StreamNet 2018

Annual Report

BPA Project # 1988-108-04

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1/1/2018 - 12/31/2018

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1. Executive Summary

The Pacific States Marine Fisheries Commission (PSMFC) hosts StreamNet, which provides access to regional fish data by maintaining a coordinated, standardized, web-based distributed information network. The need for regionally coordinated and readily accessible data has been identified by the Northwest Power and Conservation Council (NPCC), the Bonneville Power Administration (BPA), and the National Oceanic and Atmospheric Administration Fisheries Program (NOAA). StreamNet works cooperatively with the agencies that create the data by employing StreamNet supported technical staff inside these agencies and by leading or coordinating a number of initiatives to aid in assuring a regional approach to data management.

During 2018 StreamNet continued to help lead implementation of the Coordinated Assessments (CA) project. Accomplishments included review and adoption of a revised 5 year plan for the project by the StreamNet Executive Committee (SNEC). The plan prioritizes the data collected by partners. CA continued focus on the key indicators and metrics that have been identified as priorities for reporting progress on implementation of the Federal Columbia River Power System Biological Opinion. At the end of 2015, BPA identified a need to gather as much data as possible for populations they determined were priorities, and efforts continued to be focused on these populations. In 2018 updates of prioritized standard data trends, such as those related to the CA project or feeding the NPCC dashboards, were also completed as partner agency time permitted.

During 2018 BPA outlined a significant budget issue confronting the F&W program, and requested assistance in finding budget savings. To assist in this effort, cuts from the proposed FY 19 budget totaling $82,512.95 were proposed and accepted. As a result, partner agencies did not receive an anticipated restoration of funding to FY 17 levels. In addition, PSMFC staffing under the project was reduced from 4 FTE to 2.8 FTE, with some staff time shifted to other, non-BPA funded PSMFC contracts.

StreamNet maintained the Data Store as a repository for data sets from BPA projects without identified repositories. The Data Store online data archive provides access to data sets from any source, and is a secure location for permanent data set storage and retrieval for projects throughout the region.

The StreamNet subprojects in the state agencies, tribes, and US Fish and Wildlife Service all contributed to development or improvement of agency data storage systems in 2018. Additional resources were allocated to the Washington Department of Fish and Wildlife through cost savings made at the Oregon Department of Fish and Wildlife.

In addition to CA, focus continues to be on increasing the speed and efficiency of data conversion to the regional StreamNet Data Exchange Standard, and then submission to the StreamNet database. The long-term goal continues to be development of agency capacity to host data in the regional standard and share it via web services or to transfer data to StreamNet via web services. At the end of CY 2018, a fully implemented system was in place to share “trend” data that are related to CA populations, via an Application Programming Interface (API).

A wide variety of data types were disseminated through the StreamNet website in 2018 (www.streamnet.org). Improvements to the appearance and accessibility of data on the website were made in 2015. Overall use of the site (Appendix A) decreased from 54,677 page views in 2017 to 34,551 page views in 2018. Data exchange via the API continued to increase dramatically, rising to 2,399,444 hits in 2018 from 508,123 hits in 2017. Traditional use by key data providers/users such as state and federal agencies decreased from 2017, likely because data exchange via the API is replacing more traditionally measured usage. We provided several data query approaches used to locate, display and download data from the StreamNet main database, including the Integrated Query System that integrates both tabular and map based query approaches into a single system. A query system for the CA project data, as well as certain associated trends, was developed and deployed in 2016. The goal of the project is to facilitate the flow of data "from the stream to the screen".

In implementing the CA project, substantial progress was again made in 2018. However, the various state and tribal agencies are at significantly different stages in developing the capabilities of their data management infrastructure, so developing a region-wide approach to sharing indicators will continue to require more time and/or more resources. In 2018 the Columbia River Intertribal Fish Commission (CRITFC) was successful in receiving a grant from the EPA to help build capacity for data sharing by the CRITFC member tribes. Coordination with this project is an ongoing priority.

2018 was the fifth year of the SNEC. Management and policy level specialists at tribes, states, and federal agencies were recruited to serve on this group. Their primary function is to provide guidance and leadership to the StreamNet project to ensure that data management resources and work efforts are aligned with agency and regional priorities. The group revised the 5 year plan for CA, reviewed data flow, and provided direction on the development of new indicators for CA. CRITFC is represented on the Executive Committee, but most individual tribes are not. The Executive Committee agreed to invite participation by representatives of the four CRITFC tribes in 2016. This invitation was extended and tribal participation, within the limits of available time and resources, commenced in 2016.

For purposes of data sharing at the regional level, the significant institutional knowledge of an experienced cadre of biologists that have been assessing fish populations and sharing data for many years will need to be replaced with a more automated and documented system in order to assure continuity of population assessments as these highly experienced biologists begin to retire in the coming years. Projects such as StreamNet will serve a key role, both within agencies and in regional coordination, in assuring that this documentation and the data needed to inform the assessment process is accessible and stable in the future.

Summary of Recommendations

1. The CA effort has successfully reviewed and implemented data sharing for most natural origin salmon and steelhead populations in the Columbia River Basin, wherever population-scale data are available. The SNEC is the leadership team for this effort, and recommends that membership be expanded to include all federal, state, and tribal fish and wildlife managers involved in data collection for species and populations. Full participation in the CA project is needed to ensure continued progress in coordinated regional data management. Developing and sharing regional

High Level Indicators (HLIs) will provide the Northwest Power and Conservation Council (NPCC), BPA, and NOAA the ability to efficiently evaluate and report on their respective roles in fish and wildlife mitigation and recovery.

2. NOAA's Columbia Basin Task Force, the NPCC, BPA, and the states and tribes are developing a monitoring framework for natural origin salmon and steelhead populations that balances available resources with the need to monitor populations. As appropriate monitoring levels are designated for each population, implementation and data sharing should be coordinated through application of the CA process. Continued support for efforts to coordinate and implement a consistent, sustainable regional direction, including StreamNet, Pacific Northwest Aquatic Monitoring Partnership, CRITFC's intertribal monitoring data project, the StreamNet Library, and the Regional Coordination forum, is invaluable and should be continued.
3. The SNEC should be tasked with implementing a monitoring data matrix for fish species under the F&W Program. The Council should clearly articulate realistic, sustainable and affordable long-term reporting for fish populations goals under the F&W Program that engage all responsible regional parties, including federal and non-federal entities. Regional F&W managers should prioritize monitoring to ensure that RM&E efforts at the project and contract level feed into a designed system that yields constructive, valuable and timely feedback on species trends that can effectively inform recovery, mitigation, and harvest programs. Regional collaboration on the monitoring data matrix will help guide expectations on what population data are needed and will be available at the regional level.
4. The Fish and Wildlife Program would benefit from aligning BPA contracting and reporting (e.g. work elements) with the data management needs outlined in the above approach. A regionally coordinated data management system, with adopted metrics and HLIs under a monitoring framework, would help direct RM&E projects to channel results into this metric/indicator matrix. Projects that monitor salmon and steelhead populations could then provide data to the CA in the proper data exchange standard format as deliverables under contract requirements, supporting the identified consensus data needs of the region.
5. The Council program would further benefit if monitoring matrices for other species groups were then developed using the CA process, to include;
    a. All natural origin salmon and steelhead populations (listed and non-listed)
    b. Lamprey
    c. Sturgeon
    d. Resident fish species (e.g. bull trout)
    e. Wildlife
    f. Hatchery origin salmon and steelhead

    Data management activities could then be directly tied to the development and implementation of regional monitoring strategies. Work elements and reporting at the project and contract level could then be better aligned to ensure that RM&E information is focused on these agreed-to regional monitoring priorities, and would allow for data management funding to be targeted at developing and maintaining databases, websites, and repositories for these prioritized data.

6. CA methodologies for calculation of high-level indicators should be fully documented.
7. The StreamNet Data Store should continue to serve a role as a secure environmental data repository. If BPA has a desire to confirm that the Data Store is in receipt of datasets for projects that have designated the Data Store as their repository, an automated routine linking Pisces/cbfish.org and the Data Store should be developed and implemented.
8. StreamNet should continue to play a role in the development and deployment of emerging technologies in fisheries data collection through sponsorship of workshops on a biennial basis. If available, funding the engagement of agency-embedded staff in purchasing, development and testing of these technologies, with the objective of making data collection and transfer more efficient and secure across the region, can also be a StreamNet function.
9. StreamNet should continue to seek out efficiencies and new sources of revenue in order to fund agency operations that support regional data management priorities (i.e. field data stewards that compile and provide CA data). Where appropriate, the SNEC should recommend increases in traditional funding and support as needed, to complete the priorities they have established. When budget adjustments must be made, all parties should recognize the impact of these decisions on the data management process.
10. StreamNet partners should focus first on updating time series data for established trends (i.e., those already defined and mapped in the regional GIS) prior to making any effort to identify and map new stream survey reaches. The mapping of new trend locations or the refined mapping of existing trends should only be attempted after determining that the necessary GIS support exists at both the local and regional level.
11. Fish Distribution as a StreamNet data category should continue as a GIS dataset that is exchanged (or regionally harvested from data contributors) using GIS file formats. This was a significant shift from the traditional StreamNet data exchange model of regionally coordinated linear event tables when implemented in 2017. While less elegant than the historic approach (using stream routes and measures), this is a practical compromise that respects budget realities. This approach should provide the desired functionality of allowing end users and regional partners to simply visualize species distribution and habitat use type in map form.

2. Introduction

The need for regionally coordinated, securely stored, and readily accessible data has been identified by the NPCC, BPA, and NOAA. StreamNet supports a regional approach to data management, coordination, and standardization. The majority of fish-related data originate with the region's state, tribal and federal fisheries agency sampling programs. We work cooperatively with the agencies that create the data (Figure 1) by supporting technical staff inside these agencies to help manage, standardize, and geo-reference the data to the regional stream network (hydrography). StreamNet also leads or coordinates a number of initiatives to aid in assuring a regional approach to data management, and provides this data to users such as NPCC, BPA, and NOAA.

Figure 1. Formal partners and agencies participating in the StreamNet project.

Project Summary: *https://www.cbfish.org/Project.mvc/Display/1988-108-04*

Contract Summary(s): *https://www.cbfish.org/Contract.mvc/Summary/66435*

Figure 2. StreamNet Website Infographic

Primary Focal Species: Chinook - Deschutes River Summer/Fall ESU, Chinook - Lower Columbia River ESU (threatened), Chinook - Mid-Columbia River Spring ESU, Chinook - Snake River Fall ESU (threatened), Chinook - Snake River Spring/Summer , Chinook - Snake River Spring/Summer ESU (threatened), Chinook - Upper Columbia River Spring ESU (endangered), Chinook - Upper Columbia River Summer/Fall ESU, Chinook - Upper Willamette River ESU (threatened), Chum - Columbia River ESU (threatened), Coho - Lower Columbia River ESU (threatened), Cutthroat Trout, Coastal - Southwest Washington/Columbia River ESU, Cutthroat Trout, Coastal - Upper Willamette River ESU, Cutthroat Trout, Westslope , Cutthroat Trout, Yellowstone , Kokanee , Sockeye - Deschutes Subbasin, Sockeye - Lake Wenatchee ESU, Sockeye - Okanogan River ESU, Sockeye - Other, Sockeye - Snake River ESU (endangered), Steelhead - Lower Columbia River DPS (threatened), Steelhead - Middle Columbia River DPS (threatened), Steelhead - Snake River DPS (threatened), Steelhead - Upper Columbia River DPS (threatened), Steelhead - Upper Willamette River DPS (threatened), Trout, Bull (threatened), Trout, Interior Redband , Trout, Rainbow, Whitefish, Mountain

Partner agencies funded through this project are the Confederated Colville Tribes (CCT), Idaho Department of Fish and Game (IDFG), Montana Fish, Wildlife, & Parks (MFWP), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW). StreamNet works

cooperatively with the agencies that create the data through StreamNet supported technical staff inside these agencies. These data are used internally by each agency and also submitted to a central database at Pacific States Marine Fisheries Commission (PSMFC). StreamNet provides access to these data by maintaining a coordinated, standardized, web-based distributed information network. Data collected by partners are stored and made publicly available through the StreamNet website www.streamnet.org (Figure 2).

StreamNet supports data flow and management within the data source agencies through assistance in development of database systems and approaches for improving data management efficiency and data dissemination. StreamNet currently handles data sharing for some agencies and supports development of agency capacities for others. StreamNet employees and subcontractors locate data, standardize data reporting through the cooperative development of protocols, complete QA/QC of data, and then assure the flow of data from state, tribal, or agency repositories to and through StreamNet. StreamNet participates in or leads a variety of teams of data management professionals from states, tribes, and agencies that coordinate regional data sharing. Data flow is being streamlined through the implementation of application programming interfaces (APIs) for various data types.

StreamNet's current priority is to help lead implementation of the Coordinated Assessments (CA) project, in partnership with the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). CA focuses on salmon and steelhead populations in the Columbia Basin. The primary data types contained in and disseminated through the CA project relate to Viable Salmon Population (VSP) parameters including population scale estimates of natural spawner abundance, smolt to adult return rate, adult recruits per spawner (spawner to spawner ratio) smolt outmigrants and presmolt abundance. In addition to high level indicator data, related data (aka trends) is also curated by the StreamNet project, including spawner counts, juvenile counts, redd counts, and dam and weir counts. These are slightly-summarized data that relate to population estimates and estimates of VSP parameters, summarized to annual totals.

The CA Project is an effort to develop efficient, consistent, and transparent data-sharing among the co-managers (fish and wildlife agencies and tribes) and regulatory/funding agencies (BPA and NOAA) of the Columbia River Basin for anadromous fish data. The project has been coordinated by PNAMP and the PSMFC StreamNet project since its inception in 2010 (see: https://www.pnamp.org/project/coordinated-assessments-for-salmon-and-steelhead). A 5-year plan for the CA project is reviewed and approved annually by the SNEC. The SNEC is made up of fisheries professionals at the policy level from all member organizations, as well as the Columbia River Intertribal Fish Commission (CRITFC), NOAA, USFWS, PSMFC, BPA, PNAMP and the NPCC. CRITFC member tribes have been invited to participate on both the Executive Committee and Steering Committee and sometimes do attend. The tribes have made it clear that lack of funding restricts their ability to participate. The 5-year Plan prioritizes data for contribution from partners.

CA is focused on the key indicators and metrics that have been identified as priorities for reporting progress on implementation of the Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp). At the end of 2015, BPA identified a need to gather as much data as possible for populations they determined were priorities, and our efforts continued to be focused on these 69 priority

populations. Updates of certain standard data "trends", such as those related to the CA project or feeding the NPCC dashboards (including for resident fish), are also a priority.

In addition to CA, StreamNet maintains the Data Store archive service, which allows agencies and projects that don't have the capability to host and maintain data sets online to upload and preserve their data in our secure data repository, making them widely available. StreamNet also maintains the Council's HEP and Protected Areas archives, as well as substantial historical data on fish populations, habitat, hatcheries and harvest. This data is publicly available and searchable with an integrated query system.

This project supports the 2018 Council Fish and Wildlife Program. Specifically, we report on the program's approved high-level indicator categories and fish and wildlife indicators (NPCC Program, https://www.nwcouncil.org/fw/program/2014-12/Program page 101).
Data management Principles (page 104);

- Public accessibility, search-ability, and usability of data are important. All monitoring and research data collected under the program must be readily accessible in regionally consistent formats to all interested parties in a timely manner, and these should be preserved beyond the longevity of a project.
- Program reporting relies on coordinated data sharing that is facilitated using regional data systems that provide access to data from federal and state agencies and tribes, and other data gathering entities in the Columbia Basin.
- Refinement of coordinated data management systems should be guided by program evaluation and reporting needs.
- Collaboration among agencies, tribes, and other monitoring entities in the Basin is essential to prioritize regional data coordination efforts to support Program indicators and objectives, and this prioritization should be informed by the goals and objectives identification and refinement process and program guidance.
- The region should work collaboratively through established forums to continue to refine metrics, methods, and indicators that can be used consistently to evaluate and report on program progress, focal species, and their habitats.

General measures (page 105);

- Bonneville should ensure that data associated with broad categories of information (fish abundance, productivity, genetic diversity, geographic distribution, habitat conditions) are identified and accessible from a single, centralized website. Data users should be able to find references, data descriptions, and links to all the data collected in the program on fish abundance in such a website.
- Bonneville should ensure that all information about anadromous fish is summarized by specific life-cycle stages and made accessible from a single gateway location.
- Bonneville should contract for complete data products (e.g., annual population estimates for adult and juvenile spring Chinook in the Entiat) and not only collaborative processes and

preliminary data collection (e.g., redd counts or weir counts of fish). When Bonneville pays for the development of standards or protocols, the contracts should include a viable strategy for adoption.

StreamNet serves as a regional coordination body to support data management and facilitate cooperation across organizational boundaries. StreamNet staff are involved in standardization and coordination efforts on a wide variety of data management issues. We work closely with states, tribes, agencies, and with organizations such as the NPCC, CRITFC, and PNAMP to ensure data managers can communicate, share, and interpret data effectively across boundaries. StreamNet supports coordination through establishing and implementing basin-wide data reporting standards for a specific suite of fish related measures, including abundance, distribution, and productivity, with a long term goal of extending coverage to additional metrics of regional importance.

In recent years there has been a regional initiative to streamline and coordinate research, monitoring, and evaluation (RM&E) work due to the complexity, scale, and cost of these efforts. Direction from the NPCC, the BPA Data Management Strategy, and the PNAMP RM&E Strategy Implementation Road Map led StreamNet to continue to concentrate on coordination and efficiencies as our priority in 2018. The goal is to make information collected in the Columbia Basin standardized and accessible, in order to inform management questions and strategies. StreamNet can serve an important function in this effort both by building and maintaining data management infrastructure and by coordinating data management to foster effective data transfer across structural lines. Due to this focus, regular updates of more traditional trend data in StreamNet have been largely deferred for the last several years. However, significant amounts of traditional data remain available in StreamNet, much of it related to the CA project.

Data Category	Available Data	Years	Observations
Redd counts	5,287 Trends	1901 - 2018	54,125
Fish counts	474 Trends	1953 - 2018	1,523
Spawner counts	5,573 Trends	1944 - 2018	42,033
Spawning population estimates	3,258 Trends	1901 - 2016	24,003
Dam / weir counts	581 Trends	1925 - 2018	15,248
Juvenile population estimates	122 Trends	1996 - 2016	892
Hatchery returns	1,095 Trends	1906 - 2018	10,643
Freshwater harvest	2,708 Trends	1894-2015	41,724
Protected areas	29,524 Records	n/a	n/a
Fish distribution*	158,684 Features/Records	updated 2019	n/a
Barriers	Discontinued.	n/a	n/a
Facilities - dams*	7,882 Dams	n/a	n/a
Facilities - hatcheries*	539 Hatcheries	n/a	n/a
Marine Harvest	Discontinued.	n/a	
Spawner/recruit estimates	Discontinued; replaced by CA RperS.	n/a	
Maps (pre-built)	Discontinued.		

Photographs	Discontinued.		

* Beginning in 2018, fish distribution, dams, and hatcheries are managed as spatial datasets (GIS layers) rather than as tables in a database. StreamNet partners manage fish passage barrier data for their areas of focus, which informs the fish distribution spatial data that they contribute for compilation region-wide. However, given shifting priorities and reduced project funding, StreamNet no longer maintains and publishes a standardized region-wide fish passage barriers dataset. The StreamNet website directs users to the barriers data that is available from our partners.

StreamNet data specialists within the agencies accomplish data standardization and sharing. These data specialists locate and acquire data, convert them to our Data Exchange Standard (DES) format, perform Quality Assurance/Quality Control (QA/QC), add geo-referencing to tie the data to the hydrography, assist with development and utilization of database systems within agencies, and then transmit the data to the central StreamNet database at PSMFC for inter-agency and public dissemination. It should be stressed that StreamNet and BPA funding provided to agencies and tribes through StreamNet supports data management infrastructure and public accessibility of data through many portals in addition to the StreamNet web site. The following is a list of some of the data resources supported (at least in part) via StreamNet.

The CA project was designed (in part) to assist and streamline state and tribal data contributions to the **NOAA Salmon Population Summary (SPS) Database**. StreamNet project partners work with field biologists and data analysts in their respective organizations to update and document recovery population data, which is shared with NOAA.

The NPCC adopted **high-level indicators** to track the progress of fish and wildlife efforts in the Columbia Basin. The collective efforts of many entities, including the Council, contribute to improving habitat and migration while protecting and enhancing fish and wildlife. These measures cannot be interpreted as a performance measure for any single entity but instead provide a high-level overview of outcomes that reflect regional headway. These indicators are fed, in part from the CAX.

NPCC subbasin plan "**dashboards**" show extracts of subbasin plans and related links. StreamNet data are widely used in support of dashboards. In particular StreamNet partners have made the underlying "Trend" datasets that support these dashboards an update priority in each of the last five years.

The CA database is also utilized by the NPCC in building their **Population Objectives Mapper** (currently under development). The Council can tie indicator statistics to objectives in the display and interactive mapping tool of this database, showing the many goals and objectives for salmon and steelhead populations in the basin.

The **Okanogan Basin Monitoring and Evaluation Program (OBMEP)** is a monitoring program that collects long-term data on summer steelhead and spring Chinook salmon in the Okanogan River Basin. The OBMEP is a program within the Confederated Colville Tribes' Fish and Wildlife Department.

Follow Idaho Salmon Home (FISH) provides access through IDFG to information on Idaho's wild and hatchery steelhead and Chinook salmon populations. There are also distribution maps, juvenile abundance, and age data.

The **Idaho Fish and Wildlife Information System (IFWIS)** is IDFG's comprehensive information system for standardizing data on fish, wildlife, and plants in Idaho.

FishMT is MFWP's public facing web application that provides users with access to a vast amount of fish and fishing information. Through FishMT the public can get fish stocking records, survey data, species distribution, reports, publications and more. In addition, users can find fishing opportunities, report catching tagged fish, link to the regulations and buy licenses.

The MFISH database and web query system has been replaced by a new survey and inventory system, the Fisheries Information System (FIS). FIS is available through the agency internal website and holds survey data, individual fish information, distribution, barrier, tagging data and hatchery information to name a few. FIS also contains sophisticated analysis tools which incorporate the use of R statistical packages. This application puts the data entry, analysis and reporting in the hands of biologists. Data is continually updated. Sources include FWP, US Forest Service (USFS), USFWS, Bureau of Land Management (BLM) and tribal fisheries biologists, and the data are supplemented with information provided in technical documents and reports. Additional fisheries and related data can also be found through the MFWP's **Open Data site**.

The **Crucial Areas Assessment** evaluated the fish, wildlife, and recreational resources of Montana in order to identify crucial areas and fish and wildlife corridors. The assessment is part of a larger conservation effort that recognizes the importance of landscape scale management of species and habitats by fish and wildlife agencies. The Web-based **Crucial Areas Planning System (CAPS)** mapping service is aimed at future planning for a variety of development and conservation purposes so fish, wildlife, and recreational resources can be considered earlier. The western states effort has been transferred to the **Western Association of Fish and Wildlife Agencies (WAFWA)** with MFWP staff providing updated data on an annual, or as requested, basis.

StreamNet supported the proposal to develop the Oregon Salmon Recovery Tracker website (**http://odfwrecoverytracker.org/**), and took over hosting the system upon its completion in 2010. The site continues to allow users to explore and download current information related to salmon conservation and recovery in Oregon.

The ODFW **Data Clearinghouse** stores natural resource information, including reports, data files, databases, GIS files, maps, and pictures from natural resource projects. This includes agency projects that provide CA data for recovery populations, and **Oregon Watershed Council** projects funded by the **Oregon Watershed Enhancement Board**, and other **Oregon Plan partners**.

In 2017 ODFW completed a pilot to create a comprehensive information system. The creation of such a system is included in the agency's **Strategic Plan**. The goal is to create an enterprise-level resource information system that is functional, useful, comprehensive, consistent, accessible, and institutionally integrated into business operations based on resource management needs. Currently, business analysis

is being conducted. Once completed, this system will greatly improve ODFW data management and sharing efficiency.

Compass is an online Oregon fish and wildlife habitat map providing coarse-scale, non-regulatory fish and wildlife information, and crucial habitat layers emphasizing areas documented as containing important natural resources. Compass is intended to support early planning for large-scale land-use, development, or conservation projects, helping users make informed decisions related to fish and wildlife habitats as energy, transportation, conservation and other large projects are planned.

WDFW manages multiple data resources, including **SCoRE**, which provides up-to-date information on populations and provides context for the efforts WDFW and its partners are taking in the arenas of habitat, hatcheries, and harvest to protect and conserve salmon and steelhead in Washington.

SalmonScape delivers the science that helps recovery planners identify and prioritize the restoration and protection activities that offer the greatest benefit to fish. This WDFW site also offers a significant environmental education tool for students. SalmonScape merges fish and habitat data collected by state, federal, tribal and local biologists and presents them in an integrated system that can be readily accessed by other agencies and citizens. SalmonScape is an interactive mapping application designed to display and report a wide range of data related to salmon distribution, status, and habitats. The data sources used by SalmonScape include stream specific fish and habitat data, and information about stock status and recovery evaluations.

The overall objective of WDFW's spawning ground survey (**SGS)** database is to help monitor status and trends of Coastal, Puget Sound, and Columbia Basin salmonid stocks. The SGS database was designed as a repository for raw, unexpanded data collected during spawning ground surveys and from adult traps. It is intended to provide a common framework for the collection, storage, retrieval, and dissemination of data collected by public and private entities. WDFW maintains a centralized copy of the database, which contains historic and current spawning ground survey data from throughout Washington.

The USFWS **Pacific Region Fishery Resources Program** has 26 offices and staff located in Idaho, Oregon, Washington, and Hawaii. They work with partners to protect the health of aquatic habitats, recover and restore fish and other aquatic resources, and provide people with opportunities to enjoy the many benefits of healthy aquatic resources in the Pacific Northwest and Pacific Islands. The foundation of the site – and their work – is based on the **Strategic Plan for the U.S. Fish &Wildlife Service Aquatic Conservation Program (FY 2016-20)**.

In addition to these StreamNet supported programs, Bonneville separately contracts operation of **Cbfish.org**, an interactive website that provides the public an unprecedented view into **Bonneville Power Administration**'s implementation of the **Columbia Basin Fish and Wildlife Program**, which stretches across a four-state region and is the largest program of its kind in the world. Developed by the **Northwest Power and Conservation Council** pursuant to the Northwest Electric Power Planning and Conservation Act of 1980, the Program consists of measures for the purpose of protecting, mitigating, and enhancing fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries. Cbfish.org is also a web application that enables BPA and its regional partners to

manage the program's activities and accomplishments, and to define, evaluate, fund, and review portfolios of projects.

Data disseminated through StreamNet are primarily focused on the Columbia Basin (Figure 3), but other data are included when they are obtained through other contracts or are consolidated in agency databases. Much of the tribal data flow is through cooperative agreements with state StreamNet projects or through CRITFC. CRITFC is a full partner in the StreamNet project but is supported through a separate contract.

In addition to this work, StreamNet also serves as a searchable archive and approved environmental data repository for data sets that fall outside the scope of the StreamNet DES, ensuring that they are protected for the long term and remain accessible for use. These data sets include the NPCC Protected Areas list, Habitat Evaluation and Procedures (HEP) records, data sets from subbasin planning, the Hatchery Scientific Review Group (HSRG), and all other data sets submitted to the Data Store, the StreamNet online data archive.

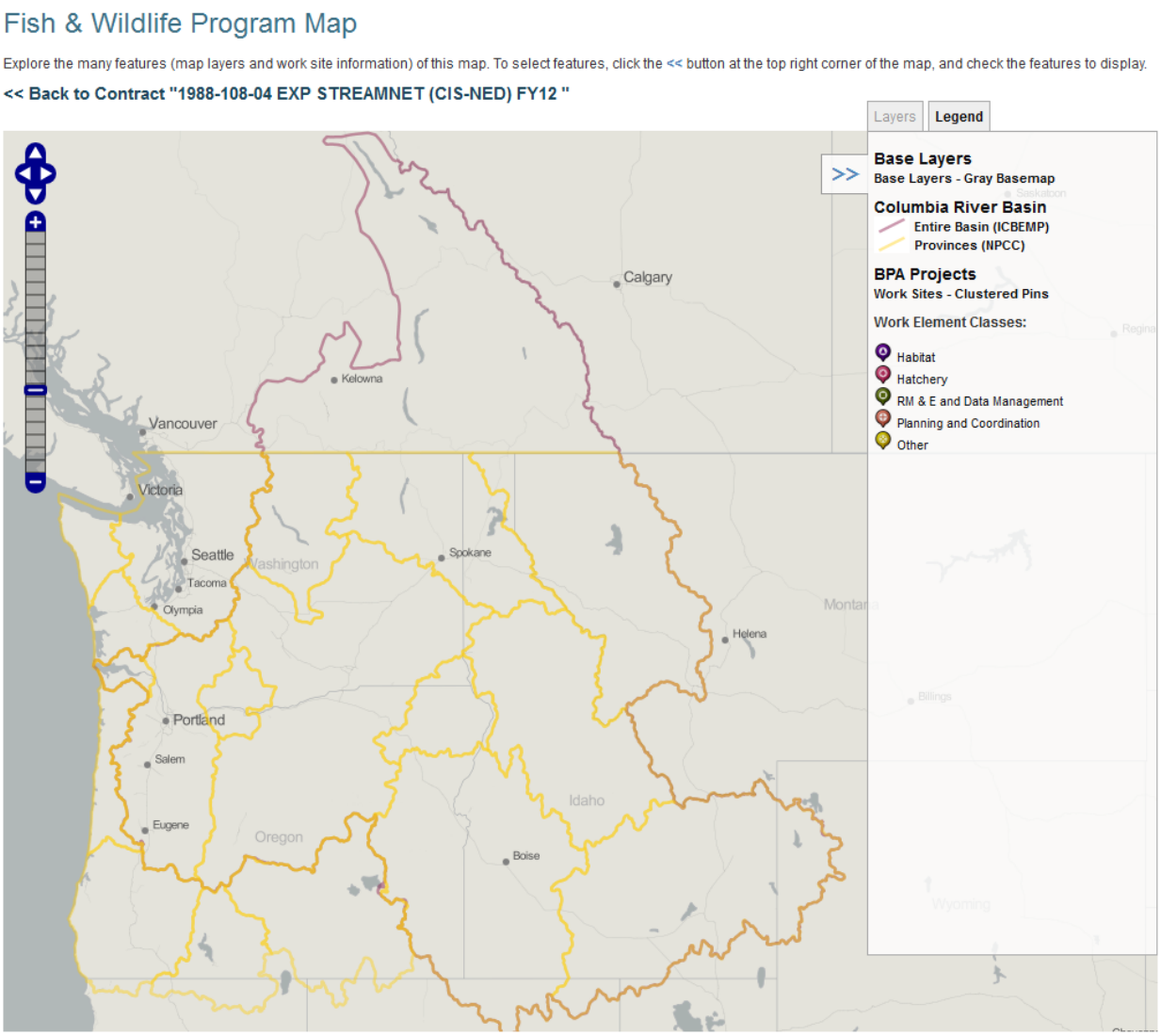


Figure 3. StreamNet Project Area: Columbia Basin

3. Results

Regional Coordination

StreamNet contributed to the coordination and standardization of monitoring data throughout the basin in 2018. We actively supported improving data sharing capabilities in the region through the CA project. This project uses an exchange network approach and dynamic web services to share data.

We continued to work with our partners in IDFG, CCT, MFWP, ODFW, CRITFC, and WDFW to promote data standardization within agencies by assisting them with development of database systems designed to ultimately have the capability to share data directly in a regional format. As part of the effort to improve coordination, in 2014 StreamNet instituted an Executive Committee structure (Table 1). In 2018 the project continued to implement the intent, using policy-level staff from partner agencies and primary data consuming organizations directly involved in setting priorities for the technical data

management staff. The Executive Committee provided direction on program priorities in 2018. The StreamNet Steering Committee remains an essential part of the organizational structure of the program as the implementation team for these priorities.

Current Members: StreamNet Executive Committee
Randy Fisher, PSMFC
Stan Allen, PSMFC
Zachary Penney, CRITFC
Tony Grover, NPCC
Jeff Lane, BPA
Greg Sieglitz, NOAA- Fisheries
Tom Stahl, ODFW
Art Martin, ODFW
Dan Rawding, WDFW
Lance Hebdon, IDFG
Don Skaar, MFWP
John Arterburn, CCT
Roy Elicker, USFWS

Current Members, StreamNet Steering Committee
Tom Pansky, BPA
Colleen Roe, CRITFC
Nancy Leonard, NPCC
Evan Brown, IDFG
Angie Schmidt, IDFG
Dawn Anderson, MFWP
Cedric Cooney, ODFW
Doug Threloff, USFWS
George Batten, CCT
Brodie Cox, WDFW
Jen Bayer, PNAMP

Table 1. Current members, StreamNet Executive and Steering Committees

StreamNet coordinated closely with PNAMP in providing technical guidance to the CA project, including development of the DES. In 2018 close coordination with the CRITFC Tribal Data and StreamNet library projects was also a priority. Staff at PSMFC and subcontracting agencies coordinated with state, federal and tribal agencies in support of increasing data flow in the region and to encourage increased use of information technology to improve the efficiency of data sharing.

Data sharing is associated with concerns over interpretation, analysis, and attribution in many cases. Data Sharing Agreements are now in place, and are presented for agreement as data are uploaded and shared.

The StreamNet project performed its planned data management and coordination activities during the period. Details on use of the StreamNet data delivery systems and responses to direct requests for data and information are presented in Appendix A.

At the June 14, 2018 SNEC meeting BPA outlined a significant budget issue confronting the F&W program in FY 19, and requested participants' assistance in finding budget savings. PSMFC had initial savings due to the anticipated retirement of one employee. In the previously approved FY 19 budget, these savings were used to restore partner funding to where it was in FY 17, fully fund all PSMFC staff on 100% BPA – StreamNet dollars, and add back 1 month of Administrative Assistant time and a small subcontract for Tom Iverson to coordinate with the tribes and the tribal ITMD project. Under this proposal, the partner agencies will not receive the anticipated increase. In addition, two months of the StreamNet Program Manager's time will be shifted to another, non-BPA funded PSMFC contract. Total savings anticipated is $82,512.95.

Routine coordination occurred in the Oregon GIS arena. In 2018, hydrography data (whole stream routes) have been maintained for supporting mapping trend data. Fish distribution and barrier data have been "decoupled" from the whole stream routes and are now submitted as stand-alone GIS datasets. This reduces the hydrography data maintenance burden and simplifies the data submission process for distribution and barriers.

Within PSMFC an integrated Columbia Basin fish facilities GIS dataset has been developed and is being maintained. This effort eliminates multiple datasets with varying degrees of accuracy for location information, and establishes a common layer which is now shared between programs. The dataset is under testing, and shows promise for broader application, such as use in the NPCC/BPA O&M review.

The IDFG StreamNet subproject continued assistance with development of the Idaho Fish and Wildlife Information System (IFWIS), and was able to download data directly from the system in a single step in order to simplify standardization of the data and speed submission to the StreamNet database, saving significant time from the previous approach. The MFWP StreamNet subproject continued working with the Fish Division to scope and develop a new data management system and associated web data delivery system. The ODFW StreamNet subproject continued work to construct a more efficient data management system for posting recovery population data to the ODFW Data Clearinghouse, the **Salmon & Steelhead Recovery Tracker**, NOAA and other management partners. Oregon StreamNet staff also coordinated internally and externally to ensure priority CA and recovery related efforts were addressed. ODFW regional coordination focused on NOAA TRT recovery population changes, regional information gathering requests, data exchange standards, traditional data category definitions, and the StreamNet query system. Two issues with overlapping population estimates was resolved through coordination with WDFW (Wenaha spring Chinook salmon) and the Confederated Tribes of the Umatilla Indian Reservation (Umatilla and Walla Walla summer steelhead populations). For now, ODFW will continue to provide these estimates. Some ODFW coordination occurred with other agencies, tribes, regional groups, non-profits, efforts outside the FWP, etc. beyond the CA process in 2018. The WDFW StreamNet subproject coordinated with the Biological Data Systems Program in WDFW on ongoing development of the Juvenile Migrant Exchange and the SCoRE data delivery system, which will be able to serve data to StreamNet in the future.

StreamNet continued to coordinate with partner agencies to build systems with regional data sharing capability. The goal is to make it possible to harvest data directly for loading into StreamNet through automated means. When implemented, this will significantly speed the process of obtaining annual data updates, and allow our data stewards to expand to the acquisition of additional priority data types. The IDFG StreamNet subproject can currently accomplish this through their IFWIS database, which the Idaho StreamNet project helped to initiate and partially supports. The CA project is designed to build this capability in all the data source agencies for a few key indicators. StreamNet worked with the agencies to develop procedures for internal conversion of the data to regional standards through a DES, and developed an automated data dissemination approach modeled after the EPA Exchange Network approach. The ODFW StreamNet subproject enhanced their CA automated data exchange

system to stay in sync with StreamNet CAX changes, increase robustness, and implement new pre-submission validation rules. In addition, the automated data exchange system was enhanced to also allow submission of traditional trend data via the StreamNet API. This replaces the previous model of submitting traditional trend data manually and increases the efficiency of traditional trend data submittals. WDFW is in the process of modifying their Salmonid Stock inventory (SaSI) to carry CA indicator data and deliver it to CA StreamNet aggregate databases using the StreamNet API.

Data Management

StreamNet continued to acquire fish data from our four partner state fish and wildlife agencies (ODFW, WDFW, IDFG and MFWP), one federal fisheries agency (USFWS for data from the national fish hatcheries), a tribal consortium (CRITFC), the Fish passage Center (FPC), and one tribe (CCT). Efforts continue to work with other tribes to access population-level indicator data for the CA project. These data have been created through a variety of funding processes and sources, only some of which are through BPA or other federal programs. As a regional data coordinator, StreamNet strives to provide all data of a given type from all sources. The project uses subcontracts to support data stewards inside these agencies to acquire quality check, develop metadata, convert when necessary, and update data of types routinely disseminated through StreamNet, and to convert these data to the regional data standard. The data are then submitted to the StreamNet database at PSMFC, where they are quality checked and managed so they become available to the StreamNet online data query systems. The data are then made publicly available for viewing and download in standardized format through the project website, **www.streamnet.org**.

Oregon made enhancements to the ODFW Data Clearinghouse, and the ODFW Spawning Ground Survey web application to increase data flow efficiency. Staff also updated the NHD-derived statewide whole stream route dataset. The Fish Habitat Distribution and Barrier Data Editor application continues to be used to facilitate internal updates to these data. Updates were made to fish distribution data and included the development of a more comprehensive coastal cutthroat trout dataset. ODFW continues to encourage the implementation of data management best practices related to standards in field and file names, metadata, folder organization, data sharing agreements and data management plans, etc. as time and resources allow, particularly as they relate to priority CA and Recovery Planning efforts. Once created, ODFW's new resource information system will significantly advance the agency in these areas of data management and increase data flow and sharing efficiency.

WDFW is moving forward with work to standardize regional and central fish data systems with particular emphasis on data informing or contributing directly to the CA high-level indicator data flows. In addition to CA systems development, WDFW StreamNet worked with agency HQ staff to implement mobile data collection platforms, staging databases and automated transfer mechanisms for sport and commercial, adult survey, and juvenile data systems, again, ultimately informing the CA exchange as well as other consumers. WDFW continued hydrography mapping to NHD framework. Final adoption of WDFW's draft new stream layer has repeatedly been delayed. When it is adopted, the StreamNet Location Manager will fully scope the layer and draft a proposal to integrate mixed scale hydro (MSH) with the new line work.

Records from the HEP project are archived on StreamNet, at the request of BPA and the NPCC. These records and associated materials on this historic program will remain accessible for regional use at **http://www.streamnet.org/hep**.

Data set Backup Assessment and Inventory

The StreamNet Data Store is a repository for any BPA projects where a recognized (monitoring methods.org) environmental data repository is not available. Improvements to the Data Store were made in 2015. Programming now pre-populates attributes from the BPA database system (cbfish.org) when project sponsors use the Data Store as a repository to secure their data. Outreach to project managers was completed with the assistance of StreamNet staff within the agencies. There are currently 128 datasets in the Data Store.

Identification of Management Questions and Strategies

StreamNet coordinates and supports implementation of the states', tribes' and federal agencies' collection, management, and sharing of fish and aquatic habitat information in the Pacific Northwest, with an emphasis on the Columbia River Basin. The primary focus of StreamNet's efforts is to provide information to support decision making by regional fish and wildlife managers and to promote understanding by the public.

The current primary focus of StreamNet is the CA project. A five year plan for CA was adopted in July, 2015 and revised in November, 2018. CA was begun in 2010, with the intent of making the collection, compilation, and reporting of fisheries data in the Columbia Basin, particularly that associated with the federal hydrosystem, more efficient. The project is focused on addressing standardizing regional fish data for high level indicators. The project is a collaborative effort amongst many partners, working under the direction of the NPCC Fish and Wildlife Program and largely funded by BPA. Data from the CA project is developed from the ground up by state and tribal fisheries and data professionals, and then standardized so that the same data is present and consistent across all databases, including the state and tribal originating agencies, StreamNet, Council dashboards, and the NOAA SPS database. While seemingly a simple task, this has actually proven to be quite complex and challenging in implementation.

CA initially focused on providing data to address the VSP data needs of NOAA for 5 year status reviews. As data began to flow for the initial 4 indicators selected as a priority for this purpose, it became clear that a longer term plan for CA was needed. In July, 2015 the SNEC adopted the plan. It is reviewed and updated by the Committee periodically, most recently in November, 2018.

The vision of the project is that high level indicators are standardized for specific regional data needs on a prioritized basis. A longer term schedule for the Coordinated Assessments Project is developed, including a general outline of when the next indicators will come on line. Close contact with HLI users (BPA, NPCC, NOAA, others) and with regional fish and wildlife managers is maintained. Collaboration and consensus is used for decision making wherever possible. Other parties (e.g. resident fish managers, habitat managers, etc.) will be recruited as needed, as CA moves to additional indicators. The plan is revisited annually to ensure alignment with regional priorities, and changed as needed if regional priorities change. The plan may require additional resources to fully implement.

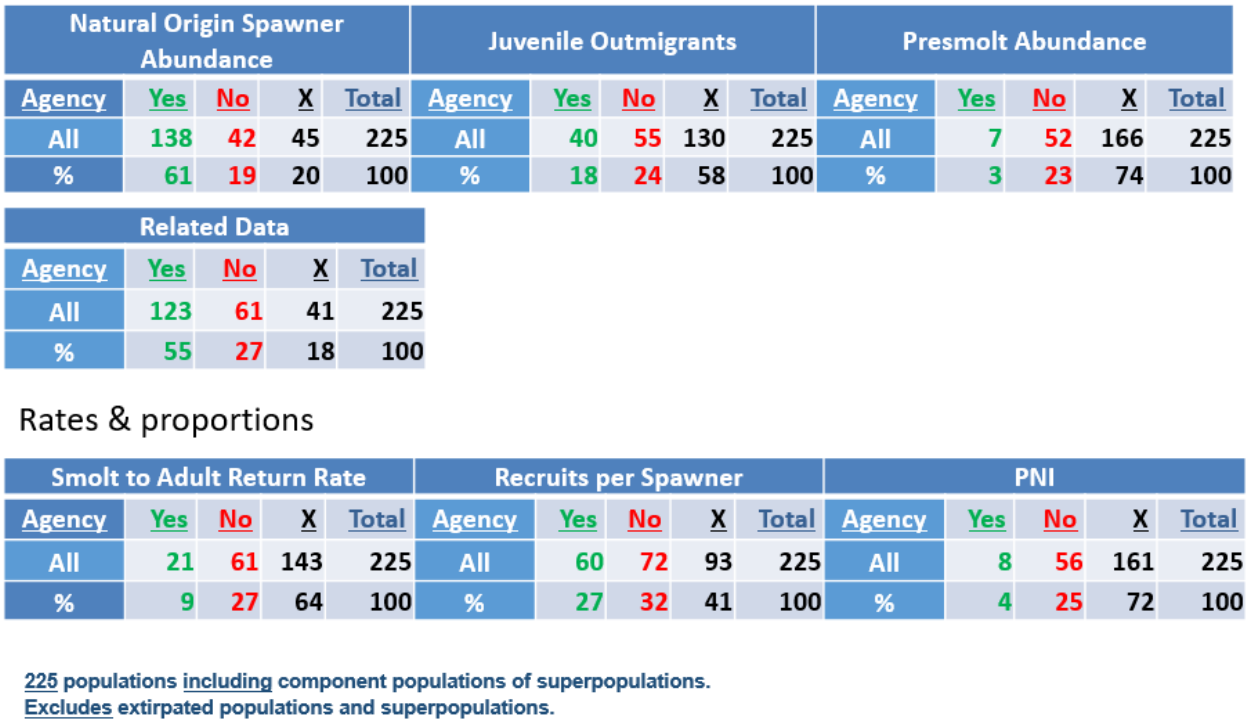
Since the adoption of the CA five year plans and StreamNet strategic plans, the SNEC has increasingly focused the efforts of the project on CA. Because the resources allotted to the project have remained fairly static as costs have slowly risen, expansion into other data categories has been limited. Standardizing data compilation and reporting under variable field conditions has also proven more difficult than anticipated. In addition, BPA has provided clear direction on the priorities that they wish to see implemented. In 2016, BPA identified 69 priority populations that were associated with data needs for the FCRPS BiOp. BPA requested that StreamNet, including all StreamNet partners, focus efforts on obtaining as much data as possible for these priority populations.

This focus on obtaining standardized data and associated trends information for the priority populations has continued to the present. In combination, this focus and relatively static resources devoted to the project has

resulted in a lack of progress on expanding into other indicators and species, such as hatchery and resident fish data, as originally planned in the StreamNet strategic and CA 5 year plans.

In early 2018 the Executive Committee again set priorities and revised the CA 5 year plan (**https://www.streamnet.org/revised-coordinated-assessments-5-year-plan-adopted-by-executive-committee/**). The Committee again made populating the existing natural origin indicators the priority for 2018. Sharing and displaying SARs for superpopulations with FPC & CRITFC was included. We continue to work with CRITFC tribes and specifically with the CRITFC Inter-Tribal Monitoring and CRITFC StreamNet Library projects (2008-507-00 and 2008-505-00) projects to integrate these 3 projects and maximize data sharing.

As the CA project has matured it has become evident that automation of data flow is more difficult than originally anticipated. Partners are still regularly involved in obtaining data from field staff, and there is a high degree of analysis required in order to produce high level population indicators. Varying environmental conditions, changes in analytical protocols, and staffing changes all contribute to a "hands-on" effort that is essential for production of the indicators. This has led to a slowdown in development of new indicators and a focus on continued QA/QC of existing indicators for the project.



Natural Origin Spawner Abundance				
Agency	Yes	No	X	Total
All	138	42	45	225
%	61	19	20	100

Juvenile Outmigrants				
Agency	Yes	No	X	Total
All	40	55	130	225
%	18	24	58	100

Presmolt Abundance				
Agency	Yes	No	X	Total
All	7	52	166	225
%	3	23	74	100

Related Data				
Agency	Yes	No	X	Total
All	123	61	41	225
%	55	27	18	100

Smolt to Adult Return Rate				
Agency	Yes	No	X	Total
All	21	61	143	225
%	9	27	64	100

Recruits per Spawner				
Agency	Yes	No	X	Total
All	60	72	93	225
%	27	32	41	100

PNI				
Agency	Yes	No	X	Total
All	8	56	161	225
%	4	25	72	100

Figure 4. Coordinated Assessments Project FY 2018 Data Flow

Documentation of Protocols and Methods

Protocols and methods used in the creation of data generally are documented through formal reports, at varying levels of detail. For this reason StreamNet has always gathered the source documents for all data in the database and asked that they be made available in the StreamNet Library, with direct links to the documents from the actual data. With the regional recognition that protocols and methods described in reports are not always sufficient for fully understanding the origin and uses of the data, a tool to support full description of methods and protocols was

developed through PNAMP with support from BPA. Use of this tool (**www.monitoringmethods.org**) to describe sampling methodology is increasing, and StreamNet built a link to the website for the CA project to specify the protocols used to calculate the indicators and metrics in the data. Providing a link to protocols and methods could easily be added to the current links to data source documents in the main StreamNet database. This will require new work on the part of the StreamNet data stewards, however, so this will have to be prioritized in the future. In 2018, development of comprehensive VSP methods compendium reports, including GIS maps to show population, MPG, and DPS/ESU level boundaries for submitted population data continued in Oregon, with Snake River Chinook still in progress. All finalized DPS/ESU compendiums are available on ODFW's Recovery Tracker and the Data Clearinghouse. Web links to these methods documents are also provided as metadata within CAX data. Oregon staff continued to update and develop new metadata, data analysis flow diagrams, and data management plans pertaining to analytical methods, field methods, and data compilation for the DES and Recovery Tracker. Oregon StreamNet continued to work with PNAMP staff to assess if NOSA analytical methods and protocols could be incorporated into MonitoringResources.org. It was determined that while complicated, it may be possible depending on a project's Work Elements within its SOW. Staff continue to promote the adherence to the agency's simple metadata standard along with the development of full FGDC compliant metadata when warranted. Additionally, WDFW StreamNet staff continued to work with contributing biologists to document methodologies and update them within our corporate reporting systems. The development of formal metadata for CA data and beyond will greatly aid efforts to document data origin, protocols used to collect the data, and uses of the data.

StreamNet does not store raw data. We do not have protocols as such that would be consistent with those in MonitoringResources.org. Data exchange standards, a data sharing agreement, and rigorous QA/QC protocols are all part of the data compilation and reporting process. We have a thorough data validation system (please refer to other parts of this review document) that is implemented whenever data are sent to the central StreamNet database from one of the data contributing StreamNet partner agencies or tribes. We have dedicated data stewards in each partner agency. These data stewards function within the agency or tribe for which they work, and coordinate with biologists across that organization to identify and collect data of interest to StreamNet, and make the flow of data to the central database happen. Data we do obtain are processed and sent to the central database as soon as possible. There are multiple redundant backup systems at PSMFC to prevent permanent data loss.

Metadata are developed by PSMFC StreamNet staff for these data. Metadata for the GIS layers comply with the FGDC standard and are available for download with the layers. Metadata for the tabular data should meet the requirements of the FGDC Biological Extension, but we often lack the required level of detail from the source agency, as many agencies have not placed high priority on creating metadata. Thus, StreamNet metadata often point to the originating agency as the source, but are only able to provide a subset of all metadata that might be desired. Essentially, StreamNet metadata describe the full consolidated data set, not the individual component data sets or individual records.

Some metadata components are required from the data source agencies as part of the DES. Specifically, we include information on 'calculation method' used, and this information is presented with all data displays and in data downloads. These are general categories or types of methods, rather than detailed descriptions. In the future as more detailed descriptions of field data collection methods become available through monitoringmethods.org, we would anticipate adding a link to the specific method used for a particular component of data. This approach has been adopted and implemented in the population-scale data types managed under CA.

To compensate for the frequent lack of formal metadata from the data source agencies, StreamNet obtains source documents for all data entered into the database. These are stored in the StreamNet Library. Links to these source

documents are presented with all views of the data and with all data downloads. Many source documents contain methods sections that provide the detail about how the data were collected. When viewed online, there are links to the bibliography record in the Library, and if the document has already been scanned and posted online the link will take users directly to the document. If the reference document has not already been scanned, the link will provide a form to request a copy of the document from the library. Recently the Library has been fixing and improving the links to the documents, making this a more complete and convenient resource for data users.

StreamNet data are published as downloadable spatial data and as publicly accessible web map services. FGDC metadata are published in web accessible folders that can be registered with and harvested by data discovery portals and clearinghouses

Metadata for data sets in the Data Store are provided by the entity that uploads the data set. The Data Store online upload process requires that descriptive information be completed before the data set is accepted. For data from projects funded under the Fish and Wildlife Program, the application pre-fills some project related metadata fields directly from the BPA Taurus database. All metadata are included whenever users download data sets. The amount of detail regarding sampling methodology and other key aspects is dependent on the entity uploading the data. The Data Store metadata constitute an extension to the FGDC Biological Profile metadata standard.

Data Entry

Data, including reference documents, in the StreamNet database must conform to StreamNet's Data Exchange Standard (DES) **https://www.streamnet.org/wp-content/uploads/2018/06/StreamNetExchangeStandard2018-1.doc**, which precisely defines the data elements, their organization in tables, and required formats. This document serves as the common denominator for the specific data types contained in the database. Adherence to the DES assures that data can be loaded into the database, can be queried accurately, and are equivalent for further analysis by users. Conversion of agency data to the DES and assuring that they conform before submission is the responsibility of the project's data stewards/compilers in the data source agencies. QA procedures are applied at the agency data steward level, and automated validation routines are run when the data are received at PSMFC. All validation failures are reported in real time to the stewards for correction, and any errors are conveyed back to the original data collectors. Additions or changes to the DES are made following a formal documented procedure adopted by the Steering Committee **ftp://ftp.streamnet.org/pub/streamnet/Projman_files/ExchangeFormat/CurrentDraft/DES-Change-Process.pdf**.

In previous years data stewards had access to an external copy of the StreamNet database, allowing them to validate new or updated data records against the database structure and contents, thereby assuring conformance with the DES and identification of any duplicate or overlapping records. Now an automated data validation and loading system is used for most data submitted to the regional StreamNet database. This system provides real-time feedback on the success (or not) of data validation. Data are submitted to the StreamNet database one record at a time, and real-time data validation is run on them at three levels. First, each field has its own set of rules. Examples include ensuring numeric fields do not contain text, ensuring codes fall within the group of allowable values, and ensuring text strings are within acceptable length ranges. The second level of validation ensures that values in the different fields within a row of data are compatible. For example, if a record is submitted that says it is for spring run coho salmon, the record is rejected because there is no such run. The third level of validation prevents duplicate data. A useful feature of the automated validation routines is that the data may be run against the validation rules and an error report obtained without actually submitting the data for inclusion in the database. This feature allows data submitters to check entire sets of data, fix all errors, and then submit the entire data set

after it is known it will pass validation in its entirety. The interface used for data submittals allows for new records, for changing existing records, and for deleting existing records.

Database triggers apply time stamps to new and modified records, and stored procedures automate the creation of data in various internal tables that enhance the filtering and rapid retrieval of data. Triggers also back up all records before they are deleted from the central StreamNet database. Thus the central database functions as a backup for all data that have been submitted in the past in the unlikely event data are lost at the submitting agency.

Georeferencing tables are maintained which allow the query systems to find data by HUC, NPCC subbasin, or state/county. StreamNet maintains a custom set of web services that allow NPCC to retrieve, in an automated way, specific sets of detailed "trend" data and CRITFC StreamNet Library reference documents (PDF) for use in their Fish Data Product.

The Integrated Query System (for "trends") and the CA query system (for population-scale HLIs) are designed so that users can quickly find and access the data they are looking for by using filters. Some features of note include: integrated maps; flexible and intuitive geographic filtering via maps; the feel of a desktop data explorer application rather than a "database website"; interactive charts; and integrated reference documentation. The user interface (EXTJS) interacts with our published web services (ColdFusion & ArcGIS Server for maps) which in turn interact with the SQL server database.

ODFW StreamNet acquired new and maintained existing datasets for population estimates from various contributors in the Columbia Basin. This resulted in the submission of all Priority 1, 2, and 3 ODFW population commitments in the CA DES format. Oregon also exchanged 70 new and 1,211 existing (including 710 for EscData only) traditional data trends originating from developing the Trend API, NPCC dashboards, opportunistic connection to CA data, priority populations within the Columbia Basin, QC information from StreamNet staff and linear referencing conducted on existing and new data. Starting in September 2018, ODFW began submitting traditional trends through the newly developed StreamNet API. New and updated existing stream routes were also submitted. Staff added records to the Oregon Fish Passage Barrier database, and updated Oregon Fish Habitat Distribution Database records in the Columbia Basin as necessary.

Options for submitting trend location geometries were evaluated in coordination with regional staff. Partners outlined options for submitting TrendID and spatial data (locations) in a geodatabase as separate feature classes (point, lines, waterbodies, and supercodes) for all related data trends submitted through the API. The new submission procedures are slated to begin in 2019.

All WDFW StreamNet staff contributed to the design of the TWS (Traps, Weirs, Surveys restructure and to ensure all measurements were being collected to support metrics needed to create focal indicators. The Location Data Manager converted cutthroat SGS (Spawner Survey Database) historic routes to more current routes. Further work continues to equate the route measures with current route measures. This data was targeted to scope how difficult it would be to use automation for all the historic routes in SGS.

Agency Data Storage

StreamNet maintains a central database containing summarized fish data for the Columbia Basin. BPA relies on the StreamNet database and StreamNet Data Store as core data repositories to secure public access to data where not provided in an alternative, publicly accessible system. The StreamNet Data Store serves as the default database for

numerous fish population metrics, as indicated in the BPA Data Management Strategy. In addition, StreamNet can function as the interim data storage location during the development of databases for new data sets, such as fish species genetics, blood work, and enzyme analysis. PSMFC also physically hosts other data storage repositories as a cooperator with state and tribal agencies. StreamNet staff now also work to ensure that data not located in the StreamNet database are secure and regionally accessible in other approved environmental data repositories.

The StreamNet subprojects in the state agencies all contributed to development or improvement of agency data storage systems in 2018. Focus continues to be on increasing the speed and efficiency of data conversion to the regional standard StreamNet DES, and then submission to the StreamNet database. The long-term goal is to develop the capacity for the agencies to host data in the regional standard and share them via web services and/or to transfer data to StreamNet via web services. Because each state uses different approaches to their data management, actions taken by the state subprojects differ accordingly.

IDFG StreamNet staff assisted BPA project biologists to identify and prioritize data available for entry into IFWIS, or an alternative accessible, backed up information system. IDFG StreamNet staff participated in meetings of the CA planning and development groups. They provided input prioritizing indicators, metrics, and metadata. They coordinated with development between the proposed DES, the prototype database and application, and the web service data exchange. Multiple sources of CA data were consolidated into complete, standardized, workbooks on a secure and backed up network drive. SQL queries were written to select, extract, and transform those data into the draft DES for NOSA and RperS. IDFG staff wrote web service routines to enable the transfer of CA data to PSMFC and NOAA databases. Those services were successfully tested and results shared with the CA Exchange Team. After appending into the IFWIS CA database, those data were then transferred to the PSMFC CA database. IDFG StreamNet staff compiled and submitted hatchery return data for 2012-2016 chinook, and 2016 steelhead and the 2016 chinook index redd counts.

MFWP StreamNet staff, in addition to maintenance and update of existing databases, assisted the Fisheries Division in continued scoping and development of an internal centralized fisheries data system being built by MFWP Application Development staff and contractors. StreamNet staff is involved to ensure that data being collected and stored conform to existing StreamNet DES guidelines and that the exchange of data with the StreamNet central database is efficient. The system has been designed to replace individual databases residing on biologists' computers, thus making truly centralized data a reality. In addition, the system includes analysis tools giving the user the ability to calculate various population estimates and other metrics needed by staff for reporting purposes, which will benefit BPA projects. StreamNet staff also continued to assist in converting data files residing with individual biologists to a file type that can be uploaded into the new system. Additional StreamNet staff efforts related to the system design and development have resulted in nine data categories MFWP submits to StreamNet being housed in the centralized database. Survey and inventory search and reporting functionality in the internal system has been greatly improved over the past year. Biologists can now search via several data categories as well as searching using a map interface. Resulting records are available in an easy to use or download format. This reporting work has also translated into the search functionality available in the new public query system, FishMT. The database currently houses over 3.5 million raw fish records statewide. In 2018, 1,190 fish survey locations were added in the Columbia Basin resulting in over 213,700 individual fish records. Statewide 2,375 new survey locations were added resulting in 915,992 individual raw fish records being added to the database. 577 redd counts at 64 locations were added in the Columbia Basin during 2018. All relevant data was submitted to StreamNet databases or the Data Store. Additional querying and reporting functionality was added to the database in the past year allowing biologists and managers to query the database using several filters, including spatial filters. These reports

are critical for biologists and managers to easily and quickly find surveys and data. An additional task moving forward will be to investigate the potential to deliver data as web services. These efforts are leading to a significantly enhanced ability for MFWP to share fisheries data in standardized format with regional entities.

MFWP StreamNet staff met with MFWP biologists, native species coordinators and University of Montana genetics staff to discuss the development of a trout genetics module in the internal Fisheries Information System. Currently genetics information is being managed in a disparate way and much efficiency could be gained by a more thorough and thoughtful approach to genetic sample submission, analysis and reporting via one system. Work on this very important effort will be ongoing with StreamNet staff providing guidance where necessary.

MFWP staff have worked over the past year to increase the amount of fisheries data available to the public. The FishMT site was released in 2018 as the new public web query tool, replacing the MFISH and Fishing Guide systems which had to be retired due to changes in technology. Additionally, statewide fisheries data has been made available through the MFWP Open Data site which allows users the ability to query and use data in a spatial or tabular way.

MFWP StreamNet staff have been very involved in the Yellowstone Cutthroat Trout (YCT) range-wide assessment. This year MFWP staff coordinated updates to the database with biologists throughout the species' native range. Additionally, work was done to investigate the possibility of integrating the YCT native trout assessment into the Inland Cutthroat Protocol (ICP) data system. This system, which was developed by Wyoming Geographic Information Science Center, is an online web application to facilitate the viewing and editing of the assessment data by biologists and fish managers. The system would be easily accessible for the biologists and managers who need to update and contribute data when they have the time and resources available. It would allow for more efficiency and flexibility as well as managing the data in the same way as other inland trout species. MFWP StreamNet staff presented information related to the ICP data system at an annual YCT Geographic Management Unit meeting with all the contributing states and agencies in attendance.

ODFW StreamNet performed routine maintenance and updates on existing core databases. In addition, efforts to improve overall agency data storage and flow from the field continued by ongoing development and maintenance of the ODFW Data Clearinghouse (DC), making Oregon's natural resource information more secure and accessible by providing a centralized storage and distribution service. During the year, 2,723 new and existing DC records were created and updated using StreamNet and other funding. This was part of an effort to, where possible, improve the accuracy of over 39,000 records from the old ODFW Library electronic bibliography into the DC in order to preserve this historic record of ODFW documents, and where possible provide access to digital copies of these documents.

Oregon StreamNet staff worked with ODFW Recovery Plan staff throughout the year to coordinate efficient exchange of CA and Recovery data to StreamNet and the ODFW **Salmon & Steelhead** Recovery Tracker, as well as data standardization, DES needs and changes, flow configuration and data sharing documents, metadata, and data system development. Through this relationship, and with other funding, Oregon updated and submitted coastal coho natural origin spawner abundance, juvenile outmigrants, smolt to adult ratio and juvenile recruits per spawner estimates to StreamNet. The lower Columbia (all species) and coastal coho (other funding) DES data was also processed and uploaded to the ODFW Recovery Tracker public website. Enhancements to the data structure and user interface for Oregon's trend database were primarily implemented to efficiently address Coordinated Assessment data needs, and to accommodate DES requirements. The Fish Habitat Distribution and Barrier Data Editor application was maintained to enhance the flow of data from the field to NRIMP and StreamNet. Oregon

StreamNet continued refining various software and web map applications for supporting mobile data access, and explored the potential to test this out more broadly across the basin.

The Oregon data storage and automated exchange system used to exchange ODFW Coordinated Assessment data with StreamNet was enhanced to support traditional trend data as well. Similar to CA data, ODFW traditional trend data is now hosted in an ODFW SQL Server database similar in structure to the one hosted at StreamNet. ODFW traditional trend data is now more readily accessible to ODFW agency staff as well as easily exchanged with StreamNet via the StreamNet API.

WDFW focused some StreamNet resources on the building, testing and refinement of several systems to store data captured from field biologists and analyzed by regional biologists. Database systems under development and implementation include those for: adult age and scales; traps, weirs and surveys; spawning ground surveys; and juvenile migration. These systems are being developed with the intent of holding BPA project data in a secure and transferable location and informing the CA indicator data sets as well as the standard StreamNet data sets. These data sets are being prototyped at WDFW headquarters and in Washington's Lower Columbia Region, but will eventually be rolled out to other regions statewide. Additionally, WDFW has been concentrating resources, when available, to the development of our Salmon Conservation Reporting Engine (SCoRE) which will enable on-demand data access via services from the data.wa.gov open data platform. Contingent on funding, we anticipate further development of these and other systems in 2019.

The USFWS's Pacific Region, which includes Oregon, Washington, and Idaho, stores data collected at 15 Pacific Region National Fish Hatcheries in three databases that include the Columbia River Information System, Fish Inventory System, and Fisheries Resource Evaluation Database. Because those databases possess different structures, the ability to aggregate and distribute data from these databases is time consuming and inefficient. The USFWS's Pacific Region is reviewing the way those data are currently stored and managed and the agency is exploring options to consolidate the National Fish Hatchery data in a single database that is Internet-based. The transition to a single database for storing Pacific Region USFWS hatchery data in an Internet-based platform would improve the efficiency of managing those data, lead to the standardization of that data, and substantially improve the ability to share USFWS hatchery data with StreamNet partners in a more timely fashion.

In calendar year 2018 BPA and the USFWS reached agreement on funding the Service's previous StreamNet activities directly. While the USFWS will remain a StreamNet partner, their funding for participation will no longer come via the StreamNet project.

Regional Sharing

Regional sharing of fish management data is StreamNet's primary purpose (Figure 5). In 2018, significant effort was expended to improve sharing of the CA indicators and metrics. StreamNet led the team that developed the DES for the project. The DES specifically identifies the data elements that are to be shared for each indicator, along with definitions, formats, and business rules for each element. The DES is used to guide the organization of data to be shared via any specific medium, whether by spreadsheet, CSV file, database file, or web service. The data elements are hosted by the originating agency in DES format and shared via web services accessed by an exchange network hosted by StreamNet.

The StreamNet project's approach is to collaborate with state, tribal, and federal fish & wildlife agencies as well as other data collection projects in the Columbia Basin for the goal of creating standardized sets of fisheries data and making this data available to a wide audience of consumers. Virtually all data sets collected by the collaborating agencies are submitted in slightly summarized format or as high level indicators with associated metadata. The project compiles no raw data into the main data sets.

All data is available to the public. There are no separate levels of data access, and data is generally available via multiple methods through the StreamNet website. There are several special-case exceptions.

In the case of the StreamNet API we do require that users request access and get issued a unique programming key to interact with data via this method. This is a case of programming best practices and data quality control rather than limiting data access.

The EPA Exchange Network requires that users register before accessing any data sets. Therefore, users who wish to access StreamNet data via this method must register and receive approval through the EPA. This is a requirement imposed by the EPA and not StreamNet.

In some cases, data such as exact spawning ground locations may be obfuscated by the submitting agency to protect the resource. In such cases, the agency will typically generalize locations to a larger map section (show a large stream section rather than a point).

StreamNet makes all compiled data available through multiple web-based data query tools as well as multiple data download formats and through specialized categories of downloadable data. In the case of Coordinated Assessments data, users must agree to an End User Agreement (EULA) to access these derived data sets. This EULA was implemented at the request of data submitting agencies.

StreamNet's primary data access tools and portals are:

StreamNet Coordinated Assessments Query (High Level Indicators)
https://cax.streamnet.org

StreamNet Time Series Abundance Data (slightly summarized time series abundance counts)
https://snq.streamnet.org

GIS Data & Mapping Applications
https://www.streamnet.org/data/interactive-maps-and-gis-data/

StreamNet Data Store (related fish and aquatic data sets)
https://app.streamnet.org/datastore_search_classic.cfm

EPA Exchange Network – CAX Node (high level indicators)
http://www.exchangenetwork.net/data-exchange/columbia-river-basin-coordinated-assessment/

NPCC Protected Areas
https://www.streamnet.org/data/protected-areas/

Habitat Evaluation Procedures (HEP)
https://www.streamnet.org/hep

StreamNet functions expressly to make data collected by the Basin's state and tribal management agencies readily accessible to all interested entities and persons. The data disseminated represent primary fish related data,

regardless of the funding sources responsible for supporting the work of field collection. Thus, all data of a given type are included, both those paid for under the Fish and Wildlife Program and similar data that are obtained based on other funding. This is important because in order to conduct assessments or monitor population status and trends, all data relevant to each population must be used, regardless of funding source or agency collecting the data.

All data of the data types contained in StreamNet are made available to anyone via the StreamNet website. Data are generally summarized annually.

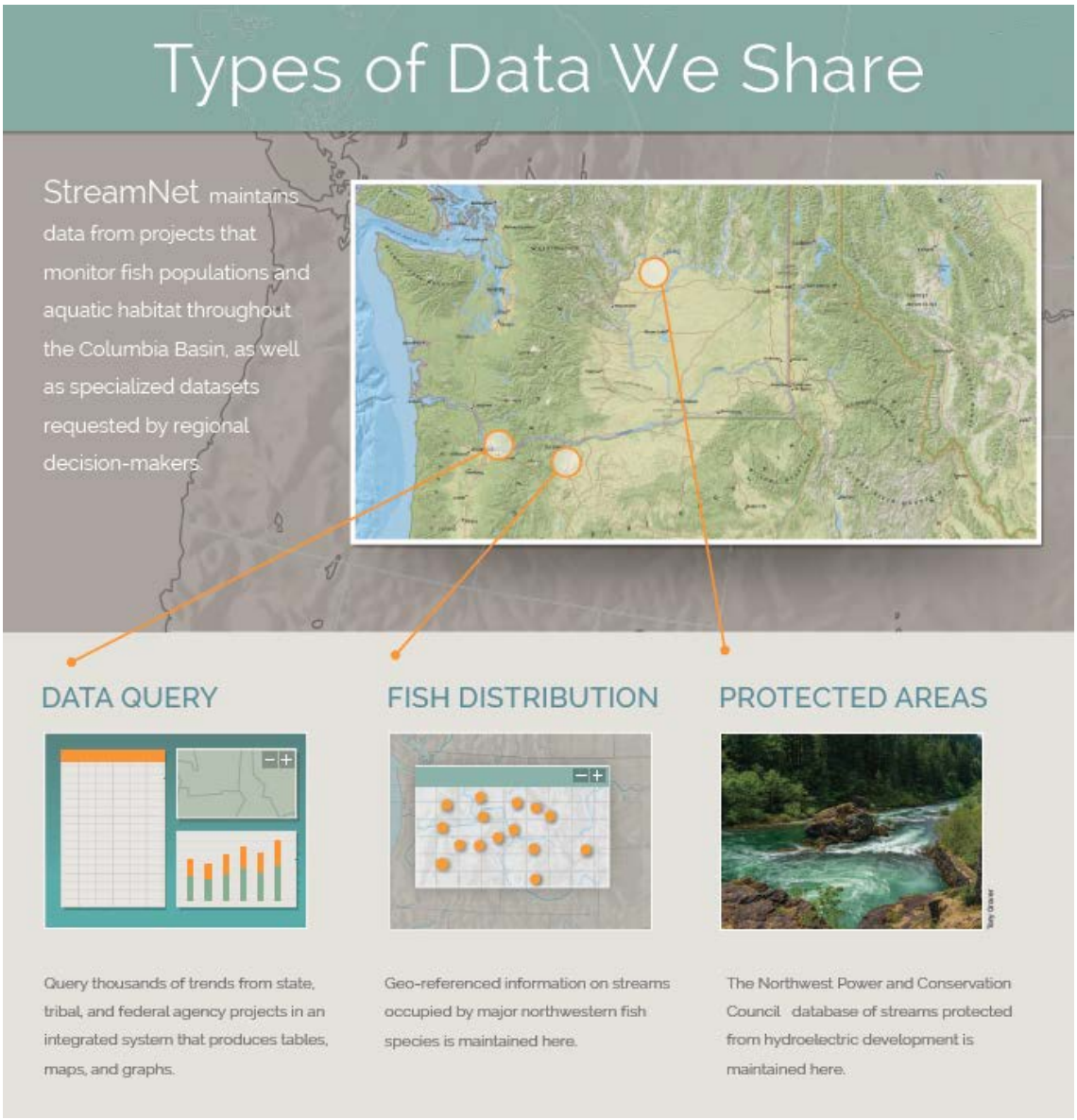


Figure 5. Data sharing Infographic from website

StreamNet also continued its role as a primary data-sharing project in the Columbia Basin, providing ready access to fisheries data. These data have traditionally been created and managed internally by the region's state, tribal and federal fish management agencies or programs, and have not been shared widely in a consistent format, except

through StreamNet. We maintained and updated a central database containing these data and then shared the data through the StreamNet website. Each StreamNet sub-project compiled state or agency specific data for the data categories and submitted them to the central database at PSMFC to add the most recent data. During 2018, the Executive Committee directed the project to resume updating selected, high priority traditional data sets, such as long-term sets that support CA indicators and those that are used to maintain the NPCC dashboards.

During 2018 a wide variety of data types primarily related to fish were disseminated through the StreamNet website at www.streamnet.org and by the agency subcontractors. We provided several data query approaches used to locate, display and download data from the StreamNet main database for standardized data and from the Data Store for data that fall outside the scope of the StreamNet DES (Figure 2).

The standard data query utilizes a tabular approach for requesting and viewing or downloading data from the main database. An interactive map application allows location of data from the main database by navigating to an area of interest, then using a 'get data' tool to view and download all data that are associated with features at that location, such as for a stream, county, HUC or hatchery. Maps and GIS layers are also available.

The Integrated Query System (IQS) integrates tabular and map based query approaches into a single system. This allows viewing and obtaining data within multiple data types by filtering or sorting on column headings in a table and also selecting on a location basis by using a map filter.

The Data Store online data archive provides access to a variety of data sets from any source, within or outside the StreamNet project, in native format. As previously mentioned, the Data Store serves as an approved environmental data repository for a wide variety of data collected in the basin, maintaining security and accessibility long term. The Data Store interface allows data producers to upload their data sets for secure storage and dissemination along with descriptive metadata. The BPA Data Management Strategy directs StreamNet to store links to associated protocols and designs to ensure data downloaded and used by third parties can be understood and properly used. The Data Store upload procedure obtains project information directly from the BPA Taurus database through www.cbfish.org and from www.monitoringmethods.org. StreamNet data and metadata are provided online as web services, allowing users to locate and obtain data through automated means such as national or regional clearinghouses, and in fact, the new IQS harvests our own web services as part of the new, more efficient approach to querying our data.

Analysis and Reporting

The StreamNet project displays and provides online access to all legacy data and data updates as soon as they are received from the source agencies, quality checked and validated, and disseminated through the various data query systems. Annual time series data are presented as 'trends', while other data sets are updated on a less regular basis as the agencies generate new information, such as for distribution and facilities. The updating of this trend data was discontinued in 2013, in order to focus efforts on CA. Therefore, the dissemination of this type of data through the StreamNet website has declined. In 2018 the StreamNet data technicians working within the data source agencies continued to identify and update trend data sets associated with CA populations, and selected those that they considered integral to a better understanding of these populations at a more localized level. The Executive Committee endorsed re-initiating updates to these selected trends, as well as those that populate the dashboards and indicator websites of the NPCC.

Data from the StreamNet database are made available through the online data query systems (Figure 2). During 2012 we initiated planning with NOAA Fisheries to develop automated means of feeding indicators and metrics

from the CA project to the Salmon Population Summary (SPS) database. During 2018 we continued assisting NOAA and state and tribal management agencies in automating data flow for their decision making needs.

StreamNet periodically issues reports on topics of interest to various users, as staff time is available. These include reports on the geographic distribution of fish, fish marking and hatchery releases, and other topics for which StreamNet holds data, or where StreamNet can serve a facilitating role with other PSMFC projects and databases. StreamNet is a data sharing and reporting repository and further analysis is not our purview. Where derived data, such as estimates of spawning populations, are disseminated through the project, they are obtained from the source agencies for inclusion in the project's data systems.

As a BPA funded project, StreamNet regularly issues required reports through Pisces and Cbfish.org. In 2018 these included quarterly progress reports and the 2018 Annual and BiOp reports.

4. Synthesis of Findings: Discussion/Conclusions

In 2012 StreamNet received significant input from the NPCC and BPA. Among their recommendations were:

- Data management should focus on addressing priority data needs. Specific guidance for StreamNet included;
    - Focus on a number of additional priority data types, including CA indicators and supporting metrics and juvenile abundance data, and Single Nucleotide Polymorphisms (SNPs) genetics data.
    - Assess the security and accessibility of data developed by BPA funded projects.
    - Participation with integrating data discovery through MonitoringResources.org.
- Increased coordination among database projects is needed to avoid potential redundancy.
- Expanded use of information technology is needed to improve efficiency in data management and sharing.
- StreamNet should take on production and dissemination of a number of additional priority data types. These included the CA indicators and supporting metrics, information on security and accessibility of BPA funded data, juvenile abundance data, resident fish data, SNPs genetics data, and data coordination through MonitoringResources.org.

The focus of StreamNet has been on the CA project since this review. CA builds on collaborative efforts such as the 2009 Anadromous Salmonid Monitoring Strategy (ASMS), the Skamania workshops where regional fish managers recommended priorities and a plan for monitoring salmon and steelhead to improve coordination of research, monitoring and evaluation. The BPA Data Management Strategy, NOAA RM&E Guidance, individual federal, state, and tribal information management system development, and CA have all derived, at least in part, from these discussions.

The SNEC (established in 2014) helps serve the coordinating role for salmon and steelhead monitoring. Updates to the established ASMS monitoring framework should involve a collaborative process among the co-managers and include not only what data need to be collected but how these data will be reported. The CA project was begun in 2010, with the intent of making the collection, compilation, and reporting of fisheries data in the Columbia Basin, particularly that associated with the federal hydrosystem, more efficient. The project is focused on addressing standardizing regional fish data for high level indicators. The project is a collaborative effort amongst many partners, working under the direction of the NPCC Fish and Wildlife Program and largely funded by BPA. Data from

the CA project is developed from the ground up by state and tribal fisheries and data professionals, and then standardized so that the same data is present and consistent across all databases, including the state and tribal originating agencies, StreamNet, Council dashboards, and the NOAA SPS database. While seemingly a simple task, this has actually proven to be quite complex and challenging in implementation.

CA initially focused on providing data to address the VSP data needs of NOAA for 5 year status reviews. As data began to flow for the initial 4 indicators selected as a priority for this purpose, it became clear that a longer term plan for CA was needed. A Five Year Plan for Coordinated Assessments was adopted by the SNEC in July, 2015. This document addresses that need.

To further help determine direction for the project, an online survey was conducted of fisheries data management professionals in the spring of 2015, asking respondents their opinions on a number of data management questions. Discussions were then held with the StreamNet Steering Committee, BPA, NPCC, and others. In July, 2015 the SNEC adopted this plan as an outline for the CA going forward for the next five years. The plan was reviewed and updated by the Committee again on September, 2017 and November, 2018.

The intent is for the CA project to be a collaborative, consensus based effort. The vision of the project is that high level indicators are standardized for specific regional data needs on a prioritized basis. A longer term schedule for the Coordinated Assessments Project is developed, including a general outline of when the next indicators will come on line. Close contact with HLI users (BPA, NPCC, NOAA, others) and with regional fish and wildlife managers is maintained. Collaboration and consensus is used for decision making wherever possible. Other parties (e.g. resident fish managers, habitat managers, etc.) are recruited as needed. The plan is revisited annually to ensure alignment with regional priorities, and changed as needed if regional priorities change. Multiple tasks will occur annually; Populating last indicators with data while developing the next DES and also automating data flow for previous indicators. The plan may require additional resources to fully implement.

The Coordinated Assessments project was partially funded for several years during the review period through a grant received by WDFW from the EPA. StreamNet was a sub-contractor under that grant. The purpose of the grant was to automate data flow on the key VSP indicators across the region. Successful acquisition of this funding fostered collaboration, but a second grant application under the same EPA program submitted in 2014 to further expand partnerships was unsuccessful.

Since the adoption of the CA five year and StreamNet Strategic Plans, the Executive Committee has increasingly focused the efforts of the project on CA. Since the resources allotted to the project have remained fairly static, even as costs have slowly risen, expansion into other data categories has been more limited than expected. In addition, BPA has provided clear direction on the priorities that they wish to see implemented. In 2016, BPA identified priority populations that were associated with data needs for the FCRPS BiOp. These were categorized by Bonneville as either Tier 1 (highest Priority) or Tier 2 (next highest priority). BPA requested that StreamNet, including all StreamNet partners, focus efforts on obtaining as much data as possible for these 18 Tier 1 and 51 Tier 2 priority populations.

This focus on obtaining standardized data and associated trends information for these priority populations has continued to the present day. In combination, this focus and relatively static resources devoted to the project has resulted in a lack of progress on expanding into other indicators and species, such as hatchery and resident fish data, as originally planned in the Strategic and CA plans.

Current recommendations for the NPCC program include establishing the Coordinated Assessments Data Exchange as the database of record for the Program. In order to function, this would require continuing funding to the salmon and steelhead co-managers to establish and maintain CA as a reliable, sustainable, and transparent data exchange for salmon and steelhead data. StreamNet is positioned to help with a collaborative process that can sustain and update the recommendations from the November 10, 2011 Columbia River Basin Collaborative Data Sharing Strategy: Salmon and Steelhead Population Abundance and Productivity Indicators for funding data management. StreamNet can continue to provide information that allows managers to evaluate current data management needs and to continue to provide the data needed to report priority HLIs on the NPCC website. The project also directly helps build and support capacity at the states and tribes to implement best data management procedures.

The primary data types contained in and disseminated through the CA project (https://www.streamnet.org/data/coordinated-assessments/) are the five VSP indicators; population scale estimates of natural spawner abundance, smolt to adult ratio, adult recruits per spawner (spawner to spawner ratio) smolt outmigrants and presmolt abundance. Traditional StreamNet data (aka Trends) is also collected, including spawner counts, juvenile counts, redd counts and dam and weir counts. These are raw data that relate to population estimates and estimates of VSP parameters, summarized to annual totals. The SNEC has endorsed updating selected traditional trend data as a priority, where it adds value. Having this data accessible in standard format and geo-referenced across the basin may be useful for assessing the effectiveness of habitat actions and will also permit a more granular review of information on populations in the CA database.

Figure 6. Project overview infographic from the website

Cooperating subcontractors have made use of assets provided by BPA through the StreamNet program to build infrastructure that contributes directly to their own decision-making capability, to degrees that vary from agency to agency. In general, agencies that have made the development of a centralized data management capability a priority have integrated StreamNet staff into their programs, and effectively use the staff to both feed data into the StreamNet database and to complete their own internal data management priorities. In general, agencies that have a more dispersed data management process use StreamNet staff primarily to feed data into the StreamNet database. Other staff separately and independently manage data for decision-making. StreamNet has integrated discussions with agency partners on how best to deploy program assets within agencies through the Executive Committee, with the goal of simultaneously assisting agency decision-makers and assuring data security and regional sharing of data.

One of the lessons learned in this project has been that embedded data management staff paid for through the StreamNet project serve an important and often unrecognized role within the agencies. So long as the flow of traditional data, and now CA information, has continued, agencies have been free to structure their data systems and use embedded staff in any structural assemblage that works for them. While this flexibility can be an asset, it is incumbent on the program to ensure that these assets are deployed to best implement regional RM&E programs. StreamNet staff will continue to focus on aligning the program with regional RM&E through discussions with the Executive and Steering Committees, the NPCC, and participation in other regional coordination efforts.

While BPA funds the majority of projects that collect fish metric data in the basin, it does not fund all of this work. In 2018 StreamNet budgets were cut and PSMFC staffing reduced to help address larger scale funding issues. Combining resources at the state, tribal, and federal level can lead to more effective and comprehensive RM&E management in the future. However, budget realities will mean that the setting of priorities and the flow of data will be a collaborative, and sometimes compromised, arrangement.

In implementing the CA project, substantial progress was made in 2018. However, the caveats identified in 2012 remain an impediment that will impact the region's ability to implement more efficient data flow to decision makers. The indicators are not calculated for all defined populations. Many indicators, particularly those related to productivity, are calculated for far fewer populations than others. Indicators are not always calculated to represent an entire population. This has led to discussion about the value of compiling and submitting data at a sub-population scale. The various state and tribal agencies are at significantly different stages in developing the capabilities of their data management infrastructure, so developing a region-wide approach to sharing these indicators will continue to require more time and/or more resources for some agencies.

One lesson learned through this project is that the existing system of decision-making is reliant on a small, core network of biologists with a long history and significant institutional knowledge that is largely irreplaceable. As these professionals retire a more automated and documented system will be essential to assure continuity of population assessments. Projects such as StreamNet could serve a key role in assuring that this documentation and the data needed to inform the assessment process are accessible and stable during any upcoming transition. Analytical method documentation for the CA project continued to be a priority for StreamNet in 2018.

Documenting the history of population assessments is key to understanding and evaluating past and present data. The goal is to provide a citable reference for co-managers and interested parties when referencing abundance and productivity data in their own reports and analysis, including detailed methods on the datasets for indicators and metrics that are in the CA DES, and document changes to methods for those indicators and metrics. This work requires a detailed examination of methods documents and datasets, which, on occasion, illuminates QA/QC issues

in VSP datasets, resulting in an intensive review of analytical methods and recalculation of VSP metrics and indicators. This often requires an enormous amount of time and coordination and therefore needs to be considered when thinking about compiling and/or documenting current or VSP metrics and indicators into DES format.

Recommendations;

1. The CA effort has successfully reviewed and implemented data sharing for most natural origin salmon and steelhead populations in the Columbia River Basin, wherever population-scale data are available. The SNEC is the leadership team for this effort, and recommends that membership be expanded, to include all federal, state, and tribal fish and wildlife managers involved in data collection for species and populations. Full participation in the CA project is needed to ensure continued progress in coordinated regional data management. Developing and sharing regional High Level Indicators (HLIs) will provide the NPCC, BPA, and NOAA the ability to efficiently evaluate and report on their respective roles in fish and wildlife mitigation and recovery.
2. NOAA's Columbia Basin Task Force, the NPCC, BPA, and the states and tribes are developing a monitoring framework for natural origin salmon and steelhead populations that balances available resources with the need to monitor populations. As appropriate monitoring levels are designated for each population, implementation and data sharing should be coordinated through application of the CA process. Continued support for efforts to coordinate and implement a consistent, sustainable regional direction, including StreamNet, PNAMP, the tribal ITMD project, the StreamNet Library, and the Regional Coordination forum, is invaluable and should be continued.
3. The SNEC should be tasked with implementing a monitoring data matrix for fish species under the F&W Program. The Council should clearly articulate realistic, sustainable and affordable long-term reporting for fish populations goals under the F&W Program that engage all responsible regional parties, including federal and non-federal entities. Regional F&W managers should prioritize monitoring to ensure that RM&E efforts at the project and contract level feed into a designed system that yields constructive, valuable and timely feedback on species trends that can effectively inform recovery, mitigation, and harvest programs. Regional collaboration on the monitoring data matrix will help guide expectations on what population data are needed and will be available at the regional level.
4. The Fish and Wildlife Program would benefit from aligning BPA contracting and reporting (e.g. work elements) with the data management needs outlined in the above approach. A regionally coordinated data management system, with adopted metrics and HLIs under a monitoring framework, would help direct RM&E projects to channel results into this metric/indicator matrix. Projects that monitor salmon and steelhead populations could then provide data to the CA in the proper data exchange standard format as deliverables under contract requirements, supporting the identified consensus data needs of the region.
5. The Council program would further benefit if monitoring matrices for other species groups were then developed using the CA process, to include;
    g. All natural origin salmon and steelhead populations (listed and non-listed)
    h. Lamprey
    i. Sturgeon
    j. Resident fish species (e.g. bull trout)
    k. Wildlife
    l. Hatchery origin salmon and steelhead

Data management activities could then be directly tied to the development and implementation of regional monitoring strategies. Work elements and reporting at the project and contract level could then be better aligned to ensure that RM&E information is focused on these agreed-to regional monitoring priorities, and would allow for data management funding to be targeted at developing and maintaining databases, websites, and repositories for these prioritized data.

6. CA methodologies for calculation of high-level indicators should be fully documented.
7. The StreamNet Data Store should continue to serve a role as a secure environmental data repository. If BPA has a desire to confirm that the Data Store is in receipt of datasets for projects that have designated the Data Store as their repository, an automated routine linking Pisces/cbfish.org and the Data Store should be developed and implemented.
8. StreamNet should continue to play a role in the development and deployment of emerging technologies in fisheries data collection through sponsorship of workshops on a biennial basis. If available, funding the engagement of agency-embedded staff in purchasing, development and testing of these technologies, with the objective of making data collection and transfer more efficient and secure across the region, can also be a StreamNet function.
9. StreamNet should continue to seek out efficiencies and new sources of revenue in order to fund agency operations that support regional data management priorities (i.e. field data stewards that compile and provide CA data). Where appropriate, the SNEC should recommend increases in traditional funding and support as needed, to complete the priorities they have established. When budget adjustments must be made, all parties should recognize the impact of these decisions on the data management process.
10. StreamNet partners should focus first on updating time series data for established trends (i.e., those already defined and mapped in the regional GIS) prior to making any effort to identify and map new stream survey reaches. The mapping of new trend locations or the refined mapping of existing trends should only be attempted after determining that the necessary GIS support exists at both the local and regional level.
11. Fish Distribution as a StreamNet data category should continue as a GIS dataset that is exchanged (or regionally harvested from data contributors) using GIS file formats. This was a significant shift from the traditional StreamNet data exchange model of regionally coordinated linear event tables when implemented in 2017. While less elegant than the historic approach (using stream routes and measures), this is a practical compromise that respects budget realities. This approach should provide the desired functionality of allowing end users and regional partners to simply visualize species distribution and habitat use type in map form.

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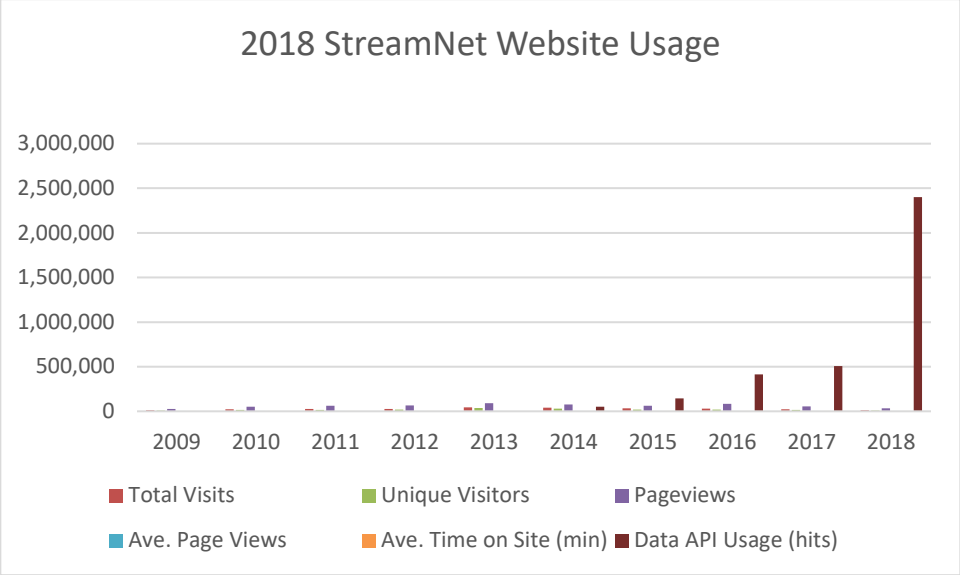
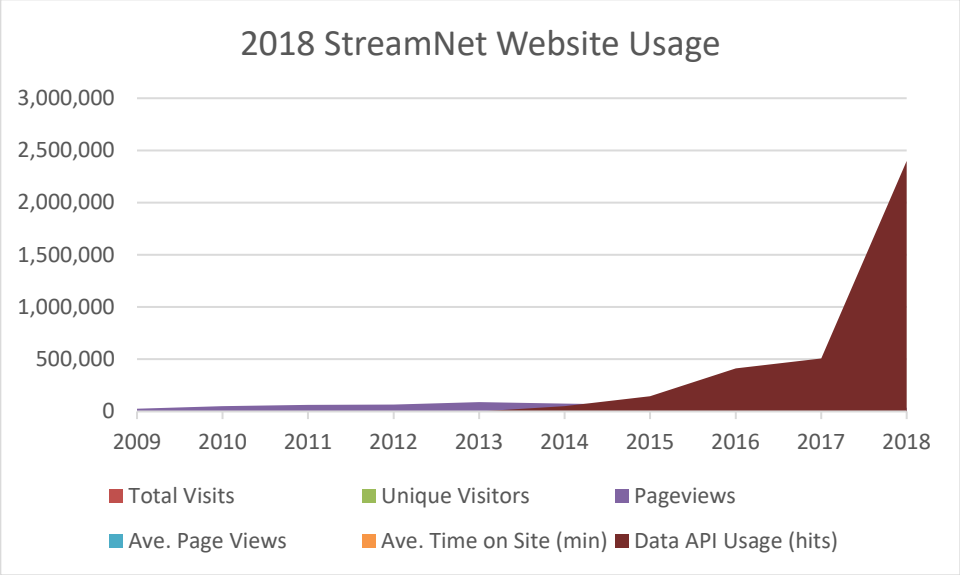
Appendix A: Use of Data & Products





Top users of the StreamNet website (no. of visits)	2,009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Internet service providers (Comcast, Verizon, etc.)	2,530	8,369	4200	12515	17711	17862	9241	10906	9621	6170
State of Oregon	594	974	881	961	600	640	776	948	380	203
U.S.D.A. Forest Service	339	593	0	443	393	241	347	308	218	172
National Oceanic and Atmospheric Administration	306	572	144	385	309	349	574	540	251	115
Bonneville Power Administration	150	296	141	258	220	213	448	536	173	91
U.S. Fish and Wildlife Service, IRM/BFO hq	185	262	111	182	109	201	256	388	208	86
Portland State University	39	55	0	88	73	70	146	103	40	81
OregonState University	64	148	40	152	186	158	187	175	146	77
Headquarters USAISC (US Army)	277	515	96	342	462	360	394	198	120	72
University of Washington	70	169	24	109	91	114	167	141	17	65
Washington State Department of Fish and Wildlife	261	584	36	156	89	165	194	220	111	64
State of Idaho	128	166	63	132	120	118	158	270	134	52
USDA Office of Operations	201	244	58	130	148	122	126	129	78	50
U.S. DOI Bueau of Land Management	95	155	81	186	139	122	176	125	83	38
Nez Perce Tribe							99	80	37	36

The number of unique visitor daily visits for StreamNet Mapping applications in 2018

Reporting period: 1/1/2018 - 12/31/2018		
Application*	**Unique Visits**	**Daily average unique visits**
StreamNet Mapper Web Application	4,585	12.6
Columbia Basin Fish Facilities Map Application	635	1.7
PNW Protected Areas & Streams Mapper	569	1.6

*These metrics only capture unique visitor accessing map data via the application. This does not include users who access the data directly as a web map service.

Appendix B: Detailed Results

Appendix B: Detailed Results

StreamNet Annual Report Details - Calendar Year 2018

A Support transfer of data into secure and accessible repositories

159. Transfer/Consolidate Regionally Standardized Data

Deliverable: StreamNet participants assist sponsors in securing data in appropriate repositories, as requested. Data are stored in appropriate repositories.

CTCR	CTCR continues to communicate with Project Sponsors, inventory data storage and offer assistance to secure accessible repositories.
IDFG	IDFG StreamNet supported state and tribal project sponsors in the transfer of data to secure and accessible repositories.
MFWP	MFWP StreamNet supported project sponsors in the transfer of data to secure and accessible repositories.
ODFW	ODFW StreamNet staff continued to assist and encourage BPA funded, ODFW, and local project sponsors to manage or locate their data within secure and accessible data repositories.
PSMFC	Gathered suggested repository information from StreamNet partners. Readied Data Store for repository function. Worked with BPA to identify projects where data sets are created but no repository identified.

PSMFC	Submitted data sets were reviewed and data/metadata suggestions were made as appropriate. Data Store and it's Publishing Service were maintained. No modifications were made to the Data Store this year..
WDFW	WDFW continues to communicate with project sponsors, review data storage and offer assistance to secure accessible repositories.

B CA data - coordination

189. Coordination-Columbia Basinwide

Deliverable: StreamNet provides leadership and coordination for the Coordinated Assessments project, including participation in the CA core team and planning group, leadership of the DES Development Team, leadership of the technical aspects of the project, and overall project participation and coordination. A 5 Year Plan for the CA Project is established and maintained.

CTCR	CTCR Data Steward participated in CA Planning Group, Exchange Configuration Team, and Hatchery Indicators Teams for DES development, provided feedback on the DES.
IDFG	IDFG StreamNet staff participated in the CASC, CATC, and supported development of CA DES and streamlined data flows via the API.
ODFW	ODFW participated in CA Planning Group, DES Development Team, and StreamNet Technical and Steering Committee meetings, along with state and other regional discussions, workshops and planning efforts related to trend data development and CA data flow. Focused attention was given to field and record level validation rule reviews and DES development efforts. Staff continued contributions to BPA regarding priority population commitments and responding to requests from StreamNet partners.

PSMFC	Regular activities during the year included CA Core Team and DES development. Project administrative duties were completed. Project goals and objectives were reviewed with the Steering and Executive Committees, and quantitative targets set for obtaining data for priority populations. Data flow was monitored and reported.
WDFW	WDFW StreamNet continued this year to participate in the CA process. Attention was given to DES development efforts, working with other agencies on overlapping populations, and continued development of data flow. Staff developed the code and process to update CA tables with final products.

C CA data - DES and database

160. Create/Manage/Maintain Database

Deliverable: The CA DES is maintained and updated to include new indicators and their supporting metrics and metadata, and CA data are loaded and QA'd in a conforming database. Discussions are held with states, tribes, NPCC staff, and others concerning development of DES for other fish metrics. Timelines and priorities are established in a 5 Year Plan for developing regional DES's.

CTCR	CTCR staff participated in the DES development meetings.
IDFG	IDFG StreamNet staff continued to support the development and maintenance of CA DES and database including validation and uploads via the API.
MFWP	CA indicators and DES' have not yet been developed for resident fish. MFWP staff are aware of work being done for the CA project and will be prepared as work begins to develop metrics and indicators for resident species.

ODFW	ODFW staff contributed to CA DES discussions, various forums and email correspondences throughout the year, including reviewing and providing input on draft StreamNet trend related data validation rules for codes, error messages and definitions for each rule.
PSMFC	C.A. data flow continued. Held meetings with DES development teams. Additional proposed changes to the DES were identified and discussed for possible implementation. Implemented new DES management structure at PSMFC after Kinney retirement.
PSMFC	Version 20170701 of the CA DES was published. Major changes included 1) improving acknowledging organizations that contributed to calculation of the HLI values, 2) refining the information collected for SAR and R/S estimates, and 3) allowing each organization to identify which of their data they consider their best estimate when they provide alternative values based on different assumptions.
WDFW	WDFW continued development of internal CA reporting database and participated in all DES development and technical meetings

D CA data - compile data

159. Transfer/Consolidate Regionally Standardized Data

Deliverable: All available CA indicators and metrics are obtained, updated, converted to the DES format, and exchanged with the CA database.

CTCR	Available CA indicators and metrics have been obtained and the process of converting to DES format and exchange has begun.

IDFG	Links to data sources were updated, and the queries ran to extract, transform, and load for all indicators and species available into the IDFG HiLI and on to the regional CAX databases via the API.
ODFW	Staff compiled and submitted all Priority 1, 2, and 3 ODFW population commitments identified by BPA for the biological opinion (BiOp) via the CA API. The submission included updates to existing datasets and additional new datasets for both adult and juvenile natural origin abundance and productivity indicators and metrics for the data exchange standard (DES). New indicators and metrics included juvenile outmigrants, juvenile RperS and SAR data. Also, Lower Columbia, Middle Columbia and Snake River DES data was processed and uploaded to the ODFW Recovery Tracker public website. Staff developed a draft of the Snake River spring Chinook Viable Salmonid Population (VSP) Compendium, a detailed field and analysis methods document for CA indicators and metrics.
PSMFC	Measurable goals developed thru the Executive Committee, reviewed with the StreamNet partners, and incorporated into the CA work plan. Revised and updated the 5 year plan for the CA project, which was adopted by the Executive Committee. Estimated and reported data flow. Attempted to maximize data flow for BPA priority populations.
WDFW	Staff compiled and submitted all Priority 1, 2, and 3 WDFW population where data is complete and finalized by biologists. The submission included updates to existing datasets and additional new datasets for both adult and juvenile natural origin abundance and productivity indicators and metrics for the data exchange standard (DES).

E CA data - automated data exchange

160. Create/Manage/Maintain Database

Deliverable: Automated feeds of CA data to the CA database are implemented, maintained, and evaluated for effectiveness, and automated data feeds to NOAA are initiated.

CTCR	CTCR initially used StreamNet's Access Database/API to transfer and update Natural Origin Spawner Abundance data. Beginning in late 2014, CTCR collaborated with Sitka Technology Group to replicate the data transfer so that it occurred from their servers, which is where the CTCR data system of record now resides.
IDFG	IDFG StreamNet staff collaborated with PSMFC staff to update validation rules and used web services to exchange data between IDFG, StreamNet, and the CAX HiLI database via the APIs.
MFWP	CA indicators and DES' have not yet been developed for resident fish. MFWP staff are aware of work being done for the CA project and will be prepared to assist with resident species indicator development and associated data management.
ODFW	The ODFW process to transmit CA data to StreamNet via the StreamNet API continued to be used successfully throughout the year. ODFW database systems and procedures were modified to conform to the updated data exchange standards. The ODFW Recovery Tracker website was updated to accept new data, and improvements to content and file structure were identified and implemented. Staff continued to trouble-shoot and edit the SQL online spawning ground survey database that will eventually allow standardization of spawning ground survey data across ODFW and will increase efficiency for data uploads from the field to the database. The database still has some operational issues and outside funding is needed to fix them before full use of the system is possible. An instructional manual has been drafted for users when the program does become fully functional.

PSMFC	A script to build all SQL Server tables related to Coordinated Assessments was posted on the StreamNet Coordinated Assessments and PNAMP web sites. Additional validation rules and related error messages were embedded into extended properties of Coordinated Assessments tables' fields in order for the StreamNet API to validate field-level values on records submitted to StreamNet against the Data Exchange Standard. Additional record-level rules were also defined. Reports were designed to summarize Coordinated Assessments data flow and incorporate related StreamNet Trends and NPCC Dashboard links and BPA priority tiers.
WDFW	Work continued on automated data feeds to StreamNet CA using the StreamNet API. Internal Agency data systems are in the process of being modified to contain CA indicator data. Internal databases and application that import, export, transform, and transfer data necessary to populate the CA focal tables were updated.

F Data - dissemination

161. Disseminate Raw/Summary Data and Results

Deliverable: The CA indicators, metrics and metadata are available, consistent with a Data Sharing Agreement on either the StreamNet website, other regionally significant sites such as those maintained by the NPCC. Website(s) provide functional, attractive, and relevant access to key data, including CA indicators. Requests for information or assistance are responded to within one business day at PSMFC. If within StreamNet capabilities, requested help or information is provided as rapidly as reasonably possible within existing resources. Metadata for the pilot explorer are provided to Sitka via web services in conformity with the project metadata exchange standards. All data that are submitted by the source agencies are available for review and download through the StreamNet online query systems and as web services. The Data Sharing Agreements are implemented effectively for CA and the Data Store.

CTCR	CTCR responded to 12 data requests this year which were either met by directing users to appropriate data sources, or by running specific queries in the OBMEP database to fulfill the request.
IDFG	IDFG StreamNet staff responded to data requests coming from internal and external partners, and the general public. The number of data requests continues to decrease as the number of IFWIS, CAX, and StreamNet users increases, and people find data for themselves.
MFWP	MFWP StreamNet staff responded to all data and map requests coming from internal staff, partners and the public. Many external data requestors are being referred to the FishMT web query system or the MFWP Open Data site to meet their data and GIS needs. Internal requests consist of data queries and map requests that internal staff cannot complete themselves. MFWP GIS staff received 42 GIS Request and 45 data requests during the calendar year and requests are tracked through an internal HelpDesk ticketing system.
ODFW	Oregon StreamNet staff responded to data requests coming from internal and external partners, and the general public, with GIS, data, and tech support requests being the most frequent. Agency staff are also viewing StreamNet-funding staff as a resource for assistance with developing standards.
PSMFC	Automated sharing with multiple organizations and tested data flow. Maintained focus on acquisition of indicators for BPA priority populations, as prioritized by the Exec Comm.
PSMFC	Made significant improvements to the website and the Data Store in 2016. The StreamNet web site was updated as needed and new project and data pages added. Maintained website and regularly fixed errors. Updated design of CA data display and query system. Reviewed with Steering and Executive Committees as well as CAPG. Continued integration work with NPCC dashboards and indicators. Discussed integration with NPCC Objectives database.

PSMFC	Direct requests for information have become less frequent over the years, as our web site has been more stable, our online services more robust, and our priority shift to population-scale data has meant that our traditional data are not updated as frequently. Only 19 non-trivial direct requests were received in 2017. These requests break out as follows:----------AGENCY TYPE----------College / university = 2Government, federal = 6Government, state = 4Government, tribal / tribal organization = 1Industrial / commercial = 1Nonprofit organization = 1Private consultant = 3Watershed council / group = 1----------REQUEST TYPE----------Data request = 4GIS data / map = 2Hardware / software technical support = 3Help with data interpretation / analysis = 1Library / Documents = 2Report error or problem = 4Other = 3----------OUTCOME----------Could only refer user to other info source(s) = 1Request fully satisfied = 15Request partially satisfied = 3
PSMFC	Implemented data sharing agreement.
PSMFC	Maintained and reviewed CA DES standards regularly. Developed and implemented validation routines. Initiated use of APIs.
WDFW	WDFW StreamNet staff responded to data requests coming from internal and external partners, and the general public, with GIS, data, and tech support requests being the most frequent.

G Compile high priority traditional StreamNet data

159. Transfer/Consolidate Regionally Standardized Data

Deliverable: Specific high priority data sets are updated and maintained. Data is compiled for selected metrics. As regional priorities for resident fish and other fish metric data are established via a CA-like process, managers are surveyed to determine the availability of such fish metric data, by priority, to detail the availability, type, and location of data. Integration with state and tribal web-based data systems is implemented where possible to do so.

CRITFC	Initiated process to regularly update linkages via monthly xml extract. Implementation is ongoing.
CTCR	CTCR's "traditional StreamNet data" included juvenile snorkel densities, redd counts, and video counts. However, the Coordinated Assessments project now captures adult steelhead spawner estimates which the redd counts were a part of. Redd count data and snorkel densities are still available on CTCR's website, and video counts are submitted to and available on the DART website.
IDFG	IDFG StreamNet staff compiled and delivered fish data to StreamNet as time and staffing allowed. The CA metric data for Chinook, steelhead, and sockeye salmon redd counts and hatchery returns were all updated through 2018. Additionally, the Generalized Fish Distribution was updated for chinook, steelhead, and redband trout. Updates were also made to the CRB Fish Facilities.
MFWP	MFWP compiled traditional Stream Net data throughout the year and using the new API exchanged the following data: 3 references, 133 redd surveys at 4 new locations. The entirety of Montanans fish distribution database for the Columbia basin was exchanged via GIS layers, including 25 updates. Fish population and genetic data were submitted as independent data sets.

ODFW	ODFW submitted 70 new and updated 1,211 existing (including 710 Trends for EscData only) traditional data records, including index redd, peak, carcass, spawner and juvenile counts, dam/weir trap counts, and juvenile and spawner abundance estimates for recovery populations from BPA projects in the Lower Columbia, Willamette, Mid-Columbia and Snake River ESU. A significant portion of the updates originated from developing record and field level validation rules and conducting QAQC for the new Trend API. These data contribute to Council websites and Biological Opinion (BiOp) assessments, and were submitted via the StreamNet API. Staff assisted the Assistant Project Leader of the spring Chinook Lower Snake River Compensation Program, with converting old .mxf files to shapefiles for the purpose of salvaging spatial Snake River spring Chinook spawning ground survey data from 2005-2007. Additions were made to the Oregon Fish Habitat Distribution Database for both anadromous and resident salmonids as well as other species (e.g. Pacific Lamprey, Bull Trout and White sturgeon) in the Columbia Basin. A total of 14 species habitat distribution datasets were converted to the data exchange standard format and provided to StreamNet, along with current metadata. Updates were also made to the NHD-derived statewide whole stream route dataset.

PSMFC	Data Category	(Available data / Years / Total records)
	Redd Counts	(5,257 time series / 1901-2017 / 49,517 records)
	Spawner Counts	(5,573 time series / 1944-2016 / 37,550 records)
	Spawner Abundance Estimates	(3,258 time series / 1901-2016 / 22,984 records)
	Hatchery - Returns	(1,095 time series / 1906-2017 / 10,518 records)
	Dam / Non-hatchery Weir Counts	(580 time series / 1925-2017 / 14,908 records)
	Fish Counts	(422 time series / 1953-2016 / 1,098 records)
	Fish Abundance Estimates	(122 time series / 1996-2016 / 384 records)
	Freshwater / Estuary Harvest	(2,708 time series / 1894-2015 / 41,495 records)
	Harvest - Marine	(579 time series / 1950-1996 / 7,198 records)
	Fish Distribution	(26,322 streams / 63,658 records)
	Facilities - Barriers	(64,261 barriers)
	Facilities - Dams	(7,882 dams)
	Facilities - Hatcheries	(539 hatcheries)
	Protected Areas	(29,524 records)

WDFW	All available and up to date population level CA data data was submitted to StreamNet. Staff continued work to update the interior Columbia River traditional trend data as time allows when not focusing on CA metrics.

H Coordination

189. Coordination-Columbia Basinwide

Deliverable: StreamNet participants coordinate with regional entities to manage and improve data sharing at the Columbia Basin scale. Coordinated Assessment-like efforts are initiated to determine specific target data needs and then collaboratively develop standards and methods that simplify, standardize, and automate data flow to meet regional priorities.

All	StreamNet partners presented information on the project at multiple forums, including the NPCC, AFS, internal meetings, and related organizations. Oregon staff created a Story Map Journal project hosted in ArcGIS Online for internal and external outreach pertaining to the StreamNet Project and ODFW's Natural Resources Information Management Program. Oregon staff also attended the NOSA Steelhead Methods Review Workshop via teleconference and provided input for a presentation given by the Eastern Oregon Fish Research Program Director. The workshop was an effort to share and explore the standardization of steelhead NOSA methods across the Columbia Basin.
CTCR	CTCR anadromous division coordinated with other separately funded CTCR programs such as the Chief Joseph Hatchery and the Resident Fish Department to keep them informed of the efforts and data structure CTCR was using for the Coordinated Assessments project.
IDFG	IDFG StreamNet expanded streamlined data flows for CAX HiLI data to include new species, populations, and life stages. We coordinated data management and analyses with tribal collaborators. We implemented updates per FWP feedback.
MFWP	Staff participated in Western Association of Fish and Wildlife Agencies (WAFWA) efforts which relate directly to the use of StreamNet data. No other support was identified or requested.

MFWP	MFWP StreamNet staff updated the central YCT Assessment database with 2018 data. Staff submitted a YCT Range-Wide2018 Access database and YCT2018update geodatabase to the StreamNet Data Store. MFWP StreamNet staff plan to attend the annual range-wide YCT meeting and report on activities done throughout the year. Work on a range-wide Story Map is ongoing and will be completed by MFWP biologists during the 2019 contract year.
ODFW	StreamNet staff responded to BPA requests for data that were not previously in CA. Staff also assisted Eastern Oregon Fish Research (EOFR) biologists with specific issues related to a BPA request to provide inventory information for all rotary screw traps that were funded by BPA, including available metrics, data location, and answering questions on missing data. Staff met with PNAMP to discuss monitoring methods and the incorporation of analytical method protocols into the MM.org structure. It was discovered that in some cases, NOSA is not listed in a Project's SOW, therefore it is not included in MM.org. It was decided that PNAMP would discuss this with BPA to figure out how to move forward. Oregon StreamNet contributed input to the Independent Scientific Review Panel (ISRP) program review.
PSMFC	
PSMFC	Prioritized coordination efforts through the Executive Committee, CA project, website, and NPCC.
PSMFC	Maintained a common facilities GIS dataset to improve quality and function in StreamNet, RMIS, and PTAGIS. Incorporated sharing of data from the Fish Passage Center in the CA database. Maintained HEP, Protected Areas, and Data Store datasets/repositories.
PSMFC	Worked with PNAMP to foster documentation and encourage improvement and participation in mm.org. Worked with data providers and CRITFC to ensure that documentation of trends via links to StreamNet library were maintained and updated.

PSMFC	Integrated Data Management Objectives into the current SOW, the CA project, and the general priorities of the StreamNet project. Reviewed CA data flow with BPA and maintained focused effort to obtain data for BPA priority populations.
WDFW	WDFW provided support to the program, including continued leadership of the CA project through the CA project steering committee.

I Enhance data efficiency

160. Create/Manage/Maintain Database

Deliverable: Agency database systems and procedures are enhanced over time to improve data flow efficiency. Web services are established, and automated flow of data to StreamNet is tested and implemented. Regional discussion and testing of devices and associated applications and storage systems occurs as funding is available. If funding and staffing permit, jointly sponsor workshops on electronic data collection.

CTCR	Beginning in late 2014, CTCR collaborated with Sitka Technology Group to establish direct connections between StreamNet's and Sitka's servers, which is where the CTCR data system of record now resides.
IDFG	IDFG StreamNet staff completed, corrected, and standardized data source workbooks for natural origin HiLI data. Validated and exchanged data with PSMFC using automated web services (i.e. SNapi).

MFWP	StreamNet staff implemented the use of the StreamNet API to achieve automatic data submission. Internal scripts were modified to accommodate the use of the API. MFWP implemented a fish distribution editor web map application to facilitate biologist data review and data updates. While this work was done outside of the contract and without StreamNet funds, it greatly benefits the program. MFWP application developer and StreamNet staff time and resources were not available during the 2018 year to investigate or implement web services for MFWP data.
ODFW	The ODFW applications and processes used to transmit CA data to StreamNet via the StreamNet API were enhanced to support traditional trend data. This work included not only enhancements to the CA applications, but the creation and maintenance of a SQL Server database to contain ODFW traditional trend data. All approved record and field-level validation rules developed for the Trend API by the Technical Committee were updated and implemented. New Data Clearinghouse records were added, and existing records were updated, increasing overall data availability and our ability to flow data using automated approaches. Staff worked to make changes to the Data Clearinghouse that will help file attachments within records be more discoverable. Fish habitat distribution data were submitted to StreamNet as stand-alone GIS datasets, thus circumventing the need to maintain these data in a linear referenced format in association with the whole stream route hydrography dataset. Options for submitting trend location geometries were evaluated in coordination with regional staff. Partners outlined options for submitting TrendID and spatial data (locations) in a geodatabase as separate feature classes (point, lines, waterbodies, and supercodes) for all related data trends submitted through the API. The new submission procedures are slated to begin in 2019.
PSMFC	Automated data flow has been achieved for most partners via the StreamNet API. Continued development of the automated data validation techniques and reviewed with partners.

PSMFC	Continued to support partners' database development and maintenance. Improved coordination with NOAAF and NPCC.
PSMFC	Final report on project posted on website. Biennial workshop will be held in 2019.
WDFW	Staff continued work to improve WDFW database for a more automated data flow to StreamNet.

J Infrastructure and base operations

160. Create/Manage/Maintain Database

Deliverable: Project infrastructure and databases are maintained and updated as needed to acquire, manage and disseminate referenced data.
Specific actions may include:
1. Computer system administration, including maintenance and upgrades to hardware and software, backup and recovery, and system security, as necessary
2. Application of appropriate data management and QA/QC procedures in loading and managing data and creation of metadata
3. Creation and maintenance of interfaces and applications to enhance data flow efficiency
4. Participation in routine management and improvement of the StreamNet Data Exchange Standard working through the Steering Committee.
5. Obtain reference documents for all data developed under WE 159 and submit them for inclusion in the collection and catalog, and,
6. Encourage and support the flow of agency reports and publications related to Columbia Basin fish and wildlife resources to the library.
7. Maintain and further develop integrated search capabilities based on the Fish Species geo-spatial datasets.

CTCR	CTCR collaborated with Sitka Technology Group to host and manage CTCR's OBMEP database. Sitka maintains database infrastructure and runs routine and redundant backups of CTCR data. They also maintain existing custom applications and are developing new tools for collecting, editing, finalizing, and distributing fisheries data.
IDFG	IDFG StreamNet staff did regular system and database administration, backup and recovery. We also updated applications and web services for StreamNet data and Coordinated Assessments. The IDFG spatial fishery databases were updated with new data. Existing applications and databases were enhanced per user feedback, and new applications and databases were supported by technical staff.

MFWP	MFWP Stream Net maintained computer infrastructure and operations to assure efficient and effective management and flow of data internally and from MFWP to the StreamNet database. MFWP is actively maintaining, designing and developing the database and infrastructure of the internal Fisheries Information System. In 2018 this work was done by MFWP Application Development staff with assistance of a sub-contractor funded with StreamNet dollars. MFWP staff, both funded and not funded by StreamNet, continue to develop or enhance tools to update hydrography layers. MFWP StreamNet staff continues to support and update relevant GIS mapping services and datasets for MFWP internal web mapping applications and for dissemination to the public through the agency Open Data website.

ODFW Routine and required system management and maintenance was performed throughout the year. Data management protocols, indicator and metric data files, analysis flow diagrams, databases and website user interfaces were updated and managed to accommodate the ODFW Recovery Tracker, traditional StreamNet and Coordinated Assessments DES and internal website modifications, as needed.

Multiple infrastructure components were consolidated into a single component used by all applications, reducing the ongoing support effort. Processes were enhanced to improve management of user accounts and software licenses. Investigation and planning began for upgrading the server infrastructure to Windows Server 2016 and SQL Server 2016 in 2019.

ODFW continued an effort to improve the accuracy of over 39,000 old ODFW Library electronic bibliography records that now reside in the Data Clearinghouse (DC) in order to preserve the historic record of ODFW documents, with the goal of providing access to digital copies of these documents. 2,175 existing records were updated, and 548 new DC records were reviewed, edited and approved, using alternate funding for non-Columbia Basin records. Staff made significant progress during the year to locate and upload electronic versions of ODFW Fisheries Information Reports, Progress Reports, Oregon Plan Reports, fish management reports, status reports, angling regulations, creel surveys and BPA funded reports published in the 1940's through the 2000's.

ODFW utilized the first half of 2018 to improving data validation rules and QAQC procedures to support the development of the new SN Trend API. Staff spent significant time and resources contributing ideas for record and field-level validation rules, validating API rules and SQL scripts, submitting error routines, testing the results on agency systems and providing recommendations to regional staff for improving data flow to the API.

ODFW updated 5 and added 53 new reference records and memos and submitted to the StreamNet Library. Staff filed and stored electronic documents for dam counts at hydropower facilities, joint staff reports, other online resources, data sets and reports. Information was obtained through email list serves, the Internet, or as a data request and are stored in an ODFW server directory. Continued to document, enter database records, and create memos obtained through electronic transmittals and data requests to the program, as needed.

ODFW upgraded Portal for ArcGIS software and continued to maintain the Fish Habitat Distribution and Barrier Data Editor application. The GIS license server was upgraded and all agency desktop GIS applications used for StreamNet

	work were upgraded to the current version. Staff reviewed the StreamNet website to assess issues with the search tool for related data. Functionality that may cause desired information to be missed was discussed with PSMFC staff. Staff initiated an in-house inventory of CA and Related Data indicators and metrics, and is cross-walking them to work elements within data collection/analysis project SOWs. This will help track and prioritize data submission efforts to the CAX and StreamNet Related Data. Existing data management plans were updated, as needed, that direct the timely collection and submission of StreamNet Related Data for populations of the Snake River spring Chinook ESU and the Snake River and Middle Columbia steelhead DPSs. Staff added Interior Columbia Technical Review Team (ICTRT) thresholds and goals as metrics in the ODFW Recovery Tracker for Snake River steelhead and chinook and Middle Columbia steelhead.
PSMFC	Maintained operations of the databases and migrated all production databases to a virtual SQL Server 2016 environment. Maintained DES through periodic review and discussion with partners. Worked with library staff to resolve issues related to updating links to documents. Implemented improvements to the facilities mapper across multiple PSMFC databases and programs.
WDFW	WDFW StreamNet staff did routine and required system and database maintenance and backup. Reviewed the new validation rules for related Trends DES to understand the new StreamNet API process of uploading this data effectively. WDFW has implemented data sharing via the API and updated internal reporting databases

K Manage project activities

119. Manage and Administer Projects

Deliverable: Regional data management priorities are addressed and project staff and budgets are effectively managed. Work detailed in this SOW is accomplished. Required SOW and budget documents are prepared and submitted on schedule.

CTCR	
FWS	
IDFG	IDFG StreamNet staff, budgets, and resources were effectively managed to meet all program objectives.
MFWP	MFWP StreamNet staff participated in project management, StreamNet Technical and Steering committee meetings. Staff were effectively supervised, and budgets were effectively tracked and managed. Staff participated in all relevant budget and Statement of Work discussions and provided input to SOW and budget.
PSMFC	Held regular meetings with the Executive Committee, the Steering Committee, BPA, NPCC, and others to ensure program alignment with regional fish and wildlife managers. Substantially simplified and streamlined the SOW. Reduced PSMFC staff dependence on BPA budget and made funds available to other partners.
PSMFC	Done on schedule. New 2 year contract implemented in 2017.
PSMFC	Done on schedule. Year 2 of a 2 year contract implemented in 2017.
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PSMFC	ODFW StreamNet staff participated in project management, StreamNet Technical and Steering Committee meetings. Staff were effectively supervised, and budgets were tracked and managed throughout the year. ODFW StreamNet staff provided input to Statement of Work and budget discussions, and submitted updated inventory reports to Regional StreamNet.
PSMFC	Regular meetings were held with both groups in 2018. Agendas were formulated, issues discussed and resolved where possible, and priorities were set. Reporting and posting of notes and decisions was facilitated via the StreamNet website.
WDFW	WDFW StreamNet staff participated in project management, StreamNet Technical and Steering Committee meetings. Staff were supervised, budgets were tracked and managed throughout the year. Staff provided input to the SOW and budget.

L Submit Progress Report for Calendar Year 2017

132. Produce (Annual) Progress Report

Deliverable: Finalize and submit 2017 Annual Report to BPA for upload into Pisces and cbfish

CTCR	CTCR provided input for the Annual Report
IDFG	IDFG StreamNet staff provided input for the Annual Report.
MFWP	MFWP StreamNet staff provided input for the Annual Report.
ODFW	ODFW StreamNet staff provided input for the Annual Report on schedule.
PSMFC	Done on schedule.
PSMFC	Done on schedule.
PSMFC	Done on schedule.
PSMFC	Completed as required in CY 2018.
WDFW	WDFW StreamNet staff provided input for the Annual Report on schedule.

N Produce Status Reports for BPA

185. Produce Pisces Status Report

Deliverable: Status Report submitted on quarterly schedule.

All	Completed as required in CY 2018.

All	Completed as required in CY 2018.
All	Completed as required in CY 2018.
All	Completed as required in CY 2019.

O Produce BiOp RPA Report 2017

202. Produce BiOp RPA Report

Deliverable: The online BiOp RPA report in Taurus (https://www.cbfish.org/BiologicalOpinionAction.mvc/Index/2014/BiOpRpaStatus) should include the data, analyses, and data management completed no later than December 31st. Any activity after the last day of the Calendar Year should be included in a subsequent BiOp report. For example, if you have completed redd surveys, but have not completed the scale analyses, you will report the preliminary data (# of redds), but not (incomplete) age distributions of carcasses, which would be reported in the subsequent CY report.

PSMFC	Completed as required in CY 2018.
PSMFC	Completed as required in CY 2018.

Q Other accomplishments

986. Catch-all for FY-18 SOW items or anything else in Calendar Year 2018

Deliverable: Catch-all for elements from the FY-18 SOW or anything else you'd like to report

CTCR	CTCR did not conduct any work beyond the SOW.
IDFG	IDFG StreamNet staff did not use BPA funding to do any work outside of the SOW.
MFWP	MFWP staff with a small amount of StreamNet staff support have upgraded the MFWP GIS infrastructure to ArcGIS 10.6. As datasets are increasingly shared with StreamNet as spatial layers, it's critical that agency infrastructures are current.
ODFW	ODFW StreamNet staff did not use BPA funding to do any work outside of the SOW. Utilizing other funding, staff developed three new super populations for dependent population groups of Coastal coho and submitted to PSMFC for inclusion into the Populations DES table. Oregon StreamNet staff also chaired and participated in GIS Coordination Group activities, including the administration of a survey regarding training needs and a resultant GIS Training Strategy for the agency. Improving GIS skills across the agency will help increase data flow efficiency to StreamNet. Lastly, ODFW continued an effort to improve the accuracy of over 39,000 old ODFW Library electronic bibliography records that now reside in the Data Clearinghouse (DC) in order to preserve the historic record of ODFW documents, with the goal of providing access to digital copies of these documents. Non-Columbia Basin records were improved using alternate funding. Staff made significant progress during the year to locate and upload electronic versions of ODFW Fisheries Information Reports, Progress Reports, Oregon Plan Reports, fish management reports, status reports, angling regulations, and creel surveys.
PSMFC	Work has been reported elsewhere.
WDFW	WDFW StreamNet staff did not use BPA funding to do any work outside of the SOW.