Columbia Basin PIT Tag Information System (1990-080-00)

2019 Annual Report

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Executive Summary

The **Columbia Basin PIT Tag Information System (PTAGIS)** is a coordination and data management project of the Pacific States Marine Fisheries Commission (PSMFC). PTAGIS develops and maintains software used to collect and contribute Passive Integrated Transponder (PIT) tag data; manages and makes those data available for download and reporting via the PTAGIS website; and operates and maintains large scale PIT tag detection sites throughout the Columbia Basin. This project is an important prerequisite component of all PIT tag research conducted for the Bonneville Power Administration (BPA) Fish and Wildlife Program.

Tagging data is collected when fish are first marked with PIT tags or recaptured after having been previously PIT-tagged. Researchers from twenty-nine organizations released over 1.9 million PIT-tagged fish in 2019, bringing the cumulative total to over 49 million fish PIT-tagged since 1987.

Observation data is collected when PIT-tagged fish pass through automated antenna systems, called interrogation sites, installed in facilities or streams. The 293 interrogation sites contributing data to PTAGIS detected 854,000 unique fish in 2019. One fish can generate many observation records as it passes through multiple PIT tag antennas at an interrogation site; 15.2 million observations were reported to PTAGIS in 2019, totaling 247 million observations since 1987.

To give additional scope to the overall data management efforts in 2019, PTAGIS processed 781,000 data files with 150 million database rows updated or inserted. All data is made available to anyone via the PTAGIS website and 583 users executed 444,000 queries resulting in 10.9 billion rows of returned data.

PTAGIS maintains and develops software for collecting tagging and observation data. Five new updates to the current PTAGIS field tagging software, P4, were released in 2019 that were primarily focused on correcting defects and implementing ergonomic changes. A pre-release version of the next generation interrogation field software, M5, was completed this year along with associated server infrastructure to support data submission, processing, and reporting. In support of M5 and other PTAGIS services, the PTAGIS web application programming interface (API) was upgraded and published into a development environment. It will become the replacement for file transfer protocol and email data file transmissions when the new software is transitioned into production. Most of the complex processing of transceiver messages, called data parsing, was migrated from the field software itself to the database server so that frequent transceiver firmware updates can be accommodated much more efficiently without the need of redeploying updated applications to the field sites. Development of M5 and associated server upgrades (Figure 1) is ongoing with plans to conduct rigorous performance evaluations in the lab and in-situ next year.

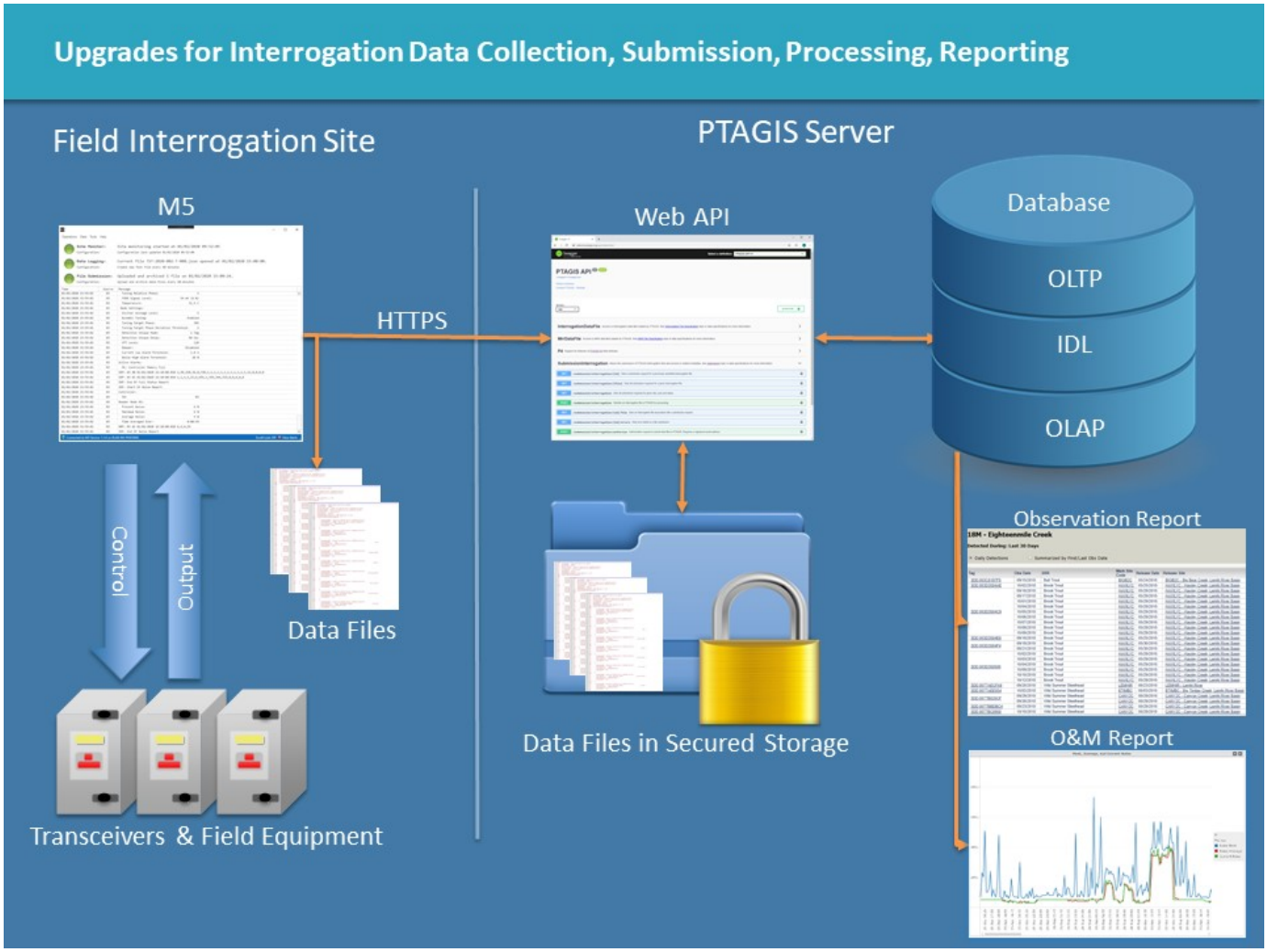


Figure 1. Conceptual drawing of systems and processes developed to support M5.

Ongoing data management and coordination activities include maintenance of validation codes used in data entry and reporting systems in addition to metadata and contact information for interrogation sites, publication of newsletters and news items, and technical support to PTAGIS users. New online video tutorials were produced to guide users in configuring some of the more complex features of the P4 tagging software. PTAGIS staff worked with the PIT Tag Steering Committee to develop a charter and recruit members for the Instream PIT Tag Detection System Subcommittee to improve coordination and support of numerous instream interrogation sites operated by various agencies throughout the Basin. In cooperation with BPA, a Portable PIT Tag Reader Loan program was implemented so that programs can borrow this relatively expensive equipment for short-term needs.

PTAGIS Operations and Maintenance (O&M) staff, based out of Kennewick, WA, provide direct management and maintenance of 29 large scale interrogation sites throughout the Columbia Basin, primarily at mainstem dam locations. This involves daily monitoring and regular onsite visits to maintain the detection equipment that provides the majority of 247 million observation events available in the database system. PTAGIS also maintains the Separation by Code systems at nine locations, which can be used by researchers to selectively segregate individual PIT-tagged fish from other tagged and non-tagged fish. Separation by Code was used in 2019 to target forty-nine groups of fish (633,000 target tags) for sampling or have them treated as the untagged population at transport dams. The detection and diversion efficiencies at these sites remained very high (> 97%) throughout the year.

PTAGIS O&M staff participate in the design, planning, and installation of new interrogation sites and detection technology. After many years of research and development, eleven new antennas were successfully installed into Spillway 1 at Lower Granite Dam at the end of 2019 (Figure 2).

Figure 2. Lower Granit Dam Spillway interrogation site displaying the black covers that allow access to the antenna components for maintenance.

These antennas and the associated infrastructure will form the first interrogation site to monitor PIT-tagged fish passage through a spillway. The following actions performed by O&M personnel were instrumental in the success of this multi-agency project:

- Designed electrical infrastructure for PIT tag rooms in two, stacked Conex boxes.
- Designed hard-wired infrastructure control systems.
- Designed transceiver remote and automated control systems.
- Created and presented CAD drawings to the U.S. Army Corps of Engineers.
- Designed, prototyped, and tested a split antenna to accommodate an expansion joint within the spillway.
- Designed conduit layout to ensure shortest possible route for best antenna performance (Figure 3).
- In partnership with the National Oceanic and Atmospheric Administration, tested all equipment post-installation.

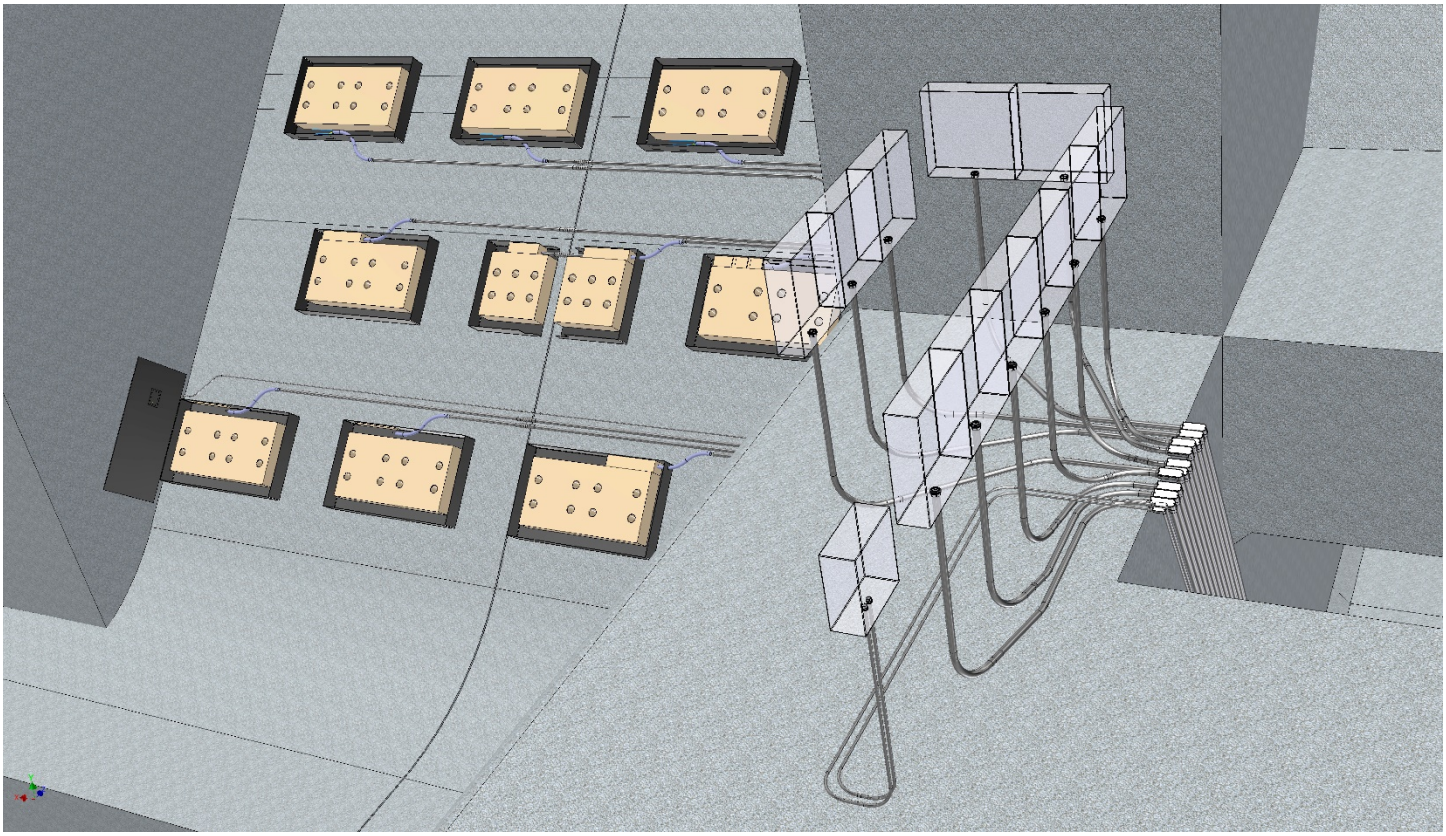


Figure 3. Drawing depicting the routing of exciter cables from the antennas on the spillway face to the transceiver enclosures in the electrical room.

PTAGIS O&M staff also provided designs for the relocation of the PIT tag room and for a new configuration of the interrogation site monitoring the Cascades Island fish ladder at Bonneville Dam. The current PIT tag room can no longer be used due to sinking ground, and the U.S. Army Corps of Engineers has agreed to relocate it to an office near the upstream counting window. In conjunction with the PIT tag room relocation, the old weir orifice antennas will be retired, and four new antennas will be installed to provide 100% pass-through detection.

In addition to designing new sites, continual maintenance is performed on existing sites 365 days a year. A real-time control system was implemented to alert O&M employees when equipment parameters are outside of limits. All transceivers are repaired in-house and returned to service rather than replaced. A custom, high-performance serial-to-Ethernet converter was developed by staff to replace costly equipment that connects transceivers to data collection computers in the field.

In 2019, PTAGIS continued to provide high quality data collection, validation, management, and reporting of PIT tag data for the Columbia River Basin, while upgrading the system to improve support and efficiency. Hundreds of users from dozens of fisheries organizations utilized PTAGIS daily to collect, contribute, and retrieve PIT tag data for salmonid and other fish species of interest in the region.

Background

The Passive Integrated Transponder (PIT) tag is an electronic tag typically measuring 9 to 12 mm long and can be coded with one of 35 billion unique codes. The tag can be automatically detected and decoded in situ – eliminating the need to sacrifice, anesthetize, handle, or restrain fish during data retrieval. The PIT tag was developed in 1987 as a research and management tool for monitoring the movement of juvenile and adult salmonids in the Columbia River Basin.

Detecting/recording devices strategically located within collection facilities at hydroelectric dams can automatically recognize fish injected with this tag.

When a fish is tagged, all related information about the tagging event and the individual fish is captured and entered into field software and uploaded to a central database by the organization responsible for the tagging. This information includes the unique PIT tag ID, tagging location, organization responsible for the tagging, species, run, rear type, weight, length, and condition. Once tagged, the fish is then released into the river system and can be identified and monitored indefinitely.

As the tagged fish migrates, it has the opportunity to pass through electronic interrogation antennas located in juvenile bypass facilities at many of the dams on the Columbia and Snake rivers as well as smaller instream detection sites in tributary locations. This electronic equipment automatically detects the PIT tag code, and records the time and location of detection. This information is automatically submitted to the central database where it is joined with the previously submitted tagging information.

When the tagged adult fish returns to the Columbia River system to spawn, the fish is again automatically detected at the permanent adult detection sites as it travels up-river. These data detections are associated with the previous information about that individual fish in the database and provides additional data on its history and migration.

The PIT tag Separation by Code (SbyC) process allows researchers to target individual tagged fish and separate them from the general population as they move through juvenile and adult fish passage facilities that are equipped with PIT tag actuated gates.

The Columbia Basin PIT Tag Information System (PTAGIS) was implemented in 1991 to manage the collection, correlation, and exchange of Columbia Basin PIT tag data. PTAGIS encompasses dedicated data collection software, a centralized relational database management system, and standardized data descriptions and reporting processes. In 2002, the scope of the Columbia Basin PTAGIS program expanded to include entries for resident and semi-anadromous stocks of rainbow and cutthroat trout, bull trout, and lamprey, sturgeon and other species.

Staff responsible for managing the data systems are located at the PSMFC headquarters in Portland, OR. A second field operations office is centrally located in Kennewick where staff designs, installs, and maintains the equipment and software needed for automated PIT tag detection and SbyC diversion. A PIT Tag Steering Committee (PTSC) provides program oversight, data standardization and technical coordination for the research community. Additional information about this program is available at www.ptagis.org.

Data Management

This section provides a summary of the program's overarching deliverable for 2019 and further describes work elements of the PTAGIS project related to collection, management and web delivery of all PTAGIS data.

Researchers contributed 1.93 million fish marked with a PIT tag to the PTAGIS database in 2019 with a cumulative 49 million records (*Figure 4.*). These records were collected and submitted to PTAGIS by 34 organizations as they marked and released fish at 396 locations throughout the Columbia Basin. The composition of marked species was similar to previous years.

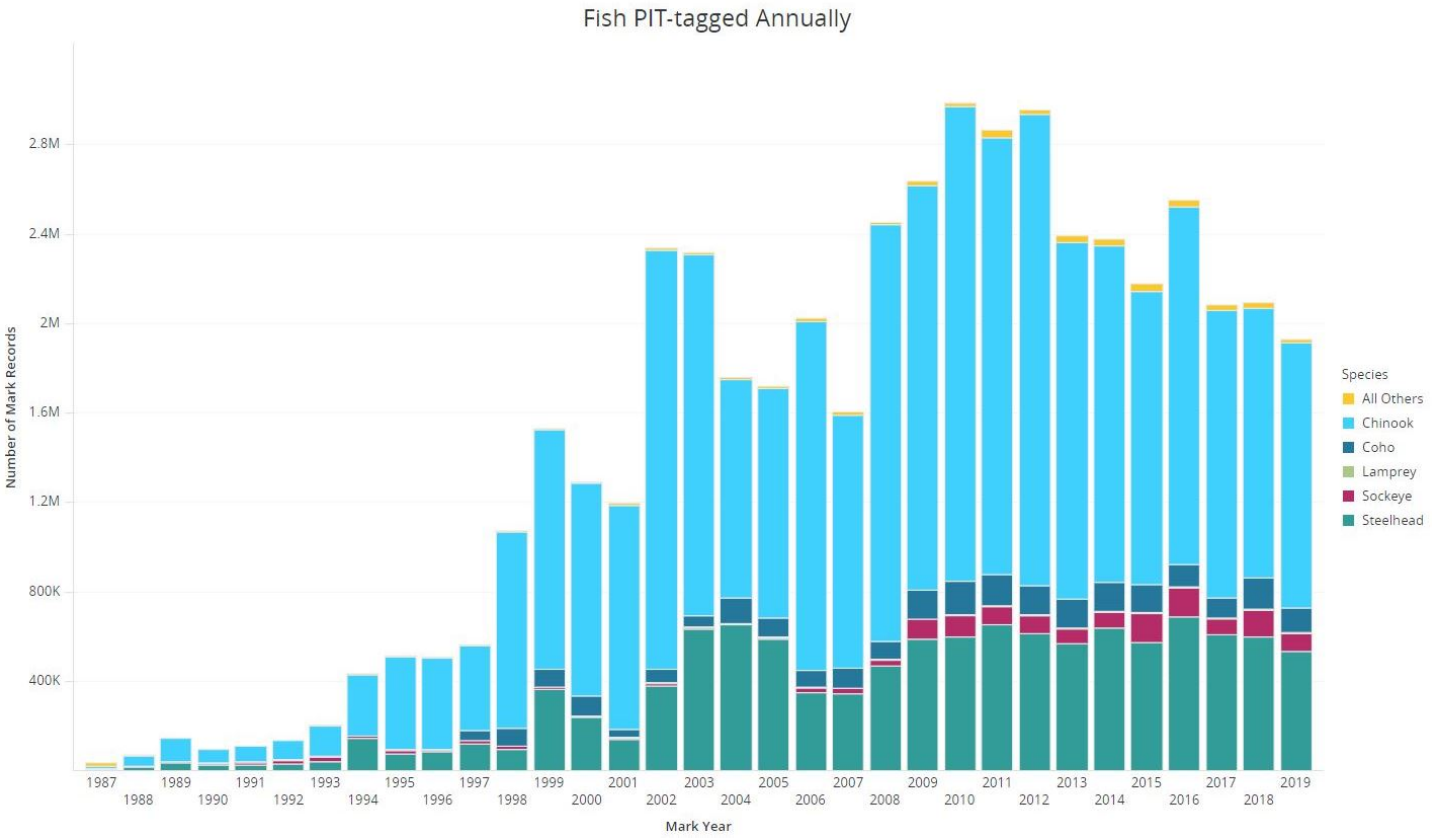


Figure 4. *Numbers of fish PIT-tagged annually by major species group.*

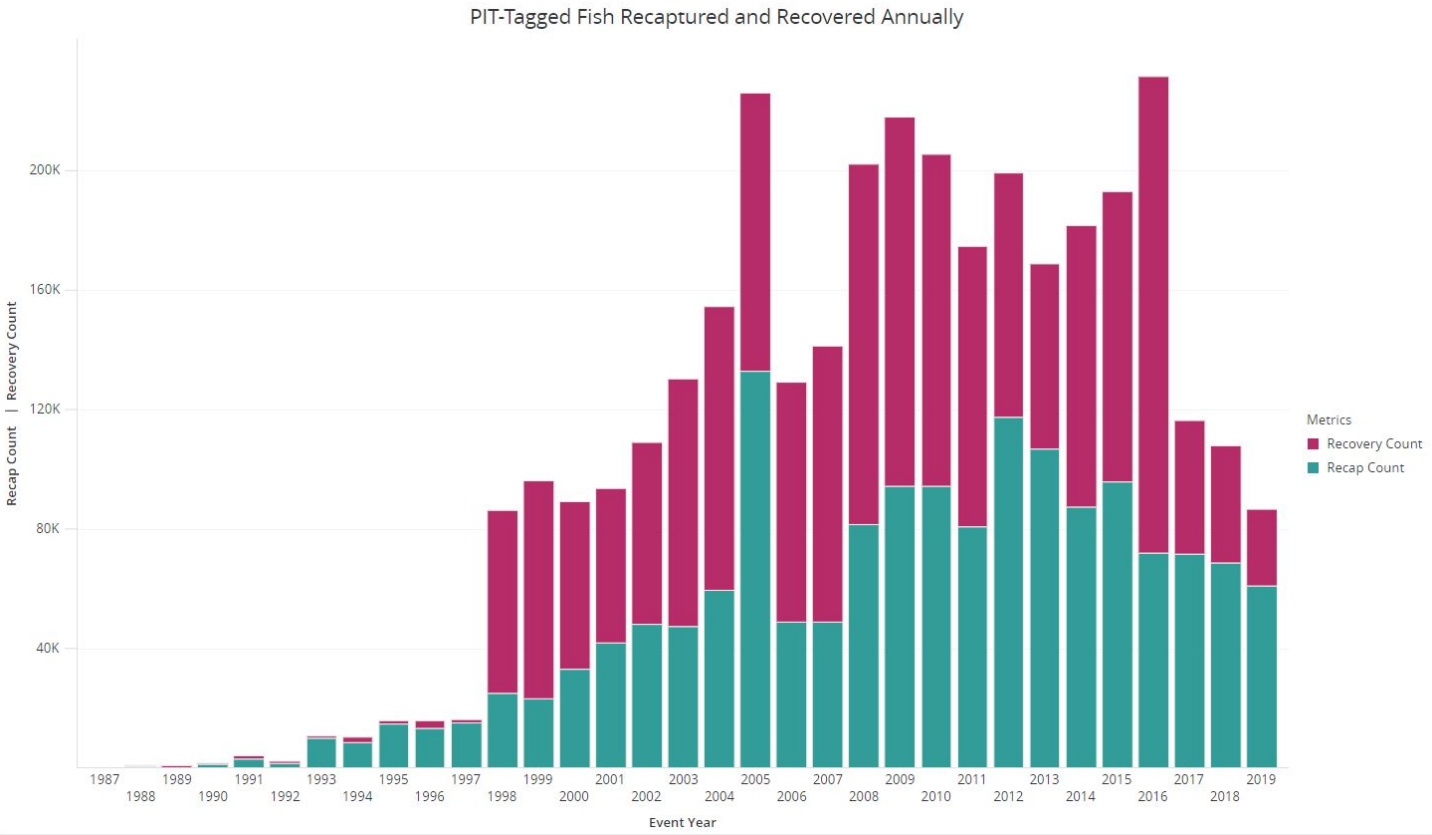


Figure 5. *Numbers of PIT-tagged fish recaptured or recovered annually.*

The number of marked fish reported as *recaptured and re-released* in 2019 was just over 60,000 and approximately 25,000 have been reported as recovered (Figure 5).

The 292 interrogation sites contributing data to PTAGIS detected 854,000 uniquely tagged fish this year (*Figure 6*). One fish can generate many interrogation records (observations) as it passes through multiple PIT tag antennas at one or more interrogation sites; 15.2 million observations were reported to PTAGIS in 2019 totaling 247 million observations since 1987 (*Figure 7*).

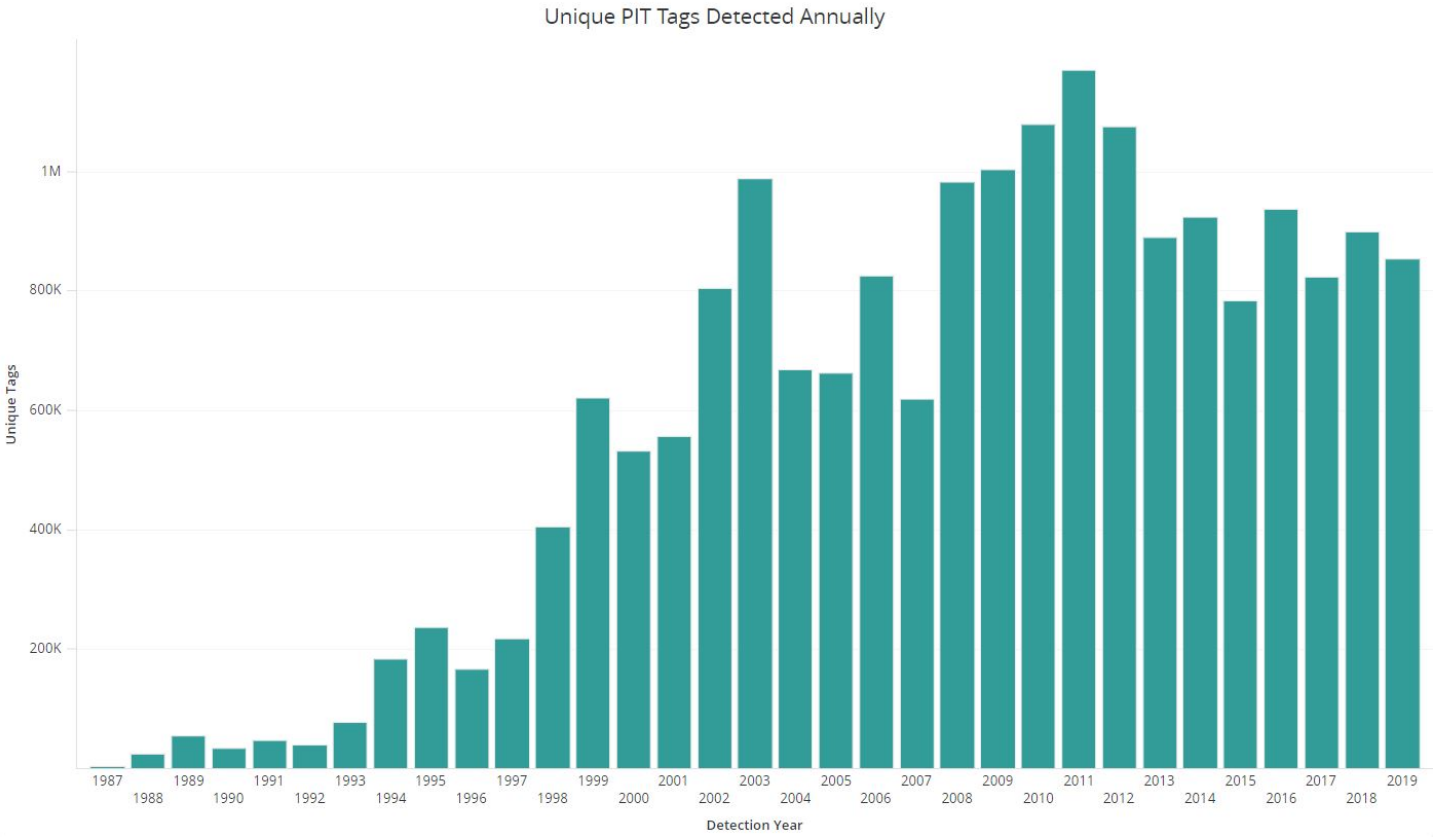


Figure 6. *Unique tags detected annually.*

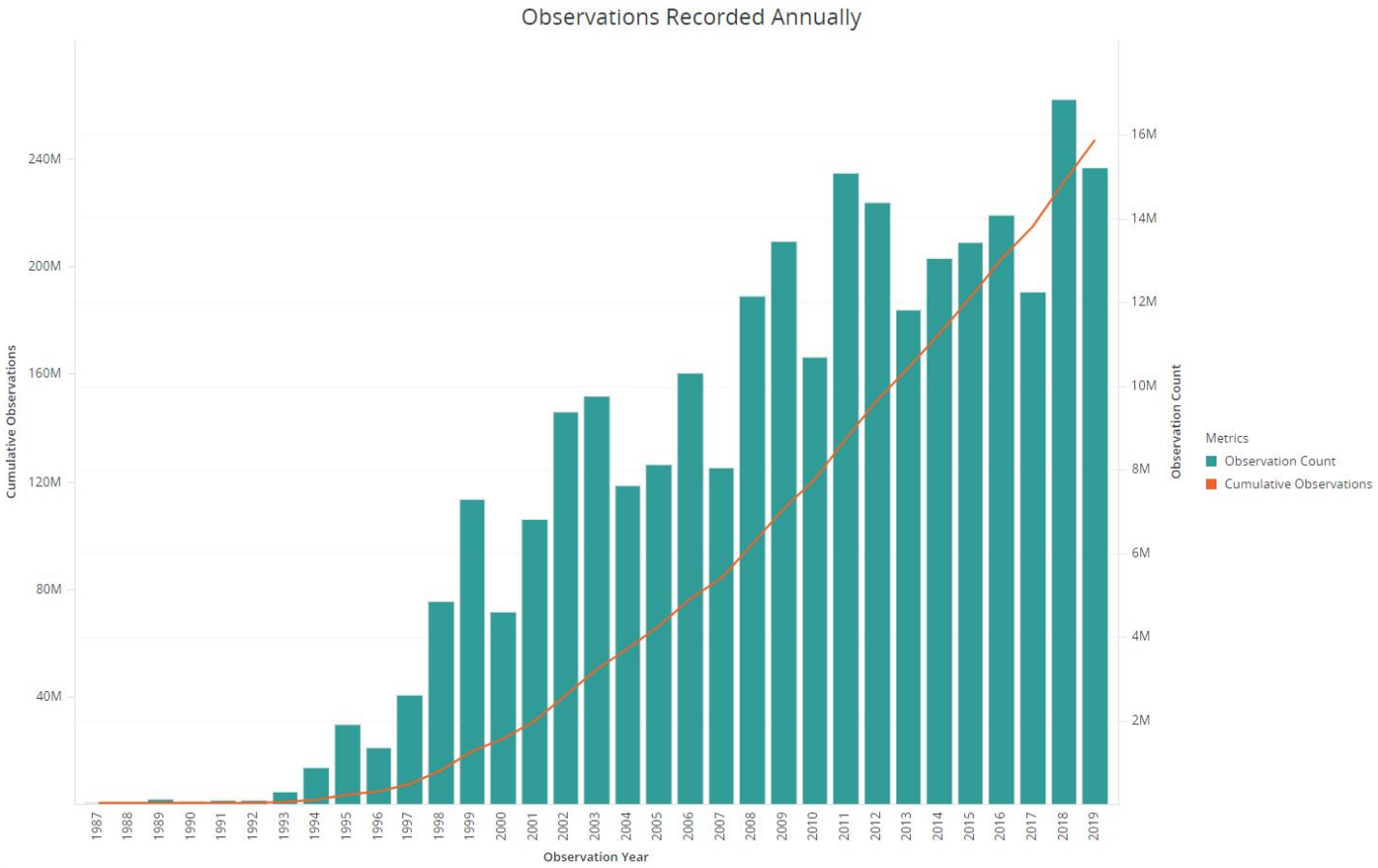


Figure 7. *Annual and cumulative observations.*

To give additional scope to the overall data management efforts in 2019: 570 PTAGIS users executed 444,000 queries resulting in 10.9 billion rows of data returned. Those 556 users are grouped by their respective organizations in Table 1.

Organization	No. Users
All Others	153
Oregon Dept. of Fish and Wildlife	56
Washington Dept. of Fish and Wildlife	56
Idaho Dept. of Fish and Game	51
U.S. Fish and Wildlife Service	35
NOAA Fisheries	27
Nez Perce Tribe	24
Yakama Nation	22
Biomark	22
Pacific States Marine Fisheries Commission	20
University of Idaho	18
Confed. Tribes of the Umatilla Indian Reser.	15
U.S. Army Corps of Engineers	14
Columbia River Inter-Tribal Fish Commission	13
Shoshone-Bannock Tribes	12
U.S. Geological Survey	11
Confed. Tribes of the Warm Springs Reser.	11
Colville Confederated Tribes	10
TOTAL	**570**

Table 1. *PTAGIS data access in 2019 summarized by organization*

D: 160. Operate, Maintain and Enhance the PTAGIS System

This objective delivers high performance\availability systems for the collection and dissemination of near-real-time PIT tag data. Managed by PTAGIS staff in the Portland, OR office, the following three subsystems provide a logical grouping of this objective:

- Field Data Collection Systems
- Server Data Management Systems
- Web Data Management Systems

The following subsections provide background, efforts and plans related to each subsystem that comprise the whole of this objective.

Field Data Collection Systems Background

PTAGIS develops and maintains three basic types of field data collection systems described in Table 2. This software is freely available to the research community to download and install on any modern Window-based PC.

System Type	Software	Description
Tagging Software	P4	Tagging software captures MRR data by interfacing with tag readers and other devices to provide an ergonomic and highly customizable data entry system to support various usages. Users can identify and correct issues with fish in-hand using robust validation and alerting. Authorized users can easily submit their datasets to PTAGIS using the software.
Interrogation Software	MiniMon, M4, M5	Interrogation software combined with communication networks provide unattended operation and continuous recording of observation data in real-time. The central database processes hourly uploads of observation data from hundreds of sites operating this software. Interrogation software provides automatic diversion of target fish to examination tanks or for transportation – called separation by code (SbyC).
Utility Software	Patch Manager, PIFF, Peripheral Emulator, Tag Inventory Manager, Tag Sorter Utility	PTAGIS provides utility software to import, standardize and submit raw observation data collected from the internal storage of a tag reader or from a data logger system operating at a small-scale interrogation site. PTAGIS also develops and supports internal software systems to perform data management, QA/QC as well as performance regression testing of the interrogation software systems.

Table 2. *Types of PTAGIS field data collection systems*

2019 Accomplishments in Field Data Collection Software

P4 Tagging Software Upgrades

PTAGIS announced in a newsletter[1] the retirement of older P4 versions 1.10-1.14 as of July 1st 2019. With each new version, multiple bugs have been fixed and community-requested features have been implemented. Versions earlier than 1.15 have multiple bugs and deprecated features that can cause issues when using P4. If researchers have one of these older versions installed, it will continue to function but they cannot submit data to PTAGIS without upgrading their installation of P4.

PTAGIS released five updates of the P4 tagging software in 2019, which included the following enhancements:

- Multiple usability improvements for the Repeating Values feature.
- Added support for multiple HPR USB devices to be used during a tag session.
- Added lock to PIT Tag field in data entry. To prevent erroneous input during data entry, the PIT tag field will not accept input after a tag is scanned until it is unlocked by clicking on it.
- Validation enhancements.
- Bug fixes.

M4 Interrogation Software Upgrades

Four internal releases of M4 were deployed to interrogation sites managed by PTAGIS in 2019. These releases were needed to support firmware changes made by Biomark to the following transceivers:

Transceiver	Final Firmware Version	Interrogation Site(s)
FS3001 OGEE	v.2.4.1	GRS
FS3001 BCC	v.1.2.0	BCC
IS1001	v.1.7.1	JO1, JO2

Table 3. Transceiver firmware versions supported in M4 upgrades

[1] PTAGIS Newsletter Volume 17 Number 1, June 2019

These new releases required redeveloping the associated setup system using Advanced Installer technology to facilitate deployment of the M4 software and related libraries to a target machine. This was due to licensing and cost issues with the previously used InstallShield technology.

Each M4 upgrade requires extensive evaluation before it is deployed into production. The next-generation interrogation software (M5) is designed to require fewer if any revisions to support future transceiver firmware updates.

M5 Interrogation Software Development

Considerable effort was put into the new development of M5 interrogation software in 2019. This also required related development efforts described in other sections to support a new data file format, new submission system via Web API, and enhanced parsing of raw field data contained within the data files when processed by the database to be made publicly available via reporting (Figure 8).

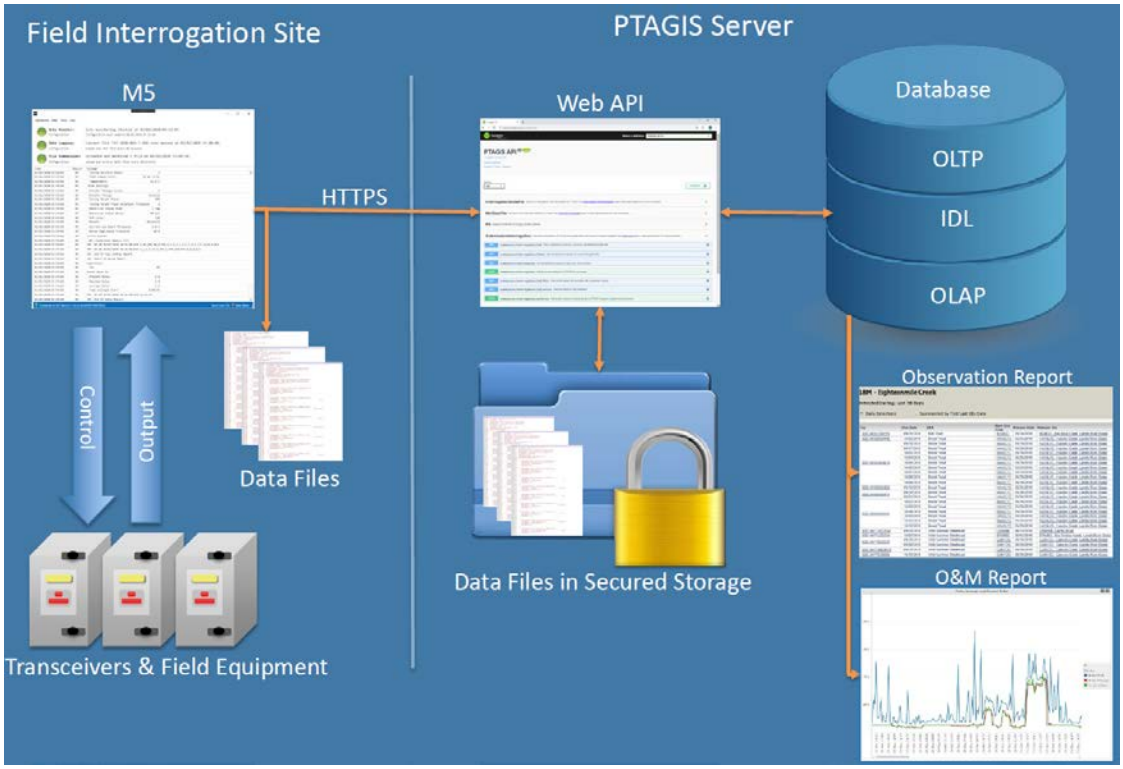


Figure 8. Overview of M5 Data Collection, Submission and Database Processing

By the end of 2019, a release of M5 (Figure 9) was ready for evaluation at an interrogation site setup within the Kennewick lab for testing. This software was developed using latest .NET Core Framework technology to run on Window 10 machines (and Linux distributions upon request). This software is a direct replacement for M4 and MiniMon software that runs at interrogation sites operating 24x7 on dedicated platforms collecting and submitting data. Data is partitioned in new JSON formatted files and submitted to the PTAGIS server via a secure Web API endpoint. The FTP protocol used by M4 and MiniMon software to submit data was deprecated due to security concerns with this decades-old technology and lack of support on agency networks. M5 supports all of the transceiver models used throughout the CRB with a simplified configuration that supports importing and converting existing M4 configuration files.

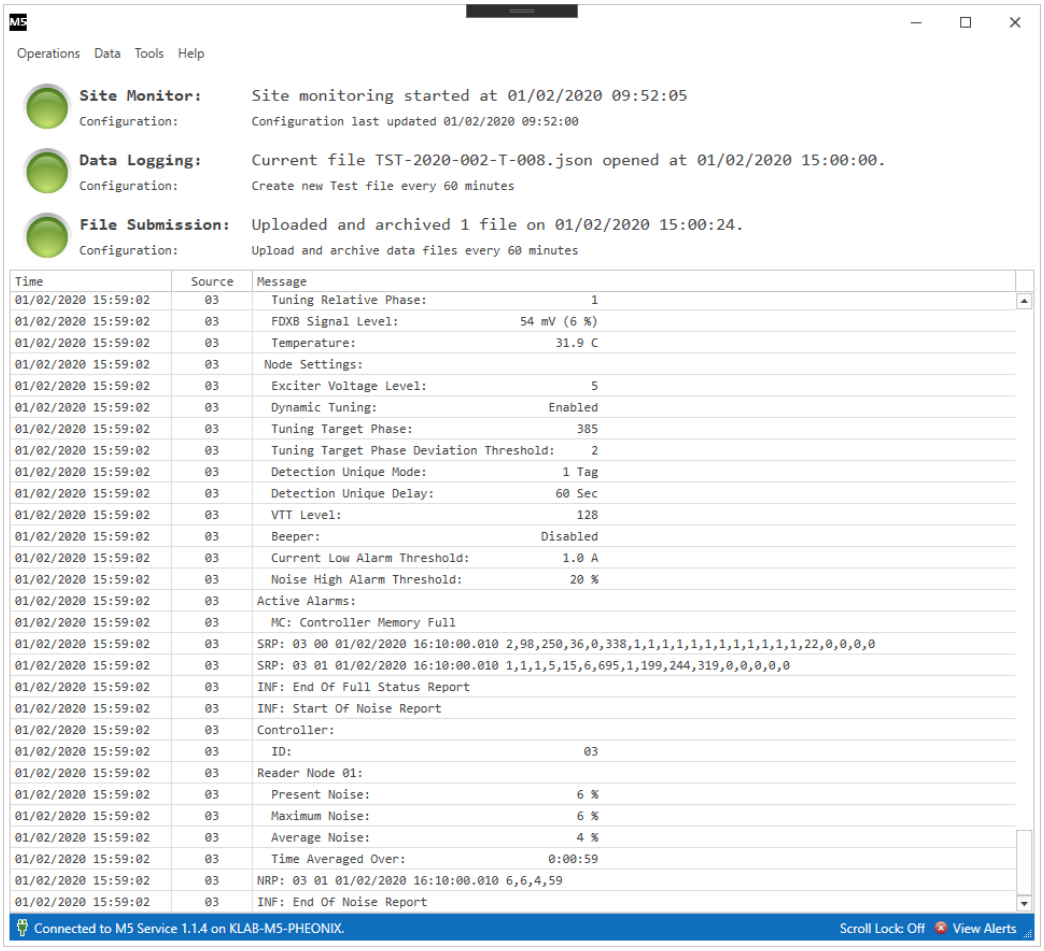


Figure 9. Early release of M5 Interrogation Software

The development of M5 also requires an evaluation of available PC platforms to replace existing Windows 7 machines currently running at interrogation sites for almost a decade which the hardware and operating systems are no longer supported. A primary concern with the Windows 10 operating system is the frequency of mandatory upgrades and reboots that would impact operating 24x7 at interrogation sites. Microsoft supports a version of Windows 10 Enterprise LTSC (Long-Term Servicing Channel) designed for fixed-purposed devices in situations requiring manual control over semi-annual upgrades. Staff coordinated with Dell engineers to evaluate two systems that support Windows 10 Enterprise. These systems are ruggedized for harsh environments, have a small form factor, and have features to support our high-availability requirements. The lower cost Dell system was determined to be underpowered for our requirements. The second, more powerful Dell system, is similar in cost and functionality as a premium desktop computer; however, there are concern about Dell's long-term support for this model that seemed to be already obsolete. Similar Linux systems from Dell were also evaluated, but there are more unknowns with this system, especially with how software is required to be deployed through a Linux vendor's 'application store'. It was determined that further evaluation from other vendors supporting Windows 10 Enterprise LTSC devices is required.

Utility Software Upgrades and Development

Based upon community requests, staff began scoping new PC-based software project to replace the PTAGIS Interrogation File Formatter (PIFF2) with extended features to support configurable data collection directly from a transceiver or via a Sat/Cell modem. This software (Figure 10) will have more robust data management features to allow repeated importing of similar datasets to eliminate data gaps and improved QA/QC. A prototype of this software was

created to help drive additional requirements. The software, called I5, will eventually replace PIFF2 and require the interrogation site data steward to perform validation and review of each dataset before submitting to PTAGIS.

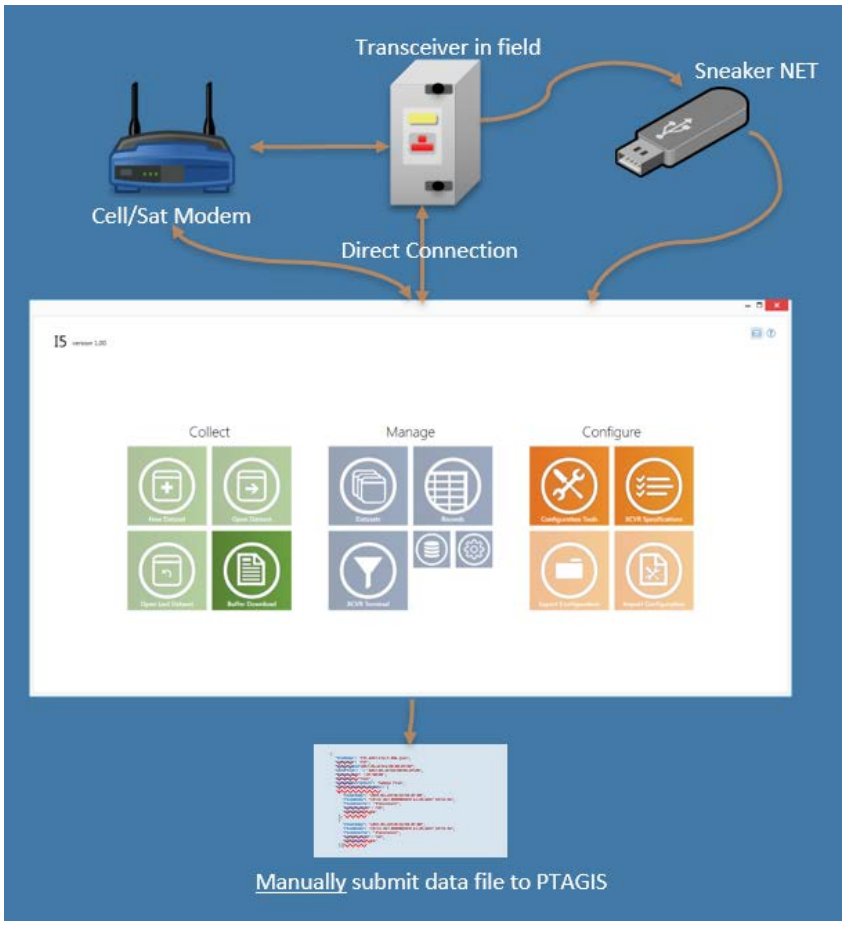


Figure 10. Overview of the I5 prototype utility software

Staff developed utility software (Figure 11) to maintain transceiver specifications used by M5 and I5 field software. The transceiver specifications include default settings and commands for each transceiver model supported by PTAGIS. These specifications can change with each new firmware upgrade and/or new transceiver models. M5 and I5 (as well as other potential agency systems) can now download up-to-date transceiver specifications from the PTAGIS Web API without an upgrade/redeployment.

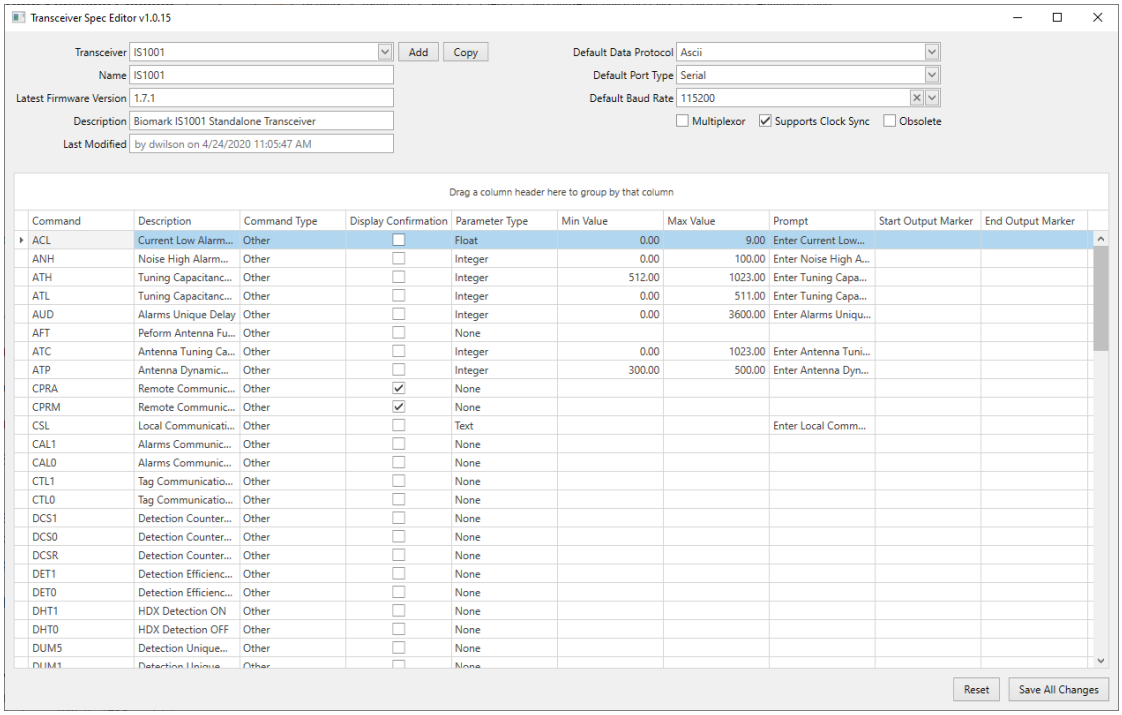


Figure 11. Transceiver Specification Editor

Staff developed a Transceiver Status Report (TSR) control panel utility application allowing O&M staff to configure rules to ensure compliant transceiver configurations across all interrogation sites.

The Tag Sorter Utility software redeveloped last year reached a confidence milestone this year after the initial 20 batches were verified by hand that all tags were correctly sorted into their original vial.

2020 Plans

Staff will continue to enhance P4, M4, PIFF 2 and internal utility software as needed. Continue development of M5 interrogation software with separation-by-code features and perform in-situ evaluations. Continue evaluation of additional Windows 10 Enterprise LTSC hardware to replace existing PCs collecting data at PTAGIS interrogation sites. Continue development of I5 interrogation data management software in coordination with Instream PIT Tag Detection System Subcommittee (IPTDS).

Server Data Management Systems

This portion of the objective addresses the continuous administration and development of a central repository for all PTAGIS data and related metadata. The central repository consists of relational and dimensional database systems that extract, transform, load and collate MRR and observation (interrogation) data submitted via various field data collection software systems developed by PTAGIS and other agencies. The deliverable of this objective is a highly functioning/available, cost-effective, and extensible data management system.

Ongoing tasks related to this portion of the objective include:

- Maintenance and enhancement of system components that support the automated extraction, transformation and loading (ETL) of field data into the central transactional and dimensional databases in near real-time with data validation and integrity verification
- Tuning automated alerting system notifying data stewards of anomalous events such as data validation failures or when remote interrogation sites fail to upload on schedule

- System administration, tuning, backup and capacity planning following industrial best practices
- Maintain processing of periodic data file extracts to support large scale data users (FPC, DART)
- Provide extended support (outside office hours) to maintain the high-availability goals of the program

2019 Accomplishments

Continued the overall interrogation dataset upgrade with further development and evaluation of the interrogation data loading (IDL) features to support new interrogation data file format, data types, validation, alerting and integration with the reporting server. IDL now supports loading corrections and the removal of previously submitted interrogation files. IDL was extended to support robust parsing of raw field data contributed from M5 and I5 software systems. After a series of staff meetings, it was determined the scope for parsing raw message output from supported transceivers can be reduced to tag detection for reporting observations and noise reports for O&M trending analysis.

Began the design and development of a new Transceiver Status Report (TSR) along with a configuration control panel to automatically identify any transceivers operating in the field with a configuration out of compliance.

Performed ongoing system administration on production, staging and development servers hosting database and related ETL systems. Coordinated with PSMFC IT staff to ensure hourly backups and weekly software updates. Refined database processing to support Adult Ladder Efficiency (ALE), Cumulative Efficiency Analysis (CEA) and Transceiver Annunciation Status System (TASS).

2020 Plans

Continue refinement of IDL features in support of M5, I5 and TSR systems. Continue effort to consolidate databases used in development of the new PTAGIS website.

Continue to learn and leverage cloud services and solutions to maintain program goals for high-availability, security, performance and costs.

Continue support of database processing (ETL) for data loading, reporting, and system alerting. Perform daily system administration to ensure the overall integrity of the PTAGIS database.

Web Data Management Systems

The PTAGIS website (www.ptagis.org) provides online access to PTAGIS data, metadata, content and services to the public. Users can browse most of the online resources anonymously, but others needing identification and authorization require the user to create an account and log in to the system. The deliverable for this portion of the objective is a highly functioning/available, cost-effective, and extensible web server and reporting systems providing public access to PTAGIS data and related resources.

Key tasks related to this portion of the objective include:

- Development and refinement of online functionality such as:
    - Online request/approval workflow services, such as PIT tag distribution for all FWP
    - Content management
    - Community outreach features to support technical coordination
    - Web API interface to allow other automated systems to consume PTAGIS data and metadata
- Development and refinement of reports, dashboards and other related infrastructure for public research and internal O&M activities
- System administration, tuning, and capacity planning following best practices in the industry
- Interoperation with server data management systems and field data collection systems

- Support high-availability and security goals of the program

2019 Accomplishments

In 2019, the PTAGIS website had 45 thousand visits from 9 thousand unique visitors and met the program goals for performance and availability.

Development of a new PTAGIS website continued in 2019 while concurrently supporting the production website. Focus this year was further development of the request-approve-implement workflow on the portion of the website called the *Dashboard* (Figure 12). Features of the Dashboard require users to log in with a user account. Additional security roles were developed as well as administrative features added to manage content and implement requests.

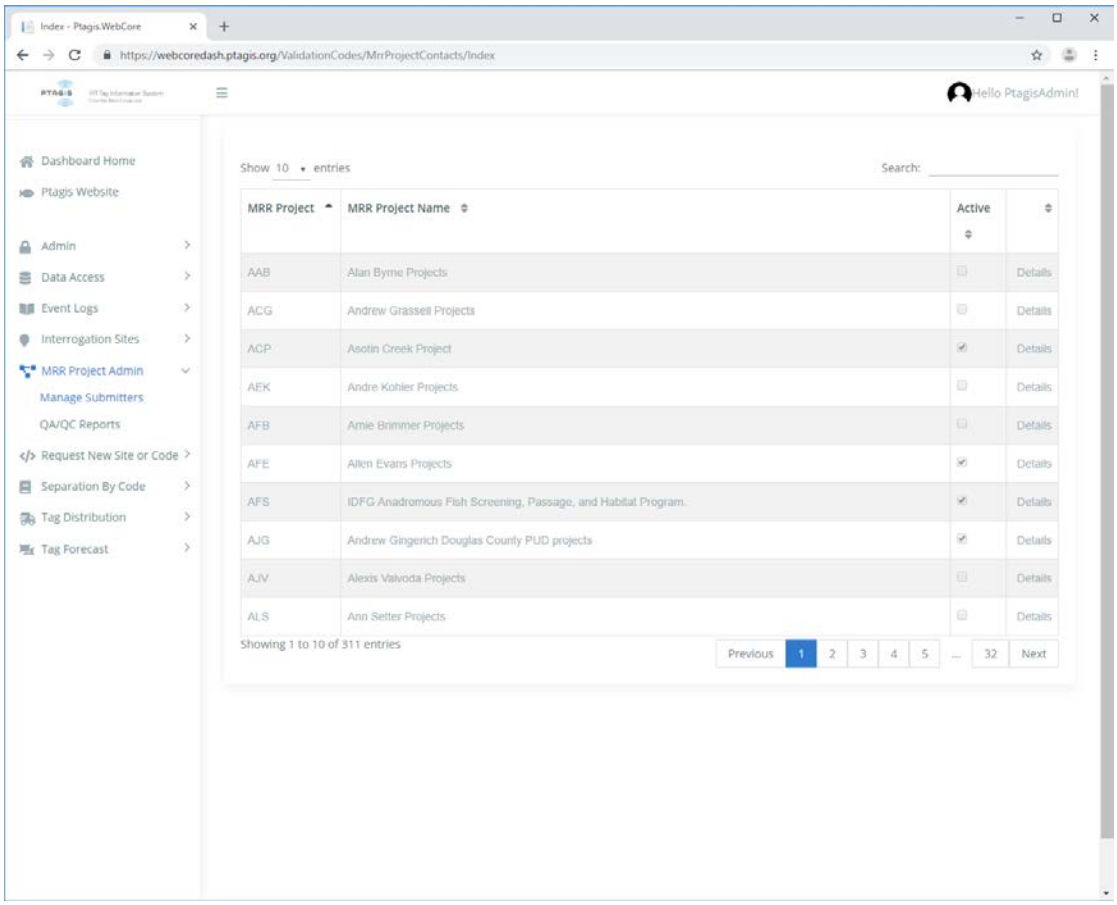


Figure 12. Dashboard section of the new PTAGIS website

Later in 2019, most of the Dashboard features were implemented. The same subcontractor that provided design and layout for the public site was reengaged to similarly design and layout features of the Dashboard. Additionally, they provided design and layout for a complex *Interrogation Site Metadata* page also completed in 2019 (Figure 13). Staff worked with PSMFC GIS department to integrate detailed ESRI maps into the new website, eventually eliminating the need to procure licensing for Google map services when the new site is rolled out into production.

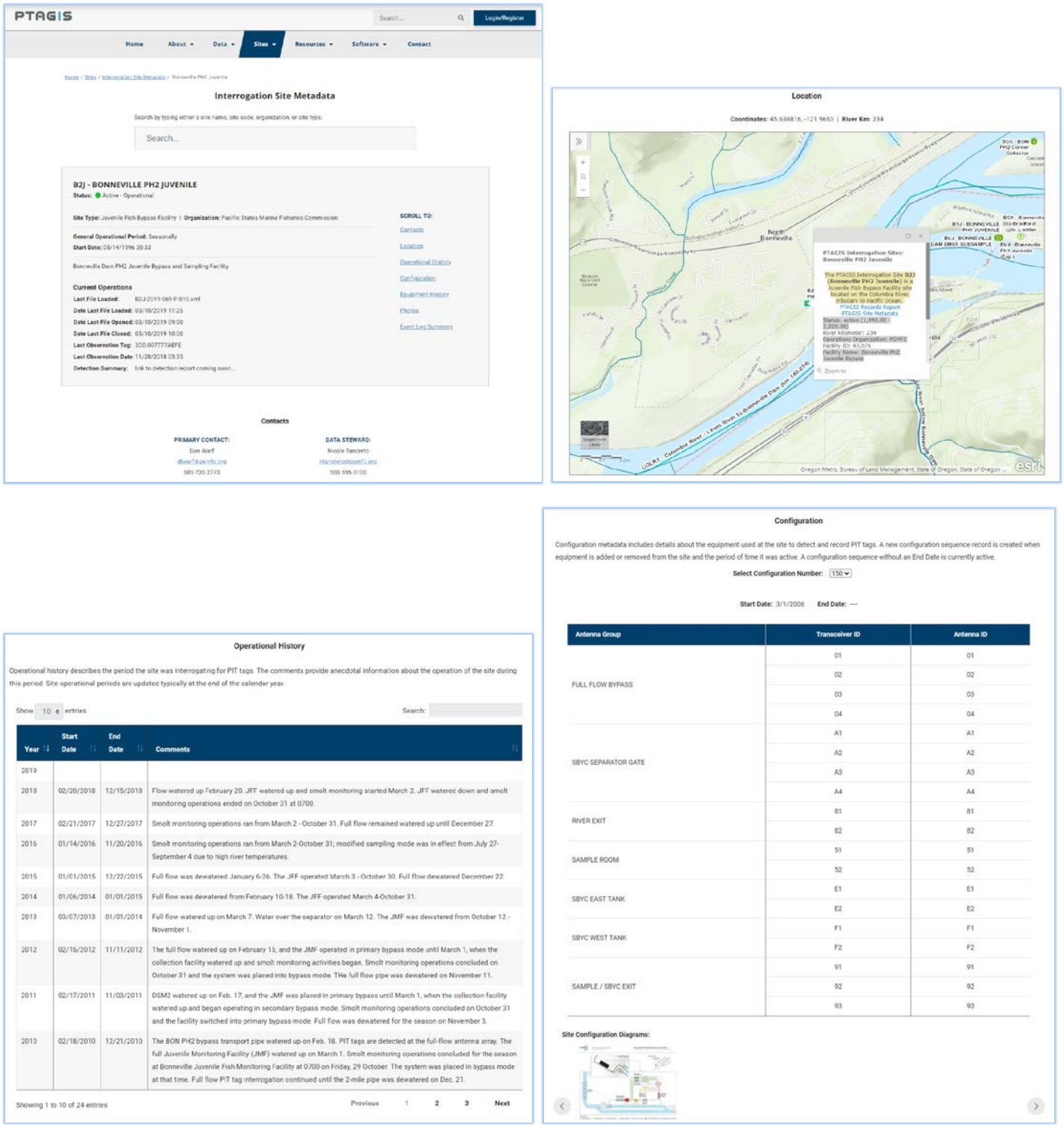


Figure13. Portions of the scrollable Interrogation Site Metadata page on the new PTAGIS website.

Staff continued development of a new PTAGIS Web API concurrently with the new website. Additional features were added/refined in support of secure M5 data submissions and the downloading of transceiver specifications. Data files submitted to PTAGIS from the field can now be accessed via the Web API, replacing the need for obsolete FTP access.

MicroStrategy 2019 upgrade was installed on a development platform with duplicated production data and reports to evaluate the new system that will eventually upgrade all of the PTAGIS reporting features. This included setting up security (SSL), maps, and an embedded API so the new reporting system can be integrated with the new PTAGIS Web

Site. This development platform and system was then scripted so it can be replicated for production deployment in 2020.

Performed system administration on production, staging and development servers hosting website and reporting systems. Worked with PSMFC IT staff to optimize the scheduling of maintenance to apply security and other patches to critical servers on a weekly basis per latest industry standards without affecting data collection or retrieval.

2020 Plans

Continue development and design of new PTAGIS website and related web API with goal of releasing in 2020. Continue to learn and leverage cloud services and solutions to maintain program goals for high-availability, security, performance and costs. Refine reporting features in coordination with interrogation dataset enhancements and an upgraded MicroStrategy reporting system.

E: 160. Operate and Maintain the Separation by Code Database

Before PTAGIS implements a Separation by Code (SbyC) project, the researcher must coordinate with all applicable agency contacts. The necessary coordination varies from project to project and facility to facility. If the project involves only routing PIT-tagged fish toward collection for transportation, minimal coordination is necessary. If the project involves diverting fish into holding tanks, much more coordination is necessary.

PTAGIS is responsible for the coordination and implementation of SbyC requests in the following nine fish passage structures at six mainstream FCRPS:

- Lower Granite Juvenile Bypass (GRJ)
- Lower Granite Adult Fish Trap (GRA)
- Little Goose Juvenile Bypass (GOJ)
- Lower Monumental Juvenile Bypass (LMJ)
- Ice Harbor Dam South Ladder (ICH)
- McNary Juvenile Bypass (MCJ)
- John Day Juvenile Bypass (JDJ)
- Bonneville PH2 Juvenile Bypass (B2J)
- Bonneville Adult Fish Facility (BO3)

The agencies and researchers whom request SbyC vary year-to-year. The focal species are typically salmonids.

The coordination portion of this objective requires various researchers to enter request metadata for each SbyC project into the database using an online service implemented on the PTAGIS website. The requester must notify appropriate contacts at the COE, NOAA and Smolt Monitoring Program which are referenced on the PTAGIS website. If the planned SbyC projects targets another researcher's PIT-tagged fish, the requester must contact and obtain the permission of that researcher. The online request service provides a checklist for these coordination actions with automated workflow so that the Fish Passage Advisory Council (FPAC) can approve each request based upon the metadata provided.

Once approved, PTAGIS staff implements the SbyC request by updating the local database of the interrogation software operating at the target facility, often more than once for each request. This is a time-sensitive process and requests often overlap each other at the same passage structure of an interrogation site. In some cases, the database containing the target fish must be computed and updated by staff in near real-time. Internal O&M reports are used to verify implementation. Additional ad-hoc coordination with researchers and facility staff is necessary to resolve issues and to ensure a successful implementation.

Implemented requests are permanently stored as metadata in the PTAGIS database and are available on the website for public review. Researchers can use past requests to quickly populate new SbyC requests that are on-going.

2019 Accomplishments

In 2019, 13 projects requested 49 target groups (action codes) of fish totaling 655,252 tags to be separated. Table 4 provides a summary of these projects.

Agency	Project Title	Target Tags
FPC	Comparative Survival Study 2019	432,101
NOAA	Migration timing and parr-to-smolt estimated survival for wild Snake River spring/summer Chinook salmon smolts	17,533
NPT	Adult Fall Chinook & Coho Salmon acquisition at Lower Granite Adult Trap through Separation by Code to acquire adult broodstock	199
NPT	Nez Perce Tribe 2019 Separation by Code Request	25,325
USGS	Estimate growth of Clearwater subyearlings	4,360
WDFW	Performance Evaluation of PIT tagged subyearling Chinook released at Lyons Ferry Hatchery 2019	20,000
WDFW	Performance Evaluation of PIT tagged subyearling Chinook released into the Grande Ronde River in 2019	4,500
ODFW	Wallowa and Imnaha Stock Steelhead Smolt Monitoring and Evaluation_2019 Releases	18,603
IDFG	Monitoring and evaluation of BY2017 Chinook Salmon smolts released from Idaho hatcheries in the Clearwater and Salmon River basins.	94,654
WDFW	2019 Lyons Ferry Hatchery Complex -Snake River, Steelhead Tributary Releases	22,983
NOAA	Investigating the origin and migration patterns of bull trout encountered at Lower Granite Dam	11
IDFG	Clearwater hatchery steelhead broodstock acquisition at Lower Granite Adult Trap through Separation by Code	65
IDFG	Monitoring Upper Salmon River A-run Steelhead Reared in Circular Tanks	14,918
	Total Target Tags	655,252

Table 4. *Separation by Code request summary for 2019*

2020 Plans

Continue processing SbyC Requests in a similar manner as this year.

Interrogation Site System O&M and Installation

PTAGIS has a complete field operations office that designs, installs, and maintains the equipment and software needed for automated PIT tag detection, including systems for enabling individual fish segregation, examinations and relocation, known as Separation by Code (SbyC). This section provides additional background on these activities and further describes the work efforts as defined in the statement of work portion of the BPA contract.

An overwhelming majority of the 231 million observation records contributed to the PTAGIS system have come from large-scale interrogation sites located at Federal Columbia River Power Systems (FCRPS) projects on the Columbia and Snake rivers (*Figure 14*). PTAGIS staff operate and maintain the electronic detection systems that collect this information under a *Memorandum of Understanding (*MOU)[2] between BPA and COE. Staff performing these tasks work out of a centrally located office in Kennewick, WA.

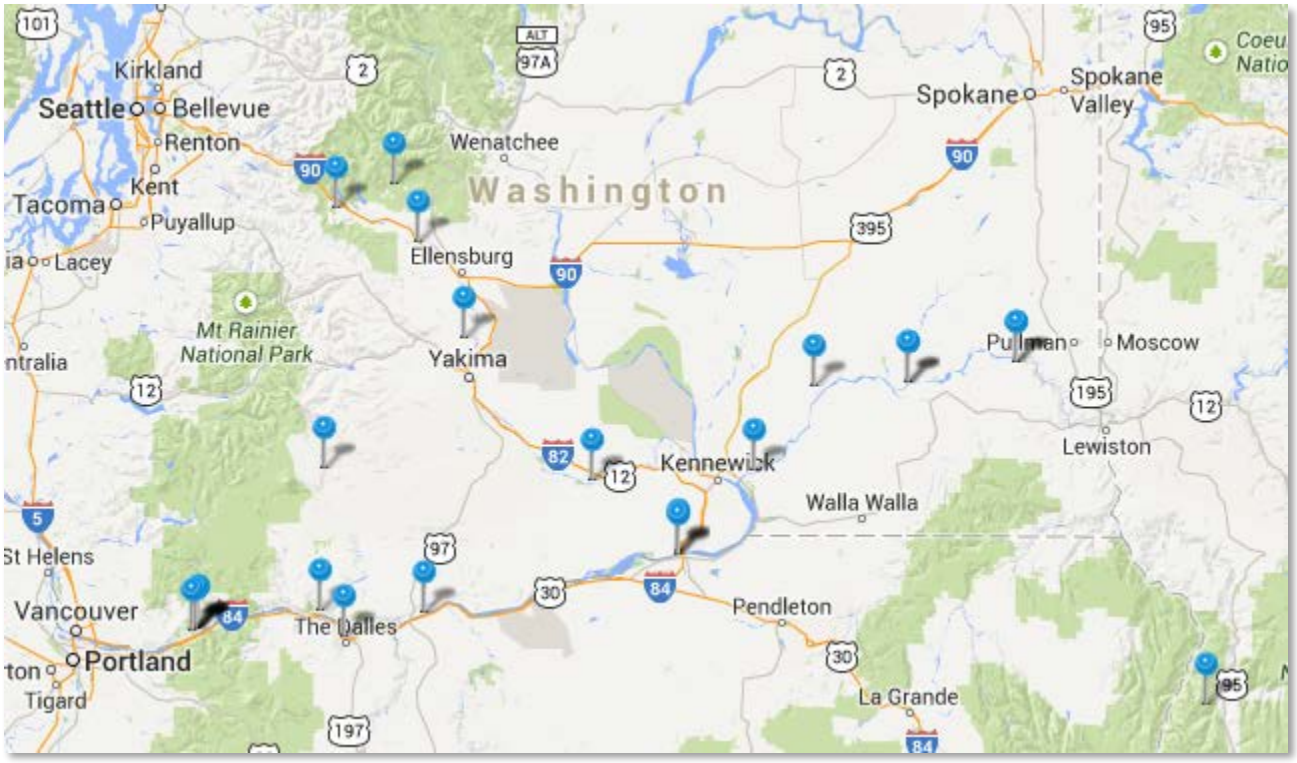


Figure 14. *Map of large-scale interrogation sites maintained by PTAGIS*

F: 70. Support Separation by Code Systems

The SbyC system is composed of fish-ways or flumes, diversion gates of all types (slide gates, rotational gates, side to side gates), air cylinders, solenoids, Programmable Logic Controllers (PLC), serial and Ethernet interfaces to PTAGIS data collection software, server-side system diagnostics and more. This work element relates to mandatory efforts to operate and maintain the systems and controls necessary to actuate the gates based upon SbyC database lookup information.

During the migration season, PTAGIS field systems personnel inspect and test SbyC pneumatic, electrical, and mechanical components at each facility on a weekly basis. During these site visits, PTAGIS staff coordinate with COE facility biologists and other researchers at the site. PTAGIS is fully responsible for the design, installation, operations and

[2] MOU between BPA and COE defining roles for installing and maintaining PIT tag infrastructure: http://www.ptagis.org/docs/default-source/ptagis-program-documents/pit-mou.pdf?sfvrsn=6

maintenance of the SbyC electrical control equipment and infrastructure to support this on-going process. The SbyC diversion gates are directly incorporated into complex passage fish structures and any malfunction or failure of the SbyC equipment can result in catastrophic consequences for smolts and adult fish routed through these facilities.

Detectors located downstream of the PIT tag diversion gates audit the path taken by tagged fish passing through those gates. The Diversion Gate Efficiency (DGE) system automatically computes the rate at which individual tagged fish are correctly routed through the diversion and facility sub-sample gates at those facilities. The instantaneous and cumulative year-to-date efficiencies are refreshed in near real-time as new detection data are received into the PTAGIS database. Staff review those efficiencies from a Web-accessible DGE report (Figure 15*)* to verify that, for each gate, the SbyC system issues the correct instructions to divert or ignore PIT-tagged fish, and that the gate operates properly to divert the targeted tags. A reported drop in the instantaneous efficiency is usually indicative of a mechanical problem at that gate. Having been alerted to the problem through the DGE report, PTAGIS staff can respond to and resolve the issue before the gate fails.

2019 Accomplishments

The diversion gate efficiencies at each SbyC site remain high due to PTAGIS and COE in-year and off-season maintenance programs (Figure 15).

Diversion Gate Efficiency Summary

([Divert Time] (Value) Between 1/1/2019 12:00:00 AM and 12/31/2019 12:00:00 AM)

B2J - Bonneville PH2 Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
B2J	SBYC SEPARATOR GATE	25,695	25,686	5	100.0%

Last Processed at 8/26/2020 9:15:01 AM

GOJ - Little Goose Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
GOJ	A-SEPARATOR GATE	38,360	37,709	632	98.4%
	B-SEPARATOR GATE	45,590	44,763	775	98.3%
	DIVERSION SBYC GATE	41,025	40,935	60	99.9%

Last Processed at 8/26/2020 9:15:01 AM

GRJ - Lower Granite Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
GRJ	A-SEPARATOR GATE	78,926	77,612	1,213	98.5%
	B-SEPARATOR GATE	38,967	38,369	553	98.6%
	DIVERSION / SBYC GATE	48,699	48,608	41	99.9%
	RCWY-10 GATE	54,898	54,332	480	99.1%
	SBYC GATE	399	0	0	

Last Processed at 8/26/2020 9:15:01 AM

JDJ - John Day Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
JDJ	SBYC GATE	0	0	0	0.0%
	SBYC SEPARATOR GATE	26,711	26,594	111	99.6%

Last Processed at 8/26/2020 9:15:02 AM

LMJ - Lower Monumental Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
LMJ	A-SEPARATOR GATE	28,659	28,293	355	98.8%
	B-SEPARATOR GATE	58,274	56,827	1,410	97.6%

Last Processed at 8/26/2020 9:15:02 AM

Figure 15*. Diversion gate efficiency summary for 2019*

Note: the diversion efficiency of the gate labeled *SBYC GATE* at GRJ cannot be measured because it does not have a downstream detection point. No SbyC projects were operated at MCJ this year.

In December 2018, a lab demonstration of an electronic gate prototype (Figure 16), developed by PTAGIS field staff, was given high praise by Lower Monumental and Little Goose COE juvenile fish facility operators. In agreement with the COE, this prototype replaced the pneumatic system that operates the SbyC B-Gate at Lower Monumental. Performance was evaluated over the 2019 season. The SbyC B-Gate operated successfully throughout 2019 with high diversion efficiency.

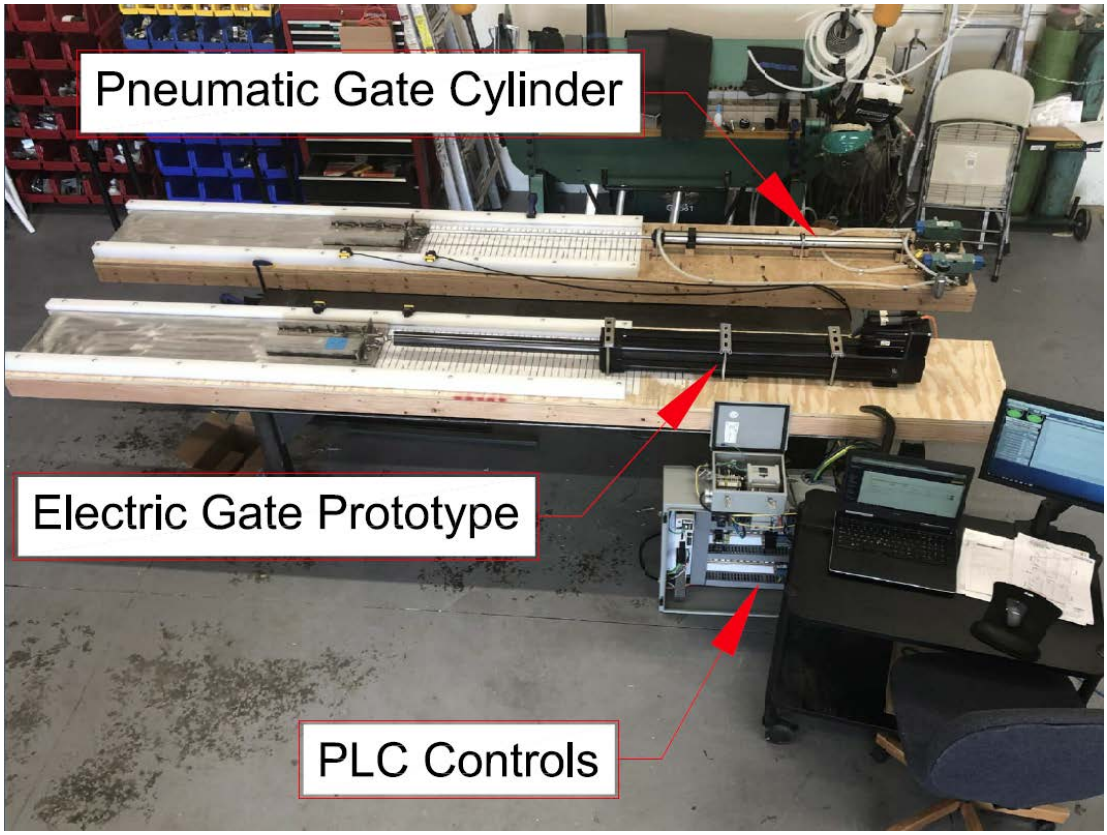


Figure 16. *Electric diversion gate prototype compared to pneumatic gate in PSMFC Kennewick Lab*

Electronic gates will lower costs by requiring less maintenance, have a significantly longer life span, and will increase diversion efficiency. They are also more operator friendly as they don't require constant lubrication inherent to pneumatic systems. With the successful 2019 season at Lower Monumental, electronic gates will replace pneumatic systems at other Snake River COE sites.

Staff will continue to operate and maintain the SbyC systems. Staff will evaluate electrically activated diversion gates to replace the current mechanisms to reduce maintenance costs and improve performance.

G: 70. Install Interrogation Systems in Field Locations

PTAGIS works with a wide range of researchers and agencies that are looking to incorporate PIT tag detection equipment into large-scale interrogation sites.

This process for installing a new interrogation system typically has the following stages:

- Field staff evaluate fish passage conditions at the proposed site
- Pre-qualification of the proposed site using radio frequency detection equipment

- Provide design requirements and feedback throughout the process to ensure the success of the project

Once a system is approved by BPA, PTAGIS coordinates with COE or other agency to install the electrical components of this system that include the transceivers, network, PLC, and the data collection computers.

Since 1993, PTAGIS has had an integral role in the NOAA Fisheries project 1983-31-900 (New Marking and Monitoring Techniques for Fish) when PTAGIS assumed responsibility from NMFS for the operation and maintenance of the permanent interrogation systems installed in the juvenile fish bypass facilities at Lower Granite, Little Goose, and McNary dams. In recent years, PTAGIS has assumed a larger role in the research, development, and evaluation of new PIT tag technologies, such as a new generation of tags, antennas, diversion gates and transceivers that provides greater read range, and lower cost for installation.

2019 Accomplishments

Lower Granite Spillway (GRS) PIT Tag Project

During the September 2018 FDDRWG meeting, the COE announced the postponement of the PIT tag portion of the GRS project until fall of 2019. During the fall of 2019 the final design of the spillway project was implemented. This work took the majority of available new-project hours for the Kennewick staff. The project was 95% complete in 2019 and will come into operation in 2020.

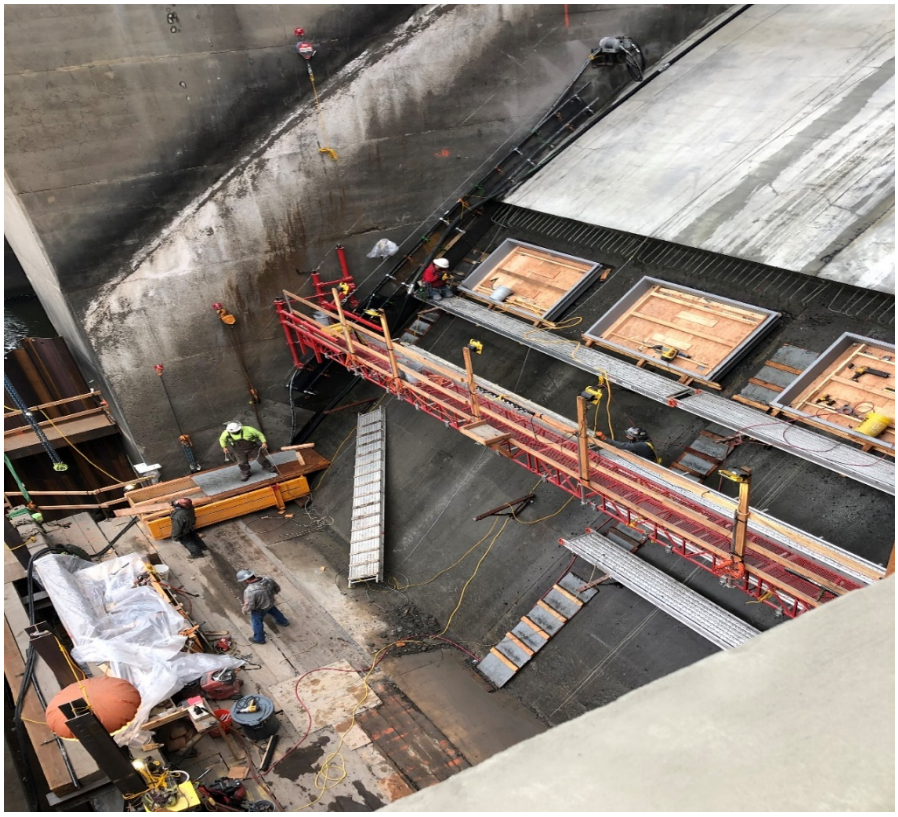


Figure 17. *Antennas added to the Spillway at Lower Granite Dam*

PTAGIS SCADA System Developed for All PTAGIS-Maintained Remote Detection Sites

The PTAGIS SCADA System continued to evolve in 2019 and has become a resource for all communication monitoring across all 29 PTAGIS sites. All automated systems are tracked for operational statuses and can be manipulated remotely. The system has reduced staff travel requirements and thus reduces overall O&M costs.

- Monitors live data from the remote sites
- Real time notification for site diagnostics
- Easy user interface for controlling automated field devices
- Historical trend logging for vital PLC data

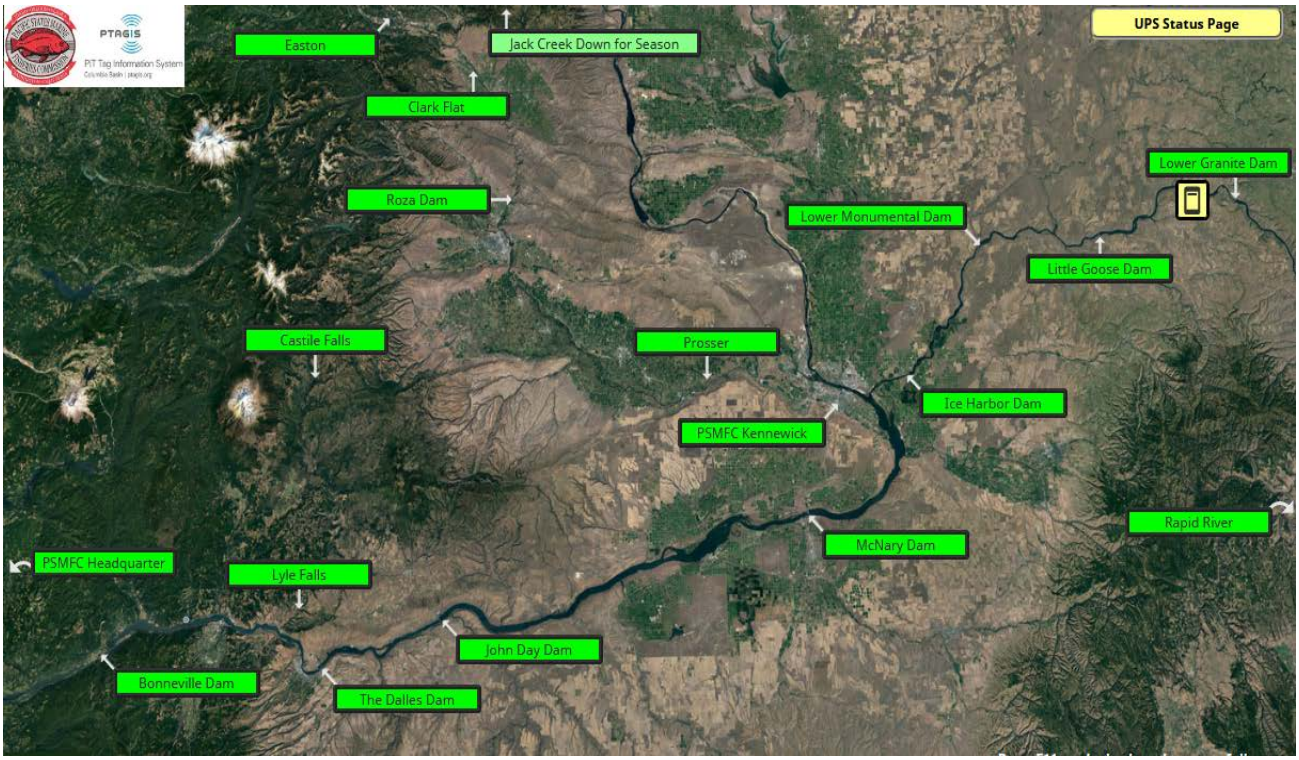


Figure 18. *SCADA Home Page*

BO2 Cascades Island Relocation Project

Due to subsidence issues and the possible loss of the BO2 PIT Tag Room at the Cascades Island tailrace level, it was determined that the PIT tag system should be relocated. During 2019 PTAGIS staff designed the infrastructure and submitted the 90% drawings to the USACE Bonneville staff. The new location is at the juncture of the UMT and the counting window. It will include 2 antennas at the UMT Entrance and 2 antennas at the counting window. The PIT Tag Room will be located within the Counting Window Room.

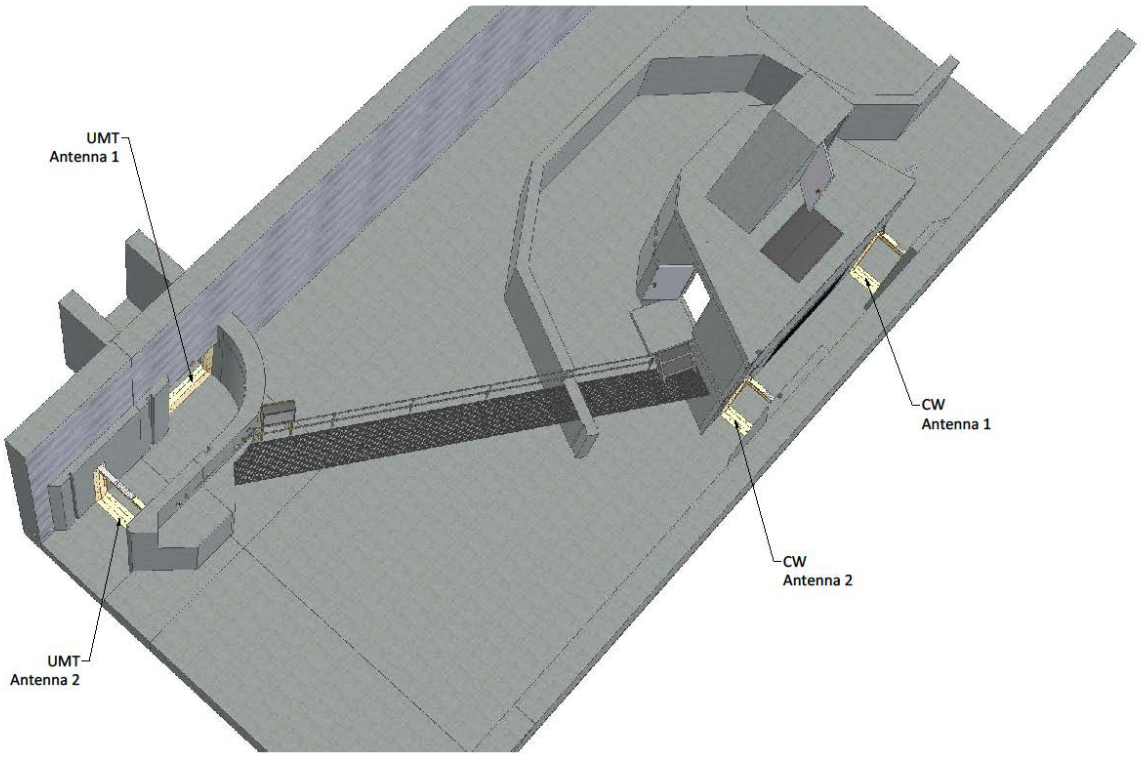


Figure 19. *Cascades Island New BO2 Antenna Locations*

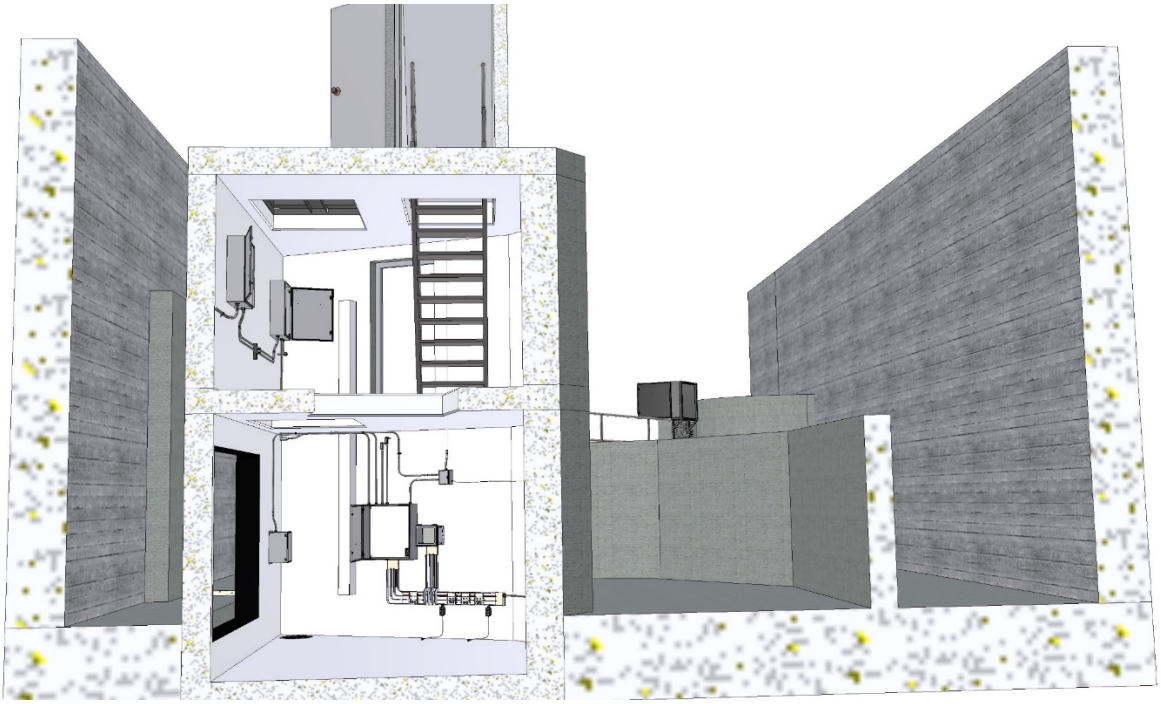


Figure 20. *Cascades Island New BO2 PIT Tag Room Location*

BO1 & BO4 Slot Antenna Replacement Project

The current generation of large slot antennas at Bradford Island and the Washington Shore have been failing at a consistent rate. Repair efforts over the past 5 years had been successful until 2019 when one of these antennas could not be repaired. A direct replacement antenna was estimated to cost $50k. A new antenna design was developed by the PTAGIS staff and submitted to manufacturing companies. Two antennas were built with a cost of under $12k each. Two more antennas will be built in 2020 to replace all four antennas at BO4. The older BO4 antennas will become spares for BO1.

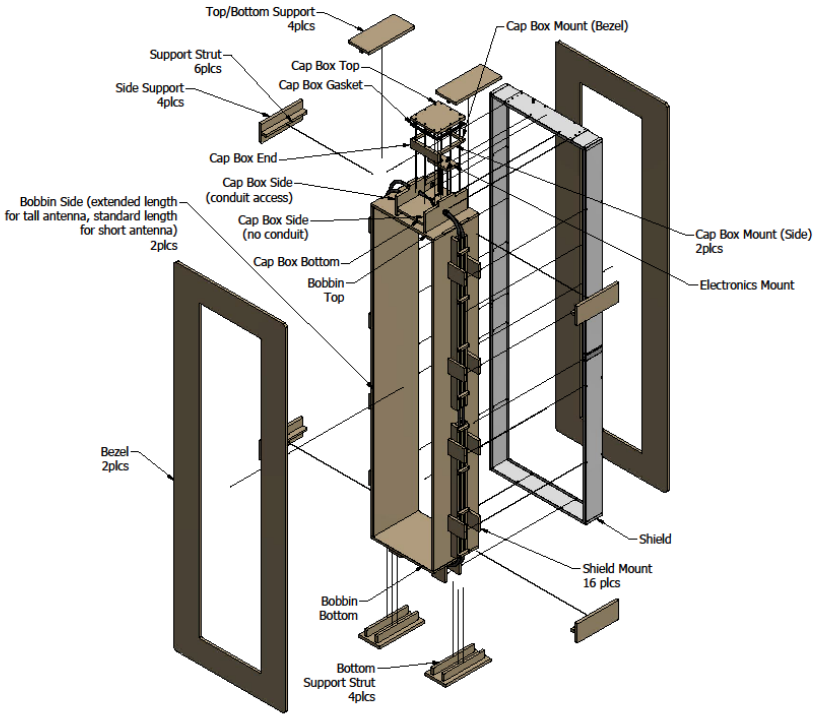


Figure 21. *PTAGIS Designed Replacement Antenna for BO1 and BO4.*

2020 Plans

- Complete the Installation and bring the Lower Granite Spillway (GRS) online
- Complete the BO2 relocation design and install the system
- Install an electrically actuated slide gate at LMJ's A Separator Gate
- Start the replacement of outdated serial communications equipment with a PTAGIS designed Serial to Ethernet Converter
- Continue to evolve the PTAGIS SCADA program

H: 160. Operate and Maintain Interrogation Systems in Field Locations

The PTAGIS field staff monitor operational reports throughout the day, 365 days a year. These reports identify the following conditions and allow field staff to respond to situations quickly:

- Data collection gaps
- Low reading efficiency of a detection system
- Transceiver failures and alarms

- Computer, network or other system failures and alarms
- Changes in environmental conditions (such as power, temperature, relative humidity) that may impact a detection system

During the portions of the season with high fish migration, field staff performed weekly, on-site, standard maintenance checks at each facility. Perform maintenance checks every other week in periods with lower migration. Site visits include tuning all readers, inspecting and adjusting the timing of diversion gates, maintenance of the data collection computers, and coordination with site operators and biologists.

Juvenile fish bypass facilities on the Snake and Columbia rivers begin operating around April 1st. Prior to these operations, the field staff perform all the necessary preseason tuning and maintenance to ensure peak performance of the juvenile fish detection and diversion equipment.

Radio frequency (RF) noise data is tracked on a continual basis, 365 days per year for the 456 antennas PTAGIS currently operates. Sites that have been quiet for years may suddenly become noisy. Tracking and mitigation consumes 10% to 30% of labor resources per year. COE and other agencies are cooperative in helping to control noise sources.

Field staff record general maintenance and anomalous events by submitting event logs to the PTAGIS system. The logs[3] are publicly available on the PTAGIS website as metadata for each interrogation site.

As certified electricians and electronic technicians, field staff repair and extensively test PIT tag reading equipment in the Kennewick lab before returning devices to service. PTAGIS inventories a minimal number of spare readers to expedite the replacement of failures and as a cost savings, repairs the equipment in-house.

2019 Accomplishments

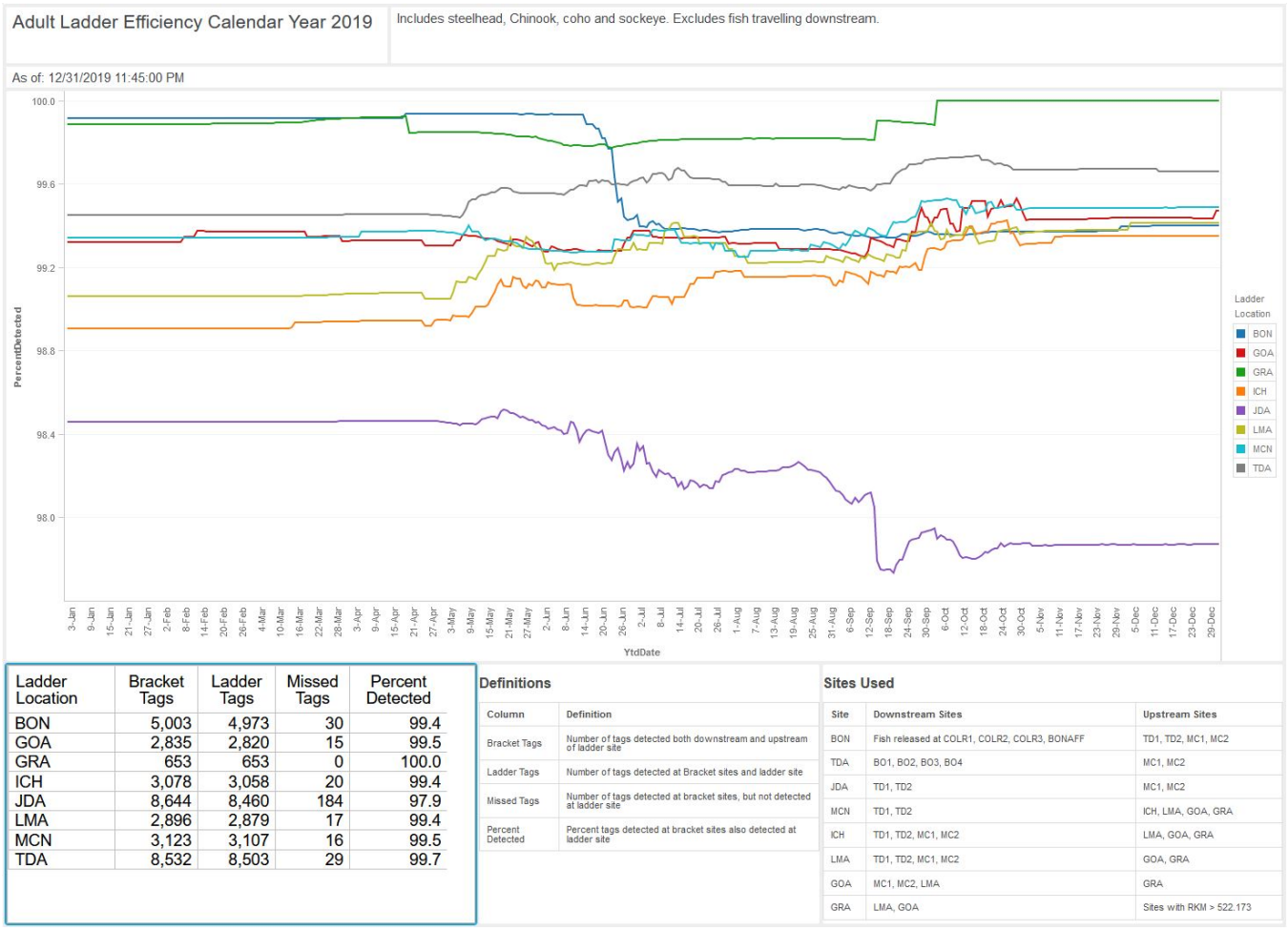
Juvenile Bypass O&M

Juvenile fish bypass facilities on the Snake and Columbia Rivers began operating in March and April. Maintained detection efficiency rates for 2019 at or above previous year's rates of greater than 99%. The single antenna in the Bonneville Corner Collector is the exception to this with an estimated efficiency rate in the seventies based upon a live fish test using 12mm tags conducted by NOAA.

Adult Ladder O&M

Adult ladder detection efficiency also remains high. In dam-to-dam comparisons, all sites maintained an approximate 97-99% detection efficiency over a 12-month rolling report period (Figure 18). In 2016, the efficiencies at LMA lowered to 97% due to the raising of the picketed leads that allowed fish to bypass the counting window and not pass through the PIT antennas. Since the decision was made at the May 2017 FPOM Meeting to leave the picketed leads in through November each year, LMA detection efficiencies have risen to 98.8% in 2018 and continued at that level into 2019.

[3] PTAGIS Event Logs for Interrogation Sites: http://www.ptagis.org/services/event-logs/view-event-logs



Ladder Location	Bracket Tags	Ladder Tags	Missed Tags	Percent Detected
BON	5,003	4,973	30	99.4
GOA	2,835	2,820	15	99.5
GRA	653	653	0	100.0
ICH	3,078	3,058	20	99.4
JDA	8,644	8,460	184	97.9
LMA	2,896	2,879	17	99.4
MCN	3,123	3,107	16	99.5
TDA	8,532	8,503	29	99.7

Definitions

Column	Definition
Bracket Tags	Number of tags detected both downstream and upstream of ladder site
Ladder Tags	Number of tags detected at Bracket sites and ladder site
Missed Tags	Number of tags detected at bracket sites, but not detected at ladder site
Percent Detected	Percent tags detected at bracket sites also detected at ladder site

Sites Used

Site	Downstream Sites	Upstream Sites
BON	Fish released at COLR1, COLR2, COLR3, BONAFF	TD1, TD2, MC1, MC2
TDA	BO1, BO2, BO3, BO4	MC1, MC2
JDA	TD1, TD2	MC1, MC2
MCN	TD1, TD2	ICH, LMA, GOA, GRA
ICH	TD1, TD2, MC1, MC2	LMA, GOA, GRA
LMA	TD1, TD2, MC1, MC2	GOA, GRA
GOA	MC1, MC2, LMA	GRA
GRA	LMA, GOA	Sites with RKM > 522.173

Figure 22. *2019 adult ladder efficiencies in dam-to-dam comparisons*

Network Enhancements

Deployed firewall appliances to the local networks of all interrogation sites operated by PTAGIS to meet security standards and improve VPN connectivity between sites and field office. To further O&M efficiency, field staff are completing the development of a SCADA interface for all sites that allows real-time communication and monitoring of PLC and related equipment in the field. Figures 23, 24 and 25 show the drill-through features of the online SCADA interface for remote monitoring.

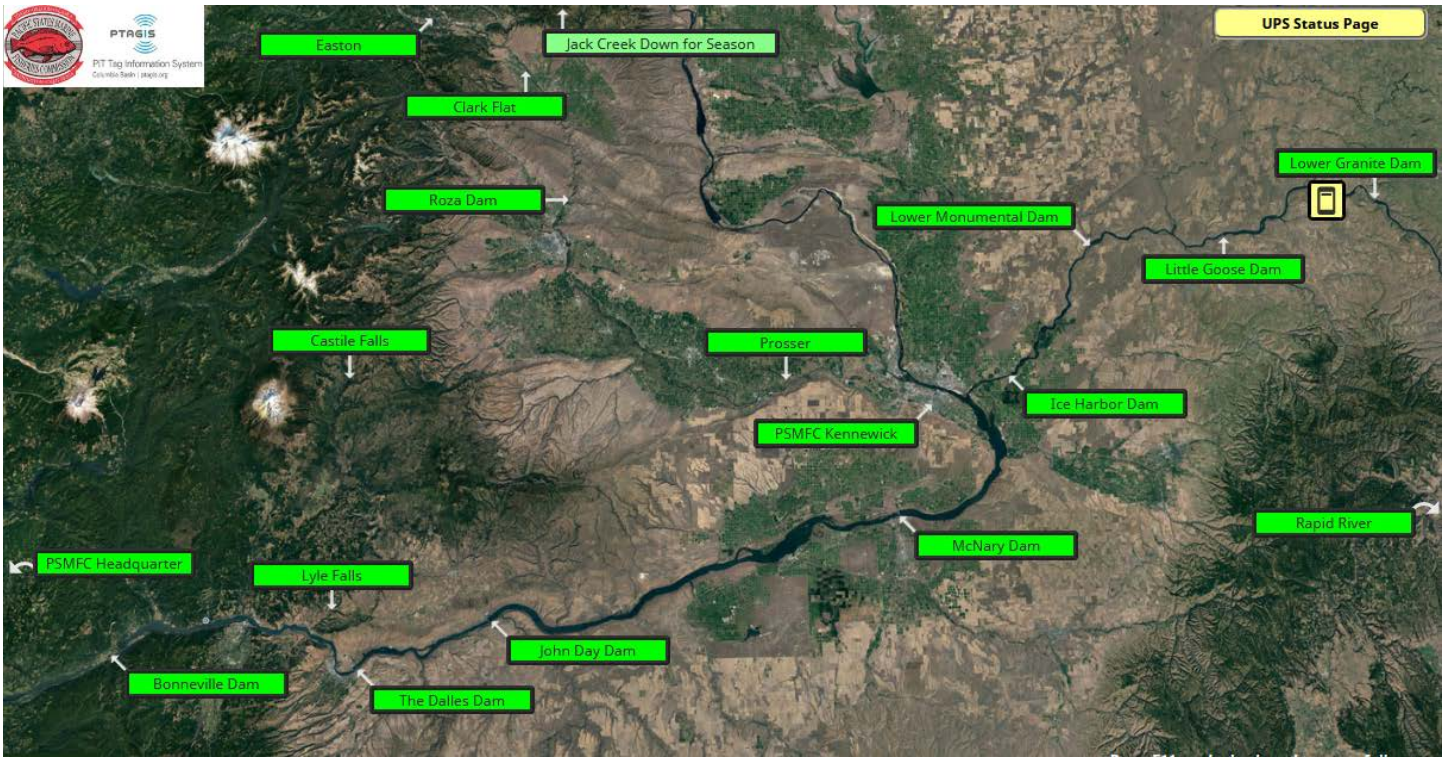
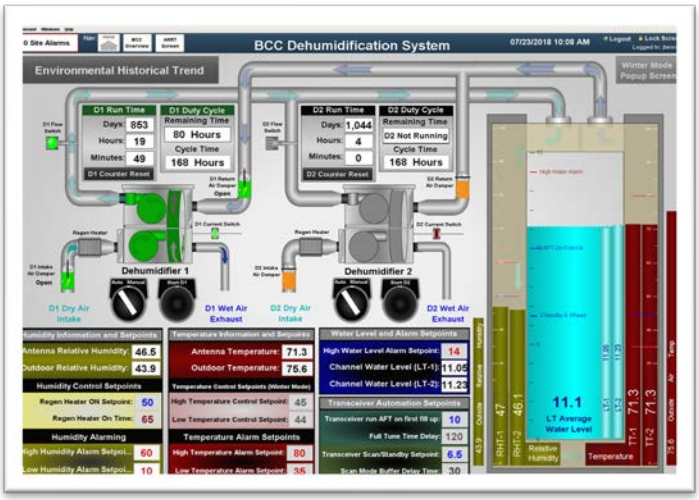


Figure 23. *SCADA drill-through interface to PTAGIS interrogation sites*



Figures 24 & 25. *SCADA drill-through interface showing humidity-control automation for large antenna at Bonneville Corner Collector (BCC)*

The online SCADA interface for the Bonneville Corner Collector (BCC) site (Figures 24 &25) allows staff to monitor and control the redundant dehumidification system that ensures the large antenna is operating at peak efficiency in real-time without having to make a 350-mile round trip to perform this on site.

Antenna Repair and Other Efforts

Field staff repair or replace failed antennas on an ongoing basis. Large antennas used at adult ladders are showing their age and are becoming more problematic. Designed in 2000 to 2002, these antennas (some weighing 1500 to 4000 pounds) are lifted out of the ladders with a crane and transported to the Kennewick office. Repair efforts include

dismantling the antenna bodies, drying the interiors, repairing areas where leakage has occurred and replacing connectors. Repair efforts become costlier with increased deterioration of the antenna bodies. Staff attempted to repair a 4000-pound antenna for BO4 but water damage was too severe. The field staff put together a design team to replace the aging antennas with an open frame design using NOAA designed underwater cable. These antennas will cost less to build, require less maintenance, and read at higher efficiencies. The first of these antennas will be available in 2019.

2020 Plans

Operate and maintain interrogation sites per established standard operating procedures (SOP). Develop a project plan for the relocation of the BO2 PIT tag room, which is currently sinking. Expand SCADA monitoring features to additional sites and tasks. Replace the four BO4 slot antennas with the new design.

J: 122. Additional Support Actions

The regional community often tasks PTAGIS staff to share their unique expertise in solving complex PIT tag detection and operational issues. This "catch-all" deliverable describes these types of ad-hoc requests that are within the program's scope of work and typically range from the following tasks:

- Regional coordination including FPOM and FFDRWG
- Transceiver, antenna and PIT tag conformance testing
- Electronics, process and control engineering
- Electrical design for PLC controls at sampling facilities
- Radio frequency identification (RFID) design
- Computer-aided design (CAD) detail
- Antenna design for the COE and others
- Cost analysis for installing PIT tag systems for the COE, NOAA and other various agencies

These tasks often overlap with deliverables described in section *F: 70. Install Interrogation Systems in Field Locations,* as they are typically the first steps performed before the installation of a new interrogation site.

2019 Accomplishments

Dual Mode Detection

After a thorough and successful evaluation by NOAA statisticians and PTAGIS staff, the detection efficiency for FDX tags does not appear to be impacted by dual-mode operations on adult ladder systems. Based on these conclusions and support of the PTSC, PTAGIS technicians enabled dual-mode at all PTAGIS maintained adult interrogation sites that have transceivers with this capability. As of October 2018, all adult ladder sites, other than the John Day, were operating in dual-mode. The John Day ladder system was placed into dual-mode in January of 2019. Ongoing evaluations in 2019 concluded that the use of dual-mode did not affect detection efficiency at John Day.

Pending further technical review and evaluation, staff are considering dual-mode operation on the full-flow bypass systems at COE juvenile fish facilities. These systems are instrumented with FS2020 transceivers, but further lab and field-testing are needed to determine if dual-mode is possible at these locations. This would allow for the detection of juvenile lamprey tagged with HDX tags. If FDX salmon detections won't be affected, a season long dual-mode test will take place at B2J's Full Flow detectors in 2020.

Bonneville Dam Powerhouse One PIT Tag Project

The PTAGIS Kennewick office continues to coordinate with USACE and NOAA personnel as part of the design team for PIT tag detection systems for Bonneville Dam. PTAGIS staff actively participated in design reviews providing technical

expertise and guidance along with conceptual CADD drawings for various aspects of the PIT tag portion of the project. These drawing sets help guide the USACE. The Kennewick staff submitted the following conceptual drawings to the design team. These designs (Figures 26 and 27) were accepted by the USACE as the leading candidates for construction:

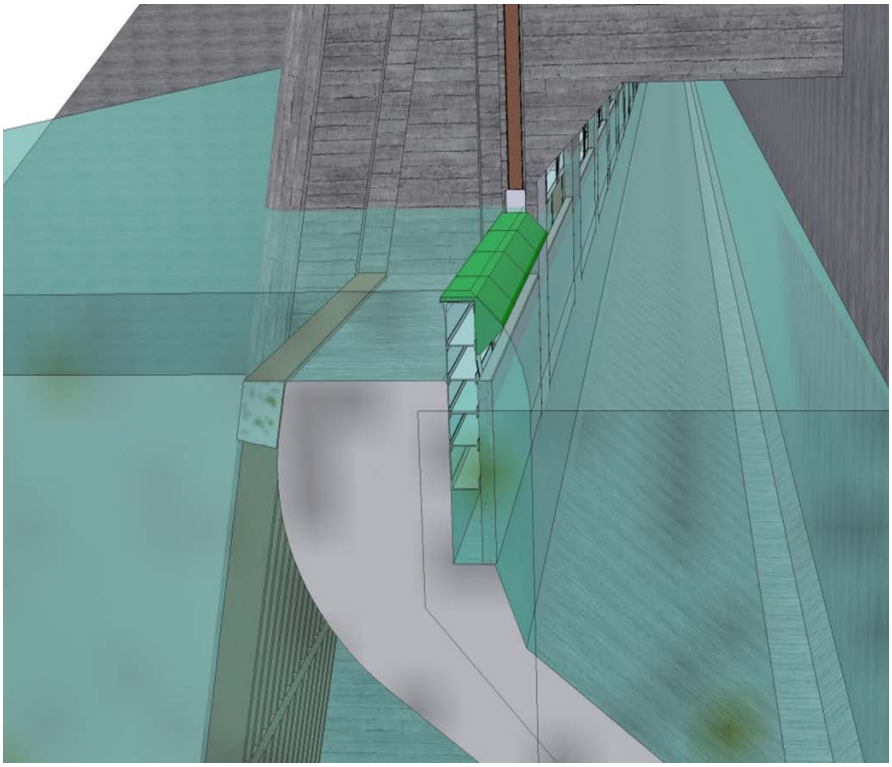


Figure 26. *Example of CADD designs developed by PTAGIS staff for the B1 I&T Sluiceway project*

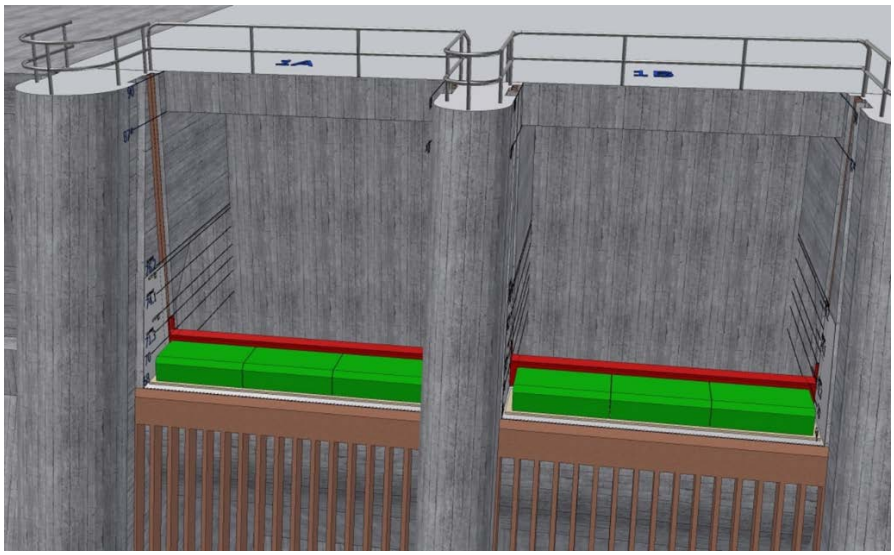


Figure 27. *Example of CADD designs developed by PTAGIS staff for the B1 I&T Sluiceway project*

2020 Plans

- Staff will continue to be members of design teams for multi-year, multi-agency projects described in this section.
- Continue to team with NOAA and the USACE to develop antenna designs for the B1 Ice & Trash Sluiceway.
- Work with NOAA and the Yakama Nation on the development of an in-stream type system for the Castile Falls fish facility.

Administration, Management and Coordination

This objective is comprised of the multiple contract work elements described in the following subsections. The work elements listed below are limited in scope and/or are well defined; therefore, no additional detail is needed:

- A: 185. Produce Pisces Status Reports – Periodic Status Reports for BPA
- B: 165. Produce Environmental Compliance Documentation
- L: 132. Submit Annual Progress Reports
- M: 202. Produce BiOp RPA Report

C: 119 Routine Administration of the Contract

This work element delivers general administration and on-going management of the BPA contract including:

- Funding package
- Hiring and supervising personnel
- Subcontracting
- Purchasing
- Budget and inventory tracking

PTAGIS is a fisheries data project of the Pacific States Marine Fisheries Commission. The Commission provides administrative support to the program, such as:

- Payroll
- Procurement
- Accounting
- Travel arrangements
- Contract review and monitoring
- Benefits, recruitment and other HR-related administration
- IT services

2019 Accomplishments

Completed all contract-related deliverables such as annual and periodic status reports on schedule. Submitted new funding package for FY20 in December 2019. Staff performed an annual inventory audit and the product was loaded into Pisces for the FY20 funding package.

Staff performed an updated cost analysis to host a PIT Tag Workshop in 2021 and submitted to BPA for approval. This cost analysis was added to a separate tab on the Line Item Budget submitted with the FY20 funding package.

Staff submitted a list of obsolete equipment scheduled for disposal in September 2019 to both BPA and PSMFC fiscal. Approvals were granted, the obsolete equipment was disposed using e-recycling methods, and inventory was updated accordingly.

Staff performance plans and reviews were completed and submitted on schedule per PSMFC guidelines.

2020 Plans

Continue routine administration of the contract as described. Audit program inventory and submit request to dispose obsolete equipment well before contracting period.

I: 122 Technical Support and Training Assistance to Field Users

This work element delivers online, email, and phone technical support/training to entities engaged in PIT tag research activities in the Columbia Basin. The focus of this support pertains to the publicly accessible *PTAGIS Field Data Collection* and *Web Data Management* systems described in previous sections of this document.

2019 Accomplishments

Staff answer approximately 25 support and coordination-related requests a month for various field software and web/reporting systems. Updated the context-sensitive help installed with P4 and PIFF 2 software with each new release. Continued to utilize Basecamp change tracking software-as-a-service to manage support requests and related software changes. Updated web-based technical documentation and online tutorial videos.

Staff started work on a new series of video tutorials for P4 in response to regular requests for PTAGIS to provide some sort of P4 training. These P4 video tutorials are short 5 to 10 minute videos providing instruction on how to do specific tasks in P4. New staff of data contributor organizations can find them on the PTAGIS Tutorials web page and view the videos covering the tasks they need to learn. Eight videos covering most of the tasks used to configure P4 were produced and published on the PTAGIS website in 2019.

2020 Plans

Complete the P4 video tutorial series so that all important P4 tasks are covered. Produce new tutorial videos for the advanced reporting system and new website. Add closed captions to all tutorial videos. Continue providing technical support for all publicly available PTAGIS systems. Create additional online video tutorials as needed and email surveys to promote better user experiences. Discontinue online forums as a form of technical support within the new PTAGIS website due to underutilization.

K: 189 Coordination- Columbia Basinwide

This objective covers standard regional coordination activities such as:

- Participating and the hosting of PIT Tag Steering Committee meetings[4]
- Participating in and providing ad-hoc data requests to policy and technical forums
- Conducting email campaigns and surveys
- Publishing and distributing a semi-annual PTAGIS newsletter[5]

The following subsections describe additional coordination activities.

Data Contributor Coordination

A diverse array of fisheries management and research organizations working in the Columbia Basin contribute MRR data and some observation data to PTAGIS. Basinwide coordination is necessary to ensure the contribution of these data are valid, timely and have adequate metadata. New *Tag Data Projects* and interrogation sites must be coordinated and approved through the PTSC before they can submit data into PTAGIS. Once approved, staff add the site metadata and

[4] PIT Tag Steering Committee Meeting Notes Archive: https://www.ptagis.org/resources/document-library/meeting-notes
[5] PTAGIS Newsletter Archive: http://www.ptagis.org/resources/document-library/ptagis-newsletter-archive

implement automation features in the Server Data Management System. Ongoing coordination among active data contributors involves the following activities:

- Manage Tag Data Project coordinator information
- Manage Interrogation Site steward information
- Manage validation codes, MRR sites and interrogation sites
- Provide start-up information for new data contributors
- Notifications about data anomalies
- Year-end reminders about data QA/QC and metadata requirements
- Special mailings as needed to disseminate information about process changes

PIT Tag Distribution and Quality Assurance

PTAGIS inventories and distributes all PIT tags to BPA Fish and Wildlife Projects (FWP). PTAGIS provides a web-enabled workflow to simplify the coordination effort and make it transparent. Aspects of this workflow process are:

- Forecasting annual PIT tag needs from FWP project leads
- Inventory management coordination between BPA and the PTAGIS Kennewick office
- BPA approval of tag requests for each project
- PTAGIS staff ship tags for each approved request
- Coordinate distribution with vendors for tags that are preloaded into needles
- Tag distribution information is archived and made available online

In addition to inventory and distribution, PTAGIS performs quality assurance (QA) on a sample of the PIT tags. This QA process uses advanced automation technology to verify the manufacturing of PIT tags meet specifications described in the contract between BPA and the vendor. This includes:

- Turn-on voltage
- Modulation percentage
- Resonant frequency
- Bandwidth/"Q"
- Size and weight

PTAGIS staff distributed 1.71 million tags to 63 FWP in 2019. The testing of 3% sample of those tags for quality assurance found no significant manufacturing defects.

2019 Accomplishments

General, on-going activities that include data contributor coordination are summarized in Table 5.

Coordination Type	Action	Count
Validation Codes	Added/Updated	19
MRR Sites	Added/Updated	29
Interrogation Sites	Added	23
	Decommissioned	3
	Updated	55
Newsletters	Published	2
News Items	Published	14
Support Requests	Fielded	~25/mo.

Table 5. Summary of on-going, general coordination activities performed in 2019

Staff coordinated a user survey in 2019 to see if there were remaining issues with the Biomark HPR Plus portable readers that were thought to be resolved through coordination in 2018 resulting in a firmware upgrade. The results of the user survey indicate the firmware upgrade seemed to resolve most issues with HPR Plus. Additional questions added to the survey produced a few enhancement requests for the P4 tagging software.

Staff and PTSC agreed to allow a researcher conducting a long-term marine survival study on the Cowichan River in western Canada to contribute PIT tag data to PTAGIS even though it is outside of the CRB. See meeting notes for details.

The subsequent sections describe substantial coordination activities completed in 2019.

2019 ISRP Review

As part of the 2019 Independent Science Review Panel (ISRP) process, staff submitted an extensive proposal detailing the activities, financials, and results of the PTAGIS program with focus on the last 10 years. The proposal was started in 2018. Staff presented highlights of this proposal to the ISRP members in March 2019. The ISRP gave the PTAGIS program proposal a "Meet science criteria" rating with a recommendation from the Northwest Power & Conservation Council (NPCC): "Sponsors will describe in their next annual report how they are improving coordination among their projects and improving communication with managers utilizing PIT-Tag arrays and related technology". The projects listed with this recommendation are:

- **1983-319-00** New Marking and Monitoring Technologies (NOAA)
- **1990-080-00** Columbia Basin PIT-Tag Information (PSMFC)
- **2018-002-00** Integrated IPTDS O&M (Biomark)

Working with the PIT Tag Steering Committee (PTSC), PTAGIS coordinated with agencies operating and contributing data from 'PIT-Tag Arrays' (*i.e.* instream interrogation sites) to form a technical subcommittee to address this concern. See details in next section regarding this coordination.

Instream PIT Tag Data System Steering Subcommittee

PTAGIS staff were part of the planning team and presented at the *Tributary PIT Tag Arrays in the Columbia Basin Workshop*[6] in October 2018. An action from this workshop was to create a formal instream steering committee to coordinate with numerous agency personnel operating and contributing data from tributary PIT tag arrays (instream interrogation sites). As part of the 2019 ISRP review process, the NPCC recommended more coordination between the principal agencies supporting instream interrogation sites and related technology.

To meet these requests, PTSC and PTAGIS staff completed a technical charter[7] in 2019 to form the Instream PIT Tag Data System (IPTDS) Steering Subcommittee (the Subcommittee). With this charter, the PTSC establishes the Subcommittee to provide technical guidance related to IPTDS operation and maintenance to the PTSC and PTAGIS while ensuring the data integrity of the PTAGIS database is not compromised. The purpose of the Subcommittee, in coordination with the full PTSC, is to develop and coordinate implementation of operation and maintenance protocols of IPTDS and to provide high quality interrogation data and associated metadata to the PIT Tag database accessible to all interested parties in the Columbia River Basin.

Once the charter was created and published on the PTAGIS website, staff and the PTSC coordinated with agencies to recruit membership for the Subcommittee. The coordination was successful and by the end of 2019, thirteen members formed the Subcommittee representing the following principal agencies operating/coordinating instream interrogation sites in the CRB:

- NOAA Fisheries (1983-319-00)
- Biomark (2018-002-00)
- Bonneville Power Administration
- Columbia River Inter-Tribal Fish Commission
- Colville Tribes
- Confederated Tribes of Warm Springs
- Idaho Department of Fish and Game
- Nez Perce Tribe
- Okanagan Nation Alliance
- Oregon Department of Fish & Wildlife
- U.S. Fish and Wildlife Service
- Washington Department of Fish and Wildlife
- Yakama Nation Fisheries

The PTSC and PTAGIS staff had concern about the potential conflict of interest given Biomark is a principal, sole-source vendor to the same community this advisory committee will be making important decisions for. The aim of the

[6] *Tributary PIT Tag Arrays in the Columbia Basin Workshop*: https://www.pnamp.org/event/tributary-pit-tag-arrays-in-the-columbia-basin-workshop

[7] IPTDS Subcommittee Charter: https://www.ptagis.org/docs/default-source/news-item-attachments/iptdscharter.pdf?sfvrsn=2

membership section of the charter and the public notice[8] listing membership was to ensure the transparent formation of the advisory committee (per Section 15.b of the Federal Advisory Committee Act). To mitigate this concern, Biomark is participating in the Subcommittee as an *Interested Party* instead of as a *Representative,* as defined within the charter; therefore, Biomark is not listed as a representative in the public notice. Per the charter, meetings are open to participation of all interested parties. Interested parties may provide input to IPTDS members but are unable to vote when the Subcommittee will operate on a consensus basis for decisions. PTAGIS communicated to Biomark representative his participation and expertise was vital to the success of the Subcommittee regardless of the formal membership role.

PTAGIS pledged the same effort of coordination for the Subcommittee as it currently does for the PTSC. Namely, this includes:

- Participating in and, in some cases, leading discussions to find consensus
- Coordinating meeting logistics and agendas
- Recording and publishing meeting notes
- Performing technical actions directed by the Subcommittee.

PTAGIS coordinated the first meeting with the Subcommittee in early 2020 with the following agenda:

- Review charter, membership and goals for the Subcommittee
- Introduction of members
- Discuss *2021 PIT Tag Workshop* ideas
- Discuss how PTAGIS can improve support instream interrogation sites
- Elect Chair and Co-Chair

PTAGIS Data Specification

The final version of the PTAGIS Data Specification (version 1.0) was published and an announcement was made in a newsletter[9]. The PTAGIS Data Specification is a living web publication and replaces the PIT Tag Specification Document that has traditionally been published as a static document. When changes are implemented at PTAGIS that require updates to the specification, it will be published with a new version number and a list of those changes.

The Data Specification includes an introduction that provides an overview of the PIT tag data as it is managed in PTAGIS for those who may be unfamiliar with the system. It also provides a brief introduction to other items that fall under the PTAGIS scope of work, such as software development, field operations, Separation by Code and coordination.

The primary purpose of the Data Specification is to provide details about both MRR and interrogation data and file requirements, submission procedures, and lists of current validation codes. A change log provides links to past specification documents and will record any changes made to current specification. The PTAGIS Data Specification is available online at www.ptagis.org/data/data-specification.

PIT Tag Reader Loaner Program

PTAGIS and Bonneville Power Administration (BPA) announced the start of a PIT tag reader loaner program to help make modern PIT tag readers available to BPA funded Fish and Wildlife projects at reduced costs. BPA has requested that

[8] Public notice of IPTDS Membership on PTAGIS website: https://www.ptagis.org/learn/iptds-subcommittee
[9] PTAGIS Newsletter October 2019, Volume 17 Issue 2: https://www.ptagis.org/docs/default-source/ptagis-newsletter-archive/vol-17-no-2-october-2019.pdf?sfvrsn=4

Columbia Basin Fish and Wildlife Programs discontinue use of Destron-Fearing FS2001 portable PIT tag readers as they are no longer supported by Biomark and may pose a safety hazard (see news item from June 11, 2018).

Figure 27. HPR Plus and HPR Lite PIT tag readers

BPA purchased two HPR Plus and seven HPR Lite readers (Figure 27) to be part of the PIT tag reader loaner program. PTAGIS will house the readers and coordinate the loaner program. The readers will be available to borrow for up to three months at a time, with the option to extend the lending period as availability permits.

The loaner program was announced in a newsletter article and a PIT Tag Reader Loan Request form (Figure 28) was created to allow researchers to borrow a reader for their FWP.

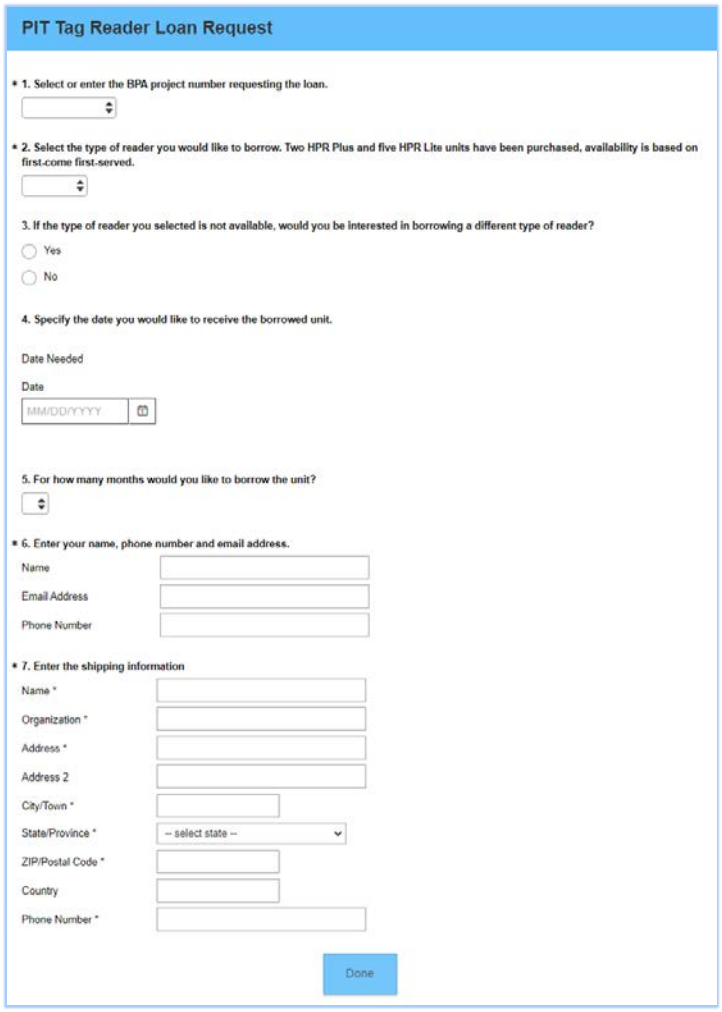


Figure 28. Online request form to request a loan for a reader from PTAGIS

Plans for 2020

Coordinate annual meetings and related activities with the PTSC and IPTD subcommittee including a PIT Tag Workshop in 2021. Discuss with PTSC the possibility of PTAGIS obtaining metadata about PIT tags distributed outside of the BPA FWP contract, such as USFWS and USACE procurements. Continue distribution, inventory and QA sampling of PIT tags to all FWP.