Chapter 8. Aquatic Organisms and Their Habitat

This chapter evaluates stream habitat and other characteristics that control the populations and distribution of fish and aquatic-dependent amphibians. Natural and management factors are examined that influence fish movement through streams, stream habitat quality, and changes in populations through time. The discussion includes an evaluation of the major downstream influences, including predation, fishing, and cyclic ocean conditions, that control fish runs. Aquatic inventories and other studies by the ODFW are summarized to provide information on aquatic habitat and populations for each watershed region. The chapter concludes with a synthesis of the results from previous chapters and provides a comprehensive analysis of the physical, water quality, and management influences on fish and aquatic amphibian habitat in the Forest. The analysis also identifies current and potential hotspots of productivity and highlights current or future limiting factors to high productivity.

NATURAL FISH PASSAGE BARRIERS

Every stream has a point above which fish use ends due to lack of flow (at least seasonally), steep gradients, and/or impassible natural barriers, such as falls and mass landslides. Debris torrents and logjams can create temporary barriers to fish passage. Fish and other aquatic vertebrates may be isolated or impeded from upstream or downstream migration by these geologic and geomorphic conditions (human-caused barriers and impediments are discussed later). The net result of these barriers and impediments to fish passage is that over time, the species' assemblage (for example, resident versus anadromous; steelhead versus coho salmon) will be determined in an individual stream. For the Forest, fish presence surveys using electroshock, nets, or observations were used to determine the upper extent of fish use and to identify passage barriers.

The Forest has a number of significant natural geologic barriers and impediments to fish passage. Map 8.1 shows the known extent of fish (anadromous and resident) within the Forest and a number of the natural barriers. The distribution of natural barriers is especially important for limiting the upstream spawning and rearing distribution of anadromous fish: coho and chinook salmon, steelhead, sea-run cutthroat trout, and lamprey. Mill Creek has two identified barriers, both probably the result of the Loon Lake landslide. The lower one is a gradient barrier below Mill Creek's confluence with Cold Creek. This gradient barrier likely represents the most downstream extent of the landslide fill. The second barrier is at Loon Lake (site of the BLM campground), which also may be the result of the landslide. According to ODFW fish distribution information, it is the lower gradient barrier that restricts anadromous fish use in Loon Lake and upstream. These two total barriers block significant, low-gradient streams draining the upper Mill Creek drainage on the Forest (Salander and Bickford Creek drainages), the Weyerhaeuser Millicoma Tree Farm (Soup and Lake Creek drainages), and intermixed BLM-managed lands.

On the southeast portion of the analysis area, another pair of permanent, geologic barriers exists at Golden and Silver Falls on Glenn Creek. However, fish passage is blocked approximately 0.5-mile downstream by a cascade that drops 45 feet over a 100-foot section

of stream length. This cascade is identified as a total barrier to anadromous fish. Only resident fish (cutthroat trout) inhabit streams in the basin above the falls (West Fork Silver, West Fork Glenn, Howell, and Cedar Creeks).

The West Fork Millicoma Basin historically contained at least seven falls that blocked or impeded anadromous fish passage. The lowest two named ones, Pidgeon Falls (8-foot drop), and Henry's Falls (7-foot drop) impede passage at lower flows for all species (Map 8.1). Fish are able to pass these two sites during freshets and higher flows in the West Fork. The next higher falls in the basin, Stulls (Stahls) Falls (15-foot drop), was a complete passage barrier prior to 1958 when the Oregon Game Commission blasted out steps and jump pools to create fish passage. During the 1960s, the bedrock cascade at Elk Falls on Elk Creek was jackhammered and blasted by the Game Commission to initiate fish passage, but these actions were unsuccessful in obtaining good anadromous passage. As a result, the Game Commission constructed a fish ladder in 1973 to further enhance fish use of the basin above Elk Falls. Three years prior to completion of the fish ladder, Elk Creek was stocked above the falls with up to 400 ripe adult coho salmon to seed the stream.

The remaining impediments and barriers to fish passage shown on Map 8.1 typically occur in higher gradient, lower order streams. In the ODFW database, these are called "Unnamed Falls" or cascades. These are the primary anadromous fish blockages in the Coos Bay, Lakeside, and lower Umpqua 5th field HUC basins.

ROAD CHANGES TO STREAM CHANNELS AND FISH PASSAGE BARRIERS

Stream channels in the Forest have been impacted through the development of the road system. Roads along streams affect stream channels and aquatic habitat by limiting riparian stand development, sediment delivery and water routing, channel movements, and fish passage at road crossings. The delivery of sediment to stream channels from roads was described in Chapter 6, *Erosion and Sediment*. Chapter 7, *Riparian Vegetation and Large Wood*, documented the role that roads play in limiting the area for productive riparian stands and the delivery of wood into stream channels. This section describes the influence of roads at constraining channel movements and creating fish passage barriers.

Methods

Most of the streams throughout the Forest are tightly confined by adjacent hillslopes (see discussion in Chapter 2, *Channel Habitat Types*). Unconfined streams provide unique, high-quality habitat for fish not found elsewhere on the Forest. These low-gradient streams are more likely to provide high-quality refuge habitat during high water since the channel can meander freely, creating tree fall into the channel and backwater areas.

Roads, especially those that parallel streams within 100 feet of the channel, also confine stream channels and reduce recruitment of streamside trees into channels. All roads paralleling streams within a 100-foot band were mapped for the Forest (Map 8.2). To understand the relative distribution of these streamside roads, the length of the segments

were summarized by stream size (small, medium, and large; see Chapter 2 for description) and watershed region. It should be noted that not all roads within 100 feet of a stream will constrain the movement of the stream channel. This measure, however, provides a good estimate for the influence of roads on the stream, riparian function, potential delivery of sediment, and the potential to limit the movement of the channel.

Results

Historically, forest roads in most areas of the Coast Range were located along streams because of the relatively easy access up wide valleys. The Forest is unique because most of the roads are on slopes or ridge tops, with very few along streams. There are approximately 551 miles of roads in the Forest, of which only about 49 miles (9%) are within 100 feet of a stream channel (Table 8-1). The Coos region has the largest percentage (12%) of roads along streams, with many of the roads paralleling large streams such as the West Fork Millicoma River (basins #9, #11, and #12) and Marlow Creek (basin #10). In the Umpqua region, 7% of the streams, mostly in the small and medium size class, are constrained by roads within 100 feet of the channel. Basin #1 has the highest percentage of roads in the Umpqua region, with most of the roads paralleling Mill Creek. The Tenmile region, which has the highest proportion of large streams with unconfined channels, has the lowest percentage of roads within 100 feet of the channel.

Table 8-1. Summary of length of roads within 100 feet streams by size class.

Region	Analysis Basin	Total Roads (mi.)	Road Length (mi.) within 100 feet of the Stream			Percent Constrained
			Stream Large	Stream Medium	Stream Small	
Coos	8	34.4	0.1	0.1	0.9	3
	9	49.0	0.6	0.4	2.0	6
	10	54.2	1.9	1.9	4.3	15
	11	93.7	5.4	5.1	5.3	17
	12	78.1	3.9	2.0	3.1	12
Umpqua	1	31.5	1.3	2.2	1.1	15
	2	22.9	0.5	0.1	0.5	5
	3	32.0	0.2	0.4	0.2	3
	4	26.0	0.4	0.5	0.6	6
	13	30.2	0.0	0.4	1.3	5
Tenmile	5	34.3	0.0	0.0	0.3	1
	6	31.4	0.0	0.0	0.5	2
	7	33.1	0.2	0.8	0.9	6
Combined		**550.8**	**14.5**	**13.9**	**21.0**	**9**

Discussion

There is a relationship between the proximity of forest roads to stream channels and aquatic habitat quality. Streamside roads are associated with reduced riparian trees and less wood in the channel (see Chapter 7, *Riparian Vegetation and Large Wood*), resulting in fewer pools and reduced winter refuge habitat. Fortunately, the length of streamside roads is limited in the Forest. Where there are streamside roads, their impacts should be examined and, where appropriate, impacts mitigated through riparian management and stream channel restoration actions, such as placing large wood in channels or by decommissioning roads.

FISH PASSAGE BARRIERS

Culverts can influence fish by keeping anadromous and resident spawning fish from reaching high-quality spawning habitat. When streams are blocked, fish are often forced to spawn downstream in less desirable areas. This is a special concern in the Forest because stream segments with sorted gravels of favored diameter are rare. Culverts also can block seasonal movement of juvenile salmon and steelhead, as well as resident cutthroat trout. Juvenile fish often are displaced downstream during high flows, and will attempt to move back upstream following high water to reclaim favorable feeding habitat and areas with less competition for food. Also, juvenile fish often will move upstream into cool tributaries during the summer to avoid unfavorable water temperatures in larger streams.

Culverts commonly block fish by creating a drop at the outlet that is higher than some fish species can jump. This is not always a problem for steelhead spawners who can scale obstacles of 5 feet or more, assuming the pool at the base of the jump is deep. Other adult fish have more difficulty jumping obstacles, and even a 2-foot drop can be a barrier for adult cutthroat trout. Since water travels through a culvert more swiftly than in a streambed, excessive velocity in the pipe is another way that culverts block fish. Providing for the upstream movement of juvenile fish and resident trout is even harder than for adult salmon and steelhead. One-foot-high drops at culvert outlets can stop small fish, and they have a reduced ability to swim upstream in fast water. The Oregon Forest Practices rules require that all new culverts be installed such that passage of both adult and juvenile fish is assured. For fish to navigate through culverts, guidelines by the ODFW indicate that the pipes need to be installed at a gradient of no more than 0.5% and have no more than a 6-inch drop at the outlet. Higher gradient installations are allowed for open-bottom culverts and for culverts with baffles installed in the bottom. These criteria create an engineering challenge for streams in the Forest, since fish-bearing streams are typically at a 2% to 4% gradient. Although using an oversized pipe and countersinking the outlet into the channel can work in some cases, it is rarely a solution in steep channels.

Methods

Examining the GIS road and fish-bearing streams coverage for the Forest identified stream crossings and their ability to pass fish. A GIS database compiled by the Forest that utilized field data from 1997 and 1998 was used to check on whether the crossing was a bridge, culvert, ford, or whether a culvert was missing because it had washed out during high flow.

The same database provided information on culvert gradient. The engineering staff at Coos Bay helped refine and update the inventory, and provided information on the drop at culvert outlets and on which culverts had been replaced since 1998.

Results

Culvert sites (where fish-bearing streams pass under roads) are relatively rare throughout the Forest, averaging only 1 for every 4.5 square miles, with the majority of sites located in the Coos region. A total of 32 culverts within fish-bearing streams were identified (Table 8-2). Culverts at over one-third of sites had been replaced in the last few years. Four of these installations were observed in the field and the replacement culverts (usually pipe arches) were well designed and capable of passing fish (Table 8-3). Five culverts had been removed and the roads decommissioned, while two other culverts had washed out during high flows and had not been replaced.

Table 8-2. Status of culverts in fish-bearing streams on the Forest.

Culvert Status	Number of Culverts	Percent of Total
Older culverts that are in place	14	44
Culverts that were recently replaced	11	34
Culverts that were removed and the road decommissioned	5	16
Culvert and fill washed out	2	6
Total	**32**	**100**

Table 8-3. Culverts in fish-bearing streams by region and analysis basin that were removed, washed out, or recently replaced.

Region	Analysis Basin	Site No.	Stream Name	Road No.	Comments
Tenmile	5	5073	Big Creek Trib.	5100	Culvert removed, road decommissioned
Tenmile	5	5072	Big Creek Trib.	5100	Culvert removed, road decommissioned
Tenmile	5	5066	Big Creek Trib.	5100	Culvert removed, road decommissioned
Tenmile	5	5086	Big Creek Trib.	5100	Culvert removed, road decommissioned
Tenmile	7	5010	South Fork Johnson Cr	2100	Culvert removed, road decommissioned
Umpqua	2	5187	Charlotte Cr Trib.	100	Fill was washed out
Coos	12	5319	W.F. Millicoma R Trib.	9360	Fill was washed out
Coos	10	454	Y Creek	1000	Replaced with 95"x67" arch
Coos	11	277	Hidden Valley Cr	9500	Replaced with 96" round pipe
Coos	11	271	Crane Cr	9000	Replaced with 103"x71" arch
Coos	11	263	Skunk Cr	9000	Replaced with 112"x75" arch
Coos	11	239	Elk Cr Trib.	9040	Replaced with 95"x67" arch
Coos	11	240	Elk Cr	9000	Replaced with 142"x91" arch
Coos	11	374	Cougar Cr Trib.	7600	Replaced with 48" round pipe
Coos	11	368	Cougar Cr Trib.	7600	Replaced with 71"x47" arch
Coos	10	432	Marlow Cr Trib.	1100	Replaced with 48" x 140' pipe with baffles
Coos	10	431	Marlow Cr Trib.	1100	
Umpqua	13	5259	Bickford Cr	1900	Culvert to be replaced in 2003

Discussion

Of the 14 older culverts that are currently in place, all have a gradient greater than 0.5% and/or an outlet drop greater than 6 inches. One-half of the 14 culverts have an outlet drop greater than 2 feet and/or a gradient greater than 4% or have an upswept inlet that prevents fish from moving upstream of the culvert inlet (Table 8-4). Based simply on the basis of length of upstream fish-bearing miles upstream of the culvert, sites #569 (Totten Creek), #5179 (Footlog Creek), and #479 (Cedar Creek) would be the highest priority sites for improving fish passage. Anadromous fish use Totten and Footlog Creeks while a natural downstream waterfall excludes anadromous fish from Cedar Creek.

Since not all fish-bearing streams have been identified for the Forest, the number of culverts with fish passage problems is probably larger than shown in Table 8-4. Additional fish-bearing streams, when found, are likely to be in the upper portions of drainage basins, which are steeper. Fish passage problems are usually more difficult to resolve for culverts installed in steeper gradient channels.

HABITAT RESTORATION PROJECTS

The Elliott State Forest, in collaboration with the Coos Watershed Association, Tenmile Lakes Partnership, and the ODFW implements a number of actions that are designed to improve aquatic habitat and watershed processes. There are no aquatic habitat restoration projects on the Forest reported by the Umpqua Basin Watershed Council. The Forest and ODFW have cooperated on several stream restoration projects on Charlotte and Mill Creeks in the Umpqua region and Palouse Creek in the Coos region. Aquatic and riparian habitat restoration actions implemented on the Forest include:

- Replacing culverts to improve fish passage.
- Planting conifers in riparian areas that are dominated by hardwoods.
- Leaving more than the required number of riparian trees along streams.
- Improving road drainage patterns to reduce sediment delivery to stream channels.
- Decommissioning roads to restore natural drainage patterns and vegetation.
- Placing large wood or boulders in channels to increase fish habitat complexity.

Methods

Most watershed restoration projects are reported to the Oregon Watershed Enhancement Board's (OWEB) watershed restoration project database. This database was used to obtain information on the location and type of watershed restoration projects in the Forest. The database includes projects from 1995-2002. Also, additional information was obtained from Forest personnel, the Coos Watershed Association, and the Tenmile Lakes Partnership. The Forest completed additional projects before 1995, which are not reported. These included a number of projects in Palouse Creek focusing on large wood placement, creation of off-channel ponds, and riparian planting.

Table 8-4. Characteristics of older culverts currently in place on the Forest.

Region	Analysis Basin	Site No.	Stream Name	Stream Size	Road No.	Pipe Diameter (in.)	Drop at Outlet (ft.)	Pipe Gradient (%)	Length of Fish-bearing Stream Upstream of Culvert (mi.)	Downstream Barriers to Anadromous Fish?
Coos	10	467	Glenn Cr	Small	1850	56	4	5	0.32 (S*)	Yes**
Coos	10	479	Cedar Cr	Medium	1850	84	0	4	0.67 (M)	Yes**
Coos	10	445	Marlow Cr Trib.	Small	1000	56	4	7	0.40 (S)	No
Coos	10	449	Piledriver Cr	Small	1000	56	2.3	3	0.27 (S)	No
Coos	9	560	Daggett Cr	Small	3300	24	6	4	0.08 (S)	No
Coos	9	569	Totten Cr	Medium	2000	72	0	9	0.32 (M) & 1.19 (S)	No
Coos	9	536	W.F. Milli. Trib.	Small	504	36	0	4	0.24 (S)	No
Coos	12	511	Trout Cr	Medium	2300	96	0	3	0.35 (M)	No
Coos	12	5331	W.F. Milli. Trib.	Small	8100	42	2	3	0.35 (S)	No
Coos	12	419	Joe's Cr	Small	8000	30	0	4	0.36 (S)	No
Coos	11	248	Elk Cr Trib.	Small	9000	42	?	3	0.30 (S)	No
Coos	11	235	Elk Cr Trib.	Small	9000	42	1	3	0.04 (S)	No
Coos	11	339	Fish Cr Trib.	Small	7400	36	1	10	0.11 (S)	No
Umpqua	1	5172	Footlog Cr	Medium	7500	72	0	4***	0.86 (M)	No

* S = small stream, M = medium stream.
** Natural falls.
*** Inlet to culvert is bent upward, creating a velocity barrier to fish movement.

Results

The locations and types of restoration projects are shown on Map 8.3 and are summarized in Appendix C. More than 150 watershed restoration projects were implemented from 1995-2002, with the majority of projects in the Coos region. The projects focused on a variety of instream, riparian, and upslope actions, including fish passage barriers, the placement of large wood in stream channels, voluntary riparian tree retention, and road surface drainage improvements. Table 8-5 summarizes the in-channel habitat (wood or boulder placements, creation of off-channel areas) and fish passage improvement projects by watershed region.

Table 8-5. In-channel habitat and fish passage improvements projects on the Forest, as reported in the OWEB database, 1995-2002.

Region	In-channel Placement of Wood or Other Enhancements*	Fish Passage Improvements**
Coos	27	34
Tenmile	2	1
Umpqua	2	0

* Includes projects where boulders were placed in the stream and off-channel habitat creation.
** Fish passage improvements include culvert replacement with new culvert or bridge, addition of downstream weirs, or removal of the culvert and restoration of natural stream channel.

Note: Projects not reported in the OWEB database include boulder weirs in the W.F. Millicoma River (1998); two sets of boulders weirs below the hatchery at the property line and one set above the hatchery in the W.F. Millicoma River (2002).

Discussion

Many restoration projects focused on fish passage improvements and the placement of wood and other structures (such as boulders) into the stream. Improving aquatic habitat connectivity by addressing fish passage barriers has increased the amount of habitat accessible to anadromous and resident fish. Increasing stream channel complexity through the addition of structure is valuable given the limited in-channel wood (Chapter 7, *Riparian Vegetation and Large Wood*) and the importance of channel structure in the retention of channel sediment, and the creation of deep, complex pools. These active restoration efforts target suitable areas as a stopgap measure until natural wood loading can be reestablished and a “passive” restoration can be reinitiated.

As noted in Table 8-5, not all instream placements are large wood. Large boulders were added to the stream, particularly in channels that were too wide to provide stable wood placements. Other non-wood placements include boulder weirs. Boulders and weirs added to stream reaches with limited channel structure help to retain gravels and capture large wood that is transported into the stream. Boulder placements were favored at locations along the lower reaches of the West Fork of the Millicoma River where log placements were not

feasible due to size required for stable logjams and the costs involved. In some cases, the decision to apply boulder placements instead of large wood represents a compromise between the need to enhance stream habitat for salmonid species, while not adversely affecting the streamside habitat of the marbled murrelet. Of particular concern in these cases is the practice of "pulling" streamside trees for large wood placement, which affects the canopy closure and tree platform base relied on by murrelets. Closed canopies are thought to reduce predation on murrelets, while some of the mature tree platforms are favored as nesting habitat.

At this time, there is no comprehensive watershed strategy for the implementation of in-channel habitat and other restoration projects. In practice, most aquatic habitat restoration projects are implemented on an "opportunistic" or project basis, primarily where there are timber sales or nearby streamside roads. Increasingly, the Forest is working cooperatively with watershed councils to implement a variety of habitat restoration projects.

FISH HABITAT PREFERENCES AND POPULATION STATUS

Fish habitats and populations change through time as a result of natural processes and impacts from management. Natural factors such as forest fires and ocean conditions can change the structure of stream habitats and influence survival and returns of anadromous fish. Management of fish runs through hatchery and harvest practices, and forest practices such as road development, also have impacted fish habitat and populations. This section describes fish habitat and population status for key fish species found in the Forest. Tables 8-6 and 8-7 describe the distribution, preferred habitats and legal status (state or federal listings) for salmonids and other fish species. The discussion then evaluates the population status and habitat needs for key anadromous fish: coho salmon, chinook salmon, steelhead trout, sea-run cutthroat trout, and lamprey. Because Forest streams contribute to regionally significant coho salmon populations, the focus of the evaluation is on these stocks.

Table 8-6. Distribution, preferred habitats, and legal status of salmonid species on the Forest.

Species	Distribution and Preferred Habitats by Life History Stage (Croot and Marglolis 1991)	Status (ODFW 1997)
Coho salmon, *Oncorhynchus kisutch*	Anadromous. Migrate through most streams in the Coos, Tenmile, and Umpqua regions, with the exception of high-gradient systems (>6%) and channels with fish passage barriers. Spawning: Returning adults enter streams between Sep-Dec; peak spawning occurs in December in small streams with gradients <5%. Redds located where gravels are the primary substrate. Rearing: Fry emerge between Feb-May. Juvenile coho rear for 1 year in freshwater in streams with gradients <4%, with a preference for pools more than 2-feet deep with logs and other cover and cool water temperatures. Over-wintering habitat preferences include complex habitats that provide refuge from high flows; side channels and pools with abundant wood.	Listed as federal threatened in 1998.* Listed as "critical" on the state sensitive species list.
Fall chinook salmon, *Oncorhynchus tshawytscha*	Anadromous. Chinook migrate and spawn primarily in the mainstem of the West Fork Millicoma River. Spawning: Returning adults enter streams between Aug-Oct, generally holding in deep pools in mainstem Millicoma River; peak spawning in Nov-Dec in areas of concentrated gravel. Rearing: Fry begin to emerge in April and then move rapidly out of the system to rear in the lower river and estuarine areas.	---
Chum salmon, *Oncorhynchus keta*	Anadromous. No viable populations on the Forest; however, there is a population of chum salmon in Marlow Creek downstream of the Forest.	Listed as "critical" on the state sensitive species list.
Winter steelhead trout, *Oncorhynchus mykiss*	Anadromous. Migrate through most streams in the Coos, Tenmile, and Umpqua regions, with the exception of very high-gradient systems (>8%) and channels with fish-passage barriers. Spawning: Returning adults enter streams between Nov-May; spawning occurs between Jan-May in low/moderate gradient streams (up to 8%). Rearing: Juveniles rear as long as 4 years in fresh water; prefer pools with cover, large wood, and cool water temperatures.	Listed as federal candidate species. Listed as "vulnerable" on the state sensitive species list.
Sea-run cutthroat trout, *Oncorhynchus clarki clarki*	Anadromous. Very little information on the distribution of sea-run cutthroat trout; they appear to migrate and rear in most streams in the Coos, Tenmile, and Umpqua regions (ODFW 1993). Both migratory and resident populations usually use smaller and higher gradient streams for spawning/rearing than those used by salmon/steelhead.	Listed as "vulnerable" on the state sensitive species list.
Resident cutthroat trout, *Oncorhynchus clarki clarki*	Resident populations of cutthroat trout are found in numerous streams in Coos, Tenmile, and Umpqua regions, including some isolated populations above fish-passage barriers. Cutthroat trout use stream channels with gradients up to 12% if there is sufficient pool habitat.	Listed as "vulnerable" on the state sensitive species list.

* In 2001, a legal ruling voided the listing decision. Later a stay was granted pending appeal by the Ninth Circuit Court, thereby temporally restoring protections to Oregon coastal coho salmon. In 2002, Trout Unlimited and others filed a petition to list the Oregon Coast coho salmon as threatened under the federal ESA. This petition requests that NOAA Fisheries define the coho population to exclude hatchery fish from the distinct population segment (Trout Unlimited et al. 2002).

Table 8-7. Distribution, preferred habitats, and legal status of non-salmonid species on the Forest.

Species*	Distribution and Preferred Habitats by Life History Stage (Croot and Marglolis 1991)	Status (ODFW 1997)
Millicoma dace, *Rinichthys cataractae*	The Millicoma dace is confined to the Coos River watershed and is morphologically distinct from Umpqua River population; the Millicoma dace has specialized by living among the bedrock cracks and rubble in the swiftest portions of the Coos River (Wagoner et al. 1990).	Listed as "naturally rare" on the state sensitive species list.
Pacific lamprey, *Lampetra tridentate;* Western brook lamprey, *Lampetra richardsoni;* River lamprey, *Lampetra ayresi*	The Pacific and river lamprey are anadromous and brook lamprey is resident. There have been no systematic surveys of lamprey presence in the Coast Range. River and brook lamprey appear to be present throughout coastal streams, with pacific lamprey the most common. ODFW stream survey crews have encountered lampreys in most stream areas they have surveyed in the Coast Range (Kostow 2002). The river lamprey is very rare (Kostow 2002).	Current petition exists to list Pacific, western brook, and other lamprey as threatened under the federal ESA (Klamath-Siskiyou Wildlands Center et al. 2003). Pacific lamprey is listed as "vulnerable" on the state sensitive species list.
Redside shiner, *Richardsonius balteatus*	Common throughout the Forest. Competes for food that is preferred by young salmonids, especially in warmer water. Up to 6 inches long.	---
Largescale sucker, *Catostomus macrocheilus*	Common in larger streams. Scrapes algae off of rocks. Up to 2 feet long.	---
Threespine stickleback, *Gasterosteus aculeatus*	Uncommon. Lives in ponds or backwater areas along streams. Builds nest among reeds and protects vigorously. Up to 4 inches long.	---
Speckled dace, *Rinichthys osculus*	Common except in steep streams. Eats small macroinvertebrates. Up to 4 inches long.	---
Coast Range sculpin, *Cottus aleuticus*	Common except in steep streams. Scrapes algae off of rocks. Up to 3 inches long.	---
Prickly sculpin, *Cottus asper*	Common except in steep streams. Scrapes algae off of rocks. Up to 3 inches long.	---

* In addition to these species, other fish that may be present on the Forest include reticulated sculpin, riffle sculpin, tui chub, and Umpqua dace. Introduced fish species, all present in Loon Lake, include largemouth bass, black crappie, bluegill, and brown bullhead.

Coho Salmon

Population Status and Trends

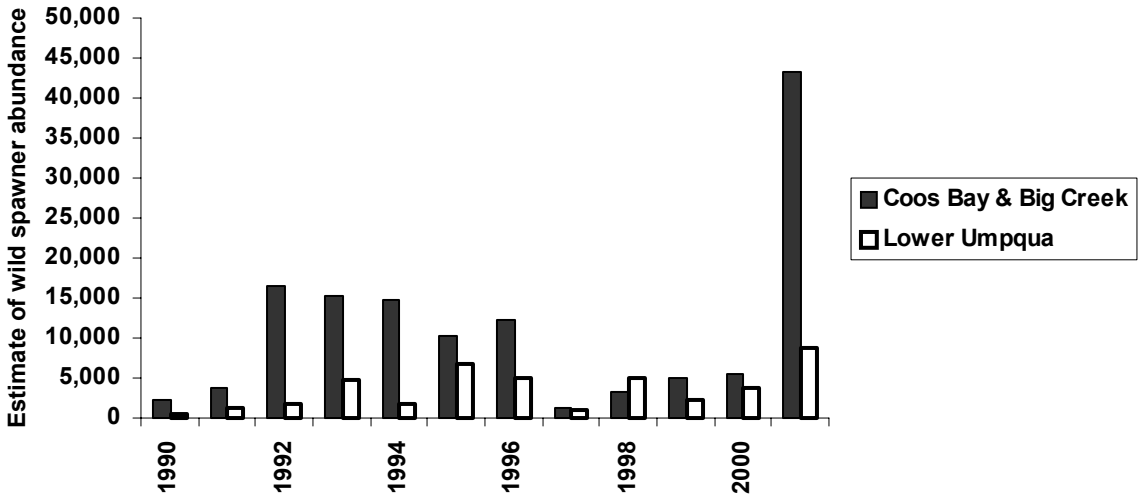
Wild Oregon coastal coho populations have historically oscillated in number. Coho populations fluctuated dramatically in the 1990s and in the early part of this century. The lowest spawner abundance was in 1997 and the highest in 2001 (Jacobs et al. 2002). Prior to the mid-1980s, the number of coho returning to streams was heavily influenced by intense ocean fishery harvest. From 1990-2002, coho spawner abundance was highest in the mid-south coast monitoring area (Sixes River to the Umpqua River, including the Coos and Tenmile regions), ranging from 26,000 adults to a high of 74,000 adults in 2001. The lowest spawner abundance was in the north coast monitoring area (Salmon River north to the Columbia), ranging from a low of 2,200 adults to a high of 34,000 adults.

The most productive coho spawning basins in the mid-south coast area have been the Coos, Tenmile Lakes and Siltcoos Lake Basins (Jacobs et al. 2002). The coho populations in the Tenmile and Siltcoos systems have a very productive lake-rearing juvenile life history. These numbers on coast-wide coho population status point to the regional importance of the Forest in helping to maintain coho populations. The Tenmile Lake and Coos River watersheds are among the most productive areas in the Coast Range. Figure 8-1 illustrates the coho spawner returns over time for the major drainages associated with the Forest (Coos Bay tributaries and Big Creek) in comparison to the lower Umpqua Basin.

Following the trend for streams in the Coast Range, the spawning populations of coho in streams draining from the Forest have fluctuated in numbers over time. Long-term spawning coho salmon counts were collected for Larson and Palouse Creeks, both tributaries to Coos Bay, beginning in the 1950s through 2002 (Figure 8-2). Peak counts of coho spawners within the surveyed section (1 mile) of Larson Creek ranged from a high of 327 fish in 1951 to a low of 6 fish in 1984. Coho spawners within the surveyed section (1 mile) of Palouse Creek ranged from a high of 523 fish in 2002 to a low of 19 fish in 1975. These fluctuations in spawner abundance are partially explained by changes in ocean productivity and associated coho survival and modification in ocean harvests. Since 1984, there have been increasing limitations on the ocean harvest of wild coho salmon.

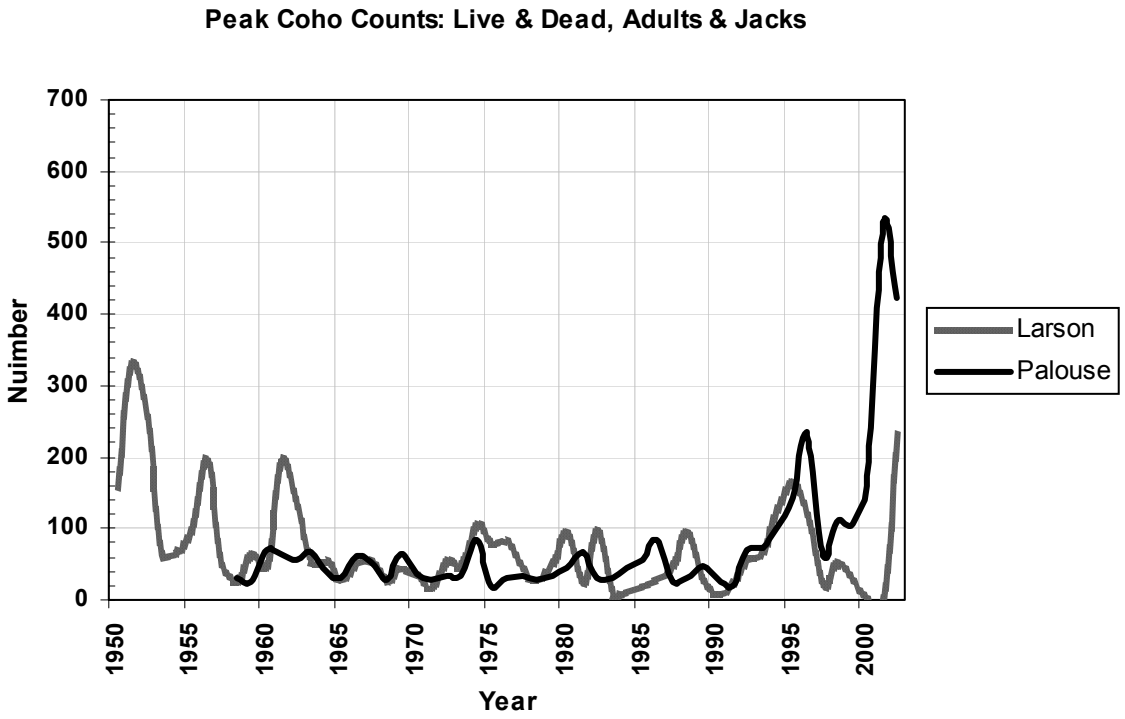
In addition to spawning surveys, assessments of juvenile coho rearing in Forest streams have been conducted. Snorkel counts of juvenile coho numbers were conducted periodically and usually associated with aquatic habitat inventories. For example, beginning in the 1950s, there are records of juvenile coho numbers for Larson Creek. Since 1998, the ODFW has been monitoring juvenile coho numbers for streams in the Coast Range. By providing a consistent methodology and systematic sampling of the same streams over time, these surveys are designed to assess regional (within the monitoring areas) trends in juvenile coho abundance. However, since the monitoring assesses juvenile coho rearing population at regional scales, it is not intended to provide trend information at the finer scale of watersheds. While these data cannot be used to estimate juvenile population numbers for individual watersheds or streams in the Forest, they do provide a consistent method that yields a useful snapshot of rearing population numbers and shifts through time.

Figure 8-1. Annual estimates of wild coho spawner abundance for stream systems within the mid-south coast and lower Umpqua management areas, 1990-2001.



Source: Jacobs et al. 2002

Figure 8-2. Palouse and Larson Creek (Coos Bay tributaries) spawning survey numbers for adult and jack coho salmon, 1950 to 2002.



The Palouse Creek spawning survey data begins in 1958; there are no recorded counts for Larson Creek in 2000 and 2001. Data from Coos Watershed Association 2003.

Table 8-8 and Map 8.4 show juvenile coho densities for selected stream segments in the Forest. To provide consistent comparisons between monitoring areas in the *Oregon Plan for Salmon and Watersheds* (State of Oregon 1999), the metric unit, number of fish per square meter (fish/m^2), is used. Coho densities range from zero to a high of 1.7 fish/m^2 for Johnson Creek in the Tenmile region. For stream reaches with multiple survey years, there can be considerable inter-annual variability in juvenile coho densities. Elk Creek, for example, varied from 0.72 fish/m^2 in 1998 to 0.21 fish/m^2 in 1999. Coho densities of approximately 0.7 fish/m^2 are considered to be adequate "seeding" for pool habitats. A number of other stream reaches exceed this density: Johnson Creek in the Tenmile region (1.7 fish/m^2); Charlotte Creek in the Umpqua region (0.91); and Elk (0.72 and 1.05) and Marlow (0.71) Creeks in the Coos region. Significantly, several sites had no observations of juvenile coho. No juveniles were observed in sampled sites Schumacher Creek in the Coos region (1998 and 2001) and in Dry (2002), Miller (2000) and Scholfield (2001) Creeks in the Umpqua region. The range of juvenile coho densities is an indication of both the productive capacity and the variability of coho numbers for streams on the Forest. These monitoring sites may be revisited, providing a way to track trends in juvenile coho densities over time.

Table 8-8. Coho densities for stream reaches in the Forest, 1998-2002.

Region	Site No.	Year	Stream Name with ODFW Survey Reach	Density (juvenile coho/m^2)
Coos	1153	1999	Cougar – reach 1	0.02
	1031	1998	Elk – reach 1	0.72
	1023	1999	Elk – reach 1	0.21
	1025	2002	Elk – reach 2	1.05
	1396	1998	Marlow – reach 3	0.71
	1403	1998	Schumacher Creek	0.0
	1403	2001	Schumacher Creek	0.0
	2416	1998	W F. Millicoma – reach 2	0.18
Umpqua	995	2000	Charlotte – reach 1	0.91
	1034	2000	Dry Creek	0.16
	1034	2002	Dry Creek	0.0
	1033	2000	Miller – reach 1	0.0
	1026	2001	Scholfield – reach 6	0.0
Tenmile	1149	2002	Johnson – reach 4	1.7

Data were collected as part of the *Oregon Plan for Salmon and Watersheds* (State of Oregon 1999) monitoring program. Data from Steve Rogers, ODFW 2003.

Habitat and Other Factors Limiting Populations

Coho abundance is limited by factors that can influence survival for each life stage for fish: ocean residence, migration (ocean spawning adults and returning juveniles), spawning, and rearing. The return of adults is strongly influenced by ocean productivity and harvest. There is evidence that ocean conditions for coho salmon oscillate with about 20-year cycles, between highly productive conditions and those with limited productivity. Since about 1998, ocean conditions appear to be in a productive phase (Taylor 2003). Until 1946, coho

populations in the area were heavily affected by a gillnet fishery, and by splash dams until 1956, especially in the Coos River system (ODFW 1993).

Spawning, rearing, and migration habitat conditions influence coho salmon populations in the Forest. The key limiting factor for migration are human barriers at road crossing culverts and tide gates. As discussed above, culverts are probably not limiting adult migration in the Forest; however, to a limited extent they do impact the movement of juvenile coho. Tide gates, which can limit fish access to streams in the Coos region, are not present in streams on the Forest. The Coos Watershed Association, in collaboration with the county and landowners, is modifying tide gates to improve fish access to estuary streams (personal communication, Jon Souder, Coos Watershed Association 2003). Waterfalls also limit the extent of coho spawning and rearing in the Forest. Improving fish passage at Stulls (Stahls) Falls and in Elk Creek opened up considerable habitat in West Fork Millicoma Basin that historically was inaccessible.

Spawning habitats on the Forest are impacted by the limited amounts of in-channel wood (Chapter 7, *Riparian Vegetation and Large Wood*) that help to retain and sort gravels. Since spawning and rearing usually take place in small, low-gradient (generally <4%) channels, wood in these stream segments is especially important for spawning populations and juvenile survival (Nickelson et al. 1992).

Because juvenile coho rear for at least one year in freshwater, they are sensitive to habitat conditions and are vulnerable to predation. High winter stream flows appear to limit juvenile coho population numbers. Coho require complex pool and off-channel habitats that provide refuge from high flows (Nickelson et al. 1992). These habitat qualities also are applicable for other salmonid species. Numbers of juvenile coho salmon, 1+ steelhead, and cutthroat trout are directly correlated with increasing complexity of pools, as measured by pool depth and amount of wood (Lonzarich and Quinn 1995). Pool complexity can be improved using restoration actions such as the addition of large wood to channels and the creation of off-channel habitats. While most streams in the Forest have confined channels, which limits the opportunities for the development of off-channel habitats, the addition of large wood was observed to increase pool complexity and gravel retention in the Coos Watershed (Coos Watershed Association 2001).

The Tenmile region is characterized by coastal lakes, which provide an ideal habitat for young coho. Historically (and currently), the Tenmile Lakes area was one of the most productive juvenile coho rearing areas in the Coast Range (Jacobs et al. 2002). Most coho salmon probably moved out of the tributaries and reared in the lakes that provided rich food sources and abundant habitat. The introductions of exotic fish into the lake system, perhaps more than the alteration of stream habitat, have affected the productivity of coho in the lakes. Reimers (1989) documented the effect of exotic fish on coho salmon in the Tenmile Lakes. From 1949-1957, the combined number of jacks and adult coho salmon returning to the lakes was estimated to average over 50,000 fish annually. During the following decade, the size of the spawning run declined, averaging less than 30,000 fish annually. It was suspected that competition for food and predation on young salmon fry by exotic fish, such as bluegill and white crappie (introduced in 1987), had increased. In response, the ODFW

decided to apply rotenone to the lakes to kill all fish, and then released 930,000 hatchery-reared coho smolts into the lakes. For several years after the rotenone treatment, spawning runs of coho returned to their early 1950s level, peaking in 1970 at 71,000 fish. However, spawning runs declined sharply in the following years, coinciding with the recovery of the exotic fish species in the lakes and the new introduction of largemouth bass.

The introduction of hatchery fish into wild populations also has impacted the genetic diversity of coho salmon populations. For example, hatchery-reared coho salmon were released into the Coos River system beginning in the early 1900s, and non-native stocks were first introduced beginning in 1933. Stocks have been introduced from the Necanicum, Coquille, Klaskanine, and Alsea systems (ODFW 1993). Steelhead trout rear throughout the Forest and are considered wild and relatively unaffected by past hatchery releases. At this time, all hatchery coho broodstock (adult spawners) are native stock derived from adults captured in the Coos River system.

Beginning in 1998, returns of adult coho originating from Oregon coastal hatcheries have been nearly 100% marked with adipose fin clips. This marking has enabled the proportion of wild spawning fish to be estimated during spawning surveys using the recovery figures from the observations of the carcasses of hatchery-reared fish (Jacobs et al. 2002). From 1998-2001, wild fish were the dominant component of all spawning populations, with the exception of the mid-coast monitoring area (Siuslaw River Basin north through the Salmon River Basin). During the last 2 years, there have been few hatchery-reared coho observed among the naturally spawning populations in the monitoring areas encompassing the Forest. In 2000, there were no fin-marked fish observed in the Tenmile and Coos regions, but the lower Umpqua did have 0.4% marked fish. In 2001, the Tenmile and Coos regions had 0.4% marked fish and the lower Umpqua had 2.9% marked fish.

Fall Chinook

Population Status and Trends

In the analysis area, the population of fall chinook was likely significantly affected by ocean harvests, and in the Coos River system by a gillnet fishery until 1946 and splash dams until 1956. Introductions of non-native hatchery stocks also likely impacted fall chinook populations. Since 1900, hatchery-reared chinook have been released into the Coos River system. Introductions of non-native stocks first occurred in 1927 when eggs from Columbia River stocks were raised and released from the Coos River Hatchery (ODFW 1993).

Fall chinook populations remained at very low levels during the 1960s. Since then, populations have recovered somewhat, but probably not to their historical abundance (Nickelson et al. 1992, ODFW 1993). Based on spawning surveys from 1986-2001, fall chinook in the mid-south coast gene conservation area, which includes the Coos and Tenmile regions, have remained stable (Jacobs et al. 2002). In contrast, over the same time period there has been a declining trend in spawner abundance in the watersheds of the Tillamook-Nestucca Basin. Although the north coast and mid-south coast watersheds have very different population dynamics, the stability in the numbers of spawning chinook in the Coos and Tenmile regions is promising.

Habitat and Other Factors Limiting Populations

Because of their comparatively large body size, chinook salmon generally require greater water depths for upstream migration than coho, steelhead or cutthroat. Chinook salmon require holding pools close to spawning areas. Suitable spawning areas include stable gravels and cobbles. On the Forest, chinook salmon are confined primarily to the larger tributaries in the West Fork Millicoma River and the lower portions of Mill Creek. In this system, the key limiting habitats are deep pools and stable spawning gravels. Limited large wood, especially large wood jams in the large channels of the river, limits the creation of deep holding pools and the retention of spawning gravels.

Hatchery fish also have the potential to impact the genetic diversity of wild chinook populations, although this impact is limited since local, native brood stocks are used. A proportion of hatchery-reared fall chinook released from Oregon hatcheries are coded-wire tagged prior to release. Based on the occurrence of the tagged hatchery fish recovered in surveys of wild spawning areas, it appears that few hatchery fish stray into chinook spawning areas. For example, in 2000 a few hatchery fish were found in surveys of Coos River tributaries, with most fish derived from the Coos River stocks (Jacobs et al. 2002). Currently, about 100,000 juvenile chinook, derived from Coos River stocks, are reared and released at the West Fork Millicoma River Hatchery (on the Forest).

Winter Steelhead

Population Status and Trends

Oregon coastal steelhead population trends have traditionally been assessed through a combination of dam passage counts and angler harvest records. Coast steelhead populations have varied in abundance from year to year, largely influenced by ocean conditions and some impacts from harvest and freshwater conditions (Nickelson et al. 1992). From 1970-1990, most coastal steelhead runs, including the Coos River population, were below the long-term average (Nickelson et al. 1992). Since 1992, restrictions in the harvest of wild steelhead have eliminated the usefulness of angler harvest reporting for monitoring the status of coastal winter steelhead stocks (Jacobs et al. 2002). The ODFW developed a survey method for estimating winter steelhead spawning by counting redds, which will be implemented coast-wide in 2003.

Habitat and Other Factors Limiting Populations

Juvenile steelhead spend 1-4 years rearing in fresh water. Using similar fresh water, juvenile-rearing habitats as coho salmon, steelhead also require deep, complex pools and off-channel habitats that provide refuge from high winter stream flows.

Although hatchery stocks have the potential to impact the genetic diversity of wild steelhead populations, currently this impact is limited because local native brood stocks are used. Releases of hatchery-reared steelhead in the Coos River system began in 1925 and continued through 1958 with mostly local stocks reared at the South Coos Hatchery (ODFW 1993). Beginning in 1970, Alsea River stocks were released into the Coos system, including the

West Fork Millicoma River. In 1980, Larson and Palouse Creeks were added to the releases of Alsea stocks. Beginning in 2003, less than 200 steelhead (all native broodstock) will be spawned at the ODFW hatchery on the lower West Fork Millicoma River (on the Forest).

Sea-run and Resident Cutthroat Trout

Population Status and Trends

Resident and anadromous cutthroat trout are native to all of the stream systems in the analysis area. Cutthroat trout are widely distributed in all of the drainages and can occur above natural barriers to migration, where resident populations reside. There is very little information on the population trends or status of resident or sea-run cutthroat trout in the Forest. Although most aquatic habitat inventory and fish survey information include observations of cutthroat, there is little other systematic survey information for the Forest.

Habitat and Other Factors Limiting Populations

Anadromous and resident cutthroat trout populations use smaller streams for spawning and rearing than those used by salmon and steelhead (ODFW 1993). Key habitat limitations for cutthroat include deep pool habitats with wood and cover. The health of the wild population would be improved by increasing habitat quality and connectivity. A key factor would be to address culverts that are fish passage barriers, including barriers for juvenile cutthroat trout.

Lamprey

Population Status and Trends

Pacific and brook lamprey are found on the Forest (river lamprey also may be present). Pacific lamprey is anadromous and brook lamprey is a resident species. Little is known about lamprey population status or trends, but the species appear to be declining. Currently, there is a petition to list Pacific, western brook, and other lamprey as threatened under the federal ESA (Klamath-Siskiyou Wildlands Center et al. 2003). Pacific lamprey is listed as "vulnerable" on Oregon's sensitive species list (ODFW 1997). Since 1968, the ODFW has counted adult Pacific lamprey at Winchester Dam on the North Umpqua River. These counts show a severe decline in lamprey abundance in the 1970s and very low numbers since that time (Kostow 2002). Although systematic presence/absence surveys targeting lampreys have not been done for Coast Range streams, lampreys appear to be present in most coastal streams (Kostow 2002). The ODFW aquatic habitat inventory and fish presence distribution crews have encountered lamprey in most areas they have surveyed on the Forest (personal communication, Randy Smith, ODF 2003).

Habitat and Other Factors Limiting Populations

Very little is known about the habitat or other issues impacting lamprey populations. Habitat issues that may contribute to the decline in lamprey populations are upstream passage over artificial barriers and through culverts and loss of high quality low-gradient flood plain habitats through channelization and reductions in in-channel large wood.

AMPHIBIANS AND REPTILES: HABITAT PREFERENCES AND POPULATION STATUS

Streams, lakes, wetlands, and riparian areas provide habitat for a number of amphibian and reptile species. Amphibians and reptiles are an important component of the forest fauna and several species are listed on the Oregon's sensitive species list. In headwater streams above the upper extent of fish distribution, amphibians are often the dominant vertebrate predators (Bury 1988). Table 8-9 describes the distribution, preferred habitats and status of aquatic and riparian-dependent amphibians on the Forest.

Reptiles, such as Western pond turtles, are found on the Forest. Pond turtles have been sighted in number of ponds and lakes, including Gould and Loon Lakes, and may be present in some slow water areas of streams (Allbritten 2002). The Western pond turtle is listed as "critical" on the state sensitive species list. Pond turtles require quiet water with rocky or mud bottoms and floating logs or other platforms for resting and basking at the water's surface. These turtles nest on land where there is appropriate substrate and a sunny location within a mile of water. Juvenile pond turtles are especially vulnerable to mortality from aquatic and nest predation and destruction of nesting areas.

Amphibians that occur in headwater stream reaches can be sensitive to disturbance. Increased sediment deposition in the stream channel and changes in water temperature regimes can affect juvenile and adult amphibians. Two headwater amphibian species, tailed frogs and seep salamanders, are especially sensitive to management impacts. Both species require clean substrate and cold waters (Bury et al. 1991). Tailed frogs and seep salamanders can be extirpated from stream systems by forest harvest actions that adversely impact habitat quality and water temperatures; because these species have limited dispersal ability, habitats are not quickly reoccupied (Corn and Bury 1989). Tailed frogs and seep salamanders are listed as "vulnerable" on the state sensitive species list (ODFW 1997).

Methods

There is limited information on the population status of aquatic and riparian-dependent amphibians in the Forest. Allbritten (2002) completed amphibian surveys of pump chances and a limited selection of streams in the Forest; Vesely and Stamp (2001) conducted a survey of amphibians on perennial, non-fish-bearing streams in the Forest.

Table 8-9. Aquatic and riparian-dependent amphibians found on the Forest.

Species	Distribution and Preferred Habitats by Life History Stage (Leonard et al. 1991)	Status (ODFW 1997)
Tailed frog, *Ascaphus truei*	Aquatic. Larvae usually found in cold, rocky streams. Adults prefer areas along the aquatic margins and cool, moist forests in the vicinity of streams. Tadpoles, especially during the first year, do not tolerate warm water. Observed on the Forest (Vesely and Stamp 2001).	Listed as vulnerable on state sensitive species list.
Red-legged frog, *Rana aurora aurora*	Adults are terrestrial and use areas adjacent to streams. Eggs laid in marshes, bogs, swamps, ponds, lakes, and slow moving streams. Observed on the Forest (ODF 1993, Allbritten 2002).	Listed as vulnerable on state sensitive species list.
Foothill yellow-legged frog, *Rana boylii*	Adults found in vicinity of permanent streams; most common in and near streams with rocky, gravely, or sandy bottoms. Eggs are attached to rocks or gravel in pools and stream margins. Observed on the Forest (ODF 1993).	Listed as vulnerable on state sensitive species list.
Pacific tree frog, *Pseudacris regilla*	Very common in the Oregon Coast Range. Requires slow, open water for breeding. Observed on Forest (Allbritten 2002).	---
Southern seep salamander (also called southern torrent salamander), *Rhyacotriton variegates*	Adults live in close proximity to cold streams, splash zones and seeps. Are uncommon. Larvae may be abundant in gravel with water percolating through it. Observed on the Forest (Vesely and Stamp 2001).	Listed as vulnerable on state sensitive species list.
Pacific giant salamander, *Dicamptodon tenebrosus*	Aquatic. Adults range through cool, moist forest areas in the vicinity of cold streams and lakes. Larvae are stream-adapted and common. Salmonids feed heavily on salamander larvae and adult salamander feed on small fish. Observed on the Forest (Vesely and Stamp 2001, Allbritten 2002).	---
Long-toed salamander, *Ambystoma macrodactylum*	Aquatic and terrestrial. Requires quiet water for breeding and feeding. Adults use downed logs or rock for cover and resting. Observed on the Forest (Allbritten 2002).	---
Dunn's salamander, *Plethodon dunni*	Adults usually associated with streams or seeps in the splash zone or under rocks, or occasionally woody debris. Eggs deposited in rocks near stream margin. Observed on the Forest (Vesely and Stamp 2001, Allbritten 2002).	---
Western red-backed salamander, *Plethodon vehiculum*	Adults range throughout forest areas, often found in rocky areas and also under logs and other wood. Observed on the Forest (Vesely and Stamp 2001, Allbritten 2002).	---
Northwestern salamander, *Ambystoma gracile*	During dry months, adults seek refuge in rotting logs and moist crevices. Larvae are adapted to ponds and slow moving streams. Observed on the Forest (Allbritten 2002).	---
Clouded salamander, *Aneides ferreus*	Adults often associated with large decayed logs and stumps, particularly Douglas-fir. Old burns and clearcuts may have large populations. Eggs laid in the cavities in large logs or stumps or in openings deep in rocks.	---
Ensatina salamander, *Ensatina eschscholtzii*	Adults often found in or under large wood, especially conifer logs, on forest floor. Eggs usually laid in cavities of logs and stumps. Observed on the Forest (Allbritten 2002).	---
Rough-skinned newt, *Taricha granulosa*	Aquatic. Adults range throughout forested areas. Eggs are deposited along the vegetated fringes of lakes, beaver ponds, and slow moving streams. Very common. Observed on the Forest (Vesely and Stamp 2001, Allbritten 2002).	---

Vesely and Stamp (2001) surveyed headwater streams for amphibians with the following goals: (1) compare populations of tailed frogs and seep salamanders in streams with riparian harvest buffers and unmanaged streams with older forests; and (2) assess the relative abundance of stream amphibians. In 1995, the Forest began implementing riparian buffers on perennial fish-bearing streams. The intensive portion of the study inventoried amphibians living in or near streams (within about 7 feet of the wetted channel). Nine pairs of streams flowing through recently clearcut units with riparian buffer strips and unharvested late-seral forests (>80 years old) were examined. Before the recent harvest, all of the streams within the clearcuts were in late-seral forest age classes. In addition to the intensive survey sites on buffered and forested stream segments, Vesely and Stamp (2001) sampled 59 transect segments at 44 sampling sites (extensive surveys) near road crossings throughout the Forest. Because of the higher road densities in the Coos region, most of the sampling effort was in this region.

Results

Allbritten (2002) found amphibians within most of the surveyed pump chance ponds. The most common species observed were rough-skinned newts and northwestern salamanders (primarily egg masses; Table 8-10). Based on the frequent sightings of egg masses, it appears that the ponds are important breeding areas for a number of aquatic-dependant amphibians, including long-toed and northwestern salamanders, and red-legged frogs. In addition to the pump chance sightings, there were some observations (not a systematic inventory) of amphibians in streams in the Coos region, with detections of Pacific giant, ensatina, western red-backed, and Dunn's salamanders.

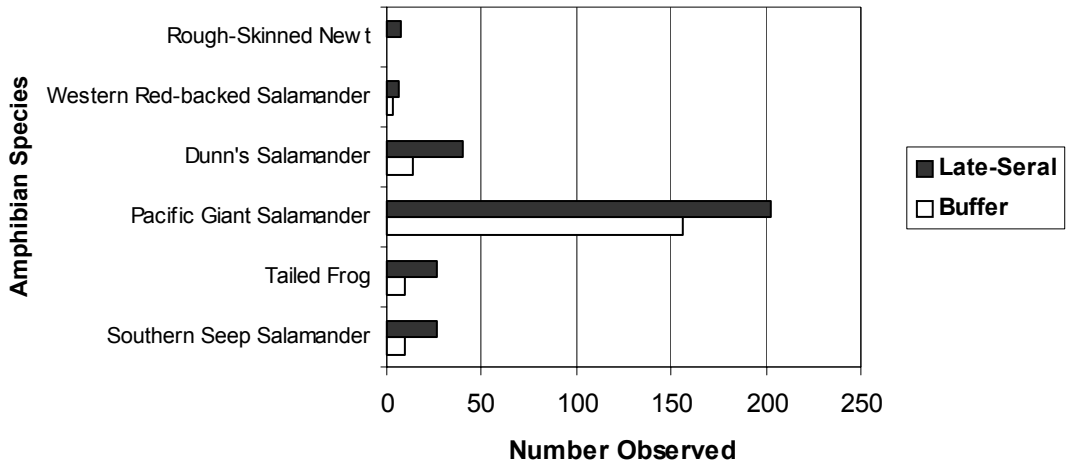
Table 8-10. Amphibians found in fire pump chance ponds on the Forest.

Species	Number of Sightings in Pump Chances	Notes
Long-toed salamander	11	Most sightings were eggs
Northwestern salamander	15	Most sightings were eggs
Pacific tree frog	9	
Red-legged frog	14	Most sightings were eggs
Rough-skinned newt	19	

Data from Marnie Allbritten, ODFW 2002.

The Vesely and Stamp study (2001) did not inventory a large enough sample of streams on the Forest in order to make general conclusions about the population status and possible impact of the non-fish-bearing stream buffers. However, the study does provide a snapshot for one time period for the distribution and numbers of amphibians for a limited number of sites. A total of 499 amphibians of 6 different species were found in streams flowing through buffered areas and late-seral stands. Figure 8-3 shows the distribution of amphibian observations for both the buffered and forested streams.

Figure 8-3. Number and species of amphibians in nine pairs of streams flowing through clearcuts with riparian buffer strips and late-seral forests (>80 years old).



Data from Vesely and Stamp 2001.

Amphibian species and their distributions varied across the study sites. Pacific giant salamanders were the most common species for both the buffered and intact forests. Small numbers of western red-backed and Dunn's salamanders were found in streams in both the buffered and forested sites. Rough skinned newts were the only species found only at the late-seral forest sites. The observations for tailed frogs and seep salamanders were highly variable. The seep salamanders were found at two of the nine riparian buffer sites and four of the nine late-seral forest sites. Tailed frogs were detected at two of the nine riparian buffer sites and seven of the nine late-seral sites. The density of tailed frogs was approximately three times greater, and seep salamander density was four times greater in the late-seral forest streams than in the buffered streams; due to the small sample size, these findings are not statistically significant. Unfortunately, the study did not report on the relationship between amphibian observations related to the distance from the wetted channel.

At the 44 extensive sampling sites, Vesely and Stamp (2001) detected tailed frog larvae at 9 out of 32 sites (28%) in the Coos region; 1 out of 6 sites (17%) in the Tenmile region; and zero out of 6 sites in the Umpqua region (0%). Seep salamanders were observed at 9 out of 32 (28%) sites in the Coos region; 1 out of 6 sites (17%) in the Tenmile region; and 3 out of 6 sites in the Umpqua region (50%).

Discussion

Both the Allbritten (2002) and Vesely and Stamp (2001) findings are consistent with other amphibian population inventories in the Coast Range. Most of the species observed in the pump chance ponds, long-toed and northwestern salamanders and red-legged and Pacific tree frogs, have larvae that are adapted to ponds and slow moving water. In other studies of headwater streams, giant salamanders were noted to be the most abundant amphibians, followed by tailed frogs, with some observations of seep and Dunn's salamanders (Bury et

al. 1991). All of these amphibians have aquatic larvae and adults that remain within close proximity to the stream.

There is evidence that forest management actions can affect amphibians residing in high-gradient headwater streams. Amphibian species richness has been found to be highest in uncut forests (Corn and Bury 1989). At the drainage scale, all species except seep salamanders were positively associated with proportion of the stream length with forest bands greater than 140 feet in width (Stoddard 2001). Species richness was highest in uncut forests and in clearcut sites with uncut forest upstream (Corn and Bury 1989). Removing or reducing riparian forest near streams can affect the microclimate and stream temperatures, both of which can impact amphibians (Chan et al. 2003). Some amphibian species have limited dispersal ability after disturbance. There are studies showing that tailed frogs and seep salamander populations in large clearcuts in the Oregon Coast Range had not recovered in 3-5 decades after harvest (Bury and Hyde 2003).

The maximum number of tailed frogs found at one of the buffer sites equals the largest number of frogs found at a late-seral site, with seven observations at each site. Similarly, the maximum number of seep salamanders found at a buffer site (7) was close to the largest number found at a late-seral site (11). The distribution of tailed frogs and seep salamanders found in the study can perhaps be explained by variable habitat qualities in both the buffered and intact forest streams. Both sites with large numbers of tailed frogs had the highest percentages of cobble substrate. There is evidence that tailed frogs prefer cobble substrates and are negatively affected by stream sedimentation (Bury et al. 1991).

To thoroughly examine the impact of riparian-buffer strategies on amphibian populations, future Forest studies should evaluate populations before and after riparian harvest and track trends over time. It is especially important to characterize stream habitat variables and water temperatures. These monitoring efforts should examine a range of stream systems and management impacts, including road sediment delivery to stream channels. In the long term, stream sedimentation may be the most important determinant of the number of amphibians (Bury et al. 1991).

SUMMARY OF STREAM HABITAT AND FISH POPULATION INVENTORIES

In 1993, the ODFW in collaboration with the ODF began inventorying stream habitats in the Forest. Since the start of the program, habitat inventories have been completed for most of the extent of anadromous salmon distribution in the Forest. Many streams have been resurveyed over subsequent years. These surveys measure instream habitat characteristics (pool size and depth, active channel width, amount of wood in the channel, and other attributes), streamside vegetation, and valley attributes (valley width and other factors) up the length of the stream and tributary channels to a point at which it is determined that fish use may cease (these surveys are not used to determine the official end of fish distribution in streams; the upper extent of fish presence is assessed through separate inventories). All streams were divided into individual stream reaches, as determined by channel gradient and valley form. Stream habitat is measured either during summer or winter periods. Summer

habitat surveys provide information on low flow conditions, while winter habitat surveys characterize stream habitat during higher flows. Since stream conditions during the winter, particularly in pools and other off-channel habitat features that offer an escape from high flows, are important for juvenile coho survival, the winter habitat surveys can provide a picture of conditions that can limit coho salmon populations.

Methods

For this analysis, the most current summer and winter habitat inventories through 2002 were used. Inventories for many of the surveyed streams began below and continued into the Forest. Information was summarized only for the stream reaches inventoried on the Forest. The aquatic habitat inventory information used in this analysis is summarized in Appendix D. Information on the number of complex pools (pools with more than three pieces of large wood) was not summarized for inventories before 1995.

Results

The aquatic habitat inventories cover more than 120 stream miles in the Forest (Map 8.5). Most of the inventoried miles are in the Coos region, which has the most miles of mapped stream channels (Figure 8-4). The inventories encompass a range of stream channel gradients, from low-gradient areas to steep headwater streams near the end of fish distribution (Table 8-11, Figure 8-5). Throughout the Forest, 64% of the known fish-bearing streams have completed aquatic habitat inventories. The Coos region has the highest percentage of inventoried fish-bearing streams (72%), followed by the Tenmile (62%), and Umpqua (42%) regions. More than 60% of inventoried stream miles are for low-gradient (<4%) channels, which provide good information on the preferred habitats for coho salmon. Based on other stream inventory data, fish presence (usually resident cutthroat) starts to end at higher gradients; usually there are no fish present above 12% gradients.

Figure 8-4. Miles of Forest streams with aquatic habitat inventories.

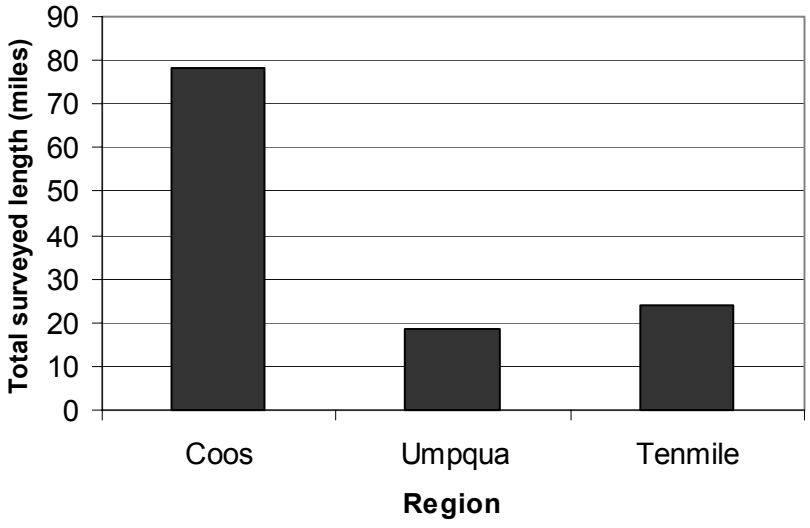
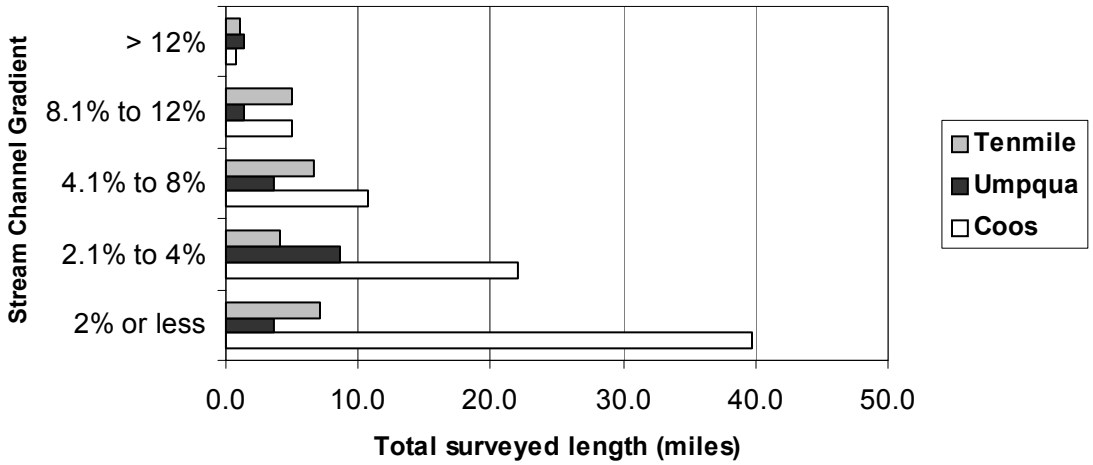


Table 8-11. Miles of streams inventoried by gradient class for each region.

Region	Surveyed Length (mi.) and Percent for Each Gradient Class					Total
	2% or less	2.1% to 4%	4.1% to 8%	8.1% to 12%	> 12%	
Coos	39.8 (50.8%)	22.0 (28.1%)	10.7 (13.7%)	5.0 (6.4%)	0.8 (1.0%)	78.3 (100%)
Umpqua	3.7 (19.8%)	8.6 (46.0%)	3.7 (19.8%)	1.4 (7.5%)	1.3 (7.0%)	18.7 (100%)
Tenmile	7.1 (29.8%)	4.1 (17.2%)	6.6 (27.7%)	5.0 (21.0%)	1.0 (4.2%)	23.8 (100%)

Source: GIS analysis of mapped ODFW aquatic habitat inventory reaches.

Figure 8-5. Miles of streams inventoried by gradient class for each region.



Low-gradient streams can contain the highest quality fish habitat and are responsive to restoration actions such as the placement of large wood. For this reason, aquatic habitat information was evaluated for stream channels with gradients less than 4%. Low-gradient stream channels are distributed in the lower reaches of most inventoried streams (Map 8.6).

Pool habitat is a good indicator of aquatic habitat quality. A pool area of 35% of the total stream area is the aquatic habitat quality benchmark established by the ODFW (Jacobsen and Thom 2001). According to this benchmark, 35% of the stream surface in pools is desirable and less than 10% is undesirable. In addition to percent pool area, an indication of pool depth and complexity provides additional information on habitat quality. According to the aquatic inventory protocol, complex pools must have at least three pieces of wood within the pool. Pools over 3.3-feet deep are summarized to provide information on these important habitats. In general, the Tenmile region has the highest quality pool habitats, measured by percent pool area, depth, and complexity (Table 8-12). It is the only region that exceeds the ODFW's benchmark for percent pools.

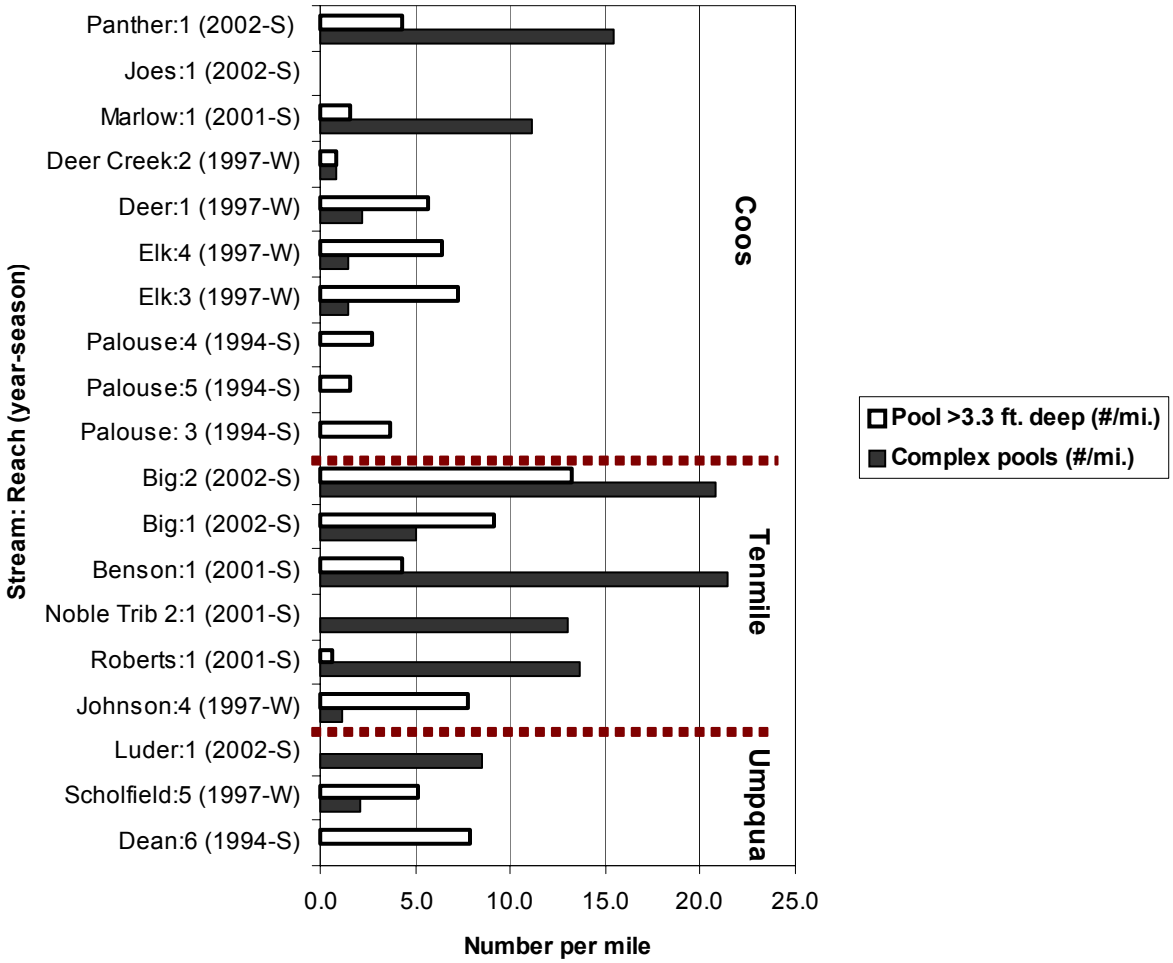
Table 8-12. Average pool characteristics for inventoried streams reaches of less than 4% gradient by region.

Region	No. Reaches	Average Percent Pools	Average No. Pools per Mile > 3.3 feet.	Average No. Complex Pools per Mile
Coos	32	27	2.7	4.7
Tenmile	14	40	3.9	9.7
Umpqua	11	25	4.1	3.2

Individual stream reaches vary in their habitat quality. Figures 8-6 and 8-7 provide summaries for the numbers of pools deeper than 3.3 feet, complex pools, and percent pool area for stream reaches less than 2% gradient and less than 40-foot active channel width. Figures 8-8 and 8-9 provide the same pool characteristics for stream reaches between 2.1% and 4% gradient and less than 40-foot active channel width. Among the streams with an active channel width less than 40 feet, the Tenmile region consistently had the highest pool habitat quality, particularly Big and Benson Creeks. In the Umpqua region, Luder Creek has the highest pool habitat values, and also has high wood loading (Chapter 7, *Riparian Vegetation and Large Wood*). However, most of the stream reaches had pool habitat values below their potential. The limited large wood in the stream channels contributes to the lower pool area and complexity. Stream channels with widths less than 40 feet are ideal candidates for the placement of large wood to increase habitat complexity.

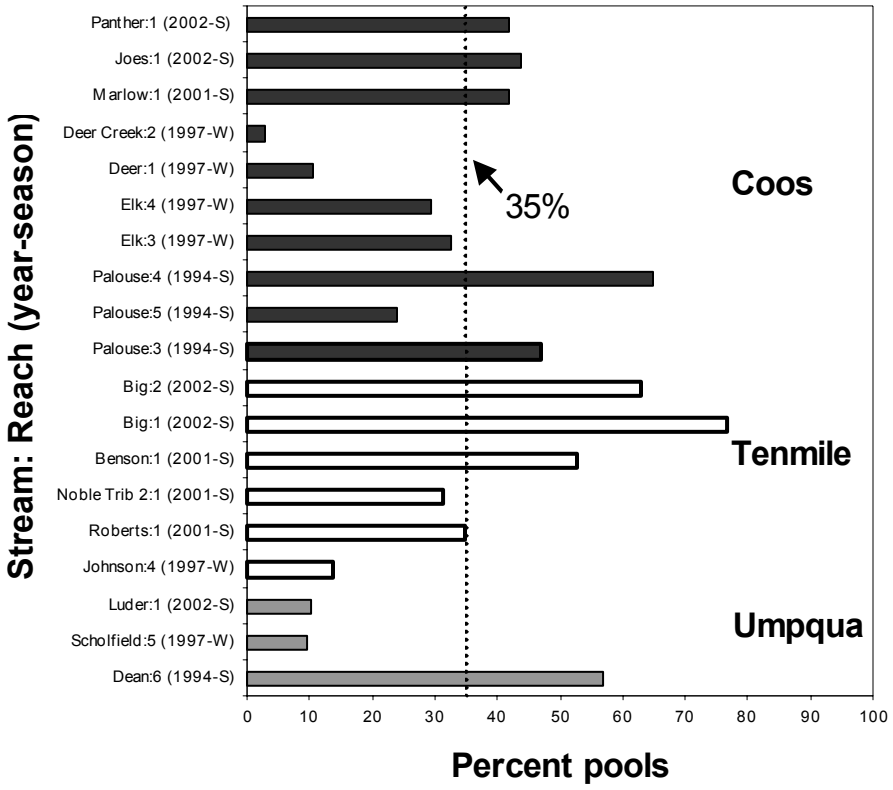
Stream reaches with larger channel widths consistently had poor indicators of habitat quality. Figures 8-10 and 8-11 provide summaries for the numbers of pools deeper than 3.3 feet, complex pools, and percent pool area for stream reaches less than 2% gradient and greater than 40-foot active channel width. Of the inventoried reaches, Dean and Charlotte Creeks in the Umpqua region and Johnson Creek in the Tenmile region had the highest quality pool habitats. The Coos region streams had the overall lowest indicators of pool habitat quality.

Figure 8-6. Pools deeper than 3.3 feet and complex pools for streams less than 2% gradient and active channel width less than 40 feet for streams by region.



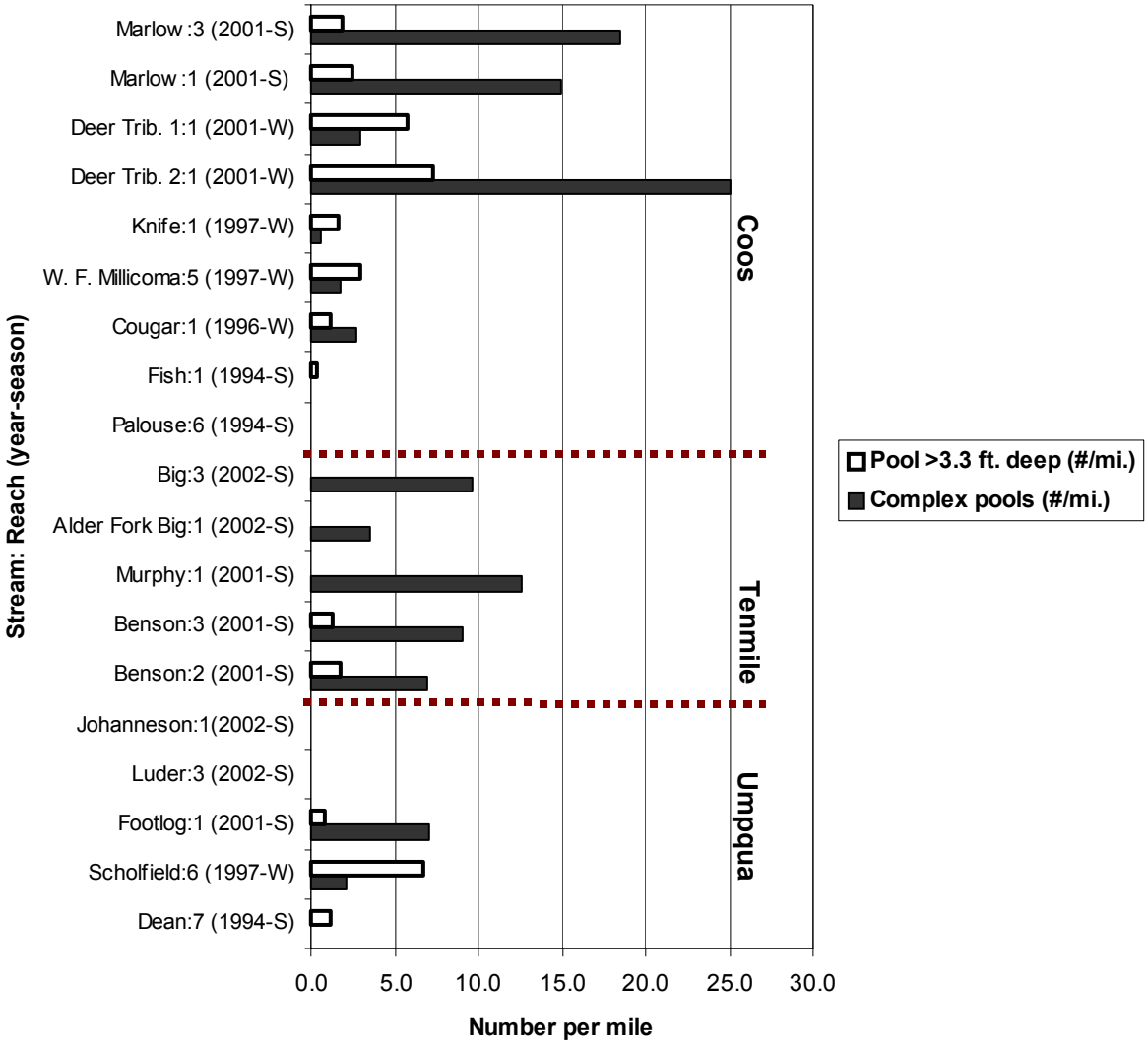
Note: There were no complex pool measurements for Palouse and Dean Creeks (data collected before 1995).

Figure 8-7. Percent pools for streams less than 2% gradient and active channel width less than 40 feet for streams by region.



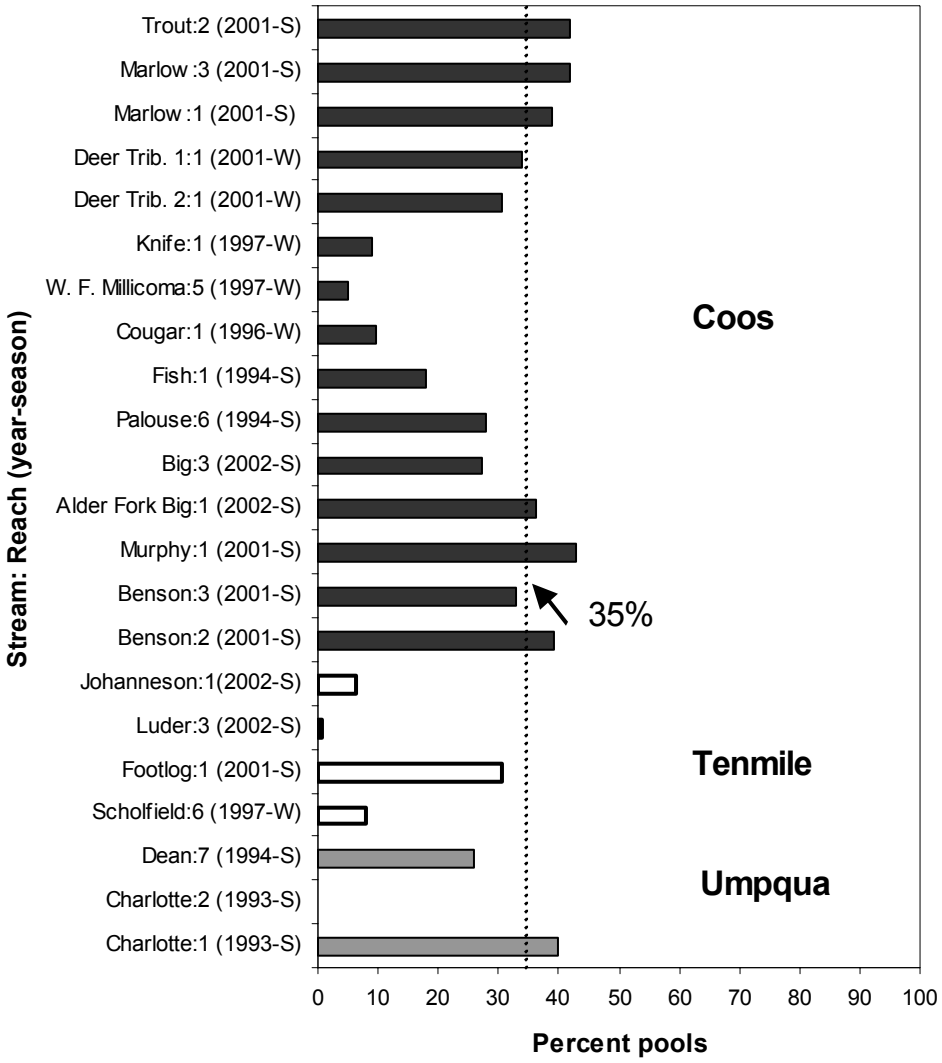
Note: The 35% pool surface area is the habitat quality benchmark established by ODFW.

Figure 8-8. Pools deeper than 3.3 feet and complex pools for streams between 2.1% and 4% gradient and active channel width less than 40 feet by region.



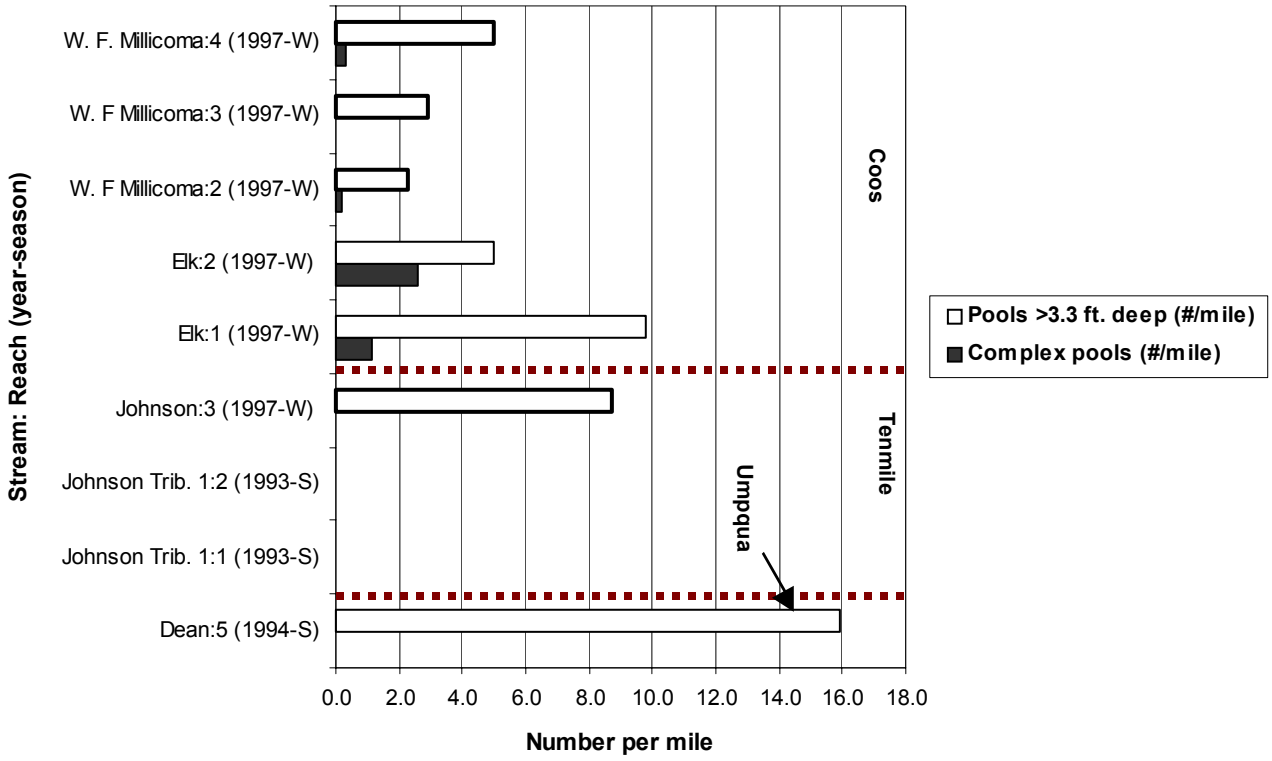
Note: There were no complex pool measurements for Palouse, Fish, and Dean Creeks (data collected before 1995).

Figure 8-9. Percent pools for streams between 2.1% and 4% gradient and active channel width less than 40 feet for streams by region.



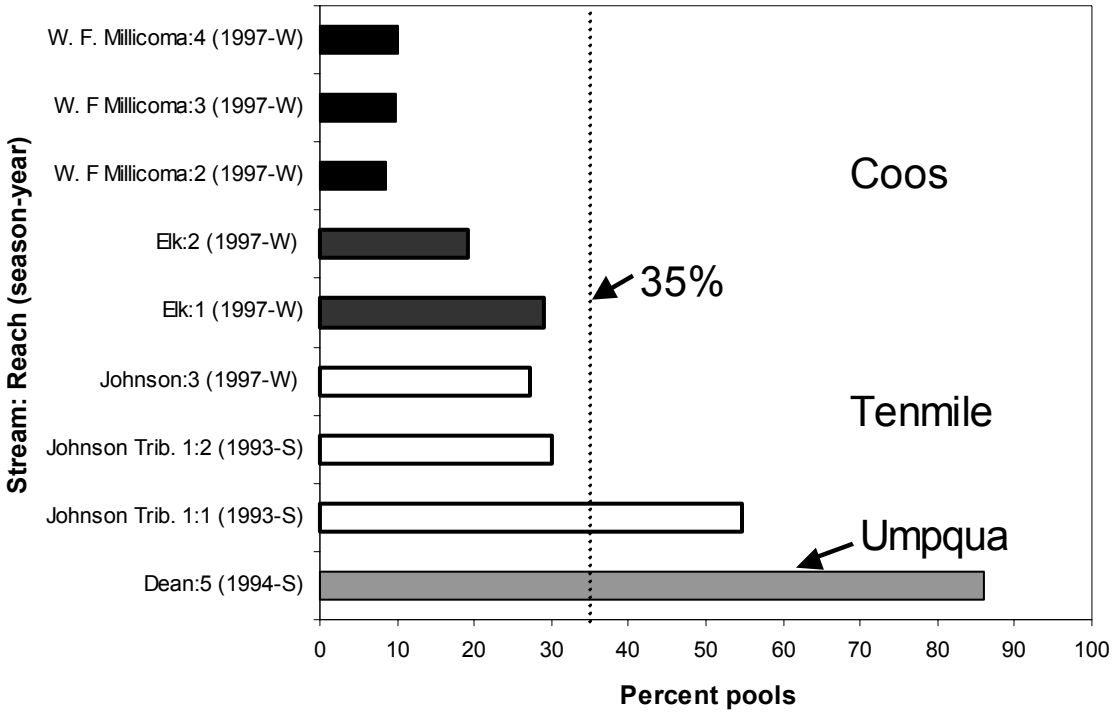
Note: The 35% pool surface area is the habitat quality benchmark established by ODFW.

Figure 8-10. Pools deeper than 3.3 feet and complex pools for streams less than 2% gradient and active channel width more than 40 feet for streams by region.



Note: There were no complex pool measurements for Charlotte, Johnson, and Dean Creeks (data collected before 1995).

Figure 8-11. Percent pools for streams less than 2% gradient and active channel width more than 40 feet for streams by region.



Note: The 35% pool surface area is the habitat quality benchmark established by ODFW.

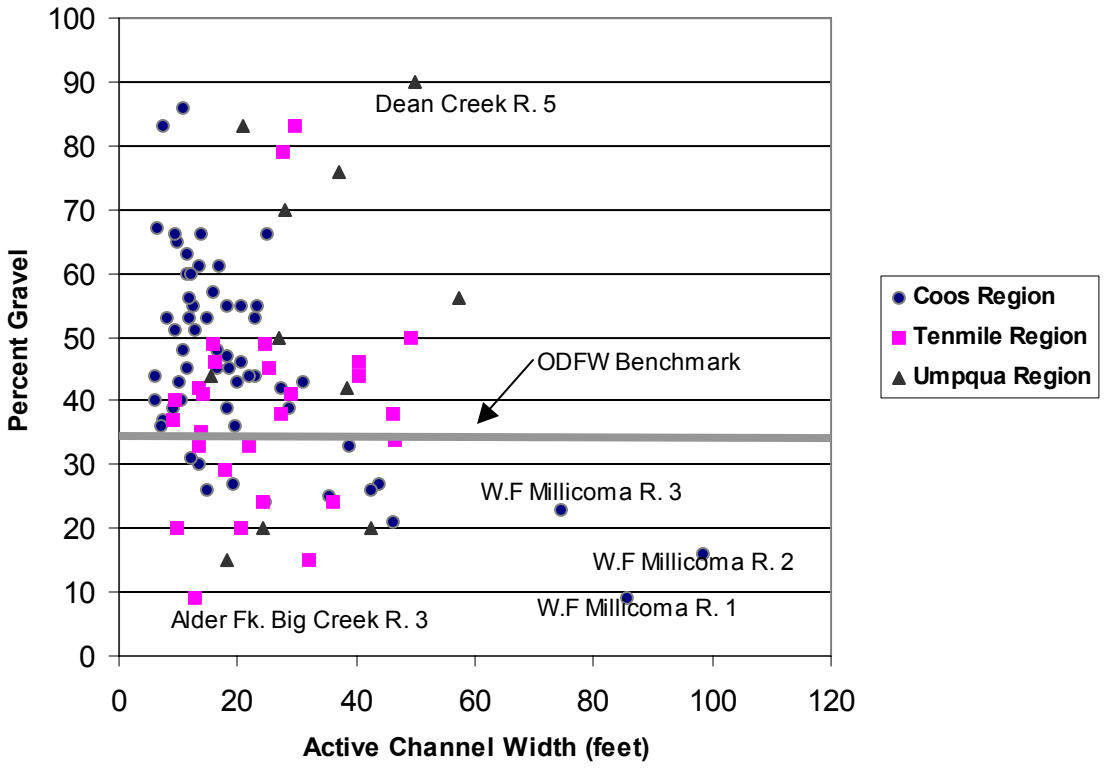
Gravel substrate in stream channels is important for providing spawning habitat and creating scour pools and other high quality habitats. A gravel area of 35% of the total riffle area is the aquatic habitat quality benchmark established by the ODFW (Jacobsen and Thom 2001). According to this benchmark, 35% of the riffle surface in gravels is desirable and less than 15% is undesirable.

Most of the inventoried low-gradient stream reaches in the Coos, Tenmile, and Umpqua regions have average percent gravels in riffle areas near the ODFW habitat benchmark (Table 8-13). However, there is considerable variability in the distribution of riffle gravels, with almost no association between gravel retention and active channel width (Figure 8-12). The wide channels of the West Fork Millicoma River, where there is limited large wood or other structure to capture material, have minimal gravel retention. On the other hand, many streams with active channel widths less than 40 feet have limited riffle gravels, which is usually associated with limited in-channel large wood.

Table 8-13. Average riffle gravel percentages for inventoried stream reaches.

Location	Average Percent Gravel
Active channel less than 40 feet	
Coos Region	49
Tenmile Region	38
Umpqua Region	50
Active channel greater than 40 feet	
Coos Region	20
Tenmile Region	40
Umpqua Region	55

Figure 8-12. Average percent gravels for inventoried reaches by region.



Note: The 35% average gravel for a stream reach is the habitat quality benchmark established by ODFW.

Discussion

There are some high quality stream habitats in the Forest, particularly in the Tenmile region and selected streams in the Coos region, such as Palouse Creek. However, many reaches of stream lack complex pool habitats. Limited wood volume in stream channels, and the interrelated issue of limited gravels in many riffle habitats, contributes to the current aquatic habitat quality. Information on habitat quality for stream reaches provides a framework for identifying opportunities to target stream habitat improvements through the placement of in-channel large wood and other restoration opportunities.

ANALYSIS

Overview

Based on information from aquatic habitat inventories and other studies for the Forest, the primary limiting factor for aquatic productivity for fish and aquatic-dependent amphibians is in-channel and riparian habitat. Other factors having an influence on aquatic habitat quality include: (1) fish passage barriers; (2) road-related sediment delivery to streams; (3) streamside roads constraining channel migration and habitat formation; (4) water quality; and (5) delivery of sediment, gravels, and large wood to channels from landslides. The first of these four factors can be significant *local* constraints on aquatic habitat productivity; at the scale of the entire Forest, however, they are not as significant as in-channel conditions and riparian habitat to current and future aquatic habitat quality. The final factor, landslide-generated material delivered to stream channels, can play a significant long-term role in improving habitat by contributing large wood and gravels to stream channels (see Chapter 6, *Erosion and Sediment*).

Many of the local factors constraining aquatic habitat quality have been addressed through effective management of the Forest. As previously discussed in this chapter, most significant fish passage barriers have been replaced or removed, and the Forest is working cooperatively with watershed councils and other interests to address the remaining passage problems. There are, in comparison to most areas in the Oregon Coast Range, very few streamside roads in the Forest. The restricted length of roads next to streams limits both sediment delivery to channels and the impact on constraining aquatic habitat formation and riparian condition. Many of these road issues on the Forest have been addressed through road decommissions and improvement of drainage patterns using effective placement of relief culverts and other measures. There remain, however, significant opportunities to address roads generating sediment delivery to streams and constraining habitat formation, especially in wide flood plains (see Chapter 6).

The chief water quality concern is elevated water temperature in some stream reaches (see Chapter 5, *Water Quality*). Most of the elevated water temperatures occur within reaches of the larger streams and rivers (e.g., West Fork of the Millicoma River), with most of the smaller tributary streams providing cool water. These cool water tributaries provide important habitat and refuge from the warmer waters for juvenile coho salmon and other fish

and amphibians. It is important to continue to maintain cool water tributary streams and explore ways to improve water temperatures where monitoring has identified water temperature issues. Large wood plays an important role in trapping gravels in Forest streams and, as large wood recovery occurs in the future, a drop in water temperature may occur.

Finally, the issue of landslide delivery of material to stream channels requires on-going adaptive management to understand and manage. There is increasing evidence that natural landslides are an important contributor of the large wood and gravels that help shape high quality aquatic habitat. Although episodic events, such as catastrophic windthrow, fire, or severe floods occur infrequently, they can add massive amounts of wood to streams in a short period of time. Landslides and debris torrents can transport large amounts of large wood and gravels from hillslopes and headwater streams into downstream reaches (Bilby and Bisson 1998). While the Forest has addressed many of the road-related landslides (see Chapter 6, *Erosion and Sediment*), there is a need to better understand the role of headwall leave trees in providing large wood that is transported to stream channels through natural landslides.

Aquatic and riparian habitat is the key issue affecting current and future aquatic habitat quality. Compared to historic levels, there appears to be limited wood in stream reaches in the Forest (see Chapter 7, *Riparian Vegetation and Large Wood*). In-channel wood is indisputably important for the creation and maintenance of stream habitat. Large wood is the primary determinant of channel form in small streams, creating pools, cover and other complex habitats (Bilby and Bisson 1998). While wood has less impact on channel form in larger streams, it does play an important role, especially in the formation of large logjams and side-channel areas. Wood in streams is related to the capture and retention of sediments, gravels, and fine organic mater.

Unfortunately, there are no quick fixes for addressing the limited wood in the Forest's streams. The streamside forest is the most important source of large wood. Input of wood, especially large conifer logs from riparian areas, will take decades (see Chapter 7). There is limited riparian habitat in the mature riparian conifer or mixed conifer/hardwood condition, which has implications for current and future large wood delivery and wildlife habitat. Riparian areas with mature conifer forests (stand ages >99 years) are important habitats for amphibians and many wildlife species (see Chapter 9, *Terrestrial Wildlife*).

Aquatic Restoration Opportunities

Low-gradient streams can contain the highest quality fish habitat, especially for spawning and rearing coho salmon, and are responsive to restoration actions such as the placement of large wood. To help identify aquatic habitat restoration opportunities, two key attributes of stream quality, percent pools and in-channel large wood, were assessed for low-gradient stream reaches of less than 4%. Stream reaches were identified with limited volume of in-channel wood (<250 cubic feet per 100 feet of stream) and moderate surface area in pools (<20%; Map 8.7). These values were chosen as very low thresholds based on ODFW aquatic habitat benchmarks and information on the range of natural variability of large wood (see Chapter 7, *Riparian Vegetation and Large Wood*). Two measures, active channel widths of less than 40 feet and greater than 40 feet, were assessed separately to provide guidance on

the appropriate type of restoration. It is important to note that because active channel width is an average for the reach, there will be sections of identified reaches with an active channel width of less than 40 feet.

For the Forest, there are more than 40 miles of streams with active channel widths less than 40 feet, which are characterized by limited habitat complexity, as expressed in percent pools and/or large wood in the channel (Table 8-14). Small stream habitats are the most responsive to the addition of large wood. These streams are found in all of the watershed analysis basins, with the largest number in the Coos region, especially basins #11 and #12 (Map 8.7).

Table 8-14. Stream reaches with limited pools and minimal in-channel wood with active channel widths less than 40 feet and gradients less than 4% that provide opportunities for aquatic habitat restoration (Map 8.7).

Region	Analysis Basin	Streams	Length of Stream by Watershed Analysis Basin (mi.)		
			Pools <20% by Reach	Large Wood <250 cu. ft. per 100 ft. of Stream	Pools <20% by Reach and Large Wood <250 cu. ft. per 100 ft. of Stream
Coos	8	Larson, Sullivan	---	1.5	0.23
	10	Marlow	---	3.3	0
	11	Cougar, Elk, Fish, Panther, W.F. Millicoma	---	7.0	8.8
	12	Deer, Joes, Knife, Otter, Trout	---	2.6	7.6
Umpqua	1	Footlog	---	1.1	---
	2	Charlotte, Luder	1.1	---	0.7
	3	Johanneson, Dean	---	2.9	---
	4	Scholfield	---	--	1.1
Tenmile	5	Alder Fork, Big, Murphy	---	4.6	0
	6	Benson, Roberts	---	4.2	0
		Combined	**1.1**	**29.7**	**18.4**

There are more than 32 miles of streams with active channel widths greater than 40 feet with low percent pools and/or large wood in the channel (Table 8-15). While these stream channels are less responsive to the addition of large wood, there are opportunities to add structure though effectively designed logjams, rock weirs, and other habitat structures. These streams are found primarily in the Coos region, particularly the West Fork of the Millicoma River and Elk Creek (Map 8.7).

Monitoring by the Coos Watershed Association on Forest streams and other parts of the Coos watershed demonstrate the habitat benefits of in-channel wood placement (Coos Watershed Association 2001). Hillslopes or roads confine many of the streams in the Forest, even low-gradient channels. However, these confined channels are responsive to the addition of large wood, which creates pools, cover, and captures bedload. While low-gradient streams should be priorities for the addition of large wood, higher gradient streams (4% to 6%) do provide important habitat, especially for steelhead and resident trout. These

streams also can benefit from the addition of large wood to the channel. Based on monitoring information, in-channel wood placements are remarkably stable, with very minor downstream movement of logs (Coos Watershed Association 2001).

Table 8-15. Stream reaches with limited pools and minimal in-channel wood with active channel widths greater than 40 feet and gradients less than 4% that provide opportunities for aquatic habitat restoration (Map 8.7).

Region	Analysis Basin	Streams	Length of Stream by Watershed Analysis Basin (mi.)		
			Pools <20% by Reach	Large Wood <250 cu. ft. per 100 ft. of Stream	Pools <20% by Reach and Large Wood <250 cu. ft. per 100 ft. of Stream
Coos	9	W.F. Millicoma	---	---	9.5
	11	Elk, W.F. Millicoma	---	1.7	4.3
	12	W.F. Millicoma	---	---	10.8
Umpqua	2	Charlotte	---	1.2	---
	3	Dean	---	0.8	---
	4	Scholfield	1.6	---	---
Tenmile	7	Johnson, Johnson Trib. 1	---	2.2	0.7
		Combined	**1.6**	**5.9**	**25.3**

High Quality Aquatic and Riparian Habitats

While most of the fish-bearing streams in the Forest will benefit from the addition of in-channel large wood, there are limited areas with high quality stream habitat. In addition, there are limited riparian areas that are in mature conifer conditions. It is important to identify these areas to provide a framework for effective management to maintain and improve these habitat attributes. In addition, these areas serve as models of quality habitat, providing a way to determine changes in key habitat attributes, such as large wood delivery and transport, monitored over time.

To help identify these high quality stream and riparian habitats, in-channel large wood and riparian stand type were assessed for low-gradient stream reaches of less than 4%. Stream reaches were identified when they had relatively large volumes of wood (>500 cubic feet per 100 feet of stream), and riparian stands within 50 feet of the stream were delineated when they had primarily conifers with stand ages older than 99 years (Map 8.8). These values were chosen as thresholds based on the range of natural variability of large wood and the limited area in mature conifer condition for the future delivery of in-channel large wood (see Chapter 7, *Riparian Vegetation and Large Wood*). While wood in stream reaches and riparian stand type are not the only determinants of aquatic habitat quality, they are key components and can be manipulated using habitat restoration actions. In addition, mature riparian conifer stands are important indicators of habitat quality for amphibian and other wildlife species (see Chapter 9, *Terrestrial Wildlife*).

For the Forest, there are very few low-gradient stream reaches (1.3 miles) with the threshold value of large wood or mature riparian stands (Table 8-16; Map 8.8). Only two streams, Palouse Creek in the Coos region and Nobel Creek in the Tenmile region, had wood volumes greater than 500 cubic feet per 100 feet of stream. Both streams are very productive systems for coho. There are less than 13 miles of streams that are bordered by mature conifers. The Coos region has the greatest length of streams with mature riparian stands, with most of the stands along the West Fork Millicoma River and Elk Creek.

Table 8-16. High quality aquatic (in-channel large wood) and mature riparian conifer (stand age older than 99 years) habitat for inventoried stream reaches with gradients less than 4% (all active channel widths, Map 8.7).

Region	Analysis Basin	Streams	Length of Stream by Watershed Analysis Basin (mi.)	
			Large Wood >500 cu. ft. per 100 ft. of Stream	Mature Conifer within 50 ft. of Steam
Coos	8	Palouse	0.8	0.5
	9	W.F. Millicoma	---	3.2
	11	Cougar, Elk, Fish, Panther, W.F. Millicoma	---	3.8
	12	Joes, Knife, Otter, Trout, W.F. Millicoma	---	1.8
Umpqua	1	Footlog	---	0.1
	2	Charlotte, Luder	---	1.6
	3	Dean, Johanneson	---	1.0
	4	Scholfield	---	0.3
Tenmile	5	Big, Murphy, Noble*	0.5	0.1*
	6	Benson	---	0.4
	7	Johnson Trib. 1	---	0.1
		Combined	**1.3**	**12.9**

* 0.1 mile of Noble Creek has mature conifer near the stream and greater than 500 cubic feet of large wood per 100 feet of stream.

RECOMMENDED ACTIONS AND MONITORING

Because there is limited wood in stream channels on the Forest, a significant opportunity exists to restore this important aquatic habitat component. Stream restoration actions could focus primarily on in-channel wood placement within two management opportunity areas: operational and strategic. Operational restoration actions would focus opportunistically on timber sales, while strategic actions would target specific stream reaches. In both cases, where possible, large wood restoration should target achieving post-project volumes within the range of natural variability for the watershed. In most cases, at least 500 cubic feet of wood should be placed per 100 feet of stream. Operational wood placement in stream channels would focus opportunities for restoration involving the planning and administration of timber sales. Key considerations for these operations include:

- Can logs be placed safely?
- Is the stream fish bearing and what fish species are present?
- What is the gradient? The criterion is less than 6%.
- What is the active channel width? The criterion is less than 40 feet.
- Are the necessary log sizes available? The criterion is log length at 2 times the active channel width.

These criteria are general guidelines; there will be opportunities, based on site-specific considerations, to deviate from the criteria. For example, with proper configuration, it is possible to place wood in the channel that is shorter than 2 times the active channel width. In situations related to a timber sale where it is not safe or appropriate to place logs in a channel, the logs can be stockpiled for use at another site.

Strategic stream restoration actions identified in this analysis can focus on stream reaches and other areas, such as roads. There are opportunities to target in-channel wood placement with other coordinated restoration actions such as improving road drainage and fish passage in the vicinity. There have been a number of these integrated projects completed on the Forest, particularly with the Coos Watershed Association (Coos Watershed Association 2001). Many of these actions can be accomplished in cooperation with local watershed councils. Actions identified in this analysis for monitoring within the Forest include:

- Examining the impact of headwater stream riparian buffer strategies on amphibian populations by evaluating populations before and after riparian harvest and tracking trends over time. It is especially important to characterize stream habitat variables and water temperatures. These monitoring efforts could examine a range of stream systems and management impacts, including road sediment delivery to stream channels.
- Assessing and tracking the impact of stream habitat restoration projects on aquatic habitat quality. On a subset of project sites, wood volume and other habitat attributes should be inventoried before and after the completion of the project, and through time.
- Develop a study to assess and track the contribution of in-unit headwall leave tree areas on the contribution of wood through landslides and torrent tracks to downstream reaches. Monitor the movement of wood through stream channels through time.
- While there are no identified fish passage barriers downstream of the Forest, there may be barriers on some small streams. For this reason, private landowners and watershed councils should be encouraged to inventory fish passage barriers downstream of the Forest.
- In stream reaches where elevated water temperatures have been identified, increasing stream gravel retention through in-channel restoration actions may help cool water temperatures. In these areas, gravel deposition and water temperatures should be monitored within stream reaches where large wood has been placed.