PACIFIC NORTHWEST AQUATIC MONITORING PARTNERSHIP

2014 Annual Report

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Amy Puls, Rebecca Scully, Katherine Pierson, Jennifer Bayer, US Geological Survey (USGS), Cook, WA, 98605

Keith Steele, Sitka Technology Group, Portland, OR, 97204

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Executive Summary

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) continued to promote integration of monitoring resources and to build tools to support monitoring in 2014. Integration of the different monitoring focal areas, of practitioners' monitoring activities 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; in 2014 this estimate amounted to 2,247 hours by 90 organizations.

In 2014, PNAMP focused on projects related to these topics: 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 data management at multiple scales for aquatic monitoring;
- planning a series of workshops for coordinating data management and exchange to support improved assessments and reporting in the Columbia River Basin;
- development of the Monitoring Metadata Exchange (MMX) template for exchanging monitoring site level metadata;
- 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;
- managing a monitoring protocol and method library (with 931 protocols and 1,603 methods in the system at the end of 2014);
- developing online tools to support monitoring design and site management;
- providing training and support related to the use of online tools;
- moderating a community forum to discuss protocols and methods;
- developing a standard taxonomic effort agreement for the Pacific Northwest to facilitate the sharing of macroinvertebrate data;
- maintaining the PNAMP website for better information discovery and delivery; and
- planning additional work related to web tools and resources.

PNAMP's work on these tasks supports Bonneville Power Administration's Fish & Wildlife Program (BPA FWP) strategies for more standardized and coordinated regional monitoring. Specifically, management of online tools to support consistent and detailed documentation for projects, supporting metadata for datasets, conducting methods reviews to develop and promote best practices, coordinating data management and exchange to support improved assessments and reporting in the Columbia River Basin, and demonstrating benefits of an integrated status and trend monitoring process, are activities that have and will continue to support BPA FWP strategies as well as PNAMP's partners' strategies. Products resulting from PNAMP's work include online applications to document details about project's metrics, protocols, methods, and study designs; a prototype application to create metadata records for datasets; data exchange standard for four Viable Salmonid Population (VSP) indicators; tools for VSP prioritization; data exchange standard for monitoring locations and the associated metadata; and guidance for implementing data management and sharing.

Although there was a great deal of progress made in 2014, PNAMP projects will always benefit from increased participation from the PNAMP steering committee members, subject matter experts, and community stakeholders. In particular the MonitoringResources.org web applications, the Monitoring Metadata Exchange (MMX) standard, and habitat data sharing activities would all benefit from additional practitioner engagement and lead to improved RM&E coordination.

Lastly, in addition to specific project tasks, 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

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. Currently, 19 state, tribal, federal, and regional entities are signatory partners of 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.

The different mandates driving monitoring and subsequent management, policy and reporting responses require 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.

PNAMP's organizational structure includes a Steering Committee (SC), staff (aka Coordination Team) to serve as coordinators and facilitators for specific topics of interest, 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 organizations 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 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.

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. The 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

The PNAMP Coordination Team is employed by the U.S. Geological Survey (USGS), Northwest Region Executive Office. In 2014, the PNAMP Coordination Team included a Coordinator (Jennifer Bayer), an Assistant Coordinator (Jacque Schei), and two staff biologists (Amy Puls and Becca Scully). Midway through the year, an additional staff biologist, Katie Pierson, joined the coordination team. Near the end of 2014, after working for PNAMP for nearly eight years, Jacque Schei resigned from the Assistant Coordinator position.

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. The PNAMP Coordinator is responsible for convening quarterly Steering Committee meetings.

In 2014, 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 continued to seek appropriate outlets for communicating PNAMP's work beyond required progress reporting. The Coordination Team represented PNAMP at several external meetings, workshops, and conferences in 2014. In addition, the Coordinator conducted briefings at meetings and for individual organizations and their executives regarding PNAMP activities throughout the region as requested.

The PNAMP website (www.pnamp.org) remained a vital communication tool to provide up to date information about PNAMP events and projects, and increase the availability of biological and natural resources information at the regional and national level. While the content of the website was maintained by PNAMP staff, technical support and hosting of the website was provided through Sitka Technology Group.

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

In-Kind Contributions

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 PNAMP staff and inter-organizational working teams, who are almost entirely supported by in-kind contributions from their respective organizations. While managing projects in this volunteer-based environment is challenging, the results are very rewarding.

It is important to us to acknowledge the generosity of 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 estimates of meeting prep or driving time (Tables 1 and 2); it is much harder to track time contributed outside of meetings. For 2014 we calculated over 2247 hours of in-kind contributions of time from meeting participation alone. This is down from last year where the two-day IMW workshop that was attended by a large number of people resulted in nearly double the amount of hours seen in most years (Figure 1). 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 2014, 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, 2014. 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.

Entity	Total Hours	Hours for SC Only
Aquatic Biology Associates Inc	2.50	
Atlantic Coast Cooperative Statistics Program	1.50	
BioAnalysts	12.00	
Bonneville Power Administration	138.25	22.00
Burns Paiute Tribe	12.00	
California Department of Fish and Wildlife	1.25	
City of Battle Ground	9.00	
City of Kelso	10.50	
City of Longview	77.13	
City of Portland	4.50	
City of Redmond	1.00	
City of Vancouver	53.63	
Clark County	27.50	
Columbia Basin Fish & Wildlife Authority	12.00	
Columbia Basin Fish & Wildlife Foundation	37.00	
Columbia River Gorge Commission	0.75	
Columbia River Inter-Tribal Fish Commission	47.50	17.00
Colville Confederated Tribes	35.00	3.00
Confederated Tribes and Bands of the Yakama Nation	38.00	
Confederated Tribes of the Umatilla Indian Reservation	24.00	
Confederated Tribes of the Warm Springs Reservation	12.00	
Cowlitz County	17.50	
EcoAnalysts, Inc	2.50	
Farmers' Conservation Alliance	1.50	
Fish First	9.00	
Fish Passage Center	12.00	
Fisheries and Oceans Canada	2.00	
Freshwater Trust	15.00	
Geosyntec Consultants	4.50	
Hart Crowser	13.50	
Idaho Department of Fish and Game	98.00	29.50
iDigBio	2.00	
Iowa Department of Natural Resources	1.50	
King County Department of Natural Resources and Parks	2.50	
Kitsap County	2.50	
Lewis County Public Works	2.00	
Loftus Consulting	1.50	
Lower Columbia Estuary Partnership	38.50	
Lower Columbia Fish Recovery Board	105.50	
Michigan State University	4.00	
Multnomah County	2.00	
National Council for Air and Stream Improvement	2.50	
National Oceanic and Atmospheric Administration	105.75	

Table 2. Continued. Estimated hours contributed by entities to PNAMP meetings.

Entity	Total Hours	Hours for SC Only
Nez Perce Tribe	26.50	
Northwest Indian Fisheries Commission	3.00	3.00
Northwest Power and Conservation Council	50.00	14.00
Oregon Department of Fish and Wildlife	71.50	
Oregon State University	4.00	
Oregon Water Resources Department	2.00	2.00
Oregon Department of Environmental Quality	47.00	
Pacific Northwest National Laboratory	13.00	
Pacific States Marine Fisheries Commission	98.25	
Plas Newydd LLC	4.50	
Port of Kalama	4.50	
Portland State University	4.50	
Private Sector	8.00	
Puget Sound Partnership	15.50	
Rhithron Associates, Inc	2.50	
Ross Strategic	1.50	
Salmon Creek Watershed Council	9.00	
SBGH-Partners LLC	1.00	
Shoshone-Bannock Tribes of Fort Hall	25.00	
Sitka Technology Group	81.00	
Smith-Root	1.00	
Snake River Salmon Recovery Board	1.50	
Statistical Design	6.00	
Stillwater Science	13.50	
Tetra Tech EC, Inc.	23.50	
The Cowlitz Indian Tribe	4.50	
University of Arizona	3.00	
University of Missouri	1.50	
University of Montana	10.50	
University of Washington	12.00	
Upper Columbia Salmon Recovery Board	17.00	
US Army Corps of Engineers	2.25	
US Bureau of Land Management	40.25	
US Bureau of Reclamation	45.50	30.00
US Fish and Wildlife Service	57.50	
US Forest Service	15.00	
US Geological Survey	65.50	9.00
US National Park Service	1.00	
US Environmental Protection Agency	13.25	6.50
Utah State University	7.00	
Washington Department of Fish & Wildlife	95.75	18.00
Washington Governor's Salmon Recovery Office	60.25	34.75
Washington State Department of Ecology	261.75	13.00
Washington State Recreation and Conservation Office	1.00	
Washington State University	1.75	
Washington State Department of Natural Resources	9.00	
Weyerhaeuser	1.25	
Total	2247.00	

Table 3. 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, 2013. 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.

Project or Topical Category	Total Hours
Coordinated Assessments	804.50
Data Best Practices	91.00
Effectiveness Monitoring Coordination, IMWs	54.25
Habitat Data Sharing	71.00
Lower Columbia Habitat Status and Trends Monitoring (HSTM)	798.50
Macroinvertebrate Data Sharing	34.00
Methods Review	6.00
Monitoring Metadata Exchange (MMX)	20.25
MonitoringResources.org, web tools	111.75
Outreach and Communication	66.75
Steering Committee Meeting Series	189.00

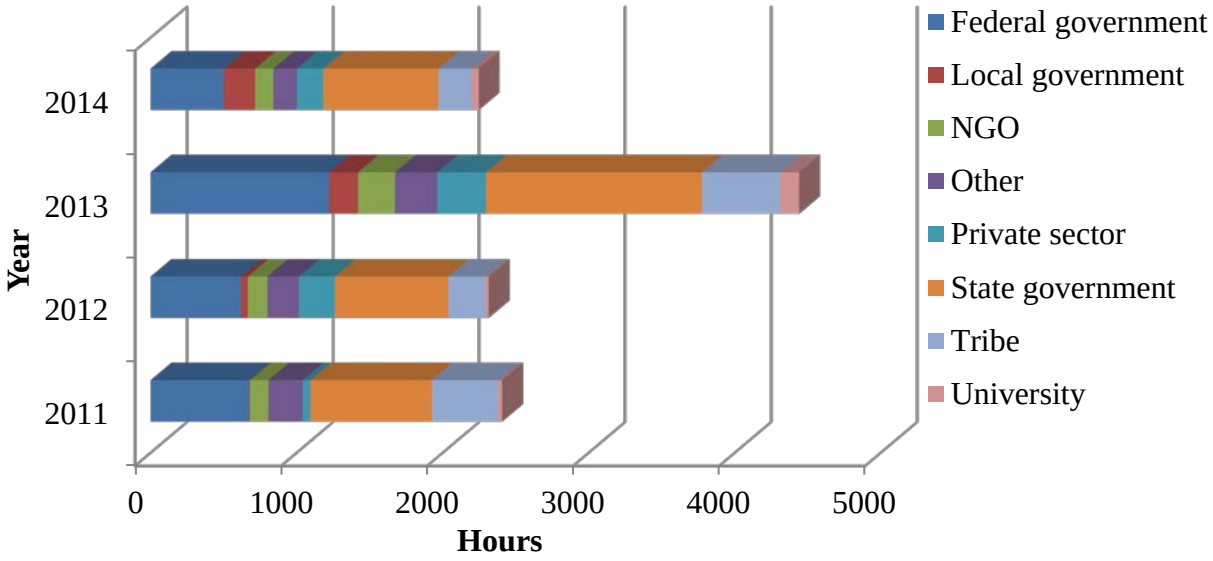

Figure 1. Estimated hours contributed to PNAMP meetings for 2011 to 2014. Hours were assigned to each meeting attendee for every PNAMP meeting from January 1, 2011 to December 31, 2014. In person meetings were assigned at time and a half to account for travel and prep times. For example, if a meeting 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. Hours were then grouped by their entity category and year. The entity category of "other" was used in cases when the other seven categories were not appropriate.

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.

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 2014 focused on tasks related to these main projects: Monitoring Resources (includes all web applications and development), High Level Indicators, Effectiveness Monitoring Coordination and Assessment, Methods Review, Lower Columbia Habitat Status and Trends Monitoring Project, Data Management and Sharing Best Practices, Coordinated Assessments, Stream Habitat Data Sharing, and Macroinvertebrate Data Sharing. Several smaller work teams met regularly to focus on specific tasks identified with these projects. Details for each project are described below. Topics or projects not listed above that have been mentioned in previous PNAMP annual reports are still being tracked; however, they were not a focus in 2014.

MonitoringResources.org

For several years, PNAMP has partnered with Sitka Technology Group to develop online resources to create a network of information and tools to support a variety of monitoring needs. The Monitoring Resources site is the base for this network of tools and information. It is intended as a place to integrate existing and future PNAMP web resources so they work together to provide an efficient interface for users. Monitoring Resources contains the framework that provides central user and organizational management and houses all other PNAMP applications, including Monitoring Methods, Sample Designer, Site Manager, Monitoring Explorer, Monitoring Advisor, and the Metadata Builder. The features and functions within this web application are designed to be modular in nature so that users can take advantage of a single feature without necessarily using other features of the system. At the same time, the individual modules of the application are designed to be able to work together for end-to-end management of the monitoring workflow and to integrate with GeoOptix.

GeoOptix is a data management system designed and implemented by Sitka in 2014 to serve BPA's CHaMP and AEM programs. To facilitate an integrated regional approach to data management Sitka leveraged many of the existing resources in Monitoring Resources.org. Although PNAMP is not directly involved in the development of GeoOptix, the integrated design will hopeful encourage regional partners to utilize the full suite of tools to document, plan and implement monitoring. GeoOptix is a cloud-based enterprise scale data management system that is used by the BPA's CHaMP and AEM monitoring programs to organize, collect, QA, store, analyze, and publish monitoring data via the web. It is integrated with Monitoring Resources to be able to import study designs from the Sample Designer and also uses protocol descriptions from Monitoring Methods to drive field data collection and QA activities. GeoOptix features a robust database in the cloud that is fronted by a web UI than can be quickly customized and "branded" for each monitoring program. A new iPad based data collection application was rolled out in that connects to this cloud database to facilitate field crew operations and data transfer. After four years of operation, the system is approaching 1 million data files that occupy nearly 1 terrabyte of disk space and projections indicate that the pace of growth in the number of data artifacts under management will accelerate. Although it is not a PNAMP sponsored system like Monitoring Resources and Monitoring Methods are, Sitka did complete a number of development and support tasks on the GeoOptix platform as part of their AEM scope of work with BPA funding in FY14. It is for this reason that Sitka activities and accomplishments on GeoOptix are included in this report.

The Monitoring Resources tools are intended to help monitoring practitioners plan and implement effective, efficient, high quality monitoring projects. They 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 these tools 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.

In 2014, Monitoring Resources development work completed by Sitka included Environmental Information Repository maintenance and a lightweight approach to maintaining high level documentation on monitoring programs and projects that operate in the region. Sitka supported these efforts and efforts by others to use them throughout the year. Sitka, BPA staff and StreamNet cleaned up data repository pointers from Pisces to provide more accurate links between RM&E projects in Pisces and the repositories that hold the data. PNAMP used this effort to update the list of Environmental Data Repositories in Monitoring Methods. During 2014, Sitka converted all maps in Monitoring Resources and GeoOptix away from GeoServer to ArcGIS Server in order to take advantage of powerful mapping tools and gain efficiencies in map-based development efforts.

This year, PNAMP continued outreach, training and user support for all of the tools. The number of users with Monitoring Resources accounts, which provided them access to all tools, grew to 1,460, up from 826 at the end of the previous year. User support involved responding to help requests submitted through the site itself or via emails or phone calls directly to staff. We continued to look for other opportunities to implement a project tracking-type process for other organizations, similar to what BPA has done. This included outreach efforts to increase awareness of the tools, including briefing organizations such as, the Washington Governor's Salmon Recovery Board (GSRO), Puget Sound Partnership (PSP), Sonja Kokos at the Bureau of Reclamation, the USFWS Climate Change Long-Term Aquatic Monitoring Partnership and the CA Fish Passage Center.

Presentations on Monitoring Resources web tools took place at the Annual AFS meeting in Quebec, as well as, at the Organization of Fish & Wildlife Information Managers (OFWIM) Conference.

PNAMP has worked to integrate the tools into PNAMP's coordination tasks by providing overviews of the tool's capabilities at project team meetings. Staff presented the tools and made suggestions on integration to the Lower Columbia Habitat Status & Trends Monitoring (HSTM) project, the Macroinvertebrate Data Sharing Project and the Habitat Data Sharing Project. To help with the general outreach PNAMP staff completed a one page Monitoring Methods fact sheet to be distributed at workshops, briefings and meetings. Additionally PNAMP coordinated with the National Fish Habitat Partnership (NFHP), who were interested in gaining access to the monitoring locations in the Monitoring Explorer for use in their own application. Using an ArcGIS Map Service, Sitka was able to inexpensively make the list of monitoring sites and related metadata available to NFHP.

There are many remaining tasks that need to be completed in order to make Monitoring Resources fully functional. We are seeking input and feedback on the tools as we continue into 2015. 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 would mutually benefit from connecting via web services to Monitoring Resources. We feel that it is imperative to the success of these tools to find additional partners to buy-in to the concepts of better documentation and information sharing and provide support by encouraging or requiring use of the tools within their own organizations. Continued outreach will be key to get this buy-in, PNAMP will continue to present to partners, at regional meetings and look for other opportunities to promote the Monitoring Resources tool set. Internally, we will also pursue ways to integrate PNAMP's other projects into the Monitoring Resources tools, specifically focusing on integrating the Coordinated Assessments project's analysis only protocols. (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 Monitoring Methods. Monitoring Methods 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. Monitoring Methods 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 Monitoring Methods available to other regional systems via web services.

By promoting collaboration and standardization through online services like Monitoring Methods, the need to perform expensive and error prone crosswalks will be reduced, which will lead to more timely, less expensive, higher quality, and more widely used monitoring data across agency boundaries. The data collection method descriptions in Monitoring Methods are used to build data dictionaries that drive electronic form displays and data collection on Sitka's GeoOptix mobile devices.

Besides the general operations, in 2014, Sitka provided technical support, problem resolution, and general maintenance of the site, most of our technical improvements centered on improving the method-to-metric

mapping tool and modifying the workflow associated with submitting protocols for review that was causing confusion for users.

PNAMP recommends additional development in 2015 as funding allows. Development would be based on needs already identified or additional feedback from users. Some additional feedback received this year included:

- Allow upload of figures, forms, documents on customized methods
- Allow ordering of methods in protocol to match how methods are implemented in field
- Integrate Sampler Designer information into the "Design" section of the protocol for the users who have documented samples in Sample Designer
- Support for documentation of analysis only protocols
- Support for documentation of high level indicators methods

In 2014, significant staff effort was put into content management of Monitoring Methods. By the end of 2014, there were 1,603 methods and 931 protocols in the system. Of these, there were 665 published methods and only 56 published protocols. PNAMP feels it is important to urge users to finalize (i.e., publish) their content instead of letting it sit for months, or years even, in draft or proposed state. In addition, it is important to the success of Monitoring Methods to have content in the system that will draw in new users, not turn them away.

In 2014, PNAMP staff deleted methods that were identified in 2013 as poorly documented. For methods that were widely referenced but poorly documented, PNAMP staff contacted users and recommend alternative methods in the system. For methods that were well documented, PNAMP staff asked users to assume ownership or PNAMP took ownership in order to work towards publication. In 2015, PNAMP will continue to identify poorly documented methods and methods that are not being actively maintained, and follow a similar process to move towards a more complete and robust documentation of information. PNAMP recommends continuing to manage content by doing yearly reviews of unpublished methods, searching out common methods, and working with users to improve and publishing content.

The creation of duplicate methods in the system creates excessive clutter in a system. In order to maintain a more organized library of methods, PNAMP will be looking into better ways to highlight well documented methods for users to see examples of what level of detail should be documented. We also recommend that program managers be identified in the system and begin 'approving' well documented methods for use in their programs. In addition, staff recommend that methods be entered (or poorly documented methods be updated) to fill any gaps in content.

PNAMP staff also continued the work 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, and responding to requests to add new organizations or monitoring programs. A majority of support was related to requirements associated with BPA Fish and Wildlife contracts.

Often times, BPA project sponsors who are reaching the deadline in their contracts expect to be able to enter method and protocol details and have content published within a matter of days, when in reality the process can take much longer. The review process alone might take up to two weeks depending on PNAMP staff schedules. We recommend BPA project sponsors be informed of these timelines and suggest that they plan ahead for future contract deadlines.

Regarding reviewing methods, when a user requests publishing of their methods, PNAMP staff review individual methods for completeness in the step by step instructions, ensure the description mostly follows a generic format, and look for duplication in the system. Staff then provide feedback via the comments section in Monitoring Methods. In 2014, two subject matter experts supported PNAMP staff in a few of the more difficult fisheries analysis methods. PNAMP staff is not experts in all methodologies documented in Monitoring Methods; therefore, we recommend that PNAMP build a network of professionals who are willing to review methods in their area of expertise. With enough people participating, it may only be a time commitment of one to two hours per month per individual. Method reviews by subject matter experts would provide more of a scientific review than what is currently being implemented by staff. It would be beneficial for BPA to encourage its project sponsors, and other partners to encourage technical staff, to share their expertise by volunteering to be method reviewers. In 2015, PNAMP will establish a Monitoring Resource advisory committee, who will provide suggestions for subject matter experts.

In 2014, BPA requested a new protocol review process be designed to integrate the review of protocols with BPA contracts. In Pisces, BPA's contract tracking database, project sponsors link all WE that describe RM&E work to Monitoring Methods protocols. The purpose is to allow project sponsors to accurately document the objective, design, methods, metrics and indicators collected as part of the BPA contracts. In September, PNAMP staff initiated the review of the BPA Statement of Work (SOW) and individual Work Elements (WE) documented by project sponsors in Pisces. PNAMP staff and BPA staff designed a process to complete the reviews, documented the process and presented to BPA COTRs two times in order to solicit feedback on the purposed review process and decided the most effective way to communicate with project sponsors and protocol owners. BPA and PNAMP staff drafted a guidance document for BPA project sponsors detailing the review process and this document provided an outline of what is expected from the BPA project Sponsors regarding documentation in Monitoring Methods and Pisces. PNAMP staff established a method to track priorities, completeness of the review and general comments, and in November we began reviewing contracts and protocols. Priority was given to contracts in the revision phase and contracts COTR requested be reviewed. PNAMP staff reviews all WE with ID 156: Develop RM&E Methods and Designs, 157: Collect/Generate/Validate Field and Lab Data or 162: Analyze/Interpret Data. Staff reviewed the WE and protocols for completeness, consistency between WEs and protocols and that WE documentation follows BPA guidance and protocols follow PNAMP guidance. We reviewed the documentation of location information, spatial and temporal design, data collection and analysis methods, metrics and indicators and the data repositories. After reviews are shared with project sponsors, protocol owners and the BPA COTR, then PNAMP staff and RM&E Support follow up with Sponsors to insure they understand the review and that the recommended changes have been made.

Reviewing BPA SOWs in conjunction with protocols in Monitoring Methods is incredibly time consuming; since the implementation of this processes in November, PNAMP staff have spent 50-60 hours a week.

Reviewing protocols causes an increase in requests for publication of methods, because according to PNAMP's guidance a protocol can't be published until all the methods contained in the protocol have been published. PNAMP staff anticipates the increase to work load will continue, resulting in an additional work load of approximately 20-30 hours a week devoted to reviewing and publishing methods.

To move forward in an efficient, coordinated manor, PNAMP staff recommends scheduling Monitoring Methods trainings with BPA sponsors. These trainings would detail the guidance for document work in contracts and in protocols. Training would hopeful simplify the review tasks by establishing the requirements before publishing is requested. Additionally, PNAMP staff would encourage users to utilize already published content in their protocols. PNAMP proposes targeting specific organizations who have large contracts with BPA. (Monitoring Methods project page; Monitoring Methods application)

Monitoring Sample Designer, Site Manager

Over the last several years, PNAMP has pursued development of two discrete, but integrated tools to support documentation of monitoring sampling designs and locations of data collection events. These applications, the Monitoring Sample Designer and the Monitoring Site Manager, were release in October 2012. These tools will aid users in creation of permanent, sharable online documentation of their designs.

The Sample Designer supports users in building a sample design. It originally was focused on developing designs 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. Now the Sample Designer also supports non-probabilistic designs. All designs created in the Sample Designer can be transfer to Sitka's data collection system (GeoOptix), to facilitate the creation of data collection events and the collection of field data.

Probabilistic designs in the Sample Designer leverage the work of Don Stevens and Tony Olsen in the application of the General Randomized Tessellation Stratified (GRTS) algorithm to facilitate selections of sites within a sample frame in a manner that is spatially balanced. The GRTS algorithm developed by Stevens and Olsen is also capable of "densifying" existing master samples and integrating sites selected by non-probabilistic means into probabilistic designs and adjusting weights accordingly.

The Sample Designer allows users to define their target frame through any number of spatial attributes that are already present in the system, plus any number of custom-defined attributes that users can append to the system for their particular purpose. The Sample Designer incorporates a sophisticated boolean logic evaluation engine to narrow the sites desired to match those of the target population.

Once sites are selected, the GRTS algorithm also assigns sites randomly to panels and strata defined by the design. The system automatically determines the range of values in the categorization variable(s) of interest and creates strata accordingly. Assuming that the user understands the parameters of their particular study, a draft statistically valid design can be produced in as little as 15 minutes.

For non-probabilistic designs, users are able to create panels and strata manually and assign sites to them manually. Both design types "pin" the starting panel to a year, which fixes multi-year designs in time and facilitates the transfer and construction of data collection events in the data collection system (GeoOptix).

Once sites are organized into blocks (an intersection of a strata and a panel), the Sample Designer has incorporated into it a feature that allows users to perform site evaluations prior to sending crews out to the field. Site evaluations are conducted to ensure that the site is a member of the target population (e.g. it is in a stream that fish spawn or rear in), is safe for crews to survey, and that the landowner has given permission (in cases where the sites are on private land or require crews to traverse private lands. When sites are rejected, the rejection reason is recorded, since the rejection reason is important for post data collection statistical data analysis.

In 2014, Sitka made significant strides in integrating the Sample Designer outputs into the workflow of a successful data collection and management system, namely champmonitoring.org (GeoOptix). For the first time, in 2014 users were able to choose from a list of designs created by the Sample Designer for use within GeoOptix. GeoOptix retrieves data about the Sample Design using web services and uses this data to import sites in preparation for scheduling them into hitches and subsequent dispatch to field crews mobile devices for data collection activities.

Study designs must be "published" or "finalized" before they can be exchanged with a data collection / data management system like GeoOptix. This is because once sites are in a data collection system and data is being collected upon them, any changes to the study design will not match the data collection effort and it is a design goal to have the design match the collection event. There were several cases during 2014 where active designs needed to evolve over the course of the field season. To accommodate this changing need while preserving the ability of the system to accurately document designs of data collection events, Sitka implemented a lightweight versioning system on study designs that allows users to create new revisions of previously published designs.

Sitka also added support in the Sample Designer to better accommodate effectiveness designs, including the ability to manually assign sites from user-uploaded sample files into panels. As part of this effort, we modified Monitoring Resources tool to introduce monitoringmethods.org-like collaborator and review roles to allow more than one person to collaborate on a design.

As for the content at the end of 2014, there were 151 sample designs within the tool, an increase from 43 sample designs at the end of last year, 53 are finalized. Within in Sample Designer there are over 1.3 million sites located on tributaries and the mainstem throughout the basin. Most of these sites represent GRTS master sample sites that are used in probabilistic designs, and some of these sites are loaded by monitoring programs as part of non-probabilistic designs (opportunistic, census, experimental, etc.). GRTS samples have been populated that support line features (stream networks and shorelines) as well as areas (e.g. the reservoirs behind Bonneville and the John Day Dam).

We recommend increased support in the coming year to load additional designs. Currently, the tool supports 'opportunistic', 'census', and 'model-based' survey types, the 2015 development includes expanding to 'control/impact' survey types.

The Site Manager supports documentation of location or site information, specifically to support information associated with master samples and sample designs created in the Sample Designer. The goal of the Site Manager tool is to provide an easy to use, easy to understand means to understand what master samples are available in a region of interest, to be able to easily upload and maintain project-specific sites, and to serve as a source for making the locations of these sites transparent to funders and other stakeholders.

The Site Manager stores a variety of master samples from both linear stream networks and area- based water bodies such as the mainstem and estuary in the Pacific Northwest, stores attribute information for sites in each master sample, and is the place users can explore details about sites in master samples and sample designs used in monitoring projects. This is also the application that allows users to upload their own sites, legacy samples, attributes and evaluations.

In 2014, Sitka made limited functional changes to the Site Manager, focusing more energy on supporting active monitoring projects use of the tool and documenting monitoring locations, including the CHaMP and AEM teams. The ultimate vision of the Site Manager as it relates to user-defined sample files is for a user to be able to easily create a file of monitoring sites either through uploading a shapefile or excel file, or by manually creating sites in the site editor itself. The "structure" of each file should be easily modified to accommodate adding or removing columns as needed to support the stratification and target frame selection processes in the Sample Designer tool. Once entered, users can benefit greatly by having the manually entered or uploaded points "snapped" to a common hydrographic network like the NHD 1:100K network. Once snapped, a wealth of standardized, pre-canned GIS attributes can be overlaid onto the point locations that take much of the difficulty and complexity out of this important process.

In 2014, Sitka made a change to the shapefile upload feature to allow shapefiles to be "re-uploaded" to modify the contents of existing uploads and add new attributes. This was regarded as a temporary solution to accommodate the immediate needs of users during the field season, but the plan is to replace this with a more robust and intuitive site editor in early 2015, prior to field season. Likewise, progress was made on the hydrography snapping and automated covariate generation feature in 2014, but more work is required in 2015 to realize the full utility of this important feature. Currently, there are 38 finalized legacy samples that have been uploaded in the Site Manager to be used in sample designs. To date, we have six master samples loaded (a combination of linear and area-based) and several more on the waiting list

Finally, to fill the need for visual designs within GeoOptix itself, rather than writing a completely separate visualization for GeoOptix, the existing visualization in the Sample Designer was turned into a component so that it could be ported to GeoOptix, thereby increasing code reuse.

Monitoring Explorer

Whereas the Site Manager and Sample Designer are concerned exclusively with pre-data collection processes, the Monitoring Explorer is concerned with post-collection visualizations. In 2013, using funding from BPA, PNAMP and Sitka began development of the Monitoring Explorer feature. The Monitoring Explorer is a database containing extensive information about the location, method, and timing of data collection events in

the field as well as the organization that collected it and specific links to where the measurement or metric data may be downloaded. It currently provides access to a full-featured interactive GIS map that utilizes ArcGIS Server and several common layers for the region. The work to populate sites (locations) in the Monitoring Explorer began in fall of 2013.

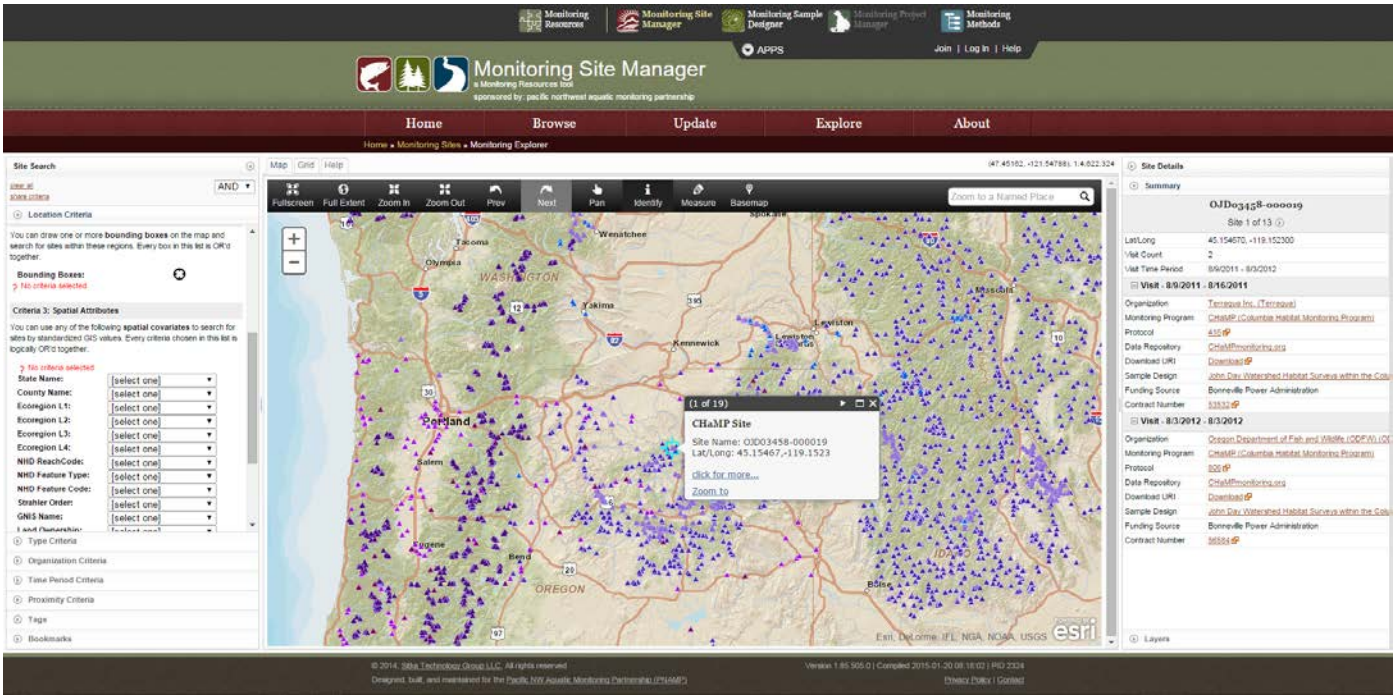

Figure 2. Screen shot of the Monitoring Explorer tool utilizing the Identify feature to display data collection event details.

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 data system that provides geographic locations in an interactive map-based format with monitoring activities linked to 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, but rather to develop a tool that has the ability to display a comprehensive list of monitoring locations and site level metadata information from other systems.

Sitka has built an interactive web mapping application that displays the location of actual data collection events in the database along with the ancillary information described above. This information is displayed in a "web friendly" way where hyperlinks to other Monitoring Resources pages or the pages of responsible agencies can be quickly called up in a browser.

The Monitoring Explorer uses the power of the ArcGIS Server and the Javascript API to provide advanced mapping and geoprocessing capabilities. This includes a full suite of base map imagery and the ability to quickly add other GIS layers of regional interest (fish population layers, Beechie classification, land ownership, etc.). A sophisticated search tool built to work closely with the map and the database allows users to find sites that have data that may be of interest to sponsors and stakeholders and quickly allow them to access data collected at that site.

Expanding the functionality of the Monitoring Explorer was a point of emphasis in the 2014 work plan and Sitka made great strides in augmenting the capabilities of this tool. To begin with, during 2014, Sitka acquired and provided to BPA for use throughout all managed applications at Sitka, a managed instance of ArcGIS Server 10.1 and subsequently converted the entire suite of monitoring applications to use this advanced tool set rather than GeoServer. A number of GIS layers were procured from various sources and added to the enterprise GIS database for the expressed purpose of displaying them in map viewers like the ArcGIS-driven Monitoring Explorer. Layers added during 2014 include:

Dynamic (Automated) GIS Layers

- PIT Tag Array Sites from PSMFC
- RM&E project site locations from Pisces
- Action Effectiveness Monitoring (AEM) Sites

Static Layers

- Refined TRT Population layers (dissolved HUC6)
- Beechie stream network classification (circa 2013)
- LIDAR Coverage Areas from Open Topography
- USGS Stream Gauges

Sites included in the Monitoring Explorer information from the CHaMP monitoring program, the Action Effectiveness (AME) the USFS PIBO and AREMP programs, Oregon Department of Environmental Quality Ambient Water Quality and National Rivers and Streams programs, and the Washington Department of Ecology Watershed Health and Salmon Recovery program. Only the AEM and CHaMP site information is automatically updated in the Monitoring Explorer display. All the other site information is static in the sense that the Monitoring Resources system does not yet have an active web service link to the database where the location information is stored.

Sitka made progress this year in standardizing GIS assets used between the BPA systems. Part of this effort included developing a corporate version of the TRT population layers that are dissolved at the HUC6 level. The goal is to have this common layer be used throughout Sitka and work will continue toward this goal in 2015. PNAMP recommends continuing the efforts to standardized GIS assets in BPA systems and working with regional partners to promote the use of standardized GIS layers. Additional PNAMP recommends document the metadata associated with the standardized BPA GIS layers.

Moving forward PNAMP will support Sitka in the goal of automate the periodic update/refresh of GIS layers that are deemed key to support programmatic RM&E efforts whenever possible. When not possible to create

automated updates, PNAMP will work with partners to find a solution to integrating site level information into the tool. PNAMP will seek partners interested in creating automatic updates into the Monitoring Explore using the Monitoring Metadata Exchange (MMX) standard detailed below. PNAMP will also seek feedback to prioritize the integration of additional GIS layers the Monitoring Explorer.

Monitoring Explorer User Interface Improvements

Sitka made a number of improvements to the user interface of the Monitoring Explorer to make it more intuitive to use. Among these improvements were:

- Changes to the navigation menu system to make the Monitoring Explorer easier to find and the creation of a new domain name www.monitoringexplorer.org that will take users directly to the Monitoring Explorer itself.
- A refactoring of the GIS layer navigation panel, which introduced a new level in the hierarchy for more consistent logical groupings of related layers.
- Refined map symbologies
- Addition of a "full screen" mode for the map to maximize the screen real estate available for map exploration.
- Addition of a category legend to the layer legend. This allows map layers that have symbology that is value dependent (e.g. color reaches with slopes > 1% purple and < 1% yellow) to properly show the user what the different colors on the layer represent. The symbology on the web map is taken directly from the ArcGIS published map service in a manner that does not require programming changes to modify the symbology.
- Added a "running" indicator to the map when data fetch operations are in progress to give the user visual feedback that activity is occurring.

PNAMP recommends continuing to improve search capabilities of the tools.

Monitoring Explorer Improvements to Searching Capabilities

One of the important features of the Monitoring Explorer is the ability to search the database of monitoring activity for sites that have particular data of interest to the analyst or researcher. As first envisioned and scoped, the Monitoring Explorer would have a variety of powerful ways of searching for monitoring data of interest across time and space. During 2014, much progress was made to improving the database searching capabilities, including:

- The ability to zoom to a particular site by site name via the "zoom to named location" search box
- The ability to search for sites by state and / or county
- The ability to search for sites by data provider identified tags
- The ability to search for sites by the general type of survey being conducted (riparian, water quality, macro invert, etc.)
- The ability to search for sites where data was collected either by a specific organization or within a particular time period

The search capabilities are constructed so that all of the above criteria can be used individually or in conjunction with other criteria. Sitka made changes to the Monitoring Explorer that helped keep the visual display of sites on the map in sync with the search results. In other words, the map now highlights the sites that are members of the search results.

Finally, we augmented the "active layer" search to include the state, county and HUC layers. The active layer search feature is one where polygon layers that are visible on a map (e.g. HUC4s) can be identified for inclusion in the search via a click on the map.

In 2015 we will work with regional partners to prioritize the development of the search capability of Monitoring Explorer. PNAMP has given demonstrations of Monitoring Explorer at regional meetings, trainings, and workshops to help educate potential users about its capabilities and encourage participation in sharing site level data. (Sample Designer project page; Sample Designer application; Site Manager project page; Site Manager application; Monitoring Explorer application)

Monitoring Metadata Exchange

In 2014 to facilitate integration of monitoring, PNAMP and regional partners including Sitka and StreamNet drafted a data exchange template for exchanging monitoring site level metadata. Monitoring Metadata Exchange (MMX) is a PNAMP standard data exchange mechanism for data collection event level metadata (the who, what, how, where, and when). Monitoring Metadata Exchange was created to be used by both producers and consumers of monitoring data to foster greater visibility and understanding of the diverse range of data collection happening throughout the region. PNAMP staff presented the first version of the MMX to regional partners and incorporated their comments to further refine the exchange. Sitka participated in the PNAMP efforts with stakeholders in to refined the MMX specification and contributed significantly to its design. Sitka attended EPA Region 10 work sessions relating to ongoing development of exchanges on the EPA Exchange Network (EN) and advocated for MMX to become an Exchange Node standard.

One of the major drivers behind drafting the MMX standard was to facilitate the sharing of site level information to be used in the Monitoring Explorer, but since the data are freely exchangeable, any organization with the desire and resources to do so could create alternative repositories and tools on top of this shared data. To facilitate the sharing in 2014 Sitka developed a REST-ful web service implementation of the MMX data exchange standard (complete with a validating xml schema). This implementation is written using Microsoft's .NET technology stack and is actually the mechanism that Sitka is using internally to integrate CHaMP and AEM site level data into the Monitoring Explorer. The source code of this implementation serves as an MMX reference implementation and can be freely shared with any organization that wants to publish their data into this exchange.

The PNAMP MMX working group will refine the MMX standard as necessary. PNAMP has adopted this standard and began seeking participation by regional partners. In 2014, PNAMP staff presented the Monitoring Explorer and MMX to various partners and outside organizations, outreach efforts will continue in 2015. PNAMP will seek additional opportunities to collaborate and establish automated transfer of information using the REST-ful web services developed by Sitka. PNAMP will target organizations with large publically available databases and BPA sponsored projects.

Additionally, PNAMP will investigate ways to integrate the MMX standard into current PNAMP projects including Coordinated Assessments and Habitat Data Sharing Projects. In the effort to increase use of the

MMX standard, PNAMP will structure all other data sharing efforts around the established standard (incorporating established data, time, location and metadata elements from the MMX standard into future data sharing efforts). (MMX project page; MMX Draft Standard)

High Level Indicators

Over the past decade there has been increasing interest at the executive level in improving our collective ability to track and communicate changes in environmental conditions and salmon populations in easily understood terms. Doing so fosters accountability, encourages consensus, supports priority-setting and budgeting, and can engender support. High level indicators (HLIs) are typically derived from one or more individual metrics across broad geographic scales and are intended to communicate complex information in easily understood terms for use in reports to Congress, legislatures, governors, and the public.

PNAMP has been working toward improved HLI reporting for many years. In 2007, PNAMP produced a white paper that highlighted the need for collaboration around HLI common reporting. In response to a need identified at the Northwest Environmental Information Sharing (NWEIS) executive summit in 2008, PNAMP produced a report summarizing: 1) high level indicators currently in use in the PNW, 2) who is using the indicator, and to the extent possible, 3) metrics being used to support the indicator (link to report). In 2009 PNAMP produced another report that built upon the earlier work, substantively advancing and providing recommendations for watershed health and salmon indicators (link to report). In 2010 PNAMP began the Coordinated Assessment for Salmon and Steelhead Project (CA) to develop efficient, consistent, and transparent data-sharing among the co-managers (fish and wildlife agencies and Tribes) and regulatory/funding agencies (BPA & NOAA) of the Columbia River Basin (CRB) for salmon and steelhead high level indicators.

At the 2013 PNAMP strategic planning meeting, partners expressed interest in revisiting the recommendations made in the 2009 report and taking steps to advance coordination of HLIs at the regional level. In 2014 a small project team was assembled and a work plan was developed outlining the proposed goal, actions, and outcomes for the project (link to work plan). In November 2014, a survey was sent to 24 monitoring program managers and policy decision makers to help better understand PNAMP partners' current interests and needs for HLI reporting. The survey explores the 2009 recommendations related to further alignment of watershed condition indicators to see if they still resonate with partners with the intention to revise as needed. Survey results will be summarized and shared in early 2015. The HLI project team will use the feedback from the survey to help refine next steps as described in the work plan.

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.

In 2013 PNAMP hosted a workshop for IMW practitioners to share their successes, failures, and insights on the challenges of this coordinated experimental approach that integrates watershed-level restoration activities with carefully designed and intensive monitoring efforts. This workshop was an opportunity for IMW practitioners to document and integrate their experiences to strengthen current and future IMW efforts and to identify the next steps PNAMP could take to assist practitioners in the planning and implementing IMWs. The summary information of current IMWs, notes from the workshop, and presentations are available on the PNAMP website. Since the workshop PNAMP facilitated a working group lead by Stephen Bennett to draft a manuscript detailing the result of the 2013 workshop. In 2014, the manuscript has been accepted by AFS Fisheries journal and will be published in the summer of 2015. Additionally, PNAMP has been working towards creating a central hub for IMW information on the PNAMP web page. This effort included gathering information from fifteen individual IMWs, collating it, and posting the information. Currently the web interface is in the design phase. PNAMP has reached out to NOAA to help coordinate IMW outreach efforts, including this web presence. PNAMP recommends continuing supporting these efforts to provide outreach regarding IMW information.

In addition to supporting the IMW community of practice, in 2014 PNAMP reinvigorated the standing forum to support effectiveness monitoring interests more generally. As of December of 2014, we are hosting quarterly teleconferences aimed at providing a forum for experts to discuss issues and identify collaboration opportunities. The first call was well attended – with 21 participants from a wide variety of entities. We agreed to support a session at the 2015 Salmon Recovery Conference on effectiveness monitoring and IMWs and to identify a focus topic for future meetings, which will resume in March 2015.
(Effectiveness Monitoring project page**)**

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. Browsing the library of methods on Monitoring Methods, you will notice measurements may be collected using different methodologies. 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.

Using the Monitoring Methods Community Forum tool, PNAMP hopes to provide more consistency in documentation and therefore a better understanding between practitioners about what everyone is doing. Further, we anticipate discussions on the community forum 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 used the community forum discussions, as well as previous PNAMP discussions, as a basis to plan for technical discussions focused on the current state of affairs for a particular protocol or method, inconsistencies and disagreements, and how to move forward. All discussions and final outcomes, whether it be agreement to use a particular method or agreement that different methods are necessary, will be documented and available online for future reference.

In 2014 PNAMP staff collaborated with Patrick Cooney, Director of Electrofishing Science, Smith-Root, Vancouver, WA on his 2014 Quebec City AFS meeting talk entitled "Electrofishing in Practice: Variations in Regional, National, and Continental Approaches". We discussed the apparent and real discrepancies within electrofishing methods and PNAMP added to the conversation by searching the Monitoring Methods library for documented electrofishing methods. There are 31 documented electrofishing methods in Monitoring Methods, 13 of those in the category of backpack electrofishing and eight within the boat electrofishing category.

The work with Mr. Cooney led PNAMP to initiating the Method Review process outlined in 2012 (link to method review process). PNAMP staff reviewed documented backpack electrofishing methods and prepared a short summary of the basic review findings. PNAMP solicited electrofishing experts to complete a second expert review, and three members of the scientific community stepped forward. Experts worked with PNAMP staff to gain understanding about the Monitoring Resources tools and due to the complicated nature of electrofishing and regulations, decided that they will work towards sharing a backpack electrofishing methodology template with the larger community. In 2015, PNAMP will facilitate an online discussion with interested parties to review methods, review the template, make suggestions, and come to a consensus on best practices for documentation. PNAMP will post the finalized electrofishing template as a method in Monitoring Methods. Upon completion of this task, PNAMP and experts will move forward with boat and barge electrofishing method reviews.

For effective review of Monitoring Methods content PNAMP seeks broad participation from the community. PNAMP recommends continuing to identify methods that are redundant in the system and are widely applied, reviewing content and facilitating agreement on robust documentation of methods. (Methods Review project page).

Lower Columbia Habitat Status and Trends Monitoring Project

Since October of 2012 PNAMP has partnered with the Lower Columbia Fish Recovery Board (LCFRB) and others to build on progress made in the PNAMP Habitat ISTM project (ISTM Habitat project page) and combine efforts with municipal stormwater managers in Southwest Washington to develop an integrated status and trends monitoring strategy for the Lower Columbia tributaries. The project, funded by the Washington Department of Ecology (WA Ecology), is a collaborative effort being led by the Lower Columbia Fish Recovery Board who has subcontracted with Stillwater Sciences and PNAMP for help with technical and facilitation tasks, respectively. The project is focused on integrating stormwater permit monitoring activities with habitat monitoring efforts to enhance regional coordination in the Lower Columbia tributaries and inform local management approaches. The project will also inform future Municipal Stormwater NPDES Permits in Southwest Washington by producing a monitoring design that addresses multi-scale questions about physical, chemical and biological attributes impacted by stormwater.

Phase 1 of the project, completed in 2013, resulted in a preliminary monitoring design and a list of recommendations and next steps (link to report). In 2014, with additional funding from WA Ecology, Phase 2 focused on increasing stakeholder engagement and finalizing the monitoring design. Over the course of the year, three workshops were held to present progress and solicit stakeholder feedback and approval. Progress in Phase 2 included refinement of the management questions and objectives; determining how best to stratify the >100,000 points of the Master Sample; determining the appropriate temporal scales for the frequency of

measurement; and exploring precision in the proposed metrics in order to 1) select repeatable metrics and 2) consider data sharability from a statistical perspective. The draft final design recommendations (link to report) will be presented in January 2015 at the fourth and final workshop for Phase 2. Phase 3 will begin in early 2015, with another grant from WA Ecology, to resolve decisions about the appropriate (or available) level of effort that will be needed to implement the recommended plan (and some final determinations of site allocation and metrics that depend on this fiscal decision).

Data Management and Sharing Best Practices

In recent years, there has been increasing attention on improving data management in the region, with focus on improving practices within individual entities and interest in the ability to share data across entities. Over the years a variety of approaches have been used by PNAMP to help further these goals. In 2014, two workshops were held and planning began for a webinar series.

In September of 2014, PNAMP supported StreamNet with a workshop entitled "Increasing Relational Capabilities between PSMFC Databases" to support in-house data integration. In November 2014 we also held an in-person workshop about "Emerging Technologies in Field Data Collection" with 109 participants from 35 organizations. The workshop included nine speed talks comparing pros and cons of the technology currently used in the field. There were then eight different hands-on demonstrations of how the technologies were put into practice in the field and the day ended with a panel discussion where ideas for future workshops and collaboration. Moving forward, the planning team (staff from StreamNet, Sitka Technology Group and PNAMP) will support a working group that can engage in a discussion of best practices for data management, hopefully leading to an electronic data capture package. In 2015, the working group will move forward with snorkeling as the first data collection activity to demonstrate this idea. The first step will be forming a small working group of interested parties who are willing to provide input on app development and potentially beta test the product.

In 2014, PNAMP approached the USGS Community for Data Integration to be a co-sponsor for a data management webinar series. Webinars will be held the third Wednesday of every month throughout 2015 (link to webinar series). Topics will include: data management overview, data management planning, data collection, data exchange, data sharing agreements, data documentation, data processing and analysis, data preservation, data citation and publishing and sharing data. Speakers will reach a national audience and come from multiple organizations.

In 2015, PNAMP staff will continue to coordinate in-person workshops to be held when there is a topic of interest and resources available to support the effort. (PNAMP Data Management project page)

Coordinated Assessments Project

Since 2011, PNAMP and the Pacific States Marine Fisheries Commission (PSMFC) StreamNet project have collaborated to coordinate the Coordinated Assessments (CA) project, which has resulted in the development of the Coordinated Assessments data exchange (CAX). The CAX defines the framework by which the fish and wildlife agencies and tribes compile and provide data for salmon and steelhead populations for access through the EPA data exchange network. The overarching goal of the CA project is to improve the timeliness, reliability, flow, and transparency of data necessary for regional assessments and management decisions for

improved environmental effectiveness, including support for biological opinions that affect state and federal agencies. Participants represent 4 states, 5 tribes, an inter-tribal consortium, and multiple federal regulatory agencies, all with an interest in collaboratively sharing fish population data for the Columbia River watershed. The federal Columbia River action agencies and fisheries co-managers have also participated through the CA Working Group; comprised of over fifty additional biologists and data managers across the Columbia River Basin representing 26 different tribal, state, federal, and academic organizations. This work benefits from existing facilitation framework provided by StreamNet, PNAMP and substantial cost share contributions from the Bonneville Power Administration.

A key output of the CA effort to date has been the development of an agreed upon data exchange standard (DES) describing the data exchange templates (DETs) for specific data elements needed to support the exchange of four VSP indicators and supporting metrics. These include: natural origin spawner abundance, smolt to adult ratio, and recruit per spawner (adult and juvenile). The DETs for these indicators were developed with wide participation of the larger working group, first through an extensive pilot program to document data flows and availability of the indicator and supporting metrics conducted with Oregon, Washington, and Idaho state agencies, six Columbia River Basin tribes, and one tribal coalition (Columbia River Inter-Tribal Fisheries Commission). This was followed by intensive focus on refining the draft DES by a development team consisting of data management and resource management expertise. The draft DES was then vetted and approved by the CA Working Group for implementation. This DES and the partnership behind it demonstrated the feasibility of successful implementation of data flows, given that work has been completed on data exchange mechanisms for these indicators, without the need to start from scratch on DET development. Documentation for the specific DETs and supporting materials can be found on the StreamNet website (link to materials). Expansion of the CAX to include additional indicators will be possible due to the initial efforts of the CA Project. Documentation of all project plans and activities may be found on the PNAMP website (Coordinated Assessments project page)..

The CA project is designed to improve access to environmental information through the creation and maintenance of a standardized database for key fish population metrics for major populations of listed and non-listed salmonids. This information can be shared across multiple agencies and jurisdictions in a common format and with improved efficiencies via the created Web services and application programming interfaces (APIs) that make data available in XML and other standard machine-readable formats. Data is shared across programs within the data collecting organizations, between agencies and tribes, and is available to the public, action agencies, and the courts, all of whom are directly involved in expensive and complex management and regulatory arrangements which are made possible and streamlined through this data management approach.

In 2014, the CA project completed several major cross-partner infrastructure components. These components included:

- XML Schema and associated documentation
- Flow Configuration Document
- Tribal Data Management Assessment and Coordination
- Development of an integrated repository and web service publishing platform

Data have begun to flow from the Confederated Colville Tribes to be hosted on the StreamNet website and accessed through the EPA exchange network as a virtual node. For 2015, we anticipate completing additional data publishing services and new data flows for the CAX , with primary focus of the added geographic areas, metrics, and indicators.

In 2015 PNAMP will seek feedback from the Coordinated Assessments participants regarding documentation of protocols for CA indicators in Monitoring Methods. PNAMP staff will use this feedback to guide the development of documentation for analysis methods and protocols. Additionally PNAMP will also present the MMX standard to CA participants and seek their input regarding establishing greater use of the standard. (Coordinated Assessments project page)

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 to improve the collective ability of the region to exchange aquatic-related habitat data in the Pacific Northwest. In 2014, activities were divided into two topic areas, stream habitat data sharing and macroinvertebrate data sharing.

Stream Habitat Data Sharing

Improving data sharing will enable timely access to data, improve data quality, and create clear channels for data management to support better management decisions. Within the Columbia River Basin there are numerous agencies, programs and projects monitoring aquatic habitat; however, these efforts were developed for specific reasons and were not designed in coordination with other efforts. Sharing information between monitoring programs could result in efficiencies, allow for coordination of monitoring, and increase agencies' and tribes' ability to make informed management decisions in the face of ever-changing management and environmental conditions.

In 2014, PNAMP staff finalized the Habitat Integrated Status and Trends Monitoring report "Evaluation and Prioritization of Monitoring Stream Habitat in the Lower Columbia Salmon and Steelhead Recovery Domain as related to the Habitat Monitoring Needs of ESA Recovery Plans". This report summarizes the effort to evaluate how seven existing habitat monitoring programs support regional management questions and objectives. The report details the commonalities among the habitat characteristics that all entities measure and monitor and how the metrics align with the priorities listed in NOAA's comprehensive recovery plan for the Lower Columbia ESUs. The full report and results can be found at PNAMP website (link to report)

Based on the findings of the report and work of others in the region, PNAMP drafted a Habitat Data Exchange Template (link to template). A data exchange template (DET) is a critical component for sharing data that describes the information participants would like to share and what format it should be shared in. The Habitat

DET references existing standards including the earlier described MMX. In 2014 PNAMP staff presented the draft Habitat DET at the Organization of Fish & Wildlife Information Managers (OFWIM) Annual Meeting in Flagstaff, AZ. We also presented the draft Habitat DET to the PNAMP Steering Committee in July, at the webinar to discuss next steps in habitat data sharing in September (described below), to the Washington State Governor's Salmon Recovery Office in November, and to the PNAMP Macroinvertebrate Planning Group in December. In 2015 PNAMP staff will continue to promote habitat data sharing and work towards refining the draft DET by seeking regional partners to offer input and apply the concepts. Based on regional feedback, PNAMP staff will likely focus the DET effort on one metric and seek a partner to test the concept. Hourly temperature data has been identified by regional partners as an important metric and could potentially be a metric to explore for DET development and better connection with other efforts already underway to share temperature data. Until the PNAMP staff receives strong commitment from regional partners interested in using a combined habitat data set, we will hold off on further refinement of the Habitat DET.

In September 2014, PNAMP hosted a web meeting to share progress on recent habitat data sharing efforts happening across the Pacific Northwest and gauge interest in future activities (link to notes). At the meeting Amy Puls (USGS/PNAMP) presented the results summarized in the Habitat ISTM Report described above. Karen Adams (Lower Columbia Fish Recovery Board) presented recent progress for the HSTM project (link to presentation). Chris Jordan (CHaMP) and Brett Roper (USFS) presented field protocol comparison results and the efforts to establish crosswalks between PIBO and CHaMP metrics (link to presentation). Becca Scully (USGS/PNAMP) presented preliminary work on a data exchange template to share metric-level habitat data between monitoring programs (link to presentation). Stephanie Miller (BLM/AREMP) presented the results of a collaborative effort among AREMP, ODFW, ODEQ and WA ECY to develop selection criteria for reference sites across the region (link to presentation). As a follow up to the meeting PNAMP staff drafted and administrated a survey to help identify priorities for collaboration and inform next steps for regional coordination aimed at improving the interoperability and flow of habitat data in the Pacific Northwest (link to survey results). In 2015 PNAMP staff will seek feedback and support from the steering committee for prioritizing tasks and moving forward. (Habitat Data Sharing project page)

Macroinvertebrate Data Sharing

There is agreement among aquatic ecologists in the Pacific Northwest that the sharing of macroinvertebrate data would be aided by a regional standard taxonomic effort (STE) agreement. Data sharing is constrained in part by lack of agreement among organizations that collect and/or process macroinvertebrates samples as to the authoritative taxonomic nomenclature appropriate for collected specimens and the level of taxonomic resolution that is appropriate for different assessment purposes. Following on work done in other regions, PNAMP's Macroinvertebrate Planning Group (MIPG) group decided to pursue development of an STE for the Pacific Northwest in October of 2012.

Work on the STE began in 2013 and continued in 2014. Taxonomists Bob Wisseman (ABA), Sean Sullivan (Rhithron), John Pfeiffer (EcoAnalysts), and Sue Salter (Cordillera Consulting) have been developing the taxa lists that provide standardized nomenclature and 3 levels of taxonomic resolution to use when identifying macroinvertebrate samples. They have also drafted supporting documentation including the rules that were used to build the taxa list and how they will be maintained in the future. In 2014 incremental progress on the draft

STE agreement was presented in February at the MIPG web meeting; in May at the International Joint Aquatic Science Meeting in Portland, OR; in November at the Society for Freshwater Science Pacific Northwest Chapter Meeting; and in December at the MIPG web meeting. The first version of the STE is planned to be finalized by spring of 2015. (NWSTE project page)

In 2014, the MIPG also began discussing symposium topics for the 2015 Annual American Fisheries Society Meeting in Portland, OR. The symposium is designed to be a follow-up to the MIPG's 2013 Oregon American Fisheries Society symposium investigating the relationship of macroinvertebrates to fish habitat quality (link to symposium summary). The group agreed on the idea proposed by Seth White (CRITFC), and a symposium abstract titled "Moving Beyond Water Quality Indices: How Can Macroinvertebrate Data from Fish Habitat Monitoring Programs Inform Food Web Analyses?" was submitted. Applicants will be notified of acceptance in February 2015.

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 2014, PNAMP Coordination Staff updated 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 five years, PNAMP has distributed a monthly email to all participants that included a summary of upcoming meetings. In 2014, this monthly communication also included one or two short summaries highlighting the latest PNAMP news. The list of participants who receive the news and meeting summary currently contains 788 recipients and continues to grow.

Beyond communicating PNAMP's work via online resources, the Coordination Team participated in several outreach activities in addition to regular PNAMP activities. In 2014, the PNAMP Coordinator gave overview presentations to the follow audiences: BPA executives and staff, Northwest Power and Conservation Council executives and staff, the Columbia River Basin Federal Caucus, state natural resource agency directors, and USGS executives.

The PNAMP Assistant Coordinator presented a series of training talks on MonitoringMethods.org and also gave several presentations describing PNAMP's online tools suite, MonitoringResources.org (see the above MonitoringResources.org summary for more details).

Steering Committee Activities

The PNAMP Steering Committee (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 steering committee is made up of representatives from the signatory partners (Appendix A). There are also several "courtesy members" that are invited to participate in steering committee meetings. Courtesy members are entities that are considering becoming a formal partner; their participation helps them understand the opportunities, responsibilities, and benefits of signatory membership. Courtesy members in 2014 included: Oregon Department of Fish and Wildlife, Kootenai Tribe of Idaho, Nez Perce Tribe, Shoshone-Bannock Tribes, Nisqually Tribe, Puget Sound Partnership and the Great Northern Landscape Conservation Cooperative. Several signatory partners have been less engaged in recent years at the Steering Committee level (California Department of Fish and Game, NOAA Fisheries, Oregon Watershed Enhancement Board, U.S. Army Corps of Engineers, U.S. Bureau of Land Management, and U.S. Forest Service). Better engagement from these partners would be beneficial to the leadership of the SC and PNAMP staff are formulating a plan to try and get better engagement from these partners. However, many of these entities do have staff engaged in projects or tasks; therefore, we believe PNAMP work is important to these entities.

In 2014, the PNAMP Coordination Staff finalized a new five-year strategic plan that resulted from the strategic planning process that began in 2013. The plan uses the adaptive management monitoring wheel as the basis for the conceptual framework. Another result of the strategic planning meeting was a new approach for SC members to engage and guide PNAMP projects. Four leadership teams were formed; each of which focused on a subset of the PNAMP annual work plan project tasks. The leadership teams meet twice in 2014 (quarters one and three) to set priorities, make recommendations for process, identify resources, review progress, and resolve issues of both short and long term importance. In the second and fourth quarters, the full SC was convened. The purposed of these meetings was to track the progress of activities, discuss how new tasks or projects align with PNAMP's goals, and offer guidance when necessary. These meetings also facilitated information exchange between SC members and work team leads. Both Leadership Team meetings and full SC meetings were facilitated by the PNAMP Coordinator and the Coordination Team prepared materials before the meetings and notes following the meetings. The Leadership Team concept is intended to allow more efficient use of the SC members' time. However, this concept does not seem to resonate with the SC, so we will reconsider if this is a good strategy in 2015. Greater participation from Steering Committee members is necessary to sustain PNAMP going forward.

Adaptive Management and Lessons Learned

Federal, state, tribal, local, and private natural resource monitoring programs in the Pacific Northwest have evolved in response to different organizational mandates, jurisdictional needs, issues and questions. However, while some issues are unique to particular entities, PNAMP has learned there is much common ground. Where common ground exists, improved coordination can avoid duplication of effort and increase cost-effectiveness of expenditures. This cooperation also allows more timely and accessible information and increases the overall quantity and quality of scientific information used to inform public policy and resource management decisions. This common ground and cooperation is central to the PNAMP strategy and mission.

Though considerable progress has been made in some aspects of regional coordination, less progress has been made in others. For example, the Coordinated Assessments Projected has made significant progress towards improving the timeliness, reliability, flow, and transparency of salmonid population data necessary for regional assessments. However, due to a lack of equally clear mandates, significantly less progress has been made furthering those same goals for high-level habitat assessments. And while PNAMP efforts have helped to support improved regional data management standards and structures, much work remains to be done.

It is important to recognize that PNAMP successes are largely attributed to the in-kind participation from member organizations' staff and other interested parties. However, this volunteer approach, combined with the diverse interests of participants, presents many challenges. Although PNAMP has made progress, expectations about scope and pace of work need to be realistic given this framework. A fundamental ongoing challenge has been to balance PNAMP's resources with the level of shared interest in working on potential subject areas. There will always be many more areas of interest than there is the capacity to address them. Expectations of PNAMP members and others should be tempered with these realities, while recognizing that adjustments in approach would yield different results. Most importantly, consistent with PNAMP's guiding principles, PNAMP's expertise and limited resources must be focused on topics of the highest priority to decision-makers.

Improved coordination across the wide spectrum of monitoring efforts of shared interest (e.g., design and implementation, from local to Pacific Northwest scales) will only occur if commitments exist within and among the hierarchy of affected programs. As reflected in the membership of PNAMP, these include local, state, tribal, federal and other entities and programs. Unfortunately engagement at the Steering Committee level has declined in recent years, especially as PNAMP founding members retire and their organizations are slow to designate replacements. Renewed commitment from signatory partners and additional commitment from courtesy members to become signatory partners would strength PNAMP's ability to effect meaningful change. While the mere existence of PNAMP represents a base level of commitment toward improved coordination, the specifics of how much coordination is sufficient for individual entities or how much coordination is attainable or sufficient to meet management expectations needs further clarification through interaction with and among PNAMP Executives.

Appendices

Appendix A. Entities signatory to the PNAMP Charter in 2014.

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	Vacant	Neil Manji Northern Regional Manager
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 Dept.
Environmental Protection Agency	Gretchen Hayslip	Dennis McLerran Regional Administrator
Idaho Department of Fish and Game	Lance Hebdon	Ed Schriever Chief of Fisheries
NOAA Fisheries	Vacant	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	Vacant	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 Ethridge 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 & 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 5:
- PNAMP website: http://www.pnamp.org/

Page 12:
- Monitoring Resources PNAMP project page: http://www.pnamp.org/project/3875
- Monitoring Resources Application: https://www.monitoringresources.org/Resources/Home/Index

Page 15:
- Monitoring Methods PNAMP project page: http://www.pnamp.org/project/3134
- Monitoring Methods Application: http://www.monitoringmethods.org/

Page 20:
- Monitoring Explorer: http://www.monitoringexplorer.org/

Page 21:
- 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
- Monitoring Explorer application: https://www.monitoringresources.org/Sites/Explorer/Index

Page 22:
- MMX PNAMP project page: http://www.pnamp.org/project/4849
- MMX Draft Standard: http://www.pnamp.org/document/4854
- 2008 PNAMP HLI Report: http://www.pnamp.org/document/2023
- 2009 PNAMP HLI Report: http://www.pnamp.org/document/2060
- 2014 PNAMP HLI Work Plan: http://www.pnamp.org/document/4743

Page 23:
- Effectiveness Monitoring PNAMP project page: http://www.pnamp.org/project/3137

Page 24:
- Method Review process document: http://www.pnamp.org/document/3885
- Method Review PNAMP project page: http://www.pnamp.org/project/3131
- ISTM Habitat PNAMP project page: http://www.pnamp.org/project/3152
- Phase 1 report for the Lower Columbia Habitat Status and Trends Monitoring project: http://www.pnamp.org/document/4244

Page 25:

- Phase 2 draft final design report for the Lower Columbia Habitat Status and Trends Monitoring project: http://www.pnamp.org/document/4997
- Data management webinar series: https://my.usgs.gov/confluence/display/cdi/2015+Data+Management+Webinar+Series
- Data Management PNAMP project page: http://www.pnamp.org/topics/2

Page 26:

- CA DETs and supporting materials: http://www.streamnet.org/caxct.html
- Coordinated Assessments PNAMP project page: http://www.pnamp.org/project/3129

Page 27:

- Coordinated Assessments PNAMP project page: http://www.pnamp.org/project/3129
- ISTM Habitat Report "Evaluation and Prioritization of Monitoring Stream Habitat in the Lower Columbia Salmon and Steelhead Recovery Domain as related to the Habitat Monitoring Needs of ESA Recovery Plans": http://www.pnamp.org/document/4769
- PNAMP Draft Habitat Data Exchange Template: http://www.pnamp.org/document/4797

Page 28:

- Habitat Data Sharing web meeting notes: http://www.pnamp.org/document/4835
- HDS web meeting presentation by Karen Adams (Lower Columbia Fish Recovery Board: http://pnamp.org/document/4808
- HDS web meeting presentation by Chris Jordan (CHaMP) and Brett Roper (USFS): http://pnamp.org/document/4812
- HDS web meeting presentation by Becca Scully (USGS/PNAMP): http://pnamp.org/document/4809
- HDS web meeting presentation by Stephanie Miller (BLM/AREMP): http://pnamp.org/document/4811
- Habitat Data Sharing Survey results: http://www.pnamp.org/document/4896
- Habitat Data Sharing PNAMP project page: http://www.pnamp.org/project/3266

Page 29:

- Northwest Standard Taxonomic Effort (NWSTE) PNAMP project page: http://www.pnamp.org/project/4210
- Oregon AFS Symposium Summary: http://www.pnamp.org/document/4208