pacific northwest aquatic monitoring partnership

2017 Annual Report

Amy L. Puls, Rebecca A. Scully, Megan M. Dethloff, Jennifer M. Bayer, Sheryn J. Olson,

and Samuel A. Cimino

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Executive Summary

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) continued to promote the integration of monitoring resources and development of tools to support monitoring in 2017. Improved coordination and integration of goals, objectives, and activities among Pacific Northwest monitoring programs 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 of time from participants at meetings, workshops, and other PNAMP hosted events; in 2017 this estimate amounted to 2,039 hours by 67 organizations.

In 2017, PNAMP focused on projects related to 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 existing projects, and initiate new tasks. The following list highlights some of PNAMP's accomplishments in 2017:

- Supported the development, training, and outreach to make MonitoringResources.org the system of record for Bonneville Power Administration (BPA) research, monitoring, and evaluation (RME) location data.
- Increased documentation of monitoring by promoting and managing the MonitoringResources.org protocol and method library (with 1,121 protocols and 1,821 methods in the system at the end of 2017, this was an increase of 144 protocols and 133 methods since the end of 2016).
- Presented a five-part webinar series on MonitoringResources.org functionality (MonitoringResources.org: An Introduction, Map Viewer: An Introduction, Documenting Methods and Protocols, Managing Sites with Master Samples and Users' Sample Sites, Documenting Sample Design). There were over 50 participants across all webinars with many individuals attending multiple webinars.
- Moderated the MonitoringResources.org community forum to discuss protocols and methods.
- Maintained the PNAMP.org website for better information discovery and delivery.

- Furthered goal of coordinated data management and exchange to support improved assessment reporting of salmon and steelhead populations in the Columbia River Basin by planning and hosting the annual Coordinated Assessments Workshop in Portland, Oregon on May 11 with 52 attendees from 22 agencies. Also facilitated bi-weekly Core Team phone calls.
- Continued efforts to improve regional coordination for data sharing and reporting of habitat indicators by planning and facilitating two stakeholder meetings and employing multiple surveys to identify indicators that best answer the selected management questions, and to identify the data needed to calculate the indicators; people from 36 organizations participated in the project.
- Furthered work to improve communications among Intensively Monitored Watershed (IMW) stakeholders by finalizing and implementing the PNAMP IMW Action Plan. Two stakeholder meetings were held to help refine the plan, and 31 people representing 16 IMWs helped compile information about their respective IMWs to inform the communication products called for in the action plan.
- Facilitated a working group of 18 members that resulted in a white paper, Citing Aquatic Monitoring Datasets: Best Practice Recommendations for Authoritative Data Citation.
- Co-sponsored the 2017 Field Technology Conference: Data Collection In Forestry, Fisheries And Natural Resources with Western Forestry and Conservation Association, StreamNet, and Sitka Technology. The conference was attended by over 160 participants. Thirty-four presenters shared their field technology discoveries, success stories, and great ideas in 15-30 minute presentations, and during a panel discussion. This event, held every two years, presents emerging technologies and their uses, or lessons learned for collecting and using forestry, fisheries, and other natural resources monitoring data.
- Identified and convened subject matter experts to plan a workshop to improve data integration through the use of Generalized Random-Tessellation Stratified (GRTS) based designs. The workshop will be held in the spring of 2018.
- Continued to coordinate development of a standard taxonomic effort agreement for the Pacific Northwest to facilitate the sharing of macroinvertebrate data.
- Facilitated the development of a conceptual model for large river systems to identify the interrelationships between anthropogenic drivers and biological endpoints via a 20 person workshop May 23-24, 2017 in Hood River, OR. Workshop participants represented eleven large river basins in the U.S., including the Columbia, Colorado, Illinois, Mississippi, Missouri, Tallapoosa, Canadian, Ohio, Hudson, Red, and Wabash Rivers.
- Continued to expand the use of the MonitoringResources.org web tools through outreach to national scale monitoring efforts, including developing a new application for design documentation for the North American Bat Monitoring Program, a continental-scale terrestrial program involving many jurisdictions. Also initiated new work with the Monarch Joint Venture partnership to evaluate potential use of MonitoringResources.org by the tri-national Monarch Monitoring Program.

PNAMP's work on these tasks supports our partner's research, monitoring, and evaluation (RME) coordination needs, including action agencies' responsibilities for the Federal Columbia River Power System Biological Opinion and the Northwest Power and Conservation Council Fish & Wildlife Program (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 method 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 all activities that have and will continue to support FWP strategies as well as PNAMP's partners' strategies. Products resulting from PNAMP's work include online tools to document details about projects' study designs, methods, protocols, and metrics; an 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.

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 and leads to increased effectiveness and efficiency of aquatic resource monitoring on a regional scale.

Although there was a great deal of progress made in 2017, 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 the regional habitat indicator data sharing activities would all benefit from additional practitioner engagement and lead to improved RME coordination.

MonitoringResources.org has been the system of record for BPA's RME protocol data since 2013, and now the platform is the system of record for RME location data. In the past four years MonitoringResources.org has grown and we now have all the original functionality outlined available. We recommend having a work session to demonstrate the tool to BPA RME staff and management, gather feedback, and document requirements to chart the future of the tool with respect to supporting BPA's metadata documentation.

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. The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) became a formal partnership 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 federal, state, tribal, 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
- 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 representative mix of participants to address these goals. Different mandates that drive monitoring and management, policy, and reporting, require collaboration with regional and national organizations and with many individual participating organizations. Regardless of the complexity involved, PNAMP believes that supporting 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 made up of representatives from the organizations that are signatory to the Charter (link to PNAMP Charter page, URLs for all links in this report can be found in Appendix C), staff (aka Coordination Team) to serve as coordinators and facilitators for specific topics of interest, and subject matter experts participating in working teams that focus on specific project tasks.

The PNAMP Steering Committee, Coordination Team, and participants share the responsibility to work together 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 of complex topics with many partners takes time and hard work. PNAMP is largely a voluntary organization, and our progress is directly related 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 experts on both subject matter and policy on what is needed to improve coordination of aquatic resource monitoring.

Steering Committee Activities

The PNAMP Steering Committee (SC) provides the science-policy interface between the executive partners and project work teams, and is responsible for communicating their respective organizations' work and needs to PNAMP, as well as communicating PNAMP progress and challenges to their organizations. The SC directs the activities of the Coordination Team and helps obtain resources to

accomplish projects. 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. By promoting communication among organizations, the SC strives to assure that monitoring plans and information are coordinated across the Pacific Northwest.

The SC comprises representatives from the signatory partners (Appendix A). Additionally, several "courtesy members" are invited to participate in SC 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 2017 included: Great Northern LCC, Kootenai Tribe of Idaho, Nez Perce Tribe, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, Puget Sound Partnership, Regional Coordinator for Yakama Nation Fisheries, Shoshone-Bannock Tribes, and Sitka Technology Group. 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 strengthen PNAMP's ability to effect meaningful change. In 2018 we plan to hold a two-day strategic planning meeting with the PNAMP Steering Committee which will include a discussion of how we can better fill vacancies and expand membership.

In 2017, the Steering Committee met in April, June, and October. The purpose 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. SC members also report these meetings are a valuable opportunity to network with their peers, who are responsible for monitoring activities in their respective agencies and tribes. These meetings also facilitated information exchange between SC members and work team leads. The PNAMP Coordinator and the Coordination Team prepared materials before the meetings, facilitated the SC meetings, and disseminated notes following each of the meetings.

PNAMP Coordination Team Activities

The PNAMP Coordination Team is employed by the U.S. Geological Survey (USGS), Northwest Region Executive Office. In 2017, the PNAMP Coordination Team included a coordinator (Jennifer Bayer), and five staff biologists (Amy Puls, Rebecca Scully, Megan Dethloff, Sheryn Olson, and Sam Cimino).

The Coordination Team's goals are to facilitate the transfer of information within PNAMP and among all relevant organizations, support relationships between science and monitoring, and promote communication among organizations to help ensure 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 enhancing understanding of PNAMP topics, successes, and challenges, and to serve as a clearinghouse for PNAMP activities and products.

The Coordination Team provides administrative support for PNAMP activities (e.g. logistical support for meetings, record keeping, and maintenance of participant information). At least one member of the Coordination Team serves as a lead or co-lead for all PNAMP projects to ensure the project progresses in a timely manner. The PNAMP Coordinator serves as the director of the organization, and is responsible for fiscal, reporting, staffing, and day to day management of PNAMP activities.

In 2017, government and non-government entities provided organizational support to the U.S. Geological Survey (USGS) to administer and staff PNAMP, with USGS staff responsible for developing and negotiating fiscal support, and managing budgets and associated contracts with those entities. PNAMP staff completed required progress reporting of the Coordination Team activities (within PNAMP) and of PNAMP activities to interested external parties. 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 2017. 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 information about PNAMP events and projects, and increased the availability of biological and natural resources information at the regional and national level. While PNAMP staff maintained the content of the website, the US Geological Survey provided technical support and hosted the website. The website has served PNAMP well since 2010, though the site could use improvements, PNAMP will need additional funding to update the design and usability of the site.

In addition to the pnamp.org website, the Coordination Team managed development of MonitoringResources.org as described in the MonitoringResources.org Project section below.

In-Kind Contributions

PNAMP is a dynamic 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. Although 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. In the past, the Coordination Team asked task leads and participants to keep track of their hours spent on PNAMP activities during the year, but very few people did. Reporting only these hours would have vastly underrepresented the total amount of time all people were truly contributing. Because it is relatively easy to track meeting participation, since 2011 we have calculated in-kind contributions based on attendance at PNAMP meetings. For teleconferences the meeting duration was used to estimate the

contribution of time from each participant. For in-person meetings contributions were calculated as 1.5 times the meeting duration to help account for travel and prep time.

For 2017 we calculated 2,039 hours of in-kind contributions of time from 67 participating organizations (Appendix B). In-kind contributions by topical category are shown in Table 1, and illustrate how using meeting time to represent participation is imperfect. For example, the hours of in-kind time recorded for meetings related to the Regional Habitat Indicator Project or Effectiveness Monitoring Coordination don't reflect the numerous hours participants spent outside of meetings compiling and submitting information about their organization's data collection and reporting efforts. Figure 1 shows in-kind contributions by organization type for 2010 through 2017. The spikes in in-kind contributions in 2013 and 2016 were the result of the two-day IMW workshops held in those years and were attended by a large number of people. While tracking meeting participation is an imperfect measure of in-kind contributions, it remains our best option.

Table 1. Estimated hours contributed to PNAMP meetings by topical category. Hours were estimated for each meeting attendee for every PNAMP meeting from January 1 to December 31, 2017. For teleconferences the meeting duration was used to estimate the contribution of time from each participant. For in-person meetings contributions were calculated as 1.5 times the meeting duration to help account for travel and prep time. Hours were then grouped by topical category.

Project or Topical Category	Total Hours
Coordinated Assessments	441.00
MonitoringResources.org - Support and Development	440.50
Large River Monitoring Forum (USGS)	393.50
Steering Committee Meeting Series	328.50
Data Management and Sharing Best Practices	124.25
Effectiveness Monitoring Coordination, IMWs	94.50
Enterprise Tools for National Monitoring (USGS)	78.50
Regional Habitat Indicators	68.25
Integrating Science with GRTS	36.50
Outreach and Communication	24.00
Methods Review	9.50

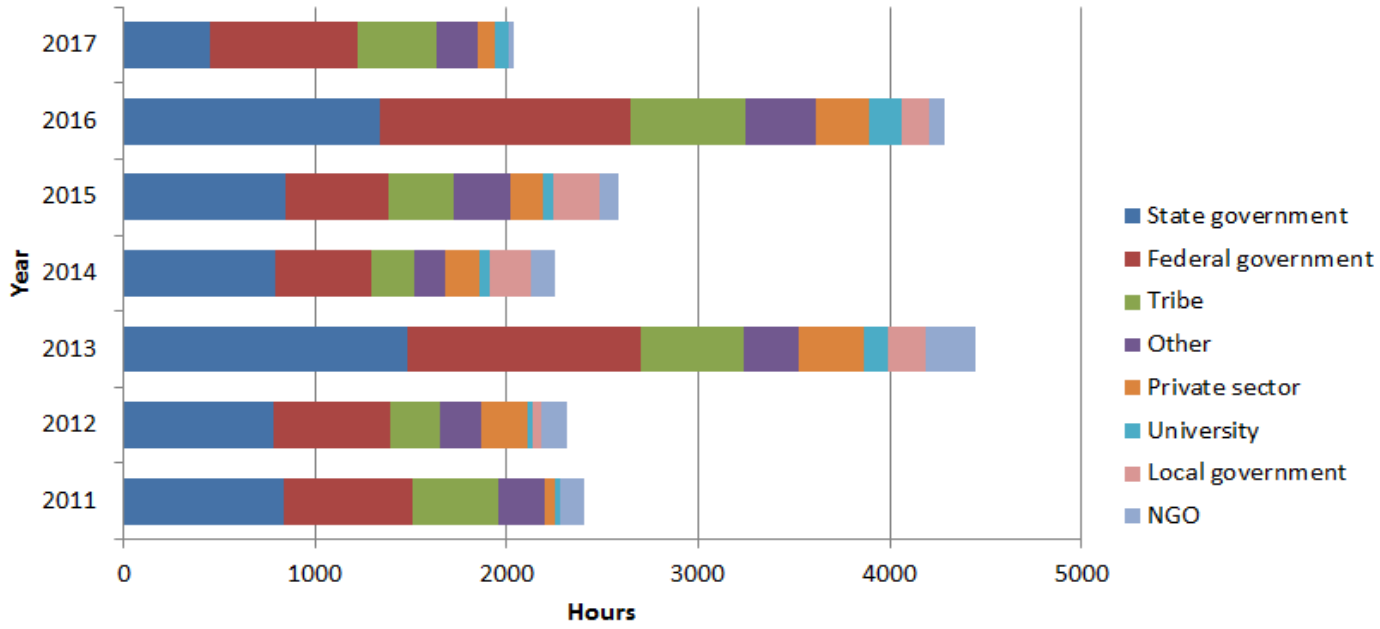

Figure 1. Estimated hours contributed to PNAMP meetings for 2011 to 2017. Hours were estimated for each meeting attendee for every PNAMP meeting from January 1, 2011 to December 31, 2017. For teleconferences the meeting duration was used to estimate the contribution of time from each participant. For in-person meetings contributions were calculated as 1.5 times the meeting duration to help account for travel and prep time. Hours were then grouped by their entity type and year. The entity type 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.

PNAMP meetings and work sessions in 2017 focused on tasks related to these main projects: MonitoringResources.org, Coordinated Assessments, Regional Habitat Indicators, Effectiveness Monitoring Coordination and Assessment, Data Managements and Sharing Best Practices, Integrating Science with GRTS, and USGS sponsored work. Several smaller work teams met regularly to focus on specific tasks identified within 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 2017.

MonitoringResources.org

Focused on coordination and collaboration, MonitoringResources.org promotes transparency and greater understanding of monitoring through a standard process of documentation and information management.

MonitoringResources.org consists of online tools that provide guidance and support for design and documentation of a monitoring project from beginning to end. The tools assist practitioners to document methods, protocols, sample designs, and implementation details associated with data collection and analysis. Once published by the practitioner, monitoring partners and the broader monitoring community can easily search and view this information, facilitating coordination and collaboration. The tools also support decision making by providing resource managers, funders, and policy makers a comprehensive view of existing and proposed monitoring projects across the region allowing them to better understand how priorities are being met, as well as where there are gaps and redundancies in monitoring.

MonitoringResources.org platform houses all other PNAMP applications, including Protocol and Method tools, Sample Designer, User Sample location files, Master Sample Library, Monitoring Explorer map viewer, Monitoring Advisor, and the Metadata Builder. MonitoringResources.org features, functions, and applications are modular, so that users can take advantage of a single application. At the same time, the individual applications are designed to work together for end-to-end management of the monitoring workflow and to integrate with data collection applications such as Sitka's GeoOptix tool. Details about individual tools can be found in fact sheets posted on PNAMP.org, MonitoringResources.org Project page, under Key Documents.

In 2017, we continued development, outreach and content support on all the tools and expanded the user base. The number of users of the MonitoringResources.org toolset grew from 382 at the end of 2016 to 476 at the end of 2017. To help with general outreach, PNAMP staff updated the

MonitoringResources.org fact sheets, training presentations, and reference guides for distribution at workshops, briefings, and meetings.

Development

PNAMP contracted with Sitka Technology Group (Sitka) through USGS and Bonneville Power Administration (BPA) to complete the 2017 planned development work. Development efforts focused on supporting RME project sponsors' needs. In 2016, BPA began a transition of their internal agency system Pisces Desktop to a web based system, Pisces Web. During transition planning BPA asked PNAMP to assess if MonitoringResources.org could be used to track locations of RME activities, which would eliminate the need to build location tracking into Pisces Web. In 2017, PNAMP and BPA staff developed and presented a proposed workflow between Pisces Web and MonitoringResources.org to the BPA management team. BPA management chose to use MonitoringResources.org to track RME work element location data (i.e. sampling sites and areas of inference). As of December 2017, all projects that contain RME work elements 156-research and development, 157-data collection, and 162-data analysis and interpretation, were required to document Protocols, Study Designs, Sample Designs, and User Sampling locations in MonitoringResources.org. Previously, project sponsors documented protocols in MonitoringResources.org and sample locations in Pisces. To support this transition, PNAMP and BPA facilitated two internal pilot group meetings and three external pilot group meetings. Based on BPA's needs, we implemented the following:

- Created a Study Design component in MonitoringResources.org to shift specific study design organization information, sampling locations, and focal species from the protocols so that protocols will be reusable and shareable.
- Updated the Sample Design tool:
    - Shifted the Area of Inference functionality from Pisces Desktop to the Sample Design tool in MonitoringResources.org to support BPA's needs
    - Made Area of Inference data available via web services
- Updated the User Sample File tool:
    - Improved functionality of User Sample File tool to match the workflow of the other MonitoringResources.org tools
    - Allowed users to upload .csv files of sampling locations, add sampling points one by one on a map, or by typing in the sample location name, latitude and longitude

In 2018, we will continue to improve MonitoringResources.org based on project sponsors' needs. To better understand those needs, PNAMP facilitated five one-on-one user testing sessions in November 2017. The next phase of development will be based on the users' feedback and BPA's continued need to support RME work element documentation. Future development will include:

- Study Designs:
    - Add version control to Study Designs
- Sample Design tool:

- Update User Sample File tool to include additional types of sample designs
- Improve the Sample Design tool workflow
- Modify steps in the Sample Design tool to simplify its use

In 2018, PNAMP recommends that we complete multiple work sessions with the BPA RME implementation team to understand how MonitoringResources.org can deliver the data the team needs. We also recommend that PNAMP continue to conduct user testing and implement improvements such as expanded and context sensitive help text.

Finally, PNAMP has seen growing interest in MonitoringResources.org from other agencies, including the US Geological Survey (USGS) and Bureau of Land Management (BLM). Over the past few years, USGS, the BLM Assessment, Inventory and Monitoring Program, and the North American Bat Monitoring Program (NABat) provided funding to improve the MonitoringResources.org tools to better address their needs and support PNAMP staff. In 2018, we will continue to work with these partners and we will start working with the Monarch Joint Venture. In all cases, PNAMP staff has been careful to coordinate development so that updates will support the full MonitoringResources.org community and BPA's needs. These are the highlights of the National Development effort for 2017:

- NABat cell section tool, supported by the MonitoringResources.org platform
- Create two-way APIs to write data to MonitoringResources.org Sample Designs

PNAMP staff will continue to pursue national interests. As we gain more partners, we see the need to put tighter controls on how we implement development. In 2018, we will draft governance documents and processes for implementing development in MonitoringResources.org. We will work with BPA to ensure needs are met. For more information on the national effort please see the section below.

Outreach

In 2017, PNAMP staff continued to perform outreach for the MonitoringResources.org tools, including:

- Shared MonitoringResources.org tips and updates in PNAMP monthly newsletter
- Poster, booth, and presentation focused on MonitoringResources.org at Idaho Chapter of American Fisheries Society
- Poster at Ecological Society of American in Portland, OR
- Completed six part webinar series on the MonitoringResources.org tools; we had over 55 participants with multiple participants attending more than one webinar. All presentations can be found on pnamp.org.
- Hosted a session on MonitoringResources.org as an enterprise tool for monitoring coordination and presented a poster on MonitoringResources.org at the Center for Data Integration biannual meeting

We continued to look for additional opportunities to implement a project tracking process for organizations. This included outreach efforts to increase awareness of the tools, such as briefings with the Oregon Watershed Enhancement Board, Idaho Department of Fish and Wildlife, and quarterly

reports to the PNAMP Steering Committee. Additionally, we have drafted an official USGS fact sheet focused on MonitoringResources.org that will be available in early 2018.

In 2018, we feel that it is imperative to the success of these tools to find additional partners who share our vision for better documentation and information sharing and who can provide support by encouraging or requiring use of the tools within their own organizations. PNAMP will continue to reach out to monitoring practitioners and look for opportunities to promote the MonitoringResources.org tool set. We recommend BPA establish a priority list of RME project sponsors to focus PNAMP's outreach efforts.

Content

PNAMP staff curates the content in MonitoringResources.org. To support finalizing content, PNAMP staff spent approximately 8 to 32 hours per week in 2017 supporting help requests received via email, phone, or the support page on the website. Requests included help with login, content entry issues, how to structure protocols and methods for specific projects, responding to comments on the discussion board, reviewing methods and protocols, and responding to requests to add new organizations or monitoring programs.

Because of PNAMP staff's hard work at the end of 2017, we have:

- 1,821 methods, 1,051 are published, with 113 methods published in 2017
- 1,121 protocols, 195 are published, with 63 published in 2017
- 11 master samples, 3 were added in 2017
- 6 projects are displayed in Monitoring Explorer, none were added in 2017

PNAMP believes it is important to urge users to finalize (publish) their content instead of leaving it in a draft state for months or years, especially because there are several mechanisms in the tools to track version changes in procedure or of location data. In addition, it is important to the success of MonitoringResources.org to have content in the system that will attract new users, not turn them away.

During the transition from Pisces Desktop to Pisces Web, BPA loaded historical location data for Work Elements 156, 157, and 162 from Pisces into MonitoringResources.org. This resulted in a Sample Design and User Sample File in MonitoringResources.org for each year a project operated. These data were not quality assurance (QA) checked before they were migrated to MonitoringResources.org. This created excess content in MonitoringResources.org and has been time consuming for PNAMP staff and BPA project sponsors to check for accuracy and finalize. PNAMP recommends that BPA provide staff to QA the location data and that BPA work with Sitka to systematically clean up the data. Additionally, the migrated RME location data has slowed MonitoringResources.org processing speed, so we recommend that BPA support Sitka to improve MonitoringResources.org speed for usability.

Adding content to MonitoringResources.org is important to the sustainability of the tool. In addition to BPA project sponsors, we are working with national partners to improve content. We have added

North American Bat Monitoring protocols and sample designs, and worked with USGS scientists to add environmental DNA (eDNA) project protocols and methods. More information on both of these efforts is outlined in the USGS Sponsored Work section below.

One important piece of content that PNAMP had not yet captured is monitoring site level metadata (i.e. final, actual data collection locations and descriptions of sampling). We have now built a tool, Monitoring Explorer, to display the who, what, where, where, and when of sampling. This tool supports collaboration by displaying multiple projects' data collection locations, protocols, sample designs, data repositories and sampling dates on the same map. To support project data entry, we facilitated drafting a standard, the Monitoring Metadata Exchange (MMX). 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. We have also built and documented web services to help exchange MMX data, but to date use of those services has been minimal. We recommend BPA identify priority projects and in 2018 PNAMP staff will focus on outreach of the Monitoring Explorer and MMX standard to those groups with the goal of adding content to the Monitoring Explorer.

(MonitoringResources.org project page; MonitoringResources.org website, MMX project page; MMX Draft Standard)

Training

In addition to one-on-one support, PNAMP staff is focusing on training, videos, improved help text and reference guides. During 2017 PNAMP staff completed the following training seminars, which included producing slides, communicating with participants, preparing worksheets and other course preparation, and following up:

- Full day training with Idaho Fish and Game, Boise ID
- Three 2.5 hour webinars to present changes BPA made to project sponsors' documentation requirements
- Developed a 3.5 hour face-to-face training seminar for presentation during winter 2018
- Produced a reference guide to support project sponsors' use of MonitoringResources.org tools

We anticipate that the time required to support users of the tools will increase in 2018, because RME project sponsors are now required to enter more information into MonitoringResources.org and edit the RME location data imported into MonitoringResources.org. In 2018, PNAMP staff will work with BPA staff to complete five half day face-to-face training seminars across the west. The staff will also conduct training seminars as they are requested by BPA project sponsors. We recommend the following to support PNAMP staff and BPA project sponsors:

- BPA provides staff to QA the RME location data
- Funding for development to add help text to the tools and improve the user interface

- PNAMP continues to conduct user interface testing to learn how to improve the workflow of the tool
- PNAMP continues to conduct training seminars

MonitoringResources.org Conclusion

MonitoringResources.org has seen increased interest from local and national monitoring efforts. PNAMP staff is working to coordinate development to increase efficiencies and support all users. In 2016, PNAMP facilitated our first meeting between all partners supporting MonitoringResources.org; in 2018, we will host technical workshops and continue to engage stakeholders.

We recommend BPA focus support on improvements to the Sample Designer tool and the User Sample File tool to accommodate their changes to the RME documentation process. We also recommend supporting efforts to understand what BPA project sponsors need and making small functionality changes to meet those needs. In 2018, we would like to work with BPA to identify priority project sponsors with enterprise data systems to link their database to the Monitoring Explorer using the MMX API. This will allow us to know who is collecting what data, where, when, and how, and to identify how PNAMP could help facilitate exchanging data between multiple entities.

Managing content in MonitoringResources.org is a time consuming process. A majority of protocols and methods have been entered by BPA project sponsors. Staff works directly with RME staff and project sponsors to review these protocols to build metadata consistent with project sponsors' RME work elements. We recommend PNAMP continue to work with RME staff to refine this process to eliminate unnecessary steps and streamline the documentation process to alleviate burden on sponsors while still providing BPA with the necessary information. We also recommend BPA supports usability updates to MonitoringResources.org and adding help text to the tools.

PNAMP anticipates an increased workload in relationship to supporting project sponsors documenting study designs in MonitoringResources.org. We recommend RME staff work with PNAMP staff to design a process for QA/QC in the location data.

MonitoringResources.org has been the system of record for BPA's RME protocol data since 2013, and now the platform has also become the system of record for RME location data. In the past four years MonitoringResources.org has grown and all the functionality originally proposed is now available. We recommend a work session to demonstrate the tool to BPA RME staff and management, gather feedback, then document requirements and chart the future of the tool supporting BPA's metadata documentation.

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. This includes support for biological opinions that affect state, tribal, and federal organizations. Participants represent four states, six 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 50 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. In addition, the project has relied on a 3-year grant from EPA for coordination and to develop a virtual node on the Exchange Network for sharing data.

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 viable salmonid populations (VSP) indicators and supporting metrics. These include: natural origin spawner abundance, smolt to adult return rate, and recruit per spawner (adult and juvenile). The DETs for these indicators were developed with wide participation of the larger working group through extensive review and collaboration. This DES and the partnership behind it demonstrated the feasibility of successful implementation of data flows. 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 is under way and made 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 alignment and maintenance of standardized databases for key fish population metrics and indicators 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 web services. Information can also be accessed through application programming interfaces (APIs) that make data available in XML and other standard machine-readable formats. Data are 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.

Since 2015, the CA project has been sharing data via the CAX, with significant growth in reporting effort in 2016 and 2017. The Coordinated Assessments state and tribal partners have all implemented an automated or semi-automated flow of data to the main CAX database using the StreamNet Representational State Transfer (RESTful) API. All agencies have submitted some or all of their available

production CAX data sets and all valid data are live and available via the node. Due to limitations of state and tribal partners' staff capacity, work on developing standards for sharing additional indicators has slowed. However, the project's five year work plan includes plans to address this need in the future.

PNAMP staff work with StreamNet, Bonneville Power Administration and contractors (TKI Natural Resource Consulting) to support the project. PNAMP facilitates the Coordinated Assessments Core Team (CACT) bi-monthly meetings and the annual Coordinated Assessments Workshop. PNAMP also supports StreamNet staff's leadership of two subgroups: the DES Development Team (DDT), which maintains and provides updates to the DET; and the Exchange Configuration Team (XCT), who developed the EPA Exchange Network virtual node for the CAX.

Regional Habitat 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.

In 2015, after recognizing overlapping interests, PNAMP partners and the Northwest Power and Conservation Council staff agreed to collaborate to advance coordination of habitat indicators at the regional level. In discussions with PNAMP steering committee members, it was also evident that other broad-scale efforts, both within and across jurisdictions, such as the State of the Salmon Report by the Washington Governor's Salmon Recovery Office, as well as reporting needs for the Clean Water Act and the Columbia River Treaty, would likely benefit from this effort.

As a pilot, we have chosen to focus on indicators related to surface water attributes as these are of interest to many reporting efforts; the four indicator topic areas are: flow, macroinvertebrates, temperature, and water quality index. The goal is to come to agreement on a small set of indicators for which data will be efficiently coordinated and communicated to allow comparisons at multiple scales across the region, while respecting the goals and unique mandates of the individual partners. A leadership team was assembled and a work plan was developed outlining the proposed goal, actions, and outcomes for the project. After agreeing on the management questions of greatest common interest at the November 2016 workshop (RHIP Workshop Summary), stakeholders went through a multistep process in 2017 to select the indicators to best answer the management questions (Survey Results, Meeting Notes), and identified the data that is needed to calculate the indicators (Meeting Notes). In 2018, stakeholders will help compile information such as who is collecting what, what methods are being used, and how it can be accessed in order to inform the development of recommendations for how to improve data accessibility and interoperability for the selected indicators. Project participants will also discuss and develop recommendations for how to improve reporting for the selected questions and indicators.

Effectiveness Monitoring Coordination and 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.

To facilitate coordination and communication among IMWs and between IMWs and regulatory agencies, PNAMP hosted three workshops, in 2008, 2013, and 2016. The 2013 workshop focused on sharing monitoring results and led to two papers, published in 2016, that clarified definitions of and the role of IMWs as long term monitoring entities, while illustrating challenges and summarizing results from 17 IMWs (Bennett et al. 2016, Bouwes et al. 2016). The 2016 workshop focused on improving the flow of information about tools, results, and guidance produced by those working in IMWs to those who can apply this information to improve decision making, policy guidance, and on-the-ground mitigation actions. Details about the workshop panel discussion, presentations, and work session outcomes can be found in the Workshop Summary.

In 2017, PNAMP held several meetings with stakeholders to take the feedback from the 2016 workshop and turn it into a practical action plan to improve two-way communications among IMWs stakeholders and help ensure IMWs outcomes (tools, results, and guidance) are valuable to policy-

makers and managers. The PNAMP 2017/2018 IMW Action Plan identifies four communication products to help disseminate results and lessons learned from the network of IMWs, and highlights the need for additional venues for stakeholders to discuss findings and practitioners to learn from one another. PNAMP received funding from NOAA (through Pacific States Marine Fisheries Commission) in October 2017 to implement the 2017/2018 Action Plan. Tasks during winter of 2017/2018 have mainly focused on working with practitioners to compile the information that will be used to inform the four communication products called for in the action plan. In 2018, PNAMP will continue to work with stakeholders to implement the action plan.

(Effectiveness Monitoring project page; Intensively Monitored Watersheds project page**)**

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.

Throughout 2017, a working group of 18 members met to discuss Data Attribution and Citation, led a discussion at the annual Coordinated Assessments (CA) workshop, May 11, and prepared a white paper, *Citing Aquatic Monitoring Datasets: Best Practice Recommendations for Authoritative Data Citation*. The working group and six authors with nine additional editors of the white paper addressed three concepts:

- PNAMP was assigned a task by their partners to convene a working group to develop best practices for the global community for data citation and attribution.
- Then, to recommend minimal and optimal metadata documentation to enable best practices data citation and acknowledgement for two case studies (SPS and CA data repositories sponsored by NOAA and StreamNet, respectively) in a white paper.
- A further task, given continued interest, will be the recommendation of best practices for metadata enabling citation to all PNAMP partners, and the larger aquatic monitoring community of practice via a peer reviewed publication.

At the CA workshop in May, 2017, PNAMP presented the working group's efforts to date with an overview of best practices for data attribution and citation. During the subsequent discussion, the participants approved adding fields to the CA data repositories to acknowledge contributors of data sets, which were implemented by July 2017. The white paper will be finalized in 2018.

During 2017, in cooperation with Western Forestry and Conservation Association and other PNAMP partners, PNAMP staff assisted with planning and conducting the 6th Field Technology Conference, Portland, OR, held in November. The 2017 conference had over 200 attendees, 30 presentations, a panel discussion, and live demonstrations. The conference is held every two years, and our participation in the last two conferences with StreamNet and Sitka staff has expanded the original focus from forestry field data collection technology to fisheries and other natural resource data

collection and data management. Presentations may be accessed here; please request a password from PNAMP staff to view these files.

In early 2017, the PNAMP Steering Committee also agreed that PNAMP should partner with OFWIM and co-sponsor their annual conference. The Organization of Fish and Wildlife Information Managers (OFWIM) is an international non-profit organization. OFWIM's mission is to promote the management and conservation of natural resources by facilitating technology and information exchange among managers of fish and wildlife information. OFWIM emphasizes coordination, outreach, technical assistance, and continuing education. PNAMP staff has begun to help plan the conference, set themes, location, field trips, and gather speakers and sponsors. Co-sponsoring is a good opportunity for PNAMP partners to coordinate, learn, and share with national leaders in information management. The conference is typically attended by over 60 people and addresses a variety of topics including but not limited to data sharing, data visualizations, application development, and database management. The conference is set for November 4-8, 2018 in Hood River, Oregon.

Integrating Science with GRTS

The monitoring of ecological resources over broad spatial and temporal scales often requires an abundance of financial and logistical resources unavailable to any single entity. Therefore, communities of governments, organizations, and individuals are often needed to provide the information required for sound natural resource management. However, because monitoring projects are developed to meet an individual organization's needs, the ability to integrate data from multiple organizations across large landscapes is often difficult due to differences in data collection methods and spatial designs.

The spatial design for a monitoring project describes how sampling effort is to be allocated across a study area. In general, there are several types of spatial designs in use: census, model-based, opportunistic, and probabilistic/randomized surveys, or a hybrid of the previous types. Each of these spatial designs has strengths and weaknesses. PNAMP partners are interested in learning opportunities and discussions addressing approaches to spatial design to enable informed decisions about developing practical and optimal spatial designs that improve our ability to share and integrate monitoring data.

MonitoringResources.org (described earlier in this report) can help users build probabilistic sample designs using an algorithm called Generalized Random-Tessellation Stratified (GRTS) to generate a spatially-balanced set of sites for status and trends monitoring. In 2017, the PNAMP steering committee suggested we host workshops/discussions with subject matter experts about how GRTS and the MonitoringResources.org tools can help solve problems monitoring practitioners face when trying to integrate data from multiple monitoring projects or trying to integrate new monitoring efforts with old. PNAMP staff convened an advisory committee of experts in October of 2017 and began planning a workshop for 2018.

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 into 2017. Taxonomists Sean Sullivan (Rhithron), John Pfeiffer (EcoAnalysts), Bob Wisseman (Aquatic Biology Associates), and Sue Salter (Cordillera Consulting) have been developing the taxa lists that provide standardized nomenclature and three 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 2017 the STE was promoted and progress was shared in November at the Society for Freshwater Science Pacific Northwest Chapter Meeting in La Conner, WA. In 2018, PNAMP plans to develop a dedicated webpage to host the STE and related documents. (Northwest Standard Taxonomic Effort page)

Outreach and Communication

Part of PNAMP's work includes reaching out to potential participants and informing the aquatic monitoring community of upcoming events and announcements, showcasing new tools, and sharing 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 2017, PNAMP Coordination Staff frequently 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 eight years, PNAMP has distributed a monthly email to all participants that included a summary of upcoming meetings. In 2017, the monthly communication continued to include one or two short summaries highlighting the latest PNAMP news, but also added a PNAMP partner highlight section to increase awareness about aquatic and terrestrial monitoring programs in the region. The 2017 list of participants who receive the news and meeting summary contains approximately 800 recipients and continues to grow.

PNAMP Coordination staff has also maintained a Twitter presence for the past three years, which steadily gained followers in 2017. Participation increased from 75 followers to approximately 100. Staff highlighted events, publications, and other items that might have been of particular interest to the regional participants, as well as releases of PNAMP newsletters.

Beyond communicating PNAMP's work via online resources, the Coordination Team promoted our activities and the MonitoringResources.org toolset by manning booths at conference trade shows including the Salmon Recovery Conference in Wenatchee, WA; the Idaho Chapter American Fisheries Society annual meeting in Boise, ID; and the Field Technology Conference in Portland, OR. The PNAMP Coordinator also gave overview presentations to the following audiences: Western Association of Fish and Wildlife Agencies staff; USFWS National Wildlife Refuge Inventory & Monitoring senior staff; Columbia Basin Partner Forum; Monarch Joint Venture staff; BPA executives and senior staff, Northwest Power and Conservation Council senior staff, US Bureau of Reclamation senior staff, and US Geological Survey executives and senior staff.

USGS Sponsored Work

Due to our success in supporting collaboration with partners in the Pacific Northwest, PNAMP staff, who are all USGS employees, have been asked to support similar work sponsored by USGS including the Large Rivers Monitoring Forum (link), exploration of development of enterprise tools for national scale monitoring programs (link to 2016 workshop), and support for USGS Fisheries Program's exploration of documentation of protocols and methods as part of a pilot Fisheries Program task.

The Large River Monitoring Forum (LRMF) focuses on fish, fish habitat research, and monitoring approaches, including: scientific objectives for comparisons within and among aquatic ecosystems; scientifically sound monitoring design; methods for data collection and analysis; and best practices for data and information management. In 2017 the forum grew from 13 to 22 scientists and expanded from five to eleven major U.S. river systems. During 2017 the LRMF held monthly meetings that were structured towards formulating a strategy for collating long-term fisheries monitoring data with data describing landscape-level stressors that affect fish populations and other biota. We also held a two-day workshop in Hood River, OR to work on a conceptual modeling design to determine how stressors are affecting fisheries communities and aid managers in making decisions.

The USGS Ecosystems Mission Area Status & Trends Monitoring Program is very supportive of exploring potential expansion of the use of PNAMP's enterprise web tools (www.MonitoringResources.org) and the concept of a facilitated monitoring network beyond the Pacific Northwest. In October 2016, we conducted a 30-person workshop (Visioning Workshop: Developing Enterprise Tools and Capacities for Large-scale Natural Resource Monitoring) to solicit input from monitoring practitioners, program managers, and information scientists to inform enhancements to MonitoringResources.org. We identified and prioritized ideas for development of this toolset as well as how we might integrate it with other enterprise resources.

In 2017, we completed a short report, published in EOS, and a longer report, published as a PNAMP product, summarizing the Visioning Workshop. We solicited additional feedback via conferences, meetings, and one-to-one conversations to glean input and ideas for moving forward. Throughout the year, we also conducted outreach on MonitoringResources.org to promote its use at a national scale. This included a range of activities including developing a new poster and presenting it at conferences, presenting an overview of the tools to various audiences, and developing a new fact sheet to be published by USGS. We worked with specific programs to explore more fully their interest in the toolset, including the Great Lake Sciences Center's data managers working on Research Vessel Catch Information System Trawl (RVCAT) to consider documentation of RVCAT methods and protocols in MonitoringResources.org, and the Monarch Joint Venture (MJV) staff to explore use of design documentation features to support their national scale collaborative monitoring efforts. The MJV outreach resulted in a successful proposal to the NFWF for 2018 funding for thorough scoping of their interests in MonitoringResources.org.

We put considerable effort into supporting three pilots as use cases for MonitoringResources.org. These existing pilots include: the North American Bat Monitoring Program, USGS Ecosystems Mission Area Pilot for eDNA projects, and the BLM Assessment, Inventory, and Monitoring Program.

Pilot 1) North American Bat Monitoring Program Collaboration (NA Bat)
We facilitated and supported a working group of NABat monitoring program staff and leaders to share MonitoringResources.org capacities and gather requirements for NABat's use of the toolset. This work informed detailed plans for the development of a NABat site selection tool using the existing MonitoringResources.org tools. In August 2017, we initiated development and expect a beta version of the NABat cell section tool to be complete by early 2018. In addition, we presented a poster describing this collaboration at the Ecological Society of America Annual Meeting in Portland, OR and conducted outreach to bat monitoring experts in Idaho and Oregon. We continue to collaborate across mission areas in USGS on this topic and were successful in competing for a USGS Community for Data Integration grant for "Developing APIs to support enterprise level monitoring using existing tools".

Pilot 2) USGS Ecosystems Mission Area (EMA) Fisheries Program Pilot
We continue to participate in the EMA Fisheries Program pilot for project implementation that strives to build a foundation for program requirements that meet current mandates for documentation. Our role is to support USGS scientists funded by EMA for eDNA research use of MonitoringResources.org to document protocols and methods. Specifically, we worked with eDNA experts to enter common eDNA protocols and methods into the toolset, coordinated with EMA Fisheries Program Lead to provide feedback on EMA memo requiring the use of MonitoringResources.org for EMA funded eDNA projects, and drafted guidance to support eDNA practitioners in entering methods and protocols into MonitoringResources.org.

Pilot 3) BLM Assessment, Inventory, and Monitoring (AIM) Program Collaboration
We continued to facilitate development work to support BLM AIM's use of the MonitoringResoures.org

sample designer tool. Specifically, we documented BLM AIM aquatic monitoring protocols in MonitoringResources.org and explored publication of AIM sites in the toolset.
In 2018, we will continue to explore interest in a facilitated national monitoring network and how the MonitoringResources.org tools can support interested partners.

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 Project has made significant progress towards improving the timeliness, reliability, flow, and transparency of salmonid population data necessary for regional assessments. Less progress has been made furthering those same goals for high-level habitat assessments; reasons for this include a lack of clear mandates as well as fewer stakeholders participating. 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

strengthen PNAMP's ability to effect meaningful change. While the continued 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.

Appendix A. Entities signatory to the PNAMP Charter in 2017

PNAMP Partners	PNAMP Steering Committee Representative
Bonneville Power Administration	Vacant
California Department of Fish and Game	Kevin Shaffer
Columbia River Intertribal Fish Commission	Denise Kelsey
Confederated Tribes of the Colville Reservation	John Arterburn
Environmental Protection Agency	Gretchen Hayslip
Idaho Department of Fish and Game	Tim Copeland
NOAA Fisheries	Greg Sieglitz
Northwest Indian Fisheries Commission	Bruce Jones
Northwest Power and Conservation Council	Nancy Leonard
Oregon Watershed Enhancement Board	Renee Davis
Pacific States Marine Fisheries Commission	Chris Wheaton
U.S. Army Corps of Engineers	Vacant
U.S. Bureau of Land Management	Vacant
U.S. Bureau of Reclamation	Jude Trapani
U.S. Forest Service	Mark Raggon
U.S. Geological Survey	Steve Waste
Washington Department of Ecology	George Onwumere
Washington Department of Fish and Wildlife	Dan Rawding
Washington Governor's Salmon Recovery Office & Recreation and Conservation Office	Keith Dublanica

Appendix B. Estimated hours contributed by entities to PNAMP meetings in 2017

Hours were estimated for each meeting attendee for every PNAMP meeting from January 1 to December 31, 2017. For teleconferences the meeting duration was used to estimate the contribution of time from each participant. For in-person meetings, contributions were calculated as 1.5 times the meeting duration to help account for travel and prep time.

Entity	Total Hours	Hours for SC Only
US Geological Survey	460.50	28.50
Confederated Tribes of the Umatilla Indian Reservation	219.00	
Pacific States Marine Fisheries Commission	146.50	47.25
Idaho Department of Fish and Game	144.00	32.50
Oregon Department of Fish and Wildlife	117.00	13.50
National Oceanic and Atmospheric Administration	89.00	30.00
Bonneville Power Administration	72.00	63.00
Confederated Tribes and Bands of the Yakama Nation	65.00	40.00
Washington Department of Fish & Wildlife	61.50	30.50
Columbia River Inter-Tribal Fish Commission	55.00	21.00
Northwest Power and Conservation Council	51.00	49.50
Nez Perce Tribe	45.50	
US Bureau of Reclamation	43.00	16.50
Washington Governor's Salmon Recovery Office	41.00	41.00
Sitka Technology Group	36.25	
Ball State University	33.00	
US Fish and Wildlife Service	32.50	
Washington State Department of Ecology	30.00	
Oregon Watershed Enhancement Board	24.00	22.50
Colville Confederated Tribes	22.00	10.50
US Environmental Protection Agency	22.00	13.50
US Bureau of Land Management	20.00	
Upper Columbia Salmon Recovery Board	14.00	
GEUM Environmental Consultants	13.50	
Western Forestry and Conservation Association	13.25	
Snake River Salmon Recovery Board	12.00	
Unknown organization	12.00	
Confederated Tribes of the Warm Springs Reservation	10.50	
The Nature Conservancy	10.00	
University of Minnesota	10.00	
US Forest Service	9.00	9.00
US Department of Agriculture	7.50	
Stillwater Science	6.50	
US National Park Service	6.50	

Entity	Total Hours	Hours for SC Only
Utah State University	6.50	
GPS World	5.50	
Oregon Department of Environmental Quality	5.50	
University of Vermont	5.00	
Statistical Design	4.50	
University of Missouri	4.50	
Terraqua Inc.	4.00	
University of Idaho	4.00	
Southern Illinois University	3.50	
Discovery Management Group, LLC	3.25	
Gulf Coast Ecosystem Restoration Council	3.00	
Lower Columbia Estuary Partnership	3.00	
National Council for Air and Stream Improvement	2.50	
Oregon Department of Agriculture	2.50	
Oregon State University	2.50	
Conservation Biology Institute	2.00	
King County Department of Natural Resources and Parks	2.00	
Michigan State University	2.00	
Pierce County	2.00	
US Army Corps of Engineers	2.00	
Columbia River Gorge Commission	1.50	
Cowlitz Tribe	1.50	
Idaho Governor's Office of Species Conservation	1.50	
Natural System Design	1.50	
Florida Fish and Wildlife Conservation Commission	1.00	
Kootenai Tribe of Idaho	1.00	1.00
Northwest Indian Fisheries Commission	1.00	
Oncorh Consulting	1.00	
Oregon Water Resources Department	1.00	
Smith-Root	1.00	
South Fork Research	1.00	
Xerces Society	1.00	
Yakima Basin Fish & Wildlife Recovery Board	0.75	
Total	2039	469.75

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

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

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

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- MonitoringResources.org website: https://www.monitoringresources.org
- MonitoringResources.org project page: http://www.pnamp.org/project/3875

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- MonitoringResources.org web services API: https://mrv1.docs.apiary.io/

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

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- MonitoringResources.org project page: http://www.pnamp.org/project/3875
- MonitoringResources.org website: https://www.monitoringresources.org
- Monitoring Metadata Exchange (MMX): https://www.pnamp.org/project/4849
- Monitoring Metadata Exchange Draft Standard: http://www.pnamp.org/document/4854

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- Coordinated Assessments materials at the StreamNet website: http://www.streamnet.org/data/coordinated-assessments/
- Coordinated Assessments PNAMP project page: http://www.pnamp.org/project/3129

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- Five Year Plan for Coordinated Assessments: https://www.pnamp.org/document/5186
- 2008 PNAMP HLI Report: http://www.pnamp.org/document/2023
- 2009 PNAMP HLI Report: http://www.pnamp.org/document/2060

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- RHIP Workshop 1 Summary: https://www.pnamp.org/document/5597
- RHIP Indicator Survey Results: https://www.pnamp.org/document/5887
- RHIP Teleconference Notes: https://www.pnamp.org/document/5904
- RHIP Teleconference Notes: https://www.pnamp.org/document/6036
- Bennett S., G. Pess, N. Bouwes, P. Roni, R. E. Bilby, S. Gallagher, J. Ruzycki, T. Buehrens, K. Krueger, W. Ehinger, J. Anderson, C. Jordan, B. Bowersox, and C. Greene. 2016. Progress and Challenges of Testing the Effectiveness of Stream Restoration in the Pacific Northwest Using Intensively Monitored Watersheds, Fisheries, 41:2, 92-103, DOI: 10.1080/03632415.2015.1127805
- Bouwes N., S. Bennett, and J. Wheaton. 2016. Adapting Adaptive Management for Testing the Effectiveness of Stream Restoration: An Intensively Monitored Watershed Example, Fisheries, 41:2, 84-91, DOI: 10.1080/03632415.2015.1127806

- PNAMP 2016 IMW Workshop Summary: https://www.pnamp.org/document/5628

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- PNAMP 2017-2018 IMW Action Plan: https://www.pnamp.org/document/5917
- Effectiveness Monitoring project page: http://www.pnamp.org/project/3137
- Intensively Monitored Watersheds project page: https://www.pnamp.org/project/3133

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- 6th Field Technology Conference Presentations: http://westernforestry.org/file-uploads/2017-field-technology-conference-materials
- Organization of Fish and Wildlife Information Managers (OFWIM): http://www.ofwim.org/

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- Northwest Standard Taxonomic Effort page: https://www.pnamp.org/project/4210

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- Large River Monitoring Forum: https://www.sciencebase.gov/catalog/item/56f0319ce4b0f59b85dd1238
- Visioning Workshop: Developing Enterprise Tools and Capacities for Large-scale Natural Resource Monitoring: https://www.pnamp.org/event/5509
- Fisheries Program Task: https://www2.usgs.gov/ecosystems/fisheries/
- MonitoringResources.org website: https://www.monitoringresources.org

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- Visioning Workshop short report in EOS: https://eos.org/meeting-reports/defining-opportunities-for-collaboration-across-data-life-cycles
- Visioning Workshop long report, Developing Enterprise Tools and Capacities for Large-scale Natural Resource Monitoring: A Visioning Workshop Report: https://www.pnamp.org/document/5990
- Developing APIs to support enterprise level monitoring using existing tools: https://www.sciencebase.gov/catalog/item/58b5fbdce4b01ccd54fde482