FISH HABITAT ASSESSMENT IN THE OREGON DEPARTMENT OF FORESTRY TILLAMOOK STUDY AREA

Peggy Kavanagh
Kim Jones
Charles Stein
Paul Jacobsen

December 2005

Oregon Department of Fish and Wildlife
Aquatic Inventories Project
28655 Highway 34
Corvallis, Oregon 97333

Table of Contents

List of Tables

List of Figures

List of Maps

List of Maps continued

Fish Habitat Assessment in the Oregon Department of Forestry Tillamook Study Area

Project Description

A collaborative project between the Oregon Department of Forestry (ODF) and the Oregon Department of Fish and Wildlife (ODFW) was initiated to synthesize aquatic habitat and fisheries information for the Tillamook drainage to assist in the development of operational management plans, stream habitat restoration projects, habitat conservation planning, and watershed analysis. The project summarizes the condition of stream habitat, the distribution and abundance of salmonid fishes, and the potential for restoration. The ODFW Aquatic Inventories Project has conducted stream habitat surveys as part of its basin survey project and habitat assessment project under the Oregon Plan for Salmon and Watersheds. The goal of these surveys was to document the status and trends of stream conditions in coastal drainages. These surveys in conjunction with fish distribution, fish presence, potential barriers to passage, and past restoration activities form the basis of the analyses.

The Tillamook study area is in northwestern Oregon and drains into the Pacific Ocean (Map 1). The Tillamook project area, as delineated by ODF ownership, is comprised of segments of drainages defined as ODF management basins (Map 2) rather than watershed boundaries. The project area covers approximately 53,780 hectares. Major drainages in the study area include the Kilchis, Wilson (Upper and Lower), Trask, Tillamook, and Nestucca Rivers. Within this study area, ODF ownership is located primarily in the Tillamook basin. ODF ownership further south, in the Nestucca basin, is patchy. A segment of ODF land is in the Willamina basin, which flows into the South Yamhill River. Table 1 lists the major river basins, streams, and ODF Management basins that correspond with Map 2. Other land ownerships in the drainage include private industrial, private non-industrial, public, and county (Map 3). Land use in the drainage is dominated by forest and agricultural-related activities. Between the 1930 and 1950's, fires burned much of the upper Kilchis, Wilson, and Trask watersheds (Map 4). The result today is a mix of trees 50-200 years old.

Historical wetland distribution reflects the extent of the Tillamook estuary and tidal flats into the Tillamook study area (Map 5). Historically, these wetlands extended quite far up the Tillamook River, to the confluence of the Little Wilson and Wilson Rivers, into the Trask and Kilchis Rivers, as well as many other tributaries in the basin. The tidal flats provided important rearing and resting places for juvenile Chinook, chum, and other salmonids (Healy, 1982). Wetlands are currently restricted to the tidal portions of Tillamook Bay. It is believed that eighty percent of the historical extent has been altered by agricultural and urbanization processes (Goode, 2000). Although the historical expanse borders ODF boundaries, the wetland distribution is important to riverine and ecosystem processes and biological needs of anadromous fish.

The Tillamook basin is comprised of four level IV ecoregions as defined by Thorson et al (2003) (Map 6). The Coastal Lowlands consists of the beaches, dune, estuary, and forests below 400 feet in elevation. The Coastal Upland ecoregion is adjacent to the Lowlands ecoregion. The Upland ecoregion area was historically dominated by Sitka spruce. Most of the Tillamook study area is in the Volcanics ecoregion, underlain by basaltic rocks, which influences the geomorphology of the region. The very southern portion of the study area borders the Mid-Coastal Sedimentary ecoregion. However the channel geology in the Tillamook study area reflects both the basaltic geology and a band of north-south trending Yamhill formation (marine sandstone and siltstones): pebbles and boulders, sand, and a mix of the pebbles, boulders, and sand (Map 7). The gradient of streams in the Tillamook study area (Kilchis, Wilson, Trask, Tillamook Rivers) is high, especially in the upper reaches. Streams in the Nestucca River basin on ODF land are lower gradient.

The area delineated by ODF is referred to as the Tillamook project area. Because of the limited amount of aquatic surveys and fish bearing streams on ODF land in the Nestucca and Willamina basins, summaries reflect the greater Tillamook basin unless otherwise stated. If information is presented for land outside of the study area, it is specifically stated. The Tillamook study area is within the hydrologic unit (HU) 17100203.

GIS coverages – sources and scales

Three digitized map layers were used for different features of this synthesis. The primary layer is the 1:100,000 USGS stream layer. It is a standardized and routed coverage, and has a unique latitude and longitude field associated with each stream (Hupperts 1998). Fish distribution and aquatic habitat data are joined to the 1:100,000 coverage. The Coastal Landscape and Analysis and Modeling Study (CLAMS: http://www.fsl.orst.edu/clams/) provided a 1:24,000 coverage and a standardized 6th field Hydrologic Unit coverage. The CLAMS coverages displayed all streams at a 1:24,000 scale (Map 8), and determined the valley width, mean annual flow, and channel size. The highest resolution coverage was developed for Oregon Department of Forestry (ODF) at the 1:12,000 scale. We used this layer to display a generalized map of salmonid distribution. Because of the different development processes, the data cannot be integrated across scales, but are displayed in the same projection (Map 8).

Fish Distribution and Abundance

Coho salmon (*Oncorhynchus kisutch*), fall and spring Chinook salmon (*O. tshawytscha*), chum salmon (*O. keta)*, and winter and summer steelhead (*O. mykiss*) occur in the mainstem and tributaries of the Tillamook study area (Maps 9, 10, and 11). Additionally, resident and anadromous cutthroat trout (*O. clarki clarki*) (Map 12) and Pacific lamprey (*Lampetra tridentata*) are present. Non-salmonid native species are present, including white sturgeon; however their distributions are not well-documented. White sturgeon are documented in the Tillamook estuary, but it is not known where these fish spawn.

ESA Designations

Coho salmon has been proposed for listing, and winter steelhead is considered a species of concern in the Tillamook study area under the federal Endangered Species Act (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/).

Fish Populations in the Tillamook study area

Chum salmon spawn and rear in the low gradient, tidal portions of the basin, and into the lower reaches of the mainstem and tributaries (Map 9). Chum salmon return mid to late October and spawn in November and December. The largest populations are in the Miami, Kilchis, and Wilson (Keith Braun, ODFW, personal communication). ODFW spawning survey data yielded peak fish counts ranging from 1 to 407 fish in 2004 in the Kilchis, Wilson, Netarts, and Nestucca rivers. Few chum salmon spawn in the Tillamook and Trask rivers.

Coho salmon reside throughout the Tillamook study area (Map 9). Coho salmon begin returning to the watershed in October and early November after spending 6 months to 1.5 years in the ocean. The peak spawning period occurs between mid-November and mid-January. Coho are distributed throughout the entire watershed except for the upper reaches of the tributaries due to barriers or high gradient. Coho prefer to spawn in the smaller tributaries, but have been observed in the upper reaches of the mainstem as well. Spawning surveys have been conducted in the Tillamook study area from 1989 to 2003 by the ODFW Coastal Salmon Inventory Project. The number of coho salmon observed throughout these reaches has varied dramatically from 1989 to 2003, but an increase was observed beginning in 1999 because of improved ocean conditions (Map 13).

Two runs of Chinook salmon are present in the Tillamook study area, a spring run and a fall run (Nicholas and Hankin 1988). Spring Chinook salmon are present in the Nestucca, Wilson, and Trask systems, returning from the ocean in April and May. They spawn in September and October, peaking in late September to early October. Fall run Chinook salmon are found in all basins and are distributed throughout the study area. Fall Chinook salmon return to the estuaries in late summer/early fall, hold until fall rains arrive, then distribute throughout the Tillamook study area (Map 10). They primarily spawn in November and December. Fall Chinook salmon extend further into the Tillamook study area than spring Chinook. Abundance of adult Fall Chinook salmon ranged from peak counts of 14 – 101 per mile in 2003 and 29 – 154 per mile in 2002 on selective surveys.

Summer and winter steelhead reside extensively throughout the mainstem and larger tributaries of the Tillamook study area (Map 11). Summer steelhead are a hatchery run released into the Nestucca and Wilson Rivers, and are thought to stray into the Trask and Kilchis. They return from late May through the summer and typically spawn in late January and February. They are not the target species of ODFW Coastal Salmon Inventory Project surveys. Winter steelhead are primarily naturally-produced and are distributed extensively throughout the basin, except for the small, steep tributaries. Winter steelhead return from early December through April and spawn from January through May with peak spawning occurring in April (Keith Braun, personal communication). 2005 spawning survey data collected by the ODFW Coastal Salmon Inventory Project for the Kilchis basin reflect a total of 20 fish and 35.2 redds per mile, based on 3.6 surveyed miles. The Wilson basin, including the Little North Fork and South Fork, had 194 fish total and 42.5 redds per mile, based on 8.3 surveyed miles. The Trask system (mainstem tributaries, North Fork, South Fork) totaled 72 adults and 17.9 redds per mile, based on 10 surveyed miles. While the Nestucca, with over 32 miles surveyed, surveyors found 378 fish and 23 redds per mile. Steelhead redd counts vary depending on year and location, ranging from 0 – 146 redds per mile.

Pacific lamprey distribution has yet to be mapped, and surveys targeting Pacific lamprey are few. However, Pacific lamprey redds and adults were counted as a part of the ODFW steelhead surveys. In 2005, redds per mile averaged 6.7 in the Kilchis, 30.5 in the Wilson; 11.5 in the Trask, and 8 in the Nestucca. Live counts were not recorded in 2005 surveys.

Anadromous and resident cutthroat trout are not the focus of any population monitoring program; therefore, counts of adults are unknown, although they are present in most streams in the Tillamook study area (Map 12).

A summary of salmonid fish populations in North Coast basins, including the Tillamook study area, was developed by Talabere and Jones (2002) to identify small watersheds (6th field HUs) that supported higher than average densities of salmon during 1989 - 2000, based on ODFW Coastal Salmonid Inventory Project data (Map 14, Table 2). The maps depict the small watersheds that had above average densities for more than 50%, 75%, and 90% of the 12 years for chum, Chinook, and coho salmon (Map14). Because systematic surveys were not conducted for steelhead, Talabere and Jones (2002) relied on professional judgment and scientific reports to determine the most important watersheds for steelhead. The selection of Salmon Habitat and Diversity Watersheds (Map 15) was based on the combination of species abundance and distribution. Those watersheds that supported a high abundance of multiple species received a higher ranking. The Oregon Department of Forestry, in consultation with ODFW, designated six watersheds (selected from the Salmon Habitat and Diversity Watersheds) within the Tillamook study area as Salmon Anchor Habitats (Map 16, Table 2) to recognize the importance of the 6th field watersheds to salmon populations. Salmon Anchor Habitats incorporate the aforementioned abundance quartiles with habitat quality and species diversity for a more robust examination. They include Elkhorn Creek, East Fork South Fork Trask River, Devils Lake Fork

Wilson River, Cedar/Ben Smith Creeks, Lower North Fork Wilson River, and South Fork Kilchis River (Table 2).

Historic Fish Distribution

Lacking historic fish distribution information, we used a map of stream size and gradient developed by the Coastal Landscape Analysis and Modeling Study (CLAMS: http://www.fsl.orst.edu/clams/) to identify areas above current fish distribution that could have potentially supported salmon in the past. We assumed that fish distribution in the Tillamook basin would be limited by stream gradient if impediments such as physical barriers or poor habitat were not present. Comparing current maps of fish distribution with the CLAMS generated maps of gradient and streams size indicates that historic fish distribution may be similar to present conditions (Maps 17 and 18).

Salmon and Lamprey life history in coastal basins

Chinook salmon return early September to early November with peak spawning activity observed in mid November to mid December. Chinook salmon prefer to spawn in larger streams at the tail crest of pools and glides and tend to use larger substrate in which to build redds. The fry emerge in early spring. Some will migrate immediately to the estuary while others will remain in freshwater until fall. After spending the summer and early fall in the estuary they will migrate to the ocean. Juvenile Chinook salmon can be found in the estuary most months of the year. Most Chinook salmon will remain in the ocean an average of 3 to 5 years. Upon return from the ocean, the adult fish often hold in the estuary until the rains increase the water levels, and then return to their natal streams to repeat the cycle. Habitat requirements for adult Chinook are deep pools for holding habitat, and gravel and cobble substrate absent of fine sediments for spawning. Juvenile Chinook salmon need cool, oxygenated water, pools, and large wood debris for cover while in their freshwater environment. Estuaries and associated wetlands provide vital nursery areas for the juvenile fish prior to their departure to the open ocean.

Coho salmon begin returning to the watershed in October and early November after spending 6 months to 1.5 years in the ocean. The peak spawning counts occur between mid-November and mid-January. Coho prefer to spawn in the smaller tributaries and have been observed in the upper reaches of the mainstem as well. The fry emerge in early spring and remain in their freshwater environment for a complete year. Thus, due to this life history trait, high quality habitat conditions are necessary year-round in order to insure survival during summer and winter. Favorable attributes include off-channel and beaver pond habitat to provide refuge from high velocity winter flows, large wood debris to provide cover from high flows and predators, and low levels of fine sediment to promote prey production.

Winter steelhead return to their natal streams from November to April after spending from 1 to 3 years in the ocean and unlike other Pacific salmon, some may survive after spawning and return to the ocean and become repeat spawners. Spawning occurs in the winter and early spring, and when the fry emerge they remain close by or occasionally migrate to the upper or lower reaches of streams and rivers. Like other salmon species, juveniles and adults rely on streams, rivers, and marine habitat during their lifecycle. Juveniles usually stay in their freshwater environment for two years before migrating to the ocean in the spring. Habitat requirements include clean, ample gravel for spawning, cold, clean, well oxygenated water, deep pools and large wood debris for cover.

Coastal cutthroat trout may exhibit four main life history strategies; an anadromous form that migrates to the estuary and/or ocean before returning to freshwater to spawn, an adfluvial form that migrates from a lake to smaller tributaries to spawn, a fluvial form that migrates to small streams from other parts of the watershed to spawn, and a resident form that both resides and spawns in small streams. Both anadromous and resident cutthroat trout are found throughout the mainstem and tributaries of the Tillamook River basins but specifically resident cutthroat tend to be found in the upper headwater reaches of the tributaries. Anadromous adults enter streams during the fall. These adults will spawn from December through May depending on water conditions. Fry emerge from the gravel in about 2 months. The young utilize slow flowing backwater areas, low velocity pools, and side channels for rearing. Young cutthroat can spend 1 to 9 years in fresh water before they migrate to the estuaries and ocean in the spring, but most commonly it is three years from emergence. Adults usually spend less than one year in the ocean before returning to spawn. Like steelhead, sea-run cutthroat trout usually survive after spawning and will return to the ocean in late March or early April. In freshwater, adult cutthroat typically reside in large pools while the young reside in riffles.

Pacific lamprey are anadromous. Mating pairs construct a nest by digging together using rapid vibrations of their tails and by moving stones using their suction mouths. Adults die within days of spawning and the young hatch in 2-3 weeks. The juveniles swim to backwater or eddy areas of low stream velocity where sediments are soft and rich in dead plant materials. They burrow into the muddy bottom where they filter the mud and water, eating microscopic plants (mostly diatoms) and animals. The juvenile lamprey will stay burrowed in the mud for 4 to 6 years and stay in the same habitat, rarely migrating within the stream system. They metamorphose into adults averaging 4.5 inches long. Lamprey migrate to the ocean in late winter during periods of high water. After 2 to 3 years in the ocean they will return to freshwater to spawn.

Habitat Survey Approach and Methods

ODFW Aquatic habitat surveys have been conducted in the Tillamook, Nestucca, and Yamhill watersheds from 1990 – 2004 (Map 19; Table 2). Due to the small number of stream reaches surveyed on ODF land in the Nestucca and Yamhill river basins, the habitat summaries reflect the Tillamook basin unless otherwise stated.

The habitat surveys describe the channel morphology, riparian characteristics, and features and quality of instream habitat during summer flow, following methods described in Moore et al. (1999) (http://osu.orst.edu/Dept/ODFW/freshwater/inventory/publicatn.htm). Each habitat unit is an area of relatively homogeneous slope, depth, and flow pattern representing different channel forming processes. The units are classified into 22 hierarchically-organized types of pools, glides, riffles, rapids, steps, and cascades, as well as slow-water and off-channel pool habitat. Length, width, and depth were either estimated or measured for each habitat unit. In addition, water surface slope, woody debris, shade, cover, and bank stability were recorded. Substrate characteristics were visually estimated at every habitat unit. Estimates of percent silt, sand, and gravel in low gradient (1-2%) riffles are used to describe gravel quantity and quality. The surveys also provided an inventory of site-specific features including barriers to fish passage (e.g., falls or culverts), mass hillside failures, and beaver activity.

Riparian transects describe tree type and size, canopy closure, and ground cover associated with the floodplain, terraces, and hillslopes adjacent to the stream. The transects measure 5 meters wide and extend 30 meters perpendicular to each side of the channel. The number and size of the trees recorded are extrapolated from these transects and summarized as the number of trees expected every 1000 feet of stream length.

Descriptions of channel and valley morphology followed methods developed at Oregon State University and described in detail in Moore et al. (1999). Valley and channel morphology defined the stream configuration and level of constraint that local landforms such as hillslopes or terraces imposed upon the stream channel (Gregory et al. 1989; Moore and Gregory 1989). The channel was described as hillslope constrained, terrace constrained, or unconstrained. Channel dimensions included active (or bankfull) channel width and depth, floodprone width and height, and terrace widths and height. These descriptions of channel morphology have equivalents within the OWEB and Rosgen channel typing system (Rosgen 1994).

Two survey designs were used within the Tillamook study area. Surveys conducted in 1990 – 1997 in the Tillamook watershed followed a basin, or census, survey design. The basin survey followed methodology proposed by Hankin (1984) and Hankin and Reeves (1988). The sampling design is based on a continuous walking survey generally from the mouth or confluence of a stream to the upper headwaters. Each stream is stratified into a series of long sections called reaches and then into short habitat units within each reach. A stream reach is a length of stream defined by some functional characteristic. This may be a change in valley and channel form, an entering tributary, major changes in vegetation type, or changes in land use or ownership. Within a watershed, field crews survey major streams and a selection of small tributaries. The methodology provides flexibility of scale, allowing information to be summarized at the level of microhabitat, associations of habitat, portions or reaches of streams, watersheds, and subunits within regions. The continuous-survey approach provides field-based estimates of habitat conditions throughout a stream, describe habitat and hydrologic relationships among streams or landscape features, and permit stream-wide estimates of fish distribution and abundance.

The second survey design is referred to as Oregon Plan surveys (OR Plan). This survey design was intended to provide estimates of habitat conditions across a broad geographic region. To accomplish this, we randomly selected sites each year from 1998-2005 in coastal drainages throughout western Oregon. Of the total sites surveyed to date, 38 sites fell within the Tillamook study area. Field protocol was similar to the basins surveys except that sites were restricted to 500 or 1,000 meters in length and some of the sites are designated to be re-surveyed on a rotational design of one, three, and nine year intervals. The randomly selected sites were combined with the basin survey reaches to describe aquatic conditions in the study area and are included in the summaries reported here

Analysis

Habitat data were summarized at the reach (basins surveys) or site (OR Plan surveys) scale to describe channel morphology, habitat structure, sediment supply and quality, riparian forest connectivity and health, and in-stream habitat complexity. Individual attributes include:

Channel morphology	Channel dimensions Channel constraint features, if any Gradient Percent secondary channels Floodplain connectivity
Pool habitat	Percent pool Percent slow, backwater, and off-channel pools Deep Pools (>1m deep) Complex pools (contain > 3 pieces large wood)
Large Wood	Pieces of large wood (>0.15m diameter and >3m length) Volume of large wood (m^3) Key pieces of wood (>0.6m diameter and >12m length)
Substrate	Percent fines, gravel, cobble, boulder, bedrock Percent fines and gravel in low gradient riffles
Riparian	Shade Density of conifer trees, by size category Density of hardwood trees, by size category

Results are presented in tables and as frequency distribution graphs, and in GIS coverages. Values were standardized as a percent or by reach length. Habitat attributes were expressed as reach or site averages or displayed at the habitat unit level. Information from a reference database was used to provide a standard point of comparison. The basins and OR Plan surveys were integrated into coverages in a Geographical Information System (Jones et al 2001). The basins surveys were routed and displayed at the channel reach and habitat unit scales, and the OR Plan surveys were displayed as points with reach summary data.

Individual stream survey reports for the river basins in the Tillamook study area are available from the Aquatic Inventories Project in Corvallis. Metadata for the GIS coverages is available online at: http://oregonstate.edu/Dept/ODFW/freshwater/inventory/index.htm

An interpretation guide for aquatic habitat data is available online at:
http://oregonstate.edu/Dept/ODFW/freshwater/inventory/index.htm

Habitat quality

Individual habitat attributes portray a view of stream characteristics. They provide a point of comparison to view the relative differences between streams and reaches within a drainage network. We integrate habitat attributes in three different fashions, considering fish, landscape, or historic perspectives. The first is in comparison to a historic context, expressed in the character of streams located in minimally human disturbed areas. These sites are referred to as reference sites, and while they provide a general context and range of stream attributes they are not intended to be prescriptive in nature.

The second and third perspectives express stream quality in terms of potential carrying capacity of a reach for juvenile coho salmon (Habitat Limiting Factors Model) and potential survival of coho salmon at each life stage (HabRate). Again, each model provides a comparison of stream attributes from a salmonid biology perspective.

Reference conditions

Reference values (Table 3) were derived from streams in areas with low impact from human activities (e.g. wilderness or roadless area, late-successional or mature forest). A total of 124 reference sites, surveyed between 1992 and 2003, were selected within the Oregon Coast Coho ESU (from Sixes River to the Necanicum, including the upper Umpqua in the Cascade ecoregion) to represent natural or historic conditions within the range of coho salmon. Each site was inspected using USGS 7.5 minute topographic maps for human-caused stressors such as roads, development, and forest management.

Attribute	Value
Number of Reaches or Sites	124
Distance Surveyed - Total (km)	161.9
Reach or Site Length (m)	
Mean (median)	1306 (971)
Range	174 - 6776
Active Channel Width (m)	
Mean (median)	9.28 (7.28)
Range	1.5 - 31.5
Gradient (%)	
Mean (median)	2.8 (2.3)
Range	0.5 - 19.2
Ownership	primarily federal
Ecoregions	Coastal 80% Cascades 20%
Geology	Sedimentary 72% Volcanic 21% Mixed 7%

While few of the sites were completely absent of human influence, we assumed that the reference sites represented a natural range of conditions. The range of data for each reference stream variable was subdivided into quartiles, 0-25%, 25-75%, and 75-100%. The value within each of the three quartiles was labeled as either low, moderate, or high. Thus, we considered that the 25th and 75th quartile breakpoints represented the values we considered low or high within a natural context. The middle 50% quartile was considered a moderate or average level. We used these values not to predict historic conditions in the Tillamook study area, but to more broadly represent the potential range of historic conditions in lower gradient (<5%) fish-bearing streams in coastal Oregon, and to provide a point of comparison for the subsequent analysis.

Habitat Limiting Factors Model (HLFM)

The HLFM model estimates the potential carrying capacity of stream habitat and identifies the limiting factors for coho salmon production (Nickelson et al 1992, Nickelson 1998). We used this model to quantify critical habitat factors for juvenile coho salmon during the summer and winter and to highlight differences between reaches. The HLFM model focuses on the amount of pool habitat in a reach, particularly the beaver pool and off-channel pool habitat. Summer habitat capacity is a function of the amount of total pool habitat; winter habitat is governed by the amount of beaver and off-channel pool habitat. One advantage of the HLFM model is that is predicts the number of coho salmon parr that the habitat can support during a particular season (capacity), in addition to quantifying habitat quality.

Stream capacity to support juvenile coho salmon during the summer was considered high if the value exceeded 2,430 fish per kilometer and low if the value was below 1250 fish per kilometer. Similar values for capacity to support winter parr were 1950 and 1000 fish per kilometer. Habitat quality was measured as the average number of juvenile fish per square meter in a kilometer of stream. The breakpoints for low and high quality were 0.15 and 0.38 fish per m^2 in the summer, and 0.12 and 0.30 fish per m^2 in the winter (Rodgers et al., 2005)).

We used data from winter surveys to estimate winter capacity for juvenile coho when available. Otherwise, summer habitat conditions were applied to a predictive model to estimate habitat capacity during the winter.

HabRate

HabRate (Burke et al. 2001) describes the quality of aquatic habitat in relation to survival of coho salmon at a particular life stage. HabRate was based on our interpretations of the published literature. Habitat requirements for discrete early life history stages (i.e. spawning, egg survival, emergence, summer rearing, and winter rearing) were summarized and used to rate the quality of reaches as poor, fair, or good, based on attributes relating to stream substrate, habitat unit type, cover and structure (large wood, undercut banks), and gradient. Reach level summaries of stream habitat were entered into a computer spreadsheet, and interpreted by logical statements to provide a limiting factor assessment of potential egg-to-fry and fry-to-parr survival for each reach. The model is a decision making tool that is intended only to provide a qualitative assessment of the habitat potential of stream reaches within a basins context. Information not common to standard stream survey designs, such as seasonal flow or temperature extremes were excluded from this analysis. Model output ranks habitat quality from 1 to 3: poor, fair, and good.

The primary difference between the HLFM and HabRate models is that HabRate considers the influence of large wood in structuring habitat complexity, whereas HLFM model emphasizes the importance of beaver ponds and alcove habitat. Both models provide an assessment of habitat features that influence the survival of coho salmon juveniles from parr to smolt. We include the finding from both models to describe habitat quality.

An evaluation of aquatic habitat incorporates the biological significance of stream attributes and knowledge of salmonid life history. The reference breakpoints are a useful point of comparison for determining whether the value of a physical stream characteristic is high or low relative to the range of natural conditions. Fish habitat models, HLFM and HabRate, view the physical habitat from a salmon biology perspective. Values of high or low capacity reflect the importance of physical features to the productive capacity of habitat for coho salmon. Values of high or low quality describe the influence of habitat on the survival of coho salmon during a particular life stage, or from one life stage to the next.

Aquatic Habitat Conditions

Aquatic Habitat overview

The ODFW Aquatic Inventories Project has conducted aquatic habitat surveys in the Tillamook basins since 1990. There are approximately 296 kilometers of surveyed stream habitat associated with 195 identified reaches within the ODF Tillamook project area. There are approximately 517 kilometers of total stream length in the Tillamook study area (based on 1:100,000 GIS stream coverage). As mentioned earlier in the report, the Nestucca and Willamina basins contain ODF land ownership but so few surveys were conducted in these areas that they were excluded from this analysis. In order to maintain some consistency between management areas delineated by the ODF and watershed areas most suitable for analysis, the Tillamook study area was broken down to the following project areas with their associated management areas and ODF districts:

Kilchis: Kilchis management area (Tillamook district).
Upper Wilson: Rogers and Larch management areas (Forest Grove district).
Lower Wilson: Wilson management area (Tillamook district).
Trask: Trask management areas (Tillamook and Forest Grove districts).
Tillamook: Tillamook management area (Tillamook district).

The total length of surveyed stream habitat varied among project areas. The following is a breakdown of each project area in relation to the entire Tillamook study area:

Project area	Stream length (km) available on ODF land	Stream length (km) surveyed on ODF land	Percent of total surveyed length	Percent surveyed length in the project area	Percent surveyed length in Tillamook study area
Kilchis	75.0	21.8	4.0	29.0	7.4
Lower Wilson	156.0	81.4	15.0	52.0	27.5
Tillamook	11.0	11.0	2.0	100.0	3.7
Trask	189.0	118.4	22.0	62.0	40.0
Upper Wilson	86.0	63.2	12.0	73.0	21.4
total	517 km	296 km	55.0%		

Most of the streams surveyed in the project areas were small to moderate sized tributaries, based on active channel width. The active channel width (bankfull width) on the surveyed streams ranged from 4.0m to 46.0m (average of 10.5m and a median of 9.0m). The gradient ranged from 0% to 23% (average of 5.3% and median of 4.0%). Thirty three percent of the 296 kilometers of stream surveyed had an average gradient greater than 5 percent. Thirteen percent (approximately 39km) had an average gradient greater than 9 percent. Tables 5A and 5B through 9A and 9B provide a list of all stream reaches and habitat conditions of selected attributes within the Tillamook study area organized by the five project areas within the basin.

Thirteen core habitat attributes considered important for successful spawning, rearing, and survival throughout various fish life history stages were analyzed. These core attributes are the amount of pool habitat, quantity of deep pools per kilometer, percent of slackwater habitat, percent of secondary channel area, percent of fines and gravel substrate found in riffle units, percent bedrock substrate, large wood pieces, volume, and key pieces, shade, and large conifers in the riparian zone. The values derived from these core attributes were compared to habitat breakpoints of the reference stream reaches and conditions. Reference sites provide a general context and range of stream attributes of minimally human-influenced sites. They are intended to provide a point of comparison to view the relative differences between streams and reaches within a drainage network. Reference values are not meant to be prescriptive, that is, to indicate the value each reach of stream must attain.

Relationship of fish populations to aquatic habitat

The surveys described components and processes that contribute to the structure and productivity of a stream and fish community. The Aquatic Inventories Project selected attributes to describe important indicators of sediment supply and quality, instream habitat complexity, and riparian forest community. These variables were summarized for reaches and sites on ODF lands within the Tillamook study area in Table 10. As mentioned earlier, we also used cumulative frequency distribution graphs to examine the survey data on ODF lands. The frequency distribution graphs are useful for determining medians and percentile values and for comparing the differences in distribution of values between multiple databases. These graphs also illustrate the habitat values with comparison to reference conditions. Figure 1 displays the gradient and active channel width of the reference streams against the entire Tillamook study area as a whole and by each of the five defined watersheds. Each of the 13 habitat attributes were plotted and display important habitat parameter values comparing the reference reaches against the 5 project areas (Figures 2 through 9).

The response of salmonid fishes to the character of aquatic habitat varies by species, life stage and time of year. Adult fish seek deep pools for holding areas while preparing to spawn and need gravel and cobble substrate that is free of fine materials to build redds and deposit eggs. Furthermore the redds require a steady flow of oxygenated water to allow the eggs and alevins to mature. Increasing amounts of fine sediments (<2mm) increases the mortality of eggs in the gravel (Everest et al. 1987). The amount of silts and fines associated with riffles is an indicator of embeddedness in spawning areas. A high percentage of fine sediment can settle (embed) in the interstitial spaces of the gravel and armor it such that it is difficult for spawning fish to dig an adequate redd (nest), and prevent oxygenated water from reaching the eggs. Fine sediment values less than 8% are desirable (Table 3). The average amount of fine sediment was the highest in the Tillamook watershed (32%), exceeding the high breakpoint. The four other project areas (Kilchis, Upper and Lower Wilson, and Trask) had moderate to low amounts of fine substrate in riffle habitat. Twenty six reaches (38km) had high levels of gravel substrate in riffle units (greater than 54%) (Map 20).

After emergence in the spring, salmonid fry typically remain in freshwater for a few weeks to two years before migrating to the ocean, depending on species. Edge cover and backwater habitats are particularly important to the survival of fry in the spring, though less so as they grow and move into larger pools during the summer. The distribution of juvenile salmonids is limited primarily by the availability of pool habitat, food resources, and acceptable water quality. In the winter, coho salmon parr prefer complex pool habitat which has low velocity refugia from high winter stream flow. This habitat is often found in the form of off-channel alcoves, dam pools, and beaver ponds (Nickelson 1992). Complex off-channel habitats are also important in these large stream reaches during the winter. Large wood is an important structural component contributing to the complexity of these preferred habitats (Sedell 1984). Juvenile coho salmon extend their distribution downstream in the winter to inhabit areas previously limited by high water temperature, including tidally influenced wetlands. Juvenile steelhead and cutthroat trout are more opportunistic in regards to habitat type, residing in pools, riffles, rapids, and cascades. Additionally, pools provide resting places and over-wintering habitat for fish. Deep pools, those greater than or equal to 1 meter deep, provide temperature refugia and provide year-round cover.

The amount of available pool habitat in the Tillamook project area differed depending upon watershed. Four project areas (Tillamook, Kilchis, Trask, and Upper Wilson) had a high number of deep pools, more than 3 pools greater than 1 meter deep per kilometer. However, the amount of pool habitat was low to moderate (Table 10) breakpoint levels, less than 45% of total habitat. The Kilchis had the highest amount of pool habitat (average of 40%). Twenty-five individual reaches exceeded the high breakpoint (45%) for percent pools (Trask 12, Kilchis 8, Upper Wilson 4, Lower Wilson 1), which represents approximately 12% of the total length of the habitat sampled (Map 21). Streams in the Trask and Kilchis accounted for the majority of this value (5.6% and 4.1%, respectively). Those reaches with higher gradient are primarily dominated by fast water habitat types, thereby decreasing the pool percent. Slackwater pools include dammed pool, beaver ponds, and backwater habitat. One project area, Upper Wilson, exceeded the high breakpoint (7%) with an average of 8.1%. It should be noted that the median value for this project area (Upper Wilson) was 0.2%. Three reaches with a very high percentage of slackwater habitat raised the average to exceed the high breakpoint value. Although the averages for the project areas are below 7%, 16 reaches (Kilchis 2, Trask 7, and Upper Wilson 7) individually met or exceeded this breakpoint. These reaches represent 5.6% (16.6km) of the sampled habitat for the Tillamook study area.

Instream wood serves many functions in a stream channel. The wood helps to scour deep pools, provide cover and nutrients, trap sediment, and provide cover from predators. Wood acts as an obstacle at higher flows, forcing the stream to cut new channels, to scour new pools, and to create undercut banks. The number of wood pieces in all project areas (except the Kilchis) was comparable to reference conditions; although wood volume was lower in all project areas (except the Upper Wilson) (Figure 3). In the Upper Wilson, the average wood volume exceeded the high reference breakpoint (58 m^3) with an average volume of 68.5m^3. Individual reaches which exceeded the high reference breakpoint were observed in the Trask and Upper and Lower Wilson basins (Map 22). The reaches in these three project areas represented 11.6 percent of the surveyed Tillamook project area exceeding the high wood volume breakpoint. A high volume of LWD indicates that large pieces of wood are observed in the surveyed reach. Reaches throughout the project area surpassed the high reference breakpoint for pieces of LWD (>21 pieces/100m), which cumulatively represents 28.6 percent of the surveyed stream. The high amounts of LWD pieces and volume correlate with the increased amount of deep pool habitat units observed in these associated project areas.

Channel morphology and amount of secondary channel indicate relatively high connectivity to the floodplain. Secondary channels increase the potential habitat available to fishes, particularly to juveniles. In comparison to reference conditions, the Kilchis and Tillamook project areas had few secondary channels, the Trask was similar, and the Upper and Lower Wilson project areas had more secondary channel area (Figure 7). Often this habitat has slower moving water than the primary channel. It provides over-wintering and summer rearing habitat for juvenile fish. Twenty-five percent of the reference streams have 5.3% of channel areas in secondary channels. The Upper and Lower Wilson project areas exceeded this value (7.2% and 7.4%, respectively). The three other project areas rated as moderate to low amounts of secondary channel. However, seventy-five individual reaches within the entire study area met or exceeded 5.3% (38% of the entire surveyed reach length) (Map 23).

Riparian vegetation is indirectly an important component of fish habitat. The riparian trees stabilize the bank, are a recruitment source of woody debris, buffer against flood impacts, and provide shade. Stabilized stream banks are more likely to develop undercut banks, which serve as important cover for fish and are less likely to contribute fine sediments. The canopy cover (shade) in all reaches rated moderate to high in relation to the reference conditions. The higher shade cover is due to a riparian composition consisting predominantly of hardwood species (red alder) 3-30 cm dbh. There were very few conifers observed in the riparian zones of any of the reaches. This is a limiting factor for recruitment of large wood (greater than 60 cm dbh) into the channel and thus a limiting factor for increasing pool and channel complexity. All trees are important and contribute to the river system. However, conifers are particularly important as they tend to grow larger than deciduous trees and are less prone to decomposition; therefore, they are the principle contribution to large wood in streams.

Many attributes in the Tillamook study area when taken individually by reach meet or exceed high breakpoint values. Almost every reach had one, if not two, attributes that exceeded the high (desirable) breakpoints and would indicates that some of the streams are in good condition to support a life stage of salmonids. However, few reaches exceeded breakpoints for 5 or more attributes; 18 of the 195 reaches are identified. These are within the Trask (7), Lower Wilson (4), Upper Wilson (6), and Kilchis (1), and they represent 3.5%, 1.2%, 0.5%, and 2.8%, respectively of all the surveyed reach length within the Tillamook study area (Table 11). Table 12 illustrates that a high percentage of the total surveyed stream length meets or exceeds the high breakpoint value for individual attributes. For example, almost 48 percent of the surveyed habitat in the entire Tillamook study area meets or exceeds the reference value for deep pools. Likewise, percent secondary channel, percent fines in riffles, pieces of LWD, and shade values exceed high breakpoints for 38%, 21%, 28%, and 46% of the surveyed habitat, respectively. These tables illustrate that there are reaches within the project areas that have good habitat conditions even though the means and medians for the entire project area indicate otherwise.

Beaver ponds are a habitat unit type considered a driving factor for coho production. Individual beaver pools and habitat units displaying important habitat characteristics which drive the two life history models we use are indicated on Map 24. The lack of beaver ponds throughout the Tillamook study area is one of the primary reasons the HLFM model predicts such low productivity of coho winter parr (Figure 10). Secondary channel habitat is more abundant in the Upper and Lower Wilson project areas. This habitat characteristic, along with deep pools containing high amounts of large wood debris, is instrumental for providing complex habitat which has low velocity refugia from high winter streamflows. The amount indicated on Map 24 suggest that this type of habitat is not uniform throughout the Tillamook study area and several areas could benefit from restoration projects aimed at increasing these habitat unit types.

Habitat quality for coho salmon

The Habitat Limiting Factors Model (HLFM) and HabRate model integrate individual habitat attributes to provide an overall assessment of conditions for adult and juvenile coho salmon. The HLFM determines the quality and carrying capacity of habitat for juvenile coho salmon during summer and winter, and HabRate estimates the quality of habitat for adult and juvenile coho salmon at every life stage. Each model provides an accurate, but different perspective on habitat in the Tillamook study area (Figures 10 and 11, Maps 24 – 29). The HLFM focuses on the availability and type of pool habitat, particularly the amount of beaver pond and alcove habitat during the winter. HabRate considers the complexity of habitat, incorporating a combination of structural components such as large wood and big substrate, as well as gradient, secondary channels and pool habitat. The HLFM model provides an estimate of carrying capacity, that is, the number of juvenile fish that can be supported within a reach of stream (presented as fish per kilometer). Both models provide a measure of habitat quality, which indicates the density independent survival (productivity) of fish at a given life stage (emergence, summer parr, winter parr to smolt).

The capacity of stream habitat to support juvenile coho salmon in the summer is moderate to high in the Tillamook and Nestucca basins (Map 25). Capacity is particularly high in the lower gradient pool-rich portion of the Tillamook and Nestucca drainages. Within the ODF study area, capacity is high in the Upper Wilson drainage and the lower portions of the Trask, Wilson, and Kilchis drainages. Habitat quality for juvenile coho salmon during the summer is very high only in the Upper Wilson, although high values were modeled for the Lower Wilson as well. The values for summer habitat are high in those areas that are low gradient and have a high percentage of pools. However, the HabRate model estimates that the quality of summer habitat is lower than HLFM because of the lack of wood in pools. HabRate rates the summer habitat in the Tillamook, Lower and Upper Wilson, and Trask projects areas as low, with some fair habitat (Figure 11).

The capacity and quality of winter habitat, as rated by HLFM (Figure 10; Maps 26, 28, and 29) in streams of the Tillamook and Nestucca basins show spatial variation. The capacity (as predicted by HLFM) is high in the upper Wilson, the lower portion of the Trask, Tillamook, and Kilchis rivers, and the upper portion of the Nestucca basin. Within the study area, the Upper Wilson stands out as having habitat with a high winter rearing capacity for juvenile coho salmon. The quality of winter habitat is in contrast to the capacity (Map 29). Both the HLFM and HabRate models show limited high quality winter rearing habitat in the study area. Again, the Upper Wilson (HLFM and HabRate) project area has moderate quality habitat. Most of the study area has low quality winter rearing habitat for coho salmon.

The quality ranking of habitat for spawning adults and emerging alevins integrates gradient, availability of pools for adults to rest, the amount of gravel and cobble, and the amount of fine sediment embedded in the riffles. The quality of habitat for spawning and emergence is fair across the study area, though there is 40% in high quality in the Trask project area (Figure 11; Map 29). Sufficient areas of good spawning habitat are present in streams in all five regions, however, such that the availability of spawning areas does not limit the populations of salmonids.

Streams in the Tillamook study area have ample spawning habitat and quality for emergence of alevins, moderate to high capacity for summer rearing of juveniles, and poor capacity and quality for winter rearing. Juvenile coho salmon would have to take advantage of rearing capacity in the lower portions of streams and estuary off forest lands during the winter. The limiting factor for coho salmon in the Tillamook study area is the quantity and quality of winter rearing habitat. The Tillamook, Trask, and Lower Wilson project areas have high capacity winter habitat in less than 10% of the streams, and the Kilchis and Upper Wilson project areas have high capacity winter habitat in less than 20% of the surveyed streams. High habitat quality for winter rearing is virtually absent in the project areas.

The CLAMS intrinsic potential (representing areas of potential high productivity) map indicates streams that may have had the highest level of productivity for juvenile coho salmon in the past (Map 30) and potentially the future. The areas on ODF land of high intrinsic potential are few. The Upper Wilson River, specifically Elliott, Deo, and Devils Lake Fork, has the most extensive section of high intrinsic potential on ODF land. The Little Nestucca has another reach on ODF land with high intrinsic potential. Within the historical wetland extent, Lower Kilchis River, Wilson River, Trask River, and most of the Tillamook River are the areas within the Tillamook basin with the largest network of high intrinsic potential. These sections downstream of and bordering ODF boundaries suggest that streams in the state forest may support the spawning fish populations and summer parr while the best winter rearing habitat for juvenile coho salmon lies immediately below the forest boundary. The character of aquatic habitat and riparian stands on forest lands may dictate the flow of sediment and large wood to the reaches below. The identification of streams on forest lands with high intrinsic potential in conjunction with the high capacity habitat identified from HLFM modeling (Map 26) is a preliminary step for identifying restoration opportunities and priorities. Many of the reaches with a high habitat capacity would benefit from the addition of large wood and off-channel habitats to increase the quality of habitat. Restoration should focus on streams with adult fish populations that could take advantage of higher quality summer and winter rearing habitat.

Small streams

Coho salmon usually reside in low and moderate gradient streams, usually less than 5 % gradient. Higher gradient streams, referred to as “small streams” in this document, are home to steelhead, cutthroat trout, sculpin, lamprey, amphibians, and other organisms. Small streams are a vital piece of the ecosystem and while they tend to function differently from larger streams, they may also be managed differently. Their importance may be overlooked due to the small channel width, lack of anadromous fish distribution, and at times, intermittent flow.

Approximately 30 percent of streams in the Tillamook study area (1:100,000 scale) is above the distribution of coho salmon, referred to as small streams in this document, located in the Trask and Upper and Lower Wilson basins (Map 31). Though represented separately in this analysis, small streams were incorporated in the larger analysis for the Tillamook habitat assessment. Small streams have a narrower active channel and higher gradient than streams within the distribution of coho salmon. The number of observed mass failures is the same (~ 4 failures per kilometer). The number of beaver activity sightings in smaller streams were about half that of all streams (Table 13). For both the small streams and all streams in the Tillamook study area, the quantity of fines and gravel substrates in riffle were moderate relative to the reference conditions. The frequency of pools in small streams is low, though there are deep pools and pool habitat in many streams. The median values of wood pieces (22.5 versus 15), volume (40.8 versus 25), and key pieces (0.5 versus 0.0) were greater in the small streams than those in the combined reaches. The Upper Wilson project area exceeded the high breakpoint levels and all other project areas for wood volume and key pieces values (Table 14, Figures 12 - 18).

Small streams are less suitable areas for instream restoration based on the steep gradient and narrow channel width (Tables 14 and 18). As noted on Map 34, small streams are amongst the areas considered low priority for instream restoration by Thom and Moore, 1997. Restoration is best accomplished in a passive fashion by protecting the riparian areas. The condition of the riparian areas influences the rate and character of input of large wood debris and sediment to the system.

Flood surveys

ODFW Aquatic Inventories Project surveyed a selection of stream reaches following the large flood event that occurred during February 1996 (Jones et al. 1998). Due to the structure of the sampling, we are only able to describe conditions in the Tillamook study area relative to the degree and extent of habitat alternation associated with the floods. The sample size in the Tillamook study area is too small to provide much more detail or to address the other five primary questions in the flood survey. Two sets of sites were surveyed with two different survey designs: 1) streams on ODF lands in the Wilson River basin were surveyed from mouth to headwaters (census survey), and 2) one kilometer stream reaches that were randomly selected by ODFW from previously surveyed streams (sample survey).

A census survey was conducted on the Rogers Creek watershed following the 1996 flood. Rogers Creek flows into the West Fork of the North Wilson in the Upper Wilson project area. We surveyed 8.5 kilometers in the mainstem and 3 unnamed tributaries. This watershed had no previous AQI survey on it. The Rogers Creek drainage received high impacts in 11 of 12 reaches. Eleven reaches experienced debris torrents at the scale of valley floor scour. The scour processes uprooted and toppled many riparian trees, mostly alder, within the active channel and floodplain. There was a massive movement of bedload throughout the area and the channel was extensively scoured and reworked. Most reaches had high amounts of fine sediment in the riffles. Large amounts of wood were deposited on the terraces, and reaches 2-4 of Rogers Tributary A were scoured to bedrock. As this was part of a larger ODF study, documentation may exist as to road network and landscape associations with the initiation points of the debris torrents. The high impact of scouring removed suitable substrate to bedrock, piled wood and boulders in huge impassable jams; thereby, eliminating suitable substrate and habitat available to fish. The duration of time until a semblance of pre-flood conditions return is lengthy. Restoration efforts would be of benefit here to develop quality habitat for fish to recover and reestablish in Rogers Creek.

Sixty one-kilometer reaches were surveyed in the North Coast; of which nine were within the Tillamook study area. The data were evaluated and placed into categories according to level of flood impact. Highly impacted reaches showed evidence of debris torrents at the scale of full valley floor scour or deposition extending for more then 7 channel widths in length. Characteristics of moderately impacted reaches include various large scale channel modifications, such as channel relocation, new channel formation, deposition of new gravel bars. Reaches with low impact ranged from no perceivable impact, high water impact (clearing of litter from low terraces and floodplain), or scour and deposition patches (localized scouring or deposition).

Of the nine randomly selected sites in the Tillamook study area, surveyors observed high impacts on Devil's Lake Fork Wilson (Upper Wilson), Fall Creek (Lower Wilson), and South Fork Jordan Creek (Lower Wilson), moderate impacts in the Little North Fork Wilson (Lower Wilson), and low impacts in Bark Shanty Creek (2 reaches), Boundary Creek, Elkhorn Creek, and South Fork Trask River (all in the Trask Project Area). Mass failures were observed on the hillsides along 6 of the stream reaches in the study area (Map 32). In general, streams on the north coast of Oregon experienced some large scale debris torrents, channel morphology adjustments, and redistribution of habitat units, sediment, and wood. Despite the low number of surveys in this area, it appears that streams in the Wilson River project area are susceptible to and showed a high level of effect in the stream channel from the 1996 flood event. Total precipitation was higher in the northern (Wilson River) part of the study area, compared to other project areas, ranging up to an average of 20 - 25 inches over 4 days (George Taylor, Oregon State University, personal communication). These one kilometer surveys reflect a range of flood impacts. Fish use post-flood is dependent upon the extent and type of flood impact. Those with lesser impact or that are lower in the watershed may see fish use return sooner than those heavily impacted.

Flooding is a natural occurrence which may alter the stream channel habitat, and overtime, the habitat adjusts to the changes. As the channel is reestablished, it will scour new pools, thereby replacing those which had been filled-in by substrate movement, assuming debris torrents did not scour to bedrock. Where beaver ponds were destroyed; riffles and glides may be formed. Often when wood and bedload accumulations created large debris jams, secondary channels may be formed. How flood modifications impact fish habitat depends upon the intensity of the movements, the age and type of material on the hillsides and in the stream channel, and the channel morphology (gradient, valley width index) of the valley. Especially evident in winter storms and flood events, material from the hillsides is carried into the channel and moved downstream. Management of upslope land that is mindful of large-scale events will benefit stream processes prior to and potentially minimize downstream impact during flood events. According to Jones et al. (1998), in stream reaches in the north coast (n=60) 9% had no impact and 61% had low impact. It can be presumed that much of the Tillamook study area had areas of low impact; therefore, use of pre-flood data is appropriate.

Barriers

Barriers and potential barriers to anadromous and resident fish exist in most riverine systems due either to human-caused or natural processes. A barrier, which includes culverts, dams, velocity barriers, natural falls, lack of sufficient water flow, etc., is defined as an impediment to the movement of any fish at any life stage. The Tillamook project area (Kilchis, Wilson, Trask, Tillamook, Nestucca) has 24 recorded barriers, as determined by Streamnet (Map 33 and Table 15). These barriers are found both within and outside known fish distribution. Fish distribution may extend beyond a partial barrier because the barrier may be specific to a species or life stage, or at a particular time of year. Data are not available to assess fish presence above all of the potential barriers.

The Streamnet barrier database incorporated the culvert inventory database; therefore, culverts in the dataset are those which do not meet acceptable fish passage criteria, not necessarily those which prevent all fish at all times. Of the 24 listed barriers, seven are culverts. These barriers are rated as to the degree, or lack thereof, of fish passage. None are known to have complete blockage, one is thought to be a partial fish passage barrier, and six have unknown passage. Movement may be prevented due to high velocity of water through the culvert, incorrectly sized culvert, culvert deterioration, or debris blocking the culvert. Maps of anadromous distribution (Maps 9 – 11) show fish past five of the listed culverts, while two appear to block migrating fish. Four allow at least some passage of coho, Chinook and steelhead, while only steelhead pass the Dog Creek (Upper Wilson) culvert.

Other barriers in the Streamnet database included fourteen falls, two dams, and one gradient barrier. Four falls were noted as having complete fish blockage, two as partial fish passage barriers, and eight have unknown passage. Anadromous fish distribution maps show fish extending past four of the falls, including two noted in the Streamnet database as impassable (Map 33). The two dams have fish ladders and allow some passage. The gradient barrier marks the end of anadromous fish passage. Resident cutthroat trout, lamprey, and sculpin may be present above the natural and human-caused barriers.

Additionally, aquatic habitat survey crews documented potential barriers to migratory fish. However, anadromous and resident salmonid fishes were found above many of these potential barriers. Additionally, quite a few were located in the headwaters areas of streams where expected.

The amount of aquatic habitat with restricted access or passage problems in the Tillamook study area as to species and life stage affected is not available. Conducting field surveys to improve documentation is recommended, and although human-caused fish passage issues do not appear to be a major issue, they are worth investigating and addressing.

Restoration

Restoration is a technique and process used in an attempt to improve stream habitat in the short term and to achieve long-term recovery goals. The goals of restoration range from improving habitat to improving natural stream processes. Treatment projects focus on improving summer and winter rearing for juvenile salmonids, improving spawning and rearing habitat, increasing nutrients in the stream, reducing sedimentation and bank erosion, and replanting native streamside vegetation. Instream habitat improvement projects to enhance rearing conditions for juvenile salmon targets increasing complexity of pools (large wood additions) and creating off-channel and slow water pool habitat. The quality of existing pools could be increased by recruitment of gravel or the addition of wood pieces. Monitoring is a critical aspect of the restoration effort, as it is important to gauge whether the methods employed helped to attain the desired effects. Achieving a noticeable response may take several high flow events; biological response could take longer.

Since 1995, 108 restoration projects have been completed on ODF lands (Table 16; Map 34) in the Tillamook study area. These projects focused on instream enhancement, passage issues, and road/drainage improvements. Twenty-eight projects placed large wood and/or boulders in the streams, sixty improved the road and drainage system, six enhanced riparian conditions, and fourteen improved fish passage.

Of these, five sites (Cedar Creek (Lower Wilson), Devils Lake Fork – two locations and Ben Smith Creek (Upper Wilson) and Dietz Creek (Kilchis)) were monitored by ODFW. In each case, large wood structure was added to the stream to improve stream structure and complexity, to allow the stream to better interact with the floodplain, and to improve overall stream habitat. Since these are fairly recent sites, substantial changes in pool area or gravel recruitment have not been observed.

In 1997, 74 stream reaches on ODF land in the Tillamook study area were identified for instream enhancement (Table 17 and Map 35; Thom and Moore. 1997). These sites were distributed primarily in the Kilchis, Trask and Wilson River basins, with a few located in the Tillamook and Nestucca Rivers. Candidate streams were selected based on numerous criteria, through both in-house techniques and field verifications, and typically within the range of coho (Table 14). Overall, stream areas suitable for coho habitat enhancement are those areas flowing through an unconstrained valley, gradient <5%, moderate size - channel width 4-12 meters, and either have or are adjacent to a known coho population area. Some habitat enhancement work was conducted on streams in the Kilchis, Trask, and Wilson Rivers, including the North Fork Kilchis River, Cruiser Creek, East Fork of South Fork Trask River, Edwards Creek, and the Little North Fork Wilson River prior to 1997. Since 1997, eleven sites (as designated by Thom and Moore 1997) on ODF land have had treatments applied (Map 35). Most of the sites have addressed instream habitat, which should be enhancing overall stream complexity. It is useful to note that 63 potential restoration reaches remain from the original list identified in 1997.

Table 17 and Map 35 display reaches of stream that have a potential to respond to instream restoration treatments. Relatively few of the reaches selected in 1997 (Thom and Moore 1997) have been treated. To date, most treated restoration sites have not been formally monitored. Documentation of site location and condition of past projects will help direct future restoration at these or adjacent sites. Criteria for instream restoration selection and treatments within the Tillamook study area will require consideration of the dynamics of the large river systems (Table 18). Map 36 depicts Thom's 1997 priority locations with restoration sites funded by OWEB since 1997. There are high priority areas which need consideration for future restoration.

Summary of Fish Populations and Aquatic Habitat Conditions in the Oregon Department of Forestry Tillamook Study Area

Fish distribution

What fish species are documented in the watershed?

- Coho salmon, fall and spring Chinook salmon, winter and summer steelhead, resident and anadromous cutthroat, Pacific lamprey, white sturgeon, and shad are present in the Tillamook study area. The occurrence and distribution of other native fishes is not documented.

Are any of these species currently state- or federally listed as endangered, threatened, or candidates?

- Coho salmon is proposed for listing as threatened. Winter steelhead is considered a species of concern in the Tillamook basin (see NOAA Fisheries web site for current status - http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/).

Are there any fish species that historically occurred in the watershed that no longer occur there? Map potential historical fish distribution.

- No species have been extirpated from Tillamook study area.
- We believe contemporary distribution is similar to historic distribution.

Which salmonid species are native to the watershed, and which have been introduced?

- With the exception of shad and some stocks of hatchery-produced salmonid fish, the remaining aforementioned salmonid species are native to the watershed. Non-native fish (bass, bluegill, etc.) including non-native salmonid stocks, are present but have not been well-documented.

Are there potential interactions between native and introduced species?

- There are potential interactions between native and introduced fish, but they have not been documented. An example is hatchery-produced and naturally-produced salmonid interactions.

Current habitat conditions

Show current condition of key habitat characteristics.

- Habitat surveys were conducted beginning in 1990, and are divided by watershed basins which best represent ODF management districts while also providing watershed areas most suitable for analysis.
- Habitat characteristics are listed in Table 10, graphed in Figures 2 through 9, and examples mapped in Maps 20 – 23.

Compare to reference streams for each characteristic.

- Reference sites provide a general context and range of stream attributes of minimally human-influenced sites, and are intended to provide a point of comparison to view the relative differences between streams and reaches within a drainage network. Reference values are not meant to be prescriptive, that is, to indicate the value each reach of stream must attain.
- Key breakpoints are presented in Table 3 and individual stream reaches are compared to these breakpoints in Tables 5A and B through 9A and B.
- The amount of pool habitat, number of deep pools, and area of secondary channel in the surveyed reaches is moderate to high. The number of key pieces of wood and the volume of large wood is low to moderate in comparison to reference conditions. The average amount of fine sediment is high for the Tillamook project area and is moderate for the Kilchis, Upper and Lower Wilson, and Trask project areas. Streamside vegetation contains very few large conifers, with only 3.6% of the total surveyed study area meeting or exceeding the high reference conditions. The amount of shade varies with stream size but overall averaged moderate to high for all reaches.

What stream reaches have high, moderate, and low levels of key pieces of large wood (>0.6m x 10m) in the channel?

- Only 6.9% of the 296 kilometers surveyed had high amounts of keypieces of large wood. 11.7% of the 296 kilometers had high amounts of LWD volume (Table 12).

What is the condition of the fish habitat in the project areas according to existing habitat data?

- Within the ODF study area, the capacity to support juvenile coho salmon is high in the Upper Wilson drainage, and the lower portions of the Trask, Wilson, and Kilchis drainages. Habitat quality for juvenile coho salmon during the summer is very high only in the Upper Wilson, although high values were modeled for the Lower Wilson as well. Stream habitat that can support a high density of coho salmon is located in reaches with low gradient and a high percentage of pool habitat. However, summer rearing habitat would benefit from additional wood complexity.
- The capacity and quality of winter habitat, as rated by HLFM (Figure 10; Maps 26, 28, and 29) in streams of the Tillamook and Nestucca basins show spatial variation across the project areas. The capacity (as predicted by HLFM) is high in the upper Wilson, the lower portion of the Trask, Tillamook, and Kilchis rivers, and the upper portion of the Nestucca basin. Within the study area, the Upper Wilson stands out as having habitat with a high winter rearing capacity for juvenile coho salmon. The quality of winter rearing habitat is low in all but the Upper Wilson drainage (Map 29). Little wood complexity is present in pools, and few beaver ponds and alcoves were observed during the surveys
- The quality of habitat for spawning and emergence is fair across the study area, with 40% in high quality in the Trask study area (Figure 11; Map 29). Sufficient areas of good spawning habitat are present in streams in all three regions, however, such that the availability of spawning areas does not limit the populations of salmonids.
- Streams in the Tillamook study area have ample spawning habitat and quality for emergence of alevins, low to moderate summer juvenile rearing capacity, and low capacity and quality for winter rearing. Juvenile coho salmon would have to take advantage of rearing capacity in the lower portions of streams and estuary off forest lands during the winter. The limiting factor for coho salmon in the Tillamook study area is the quantity and quality of winter

rearing habitat. The Tillamook, Trask, and Lower Wilson project areas have high capacity winter habitat in less than 10% of the streams, and the Kilchis and Upper Wilson project areas have high capacity winter habitat in less than 20% of the surveyed streams. High habitat quality for winter rearing is virtually absent in the project areas.

How many miles of fish-bearing or potentially fish-bearing streams are blocked by culverts, and where are these blockages?

- Twenty four fish barriers were identified on ODF lands. Seven of these are culverts which may warrant closer inspection. None of the culverts are noted as impassable, one is noted as a partial barrier, and the status of the remaining six is unknown. There are two dams in the area as well. The passage status of Tuffy Dam is unknown while the EF of SF Trask Intake Dam is believed to be a partial barrier. The remaining potential barriers are natural waterfalls. It is possible that other barriers that have not been noted here do exist.
- The amount of aquatic habitat with restricted access in the Tillamook study area based on Streamnet barrier data is approximately 108.1 square kilometers. However, all but one of these barriers is a natural falls. The area restricted behind one culvert is 3.6 square kilometers. Documentation as to the species and life stage affected by each barrier is limited and worth verifying. Field surveys to improve documentation are recommended, although passage does not appear to be a major issue.

Are there watersheds where the current level of instream wood is a limiting factor for achieving properly functioning aquatic systems?

- Several reaches in the Tillamook study area meet the LWD reference conditions (Tables 5A, B – 9A, B). Additional large wood would increase the opportunity for complex instream habitat, creation of off-channel habitat, and sediment sorting.
- Large wood is a limiting factor in the Tillamook study area for creation of high quality winter rearing habitat for salmonids.

Analyze restoration potential

Which reaches have the most potential to increase fish populations?

- Reaches with the most potential to increase fish production are those with a high intrinsic potential that are within Salmon Anchor Habitat watersheds or watersheds with high fish abundance. Secondarily, reaches within SAH watersheds that have an abundance of pool habitat have the potential to respond to restoration treatments and improve fish productivity.
- A long term strategy to grow large conifer trees in the riparian areas will improve conditions across the project areas and increase complexity of stream habitat for fish production as the trees naturally recruit to the channel. Although alders along the streamside serve important functions, large riparian conifers are necessary as well for their size and persistence in the system.
- Site selection will require an in-depth analysis of the unit level GIS and Oregon Plan site data coupled with field verification. Reviewing areas of high intrinsic potential (wide valley, low gradient, and low to moderate flow) (Maps 25 - 28) combined with on the ground verification would be beneficial. Comparing areas of high intrinsic potential with locations that score well in the Limiting Factors and HabRate models will also help in selecting likely coho restoration areas. Habitat complexity and floodplain connectivity requires the placement of

large wood in selected stream segment to create complex pool and bank overflow opportunities. Taking advantage of the existing secondary channels will accelerate the process. The North Coast Guide to Restoration Site Selection from 1997 identifies over 74 potential reaches within the Tillamook study area that have restoration potential. Only 11 have been treated to date.

- Reduction of fine sediment will require a detailed hydrologic study to determine source, transport, and storage of sediment in the basin. The data available through the stream surveys only identify areas collecting excessive amounts of fine sediment.
- Site verification prior to restoration planning is necessary because some of the surveys are 10+ years old, and proper implementation depends on site-specific factors.

Which reaches have the most potential to meet or exceed breakpoint levels?

- All of the reaches have the potential to meet many of the reference conditions over time. Restoration and protection strategies can expedite the opportunity to improve aquatic habitat complexity, sediment, and riparian structure in the Tillamook Project Area.
- Examples of areas with higher intrinsic potential for coho include:
  Wilson River from the North Fork to Elk Creek.
  Devils Lake Fork from Elliott Creek to the end of ODF ownership.
  Elliott Creek from the mouth to near the headwaters.
  Kilchis River from the Little South Fork to Sharp Creek
  South Fork Trask River from the mouth to the East Fork of the South Fork.
  North Fork Trask from the mouth to Clear Creek.
  Upper Elkhorn Creek.

What is the magnitude of possible additional habitat with restoration of access?

- Seven culverts potentially restrict fish passage on ODF lands. Surveys are needed to determine the condition of the culvert, the ability of fish of many sizes and types to pass, and to document the quantity and quality of habitat for salmonid species above the culverts.

What is the relative priority of barriers for removal, replacement, or repair?

- The ODF and Streamnet barrier databases do not provide a lot of detail. Site checks are necessary to verify the nature and extent of the passage issues. With only nine manmade passage issues (seven culverts, two dams), determination of whether they impede any life stage for fish passage is the first priority. When that is known, repairs or removal can be prioritized.

Describe the types and locations of potential enhancement projects?

- Based on the intrinsic potential information (valley width, stream gradient, stream flow), many of the streams on ODF land are moderate to good candidates for enhancement activities. With the exception of the smallest tributaries and the headwaters areas, many streams are low to moderate gradient, in moderate to wide channels and valleys. Coho tend to favor lower gradient, unconstrained tributaries while steelhead utilize the more constrained moderate sized stream reaches that are steeper than coho prefer. Many streams would benefit from the addition of large woody debris, which would entrap substrate, scour deep pools, and provide cover for fish. Examples include Devils Lake Fork (Upper Wilson) and North Fork Trask (Trask) from the mouth to Clear Creek.

- Enhancement activities can be more effective when a watershed approach is utilized. For example, rather than constructing one or two habitat structures in each of ten widely scattered locations, constructing these same structures in one watershed can enhance a longer continuous section of stream. With riparian plantings and the removal of a passage barrier, a whole watershed could be improved.
- Priorities related to fish habitat are discussed above – improving habitat complexity, floodplain connectivity, and reduction of fine sediment.
- Riparian plantings to increase the number, size, and species of conifer trees in the riparian zone would benefit floodplain connectivity and increase long-term large wood recruitment. Riparian enhancement for larger and greater mix of conifer species will again require site visits to identify appropriate floodplain and terrace sites within the Tillamook study area.
- The riparian surveys are a sample (not a census) of conditions along the rivers in the Tillamook study area, and hence only indicate the need for restoration.

Describe confidence level in restoration analysis.

- The aquatic surveys, between 1990 and 2002, described the overall conditions within each reach at the time of the survey. Restoration recommendations were based on existing habitat surveys (although selected attributes of the habitat data may out of date for this use), channel and valley configuration, and digital elevation models. Because successful restoration depends on site-specific characteristics, we recommend: 1) site visits prior to final planning, 2) analysis of habitat data (available in GIS and database) at the habitat unit scale, 3) re-examination of gradient and valley form, 4) more comprehensive road and barrier information, and 5) more detailed description of riparian conditions.

References

Burke, J. L, K. K. Jones, and J. M. Dambacher. 2001. HabRate: A Stream Habitat Evaluation Methodology for Assessing Potential Production of Salmon and Steelhead in the Middle Deschutes River Basins. Oregon Department of Fish and Wildlife, Corvallis.

Chilcote, M. 1997. Conservation status of steelhead in Oregon. Oregon Department of Fish and Wildlife, Portland.

Everest, F., R. Beschta, J. Scrivener, K. Koski, J. Sedell, and C. Cedarholm. 1987. Fine sediment and salmonid production: A paradox. Pp. 98-142 in E.O. Salo and T.W. Cundy, eds. Streamside Management: Forestry and Fishery Interactions. University of Washington, Seattle.

Good, J.W. 2000. Summary and current status of Oregon's estuarine ecosystems. *in* The Oregon state of the environment report 2000. Oregon Progress Board, Salem, OR. 214 p.

Healy, M.C. 1982. Juvenile Pacific salmon in estuaries: the life support system. Pages 315-341 *in* V. S. Kennedy *ed.* Estuarine Comparisons. Academic Press, New York. 709 pp.

Hupperts, K. 1998. Managing Oregon's aquatic resources: a dynamic segmentation application. Masters thesis. Portland State University, Portland, Oregon.

Jones, K.K., R.L. Flitcroft, and B.A. Thom. 2001. Spatial patterns of aquatic habitat in Oregon. Pages 266–280 In First International Symposium on GIS in Fisheries Science. T. Nishida, Editor.

Jones, K.K., Foster, S, and K.M.S. Moore. 1998. Preliminary assessment of 1996 flood impacts: Channel morphology and fish habitat. Oregon Department of Fish and Wildlife, Corvallis.

Nicholas, J. W., and D. G. Hankin. 1988. Chinook salmon populations in Oregon coastal river basins: Description of life histories and assessment of recent trends in run strengths. Oregon Department of Fish and Wildlife, Information Report 88-1, Salem.

Nickelson, T.E., Solazzi, M.F., Johnson, S.L., and Rodgers, J.D. 1992. An approach to determining stream carrying capacity and limiting habitat for coho salmon (Oncorhynchus kisutch). p. 251-260 In Proceedings of the coho workshop. Edited by L. Berg and P.W. Delaney. Nanaimo, B.C., May 26-28, 1992.

Nickelson, T. E. 1998. A Habitat-Based Assessment of coho Salmon Production Potential and Spawner Escapement Needs for Oregon Coastal Streams. Oregon Department. Fish and Wildlife, Information Report, 98-4, Salem.

Rodgers, J. D., K. K. Jones, A. Talabere, and C. H. Stein. 2005. Oregon Coast Coho Assessment: Habitat. Oregon Plan for Salmon and Watersheds, Oregon Department of Fish and Wildlife, Salem.

Sedell, J. R. 1984. "Habitats and salmonid distribution in pristine, sediment-rich valley systems: S. Fork Hoh and Queets River, Olympic National Park," pp. 33-46 in Meehan, W. R., T. R. Merrell, and T. A. Hanley, eds., Fish and Wildlife Relationships in Old-Growth Forests, American Institute of Fishery Research Biologists, December, 1984.

Talabere, A. G., and K. K. Jones. 2002. Pacific Salmon Conservation: Designating Salmon Habitat and Diversity Watersheds; A Process to Set Priorities for Watershed Protection and Restoration. Oregon Department of Fish and Wildlife, Corvallis.

Thom, B. and K. Moore. 1997. North Coast Stream Project Guide to Instream and Riparian Restoration Sites and Site Selection. Oregon Department of Fish and Wildlife.

Thorson, T.D., Bryce, S.A., Lammers, D.A., Woods, A.J., Omernik, J.M., Kagan, J., Pater, D.E., and Comstock, J.A., 2003. Ecoregions of Oregon (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Tables, Figures, and Maps

Table 1. ODFW surveyed streams listed by basin and ODF management area.

Basin	ODFW surveyed stream	ODF management area
Kilchis	Clear Creek	Tillamook
	Kilchis River	
	Kilchis River (1866)	
	Little South Fork Kilchis River (1807)	
	Myrtle Creek (1938)	
	North Fork Kilchis River (2004)	
	Sharp Creek (1817)	
	South Fork Kilchis River (1987)	
	Triangulation Creek (1995)	
Wilson	Berry Creek	Tillamook
	Cedar Creek	
	Fall Creek	
	Jordan Creek	
	Kansas Creek	
	Little North Fork Wilson River	
	Rogers Creek	
	Rogers Creek Tributary B	
	South Fork Jordan River	
	West Fork North Fork Wilson River	
	White Creek	
	Ben Smith Creek (2939)	
	Cedar Creek Tributary (2963)	
	Jordan Creek (3075)	
	Jordan Creek (3076)	
	Negro Jack Creek (593)	
	North Fork Cedar Creek (2011)	
	North Fork Wilson River (2976)	
	Runyon Creek (2950)	
	South Fork Jordan Creek (3112)	
	South Fork Wolf Creek (2919)	
	West Fork North Fork Wilson River (2977)	
	White Creek (1792)	
	Zig Zag Creek Tributary (2935)	
Upper Wilson	Devils Lake Fork Wilson River	Forest Grove - Larch
	Drift Creek	
	Elk Creek	
	Elliot Creek	
	West Fork Elk Creek	
	Elk Creek (3039)	
	Devils Lake Fork Wilson River	Forest Grove - Rogers
	Deyoe Creek	
	Idiot Creek	
	Jordan Creek	
	South Fork Wilson River	
	South Fork Wilson River Tributary B	
	South Fork Wilson River Tributary C	
	Deo Creek (3022)	
	South Fork Wilson River Tributary (3019)	

Table 1 continued.

Basin	ODFW surveyed stream	ODF management area
Trask	Middle Fork North Fork Trask River	Forest Grove
	North Fork North Fork Trask River	
	Bales Creek	Tillamook
	Bark Shanty Creek	
	Bill Creek	
	Blue Bus Creek	
	Boundary Creek	
	Clear Creek	
	Cruiser Creek	
	East Fork South Fork Trask River	
	Edwards Creek	
	Elkhorn Creek	
	Headquarters Camp Creek	
	Joyce Creek	
	Miller Creek	
	North Fork Trask River	
	Pigeon Creek	
	Rock Creek	
	Scotch Creek	
	South Fork Trask River	
	Steampot Creek	
	Stretch Creek	
	Trask River	
	Tucca Creek	
	Barney River Tributary (2891)	
	Blue Bus Creek (2828)	
	Boundary Creek (12)	
	Clear Creek (3064)	
	Cruiser Creek (2875)	
	East Fork South Fork Trask River (780)	
	Norht Fork Trask River Tributary (2834)	
	North Fork North Fork Trask River (3086)	
	Rawe Creek (576)	
	Sheridan Creek (731)	
	South Fork Summit Creek (758)	
	South Fork Summit Creek (772)	
	Trask River Tributary (2817)	
Tillamook	Fawcett Creek	Tillamook
	Simmons Creek	
	Fawcett Creek (844)	
	Simmons Creek (852)	
Nestucca	Elk Creek	Tillamook
	Nestucca River	Forest Grove
Willamina	Willamina Creek	Forest Grove
	Willamina Creek Section 6 Tributary	

Table 2. Salmon Habitat and Diversity Watersheds (Talabere and Jones, 2002): Species abundance within the Tillamook project area.

Coho, Fall Chinook, and Chum: based on 1989 – 2000 ODFW spawning survey data.
Steelhead: presence (X) based on professional judgment of ODFW biologists (Susac) and a steelhead status review (Chilcote 1997).
Salmon Anchor Habitats (X) are indicated in the table, but not on maps.
Colors and percentiles on Map 14 match percentiles listed below.
Project Area refers to ODF Tillamook Habitat Assessment project area.

Ref. #	Sub-watershed Name	Coho	Fall Chinook	Chum	Steelhead	ODF- Salmon Anchor Habitat	Within Project Area
42	Upper Little Nestucca River	>50					X
43	Middle Little Nestucca River	>50	>50				
44	Lower Little Nestucca River	>50	>50				X
45	Upper Nestucca River	>50					X
46	Elk Creek	>90	>50				X
47	Testament Creek	>50					X
48	Niagara Creek	>50	>90				X
49	Powder / Bays Creeks	>50	>50		X		
50	East Creek	>50	>50				X
51	Farmer / Wolfe		>50				X
52	Beaver Creek		>50		X		X
53	Three Rivers	>50					
54	Lower Nestucca River	>50	>50				
55	Upper Tillamook River	>75	>90	>75			X
56	Lower Tillamook River	>50	>50				
57	Elkhorn Creek	>90	>50			X	X
58	Upper Trask River	>50	>50				X
59	North Fork Trask River	>75	>75		X		X
60	Gold Creek		>50				X
61	South Fork Trask River	>90	>90		X		X
62	East Fork South Fork Trask River	>75				X	X
63	Lower Trask River	>75	>75				
64	Devils Lake Fork Wilson River	>75				X	X
65	Elk Creek	>50	>50				X
66	South Fork Wilson River	>75	>50				X
67	Cedar / Ben Smith Creeks	>75	>90		X	X	X
68	North Fork Wilson River	>50	>50				X
69	Muesial Creek				X		X
70	Jordan Creek		>50		X		X
71	Lower Wilson River				X		X
72	Lower North Fork Wilson River	>50	>90	>90	X	X	X
73	North Fork Kilchis River	>50	>50				X
74	South Fork Kilchis River	>75	>75	>75		X	X
75	Lower Kilchis River	>50	>75	>90			X
76	Miami River	>50	>50	>90			
79	Neskowin	>75					

Table 3. Habitat benchmarks based on reference streams within the distribution of coho salmon.

Parameter	Definition	Low break point	High break point
percent pools	percent primary channel area represented by pool habitat	<19%	>45%
deep pools/km	pools > 1m deep per kilometer of primary channel	=0	>3
percent slackwater pools	percent primary channel area - slackwater pool habitat (beaver pond, backwater, alcoves, isolated pools).	=0%	>7%
percent secondary channels	percent total channel area represented by secondary channels	<0.8%	>5.3%
pieces lwd/100m	# pieces of wood > 0.15m diameter X 3m length per 100 meters primary stream length	<8	>21
volume lwd/100m	volume (m3) of wood > 0.15m diameter X 3m length per 100 meters primary stream length	<17	>58
key pieces lwd/100m	# pieces of wood > 60 cm diameter X > 12 meters long per 100 meters primary stream length	<0.5	>3
percent fines in riffles	visual estimate of substrate composed of <2mm diameter particles	<8%	>22%
percent gravel in riffles	visual estimate of substrate composed of 2-64mm diameter particles	<26%	>54%
percent bedrock in stream	visual estimate of substrate composed of solid bedrock	<1%	>11%
# conifers > 50 cm dbh	number of conifer trees larger than 50 cm dbh within 30m both sides of stream per 305m of primary stream length	<22	>153
# conifers > 90 cm dbh	number of conifer trees larger than 90 cm dbh within 30m both sides of stream per 305m of primary stream length	=0	>79
percent shade	percent of 180 degree sky; includes topographic and tree shade	<76%	>91%

Table 4. Comparison of reach length, active channel width, gradient, ownership, ecoregions, and geology between reference surveys and ODF Tillamook project area regions.

		Reaches within:					
Attribute	**Reference Reaches**	**Tillamook**	**Kilchis**	**Trask**	**Upper Wilson**	**Lower Wilson**	**All Basins**
Number of Reaches or Sites	124	7	16	75	42	55	195
Distance Surveyed - Total (km)	162km	11.3km	21.8km	118.4km	63.2km	81.4km	296km
Mean (median)	1306m (971m)	1619m (1526m)	1366m (1017m)	1579 (1218m)	1505m (1122m)	1480m (1052m)	1519
Range	174m - 6776m	506m - 3648m	502m - 3207m	140m - 5358m	163m - 4807m	175m - 9073m	140m - 9073m
Active Channel Width (meters):							
Mean (Median)	9.28m (7.28m)	10.0m (9.0m)	19.8m (18.0m)	10.2m (8.0m)	8.5m (7.5m)	10.0m (9.0m)	10.5m (9.0m)
Range	1.5m – 31.5m	8.4m - 12.5m	4.0m - 42.6m	3.4m - 46.0m	2.1m - 26.5m	4.0m - 26.0m	4.0m - 46.0m
Gradient (%):							
Mean (median)	2.8 (2.3)	5.3 (4.0)	4.4 (2.0)	4.5 (3.0)	6.5 (4.0)	5.9 (4.0)	5.3 (4.0)
Range	0.5 – 19.2	2.3 - 9.3	0.7 - 22	0 - 15	0.5 - 23.4	0.8 - 23	0 - 23.4
Ownership	Primarily federal	State	State	State	State	State	State
Ecoregions	Coastal 80% Cascades 20%	100% Coast Range Volcanics	100% Coast Range Volcanics	100% Coast Range Volcanics	100% Coast Range Volcanics	100% Coast Range Volcanics	100% Coast Range Volcanics
Geology	Sedimentary 72%	100% Volcanic	100% Volcanic	100% Volcanic	100% Volcanic	100% Volcanic	100% Volcanic

Table 5A. Summary of stream reaches surveyed within the Tillamook project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TILLAMOOK
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
FAWCETT CREEK (844)	7/4/2000	1	506	2.0	8.0	1	MV	CH	ST	YT	**99**	**0**	n/a	n/a	199
FAWCETT CREEK	5/22/1995	2	1716	0.0	2.0	3	MT	CA	ST		84	3	34	28	0
FAWCETT CREEK	5/23/1995	3	2307	0.0	4.0	2	MT	US	TH	ST	80	7	43	26	0
FAWCETT CREEK	5/24/1995	4	510	0.0	7.0	1	MV	CH	TH	ST	84	9	47	23	0
FAWCETT CREEK	5/25/1995	5	1526	0.0	9.0	3	MT	US	TH	ST	84	7	37	41	0
SIMMONS CREEK	6/6/1995	2	3648	4.1	4.0	2	MV	CH	ST		89	5	18	41	38
SIMMONS CREEK (852)	8/16/2001	1	1122	3.0	3.0	7	CT	CT	ST		**95**	**1**	10	50	9

* See methods for an explanation of abbreviations and field names.
Values in bold meet or exceed high reference breakpoints.

Table 5B. Summary of stream reaches surveyed within the Tillamook project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TILLAMOOK
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
FAWCETT CREEK (844)	1	11.0	6.0	12.0	1.0	**6.0**	1.00	15	44	1	691	142	20
FAWCETT CREEK	2	12.0	0.0	20.2	0.2	2.0	0.00	12	17	1	122	12	0
FAWCETT CREEK	3	12.0	0.0	9.9	0.8	3.0	0.00	10	11	0	107	46	0
FAWCETT CREEK	4	9.0	0.0	15.5	1.2	**4.0**	0.00	**22**	23	0	61	15	0
FAWCETT CREEK	5	9.0	0.0	15.7	5.4	**4.0**	0.00	**35**	38	2	406	41	0
SIMMONS CREEK	2	8.0	0.0	15.0	2.0	**4.0**	0.00	**26**	32	1	444	0	0
SIMMONS CREEK (852)	1	9.0	9.0	19.0	0.0	0.0	0.00	15	7	0	61	0	0

* See methods for an explanation of abbreviations and field names.
Values in bold meet or exceed high reference breakpoints.

Table 6A. Summary of stream reaches surveyed within the Kilchis project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: KILCHIS
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
CLEAR CREEK	10/7/1994	1	575	2.0	2.0	10	MT	CA	AG	ST	84	2	**7**	**80**	2
CLEAR CREEK	10/7/1994	2	3207	2.4	5.0	2	MV	CH	YT	YT	**91**	3	20	**59**	38
CLEAR CREEK	10/12/1994	3	1708	2.0	8.0	1	SV	CH	MT	MT	**96**	6	**0**	0	1
KILCHIS RIVER	10/18/1994	6	762	0.2	1.0	3	CT	CA	MT	OG	65	**1**	23	35	7
KILCHIS RIVER	10/18/1994	7	2483	0.4	1.0	1	MV	CH	MT	OG	73	15	23	27	27
KILCHIS RIVER	10/18/1994	8	2800	1.6	1.0	3	CT	CA	MT	MT	69	10	22	33	21
KILCHIS RIVER	10/19/1994	9	1885	0.4	2.0	1	MV	CH	YT	MT	78	4	23	28	24
KILCHIS RIVER	4/4/1995	10	1947	1.2	2.0	3	TC	CA	ST	YT	81	12	**3**	39	14
KILCHIS RIVER	4/5/1995	11	862	0.9	2.0	1	SV	CB	ST	YT	75	55	**0**	37	18
KILCHIS RIVER (1866)	6/29/1998	1	1041	5.0	1.0	3	CT	CA	ST		70	12	**8**	12	37
LITTLE SOUTH FORK KILCHIS RIVER (1807)	6/28/2000	1	590	1.5	2.0	2	MV	CH	ST	LT	87	2	10	25	102
MYRTLE CREEK (1938)	8/13/2001	1	526	5.0	7.0	2	MV	CH	ST	YT	73	12	**0**	31	128
NORTH FORK KILCHIS RIVER (2004)	7/1/1998	1	1004	**8.5**	2.0	4	CT	CA	ST		82	10	9	27	30
SHARP CREEK (1817)	9/1/1999	1	947	2.0	12.0	2	SV	CH	ST		**96**	23	**3**	20	63
SOUTH FORK KILCHIS RIVER (1987)	8/11/2004	1	1029	0.0	1.0	3	CT	CA	ST		75	**0**	16	31	35
TRIANGULATION CREEK (1995)	7/19/2001	1	502	**10.0**	22.0	1	SV	CB	ST		**96**	39	**0**	16	118

* See methods for an explanation of abbreviations and field names.
Values in bold meet or exceed high reference breakpoints.

Table 6B. Summary of stream reaches surveyed within the Kilchis project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: KILCHIS
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
CLEAR CREEK	1	14.0	3.0	**54.3**	**22.2**	**7.0**	0.70	4	7	0	244	61	0
CLEAR CREEK	2	9.0	8.0	19.6	1.6	3.0	0.50	16	28	1	218	26	0
CLEAR CREEK	3	9.0	7.0	41.5	**38.5**	3.0	0.40	**27**	37	1	732	0	0
KILCHIS RIVER	6	29.0	4.0	**62.4**	0.0	**8.0**	1.80	3	5	0	366	**183**	**122**
KILCHIS RIVER	7	32.0	5.0	**55.4**	0.0	**6.0**	1.60	1	4	0	305	61	0
KILCHIS RIVER	8	43.0	4.0	**49.5**	0.0	**6.0**	1.80	1	4	0	163	0	0
KILCHIS RIVER	9	32.0	7.0	**49.2**	0.0	**4.0**	1.60	1	3	0	284	0	0
KILCHIS RIVER	10	30.0	5.0	**47.8**	0.1	**6.0**	1.60	5	7	0	203	0	0
KILCHIS RIVER	11	27.0	3.0	**51.1**	0.9	**9.0**	1.40	6	7	0	853	0	0
KILCHIS RIVER (1866)	1	22.0	3.0	**61.0**	1.0	**12.0**	2.00	1	4	0	183	0	0
LITTLE SOUTH FORK KILCHIS RIVER (1807)	1	16.0	4.0	37.0	1.5	**8.0**	1.00	3	7	0	661	0	0
MYRTLE CREEK (1938)	1	4.0	11.0	14.0	1.0	0.0	1.00	**22**	22	1	325	61	20
NORTH FORK KILCHIS RIVER (2004)	1	16.0	6.0	25.0	1.5	**4.0**	1.00	11	21	1	92	0	0
SHARP CREEK (1817)	1	6.0	8.0	23.5	0.0	2.0	0.50	19	34	1	82	0	0
SOUTH FORK KILCHIS RIVER (1987)	1	20.0	4.0	39.0	0.0	2.0	1.00	7	12	0	0	0	0
TRIANGULATION CREEK (1995)	1	7.0	10.0	13.0	0.0	0.0	0.00	**21**	51	2	264	0	0

* See methods for an explanation of abbreviations and field names.
Values in bold meet or exceed high reference breakpoints.

Table 7A. Summary of stream reaches surveyed within the Trask project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TRASK
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
BALES CREEK	8/10/1994	1	1183	**10.2**	4.0	2	MV	CH	ST		100	3	11	32	17
BALES CREEK	8/11/1994	2	652	**8.1**	6.0	4	MT	US	ST		100	4	24	34	12
BALES CREEK	8/11/1994	3	1299	**9.6**	7.0	2	MV	CH	ST		**100**	9	**8**	**68**	15
BALES CREEK	8/15/1994	4	1862	3.7	5.0	2	MT	US	ST		100	4	10	48	2
BARK SHANTY CREEK	8/18/1995	1	4427	**6.5**	3.0	2	MV	CH	ST		**93**	9	10	35	71
BARK SHANTY CREEK	8/24/1995	2	388	3.3	10.0	1	SV	CH	ST		78	16	20	20	111
BARK SHANTY CREEK	8/6/1995	3	1182	**9.8**	2.0	2	MV	CH	ST		**94**	**1**	19	**62**	43
BARK SHANTY CREEK	8/30/1995	4	1226	**10.7**	6.0	2	MV	CH	ST		**99**	12	29	33	96
BARK SHANTY CREEK	9/6/1995	5	1566	**8.8**	12.0	1	MV	CH	ST		**98**	6	28	**60**	85
BARNEY RIVER TRIBUTARY (2891)	7/12/2000	1	748	0.0	0.0	1	WF	US	ST		34	**0**	100	0	1
BILL CREEK	8/23/1994	1	1038	4.7	4.0	3	SV	CH	LT		**98**	24	20	**56**	19
BILL CREEK	8/23/1994	2	1018	4.1	4.0	5	MT	CA	LT		**96**	10	13	**56**	15
BLUE BUS CREEK	7/26/1994	1	140	0.0	3.0	15	CT	TC	LT		100	**0**	22	50	1
BLUE BUS CREEK	7/27/1994	2	2721	2.1	10.0	2	MT	CA	LT		**98**	6	32	42	15
BLUE BUS CREEK (2828)	7/8/1999	1	476	1.0	5.0	6	CT	CA	YT		84	**0**	29	50	20
BOUNDARY CREEK	7/18/1994	1	174	**25.6**	4.0	11	MT	CA	LT		100	**1**	**7**	**83**	1
BOUNDARY CREEK	7/18/1994	2	2304	**12.8**	7.0	4	MT	CA	LT		**98**	2	21	42	6
BOUNDARY CREEK (12)	9/3/1998	1	1007	**5.3**	2.0	4	CT	CA	ST	YT	**92**	3	17	38	32
CLEAR CREEK	7/27/1995	1	3097	**7.9**	3.0	3	MV	CH	ST		**94**	10	26	22	39
CLEAR CREEK	8/2/1995	2	2679	3.3	10.0	2	MV	CH	ST		**97**	10	33	40	69
CLEAR CREEK #2 (3064)	8/14/2000	1	1016	1.0	2.0	2	MV	CH	ST		**92**	11	14	33	16
CRUISER CREEK	10/4/1994	1	3061	1.0	3.0	1	SV	CH	MT		**99**	16	20	**59**	16
CRUISER CREEK (2875)	7/29/2003	1	1007	0.0	5.0	2	MV	CH	LT		**99**	26	18	53	19
E FK OF SOUTH FORK TRASK RIVER	7/16/1990	1	1092	**7.2**	3.0	8	CT	TC	MT		74	17	**8**	**55**	39
E FK OF SOUTH FORK TRASK RIVER	7/16/1990	2	5358	3.2	2.0	2	MV	CH	MT		77	14	**5**	20	33
E FK OF SOUTH FORK TRASK RIVER	7/17/1990	3	539	3.6	4.0	1	MV	CH	MT		83	48	**7**	17	9
E FK OF SOUTH FORK TRASK RIVER	7/17/1990	4	4203	4.6	2.0	8	MT	US	MT		89	12	**7**	**60**	17
E FK OF SOUTH FORK TRASK RIVER	7/23/1990	5	1255	**6.4**	2.0	5	CT	TC	MT		**91**	**1**	**5**	34	19
E FK OF SOUTH FORK TRASK RIVER	7/23/1990	6	2797	**7.5**	2.0	8	MT	US	MT		83	8	10	32	12
E FK OF SOUTH FORK TRASK RIVER	7/25/1990	7	1863	2.3	6.0	1	MV	CH	MT		**92**	36	**8**	17	24
E. FK OF S. FK TRASK RIVER (780)	8/7/2003	1	1030	3.0	2.0	2	MV	CH	ST		**93**	5	24	29	71
EDWARDS CREEK	7/11/1991	1	245	0.3	2.0	6	MT	US	MT	ST	85	8	**5**	30	63
EDWARDS CREEK	7/15/1991	2	1424	0.8	2.0	12	MT	UA	MT	ST	76	4	16	27	20
ELKHORN CREEK	9/21/1994	2	4757	**8.2**	2.0	2	SV	CH	MT		**91**	20	20	50	8
ELKHORN CREEK	9/30/1994	3	967	1.0	2.0	8	MT	US	YT		**97**	**0**	29	**57**	4

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 7A. Summary of stream reaches surveyed within the Trask project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TRASK
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
HEADQUARTERS CAMP CREEK	6/28/1994	1	1441	3.4	3.0	4	MT	CA	LT		**98**	**1**	31	31	15
HEADQUARTERS CAMP CREEK	6/29/1994	2	3478	5.0	10.0	2	MV	CH	LT		**99**	2	23	51	21
JOYCE CREEK	8/15/1994	1	521	0.0	2.0	2	CT	CA	ST		100	8	30	32	37
JOYCE CREEK	8/15/1994	2	1825	4.9	5.0	2	SV	CH	ST		**94**	2	13	37	34
MID FK OF NORTH FORK TRASK RIVER	8/15/1990	1	2689	**7.8**	2.0	2	MV	CH	MT		77	28	**4**	17	16
MID FK OF NORTH FORK TRASK RIVER	8/16/1990	2	2507	2.5	4.0	1	MV	CB	MT	ST	74	23	**4**	17	42
MID FK OF NORTH FORK TRASK RIVER	8/22/1990	3	1015	0.7	3.0	1	MV	CH	MT	ST	78	32	**6**	31	22
MID FK OF NORTH FORK TRASK RIVER	8/22/1990	4	233	**29.0**	2.0	2	MV	CH	MT	ST	74	11	**8**	**64**	6
MID FK OF NORTH FORK TRASK RIVER	8/22/1990	5	1438	1.6	2.0	1	MV	CH	MT		85	29	**4**	37	2
MID FK OF NORTH FORK TRASK RIVER	8/23/1990	6	187	3.5	2.0	8	MV	CH	MT		**92**	24	**6**	20	6
MID FK OF NORTH FORK TRASK RIVER	8/23/1990	7	1474	2.0	2.0	1	MV	CH	MT		**94**	42	**5**	42	6
MID FK OF NORTH FORK TRASK RIVER	8/27/1990	8	452	0.9	1.0	4	MV	CH	MT		**97**	40	**5**	29	3
MILLER CREEK	8/16/1994	1	3273	**5.4**	6.0	2	MV	CH	LT		100	2	36	**54**	4
N FK OF NORTH FORK TRASK RIVER	8/8/1990	1	447	0.0	1.0	2	CT	TC	MT		**91**	12	**0**	20	6
N FK OF NORTH FORK TRASK RIVER	8/8/1990	2	1187	0.3	2.0	5	CT	TC	MT		82	9	**5**	20	19
N FK OF NORTH FORK TRASK RIVER	8/8/1990	3	1395	**5.6**	2.0	2	MV	CH	MT		75	4	**1**	33	13
N FK OF NORTH FORK TRASK RIVER	8/9/1990	4	1555	0.8	2.0	1	MV	CB	MT		74	38	**0**	5	9
N. FK OF THE N. FK TRASK RIVER (3086)	8/22/2002	1	493	1.0	4.0	1	SB	CB	ST		80	36	**0**	25	78
NORTH FORK TRASK RIVER TRIB. (2834)	9/26/2000	1	526	1.5	11.0	2	SV	CH	ST		89	31	**0**	0	24
PIGEON CREEK	8/4/1994	1	2601	3.6	9.0	2	MV	CH	LT		**99**	8	16	35	17
RAWE CREEK (576)	8/16/2000	1	845	2.0	6.0	2	MV	CH	ST		70	6	**0**	0	47
ROCK CREEK	7/12/1995	1	3335	**8.5**	8.0	2	MV	CH	ST		100	19	11	34	47
SCOTCH CREEK	8/2/1994	1	2688	1.4	12.0	1	MV	CH	ST		**98**	8	52	39	3
SHERIDAN CREEK (731)	9/1/2003	1	511	**10.0**	12.0	2	SV	CH	ST		57	**1**	**0**	0	232
SOUTH FORK SUMMIT CREEK (758)	7/21/2004	1	431	2.0	14.0	1	SV	CH	ST	TH	**92**	3	16	**84**	8
SOUTH FORK SUMMIT CREEK (772)	8/25/1999	1	1032	2.0	6.0	3	CT	CA	ST		**98**	8	84	0	43
SOUTH FORK TRASK RIVER	8/20/1997	1	1898	0.0	1.0	6	MT	CA	RR	TH	74	15	13	14	0
SOUTH FORK TRASK RIVER	8/24/1997	2	989	0.0	1.0	1	MV	CH	ST		74	26	15	22	0
SOUTH FORK TRASK RIVER	8/24/1997	3	1045	0.0	2.0	1	MV	CH	ST		80	12	13	22	0
SOUTH FORK TRASK RIVER	8/25/1997	4	1696	0.0	2.0	3	MT	CA	ST		87	5	19	24	0
SOUTH FORK TRASK RIVER	8/26/1997	5	2239	0.0	2.0	2	MT	CA	ST		**91**	8	20	23	0
SOUTH FORK TRASK RIVER	8/25/1994	6	718	0.6	2.0	2	MV	CH	YT		**98**	15	20	51	12
SOUTH FORK TRASK RIVER	8/26/1994	7	1218	3.4	2.0	7	MT	TC	YT		**97**	13	19	49	7
SOUTH FORK TRASK RIVER	8/26/1994	8	1440	1.3	3.0	2	MV	CH	YT		**100**	20	21	45	13
SOUTH FORK TRASK RIVER	9/8/1994	9	1378	3.4	5.0	6	MT	CA	YT		100	9	23	**68**	24

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 7A. Summary of stream reaches surveyed within the Trask project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TRASK
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
STEAMPOT CREEK	8/8/1994	1	2806	4.6	7.0	2	MV	CH	LT		**97**	5	42	36	2
STRETCH CREEK	7/21/1994	1	1056	**6.4**	6.0	3	CT	CA	LT		**99**	3	16	38	11
STRETCH CREEK	7/25/1994	2	503	4.6	10.0	3	MV	CH	LT		100	3	17	**76**	4
TRASK RIVER	9/10/1997	7	3562	0.1	0.0	2	MV	CH	RR	ST	66	26	13	14	1
TRASK RIVER TRIBUTARY (2817)	9/21/1998	1	506	**10.0**	15.0	2	MV	CH	ST		**98**	19			0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 7B. Summary of stream reaches surveyed within the Trask project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TRASK
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	WOOD DEBRIS KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
BALES CREEK	1	10.0	21.0	6.7	0.1	0.0	0.50	11	15	0	61	0	0
BALES CREEK	2	6.0	118.0	1.6	0.0	0.0	0.50	**25**	31	0	61	0	0
BALES CREEK	3	7.0	34.0	4.1	0.0	0.0	0.50	**29**	27	0	152	0	0
BALES CREEK	4	6.0	78.0	3.1	0.0	0.0	0.60	6	8	0	0	0	0
BARK SHANTY CREEK	1	16.0	3.0	25.1	0.8	**6.0**	0.70	**26**	**70**	**3**	54	0	0
BARK SHANTY CREEK	2	12.0	4.0	22.4	3.3	2.0	0.50	**40**	**153**	**8**	30	0	0
BARK SHANTY CREEK	3	14.0	5.0	32.8	2.1	**4.0**	0.70	19	49	2	152	0	0
BARK SHANTY CREEK	4	9.0	8.0	18.1	3.0	0.0	0.40	**30**	**61**	**3**	671	0	0
BARK SHANTY CREEK	5	6.0	16.0	16.3	**10.3**	1.0	0.40	**28**	57	2	224	0	0
BARNEY RIVER TRIBUTARY (2891)	1	46.0	1.0	**79.0**	**29.0**	**18.0**	1.00	14	10	0	1077	0	0
BILL CREEK	1	9.0	14.0	11.3	0.0	1.0	0.40	9	7	0	122	0	0
BILL CREEK	2	8.0	8.0	18.6	0.0	0.0	0.40	15	19	0	61	0	0
BLUE BUS CREEK	1	5.0	0.0	0.0	0.0	0.0	0.00	5	2	0	61	61	0
BLUE BUS CREEK	2	5.0	65.0	5.8	1.8	0.0	0.40	16	30	0	146	0	0
BLUE BUS CREEK (2828)	1	7.0	13.0	7.0	0.0	0.0	0.00	**40**	50	2	0	0	0
BOUNDARY CREEK	1	4.0	36.0	25.3	**21.7**	0.0	0.30	**22**	26	0	427	0	0
BOUNDARY CREEK	2	5.0	185.0	2.4	1.1	0.0	0.70	20	38	0	411	48	0
BOUNDARY CREEK (12)	1	9.0	6.0	33.0	0.3	**4.0**	0.67	**23**	27	1	356	7	0
CLEAR CREEK	1	16.0	4.0	24.5	2.1	**4.0**	0.60	16	37	0	198	0	0
CLEAR CREEK	2	8.0	12.0	8.5	0.6	1.0	0.60	**23**	46	1	579	15	0
CLEAR CREEK #2 (3064)	1	15.0	6.0	41.5	0.0	**8.0**	1.00	5	8	0	81	0	0
CRUISER CREEK	1	8.0	16.0	8.0	0.1	0.0	0.40	**21**	36	1	549	0	0
CRUISER CREEK (2875)	1	6.0	16.0	9.0	1.0	0.0	0.00	18	13	0	650	**183**	0
E FK OF SOUTH FORK TRASK RIVER	1	19.0	4.0	34.2	0.5	**6.0**	0.90	n/a	n/a	n/a	n/a	n/a	n/a
E FK OF SOUTH FORK TRASK RIVER	2	13.0	6.0	30.1	0.2	**9.0**	0.80	n/a	n/a	n/a	n/a	n/a	n/a
E FK OF SOUTH FORK TRASK RIVER	3	8.0	5.0	**60.0**	0.0	**14.0**	0.70	n/a	n/a	n/a	n/a	n/a	n/a
E FK OF SOUTH FORK TRASK RIVER	4	11.0	5.0	**45.2**	1.4	**7.0**	0.60	n/a	n/a	n/a	n/a	n/a	n/a
E FK OF SOUTH FORK TRASK RIVER	5	8.0	5.0	**53.3**	0.7	**4.0**	0.50	n/a	n/a	n/a	n/a	n/a	n/a
E FK OF SOUTH FORK TRASK RIVER	6	7.0	8.0	25.8	0.4	2.0	0.40	n/a	n/a	n/a	n/a	n/a	n/a
E FK OF SOUTH FORK TRASK RIVER	7	4.0	10.0	21.9	0.0	**5.0**	0.40	n/a	n/a	n/a	n/a	n/a	n/a
E. FK OF S. FK TRASK RIVER (780)	1	21.0	13.0	13.0	0.0	**4.0**	1.00	0	1	0	203	0	0
EDWARDS CREEK	1	10.0	4.0	17.0	0.3	0.0	0.30	1	10	0	n/a	n/a	n/a
EDWARDS CREEK	2	9.0	6.0	18.0	0.9	1.0	0.30	6	17	1	n/a	n/a	n/a
ELKHORN CREEK	2	12.0	9.0	20.8	0.4	2.0	0.50	15	32	1	305	17	0
ELKHORN CREEK	3	12.0	6.0	**64.5**	**55.3**	2.0	0.40	15	22	0	579	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 7B. Summary of stream reaches surveyed within the Trask project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TRASK
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	WOOD DEBRIS KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
HEADQUARTERS CAMP CREEK	1	7.0	11.0	12.7	0.2	1.0	0.50	20	47	0	198	0	0
HEADQUARTERS CAMP CREEK	2	3.0	111.0	1.8	0.0	0.0	0.40	20	47	1	335	24	0
JOYCE CREEK	1	12.0	6.0	31.1	**10.3**	2.0	0.40	**22**	19	0	0	0	0
JOYCE CREEK	2	10.0	5.0	19.8	2.6	0.0	0.40	**30**	56	1	49	0	0
MID FK OF NORTH FORK TRASK RIVER	1	10.0	6.0	39.3	0.1	**9.0**	0.70	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	2	8.0	5.0	31.8	0.2	**10.0**	0.60	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	3	8.0	8.0	31.4	0.0	**7.0**	0.70	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	4	6.0	4.0	40.9	**7.7**	0.0	0.30	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	5	8.0	7.0	34.2	0.3	2.0	0.30	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	6	10.0	2.0	**57.3**	0.0	**4.0**	0.40	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	7	8.0	5.0	**46.1**	2.1	3.0	0.30	n/a	n/a	n/a	n/a	n/a	n/a
MID FK OF NORTH FORK TRASK RIVER	8	6.0	7.0	**72.4**	**13.0**	**7.0**	0.40	n/a	n/a	n/a	n/a	n/a	n/a
MILLER CREEK	1	4.0	286.0	1.2	0.0	0.0	0.50	**22**	36	0	102	0	0
N FK OF NORTH FORK TRASK RIVER	1	14.0	6.0	29.6	0.0	**4.0**	0.60	n/a	n/a	n/a	n/a	n/a	n/a
N FK OF NORTH FORK TRASK RIVER	2	14.0	6.0	27.6	0.0	**6.0**	0.70	n/a	n/a	n/a	n/a	n/a	n/a
N FK OF NORTH FORK TRASK RIVER	3	11.0	4.0	44.1	0.0	**14.0**	0.70	n/a	n/a	n/a	n/a	n/a	n/a
N FK OF NORTH FORK TRASK RIVER	4	10.0	6.0	**46.3**	0.5	**13.0**	0.90	n/a	n/a	n/a	n/a	n/a	n/a
N. FK OF THE N. FK TRASK RIVER (3086)	1	11.0	3.0	**61.0**	0.0	**22.0**	1.00	4	3	0	589	0	0
NORTH FORK TRASK RIVER TRIB. (2834)	1	6.0	6.0	25.0	0.0	**4.0**	1.00	**44**	**70**	2	61	0	0
PIGEON CREEK	1	5.0	85.0	1.8	0.0	0.0	0.50	13	24	0	264	0	0
RAWE CREEK (576)	1	12.0	12.0	7.5	1.0	0.0	0.00	16	33	1	51	0	0
ROCK CREEK	1	7.0	14.0	7.9	0.1	0.0	0.40	12	40	2	637	20	0
SCOTCH CREEK	1	4.0	100.0	1.4	0.0	0.0	0.30	**23**	42	0	386	0	0
SHERIDAN CREEK (731)	1	8.0	16.0	2.0	0.0	0.0	0.00	14	13	0	0	0	0
SOUTH FORK SUMMIT CREEK (758)	1	4.0	41.0	2.0	0.0	0.0	0.00	**49**	**81**	2	345	41	0
SOUTH FORK SUMMIT CREEK (772)	1	6.0	8.0	26.0	0.0	0.0	0.00	**36**	**58**	**3**	102	0	0
SOUTH FORK TRASK RIVER	1	26.0	6.0	35.1	0.0	**6.0**	1.20	4	2	0	0	0	0
SOUTH FORK TRASK RIVER	2	19.0	10.0	36.2	0.0	**5.0**	1.60	0	0	0	0	0	0
SOUTH FORK TRASK RIVER	3	23.0	16.0	4.1	0.0	2.0	0.80	6	5	0	0	0	0
SOUTH FORK TRASK RIVER	4	14.0	16.0	15.5	1.5	2.0	0.70	11	10	0	61	0	0
SOUTH FORK TRASK RIVER	5	14.0	15.0	14.9	0.0	3.0	0.90	8	10	0	61	0	0
SOUTH FORK TRASK RIVER	6	12.0	4.0	29.4	0.3	**5.0**	0.60	9	10	0	122	0	0
SOUTH FORK TRASK RIVER	7	12.0	5.0	26.9	0.4	2.0	0.60	9	8	0	30	30	0
SOUTH FORK TRASK RIVER	8	10.0	7.0	22.6	0.0	1.0	0.40	9	14	0	163	0	0
SOUTH FORK TRASK RIVER	9	8.0	18.0	6.7	0.3	1.0	0.60	12	22	1	30	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 7B. Summary of stream reaches surveyed within the Trask project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: TRASK
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	WOOD DEBRIS KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
STEAMPOT CREEK	1	6.0	46.0	3.4	0.2	0.0	0.40	**27**	44	0	91	0	0
STRETCH CREEK	1	5.0	40.0	6.5	2.8	0.0	0.40	**26**	35	0	0	0	0
STRETCH CREEK	2	3.0	0.0	0.0	0.0	0.0	0.00	**36**	39	0	122	0	0
TRASK RIVER	7	26.0	8.0	**55.3**	0.0	**5.0**	2.00	0	0	0	518	30	0
TRASK RIVER TRIBUTARY (2817)	1	4.0	7.0	15.0	0.0	0.0	0.00	**24**	39	1	61	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 8A. Summary of stream reaches surveyed within the Upper Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: UPPER WILSON
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
DEO CREEK (3022)	7/17/1998	1	760	0.5	0.0	14	WF	UA	ST	WL	42	**0**	76	20	0
DEO CREEK	10/13/1997	1	1466	3.5	4.0	2	MV	CH	ST		88	5	46	25	10
DEO CREEK	10/14/1997	2	670	0.2	1.0	6	WF	US	ST		52	**0**	81	16	0
DEO CREEK	10/14/1997	3	337	**8.1**	2.0	6	CT	TC	ST		**91**	**0**	58	24	0
DEO CREEK	10/15/1997	4	1233	**6.1**	4.0	2	OV	CH	ST		90	**0**	63	23	0
DEVILS LAKE FORK	7/16/1991	1	1575	**6.1**	6.0	1	SV	CH	MT	ST	69	13	15	25	116
DEVILS LAKE FORK	7/17/1991	2	684	**11.3**	1.0	16	WF	UB	MT	ST	59	3	10	34	17
DEVILS LAKE FORK	7/22/1991	3	2309	**6.2**	2.0	2	SV	CB	MT	ST	79	10	9	28	34
DEVILS LAKE FORK	7/22/1991	4	496	**5.4**	4.0	1	SV	CH	MT	ST	58	2	**0**	0	69
DEVILS LAKE FORK	7/22/1991	5	767	**9.9**	4.0	1	SV	CB	MT	ST	74	10	9	32	97
DEVILS LAKE FORK	7/25/1991	6	3094	**43.5**	2.0	5	WF	UA	MT	ST	85	9	9	24	41
DEVILS LAKE FORK	7/25/1991	7	2790	3.6	2.0	6	MT	US	MT	ST	68	38	19	17	11
DEVILS LAKE FORK	7/30/1991	8	1268	1.4	1.0	6	MV	CH	MT	ST	46	21	18	30	0
DRIFT CREEK	7/28/1994	1	4807	1.4	8.0	2	SV	CH	ST	YT	88	9	15	**66**	26
ELK CREEK	7/22/1997	1	1341	3.1	3.0	2	SV	CH	LT		77	7	9	13	100
ELK CREEK	7/22/1997	2	3650	4.0	4.0	1	SV	CH	LT	ST	81	6	21	16	83
ELK CREEK	7/29/1997	3	1152	3.9	4.0	2	SV	CH	ST	LT	85	**1**	12	37	55
ELK CREEK (3039)	8/19/1999	1	1037	0.0	3.0	4	MV	CH	ST		79	11			61
ELLIOT CREEK	9/20/1997	1	1091	**17.0**	2.0	5	MT	CT	MT		75	**0**	29	29	13
ELLIOT CREEK	9/20/1997	2	336	**5.3**	3.0	1	MV	CH	MT		76	**0**	33	29	27
ELLIOT CREEK	9/22/1997	3	409	**19.4**	4.0	2	MT	CA	MT		79	**0**	31	25	52
ELLIOT CREEK	9/22/1997	4	163	**6.6**	10.0	3	MT	CA	MT		75	12	26	27	58
ELLIOT CREEK	9/22/1997	5	557	2.6	3.0	1	MV	CH	MT		72	3	33	27	32
IDIOT CREEK	7/19/1994	1	1037	**9.1**	4.0	2	MV	CH	ST	YT	100	30	**4**	34	54
IDIOT CREEK	7/20/1994	2	4545	1.2	9.0	2	SV	CH	ST	YT	**99**	39	**5**	47	30
JORDAN CREEK	7/23/1997	11	1568	2.8	12.0	1	MV	CB	ST		**97**	14	13	24	83
JORDAN CREEK	7/29/1997	12	1648	2.1	23.0	1	MV	CH	ST		**95**	9	24	37	32
SOUTH FORK WILSON RIVER	9/9/1997	1	4186	2.7	1.0	2	MV	CH	ST		77	9	10	21	53
SOUTH FORK WILSON RIVER	9/9/1997	2	2575	**6.5**	2.0	2	MV	CH	ST		83	10	10	33	77
SOUTH FORK WILSON RIVER	9/23/1997	3	2645	**7.0**	3.0	1	MV	CH	LT		90	3	23	22	24
SOUTH FORK WILSON RIVER	10/7/1997	4	2350	**5.3**	7.0	2	MV	CH	LT		**93**	9	24	21	41
SOUTH FORK WILSON RIVER	10/7/1997	5	921	4.7	23.0	1	MV	CH	LT		89	11	26	35	4
SOUTH FORK WILSON RIVER	10/12/1997	6	738	4.4	22.0	1	MV	CH	LT		85	**0**	25	30	2
S. FORK WILSON RIVER TRIB B	8/7/1996	1	1025	**21.5**	4.0	7	CT	CA	ST	LT	77	**0**	10	**62**	2
S. FORK WILSON RIVER TRIB B	8/12/1996	2	1175	**13.4**	13.0	2	MV	CH	ST	LT	84	3	**7**	**75**	9
S. FORK WILSON RIVER TRIB C	8/13/1996	1	799	**14.6**	6.0	7	CT	CA	ST		100	5	11	29	24

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 8A. Summary of stream reaches surveyed within the Upper Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: UPPER WILSON
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
S. FORK WILSON RIVER TRIB C	8/13/1996	2	435	**6.1**	8.0	2	MV	CH	ST		**95**	2	11	**56**	19
S. FORK WILSON RIVER TRIB C	8/13/1996	3	550	**16.7**	8.0	4	CT	CA	ST		**97**	**0**	9	47	19
S. FORK WILSON RIVER TRIB C	8/14/1996	4	1798	**8.0**	15.0	2	MV	CH	LT	ST	**98**	4	12	41	9
S. FK WILSON RIVER TRIB. (3019)	8/8/2003	1	474	2.0	8.0	1	SV	CH	ST		73	38	**0**	0	79
WEST FORK ELK CREEK	7/31/1997	1	1836	2.5	8.0	1	SV	CH	ST	LT	85	10	10	30	94
WEST FORK ELK CREEK	7/31/1997	2	932	1.8	20.0	1	SV	CH	ST		88	9	**5**	20	71

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 8B. Summary of stream reaches surveyed within the Upper Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: UPPER WILSON
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	WOOD DEBRIS KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
DEO CREEK (3022)	1	14.0	4.0	**88.0**	**77.5**	**12.0**	1.00	**26**	33	1	234	0	0
DEO CREEK	1	4.0	27.0	8.2	6.3	3.0	0.60	**35**	**144**	**6**	1311	61	0
DEO CREEK	2	26.0	3.0	**97.3**	**89.5**	**6.0**	0.60	**21**	**117**	**5**	305	0	0
DEO CREEK	3	4.0	47.0	9.5	**9.5**	0.0	0.30	**34**	**153**	**9**	1036	0	0
DEO CREEK	4	4.0	98.0	2.8	2.4	0.0	0.40	**35**	**148**	**7**	1016	61	0
DEVILS LAKE FORK	1	12.0	5.0	24.0	1.2	**6.0**	0.50	5	14	0	n/a	n/a	n/a
DEVILS LAKE FORK	2	14.0	6.0	16.0	0.0	2.0	0.50	4	7	0	n/a	n/a	n/a
DEVILS LAKE FORK	3	10.0	7.0	31.0	0.6	**4.0**	0.60	6	15	0	n/a	n/a	n/a
DEVILS LAKE FORK	4	10.0	10.0	**93.0**	5.4	0.0	0.90	**33**	**189**	0	n/a	n/a	n/a
DEVILS LAKE FORK	5	11.0	3.0	29.0	**80.9**	**4.0**	0.40	4	11	0	n/a	n/a	n/a
DEVILS LAKE FORK	6	8.0	4.0	**51.0**	**30.0**	2.0	0.40	13	37	0	n/a	n/a	n/a
DEVILS LAKE FORK	7	6.0	8.0	43.0	**10.5**	2.0	0.50	2	8	0	n/a	n/a	n/a
DEVILS LAKE FORK	8	5.0	11.0	38.0	**7.4**	2.0	0.50	7	30	0	n/a	n/a	n/a
DRIFT CREEK	1	7.0	22.0	6.5	0.5	0.0	0.40	**24**	21	0	1273	69	0
ELK CREEK	1	21.0	8.0	21.1	0.0	**6.0**	1.20	5	7	0	549	0	0
ELK CREEK	2	10.0	19.0	10.8	0.0	**4.0**	1.10	2	3	0	244	0	0
ELK CREEK	3	9.0	29.0	9.9	0.3	2.0	0.80	18	32	0	488	0	0
ELK CREEK (3039)	1	12.0	6.0	37.0	0.0	**10.0**	1.00	2	9	0	305	**163**	0
ELLIOT CREEK	1	9.0	6.0	28.2	0.0	2.0	0.60	19	15	0	488	41	0
ELLIOT CREEK	2	10.0	5.0	22.0	0.0	0.0	0.50	**35**	27	0	366	61	0
ELLIOT CREEK	3	4.0	24.0	7.0	0.0	0.0	0.40	**27**	25	0	732	122	0
ELLIOT CREEK	4	9.0	0.0	0.0	0.0	0.0		**50**	**63**	2	975	0	0
ELLIOT CREEK	5	9.0	5.0	31.9	0.0	3.0	0.60	**56**	53	1	1463	0	0
IDIOT CREEK	1	8.0	6.0	3.0	5.4	1.0	0.30	9	13	0	366	48	0
IDIOT CREEK	2	7.0	8.0	20.1	3.4	1.0	0.40	9	10	0	953	60	6
JORDAN CREEK	11	6.0	9.0	12.0	0.0	**4.0**	0.60	17	33	1	280	24	0
JORDAN CREEK	12	5.0	40.0	4.5	0.0	0.0	0.50	**38**	**105**	**5**	768	98	0
SOUTH FORK WILSON RIVER	1	15.0	7.0	36.0	5.6	**6.0**	0.90	4	7	0	73	0	0
SOUTH FORK WILSON RIVER	2	16.0	9.0	25.0	0.0	**4.0**	0.90	11	15	0	549	20	0
SOUTH FORK WILSON RIVER	3	12.0	13.0	9.6	0.0	**4.0**	0.70	**29**	**93**	**4**	975	20	0
SOUTH FORK WILSON RIVER	4	4.0	104.0	2.2	0.0	2.0	0.90	**23**	**163**	**7**	1605	41	0
SOUTH FORK WILSON RIVER	5	3.0	0.0	0.0	0.0	0.0	0.00	**77**	**594**	**25**	2012	122	0
SOUTH FORK WILSON RIVER	6	2.0	0.0	0.0	0.0	0.0	0.00	11	**103**	**4**	1219	61	0
S. FORK WILSON RIVER TRIB B	1	5.0	6.0	14.1	1.0	2.0	0.40	13	28	1	163	0	0
S. FORK WILSON RIVER TRIB B	2	4.0	26.0	4.2	0.5	0.0	0.40	**32**	**65**	2	874	102	0
S. FORK WILSON RIVER TRIB C	1	6.0	10.0	12.8	0.0	0.0	0.40	8	12	1	30	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 8B. Summary of stream reaches surveyed within the Upper Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: UPPER WILSON
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	WOOD DEBRIS KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
S. FORK WILSON RIVER TRIB C	2	5.0	8.0	16.1	0.0	0.0	0.50	20	57	**3**	1158	61	0
S. FORK WILSON RIVER TRIB C	3	6.0	8.0	18.3	0.8	1.0	0.50	**24**	**74**	**4**	122	0	0
S. FORK WILSON RIVER TRIB C	4	4.0	17.0	17.1	0.1	0.0	0.30	**22**	**82**	**5**	335	0	0
S. FK WILSON R. TRIB. (3019)	1	9.0	7.0	16.0	0.0	**4.0**	1.00	15	32	2	467	20	0
WEST FORK ELK CREEK	1	7.0	34.0	4.3	0.2	2.0	0.90	**44**	**92**	2	224	0	0
WEST FORK ELK CREEK	2	5.0	0.0	0.0	0.0	0.0	0.00	**65**	**137**	**3**	549	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 9A. Summary of stream reaches surveyed within the Lower Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: LOWER WILSON
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
BEN SMITH CREEK (2939)	7/15/1998	1	827	**10.2**	3.0	8	CT	CA	ST		**92**	**1**	17	34	38
BERRY CREEK	8/30/1995	1	1604	**11.9**	4.0	1	SV	CH	ST		**94**	7	17	33	44
BERRY CREEK	9/5/1995	2	2225	1.9	13.0	1	SV	CH	ST		**96**	10	12	18	35
CEDAR CREEK	7/8/1997	1	1426	**10.7**	2.0	8	MT	TC	LT		68	10	22	28	9
CEDAR CREEK	7/9/1997	2	2715	**5.6**	2.0	4	MT	CA	LT		59	11	26	28	23
CEDAR CREEK	7/15/1997	3	486	**7.8**	2.0	2	MV	CH	LT		63	12	21	28	31
CEDAR CREEK	7/15/1997	4	599	**24.2**	3.0	4	MT	CA	LT		63	5	24	31	31
CEDAR CREEK	7/17/1997	5	1288	**23.6**	5.0	3	MV	CH	LT		73	2	26	29	95
CEDAR CREEK	7/24/1997	6	1337	4.0	23.0	1	MV	CH	LT		77	11	20	30	67
CEDAR CREEK TRIBUTARY (2963)	7/2/2003	1	474	3.0	6.0	6	MT	CA	ST	MT	**96**	**1**	10	35	49
FALL CREEK	7/6/1994	1	312	0.0	11.0	1	SV	CH	ST	YT	**91**	10	**0**	5	45
FALL CREEK	7/6/1994	2	2805	**7.7**	6.0	4	MT	CA	ST	YT	**99**	7	22	44	60
FALL CREEK	7/11/1994	3	1168	**7.5**	16.0	2	SV	CH	ST	YT	100	22	25	**54**	49
JORDAN CREEK	6/23/1997	1	283	0.8	2.0	1	SV	CH	RR		76	31	9	14	45
JORDAN CREEK	6/24/1997	2	2377	2.0	2.0	1	SV	CB	ST		90	24	10	14	47
JORDAN CREEK	6/30/1997	3	1736	2.6	2.0	2	CT	CA	ST		81	12	11	17	51
JORDAN CREEK	7/7/1997	4	3779	2.0	2.0	1	MV	CB	ST		85	20	12	16	62
JORDAN CREEK	7/10/1997	5	332	0.0	2.0	3	CT	TC	ST		**97**	6	10	15	87
JORDAN CREEK	7/10/1997	6	2235	**6.3**	3.0	2	MV	CH	ST		**91**	28	14	12	69
JORDAN CREEK	7/15/1997	7	408	**10.2**	3.0	5	WF	US	ST		87	**1**	17	16	73
JORDAN CREEK	7/16/1997	8	615	0.4	3.0	1	MV	CH	ST		**95**	15	10	13	53
JORDAN CREEK	7/16/1997	9	692	5.1	8.0	1	MV	CH	ST		**97**	14	17	22	93
JORDAN CREEK	7/23/1997	10	175	1.6	6.0	0	WF	US	ST		**92**	**1**	**0**	0	408
JORDAN CREEK (3075)	7/10/1998	1	998	**12.0**	3.0	3	CT	CA	ST	MI	83	18	11	23	71
JORDAN CREEK (3076)	8/18/1999	1	938	**18.0**	3.0	5	CT	CA	ST		84	16	**0**	21	55
KANSAS CREEK	7/12/1994	1	778	2.2	6.0	2	SV	CH	MT	YT	**100**	25	28	44	47
KANSAS CREEK	7/12/1994	2	1031	1.6	11.0	1	SV	CH	MT	YT	100	5	26	**63**	27
LITTLE NORTH FORK WILSON RIVER	7/2/1991	1	1954	2.1	1.0	3	CT	CA	MT	ST	60	28	9	25	19
LITTLE NORTH FORK WILSON RIVER	7/9/1991	2	2303	5.1	1.0	3	MT	CA	MT	TH	69	23	10	23	46
LITTLE NORTH FORK WILSON RIVER	6/29/1995	3	9073	**5.6**	2.0	2	SV	CH	ST		**93**	7	10	29	71
LITTLE NORTH FORK WILSON RIVER	7/25/1995	4	1690	**9.5**	4.0	1	SV	CH	ST		**96**	3	13	**63**	66
LITTLE NORTH FORK WILSON RIVER	8/9/1995	5	2362	**14.9**	2.0	2	MT	US	ST	TH	**97**	**1**	11	45	11
LITTLE NORTH FORK WILSON RIVER	8/10/1995	6	1315	**8.0**	9.0	2	MV	CH	ST	TH	100	2	18	38	25
NEGRO JACK CREEK (593)	6/23/1999	1	411	**9.0**	9.0	3	MT	CA	RR	YT	69	3	21	46	44
NORTH FORK CEDAR CREEK (2011)	8/24/1999	1	907	5.0	3.0	4	CT	CA	ST		**95**	**1**	20	**60**	48
NORTH FORK WILSON RIVER (2976)	8/4/2004	1	1064	**22.0**	3.0	2	MV	CH	ST		64	3	13	17	187

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 9A. Summary of stream reaches surveyed within the Lower Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: LOWER WILSON
REACH SUMMARY

STREAM	SURVEY DATE	REACH #	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT %	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
ROGERS CREEK	6/6/1996	1	2234	**15.1**	4.0	3	MT	US	ST		63	2	22	30	42
ROGERS CREEK	6/12/1996	2	787	**11.6**	5.0	3	MT	US	ST		69	2	23	33	43
ROGERS CREEK (SURV. AS TRIB C)	6/25/1996	3	778	2.9	9.0	2	MV	CH	ST		63	4	20	30	44
ROGERS CREEK (SURV. AS TRIB C)	6/27/1996	4	365	5.0	14.0	1	MV	CH	ST		86	3	30	26	32
ROGERS CREEK TRIB B	6/24/1996	1	539	1.7	9.0	3	CT	CA	ST		68	4	19	29	41
ROGERS CREEK TRIB B	6/25/1996	2	520	**10.0**	13.0	2	MV	CH	ST		66	2	37	26	56
RUNYON CREEK (2950)	7/4/2002	1	510	**25.0**	8.0	4	CT	CA	LT		**97**	**1**	**6**	**73**	71
SOUTH FORK JORDAN CREEK	6/27/1994	1	1052	**6.0**	4.0	2	MV	CH	LT	TH	**95**	19	9	25	46
SOUTH FORK JORDAN CREEK	6/29/1994	2	2509	3.9	5.0	3	MV	CA	LT	TH	**96**	9	12	34	19
SOUTH FORK JORDAN CREEK	6/30/1994	3	1113	1.1	12.0	1	SV	CH	LT	TH	**99**	23	17	43	48
SOUTH FORK JORDAN CREEK (3112)	7/9/1998	1	468	1.0	5.0	2	MV	CH	ST		76	20	16	14	117
SOUTH FORK WOLF CREEK (2919)	8/12/2003	1	545	**9.0**	11.0	1	SV	CH	ST		**94**	6	**0**	0	160
W. FK OF NORTH FK WILSON RIVER	9/11/1995	1	3223	**8.6**	2.0	2	SV	CH	ST	YT	75	3	**4**	19	76
W. FK OF NORTH FK WILSON RIVER	9/12/1995	2	2804	2.0	3.0	2	SV	CH	ST	YT	84	3	**5**	19	67
W. FK OF NORTH FK WILSON RIVER	9/13/1995	3	3508	4.1	9.0	1	SV	CH	ST	PT	90	29	13	48	50
W. FK OF N. FK WILSON RIVER (2977)	8/4/2004	1	992	**18.0**	3.0	3	CT	CA	ST		66	2	**3**	17	148
WHITE CREEK	9/6/1995	1	3145	4.2	6.0	1	SV	CH	YT	LT	75	3	**8**	36	33
WHITE CREEK (1792)	8/29/2002	1	1153	**14.0**	6.0	2	SV	CH	ST		78	**0**	**3**	24	85
ZIG ZAG CREEK TRIBUTARY (2935)	7/15/1999	1	455	0.0	12.0	2	CT	CA	ST		90	46	18	12	31

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 9B. Summary of stream reaches surveyed within the Lower Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: LOWER WILSON
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	WOOD DEBRIS KEY PIECES #/100m	CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS #>50cm dbh /305m	RIPARIAN CONIFERS #>90cm dbh /305m
BEN SMITH CREEK (2939)	1	10.0	5.0	23.5	1.2	0.0	0.00	**21**	29	1	58	14	7
BERRY CREEK	1	11.0	8.0	19.5	0.1	**4.0**	0.70	15	29	0	0	0	0
BERRY CREEK	2	6.0	73.0	4.3	0.0	1.0	0.60	20	**59**	1	61	0	0
CEDAR CREEK	1	13.0	11.0	18.1	0.0	3.0	0.80	14	10	0	91	0	0
CEDAR CREEK	2	11.0	10.0	20.9	0.0	**4.0**	0.80	13	12	0	183	12	0
CEDAR CREEK	3	12.0	7.0	20.9	0.8	0.0	0.60	16	10	0	61	0	0
CEDAR CREEK	4	7.0	10.0	15.7	0.2	1.0	0.50	**36**	27	0	0	0	0
CEDAR CREEK	5	8.0	6.0	14.9	0.1	1.0	0.40	**31**	42	0	0	0	0
CEDAR CREEK	6	5.0	16.0	7.5	1.8	1.0	0.10	**62**	**115**	**3**	30	0	0
CEDAR CREEK TRIBUTARY (2963)	1	6.0	9.0	7.0	1.0	0.0	0.00	**25**	25	0	183	20	0
FALL CREEK	1	8.0	20.0	5.7	0.0	3.0	0.60	1	4	0	0	0	0
FALL CREEK	2	9.0	14.0	6.4	0.3	0.0	0.30	1	3	0	81	0	0
FALL CREEK	3	5.0	20.0	5.6	0.0	1.0	0.40	8	11	0	61	20	0
JORDAN CREEK	1	6.0	8.0	40.9	0.0	**17.0**	0.80	3	3	0	0	0	0
JORDAN CREEK	2	16.0	5.0	34.3	1.0	**11.0**	1.00	7	11	0	76	0	0
JORDAN CREEK	3	17.0	6.0	27.3	1.3	**9.0**	1.00	12	16	0	102	0	0
JORDAN CREEK	4	10.0	7.0	43.8	0.4	**12.0**	1.30	9	9	0	122	17	0
JORDAN CREEK	5	14.0	6.0	32.5	5.0	**9.0**	1.20	8	11	0	427	61	0
JORDAN CREEK	6	11.0	7.0	28.5	0.1	**12.0**	1.00	6	8	0	122	15	0
JORDAN CREEK	7	13.0	20.0	5.4	0.0	2.0	0.40	**21**	29	1	61	0	0
JORDAN CREEK	8	11.0	5.0	32.1	4.3	**10.0**	0.70	5	6	0	0	0	0
JORDAN CREEK	9	8.0	6.0	13.8	0.8	**10.0**	0.80	**52**	**118**	**4**	264	41	0
JORDAN CREEK	10	0.0	0.0	0.0	0.0	0.0	0.00	3	5	1	0	0	0
JORDAN CREEK (3075)	1	10.0	6.0	21.0	1.0	**4.0**	1.00	14	51	2	122	0	0
JORDAN CREEK (3076)	1	12.0	6.0	31.0	0.0	**6.0**	1.00	12	24	0	92	21	0
KANSAS CREEK	1	5.0	8.0	20.6	0.6	1.0	0.40	2	1	0	122	0	0
KANSAS CREEK	2	4.0	13.0	19.2	2.4	0.0	0.40	17	33	1	274	61	30
LITTLE NORTH FORK WILSON RIVER	1	16.0	4.0	32.0	1.0	**8.0**	0.90	7	14	1	n/a	n/a	n/a
LITTLE NORTH FORK WILSON RIVER	2	15.0	0.0	**49.7**	0.4	**5.0**	0.80	6	36	1	n/a	n/a	n/a
LITTLE NORTH FORK WILSON RIVER	3	20.0	3.0	35.2	1.8	**6.0**	0.80	15	37	1	122	7	7
LITTLE NORTH FORK WILSON RIVER	4	18.0	3.0	20.7	2.3	**7.0**	0.80	**41**	**68**	1	203	0	0
LITTLE NORTH FORK WILSON RIVER	5	14.0	5.0	28.3	1.0	3.0	0.70	**21**	34	1	98	0	0
LITTLE NORTH FORK WILSON RIVER	6	6.0	33.0	7.8	0.0	1.0	0.50	**22**	29	0	274	0	0
NEGRO JACK CREEK (593)	1	4.0	23.0	4.0	0.0	0.0	0.00	5	5	0	122	81	**81**
NORTH FORK CEDAR CREEK (2011)	1	9.0	7.0	28.0	0.0	3.0	1.00	**59**	**103**	**4**	0	0	0
NORTH FORK WILSON RIVER (2976)	1	26.0	7.0	25.0	0.0	**5.0**	1.00	11	14	0	224	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 9B. Summary of stream reaches surveyed within the Lower Wilson project area of the ODF Tillamook study area.

ODF TILLAMOOK PROJECT AREA: LOWER WILSON
REACH SUMMARY

STREAM	REACH #	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS			CONIFER TREES TOTAL/305m	RIPARIAN CONIFERS	
								PIECES #/100m	VOLUME (m3)/100m	KEY PIECES #/100m		#>50cm dbh /305m	#>90cm dbh /305m
ROGERS CREEK	1	13.0	6.0	19.0	0.9	3.0	0.60	19	19	0	76	0	0
ROGERS CREEK	2	9.0	5.0	24.2	0.8	**5.0**	0.50	14	19	0	0	0	0
ROGERS CREEK (SURV. AS TRIB C)	3	8.0	6.0	14.5	0.2	2.0	0.40	**21**	18	0	183	0	0
ROGERS CREEK (SURV. AS TRIB C)	4	7.0	9.0	17.7	3.1	2.0	0.50	**71**	**78**	0	61	0	0
ROGERS CREEK TRIB B	1	8.0	6.0	13.5	0.2	**4.0**	0.50	**23**	18	0	122	0	0
ROGERS CREEK TRIB B	2	7.0	7.0	9.4	0.4	0.0	0.40	17	12	0	914	0	0
RUNYON CREEK (2950)	1	6.0	6.0	21.0	0.0	0.0	0.00	**33**	49	2	81	20	0
SOUTH FORK JORDAN CREEK	1	8.0	25.0	6.8	0.0	1.0	0.50	3	2	0	183	30	0
SOUTH FORK JORDAN CREEK	2	10.0	16.0	9.1	0.1	0.0	0.40	9	14	0	24	0	0
SOUTH FORK JORDAN CREEK	3	7.0	172.0	0.7	0.0	0.0	0.40	8	17	0	457	30	0
SOUTH FORK JORDAN CREEK (3112)	1	9.0	9.0	6.0	1.0	0.0	1.00	16	38	1	0	0	0
SOUTH FORK WOLF CREEK (2919)	1	7.0	12.0	8.0	0.0	0.0	0.00	**22**	37	1	20	0	0
W. FK OF NORTH FK WILSON RIVER	1	13.0	14.0	21.1	0.0	**4.0**	1.10	8	18	0	163	0	0
W. FK OF NORTH FK WILSON RIVER	2	11.0	12.0	25.2	0.0	2.0	0.60	**24**	47	0	183	91	0
W. FK OF NORTH FK WILSON RIVER	3	8.0	18.0	19.9	0.0	1.0	0.60	**26**	55	0	396	46	0
W. FK OF N. FK WILSON RIVER (2977)	1	21.0	16.0	12.0	0.0	2.0	1.00	11	9	0	406	0	0
WHITE CREEK	1	7.0	16.0	24.8	0.0	2.0	0.60	15	33	2	274	46	30
WHITE CREEK (1792)	1	11.0	4.0	25.0	3.0	**5.0**	1.00	10	15	0	264	20	20
ZIG ZAG CREEK TRIBUTARY (2935)	1	5.0	6.0	18.0	0.0	**4.0**	0.00	20	**60**	2	61	0	0

* See methods for an explanation of abbreviations and field names. Values in bold meet or exceed high reference breakpoints.

Table 10. Summary of conditions for key habitat attributes.

Habitat survey reach values and habitat parameters relative to reference conditions.

		Habitat variables for ODF project areas within the Tillamook study area											
		Tillamook 11.3km n=7		Kilchis 21.8km n=16		Trask 118.4km n=75		Upper Wilson 63.2km n=42		Lower Wilson 81.4km n=55		All Project Areas 296km n=195	
Parameter	Habitat Breakpoints	average	median	average	median	average	median	average	median	average	median	average	median
percent pools	Low <19%								16%	19%			
	Moderate	15%	16%	40.2%		23.8%	21.9%	21.9%			19.5%	23.1%	19.8%
	High >45%				45%								
deep pools/km	Low 0												
	Moderate						2	2.4	2		2		2
	High >3	3.3	4	5	5	3.3				3.6		3.3	
% slackwater pools	Low 0												
	Moderate	1.5%	1.0%	4.3%	0.5%	2.4%	0.2%		0.2%	0.7%	0.2%	3.3%	0.2%
	High >7%							8.1%					
% secondary channel	Low <0.8		0.0										
	Moderate	1.3		2.7	1.8	4.4	3.3						3.7
	High >5.3							7.2	5.3	7.4	5.6	5.6	
% fines in riffles	High >22%	32%	35%										
	Moderate			10%	8%	17%	16%	21%	13%	15%	13%	17%	14%
	Low <8%												
% gravel in riffles	Low <26%												
	Moderate	35%	35%	31%	30%	36%	34%	30%	28%	29%	28%	32%	30%
	High >54%												
%bedrock	High >11%			13%		13%	9%					11%	
	Moderate	5%	5%		10%			9%	7%	11%	7%		8%
	Low <1%												
pieces LWD/100m	Low <8				5.6								
	Moderate	19.2	15	9.3		17.9	15.6	22.2	19.3	18	14.6	18	15
	High >21												
volume LWD/100m	Low <17			15.7	6.7								
	Moderate	24.6	23.2			30.5	26.9		32.3	29	18.7	38	25
	High >58							68.5					
key pieces/100m	Low <0.5			0.4	0		0				0		0
	Moderate	0.7	1			0.7		2.4	1	0.6		1	
	High >3												
# conifers > 50cm dbh	Low <22		15		0	6.4	0		0	12.3	0	18	0
	Moderate	36.6		24.5				29.9					
	High >153												
# conifers >90cm dbh	Low 0		0		0	0	0		0		0		0
	Moderate	2.9		8.9				0.1		3.3		2	
	High >79												
%shade	Low <76%												
	Moderate	88%	84%	81%	80%	89%		81%	84%	84%	87%	85%	88%
	High >91%						93%						

Table 11. Summary of reaches within the Tillamook study area that have at least 5 attributes (in bold) that meet or exceed high reference breakpoint values.

PROJECT AREA	STREAM	DATE	REACH	LENGTH	% SEC CHAN	GRADIENT	VWI	VALLEY TYPE	CHANNEL FORM	LAND-USE1	LAND-USE2	SHADE	% BEDROCK	% RIFFLE FINES	% RIFFLE GRAVEL	LARGE BOULDER PER/100m	ACW	% POOL	% SLACK WATER	DEEP POOLS (>1m)/ KM	LWD PIECES /100m	LWD VOL /100m	KEY PIECES LWD/100m	TOTAL CONIFERS	CONIFERS >50cm	CONIFERS >90cm
KILCHIS	KILCHIS RIVER	10/18/1994	6	762	0.2	1.0	3	CT	CA	MT	OG	65	**1**	23	35	7	29.0	**62.4**	0.0	**8.0**	3	5	0	366	**183**	**122**
LOWER WILSON	JORDAN CREEK	7/16/1997	9	692	5.1	8.0	1	MV	CH	ST		**97**	14	17	22	93	8.0	13.8	0.8	**10.0**	**52**	**118**	**4**	264	41	0
LOWER WILSON	LITTLE NORTH FORK WILSON RIVER	7/25/1995	4	1690	**9.5**	4.0	1	SV	CH	ST		**96**	3	13	**63**	66	18.0	20.7	2.3	**7.0**	**41**	**68**	1	203	0	0
LOWER WILSON	NORTH FORK CEDAR CREEK (2011)	8/24/1999	1	907	5.0	3.0	4	CT	CA	ST		**95**	**1**	20	**60**	48	9.0	28.0	0.0	3.0	**59**	**103**	**4**	0	0	0
LOWER WILSON	RUNYON CREEK (2950)	7/4/2002	1	510	**25.0**	8.0	4	CT	CA	LT		**97**	**1**	**6**	**73**	71	6.0	21.0	0.0	0.0	**33**	49	2	81	20	0
TRASK	BALES CREEK	8/11/1994	3	1299	**9.6**	7.0	2	MV	CH	ST		**100**	9	**8**	**68**	15	7.0	4.1	0.0	0.0	**29**	27	0	152	0	0
TRASK	BARK SHANTY CREEK	8/18/1995	1	4427	**6.5**	3.0	2	MV	CH	ST		**93**	9	10	35	71	16.0	25.1	0.8	**6.0**	**26**	**70**	**3**	54	0	0
TRASK	BARK SHANTY CREEK	8/30/1995	4	1226	**10.7**	6.0	2	MV	CH	ST		**99**	12	29	33	96	9.0	18.1	3.0	0.0	**30**	**61**	**3**	671	0	0
TRASK	BARK SHANTY CREEK	9/6/1995	5	1566	**8.8**	12.0	1	MV	CH	ST		**98**	6	28	**60**	85	6.0	16.3	**10.3**	1.0	**28**	57	2	224	0	0
TRASK	BOUNDARY CREEK	7/18/1994	1	174	**25.6**	4.0	11	MT	CA	LT		100	**1**	**7**	**83**	1	4.0	25.3	**21.7**	0.0	**22**	26	0	427	0	0
TRASK	E FK OF SOUTH FORK TRASK RIVER	7/23/1990	5	1255	**6.4**	2.0	5	CT	TC	MT		**91**	**1**	**5**	34	19	8.0	**53.3**	0.7	**4.0**	n/a	n/a	n/a	n/a	n/a	n/a
TRASK	MID FK OF NORTH FORK TRASK RIVER	8/27/1990	8	452	0.9	1.0	4	MV	CH	MT		**97**	40	**5**	29	3	6.0	**72.4**	**13.0**	**7.0**	n/a	n/a	n/a	n/a	n/a	n/a
UPPER WILSON	DEYOE CREEK	10/14/1997	2	670	0.2	1.0	6	WF	US	ST		52	**0**	81	16	0	26.0	**97.3**	**89.5**	**6.0**	**21**	**117**	**5**	305	0	0
UPPER WILSON	DEYOE CREEK	10/14/1997	3	337	**8.1**	2.0	6	CT	TC	ST		**91**	**0**	58	24	0	4.0	9.5	**9.5**	0.0	**34**	**153**	**9**	1036	0	0
UPPER WILSON	SOUTH FORK WILSON RIVER	9/23/1997	3	2645	**7.0**	3.0	1	MV	CH	LT		90	3	23	22	24	12.0	9.6	0.0	**4.0**	**29**	**93**	**4**	975	20	0
UPPER WILSON	SOUTH FORK WILSON RIVER	10/7/1997	4	2350	**5.3**	7.0	2	MV	CH	LT		**93**	9	24	21	41	4.0	2.2	0.0	2.0	**23**	**163**	**7**	1605	41	0
UPPER WILSON	SOUTH FORK WILSON RIVER TRIB C	8/13/1996	3	550	**16.7**	8.0	4	CT	CA	ST		**97**	**0**	9	47	19	6.0	18.3	0.8	1.0	**24**	**74**	**4**	122	0	0
UPPER WILSON	SOUTH FORK WILSON RIVER TRIB C	8/14/1996	4	1798	**8.0**	15.0	2	MV	CH	LT	ST	**98**	4	12	41	9	4.0	17.1	0.1	0.0	**22**	**82**	**5**	335	0	0

Table 12. Summary of stream reach length and percent of stream reach length which meet or exceed high reference breakpoint value for each attribute in the prescribed project areas.

PROJECT AREAS

	TILLAMOOK 11.3km n=7			KILCHIS 21.8km n=16			TRASK 118.4km n=75			UPPER WILSON 63.2km n=42			LOWER WILSON 81.4km n=55		
ATTRIBUTE & HIGH BREAKPOINT	LENGTH (km)	% OF PROJECT AREA	% OF TOTAL STUDY AREA	LENGTH (km)	% OF PROJECT AREA	% OF TOTAL STUDY AREA	LENGTH (km)	% OF PROJECT AREA	% OF TOTAL STUDY AREA	LENGTH (km)	% OF PROJECT AREA	% OF TOTAL STUDY AREA	LENGTH (km)	% OF PROJECT AREA	% OF TOTAL STUDY AREA
percent pools (>45%)	0.0	0.0	0.0	12.3	56.2	4.2	15.4	13.0	5.2	5.0	7.9	1.7	2.3	2.8	0.8
deep pools/km (>3)	8.4	74.1	2.8	13.9	63.6	4.7	50.1	42.3	16.9	25.5	40.3	8.6	43.9	53.9	14.8
percent slackwater pools (>7%)	0.0	0.0	0.0	2.3	10.4	0.8	4.6	3.9	1.6	9.6	15.2	3.2	0.0	0.0	0.0
percent secondary channel (>5.3%)	0.0	0.0	0.0	1.5	6.9	0.5	41.0	34.6	13.8	26.0	41.1	8.8	44.4	54.5	15.0
percent fines in riffles (<8%)	0.0	0.0	0.0	8.1	37.0	2.7	32.9	27.8	11.1	8.6	13.6	2.9	13.7	16.8	4.6
percent gravel in riffles (>54%)	0.0	0.0	0.0	3.7	16.9	1.2	21.4	18.1	7.2	7.4	11.7	2.5	5.3	6.5	1.8
percent bedrock (<1%)	1.6	14.1	0.5	1.7	7.8	0.6	5.2	4.4	1.8	8.3	13.1	2.8	6.8	8.4	2.3
pieces LWD/100m (>21)	5.6	49.4	1.9	2.7	12.3	0.9	32.0	27.0	10.8	24.0	38.0	8.1	20.5	25.2	6.9
volume LWD/100m (>58m^3)	0.0	0.0	0.0	0.0	0.0	0.0	8.0	6.8	2.7	18.9	29.9	6.4	7.6	9.3	2.6
key pieces/100m (>3)	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.2	0.9	14.7	23.2	5.0	2.9	3.6	1.0
# conifers > 50cm dbh (>153)	0.0	0.0	0.0	0.8	3.5	0.3	1.0	0.8	0.3	1.0	1.6	0.3	0.0	0.0	0.0
# conifers >90cm dbh (>79)	0.5	4.4	0.2	0.8	3.5	0.3	1.0	0.8	0.3	5.1	8.1	1.7	3.2	3.9	1.1
percent shade (>91%)	1.6	14.1	0.5	6.3	28.8	2.1	77.5	65.4	26.2	15.0	23.7	5.1	36.3	44.6	12.3

Table 13. Comparison of reach attributes between small streams (upstream of coho distribution) and the Tillamook study area.

Attribute	Trask	Upper Wilson	Lower Wilson	Small stream basins	Tillamook study area
Number of Reaches or Sites	16	20	16	52	195
Distance Surveyed - Total (km)	29km	37km	25km	91km	296km
Active Channel Width (meters):					
Mean (Median)	6.5m (6.2m)	6.2m (4.8m)	8.7m (7.7m)	7.3m (6.1m)	10.6m (9.0m)
Range	3.4 - 13.5m	2.1 - 26.5	4.1 - 19.6m	2.1 - 26.5	2.1 - 26.5
Gradient (%):					
Mean (median)	7.7 (7.2)	11.1 (8.3)	8.8 (9.0)	9.0 (8.1)	5.4 (3.7)
Range	2.1 - 12.5	0.7 - 23.4	2.1 - 23.0	0.7 - 23.4	0 - 23.4
Beaver activity sightings					
Percentage of sites	31%	20%	6%	19%	26%
Number counted	9	23	2	34	218
Average number / kilometer	0.3	0.6	0.08	0.37	0.7
Mass failure sightings					
Percentage of sites	81%	90%	50%	75%	52%
Number counted	51	187	103	341	1258
Average number / kilometer	1.8	5	4	3.7	4

Table 14. Small stream (upstream of coho distribution) habitat survey reach values and habitat parameters relative to reference conditions and the Tillamook study area.

Parameter	Habitat Breakpoints	Trask 29km n=16		Upper Wilson 37km n=20		Lower Wilson 25km n=16		Combined small streams 91km n=52		Tillamook study area 296km n=195	
		average	median	average	median	average	median	average	median	average	median
percent pools	Low <19%	8%	4%	14%	6%	16%	16%	13%	8%		
	Moderate									23.1%	19.8%
	High >45%										
deep pools/km	Low 0		0	0.8	0						
	Moderate	0.5				2.1	1.3	1.2	0.35		2
	High >3									3.3	
% slackwater pools	Low 0				0.2%						
	Moderate	1.5%	0.2%	6.7%		0.8%	0.3%	2.8%	0.2%	3.3%	0.2%
	High >7%										
% secondary channel	Low <0.8										
	Moderate						5.1				3.7
	High >5.3	9.7	9.6	7.3	8.5	14.0		11.0	10.2	5.6	
% fines in riffles	High >22%	23%		24%							
	Moderate		21%		14%	20%	20%	22%	20%	17%	14%
	Low <8%										
% gravel in riffles	Low <26%										
	Moderate	45%	41%	37%	33%	37%	33%	40%	37%	32%	30%
	High >54%										
%bedrock	High >11%									11%	
	Moderate	7%	6%	7%	5%	9%	5%	7%	5%		8%
	Low <1%										
pieces LWD/100m	Low <8										
	Moderate						20.5			18	15
	High >21	23	24.2	30	24	23		25	22.5		
volume LWD/100m	Low <17										
	Moderate	45	38.4			36	30.8		40.8	38	25
	High >58			121	97.5			65			
key pieces/100m	Low <0.5		0.3			0.5	0.5				0
	Moderate	1.3						2.2	0.5	1	
	High >3			5.2	4.2						
# conifers > 50cm dbh	Low <22	4.3	0			12.75	0	19	0	18	0
	Moderate			42	51						
	High >153										
# conifers >90cm dbh	Low 0	0	0	0	0		0	0.8	0		0
	Moderate					1.9				2	
	High >79										
%shade	Low <76%										
	Moderate			89%	91%	88%				85%	88%
	High >91%	97%	99%				94%	92%	96%		

Table 15. Barriers and associated features (as identified by Streamnet) within the Tillamook project area.

Stream LLID	Stream name	Record id	Barrier Type	Passage*	Adult passage**	COMMENTS
1234936456064	Wilson River	1296	Culvert	99	coho, chinook, steelhead above	Steel beam creates an 18" drop. Rails within culvert as aid to fish passage. Impassable to juveniles.
1236235454542	Trask River	1539	Culvert	99	coho, chinook, steelhead above	Water falls 6" onto fill. Water velocity is high.
1236047454356	South Fork Trask River	1540	Culvert	2	coho, chinook, steelhead above	Water velocity/drop exclude fish at most flows.
1236039454319	South Fork Trask River	1541	Culvert	99	coho, chinook, steelhead above	Water falls 10' to bedrock, then down a nearly vertical chute.
1234612454654	MF of NF Trask River	51001	Falls	2	coho, steelhead above	Passage status reported as impassable.
1234612454654	MF of NF Trask River	51002	Falls	1	coho, steelhead above	Passage status reported as impassable.
1234612454654	MF of NF Trask River	51003	Falls	1	ends at or below	Passage status reported as impassable.
1236034455473	Jordan Creek	51005	Falls	1	coho, steelhead above	Passage status reported as impassable.
1237387454728	Little NF Wilson River	51006	Gradient Barrier	2	ends at or below	Passage status reported as marginal.
1235633454466	Bark Shanty Creek	51021	Falls	99	coho, chinook, steelhead above	Passage status reported as impassable.
1235633454466	Bark Shanty Creek	51022	Falls	99	ends at or below	Passage status reported as unknown .
1235441452821	Elk Creek	51028	Falls	2	ends at or below	CTS barrier is assumed. Passage is marginal. No height was listed.
1235095455952	Dog Creek	51032	Dog Cr Culvert & Fishway	99	steelhead above	Falls located at the mouth of the stream
1234214456160	Idiot Creek	51033	Falls	1	ends below	Passage status reported as impassable.
1238477452664	Saling Creek	51498	Culvert	99	ends at or below	
1236446454874	Kansas Creek	51501	Falls	99	ends at or below	
1234619456061	South Fork Wilson River	51733	Tuffy Dam	99	coho, chinook, steelhead above	Laddered.
1236051454165	EF of SF Trask River	51734	EF of SF Trask Intake Dam	2	coho, chinook, steelhead above	Dam has fish trap. Coho use ladder OK.
1233864456150	Elliot Creek	55538	University Falls	99	ends at or below	
1235232453655	EF of SF Trask Tributary	55542	Culvert	99	ends at or below	3' drop--too steep for fish passage.
1234372456091	Wilson River Tributary	55544	Falls	99	ends at or below	
1234417454445	Elkhorn Creek Tributary	55546	Falls	99	ends below	
1235151453614	Rock Creek	55551	Falls	99	ends at or below	
1237551455118	Clear Creek Tributary	55553	Falls	99	fish use not mapped	

*Passage 1=complete 2=partial 4=nonblocking 99=unknown
**Migratory fish passage (coho, fall and spring chinook, winter steelhead) as mapped by Streamnet.

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

					Targeted Species			
Basin	**Stream name**	**Year**	**Project Description**	**Project goals**	**coho**	**steelhead**	**chinook**	**cutthroat**
Nestucca	Bays Cr	1998	peak flow passage improvements, flood/slide repair	improve drainage erosion control	x	x	x	x
Nestucca	East Cr	1996	peak flow passage improvements, surface drainage improvements	erosion control	x	x	x	x
Nestucca	Fall Cr	1998	beaver management, surface drainage improvements	improve drainage erosion control	x	x	x	x
Nestucca	Saling Cr	2002	peak flow passage improvements, road vacated, road grass seeded	improve drainage erosion control	x	x	x	x
Kilchis	Clinton Cr, Roller Cr & tribs	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Kilchis	Sam Downs Cr, N Fk Kilchis R, Clear Cr & Clinton Cr	1996	peak flow passage improvements, surface drainage improvements	erosion control	x	x	x	x
Kilchis	Clear Cr	1998	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		
Kilchis	Dietz Cr	2003	instream large wood placement	improve gravel retention improve complexity and overwintering habitat improve spawning and rearing habitat	x	x		x
Kilchis	Jody Cr, Iris Cr	1997	culverts removed, bridges installed	improve fish passage	x	x		x
Kilchis	Kilchis R	1997	hardwood conversion	large wood recruitment, stream shade	x	x	x	x
Kilchis	Kilchis R	1997	peak flow passage improvements, surface drainage improvements, road grass seeded; 1 culvert replaced	improve fish passage, erosion control improve drainage	x	x	x	x
Kilchis	Kilchis R (Barkens Bridge)	1997	hardwood conversion	large wood recruitment, stream shade	x	x	x	x
Kilchis	Kilchis R, trib of & Roller Cr	2003	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road grass seeded	erosion control improve drainage	x	x		x
Kilchis	Little South Fork Kilchis R	1997	hardwood conversion	large wood recruitment, stream shade	x	x	x	x
Kilchis	Little South Fork Kilchis R	1998	instream large wood placement	improve complexity and pool area improve gravel retention improve spawning and rearing habitat improve overwintering habitat	x	x		x
Kilchis	North Fork Kilchis R	1996	instream large wood placement hardwood conversion		x	x		x
Kilchis	Pipe Cr	1998	culvert removed, bridge installed	improve fish passage	x	x		x
Kilchis	Sam Downs Cr	1998	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Kilchis	Sam Downs, Kilchis R	2003	channel reestablishment; peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road seeded	improve drainage erosion control	x	x	x	x
Kilchis	South Fork Kilchis R	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Tillamook	Simmons Cr	1997	culvert removed, bridge installed	improve fish passage	x	x	x	x
Tillamook	Simmons Cr	2001	peak flow passage improvements, road sidecast pulled back, road vacated, 1 culvert removed and not replaced	improve drainage erosion control improve fish passage	x			

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

Basin	Stream name	Year	Project Description	Project goals	Targeted Species coho	 steelhead	 chinook	 cutthroat
Tillamook	Simmons Cr	2002	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road vacated, road grass seeded	improve drainage erosion control				
Trask	Bark Shanty Cr, Telephone Shan	1996	beaver management, peak flow passage improvements, surface drainage improvements	erosion control		x	x	x
Trask	Bark Shanty Cr, tribs of and North Fork Trask R, tribs of	1999	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	Boundary Cr, Headquarters Cr, and Stretch Cr	1999	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Clear Cr & North Fork Trask R	1997	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	Edwards Cr & South Fk of South Fork Trask R	1997	peak flow passage improvements, sidecast pulled back, storm damage sites repaired	improve drainage erosion control	x	x	x	x
Trask	Edwards Cr; Steampot Cr	1997	peak flow passage improvements, road vacated, road grass seeded	improve drainage erosion control	x	x	x	x
Trask	Headquarters Cr & Michael Cr	1997	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	North Fork Trask R, Shanty Cr	1995	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	Bark Shanty Cr, Mill Cr, unnamed trib	2003	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control		x	x	x
Trask	Bark Shanty Cr, trib of	2000	peak flow passage improvements, surface drainage improvements, road sidecast pulled back	improve drainage erosion control	x	x	x	x
Trask	Bill Cr	1998	instream large wood placement, rootwad placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Blue Bus Cr	1999	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Boundary Cr	2001	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Cruiser Cr	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x		x
Trask	Cruiser Cr	1995	peak flow passage improvements, surface drainage improvements, 2 culverts replaced	improve drainage erosion control improve fish passage	x	x	x	x
Trask	East Fork of South Fork Trask R	1996	anchored log structures, 4 weirs, boulder placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention	x	x	x	x

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

Basin	Stream name	Year	Project Description	Project goals	Targeted Species coho	steelhead	chinook	cutthroat
				improve overwintering habitat				
Trask	East Fork Trask R	1995	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	East Fork Trask R	2000	peak flow passage improvements, surface drainage improvements, road sidecast pulled back	improve drainage erosion control	x	x	x	x
Trask	Edwards Cr	1996	anchored log structures, 2 off-channel alcoves created	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x	x	
Trask	Edwards Cr	1998	rootwad placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x	x	x
Trask	Edwards Cr	2001	peak flow passage improvements, surface drainage improvements, road vacated, 6 culverts removed and not replaced	improve drainage erosion control improve fish passage	x	x	x	x
Trask	Edwards Cr	2001	road vacated, 2 culverts removed and not replaced	improve drainage erosion control improve fish passage	x			
Trask	Edwards Cr / S Fk Trask R	1998	instream large wood placement, anchored log structures, weirs, side-channels, alcoves	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x	x	
Trask	Elkhorn Cr, tribs of	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	North Fork Trask R	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	North Fork Trask R	2001	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Trask	North Fork Trask R	1997	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Trask	Pothole Cr	1999	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Pothole Cr	2002	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Rock Cr	1998	instream large wood placement, rootwad placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	South Fork Trask R	1996	hardwood conversion	large wood recruitment, stream shade	x	x	x	x
Trask	South Fork Trask R	1996	anchored log structures, 6 weirs, 1 deflector, 1 alcove created	improve complexity and pool area improve spawning and rearing habitat improve gravel retention	x	x	x	x

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

Basin	Stream name	Year	Project Description	Project goals	Targeted Species coho	steelhead	chinook	cutthroat
				improve overwintering habitat				
Trask	South Fork Trask R, tribs of	1999	peak flow passage improvements, surface drainage improvements	improve drainage erosion control				
Trask	Summit Cr	1998	rootwad placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	Trask R	1995	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Trask	Trask R	2003	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road grass seeded	improve drainage erosion control	x	x	x	x
Trask	Upper South Fork Trask R	1998	rootwad placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Trask	West Fork Bales Cr	2001	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Cedar Cr, North Fork Wilson R, & West Fork Wilson R, tribs	1998	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Hann Cr, Ben Smith Cr, Jordan Cr	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Jordan Cr, Hann Cr	1996	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Keenig Cr, Little North Fork Wilson R, Muesial Cr	2000	peak flow passage improvements, surface drainage improvements, bridge construction, armor fills, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	Little N Fk Wilson R & Smith Cr	1996	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson, Kilchis	LN Fk Wilson R, Clear Cr, Sam Downs Cr	2003	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road vacated, road grass seeded, 8 culverts removed and not replaced, 1 culvert replaced	improve drainage erosion control improve fish passage	x	x	x	x
Wilson	North Fork of West Fork Wilson R & West Fork Wilson R	2000	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, 1 low-water crossing modified with bridge	improve drainage erosion control improve fish passage	x	x	x	x
Wilson	Phipps Cr, Spaur Cr, Jordan Cr	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Spaur Cr, S Fk Jordan Cr & Fox Cr	1997	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	West Fork Wilson R & Morris Cr	1997	peak flow passage improvements, surface drainage improvements	improve drainage erosion control		x	x	x
Wilson	Wolf Cr & Wilson R	1998	peak flow passage improvements,	improve drainage	x	x	x	x

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

Basin	Stream name	Year	Project Description	Project goals	Targeted Species coho	steelhead	chinook	cutthroat
			surface drainage improvements, road grass seeded	erosion control				
Wilson	Beaver Cr	2001	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Ben Smith Cr	2000	instream large wood placement, boulder placement, road closure	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x			
Wilson	Ben Smith Cr	2001	peak flow passage improvements, surface drainage improvements, road sidecast pulled back	improve drainage erosion control	x	x		x
Wilson	Ben Smith Cr	2001	riparian tree planting	large wood recruitment, stream shade	x	x	x	x
Wilson	Cedar Cr	2000	instream large wood placement, boulder placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x			
Wilson	Cedar Cr	1997	instream large wood placement, road closure	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat improve drainage erosion control	x	x	x	x
Wilson	Cedar Cr	1996	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Devils Lake Fork	1999	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Wilson	Devils Lake Fork	2002	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Wilson	Devil's Lake Fork Cr	1997	anchored log structures, deflectors	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		
Wilson	Devil's Lake Fork Cr	1997	instream large wood placement, weirs	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x		x
Wilson	Devils Lake Fork Cr, trib of	1997	Voluntary Riparian Tree Retention peak flow passage improvements, surface drainage improvements, road relocated, trail closure; 2 culverts replaced with corrugated pipe	large wood recruitment, stream shade improve drainage erosion control improve fish passage				
Wilson	Elliot Cr	1997	anchored log structures		x	x		x
Wilson	Idiot Cr, Drift Cr	1997	peak flow passage improvements, surface drainage improvements, 2 large landslides stabilized, road relocated	improve drainage erosion control				

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

					Targeted Species			
Basin	Stream name	Year	Project Description	Project goals	coho	steelhead	chinook	cutthroat
Wilson	Jones Cr	2000	instream large wood placement	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x			
Wilson	Jordan Cr	1997	hardwood conversion	large wood recruitment, stream shade	x	x	x	x
Wilson	Kansas Cr	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Kansas Cr	2002	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road closure, road grass seeded, 1 culvert replaced	improve drainage erosion control improve fish passage				x
Wilson	Keenig Cr, Muesial Cr, Wolf Cr	2004	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	Little North Fork Wilson R	1996	culvert replaced	improve fish passage	x			x
Wilson	Little North Fork Wilson R	2000	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	Little North Fork Wilson R	2002	peak flow passage improvements, surface drainage improvements, road sidecast pulled back, road grass seeded	improve drainage erosion control			x	
Wilson	Muesial Cr	1998	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	North Fk W Fk N Fk Wilson R & W Fk N Fk Wilson R	1998	rock riprap, peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	Phipps Cr	1997	riprap, railcar bridge installation peak flow passage improvements, surface drainage improvements,	improve fish passage improve drainage erosion control	x	x	x	x
Wilson	Runyon Cr	1996	peak flow passage improvements, surface drainage improvements	improve drainage erosion control	x	x	x	x
Wilson	South Fork Wilson R	1997	anchored log structures, deflectors, structure repair	improve complexity and pool area improve spawning and rearing habitat improve gravel retention improve overwintering habitat	x	x	x	x
Wilson	South Fork Wilson R, trib of	1998	peak flow passage improvements, surface drainage improvements, road relocated	improve drainage erosion control				
Wilson	South Fork Wilson R, trib of	1995	peak flow passage improvements, surface drainage improvements, 2 culverts replaced with corrugated pipe	improve drainage erosion control improve fish passage				
Wilson	South Fork Wilson R, trib of	1997	Voluntary Riparian Tree Retention, peak flow passage improvements, surface drainage improvements	large wood recruitment, stream shade improve drainage erosion control				
Wilson	West Fork Wilson R	1998	bridge replacement	improve fish passage	x	x	x	x
Wilson	Wilson R	2000	peak flow passage improvements,	improve drainage	x	x	x	x

Table 16. OWEB funded instream restoration projects on ODF land in the Nestucca, Kilchis, Tillamook, Trask and Wilson basins, highlighting some actions and goals and the species benefitting from the restoration project.

Basin	Stream name	Year	Project Description	Project goals	Targeted Species coho	steelhead	chinook	cutthroat
			surface drainage improvements, road sidecast pulled back	erosion control				
Wilson	Wilson R, trib of	1998	peak flow passage improvements, landslide stabilized	improve drainage erosion control	x	x	x	x
Wilson	Wilson R, trib of	2002	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	Wilson R, tribs of	1998	peak flow passage improvements, surface drainage improvements, road grass seeded	improve drainage erosion control	x	x	x	x
Wilson	Wilson R, tribs of	1999	peak flow passage improvements, surface drainage improvements, road sidecast pulled back	improve drainage erosion control	x	x	x	x

Table 17. Potential instream enhancement sites for the Tillamook Study Area.

Lower Nestucca River

Stream Segment	Length (m)	Length (ft)	Channel Width	. Priority	Access	Habitat Survey	Work 90-'96	Field Verified	ODF District	From	To	Since 1997?	Treated Type	Miles affected
East Beaver Creek	1083	3552	4-12m	2	M			X	TILL	ROAD X-ING AT T3S-R9W-1SW	END OF COHO			
East Creek	3610	11842	12-20m	4	M			X	TILL	MOON CREEK	DETRICK RANCH			
East Beaver Creek	3979	13052	4-12m	5	M			X	TILL	ROAD X-ING AT T3S-R9W-1SW	END OF COHO			
Bear Creek(Upper Nestucca	1753	5751	4-12m	3	L			X	TILL	NESTUCCA RIVER	END OF COHO			
Elk Creek	436	1429	4-12m	4	M			X	TILL	NESTUCCA RIVER	END OF COHO(FALLS)			
Nestucca River	1646	5398	12-20m	4	H			X	FG	ELK CREEK	END OF COHO(BARRIER)			
Elk Creek	2100	6887	4-12m	5	M			X	TILL	NESTUCCA RIVER	END OF COHO(FALLS)			

Priority:1 = High, 2 = Moderate, 3 = Low, 4 = Very Low, 5 = Federal Land(No priority); Access: H = High, M = Moderate, L = Low, U = Unknown;ODF District: AST = Astoria, FG = Forest Grove, TILL = Tillamook.

Tillamook River

Stream Segment	Length (m)	Length (ft)	Channel Width	Priority	Access	Habitat Survey	Work 90-'96	Field Verified	ODF District	From	To	Since 1997?	Treated Type	Miles affected
Fawcett Creek	1659	5441	4-12m			yes			X	ODF Boundary	T2S-R9W-23			
Simmons Creek	2637	8649	4-12m			yes		X	X	ODF Boundary	Barrier at T2S-R9W-26E	Y	Replaced Culverts	2.4

Trask River

Stream Segment	Length (m)	Length (ft)	Channel Width	Priority	Access	Habitat Survey	Work 90-'96	Field Verified	ODF District	From	To	Since 1997?	Treated Type	Miles affected
South Fork Trask River	5203	17066	12-20m					X	X	Mouth	Bill Creek			
South Fork Trask River	4635	15202	4-12m			yes		X	X	Bill Creek	Headwaters at T2S-R8W-35W			
Edwards Creek	5411	17747	4-12m			yes			X	Mouth	End of old road	Y	large wood, culverts removed	6.5
Joyce Creek	672	2204	4-12m			yes		X	X	Mouth	1st TJ on right			
Bill Creek	1084	3556	4-12m			yes		X	X	Mouth	Upper ODF Boundary	Y	large wood	0.75
Bill Creek	264	867	4-12m			yes		X	X					
E Fk of S Fk Trask River	9627	31578	12-20m					X	X	Scotch Creek	TJ on left at T2S-R7W-26			
E Fk of S Fk Trask River	1799	5900	4-12m					X	X	TJ on left at T2S-R7W-26	Boundary of SEC 25 and 26			
Steampot Creek	1207	3959	4-12m			yes		X	X	Mouth	TJ on right at T2S-R7W-21SE			
Boundary Creek	936	3070	4-12m			yes		X	X	Mouth	Headquarters Camp Cr.	Y	large wood	0.1
Headquarters Camp Creek	590	1935	4-12m			yes		X	X	Boundary Creek	Stretch Creek	Y	large wood	1.4
Rock Creek	1024	3358	4-12m			yes		X	X	Mouth	1000m (Bend to left)	Y	large wood	1.5
Hembre Creek	448	1471	4-12m					X	X	Mouth	Road Crossing			
Bark Shanty Creek	1747	5732	12-20m			yes		X	X	Mouth	Barrier at T1S-R7W-32S			
Michael Creek	984	3228	4-12m					X	X	Mouth	TJ on left at T1S-R7W-23			
Clear Creek	4547	14913	4-12m			yes		X	X	Mouth	Barrier at T1S-R6W-7			
N Fk of N Fk Trask River	5428	17803	12-20m					X	X	Mouth	Large TJ on left at T1S-R6W-9			
N Fk of N Fk Trask River	3701	12140	4-12m						X	Large TJ on left at T1S-R6W-9	Forks at T1N-R6W-34			
M Fk of N Fk Trask River	3979	13051	12-20m			yes			X	Elkhorn Creek	Barrier at T1S-R6W-27			
Elkhorn Creek	3758	12327	12-20m			yes			X	Mouth	Cruiser Creek			
Elkhorn Creek	4399	14430	4-12m			yes			X	Cruiser Creek	TJ at T2S-R6W-7SW			
Elkhorn Creek Trib 1	1553	5094	4-12m			yes			X	TJ at T2S-R6W-7SW	T2S-R7W-13C			
Cruiser Creek	1525	5002	4-12m			yes			X	ODF Boundary	400m past TJ Right			
Cruiser Creek Trib 1	797	2614	4-12m						X	Mouth				

Wilson River

Stream Segment	Length (m)	Length (ft)	Channel Width	Priority	Access	Habitat Survey	Work 90-'96	Field Verified	ODF District	From	To	Since 1997?	Treated Type	Miles affected
Beaver Creek	198	651	4-12m						X	ODF Boundary	upstream 200m			
Little North Fork Wilson Rive	4930	16169	12-20m			yes			X	White Creek	Barrier at T1N-R8W-33			

Table 17. Potential instream enhancement sites for the Tillamook Study Area.

White Creek	1858	6096	4-12m			yes			X	Mouth	TJ on right at T1S-R8W-6			
Fox Creek	1420	4657	4-12m						X	Mouth	Barrier at T1S-R7W-6			
Jordan Creek	5428	17803	12-20m					X	X	South Fork Jordan Creek	Falls at T1N-R7W-26			
S Fk Jordan Creek	2992	9814	4-12m			yes			X	Mouth	End of Road			
Phipps Creek	1252	4107	4-12m					X	X	Mouth	upstream 1250m			
Cedar Creek	2661	8727	12-20m					X	X	mouth	TJ on right at T1N-R7W-7	Y	large wood	0.5
Cedar Creek	3101	10170	4-12m					X	X	TJ on right at T1N-R7W-7	past N Fk 1100m			
N Fk Cedar Creek	1163	3816	4-12m						X	Mouth	Forks at T1N-R8W-1			
Cedar Creek Trib 1	1188	3895	4-12m						X	Cedar Creek	upstream 1200m			
Jones Creek	733	2403	4-12m					X	X	Mouth	300m above Cedar Creek Rd			
North Fork Wilson River	3029	9934	12-20m					X	X	W Fk of N Fk Wilson	Morris Creek			
North Fork Wilson River	3946	12944	4-12m						X	Morris Creek	Forks at T2N-R7W-14N			
West Fk North Fk Wilson Riv	3196	10481	12-20m			yes		X	X	North Fork Wilson River	Roger Creek			
West Fk North Fk Wilson Riv	3272	10733	4-12m			yes			X	Roger Creek	1st TJ on left at T2N-R8W-25			
Roger Creek	2101	6893	4-12m						X	W Fk of N Fk Wilson	TJ on left at T2N-R7W-17			
Elk Creek	3057	10028	4-12m						X	Wilson River	TJ on left at T2N-R6W-29			
South Fork Wilson River	3979	13050	12-20m			yes		X	X	S. Fk Camp	T1N-R6W-9NE			
South Fork Wilson River	4136	13567	4-12m			yes		X	X	T1N-R6W-9NE	TJ on right at T1N-R6W-15			
Idiot Creek	1514	4965	4-12m			yes		X	X	Mouth	Barrier at T2N-R6W-28			
Drift Creek	686	2249	4-12m			yes			X	Mouth	Barrier at 700m			
Devils Lake Fork	1677	5502	12-20m			yes			X	Drift Creek	Elliot Creek			
Devils Lake Fork	7915	25961	4-12m			yes			X	Elliot Creek	Headwaters at T1N-R5W-5SE	Y	large wood	1.75
Elliott Creek	2439	7999	4-12m			yes			X	Mouth	Falls			
Deo Creek	2704	8869	4-12m			yes			X	Mouth	Road X-ing at T1N-R6W-1			
Devils Lake Fork Trib 1	2223	7293	4-12m						X	Mouth	End of ODF ownership			

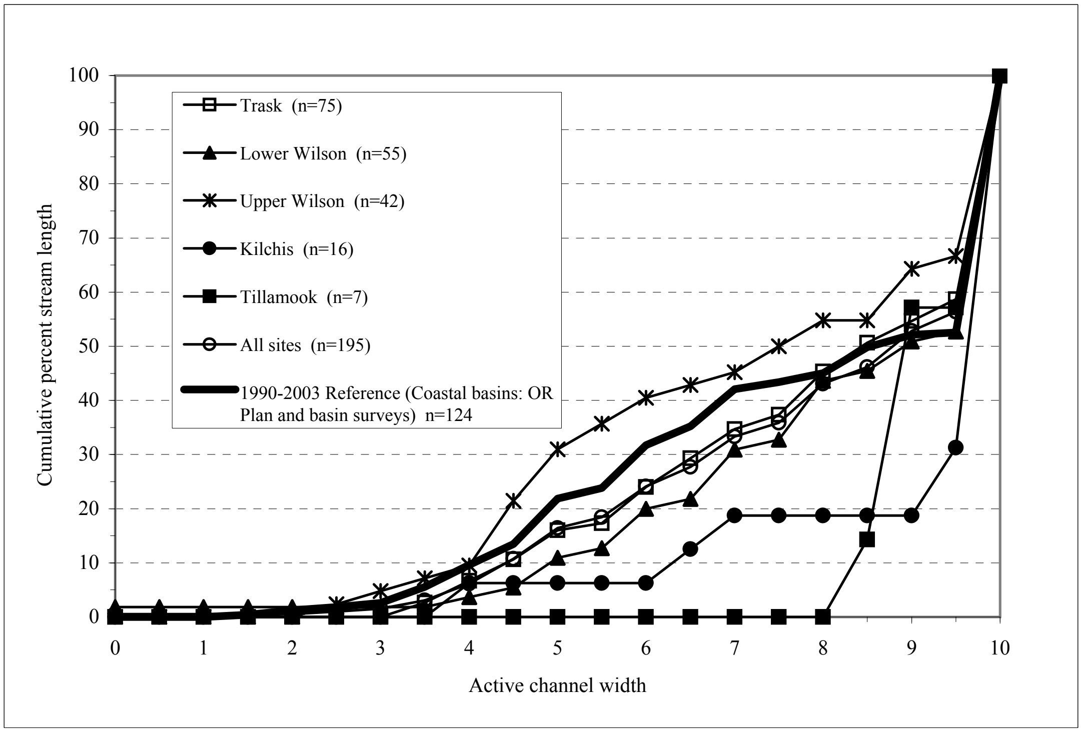
Kilchis River

Stream Segment	Length (m)	Length (ft)	Channel Width	Priority	Access	Habitat Survey	Work 90-'96	Field Verified	ODF District	From	To	Treated Since 1997?	Treated Type	Miles affected
Kilchis River Trib 1	114	373	4-12m						X	ODF Boundary	Upstream 100m			
Clear Creek	2477	8126	4-12m			yes		X	X	2nd Bridge	TJ on left at T1S-R9W-3	Y	large wood in Sec 23	0.5
Little South Fk Kilchis River	1978	6487	12-20m			yes		X	X	Iris Creek	Sam Downs Creek			
Little South Fk Kilchis River	3200	10496	4-12m			yes		X	X	Sam Downs Creek	TJ on left at T1N-R9W-13	Y	large wood	1
Sam Downs Creek	1892	6206	4-12m			yes		X	X	Mouth	Anns Creek	Y	Channel Reestablishment	0.03
South Fork Kilchis River	6140	20139	12-20m			yes		X	X	Company Creek	Fitch Creek			
S Fk Kilchis River	1063	3488	4-12m			yes		X	X	Fitch Creek	1st TJ on left at T1N-R8W-9			
Company Creek	466	1529	4-12m					X	X	Mouth	500m			
Schroeder Creek	1912	6271	12-20m					X	X	mouth	French Creek			
Schroeder Creek	954	3128	4-12m					X	X	French Creek	TJ on left at T2N-R8W-19			
North Fork Kilchis River	1270	4164	12-20m			yes		X	X	Fossil Canyon	Triangulation Creek			
North Fork Kilchis River	2108	6914	4-12m			yes		X	X	Triangulation Creek	Kilchis River Falls			
Triangulation Creek	347	1137	4-12m					X	X	Mouth	350m			
Fick Creek	391	1283	4-12m					X	X	Mouth	400m			

Table 18. Criteria for selecting restoration sites

Best stream reaches for restoration	Poor stream reaches for restoration	Rational	Solution
low gradient (<5%)	high gradient (>5%)	Structures placed in steep reaches will probably get washed down stream.	Although the overall gradient may be steep, it may be possible to locate flats or benches of low gradient. Instream work should be limited to such areas.
moderate channel size (<12m)	large channel size (>12m)	Structures placed in wide channels will probably get washed down stream.	Large channel restoration should use very large pieces of wood that partially extend into the channel.
moderate valley type	steep valley shape	Streams in steep valleys are constrained by the valley walls. During high flow events, there is limited over-wintering habitat potential.	Instream structures should be limited to sections of wider valley where stream energy can be dissipated.
water temperature cool enough for juvenile salmon summer survival	water too warm for juvenile salmon summer survival	Fish have water temperature tolerances.	Efforts to restore or improve streamside shading may result in water temperature suitable to salmonids.
water supply adequate to support young salmon summer survival	inadequate water supply to support young salmon summer survival	Fish need adequate water supply for survival	Although inadequate water supply during the summer, these reaches may provide over-wintering opportunities. However, if the stream is too steep, has inadequate water parameters, or not adjacent to summer rearing areas, there is little restoration potential. Restoration efforts in such streams should carefully assess winter rearing potential.
unobstructed access by juvenile and adult salmon during migration	restricted access to juvenile and adult migration	Salmon need access to the stream system	Streams blocked by culverts or other physical properties make them desirable for restoration.

Oregon Department of Forestry: Tillamook Study Area



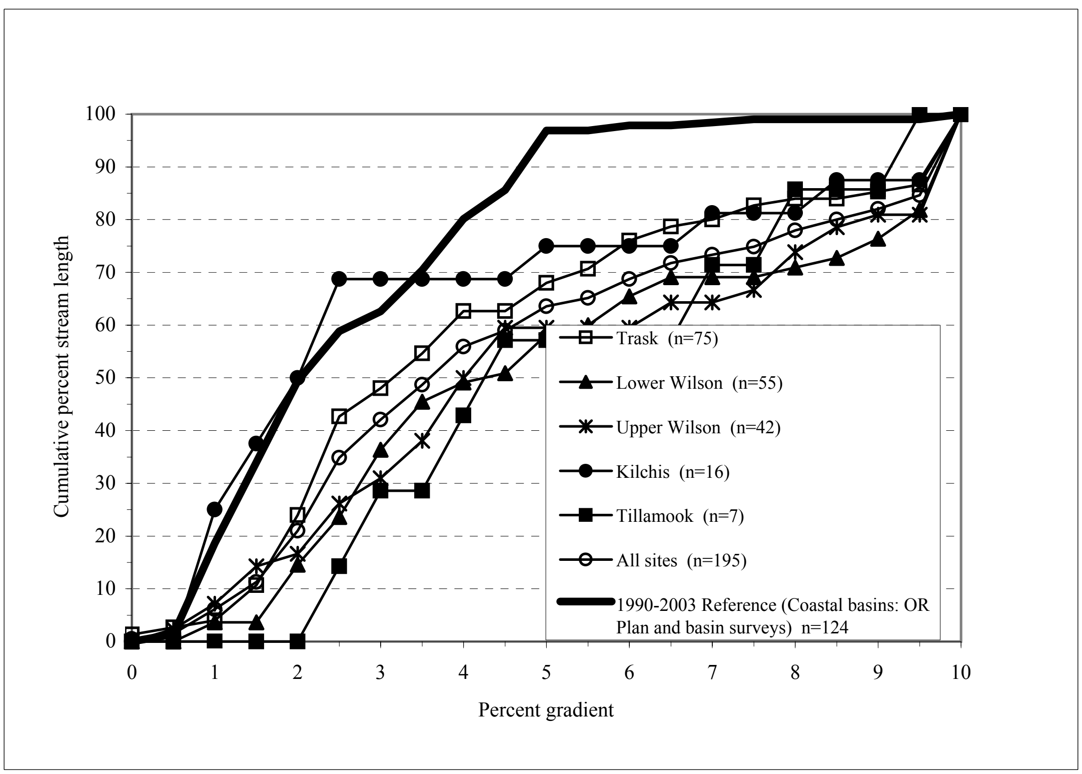
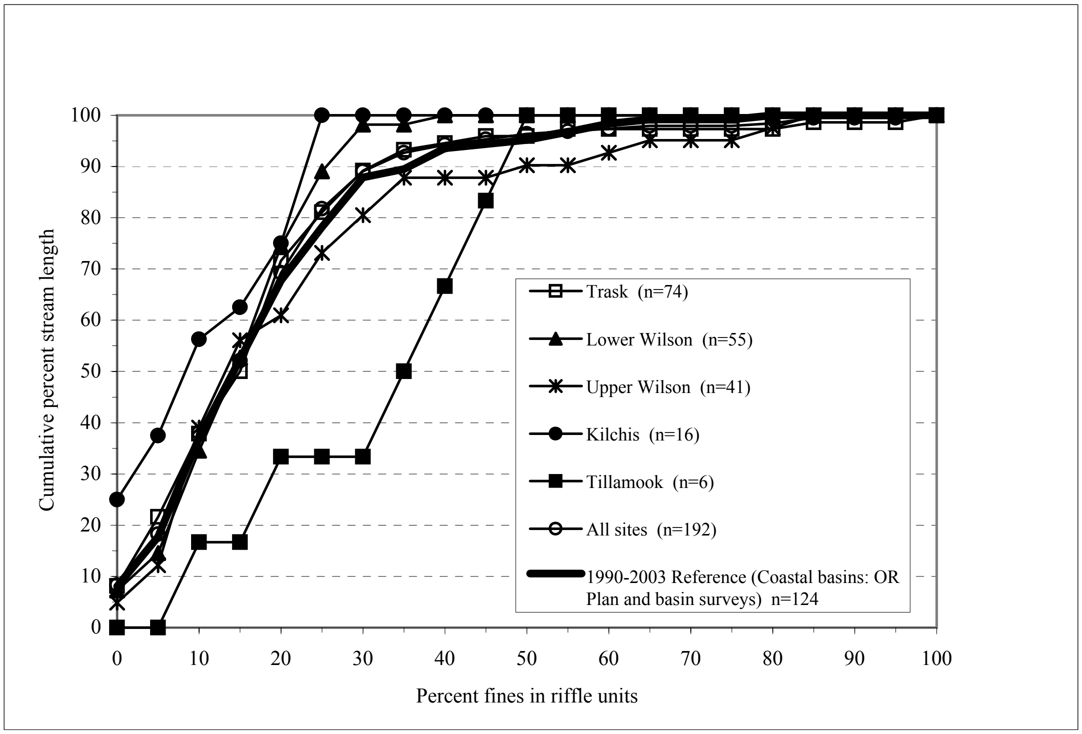


Figure 1. Cumulative frequency distribution comparing active channel width and gradient within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



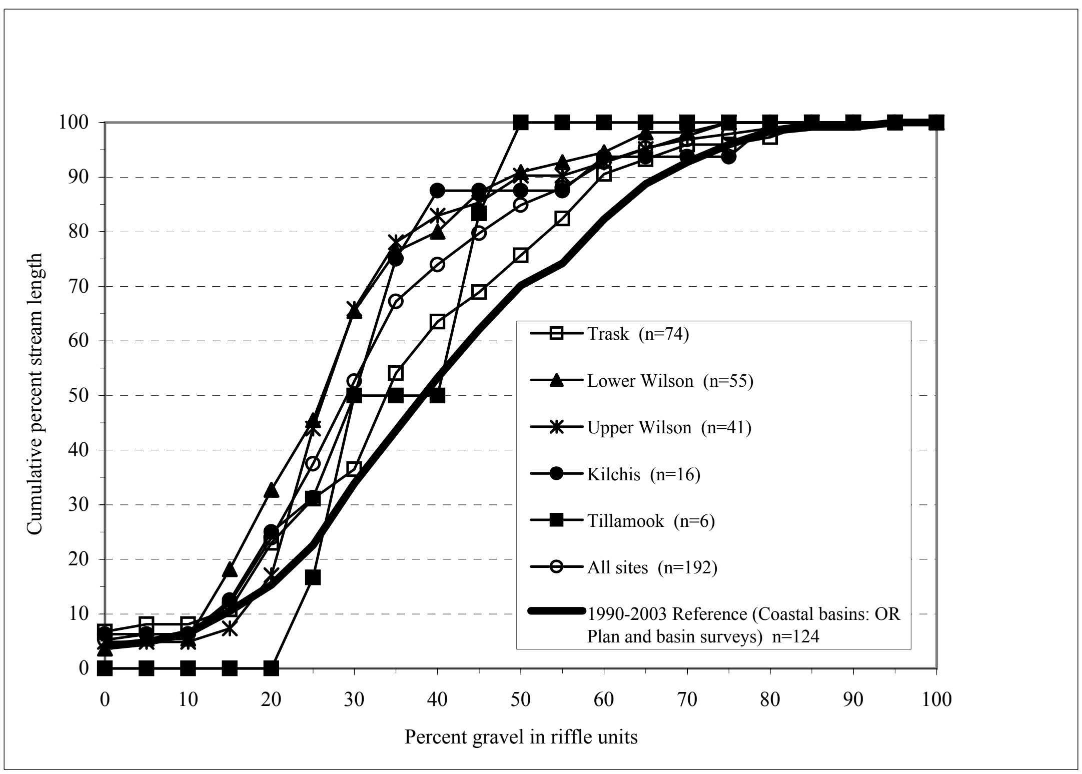
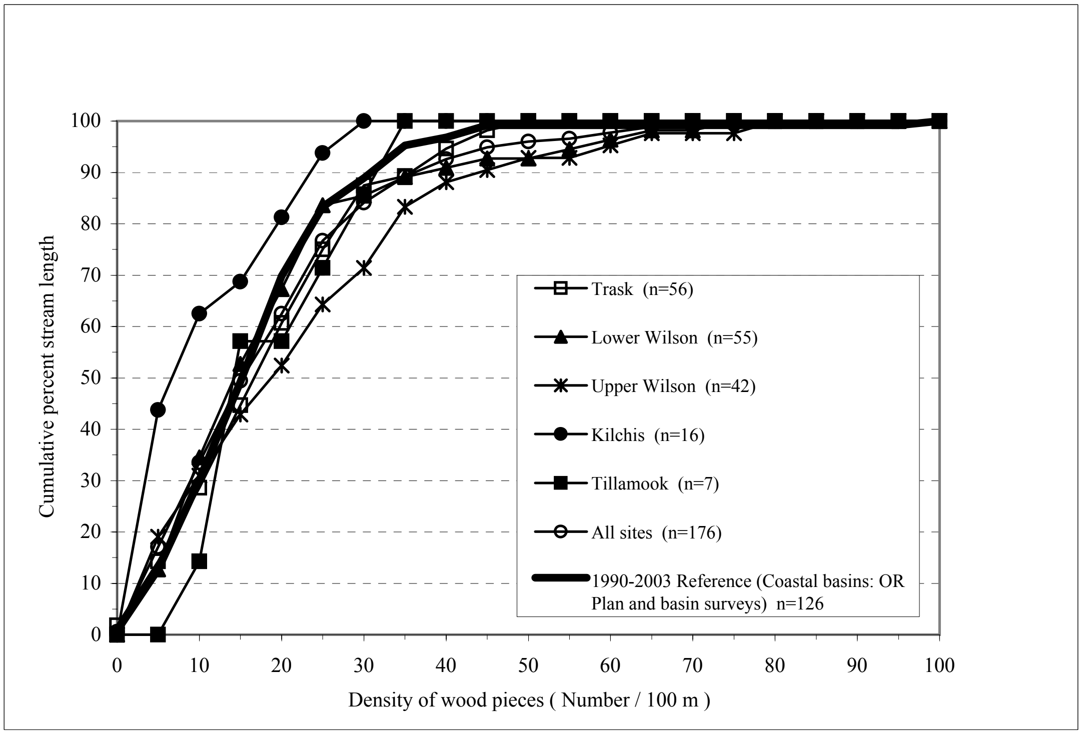


Figure 2. Cumulative distribution frequencies comparing fines and gravel within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



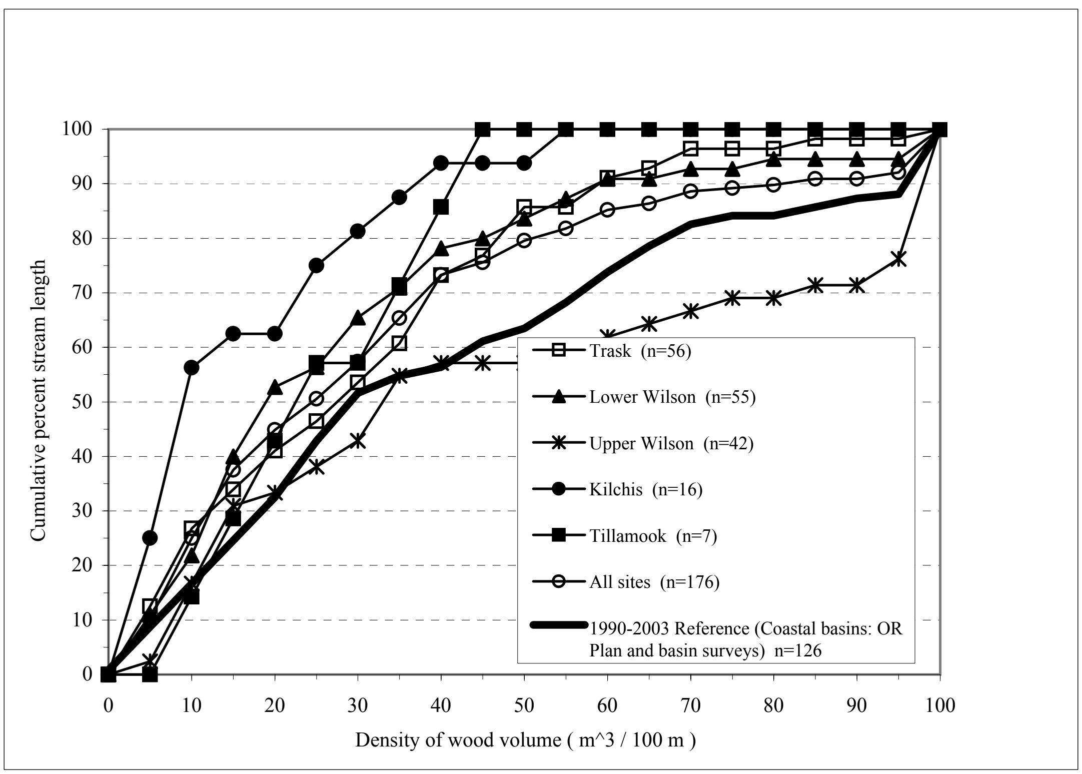
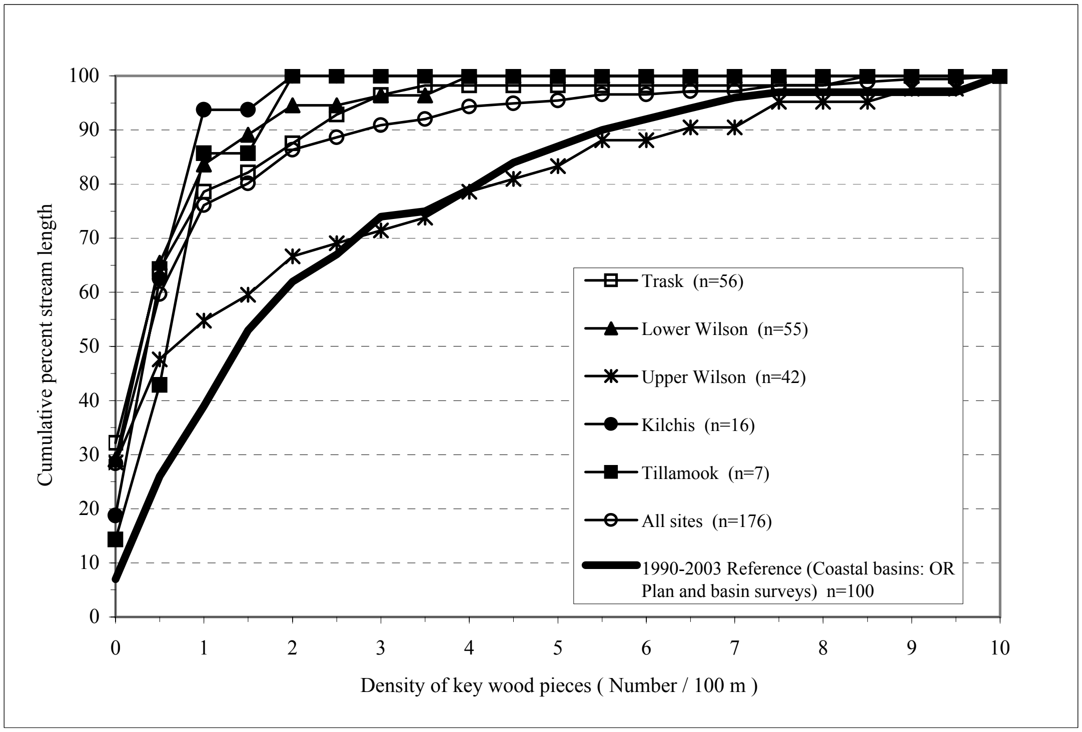


Figure 3. Cumulative distribution frequencies comparing wood volume and pieces within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



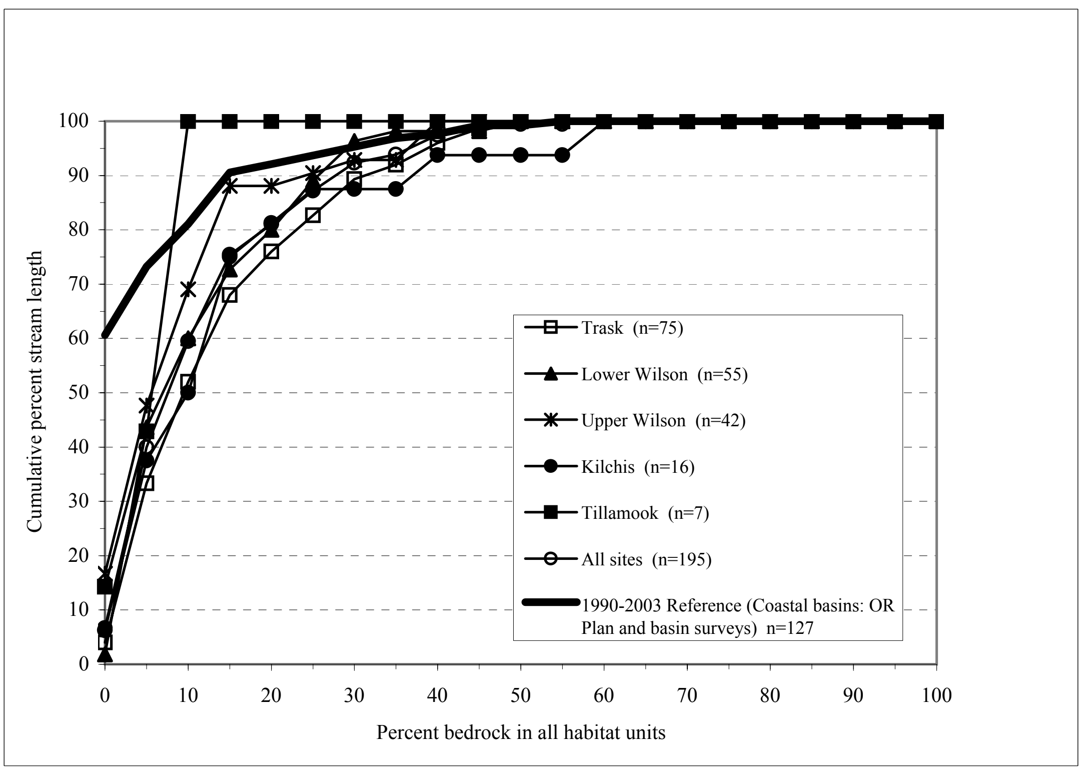
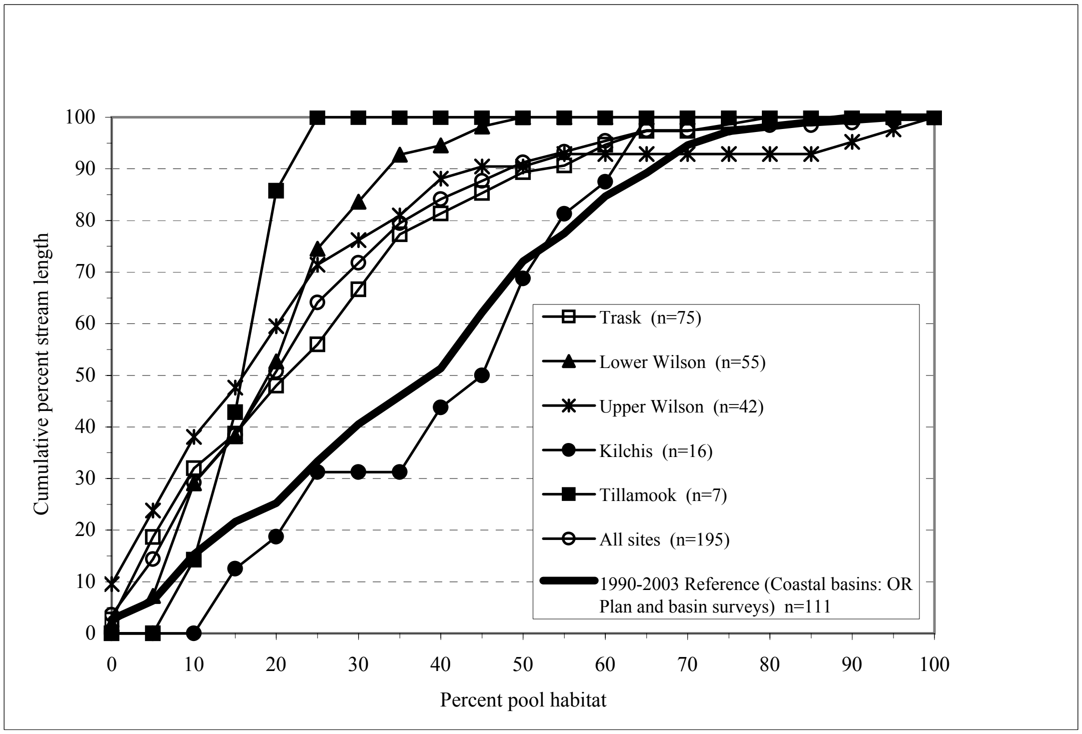


Figure 4. Cumulative distribution frequencies comparing LWD keypieces and bedrock within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



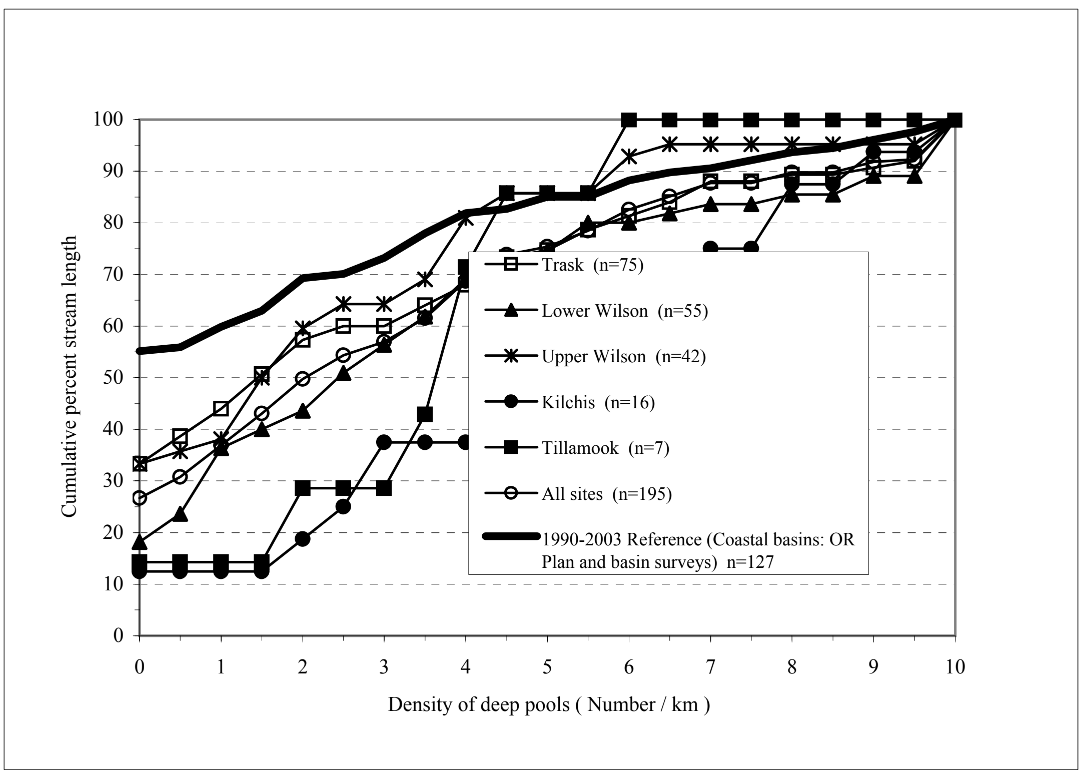
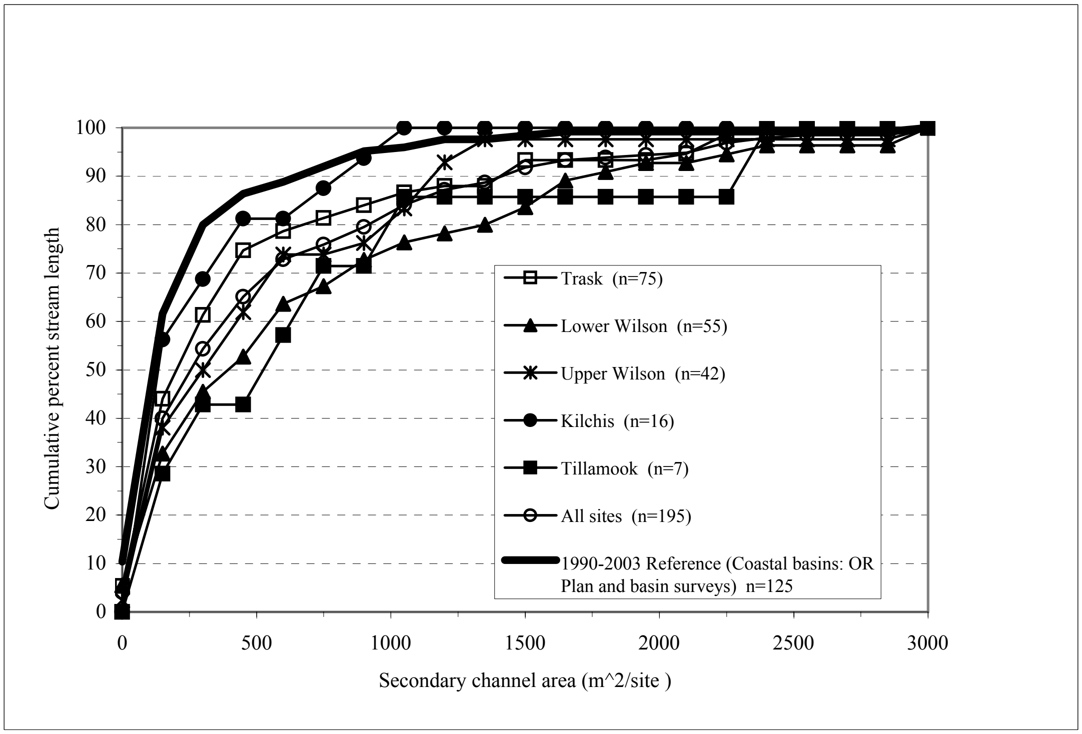


Figure 5. Cumulative frequency distribution comparing pools and deep pools within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



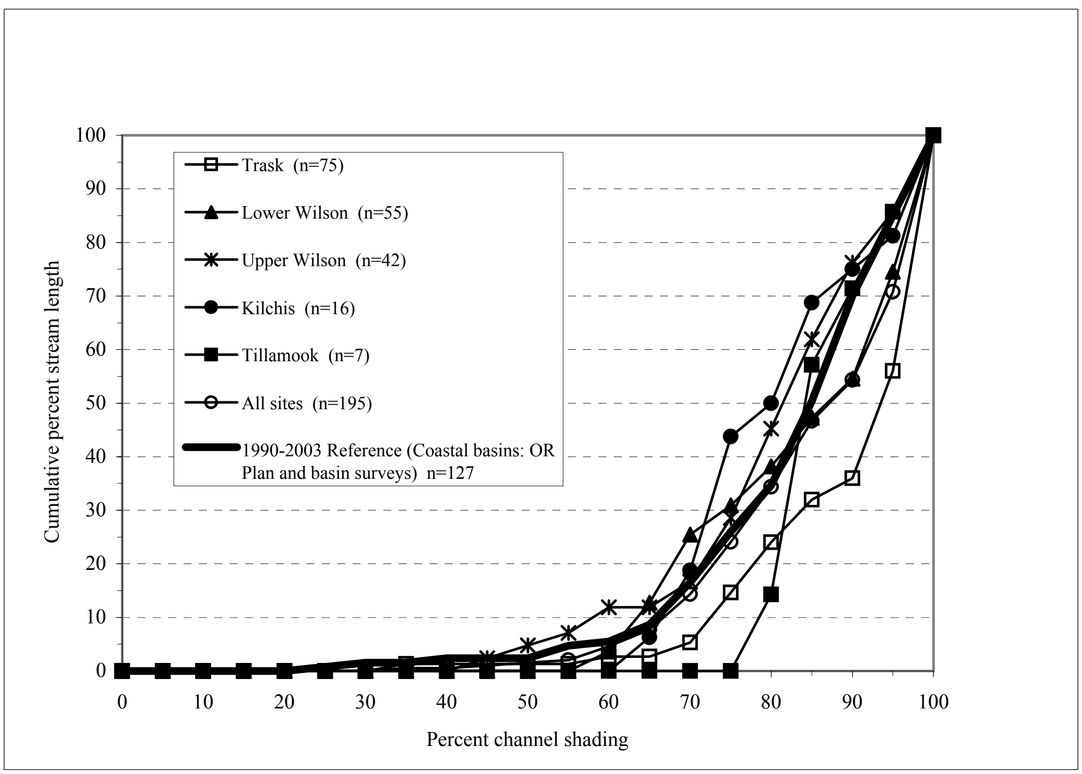
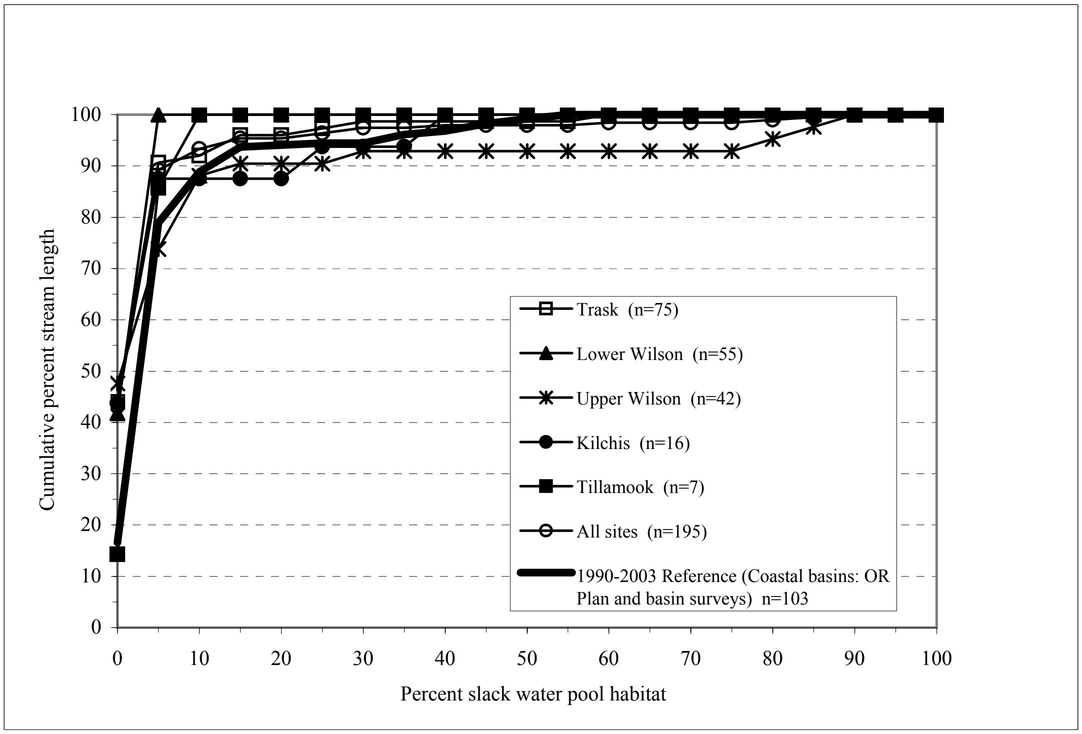


Figure 6. Cumulative distribution frequencies comparing secondary channel and shade within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



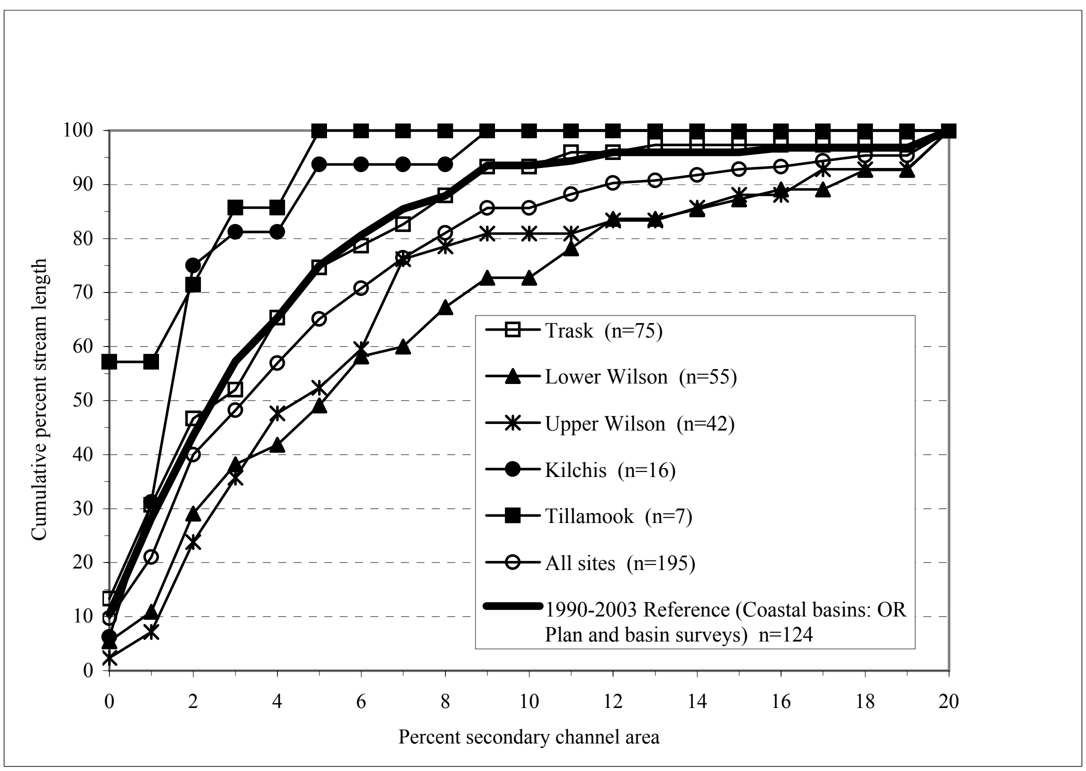
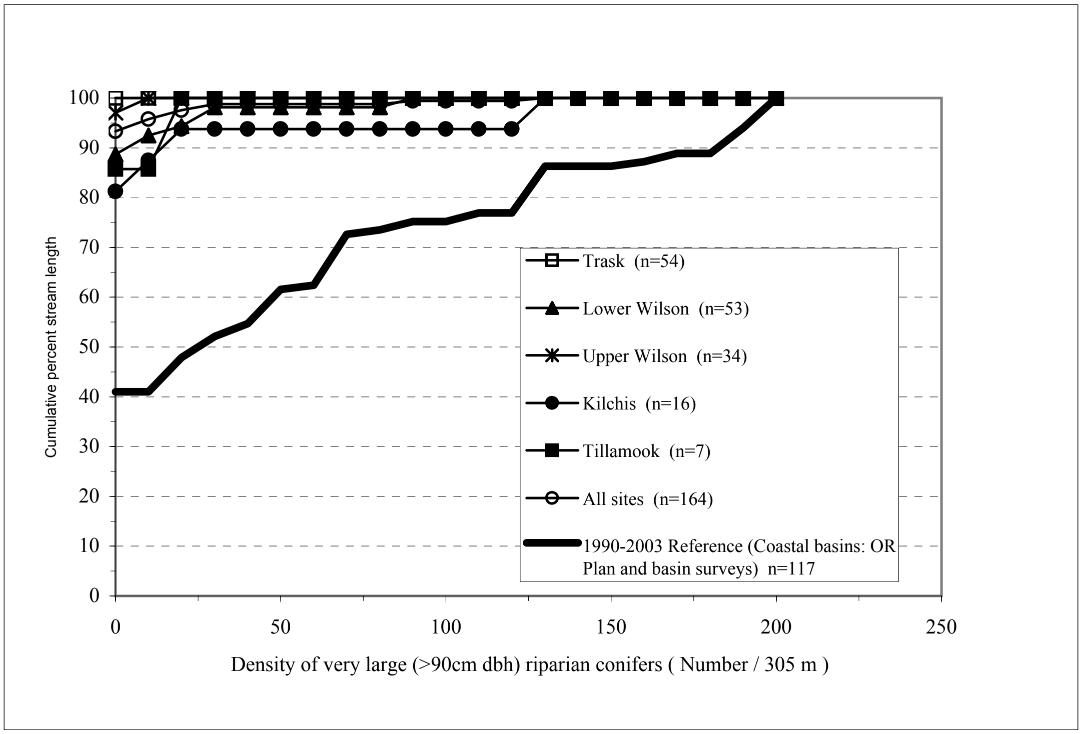


Figure 7. Cumulative frequency distribution comparing slack water pool habitat and percent secondary channel habitat within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



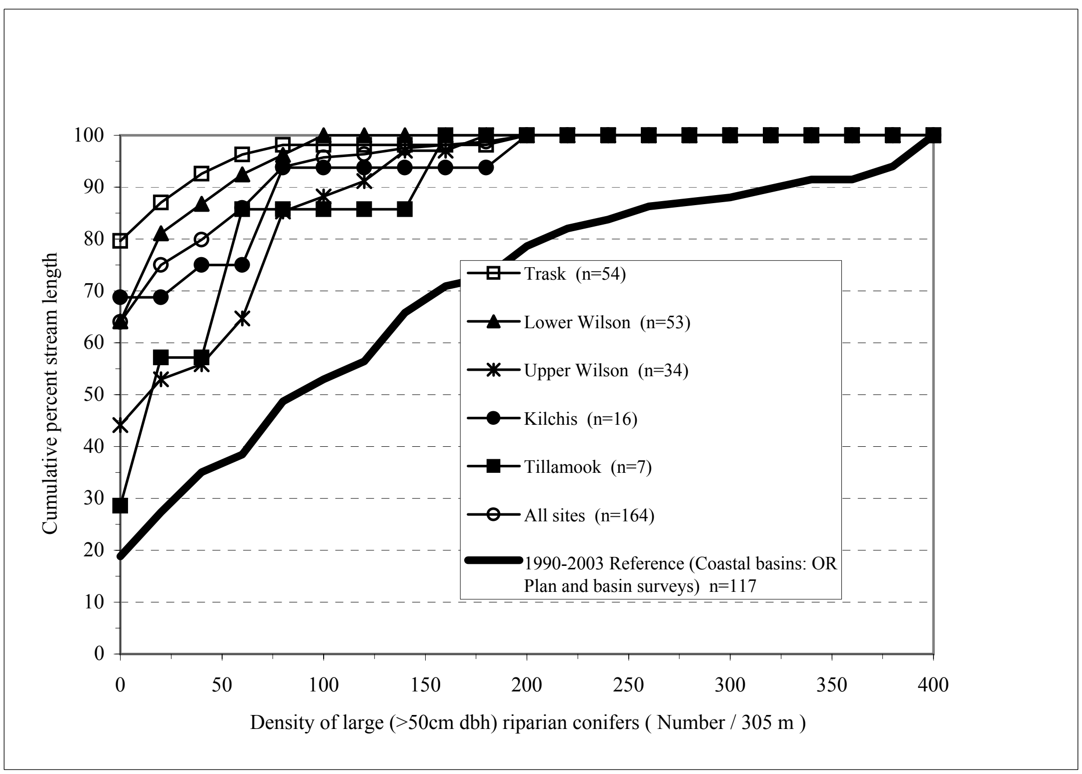


Figure 8. Cumulative distribution frequencies comparing very large and large riparian conifers within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area

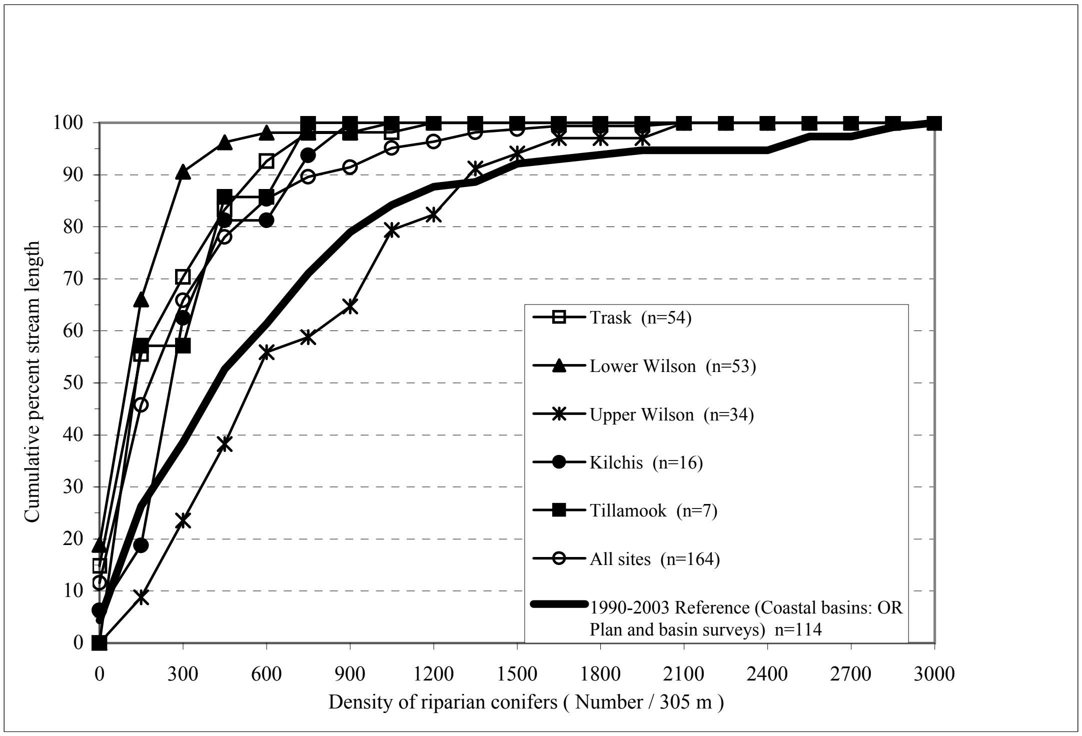
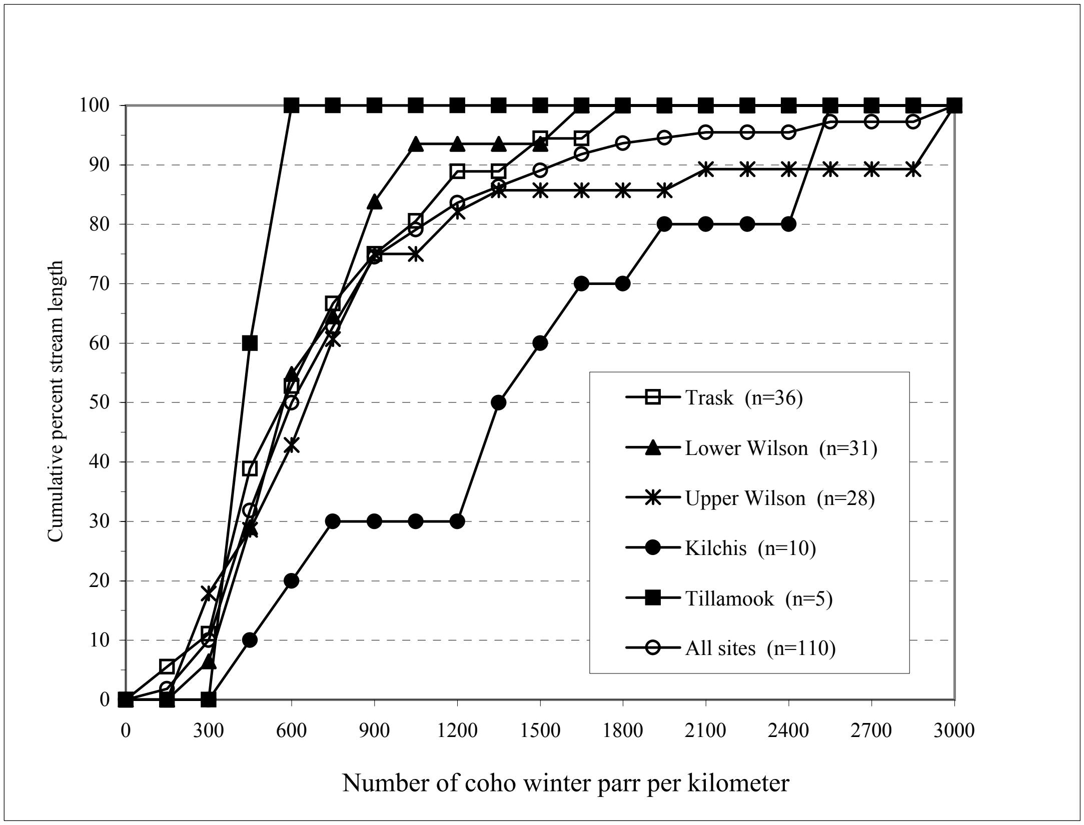


Figure 9. Cumulative frequency distribution comparing riparian conifers within the ODF Tillamook study area to reference conditions.

Oregon Department of Forestry: Tillamook Study Area



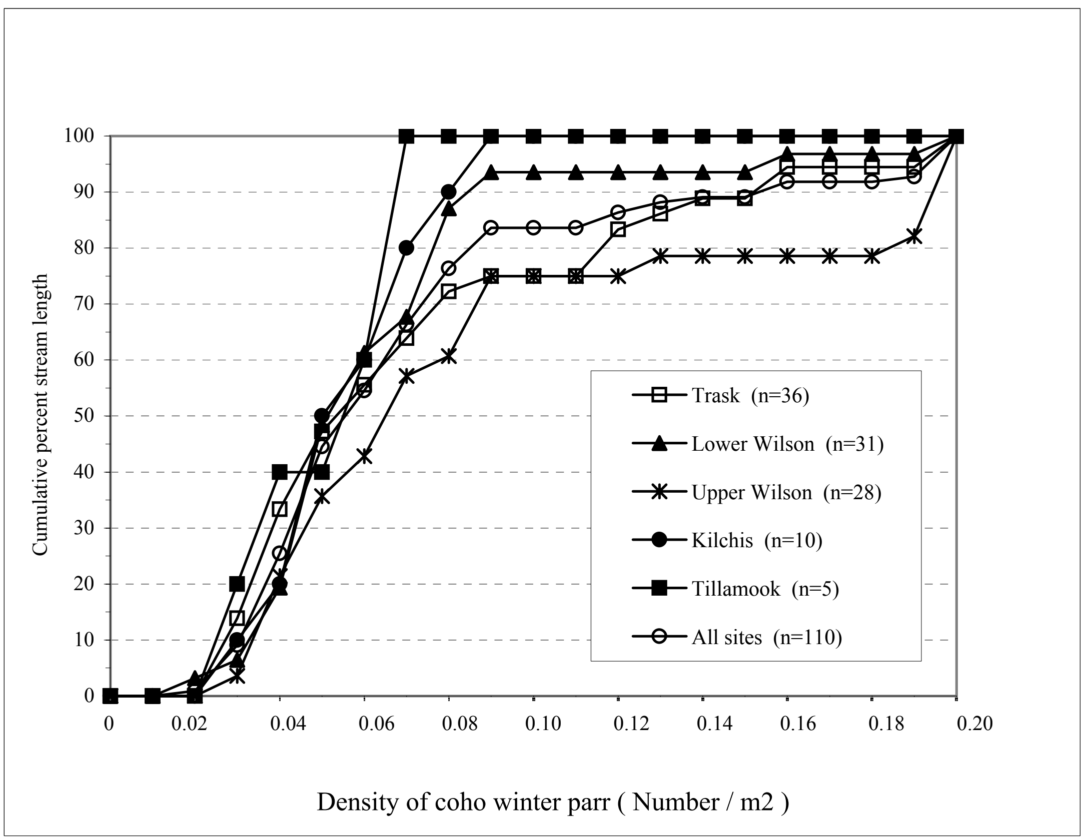


Figure 10. Cumulative frequency distribution comparing production of coho winter parr with each of the five Tillamook project areas and as a cumulative total. (Based on the Habitat Limiting Factors Model - HLFM)

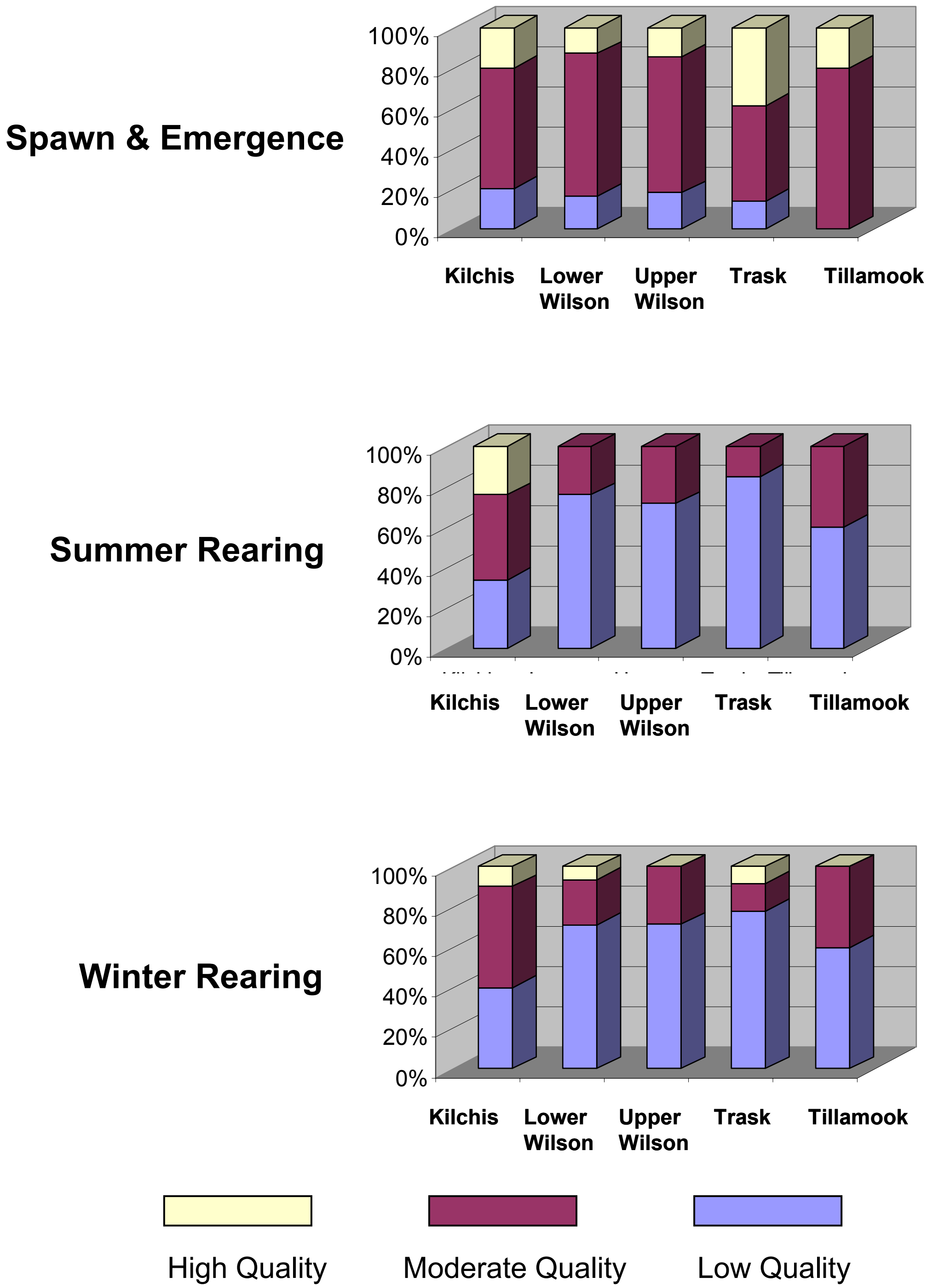
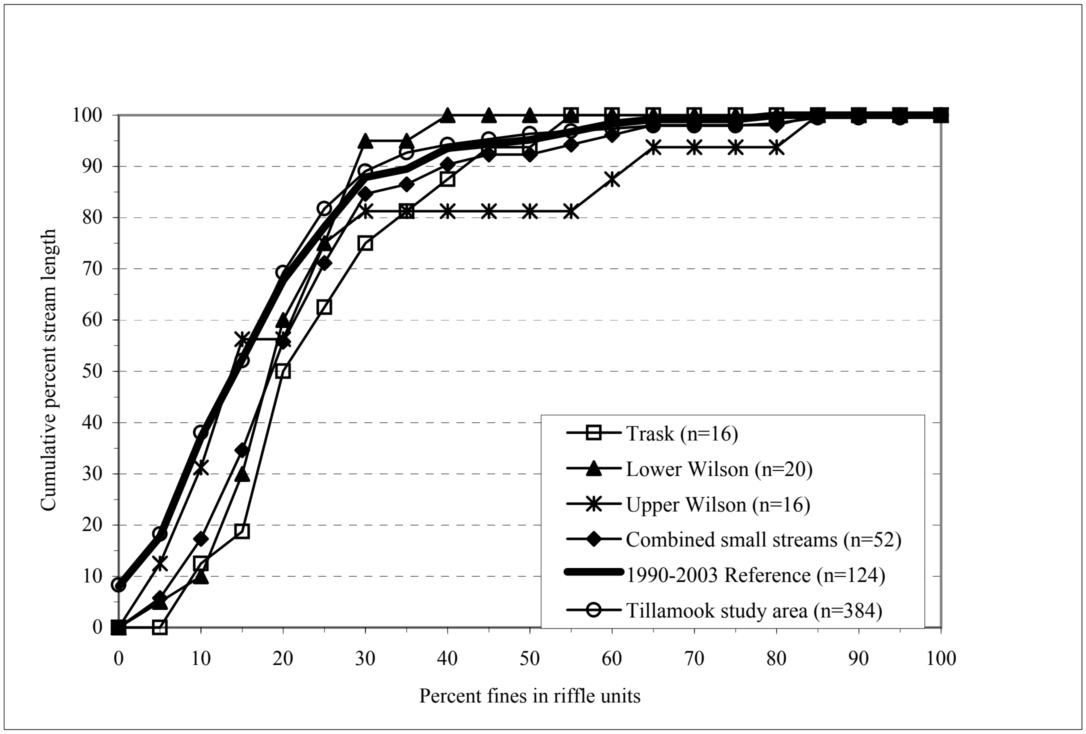


Figure 11. Fish habitat quality in each project area in the Tillamook study area. Ratings are based on HabRate model. The crème color is high quality, burgundy is moderate quality, and blue is low quality habitat relative to each life stage of coho salmon.

Oregon Department of Forestry: Tillamook Study Area



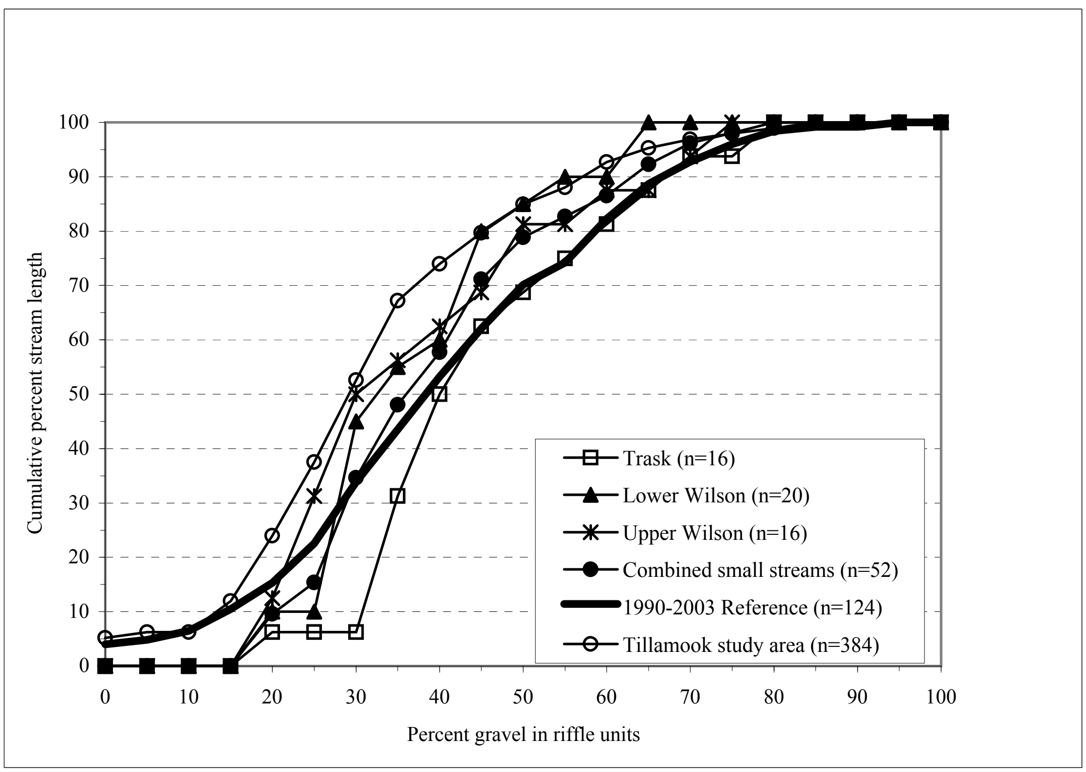
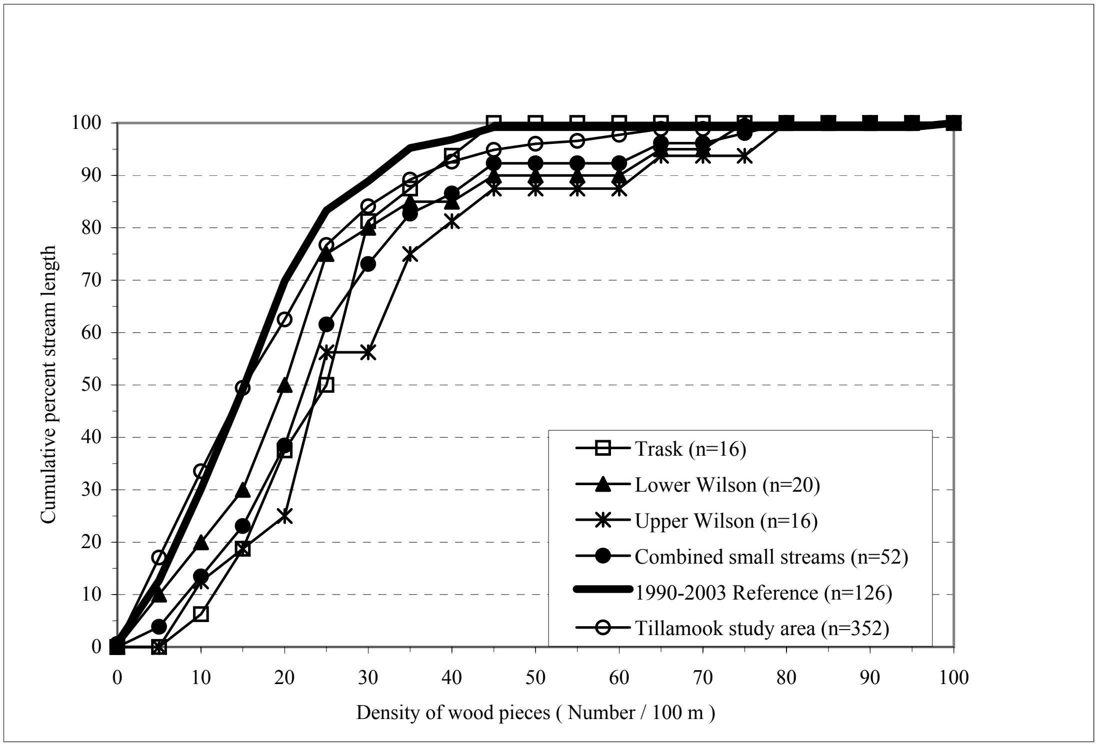


Figure 12. Cumulative frequency distribution comparing fines and gravel of small streams within the ODF Tillamook study area to reference conditions and the study area.

Oregon Department of Forestry: Tillamook Study Area



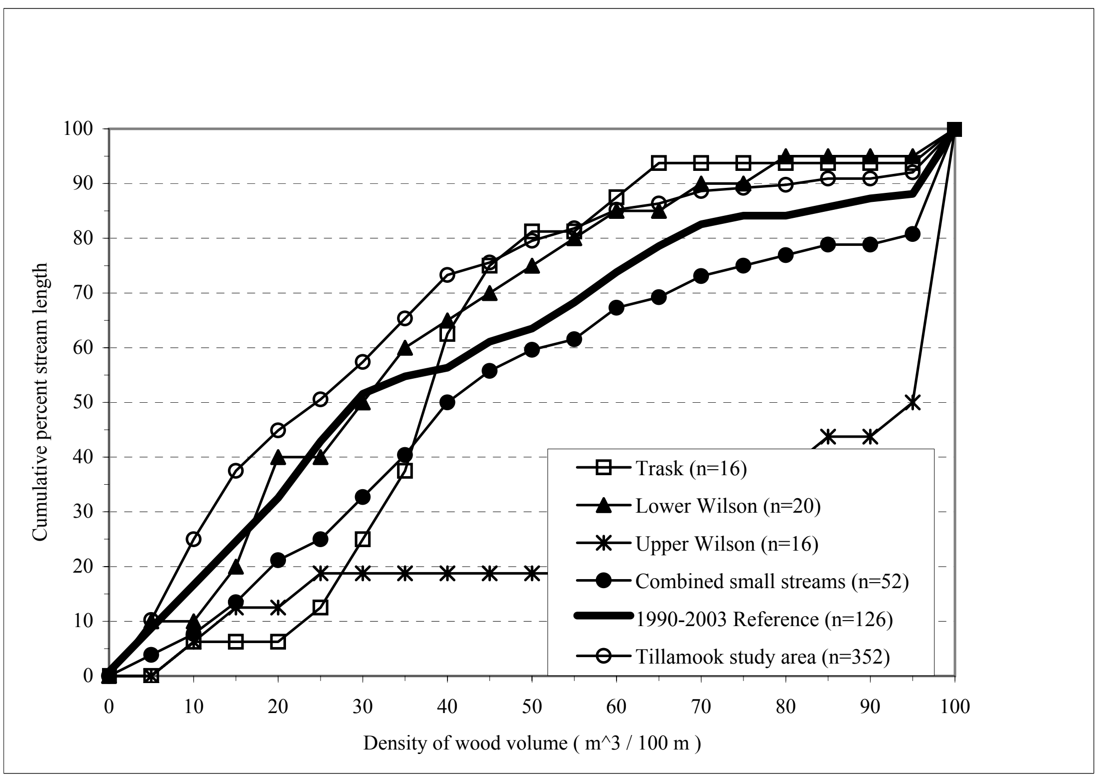
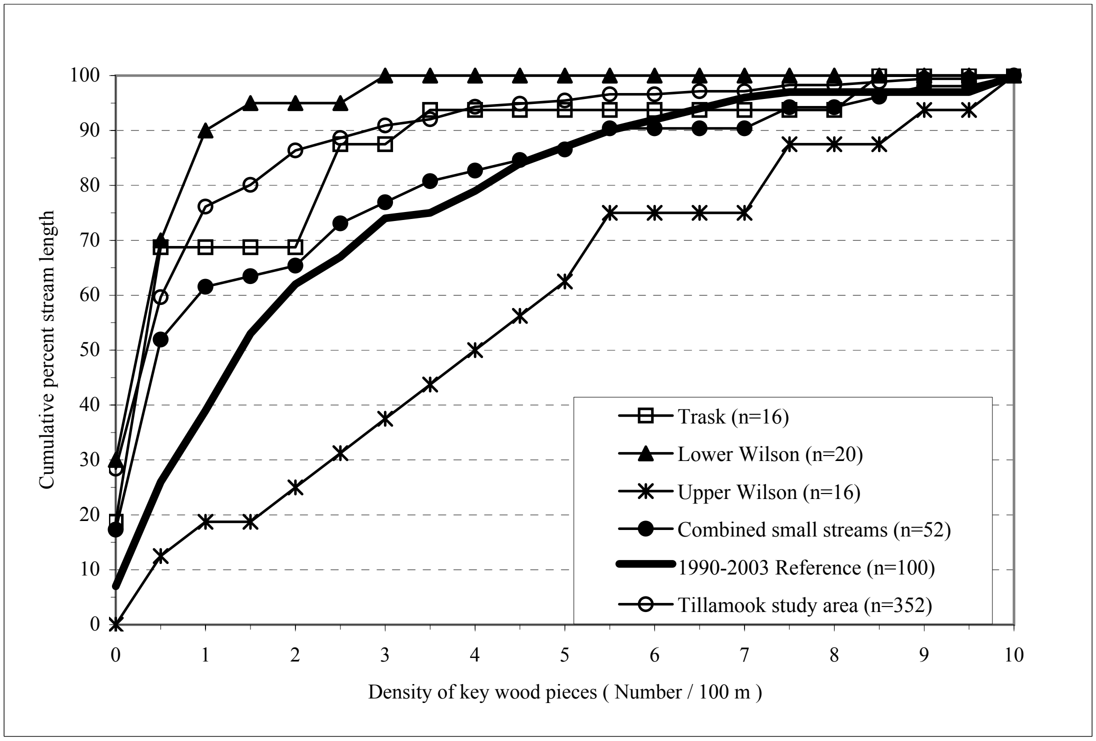


Figure 13. Cumulative frequency distribution comparing wood pieces and volume of small streams within the ODF Tillamook study area to reference conditions and the study area.

Oregon Department of Forestry: Tillamook Study Area



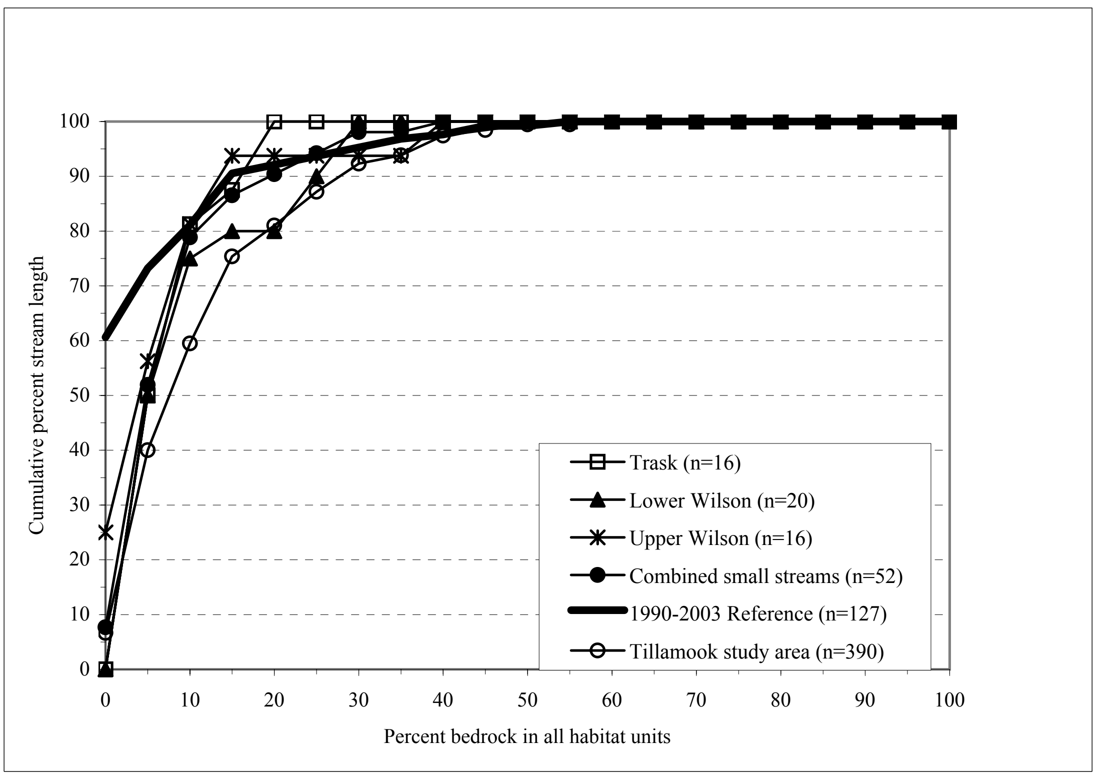
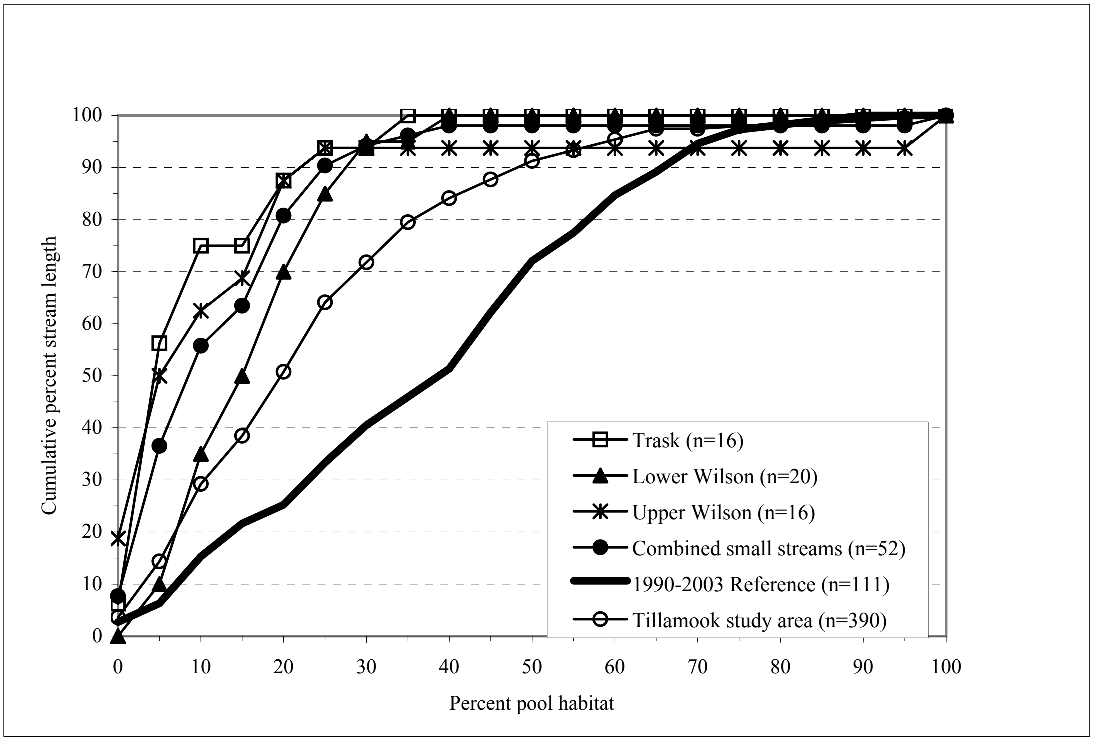


Figure 14. Cumulative frequency distribution comparing LWD keypieces and bedrock substrate of small streams within the ODF Tillamook study area to reference conditions and the study area.

Oregon Department of Forestry: Tillamook Study Area



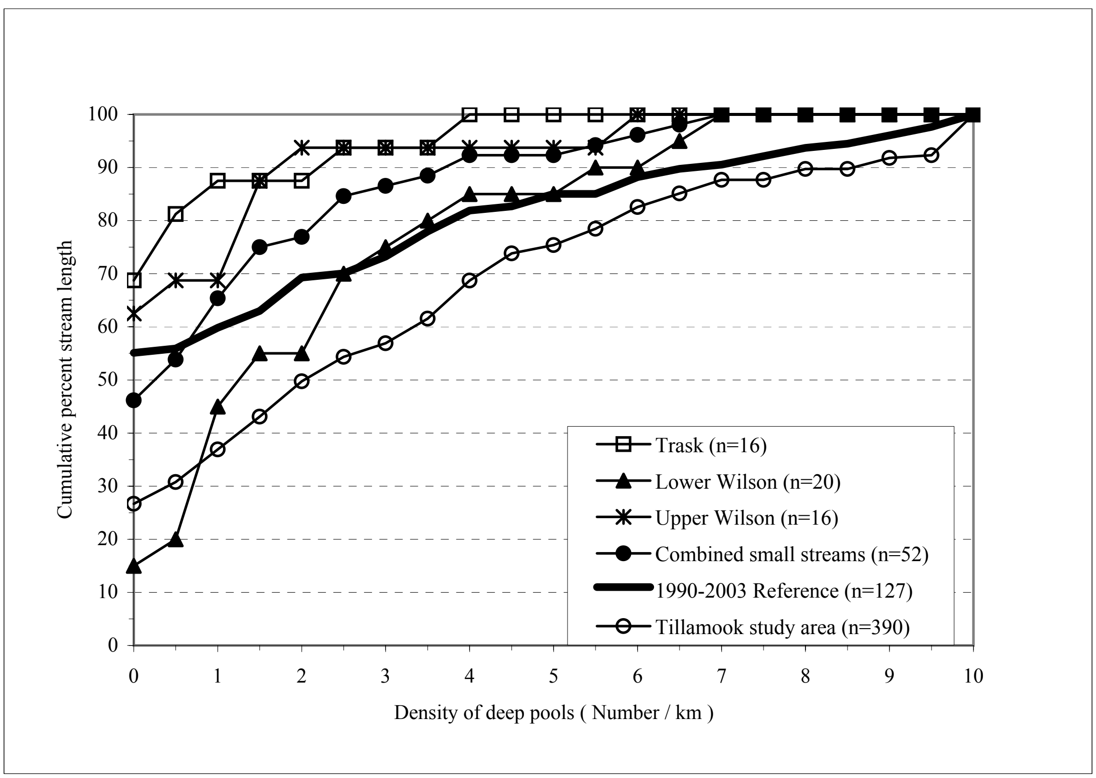
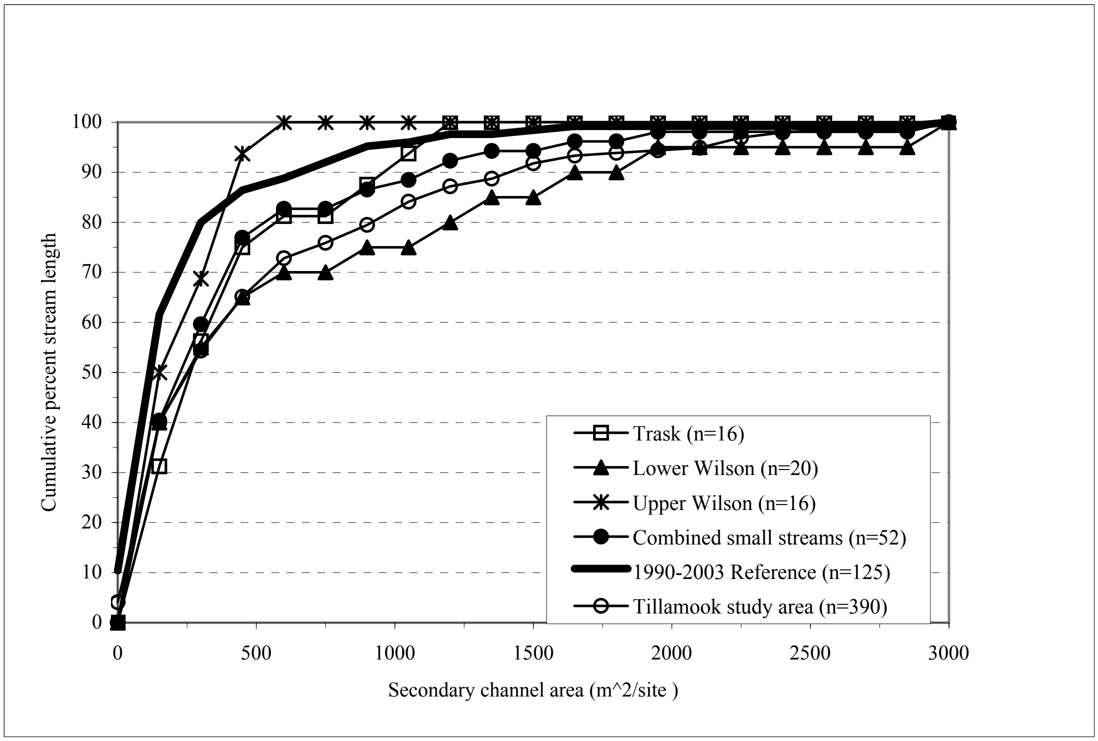


Figure 15. Cumulative frequency distribution comparing pools of small streams within the ODF Tillamook study area to reference conditions and the study area.

Oregon Department of Forestry: Tillamook Study Area



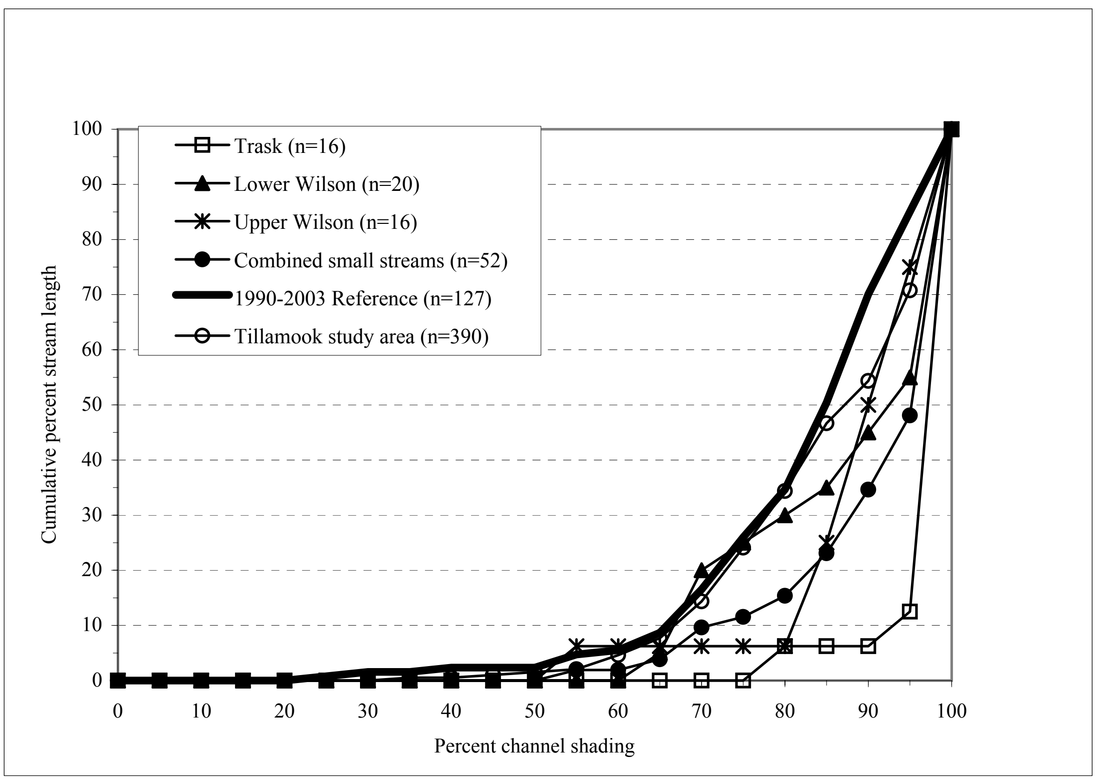
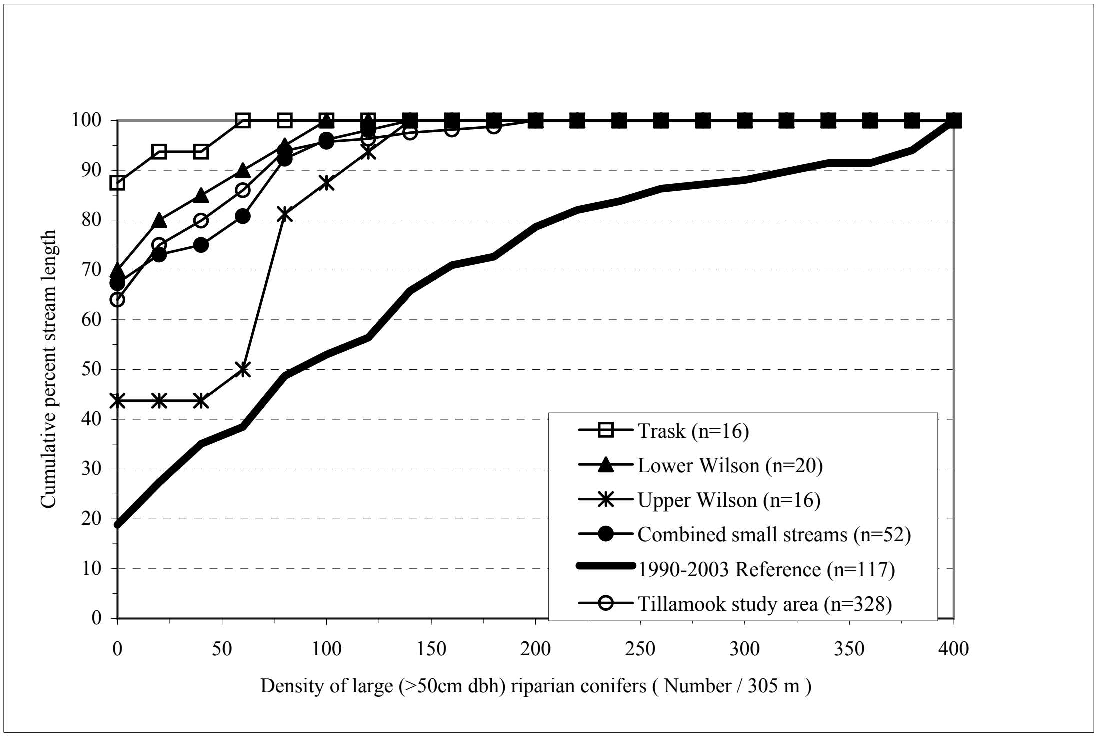


Figure 16. Cumulative frequency distribution comparing secondary channel and shade of small streams within the ODF Tillamook study area to reference conditions and the study area.

Oregon Department of Forestry: Tillamook Study Area



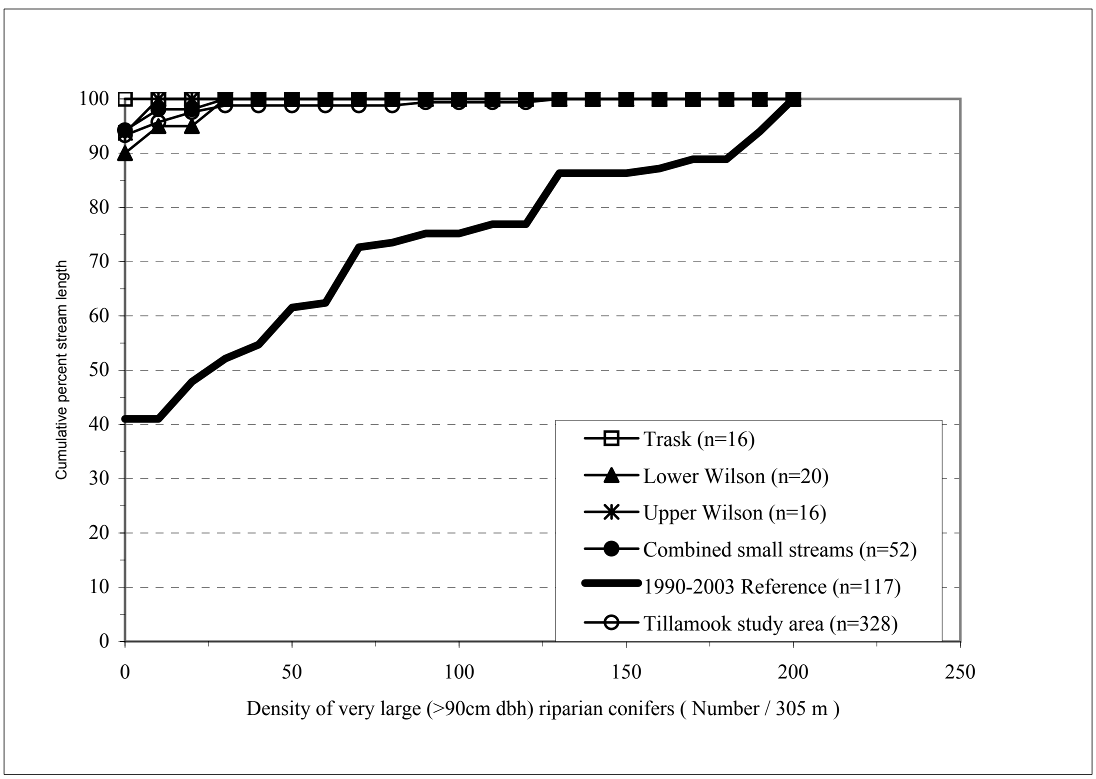


Figure 17. Cumulative frequency distribution comparing large riparian conifers of small streams within the ODF Tillamook study area to reference conditions and the study area.

Oregon Department of Forestry: Tillamook Study Area

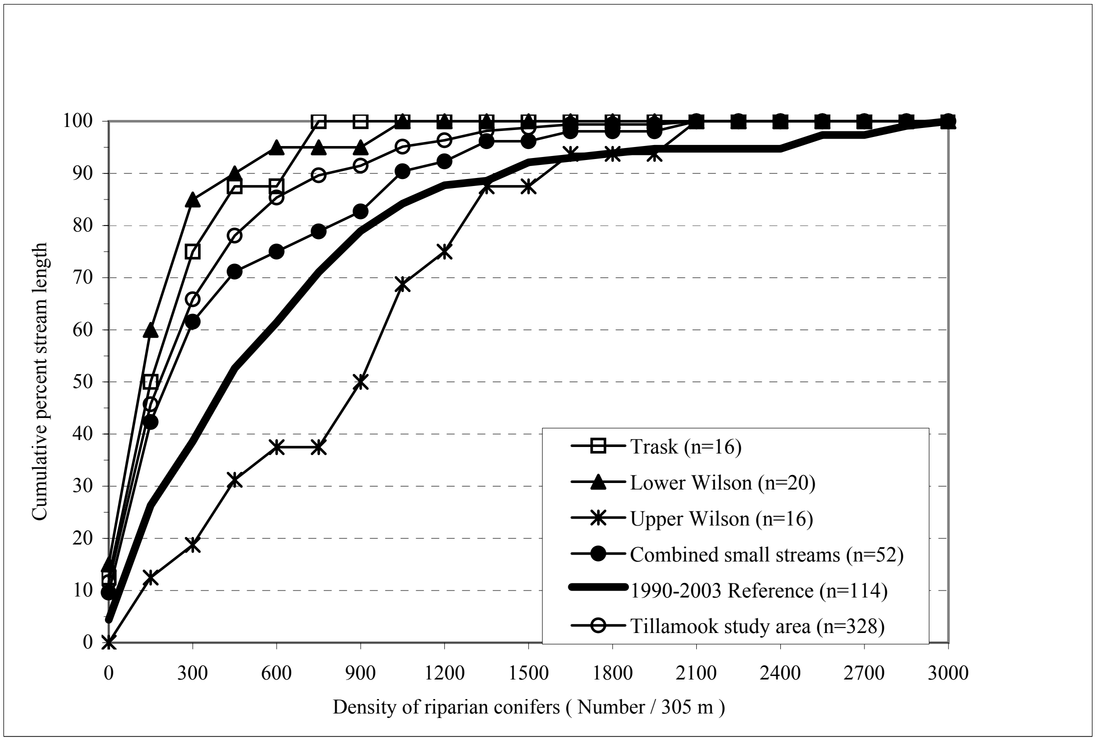
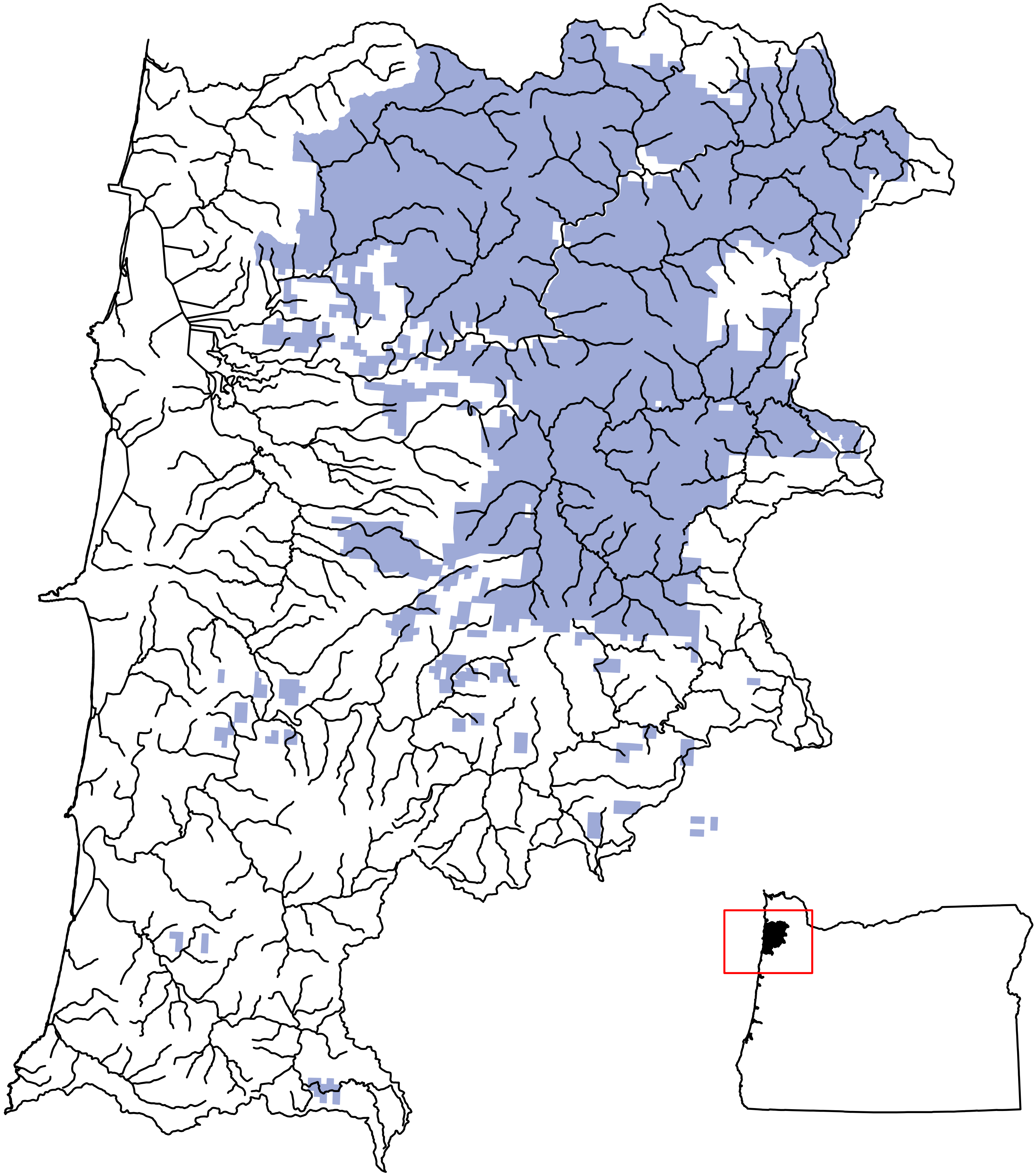
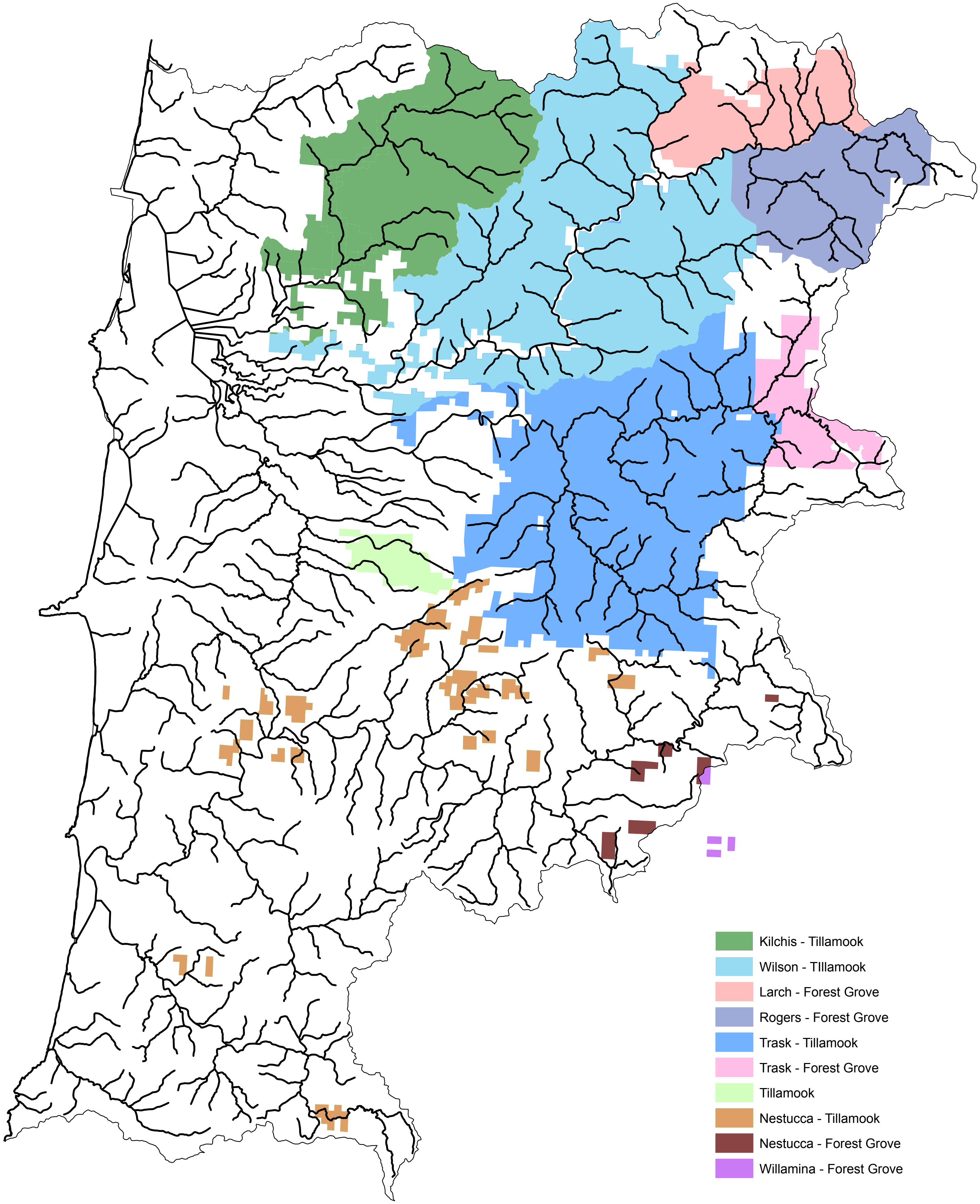


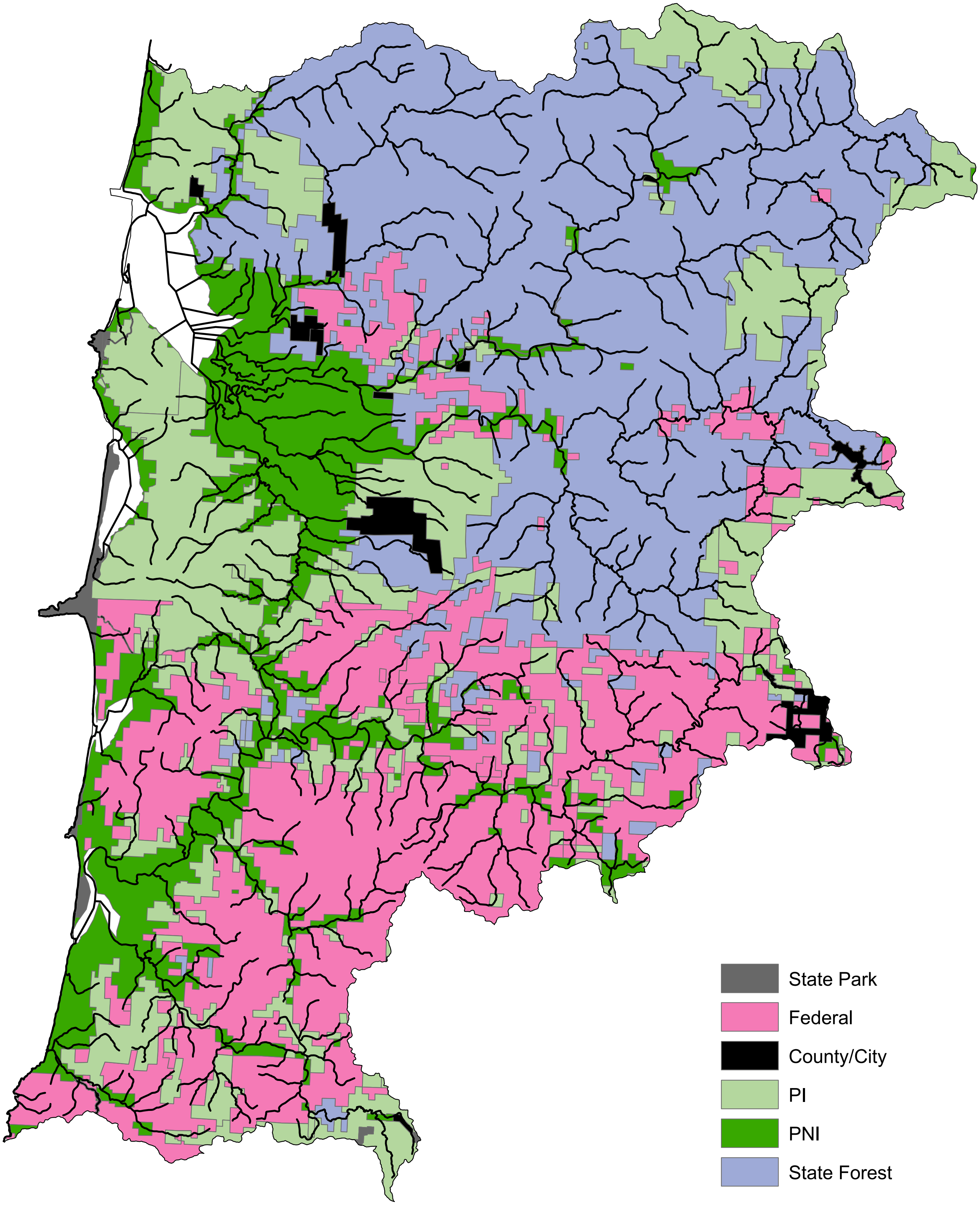
Figure 18. Cumulative frequency distribution comparing riparian conifers of small streams within the ODF Tillamook study area to reference conditions and the study area.



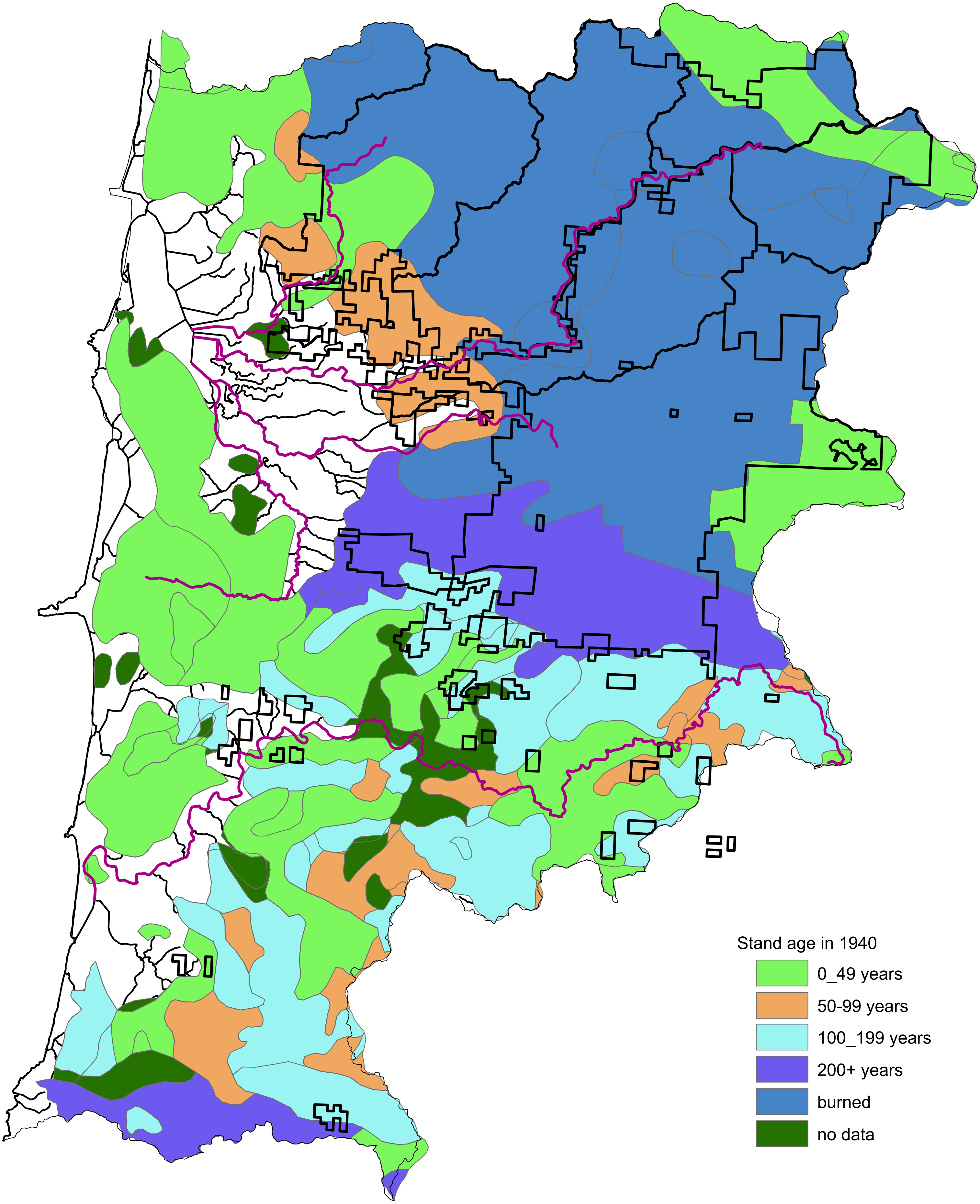
Map 1. The Tillamook study area in the state of Oregon.



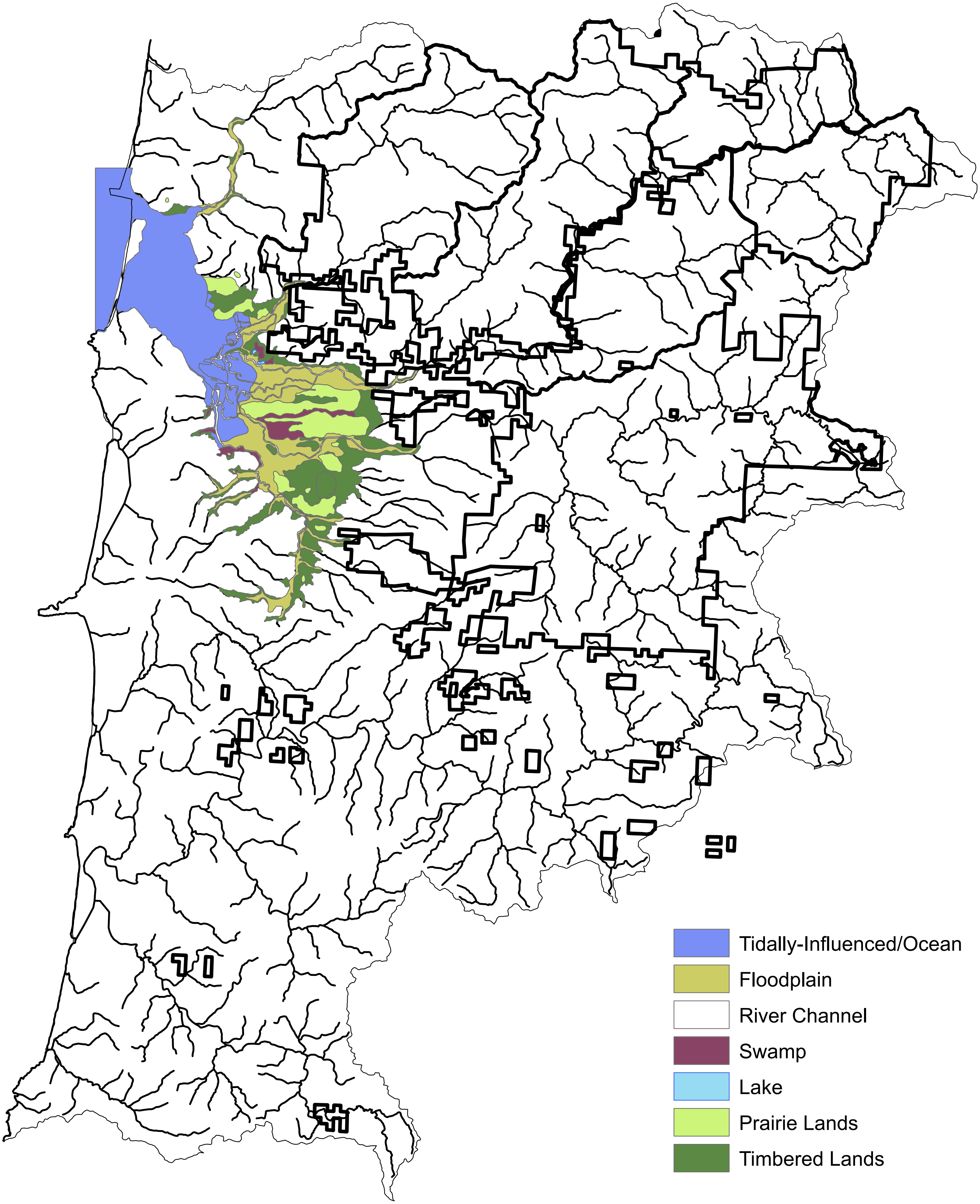
Map 2. ODF management areas presented by river basin and management zone.



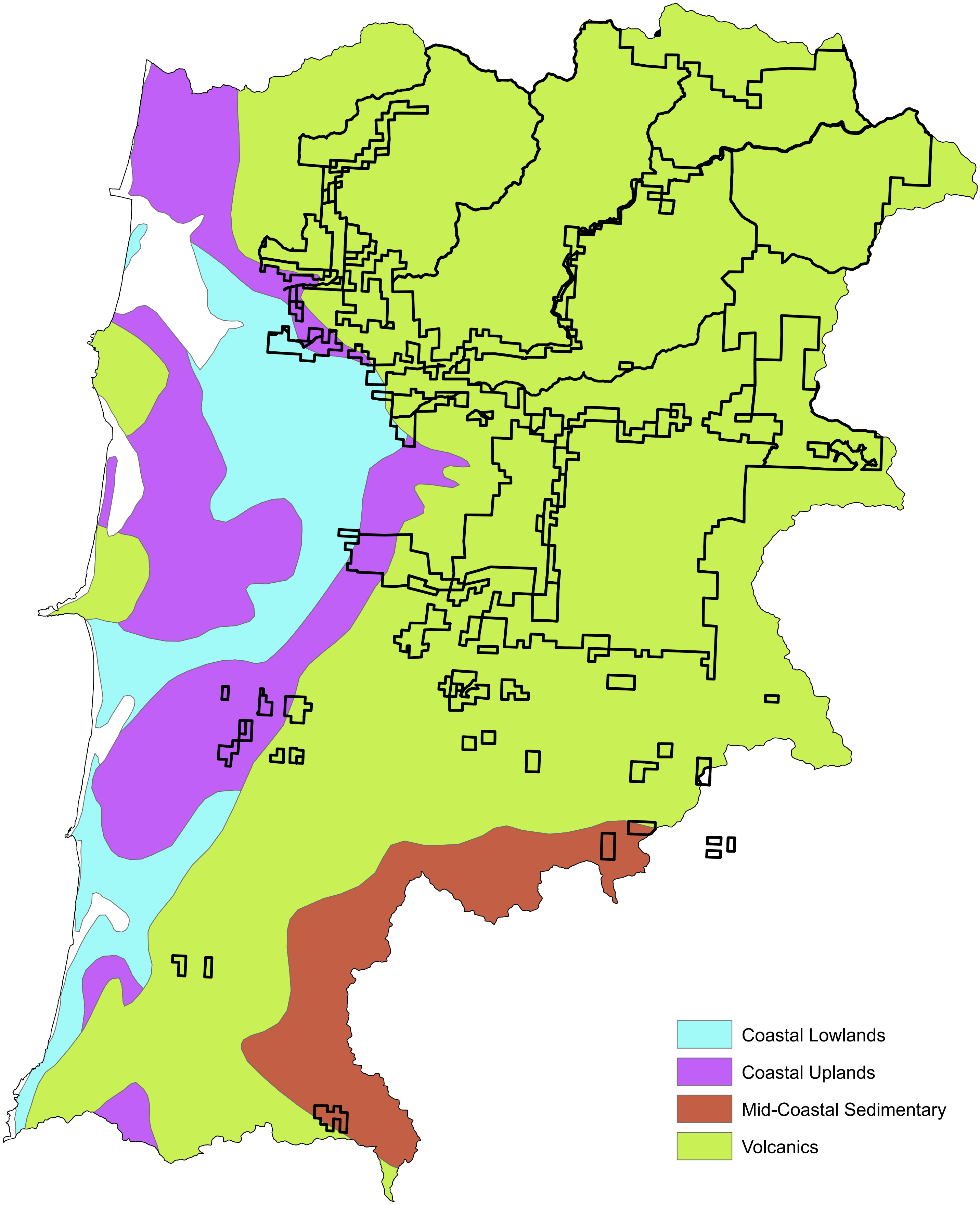
Map 3. Landownership in the Tillamook study area.



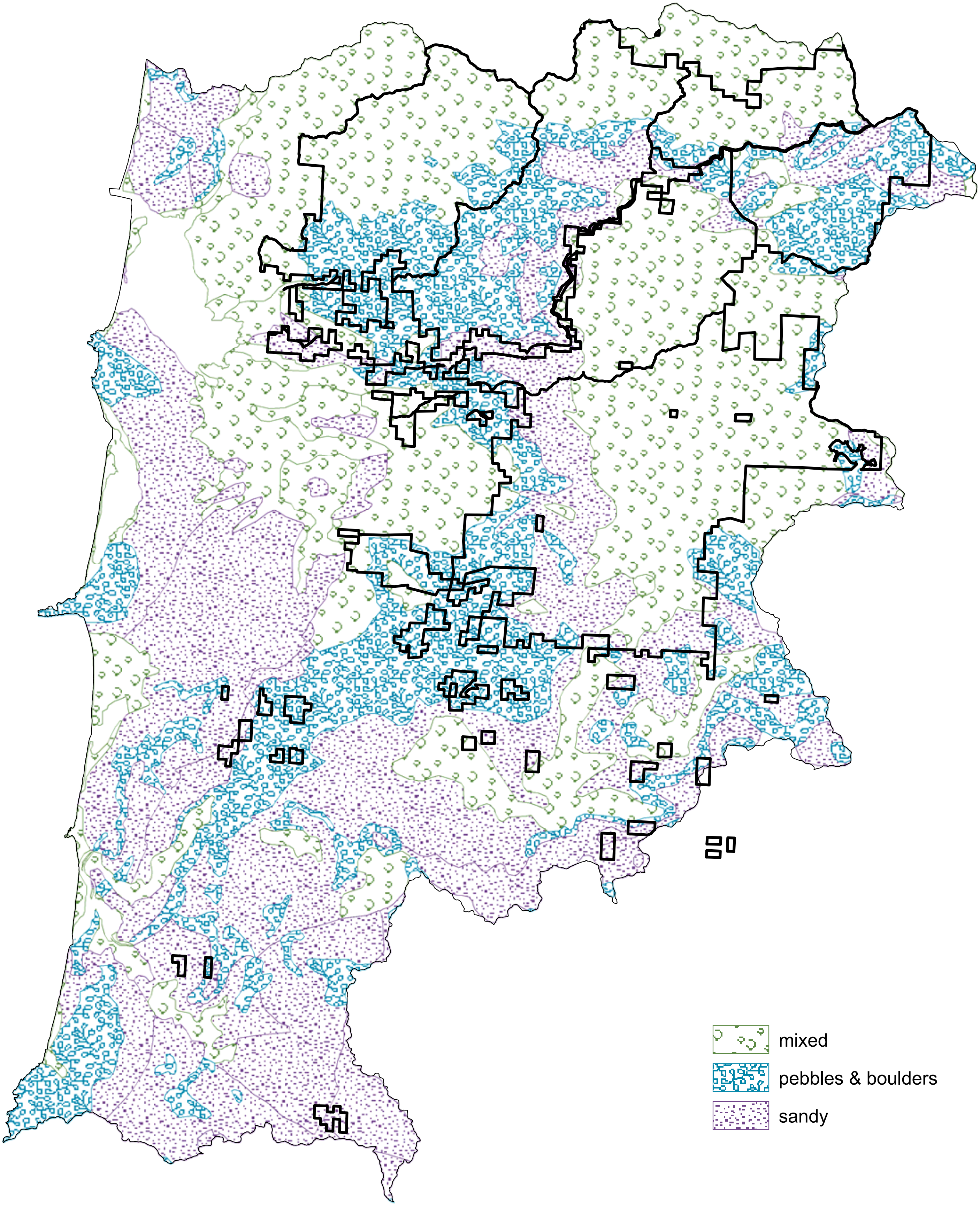
Map 4. Stand age in 1940 of forested land in the Tillamook study area.



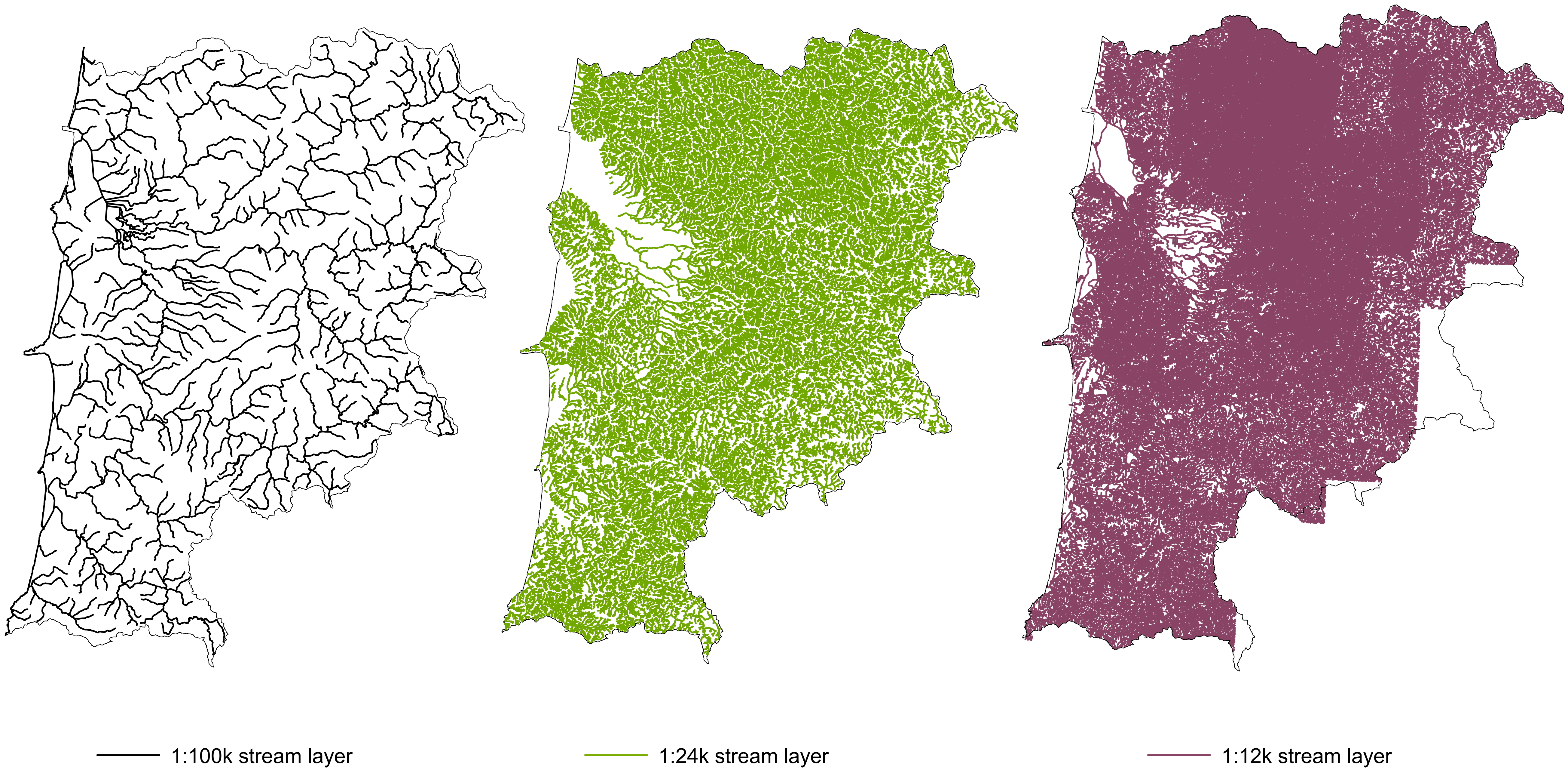
Map 5. Historical wetland distribution in the Tillamook study area.



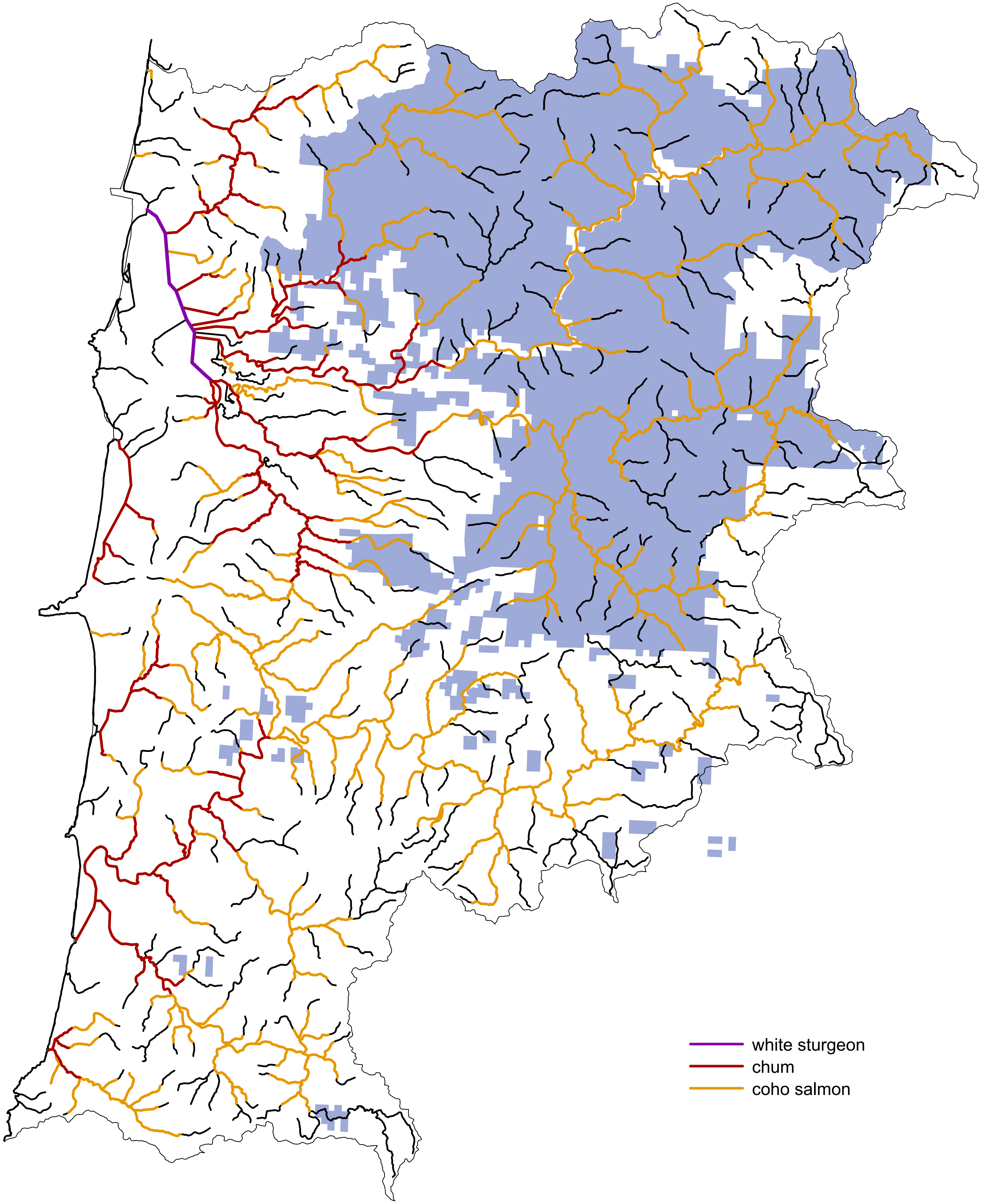
Map 6. Level IV ecoregions in the Tillamook study area (Thorson et al. 2003).



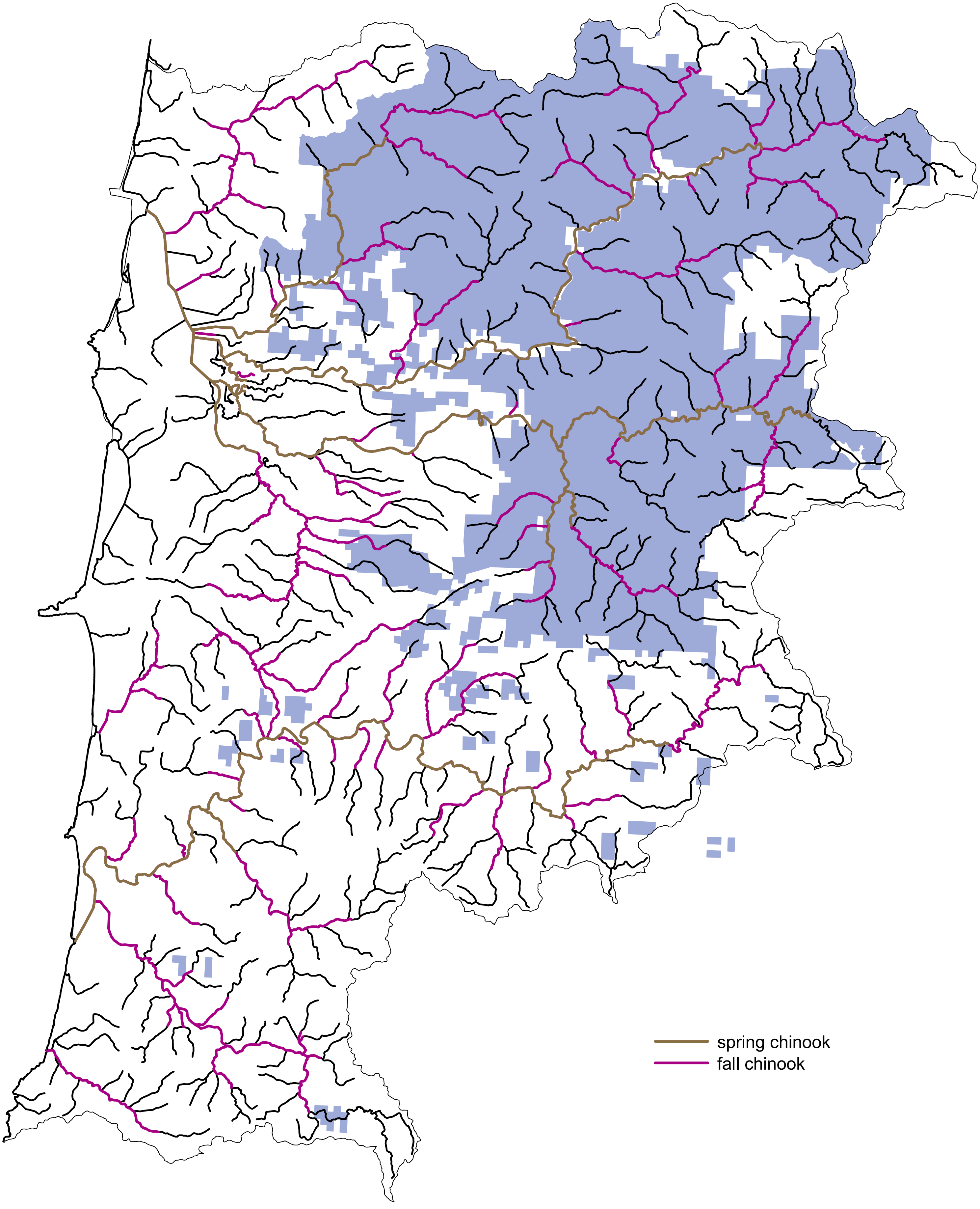
Map 7. Channel geology in the Tillamook study area.



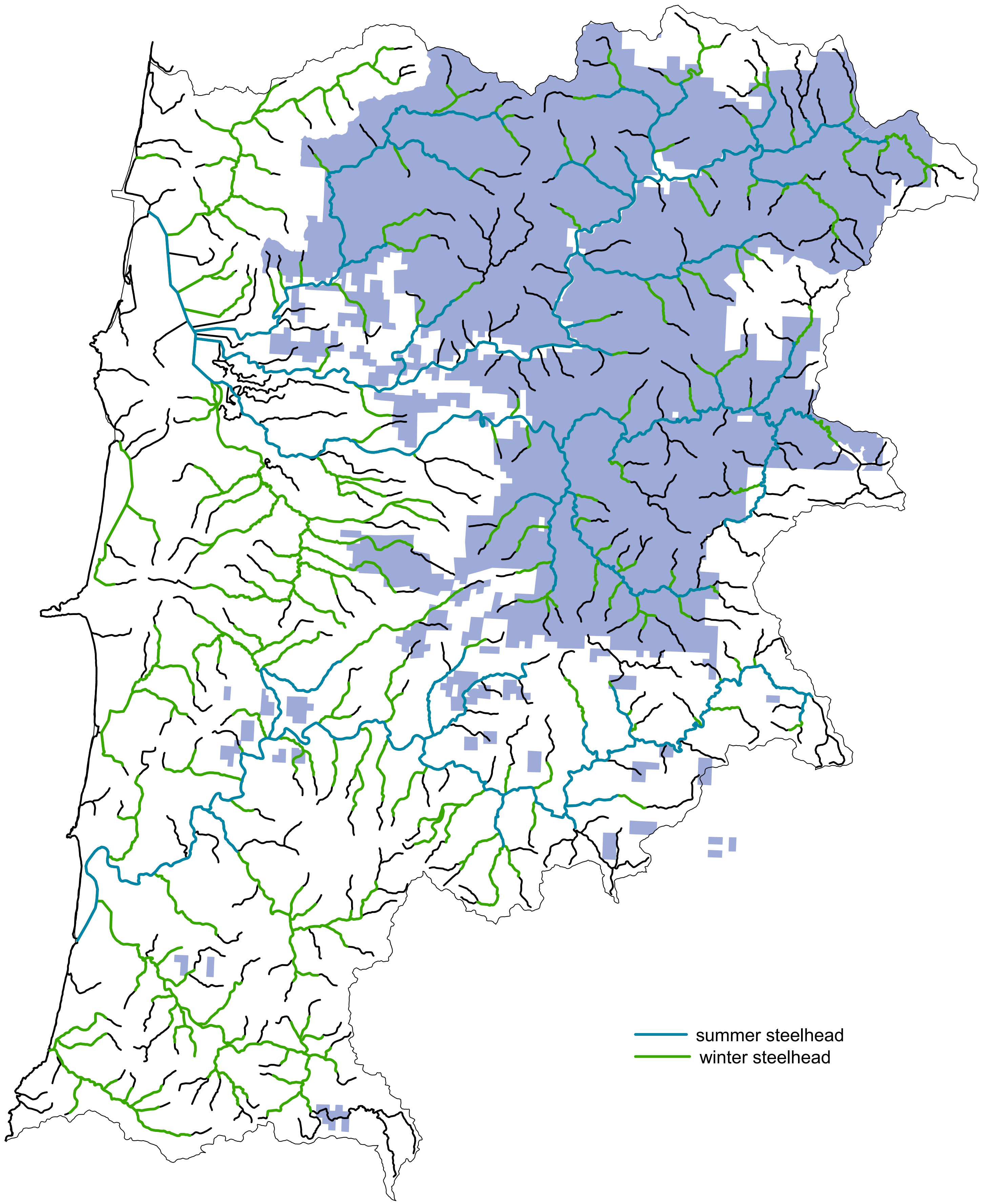
Map 8. Stream layers - 1:100k (ODFW), 1:24k (CLAMS), 1:12k (ODF) - in the Tillamook study area.



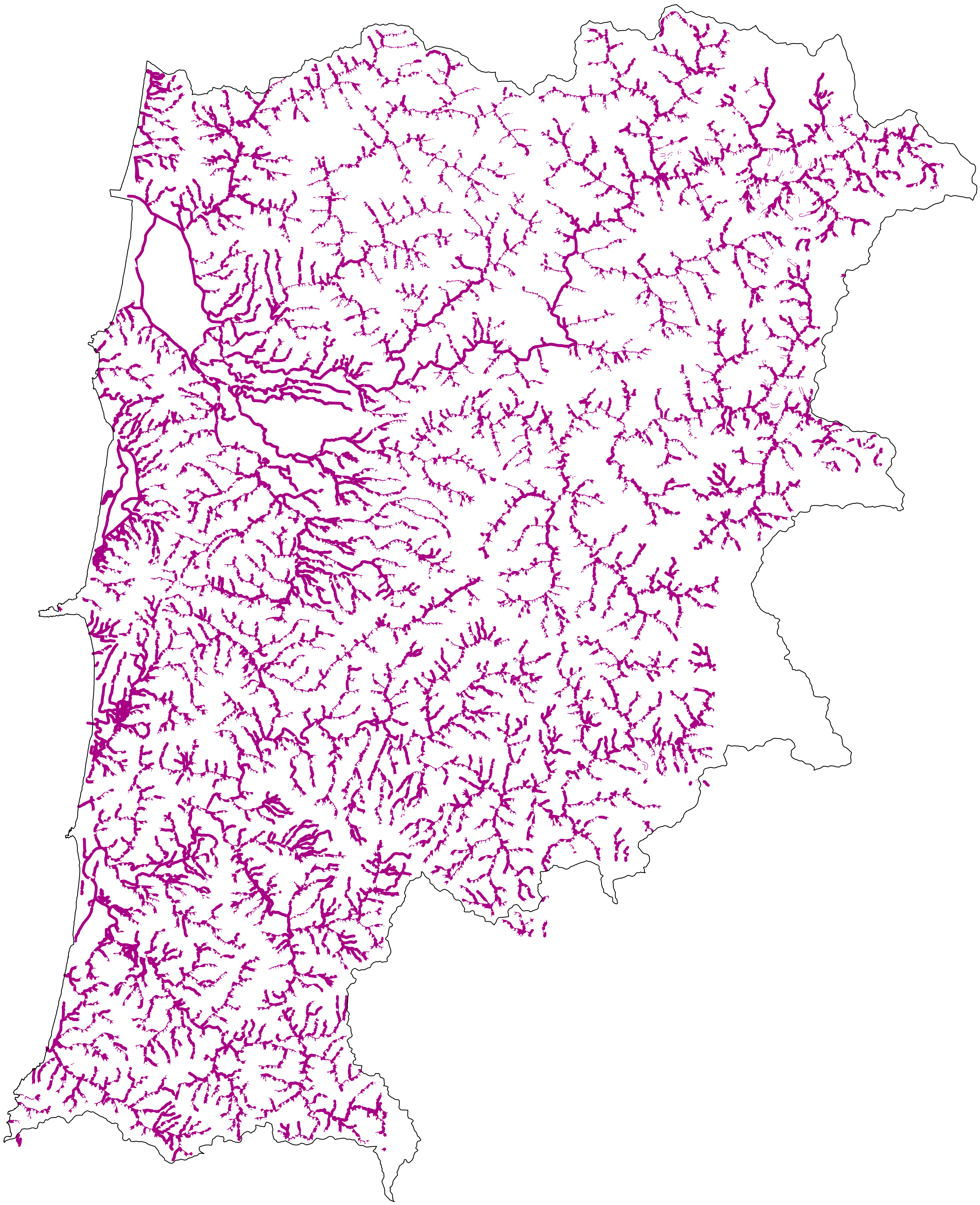
Map 9. White sturgeon, chum, and coho salmon distribution in the Tillamook study area.



Map 10. Spring chinook and fall chinook salmon distribution in the Tillamook study area.



Map 11. Summer and winter steelhead distrbutions in the Tillamook study area.



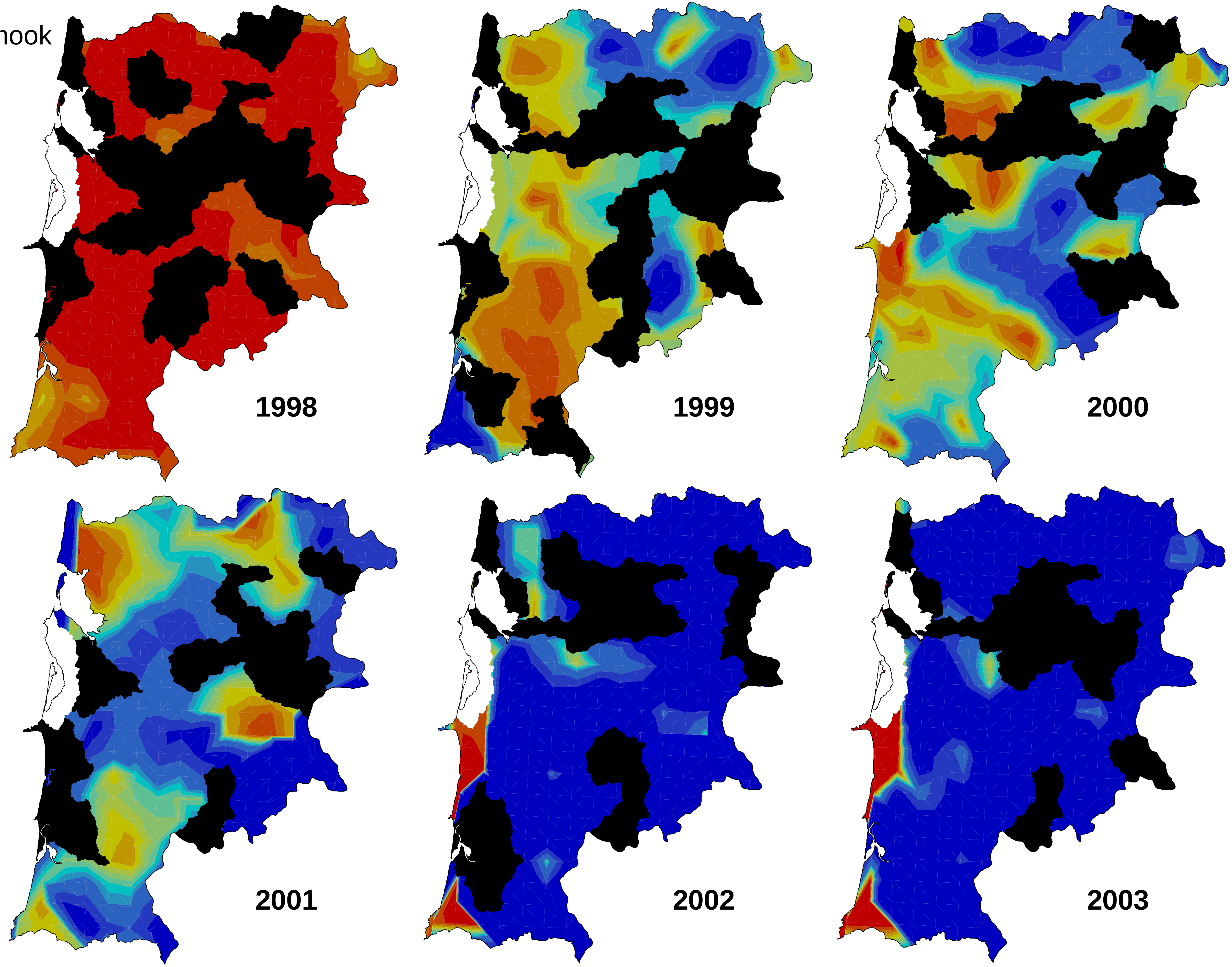
Map 12. Cutthroat trout distribution in the Tillamook study area (source: ODF).

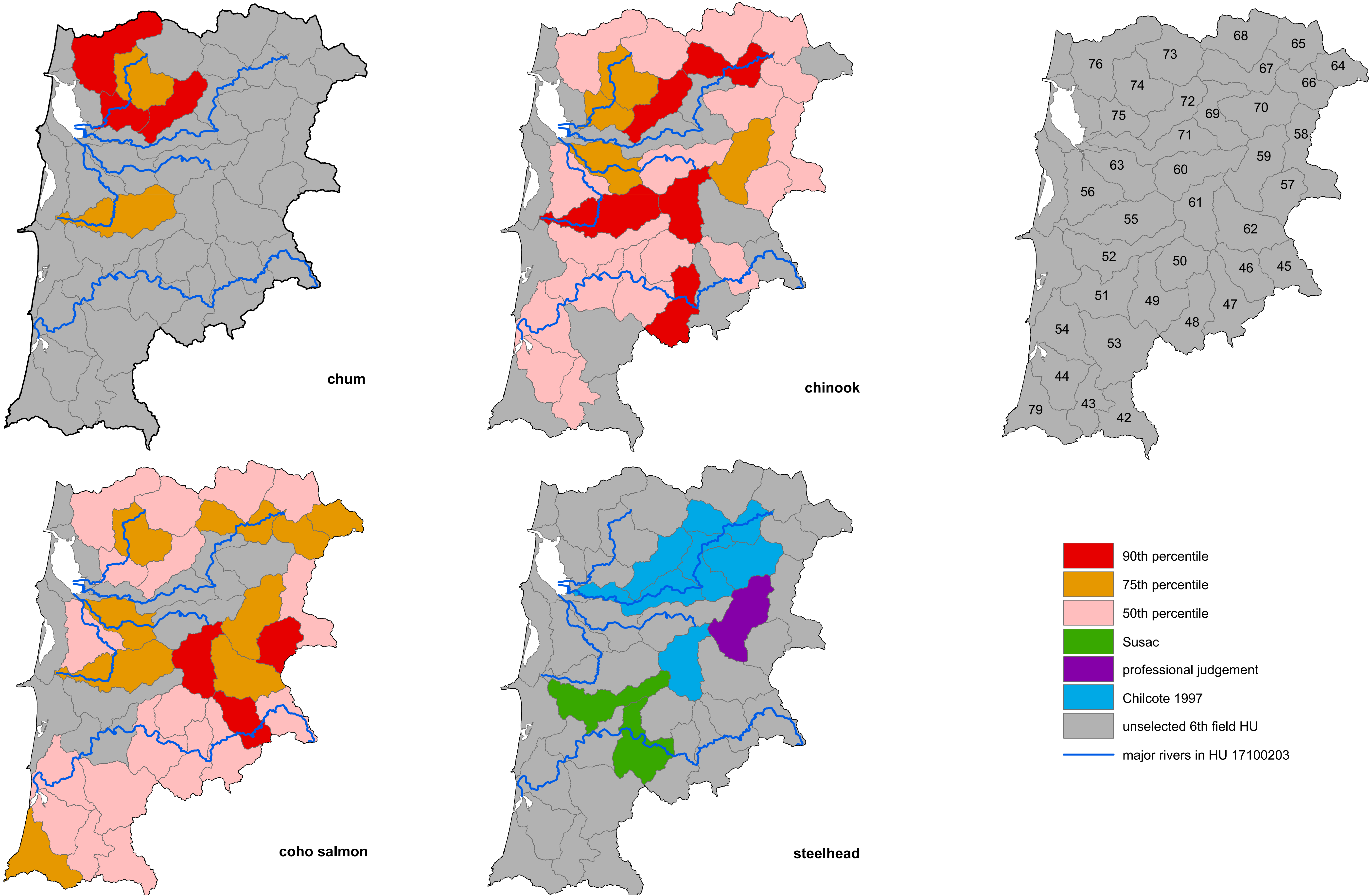
Map 13. ODF Tillamook Study Area:

Spatial Distribution Maps of Abundance of Returning Wild Adult Coho

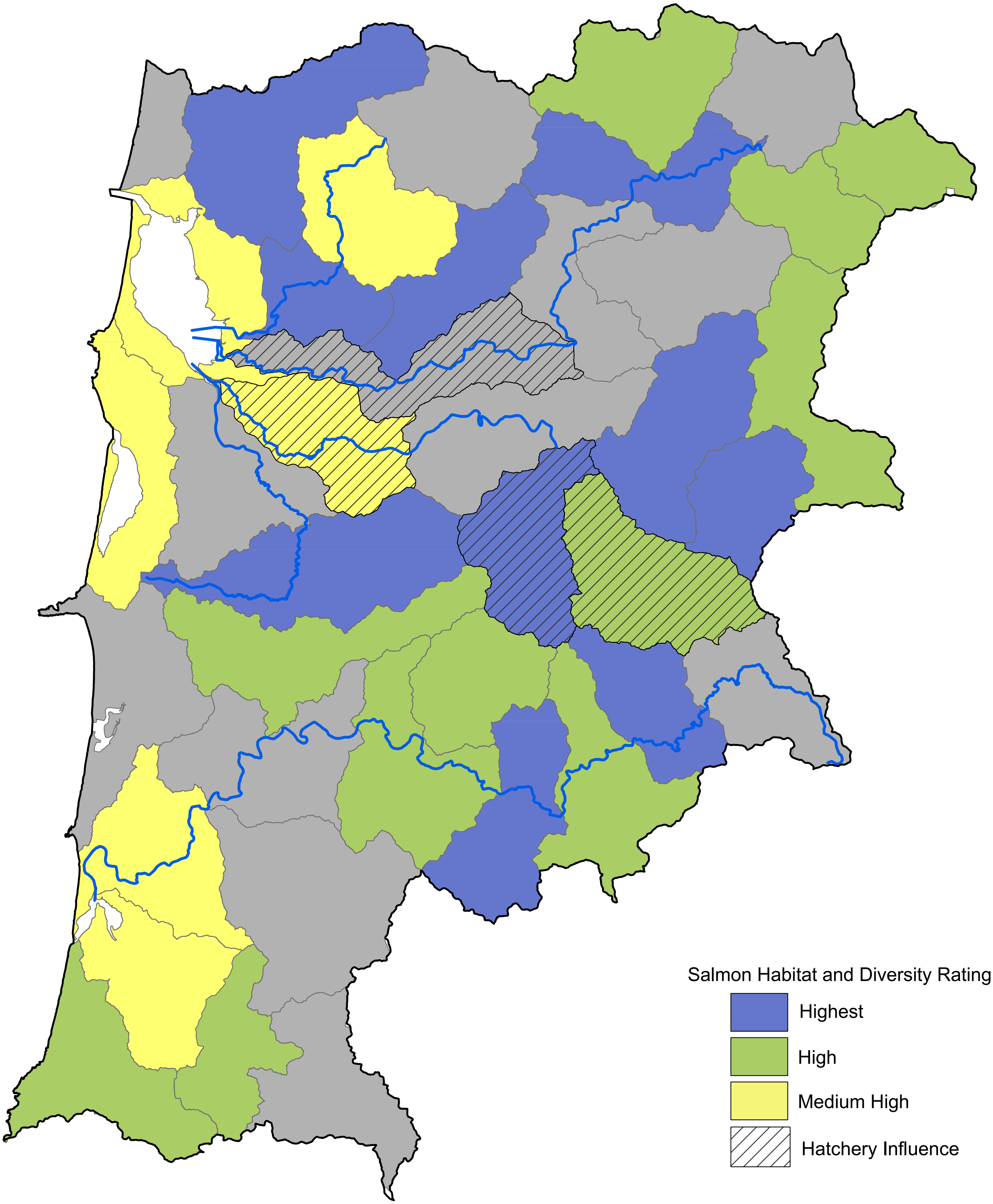
Wild Adult Coho per Mile

- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10
- 10 - 15
- 15 - 20
- > 20
- No Survey Data
- Outside of Coho Distribution

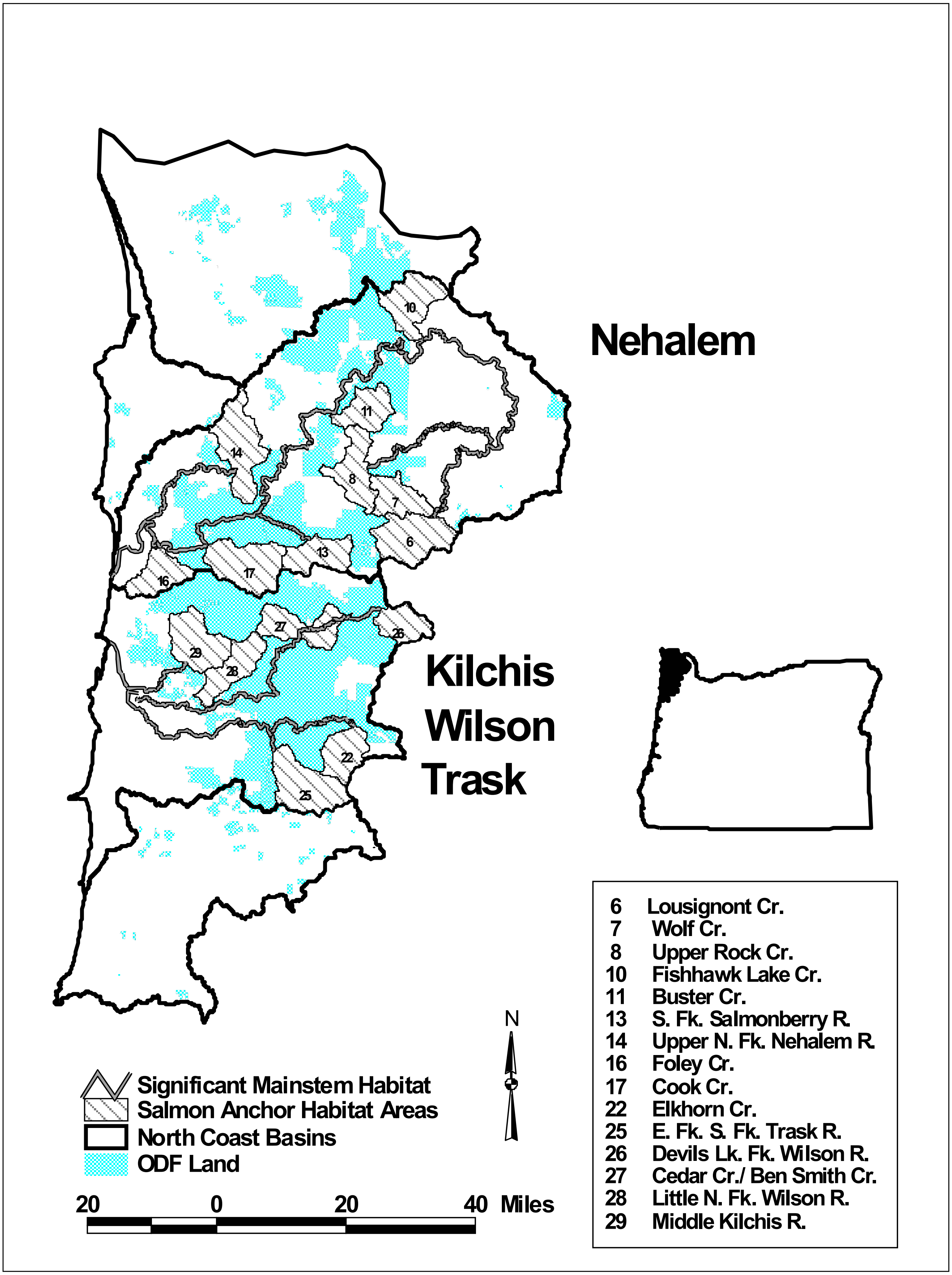




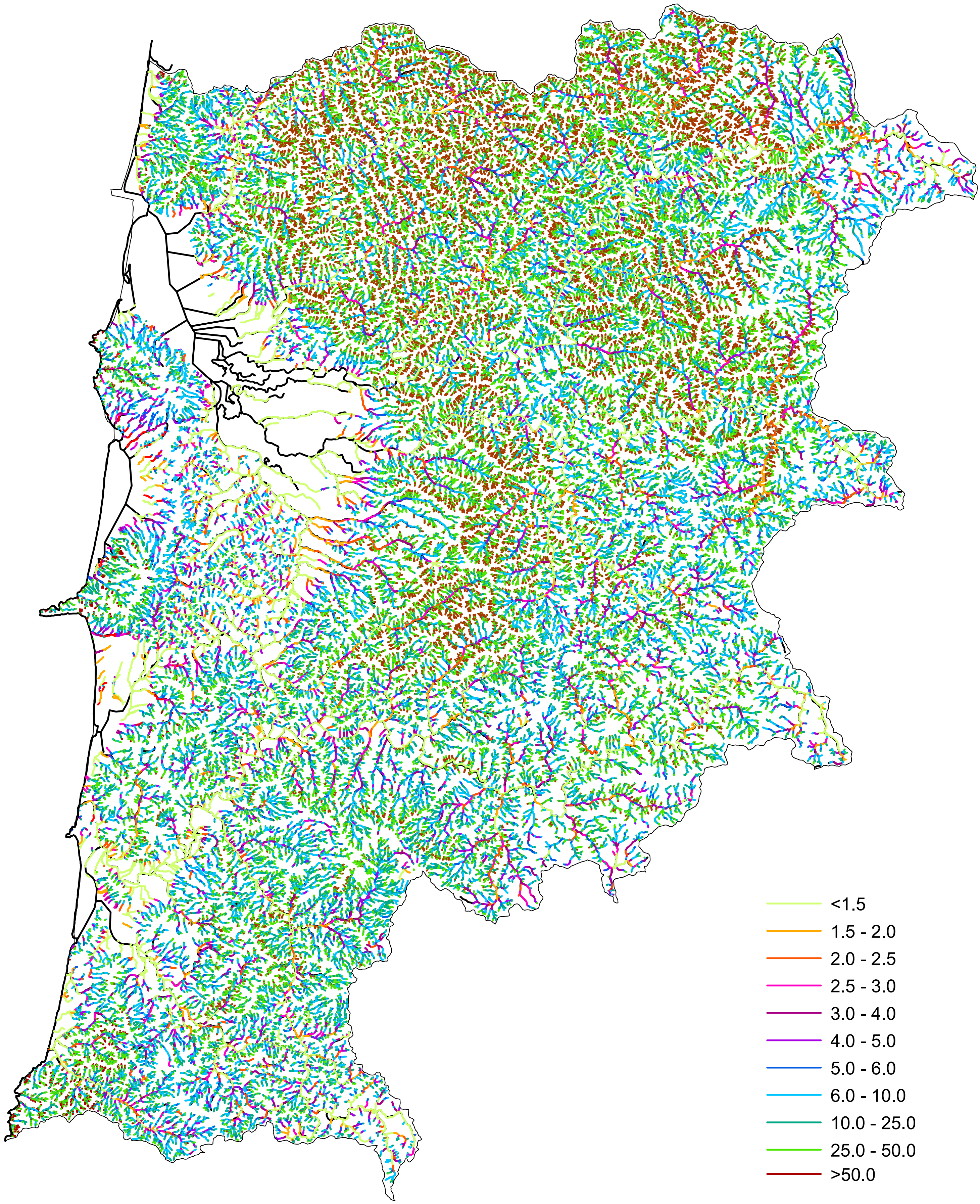
Map 14. Species abundance and diversity within the Tillamook study area per ODFW Coastal Salmonid Inventory Project data 1989 - 2000. Warm-colored (red, orange, pink) 6th field HUs indicate watersheds that had above average densities for more than 50%, 75%, and 90% of the 12 years for chum, Chinook, and coho salmon (Talabere and Jones, 2002). Steelhead presence is indicated by the cool colors (green, purple, blue). Numbered 6th field HU correspond with subwatersheds on Table 2.



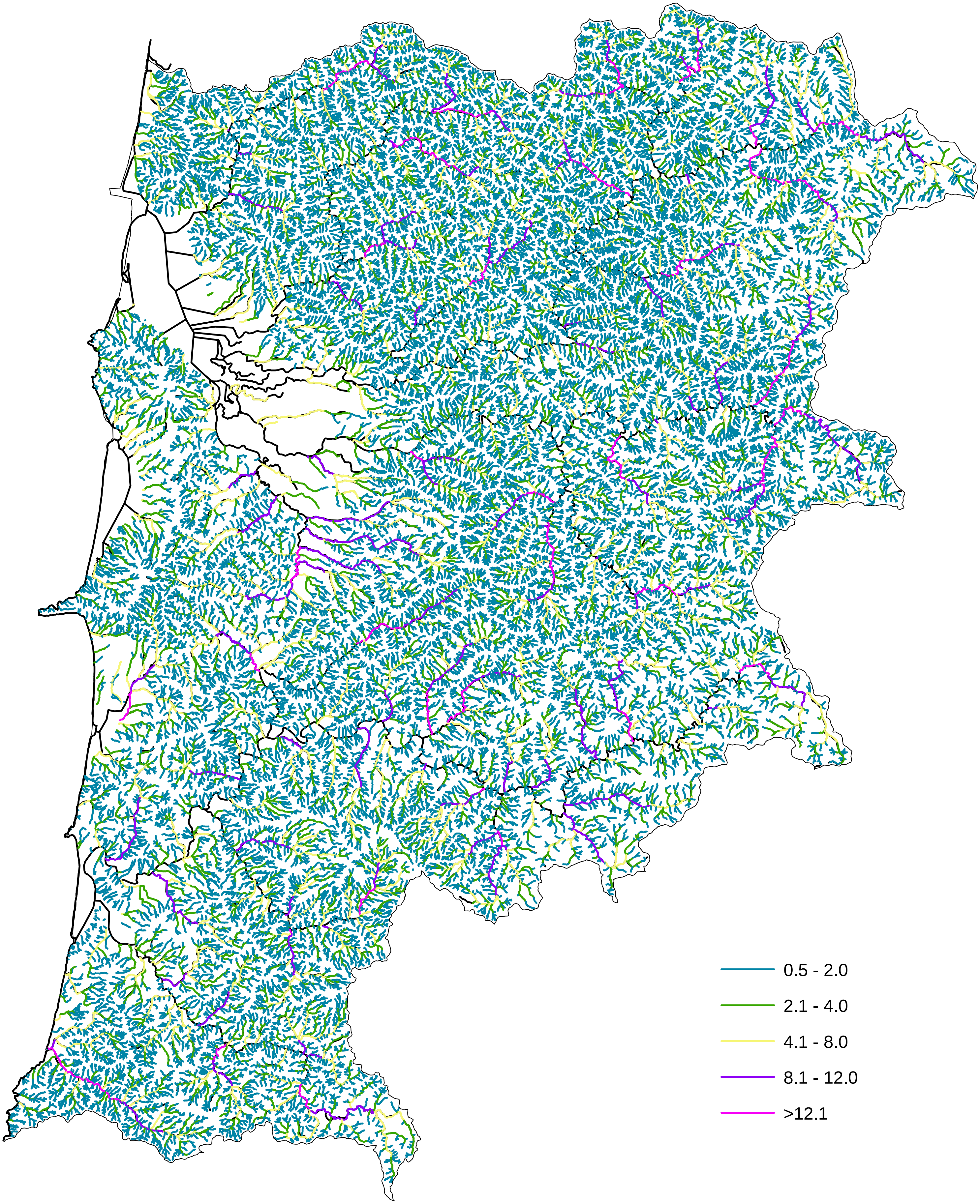
Map 15. Salmon habitat and diversity subwatersheds displayed in ranking colors in the Tillamook study area (Talabere and Jones, 2004). Rankings are based on habitat quality and salmon diversity and abundance. Subwatersheds with high hatchery influence have not been removed.



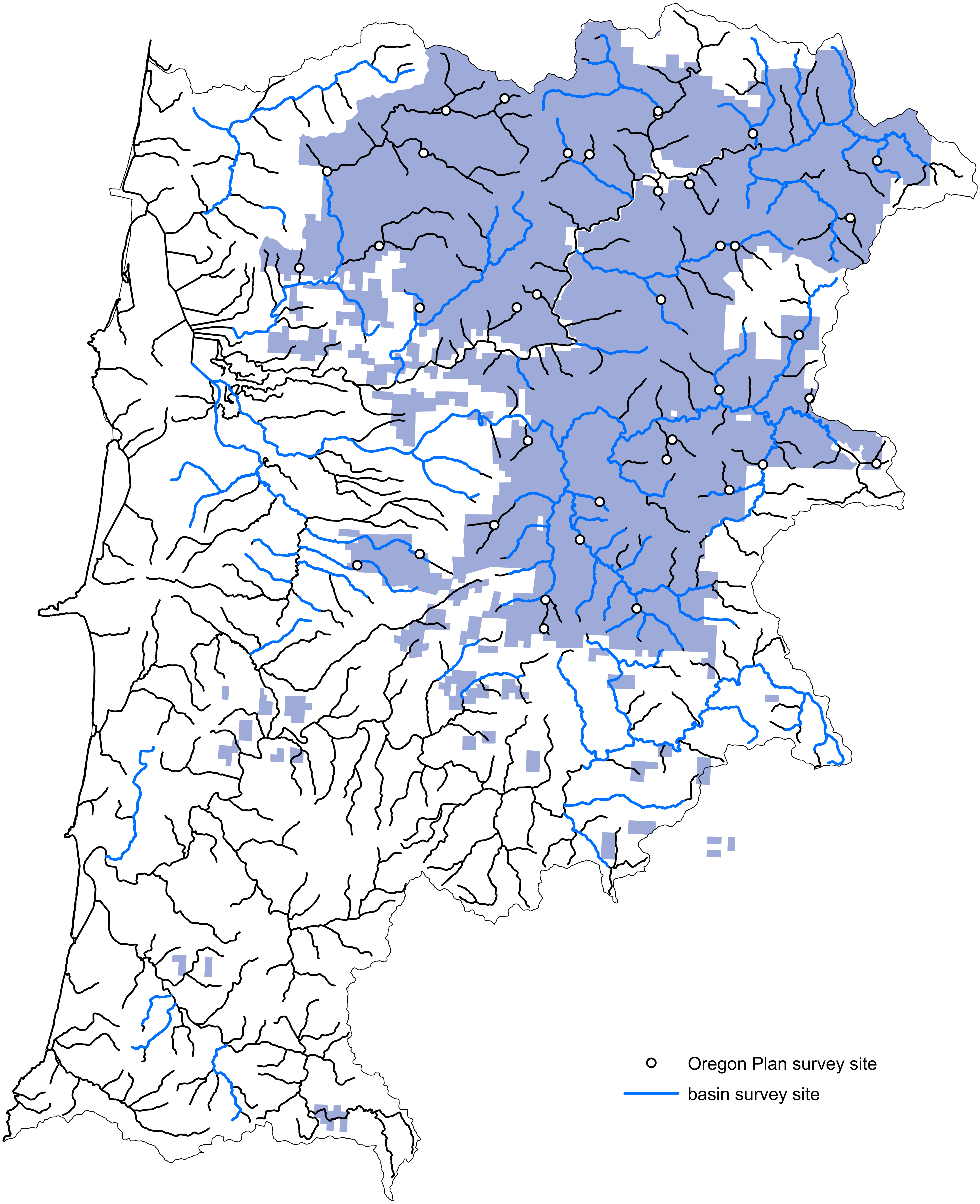
Map 16. Salmon Anchor Habitat Watersheds on ODF lands in the North Coast.



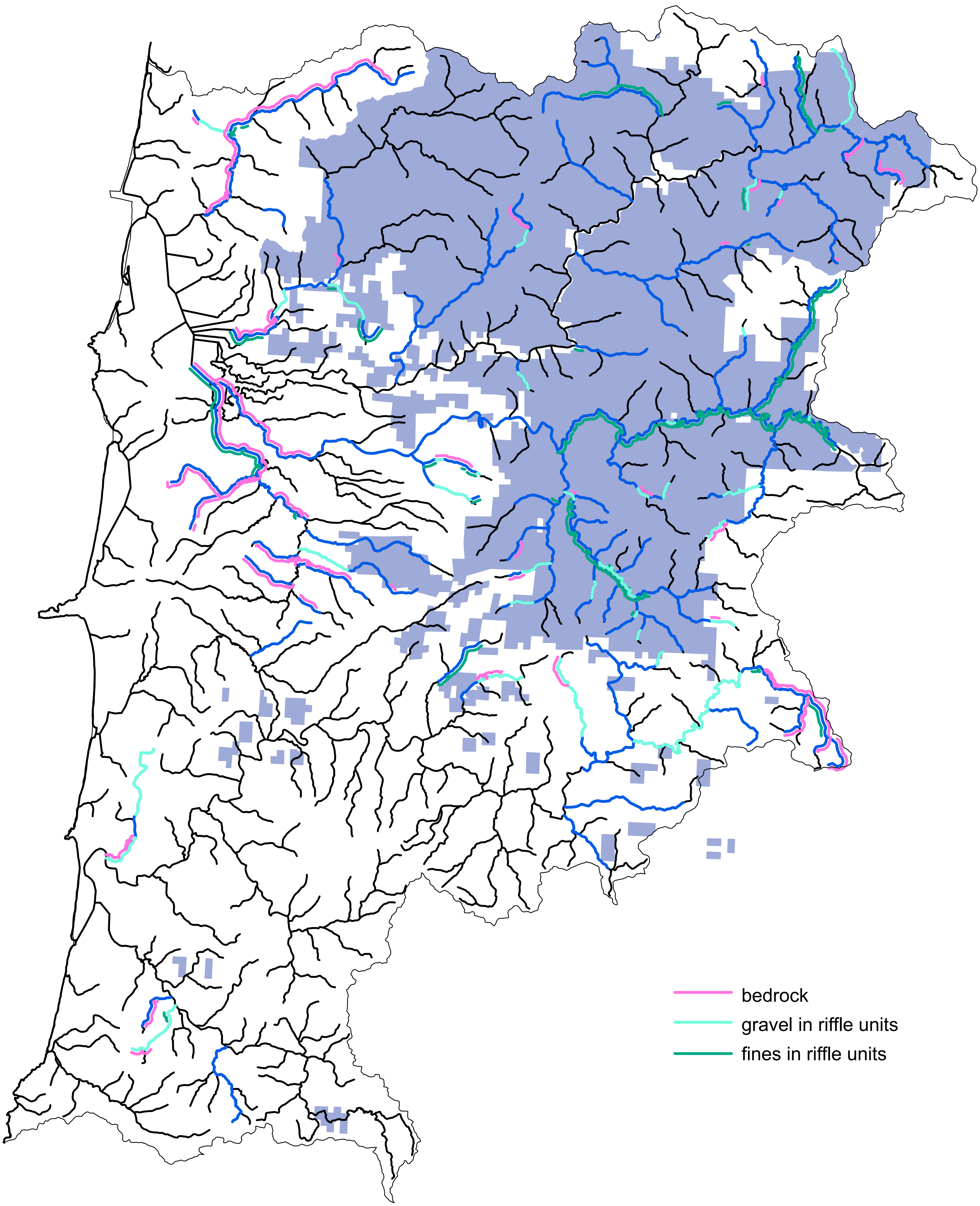
Map 17. Gradient of streams in the Tillamook and Nestucca basins (source: CLAMS).



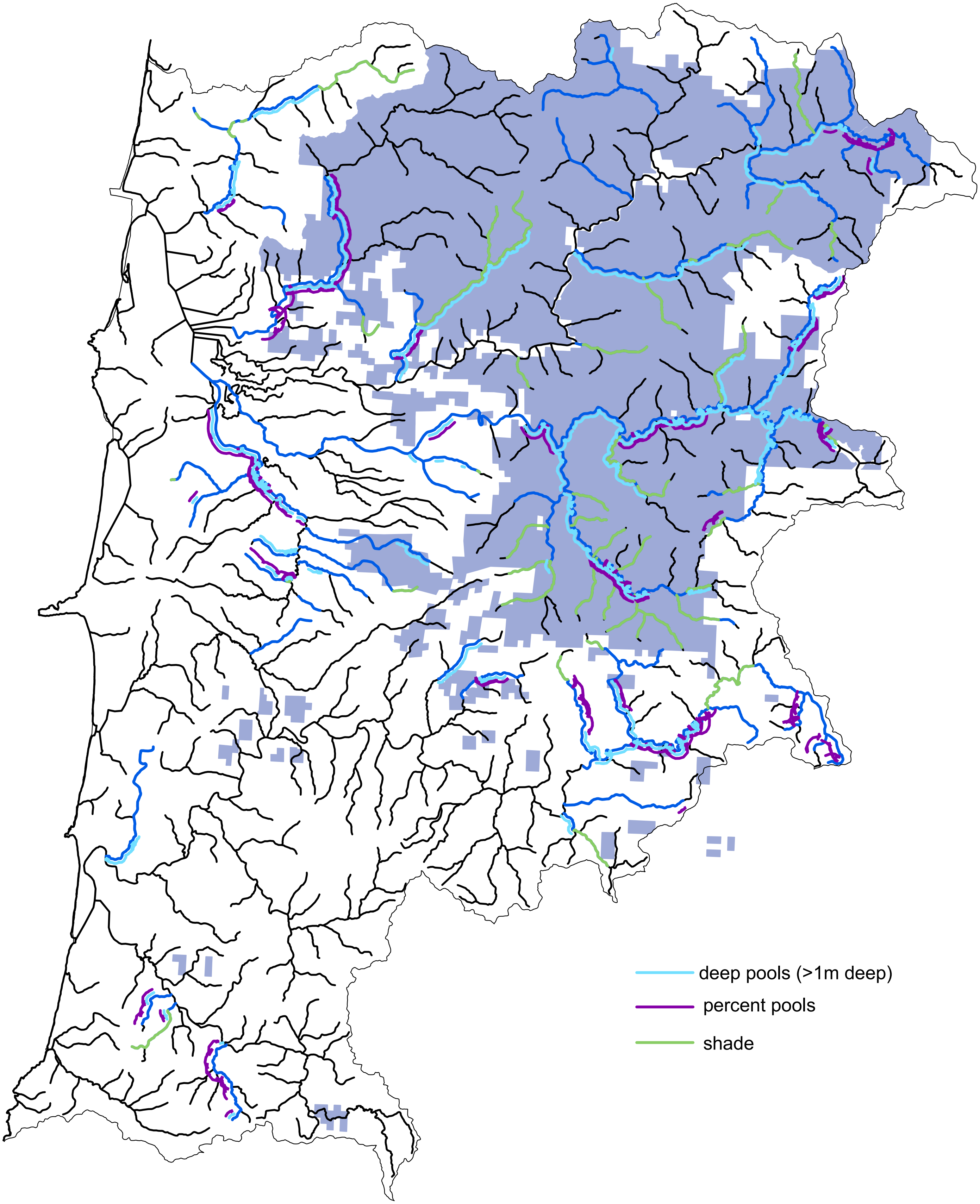
Map 18. Active channel width (m) of streams in the Tillamook and Nestucca basins (source: CLAMS).



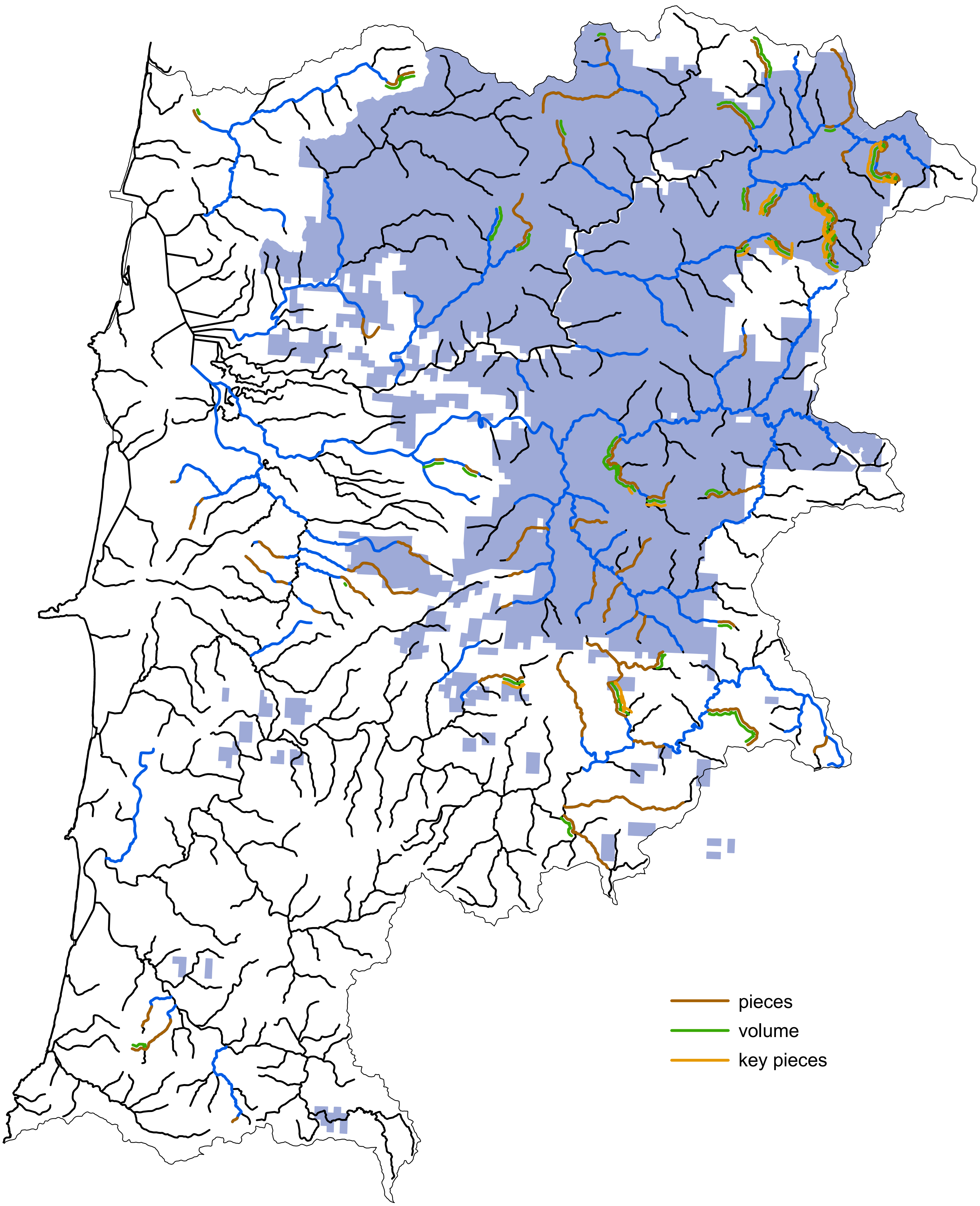
Map 19. Summer survey sites - Oregon Plan and basin - in the Tillamook study area.



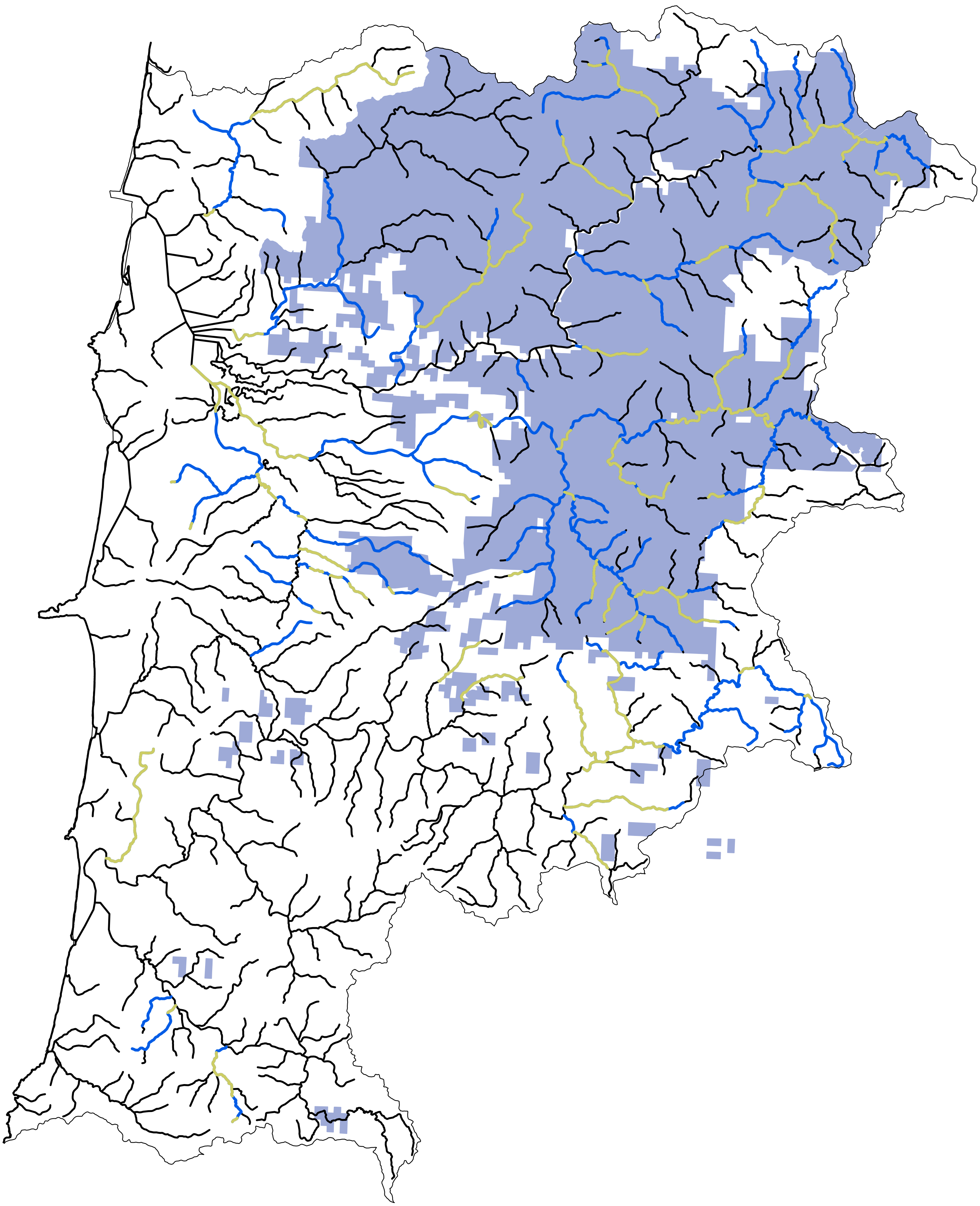
Map 20. Reaches which meet or exceed the high breakpoint for key habitat characteristics - percent fine and gravel substrates in riffle units and percent bedrock - in the Tillamook study area.



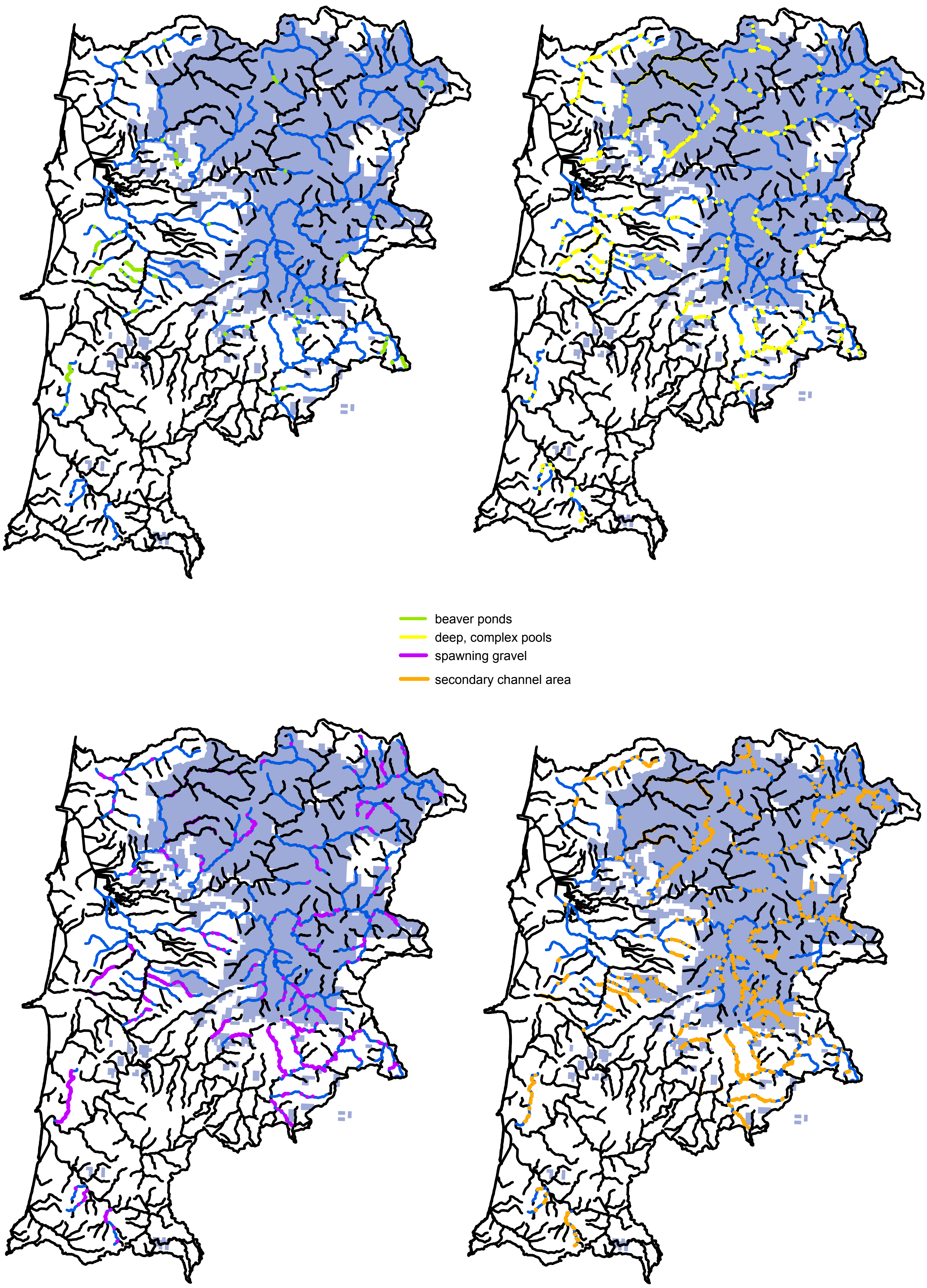
Map 21. Reaches with key habitat characteristics - percent pools, number of deep pools, percent shade - which meet or exceed the high breakpoint level in the Tillamook study area.



Map 22. Reaches which meet or exceed the high breakpoint for key habitat characteristics - number of pieces, volume, and key pieces of large wood per 100 meters of primary channel length - in the Tillamook study area.



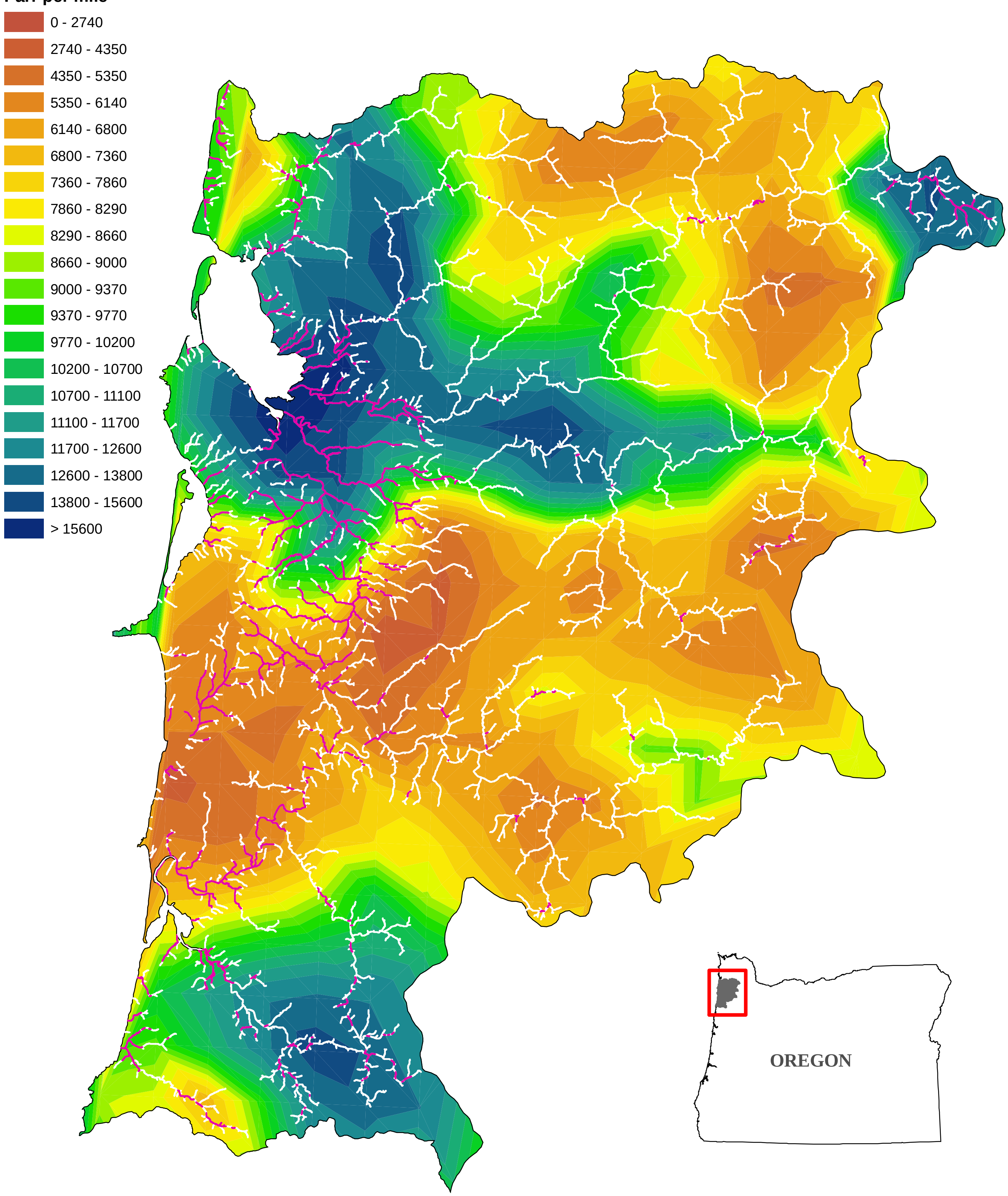
Map 23. Reaches which meet or exceed the high breakpoint for key habitat characteristics - secondary channel area - in the Tillamook study area.



Map 24. Habitat units displaying important habitat characteristics - beaver ponds, deep pools with wood, spawning area, secondary channel area - in the Tillamook study area.

Map 25. ODF Tillamook Study Area:

Summer Habitat Capacity for Juvenile Coho Salmon



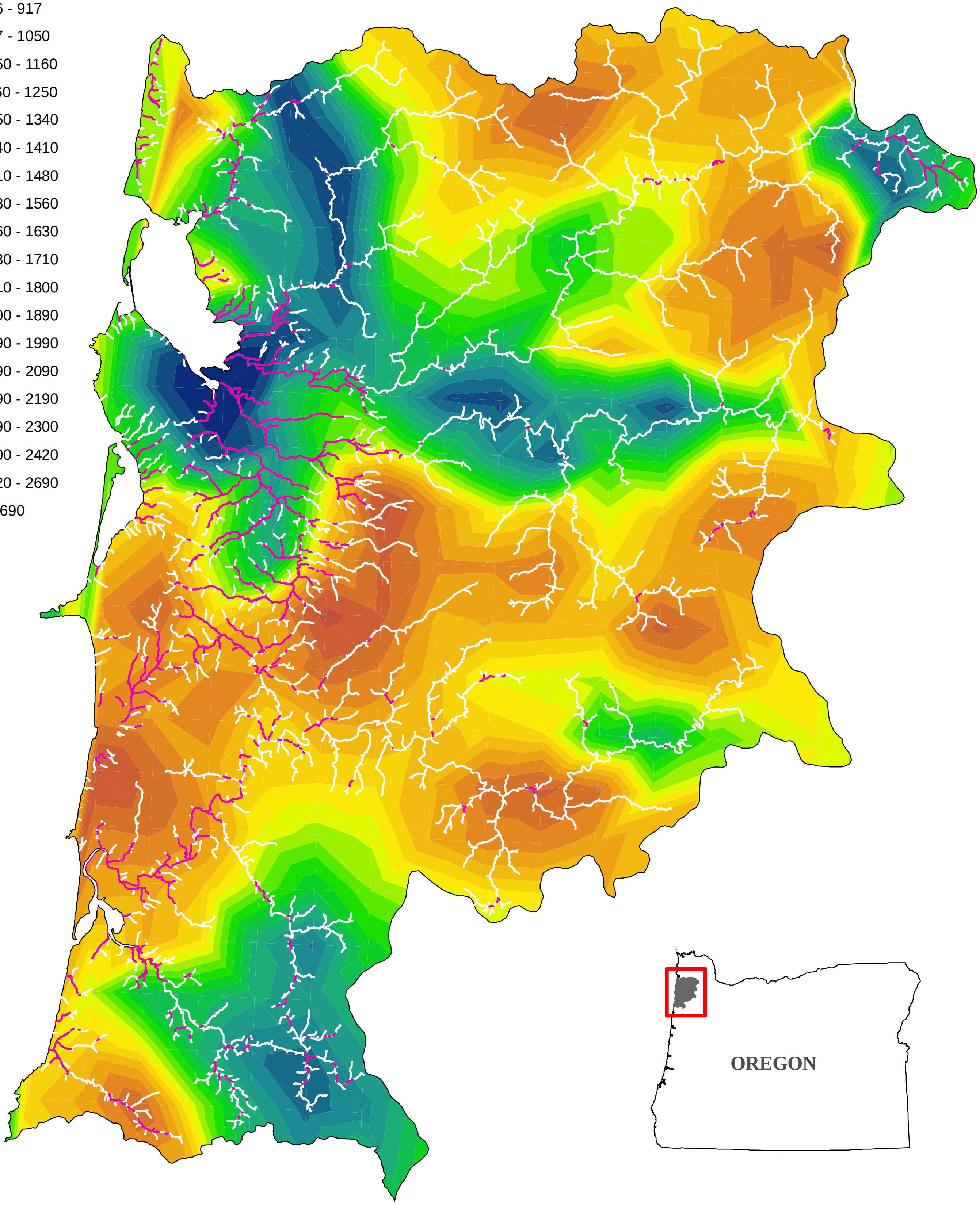
Map 26. ODF Tillamook Study Area:

Winter Habitat Capacity for Juvenile Coho Salmon

Coho Distribution
High Intrinsic Potential

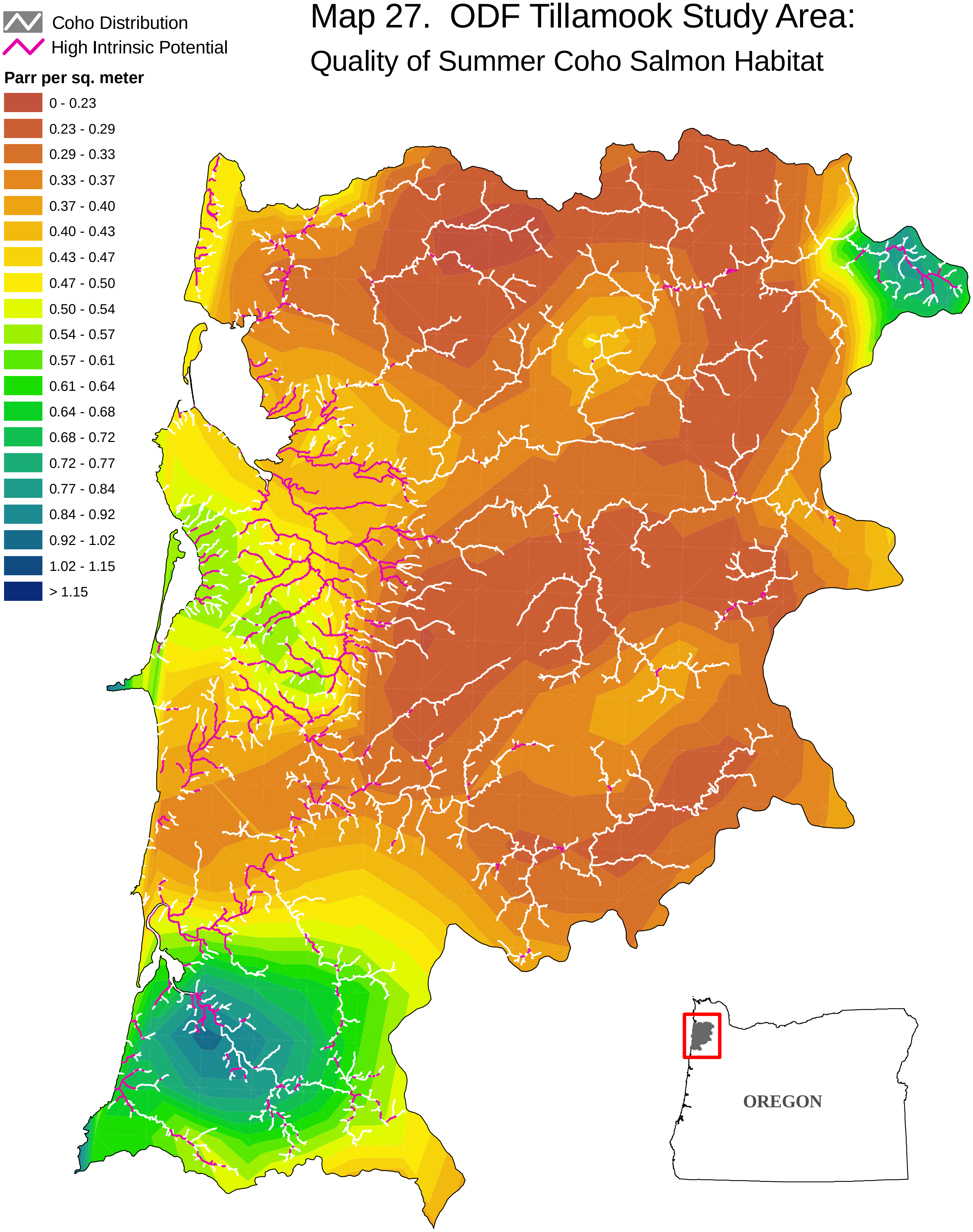
Parr per mile

0 - 736
736 - 917
917 - 1050
1050 - 1160
1160 - 1250
1250 - 1340
1340 - 1410
1410 - 1480
1480 - 1560
1560 - 1630
1630 - 1710
1710 - 1800
1800 - 1890
1890 - 1990
1990 - 2090
2090 - 2190
2190 - 2300
2300 - 2420
2420 - 2690
> 2690



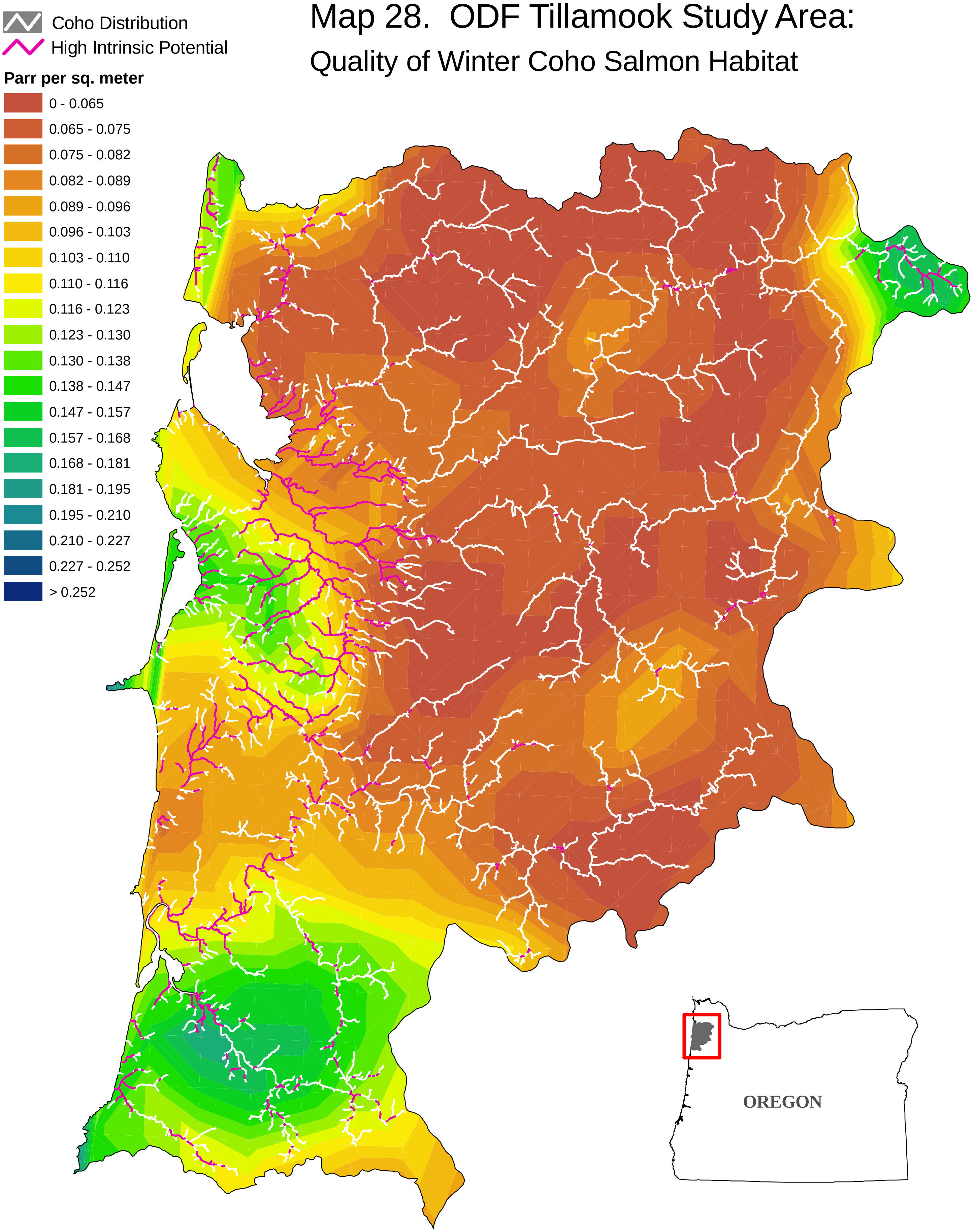
Map 27. ODF Tillamook Study Area:

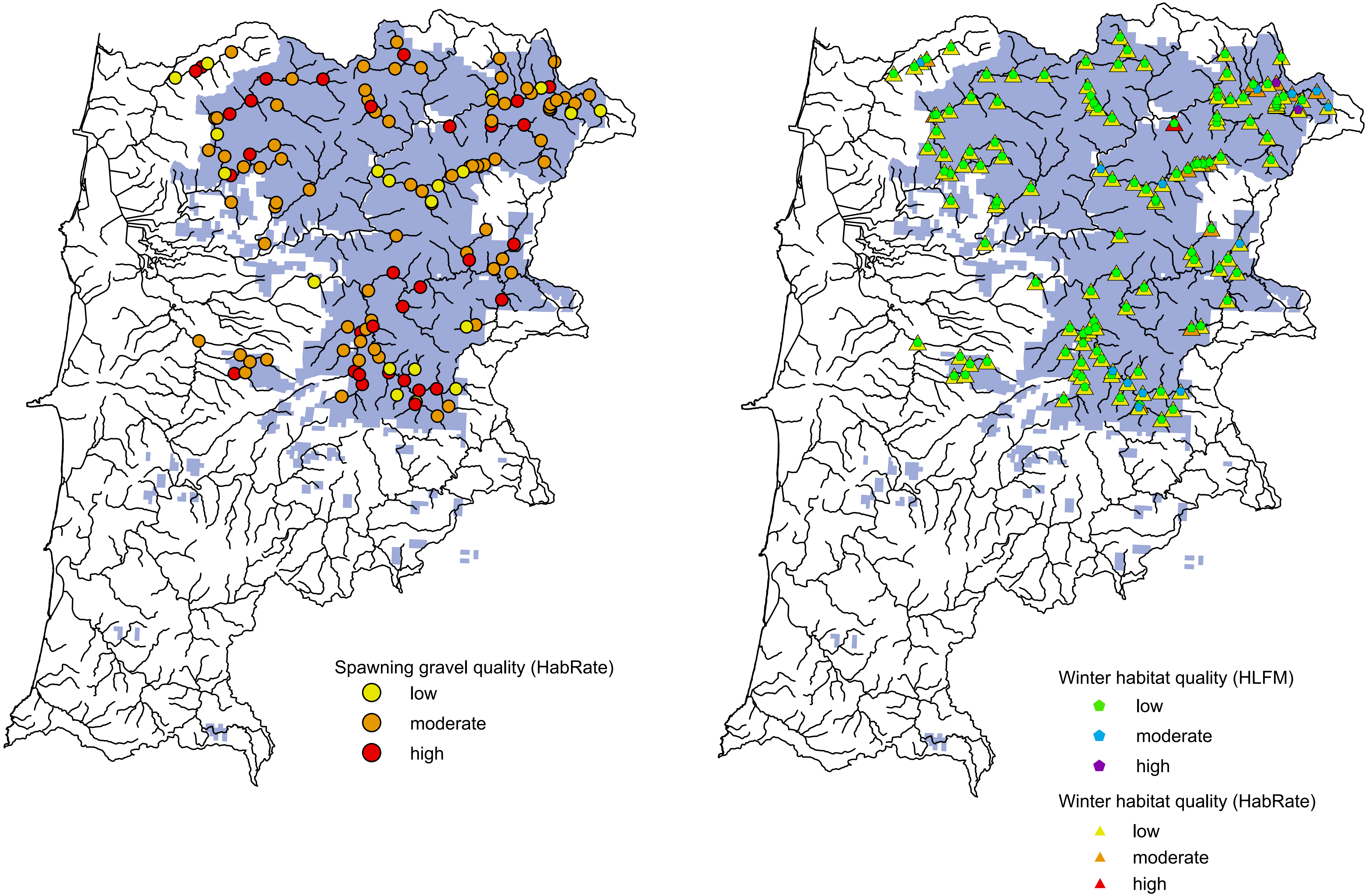
Quality of Summer Coho Salmon Habitat



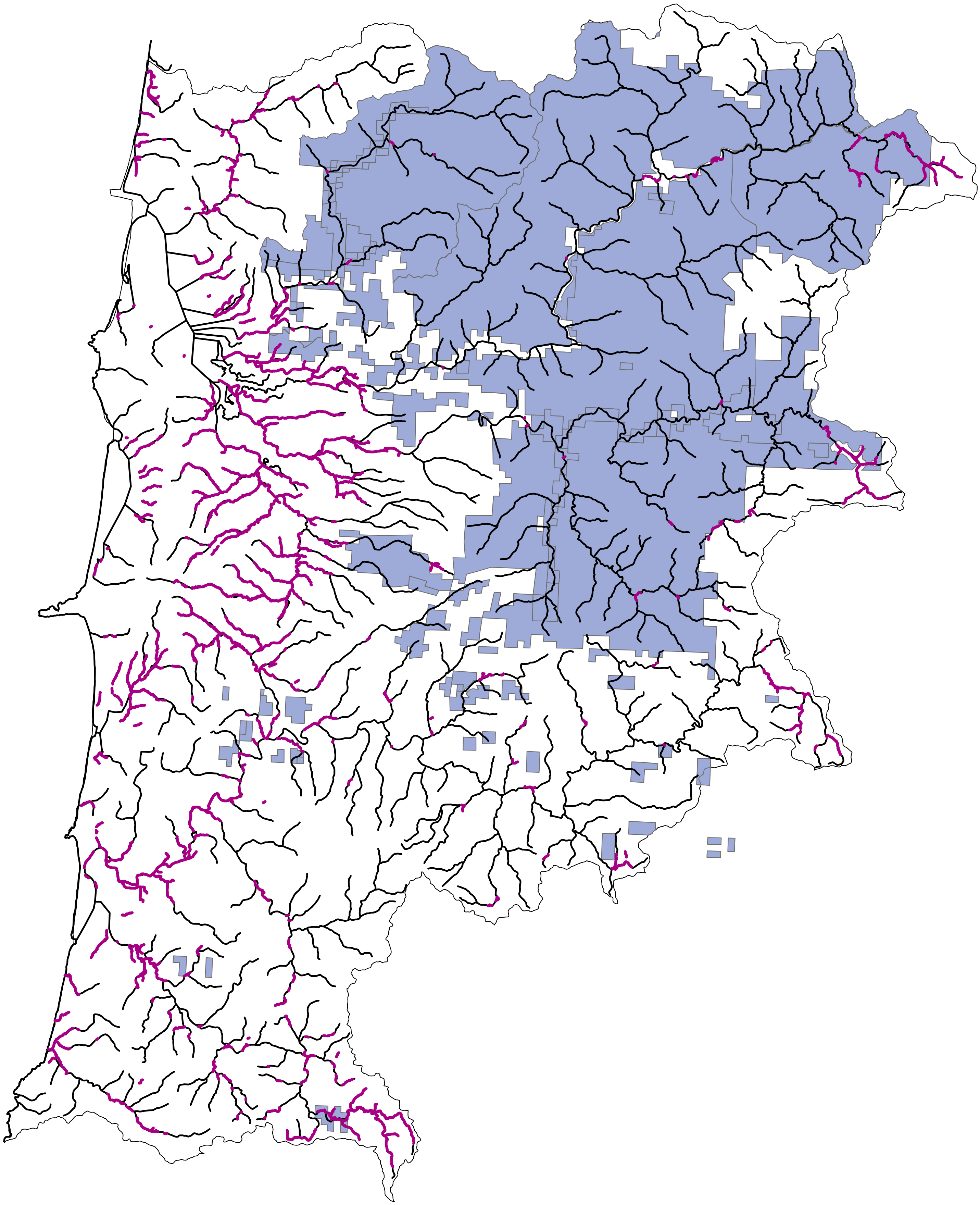
Map 28. ODF Tillamook Study Area:

Quality of Winter Coho Salmon Habitat

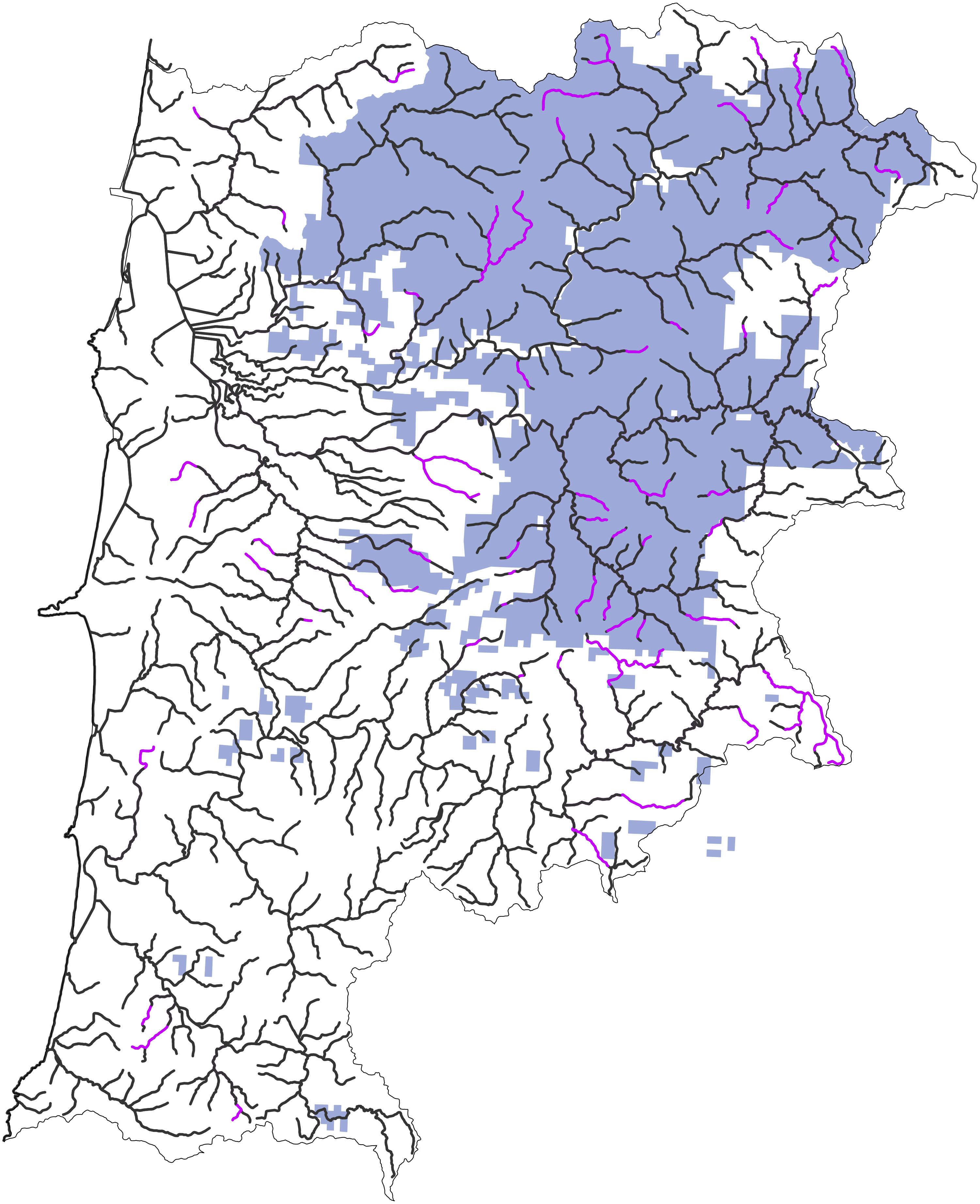




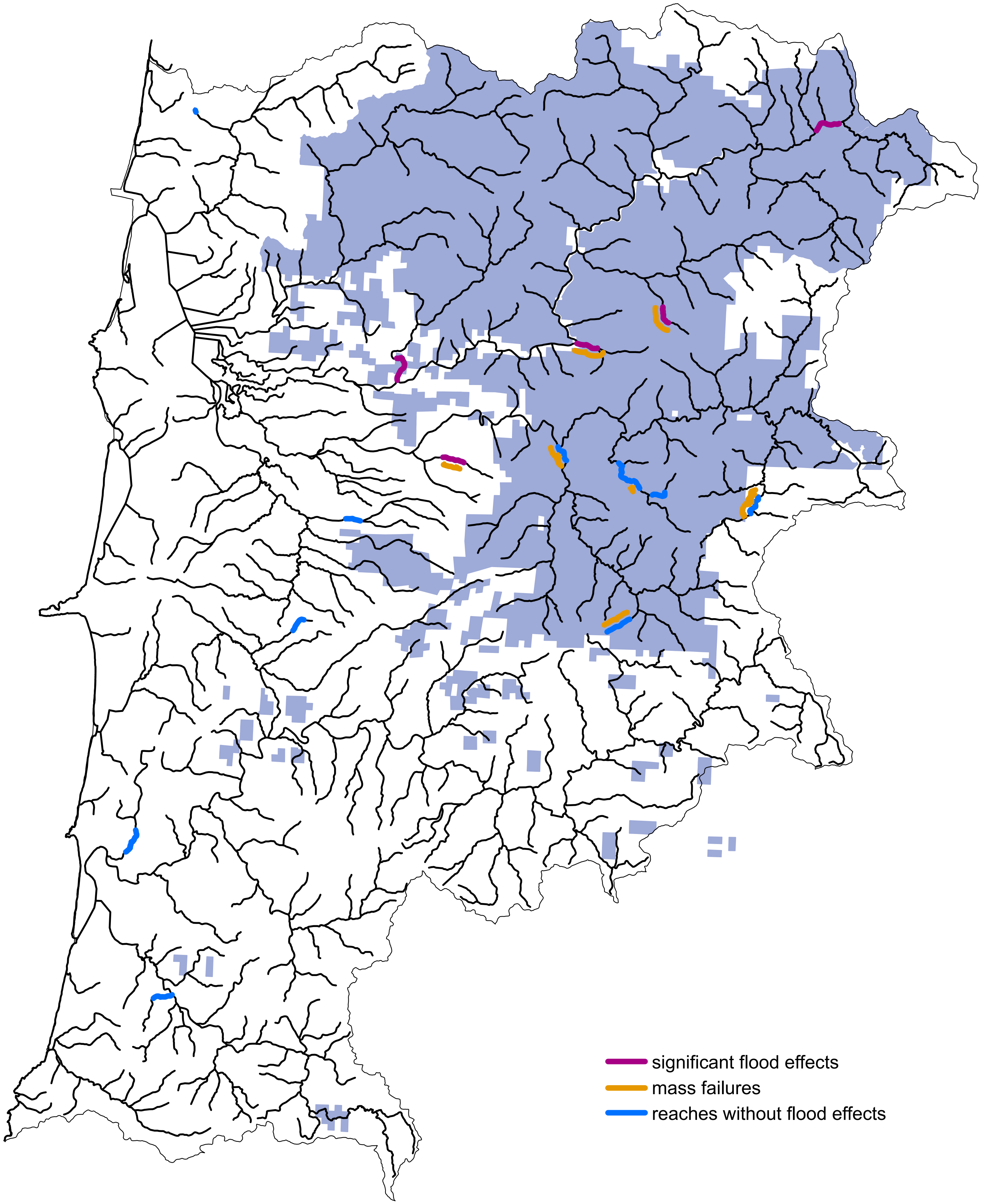
Map 29. Quality of winter habitat and spawning gravel within coho salmon distribution in the Tillamook study area.



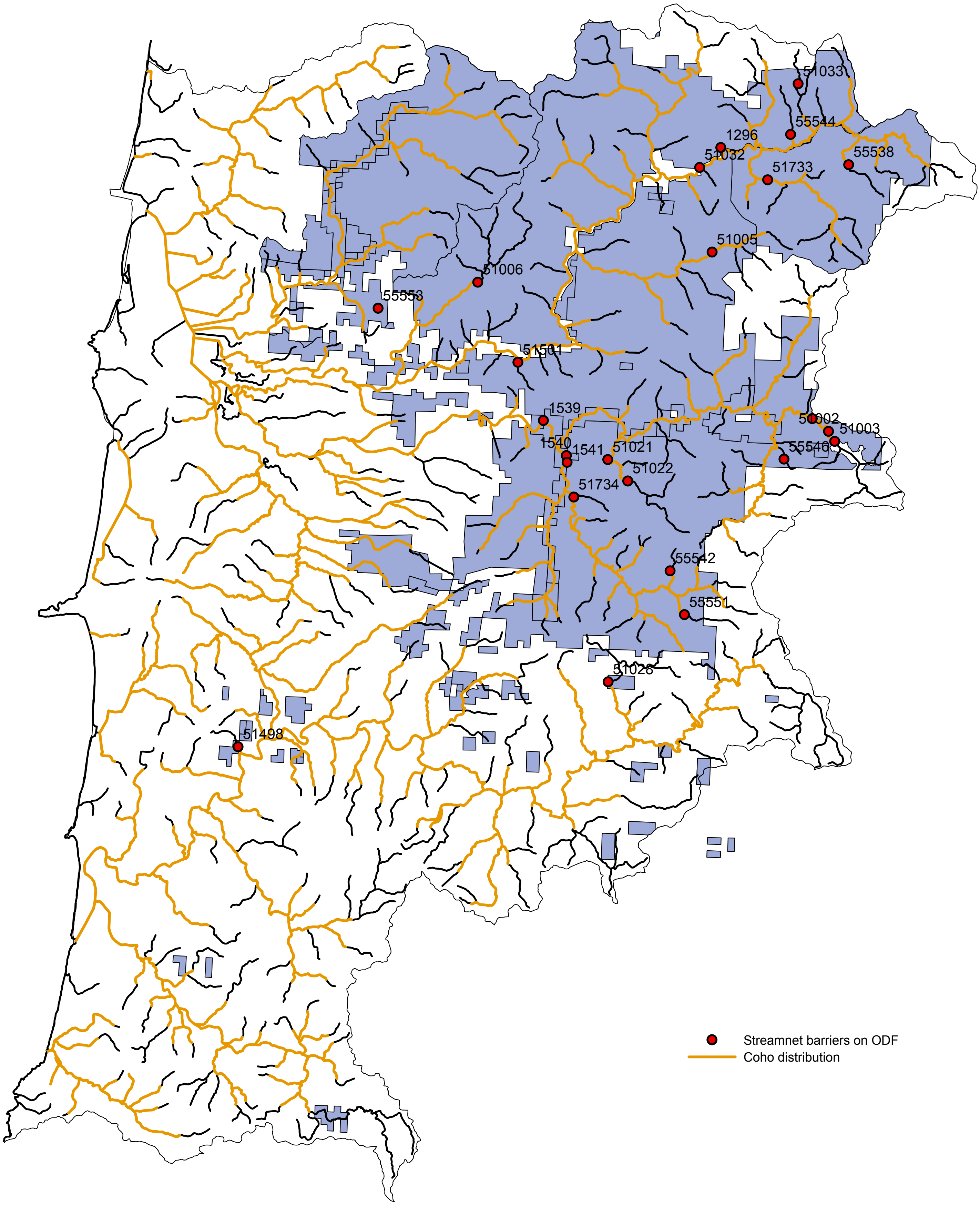
Map 30. Intrinsic potential for coho salmon (>0.80 = high) in the Tillamook study area (source: CLAMS).



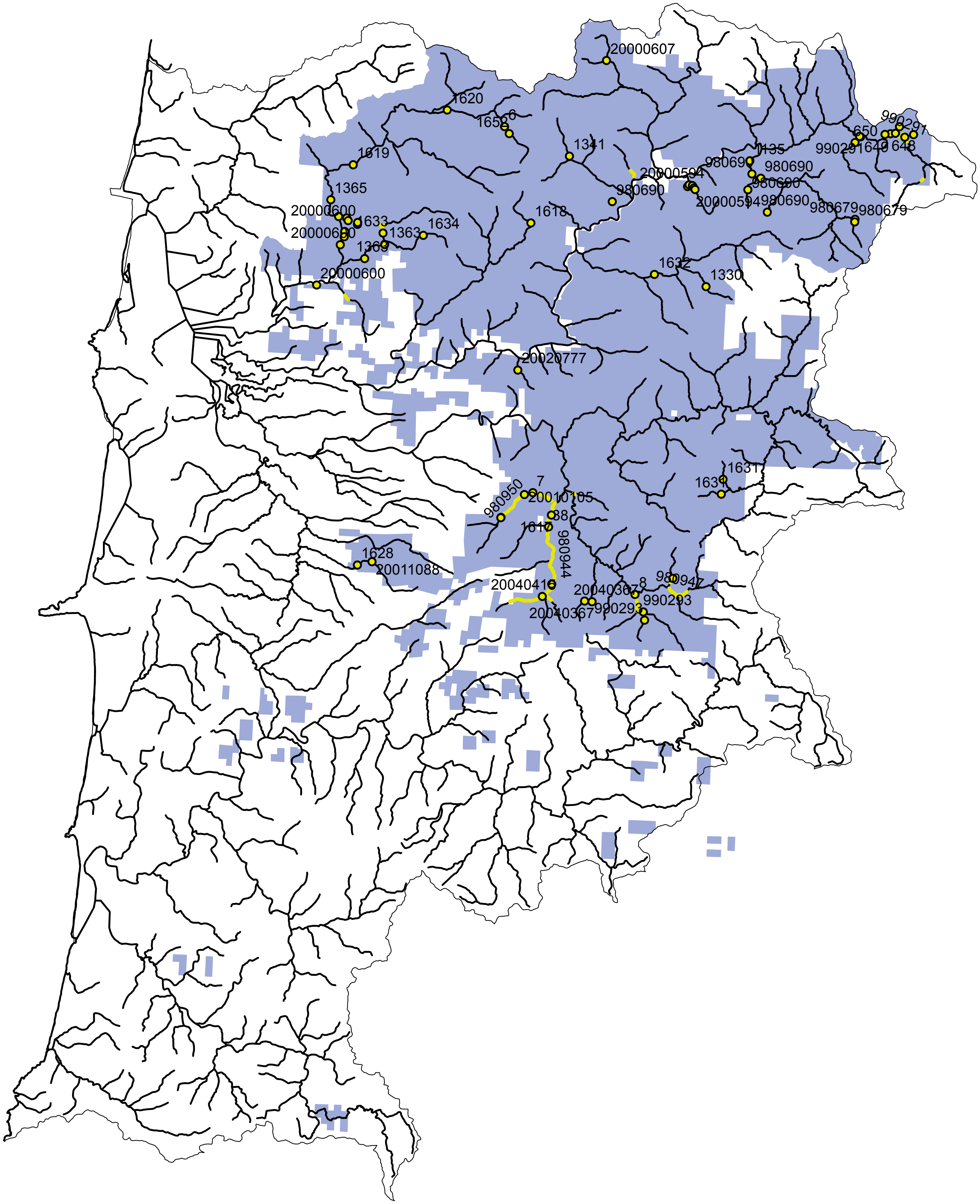
Map 31. Small streams, defined as habitat upstream of coho salmon distribution, displayed as purple linework in the Tillamook study area.



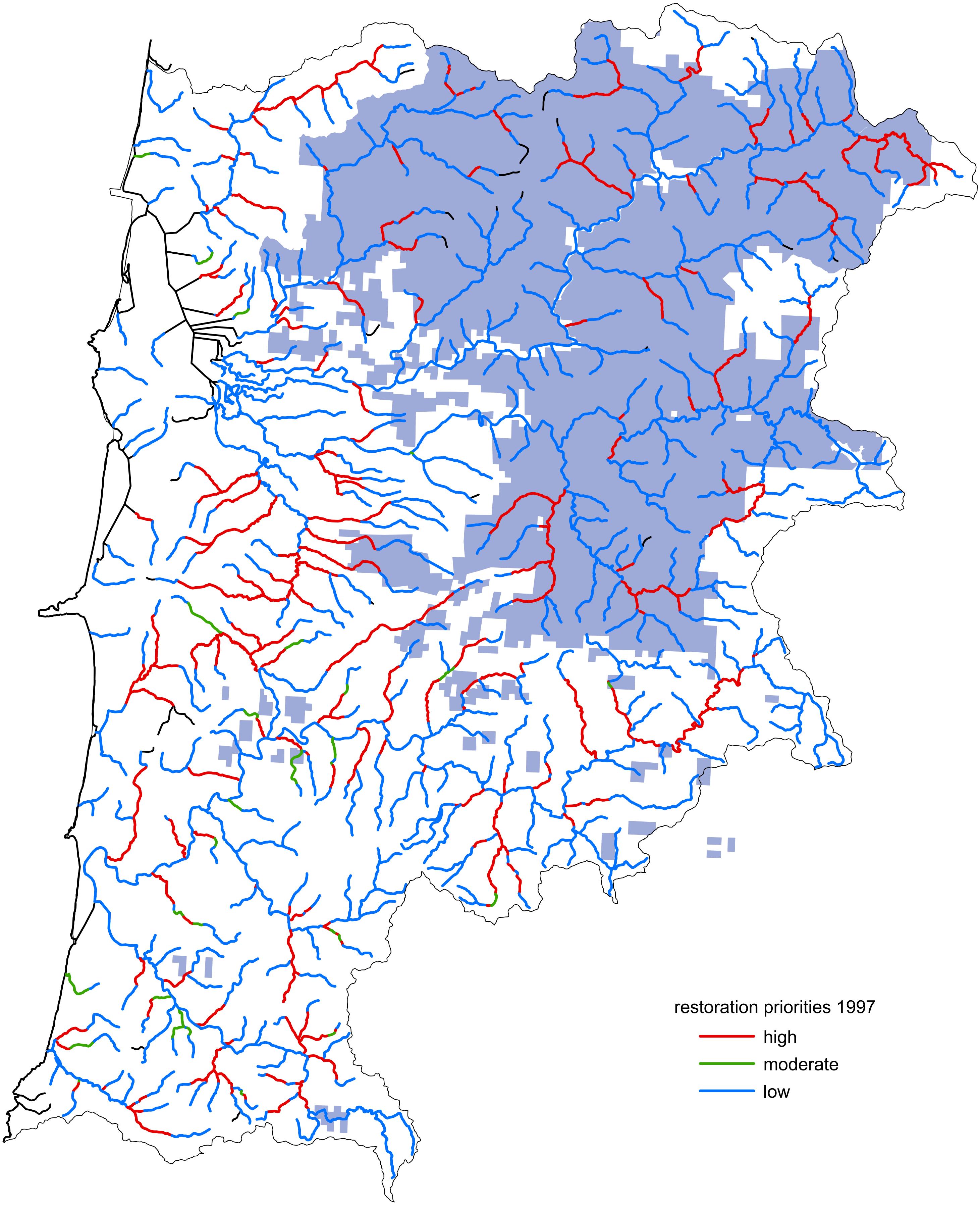
Map 32. Effects of the 1996 flood within the Tillamook study area. Sites were randomly chosen from previous basin surveys.



Map 33. Coho salmon distribution and Streamnet barriers (identified by RecordId) within the Tillamook study area.



Map 34. Instream restoration projects (identified by project number) funded by OWEB in the Tillamook study area.



Map 35. Potential sites for restoration based on priority level in the Tillamook study area (Thom and Moore, 1997).

Map 36. Instream restoration projects within coho salmon distribution in the Tillamook study area.