THE OREGON PLAN for Salmon and Watersheds

2000 Reference Site Selection and Survey Results

Report Number: OPSW-ODFW-2001-6

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Monitoring Report No. OPSW-ODFW-2001-6

November 11, 2001

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Funds supplied by:

Oregon Forest Industries Council, State of Oregon (OPSW)

Citation: Thom, B. A., P. S. Kavanagh, and K. K. Jones. 2001. Reference Site Selection and Survey Results, 2000. Monitoring Program Report Number OPSW-ODFW-2001-6, Oregon Department of Fish and Wildlife, Portland, Oregon.

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Introduction

The Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project conducts stream habitat surveys as part of the Oregon Plan for Salmon and Watersheds. The goal of these surveys is to document the status and trends of stream conditions that exist in coastal drainages of western Oregon. To better interpret landscape patterns in aquatic habitat character, the Aquatic Inventories Project has sought to improve the definition of a set of reference conditions from which to compare habitat survey sites.

Over the past three years, the set of reference conditions used in analyses was selected from basin-wide habitat surveys conducted between 1992 and 1997. These conditions did not adequately represent the variety of stream sizes, geologic types, or ecoregions present in all coastal streams. The Aquatic Inventories Project selected a set of new reference survey locations that better represent reference conditions in coastal streams for a variety of ecoregions, geologic types, and basins.

Reference site definition

The reference sites selected for the year 2000 represented watershed areas with low impact from human activities such as roads, development, and forest management. Ideally, areas would have been selected that were completely free from human disturbance, but we concluded it was more important to represent a larger geographic range of conditions across the landscape.

Site selection and survey

The selection of reference sites by the ODFW Aquatic Inventories Project involved the following steps:

1) Delineation of reference watersheds
2) Selection of randomly chosen sites within the reference watersheds
3) Reconnaissance of sites
4) Field verification and survey.

In order to expedite the selection process, the initial reference watersheds were selected from two previous reference site selection procedures. The first was the Oregon Department of Environmental Quality (DEQ) Laboratory Division (Mrazik 1999) procedure. The second set was a subset of the Oregon Chapter American Fisheries Society (ORAFS) Aquatic Diversity Areas (Oregon Chapter AFS 1993). The DEQ reference sites were used to delineate entire watersheds, upstream of the DEQ sample points. The benefits of using the previously selected DEQ sites were the following: biologists from throughout coastal drainages had made the selections, the sites had been evaluated at a gross level for human disturbance, and they had been field-verified. The ORAFS reference watersheds represented a wider range of conditions on the landscape, were at a much coarser scale of resolution, and had not been field-verified. Both sets were evaluated to determine if they represented a variety of geologic and ecoregion types within watersheds. From this set of watersheds, twenty-six separate analysis areas (watersheds) were selected. The methods used were those described by Moore et al. (1997) and Thom et al. (2000).

The twenty-six selected watersheds were overlaid with the existing Oregon Plan random habitat survey sample sites to select unique potential sample locations. From this set of potential sample sites, one to two reference sample locations were randomly selected from each of the twenty-six analysis areas to achieve the goal of approximately fifty reference surveys for the year 2000.

Site verification in the office and field sometimes yielded site movement. Sites may have been moved or dropped in the laboratory based on their proximity to obvious human disturbance (houses, floodplain roads, and upstream road crossings) as determined from a topographic map. Field verification yielded site movement in cases when human disturbance was not evident from the topographic map. Sites were moved if a site of similar stream size, geology, or ecoregion could be found in close proximity to the randomly chosen sites. However, watersheds were dropped if acceptable sites could not be found in the area. As the sites were randomly chosen, some watersheds were selected more than once. Due to the limited number of relatively unimpacted watersheds and the sampling overlap, dropped sites did not reduce the range (stream size, geologic type, etc.) of sites surveyed.

While the reference sites for the year 2000 do not represent all of the reference areas that could be surveyed, they are a more accurate depiction of the stream sizes, geology, and ecoregions that exist in coastal drainages. The year 2000 reference surveys are a substantial improvement over the previous set of reference conditions in their overall representation of habitat condition in coastal basins.

Differences in watershed characteristics between 1990-1997 and 2000 reference surveys

The sites surveyed during the summer of 2000 were representative of aquatic conditions in minimally influenced streams in western Oregon. The reference sites used previously were based on select basin-wide surveys conducted from 1990 to 1997, primarily in the Cascade Range (Figure 1). The 1990-1997 reference surveys were located in unmanaged watersheds with few human impacts, were predominantly under federal ownership, and were mainly of volcanic parent geology. The 1990-1997 reference surveys had limited applicability to the Coast Range watersheds. The 2000 reference surveys were selected from Coast Range and Cascade watersheds, volcanic and sedimentary geology, and had an even distribution of stream orders and basin areas. The ownership included federal, forest industry, and state lands. Streams on private non-industrial lands did not meet any of the selection criteria. The 2000 reference streams were surveyed during the same sampling season, as opposed to the eight-year span encompassed in the 1990-1997 reference surveys. Additional comparisons of the two reference surveys are made in Table 1.

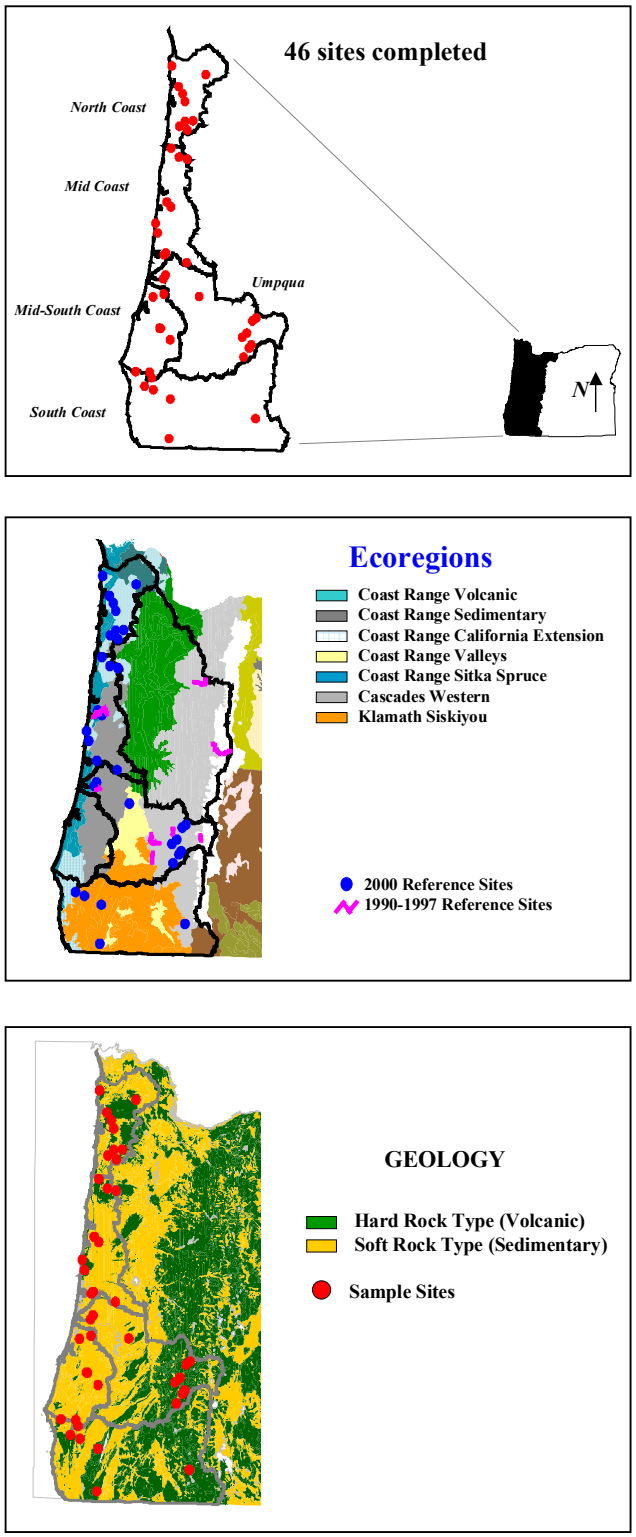


Figure 1. Location of 46 sample sites in relation to Gene Conservation Areas (top), ecoregions and 1990-97 reference sites (center), and geology zones (bottom).

Table 1. Comparison of 2000 and 1990-1997 reference sites.

Attribute	2000 Reference	1990-97 Reference
Distance surveyed (km)	30.1	93.1
Number of reaches surveyed	46	53
Active channel width (m)		
Mean (median)	10.0 (8.35)	10.6 (9.65)
Range	1.2 – 24.6	0.5 – 21.5
Gradient (%)		
Mean (median)	5.3 (2.9)	4.4 (3.85)
Range	0.5 – 27.4	0.7 – 14.5
Land ownership	mixed	primarily federal
Ecoregions	primarily Coast Range	primarily Cascades
Geology	sedimentary & volcanic	primarily volcanic

Results and Discussion

The Aquatic Inventories Project focused on specific variables to describe important indicators of sediment supply and quality, riparian forest connectivity and health, habitat structure, and instream habitat complexity. There are many processes and components that contribute to the structure and productivity of a creek and of a fish community. The Aquatic Inventories Project found specific attributes to be less variable between years and surveyors (Thom et al., 1999). These attributes were summarized in terms of percentiles on Table 2. Figures 2 and 3 summarize the 1990-1997 and 2000 reference surveys. We used cumulative frequency distributions to examine the survey data. The frequency distribution graphs are useful for determining medians and percentile values, and for comparing the differences in distribution of values between two or more datasets (Zar, 1996). Although reference conditions and benchmark values may reveal similar results, they should be considered differently (Moore, 1997). Benchmark values are derived from ODFW Aquatic Inventories Project basin surveys. They function as guidelines when examining stream conditions (Moore and Jones, 1996).

The quantity of fine sediments in salmon spawning gravels can influence the survival of eggs and alevins in the substrate (Bjornn and Reiser, 1991). Survival to emergence is inversely related to the amount of fine sediments. Approximately 85 percent of the 2000 reference surveys had fine sediment levels less than twenty percent in low gradient riffle habitat. The 25th and 75th percentiles were five and fifteen percent fines, respectively, with a median value of eleven percent

fines. The underlying parent geology appeared not to affect the percent of riffle fines in reference streams, but the sample size was small (Figure 4). The number of sites of soft rock type (sedimentary) was twenty-five, while the number of sites with hard rock type (volcanic) was twenty-one.

Table 2. Frequency distribution of key habitat variables for reference stream reaches. ODFW habitat surveys during the summer of 2000 (n = 46 reaches). Quality of habitat feature increases to the right.

	Percentile		
	25th	Median	75th
Fines[1] in riffle units (%)	15	11	5
Gravel[2] in riffle units (%)	26	35	55
Shade[3] (% of 180)	77	84	92
Large riparian conifers[4]	0	50	120
Wood pieces[5]	8	16	24
Key wood pieces[6]	0.3	1.4	2.6
Pool area (%)[7]	15	28	35
Deep pools[8]	0	1.5	5.5

[1] Fines are sediments <2 mm diameter; ocular estimates of surface composition
[2] Gravels are 2-64 mm diameter; ocular estimates of surface composition
[3] Measured with a clinometer; percent of 180% that topography or vegetation visually occludes the sky
[4] Conifer trees ≥50 cm dbh along 305 m (1000 feet) length of stream
[5] Large wood debris ≥3 m length and ≥15 cm diameter per 100 m of stream length
[6] Large wood debris ≥10 m length and ≥60 cm diameter per 100 m of stream length
[7] Percent wetted area of stream habitat
[8] Pools ≥1 m deep per 1 km of stream length

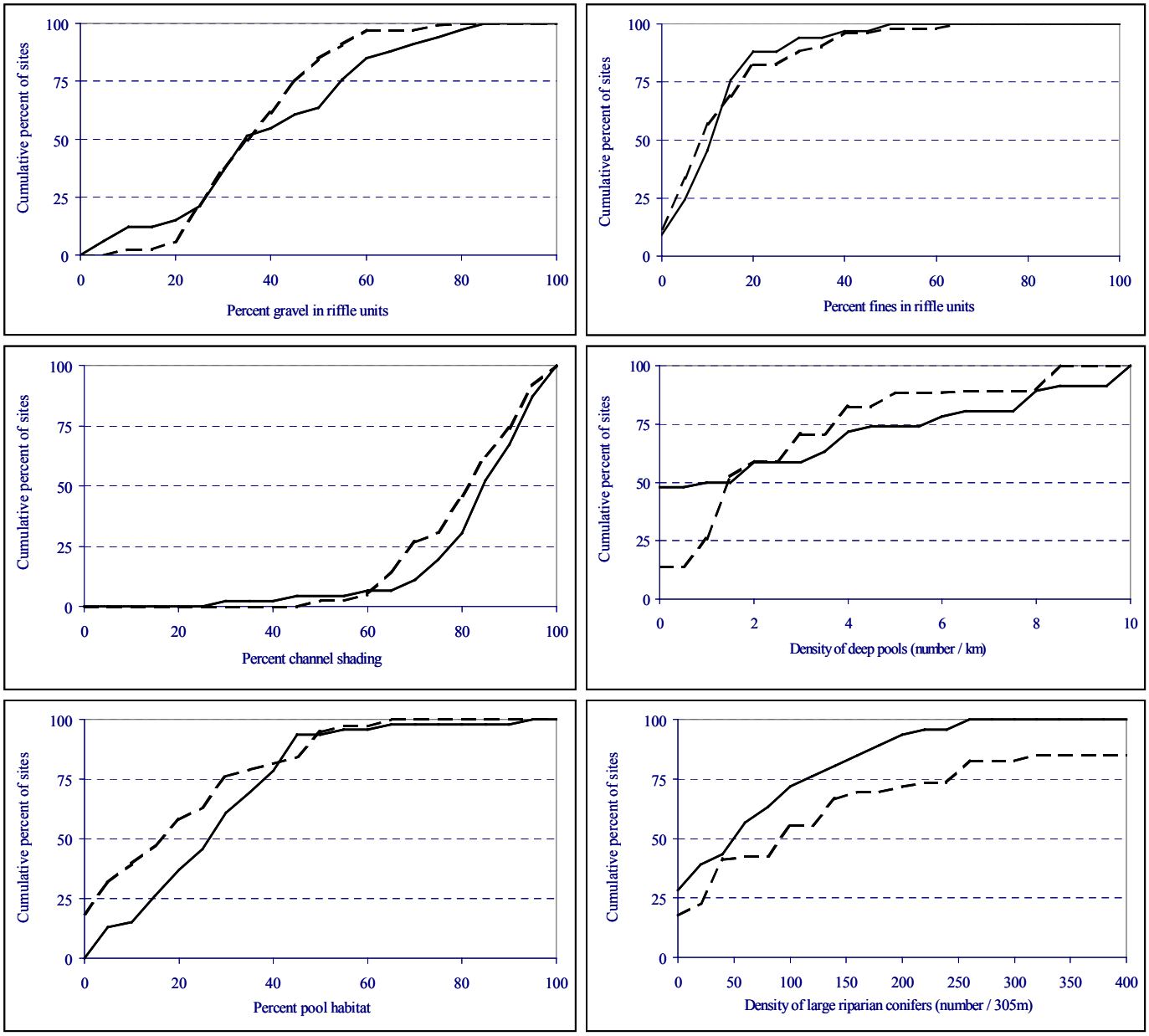
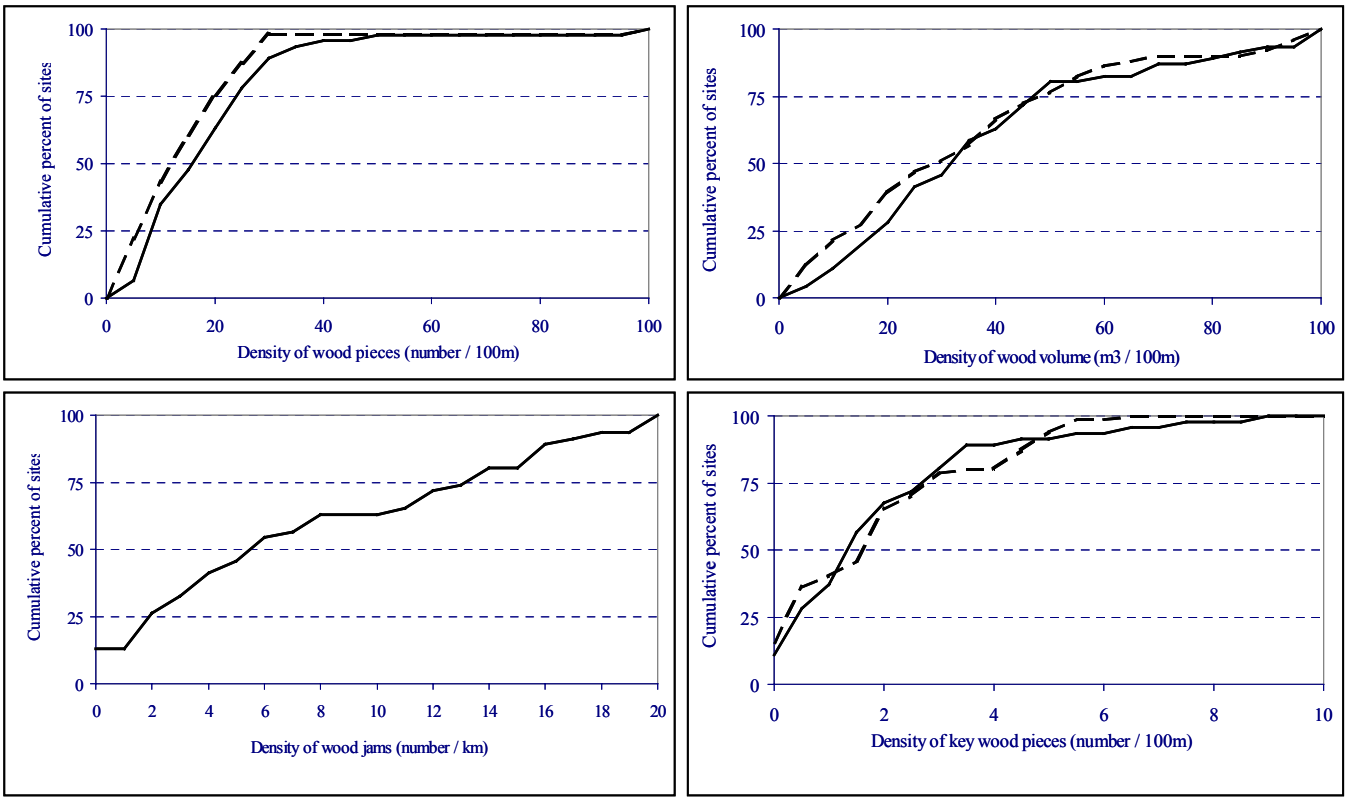


Figure 2. Cumulative frequency distributions of key habitat variables for comparing stream reaches from 1990-1997 reference surveys and 2000 reference surveys: riffle units with gravel and fine substrates, channel shading, deep pools, pools, and large riparian conifers (>50 cm dbh).



----- 1990-1997 Reference Surveys

—— 2000 Reference Surveys

Figure 3. Cumulative frequency distributions of key habitat variables for comparing stream reaches from 1990-1997 reference surveys and 2000 reference surveys: wood pieces, wood volume, wood jams, and key wood pieces. The density of wood jams was not calculated form the 1990-1997 reference surveys.

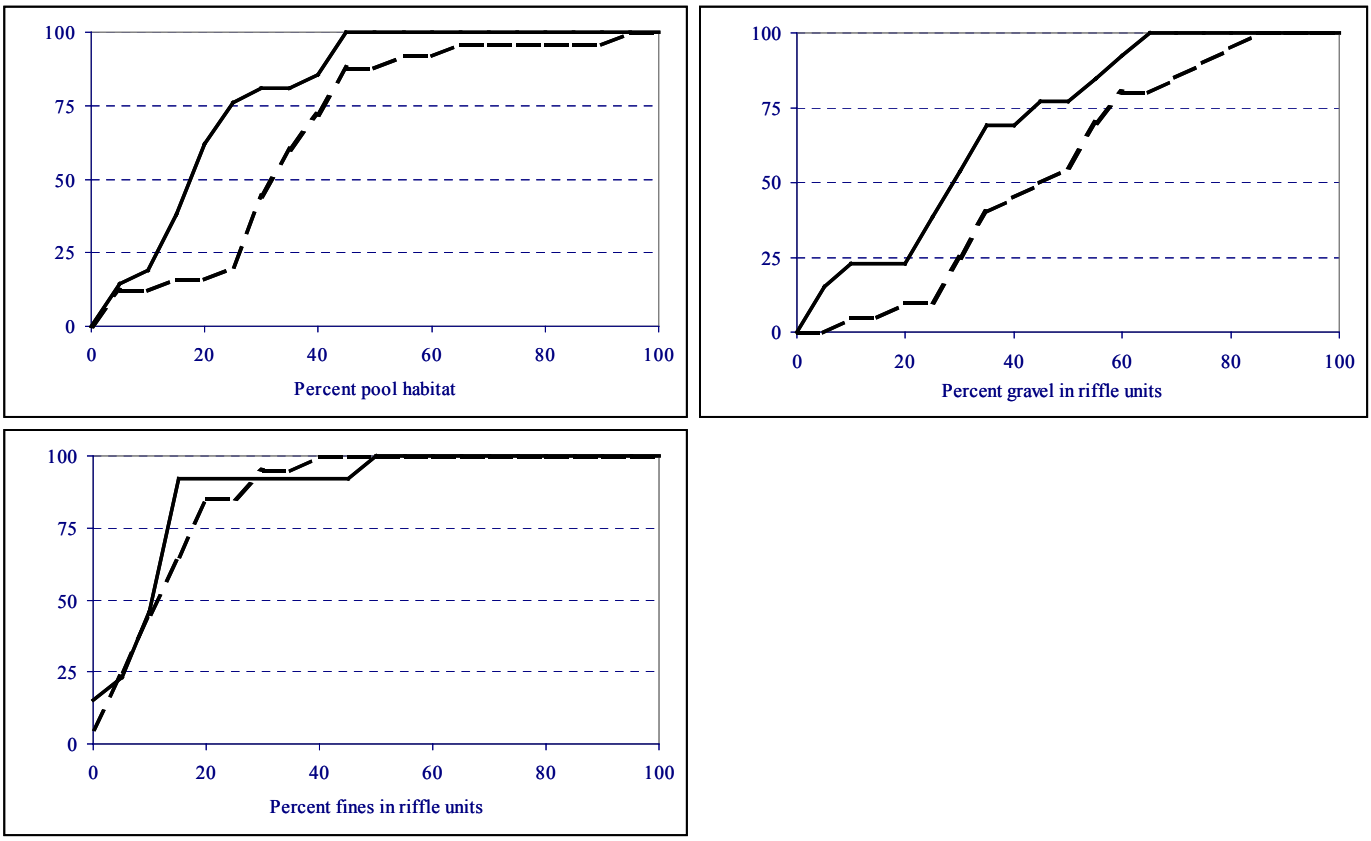


Figure 4. Cumulative frequency distributions of key habitat variables in stream reaches within soft and hard geologies in the 2000 reference surveys: percent pool habitat and percent gravel and fine sediments in riffle units.

Gravel is essential substrate for salmonid spawning and salmonid egg incubation (Bjornn and Reiser, 1991). A stream reach with more than thirty-five percent gravel in riffles is desirable, less than fifteen percent is less desirable (Moore, 1997). Reference conditions had a median of thirty-five percent gravel in riffle units, 25th and 75th percentiles of twenty-six and fifty-five percent, respectively. Seventeen percent of the reference stream length had less than fifteen percent gravel. The underlying geology appeared to effect the percent of riffle gravel in reference streams; sites with sedimentary geology had greater gravel density on average (Figure 4).

The vegetation in the riparian zone provides nutrients, insects, shade, inputs of organic and wood materials, stable banks, a buffer for flood impacts, and can influence water temperature. While it is important to consider both riparian zone influence and channel width, general guidelines can be drawn from the reference surveys. The 25th percentile for reference stream channel shading was seventy-seven percent, while the 75th percentile was ninety-two percent. The median shade value was eighty-four percent of stream length. The number of large riparian conifers is another indicator of riparian integrity. In reference sites, fifty percent of the stream reaches had at least fifty conifer trees larger then 50 cm dbh per 305 meters of stream length. The 25th and 75th percentiles were 0.0 and 120 trees per 305 meters, respectively. The range of values in the shade and large riparian conifer attributes reflects the structural differences at the reference sites.

Instream wood provides a number of functions to the stream channel. The wood helps to scour deep pools, trap sediment, and provide cover and nutrients. Wood pieces are an attribute that describes the quantity of wood (at least 0.15 meters diameter and 3 meters in length) per 100 meters of stream channel length. In the reference streams, the median value was 16 pieces of wood per 100 meters channel length. The 25th percentile was less than eight pieces and the 75th percentile was greater than 24 pieces. Wood volume indicates the total amount of wood, integrating number of pieces and size. The volume of wood had a median of 32 m^3 per 100 m of channel length. The 25th percentile was 18 m^3 and the 75th percentile was 47 m^3 per 100 m of stream channel length. The number of key pieces (key pieces are at least 10 meters and 0.6 meters dbh) describes wood quality, wood with a long-term role in streams. The median was 1.4 key pieces per 100 meters of reference stream length. The 25th percentile was 0.3 key pieces per 100 meters of reference stream length and the 75th percentile was 2.6 key pieces per 100 meters of reference stream length. The number of wood jams is a measure of wood complexity (not calculated for the 1990-97 surveys), based on a conglomeration of at least five pieces of countable wood. The median number of jams was 5.5 per kilometer of stream length. The 25th and 75th percentiles were 2 and 13 jams per kilometer of stream channel length, respectively.

Pools provide slow water resting areas for fish. Eighty-five percent of the reference sites had at least ten percent of the stream area in pool habitat. Deep pools, especially those with complex cover, provide high quality habitat. The median number of deep pools in reference streams was 1.5 per kilometer of stream length. The 25th and 75th percentiles were 0 and 5.5 deep pools per kilometer, respectively. The sites with sedimentary geology appeared to have more pool habitat than sites of volcanic geology (Figure 3).

Conclusions

The reference sites surveyed in the year 2000 were more representative of the western Oregon landscape than the 1990-1997 reference set due to the selection process. Established DEQ and ORAFS site selections were used as the basis of the selections. The previous reference set was biased towards surveys conducted in the Cascade Range, thereby limiting the features described. The new set reflects coastal watershed conditions on lands representing a mix of ecoregions, stream sizes, and geology.

In relation to the previous reference set, the 2000 reference set had streams with higher densities of gravel in riffle units, more wood pieces, and greater channel shading. The wood densities were more variable than the 1990-1997 reference set. The density of deep pools in the 2000 reference set was lower in half of the streams, which may be due to a larger number of small streams in this reference selection as opposed to the 1990-1997 set. The number of wood key pieces was similar, while the number of large riparian conifers was lower. Fewer large riparian conifers can be attributed to the site selection process. The previous 1990-1997 reference set was based on mature forests and late successional forest land types. The 2000 reference set had a wider range of forest management, including harvest history in the riparian zone and uplands. Few sites existed in which no management had occurred.

The attributes described did not represent all conditions necessary for high quality salmon habitat; they represented important characteristics of habitat structure within and adjacent to the stream channel. The 2000 reference set is an important baseline from which to gauge the character of Oregon coastal watershed streams in relation to the salmon productivity.

The reference surveys characterized the complexity of instream aquatic and riparian habitat in Oregon's coastal basins. The data in the reference sets are representative of the range of conditions in small watersheds that have not been intensively managed. However, due to the small sample size, this data set cannot be used to describe the reference conditions of selected ecoregions, basins, geology types, or natural disturbance regimes. Determining reference conditions for specific criteria would require a similar sample design within each stratum.

Acknowledgments

We appreciate the funding, technical review, and logistical support of the Oregon Forest Industry Council and its member companies. We particularly acknowledge the assistance of J. McCauley and Dr. V. Kaczynski.

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