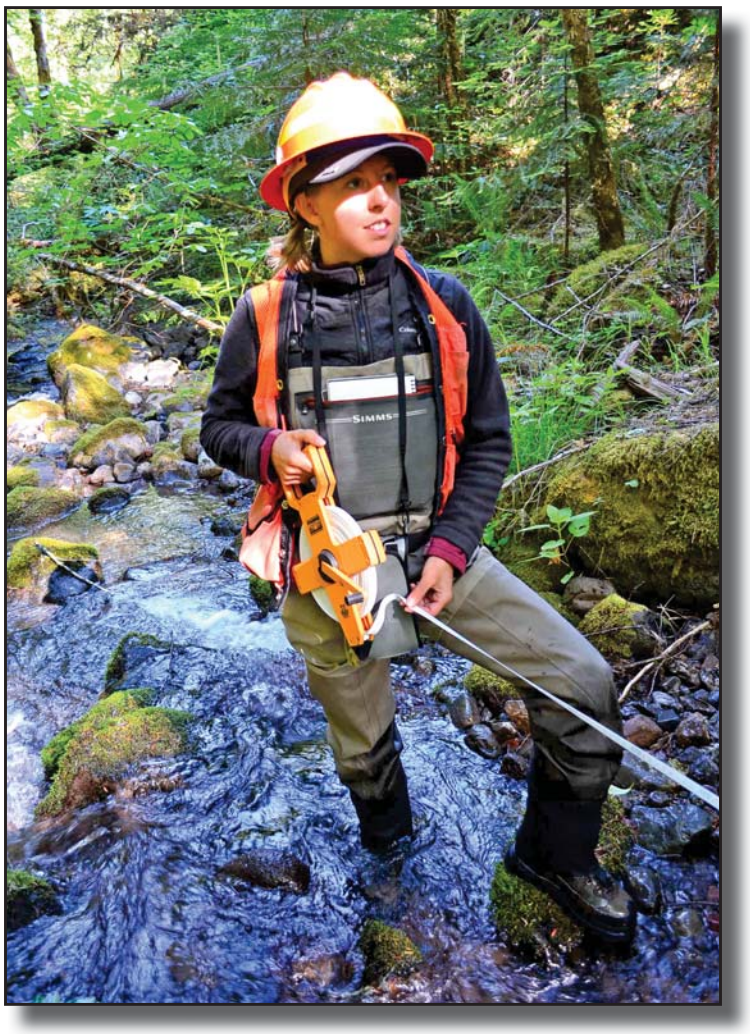
Aquatic and Riparian Effectiveness Monitoring Program

Interagency Monitoring Program – Northwest Forest Plan Area

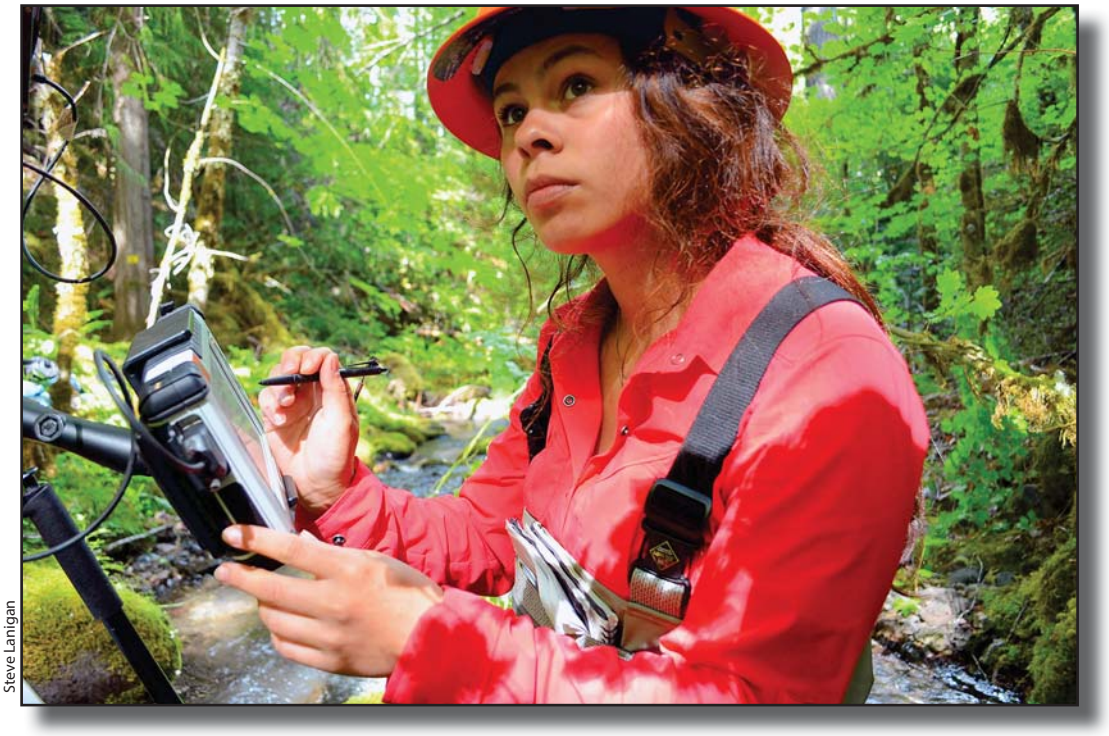


2013 Annual Report

Steve Lanigan, Stephanie Miller, Heidi Andersen, Peter Eldred, Ron Beloin, Mark Raggon, Sean Gordon, Steve Wilcox

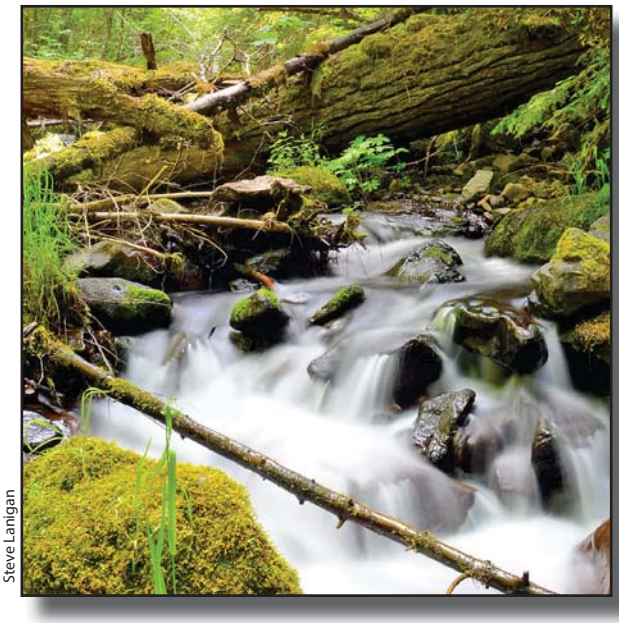
January 2014

Table of Contents



Steve Lanigan

Executive Summary



Steve Lanigan

The Aquatic and Riparian Effectiveness Monitoring Program (AREMP) is a "Service First" program consisting of USDA Forest Service (FS) and USDI Bureau of Land Management (BLM) employees working together to evaluate if the Northwest Forest Plan's (NWFP) Aquatic Conservation Strategy is maintaining and restoring watershed condition within the NWFP area. The NWFP provides management direction for 24 million acres of federal lands in western Washington and Oregon, and northern California. We are proud to share the following highlights of AREMP accomplishments in 2013 with you.

20-Year Evaluation of Watershed Condition

The AREMP team continued to investigate possible improvements to our upslope/riparian model of watershed condition for the 20-year NWFP report. This included:

- Produced a draft specification for a unified, process-based evaluation model, including a description of rationale, structural diagrams, and a spreadsheet of indicator details;
- Reviewed the draft model specification with regional fish and hydrology leads from the USFS and BLM;
- Began investigating refinements to specific indicators of watershed condition based on their biophysical context: landslide risk (by including geology as a contextual variable), vegetation (using vegetation zones).

Successful field season

We sampled streams in 28 watersheds spread throughout the NWFP area.

- Collected stream data from 187 stream sites to measure physical and biological attributes used to assess watershed condition as part of our field sampling program.
- Continued our quality control program by resurveying 12 sites, to assess measurement reliability.
- Continued to survey for aquatic invasive species as part of our stream condition surveys.

Support to Local Units

We assisted with several GIS analyses to provide tools for use by local FS/BLM specialists. We also provided "value added" survey and monitoring services for BLM and FS units.

Support to local units (which they funded) included:

- Deployed temperature sensors to establish an air and water temperature monitoring network (fig. 1).

Initiated a surface water irrigation diversion study to prioritize where screens may be needed to prevent fish mortality.

Customized reports summarizing the 15-yr report upslope-riparian model results were produced for:

BLM Western Oregon Plan Revisions area
NOAA - Fisheries Puget Sound
USFS Gifford Pinchot National Forest

Steve Lanigan

Figure 1—As one of several "value added efforts," we downloaded air temperature data from an air and water temperature network we established in 2011.

Sharing stream survey data with other agencies

Several status and trend stream habitat monitoring programs exist within the Pacific Northwest. All differ, sometimes only slightly, in sample frames, the attributes measured, and the protocols used. Programs that use a probabilistic survey design (such as AREMP) that overlap in their sample frames have a unique opportunity to share data between programs. We conducted a case study, to determine if Oregon Department of Fish and Wildlife (ODFW) and AREMP can share data within the coastal Oregon province (fig. 2). We found that differences in protocols, number of sites sampled within a watershed, and years in rotating panels create a significant barrier to sharing of stream survey data between agencies. If we can overcome protocol differences we would be able to augment AREMP samples provided that ODFW samples happen to fall within an AREMP selected watershed in the appropriate year.

We also continued our participation in the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) by participating in Lower Columbia River Endangered Species Act salmon recovery area workshops where state and federal agencies are proposing to use a master sample design to determine sampling sites, establish common protocols, and share data for habitat status and trend monitoring.

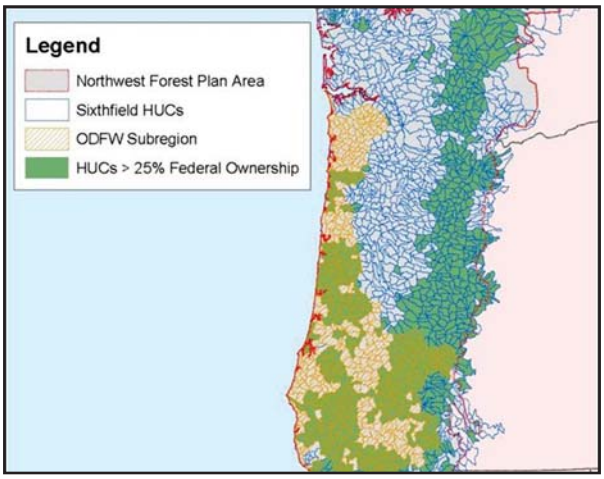


Figure 2—Map showing how the Oregon Department of Fish and Wildlife status and trend monitoring program overlaps with the Aquatic and Riparian Effectiveness Monitoring Program sampling domain (noted as HUCS > 25% Federal Ownership).

Introduction

Johanna Ruff

This report tells the story of our NWFP monitoring efforts and support to local units in 2013. The NWFP, a management strategy applied to 24 million acres of federal land in the Pacific Northwest (fig. 3), was approved in 1994. The NWFP includes an Aquatic Conservation Strategy that requires the protection, restoration, and monitoring of aquatic ecosystems under the NWFP's jurisdiction (USDA-USDI 1994). AREMP was developed to fulfill the monitoring component of the strategy.

During 2013, AREMP staff worked toward or accomplished several key objectives. A complete discussion of each of these accomplishments is provided in subsequent sections. Updates are also provided for budget and personnel required to accomplish the tasks assigned to the monitoring program. The overall objectives of AREMP include:

Collecting data for asessing the condition of aquatic, riparian, and upslope ecosystems;

Developing multi-criteria models to refine indicator interpretation;

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 to 40,000 acres in size.

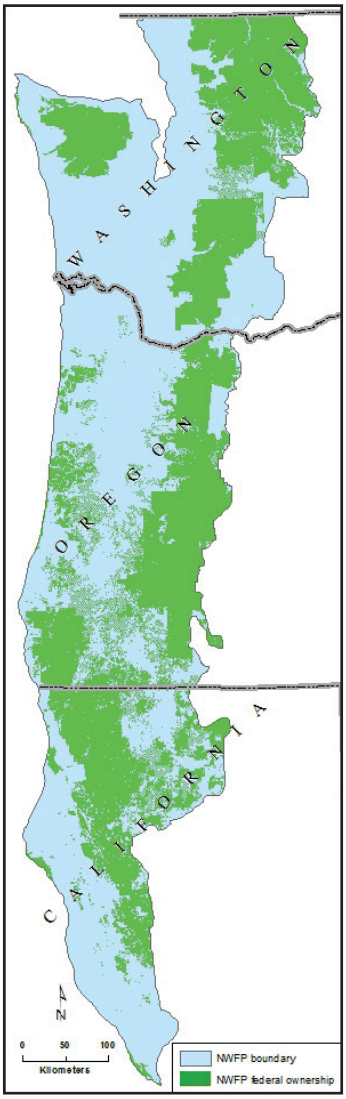


Figure 3—Northwest Forest Plan (NWFP) area and federal lands being evaluated for watershed condition.

Accomplishments

Steve Lanigan

20-Year Evaluation of Watershed Condition

Our 20-year assessment of status and trend for upslope and riparian ("watershed") condition is scheduled to be available on-line during the spring of 2015. Key preparations for doing analyses and producing the report next year include the following:

Model Structure

We began investigating whether to replace our five existing provincial models used in our 15-year assessment with a unified watershed condition assessment model that relies on contextual information for determining what attribute evaluation criteria should be used. This change should streamline the modeling process and improve regional consistency of the scores. We also are testing moving from a more indicator-based approach (roads, vegetation) to a more process-based (erosion, shading) structure. We reviewed these draft changes with a small group of regional hydrologists and fish biologists from FS and BLM, and feedback was positive.

Landslide Risk Assessment

We continued our efforts to improve our landslide risk model by including geology as a contextual variable. An initial model was produced in 2010 but was not integrated into the 15-year report because more refinement and testing was needed. We reinitiated contact with the Region 5 geologists who helped develop the model and are also looking at integrating this work with the landslide model embedded in the Netmap modeling system.

Roads Layer

We updated our roads layer to include the best available information. This was done by compiling all the Forest Service roads in INFRA (Forest Service corporate database) along with any other Forest Service non-system roads (roads not tracked in INFRA) that that have been digitized. The Forest Service ownership was then erased out of the BLM Ground Transportation layer in Region 6 (WA and OR) and the resulting erased layer pasted together with the Forest Service road's layer. For Region 5 (CA) the Forest Service ownership was erased out of a roads layer compiled by the Geographical Information Center, California State University, Chico CA. This layer was compiled for the California department of Fish and Wildlife to help determine reference watersheds. All layers were pasted together and include all attributes from all data sources.

Web Mapping

It's always been challenging to facilitate the participation of experts from around the NWFP region to help build and review our watershed assessment model. In the past we have relied on provincial workshops to gather input and review results, but this approach has become more difficult with tightening travel budgets. Also, the need for considerable iterative feedback has always meant that we must conduct a significant portion of the

process via email. Exporting maps and data of our interim results from our GIS model is time-consuming and a less than optimal format for our reviewers. To address this, we have begun work with the R6 Data Resources Management team to put our GIS data online as interactive maps. These maps and associated data should be easier for reviewers to navigate and also will be able to serve as a mechanism to deliver our final results to managers, analysts, and the public.

Stream Status and Trend Field Sampling

One-hundred eighty-seven stream sites within 28 watersheds spread throughout the NWFP area were sampled during 2013 (fig. 4). These watersheds were sequentially sampled from the subset of the 250 watersheds originally selected for monitoring the NWFP. The 250 watersheds were selected at random using a generalized random tessellation sampling design, which guarantees a spatially balanced sample (Reeves et. al. 2004, Stevens and Olsen 2003, 2004). Twelve sites were resurveyed as part of our quality control program.

Protocol changes

There were three changes to the field sampling protocol this year:

1. We increased the sample size of substrate and fines.
   - Based on a reliability analysis, we found high levels of within site variability. To investigate whether larger sample sizes could mitigate the variability to a more acceptable level we increased the number of substrate measurements from 105 to 300 and increased the number of fines grids to accommodate the entire pool tail.
2. We dropped amphibian surveys and solar shade.
   - Based on the reliability analysis, we found that we were unable to reliably detect amphibians. Time of day and season, difficulty of terrain, and observer bias all contribute to detectability error. After review, we decided that to reliably detect amphibian presence/absence would require a significant change in our survey program which would come at the cost of collecting less data on other attributes.
   - Solar shade had been collected for the purpose of validating the Netmap shade model developed by Chris Parks (Forest Hydrologist on the Rogue River-Siskiyou National Forest). Much of the data collected by AREMP were in highly shaded areas. We felt that an adequate sample size for heavily shaded areas has been collected and recommended that model developers focus on lower shade value areas as identified by the model for further validation.
   -

Aquatic invasive species surveys

AREMP field crews participated in the seventh year of a regional survey effort (fig. 5) to locate aquatic invasive species on federal lands (Raggon and Lanigan 2013). These surveys were funded

Figure 4—Map of the watersheds surveyed during the 2013 field season.

by the FS Pacific Northwest Region (Region 6) Invasive Species Program and incorporated into our normal stream surveys. Protocols developed by Oregon State University Sea Grant College Program personnel were used to survey for 34 aquatic/terrestrial plants and animals identified as primary threats to northwest watersheds. Among the key species included were: New Zealand mudsnails (*Potamopyrgus antipodarum*), zebra mussels (*Dreissena polymorpha*), quagga mussels (*D. rostriformis bugensis*), yellow flag iris (*Iris pseudacorus*), kudzu (*Pueraria lobata*), feral swine (*Sus scrofa*), nutria (*Myocaster coypus*), red swamp crayfish (*Procambarus clarkia*), ringed crayfish (*Orconectes neglectus*), rusty crayfish (*Orconectes rusticus*) and northern crayfish (*Orconectes virilis*).

Documentation and in-the-field training on species identification, data collection, and reporting were provided to AREMP field coordinators and field crews by personnel from the Oregon State University Sea Grant Program. The field protocols were the same as those used in 2008 - 2012. In 2013, AREMP crews recorded a total of nine invasive detections. Five of the nine detections were determined to be misidentified in the field during verification by staff and experts from the OSU's Sea Grant Program. Two of the four correctly verified detections were of Himalayan [Armenian] blackberry (*Rubus armeniacus*). One was of English ivy (*Hedera helix*). The only invasive aquatic species detected was the ringed crayfish at the Evans Creek watershed (a tributary to the Rogue River at the town of Rouge River). All of the correctly identified invasive species occurred in Oregon; none occurred in Washington or California.

Tony Lowndes

Figure 5—Crews sampled for invasive species in stream riparian areas.

Our 2013 Aquatic Invasive Species report is available at http://www.reo.gov/monitoring/reports/watershed/AREMP%20Aquatic%20Invasive%20Species%20Report%202013.pdf.

Quality assessment program

The monitoring program's Quality Assessment Program (QAP) includes several components. During each field season, a subset of randomly selected watersheds are revisited (two stream sites in each watershed). Revisits generally occur within a few weeks of the initial site visit, and the survey is always performed by a crew (fig. 7) that differed from the previous visit. This allows us to compare the reliability of our measurements.

We are also undergoing an extensive revision and upgrade of our collection and storage of AREMP data. The Service First Mobile GIS group in Region 6 is incorporating our field data collection application into the standard Region 6 S1 ArcPad collection tool. We will be incorporating more extensive error checking into the field data collection application so errors can be found and corrected while crews are still in the field. We are also building database tools to flag errors in our existing database and correct them when possible. Our data summary calculation code is being incorporated into the new database format to make our end of year calculations and reporting more efficient.

Stream condition trend analysis

In 2010, we began revisiting watersheds where streams were originally sampled in 2002. Currently, we have four years of repeated data that will eventually allow us to determine trend in stream condition. While most attributes were collected and uploaded into our SDE database by the end of a field season, some attributes such as water temperature and macroinvertebrate identification will take additional time to process and summarize. As we work to collate data and incorporate the cleaned data into the SDE database, we are also reevaluating and updating the models we use to reflect the most accurate and current available science.

Assisting Local Units

As FS, BLM, FS Pacific Northwest Research Station (PNW), and USDI Geological Services Forest Rangeland and Ecosystem Science Center (USGS FRESC) specialists have become aware of the high quality of AREMP crews and the products we produce, we have been funded at both the local and regional level to provide an array of "value-added" survey and monitoring services. Because we are a "Service First" organization, we are able to use both BLM and FS funds and have a very low (10%) overhead.

Value-added surveys were done with crews funded by the programs requesting our help. Value-added crews were also staffed independently from our core stream condition status and trend survey crews. Our support to local units usually consisted of conducting surveys/monitoring efforts when local units did not have the time needed to hire, train, and supervise crews for relatively short term survey or monitoring projects. The FS Region 6 Regional Office and BLM State Office also funded AREMP crews to collect data for regional projects. We also conducted several GIS analyses to assist local unit hydrologists and fish biologists. The following describe in more detail our support to local units. The agency/unit (s) that provided funds or in-kind support is shown in parentheses.

Aquatic organism passage study

(Partners: FS-Region 6 Natural Resources and Engineering, BLM, USGS FRESC, and PNW)

We conducted a 2012-2013 pilot study to evaluate methods to monitor the effectiveness of aquatic organism passage (AOP) restoration (i.e., replaced culverts). Field work occurred on the Siuslaw National Forest. Two independent field efforts used separate methods to collect data about different biological responses to AOP crossings: individual movement and occupancy. The movement of individual fish implanted with passive integrated transponder (PIT) tags was monitored for five months at four AOP crossings. Each AOP crossing location was instrumented with stationary antennae that recorded data on fish movement through the crossing. Additional individual movement data was collected every two weeks using portable backpack antennae (fig. 6). The occupancy field effort completed 521 surveys associated with 103 culverts on the forest. Crews completed 79 mark-recapture surveys that will enable quantitative statements about the probability of capture to be made, and then as a result, the probability of occupancy and abundance of each species. Final data products and methods recommendations will be completed in 2014.

Steve Lanigan

Figure 6—AREMP employees electrofishing at an aquatic organism passage study site to determine fish movement.

Air and water temperature network (Partners: FS Region 6 and BLM Oregon State Office climate change programs)

We've monitored year-round instream and air temperatures (fig. 7) in watersheds throughout the NWFP Area in Oregon and Washington (Andersen 2013a) for the last three years (2011-2013) to provide baseline temperature data to climate scientists, aquatic ecologists, fish biologists, and hydrologists to help predict the sensitivity of streams to climate change. Temperature sensor locations are also provided to the FS Rocky Mountain Research Station as part of an on-going project to map stream temperature sensor locations throughout the United States (http://www.fs.fed.us/rm/boise/AWAE/projects/stream_temperature.shtml). To date we have 375 sensors deployed in 144 watersheds.

Steve Lanigan

Figure 7—Thermographs were attached to boulders using a special underwater epoxy.

Shade measurements (Partners: Siskyou National Forest and FS-Region 6 Natural Resources)

AREMP staff continued a partnership with FS hydrologists to expand the spatial extent of a "rapid shade model" developed for stream shade assessments. The model was originally developed for the Siskiyou National Forest, and then expanded to the entire NWFP area by Chris Park (Rogue River-Siskiyou NF Hydrologist). The model uses gradient nearest neighbor (GNN) vegetation data (Ohmann and Gregory 2002) and 10 meter digital elevation models (DEM) to determine current shade conditions and site potential tree height to determine target shade conditions. It then compares current to potential shade to look for possible thinning and planting opportunities. Stream shade data, collected by AREMP crews from the Willamette and Rogue River-Siskiyou National Forest, was used to analyze the models ability to predict riparian shade. The model validation showed that RAPID was unable to predict shade measurements at points in the field due mostly to the size of the 30 meter pixels in the GNN vegetation data combined with the mapping accuracy of the GIS stream layer (fig. 8). Measurement of shade in the field at a specific stream point is just too fine of a scale for our current GIS data to predict. We are exploring if the model results can be used as a more generalized predictor of shade condition in a watershed.

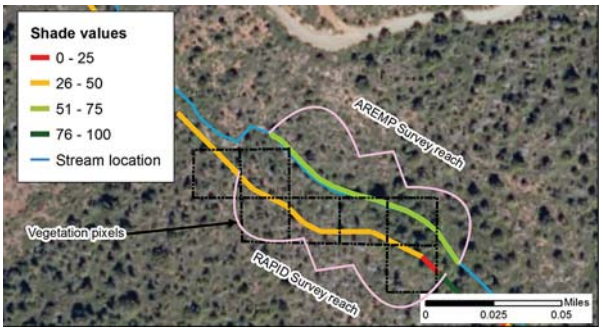


Figure 8—The locations between the actual stream ("AREMP survey reach") and the DEM generated stream ("RAPID survey reach") do not match well, resulting in the RAPID shade model using data from areas that do not closely follow the true stream channel. Since the DEM generated stream did not follow the actual stream, much of the nearby upslope, less-vegetated (as shown by the "vegetation pixels") was used in the average RAPID model calculation resulting in an underestimate of shade.

Region 6 Surface water diversion inventory

(Partner: FS Region 6 Fisheries)

Surface water diversions that occur throughout the Pacific Northwest Region (PNW) of the USDA Forest Service (USFS) have the potential to entrain and kill fish. Because the accuracy of over 65,000 diversion locations on USFS lands in the PNW is variable and the effect on fish is largely unknown, AREMP is inventorying surface water diversions, focusing first on east-side Oregon forests. The inventory is a two-stage process where we first perform an in-office GIS evaluation to generate a list of sites for field visits, and second, a field visit to high priority sites to locate and evaluate the diversion (fig. 9). Initial surveys have been completed for Deschutes, Wallowa-Whitman, Umatilla, Malheur, Fremont, Winema, Ochoco, and Siuslaw NF; 857 sites have been recommended for visitation from the total of 1364 evaluated. This list will be further prioritized by Ranger District and/or Forest personnel with local water resource knowledge and those determined as priority will be visited by field crews. With additional funding, field surveys can be performed on the highest priority sites recommended by local units.

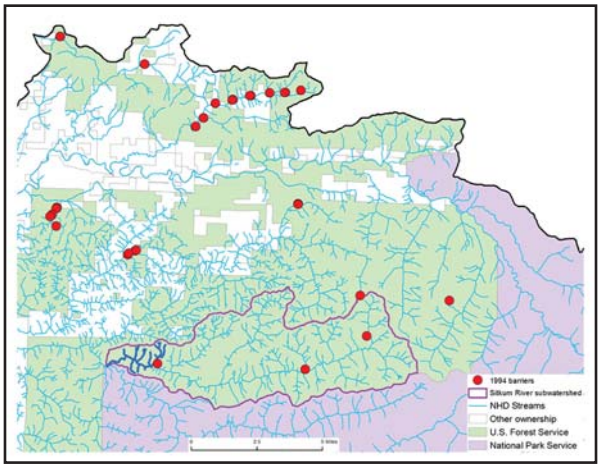
Jeff Metzger

Figure 9—Surface water diversion sites are being evaluated to determine if fish screens are needed to prevent fish from being killed.

Fish passage barriers

(Partners: FS Region 5 and 6 and BLM Fisheries)

We began compiling data from local, regional, and national data bases to determine the location of existing fish passage barriers and what barriers have been removed. Our goal is to produce a map showing every known human-caused barrier present in 1994 (when the NWFP Record of Decision was signed) along with which barriers have been removed (fig. 10) This map will help inform how management actions have resulted in improving watershed connectivity.



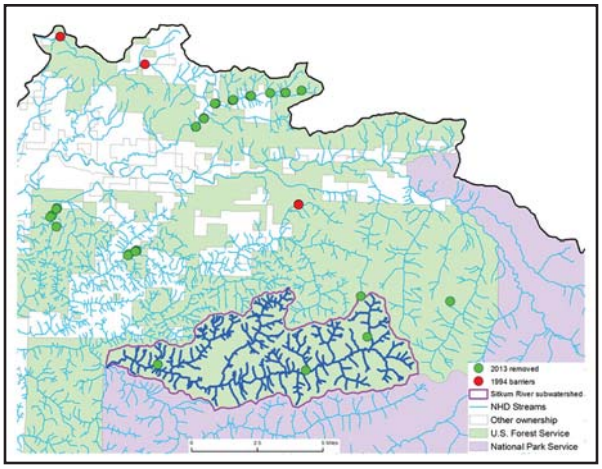


Figure10—Upper map shows fish passage barriers in 1994 based on barrier surveys and barrier removal data (Olympic National Forest). Lower map shows existing & removed barriers in 2013 and how much stream habitat became accessible in the Stitkum watershed.

Macroinvertebrate indices

We are adding to the regional effort to standardize macroinvertebrate taxonomy (fig. 11) and evaluation through a cooperative agreement with the Utah State University "Bug Lab."Our goal is to create a new macroinvertebrate bioassessment index that can be applied at both the regional and reach scales to make status determinations. A bioassessment index developed for use at multiple spatial scales would be highly valued by the various agencies that collect macroinvertebrates as bioindicators of stream condition. This tool would allow for each group to use standardized taxonomic information and a robust tool tailored to Pacific Northwest streams.

Steve Lanigan

Figure 11—We're working with the Utah State University "Bug Lab" to create a macroinvertebrate bioassessment index tailored to Pacific Northwest streams.

Reference conditions

AREMP is leading a regional partnership to work toward a standardized regionally consistent reference site network with Oregon Department of Fish and Wildlife Aquatic Inventories Project (ORAQI) and Division of Water Quality (ODEQ), Washington Department of Ecology (WDE), and California Department of Fish and Wildlife Aquatic Bioassessment Laboratory (CDFW) monitoring programs. Creation of a consistent network of reference sites will allow each organization to use reference site data collected by the other agencies to better inform stream attribute benchmark selection.

Customized reports

The AREMP team prepared a number of customized reports for collaborators using results from the 15-year upslope-riparian model. These reports included maps, graphs and narrative comparing the focal region to the rest of the NWFP area. Customized summaries were prepared for:

BLM Western Oregon Plan Revisions (fig. 12) (Lanigan et al. 2013a)

USFS Gifford Pinchot National Forest (Lanigan et al. 2013b)

NOAA Fisheries - Puget Sound area (Lanigan et al. 2013c)

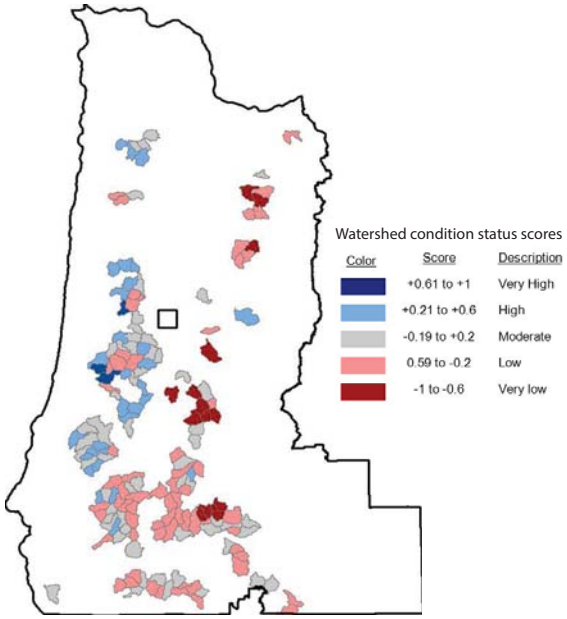
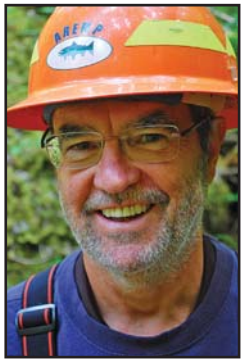


Figure 12—Watershed condition (upslope/riparian) status scores and major components for the BLM's Resource Management Plan area for western Oregon.

Program Updates

Staffing update

We welcomed the arrival of:



Ron Beloin as our Database Manager. Ron previously worked as a data base contractor for EPA and the National Science Foundation Long Term Ecological Research Project, and for a private research institute. He was also a research assistant at Oregon State University.

We said good bye to:

Steve Lanigan, the AREMP, Program Manager since 2001, is retiring at the end of January, 2014. He intends to devote more time to fish sampling with a fly rod.

Jeff Metzger, our long time Technical Assistant, left to work for BLM as a field technician.

John Speece, our Field Coordinator of the Aquatic Organism Passage Study left to work as the Conservation Reserve Enhancement Program Planner for Crook, Deschutes and Jefferson Counties, OR.

Employment

We employed nine year-round employees who were a combination of permanent and year-round "term" employees. Twenty two crew members were employed between May – October; they were a combination of seasonal employees and Student Conservation Association interns.
AREMP Summer employment information for 2014 is posted at http://www.reo.gov/monitoring/employment/index.shtml.

Student Conservation Association interns

Since 2004, a total of 57 Student Conservation Association (SCA) interns have gained valuable experience in the field of natural resources working with AREMP. In 2013, we hired four SCA interns as survey crew members and four SCA interns for our temperature monitoring crew to deploy stream and air temperature sensors in watersheds throughout Oregon and Washington. We continued to collect high quality data and provided valuable work experience to the interns (Andersen 2013b). One of the GS-grade employees we hired in 2012 was formerly an SCA intern. This was a very successful partnership and one we hope to continue in 2014.

Annual watershed reports and data available on program website

Data summaries from 2002 to 2006 are available on our website: http://www.reo.gov/monitoring/data-maps/watershed-data-maps.shtml. We respond to all data requests and compile whatever custom data are needed. We have begun collaborative efforts with the DRM team with the goal of making all our data available in the Enterprise Data Warehouse.

Data requests

In 2013, AREMP staff continued to provide data from our field surveys to local management units and other state and federal offices. The following data were requested and received in 2013:

Amphibian, invertebrate data and stream temperature data for Salmon and Scott RD on the Klamath National Forest

Stream temperature and survey summary data for Seattle public Utilities

Stream summary data for the Willamette National Forest

Stream temperature data for Dan Isaak (FS RMRS) to support interagency stream temperature modeling effort across the Pacific Northwest area

Stream temperature data for the Shasta-Trinity National Forest

Invertebrate data for California for Joseph Furnish, FS Region 5 Aquatic Ecologist

Stream survey summary information for Methow Valley Ranger District, Okanogan National Forest

Large wood measurements were provided to Chris Jordan of NOAA for data to use in calibration of their wood estimation model

A list of watersheds with thermograph deployments for the Mount Baker/Snoqualmie NF was provided to Karen Chang for their planning needs

Stream temperature data were provided to Jamie Lamperth of the WA Dept of Fish and Wildlife for the Lewis River area.

Other, non-specific data requests were directed to the AREMP data download website: http://www.reo.gov/monitoring/reports/watershed/aremp/aremp.htm

Literature Cited and Related Publications

Literature Cited

Andersen, H.V. 2013a. Aquatic and Riparian Effectiveness Monitoring Program. Stream and Air Temperature Monitoring Report. 2013 Field Season. http://www.reo.gov/monitoring/reports/watershed/2013.AREMP.Thermographs.Report.pdf

Andersen, H.V. 2013b. Aquatic and Riparian Effectiveness Monitoring Program. Student Conservation Association - 2013 Overview. http://www.reo.gov/monitoring/employment/AREMP.2013.SCA.report.pdf

Gallo, K.; Lanigan, S.H.; Eldred P.; Gordon S.N.; Moyer C. 2005. Northwest Forest Plan – the first 10 years (1994-2003): preliminary assessment of the condition of watersheds. Gen. Tech. Rep. PNW-GTR-647. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 133 p.

Gaueman, W.; Stevens, D.L. 2009. Trend detection in three key metrics under the AREMP survey design. Unpublished report. 24 p. On file with AREMP/RPM, USDA Forest Service Pacific Northwest Region, 333 SW first Ave., Portland OR 97204.

Lanigan, S.H; Gordon, S.N. 2012. A comparison of the USFS national watershed condition classification system to the Northwest Forest Plan watershed monitoring results. http://www.reo.gov/monitoring/reports/watershed/WCC%20vs%20Aremp%20white%20paper.pdf

Lanigan, S.H.: Gordon, S.N.; Miller, S. 2013a. Northwest Forest Plan—the first 15 years (1994–2008): watershed condition status and trend.Results for the BLM RMPs for Western Oregon. http://www.reo.gov/monitoring/reports/watershed/AREMP%20analysis%20for%20BLM%20WO%20RMP%202012.pdf

Lanigan, S.H.: Gordon, S.N.; Miller, S. 2013b. Northwest Forest Plan—the first 15 years (1994–2008): watershed condition status and trend. Results for the Gifford Pinchot National Forest. http://www.reo.gov/monitoring/reports/watershed/Gifford%20Pinchot%20National%20Forest%20Service%202013%20Watershed%20Condition%20Monitoring%20Report.pdf

Lanigan, S.H.: Gordon, S.N.; Miller, S. 2013c. Northwest Forest Plan—the first 15 years (1994–2008): watershed condition status and trend. Results for the Puget Sound. http://www.reo.gov/monitoring/reports/watershed/Puget%20Sound%202013%20Watershed%20Condition%20Monitoring%20Report.pdf

Lanigan, S.H.; Gordon, S.N.; Eldred, P.; Isley, M.; Wilcox, S.; Moyer, C.; Andersen, H. 2012. Northwest Forest Plan—the first 15 years (1994–2008): watershed condition status and trend. Gen. Tech. Rep. PNW-GTR-856. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 155 p.

Ohmann, J.L.; Gregory, M.J. 2002. Predictive mapping of forest composition and structure with direct gradient analysis and nearest-neighbor. Journal of Forest Research. 32: 725-741.

Potyondy, J.P. ; Geier, T.W. Watershed Condition Classification Technical Guide. 2011. Watershed condition classification technical guide. FS-978. U.S. Department of Agriculture Forest Service. http://www.fs.fed.us/publications/watershed/watershed_classification_guide.pdf

Raggon, M.; Lanigan, S.H. 2013. Aquatic & Riparian Invasive Species Survey. http://www.reo.gov/monitoring/reports/watershed/AREMP%20Aquatic%20Invasive%20Species%20Report%202013.pdf

Reeves, G.H.; Hohler, D.B.; Larsen, D.P. [et al.]. 2004. Effectiveness monitoring for the aquatic and riparian component of the Northwest Forest Plan: conceptual framework and options. Gen. Tech. Rep. PNW-GTR-577. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 71 p.

Stevens, D.L., Jr.; Olsen, A.R. 2003. Variance estimation for spatially balanced samples of environmental resources. Environmetrics 14:593-610.

Stevens, D.L., Jr.; Olsen, A.R. 2004. Spatially-balanced sampling of natural resources. Journal of the American Statistical Association. 99:262-278.

U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Bureau of Land Management. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl and standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. [Place of publication unknown]. 74 p. [plus attachment A: standards and guidelines].

Presentations (2012-2013)

Gordon, S.N. 2013. Overview of the AREMP program. Oregon Watershed Enhancement Board, January meeting.

Lanigan, S.H. 2013. Fish passage barriers & their removal. USFS Region 6 Spring Aquatics Workshop.

Lanigan, S.H. 2013. Fish passage barriers & their removal. Update. USFS Region 6 Fall Aquatics Workshop.

Lanigan, S.H. 2012. Overview of AREMP program. USFS Region 5 webinar.

Lanigan, S.H. 2013. AREMP results and how to use them. USFS Region 6 Spring Planners Meeting.

Lanigan, S.H.; Miller, S. 2013. Senior Management Group task follow up. Senior Management Group March meeting.

Miller, S. 2012. AREMP overview. BLM Branch of Resources Planning, Science and Monitoring presentation to the Deputy Director.

Miller, S. 2012. AREMP overview. CFSL Fall Presentation series.

Miller, S. 2012. "Cool Soda example" Use of GIS derived data as a management tool to identify within watershed restoration potential. USFS Sweet Home Ranger District.

Miller, S. 2012. Monitoring Watershed Condition Status & Trend. AREMP overview. USFS Region 6 fall aquatics workshop.

Miller, S. 2013. Diversion Inventory update. USFS Region 6 spring and fall aquatics workshop.

Miller, S. 2013. AREMP Watershed Condition Status & Trend overview. BLM Fish Biologist meeting.

Miller, S. 2013. AREMP Macroinvertebrate Bioassessment Tool. PNAMP, ISTM meeting.

Miller, S. 2013. AREMP Macroinvertebrate Bioassessment Tool. NW Bioassessment Workgroup meeting.

Miller, S. 2013. Reference Site Analysis overview. Statistical Working Group seminar series.

Miller, S. 2013. Management Review – Sharing data & Model revisions. Spring Senior Management Group meeting.

Raggon, M.F. 2013. AREMP AIS disinfection methods. Roseburg BLM "Hydrology Breakfast".

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Cover photo by Steve Lanigan

Jared Blake

Appendix A - Watersheds Surveyed in 2013 - UPDATE

Watersheds surveyed in 2013 with the number of sites surveyed in each watershed. Creek Codes with a (^) represent resurveyed watersheds that were initially surveyed in 2004 or 2005.

Note: Sites where quality assessment/quality control (QA/QC) were also conducted are denoted by (*). QA/QC sites are where a second independent crew returned to sample the same reach to determine variability in our measurements. Two sites were resurveyed in each QAQC watershed.

State	Province	Local Unit	6th Field HUC	6th Field HUC Name	Creek Code	County	Number of Sites
CA	KLAMATH/SISKIYOU	SHASTA-TRINITY NF	180102120405	INDIAN VALLEY CREEK	CAINV	TRINITY	7
CA	KLAMATH/SISKIYOU	SIX RIVERS NF	180102111203	HORSE LINTO CREEK	CALIN^	HUMBOLDT	4*
CA	HIGH CASCADES	SHASTA-TRINITY NF	180200040103	HORSE CREEK	CAHOR	SISKIYOU	11
CA	KLAMATH/SISKIYOU	KLAMATH NF	180102080302	INDIAN CREEK	CAIND	SISKIYOU	4
CA	KLAMATH/SISKIYOU	SHASTA-TRINITY NF	180102110403	STONEY CREEK	CASTN^	TRINITY	5*
CA	KLAMATH/SISKIYOU	MENDOCINO NF	180101040208	FLY CREEK	CAHOW^	MENDOCINO	6
CA	KLAMATH/SISKIYOU	KLAMATH NF	180102090103	EAST FORK INDIAN CREEK	CAEIN^	SISKIYOU	6*
OR	KLAMATH/SISKIYOU	ROGUE RIVER NF	171003090107	LOWER CARBERRY	ORLCB^	JACKSON	6
OR	HIGH CASCADES	MEDFORD BLM	180102060405	KEENE CREEK	ORKEN	JACKSON	6
OR	HIGH CASCADES	ROGUE RIVER NF	171003070803	UPPER SF LITTLE BUTTE CK	ORSBT^	JACKSON/KLAMATH	6
OR	KLAMATH/SISKIYOU	SISKIYOU NF	171003110604	BAKER CREEK	ORBAK^	JOSEPHINE	4
OR	KLAMATH/SISKIYOU	MEDFORD BLM	171003080301	UPPER EVANS CREEK	OREVN^	JACKSON	8*
OR	HIGH CASCADES	ROGUE RIVER NF	171003070112	MILL CREEK	ORMLL^	JACKSON	6*
OR	KLAMATH/SISKIYOU	ROSEBURG BLM	171003020506	UPPER SHIVELY OSHEA	OROSH^	DOUGLAS	10
OR	HIGH CASCADES	UMPQUA NF	171003010302	BEAR CREEK	ORBRC^	DOUGLAS	8
OR	WESTERN CASCADES	UMPQUA NF	171003010501	WARM SPRINGS CREEK	ORWRM^	DOUGLAS	9
OR	WESTERN CASCADES	EUGENE BLM	170900020101	UPPER MOSBY CREEK	ORTBL^	LANE	7
OR	WESTERN CASCADES	WILLAMETTE NF	170900010303	LOWER SALT CREEK	ORLST^	LANE	8*
OR	HIGH CASCADES	DESCHUTES NF	170703010703	UPPER TROUT CREEK	ORUTR^	DESCHUTES	10
OR	WESTERN CASCADES	WILLAMETTE NF	170900040202	HACKLEMAN CREEK	ORFLK^	LINN	8*
OR	WA/OR COAST RANGE	SIUSLAW NF	171002050302	MIDDLE DRIFT CR/ALSEA R	ORMDC	LINCOLN	4
OR	WESTERN CASCADES	WILLAMETTE NF	170900050502	GOLD CREEK	ORGOL^	MARION	5
OR	WESTERN CASCADES	MT. HOOD NF	170900110201	CUB CREEK	ORCUB^	MARION	7
OR	WA/OR COAST RANGE	SIUSLAW NF	171002030204	NESTUCCA R/ NIAGARA CR	ORNIA^	TILLAMOOK	4
OR	WA/OR COAST RANGE	EUGENE BLM	171002060201	UPPER WILDCAT CREEK	ORWLD^	LANE	7
WA	OLYMPIC PENINSULA	OLYMPIC NF	171001020208	SALMON RIVER	WASLM^	JEFFERSON	7
WA	NORTH CASCADES	MT. BAKER-SNOQUALMIE NF	171100080103	NF STILLAGUAMISH R AT SQUIRE CK	WASQR^	SNOHOMISH	6
WA	NORTH CASCADES	MT. BAKER-SNOQUALMIE NF	171100040104	GLACIER CREEK	WAGLA^	WHATCOM	8

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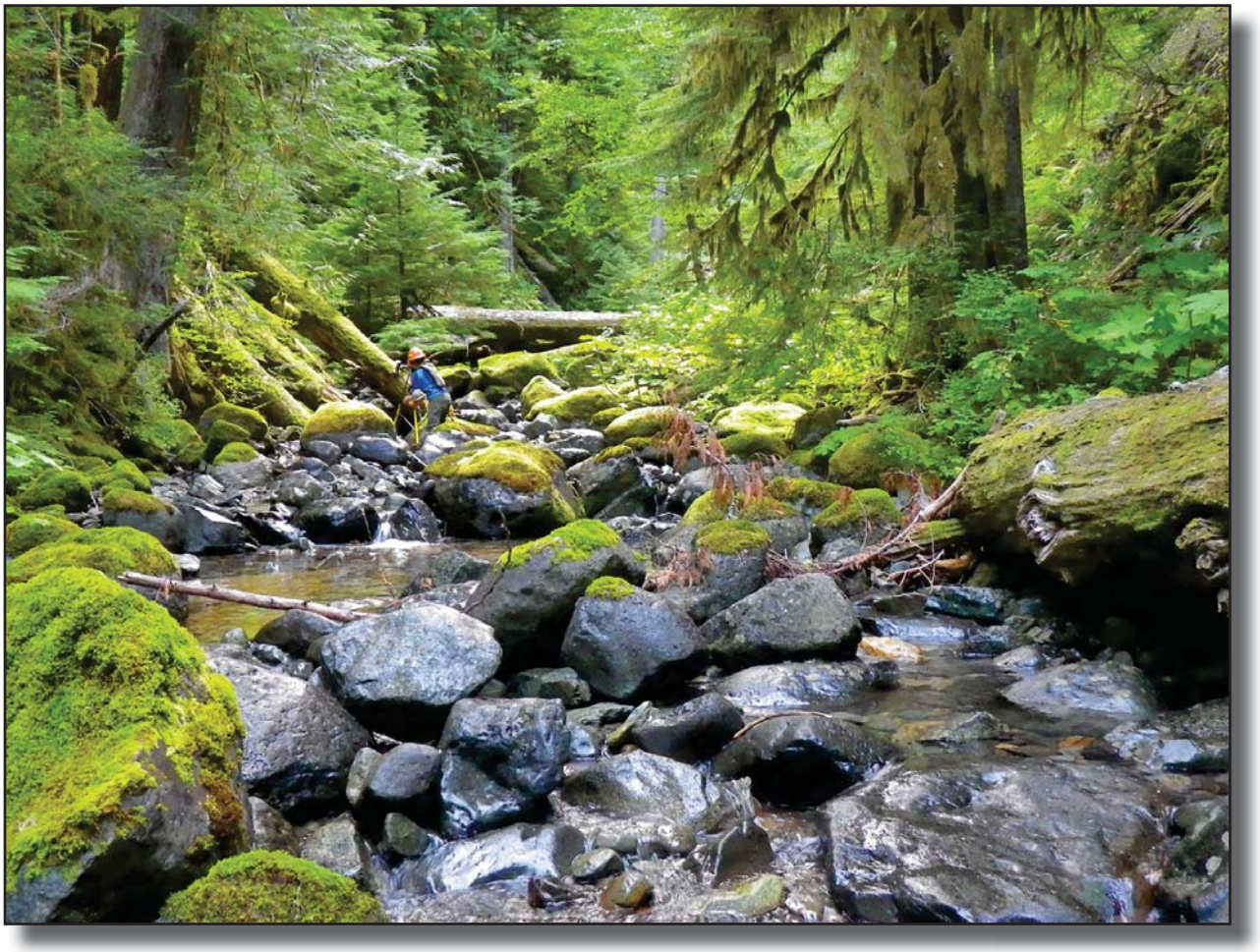

Becki Gehri