

CHAPTER 3

Effects of Proposed Alternatives on Aquatic Habitats and Native Fishes

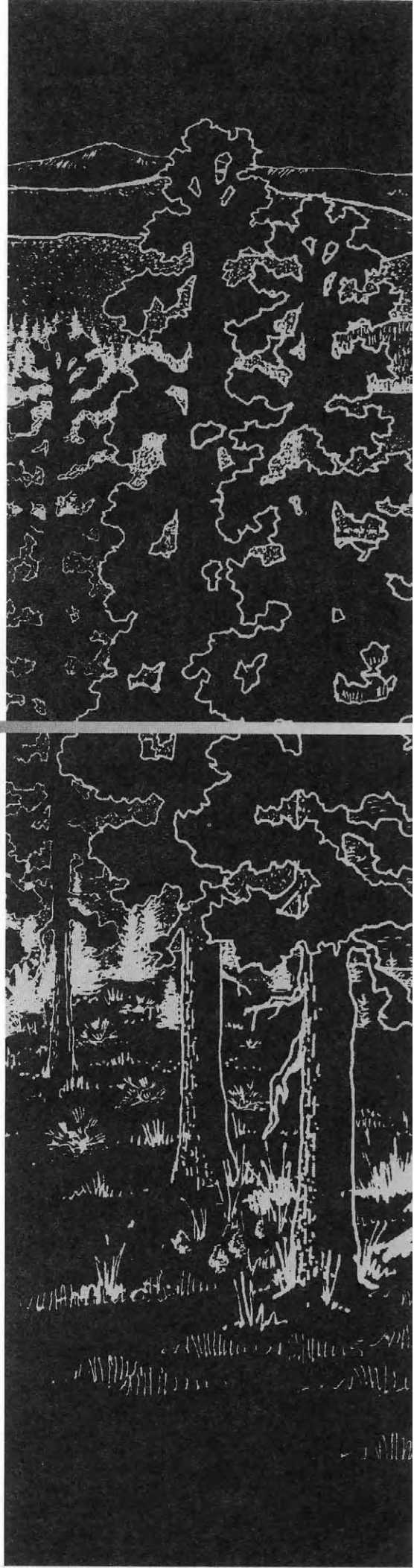
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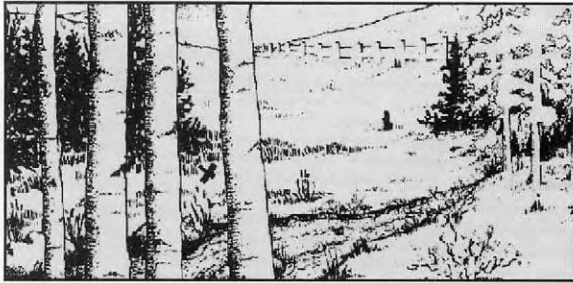


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Introduction

The Aquatics and Riparian Science Teams analyzed the seven alternatives by evaluating their effectiveness in sustaining aquatic ecosystem structure and function, and their expected effect on 25 taxa of native fishes. Our analysis focused on alternatives as defined in Chapter 3 of the Preliminary Draft Environmental Impact Statements (EISs) (USDA and USDI 1996a, 1996b).¹ The analysis consisted of three steps. In step one, we identified the level of protection, maintenance, or restoration of aquatic and riparian habitats offered by each alternative. In step two, we identified expected changes in distribution and status of seven widely-distributed salmonid species that would likely result from implementation of each alternative. Step three involved a similar, though less intensive, effort to identify expected changes in the populations of 18 more narrowly-distributed fish species of special concern. Each step built on the preceding one, as the sections below demonstrate.

Our assessment is based on professional interpretation of both quantitative and qualitative information collected for the purpose of this evaluation or generated as part of the broader scientific assessment (Lee and others, in press). Participants in the evaluation (evaluation team) included Forest Service (FS) and Bureau of Land Management (BLM) scientists from the Science Integration Team (SIT) Aquatics Team that participated in the Broad-scale Assessment of Aquatics Species and Habitats (Lee and others, in press), and additional invited scientists from the FS, Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), and U.S. Fish and Wildlife Service (USFWS) (appendix 3-A). Information relative to the alternatives and individual fish species were prepared by the SIT, Eastside EIS (EEIS) and Upper Columbia River Basin EIS (UCRB) staffs and presented to

the evaluation team in a series of discussions held at the Forestry Sciences Laboratory in Boise, Idaho, on March 7 and 8, and 11 to 13, 1996. The intent of the discussions was to explore issues and probable outcomes associated with each alternative. A series of questions was developed by the evaluation team and used to guide discussion (described below). Notes taken during the discussion were used by the SIT aquatics team to frame the issues and formulate the evaluation in this report. The conclusions presented herein reflect the consensus view of the SIT Aquatics Team that participated in the evaluation.

Our analysis remains subjective in the sense that to draw conclusions we filtered the anticipated allocations and patterns of ground-disturbing and restoration activities, and the current distribution and status of fishes through our understanding of the likely mitigative effects of each alternative. Our analysis is based in existing data and spatial patterns in those data. We believe any interpretations that must rationalize conclusions against existing species distributions, patterns of disturbance, and relationships between the two cannot strongly diverge from those we have made in our analysis. In the time available for analysis, however, we had the choice to either develop data and relationships on which to base our opinions or more systematically develop opinions expressed without the benefit of any detailed understanding or data. We chose to draw conclusions from data and relationships.

In our evaluation, we refer to two separate elements of a species' range, core and fringe. Core areas refer to those portions of the species' distribution where there are concentrations of strong populations (strongholds) and the species is well distributed among adjacent watersheds and sub-basins. Generally, such areas are found toward the central part of the species' distribution, but may

¹Analysis of the seven alternatives is based on the definitions found in the preliminary draft version of the Environmental Impact Statements (February 1996). Detailed information cited in this chapter pertaining to the Preliminary Draft EIS is reproduced in appendix I in Volume II of this document.

occur broadly across the Basin.² For anadromous species with very few strong populations remaining, core areas are distinguished by large, contiguous blocks that are occupied by the species. For example, the central Idaho subbasins of the Salmon River would be considered core areas for steelhead, even though populations are generally depressed in that area. In general, we anticipate that populations associated with the core(s) of a species' distribution are most likely to persist in the face of environmental change and disturbance (Lee and others, in press). Strong populations generally support the full expression of life histories including migratory forms, and are likely to be more resilient than depressed populations or those on the fringe of the species' range. We believe conservation of core areas is critical to species preservation, since these areas are most likely to persist in the face of unforeseen environmental change. In contrast, fringe areas refer to the portions of the range that are on the periphery of the species' range. Fringe areas are characterized by a relatively small number of occupied watersheds that are often isolated from the larger portions of the species' range. Fringe areas are potentially important because they may include significant portions of the genetic variability found in a species. The core and fringe distributions considered in this analysis are based on the distribution and status of fishes as described in Lee and others (in press).

In the sections below, we describe each step in the evaluation process. Within each step, we present major assumptions and information used in the evaluation, criteria or questions used to judge alternatives, major findings, and major uncertainties.

Aquatic Viability Analysis: Species, Rationale, and Approach

Our analysis of viability was directed exclusively at fish by examining fish distribution and status, and inferred habitat conditions as influenced by allo-

cations and patterns of ground-disturbing and restoration activities. The analysis consisted of two parts. Part one addressed the viability of the seven widely-distributed salmonids focused on in the aquatics assessment (Lee and others, in press): bull trout, redband trout, westslope and Yellowstone cutthroat trout, ocean-type and stream-type chinook salmon, and steelhead trout. As discussed in Lee and others (in press), these species are viewed as important indicators of aquatic integrity.

Part two focused on 18 of the 39 narrowly-distributed endemic or sensitive taxa that were identified in Lee and others (in press) (table 3.1). Some of these species are federally listed under the Endangered Species Act of 1973 (ESA). Whether listed or not, we omitted from analysis those taxa that do not occur in more than one National Forest or BLM District, since they are better addressed by the individual administrative units. We also omitted species for which Federal land management has little or no perceived influence on their viability.

We did not assess viability of desirable introduced species because the distribution of introduced species tends to be irregular. Viability is more of a local issue that applies to individual populations within small areas. It is not a broad-scale issue, and there is little for our analysis to contribute. Introduced species tend to persist wherever humans choose to stock them.

Information on non-fish, aquatic organisms and pertinent aspects of aquatic systems is limited, and is often specific to an individual site. Many aquatic invertebrates have very localized distributions, making effects of watershed-scale disturbance difficult to detect. For these reasons, we decided it was inappropriate to address the non-fish, aquatic biota in a broad-scale evaluation of alternatives.

²The Basin is defined as those portions of the Columbia River basin inside the United States east of the crest of the Cascades and those portions of the Klamath River basin and the Great Basin in Oregon.

Table 3.1. Rare and sensitive fish taxa in the Interior Columbia Basin Ecosystem Management Project (ICBEMP) analysis areas. This list excludes seven widely-distributed salmonids that were focal species in the Aquatics chapter of the *Assessment of Ecosystem Components*.¹ Viability analyses will be conducted only on those 18 taxa occurring in more than one BLM/Forest Service jurisdiction and affected by land management activities.

ICBEMP Sensitive Fish Species	Occur in more than one BLM/FS jurisdiction?	Affected by land management?	Viability analysis?
White sturgeon	Yes	No	No
Klamath lamprey	No	No	No
River lamprey	Yes	No	No
Pacific lamprey	Yes	Yes	Yes
Goose Lake lamprey	No	Yes	No
Pit-Klamath brook lamprey	Yes	Yes	Yes
Sockeye salmon	Yes	No	No
Chum salmon	Yes	No	No
Coho salmon	Yes	No	No
Coastal cutthroat trout	No	Yes	No
Lahontan cutthroat trout	Yes	Yes	Yes
Pygmy whitefish	Yes	Yes	Yes
Burbot	Yes	No	No
Sand roller	Yes	No	No
Northern roach	No	Yes	No
Alvord chub	No	Yes	No
Borax Lake chub	No	Yes	No
Catlow tui chub	No	Yes	No
Oregon Lakes tui chub	Yes	Yes	Yes
Summer Basin tui chub	No	Yes	No
Sheldon tui chub	No	Yes	No
Hutton tui chub	No	Yes	No
Leatherside chub	Yes	Yes	Yes
Foskett speckled dace	No	Yes	No
Lost River sucker	Yes	Yes	Yes
Warner sucker	Yes	Yes	Yes
Goose Lake sucker	Yes	Yes	Yes
Shortnose sucker	Yes	Yes	Yes
Klamath largescale sucker	Yes	Yes	Yes
Wood River bridgelip sucker	Yes	Yes	Yes
Torrent sculpin	Yes	Yes	Yes
Shorthead sculpin	Yes	Yes	Yes
Pit sculpin	No	Yes	No
Slender sculpin	Yes	Yes	Yes
Margined sculpin	Yes	Yes	Yes
Wood River sculpin	Yes	Yes	Yes
Shoshone sculpin	No	No	No
Malheur sculpin	Yes	Yes	Yes
Sunapee char	No	No	No

¹Lee, D.C.; Sedell, J.R.; Rieman, B.; [and others]. (in press). Chapter 4. Broad-scale assessment of aquatic species and habitats. In: Quigley, Thomas M.; Arbelbide, S.J., tech. eds. An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great basins. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; (Quigley, Thomas M., tech. ed. The Interior Columbia Basin Ecosystem Management Project: scientific assessment).

Step 1: Suitability of Proposed Alternatives for Aquatic Ecosystem Protection

The major elements of the aquatic conservation strategy were evaluated on the basis of interim widths of riparian areas and activities allowed within them, treatment of strongholds and "at-risk" populations, treatment of priority watershed or aquatic categories, amount of watershed and riparian restoration, and major assumptions needed to determine successful outcomes.

Riparian Widths and Activities

Current forest plans and forest practice rules regulate two major features of Riparian Habitat Conservation Areas (RHCA) used in Alternatives 2, 3, and 7 and Riparian Management Areas (RMA) used in Alternatives 4, 6, and parts of Alternative 5: their width and the type and amount of activities permitted to take place within them. Evaluating the effectiveness of RHCAs and RMAs to protect and manage riparian areas is difficult because of the complexity of the ecological functions they provide, the extended time over which impacts can occur, and the often long duration it can take for ecosystems to recover. Four biophysical principles underlie any evaluation of a riparian management strategy: (1) the functions and processes that govern production in a stream are generally dependent on predictable and near-natural energy and nutrient inputs; (2) wildlife has a disproportionately high use of riparian areas and stream-side forests compared with the overall landscape; (3) small streams are generally more affected by hill-slope activities than are larger streams; and (4) as adjacent slopes become steeper, the likelihood of disturbance resulting in discernable instream effects increases.

The width necessary to protect stream and riparian area structure and function at the small watershed level, and limits to disturbance near streams, will necessarily be based on watershed and site-specific analysis. The dimensions of riparian pro-

tection areas, particularly if they are to be used as interim or default standards, could include safety factors to allow for natural disturbances, uncertainties about the riparian ecosystem of interest, and changes in public values (National Research Council 1995). If an additional margin of error is allowed (not unlike bridge design accounting for unknown factors and longevity of structure), the probability of habitat improvement becomes greater and options for future management decisions are increased (FEMAT 1993, National Research Council 1995).

Channelized flow from intermittent and small streams into fish-bearing streams is a primary source of sediment in mountainous regions (Belt and others 1992). Gray (1970, 1978) identified four mechanisms by which vegetation enhances soil stability including: (1) mechanical reinforcement by roots; (2) regulation of soil moisture content; (3) buttressing between trunks or stems of plants; and (4) surcharge from the weight of trees. Gray and Megahan (1981) evaluated these hydro-mechanical effects in the Idaho batholith and found that the first three are highly important in stabilizing slopes, hollows, and intermittent streams. Gray and Megahan (1981) recommended using buffer zones along the margins of streams, and establishment of vegetative-leave-areas in critical areas, such as hollows and intermittent streams. Further, the assumption that large woody debris (LWD) recruitment in streams comes only from adjacent stream banks is not warranted given that intermittent streams provide large quantities of LWD during floods, after fires, and from debris torrents (Reeves and others 1995). Many of these small intermittent streams will not have full protection of ecological functions without an adequate RMA (Erman and Mahoney 1983, McGurk and Fong 1995).

The riparian goals and objectives of Alternatives 2 through 7, with the exception of the commodity-emphasis areas of Alternative 5, are to protect and restore riparian functions. The actual size of the riparian areas depends on the local characteristics that define them and a clear vision of how to

achieve the riparian management goals and objectives. Some of the goals of the aquatic conservation strategy for an alternative are to maintain the function of instream processes over the life of the plan and several additional decades. With the exception of current forest plans (Alternative 1) and the commodity-emphasis areas of Alternative 5, the alternatives utilize one-half to two maximum site potential tree heights³ (90 ft or 27.4 m for cold forest, 120 ft or 36.6 m for dry forest, and 150 ft or 45.7 m for moist forest) depending on stream size, plus the flood-prone (11-year floodplain) area or the 100-year floodplain, whichever is greater, as a standard for defining riparian widths.

Conservatively managed RHCAs and RMAs of one maximum site potential tree height are likely adequate to maintain most key riparian functions (for example, stream shading, large woody debris recruitment, small organic litter inputs, and nutrient regulation) throughout several decades or 100 years. The width dimensions of RHCAs and RMAs in Pacific Anadromous Fish Strategy (PACFISH 1994) (Alternative 2) and the deviation from PACFISH in Alternatives 3, 4, 6, 7, and parts of Alternative 5 in general provide adequate protection and a margin for error for riparian processes critical for maintaining fish species in most instances (FEMAT 1993; Lee and others, in press; Murphy 1995; National Research Council 1995; PACFISH 1995). Alternatives 2, 3, and 7 use site potential tree height, 100-year floodplain width, or a specified distance (50-300 ft or 15.2-91.5 m depending on whether the stream is fish-bearing and intermittent or permanently flowing). Alternatives 4 and 6 use the same site potential tree height standards as Alternatives 2, 3, and 7 with a minimum of 90 feet (27.4 m) for cold forest intermittent streams, to 300 feet or 91.5 meters (2 tree heights) for larger fish-bearing streams in moist forests. The width is dependent on potential vegetation type or one tree height to two tree heights. In addition, the RMAs for

Alternatives 4 and 6 can vary depending on the steepness of the adjacent slope; larger riparian widths are defined where steep slope influences occur. Generally, for slopes greater than 30 percent, RMAs will be wider than 300 feet (91.5 m).

Alternative 1 and the commodity-emphasis areas of Alternative 5 do not adequately protect riparian functions for several reasons. The existing forest plans (Alternative 1) are highly variable in providing riparian protection. They frequently provide no protection for intermittent streams, and generally do not fully protect riparian dependent functions (Lee and others, in press; Murphy 1995; PACFISH 1995). In Alternative 5 timber and livestock emphasis areas, which encompass nearly all of eastern Oregon and the northern third of the UCRB area, RMA widths vary from 20 feet (6.1 m), to a maximum of one site potential tree height, depending on the individual function or combined functions that require protection. RMA widths are the same as Alternatives 4 and 6 in non-timber or livestock emphasis areas of the Basin. While ecological functions of riparian areas would be protected under Alternative 5, the alternative does not provide enough information to evaluate whether a minimum or maximum width would be used. The maximum width of one site potential tree height leaves little margin for uncertainty, and less than one site potential tree height would not provide full, direct ecological protection or have the possibility to provide for other organisms with greater habitat requirements. The variable widths of riparian areas suggest a one-size-fits-all approach of a maximum of one site potential tree height will not accommodate all organisms (PACFISH 1995). PACFISH (1995) prescribed 90 meters (295 ft) minimum RHCA widths for fish-bearing streams to maintain stream function from non-channelized source sediment inputs. A review of the literature indicates that the minimum widths recommended by PACFISH would also be sufficient to provide for other riparian functions with a margin for error (Belt and

³Site potential tree height is defined as "the average maximum height of the tallest dominant trees (200 years or more) for a given site class."

others 1992; Beschta and others 1987; Brazier and Brown 1973; Gregory and others 1987; Lee and others, in press; McDade and others 1990; National Research Council 1995; Sedell and Beschta 1991; Steinblums and others 1984).

There is no provision in commodity-emphasis areas under Alternative 5 for protecting intermittent streams from which many disturbances originate (such as, landslides, sediment entry, and woody debris recruitment; Belt and others 1992). In addition, the watershed analysis procedure for the commodity-emphasis areas under Alternative 5 is concerned primarily with hydrologic and geomorphic functions, and not ecosystem functions of the landscape. In commodity-emphasis areas under Alternative 5, only site-specific analysis is required at the project scale, making it difficult to determine cumulative effects at a watershed level.

A major assumption made under Alternatives 4, 5, and 6 is that active management of RMAs is necessary to reduce fire severity. This would be accomplished by recreating a mosaic of stands in different conditions that offer natural firebreaks and less concentrated food sources for pests, mimicking historical forest conditions. The trade-off between fire risk and the risks associated with management activities is a watershed and site-specific issue, and no clear direction is given for the reconciliation of competing ecological needs in the preliminary draft EIS standards and guidelines (see appendix I, Vol. II). While productivity and fuel loading may be highest in the RMAs, these zones are generally moister and historically had longer fire return intervals (Agee 1994). Thus, in an ecological sense, fire management concerns are generally not a primary emphasis in riparian zones. Although riparian corridors sometimes experienced high-intensity fires, the more typical fire pattern was high-intensity fires that burned down to the riparian corridors, decreased in intensity, and often went out (Agee 1994). Given the importance of the riparian area to fish and aquatic habitat, a prudent course of treatment benefiting both RMAs and the entire landscape might be to treat the fire-prone portions of the

landscape outside of riparian areas. By focusing treatment in areas adjacent to riparian zones, historical refuges within the RMAs would be protected, where activities occurring closer to the stream have a greater probability for adverse effects on the stream. Although break up of current continuity of fuels is a needed treatment over much of the landscape, little is known about the minimum threshold of treatment that would sufficiently reduce fuel loadings and thereby reduce the potential for and frequency of major catastrophic fire. Historically, almost all of the low-severity fire regimes were in a mosaic, "fire-safe" condition (Agee 1994). If the upland landscape can be restored to a more sustainable character through thinning and prescribed burning, wild-fires can be largely controlled before they burn riparian zones.

For the purposes of this evaluation, we assumed that the large tree standard contained in the interim RMA objectives and standards for Alternatives 4, 5, and 6 (see appendix I) takes precedence over the fire regime and fire-severity standards applied directly to riparian zones. In other words, if in a dry forest type the RMAs were mostly composed of mixed-age firs, then the big firs would generally be of high ecological value and be in short supply along streams and the RMAs would meet the silviculture standard for mature or late-successional stage in zone 1. Thinning, from below (removing the smaller, younger, understory trees), would achieve the desired fire management goals (reducing fuel ladders) while also meeting the large tree standards near streams; this is different from converting the entire area to a dry forest composition.

Treatment of Strong and At-Risk Populations

Alternatives 3 through 6 do not specifically provide a mechanism for recognizing at-risk or critical habitats within subbasins other than those that require watershed/ecosystem analysis. Although conservation/restoration of strongholds for key salmonids is an important and logical priority, recognition and prioritization of other habitats

that support depressed populations of sensitive or narrowly-distributed species is also important in order to restore the condition of aquatic ecosystems.

We could not identify any scheme for prioritizing restoration activities in important but at-risk sub-watersheds. For example, because the fringe distributions of several of the key salmonids are represented only by depressed populations and are not in Category 1 watersheds,⁴ they would not require watershed analysis. There appears to be no mechanism in any of the alternatives outside of the intent to consider watersheds at risk. In guideline A-G26 (Aquatics-Guideline 26; see appendix I), it is suggested that managers (when prioritizing watershed restoration activities) consider threatened and endangered species, important life histories, and riparian dependent species. We assumed that there was no mechanism to prioritize protection of important and at-risk habitats or populations (such as depressed populations found in the fringe distributions) if they did not coincide with strong, Category 1, or priority watersheds. This may be particularly significant for the fringe dis-

tributions of several species. Although fringe areas may contribute a disproportionately large part of the genetic diversity or variability for some species, they are generally composed of depressed populations that are not considered under the strategies associated with any alternative.

Treatment of Priority Watersheds and Category Watersheds

Priority watersheds in Alternative 2 are replaced by watershed Categories 1⁴, 2⁵, and 3⁶ in Alternatives 3 through 6. Although the ecosystem management alternatives require a mid-level (sub-basin) analysis, the discussion does not clearly acknowledge the uncertainty and limited utility of the aquatic classification scheme. The classifications were intended to communicate broad-scale issues and opportunities regarding conservation and restoration potential of aquatic ecosystems, not to develop a prescription (Lee and others, in press). They are based on coarse data that have not been verified. Examination of new and finer-level information would likely result in many modifications. A process for designating water-

⁴Category 1 Watershed: These high integrity subbasins most closely resemble natural, fully functional aquatic ecosystems. In general they support large, often continuous blocks of high-quality habitat and watersheds with strong populations of multiple species. Connectivity among watersheds and through the mainstem river corridor is unimpeded, and all life histories, including migratory forms, are present and important. Native species predominate, though introduced species may be present. These sub-basins provide a system of large, well-dispersed habitats resilient to large-scale disturbances. They provide the best opportunity for long-term persistence of native aquatic assemblages and may be important sources for re-founding other areas.

⁵Category 2 Watershed: These moderate integrity subbasins support important aquatic resources, and often have watersheds classified as strongholds for one or more species scattered throughout. The integrity of the fish assemblage is high or moderate. The most important difference between Category 1 and Category 2 watersheds is increased fragmentation in Category 2 that has resulted from habitat disruption or loss. These subbasins have numerous watersheds where native species have been lost or are at risk. Connectivity among watersheds exists through the mainstem river system, or has the potential for restoration of life-history patterns and dispersal among watersheds. Because these subbasins commonly fall in some of the more intensively managed landscapes, they may have extensive road networks. Stronghold watersheds that require conservative protection are scattered rather than contiguous. These subbasins are more likely to provide opportunities to explore or experiment with watershed restoration through active manipulation, or through attempts to produce more episodic disturbance followed by long periods of recovery.

⁶Category 3 Watershed: These low integrity subbasins may support populations of key salmonids or have other important aquatic values, such as threatened and endangered species, narrow endemics, and introduced or hatchery supported sport fisheries. In general, however, these watersheds are strongly fragmented by extensive habitat loss or disruption throughout the component watersheds, and most notably through disruption of the mainstem corridor. Major portions of these subbasins are often associated with private and agricultural lands not managed by Forest Service or BLM. Although important and unique aquatic resources exist, they are usually localized. Opportunities for restoring connectivity among watersheds, full expression of life histories, or other large-scale characteristics of fully functioning and resilient aquatic ecosystems are limited or nonexistent in the near future. Because the remaining aquatic resources are often strongly isolated, risks of local extinction may be high. Conservation of the remaining productive areas may require a disproportionate contribution from federal management agencies, because these sub-basins often include large areas of non-Federal land.

shed categories that can be amended through mid-level analysis, however, is not provided. In our evaluation we assumed that strongholds can be identified and verified with subbasin analysis. We also assumed that aquatic classification can be amended and verified as well.

Land Use and Management Activities

We assumed that harvest and thinning activities have potentially negative net effects on aquatic systems, and that prescribed burning, livestock management, watershed restoration, and riparian restoration have potentially positive net effects. We recognize that these generalizations are not true in all situations and within all subbasins. Effects of timber harvesting and thinning are difficult to determine at the broad scale. However, with the exception of helicopter logging, most timber harvest activities have an ecological downside and higher risk potentials. This risk potential stems from additional road, landing, and skid trail soil compaction. Megahan and others (1992) concluded that new Best Management Practices (BMPs) can reduce sediment yields compared to historical practices, but risks of increased sedimentation from forest management practices will continue to occur if road building and timber harvesting take place. Menning and others (1996) adapted a cumulative watershed effects accounting system to model forest stand response to fire and timber harvest activities. Their coefficients for different types of wildfires, timber harvest, grazing activities, and roads reflect the relative associated risk to watersheds from sedimentation and are consistent with our assumptions.

We assumed that prescribed burning would not require new roads or activities to effectively treat the landscape and would result in no soil compaction. In reviewing literature on watersheds from the western United States, Beschta (1990) concluded that where low-severity burns occur (as with prescribed burning), much of the organic matter comprising the forest floor may remain following burning. In these situations, the effects of burning

are generally insignificant with regard to a wide range of hydrologic and water quality variables.

Restoration may include a variety of activities that influence aquatic habitats, but it is not possible to determine the relative significance of those activities from their allocation in the alternatives. Because restoration activities or the levels of those activities are not clearly defined, we assumed that restoration means significant progress in the restoration of the processes and functions relevant to aquatic habitats and species in the treatment area. We generally assumed that more restoration was better, and that moderate and high levels of restoration in terms of acres or hectares treated per decade (see "Major Assumptions and Information Used to Judge Alternatives" section later in this chapter) would produce positive trends in the status and distribution of a species. This assumption would hold true as long as those activities were subsequent to watershed/ecosystem analysis and were distributed across a portion of the species' range where they would be beneficial (for instance, where the species is still present and capable of responding). We also recognized that some risk is inherent in all forest management and restoration activities, and assumed that high restoration alternatives would be pursued with an approach that maximizes learning while minimizing risks.

Major Assumptions Needed to Determine Successful Evaluation Outcomes

As established in the preliminary draft EISs, standards represent required actions, and guidelines are suggestions for achieving objectives and are not required actions (see appendix I for details). Because we could not anticipate when guidelines would or would not be followed, our analyses represent the outcomes associated with the situation where they would generally not be followed. We recognized that in some circumstances and in some areas, guidelines would be implemented. Many of the standards and guidelines in the interim RMAs appeared decoupled from the aquatic conservation objectives. They referred to meeting

Riparian Management Objectives (RMOs) and protecting RMAs but did not refer back to the ecological objectives. We further assumed in our analysis that the interim standards would become final or long-term standards, since there was no time period specified for analyzing watersheds and the outcome of watershed analysis is unknown.

Ecosystem management standards

In Alternatives 3 through 7, ecosystem management planning is emphasized. As such, we assumed that it would be completed or there would be greater difficulty and uncertainty surrounding the management of landscapes and cumulative effects. Our assumptions regarding several important standards in the ecosystem management section of the preliminary draft EISs (see appendix I) are as follows:

- EM-S12⁷ (Develop and implement a standardized road condition and risk inventory.) We assumed that it would be done within the first one to two years or that the guideline for effective watershed restoration (a key element in our evaluation) would be uncertain and the intent of Alternatives 3 through 7 would not be met.
- EM-S13 (Construct new road crossings to maintain fish passage.) We assumed an ecosystem management standard requires maintaining hydrologic processes not just fish passages. As such, the road's management standard in the Aquatic Strategies Interim Objectives and Standards section of the preliminary draft EISs was assumed, specifically in areas where new stream crossings would accommodate a 100-year flood.
- EM-S14 (Transportation plans should be developed in an integrated resource manner, supporting ecosystem analysis and prioritizing roads for

rehabilitation, closure, or obliteration.) We assumed it would be done in the same time-frame or parallel to the above-mentioned Standard EM-S12.

- EM-S15 (There shall be no net increase in road density in any cluster. Road mileage increases will be offset by an equal or greater mileage decrease on a per cluster basis.) Subwatersheds [6th hydrologic unit code (HUC)] through sub-basins (4th HUC) are the appropriate scales to relate the ecological and cumulative effects consistent with the ecosystem analysis requirements presented in Alternatives 3 through 7. This is the only place where a cluster is assigned a specific implementation requirement as opposed to a strategic basin view. We assumed that there was an ecological basis for reducing moderate-to high-density roaded watersheds, but there was no equal ecological basis for trading road reduction in these areas for more roads in very low-density or unroaded watersheds. Thus, we assumed that a reduction in roads in high-density areas would not offset the negative effects of increasing roads in low or unroaded areas.
- EM-S16⁸ (Use adaptive management.) In order for there to be an effective adaptive management program, we assumed that resources would be allocated and priorities established, so that road inventories, watershed analysis, and design and implementation of inventory and monitoring programs would be in place within a two-year timeframe.

Aquatic strategies standards

Watershed and riparian restoration management:

- A-S3⁹ (Attainment and process for assessing Proper Functioning Condition should be

⁷EM-S12 indicates Ecosystem Management - Standard, followed by the specific standard number cited (Chapter 3, Preliminary Draft EISs) (USDA and USDI 1996a, 1996b).

⁸EM-S16 indicates Ecosystem Management - Standard 15; Standard 15 was added to this evaluation of alternatives at a later date than the other standards cited in this discussion and is therefore found in the August 1996 version of the Draft EIS.

⁹A-S3 indicates Aquatics - Standard, followed by the specific standard cited (Chapter 3, Preliminary Draft EISs) (USDA and USDI 1996a, 1996b).

required.) We assumed the attainment of proper functioning condition (PFC) would be required and that if it were not, management activities would be modified to attain PFC. The PFC concept is an example of a poorly-defined condition that is directed to be met, but for which the preliminary draft EISs do not address the ecological elements directly or specifically. We have assumed that PFC addresses both the hydrologic and geomorphic aspects of channels, stream banks, and surface water as well as the vegetative characteristics. Further, we have assumed that PFC achieves hydrologic function first and that the manager's decision-making options are between achieving hydrologic function and attaining site-specific vegetation potential. For purposes of aquatic and terrestrial organism communities, we assumed that vegetation standards are specifically included. Conservation and restoration of PFC in riparian areas includes managing toward an advanced successional stage of riparian vegetation with multiple species and age classes of woody vegetation. This is ecologically necessary. We further assume that PFC is an interdisciplinary team process; similar to watershed analysis, it will likely require more than one person to complete the analysis.

The PACFISH Recommended Livestock Grazing Guidelines¹⁰ lists specific attributes of PFC, recommendations for modifying current directions, and priorities for taking action. The specificity of the guidelines provides a credible basis for evaluating and monitoring, and increases their ability for implementation.

Monitoring and inventory:

- A-S7 (Regional and State offices shall develop monitoring frameworks.) We assumed a monitoring program would be developed.

- A-S8 (Regional and State offices should oversee, ensure, and report results of monitoring programs.) We assumed regional and state offices would oversee and ensure monitoring programs and report their results.
- A-S10 (Monitoring shall be conducted to determine if objectives are being met...If analysis indicates that Watershed or Riparian Management Objectives are not being met due to natural conditions or to processes or action outside of management control, then new objectives should be developed on the basis of new information.) We thought that this was a standard that implied a cumulative watershed effects (CWE) analysis. Currently only the Aquatics Guideline A-G25 directly addresses CWE: "Consider establishing qualitative and quantitative watershed disturbance (natural and management) levels or parameters for upland and riparian area zones to provide early indication of potential watershed cumulative effects and causal mechanisms for aquatic and riparian conditions." Alternative 7 is the only alternative that directly addresses CWE by calling for a consistent equivalent clearcut area (ECA) CWE method and setting a 15 percent ECA threshold which would trigger a watershed analysis (McCammon 1993). This threshold is at a watershed scale and does not distinguish near-stream disturbances from upslope disturbances or set a lower threshold near streams than for upslope areas. Alternatives 4 and 6 put forward a riparian zoning scheme which sets the foundation for CWE determination that could be sensitive to spatial variations in considering watershed disturbing effects (McGurk and Fong 1995, Menning and others 1996). However, only the vegetation management was directly required as a standard (directing more riparian forests toward mature and old forest condi-

¹⁰Personal communication. May 24, 1995 [revised July 31, 1995]. John Lowe, U.S. Forest Service. Internal document on file with: U.S. Department of Agriculture, Forest Service, U.S. Department of Interior, Bureau of Land Management, Interior Columbia Basin Ecosystem Management Project, 112 E. Poplar, Walla Walla, WA. 99362.

tions). Developing disturbance limitation criteria for each zone within the first couple of years of a plan would help prorate CWE and spatially locate these away from streams. All of the alternatives would provide greater protection for aquatic systems if they had such criteria. Such a scheme would allow more creative solutions and proposed new activities to be developed for currently disturbed watersheds, because planning models could be used before implementation of a project as opposed to instream RMOs which are an after-the-project measure of past events.

Key watersheds and watershed categories:

- A-S12 (Ecosystem analysis should be performed in Category 2 and 3 watersheds before Environmental Assessment (EA) or EIS required activities, otherwise interims apply.) We assumed ecosystem analysis would be conducted in strongholds and high-priority watersheds in Category 2 and 3 watersheds for Alternatives 3, 4, parts of Alternative 5, and 6.

Non-Federal Lands

No alternative addressed the role of non-Federal lands in achieving the goals and objectives of the aquatic conservation strategy. In assessing the role of non-Federal land in the maintenance of fish habitat and water quality, we assumed that the federally managed lands would likely act as anchors, and that, as important as non-Federal land is to certain fishes and aquatic communities, improvements would not be systematic throughout the Basin and conditions would not likely improve substantially. We based this assumption on the following reasons: (1) the goals of the states' natural resource agencies generally are not specifically aimed at restoring aquatic ecosystems and biodiversity, but instead are aimed at meeting societal needs while disrupting ecological processes and structures as little as possible; (2) as one moves from the broad and uniform application of forest practice rules, which are themselves not fully protective of riparian function (FEMAT 1993, Murphy 1995, National Research Council

1995, Spence and others 1996) to rangelands and then to settlement areas at the urban/wildland interface, the outcomes of regulations and laws are variable, localized and often vague; and (3) adequate information about species in a site that will be affected by management activity is generally lacking, especially in terms of the biological condition and presence of rare species. While each State within the Basin has goals associated with their policies, the actual implementation of those goals through adherence to the requirements embodied in the standards remains less certain. For these reasons, we assumed the outcomes were highly uncertain and problematic for such policies to protect and restore riparian and aquatic resources through time. Private lands affect corridors, low- to mid-elevation watersheds, valleys, and meadows. All of these are important to different aquatic communities and to water quality. Private land ownership patterns afford Federal managers the opportunity to cooperate in maintaining and restoring of aquatic resources or to become more conservative to accommodate continued effects within the sub-basins and the Basin.

Summary and Comparison

All of the alternatives lack specific performance measures. Performance measures would be quantifiable ecological goals in the sense that they measure a biological or physical process or state (such as, water quality and instream RMOs); they are not a measure of causal mechanisms. These would be measures from which one could determine the desired future conditions of the stream, watershed, or riparian vegetation. We do not view these performance measures as absolute thresholds or targets, but rather in the sense of relative health of the system, much like foresters view measures of mortality, growth rate, and so on. If the overall goal is to maintain and/or restore natural ecosystem processes and conditions, then some performance measures are needed that can be used to indicate if the current trend is moving in the desired direction. For example, the science literature supports that more ecological functions

and habitats along forest streams can be provided if the adjacent stand is in a mature or late-successional condition (FEMAT 1993, Murphy 1995, National Research Council 1995). Measures of this condition are the number and size classes of large trees for a given potential vegetation group (PVG). If this condition exists or could be attained, one could expect the instream conditions to eventually reflect the desired instream conditions. Likewise, with limits on disturbance in watersheds, the desired state could be maintained or potentially restored in a shorter period of time than if there were or had been no limits to watershed disturbance.

The instream RMOs are an attempt to quantitatively provide a measure of the current condition of a stream or streambank. They reflect causal mechanisms occurring recently or in the distant past. Changes in these measurable instream characteristics could be a result of decades of past degradation, a recent large flood, human disturbance, or multiple causes. In aggregate, RMOs are useful in determining trends and current watershed conditions, but are not well connected to planning and implementing ecosystem management within these alternatives.

Under Alternatives 2 through 6, RMO objectives are not expected to be met instantaneously, but rather would be achieved over time. While the RMOs vary somewhat, the timeframe for attainment of RMOs does not appear to vary with alternative except when concerning watershed restoration activity levels. This reduces our ability to use RMOs to evaluate their effectiveness within each alternative. In Alternatives 4 and 6, "all of the described features may not occur within a watershed, but all generally should occur at the watershed scale." We were given no guidance in any alternative as to how the condition of a watershed relative to RMOs would affect project implementation. If RMOs are below standard for the watershed, do projects continue that can further degrade habitat? We assumed not. We further assumed that if watershed analysis allowed one to make changes in standards and guidelines in

Alternatives 3, 4, 6, and parts of Alternative 5, such changes would not result in degradation or halt restoration trends for habitats, populations, or riparian conditions.

The alternatives are very complex and do not vary systemically to allow a marginal evaluation of the effectiveness of their components. We were often required to evaluate them on the stated alternative approach rather than on the specific elements of an alternative. For example, the real difference between Alternatives 4 and 6 is that they will be implemented at different rates and that adaptive management will figure more prominently in Alternative 6. The difference between Alternatives 2 and 3 appears to be the immediate incorporation of new information gained through the science assessment.

In summary, five of seven alternatives articulated an aquatic conservation strategy sufficient to maintain and restore aquatic and riparian ecological processes through time (table 3.2), Alternative 7 gave the most direct and specific direction regarding performance measures coupled with its reserves and its passive approach. Alternative 6 with its emphasis on adaptive management and cautious approach and Alternative 4 with its aggressive restoration, had less-specific descriptions of processes and performance measures, but RMAs were to be slope adjusted. Alternatives 2 and 3, with the ability to change widths of RHCA's and RMOs with site-specific (not watershed-specific) analysis, rated lower. Finally, Alternatives 1 and 5 did not rate as ecologically satisfactory in their ability to meet the goals and objectives of the aquatic conservation strategy.

Table 3.2. Suitability of proposed alternatives for aquatic ecosystem protection.

Evaluation Questions	Alternative						
	1	2	3	4	5	6	7
Does the aquatic conservation strategy maintain and restore aquatic and riparian ecological processes through time?	No	Yes	Yes	Yes	Yes, in non-production emphasis areas No, in production emphasis areas	Yes	Yes
Is watershed or ecosystem analysis required for specifically identified watersheds?	No, except in FEMAT ¹ key watersheds	Yes, but is site-specific, not ecosystem-specific except in FEMAT ¹ key watersheds	Yes, but is site-specific, not ecosystem-specific except in FEMAT ¹ key watersheds	Yes, watershed analysis in Category 1 and all strongholds, ecosystem analysis in high-priority watersheds and FEMAT ¹ key watersheds	Yes, ecosystem analysis in Category 1 non-production emphasis areas; No, in production emphasis areas except FEMAT ¹ key watersheds	Yes, watershed analysis in Category 1 and all strongholds, ecosystem analysis in high-priority watersheds and FEMAT ¹ key watersheds	Yes, watershed analysis in high-priority watersheds, 1,000 acre roadless areas, and FEMAT ¹ key watersheds
Can standards and guidelines be modified after ecosystem analysis?	Highly variable, No	No	Yes	Yes	Yes, in non-production emphasis areas; No, in production emphasis areas	Yes	No
What are the relative benefits of the proposed intensity of riparian and watershed restoration (road obliteration)?	Low	Moderate	Moderate	High	Moderate	High	Low-Moderate

¹Forest Ecosystem Management Assessment Team (FEMAT¹). 1993. Forest ecosystem management: an ecological, economic, and social assessment. Portland, OR: U.S. Department of Agriculture; U.S. Department of Interior [and others]. [irregular pagination].

Step 2: Projected Effects on Widely-Distributed Salmonid Species

The "Broadscale Assessment of Aquatic Species and Habitats" (Lee and others, in press) identified seven widely-distributed salmonids that serve as indicators of environmental change. These seven key salmonids are bull trout, westslope cutthroat trout, Yellowstone cutthroat trout, redband trout, steelhead, ocean-type chinook salmon, and stream-type chinook salmon. In this exercise, we identified the expected effect of the seven alternatives on future distribution and status of each of these salmonids.

Major Assumptions and Information Used to Judge Alternatives

We followed the general assumptions identified by the SIT for evaluating alternatives.¹¹ Specific to salmonids, we assumed that during implementation of the alternatives the presence or absence of strong populations (strongholds), as defined by the SIT in Lee and others (in press), would be verified using local information when activity levels depended on such strongholds. For the purpose of our evaluation, however, we used known and projected status maps (Lee and others, in press) as a reasonable estimate of the current distribution and abundance of strongholds. In our analysis we relied strongly on the information regarding the distribution and status of fishes generated by the aquatic assessment (Lee and others, in press). We also used the spatial and temporal allocation of management activities and road densities developed in the preliminary draft EISs to describe the patterns of management with the potential to influence fishes under each of the alternatives. We developed four primary pieces of

information as follows: (1) a series of classification trees to describe current patterns in fish distribution associated with landscape characteristics and to predict simple trends in distribution associated with changes in those characteristics, (2) a summary of anticipated road density changes across the current distribution of fishes, (3) a summary of the current ownership and management cluster for the current distribution of fishes, and (4) a summary of the anticipated intensity of management activities across the current distribution of fishes. Each informational piece provided some sense of where and how much of the anticipated management change was likely to influence each of the species we considered. Each has important limitations or inconsistencies and represents only a single element in a larger and more complex picture. Any conclusions must be drawn from the weight and consistency of trends anticipated from the models, from the patterns in allocation of roads and other land-disturbing activities, the allocation of restoration activities, and the mitigation of disturbance expected through the standards and specific direction of the alternatives.

Classification trees—In order to help track changes in population distribution and status that might result from each alternative, we developed a series of classification trees that linked population status of each species to physical landscape features and management activities. We followed the approach of Lee and others (in press), except that we used a smaller subset of landscape variables to describe the physical setting, and additional measures of road density that were calculated from the one-square-kilometer (0.39 mi²) road-density data summarized for each subwatershed [8,000-20,000 acre (3,239-8,097 ha) watersheds, 6th HUC] (appendix 3-B). The resulting classification trees' probability distributions associated with each node are presented in appendix 3-B. Uncertainty in classifications can be evaluated through classifi-

¹¹Personal communication. March 15, 1996. Sylvia J. Arbelbide, Minerals Area Management Director, U.S. Forest Service, Pacific Southwest Region, San Francisco, CA. Memo, on file with: U.S. Department of Agriculture, Forest Service, U.S. Department of Interior, Bureau of Land Management, Interior Columbia Basin Ecosystem Management Project, 112 E. Poplar, Walla Walla, WA 99362.

cation success tables (see Lee and others, in press). However, because we used the existing patterns of occurrence as estimates of the likelihood for a given species occurrence under similar conditions in the future, classification success is irrelevant. Confidence intervals for the proportions could be estimated but generally would be comparable in magnitude to the estimated change in distribution. We did not conclude, therefore, that significant changes are likely or unlikely based only on these simple models; we merely used them as an indication of the trends that would be consistent with changes in allocation of roads. The development and utility of classification trees with these data are covered in detail in Lee and others (in press).

The resultant classification trees consistently showed that the likelihood of a strong population decreased with increasing road density in many portions of the landscape for all of the resident species. We used classification trees to predict the likelihood of strong populations and/or depressed populations for each alternative, using the projected road densities in year 100. With the models, we predicted a range of responses that were interpreted for each species by comparison with the current condition. For example, Yellowstone cutthroat trout are currently classified as strong in about 34 percent (Alternative 0 = $0.341 = 34\%$) of the subwatersheds within the potential historical range (table 3.3). Under Alternative 1, the probability assignment was 0.325 or a change of -0.016 suggesting a declining trend in the occurrence of strong subwatersheds. The predicted loss represents about 4.7 percent of the current distribution of strong subwatersheds across the assessment area. The results also suggest a negative but less substantial change (0.9% of current) in the combined distribution (strong and depressed) for this subspecies (table 3.3).

From these results we could anticipate negative trends in both the status and complete distribution of Yellowstone cutthroat trout associated with the distribution of roads. We might further anticipate a larger change in status than in overall dis-

tribution. In other words, the changes from strong to depressed are more likely to occur than are changes from present to absent. Because the models were based on fish distributions and road density allocations by subwatershed, the predictions could also be summarized by subbasin (table 3.4) to provide a spatially explicit characterization of the anticipated changes. In this example, larger changes in status of subwatersheds should be expected in the Salt subbasin than in the Teton subbasin although both show a negative trend (table 3.4). This information was summarized by species and subbasin in a series of tables (tables 3.3-3.10) that were made available to the evaluation team.

The effects of increasing road densities include more than simply the total number of roads; there often are attendant landscape effects associated with roads which cannot be directly measured or projected (Lee and others, in press). Thus, we used road density as a general indicator of human disturbance. One could develop protracted arguments that future roads will not be as harmful as historical roads, or alternatively, that removing roads is not as favorable as having never built them at all—all of which makes evaluating future effects of roads problematic. To simplify, we assumed that future distributions of fish would be influenced by road-density patterns consistent with current relationships unless clearly mitigated by management. Therefore, the predicted changes in probability assignments from the classification trees are useful measures of relative changes that are based on empirical patterns.

Whether or not projected roads and their related effects will influence the status of fishes must be drawn from these empirical patterns, an understanding of the limitations, and the likely mitigative or exacerbating effects of each alternative. It is important to emphasize this point. Changes in road densities projected from the preliminary draft EIS may not reflect actual changes in road-related disturbance, but instead reflect the density of roads that are open and maintained.

Table 3.3. Projected changes in probability assignments for each alternative, Basin-wide and by species for four resident salmonids.

Probability that species status is strong (STR), or either strong or depressed (SR).

Alternative	Bull trout		Westslope cutthroat		Yellowstone cutthroat		Redband trout	
	STR	SR	STR	SR	STR	SR	STR	SR
current*	6.4%	28.3%	21.4%	75.8%	34.1%	62.4%	17.5%	54.3%
1	5.9%	26.8%	20.7%	75.7%	32.5%	61.9%	17.1%	54.3%
2	6.4%	27.6%	21.1%	75.8%	34.1%	62.4%	17.5%	54.3%
3	6.5%	27.9%	21.7%	76.0%	34.2%	62.4%	17.5%	54.3%
4	6.5%	28.0%	21.7%	76.0%	34.5%	62.5%	17.5%	54.3%
5	6.3%	27.6%	21.1%	75.8%	33.1%	61.9%	17.4%	54.3%
6	6.6%	28.3%	21.9%	76.0%	34.5%	62.5%	17.5%	54.3%
7	6.7%	29.1%	22.4%	76.0%	34.6%	62.6%	17.5%	54.3%

*Estimates for current condition.

Relative change* in STR and SR between current and each alternative (DSTR and DSR, respectively).

Alternative	Bull trout		Westslope cutthroat		Yellowstone cutthroat		Redband trout	
	DSTR	DSR	DSTR	DSR	DSTR	DSR	DSTR	DSR
1	-8.5%	-5.2%	-3.4%	-0.2%	-4.8%	-0.9%	-2.0%	—
2	-0.8%	-2.3%	-1.6%	0.0%	—	—	-0.1%	—
3	1.8%	-1.3%	1.2%	0.2%	0.2%	0.0%	0.1%	—
4	2.1%	-1.1%	1.2%	0.2%	1.2%	0.2%	0.2%	—
5	-2.0%	-2.4%	-1.4%	0.0%	-3.1%	-0.8%	-0.7%	—
6	2.8%	-0.1%	2.4%	0.2%	1.0%	0.2%	0.2%	—
7	4.3%	2.9%	4.4%	0.3%	1.4%	0.3%	0.2%	—

*Relative change is calculated as [(projected - current) / current].

Thus, reductions in projected road density may only equate to road closures and not necessarily to road obliteration. Reductions in road density projected through the preliminary draft EISs may not carry the full ecologic and hydrologic benefits associated with true road obliteration, while at the same time increases in density may still carry the full costs. The analysis must be based on trends and a more subjective interpretation of the likely mitigation or exacerbation of that trend as it is tied to watershed restoration activities (for example, true road obliteration and the associated standards under each alternative). Trends predicted with models also are not dramatic and may be under-

stated. For example, relationships between current road densities and the distribution and status of anadromous fishes are weak. This does not imply that roads and their related effects are not important for anadromous fish habitats, rather that the effects of roads may be confounded by the resolution of available data, the limited sample size, and other causes of decline (Lee and others, in press). Other factors likely to influence fish populations are included only to the degree that they will be represented by roads as a surrogate measure of that disturbance.

Table 3.4. Projected changes in probability assignments for Alternative 1, by species.

Alternative 1 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Methow	-1.1%	-4.5%	-0.6%	-0.3%	—	—	—	—
	Upper Columbia-Entiat	-1.1%	-4.5%	—	—	—	—	—	—
	Wenatchee	-0.4%	-1.5%	0.6%	0.4%	—	—	-0.6%	0.0%
	Naches	0.3%	-2.1%	—	—	—	—	—	—
	Upper Malheur	-0.2%	-2.6%	—	—	—	—	—	—
	Brownlee Reservoir	—	—	—	—	—	—	-1.3%	0.0%
	Imnaha	-1.6%	—	—	—	—	—	—	—
	Upper John Day	-0.1%	-0.9%	—	—	—	—	—	—
	North Fork John Day	-0.2%	-2.8%	—	—	—	—	—	—
	Middle Fork John Day	-0.5%	-5.1%	—	—	—	—	—	—
UCRB	Upper Klamath Lake	—	—	—	—	—	—	-3.7%	0.1%
	Upper Kootenai	-0.4%	-4.0%	-1.1%	-0.1%	—	—	—	—
	Fisher	-0.2%	-1.4%	—	—	—	—	—	—
	Yaak	-0.4%	-2.2%	—	—	—	—	—	—
	Lower Kootenai	-0.3%	-2.4%	-3.1%	-0.3%	—	—	—	—
	Moyie	—	—	-1.9%	-0.4%	—	—	—	—
	Upper Clark Fork	0.1%	2.3%	-1.1%	-1.4%	—	—	—	—
	Flint-Rock	-3.1%	-7.0%	-7.9%	-3.0%	—	—	—	—
	Blackfoot	-0.7%	-3.0%	-2.7%	-0.1%	—	—	—	—
	Middle Clark Fork	-0.3%	-2.8%	-0.5%	-0.1%	—	—	—	—
	Bitterroot	-1.2%	-9.4%	0.0%	-0.6%	—	—	—	—
	Stillwater	-0.5%	-5.9%	—	—	—	—	—	—
	Swan	-1.3%	-15.2%	-3.0%	0.0%	—	—	—	—
	Lower Clark Fork	-0.3%	-3.1%	-1.0%	0.0%	—	—	—	—
	Priest	-0.1%	-1.0%	—	—	—	—	—	—
	St. Joe	-0.2%	-2.3%	-0.5%	-0.1%	—	—	—	—
	Palisades	—	—	—	—	-8.8%	-1.0%	—	—
	Salt	—	—	—	—	-16.5%	-9.1%	—	—
	Teton	—	—	—	—	-2.9%	-0.2%	—	—
	Big Lost	-8.0%	—	—	—	—	—	-3.8%	0.1%
	Big Wood	—	—	—	—	—	—	-6.0%	0.2%
	North & Middle Fork Boise	-3.9%	-0.2%	—	—	—	—	-8.0%	0.3%
	Boise-Mores	-1.2%	—	—	—	—	—	-2.8%	0.1%
	South Fork Boise	-8.6%	-4.7%	—	—	—	—	-11.3%	0.4%
	South Fork Payette	-0.6%	-0.7%	—	—	—	—	-6.7%	0.2%
	Middle Fork Payette	-1.4%	-16.3%	—	—	—	—	-2.3%	0.1%
	Payette	-0.1%	-1.2%	—	—	—	—	—	—
	North Fork Payette	-0.5%	-5.0%	—	—	—	—	-0.9%	0.0%
	Weiser	-0.1%	-0.8%	—	—	—	—	—	—
	Pahsimeroi	-1.6%	—	-7.6%	1.1%	—	—	—	—
	Middle Salmon-Panther	-1.7%	-2.7%	-0.6%	0.2%	—	—	—	—
	Lemhi	-1.0%	-0.3%	-0.7%	-0.1%	—	—	-1.2%	0.0%
	Middle Salmon-Chamberlain	-0.5%	-1.2%	-1.3%	-1.1%	—	—	—	—
	South Fork Salmon	-4.0%	-3.3%	-0.8%	0.0%	—	—	—	—
	Lower Salmon	-0.6%	-6.9%	—	—	—	—	—	—
	Little Salmon	-2.3%	-10.6%	—	—	—	—	—	—
	Upper Selway	-0.1%	-1.5%	—	—	—	—	—	—
	Lochsa	-0.1%	-0.9%	—	—	—	—	—	—
	South Fork Clearwater	-0.2%	-2.3%	—	—	—	—	—	—
	Upper N. Fork Clearwater	-0.4%	-4.1%	-6.4%	0.1%	—	—	-0.6%	0.0%
	Lower N. Fork Clearwater	-0.2%	-2.0%	—	—	—	—	—	—

*DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong.

"Change" is the difference between the alternative and current.

Table 3.5. Projected changes in probability assignments for Alternative 2, by species.

Alternative 2 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Upper Columbia-Entiat	-1.1%	-4.5%	—	—	—	—	—	—
	Burnt	1.3%	6.8%	—	—	—	—	—	—
	Powder	0.6%	1.9%	—	—	—	—	—	—
	Upper Grande Ronde	0.9%	4.9%	—	—	—	—	—	—
	Upper John Day	0.5%	2.4%	—	—	—	—	—	—
	North Fork John Day	2.8%	2.8%	—	—	—	—	—	—
	Middle Fork John Day	1.1%	3.4%	—	—	—	—	—	—
	Williamson	—	—	—	—	—	—	1.1%	0.0%
UCRB	Upper Klamath Lake	—	—	—	—	—	—	-3.7%	0.1%
	Upper Kootenai	-0.3%	-3.1%	-0.7%	-0.1%	—	—	—	—
	Fisher	-0.2%	-1.4%	—	—	—	—	—	—
	Yaak	-0.4%	-2.2%	—	—	—	—	—	—
	Lower Kootenai	-0.3%	-2.4%	-3.1%	-0.3%	—	—	—	—
	Moyie	—	—	-1.9%	-0.4%	—	—	—	—
	Blackfoot	-0.7%	-2.5%	-2.3%	0.0%	—	—	—	—
	Middle Clark Fork	-0.3%	-2.8%	-0.5%	-0.1%	—	—	—	—
	Bitterroot	-0.8%	-6.0%	-0.1%	-0.5%	—	—	—	—
	Stillwater	-0.5%	-5.9%	—	—	—	—	—	—
	Swan	-1.0%	-11.9%	-3.0%	0.0%	—	—	—	—
	Lower Clark Fork	-0.3%	-3.1%	-0.7%	-0.1%	—	—	—	—
	Priest	-0.1%	-1.0%	—	—	—	—	—	—
	St. Joe	-0.2%	-2.3%	-0.5%	-0.1%	—	—	—	—
	Boise-Mores	0.3%	2.4%	—	—	—	—	—	—
	Lower Salmon	-0.3%	-2.9%	—	—	—	—	—	—
	Little Salmon	-1.8%	-5.3%	—	—	—	—	—	—
	South Fork Clearwater	-0.2%	-2.3%	—	—	—	—	—	—
	Upper N. Fork Clearwater	-0.4%	-4.1%	-6.4%	0.1%	—	—	-0.6%	0.0%
	Lower N. Fork Clearwater	-0.2%	-2.0%	—	—	—	—	—	—

*DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong.

"Change" is between the alternative and current.

Road distributions—To examine potential patterns of road disturbance on aquatic habitats independent of the models, we also cross-tabulated current known status with current and projected road-density class for each species of interest (table 3.11). Interpretation of these tables was based on a comparison of distributions of road-density class with each alternative. For example, 46 subwatersheds supporting strong Yellowstone cutthroat populations are presently classified as "none" in mean road density (table 3.11). No change is projected for the number of currently strong watersheds in this road-density class under Alternative 1. Some decline in the number of subwatersheds classified as "very low" or "low" is projected while an

increase in the number classified as "moderate" or "high" is also expected. The projected trend, then, is for an increase in road densities associated with watersheds currently supporting strong Yellowstone cutthroat trout. As discussed in the previous section, interpretations tied to road densities must be tempered by the understanding that projected reductions in road densities under each alternative do not necessarily equate to true road obliteration. Changes in road densities provide only trend information that may understate associated negative hydrologic and ecologic effects. Road-density changes must therefore be interpreted as trends and in light of the mitigating effects of each alternative.

Table 3.6. Projected changes in probability assignments for Alternative 3, by species.

Alternative 3 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Pend Oreille	0.3%	0.9%	2.6%	0.0%	—	—	—	—
	Kettle	0.5%	1.0%	—	—	—	—	—	—
	Sanpoil	0.5%	1.4%	—	—	—	—	—	—
	Methow	0.8%	2.1%	3.4%	1.6%	—	—	—	—
	Upper Columbia-Entiat	-1.1%	-4.5%	4.1%	2.1%	—	—	—	—
	Wenatchee	0.4%	—	1.6%	0.2%	—	—	—	—
	Naches	-0.4%	—	1.7%	0.9%	—	—	—	—
	Burnt	1.3%	6.8%	—	—	—	—	—	—
	Powder	0.6%	1.9%	—	—	—	—	—	—
	Imnaha	0.1%	1.6%	—	—	—	—	—	—
	Upper Grande Ronde	0.9%	4.9%	—	—	—	—	—	—
	Wallowa	0.2%	2.1%	—	—	—	—	—	—
	North Fork John Day	2.0%	—	—	—	—	—	—	—
	Middle Fork John Day	0.4%	-5.1%	—	—	—	—	—	—
	Upper Deschutes	2.9%	—	—	—	—	—	0.5%	0.0%
	Williamson	—	—	—	—	—	—	1.1%	0.0%
	Upper Klamath Lake	—	—	—	—	—	—	1.9%	-0.1%
UCRB	Upper Kootenai	0.6%	-2.3%	1.0%	-0.3%	—	—	—	—
	Fisher	0.3%	-1.4%	—	—	—	—	—	—
	Yaak	0.3%	-2.2%	—	—	—	—	—	—
	Lower Kootenai	0.1%	0.3%	-3.1%	-0.3%	—	—	—	—
	Moyie	0.3%	—	-1.9%	-0.4%	—	—	—	—
	Upper Clark Fork	0.1%	2.2%	-1.1%	-1.4%	—	—	—	—
	Flint-Rock	-0.1%	-0.6%	2.6%	0.0%	—	—	—	—
	Blackfoot	-0.4%	-0.9%	-2.3%	0.0%	—	—	—	—
	Middle Clark Fork	0.2%	-2.8%	—	—	—	—	—	—
	Bitterroot	—	-4.4%	-0.7%	-0.1%	—	—	—	—
	Stillwater	0.1%	-4.8%	—	—	—	—	—	—
	Swan	-0.5%	-8.6%	-3.0%	0.0%	—	—	—	—
	Lower Clark Fork	-0.1%	-3.1%	0.1%	-0.2%	—	—	—	—
	Pend Oreille Lake	0.1%	0.9%	—	—	—	—	—	—
	Priest	0.7%	2.6%	1.1%	-0.2%	—	—	—	—
	Upper Coeur D'alene	0.9%	—	—	—	—	—	—	—
	St. Joe	-0.1%	-2.1%	-0.5%	-0.1%	—	—	—	—
	Palisades	—	—	—	—	1.2%	0.4%	—	—
	North & Middle Fork Boise	0.2%	0.6%	—	—	—	—	1.0%	0.0%
	Boise-Mores	-1.2%	—	—	—	—	—	-2.8%	0.1%
	South Fork Payette	0.1%	0.4%	—	—	—	—	1.1%	0.0%
	Middle Salmon-Chamberlain	0.1%	1.3%	0.7%	0.2%	—	—	—	—
	Lower Salmon	0.0%	-1.9%	—	—	—	—	—	—
	Little Salmon	-1.0%	-2.6%	—	—	—	—	—	—
	Lower Selway	0.1%	0.2%	1.4%	0.7%	—	—	—	—
	Lochsa	0.3%	-0.6%	2.5%	1.3%	—	—	—	—
	South Fork Clearwater	0.7%	-0.8%	—	—	—	—	—	—
	Clearwater	0.1%	—	2.8%	1.4%	—	—	—	—
	Upper N. Fork Clearwater	-0.1%	-4.0%	-5.0%	0.1%	—	—	-0.6%	0.0%
	Lower N. Fork Clearwater	0.1%	-2.0%	—	—	—	—	—	—

* DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong.

"Change" is between the alternative and current.

Table 3.7. Projected changes in probability assignments for Alternative 4, by species.

Alternative 4 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Pend Oreille	0.3%	0.9%	2.6%	0.0%	—	—	—	—
	Kettle	0.5%	1.0%	—	—	—	—	—	—
	Sanpoil	0.5%	1.4%	—	—	—	—	—	—
	Okanogan	0.0%	—	—	—	—	—	—	—
	Methow	0.8%	2.1%	3.4%	1.6%	—	—	—	—
	Upper Columbia-Entiat	-1.1%	-4.5%	4.1%	2.1%	—	—	—	—
	Wenatchee	0.4%	—	1.6%	0.2%	—	—	—	—
	Naches	-0.4%	—	1.7%	0.9%	—	—	—	—
	Brownlee Reservoir	0.3%	2.3%	—	—	—	—	—	—
	Burnt	1.3%	6.8%	—	—	—	—	—	—
	Powder	0.6%	1.9%	—	—	—	—	—	—
	Imnaha	0.1%	1.6%	—	—	—	—	—	—
	Upper Grande Ronde	0.9%	4.9%	—	—	—	—	—	—
	Wallowa	0.2%	2.1%	—	—	—	—	—	—
	Upper John Day	0.3%	0.5%	—	—	—	—	—	—
	North Fork John Day	2.0%	—	—	—	—	—	—	—
	Middle Fork John Day	0.4%	-5.1%	—	—	—	—	—	—
	Upper Deschutes	3.1%	—	—	—	—	—	0.5%	-20.0%
	Lower Crooked	—	—	—	—	—	—	0.8%	-30.0%
	Williamson	—	—	—	—	—	—	1.1%	-40.0%
	Upper Klamath Lake	—	—	—	—	—	—	1.9%	-60.0%
UCRB	Upper Kootenai	0.6%	-2.3%	1.0%	-0.3%	—	—	—	—
	Fisher	0.3%	-1.4%	—	—	—	—	—	—
	Yaak	0.3%	-2.2%	—	—	—	—	—	—
	Lower Kootenai	0.1%	0.3%	-3.1%	-0.3%	—	—	—	—
	Moyie	0.3%	—	-1.9%	-0.4%	—	—	—	—
	Upper Clark Fork	0.1%	2.2%	-1.1%	-1.4%	—	—	—	—
	Flint-Rock	-0.1%	-0.6%	2.6%	0.0%	—	—	—	—
	Blackfoot	-0.5%	-1.4%	-1.9%	0.0%	—	—	—	—
	Middle Clark Fork	0.2%	-2.8%	—	—	—	—	—	—
	Bitterroot	—	-4.4%	-0.7%	-0.1%	—	—	—	—
	Stillwater	0.1%	-4.8%	—	—	—	—	—	—
	Swan	-0.5%	-8.6%	-3.0%	0.0%	—	—	—	—
	Lower Clark Fork	-0.1%	-3.1%	0.1%	-0.2%	—	—	—	—
	Pend Oreille Lake	0.1%	0.9%	—	—	—	—	—	—
	Priest	0.7%	2.6%	1.1%	-0.2%	—	—	—	—
	Upper Coeur D'alene	0.9%	—	—	—	—	—	—	—
	St. Joe	-0.1%	-2.1%	-0.5%	-0.1%	—	—	—	—
	Palisades	—	—	—	—	1.2%	0.4%	—	—
	Salt	—	—	—	—	0.9%	0.1%	—	—
	Lower Henrys	—	—	—	—	3.4%	2.4%	—	—
	Portneuf	—	—	—	—	1.8%	0.1%	—	—
	North & Middle Fork Boise	0.2%	0.6%	—	—	—	—	1.0%	0.0%
	Boise-Mores	-1.2%	—	—	—	—	—	-2.8%	0.1%
	South Fork Payette	0.1%	0.4%	—	—	—	—	1.1%	0.0%
	Middle Fork Payette	0.9%	4.0%	—	—	—	—	2.3%	-0.1%
	North Fork Payette	0.3%	1.6%	—	—	—	—	1.7%	-0.1%
	Weiser	0.3%	2.4%	—	—	—	—	—	—
	Middle Salmon-Chamberlain	0.1%	1.3%	0.7%	0.2%	—	—	—	—
	Lower Salmon	0.0%	-1.9%	—	—	—	—	—	—
	Little Salmon	-1.0%	-2.6%	—	—	—	—	—	—
	Lower Selway	0.1%	0.2%	1.4%	0.7%	—	—	—	—
	Lochsa	0.3%	-0.6%	2.5%	1.3%	—	—	—	—
	South Fork Clearwater	0.7%	-0.8%	—	—	—	—	—	—

Table 3.7 (continued)

Alternative 1 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
	Clearwater	0.1%	—	2.8%	1.4%	—	—	—	—
	Upper N. Fork Clearwater	-0.1%	-4.0%	-5.0%	0.1%	—	—	-0.6%	0.0%
	Lower N. Fork Clearwater	0.1%	-2.0%	—	—	—	—	—	—

*DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong.

"Change" is between the alternative and current.

Table 3.8. Projected changes in probability assignments for Alternative 5, by species.

Alternative 5 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Upper Columbia-Entiat	-1.1%	-4.5%	—	—	—	—	—	—
	Brownlee Reservoir	—	—	—	—	—	—	-1.3%	0.0%
	Burnt	1.3%	6.8%	—	—	—	—	—	—
	Powder	0.6%	1.9%	—	—	—	—	—	—
	Upper Grande Ronde	0.9%	4.9%	—	—	—	—	—	—
	Upper John Day	0.3%	0.5%	—	—	—	—	—	—
	North Fork John Day	2.0%	—	—	—	—	—	—	—
	Middle Fork John Day	0.4%	-5.1%	—	—	—	—	—	—
	Williamson	—	—	—	—	—	—	1.1%	0.0%
UCRB	Upper Klamath Lake	—	—	—	—	—	—	1.9%	-0.1%
	Upper Kootenai	-0.4%	-4.0%	-1.1%	-0.1%	—	—	—	—
	Fisher	-0.2%	-1.4%	—	—	—	—	—	—
	Yaak	-0.4%	-2.2%	—	—	—	—	—	—
	Lower Kootenai	-0.3%	-2.4%	-3.1%	-0.3%	—	—	—	—
	Moyie	—	—	-1.9%	-0.4%	—	—	—	—
	Upper Clark Fork	0.1%	2.2%	-1.1%	-1.4%	—	—	—	—
	Blackfoot	-0.4%	-0.9%	-2.3%	0.0%	—	—	—	—
	Middle Clark Fork	-0.3%	-2.8%	-0.5%	-0.1%	—	—	—	—
	Bitterroot	—	-4.4%	-0.7%	-0.1%	—	—	—	—
	Stillwater	-0.5%	-5.9%	—	—	—	—	—	—
	Swan	-0.5%	-8.6%	-3.0%	0.0%	—	—	—	—
	Lower Clark Fork	-0.3%	-3.1%	-1.0%	0.0%	—	—	—	—
	Priest	-0.1%	-1.0%	—	—	—	—	—	—
	St. Joe	-0.2%	-2.3%	-0.5%	-0.1%	—	—	—	—
	Salt	—	—	—	—	-16.5%	-9.1%	—	—
	Teton	—	—	—	—	-2.9%	-0.2%	—	—
	Big Lost	-8.0%	—	—	—	—	—	-3.8%	0.1%
	Big Wood	—	—	—	—	—	—	-6.0%	0.2%
	Boise-Mores	-1.2%	—	—	—	—	—	-2.8%	0.1%
	Middle Fork Payette	-1.4%	-16.3%	—	—	—	—	-2.3%	0.1%
	Payette	-0.1%	-1.2%	—	—	—	—	—	—
	North Fork Payette	-0.5%	-5.0%	—	—	—	—	-0.9%	0.0%
	Weiser	-0.1%	-0.8%	—	—	—	—	—	—
	Lower Salmon	0.0%	-1.9%	—	—	—	—	—	—
	Little Salmon	-1.0%	-2.6%	—	—	—	—	—	—
	South Fork Clearwater	0.7%	-0.8%	—	—	—	—	—	—
	Clearwater	0.1%	—	2.8%	1.4%	—	—	—	—
	Upper N. Fork Clearwater	-0.4%	-4.1%	-6.4%	0.1%	—	—	-0.6%	0.0%
	Lower N. Fork Clearwater	-0.2%	-2.0%	—	—	—	—	—	—

*DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong.

"Change" is the difference between the alternative and current.

Table 3.9. Projected changes in probability assignments for Alternative 6, by species.

Alternative 6 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Pend Oreille	0.3%	0.9%	2.6%	0.0%	—	—	—	—
	Kettle	0.5%	1.0%	—	—	—	—	—	—
	Sanpoil	0.5%	1.4%	—	—	—	—	—	—
	Methow	0.8%	2.1%	3.4%	1.6%	—	—	—	—
	Upper Columbia-Entiat	-1.1%	-4.5%	4.1%	2.1%	—	—	—	—
	Wenatchee	0.4%	—	1.6%	0.2%	—	—	—	—
	Naches	-0.4%	—	1.7%	0.9%	—	—	—	—
	Burnt	1.3%	6.8%	—	—	—	—	—	—
	Powder	0.6%	1.9%	—	—	—	—	—	—
	Imnaha	0.1%	1.6%	—	—	—	—	—	—
	Upper Grande Ronde	0.9%	4.9%	—	—	—	—	—	—
	Wallowa	0.2%	2.1%	—	—	—	—	—	—
	Upper John Day	0.5%	2.4%	—	—	—	—	—	—
	North Fork John Day	2.8%	2.8%	—	—	—	—	—	—
	Middle Fork John Day	1.1%	3.4%	—	—	—	—	—	—
	Upper Deschutes	2.9%	—	—	—	—	—	0.5%	0.0%
	Williamson	—	—	—	—	—	—	1.1%	0.0%
	Upper Klamath Lake	—	—	—	—	—	—	1.9%	-0.1%
UCRB	Upper Kootenai	0.6%	-2.3%	1.0%	-0.3%	—	—	—	—
	Fisher	0.3%	-1.4%	—	—	—	—	—	—
	Yaak	0.3%	-2.2%	—	—	—	—	—	—
	Lower Kootenai	0.1%	0.3%	-3.1%	-0.3%	—	—	—	—
	Moyie	0.3%	0.0%	-1.9%	-0.4%	—	—	—	—
	Flint-Rock	-0.1%	-0.6%	2.6%	0.0%	—	—	—	—
	Blackfoot	0.2%	1.3%	1.6%	-0.1%	—	—	—	—
	Middle Clark Fork	0.2%	-2.8%	—	—	—	—	—	—
	Stillwater	0.1%	-4.8%	—	—	—	—	—	—
	Swan	0.2%	-0.4%	1.1%	0.1%	—	—	—	—
	Lower Clark Fork	-0.1%	-3.1%	0.1%	-0.2%	—	—	—	—
	Pend Oreille Lake	0.1%	0.9%	—	—	—	—	—	—
	Priest	0.7%	2.6%	1.1%	-0.2%	—	—	—	—
	Upper Coeur D'alene	0.9%	—	—	—	—	—	—	—
	St. Joe	-0.1%	-2.1%	-0.5%	-0.1%	—	—	—	—
	Palisades	—	—	—	—	1.2%	0.4%	—	—
	Lower Henrys	—	—	—	—	3.4%	2.4%	—	—
	Portneuf	—	—	—	—	1.8%	0.1%	—	—
	North & Middle Fork Boise	0.2%	0.6%	—	—	—	—	1.0%	0.0%
	Boise-Mores	0.3%	2.4%	—	—	—	—	—	—
	South Fork Payette	0.1%	0.4%	—	—	—	—	1.1%	0.0%
	Middle Salmon-Chamberlain	0.1%	1.3%	0.7%	0.2%	—	—	—	—
	Little Salmon	0.6%	5.6%	—	—	—	—	—	—
	Lower Selway	0.1%	0.2%	1.4%	0.7%	—	—	—	—
	Lochsa	0.3%	-0.6%	2.5%	1.3%	—	—	—	—
	South Fork Clearwater	0.9%	1.6%	—	—	—	—	—	—
	Clearwater	0.1%	—	2.8%	1.4%	—	—	—	—
	Upper N. Fork Clearwater	-0.1%	-4.0%	-5.0%	0.1%	—	—	-0.6%	0.0%
	Lower N. Fork Clearwater	0.1%	-2.0%	—	—	—	—	—	—

*DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong.

"Change" is the difference between the alternative and current.

Table 3.10. Projected changes in probability assignments for Alternative 7, by species.

Alternative 7 EIS	Subbasin	Bull Trout		Westslope Cutthroat		Yellowstone Cutthroat		Redband Trout	
		DSTR*	DSR*	DSTR	DSR	DSTR	DSR	DSTR	DSR
EEIS	Pend Oreille	0.3%	0.9%	2.6%	0.0%	—	—	—	—
	Kettle	0.7%	3.5%	—	—	—	—	—	—
	Sanpoil	0.5%	1.4%	—	—	—	—	—	—
	Methow	0.8%	2.1%	3.4%	1.6%	—	—	—	—
	Upper Columbia-Entiat	—	—	4.1%	2.1%	—	—	—	—
	Wenatchee	0.4%	—	1.6%	0.2%	—	—	—	—
	Naches	-0.4%	—	1.7%	0.9%	—	—	—	—
	Burnt	1.3%	6.8%	—	—	—	—	—	—
	Powder	0.6%	1.9%	—	—	—	—	—	—
	Imnaha	0.1%	1.6%	—	—	—	—	—	—
	Upper Grande Ronde	0.9%	4.9%	—	—	—	—	—	—
	Wallowa	0.2%	2.1%	—	—	—	—	—	—
	Upper John Day	0.5%	2.4%	—	—	—	—	—	—
	North Fork John Day	2.8%	2.8%	—	—	—	—	—	—
	Middle Fork John Day	1.1%	3.4%	—	—	—	—	—	—
	Upper Deschutes	3.1%	—	—	—	—	—	0.5%	0.0%
	Williamson	—	—	—	—	—	—	1.1%	0.0%
	Upper Klamath Lake	—	—	—	—	—	—	1.9%	-0.1%
UCRB	Upper Kootenai	1.1%	3.9%	3.7%	-0.2%	—	—	—	—
	Fisher	0.7%	2.9%	1.0%	0.1%	—	—	—	—
	Yaak	1.5%	13.5%	0.7%	0.2%	—	—	—	—
	Lower Kootenai	0.6%	6.1%	3.5%	-0.3%	—	—	—	—
	Moyie	1.3%	11.9%	—	—	—	—	—	—
	Flint-Rock	-0.1%	-0.6%	2.6%	0.0%	—	—	—	—
	Blackfoot	0.2%	1.3%	2.0%	-0.1%	—	—	—	—
	Middle Clark Fork	0.7%	2.1%	1.1%	0.0%	—	—	—	—
	Flathead Lake	0.5%	1.4%	—	—	—	—	—	—
	Stillwater	1.0%	5.6%	—	—	—	—	—	—
	Swan	0.2%	-0.4%	1.1%	0.1%	—	—	—	—
	Lower Clark Fork	0.9%	2.0%	1.8%	0.0%	—	—	—	—
	Pend Oreille Lake	0.4%	4.6%	—	—	—	—	—	—
	Priest	0.7%	2.6%	2.2%	-0.3%	—	—	—	—
	Upper Coeur D'Alene	1.1%	2.0%	—	—	—	—	—	—
	St. Joe	0.2%	0.8%	—	—	—	—	—	—
	Palisades	—	—	—	—	1.2%	0.4%	—	—
	Upper Henrys	—	—	—	—	2.4%	0.6%	—	—
	Lower Henrys	—	—	—	—	3.4%	2.4%	—	—
	Portneuf	—	—	—	—	1.8%	0.1%	—	—
	North & Middle Fork Boise	0.2%	0.6%	—	—	—	—	1.0%	0.0%
	Boise-Mores	0.3%	2.4%	—	—	—	—	—	—
	South Fork Payette	0.1%	0.4%	—	—	—	—	1.1%	0.0%
	North Fork Payette	0.1%	1.4%	—	—	—	—	—	—
	Middle Salmon-Chamberlain	0.1%	1.3%	0.7%	0.2%	—	—	—	—
	Little Salmon	0.6%	5.6%	—	—	—	—	—	—
	Lower Selway	0.1%	0.2%	1.4%	0.7%	—	—	—	—
	Lochsa	0.3%	-0.6%	2.5%	1.3%	—	—	—	—
	South Fork Clearwater	0.9%	1.6%	—	—	—	—	—	—
	Clearwater	0.1%	—	2.8%	1.4%	—	—	—	—
	Upper N. Fork Clearwater	0.3%	1.2%	0.8%	-0.1%	—	—	—	—
	Lower N. Fork Clearwater	0.3%	1.0%	—	—	—	—	—	—

*DSTR = Change in the probability that species status is strong; DSR = Change in the probability that species status is depressed or strong. "Change" is the difference between the alternative and current.

Table 3.11. Current known status (strong or depressed) for each of seven salmonids versus current (Alternative 0) mean road density class and the projected allocation and distribution of road density classes for each alternative.

Bull trout		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	60	24	134	238	352	4
	Strong	124	24	72	22	28	0
1	Depressed	54	20	112	241	381	4
	Strong	117	19	72	32	30	0
2	Depressed	59	25	137	256	333	2
	Strong	123	26	66	27	28	0
3	Depressed	59	29	188	403	133	0
	Strong	121	33	70	38	8	0
4	Depressed	59	30	192	403	128	0
	Strong	121	33	71	37	8	0
5	Depressed	59	27	141	301	283	1
	Strong	121	28	67	29	25	0
6	Depressed	60	29	205	387	131	0
	Strong	124	30	74	34	8	0
7	Depressed	60	31	221	370	130	0
	Strong	124	30	76	32	8	0

Westslope cutthroat trout		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	87	39	180	350	822	7
	Strong	192	34	109	110	139	3
1	Depressed	79	35	151	348	865	7
	Strong	185	31	98	117	153	3
2	Depressed	81	42	174	342	839	7
	Strong	191	34	102	115	142	3
3	Depressed	81	47	210	788	358	1
	Strong	191	40	136	194	24	2
4	Depressed	81	47	210	794	352	1
	Strong	191	40	136	195	23	2
5	Depressed	81	44	174	430	750	6
	Strong	191	35	105	129	125	2
6	Depressed	87	44	228	775	350	1
	Strong	191	41	140	189	24	2
7	Depressed	87	45	237	769	346	1
	Strong	192	40	154	175	24	2

Table 3.11 (continued)

Yellowstone cutthroat trout		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	4	8	19	51	91	0
	Strong	46	25	59	42	37	0
1	Depressed	2	2	20	51	98	0
	Strong	46	21	56	45	41	0
2	Depressed	4	8	19	50	92	0
	Strong	46	25	59	42	37	0
3	Depressed	4	8	20	52	89	0
	Strong	46	25	59	43	36	0
4	Depressed	4	8	28	49	84	0
	Strong	46	25	60	42	36	0
5	Depressed	4	7	17	47	98	0
	Strong	46	25	55	45	38	0
6	Depressed	4	8	23	51	87	0
	Strong	46	25	59	43	36	0
7	Depressed	4	8	23	51	87	0
	Strong	46	25	59	43	36	0

Redband trout		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	148	37	365	678	772	21
	Strong	49	24	114	188	428	13
1	Depressed	135	32	339	702	792	21
	Strong	34	20	115	200	434	13
2	Depressed	148	37	360	829	637	10
	Strong	49	25	118	282	339	3
3	Depressed	148	38	406	973	451	5
	Strong	47	36	121	343	266	3
4	Depressed	148	40	416	1025	388	4
	Strong	48	38	129	370	228	3
5	Depressed	141	39	364	911	557	9
	Strong	38	26	127	312	310	3
6	Depressed	148	39	417	987	425	5
	Strong	49	36	128	340	260	3
7	Depressed	148	40	425	982	422	4
	Strong	49	37	127	340	260	3

Table 3.11 (continued)

Steelhead trout		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	199	52	240	406	518	16
	Strong	0	0	3	7	12	1
1	Depressed	189	45	224	423	534	16
	Strong	0	0	2	7	13	1
2	Depressed	199	53	242	490	443	4
	Strong	0	0	5	13	5	0
3	Depressed	197	63	281	629	258	3
	Strong	0	0	4	16	3	0
4	Depressed	197	63	281	635	252	3
	Strong	0	0	4	16	3	0
5	Depressed	197	57	241	583	350	3
	Strong	0	0	4	14	5	0
6	Depressed	199	61	289	628	251	3
	Strong	0	0	5	15	3	0
7	Depressed	199	61	290	628	250	3
	Strong	0	0	5	15	3	0

Stream-type chinook salmon		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	101	30	129	153	247	8
	Strong	0	2	1	1	3	1
1	Depressed	97	31	110	164	258	8
	Strong	0	2	1	1	3	1
2	Depressed	101	31	131	193	210	2
	Strong	0	2	2	3	1	0
3	Depressed	100	34	161	275	97	1
	Strong	0	2	2	3	1	0
4	Depressed	100	34	161	276	96	1
	Strong	0	2	2	3	1	0
5	Depressed	100	32	131	248	156	1
	Strong	0	2	2	3	1	0
6	Depressed	101	33	167	270	96	1
	Strong	0	2	2	3	1	0
7	Depressed	101	33	168	270	95	1
	Strong	0	2	2	3	1	0

Table 3.11 (continued)

Ocean-type chinook salmon		Mean Road Density (miles of road / mi ²)					
Alternative	Status	None < 0.02	Very Low 0.02 - 0.1	Low 0.1 - 0.7	Moderate 0.7 - 1.7	High 1.7 - 4.7	Extremely High > 4.7
0	Depressed	4	1	15	30	21	0
	Strong	0	0	7	12	6	0
1	Depressed	3	2	15	30	21	0
	Strong	0	0	7	12	6	0
2	Depressed	4	1	15	30	21	0
	Strong	0	0	7	12	6	0
3	Depressed	4	2	15	43	7	0
	Strong	0	0	7	15	3	0
4	Depressed	4	2	15	44	6	0
	Strong	0	0	7	15	3	0
5	Depressed	4	1	15	30	21	0
	Strong	0	0	7	12	6	0
6	Depressed	4	2	15	43	7	0
	Strong	0	0	7	15	3	0
7	Depressed	4	2	15	43	7	0
	Strong	0	0	7	15	3	0

Ownership and management class—We cross-tabulated the current known and predicted status of each key species with an ownership and management designation developed by the SIT Aquatics Team (Lee and others, in press) for each subwatershed (tables 3.12-3.18). Allocation of ownership and management designation was used to consider the relative significance of management activities on FS- and BLM-administered lands. For example, 139 subwatersheds known or predicted to support strong Yellowstone cutthroat trout are found on Forest Service-administered lands (for example, management clusters: FG, FH, FM, FW in table 3.14) but none are on BLM-administered lands (management cluster BR in table 3.14). Thus, approximately 66 percent of all the currently strong populations are associated with FS-administered lands and are likely to be influenced directly by the activities considered under these alternatives.

Management activities—The projected forest and range management activities vary in intensity under each alternative. They also vary spatially within and among the alternatives by forest and rangeland cluster. To further our evaluation of the potential influence of management activities on the distribution and status of the salmonid

species, we summarized activities across species distributions and status classifications. We considered timber harvest, thinning, watershed restoration, prescribed burning, livestock management, and riparian restoration as potentially important management activities in our summary. All activities were not given equal importance. For example, livestock management is expected to have only a minor influence on aquatic habitats relative to active riparian restoration, which includes fencing and the potential to fully exclude livestock from critical habitats.

Management activities summary tables were generated in a four-step process. First, we tallied the number of subwatersheds for each species and status-class by forest and rangeland clusters and summarized as a proportion of the total occurrence in the entire assessment area (table 3.19). For example, 62 percent of the Yellowstone cutthroat trout subwatersheds currently considered strong occur in Forest Cluster 1 (table 3.19). Second, we used the assignment of activity levels and the midpoint of reported rates for each activity (see appendix I; tables 3 and 10 in the “Rule Sets for Management Activity Levels by Cluster by Alternative” section of the preliminary draft EIS)

to estimate the rate of implementation for each activity by cluster and alternative. Third, we multiplied the activity rate by the proportion of the species distribution occurring in the appropriate forest or range cluster. Finally, we summed across cluster by species occurrence, status, or class to estimate the total proportion of the distribution that would be influenced by a particular activity per decade (table 3.20). For example, under Alternative 1 we would anticipate that 2.8 percent of the current distribution of strong subwatersheds for Yellowstone cutthroat trout would be exposed to timber harvest per decade, 1.3 percent to thinning, 1.3 percent to watershed restoration (table 3.20), and so on.

We assumed that an activity would have the same effect in any watershed unless mitigating or exacerbating activities were clearly identified within the alternative. The summaries provided simple indices for comparisons across species distributions and among alternatives. Many land-use management activities have been generally associ-

ated with disruption of watershed function and negative effects on the processes that maintain and create high-quality habitats for fishes (Lee and others, in press). However, we had no method to weigh or model the effects of land use and management activities allocated under each alternative as we did with road allocation. Thus, we were forced to evaluate risks largely on the content and direction of each alternative and the allocation of activities across a species range.

Although the risks associated with land use can be mitigated by careful planning, analysis, and implementation, we generally assumed that increased levels of ground-disturbing activities associated with timber harvest and thinning increased risks for the species considered. We assumed that watershed and riparian restoration, and livestock management would have positive net effects and provide the greatest benefits for species in watersheds with the potential to respond. It was not clear, however, how effective those activities would be in restoring watershed and hydrologic processes.

Table 3.12. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Bull trout

Management cluster ¹	Absent ²	Depressed ²	Strong ²	Total	Percent
BR	207	21	2	230	5.23
FG	203	86	46	335	7.62
FH	354	112	17	483	10.98
FM	428	294	34	756	17.19
FW	278	131	155	564	12.82
NP	33	8	2	43	0.98
PA	590	19	2	611	13.89
PF	752	108	7	867	19.71
PR	304	11	2	317	7.21
TL	167	23	3	193	4.39
Total	3316	813	270	4399	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.13. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Westslope cutthroat trout

Management cluster ¹	Absent ²	Depressed ²	Strong ²	Total	Percent
BR	3	55	4	62	2.35
FG	32	89	68	189	7.16
FH	55	145	40	240	9.09
FM	44	504	154	702	26.59
FW	83	120	277	480	18.18
NP	2	40	0	42	1.59
PA	153	47	0	200	7.58
PF	138	413	38	589	22.31
PR	36	21	1	58	2.2
TL	23	50	5	78	2.95
Total	569	1484	587	2640	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.14. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Yellowstone cutthroat trout

Management cluster ¹	Absent ²	Depressed ²	Strong ²	Total	Percent
BR	28	2	0	30	4.9
FG	4	44	55	103	16.83
FH	25	20	42	87	14.22
FM	7	4	3	14	2.29
FW	0	8	39	47	7.68
NP	1	1	22	24	3.92
PA	75	45	19	139	22.71
PF	10	35	25	70	11.44
PR	61	12	4	77	12.58
TL	19	2	0	21	3.43
Total	230	173	209	612	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.15. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Redband trout

Management cluster ¹	Absent ²	Depressed ²	Strong ²	Total	Percent
BR	724	284	36	1044	19.59
FG	87	137	126	350	6.57
FH	110	318	202	630	11.82
FM	131	219	13	363	6.81
FW	191	178	75	444	8.33
NP	0	8	0	8	0.15
PA	614	347	13	974	18.28
PF	207	212	245	664	12.46
PR	370	290	19	679	12.74
TL	60	27	86	173	3.25
Total	2494	2020	815	5329	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.16. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Steelhead trout

Management cluster ¹	Absent ²	Depressed ²	Migration ²	Strong ²	Total	Percent
BR	729	31	10	0	770	20.66
FG	122	155	1	5	283	7.59
FH	231	214	7	8	460	12.34
FM	78	166	20	1	265	7.11
FW	69	277	46	2	394	10.57
NP	0	0	0	0	0	0
PA	216	205	107	2	530	14.22
PF	238	188	18	2	446	11.97
PR	268	142	40	0	450	12.07
TL	66	53	7	3	129	3.46
Total	2017	1431	256	23	3727	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.17. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Stream-type chinook salmon

Management cluster ¹	Absent ²	Depressed ²	Migration ²	Strong ²	Total	Percent
BR	721	10	18	0	749	21.72
FG	168	91	10	1	270	7.83
FH	291	117	9	3	420	12.18
FM	130	111	19	0	260	7.54
FW	165	168	47	3	383	11.11
NP	0	0	0	0	0	0
PA	332	45	105	0	482	13.98
PF	301	79	23	1	404	11.72
PR	316	28	49	0	393	11.40
TL	67	19	1	0	87	2.52
Total	2491	668	281	8	3448	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.18. Summary of current known and predicted status of seven salmonid species versus ownership and land management designation for each subwatershed. The data represent a summary of the current status databases by management cluster as defined in Lee and others (1996).

Ocean-type chinook salmon

Management cluster ¹	Absent ²	Depressed ²	Migration ²	Strong ²	Total	Percent
BR	21	0	0	0	21	3.87
FG	19	2	0	1	22	4.06
FH	36	4	0	0	40	7.38
FM	12	3	0	2	17	3.14
FW	19	8	0	0	27	4.98
NP	0	0	0	0	0	0
PA	89	21	43	5	158	29.15
PF	68	14	11	8	101	18.63
PR	72	15	9	5	101	18.63
TL	50	4	1	0	55	10.15
Total	386	71	64	21	542	100

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private agriculture; PF = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

²Known + predicted.

Table 3.19. Distribution of species status for the seven key salmonids by forest and range cluster. Estimates represent the percent of subwatersheds for that species and status associated with each cluster defined in the preliminary draft EISs.

Species Distributions by Cluster

Species Category	Forest Cluster						Range Cluster					
	1	2	3	4	5	6	1	2	3	4	5	6
Bull trout												
Present	15.8	29.3	16.1	20.3	9.2	4.5	3.0	18.2	31.1	4.2	16.4	2.1
Strong	45.2	33.0	8.5	7.8	3.3	0.4	0.4	33.0	20.7	1.1	17.0	3.3
Depressed	11.7	26.4	19.7	26.1	11.1	2.3	1.8	8.9	37.3	2.5	14.0	2.3
Westslope cutthroat trout												
Present	17.6	24.3	16.2	33.9	3.2	4.3	0.8	18.4	28.0	0.6	13.8	0
Strong	30.3	41.2	8.5	16.7	1.7	0.3	0	44.1	12.9	1.2	11.9	0
Depressed	12.8	15.5	17.2	44.0	4.0	6.2	1.3	5.7	33.9	0.5	12.9	0
Yellowstone cutthroat trout												
Present	30.3	9.4	0	2.3	6.0	20.9	0	11.5	12.4	0	24.8	51.4
Strong	61.7	12.0	0	0.0	0.0	14.4	0	23.4	19.6	0	41.1	15.8
Depressed	1.7	9.8	0	5.2	15.6	33.5	0	0.6	7.5	0	11.0	80.9
Redband trout												
Present	5.7	18.5	11.6	6.6	22.5	14.1	8.9	11.9	28.9	9.6	18.6	18.3
Strong	0.5	17.8	14.7	5.1	27.9	19.2	5.9	8.9	33.7	11.9	17.8	19.4
Depressed	8.3	14.6	9.8	6.3	24.0	10.2	11.2	8.0	25.6	10.5	18.9	19.1
Steelhead trout												
Strong	0	13.0	0	0	56.5	0	47.8	0	0	30.4	0	8.7
Depressed	13.1	33.1	21.4	1.7	20.8	0.6	10.7	21.9	28.7	7.8	19.0	5.7
Corridor	8.6	25.3	18.7	4.7	3.5	5.8	9.3	19.5	14.4	36.2	14.4	0
Stream-type chinook salmon												
Strong	0	0	0	0	100	0	12.5	0	50.0	0	0	37.5
Depressed	19.2	40.0	17.4	0.9	20.8	0.1	6.1	27.1	30.7	3.4	17.8	4.5
Corridor	10.6	29.8	19.1	6.0	6.4	2.1	9.9	20.6	13.8	25.2	22.0	2.8
Ocean-type chinook salmon												
Strong	0	36.0	20.0	0.0	28.0	0	36.0	36.0	16.0	8.0	4.0	0
Depressed	1.4	33.8	9.9	11.3	16.9	12.7	5.6	33.8	0	33.8	15.5	11.3
Corridor	0	0	24.6	15.4	0	9.2	0	0	20.0	64.6	15.4	0
Fringe Areas												
Bull trout	0	0	18.2	0	63.6	0	0	0	81.8	0	18.2	0
Westslope cutthroat trout	0	0	0	0	100	0	100	0	0	0	0	0
Redband trout	0	0	0	0	0	33.3	0	0	0	0	0	100
Ocean-type chinook salmon	0	48.0	20.0	0	24.0	0	0	44.0	0	28.0	4.0	24.0

Table 3.20. Forest and range management activities and distributions of seven key salmonids. Estimates represent the percentage of the species distribution for the specified status or category predicted to experience the activity per decade. Estimates are based on the allocation of activities by alternative in the preliminary draft EIS, and on the distribution and status of each species as defined in Lee and others (1996).

Species	Status	Alt.	Forest Activity				Range Activity	
			Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Bull trout								
	Strong	1	4.7	2.1	1.5	2.5	7.8	0.9
		2	2.6	1.8	3.6	2.5	10.6	0.9
		3	3.3	2.4	3.6	6.4	9.5	16.0
		4	3.3	3.6	4.9	9.3	10.6	28.7
		5	3.6	2.6	3.7	4.5	10.5	8.9
		6	2.8	3.3	3.9	7.0	11.8	21.1
		7	2.0	1.6	1.5	3.2	12.1	2.5
	Depressed	1	7.1	3.2	1.5	2.4	5.4	0.8
		2	3.8	2.6	2.9	2.4	9.2	0.8
		3	5.0	4.2	2.9	5.0	8.4	20.5
		4	5.0	5.5	4.6	8.3	9.2	25.4
		5	5.9	4.7	3.2	5.1	9.1	8.4
		6	3.6	5.0	3.8	7.1	10.2	11.7
		7	1.9	1.8	1.5	4.6	10.7	2.6
	Fringe	1	7.4	3.7	1.2	2.0	7.9	1.2
		2	2.4	3.1	1.7	2.0	14.7	1.2
		3	5.7	5.3	1.7	2.9	13.6	38.0
		4	5.7	5.7	3.3	7.6	14.7	38.0
		5	5.7	5.7	3.3	5.7	14.7	7.9
		6	2.0	5.3	3.3	7.6	16.0	7.9
		7	1.6	3.1	1.2	2.9	16.0	1.2
Westslope cutthroat trout								
	Strong	1	5.5	2.3	1.5	2.5	8.6	0.8
		2	3.0	2.0	3.5	2.5	10.3	0.8
		3	3.7	2.8	3.2	6.1	9.6	10.0
		4	3.7	4.2	5.2	9.1	10.3	26.7
		5	4.2	3.0	3.5	4.8	10.3	5.7
		6	3.2	4.0	3.9	7.0	11.1	21.9
		7	2.0	1.5	1.5	3.6	11.2	1.3
	Depressed	1	7.4	3.4	1.5	2.5	4.4	0.7
		2	4.4	2.9	2.6	2.5	7.7	0.7
		3	5.4	5.0	2.6	4.5	6.9	17.9
		4	5.4	5.9	4.3	7.9	7.7	20.6
		5	7.0	5.3	2.7	4.4	7.6	6.1
		6	4.5	5.5	3.8	7.1	8.6	8.1
		7	2.0	1.6	1.5	5.5	8.7	0.8

Table 3.20 (continued)

Species	Status	Alt.	Forest Activity				Range Activity	
			Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Yellowstone cutthroat trout	Fringe	1	9.0	4.5	1.5	2.5	3.0	1.2
		2	2.0	4.5	1.5	2.5	9.0	1.2
		3	7.0	7.0	1.5	2.5	9.0	1.2
		4	7.0	7.0	4.0	10.0	9.0	38.0
		5	7.0	7.0	4.0	7.0	3.0	38.0
		6	2.5	7.0	4.0	10.0	9.0	38.0
		7	2.0	4.5	1.5	2.5	16.0	1.2
	Strong	1	2.8	1.3	1.3	2.2	7.2	1.2
		2	1.8	1.3	3.2	2.2	12.0	1.2
		3	2.2	2.1	3.2	5.5	9.5	29.4
		4	2.2	2.5	3.5	8.4	12.0	38.0
		5	2.8	1.8	3.2	3.4	12.0	22.2
		6	2.2	2.5	3.2	6.2	14.9	30.8
		7	1.8	1.3	1.3	2.8	16.0	7.0
Redband trout	Depressed	1	3.7	1.3	0.8	1.4	2.9	1.0
		2	1.3	1.3	1.1	1.4	7.9	1.0
		3	2.1	3.3	1.1	1.8	7.4	31.3
		4	2.1	3.5	1.7	4.5	7.9	31.5
		5	3.5	2.6	1.4	3.6	7.9	29.0
		6	1.6	3.5	1.5	4.2	8.6	29.2
		7	1.1	1.2	0.8	2.8	13.2	25.6
	Strong	1	6.5	2.7	1.3	2.1	6.1	1.2
		2	2.5	2.3	2.1	2.1	11.8	1.2
		3	4.3	4.6	2.1	3.6	10.7	27.2
		4	4.3	5.5	3.5	7.4	11.8	37.1
		5	5.3	4.5	2.8	5.7	11.4	21.4
		6	2.4	5.1	2.9	6.8	13.0	24.7
		7	1.7	2.1	1.3	3.9	15.6	12.7
	Depressed	1	5.3	2.3	1.1	1.8	5.4	1.1
		2	2.1	2.0	1.9	1.8	10.8	1.1
		3	3.6	3.6	1.9	3.3	9.6	24.5
		4	3.6	4.3	3.1	6.5	10.8	35.5
		5	4.3	3.6	2.5	4.5	10.1	23.1
		6	2.1	4.1	2.7	5.9	12.1	26.1
		7	1.5	1.8	1.1	3.0	14.9	12.0
	Fringe	1	2.0	0.5	0.5	0.8	3.0	1.2
		2	0.7	0.5	0.5	0.8	9.0	1.2
		3	0.8	2.3	0.5	0.8	9.0	38.0
		4	0.8	2.3	0.5	2.3	9.0	38.0
		5	2.3	1.5	0.5	2.3	9.0	38.0
		6	0.8	2.3	0.5	2.3	9.0	38.0
		7	0.7	0.5	0.5	2.3	16.0	38.0

Table 3.20 (continued)

Species	Status	Alt.	Forest Activity				Range Activity	
			Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Steelhead trout								
	Strong							
		1	5.9	2.7	1.0	1.7	2.6	1.0
		2	1.4	2.7	1.4	1.7	7.8	1.0
		3	4.3	4.2	1.4	2.3	7.8	4.2
		4	4.3	4.5	3.2	7.0	7.8	33.0
		5	4.3	4.2	2.8	4.9	5.0	33.0
		6	1.7	4.5	2.8	6.6	7.8	33.0
		7	1.4	2.7	1.0	1.7	13.9	15.4
	Depressed							
		1	6.2	2.7	1.4	2.3	7.4	1.1
		2	2.7	2.0	3.0	2.3	12.0	1.1
		3	4.2	3.3	3.0	5.3	10.8	20.7
		4	4.2	4.8	4.6	8.3	12.0	35.6
		5	4.3	3.8	3.6	5.7	11.3	17.0
		6	2.3	4.3	3.6	7.0	13.3	25.1
		7	1.8	2.0	1.4	3.3	15.0	6.1
	Corridor							
		1	4.5	1.8	1.0	1.7	6.2	1.1
		2	2.3	1.2	2.3	1.7	10.8	1.1
		3	2.9	2.3	0.0	0.0	9.9	11.7
		4	2.9	3.6	3.3	5.8	0.0	35.6
		5	3.3	2.6	2.4	4.1	10.2	23.2
		6	1.9	3.1	2.5	4.8	11.8	30.3
		7	1.3	0.0	1.0	3.0	15.0	14.4
Stream-type chinook salmon								
	Strong							
		1	9.0	4.5	1.5	2.5	6.0	1.2
		2	2.0	4.5	1.5	2.5	12.5	1.2
		3	7.0	7.0	1.5	2.5	12.5	33.4
		4	7.0	7.0	4.0	10.0	12.5	38.0
		5	7.0	7.0	4.0	7.0	11.8	19.6
		6	2.5	7.0	4.0	10.0	12.5	19.6
		7	2.0	4.5	1.5	2.5	16.0	15.0
	Depressed							
		1	6.3	2.6	1.5	2.5	8.1	1.1
		2	2.7	2.1	3.4	2.5	12.1	1.1
		3	4.2	3.2	3.4	5.9	11.0	20.6
		4	4.2	4.8	5.1	9.3	12.1	34.1
		5	4.3	3.6	3.9	6.0	11.7	12.8
		6	2.5	4.4	3.9	7.5	13.4	22.8
		7	2.0	2.1	1.5	3.3	14.3	4.0
	Corridor							
		1	5.0	2.1	1.1	1.9	6.3	1.1
		2	2.5	1.5	2.6	1.9	10.9	1.1
		3	3.3	2.5	2.9	5.1	9.6	15.4
		4	3.3	3.9	3.8	6.6	12.4	35.8
		5	3.5	2.9	2.8	4.4	10.3	23.2
		6	2.1	3.4	2.9	5.4	12.4	30.8
		7	1.5	2.1	1.1	3.1	15.1	11.4

Table 3.20 (continued)

Species	Status	Alt.	Forest Activity				Range Activity	
			Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Ocean-type chinook salmon								
	Strong	1	6.5	2.7	1.3	2.1	8.6	1.2
		2	2.5	2.1	2.7	2.1	12.6	1.2
		3	4.3	3.4	2.7	4.6	12.4	8.6
		4	4.3	5.0	4.4	7.8	12.6	38.0
		5	4.3	3.9	3.4	5.9	10.5	18.9
		6	2.1	4.5	3.4	6.7	12.9	32.1
		7	1.7	2.1	1.3	3.0	16.0	4.1
	Depressed	1	6.2	2.4	1.3	2.1	7.4	1.2
		2	2.6	2.1	2.4	2.1	11.4	1.2
		3	3.9	3.8	2.4	4.2	10.4	11.0
		4	3.9	5.1	4.1	7.6	11.4	38.0
		5	4.8	3.8	2.8	5.4	11.0	25.6
		6	2.7	4.8	3.1	6.5	12.5	38.0
		7	1.7	1.8	1.3	3.7	16.0	17.8
	Corridor	1	3.8	1.8	0.7	1.1	3.8	1.1
		2	2.4	1.1	1.2	1.1	9.5	1.1
		3	2.8	2.6	1.2	2.1	8.7	13.0
		4	2.8	3.2	1.6	3.2	9.5	34.8
		5	3.6	2.9	1.2	2.5	9.5	28.1
		6	1.8	2.6	1.6	3.2	10.5	28.1
		7	0.9	0.7	0.7	3.2	14.6	22.9
	Fringe	1	6.8	2.7	1.4	2.3	8.7	1.2
		2	2.6	2.1	3.1	2.3	12.1	1.2
		3	4.3	3.3	3.1	5.4	11.8	11.5
		4	4.3	5.2	5.1	8.6	12.1	38.0
		5	4.3	3.8	3.7	6.4	12.1	21.8
		6	2.3	4.7	3.7	7.2	12.4	38.0
		7	1.8	2.1	1.4	3.2	16.0	20.3

We assumed that risks were greatest and benefits least if activities were not clearly tied to the implementation of watershed/ecosystem analysis. Watershed and riparian restoration activities are more likely to be efficiently and effectively focused if they are associated with a broad-scale analysis and are not merely mitigation tacked onto site- and project-specific activities. We also assumed risks were greater if the associated riparian conservation strategy was inadequate as considered in the first step of this analysis.

We recognize the potential benefits of prescribed fire in restoring the structure and function of terrestrial ecosystems, but were not able to evaluate species benefits in our analyses. We generally assumed the effects of prescribed fire activities to be benign.

In our discussion of alternatives, we considered the magnitude of an activity relative to the range of activities projected across a species distribution and among alternatives. For example, combined

timber and thinning activities were considered low when less than 5 percent of the species/status distribution was potentially influenced per decade, and high when 10 percent or more was affected. The allocation of activities in sensitive areas was also considered. For example, high levels of timber harvest and low levels of restoration in the fringe distribution of species (largely represented by depressed and highly-fragmented populations) were viewed negatively.

Framework for Judging Alternatives

We used a series of eleven questions to explore the potential effect of each alternative on focal fish species (table 3.21). Questions 1 to 5 were addressed on a species-by-species basis. For Ques-

tions 6 to 11, however, the evaluation team decided that the answers applied to all species. We used the discussion generated by each question to formulate the findings discussed in the next section, but did not attempt to systematically craft an answer to each question for each species that reflected the range of opinions expressed in the discussion.

Findings by Species

We begin each of the following sections with a brief overview of the current status of each salmonid species, as described by Lee and others (in press). We then provide a synoptic report on the expected effect of each alternative, followed by a brief comparative summary of all the alternatives.

Table 3.21. General questions used to guide the discussion of possible effects from each of the seven proposed alternatives on widely-distributed salmonids.

Does the alternative:

- (1) Conserve core areas of (relatively) high population density within the species' range?
 - (2) Identify at-risk areas and use those areas to prioritize restoration and management prescriptions?
 - (3) Decrease fragmentation of aquatic habitats and maintain/restore corridors as critical components of connectivity among populations?
 - (4) Maintain, protect, and/or restore proper functioning conditions of riparian habitats within the range of this species?
 - (5) Address other specific threats to this species?
 - (6) Emphasize the uncertainty of restoration treatments and provide a framework for adaptive management as better information is available to judge treatment results?
 - (7) Attempt to minimize the effects of introduced species?
 - (8) Adequately protect aquatic habitats within the range of this species from increased sedimentation associated with land-use activities?
 - (9) Maintain, protect, and/or restore water quality within the range of this species?
 - (10) Maintain, protect, and/or restore water quantity within the range of this species?
 - (11) Address the importance of non-Federal lands to conservation and restoration strategies?
-

Bull trout (*Salvelinus confluentus*)

Bull trout currently occur in approximately 45 percent of the subwatersheds comprising the potential historical range. Although they are distributed broadly throughout the potential range and the assessment area, the current distribution is patchy. Bull trout are classified as strong in 6 percent of the potential range. Approximately 50 percent of those strong populations are contained within or associated with wilderness areas. Many remaining populations are believed to be fragmented and relatively isolated, either through the loss of migration corridors or the disruption of suitable habitat networks (Lee and others, in press). These populations may be at risk even with no further habitat loss. Because approximately 93 percent of the strong subwatersheds and 76 percent of the depressed-status subwatersheds are on Federal land (table 3.12), and because bull trout appear to be particularly sensitive to land-use effects (Lee and others, in press), future management of FS- and BLM-administered lands will play a major role in the trends and distribution of bull trout within the assessment area.

Alternative 1—Under Alternative 1, we expect bull trout populations to decline throughout much of their current range. The strong populations associated with wilderness areas may be influenced relatively little, but the remaining distributions will be subject to moderate and high levels of timber harvest and thinning activities (table 3.20), and new road construction. The number of subwatersheds with low-road densities or no roads that support spawning and rearing are projected to decline, while the number of subwatersheds with high road densities should increase (table 3.11). Results of the classification tree analysis suggest a decline in the frequency of both strong and depressed populations (tables 3.3 and 3.4). Without adequate protection of riparian function (described in “Step 1” section of this chapter) and with relatively limited watershed restoration (table 3.20), we have little reason to believe that these negative trends will be mitigated. Declines in the status and distribution of bull trout should be most pronounced within areas

which emphasize commodity production; these areas include portions of the Blue Mountains, the Southern Cascades, and the Upper Klamath reporting units of the EEIS planning area, and the Northern Glaciated Mountains, Lower Clark Fork and Upper Clark Fork units in the UCRB planning area. Continued declines in the fringe distributions are anticipated because activities in that area are expected to be as high or higher than in other portions of the range, and because these parts of the range are not represented by any strong populations. The loss of the fringe populations could represent a disproportionate loss of genetic variability for this species. Bull trout are most likely to persist within the Central Idaho Mountains, the South Fork Flathead subbasin with a conservation emphasis, and in wilderness areas in the Northern Cascades.

Alternative 2—Bull trout are provided increased protection under the Inland Native Fish Strategy (INFISH) (1995), the implementation of ecosystem analysis, and relatively low or moderate levels of timber harvest and thinning activity (table 3.20) under Alternative 2. Much of the high quality habitat associated with strong populations in priority watersheds should be protected by the standards that apply therein. Increased watershed restoration should also reduce the risk to some strong populations. The projected distribution of road densities associated with bull trout habitats (table 3.11), however, suggests little increase in the frequency of subwatersheds with no roads or very low road densities. The models also predict a minor decline in occurrence of strong, or of strong and depressed populations (tables 3.3 and 3.5). More limited watershed restoration, a relative lack of riparian restoration activity in the fringe portion of the existing range (table 3.20), and a production-conservation emphasis in the rangelands associated with the fringe distribution suggest potential decline of these populations. With the emphasis on bull trout in the INFISH conservation strategy, we expect bull trout to persist throughout much of the current distribution of strong populations. We do not anticipate extensive rebuilding of habitat networks, however.

Because of the existing fragmentation and isolation of some populations, particularly those outside central Idaho and in the fringe distributions, some populations may face elevated risk of extinction through natural disturbance events, even without further habitat loss.

Alternative 3—Under Alternative 3, much of the current distribution of strong populations of bull trout will likely be conserved. It is unclear whether significant rebuilding of the population will occur, however, and we are concerned that the fringe distribution will be further eroded. Road-density reductions are projected across the bull trout distributions (table 3.11), and model predictions suggest an increasing trend in the occurrence of strong subwatersheds (tables 3.3 and 3.6). Because of the emphasis on ecosystem analysis in Category 1 (see footnote 4 for definition) and strong subwatersheds, and a moderate level of watershed restoration in the strong distribution, we anticipate that the core of the bull trout distribution associated with the Central Idaho Mountains and eastern fringe of the Northern Glaciated Mountains in the UCRB area, and the Northern Cascades and Blue Mountains of the EEIS area will be conserved if not strengthened. Model projections, however, suggest a decline in the complete distribution (strong and depressed) that implies further declines in some portions of the range (tables 3.3 and 3.6). Because ecosystem analysis will not be required in depressed subwatersheds outside of Category 1 subbasins or priority areas, a general decline rather than rebuilding of habitat networks outside these core areas may occur. The risks could be exaggerated in the fringe distribution areas because of relatively high timber and thinning activity, and little watershed restoration (table 3.20). Relatively intensive riparian restoration activities could provide some benefits for bull trout populations in the rangeland portions of the fringe distributions. However, benefits are more likely in corridors than in spawning and rearing habitats. Because critical spawning and initial rearing habitats for bull trout tend to be limited to higher-elevation portions of the occupied watershed, particularly on the south-

ern limits of the range associated with the fringe, activities on the forestlands are likely to be far more important compared to rangelands.

Alternative 4—The core distributions of bull trout associated with Category 1 watersheds will likely be conserved and perhaps strengthened under this alternative. Some rebuilding in more fragmented or depressed portions of the range is likely, but large improvements are not expected. The active restoration associated with this objective provides a relatively high level of watershed restoration and road-density reduction. Road-density projections show positive trends associated with both the strong and complete distribution of bull trout populations (table 3.11). Model predictions also suggest a relatively strong positive trend in the occurrence of strong subwatersheds (tables 3.3 and 3.7). Although timber and thinning activities are relatively high in the subbasins supporting strong populations, watershed restoration is also increased (table 3.20). Because of the emphasis on ecosystem analysis in Category 1 and stronghold watersheds, there should be an opportunity to prioritize forest and watershed restoration efforts in areas representing the least risk and greatest benefit for important bull trout populations. Projected and anticipated trends on the fringe and less prominent portions of the bull trout distributions are less encouraging. Model predictions suggest a moderate decline in the occurrence of the complete distribution of spawning and rearing subwatersheds (strong and depressed) (tables 3.3 and 3.7). Timber harvest and thinning activities are also anticipated to be higher in the depressed and fringe portions of the distribution than in the strong subwatersheds (table 3.20). Although watershed restoration activity is still projected to be relatively high in these latter subbasins, the lack of ecosystem analysis outside the Category 1 subbasins or strong subwatersheds suggests that prioritization of activities may not effectively mitigate the inherent risks associated with increased forest restoration and timber harvest activity.

Alternative 5—Under Alternative 5, we anticipate declines in the distribution and status of bull trout populations in major portions of both the

EEIS and UCRB areas. The core of the bull trout distributions associated with the Category 1 and aquatics-emphasis watersheds should fare well under this alternative. A substantial amount of wilderness, the emphasis on ecosystem analysis, and restoration focused to benefit strong populations (see Alternative 4), will likely sustain and perhaps expand the distribution of bull trout within these select subbasins (Category 1, and Forest Clusters 1 and 2). The emphasis on commodity production and the lack of ecosystem analysis in major portions of the species range, however, suggest that other populations will not do well. Although activity projections imply moderate or high levels of watershed restoration under this alternative (table 3.20), we anticipate inadequate protection or restoration of riparian function and aquatic ecological processes where riparian protection standards are relaxed (see “Step 1” section of this chapter). The model predictions of a general decline in the occurrence of both the strong and combined distributions (tables 3.3 and 3.8) are not likely to be mitigated in areas with increased activity and road construction. We anticipate a definite decline in the distributions in the northern Idaho and western Montana portions of the UCRB area and in the Blue Mountains and Upper Klamath regions of the EEIS area. The Upper Klamath represents a major portion of the fringe distribution of this species; losses here could mean a disproportionate loss of genetic variability for bull trout.

Alternative 6—Alternative 6 would probably conserve and perhaps strengthen the core of the bull trout distribution in strong populations. Decreasing trends in road density are predicted within the strong and depressed subwatersheds (table 3.11). The models also predict a relatively strong positive trend in the occurrence of strong populations (tables 3.3 and 3.9). Projected timber and thinning activities within the strong distributions are moderate, but an emphasis on watershed restoration is retained (table 3.20). The emphasis on ecosystem analysis within Category 1 and strong population areas and the additional emphasis on monitoring and adaptive management implied by this alternative also suggest a substan-

tial opportunity to focus management activities in a manner that represents the least possible risk for many of these populations. We are unsure about the likely trends in bull trout populations in the remaining portions of the distribution. Subwatersheds supporting depressed populations of bull trout outside the Category 1 subbasins will not necessarily receive the consideration afforded by ecosystem analysis. Although some erosion of the current distribution of depressed and fringe populations might occur, lower levels of timber harvest and thinning activity and the moderate emphasis on watershed restoration in both the depressed and fringe distributions might allow successful restoration of some subwatersheds (table 3.20). Road density projections suggest substantial road reductions may occur in some of the depressed subwatersheds (table 3.11), while model projections suggest essentially no change in the combined distributions (tables 3.3 and 3.9).

Alternative 7—Alternative 7 provides a substantial opportunity for conservation and restoration of bull trout status and distributions throughout the EEIS and UCRB planning areas. Decreasing trends in road density are predicted within both the strong and depressed subwatersheds (table 3.11). Although watershed restoration activities are low, timber harvest and thinning activities are also low (table 3.20). Model predictions represent the strongest positive trends observed across any of the alternatives for both the strong and combined distributions (tables 3.3 and 3.10). Important caveats to these apparent positive responses include the risks represented by the lack of both forest and watershed restoration under this alternative. The legacy of historical management activities may place systems without active restoration at risk. These risks are likely to be most important in the more fragmented portions of the range where bull trout persist, and in relatively small and isolated remnants of the historical habitat network that will not be included in reserves. This would be a particularly relevant concern for the fringe portions of this species’ range. We anticipate that the projected response in the core of the species distribution associated with strong subwatersheds would not be substan-

tially slowed by these problems. It is unclear whether these risks are enough to negate the apparent positive trend in the more depressed portions of the range.

Summary—Bull trout populations appear to be depressed throughout most of their current distribution. Despite the relatively poor condition, they retain a wide distribution. An important part of the remaining strong distribution is found within wilderness areas around the Basin and will likely persist under most alternatives. The largest, most secure portion of the distribution is found in the Central Idaho Mountains. Alternatives 2, 3, 4, 6, and 7 would likely conserve the cores of the bull trout distribution while Alternatives 1 and 5 would not (table 3.22). None of the alternatives provide for extensive rebuilding in the more depressed parts of the range. Alternatives 3, 4, 6, and 7 provides some potential for active restoration that could benefit depressed bull trout populations, but it is not clear that the analysis and planning necessary to effectively and efficiently prioritize those efforts will exist. None of the alternatives provides strong protection or emphasis for restoration of what may be a particularly important fringe distribution. Furthermore, none of the alternatives provides strong guidance or an opportunity for securing or restoring migratory corridors that exist outside of Federal lands, which may seriously isolate some populations.

Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)

Westslope cutthroat trout are broadly distributed in the northern portion of the UCRB planning area, but are restricted to the Northern Cascades and a small portion of the Blue Mountains in the EEIS planning area. The latter area represents a relatively isolated group that is considered in the fringe of the distribution. This subspecies of cutthroat trout remains one of the most widely distributed salmonids in the assessment area; it is still found in approximately 85 percent of the potential historical range. Although they persist widely, most populations have declined in status. Strong populations are believed to exist in about 22 per-

cent of the potential historical range, 40 percent of which is associated with wilderness. Introgression and competition with introduced salmonids, fishing, and habitat disruption are believed to be important factors contributing to the depressed condition of most populations. Road density and land management classification were useful variables in classification and prediction of westslope cutthroat trout distributions (Lee and others, in press). The broad distribution of westslope cutthroat trout within the historical range and the persistence of populations in some heavily managed watersheds demonstrate that local extinctions have not been widespread. Although populations may persist in the face of extensive, human-caused disturbance, many exist only in low numbers or as restricted, resident populations that reflect little of the diversity and production of historical populations. Because approximately 70 percent of the current distribution and 93 percent of the remaining strong distribution are found on FS- and BLM-administered lands (table 3.13), forest and rangeland management is likely to play an important role in the future distribution and status of this subspecies.

Alternative 1—Westslope cutthroat trout will likely persist throughout much of their current distribution under this alternative, but a continued decline in status throughout a major part of that distribution is anticipated. Some of the more restricted populations may disappear. High levels of timber harvest and thinning activities are projected throughout a major portion of the species range, with little emphasis on watershed or riparian restoration (table 3.20). Road densities are expected to increase across the species' range (table 3.11). The models predict a relatively strong declining trend in the occurrence of strong populations, and a lesser negative trend in the complete distribution (tables 3.3 and 3.4). Current Forest plans are likely to provide a variable level of protection for these populations. The general emphasis on timber production throughout much of the range, a lack of mid-scale analysis to focus activities and minimize risks in particularly important or sensitive populations, and the general lack of a consistent riparian protection strategy suggest that

the projected declines are unlikely to be mitigated (see “Step 1” section of this chapter). Because an important core of the remaining strong westslope cutthroat trout populations is associated with wilderness areas in the UCRB and to a lesser extent in the North Cascades portion of the EEIS planning areas, some strong populations will persist across the analysis area. Because westslope cutthroat trout tend to persist even in some heavily managed areas, they are likely to persist throughout much of their current distribution. More populations, however, may be limited to remnant status dominated primarily by resident forms, low densities, and potentially high levels of genetic introgression. A decline in status seems most likely in the timber-emphasis areas of the UCRB area, predominantly in northern Idaho and Montana. The fringe distribution in the Blue Mountains of the EEIS area may also be particularly vulnerable. Because relatively few productive subwatersheds remain in this area, further losses could represent an important loss of genetic variability for the subspecies.

Alternative 2—The INFISH strategy, focused in priority watersheds and low and moderate land-disturbing activities, could protect much of the core of the westslope cutthroat trout distribution under this alternative. We do not anticipate important rebuilding, but distributions and status should not decline dramatically outside of the species fringe in the EEIS planning area. In general, we anticipate that strong populations associated with wilderness and a conservation emphasis in the Central Idaho Mountains and northeastern Montana of the UCRB area, and in the North Cascades of the EEIS area will maintain their current condition. Increased activity, including both commodity production and increased efforts for restoration, may produce mixed results for the remaining populations scattered throughout much of northern Idaho and Montana in the UCRB. Road-density projections suggest little change in the overall distributions associated with strong subwatersheds outside of wilderness (table 3.11), but the models predict a moderate, declining trend in the frequency of occurrence for these same areas (tables 3.3 and 3.5). An emphasis on

riparian protection associated with INFISH standards could mitigate this trend in priority watersheds. Because westslope cutthroat seem to persist even with moderate levels of disturbance, a significant opportunity for restoration of strong populations exists throughout much of the range. The moderate level of restoration associated with the distribution of strong subwatersheds (table 3.20) could work to secure watersheds that are at risk and might rebuild adjacent depressed systems. We are less optimistic that important restoration will occur in depressed portions of the range that are not associated with strong populations or priority subbasins. Relatively little watershed restoration activity is projected in association with the depressed or fringe distributions for this subspecies (table 3.20), and INFISH riparian protection standards would not result in rapid recovery of watershed conditions where disturbances have been extensive. Although a rapid loss of populations is not anticipated in the depressed and fringe portions of the range, any erosion of the fringe could be an important loss of genetic variability for the subspecies.

Alternative 3—Alternative 3 should conserve and perhaps slightly expand the distribution of subwatersheds supporting strong populations of westslope cutthroat trout. We do not anticipate strong rebuilding in the more fragmented and depressed portions of the subspecies range, although road-density projections show overall decreasing trends in both the strong and depressed distributions (table 3.11). Model predictions also suggest a positive trend in the frequency of strong populations (tables 3.3 and 3.6). Although timber harvest and thinning activities are moderate in the subbasins supporting strong subwatersheds, moderate watershed and riparian restoration (table 3.20) could secure some at-risk systems. Ecosystem analysis in Category 1 and all strong subwatersheds, and INFISH riparian standards, should protect sensitive watersheds. Those analyses should also provide an opportunity to prioritize timber harvest and restoration activities in a manner that secures or expands distributions by focusing activities in areas with the least risk and greatest potential gain through restoration.

Table 3.2.2. Projected effects of the seven proposed alternatives on bull trout.

Will the Alternative:	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Conserve strong populations in the central or core portions of the species' range?	No	Yes	Yes	Yes	No	Yes	Yes
2. Prevent declines in habitats or populations throughout the entire species' range? — if "no", where are declines most likely to occur (on FS/BLM lands)?	No	No	No	Uncertain	No	Uncertain	Uncertain
3. Help rebuild depressed populations by restoring habitats? — if "yes", where?	Outside wilderness and other protected areas	Forest Clusters 3 and 4, and fringe in rangeland	Mixed results across species' range	Category 2 and 3	Category 2 and 3; commodity-commodity-emphasis areas	Forest Cluster 4 and Flint Rock	Isolated remnants
What is the role of factors other than habitat?	No	Yes	Yes	Yes	Yes	Yes	Yes
		INFISH' Priority watersheds	Forest Clusters 2, 4, and 5	Mixed results across species' range	Category 1; Forest Cluster 1 and 2	Mixed results across species' range	
	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats. Highly-fragmented and isolated populations may risk extirpations even with no further habitat loss.						

¹(INFISH) Inland Native Fish Strategy. 1995. Environmental Assessment: Decision Notice and Finding of No Significant Impact. Interim Strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana, and portions of Nevada. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Northwest Regions. [irregular pagination].

We anticipate that any gains will be most prominent in the areas associated with the conservation and restoration emphasis in the Central Idaho Mountains and northeastern Montana within the UCRB planning area. We are less optimistic that positive changes in status will occur in the depressed subwatersheds for westslope cutthroat trout outside of the Category 1 subbasins. A positive trend in road densities (table 3.11) and a small but a positive trend in model predictions for the entire distribution suggests that there will not be extensive erosion of the current distribution. Increased timber harvest and thinning activity without a comparable increase in watershed restoration, however, suggests that large net gains are unlikely. For depressed populations, INFISH standards should provide protection but are unlikely to lead to rapid recovery in watershed and habitat conditions. No gain and some erosion of depressed populations can be anticipated in the fringe distribution associated with the Blue Mountains in the EEIS area because of relatively high levels of timber harvest and thinning, and low levels of watershed restoration (table 3.20).

Alternative 4—Alternative 4 proposes increased active management. This suggests both risks and important opportunities for management that will influence the distribution of westslope cutthroat trout. We anticipate that the core distributions of strong populations will be conserved and potentially strengthened. Moderate levels of timber harvest but also some of the highest allocations of watershed restoration are projected for the currently strong subwatersheds (table 3.20). The relative magnitude of watershed restoration coupled with implied protection in ecosystem analysis suggests an opportunity to secure important, but potentially at-risk systems. Decreasing trends in road densities (table 3.11) and model predictions for the occurrence of strong subwatersheds (tables 3.3 and 3.7) in Forest Clusters 2, 3, and 4 add support. The requirement for ecosystem analysis in Category 1 and strong subwatersheds provides a mechanism to prioritize restoration and to focus timber harvest and thinning activities where they

pose the least risk. Ecosystem analysis and extensive restoration might also allow an extension of some strong populations by focusing work in systems with the greatest potential to respond. Conservation and strengthening of the depressed distribution outside Category 1 subbasins may be less likely. Although moderate levels of watershed and riparian restoration are expected in subbasins supporting depressed and fringe populations, high levels of timber harvest and thinning activity are also predicted for these systems (table 3.20). The riparian protection measures associated with this alternative should conserve much of the distribution, but restoration of depressed populations will be less likely without the planning and prioritization of activities implied by ecosystem analysis. Because that analysis is not required outside the Category 1 and strong systems, it is not likely to occur throughout the depressed or fringe distribution of this subspecies. Implementation will produce varied results in restoration that we cannot anticipate. The potential for important gains is present, but we are uncertain whether they will be realized. A failure to secure or strengthen the limited fringe distribution within the EEIS area could result in an important loss of genetic variability for this subspecies.

Alternative 5—Under Alternative 5, we anticipate both positive and negative effects on the distribution and status of westslope cutthroat trout across the assessment area. Many of the strong subwatersheds for westslope cutthroat trout are associated with Category 1 subbasins outside of the areas proposed for timber or livestock emphasis in this alternative. Where ecosystem analysis is required, it should produce results similar to Alternative 4. In that respect, we expect Alternative 5 to conserve and perhaps strengthen portions of the core of the range. In contrast, important areas that support both strong and depressed westslope cutthroat are found in the proposed timber and livestock emphasis subbasins, where declines in status are expected. High levels of timber harvest and thinning throughout much of northern Idaho and western Montana increase the risk to the remaining strong popula-

tions in that region. Although moderate levels of watershed restoration activities are implied, we anticipate that they will be less effective than the ecosystem analysis and more conservative riparian protection measures proposed under other alternatives and conservation emphasis areas (see “Step 1” section of this chapter). The predicted loss of strong subwatersheds is likely to be focused in this region and may not be mitigated through the less conservative protection measures. We expect little restoration of the already depressed populations for much of the range. The road projections do not show decreasing trends (table 3.11) and the model projections for the complete distribution suggest no change (tables 3.3 and 3.8). High levels of timber harvest and thinning activities are not compensated by similar increases in watershed restoration in either the depressed or fringe distributions (table 3.20). Because much of the depressed and all of the fringe distributions are associated with a timber and range management emphasis and less conservative riparian protection, we do not expect any substantial improvement in habitat conditions. Some erosion of the current distribution might occur without active watershed restoration, especially in some of the more seriously restricted populations.

Alternative 6—As in several of the preceding alternatives, we expect cores of strong subwatersheds for westslope cutthroat trout to be conserved and potentially strengthened under this alternative. Road density projections show positive trends in the strong subwatersheds (table 3.11) and model projections suggest a moderate increasing trend as well (tables 3.3 and 3.9). The projection of moderate timber and thinning activities and moderate levels of watershed restoration suggest an opportunity to focus work to secure at-risk systems and perhaps rebuild those with important potential. The requirement for ecosystem analysis throughout the Category 1 and all strong subwatersheds and the additional emphasis on adaptive management implied in this alternative provide a mechanism that should encourage progress. We remain uncertain about the trends for depressed populations outside the Category 1 sub-

basins. Subwatersheds that do not support strong populations may not have the benefit of ecosystem analysis. A moderate allocation of watershed restoration associated with the distribution of depressed populations provides an important opportunity for restoration of some populations. Positive changes in road densities (table 3.11) and predictions of modest but increasing trends in the complete distribution (tables 3.3 and 3.9) also suggest restoration of some populations. An effective and efficient prioritization of restoration activities may not occur, however, without the commitment to ecosystem analysis. This alternative also appears to provide the best opportunity for restoration of the depressed populations associated with the fringe of the range. Limited timber harvest activities and a strong emphasis on watershed and riparian restoration associated with these subwatersheds (table 3.20) provides a unique opportunity to protect these important fringe populations.

Alternative 7—Our analyses support positive trends in the distribution and status for westslope cutthroat trout under Alternative 7. There are strong positive trends projected in road densities (table 3.11) and similarly optimistic predictions in the occurrence of strong populations from the models (tables 3.3 and 3.10). These patterns, together with relatively low levels of land disturbing activities in strong subwatersheds, suggest that the core of strong populations throughout the assessment area should be conserved and strengthened under this alternative. These patterns suggest benefits for depressed populations as well, but the lack of active watershed restoration makes us less certain about those gains. Much of the depressed distribution for westslope cutthroat trout is associated with moderately and heavily roaded watersheds (table 3.11). Although strict riparian protection standards should minimize further degradation in these systems, many watersheds may not recover without active road obliteration or other efforts to restore the watershed, hydrologic, and riparian processes needed to create and maintain complex and productive habitats.

Summary—Westslope cutthroat trout are likely to persist throughout most of their current distribution under any of the alternatives. The distribution and status of healthy populations, however, could be strongly influenced by the management associated with the range of alternatives. We would anticipate further decline in the status of the species under Alternative 1. Although Alternative 5 would likely conserve much of the core of strong populations in the current range, we would expect declines of healthy populations in the UCRB area under this alternative. Alternatives 2, 3, 4, 6 and 7 all appear likely to conserve most of the strong populations across the assessment area (table 3.23). Alternatives 3, 4, 6, and 7 may offer some potential for strengthening those cores through expanded watershed restoration and the prioritization of restoration and conservation activities through ecosystem analysis and/or the reduction of land-disturbing activities. We do not anticipate restoration of many currently depressed populations under Alternatives 2 and 3. Increased emphasis on active restoration under Alternatives 4 and 6 provides an opportunity for some progress toward restoring depressed populations. A lack of commitment to the analysis necessary to effectively focus and prioritize conservation and restoration efforts, however, may limit that potential. None of the alternatives assure conservation and restoration of the depressed populations associated with the fringe of the subspecies range in the EEIS planning area.

Yellowstone cutthroat trout **(*Oncorhynchus clarki bouvieri*)**

Yellowstone cutthroat trout have the narrowest distribution of any of the key salmonids, having formerly occupied about 8 percent of the Basin. Their range is restricted to the UCRB planning area in the Snake River drainage upstream from Shoshone Falls, Idaho. Yellowstone cutthroat trout currently persist in about 66 percent of the potential historical range. Despite their narrow distribution, the species was judged to support the largest

proportion of strong populations of any key salmonid. Within the potential historical range, 32 percent of the populations were listed as strong. Introgression with introduced rainbow trout and cutthroat trout poses serious threats, however, and may weaken some populations identified as strong.

Management of FS- and BLM-administered lands is key to the survival of Yellowstone cutthroat trout; 57 percent of strong populations and 48 percent of depressed populations occur on these lands (table 3.14). An additional 13 percent of the strong populations occur within Teton National Park, Wyoming. A total of 35 percent of the strong populations are within designated wilderness or National Parks. The current range of Yellowstone cutthroat trout includes both forest and rangelands. Activities in both land types will affect the species' persistence.

Alternative 1—Management under Alternative 1 will likely contribute to declines in Yellowstone cutthroat trout outside of designated wilderness areas and National Park Service-administered lands. Although individual Forest plans may provide some levels of site-specific protection and restoration for important local stocks, this alternative lacks a consistent conservation and restoration approach. Populations outside of National Parks and designated wilderness will be affected by increased timber harvest, thinning, and road construction (table 3.20). The number of subwatersheds with high road densities is expected to increase (table 3.11). Models predict a decline in the species distribution and in strong populations (tables 3.3 and 3.4), especially in the Palisades and Salt River subbasins. Very little watershed restoration is planned under this alternative. Within rangelands, Alternative 1 provides little improvement in livestock management and very little planned riparian restoration (table 3.20). Declines will likely be most pronounced in areas managed most intensively for timber and range commodity production.

Table 3.23. Projected effects of the seven proposed alternatives on westslope cutthroat trout.

Will the Alternative:	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Conserve strong populations in the central or core portions of the species' range?	No	Yes	Yes	Yes	No	Yes	Yes
2. Prevent declines in habitats or populations throughout the entire species' range? — if “no”, where are declines most likely to occur (on FS/BLM lands)?	No	No	No	No	No	Uncertain	Yes
3. Help rebuild depressed populations by restoring habitats? — if “yes”, where?	Outside wilderness and other protected areas	Outside INFISH ¹ Priority watersheds; Forest Clusters 3, 4, and 5	Category 2 and 3; Forest Clusters 3 (western MT) and 4, and Upper Clark Fork	Category 2 and 3; Western MT	Category 2 and 3; commodity-emphasis areas		
	No	No	Yes	Yes	No	Yes	Yes
What is the role of factors other than habitat?	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats.		Forest Cluster 2 and some of 4	Category 1; Forest Clusters 2, 3, and 4		Mixed results across species' range	

¹(INFISH) Inland Native Fish Strategy. 1995. Environmental Assessment: Decision Notice and Finding of No Significant Impact. Interim Strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana, and portions of Nevada. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Northwest Regions. [irregular pagination].

Alternative 2—Alternative 2 will likely result in continued declines in Yellowstone cutthroat trout outside of designated wilderness areas and National Park Service-administered lands. Although some increased protection of watersheds may be afforded, land-disturbing activities will continue in important core areas and there is minimal emphasis on restoration of degraded areas. Increased protection is afforded under the application of INFISH guidelines that would require watershed analysis if standards were to be altered. Important core areas are not clearly identified under this alternative. Land-disturbing activities including harvest and thinning are relatively low (table 3.20), and minimal changes in road densities are expected (table 3.11). Models sensitive to road densities predict no change in the probability of populations (tables 3.3 and 3.5). The alternative identifies riparian areas and landslide-prone areas, but at-risk populations or habitats that may require added emphasis are not identified. There is little emphasis on restoration of depressed habitats. For depressed populations in rangelands, there is a high emphasis on livestock production, a low emphasis on riparian restoration, and moderate increases in livestock management (table 3.20). Consequently, currently degraded habitats may be degraded further and other areas may not receive the restoration effort needed to reverse population declines.

Alternative 3—It is uncertain whether Alternative 3 will improve overall conditions for Yellowstone cutthroat trout, although most important core areas should be protected. This alternative identifies important core areas by listing subbasins that support important strongholds under a Category 1 designation, and it applies emphasis to other strongholds outside Category 1 areas. There is little emphasis on prioritization of restoration in degraded areas. Similar to Alternative 2, some increased protection is afforded under the application of INFISH guidelines that would require watershed analysis for standards to be altered. Minor changes in road densities are anticipated (table 3.11) and the model predicts virtually no change in the occurrence of populations

except for a small improvement in the Palisades subbasin (tables 3.3 and 3.6). Although thinning is projected in Clusters 5 and 6 as part of this alternative, most of this activity will be in forest types other than the cold forest which dominates the range of Yellowstone cutthroat trout. Within rangelands, riparian restoration is increased, livestock management improves moderately, and there are small Animal Unit Month (AUM) reductions for depressed populations (table 3.20).

Alternative 4—Alternative 4 should adequately protect core areas for Yellowstone cutthroat trout and provide modest improvement in depressed areas through watershed and riparian restoration. This alternative identifies important core areas by designating Category 1 subbasins that support important strongholds, and emphasizes other strongholds outside Category 1 areas. Road densities decrease in the more highly roaded subwatersheds within the range of depressed populations, and do not increase in watersheds supporting strong populations (table 3.11). The model predicts improved probabilities of all populations and strong populations in the Palisades, Salt, Lower Henrys, and Portneuf subbasins (tables 3.3 and 3.7). Thinning is projected in Clusters 5 and 6 as part of this alternative, again most of which will be outside the range of Yellowstone cutthroat trout. Within depressed populations in rangelands, restoration is emphasized in Range Cluster 6, livestock management improves moderately, and there are small AUM reductions (table 3.20).

Alternative 5—Alternative 5 is expected to exacerbate declines in the overall status of Yellowstone cutthroat trout in commodity-emphasis areas. Yellowstone cutthroat trout stocks overlap commodity-emphasis areas and will be subject to extensive land disturbance from timber harvest and livestock. Core areas outside of commodity-emphasis areas will be managed identically to Alternative 4. Areas with high road density would increase with this alternative (table 3.11) and the model predicts reductions in the distribution of the species and in strong populations (tables 3.3

and 3.8). High levels of harvest and thinning occur, especially in depressed population areas (table 3.20). Within commodity-emphasis areas, standards provide minimal protection of riparian areas, minimal ecosystem analysis, and there is no process to address cumulative watershed effects (see “Step 1” section).

Alternative 6—This alternative protects most core areas and applies a conservative and adaptive approach to restoration that should benefit Yellowstone cutthroat trout. Similar to Alternative 4, this alternative identifies most but not all important core areas by designating Category 1 subbasins that support important strongholds and emphasizing strongholds outside Category 1 areas. Timber harvest levels are low in all key areas, so risks are minimized. Road densities are reduced in some of the more highly roaded areas (table 3.11), which increases the likelihood of populations persisting in the Palisades, Lower Henrys, and Portneuf subbasins (tables 3.3 and 3.9). This alternative has a system of RMAs with stronger requirements for ecosystem analysis and whose widths are adjusted by slope. In rangelands, Alternative 6 has a moderate increase in livestock management and a large increase in riparian restoration (table 3.20).

Alternative 7—This alternative provides a system of reserves to conserve important core areas that, if extensive, would benefit Yellowstone cutthroat trout. Our analysis of Alternative 7 is incomplete because the EIS teams did not identify reserves within the Greater Yellowstone Ecosystem, which covers much of the range of Yellowstone cutthroat trout. We might assume that such reserves would build on existing National Parks and wilderness areas that harbor much of the core of the distribution. This alternative includes a combination of RHCAs, requirements for ecosystem analysis, and a cumulative-effects process that should protect core areas. This alternative has the lowest level of timber harvest and thinning (table 3.20). Road densities are expected to decline in the more highly roaded areas (table 3.11), which suggests a substantive increase in both species occurrence and

strong populations (table 3.3). Increases would be expected in the Palisades, Upper and Lower Henrys, and Portneuf subbasins (table 3.10). Although restoration in forested areas is not emphasized, reduced human disturbance should benefit depressed populations. Within rangelands, this alternative includes a 50 percent reduction in AUMs, the largest increases in livestock management, and a moderate increase in active riparian restoration (table 3.20). These factors should benefit Yellowstone cutthroat trout in currently degraded rangeland habitats. As with other alternatives, it does not identify at-risk populations outside of strongholds. Unlike the other alternatives, it is much more comprehensive in addressing the influence of other factors such as mining, transport and storage of toxic materials, and water transfers.

Summary—Yellowstone cutthroat trout are likely to persist under all alternatives. All alternatives provide various levels of protection of core areas. The degree to which degraded habitats are restored best distinguishes the alternatives and leads to the more favorable ratings. Alternatives 4, 6, and 7 are expected to conserve core areas and move toward restoration of degraded habitats (table 3.24). Alternative 3 provides uncertain benefits to Yellowstone cutthroat trout; although some core areas are adequately conserved, many other areas will be affected by additional land-disturbing activities. Alternatives 1, 2 and 5 can be expected to exacerbate declines in Yellowstone cutthroat trout populations outside of specially protected areas.

Redband trout (*Oncorhynchus mykiss* ssp.)

Redband trout are the most widely distributed of the salmonids considered in this analysis. Redband trout occur in about 73 percent of the assessment area. Two general forms of redband were identified within the assessment area: one associated with the distribution of steelhead (sympatric redband) and a second outside the historical range of steelhead (allopatric redband).

Table 3.24. Projected effects of the seven proposed alternatives on Yellowstone cutthroat trout within the Basin.¹

Will the Alternative:	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Conserve strong populations in the central or core portions of the species' range?	No	No	Yes	Yes	No	Yes	Yes
2. Prevent declines in habitats or populations throughout the entire species' range? — if “no”, where are declines most likely to occur (on FS/BLM lands)?	No	No	Uncertain	Yes	No	Yes	Yes
	Palisades, Salt River, and areas managed most intensively for timber and range commodities	Areas managed most intensively for timber and range commodities	Areas managed most intensively for timber and range commodities		Commodity-emphasis areas		
3. Help rebuild depressed populations by restoring habitats? — if “yes”, where?	No	No	Yes	Yes	No	Yes	Yes
			Palisades	Palisades, Salt, Lower Henrys, and Portneuf		Palisades, Lower Henrys, and Portneuf	Palisades, Upper and Lower Henrys, and Portneuf
What is the role of factors other than habitat?	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats.						

¹The Basin is defined as those portions of the Columbia River basin inside the United States east of the crest of the Cascades and those portions of the Klamath River basin and the Great Basin in Oregon.

Sympatric redband trout persist in about 69 percent of the potential historical range and allopatric forms persist in about 49 percent of the potential historical range.

Although the taxonomic status of redband trout is uncertain, studies suggest long-term isolation of allopatric forms with concomitant genetic differentiation among several populations in isolated basins (Behnke 1992, Berg 1987). Allopatric forms are distributed among a number of isolated subbasins that may represent several evolutionarily distinct lineages and thus important components of the genetic variability of the species. These groups are associated with the Wood and Kootenai Rivers in the UCRB area, and the Upper Klamath Basin and a complex of isolated subbasins in south central Oregon in the EEIS area (Goose Lake, Warner, Catlow Valley, and Harney) (Lee and others, in press). Because of their potentially unique characteristics, each of these groups may warrant identification as separate evolutionary units or subspecies (Williams and others 1989) and could be considered as part of the fringe distribution for the species. We consider the likely influences of alternatives on the broad distribution of redband trout in the next section. In later sections dealing with sensitive species, we also briefly consider effects specific to the Upper Klamath Basin and isolated subbasins in south-central Oregon.

Redband trout are generally believed to be resilient to disturbance and their persistence across the historical range supports this view. Most populations are believed to be depressed, however, and strong populations are thought to exist in only 9 to 17 percent of their historical range. About 55 percent of the current distribution occurs on Federal lands and 33 percent of that is found in subbasins dominated by rangelands (table 3.15). Management of FS- and BLM-administered lands and both timber harvest and grazing activities should play an important role in the distribution and status of this species. Because redband trout remain relatively widely distributed, active restoration of some habitats could play an

important role in restoring or securing a stronger distribution.

Alternative 1—We anticipate further declines in the status and distribution of redband trout under this alternative. Moderate to high levels of timber harvest activities (table 3.20), and increasing road densities (table 3.11) are projected throughout the range. The model predictions suggest a declining trend in the distribution of strong populations (tables 3.3 and 3.4). Current Forest plans may provide varied levels of protection for both strong and depressed populations. The lack of a consistent riparian conservation strategy and the allocation of only low levels of watershed and riparian restoration activities (table 3.20), however, suggest increased disturbance and negative trends. Under this alternative there is an emphasis on commodity production for forestlands, rangelands, or both, in all of the subbasins supporting the fringe populations, suggesting a downward trend. Although redband trout are likely to persist and may even remain widely distributed under this alternative, we anticipate a significant loss in the status and distribution of strong populations, and a risk of compromising a significant part of the genetic variability for the species.

Alternative 2—Under Alternative 2 we anticipate that the status for much of the distribution of sympatric redband trout will be conserved in both the EEIS and UCRB planning areas. We expect that the distribution and status of the allopatric populations representing the species fringe will decline. Alternative 2 incorporates the INFISH strategy including watershed analysis and riparian conservation standards that should provide important protection for populations exposed to land management in priority watersheds. The distribution of sympatric redband populations overlaps strongly with bull trout and some west-slope cutthroat trout that were the focus of the INFISH strategy, and with anadromous salmonids emphasized in PACFISH and FEMAT. For that reason many of the priority watersheds will convey some protection to redband trout as well. The additional protection could reduce the threats

associated with moderate or low levels of timber harvest and thinning activities (table 3.20) in the central and northern portions of the species range. Within the priority watersheds, many of the strong populations of redband trout in both analysis areas should be conserved. With only limited watershed and riparian restoration, however, we do not expect any important rebuilding in the depressed part of this distribution. For redband trout outside the priority watersheds, further declines in status should be anticipated. Losses may be particularly significant for the allopatric form. Moderate levels of timber harvest and a production/conservation emphasis for all rangelands associated with the allopatric populations suggest a potential for significant watershed disturbance. Because many of the populations in the fringe distributions are already depressed, there is little riparian or watershed restoration anticipated. Many of these populations may fall outside the riparian protections afforded to the priority INFISH watersheds, and we cannot expect any significant restoration. Further losses in the fringe populations could represent major losses in the genetic diversity of this species.

Alternative 3—The cores of strong sympatric redband trout populations on Forest Service-administered lands should be conserved under this alternative. It is unclear what the trends will be in the remainder of the range, particularly the allopatric form outside of INFISH priority subwatersheds. The requirement for ecosystem analysis in Category 1 and all subwatersheds supporting strong populations should provide protection for much of the distribution of sympatric redband trout in both analysis areas. However, relatively little watershed restoration is projected for forested lands supporting depressed populations (table 3.20). The potential lack of ecosystem analysis (outside Category 1 and strong subwatersheds) to effectively prioritize activities that do occur, indicates that little restoration of depressed populations could be expected in this part of the range. A large portion of the redband distribution is found in rangelands. The projection of relatively high riparian restoration activities for depressed

fringe and strong subwatersheds (table 3.20) indicates a potential to secure existing strongholds and restore other areas to a more productive condition. The lack of ecosystem analysis to effectively prioritize conservation and restoration efforts and the produce/conservation emphasis on all of the rangelands associated with the southern portion of the species distribution could negate overall species gains.

Alternative 4—The cores of strong sympatric redband populations should also be conserved and possibly extended under this alternative. Although moderate levels of timber harvest and thinning activities are associated with this alternative (table 3.20), the requirement for ecosystem analysis and more conservative riparian conservation standards in strong and Category 1 watersheds could mitigate much of the disturbance. Results are less certain for areas outside of Category 1 and strong subbasins. Strong trends were not evident in either the road density projections (table 3.11) or the modeled probabilities (tables 3.3 and 3.7) but moderate or high levels of watershed and riparian restoration activities are projected across the species range (table 3.20). Those restoration efforts coupled with the ecosystem analysis will provide some opportunity to secure and extend the strongholds. By effectively prioritizing both forest and aquatic restoration activities to minimize risk in important watersheds, some gains could be made. A similar opportunity exists across the distribution of depressed and fringe populations where high levels of both watershed and riparian restoration are projected (table 3.20). The lack of Category 1 or many strong watersheds in this part of the species range, however, suggests that ecosystem analysis will not be required and might be omitted across much of the area. Without the framework to effectively focus conservation and restoration efforts, it is uncertain if significant gains can be made across much of the range of depressed and fringe populations.

Alternative 5—Although the core of the strong sympatric redband trout distribution should be conserved or even strengthened in the UCRB

area, we would expect a large part of that distribution in the EEIS area to seriously decline under this alternative. All of the fringe distribution associated with the allopatric form would be expected to decline in status as well. The requirement for ecosystem analysis, an aquatic conservation emphasis, and moderate or high levels of watershed and riparian restoration activities (table 3.20) should benefit redband trout in the central region of Idaho that lies outside commodity-emphasis areas. The opportunity to secure and extend the distribution of strong subwatersheds should be similar to that discussed under Alternative 4. An emphasis on timber or livestock production extends over most of the remaining portion of the strong distribution and over all of the fringe distribution for the allopatric form. Within these portions of the redband range a lack of ecosystem analysis to prioritize restoration activities, a less conservative riparian protection standards (see "Step 1" section for details), and higher levels of disturbance can be expected to contribute to declines in the existing distributions. We would anticipate some decline in the status and distribution of redband trout throughout much of this area. Models predict a reduced probability of occurrence for allopatric redband trout in the Williamson and Upper Klamath subbasins (tables 3.3 and 3.8). Any declines in the fringe distributions could represent losses in the genetic variability for this species.

Alternative 6—Similar to Alternative 4, the cores of strong sympatric redband populations should be conserved and perhaps extended under this alternative. This alternative has low levels of timber harvest and thinning activities (table 3.20). The requirement for ecosystem analysis, and more conservative riparian conservation standards in strong and Category 1 watersheds should protect most core areas. Results are less certain for areas outside of Category 1 and strong subbasins. Although high road densities were projected to decrease (table 3.11), no trends were evident in the modeled probabilities (tables 3.3 and 3.9). Moderate or high levels of livestock management, watershed restoration, and riparian restoration

activities are projected across the species range (table 3.20). Those restoration efforts coupled with ecosystem analysis will provide some opportunity to secure and extend the strongholds. Although this alternative places less emphasis on forest and aquatic restoration activities than does Alternative 4, it also has less risk from land-disturbing activities (table 3.20). A similar opportunity exists across the distribution of depressed and fringe populations where high levels of both watershed and riparian restoration are projected (table 3.20). The lack of Category 1 or many strong watersheds in this part of the species range, however, suggests that ecosystem analysis will not be required and might be omitted across much of the area. Without the framework to effectively focus conservation and restoration efforts it is uncertain if significant gains can be made across much of the range of depressed and fringe populations.

Alternative 7—This alternative provides a system of reserves which conserve core areas. These reserves should be adequate to protect most of the core areas for both sympatric and allopatric forms. Exceptions are the Harney and Goose Lake subbasins where reserves will not include core areas for allopatric redband trout. This alternative includes a combination of RHCAs, requirements for ecosystem analysis, and a cumulative effects process that should conserve most strongholds. The alternative has the lowest level of timber harvest and thinning (table 3.20). The road densities have reductions in current high-density areas and increases in low- and moderate-density areas (table 3.11). The models predict small changes in the probability of occurrence with slightly improved occurrence in the Williamson and Upper Klamath Lake subbasins (tables 3.3 and 3.10). Although restoration in forested areas is not emphasized, reduced human disturbance should benefit depressed populations. Within rangelands, this alternative includes a 50 percent reduction in AUMs, the largest increase in livestock management, and a large increase in riparian restoration (table 3.20). These factors should benefit redband trout in currently degraded rangelands. This alter-

native also has more comprehensive coverage of other factors including mining, transport and storage of toxic materials, and water transfers.

Summary—Although redband trout are likely to persist under all of the alternatives, the degree to which strongholds (especially isolated allopatric populations on the fringe of the species range) are conserved varies across alternatives. Alternatives 4 and 6 are expected to conserve most remaining core areas and move toward restoration of some degraded habitats, although benefits are uncertain for fringe populations. Alternative 7 does the most extensive job of conserving habitats for redband trout, including fringe populations in rangelands, although core areas in the Harney and Goose Lake subbasins may remain at risk (table 3.25). Alternatives 2 and 3 conserve sympatric strongholds, but declines are expected in the allopatric form comprising the fringe of the species. Alternatives 1 and 5 are anticipated to contribute to continued declines in status and distributions of redband trout populations.

Steelhead (*Oncorhynchus mykiss mykiss*)

Steelhead formerly occupied approximately 50 percent of the subwatersheds in the Basin and were found in Ecological Reporting Units (ERUs) within both the UCRB and EEIS planning areas. Steelhead are extinct in approximately 54 percent of the historical range, primarily as a result of blocked access to historical habitats. Few healthy populations persist within the current range; 1.3 percent of the subwatersheds support strong populations. Wild fish unaltered by hatchery stocks are likely rare, and expected in only 10 percent of the potential historical range (Lee and others, in press). Steelhead are currently a Federal Candidate species for listing under the Endangered Species Act. We evaluated these alternatives on their own merit, regardless of potential future requirements for consultation under the ESA. Any additional requirements through Section 7 of the ESA would be expected to provide added protection for critical habitats. Management of FS- and BLM-administered lands could strongly influence the

status and distribution of steelhead, because 70 percent of strong subwatersheds and 59 percent of depressed ones are located on FS- or BLM-administered land (table 3.16). Approximately 19 percent of the depressed populations occur in wilderness areas. Because so few strong populations persist, virtually all subwatersheds that sustain wild and naturally reproducing steelhead should be considered critical habitats for biological reasons. Steelhead are dependent on habitats in both forested areas and rangelands and activities in both categories will affect populations.

Because of their extensive migrations and diverse life histories, steelhead and other anadromous fishes are influenced by Federal land management in spawning and rearing areas and migration corridors, and by a large number of other factors that operate outside of Federal lands in freshwater, estuaries, and the ocean environment. About 68 percent of the migration corridors between freshwater spawning and rearing habitats and the ocean lie on private or tribal lands (table 3.16). The quality and connectivity of habitats in both mainstem rivers and smaller watersheds will likely influence the strength and persistence of remaining steelhead populations (Lee and others, in press). Recent declines in steelhead stocks can be attributed primarily to the construction and operation of mainstem dams on the Columbia and Snake Rivers (CBFWA 1990, Raymond 1988). Because of mortalities associated with the dams (IDFG and others 1990; Raymond 1979, 1988), only the most productive populations may retain the resilience to persist in the face of natural and human caused disturbance (Lee and others, in press). Any changes in the environment that influence survival and productivity of remaining steelhead populations, including improvements in spawning and rearing habitats and reduced mortality from fishing, predation, and mainstem passage, will improve chances for persistence in variable environments (Emlen 1995). Simply put, under current conditions in migrant survival, many steelhead populations are at serious risk.

Table 3.25. Projected effects of the seven proposed alternatives on redband trout.

Will the Alternative:	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Conserve strong populations in the central or core portions of the species' range?	No	Yes	Yes	Yes	No	Yes	Yes
2. Prevent declines in habitats or populations throughout the entire species' range? — if "no", where are declines most likely to occur (on FS/BLM lands)?	No	No	Uncertain	Uncertain	No	Uncertain	No
3. Help rebuild depressed populations by restoring habitats? — if "yes", where?	Outside wilderness and other protected areas	Allopatric form outside INFISH' priority areas, and Range Cluster 6	Allopatric form outside INFISH' priority areas, and Range Cluster 6	Category 2 and 3, and Range Cluster 6	EEIS and Wood and Kootenai; Range Cluster 6	Category 2 and 3, and Range Cluster 6	Western portion of Range Cluster 6; Harney and Goose Lake subbasins
What is the role of factors other than habitat?	No	Yes	Yes	Yes	Yes	Yes	Yes
	Mixed results across species' range depending on intensity of riparian restoration and livestock management activities.						
	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats.						

*(INFISH) Inland Native Fish Strategy. 1995. Environmental Assessment: Decision Notice and Finding of No Significant Impact. Interim Strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana, and portions of Nevada. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Northwest Regions. [irregular pagination].

The differences between populations that persist and those that are extirpated will be strongly influenced by the survival and productivity of the populations as they are influenced by freshwater spawning and rearing habitats. Without substantial improvement in migrant survival, conserving and restoring the quality of freshwater habitats may make an important difference in persistence for many of the remaining populations. In the short term, conservation and restoration of habitats directly associated with remaining populations will be most important. In the long term, assuming mainstem conditions are resolved, it will be necessary to conserve and restore broader networks to support the full expression of life histories and species (Lee and others, in press; Lichatowich and Mobrand 1995). To ensure persistence and rebuilding of stocks, conservation and restoration of habitat on Federal lands must work in concert with other factors affecting steelhead. Although conservation and restoration of freshwater habitats may make the critical difference in persistence of many stocks, such activities are not likely to substantially improve the distribution and abundance of steelhead without substantial improvements in survival outside of spawning and rearing areas.

In our analysis of alternatives for steelhead, we did not rely on the classification trees tied to road density to consider potential trends. As discussed earlier, the models were not as useful for predicting the likelihood of changes in the distribution of populations of anadromous salmonids as they were for resident salmonids (table 3.3). As Lee and others (in press) noted, there are several potential reasons why the models do not perform as well for the anadromous species. First, anadromous salmonids have extensive migrations and their widely-dispersed life stages, status, and distribution are influenced by factors within freshwater spawning and rearing areas, as well as by factors outside those areas. Although road density will influence the quality of freshwater spawning and rearing habitats, roads do not adequately reflect other factors (for example, mainstem passage, predation, harvest, and ocean conditions)

that influence the survival of life stages that migrate from freshwater spawning and rearing habitats. Second, the model does not differentiate between wild and hatchery-supplemented anadromous fish stocks. In some heavily-disturbed subwatersheds with high road densities, remnant numbers of anadromous fish may be present only because of supplementation with hatchery-reared fish. Third, too few strong populations are present to relate their presence to road density. As a result, the classification trees do not adequately predict the influence of changes in road density across alternatives on the status of anadromous fish.

The scientific literature illustrates that the quality of freshwater spawning and rearing areas will influence the survival, condition, and distribution of juvenile anadromous salmonids (see for example Meehan 1991). There is little reason to anticipate that freshwater life stages of the anadromous forms will respond in substantively different ways than resident forms. Anadromous salmonids in many portions of the Basin overlap in distribution with resident salmonids including redband trout, bull trout, and westslope cutthroat trout. Consequently, models for resident salmonids may be useful surrogates for anadromous species during their freshwater spawning and rearing stages. We used results of the predictive models for these resident salmonids as additional information to consider the alternatives with regard to the status of steelhead.

Alternative 1—Management under Alternative 1 will likely contribute to continued declines in steelhead across their range. Although individual Forest plans may provide some levels of site-specific restoration and protection for important local steelhead stocks, this alternative lacks a consistent conservation and restoration approach. Steelhead populations within designated wilderness areas in central Idaho (UCRB area) should not be adversely affected by this alternative. Populations outside of wilderness areas, however, would likely be exposed to increased timber harvest and thinning activities (table 3.20) and road construction. The number of subwatersheds with

moderate and high numbers of roads is expected to increase and subwatersheds with no roads are expected to decrease (table 3.11). Results of the classification tree analysis for bull trout, redband trout, and westslope cutthroat trout suggest widespread declines in the frequency of both strong and depressed populations within the range of steelhead (table 3.4). Very little watershed restoration is planned under this alternative (table 3.20). Timber harvest and road construction would also increase within areas supporting what may be the last remaining genetically intact steelhead stocks in Forest Clusters 2 and 5. Within rangelands, Alternative 1 provides only modest improvements in livestock management and very little planned riparian restoration (table 3.20). Declines would likely be most pronounced in areas managed most intensively for timber and range commodity production.

Alternative 2—Important habitats currently supporting strong populations of steelhead are likely to be conserved under this alternative. Most populations would be provided increased protection through the maintenance of both the INFISH and PACFISH riparian strategies as well as relatively low levels of projected land-disturbing activities. In general, we anticipate that habitats for important remnant populations associated with Federal lands will be largely conserved in current conditions. Continued disruption of habitats may occur where land-disturbing activities are most concentrated in the commodity-emphasis areas of Forest Cluster 3 and are associated with portions of the northern and southern Cascades and the lower Snake and Salmon Rivers in the Columbia Plateau and Central Idaho Mountains. Reductions in some of the highest watershed road densities (table 3.11) and moderate levels of watershed restoration activity (table 3.20) should work to improve conditions for some of the depressed populations that may persist in degraded habitats outside of these areas. In general, we would not expect strong rebuilding of steelhead populations under this alternative. The projections of watersheds with low road densities (table 3.11) and the trends predicted by the classifica-

tion models for bull trout and westslope cutthroat trout that tend to overlap distributions with steelhead, suggest little in the way of major habitat restoration that would lead to substantial rebuilding of depressed stocks in degraded environments.

Alternative 3—We anticipate mixed results for habitats supporting steelhead populations throughout the current distribution of this species under Alternative 3. The few strong populations remaining will benefit from the focus of ecosystem analysis and more restrictive riparian protection measures associated with PACFISH and INFISH. Those benefits may not translate widely in the remaining distribution. Moderate or high timber harvest and thinning activities are forecast for most of the range including both strong and depressed populations (table 3.20). An increase in watersheds with very low and low road densities and a reduction in watersheds with high or extreme road densities (table 3.11) indicate some mitigation of increased activity, but low or moderate levels of watershed restoration in spawning and rearing habitats and none in seasonal or corridor watersheds suggest that activities may be focused more heavily on road closures than on full restoration. Because so few strong steelhead populations remain, the application of ecosystem analysis (Category 1 or strong populations) may provide little benefit to many of the depressed populations. Steelhead habitats that overlap with the current strong distributions of bull trout and westslope cutthroat trout, or are found in the Section 7 watersheds (largely the Central Idaho Mountains and Northern Cascades) are likely to fair best under this alternative. We anticipate that the habitats supporting currently strong populations and perhaps an important portion of the depressed populations (primarily in Forest Categories 1 and 2) will be conserved or modestly strengthened under this alternative. The remaining part of the range is less likely to benefit under this alternative, and we would not anticipate a strong rebuilding of habitats that could support broadly increasing populations.

Alternative 4—We anticipate that this alternative will largely conserve the habitats for remaining strong populations of steelhead if watershed restoration and ecosystem analysis are effective at focusing and mitigating more intensive land management activities. Although combined timber harvest and thinning activities are anticipated to be moderate to high, positive changes in road densities (table 3.11) and some of the highest levels of watershed and riparian restoration across alternatives (table 3.20) could mitigate some of this risk. Additionally, the focus on ecosystem analysis in Category 1 watersheds and watersheds supporting strongholds for salmonids should allow activities to be focused with the least risk to critical habitats and perhaps with the benefit of extending and strengthening those distributions. Conservation or restoration of habitats across the distribution of depressed steelhead populations is less likely. Even though high levels of watershed and riparian restoration are predicted for much of the depressed distribution in watersheds that do not coincide with Category 1 or strongholds for other species, the lack of ecosystem analysis could mean that activities are focused ineffectively. The potential to benefit habitats through increased active restoration is important but we are uncertain whether it can be realized without detailed analysis and planning. The greatest benefits should be afforded to the strong populations found principally in the Blue Mountains and to depressed populations associated with Forest Cluster 1 in the Central Idaho Mountains. The greatest risks are likely associated with depressed populations in the Blue Mountains, Columbia Plateau, and Central Idaho Mountains associated with Forest Clusters 3, 4, and 5.

Alternative 5—Alternative 5 is not expected to conserve habitats supporting strong populations or prevent further declines in habitats for steelhead across much of the range. Although this alternative adequately conserves some remaining strongholds outside of commodity-emphasis areas, steelhead trout stocks that overlap commodity-emphasis areas in Forest Cluster 5 and Range Clusters 1 and 6 will be subject to land disturbance from timber harvest and livestock. Core

areas outside of commodity-emphasis areas will be managed identically to Alternative 4. Within commodity-emphasis areas, standards provide little protection to riparian areas and minimal ecosystem analysis and there is no process to address cumulative watershed effects. High levels of harvest and thinning are not compensated by increased watershed restoration or road-density reductions (tables 3.11 and 3.20). Results of the predictive models suggest declines in the frequency of both strong and depressed populations of bull trout within the range of steelhead (table 3.8). Except for Alternatives 1 and 2, this alternative has the smallest reduction in high road densities (table 3.11).

Alternative 6—This alternative provides protection for the habitats supporting strong populations and much of the depressed distribution similar to that under Alternative 4. Because activity levels are lower and there is an emphasis on a more conservative and adaptive approach, we would anticipate similar benefits and perhaps fewer risks than under Alternative 4. Similar to Alternative 4, this alternative places special emphasis on subbasins that support strongholds or a Category 1 recognition. Because so few strongholds for steelhead remain, and because portions of the range may not overlap with other species or Category 1 watersheds, all remaining populations may not receive a conservation emphasis or the focus of ecosystem analysis. Timber harvest levels are generally low or moderate in most areas, so risks tend to be minimized and to some extent mitigated by positive changes in road densities, moderate levels of watershed restoration and high levels of riparian restoration (table 3.20). Some thinning in areas within Forest Clusters 2 and 6, supporting genetically intact populations, would occur. An emphasis on watershed restoration (table 3.20) and reduced road density (table 3.11) should particularly benefit Forest Clusters 2 and 5 that support all of the strong and most of the depressed populations. Results of the classification tree analysis for resident salmonids suggest a positive trend in the distribution of bull trout and westslope cutthroat trout in most subbasins within the range of steelhead (table 3.9).

Alternative 7—This alternative provides a system of reserves and very restricted management activities that should conserve much of the remaining distribution of steelhead. It may lead to some rebuilding of habitats in the reserve areas, but restoration of habitats in more degraded landscapes will be mixed, occurring more slowly in areas without active watershed restoration. This alternative identifies roadless reserves that will contain an important, but not dominant, part of the remaining, occupied steelhead habitats (table 3.11). With limited timber harvest and thinning activities (table 3.20), the combination of riparian habitat conservation requirements for ecosystem analysis and a cumulative effects process should conserve the current conditions of most habitats outside the reserves. The continued degradation of some watersheds with a legacy of past management, however, is unlikely to be mitigated with the limited watershed restoration activity. Results of the predictive models suggest positive trends in the frequency of both strong and depressed populations of bull trout and westslope cutthroat trout within the range of steelhead (table 3.10). Within rangelands, this alternative includes a major reduction (50%) in grazing, the largest increases in livestock management, and a moderate increase in active riparian restoration (table 3.20). These factors should benefit steelhead stocks in currently degraded rangeland habitats perhaps more strongly than those in degraded forest environments. Similar to the other alternatives, Alternative 7 does not identify depressed populations outside of strongholds for any special emphasis. Unlike the other alternatives, it is much more comprehensive in addressing the influence of other factors such as mining, transport and storage of toxic materials, and water transfers.

Summary—Steelhead have been extirpated from the majority of their historical range. Most remaining steelhead populations are depressed and the long-term persistence of remaining populations is highly uncertain. Because of high mortalities associated with dams and other factors in the ocean and migratory corridors, freshwater habitats may make the important difference between pop-

ulations that persist and those that go extinct. Conservation or restoration of currently occupied habitats may be critical to the persistence of the remnant populations. All of the alternatives except Alternatives 1 and 5 are anticipated to conserve the habitats currently supporting strong populations (table 3.26). Although each of the alternatives will confer some protection for habitats supporting depressed populations, the results under all of the alternatives are likely to be mixed and uncertain. Alternatives 2 and 3 provide extended protection to steelhead habitats associated with the implementation of the PACFISH and INFISH conservation strategies but provide relatively little emphasis on habitat restoration. Alternatives 1, 3, 4 and 5 support high levels of timber harvest and thinning activities that represent increased risks for some populations. Although an increased emphasis on watershed restoration activities under these alternatives could mitigate much of the risk and provide important restoration of current and potential future habitats, the lack of a clear emphasis on ecosystem analysis outside of the Category 1 or stronghold watersheds makes that result uncertain. Alternative 6 is similar to Alternative 4 in this regard but the lower levels of land-disturbing activity, and the more conservative and adaptive approach could benefit populations across the range. Continuing declines are most likely under Alternatives 1 and 5 particularly in the commodity-emphasis areas outside Forest Clusters 1 and 2. Alternative 7 with the implementation of conservation reserves, reduced land-disturbing activities, and a restrictive riparian management strategy will likely conserve much of the remaining habitat. Some degraded habitats, however, may be restored more slowly or even decline further with limited emphasis on active restoration in Alternative 7. It is unlikely that any activities on Federal lands will result in strong rebuilding of steelhead populations without substantial improvements in other factors influencing these populations. If conditions outside spawning and rearing habitats remain poor, it is possible that many remaining stocks will continue to decline.

Table 3.26. Projected effects of the seven proposed alternatives on steelhead trout and stream-type chinook salmon.

Will the Alternative:	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Conserve strong populations in the central or core portions of the species' range?	No	Yes	Uncertain	Yes	No	Yes	Yes
2. Prevent declines in habitats or populations throughout the entire species' range? — if "no", where are declines most likely to occur (on FS/BLM lands)?	No	No	No	Uncertain	No	Yes	Uncertain
3. Help rebuild depressed populations by restoring habitats? — if "yes", where?	Outside of wilderness and other protected areas	Forest Cluster 3	Category 2 and 3 subbasins, Forest Cluster 5	Category 2 and 3 subbasins, Forest Clusters 3, 4, and 5	Category 2 and 3 subbasins, commodity-emphasis areas		Outside reserves in currently degraded watersheds
	No	Yes	Yes	Yes	Yes	Yes	Yes
What is the role of factors other than habitat?		PACFISH' priority watersheds	Category 1 subbasins, Forest Clusters 1 and 2			Mixed results across species' range	
The combined effects of hydropower operations, hatcheries, and harvest may limit increases in wild populations in areas where freshwater spawning and rearing habitats are restored. Similarly, protection of high-quality freshwater habitats will not guarantee population persistence without mitigation of other factors.							

(PACFISH) U.S. Department of Agriculture, Forest Service and U.S. Department of Interior, Bureau of Land Management, 1994. Draft environmental assessment. Interim strategies for managing anadromous fish-producing watersheds on Federal lands in eastern Oregon and Washington, Idaho, and portions of California. Washington DC: U.S. Department of Agriculture, Forest Service; U.S. Department of Interior Bureau of Land Management. [irregular pagination].

Stream-type chinook salmon *(Oncorhynchus tshawytscha)*

Stream-type chinook salmon formerly occupied approximately 45 percent of the subwatersheds in the Basin and were found within both the UCRB and EEIS planning areas. Stream-type chinook salmon are extirpated in about 72 percent of the historical range, primarily as a result of blocked access to historical habitats. Remaining chinook salmon stocks are extremely depressed. Few healthy populations persist in the current range; less than 1 percent of the subwatersheds support strong populations. Wild fish, unaltered by hatchery introgression, are likely found in only 4 percent of the historical range. Snake River stocks of stream-type chinook salmon are currently listed as a threatened species under the Federal ESA. We evaluated these alternatives on their own merits, regardless of future requirements for consultation under the ESA. Additional requirements through Section 7 of the ESA would be expected to provide added protection for critical habitats. Management of FS- and BLM-administered lands affects 88 percent of subwatersheds with strong populations of stream-type chinook, and 72 percent of subwatersheds with depressed populations (table 3.17). Approximately 38 percent of the strong and 23 percent of the depressed populations occur in wilderness areas. Because so few strong populations persist, virtually all subwatersheds that sustain wild and naturally-reproducing stream-type chinook salmon should be considered critical habitats. Chinook salmon are dependent on habitats in both forestland and rangeland areas; activities in either category will affect populations.

Because of their anadromous life history, stream-type chinook salmon are affected by Federal land management in migration corridors and spawning and rearing areas, and by other factors that operate outside of Federal lands in freshwater, estuaries, and the ocean environment. Approximately 64 percent of the migration corridors between freshwater spawning and rearing habitats and the ocean lie on private or tribal lands. Restoration of

habitats and habitat connectivity in both mainstem rivers and subbasins may be important for stream-type chinook salmon stocks to persist (Lee and others, in press). Recent declines in stream-type chinook salmon stocks can be attributed primarily to the construction and operation of mainstem dams on the Columbia and Snake Rivers (CBFWA 1990, Raymond 1988). Due to passage mortalities associated with the dams (IDFG and others 1990; Raymond 1979, 1988), only the most productive populations may retain the resilience to persist in the face of natural and human-caused disturbance. Any changes in the environment that influence survival and productivity of remaining stream-type chinook salmon stocks, including improvements in spawning and rearing habitats and reduced mortality from fishing, predation, and mainstem passage, will improve chances for persistence in stochastic environments (Emlen 1995). Simply put, under current conditions in migrant survival, many stocks are at serious risk. The differences between chinook populations that persist and those that are extirpated may depend on their survival and productivity in freshwater spawning and rearing habitats. Without substantial improvement in migrant survival, conserving and restoring the quality of freshwater habitats may make an important difference in persistence for many populations. In the longer term, assuming mainstem conditions are resolved, it will be necessary to conserve and restore broader habitat networks to support the full expression of life histories and species (Lee and others, in press; Lichatowich and Mobrand 1995).

To ensure population persistence and rebuilding, conservation and restoration of Federal-land habitat must work in concert with other factors affecting stream-type chinook salmon. Although conservation and restoration of freshwater habitats may be critical to stock persistence, such efforts are unlikely to improve the distribution and abundance of stream-type chinook salmon without substantial improvements in survival outside of spawning and rearing areas.

As described previously for steelhead trout, classification trees for predicting the likelihood of changes in the distribution of strong populations of chinook salmon were not sensitive to changes in road density as they were for resident salmonids. Similar to steelhead, models for resident salmonids may be useful surrogates for stream-type chinook salmon during their fresh-water spawning and rearing stages. We used results of the classification trees for redband trout, bull trout, and westslope cutthroat trout to provide additional information when considering the effects of each alternative on stream-type chinook salmon. Results of the alternative evaluation for chinook are similar to those for steelhead. Stream-type chinook salmon tend to occupy larger streams and are more depressed than are most steelhead stocks.

Alternative 1—Alternative 1 will likely contribute to continued declines in stream-type chinook salmon within spawning and rearing areas and migration corridors across their range. Although individual Forest plans may provide some levels of site-specific restoration and protection for local stocks, this alternative lacks a consistent conservation and restoration approach. Stream-type chinook salmon populations within designated wilderness in central Idaho (UCRB area) should not be adversely affected by this alternative. Populations outside of wilderness, however, will be affected by increased timber harvest and thinning activities and increased road construction (table 3.20). The number of subwatersheds with moderate and high numbers of roads is expected to increase (table 3.11). Very little watershed restoration is planned under this alternative (table 3.20). Timber harvest and road construction will also increase within areas supporting what may be the last remaining genetically intact stocks in Forest Clusters 2 and 5. Within rangelands, Alternative 1 has only modest improvements in livestock management and very little planned riparian restoration (table 3.20). Declines will likely be most pronounced in areas managed most intensively for timber and range commodity production.

Alternative 2—Alternative 2 will likely protect the few remaining strong populations of stream-type chinook salmon, but is unlikely to prevent declines in other portions of the species's range or to help rebuild depressed populations in areas with degraded habitat outside of PACFISH priority watersheds. Although increased protection of watersheds may be provided, land-disturbing activities will continue throughout much of the range and there is little emphasis on restoration of degraded areas. Increased protection is included under the application of PACFISH guidelines that would require watershed analysis if standards were to be altered. Land-disturbing activities including harvest and thinning are relatively low (table 3.20). Low levels of timber harvest and moderate thinning activities would occur in Forest Cluster 5, which supports all of the remaining strong stream-type chinook salmon populations and offsets some by moderate levels of road reduction (reducing high and extremely high road densities). Basin-wide, there is essentially no expected change in the number of unroaded to low road-density subwatersheds (table 3.11). Alternative 2 identifies riparian areas and landslide-prone areas, but populations or habitats that may require special emphasis are not identified. There is also a lack of emphasis on restoration of depressed habitats. In rangelands, there is little emphasis on riparian restoration and increases in livestock management would occur (table 3.20). Consequently, currently degraded habitats may not receive the restoration effort needed to reverse population declines.

Alternative 3—We are uncertain whether Alternative 3 will conserve remaining strong populations, and do not expect it to prevent further declines in populations of stream-type chinook salmon. Limited restoration of degraded habitats in some areas is expected. Since Forest Cluster 5 supports all of the remaining strong populations (table 3.19) and many of the wild populations without hatchery influence, activities within this cluster are particularly important. Moderate levels of timber harvest and high levels of thinning are planned for Forest Cluster 5 under this alternative.

These activities are offset some by moderate levels of road reduction, but only a low level of watershed restoration is planned. While increased watershed protection is provided under the application of PACFISH guidelines and ecosystem analysis in subwatersheds with strong populations, it is uncertain whether there will be sufficient emphasis on restoring and protecting habitats across entire subbasins within Forest Cluster 5 to prevent further declines of population strongholds. We are concerned that subwatersheds which currently support strong populations may become more isolated and fragmented by activities occurring upstream and in adjacent subwatersheds that are not provided the same level of protection. Because chinook tend to spawn in larger streams, spawning conditions may be influenced by the cumulative effect of activities in multiple watersheds. In Forest Clusters 1 and 2, which represent much of the best remaining habitats for stream-type chinook, low levels of harvest and moderate levels of watershed restoration should help to protect high-quality habitats and restore degraded conditions on Federal lands within central Idaho and the northern Cascades.

Alternative 4—Alternative 4 can conserve strong populations, prevent further declines in habitats and populations, and help rebuild depressed populations in degraded areas—but only if watershed restoration is effective in improving habitat conditions. Although this alternative emphasizes active management to restore degraded areas, there are risks associated with land-disturbing activities. Levels of timber harvest and thinning are higher than in most other alternatives (table 3.20). There are moderate timber harvest and thinning activities in Forest Clusters 3 and 5, which are offset by moderate levels of watershed restoration and moderate and high levels of road reduction. This alternative has a system of RMAs with stronger requirements for ecosystem analysis and slope-adjusted RMA widths. Increased emphasis on watershed restoration and reduced road densities (table 3.11) potentially could improve habitat conditions throughout most of the species' range. Restoration activities could

negatively affect habitats and negate the benefits, however, if not closely monitored to ensure effectiveness. Benefits seem most assured in Forest Clusters 1 and 2, which have lower levels of harvest and thinning activities. In rangelands, Alternative 4 has a moderate increase in livestock management and a large increase in riparian restoration (table 3.20).

Alternative 5—Alternative 5 is not expected to conserve strong populations or prevent further declines in habitats or populations of stream-type chinook salmon stocks. Although this alternative adequately protects populations outside of commodity-emphasis areas, stream-type chinook salmon overlap commodity-emphasis areas in Forest Cluster 5 and Range Clusters 1 and 6 and will be subject to moderate to high land disturbance from timber harvest and livestock. Areas outside of commodity-emphasis areas, such as Forest Clusters 1 and 2, will be managed similarly to Alternative 4 and will see similar benefits. Within commodity-emphasis areas, standards provide little protection of riparian areas and minimal ecosystem analysis and there is no process to address cumulative watershed effects. High levels of harvest and thinning are not compensated by increased watershed restoration or road-density reductions (table 3.20). Except for Alternatives 1 and 2, this alternative has the smallest reduction in high road densities (table 3.11).

Alternative 6—Alternative 6 protects strong populations and applies a conservative and adaptive approach to restoration that should benefit stream-type chinook salmon stocks throughout their range. Similar to Alternative 4, this alternative places special emphasis on Category 1 subbasins and subwatersheds that support strong populations. Because so few strongholds for stream-type chinook salmon remain, however, many core areas that support depressed populations do not receive a conservation emphasis. Timber harvest levels are low in most areas so risks are minimized (table 3.20). Under Alternative 6 there would be some thinning in areas within Forest Clusters 2 and 6 that support genetically intact populations. This alternative has a system of RMAs with

stronger requirements for ecosystem analysis, and requirements are adjusted based on slope. Moderate levels of watershed restoration and extensive reductions in road densities (table 3.11) should benefit stream-type chinook throughout their range. In rangelands, Alternative 6 has increased livestock management and a large increase in riparian restoration (table 3.20).

Alternative 7—Alternative 7 provides a system of reserves to conserve core areas and restrictive RMAs that should protect strong populations, but depressed populations in currently degraded habitats outside of reserves may continue to decline. Although restoration activities are low, land-disturbing activities are also minimal. Alternative 7 identifies special-emphasis areas as 1,000-acre (405 ha) roadless reserves that will contain the best remaining habitats and strongest populations. This approach will overlook some core populations in degraded habitats. Despite this problem, the combination of RHCA, requirements for ecosystem analysis, and a cumulative effects process should conserve most core areas. This alternative has the lowest level of timber harvest and thinning (table 3.20). However, some thinning would occur within areas of high genetic integrity in Forest Cluster 5. Although restoration is not emphasized, reduced human disturbance coupled with reductions in road densities (table 3.11) should benefit depressed populations. Within rangelands, this alternative includes a 50 percent reduction in AUMs, the largest increases in livestock management, and a moderate increase in active riparian restoration (table 3.20). These factors should benefit stream-type chinook salmon stocks in currently degraded rangeland habitats. Similar to other alternatives, it does not identify at-risk populations outside of strongholds. Unlike the other alternatives, it is much more comprehensive in addressing the influence of other factors such as mining, transport and storage of toxic materials, and water transfers.

Summary—Most remaining stream-type chinook salmon populations are depressed and strong populations are rare. In the absence of strong populations, subwatersheds that retain high genetic

integrity and those supporting naturally reproducing populations should be considered critical habitats. As with steelhead trout, until passage mortalities associated with the hydroelectric system in the mainstem migration corridors and other factors outside Federal lands are resolved, the resilience and persistence of stream-type chinook salmon stocks will be largely dependent on the quality of freshwater habitats (Lee and others, in press). High-quality spawning and rearing habitats can increase the likelihood that stocks will persist in stochastic environments (Emlen 1995). As a result, aggressive and extensive protection and restoration of spawning and rearing habitat will be needed to retain stock resilience. Alternative 1 will likely contribute to continued declines in stream-type chinook salmon within spawning and rearing areas and migration corridors across their range (table 3.26). Alternative 2 will likely protect the few remaining strong populations, but is unlikely to prevent declines in other portions of the species' range or to help rebuild depressed populations in areas with degraded habitat. We are uncertain whether Alternative 3 will conserve remaining strong populations, and do not expect it to prevent further declines. Alternative 4 can conserve strong populations, prevent further declines in habitats and populations, and help rebuild depressed populations in degraded areas—but only if watershed restoration is effective in improving habitat conditions. Alternative 5 is not expected to conserve remaining strong populations or prevent further declines in populations, though they may help rebuild some depressed populations. Alternative 6 is similar to Alternative 4, but applies a more conservative and adaptive approach to restoration that should benefit stream-type chinook salmon stocks throughout their range. Alternative 7 provides a system of reserves to conserve core areas and restrictive RMAs that should protect strong populations, but depressed populations in currently degraded habitats outside of reserves may continue to decline. With the exception of Alternative 7, none of the alternatives address effects other than timber and livestock-based activities. Moreover, none of the alternatives address the needs and

opportunities for restoring habitat conditions outside Federal lands, nor do they address the need for a comprehensive approach to restoring stream-type chinook salmon habitat and alleviating causes of mortality in freshwater spawning and rearing areas, migration corridors, estuaries, and the ocean. Without a comprehensive approach, even those alternatives that most benefit stream-type chinook salmon could not be expected to ensure persistence.

Ocean-type chinook (*Oncorhynchus tshawytscha*)

Ocean-type chinook salmon formerly occupied about 7 percent of the subwatersheds in the Basin and were found primarily in mainstem reaches of the Snake and Columbia Rivers within the UCRB and EEIS planning areas. The species occurred in six ERUs and was present in the fewest subwatersheds of any of the seven key salmonids. Ocean-type chinook salmon are extinct in approximately 70 percent of the historical range, primarily as a result of blocked access to historical habitats. Remaining ocean-type chinook salmon stocks are depressed and at risk. Few healthy populations persist in the current range; 15 percent of the subwatersheds support strong populations and all of these are within the lower mainstem and mid-Columbia Rivers. Wild fish, unaltered by hatchery stocks, are rare and present in 5 percent of the historical range. Ocean-type chinook salmon stocks in the UCRB area are severely depressed and stocks in the Snake River are listed as a threatened species under the Endangered Species Act. As with steelhead and stream-type chinook salmon, we evaluated the alternatives on their own merits, regardless of future requirements for consultation under the ESA. Additional requirements under Section 7 of the Endangered Species Act would be expected to provide added protection of critical habitats. Management of FS- and BLM-administered lands will have a relatively minor influence on ocean-type chinook salmon populations; 14 percent of strong populations and 22 percent of depressed populations are on federally administered land (table 3.18). Approximately 10

percent of the depressed populations are in wilderness areas.

The effects of Federal land management on ocean-type chinook salmon are less direct than on steelhead trout and stream-type chinook, because ocean-type chinook depend on lower-elevation, mainstem river habitats. The species is proportionally more affected by a large number of other factors that operate outside of Federal lands in freshwater, estuaries, and the ocean environment. All of the migration corridors between freshwater spawning and rearing habitats and the ocean lie on private or tribal lands. Restoration of habitats and habitat connectivity in mainstem rivers will be necessary for ocean-type chinook salmon stocks to persist. Recent declines in ocean-type chinook salmon stocks can be attributed primarily to the construction and operation of mainstem dams on the Columbia and Snake Rivers (CBFWA 1990). With some exceptions, the resilience and persistence of ocean-type chinook salmon stocks will be largely dependent on the quality and diversity of mainstem habitats outside of Federal lands. For ocean-type chinook salmon to persist, the combination of factors that influence stocks over space and time needs to be addressed simultaneously.

Within the UCRB area, wild and naturally spawning stocks of ocean-type chinook salmon will require aggressive and extensive protection and restoration of mainstem spawning and rearing habitat and migration corridors to improve the likelihood of persistence. Management of Federal lands does not unilaterally influence the quality of most mainstem habitats, primarily because mainstem areas are profoundly influenced by activities outside of Federal lands. Mainstem areas might benefit from land management activities that substantially reduce sediment and ensure an abundant supply of water with suitable chemical and physical characteristics during key life history stages. In many cases, however, waters from Federal lands are obstructed and altered by dams and impoundments in their lower elevations. Federal land management does influence mainstem river conditions where tributaries enter mainstems directly.

In contrast, ocean-type chinook salmon stocks in the lower and mid-Columbia River areas of the EEIS area are relatively strong, though much of their range has been lost due to hydroelectric development and many stocks are heavily influenced by hatcheries.

As a result of the considerations described above, none of the alternatives would be expected to meet the habitat needs of the ocean-type chinook salmon, manage perceived threats, nor ensure persistence of the populations. Alternatives 6 and 7 have the most conservative approach to conserving and restoring watersheds. These alternatives might result in some benefit to ocean-type chinook salmon if actions tend to improve water quality and quantity on Federal lands through reductions in road densities, reduced timber harvest, reduced grazing, and adequate protection of RHCAs and RMAs (tables 3.11 and 3.20). It is uncertain if these effects would be sufficient to improve population persistence, however. The remainder of the alternatives (that is, Alternatives 1-5) would likely not benefit ocean-type chinook salmon because these alternatives continue land-disturbing activities and do not emphasize restoration of degraded mainstem habitats. In summary, none of the alternatives can be expected to ensure the persistence of ocean-type chinook salmon, and two have uncertain benefits. To ensure persistence, a comprehensive approach is needed that addresses the myriad factors that affect the species, both on and off of Federal lands.

Step 3: Evaluation of Effects on Sensitive Species

General Assumptions and Information Base

We made three general assumptions in addition to those mentioned above:

1. Management strategies for sensitive fishes with restricted, narrowly endemic distributions are more appropriately described at a fine scale

involving site-specific agreements and local land-use planning. Analyses of strategies at the broader scale, such as the ICBEMP preliminary draft EIS alternatives, are inappropriate for such species.

2. Nothing is designed or implied in the preliminary draft EIS alternatives that precludes or nullifies management agreements, recovery plans, biological opinions, or other documents that provide site-specific or species-specific strategies for sensitive, endemic taxa. In other words, whatever protections that are in place for sensitive species at local planning levels will remain in effect and applicable provisions contained in preliminary draft EIS alternatives will only add to existing measures, not substitute for them.
3. Species listed as threatened or endangered pursuant to the Endangered Species Act receive protection through Section 7 requirements, existing biological opinions, and critical habitat designations despite which preliminary draft EIS alternative is chosen.

To aid in our evaluation, we prepared summary tables, similar to those prepared for the key salmonids, that show levels of activity within the reported range of each species (table 3.27), mean values for selected variables across the historical and current range (table 3.28), and ownership and management designations (table 3.29). The effects of alternatives on 18 rare and sensitive fishes are summarized in table 3.30 by rating their ability to provide sufficient protection to halt further declines.

Pacific lamprey (*Lampetra tridentata*)

The distributional data for Pacific lamprey spawning and rearing areas are lacking in some regions. In general, our knowledge of this species precludes evaluation except that we believe juvenile steelhead approximate the distribution and habitat requirements of Pacific lamprey. We assume that the evaluation of alternatives for steelhead would serve as an appropriate proxy for Pacific lamprey.

Table 3.27. Forest and range management activities and distribution of select sensitive species. Estimates represent the percentage of the reported distribution predicted to experience the activity per decade. Estimates are based on the allocation of activities for alternatives in the preliminary draft EISs, and on the distributions of sensitive species as defined in Lee and others (1996).

Species	Alt.	Forest Activity				Range Activity	
		Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Pacific lamprey	1	6.6	3.0	1.2	2.0	6.4	1.2
	2	2.7	2.3	2.3	2.0	12.0	1.2
	3	4.8	4.0	2.3	4.0	11.7	18.2
	4	4.8	5.1	3.7	7.3	12.0	37.2
	5	4.8	4.6	3.2	5.5	10.5	20.6
	6	2.0	4.5	3.2	6.7	12.3	24.7
	7	1.6	2.3	1.2	3.3	15.7	10.2
Pit-Klamath brook lamprey	1	9.0	4.5	1.5	2.5	7.3	1.2
	2	2.3	4.3	1.7	2.5	14.0	1.2
	3	7.0	6.8	1.7	2.8	14.0	27.5
	4	7.0	7.0	4.0	9.8	14.0	38.0
	5	7.0	7.0	4.0	7.0	12.3	11.7
	6	2.5	6.8	4.0	9.8	14.0	11.7
	7	2.0	4.3	1.5	2.8	16.0	1.2
Lahontan cutthroat trout	1	0.0	0.0	0.0	0.0	3.0	1.2
	2	0.0	0.0	0.0	0.0	9.0	1.2
	3	0.0	0.0	0.0	0.0	3.0	38.0
	4	0.0	0.0	0.0	0.0	9.0	38.0
	5	0.0	0.0	0.0	0.0	9.0	38.0
	6	0.0	0.0	0.0	0.0	16.0	38.0
	7	0.0	0.0	0.0	0.0	16.0	1.2
Pygmy whitefish	1	6.6	3.3	1.5	2.5	8.1	0.8
	2	4.4	2.7	2.8	2.5	11.1	0.8
	3	5.2	4.8	2.8	4.8	11.1	16.8
	4	5.2	5.3	3.8	7.9	11.1	26.4
	5	6.8	5.1	2.8	3.9	11.1	0.8
	6	4.3	4.8	3.8	7.0	11.1	10.4
	7	2.0	1.5	1.5	5.6	11.1	0.8
Oregon Lakes tui chub	1	9.0	4.5	1.5	2.5	3.0	1.2
	2	2.0	4.5	1.5	2.5	9.0	1.2
	3	7.0	7.0	1.5	2.5	9.0	38.0
	4	7.0	7.0	4.0	10.0	9.0	38.0
	5	7.0	7.0	4.0	7.0	9.0	38.0
	6	2.5	7.0	4.0	10.0	9.0	38.0
	7	2.0	4.5	1.5	2.5	16.0	38.0
Leatherside chub	1	0.9	0.2	0.2	0.4	3.9	1.2
	2	0.3	0.2	0.2	0.4	10.1	1.2
	3	0.4	1.1	0.2	0.4	7.8	38.0
	4	0.4	1.1	0.2	1.1	10.1	38.0
	5	1.1	0.7	0.2	1.1	10.1	32.3
	6	0.4	1.1	0.2	1.1	12.8	32.3
	7	0.3	0.2	0.2	1.1	16.0	18.2

Table 3.27 (continued)

Species	Alt.	Forest Activity				Range Activity	
		Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Lost River sucker	1	9.0	4.5	1.5	2.5	8.3	1.2
	2	4.0	3.0	2.8	2.5	15.1	1.2
	3	7.0	5.8	2.8	4.8	15.1	33.4
	4	7.0	7.0	4.0	8.5	15.1	38.0
	5	7.0	7.0	4.0	7.0	14.4	5.8
	6	2.5	5.8	4.0	8.5	15.1	5.8
	7	2.0	3.0	1.5	4.8	16.0	1.2
Warner sucker	1	0.0	0.0	0.0	0.0	3.0	1.2
	2	0.0	0.0	0.0	0.0	9.0	1.2
	3	0.0	0.0	0.0	0.0	9.0	38.0
	4	0.0	0.0	0.0	0.0	9.0	38.0
	5	0.0	0.0	0.0	0.0	9.0	38.0
	6	0.0	0.0	0.0	0.0	9.0	38.0
	7	0.0	0.0	0.0	0.0	16.0	38.0
Goose Lake sucker	1	9.0	4.5	1.5	2.5	3.0	1.2
	2	2.0	4.5	1.5	2.5	9.0	1.2
	3	7.0	7.0	1.5	2.5	9.0	1.2
	4	7.0	7.0	4.0	10.0	9.0	38.0
	5	7.0	7.0	4.0	7.0	3.0	38.0
	6	2.5	7.0	4.0	10.0	9.0	38.0
	7	2.0	4.5	1.5	2.5	16.0	1.2
Shortnose sucker	1	9.0	4.5	1.5	2.5	8.1	1.2
	2	3.0	3.8	2.1	2.5	15.0	1.2
	3	7.0	6.4	2.1	3.6	15.0	32.5
	4	7.0	7.0	4.0	9.3	15.0	38.0
	5	7.0	7.0	4.0	7.0	14.1	6.7
	6	2.5	6.4	4.0	9.3	15.0	6.7
	7	2.0	3.8	1.5	3.6	16.0	1.2
Klamath largescale sucker	1	9.0	4.5	1.5	2.5	6.6	1.2
	2	2.6	4.0	1.9	2.5	13.2	1.2
	3	7.0	6.6	1.9	3.2	13.2	23.1
	4	7.0	7.0	4.0	9.5	13.2	38.0
	5	7.0	7.0	4.0	7.0	10.7	16.2
	6	2.5	6.6	4.0	9.5	13.2	16.2
	7	2.0	4.0	1.5	3.2	16.0	1.2
Wood River bridgelip sucker	1	2.4	0.6	0.6	1.0	3.0	1.2
	2	0.8	0.6	0.6	1.0	9.0	1.2
	3	1.0	2.8	0.6	1.0	9.0	38.0
	4	1.0	2.8	0.6	2.8	9.0	38.0
	5	2.8	1.8	0.6	2.8	9.0	38.0
	6	1.0	2.8	0.6	2.8	9.0	38.0
	7	0.8	0.6	0.6	2.8	16.0	38.0

Table 3.27 (continued)

Species	Alt.	Forest Activity				Range Activity	
		Harvest	Thinning	Watershed Restoration	Prescribed Burning	Livestock Management	Riparian Restoration
Torrent sculpin	1	7.3	3.6	1.2	2.1	3.4	0.8
	2	4.1	3.2	1.6	2.1	7.5	0.8
	3	5.7	5.4	1.6	2.7	7.0	15.5
	4	5.7	5.8	3.2	6.3	7.5	24.1
	5	7.2	5.7	2.0	3.6	7.0	14.7
	6	4.2	5.4	3.2	6.3	8.0	14.7
	7	1.6	1.8	1.2	5.0	10.1	8.9
Shorthead sculpin	1	6.3	3.1	1.4	2.3	3.9	0.8
	2	3.2	2.9	2.2	2.3	7.8	0.8
	3	4.8	4.7	2.2	3.7	6.8	20.2
	4	4.8	5.0	3.6	7.8	7.8	24.3
	5	6.0	4.7	2.7	4.1	7.3	13.5
	6	3.6	4.9	3.4	7.0	9.0	14.6
	7	1.8	2.0	1.4	4.1	10.2	4.3
Slender sculpin	1	9.0	4.5	1.5	2.5	9.0	1.2
	2	3.3	3.5	2.3	2.5	16.0	1.2
	3	7.0	6.2	2.3	4.0	16.0	38.0
	4	7.0	7.0	4.0	9.0	16.0	38.0
	5	7.0	7.0	4.0	7.0	16.0	1.2
	6	2.5	6.2	4.0	9.0	16.0	1.2
	7	2.0	3.5	1.5	4.0	16.0	1.2
Margined sculpin	1	3.5	1.8	0.6	1.0	3.0	1.2
	2	0.8	1.8	0.6	1.0	9.0	1.2
	3	2.7	2.7	0.6	1.0	9.0	1.2
	4	2.7	2.7	1.6	3.9	9.0	38.0
	5	2.7	2.7	1.6	2.7	9.0	38.0
	6	1.0	2.7	1.6	3.9	9.0	38.0
	7	0.8	1.8	0.6	1.0	16.0	38.0
Wood River sculpin	1	3.4	0.8	0.8	1.4	3.0	1.2
	2	1.1	0.8	0.8	1.4	9.0	1.2
	3	1.4	3.9	0.8	1.4	9.0	38.0
	4	1.4	3.9	0.8	3.9	9.0	38.0
	5	3.9	2.5	0.8	3.9	9.0	38.0
	6	1.4	3.9	0.8	3.9	9.0	38.0
	7	1.1	0.8	0.8	3.9	16.0	38.0
Malheur sculpin	1	2.7	1.4	0.5	0.8	3.0	1.2
	2	0.6	1.4	0.5	0.8	9.0	1.2
	3	2.1	2.1	0.5	0.8	9.0	38.0
	4	2.1	2.1	1.2	3.0	9.0	38.0
	5	2.1	2.1	1.2	2.1	9.0	38.0
	6	0.8	2.1	1.2	3.0	9.0	38.0
	7	0.6	1.4	0.5	0.8	16.0	38.0

Table 3.28. Means for landscape variables associated with the historical range of 17 select sensitive species. The species' distributions and the summary of landscape variables are as defined in Lee and others (1996).

Species	Range	Number of watersheds	Variables								
			anadac ¹	dampass ²	drnden ³	elev ⁴	mttemp ⁵	pprecip ⁶	rdmean0 ⁷	slope ⁸	huorder ⁹
Goose Lake sucker	historical	11	0	0	1.15	5400	6.59	531	2.4	12.1	4.1
	current absent	4	0	0	0.98	5240	6.74	519	1.7	10.9	8.4
	current present	7	0	0	1.22	5476	6.53	536	2.8	12.6	2.1
Klamath largescale sucker	historical	39	0	0	0.61	4912	6.41	565	2.9	9.0	19.1
	current absent	7	0	0	0.78	5184	5.83	520	3.2	8.6	7.3
	current present	32	0	0	0.57	4846	6.55	577	2.9	9.0	22.0
Warner sucker	historical	20	0	0	1.09	5321	6.84	431	1.3	8.9	7.4
	current absent	12	0	0	1.11	5371	6.64	446	1.3	8.1	2.6
	current present	8	0	0	1.07	5259	7.07	411	1.2	10.0	13.4
Short nose sucker	historical	26	0	0	0.58	4837	6.61	538	2.8	9.3	25.5
	current absent	7	0	0	0.26	4535	7.75	394	2.6	8.8	24.9
	current present	19	0	0	0.64	4885	6.43	561	2.9	9.3	25.6
Lost River sucker	historical	13	0	0	0.48	4674	7.08	488	2.5	9.8	27.1
	current absent	6	0	0	0.44	4718	7.53	419	2.6	8.1	15.9
	current present	7	0	0	0.51	4641	6.73	542	2.4	11.0	35.7
Malheur sucker	historical	43	0	0	1.09	4924	6.52	386	1.8	8.2	12.1
	current absent	10	0	0	1.01	5006	7.05	418	1.4	9.0	14.9
	current present	33	0	0	1.13	4885	6.27	370	2.0	7.8	10.7
Shorthead sculpin	historical	784	0.49	3.11	1.23	4718	5.24	753	1.5	20.1	49.6
	current absent	712	0.53	3.35	1.24	4697	5.30	744	1.4	20.1	53.2
	current present	72	0.15	0.77	1.18	4915	4.73	840	1.9	20.6	15.1
Wood River sculpin	historical	34	0	0	1.27	5724	4.58	441	1.2	15.3	12.9
	current absent	9	0	0	1.14	4725	5.64	348	1.7	7.4	18.4
	current present	25	0	0	1.32	6183	4.24	484	1.0	18.9	10.3
Margined sculpin	historical	37	0.81	4.25	1.28	2178	9.22	536	1.2	13.1	80.8
	current absent	19	0.82	3.93	1.27	1891	9.75	487	1.0	12.5	158.4
	current present	18	0.81	4.55	1.29	2441	8.74	580	1.4	13.6	9.7
Torrent sculpin	historical	459	0.53	3.29	1.17	3890	6.34	680	1.7	17.8	258.3
	current absent	369	0.57	3.68	1.19	3947	6.31	673	1.6	17.8	259.5
	current present	90	0.38	1.95	1.11	3689	6.43	703	2.0	17.7	253.9

Table 3.28 (continued)

Species	Range	Number of watersheds	Variables								
			anadac ¹	dampass ²	drndent ³	elev ⁴	ntemp ⁵	pprecip ⁶	rdmean0 ⁷	slope ⁸	hucorder ⁹
Slender sculpin	historical	13	0	0	0.63	4830	6.33	542	2.9	9.8	30.9
	current absent	5	0	0	0.65	4729	6.66	282	3.4	9.7	15.1
	current present	8	0	0	0.62	4873	6.20	650	2.7	9.8	37.5
Oregon Lakes tui chub	historical	3	0	0	0.96	4835	7.41	389	1.2	10.3	14.7
	current absent	0	—	—	—	—	—	—	—	—	—
	current present	3	0	0	0.96	4835	7.41	389	1.2	10.3	14.7
Leatherside chub	historical	115	0	0	1.25	6026	5.02	512	0.9	13.4	53.6
	current absent	102	0	0	1.25	6124	4.93	529	0.9	13.8	58.3
	current present	13	0	0	1.21	5285	5.95	389	1.3	10.8	17.5
Pit-Klamath brook lamprey	historical	14	0	0	0.93	5146	6.01	618	3.1	9.3	15.8
	current absent	0	—	—	—	—	—	—	—	—	—
	current present	14	0	0	0.93	5146	6.01	618	3.1	9.3	15.8
Pacific lamprey	historical	1317	0.53	3.27	1.23	4295	6.46	588	1.4	17.1	156.9
	current absent	1132	0.46	2.99	1.25	4440	6.35	593	1.4	16.7	91.2
	current present	185	0.91	4.78	1.13	3511	7.06	562	1.5	19.2	512.3
Lahontan cutthroat trout	historical	8	0	0	1.23	5286	7.82	305	0.6	11.2	5.3
	current absent	6	0	0	1.18	5153	7.90	300	0.7	10.7	6.1
	current present	2	0	0	1.44	5853	7.47	326	0.3	13.1	2.2
Pygmy whitefish	historical	34	0	0	0.96	3558	5.57	809	1.7	19.2	321.0
	current absent	11	0	0	0.86	2772	6.81	542	1.7	18.2	714.4
	current present	23	0	0	1.02	3953	4.94	943	1.8	19.8	123.4

¹anadac – access for anadromous fish (0 = no; 1 = yes).²dampass – number of intervening dams.³drden – drainage density (mi/mi²).⁴elev – mean elevation (ft).⁵mtmp – mean annual temperature.⁶pprecip – mean annual precipitation.⁷rdmean0 – mean road density.⁸slope – area weighted average midslope.⁹hucoder – number of upstream 6th-code hydrologic units.

Table 3.29. Summary of current reported distributions of 17 select sensitive species versus ownership and land management designation for each watershed. The data represent a summary of the assemblage database by management cluster as defined in Lee and others (1996).

Species	Range	Number of watersheds	Management Clusters'									
			BR	FG	FH	FM	FW	NP	PA	PF	PR	TL
Goose Lake sucker	historical	11	0	0	0.320	0	0	0	0.140	0.520	0.027	0
	current absent	4	0	0	0.310	0	0	0	0.430	0.250	0.000	0
	current present	7	0	0	0.320	0	0	0	0.000	0.640	0.040	0
Klamath largescale sucker	historical	39	0.027	0.006	0.300	0.037	0.016	0	0.052	0.54	0.019	0
	current absent	7	0	0	0.440	0	0	0	0.036	0.52	0	0
	current present	32	0.033	0.008	0.270	0.046	0.020	0	0.056	0.54	0.024	0
Warner sucker	historical	20	0.690	0	0.056	0	0	0	0	0.019	0.210	0
	current absent	12	0.800	0	0.100	0	0	0	0	0.035	0.063	0
	current present	8	0.550	0	0	0	0	0	0	0	0.400	0
Shortnose sculpin	historical	26	0.039	0.009	0.180	0.047	0.023	0	0.076	0.600	0.028	0
	current absent	7	0	0	0	0.025	0	0	0.250	0.670	0.050	0
	current present	19	0.045	0.011	0.210	0.051	0.027	0	0.048	0.580	0.025	0
Lost River sculpin	historical	13	0.071	0	0.085	0.011	0.042	0	0.088	0.650	0.052	0
	current absent	6	0.160	0	0.160	0	0	0	0.120	0.440	0.120	0
	current present	7	0	0	0.026	0.020	0.075	0	0.064	0.810	0	0
Malheur sculpin	historical	43	0.500	0	0.240	0	0	0	0.019	0.031	0.220	0
	current absent	10	0.570	0	0.046	0	0	0	0.044	0	0.340	0
	current present	33	0.460	0	0.330	0	0	0	0.007	0.045	0.160	0
Shorthead sculpin	historical	784	0.083	0.077	0.090	0.170	0.140	0.014	0.130	0.18	0.083	0.041
	current absent	712	0.083	0.071	0.085	0.170	0.140	0.011	0.130	0.18	0.086	0.041
	current present	72	0.085	0.13	0.140	0.190	0.110	0.047	0.051	0.13	0.054	0.044
Wood River sculpin	historical	34	0.300	0.190	0.031	0	0	0	0.088	0	0.290	0
	current absent	9	0.230	0	0	0	0	0	0.21	0	0.260	0
	current present	25	0.340	0.280	0.045	0	0	0	0.032	0	0.310	0
Margined sculpin	historical	37	0	0.036	0.036	0.013	0	0	0.730	0.080	0.110	0
	current absent	19	0	0.033	0	0	0	0	0.760	0.080	0.120	0
	current present	18	0	0.039	0.068	0.026	0	0	0.690	0.080	0.093	0
Torrent sculpin	historical	459	0.041	0.033	0.076	0.150	0.100	0	0.240	0.220	0.089	0.043
	current absent	369	0.025	0.033	0.069	0.130	0.120	0	0.270	0.220	0.088	0.051
	current present	90	0.098	0.034	0.100	0.260	0.026	0	0.160	0.220	0.091	0.015

Table 3.29 (continued)

Species	Range	Number of watersheds	Management Clusters ¹									
			BR	FG	FH	FM	FW	NP	PA	PF	PR	TL
Slender sculpin	historical	13	0	0	0.210	0.029	0.041	0	0.035	0.680	0	0
	current absent	5	0	0	0.170	0.043	0	0	0	0.790	0	0
	current present	8	0	0	0.230	0.023	0.058	0	0.050	0.640	0	0
Oregon Lakes tui chub	historical	3	0.650	0	0	0	0	0	0	0.089	0.26	0
	current absent	0	0	0	0	0	0	0	0	0	0	0
	current present	3	0.650	0	0	0	0	0	0	0.089	0.26	0
Leatherside chub	historical	115	0.440	0.085	0.056	0	0.065	0.086	0.072	0.041	0.099	0.023
	current absent	102	0.460	0.079	0.056	0	0.074	0.097	0.078	0.032	0.097	0.026
	current present	13	0.350	0.130	0.055	0	0	0	0.022	0.1	0.12	0
Pit-Klamath brook lamprey	historical	14	0	0	0.280	0.015	0.048	0	0.063	0.6	0	0
	current absent	0	0	0	0	0	0	0	0	0	0	0
	current present	14	0	0	0.280	0.015	0.048	0	0.063	0.6	0	0
Pacific lamprey	historical	1317	0.200	0.068	0.110	0.058	0.090	0	0.170	0.130	0.130	0.037
	current absent	1132	0.240	0.077	0.110	0.055	0.081	0	0.150	0.120	0.130	0.042
	current present	185	0.003	0.022	0.120	0.072	0.140	0	0.290	0.190	0.150	0.010
Lahontan cutthroat trout	historical	8	0.900	0	0	0	0	0	0	0	0.097	0
	current absent	6	0.880	0	0	0	0	0	0	0	0.120	0
	current present	2	1	0	0	0	0	0	0	0	0	0
Pygmy whitefish	historical	34	0	0.035	0.010	0.240	0.024	0.019	0.100	0.400	0	0.170
	current absent	11	0	0.100	0.029	0.038	0	0	0.240	0.330	0	0.260
	current present	23	0	0	0	0.340	0.037	0.029	0.036	0.430	0	0.120

¹BR = BLM rangelands; FG = FS forest and rangeland, moderate impact, grazed; FH = FS forest, high impact, grazed; FM = FS forest, high-moderate impact, no grazing; FW = FS-managed wilderness; NP = NPS forestland; PA = Private land and FS forestland; PR = Private and BLM rangeland; TL = Tribal lands.

Table 3.30. Evaluation of effects of alternatives on rare and sensitive fishes. The table answers the question, “Will the alternative provide sufficient protection to prevent declines in habitats and populations of 18 rare and sensitive fish species?”

Species	Proxy for Analysis	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Pygmy whitefish	None	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shortnose sucker, Lost River sucker, Klamath largescale sucker, Slender sculpin ¹	None	No	Yes	Yes	Yes	No	Yes	Yes
Warner sucker, Redband trout ²	None	No	No	U ³	U ³	No	U ³	U ³
Wood River sculpin, Wood River bridgelip sucker ⁴	None	No	Yes	Yes	Yes	No	Yes	Yes
Malheur sculpin, Redband trout ⁵	None	No	No	U ³	U ³	No	U ³	U ³
Pacific lamprey	Juvenile steelhead trout	No	No	No	U ³	No	Yes	U ³
Pit-Klamath brook lamprey	Goose Lake sucker, Redband trout ¹	No	U ³	UV	U ³	No	U ³	U ³
Goose Lake sucker	Redband trout	No	No	U ³	U ³	No	U ³	U ³
Torrent sculpin	Westslope cutthroat	No	No	No	No	No	U ³	Yes
Shorthead sculpin	Bull trout	No	No	No	U ³	No	U ³	U ³
Margined sculpin	Redband trout	No	No	U ³	U ³	No	U ³	Yes
Lahontan cutthroat trout	Protected under the ESA, Section 7, regardless of the alternative.							
Oregon Lakes tui chub	Information on current distributions and status of these species was insufficient for analysis.							
Leatherside chub								

¹ Klamath Basin Rare and Sensitive Fishes.

² Occur in the Warner Basin.

³ U = Uncertain.

⁴ Wood River Sensitive Fishes.

⁵ Occur in the Harney Basin.

Refer to “Findings by Species, Steelhead” section of this chapter for a discussion of how alternatives would affect Pacific lamprey. Within the assessment area, Pacific lamprey and steelhead are believed to spawn in many of the same streams and the young of both species utilize similar rearing streams and would respond similarly to management activities. Strongholds for steelhead also are believed to be important areas for lamprey. As both species are anadromous, both are affected by dams and hydroelectric operations. Both species are harvested, although lampreys are taken as ammocoetes for bait and by Native Americans for

ceremonial purposes. The fringe population of Pacific lampreys noted in the Klamath Basin may represent Klamath lampreys (*Lampetra similis*) or a land-locked form of Pacific lamprey. Moyle and others (1995) noted substantial confusion regarding lamprey taxonomy and identification in the Klamath Basin.

Pit-Klamath brook lamprey (*Lampetra lethophaga*)

The Pit-Klamath brook lamprey is a non-parasitic lamprey native to the Upper Klamath Basin and

upper Pit River (such as the Goose Lake Basin). This non-anadromous species completes its life cycle in small streams and moderate-size rivers. Relatively little is known about its distribution and life history requirements, but we assume them to be similar to other native, stream-dwelling fishes within this area. Based on distribution, two proxies would be appropriate for this species: Klamath Basin sensitive fishes for that portion of the Pit-Klamath brook lamprey's range in the Klamath Basin, and the Goose Lake sucker and redband trout for that portion of the lamprey's range in the Goose Lake Basin. Refer to "General Assumptions and Information Base", "Klamath Basin rare and sensitive fishes", and "Goose Lake sucker and redband trout in the Goose Lake basin" sections for a discussion of how alternatives would affect the Pit-Klamath brook lamprey. It is uncertain whether any alternative would prevent declines in populations and habitats of this species; Alternatives 1 and 5 would not prevent declines.

Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)

Populations of Lahontan cutthroat trout within the assessment area comprise the northern fringe of the distribution of this subspecies. Populations in Willow and Whitehorse Creeks within the assessment area were long-considered to comprise a separate subspecies and should be accorded special emphasis because of their long isolation from other Lahontan cutthroat trout and their occurrence in the most northerly native habitats of the subspecies. Populations in Washington, and in Oregon's Mann Lake are introduced, are of uncertain genetic purity, and are not considered further for purposes of this analysis. The subspecies is listed as threatened pursuant to the ESA throughout its range. Populations within the assessment area have received special emphasis through ESA Section 7 consultation, particularly as pertaining to effects of livestock grazing, which comprises the principal threat in addition to non-native trout introductions. Because the preliminary draft EIS alternatives would provide little protection beyond that already stipulated in Section 7 biological

opinions and recovery planning documents, and because Section 7 requirements would remain in place regardless of the alternative selected, we believe that the Lahontan cutthroat trout in the assessment area would not be adversely affected by the selection of a preliminary draft EIS alternative.

Pygmy whitefish (*Prosopium coulteri*)

Pygmy whitefish are widely distributed in deep lakes and coldwater streams in the northern, glaciated portions of the Columbia River Basin. They often occur in lakes, but may move to smaller tributary streams for spawning. Water quality and maintenance of instream flows in tributary streams are the primary factors needed to maintain the species. Unlike many of the sensitive fishes in our analysis, we believe that the lake habitats of pygmy whitefish are less likely to be negatively impacted by management activities on FS- or BLM-administered lands. Only 33 percent of existing populations occur on FS- or BLM-administered lands (table 3.29). In general, we believe that all alternatives offer at least minimal protections needed by this species. Alternatives 1 and 5 would offer less protection than other alternatives because of greater timber harvests and road construction associated with these alternatives (table 3.27). Nonetheless, we believe that populations can persist with implementation of any alternative.

Oregon Lakes tui chub (*Gila bicolor oregonensis*)

The Oregon Lakes tui chub is endemic to Oregon's Abert Lake Basin, including the Chewaucan River and XL Spring. Agricultural practices, livestock grazing, and introductions of non-native species are the primary factors affecting this species. Unfortunately, no recent information is available on population status. Tui chubs in nearby Summer Lake Basin have hybridized with chubs from outside the basin, which were presumably introduced as bait fish for introduced rainbow trout. The Summer Basin tui chub, therefore,

is considered to be at high risk of extinction. As tui chub populations in the Chewaucan River occur below trout fisheries, the possibility exists for genetic contamination from introduced fish. The population at XL Spring is on private land and its status is unknown, but we presume it would not be affected by the preliminary draft EIS alternatives. With so little information available, we concluded that an evaluation of alternatives for the Oregon Lake tui chub was not possible at this time.

Leatherside chub (*Gila copei*)

Within the assessment area, the leatherside chub has been reported from the 1940s to the 1970s in widely-scattered areas of the Upper Snake and Big Wood drainages in Idaho. More recent surveys conducted in 1995 (Belk and Wilson 1995) found leatherside chubs in the Goose Creek drainage south of Burley, Idaho, but otherwise no recent collections are known. Because of the scarcity of distribution data and habitat-requirement data, we did not believe that there was sufficient information to perform an analysis of alternatives for this species.

Klamath Basin rare and sensitive fishes

Because of similar distributions, habitat requirements, and/or threats, the following Klamath Basin fishes were considered as one group for our analysis: shortnose sucker (*Chasmistes brevirostris*), Lost River sucker (*Deltistes luxatus*), Klamath largescale sucker (*Catostomus snyderi*), and slender sculpin (*Cottus tenuis*). The endangered shortnose and Lost River suckers are restricted primarily to Upper Klamath and Agency Lakes except for spawning runs into tributary streams. The Klamath largescale sucker occupies Upper Klamath and Agency Lakes, but also may occur in a resident stream form, inhabiting larger streams such as the Sprague, Sycan, Wood, and Williamson Rivers. The slender sculpin occurs in the same habitats as the catostomids as well as some smaller streams in the Upper Klamath Basin. For considerations of land management activities, all of these

taxa are affected by deteriorating water quality in streams and downstream lake habitats. Timber harvesting and associated road-building activities, livestock grazing, and riparian area management are among the primary factors influencing water quality in streams and lakes of the Klamath Basin.

Alternatives 1 through 7—Under Alternative 1 we believe that the Klamath Basin sensitive fishes would continue to decline and would face increasing deterioration of water quality throughout the basin. Timber harvesting and livestock grazing, both of which contribute to deterioration of water quality in the basin, would remain at relatively high levels under Alternative 1. Alternative 2 would tend to maintain existing conditions with little deterioration of habitat quality, but also with little improvement because of low emphasis on restoration efforts. The net impacts of Alternative 3 would be similar to Alternative 2, although Alternative 3 proposes moderate tree harvest and high emphasis on restoration activities. Alternative 4 was rated as the best for the sensitive Klamath Basin fishes because this alternative included the highest levels of restoration activities. Aquatic and riparian habitats in the Klamath Basin have deteriorated substantially from overgrazing by livestock and high levels of timber harvest and road construction. Increased protection and restoration activities are both vital for long-term persistence of sensitive fish species. Restoration efforts would likely provide benefits for endangered and sensitive fishes in the Klamath Basin. Under Alternative 5, we would anticipate continued decline and deterioration of water quality because of moderate to high levels of resource use and low emphasis on restoration programs. For Alternative 5, activities such as livestock grazing, road building, and timber harvesting would be more likely to contribute to the deterioration of water quality given the protection of narrower riparian zones under this alternative. For Alternative 6, we would anticipate results similar to Alternatives 2 and 3 because of lower resource use. Alternative 6 also includes low levels of restoration activities, which results in a lower rating than Alternative 4. Alternative 7 would

result in increased protection of existing habitats and would include a higher level of livestock management as well as a 50 percent reduction in AUMs which should result in a significant reduction in grazing impacts. Overall, Alternative 7 was rated quite high because the broader riparian zones within this alternative's aquatic conservation strategy would provide substantial protection against sediment entering streams and contribute to deterioration of water quality in the Klamath Basin.

Goose Lake sucker (*Catostomus occidentalis lacusanseirinus*) and redband trout (*Oncorhynchus mykiss* ssp.) in the Goose Lake Basin

Redband trout in the Goose Lake Basin are a good proxy for the Goose Lake sucker. Both sensitive fishes occur in Goose Lake, tributary streams, and to a lesser extent, in reservoirs in the Goose Lake Basin. Historically, populations of the Goose Lake sucker and redband trout ascended larger streams tributary to Goose Lake in the spring during spawning runs. Both fishes are impacted by livestock grazing, riparian management, and overall water quality. Habitats for both fishes are highly degraded compared to historical conditions. Rangeland management issues are of primary concern for both taxa. Redband trout in the Goose Lake Basin also occur in slightly higher elevation streams than do the Goose Lake suckers and, therefore, may be adversely affected by timber harvest and road construction as well.

Alternatives 1 through 7—Under Alternative 1, conditions would continue to deteriorate. This alternative offers the least protection for rangeland riparian habitats because AUMs would remain relatively high compared to that of other alternatives. Timber harvest levels in Alternative 1 would remain high, negatively affecting headwater populations and downstream water quality (table 3.27). Existing riparian management zones and buffer widths have not proven to be adequate in reducing disturbances from livestock grazing, road building, and timber harvesting. Alternative 2 was rated fair because of increased riparian area pro-

tection, but still below most alternatives. Riparian habitat conservation areas for Alternative 2 offer improved protection from adverse impacts associated with livestock grazing when compared to existing conditions. The strength of Alternative 2 is in protection with little emphasis on restoration activities. Alternative 3 also would result in a gradual improvement over existing conditions because of more emphasis on restoration activities and improved riparian zone management through the aquatic conservation strategy. Alternatives 4 and 6 were rated the same and considerably above existing conditions. The higher ratings were warranted because of slightly lower AUMs and slightly higher levels of restoration. For both of these alternatives, improved riparian zone management would decrease impacts associated with livestock grazing. Alternative 5 was rated poorly because of high livestock grazing and little restoration. For Alternative 5, activities such as livestock grazing, road building, and timber harvesting would be more likely to contribute to deterioration of water quality given the narrower protection of riparian zones described for this alternative. Although Alternative 7 would result in greatest reduction in AUMs and most restrictive riparian management standards and guidelines, the effect on the Goose Lake sucker is uncertain as the models for redband trout indicate declines in the Goose Lake Basin. In general, riparian areas would receive the greatest protection under this alternative and have the potential to quickly respond with improved habitat conditions.

Warner sucker (*Catostomus warnerensis*) and redband trout (*Oncorhynchus mykiss* ssp.) in the Warner Basin

The Warner sucker, a threatened species pursuant to the ESA, occupies lake and stream habitats in Oregon's Warner Basin. A small portion of the species range also extends into the California portion of the basin. All remaining populations of the species primarily occur at lower elevations in the basin (table 3.28), and are affected by livestock grazing, riparian area management, and agricul-

tural practices. Approximately 55 percent of the current populations are on BLM-administered rangelands (table 3.29). Lake habitats are dominated by introduced species, which pose additional problems by preying on larval and juvenile Warner suckers. Historical and current distributions of the Warner sucker are largely sympatric with the redband trout native to the Warner Basin, although in one or two localities, redband trout extend their distribution further into headwater areas. We believe that the Warner sucker and Warner Basin form of redband trout can be analyzed together for the purposes of this panel.

Alternatives 1 through 7—Alternative 1 would continue declines of the Warner sucker and redband trout because of relatively high levels of livestock grazing, less emphasis on livestock management, and little riparian restoration. While the number of AUMs would decrease in all alternatives, the least declines are associated with Alternatives 1 and 5, with the greatest decrease in AUMs occurring with Alternative 7. According to our analysis (table 3.27), the treatment level for livestock management is smallest for Alternative 1, moderate for Alternatives 2 to 6, and highest for Alternative 7. A higher level of livestock management should result in better management of grazing and therefore result in fewer impacts to critical riparian habitats. Our analysis of riparian restoration activities (table 3.27) indicates that Alternatives 1 and 2 include very little emphasis on riparian restoration, with high levels of riparian restoration occurring in Alternatives 3 to 7. Overall, Alternative 2 rated slightly higher than current conditions because of improved riparian management and a higher level of livestock management. Alternative 3 also rated higher than existing conditions because of a much greater emphasis on riparian restoration. Riparian areas quickly improve in condition with better protection and restoration programs. Alternatives 4 and 6 were rated the same and considerably above existing conditions. The higher ratings were warranted because of slightly lower AUMs and slightly higher levels of restoration. Alternative 5 was rated poorly because of high livestock grazing. As

noted in other discussions, narrower riparian management zones associated with this alternative would be more likely to result in loss of riparian function given higher livestock use. We believe that Alternative 7 would result in the best conditions for the Warner sucker and redband trout in the Warner Basin because this alternative would result in the greatest reduction in AUMs and the most restrictive riparian management standards and guidelines. As a result, riparian areas would receive the greatest protection under this alternative and should quickly respond with improved habitat conditions. Still, we are uncertain that this alternative would prevent declines in habitats and populations of the Warner sucker.

Wood River sensitive fishes

The Wood River sculpin (*Cottus leiopomus*) and Wood River bridgelip sucker (*Catostomus columbianus hubbsi*) are endemic to rivers and streams in Idaho's Big Wood and Little Wood drainages. Although precise distribution information is lacking for the suckers, both species appear to prefer fast-flowing stream and river habitats of high quality. Their ranges are believed to be sympatric over much of the Wood River Basin. Key factors influencing their status include diversions and channelization, loss of riparian habitats, development of floodplains, overgrazing by livestock, and reduced water quality. Approximately 67 percent of existing populations of both fishes occur on FS- or BLM-administered lands (table 3.29). Because of similar ranges, habitat requirements, and threats, we considered both taxa to be subject to the same evaluation of alternatives.

Alternatives 1 through 7—For all alternatives, activities that substantially improve riparian habitat conditions will do the most for persistence of these fishes on Federal lands. Timber harvest and roads will influence water quality, but will not be as important as grazing and riparian management practices for these species that occur in lower-elevation portions of the drainages. Under Alternative 1, we believe that many of the factors that have resulted in declines of these taxa would

continue. Timber harvest levels and grazing levels would be highest under this alternative, which would contribute to continued loss of riparian function and reduced water quality. For Alternative 2, timber harvest would be the lowest of any alternatives (only Alternative 7 is equally low) and levels of livestock management would be moderate (Alternatives 2 through 6 would have equal levels of livestock management activities, see table 3.27). Riparian restoration activities would be low for Alternative 2. Overall, conditions for Wood River sensitive fishes should improve under Alternative 2 compared to existing conditions. Habitat conditions under Alternative 3 also should improve compared to existing conditions, but with slightly more timber harvest and riparian restoration activities. Management under Alternatives 4 and 6 also should improve conditions compared to existing habitat quality. Both Alternatives 4 and 6 should result in improvements for these sensitive fishes. We believe that under Alternative 5, impacts of livestock grazing and timber harvest would continue to cause problems and loss of habitat quality. The combination of narrow riparian management zones with relatively high levels of livestock grazing and timber harvest would be detrimental to these fishes. Overall, trends of sensitive fishes would be similar between Alternative 5 and existing conditions. Alternative 7 would have lowest AUMs and highest levels of livestock management activities of any alternative, which would result in the highest relative improvement of riparian conditions. Alternative 7 also would have the lowest timber harvest levels. Overall, Alternative 7 would be the most beneficial for these species, although their status also should improve under Alternatives 2, 3, 4, and 6.

Malheur sculpin (*Cottus bairdi* ssp.) and redband trout (*Oncorhynchus mykiss* ssp.) in the Harney Basin

The Malheur sculpin is endemic to streams in Oregon's Harney Basin. This sculpin requires coolwater streams of high quality. High levels of sediments are not tolerated. Within Harney Basin, the distribution of the Malheur sculpin is sym-

patric with that of the redband trout. Both the Malheur sculpin and redband trout are adversely affected by activities that increase water temperature, turbidity, and sediment loads. Livestock grazing, road building, and timber harvesting are primary activities affecting these taxa on FS- and BLM-administered lands. Because of similarity in distribution, habitat requirements, and threats, we considered both taxa to be subject to the same evaluation of alternatives. The form of redband trout in Harney Basin is often considered to be distinct because of its extended isolation from other stocks.

Alternatives 1 through 7—Under Alternative 1 we believe that conditions for the Malheur sculpin and redband trout would continue to deteriorate and that this alternative offers the least protection for rangeland riparian habitats because AUMs would only decrease slightly compared to that of other alternatives. Alternative 1 also includes the highest level of timber harvest of any alternative within the range of the Malheur sculpin (table 3.27). Alternative 2 is rated higher than existing conditions because of increased riparian area protection and reduced timber harvest. We believe that Alternative 3 also would result in improvements from existing conditions because of more emphasis on riparian restoration activities. Alternatives 4 and 6 were rated the same and much above existing conditions. The higher ratings were warranted because of slightly lower AUMs and slightly higher levels of restoration. Alternative 5 was rated lower because of higher levels of livestock grazing. As noted in discussions of other sensitive fishes, the narrower riparian management areas associated with Alternative 5 coupled with relatively high levels of livestock grazing would decrease proper functioning condition of riparian areas. We believe that Alternative 7 would result in the best conditions for the Harney Basin sensitive fishes because it would result in the greatest reduction in AUMs, lowest timber harvest levels, highest level of livestock management, and most restrictive riparian management standards and guidelines. As a result, riparian areas would receive the

greatest protection under this alternative and should quickly respond with improved habitat conditions. All Alternatives except 1 and 5 should improve conditions for these sensitive fishes, yet the ability of even the most protective alternatives to prevent declines in habitats and populations remains uncertain.

Torrent sculpin (*Cottus rhotheus*)

Historically, torrent sculpin were widely distributed within the Columbia River drainage. Many of the cold, clear waters preferred by the torrent sculpin and other species (such as, shorthead sculpin, bull trout, westslope cutthroat trout, and redband trout) have been degraded by timber harvest and associated road construction. Although the current distribution of torrent sculpin clearly has declined, our knowledge is limited because in much of the assessment area, sculpins often are reported generically as *Cottus* sp. with little attention paid to specific identification. The species prefers coldwater streams and smaller rivers, and typically occurs at lower elevations than the shorthead sculpin. Approximately 52 percent of the existing populations occur on FS- or BLM-administered lands (table 3.29). We believe that westslope cutthroat trout are an appropriate proxy for torrent sculpin in that they occupy many of the same habitats and have similar requirements for cold, high-quality habitat conditions. There is a strong association between the distributions of westslope cutthroat trout and torrent sculpin (chi-square test of independence, $P < 0.01$). Refer to section "Projected Effects on Widely-Distributed Salmonid Species" on westslope cutthroat trout for a discussion of how alternatives would affect torrent sculpin. Unlike westslope cutthroat or redband trout, however, torrent sculpin have less vagility (that is, less capacity or tendency to become widely dispersed). Once eliminated from a river system, they are unlikely to recolonize without artificial assistance. Alternatives with high riparian zone protection would be most advantageous for this species. For restoration efforts to be successful, transplants of the torrent sculpin into restored areas would likely be necessary.

Shorthead sculpin (*Cottus confusus*)

Historically, shorthead sculpin were widely distributed within the Columbia River drainage. In the lower Columbia River drainage, they are known from the Deschutes, Yakima, Wenatchee, and John Day River drainages. In the mid and upper Columbia River drainage, shorthead sculpin are known from the Snake, Spokane, Pend Oreille, Kootenai, Coeur d'Alene, and St. Joe River drainages. Many of the cold, clear waters preferred by this species have been degraded by timber harvest and associated road construction. Although the current distribution of shorthead sculpin clearly has declined, our knowledge is limited because in much of the assessment area, sculpins often are reported generically as *Cottus* sp. with little attention paid to specific identification. The species prefers coldwater streams and smaller rivers, and typically occurs at higher elevations than the torrent sculpin. Approximately 66 percent of existing populations occur on FS- or BLM-administered lands (table 3.29). We believe that bull trout are an appropriate proxy for shorthead sculpin in that they occupy many of the same habitats and have similar requirements for cold, high-quality habitat conditions. There is a strong association between the distributions of bull trout and shorthead sculpin (chi-square test of independence, $P < 0.01$). Refer to "Findings by Species, Bull trout" section of this chapter for a discussion of how alternatives would affect shorthead sculpin. Unlike bull trout, however, shorthead sculpin have low vagility. Once eliminated from a river system, they are unlikely to recolonize without artificial assistance. Alternatives with high riparian zone protection would be most advantageous for this species. For restoration efforts to be successful, transplants of the shorthead sculpin into restored areas likely would be necessary.

Margined sculpin (*Cottus marginatus*)

The margined sculpin is restricted to streams in the Blue Mountains portion of the middle Columbia River drainage. Like many sculpins,

they are relatively poorly known and subjected to lumping as *Cottus* sp. in collections. Current information indicates that only about 13 percent of existing populations occur on FS- or BLM-administered lands (table 3.29). Within their range, they occur sympatrically with redband trout. Redband trout should be a good proxy for this species because both occupy similar habitats and are adversely affected by increases in water temperature, turbidity, and stream sedimentation. There is a strong association between the distributions of redband trout and margined sculpin (chi-square test of independence, $P < 0.01$). Therefore, we used redband trout as a proxy for margined sculpin in this analysis. Refer to "Findings by Species, Redband trout" section for a discussion of how alternatives would affect the margined sculpin. Unlike redband trout, however, margined sculpin have less vagility. Once eliminated from a river system, they are unlikely to recolonize without artificial assistance. Alternatives with high riparian zone protection would be most advantageous for this species. For restoration efforts to be successful, transplants of the margined sculpin into restored areas would likely be necessary.

Aquatic Mollusk Species

There are five federally listed (status, endangered) aquatic snails that are found in the Basin (Frest and Johannes 1995). They are:

- Lanx* n. sp. 1 (Banbury Springs lanx)
- Physa natricina* (Snake River physa)
- Pyrgulopsis idahoensis* (Idaho springsnail)
- Taylorconcha serpenticola* (Bliss Rapids springsnail)
- Valvata utahensis* (desert valvata)

According to Frest and Johannes (1995), the Banbury Springs lanx, Bliss Rapids springsnail, and desert valvata may occur on federally administered lands in Idaho (specifically, BLM). For each of these three species, we provide a brief summary of the reasons that we did not complete a viability analysis for the UCRB planning area.

Banbury Springs lanx (*Lanx* n. sp. 1)

This species occurs in only three known populations in the Snake River drainage in Gooding County, Idaho. It is considered a very local endemic that is threatened primarily by agricultural and fish-farm runoff and water diversions. Because of the very local distribution of the species, the alternatives in the UCRB preliminary draft EIS will not be site specific (fine scale) enough to determine the effect on viability. This analysis and determination should be done on a site-specific, project basis rather than on a landscape scale.

Bliss Rapids springsnail (*Taylorconcha serpenticola*)

The current distribution of this species is limited to very few sites within the original range. The original range was a limited reach of the middle Snake River, from Indian Cove Bridge to Twin Falls, Idaho. Most spring and river populations have been extirpated or are much reduced. Threats to this species have been the diversion or capping of springs and surface water and groundwater pollution from agricultural runoff. Because of the very limited distribution of this species, as with the Banbury Springs lanx, it is not appropriate to look at viability at the landscape scale. This should be done at a site-specific, project level.

Desert valvata (*Valvata utahensis*)

The distribution of this species has become very limited and has been extirpated in much of its original range. It is currently found in a "couple of Snake River sites" and spring-fed pools with no outlets (Frest and Johannes 1995). It is considered a local endemic. The pollution of surface and groundwater from agricultural runoff and the impoundments of rivers continue to threaten the species. The taxon is continuing to decline. The very limited number and distribution of the species make it inappropriate to do a viability

analysis at the landscape scale. The assessment of viability needs to be done at a site-specific, project level.

All three of these species are local endemics with very limited distribution and numbers. The science assessments and preliminary draft EISs are focused on a landscape or a large watershed scale. Direction in the alternatives is unlikely to be so specific that effects on these species would be identifiable or predictable. The major threats to these species are linked primarily to agriculture and river impoundments, and are outside of the management authority of the BLM. Therefore, we feel it is not valid to attempt to do a viability analysis given the scale of our data and the scale of the decisions to be made. Local administrative units have the opportunity to analyze the effects of proposed projects on these species and determine management needs to protect them from potential activities.

Summary of Aquatic Habitats and Native Species Evaluation of Alternatives

Evaluation of the ICBEMP aquatic conservation strategies and the expected effect of each alternative on the future habitats, population status, and distribution of 7 key salmonids and 18 rare and sensitive fishes are very complex. Each piece of information used in our evaluation provided some sense of where and how much of the anticipated change in management is likely to influence each of the species considered. Each piece of information has important limitations, and represents only a single element in this larger and very complex picture. Our conclusions are drawn from the strength and consistency of trends adapted from the models, the patterns in allocation of roads and other land disturbing activities, the allocation of restoration activities, and the mitigation of disturbance expected through riparian and ecosystem objectives and standards, as well as specific direction given in each alternative.

The evaluation by species centered on each alternatives' ability to conserve core and fringe areas,

prevent declines in habitat and populations, and rehabilitate habitats and depressed populations. Core areas are concentrations of strong populations, and are areas where the species is well distributed among adjacent watersheds. Fringe areas are where comparatively few occupied watersheds are isolated and fragmented from the larger portions of the species range, but have high genetic integrity or potentially unique genetic characteristics which aid the robustness of the species.

The expected response of a species to any alternative is complex, and the answer to each of a set of evaluation questions for every alternative represents a judgment on our part given the weight of the evidence presented. For example, with Alternative 5, the answer to the question "will strong populations in the central or core areas for bull trout be conserved?" was "no", yet strongholds associated with Category 1 watersheds should fare well under this alternative. The proportion of wilderness and emphasis on ecosystem analysis and restoration are focused to benefit strong populations under this alternative, and will likely sustain and even expand the distribution of bull trout within these select subbasins. However, areas which emphasize commodity production (for example, eastern Oregon and the northern one-third of the UCRB planning area) occupy larger areas of the species range, and our data suggest that populations here will not fare well, leading us to a negative conclusion. Exceptions are found within all of our summary determinations. If we could not assign a "yes" or "no" answer because of insufficient information or multiple factors leading to uncertainty, we responded with "uncertain."

Our summary is based on professional interpretation of both quantitative and qualitative information collected for the purpose of the alternative evaluation or generated as part of the broader scientific assessment (Lee and others, in press). From table 3.31, it is clear that Alternatives 1 and 5 would not sustain aquatic and riparian ecosystem structure and function through time, nor would they adequately protect the key salmonid species or the rare and sensitive species. Alternatives 2, 3,

4, 6, and 7 would sustain and restore aquatic and riparian ecosystems through time, but would have mixed results for both key salmonids and rare and sensitive species. The response of the key salmonids to Alternatives 2, 3, 4, 6, and 7 would be more complex, yet consistent with the ratings for the aquatic conservation strategies. More species would fare better under Alternatives 4, 6, and 7 than under Alternatives 2 and 3. The aquatic conservation strategy ratings, based on combined evaluation of interim RMA widths, specific direction regarding performance measures, and whether an ecosystem analysis is required in strongholds and high-priority watersheds, are highest for Alternatives 4, 6, and 7. Alternatives 2 and 3 do not include major restoration efforts or an ecosystem analysis requirement. They appeared to provide little more than a comprehensive project analysis and therefore, rate somewhat lower.

It is uncertain whether any of the alternatives would conserve fringe populations and habitats for the anadromous salmonids (such as, steelhead

trout, stream-type chinook, and ocean-type chinook). Uncertainty also exists concerning preventing population declines and rebuilding depressed areas for these species. Most of these populations are depressed or federally listed and are significantly influenced by hydroelectric dams, ocean conditions, hatcheries, and land management activities outside of Federal lands. Ocean chinook are proportionately more affected by a large number of factors that operate outside of Federal lands in freshwater, estuaries, and the ocean environment. All of their migration corridors between freshwater spawning and rearing habitats and the ocean lie on private or tribal lands. The most conservative approach to conserving and restoring watersheds would be provided by Alternatives 6 and 7. Given the effects of non-Federal land conditions and activities, the halting of declines and rebuilding of anadromous fish populations requires focused and coordinated efforts by several national, regional, and state agencies and institutions.

Table 3.31. Summary of aquatic habitats and native fishes evaluation of preliminary draft alternatives.

Number of key salmonid species and rare and sensitive fishes given sufficient protection to:	Alternative 1			Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6			Alternative 7		
	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U
6 Key Salmonid Species¹																					
Conserve strong populations	0	6	0	5	1	0	4	0	2	6	0	0	0	6	0	6	0	0	6	0	0
Prevent declines	0	6	0	0	6	0	0	4	2	1	1	4	0	6	0	3	0	3	2	1	3
Rebuild depressed populations	0	6	0	4	2	0	6	0	0	6	0	0	4	2	0	6	0	0	6	0	0
15 Rare and Sensitive Species²																					
Prevent declines	1	14	0	7	7	1	7	3	5	7	1	7	1	14	0	8	0	7	9	0	6
Does the aquatic conservation strategy maintain and restore aquatic and riparian ecological processes through time?	No			Yes			Yes			Yes			No, in commodity-emphasis areas			Yes			Yes		

¹Ocean-type chinook are minimally impacted by FS and BLM lands and no core strongholds exist on FS or BLM lands. They are, therefore, not included in this summary.

²Three of the 18 rare and sensitive fishes addressed in the evaluation were not included in this summary because one species is protected under the ESA, Section 7, regardless of the alternative, and two species have insufficient information to conduct an analysis. Also of note, pygmy whitefish are large, lake-dwelling fish that would be minimally impacted by any alternative.

U = Uncertain; Y = Yes; N = No

References

- Agee, James K. 1994. Fire and weather disturbances in terrestrial ecosystems of the eastern Cascades. Gen. Tech. Rep. PNW-GTR-320. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p. (Everett, Richard L., assessment team leader; Eastside forest ecosystem health assessment; Hessburg, Paul F., science team leader and tech. ed., Vol. III: assessment.)
- Behnke, R.J. 1992. Native trout of western North America. Monograph No. 6. Bethesda, MD: American Fisheries Society. 275 p.
- Belk, M.C.; Wilson, K.W. 1995. Survey of Cassia, Goose, Trapper, and Beaverdam Creeks to determine distribution of leatherside chub (*Gila copei*). Report of Department of Zoology, Provo, UT: Brigham Young University. [not paged].
- Belt, G.H.; O'Laughlin, J.; Merrill, T. 1992. Design of forest riparian buffer strips for the protection of water quality: analysis of scientific literature. Report No. 8. Moscow, ID: University of Idaho, Idaho Forest, Wildlife and Range Policy Analysis Group. [not paged].
- Berg, W.J. 1987. Evolutionary genetics of rainbow trout, *Parasalmo gairdnerii* (Richardson). Davis, CA: University of California, Davis. 125 p. Ph.D. dissertation.
- Beschta, R.L. 1990. Effects of fire on water quantity and quality. Chapter 17. In: Walstad, J.D.; Radosovich, S.R.; Sandberg, D.V., eds. Natural prescribed fire in Pacific Northwest forests. Corvallis, OR: Oregon State University Press. 317 p.
- Beschta, R.L.; Bilby, R.E.; Brown, G.W. [and others]. 1987. Stream temperature and aquatic habitat: Fisheries and forestry interactions. In: Salo, E.O.; Cundy, T.W., eds. Streamside management: Forestry and fishery interactions. Contribution 57. Seattle, WA: University of Washington, Institute of Forest Resources: 191-232.
- Brazier, J.R.; Brown, G.W. 1973. Buffer strips for stream temperature control. Research Paper 15. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. [not paged].
- Columbia Basin Fish and Wildlife Authority (CBFWA). 1990. Integrated system plan for salmon and steelhead production in the Columbia Basin. 442 p. On file with: Northwest Power Planning Council, 851 S.W. Sixth Avenue, Suite 1100, Portland, OR.
- Emlen, J.M. 1995. Population viability of the Snake River chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences; 52: 1442-1448.
- Erman, D.C.; Mahoney, D. 1983. Recovery after logging in streamside bufferstrips in Northern California. Contribution No. 186. 48 p. On file with: Center for Water and Wildland Resources, University of California-Davis, Davis, CA. 95616.
- Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest ecosystem management: an ecological, economic, and social assessment. Portland, OR: U.S. Department of Agriculture; U.S. Department of Interior [and others]. [irregular pagination].
- Frest, T.J.; Johannes, E.J. 1995. Interior Columbia Basin mollusk species of special concern. Final report to the Interior Columbia Basin Ecosystem Management Project. Contract #43-0E00-4-9112. On file with: U.S. Department of Agriculture, Forest Service, U.S. Department of Interior, Bureau of Land Management, Interior Columbia Basin Ecosystem Management Project, 112 E. Poplar, Walla Walla, WA 99362. [not paged].

- Frissell, Christopher A.; Bayles, David. 1996. Ecosystem management and the conservation of aquatic biodiversity and ecological integrity. *Water Resources Bulletin*. 32(2):229-240.
- Gray, D.H. 1970. Effects of forest clearcutting on the stability of natural slopes. *Association of English Geologists Bulletin*. 7: 45-67.
- Gray, D.H. 1978. Role of woody vegetation in reinforcing soils and stabilizing slopes. In: *Proceedings of soil reinforcement and stabilizing techniques engineering practicum*. Sydney, Australia: New South Wales Institute of Technology: 253-306.
- Gray, D.H.; Megahan, W.F. 1981. Forest vegetation removal and slope stability in the Idaho batholith. Research Paper INT-271. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 23 p.
- Gregory, S.V.; Lamberti, G.A.; Erman, D.C.; [and others]. 1987. Influence of forest practices on aquatic production. In: Salo, E.O.; Cundy, T.W., eds. *Streamside management: forestry and fishery interactions*. Proceedings of the symposium. 1986 February. Contribution No. 57. Seattle, WA: Institute of Forest Resources, University of Washington. 233-255.
- Idaho Department of Fish and Game (IDFG); Nez Perce Tribe of Idaho; Shoshone-Bannock Tribes of Fort Hall. 1990. *Salmon River sub-basin salmon and steelhead production plan*. Boise, ID. Idaho Department of Fish and Game. [not paged].
- (INFISH) Inland Native Fish Strategy. 1995. *Environmental Assessment: Decision Notice and Finding of No Significant Impact. Interim Strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana, and portions of Nevada*. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Northwest Regions. [irregular pagination].
- Lee, D.C.; Sedell, J.R.; Rieman, B.; [and others]. (in press). *Broad-scale assessment of aquatic species and habitats*. In: Quigley, Thomas M.; Arbelbide, S.J., tech. eds. *An assessment of ecosystem components in the Interior Columbia Basin and portions of Klamath and Great basins*. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. (Quigley, Thomas M., tech. ed. *The Interior Columbia Basin Ecosystem Management Project: Scientific assessment*).
- Lichatowich, J.A.; Mobrand, L.E. 1995. *Analysis of chinook salmon in the Columbia River from an ecosystem perspective*. Portland, OR: U.S. Department of Energy, Bonneville Power Administration [Unpublished report]. Contract No. DE-AM79-92BP25105.
- McCammon, B. 1993. *Determining the risk of cumulative watershed effects resulting from multiple activities—Endangered Species Act, Section 7*. Portland, OR: U.S. Department of Agriculture Forest Service. [not paged].
- McDade, M.H.; Swanson, F.J.; [and others]. 1990. *Source distances for coarse woody debris entering small streams in western Oregon and Washington*. *Canadian Journal of Forest Resources*. 20: 326-330.
- McGurk, Bruce J.; Fong, Darren R. 1995. *Equivalent roaded area as a measure of cumulative effect of logging*. *Environmental Management*. 19(4): 609-621.
- Meehan, W.R., ed. 1991. *Influences of forest and rangeland management on salmonid fishes and their habitats*. Special Publication 19. Bethesda, MD: American Fisheries Society. [not paged].

- Megahan, W.F.; Potyondy, J.P.; Seyedbagheri, K.A. 1992. Best management practices and cumulative effects from sedimentation on the South Fork Salmon River: an Idaho case study. In: Naiman, R.J., ed. *Watershed management: Balancing sustainability and environmental change*. Symposium- new perspectives for watershed management in the Pacific Northwest; Seattle, WA. New York: Springer-Verlag: 385-400.
- Menning, K.M.; Erman, K.; Johnson, N.; Sessions, J. 1996. Modeling aquatic and riparian systems, assessing cumulative watershed effects, and limiting watershed disturbance. Davis, CA: University of California-Davis, Sierra Nevada Ecosystem Project. [not paged].
- Moyle, P.B.; Yoshiyama, R.M.; Williams, J.E.; Wikramanayake, E.D. 1995. *Fish Species of Special Concern in California* (2nd Edition). Sacramento, CA: California Department of Fish and Game. [not paged].
- Murphy, M.L. 1995. Forestry impacts on freshwater habitats and anadromous salmonids in the Pacific Northwest and Alaska: Requirements for protection and restoration. NOAA Coastal Ocean Program. Decision Analysis Series No.7. Silver Spring, MD: Department of Commerce, National Oceanic and Atmospheric Administration, Coastal Ocean Office. 156 p.
- National Research Council. 1995. Upstream: Salmon and society in the Pacific Northwest. Washington, DC: National Research Council. Chapter 3. 39-66.
- (PACFISH) U.S. Department of Agriculture, Forest Service and U.S. Department of Interior, Bureau of Land Management. 1994. Draft environmental assessment. Interim strategies for managing anadromous fish-producing watersheds on Federal lands in eastern Oregon and Washington, Idaho, and Portions of California. Washington DC: U.S. Department of Agriculture, Forest Service; U.S. Department of Interior Bureau of Land Management. [irregular pagination].
- (PACFISH) U.S. Department of Agriculture, Forest Service and U.S. Department of Interior, Bureau of Land Management. 1995. Decision Notice/Decision Record, FONSI, EA, Appendices for the Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California. Washington DC: U.S. Department of Agriculture, Forest Service and U.S. Department of Interior Bureau of Land Management. [irregular pagination].
- Raymond, H.L. 1979. Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. *Transactions of the American Fisheries Society*. 108: 505-29.
- Raymond, H.L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer chinook salmon and steelhead in the Columbia River Basin. *North American Journal of Fisheries Management*. 8: 1-24.
- Reeves, G.H.; Benda, L.E.; Burnett, K.M. [and others]. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionarily significant units of anadromous salmonids in the Pacific Northwest. In: Nielson, J., ed. *Evolution and the aquatic ecosystem: defining unique units in population conservation*. Symposium 17. Bethesda, MD: American Fisheries Society. [not paged].
- Sedell, J.R.; Beschta, R.L. 1991. Bringing back the "bio" in bioengineering. In: Colt, J.; Dendral, S., eds. *Fisheries bioengineering: Proceedings of the symposium*. Bethesda, MD: American Fisheries Society. 10: 160-175.

Spence, B.C.; Lomninsky, G.A.; Hughes, R.M.; Novitzki, R.P. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Services Corp., Corvallis, OR. (Available from the National Marine Fisheries Service, Portland, Oregon.)

Steinblums, I.J.; Froehlich, H.A.; Lyons, J.K. 1984. Designing stable buffer strips for stream protection. *Journal of Forestry*. 82:49-52.

U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management. February 1996a. Interior Columbia Basin Ecosystem Management Project; Eastside Preliminary Draft Environmental Impact Statement (internal draft). On file with: U.S. Department of Agriculture, Forest Service, U.S. Department of Interior, Bureau of Land Management, Interior Columbia Basin Ecosystem Management Project, 112 E. Poplar, Walla Walla, WA 99362. [irregular pagination].

U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management. February 1996b. Interior Columbia Basin Ecosystem Management Project; Upper Columbia River Basin Preliminary Draft Environmental Impact Statement (internal draft). On file with: U.S. Department of Agriculture, Forest Service, U.S. Department of Interior, Bureau of Land Management, Interior Columbia Basin Ecosystem Management Project, 112 E. Poplar, Walla Walla, WA 99362. [irregular pagination].

Williams, J.E.; Johnson, J.E.; Hendrickson, D.A. [and others]. 1989. Fishes of North America endangered, threatened, or of special concern: 1989. Bethesda, MD: American Fisheries Society. 14(6): 2-20.

Appendix 3-A.

Aquatic/Riparian Evaluation of Alternatives
Workshop participants. Workshop was held in
Boise, Idaho, from March 6 to 13, 1996.

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Appendix 3-B

Classification trees used for predicting species status.

Classification trees were developed using the approach outlined by Lee and others (in press) in order to project status under each of the alternatives. Table B.1 describes the variables used in tree development. The remaining sections summarize tree structure. Figures B.1 to B.8 graphically show tree structure. All classification trees except that developed for ocean-type chinook were sensitive to road-density measures. Future predictions were made using the projected road-density layers.

Table B.1. Descriptions of landscape variables used in the abbreviated analysis of fish distribution. All values expressed as percents refer to the percent area of the subwatershed.

Variable Name	Description
<i>eru</i>	Ecological Reporting Unit
<u>Physiographic and Geophysical Variables</u>	
<i>slope</i>	area weighted average midslope
<i>pprecip</i>	mean annual precipitation (PRISM)
<i>elev</i>	mean elevation (ft)
<i>mtemp</i>	mean annual temperature
<i>solar</i>	mean annual solar radiation
<i>drnden</i>	drainage density (mi/mi ²)
<i>anadac</i>	access for anadromous fish (0 = no, 1 = yes)
<i>dampass</i>	number of intervening dams
<i>hucorder</i>	number of upstream 6th-code hydrologic units
<i>hk</i>	soil texture coefficient
<i>baseero</i>	base erosion index
<i>ero</i>	surface erosion hazard
<i>bank</i>	streambank erosion hazard
<u>Ownership and Management Variables</u>	
<i>rdmean0</i>	mean road density
<i>rdmed0</i>	median road density class
<i>rdgeo0</i>	geometric mean road density
<i>mgclus</i>	management classification

Bull trout presence/absence, two-step model

Summary

Variables used in tree construction: "mtemp" "rdgeo0" "hucorder" "pprecip" "eru"

Number of terminal nodes: 7

Residual mean deviance: 0.9658 = 2617 / 2710

Misclassification error rate: 0.2172 = 590 / 2717

Figure B.1. Tree structure

Node) Split criterion	Sample size	Deviance	Mode	Absent	Present
1) root	2717	3279.00	A	(0.7085	0.2915)
2) mtemp<5.08	1475	2024.00	A	(0.5586	0.4414)
4) rdgeo0<0.893289	951	1314.00	P	(0.4669	0.5331)
8) hucorder<16.5	842	1145.00	P	(0.4181	0.5819)
16) pprecip<593.731	116	142.10	A	(0.6983	0.3017) *
17) pprecip>593.731	726	959.30	P	(0.3733	0.6267) *
9) hucorder>16.5	109	94.38	A	(0.8440	0.1560) *
5) rdgeo0>0.893289	524	616.20	A	(0.7252	0.2748)
10) hucorder<0.5	296	252.30	A	(0.8480	0.1520) *
11) hucorder>0.5	228	312.10	A	(0.5658	0.4342)
22) eru<7.5	104	121.20	A	(0.7308	0.2692) *
23) eru>7.5	124	169.30	P	(0.4274	0.5726) *
3) mtemp>5.08	1242	878.90	A	(0.8865	0.1135) *

* denotes terminal node

Bull trout status

Summary

Variables used in tree construction: "rdgeo0" "solar" "baseero" "drnden" "bank" "rdmean0" "eru"

Number of terminal nodes: 8

Residual mean deviance: 0.723 = 566.8 / 784

Misclassification error rate: 0.1427 = 113 / 792

Figure B.2. Tree Structure

Node) Split criterion	Sample size	Deviance	Mode	Depressed	Present
1) root	792	821.20	D	(0.7866	0.2134)
2) rdgeo0<0.027454	198	274.30	S	(0.4848	0.5152)
4) solar<242.706	20	0.00	D	(1.0000	0.0000) *
5) solar>242.706	178	242.900	S	(0.4270	0.5730)
10) baseero<59.6157	145	201.000	D	(0.5034	0.4966)
20) drnden<1.30505	95	123.900	D	(0.6421	0.3579) *
21) drnden>1.30505	50	55.110	S	(0.2400	0.7600) *
11) baseero>59.6157	33	20.110	S	(0.0909	0.9091) *
3) rdgeo0>0.027454	594	418.600	D	(0.8872	0.1128)
6) bank<51.8028	109	124.200	D	(0.7431	0.2569) *
7) bank>51.8028	485	271.400	D	(0.9196	0.0804)
14) rdmean0<2.87869	411	257.900	D	(0.9051	0.0949)
28) eru<2.5	5	5.004	S	(0.2000	0.8000) *
29) eru>2.5	406	238.500	D	(0.9138	0.0862) *
15) rdmean0>2.87869	74	0.000	D	(1.0000	0.0000) *

* denotes terminal node

Westslope cutthroat trout status

Summary

Variables used in tree construction: "anadac" "mngclus" "rdgeo0" "hk" "solar" "rdmean0" "bank"
 "pprecip" "mtemp" "hucorder" "xisq0" "slope"

Number of terminal nodes: 19

Residual mean deviance: 1.165 = 1888 / 1621

Misclassification error rate: 0.214 = 351 / 1640

Figure B.3. Tree structure

Node)	split criterion	Sample size	Deviance	Mode	Absent	Depressed	Strong
1) root		1640	3108.00	D	(0.19630	0.60240	0.20120)
2) anadac<0.5		1057	1511.00	D	(0.07852	0.75210	0.16930)
4) mngclus:FG,FH,FM,FW		631	908.40	D	(0.03645	0.70210	0.26150)
8) rdgeo0<0.276237		207	320.90	S	(0.01932	0.48790	0.49280)
16) hk<0.207		33	20.11	D	(0.00000	0.90910	0.09091) *
17) hk>0.207		174	269.10	S	(0.02299	0.40800	0.56900)
34) solar<234.838		43	50.92	D	(0.00000	0.72090	0.27910) *
35) solar>234.838		131	194.00	S	(0.03053	0.30530	0.66410)
70) rdmean0<0.486637		68	70.25	S	(0.05882	0.08824	0.85290) *
71) rdmean0>0.486637		63	86.94	D	(0.00000	0.53970	0.46030) *
9) rdgeo0>0.276237		424	505.20	D	(0.04481	0.80660	0.14860)
18) bank<59.4293		31	65.08	D	(0.19350	0.41940	0.38710) *
19) bank>59.4293		393	413.90	D	(0.03308	0.83720	0.12980) *
5) mngclus:NP,PA,PF,PR,TL		426	465.20	D	(0.14080	0.82630	0.03286)
10) pprecip<527.034		106	142.00	D	(0.31130	0.67920	0.00943)
20) solar<296.847		98	121.90	D	(0.25510	0.73470	0.01020) *
21) solar>296.847		8	0.00	A	(1.00000	0.00000	0.00000) *
11) pprecip>527.034		320	291.60	D	(0.08438	0.87500	0.04063) *
3) anadac>0.5		583	1261.00	A	(0.40990	0.33100	0.25900)
6) mtemp<5.809		434	940.50	D	(0.26040	0.40090	0.33870)
12) rdmean0<0.0484976		136	260.00	S	(0.30880	0.13240	0.55880)
24) hucorder<26		117	212.30	S	(0.21370	0.15380	0.63250) *
25) hucorder>26		19	12.79	A	(0.89470	0.00000	0.10530) *
13) rdmean0>0.0484976		298	609.30	D	(0.23830	0.52350	0.23830)
26) solar<265.875		41	59.42	S	(0.12200	0.12200	0.75610)
52) rdmean0<2.75627		30	17.47	S	(0.03333	0.03333	0.93330) *
53) rdmean0>2.75627		11	23.98	A	(0.36360	0.36360	0.27270) *
27) solar>265.875		257	488.90	D	(0.25680	0.58750	0.15560)
54) xisq0<360.367		103	127.20	D	(0.04854	0.79610	0.15530) *
55) xisq0>360.367		154	313.00	D	(0.39610	0.44810	0.15580)
110) solar<325.618		62	106.40	A	(0.64520	0.25810	0.09677) *
111) solar>325.618		92	179.20	D	(0.22830	0.57610	0.19570)
222) slope<34.3295		84	152.00	D	(0.22620	0.63100	0.14290) *
223) slope>34.3295		8	8.997	S	(0.25000	0.00000	0.75000) *
7) mtemp>5.809		149	149.50	A	(0.84560	0.12750	0.02685)
14) mngclus:FH,FW,PA,PF,PR		129	65.28	A	(0.93020	0.06977	0.00000) *
15) mngclus:FG,FM,TL		20	41.19	D	(0.30000	0.50000	0.20000) *

* denotes terminal node

Yellowstone cutthroat trout status

Summary

Variables used in tree construction: "rdgeo0" "drnden" "mtemp" "mngclus" "hucorder"

Number of terminal nodes: 7

Residual mean deviance: 1.031 = 399.1 / 387

Misclassification error rate: 0.2208 = 87 / 394

Figure B.4. Tree structure

Node)	split criterion	Sample size	Deviance	Mode	Absent	Depressed	Strong
1)	root	394	846.30	S	(0.26900	0.29190	0.4391)
2)	rdgeo0<0.140255	161	160.50	S	(0.00621	0.17390	0.8199)
4)	drnden<0.99565	87	10.92	S	(0.01149	0.00000	0.9885)*
5)	drnden>0.99565	74	98.16	S	(0.00000	0.37840	0.6216)*
3)	rdgeo0>0.140255	233	481.30	A	(0.45060	0.37340	0.1760)
6)	mtemp<6.1345	180	378.00	D	(0.29440	0.47780	0.2278)
12)	mngclus:FG,PF	58	94.75	D	(0.03448	0.51720	0.4483)
24)	hucorder<10.5	45	64.63	D	(0.02222	0.66670	0.3111)*
25)	hucorder>10.5	13	7.05	S	(0.07692	0.00000	0.9231)*
13)	mngclus:BR,FH,FM,PA,PR,TL	122	239.10	D	(0.41800	0.45900	0.1230)
26)	drnden<1.55755	66	120.20	A	(0.62120	0.24240	0.1364)*
27)	drnden>1.55755	56	88.18	D	(0.17860	0.71430	0.1071)*
7)	mtemp>6.1345	53	9.92	A	(0.98110	0.01887	0.0000)*

* denotes terminal node

Redband trout status

Summary

Variables used in tree construction: "mngclus" "mtemp" "hucorder" "eru" "elev" "anadac" "rdgeo0"

Number of terminal nodes: 14

Residual mean deviance: 1.471 = 2577 / 1752

Misclassification error rate: 0.3596 = 635 / 1766

Figure B.5 Tree Structure

Node)	split criterion	Sample size	Deviance	Mode	Absent	Depressed	Strong
1)	root	1766	3530.00	A	(0.46720	0.39130	0.14160)
2)	mngclus:BR,FM,PA,PR1243	1243	2085.00	A	(0.60180	0.33950	0.05873)
4)	mtemp<6.822	365	696.50	D	(0.40000	0.49320	0.10680)
8)	hucorder<1.5	258	486.70	A	(0.47290	0.43020	0.09690) *
9)	hucorder>1.5	107	189.20	D	(0.22430	0.64490	0.13080)
18)	eru<11.5	95	153.10	D	(0.25260	0.67370	0.07368) *
19)	eru>11.5	12	16.30	S	(0.00000	0.41670	0.58330) *
5)	mtemp>6.822	878	1299.00	A	(0.68560	0.27560	0.03872)
10)	mtemp<10.1465	775	1203.00	A	(0.65160	0.30580	0.04258)
20)	elev<5493.5	731	1072.00	A	(0.67170	0.29820	0.03010)
40)	hucorder<0.5	383	442.90	A	(0.77280	0.21670	0.01044)
80)	mngclus:FM,PA	106	146.30	A	(0.53770	0.46230	0.00000) *
81)	mngclus:BR,PR	227	247.10	A	(0.86280	0.12270	0.01444) *
41)	hucorder>0.5	348	588.20	A	(0.56030	0.38790	0.05172)
82)	hucorder<144	308	537.80	A	(0.50320	0.43830	0.05844)
164)	mtemp<7.126	46	60.39	A	(0.78260	0.15220	0.06522) *
165)	mtemp>7.126	262	457.00	D	(0.45420	0.48850	0.05725) *
83)	hucorder>144	40	0.00	A	(1.00000	0.00000	0.00000) *
21)	elev>5493.5	44	94.47	D	(0.31820	0.43180	0.25000) *
11)	mtemp>10.1465	103	51.17	A	(0.94170	0.04854	0.00971) *
3)	mngclus:FG,FH,FW,PF,TL	523	1036.00	D	(0.14720	0.51430	0.33840)
6)	anadac<0.5	404	680.90	D	(0.05446	0.57920	0.36630)
12)	elev<3188	34	55.70	S	(0.23530	0.08824	0.67650) *
13)	elev>3188	370	580.60	D	(0.03784	0.62430	0.33780)
26)	rdgeo0<0.118466	89	148.50	S	(0.04494	0.40450	0.55060) *
27)	rdgeo0>0.118466	281	408.00	D	(0.03559	0.69400	0.27050) *
7)	anadac>0.5	119	252.40	A	(0.46220	0.29410	0.24370) *

* denotes terminal node

Steelhead status

Summary

Variables used in tree construction: "hucorder" "dampass" "elev" "eru" "rdgeo0"

Number of terminal nodes: 17

Residual mean deviance: 0.8778 = 1175 / 1338

Misclassification error rate: 0.1528 = 207 / 1355

Figure B.6 Tree structure

Node) Split criterion	Sample size	Deviation	Mode	Absent	Depressed	Migration	Strong
1) root	1355	2400.00	D	(0.13140	0.68710	0.16680	0.01476)
2) hucorder<21.5	1064	1419.00	D	(0.16730	0.78480	0.02914	0.01880)
4) hucorder<0.5	563	809.20	D	(0.26110	0.70870	0.00888	0.02131)
8) dampass<3.5	144	104.60	D	(0.03472	0.90970	0.00000	0.05556)
16) elev<4935.5	116	41.22	D	(0.04310	0.95690	0.00000	0.00000)*
17) elev>4935.5	28	33.50	D	(0.00000	0.71430	0.00000	0.28570)*
9) dampass>3.5	419	628.30	D	(0.33890	0.63960	0.01193	0.00955)
18) elev<3432.5	66	92.16	A	(0.66670	0.31820	0.01515	0.00000)*
19) elev>3432.5	353	499.30	D	(0.27760	0.69970	0.01133	0.01133)
38) eru<6.5	152	150.80	D	(0.13160	0.84870	0.00658	0.01316)
76) eru<5.5	54	85.38	D	(0.35190	0.61110	0.00000	0.03704)*
77) eru>5.5	98	22.30	D	(0.01020	0.97960	0.01020	0.00000)*
39) eru>6.5	201	317.00	D	(0.38810	0.58710	0.01493	0.00995)
78) rdgeo0<0.0206938	71	83.25	D	(0.21130	0.77460	0.01408	0.00000)*
79) rdgeo0>0.0206938	130	215.90	A	(0.48460	0.48460	0.01538	0.01538)
158) elev<6237.5	70	121.50	D	(0.32860	0.61430	0.02857	0.02857)*
159) elev>6237.5	60	76.38	A	(0.66670	0.33330	0.00000	0.00000)*
5) hucorder>0.5	501	513.70	D	(0.06188	0.87030	0.05190	0.01597)
10) elev<1427	19	29.11	M	(0.05263	0.26320	0.68420	0.00000)*
11) elev>1427	482	422.50	D	(0.06224	0.89420	0.02697	0.01660)*
3) hucorder>21.5	291	369.00	M	(0.00000	0.32990	0.67010	0.00000)
6) hucorder<121	127	170.30	D	(0.00000	0.60630	0.39370	0.00000)
12) elev<1053.5	9	0.00	M	(0.00000	0.00000	1.00000	0.00000)*
13) elev>1053.5	118	152.40	D	(0.00000	0.65250	0.34750	0.00000)
26) eru<6.5	51	28.04	D	(0.00000	0.92160	0.07843	0.00000)*
27) eru>6.5	67	92.15	M	(0.00000	0.44780	0.55220	0.00000)
54) hucorder<65	54	74.19	D	(0.00000	0.55560	0.44440	0.00000)
108) elev<4564.5	24	26.99	M	(0.00000	0.25000	0.75000	0.00000)*
109) elev>4564.5	30	30.02	D	(0.00000	0.80000	0.20000	0.00000)*
55) hucorder>65	13	0.00	M	(0.00000	0.00000	1.00000	0.00000)*
7) hucorder>121	164	117.60	M	(0.00000	0.11590	0.88410	0.00000)
14) dampass<2.5	16	19.87	D	(0.00000	0.68750	0.31250	0.00000)*
15) dampass>2.5	148	62.24	M	(0.00000	0.05405	0.94590	0.00000)*

* denotes terminal node

Ocean-type chinook salmon status

Summary

Variables used in tree construction: "hucorder" "elev" "dampass" "eru"

Number of terminal nodes: 11

Residual mean deviance: 0.5208 = 116.1 / 223

Misclassification error rate: 0.07265 = 17 / 234

Figure B.7. Tree structure

Node) Split criterion	Sample size	Deviation	Mode	Absent	Depressed	Migration	Strong
1) root	234	585.00	A	(0.4444	0.21790	0.25210	0.08547)
2) hucorder<1080	171	365.00	A	(0.6082	0.20470	0.07602	0.11110)
4) hucorder<5.5	90	81.49	A	(0.8667	0.02222	0.11110	0.00000)
8) elev<2113	23	31.490	A	(0.5652	0.00000	0.43480	0.00000)
16) dampass<3.5	9	6.279	M	(0.1111	0.00000	0.88890	0.00000)*
17) dampass>3.5	14	11.48	A	(0.8571	0.00000	0.14290	0.00000)*
9) elev>2113	67	17.99	A	(0.9701	0.02985	0.00000	0.00000)*
5) hucorder>5.5	81	193.20	D	(0.3210	0.40740	0.03704	0.23460)
10) dampass<7.5	34	75.77	S	(0.2353	0.14710	0.05882	0.55880)
20) eru<3.5	14	11.48	S	(0.0000	0.00000	0.14290	0.85710)*
21) eru>3.5	20	43.22	A	(0.4000	0.25000	0.00000	0.35000)
42) dampass<2.5	11	14.42	S	(0.0000	0.36360	0.00000	0.63640)
84) elev<1888.5	6	0.000	S	(0.0000	0.00000	0.00000	1.00000)*
85) elev>1888.5	5	5.004	D	(0.0000	0.80000	0.00000	0.20000)*
43) dampass>2.5	9	6.279	A	(0.8889	0.11110	0.00000	0.00000)*
11) dampass>7.5	47	71.26	D	(0.3830	0.59570	0.02128	0.00000)
22) elev<3145.5	30	28.06	D	(0.1000	0.86670	0.03333	0.00000)*
23) elev>3145.5	17	12.32	A	(0.8824	0.11760	0.00000	0.00000)*
3) hucorder>1080	63	81.08	M	(0.0000	0.25400	0.73020	0.01587)
6) elev<2103.5	46	9.635	M	(0.0000	0.00000	0.97830	0.02174)*
7) elev>2103.5	17	7.606	D	(0.0000	0.94120	0.05882	0.00000)*

* denotes terminal node

Stream-type chinook salmon status

Summary

Variables used in tree construction: "hucorder" "mtemp" "elev" "rdgeo0" "dampass" "rdmean0" "eru"

Number of terminal nodes: 17

Residual mean deviance: 1.107 = 1399 / 1264

Misclassification error rate: 0.2272 = 291 / 1281

Figure B.8. Tree structure

Node)	Split criterion	Sample size	Deviation	Mode	Absent	Depressed	Migration	Strong
1)	root	1281	2756.00	A	(0.44420	0.35910	0.19050	0.00625)
2)	hucorder<29.5	1006	1670.00	A	(0.55670	0.40760	0.02783	0.00795)
4)	hucorder<0.5	509	627.30	A	(0.76230	0.21810	0.01965	0.00000)
8)	mtemp<5.7595	340	454.30	A	(0.69120	0.29710	0.01176	0.00000)*
9)	mtemp>5.7595	169	127.00	A	(0.90530	0.05917	0.03550	0.00000)
18)	elev<1537.5	16	17.99	A	(0.75000	0.00000	0.25000	0.00000)*
19)	elev>1537.5	153	94.94	A	(0.92160	0.06536	0.01307	0.00000)*
5)	hucorder>0.5	497	854.40	D	(0.34610	0.60160	0.03622	0.01610)
10)	mtemp<7.461	365	545.30	D	(0.22190	0.72880	0.02740	0.02192)
20)	rdgeo0<0.8215135	211	289.40	D	(0.16110	0.78200	0.03791	0.01896)
40)	dampass<3.5	17	29.71	D	(0.11760	0.64710	0.00000	0.23530)*
41)	dampass>3.5	194	237.50	D	(0.16490	0.79380	0.04124	0.00000)
82)	hucorder<11.5	166	191.50	D	(0.19280	0.78920	0.01807	0.00000)
164)	rdgeo0<0.0645532	97	83.42	D	(0.10310	0.87630	0.02062	0.00000)*
165)	rdgeo0>0.0645532	69	96.07	D	(0.31880	0.66670	0.01449	0.00000)
330)	elev<5682.5	31	28.34	D	(0.09677	0.87100	0.03226	0.00000)*
331)	elev>5682.5	38	52.68	A	(0.50000	0.50000	0.00000	0.00000)*
83)	hucorder>11.5	28	26.28	D	(0.00000	0.82140	0.17860	0.00000)*
21)	rdgeo0>0.8215135	154	243.40	D	(0.30520	0.65580	0.01299	0.02597)*
11)	mtemp>7.461	132	204.00	A	(0.68940	0.25000	0.06061	0.00000)
22)	eru<3.5	19	31.34	D	(0.21050	0.68420	0.10530	0.00000)*
23)	eru>3.5	113	150.00	A	(0.76990	0.17700	0.05310	0.00000)*
3)	hucorder>29.5	275	336.40	M	(0.03273	0.18180	0.78550	0.00000)
6)	hucorder<57.5	77	141.90	M	(0.09091	0.37660	0.53250	0.00000)
12)	mtemp<8.8675	63	86.05	M	(0.00000	0.42860	0.57140	0.00000)*
13)	mtemp>8.8675	14	27.78	A	(0.50000	0.14290	0.35710	0.00000)*
7)	hucorder>57.5	198	155.80	M	(0.01010	0.10610	0.88380	0.00000)
14)	dampass<2.5	16	19.87	D	(0.00000	0.68750	0.31250	0.00000)*
15)	dampass>2.5	182	99.26	M	(0.01099	0.05495	0.93410	0.00000)*

* denotes terminal node