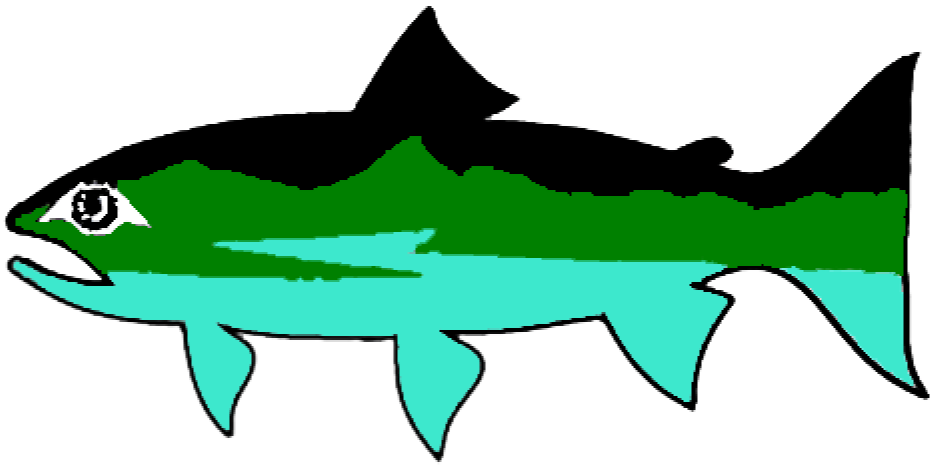
Aquatic and Riparian Effectiveness Monitoring Program
Interagency Monitoring Program – Northwest Forest Plan



2004 Annual Technical Report

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A copy of this report is also available on our Watershed Monitoring Website:
http://www.reo.gov/monitoring/watershed/

Summary

Highlights of the Aquatic and Riparian Effectiveness Monitoring Program (AREMP) during 2004 include:

- Program personnel are nearing completion of a Preliminary Assessment of Aquatic and Riparian Resources under the Northwest Forest Plan, with an expected publication date of spring, 2005.
- Workshops were conducted to refine aquatic province decision support models. Aquatic specialists reviewed model results and suggested changes in the model structures and evaluation criteria to ensure that the attributes evaluated in the models were sensitive to the management activities implemented in the watersheds.
- Summer field crews sampled 20 sixth-field watersheds to measure physical, biological, and chemical attributes used to assess watershed condition. Twenty sites were also resurveyed in 2004 that were first surveyed in 2003. Data from these sites will allow us to examine trends more quickly than waiting until all 250 watersheds are sampled before we do any repeat surveys.
- AREMP and PacFish/InFish (also known as PIBO) staff agreed upon a common set of field protocols for a core set of physical, biological, and chemical attributes. This represents a monumental accomplishment as well as a first: getting two large-scale, established monitoring programs to agree on common field methodology.
- The Field Data Quality Assessment Program began exploring how to compare distributions of initial surveys and resurveys in order to establish differences between measurements. This information will be used to determine the programs' ability to detect change.
- The program proactively developed a protocol to prevent the spread of invasive aquatic species and disease (collectively referred to as exotics).
- A landslide model is being developed to determine which topographic features are associated with landslides. A key component is assessing how to extend the landslide models used by the Coastal Landscape Analysis and Modeling Study to the extent of the Forest Plan.
- Student Conservation Association interns were utilized as a successful component of the summer field staff.
- The anticipated costs for fully implementing the monitoring plan is $36,640 to sample each watershed, or $6,107 per sample site. This assumes that an average of 6 sites will be sampled in each of the 50 sampled watersheds each year.
- The program team leader continues to lead the Pacific Northwest Aquatic Monitoring Partnership watershed workgroup. The workgroup is addressing key issues that currently hamper various agencies and existing monitoring programs from sharing information.
- Annual Watershed Reports and associated data will now be placed onto the program's website.

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Introduction

Background

The Northwest Forest Plan (hereafter referred to as "the Plan"), a management strategy applied to 24 million acres of federal land in the Pacific Northwest, was approved in 1994. The Plan includes an Aquatic Conservation Strategy that requires the protection, rehabilitation, and monitoring of aquatic ecosystems under the Plan's jurisdiction (USDA-USDI 1994). The Aquatic and Riparian Effectiveness Monitoring Program (hereafter referred to as the monitoring program) was developed to fulfill the monitoring component of the strategy. The objectives of the monitoring plan include assessment of the condition of aquatic, riparian, and upslope ecosystems at the watershed scale; development of ecosystem management decision support models to refine indicator interpretation; development of predictive models to improve the use of monitoring data; providing information for adaptive management by analyzing trends in watershed condition and identifying elements that result in poor watershed condition; and providing a framework for adaptive monitoring at the regional scale (Reeves et al. 2004). Monitoring is conducted at the subwatershed scale (US Geologic Survey 6th-field hydrologic unit code [HUC]). These subwatersheds (hereafter referred to as "watersheds") are approximately 10,000-40,000 acres in size.

The purpose of this report is two-fold. First, this report provides an overview of monitoring efforts in 2004. Second, this report serves as a track record for the program as well as indicating future direction of the program at the time of the report.

2004 Monitoring Program Objectives

During 2004, the program worked toward several objectives.

- Conduct a 10-year preliminary assessment of the condition of watersheds under the Northwest Forest Plan.
- Refine the decision support models and indicator evaluation curves developed during 2003 for each of the seven aquatic provinces in the Plan area through a series of workshops.
- Complete in-channel surveys to measure physical, biological, and chemical attributes used to assess watershed condition in 20 watersheds.
- Standardize a core set of field protocols between this program and the PacFish/InFish program (also known as PIBO). This effort includes updating and synchronizing the calculations (equations) used for the core attributes between the two programs.
- Continue on-going efforts towards the Quality Assessment Program.
- Complete an invasive species disinfection protocol.
- Initiate an assessment of landslides with a data collection and model development effort.
- Use Student Conservation Association interns on field crews.
- Continue participation in the Pacific Northwest Aquatic Monitoring Partnership.

A complete discussion of each of these objectives is provided in subsequent sections. Included for each topic is a brief overview and any pertinent progress or results. Updates are also provided for budget and personnel required to accomplish the tasks assigned to the module, use of biological indicators in decision support models, and efforts to get reports posted on our website.

2004 Monitoring Program Accomplishments

Ten-Year Assessment of the Northwest Forest Plan

Considerable progress was made toward completing an assessment of the aquatic conservation strategy during the first ten years of the Northwest Forest Plan (Gallo et al. *In Press*).The purpose of the assessment was to describe the current status of the condition of watersheds and describe how conditions have changed since the Plan was implemented. We examined the condition of 250 randomly selected 6^{th}-field watersheds in the Plan area. The distributions of conditions were presented for watersheds and for many of the attributes that contribute to the condition of watersheds by land-use allocation. This report will be published in early spring 2005.

The assessment consisted of aggregating road, vegetation, and in-channel data to assess the condition of 6th-field watersheds. A decision support model based on expert judgment was used to aggregate upslope, riparian, and in-channel indicators of watershed condition to estimate the condition of the watershed in a repeatable and transparent manner. The distribution of watershed conditions was based on these scores in the 250 watersheds. Road and vegetation data were available for all 250 randomly selected watersheds. However, watershed monitoring for the Plan has only been conducted for the last two years; consequently, in-channel data were available for only 55 of the 250 randomly selected watersheds.

Also included in this document is an evaluation of the aquatic and riparian effectiveness monitoring program, the Plan's watershed monitoring program, and a brief description of the issues that have emerged since the implementation of the Plan. The monitoring program was implemented in 2002, and an examination of the program is underway to ensure that the program is running efficiently and that the data collected are relevant and have an acceptable level of accuracy and precision to be able to track changes in the condition of watersheds through time.

Decision Support Models

In 2003, the program conducted a series of workshops during which expert teams from each physiographic province convened to construct a decision support model for their province. This year, we continued refining the models. The expert teams reviewed model results and suggested changes in the model structures and evaluation criteria to ensure that the attributes evaluated in the models were sensitive to the management activities implemented in the watersheds. Further, we wanted to ensure that the model results were consistent with the experts' opinions on the condition of the watersheds evaluated.

The decision support models were used in the status and trend assessment of the condition of watersheds in the Northwest Forest Plan area conducted this year for the 10-year evaluation of the Forest Plan. When a peer review of the status and trend assessment report is complete, the models and evaluation criteria will be sent to the members of the expert teams for their use. The models should be in the hands of the expert teams by the end of January 2005.

2004 Field Sampling Targets

Twenty watersheds spread throughout the Plan area were sampled during 2004 (Figure 1, Table 1). These watersheds were sequentially sampled from the subset of the two hundred fifty watersheds originally selected for monitoring the Northwest Forest Plan. The 250 watersheds were selected at random using Generalized Random Tessellation Sampling design, which guarantees a spatially balanced sample (Stevens and Olsen 2003, 2004). Watersheds must contain a minimum of 25 percent federal ownership (USDA Forest Service, USDI Bureau of Land Management, or USDI National Park Service) along the total length of the stream (1:100,000 National Hydrography Dataset stream layer) to be considered for sampling in the monitoring plan. Twenty trend sites were also surveyed for trend purposes (Table 2).

During the 2004 field season, 16 watersheds were dropped from the sample list for various reasons:

- Seven were dropped because most if not all stream channel sites on federal lands were dry;
- Three were dropped due to inaccessibility (crews were unable get into the watershed); *and*
- Six were dropped because there was too much water to sample safely.

Inter-Program Standardization of Field Protocols & Calculations

The Aquatic and Riparian Effectiveness Monitoring Program and the PacFish/InFish program (also known as PIBO; a large-scale federal monitoring program that focuses on managed and unmanaged lands in the upper Columbia basin; more information can be found at http://www.fs.fed.us/biology/fishecology/emp/index.html) were able to agree upon a common set of field protocols for a core set of attributes. This represents a monumental accomplishment as well as a first: getting two large-scale, established monitoring programs to agree on common field methodology. While both programs collected data on a similar set of attributes, each had an established method and a legacy dataset. During the spring of 2004 the program and the PacFish/InFish program undertook a monumental effort to standardize field protocols for a core set of attributes (Table 3). These efforts were the "next step" from the efforts that took place during the 2003 field season (Moyer et al., 2004). The definition, reason for sampling, and method of sampling (including the minimum number, frequency and location of measurements) were all agreed upon, based on sound scientific methods and advice from agency professionals and university scholars. (It is important to note that the number of measurements and locations agreed to between programs was the *minimum* value acceptable to each program and that each program is at liberty to collect more information if they need to for the purpose of satisfying their program objectives.) Over the course of the spring, both programs participated in the process through conference calls, site visits, field visits, and protocol tests.

A detailed document (with clear graphic illustrations) outlining the final agreed to protocols is available at http://www.reo.gov/monitoring/watershed/docs/2004-Final-AREMP-PIBO-Core-Attributes-Stream-Sampling-Protocol.pdf. Each program then worked from this document to incorporate the final protocol into their field protocols. The two programs will come together in early spring 2005 and discuss any needed changes or unaccounted for situations which the current protocols do not work or work poorly.

Physical protocols–Several aspects of the physical protocols were changed for both programs. These are *brief* descriptions of the final methods:

- Reach layout (the site monument, digital photos, site length, and transect spacing) were standardized in such a way as to maximize repeatability between crews. For example, the length of the reach is determined by bankfull width categories rather than 20 times the bankfull width.
- Data for bankfull width, streambed particle size, and large wood pieces are recorded for those attributes in all channels (primary and otherwise). (This represents a change from previous years' data collection efforts by the program were only primary channels were surveyed.)
- The valley length is derived from a straight-line measurement from the beginning of the reach to the end of the reach.
- Site elevation change is measured from the left bank wetted edge at the first and last transect in each reach. These measurements are taken at least twice (and no more than three times) with a maximum disagreement between values of no more than 10 percent.
- Five streambed particles are collected from each of the 21 transects in the site. These particles are measured on the intermediate axis and those measurements are aggregated in order to calculate a D50.
- Average bankfull width is measured at each of the eleven major transects and all eleven measurements are averaged across the site.

- Pool classification, length (along the thalweg), and residual depth are measured for all primary channel pools throughout the site.
- Percent pool tail crest fines are taken at the upstream edge of the pool tail crest at 25, 50, and 75 percent of the distance across the pool tail crest. Grid intersections under which the substrate cannot be viewed are now recorded as no measurement.
- Dimensions for all large wood pieces are estimated (including those in log jams) with a subset of them measured for correction purposes. Wood type and location are also recorded.

Biological protocol–The only common biological attribute between programs is the collection of macroinvertebrates. Both programs sought clarification of and agreed to use the protocol developed by Hawkins et al. (2001).

Water chemistry protocol–For water chemistry, only one attribute – water conductivity – was standardized between the programs. The location to take the reading and the minimum number of measurements were agreed to.

Calculation methods–As a natural extension of standardizing field protocols and based on difficulties encountered during previous attempts to share summarized data, e.g., the distribution of percent pool tail crest fines because the PacFish/InFish program used no-measurements while the program did not have that option in data collection, both programs worked toward a common calculations document as well. Details of calculation methods such as equations and data inputs were captured in a common document (Table 3). This document will be available in early spring 2005 at http://www.reo.gov/monitoring/report_show.php?show=watershed.

Field Data Quality Assessment Program

Several changes were made to improve the Quality Assessment Program during 2004.

- Selection of sites for resurvey was based on the distribution of average bankfull widths of all sites within a single survey trip. This was put into place in order to distribute the resurvey efforts across sites of all sizes, i.e., to avoid resurveys in all the small sites or all of the large sites.
- The resurvey effort was unequally distributed amongst the watersheds. We adopted a system of zero, one, and two sites being selected in any three watersheds. By concentrating the sites, we reduced travel time between watersheds in an effort to find money savings for the program.
- Effort was made toward documenting the programs' implementation of the Quality System Management Plan (Palmer, 2002). Data processing and Quality Control/Quality Assurance steps were documented.
- A new idea of comparing distributions of initial surveys and resurveys in order to establish differences between measurements is being explored. If the two distributions are the same (in terms of means, variances, etc.) then, in theory, they should produce the same estimate of trend in attribute values, thereby indicating the programs' ability to detect change. This idea continues to be explored as a method to assess the quality of the field data.
- The Quality Assessment Program (also referred to as the QA/QC program in previous reports) was renamed as the Field Data Quality Assessment Program in recognition of the fact that all of the guidance, analysis, and results pertain directly to the field component of the monitoring program and not to the GIS component of the monitoring program.

Invasive Species Disinfection Protocol

The program proactively developed a protocol to prevent the spread of invasive aquatic species and disease (collectively referred to as exotics). One aquatic invasive species and two terrestrial tree diseases were the primary targets of the protocol. Staff worked closely with a northwest expert on invasive aquatic species to develop and implement techniques known to prevent the spread of New Zealand mud snails. Commonly accepted Forest Service practices for the prevention of Port Orford cedar root rot and Sudden Oak Death syndrome were incorporated as well. The Oregon Department of Environmental Quality decided to also use the same gear disinfection checklist for the prevention of the spread of exotics. Components of the protocol address vehicles that travel between watersheds and stream sampling equipment. Techniques are simple and easy to implement such as the rinsing of wading boots in a mild bleach solution and utilizing high-pressure car washes to clean vehicles. This protocol will be posted on the programs' website mid-winter 2005.

Landslide Analyses

The program is determining how to incorporate mass wasting into watershed condition assessments. A key component is extending the landslide models developed by Dan Miller of Earth Systems Institute for the Coastal Landscape Analysis and Modeling Study (CLAMS) to the extent of the Forest Plan. The first step is using landslide data to calibrate a GIS model that identifies areas within watersheds that have high potential for mass wasting. Adam Dresser (Six Rivers National Forest) assisted by collecting and digitizing data on landslide location from aerial photographs in 14 watersheds. These data will be used to determine the topographic features associated with landslides. Because the CLAMS model is limited in that data from only one time period were used to calibrate the model, the model predicts only probable landslide location and not landslide rates associated with disturbance events. Therefore, in two watersheds, we will use data from several time periods to include landslides and debris flows from multiple storm events so we can interpret results in terms of landslide rate, rather than just landslide density. This information will allow us to speak directly to management impacts on frequency of landslide events and provide data to relate the effects of a single storm to the cumulative effects of many storm events. The air photo interpretation should be completed at the end of January 2005, and we expect to have the model runs completed in spring 2005. The next step is to incorporate the model results into the decision support models used to evaluate watershed condition.

Student Conservation Association Interns

Ten student Conservation Association (SCA) interns were hired as crewmembers during the 2004 field season, at the suggestion of the Bureau of Land Management Oregon State Office State Director. Compared to hiring GS-0404-05 Biological Science Technicians, there was an $83,000 cost savings to the program. We also continued to collect high quality data, and provided valuable work experience to the interns. Overall, this was a very successful partnership and one we hope to continue in 2005 if the following concerns are resolved: A) Intern per diem rates were judged to be too low; and B) there were delays with interns getting their stipends and per diem checks in a timely manner from the SCA headquarters.

Pacific Northwest Aquatic Monitoring Partnership

Support for the cooperative monitoring efforts between state, federal, and tribal agencies within Washington, Oregon, California, and Idaho – known as the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) continued to build, as shown by the signing of a PNAMP charter by 15 state, federal, and tribal executive signatories. Charter agencies also agreed to fund a full-time executive coordinator. The program team leader had been fulfilling these duties on a volunteer basis. The program team leader is continuing as the leader of the Watershed Workgroup (a subgroup of PNAMP). The Watershed Workgroup is working toward the mission of PNAMP by addressing two key issues that currently hamper various agencies and existing monitoring programs from sharing information. First, they are working toward a universal sample design that tiers to multiple spatial scales as well as varying objectives. Second, they are making progress toward a commonly accepted set of field protocols for a core set of attributes.

Common sample design–The Watershed Workgroup is actively engaged with scientists and statisticians from the US Environmental Protection Agency's Environmental Resources Laboratory – Corvallis to develop a common sample design. Currently, a draft of a proposed common random sample design based on using the Generalized Random Tessellation Sampling strategy is available. This design accounts for differences in scale (from local restoration projects to multi-state monitoring programs), density of sample points (one sample point per 1000 m of stream to one sample point per 4th field HUC), and differences in objectives (changes in a stream channel on a sub-reach basis to changes across the Plan area). The state of Washington is in the process of developing a status and trend monitoring program and this program is proposed as a "case study" of how to integrate state and federal monitoring programs using the common sample design.

Inter-agency side-by-side protocol test–On a related but somewhat different course of actions, the Watershed Workgroup has brought together a consortium of federal and state programs to test a variety of field protocols for a core set of attributes (the exact set of attributes is still under discussion). This effort is tentatively funded by the US Department of Commerce National Oceanic and Atmospheric Administration, the USDI Bureau of Land Management, the USDI Bureau of Reclamation, and the USDA Forest Service – Washington Office and is scheduled to take place during the summer of 2005 with the following list of participants:

- Aquatic and Riparian Effectiveness Monitoring Program;
- PacFish/Infish Biological Opinion Monitoring Program (PIBO);
- EPA Environmental Monitoring and Assessment Program;
- Upper Columbia Monitoring Program;
- California Department of Fish and Game
- Oregon Department of Fish and Wildlife;
- Oregon Department of Environmental Quality;
- Washington Department of Ecology; *and*
- USDA Forest Service Region 6 Stream Survey Program.

In addition, the USDA Rocky Mt Research Station will intensively survey the same segments of stream in order to establish a baseline set of values in which to compare the results of the different protocols to.

Program Updates

Fiscal Year 2004 Budget

During the 2004 field season, the program employed 27 persons directly tied to the summer fieldwork, five of which represent core staff and the balance represent temporary employees and SCA interns. These staff members accumulated approximately 1,350 field person days (one person for one day in the field).

For full implementation of the monitoring plan, i.e., sample 50 watersheds, it will cost $36,640 to sample each watershed, or $6,107 per sample site. This assumes that an average of 6 sites will be sampled in each watershed. These figures were derived from taking our total budget and dividing by the number of watersheds sampled, therefore the figures include overhead and other non-field related costs. Field sampling costs would decrease if we continue to use SCA interns on our field crews.

General Field Crew Structure

As a result of the refined protocols and in an effort to meet program objectives under a limited budget, crews were structured with four members (down one person from 2003). Additionally, crews were comprised of both federal employees (General Schedule; GS) and Student

Conservation Association interns (see above). Each crew had a GS-0404-06 crew leader, a GS-0404-05 crewmember and two interns. We continued to use three field coordinators to check the data for quality assurance, to serve as the conduit for equipment repair and replacement, and as a check to ensure protocols were correctly followed. The field coordinator positions ensured a well-coordinated field effort. As a change from last year, we kept one field coordinator in the office each trip in order to handle the logistics for the next trip as well as manage any emergency situations that arose. The two-person site reconnaissance crew proved invaluable, as they were able to make "on the ground" judgments about whether or not crews would be able to sample a watershed. They used a variety of criteria such as crews' ability to move in the watershed, size of the stream, and external hazards (e.g., local area drug lords).

Changes in Annual Calendar

As a result of evaluating our historic calendar of events and considerable efforts on the part of the core staff, the program had shifted its' annual calendar ahead approximately 60 to 90 days. In order to have adequate time to prepare for the summer field seasons, the program staff decided to start efforts in January. The program subsequently shifted its' timelines back for routine tasks such as this annual Technical Report.

Biological Indicators Analysis

Currently the monitoring program's assessment of watershed condition does not include data on fish, amphibians, and other aquatic- and riparian-dependent species. We are working with Pacific Northwest Research Lab scientists to identify which biological metrics are most appropriate to use. Incorporating biological attributes into future iterations of the decision support models is a high priority for the monitoring program.

Written Products

Standardizing Report Formats

The program is working toward standardizing the format of all reports produced for external use (e.g., this one and the annual Watershed Reports). The program team leader has decided to adopt the USDA Forest Service Pacific Northwest Research Station authors guidelines. These guidelines can be found at http://fsweb.pdc1.r6.fs.fed.us/pnw/cg/authors/index.shtml.

Annual Watershed Reports and Data Available on Program Website

In order to better facilitate the use of field and GIS data by local area managers, the program will start placing the annual Watershed Reports and the associated data onto the program's website. This is currently a work in progress and will be finished early in 2005. The current web page will be updated to show links to the reports and data. At the writing of this document, the reports will be posted at http://www.reo.gov/monitoring/reports.htm#watershed while the data will be posted under http://www.reo.gov/monitoring/maps.htm (this is subject to change depending on constraints of the website). Individual measurement data will not be posted on the web, however it is available by contacting the data manager, Jake Chambers (541.750.7067), who will work with individuals requesting information.

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Acknowledgements

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Thanks to the BLM Buglab for conducting the laboratory analysis of the benthic macroinvertebrate samples. Loren Bahls, Ph.D. is completing periphyton sample analysis. The Cooperative Chemical Analysis Laboratory at Oregon State University in Corvallis, OR conducted laboratory analysis for water chemistry.

Peter Eldred and Steve Wilcox conducted analyses on upslope and riparian vegetation and roads, and constructed maps for this report. Jake Chambers, Mike Reeves, Jason Glick, Brandon Nolan and Susan Grimes provided valuable assistance with field data entry and data quality control. Jenni Dykstra, Kris Fausti, and Ted Sedell handled field crew coordination. Scott Montross and Mark Isley continued to develop the Field Recon component of the summer field season. Summer field staff included: Nick Haxton, Pete Gruendike, Jennifer Kauffman, Mark Jessop, Brian Dwyer, Kathy Gwecke, Katy Hanna, Miko Nadel, Nicole Freeman, Justine Schneider, Craig Maier, Drew Haerer, Anson Friar, Mike Scafini, Jessica Rasmussen, Mariah McAlister, Mike Reeves, Jason, Glick, Brandon Nolan and Susan Grimes.

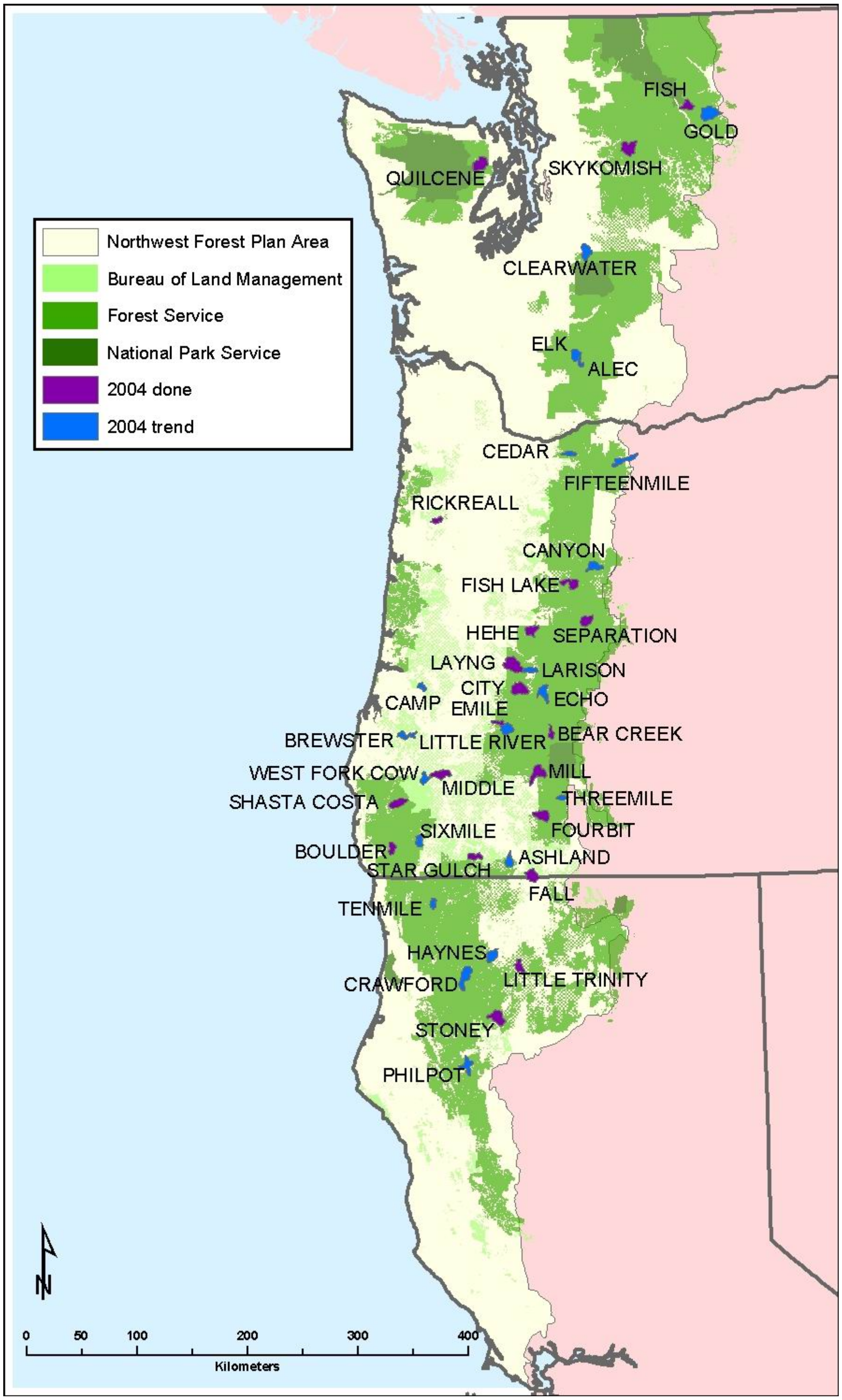

Figure 1 Map of the watersheds surveyed during 2004 summer field season. Watersheds coded in red represent those in which an initial survey took place, while those in orange were surveyed for trend purposes.

Table 1 Watersheds surveyed in 2004 as original surveys along with the number of sites surveyed in each watershed.

State	Province	Local Unit	6th Field HUC	6th Field HUC Name	Creek Code	County	Number of sites
CA	Klamath Siskiyou	Shasta - Trinity NF	180102110102	LITTLE TRINITY RIVER	CATRN	TRINITY	7
CA	Klamath Siskiyou	Shasta - Trinity NF	180102110403	STONEY CREEK	CASTN	TRINITY	8
OR	Coast Range	Salem BLM	170900070201	UPPER RICKREALL CREEK	ORURK	POLK	6
OR	Klamath Siskiyou	Medford BLM	171003090203	APPLEGATE RIVER/STAR GULCH	ORSTR	JACKSON	8
OR	Klamath Siskiyou	Roseburg BLM	171003020901	MIDDLE CREEK	ORMDL	DOUGLAS	6
OR	Klamath Siskiyou	Siskiyou NF	171003100601	SHASTA COSTA CREEK	ORSHA	CURRY	7
OR	Klamath Siskiyou	Siskiyou NF	171003120106	BOULDER CREEK	ORBDR	CURRY	8
OR	Southern High Cascades	Medford BLM	180102060502	FALL CREEK	ORFAL	JACKSON	5
OR	Southern High Cascades	Rogue River NF	171003070112	LOWER MILL CREEK	ORMLL	JACKSON	5
OR	Western Cascades	Rogue River NF	171003070402	CLARKS FORK CREEK/FOURBIT CREEK	ORFOR	JACKSON	5
OR	Western Cascades	Umpqua NF	170900020101	LAYNG CREEK	ORLNG	LANE	4
OR	Western Cascades	Umpqua NF	171003010801	STEAMBOAT HEADWATERS/CITY CREEK	ORSTM	LANE	6
OR	Western Cascades	Umpqua NF	171003011104	EMILE CREEK	OREML	DOUGLAS	7
OR	Western Cascades	Umpqua NF	171003010402	BEAR CREEK	ORBRC	DOUGLAS	8
OR	Western Cascades	Willamette NF	170900040201	UPPER SEPARATION CREEK	ORSEP	LANE	5
OR	Western Cascades	Willamette NF	170900040102	FISH LAKE CREEK	ORFLK	LINN	7
OR	Western Cascades	Willamette NF	170900010902	FALL CREEK/HEHE CREEK	ORHHE	LANE	8
WA	Eastern Northern Cascades	Wenatchee NF	170200090203	FISH CREEK	WAFSH	CHELAN	6
WA	Olympic	Olympic NP	171100180601	UPPER BIG QUILCENE RIVER	WAQUL	JEFFERSON	5
WA	Western Northern Cascades	Mt Baker – Snoqualmie NF	171100060201	UPPER NORTH FORK SKYKOMISH RIVER	WASKY	SNOHOMISH	6

Table 2 Watersheds surveyed in 2004 as trend surveys along with the number of sites surveyed in each watershed.

State	Province	Local Unit	6th Field HUC	6th Field HUC Name	Creek Code	County	Number of sites
CA	Klamath Siskiyou	Klamath NF	180102090402	TENMILE CREEK	CATEN	SISKIYOU	1
CA	Klamath Siskiyou	Klamath NF	180102100106	CRAWFORD CREEK	CACFD	SISKIYOU	1
CA	Klamath Siskiyou	Klamath NF	180102080203	PAYNES LAKE CREEK	CAHAY	SISKIYOU	1
CA	Klamath Siskiyou	Shasta - Trinity NF	180102120402	PHILPOT CREEK	CAPHL	TRINITY	1
OR	Coast Range	Coos Bay BLM	171003030504	UPPER CAMP CREEK	ORCMP	COOS	1
OR	Coast Range	Coos Bay BLM	171003050404	BREWSTER CANYON	ORBRW	COOS	1
OR	Klamath Siskiyou	Medford BLM	171003020804	WEST FORK COW CREEK/BEAR CREEK	ORBER	DOUGLAS	1
OR	Klamath Siskiyou	Rogue River NF	171003080106	ASHLAND CREEK	ORASH	JACKSON	1
OR	Klamath Siskiyou	Siskiyou NF	171003110603	SIXMILE CREEK	ORSXM	JOSEPHINE	1
OR	Northern High Cascades	Mt Hood NF	170701050201	HEADWATERS FIFTEENMILE CREEK	ORHFM	WASCO	1
OR	Southern High Cascades	Deschutes NF	170703010907	CANYON CREEK	ORCYN	JEFFERSON	1
OR	Southern High Cascades	Winema NF	180102030202	THREEMILE CREEK	ORTHR	KLAMATH	1
OR	Western Cascades	Mt Hood NF	170800010504	CEDAR CREEK	ORCDR	CLACKAMAS	1
OR	Western Cascades	Umpqua NF	171003011101	LITTLE RIVER HEADWATERS	ORLRV	DOUGLAS	1
OR	Western Cascades	Willamette NF	170900010106	UPPER MIDDLE FK WILLAMETTE/ECHO CREEK	ORECH	LANE	1
OR	Western Cascades	Willamette NF	170900010504	MIDDLE FORK WILLAMETTE/LARISON CREEK	ORLAR	LANE	1
WA	Eastern Northern Cascades	Okanogan NF	170200080703	MAINSTEM LOWER METHOW RIVER/GOLD CREEK	WAGOL	OKANOGAN	1
WA	Western Cascades	Gifford Pinchot NF	170800020108	ALEC CREEK	WAALC	SKAMANIA	1
WA	Western Cascades	Gifford Pinchot NF	170800020203	ELK CREEK	WAELK	SKAMANIA	1
WA	Western Cascades	Mt Baker – Snoqualmie NF	171100140202	CLEARWATER RIVER	WACLR	PIERCE	1

Table 3 Information for the core attributes from the common field protocols including definition, equation, precision and the frequency of measurement.

Core-Attribute	Code	Definition	Equation	Precision (meters)	Minimum # of Measurements
Average Bankfull Width	BF	Average of all bankfull widths in the reach measured at 11 transects.	(Sum of BF widths / 11)	1/10	11
Bankfull Width:Depth Ratio	BF_WD	The W:D ratio of the reach at a single cross-section.	Depth = (Area of cross-section / bankfull width) Width = BF width (Width / Depth)	1/1	1 (width) : 10 (depth)
Entrenchment Ratio	ENT	The floodprone width (FP) divided by the bankfull width (BF) at a single cross-section.	(FP width / BF width)	no units 1/10	1
Sinuosity	SIN	Reach length (measured along the thalweg) divided by the straight valley length (length from the bottom to the top of the reach).	(Reach Length / Valley length)	no units 1/10	1
Reach Gradient (% Slope)	GRAD	The average elevation change of the water surface from the bottom to the top of the reach divided by the reach length (measured along the thalweg).	(Ave Change in Elevation / Reach Length) * 100	1/10 as a %	2
Ave Residual Pool Depth	RES	The average of the residual pool depths for all pools.	(Sum of (Pool Max Depth - Pool Tail Depth)) / Number of Pools	1/100	All qualifying pools, according to the core-attribute protocol.
Pool Frequency	POOLS	The number of pools per meter.	(# pools / reach length)	1/1000	All qualifying pools, according to the core-attribute protocol.

Core-Attribute	Code	Definition	Equation	Precision (meters)	Minimum # of Measurements
Percent Pools	PER_POOL	Percent of reach length that is pool habitat.	(Sum of pool lengths / reach length) * 100	1/10 as a %	All qualifying pools, according to the core-attribute protocol.
Large Wood Frequency	WOOD	The number of qualifying wood pieces per meter.	(# pieces / reach length)	1/1000	All qualifying pieces, according to the core-attribute protocol.
Large Wood Volume	WOOD_VOL	Cubic meters of wood per meter.	(Sum of (Volume for each piece)) / # of pieces	1/1000	All qualifying pieces, according to the core-attribute protocol. Estimated length and diameter will be adjusted prior to volume calculations.
Percent PTC Fines	PTC_FINE	The percent surface fines measured 3 times at the tail crest of a pool.	(# Fines Measurements / (150 - # non-measurements)) * 100	1/10 as a %	Measured 3 times on the first 10 qualifying pools, according to the core-attribute protocol (excluding human and beaver formed dammed pools).
D50 Pebble Count	D50	The D50 (mm) is the 50th percentile (median distribution) of the substrate particles measured.	Intermediate axis diameter of the median particle collected from particle counts.	1/1000	5 particles per transect on 21 transects
D84 Pebble Count	D84	The D84 (mm) is the 84th percentile. 84% of the substrate particles measured are less than the size calculated.	Intermediate axis diameter of the particle for which 84% of the particles are smaller (84th percentile).	1/1000	5 particles per transect on 21 transects
D16 Pebble Count	D16	The D16 (mm) is the 16th percentile. 16% of the substrate particles measured are less than the size calculated.	Intermediate axis diameter of the particle for which 16% of the particles are smaller (16th percentile).	1/1000	5 particles per transect on 21 transects