pacific northwest aquatic monitoring partnership

2020 Annual Report

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Acknowledgements

The Pacific Northwest Aquatic Monitoring Partnership is a collaborative effort among many individuals throughout the region. We would like to thank Bonneville Power Administration, US Bureau of Land Management, US Bureau of Reclamation, and US Geological Survey for their funding contributions. Thank you to all our partners, participants, and collaborators for their continued time and effort in this important endeavor. And special thanks to Nancey Leonard (PSMFC-StreamNet) for her contributions to this report.

Executive Summary

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. In 2020, the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) continued to promote the integration of monitoring resources and development of tools to support monitoring.

PNAMP operates through inter-organizational working teams to advance and achieve objectives for a variety of projects that simultaneously support partner needs and PNAMP goals. For each project, the PNAMP Coordination Team identifies interested Steering Committee members and subject matter experts to form the working teams who provide project guidance and leadership. The working teams also act as an intermediary between the larger group of project participants and the Steering Committee.

In 2020, PNAMP focused on projects related to new technologies to advance natural resource monitoring efforts and research, best practices for data management and visualization, and fish monitoring. PNAMP advanced its coordination goals and objectives for these topics by hosting workshops, work sessions, and meetings. Steering Committee members, subject matter experts, and other interested stakeholders participated in these events to exchange information about their own programs, coordinate existing efforts, and initiate new tasks. The PNAMP Coordination Team tracked in-kind contributions of time from participants at PNAMP hosted events; in 2020 this estimate amounted to 1,769 hours by participants from over 120 organizations.

The following list highlights some of PNAMP's accomplishments in 2020:

- Increased documentation of monitoring by promoting and managing the MonitoringResources.org protocol and method library. Total numbers at the end of 2020:
    - 1,813 methods, 1,172 are finalized (68 of those finalized in 2020), and 143 methods have been archived
    - 1,254 protocols, 262 are finalized (30 of those finalized in 2020), and 7 protocols have been archived
- Supported development, training, and outreach for MonitoringResources.org to serve as the system of record for Bonneville Power Administration (BPA) research, monitoring, and evaluation (RM&E) monitoring metadata.
- Designed outreach and training for BPA Project Sponsors with MonitoringResources.org content in the 2021 Anadromous Fish Habitat and Hatchery Independent Scientific Review Panel review.
- Facilitated work sessions with StreamNet and BPA to outline the data requirements for tracking Screw Traps and outline how MonitoringResources.org and StreamNet data systems can provide the information needed.

- Provided one-to-one email and telephone support for MonitoringResources.org users, as well as in-person training as requested, videos, webinars, revisions for context-sensitive help text, and reference guides.
- Facilitated working group to define a controlled vocabulary for exchanging stream habitat metrics for four federal long-term, large-scale monitoring programs.
- Organized and hosted the Emerging Technologies Information Sessions Webinar Series with StreamNet co-lead. In 2020, this included three webinars in October on aerial monitoring of aquatic systems and three webinars on eDNA in November. These six webinars had a total attendance of 542 participants, and recordings of the webinars on PNAMP's YouTube Channel have been viewed in total 944 at the time this was written.
- Continued support for the Coordinated Assessments Partnership by facilitating the Core Team meetings and engaging and assisting as needed with the Data Exchange Standard Development Team chaired by Pacific States Marine Fisheries Commission (PSMFC)-StreamNet staff to improve the timeliness, reliability, flow, and transparency of data necessary for regional assessments and management decisions for improved environmental effectiveness.
- Presented findings from the 2019 *Key Findings and Lessons Learned from Pacific Northwest Intensively Monitored Watersheds* report at two virtual meetings: National Oceanic and Atmospheric Administration's (NOAA) West Coast Region Recovery Coordinators meeting on July 8, 2020 and the Pacific Coastal Salmon Recovery Fund grantees meeting on Aug 5, 2020. In addition, the report and its findings were highlighted in the Pacific Coastal Salmon Recovery Fund 2020 Report to Congress.
- Helped organize and host quarterly Community for Data Integration Data Visualization Collaboration Area webinars with US Geological Survey co-leads. Each webinar was attended by 80-90 people, and recordings of the webinars were posted to the CDI-DataViz Confluence Wiki.
- Formed the Fish Monitoring Work Group core team, formalized the purpose and structure of the larger work group, and began planning for the kick-off meeting to be held in early 2021.
- Wrote and distributed the PNAMP monthly newsletter to our listserv of over 1,000 members.

PNAMP's work on these tasks supports our partners' research, monitoring, and evaluation (RM&E) 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 strategies for more standardized and coordinated regional monitoring. Specifically, PNAMP manages online tools to support consistent and detailed documentation for projects, supports metadata documentation for datasets, conducts reviews of methodologies to develop and promote best practices, coordinates data management and exchange to support improved assessments and reporting in the Columbia River Basin, and supports projects to demonstrate benefits of an integrated status and trend monitoring process. These activities will continue to support Fish & Wildlife Program strategies as well as PNAMP partners' strategies.

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

There was a great deal of progress made in 2020 on addressing PNAMP partner needs. Continued success of PNAMP and supported projects will always benefit from increased participation from the PNAMP steering committee members, subject matter experts, and community stakeholders.

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 provides the forum where this collaboration can occur and facilitates exchanges among subject matter and policy experts that is necessary to accomplish these goals. PNAMP has a representative mix of participants to address these goals and we continue to seek increased and diverse participation. 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, URLs for all links in this report can be found in the References section), staff (aka Coordination Team) to serve as coordinators and

facilitators for specific topics of interest, and subject matter experts and stakeholders participating in working teams that focus on specific project tasks.

The PNAMP Steering Committee, Coordination Team, and working team participants share the responsibility to collaboratively accomplish our goals efficiently and consistently. Support and open communication are essential for PNAMP to be able to respond to needs of the region. It is equally important to highlight that PNAMP is largely a voluntary organization, whose progress is directly related to participation, the complexity of topics, and the time and hard work required to coordinate many partners. To be successful, we need to hear from subject matter and policy experts on what is needed to improve coordination of aquatic resource monitoring.

Steering Committee Activities

The PNAMP Steering Committee (SC) comprises representatives from the signatory partners (Appendix A). The SC provides the science-policy interface between the signatory partner's executives 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 assists 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.

In addition to the signatory partners, 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 2020 included: Columbia River Inter-Tribal Fish Commission, Columbia Basin Fish and Wildlife Library, Idaho Governor's Office of Species Conservation, Natural Resources Conservation Service, Nez Perce Tribe, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, Puget Sound Ecosystem Monitoring Program, and Yakama Nation Fisheries Program.

In 2020, the SC met in February, June, and September. These meetings tracked the progress of activities, discussed how new tasks or projects align with PNAMP's goals, and offered guidance when necessary. The meetings also provided an opportunity for SC members to connect and communicate with their regional colleagues about monitoring activities in their respective agencies and tribes. The PNAMP Coordinator and the Coordination Team prepared materials before the meetings, facilitated the SC meetings, and disseminated notes following the meetings.

PNAMP Coordination Team Activities

The PNAMP Coordination Team is employed by the U.S. Geological Survey (USGS), Northwest Region Executive Office. In 2020, the PNAMP Coordination Team included PNAMP Coordinator (Jennifer Bayer), Deputy Coordinator (Amy Puls), MonitoringResources.org Project Leader (Rebecca Scully), and two Staff Biologists (Sam Cimino and Meg Dethloff).

The Coordination Team's goals are to facilitate the transfer of information within PNAMP partners/participants and among all relevant Pacific Northwest 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 initiates and facilitates the development, presentation, and distribution of products aimed at enhancing understanding of PNAMP topics, successes, and challenges, and serves 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 2020, funding was provided by Bonneville Power Administration ($429,933), US Geological Survey ($100,000), US Bureau of Reclamation ($60,000), and US Bureau of Land Management ($25,000) to the 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 sought appropriate outlets for communicating PNAMP's work beyond required progress reporting. The Coordination Team represented PNAMP at several external virtual meetings and workshops in 2020. 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) remains a vital communication tool to provide information about PNAMP events and projects and increase the availability of biological and natural resources information at the regional and national level. While PNAMP staff maintain the content of the website, the US Geological Survey provides technical support and hosts the website. The website has been a valued PNAMP resource since 2010. 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 acknowledge the generosity of in-kind contributions from participants. Over the years, the Coordination Team 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 virtual meetings/webinars, 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. In 2020 we adjusted the way in-kind time was calculated for planning meetings; these contributions are now calculated as 1.5 times the meeting duration to help account for work done by planning team members outside of the meeting. While we believe this still to be an underestimate of the true amount of time planning team members are contributing to tasks, we feel it better represents their efforts.

For 2020 we calculated 1,769 hours of in-kind contributions of time from over 120 participating organizations (Appendix B). In-kind contributions by project/topic are shown in Table 1. In-kind contributions by organization type for 2011 through 2020 are shown in Figure 1. The spikes in in-kind contributions in 2013, 2016, 2018, and 2019 were the result of multi-day workshops held in those years that were attended by large numbers of people. In-kind hours contributed in 2020 were below average, this was most likely due to the COVID-19 pandemic leading to fewer/shorter meetings. However, we did see higher than average attendance at the virtual events we did hold during the second half of the year. 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 project/topic. Hours were estimated for each meeting attendee for every PNAMP meeting from January 1 to December 31, 2020. For virtual meetings the duration was used to estimate the contribution of time from each participant. For in-person and planning 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/topic	Total Hours
Emerging Technologies Information Sessions (ETIS)	964.5
Steering Committee Meeting Series	277.5
Data Visualization Collaboration Area	207
Intensively Monitored Watersheds (IMW)	165
Stream Habitat Metric Integration	47.5
Coordinated Assessments Partnership (CAP)	32.5
MonitoringResources.org	31.5
Coordination, Communication, and Outreach about PNAMP	26
Fish Monitoring Workgroup	17.5

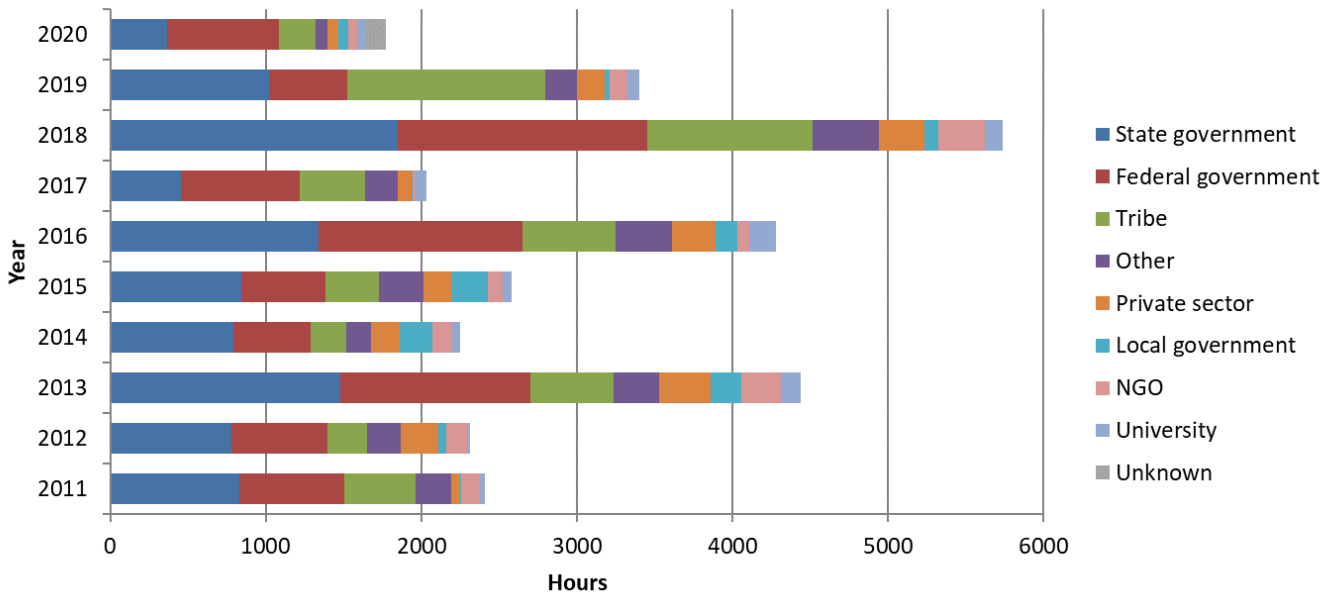

Figure 1. Estimated hours contributed to PNAMP meetings for 2011 to 2020. Hours were estimated for each meeting attendee for every PNAMP meeting from January 1, 2011 to December 31, 2020. For teleconferences the meeting duration was used to estimate the contribution of time from each participant. For in-person and planning 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

Using a project-focused structure, PNAMP gathers 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 work group and the SC. In addition, it is important to have a dedicated lead for all projects, whether it is someone from the Coordination Team, a Steering Committee member, or subject matter expert who participates in PNAMP. In the absence of a lead who can dedicate time to move things along, final products can be significantly delayed, much to the frustration of the interested parties.

PNAMP meetings and work sessions in 2020 focused on tasks related to these main projects:

- MonitoringResources.org
- Stream Habitat Metric Integration
- Emerging Technologies Information Sessions
- Coordinated Assessments Partnership
- Intensively Monitored Watersheds Forum
- Data Visualization Collaboration Area
- Fish Monitoring Work Group

Several 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, these were not a focus in 2020.

MonitoringResources.org

Focused on coordination and collaboration, MonitoringResources.org promotes transparency and greater understanding of monitoring events and procedures 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 monitoring projects from cradle to grave. The tools assist practitioners to document methods, protocols, sample designs, study plans and implementation details associated with data collection and analysis. Colleagues 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 understand better how priorities are being met and where there are gaps and redundancies in monitoring.

The MonitoringResources.org platform houses complementary PNAMP applications, including the Protocol and Method tools, Sample Designer, Master Sample Library, and the Monitoring Explorer map viewer. MonitoringResources.org features, functions, and applications are designed to work together for comprehensive management of the monitoring workflow. Details about individual tools can be

found in training modules and fact sheets posted on PNAMP.org at the MonitoringResources.org Project page in the Related Documents.

MonitoringResources.org supports Bonneville Power Administration (BPA) Project Sponsors with RM&E Work Elements (WE): WE156-research and development, WE 157-data collection, and WE162-data analysis and interpretation. Since 2017 we've seen a growing need for helping BPA Project Sponsors due to the changes in the BPA contractual requirement for project sponsors with RM&E Work Elements 156, 157 and 162 to document protocols, study plans, and sample designs in MonitoringResources.org. Before 2017, project sponsors were only required to document protocols in MonitoringResources.org and document sample locations in BPA's contracting tool 'Pisces Web'.

In 2020, we continued development, outreach, and content support for MonitoringResources.org tools and continued to expand the user base. The number of users of the MonitoringResources.org toolset grew from 650 at the end of 2019 to 694 at the end of 2020. To help with outreach in 2020, PNAMP staff:

- Updated the guidance document
- Created training modules for specific documentation types (methods, protocols, sample designs, study plans, and the interactions between MonitoingResources.org and BPA contracting)
- Created updated training videos
- Created a Project Sponsor Orientation training presentation
- Provided briefings and updates of the toolset at various meetings and virtual work groups

MonitoringResources.org Outreach

In 2020, PNAMP's key outreach task was to prepare training tutorials and presentations for MonitoringResouces.org project sponsors to prepare for the Northwest Power and conservation Council's 2021 Anadromous Fish Habitat and Hatchery Independent Scientific Review Panel Review. As part of our outreach, we:

- Created training modules specific to documenting methods, protocols, sample designs, study plans, as well as a training module concerning the interactions between BPA contracts and MonitoringResources.org
- Held a one-hour MonitoringResources.org orientation presentation for project sponsors on two separate occasions (link to youtube)
- Conducted one-to-one webinar protocol reviews with project sponsors within the Columbia River Basin, including Idaho Department of Fish and Game (IDFG), Columbia River Intertribal Fish Commission, and Confederated Tribes of the Umatilla Indian Reservation
- Reached out to project sponsors over email and phone calls to finalize MonitoringResources.org products and assist with questions and concerns

In addition to preparations for the 2021 Anadromous Fish Habitat and Hatchery Independent Scientific Review Panel review, we continued outreach for MonitoringResouces.org via:

- Discussions of progress and planned work with PNAMP's Steering Committee
- Conversations with current and potential users outside the Columbia River basin
- Promoting innovative and well documented methods each month through PNAMP Newsletter in the section titled "Tool Time"
- Talks with the Facilities Layer/Smolt Trap Inventories work group

We feel that it is imperative for 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 the use of the tools within their own organizations. In 2021, PNAMP will continue to reach out to monitoring practitioners, look for opportunities to promote the MonitoringResources.org toolset, support project sponsors, and conduct user testing.

MonitoringResources.org Development

MonitoringResources.org is continuously being improved based on user feedback and stakeholder's needs. In 2020, PNAMP staff worked to streamline and enhance the process for updating the tool. With BPA's support, we drafted a charter to describe the roles and responsibilities of stakeholders. We also built a process for stakeholders to convey ideas and needs to the PNAMP staff and outlined the steps for PNAMP staff to translate ideas into well-documented stories with requirements and cost estimates for prioritizing and implementation.

PNAMP contracted with Sitka Technology Group (Sitka) through USGS and BPA to complete development work. In 2020 we continued to focus on the use cases outlined in the 2019 Feedback and Recommendations Report, 1) document metadata and 2) discover metadata.

To support users who are documenting metadata we:

- General
    - Created a User Portfolio (Figure 2) to organize all users content, simplifying finding, editing, and updating
    - Updated the rich text editor simplifying the process of entering content into the tool
    - Made all table widths dynamic to simplify the use of the searching tools
    - Made sidebar navigations collapsible to create more space for users to enter or view content
    - Updated help text and vocabulary

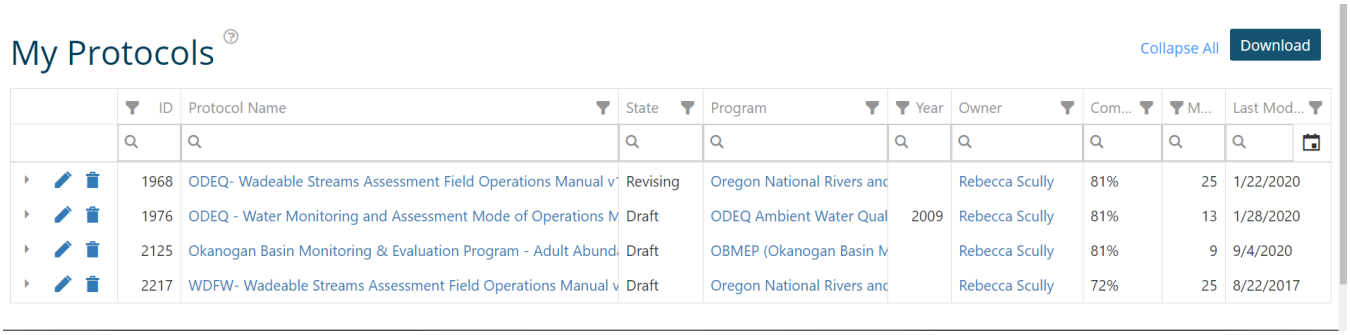

Figure 2. New user Portfolio to facilitate user finding their documentation on MonitoringResources.org.

- Sample Design
    - Updated the sample design table view to match all other tables in the tool
    - Updated Area of Inference documentation tool
        - Removed duplicate layers
        - Improved the user interface
        - Added functionality for users to add all sites uploaded into the sample design to the Area of Inference
    - Sped up generation of covariates when new sites are added to a sample design
    - Updated the background mapping technology to unify the user experience and simplify updating maps across the tool
- Protocols
    - Streamlined the metric method mapping section of the protocol

To improve the data discovery tools, we continued to improve the Monitoring Explorer:

- Updated the layer styling
- Added a tool to display metadata about the individual shapes in each layer
- Improved the layer legend
- Added capability to upload spreadsheets of data collection events to Monitoring Explorer (only Admin can upload sites at this time, we are seeking support to expand this to other user types)

In the fall of 2020, PNAMP staff completed an engagement with usability experts from Science Gateways Community Institute (SGCI). SGCI is funded by the National Science Foundation to provide services, resources, community support, and education for creating and sustaining science gateways (SGCI website). Our engagement focused on improvements to the navigation of the tool and the Monitoring Explorer map viewer. PNAMP staff worked with SGCI experts for six weeks. SGCI developed recommendations, mockups, and prioritized fixes based on the impact of issues on users. PNAMP staff

will work with Sitka to get cost estimates on the ideas and prioritize the work based on the other MonitoringResouces.org goals.

In 2021, our goal is to continue to improve the tools based on the partner's needs. Our goals are to:

- Improve Monitoring Explorer, focusing on getting more sites into the tool and enhanced search
- Simplify the process for content generators
- One new output from MonitoringResources.org to help with the discovery of monitoring
- Create a link between a regional data system and MonitoringResources.org
- Continue to do user testing and work closely with BPA's RM&E team to implement improvements

We continually seek partners to add information to MonitoringResouces.org and reuse MonitoringRescouers.org documentation. In 2020, PNAMP facilitated a series of meeting with StreamNet, MonitoringResources.org, and BPA to scope efficient exchange of information among existing data systems. Our initial focus was improving the exchange of information related to BPA funded projects that collect data using rotary screw traps (RSTs) among Monitoringresources.org, StreamNet's local scale data system, Coordinated Assessments Exchange (CAX), and the PSMFC-Columbia Basin Fish Facilities Mapper, with emphasis on location of the trap sites. We described the data fields to be included in the screw trap inventory, identified the regional data system serving as the system of record for each data field, and if there is no system of record, agreed on where to find the data we need. BPA staff applied these data field descriptions to organize metadata related to these RSTs. StreamNet will use this draft to develop a data table linked to the StreamNet facilities layers, MonitoringResources.org metadata, and other regional data systems tracking screw traps.

To successfully exchange information for a repeated exercise to share and inventory of RSTs, we outlined the development work needed in each data system. In 2021, PNAMP staff will coordinate with StreamNet and PITAGIS staff to outline detailed development requirements to exchange information in a consistent way. Based on available funding, we will implement the changes to our respective data systems. Simultaneously, the working group will look for additional opportunities to link systems, data types, and information.

MonitoringResources.org Content

PNAMP staff curates the content in MonitoringResources.org. To support finalizing content, PNAMP staff spent approximately 10 to 40 hours per week in 2020, supporting help requests received via email, phone, or the website's support page. Requests included help with login, content entry, sample design, and sampling location assistance, how to structure protocols and methods for specific projects, responding to help requests from the support desk, reviewing methods and protocols, and responding to requests to add new organizations or monitoring programs. More complex support involves assisting sponsors in choosing and developing appropriate metadata in MonitoringResources.org to support their contract work elements in Pisces Web. Additionally, PNAMP staff has continued to

archive MonitoringResources.org content that has long been unused, has never been finalized, and was associated with long-expired contracts and projects.

It is important for users to finalize (publish) their content instead of leaving it in a draft state for their own organizations' continuity. The mechanisms to track version changes in procedures or of location data add valuable provenance. It is also essential to the success of MonitoringResources.org to have content in the system that can be shared and will attract new users.

Starting in 2018, PNAMP staff has been making an effort to clean up content by contacting owners and archiving content. We archive unused content, content associated with long-expired contracts, been abandoned for years, and/or do not meet publication standards. Archiving removes the content – e.g. protocols, methods, sample design, study plan– from the search tables but maintains a persistent URL so that if the protocol, method, study design, or sample design is linked outside of MonitoringResources.org that link is maintained. Owners of archived content can still see the content from their "Portfolio" page and can continue to update the information and request finalizing when they are finished.

Adding content to MonitoringResources.org is important for its sustainability, it creates findable, accessible documentation of how data is collected and analyzed. Additionally, adding content promotes standardization and reuse of methods/protocol. In addition to BPA project sponsors, we are working with national partners to improve content.

As of mid-December 2020, MonitoringResources.org contains:

- 1,813 methods, 1,172 are finalized (68 of those finalized in 2020), and 143 methods have been archived
- 1,254 protocols, 262 are finalized (30 of those finalized in 2020), and 7 protocols have been archived
- 12 master Generalized Random Tesselation Stratified (GRTS) samples
- 7 projects are displayed in Monitoring Explorer

MonitoringResources.org Training

To reflect changes in MonitoringResources.org and to support increased demand by Project Sponsors, training materials were updated (see the MonitoringResources.org Outreach section above), and PNAMP staff provided support and 1-1 training on demand, videos, webinars, revisions for context-sensitive help text, and reference guides.

During 2020, PNAMP:

- Revised help text throughout the site in concert with software updates
- Updated the MonitoringResources.org guidance document, FAQ page, and glossary
- Edited and updated training videos that addressed specific aspects of documentation in MonitoringResources.org

Going forward, we recommend the following to support PNAMP staff and BPA project sponsors:

- Add and maintain help text to improve user interface and to eventually eliminate the need for training seminars.
- PNAMP conducts ongoing user testing to assess priorities for improving the user interface, user experience, and navigation.
- PNAMP continues to conduct training seminars, produce how-to videos, and update the guidance document

MonitoringResources.org Conclusion

PNAMP staff is continuously working to support and streamline the process for entering data and discovering data in MonitoringResources.org. In 2021 we will continue to gather feedback and make improvements based on user's needs. One of our key goals for MonitoringResoursourcs.org is to support the Northwest Power and Conversation Council (NPCC) Fish and Wildlife Program's Project Sponsors meet review requirements from the NPCC's Independent Scientific Review Panel process as well as BPA's Contracting Officer's Representatives. 2020 focused on designing training, developing training materials, and making improvements to the tools. We will continue to reach out to BPA Project Sponsors who are part of the NPCC's next review cycle to help create content to be used in their review.

Managing content in MonitoringResources.org is a time-consuming process. Most of the protocols, methods, study plans and sample designs in the system are entered by BPA Project Sponsors. PNAMP staff reviews this content for completeness, but we cannot check for consistency between MonitoringResources.org documentation and BPA RM&E work elements. PNAMP recommends BPA RM&E staff engage with MonitoringResources.org to review documentation related to the Work Elements. PNAMP staff is interested in learning how to facilitate this effort.

Stream Habitat Metric Integration

Since PNAMP's inception, we have encouraged data sharing and supported efforts to improve coordination of the collection and analysis of stream habitat data. Building on past efforts, with support from USGS, in 2019 we initiated an effort to integrate stream habitat metrics from four federal funded monitoring programs:

- Bureau of Land Management Aquatic Assessment, Inventory, and Monitoring (AIM) program,
- US Environmental Protection Agency National Aquatic Resources Surveys (NARS) National Rivers & Streams Assessment (NRSA),
- US Forest Service (USFS) Aquatic and Riparian Effectiveness Monitoring Program (AREMP), and
- USFS PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program.

PNAMP staff formed a project team composed of experts from each program and other USGS staff. Based on existing metadata, PNAMP staff proposed a controlled vocabulary detailing a sub-set of metrics to exchange across the programs. In 2020, we facilitated a series of meetings with the project team to begin agreeing on the metrics. Using the controlled vocabulary and Darwin Core principles for

biological data exchange, we wrote the first draft of data exchange specifications. Based on these specifications, PNAMP staff and USGS experts documented a workflow to integrate data from the individual data sets into one data set (

Figure 3). To automate the creation of a combined data set, we wrote and documented R code on GitHub. Three of the four programs share their data publicly in a machine-readable way, we pull that data into one data set. In ScienceBase, a USGS collaborative scientific database, we document metadata about the original data sets and the new integrated data set. We used MonitoringResources.org, PNAMP's online, publicly accessible suite of information and tools to document monitoring methods, protocols, and sample designs, to document the detailed data collection methods from each of the four programs. We shared this work at the 2020 Oregon American Fisheries Society Annual Meeting in Bend, OR, with the Oregon Stream Team, and the PNAMP Steering Committee.

As the year drew to a close, we worked to finalize documentation, so that in 2021 we can share the combined data set. Next year PNAMP will continue working with the project team to complete the documentation of the data exchange specifications. We will publish the ScienceBase, GitHub, and MonitoringResources.org documentation. We will produce the first draft of an integrated data set. Coordinating with USGS colleagues we will link the data collection locations to the NHD+ layer and extract a standard set of watershed metrics for each site. We will outreach the data set and a demonstration R Shiny application designed to improve the sharing, downloading, and reuse of the stream habitat metrics.

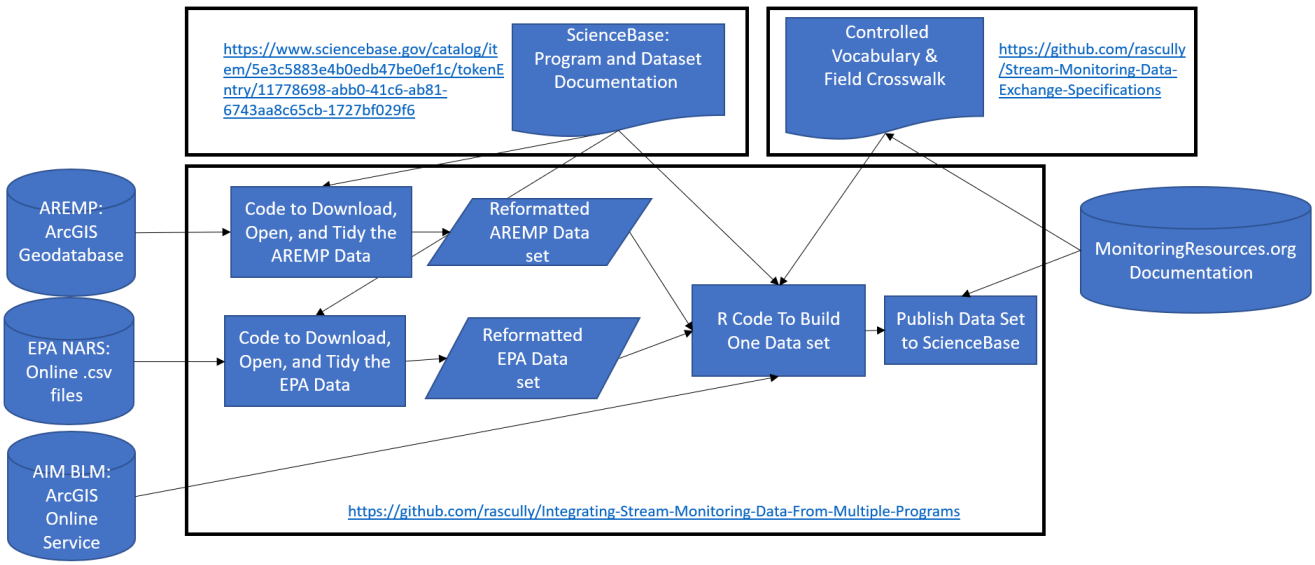

Figure 3. Workflow for integrating stream habitat metrics.

Emerging Technologies Information Sessions

During 2020, to help partners learn about emerging technologies in aquatic monitoring and data management, PNAMP and StreamNet co-organized the Emerging Technology Information Sessions (ETIS) Webinar Series. Originally planned as an in-person event for November 2020, it was reworked into a webinar series because of restrictions on in-person gatherings due to the COVID-19 pandemic. We organized and hosted 13 webinars that featured 27 presenters total. Held October 2020 through February 2021, each month focused on one of four topics (see schedule below for details). Topics and presenters were identified by the 13 person ETIS Planning Group made up of members from PNAMP, StreamNet, Bonneville Power Administration, Columbia Basin Fish &Wildlife Library, Oregon Department of Fish and Wildlife, Oregon Watershed Enhancement Board, US Bureau of Reclamation, and US Geological Survey. Over 600 people participated in the ETIS webinar series, with attendance at each webinar ranging from 30 to 150 people from across the USA and other countries. Each of the webinars was recorded and posted to PNAMP's YouTube Channel to support broader access. At the time this was written, the ETIS recordings had over 1,300 views on YouTube.

ETIS Webinar Series Schedule

October 2020: Aerial Monitoring of Aquatic Systems

Tuesday, Oct 6 (learn more | watch recording)

- Richie Carmichael (Biomark) : *Drone Assisted Stream Habitat (DASH) Protocol: Establishing consistency and compatibility between UAS monitoring programs*
- Sarah Hoffmann (Biomark) : *Machine learning applications for conservation*

Tuesday, Oct 13 (learn more | watch recording)

- Kain Kutz (USFS) : *Mapping riparian habitat and geomorphology monitoring applications within the United States Forest Service (USFS) using unmanned aerial systems (UAS) acquired imagery*
- Lauren Burns (Columbia River Intertribal Fish Commission) : *Integrating unmanned aerial vehicles into large-scale habitat monitoring in the Columbia River Basin*

Tuesday, Oct 20 (learn more | watch recording)

- Mischa Hey (Quantum Spatial) : *Characterizing riverine fish habitat with bathymetric LiDAR*
- Phil Roni (Cramer Fish Sciences) : *Review of remote sensing and emerging technologies for use in evaluating floodplain and riparian projects*

November 2020: eDNA

Tuesday, Nov 3 (learn more | watch recording)

- David Pilliod and Matthew Laramie (USGS) : *eDNA 101: Overview of sampling and extraction methods for environmental DNA*

Tuesday, Nov 10 (learn more | watch recording)

- Carl Ostberg (USGS) : *eDNA 201: Using environmental DNA for single-species assessments*

Tuesday, Nov 17 (learn more | watch recording)

- Taylor Wilcox (National Genomics Center for Wildlife and Fish Conservation) : *eDNA 301: Multi-species and biodiversity assessments, focusing on laboratory procedures and interpretation of results including challenges and future directions*

January 2021: Fish Monitoring and Assessment

Thursday, Jan 7 (learn more | watch recording)

- Chris Harrington (IDFG), Justin L Welty (USGS), Michelle Steg-Geltner (Yakama Nation), and Samantha Smith (Nez Perce Tribe) : *Latest applications for handheld devices for field data collection*

Thursday, Jan 14 (learn more | watch recording)

- Thomas Delomas (PSMFC/IDFG) : *Measuring ploidy with non-lethal tissue samples and amplicon sequencing.*
- John Hargrove (PSMFC/IDFG) : *Parentage-based tagging improves escapement estimates for ESA-listed adult Chinook Salmon and Steelhead in the Snake River basin.*

Thursday, Jan 21 (learn more | watch recording)

- Gabriel Brooks and Benjamin Sandford (NOAA) : *Advances in PIT tag technology and what this can mean for assessments.*

Thursday, Jan 28 (learn more | watch recording)

- Ryan Kinzer (Nez Perce Tribe) : *A streamlined data flow for improved decision making: data collection to analysis and all the gunk in between.*
- Dan Isaak (USFS) : *The Fish Data Analysis Tool: Applying spatial stream network models with standardized databases to provide information for decision making.*

February 2021: Data Management

Thursday, Feb 11 (learn more | watch recording)

- Amanda Whitmire (Stanford University) : *The basics of data management plans for research*
- Stacy Schumacher (Confederated Tribes of the Umatilla Indian Reservation) : *The Centralized Data Management System used by the Confederated Tribes of the Umatilla Indian Reservation for the storage of fisheries data*

Thursday, Feb 18 (learn more | watch recording)

- Kevin D. Henry and Jeff Peters (USGS) : *Data visualization tools and frameworks for hazards and risk research*
- Brendan Ward (Astute Spruce, LLC) : *Using open-source technologies to build spatial web apps*

Thursday, Feb 25 (learn more | watch recording)

- Tami Wilkerson (Columbia Basin Fish & Wildlife Library/CRITFC): *Tools and best practices for data sharing and reuse to advance research*
- Patricia Soranno (Michigan State University): *The ethics of data sharing in the environmental sciences*

At the end of each month/topic, a survey was sent to webinar attendees to gauge satisfaction and see how webinars could be improved. Survey responses were overwhelmingly positive (Table 2). When

asked if they had anything else they wanted to say, several respondents included thanks and gratitude for making recordings available for all the webinars. The few negative comments received had to do with the online meeting platform. In response to this feedback, PNAMP staff adjusted pre-meeting communications to include information for troubleshooting meeting platform issues.

In 2021, staff will begin planning for an in-person ETIS event to be held fall of 2022.

Table 2. Responses to a subset of the ETIS Survey questions (n=63).

1. Why did you attend/watch the webinars? Select all that apply.	
To increase my knowledge of the topic	98%
To apply what I learn to my work	60%
To make connections with people	21%
To see what my competition is doing	8%
Other	3%
2. Did the webinars meet your expectations and reasons for attending/watching?	
Yes	95%
No	0%
Other	5%
3. Percent of respondents that were either satisfied or very satisfied with the following aspects of the webinar	
Speakers and topics	98%
Microsoft Teams meeting platform	84%
Date/time	85%
Webinar length	92%
Pre-event communications/ information	87%

Coordinated Assessments Partnership

Since 2011, PNAMP and the PSMFC StreamNet program have collaborated to manage the Coordinated Assessments Partnership (CAP), 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 CAP is to improve the timeliness, reliability, flow, and transparency of data necessary for regional assessments and management decisions for improved environmental effectiveness.

CAP accomplishes this goal by improving access to fish information through the creation of data exchange standards for key fish population metrics and indicators for Endangered Species Act listed and non-listed salmonids and by helping partners publish data via the Coordinated Assessments Exchange (CAX), which is managed by the PSMFC StreamNet Project. This information is accessible through the online CAX query where the information can be viewed and downloaded. Submittal from partner agency data systems to CAX and downloading from the CAX data system is also supported via web services through an application programming interfaces (APIs) that make data available in XML and other standard machine-readable formats.

CAP 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 informing decision-making and reporting for fish populations in the Pacific Northwest. This work benefits from the existing facilitation framework provided by StreamNet, PNAMP, and the substantial cost share contributions from the Bonneville Power Administration. In addition, multi-year grants from EPA to support high level indicator (HLI) development and data sharing.

During 2020, the Nez Perce Tribe started submitting their data directly to the CAX system and the Yakima Nation's STAR data system has increased their data submittal as well. We also saw improvements in the data sharing capacity of other tribes, some of whom benefited from the small StreamNet subcontracts received in 2020, and we expect to see additional tribes to start flowing data into the CAX during 2021. These HLI data are accessible through the CAP's Indicator query mapper, and include:

- Over 12,000 records for the five natural-origin salmon and steelhead HLI categories: Smolt to Adult Return, Recruits per Spawner, Natural Origin Spawner Abundance, Juvenile Outmigrants and Proportionate Natural Influence (SAR, RperS, NOSA, JuvOut, and PNI, respectively).
- 193 Columbia River Populations, of which 69 are NOAA BiOp priority populations, currently have HLIs included in the CAX, with some having HLIs spanning from 1938 to the latest available year. Additional HLI data from outside the Columbia River Basin is also flowing into the CAX in support of broader regional needs.
- 10 salmon and steelhead organizations are currently submitting standardized HLIs to the CAX including Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Colville Tribes, Nez Perce Tribe, Yakama Nation, Fish Passage Center, US Fish and Wildlife Service, two consulting firms that submitting on behalf of a state agency.

With increasing number of new organizations submitting data to the CAX system, most of whom were not engaged when CAP began in 2011, the need to tighten up CAP processes, improve documentation, and CAP communication became evident. One area of focus was improving how StreamNet and PNAMP can leverage their areas of expertise and membership to benefit CAP. In 2020 we formalized how the PNAMP Fish Monitoring Work Group (FMWG) can assist developing new HLIs identified by StreamNet Executive Committee by bringing together the relevant fish and habitat experts, and how the FMWG can also assist the CAP Data Exchange Standard Development Team (DDT) by participating in CAP DDT ad hoc workgroups as needed. The other area of focus was to address the need for better documentation and communication. In response to this need, the CAP co-leads Jen Bayer and Nancy Leonard, worked with the CAP Core Group that is facilitated by Jen (PNAMP) to update existing documents and to develop new documents. These 2020 products have included:

- The first CAP newsletter produced in November 2020
- Adoption of the first CAP logo that was included in the CAP newsletter

- Revised CAP workgroup roles and responsibilities document to clarify existing groups and how the revitalized FMWG will support CAP HLI development and refinement process.
- Updated 5-year Plan for Coordinated Assessments Partnership, adopted by the StreamNet Executive Committee in September 2020.
- Talking points to inform Washington Department of Fish and Wildlife discussions with Northwest Indian Fisheries Commission and Puget Sound tribes
- Draft CAP partners and participants definitions to clarify expectations for organizations that engage with different levels in CAP.
- Updates to the PNAMP webpage for the CAP project

This effort to improve documentation and communication about CAP has also resulted in improved figures to help understand the relationship among groups and the process that have been used in presentations to Columbia River Intertribal Fish Commission Inter-Tribal Monitoring Data, StreamNet committees, and PNAMP Steering Committee (e.g. see Executive Committee slides). This work also helped informed the StreamNet Vision and Strategic Plan adopted in September 2020 to ensure alignment in how overlap StreamNet-CAP groups and tasks are described. Ongoing work includes development of short fact sheets for the CAP and the new HCAX effort starting in 2021, and a refined Data Exchange Standard procedure and CAP DDT charter that is being developed by StreamNet staff.

In addition to improving documentation and communication, efforts in 2020 also continued to focus on improving the quality of data accessible through the CAX, which is an ongoing goal for the CAP. This summer StreamNet staff with assistance from PNAMP worked with a subgroup of the CAP DDT to rapidly address the need to distinguish between NOSA and escapement over a short time period (a few months this summer). This modification was vetted by a small workgroup of experts and successfully implemented, addressing a critical need to improve the quality of the data identified by BPA and NOAA.

During this year the CAP Core Team also invested time to develop a proposal to advance a new category of HLIs that have been on the 5-year plan for CAP for several years. The proposal submitted by CAP was successful in securing an award from the EPA Exchange Network FY2020 for the HCAX project. The HCAX will advance development and flow of standardized hatchery indicators to inform regional needs including the NPCC Fish and Wildlife Program. This work will leverage existing CAP groups and processes to develop standardized indicators and the structured data exchange standard that will inform how these data will flow from partners to the CAX. This is an exciting project as it will show the applicability of the CAP approach to a new data category and engage a different group of individuals that will include hatchery managers.

The StreamNet Program also submitted a proposal to received NOAA IJFA through PSMFC to support further CAP activities. This proposal was funded for FY21 and includes funding for PNAMP to collaborate with StreamNet in conducting outreach to Puget Sound tribes in collaboration with NOAA and WDFW. Some of the funding secure is also going to improving access to super/subpopulation HLI

data and supporting the Colville Tribes in developing HLIs and submitting these to the CAX for a new population of interest to NOAA.

Intensively Monitored Watersheds Forum

An Intensively Monitored Watershed (IMW) is a watershed scale experiment to determine if habitat restoration actions intended to improve juvenile salmonid survival are meeting their biological and ecological objectives. PNAMP brings together IMW stakeholders to find ways to align existing and new monitoring efforts, provide more scientifically robust data for use in management decisions, and improve cost efficiency in the implementation of monitoring programs. We want to improve reporting and access to information by working toward more coordinated approaches, monitoring designs, and data management systems.

To facilitate coordination and communication among IMWs and between IMWs and regulatory agencies, PNAMP has hosted many conference calls and four workshops (2008, 2013, 2016, and 2018). These meetings and workshops have resulted in number of papers (i.e. Bennett et al. 2016, Bouwes et al. 2016; Haskell et al. 2019, Hillman et al. 2019), as well as improvements to MonitoringResources.org and the PNAMP IMW website to better support the IMW community of practice.

PNAMP finalized the Key Findings and Lessons Learned from Pacific Northwest Intensively Monitored Watersheds report in 2019. The report summarizes the key findings and lessons learned from 16 IMWs in British Columbia, California, Idaho, Oregon, and Washington, and addresses the underlying assumption that habitat restoration improves juvenile salmonid survival and eventually leads to increased adult returns. In 2020, PNAMP staff was invited to present the report findings at two virtual meetings: NOAA's West Coast Region Recovery Coordinators meeting on July 8, 2020 and the Pacific Coastal Salmon Recovery Fund grantees meeting on Aug 5, 2020. In addition, the report and its findings were highlighted in the Pacific Coastal Salmon Recovery Fund 2020 Report to Congress (Franks, 2021).

In May of 2020, 58 people participated in a 3.5 hour virtual meeting of the PNAMP IMW Forum to discuss progress on communication products, impacts and adjustments to IMW work because of COVID-19, and areas/ideas for collaboration and collective action. Meeting materials including agenda, notes, and a recording of the meeting can be found here.

At the end of 2020, PNAMP was approached by the Lower Columbia and Snake River salmon recovery boards about helping to facilitate a synthesis of IMW management applications. The goal of the synthesis would be to help salmon recovery regions, lead entities, and habitat restoration practitioners apply and convey to stakeholders what we are learning from the IMW network to habitat conservation and restoration work. In 2021, PNAMP will explore if there is interest/availability among IMW stakeholders to participate in a management applications synthesis, and if so, if there are resources available to help fund this work. Other IMW work planned for 2021 includes working with IMW practitioners to produce updated factsheets for each IMW and publishing this information to the PNAMP IMW website.

Data Visualization Collaboration Area

Among the Pacific Northwest aquatic monitoring community there is considerable interest and enthusiasm for learning useful ways to visualize data for greater understanding, accessibility, and re-use. In March 2018, PNAMP launched the Data Visualization Work Group, by December 2019 the group had met 13 times and the distribution list had over 80 people from 35 different organizations.

Despite its popularity, due to funding constraints and other priorities, PNAMP could not continue to support the Data Visualization Work Group at the level it had been. In order to continue providing PNAMP partners with learning opportunities on data visualization best practices, the decision was made to join forces with the USGS to form the Data Visualization Collaboration Area within the USGS Community for Data Integration (CDI).

In spring of 2020, PNAMP worked with USGS CDI staff to identify data visualization experts to serve on an organizing team. In May, the newly formed organizing team composed of six USGS staff from across the United States (including one PNAMP staff member) agreed on the following goals for the collaboration area: serve as a professional hub and creative home to promote open data visualization trainings and discussions; foster a creative, collaborative community of people who come to data vis from a variety of backgrounds with any set of design tools; host quarterly webinars where members can connect and learn; and utilize communication platforms like Microsoft Teams to enable collaboration area members share skills, knowledge, ideas, and meaningful critique.

Quarterly, 90-minute webinars were held virtually starting in July 2020. Recordings are available on the Data Visualization Playlist on PNAMP's YouTube channel. At the October webinar, we announced the "CDI-DataViz Team" hosted on the Microsoft Teams platform. The team has four online discussion boards (aka channels): 1) General - for general team reminders and posts, 2) Create and Collab - for posting and receiving feedback, troubleshooting, and collaboration, 3) Meet and Greet - for introducing yourself and networking with other members, and 4) Tips and Tricks - for sharing cool ideas, tips, and data visualizations. At the time this was written, there were 88 members of the CDI-DataViz Team. We also used a listserv to share webinar information and other related announcements, there were 143 people signed up for the CDI-DataViz listserv.

In 2021, the organizing team will continue to host quarterly webinars, moderate the CDI-DataViz Team discussion boards, and solicit feedback from participants on high priority topics to address.

Fish Monitoring Work Group

In 2020, PNAMP staff and steering committee members agreed there was a need and willingness to restart the PNAMP Fish Monitoring Work Group (FMWG). A small core team was formed to formalize the purpose and structure of the larger work group and planning for the kick-off meeting began at the end of the year. Progress made by the core team in 2020 is described below.

The purpose of the work group will be to:

- Support collaboration, communication and coordination among fish monitoring practitioners in the Pacific Northwest for effective monitoring and assessment methods and efficient data sharing
- Host Fish Monitoring Workshops to address specific topics identified by PNAMP partners with respect to fish monitoring
- Support the Coordinated Assessments Partnership (and CAX data exchange processes) and StreamNet by facilitating discussions among data providers and reporting/decision makers related to fish monitoring data sharing and reporting needs.
- Support Fish & Wildlife Program Project Sponsors work to complete required metadata documentation in MonitoringResources.org

Communications will primarily be via virtual meetings. Infrequent in-person meetings will be considered, as appropriate. PNAMP will host and manage these meetings, while specific tasks will be managed by volunteer leads and participants. A kick-off webinar was scheduled for February 2021 to introduce the purpose of the work group and identify leads and participants for priority tasks.

Outreach and Communication

Part of PNAMP's work includes reaching out to potential participants as well as informing the aquatic monitoring community of upcoming events and announcements, showcasing new tools, and sharing relevant documents. PNAMP's outreach and communications efforts include: maintaining the PNAMP website, posting content to social media, producing and disseminating monthly news and meeting summaries, producing fact sheets which describe PNAMP and individual projects, and presentations to interested groups and organizations.

In 2020, PNAMP Coordination Staff regularly updated content on pnamp.org. We posted PNAMP event materials (agendas, meeting prep documents, notes, presentation slides, links to recordings, etc.) and logistics (dates, locations, virtual meeting links), updates to PNAMP project pages, announcements from around the region, jobs openings of interest to the aquatic monitoring community, and PNAMP newsletters.

Staff used twitter to highlight PNAMP and partner events, publications, and other items that are of interest to the regional participants, including release of the monthly PNAMP newsletters. PNAMP staff established a Twitter presence in August of 2014, which steadily gained followers in 2020. We currently have 148 followers.

For the last few years, staff have also posted content on PNAMP's YouTube channel. In 2020, with the COVID-19 pandemic severely limiting travel and in-person meetings, recorded webinars that could be watched any time was especially appreciated by PNAMP participants. We posted 10 recordings in 2020 that have been viewed over 1,200 in total.

For the past eleven years, PNAMP has distributed a monthly newsletter to all who are interested. In 2020, the monthly communication continued to include a summary of upcoming meetings, a few short stories highlighting the latest news from PNAMP and our partners, and a feature on method of interest

in PNAMP's MonitoringResources.org tool. In 2020, the number of people registered to receive the monthly newsletter grew by 203 to a total of 1,024 people.

Beyond communicating PNAMP's work via online resources, the PNAMP Coordinator also gave overview presentations to the following audiences: BPA executives and senior staff, Northwest Power and Conservation Council Fish and Wildlife Committee, and the Columbia River Basin Federal Caucus.

Adaptive Management and Lessons Learned

In 2020, PNAMP strived to be consistent and thorough in asking for feedback and responding to input. Using online surveys and live polling during meetings, we sought feedback on the MonitoringResources.org toolset, the Emerging Technologies Information Sessions webinar series, the PNAMP IMW website, and the Data Visualization Collaboration Area. We consistently received good response rates to these feedback requests and appreciated the information provided, which helped us improve our performance over time.

In addition to project specific surveys, we also sent a general survey to the PNAMP listserv to gauge satisfaction with PNAMP projects and seek feedback on how we might improve. Responses to a subset of the survey questions are included in Table 3. Overall, feedback was mostly positive with PNAMP activities meeting participants expectations and almost half of respondents wishing they had more time to participate in PNAMP activities. We also provided space for respondents to provide feedback in an open-ended format; all responses were positive and included:

- "Keep doing the great job you are all doing!"
- "Thank you!"
- "Looking forward to 2021!"
- "Keep up the great work! PNAMP continues to engage with, and advance on, long standing challenges related to monitoring and data management. PNAMP's growth and durability are a testament to its relevance to the region, and an example for resource managers across North America."
- "PNAMP serves a valuable role in the monitoring community. I also very much appreciate the constructive and professional approach of PNAMP staff and leadership. Thank you for a job well done."

Table 3. Responses to a subset of the PNAMP General Survey questions (n=30).

1. What 2020 PNAMP activities did you participate in? Select all that apply.	
CDI Data Visualization webinars	37%
Coordinated Assessment Partnership meetings	47%
Emerging Technology Information Series (ETIS) webinars	83%
Habitat Data Metric Integration meetings	13%
IMW Forum meetings	33%
MonitoringResources.org trainings	43%
PNAMP Steering Committee meetings	53%

	Other	3%
2.	**Why did you participate in the activities selected above? Select all that apply.**	
	To increase my knowledge of the topic	87%
	To apply what I learn to my work	67%
	To improve coordination of my work with others	60%
	To make connections with people	53%
	To share my work/expertise	40%
	My supervisor made me participate	10%
	Other	10%
3.	**Did the activities meet your expectations and reasons for participating?**	
	Completely	67%
	Mostly	23%
	Somewhat	10%
	Not at all	0%
4.	**Do you wish you could have participated in PNAMP activities more than you did? What were the obstacles to your participation? Select all that apply**	
	Didn't know that an activity was happening or found out too late	6%
	Not enough funding	3%
	Not enough time	47%
	Supervisor would not approve	0%
	I was happy with my level of participation and faced minimal obstacles	57%
	Other	3%
5.	**If a particular PNAMP activity is relevant to a friend or colleague's work, how likely are you to pass along information about it?**	
	Very likely	24
	Somewhat likely	6
	Somewhat unlikely	0
	Very unlikely	0

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. PNAMP has made progress, but expectations about scope and pace of work need to be realistic given these operational constraints. A fundamental ongoing challenge has been to balance PNAMP's resources with the level of shared interest in working on potential subject areas.

We have seen renewed commitment from signatory partners and additional interest from courtesy members to become signatory partners in PNAMP, which will enhance 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, benefits from steady participation from PNAMP Steering Committee members.

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 but we are appreciative of the growing participation we have seen in the past year.

References

Introduction

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

Coordination Team Activities

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

MonitoringResources.org

- MonitoringResources.org website: https://www.monitoringresources.org
- MonitoringResources.org Project page: https://www.pnamp.org/project/monitoring-resources
- Science Gateways Community Institute (SGCI) website: https://sciencegateways.org/home
- MonitoringResources.org guidance document: https://www.pnamp.org/document/11042
- MonitoringResources.org FAQ page: https://www.monitoringresources.org/Resources/Home/FAQ
- MonitoringResources.org glossary: https://www.monitoringresources.org/Resources/Glossary/Index
- MonitoringResources.org training videos: https://www.monitoringresources.org/Resources/Video/Index

Emerging Technologies Information Sessions

- Tuesday, Oct 6 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-aerial-monitoring-of-aquatic-systems-1
  - Watch recording: https://www.youtube.com/watch?v=G3sSLGx98aE
- Tuesday, Oct 13 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-aerial-monitoring-of-aquatic-systems-2
  - Watch recording: https://www.youtube.com/watch?v=2-WUtspCYgQ
- Tuesday, Oct 20 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-aerial-monitoring-of-aquatic-systems-3
  - Watch recording: https://www.youtube.com/watch?v=gqi9oRnz3oA
- Tuesday, Nov 3 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-edna-101
  - Watch recording: https://www.youtube.com/watch?v=el_zdTqDw1I
- Tuesday, Nov 10 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-edna-201
  - Watch recording: https://youtu.be/xrcz4DXliyU
- Tuesday, Nov 17 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-edna-301
  - Watch recording: https://www.youtube.com/watch?v=8_WwwnbswDQ
- Thursday, Jan 7 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-fish-monitoring-and-assessment-1
  - Watch recording: https://youtu.be/-gcJrlO4D0k
- Thursday, Jan 14 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-fish-monitoring-and-assessment-2
  - Watch recording: https://youtu.be/m37rqlUPfHM
- Thursday, Jan 21 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-fish-monitoring-and-assessment-3
  - Watch recording: https://youtu.be/lwAmB8LDHuQ
- Thursday, Jan 28 webinar
  - Learn more: https://www.pnamp.org/event/etis-webinar-series-fish-monitoring-and-assessment-4
  - Watch recording: https://youtu.be/-Zc_w76mzG4

- Thursday, Feb 11 webinar
    - Learn more: https://www.pnamp.org/event/etis-webinar-series-data-management-1
    - Watch recording: https://youtu.be/02EJmeNQlDk
- Thursday, Feb 18 webinar
    - Learn more: https://www.pnamp.org/event/etis-webinar-series-data-management-2
    - Watch recording: https://youtu.be/7X4E4xxba4g
- Thursday, Feb 25 webinar
    - Learn more: https://www.pnamp.org/event/etis-webinar-series-data-management-3
    - Watch recording: https://youtu.be/v3_bGD9BETk

Coordinated Assessments Partnership

- Coordinated Assessments Partnership indicator query mapper: https://cax.streamnet.org/
- Coordinated Assessments Partnership 5-year plan: https://www.streamnet.org/wp-content/uploads/2020/10/Five-Year-Plan-for-Coordinated-Assessments-rev20200902-Final.doc
- Coordinated Assessments PNAMP project page: https://www.pnamp.org/project/coordinated-assessments-for-salmon-and-steelhead
- StreamNet Executive Committee slides: https://www.streamnet.org/wp-content/uploads/2020/10/Executive_Committee-20200902-Final.pptx
- StreamNet Vision and Strategic Plan: https://www.streamnet.org/wp-content/uploads/2020/10/StreamNet-Vision-Strategic-Plan-Final-Adopted20200902.doc

Intensively Monitored Watersheds Forum

- 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 IMW website: https://www.pnamp.org/imw/overview
- IMW Key Findings and Lessons Learned report: https://www.pnamp.org/document/15052
- PNAMP IMW Forum May 2020 event page: https://www.pnamp.org/event/pnamp-imw-forum-webinar-may-2020

Data Visualization Collaboration Area

- USG CDI Data Visualization Collaboration Area: https://my.usgs.gov/confluence/display/cdi/Data+Visualization+Collaboration+Area
- PNAMP's YouTube channel Data Visualization Playlist: https://www.youtube.com/playlist?list=PL4k5JtWFYIsW4naO58gBgVlfKUo3aahgD
- USGS CDI DataViz listserv sign-up: https://listserv.usgs.gov/mailman/listinfo/cdi-dataviz

Outreach and Communication

- PNAMP website: https://www.pnamp.org/
- PNAMP Twitter account: https://twitter.com/PNAMPmonitoring
- PNAMP YouTube Channel: https://www.youtube.com/channel/UC6i-mCyumwk7x9hNy9WdvdQ
- PNAMP monthly newsletter archive: https://www.pnamp.org/newsletter?p=0&l=10&sort=%7B%22date%22:%22desc%22%7D

Appendix A. Entities signatory to the PNAMP Charter in 2020

PNAMP Signatory Partners	Steering Committee Representative
Bonneville Power Administration	Jody Lando
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	Christopher Zell
Idaho Department of Fish and Game	Tim Copeland
NOAA Fisheries	Greg Sieglitz
Northwest Indian Fisheries Commission	Bruce Jones
Northwest Power and Conservation Council	Leslie Bach
Oregon Watershed Enhancement Board	Renee Davis
Pacific States Marine Fisheries Commission	Nancy Leonard
U.S. Army Corps of Engineers	Vacant
U.S. Bureau of Land Management	Vacant
U.S. Bureau of Reclamation	Mitch Mumma
U.S. Forest Service	Chris Hirsch
U.S. Geological Survey	Steve Waste
Washington Department of Ecology	Glenn Merritt
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 2020

Hours were estimated for each meeting attendee for every PNAMP meeting from January 1 to December 31, 2020. For teleconferences the meeting duration was used to estimate the contribution of time from each participant. For in-person and planning meetings, contributions were calculated as 1.5 times the meeting duration to help account for travel and prep time.

Entity	Hours
US Geological Survey	270.75
Unknown	125.5
National Oceanic and Atmospheric Administration	123
Columbia River Inter-Tribal Fish Commission	117.75
Bonneville Power Administration	93
Washington Department of Fish & Wildlife	82
Idaho Department of Fish and Game	78.5
US Fish and Wildlife Service	76.5
US Forest Service	67.5
Oregon Department of Fish and Wildlife	61
King County Department of Natural Resources and Parks	36
Pacific States Marine Fisheries Commission	34.5
Oregon Watershed Enhancement Board	33.5
Washington State Department of Ecology	31.5
US Bureau of Land Management	29.5
US Bureau of Reclamation	28.5
Northwest Power and Conservation Council	27
Washington Governor's Salmon Recovery Office	22
Confederated Tribes and Bands of the Yakama Nation	21.5
Nez Perce Tribe	21.5
Cramer Fish Sciences	18
Confederated Tribes of the Colville Reservation	15.5
Idaho Governor's Office of Species Conservation	15
Washington State Department of Natural Resources	12
US Department of Agriculture	11.5
Oregon State University	11.5
Wild Fish Conservancy Northwest	9
Columbia Land Trust	9
US National Park Service	9
Exeltech Consulting, Inc.	7.5
Quinault Indian Nation	7.5
Upper Deschutes Watershed Council	7.5
Northwest Indian Fisheries Commission	7

Entity	Hours
US Environmental Protection Agency	7
Snake River Salmon Recovery Board	6
Cowlitz Tribe (officially The Cowlitz Indian Tribe)	6
Confederated Tribes of the Umatilla Indian Reservation	6
University of Hawaii	6
North Pacific Anadromous Fish Commission	5.5
Skokomish Tribe	4.5
University of California, Santa Barbara	4.5
EcoAnalysts, Inc	4.5
Oregon Department of Agriculture	4.5
Biomark	4.5
Trout Unlimited	4.5
Confederated Tribes of the Chehalis Reservation	4.5
Snohomish County	4.5
Oregon Department of Transportation	4.5
Smith-Root	4.5
Wheeler Soil and Water Conservation District	4.5
Grande Ronde Model Watershed	4.5
Confederated Tribes of the Warm Springs Reservation	4.5
ABI Environmental Services	4.5
Tillamook Estuaries Partnership	4.5
London Natural History Museum	4.5
Shoshone-Bannock Tribes of Fort Hall	4
Iowa Tribe Of Oklahoma	3
Hood Canal Coordinating Council	3
BioAnalysts	3
Quantum Spatial	3
Lower Columbia Fish Recovery Board	3
Jonah Ventures	3
Bonneville Environmental Foundation	3
Aspect Consulting	3
Lake County Umbrella Watershed Council	3
Idaho State University	3
Research Institute for Nature and Forest (INBO)	3
National Aeronautics and Space Administration	3
EcoLogic Research	3
Gloucester Marine Genomics Institute	3
Boise State University	3
Washington State University	3

Entity	Hours
United Water Conservation District	3
Klamath Soil and Water Conservation District	3
Able Guide Service	3
Douglas County PUD	3
Lower Elwha Klallam Tribe	3
California Department of Fish and Wildlife	3
University of North Carolina, Asheville	3
Lower Colorado River Authority	3
Astute Spruce Consulting	3
Curry Watershed Partnership	1.5
Washington State Department of Health	1.5
Wildfowl and Wetlands Trust	1.5
Monterey Bay Aquarium Research Institute	1.5
Gilliam Soil and Water Conservation District	1.5
Utah Department of Environmental Quality	1.5
ID-GENE Ecodiagnostics	1.5
Stanford University	1.5
Private Sector	1.5
Hoh Tribe	1.5
Wild Salmon Center	1.5
McKenzie River Trust	1.5
Fisheries and Oceans Canada	1.5
Cranfield University, UK	1.5
10,000 Years Institute	1.5
Island County	1.5
University of Guelph	1.5
Upper Columbia Salmon Recovery Board	1.5
Middle Deschutes Watershed Council	1.5
International Year of the Salmon	1.5
University of Washington	1.5
Stillwater Science	1.5
Walla Walla Basin Watershed Council	1.5
Woods Hole Oceanographic Institution	1.5
Oregon Department of State Lands	1.5
Connecticut Agricultural Experiment Station	1.5
Aero Solution LLC	1.5
University of Chicago	1.5
Stillaguamish Tribe	1.5
University of Alaska	1.5

Entity	Hours
North Carolina State University	1.5
Galway-Mayo Institute of Technology	1.5
University of California	1.5
University of Arkansas	1.5
Oregon Department of Environmental Quality	1.5
Okanagan Nation Alliance	1.5
Quileute Tribe	1.5
University of Victoria	1.5
University of Texas	1.5
Fish Sciences	1
HDR, Inc.	1
Total Hours	1769