fuels Management: These two alternatives would have the least effect on fuels management. Hazardous fuels treatment projects could be implemented without any considerations for POC root disease. The absence of restrictions on water use or requirements for Clorox bleach would maintain the effectiveness of water-use operations during prescribed-burning operations. Road access would be available to more cheaply implement projects and utilize the full mix of fuel treatment options to accomplish the most treatment acres of any alternative.

Alternative 6

Wildland Fire Operations: This alternative is similar to Alternative 3, except that the change to uninfested 7th field watersheds reduces the total watershed acres with added protection by 46 percent. There is a 46 percent increase in the acres of POC cores (49,675 total acres) and a 52 percent reduction in the acres of POC buffers (219,016 acres) relative to Alternative 3. Reducing road density in POC cores and buffers would limit access for resources such as engines and hand crews. This could increase the time it takes to respond to a wildland fire and lead to larger fires. It could also require the use of more resources and water than if better access allowed prompt and successful initial attack. Many of these POC cores and buffers are also adjacent to private property and communities. Additional restrictions on water use within the POC cores and buffers could also reduce helicopter efficiency and could increase wildland fire operations cost. POC management practices may have to be foregone in these areas if a wildland fire threatens nearby property.

This alternative could contribute to larger unwanted wildland fire size and higher operations costs. It would also slightly increase the risk of POC fire mortality in the POC cores and buffers due to less efficient initial attack and larger fire size. This potential is less than Alternative 3, but greater than the other alternatives, due to the reduced acres with added protection. The 7th field watersheds are also more dispersed over the range of POC than the 6th field watersheds of Alternative 3. This could allow more opportunities to maintain and plan access for fire operations (including wildland fire use).

Fuels Management: This alternative would have the second greatest effect on fuels management. Many of the uninfested 7th field watersheds are adjacent to or include high priority for treatment wildland-urban interface areas. Approximately 3,240 POC core and 19,800 POC buffer acres are within the wildland-urban interface. This is more POC core acres, but less POC buffer acres than Alternative 3. Reducing road density or increasing seasonal road closures in POC cores and buffers would limit access for fuel treatment projects. The prohibition on timber sales would eliminate commercial thinning as a tool for treating overstocked stands in cores. Treatment options may not be feasible or costs would be increased. The result would be the second least amount of acres treated because of higher costs, or result in not treating the POC cores and buffers and treating less expensive acres elsewhere. This could result in larger and more severe wildfires in POC cores and buffers as well as threaten communities.

Air Quality

Affected Environment

The Federal "Clean Air Act," as amended in 1990, is designed to reduce air pollution, protect human health, and preserve the Nation's air resources. To protect air quality, the Act requires Federal agencies to comply with all Federal, state, and local air pollution requirements (Section 118).

Effects of the Alternatives

The effects of the alternatives on air quality are unquantifiable and inconsequential. The degree to which Alternatives 1, 2, 3, or 6 might increase wildland fire size because of increased POC mitigation measures is offset by the reduction in overall mortality which would slightly decrease fuel loading and soil erosion that could lead to wind-borne soil.

Recreation, Visual, Wilderness, and Wild and Scenic Rivers

Affected Environment

Recreation within the analysis area ranges broadly, from relatively unstructured and dispersed recreation use, to structured, activity-based recreation within managed areas, sites, roads, or trails. Total recreation use on public lands within the analysis area is approximately 2.5 million visitor use days.

The analysis area has a number of developed campgrounds, lakes, rivers, and trails (such as horse, foot, and motorized) on public lands where recreation use (47 percent) is managed (USDI-BLM 1995b). Managed sites in the area operate near capacity during the high use months of June through September.

Segments of the Rogue, Illinois, and Chetco Rivers within the range of POC are congressionally designated components of the National Wild and Scenic Rivers System; other streams are in various stages of study and evaluation for inclusion within the system. These river reaches provide over 1 million visitors per year with whitewater rafting opportunities.

There are numerous wilderness areas (such as the Kalmiopsis and Wild Rogue Wilderness Areas) throughout the region, and a few wilderness study areas. Wilderness is valuable as an area undisturbed by human activity and left to natural processes. These areas also provide unconfined primitive recreation opportunities for hikers and horseback riders, and mechanized activity is not allowed. These areas do allow horseback riding, pack stock, and some livestock grazing.

Dispersed recreation consists of back-country camping, hiking, horseback riding, picnicking, general sightseeing, driving for pleasure, hunting, fishing, whitewater rafting, winter sports, and off-highway vehicle use. These uses account for about 20 percent of total use throughout the analysis area, and are typically by those desiring an uncontrolled environment, unaffected by other users (as occurs in managed sites). Off-highway vehicles include two-, three-, and four-wheeled vehicles capable of traversing miles of rough terrain in a day, and are sometimes transported in pickups or on trailers from site to site, sometimes in widely separated parts of the POC range including both ways between California and Oregon.

Dispersed recreation activities, which are affected by level of access, are most likely to be affected by general land use management Standards and Guidelines, due to the unstructured nature of the activities and their prevalence on all public lands. Recent innovations with geographic positioning systems and associated games and hunts may encourage an increase in cross-country travel.

There are no existing demand analyses for dispersed recreation opportunities within the analysis area. Off-highway vehicle industry leaders predict, however, that off-highway vehicle use has, and continues to, rise dramatically within the State.

Off-highway vehicle management guidelines vary slightly between the different land management agencies; however, they all basically contain the same tenets of protection of natural resources, providing for visitor safety, and minimizing conflicts among various users (USDI-BLM 1995b).

Depending on the resource conditions and characteristics within different drainages or areas, lands are generally classified as *open*, *closed,* or *limited*, to off-highway vehicle use. *Open* is defined as an area where all types of vehicle use is permitted at all times, anywhere in the area subject to applicable operating regulations and vehicle standards. *Closed* is simply defined as an area where any off-highway vehicle use is prohibited. *Limited* means an area is restricted at certain times, in certain areas, and/or to certain vehicular use (43 CFR 8340.0-5).

These off-highway vehicle use classifications are periodically reviewed as part of each Agencies' land management planning process and are adjusted/changed as needed to respond to changing resource conditions, use patterns, and public input expressing a demand for recreation opportunities.

The Agencies also include off-highway vehicle use, horseback riding, hiking, mountain biking, and any other mode of transport in the construct of specific transportation management plans. Such plans are usually part of or adjunct to the broader land management plan governing that particular administrative unit, and address broad issues concerning access to public lands.

The visual resource within the analysis area has been inventoried and has received scenery quality ratings based upon an analysis of a particular viewshed's uniqueness within the region, its relative importance as a component of the characteristic landscape when viewed from popular observation points (Interstate highways, viewpoints, points along rivers and trails), and other factors. Generally, the scenery quality within the area is considered high by most visitors based upon the prevalence of extensive conifer stands, interesting physiographic features, and opportunities for viewing. Although POC seldom occurs in pure stands, its dense, green foliage makes a significant scenic and esthetic contribution to the forests. Its affinity for water particularly brings it into contact with many forest users, such as at campgrounds and other high-use areas. Recreation activities that may be linked with the occurrence of POC include camping in sites dominated by a POC overstory, and photography.

The overall character and perceived quality of the visual resource varies by location, viewer, and type of use. Qualitative statements regarding scenic quality are dependent on a variety of factors. It can be assumed, however, that the color contrasts presented by browning POC crown(s) amidst a stand of healthy trees would create a color contrast at that site. Higher mortality generally translates into increased contrasts, thus degrading the visual scene for some visitors. In areas where POC is the dominant species and it is unlikely that a replacement stand will develop (certain ultramafic sites), the impacts to the perceived qualities of the visual resource will be greatest.

Effects of the Alternatives

There are two distinct ways the alternatives affect recreation-related use. The first is the degree to which alternatives limit access. Access and availability of public lands for recreation use is a key variable used for analysis of each alternative. Existing levels of availability of public lands for recreation use is deemed adequate at this time. The second is the degree to which the alternatives contribute to wilderness and esthetic resources by maintaining POC over the long term.

It is assumed that increasing human populations within the area would increase recreation use of public lands. Demand would increase relative to growth. Cumulative effects would be relative to levels of increased demand and reduced availability.

Road closure methods, such as gates, suffer a certain degree of vandalism and forceful breaching by those unwilling to honor the closure. The level of such activity seems related to the level of agency enforcement of the closures. There would likely be an incremental increase in such incidents with increased gating.

Off-highway vehicle use, horseback riding, and all vehicular use are recognized as probable PL export agents, and thus are most affected (targeted) by any use restrictions. Saddle and pack stock require reasonable watering opportunities, increasing the probable exposure to POC and PL areas.

Although the Standards and Guidelines of the various alternatives generally do not affect wilderness, wilderness study areas, or wild and scenic rivers directly, each of the alternatives could allow for varying levels of introduction of PL into these lands and waters via foot and horse traffic. There would be a resultant reduction in wilderness values as well as visual quality and related recreation experience.

Alternative 1

Access to and availability of public lands for recreation use appears to be adequate for present demand. Any effects associated with this alternative would increase or decrease based on the level of access provided to the public. Current direction allows for gating or barricading roads to protect POC when consistent with other resource objectives. A desire to maintain public access is always a major concern whenever a road closure is considered. Public input and feedback thus far has generally not indicated a perception of overly-restricted access. Various other road closures have occurred for other resource-related reasons, and have generally not elicited noticeable public resistance (except in isolated circumstances). As future use increases—depending upon the level of road or seasonal restrictions imposed—demand could be displaced to other lands, resulting in a reduction in the quality of user experience.

This alternative would result in infestation of 49 to 58 percent of high-risk areas (those most associated with water) throughout all portions of the range except at Coos Bay BLM District/ Siskiyou NF Powers Ranger District. There would be a corresponding reduction in the aesthetic environment to individual recreationists. The visual quality of the characteristic landscape could suffer degradation until and if stands recover with replacement conifer species. Negative effects on wilderness values could increase.

Alternative 2

Effects of Alternative 2 are similar to Alternative 1. Management Practices 8 (Routing Recreation Use) and 9 (Road Management Measures) are probable effect-producing actions depending on the degree of the closure or restrictive action. Application would be variable depending upon POC and PL locations and the nature of the use or activity—there is no reliable indicator of the totality of any effect. These types of actions have already occurred over the past decade for various management reasons throughout the area. Individual occurrences of such management actions would require specific analysis based on their scale and scope, and the interest level and nature of stakeholders affected. Depending on the relative importance of certain roads or road systems to particular user groups, controversial or recreation-impacting closures could occur. As future use increases—depending upon the level of road or seasonal restrictions—demand could be displaced to other lands, resulting in a reduction in the quality of user experience.

Given the flexibility of management options within this alternative, and the unlikelihood of substantial decreases in access or availability of recreation opportunities when compared with the current direction, access effects associated with this alternative are considered negligible.

This alternative would result in infestation of 40 to 51 percent of high-risk areas (those most associated with water) throughout all portions of the range except at Coos Bay BLM District/ Siskiyou NF Powers Ranger District. As in Alternative 1, there would be a corresponding degradation in the aesthetic environment as perceived by individual recreationists. The visual quality of the characteristic landscape could suffer degradation until and if stands recover with replacement conifer species. Effects on wilderness values would be somewhat less than Alternative 1.

Alternatives 3 and 6

In addition to the effects described for Alternative 2, Management Practices applying to POC cores (Management Practices 1 [Minimize Entry], 3 [No Vehicles], and 6 [Trails]) are probable effect-producing actions. Alternatives 3 and 6 close or limit use of all discretionary roads in POC cores except mainline (tie) roads. These road closures could reduce access to trailheads and limit accessibility to recreationists. This reduction in accessibility would remain until trails could be built out to the nearest road. Depending on the level of closure involved, the effect would range from low to a level where existing demand for access and availability is not being met, and recreationists (especially off-highway vehicle users) would be displaced to other lands, decreasing the quality of the recreation experience for the user.

POC buffer protection Management Practice 1 (Transportation Analysis) is a probable effect-producing action. The level of availability of roads for public use, and the resulting effects, are the same as those described for the Management Practice 3 (No Vehicles) above.

These alternatives would result in infestations of 32 to 43 percent (Alternative 3) or 30 to 41 percent (Alternative 6) of high-risk areas (those most associated with water) throughout all portions of the range except at Coos Bay BLM District/Siskiyou NF Powers Ranger District. Although less than Alternative 1 and 2, there would be some reduction in the aesthetic environment for individual recreationists. The visual quality of the characteristic landscape could suffer degradation until and if stands recover with replacement conifer species. Wilderness values could be degraded slightly, but would be best protected in these alternatives.

Alternatives 4 and 5

Removing existing POC disease-prevention practices would have little effect on the availability of recreation opportunities on public lands. The lack of closures or access restrictions would, however, lessen the likelihood of impacting an individual user group concerned about losing access to a favorite area. This alternative would also decrease the likelihood of displacement-related congestion in other areas in the future.

This alternative would result in infestation of 83 to 89 percent of high-risk areas (those most associated with water) throughout all portions of the range except at Coos Bay BLM District/ Siskiyou NF Powers Ranger District. Recreation activities that may be linked with the occurrence of POC (such as camping in sites dominated by a POC overstory, and certain photographic activities) would be negatively affected. The effect would simply be the loss of the aesthetic environment that served as a draw to individual recreationists and a backdrop for their chosen activity.

Visual resources would be affected by the eventual loss of POC—effects would vary depending on the amount of POC in a viewshed. The visual quality of the characteristic landscape could suffer degradation until and if stands recover with replacement conifer species. Stands are more likely to recover under Alternative 4 than 5, because of the accelerated resistance breeding program. As explained in the Planting Assumption (found in the Assumptions and Clarifications section of this chapter), however, reforestation efforts will avoid high public use areas, such as campgrounds or along roads, at least until those areas test negative for the presence of PL in the soil. Wilderness values could be significantly impacted as PL spreads to additional drainages.

Areas of Critical Environmental Concern and Research Natural Areas

Affected Environment

As a part of the preplanning process for the SEIS, the staff considered and evaluated all lands within the Oregon range of POC that are designated areas of critical environmental concern (ACECs) and/or research natural areas (RNAs). "The Federal Land Policy and Management Act" and BLM policy require the BLM to give priority to designation and protection of ACECs during the land use planning process. ACECs are areas within BLM-administered lands where special management is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or natural systems or processes, or to protect life and safety from natural hazards. Appendix 8 contains a complete description of the ACEC criteria.

ACECs may be nominated by members of the public, other agencies, and BLM staff at any time. BLM policy requires that RNAs be managed as ACECs; therefore, areas nominated as RNAs must meet the ACEC criteria. RNA management goals and plans are usually more restrictive than ACEC management alone, as RNAs are created for scientific research and should maintain values for the representative cells and values.

Existing Areas of Critical Environmental Concern and Research Natural Areas

At present there are 37 existing ACECs or RNAs in the range of POC in Oregon. Eighteen ACECs or RNAs do not contain POC; 18 ACECs do. See Appendix 8 for a listing of the ACECs or RNAs that contain POC and their size, primary objectives, and other management information. Appendix 8 also includes the process and requirements for designation of ACECs.

Management activities in or near ACECs must be implemented in such a manner so as to be compatible with specific management objectives identified in site-specific activity management plans. In general, direction requires the BLM to: (1) manage ACECs for the maintenance, protection, or restoration of relevant and important resource values; (2) manage RNAs for the purpose of scientific study, research, and education, and to provide a baseline against which human impacts on natural systems can be measured; and (3) manage outstanding natural areas for recreation in a way which will not damage the natural features that make the area outstanding.

Management plans for each area will address such actions as land acquisition, fire use, interpretation, introduced species, wildland fire operations, domestic grazing, insects and disease, public use, minerals, and hydrology. Direction requires pursuit of mineral withdrawals for all RNAs; the inventory and designation of new RNAs as appropriate "cells" are identified, a limitation of off-highway vehicle use in all special areas to existing roads (unless closed), and development of monitoring plans that address ecological status, defensibility, and compliance monitoring issues.

Effects of the Alternatives

Eighteen of the ACECs or RNAs are not known to have POC; hence, there is no effect under any of the alternatives. Fourteen ACECs or RNAs have POC and no known root disease. Seven of these ACECs or RNAs were selected at least partially for the presence of POC plant communities. Five ACECs or RNAs currently have root disease. Three of the infested ACECs or RNAs were selected at least partially for the presence of POC plant communities.

The risk to any specific ACECs or RNAs is generally the same as percentages described in the Pathology section for each alternative. Under Alternatives 1, 2, 3, and 6, management plans for the ACECs or RNAs would be developed where they do not exist and these areas would be managed to reduce the spread of (or possibly eliminate) PL, according to the Standards and Guidelines of the selected alternative. Under Alternatives 4 and 5, existing areas of PL would remain untreated, placing those ACECs or RNAs selected for the presence of POC plant communities at higher risk of losing those values for which they were selected. These alternatives would raise the probability of infestation occurring, particularly on sites favorable for the pathogen, compared to Alternatives 1, 2, 3, and 6.

Culturally Significant Products for American Indian Tribes

Affected Environment

The current range of POC falls within the traditional territories of numerous American Indian Tribes along the west coast of North America. Included is the 5,400-acre forest of the Coquille Indian Tribe in west-central Oregon which is managed according to many of the Standards and Guidelines of adjacent Federal land. The Tribe and the Bureau of Indian Affairs may choose to adopt the selected alternative at a future date. Other Tribes in Oregon and California also manage lands containing POC, but these are not directly affected by the management requirements of the various alternatives. POC continues to play a significant role in the cultural and religious life of many Tribes living within the POC range from west-central Oregon south through northwest California. Native cultures toward the northern end of the POC range suffered more severe disruption during U.S. settlement of the region in the mid-19th century than those toward the southern end of POC range. As a result, POC use was largely disrupted and information is limited. Specific information concerning where, how, what time of year, and by whom POC is harvested and used is restricted from distribution.

Cedars of all types are considered the most used wood by native cultures of the Pacific Northwest. Despite declining availability, the cultural importance of POC remains high given its physical and structural characteristics, distinctive appearance, and aroma. The smells of POC also enhance the meaning of cultural rituals. Known for its durability, POC has straight grain properties allowing it to be split evenly. In contrast, spruce, which is also valued, does not split as evenly and has more pitch. Therefore POC is sought as a source of planks for building traditional structures and for arrows or lances that support bone or stone projectile points. However, shortages and diminishing accessibility to mature trees sometimes relegates POC to parts of a plank house or sweat lodge, such as benches or sidewalls. This is also true for construction of canoes.

POC has other traditional uses. Boughs are used as brooms, and the bark and roots are peeled and finely shredded for use in making traditional clothing, basketry, nets, twine, mats, and other items. Limbs may be twisted into rope.

Unlike western red cedar and incense cedar, POC has limited medicinal value due to its highly toxic character as a diuretic. Similarly, POC is less effective than incense cedar for preserving and storing perishable materials such as feathers, hides, and other materials. POC typically does not have the cedar-closet aroma of other cedars.

The declining availability of healthy, mature POC trees through the 20th century has increased the importance of remaining POC stands to Tribes. Although the region has experienced an economic and cultural rejuvenation by the Tribes, a declining availability of POC due to several factors, including past timber cutting, disease, endangered species protection, fish protection, and land use allocations, hinders Tribal initiatives to restore and revive cultural traditions.

Agencies issue permits for collection of special forest products including non-POC boughs, beargrass, and cones, but seldom issue permits for POC product collections. Therefore, quantitative data concerning modern-day cultural uses of POC is highly variable among the

Tribes and generally not readily available outside Tribal communities. In general, however, use of POC is at modest levels. No information is available regarding the association of other culturally important species associated with the occurrence of POC.

Maintenance of POC stands on Federal lands as a culturally-important species is important to Tribes and fulfills Federal policies and goals for accommodating traditional Tribal uses. These uses are also consistent with the "American Indian Religious Act," and other statutes that highlight the importance of traditional cultural uses of plants on Federal lands. There are no effects to the exercise of those rights, because there are no off-reservation treaty reserved rights within POC range.

Effects of the Alternatives

There are two distinct ways the alternatives affect Tribal uses of POC products: (1) the degree to which alternatives limit access to products, and (2) the degree to which the alternatives maintain collectable quantities of POC over the long term.

Access to Products: Access is least restricted in Alternatives 4 and 5, and increasingly more restricted with Alternatives 1, 2, 3, and 6, respectively. For example, Alternatives 1, 2, 3, and 6 include a variety of management practices including sanitation measures (removal of roadside POC in disease infested areas), road construction restrictions, restrictions on harvesting boughs, and washing vehicles accessing diseased areas. Alternatives 3 and 6 would result in further access restrictions in some watersheds. However, because of the modest demand and the availability of at least some products from private lands, the actual difference between the alternatives is extremely small, perhaps affecting less than one collection request per year in the most restrictive cases of Alternative 3 and 6. Further, the adverse effect on access is more than compensated for, in the view of the Tribes, by what they view as the long-term benefits of reduced access. The Tribes contacted for this SEIS felt strongly that slowing the spread of the root disease was important to protect their cultural uses. Many responses advocated limiting access to areas to achieve that goal by restricting the introduction of disease-infested soil.

Maintain Collectable Quantities: Even though access and collection restrictions of some alternatives may remain in place indefinitely, the effect on Tribes depends primarily on the amount of healthy POC that would be provided by each alternative over the long term.

An analysis of the six SEIS alternatives on the spread and impacts of PL on POC stands reveals useful trends in determining the implications for availability of POC on Federal lands for cultural use. The pathology effects section indicates the six alternatives pose insignificant differences for POC stands in low-risk areas. The occurrence of low-risk areas varies greatly in the POC range, from 80 percent of the area in the northern coastal areas of western Oregon, to 60 percent in the southern coastal range of California, and 40 percent in inland areas of POC. The analysis does indicate significant differences posed by the alternatives on high-risk areas within the region. Therefore, only 20 percent of the Northern Coastal Range shows significant variation in results of the alternatives over a 100-year period. This increases to 60 percent in the areas further inland. The analysis further determines for uninfested high-risk sites that the alternatives would lead to the following infestation rates over the next 100 years (from Table 3&4-8 in the Pathology section):

Alternative 1 — 40 percent;
Alternative 2 — 30 percent;
Alternative 3 — 20 percent;
Alternative 4 — 80 percent;
Alternative 5 — 80 percent; and
Alternative 6 — 18 percent.

Those stands newly infested are expected to experience a 90 percent mortality rate within 20 years or less of becoming infested.

The primary difference in alternatives is in the application of management actions to prevent/reduce the spread of disease in uninfested areas of Alternatives 1, 2, 3, and 6, and the lack of such provisions in Alternatives 4 and 5. However, Alternative 4 includes a strong emphasis on disease resistance breeding in POC planting stock, which would increase the availability of POC products as they grow older.

Given the following factors that: (1) the alternatives only vary significantly for high-risk sites in regard to rate of disease spread; (2) Tribal reliance on POC stands for culturally important products is at modest levels; and (3) under all alternatives some level of healthy accessible POC stands would be sustained over the 100-year analysis period, the difference in effects on Tribal use of POC among Alternatives 1 through 6 is immeasurable. It should be noted however that Alternative 5 poses a potentially greater effect over a longer time span because it combines lack of disease prevention measures with a nonaggressive genetics program, and thus could impact Tribal product availability more than for the other alternatives. However, the difference will be insignificant through the 100-year period addressed by the SEIS.

Note: Persons contacted in soliciting information for this section included Don Ivy and George Wasson of the Coquille Indian Tribe, the Hoopa Tribe Forestry Department, Jason Younker of the University of Oregon, Forest Service Region 6 Tribal Affairs Specialist Les McConnell, land management agency Cultural Resource Specialists Dr. Steve Samuels, Isaac Barner, Dr. Mike Southard, and Reg Pullen.

Special Forest Products

Affected Environment

POC shares the same decay-resistant properties as other cedars, such as western red cedar and incense cedar, and is used for posts, rails, and shakes. Western red cedar and incense cedar are more sought after because they have a wider range and are more easily accessible.

POC is in greatest demand for boughs during Christmas and to a lesser degree, for year-long floral arrangements. Boughs have a graceful, flat, beaded-lace appearance that makes them ideal for tying continuous strands to a wire backing for garlands or for layering into Christmas wreaths. The foliage also combines beauty with durability and needle retention that allows it to be preserved with glycerin mixtures for long-lasting floral displays. These attributes make POC a desirable commodity for personal use and commercial harvest. Commercial buying sheds in southwest Oregon purchased more than 400,000 pounds of POC boughs during 2002, yet less than 4 percent came from Federal land. The existing market for POC boughs could accommodate an increase in Federal bough supply either through expansion of demand or substituting POC boughs for western red cedar boughs. The price paid by the sheds ranged from $0.25 to $0.35 per pound, making POC economically desirable to harvest during a time of year when other agricultural work is diminishing.

The nature of commercial POC harvest involves an individual or crew making numerous trips from a vehicle into a grove of POC to clip and carry bundled boughs back to the road. Typically, a road will bisect several draws in a drainage growing POC, and harvesters will drive a road visiting and collecting from each draw. Greatest demand is prior to Christmas, typically a wet time of year, which increases these chances of moving infested soil by mud on shoes or vehicle tires. The intensity and focus of the foot traffic during commercial harvest in POC groves makes this a higher risk activity for PL spread than incidental foot traffic from hiking, hunting, or gathering of other special forest products such as mushrooms.

In addition to spring and fall mushroom gathering, other products potentially sharing range with POC or in demand during the wet season include firewood and Christmas trees. Both of these activities require a permit, so there are opportunities to close areas and direct collectors to areas with low risk. Within the range of POC, the Agencies issue approximately 800 personal use firewood permits, 1,200 mushroom permits, and 2,900 permits for individual Christmas trees each year. Closures of road systems that pass through POC range could affect access to Christmas tree cutting areas or limit availability of firewood permits. Mushroom gatherers using road systems for access or walking through the woods between infested and uninfested areas may be affected either by road closures, spread control techniques, or denial of permits.

Effects of Alternatives

The effects of the alternatives are based entirely on management constraints to the program. POC products are such a small percentage of the live POC on Federal lands that mortality differences between the alternatives are deemed to have little potential to affect supply in the foreseeable future.

Alternative 1

This alternative continues the current direction in the land and resource management plans of the BLM Districts and the Siskyou NF. Limitations on the harvest of POC boughs, stemming in part from incompatibility with the objectives of various land use allocations, and in part because of concerns about the role of bough collection in the spread of POC root disease, would continue. The level of harvest activity from Federal lands is expected to continue to provide only a small percentage (less than 4 percent) of total harvested boughs in southwest Oregon. Other special forest product opportunities within the range of POC are expected to continue at their present levels.

Alternative 2

Alternative 2 is similar to Alternative 1, except that practices currently implemented or recently developed are better described, a risk key is included for clarification of the environmental conditions that would trigger additional control or mitigation measures, and emphasis is added for 162 uninfested watersheds. Implementation of disease-control practices is expected to be somewhat more consistent than under Alternative 1. Bough harvest is expressly prohibited, except under specified permit conditions. There will be instances where site-specific analysis of a project would require the undertaking of some proactive POC roadside sanitation. These projects could provide several tons of boughs with the utilization of the severed trees. This translates into the level of bough harvest activity from Federal lands remaining approximately the same, or slightly higher, than current levels. Additionally, there may be road management practices that would result in a slight decrease (less than 5 percent) in other special forest products permits for firewood and Christmas trees due to restricting access to lands during the wet season or closing roads. Areas for firewood or Christmas tree cutting outside these closure areas are generally available to accommodate these requests.

Alternative 3

Alternative 3 incorporates all of the direction from Alternative 2, and adds protections for uninfested 6th field watersheds by creating POC core areas totaling 34,000 acres (or over 10 percent of the land base occupied by POC). The key management directions for these POC core areas relevant to this analysis are (1) closing of some road systems, and (2) suspension of all special forest products permitting in these areas. However, as in Alternative 2, there would be POC sanitation projects (including in POC buffer areas) that could provide several tons of boughs for utilization. As with Alternatives 1 and 2, the availability of boughs is tied primarily to sanitation and other management activities, which would remain similar to current levels or increase slightly. Hence, bough availability under this alternative would be approximately the same as current levels.

With restricted road access and special forest products permits in the POC core areas, and additional road closures or seasonal limitations put on activities in POC buffers (approximately 33 percent of the Federal land within the POC range in Oregon), there is an expectation of a slight decrease in mushroom, firewood, and Christmas tree special forest products permits. Because much of the core and buffer areas are in wilderness or inventoried roadless areas, any reductions in available collection areas would be small enough to be essentially negated through permitting in other areas.

Alternatives 4 and 5

Alternatives 4 and 5 remove the current management techniques used to control the spread of PL and are differentiated only by the increase of the disease-resistant seed program in Alternative 4 and discontinuing the resistance breeding program in Alternative 5. The effects for both alternatives with regard to special forest products would be similar. In the long term, a program of growing and planting seedlings may offer more opportunity for bough harvest than natural regeneration alone may offer, but plantings of disease resistant trees are not expected to be subject to bough cutting within the near future. Depending on Agency funding for the preparation and administration of bough sales increases, there would be a enough market and product availability to support 100 to 200 tons of bough collection per year. Additionally, there may be a slight increase in other special forest products permits due to increased access to lands, including during the wet season.

Alternative 6

The effects for Alternative 6 would be similar to Alternative 3. This alternative identifies uninfested watersheds at the 7th field level, which would result in POC cores approaching 49,000 acres (46 percent more than Alternative 3) and POC buffers of 219,000 acres (53 percent less than Alternative 3.) While the POC core acres are larger than in Alternative 3 and not so concentrated to inventoried roadless and wilderness areas, reduced POC buffer areas and closer permit substitute areas (the 7th field watersheds are smaller and less likely to affect large blocks) would likely affect mushroom, firewood, and Christmas tree special forest products permits about the same as Alternative 3. As with Alternative 3, this effect could be offset through increased permitting in other available areas. Road sanitation is predicted to increase, potentially increasing bough cutting available under this alternative when compared with Alternative 3.

Timber Harvest

Affected Environment

Timber harvest occurs for a variety of reasons on the BLM and FS units within the range of POC. An understanding of timber harvest activity and the lands involved is important to calculating the effects of the alternatives on future timber harvest. It is also illustrative about the amount and nature of harvest activity on public lands, acknowledged to be a factor in POC root disease spread.

Probable Sale Quantity

Within the Oregon portion of the range of POC, long-term sustained-volume production is a Northwest Forest Plan goal on about 11 percent of the Federal forestlands. These lands which comprise the harvest landbase, the Matrix and Adaptive Management Area land allocations, are managed for regularly-scheduled timber harvest while meeting a non-declining yield policy objective (Table 3&4-22).

The annual timber harvest volume expected to come from these lands is called probable sale quantity, or PSQ. The decisions regarding harvest methods and scheduling in the Matrix and Adaptive Management Areas are made after considering a variety of nontimber resource

Table 3&4-22.—*Acres by Northwest Forest Plan land allocation and administrative unit within the range of Port-Orford-cedar in Oregon*

	Northwest Forest Plan Land Allocations					
Unit	Congressional Reserves	Late-Successional Reserves	Administratively Withdrawn	Riparian Reserve [1]	Matrix/ Adaptive Management Area	Total
Coos Bay	433	45,941	2,641	79,575	26,526	155,116
Medford	24,894	119,355	1,935	58,460	27,511	232,155
Roseburg	-	45,417	635	23,920	15,293	85,265
Siskiyou	230,583	571,621	44,894	109,267	93,080	1,049,445
Oregon total	255,910	782,334	50,105	271,222	162,400	1,521,981

[1] Includes about 25% Matrix/Adaptive Management Area non-forest. Ratio of Riparian Reserve and non-forest to Matrix differs by administrative unit. Only the Matrix and Adaptive Management Area acres contribute to PSQ.

values at the administrative unit, watershed, and site-specific scales. PSQ levels are established in the land and resource management plan for each administrative unit, and currently reflect the plan amendments of the Northwest Forest Plan (USDA-FS and USDI-BLM 1994b) (Table 3&4-23). No previous PSQ adjustment was made for the current POC Standards and Guidelines. For the purposes of this analysis, it is assumed that PSQ is directly proportional to the forested lands dedicated to its production. That means for each acre removed from the Matrix or Adaptive Management Areas, there is a proportional and nearly straight-line reduction in PSQ. As noted in the Assumptions section earlier in this chapter, the following discussion assumes full implementation of the Northwest Forest Plan harvest volume, and other Northwest Forest Plan objectives.

On most of the Federal land management units in Oregon, POC is concentrated within the riparian areas and therefore contributes little towards the PSQ. The exceptions to this are on the Coos Bay BLM lands and the Powers Ranger District of the Siskiyou NF. Within this area, POC is more well-distributed across the landscape resulting in about 5 percent of the volume in any given harvest unit being POC. Disease-related POC mortality does not necessarily affect attainment of the PSQ. In addition to generally being only a minor stand component, the dead trees remain salvageable for long periods of time, and their growing space, if not readily captured by existing competitors, will be naturally restocked with other tree species

Other Harvests

A strength of the Northwest Forest Plan is the expectation that some form of density management (thinning) will be done in Late-Successional Reserves and some Riparian Reserves to help these lands more readily meet their primary objective of becoming habitat for late-successional forest-related species or contributing to achievement of water quality objectives. This type of harvest is typically limited to thinning in stands less than 80 years old, but may take place in older stands if necessary to reduce the risk of a major wildland fire. The resultant volume does not contribute to PSQ and there is no programmed level of harvest. Nevertheless, within the range of POC, recent Late-Successional Reserve harvest activity has taken place at an estimated rate of 3 million board feet per year and 300 acres per year when combined across all the Oregon management units. There is a considerably higher capacity for these treatments. About 20 to 30 percent of all Late-Successional Reserve acreage within Northwest Forest Plan area are between 30 and 80 years of age and much of that would benefit from thinning. Within the Oregon portion of the POC range, the potential for these treatments is estimated to be about 85,000 acres.

Salvage activities may also take place in most land allocations depending upon the magnitude of the disturbance event. Late-Successional Reserves permit salvage if an event such as a

Table 3&4-23.—*Annual probable sale quantity [PSQ] in millions of board feet annually by administrative unit and within the range of Port-Orford-cedar* [1]

	Administrative Unit						
	Oregon				California		
	Coos Bay	Medford	Roseburg	Siskiyou	Six Rivers	Klamath	Shasta-Trinity
Total PSQ	22	47	37	24	16	51	82
PSQ within POC range	13	6	6	24	7	10	1

[1] Millions of board feet in 32-foot logs.

fire, windstorm, or disease has reduced canopy cover below 40 percent on an area larger than 10 acres. Salvage may be proposed, for example, within the Late-Successional Reserves of the 2002 Biscuit Fire area. Annual levels of salvage volume are highly variable. The exception to salvage operations occurs upon the nearly 17 percent of Federal lands designated as Congressional Reserves.

Harvest Activity

Harvest volumes per acre are variable depending upon the land allocation and whether a complete (regeneration), partial (thinning), or salvage harvest is implemented; but it would be reasonable to estimate about 20,000 board feet per acre is average. Further, the average logging truck carries about 5,000 board feet. Finally, the ratio of tractor to cable partial-suspension or full-suspension (ground-based to nonground-based) logging is about 20 to 80. With these numbers, general levels of ground-disturbing activities and road use related to logging can be calculated.

Annual volume harvested on Federal lands in the Oregon portion of the POC range is about 49 million board feet (PSQ plus reserve thinning and salvage volume). This results in harvest on approximately 2,500 acres per year. With 20 percent of the range actually having POC, and 13 percent of that being infested with PL (Table 3&4-10), about 65 acres of harvest are likely to occur on PL-infested soils in any given year. The level of disturbance and therefore the likelihood of moving PL varies by the type of harvesting method used. The harvest methods on Federal lands within the Oregon range of POC were reported to be 23 percent tractor or no suspension, 58 percent cable with partial suspension, and 20 percent full suspension (cable or helicopter).

Transporting the annual volume from the Federal forests in Oregon requires about 10,000 truck trips, traveling to various mills, sometimes out of state. For California, the 19 million board feet being harvested within the range of POC translates to another 3,800 truck trips. Timber management personnel from the northern California forests estimate the amount of wood traveling into Oregon from their timber sales is less than 2.5 million board feet per year, or up to 500 truckloads per year. Some of these trucks could come from PL-infested areas. The potential for exchange of spores at mill yards, using out-of-state logs and logging trucks as infection vectors, is probably very slight, given the level of infestation in northern California forests, Federal timber sale mitigation measures, and poor spore survival under high temperatures (Goheen, D.J., *personal communication*).

On Federal lands, all harvests are done by the highest qualified bidder or their agents, using private logging equipment. There is the possibility of infestation being spread throughout the range or between states with this equipment. The risk is higher with equipment used on private lands within the range of POC where it is not subject to the level of mitigations and seasonal constraints applied to Federal timberlands. This may be of particular concern with equipment used in the area between Port Orford and Coos Bay, Oregon, where POC and PL are scattered throughout many private forest lands and the level of infestation is higher than on any of the Federal lands in this analysis. The current POC management practice of cleaning equipment before permitting a purchaser to work in or near uninfested POC stands on Federal lands reduces the likelihood of such spread. The intermingled nature of private and Federal lands in this area and the relative lack of mitigations and seasonal restraints on private operations increases the potential for infestation of Federal lands along shared haul routes (roads).

Effects of the Alternatives

There are three possible ways the alternatives could affect the level of timber harvest. First, to the extent PL kills trees important to PSQ, the alternatives with the highest mortality would be the ones to most affect timber harvest. As noted in the Affected Environment section, this element has virtually no effect on PSQ either because POC are a minor stand component within most Matrix/Adaptive Management Area land allocations, or because they could be salvaged and their growing space readily utilized by resistant POC stock or other tree species.

Second, if the Standards and Guidelines actually prohibit harvest on certain areas within the PSQ harvest landbase, there is a direct and proportional reduction in harvest levels. This is the case in Alternatives 3 and 6 which include the establishment of harvest-prohibited POC core areas. Thirdly, when considering all of the other costs that go into timber sale economics, if the Standards and Guidelines result in increased cost, some stands within the PSQ landbase may become too expensive to harvest. This effect is real, but very difficult to quantify at the programatic scale.

Alternatives 1 and 2

These alternatives are essentially the same in their effects to PSQ. Neither prohibits harvest on any lands, but both increase costs. The exception to this is the clause in the Alternative 2 risk key which identifies uninfested 7th field watersheds containing more than 100 acres of POC stands on Federal lands. The decision could be made to drop a project. If all of these 7th field watershed stands were dropped from the harvest landbase, the reduction to the combined Oregon PSQ would be about 2 million board feet per year. The actual impact of this Standard and Guideline to Alternative 2 should be less than this amount. Estimates listed in the cost section for washing ($28,000 and $22,000 for Alternatives 1 and 2, respectively) and a portion (33 percent) of the $37,000 sanitation costs ($51,000 and $41,000 for Alternatives 1 and 2, respectively), are probably directly attributable to timber sales and borne by purchasers. This amounts to about $0.80 per thousand board feet. Optional seasonal restrictions for scheduling logging operations could also reduce the availability of prospective bidders or increase the costs related to timber harvest. Many of these additional mitigation treatments and their costs currently exist under Alternative 1, the No-Action Alternative. Alternative 2, would provide for a more consistent application of these treatments. Any additional mitigation treatment costs will impact bid rates and therefore, Federal timber receipts.

The Standard and Guideline in Alternative 2 that encourages nonground based equipment would further increase harvest costs an undetermined amount compared to Alternative 1.

Alternative 3

In addition to the effects listed for Alternatives 1 and 2, Alternative 3 prohibits timber harvest from POC cores. Table 2-2 shows the area of cores falling in the Matrix/Adaptive Management Area/Riparian Reserve land allocation as approximately 5,410 acres. The percentage of this figure that is actually Riparian Reserve varies by administrative unit based on their field experience. Similarly, a portion of this land is non-forest. Applying these factors to the 5,400 acres as shown in Table 3&4-24a results in approximately 2,260 acres within POC cores as currently contributing to PSQ.

Table 3&4-24a.—*Alternative 3 Port-Orford-cedar core acres and resultant PSQ reduction for Oregon*

Unit	Table 2-2 acres Matrix/Adaptive Management Areas/Riparian Reserves	Reduction factor Riparian Reserves	Non-forest	PSQ acres	PSQ volume per 1,000 acres in MMBF [1]	PSQ reduction in MMBF
Coos Bay	[No cores]	n/a	n/a	0	n/a	0
Medford	1,633	0.43	0.25	522	0.25	0.13
Roseburg	5	0.52	0.09	2	0.41	0.00
Siskiyou	3,772	0.40	0.14	1,735	0.30	0.52
Oregon Total	5,410			2,259		0.65

[1] MMBF = million board feet in 32-foot logs.

The PSQ reduction for each acre in cores can be estimated using each administrative unit's ratio of Matrix/Adaptive Management Area acres (Table 3&4-22) to PSQ (Table 3&4-23). These ratios are shown in Table 3&4-24a are PSQ volume per 1,000 acres. As shown in Table 3&4-24a, the total PSQ reduction for this alternative is about 0.6 million board feet, or about 1.2 percent. There would be a proportional reduction in jobs, and in harvest acres and logging trucks.

There is no prohibition of harvest in POC buffers designated under Alternative 3, so they have no effect on PSQ. As discussed in Chapter 2, the management objective of these POC buffers is to reduce the possibility of PL spreading into the POC cores.

The restriction against timber harvest in the POC cores will also restrict the ability of the Agencies to do commercial thinning on approximately 6,000 acres of 40- to 80-year-old stands in Late-Successional Reserves (approximately one-third of the Late-Successional Reserve acres in these watersheds). This thinning is done to accelerate the development of late-successional forests or restore ecological processes. Such thinning is a major strength of the Northwest Forest Plan, but with nearly 2,000,000 acres of thinning needs in the North-west Forest Plan area, this 6,000 acres may not be significant unless it conflicts with specific identified habitat or fuel reduction thinning plans. This could occur, however, because a portion of these acres appear to be in the unburned wildland/urban interface along the west-ern edge of the Illinois Valley.

Alternatives 4 and 5

These alternatives would not affect PSQ because they do not make any acres unavailable for timber harvest. The $0.80 per thousand board feet cost, the seasonal restrictions, and the extra cost for nonground-based logging equipment of Alternatives 1 and 2 would not be incurred. Without these current site-specific mitigation measures to control the spread of PL infestation and their associated costs, there should be an anticipated increase in the bid rates and thusly, the Federal timber receipts.

Alternative 6

Alternative 6 is similar to Alternative 3, differing primarily (1) in the application of POC cores and buffers at the 7th field watershed level, instead of 6th field watersheds, and (2) in that watersheds with less than 50 percent Federal ownership were excluded. Table 2-3 shows the area of POC cores in the Matrix/Adaptive Management Area/Riparian Reserve land allocation as approximately 6,630 acres. As with Alternatives 3, the percentage of this figure that is Riparian Reserve and nonforest is based on each units' field experience. Applying these percentages to the 6,600 acres as shown on Table 3&4-24b results in approximately 3,010 acres currently contributing to PSQ. The predicted reduction in PSQ for this alternative is calculated using the same acres-to-volume ratios as for Alternative 3. As shown on Table 3&4-24b, the total PSQ reduction would be about 0.9 million board feet in the Oregon portion of the POC range, or about 1.7 percent. There would be a proportional reduction in jobs, and in harvest acres and logging truck traffic.

There is no prohibition of harvest in POC buffers designated under Alternative 6, so this designation has no effect on PSQ. As discussed in Chapter 2, The Alternatives, the management objective of these POC buffers is to reduce the possibility of PL spreading into the POC cores.

These analyses are not intended to be precise enough to redeclare PSQ, but to provide a general quantification of the effects of these alternatives. Precise PSQ calculations would require identification of the actual affected stands in unit databases and then rerunning each unit's harvest scheduling model without those stands.

As in Alternative 3, the restriction against timber harvest in the POC cores will also restrict the ability of the Agencies to do commercial thinning (also known as density management within the Late-Successional Reserves) on approximately 9,000 acres of 40- to 80-year-old stands in Late-Successional Reserves (approximately one-third of the Late-Successional Reserve acres in these watersheds). This thinning is done to accelerate the development of late-successional forests, enhance habitat development, reduce fire danger, or restore ecological processes. Such density management thinnings are a major strength of the Northwest Forest Plan, but with nearly 2,000,000 acres of thinning needs in the Northwest Forest Plan area, this 9,000 acres may not be significant unless it conflicts with specific identified habitat or fuel reduction plans. This could occur, however, because a portion of these acres appear to be in the unburned wildland-urban interface along the western edge of the Illinois Valley.

Table 3&4-24b.—*Alternative 6 Port-Orford-cedar core acres and resultant PSQ reduction for Oregon*

	Table 2-2 acres	Reduction factor				
Unit	Matrix/Adaptive Management Areas/Riparian Reserves	Riparian Reserves	Non-forest	PSQ acres	PSQ volume per 1,000 acres in MMBF [1]	PSQ reduction in MMBF
Coos Bay	0	0.62	0.13	0	0.51	0.0
Medford	285	0.43	0.25	92	0.25	0.02
Roseburg	0	0.52	0.09	0	0.41	0.00
Siskiyou	6,343	0.40	0.14	2,918	0.30	0.88
Oregon Total	6,628			3,010		0.9

[1] MMBF = million board feet in 32-foot logs.

Livestock Grazing

Affected Environment

Livestock graze on public and private lands throughout the West. Livestock grazing ranches have been passed down generation lines to their children and can be a sole way of income for some people, or a supplemental income for others. Livestock grazing ranges from riparian zones and meadows to the peaks of the mountains. Livestock will travel between water sources, feed, and salt locations. They are usually controlled within a designated area called a grazing allotment. Every grazing allotment has its own unique grazing management strategy which includes type of livestock, age class, breed type, movement of livestock, distribution of livestock, season of use, topography, pasture rotations, and environmental constraints.

Since the 1950s PL has been causing root disease and death among POC trees in southwestern Oregon. PL spores are borne by water and spread through waterways or by transfer of soil (often in the form of mud). This can occur by vehicles, humans, and animals. POC is found in riparian areas throughout the Siskiyou NF and BLM lands, but very few POC populations are found within grazing allotments in this area. The table below indicates the grazing allotments that are within the range of POC for BLM- and FS-administered lands.

Effects of the Alternatives

As noted in the Table 3&4-25, grazing allotments total 9,282 acres of BLM and 33,882 acres of FS lands within the range of POC. The number of livestock grazing is low within allotments having POC, and those allotments are relatively large. The result is that all except two NF allotments have minimal cohabitation with livestock range of use and POC habitat. As indicated in the Pathology section, large animals have a probability of 5 to pick-up and transport infested soils and the probability drops to 1 during the months of June through September. Unlike wildlife movement, grazing management strategies can greatly control and reduce the potential of PL spread and POC contaminations by livestock. This can be done by educating the permittee/public, limiting the season of use around POC habitat to the drier periods, eliminating movement from infested areas to uninfested areas, removing mud from livestock prior to entering the area, and washing mud from vehicles prior to entering POC area. The transportation of livestock over long distance greatly reduces the potential for caring the PL from infested areas to uninfested POC habitats.

In Alternative 1, 2, 4, and 5, little effect would occur on the permittees operations. In Alternatives 1 and 2, one or more of the above measures may be applied if there appears to be significant risk.

Alternative 3 would close connector (but not mainline) roads in or near POC in uninfested watersheds. These closures will have most effect on the Pistol River and Signal Butte Allotments because they are relatively large and have a higher concentration of POC than other allotments. Closures would limit access within (but probably not to) the allotments, affecting permittees' ability to transport cattle to and from the grazing areas, limiting salt placing, cattle distribution, improvement maintenance, and utilization monitoring and other management.

Table 3&4-25.—*Livestock grazing allotments within the range of Port-Orford-cedar on BLM- and FS-administered lands*

Agency	Allotment	Acres	Animal unit months /animal units [1]	Season of use	Permit status	POC present
Grants Pass BLM	Deer Creek	1,165	15/30 18/27 9/18	4/1 - 5/31 5/1 to 5/31 10/16 - 12/15	Vacant	No
Grants Pass BLM	Q Bar X	15	5/2.5	10/1 to 10/15	Vacant	No
Grants Pass BLM	Reeves Creek	2,313	38/95	4/15 to 6/15	Canceled	No
Grants Pass BLM	Cherry Gulch	40	3/6	4/1 - 5/30 9/1 - 10/15	Canceled	No
Grants Pass BLM	Glade Creek	580	5/17	4/20 - 7/31	Canceled	No
Grants Pass BLM	Jump Off Joe	40	8/8	4/16 - 5/15	Canceled	No
Grants Pass BLM	Pickett Mountain	540	6/38	4/1 - 8/30	Canceled	No
Grants Pass BLM	Easterly Lake	4,457	38/152	4/1 - 7/31	Canceled	No
Glendale BLM	No grazing allotments					
Roseburg BLM	No grazing allotments					
Coos Bay BLM [2]	Kamph	113	56/336	10/1 - 4/1	Active	No
Coos Bay BLM [2]	Haga/Barton	13	13/78	4/1 - 10/01	Active	No
Coos Bay BLM [2]	Knapp	6	6/36	4/1 - 10/1	Active	No
Siskiyou NF	Pistol River	7,150	40/200	6/1 - 10/31	Active	Yes
Siskiyou NF	Chetco	4,445	36 /144	6/1 - 10/1	Active	Yes
Siskiyou NF	Signal Butte	2,103	10/120	4/1 - 3/31	Active	Yes
Siskiyou NF	Oak Flat	102	19/76	6/1 - 9/30	Active	No
Siskiyou NF	Agness Ranch	43	7/ 49	3/1 - 9/30	Active	No
Siskiyou NF	Big Bend	72	24/150	4/25 - 10/31	Active	Yes
Siskiyou NF	Shasta Flat	10	3/36	4/1 - 3/31	Active	No
Siskiyou NF/Rogue NF	Big Grayback	20,000	60/280	6/1 - 10/31	Active	Yes
Total BLM		9,282	220/843.5			
Total FS		33,882	199/1055			

[1] All FS grazing allotments animal unit months/animal units are in number of head months.
[2] Coos Bay BLM are not allotments, but Cooperative Management Agreements and the nearest POC are two or more miles away. There are other grazing allotments on the Coos Bay BLM Resource area, but they have no POC habitats within the allotments.

The Chetco, Big Bend, and Shasta Flat Allotments fall all or partially within uninfested watersheds in both Alternatives 3 and 6. Management on the Chetco Allotment could be affected, but to a much lower scale because the POC is located in the steep topography of the northeast corner of the allotment were cows do not reach very often. Effects to management on the Big Bend and Shasta Flat Allotments will have minimal because they are small and along main roads.

A decision to prohibit cattle within POC cores (Management Practice 1, Minimize Entry) could lead to closing some of these allotments because of the difficulty of fencing the POC stands.

Mining

Affected Environment

Mining often occurs within the range of POC, frequently in or near habitats associated with POC. Mining history in the area dates back to the first gold discovery in Oregon, in Josephine Creek about 1850.

There are approximately 800 mining claims on the Siskiyou NF, mostly on the Illinois Valley and Galice Ranger Districts. A lesser number of additional claims are concentrated on the Medford BLM District, mostly in these same drainages, and there are additional claims scattered across of the range of POC. Most of these claims are placer claims associated with streams. The remainder are generally upslope, away from POC or on sites at low risk for spread of PL. Some streams are claimed along most of their length. Mining claimants have various access and use rights on the claims, a type of property right; numerous laws apply.

Claimants and other prospectors generally submit a written or verbal notice of intent to operate each year, describing the intended scope of their operation. The Agencies consider the location, season, and scope of the operation and advise the claimant whether a plan of operation is required. A plan of operation is generally not necessary when miners are using suction dredges less than 4 inches diameter, moving only a few yards of material, not proposing to leave established roads or alter vegetation, and working within the June/July through September/October (depending on location) dry summer season. A free State dredging permit is required for these "casual use" activities.

The number of notices of intent received by the Siskiyou NF is down to an estimated 30 to 50 per year; the number of actual operations within the POC range in Oregon is believed to be under 100 per year, down substantially from 200 to 300 ten years ago.

Claimants normally work a week or two, or some weekends; and typically camp in dispersed campsites along system roads or on short spur roads. Their camping and traffic numbers are far exceeded by annual recreational traffic on the same roads, in the same areas.

If claimants or prospectors propose to operate outside of the summer season or otherwise propose an action that is likely to cause a significant surface disturbance, a plan of operation is required. These plans require a NEPA evaluation, restoration plan, and bond. The agencies append and enforce various reasonable environmental safeguards to such plans including applicable PL control measures, but such requirements may not necessarily prohibit the miner from reaching and operating their claim. Few claims in the POC range are operated at a large enough scale to require a plan of operation, and the ones that are, should, with PL mitigations measures in place, not pose disease risk in excess of that for any other forest management operation.

Each of the existing land and resource management plans contains Standards and Guidelines relevant to mining.

Effects of the Alternatives

All of the alternatives would have little if any effect on activities not requiring a plan of operation. This type of summer use is generally considered a minimal threat to POC.

For operations requiring a plan of operation, Alternatives 1, 2, 3, and 6 would have a similar effect, potentially increasing costs by requiring PL-controlling management practices where indicated by the risk key (Alternatives 2, 3, and 6) or other analysis (Alternative 1). In some circumstances, all alternatives, particularly Alternative 4 and possibly 5, would lead the Agencies to require restoration efforts to include planting of resistant POC. The effects for Alternatives 3 and 6 would be similar to 1 and 2, since ultimate access to claims within POC cores generally would not be prohibited.

Costs

Affected Environment

Introduction

Presently, Federal Agencies use a number of program activities to lessen the spread of PL. These efforts cost money that is ultimately borne by the Agencies, either directly or indirectly. Direct program costs are paid via Agency appropriated funds for such things as labor, vehicles, equipment, and facilities. Almost all of the POC program costs, in fact, are funded in this manner. The direct program activities include such costs as the design, sale, and administration of POC special forest products; the design, conduct, and administration of POC timber sale and service contract stipulations; program monitoring; resistance breeding; planting POC; and overall program management.

Direct costs related to mitigating adverse effects of spreading the pathogen, but within the context of larger, unplanned activities, such as wildland fire suppression costs of washing fire vehicles or treating water with Clorox bleach, are not captured in this analysis. On the Biscuit Fire of 2002, approximately $1.5 million was spent for vehicle washing, dust abatement, and treatment of firefighting water with Clorox bleach (see Chapter 3&4, Fire and Fuels, Wildland Fire Operations subsection).

Indirect program costs more integrally interwoven into general Federal land management practices have not been captured or analyzed. For example, best management practices to benefit POC management objectives, such as appropriate road drainage design, are components of specific projects that are not distinguishable as POC program costs. Since these indirect program costs are not easily quantifiable, they are not included here. They are a relatively small, but not necessarily insignificant, part of the total cost for these activities. Also not included are general overhead and support costs. The following discussion covers only identifiable direct POC program costs.

Existing Costs by Program Activity

POC program work-units and unit costs are grouped into the following eight basic program categories. In this analysis, reported Federal administrative unit costs were used to calculate Alternative 1 costs. The total direct program costs are estimated at $860,000 per year. This is the Alternative 1 cost displayed in Table 3&4-26 in the following Effects of the Alternatives section.

Program Costs: Under the current conditions of Alternative 1, labor costs for two full-time Agency program managers and District support personnel, for the BLM and USFS respectively, are the principle costs. Included in their expenses are vehicles, supplies, and travel costs. In addition, there are other employees designing and administering elements of the program with similar program costs. While the costs of FS pathologists providing regional consultation for POC issues are included in this element, it should be recognized that these positions would probably not be eliminated but rather the workload would shift for POC to

Table 3&4-26.—*Summary of average annual Port-Orford-cedar program costs for the first 10 years [$] by category and alternative*

	Alternative					
Category	1	2	3	4	5	6
Programmatic costs	348,000	348,000	348,000	0	0	348,000
Eradication	4,000	6,000	12,000	0	0	16,000
Roadside sanitation	51,000	41,000	102,000	0	0	153,000
Roads/trails	37,000	37,000	48,000	0	0	54,000
Washing	28,000	22,000	28,000	0	0	28,000
POC special forest products	5,000	5,000	5,000	0	0	5,000
Resistance breeding	381,000	381,000	381,000	475,000	92,000	381,000
Monitoring	6,000	6,000	8,000	2,000	1,000	8,000
Totals	860,000	846,000	932,000	477,000	93,000	993,000

[1] Estimated costs are rounded to the nearest $1,000. Expenditures are computed using present-day values and are gross costs. An annual compound rate of 2-6% increase should be anticipated for maintaining a given program funding level.

other disease projects. The total program costs for Fiscal Year 2002 are estimated at $348,000.

Eradication: In the last 7 years, only one eradication project has been completed, at a cost of $23,000. A follow-up treatment is estimated to cost $5,000. With the $28,000 spread over a 7-year period, the average annual cost is $4,000.

Roadside Sanitation: In a recent survey of all BLM and FS Oregon administrative units, sanitation costs were estimated to be $2,500 per mile for removal of unmerchantable POC on about 20 miles of roads per year. The total annual cost for roadside sanitation is approximately $51,000.

Roads/Trails: Current treatments include renovation or relocating existing roads, road closures, and moving trails. These costs are estimated at $37,000 per year.

Washing: Current costs of washing applied to timber sale contracts average approximately $2,700 per sale. Analysis for Alternative 1 assumed 1.5 timber sales per year for each of the four administrative units. Under service and construction contracts, there is an average of six contracts per year per administration unit, with an average estimated washing cost of $500 per contract. The existing washing cost is estimated at $28,000 per year.

Port-Orford-Cedar Special Forest Products: Under current management direction, only one administrative unit sells POC boughs. It costs that unit approximately $5,000 per year to manage these sales.

Resistance Breeding: BLM and the FS spent $333,000 in Fiscal Year 2001 on the resistance breeding program. As described in a 2002 interagency agreement between the BLM and FS, the costs for Fiscal Year 2003 are $369,000 for the resistance breeding program.

Monitoring: Present POC monitoring includes field measurement and evaluation of common garden study sites, operational project monitoring, semiannual technical review of POC research, and annual program reviews by each administrative unit. These costs are estimated at $6,000 per year. It should be noted that some of the above POC program treatments are often undertaken for other reasons. Roadside sanitation, for example, is partially accomplished as a by-product of routine roadside brushing.

Effects of the Alternatives

Alternatives 2 through 6 costs are predicted using Alternative 1 as a baseline and then adjusting each expected alternative costs based on the differences in the Standards and Guidelines for each alternative. A summary of this data is shown in Table 3&4-26 and discussed in detail as follows.

Program Costs: There would be no change in costs with the implementation of Alternatives 2, 3, or 6. These costs cease under Alternatives 4 and 5.

Eradication: It is assumed that under Alternative 2 eradication treatments would be tried more regularly than under current practices. With a 50 percent increase under this alternative, the cost would be $6,000 per year. Eradication treatments are predicted to triple under Alternative 3 and quadruple under Alternative 6, to three and four (respectively) eradication projects needed every 7 years under this alternative, because of aggressive action to eliminate new infestations in the POC core areas within the uninfested watersheds. The average annual costs under Alternative 3 would be $12,000, and $16,000 under Alternative 6. Alternatives 4 and 5 would not use eradication.

Roadside Sanitation: Use of the site-specific POC Risk Key under Alternatives 2, 3, and 6 permits better identification of areas not needing treatment in the North Coast Risk Region. There will probably be less roadside sanitation on the “checkerboard” lands of the BLM districts under Alternative 2, and about the same level as under Alternative 1 on the remainder of the range. It is projected that this would result in a 20 percent decrease in the road miles treated, and a projected cost of $41,000 per year. With Alternatives 3 and 6 there would still be a probable decrease in roadside sanitation on the “checkerboard” lands of the BLM Districts; however, this would be offset by the requirement for roadside sanitation in the POC buffers of the uninfested 6th field watersheds. It is estimated that the cost for Alternative 3 would be double Alternative 1, or $102,000 per year. For Alternative 6, because core acres are about 50 percent more than in Alternative 3 and the 7th field watersheds are spread more throughout the range, the cost is estimated at $153,000 per year. Alternatives 4 and 5 assume that no roadside sanitation would be done, so there are no costs.

Roads/Trails: The POC Risk Key described as part of Alternatives 2, 3, and 6 would indictate appropriate road and trail management actions. Cost-effectiveness criteria, as defined by the Purpose statement of this SEIS, may further direct proposed actions to not necessarily treat roads and trails themselves, but to mitigate their effects on POC. An example of this rationale could be to sanitize a given road system rather than surfacing it. Most of the road renovations, relocation of existing roads, road closures, and moving of trails has previously occurred on the Siskiyou NF and would continue at the level identified for Alternative 1. Alternatives 3 and 6 require additional road treatments to protect POC core areas. However, many of the POC core areas are in withdrawn land uses or administratively designated roadless areas, particularly in Alternative 3. There is a projected 30 percent increase in road relocation and closure cost under Alternative 3, and a 45 percent increase projected for Alternative 6, for at total cost of $48,000 and $54,000 per year respectively. Under Alternatives 4 and 5 road projects to specifically address POC considerations would not be done.

Washing: Similar to the discussion for roadside sanitation, the use of the site-specific POC Risk Key under Alternatives 2, 3, and 6 provides greater predictability about the level of vehicle washing that will take place. There will probably be less vehicle washing within the "checkerboard" lands of the BLM districts under Alternative 2, and about the same level as under Alternative 1 on the remainder of the range. It is projected that this would result in a 20 percent decrease in the amount of vehicle washing and a projected cost of $22,000 per year. With Alternatives 3 and 6 there would still be a probable decrease in vehicle washing within the checkerboard lands of the BLM districts, but this would be offset by the increase in washing in the POC buffers. It is estimated that this cost would be the same as Alternative 1, $28,000 per year. Washing for lessening the probability of long-range PL spread would continue for Alternatives 1, 2, 3, and 6. Alternatives 4 and 5 would terminate present washing expenditures.

Port-Orford-Cedar Special Forest Products: Alternatives 2, 3 and 6 would not change this expenditure, while Alternatives 4 and 5 would terminate special permit administration related to PL control, and related cost.

Resistance Breeding*:* Actual costs for Fiscal Years 2001 through 2002, and projected costs for Fiscal Years 2003 through 2006, as described in a 2002 BLM and FS interagency agreement is used as a basis to estimate the resistance breeding program costs. For the last 4 years of the 10-year analysis period, breeding costs are assumed to remain level at $350,000 per year. Included in these costs are breeding and monitoring costs. Also, increases or decreases of these costs for Alternative 4 or 5, respectively, were estimated by the FS Dorena Genetic Resource Center personnel. Associated field work, such as new field selections, would remain the same for Alternatives 1, 2, and 3, accelerate under Alternative 4, and not occur under Alternative 5. Although cost projections in this section are limited to 10 years, it should be noted that at current cost projections, the Alternatives 1, 2, 3, and 6 overall breeding program costs will ultimately total approximately $16 million dollars spent over the next 42 years, while the total estimated cost of Alternative 4 would be approximately $3 million dollars expended over the next 7 years. Breeding costs under Alternative 5 would generally be discontinued. Costs for maintaining breeding orchards at the appropriate alternative level would continue under all alternatives. Future sale of resistant seed to private industry could offset some of these costs.

Monitoring: Alternative 2 would leave these costs unchanged. Alternatives 3 and 6 would require one-third more administrative monitoring to maintain disease-free POC cores and buffers. The cost for Alternatives 3 and 6 monitoring would be $8,000 per year. Alternatives 4 and 5 eliminate many of the monitoring elements contained in Appendix 5, Monitoring. Alternative 4 would keep about one-third of the Alternative 1 monitoring costs to track genetic results and root disease spread, for a cost of $2,000 per year. Alternative 5 would retain about 15 percent of the Alternative 1 costs for tracking root disease spread, or about $1,000 per year.

Additional Costs for Port-Orford-Cedar Mitigation Measures During Fire Suppression. While the increase in Biscuit Fire suppression costs attributable to POC mitigation practices (estimated at $1.5 million) is indicative of a direct program cost applicable to Alternatives 1, 2, 3, and 6, it is very difficult to estimate this type of unplanned event on an annual cost basis. The Biscuit Fire burned about 500,000 acres and 29 percent of the Federal acres with POC in a single year. The Fire and Fuels section of the "Draft SEIS To Remove or Modify the

Survey and Manage Mitigation Measure Standards and Guidelines" (USDA-FS and USDI-BLM 2003c) predicted future wildland fires within the range of the northern spotted owl will encompass 113,000 acres annually. Although the POC range includes some of the most fire-prone portions of the owl range, the proportion of the 113,000 acres attributable to the POC range cannot exceed 15 to 20 percent. Such a relationship would suggest fire-related root disease mitigation costs might be range from about $30,000 to $40,000 per year. Basing such numbers on the Biscuit Fire, however, is not representative. As noted in the fire section, fires that are extinguished during initial attack have few costs attributable to POC mitigation. On the other hand, the Biscuit Fire was so large as to generate economies of scale; mid-size fires would experience a higher percentage of suppression costs going to POC mitigation. A reasonable prediction is tens of thousands of dollars per year applicable to Alternatives 1, 2, 3, and 6.

Costs May Vary by Year. While annual costs are projected over a 10-year horizon, individual category expenditures may vary over the period. Some category costs will be higher at the beginning of implementation, while becoming lower at the end of the 10-year period. Under Alternative 4, resistance breeding is a category where annual program costs would began at $333,000 in 2003, increasing to to $516,000 in 2007, and then settling to $433,000 in 2010. Other cost categories shown in Table 3&4-26 may vary from year-to-year also, but are anticipated to remain on a relatively even-flow over 10 years. While cost estimations were for a 10-year timeframe, it is not implied that POC program costs for any of the alternatives would stop at the end of the decade.

Environmental Justice

Affected Environment

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994) requires that all Federal agencies

> . . . make achieving Environmental Justice part of [their] mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.

Potential effects on minority groups, low income, and subsistence populations are to be addressed. Potential effects on American Indians are covered in Chapter 3&4, Culturally Significant Products for American Indian Tribes section. Race, class, occupational classifications, and immigration policies influence people's environmental perceptions, encounters, and experiences (Taylor 2002).

Racial Background

Illustrating this point, many nontimber forest workers involved in the collection of POC forest products, as well as other special forest products, originally came from other countries, such as Canada, Mexico, Guatemala, Honduras, and El Salvador in the Americas; and Laos and Cambodia in Southeast Asia (Brown and Marin-Hernandez 2000). While personally interested at many levels in natural resource management issues, many of these groups of people may also have linguistic, institutional, cultural, economic, or historic barriers to actively participating in public planning processes (Frewing-Runyon 1999).

Ten counties within the states of Oregon and California encompass the natural range of POC. Racial composition of the people that live within these counties is shown on Table 3&4-27.

Wages and Employment

While over 76 million new jobs were created in the last 30 years in the United States, the manufacturing sector of the economy that includes forest products has declined from nearly 22 percent of all jobs to less than 12 percent. Within the range of POC, county employment levels have reflected this trend—manufacturing sector jobs in Del Norte County, in northern California, for example, decreased from 25.1 percent in 1970, to 4.3 percent in 2000. While higher-paying manufacturing jobs became replaced by generally lower-paying services-related jobs, average annual earnings in these counties have declined (see Table 3&4-28). Compounding the effects of the lower personal incomes has been flat-to-rising unemployment rates. On a relative basis, every county unemployment rate is higher than both the State and national averages.

Table 3&4-27.—*Demographic statistics within the Oregon portion of the range of Port-Orford-cedar [2000 Census]*

County	White	Black or African American	American Indian/ Alaskan native	Asian	Native Hawaiin/other Pacific Islander	Some other race	Two or more races
Coos	57,740	194	1,515	568	107	664	1,991
Curry	19,634	32	452	147	24	234	614
Douglas	94,234	177	1,530	628	93	1,025	2.,712
Jackson	166,125	724	1,980	1,631	322	5,218	5,269
Josephine	71,103	202	949	476	83	883	2,030
Total	408,836	1,329	6,426	3,450	629	8,024	12,616
State total	2,961,623	55,662	45,211	101,350	7,976	144,832	104,745

Table 3&4-28.—*Average earnings and unemployment rate for the Oregon counties within the range of POC*

	Annual earnings [$]		Unemployment rate [%]	
County	1990	2000	1990	2000
Douglas	26,850	25,724	8.1	7.8
Coos	26,735	24,636	8.3	7.4
Curry	22,273	20,571	6.6	6.3
Josephine	23,453	23,421	7.1	6.9
Jackson	26,414	26,614	6.8	5.3
State average	29,203	32,493	5.9	4.9
National average	33,153	36,316	5.5	4.0

Source: Sonoran Institute/BLM Economic Profile System, 2003.

Effects of the Alternatives

This SEIS supplements EISs for the land and resource management plans of the three BLM districts and the Siskiyou NF, and the Environmental Justice discussion and consequences therein. These previous documents analyzed the effects of related management actions including human health, economic, and social effects.

The potential of the alternatives to affect American Indians was identified as an issue in this SEIS, and is addressed in the Culturally Significant Products for American Indian Tribes effects section earlier in this chapter. Tribal input was specifically sought during scoping and during analysis of effects of the alternatives.

There is high participation by minority and low-income populations in collecting special forest products. Permits for collecting boughs will be severely restricted in Alternatives 1, 2, 3, and 6 (similar to current direction). Permits, both commercial and personal use, for wild plants, mosses, bark, roots, mushrooms, firewood, and others could be reduced from current levels under Alternatives 2, 3 and 6 (as described in the Special Forest Products effects section in this chapter), depending in part upon the results of analysis under the POC Risk Key. Such permits would be reduced further under Alternatives 3 and 6 by restrictions in the POC core and buffers for uninfested watershed featured in these alternatives. However, under all three alternatives, it is expected that special forest products permits would be reduced by less than 5 percent from current levels. Conversely, Alternatives 4 and 5 will markedly increase special forest products harvest levels. These potential impacts to Environmental Justice are less than current levels under Alternatives 4 and 5, and slightly more than current under Alternatives 2, 3, and 6.

Alternative 3 would result in a PSQ reduction of 0.6 million board feet per year, or about seven full-time jobs directly in the logging and milling industry. Alternative 6 would result is a PSQ reduction of 0.9 million board feet per year, or about ten full-time jobs. As part of Alternative 4, direct employment will increase by the equivalent of approximately eight full-time jobs resulting from an expanded special forest products program. No other Environmental Justice effects are identified.

Civil Rights Impact Assessment

Introduction

The Civil Rights Impact Assessment examines whether the alternatives identified in the draft SEIS may result in an adverse or disparate effect to additional groups of people beyond those considered by the Environmental Justice section. In accordance with USDA Departmental Regulation Number 4300-4, these additional groups or classes include:

Race, Color, National Origin	Age
Disability	Gender
Marital, Familial, Parental Status	Religion
Sexual Orientation	Genetics
Political Beliefs	Income from Public Assistance

It is assumed that these populations of people will continue to use or enjoy Federal forest lands for diverse purposes (such as recreation, hunting, and employment) and may be interested in, or potentially affected by, the proposed alternative.

Because this proposed alternative will result in a notice to be published in the *Federal Register*, this Civil Rights Impact Analysis has been prepared in accordance with Interim Use Departmental Directive (DR) 4300-4, Section 9.a.(1).

Demographic Information

Consistent with Council on Environmental Quality guidelines for determining affected environment for Environmental Justice (Council on Environmental Quality, Environmental Justice Guidance under the National Environmental Policy Act, December 10, 1997, section III.C.3), three maps were examined (see file copy of draft assessment) that describe specific racial groups (African American, Asian Pacific Islander, and Hispanic) living within the area of both the natural range of POC and the ten counties covered by the range of POC, five in Oregon and five in California. A fourth map was also examined, identifying population levels of people with disabilities (mobility disability for ages 16 to 64). Information on the other groups is either not available or too generalized to be useful for evaluation.

Analysis of the maps shows that the identified ethnic and disabled populations are present or in areas adjacent to the natural range of POC, but do not live evenly throughout this area. People with disabilities, for example, are generally congregated along the Interstate 5 highway corridor. The analysis area covers both metropolitan areas with diverse populations and economies, and rural areas with lower population densities in general, and lower population levels of minorities and disabled persons specifically.

Alternatives Considered

Alternative 1

This alternative would maintain the existing language in the Coos Bay, Roseburg, and Medford BLM District RMP/EISs and the Siskiyou NF EIS that described the range of social impacts of the existing program direction. No additional civil rights impacts are expected to accrue from maintaining the existing direction.

Alternatives 2, 3, and 6

Hispanic and some Asian populations tend to be disproportionately involved with the collection of special forest products from Federal lands within the natural range of POC. No reduction in collection of POC boughs is anticipated under these alternatives, but a slight decrease of less than 5 percent of other special forest products is predicted, and therefore, a slight adverse economic impact on these groups of people is anticipated. No mitigations for this effect have been identified.

Alternative 4 and 5

The analysis shows no additional adverse effects beyond Alternative 1, in terms of adverse civil rights impacts, are expected from implementing any of these three alternatives. Beneficial effects can be expected for groups involved with bough collecting, as levels of special forest products permitting dramatically increase.

Conclusion and Findings

This document has identified the demographic composition of the affected area; the types of potential impacts, if any, resulting from the alternatives; current information from scoping; and potential adverse or disparate impacts as they relate to groups of people identified in civil rights legislation.

Other than some slight potentially adverse economic effects to Hispanic and Asian populations as described above, no other adverse or disparate effects to the additional groups or classes of people are expected. The proposed action detailed in the draft SEIS is anticipated to comply fully with all applicable civil rights statutes, including Title VI of the "Civil Rights Act" of 1964.

Critical Elements of the Human Environment

Table 3&4-29 addresses the critical elements of the human environment.

Other Environmental Consequences

When considering the overall environmental impacts of this proposal, it is important to remember that this SEIS supplements the Siskiyou land and resource management plan EIS that has been amended by the Northwest Forest Plan SEIS (USDA-FS and USDI-BLM 1994a) and the Survey and Manage SEIS (USDA-FS and USDI-BLM 2000). This SEIS also supplements the EIS for the land management plans for the Coos Bay, Medford, and Roseburg BLM Districts which themselves incorporated the Northwest Forest Plan SEIS (USDA-FS and USDI-BLM 1994a) and were subsequently amended by the Survey and Manage SEIS (USDA-FS and USDI-BLM 2000). The Northwest Forest Plan final SEIS addressed issues and environmental impacts dealing with the full range of multiple-uses on Federal lands and led to sweeping decisions regarding timber management and resource conservation. The Survey and Manage Final SEIS was narrowly focused on issues concerning implementation of the Survey and Manage Standards and Guidelines. This SEIS is narrowly focused on the management practices and mitigation measures for the management of POC and its root disease. This SEIS only addresses management of POC and does not change the fundamental decisions or substantially change environmental impacts disclosed in the previous impact statements.

The Council on Environmental Quality regulations require that the discussion of environmental consequences include

> . . . any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented (40 CFR 1502.16).

Table 3&4-29.—*Critical elements of the human environment*

Air Quality	Air Quality is addressed in the Air Quality section.
American Indian Religious Concerns	American Indian religious concerns are addressed in the Culturally Significant Products for American Indian Tribes section.
Areas of Critical Environmental Concern [ACECs]	Areas of critical environmental concern are addressed in the Areas of Critical Environmental Concern and Research Natural Areas section.
Cultural Resources	There are no site-specific actions authorized by this programmatic SEIS. No artifacts will be disturbed as a direct result of any of the alternatives.
Energy	Executive Order 13212 provides that agencies shall expedite review and take action to expedite projects that will increase the production, transmission, or conservation of energy. BLM Instruction Memorandum OR-2002-081 requires NEPA documents to contain information from which the Agency can later complete a Statement of Adverse Energy Impacts. Alternatives 1, 2, 3, and 6 contain requirements that could increase the construction and maintenance costs for access and development of energy sources, if any are discovered, as well as for transmission wires or pipes, buried or not. A recent example is the Winston to Coos Bay natural gas pipeline, for which the EIS notes PL-reducing mitigation measures will be required when in the proximity of POC stands. Conceivably a project may have to be rerouted.
Environmental Justice	Environmental Justice is addressed in the Environmental Justice and Civil Rights Impact Analysis section.
Prime Farmlands or Unique Land Characteristics	Prime farmlands and other unique Federal land characteristics are required to be identified and restored as part of the "Surface Mining and Reclamation Act" of 1977. Any surface coal mining operations within the natural range of POC on the Coos Bay, Medford, and Roseburg BLM Districts, and the Siskiyou NF will utilize the appropriate standards and guidelines to maintain POC and meet the requirements of the Act.
Floodplains	Executive Order 11988, as amended, requires agencies to determine if a proposed action will occur in a floodplain and if the action will significantly affect the quality of the human environment. The objective of the law is to avoid adverse impacts associated with occupancy and modification of floodplains and to avoid floodplain development. The alternatives themselves do not authorize any actions, only mitigation measures to control POC root disease. These measures do affect floodplains in ways that significantly affect the quality of the human environment. The potential effect of the alternatives on water flows that could affect floodplains is addressed in detail in the Water and Fisheries section.
Invasive Species	Executive Order 13112 requires the prevention of introduction of invasive species and to provide for their control and to minimize their economic, ecological, and human health impacts. PL is considered an invasive species and two of the purposes of this SEIS are to reduce its introduction and to slow its spread.
Invasive and Nonnative Species	The "Lacey Act" of 1981, as amended, makes it unlawful to import, export, sell, acquire, or purchase fish, wildlife, or plants. None of the alternatives propose such activities.
Noxious Weeds	The "Federal Noxious Weed Act" of 1974, as amended, requires carrying out operations or measures to eradicate, suppress, control, or prevent or retard the spread of any noxious weed. The Botany section and biological evaluations [Appendix 7] describe such actions.
Threatened or Endangered Species	Threatened, endangered, and Agency sensitive species wildlife and botanical species are addressed in the draft biological evaluations [Appendix 7]. Two listed fish, the southern Oregon/northern California Coho and the Oregon Coast coho, are addressed in the Water and Fisheries section.
Wastes, Hazardous or Solid	The "Resource Conservation and Recovery Act" of 1976 and the "Comprehensive Environmental Response, Compensation, and Liability Act" of 1980 are laws that regulate hazardous waste that endangers public health or the environment. The alternatives themselves do not authorize any actions, only mitigation measures to control POC root disease. The only potentially hazardous material proposed for use by this SEIS is Clorox. The use and hazard of Clorox are addressed in the Clorox section. Containers will be disposed of in approved dumps.
Water Quality, Drinking or Ground	The Water and Fisheries section address water quality and conformance with state water quality standards.
Wetlands/Riparian Zones	Executive Order 11990 requires Federal agencies to avoid destruction or modifications of wetlands and to avoid undertaking or providing assistance for new construction located in wetlands. The alternatives themselves do not authorize any actions, only mitigation measures to control POC root disease. These measures do not destroy, modify, or undertake/assist new construction located in wetlands. The alternatives address various ways to mitigate root disease in POC, which is often a component of wetlands. The alternatives could variously benefit wetlands.
Wild and Scenic Rivers	Wild and scenic rivers are discussed in the Recreation section.
Wilderness	Wilderness and wilderness study areas are discussed in the Recreation section.

Adverse Environmental Effects Which Cannot Be Avoided

An agency does not have to avoid adverse effects, but must identify and disclose any adverse environmental, social, and economic effects in the impact statement. This SEIS attempts to describe all identifiable adverse effects caused by the alternatives herein. Adverse effects which cannot be avoided include the continued spread of POC root disease at some level. Because the introduced disease is virulent and is spread by vectors such as elk and water, no mitigation could be proposed that could completely stop the POC mortality. At least some of the alternatives seek to mitigate that mortality through an active resistance breeding program.

Relationship Between Short-Term Uses of the Human Environment and Maintenance of Long-Term Productivity

The Agencies' land and resource management plans, as amended by the Northwest Forest Plan, committed NF System- and BLM-administered lands to multiple-use, including commercial timber commodity production. The environmental analyses supporting those plans determined that the loss in long-term productivity of forest soils and other components necessary for a healthy forest environment would be minimal. The alternatives explored in this SEIS are projected to have little relative additional effect on soil productivity. Slight effects are discussed in the Ultramafic Soils and the Water and Fisheries sections.

Irreversible or Irretrievable Impacts

Irreversible refers to a loss of nonrenewable resources, such as mineral extraction, heritage (cultural) resources, or to those factors which are renewable over long time-spans, such as soil productivity. Irretrievable commitment applies to losses that are temporary, such as loss of forage production in an area being used as a ski run or use of renewable natural resources.

Since POC will clearly not be extirpated from any significant portion of its range, nor is it likely to lose any significant genetic variability, there will be no irreversible or irretrievable impacts.

Conflicts with Other Plans

The CEQ regulations (40 CFR 1502.16) require a discussion of

> . . . possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian Tribe) land use plans, policies and controls for the area concerned.

This SEIS incorporates by reference the discussions in the underlying land and resource management plans as amended, and nothing in this SEIS would alter the conclusions in those plans regarding the possible conflicts with other plans.

The management direction in this SEIS applies only to federally-managed lands where state and local land use plans, policies, and controls have little application. Similarly, the alternatives in this SEIS do not apply to Tribal and Indian-owned lands, with one exception. The Coquille Indian Tribe currently manages approximately 5,400 acres of forest lands (Coquille Forest) under the same Standards and Guidelines as the adjacent Federal land management agency (Coos Bay BLM District).

Western states have raised concerns about the occurrence of catastrophic wildland fires in recent years, which led to formation of the National Fire Plan, a national multi-agency policy designed to prevent catastrophic wildland fires through broad-scale fuel treatment and improved suppression efforts. The National Fire Plan proposes aggressive hazardous fuels abatement activities around communities and at-risk landscapes. The 2002 fire season was particularly problematic within the range of POC. Some of the harvest prohibitions in Alternatives 3 and 6 could directly affect the Agencies' ability to meet their hazardous fuels treatment commitments around communities in the wildland/urban interface. The other alternatives do not have such restrictions.