9 Fish and Fish Habitat

9.1 Introduction

A variety of native and introduced fish species inhabit the Wilson River watershed. Native species, especially salmonids, are of particular interest and, assuming they are the most sensitive species in stream networks, are often used as indicators of overall aquatic health (WPN 1999, Bottom et al. 1998, Carigan and Villard 2002). Other fish species, however, are also increasingly being used to indicate aquatic health (e.g., lampreys) and knowledge about which species inhabit particular areas is important for predicting the types and severity of species interactions and their ecological consequences.

The health of fish populations is intricately linked to aquatic habitat conditions. Habitat conditions that are good for salmonids generally reflect habitat conditions that are good for other species of aquatic biota. In many cases, understanding historic and current aquatic habitat conditions allows resource managers to better predict how various land use practices influence species distributions, relative abundance and population status. Furthermore, understanding how current habitat conditions compare to historic conditions allows land use managers to asses how subwatersheds may be functioning (e.g., meeting proper functioning condition).

In many cases, answers to OWEB questions were sufficiently answered in the 2001 OWEB watershed assessment (e.g., native/introduced species present, fish distributions and life histories; E & S Environmental Chemistry) and are, therefore, only briefly addressed and referenced here. In other cases (e.g., fish population abundance, aquatic habitat conditions, barriers to fish passage), additional surveys/projects have been completed since the 2001 OWEB assessment and have been incorporated below.

9.2 Species, Listings, and Extinctions

Six salmonids (steelhead trout, cutthroat trout, Chinook, chum, pink[86] and coho salmon), three species of lamprey (Pacific, river, Western brook lamprey), two species of sturgeon (Green and White sturgeon), and several species of non-game fish have either been documented in, or, where records are lacking, are presumed to inhabit[87] the Wilson River watershed (Table 63). While all species (with the

[86] Juvenile pink salmon were documented in a smolt trap on the Little North Fork Wilson in 2003. Dave Plawman (ODFW-Tillamook Fish Biologist), personal communication, July 12, 2007.
[87] Based upon geographic species distributions and/or documented presence in nearby river systems.

exception of the summer steelhead *race*) are native to the Wilson River, not all species and life stages are found throughout the basin. For example, adult and sub-adult sturgeon are found in tidewaters of the Wilson River while adult sockeye salmon[88], but no juveniles, have been documented. The salmonid life history strategies were presented in the 2001 OWEB assessment and are therefore not presented here (E & S Environmental Chemistry 2001).

Several of the species inhabiting the Wilson River watershed have been extensively reviewed by State and/or Federal biologists and listed as *Species of Concern, Sensitive, Vulnerable, Candidate, Threatened*, or *Endangered* species (includes both State and Federal listings). The Federal government authority responsible for protecting anadromous species, NOAA Fisheries, recently issued final species listing determinations (2005-2006) and final critical habitat designations (2005) for several species (includes Species Management Units and Distinct Population Segments) of anadromous salmonids found in the Pacific Northwest (Table 63).

As of December 2007, none of the anadromous salmonid species inhabiting the Wilson River watershed are currently listed as *Threatened* or *Endangered* under the federal Endangered Species Act (ESA; Table 63). The Oregon Coastal winter steelhead trout are federally listed as a *Species of Concern* and are listed by the State as *Vulnerable*. In the most recent assessment of Species Management Units (SMUs) of Oregon native fishes (ODFW 2005), the Oregon Coastal winter steelhead trout are listed as Potentially At Risk of extinction (Table 63). Neither the coastal fall and spring Chinook salmon SMUs are listed by the State but the interim assessment for the Spring run is Potentially At Risk and the Fall run Not At Risk of extinction (Table 63). While wild coastal coho populations are still doing poorly, as of December 2007, they were no longer federally listed as *Threatened* – although the official State listing is *Sensitive/Critical* – in part, because the U.S. District court ruled that hatchery fish must be included in counts when assessing population sizes. Nevertheless, counts of wild Coastal coho, aside from a few years with high numbers of adult returns that corresponded with high-productivity ocean cycles, continue to remain and are likely to be re-listed by NOAA Fisheries as *Threatened*. Additionally, chum salmon populations are listed by the State as *Sensitive/Critical* (Table 63).

Lamprey are increasingly also becoming regarded as indicator species of overall aquatic health and three species of lamprey are known (or suspected) to inhabit

[88] Gillnet fishery records from the 1920's make no mention of sockeye salmon. Additionally, there are generally less than 5 adults captured by fisheries biologists every year and they are presumed to be Columbia River strays.

the Wilson River watershed (Table 63). The Pacific and river lampreys are anadromous fishes while the and Western brook lamprey are solely freshwater residents. All three species are federally listed as *Species of Concern* and listed by the State as Sensitive/Vulnerable, with the latest population assessments of At Risk for both the Pacific and Western brook lampreys (Table 63).

Additionally, two species of sturgeon, Green and White sturgeon, spend at least portions of their life cycles in the lowermost reaches of the Wilson River. Neither species are listed by the State but the North Coast ESU of the Green sturgeon is federally listed as a Species of Concern (Table 63). Several other species of non-game fish inhabit the Wilson River watershed but little is known about the health, abundance, distributions or status of their populations.

9.3 Native and Introduced Salmonids

All the salmonids currently found in the Wilson River are native to the watershed except summer steelhead trout, which are not indigenous to Tillamook Bay. They have been stocked throughout the Basin since 1965 but are not known to be naturally reproducing or self-sustaining in the Basin.[89]

9.4 Native/Introduced Species Interactions

Summer steelhead trout are currently the only introduced salmonid known to inhabit the watershed. They are, however, reportedly not naturally reproducing (see previous footnote). Given their presence in the system and the similarity of their habitat/food preferences to other native salmonids, it is likely that summer steelhead are negatively interacting with native salmonids (e.g., occupying habitat, consuming food resources, behavioral interactions) but the extent and severity is unknown. The Tillamook Estuaries Partnership, with funding from the US Environmental Protection Agency's National Estuary Program, has in place an aggressive exotic species detection program that covers Tillamook Bay (Cohen 2004) but no such systematic program exists for the detection of introduced species in the Wilson River and implementation of the plan has been stymied by lack of funding.

[89] Summer steelhead trout are not known to be naturally reproducing or self-sustaining (Keith Braun [ODFW-Tillamook Fish Biologist], personal communication, July 12, 2007).

Table 63. Status of native fish species found (or likely to be found) in the Wilson River watershed (as of December 2007). Species populations or management units that have not been evaluated have no data in the cells.

Species [1]	ESU / DPS / SMU [2]	ESA Listing Status [3]	ESA Critical Habitat[4]	Oregon State Status[5]	Interim Assessment[6]
Steelhead trout (*Oncorhynchus mykiss*)	Coastal Winter	Species of Concern [7]	NA	Sensitive/ Vulnerable	Potentially at Risk
Chinook salmon (*O. tshawytscha*)	Coastal Fall	Not Warranted	NA	NA	Not at Risk
Chinook salmon (*O. tshawytscha*)	Coastal Spring	Not Warranted	NA	NA	At Risk
Chum salmon (*O. keta*)	Coastal	Not Warranted	NA	Sensitive/ Critical	At Risk
Pink salmon (*O. gorbuscha*)	Undefined in Oregon				
Coho salmon (*O. kisutch*)	Coastal	Not Warranted [7]	NA	Sensitive/ Critical	Not at Risk
Cutthroat trout (*O. clarki clarki*)	Oregon Coast	Not Warranted[7,8]	NA	Sensitive/ Vulnerable	Not at Risk
Pacific lamprey (*Lampetra tridentata*)	Coastal	Species of Concern [9]	NA	Sensitive/ Vulnerable	At Risk
River lamprey (*L. ayresi*)	Oregon Coast	Species of Concern [9]	NA	Sensitive/ Vulnerable	NA
Western brook lamprey (*L. richardsoni*)	Coastal	Species of Concern [9]	NA	Sensitive/ Vulnerable	At Risk
Green sturgeon (*Acipenser medirostris*)	North Coast [10]	Species of Concern [9]	NA	NA	Not At Risk
White sturgeon [11] (*Acipenser transmontana*)	Oregon	NA	NA	NA	Not At Risk
Threespine stickleback (*Gasterosteus aculeatus*)					
Coast Range sculpin (*Cottus aleuticus*)					
Prickly sculpin (*Cottus asper*)					

Sources for ESU/DPS/SMU: NOAA Fisheries Northwest Regional Office website (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Index.cfm) and ODFW's Oregon Native Fish Status Report (2005).

1 The ESA defines a "species" to include any distinct population segment (DPS) of any species of vertebrate fish or wildlife.

2 For Pacific salmon, NOAA Fisheries considers an Evolutionarily Significant Unit, or "ESU," a "species" under the ESA. For Pacific steelhead, NOAA Fisheries has delineated Distinct Population Segments (DPSs) for consideration as "species" under the ESA.

[3] Updated final listing determinations for salmon species were issued on June 28, 2005 (70 FR 37160). Updated final listing determinations for West Coast steelhead species were issued on January 5, 2006 (71 FR 834).
[4] Final critical habitat designations for several West Coast salmon and steelhead species were issued on September 2, 2005 (70 FR 52488 and 52630).
[5] As of 2/13/2007. From the State Threatened and Endangered and State Sensitive lists.
[6] Assessment of Species Management Units (SMUs) From ODFW's Native Fish Report (2005).
[7] Updated from the 2001 Wilson River Watershed Assessment (E & S Environmental 2001). Likely to be re-listed by NOAA Fisheries as *Threatened* in early 2008.
[8] There is still some debate within NOAA Fisheries whether this ESU is likely to become endangered in the near future.
[9] Species petitioned with the US Fish and Wildlife Service for listing.
[10] Northern Coast species management unit (SMU), reflecting the DPS definitions set by NOAA Fisheries.
[11] Lower Columbia/Coastal population of Oregon species management unit (SMU).

9.5 Historic Salmonid Distribution

Salmon and trout were known to inhabit the Wilson River watershed and have been utilized by humans for at least the last 1,000 years (USACE 1975). Information pertaining to their distribution at the time of European settlement through the early 1900's, however, is virtually non-existent. Even distributions of other species native to the watershed (e.g., lampreys, minnows, suckers, sculpins, sturgeons, etc.) are not clearly defined.

There is a dearth of historical fish distribution information for fishes inhabiting the Wilson River watershed. Recognizing this, the Oregon Department of Fish and Wildlife (ODFW) conducted an analysis using a map of stream size and gradient developed by the Coastal Landscape Analysis and Modeling Study (CLAMS[90]) to identify areas above current fish distributions that could have potentially supported salmon/steelhead in the past (Kavanagh et al. 2005). The analysis assumed that fish distribution would have been limited by stream gradients if impediments such as physical barriers or poor habitat were not present and compared the current fish distribution maps with the CLAMS-generated maps. Although somewhat speculative in nature, the results indicate that historic salmon distributions may have been similar to their present distributions[91].

9.6 Current Salmonid Distributions

There are approximately 2,421.4 miles of perennial and intermittent streams in the Wilson River watershed (Table 64). Anadromous salmonid species, present in every subwatershed in the Wilson River basin, can be found along roughly 119.6 miles of Wilson River streams, or in approximately 20.2% of the perennial streams found in the watershed. Including resident cutthroat trout, salmonids can

[90] Found online at http://www.fsl.orst.edu/clams/.
[91] See maps 17 and 18 in Kavanagh et al. 2005.

be found along roughly 312.7 miles of Wilson River streams, or in approximately 52.8% of the perennial streams found in the watershed (Table 64). Chum salmon have the most restricted distribution (~16 miles; Table 65 and Map 5) while winter steelhead trout have the broadest *mapped* distribution (~116 miles; Table 65 and Map 8). Although ubiquitous throughout the Wilson River watershed, no specific spatial data layers yet exist mapping the distribution of coastal cutthroat trout. Additionally, little is known about the spatial extent of the sea-run (anadromous) form of coastal cutthroat trout. Overall, however, coastal cutthroat trout frequently occur well upstream of winter steelhead trout and exhibit the broadest salmonid distribution in the Wilson River, generally corresponding to "Type F" (fish-bearing) streams (see Table 64 footnotes).

Table 64. Fish presence by stream type.

Stream Type	Fish Presence [1]	Stream length (miles)	% Stream Type	% of Total
Perennial	Fish[2]	312.66	52.8	12.9
	Non-fish[3]	167.30	28.3	6.9
	Unknown	111.73	18.9	4.6
Intermittent	Fish[2]	0.00	0.0	0.0
	Non-fish[3]	782.61	42.8	32.4
	Unknown	1,047.28	57.2	43.2

[1] Classified by the Oregon Department of Fish and Wildlife. Includes both verified and non-verified presence and/or absence. Stream classification rules under the FPA, however, have changed and all unknown streams are in the process of being reclassified as Fish or Non-fish using DEM-modeled criteria.

[2] Fish-bearing = Type F.

[3] Non fish-bearing = Type N.

The Oregon Department of Fish and Wildlife, based upon the species/race life history stages, has designated stream segments by the type of fish use (roughly corresponding to their respective life history stages). Fish use type 1 corresponds to spawning and rearing habitat, type 2 to rearing and migration habitat, and type 4 to previous or historic distribution (i.e., not detected/observed in the within the past five reproductive cycles).

Chum salmon, the anadromous salmonid species with the narrowest distribution range in the Wilson River watershed (refer to Table 65 and Map 5), can only be found in the lowermost reaches of the Wilson River in the Lower Wilson (lower two thirds) and Little North Fork Wilson (lower third) subwatersheds (Map 5).

Spring Chinook salmon, the anadromous salmonid with the second-most restricted distribution range in the Wilson River watershed (refer to Table 65 and

Map 6) and can generally be found in the mainstem of the Wilson River from tidewater up to the confluence of the Devils Lake Fork and South Fork of the Wilson subwatersheds (Map 6).

Table 65. Wilson River anadromous fish presence by species, miles, and percent of the perennial streams in the watershed inhabited by the species. [1]

Common Name	Miles Inhabited	% Inhabited [1]	Distribution Map [2]
Chum salmon	15.59	2.6	Map 5.
Chinook salmon – Spring run	32.77	5.5	Map 6.
Summer Steelhead [3]	73.51	12.4	Map 8.
Chinook salmon – Fall run	76.24	12.9	Map 6.
Coho salmon	105.85	17.9	Map 7.
Winter steelhead	116.20	19.6	Map 8.

[1] Percent of perennial streams in the Wilson River watershed occupied by the species.
[2] An Oregon Department of Fish and Wildlife (ODFW) analysis derived from juvenile anadromous salmonid productivity and habitat distributions concluded that historic distributions of anadromous salmonids in the Wilson River watershed were probably very similar to their current distributions (Kavanagh et al. 2005).
[3] Not a native race of fish. Summer steelhead were introduced into the Wilson in the early 1960's and are entirely supported by hatchery programs.

The species with the next broadest range of distribution are the summer steelhead trout and the fall Chinook salmon, each inhabiting nearly the same number of miles of streams in the Wilson River watershed (refer to Table 65 and Maps 6 and 8). Both species can be found in every subwatershed of the Wilson River but summer steelhead trout can generally be found further upstream than fall Chinook in the Devils Lake Fork and Jordan Creek subwatersheds while fall Chinook salmon can generally be found further upstream than summer steelhead in the Little North Fork, Upper Wilson/Cedar Creek, North Fork and South Fork subwatersheds (Maps 6 and 8).

Coho salmon have the second broadest distribution of anadromous salmonids found in the Wilson River (refer to Table 65 and Map 7), are widely distributed throughout the mainstem and larger tributaries of the Wilson, and are found in all the subwatersheds in the Wilson (Map 7).

Winter steelhead are the most broadly dispersed of all the anadromous salmonids found in the Wilson River (excludes the resident form of cutthroat trout), are widely distributed throughout the mainstem and moderate to larger tributaries of the Wilson, and are also found in every subwatershed in the Wilson (Table 65 and Map 8).

9.7 Historic Salmonid Abundance

Salmon runs in Oregon's rivers and streams have been reduced from predevelopment conditions but it is unclear by how much (Meengs and Lackey 2005) because reliable and consistent fish counts don't appear until several decades after settlement. Additionally, there is little data specific to the Wilson River watershed that characterizes the historic abundance of fish. There are, however, some basin-wide (Tillamook Basin) studies from which we can infer historical trends and actions that were likely to have affected fish populations in the Wilson River watershed in historical times.

Some of the earliest accounts of fish in the basin come from some of the first European explorers who, from their interactions with the Native Tillamook peoples, described how the Tillamook caught "many salmon in the small creeks" (Bancroft 1886). Early settlers to the region describe the rivers of the area as teeming with hordes of trout and salmon, especially as the freshets arrived in the fall (Maddux 1976). By the late 1800's, commercial salmon gillnet fisheries in the bay were operational. The first cannery in the bay opened in 1885 and stimulated a small commercial fishery, presumably targeting coho salmon (*Oncorhynchus kisutch*), one of the most abundant anadromous fishes present in pre-settlement Tillamook Bay (Coulton et al. 1996). Despite the San Francisco market for Tillamook Bay canned salmon (USACE 1975), canneries did not keep pack records until 1892. That same year, the first commercial fishing regulations (directed at coho) were instituted and involved seasonal and weekend closures (Mullen 1981). Even though coho were being intensively harvested beginning in the 1880's, catch records for these early commercial fisheries were often not kept. Spawning records, however, *were* kept beginning in the early 1900's and continue, with few interruptions, through to today (discussed in greater detail below).

Even though there is a paucity of data on historic salmon abundance in the Tillamook Basin from the mid-1800's until the early 1900's, we can use 1) estimated salmon harvest by Native Americans inhabiting the area, 2) fishery data and 3) cannery data to generate rough estimates of how large the runs were. For example, using Tillamook Native American population estimates and likely salmon consumption and harvest rates (for all species combined), Meengs and Lackey (2005) estimated that the Native Tillamook peoples harvested an average 1.97 million pounds of salmon from the Tillamook Basin every year. Using Craig and Hacker's (1940) estimate that Native Americans harvested anywhere from 28-57% of a run, depending on the size of the run, we estimate that average yearly biomass of all salmon returning the Tillamook Basin was between 3.46 – 7.04 million pounds. The Northwest Power Planning Council (1986) determined that the average weight for all species of salmon returning to the Columbia River was 6.62 – 9.27 pounds. Using this estimate to convert the total run size in pounds to the numbers of individuals returning to the Tillamook Basin, we estimate that the average annual run size was between 0.37 – 1.06 million salmon (Table 66). Using cannery pack data from the late 1800's, Meengs and Lackey (2005) estimated that the average annual run size in the Tillamook Basin in the late 1800's was approximately 285,000 salmon (234,000 coho and 51,000 Chinook; Table 66).

Table 66. Estimated historical smolt and adult anadromous salmonid counts from the Tillamook Basin and Wilson River in the late 1800's.

Basin/Subbasin [1]	# Coho Smolts	# Coho Adults	# Chinook Adults	Total Adults	Reference
Tillamook Bay	--	--	--	370,000-1,060,000 [2]	Meengs and Lackey 2005 Craig and Hacker 1940 NWPPC 1986
Tillamook Bay	--	234,000	51,000	285,000 [3]	Meengs and Lackey 2005
Tillamook Bay	3,288,000	329,000 [4]	--	--	Lawson et al. 2007
Tillamook Bay	--	292,500 [5]	--	--	Lawson et al. 2007
Wilson River	--	62,300-112,100 [4]	--	--	Lawson et al. 2007

[1] Tillamook Bay estimates include the Wilson River subbasin.
[2] Estimate derived from Native American consumption rates and amounts and average fish size.
[3] Estimate derived from historic cannery pack data.
[4] Estimate derived from juvenile salmonid productivity and stream habitat potential.
[5] Estimate derived from fisheries catch data.

In a study that focused specifically on coho salmon, Lawson and others (2007), using coho salmon smolt abundances and 1950's fisheries catch data from the Tillamook Basin and the *current* habitat potential, estimated that the annual historic number of returning adult coho salmon to the Tillamook Basin would have been between 292,500 (catch data) and 329,000 (from smolt abundance and stream habitat potential; Table 66). Lawson and others (2007) also estimated historic productivity of systems based on the number of hectares in a basin and provided an estimate of the number of adult coho salmon per hectare per year (see Figure 23 in Lawson et al. 2007). Using their productivity estimate for basins larger than ~12,355 acres (5,000 hectares), we calculated that the Wilson River may have produced between 62,300-112,100 adult coho per year (25th and 75th percentiles, respectively; Table 66). Lawson and others (2007) also estimated that the number of potential coho salmon *smolts* annually leaving the

Tillamook Basin in the late 1800's would have been about 3.29 million (Table 66). These estimates, however, should be regarded only as approximations of potential historic adult and juvenile abundances as there were a number of assumptions that were used in the calculations.

Because of their reliance on salmon as a primary protein source, salmon abundance has been shown to be a good predictor of Native American populations (Baunhoff 1963, Sneed 1972, Donald and Mitchell 1975, Hunn 1982). It is possible, however, that the precipitous population decline experienced by the Native Tillamook peoples (from first European contact through the middle to end of the 1800's) affected the size of salmon runs in Tillamook Bay, including the Wilson River. Therefore, salmon runs may have been larger from about the 1850's through the 1880's than just about any other time in post-glacial history because the Native Tillamook peoples were no longer harvesting large quantities of fish (Craig and Hacker 1940, Hewes 1973). Estimating run sizes or abundances prior to the 1900's with any degree of certainty, however, is difficult. Reliable and consistent fisheries data from the early 1900's to today, on the other hand, provides more reliable abundance estimates.

In a 1965 Oregon Fish Commission (later changed to "Oregon Department of Fish and Wildlife") report, Arthur Oakley reported the landings of Tillamook Bay salmonids (round weight) from 1923-1961 and the estimated numbers of fish caught in the fishery each November from 1957-1961. Oakley reported the numbers during three time periods (1923-47, 1948-56, and 1957-61) and assumed that the fish weights reported by fish buyers from 1957-61 was the actual total weight of the fish. During the reported time period, chum salmon were the most abundant salmonid captured in the fishery, with coho, Chinook, and steelhead following (Table 67). The poundage of each salmonid species captured in the fishery declined dramatically during each of the three successive time with declines of 91-97.5% from 1923 to 1961 (Table 67). Because there were limited fishing restrictions and closures during these time periods and the declines extended to stocks and localities outside of the Tillamook basin, Oakley attributed the decline to "some climatological or oceanic factor" and not necessarily to heavy fishing pressures (mortality rate of ~40%) or other "deleterious watershed activities."

9.8 Current Salmonid Abundance

The majority of abundance data (e.g., spawning counts, resting hole counts, juvenile outmigrants) collected by the Oregon Department of Fish and Wildlife (ODFW) is tabulated at a coarse scale (e.g., 5th Field or combination of 5th Field HUCs) and is similarly reported here, except where finer-scale resolution exists.

A three-year Rapid Biological Assessment (RBA), started in 2005, is ongoing in the Tillamook Basin (Bio-Surveys 2005, 2006). Information from the RBAs is presented on a subwatershed basis, where available.

Table 67. Average annual catch (in pounds) and average number of fish captured annually (in parentheses; 1957-61 only) of Tillamook Bay salmonid fisheries from 1923-1961 as reported by Oakley (1966).

	Species				
Time Period	**Steelhead**	**Chinook**	**Coho**	**Chum**	**Totals**
1923-47	36,987	277,406	384,656	844,016	1,543,065
1948-56	25,225	152,480	123,861	306,653	608,219
1957-61	2,957 (355)	19,247 (832)	9,620 (955)	69,386 (6,292)	101,210 (8,413)

Although variable, salmonid abundances have increased, some dramatically, since the 2001 OWEB watershed assessment. Most abundance estimates peaked between 2001 and 2003, except for peak counts of adult spring Chinook salmon in resting holes which peaked in 2004 (Table 68). It should be noted, however, that 1) these increasing abundance estimates correspond closely with the recent cycles of ocean productivity and 2) numbers are still a fraction of historic abundance estimates. Caution, therefore, should be used when considering the relative influence of freshwater habitats on recent abundance estimates.

Adult coho salmon abundance estimates for Tillamook Bay increased substantially in 2002 and 2003 but declined substantially between 2003 and 2004 (Table 68). Adult fall Chinook salmon counts in Tillamook Bay, however, have remained relatively stable since 2001 while spring Chinook salmon counts appear to be on the rise (Table 68). Adult Chum salmon counts in Tillamook Bay have decreased dramatically since 2001 and, at last count in 2004, the Tillamook population is 20% lower than the historic 30 year average but appears to be rebounding[92] (Table 68). There is no long-term Wilson River winter steelhead data available but recent counts indicate a decrease in the numbers of returning adults between 2003 and 2004 (Table 68). However, due to the small data sample, a reliable trend is not yet feasible. Few studies have targeted Tillamook Bay or Wilson River coastal cutthroat trout. The ODFW, however, has been running downstream migrant smolt traps in the Wilson River and expanded adult coastal cutthroat trout estimates increased from 1998 through 2001 but have been declining since (Table 68).

[92] Keith Braun (ODFW-Tillamook Fish Biologist), personal communication, 7/12/07.

Table 68. Adult abundance estimates and trend data (for spring Chinook salmon) by population, species and return year. Source: Oregon Department of Fish and Wildlife's 2005 Oregon Native Fish Status Report.

			Abundance by Return Year							30 Year Average
	Species	Run	1998	1999	2000	2001	2002	2003	2004	
Tillamook [a]	Coho [b]		--	--	1,734	1,416	13,733	14,042	4,584	
Tillamook [c]	Chinook	Fall [d]	--	--	3,876	14,820	16,872	13,908	15,048	14,364
Tillamook [e]	Chinook	Spring	--	--	2.7 [f]	2.7 [f]	4.5 [f]	3.6 [f]	9.2 [f]	8.1 [f]
Tillamook [g]	Chum [d]		--	--	5,508	40,176	36,126	23,733	20,169	24,462
Wilson [h]	Steelhead [i]	Winter	--	--	--	--	--	7,855 [j]	6,168 [j]	
Wilson [k]	Coastal Cutthroat Trout [l]		2,500	1,250	2,950	3,800	--	1,800	1,000	

[a] Includes Netarts Bay tributaries and Watseco Creek.
[b] Full seeding level = 5,700.
[c] Includes Netarts Bay tributaries.
[d] Expanded from peak counts of spawning fish per mile.
[e] Primarily from the Wilson, Kilchis, and Trask Rivers.
[f] Trend data only: number of adults counted per resting hole.
[g] All tributaries to Tillamook Bay.
[h] Wilson River and Kilchis River basins.
[i] Long-term data unavailable.
[j] Calculated from number of redds per mile, assuming 1.04 adults/redd (from Susac 2005).
[k] Little North Fork Wilson
[l] Approximate expanded number of downstream migrants captured in an ODFW Lifecycle Monitoring Program downstream migrant smolt trap. Years in which expansions could not be made are not presented.

Estimates of the number of juvenile salmonid species inhabiting the Wilson River during the summers of 2005 and 2006 were calculated in the Tillamook RBA studies. Information in the RBA was tabulated at the stream level (e.g., 7th Field HUCs and higher) and is presented at both the stream (Appendix K) and subwatershed (e.g., 6th Field HUCs; below) levels. Because the RBAs were carried out in the summer after nearly all of the Chinook and all of the chum salmon juveniles have left the system, their numbers were not reported. Additionally, RBA surveyors were unable to make distinctions between young-of-the-year (YOY) steelhead and cutthroat trout. Their counts, therefore, were combined into a "0+" category. Steelhead and cutthroat trout older than one year were differentiated into distinct categories.

Wilson River summer juvenile coho abundances in 2006 were much greater than 2005 (Table 69) and, being the most productive coho stream in the Tillamook Basin, accounted for approximately 43% of the entire Tillamook Basin juvenile coho population. The increase in numbers of juvenile coho in 2006 was in response to a surge in adult escapement for the 2005 winter brood, a direct result of good ocean productivity cycles. The top three producers of juvenile coho salmon in 2005 were, in order of magnitude, the Little North Fork of the Wilson, Devils Lake Fork, and the mainstem Wilson River (spanning several subwatersheds) and accounting for a combined 68.1% of the coho produced in the Wilson River (Table 69). The top three in 2006 were the same with the exception that the third biggest producer was the North Fork of the Wilson, replacing the mainstem Wilson, and accounting for a combined 63.2% of the coho produced in the Wilson River (Table 69).

Wilson River summer juvenile steelhead (age 1+) abundances were slightly lower in 2006 than 2005 (Table 69) but the Wilson River was still the most productive Tillamook Basin steelhead producing stream. The top three producers of juvenile steelhead in 2005 were, in order of magnitude, the mainstem Wilson River (spanning several subwatersheds), Little North Fork of the Wilson, and Devils Lake Fork, accounting for a combined 75.8% of the steelhead produced in the Wilson River (Table 69). The top three producers in 2006 were the same as in 2005, with the exception that the North Fork of the Wilson replaced the Devils Lake Fork, and accounted for a combined 76.4% of the steelhead produced in the Wilson River (Table 69). It should be noted, however, that steelhead are predominantly found in riffles/rapids and the RBA surveys only counted individuals in pools. Therefore, the actual number of steelhead juveniles produced is likely to be significantly underestimated by the RBAs.

Wilson River summer juvenile cutthroat trout (includes both resident and anadromous forms age 1+) also were slightly lower in 2006 than in 2005 (Table 69). The top three producers of cutthroat trout in 2005 were, in order of magnitude, the mainstem Wilson River (spanning several subwatersheds), the Little North Fork of the Wilson, and Jordan Creek, accounting for a combined 54.4% of the cutthroat trout produced in the Wilson River (Table 69). The top three producers in 2006 were the same, with the exception that the North Fork of the Wilson replaced Jordan Creek, and accounted for a combined 66.1% of the cutthroat trout produced in the Wilson River (Table 69).

The overall top three producers of juvenile salmonids in 2005 (and the most abundant salmonid) were, in order of magnitude, the mainstem Wilson River (0+ trout), the Little North Fork of the Wilson (coho salmon), and the Devils Lake Fork of the Wilson (coho salmon; Table 69). The top three producers in 2006 were the same except the Little North Fork of the Wilson (coho salmon) was the top producer, the mainstem Wilson River (coho salmon) was the second largest producer, and the Devils Lake Fork of the Wilson (coho salmon) was the third largest producer of juvenile salmonids (Table 69).

Table 69. Estimated abundance of Wilson River summer juvenile salmonids by species, subwatershed and year. Relative percent contribution (species by watershed) in parentheses. For a complete list of abundance estimates by sample locations, see Appendix O – Juvenile Salmonid Abundances. Source: 2005 and 2006 Tillamook Rapid Biological Assessments.

6th Field HUC	Year	Expanded Juvenile Salmonid Abundance and (subwatershed % contribution to the watershed, by species)			
		Coho	0+ trout	Steelhead [1]	Cutthroat [2]
Non-classified HUCs[3]	2005	17,875 (19.8)	35,545 (40.0)	12,030 (50.0)	2,120 (21.9)
	2006	23,725 (11.3)	12,990 (22.4)	10,025 (45.9)	3,245 (37.3)
Lower Wilson	2005	435 (<1)	315 (<1)	15 (<1)	125 (1.3)
	2006	575 (<1)	45 (<1)	55 (<1)	75 (<1)
Little North Fork Wilson	2005	25,430 (28.1)	19,970 (22.5)	3,960 (16.4)	1,590 (16.5)
	2006	63,960 (30.3)	15,650 (27.0)	4,070 (18.6)	1,590 (18.3)
Middle Wilson	2005	460 (<1)	970 (1.1)	210 (<1)	185 (1.9)
	2006	185 (<1)	680 (1.2)	175 (<1)	195 (2.2)
Jordan Creek	2005	3,165 (3.5)	5,060 (5.7)	1,635 (6.8)	1,545 (16.0)
	2006	15,585 (7.4)	5,375 (9.3)	930 (4.3)	715 (8.2)
Upper Wilson/ Cedar Creek	2005	5,460 (6.0)	4,780 (5.4)	470 (2.0)	1,175 (12.2)
	2006	21,525 (10.2)	6,145 (10.6)	1,460 (6.7)	785 (9.0)
North Fork Wilson	2005	9,365 (10.4)	9,450 (10.6)	1,980 (8.2)	1,345 (13.9)
	2006	26,545 (12.6)	8,740 (15.1)	2,605 (11.9)	910 (10.5)
Devils Lake Fork	2005	18,280 (20.2)	7,665 (8.6)	2,275 (9.4)	1,155 (12.0)
	2006	42,880 (20.3)	5,175 (8.9)	1,275 (5.8)	555 (6.4)
South Fork Wilson	2005	9,920 (11.0)	5,040 (5.7)	1,500 (6.2)	425 (4.4)
	2006	15,900 (7.6)	3,145 (5.4)	1,230 (5.6)	620 (7.1)
	2005	90,390	88,795	24,075	9,665
	2006	210,880	57,945	21,825	8,690

[1] Winter steelhead counts.
[2] Coastal cutthroat trout. No distinction made between resident and anadromous forms.
[3] The Rapid Biological Assessment (RBA) surveys did not categorize the mainstem Wilson River (or unnamed tributaries) into 6th Field HUCs.

The ODFW, for approximately the last 60 years, has conducted spawning surveys (abundance data) and adult resting hole counts (trend data) in several streams in and around the Tillamook Basin, including in the Wilson River. Spawning surveys targeted coho, chum and fall Chinook salmon while resting hole counts targeted summer steelhead, spring Chinook salmon and sea-run cutthroat trout.

Chum salmon spawning counts indicate substantial fluctuation in the last several decades with relatively steady but very small numbers of spawning individuals in the Wilson River during the last 10+ years while, overall, counts are well-depressed compared with historic numbers (Figure 50). Fall Chinook spawning counts in the Wilson River also indicate annual fluctuation but the counts over the last 30+ years have remained relatively constant and similar to, but slightly depressed from, historic numbers (Figure 51). Coho salmon spawning counts in the Wilson River indicate steady and dramatic declines from the 1970's through the 1990's when the population crashed, but recent years have seen a dramatic, but variable increase in counts (Figure 52).

Spring Chinook salmon resting hole counts in the Wilson River indicate a low, steady, cyclic pattern of several fish counted per resting hole for a year or two followed by few to no fish counted per resting hole for a year or two (Figure 53). Summer steelhead resting hole counts in the Wilson River also indicate a variable but relatively steady number of adult steelhead counted with an increasing trend in the number counted in each hole since the mid-1990's (Figure 54). Sea-run cutthroat trout resting hole counts in the Wilson River plummeted in the 1970's and have remained relatively low (~3 fish per resting hole) since, with the exception of 2004-2005 where counts were similar to pre-1970 levels (Figure 55).

Most of the native salmonids found in the Tillamook Basin and Wilson River have been supplemented by hatchery fish at some point in the past. Recent stocking of Tillamook Basin hatchery fish, however, has been limited (Table 70) and no stocking of either chum salmon or cutthroat trout has occurred in the Tillamook Basin in the last ten years[93].

[93] There has never been a hatchery program for chum salmon in Tillamook Bay. The only releases ever done were "payback fish" for eggs taken for other purposes (personal communication, Keith Braun, ODFW-Tillamook Fish Biologist, 7/12/07).

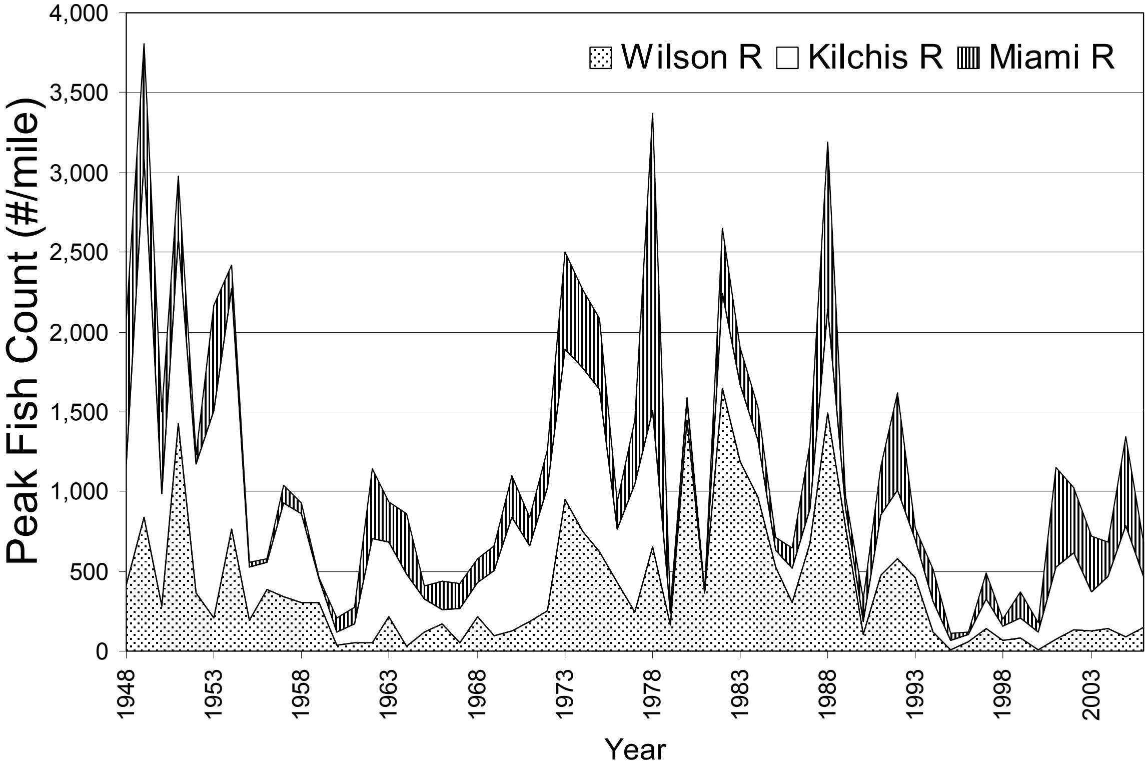

Figure 50. Chum salmon spawning counts, expressed as the peak number of fish per mile, from principle streams in the Tillamook Basin.

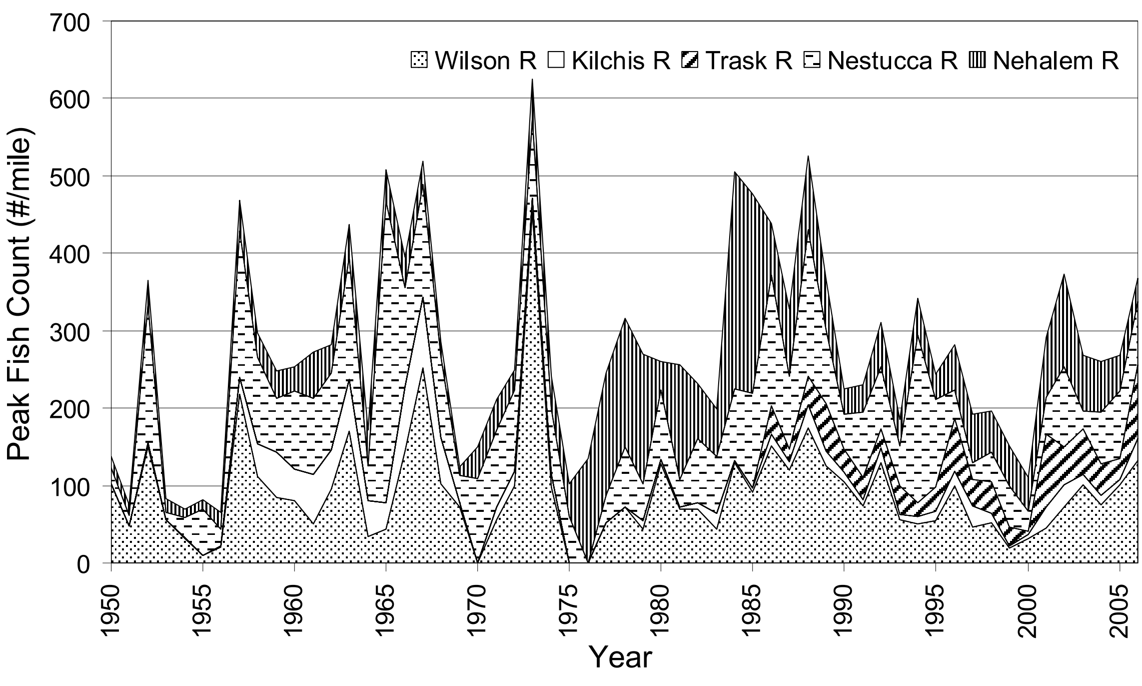

Figure 51. Fall Chinook salmon spawning counts, expressed as the peak number of fish per mile, from principle streams in and around the Tillamook Basin.

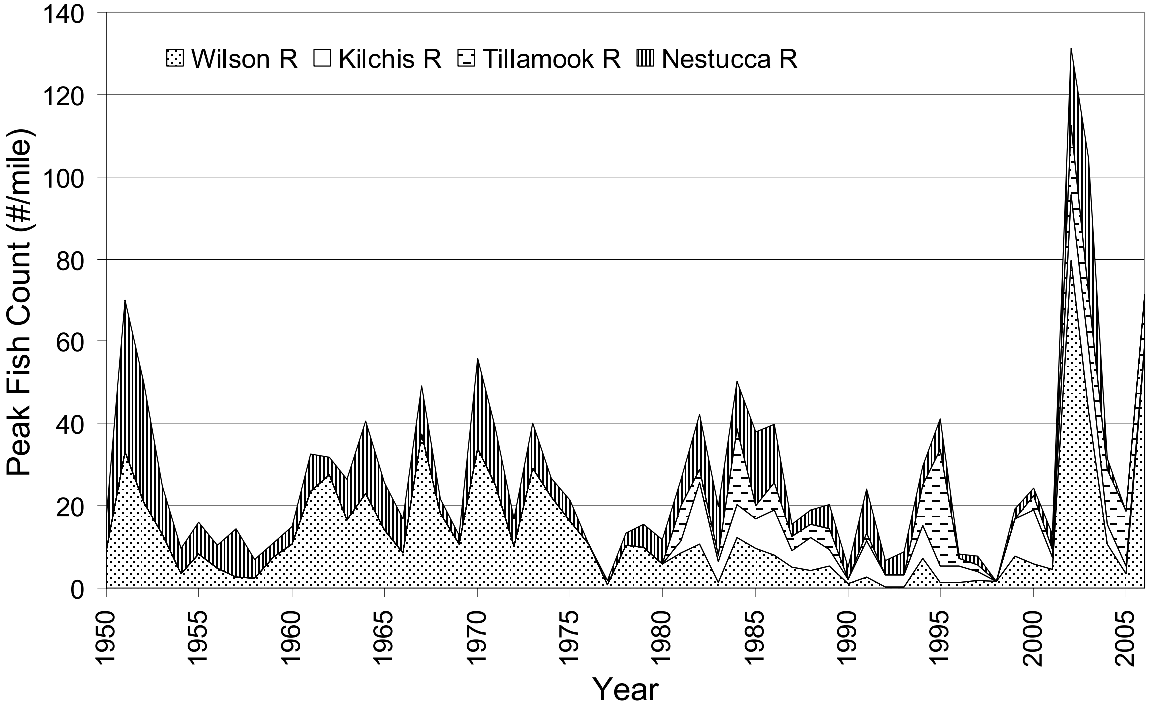

Figure 52. Coho salmon spawning counts, expressed as the peak number of fish per mile, for principle streams in and around the Tillamook Basin.

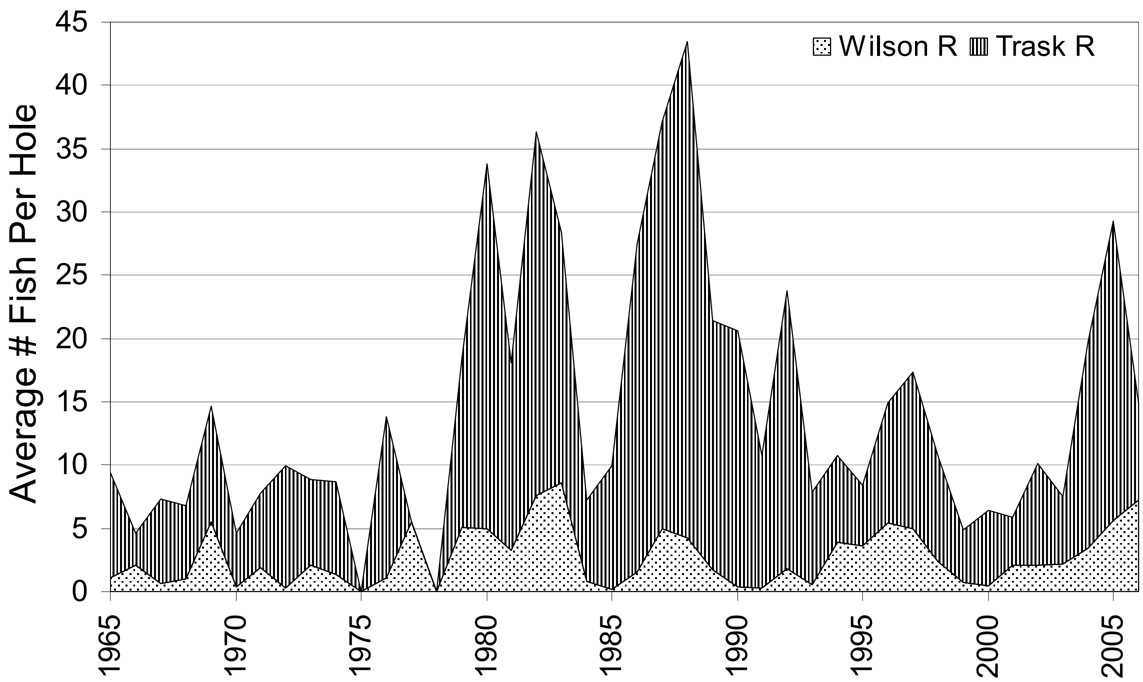

Figure 53. Spring Chinook salmon resting hole counts, expressed as the average number of fish per hole, for principle streams in the Tillamook Basin.

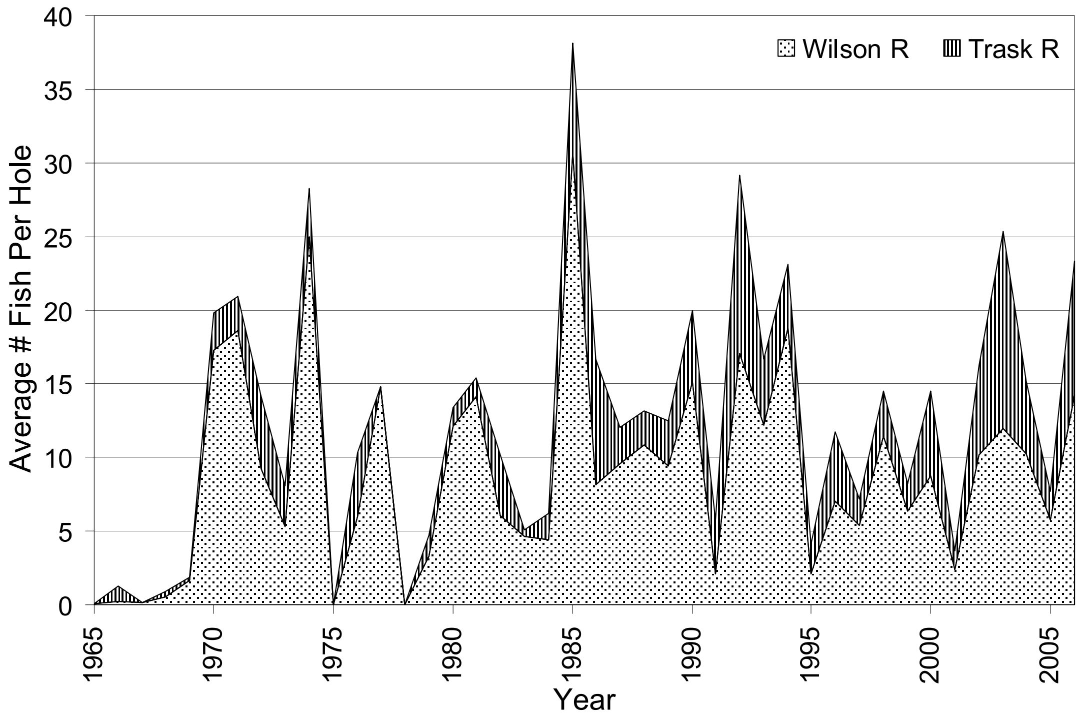

Figure 54. Summer steelhead resting hole counts, expressed as the average number of fish per hole, for principle streams of the Tillamook Basin.

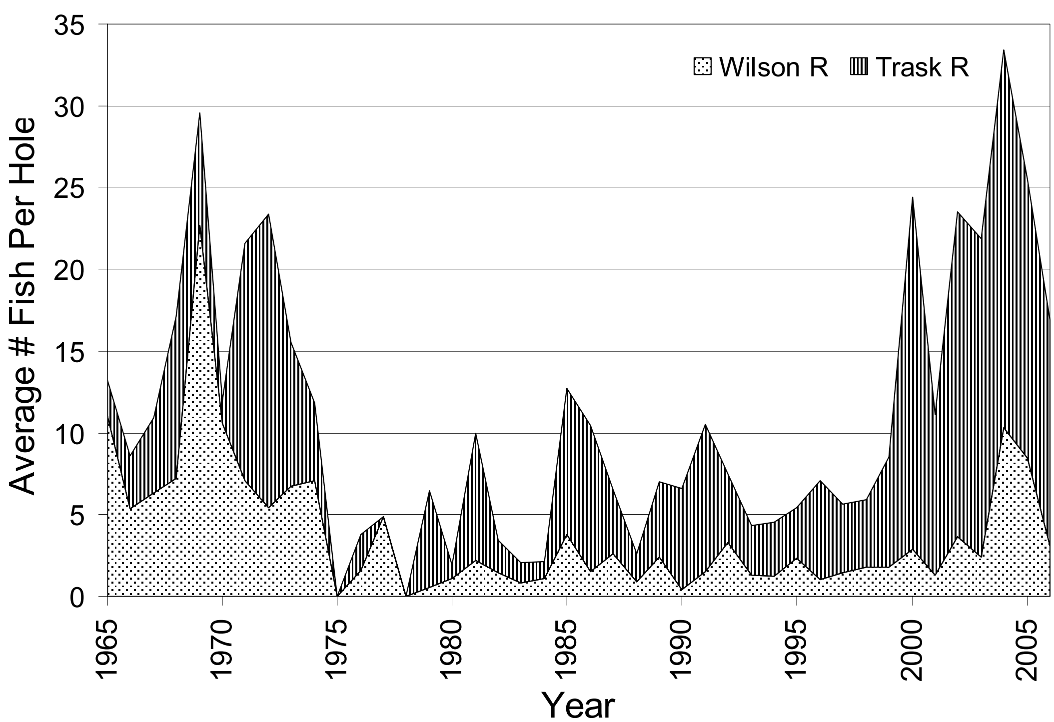

Figure 55. Sea-run cutthroat trout resting hole counts, expressed as the average number of fish per hole, for principle streams of the Tillamook Basin.

Table 70. Recent hatchery releases of native juvenile salmonids in the Tillamook Basin and Wilson River.

System	Species	Run	Type	Average # Per Year [1]
Wilson River	Steelhead	Winter	Smolts	110,000
		Summer	Smolts	50,000
	Chinook	Spring	Smolts	125,000
		Spring	Unfed Fry [3]	20,000
		Fall	Unfed Fry [3]	60,000
Tillamook Basin (excluding the Wilson River)	Coho		Smolts	Variable [2]
	Chinook	Fall	Smolts	113,000
		Fall	Unfed Fry [3]	290,000
		Spring	Smolts	220,000
	Chum			No Stocking
	Cutthroat Trout			No Stocking

[1] Averages from 1998-2002 or 1999-2003, depending on available data.
[2] Releases have gone from ~200K to ~100K. An Oregon Department of Fish and Wildlife study (2005) indicates that since 2002, less than 6% of spawning fish were of hatchery origin.
[3] Unfed fry are STEP (Salmon and Trout Enhancement Program) hatchbox fry and the actual number of fry released annually varies drastically.

9.9 Current Salmonid Population Status

The overall status of anadromous salmonids in the Wilson River has not changed from the 2001 OWEB Wilson River watershed analysis. With the exception of fall Chinook salmon, which are maintaining a relatively robust population, and winter steelhead, for which not enough information exists, populations of the rest of the native salmonids inhabiting the Wilson River are depressed compared with historic abundances[94]. Recent population trends (e.g., <10 years), however, derived from current ODFW and RBA data, have changed from the 2001 OWEB watershed analysis. While the recent increased coho salmon counts look promising, it should be noted that there has been tremendous temporal variability, indicating the tenuous nature of population recovery attempts (see Figure 52).

[94] Historic salmonid abundances discussed in Section 9.2.

Table 71. Status and recent population trends of anadromous salmonids in the Wilson River.

Species/race	Status	Population Trends	
		Through 2001[a]	Present[b]
Chinook salmon			
Fall	Healthy	Stable or Increasing	Stable / Possibly increasing
Spring	Heavily supported by hatchery fish, depressed compared with historic abundance	Possibly declining	Stable / Possibly Increasing
Coho salmon	Heavily influenced by hatchery fish, severely depressed compared with historic abundance	Declining	Highly Variable
Chum salmon	Depressed compared to historic abundance	Declining	Stable
Steelhead trout			
Winter	Heavily influenced by hatchery fish, numbers appear low	Declining	Insufficient Data / Possibly Declining
Summer	Introduced, supported entirely by hatchery fish	Declining	Variable / Possibly Increasing
Cutthroat trout	Stable/Depressed	Possibly Declining	Variable / Possibly Increasing

[a] From Table 2.2 in the 2001 OWEB Wilson River watershed assessment (E & S Environmental Chemistry 2001).
[b] Sources: the Tillamook Bay Environmental Characterization (TBNEP 1998), the Oregon Department of Fish and Wildlife's Oregon Native Fish Status Report (ODFW 2005), recent Tillamook Basin Rapid Biological Assessments (Bio-Surveys 2005 and 2006) and long-term ODFW spawning and resting hole counts.

9.10 Fish Habitat Condition[95]

9.10.1 Methods

The Oregon Department of Fish and Wildlife (ODFW) has conducted extensive stream habitat surveys throughout the State beginning in the early 1990's and continuing through today. To 1) assess current aquatic habitat conditions and 2) develop reference/benchmark habitat conditions relevant to Oregon coastal streams, the ODFW conducted a supplemental Tillamook Basin analysis of aquatic habitat data collected from 1991 through 2003 (Kavanagh et al. 2005). The ODFW, based on summary data from the long-term Aquatic Inventories Project (AIP), originally developed reference/benchmark aquatic habitat values derived from streams in areas with low impact from human activities (e.g.,

[95] Fish habitat condition is assessed relative to Properly Functioning Conditions (PFCs).

wilderness or roadless areas, late-successional or mature forest; Foster et al. 2001) and included both coastal and Cascadian streams. Data from the supplemental Tillamook Basin aquatic habitat surveys (Kavanagh et al. 2005) refined some of the reference/benchmark values to reflect conditions specific to Tillamook Basin systems.

A total of 124 reference sites, surveyed between 1992 and 2003, were selected within the Oregon Coastal coho ESU (from Sixes River to Necanicum, including the upper Umpqua in the Cascade ecoregion) to represent natural or historic conditions within the range of coho salmon. Data from these surveys were compiled and the 25th and 75th quartiles were used by ODFW as a range of conditions representing “UNDESIRABLE/LOW” quality (25th quartile) and “DESIRABLE/HIGH” quality (75th quartile) habitat breakpoints. In this watershed analysis, we use the terms LOW and HIGH to represent the 25th and 75th quartiles, respectively. Additionally, for the purposes of this assessment, we assume that data from ODFW’s 75th quartile represents Properly Functioning Conditions but also recognize that the middle 50% of the data also represents some level of proper function. From these data, twelve key habitat attributes with particular relevance to Tillamook Basin streams (as identified by the ODFW; Foster et al. 2001) were selected to represent reference/benchmark conditions against which watersheds, subwatersheds, streams and reaches could be assessed. ODF requested the data be summarized by subwatershed (see Table 72 below). To provide managers with decision-making tools relative to specific locations within subwatersheds, however, the data are also presented at the stream- and reach- levels in Appendix P – Summary of Aquatic Habitat Conditions.

Individual streams were not compared to PFCs. Rather, all aquatic habitat variables from all reaches within each subwatershed were compared to ODFW-established reference conditions, pooled by subwatershed, and the *overall* conditions within each subwatershed were then “scored” by calculating the percent of stream reach aquatic habitat conditions falling into each ODFW-established quartile (i.e., what proportion of the key habitat attributes in all stream reaches in a subwatershed are meeting PFCs). Subwatersheds were then rated as Minimally Degraded, Degraded, or Severely Degraded (refer to Table 72 and Table 74 for a complete list of definitions and criteria). It is important to note, however, that some subwatersheds (e.g., Lower Wilson River and Middle Wilson River) contained relatively few surveyed stream reaches. Additionally, the use of LOW and HIGH habitat breakpoints as assessed using relatively recent habitat data (e.g., within the past 20 years) is problematic, but currently the only tool available. Caution, therefore, should be exercised when interpreting the degree to which a subwatershed is rated as properly functioning.

Table 72. Aquatic habitat benchmarks established by the Oregon Department of Fish and Wildlife. Bolded terms represent key habitat attributes.

Habitat Type	Description	Range of Conditions [1]	
		Low	High
POOLS	POOL AREA (% Total Stream Area)	**<19**	**>45**
	POOL FREQUENCY (Channel Widths Between Pools)	>20	5-8
	RESIDUAL POOL DEPTH (m)		
	SMALL STREAMS (<7m width)	<0.2	>0.5
	MEDIUM STREAMS (≥7m & <15m width)		
	Low Gradient (slope <3%)	<0.3	>0.6
	High Gradient (slope >3%)	<0.5	>1.0
	LARGE STREAMS (≥15m width)	<0.8	>1.5
	COMPLEX POOLS (Pools w/ LW [2] pieces ≥3)/km	<1.0	>2.5
	DEEP POOLS (>1m deep/km)	**=0**	**>3**
RIFFLES	WIDTH/DEPTH RATIO (Active Channel)		
	EAST SIDE	>30	<10
	WEST SIDE	>30	<15
	GRAVEL (% Area)	**<26**	**>54**
	SILT-SAND-ORGANICS (% Area) – FINES	**>22**	**<8**
	VOLCANIC PARENT MATERIAL	>15	<8
	SEDIMENTARY PARENT MATERIAL	>20	<10
	CHANNEL GRADIENT <1.5%	>25	<12
SIDE CHANNELS	% SECONDARY CHANNELS	**<0.8**	**>5.3**
POOLS & RIFFLES	BEDROCK (% Area)	**>11**	**<1**
SHADE	(Reach Average, %)	**<76%**	**>91%**
	STREAM WIDTH <12 meters		
	WEST SIDE	<60	>70
	NORTHEAST	<50	>60
	CENTRAL - SOUTHEAST	<40	>50
	STREAM WIDTH >12 meters		
	WEST SIDE	<50	>60
	NORTHEAST	<40	>50
	CENTRAL - SOUTHEAST	<30	>40
LARGE WOOD (LW) [3]	(15cm x 3m minimum piece size)		

Habitat Type	Description	Range of Conditions [1]	
		Low	High
	PIECES / 100 m stream length	**<8**	**>21**
	VOLUME / 100 m stream length	**<17**	**>58**
	"KEY" PIECES (>60cm dia. & ≥10m long) /100m	**<0.5**	**>3**
RIPARIAN CONIFERS	(30m from both sides of channel)		
Western Oregon	NUMBER >20in dbh/1000ft stream length	<150	>300
	NUMBER >35in dbh/1000ft stream length	<75	>200
	NUMBER >20in dbh/1000ft stream length	**<22**	**>153**
	NUMBER >35in dbh/1000ft stream length	**=0**	**>79**

[1] Established by the Oregon Department of Fish and Wildlife Aquatic Inventories and Analysis Project (Foster et al. 2001) and the Fish Habitat Assessment in the ODF Tillamook Study Area (Kavanagh et al. 2005). High and low values represent stream survey data that fell above and below the 75th and 25th percentiles, respectively. Shaded values represent the 12 key aquatic habitat attribute criteria established using only Oregon Coast reference sites (e.g., they do not include, with the exception of the Umpqua River, Cascadian streams).
[2] Instream large wood
[3] Values for large wood in streams in forested basins

9.10.2 Results

Every subwatershed exhibited key habitat attributes that were skewed toward POOR conditions (Table 73). On the other hand, every subwatershed exhibited key habitat attributes that were skewed toward GOOD conditions (Table 73). In general, most of the reaches in the subwatersheds exhibited LOW pool conditions (e.g., % Pools and Deep Pools; Table 73). In fact, greater than 50% of the surveyed reaches in the Jordan Creek, Middle Wilson, Upper Wilson/Cedar Creek, and South Fork Wilson subwatersheds exhibited LOW levels of % Pools. Jordan Creek, however, *also* exhibited HIGH levels of Deep Pools (Table 73). With the exception of the Jordan Creek and Lower Wilson subwatersheds, most of the subwatersheds exhibited a relatively HIGH % Side Channels (Table 73). The majority of the surveyed reaches contained moderate amounts of % Bedrock but the Upper Wilson/Cedar Creek subwatershed exhibited relatively low % Bedrock (Table 73). Additionally, half of the subwatersheds exhibited a relatively high amount of % Fines (e.g., poor habitat quality; Lower Wilson, Devils Lake Fork, North Fork Wilson, and South Fork Wilson; Table 73).

Table 73. Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project habitat condition in the Wilson River watershed. Percent of reaches (and number) by subwatershed (6th Field HUC) of key aquatic habitat attributes falling into LOW and HIGH categories, as specified by ODFW Aquatic Inventories Project. Highlighted boxes represent data that are ≥50% different from benchmark/reference conditions. For aquatic habitat conditions displayed by subwatershed, stream and reach refer to Appendix P – Summary of Aquatic Habitat Conditions.

Habitat Parameter	Devils Lake Fk . – 26 reaches			Jordan Creek – 15[b] reaches		
	<25% (LOW)	>25% but <75%	>75% (HIGH)	<25% (LOW)	>25% but <75%	>75% (HIGH)
% Pools	38 (10)	50 (13)	12 (3)	50 (7)*	50 (7)*	0 (0)*
Deep Pools	27 (7)	46 (12)	27 (7)	14 (2)*	21 (3)*	64 (9)*
% Side Channels	8 (2)	50 (13)	42 (11)	13 (2)	67 (10)	20 (3)
% Bedrock	31 (8)	42 (11)	27 (7)	67 (10)	27 (4)	7 (1)
% Fines	31 (8)	54 (14)	15 (4)	7 (1)	87 (13)	7 (1)
% Gravel	31 (8)	65 (17)	4 (1)	80 (12)	20 (3)	0 (0)
# Pieces LW	31 (8)	23 (6)	46 (12)	50 (7)*	43 (6)*	7 (1)*
LW Volume	38 (10)	42 (11)	19 (5)	71 (10)*	21 (3)*	7 (1)*
Key Pieces LW	65 (17)	35 (9)	0 (0)	64 (9)*	29 (4)*	7 (1)*
% Shade [a]	38 (10)	42 (11)	19 (5)	0 (0)	40 (6)	60 (9)
# Conifers >50cm DBH	62 (16)	38 (10)	0 (0)	64 (9)*	36 (5)*	0 (0)*
# Conifers >90cm DBH	96 (25)	4 (1)	0 (0)	100 (14)*	0 (0)*	0 (0)*
Percentage of Reach-parameters by category	41.3% (129/312)	41.0% (128/312)	17.6% (55/312)	48.0% (83/173)	37.0% (64/173)	15.0% (26/173)

[a] Some variables were only assessed in 14 of the 15 stream reaches (denoted with an asterisk*).

[b] Not a quantitative measure.

Table 73 (continued). Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project habitat condition in the Wilson River watershed. Percent of reaches (and number) by subwatershed (6th Field HUC) of key aquatic habitat attributes falling into LOW and HIGH categories, as specified by ODFW Aquatic Inventories Project. Highlighted boxes represent data that are ≥50% different from benchmark/reference conditions. For aquatic habitat conditions displayed by subwatershed, stream and reach refer to Appendix P – Summary of Aquatic Habitat Conditions.

Habitat Parameter	Little N. Fk. Wilson – 9 reaches			Lower Wilson – 2 reaches		
	<25% (LOW)	>25% but <75%	>75% (HIGH)	<25% (LOW)	>25% but <75%	>75% (HIGH)
% Pools	22 (2)	67 (6)	11 (1)	0 (0)	100 (2)	0 (0)
Deep Pools	0 (0)	44 (4)	56 (5)	50 (1)	50 (1)	0 (0)
% Side Channels	0 (0)	44 (4)	56 (5)	0 (0)	100 (2)	0 (0)
% Bedrock	22 (2)	67 (6)	11 (1)	50 (1)	50 (1)	0 (0)
% Fines	0 (0)	100 (9)	0 (0)	100 (2)	0 (0)	0 (0)
% Gravel	33 (3)	56 (5)	11 (1)	0 (0)	50 (1)	50 (1)
# Pieces LW	11 (1)	67 (6)	22 (2)	50 (1)	50 (1)	0 (0)
LW Volume	11 (1)	67 (6)	22 (2)	50 (1)	50 (1)	0 (0)
Key Pieces LW	33 (3)	67 (6)	0 (0)	50 (1)	50 (1)	0 (0)
% Shade	33 (3)	0 (0)	67 (6)	0 (0)	0 (0)	100 (2)
# Conifers >50cm DBH	100 (9)	0 (0)	0 (0)	50 (1)	50 (1)	0 (0)
# Conifers >90cm DBH	78 (7)	22 (2)	0 (0)	50 (1)	50 (1)	0 (0)
Percentage of Reach-parameters by category	28.7% (31/108)	50.0% (54/108)	21.3% (23/108)	37.5% (9/24)	50.0% (12/24)	12.5% (3/24)

Table 73 (continued). Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project habitat condition in the Wilson River watershed. Percent of reaches (and number) by subwatershed (6th Field HUC) of key aquatic habitat attributes falling into LOW and HIGH categories, as specified by ODFW Aquatic Inventories Project. Highlighted boxes represent data that are ≥50% different from benchmark/reference conditions. For aquatic habitat conditions displayed by subwatershed, stream and reach refer to Appendix P – Summary of Aquatic Habitat Conditions.

Habitat Parameter	Middle Wilson – 7 reaches			N. Fk. Wilson – 9 reaches		
	<25% (LOW)	>25% but <75%	>75% (HIGH)	<25% (LOW)	>25% but <75%	>75% (HIGH)
% Pools	100 (7)	0 (0)	0 (0)	44 (4)	56 (5)	0 (0)
Deep Pools	71 (5)	29 (2)	0 (0)	11 (1)	44 (4)	44 (4)
% Side Channels	0 (0)	43 (3)	57 (4)	0 (0)	56 (5)	44 (4)
% Bedrock	29 (2)	57 (4)	14 (1)	11 (1)	89 (8)	0 (0)
% Fines	14 (1)	29 (2)	57 (4)	33 (3)	44 (4)	22 (2)
% Gravel	43 (3)	57 (4)	0 (0)	22 (2)	78 (7)	0 (0)
# Pieces LW	0 (0)	29 (2)	71 (5)	11 (1)	33 (3)	56 (5)
LW Volume	29 (2)	57 (4)	14 (1)	11 (1)	78 (7)	11 (1)
Key Pieces LW	43 (3)	57 (4)	0 (0)	78 (7)	22 (2)	0 (0)
% Shade	0 (0)	57 (4)	43 (3)	67 (6)	33 (3)	0 (0)
# Conifers >50cm DBH	86 (6)	14 (1)	0 (0)	100 (9)	0 (0)	0 (0)
# Conifers >90cm DBH	100 (7)	0 (0)	0 (0)	100 (9)	0 (0)	0 (0)
Percentage of Reach-parameters by category	42.9% (36/84)	35.7% (30/84)	21.4% (18/84)	40.7% (44/108)	44.4% (48/108)	14.8% (16/108)

Table 73 (continued). Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project habitat condition in the Wilson River watershed. Percent of reaches (and number) by subwatershed (6th Field HUC) of key aquatic habitat attributes falling into LOW and HIGH categories, as specified by ODFW Aquatic Inventories Project. Highlighted boxes represent data that are ≥50% different from benchmark/reference conditions. For aquatic habitat conditions displayed by subwatershed, stream and reach refer to Appendix P – Summary of Aquatic Habitat Conditions.

Habitat Parameter	Upper Wilson/Cedar Creek – 17 reaches			S. Fk. Wilson – 12 reaches		
	<25% (LOW)	>25% but <75%	>75% (HIGH)	<25% (LOW)	>25% but <75%	>75% (HIGH)
% Pools	65 (11)	35 (6)	0 (0)	83 (10)	17 (2)	0 (0)
Deep Pools	47 (8)	41 (7)	12 (2)	50 (6)	25 (3)	25 (3)
% Side Channels	0 (0)	12 (2)	88 (15)	0 (0)	33 (4)	67 (8)
% Bedrock	6 (1)	41 (7)	53 (9)	8 (1)	67 (8)	25 (3)
% Fines	18 (3)	47 (8)	35 (6)	33 (4)	58 (7)	8 (1)
% Gravel	12 (2)	76 (13)	12 (2)	25 (3)	50 (6)	25 (3)
# Pieces LW	0 (0)	24 (4)	76 (13)	8 (1)	42 (5)	50 (6)
LW Volume	18 (3)	59 (10)	24 (4)	25 (3)	17 (2)	58 (7)
Key Pieces LW	24 (4)	76 (13)	0 (0)	8 (1)	33 (4)	58 (7)
% Shade	29 (5)	18 (3)	53 (9)	0 (0)	58 (7)	42 (5)
# Conifers >50cm DBH	94 (16)	6 (1)	0 (0)	58 (7)	42 (5)	0 (0)
# Conifers >90cm DBH	100 (17)	0 (0)	0 (0)	100 (12)	0 (0)	0 (0)
Percentage of Reach-parameters by category	34.3% (70/204)	36.3% (74/204)	29.4% (60/204)	33.3% (48/144)	36.8% (53/144)	29.9% (43/144)

While stream survey data is compared to these aforementioned benchmark/reference conditions, the ODFW does not rate the overall ecological function of streams or subwatersheds and there are no agency- or literature-established criteria for doing so[96]. To rate the overall aquatic functionality of aquatic habitats (i.e., Proper Functioning Condition [PFC]) in each subwatershed, we established criteria that incorporate ODFW Aquatic Inventories Project-established reference conditions for key aquatic habitat attributes (Table 74). Using ODFW's Aquatic Inventories Project stream survey data, the twelve key aquatic habitat attributes in each reach were compared to benchmark/reference conditions and summed by stream and subwatershed. The Proper Functioning Condition of each subwatershed was rated according to an intuitive set of criteria based upon how the key habitat attribute survey data compared to ODFW-established "benchmark/reference" conditions (i.e., how the observed data compared to ODFW "benchmark/reference" data). Criteria, and the resulting Proper Functioning Condition ratings, are presented in Table 74. In subwatersheds where less than 5 stream reaches were surveyed, Proper Functioning Condition was not rated.

While we have defined different functioning conditions based on how the data fall into discrete quartiles, it is important to note that on-the-ground data represent a *range* of conditions. Therefore, we have attempted to account for this range of conditions by indicating more than one (condition) classification for the subwatershed of interest (see Table 75 for some examples). Additionally, in this ranking scheme, each of the 12 key habitat attributes is weighted equally. If, however, land use managers have reason to believe one or more of the key attributes deserves more weight than another, the overall subwatershed condition rating would change. Finally, because the data are a snapshot(s) in time, long-term habitat monitoring is critically important for accurately capturing and assessing trends in the aquatic conditions in the Wilson River watershed. Nevertheless, the current subwatershed condition ratings provide a baseline against which future ratings can be gauged for determining trends and assessing the effectiveness of protection and/or restoration actions.

Proper Functioning Condition was rated in seven of the eight subwatersheds found in the Wilson River (Table 75). There was not enough stream survey information in the Lower Wilson River subwatershed (e.g., less than 5 surveyed stream reaches) to assess/rate the Proper Functioning Condition. Of the seven subwatersheds rated, none had key habitat attribute data that met the criteria for the "Very Good Condition" (i.e., none were in as good of condition as the ODFW AIP reference streams). Data from one subwatershed (Little North Fork

[96] Some previous watershed assessments have presented a weighted rating criteria after discussions with managers identified clear rankings of variables.

Wilson), however, was similar enough that it received a GOOD condition rating. Two subwatersheds were rated as being in MODERATE condition (Upper Wilson/Cedar Creek and South Fork Wilson), three were rated at as being POOR condition (Devils Lake Fork, Middle Wilson and North Fork Wilson) and one was rated as being in VERY POOR condition (Jordan Creek; Table 75).

While the PFC ratings are derived from established benchmark/reference conditions, there is no established criteria for rating streams, subwatersheds, or watersheds based on the benchmark/reference conditions. Additionally, while there is certainly broad-scale utility in rating subwatersheds (e.g., to identify long-term condition trends or subwatersheds where restoration activities could be focused), it may be more useful to identify small-scale areas where restoration efforts may be focused (e.g., streams or stream reaches). We have, therefore, provided a detailed list of stream and reach conditions in Appendix P – Summary of Aquatic Habitat Conditions.

Table 74. Definitions and criteria for scoring subwatershed Proper Functioning Conditions (PFCs) based on established "benchmark/reference" aquatic habitat conditions (e.g., ODFW AIP data).

		Quartile Criteria[2]			
Subwatershed Condition[1]	**Definition**	**Lower 25%**	**Middle 50%**	**Upper 25%**	**Data Distribution Curve Description [1]**
VERY GOOD	Aquatic habitat conditions in the subwatershed are functioning in an ecologically appropriate manner	<25	>55	>25	Skewed slightly / heavily right of a normal distribution
GOOD	Aquatic habitat conditions in the subwatershed are *generally* functioning in an ecologically appropriate manner	>20	>45	20-25	Approximately normally distributed (e.g., normally distributed data relative to the ODFW "benchmark/reference" reaches)
MODERATE	Some of the aquatic habitat conditions in the subwatershed are functioning in an ecologically appropriate manner but some are not and/or are threatened by degradation	≤35	≤50	<25	Skewed slightly left of normal
		>25	<50	>25	Elevated lower and upper quartiles, depressed middle quartile
		<25	>50	<25	Depressed lower and upper quartiles, elevated middle quartile
POOR	Many of the aquatic habitat conditions in the subwatershed have been degraded and are not functioning in an ecologically appropriate manner	>35	≤50	<25	Skewed comparatively left of normal
VERY POOR	Most of the aquatic habitat conditions in the subwatershed have been degraded and are not functioning in an ecologically appropriate manner	>45	≤50	<20	Skewed heavily left of normal

[1] As compared to the reference watershed data compiled in the ODFW Coastal stream survey data.
[2] "Benchmark/reference" conditions established by the Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories and Analysis Project (Foster et al. 2001) and the Fish Habitat Assessment in the ODF Tillamook Study Area report (Kavanagh et al. 2005).

Table 75. Proper Functioning Condition ratings for Wilson River subwatersheds based on the percent (and total number) of key habitat attributes in all stream reaches falling into each of three Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project habitat rating quartile categories.

Subwatershed	# Stream Reaches	<25% (LOW)	>25% but <75%	>75% (HIGH)	Proper Functioning Condition Rating [a]
Devils Lake Fk.	26	41.3% (129/312)	41.0% (128/312)	17.6% (55/312)	POOR
Jordan Cr.	15 [b]	48.0% (83/173)	37.0% (64/173)	15.0% (26/173)	VERY POOR
Little N. Fk. Wilson	9	28.7% (31/108)	50.0% (54/108)	21.3% (23/108)	GOOD
Lower Wilson	2	37.5% (9/24)	50.0% (12/24)	12.5% (3/24)	Na
Middle Wilson	7	42.9% (36/84)	35.7% (30/84)	21.4% (18/84)	POOR
N. Fk. Wilson	9	40.7% (44/108)	44.4% (48/108)	14.8% (16/108)	POOR
Upper Wilson/Cedar Cr.	17	34.3% (70/204)	36.3% (74/204)	29.4% (60/204)	MODERATE
S. Fk. Wilson	12	33.3% (48/144)	36.8% (53/144)	29.9% (43/144)	MODERATE

[a] Proper Functioning Condition was not rated for subwatersheds with fewer than 5 surveyed stream reaches.
[b] Some of the key habitat attributes were only recorded by ODFW Aquatic Inventories Project surveyors in 14 of the 15 surveyed stream reaches.

9.11 Instream Large Wood

The purpose of this section is to summarize the amount of instream large wood (LW) observed during ODFW Aquatic Inventory Project (AIP) surveys. Discussions pertaining to both modeled riparian and landslide LW contributions can be found in sections

9.11.1 Methods

The Oregon Department of Fish and Wildlife (ODFW) conducted extensive stream habitat surveys throughout the State beginning in the early 1990's and they continue through to today. To 1) assess current aquatic habitat conditions and 2) develop reference/benchmark habitat conditions relevant to Oregon coastal streams, the ODFW conducted a Tillamook Basin analysis of aquatic habitat data collected from 1991 through 2003 (Kavanagh et al. 2005). Additional aquatic habitat data were collected by ODFW in 2004 and 2006. Both sets of data are presented below.

The ODFW defines key pieces of large instream wood as having a diameter greater than 2 feet (60 centimeters) and greater than or equal to 33 feet (10 meters) in length and breaks the number of key pieces of large instream wood per 330 feet (100 meters) of stream length into three categories (Foster et al. 2001). According to these reference criteria, stream reaches that contain more than 3 pieces of large instream wood per 330 feet (100 meters) constitutes a HIGH level, reaches containing less than 0.5 pieces per 330 feet (100 meters) constitutes a LOW level, and reaches containing from 0.5 to 3.0 pieces per 330 feet (100 meters) constitutes a moderate level. It is important to note that relatively few streams within each subwatershed were surveyed and results should be interpreted accordingly.

9.11.2 Results

Data from ODFW aquatic habitat surveys conducted in 2004 and 2006 indicate that 53% of stream reaches surveyed in the Wilson River watershed (51 of 96) contained moderate to HIGH levels of key pieces of wood while 47% (45 of 96) contained LOW levels of key pieces of wood (Table 76). Of the stream reaches rated moderate to HIGH, however, only 8 of 96 (8.3%) were rated as having a HIGH number of key pieces of large wood (Table 76). At the subwatershed scale, the South Fork of the Wilson River, the Upper Wilson/Cedar Creek, the Little North Fork of the Wilson River, the Middle Wilson River and the Lower Wilson River all had 50% or better of the stream reaches rated moderate or HIGH for key pieces of large wood (91.7%, 76.5%, 66.7%, 57.1% and 50%, respectively), while the only subwatershed with 25% or less of the stream reaches rated moderate or HIGH was the North Fork of the Wilson River (Table 76), making it a good candidate for activities that will lead to increased instream large wood recruitment. At the reach scale, one reach in Jordan Creek (1 of 11 reaches; Jordan Creek subwatershed), four reaches in the mainstem of the South Fork Wilson (4 of 6 reaches; South Fork Wilson subwatershed) and three reaches in tributaries to the South Fork Wilson (3 of 6 reaches; South Fork Wilson subwatershed) contained high levels of key pieces of wood (Table 76).

Table 76. Number of stream reaches, by stream and subwatershed, with low, medium, and high levels of key pieces of wood (# key pieces/100m). Data summarized from Oregon Department of Fish and Wildlife's (ODFW) Aquatic Inventories Project surveys (see Appendix P – Summary of Aquatic Habitat **Conditions** for details).

		Number of reaches per category		
Subwatershed	Stream (# reaches) [1]	LOW (<0.5 pieces)	medium (≥0.5≤3.0)	HIGH (>3.0 pieces)
Devils Lake Fk.	Devils Lake Fk. (8)	8	0	0
	Deyoe Cr. (4)	0	4	0
	Drift Cr. (1)	1	0	0
	Elk Cr. (4)	3	1	0
	Elliot Cr. (5)	3	2	0
	Idiot Cr. (2)	2	0	0
	W. Fk. Elk Cr. (2)	0	2	0
Jordan Creek	Jordan Cr. (11)	6	4	1
	S. Fk. Jordan Cr. (3)	3	0	0
Little N.Fk. Wilson	Berry Cr. (2)	0	2	0
	Little N. Fk. Wilson (6)	3	3	0
	White Cr. (1)	0	1	0
Lower Wilson	Kansas Cr. (2)	1	1	0
Middle Wilson	Fall Creek (7)	3	4	0
N. Fk. Wilson	Rodgers Cr. (2)	2	0	0
	Rodgers Cr. Tribs (4)	4	0	0
	W.Fk.N.Fk. Wilson (3)	1	2	0
Upper Wilson/ Cedar Creek	Ben Smith Cr. (4)	1	3	0
	Cedar Cr. (7)	3	4	0
	Jones Cr. (3)	0	3	0
	N. Fk. Cedar (3)	0	3	0
S. Fk. Wilson	S. Fk. Wilson (6)	1	1	4
	S. Fk. Wilson Tribs (6)	0	3	3
TOTALS	**# streams (# reaches)**			
Devils Lake Fk.	7 (26)	17	9	0

		Number of reaches per category		
Subwatershed	Stream (# reaches) [1]	LOW (<0.5 pieces)	medium (≥0.5≤3.0)	HIGH (>3.0 pieces)
Jordan Cr.	2 (14)	9	4	1
Little N. Fk. Wilson	3 (9)	3	6	0
Lower Wilson	1 (2)	1	1	0
Middle Wilson	1 (7)	3	4	0
N. Fk. Wilson	3 (9)	7	2	0
Up. Wilson/Cedar	4 (17)	4	13	0
S. Fk. Wilson	2 (12)	1	4	7

[1] Summarized from ODFW Aquatic Inventories Project aquatic habitat stream surveys conducted in the Wilson since 2001.

9.12 Splash-Damming and Effects

While splash-damming was commonplace in the Tillamook River, it was a technique apparently not utilized in the Wilson River (Sedell and Duval 1985). Instead, large log drives that occurred during high water events were the norm (Farnell 1980) and occurred as far upstream as the Lee's Camp area (~30 miles upstream of tidewater; Sedell and Duval 1985). Even though Farnell (1980) mentions that log drives occurred in the Wilson River basin as far upstream as 22.5 miles, there is no factual evidence of log drives upstream of head of tide. There is, however, stream channel evidence of log drives (refer to Map 20) on the Wilson River which were apparently utilized between 1893 and 1908 (Farnell 1980). There is insufficient information, however, pertaining to the effects these log drives may have had on the Wilson River. Potential effects from log drives may have included increased bank erosion (from log scouring), increased sedimentation rates from bank erosion, decreased riparian vegetation (from log scouring), removal of naturally-occurring large wood accumulations (from "flushing" as wood rafts built up behind them or purposely by humans in preparation for log drives), and displacement of streambed gravels/substrates (Sedell and Duval 1985).

9.13 Fish Passage Barriers

Access to quality habitats is one of the keys to salmonid survival in the Wilson River watershed. Salmon need an unrestricted network of connected streams to ensure genetic diversity and long-term survival (Roni et al. 2002). Connected fish-habitat depends, in part, on successful fish passage through culverts. Culverts at road stream crossings can become impassable for several reasons. Fish moving upstream may be unable to enter a culvert because the culvert outlet is suspended at a height too high for a fish to jump. Culverts can become clogged with debris that prevents fish passage. Steep gradient culverts may increase water velocity making fish passage impossible or very restricted, and water depth in a culvert may become too shallow for fish to swim.

Culverts are relatively easy to inventory and evaluate; they are located along roads that are accessed by vehicle or on foot. Managers can determine which culverts are obstacles to fish passage and decide whether to replace or repair a culvert. This simple determination is a necessary component to a successful salmon-river restoration plan. First, however, culverts need to be inventoried and classified as to their overall functionality.

In 2006, workers from Duck Creek Associates, Inc. surveyed all the open and blocked roads in the Wilson River watershed. Every stream crossing was rated in terms of the likelihood that the stream supported fish. Surveyors' classified streams while at a stream crossing as either fish bearing, likely fish bearing, unlikely fish bearing, or no fish presence. This was based solely on professional judgment that included estimating stream gradient (> 20% = no fish) and visually inspecting downstream of a culvert for an obvious natural barrier to upstream migration such as a waterfall. Additionally, surveyors judged whether or not adult and juvenile fish could pass through a particular culvert based on the gradient of the culvert, debris blocking the culvert, and the general condition of the culvert.

Surveyors identified 926 stream crossings, of which 144, or 16%, were considered (known, likely or observed) barriers to fish-passage (Table 77, Maps 58-59). Blockage types described by surveyors range from collapsed and sediment filled culverts to blocked inlets and outlets and well as perched culverts.

Table 77. Results from the 2006 field assessment of culverts. Barriers to fish passage were classified as an observed barrier, a likely barrier, a possible barrier, or no barrier at all to adult and juvenile fish.

Barrier Type	Observed Barrier	Likely Barriers	Possible Barriers	No Barriers
Adult and Juvenile	1	15	105	100
Juvenile Only	2	10	11	NA
No Fish	NA	NA	NA	682
Total	3	25	116	782

For the purposes of this assessment, we estimated the number of miles of potential fish habitat blocked to upstream migrations. Miles of potentially blocked habitat was measured in a GIS by overlaying the stream crossing point layer on the ODFW stream layer. First the intersection of the stream crossing, stream, and road layers were located, then we used the measuring tool to determine the length of "verified" or "assumed" fish habitat that had been blocked by the barrier. As described in the GIS metadata associated with the stream layer, "verified" and "assumed" are designations of fish presence. Table 78 lists the number of miles of potential fish habitat blocked by culvert barriers. Adult barriers block a slightly higher percentage of potential habitat than do juvenile only barriers. There were 313 stream miles designated as fish habitat. Nearly 25 miles or 7.8% of potential habitat are blocked by impassable culverts (a detailed list of the road location of these barriers is given in Appendix Q – Fish Barriers).

Table 78. Miles of potential fish habitat blocked by culvert barriers along roads in the Wilson River watershed. Potential fish habitat refers to the ODFW designation of verified and assumed fish presence.

Age Class Barrier	Miles of potential habitat blocked	Percent of total fish bearing streams
Adult Barrier	14.3	4.6
Juvenile barrier	10.3	3.3
Total	**24.6**	**7.8**

Beaver. Each stream crossing was evaluated for the effects of beaver activity. Beaver activity was noted at 10 of the 926 stream crossings.

9.14 Priority Streams

The ability to identify particular streams or stream segments where protective measures would likely produce the greatest overall benefit to aquatic health is of particular importance to natural resource managers. To date, however, no comprehensive criteria existed whereby natural resource managers could select geographic areas in which to concentrate protective/restorative measures based upon a clearly-defined prioritization scheme. Duck Creek Associates, in conjunction with ODF staff, identified several factors critical to the protection of aquatic resources and developed a process for prioritizing where those activities would be likely to produce the greatest overall beneficial impacts to aquatic resources.

9.14.1 Methods

In order to develop a scheme for prioritizing stream reaches where, if protected and/or restored, would provide the greatest overall beneficial impacts to aquatic resources, we identified several factors known to be of particular importance. They included:

- the presence of ODF Salmon Anchor Habitat/s (SAH),
- areas of high fish use (e.g., high juvenile density[97]), as measured during the 2005 Tillamook Basin Rapid Biological Assessment (RBA; Bio-Surveys)[98],
- areas of high fish habitat intrinsic potential[99] (IP; see discussions in Chapter 4 Stream Channels and Channel Modification and Appendix E – Detailed Methodologies),
- areas of anadromous fish spawning and rearing, as identified by ODFW fish use GIS layers (e.g., Type 1),
- areas of anadromous fish rearing and migration, as identified by ODFW fish use GIS layers (e.g., Type 2), and
- the presence of fish-bearing streams (Type F), as identified by ODF GIS layers.

After identifying their relative importance to ODF, we combined them into a logical prioritization scheme. Consequently, the list can be used as a screening tool – when overlayed in a GIS – to identify streams and stream reaches that are of particular importance to aquatic resources. We did not include the presence of listed (state and/or federal) or candidate fish species because of the tenuous and changing nature of species listings. They could be included in future stream/stream reach identification scenarios, however, if managers deemed it appropriate. Additionally, to the best of our knowledge, no chum salmon juvenile density data for the Wilson River watershed exists[100] nor are there literature-established values for defining their habitat IPs.

The resulting prioritization scheme took the following form (in order of importance from greatest to least):

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[97] Density data (# fish/square foot) from the 2005 RBA were divided into quartiles and the 75th quartile was used as the breakpoint for defining "high density". Coho >0.587; steelhead >0.127, cutthroat >0.122.
[98] GIS layers were not yet available for the 2006 RBA survey but will eventually be available from the Tillamook Estuaries Partnership offices located in Garibaldi, OR and online at www.tbnep.org.
[99] Species-specific habitat intrinsic potentials are discussed in great length in Burnett et al. 2007 where values ≥0.75 are considered "high" (unless otherwise specified, we assumed the same).
[100] There are, however, outmigrant smolt trap data for chum salmon from the Little North Fork Wilson subwatershed.

1. SAH overlayed with areas of high fish density (or where density information is lacking, high IP),
2. SAH,
3. Areas outside of SAH with high fish density (or where density information is lacking, high IP),
4. Areas where multiple anadromous fish species spawn and rear,
5. Areas where multiple anadromous fish species rear and migrate,
6. Areas where a single anadromous fish species spawns and rears,
7. Areas where a single anadromous fish species rears and migrates,
8. Fish-bearing streams, and
9. Areas of high IP but where no fish are present.

9.14.2 Results

Salmon Anchor Habitats (SAHs) occur in the Little North Fork Wilson, Upper Wilson/Cedar Creek (including Ben Smith Creek), and Devils Lake Fork subwatersheds. When overlayed with areas of high fish density and – where density information is lacking – high IP, two stream sections (both in the Little North Fork Wilson subwatershed) were identified (Table 79).

Chum salmon are likely not well represented by the fish stream/reach prioritization scheme. They do not occur[101], however, on ODF lands and because 1) they are generally only present during cooler months (e.g., fall/winter) and 2) their young enter the ocean before the warmer summer water temperatures, chum salmon are not likely to be negatively influenced by current ODF management practices.

[101] Official ODFW species presence/absence layers do not depict chum salmon in waters on ODF lands. However, ODFW Fish Biologists on the Tillamook district (Keith Braun and Dave Plawman) note that chum salmon have been observed on ODF/BLM matrix lands.

Table 79. Priority stream reach categories (ranked from low to high) for protection and/or restoration.

Prioritization Attributes	Subwatershed Name	Miles in Wilson River[1]	Length (mi) and Percent on ODF lands
Non-fish-bearing streams but with high IP	Devils Lk Fk	0.23	0.15 (64)
	Jordan Cr	0.07	0.07 (100)
	Little N Fk Wilson	0.11	0.11 (100)
	Middle Wilson	0.05	0.05 (100)
	Upper Wilson/Cedar Cr	0.10	0.10 (100)
Fish-bearing streams	Devils Lk Fk	60.09	51.66 (86)
	Jordan Cr	33.96	28.36 (84)
	Little N Fk Wilson	38.30	29.91 (78)
	Lower Wilson	52.55	15.16 (29)
	Middle Wilson	26.62	23.67 (89)
	N Fk Wilson	41.05	28.68 (70)
	S Fk Wilson	32.94	32.94 (100)
	Upper Wilson/Cedar Cr	41.69	34.78 (83)
Rearing and migration corridors used by a single anadromous species	No streams match this query	NA	
Spawning and rearing corridors used by a single anadromous species	No streams match this query	NA	
Rearing and migration corridors used by multiple anadromous species	Lower Wilson	1.49	0.0 (0)
Spawning and rearing corridors used by multiple anadromous species	Devils Lk Fk	5.95	5.67 (95)
	Jordan Cr	3.40	3.38 (99)
	Little N Fk Wilson	2.49	1.62 (65)
	Lower Wilson	5.70	0.79 (14)
	Middle Wilson	4.08	3.41 (84)
	N Fk Wilson	4.03	3.30 (82)
	S Fk Wilson	2.56	2.56 (100)
	Upper Wilson/Cedar Cr	4.82	3.59 (74)
Areas outside of SAH but with high density and high IP	Devils Lk Fk	2.99	
	Jordan Cr	4.07	
	Lower Wilson	14.57	
	Middle Wilson	9.31	
	N Fk Wilson	5.99	
	S Fk Wilson	3.38	
Areas inside of SAH and with high density and high IP	Little N Fk Wilson	0.19	
	Devils Lk Fk	2.65	2.65 (100)

[1] **Includes all stream in the Wilson River watershed, not just streams occurring on ODF lands.**

9.15 Key Findings and Recommendations

None of the anadromous salmonid species inhabiting the Wilson River watershed are currently listed as *Threatened* or *Endangered* under the federal Endangered Species Act (ESA; refer to Table 63 in section 9.3 Native and Introduced Salmonids). Numerous species/stocks, however, including several non-salmonids, are listed by the state as *Sensitive/Vulnerable* or *Sensitive/Vulnerable* (Table 63). While no introduced salmonids, except the summer steelhead stock/race, are known to occur in the Wilson River, information pertaining to the introduction and establishment of non-salmonid species is severely lacking. Additionally, information pertaining to native non-salmonid abundance and distribution is non-existent.

Although the Tillamook Bay estuary is likely to be the conduit for potential introduced species invasions, we recognize that such introductions may occur off ODF lands. However, because some invasions can have far-reaching and catastrophic effects on local, native populations, we recommend that ODF maintain a close working relationship with the ODFW and Tillamook Estuaries Partnership to identify, in the early stages, potential invasions by non-native species.

Historic salmonid distributions are likely very similar to their current distributions (Kavanagh et al. 2005) and current abundances, with the exception of fall Chinook salmon, are likely severely depressed compared to their pre-European abundances. Indeed, abundance counts from the past 50+ years, with few exceptions, generally indicate decreasing abundances coupled with high variability, underscoring the tenuous nature of many of these stocks/runs (refer to sections 9.7 – Historic Salmonid Abundance and 9.8 – Current Salmonid Abundance for more detailed information). Accordingly, extra precaution should be employed when considering whether a species will be impacted by management actions. Additional caution is urged when considering the effects of multiple actions within relatively discrete geographic areas (e.g., individual streams).

Because of the high variability in peak abundance counts, we recommend extreme caution when interpreting the effectiveness of restoration activities, especially over the short-term. Additionally, the effectiveness of restoration projects should be repeatedly assessed over the course of several years and even decades. Furthermore, long-term monitoring activity costs should be included when calculating future projects' costs.

Fish habitats in the Wilson River watershed have been significantly influenced by both natural and human-caused disturbances. The Tillamook Burn fires and subsequent timber harvest and road-building activities significantly altered the types and availability of high-quality aquatic habitats present in the Wilson. Perhaps the most significant effect was the removal of large wood from the system, both from the streams ("stream-cleaning") and from the riparian (fires and subsequent harvest). The lack of instream large wood pieces (see section 9.10 – Fish Habitat Condition) is likely having a detrimental effect on the overwintering abilities of juvenile salmonids and on the accumulation of gravels, especially in the Jordan Creek subwatershed where 80% of the surveyed stream reaches exhibited LOW percent gravel, HIGH percent bedrock and LOW percent pools, relative to ODFW "reference/benchmark" reach data (Table 73; although this may partially be a relic of historic log drives).

Data for several key habitat attributes from reaches throughout the various Wilson River subwatershed often are not apportioned according to ODFW's Aquatic Inventories Project (AIP) reference reach data. When considered collectively, however, the data may suggest that aquatic habitat conditions in the Wilson River are still exhibiting some level of functionality. For example, data for conditions within the Little North Fork of the Wilson subwatershed are fairly evenly distributed among the LOW, moderate and HIGH categories (28.7%, 50%, and 21.3%, respectively), indicating that its aquatic habitat conditions are likely functioning in a manner similar to other coastal watersheds that have experienced relatively little human disturbance (refer to section 9.10 – Fish Habitat Condition). Key habitat attribute data from the Jordan Creek subwatershed, on the other hand, are skewed relatively heavily toward LOW categories (48% LOW, 37% moderate, 15% HIGH), indicating that its aquatic habitat conditions may be compromised. Indeed, two other subwatersheds exhibit similar patterns (Devils Lake Fork and North Fork Wilson). In contrast, key habitat attribute data for the Upper Wilson/Cedar Creek, Middle Wilson and South Fork Wilson subwatersheds indicate only a moderate distributional skew away from reference conditions (refer to section 9.10 Fish Habitat Condition).

In order to develop a scheme for prioritizing stream reaches, we identified several factors known to be of particular importance (see section 9.14 Priority Streams for details). After identifying their relative importance to ODF, we combined them into a logical prioritization scheme. The resulting list (also detailed in section 9.14 – Priority Streams), organized by decreasing importance and (generally) increasing land area, can be used as a screening tool – when overlayed in a GIS – to identify streams and stream reaches that are of particular importance. These streams/reaches, if protected and/or restored, would provide the greatest overall beneficial impacts to aquatic resources. Priority streams/reaches occur in every subwatershed (see Table 79 in section 9.14 – Priority Streams) and ranged in length from less than 0.1 miles to more than 60 miles with most of the reaches occurring in large, contiguous chunks (as opposed to fragmented). Because of the presence of Salmon Anchor Habitats, the subwatersheds with the highest priority streams all occur in the Little North Fork Wilson, Upper Wilson/Cedar Creek (including Ben Smith Creek), and Devils Lake Fork subwatersheds. Not surprisingly, this result also *generally* corresponds with subwatersheds where aquatic habitat conditions were in MODERATE to GOOD shape (compared to ODFW "reference/benchmark" streams). The identification and placement of future conservation and restoration measures could largely be informed using this list to identify areas of concern.

Additionally, when evaluating fish abundance estimates, aquatic habitat conditions, habitat intrinsic potentials (IP), and core coho and steelhead habitats in conjunction with each other, subwatersheds can be compared to assess where *initial* restoration efforts could be focused. For example, aquatic habitat conditions in the Upper Wilson/Cedar Creek and the Little North Fork Wilson were rated as being in MODERATE and GOOD condition (respectively), the subwatersheds contains high IP for coho and steelhead, areas of high core habitat for coho and steelhead, and contributes relatively large numbers of coho, steelhead and cutthroat trout. Restoration efforts in these subwatersheds, therefore, would be a low priority, relative to other subwatersheds. Conversely, aquatic habitat conditions in the Devils Lake Fork and the South Fork Wilson were rated as being in POOR and MODERATE condition (respectively), yet the subwatershed contains areas of high IP and core habitats for coho and steelhead, contribute relatively large numbers of coho salmon and cutthroat trout but produces relatively few steelhead. Therefore, restoration efforts in these subwatersheds could be focused on improving aquatic habitat conditions (e.g., increasing the number of pools and pieces of large wood), primarily for steelhead (low abundances), but also for coho, which are likely to re-listed. Likewise, aquatic habitat conditions in Jordan Creek and the Middle Wilson were rated as being in VERY POOR and POOR condition (respectively), the subwatersheds contain areas of high IP and core habitat for steelhead (but none for coho), yet they produce relatively few of both[102]. Restoration efforts here could be focused on increasing the number of pools, number of deep pools (primarily in the Middle Wilson), percent gravel and large wood.

Two actions would arguably have the largest beneficial impact on aquatic wildlife and their associated habitats:

1. encouragement of instream large wood recruitment in landslide- and debris-flow prone areas in and upstream of high priority aquatic areas,

[102] The exception being that portions of non-HUC-classified streams in the Wilson that produced coho and steelhead may be part of the Middle and Lower Wilson subwatersheds. Refer to Table 69 and the Tillamook Estuaries Partnership's 2005 and 2006 Rapid Biological Assessments.

2. placement of instream large wood in and upstream of high priority aquatic areas.

As key pieces of large wood begin to recruit to (or are placed in) the streams, we would expect to see an increase in pool frequency, decreases in the number of habitats where bedrock dominates, increases in gravels, and increases in aquatic cover associated with wood accumulations. It is important to note, however, that the effectiveness of instream large wood depends on size of the receiving channel, size of the piece(s) of wood and the probability that large wood additions will accumulate (related to channel roughness, meander, riparian vegetation, wood size/length, etc.). Our modeling results indicate that riparian stands will be unable to provide adequate functional wood throughout the next century for streams of about 30 feet in width and greater. Streams of this width are at the upper end (and beyond) the size range generally recommended for large wood placement (e.g., ODF & ODFW 1995). Nevertheless, these are the streams with highest value for fish and the lowest potential for large wood recruitment (see Maps 31, 32, 33, and 37). It will be worthwhile, therefore, to look for opportunities for stable wood placement within these general areas. The models used an estimate of average channel width, and do not capture details of spatial variability in channel configuration: some reaches within the channels identified as high priority for fish, and low potential for riparian recruitment of functional wood, will fall within the range of channel widths and slopes recommended for wood placement (page 5 in ODF & ODFW 1995). These are the sites to look for.

In summary, there has been a decreasing abundance in most species in the last 50+ years, aquatic habitat conditions are moderately impaired, and the Little North Fork Wilson is in the best overall aquatic shape (and the high fish numbers generally reflect this). On the other hand, aquatic conditions in the Jordan Creek, Devils Lake Fork, Middle Wilson and North Fork Wilson subwatersheds are in the poorest shape and, with the exception of the North Fork Wilson where numbers are high and the Devils Lake Fork where coho numbers are high, fish numbers generally reflect this. Additionally, there are low amounts of instream large wood and numbers of pools (including deep pools) throughout the watershed. Adhering to the management recommendations mentioned above will help to 1) ensure adequate funding for long-term monitoring activities, 2) reduce the likelihood that an exotic species invasion will go unnoticed for some time, 3) reduce sedimentation and erosion and increase riparian shade (in some areas), 4) restore fish passage to useable habitat, 5) enhance the recruitment of large wood to streams thereby improving aquatic habitat complexity, and 6) maintain (or enhance) aquatic habitat conditions throughout the Wilson.

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