StreamNet 2017

Annual Report

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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 through 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 2017 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. This document prioritizes the work of collection of data from 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 (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 efforts continued to be focused on these populations. In 2017 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.

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

The StreamNet subprojects in the state agencies all contributed to development or improvement of agency data storage systems in 2017. Additional resources were allocated to the Washington Department of Fish and Wildlife (WDFW) through cost savings made at the Oregon Department of Fish and Wildlife (ODFW).

During 2017 an Emerging Technologies workshop was held. StreamNet worked with PNAMP, Sitka Technologies, and the Western Forestry Resources Center to support this effort.

In addition to CA, focus continues to be on increasing the speed and efficiency of data conversion to the regional standard StreamNet Data Exchange Standard (DES), 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 and/or to transfer data to StreamNet via web services. At the end of CY 2017, a meeting was held to discuss use of Application Programming Interfaces (APIs) to share “trend” data that was related to CA populations.

A wide variety of data types were disseminated through the StreamNet website in 2017 (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 83,182 pageviews in 2016 to 54,677 pageviews in 2017. Data exchange via API (automated programming interface) continued to increase dramatically, rising to 508,123 hits in 2017. Use by key data providers/users such as state and federal agencies decreased from 2017, likely, at least in part, because data exchange via 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 (IQS) 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 2017. 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 these indicators will continue to require more time and/or more resources. In CY 2017 CRITFC was successful in receiving a grant from the EPA to help build capacity for data sharing in the CRITFC member tribes. Coordination with this project is an ongoing priority.

2017 was the fourth year of the project's Executive Committee. 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. The Columbia River Intertribal Fish Commission (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 StreamNet Executive Committee should continue to be used to focus and prioritize the CA Project. This should specifically include prioritizing selection of new high-level indicators, taking into account regional data needs, such as NOAA status assessments and NPCC high-level indicators and dashboards. Priorities should incorporate realistic assessments of available staff and other agency priorities.
2. The StreamNet Executive Committee should continue to encourage expanded membership on the Executive Committee for any entity, especially tribes, who are significant data providers.

3. The StreamNet Executive Committee should also continue to evaluate and prioritize updating traditional StreamNet data sets to reflect an emphasis on those that add value to ongoing regional O&M efforts. These include updating geo-referenced surveys that are supportive of a more granular understanding of high-level indicator trends, and maintenance of regional databases such as fish distribution and facilities.
4. StreamNet should provide accessible and useful displays of information at the regional scale, with special focus on the CA project. Improvements to the StreamNet website should include GIS-based, population level graphical presentation of the high-level indicators as they are developed. StreamNet should also assist in supporting the efforts of others (NOAA, NPCC, etc.) who are engaged in similar efforts by focusing on automating and streamlining the flow of data for these efforts.
5. While focusing the CA project on high-level indicators that support regionally significant monitoring efforts, clear direction and consensus should be used to guide agencies and tribes to submit data that support population level assessments. Where such data are lacking, the Executive Committee should provide overall project direction to address any concerns. If warranted, they may wish to use lower level or even higher-level information and incorporate that into the CA database.
6. The StreamNet Executive Committee should periodically evaluate whether regional data collection and management efforts are aligned with the high-level data needs identified by the users of CA data, and make recommendations for funding and support provided to BPA, NPCC, NOAA, and others from a regional perspective.
7. Where data are needed in support of regional prioritization (i.e. resident fish data for NPCC indicators and dashboards), StreamNet should prioritize infrastructure and data management assistance needed to support such indicators. This will require advance planning in order to potentially shift resources or request additional support, as agencies are currently fully committed to ongoing efforts. BPA and the StreamNet Executive Committee should clearly convey to agencies the importance of contributing to regional efforts. This will assist in gaining acceptance and buy-in from agency managers and biologists.
8. CA methodologies for calculation of high-level indicators should be fully documented.
9. 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 and the Data Store should be developed and implemented.
10. 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.
11. 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 StreamNet Executive committee

should recommend increases in traditional funding and support as needed, to complete the priorities they have established.

12. 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.
13. 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 last year. 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 majority of fish-related data originate with the region's state, tribal and federal fisheries agency sampling programs. These data are generally used internally, and may be difficult to access across organizational boundaries. The need for regionally coordinated, securely stored, 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 supports a regional approach to data management, coordination, and standardization. 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).

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

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).

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

This project supports the 2017 Northwest Power and Conservation Council Fish and Wildlife Program. Specifically: Reporting 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, Columbia River Intertribal Fish Commission (CRITFC), and the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) to ensure that data managers can communicate, share, and interpret data effectively across boundaries. The StreamNet project 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 concentrate on coordination and efficiencies as our priority in 2017. 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. The primary focus of StreamNet staff in 2017 has continued to be implementation of the CA project, a regional cooperative effort to standardize and automate data reporting on key indicators for salmon and steelhead populations. Due to this focus, regular updates of more traditional trend data in StreamNet has 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 - 2017	54,125
Fish counts	474 Trends	1953 - 2017	1,523
Spawner counts	5,573 Trends	1944 - 2017	42,033
Spawning population estimates	3,258 Trends	1901 - 2016	24,003
Dam / weir counts	581 Trends	1925 - 2017	15,248
Juvenile population estimates	122 Trends	1996 - 2016	892
Hatchery returns	1,095 Trends	1906 - 2017	10,643
Freshwater harvest	2,708 Trends	1894-2015	41,724
Protected areas	29,524 Records	n/a	n/a
Fish distribution*	63,658 Records	n/a	n/a
Barriers*	64,261 Barriers	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 2017, fish distribution, barriers, dams, and hatcheries are being managed as GIS layers rather than as tables in a database.

StreamNet data specialists within the agencies accomplish data standardization and sharing. These data specialists locate and acquire data, convert them to standard (DES) format, perform Quality Assurance/Quality Control (QA/QC), add geo-referencing to tie the data to the stream network (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 database. 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 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.

In 2017, the CA database was utilized by the NPCC in building their **Population Objectives Mapper** (currently under development). The Council was able to use population polygons and indicator statistics when building the display and interactive mapping tool of this database of 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 created in 2004 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 and is funded primarily by BPA through the Columbia Basin Fish Accords.

Follow Idaho Salmon Home (FISH) provides access through IDFG to information on Idaho's wild and hatchery steelhead and Chinook salmon populations. If you've ever wondered how many steelhead came back last year, how old those fish were or simply how the wild salmon run from 2012 compared to previous years, this is the place for you. 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. Discover what they offer by browsing their Fisheries, Wildlife, Species Diversity, Lands and GIS resources. View the IFWIS applications, stay updated on latest releases by following the IFWIS Blog, or learn more about IFWIS.

FishMT is Montana Fish, Wildlife & Parks FWP's (FWP) new, public facing web application that provides users with access to vast amount of fish and fishing information. Through FishMT the public can get information related to 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 had been replaced by a new survey and inventory system (FIS). FIS is available through the agency internal website and holds survey data, individual fish information, distribution, tagging data and hatchery data to name a few. FIS also contains sophisticated analysis tools which incorporate the use of R statistical code. This application puts the data entry, analysis and reporting in the hands of biologists. The database is managed and maintained by the Technology Services Division of Montana Fish, Wildlife, and Parks. Data is continually updated, and

sources include FWP, US Forest Service (USFS), US Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM) and tribal fisheries biologists and supplemented with information provided in technical documents and reports.
Additional fisheries and related data can also be found through the FWP'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 basis.

The **Natural Resources Information Management Program (NRIMP)** supports the efforts of ODFW by:

- Identifying and prioritizing natural resource information needs for fish and wildlife management.
- Developing and promoting the use of modern data collection and analysis techniques.
- Promoting the use of technology that will benefit the department's natural resource data collection and management needs.
- Developing and providing consistent, accessible, high-quality information.
- Encouraging the synthesis and transfer of scientific information into management recommendations.
- Developing and promoting a multidisciplinary approach to fish, wildlife, and habitat management.
- NRIMP provides GIS data, maps and reports, data standards and protocols, information on angling opportunities within Oregon, and links to other state agencies.

The ODFW **Salmon Recovery Tracker** website provides information on the health of Oregon's anadromous salmon and steelhead populations. Website users can explore and download information related to salmon conservation and recovery in Oregon. The Salmon Recovery Tracker was built to make it easier for the public to explore the health of salmon populations and access critical underlying data. It is a first step in helping the state open its information to the public in an easy-to-use medium.

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. The goal of the Data Clearinghouse is to make Oregon's natural resource information more accessible and to provide a centralized accumulation and distribution service for Oregon's natural resource data. The increased availability of data provided by the Data Clearinghouse will support the Oregon Plan Assessment process, as well as other resource management efforts.

Compass, the first-of-its-kind online fish and wildlife habitat map provides 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.

ODFW continued the development of an enterprise-level resource information system based on the varied management processes and information used to carry out agency authorities and achieve the agency's mission for species and habitats in given locations through time. This system will significantly advance the agency's data management efforts and increase data flow and sharing efficiency.

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 middle school and high school 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.

Washington's eleven species and subspecies of native salmonid fish constitute a biological resource of spectacular commercial and cultural importance. Unfortunately, this resource is under heavy pressure from human population growth and development. Urban and industrial land conversion, forestry and agricultural practices, water diversion, municipal water demands, overfishing, and hydropower development have contributed to the decline of several salmonid stocks. A large recovery effort at the local, state, and federal level is currently underway to prevent further declines and improve the condition of already imperiled stocks.

The overall objective of WDFW's **SGS** is to help monitor status and trends of Coastal, Puget Sound, and Columbia Basin salmonid stocks. The Spawning Ground Survey database (SGS) 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 USF&WS **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.

The Council 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.

Subbasin plans are complex documents. To show key elements of these plans simply and efficiently, NPCC has made these "**dashboards**" for those subbasins with plans. They show extracts of the plans and links to related management plans, local maps, and contact information. StreamNet data are widely used in support of Cbfish, high-level indicators, and NPCC dashboards.

Data disseminated through the project 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 the respective state StreamNet projects or through the Columbia River Inter-Tribal Fish Commission (CRITFC), which is a full partner in the StreamNet project but which is supported through a separate contract.

During 2017 project data collection and coordination focused on leadership of the CA project with PNAMP. CA is an effort to locate and obtain derived data on high-level viable salmonid population (VSP) indicators, and to develop a DES for these indicators and supporting information.

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.

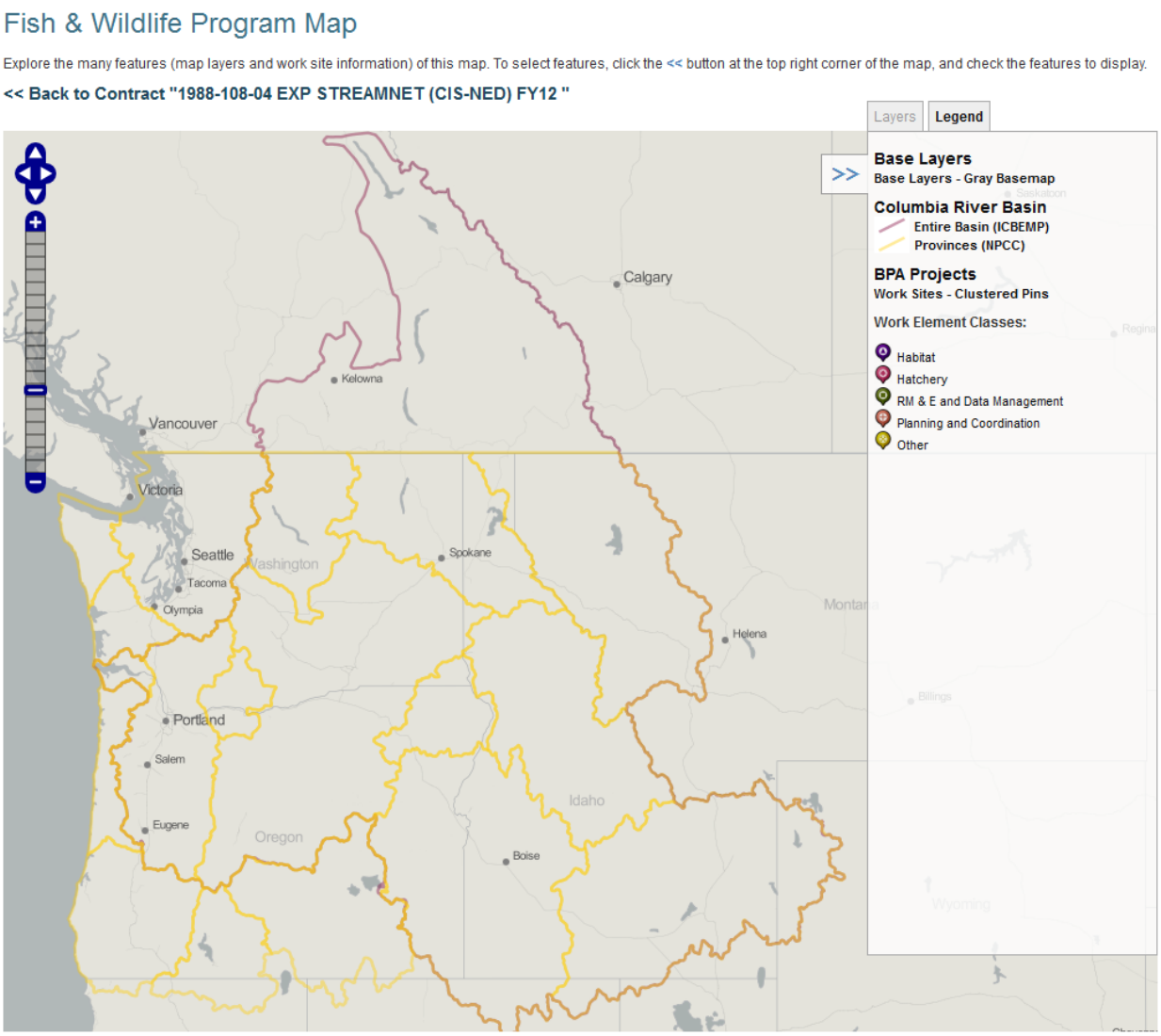


Figure 3. StreamNet Project Area: Columbia Basin

3. Results

Regional Coordination

StreamNet contributed to the coordination and standardization of monitoring data throughout the basin in 2017. 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, Confederated Tribes of the Colville Reservation (CCT), Montana Fish, Wildlife, and Parks (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 2017 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 2017. 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
Bryan Mercier, BPA
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
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. 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.

Routine coordination occurred in the Oregon GIS arena. In 2017, 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 now, 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. 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 Coordinated Assessments (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. The issue with overlapping population estimates was resolved through coordination with WDFW (Wenaha) and CTUIR (Grande Ronde, Umatilla, and Walla Walla StS and ChS 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 CY-2017. 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. ODFW's application that loads CA from an Access database into a SQL database and then on to StreamNet via the StreamNet API was also updated and enhanced. 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), 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.

Montana assisted in convening a Bull trout workshop during the contract year. The Northwest Power and Conservation Council, Montana Fish, Wildlife and & Parks, and StreamNet co-organized this workshop to identify existing Bull Trout objectives. The workshop helped to inform the Council's 2014 Columbia River Basin Fish and Wildlife Program's task for refining program goals and objectives; discuss existing reporting needs and data availability related to Bull Trout; and, to explore opportunities to facilitate data sharing across jurisdictions/entities.

Oregon spent significant time participating in the development, update and maintenance of the CA and StreamNet DES's throughout the year, including facilitating a major change to the CA RperS and SAR tables that were accepted by the DDT, and updating the application used to exchange the four CA DES indicators. Enhancements were also made to the ODFW Data Clearinghouse, and the ODFW Spawning Ground Survey web application to increase data flow efficiency continued. Staff updated the NHD-derived statewide whole stream route dataset. The Fish Habitat Distribution and Barrier Data Editor application was implemented 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 our 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 here: http://www.streamnet.org/hep.

Database 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) 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. At least 17 new or revised datasets were uploaded into the Data Store in 2017, ranging from Clearwater (Idaho) juvenile chinook telemetry to Montana trout genetic sample analysis.

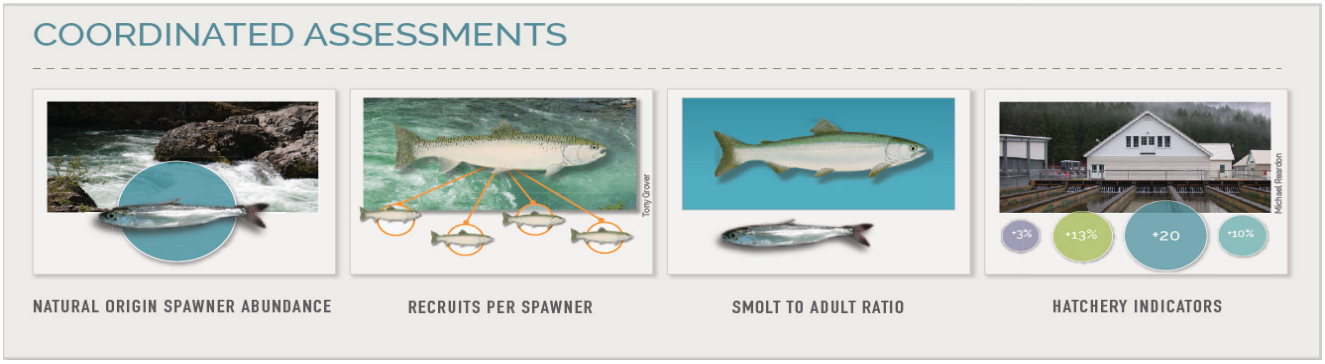
Identification of Management Questions and Strategies

A regional data management and coordination approach is necessary if the many data collectors in the basin wish to cooperate and share information. StreamNet serves this regional coordination function. The StreamNet Executive Committee brings together policy level fish and wildlife managers from across the region to review data management issues, set priorities, and direct the StreamNet partners at a policy level. The StreamNet Steering Committee, made up of data management professionals from within partner agencies, as well as technical experts representing many primary data consumers, then works to ensure implementation of the established regional data management objectives. Data managers from a diverse set of agencies and tribes are called together in regional forums to discuss topics of interest. These forums serve to identify data management questions that otherwise would be handled on an individual basis. Strategies can then be identified to address these questions and concerns, and data management considerations can be incorporated early in the development of monitoring plans and approaches.

The CA project is a result of identifying a key deficiency in regional data management, namely the potential inability to share and compare information on fish populations across structural boundaries due to differences in data collection and management practices. This has generally required decision makers to establish individual networks of biologists and staff to ensure the flow of data needed to assess fish populations. The CA project is designed to structure this flow so that it becomes standardized, automated, and sharable throughout the region; first on key VSP indicators, then expanding to other data as time proceeds. The BPA Data Management Strategy supports the CA project to promote sharing and proper management of data.

During 2015 the StreamNet Executive Committee established the priority of focusing on collection, review, and reporting of the Natural Origin indicators for populations (Figure 4). In 2017 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 FY 2017. Sharing and displaying SARs for superpopulations with FPC & CRITFC was implemented. The Committee also asked that we continue to work with CRITFC tribes to include them in data flow to the extent that resources allow them to do so. The Committee-directed StreamNet coordination with the NPCC led to a successful Bull trout workshop, hosted by MFWP in April, where we identified players and discussed data needs and regional data sharing for this species.

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.



Coordinated Assessments Data Flow in 2017

Published Coordinated Assessments Records

As of December 31, 2017

High Level Indicator	Agency[2]	Populations Reported[3]	Records From All Populations	TRT Populations Reported	Records From TRT Populations	% of the 213 TRT[4] Populations
Natural Origin Spawner Abundance (NOSA)	CCT	1	12	1	12	0.5
	IDFG	24	1,164	24	1,164	11.3
	ODFW	72	2,189	51	1,706	23.9
	WDFW	67	2,053	67	2,053	31.5
	All	164	5,418	143	4,935	67.1
Presmolt Abundance	CCT	1	31	1	31	0.5
	IDFG	0	0	0	0	0.0
	ODFW	4	81	4	81	1.9
	WDFW	2	20	2	20	0.9
	All	7	132	7	132	3.3
Juvenile Outmigrants	CCT	1	9	1	9	0.5
	IDFG	21	472	21	472	9.9
	ODFW	5	100	5	100	2.3
	WDFW	25	319	25	319	11.7
	All	52	900	52	900	24.4
Smolt to Adult Return Rate (SAR)	CCT	1	7	1	7	0.5
	IDFG	0	0	0	0	0.0
	ODFW	5	80	5	80	2.3
	FPC	26	663	26	663	12.2
	WDFW	3	24	3	3	1.4
	All	35	774	35	753	16.4
Recruits per Spawner (R/S)	CCT	1	2	1	2	0.5
	IDFG	18	1,001	18	1,001	8.5
	ODFW	42	1,799	21	1,379	9.9
	WDFW	27	293	27	293	12.7
	All	88	3,095	67	2,675	31.5
All HLIs	All	199	10,319	178	9,416	83.6

[1] "Published" is defined as the data available to all on the CA query system (CAX).

[2] CCT = Confederated Tribes of the Colville Reservation; IDFG = Idaho Department of Fish and Game; ODFW = Oregon Department of Fish and wildlife; FPC = Fish Passage Center; WDFW = Washington Department of Fish and Wildlife."

[3] A record for a superpopulation is counted only once, for that superpopulation; component populations are not included in the counts.

[4] The 213 "TRT populations" are those in the Columbia Basin not listed as extirpated.

Published[1] Coordinated Assessments Records

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Figure 4. Coordinated Assessments Project FY 2017 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, and for that 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. We are working to add similar capability to the Data Store and potentially the main StreamNet database in the future. 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 2017, development of comprehensive Viable Salmonid Populations (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. When all DPS/ESU compendiums are finalized, they will be made available on ODFW's Recovery Tracker and the Data Clearinghouse. Oregon staff continued to update and develop new metadata and data analysis flow diagrams 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.

Data Entry

Database development and management, including data loading and QA, was performed by PSMFC central staff and the project staff in the participating agencies in order to manage the data that are obtained, standardized and disseminated through the project. Data were obtained, loaded and quality checked, geo-referenced, and converted to the DES for transmittal to the project database at PSMFC. In 2017, PSMFC instituted additional cost savings to StreamNet through assumption of additional projects, and BPA provided some funding for increased activities. The StreamNet Executive Committee used these resources to increase direct funding to WDFW and to the USFWS to increase data management activities for CA. Funding was also used to assist IDGF with increases in overhead expense.

StreamNet currently utilizes centralized databases due to the current capabilities of agency infrastructure. A longer-term goal is to support the agencies in development of internal data infrastructure that will allow automated data

dissemination from the agencies via web services in regionally standardized format. Data were managed and stored at the subcontracting agency level to support this data entry/development process, and in the consolidated regional scale database at PSMFC, where the data are stored, managed and backed up for use through the StreamNet data query systems.

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 Coordinated Assessments (CA) DES format. Oregon also exchanged 229 new and 701 existing (including 401 for EscData only) traditional data trends originating from the BPA Inventory effort, 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. 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.

WDFW StreamNet staff loaded the WDFW CA database with NOSA (2010-2012) and SAR (2003-2010) data to test exchanging data with PSMFC through the API. Although the test was successful, this data was not published as at that time PopFit and TRTmethod needed to be documented further to accurately reflect the data. The Upper Columbia Data Steward conducted a regional WDFW review to identify CA metric data and associated time series for CA data in the upper Columbia Basin. These data were identified and compiled for future integration into the CA database. All StreamNet staff contributed to the new 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 2017. 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 the Idaho Fish and Wildlife Information System (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 NOAAF 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. 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 2017, 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. 577redd counts at 64 locations were added in the Columbia Basin during 2017. 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.

StreamNet staff met with FWP 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 2017 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 range-wide native assessment. During the past calendar year MFWP staff have 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. 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, 327 new and existing DC records were created and updated. In 2017, using partial funding from other sources, we initiated an effort to, where possible, improve the accuracy of, and migrate 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, 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 and adult 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. An integrated mapper data capture system was completed and incorporated into an existing web application. This mapper was expanded to enhance the flow of data from the field to NRIMP and StreamNet. Oregon StreamNet continued refining and various software and web map applications for supporting mobile data access, update and creation of fish passage barrier data, and explored the potential to test this out more broadly across the basin.

Oregon StreamNet's server infrastructure and application were updated to .NET 4.6, Visual Studio 2017, Windows 10, Windows Server 2012 R2 and SQL Server 2012, modern Microsoft technologies with long-term support. In addition, a plan was developed to increase capacity of the infrastructure through 2021 as needed.

WDFW focused some SN 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 2017.

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 2017 BPA and the USFWS reached agreement on funding the Services' 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 2017, 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 being hosted by the originating agency in DES format and shared via web services accessed by an exchange network hosted by StreamNet.

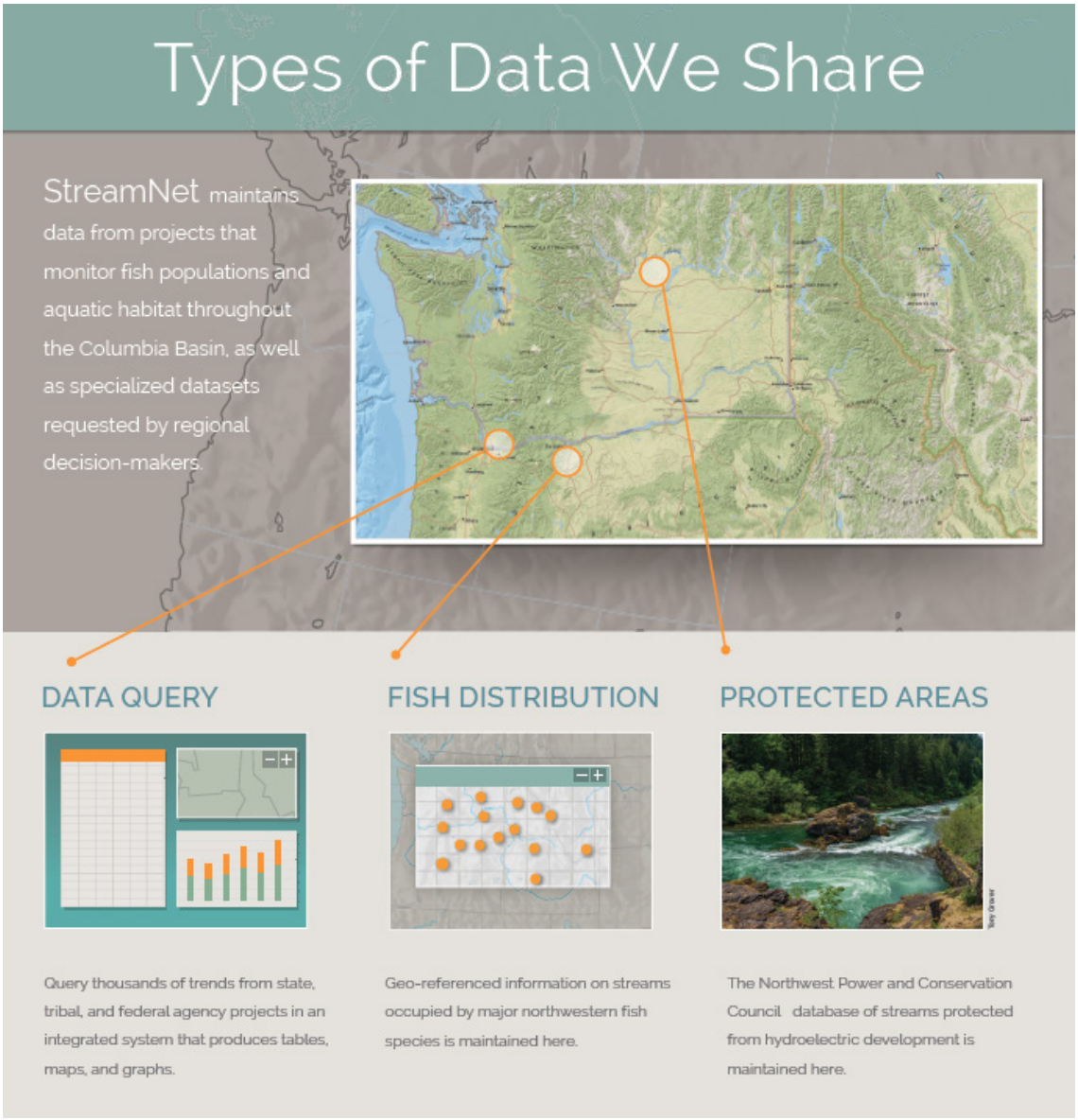

Figure 5. Data sharing Infographic from website

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 2017, 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 2017 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 both 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 query. During 2016, work began on a query system that will be used for accessing CA data and related trends. As older trend data sets are not updated over several years, the CA database, along with the trend data associated with these populations, should become the predominate search location for users of StreamNet. The older systems will be maintained only as necessary to maintain access to data.

The Data Store online data archive provides access to non-standardized data 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 additional links with Taurus and www.monitoringmethods.org are planned. StreamNet data and metadata were 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 2017 the StreamNet data technicians working within the data source agencies identified 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 2017 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. In 2017 these included quarterly progress reports and the 2016 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.

During 2017 StreamNet continued to carry out these instructions. Results are discussed in this report. In completing those tasks, a number of lessons have been learned.

One lesson learned has been that StreamNet should focus efforts on CA and key VSP indicator information in such a way that it helps regional decision makers, ultimately in real time, within existing resources. The flow of traditional StreamNet data should also be focused on providing more detail to populations and priorities of the CA project. Data flow for existing CA indicators, development of new DES and indicators within the CA project, and specifically identified trends associated with the CA populations and species should be prioritized. Given existing resources, StreamNet and the data management infrastructure within StreamNet partners should seek out and implement the priorities of the region's fish and wildlife managers. Where those are not clearly articulated, StreamNet should seek guidance from the Executive Committee on next steps. Where resources are not available to provide the desired data, if data management infrastructure is the bottleneck, StreamNet should seek additional support in order to meet these needs.

The Executive Committee has provided a useful and important function for StreamNet, and particularly for the CA project. This group should continue to play an important role in determining priorities for the project. In addition, it serves as a venue where managers from the data providing organizations can discuss and outline their issues and resource needs to BPA, NPCC, NOAA, USFWS, and others who may need, direct, and fund data collection. This will be important going forward, so that funders and data providers both have clear understanding of what is being sought and what is needed to meet the demand. One lesson learned is that the structure of the Executive

Committee may not be perfectly aligned with the data providing entities, in that several tribes who collect and analyze large amounts of fisheries data are not on the committee. Discussions should be held next year on ways to address this issue.

In 2015, it became evident that maintaining a standardized tabular GIS standard through StreamNet support and funding to data providers was not feasible, given the other priorities of the project. In January 2014, PSMFC created a GIS Center to provide a base level of centralized GIS support for all of its data projects. Thus far, this centralized support has been adequate to help StreamNet meet the less intensive GIS needs associated with mapping fish data at the population level. PSMFC's GIS staff works closely with StreamNet to identify and meet needs as they arise with the understanding that, should the project's GIS needs return to the pre-2014 level, additional project funding to support a GIS technician or specialist may be needed. Currently, PSMFC's GIS Center is working with StreamNet to support the population boundary mapping and visualization needs of the Coordinated Assessments project, coordinate and maintain a regional 'fish facilities' dataset to serve as a point of integration across multiple Columbia Basin projects administered by the Commission (StreamNet, PTAGIS, RMIS, and others), and to provide technical support to the NPCC's Fish and Wildlife Program.

The latest SOW includes a goal to update, where possible, some of the project's traditional, spatially explicit data categories. While the main focus is on compiling and publishing HLI data for priority populations, partners are also being directed to resume targeted updates to stream survey 'trends' associated with BPA and NPCC's priority populations, and fish distribution for priority anadromous species in the Columbia Basin.

Given limited GIS support and a need to stay within current budgets, the PSMFC GIS Center would like to make the following recommendation to streamline the data submission process and concentrate the effort where it will be most fruitful.

- 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.
- Fish Distribution as a StreamNet data category should be redefined as a GIS dataset that is exchanged (or compiled regionally) using GIS file formats. This is a significant shift from the traditional StreamNet model. While less elegant than a regionally coordinated linear event table 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 simply visualize species distribution and habitat use type in map form.

A related lesson is datasets that indirectly support priority recovery and CA data such as hydrography, distribution, and barriers will also lose their utility over time if not prioritized and supported appropriately. The Executive Committee gave direction to maintain fish distribution and area facilities GIS layers as a regional reference source as their priority. Maintenance of the other data types will be secondary and should not interfere with higher priorities.

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. Combining resources at the state, tribal, and federal level can lead to more effective and comprehensive RM&E management in the future. However, that also means 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 2017. 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 2017.

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 StreamNet Executive Committee should continue to be used to focus and prioritize the CA Project. This should specifically include prioritizing selection of new high-level indicators, taking into account regional data needs, such as NOAA status assessments and NPCC high-level indicators and dashboards. Priorities should incorporate realistic assessments of available staff and other agency priorities.
2. The StreamNet Executive Committee should continue to encourage expanded membership on the Executive Committee for any entity that is a significant data provider.
3. The StreamNet Executive Committee should also continue to evaluate and prioritize updating traditional StreamNet data sets to reflect an emphasis on those that add value to ongoing regional O&M efforts. These include updating geo-referenced surveys that are supportive of a more granular understanding of high-level indicator trends, and maintenance of regional databases such as fish distribution and facilities.
4. StreamNet should provide accessible and useful displays of information at the regional scale, with special focus on the CA project. Improvements to the StreamNet website should include GIS-based, population level graphical presentation of the high-level indicators as they are developed. StreamNet should also assist

in supporting the efforts of others (NOAA, NPCC, etc.) who are engaged in similar efforts by focusing on automating and streamlining the flow of data for these efforts.

5. While focusing the CA project on high-level indicators that support regionally significant monitoring efforts, clear direction and consensus should be used to guide agencies and tribes to submit data that support population level assessments. Where such data are lacking, the Executive Committee should provide overall project direction to address any concerns. If warranted, they may wish to use lower level or even higher-level information and incorporate that into the CA database.
6. The StreamNet Executive Committee should periodically evaluate whether regional data collection and management efforts are aligned with the high-level data needs identified by the users of CA data, and make recommendations for funding and support provided to BPA, NPCC, NOAA, and others from a regional perspective.
7. Where data are needed in support of regional prioritization (i.e. resident fish data for NPCC indicators and dashboards), StreamNet should prioritize infrastructure and data management assistance needed to support such indicators. This will require advance planning in order to potentially shift resources or request additional support, as agencies are currently fully committed to ongoing efforts. BPA and the StreamNet Executive Committee should clearly convey to agencies the importance of contributing to regional efforts. This will assist in gaining acceptance and buy-in from agency managers and biologists.
8. CA methodologies for calculation of high-level indicators should be fully documented.
9. 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 and the Data Store should be developed and implemented.
10. 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.
11. 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 StreamNet Executive committee should recommend increases in traditional funding and support as needed, to complete the priorities they have established.
12. 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.
13. Fish Distribution as a StreamNet data category should be redefined as a GIS dataset that is exchanged (or regionally harvested from data contributors) using GIS file formats instead of regionally coordinated linear event tables. This is a significant shift from the traditional StreamNet data exchange model. 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.

References

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3. *Schmidt, Bruce, and the StreamNet Steering Committee. 2009. Considerations for Regional Data Collection, Sharing and Exchange. ftp://ftp.streamnet.org/pub/streamnet/projman_files/Data_Sharing_Guide_2009-06-01.pdf*

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8. *Kinney, Bill. 2015 Summary Report to BPA of the StreamNet review of Fish Data Projects' Work Statement Elements and recommended assignment of Data Repository IDs from the Monitoring Methods list of Environmental Information Repositories, January 31, 2015*

9. *Coordinated Assessments for Salmon and Steelhead-PNAMP website. http://www.pnamp.org/project/3129*

10. *Monitoring Methods Monitoring Protocols-website. https://www.monitoringmethods.org/Protocol/Index*

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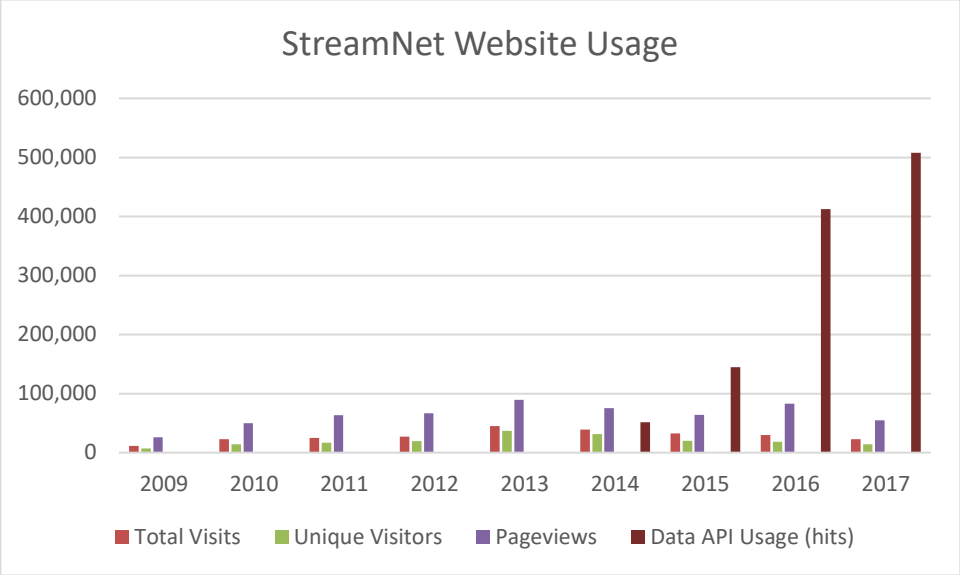
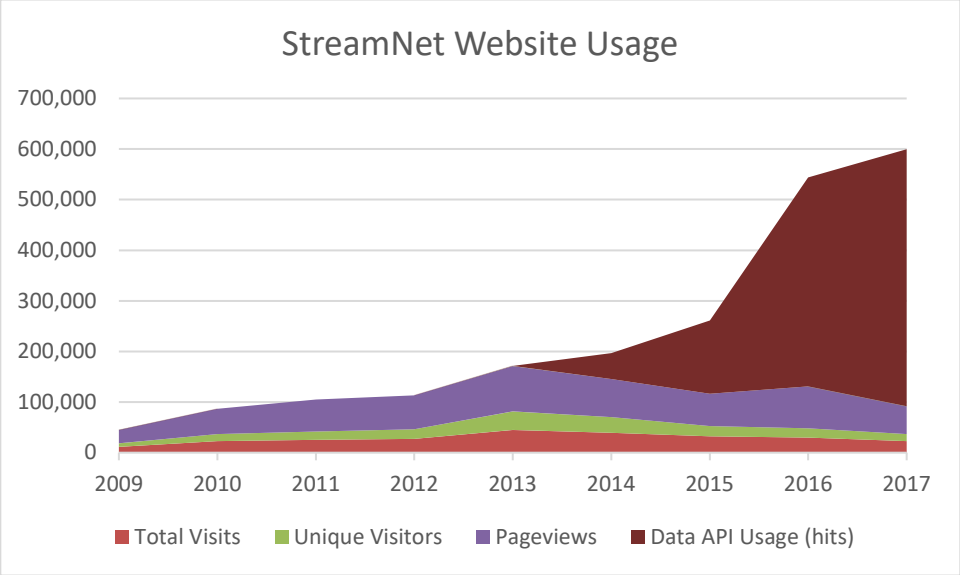
12. *NPCC 2017 Columbia River Basin Fish and Wildlife Program*

Appendix A: Use of Data & Products





Top users of the StreamNet website (no. of visits)	2017	2016	2015	2014	2013	2012	2011	2010	2009
Internet service providers (Comcast, Verizon, etc.)	**9,621**	10,906	9,241	17,862	17,711	12,515	4,200	8,369	2,530
State of Oregon	**380**	948	776	640	600	961	881	974	594
National Oceanic and Atmospheric Administration	**251**	540	574	349	309	385	144	572	306
U.S.D.A. Forest Service	**218**	308	347	241	393	443	0	593	339
U.S. Fish and Wildlife Service, IRM/BFO hq	**208**	388	256	201	109	182	111	262	185
Bonneville Power Administration	**173**	536	448	213	220	258	141	296	150
Oregon State University	**146**	175	187	158	186	152	40	148	64
State of Idaho	**134**	270	158	118	120	132	63	166	128
Headquarters USAISC (US Army)	**120**	198	394	360	462	342	96	515	277
Washington State Department of Fish and Wildlife	**111**	220	194	165	89	156	36	584	261
U.S. DOI Bureau of Land Management	**83**	125	176	122	139	186	81	155	95
USDA Office of Operations	**78**	129	126	122	148	130	58	244	201
HDR	**65**	160	79	75	75	82	18	58	61
State of Montana	**53**	116	74	77	67	75	8	102	45
Portland State University	**40**	103	146	70	73	88	0	55	39
Environmental Science Associates	**38**	87							
Nez Perce Tribe	**37**	80	99						
University of Washington	**17**	141	167	114	91	109	24	169	70
National Wetlands Research Center, USGS	**17**	78	38	45	59	82	23	70	38

Appendix B: Detailed Results

StreamNet Annual Report Details - Calendar Year 2017

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 DES and streamlined data flows.
ODFW	ODFW continued to participate 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 CA data flow. Focused attention was given to regional information gathering requests for indicators not previously compiled for data sharing, field and record level validation rule reviews and DES development efforts. Attention was also given to coordinated data visualization, review and future direction, and to assess differences between published data in the CAX vs NOAA's SPS database. Differences in Oregon were shown to be appropriate given the way the to two systems are managed.

PSMFC	Regular activities during the year included CA Core Team, DES development, and Data attribution work group. A CA workshop was co-sponsored with PNAMP in May. Project administrative duties were completed. Project goals and objectives were reviewed with the Executive Committee, 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.
MFWP	CA indicators and DES' have not yet been developed for resident fish. MFWP staff have been staying 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 significant input to CA DES discussions, various forums and email correspondences throughout the year, including submitting a detailed SAR and RperS proposal to the SN DES Development Team (DDT) to describe needed changes and potential solutions to the CA DES. The need for the changes arose because indicators were not displaying correctly on the CAX website. In addition to better returns and recruit definitions in the DES tables, the modifications also defined how harvest and broodstock are included and reported for different SAR and RperS categories. Data management protocols, manuals, databases, file naming standards, QA procedures, and directories were also updated based on these changes, as needed.
PSMFC	C.A. data flow continued. Reviewed DES at spring workshop. Held meetings with DES development teams. Additional proposed changes to the DES were identified and discussed for possible implementation.
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 regional CAX databases.
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). DES changes necessitated the resubmission of previous year's data for Snake River and Middle Columbia River Chinook and steelhead. Also, Lower Columbia DES data was processed and uploaded to the ODFW Recovery Tracker public website. ODFW updated 21 and added 46 new references to the StreamNet Library in support of BPA funded projects, traditional StreamNet and Coordinated Assessments data Staff continued to update and develop new metadata and data analysis flow diagrams pertaining to analytical methods, field methods, and data compilation for the DES and Recovery Tracker.
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. reviewed plan with broader group at 2017 workshop. Compared data flow with BPA priorities and 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 databases.
MFWP	CA indicators and DES' have not yet been developed for resident fish. MFWP staff have been staying 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	Staff maintained and enhanced internal databases and applications to extract, transform, and transfer data as necessary, along with the ODFW CA automated data exchange system to stay in sync with StreamNet CAX changes, increase robustness, implement new pre-submission validation rules, and only upload data which has been modified since the previous upload. The ODFW Recovery Tracker website was updated to accept new data and improvements to content and file structure were identified and implemented. Conversion of a MS Access spawning ground survey database into SQL continued and was tested using 2017 steelhead GRTS data. The SQL database is functional but additional fixes and enhancements need to be implemented. This project will eventually allow standardization of spawning ground survey data across ODFW and will increase efficiency for data uploads from field to the database.
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 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 needs. Internal requests consist of data queries and map requests that internal staff cannot complete themselves. MFWP GIS staff received 66 GIS or 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.
PSMFC	Work on data sharing agreement has been ongoing. Offered shared data to NOAA-Fisheries for use in current 5 year status review, but they determined that existing methodology was best for the current process. Automated sharing with multiple organizations and tested data flow. Current focus in on acquisition of NOSA indicators as prioritized by the Exec Comm. Initiating testing and configuration of the EPA node, which did go live in 2016.
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 = 2
Government, federal = 6
Government, state = 4
Government, tribal / tribal organization = 1
Industrial / commercial = 1
Nonprofit organization = 1
Private consultant = 3
Watershed council / group = 1

----------REQUEST TYPE----------
Data request = 4
GIS data / map = 2
Hardware / software technical support = 3
Help with data interpretation / analysis = 1
Library / Documents = 2
Report error or problem = 4
Other = 3

----------OUTCOME----------
Could only refer user to other info source(s) = 1
Request fully satisfied = 15
Request partially satisfied = 3

PSMFC Participated in PNAMP-led Data Attribution work group. Implemented revised data sharing agreement in 2017 reflecting new, agreed-upon standards.

PSMFC	Maintained and reviewed CA DES standards regularly. Developed validation routines for time series data traditionally compiled by StreamNet project.
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	Idaho compiled and delivered fish data to StreamNet as time and staffing allowed. The Chinook, steelhead, and sockeye salmon redd counts and hatchery returns were all updated through 2017.

MFWP	MFWP compiled traditional StreamNet data throughout the year and exchanged the following data: 42 fish distribution records, 3 references, 577 redds at 64 locations, and barriers with associated fish data. Fish population and genetic data were submitted as independent data sets.
ODFW	ODFW submitted 229 new and updated 701 existing (including 401 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. These data contribute to Council websites and Biological Opinion (BiOp) assessments. Staff added records to the Oregon Fish Habitat Distribution Database for both anadromous and resident salmonids as well as other species (e.g. pacific lamprey) in the Columbia Basin. Updates were 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.
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.
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 2017 data. Staff submitted a YCT Range-Wide2017 Access database and YCT2017update geodatabase to StreamNet Data Store. The annual range-wide meeting was postponed this year however when it is rescheduled MFWP StreamNet staff will attend and report on activities done throughout the year.Work on a range-wide Story Map was started and will be completed during the 2018 contract year.

ODFW	Oregon StreamNet staff attended the Coordinated Assessment Workshop and participated in Data Attribution efforts facilitated by PNAMP. Staff also had several discussions with PNAMP staff regarding the incorporation of analytical method protocols into the MR.org structure. Examples of other support to the Program include gathering information needed to form recommendations on common goals to help define a shared path to long-term salmon recovery; responding to a BPA request regarding BPA funded Projects that may not be providing juvenile data to CAX; and developing new data streams for juvenile indicators and metrics that will be incorporated into CAX or StreamNet Related Data. StreamNet staff also helped review the State of the Salmon dashboard website.
PSMFC	Prioritized coordination efforts through the Executive Committee, CA project, website, presentations to NPCC, and other activities. Continued working on habitat indicators.
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.
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 embarked on additional 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.
MFWP	StreamNet staff have implemented internal scripting to allow for a more streamlined process for submitting data to StreamNet. StreamNet staff and MFWP application developers did not have time or resources to investigate or implement web services for MFWP data.

ODFW	Staff prepared for and participated in the StreamNet Technical meeting to discuss uploading Traditional data (Trends) through the SteamNet API. New Data Clearinghouse records were added, and existing records were updated, increasing overall data availability and our ability to flow data using automated approaches. Options for submitting fish distribution data via alternative approaches were evaluated in coordination with regional staff. ODFW implemented a Fish Habitat Distribution and Barrier Data Editor web map application to facilitate data review and update.
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	Shared data with partners and BPA through final report on project.
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. This work is being 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 the FWPMapper, the internal web mapping application, 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.

Staff completed infrastructure and application migrations to .NET 4.6, Visual Studio 2017, Windows 10 v1703, Windows Server 2012 R2 and SQL Server 2012, and performed routine and required system monitoring, management and maintenance throughout the year. A plan to increase capacity in the infrastructure through 2021 as it becomes necessary was created, and multiple infrastructure components were consolidated into a single component used by all applications, reducing the ongoing support effort.

ODFW upgraded enterprise GIS software including the addition of Portal for ArcGIS to support internal spatial data applications. The GIS license server was upgraded and GIS licensing for the agency was maintained. Oregon StreamNet staff chaired and participated in GIS Coordination Group activities, including the development of a draft strategy for supporting mobile data collection.

Staff conducted a review of programming updates implemented on the ODFW Recovery Tracker website and documented some discrepancies with information displayed on the site and data file structures available for download and review. Staff successfully updated the necessary documentation and file structures to improve graphical and data interpretations and metadata describing the downloadable files and data dictionaries.

Three data management plans were drafted that will 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.

ODFW initiated an effort to, where possible, improve the accuracy of, and migrate over 39,000 records from the old ODFW Library electronic bibliography into the DC in order to preserve this historic record of ODFW documents, with the goal of providing access to digital copies of these documents. Six existing records were updated, and 321 Data Clearinghouse records were reviewed, edited and approved. Staff made progress late in the year to locate and upload electronic versions of ODFW Fisheries Information Reports published in the 1970’s through early 2000’s.

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.

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.

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. 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.
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PSMFC	Done on schedule. New 2 year contract implemented in 2017.
PSMFC	Discovered this process was inadvertently omitted for last several years. Began restoring cost share reporting at the end of 2017.
PSMFC	Done on schedule. New 2 year contract implemented in 2017.
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 2017. 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	Oregon StreamNet staff provided input for the Annual Report.
PSMFC	Done on schedule.
PSMFC	Done on schedule.

PSMFC	Done on schedule.
PSMFC	Completed as required in CY 2017.
WDFW	WDFW StreamNet staff provided input for the Annual Report.

N Produce Status Reports for BPA

185. Produce Pisces Status Report

Deliverable: Status Report submitted on quarterly schedule.

All	Completed as required in CY 2017.
All	Completed as required in CY 2017.

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 2017.

PSMFC	Completed as required in CY 2017.

Q Other accomplishments

986. Catch-all for FY-17 SOW items or anything else in Calendar Year 2017

Deliverable: Catch-all for elements from the FY-16 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 10.5.

ODFW	ODFW StreamNet staff did not use BPA funding to do any work outside of the SOW. Utilizing other funding, staff updated and submitted Coastal coho natural origin spawner abundance and adult recruits per spawner estimates to StreamNet. The Coastal coho DES data was processed and uploaded to the ODFW Recovery Tracker public website, also using alternative funding.
PSMFC	Work has been reported elsewhere.
WDFW	WDFW StreamNet staff did not use BPA funding to do any work outside of the SOW.