Nez Perce–Clearwater National Forests
Forest Plan Assessment

1.0 Terrestrial and Aquatic Ecosystems and Watersheds

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1. Terrestrial and Aquatic Ecosystems and Watersheds

1.1 TERRESTRIAL ECOSYSTEMS

1.1.1 *Existing Information*

- Fire Management Plans for the Selway-Bitterroot Wilderness, the Gospel-Hump Wilderness, the Frank Church River-of-No-Return Wilderness, and the Clearwater Fire Management Area
- Forest Inventory and Assessment data are available for both Forests. A full data set was completed in 2007, with annual remeasurements of 10% of the plots for the past 5 years.
- Extensive assessment of vegetation was done between 2004 and 2007 for forest plan revision. Those pieces of assessment are still available and offer a comprehensive look at vegetation for the planning area.
- Historical Range of Variability in Eastern Cascades Forests, Washington, USA (Agee 2003)
- Fire's Influence on Ecosystems of the Clearwater National Forest: Cook Mountain Fire History Inventory (Barrett 1982)
- Classifying Fire Regimes and Defining Their Topographic Controls in the Selway-Bitterroot Wilderness (Barrett and Arno 1991)
- Fire Regimes on the Clearwater and Nez Perce National Forests, North Central Idaho (Barrett 1993)
- Fire Episodes in the Inland Northwest (1540-1940) Based on Fire History Data (Barrett et. al 1997)
- Coarse Woody Debris: Managing Benefits and Fire Hazard in the Recovering Forest (Brown et. al 2003)
- Postglacial Fire, Vegetation, and Climate History in the Clearwater Range, Northern Idaho, USA (Brunelle and Whitlock 2003)
- Holocene Fire and Vegetation along Environmental Gradients in the Northern Rocky Mountains (Brunelle et. al 2005)
- Forest Habitat Types of Northern Idaho: A Second Approximation (Cooper et. al 1991)
- Impact of the Pleistocene on the Genetic Structure of North American Conifers (Critchfield 1984)
- Relative Effects of Habitat Loss and Fragmentation on Population Extinction (Fahrig 1997)
- Fahrig, Lenore. 2002. Effect of Habitat Fragmentation on the Extinction Threshold: A Synthesis (Fahrig 2002)
- Patchy Reaction-Diffusion and Population Abundance: The Relative Importance of Habitat Amount and Arrangement (Flather and Bevers)
- Managing Coarse Woody Debris in Forests of the Rocky Mountains (Graham et. al 1994)
- Old-Growth Forest Types of the Northern Region (errata corrected 2/05) (Green et. al 1992)

- Fire Regimes in the Stillman Analysis Area, Selway Ranger District (Green 1994)
- Using a Coarse-Filter Approach with Species Assessment for Ecosystem Management (Haufler et. al 1996)
- An Environmental Narrative of Inland Northwest United States Forests, 1800-2000 (Hessburg and Agee 2003)
- Dry Forests and Wildland Fires of the Inland Northwest USA: Contrasting the Landscape Ecology of the Pre-Settlement and Modern Eras (Hessburg et. al 2005)
- Management Implications of Recent Changes in Spatial Patterns of Interior Northwest Forests (Hessburg and Smith 1999)
- Old-growth, Disturbance, and Ecosystem Management (Johnson et. al 1995)
- Fire Ecology of the Forest Habitat Types of Northern Idaho (Smith and Fischer 1997)
- Cascading Effects of Fire Exclusion in Rocky Mountain Ecosystems: A Literature Review (Keane et. al 2002)
- Do Remnant Old-Growth Trees Accelerate Rates of Succession in Mature Douglas-fir Forests? (Keeton and Franklin 2005)
- Fire-Climate-Vegetation Interactions in Subalpine Forests of the Selway-Bitterroot Wilderness Area, Idaho and Montana, USA (Kipfmueller 2003)
- Overview of the Use of Natural Variability Concepts in Managing Ecological Systems (Landres et. al 1999)
- Bitterroot Forest Reserve, Idaho portion (Leiberg 1900)
- Using Fire History Models to Estimate Proportions of Old Growth Forest in Northwest Montana, USA (Lesica 1996)
- Historical Vegetation Types of the Interior Columbia River Basin (Losensky 1994)
- Columbia River Basin Ecosystems: Late Quaternary Environments (Mehringer 1996)
- Historical Range of Variability: A Useful Tool for Evaluating Ecosystem Change (Morgan et. al 1994)
- Preparing for Climatic Change: The Water, Salmon, and Forests of the Pacific Northwest (Mote et. al 2003)
- Ecology of Seral Shrub Communities in the Cedar-Hemlock Zone of Northern Idaho (Mueggler 1965)
- Middle Rockies-Blue Mountains Ecoregional Conservation Plan (Nature Conservancy 2000)
- Ecological Units of the Northern Region: Subsections (Nesser et. al 1997)
- Nezperce National Forest Land Classification (Nez Perce National Forest 1911)
- Forest Statistics, Benewah County, Idaho (USDA Forest Service 1937)
- Forest Statistics, Clearwater County, Idaho (USDA Forest Service 1938)
- Forest Statistics, Idaho County, Idaho (USDA Forest Service 1938)
- Forest Statistics, Latah County, Idaho (USDA Forest Service 1938)
- Forest Statistics, Lewis County, Idaho (USDA Forest Service 1938)

- Forest Statistics, Nez Perce County, Idaho (USDAForest Service 1938)
- Selway National Forest Land Classification (USDA Forest Service 1914)
- Selway National Forest Report on Timber and Valuation Survey (USDA Forest Service 1921)
- Clearwater National Forest Land Classification (USDA Forest Service 1915)
- Potential Natural Vegetation (PNV) Classification for Western and Central Montana, and Northern Idaho (USDA Forest Service 2002)
- Ecological Subregions of the United States, Chapters 44 and 45 (USDA Forest Service, 1994)
- The Role Of Climate And Vegetation Change In Shaping Past and Future Fire Regimes in the Northwestern U.S. and the Implications for Ecosystem Management (Whitlock et. al 2003)
- Holocene Fire Activity as a Record of Past Environmental Change (Whitlock and Bartlein 2004)
- Holocene Fire Reconstructions from the Northwestern U.S.: An Examination at Multiple Time Scales (Whitlock et. al 2003)
- Influence of Precipitation Cycles on Forestry (Marshall 1927)
- The complex nature of mixed severity fire regimes (Agee 2004)
- Mixed-severity fire regimes in the Northern Rocky Mountains: Consequences of fire exclusion and options for the future (Arno et al. 2000)
- Estimates of snag densities for northern Idaho forests in the northern region: Region one vegetation classification, mapping, inventory and analysis report (Bollenbacher et al. 2009)
- Succession Functions of Pathogens and Insects (Byler and Hagle 2000)
- Forest resources of the Nez Perce National Forest (Disney 2010)
- Succession functions of pathogens and insects: Ecoregion sections M332a and M333d in northern Idaho and western Montana: Volume 1 analysis methods (Hagle, Johnson et al. 2000)
- Successional functions of pathogens and insects: Ecoregion sections M332a and M333d in northern Idaho and western Montana: Volume 2 results and conclusions (Hagle, Schwandt, et al. 2000)
- Health declines in western interior forests: symptoms and solutions (Harvey et al. 1995)
- Death of an ecosystem: Perspectives on western white pine ecosystems of North America at the end of the twentieth century (Harvey et al. 2008)
- Abundance and characteristics of snags in western Montana forests (Harris 1999)
- Mass Selection for Blister Rust Resistance: A Method for Natural Regeneration of Western White Pine (Hoff et al. 1976)
- Disease and insect resistance in conifers associated with the cedar/hemlock ecosystem (Hoff and McDonald 1994)
- Forest resources of the Clearwater National Forest (Hughes 2011)

- Restoring whitebark pine forests of the Northern Rocky Mountains, USA (Keane and Parsons 2010)
- Restoration concepts and techniques (Keane and Arno2001)
- Cascading effects of fire exclusion in the Rocky Mountain ecosystems: a literature review (Keane et al. 2002)
- Fire in ecosystem distribution and structure: Western forests and scrublands (Kilgore 1981)
- Review of literature on climate change and forest diseases of western North America (Kliejunas et al. 2009)
- Inventory of giant western redcedar groves on the Clearwater National Forest (Lichthardt 1998)
- Fire, competition and forest pests: landscape treatment to sustain ecosystem function (McDonald et al. 2000)
- Forest health and ecological integrity in the Northern Rockies. Forest Pest Management Rep (Monnig and Byler 1992)
- Ecological Units of the Northern Region: Subsections (Nesser et al. 1997)
- White pine and the American west: A vanishing species, can we save it? (Neuenschwander et al. 1999)
- Suggested stocking levels for forest stands in northeastern Oregon and southwestern Washington: An implementation guide for the Umatilla National Forest (Powell 1999)
- Western white pine bulletin (Rockwell 1917)
- Effects of stand density management on forest insects and diseases (Safranyik et al. 1998)
- Whitebark pine in peril: A case for restoration (Schwandt 2006)
- Overview of whitebark pine ecosystems: Ecological importance and future outlook (Tomback 2007)
- Whitebark pine communities: Ecology and restoration (Tomback et al. 2001)
- Biodiversity losses: The downward spiral (Tomback and Kendall 2001)
- Climate change implications for resource management on the Kootenai and Idaho Panhandle National Forests (USDA Forest Service 2010)
- Endangered and threatened wildlife and plants; 90–Day finding on a petition to list Pinus albicaulis (whitebark pine) as endangered or threatened with critical habitat (USDI FWS 2010)
- Fire history on the Idaho Panhandle National Forests (Zack and Morgan 1994)

1.1.2 *Informing the Assessment*

“Revised plans must contain plan components that address the composition, structure, ecological processes, and connectivity of plan area ecosystems in a manner that promotes their ecological integrity (36 CFR 219.8(a) and 219.9(a)(1).” The plan must provide for the diversity of habitats and species, within Forest Service authority, consistent with the inherent capability of the plan area (219.8). The plan defines the ecological conditions to maintain the diversity of habitats and persistence of native species. The plan must include plan components designed to maintain, restore, or promote the ecological integrity of terrestrial (and aquatic) ecosystems. In addition to Plan Components for Ecosystem Integrity and Ecosystem Diversity {Interim planning directives (draft), sec. 27.11-27.11d)} and Fundamental Ecosystem Elements (sec. 27.12–27.12c), the plan also includes additional regarding Species-Specific Plan Components (sec. 27.13–27.13c).

1.1.2.1 **Current Conditions**

Abiotic Ecosystem

The overall ecological context for the Northern Rocky Mountain forests is the interaction of effective water availability (moisture, temperature, and soils) and disturbance processes and the pattern of vegetation resulting from those interactions. In the western portion of the Northern Rocky Mountains (i.e., northern Idaho), the warmer Pacific maritime air mass dominates, producing upwards of 30–40 inches of precipitation each year resulting in forest dominated by grand fir, western red cedar, white pine, and western hemlock. Air masses can also move across this region from the southwest—crossing California and Nevada and bringing little moisture but bringing dry thunderstorms when they hit the mountains and valleys of southern and central Idaho. One such storm can release over 80,000 lightning strikes. Also, dry, cold air masses are sometimes are pulled out of north-central Canada, bringing high winds; very dry air; and in winter, very cold temperatures. Big fire years have been the result of dry lightning storms that cause ignitions followed by a shift in weather that pulled dry winds from the northeast.

This climate context, combined with soils, defines where different forest types can occur. The soils part of the equation is best understood by looking at the National Hierarchy of Ecological Units—Provinces at the largest scale, further subdivided into Sections at the scale of National Forest size, and ultimately, Subsections (Nesser et al. 1997). Subsections were developed by further subdividing Sections. For forest planning, Biophysical Settings were developed that are approximately equivalent to the Subsections in scale and roughly approximate the boundaries of the Subsections, but were developed from aggregating landtypes to provide a picture of lands with very similar topography, water balances, growing seasons, and forest types.

The Nez Perce-Clearwater National Forests are almost entirely within two ecological Provinces as delineated by Bailey (1994): the Northern Rocky Mountain Forest Steppe—Coniferous Forest—Alpine Meadow Province, (north of the Middle Fork Clearwater and Lochsa Rivers) and Middle Rocky Mountain Steppe—Coniferous Forest—Alpine Meadow Province (south of the Middle Fork and Lochsa Rivers), called M333 and M332, respectively. The Northern Rocky Mountain Forest Steppe province (M333) extends from east of the Cascade Mountains in Washington state to the Continental Divide in Montana, into Canada to the north, and throughout northern Idaho. The Middle Rocky Mountain Steppe province (M332) extends over the Blue Mountains in northeastern Oregon, the Salmon Mountains in central Idaho, and into the basins and ranges of southwestern Montana.

Most of these two provinces have been glaciated with landforms typical of this process.

Two ecological sections (USDA Forest Service 1994) within these two provinces dominate the Nez Perce-Clearwater National Forests: the Idaho Batholith (M332A) and Bitterroot Mountains (M333D). Small pieces of sections 331A (Palouse) and M332G (Seven Devils area) also occur within the Forests. However, these two sections have narrow extents and are similar enough to the adjacent sections, that for Forest Planning purposes, they have been combined with the adjacent Sections—Palouse (331A) with the Bitterroot Mountains (M333) and Seven Devils (M332G) with the Idaho Batholith (M332A). Following are brief descriptions of the attributes that are distinctive to the zone within each of the sections (USDA Forest Service 1994).

These descriptions set the context for the diversity that is found on the Forests. They provide concise images of the topography, vegetation, climate, and wildlife that can be found here. Comparing historic conditions in these sections to current conditions indicates how vegetation and wildlife habitat have changed over time, which, in turn, may point to needed changes in management direction.

Idaho Batholith—Section M332A

Climate is maritime-influenced, cool temperate with dry summers. Severe winters are usual, average temperatures can range from below 0 degrees F (°F) in the winter to above 100 °F in the summer. River valleys have more moderate winter temperatures.

Common tree species include grand fir, Douglas-fir, lodgepole pine, Engelmann spruce, subalpine fir, and western ponderosa pine. Whitebark pine, once a keystone species at high elevations, and western white pine, once a key species on moist, moderate sites, have both severely declined due to white pine blister rust, mountain pine beetle outbreaks, and lower fire occurrence. Lower elevation, non-forest vegetation includes Idaho fescue, bluebunch wheatgrass, hackberry, hawthorn, and more mesic shrubs. Whitebark pine occurs at high elevations. Geology consists of Lower Tertiary and Mesozoic granite with areas of Tertiary and Quaternary sediments and basalts. Volcanic ash accumulations in some soils make them very productive. Breaklands have very steep, straight tributaries with high sediment delivery efficiency. Rolling uplands have gentle slopes, with complex dendritic and structurally controlled drainage patterns with low sediment delivery efficiencies. Rare or unusual plant species include MacFarlane’s four-o’clock, Pacific dogwood, and *Dasynotus daubenmirei* (Dasynotus).

Bitterroot Mountains—Section M333D

Climate is maritime-influenced, cool, moist temperate with relatively mild winters and dry summers. Winters can be severe with average temperatures from below 0 °F in the winter to above 100 °F in the summer. Lower elevation river valleys have more moderate winter temperatures.

Common tree species include grand fir, western redcedar, Douglas-fir, ponderosa pine, subalpine fir, lodgepole pine, western hemlock, and western white pine. Whitebark pine, once a keystone species at high elevations, and western white pine, once a key species on moist, moderate sites, have both severely declined due to white pine blister rust, mountain pine beetle outbreaks, and lower fire occurrence. Geology is mostly Precambrian metasedimentary rocks of the Belt Supergroup, borderzone metamorphics, and Idaho batholith. Steep, dissected mountains, some with sharp crests and narrow valleys exist. Rare or unusual plant species include Pacific dogwood, *Dasynotus daubenmirei* (Dasynotus), deer fern, and clustered ladyslipper.

In the development of the 2007 Clearwater and Nez Perce National Forest plan revisions, Planning Team Silviculturist Kris Hazelbaker and Forest Ecologists (Pat Green, Nez Perce National Forest, and Jim Mital, Clearwater National Forest) refined the stratification of the Forest's landscapes. Their purpose was to recognize and characterize the distinctions across the landscape resulting from the influences of topography, site productivity, and fire regimes on forest vegetation. Local Landtype Association Groups or Vegetation Response Units were used to divide each section into three Biophysical Settings: Breaklands, Uplands, and Subalpine. These settings are roughly similar to the subsections described in Ecological Units of the Northern Region: Subsections (Nesser et al. 1997).

Included with each landscape are generalized descriptors of topography (slope, aspect, stream, and riparian characters); disturbance regime (intensity, frequency, scale); and vegetation (composition, structure, function). Breaklands are characterized by steep slopes at lower elevations, with warmer temperature regimes. Uplands are generally above the Breaklands in elevation and have more rolling topography. They tend to be cooler and more mesic than the Breaklands. The Subalpine setting is above the Uplands elevationally, with mixed topography and generally colder temperatures. Disturbance regimes differ between the three settings, with more frequent, less severe fire common on the Breaklands; infrequent mixed-severity or stand-replacing fires typical on the Uplands; and slightly more frequent than on Uplands, mixed and stand-replacing fires on Subalpine settings.

Wildlife and plants adapted to this landscape and its natural disturbance processes. Franklin (1987) contends that landscape management practices should "…reduce the emphasis on dispersing small clearcut patches through the forest landscape". Franklin (1987) further contends that "…fragmentation that results (from small clearcuts) does not enhance many resource values…and that …clearcutting generally must be avoided within the reserved patches because of the substantial vulnerability that results from placing even small cuts within a reserved tract." Landscape management practices should "…identify and reserve large patches of primeval forest…for maintenance of interior species…" (Franklin 1987, p. 15). Larger, contiguous habitat patches, especially those with interior forest species, reduce fragmentation and promote habitat connectivity. Likewise, ungulate species rely on productive grass/shrub/forb forages that are most nutritious only in early forest habitats. Abundant forage, in proximity to large patches of hiding cover, to avoid predation and human disturbance are preferred by big game.

In addition to a spatial arrangement, forests have been affected by climate, weather, and disturbance in a temporal context as well. Over the past century, wildfire occurrence has varied greatly. Figure 1-1 and Figure 1-2 below show the numbers of acres that have burned annually since 1870.

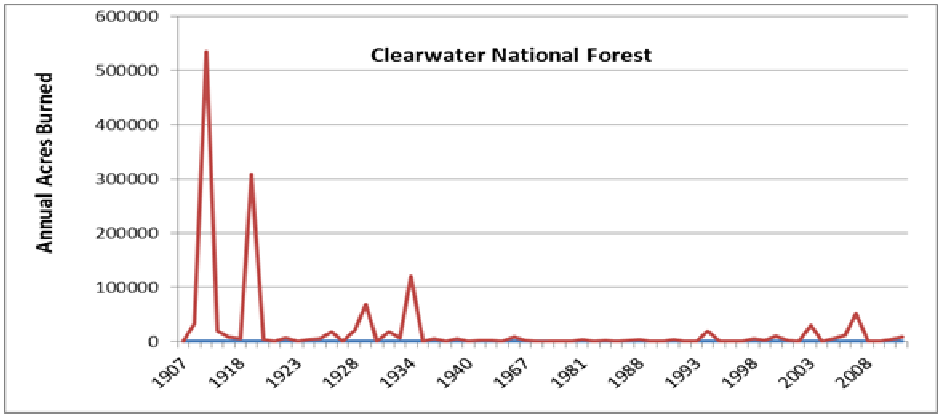


Figure 1-1. Annual acres burned on the Clearwater National Forest portion of the planning unit since 1870

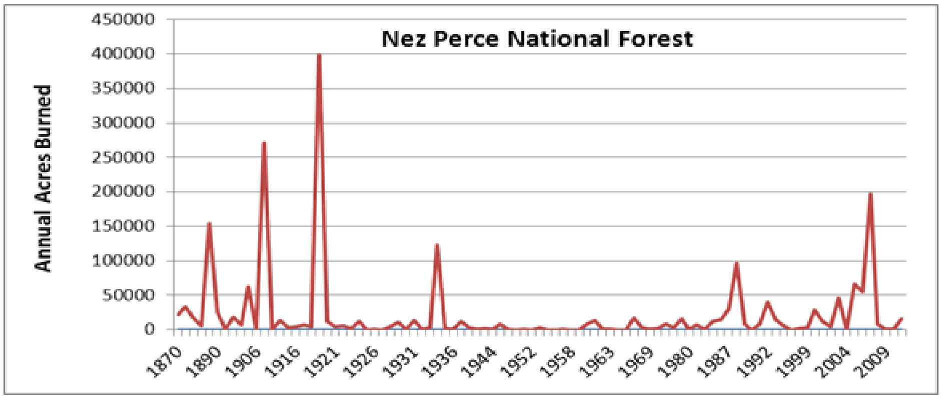


Figure 1-2. Annual acres burned on the Nez Perce National Forest portion of the planning unit since 1870

First analysis of these data seemed to show that after the wildfires of the early 1900s and the development of the US Forest Service as an effective fire fighting force, fire suppression was very effective until fuels built up through natural forest growth and mortality to the point where fires were unstoppable, hence the increase in fires over the recent decades. However, an analysis of climatic patterns over this time has shown another significant influence. The northwestern United States is heavily influenced by a cyclic phenomenon called the Pacific Decadal Oscillation (PDO). Similar to El Nino and La Nina, this weather trend is related to oceanic temperatures in the northern Pacific Ocean. Fluctuation in the PDO since 1900 is illustrated in Figure 1-3.

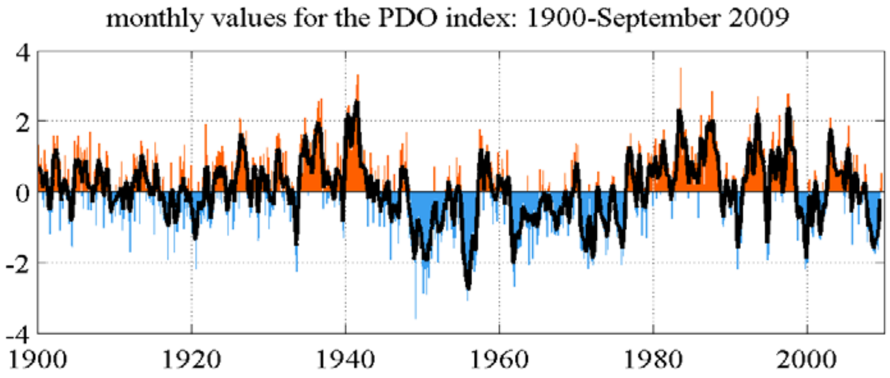


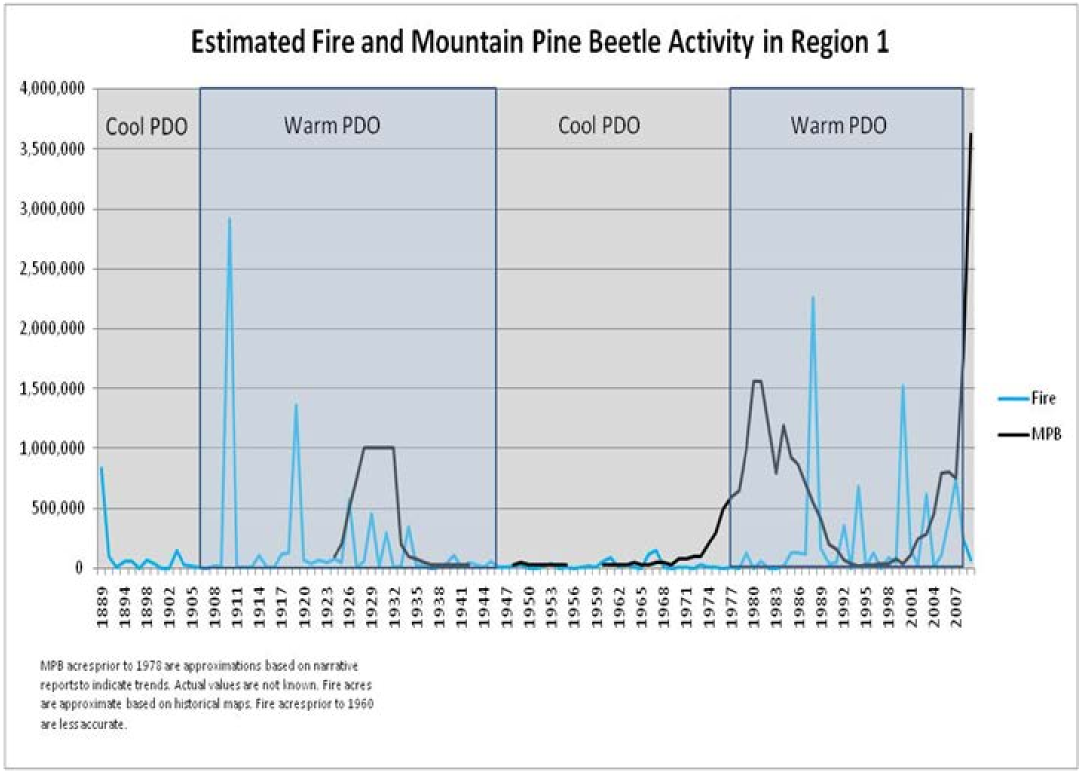
Figure 1-3. Monthly values for the Pacific Decadal Oscillation index from 1900 to September 2009

When PDO data are overlaid on the fire statistics an interesting correlation is seen. A period between 1940 until 1980 was in the cool wet phase, which would have limited wildfires while at the same time promoted tree growth, regeneration, and significant increases in forest density. Clearly cool wet trends resulted in lower wildfire occurrence regardless of the fuel loading across the region. Climate is the most controlling factor for wildfire and the one we can least influence.

A more detailed comparison between PDO fluctuations and documented extreme forest wildfire years shows another correlation: severe fire years clearly tend to occur almost exclusively when warm weather spikes follow cool, wet weather cycles. This correlation makes sense because cool, wet weather promotes rapid vegetation growth and the subsequent warm, dry cycles cause mortality and dry fuel conditions. This correlation is also supported by a more recent study of climate and fire correlations across the northern Rockies by Morgan et al. (2008).

Climatic patterns therefore appear to be a major driver of severe and widespread wildfire effects across forests. This correlation is more recently evidenced by the fire patterns between 2000 and 2007. Although our forests have not changed much, the cooler summers of 2008, 2009, 2010, and 2011 have resulted in few major fires in the northern Rockies although fuel conditions and fire suppression capabilities have not changed during this time.

As with fire, three major mountain pine beetle outbreaks over the last 100 years have also occurred during the warm phase of the PDO (Figure 1-4). The current outbreak was a result of millions of acres of young forests being created by disturbance factors around the turn of the century (1880–1930).



MPB acres prior to 1978 are approximations based on narrative reports to indicate trends. Actual values are not known. Fire acres are approximate based on historical maps. Fire acres prior to 1960 are less accurate.

Figure 1-4. Estimated fire and mountain pine beetle activity in Region 1 of the Forest Service

1.1.2.2 Existing Conditions and Trends

Forest Composition

Existing Conditions

Existing conditions for composition are described with maps, tables, and descriptions of the forest covers found on the Forests. Figure 1-5 puts the vegetation on the Forests in context with the remainder of the Northern Rocky Mountains. Mixed mesic species clearly dominate the cover types here, and they are much more widespread than in Montana. The Idaho panhandle region to the north is very similar.

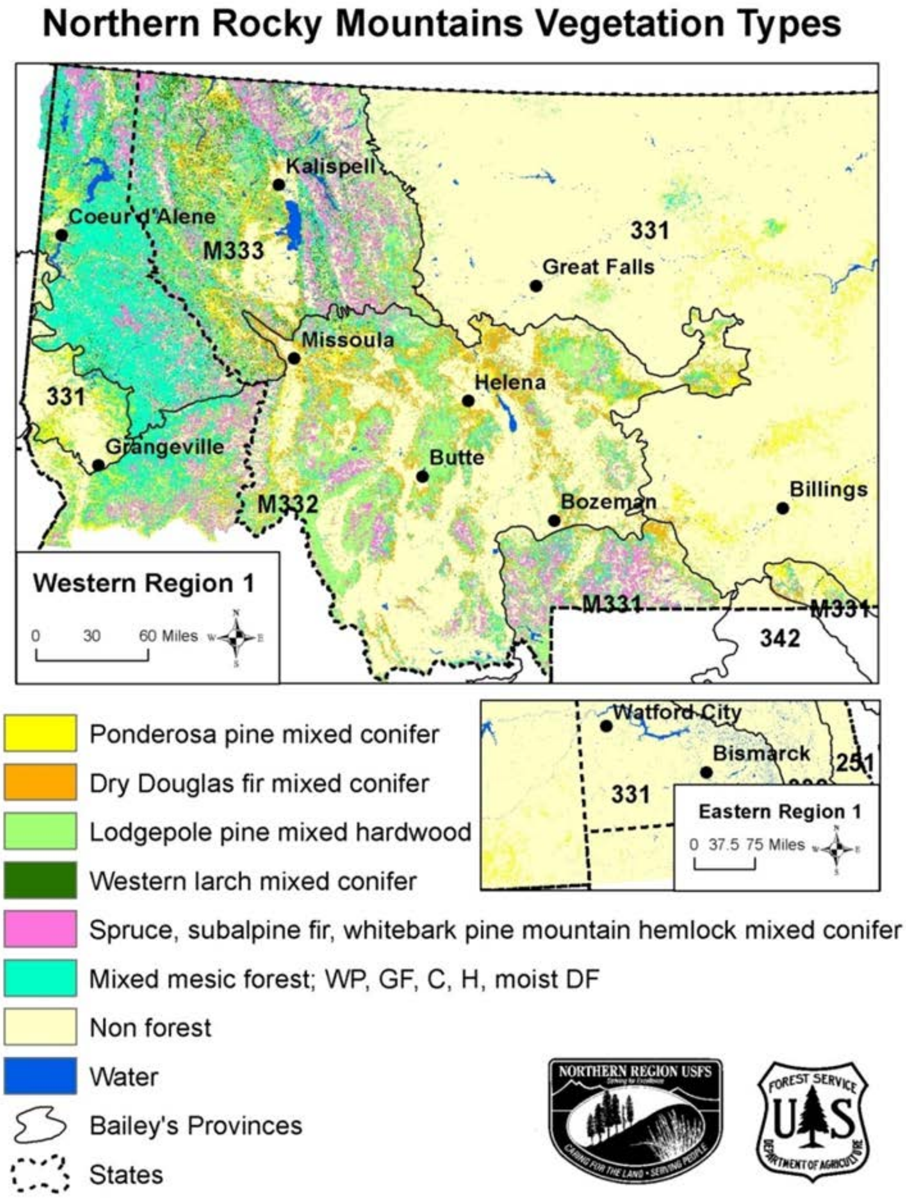


Figure 1-5. Ecological units of the Northern Rocky Mountains and Spatial distribution of key forest dominance types in the Northern Rocky Mountains

Table 1-1 provides a tabular description of the current cover types, drawn from the Forest Inventory and Assessment (FIA) plots on the Forests. Species names follow the Northern Region Vegetation Mapping protocol for percent of cover of a species. Grand fir, western redcedar, western hemlock, and moist Douglas-fir are in the mixed mesic type (turquoise on Figure 1-5). Subalpine fir, Engelmann spruce, and whitebark pine are in the subalpine type (pink on Figure 1-5).

Table 1-1. Existing forest-wide composition by species or species mix

Species	Percent
Grand fir	9
Grand fir mix	9
Subalpine fir	11
Subalpine fir mix	7
Western larch	1
Whitebark pine	<1
Lodgepole pine	12
Lodgepole pine mix	5
Engelmann spruce	3
Engelmann spruce mix	5
Ponderosa pine	5
Ponderosa pine mix	1
Douglas-fir	11
Douglas-fir mix	11
Western redcedar	4
Western redcedar mix	3
Western hemlock	2
Western hemlock mix	1

Source: Nez Perce and Clearwater Hybrid Forest Inventory and Assessment data collected in 2000–2002 and 2004–2007.

Table 1-2 through Table 1-7 provide the percentage of area for the different forest compositions for each of the biophysical settings of the Nez Perce-Clearwater National Forests, as measured from the FIA plots on the Forests.

Table 1-2. Idaho Batholith Breaklands (approximately 639,000 acres)—119 FIA plots

Composition	Area (%)
Ponderosa pine mixes	35
Douglas-fir/western larch mixes	23
Grand fir/Western redcedar mixes	34
Lodgepole pine mixes	2
Subalpine fir/Engelmann spruce mixes	1
None (grass/shrub)	4

Table 1-3. Bitterroot Mountains Breaklands (approximately 764,000 acres)—113 FIA plots

Composition	Area (%)
Ponderosa pine mixes	1
Douglas-fir/western larch mixes	33
Western redcedar/grand fir mixes/western hemlock	50
Western white pine mixes	0
Lodgepole pine mixes	3
Subalpine fir/Engelmann spruce mixes	4
None (grass/shrub)	9

Table 1-4. Idaho Batholith Uplands (approximately 441,000 acres)—73 FIA plots

Composition	Area (%)
Ponderosa pine mixes	1
Douglas-fir/western larch mixes	19
Western redcedar/grand fir mixes	45
Lodgepole pine mixes	16
Subalpine fir mixes	15
None (grass/shrub)	3

Table 1-5. Bitterroot Mountains Uplands (approximately 339,000 acres)—58 FIA plots

Composition	Area (%)
Ponderosa pine mixes	0
Douglas-fir/western larch mixes	14
Western redcedar/grand fir mixes	71
Western white pine mixes	0
Lodgepole pine mixes	2
Subalpine fir mixes	10
None (grass/shrub)	3

Table 1-6. Idaho Batholith Subalpine (approximately 1,245,000 acres)—174 plots

Composition	Area (%)
Ponderosa pine mixes	0
Douglas-fir/western larch mixes	11
Western redcedar/grand fir mixes	8
Western white pine mixes	0
Lodgepole pine mixes	18
Subalpine fir mixes	57
None (grass/shrub)	0

Table 1-7. Bitterroot Mountains Subalpine (approximately 501,000 acres)—69 FIA plots

Composition	Area (%)
Ponderosa pine mixes	0
Douglas-fir/western larch mixes	10
Western redcedar/grand fir mixes	4
Western white pine mixes	0
Lodgepole pine mixes	33
Subalpine fir mixes	48
None (grass/shrub)	5

Dry Ponderosa Pine and Douglas-fir Forests

Ponderosa pine is often the only tree species that can colonize the hot, dry surface conditions of a disturbed site. This extinction is especially true on the Breakland biophysical setting adjoining the Salmon River, South Fork Clearwater River, Selway River, and to a lesser extent, along the Lochsa River. Areas on the Palouse, adjacent to the prairie, also support this dominance type. Over time, as ponderosa pine matures, it provides a shaded environment where less heat tolerant Douglas-fir and other species can establish. With frequent understory fires as part of the dominant low-severity fire regime, the thick-barked ponderosa pine survives while the thinner-barked Douglas-fir and ponderosa pine seedlings do not. If frequent fires are sustained, the ponderosa pine forest can develop into large patches of open grown old forest structure (Figure 1-6), intermixed with smaller openings that can persist for centuries provided moisture and temperature regimes do not dramatically change. During a cool, wet climatic timespan, or through fire suppression, young Douglas-fir and ponderosa pine may become established; in a few decades, this change can result in a dense forest structure (Figure 1-6). The increased biomass and structural heterogeneity of these dense stands allows fires to develop into large, active crown fires that bring this site back to the initial stand establishment phase or, if fire reburns these areas soon, may limit forest establishment due to loss of seed source, limited soil moisture, and high surface soil temperature.

Figure 1-6. Left, open-grown ponderosa pine with frequent, low-severity fire. Right, ponderosa pine forest without fire, showing Douglas-fir and grand fir of multiple sizes in the understory.

Western Larch/Mixed Conifer Forests

These forests developed under fire regimes that included infrequent stand-replacing fires (200+ years) and more frequent (20–100 years) mixed severity fires. On mesic sites, these forests produced a diverse pattern of western larch and Douglas-fir, with grand fir, western white pine, and other species sometimes found in the mix. On cooler sites, these forests included western larch mixed with lodgepole pine, Engelmann spruce, and subalpine fir. These sites were dominated by lethal fire regimes that produced very large patches with older legacy larch often represented (Figure 1-7). Many old western larch can be found with evidence of fire scars dating back centuries.

Western larch is not very susceptible to insects and diseases common to other associated tree species. As such, it brings fire and disease resistance to the forest, making the forest resilient to those disturbances.

These forests are perhaps the most scenic with their October change in color.

All larch forests typically had relict, old trees, with younger larch and other species forming a second cohort. This two-aged structure was maintained by periodic low-severity fire that visited many stands one, two, or even three times between stand-replacing fires. The presence of low-severity fire allowed complex, old forest structures to persist for many centuries as larch can be a very long-lived seral species.

Figure 1-7. Left, western larch mixed conifer stand on north-aspect breaklands. Right, western larch as legacy trees in a young stand.

Grand Fir, Douglas-fir, Cedar, Hemlock Forests

Mixed species, shade-tolerant forests are found where fire return intervals are long, allowing these late seral, fire-sensitive species to dominate. This is especially true on grand fir mosaic sites, which are cooler and moister than similar non-mosaic sites. Mosaic sites often have very little evidence of fire. Old grand fir or subalpine fir usually dominate there, with some western redcedar, Engelmann spruce, and occasional western white pine (Figure 1-8).

Outside of the mosaic stands, these forests are the most diverse on the forest. Any native forest species can be found mixed with the dominant species here. They see a very wide range of fire occurrence. Stand-replacing fires occur every 25 to 200+ years, though with the shorter return intervals, seral shrubfields and seral conifer species dominate. Between stand-replacing fire events, non-lethal or mixed severity fires result in a diverse forest with multiple age and size classes (Figure 1-9).

Root disease is widespread in these stands and is particularly damaging to Douglas-fir and grand fir. Annual losses of 5% of the basal area in a stand are typical. Openings regenerate with the same species and are subsequently infected with root disease; and the cycle repeats. Western redcedar has long been considered to be tolerant of root disease, but recent observations indicate that it, too, is seeing the effects, with increasing crown thinning and mortality.

On slightly drier sites, such as found in the South Fork Clearwater and Salmon River drainages, grand fir and Douglas-fir can dominate longer before succumbing to root disease.

Figure 1-8. . Left, multi-storied grand fir stand. Right, very old western redcedar stand with a single canopy layer.

Figure 1-9. Left, low severity fire in a cedar/grand fir stand that left fire scars on the larger trees, and killed some of the smaller trees, reducing the multiple stories. Right, the pattern of mixed severity fire on these sites.

Western White Pine Forests

White pine was a prominent species on sites with western redcedar as the potential vegetation type (PVT). Most of this PVT is found north of the Lochsa River. Prior to the early 1900s and the introduction of white pine blister rust, white pine dominated these sites (Figure 1-10). Prior to the advent of blister rust, white pine stands originated after severe, stand-replacing fires that occurred during relatively dry climatic periods (Marshall 1927). White pine was maintained by more frequent, low- to mixed-severity fires. Blister rust was a nonnative disease, and since white pine had not been selected for resistance over its history, it rapidly succumbed to infections.

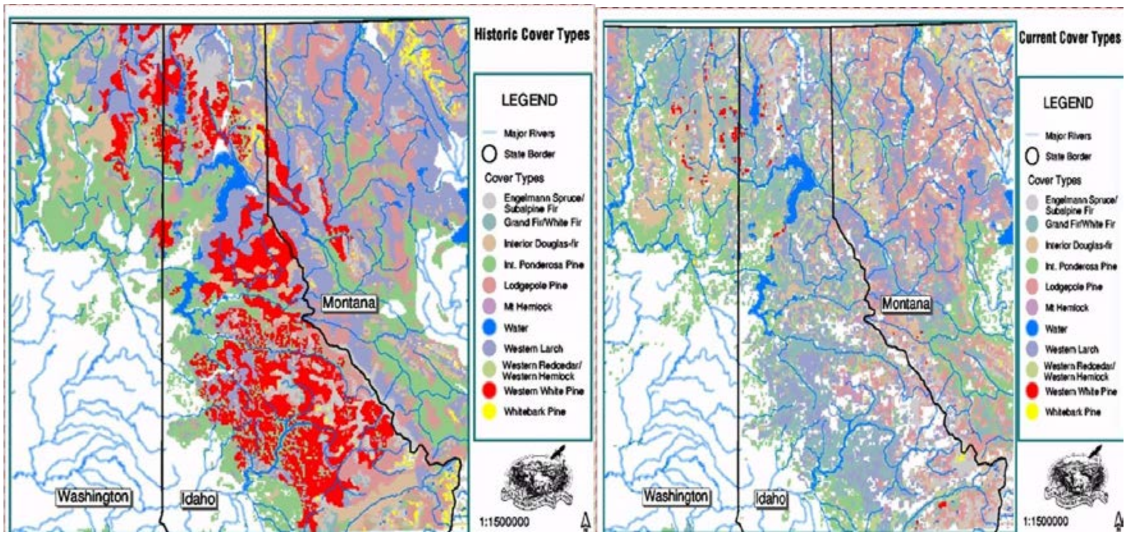


Figure 1-10. Change in forest cover type over the past 100 years

As white pine forests have been lost to white pine blister rust, the trees replacing them were often western hemlock, grand fir, and Douglas-fir. These species are extremely susceptible to root disease. Douglas-fir, for instance, often dies out of a stand by the time it is 80–100 years old. The stand regenerates to more grand fir, Douglas-fir, or western hemlock (in the North Fork Clearwater River drainage and the Palouse). These young trees again succumb to root disease, and this cycle reduces the persistence and longevity of forests occupying these same sites today.

Significant progress has been made toward developing rust resistant white pine for out planting in many areas of northern Idaho. Trees grown from the current seed sources are about 60% resistant to blister rust (Figure 1-11). In addition, natural reproduction from surviving white pine trees has shown about an 18% survival rate, and offers another source of blister rust resistance (Hoff et al. 1976).

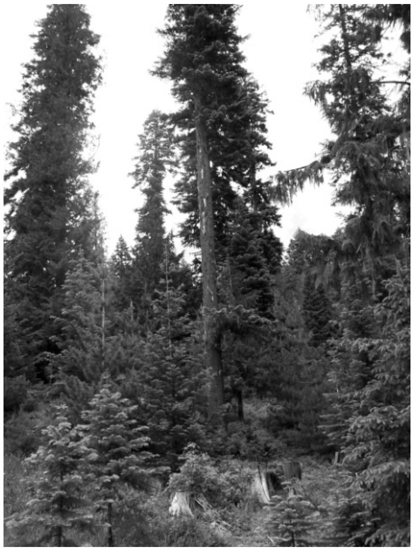


Figure 1-11. Young rust-resistant white pine planted in a mixed species stand under a shelterwood

Lodgepole Pine Forests

Lodgepole pine stands are extensive on the subalpine biophysical settings, and lodgepole forests are typically even-aged, single-story forests. Once they reach 60–80 years old with a stand size over 8 inches dbh, they often experience severe mortality caused by mountain pine beetle activity (Figure 1-12), which creates snags and down wood. These snags and down wood produce fuel conditions that lead to potentially severe fire effects, depending on time since the infestation (Jenkins 2008). On lodgepole pine–dominated sites, stand-replacing fire was common and severity was affected by periodic outbreaks of mountain pine beetle that led to large fuel loads and pulse events for snags.

If the stands avoid severe fires, they eventually go through succession to a forest of mixed subalpine fir and Engelmann spruce.

Figure 1-12. Left, typical stand structure of a lodgepole stand that is entering the stage of being susceptible to mountain pine beetle infestations. Right, a closer view of the stand, showing the sparse understory.

Whitebark Pine / Subalpine Fir and Engelmann Spruce Forests

Whitebark pine is associated with high elevation and its distribution has been primarily influenced by the cold continental air masses in higher elevations in northern Idaho. On the Nez Perce–Clearwater National Forests, whitebark pine is typically found above 6,500 feet elevation. Forest associates are other high-elevation species, such subalpine fir, Engelmann spruce, mountain hemlock, and subalpine larch. The spruce/subalpine-fir types are home to Canada lynx, a species listed under the Endangered Species Act (ESA), so it is an important associate of forests at high elevations.

Whitebark pine trees occur in pure stands on some of the higher ridges and mountain tops. When they occur at the lower elevations within their range, they typically serve as a minor early seral species in mixed conifer stands. At the other extreme, where they are found at the uppermost elevations (above 8,000 feet) in rather pure stands, they can serve as a major climax species. This tree is considered a “keystone” and “foundation” species because of its significant role in subalpine ecosystems (Keane and Parsons 2010, Tomback and Kendall 2001, Tomback et al. 2001). Whitebark pine was recently petitioned for listing under the ESA, but was precluded.

Whitebark pine is susceptible to mountain pine beetle. Three outbreaks of mountain pine beetle in the northern Rockies have occurred over the past 100 years. The first outbreak in the 1920s to 1930s, killed significant areas of whitebark pine and left many “Ghost Forests” (Evenden 1934, 1944). These snags can still be seen today.

In the past couple of decades, white pine blister rust has arrived at the high elevation sites where whitebark pine lives and has been decimating the remaining trees. There is a west-wide effort to collect seed from apparently rust-resistant trees and begin a breeding program for rust-resistant whitebark pine. Seed from this effort would be used to restore whitebark pine as opportunities arise. In addition, as wildfires occur or fire use proceeds, openings in the subalpine forests create opportunities for natural regeneration from remaining rust-resistant trees and for selection for rust resistance.

Several outbreaks of spruce beetle have also occurred. This beetle has a 2-year life cycle and can cause significant mortality in the large tree size class (>20 inches dbh). Vast areas of large diameter spruce forests do not exist, so when an outbreak of spruce beetle occurs, local mortality can be high; however, acres infested are low compared to mountain pine beetle in whitebark pine and lodgepole pine.

Dead Standing Wood

Snags (standing dead trees) are ecologically important for several reasons. They are important habitat structures (nesting, feeding, perching, and/or roosting) for a wide variety of wildlife species. Once they fall, snags become down wood that provide other habitat structures (including den sites) for a different and very wide suite of wildlife species and some plant species. Down wood is also critical for nutrient cycling, moisture retention, diversity of soil micro-organisms, and hydrologic function as well as for providing effective microsites for tree regeneration. Snags are short term and vary greatly throughout the life cycle of a forest stand. If a stand originates following a fire, the resulting young stand may begin under a high number of snags. However, most snags only remain standing from a few years to a very few decades. How long these snags remain standing is a function of the structure, species composition, and age of the previous stand; fire severity; snag size; and site factors such as soil characteristics, slope position, and landscape position. An insect or disease outbreak may rapidly increase the number of snags. A severe windstorm may rapidly reduce the number of snags (while increasing the amount of down wood). Root pathogens may provide gradual input of snags until all the trees are killed; but, depending on the particular pathogen; these snags may not remain standing for very long. Various severe weather conditions may serve either to increase or decrease snag numbers.

As found in both Bollenbacher et al. (2009) and Harris (1999), the distribution of snags across the landscapes in northern Idaho and western Montana is very clumpy, or uneven. For example, when analyzing snag distributions on several national forests in northern Idaho (Idaho Panhandle, Nez Perce, and Clearwater National Forests), Bollenbacher et al. (2009) found that the percent of FIA plots having any snags occurring on them varied from 4% to 5%, depending on the habitat type, dominance groups, and snag class. The conclusion is that over much of the area, no snags exist, while other areas have numerous snags. The primary reason for this uneven distribution of snags across the landscape is simply that many snags are created from periodic, broad- and fine-scale disturbances, such as fire, insects, and diseases, and these disturbances do not occur evenly across space.

Table 1-8 illustrates the range and average number of snags and live trees that occur within each of three seral stages by Habitat Type Group and Dominance Groups. Information is from all of the northern Idaho national forests.

Table 1-8. Snags and live trees per acre ranges by seral stage and diameter class seral stage is based on stand size as derived by basal area weighted average diameter. Note: early seral = 0.0–4.9 inches average diameter at breast height (dbh); mid-seral = 5.0–14.9 inches average dbh; late-seral = >15.0 inches average dbh

Dominance Group	Habitat Type Group	Snags >15 inches DBH	Snags >20.0 inches DBH	Live Trees >15.0 inches DBH
Ranges per Acre in Early-seral Conditions (0–4.9 inches average stand diameter)				
All Other Groups	Dry	2.1–4.2 (3.1)	0.9–1.8 (1.3)	0.3–3.0 (1.4)
	Low and Mid Elevation Moist	4.3–6.7 (5.5)	2.2–3.5 (2.9)	1.1–5.6 (3.1)
	Subalpine	3.2–5.0 (4.1)	1.0–1.8 (1.4)	1.1–3.6 (2.6)
Lodgepole Pine	All	0.9–2.4 (1.6)	0.1–0.7 (.4)	0.7–3.2 (1.8)
Ranges per Acre in Mid-seral Conditions (5.0–14.9 inches average stand diameter)				
All Other Groups	Dry	2.0–5.0 (3.4)	0.8–2.1 (1.3)	20.7–32.5 (26.4)
	Low and Mid Elevation Moist	3.8–6.6 (5.2)	1.9–3.4 (2.6)	26.2–34.1 (30.1)
	Subalpine	3.0–5.0 (4.0)	0.9–2.0 (1.4)	19.7–25.5 (22.6)
Lodgepole Pine	All	1.1–3.4 (2.2)	0.2–1.1 (0.5)	10.8–18.8 (14.6)
Ranges per acre in Late-seral Conditions (≥15 inches average stand diameter)				
All Other Groups	Dry	2.4–6.2 (4.2)	1.3–3.4 (2.2)	18.8–32.5 (25.4)
	Low and Mid Elevation Moist	6.0–12.3 (8.9)	3.4–6.9 (5.1)	32.3–47.2 (39.6)
	Subalpine	4.6–11.3 (7.7)	1.7–4.3 (2.9)	23.0–45.0 (33.5)
Lodgepole Pine	All	None	None	None

Note: Estimated mean for each range is displayed in parentheses.
Source: Table 12 in Bollenbacher et al. (2009)

Trend and Departure

Root rot study plots throughout northern Idaho show that over the past 40 years, the incidence of root disease has increased, as has the resulting mortality in susceptible tree species. This increase has been in the extent and the intensity of the diseases. In many cases, this increase results from the loss of western white pine, which has increased the presence of susceptible species, such as Douglas-fir and grand fir.

Recently, the U.S. Fish and Wildlife Service completed a status review of whitebark pine for potential listing as a threatened or endangered species. They concluded that the species warranted listing but was precluded because of the need to address higher priority species. Whitebark pine is now designated as a Candidate species. Mountain pine beetles, fire exclusion policies, and the introduction of white pine blister rust disease have been found to be responsible for a significant decline of this species across its range in western North America (Keane and Parsons 2010, Schwandt 2006). In northern Idaho and Montana, white pine blister rust has killed a quarter to half of all whitebark pine trees, and since the late 1990s, mountain pine beetle-caused mortality has increased (USDA Forest Service 2010). In addition, climate change could detrimentally affect this species; either directly or indirectly through interactions of bark beetles, blister rust, wildfires, or a combination (Keane and Parsons 2010, USDA Forest Service 2010, USDI FWS 2010).

Active restoration efforts, such as those described in Keane and Arno (2001) and Schwandt (2006), are believed to be necessary to achieve restoration objectives. Without management intervention, losses of this tree across its range could have major consequences for biodiversity (Tomback 2007).

Douglas-fir and western larch are at the bottom end of their HRVs and frand fir and western redcedar are above their HRV on the Idaho Batholith Breaklands biophysical setting (Table 1-9). Seral grass and shrub types are only one-half to one-quarter of the HRV. In general, this reduction indicates a loss of shade-intolerant, fire-tolerant species and an increase in shade-tolerant, fire-intolerant species. In this setting where fire has a frequent return interval, such a shift makes for a vulnerable forest.

Table 1-9. Historic Range of Variation versus existing dominance type—Idaho Batholith Breaklands

Dominance Type	Historic Range of Variation (%)	Existing (%)
Ponderosa Pine/Mix	21–41	35
Douglas-Fir	19–37	20
Lodgepole Pine	3–7	2
Western Larch/Douglas-Fir	3–7	3
Grand Fir/Western Redcedar	11–21	34
White Pine	0–0	0
Subalpine Fir/Spruce Mix	2–4	1
Seral Grass/Shrub	8–16	4
Non-Forest	16	9

Ponderosa pine is far below its HRV for the Bitterroot Mountains Breakland biophysical setting (Table 1-10). Western larch mixes are also far below their historic occurrence, and pure Douglas-fir is above its HRV (Table 1-10). Similarly, grand fir and western redcedar, shade-tolerant, fire-intolerant species, are 3–5 times higher than they were historically. In general, this shift indicates a decline in fire- and disease-resistant species and an increase in disease-susceptible, fire-intolerant species.

Table 1-10. Historic Range of Variation versus existing dominance types—Bitterroot Mountains Breaklands

Dominance Type	Historic Range of Variation (%)	Existing (%)
Ponderosa Pine/Mix	9–19	1
Douglas-Fir	14–22	31
Lodgepole Pine	0	3
Western Larch/Douglas-Fir	13–20	2
Grand Fir/Western Redcedar	9–17	50
White Pine	10–25	0
Subalpine Fir/Spruce Mix	0	4
Seral Grass/Shrub	8–15	9
Non-Forest	10	10

Ponderosa pine and western larch mixes are well below their HRV, grand fir and western redcedar are somewhat above their HRV, and seral grasses and shrubs are at the lower end of their HRV for Idaho Batholith Upland biophysical setting (Table 1-11). Similar to the breakland settings, shade-intolerant, drought-tolerant, fire-tolerant, and disease-resistant species have been lost and shade-tolerant, drought-intolerant, fire-intolerant, and disease-susceptible species have increased. This shift lowers the overall resilience of the system.

Table 1-11. Historic Range of Variation versus existing dominance types—Idaho Batholith Uplands

Dominance Type	Historic Range of Variation	Existing
Ponderosa Pine/Mixed	11% to 23%	1%
Douglas-fir	11% to 23%	18%
Lodgepole Pine	15% to 29%	16%
Western Larch/Douglas-fir	3% to 7%	1%
Grand Fir/Western Redcedar	21% to 41%	45%
White Pine	0% to 0%	0%
Subalpine fir/Spruce Mix	2% to 4%	15%
Seral Grass/Shrub	3% to 7%	3%
Non-Forest	4%	4%

Ponderosa pine and western larch mixes are below the HRV, and western white pine has no presence rather than being about one-third of the landscape for the Bitterroot Mountains Uplands Biophysical setting (Table 1-12). On the other hand, grand fir and western redcedar have expanded to 3–5 times their historic presence. Similar to the breakland settings, shade-intolerant, drought-tolerant, fire-tolerant, and disease-resistant species have been lost and shade-tolerant, drought-intolerant, fire-intolerant, and disease-susceptible species have increased. This shift lowers the overall resilience of the system.

Table 1-12. Historic Range of Variation versus existing dominance types—Bitterroot Mountains Uplands

Dominance Type	Historic Range of Variation	Existing
Ponderosa Pine/Mixed	5–10	0
Douglas-fir	5–15	12
Lodgepole Pine	3–7	2
Western Larch/Douglas-fir	7–15	2
Grand Fir/Western Redcedar	15–25	71
White Pine	20–40	0
Subalpine Fir/Spruce Mix	1	10
Seral Grass/Shrub	3–7	3
Non-Forest	3	3

Western larch mixes, seral grasses, and shrubs are also below their HRV for the Idaho Batholith Subalpine biophysical setting (Table 1-13). Subalpine fir and Engelmann spruce mixes are well above their HRV, and the whitebark pine component, which should be found on these forests, is less than one-tenth of its HRV (Table 1-13).

Table 1-13. Historic Range of Variation versus existing dominance types—Idaho Batholith Subalpine

Dominance Type	Historic Range of Variation	Existing
Ponderosa Pine/Mixed	0	0
Douglas-fir	4–10	9
Lodgepole Pine	12–28	18
Western Larch/Douglas-fir	3–7	2
Grand Fir/Western Redcedar	0	8
Subalpine Fir/Spruce Mix	20–32	55
Subalpine fir/Whitebark pine	20–33	2
Seral Grass/Shrub	3–7	0
Non-Forest	20	20

Western larch mixes and western white pine are below their HRV for the Bitterroot Mountains Subalpine Biophysical setting (Table 1-14). Subalpine fir and Engelmann spruce mixes are well above their HRV, and the whitebark pine component, which should be found in these forests, is less than one-tenth of HRV. Even combining the two types of subalpine fir forest, the existing (48%) is well above the combined HRV (38%) (Table 1-13 and Table 1-14).

Table 1-14. Historic Range of Variation versus existing dominance types—Bitterroot Mountains Subalpine

Dominance Type	Historic Range of Variation	Existing
Ponderosa Pine/Mix	0	0
Douglas-fir	7–13	9
Lodgepole Pine	18–38	33
Western Larch/Douglas-fir	4–8	1
Grand Fir/Western Redcedar	0	4
White Pine	5–9	0
Subalpine fir/ spruce mix	8–18	45
Subalpine fir/Whitebark pine	11–20	3
Seral Grass/Shrub	6–12	5
Non-Forest	14	14

Tree Size

Existing Conditions

The different stages of succession are often referred to as seral stages and can be described as follows:

- **Non-stocked and Trees <5 inches—**Communities that occur early in the successional path and generally have less complex structural developmental than other successional communities. Stands dominated by trees in the seedling/sapling or small size classes are typically in this early seral stage.
- **Trees 5–9 inches—**Communities that occur in the middle of the successional path. For forests, this stage usually corresponds to stands that are dominated by trees in the medium or large size classes.
- **Late-seral—**Communities that occur in the later stage of the successional path with mature, generally larger individuals. Generally, stands in this late-seral stage will be dominated by trees in the large size class.
- **Old growth—**Old Growth is a subset of the late-seral communities. Not only are these dominated by larger, older trees, but they have dead and down material present. Old growth in different forest types looks differently. Green et al. (1992) described old growth characteristics for the Northern Rockies. FIA data have been used to determine how much old growth, of all forest types, is found on the Forests.
- **Snags—**Are standing dead trees. Bollenbacher et al. (2009) evaluated snag conditions in northern Idaho, and concluded that there was no statistical difference between roaded and unroaded lands as far as numbers of snags.

Table 1-15 shows the current size class distribution forest-wide, and describes which species are most common in each size class for the Nez Perce-Clearwater National Forests. The information is derived from FIA plots across the Forests.

Figure 1-13 is a graphic display of how size classes are distributed for each cover type. This information is for the southern part of the forest, what was the Nez Perce National Forest. Figure 1-14 is a graphic display of how size classes are distributed for each cover type. This information is for the northern part of the forests, what was the Clearwater National Forests. For both forests, and the Nez Perce-Clearwater Forests overall, the 5 inch to 15 inch size classes are by far the most common.

Table 1-15. Nez Perce-Clearwater National Forests, current size class and species composition

Size Class	Percentage of National Forest Area	Species Composition (Plurality)
Non-forest	2	Grasslands, permanent shrub lands, rock, water
Non-stocked	4	Seral shrub and forb species
Trees <5 inches	3	Spruce/subalpine fir, Douglas-fir, grand fir, lodgepole pine, western larch
Trees 5–9 inches	11	Lodgepole pine, spruce/subalpine fir, Douglas-fir
Trees 9–14 inches	33	Grand fir, spruce/subalpine fir, Douglas-fir, lodgepole pine
Trees 14–21 inches	34	Grand fir, subalpine fir/Engelmann spruce, Douglas-fir, lodgepole pine, ponderosa pine, western redcedar, western hemlock
Trees >21 inches	13	Grand fir, Douglas-fir, ponderosa pine, subalpine fir/Engelmann spruce, western redcedar, western hemlock

Source: Nez Perce and Clearwater Hybrid Forest Inventory and Assessment data collected from 2000-2002 and 2004-2007.

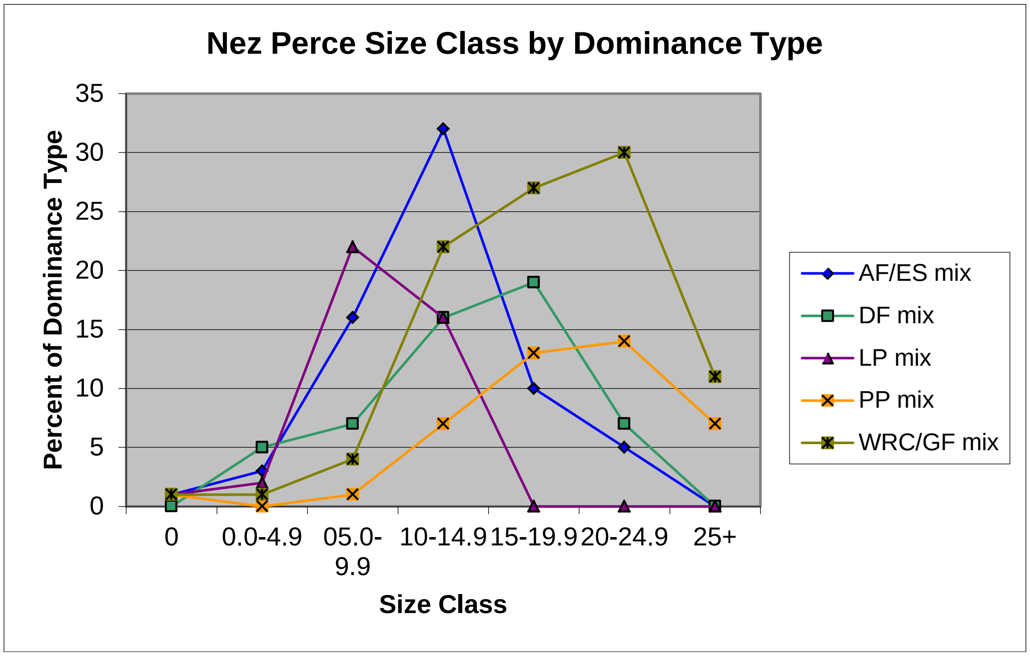


Figure 1-13. Nez Perce National Forest size class by dominance type

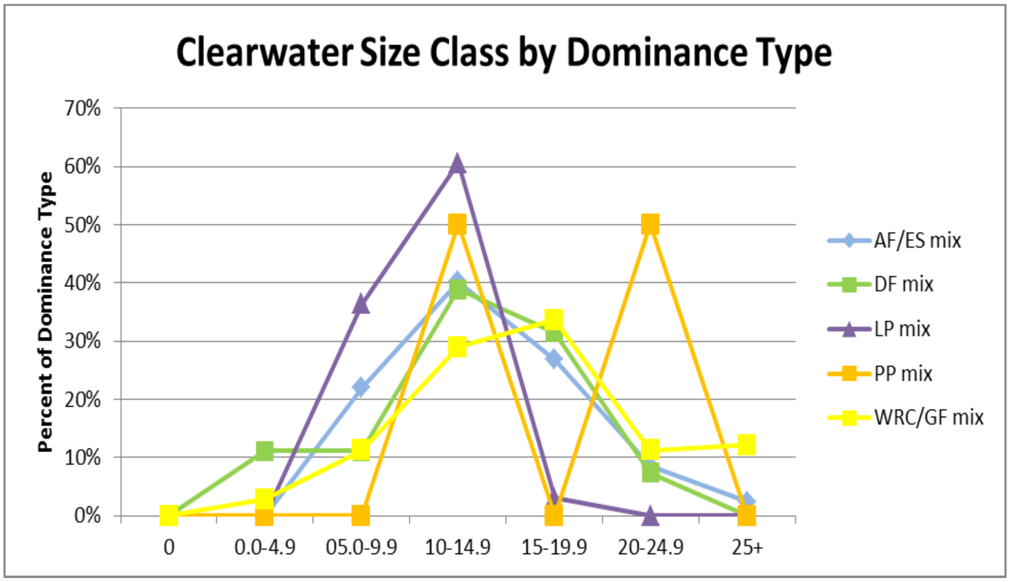


Figure 1-14. Clearwater National Forest size class by dominance type. Source: Baseline FIA data, collected 2000–2002

Trends and Departure

Seral grass and shrubs as well as the smallest tree sizes are below their HRV for the Idaho Batholith Breaklands (Table 1-16). The 15–19.9 inches and ≥20 inches size classes are above the HRV for the Idaho Batholith Breaklands (Table 1-16).

Table 1-16. Historic Range of Variation for tree size: Idaho Batholith Breaklands

Size Class	Historic Range of Variability (%)	Existing (%)
Non-forest	16	16
Seral grass / shrub	6–15	4
0–4.9 inches	3–7	2
5–14.9 inches	25–49	24
15–19.9 inches	10–20	38
>20 inches	11–23	32

Seral grasses and shrubs and the small size class of trees are below their HRV for the Bitterroot Mountains Breaklands (Table 1-17). The 5–14.9 inch size class is above their HRV and the largest two size classes are within their HRV (Table 1-17). For the Idaho Batholith Uplands size distribution, the mid-size class is well above the HRV and the 15–19.9 inch class is below the HRV (Table 1-18). The Bitterroot Mountains Uplands size distribution is within the HRV, although the mid-size class, 5–14.9 inches, is near the upper end of the range (Table 1-19). For the Idaho Batholith Subalpine size distribution, the small size is below the HRV, and the medium size class, 5–14.9 inches, is far above the HRV (Table 1-20). Seral grasses and shrubs and small tree size class are below the HRV, medium size (5–14.9 inches) is nearing the upper end of its HRV, and the 15–19.9 inches class is just above its HRV for the Bitterroot Mountains Subalpine size distribution (Table 1-21).

Table 1-17. Historic Range of Variability for tree size: Bitterroot Mountains Breaklands

Size Class	Historic Range of Variability (%)	Existing (%)
Non-forest	10	10
Seral grass / shrub	8–17	7
0–4.9 inches	6–13	3
5–14.9 inches	17–36	41
15–19.9 inches	16–33	30
>20 inches	17–33	18

Table 1-18. Historic Range of Variability for tree size: Idaho Batholith Uplands

Size Class	Historic Range of Variability (%)	Existing (%)
Non-forest	4	4
Seral grass / shrub	3–7	3
0–4.9 inches	6–13	7
5–14.9 inches	21–41	53
15–19.9 inches	25–47	15
>20 inches	11–25	22

Table 1-19. Historic Range of Variability for tree size: Bitterroot Mountains Uplands

Size Class	Historic Range of Variability (%)	Existing (%)
Non-forest	3	3
Seral grass / shrub	3–7	4
0–4.9 inches	6–13	8
5–14.9 inches	21–41	39
15–19.9 inches	24–48	33
>20 inches	12–24	15

Table 1-20. Historic Range of Variability for tree size: Idaho Batholith Subalpine

Size Class	Historic Range of Variability (%)	Existing (%)
Non-forest	20	20
Seral grass / shrub	3–6	5
0–4.9 inches	10–20	5
5–14.9 inches	23–47	66
15–19.9 inches	10–17	15
≥20 inches	4–6	8

Table 1-21. Historic Range of Variability for tree size: Bitterroot Mountains Subalpine

Size Class	Historic Range of Variability (%)	Existing (%)
Non-forest	14	14
Seral / grass shrub	11–23	4
0–4.9 inches	3–5	1
5–14.9 inches	39–79	69
15–19.9 inches	7–14	15
>20 inches	4–8	7

Density

Existing Conditions

While quantifying historical forest densities is difficult, general inferences can be made based on the knowledge of historical disturbance regimes and forest succession. Comparing historic photos to more recent photos of the same landscape, illustrates that stand densities have dramatically increased over the past 100 years. This increase is likely from fire suppression combined with a 40-year period of more moist climatic conditions. These moist conditions allowed dense stands, often thousands of stems to an acre, to establish where the soils and long-term moisture conditions will only support 75 to 200 mature trees per acre.

Research has shown that fire suppression for the last several decades has led to increased stand density (Keane et al. 2002). Fire exclusion has led to stands that are much denser than occurred historically.

Increasing forest density results in a forest with fuel characteristics that could support a fast-moving, intense crown fire. This fuel characteristic is not only from greater fuel quantities in a dense forest, but also of the vertical and horizontal continuity of fuels. On most of the sites where fire suppression and other factors have led to increased forest densities, not only has the number of trees per area increased but so has the number of canopy layers in a given stand, which has increased the continuity of vertical fuels. The lower tree and tall shrub canopies serve as ladder fuels to increase the likelihood of a surface fire moving upwards to become a crown fire.

The susceptibility of a forest to insects and diseases is heavily influenced by density and its impact on tree vigor. As the density increases, a deficit of soil moisture develops and trees lose their ability to withstand attacks by insects, pathogens, and parasites (Powell 1999, Safranyik et al. 1998). Density-related tree mortality from insects, diseases, and competition leads to increased dead fuel quantities and higher fuel hazards.

Trends and Departure

As stated above, current stand densities are higher than historic stand conditions. Not only are they more dense, but the canopy layers have increased, so that what were historically single-storied stands, such as the open-grown ponderosa pine on breaklands, are now often multi-storied stands. More mesic stands that were historically two-storied, such as western larch/Douglas-fir stands, are also now multi-storied.

The trend of increasing forest density also influences species composition. Western larch and ponderosa pine are very intolerant of shade. In a stand with mixed species, as the density of more shade-tolerant species (e.g., Douglas-fir, grand fir, hemlock, and cedar) increase, the larch and ponderosa pine will likely die out (unless a disturbance reduces the competition from the shade-tolerant species).

The climate change predictions for the northern Rockies generally forecast warmer temperatures and longer, drier summers. If those predictions are correct, the effect of dense forests on the soil-water balance could be compounded. In general, the soil-water balance (especially in the summer droughty period) determines which tree species and how many trees can ultimately survive on a specific site. Seral tree species (e.g., ponderosa pine and western larch) have the unique ability to establish on bare soil surfaces where high surface temperatures exclude other species.

Forest Pattern

(to be completed after SIMPPLLE runs are completed)

Insects and Disease

Insects and diseases are ongoing ecosystem drivers. They have been present as long as this forest has been in existence, and they continue to affect forest composition and structure. Mountain pine beetle has been seriously affecting lodgepole pine across the forest, wherever it is mature—older than 80 years old or over 7 inches in diameter. Douglas-fir beetle has been an ongoing driver in Douglas-fir forests, particularly where the trees are large (over 21 inches in diameter) or overcrowded and stressed. That stress may be the result of stand density or root rots affecting the trees. Root rots—primarily *Armillaria*, *Annosus*, and *Schweinitzii*—affect many species, but are particularly damaging to grand fir, Douglas-fir, subalpine fir, Engelmann spruce, and young ponderosa pine. Other root rots are also found on the forest, although they tend to be less common.

Mountain pine beetles in white pines and lodgepole pine (and occasionally spruce beetles) are capable of serving as stand-replacing agents. These beetles have a mixed effect on succession. They can open canopies enough to provide regeneration opportunities for shade-intolerant tree species, but more commonly, they release shade-tolerant understory tree species. By the fuels they create, these bark beetles can influence the probability of large stand-replacing fires, which in turn, can reset the successional sequence. In some situations, Douglas-fir bark beetle can also do the same thing on a smaller scale.

Recently, bark beetle populations and resulting tree mortality have increased substantially in western North America. On the Nez Perce-Clearwater National Forests, beetle-caused tree mortality has also been substantial, although less severe than some other areas (Table 1-22).

Table 1-22. Acres of bark beetle mortality 2001–2011. Data are compiled from Aerial Detection Surveys. Bark beetles included in these data are Mountain Pine Beetle, Douglas-fir Beetle, Spruce Beetle, Western Pine Beetle, Western Balsam Bark Beetle, Pine Engraver, Douglas-fir Engraver, and Fir Engraver.

Dead Trees Per Acre	1–5	6–15	15+
Nez Perce National Forest acres	292,236	138,748	61,194
Clearwater National Forest acres	217,740	42,175	5,276
Total	509,976	180,923	66,740

Historically, root pathogens most commonly acted as thinning agents. In natural mixed-species stands, root pathogens caused the greatest mortality to Douglas-fir, followed by true firs. White pine and larch were the most resistant tree species (Hoff and McDonald 1994; Monnig and Byler 1992). Root pathogens thinned out the Douglas-fir and favored the pines and larch, which increased the relative amount of pine and larch over the first 150+ years of stand life (Rockwell 1917).

However, in the past century, disease-tolerant species, such as western white pine, western larch, and ponderosa pine, have decreased significantly in abundance due to white pine blister rust, wildfire suppression, and historical harvesting practices. These species have been replaced with Douglas-fir, grand fir, and subalpine fir, which are the species most susceptible to root diseases, resulting in substantially increased tree mortality and productivity losses in today’s forests (Byler et al. 2000). Root diseases reduce stand densities, stall forest succession, result in smaller trees, and substantially reduce forest productivity (Figure 1-15). Thus, moderate and high severity root disease centers are a major source of forest mortality and a long-term constraint on forest carbon sequestration rates.

Root disease is the leading cause of tree mortality on the Nez Perce National Forest (22% of all mortality) (Disney 2010), and the Clearwater National Forest (49% of all mortality) (Hughes 2011) (Table 1-23). Root diseases affect more acres on these National Forests than wildland fire, bark beetles, and timber harvest combined. Because root diseases can reduce tree growth and stocking densities for many decades, their effects on forest carbon stocks and flux are more persistent that the effects of other disturbance agents.

Figure 1-15. Typical root disease centers of moderate severity. Note the dead standing trees, reduced stand density, loss of crown cover, and substantially lower productivity. Because these effects persist for long periods until disease resistant tree species are able to occupy the site, root diseases limit forest carbon stocks and sequestration rates for longer periods than other disturbances.

Table 1-23. Estimated acres of low, moderate, and high root disease effects on the Nez Perce and Clearwater National Forests

Root Disease Severity	Low (1–20 ft^2 basal area per acre loss)	Moderate (21–80 ft^2 basal area per acre loss)	High (>80 ft^2 basal area per acre loss)
Nez Perce National Forest acres	864,119	338,639	15,976
Clearwater National Forest acres	609,280	469,787	21,795
Total	925,099	808,429	37,771

Source: National Insect and Disease Risk Map (USDA Forest Service 2007)

Historically, western white pine was a common tree species, particularly on the Clearwater National Forest, and dominated a very large part of the moist habitat types. In the early part of the 20th century, white pine blister rust (a Eurasian disease) was accidentally introduced to western North America. This exotic disease, combined with a mountain pine beetle outbreak in white pines in northern Idaho in the late 1930s, has been the primary cause for the loss of white pine in this area (Neuenschwander et al. 1999). With the loss of white pine, there have been large increases in the amount of Douglas-fir and subalpine fir cover types, and a major acceleration of forest succession toward shade-tolerant, late-successional true firs, hemlocks, and cedars.

Historically, western white pine had an important ecological role in forests of the Interior Northwest (Harvey and others 1995; Monnig and Byler 1992). Especially important was this species ability to form a stable, relatively long-lived forest that was perpetuated by a combination of mixed-severity and stand-replacing wildfires (Zack and Morgan 1994). Even though fire occurred in this forest type fairly regularly, old-growth structures often persisted for several centuries. Across its range, western white pine is now estimated to be less than 5% of what it was at the turn of the 20th century (Neuenschwander et al. 1999).

With the impact of white pine blister rust and the decrease in fire, the role of insects and pathogens as disturbance agents is growing and changing. White pine blister rust accounts for major changes in forest successional patterns, having removed more than 90% of two conifer species (white pine and whitebark pine). With the absence of white pine and decreased amounts of ponderosa pine and larch, root pathogens have been transformed from thinning agents into major stand-change agents in Douglas-fir and true fir stands. Root pathogens now produce significant canopy openings on many sites. Depending upon the habitat type, root pathogens may either stall stands in a diseased shrub/sapling/open pole successional stage, or strongly accelerate succession towards shade-tolerant species. In the historic forests that were dominated by seral tree species, insect and diseases probably served as stabilizing agents, removing the maladapted late seral and climax species early in stand development, which would preserve only the best climax trees and favor the dominance of the long-lived seral species (Harvey et al. 1999).

The role of bark beetles has also changed. Because more Douglas-fir exists relative to historical conditions, Douglas-fir bark beetles are now more important change agents than they were historically. In all but the driest habitat types, Douglas-fir bark beetles accelerate succession in the short term, and in the long term, they create fuel conditions and stands structures that may increase the risk of stand-replacing wildfires.

Native insects and pathogens are also now responsible for a relatively much larger proportion of forest disturbance than they were historically. The impact of all these insects and pathogens in the short term is to strongly accelerate succession towards late seral, shade-tolerant tree species. An analysis of pathogen and insect impacts in northern Idaho (ecosections M332a and M333d as described by Bailey et al [1994]) by Hagle, Schwandt, et al. (2000) examined successional changes from 1935 to 1975. This analysis shows that in 40 years, pathogens and insects changed forest cover types to more late-successional, shade-tolerant tree species from the more intolerant species such as ponderosa pine, white pine, and western larch, on over 80% of the area dominated by moist forest habitat types (Byler and Hagle 2000). The same analysis of insect and pathogen impacts also showed that almost 40% of the moist habitat type area analyzed was either stalled in small tree structures or was actually moving back towards the small tree structures as a result of the removal of the largest trees by root disease.

The potential influence of climate change on some of the key forest insects and diseases of the northern Rockies is discussed in Kliejunas et. al. (2009). It is generally believed that climate change will lead to reductions in tree health and will improve conditions for some insects, such as bark beetles, and highly damaging pathogens, such as root disease.

Timber Harvest and Prescribed Fire

Timber harvest and other silvicultural practices have occurred on the Nez Perce and Clearwater National Forests. These activities have affected substantially fewer acres than bark beetle-caused tree mortality, wildland fire, and root diseases (Table 1-24).

Table 1-24. Acres of silvicultural treatments for 2001-2011. Source: Northern Region FACTS database

Silvicultural Treatment	Even-aged timber harvest	Uneven-aged timber harvest	Intermediate Harvest	Precommercial Thinning	Prescribed Fire
Nez Perce National Forest acres	4,286	529	6,094	6,616	39,996
Clearwater National Forest acres	5,334	857	3,923	7,832	44,832
Total	9,620	1,386	10,017	14,448	84,828

Fire was a major disturbance process that historically shaped forests. Wildfire greatly influenced the composition, structure, and function of vegetation across the landscape. Where fire disturbance was common, ecosystems favored the long-lived, fire-adapted, shade-intolerant tree species (ponderosa pine, larch, white pine, and whitebark pine). Shorter-lived, shade-intolerant, fire-adapted tree species (Douglas-fir, and lodgepole pine) were also present in significant amounts, particularly in younger stands, but declined through time due to effects of insects and pathogens. Shade-tolerant, fire-intolerant tree species (cedar, western hemlock, grand fir, and spruce-alpine fir) were certainly present, but rarely survived long enough to dominate stands, except where the interval between fires was unusually long and where root disease was not severe.

The dominant, historical fire regime that occurred within forested vegetation in the Inland Empire can be characterized as a variable or mixed-severity fire regime (Zack and Morgan 1994, Kilgore 1981, Brown 2000). This type of fire regime commonly had a moderately short fire-return interval for nonlethal or mixed severity fires, with lethal crown fires occurring less often. Relative to the other two common fire regimes that are often recognized for forested vegetation—the nonlethal and stand-replacement regimes—the mixed-severity fire regimes are the most complex (Agee 2004). Individual mixed-severity fires typically leave a patchy pattern of mortality on the landscape, which creates highly diverse communities. These fires kill a large percentage of the more fire-susceptible tree species (e.g., hemlock, grand fir, subalpine fir, lodgepole pine) and a smaller proportion of the fire-resistant species, including western larch, ponderosa pine, whitebark pine, and western white pine (Arno et al. 2000).

Over the last 25 years (1985–2010) acres burned has increased, but less than the early 20th century.

Large, infrequent stand-replacing wildfires created a dynamic shifting mosaic of forest successional stages on a very large scale (Figure 1-16). In between the stand-replacing fires, vegetation, aquatic systems, and wildlife habitat had long periods to develop. Intermediate disturbances (low and mixed severity fire; some insect, pathogen, and weather events) introduced finer scale variability within these larger patches (Figure 1-17). As a result, blocks of wildlife habitat tended to be large, and blocks of mature/late-successional forest also tended to be large, but internally diverse.

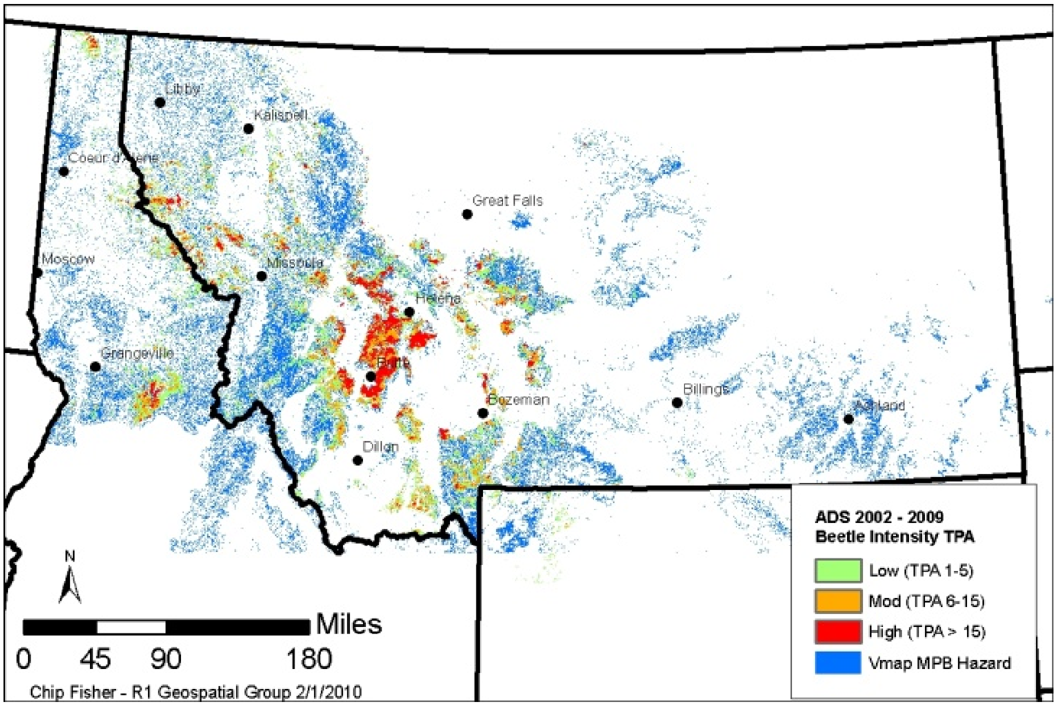
Mixed severity fire regimes on 30% to 70% of the landscape reduced larger patches of regenerating, previously severely burned forests to a mosaic pattern of patches of various sizes with 20% to 80% of the trees surviving within the fire boundaries (Figure 1-18).

Figure 1-16. Stand-replacing fire pattern on a mesic upland site

Figure 1-17. Low-severity fire on a mesic grand fir/cedar site. Only very small trees in the understory were killed, leaving older trees alive and standing, and reducing stand density and canopy layers.

Figure 1-18. Pattern of a mixed severity fire on a mesic site

An additional effect of reduced amount of disturbance beginning in the 1940s under a cool PDO and fire suppression has been the homogenization of the size class of lodgepole pine forests. This departure in pattern set up conditions for expansive lodgepole pine forests to be susceptible to the mountain pine beetle at the same time (Figure 1-19). Mountain pine beetle outbreaks are very responsive to habitat and climate conditions. They require large expanses of susceptible-aged and homogenous forest. Outbreaks tend to occur during warm and dry conditions and can cease following extreme winter cold (Safranvik 1978). Outbreaks also require an abundance of suitable habitat for the insect to attack and reproduce. (McGregor et al. 1981; Shore and Safranyik 1992). Over the last decade, mountain pine beetle activity has increased in high-elevation whitebark pine across much of the western United States and Canada. (Gibson et al. 2008). Populations in these high elevation stands are at levels higher than previously recorded, even though an outbreak did occur in the 1920s in whitebark pine.



Chip Fisher - R1 Geospatial Group 2/1/2010

Figure 1-19. The current outbreak and severity of mortality linked to the pattern of susceptible host tree species

1.1.3 *Summary*

The summary implications of a long, cool PDO during the mid-twentieth century, combined with fire suppression in the northern Rocky Mountains is outlined in Table 1-25.

Table 1-25. Summary of the documented effects of fire exclusion by organizational level and ecosystem characteristic

Scale	Ecosystem Attributes	Fire Exclusion Effect
Stand	Composition	Increased number of shade-tolerant species, decreased number of fire-tolerant species, decreased forage quality, decreased plant vigor, and decreased biodiversity in plant and animals
	Structure	Increased vertical stand structure, multistoried canopies, increased canopy closure, increased vertical fuel ladders and continuity, greater biomass, higher surface fuel loads, and greater duff and litter depths
	Ecosystem processes	Slowed nutrient cycling, greater fire intensities and severities, increased chance of crown fires, increased insect and disease epidemics, short term increase in stand productivity, decrease in individual plant vigor, and decreased decomposition. Increased leaf area; increased evapotranspiration, rainfall interception, autotrophic and heterotrophic respiration; increased snow ablation
	Soil dynamics	Decreased nutrient (Nitrogen, Phosphorus, Sulfur) availability; increased pore space, water-holding capacity; lower soil temperatures; increased hydrophobic soils; and increased seasonal drought
	Wildlife	Increased hiding and thermal cover, increased coarse woody debris, lower forage quality and quantity, increased insect and disease, and decreased biodiversity
	Resources	Decrease in aesthetics, increased timber production, increased risk to human life and property, increased firefighting efforts, and improved air quality.
Landscape	Composition	Decrease in early seral communities, increased landscape homogeneity, increase in dominance of one patch type, and decreased patch diversity
	Structure	Increase in patch evenness, patch size, patch dominance, and contagion
	Disturbance	Larger and more severe fires, increase in crown fires, increased insect and disease epidemics, and increased contagion resulting in more severe insect and disease epidemics
	Carbon and water cycles	Increased water use, increase in drought, lower streamflows, higher emissions of carbon dioxide from respiration, increased water quality, and decreased stream sediment
	Resources	Decreased visual quality, and viewing distance

Note: References for each effect are detailed in Keane et al. (2002)

1.1.4 *Trends*

The scientific assessment done for the Interior Columbia Basin Ecosystem Management Project indicates that vegetation has changed dramatically from historic conditions. Subbasin assessments done on each forest validated these changes and tied them to specific watersheds. Some forest types and structures have declined, while others have increased. These changes have implications for the future health of ecosystems on these forests.

In particular, large, old western redcedar forests have decreased; large, old, single-story ponderosa pine forests have decreased; early seral forests have decreased; grasslands have been invaded by weeds; and white pine blister rust has almost eliminated western white pine and is currently decimating whitebark pine. Timber harvest that has occurred has often targeted the forest types that are below historic levels (i.e., large, old trees).

Maintaining wildlife diversity is directly tied to maintaining habitat diversity. Historic wildlife population levels were a reflection of historic high vegetative diversity. For a variety of reasons, including past timber harvest practices that targeted large trees and fire exclusion that reduced early seral conditions, current forest vegetation is less diverse than historic conditions. For example, less old cedar and old ponderosa pine types exist because of logging and recent increases in fire severity in dry forests, which results in less old forest habitat available for wildlife species that depend on these habitats.

1.1.5 *Resource Specific Information*

1.1.5.1 Natural Range of Variation for Each Key Ecosystem Characteristic

Range of Variation definition: the range in vegetation communities, their associated structural and compositional characteristics; range in processes; and the range in patches of communities and their relationship to other patches. Range of variation addresses variability inherent within vegetation communities through time and space. It is NOT a snapshot from one point in time. Not enough historic information exists to define a range of vegetation conditions that existed in the past. The average conditions over a broad area—in this case ecosections and settings—gives an average of historic conditions. The range of historic occurrence of these species and size classes varied tremendously with disturbances, particularly fire. Forest dominance types were weighted toward the seral/intolerant species such as ponderosa pine, western larch, and lodgepole pine following fires. Shade-tolerant species such as grand fir, western redcedar, and subalpine fir increased in dominance as decades passed after a fire. Douglas-fir is moderately tolerant to shade, and was found in both early seral and late seral forests. Size classes of trees also varied with time since the last fire, and depended on the type of fire that occurred—from stand-replacing to light underburns.

The description of historic vegetation presented here is based on a combination of information from Leiberg’s (1898) survey of the Bitterroot Forest Reserve (the Idaho portion of which is now the Clearwater and Nez Perce National Forests), and reports prepared for the Interior Columbia River Basin project. These are not the only sources of historic information, but are readily available and have been the most common source of historic data used on these two Forests to describe historic conditions for project analyses.

Leiberg (1898) described the non-forest vegetation in the Idaho portion of the Bitterroot Forest Reserve (now the Nez Perce and Clearwater National Forests) in his survey. His "grazing areas" were of three types: riparian meadows, temporary meadows that followed repeated forest fires, and the dry ponderosa pine/bunchgrass hillsides. Together, these three types covered over 100,000 acres on the Reserve. The Reserve boundary excluded much of the lower elevation forest and grassland on the west edge of the current Forest boundary, particularly on the southwest edge of the forest.

Leiberg (1898) also described a landscape that was profoundly influenced by fire over a long period, as he could see evidence of fire that spanned the previous 200 years. He estimated that 30% to 50% of the Forest had been burned severely in the previous 30 to 40 years, much due to prospectors burning the Forest to make their search for valued minerals easier. His estimate was that about 11,000 acres burned annually in the Reserve before the arrival of white settlers in the area.

Forest species composition and structure were greatly influenced by widespread forest fires over the previous 200 or more years. Early seral forests were common. Species such as whitebark pine, aspen, and birch were more common. Snags were well represented across the entire landscape.

Losensky (1994) used climatic areas to summarize vegetation in his draft report for the Interior Columbia Basin Ecosystem Management Project. Climatic areas that correspond to the Clearwater are the St. Joe-Lochsa (Climatic Area 8) and Palouse (Climatic Area 3); and those for the Nez Perce are the Clearwater-Selway (Climatic Area 6) and Snake-Salmon-Clearwater (Climatic Area 4).

Local pollen studies indicate that the current forest composition has been in place for only about 1,000 to 1,500 years, with western redcedar the latest arrival. That is a relatively short time measured by tree generations.

"Change is perpetuated not only by plant responses to climate, but by disturbances that accompany climatic change; fire and disease often follow drought. If vegetation changes lag climate changes (Davis 1989; Franklin et al. 1991) then, in the long view, vegetation often is out of equilibrium with climate and is subject to rapid variation through natural disturbances. Understanding the history and probable consequences of these disturbances gives land managers potent tools for selecting ecologically and socially acceptable alternatives for influencing the course of changing ecosystems (Arno et al. 1995)" (Mehringer 1996).

Fire history studies indicate extensive fire. Leiberg (1898) reported that about 40% of the reserve had been badly burned in the previous 40 years. While he attributes much of that burning to mining prospectors, he also indicates that the same number of acres burned 100 years previously, in the last half of the 18th century, prior to the advent of mining prospectors.

Local fire history studies have been done around Cook Mountain in the North Fork Clearwater drainage, in the Selway Bitterroot Wilderness, in the Stillman Point area in the Selway drainage, and other areas. These studies indicate a long history of fire, both stand-replacing and lower severities that are typical of specific vegetation and topography settings.

No comprehensive inventories of vegetation exist from prior to the 1950s. However, there were surveys completed, beginning with Leiberg's 1898 survey of the Bitterroot Forest Reserve, early (1911-1915) forest survey/inventories, extensive forest inventories done state-wide in the 1930s, pollen studies from bogs that chronicle vegetation changes over long time spans, and fire history studies that document the level and frequency of fire that shaped vegetation composition and structure.

Synthesis of Information

The description of historic vegetation presented here is based on a combination of information from Leiberg's 1898 survey of the Bitterroot Forest Reserve; fire history studies done on the forests; pollen studies from the Northern Rockies; early forest inventories from 1911, 1914, and 1915; and reports prepared for the Interior Columbia River Basin project. These are not the only sources of historic information, but are readily available and have been the most common source of historic data used on these two Forests to describe historic conditions for project analyses.

Historic Size Class Distribution by National Forest

These size class names follow the inventory data from the 1930s era forest inventories (Table 1-26 and Table 1-27).

Table 1-26. Clearwater National Forest inventory data

Species	Non-stocked	Seed/Sap	Poles	Mature	Overmature	
PP	8.9	11.1	12.5	9.3	58.2	
DF	31	21.7	24	16.9	6.4	
L-DF	27.7	21.1	15.3	12.8	23.1	
LP	33	38.8	21.3	5.9	1	
WP	18.8	23.2	19.1	12.1	26.8	
S-F	23.8	4.4	13.4	24.7	33.7	
Ave.	23.9	20.1	17.6	13.6	24.9	
Breaklands weighted average based on species composition						**Totals**
	22.2	15.8	16.9	16.1	29.0	100
Uplands weighted average based on species composition						
	22.8	17.5	16.2	14.9	28.6	100
M333D Subalpine weighted average based on species composition						
	27.3	19.8	16.6	15.5	20.8	100
M332A Subalpine weighted average based on species composition						
	21.7	14.4	25.2	22.7	16.1	100

Table 1-27. Nez Perce National Forest inventory data

Species	Non-stocked	0–6 inches 1–40 years	6–12/14 inches 41–100 years	Mature 101–150 years	Overmature >151 years	
PP	6.1	2.7	9.6	23.4	58.2	
DF	15.7	9.8	27.9	28.4	18.2	
L-DF	15.7	19.7	15.8	28	20.8	
LP	17.7	34.9	35.1	9.2	3.1	
S-F	28.6	3.6	18	27.2	22.6	
Ave.	16.8	14.1	21.3	23.2	24.6	
Breaklands weighted average based on species composition Totals						
	13.6	10.8	20.3	23.5	31.7	100
Uplands weighted average based on species composition						
	16.1	13.4	22.7	22.3	25.5	100
Subalpine weighted average based on species composition						
	21.7	14.4	25.2	22.7	16.1	100

Historic Species Composition by Ecosection

The entire set of historic information, contains information about how much of different species were found on the forest, as well as the sizes and condition of the trees (Table 1-28). Maps, early inventories, and descriptions indicate where different species were found, as well as how size classes were arranged.

Table 1-28. Ecosystem Diversity Matrix- historic M332A and M333D

Eco-Section summaries		**Feb 06**						
Idaho Batholith M332A	**Breaklands**	**Uplands**	**Subalpine**	**Associated Fire Regime**				
	(Warm/Dry)	**(Mesic)**	**(Cold)**	**Frequency of stand replacing fire (from Fire Ecology of the Forest Habitat Types of Northern Idaho)**				
Dominance Type	%	%	%					
PP/mix	40	27		500 years				
DF/mix	27	35		120 years on uplands, 400 years on breaklands				
LP/mix	17	24	50	120 years				
WL-DF	4	2	1	175 years				
GF mix	4	12		140 years				
Spruce-Fir mix			29	170 years				
Subalpine(with whitebark pine)			20	180 years				
Grass/Shrub	8							
	100	100	100					
Bitterroot Mountains M333D	**Breaklands**	**Uplands**	**Subalpine**	**Associated Fire Regime**				
	(Warm/Dry)	**(Mesic)**	**(Cold)**	**Frequency of stand replacing fire (from Fire Ecology of the Forest Habitat Types of Northern Idaho)**				
Dominance Type	%	%	%					
PP/mix	15	11		500 years				
DF/mix	12	5		120 years on uplands, 400 years on breaklands				
LP/mix			31	120 years				
WL-DF	25	35	23	175 years				
Western white pine/Cedar/Grand fir	31	43	5	200 years, 500+ years on wet cedar sites				
Spruce-Fir mix	17	6	18	170 years				

Eco-Section summaries		**Feb 06**						
Subalpine(with whitebark pine)			23	180 years				
	100	100	100					

These are average occurrences. Sources: Historical Vegetation Types of the Interior Columbia River Basin. B. John Losensky. December, 1994. Bitterroot Reserve. John Leiberg. 1898. Clearwater National Forest Land Classification. USDA Forest Service. 1915. Selway National Forest Land Classification. USDA Forest Service. 1914. Nez Perce National Forest Land Classification. USDA Forest Service.1911.

These are historic **averages**. The historic ranges for each of these forest types and size classes were very wide—after a severe fire year, there might be a high percentage of seral grasses and shrubs, which would develop into the small size class, and then grow up through the larger size classes. Or after a long, cool, moist period with low fire occurrence, the same early seral types would be at very low levels, while larger size classes would be much higher. There isn't a good way to know what those extremes were. However, wildlife literature (Fahrig) indicates that losses (or gains) of 33% of a habitat will result in little effect to dependent species, and losses of 67% of a habitat will start to have a noticeable effect on dependent species. With that in mind, the average occurrence of each cover type and size class was buffered by 33% to estimate what a sustainable natural range of variation would be.

Historic Fire Regimes and Patch Sizes

Historically, south-aspect breaklands (both on the Idaho Batholith and Bitterroot Mountains sections) were maintained in a stable forest cover by frequent, low-severity fires. These low severity fires occurred every 5 to 30 years on average, though the ranges were much broader. (Kapler Smith and Fischer, 1997) North-aspect breaklands are a little more moist, and have a history of both low severity every 5 to 50 years and mixed severity fire every 20 to 50 or more years. Patches, especially under the low severity regime, ranged up to 1000 acres. These patch sizes were strongly influenced by topography, as fires often burned over an entire hillside, stopping at ridgelines, streams, or changes in aspect. On southerly aspects, regeneration often occurred as small patches in openings created by fire, but could also occur as individual trees (Figure 1-20). A study done on the forest showed that on both north and south aspect breaklands, patches averaged 57 acres, and 47% of old forest acres were in patches of 1000 to 6000 acres. (Green, unpublished data)

Figure 1-20. Small patch of small ponderosa pine trees that have regenerated into an opening in a stand of larger ponderosa pine

Uplands historically had mixed severity fires every 30 to 100 years, with stand replacing fires every 100 to 200+ years (Kapler Smith and Fischer, 1997). Patches on the Uplands biophysical setting were much more variable than those on the breaklands (Figure 1-21). Old forest patches averaged 30 to 60 acres, with half to two-thirds of the acres occurring in 40 to 1500 acre patches (Green, unpublished, 2000).

Figure 1-21. Forest pattern in the uplands (lower elevations) and subalpine (higher elevation) biophysical settings

1.1.5.2 Natural Range of Variation versus Current Condition

While the historic and current vegetation conditions are described from different sources, general changes in vegetation composition and structure can be seen:

- Loss of ponderosa pine, particularly the old forests. Tied to harvest and fire exclusion followed by stand-replacing wildfire. Ponderosa pine requires open growing conditions to reproduce.
- Loss of old western redcedar stands. This loss is less acute on the national forests than on adjacent lands, and is primarily tied to harvest.
- Loss of western larch. Tied to harvest, fire exclusion, and possibly climate change. Western larch requires open growing conditions to reproduce and remain dominant in a stand.
- Loss of western white pine. Tied to white pine blister rust (an exotic disease), harvest, and fire exclusion. White pine requires moderately open to open growing conditions to reproduce and grow well.
- Loss of whitebark pine. Tied to white pine blister rust (an exotic disease), and fire suppression. Whitebark pine requires open growing conditions to reproduce and grow well.
- Loss of young forests. Tied to fire exclusion and declining timber harvest.
- Loss of old forests. Tied to harvest and increased fire severity (see “loss of ponderosa pine” and “loss of western larch”).
- Lodgepole pine is mature across much of the forest. Mountain pine beetle activity is high, and this forest type is experiencing major changes in age class structure. Increased fire activity in this type is expected over the next 10 to 25 years.
- In general, insect and disease activity in all forest types is elevated above historic levels.

1.1.6 *Information Needs*

The following information needs have been identified:

- Current forest inventory
- Condition and trends relative to insect and disease occurrence
- Future trend information, patch size assessment, and HRV estimates from SIMPPLLE

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1.2 NON-FOREST VEGETATION

1.2.1 *Existing Information*

- Alpine and subalpine vegetation of the Wallowa, Seven Devils, and Blue Mountains (Johnson 2004)
- Bunchgrass plant communities of the Blue and Ochoco Mountains: A guide for managers (Johnson and Swanson 2005)
- Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas (Tisdale 1986)
- Christie Creek and Sherwin Creek Allotments Environmental Assessment (USDA Forest Service 2011)
- Interior Columbia Basin Final Environmental Impact Statement (ICBEMP 2000)
- Interpreting long-term trends in Blue Mountain ecosystems from repeat photography (Skovlin and Thomas 1995)
- Island Ecosystem Analysis at the Watershed Scale (EAWS), intensive vegetation plot data (USDA Forest Service 2008)
- Nez Perce National Forest eastside allotment analysis
- Potential vegetation hierarchy for the Blue Mountains section of northeast Oregon, southeastern Washington, and west-central Idaho (Powell et al. 2007)
- Red River Ecosystem Analysis at the Watershed Scale (EAWS) (USDA Forest Service 2003)

1.2.2 *Current Condition*

The Nez Perce and Clearwater National Forests contain a mosaic of forest, grassland, and shrubland vegetation. Forest Inventory and Assessment plots throughout the planning area indicate that approximately 15% of the breaklands and <5% of the uplands are nonforested—they are primarily grasslands and shublands. Dr. Edwin Tisdale states, “The grasslands and shrublands of the middle Snake and lower Salmon River Valleys and their tributaries constitute a relatively small, but distinctive vegetation region of the Pacific Northwest” (Tisdale 1986). In the dry canyon lands of west-central Idaho, Dr. Tisdale classified 5 shrubland series dominated by snowberry, stiff sage, mountain mahogany, hackberry, and smooth sumac; and 3 grassland series dominated by bluebunch wheatgrass, Idaho fescue, prairie Junegrass, Sandburg’s bluegrass and a variety of native forbs. Lower elevation river terraces also include sand dropseed, red three awn, and needle and thread grass. Mountain meadows typically are dominated by native grasses and sedges, including tufted hairgrass and Nebraska sedge, and non-native species including Kentucky bluegrass (Skovlin and Thomas 2005). Higher elevation grasslands are dominated by native grasses including green fescue, Idaho fescue, prairie Junegrass, needlegrass, mountain brome, native sedges, and a variety of native forbs (Johnson 2004).

Specific information regarding the condition of the non-forest vegetation within the planning area is limited. Sampling and evaluation of grassland vegetation is generally conducted as a component of “range analysis”, but this analysis information is relatively sparse. Range forage is considered to be grassland vegetation, riparian/meadow vegetation, and palatable grass and forb vegetation produced under a timber canopy.

Intensive vegetation plot data were collected in 2005 for the Island EAWS area, located between the Salmon and Snake Rivers (Forest Service 2005). This analysis, which may typify range conditions in the Salmon River canyons, determined that approximately 52% of sampled areas retain high native species integrity. However, a significant portion of the assessment area is highly susceptible to invasive weeds and a high risk of continued weed expansion exists. Vegetation plots showed grassland integrity to be low (approximately 25% of samples). Low integrity grasslands and the presence of invasive species suggest the grasslands to be in very poor to perhaps fair condition and in a very early to early ecological condition.

Although grasslands, shrublands, and transitory range typically produce abundant forage, potential resource impacts from livestock grazing are more frequently encountered in riparian areas. In-stream habitat condition data were also collected in 2005 for the Island EAWS area. Sampling included a variety of parameters used to determine if streams met the Forest Plan standards (as amended by PACFISH). Several reaches of Deer Creek, Johnson Creek, Joe Creek, Christie Creek, and Sherwin Creek were determined to exceed the standards for width/depth ratio, percent cobble embeddedness, percent fines, and bank stability. These streams do not meet the PACFISH Grazing Management standards (Forest Service 2005) and were also determined to be Functioning at Risk with Static Trend by an interdisciplinary team conducting Properly Functioning Condition (PFC) assessments.

An assessment being conducted in the Clearwater drainage of the Nez Perce National Forest (eastside assessment) reveals that of 44 benchmark areas in the project area, 17 are currently meeting the desired conditions, 24 are moving toward meeting the desired conditions, and 3 are not meeting or moving toward the desired conditions.

Newsome and Red River EAWS conducted in the Clearwater drainage of the Nez Perce National Forest conclude that data on the impacts of grazing in the watershed is limited. Grazing in the watersheds usually occurs near roads and results in localized impacts.

Professional knowledge of the area suggests that cattle do not have a large impact on vegetation. The Red River EAWS determined that the level of grazing has recently declined from loss of forage, primarily because of fire suppression and the advancement of succession, which causes a decline in undergrowth and forage. This change has shifted grazing out of early serial habitat and into road corridors, seeps, and native meadows. In addition to the changes in the forage base, operational expenses have increased as the cost of public land grazing increases. Most of the grazing in the Red River EAWS planning area occurs on private land.

Although actual data are limited, rangeland condition on the Clearwater National Forest is thought to be similar to conditions described above for the Clearwater drainage of the Nez Perce National Forest.

In some areas, perennial grassland vegetation has declined as annual grasses, such as cheatgrass, have expanded. More recently, exotic annual grasses are being replaced by even more aggressive invasive weeds. This decline in vegetation from native perennial grasses, to exotic annual grass, to invasive weeds has resulted in the significant decline in native plant production, in some areas dropping from roughly 250 to 100 to 25 pounds per acre respectively. Table 1-29 provides an example from the Christie/Sherwin allotment analysis that illustrates the decline in animal unit months (AUMs) due to site conversion to “weedy” species.

Table 1-29. Christie Creek and Sherwin Creek allotment of unsuitable acreage and animal unit months (AUMs) lost due to conversion from cheatgrass to “weedy” species

Allotment	Pasture	Weedy Acreage	AUMs lost
Christie Creek	Rhett	83	11
	Christie Creek	106	11
	Deer Creek	151	20
Sub total		340	42
Sherwin Creek	Lower Center Ridge	238	32
Total		578	74

Conifer encroachment into meadows, shrublands, and grasslands has resulted in the loss of forage production throughout the planning area. Timber canopy closure and encroachment has reduced forage production by at least 21% over the past 60 years on the Christie Creek allotment on the Nez Perce National Forest.

1.2.3 *Trends and Drivers*

Over the next 20 years, it is probable that certain environmental influences will continue to negatively impact range condition and forage production. Invasive weeds will likely continue to spread and increase in abundance and density. Existing grasslands/shrublands will see additional conifer encroachment and conversion to a timber dominate community.

Primary natural disturbance agents on bunchgrass sites include fire, wild ungulates, small mammals, insects, disease, and slope-driven soil movement. As a result of these disturbance factors, vegetation does not naturally consist entirely of late-succession vegetation. Instead the natural vegetation landscape generally contains a mix of vegetation communities (Johnson and Swanson 2005).

1.2.4 *Information Needs*

None identified.

1.2.5 *Literature Cited*

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1.3 AQUATIC ECOSYSTEMS

1.3.1 *Existing Information*

Relevant existing information regarding management of aquatic ecosystems in the plan area includes the following:

- Interior Columbia River Basin Science Assessment Team/ICBEMP (Lee et al. 1997)
- PIBO Effectiveness Monitoring Program 2012 Annual Monitoring Report (Meredith et al. 2012)
- Analysis of PIBO Data and Trends: A Report on Habitat Conditions in the Nez Perce/Clearwater Study Area (Meredith 2013)
- Clearwater and Nez Perce National Forests monitoring reports and data
- South Fork Clearwater (USDA Forest Service 1998), Selway/Middle Fork Clearwater (USDA Forest Service 2001), and Lochsa (USDA Forest Service 1998) subbasin/landscape assessments
- Red River, Newsome, Slate Creek, Island, Crooked River, Meadow Face watershed analyses (USDA Forest Service 1998–2008)
- Orogrande, Lochsa Corridor Assessment, Eldorado, Crooked Brushy, Upper Lolo, Clearwater subbasin, Potlatch River, Upper Palouse River, Lolo/Orofino, Elk Creek–Long Meadows, and Palouse River watershed analyses (USDA Forest Service 1998–2009)
- Data, analysis, and scientific references included throughout this chapter and in the References Cited section

1.3.2 *Informing the Assessment*

Aquatic conditions on the Nez Perce–Clearwater National Forests have been summarized in watershed analyses, landscape assessments, and various subbasin-related documents prepared for Endangered Species Act consultations for listed fish and designated critical habitat. These assessments began in the late 1990s and continued through the mid-2000s (see list in section 1.1.1, Existing Information).

1.3.2.1 **Current Condition of Aquatic Ecosystem Characteristics and Integrity**

Key characteristics identified for this assessment include the following:

- Stream habitat complexity, along with distribution and connectivity of watersheds identified as critical for the conservation and propagation of at-risk aquatic species
- Riparian areas, further defined as Riparian Conservation Areas (RCAs), and their process and function
- Aquatic species diversity, distribution, and abundance
- Watershed condition and function attributes, including sediment transport and water yield regimes, as influenced by upland disturbances
- Ability of native aquatic species to move throughout the plan area
- Distribution and extent of aquatic habitat patches necessary to support population strongholds for native aquatic species

The current condition of stream habitats varies widely across the plan area, ranging from largely unaffected by human disturbances (in designated wilderness areas) to highly disturbed, with varying degrees of impaired function. On a finer scale, habitat condition varies among stream reaches, even within the same 6th field hydrologic units code (HUC), due to both human-caused and natural disturbances.

The Nez Perce–Clearwater National Forests contain portions of 11 subbasins (4th field HUCs), including Palouse/Hangman, Lower North Fork Clearwater, Upper North Fork Clearwater, Lower Clearwater, Middle Fork Clearwater, South Fork Clearwater, Lochsa, Upper Selway, Lower Selway, Lower Salmon, Lower Little Salmon, and Middle Salmon–Chamberlain. Within the context of the Interior Columbia River Basin, watersheds within the Forests support a significant percentage of remaining spawning and rearing habitats accessible to anadromous fish in the Snake River basin. In addition, a number of the watersheds on the Forests support strongholds for at-risk fish species (Lee et al. 1997).

Lee et al. (1997) developed a watershed classification scheme for watersheds in the Interior Columbia River Basin to provide a spatially explicit description of aquatic issues, needs, and opportunities. Category 1 watersheds are described as systems that most closely resemble natural, fully functional aquatic ecosystems that are generally made up of continuous blocks of high-quality habitat. Category 2 watersheds are similar but exhibit a greater degree of habitat fragmentation, caused by habitat disruption or loss, and contain a substantial number of subwatersheds in which native species have been lost or are at risk. Category 3 watersheds are substantially fragmented by extensive habitat loss or disruption, most notably through disruption of a mainstem corridor; in these watersheds, opportunities for full restoration are limited. Because the remaining aquatic resources are often isolated, risks of local extirpation are high.

Lee et al. (1997) summarized aquatic and hydrologic integrity as follows: a system with high hydrologic integrity is defined as a network of streams, along with their unique groundwater ecosystems, existing where the upland, floodplain, and riparian areas have resilient vegetation, where the capture, storage, and release of water limit the effects of sedimentation and erosion, and where infiltration, percolation, and nutrient cycling provide for diverse and productive aquatic and terrestrial environments. A system with high aquatic integrity is defined as a mosaic of well-connected, high-quality water and habitats that support a diverse assemblage of native and desired nonnative species, the full expression of potential life histories and dispersal mechanisms, and the genetic diversity necessary for long-term persistence and adaptation in a variable environment. Existing physical and biotic attributes within Interior Columbia River Basin watersheds were assessed against these criteria, including attributes on the Nez Perce–Clearwater National Forests (Table 1-30).

Table 1-30. Interior Columbia River Basin classification of subbasins on the Nez Perce–Clearwater National Forests

Subbasin	Category	Aquatic Integrity	Hydrologic Integrity
Palouse/Hangman	2	Low	Low
Lower Clearwater	2	Low	Low
North Fork Clearwater (Upper and Lower)	2	Moderate	Moderate
Lochsa	2	High	High
Middle Fork Clearwater	2	Moderate	Moderate
South Fork Clearwater	2	Moderate	Low
Lower Selway	2	High	High
Upper Selway	1	High	High
Lower Salmon	2	Moderate	Low
Lower Little Salmon	2	Moderate	Moderate
Middle Salmon–Chamberlain	1	High	High

Source: Lee et al. 1997

PACFISH/INFISH BIOLOGICAL OPINION (PIBO) MONITORING

PACFISH/INFISH amended all Forest Plans in the Interior Columbia River Basin in the mid-1990s, including those for the Nez Perce–Clearwater National Forests. PACFISH and INFISH provided aquatic and riparian management strategies to protect habitat for anadromous salmonids and bull trout. These strategies were intended to provide consistent, interim guidance to National Forests prior to revision of Forest Plans. In 1998, the National Marine Fisheries Service and U.S. Fish and Wildlife Service completed Biological Opinions for Forest Plans, as amended by PACFISH and INFISH, which required monitoring of managed lands to determine if current management practices were meeting PACFISH and INFISH riparian management objectives. A broadscale monitoring and data collection effort was initiated across the Interior Columbia River Basin to meet this requirement; monitoring and data collection began in 1998 and have continued to the present (2014). The sampling protocol includes metrics associated with macroinvertebrate assemblage and stream habitat. Stream habitat data include percent surface fines at pool tailouts, median grain size of substrate (D_{50}), percent pools, residual pool depth, bank angle, percent undercut banks, large woody debris, and stream bank stability (Meredith et al. 2012). The protocol for collection of these data is fully described in Archer et al. (2012).

The analysis of stream habitat data includes comparisons of data from reference and managed sites and assessments of trend using a habitat index approach to determine statistically significant departures from reference data and trends, according to methods described in Al-Chokhachy et al. (2010). A predictive relationship was developed between landscape and environmental characteristics and habitat condition at reference sites to minimize sources of variation. This statistical approach controls for inherent differences in climate and landscape characteristics among sites (Meredith et al. 2012). For analysis of macroinvertebrate data, distribution of observed versus expected macroinvertebrate scores in reference and managed sites was analyzed according to methods described in Hawkins (2006).

Reference conditions from PIBO sites across the Interior Columbia River Basin represent the natural range of variability in aquatic ecosystems in the Interior Columbia River (Kershner et al. 2004), including those within the Nez Perce–Clearwater National Forests. Given the wide range of values seen in data from reference sites, and the inherent natural disturbance regimes that shape stream habitats, a range of indexed reference conditions is more useful than comparisons of single values that represent only one end of the distribution of values seen in reference reaches (Kershner and Roper 2010). A wide range of aquatic conditions may exist in reaches with little or no recent management history.

For this analysis, overall trends across the Interior Columbia River Basin and trends from sites on the Nez Perce–Clearwater National Forests are presented in the following discussion, based on data collected through 2012. The indexed scores used to describe the existing condition and trends of managed and reference sites in the Nez Perce–Clearwater National Forests provide results that are statistically robust and avoid erroneous conclusions related to trends and the effects of land management activities, conclusions that can occur when simple comparisons between reference and managed stream data are made (Roper et al. 2007; Al-Chokhachy et al. 2010).

Other Monitoring and Data Sources

Available substrate and fish population monitoring data collected since the last planning effort on both national forests are presented as well, with the caveat that statistically robust conclusions cannot be made. The Forests have completed numerous watershed analyses at the 5th field HUC and several landscape assessments at the 4th field HUC; where available, results and conclusions from these analyses have been included and cited. Summaries of past timber harvest, roads, and information related to existing conditions in RCAs were obtained from the Forests' GIS coverages.

Palouse/Hangman

This area is located at the northernmost portion of the Nez Perce–Clearwater National Forests and includes extensive mixed-ownership lands. Unlike many other watersheds on the Forests, the Palouse watershed on National Forest lands does not support anadromous fish, due to a natural barrier well downstream (Palouse Falls). Salmonid species currently present include introduced brook and rainbow trout.

Riparian

Riparian areas in the subbasin have been affected by road construction, timber harvest, mining, and livestock grazing (USDA Forest Service 2003a). Table 1-31 summarizes road construction and timber harvest in watersheds and in RCAs.

Table 1-31. Watershed conditions related to roads and timber harvest in Riparian Conservation Areas (RCAs) in Palouse/Hangman 6th field hydrologic units code (HUC)

Watershed 6th field HUC Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Headwaters Palouse River	6.7	46	21	61	20	42	217
Meadow Creek	3.4	4	1	17	8	12	47
Big Creek	5.6	3	0	15	8	17	16
Gold Creek	4.7	5	0	10	6	12	39
Palouse River/Rock Creek	6.0	8	0	5	5	10	27

Riparian areas and streams have also been affected by past and ongoing livestock grazing. Much of the available forage is considered transitory and associated with past timber harvest units. As noted in the Upper Palouse Watershed Analysis (USDA Forest Service 2003a), most direct impacts related to grazing have been observed in limited areas along Strychnine and Dry Fork creeks. In steeper stream channels in other areas, heavy use of roads and an abundance of old clearcuts on upland sites may be helping to disperse cattle away from streamside zones. In short, livestock grazing causes site-specific effects to riparian areas, but the extent of transitory forage available, combined with steeper, confined channels, may preclude widespread adverse effects to riparian conditions.

As described in the watershed analysis (USDA Forest Service 2003a), historic mining operations have altered riparian areas, particularly near the North Fork Palouse River. Other known mining sites are found in the Mountain Gulch and Mizpah areas. Several old mine adits exist in these areas, and current claimants continue to rework some of these sites. Road densities are particularly high near the old Mizpah Mine.

Departures from reference conditions would likely be associated with construction of roads adjacent to streams, past timber harvest, and grazing and mining in specific sites. Construction of roads adjacent to streams functionally reduces or eliminates the number of trees available to fall into the stream. In the case of streamside timber harvest, riparian stands are converted to early seral conditions.

Aquatic Habitat

Stream habitat conditions in this subbasin have been affected by an extensive history of development. The attributes most affected, which represent the most significant departure from historic conditions, include substrate and channel morphology. Substrate and channel morphology changes are related to changes in erosion and mass wasting processes.

Available stream survey data suggest moderate to high levels of fine sediment in stream substrates, with cobble embeddedness ranging from 31% to 90% and percent surface fines from 30% to 67% (USDA Forest Service 2003a). High levels of substrate sediment are likely due to low stream gradient and geology, as well as the history of ground-disturbing activities, specifically road construction, which resulted in existing high road densities (Table 1-31).

More recent stream data were collected from 1999 through 2012 using PIBO protocols. The condition of additional stream habitat attributes was assessed and summarized in 2013. Because of the limited number of sample sites in the Palouse subbasin, particularly reference sites, the data were combined with data from the Lower Clearwater and Middle Fork Clearwater. Results from this analysis are therefore discussed in the section on the Lower Clearwater subbasin, below.

Aquatic Biota

Contemporary and past stream survey data indicate that the only salmonid species present in the National Forest portion of this subbasin are nonnative brook trout and hatchery-origin rainbow trout. Anadromous fish were not present historically and are not currently present, because Palouse Falls prevents all upstream fish migration. Documentation of fish populations within the Palouse River drainage prior to fish stocking in the early 1900s is limited (USDA Forest Service 2003a). Historically, the drainage may have supported westslope cutthroat trout. Recent stream surveys indicate rainbow and brook trout are found in the Palouse River, along with sculpin and longnose dace.

Idaho Department of Fish and Game has reported an observation of possible westslope cutthroat trout in the headwaters of the Palouse River. Additional investigation is needed.

Identification of Stronghold Watersheds

Due to lack of any population of native fish in the Palouse subbasin on National Forest lands, no stronghold watersheds have been identified, and no watersheds were identified as a high priority for aquatic restoration, although restoration activities are warranted to restore and conserve aquatic species other than salmonids, and to provide for hydrologic function. Further investigation of the westslope cutthroat trout observation is warranted as well.

North Fork Clearwater—Upper and Lower

The North Fork Clearwater Basin is made up of two 4th field HUCs, referred to as the Lower North Fork Clearwater (below Aquarius and the mouth of Beaver Creek, including Beaver Creek) and the Upper North Fork Clearwater (above Aquarius and the mouth of Beaver Creek). The Nez Perce–Clearwater National Forests administer approximately 62% of the total basin. The Lower North Fork Clearwater contains a high percentage of mixed-ownership lands.

Riparian

Riparian areas within the mainstem North Fork Clearwater River and a number of its tributaries were affected by natural wildfires occurring in the early 1900s (IDEQ 2003). Road construction and timber harvest activities have decreased the riparian cover along many tributaries throughout the watershed. Mining, agricultural, and forestry-related activities have also changed the stream channel locations and morphology in some areas. These changes have decreased streamside shade and increased the solar radiation to the streams.

Table 1-32 and Table 1-33, below, summarize past road construction and timber harvest in watersheds and in RCAs.

Table 1-32. Watershed conditions related to roads and timber harvest in Riparian Conservation Areas (RCAs) in Upper North Fork Clearwater 6th field hydrologic units

Watershed 6th Field Hydrologic Units Code Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
North Fork Clearwater—Vanderbilt	0.5	2	3	2	0	2	4
Meadow Creek	0.5	3	0	1	0	5	10
Long Creek	1.0	9	2	2	2	18	27
North Fork Clearwater—Elizabeth	3.7	31	40	18	14	35	115
Lake Creek	1.8	14	12	19	19	40	60
Kelly Forks	0	0	0	0	0	0	0
Upper Kelly Creek	0.1	0	0	0	0	0	0
Lower Kelly Creek	0.4	11	5	0	0	0	19
Upper Cayuse Creek	0.4	1	1	0	0	1	6
Middle Cayuse Creek	0.3	<1	0	0	0	0	2
Gravey Creek	2.9	14	1	24	16	33	19
Monroe Creek	0	0	0	0	0	0	0
Lower Cayuse Creek	0.3	2	0	0	0	3	5
Toboggan Creek	0.5	1	1	0	0	2	7
Moose Creek	2.1	10	1	21	21	39	32
Osier Creek	3.6	10	3	37	29	43	47
Little Moose Creek	0	0	0	0	0	0	0
North Fork Clearwater—Cold Springs	1.4	22	18	6	4	24	71
Fourth of July Creek	0	0	0	0	0	0	0
North Fork Clearwater—Cave Creek	0.4	12	2	0	0	10	29
Upper Weitas Creek	0.3	0	0	0	0	0	0
Middle Weitas Creek	0.3	3	0	0	0	0	20
Little Weitas Creek	0.5	<1	0	0	0	0	3
Lower Weitas Creek	0.5	1	2	0	0	1	8

Watershed 6th Field Hydrologic Units Code Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Middle Creek	1.5	4	1	7	8	14	26
Hemlock Creek	1.5	5	3	7	5	10	25
Johnny Creek	0.5	0	0	0	0	0	0
Upper Orogrande Creek	6.4	2	2	6	4	7	17
French Creek	4.4	13	5	30	20	42	62
Lower Orogrande Creek	5.5	30	27	52	42	75	107
North Fork Clearwater—Little Washington Creek	3.4	24	20	24	21	43	145
Washington Creek	5.5	21	4	16	18	35	84
North Fork Clearwater—Rock Creek	1.5	10	7	10	13	24	84
North Fork Clearwater—Sneak Creek	2.6	17	27	29	26	41	125
Quartz Creek	2.2	18	32	20	23	37	170
Upper Skull Creek	0.1	0	0	0	0	0	0
Lower Skull Creek	2.3	10	27	28	23	36	76
Collins Creek	<0.1	0	0	0	0	0	1

Table 1-33. Watershed conditions related to roads and timber harvest in Riparian Conservation Areas (RCAs) in Lower North Fork Clearwater 6th field hydrologic units

Watershed 6th Field Hydrologic Units Code Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Beaver Creek	6.1	12	12	10	6	15	86
North Fork Clearwater—Salmon Creek	2.6	5	11	5	3	6	42
Isabella Creek	0.7	7	5	10	15	22	33
Little North Fork Clearwater—Minnesoka	1.0	3	3	4	4	7	35
Upper Elk Creek	3.0	24	1	12	10	33	95
Middle Elk Creek	6.0	1	0	3	2	4	7
Bull Run Creek	5.3	1	0	4	2	3	5
Lower Elk Creek	4.2	1	0	7	4	5	10
Long Meadow Creek	5.5	7	0	8	4	9	47

Several major drainages within the North Fork Clearwater Basin have undergone substantial changes in riparian and aquatic resources over the last 135 years, as a result of mining activity (USDA Forest Service 1999a). Orogrande Creek, Moose Creek, and the upper North Fork drainages (including Bostonian, Vanderbilt, Lake, and Long creeks) were subjected to placer-mining by hand, dredge, and large machinery in the late 1800s and early 1900s. Riparian areas and stream channels appear to have been altered numerous times. Due to this mining activity, which was followed up by road development and timber harvest (summarized above), changes in stream channel morphology, water temperatures, and riparian conditions have occurred, which reduced the overall spawning and rearing potential of the drainage (USDA Forest Service 1999a). While grazing activities were scattered throughout several drainages affected by the large fires, including the Weitas and Kelly creek drainages, these activities mostly impacted localized riparian areas and did not affect aquatic resources as much as mining and timber harvest did.

Aquatic Habitat

Landslides, debris avalanches, and other forms of mass wasting are the dominant erosional processes in the subbasin (IDEQ 2003). Landslides are natural events across much of the basin, but the risk has increased due to road construction and timber harvest over the past 40 years. About 370 landslides were reported in the basin in the winter of 1995–1996; the landslides resulted from storm events, and the majority were initiated from forest roads. In a study of habitat conditions in the mainstem North Fork Clearwater conducted in the late 1990s (Clearwater BioStudies 1999), the effects of the 1995–1996 flood events were found to be generally confined to localized reaches of the river. Increased gravel-sandbar formations were visually observed, especially downstream of the confluence with Quartz Creek. However, substrate monitoring data showed fine sediment did not increase from pre-flood conditions. Riffle stability index data collected on 5 mainstem reaches from Dworshak Reservoir to Orogrande Creek showed fine sediment ranging from 2.4% to 7.7% in the riffle-run habitats; an average of 10% fine sediment was reported in an earlier study of essentially the same area (Orcutt et al. 1968).

Existing aquatic habitat conditions in some tributaries to the North Fork Clearwater River have been affected by landslides and roads. Available data suggest varying degrees of degradation in substrate conditions and possibly a reduction in the number of pools. Cobble embeddedness ranged from lows of about 23% to highs exceeding 64% in managed watersheds.

PACFISH/INFISH Monitoring Data Summary for the North Fork Clearwater Basin

Findings indicate that habitat complexity in the North Fork Clearwater Basin is similar in managed sites and reference sites on the Forests and across the entire Interior Columbia River Basin. Exceptions were bank angle and pool percent, where the distribution of the managed sites was skewed slightly better than the reference sites. The reference sites in the subbasin exhibited a larger range in wood frequency index than managed sites did, which could be due to disturbance in the reference sites that did not occur in the managed sites. The conditions of the macroinvertebrate assemblage at managed sites were similar to conditions at reference sites in the local study area and reference sites across the Interior Columbia River Basin. Sites scoring greater than 0.8 are generally considered to be within the range of reference condition, and the vast majority of the 19 managed sites for which data were available within the North Fork Clearwater Basin scored greater than 0.8.

Figure 1-22 and Figure 1-23 provide a visual summary of this analysis. Variables assessed in the final index include bank angle, large woody debris frequency, percent pool fines, D_{50}, pool percent, and residual pool depth.

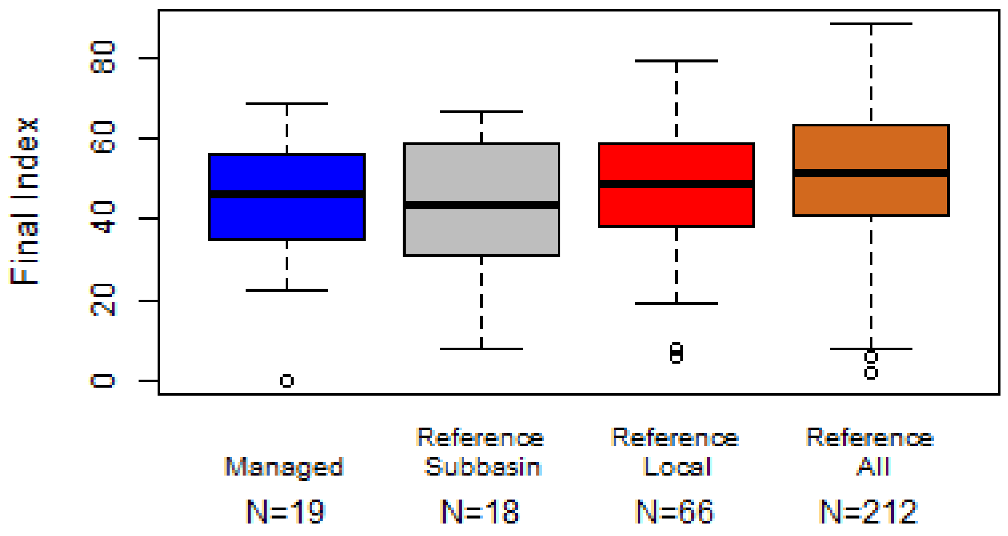

Figure 1-22. Summarized habitat index scores from managed reaches in the North Fork Clearwater Basin, compared to reference reaches within the basin, across the Nez Perce–Clearwater National Forests, and across the Interior Columbia River Basin

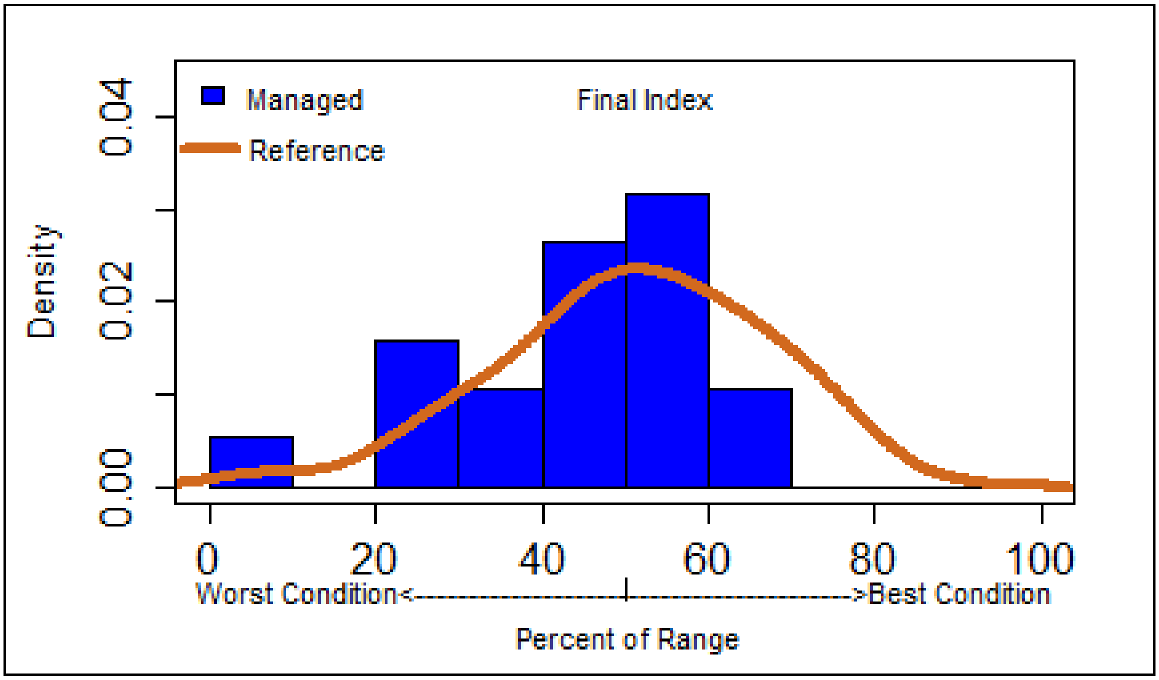

Figure 1-23. Final index summary of PACFISH/INFISH monitoring data showing relative conditions from managed sites versus reference sites

Aquatic Biota

Due to construction of Dworshak Dam in the late 1960s, fish assemblages within the North Fork Clearwater and its tributaries have undergone a change in composition of species. Anadromous fish are blocked from returning to the North Fork Clearwater River above the dam and are considered extirpated. Native westslope cutthroat trout and bull trout continue to persist in the river and tributaries above the dam, along with smaller numbers of rainbow trout. These rainbow trout may be the residualized vestiges of the former anadromous *O. mykiss* population that was extirpated by the dam, or they may be the result of subsequent plantings of hatchery rainbow trout, or they could be both.

The range and number of connected, strong populations of westslope cutthroat trout in the North Fork Clearwater and tributaries suggest that the basin supports one of the strongest populations of westslope cutthroat trout in Idaho (USDA Forest Service 1999b).

Bull trout populations are currently considered depressed in most of the tributaries within the North Fork Clearwater Basin. In places where fisheries–riparian habitats are severely degraded, remaining bull trout populations may be dominated by resident forms isolated in headwater tributaries and may include few if any fish exhibiting a migratory life history. Other factors that have influenced bull trout populations include the introduction of brook trout and angler mortality prior to 1993, when harvest of bull trout became illegal in the North Fork Clearwater Basin.

The number of strong populations of bull trout and westslope cutthroat trout in the North Fork Clearwater Basin has declined over the past 100 years, and bull trout are currently considered depressed (USDA Forest Service 2000). Declines in these populations in individual drainages or in collections of drainages have been affected by various changes in the physical conditions, including 1) increased stream temperatures, 2) elevated fine sediment concentrations in the substrates within spawning and rearing areas, and 3) physical removal or destruction of large organic debris, which decreased the overall rearing habitat.

The construction of Dworshak Dam created Dworshak Reservoir. Development of an adfluvial life history strategy among bull trout has subsequently occurred. The existence of relatively robust local populations of bull trout in the Upper North Fork Clearwater subbasin may be partly the result of large adfluvial bull trout with high fecundity spawning in the higher-elevation reaches of many 6th field HUC watersheds.

Other native fish species include mountain whitefish and sculpins.

Nonnative fish species that have been introduced into Dworshak Reservoir and the North Fork Clearwater Basin include kokanee, smallmouth bass, brook trout, and hatchery rainbow trout.

Identification of Stronghold Watersheds

Table 1-34. Population strongholds and potential strongholds in the North Fork Clearwater subbasins

6th Field Hydrologic Unit Code	Spring Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Stronghold Watershed[a]
North Fork Clearwater—Vanderbilt			X	X	
Lake			X	X	
Meadow					X
Kelly Forks			X	X	
Upper Kelly Creek			X	X	
Lower Kelly Creek			X	X	
Upper Cayuse			X	X	
Middle Cayuse			X	X	
Lower Cayuse			X	X	
Toboggan			X	X	
Moose Creek					X
Osier					X
Upper Weitas Creek			X	X	
Middle Weitas Creek			X	X	
Lower Weitas			X	X	
Johnny Creek			X	X	
Quartz Creek					X
Upper Skull			X	X	
Lower Skull					X
Collins Creek			X	X	
Isabella					X

[a] Potential population stronghold watersheds are identified for aquatic restoration. These watersheds are currently degraded but have high inherent potential for one or more imperiled salmonid species.

Lochsa Subbasin

The Lochsa subbasin is comprised of predominantly undeveloped forestland, with the majority of the land base administered by the Nez Perce–Clearwater National Forests. Most of the Lochsa River is designated as a Wild and Scenic River, and about half the subbasin south of the river is part of the Selway-Bitterroot Wilderness Area. The subbasin is above 8,600 feet in elevation at its eastern end, and its waters join to form the Lochsa River, which flows west 67.5 miles to its mouth, at an elevation of about 1,400 feet. The Lochsa River combines with the Selway River at Lowell, Idaho, to form the Middle Fork Clearwater River.

Large and intense forest fires are known to have swept the subbasin in 1910, 1919, 1924, and 1934 and may have occurred regularly before records were kept. The hot, intense fires stripped the soils of protective vegetation and exposed them to erosion. Many burned and eroded areas have not yet been reforested, largely because of these fire-damaged soils. The combination of loose soils, steep slopes, and intense rain-on-snow precipitation events produces landslides that dissect the subbasin with steep valleys and periodically deliver sediment to its streams. The subbasin landforms and the historic record confirm that these dynamic, high-energy processes occur repeatedly and define the normal subbasin condition.

Riparian

Riparian areas within the Lochsa subbasin were affected by natural wildfires occurring in the early to mid-1900s (USDA Forest Service 2008). Road construction and timber harvest activities have decreased the riparian cover along many tributaries throughout the watershed. The construction of U.S. Highway 12 permanently reduced riparian cover and woody debris recruitment along many sections of the Lochsa River. River morphology was also affected by the elimination of some river meanders.

Road construction and maintenance within tributary drainages may have resulted in greater effects due to smaller stream size and closer proximity of the roads to the streams. An overall reduction likely occurred in the quantity and quality of spawning and rearing habitat, due to increased sediment inputs and loss of riparian trees. Road construction also created barriers where roads crossed streams. Since 2000, more than 21 culverts on fish-bearing streams were removed to improve access to at least 37 stream miles for fish and other aquatic organisms (USDA Forest Service 2008).

Table 1-35 summarizes existing riparian conditions as they relate to road construction and timber harvest.

Table 1-35. Road density and timber harvest information for Riparian Conservation Areas (RCAs) in Lochsa River 6th field Hydrologic Units Code (HUCs)

Watershed 6th field Hydrologic Units Code Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Upper Crooked Fork Creek	1.5	2	1	9	4	7	19
Boulder Creek (Crooked Fork)	0.8	1	2	4	0	2	7
Lower Crooked Fork Creek	6.3	9	22	19	19	30	68
Upper Brushy Fork Creek	3.3	1	0	10	7	13	2
Spruce Creek	1.8	2	0	7	15	25	5
Lower Brushy Fork Creek	5.4	8	6	19	22	35	63
Upper Colt Killed Creek	0	0	0	0	0	0	0
Upper Big Sand Creek	0	0	0	0	0	0	0
Hidden Creek	0	0	0	0	0	0	0
Lower Big Sand Creek	0.3	5	0	0	0	0	13
Middle Colt Killed Creek	0.1	<1	0	0	0	0	0
Colt Creek	0.4	3	0	0	0	8	8
Storm Creek	0.1	0	0	0	0	0	0
Lower Colt Killed Creek	2.6	4	5	13	7	13	46
Lochsa River—Walton Creek	2.4	3	8	8	4	11	19
Legendary Bear Creek	4.4	7	16	15	11	29	19
Lochsa River—Wendover Creek	4.1	13	35	17	12	34	21

Watershed 6th field Hydrologic Units Code Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Fishing Creek	3.1	10	12	21	17	38	20
Upper Warm Springs Creek	0	0	0	0	0	0	0
Wind Lakes Creek	0	0	0	0	0	0	0
Lower Warm Springs Creek	0	0	0	0	0	0	0
Lochsa River—Weir Creek	0.8	3	6	4	2	4	22
Post Office Creek	1.3	1	0	6	8	11	4
Lake Creek	0	0	0	0	0	0	0
Lochsa River—Stanley Creek	0.5	1	2	0	0	<1	18
Lochsa River—Bald Mountain	0.4	2	0	2	0	3	12
Boulder Creek (Middle Lochsa)	>0.01	0	0	0	0	0	1
Upper Fish Creek	0.6	1	0	4	2	3	5
Hungery Creek	0.3	<1	0	0	0	0	0
Lower Fish Creek	0.1	<1	0	0	0	0	1
Lochsa River—Bimerick	0.4	<1	3	0	0	0	29
Old Man Creek	0	0	0	0	0	0	0
Split Creek	0	0	0	0	0	0	0
Fire Creek	0	0	0	0	0	0	0
Deadman Creek	1.8	1	0	15	8	10	6
Lochsa River—Glade Creek	1.5	3	2	9	6	10	33
Canyon Creek	5.7	13	7	48	27	56	44
Pete King Creek	5.5	18	8	30	18	48	84

Aquatic Habitat—Streams

Larger streams in the Lochsa subbasin generally provide good to excellent spawning and rearing habitat for all aquatic species. Stream habitat alterations caused by high spring runoff events after wildfire may have reduced fish densities or eliminated subpopulations in smaller drainages. Current conditions suggest that the effects were short-term; fish species recolonized affected areas over time. Overall, this area provided habitat conditions that allowed fish populations to be resilient and adapt to major natural perturbations (i.e., wildfires and floods).

Historically, increased sediment delivery in the Lochsa subbasin was associated with flood and fire events (USDA Forest Service 2008). Sediment production increased rapidly after fire, then tapered off to near zero for several years or decades until the next natural disturbance event. Substrate conditions within the undeveloped drainages south of the Lochsa River may have changed after the 1910 and 1929 fires. More recently, road construction has contributed to high sediment levels in some watersheds. Road failures during the 1995–1996 flood events contributed to elevated sediment levels in streams as well.

PIBO Data Summary for the Lochsa Subbasin

Stream data were collected from 1999 through 2012 using PIBO protocols, and the data were summarized in 2013. The analysis of these data indicates that habitat complexity in the Lochsa subbasin is similar in managed sites and reference sites in the local study area and across the entire Interior Columbia River Basin. One exception included pool percent, where data from managed sites suggested slightly better conditions than in reference watersheds. In addition, the percent fines and D_{50} indices exhibited larger variation for reference sites than for managed sites in the subbasin. The condition of macroinvertebrates was similar in managed and reference sites within the subbasin, in sites on the Nez Perce–Clearwater National Forests, and throughout the Interior Columbia River Basin. Sites scoring greater than 0.8 are generally considered to be within the range of reference condition; within the Lochsa subbasin, the majority of the 14 managed sites scored greater than 0.8.

These results are summarized in the Figure 1-24 and Figure 1-25. Variables assessed in the final index include bank angle, large woody debris frequency, percent pool fines, D_{50}, pool percent, and residual pool depth.

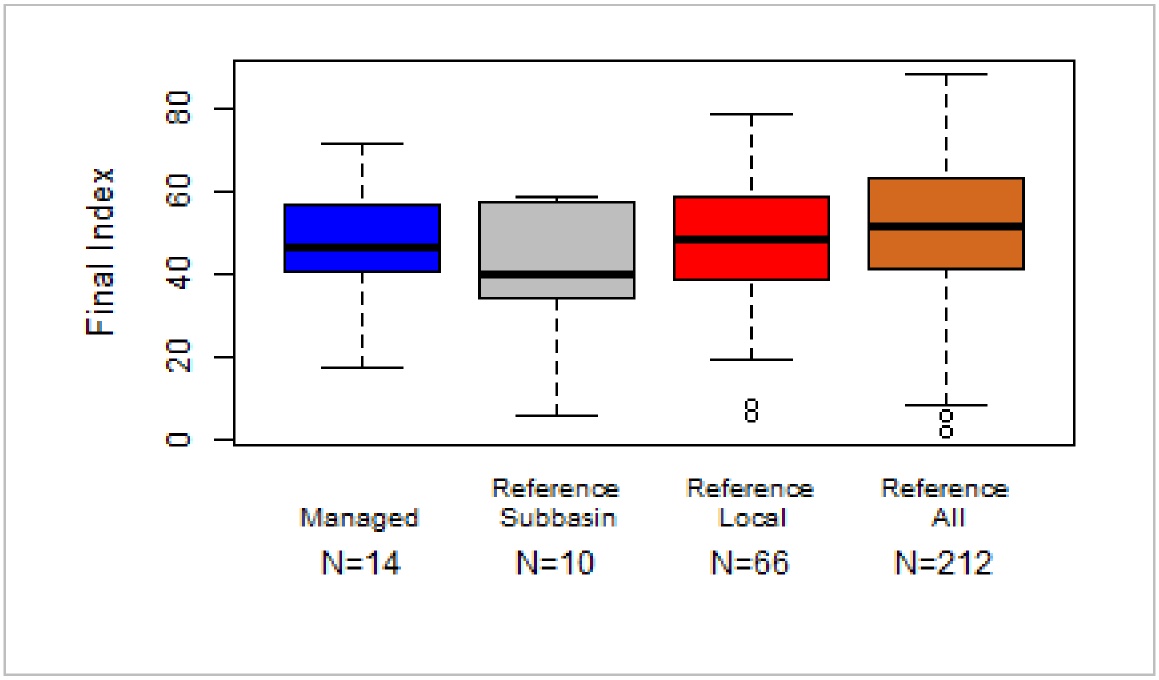

Figure 1-24. Summarized habitat index scores from managed reaches in the Lochsa subbasin, compared to reference reaches within the subbasin, across the Nez Perce–Clearwater National Forests, and across the Interior Columbia River Basin

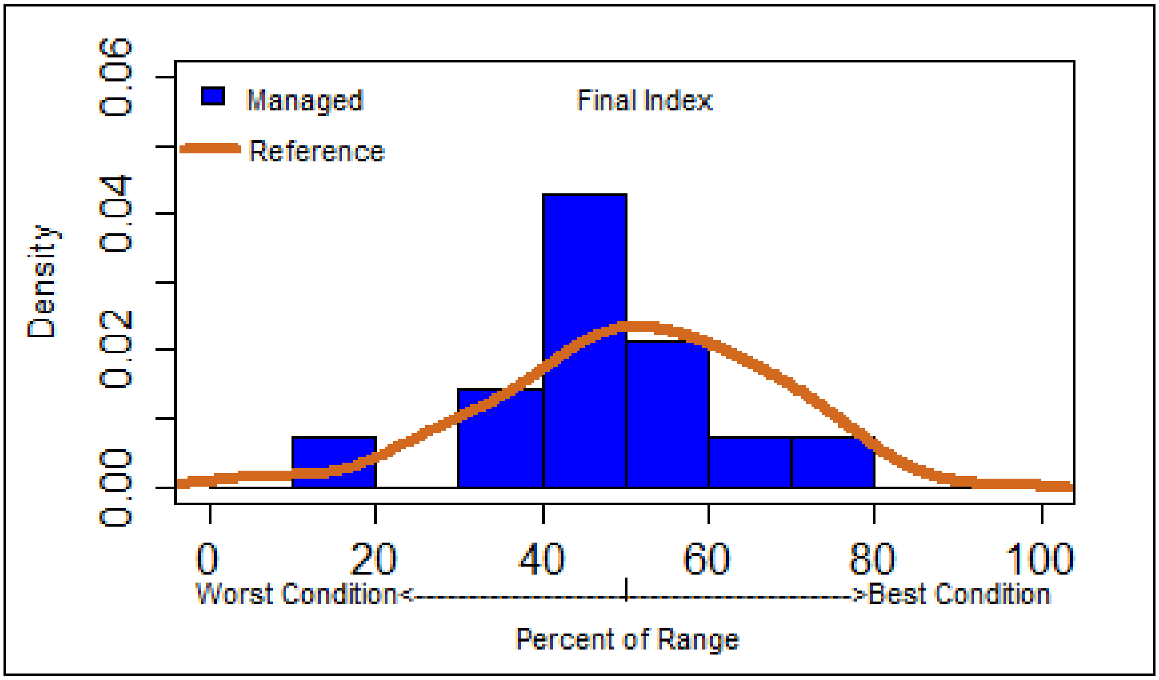

Figure 1-25. Final index summary of PACFISH/INFISH monitoring data showing relative conditions from managed sites versus reference sites

Aquatic Biota

The Lochsa subbasin remains accessible to anadromous fish and continues to provide substantial spawning and rearing areas for spring chinook salmon and steelhead trout throughout the mainstem and many tributaries. Juvenile Pacific lampreys (also an anadromous species) have been documented in the mainstem Lochsa River. The subbasin provides substantial spawning and rearing habitat for non-anadromous fish species, including westslope cutthroat trout, bull trout, mountain whitefish, inland redband trout, and sculpin. Largescale sucker, bridgelip sucker, northern pikeminnow, chiselmouth, longnose dace, speckled dace, and redside shiner are present in the river as well, particularly in the lower reaches of the mainstem.

Identification of Stronghold Watersheds

Table 1-36. Population stronghold and potential stronghold watersheds for the Lochsa subbasin

6th Field Hydrologic Unit Code	Spring Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Stronghold Watershed[a]
Upper Crooked Fork Creek		X		X	
Boulder Creek (Crooked Fork)		X		X	
Lower Crooked Fork Creek					X
Spruce Creek					X
Upper Brushy Fork Creek					X
Lower Brushy Fork Creek					X
Upper Colt Killed Creek	X	X	X	X	
Middle Colt Killed Creek	X	X	X	X	
Colt Creek			X	X	
Storm Creek	X	X	X	X	
Upper Big Sand Creek				X	
Lower Big Sand Creek				X	
Hidden Creek					
Lower Colt Killed Creek	X	X	X	X	
Legendary Bear Creek					X
Lochsa River—Wendover Creek					X
Fishing Creek					X
Wind Lakes Creek				X	
Upper Warm Springs Creek				X	
Lower Warm Springs Creek	X	X		X	
Lake Creek		X	X	X	
Boulder Creek (Middle Lochsa)		X	X	X	
Upper Fish Creek		X		X	
Hungery Creek		X		X	
Lower Fish Creek		X	X	X	
Old Man Creek		X			
Deadman Creek					X
Canyon Creek					X
Pete King Creek					X

[a] Potential population stronghold watersheds would have a high priority for aquatic restoration. These watersheds have been identified as currently degraded but have high inherent potential for one or more imperiled salmonid species.

Lower Clearwater/Middle Fork Clearwater

Landownership in these subbasins is highly mixed and comprised of private, state, federal, and tribal holdings. Potlatch Corporation and the Idaho Department of Lands manage substantial portions of the land base, and properties managed by these two entities are highly intermixed with those administered by the Nez Perce–Clearwater National Forests. Less than 10% of the land area has been given any protected status, with the majority of protected lands being inventoried roadless area (Ecovista 2003).

Riparian: Riparian areas in the Lower Clearwater subbasin are among the most altered of any on the Nez Perce–Clearwater National Forests, as indicated below in Table 1-37, most notably in the Lolo Creek watershed. In addition to roads and timber harvest, livestock grazing and mining have affected specific areas within the Lolo and Potlatch watersheds.

Table 1-37. Road density and timber harvest information for Riparian Conservation Areas (RCAs) in Lower Clearwater and Middle Fork Clearwater 6th field Hydrologic Units Code (HUCs)

Watershed 6th field HUC Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
MF Clearwater—Big Smith	3.2	6	34	26	13	20	55
Upper Clear Creek	3.4	3	4	26	5	10	27
South Fork Clear Creek	1.8	4	1	13	6	11	36
Lower Clear Creek	3.2	6	2	10	3	10	30
Upper Lolo Creek	5.2	41	3	43	39	86	109
Musselshell Creek	5.5	23	0	25	15	35	52
Middle Lolo Creek	4.7	25	1	22	19	46	67
Eldorado Creek	5	38	1	44	34	77	82
Upper Orofino Creek	7.3	16	6	18	10	27	82
WF Upper Potlatch River	3.0	15	0	9	6	13	86
EF Potlatch River	4.8	3	0	1	<1	2	28
Potlatch River—Hog Meadows	3.2	14	0	14	9	19	98
Corral Creek	2	6	0	12	7	12	71
Upper Big Bear Creek	3.1	11	0	5	7	12	96

Aquatic Habitat

Lolo Creek and the Potlatch River are 2 of the larger 5th field HUC watersheds in the Lower Clearwater subbasin, and Clear Creek is the largest 5th field HUC in the Middle Fork Clearwater subbasin. The Nez Perce–Clearwater National Forests also administer the headwaters of Orofino Creek in the Lower Clearwater subbasin. All 4 watersheds provide spawning and rearing habitat for spring chinook salmon and steelhead trout. Westslope cutthroat trout are present in the upper reaches of Lolo and Clear creeks. Available data suggest bull trout presence is sporadic in all 4 watersheds. These watersheds have been affected by road construction, timber harvest, and other land development activities on adjacent private and State of Idaho lands. Lolo Creek has been affected by past in-channel mining as well.

Habitat in Lolo Creek in particular is characterized by high levels of deposited sediment and cobble embeddedness, which generally exceeds 45% in all surveyed reaches, ranging from 37% to 99% (USDA Forest Service 2003b).

In Clear Creek, stream surveys conducted in 1985 indicated high levels of sediment and higher-than-preferred stream temperatures in the lower reaches on private lands (USDA Forest Service 2011). Sediment levels and temperature were lower in the middle and upper reaches. Sediment levels that exceed desired conditions have likely affected the quality and quantity of habitat available for trout and salmon. A lack of pool habitat as well as shallow water depths were also noted as issues affecting fish production in the middle and upper reaches of Clear Creek. Natural barriers to upstream fish passage exist on the Middle Fork Clear Creek just below Solo Creek and on the West Fork Clear Creek. Fish were observed in the Middle Fork above the barrier during culvert inventories on Forest Road 286.

More recent measurements of cobble embeddedness in Clear Creek were made in 2011 and 2012. Values ranged from 30% to 44% (USDA Forest Service 2012).

High levels of deposited sediment were also found in the Potlatch River, particularly lower-order, low-gradient tributaries such as those found in the Corral and Upper Big Bear watersheds. Cobble embeddedness ranged from 40% to 100% in surveyed reaches in the Potlatch watershed on National Forest lands in 2005 (Clearwater Biostudies 2006).

PACFISH/INFISH Monitoring Summary for the Palouse, Lower Clearwater, and Middle Fork Clearwater

Additional stream data from the Palouse, Lower Clearwater, and Middle Fork Clearwater subbasins were collected from 1999 through 2012 using PIBO protocols. The condition of stream habitat attributes was assessed and summarized in 2013. No reference reaches were identified within any of these subbasins, so data were compared to reference reaches from other subbasins on the Nez Perce–Clearwater National Forests and the entire Interior Columbia River Basin study area.

Findings in this assessment are consistent with the previous discussion of habitat conditions in the Lower Clearwater, Palouse, and Middle Fork Clearwater subbasins. The assessment found that habitat complexity at managed sites was generally lower than in reference sites. While some sites received scores in the range of reference conditions, many sites received a low condition score, and few sites received a high condition score. The measures of residual pool depth, percent pools, and bank angle generally received higher habitat condition scores than reference conditions in the Nez Perce–Clearwater study area and in all of the Interior Columbia River Basin. Wood counts were similar to those at reference sites as well. However, the distribution of D_{50} and percent fines was greatly skewed toward condition scores worse than reference. Therefore, lower scores for habitat condition were largely related to degraded substrate conditions. In addition, the distribution of macroinvertebrate scores at managed sites was skewed toward worse condition compared to reference, indicating lower diversity of macroinvertebrates than in reference sites.

These results are summarized in Figure 1-26 and Figure 1-27.

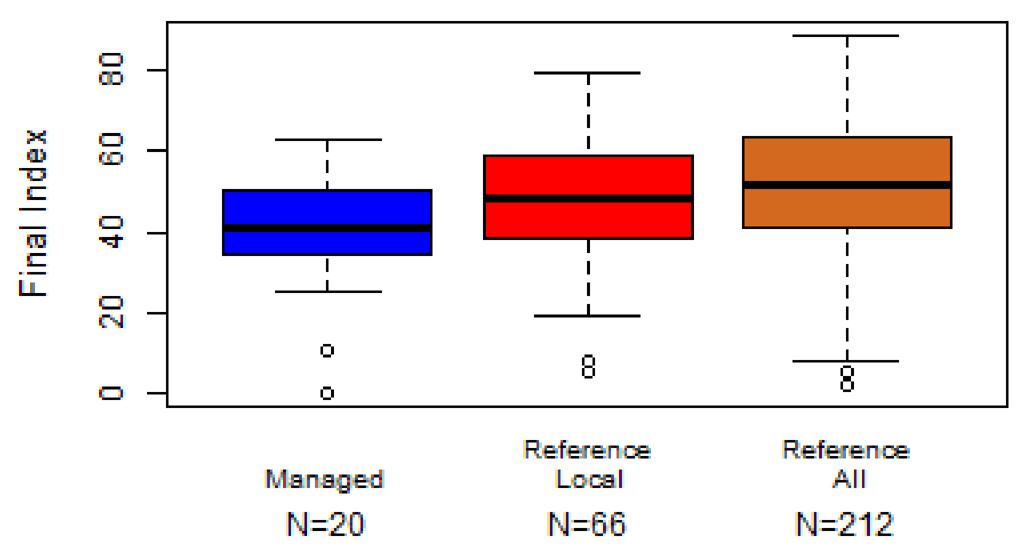

Figure 1-26. Summarized habitat index scores from managed reaches in the Palouse, Lower Clearwater, and Middle Fork Clearwater subbasins, compared to reference reaches across the Nez Perce–Clearwater National Forests and the Interior Columbia River Basin

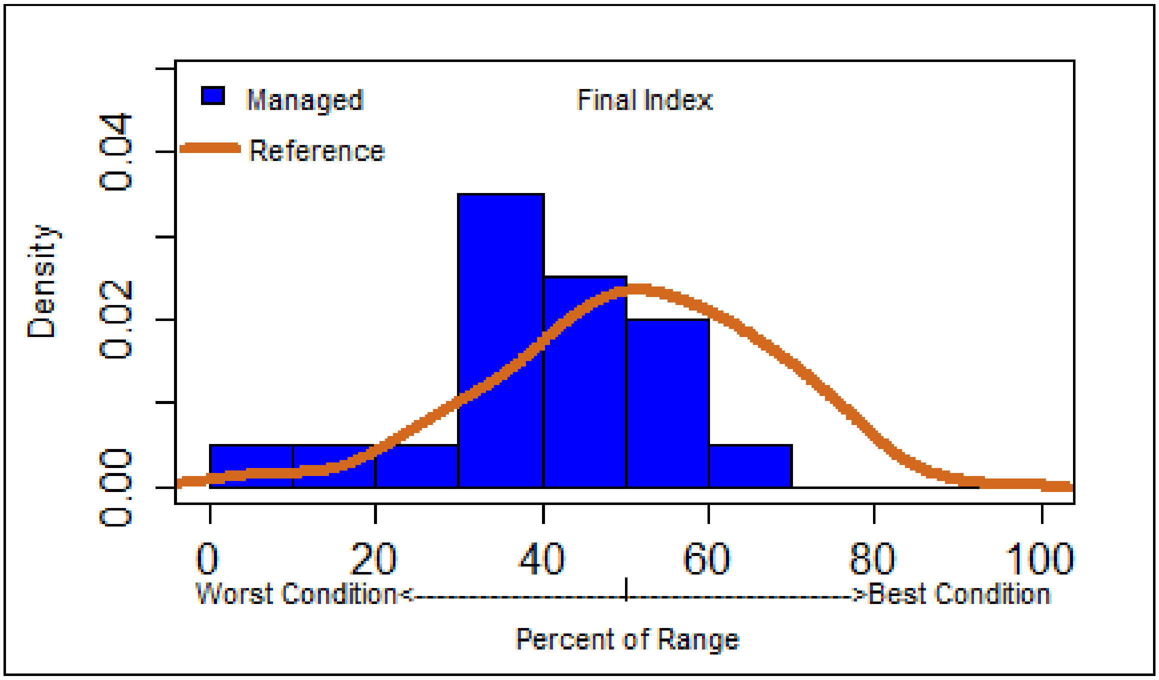

Figure 1-27. Final index summary of PACFISH/INFISH monitoring data showing relative conditions from managed sites compared to reference sites in the Palouse, Lower Clearwater, and Middle Fork Clearwater subbasins

Aquatic Biota

The mainstem Clearwater River provides spawning and rearing habitat for Snake River fall chinook salmon. Other species found in both the Clearwater River and Middle Fork Clearwater River include largescale sucker, bridgelip sucker, northern pikeminnow, chiselmouth, longnose dace, speckled dace, smallmouth bass, and redside shiner. Westslope cutthroat trout, bull trout, and redband trout occur opportunistically as water temperatures allow. Cold water releases from Dworshak Reservoir in the mid to late summer may facilitate use of this section of river by these species while providing thermal refuge for returning adult steelhead trout in August and September. This section of the river also supports the most known spawning and rearing by fall chinook salmon in the Clearwater Basin, although additional spawning in the lower reaches of the South Fork Clearwater River and Selway River has been facilitated by hatchery releases.

Lolo Creek provides spawning and rearing habitat for spring chinook salmon and steelhead trout and supports westslope cutthroat trout in higher-elevation reaches. Bull trout have been observed sporadically in this watershed, and no known spawning area has been identified (USDA Forest Service 2003b). Steelhead trout spawn and rear in the Potlatch River, but no other salmonid has been observed there during surveys on National Forest lands (Clearwater Biostudies 2006). Clear Creek provides spawning and rearing habitat for steelhead trout in all accessible reaches. Clear Creek also provides spawning and rearing habitat for spring chinook salmon spawning in larger, low-gradient reaches. Westslope cutthroat trout populations are present in small, high-elevation tributaries. As in Lolo Creek, bull trout have been observed sporadically in this watershed, but no known spawning area has been identified.

Steelhead trout can be assumed to be present in all smaller, accessible tributaries of the Clearwater and Middle Fork Clearwater rivers that have flows and gradient that can support fish. Westslope cutthroat trout may be present as well.

Identification of Stronghold Watersheds

Because of the level of degradation of habitat in the 5th and 6th field HUCs in the Lower Clearwater and Middle Fork Clearwater subbasins, and the lack of known strong populations of any at-risk fish species, no stronghold watersheds were identified (Table 1-38).

Table 1-38. Potential stronghold watersheds for the Middle Fork Clearwater and Lower Clearwater subbasins

6th Field Hydrologic Unit Code	Spring Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Stronghold Watershed[a]
Upper Clear Creek					X
South Fork Clear Creek					X
Lower Clear Creek					X
Upper Lolo Creek					X
Eldorado Creek					X
Middle Lolo Creek					X
Musselshell Creek					X
WF Upper Potlatch River					X
EF Potlatch River					X
Potlatch River – Hog Meadows					X
Corral Creek					X

[a] Potential population stronghold watersheds would have a high priority for aquatic restoration. These watersheds have been identified as currently degraded but have high inherent potential for one or more imperiled salmonid species.

Upper and Lower Selway Subbasins

The Upper and Lower Selway subbasins encompass approximately 1.2 million acres characterized by vast roadless and designated wilderness areas, rugged river breaklands, deep river and stream canyons, and broad glaciated stream bottoms at the higher elevations. Smaller inclusions of rolling uplands are present in the Lower Selway subbasin (USDA Forest Service 2001). The Bitterroot National Forest administers a portion of the Upper Selway subbasin, generally upriver of Goat Creek and including the lower portion of Running Creek. The Nez Perce–Clearwater National Forests administer the Upper Selway subbasin downriver of Goat Creek, including the Goat Creek watershed, the upper portion of Running Creek, and the entire Lower Selway subbasin except for a small amount of privately owned land.

The Lower Selway subbasin below Selway Falls has been affected by human activity including limited private land development, road construction, timber harvest, and limited livestock grazing. Mining activity has not affected stream or riparian conditions in the subbasin.

The Meadow Creek 5th field HUC watershed is largely roadless, although the majority of its acreage is located outside of designated wilderness. Timber harvest and road construction have occurred in the Horse Creek watershed, however, as part of an ongoing paired watershed study that addressed how increases in sediment yield affect stream habitat.

Riparian

Riparian areas in specific watersheds in the Lower Selway subbasin have been affected by human activities, most notably construction of Selway River road #223 along the mainstem Selway River in the lower 19 miles. Other streamside roads are found in the O'Hara and Meadow Creek watersheds. Generally, effects from these roads would be considered site-specific, although the stream-adjacent road in O'Hara Creek has experienced mass failure events repeatedly in the past 25 years; these events temporarily affected O'Hara Creek and the Selway River through increases in suspended and deposited sediment. Changes in aquatic function have also occurred from past timber harvest in RCAs, establishment of dispersed campsites in RCAs, and construction of developed campgrounds in RCAs.

Table 1-39 summarizes the extent of these activities by 6th field HUC in watersheds outside of designated wilderness. Watersheds that are largely or entirely located in designated wilderness were not included in Table 1-39, because for these watersheds, every column would have contained zeros.

Table 1-39. Road density and timber harvest information for Riparian Conservation Areas (RCAs) in the Upper and Lower Selway 6th field Hydrologic Units Code (HUCs) outside of designated wilderness (in part or entirely) and administered by the Nez Perce–Clearwater National Forests

Watershed 6th field HUC Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Selway River—Goddard Creek	1.7	4	5	12	4	10	23
O'Hara Creek	1.8	10	5	12	3	10	59
Selway River—Rackliffe Creek	0.54	6	1	2	0	10	5
Gedney Creek	0.18	<1	1	0	0	0	4
Selway River—Glover Creek	1.2	9	6	6	2	7	30
Horse Creek	1.5	1	1	7	3	6	7
Lower Meadow Creek	0.24	2	2	0	0	2	5
Buck Lake Creek	0	0	0	0	0	0	0
Sable Creek	0.09	0	0	0	0	0	0
Middle Meadow Creek	0	0	0	0	0	0	0
East Fork Meadow Creek	0.61	<1	0	0	0	0	5
Upper Meadow Creek	0.23	1	0	2	0	1	3
Upper Running Creek	0.24	2	0	0	0	<1	7
Lower Running Creek	0.07	1	0	0	0	<1	2

Aquatic Habitat

Above Selway Falls, nearly all 6th field HUC watersheds in the Upper and Lower Selway subbasins can be considered in a natural or near natural condition, due to lack of human disturbance. Nearly all of these watersheds have been affected by extensive wildfires, from 1910 through the present. In addition, establishment of spotted knapweed over a very large geographical area represents a significant departure from historic conditions in roadless and wilderness areas in the Upper and Lower Selway subbasins (USDA Forest Service 2001).

The Meadow Creek watershed has been affected by limited human development in some 6th field HUCs, including Horse Creek (timber harvest and road construction) and Upper Meadow Creek (past livestock grazing).

Habitat in 6th field HUCs below Selway Falls has been affected by human development in varying degrees. Portions of the O'Hara watershed and other watersheds in the Selway River–Goddard 6th field HUC have moderate road densities, with roads that in some cases are continually resulting in mass failures and delivery of sediment to streams (USDA Forest Service 2001). Moderate to high levels of cobble embeddedness are evident in streams such as Hamby Fork (O'Hara watershed) and Goddard Creek (USDA Forest Service 1999c). Some streams were subjected to extensive large woody debris clearing efforts in the 1940s, 1950s, and 1960s.

PACFISH/INFISH Monitoring Data Summary for the Selway

Additional data from streams in the Upper and Lower Selway subbasins were collected from 1999 through 2012 using PIBO protocols; these data were assessed and summarized in 2013. Findings indicate that habitat conditions in managed reaches are in poorer condition than reference sites in the Selway basin, the Nez Perce–Clearwater National Forests, and in the entire Interior Columbia River study area. There were, however, a low number of managed sites located in the Selway study area (n = ~7), but residual pool depth, pool percent, D_{50}, and percent fines all exhibited generally worse conditions than reference sites. Wood frequency and bank angle exhibited a similar distribution to reference conditions.

Despite the lower habitat conditions in managed sites, macroinvertebrate indices exhibited a distribution similar to that of reference sites and were not significantly different from reference indices.

These conclusions are summarized in Figure 1-28 and Figure 1-29.

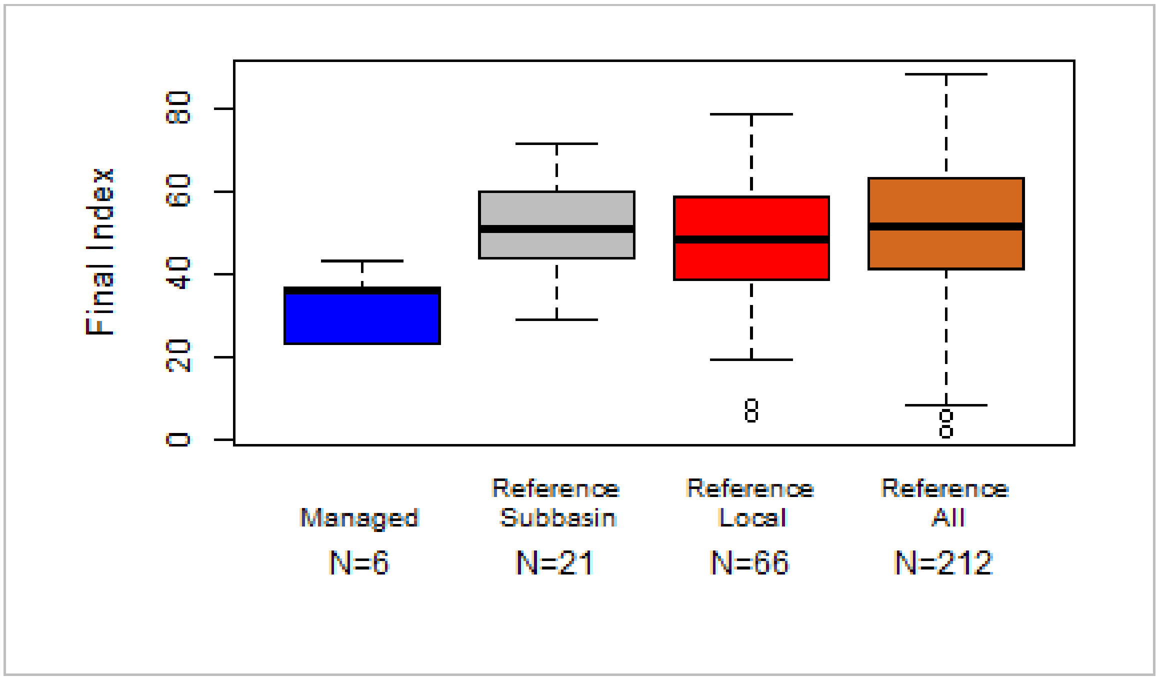

Figure 1-28. Summarized habitat index scores from managed reaches in the Lower Selway subbasin, compared to reference reaches in the Upper and Lower Selway subbasins, across the Nez Perce–Clearwater National Forests, and across the Interior Columbia River Basin

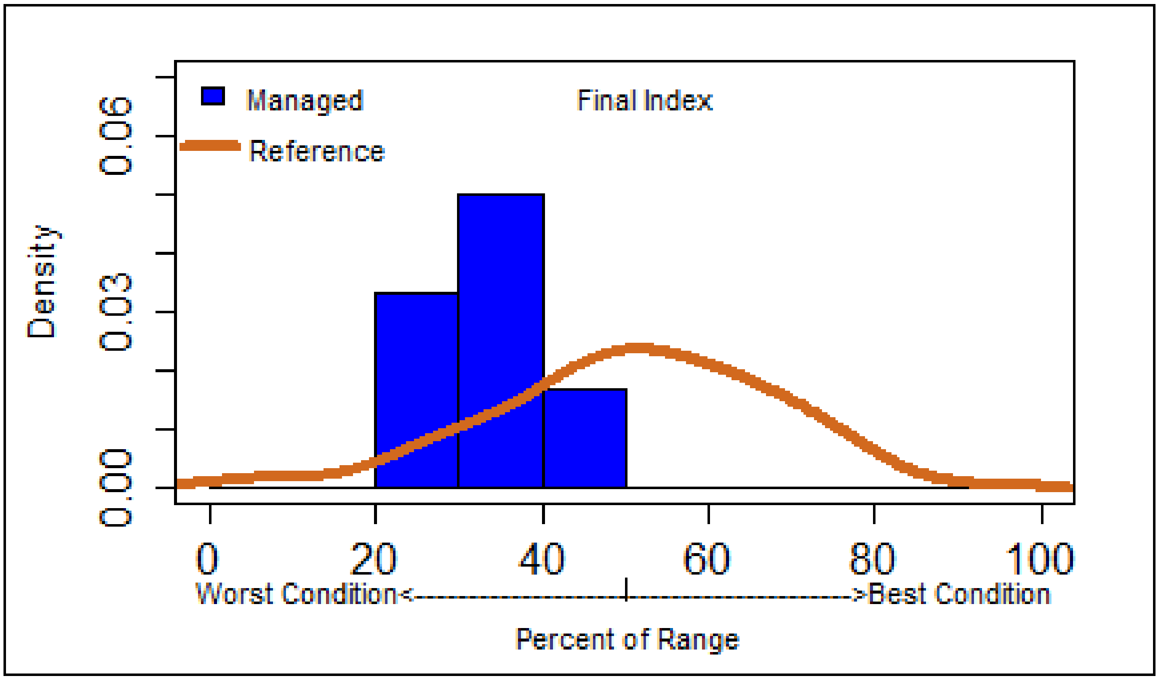

Figure 1-29. Final index summary of PACFISH/INFISH monitoring data showing relative conditions from managed sites reaches in the Lower Selway subbasin, versus reference sites reaches in the Upper and Lower Selway subbasins, across the Nez Perce–Clearwater National

Aquatic Biota

The Upper and Lower Selway subbasins provide spawning and rearing habitat for steelhead trout, spring chinook salmon, interior redband trout, bull trout, and westslope cutthroat trout. Mountain whitefish are also present in high numbers. The mainstem Selway River below Selway Falls also provides spawning and rearing habitat for fall chinook salmon, and Pacific lamprey ammocoetes (juveniles) have been documented in the river both below and above Selway Falls up to Bear Creek. Extensive beds of western pearlshell mussel are present in the river as well.

Other species include largescale sucker, bridgelip sucker, northern pikeminnow, chiselmouth, longnose dace, speckled dace, smallmouth bass, and redside shiner.

Identification of Stronghold Watersheds

The number of watersheds identified as population strongholds reflects the wilderness and roadless character of the Upper and Lower Selway subbasins (Table 1-40). These subbasins represent the core area of population strongholds still remaining within the Clearwater Basin, particularly for steelhead trout, bull trout, and westslope cutthroat trout.

Table 1-40. Population strongholds in the Upper and Lower Selway subbasins (watersheds administered by the Bitterroot National Forest not included)

6th Field Hydrologic Unit Code	Spring Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Stronghold Watershed[a]
Selway River—Goddard					X
O'Hara					X
Selway River—Rackliffe					X
Gedney Creek		X		X	
Selway River—Glover					X
Horse Creek					
Lower Meadow Creek	X	X			
Buck Lake Creek		X			
Sable Creek		X			
Middle Meadow Creek	X	X		X	
East Fork Meadow Creek			X	X	
Upper Meadow Creek			X	X	
Otter				X	
Selway River—Pinchot		X		X	
Three Links		X		X	
Marten		X		X	
East Moose Headwaters					
Upper East Moose Creek				X	
Cedar Creek				X	
Middle East Moose Creek	X	X		X	
Lower East Moose Creek	X	X		X	
Upper North Moose Creek				X	
West Moose Creek				X	
Middle North Moose Creek	X	X	X	X	
Rhoda Creek			X	X	
Lower North Moose Creek	X	X	X	X	
Lower Moose Creek	X	X	X	X	
Selway River—Elk Creek		X		X	
Ditch Creek		X		X	

6th Field Hydrologic Unit Code	Spring Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Stronghold Watershed[a]
Selway River—Dog Creek		X		X	
Pettibone Creek		X		X	
Upper Bear Creek				X	
Wahoo Creek					
Middle Bear Creek		X		X	
Upper Cub Creek				X	
Lower Cub Creek	X	X			
Paradise Creek				X	
Lower Bear Creek	X	X		X	
Goat Creek		X		X	
Upper Running Creek				X	
Lower Running Creek	X	X	X	X	

[a] Potential population stronghold watersheds would have a high priority for aquatic restoration. These watersheds have been identified as currently degraded but have high inherent potential for one or more imperiled salmonid species.

South Fork Clearwater

The South Fork Clearwater subbasin encompasses an area of about 752,000 acres. The subbasin contains a mix of ownerships, with the U.S. Forest Service administering over 60% of the area. Many areas of the subbasin have been heavily managed.

Riparian Areas

Broadscale riparian conditions and function were most recently assessed in 1998 (USDA Forest Service 1998). The assessment considered historic mining activities in riparian areas (primarily dredge mining), length and density of streamside roads, grazing effects, and past timber harvest in riparian areas. In summary, changes in riparian function have occurred from human activity in many areas in the subbasin. The greatest amount of change has occurred along the tributaries to mainstem rivers in the upper basin, along the South Fork Clearwater River, and along meadow sections. Historic mining and roads that encroach on riparian/stream areas are believed to have had the greatest effect on riparian function. These activities have resulted in press disturbances, or semi-permanent alterations of the riparian environments. Available information regarding historic conditions suggests this regime alteration is not within the range of natural disturbances in the subbasin (USDA Forest Service 1998).

The existing conditions of riparian areas in each of the 6th field HUC watersheds with lands entirely or partially administered by the Forest Service are summarized in Table 1-41.

Table 1-41. Summary of road density and timber harvest information for Riparian Conservation Areas (RCAs) in the South Fork Clearwater subbasin

Watershed 6th Field HUC Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
SF Clearwater—Rabbit Creek	1.8	2	2	2	1	3	12
SF Clearwater—Grouse Creek	4.7	12	59	33	22	36	103
Meadow Creek	4.6	21	5	39	15	38	90
Mill Creek	2.6	9	4	21	5	18	39
SF Clearwater—Lightning Creek	2.5	6	5	9	5	11	45
Upper Johns Creek	0.1	0	0	0	0	0	0
Gospel Creek	0.1	0	0	0	0	0	0
Lower Johns Creek	1.2	2	3	10	4	6	11
SF Clearwater—Leggett	3.6	21	7	14	5	21	129
Tenmile Creek	0.53	5	1	1	1	6	15
SF Clearwater—Wing Creek	2.1	4	3	10	3	9	56
Twentymile Creek	0.82	2	0	2	0	4	15
Silver Creek	1.1	1	2	7	3	4	21
SF Clearwater—Peasley Creek	3.4	18	7	21	11	26	124
Upper Crooked River	1.2	10	1	5	2	13	30
Lower Crooked River	3.3	12	1	22	6	25	47
Upper Newsome Creek	3.2	11	2	17	5	14	67
Lower Newsome Creek	3.7	12	2	23	5	19	68
Upper American River	2.0	5	0	9	2	10	18
East Fork American River	2.1	2	0	11	2	7	17
Lower American River	1.7	1	0	7	3	4	12
Elk Creek	3.8	6	1	11	3	11	32
Lower Red River	4.0	26	2	26	9	36	114
Upper Red River	2.9	26	0	21	9	35	116

Watershed 6th Field HUC Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
South Fork Red River	3.0	16	1	22	8	24	63
Middle Red River	5.3	30	1	47	24	54	127

Changes in riparian function have occurred from road construction, timber harvest, mining, and livestock grazing in riparian areas. Although watersheds within the South Fork Clearwater subbasin exhibit relatively high percentages of RCAs affected by past timber harvest and road construction (e.g., Middle Red River, Meadow), the greatest amount of change at the subbasin scale is evident along the tributaries in the upper basin, along the mainstem South Fork Clearwater River, and along many meadow sections. Historic mining and roads that encroach on riparian areas and streams had the greatest effect on riparian condition. Substantial lengths of stream in Crooked River, Red River, American River, Newsome Creek, and upper reaches of the South Fork Clearwater River were historically dredge mined, resulting in substantial and pervasive effects to riparian and stream function. Sterile dredge piles currently exist in all these areas. In addition to riparian effects, this activity resulted in straightening of stream channels, with simplification of habitat in some cases (e.g., Newsome Creek, American River, Red River) and creation of tortuous meanders in the case of Lower Crooked River.

Grazing of domestic livestock has also affected riparian function in some watersheds. In 2010 and 2011, an inventory of stream reaches most susceptible to grazing in active and vacant allotments was initiated in the subbasin, using a truncated version of the PIBO monitoring protocol to determine bank stability, width:depth ratio, and lower bank angle. In short, only 3 of 32 reaches met riparian management objectives (RMOs) as currently described in PACFISH and INFISH (*see below under Current Forest Plan Direction)*. The 3 reaches that did meet RMOs had not been grazed for over 2 decades. Several of the reaches that did not meet width:depth ratio and lower bank angle RMOs, however, were channel types that would not be expected to meet RMOs under more pristine conditions (e.g., B2, A2, B3, A3 Rosgen channel types).

Aquatic Habitat

Extensive alterations of stream habitats in this subbasin have occurred from human disturbances. As described previously, the most notable disturbances have been in-channel mining activities and road encroachment into streamside areas. In an assessment of stream conditions in the subbasin (USDA Forest Service 1998), streams exhibiting the poorest habitat (or habitat considered to have undergone a high degree of change when compared to historic conditions) included Red River, Crooked River, Newsome, Leggett, Cougar, Peasley, Meadow, and tributaries to Lower Johns Creek flowing from the west side of the watershed. The habitat attributes most commonly considered degraded were substrate (degraded by high fine sediment deposition), large woody debris, number of pools, and pool quality; these degraded attributes are indicative of poor habitat complexity.

Watersheds with habitat conditions that appear to have undergone the least amount of change, in comparison to historic conditions, included Johns Creek (other than the west-side tributaries), Silver Creek, Twentymile Creek, and Tenmile Creek (USDA Forest Service 1998).

PACFISH/INFISH Monitoring Summary for the South Fork Clearwater

Additional data from streams in the South Fork Clearwater subbasin were collected from 1999 through 2012 using PIBO protocols; these data were assessed and summarized in 2013. Findings indicate that channel morphology (percent pools, residual pool depth) was below all

Interior Columbia River Basin reference sites as well as reference sites from the Nez Perce–Clearwater National Forests and the South Fork Clearwater subbasin. Wood counts, percent fines, bank angle, and D_{50} were comparable to measurements at reference sites across the Interior Columbia River Basin and in the local area. Habitat complexity (i.e. final index) was low, and benthic macroinvertebrate indices suggested management has eliminated some of the expected macroinvertebrate taxa within this system.

The index shows a substantial shift in the distribution of index scores toward worst condition in the managed reaches, as compared to the distribution of scores for all reference reaches.

These conclusions are summarized in Figure 1-30 and Figure 1-31.

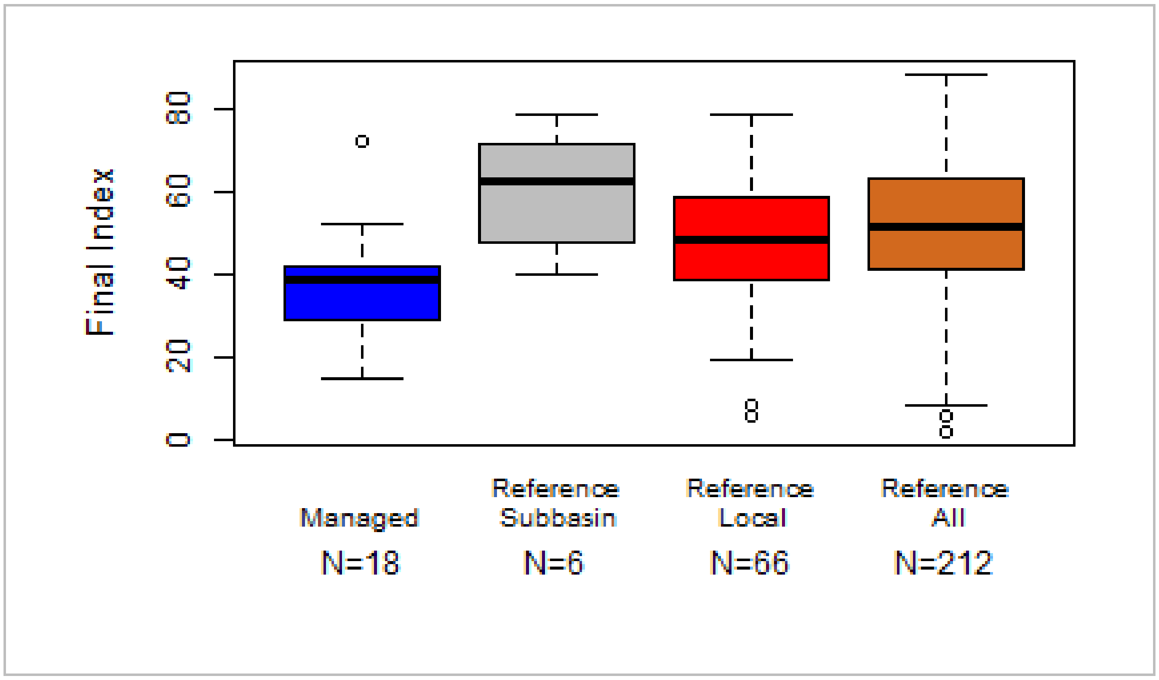

Figure 1-30. Summarized habitat index scores from managed reaches in the South Fork Clearwater subbasin, compared to reference reaches in the South Fork Clearwater subbasin, across the Nez Perce–Clearwater National Forests, and across the Interior Columbia River Basin

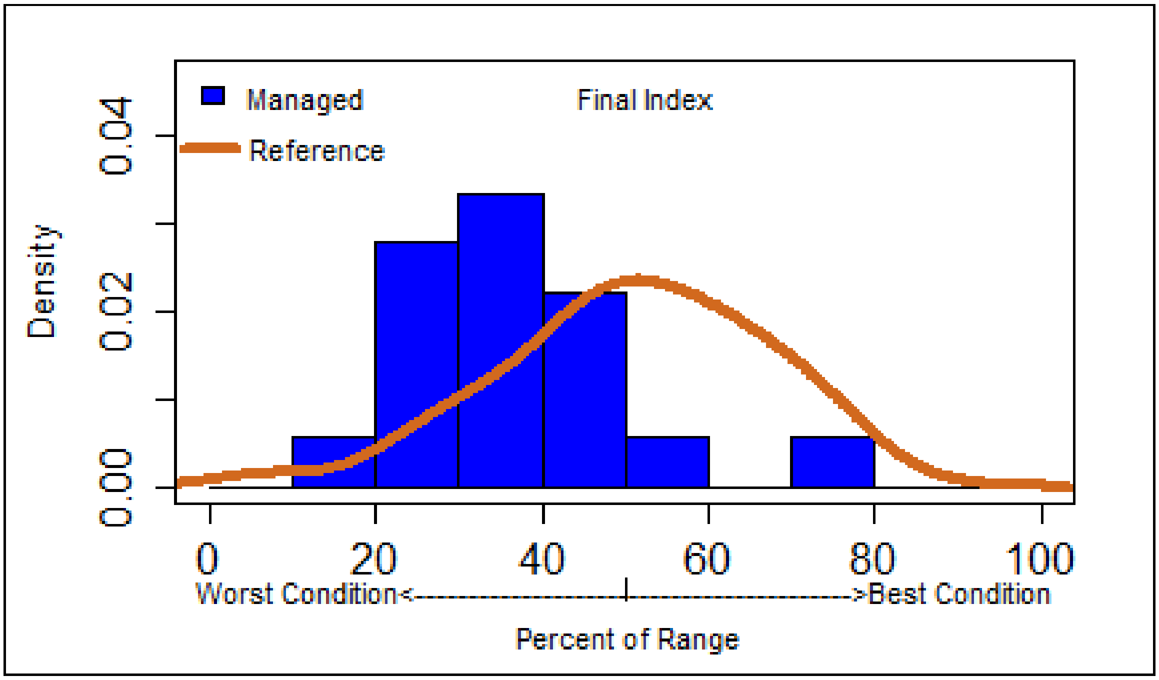

Figure 1-31. Final index summary of PACFISH/INFISH monitoring data showing relative conditions from managed sites in the South Fork Clearwater subbasin, versus reference sites

These results generally corroborate findings contained in the South Fork Clearwater landscape assessment and various watershed analyses that were completed in the late 1990s and early 2000s.

Aquatic Biota

The South Fork Clearwater subbasin currently supports spawning and rearing for Snake River fall chinook salmon (mainstem river lower reaches), Snake River steelhead trout (mainstem and accessible tributaries), Columbia River bull trout (mainstem migration corridor, spawning and rearing in a few tributaries), spring chinook salmon (mainstem and larger, accessible tributaries), westslope cutthroat trout (mainstem migration corridor and most tributaries), and Pacific lamprey (mainstem and Red River). In addition, western pearlshell mussel populations have been identified in the mainstem river, American River, Red River, and Crooked River, and the species may be present elsewhere. Sculpins, dace, suckers, and northern pikeminnow are also present.

Identification of Stronghold Watersheds

identified as currently degraded but have high inherent potential for one or more imperiled salmonid species.

Despite high inherent potential for anadromous fish spawning and rearing, the South Fork Clearwater subbasin currently offers only 1 population stronghold for steelhead trout and spring chinook salmon (Lower Johns Creek), only 1 other population stronghold for steelhead trout (Tenmile Creek), and only 3 population strongholds for bull trout (Tenmile Creek, Upper Johns Creek, and Gospel Creek) (Table 1-42). Full restoration of degraded reaches within the Newsome, American River, and Red River watersheds would create additional population strongholds in habitat with very high inherent potential for anadromous fish, particularly spring chinook salmon (USDA Forest Service 1998). Full restoration of Upper and Lower Crooked rivers would accomplish the same objective, but in habitat with very high inherent potential for steelhead trout and bull trout.

Restoration of all degraded reaches in the subbasin would contribute to improved temperature and sediment conditions in the mainstem South Fork Clearwater River, thereby improving its function as a migration corridor and increasing the river's capacity to provide winter rearing habitat. In addition, fall chinook salmon and steelhead trout spawn in the mainstem river.

Table 1-42. Population strongholds in the South Fork Clearwater subbasin

6th Field Hydrologic Unit Code	Spring Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Stronghold Watershed[a]
Meadow					X
Mill					X
Lower Johns	X	X			
Upper Johns			X	X	
Gospel			X	X	
Twentymile				X	
Tenmile		X	X	X	
Upper Crooked River					X
Lower Crooked River					X
Upper Newsome					X
Lower Newsome					X
Upper American River					X
East Fork American River					X
Lower American River					X
Elk					X
Lower Red River					X
Upper Red River					X
South Fork Red River					X
Middle Red River					X

[a] Potential population stronghold watersheds would have a high priority for aquatic restoration. These watersheds have been Lower Salmon/Lower Little Salmon/Middle Salmon–Chamberlain

The Nez Perce–Clearwater National Forests administer portions of these 3 subbasins; the Lower Salmon and Lower Little Salmon subbasins contain lands intermixed with private, Bureau of Land Management, and State of Idaho lands in the Lower Salmon and Lower Little Salmon subbasins. Portions of the Middle Salmon–Chamberlain subbasin are also administered by other National Forests, most notably the south side of the river, which is administered by the Payette National Forest.

Riparian Areas

Table 1-43, below, summarizes riparian conditions as they relate to road construction and timber harvest. In addition to these activities, past and ongoing livestock grazing and past and ongoing mining activities have affected specific reaches in some watersheds. Mining has resulted in substantial effects to riparian conditions in several areas, including Upper Little Slate Creek, Meadow Creek (Wind River drainage), Upper Crooked Creek, Rhett Creek, and Little Mallard Creek. Livestock grazing has affected portions of most watersheds in the Lower Salmon subbasin, which supports the most grazing animal unit moths (AUMs) on the Nez Perce–Clearwater National Forests. In addition, a substantial area of the subbasin is in private ownership, which includes ranching operations for cattle and/or sheep. Big Mallard Creek in the Middle Salmon–Chamberlain subbasin was historically grazed but has not been grazed for over a decade.

A substantial portion of the Middle Salmon–Chamberlain subbasin is currently in designated wilderness or is roadless, and riparian areas are largely unaffected by landscape-scale human disturbances. The portion of the Lower Little Salmon subbasin administered by the Nez Perce–Clearwater National Forests mostly includes the Rapid River watershed, with riparian areas that are mostly unaffected by roads and past timber harvest. Some riparian reaches may be affected by streamside trails, dispersed campsites, livestock grazing, and establishment of noxious weeds.

Table 1-43. Summary of road density and timber harvest information for Riparian Conservation Areas (RCAs) in the Lower Salmon, Lower Little Salmon, Middle Salmon–Chamberlain subbasins, Nez Perce–Clearwater National Forests portion only

Watershed 6th field HUC Name	Watershed Road Density (mi/mi²)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Middle Salmon – Hot Springs	0	0	0	0	0	0	0
Middle Salmon - Dillinger	0	0	0	0	0	0	0
Upper Sabe Creek	0.1	0	0	0	0	0	0
Lower Sabe Creek	0	0	0	0	0	0	0
Upper Bargamin Creek	0.4	<1	0	0	0	0	8
Middle Bargamin Creek	0.2	<1	0	0	0	0	1
Lower Bargamin Creek	0	0	0	0	0	0	0
Middle Salmon — Richardson	0	0	0	0	0	0	0
Big Mallard Creek	0.7	3	0	4	<1	3	21
Middle Salmon —Trout	0.4	0	4	0	0	0	3
Rhett Creek	0.4	1	0	0	0	3	2
Middle Salmon —Jersey	0.6	3	2	0	0	3	11
Middle Salmon —Indian	0.1	0	0	0	0	0	0
Middle Salmon —Bear	0	0	0	0	0	0	0
Middle Salmon —Bull Creek	0	0	0	0	0	0	0
Sheep Creek	0.1	0	0	0	0	0	1
Lower Crooked Creek	0.1	0	1	0	0	0	0
Lake Creek	0.2	2	0	0	0	2	9
Big Creek	0.5	5	0	0	0	10	15
Upper Crooked Creek	2.1	15	0	5	3	26	50
Middle Salmon —Carey	0.9	1	0	11	7	10	17
Wind River	0.3	0	0	<1	0	0	5
Meadow Creek	2.1	11	0	8	3	19	36
Salmon River —Kelly Creek	1.9	9	3	14	9	17	69

Watershed 6th field HUC Name	Watershed Road Density (mi/mi^2)	Roads in Streamside RCAs (miles)	Roads on Landslide Prone (miles)	Watersheds with Timber Harvested (%)	RCAs with Timber Harvested (%)	RCAs with Roads and Harvest (%)	Number of Forest Service Road/Stream Crossings
Allison Creek	2.5	6	16	16	11	25	35
Salmon River —Berg Creek	2.0	7	15	13	8	18	44
Salmon River —Fiddle Creek	3.3	3	16	9	5	8	39
Race Creek	2.1	5	8	14	8	14	56
Salmon River —China Creek	4.0	8	12	12	1	11	46
John Day Creek	2.6	1	1	7	3	5	6
Salmon River —Sherwin Creek	3.0	5	5	4	2	9	38
Upper Little Slate Creek	2.7	11	0	14	7	17	56
Lower Little Slate Creek	1.4	1	0	8	2	4	9
Upper Slate Creek	1.5	2	4	7	4	13	10
Lower Slate Creek	2.2	12	12	8	4	14	51
Salmon River —McKinzie Creek	3.3	2	2	6	2	5	20
Skookumchuck Creek	3.8	5	4	18	9	16	31
Deer Creek	2.0	1	3	6	3	11	6
North Fork White Bird Creek	4.3	12	4	26	12	32	49
South Fork White Bird Creek	4.0	16	5	33	11	33	50
Rapid River—Copper Creek	0.3	0	6	3	2	2	8
West Fork Rapid River	0.1	0	0	0	0	0	1
Lower Rapid River	1.3	1	3	6	2	4	18
Squaw Creek	1.5	4	8	8	2	15	14

Aquatic Habitat—Streams

Streams in the Middle Salmon–Chamberlain subbasin that are administered by the Nez Perce–Clearwater National Forests are mostly unaffected by human development, with vast acreages located in roadless or designated wilderness areas. Bargamin and Sabe creeks are large watersheds that have not been subjected to much, if any, human development, and they are thought to offer high-quality habitat for resident and anadromous fish. Streams in the Lower Salmon subbasin are generally far more developed, with varying degrees of effects to stream habitat. Deposited sediment is frequently a limiting factor, as in most other streams on the Nez Perce–Clearwater National Forests. In basalt breakland landtypes, however, streams affected by human development typically exhibit aggradation of larger substrate materials and fewer areas with high levels of fine sediment deposition. These streams can be highly productive for fish, however, possibly due to a greater groundwater influence.

Some stream reaches in the Lower Salmon subbasin are subjected to water withdrawal for irrigation and domestic use.

PACFISH/INFISH Monitoring Data Summary for the Salmon

Additional data from streams in the Lower Salmon, Lower Little Salmon, and Middle Salmon–Chamberlain subbasins were collected from 1999 through 2012 using PIBO protocols; these data were assessed and summarized in 2013. Findings indicate that habitat complexity is generally similar in managed sites and reference sites in the local study area and across the entire Interior Columbia River Basin. Exceptions were residual pool depth and pool percent, which scored better than reference sites across the entire Interior Columbia River Basin. Also, both reference and managed sites in the Salmon subbasin scored higher for the pool percent index than sites in the greater Nez Perce–Clearwater subbasin. D_{50} and percent fines in the subbasin spanned a wider range of conditions than was found on the Nez Perce–Clearwater National Forests sites and at all sites within the Interior Columbia River Basin. The same pattern was observed at both managed and reference sites. A number of sites received the lowest score possible (“0”). Wood frequency was similar to findings at reference sites in the Nez Perce–Clearwater National Forests and across the Interior Columbia River Basin but higher than at reference sites in the Salmon subbasin. The macroinvertebrate index at managed sites also exhibited a distribution similar to the distribution found at reference sites in the Salmon subbasins, in the Nez Perce–Clearwater National Forests, and across the Interior Columbia River Basin.

These results are summarized below in Figure 1-32 and Figure 1-33.

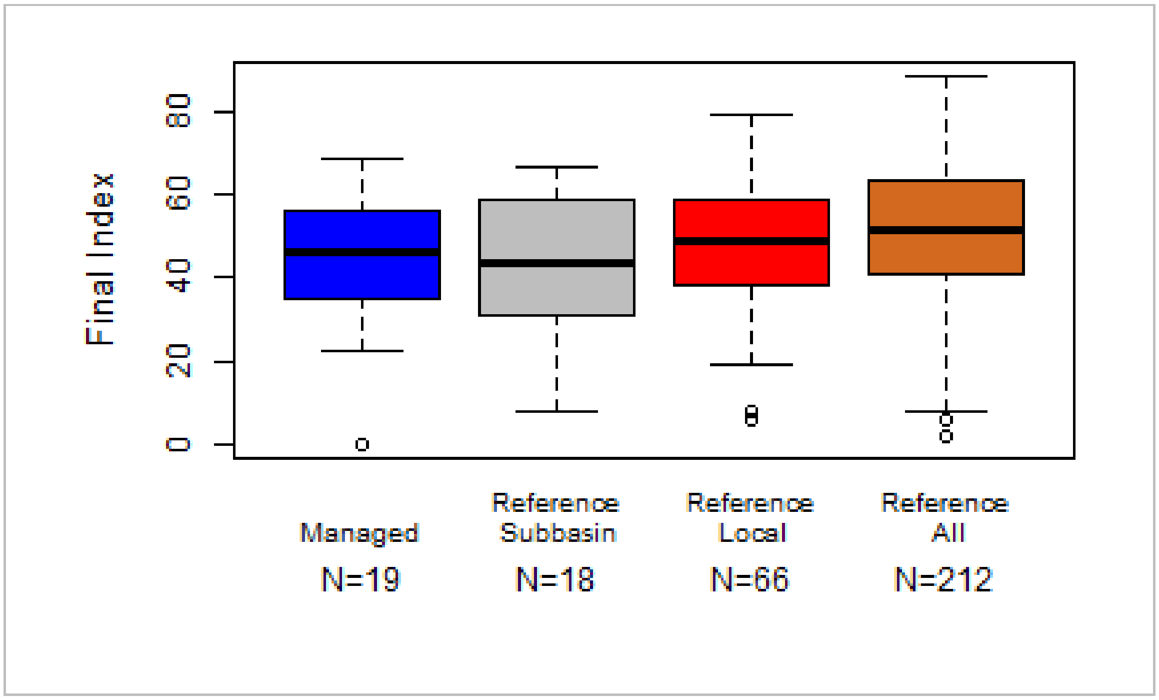

Figure 1-32. Summarized habitat index scores from managed reaches in the Salmon subbasins, compared to reference reaches in the Salmon subbasins, across the Nez Perce–Clearwater National Forests, and across the Interior Columbia River Basin

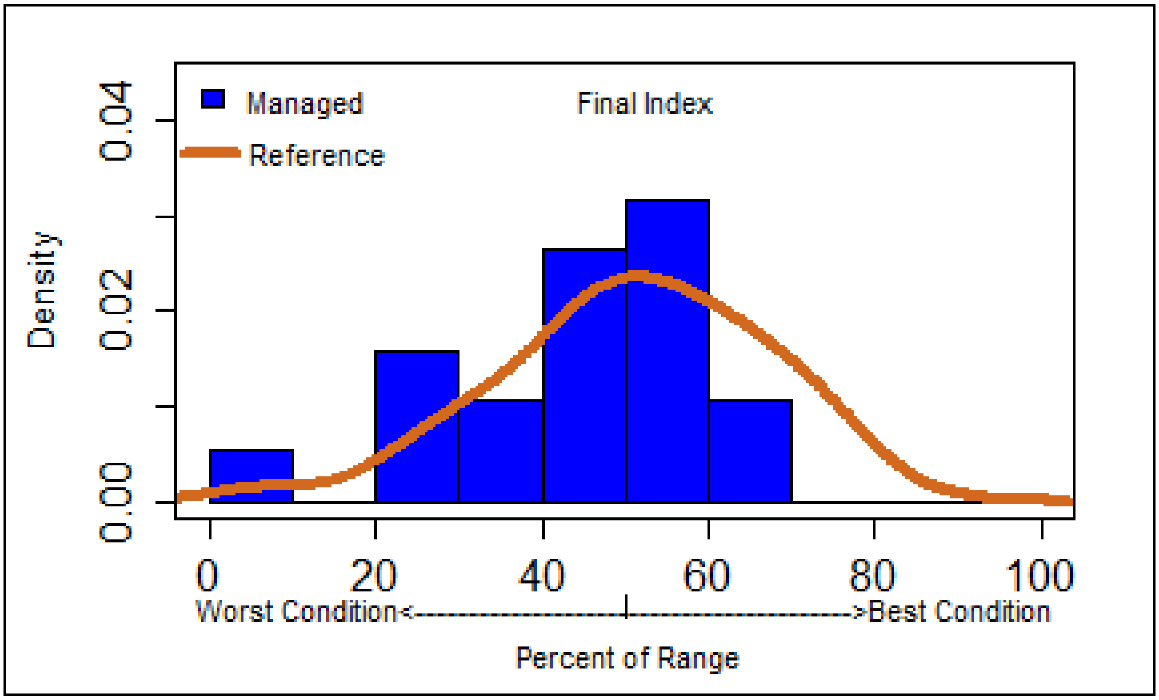

Figure 1-33. Final index summary of PACFISH/INFISH monitoring data showing relative conditions from managed sites, versus reference sites

Aquatic Biota

Streams in the Salmon subbasins provide spawning and rearing habitat for steelhead trout, spring/summer chinook salmon, interior redband trout, bull trout, and westslope cutthroat trout. The mainstem Salmon River supports spawning and rearing of fall chinook salmon and functions as a migration corridor for sockeye salmon, which spawn upriver in lakes at the headwaters of the Salmon River. Mountain whitefish are abundant in the river and lower reaches of most larger tributaries. White sturgeon are present in the river as well. Pacific lamprey ammocoetes (juveniles) have been documented in the river, and western pearlshell mussel are known to be present in the river and some of the larger tributaries.

Other species that are present in the Salmon River include largescale sucker, bridgelip sucker, northern pikeminnow, chiselmouth, longnose dace, speckled dace, smallmouth bass, and redside shiner.

Identification of Stronghold Watersheds:

Table 1-44. Population strongholds in the Lower Salmon, Lower Little Salmon, and Middle Salmon–Chamberlain subbasins

6th Field Hydrologic Code	Spring/Summer Chinook Stronghold	Steelhead Trout Stronghold	Bull Trout Stronghold	Westslope Cutthroat Stronghold	Potential Population Stronghold[a]
Upper Sabe Creek	X	X	X	X	
Lower Sabe Creek	X	X	X	X	
Upper Bargamin	X	X	X	X	
Middle Bargamin	X	X	X	X	
Lower Bargamin	X	X	X	X	
Big Mallard				X	
Sheep		X		X	
Lower Crooked Creek	X	X	X		
Wind River				X	
Rapid River—Copper	X	X	X		
West Fork Rapid River	X	X	X	X	
Lower Rapid River	X	X	X	X	
John Day Creek					X
Upper Little Slate					X
Middle Little Slate					X
Lower Little Slate					X
Skookumchuck Creek					X
Lower Slate Creek					X
North Fork White Bird					X
South Fork White Bird					X

[a] Potential population stronghold watersheds would have a high priority for aquatic restoration. These watersheds have been identified as currently degraded but have high inherent potential for one or more imperiled salmonid species.

1.3.3 *Status of Ecosystem Integrity—Trends and Drivers*

1.3.3.1 Trends

Trends in aquatic ecosystems were assessed using a combination of summarized stream survey data, Forest Plan monitoring data, and PIBO monitoring data. Since PACFISH and INFISH amended the Forest Plans in 1995[1], commercial timber harvest and road building in stream-adjacent riparian areas have declined substantially. The intent of PACFISH and INFISH was to protect existing quality anadromous and inland fish habitat and arrest habitat degradation on federal lands, thus allowing restoration of aquatic and riparian ecosystems to occur at natural rates. At a minimum, PACFISH and INFISH were intended to hold the line on habitat degradation over the short term until long-term, ecosystem-based restoration strategies could be developed to protect and restore anadromous fish-producing waters on lands within the Columbia River basin.

Both the Nez Perce and Clearwater National Forests implemented various watershed improvement activities beginning in the mid to late 1980s. These activities included direct stream improvements, as well as press sediment reduction in the form of road decommissioning. Currently, aquatic improvement activities generally include stream crossing upgrades, road decommissioning, road drainage improvements, and direct stream channel improvements in areas that were historically dredge mined. Fencing of riparian corridors and wet meadows has also been implemented to exclude cattle from riparian areas.

Substantial portions of many watersheds have burned in wildfires over the past 3 decades, most notably portions of the Lochsa, Middle Salmon–Chamberlain, Lower Salmon, and Upper Selway subbasins.

Information related to trends is summarized below by subbasin.

South Fork Clearwater Subbasin

As summarized previously, the South Fork Clearwater subbasin has experienced a long history of land management activities, some of which have resulted in degraded conditions. The most notable degraded watersheds include Newsome Creek, Red River, Meadow Creek (South Fork Clearwater), Crooked River, and to a lesser extent American River. In-channel dredge mining and moderate to high road densities, particularly in stream-adjacent riparian areas, were identified as the primary factors contributing to degraded habitat (USDA Forest Service 1998). The analysis of PIBO data collected throughout the subbasin indicated lower habitat complexity overall, compared to reference sites, as well as a shift in benthic macroinvertebrate assemblages that is indicative of degraded stream conditions.

In 2003, a watershed analysis was completed for Red River (USDA Forest Service 2003c), which is one of the most degraded 5th field HUC watersheds in the subbasin. Average decadal sediment yields were summarized at the 5th and 6th field HUC watershed scales. This summary illustrated the developmental history of the watershed, particularly the effects of

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[1] Background information regarding the amending of Forest Plans in the Interior Columbia River Basin with PACFISH and INFISH can be found here: http://www.fs.usda.gov/detail/r6/landmanagement/resourcemanagement/?cid=fsbdev2_027084

road construction and timber harvest. Because of excessively degraded sediment conditions documented in the early to mid-1980s, the previous forest planning effort suspended additional sediment-producing activities (e.g., timber harvest) in a number of subwatersheds until monitoring data showed that stream habitat in these watersheds met desired conditions. Therefore, timber harvest and road construction did not occur between 1993 and 2005. Harvest after 2005 adhered to PACFISH standards and guidelines, and road construction was limited to temporary roads only.

A comparison of sediment conditions in Red River and 2 streams considered to support reference conditions was made in the 2003 watershed analysis. The 2 reference streams were Bargamin Creek (tributary to the Salmon River) and Meadow Creek (tributary to the Selway River). Although these streams are located in different subbasins, the data used for comparisons came from reaches with similar geology, channel characteristics (e.g., gradient), and landform. Figure 1-34 and Figure 1-35 illustrate the results.

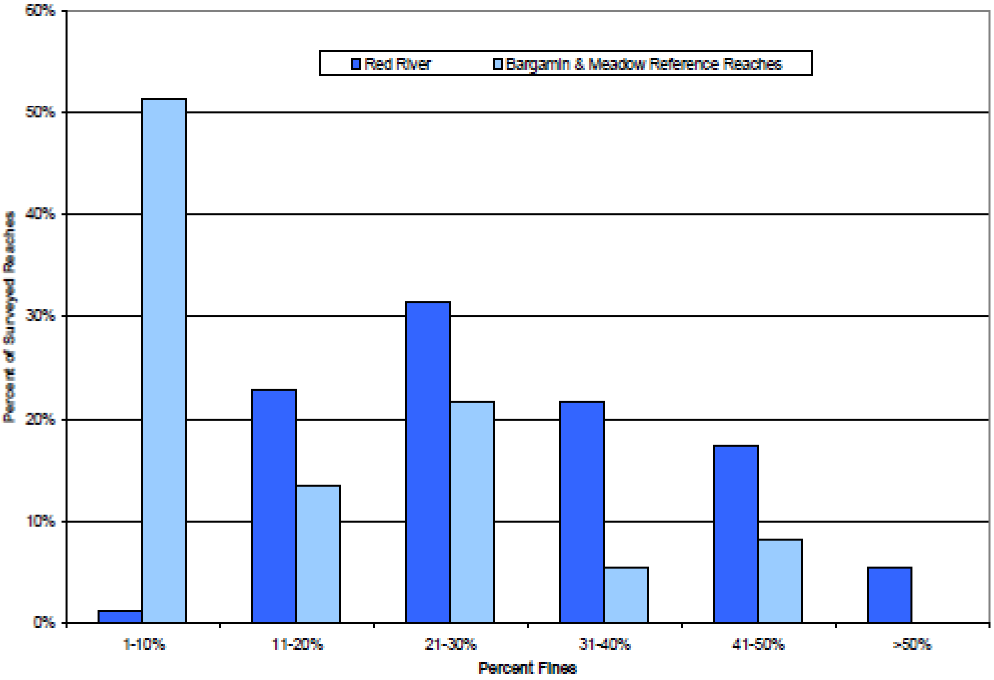

Figure 1-34. Comparison of percent surface fines in surveyed reaches in Red River and reference reaches, showing percent of surveyed reaches in each percent fine category

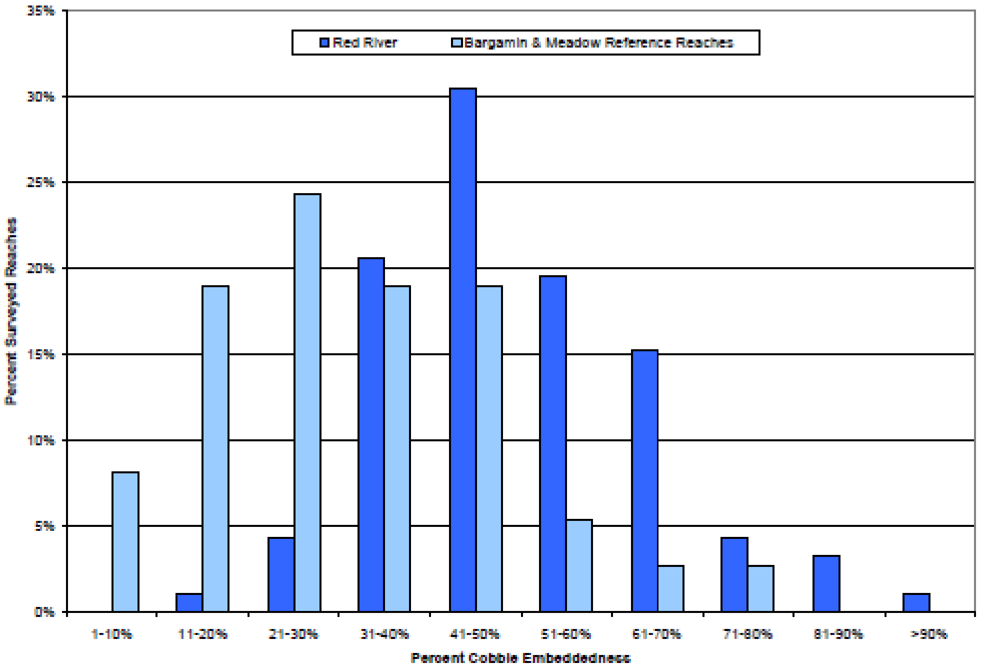

Figure 1-35. Comparison of percent cobble embeddedness in surveyed reaches in Red River and reference watersheds

These data show that, at the time this analysis was conducted (early 2000s), Red River had more reaches with high percent surface fines and high percent cobble embeddedness than Bargamin and Meadow creeks did. These data helped establish a correlation between roaded development and deposited sediment, similar to relationships between road density and stream conditions described in published literature (Furniss et al. 1991; Rhodes et al. 1994; Sedell et al. 1997; Lee et al. 1997; Gucinsky et al. 2001; Luce and Black 1999; Baxter et al. 1999; Jones et al. 2000). High road density is correlated with varying degrees of degraded fish habitat, using indicators such as cobble embeddedness, percent surface fines, width:depth ratio, stream temperature, amount of large woody debris, and number of pools (Sedell et al. 1997).

In addition, Forest Plan monitoring stations were established in the late 1980s in Red River, Newsome Creek, and Crooked River (all 5th field HUC watersheds in the upper portion of the subbasin, heavily degraded by dredge mining or a combination of dredge mining and moderate to high road density). Cobble embeddedness was measured at these sites in randomly selected areas, starting in 1988, with the most recent measurements in 2013. Results are displayed below in Table 1-45. Cobble embeddedness levels less than 30% are generally considered desirable for fish production (i.e., spawning and rearing) in Idaho Batholith watersheds, and levels less than 20% are ideal for fish production.

Table 1-45. Percent cobble embeddedness for Main Red River, Johns Creek, Newsome Creek, and Crooked River Forest Plan monitoring sites, 1988–2012 (sample size n = 10–15 hoops sampled at each site for each year's sampling)

Site	1987	1988	1989	1990	1993	1994	2002	2012/13
Crooked River		40		69		36		16
Upper Main Red River		59	75	50		78	45	35
Main Red River				66		54	67	26
Upper Newsome		49		79		51		32
Lower Newsome		45		62	55	29		19
Johns Creek (reference)	25	22	31	21	26			24

These data show high percent cobble embeddedness through the 1990s and suggest improved conditions in 2012/13, compared to preceding years. In the case of Crooked River, the upper reaches of West Fork Crooked River were burned by wildfires in 2007 and 2012, in some areas severely, and limited timber harvest and temporary road construction occurred; however, this level of disturbance does not appear to have resulted in high levels of deposited sediment downstream, which are expected following a fire. Improving conditions at the Upper Main Red River and Main Red River sites are thought to have resulted from a cessation of major ground-disturbing activities and from extensive aquatic restoration in the form of road decommissioning in Upper Red River in the mid-2000s.

The Johns Creek site is located near the mouth and represents the closest data set available to assess trend in a reference reach in the South Fork Clearwater subbasin. Although portions of Johns Creek have been managed, the majority of the watershed has not. Repeated sampling since 1987 has shown no evident trend in cobble embeddedness, suggesting that substrate conditions at that site have remained static since the last planning effort. In contrast, data from the managed sites indicate a reduction in cobble embeddedness at every site. These data suggest that improvement in substrate conditions in managed watersheds has occurred in the South Fork Clearwater subbasin.

Trends in stream conditions were assessed in the PIBO data analysis for the South Fork Clearwater subbasin as well. The findings of this analysis corroborate trends suggested by cobble embeddedness sampling at Forest Plan monitoring sites. In summary, despite lower-than-expected values for habitat condition, all aspects of habitat condition either remained constant or improved between the first time the site was sampled by PIBO (late 1990s) and the last time (2010 or 2011). For instance, pool tail fines decreased at a significant number of sites, and residual pool depth increased at a significant number of sites. Significant increases in median streambed substrate size (D_{50}) and percent of the stream with undercut banks were also observed. However, no significant change in large wood frequency, bank angle, pool percent, or bank stability was observed.

Improved conditions likely represent a combination of active and passive restoration within the basin. At reference sites, no significant changes were noted in any aspects of habitat condition. Static conditions at these sites, when compared to improving conditions at managed sites, suggest that active restoration, along with reduction or cessation of large-scale disturbances since the last forest planning period, has allowed for recovery of degraded reaches in this subbasin.

Lower Clearwater/Middle Fork Clearwater/Palouse/Hangman

Some long-term monitoring data are available for these subbasins in some 5th field HUCs. These data are summarized in Forest Plan monitoring reports produced by the Clearwater National Forest from the 1990s through 2009.

Monitoring of stream substrate conditions has been conducted in the Potlatch and Little Sand (Palouse subbasin) drainages, in the form of Wolman pebble counts. These data are summarized in Table 1-46 through Table 1-48.

Table 1-46. East Fork Potlatch River summarized Wolman pebble count data

Year	% Fine Sediment 0–2 mm	% Fine Sediment 0–4mm	D_{50} in mm	D_{84} in mm
1997	17.7	19.5	48 (Very Coarse Gravel)	254 (Large Cobble)
2004	18.5	20.0	40 (Very Coarse Gravel)	167 (Small Cobble)
2009	16.6	18.0	34 (Very Coarse Gravel)	128 (Small Cobble)
Mean	17.77	19.03	41 (Very Coarse Gravel)	183 (Large Cobble)

Source: USDA Forest Service 2009

Table 1-47. Little Boulder Creek (Potlatch River) summarized Wolman pebble count data

Year	% Fine Sediment 0–2 mm	% Fine Sediment 0–4mm	D_{50} in mm	D_{84} in mm
1994	33.4	36.9	36 (Very Coarse Gravel)	157 (Small Cobble)
1997	28.7	30.3	52 (Very Coarse Gravel)	220 (Large Cobble)
2004	33.5	34.1	58 (Very Coarse Gravel)	220 (Large Cobble)
2009	42.0	43.0	19 (Medium Gravel)	161 (Small Cobble)
Mean	34.4	36.08	41 (Very Coarse Gravel)	190 (Large Cobble)

Source: USDA Forest Service 2009

Table 1-48. Little Sand Creek (Palouse River) summarized Wolman pebble count data

Year	% Fine Sediment 0-2 mm	% Fine Sediment 0-4mm	D_{50} in mm	D_{84} in mm
2004	24.6	25.7	24 (Medium Gravel)	104 (Small Cobble)
2009	29.8	31.2	13 (Medium Gravel)	94 (Small Cobble)
Mean	27.2	28.45	19 (Medium Gravel)	99 (Small Cobble)

None of these data for monitored areas indicate desired conditions are being met for percent surface fines in spawning and rearing habitats (generally less than 10% for both the 2 mm and 4 mm categories). Data collected in Little Boulder Creek indicate that percent surface fines has increased from all previous years when it was measured, starting in 1994. Other than that, no discernible trend is evident for the monitored reaches.

In the Orofino Creek watershed on National Forest lands, the only instream monitoring conducted has been for stream temperature. This monitoring indicated that stream temperatures exceeded desirable levels (less than 16 °C) for extended periods in the mid-to-late summer. In the Potlatch River watershed, riparian improvements to address effects from cattle grazing, including construction and maintenance of riparian fences, were implemented in the mid to late 2000s, and these changes have resulted in improved riparian conditions. Improved riparian conditions may result in improved stream temperature conditions.

The Potlatch River and Orofino Creek watersheds have not experienced any landscape-scale disturbances in the past 10 years on National Forest lands.

Due to the lack of large-scale disturbances in these watersheds, stream habitat conditions on National Forest lands are assumed to have been mostly static in the past 20 years.

In Lolo Creek, long-term monitoring of fish population abundance has occurred, but long-term habitat monitoring sites have not been established (other than PIBO sites; data discussed below). Stream surveys conducted over the past 20 years suggest that habitat conditions, particularly substrate conditions, have remained static. Cobble embeddedness levels have remained high, averaging about 41%, with many individual sites much higher. In 1993, stream surveys conducted in Lolo Creek suggested a mean cobble embeddedness of 46%, which was a composite estimate based on observations throughout many reaches. In 2013, cobble embeddedness was measured at 7 sites in the Lolo watershed, including 2 in mainstem Lolo Creek. Mean cobble embeddedness ranged from 27% to 56%, with all sites but 1 exceeding 30%, and 4 sites at 40% or greater. Fifteen measurements were taken at each site.

In the Middle Fork Clearwater subbasin, no long-term monitoring sites have been established (other than PIBO sites; data discussed below). The principal tributary to the Middle Fork Clearwater River is Clear Creek, which is comprised of about 65,000 acres and supports spawning and rearing for anadromous and resident fish, as well as other aquatic organisms. Stream habitat trend data are not available, but the watershed has been degraded by timber harvest, road construction, development on private lands, and removal of large woody debris from streams (USDA Forest Service 2001). These activities collectively resulted in changes to the historic hydrologic regimes and sediment processes, as well as increased habitat simplification from increased sediment deposition and loss of pool habitat.

Recent data related to deposited sediment were collected at several sites in the Clear Creek watershed on National Forest lands in 2012. Mean cobble embeddedness in mainstem Clear Creek plus several tributaries ranged from 31% in one tributary to 55% in mainstem Clear Creek (USDA Forest Service 2012). These levels are generally higher than desired for fish production and probably higher than historic conditions.

PIBO monitoring data were collected at sites across the Lower Clearwater, Middle Fork Clearwater, and Palouse subbasins and analyzed in 2013. As previously discussed, differences in stream conditions at managed sites and reference sites were primarily related to substrate (i.e., high levels of deposited sediment). Composition of macroinvertebrates was consistent with degraded habitat conditions. Assessment of trend suggested that most measures of habitat condition at managed sites did not change significantly during the period of the study (1999–2012). Exceptions included a significant increase in bank angle (which is indicative of worse condition) and a significant increase in wood frequency (which is indicative of better condition). Trend analysis of substrate conditions corroborates conclusions in the previous discussion; namely, substrate conditions in the Lower Clearwater, Middle Fork Clearwater, and Palouse subbasins are generally static, with levels of deposited sediment higher than levels in reference sites.

Selway River—Upper and Lower

The Nez Perce–Clearwater National Forests administer a portion of the Upper Selway subbasin (upper reaches are administered by the Bitterroot National Forest) and nearly all of the Lower Selway subbasin. As previously discussed, a substantial portion of the acreage in the Selway is within designated wilderness or is roadless. Large areas in both subbasins have been affected by wildfires in the past century and within the past 20 years, and in some cases repeatedly.

Stream survey data from wilderness area streams do not suggest pervasive degradation, however (USDA Forest Service 2001). Summarized reach data from basinwide stream surveys conducted in the 1990s in tributaries to the main river (Three Links Creek, Ditch Creek, and Wounded Doe Creek) indicate very low levels of deposited sediment, with mean cobble embeddedness less than 20% in the vast majority of surveyed reaches (*Nez Perce National Forest unpublished data summaries, 1992–1998).* Three Links Creek and Ditch Creek experienced large wildfires in the 1930s, and Wounded Doe Creek had most recently burned 2 years prior to the survey being conducted. Other habitat indicators, such as large woody debris and number of pools, were more variable. Wounded Doe Creek in particular exhibited high levels of large woody debris.

Repeated observations of Bear Creek, a large watershed in the Upper Selway subbasin that has burned at least 3 times since 1987, indicated low levels of deposited sediment, despite a history of landslides that occurred after the fire events. These levels may be due to high stream energy that is sufficient to move introduced sediment downstream. Observations also included the formation of large debris jams in mainstem Bear Creek that have become larger every year since the 1988 fire.

High-severity fires occurred in the Upper Selway in the mid-1990s and early 2000s. Post-fire monitoring conducted by Bitterroot National Forest personnel in the early 2000s indicated either no effects or short-term effects to fish and habitat; long-term increases in large woody debris recruitment, number of pools, and habitat complexity were also found, as well as higher densities of fish than were observed prior to the fires (Jakober 2002). In post-fire monitoring conducted by Nez Perce National Forest personnel in the early 1990s in East Moose Creek, short-term increases in deposited sediment were noted. However, over the long term, reductions in deposited sediment occurred; these reductions, coupled with increased large woody debris recruitment and resulting habitat complexity, may have caused an increase in stream productivity (Green and Gerhardt 1991; K. Thompson, Forest Service, pers. obs. 2004).

Timber harvest, road construction, domestic livestock grazing, and instream activities have occurred in watersheds in the Lower Selway subbasin over the past 50 years. Streams exhibit degraded conditions in some reaches, primarily related to increases in sediment yield, landslides, and deposited sediment (Nez Perce National Forest unpublished data summaries*).* Some stream and watershed restoration activities were conducted in the late 1980s through the early 2000s, mostly in the O’Hara and Goddard watersheds. These activities included instream structures, road decommissioning, and riparian planting.

Monitoring of stream conditions has been conducted in the Lower Selway subbasin. Forest Plan monitoring stations were established in Gedney Creek, O’Hara Creek, and Meadow Creek. Cobble embeddedness was most recently measured at these sites in 2012 and 2013.

The Gedney Creek and Meadow Creek sites are considered reference sites because they are largely roadless. Data are depicted below in Table 1-49.

Table 1-49. Cobble embeddedness data from 4 sites in the Lower Selway subbasin (sample size n = 10–15 hoops sampled at each site for each year's sampling)

Site	1988	1989	1990	1991	2012/20013
Gedney (reference)		27	33	28	6
Meadow Creek (upper)		28			28
Meadow Creek (lower)		33	43	27	19
O'Hara	29		65	29	25

Substrate monitoring data in the Lower Selway are somewhat limited, both in terms of sites and years the sites were visited. For the Gedney site, collection of meaningful cobble embeddedness data in 2012 was somewhat limited due to a preponderance of boulders at the site. Additional monitoring is needed in this stream and others.

Stream data were also collected for O'Hara Creek in 2005. Higher levels of cobble embeddedness were indicated in this survey, averaging 38% in mainstem O'Hara, 41% in West Fork O'Hara, and 53% in Hamby Fork. These measurements were taken at multiple locations in each stream.

PIBO monitoring data collected from sites in the Upper and Lower Selway subbasins were analyzed in 2013. As previously discussed, residual pool depth, pool percent, D_{50}, and percent fines all exhibited generally worse condition than reference sites. For all metrics except for percent fines, measures of habitat condition at managed sites remained the same during the study time frame. For percent fines, in all of the 7 sites that were assessed, an increase between the first and last sampling period was indicated. In the reference sites, a significant increase in bank stability was indicated, but no significant changes occurred in the other measures of habitat condition.

North Fork Clearwater—Upper and Lower

The Nez Perce–Clearwater National Forests administer a substantial portion of the Lower North Fork Clearwater subbasin and nearly all the Upper North Fork Clearwater subbasin. Although portions of the Lower North Fork Clearwater have been heavily managed, including lands administered by the Forest Service and those in private ownership, much of the Upper North Fork Clearwater remains roadless and undeveloped. As previously discussed, except for the very lowest reach, the North Fork Clearwater River and tributaries are no longer accessible to upstream migrating fluvial and anadromous fish, as all upstream passage is blocked by Dworshak Dam.

Long-term monitoring data of stream conditions established since the last forest planning effort across the subbasins are not available, although site-specific data have been collected in many areas. Observations made in 2009 suggest habitat conditions in the subbasins are static and have not changed substantially since 1998 (USDA Forest Service 2009).

PIBO monitoring conducted in the North Fork Clearwater subbasins from 1999 to the present indicates that most individual aspects of habitat condition in managed sites of the North Fork Clearwater are either static or improving. Significant increases in macroinvertebrate indices, bank stability, and D_{50} were noted. Pool percent was the only measure of habitat condition that showed a significant decrease. The remaining measures did not change significantly. In the reference sites, a significant positive change in bank stability was noted, but no other aspects of condition changed significantly. These results suggest that habitat degraded by previous management actions may be improving, except for pools.

Lochsa Subbasin

The Nez Perce–Clearwater National Forests administer a substantial portion of this subbasin. However, the upper third of the subbasin includes a checkerboard of private ownership.

Substrate monitoring has been conducted in the Lochsa subbasin over 22 years in Pete King and Deadman creeks (both watersheds have relatively high road densities and a history of disturbance). The monitoring involved core sampling in spawning habitat. Summaries of these data are displayed in Figure 1-36 and Figure 1-37 below.

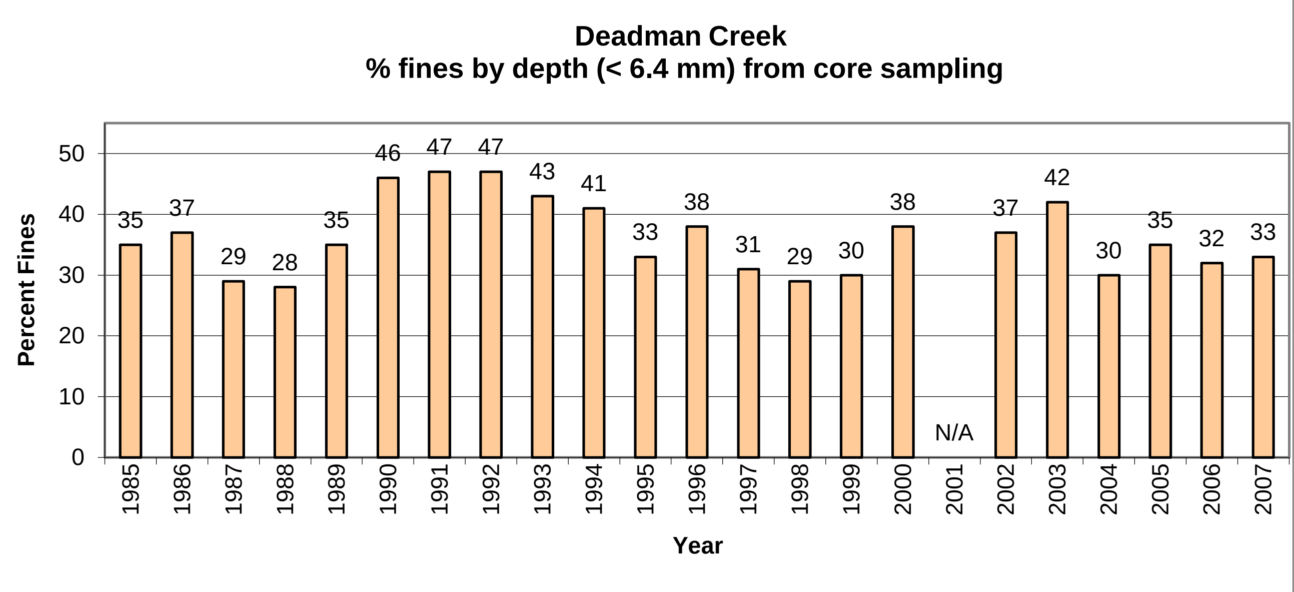

Figure 1-36. Comparison of average percent fines (<6.4 mm) for 1985–2007 at permanent substrate monitoring sites in Lower Deadman Creek

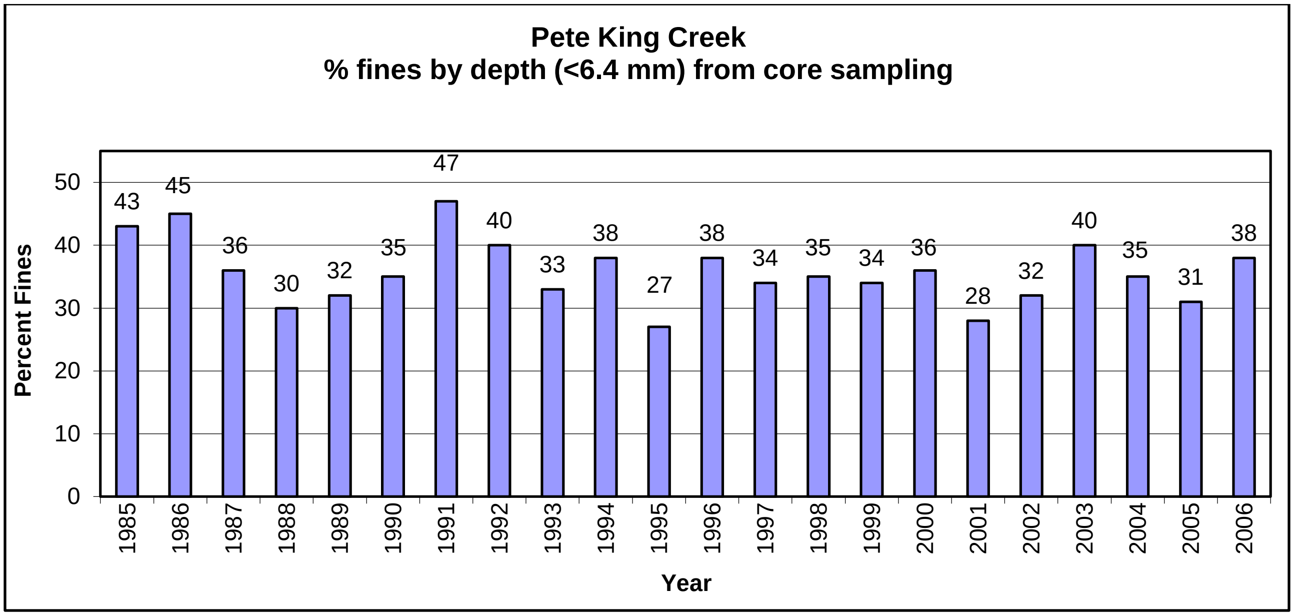

Figure 1-37. Comparison of average percent fines by depth (<6.4 mm) for 1985–2006 at permanent substrate monitoring sites in Lower Pete King Creek

Additional substrate monitoring data are needed.

In other watersheds, observations suggest that habitat conditions in the subbasins are static and have not changed substantially since 1998 (USDA Forest Service 2009).

PIBO monitoring conducted in the Lochsa subbasin indicates that individual aspects of habitat condition in managed sites are either staying the same or improving. Significant increases in large wood frequency, significant decreases in bank angle, and significant increases in percent undercut bank were noted. No significant changes in pool fines <6mm, pool percent, D_{50}, or bank stability were evident, however. In the reference sites, a significant increase in large wood frequency was indicated, but other habitat conditions were static. Increases in large woody debris were noted at all PIBO sites across the subbasin.

In addition to PIBO monitoring, counts of large woody debris in several watersheds were conducted by the Nez Perce Tribe from 2011 to 2013, in reaches with stream-adjacent roads and in reaches without (Christian and Johnson 2014). Comparison of these data indicated that more woody debris was present in stream reaches without stream-adjacent roads than in reaches with a road; this result would be expected given that a road on one side of the stream effectively removes at least half of the woody debris available to fall into the stream. Further, in reaches without a stream-adjacent road, more of the debris was in the form of large debris jams, which better represent natural conditions and are more likely to remain in stream channels over time.

Middle Salmon–Chamberlain, Lower Salmon, Lower Little Salmon Subbasins

The Nez Perce–Clearwater National Forests administer relatively small portions of these 3 subbasins, even though substantial amounts of subbasin acreage are included on the Forests. In the case of the Lower Salmon, most of the acreage is downriver from the Forests boundary. Where Forest Service lands occur, there is mixed ownership, including private, BLM, and State of Idaho administered lands. In the case of the Lower Little Salmon, the

Forests administer a large portion of the Rapid River drainage. In the Middle Salmon–Chamberlain, the Forests administer the north side of the Salmon River only, with the Payette National Forest administering the other side.

Long-term Forest Plan monitoring sites have been established within the Slate Creek and White Bird drainages (Lower Salmon tributaries). Substrate measurements were most recently taken from the 2 sites in Slate Creek. Data are summarized in Table 1-50.

Table 1-50. Mean cobble embeddedness (%) from Forest Plan monitoring sites in the Lower Salmon subbasin, 1988–2012 (sample size n = 10–15 hoops sampled each year)

Site	1988	1989	1990	1993	1994	1995	2012
Little Slate Creek	21	38	38	45	64	55	27
North Fork Slate Creek	30	30		27	36		23

These data suggest substrate conditions have improved in Slate Creek since the early to mid-1990s. These results are consistent with those from other Forest Plan monitoring sites on the Nez Perce National Forest, indicating an improvement in substrate conditions at most, if not all, managed sites established during the previous forest planning effort.

PIBO monitoring conducted on the Forests' portions of the Middle Salmon–Chamberlain, Lower Little Salmon, and Lower Salmon subbasins indicated that most habitat attributes at managed sites did not change significantly during the period of the study. Bank stability, however, exhibited a significant increase during the period of the study, while pool percent exhibited a significant decrease.

Summary of Trends, Including PIBO Monitoring

The information presented in previous sections suggests that improving trends in some watersheds have occurred since the last forest planning effort (1987), particularly trends related to sediment, but stream conditions in other watersheds have not improved.

Espinosa et al. (1997) concluded that the previous planning effort and implementation of best management practices (BMPs) for the Clearwater National Forest failed to result in improved conditions in some of its most degraded watersheds, including Lolo, Eldorado, and Pete King creeks. Substrate data collected in Pete King Creek since the mid-1990s do not suggest that sediment conditions have improved (Figure 1-37), despite watershed improvement activities and the absence of landscape-scale disturbances. Cobble embeddedness measurements taken in 2013 in mainstem Lolo Creek do not suggest improved substrate conditions in this watershed.

PIBO monitoring data for the Lower Clearwater subbasin from 1999 through 2012, including Lolo and Eldorado creeks, also indicated that trends are static. Data indicated that D_{50} and percent pool tail fines, both indicators of substrate condition, remain in a poor condition, compared to reference sites, and that macroinvertebrate diversity is generally worse than in reference reaches on the Forests and across the Interior Columbia River Basin. Although data from Lolo and Eldorado creeks were grouped with data from the Palouse and Middle Fork Clearwater subbasins, the data from sites in Lolo and Eldorado creeks do not suggest a departure from these overall conclusions.

PIBO monitoring data from the North Fork Clearwater and Lochsa subbasins, conversely, suggest some habitat attributes may have improved during the study period (1999–2012). However, trends in substrate conditions measured by the PIBO protocol appear to be static.

In the South Fork Clearwater subbasin, an improving trend is suggested by Forest Plan monitoring substrate data, specifically cobble embeddedness measured in managed watersheds. At all managed sites sampled in 2012, decreases in cobble embeddedness were evident when the data were compared to measurements taken in the late 1980s and early 1990s. Most notable among these decreases were sites in Red River and Newsome Creek, which had moratoriums on additional sediment-producing activities (e.g., timber sales) until the sites had recovered to desired conditions established in the last planning effort. Logic suggests that cessation of large-scale development, along with watershed restoration activities initiated in the early 1990s and continuing through 2012 (especially those associated with removal of chronic sediment sources), resulted in improved substrate conditions.

PIBO monitoring data from the South Fork Clearwater subbasin also indicate improving trends in stream conditions; however, similar to substrate conditions, stream conditions at managed sites are worse than conditions at reference sites.

In the Upper Selway subbasin and most of the Lower Selway subbasin, PIBO data indicate static trends in stream habitat conditions, despite many large-scale disturbances since the last planning effort (wildfires and rain-on-snow flood events in the winter of 1995–1996). Stream conditions in these areas are comparable to other reference reaches throughout the Interior Columbia River Basin. Post-fire monitoring data and observations of burned stream reaches in the Upper and Lower Selway do not indicate long-term increases in deposited sediment have occurred as the result of wildfires. In the managed section of the Lower Selway, however, conditions appear to have been on a declining trend during the study period (1999–2012), particularly those associated with substrate; residual pool depth, pool percent, D_{50}, and percent fines all exhibited generally worse condition than reference sites.

Data from the Forest Plan monitoring sites suggest moderate decreases in cobble embeddedness at 3 of 4 sites since the early 1990s, which is not consistent with PIBO trends related to substrate. This inconsistency may be the result of the small number of sites sampled. Additional data are needed from a greater number of sites before conclusions can be made regarding substrate trends in managed watersheds in the Lower Selway.

In the Salmon River subbasins, Forest Plan monitoring station data suggest substrate conditions may have improved at 2 sites between the early to mid-1990s and 2012. Both sites are located in the Slate Creek drainage (Lower Salmon subbasin). Portions of Slate Creek have been heavily managed in the past, particularly Little Slate Creek. PIBO monitoring data from all the Salmon River subbasins currently administered by the Nez Perce–Clearwater National Forests suggest trends are static, although they are highly variable among sites, particularly the trend for substrate metrics. High variability was suggested in both managed and reference sites.

1.3.3.2 **Drivers**

- Roads
- Floods/landslides

- Wildfires
- Climate change

Roads

The most notable alteration of upland and riparian conditions that has influenced stream process and function across the Nez Perce–Clearwater National Forests is road development (USDA Forest Service 1998, 2001, 2003a,c; 1999b; Ecovista 2003). Road development has been correlated to instream conditions, including substrate composition, large woody debris, and number and quality of pools on both the Clearwater National Forest and the Nez Perce National Forest (USDA Forest Service 2003a; Huntington 1995). High levels of deposited substrate sediment and simplified habitat conditions are correlated with roaded development in watersheds, particularly in riparian areas. System roads cover an estimated 2,400 acres (600 road miles) within RCAs on the Nez Perce National Forest and an estimated 4,000 acres (1,000 road miles) within RCAs on the Clearwater National Forest. Recovery potential is limited as long as the road prism continues to exist on the landscape, although site-specific improvements can be made to reduce effects, particularly those associated with streamside roads and stream crossings.

The specific effects of road development on watershed condition and its correlation to instream habitat, particularly deposited sediment, are well described in the literature. As described in Furniss et al. (1991), construction of roads and road networks can lead to greatly accelerated erosion rates in watersheds, and increased sedimentation in streams following road construction can be dramatic and long lasting (Haupt 1959; Swanson and Dyrness 1975; Beschta 1978; Gardner 1979; Reid and Dunne 1984). Surface erosion from road surfaces, cut banks, and ditches represents a significant source (and in some landscapes, the dominant source) of road-related sediment input to streams (Gucinski et al. 2001). Increased sediment delivery to streams after road building has been well documented in the research literature for the Pacific Northwest and Idaho (Bilby et al. 1989; Megahan and Kidd 1972; Reid and Dunne 1984; Rothacher 1971; Sullivan and Duncan 1981). The negative effects of roads on physical instream habitat and aquatic biota have been summarized in a comprehensive review in Trombulak and Frissell (2000).

Also well described are correlations between population strongholds of at-risk salmonids and roadless and wilderness areas. Across the Interior Columbia River Basin, many of the population strongholds for at-risk species occurred in areas of low road density; the higher the road density, the lower the proportion of subwatersheds that support strong populations of key salmonids (Lee at al. 1997). Empirical analysis of 3,327 combinations of known species' status and subwatershed conditions across the Interior Columbia River Basin indicated that at-risk salmonids were less likely to use moderate to highly roaded areas for spawning and rearing, and if they were found in those areas, these fish were less likely to be at strong population levels (Lee et al. 1997). More locally, Huntington (1995) found that habitat and salmonid abundance differed in managed and unroaded landscapes on the Clearwater National Forest; these findings, particularly the relationship between deposited sediment and distribution and abundance of salmonids, are consistent with the findings of Lee et al. (1997).

Similarly, in an assessment of water quality and habitat conditions in the Lochsa subbasin, which was completed for the Idaho Department of Environmental Quality, Bugosh (1999) found higher levels of cobble embeddedness in streams in roaded watersheds than in streams in watersheds without roads, although differences were most notable in steeper stream channels.

Rhodes et al. (1994) concluded that the best water quality and habitat conditions for salmon exist in roadless/wilderness areas and that roadless and wilderness areas provide the only high-quality habitats and islands of natural functioning systems left in the entire Snake River basin. In a status review of westslope cutthroat trout, Shepard et al. (2005) concluded that the strongest populations with highest genetic integrity were associated with areas of low roaded development.

Stream channel and riparian conditions have changed in areas of human development, with the most significant effects associated with in-channel dredge mining that occurred in tributaries to the upper South Fork Clearwater River and in the South Fork Clearwater River itself, over an estimated total stream length of 30 miles. Areas within the Lolo Creek drainage, the Florence Basin (Slate Creek), and Upper Crooked Creek, along with specific sites in the North Fork Clearwater and Palouse subbasins, have been affected by past in-channel mining as well.

Other factors that have affected riparian and stream conditions include campground facilities, administrative sites, dispersed recreation adjacent to streams, timber harvest, livestock grazing, and trail use and construction.

All subbasins across the planning area include habitat with high to very high potential to support diverse aquatic species assemblages and at-risk fish species, including those currently listed under the Endangered Species Act (ESA). However, the distribution of areas where human disturbances are minimal is patchy and located at higher elevations, where access is difficult and roaded development has not occurred. At the mid to lower elevations, a majority of stream reaches, including those critical to spawning by large anadromous fish, have been affected by streamside road development and other activities such as mining and livestock grazing. Many mainstem river reaches are temperature limited in the summer. Therefore, condition of downstream reaches may limit connectivity of higher-elevation stronghold reaches, even where the physical connections are intact. Lack of connectivity has been identified as a limiting factor for both anadromous and resident trout species, including bull trout and westslope cutthroat trout (USDA Forest Service 1998).

Floods/Landslides

Floods, landslides, and debris torrents are natural events, often associated with wildfires, which are included in the disturbance regimes of many stream reaches on the Nez Perce–Clearwater National Forests. Although the short-term effects may be deleterious, particularly in streams already degraded, some stream systems may be dependent on these events to sort gravels, create spawning habitat for salmonids, and recruit large amounts of woody debris (in a pulse event), all of which can increase habitat complexity and productivity over the long term (Reeves et al. 1995; Beechie and Bolton 1999).

The most recent event that affected streams in many watersheds across the Forests occurred in the winter of 1996–1997. It included a series of rain-on-snow and high precipitation events. Areas within the Selway, Lochsa, and Lower Clearwater basins—and most notably, low-elevation portions of the North Fork Clearwater Basin—were most affected, resulting in a series of mass failure events in both natural landscapes and those with roads and timber harvest units.

Wildfire

Wildfire historically has been a primary driver of stream habitat conditions and trends across the Nez Perce–Clearwater National Forests and is currently a primary disturbance agent on the landscape. The effects of wildfire on riparian and stream conditions in the Pacific Northwest are well described in the literature (see discussion below). Like floods and landslides, fire plays an important role in structuring aquatic ecosystems (Bisson et al. 2003).

Fire Effects to Riparian Areas

Fire regimes in riparian areas are generally different from upland regimes. Fire in riparian areas tends to be less frequent and of lower intensity than fire in surrounding uplands (Pettit and Naiman 2007; Dwire and Kauffman 2003), but longer fire intervals may result in greater accumulation of fuels and consequently high fire severity if the riparian area burns under extreme conditions (Russell and McBride 2001; Everett et al. 2003). Agee (1998) observed a riparian zone in a high-elevation tributary to the Salmon River that burned at higher severity than surrounding uplands on the Payette National Forest and surmised that fuels in riparian zones had accumulated at a higher rate due to less frequent fire, compared to the uplands that burned at lower severity. Others, however, have observed that fire severity in riparian areas depends on upland severity (Halofsky and Hibbs 2008; Arkle and Pilliod 2010) or other factors unrelated to fuel type and distribution, such as landform features (Everett et al. 2003; Moore and Richardson 2012). Halofsky and Hibbs (2008) concluded that high fire severity in riparian areas in southwest and central Oregon was strongly associated with high fire severity in the adjacent uplands and steep slope gradients.

Within the Nez Perce–Clearwater National Forests, a substantial amount of acreage has been burned by wildfires since the last planning effort, particularly in tributaries to the Salmon River. Fire events culminated in the summer of 2007, when a combined acreage of more than 250,000 acres burned over a period of 3 months, starting in mid-July. Substantial acreage burned in 2001 and 2005 in the Lochsa, Selway, South Fork Clearwater, Lower Salmon, and Middle Salmon–Chamberlain subbasins as well. In September 2012, late-season ignitions resulted in over 80,000 acres burned in tributaries to the Lower Salmon, Middle Salmon–Chamberlain, South Fork Clearwater, and Lochsa subbasins.

To assess how wildfires have affected riparian areas on the Forests under extreme fire conditions, a subset of the largest fires was selected from the 2007, 2012, and 2013 fire seasons. Fire severity within streamside RCAs was estimated using Burned Area Reflective Classification (BARC) satellite imagery mapping, subsequently refined by field observations. Acres of high, moderate, and low severity and unburned acres within RCAs were summarized for each fire to provide a gross estimate of the percentage within each category. The results of this analysis are displayed in Table 1-51.

Table 1-51. Acres of high, moderate, and low severity and unburned acres within riparian conservation areas by fire

Fire Name	Year	Subbasin	Unburned (acres)	Unburned (%)	Low (acres)	Low (%)	Moderate (acres)	Moderate (%)	High (acres)	High (%)
Rattlesnake	2007	Middle Salmon, South Fork Clearwater	1,311	11	5,360	43	4,238	34	1,434	12
Poe Cabin	2007	Lower Salmon, Snake	2,624	11	16,712	69	3,189	13	1,730	7
Fern	2012	Lochsa	0	0	3,601	96	121	3	12	<1
McGuire	2012	Middle Salmon, South Fork Clearwater	1,279	23	2,166	45	1,545	28	176	3
Porcupine	2012	Selway, Middle Salmon	1,004	19	2,477	48	1,574	31	100	2
Sheep	2012	Lower Salmon	3,978	57	2,240	32	657	9	156	2
Rough	2013	Lower Salmon	680	36	1,110	59	81	4	2	<1
Flat Creek	2013	Upper North Fork Clearwater	420	67	189	30	7	1	14	2
Total			**11,296**	**19**	**33,855**	**56**	**11,412**	**19**	**3,624**	**6**

As Table 1-51 indicates, the majority of streamside riparian acres included within fire perimeters in 2007, 2012, and 2013 were either unburned or burned at low severity. In terms of acres burned and percentage of high severity in the uplands, 2007 and 2012 were two of the most extreme fire years on record. The RCA results are consistent with assessments completed on the adjacent Bitterroot National Forest in the Upper Selway from fires that burned in 2000. The highest percentage of high-severity fire in riparian areas reported in post-fire monitoring reports was about 10% (Jakober 2002).

On a broad scale, these data suggest streamside riparian areas on the Forests maintain an inherent resistance to high fire severity, particularly toward the northern latitudes. These large wildfires (Table 1-51) have followed a consistent pattern of low to moderate fire severity with pockets of high severity in streamside riparian areas, and substantial portions remaining unburned. High-severity fire in riparian areas was nearly always associated with high severity in adjacent uplands (unpublished BARC maps 2007–2013), which is consistent with the findings of Halofsky and Hibbs (2008). An exception was noted with the 2007 Poe Cabin Fire, where some riparian corridors along stream tributaries to the Snake River burned at high and moderate severity, while surrounding uplands burned at low severity. In this case, surrounding uplands were grasslands, and riparian areas were made up of brush and small hardwoods. Riparian corridors burning at higher severity than surrounding uplands were not evident in forested habitat types within this fire perimeter (Poe Cabin Fire Severity map 2007, available in the project record).

Although the relative percent of riparian acres burned at high severity has been consistently low within large fire perimeters, percent of high fire severity within individual 6th and 7th field HUC watersheds has been much more variable. In some cases, high-severity fire in RCAs has resulted in short-term adverse effects to fish and habitat. For example, the McGuire Fire caused direct mortality of fish, presumably from high water temperatures adjacent to very high-severity fire as it burned through the riparian area. In the Sheep Fire, a series of intense summer thunderstorms within the John Day drainage generated slope failures and debris torrents that initiated in upland areas, which had burned at high severity. Some of these slope failures were associated with roads. In both cases, high-severity fire in riparian areas was included within large blocks of high-severity fire on the uplands (Sheep and McGuire Fire BARC Maps 2012, available in the project record). Therefore, even though percent of high severity within RCAs is low at a broad scale, at finer scales it can be much higher and result in short-term local adverse effects to aquatic resources.

Fire Effects to Individual Fish, Streams, and Habitat

As described by Gresswell (1999), the effects of fires on aquatic habitat can be direct and immediate, or indirect and sustained over an extended period (Yount and Neimi 1990). Mortality of fish is generally associated with intense, high-severity fire in riparian areas (Minshall et al. 1989; Rieman et al. 1997). Mortality is probably the result of short-term increases in stream temperature to lethal levels, although chemical toxicity from smoke or ash could be a factor as well (Minshall et al. 1989).

Indirect or sustained effects are generally associated with watershed and stream habitat attributes, including changes in hydrologic regime, erosion, debris flows, recruitment of large woody debris, formation of debris jams, and riparian cover (Swanson and Lienkaemper 1978; Megahan 1991), as described in Rieman et al. (1997).

Long-term increases in stream temperature have also been documented (Sestrich et al. 2011; Mahlum et al. 2011), in some cases persisting for years after the fire (Dunham et al. 2007; Mahlum et al. 2011). Other studies have documented no temperature increases or minor long-term increases (Minshall et al. 1989; Minshall and Brock 1991). Dunham et al. (2007) found rainbow trout and tailed frog larvae present in streams in the Boise River basin affected by fire and concluded these species may be more resilient to high stream temperatures than previously thought. As described in Rieman et al. (1997), fire may create changes in watershed processes (e.g., surface erosion and mass failure) that are often considered negative for fish, but the spatial and temporal nature of the disturbances is important (Reeves et al. 1995), and episodic contributions of large woody debris and coarse sediments that often occur after fires may result in beneficial long-term effects and an amelioration of short- or long-term negative effects, including increases in stream temperature.

Rieman et al. (1997), Rieman and Clayton (1997), Jakober (2002), Howell (2006), and others have documented increased abundance of fish years after fires, even in reaches where the fire had resulted in local extirpation of fish (Rieman et al. 1997; Jakober 2002). Sestrich et al. (2011) documented a decline in nonnative brook trout over time and rapid recovery of native westslope cutthroat trout in severely burned areas in the Bitterroot River, suggesting fire may have shifted the competitive advantage in favor of the native species.

Roper et al. (2007), using PIBO data to assess stream response to natural vegetative disturbances in wilderness and roadless watersheds in central Idaho, found that 3 stream attributes (sinuosity, D_{50}, and percent undercut bank) were correlated to the level of natural disturbance, but 8 attributes were not. Further, the 3 attributes most correlated with level of natural disturbance in the study area showed less change than changes commonly associated with human disturbances, suggesting an underlying difference in the 2 types of disturbance.

Post-fire monitoring conducted on the Nez Perce–Clearwater National Forests, and in streams on the adjacent Bitterroot National Forest, suggests that harmful effects from wildfires do not persist over time. In a report from monitoring conducted in the Upper Selway on the Bitterroot National Forest, Jakober (2002) found increases in large woody debris, number of pools, residual pool volume, and habitat complexity, and no evidence of long-term sedimentation of fish habitat. Jakober and Dentino (2003) described similar results after long-term monitoring of another fire in the Upper Selway; in addition, they noted increased abundance of bull trout and cutthroat trout. They also documented a 2–3 ^{o}C increase in stream temperatures but surmised this increase was not enough to preclude cold water species such as bull trout, since numbers of bull trout had increased in the years following the fire.

In monitoring the effects to streams from a large fire that occurred in 1988 in the Lower Selway, Green and Gerhardt (1991) documented changes in stream channels and increased surface fines in 1989 and 1990, but by 1991, surface fines were lower, indicating much of the fine sediment delivered after the fire had been moved downstream. Subsequent observations of the burned area in 2004 indicated little or no fine sediment deposition. Although evidence of increased peak flows was present (including aggradation of larger materials, pool filling, bank erosion, and channel realignment), significant increases in large woody debris recruitment had created new pools and increased habitat complexity (Thompson 2004).

The Upper and Lower Selway subbasins have been repeatedly burned by wildfires since the last forest planning effort, with some areas experiencing re-burns from previous fires in the late 1980s. Stream data collected from numerous reference sites within both subbasins do not suggest a departure from data collected at reference sites across the Interior Columbia River Basin (see PIBO trend discussion, above). When considered together, previous monitoring efforts and the results of PIBO data analysis suggest that wildfires in the Selway Basin have not resulted in substantial, long-term changes in habitat conditions.

Management Implications

Wildfires are one of the most significant drivers of watershed conditions across the Pacific Northwest and are a primary disturbance agent. They are likely to continue in this role into the future under just about all climate change scenarios (Isaak et al. 2010). Many studies, including monitoring and inventory conducted on the Nez Perce–Clearwater National Forests, have found that over various timescales, the aquatic habitat resulting from disturbances caused by fire (even high-severity fire) is more productive than similar habitats where the fire events were suppressed or altered by human influences (Reeves et al. 1995; Dunham et al. 2003; Benda et al. 2003; Rieman et al. 2003).

Consideration of the potential effects of wildfire, over both the short term and the long term, should include the existing condition of watersheds and streams and their connectivity (Rieman et al. 2010). In currently degraded watersheds, or those with at-risk, disconnected fish populations, a prudent strategy might focus on restoring connectivity and improving watershed function (Rieman et al. 2003; Rieman et al. 2010), while avoiding simplistic solutions related to vegetation management that compound problems already present in the watershed (Rieman and Clayton 1997). On the Nez Perce–Clearwater National Forests, however, connectivity among most populations is relatively high. In intact watersheds with relatively robust fish populations, wildfires would most likely not be a threat to the persistence of these populations (Dunham et al. 2003), and use of prescribed fire or wildland fire would be an appropriate management strategy.

In other watersheds that are currently degraded but support somewhat robust fish populations, the effects of additional ground disturbance linked to forest thinning and fuels management could be minor compared to past effects of fragmentation or watershed disruption (Rieman et al. 2010). These watersheds may present opportunities to use existing road networks to support forest restoration in some areas; in other areas within these watersheds, road obliteration and barrier removal could be used to restore hydrologic and biological connectivity (Rieman et al. 2000; Brown et al. 2004).

Scientists interested in interactions between fire and the aquatic environment recognize that vegetation treatments may need to take place in some altered ecosystems of the Pacific Northwest, especially considering current and future effects of climate change (Bisson et al. 2003; Noss et al. 2006; Reeves et al. 1995; Rieman and Clayton 1997; Rieman et al. 2000; Everest and Reeves 2007; Luce et al. 2012). Public land managers often display a need for treatment in riparian areas by identifying fuel accumulations and the potential for severe wildfire. To date, justification for treatments in riparian reserves is based on anecdotal information or information gained from studies on forest harvest and forest fire (Stone et al. 2010). Consequently, considerable social and scientific debate occurs regarding the need to treat riparian forests because of fuel accumulation (Rhodes and Baker 2008; Stone et al.

2010). Ecological justification for treatments in riparian reserves has yet to be supported by empirical evidence, because few studies in the literature are specifically designed to address this question (Arkle and Pilliod 2010; Stone et al. 2010).

Also of note, the Nez Perce–Clearwater National Forests generally have a less intense, shorter natural fire return interval than many other forested areas in the Pacific Northwest, and less precipitation that primarily comes as snow during winter months. Therefore, a slower average movement of sediment and woody material from terrestrial to aquatic systems, and then through the stream network, would be expected compared to areas with longer natural fire return intervals and greater precipitation (Roper et al. 2007). When planning vegetation treatments that are intended to mimic natural disturbance regimes, land managers should take into account that natural disturbance processes may differ depending on the geoclimatic setting (Brown et al. 2004), and the role of these disturbance processes in forming and maintaining stream habitats may differ as well.

Given that the positive and negative impacts of riparian fuel treatments remain largely undocumented in the literature, additional experimental studies of fuel treatment effects on aquatic and riparian ecosystems are needed before generalizations can be made across different forest types and local conditions (Dwire et al. 2010; Stone et al. 2010). Therefore, proposals to treat fuels within riparian reserves should proceed with caution. When developing fuel treatments that consider the aquatic environment, the potential for success may be greater when particularly damaging roads are decommissioned (Rieman and Clayton 1997). Where habitat is less degraded, researchers suggest mimicking natural disturbances, avoiding simplistic treatments, and maintaining a strong focus on experimentation and monitoring (Reeves et al. 1995; Rieman and Clayton 1997; Gresswell 1999; Bisson et al. 2003; Luce and Rieman 2010; Arkle and Pilliod 2010).

Fuel treatments within RCAs may be most appropriate at specific sites where human life and property are at risk from unnaturally high fuel accumulations. However, available information for streams and riparian areas on the Nez Perce–Clearwater National Forests does not suggest that fuel reduction in RCAs is needed to protect aquatic resources from the effects of fire. Table 1-51 summarizes burn severities in RCAs for the most extreme fire years in recent history. High-severity fire in RCAs has consistently been below 12% of the total RCAs within a given fire perimeter, and by far the highest percentage of RCA acreage was either unburned or burned at low severity. Short-term adverse fire effects to fish and streams have been noted, however, but it is unclear if fuel reduction in RCAs would have reduced those effects.

Prescribed fire, wildland fire use, and low-impact logging methods (e.g., helicopter or full-suspension cable yarding) could be used as tools to restore or maintain structure and function in RCAs, where these elements have been affected by past management actions, and where needed to achieve fuels and vegetation management objectives. However, when expanding efforts in timber harvest to minimize the risks of large fires, the negative risk to streams and native salmonids (e.g. destabilized streambanks, invasive plant species introduction, fine sediment accumulation) increases accordingly (Rieman and Clayton, 1997). Activities proposed in riparian areas to reduce fuels should be planned to reduce or eliminate harmful stream alteration.

Climate Change

Please see Appendix A for information regarding climate change.

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1.4 WATERSHEDS

1.4.1 *Existing Information*

In 2011, the Forests conducted the following coarse-level analyses of most 6th field HUCs on the Forests using the Watershed Condition Assessment tool[2]. For these analyses, the Forests used data and information from previously conducted watershed analyses, subbasin assessments, and planning unit assessments. The following watershed scale analyses were used:

- Island Ecosystem Analysis at the Watershed Scale (USDA Forest Service 2008a)
- Slate Creek Ecosystem Analysis at the Watershed Scale (USDA Forest Service 2000a)
- Crooked River Ecosystem Analysis at the Watershed Scale (Unpublished data)
- Meadow Face Ecosystem Analysis at the Watershed Scale (EAWS) (USDA Forest Service 2001a)
- Newsome Creek Ecosystem Analysis at the Watershed Scale (USDA Forest Service 2002a)
- Red River Ecosystem Analysis at the Watershed Scale (USDA Forest Service 2003a)
- Orogrande Ecosystem Analysis at the Watershed Scale (EAWS) (USDA Forest Service 2004a)
- Upper Lochsa Corridor Assessment (USDA Forest Service 2008b)
- Eldorado Creek Ecosystem Analysis at the Watershed Scale (EAWS) (USDA Forest Service 2003b)
- Crooked Brushy Ecosystem Analysis at the Watershed Scale (USDA Forest Service 2004b)
- Upper Lolo Ecosystem Analysis at the Watershed Scale (EAWS) (USDA Forest Service 2003c)
- Upper Palouse Ecosystem Analysis at the Watershed Scale (USDA Forest Service 2003d)
- Clearwater Subasin Ecosystem Analysis at the Watershed Scale (USDA Forest Service 1997a)
- Elk Creek/Long Meadow Ecosystem Analysis at the Watershed Scale (EAWS) (USDA Forest Service 2005)

The following subbasin assessments (SBAs) were completed for the 5th field HUC:

- Selway and Middle Fork Clearwater Rivers Subbasin Assessment (USDA Forest Service 2001b)
- Clearwater SBA (Ecovista et al. 2003)

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[2] Results are available at http://www.fs.fed.us/publications/watershed/. This Web site also documents the procedures used and the rationale for the watershed condition framework.

- Palouse Subbasin Ecosystem Analysis At The Watershed Scale: Upper Palouse, Lower Palouse And Meadow Creek Watersheds (USDA Forest Service 1998)
- South Fork Clearwater River Landscape Assessment (USDA Forest Service 1998)
- Salmon River Subbasin Assessment (USDA Forest Service 2000b)

The Forests also developed several Planning Unit Assessment (PUA) documents that are similar in scope and scale to landscape assessments:

- South Fork Clearwater River (USDA Forest Service 1997b)
- Selway River (USDA Forest Service 1999)

Forest Service staff on the Clearwater National Forest wrote an annual Forest Plan Monitoring Report from 1988 to 2010 (unpublished data); staff on the Nez Perce National Forest developed a similar report each year from 1988 to 2009 (unpublished data).

Since the late 1990s, the Nez Perce Tribe has been working with the Forests to improve fisheries habitat and watershed conditions. The following monitoring reports are available for their watershed and aquatics restoration projects:

- Lochsa River Watershed annual reports 2008–2011 (Lloyd and Forestieri 2008, 2009, 2010; Christian 2010, 2011)
- Lolo Creek annual reports 1998–2010 (NPT 1998, 1999a, 2000b,c, 2001c,d; McRoberts 2003a, 2004a, 2005a, 2006a, 2007a, 2008a, 2009a; Johnson 2010a, 2011a)
- Lolo Creek monitoring reports 2003–2010 (Breckon 2003; Tompkins et al. 2005a; Tompkins et al. 2006b; Main et al. 2007a; Main and McRoberts 2008a; Main and Johnson 2009a, 2010a)
- Meadow Creek (McComas Meadows) annual reports 1998–2010 (NPT 1999b, 2000d,e,f, 2001e,f; McRoberts 2003b, 2004b, 2005b, 2006b, 2007b, 2008b, 2009b; Johnson 2010b, 2011b)
- Meadow Creek monitoring reports 2003–2010 (Tompkins et al. 2005b; Tompkins et al. 2006c; Main et al. 2007b; Main and McRoberts 2008b; Main and Johnson 2009b, 2010b)
- Mill Creek annual reports 2000–2010 (NPT 2000a, 2001a,b; McRoberts 2003c, 2004c, 2005c, 2006c, 2007c, 2008c, 2009c; Johnson 2010c, 2011c)
- Mill Creek monitoring reports 2003–2010 (Tompkins et al. 2005c; Tompkins et al. 2006a; Main et al. 2007c; Main and McRoberts 2008c; Main and Johnson 2009c, 2010c)
- Newsome Creek annual reports 2002–2011 (Bransford 2003b, 2004b, 2005b, 2007a,b, 2008b, 2009b, 2010b, 2011b)
- Red River Report 2002–2011 (Bransford 2003a, 2004a, 2005a, 2007c,d, 2008a, 2009a, 2010a, 2011a)
- Watershed Condition Framework: A Framework for Assessing and Tracking Changes to Watershed Condition (USDA Forest Service 2011)
- Watershed Condition Classification Technical Guide (Potyondy and Geier 2011)

1.4.2 *Informing the Assessment*

1.4.2.1 **Current Conditions**

In 2011, the Forest Service conducted a coarse-level watershed condition classification (WCC) of all 6th field HUCs, using the Watershed Condition Classification Technical Guide (Potyondy and Geier 2011). The WCC system is a means of classifying watersheds based on a core set of 24 national watershed condition indicators related to watershed processes (Figure 1-38). The 24 attributes are surrogate variables representing the underlying ecological functions and processes that affect soil and hydrologic function. Each attribute was given a rating of 1 (good), 2 (fair), or 3 (poor). The 24 ratings were then put through an algorithm to identify a watershed condition class score. Aggregate class scores of 1, 2, and 3 directly correspond to final class rankings of I, II, and III, respectively; with the nomenclature of Class I, Class II, and Class III. The attribute ratings and the watershed class scores are stored in the Watershed Condition and Tracking Tool (WCATT) database.[3]

Information from the numerous EAWS, PUAs, SBAs, monitoring reports, and models was used to develop the rankings for each of the attribute ratings in the WCC system. Within this system, Class I watersheds are considered “functioning properly,” Class II watersheds are “functioning at risk,” and Class III watersheds have “impaired function.” Across the Forests, 220 6th field HUC watersheds are designated as managed (at least in part) by the Forests. These managed watersheds include 140 Class I, 73 Class II, and 7 Class III watersheds (Figure 1-39).

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[3] Watershed condition classes are available to the public at http://www.fs.fed.us/publications/watershed/.

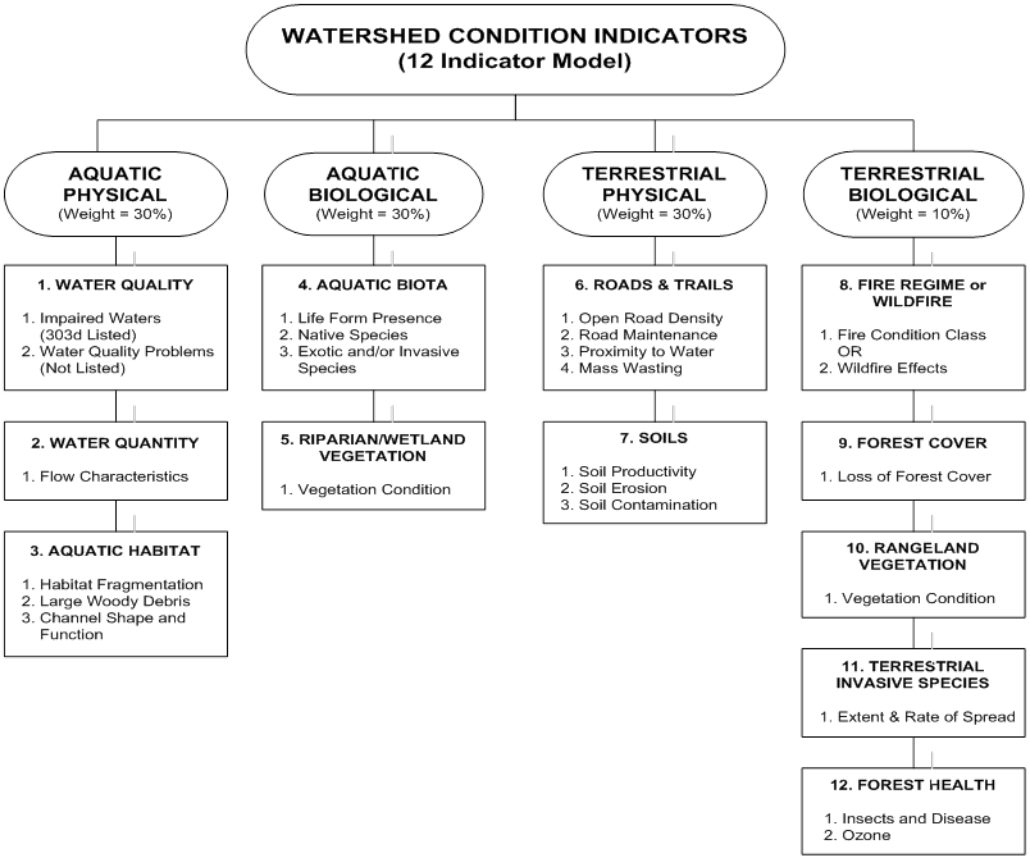
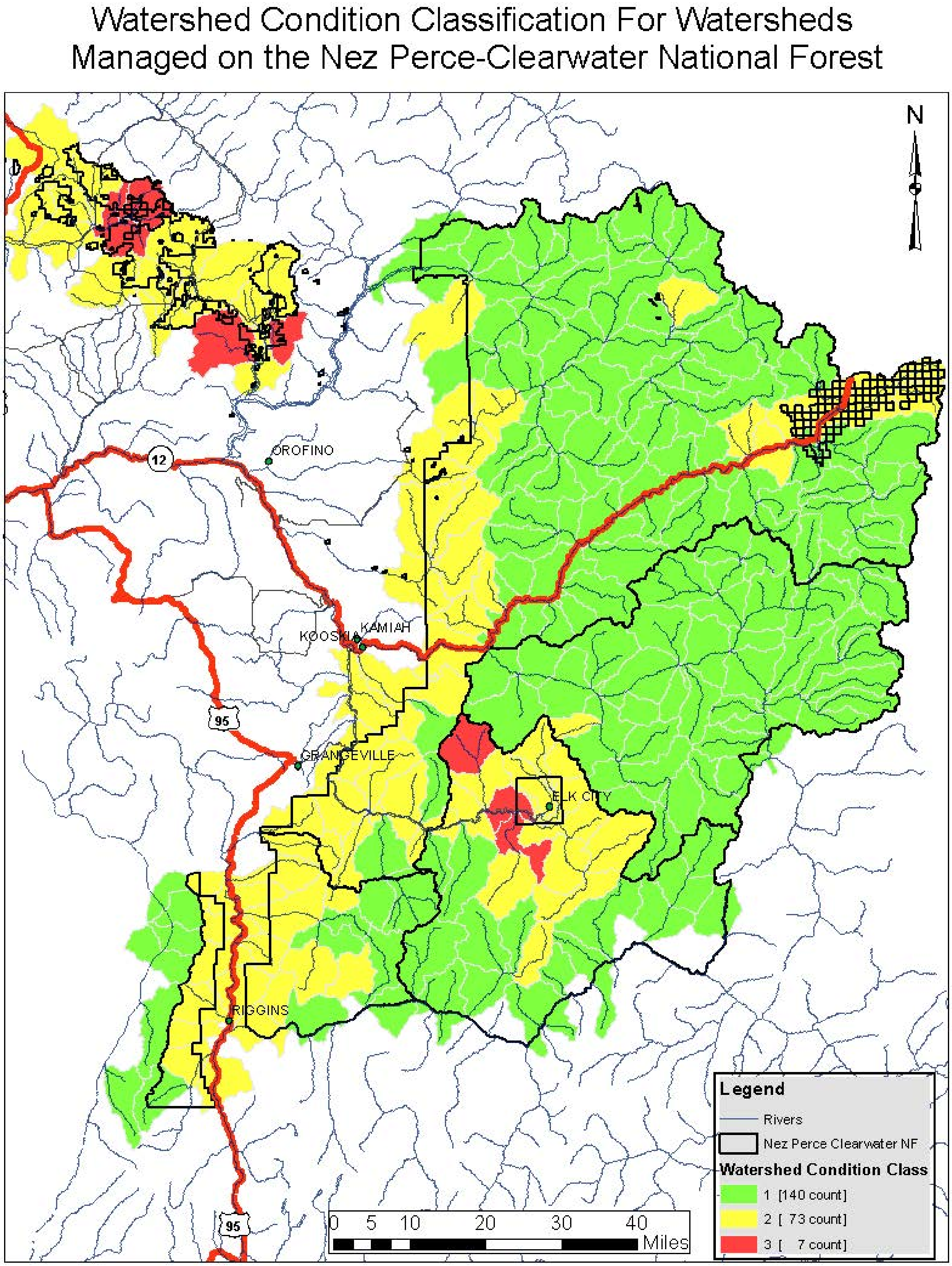


Figure 1-38. Watershed condition framework, 12-indicator model



Watershed Condition Classification For Watersheds Managed on the Nez Perce-Clearwater National Forest

Figure 1-39. Map of watersheds

Class I watersheds are primarily in Wilderness or unroaded areas of the Forests. Class II watersheds are mostly in areas with active vegetation management and higher road density. Class III watersheds are also in areas with active vegetation management and high road density, but these watersheds also have legacy features that have degraded watershed conditions (e.g., dredge mining in Crooked River).

1.4.2.2 **Trends and Drivers**

Trends in Class I watersheds are relatively static. The primary drivers of change in these areas are wildfires, landslides, and insect/disease infestations. Changing climate may have contributed to and possibly exacerbated the magnitude and extent of effects from these drivers. Forest management direction over the past 10 years has been to allow natural processes to dictate variations in watershed conditions in these areas. Several Class I watersheds have the potential to degrade into Class II with only moderate climatic changes, due to the influence of multiple stressors (Figure 1-40).

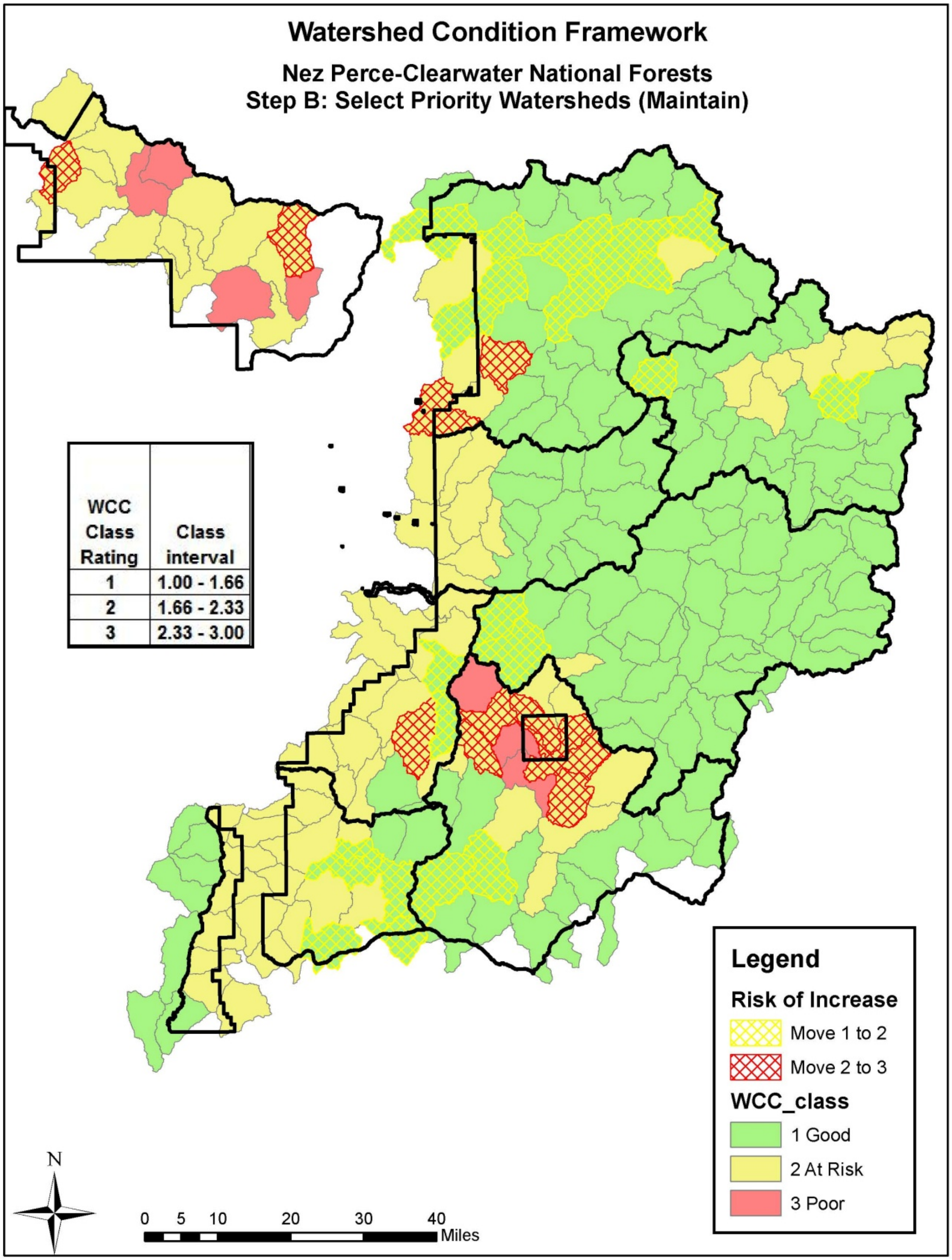
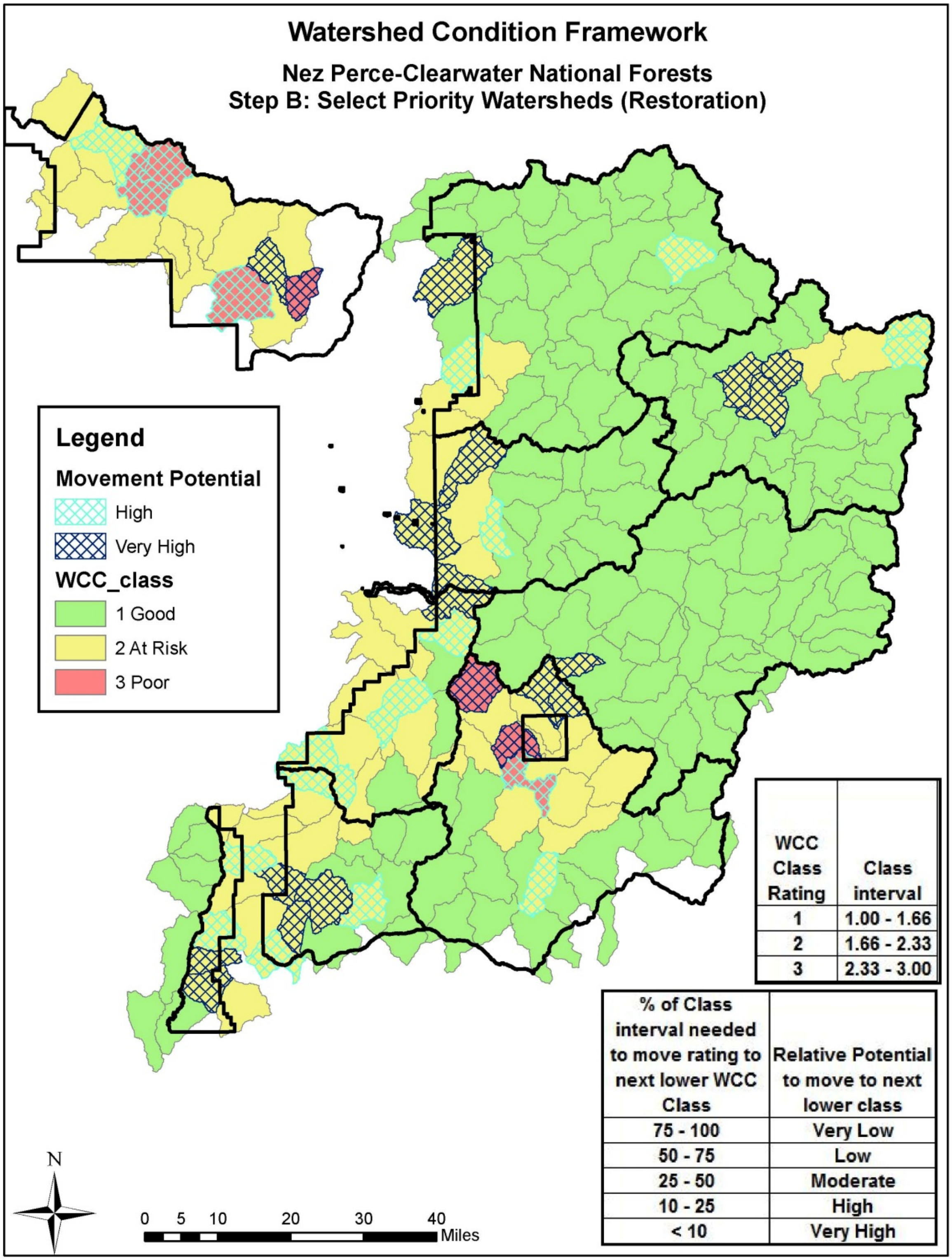


Figure 1-40. Watershed condition framework, Nez Perce–Clearwater National Forests (maintain)

In Class II and Class III watersheds, the trends are mixed: while some watersheds are declining (e.g., Upper Little Slate Creek is continuing to have issues with bark beetle infestations), most watersheds are showing slow, continual improvement as restoration activities are implemented (e.g., Fishing Creek was moved from a Class II to a Class I in 2012 after remaining restoration projects were completed). Some Class II and Class III watersheds are relatively static, with minimal changes in either direction. Several Class II watersheds are at risk of moving to further degraded conditions (Figure 1-40). However, several other watersheds have the potential to move to an improved class as restoration projects are implemented (Figure 1-41).



WCC Class Rating	Class interval
1	1.00 - 1.66
2	1.66 - 2.33
3	2.33 - 3.00

% of Class interval needed to move rating to next lower WCC Class	Relative Potential to move to next lower class
75 - 100	Very Low
50 - 75	Low
25 - 50	Moderate
10 - 25	High
< 10	Very High

Figure 1-41. Watershed condition framework, Nez Perce–Clearwater National Forests (restoration)

In road-accessible areas, projects have been designed to incorporate a soil and water improvement component to minimize the potential for soil erosion and mass wasting; this improvement is expected to help restore water flow patterns and reestablish native plant species. The main efforts have included the following: restoration of vegetation to natural species, age, and opening patterns; soil decompaction of skid trail and log landings; and reduction of impacts of forest roads by road reconstruction, maintenance, and decommissioning. In road-accessible areas, timber harvest, fire, mining, livestock grazing, recreation activities, road location, and management have combined with natural disturbances to either accentuate or lessen the intensity or duration of watershed processes. Changing climate may have contributed to and possibly exacerbated the magnitude and extent of the effects of these drivers.

The watershed condition framework (WCF) improves watershed restoration planning and implementation efforts on National Forests by targeting the implementation of integrated suites of activities in watersheds that have been identified as priorities for restoration. The WCF is a 6-step system to reestablish the structure and function of an ecosystem. The 6 steps are as follows:

- Step A: Classify the condition of all 6th field HUC watersheds on the Forests
- Step B: Prioritize watersheds for restoration
- Step C: Develop a Watershed Restoration Action Plan
- Step D: Implement the plan
- Step E: Track accomplishments
- Step F: Monitor improvement

In 2011, 4 watersheds were designated as priority restoration watersheds through the WCF: Upper Little Slate Creek, Upper Elk Creek, Upper Clear Creek, and Fishing Creek. For each of these 4 watersheds, a watershed restoration action plan (WRAP) was developed to designate the essential projects necessary to restore the watershed to a better condition. In addition to the priority restoration watersheds, the Forests have ongoing partnership restoration projects with the Nez Perce Tribe; these projects include most of the Middle Fork Clearwater, South Fork Clearwater, Lochsa, and Selway river basins, as well as the Collaborative Forest Landscape Restoration Program (CFLRP), which covers most of the Middle Fork Clearwater and Selway river basins. These large-scale restoration efforts provide annual improvements to these watersheds (Figure 1-42).

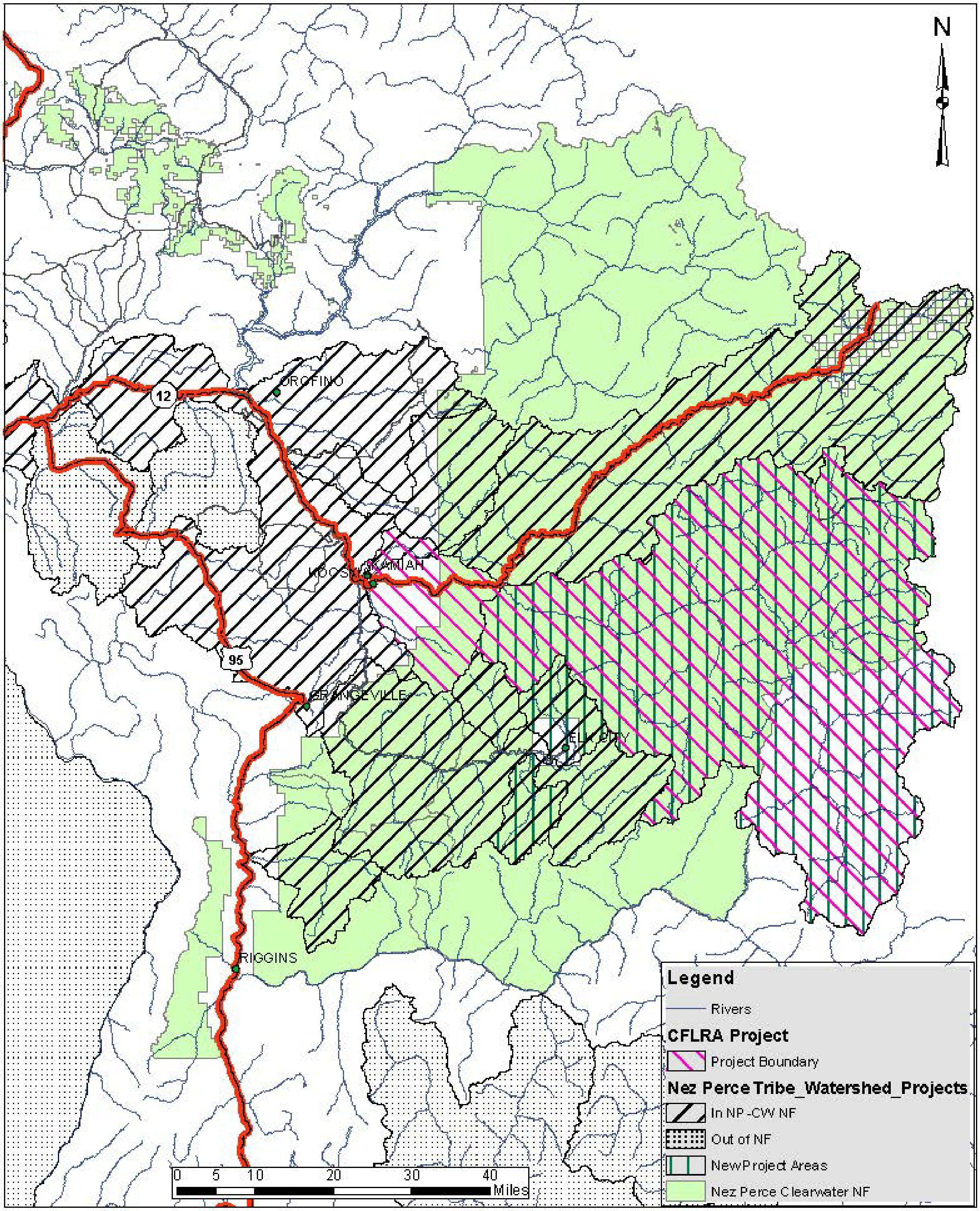


Figure 1-42. Collaborative Forest Landscape Restoration Program (CFLRP) projects

1.4.2.3 **Resource-Specific Information**

Size and Location of Watersheds

To demonstrate improvement in condition class, activities need to be tracked at the smallest feasible watershed unit, the 6th field HUC (typically 10,000–40,000 acres). At this scale, the effects of multiple, large-scale activities (e.g., fires, timber harvest, roads) can be observed, while the effects of numerous, small-scale activities (e.g., culvert replacement, abandoned mine reclamation) can be discerned without substantial dilution.

Some statistics require a table summarizing all watersheds on the Forests; in such cases, a 5th field HUC is used, even though most of the assessments are done at the 6th field HUC.

1.4.3 *Information Needs*

The following GIS calculations and/or map products have been identified as necessary:

- Summary of current road mileage and road density by 6th field HUC
- Summary of road mileage and road density from 1990 (or approximately when the old Forest Plan started) by 6th field HUC
- Map of Nez Perce Tribe’s BPA project areas
- Map of CFLRP area
- Map of past restoration projects

The following spreadsheets and/or tables have been identified as necessary:

- Table of WCC by 6th field HUC
- Table of road density by 6th field HUC, showing comparison of current to historic

1.4.4 *Literature Cited*

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