PACIFIC NORTHWEST AQUATIC MONITORING PARTNERSHIP

Annual Report for 2012

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Executive Summary

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) continued promoting integration of monitoring resources and building tools to support monitoring in 2012. Integration of the different monitoring focal areas, of practitioners from a variety of organizations, and of monitoring programs goals and objectives is essential to improving the quality and consistency of monitoring in the region.

PNAMP operates through inter-organizational teams to make progress on a variety of projects identified to support partner needs and PNAMP goals. These teams are largely ad hoc and formed for the specific purpose of achieving the objectives of the identified projects. For each project, the PNAMP Coordination Team identified interested Steering Committee (SC) members and subject matter experts to form the working teams that provide guidance and leadership. In addition, the teams acted as an intermediate between the larger group of interested participants and the SC, thus maintaining the concept of better SC/participant exchange. The PNAMP Coordination Team continued to facilitate dialog among experts to move forward with ongoing and new projects. In addition, the Coordination Team continued their efforts to track in kind contributions at meetings, workshops, and other PNAMP hosted events.

PNAMP focused on projects related to these topics in 2012: data management, integration of monitoring, monitoring design, species and watershed monitoring, and technologies to advance monitoring. PNAMP advanced its coordination goals and objectives for these topics by hosting workshops, work sessions, and meetings. Steering Committee members and subject matter experts participated in these meetings to exchange information about their own programs, coordinate on existing projects, and initiate new tasks, including:

- supporting overall data management for monitoring;
- planning and co-hosting a continuing series of workshops for coordinating data management and exchange to support improved assessments and reporting in the Columbia River Basin;
- finalizing of guidance for a regional data management and sharing strategy;
- working to implement metadata recommendations;
- continuing work to demonstrate a “master sample” based integrated status and trend monitoring project in the Lower Columbia River recovery area;
- coordinating with municipal stormwater managers in Southwest Washington to develop an integrated status and trends monitoring design for the Lower Columbia region;
- developing online tools to support monitoring design and site management;
- developing a prototype tool to support creation of metadata records;
- managing a monitoring protocol and method library;
- moderating a community forum to discuss protocols and methods;
- providing training related to the use of online tools;

- planning and co-hosting a series of work sessions for coordinating data management and exchange of habitat data;
- planning and hosting a forum focused on topics related to remote sensing acquisition and application/analysis in aquatic habitats;
- maintaining the structure of the PNAMP website for better information discovery and delivery; and
- planning additional work related to web tools and resources, such as integration of all web resources, development of a data steward community of practice, and supporting websites that provide much needed educational guidance about monitoring.

Lastly, in addition to specific projects, PNAMP continued to emphasize communication as a tool to support collaboration and provided a forum where monitoring practitioners and policy staff could interact and exchange information. PNAMP operates by open, inclusive processes and all meetings and documents are readily accessible on the PNAMP website.

The opportunity provided by the PNAMP forum to allow its partners and participants to collectively focus on issues, results, and future needs related to monitoring increases coordination and collaboration in the near term, and increases effectiveness and efficiency of aquatic resource monitoring on a regional scale in the long term.

Introduction

Overview

Federal, state, tribal, local, and private aquatic monitoring programs in the Pacific Northwest have evolved independently in response to different organizational mandates, jurisdictional needs, issues and questions. Planning and coordination of monitoring activities have evolved slowly but steadily over the past ten years. The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) became a formal institution in 2004, charged with providing a forum for coordination of aquatic monitoring efforts in the region. The geographic area of this coordination includes the Pacific Northwest region from Northern California to Canada where participating entities are implementing monitoring efforts. As of 2012, 20 state, tribal, federal, and regional entities signed the PNAMP Charter (Appendix A).

The guiding principles behind PNAMP are that monitoring will be improved if all programs:

- use consistent monitoring approaches and protocols,
- follow a scientific foundation,
- support monitoring policy and management objectives, and
- collect and present information in a manner that can be shared.

These goals require considerable effort and commitment to collaboration by many entities and individuals. PNAMP strives to provide the forum where this collaboration can occur and to facilitate the exchange among subject matter and policy experts that is necessary to accomplish these goals. Although we are always supportive of more participation, we believe PNAMP has a good combination of participants to address these goals.

PNAMP

PNAMP's organizational structure includes a Steering Committee (SC), staff to serve as coordinators and facilitators for specific topics of interest (Coordination Team), and a number of subject matter experts participating in working teams that focus on specific projects and their related tasks. The SC is composed of representatives from all entities that are signatory to the Charter (link to PNAMP Charter page) and working team leads, a combination that allows the interface of technical and policy interests. The agency representatives are responsible for communication to PNAMP regarding their respective organizations' work and needs, as well as delivering PNAMP progress and challenges to their organizations. Participants from the working teams largely contribute in-kind hours to support PNAMP projects. PNAMP has found that in some cases it is necessary to secure dedicated time from individuals in order to move forward quickly on the tasks related to a project. In these instances, time may be supported by PNAMP funding, usually for a person to serve as a lead for a particular task.

Over the years, PNAMP has developed a better understanding of how the goals of each project are inherently interdependent on each other and the goals of our partners. PNAMP has been working on a number of projects that support integration, which is important for establishing a regional partnership for aquatic resource monitoring that bridges the technical focus and individual organizations. There are core features of all monitoring programs that, if well documented and shared, can lead to better integration in the region. These features include monitoring design (including objectives, methods, study design, location, etc.) and data management and exchange. In addition, PNAMP has realized that regional monitoring efforts would be better integrated and coordinated if they were well documented and had agreed upon reporting standards.

The different mandates driving monitoring and subsequent management, policy and reporting response requires collaboration with other regional and national organizations, as well as many individual participating organizations. Regardless of the complexity involved, PNAMP believes that support of coordination and collaboration based on the four guiding principles is important for a successful regional monitoring network.

The PNAMP Steering Committee, Coordination Team, and participants share the responsibility to work across PNAMP to accomplish our goals efficiently and consistently. We encourage those in the region who seek assistance with aquatic resource monitoring issues to contribute to PNAMP. Coordination on complex topics with many partners takes time and hard work. Since PNAMP is a voluntary organization, our progress is directly correlated to participation. Support and open communication are essential for PNAMP to be able to respond to needs of the region. We need to hear from both subject matter and policy experts on what is needed for better coordinated aquatic resource monitoring.

Results and Discussion

PNAMP is a forum for the community of aquatic monitoring practitioners in the Pacific Northwest. PNAMP Coordination Team hosts the forum to facilitate collaboration around aquatic monitoring topics of interest, promote best practices for monitoring, and encourage coordination and integration of monitoring activities as appropriate. The forum's activities are conducted by participant working groups and teams as endorsed by the partner-based steering committee. All PNAMP activities are open to anyone who wishes to participate.

Coordination Team Activities

PNAMP Coordination Team is employed by the U.S. Geological Survey (USGS), Northwest Region Executive Office. The PNAMP Coordination Team includes a Coordinator (Jennifer Bayer), an Assistant Coordinator (Jacque Schei), Special Assistant to PNAMP (Amy Puls) and a Communications Specialist (Sarah Beldin). In 2012, PNAMP also benefitted from the work of an Information Management Liaison (Kathryn Thomas); however that position will not be continued in 2013. PNAMP occasionally hires staff on detail positions to support PNAMP work. In 2012, staff on detail included Sally Sauter who assisted with PNAMP's Integrated Status and Trend Fish Monitoring Component and another staff member to support method clean-up and documentation in MonitoringMethods.org. In the future, PNAMP will look for longer term support options for the online tools that have been developed.

The Coordination Team's goals are to facilitate the transfer of information within PNAMP and across all relevant organizations, support relationships between science and monitoring, and promote communication among organizations to help assure that monitoring plans and information are coordinated across the Pacific Northwest. The Coordination Team works to initiate and facilitate the development, presentation, and distribution of products aimed at heightening understanding of PNAMP issues, successes, and problems and to serve as a clearinghouse for PNAMP activities and products.

The Coordination Team is responsible for administrative requirements of PNAMP activities (e.g. meeting logistical support, record keeping, and maintenance of participant information). At least one member of the Coordination Staff serves as a lead or co-lead for all PNAMP projects to ensure the project moves along in a timely manner. In 2012, the Information Management Liaison chaired the Data Management Leadership Team and was responsible for planning and convening their quarterly meetings. In the future, the PNAMP Coordinator will assume this role, along with planning and convening quarterly Steering Committee meetings.

In 2012, organizational support was provided by developing and negotiating fiscal support with government and non-government entities and managing budgets and associated contracts with those entities. Required progress reporting regarding the Coordination Team's activities (within PNAMP) and PNAMP activities to interested external parties was completed. The Coordination Team

represented PNAMP at several external meetings, workshops, and conferences in 2012. In addition, the Coordinator conducted briefings at meetings and for individual organizations and their executives regarding PNAMP activities throughout the region as requested.

The Coordination Team continues to seek appropriate outlets for communicating PNAMP's work beyond required progress reporting. In 2012, PNAMP again sought expertise through Cooperative Ecosystem Studies Unit (CESU) agreements to support our website (www.pnamp.org). At the beginning of 2012, we continued to be supported by Montana State University (MSU). When our agreement with MSU ended in June, we decided to seek another CESU partner because changes to MSU's program indicated that our goals for the CESU agreement did not align as well with MSU's goals anymore. To that end, we initiated a new CESU agreement in July with the University of Idaho. The University of Idaho was able to migrate the PNAMP website to their servers and host it throughout the remainder of 2012. In addition, a provided technical assistance in maintaining the PNAMP website to support delivery of scientific information and increase the availability of biological and natural resources information at the regional and national level. We envision that this partnership will continue into 2013.

In addition to the main PNAMP site, the Coordination Team also managed several other sites that are completed or are in development for the various web resource projects described in the Results section below.

PNAMP

Coordination Team Activities: Organizational Development

PNAMP is a dynamic, growing association of state, federal, and tribal partners and includes a variety of participants from other organizations. Projects are supported by staff and working teams, who are almost entirely supported by in-kind contributions from their organizations. While managing projects in this volunteer-based environment is challenging, the results are very rewarding. One concern is our ability to account for these in-kind contributions from participants. Over the years, the Coordination Team has tried various ways to track in-kind contributions. We have found it to be relatively easy to track meeting hours and assign in-kind contributions based on attendance at PNAMP meetings and an estimate of meeting prep or driving time (Tables 1 and 2). The Coordination Team has attempted to track time participants spent working on PNAMP projects outside of meetings, but this is challenging because it requires input directly from participants. It has been difficult to get a comprehensive tally for

the year from participants and task leads. Requests have been made to participants asking them to track hours spent on PNAMP activities during the year; however, relatively few participants actually do. Since we were not able to come up with an accurate assessment of these hours in 2012, we are not reporting any estimates here. The Coordination Team plans to continue requesting in-kind estimates from participants in the future.

Table 1. Estimated hours contributed by entities to PNAMP meetings. Hours were assigned to each meeting attendee for every PNAMP meeting from January 1 to December 31, 2012. In person meetings were assigned at time and a half to account for travel and prep times. For example, if a meeting lasted 6 hours, participants were assigned 9 hours of in-kind contribution. Teleconference times were counted as recorded. These estimates assign the full meeting time to each meeting attendee, regardless of if they attended the whole meeting or not. Note: Contractors/consultants were assigned to the funding agency where possible (noted in entity name). The rest of the contractors/consultants were grouped as one entity.

Entity	Total Hours	Hours for Steering Committee Only
Bureau of Land Management	14.25	
Bonneville Power Administration and contractors	157	157
Burns Paiute Tribe	12	
California Dept. of Fish & Game	11.75	
Columbia Basin Fish & Wildlife Authority	97	88
Clark County	18.5	
Coast Fork Willamette Watershed Council	1.5	
Colville Confederated Tribes	20	3
Confederated Tribes and Bands of the Yakama Nation	22	
Confederated Tribes of the Warm Springs Reservation	12	
Consultants (grouped)	221.5	
Columbia River Inter-Tribal Fish Commission	111.5	91.25
Confederated Tribes of the Umatilla Indian Reservation	32.5	
DOGAMI	20.25	
EDS	57.5	
Environmental Protection Agency	62.00	
Freshwater Trust	13.5	
Idaho Department of Fish and Game	57	
Longview	3.75	
Lower Columbia River Estuary Partnership	16.5	
Lower Columbia River Fish Recovery Board	104	
Nez Perce Tribe	17.25	

Table 1 Continued. Estimated hours contributed by entities to PNAMP meetings.

Entity	Total Hours	Hours for Steering Committee Only
NOAA Fisheries	160.75	61
Nooksack Indian Tribe	4.5	
Northwest Power and Conservation Council	86.5	59.75
Northwest Habitat Institute	12	
Northwest Indian Fisheries Commission	6.75	3.75
Oregon Department of Environmental Quality	26.75	
Oregon Department of Fish and Wildlife	290.75	31
Oregon Water Resources Dept.	4.5	
Oregon Watershed Enhancement Board	5.5	
Pierce Co.	6.75	
Pacific Northwest National Laboratory	12	
Pacific States Marine Fisheries Commission	165.75	108
Private	57.25	
Quinault Indian Nation	2.25	
Redmond	2.25	
Shoshone-Bannock Tribes of Fort Hall	12	
SRSRB	10.5	
Tulalip Tribes	9	
Upper Columbia Salmon Recovery Board	4.5	
U.S. Army Corps of Engineers	4.5	
U.S. Bureau of Reclamation	62.5	62.5
U.S. Forest Service	48.25	19.5
U.S. Fish and Wildlife Service	20.25	
U.S. Geological Survey	171.5	27.75
University of Idaho	1.5	
University of Wyoming	4.5	
Washington Department of Ecology	131.25	32.75
Washington Governor’s Salmon Recovery Office	144.5	27.5
Watershed Sciences	9	
Washington Department of Fish & Wildlife	120	3
Wild Salmon Center	9.75	

Table 2. Estimated hours contributed by topical category to PNAMP meetings. Hours were assigned to each meeting attendee for every PNAMP meeting from January 1 to December 31, 2012. Meeting times were assigned at time and a half to account for travel time and prep times for the meeting. For example, if a meeting lasted 6 hours, participants were assigned 9 hours for that meeting. This was only done for on-site meetings. Teleconference times were counted as recorded. In addition, these estimates assign the full meeting time to each meeting attendee, regardless of if they attended the whole meeting or not.

Topical Category	Total Hours
Data Management Topics (Leadership Team, Coordinated Assessments, Metadata, Habitat Data Sharing)	1472.75
Web Resources (MonitoringMethods.org, Master Sample, etc.)	197.25
Integrated Status and Trends Monitoring Demonstration Project	556.25
Steering Committee	449.25

In June of 2012, PNAMP helped organize an Airborne Hydrographic LiDAR Workshop series that was attended by over 150 people; however many of these people did not identify their affiliation at the time of the workshop so they were not included in the in-kind hour totals.

This year, one of our subcontractors (Sitka Technology Group) reported in-kind contributions at approximately $35K. Sitka's management of the web development projects for PNAMP included detailed documentation of contributed resources, so accurate estimates were readily available. PNAMP does not typically receive estimates of in-kind contributions from other participants. It is the responsibility of the Coordination Staff to keep track of the amount of hours participants spend in PNAMP hosted meetings and workshops.

Project Activities

For several years, PNAMP's work and associated meetings and work sessions have been driven by ongoing and new projects. This is in contrast to the previous approach of standing work group meetings (organized around topics) throughout the year. The project-focused structure allows for better information distribution among participants in cases where a project cuts across multiple topical areas. Topical meetings that were scheduled on a regular basis during 2012 were the Data Management Leadership Team meeting series, Habitat Data Sharing sessions, and the Remote Sensing Forum.

Using a project-focused structure, PNAMP is able to gather interested SC members and subject matter experts to form working teams that focus on completing specific tasks for the project. These teams guide the progress of the project and act as intermediaries between the larger workgroup and the SC. We have found that this structure allows better SC/workgroup exchange without asking every SC member to track every activity. It also allows support from a larger forum of subject matter experts who are able to contribute to an open, inclusive process if they choose. The project-focused structure recognizes the smaller work teams while maintaining the framework of a larger forum of interested participants

In addition, PNAMP has found that it is important to have a dedicated lead for all projects, whether it is someone from the Coordination Team, a SC member, or subject matter expert who participates in PNAMP. In the absence of a lead who can dedicate time to move things along, PNAMP has found that final products can be significantly delayed, much to the frustration of interested parties. In cases where no volunteer lead has been identified via in-kind time contribution, PNAMP has distributed funds to support the time of a lead, as the budget allows.

PNAMP meetings and work sessions in 2012 focused on tasks related to these main projects: MoitoringResources.org (includes all web resource development), Coordinated Assessments, Habitat Data Sharing, Data Best Practices (Data Steward Community of Practice, Regional Metadata Guidance, and the Data Management Leadership Team Meeting Series), Remote Sensing Forum, Methods Review, Integrated Status and Trends Monitoring Demonstration Project and Other PNAMP Activities. Several smaller work teams met regularly to focus on specific tasks identified with these projects. Additional details are described below. Other topics or projects mentioned in previous PNAMP annual reports are still being tracked, but largely did not make much progress in 2012. These topics and projects, and plans for the future, are described briefly at the end of this section.

MonitoringResources.org

For the past several years, PNAMP has been focused on developing online resources to create a network of information and tools to support many facets of monitoring. After much of the development work was complete on Monitoring Methods and PNAMP began development of new tools, we realized that thoughtfully planning our web resources so they worked together to provide an efficient interface for users was critical. This would

allow for more efficient transfer of information and less burden on users. So, in 2012, we began development of the MonitoringResources.org site to integrate existing and future PNAMP web resources. This suite of complementary tools is intended to help monitoring practitioners plan and implement effective, efficient, high quality monitoring projects. The tools provide guidance and support for design and documentation of a monitoring project from the early design stage through implementation and generation of descriptive statistics. Using MonitoringResources.org allows practitioners to easily document information about their projects and programs and share it with many partners. Resource managers, funders, and policy makers benefit by getting a comprehensive view of existing and proposed monitoring projects in a region that allows them to better understand how well priorities are being met, as well as where there are gaps and overlaps in monitoring.

The goal was that MonitoringResources.org would contain the framework that provided the central user and organizational management. In addition, MonitoringResources.org would be the central website that housed all other PNAMP applications, including Monitoring Methods, Sample Designer, Site Manager (including Monitoring Explorer), Monitoring Advisor, and the Metadata Builder.

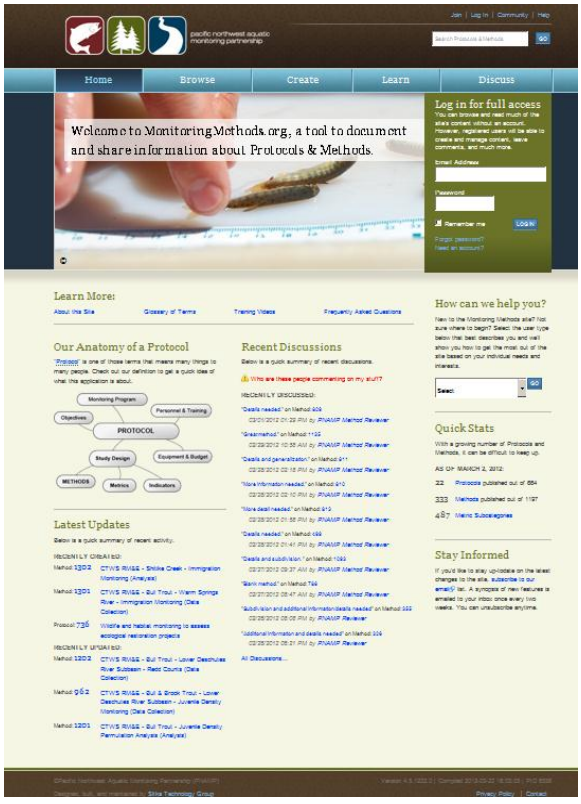
We did not fully develop all content on the MonitoringResources.org site in 2012, as that work was not outlined in our work plan for the year. We were able to set up a common identity and account management platform developed by Sitka Technology Group that enables single signon between the multiple tools developed by PNAMP. This means users can sign into one application and be automatically logged into all other PNAMP applications residing in the MonitoringResources.org framework. In addition, Monitoring Methods, Sample Designer, Site Manager, Monitoring Advisor, and the Metadata Builder were all integrated into the MonitoringResources.org framework.

There are many supporting tasks left to complete to make MonitoringResources.org fully functional. We are currently seeking input and feedback on the tools as we continue into 2013 and into our next phase of development. In addition, these tools are intended to support information sharing across other online systems, so we are also seeking input with respect to what systems and organizations to try to connect with. (Monitoring Resources project page; Monitoring Resources application)

MonitoringMethods.org

In an effort to move forward with promoting improved business practice around documentation and to support standards development, PNAMP developed MonitoringMethods.org. MonitoringMethods.org is a free, online

resource where monitoring practitioners can document methods and protocols or find information about others' methods and protocols, as well as definitions of monitoring terminology. MonitoringMethods.org also hosts a Community Forum to promote information exchange and collaboration between regional monitoring practitioners about topics of interest to this community. PNAMP makes information from MonitoringMethods.org available to other regional systems via web services.



In 2012, PNAMP received funds to add more features to MonitoringMethods.org. The major development in 2012 included:

- **Approvers** – we have added the ability for Monitoring Programs to appoint one or more persons as "approvers" of methods that could be used by their program
- **Suggested Methods** - when documenting a protocol, if you add metrics/indicators first, Monitoring Methods will suggest methods you might consider using. Of course, you can still add methods by searching by title, ID, or keyword, though you may find this new "Suggested Methods" tab faster. The suggestions are based on a one-time review of all the methods in the system by PNAMP and will begin to be populated by other users' metric-method mappings (see below)
- **Metric-Method Mapping** - After adding metrics and methods, users will review and finalize the associations between metrics/indicators and the methods used to generate them on the new "Metric-Method Mapping" page. These mappings will support future analysis for program managers and analysts interested in combining and synthesizing data. They will also help us to make more accurate or appropriate method suggestions over time.
- **Request Publishing** - When users are confident a method or protocol is complete, they can click the new "Request Publishing" button (on the left side bar of the Edit page). The system will check to ensure required information is there and, for protocols, checks that all methods it references have been published. Our premise is that it would not be good for the monitoring community if the system advertised that a protocol is "published" and yet let its underlying methods be altered.

- **Implementation Notes** - After publishing a protocol or method, owners can no longer edit it. But, realizing that things happen out in the field and users may need to adjust to the reality on the ground, we developed an "Implementation Notes" tab to both protocols and methods to give users a place to quickly record these necessary tweaks.

  This new tab is only enabled when a protocol or method is published. Since methods are often shared across various protocols, when entering notes on methods, you need to first select your protocol. You may also review (but not edit) any implementation notes left by other protocol owners of the same method. Our hope is that these implementation notes will be valuable feedback to the owner when it comes time to creating a new version of the method or protocol.

PNAMP staff also continued to support users in documenting their protocols and methods in Monitoring Methods. Staff spent approximately three to seven hours per week supporting requests received via email, phone, or the support page on the website. Requests included help with login, any content entry issues, support with how to structure protocols and methods for specific projects, responding to discussion board comments, reviewing methods that have been submitted for publishing (review for completeness, generic description, and possible duplicates), responding to requests to add new organizations or monitoring programs. A majority of support was related to requirements associated with Bonneville Power Administration Fish and Wildlife contracts.

In addition, staff provided training as necessary for Monitoring Methods in 2012, including one-on-one training support and larger group trainings. PNAMP staff conducted trainings for Idaho Department of Fish and Game staff and Nez Perce Tribe staff in June and July. In addition, several training sessions outlining new features in Monitoring Methods and BPA requirements were presented to BPA project sponsors in November and December of 2012. (Monitoring Methods project page; Monitoring Methods application)

Monitoring Sample Designer, Site Manager & Explorer

PNAMP, working with Oregon State University, developed a prototype web-based master sample tracking and management system to support PNAMP's ISTM demo project for the lower Columbia ESU. The prototype was found to be useful by the community, and it was decided that PNAMP should develop a production level application to support the needs of the entire Pacific Northwest. Over the past year, PNAMP pursued development of two discrete, but integrated tools to support a master sample based design and tracking system. Both applications were completed in October of 2012. The first application, Sample Designer, facilitates the process of: building your sample design using a probabilistic site selection (using an algorithm called

Generalized Random-Tessellation Stratified (GRTS)) to generate a spatially-balanced set of sites for status and trends monitoring; defining the target frame; stratification; site evaluation; and creating panels, It also supports creation of permanent, sharable online documentation of users' work.

The other application, Site Manager, supports documentation of site information, specifically to support information associated with master samples and sample designs created in the Sample Designer. The Site Manager stores designs (from both linear stream networks and area- based water bodies such as the mainstem and estuary), stores attribute information for sites in each master sample, and is the place users can explore sites in master samples and sample designs used in monitoring projects. This is also the application that allows users to upload their own sites, attributes and evaluations. The Site Manager is also the tool that would serve as the base for the Monitoring Explorer feature.

The idea for the Monitoring Explorer was based on a variety of past PNAMP discussions and new tool development. Since 2005, PNAMP participants have expressed the need for a web-based tool that provides geographic locations of monitoring activities linked with information about who is carrying out the activities and what is being monitored. PNAMP developed an idea for a tool that would provide information associated with project sites from multiple organizations in one online resource so users wouldn't have to search through a variety of project tracking databases to gather the information they need. Proponents envision that this tool would support the ability to summarize current and historic monitoring activities and would assist in coordinating future activities. It should be noted that the intent is not for PNAMP to develop a tool that becomes a system of record for all monitoring location information in the region, much less monitoring data, but instead to develop a tool that has the ability to display a comprehensive list of location information from other systems.

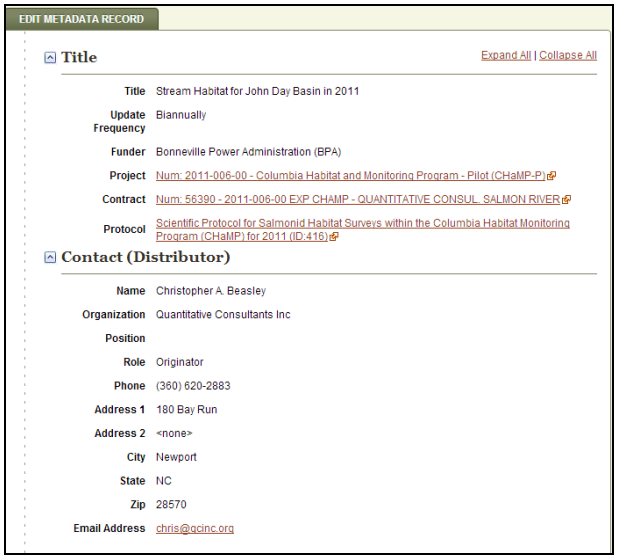
In 2012, PNAMP staff presented a vision for the Monitoring Explorer to participants and partners, highlighted ideas from past and current efforts that we intend to build on, and solicited feedback from a variety of PNAMP participants on how they might use such a tool and what options they would like to see in the user interface. A mock-up of design ideas from Sitka Technology Group was provided (link to design broadsheet) to help participants get an idea of what we are envisioning. Background details of this scoping exercise were written up in a short status report and distributed to participants. In addition, a summary of the results of the scoping exercise were also distributed in a report.

PNAMP plans to continue with additional development of the Sample Designer and Site Manager in 2013. Development will focus on making improvements identified during user testing and feedback. In addition, development of the Monitoring Explorer will begin in 2013. PNAMP will continue to solicit feedback from users as development progress. (Sample Designer project page; Sample Designer application; Site Manager project page; Site Manager application)

Metadata Builder

While drafting the 2011 Regional Metadata Tool Recommendations report, the Metadata Working Group recommended the concept of a metadata builder that would be comprised of a set of scripts that pull various metadata elements from existing organizational project management and documentation systems. At the time of the report the metadata builder was not considered a priority approach to building metadata records. However, when BPA issued a new mandate in 2011 for project sponsors to provide a metadata record for all new datasets developed through BPA funding PNAMP believed the idea should be pursued. In late 2011, BPA provided funding for development of a prototype tool. Funds were awarded to PNAMP via USGS. USGS subcontracted with Sitka Technology Group for the development of the prototype.

Development of the Metadata Builder prototype began in 2012, and was facilitated by leveraging the development effort on Monitoring Resources. By building Metadata Builder as a component within Monitoring Resources, much of the framework, code, and user-interfaces were quickly implemented based on well-defined patterns. These efficiencies helped to reduce cost on the prototype application. In addition, because this was a pilot effort intended to show proof of concept for a metadata builder, the intent was to focus on 'discovery level' metadata for datasets – a subset of the full standard record, based on priority elements identified by PNAMP's Metadata Working Group, StreamNet, NOAA's InPort, and input from BPA.



The prototype Metadata Builder was completed in the fall of 2012. The tool extracts data via web services from information systems (Pisces, Taurus (aka cbfish.org), and Monitoring Methods) that store data on individual contracts or individual protocols. The prototype develops a 'discovery level' metadata record that uses a limited set of ISO metadata standard elements. PNAMP provided a demo of the prototype tool to the PNAMP Metadata Working Group and the Data Management Leadership Team to ask for review and feedback in the fall of 2012. A short summary report of the development process, lessons learned, and feedback received was drafted. We anticipate receiving more feedback from BPA project sponsors as they use the prototype to fulfill contracting requirements. At this time, no additional development is planned for this tool in 2013. (Metadata Builder project page)

Monitoring Advisor

PNAMP, working in partnership with the State of the Salmon Project, has been hosting and maintaining the Salmon Monitoring Advisor (SMA) website since 2011. The SMA site was developed by a working group of scientists through a series of workshops 2008 to 2010, funded by a grant from the Gordon and Betty Moore Foundation. The grant was administered through the United States National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara, California. The working group was composed of 14 scientists with extensive experience in a variety of governmental and nongovernmental organizations, many of which are involved in PNAMP. After migrating the site to PNAMP hosted servers in early 2012, PNAMP had the software platform that the site was hosted on updated. This update was to provide a more user friendly editing platform for PNAMP staff and others in the future. Since all components did not transfer directly, there was some work required to make sure all original components from the site were completely transferred to the new platform. In addition, the site theme was updated to match the Monitoring Resources theme and a new URL was established for the site (http://www.monitoringadvisor.org/) with the intention of changing the name from Salmon Monitoring Advisor to just Monitoring Advisor.

PNAMP will wait to widely advertise this new look and name as we would like to make more progress on planned updates to the site content in 2013. These improvements include: ensuring the language used does not conflict with language used on other PNAMP sponsored sites, incorporating Steering Committee comments, and ensuring all hyperlinks are mapped appropriately. Also, with the support of subject matter experts, we would like to expand the content on the site to include information about monitoring watersheds, habitat, and other interests in addition to the current emphasis, which is salmon population monitoring. In the future, we would like to integrate the content from the Monitoring Advisor directly into Monitoring Resources, but for now, there are links in the

Learn menus and throughout the applications as appropriate.
([Monitoring Advisor project page](); [Salmon Monitoring Advisor website]())

Coordinated Assessments Project

The Coordinated Assessments (CA) project is a response to the Federal Columbia River Power System (FCRPS) Action Agencies and fishery co-managers agreements in the Columbia River Basin Anadromous Salmonid Monitoring Strategy (ASMS) ([link to Strategy]()) to provide data related to Viable Salmonid Population (VSP) indicators. Performing assessments and reporting answers to management questions that rely on VSP data are needed to support 1) federal reporting for the Federal Power System Biological Opinion (BiOp), 2) federal recovery group reporting for the Endangered Species Act (ESA), 3) state agency mandated reporting, and 4) tribal Accord reporting needs.

Phase I ([link to work plan]()) of the CA was initiated in 2010 with PNAMP and the Columbia Basin Fish and Wildlife Foundation (CBFWF, then CBFWA) developing a draft data exchange template (DET) containing a listing of proposed data elements for exchange of three VSP indicators – natural origin spawner abundance, smolt to adult ratios, and recruits per spawner – and supporting metrics. A fourteen member Coordinated Assessments (CA) Planning Group (CAPG) was convened to guide the implementation of the project. PNAMP contracted with Ross & Associates to provide facilitation expertise.

Phase II ([link to work plan]()) of the CA was initiated in October 2010 with a workshop of co-managers and representatives of other key organizations to review the efforts of Phase I and initiate a field effort to survey the data available for the draft data exchange template. Nine state and tribal fisheries management agencies worked with data technicians hired for the CA project and managed through StreamNet to survey the data the tribe or agency had for the VSP/DET draft and to develop data flow diagrams illustrating the data flow from collection to indicator calculation. The nine data technicians worked at eleven different locations for a period up to 6 months. In addition the effort initiated an assessment of the gaps, needs and priorities for developing data sharing capabilities of the state agencies and tribes participating in the effort. The status of the project was reviewed and lessons learned presented to the project participants at an April 2011 workshop ([link to workshop page]()).

After the April workshop, CA activities focused on developing an overall strategy that would guide the participating organizations in: 1) developing their capacity for managing the data supporting VSP indicators and 2) developing a process to organize and share the VSP and supporting metrics in DET format. The participating state agencies and tribes developed individual data management strategies to support sharing of the VSP indicators as part of the overall strategy. Another workshop was hosted in September 2011, during which participants provided input on the draft strategy. The final draft

"Columbia River Basin Collaborative Data Sharing Strategy: Salmon and Steelhead Population Abundance and Productivity Indicators" was published after a follow-up review period (link to final report).

Phase III (link to work plan) focused on the development of the VSP/DET. Under the guidance of StreamNet and support from PNAMP and CBFWF, a data-exchange-template-development-team (DDT) met multiple times to review each proposed data element and revise its definition and format for inclusion on the final standard. During this time the previously used label of data exchange template was changed to data exchange standard (DES). The DES was conditionally approved by CA participants in a workshop and after final edits by the DDT, the CAPG approved the DES v1.0 (link to DES) regional implementation.

Phase IV (link to work plan) will be conducted mainly in 2013. One of the Phase IV goals has been met in 2012, the submission of a data exchange network funding proposal submitted to EPA in early November. The proposal, submitted through Washington State Department of Fish and Wildlife and entitled "Columbia River Salmonid Coordinated Assessments Data Exchange", proposes the development of a Salmonid Coordinated Assessment Data Exchange (SCADE) in support of the CA effort. The SCADE, if funded, would improve the ability of partners to manage, exchange, access and use these data in support of improved local and regional management decisions.

In addition to the above goal, in 2013 the CA partners hope to initiate data exchange using the DES v.0 and initiate expansion of the project to include development of hatchery data DES elements and possibly other regional priority indicators. An early spring workshop is planned.

Habitat Data Sharing

Organizations throughout the region collect habitat condition data for a number of purposes including management and regulation of activities that affect fish habitat, assessment of watershed health, Clean Water Act applications and landscape metrics to support BiOp requirements. One important driver for the sharing of habitat data is the need of tribes and organizations at all levels to report on status and trends of fish and habitat condition and action effectiveness of restoration work at the project and watershed scales.

PNAMP initiated the Habitat Data Sharing (HDS) project in mid-2011 with the formation of a project work team consisting of PNAMP and CBFWA staff. PNAMP contracted with Ross & Associates to provide facilitation expertise during this effort. Initial interviews conducted by PNAMP staff in June and July 2011, with 11 people representing federal, state, tribal, and NGO interests in aquatic resource management. A workshop was held on July 26, attended by nearly 20 invited participants, and a broad scoping activity was conducted (link to workshop page). In the fall, the HDS Leadership Team was assembled to guide the project's activities. They held their first meeting in December of 2011. Collectively, the core and leadership team developed and implemented the 2012 work plan (link to work plan) that described seven activity areas. In addition, a subgroup, the

macroinvertebrate planning group (MIPG), focused on the activity concerning the use of macroinvertebrate data as a component of data sharing. The habitat data considered includes physical, chemical, biological, and geological characteristics of streams and their riparian zones throughout the Pacific Northwest region.

The HDS Leadership Team met four times in 2012 and the MIPG met six times. The first four activities all involved aspects of instream habitat data sharing. For activity one, identification of a short list of priority habitat characteristics, the core team developed a draft list of priority habitat characteristics based on the tabulated results of the ISTM Habitat effort and refined the list through consultation with the HDS Leadership Team and the ISTM Habitat participants. The resulting list (link to list) is considered a working product that can be expanded and refined with additional input. For activity two, DET prototype for selected habitat characteristic data, the core team worked with representatives of Washington GSRO to select habitat characteristics from the activity one priority list that are of particular interest to the GSRO in reporting for the State of the Salmon Report. The group chose four habitat characteristics of interest and the core team evaluated the data sharing issues that would be associated with GSRO obtaining and compiling these data from ISTM Habitat participating organizations. These issues were evaluated and discussed in a report presented to the HDS Leadership Team and the PNAMP Steering Committee (link to report). While the report did not specify DET recommendations, it was seen as a pilot that informed the process of defining data exchange targets for regional habitat data sharing. The core team and HDS Leadership Team determined that it was too early in the process of evaluating regional habitat data sharing needs to make much progress on activity three (creating habitat indices for improved sharing using normalization of habitat metrics and measurements) and activity four (needs assessment for habitat data sharing).

Discussions related to activity five, macroinvertebrate data as a component of habitat characterization data for sharing, were embraced by the MIPG. Two topics of interest emerged during the year. The first was the identified need for regional standard taxonomic effort (STE) agreements that addressed both level s of resolution and appropriate taxonomic nomenclature. This topic was considered in a special session organized and facilitated by PNAMP staff at the Northwest Biological Assessment Working-group's annual workshop in Boise, Idaho. Four speakers presented perspectives on STE from the agency, taxonomic lab, national, and regional viewpoints, respectively (link to event). The workshop included an extended panel and group discussion on the need for a Northwest STE and considerations in developing these agreements. The STE activity will continue in 2013. The second topic of

interest considered by the MIPG was the relationships between macroinvertebrates and fish habitat quality. A briefing paper was developed to describe the conceptual framework for these ideas and to solicit wider input. PNAMP is organizing a session at the 2013 Oregon chapter AFS to further explore the topic.

Activities six (remote sensing as a new/improved source of habitat characterization at multiple scales) and seven (habitat data discovery) were not unique to the HDS project but were rather placeholders for HDS Leadership Team input into these two emerging topics. The Remote Sensing Forum, reported in another section, was initiated in 2012 and the HDS participants were invited to comment and join in this Forum. The efforts of the Monitoring Resources project, reported in another section, resulted in a prototype Explorer feature that could facilitate habitat data discovery. The HDS Leadership team was kept apprised of this effort and their comments were solicited on the final prototype.

The HDS leadership team reviewed progress on these activities in October 2012 and provided the project core team input on suggested next steps. The resulting 2013 work plan (link to work plan) took the continuing activities of 2012 and consolidated them into two topic areas – instream habitat data sharing and macroinvertebrate data sharing – each of which will be supported by several activities. The work plan has now been approved by both the HDS Leadership Team and the PNAMP Steering Committee.

Data Best Practices

In recent years, there has been significant attention on advancing data management in the region. PNAMP recognizes the importance of data management to regional monitoring activities and the highly technical nature of data management discussions. To facilitate dialog between PNAMP work teams, regional information management groups, and regional application development teams, PNAMP continues to support a member of the Coordination Team to help guide and move these projects along. In 2011, the Coordination Team developed a new position, the Information Management Liaison, to replace the Data Steward. Throughout 2012, the PNAMP Information Management Liaison was responsible for supporting specific projects; coordinating and facilitating meetings related to regional data management efforts; providing recommendations to the PNAMP Coordinator and SC on regional data management issues, tools, and procedures; communicating with monitoring practitioners to identify needs; and communicating user requirements to development teams (link to PNAMP Data Management page). Tasks undertaken by the Information Management

Liaison will be distributed among remaining PNAMP members in 2013.

The data best practices project is an ongoing activity of the PNAMP community to advocate and promote data management and communication worthy of our aquatic monitoring. Currently the project consists of three activities that are conducted on an 'as-needed' basis rather than with targeted deliverables.

Data Steward Community of Practice:

PNAMP coordination staff has identified the need to provide ongoing support to data professionals affiliated with PNAMP partners, either directly or indirectly. In 2012, periodic mailings were made to the data steward community of practice to announce meetings and trainings of interest. A survey has been conducted of DMLT and Data Steward mailing list members so as to solicit input on the types of data management activities they would like PNAMP to facilitate in and the level of effort behind those activities.

The management and communication of data is receiving increasing importance in the business activities of many different agencies. Information on standards and perspectives are being developed that can help the PNAMP community of data stewards. The Data Steward Resources is a special place in the PNAMP web site where documents that can be of value to the PNAMP data steward community are posted and can be queried using a proscribed set of filters. The Data Steward Resources on-line library was initiated in 2012 and currently contains documents that have been tagged by one or more of six keywords: best practices, data dictionary, data exchange, data life cycle planning, GIS, and metadata.

Regional Metadata Guidance:

Metadata describe the content, quality, condition, and other characteristics of data. A standard metadata report can be used to enhance searching and discovery of data sets and to facilitate understanding of the meaning and proper use of datasets. For organizations that collect data, metadata help enhance the quality, usability and value of data for internal and external users. Organizations should view metadata creation as integral to their workflow and metadata as integral to datasets.

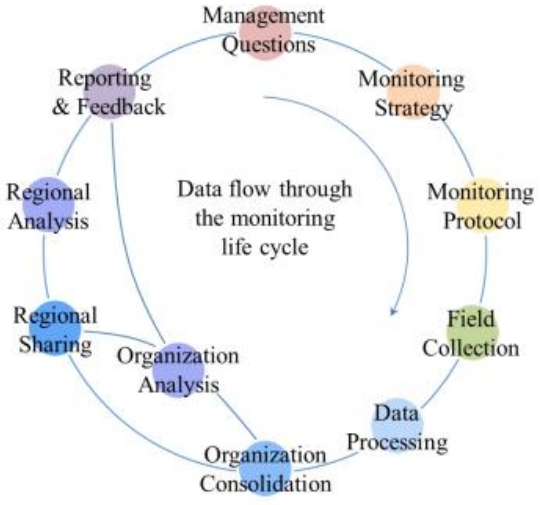
The Metadata Working Group has worked with a contractor, Environmental Data Services, to write a regional metadata guidance report, "Regional Guidance on Metadata for Environmental Data" in 2010 (link to report) and a scoping report in 2011 titled "Regional Metadata Tool Recommendations" (link to report).

In 2012, the metadata working reviewed the prototype Metadata Builder (link to meeting notes) and provided input on the applicability of this tool for providing discovery level metadata as well as dataset level metadata. As dataset metadata standards are transitioning from FGDC to ISO definitions, the group has been eager for ISO metadata creation tools to become more available. In 2013, the metadata working group will continue to operate as an ad-hoc group that meets as informed and directed by DMLT members.

Data Management Leadership Team Meeting Series:

The Data Management Leadership Team (DMLT) is a long standing open-membership group of PNAMP partners and participants that are interested in promoting best practices for aquatic data management and sharing. It meets quarterly on a standing basis. Meetings regularly consist of updates on projects with direct relationships to data issues. In 2012, the project-focused orientation of the meetings continued with the addition of a special presentation or topic-focused discussion.

The DMLT met four times in 2012. At the meetings, updates were provided for the projects described below in addition to the focus topic of that meeting. Focus topics in 2012 included a guest presentation on semantic technologies to help manage data and on observational ontology for the salmon research community, an initial discussion on data sharing agreements, and a 'web-tool blitz' where a variety of tools to aid aquatic monitoring develop by PNAMP partners were presented.



In 2012, the DMLT originated "Guidance for Implementing Successful Data Management and Sharing" document (formerly known as regional data management and sharing roadmap) (link to report) was finalized with its adaptation by the PNAMP Steering Committee. The document, a PNAMP publication, describes five actions that need to be considered by data managers and their organizations in determining best practices for data management: 1) describe protocols, standardize data processing, 3) develop metadata, 4) use common terminology, and 5) plan for data sharing.

The DMLT will continue to meet on a regular basis in 2013 to address regional data management needs.

Remote Sensing Forum

Remotely sensed data are of increasing interest to resource managers. Both data availability and advances in interpretation methodologies and technology continue to evolve rapidly. Previously PNAMP hosted a special session on remote sensing applications at the 2008 American Society of Photogrammetry and Remote Sensing (ASPRS) annual conference. PNAMP published a compilation of papers from that session in 2009 (link to remote sensing special publication).

In 2012, PNAMP, with guidance from a planning group consisting of two GSRO and one WDFW representatives, convened the Remote Sensing Forum (RS Forum). The structure of the RS Forum was quarterly informational online presentations on topics related to remote sensing acquisition and application/analysis in aquatic habitats. In

2012 the Forum sponsored three presentations and a series of workshops:

- Dr. Ken Pierce, WDFW, on Puget Sound High Resolution Change Detection (link to presentation, link to Forum notes).
- Dr. Jim McKean, USFS, on 'Organizing and interpreting high resolution channel topographic data using the river bathymetry toolkit and wavelet transformations' (link to presentation, link to notes).
- Dr. Jim McKean, USFS, on 'Effects of changing flow regimes on stream physical habitat in low-gradient meadows' (link to presentation).
- Airborne Hydrographic LiDAR workshops, held in Boise, Seattle, Corvallis, and Portland, featured three speakers and introduced a new commercial 'green' LiDAR sensor. The presentations were 'Overview to airborne topo-bathymetric LiDAR' (link to presentation), Description of aquatic physical habitat in channels using a narrow-beam bathymetric LiDAR' (link to presentation), and 'Deployment of a hydrographic airborne laser scanner in the Pacific Northwest'.

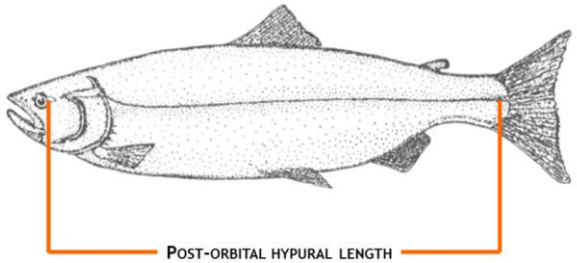
PNAMP plans to continue to Forum in 2013.

Methods Review

One of PNAMP's objectives is to understand partners' needs with respect to monitoring methodology and to facilitate collaboration, coordination, discussion, and evaluation of implementation of monitoring methodology. In browsing the list of methods on Monitoring Methods, you'll notice that measurements may be collected using several different methods. Methods may be different because of different study objectives, locations, equipment used, or differing opinions of practitioners about what is the best practice. For collaborative projects or programs that share data, it can be difficult to appropriately combine datasets if there is a lack of understanding of the details of the methods used to collect the data. With the development of the Monitoring Methods Discussion Board, PNAMP hopes to provide more consistency in method documentation and therefore a better understanding between practitioners about what everyone is doing. Further, we anticipate discussions in the community about implementation of monitoring methods, study design details, etc. It is expected that these discussions will help point out agreements and inconsistencies related to methods, but may not always have a clear resolution. With the Methods Review effort, we will use the Discussion Board, as well as previous PNAMP discussions, as a basis to plan for technical discussions focused on the current state of affairs for a method, inconsistencies and disagreements, and how to move forward.

In 2012, PNAMP hosted one online method review. The topic we focused on was measuring fish length. The method review was initiated after a training session for Monitoring Methods in which the group had a discussion about whether or not it was important to document how to measure fish length (all species and life stages) and if yes, what details needed to be included in the method. After discussion with that group, PNAMP staff investigated how many methods were documented in Monitoring Methods that described how to measure fish length and how well documented they were. After gathering some information about what methods were in

the system and what methods were documented in published literature, PNAMP staff posted a query about this topic on the Monitoring Methods Discussion Board (link to topic conversation) and asked the community for input. After feedback was received, the group made a decision about the best way to document methods describing measuring fish length. PNAMP staff entered new methods for the community recommended methods. Since that time, owners of other methods that describe how to measure fish length have been encouraged to delete their methods and start using the community recommended methods. It is our hope that by combining or eliminating redundant methods in Monitoring Methods, it will be easier in the long term to identify best practices and promote consistent documentation.

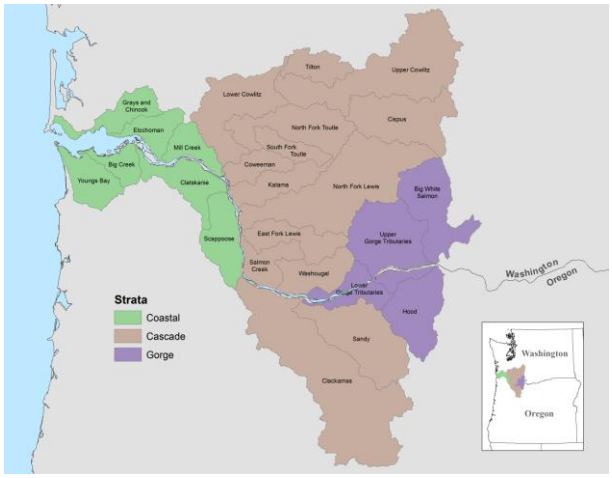


PNAMP plans to continue method reviews in 2013. Currently, we have a workshop planned for the Oregon Chapter American Fisheries Society (AFS) Annual Meeting and another planned for the Western Division AFS Annual meeting to host method discussions about fish abundance and physical habitat methods. (Methods Review project page)

Integrated Status and Trends Monitoring Demonstration Project

The Integrated Status and Trends Monitoring Demonstration Project (ISTM demo project) has been developed over the past several years with collaborative effort involving PNAMP partners and other local partners in the Lower Columbia River (LCR). The ISTM demo project is intended to demonstrate an approach and utility of an integrated design framework for the collection of information to address questions on the status and trends of physical, chemical, and biological attributes in stream networks.

After many discussions to scope and refine the project, the group decided to conduct a demonstration in the LCR recovery area. The ISTM demo project will provide entities tasked with monitoring fish populations and aquatic habitat in the Pacific Northwest with a roadmap for integration of scientifically sound monitoring programs intended to meet the needs of decision-makers and managers. Specifically, it will apply this approach and develop recommendations for integrated monitoring plans (based on monitoring conducted by the Oregon Department of Fish and Wildlife (ODFW), the U.S. Forest Service (USFS), NOAA Fisheries (NOAA), the Lower Columbia Fish Recovery Board (LCFRB), the Washington Department of Fish and Wildlife (WDFW), and the Washington Department of Ecology (WDOE)) for salmon, steelhead, and potentially bull trout populations listed under the ESA, and their habitats in the LCR.



Among the many monitoring components, key features of this effort are improved understanding of the extent and qualities of existing information, key gaps, and how a region-wide "master sample" concept can be applied to select sampling locations where appropriate. Generic objectives in the ISTM demo project for both habitat and fish are:

1) Identify and prioritize management decisions, questions, and objectives;
2) Evaluate the extent to which existing programs align with these management decisions, questions, and objectives;
3) Identify the most appropriate monitoring design(s) to inform priority management decisions, questions, and objectives;
4) Use trade-off analysis to develop specific recommendations for monitoring based on outcomes of objectives 1-3; and
5) Recommend implementation and reporting mechanisms.

The PNAMP Coordination Team has facilitated development of the ISTM project as part of PNAMP activities in conjunction with other PNAMP tasks in order to fully capitalize on partners' in-kind contributions of staff time. In-kind contributions have largely been the primary mechanism to advance this work to date, but in 2012, several specific tasks continued on funding from Bonneville Power Administration (BPA) in order to complete the work in the absence of a technical lead.

Progress on the project has been broken out into components and detailed below. Each component is in a different state of maturity, but the Coordination Team facilitated progress to ensure that all were linked as necessary to benefit the project as a whole.
(link to ISTM Demonstration project)

Fish Monitoring Component

(Task leads: Dan Rawding, Jeff Rodgers, Bernadette Graham Hudson)

The specific goal of the fish sub-workgroup of the ISTM project is to develop a coordinated VSP monitoring program that addresses key regional (priority) monitoring questions and develops study designs of sufficient quality and quantity to determine status and trend of LCR salmon and steelhead. This will provide entities tasked with monitoring salmon and steelhead populations in the Pacific Northwest with a roadmap of the steps needed to develop an integrated, scientifically sound monitoring program that meets the needs of regional decision-makers and managers. The intent is to apply this approach to develop a specific monitoring plan for ESA listed salmon and steelhead populations in the LCR, concentrating on the monitoring of VSP parameters. It is anticipated that this project will ultimately lead to a transparent, scientifically credible, and cost-effective fish

monitoring program in the LCR, which can be used as a model for the remainder of the Columbia Basin.

In 2010, staff from ODFW, WDFW, and the LCFRB led an effort to host a series of workshops with monitoring program managers, ISTM participants, and the Joint Salmon Science Team (JSST) to prioritize fish monitoring needs. Task leads used the information gathered at the workshops to identify and prioritize management decisions, questions, and objectives for integrated status and trend monitoring of salmon and steelhead populations in the LCR planning domain (Objective 1). In addition, work related to the Data Management component of ISTM supported this task (see the Data Management Section below for more details). Details of this work that completed Objective 1 for the fish component can be found in the final report: "Identification and Prioritization of Management Decisions, Questions, and Objectives for Lower Columbia River Integrated Status and Trend Salmon and Steelhead Monitoring, PNAMP 2010; link to Obj. 1 report).

In 2012, the ISTM Fish team completed Objective 2 and produced two reports, one to present results of Objective 2 and one to present a summary of data management status for populations in the LCR. In the first report, we developed a prioritization tool that included factors such as population recovery priority, current natural origin abundance, the potential for fish in/out monitoring, and special cases identified in the recovery plans along with the prioritization of Viable Salmonid Population (VSP) population monitoring indicators. The tool incorporated spatially explicit information on both the priority of the monitoring data and the feasibility/relative expense of obtaining it.

In the Objective 2 draft report (link to Obj. 2 report), we evaluate how existing monitoring programs align with the management decisions, questions, and objectives identified in the first objective. To accomplish this task, we describe criteria to evaluate the 10 indicators against the priorities identified in the first report for all 103 populations of salmon and steelhead that are addressed in the states of Washington and Oregon recovery plans for the LCR. In addition to identifying the gaps, we make recommendations to improve population specific indicators that are not meeting the monitoring goals. Using graphs, we are able to succinctly display monitoring gaps and opportunities to improve these by species, adult and juvenile life stage, population, and indicator.

It is important to stress that the low scores given to some of the current monitoring programs in the LCR do not necessarily indicate that current monitoring efforts provide

low quality information. The scoring system we have developed essentially establishes what the gold standard should be for specific monitoring approaches. Useful information can be and is being obtained from monitoring programs that fail that standard. The intent of this report is not to point fingers at the shortcomings of existing monitoring programs, but rather provide regional managers and policy makers with the information they need to understand the caveats that should be associated with information they receive from existing monitoring programs, as well as specifics on what is needed to improve the quality of this information.

The purpose of Objective 3 is to identify the most appropriate monitoring design(s) to inform priority management decisions, questions, and objectives. This objective has three parts, which include a review of current monitoring, development of spatial sampling frames for adult VSP monitoring, and simulations of various sampling strategies to address bias, precision, and cost tradeoffs. The review of various monitoring designs was incorporated in the evaluation of the alignment of existing programs (Objective 2). A draft distribution model for Chinook, coho, chum, and steelhead is completed and awaiting review by the mangers and has been used by NOAA to assess fall Chinook recovery actions. The sampling strategies have been developed and are being assessed using census data and simulations. A workshop was conducted in February 2012 (link to event) with managers to present these results and receive comments before finalizing the reports for these objectives.

Based on draft reports for Objectives 2 and 3, informal trade-off analyses have been used to develop specific recommendations for monitoring (Objective 4). These preliminary recommendations can be found as part of a gaps assessment and were scheduled to be presented to policy representatives and managers in 2012.

The final objective includes implementation and reporting recommendations. The implementation recommendation will be derived from the gaps analysis in Objective 2, evaluation of monitoring designs in Objective 3, and the informal trade-off analysis in Objective 4. The reporting mechanisms will be the result of the data management strategy described in the following section. Completion of this objective is scheduled to occur in 2012. (link to Fish Component project)

Data Management Component

(Task leads: Cedric Cooney, Brodie Cox)

Both ODFW and WDFW were funded in 2010 through 2011 to complete data management tasks to support ISTM. These tasks also support the Coordinated Assessments effort and the Data Management strategy for each of the Columbia River fish management agencies described above in the Coordinated Assessments effort. Evaluation of the Data Collection, Storage, and Management for the Lower Columbia River Salmon and Steelhead Monitoring Program" (PNAMP 2012-002; link here).

Since ODFW and WDFW are primary conductors of status and trends monitoring of salmon and steelhead in LCR, it is critical for

them to catalog, manage and share monitoring data in order to support ESA status determinations and to evaluate the response of fish populations to the implementation of the 2008 FCRPS Biological Opinion. In 2010, the ISTM data management effort had a goal to support Objective 2 of the fish monitoring component by pursuing completion of the data management development steps for one of the three VSP parameters - adult abundance. However, monitoring of the remaining indicators provides little value unless the data collection can be efficiently stored, managed, queried, analyzed, and reported to managers. There are data management challenges in reporting the status and trends of populations by indicator within the LCR because there are multiple entities involved in monitoring. Some of these issues have been noted including:

1) Databases should be coordinated such that a common set of metadata and common data dictionaries are used to track information so that it can be shared among monitoring partners;
2) Monitoring agencies should develop automated internal infrastructure to assess and evaluate their data such that all methods and calculations are transparent and repeatable;
3) The regional salmon recovery partners should build distributed data systems that can communicate between monitoring partners and report to the progress in salmon recovery; and
4) The monitoring partners should coordinate their sampling programs to fit within an integrated sampling program.

This led ODFW and WDFW to evaluate the collection, storage, and management for the Lower Columbia River Salmon and Steelhead monitoring program data. We used a similar approach to assessing the alignment of fish monitoring data to priorities based on filters for different components of the prioritization of data management. This report is currently under review by regional policy representatives and mangers.

Due in part to the work conducted for the ISTM project, ODFW was able to develop a schematic of desired future design for data management and sharing, including a clear structure to data flow. ODFW is committed to pursuing this design, or adapting the design as necessary to meet agency and regional needs.

WDFW has continued to build on the data management tasks completed in 2010 for fisheries, spawning ground survey (SGS), age and scales (A&S), and juvenile migrant (JMX) databases. These data contributed to the completion of objectives 2-5. The spatial data from SGS was used to develop adult salmon and steelhead sampling frame and these spatial locations were used to evaluate sampling designs (Objective 3). WDFW continues to populate these databases and develop data entry forms to facilitate their use.

Tributary Habitat Monitoring Component

(Task leads: Amy Puls, Jeff Rodgers, Bernadette Graham Hudson)

In response to ESA listings for salmon and steelhead, federal and state agencies, local governments, private industry, and the tribes have invested substantial resources to restore and protect the ecological function of rivers and streams in the Pacific Northwest. One of the important salmon recovery needs is the ability to describe, with known certainty, the status and long-term trends of the habitat conditions (physical, chemical, and biological conditions) of these aquatic resources. The goal of this component is to develop a coordinated habitat monitoring program for the LCR ESU that meets these information needs and ultimately answers the question: "Are the primary habitat factors limiting the viability of the salmon and steelhead populations and ESU increasing, decreasing, or stable?"

In early 2012, the tributary habitat monitoring working group, comprised of representatives from the seven participating habitat monitoring programs in the LCR ESU, finished their review of tributary attributes measured by 3 or more of the programs. The programs being analyzed were Clark County Washington Stormwater Needs Assessment Program, Columbia Habitat Monitoring Program (CHaMP), Oregon Department of Environmental Quality (ODEQ) National Rivers and Streams Assessment, Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventory, Washington State's Salmon Recovery Funding Board (SRFB) Action Effectiveness Monitoring, US Forest Service (USFS) Aquatic and Riparian Effectiveness Monitoring Plan, and Washington Department of Ecology (WADOE) Monitoring for Watershed Health and Salmon Recovery. Program representatives considered information on the scope and scale of each program, as well as detailed descriptions of the collection and analysis methods to determine what data could potentially be shared. After reviewing the collection and analysis methods for a given measurement or metric, each program identified which of the other programs' data they could use, as well as differences in methods that prohibited data consolidation. These online work sessions allowed for documentation of current program similarities, as well as areas that need to be addressed to increase compatibility.

As the measurement and metric comparison was wrapping up, the Lower Columbia Fish Recovery Board (LCFRB) together with the City of Longview was awarded a Grant of Regional or Statewide Significance (GROSS Grant) from WDOE to build on progress made in the Habitat ISTM project and combine efforts with municipal stormwater managers in

Southwest Washington to develop an integrated status and trends monitoring design for the Lower Columbia region. The grant included money to subcontract for technical and statistical assistance; this subcontract was awarded to Tetra Tech. The project continues to be a collaborative effort and now includes Tetra Tech, Sitka Technology Group, Stevens Environmental Statistics LCC, stormwater permittees of Southwest Washington, as well as the original ISTM partners of CHaMP, Clark Co, ODEQ, ODFW, SRFB, USFS, and WADOE. PNAMP will remain actively involved with the project by participating on both the leadership and core teams. The aim of the project remains the same, to demonstrate the approaches and utility of integrating data collection and management to address multi-scale questions about the status and trends of physical, chemical, and biological attributes of tributaries in the Lower Columbia region.

The combined project is to be implemented in three phases starting in November of 2012 and finishing by June of 2013. The contracting team spent the last few months of 2012 gathering the necessary information from the stormwater permittees (equivalent to the information obtained for ISTM objectives 1 and 2 discussed above in the ISTM overview), and will spend the first half of 2013 completing ISTM objectives 3-5 for the combined project. This will include a gap analysis to determine how well existing programs' spatial, temporal, and response designs meet monitoring priorities across the region; recommendations to filling monitoring gaps; a trade-off analysis relating potential monitoring design scenarios with management questions, field constraints, and cost; and final recommendations for implementation. (link to ISTM Habitat Component project)

Mainstem Component

(Task leads: Tim Counihan, Jill Hardiman)

Similar to what is proposed for tributary habitat in the LCR, the inclusion of a component to demonstrate what is needed to implement an integrated monitoring program for estuaries and non-wadeable streams and rivers would be beneficial to the ISTM demo project. Co-locating this work in the area proposed for the ISTM demo has advantages; similar to what has been described in this report for tributary streams. There are multiple jurisdictions that could be involved and multiple existing monitoring efforts that could be integrated.

Previous work by the USGS-Columbia River Research Laboratory has utilized Digital Elevation Models (DEMs) of the river channel and upland areas to generate a "master sample(s)" for the Columbia and Snake River reservoirs using a Generalized Random-Tessellation Stratified (GRTS) algorithm for an areal-based resource. They have compiled and are continuing to process geospatially referenced data representing the aquatic habitats of the mainstem Columbia River from Bonneville Dam upstream to the Canadian Border and the Snake River from its confluence with the Columbia River upstream to the border of the State of Wyoming.

In 2011, PNAMP worked with USGS and Sitka Technology Group to develop a plan to align and integrate the mainstem master

sample into the Master Sample Tool. The areal-based master sample is different from the existing linear master samples in the prototype tool for the tributaries. To define the sampling frame for the river channel and upland areas of the Columbia and Snake Rivers, USGS used the presence of hydroelectric projects to delineate discrete geographic units. For example, they defined the sample frame for Bonneville Reservoir as the area bounded by Bonneville Dam at the downstream extent and The Dalles Dam as the upstream extent. They used the forebay elevation of the upstream hydroelectric project (The Dalles Dam in this example) as a benchmark to define the maximum elevation for the floodplain extent. They then used the GRTS algorithm to generate a master sample list of sites for this area. This technique was chosen to define the floodplain because the extents of the current and historic floodplains are currently undefined and because it was the same technique to define the floodplain for the master sample previously formulated for the Columbia River Estuary.

As part of the integration, the group discussed the benefits and drawbacks associated with presenting USGS' efforts as one comprehensive master sample (for the entire Columbia River Basin) or as discrete units as described above. Ultimately, how the master sample is grouped or divided will be based on the user's needs with respect to allocating samples over an area that encompasses their monitoring program requirements, but the decision was made to present multiple master samples corresponding to discrete geographic units. That is, USGS will provide a master sample for Bonneville Reservoir, The Dalles Reservoir, etc., to incorporate into the Master Sample Tool. The group also decided that USGS would provide a basic level of information that will allow some stratification by users if desired. Attributes that include State, County, Hydrologic Unit Codes, etc., will be associated with the mainstem master sample files. Further, the group discussed more fully developing the framework for an ISTM for a smaller section of the Columbia River; the Bonneville Reservoir. We chose this area because it is an area where USGS is data rich and because there are other efforts underway that would provide an opportunity to integrate monitoring of the mainstem and tributary systems. The Bonneville Reservoir is also contained within the Columbia Gorge National Scenic area and several important salmonid bearing tributaries (e.g., Hood River, Klickitat River, Wind River) empty into this reach of the Columbia River. For this area of the Columbia River, we will incorporate attributes such as high resolution bathymetry, output from hydrodynamic modeling runs, and other habitat information currently housed at the Columbia River Research Laboratory. USGS will continue the work to attribute the master sample files into 2012 before sending

the files to Sitka to incorporate into the Master Sample Tool.

USGS also began working toward the development of a framework for the integrated monitoring of the mainstem Columbia and Snake Rivers and their associated floodplains. In 2011, they initiated contact with a diverse array of stakeholders that could potentially participate in the development of a mainstem ISTM. They contacted 19 stakeholders to enlist their input and received confirmation of willingness to be involved in this process from a number of these organizations. Further, USGS has been involved in the Lower Columbia River Science Work Group discussions regarding the establishment of a monitoring program for the Columbia River Estuary. They worked to coordinate their efforts with the Lower Columbia River Estuary Partnership to ensure that the efforts for the Columbia River Estuary and the mainstem Columbia and Snake Rivers are as consistent as possible.

We have produced a draft report that reports out on our progress towards these objectives; the report is currently in review. In this report, we describe our progress towards establishing a framework that would facilitate the development of an integrated monitoring framework for the mainstem Columbia River. We present and discuss planning and regulatory documents and legislation that can be used to help identify decision and questions that can be informed an Integrated Status and Trends Monitoring program (ISTM). We discuss existing monitoring efforts and studies that could help inform aspects of the ISTM, present our efforts to formulate sample frames for reaches portions of the mainstem Columbia and Snake Rivers, and discuss our efforts to facilitate the incorporation of the sample frame into a "Master Sample Tracking Tool" that is being developed by the Pacific Northwest Aquatic Monitoring Partnership. We discuss aspects of response and survey designs as they pertain to the formulation of a mainstem Columbia River ISTM. As efforts to formulate an ISTM for the mainstem Columbia River proceed, practitioners should utilize the extensive literature describing the planning and implementation of fish and wildlife mitigation and recovery efforts in the Columbia River Basin. Further, we should involve scientists that have experience planning, implementing, and maintaining large river monitoring efforts such as those in the Colorado, Illinois, and Mississippi Rivers. The task of formulating, implementing, and maintaining a mainstem Columbia River ISTM is daunting and will take much effort. However, the implementation of the program will provide for fiscal accountability and efficiencies by avoiding duplication of effort by agencies and by ensuring the expensive mitigation actions being conducted in the Columbia River are having their intended effects and are cost effective.

Oregon State University (OSU) Master Sample Tracking Tool

(Task leads: Don Stevens, Lisa Madsen, Phil Larsen)

The purpose of this component was to develop a prototype of a master sample management tool using the LCR region as a proof of concept and to provide the necessary statistical

support for the development. The prototype was to be developed in a manner to make it easily extendable to a larger region. It would be web-based and support sample selection from the population domain. It would also allow users to know who else had selected sites from the master sample covering stream networks in their domains; to design individual or integrated monitoring programs; to know how existing sites related to a common master sample; and what information was collected at a site over time. The goal was also to allow users access to basic statistical analysis tools in order to perform a valid statistical analysis of data. Bonneville Power Administration funded the development of the prototype in July of 2009, as well as dedicated analytical support during prototype development for design and utilization of results of the monitoring design based on the master sample. At the end of 2010, a prototype was available from OSU, along with a draft user guide. WDFW staff, working with OSU, used the prototype to develop a GRTS sampling design to estimate adult Coho salmon. Some of the software tools for sample selection and analysis and their associated web interface were not in place at the end of 2010 and were planned to be completed in 2011. Based on initial user feedback, PNAMP felt the prototype achieved its proof-of-concept intent and started thinking about using the prototype tool as a base to develop a more robust tool that encompassed the entire region.

In 2011, OSU 1) subcontracted with an outside firm, Sitka Technology Group, to begin planning for the transition to a production-level system and assist with some web development tasks; 2) re-allocated the budget to increase the level of statistical support; and 3) added a Graduate Research Assistant (GRA) to the project to assist in developing the R code for the analysis task.

At the end of OSU's contract in September 2011, the prototype had the capability to select sites based on county, salmon recovery region, USGS hydrologic code, or WRIA (Water Resource Inventory Area). Preliminary search results can be further refined by imposing additional criteria, e.g., owner type. In addition, OSU developed an interface to the R language to select a sample of specified size from the subset of sites that meet screening criteria, create panels if desired, and provide stratification and variable probability options. An option to incorporate legacy sites into selection from the master sample was also added. The legacy sites are merged with selected master sample sites to preserve spatial balance of the composite sample.

OSU also completed the R tool for conducting basic statistical analysis. This tool uses site evaluation information and metric results as input. The site evaluation information is used to adjust probability weights, and to calculate proportions (with confidence limits) in all evaluation classes. The basic analysis calculates estimates of population attributes for both categorical and continuous variables. For categorical response variables, the proportions in each response category are estimated and confidence intervals are provided. For continuous responses, the population cumulative distribution function is estimated, as are population statistics, such as mean, variance, and selected percentiles.

Sitka Technology Group's work focused on reviewing the code and underlying structure of the prototype website, transferring the website from OSU servers to PNAMP hosted and managed servers, and beginning development of a user task list and broadsheet for the regional master sample management tool. This prototype tool led to the development of the Sample Designer, an element of MonitoringResources.org. Details about the development of this tool can be found in the MointoringResources.org section above. . (link to ISTM Master Sample project; link to prototype tool)

Other PNAMP Projects/Topics

As mentioned above, other topics or projects mentioned in previous PNAMP annual reports are still being tracked and accounted for, but did not make substantial progress in 2012.

Assistance with CRITFC Salmon Population Crosswalk Database Project

In late 2011, Columbia River Inter-Tribal Fish Commission (CRITFC) received funding for the "Columbia River Basin Population Crosswalk Geodatabase and Online Interactive Mapping Application". This project will develop a crosswalk of fish population/units using data that have been already defined by the managing organizations within the Columbia Basin. The crosswalk, in the form of a geodatabase, will be available online with an associated interactive mapping application. In 2012, PNAMP, through the Information Management Liaison, assisted CRITFC in organizing three focus group sessions. The focus sessions allowed future users of the tool and other interested PNAMP participants to review progress on the tool and to provide suggestions and comments.

Effectiveness Monitoring Coordination & Assessment

This project is an effort to integrate and align existing and new regional effectiveness monitoring efforts, provide more scientifically robust data for use in management decisions, and improve cost efficiency in the implementation of monitoring programs. The focus of this effort is on coordinating approaches, monitoring design, and data management systems to allow alignment and reporting of results; informing a regional network of effectiveness monitoring coverage; and encouraging programmatic-level planning consistency across the region for Intensively Monitored Watersheds (IMW) and effectiveness monitoring projects and programs. Efforts are focused on supporting partner efforts to move away from "one-at-a-time", project-by-project decision making and moving toward coordinated efforts.

Toward this goal, in 2012 PNAMP supported BPA's efforts to survey Fish and Wildlife Program habitat action effectiveness projects by conducting outreach to non-BPA funded habitat projects. This work is needed to support BPA and regional level prioritization of project level action effectiveness across the different categories of habitat actions, and the standardization of metrics and designs for roll-up assessments. Response was poor, as it was not clear how partners would benefit from providing the information and BPA initiated

new “Expert Panels” to work internal to the Fish and Wildlife Program.

Also in 2012, practitioners leading IMWs requested PNAMP sponsor a workshop focused on current status, challenges and collaboration opportunities specific to IMW’s. Planning for this workshop is underway and the event is tentatively planned for late March 2013.
(link to Effectiveness Monitoring project**)**

Implementation Tracking

PNAMP is interested in identifying opportunities to crosswalk information between implementation tracking systems and indicators commonly used for reporting. PNAMP also supports identifying tools that could be used to share information between systems and would like to help others explore the use of these tools (as the needs arise) beyond their current focus.

PNAMP hosted a workshop in 2009 to highlight this topic, but progress since has been minimal. Recently, PNAMP has been asked to be part of a national team to define project tracking/implementation monitoring for habitat restoration projects for the National Fish Habitat Action Plan and Partnership (NFHAP and NFHP). NFHP is interested in defining metrics and data standards for NFHP partnerships in order to better track conservation actions and inform the habitat assessment conducted every five years by NFHP partners.

Outreach and Communication

A large part of PNAMP’s work focuses on reaching out to potential participants and informing the aquatic monitoring community of upcoming events and announcements, showcasing new tools, and posting relevant documents. PNAMP’s outreach and communications efforts can be categorized into four areas: maintaining the PNAMP website, producing and disseminating the monthly news and meeting summary email, producing fact sheets which describe PNAMP and individual projects, and presentations to interested groups and organizations.

Throughout 2012, PNAMP’s Communication Specialist was tasked with updating content on the PNAMP website. Most updates included tracking PNAMP and other meeting details (dates, locations, and online conference and phone information) and posting documents related to meetings and other PNAMP projects. Announcements and jobs openings of interest to the aquatic monitoring community were also posted on a regular basis.

For the past few years, PNAMP has distributed a monthly email to all participants that included a summary of upcoming meetings. In 2012, this monthly communication expanded to include one or two short summaries highlighting the latest PNAMP news. The list of participants whom receive the news and meeting summary currently contains 631 recipients and continues to grow.

Also in 2012, the first iteration of a PNAMP fact sheet was developed. This two page document contains general information about who PNAMP is and what PNAMP does.

Information about projects that PNAMP pursued in 2012 will obviously change in the years to come and we envision that subsequent versions of this general fact sheet will be produced as PNAMP evolves and projects are completed.

Beyond communicating PNAMP's work via online resources, the Coordination Team participated in several outreach activities in addition to regular PNAMP activities. The PNAMP Coordinator presented overview presentations for BPA & Northwest Power and Conservation Council executives and staff, for the Columbia River Basin Federal Caucus, and for the Independent Scientific Review Panel & the Program Evaluation and Reporting Committee. The PNAMP Assistant Coordinator presented a series of training talks on MonitoringMethods.org and also gave several presentations describing PNAMP's newest online tools suite, MonitoringResources.org. Additionally, PNAMP participated in the Great Northern Landscape Conservation Cooperative's Webinar series in December which attracted over 40 participants eager to learn about PNAMP's online resources.

Steering Committee Activities

The PNAMP SC provides the science-policy interface between the Executive partners and project work teams, reviews work team progress, obtains resources needed to accomplish projects, and directs the activities of the Coordination Team. The SC provides assistance to PNAMP initiatives by participating in the formulation, development, and review of recommendations for activities of PNAMP work teams and integrating these activities with their own organizational activities. The SC facilitates the transfer of information between PNAMP and their respective organizations. By promoting communication among organizations, the SC strives to assure that monitoring plans and information are coordinated across the Pacific Northwest.

The SC met four times in 2012 for regular meetings, alternating between Portland and Olympia to maximize access for face to face participation. The primary activity at the regular meetings was tracking the progress of current activities and discussion of new tasks or projects that align with PNAMP's goals. These meetings also facilitated information exchange between SC members and work team leads. The PNAMP Coordinator facilitated meetings and the Coordination Team prepared materials before the meetings and notes following the meetings. The SC also continued to discuss priorities for current and new projects, both for PNAMP staff to lead as well as ideas that could be developed as proposals to partner funding sources.

Based on SC feedback, the Coordination Team began developing a new way to track PNAMP project information. This new work planning tool was used throughout 2012 and received positive reviews from SC members.

Appendices

Appendix A. Entities signatory to the PNAMP Charter as of December 2012.

PNAMP Partners	PNAMP Steering Committee Rep	PNAMP Executive Network Representative
Bonneville Power Administration	Jim Geiselman	Lorri Bodi VP Environment, Fish and Wildlife
California Department of Fish and Game	Scott Downie	Neil Manji Northern Regional Manager
Columbia Basin Fish and Wildlife Authority	Tom Iverson	Nathan Small Chair
Columbia River Intertribal Fish Commission	Phil Roger	Paul Lumley Executive Director
Confederated Tribes of the Colville Reservation	John Arterburn	Joe Peone Director, Fish and Wildlife Department
Environmental Protection Agency	Gretchen Hayslip	Dennis McLerran Regional Administrator
NOAA Fisheries	Scott Rumsey	William Stelle, Jr. Regional Administrator
Northwest Indian Fisheries Commission	Bruce Jones	Mike Grayum Executive Director
Northwest Power and Conservation Council	Nancy Leonard	Tony Grover Director of Fish and Wildlife Division
Oregon Watershed Enhancement Board	Greg Sieglitz	Tom Byler Executive Director
Pacific States Marine Fisheries Commission	Bruce Schmidt	Randy Fisher Executive Director
U.S. Army Corps of Engineers	Vacant	Colonel Steven R. Miles, P.E. U.S. Army Commander and Division Engineer
U.S. Bureau of Land Management	Al Doelker	Jerome Perez State Director, Oregon/Washington
U.S. Bureau of Reclamation	Michael Newsom	Lorri Gray Regional Director
U.S. Forest Service	Linda Ulmer	Kent Connaughton Regional Forester PNW Region
U.S. Geological Survey	Steve Waste	Max Etheridge Northwest Regional Director
Washington Department of Ecology	Bob Cusimano	Rob Duff Environmental Assessment Program Manager
Washington Department of Fish and Wildlife	Dan Rawding	Phil Anderson Director
Washington Governor's Salmon Recovery Office & Washington Recreation and Conservation Office	Keith Dublanica	Kaleen Cottingham Director

Appendix B. List of documents referenced in this report and associated hyperlinks.

Page 3:

- PNAMP Charter: http://www.pnamp.org/charter

Page 6:

- PNAMP website: http://www.pnamp.org/

Page 11:

- Monitoring Resources: http://www.MonitoringResources.org
- Monitoring Resources PNAMP project page: http://www.pnamp.org/project/3875
- Monitoring Resources Application: https://www.monitoringresources.org/Resources/Home/Index

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- Monitoring Methods PNAMP project page: http://www.pnamp.org/project/3134
- Monitoring Methods Application: http://www.monitoringmethods.org/

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- Monitoring Explorer Broadsheet: http://www.pnamp.org/sites/default/files/2012-04-17_pnamp_broadsheet-explorer_feature_draft.pdf
- Monitoring Explorer Status Report: http://www.pnamp.org/document/3845
- Results of the Monitoring Explorer scoping exercise: http://www.pnamp.org/document/3976.
- Sample Designer PNAMP project page: http://www.pnamp.org/project/3263
- Sample Designer application: https://www.monitoringresources.org/Designer/Home/Index
- Site Manager PNAMP project page: http://www.pnamp.org/project/3876
- Site Manager application: https://www.monitoringresources.org/Sites/Home/Index
- 2011 Regional Metadata Tool Recommendations Report: http://www.pnamp.org/document/3296

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- Monitoring Advisor PNAMP project page: http://www.pnamp.org/project/3878
- Salmon Monitoring Advisor website: https://salmonmonitoringadvisor.org/
- Columbia River Basin Anadromous Salmonid Monitoring Strategy (ASMS)**:** http://www.cbfwa.org/ams/
- Phase I CA work plan: http://www.pnamp.org/document/3033
- Phase II CA work plan: http://www.pnamp.org/document/3258
- April 2011 CA workshop: http://www.pnamp.org/event/3345

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- Columbia River Basin Collaborative Data Sharing Strategy: Salmon and Steelhead Population Abundance and Productivity Indicators: http://www.pnamp.org/document/3546
- Phase III CA work plan: http://www.pnamp.org/document/3936
- Phase IV CA work plan: http://www.pnamp.org/document/3996
- Data Exchange Standard v1.0: http://www.pnamp.org/document/4044

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- 2011 HDS workshop: http://www.pnamp.org/event/3452
- HDS 2012 work plan: http://www.pnamp.org/document/3670
- HDS list of priority habitat characteristics: http://www.pnamp.org/document/3706
- HDS GSRO pilot report: http://www.pnamp.org/document/3999
- Northwest Biological Assessment Working-group's annual workshop: http://www.pnamp.org/event/3981

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- HDS 2013 work plan: http://www.pnamp.org/document/4088

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- PNAMP Data Management page: http://www.pnamp.org/topics/2
- Regional Guidance on Metadata for Environmental Data: http://www.pnamp.org/document/2771
- Regional Metadata Tool Recommendations: http://www.pnamp.org/document/3422

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- Prototype Metadata Builder meeting notes: http://www.pnamp.org/document/4043
- Guidance for Implementing Successful Data Management and Sharing: http://www.pnamp.org/document/3608

Page 23:

- PNAMP compilation of papers from ASPRS 2009 session: http://www.pnamp.org/document/2546
- Remote Sensing Forum - Puget Sound High Resolution Change notes: http://www.pnamp.org/document/3841
- Dr. Ken Pierce, WDFW, presentation on Puget Sound High Resolution Change Detection: http://www.pnamp.org/document/3840
- Remote Sensing Forum – River Bathymetry Toolkit notes: http://www.pnamp.org/document/3955
- Dr. Jim McKean, USFS, presentation on 'Organizing and interpreting high resolution channel topographic data using the river bathymetry toolkit and wavelet transformations': http://www.pnamp.org/document/3952

- Dr. Jim McKean, USFS, presentation on 'Effects of changing flow regimes on stream physical habitat in low-gradient meadows': http://www.pnamp.org/document/4066.
- 'Overview to airborne topo-bathymetric LiDAR'workshop presentation: http://www.pnamp.org/document/3951
- Presentation on 'Description of aquatic physical habitat in channels using a narrow-beam bathymetric LiDAR': http://www.pnamp.org/document/3893

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- Monitoring Methods Discussion Board, fish length conversation: https://www.monitoringmethods.org/Discussion/ViewComment/616
- Methods Review PNAMP project page: http://www.pnamp.org/project/3131

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- ISTM demo project: http://www.pnamp.org/project/3132

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- ISTM Objective 1 report: http://www.pnamp.org/document/3169
- ISTM Objective 2 draft report: http://www.pnamp.org/document/3711

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- ISTM workshop February 2012: http://www.pnamp.org/event/3667
- ISTM Fish project: http://www.pnamp.org/project/3151

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- Evaluation of the Data Collection, Storage, and Management for the Lower Columbia River Salmon and Steelhead Monitoring Program": http://www.pnamp.org/sites/default/files/061221__istm_dm_report_final.pdf

Page 30:

- ISTM Habitat project: http://www.pnamp.org/project/3152

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- ISTM Master Sample PNAMP project page: http://www.pnamp.org/project/3150
- ISTM Master Sample prototype tool: https://www.monitoringresources.org/Designer/Home/Index

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- Effectiveness Monitoring PNAMP project page: http://www.pnamp.org/project/3137
- PNAMP Fact sheet: http://www.pnamp.org/document/4002