

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

2017 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 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.

PTAGIS develops and maintains software for entering/collecting both tagging and detection data. Tagging data is collected when fish are first marked with PIT tags or recaptured after having been previously PIT-tagged. Detection data is collected when PIT-tagged fish pass through automated antenna systems, called interrogation sites, installed in facilities or streams. Staff conducted six training sessions during the winter of 2017 to promote adoption of the new P4 tagging software, which was released in 2016. Participant feedback led to significant enhancements of the software and five additional releases were made throughout the year to add functionality and fix issues. The use of P4 increased

after the training sessions, and by the end of the year the majority of tagging data was being submitted from P4. PTAGIS plans to retire the legacy tagging software (P3) at the end of 2018.

Researchers from 36 organizations contributed just over 2 million fish marked with a PIT tag to the PTAGIS database in 2017 with a cumulative total of over 45 million records since 1987. The 309 interrogation sites contributing data to PTAGIS detected 822 thousand uniquely tagged fish this year. One fish can generate many interrogation records as it passes through multiple PIT tag antennas at one or more detection sites; 12.2 million detections were reported to PTAGIS in 2017 totaling 214 million detections since 1987. To give additional scope to the overall data management efforts in 2017: PTAGIS processed 422 thousand data files with 134 million database rows updated or inserted; 486 users executed 342 thousand queries resulting in 7.1 billion rows of data returned.

PTAGIS Operations and Maintenance (O&M) staff, based out of Kennewick, Washington, provide direct O&M of 29 large scale interrogation sites throughout the Columbia Basin, primarily at main stem dam locations. This involves daily monitoring and regular onsite visits to maintain the detection equipment that provides the majority of 214 million observation events available in the database system. PTAGIS also maintains the Separation by Code systems at eight locations which can be used by researchers to selectively segregate individual PIT-tagged fish from other tagged and non-tagged fish. The detection and diversion efficiencies at these sites remained very high throughout the year.

PTAGIS O&M staff participate in the design, planning and installation of new interrogation sites and detection technology. The interrogation sites in the ladders at John Day Dam were operated in passive recapture mode during 2017 while the US Army Corps of Engineers completed construction. Staff once again participated in the Lower Granite Spillway Detection Project, which moved beyond the design phase into building and testing prototype antennas. The schedule for installation of this system is still TBD.

PTAGIS O&M staff also completed testing for the BPA tag procurement contract. The ½ scale BCC antenna and automated read range equipment completed last year reduced the testing time significantly. During the previous tag testing in 2011, 18 tag types were tested over six and a half months, totaling 1,150 hours of test time. During the testing this year, 27 tag types were tested over three and a half months, totaling 778 hours of test time.

Four adult lamprey tagged with full-duplex tags and released below Prosser Dam passed into an area behind the picketed leads near the counting window; because of their proximity to the counting window antennas the tags were being continuously read, blocking detection of all other tags. The fish were removed with the cooperation of Bureau of Reclamation and the Yakama Nation, but the possibility of this occurring remains high if adult lamprey continue to be tagged with full-duplex tags. In response, PTAGIS considered switching all capable transceivers into dual-detection mode, which allows both full-duplex and half-duplex tags to be detected by the same equipment. Lab tests indicated that this should not reduce detection efficiencies, and a field test was conducted during the fall run at The Dalles Dam to confirm the lab results. The option to enable dual- detection mode at most adult ladder sites may be useful to lamprey and salmonid researchers alike, lamprey could be tagged with half-duplex tags and still get travel information through ladders, without the possibility of impacting adult salmonid detections.

In 2017, PTAGIS continued to provide high quality data collection, validation, management and reporting of PIT tag data for the Columbia River basin. Hundreds of users from dozens of fisheries organizations utilized PTAGIS on a daily basis 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 2017 and further describes work elements of the PTAGIS project related to collection, management and web delivery of all PTAGIS data.

Researchers contributed 2.08 million fish marked with a PIT tag to the PTAGIS database in 2017 with a cumulative 45 million records (Fig. 1). These records came from 36 organizations as they released the fish into 362 site locations throughout the Columbia Basin. The composition of marked species was similar to previous years (Fig. 2).

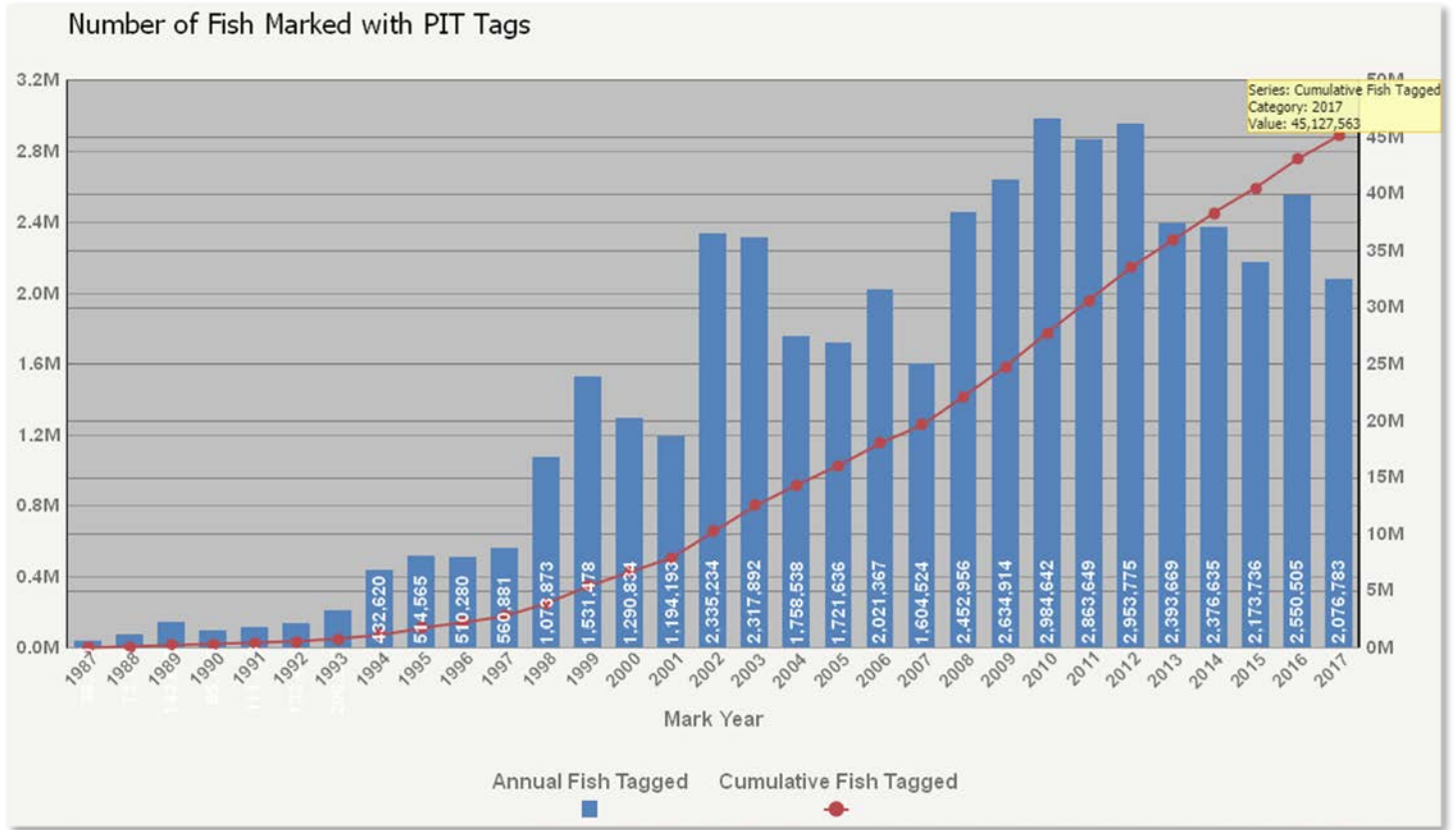


Figure 1. Annual and Cumulative Number of Fish Marked with PIT Tags

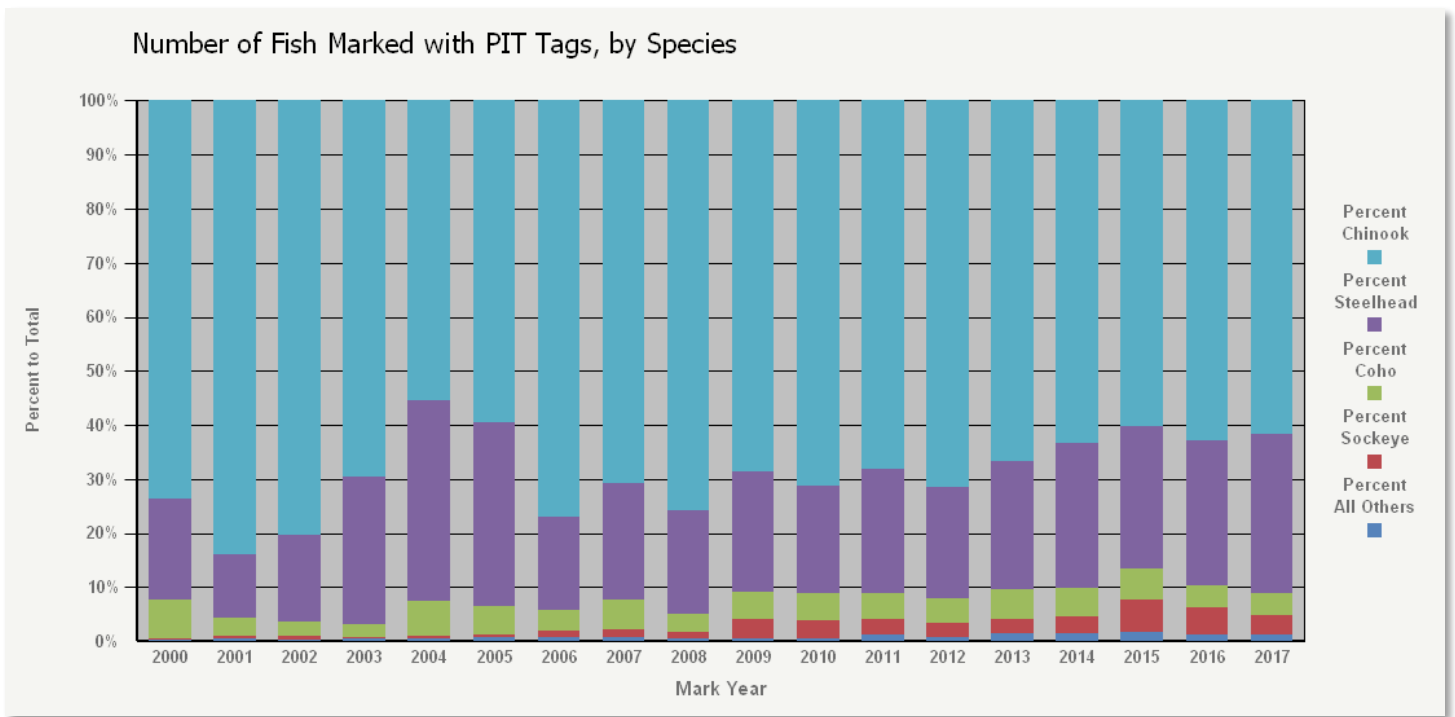


Figure 2. Number of Fish Marked with PIT Tags, by Species

The number of marked fish reported as *recaptured and re-released* approached 83 thousand. The reporting of mortality/recovery events typically happen later in the following years. Currently there are 44 thousand recovery/mortality events; however, this number will increase in outgoing years and most likely will be similar to the 2016 number of 160 thousand.

The 309 interrogation sites contributing data to PTAGIS detected 822 thousand uniquely tagged fish this year (Fig. 3). One fish can generate many interrogation records as it passes through multiple PIT tag antennas at one or more detection sites; 12.2 million detections were reported to PTAGIS in 2017 totaling 214 million detections since 1987 (Fig. 4).

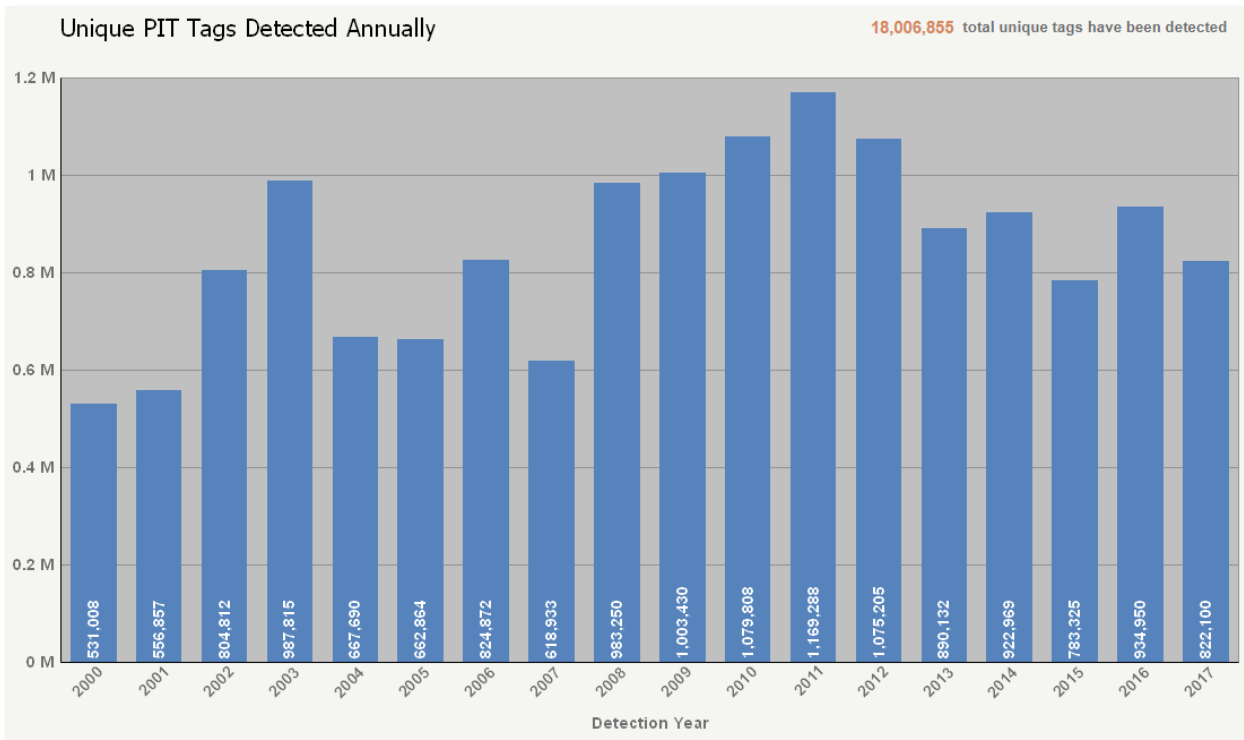


Figure 3. Unique PIT Tags Detected Annually

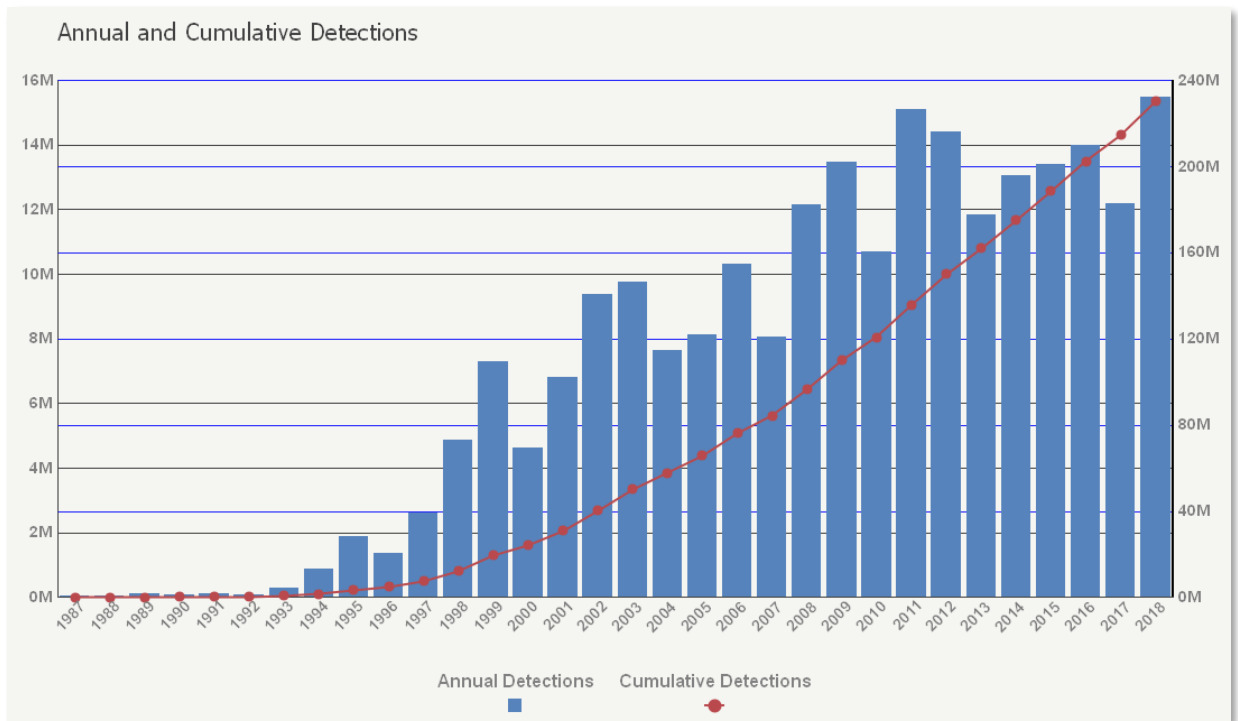


Figure 4. Annual and Cumulative Detections

To give additional scope to the overall data management efforts in 2017: 486 users executed 342 thousand queries resulting in 7.1 billion rows of data returned.

C: 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

With the multi-year effort to upgrade of the Mark-Recapture-Recovery dataset completed, this year staff turned their attention to begin a similar upgrade of the interrogation dataset to align PTAGIS with the current needs of the research community. This upgrade will start with coordination with the community to help refine interrogation site metadata as a driver for additional work, such as redeveloping the automated data submission system and developing new interrogation site steward web portal.

Visual Studio Enterprise subscriptions are the primary software development tool used by Portland staff to perform work listed under this objective. The subscriptions include cloud-based repository system to promote backup and version control of all PTAGIS source code. The retail subscriptions of this software were difficult to manage for individual staff members. This year, the five retail subscriptions were consolidated into a single, multi-year Dell Premier VLA used by PSMFC to facilitate renewal efforts and take advantage of volume pricing.

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 1*. 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	P3, 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	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. This software provides automatic diversion of target fish to examination tanks or for transportation – called separation by code (SbyC).
Utility Software	PIFF, Peripheral Emulator, Interrogation File Browser, Patch Manager	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 1. Types of PTAGIS Field Data Collection Systems

2017 Accomplishments

PTAGIS released five updates of the [P4 tagging software](#), which included the following enhancements:

- Added Scale ID field + auto incrementing (Genetic ID)
- Enhanced validation for Event Types
- Added batch update feature to data entry in support of mark-hold-and-release scenarios
- Support multiple reader input in data entry to support pre-scanning for PIT tags and similar scenarios
- Filtering of validation codes for each project
- Password restriction for configuration and management features
- Enhanced querying and record management
- Installation improvements to support agency security standards
- Updated documentation and video tutorials

The popularity of P4 increased throughout the community as a measured by number of file submissions from P4 eclipsing those submitted by P3 towards the end of 2017 (*Fig. 5*).

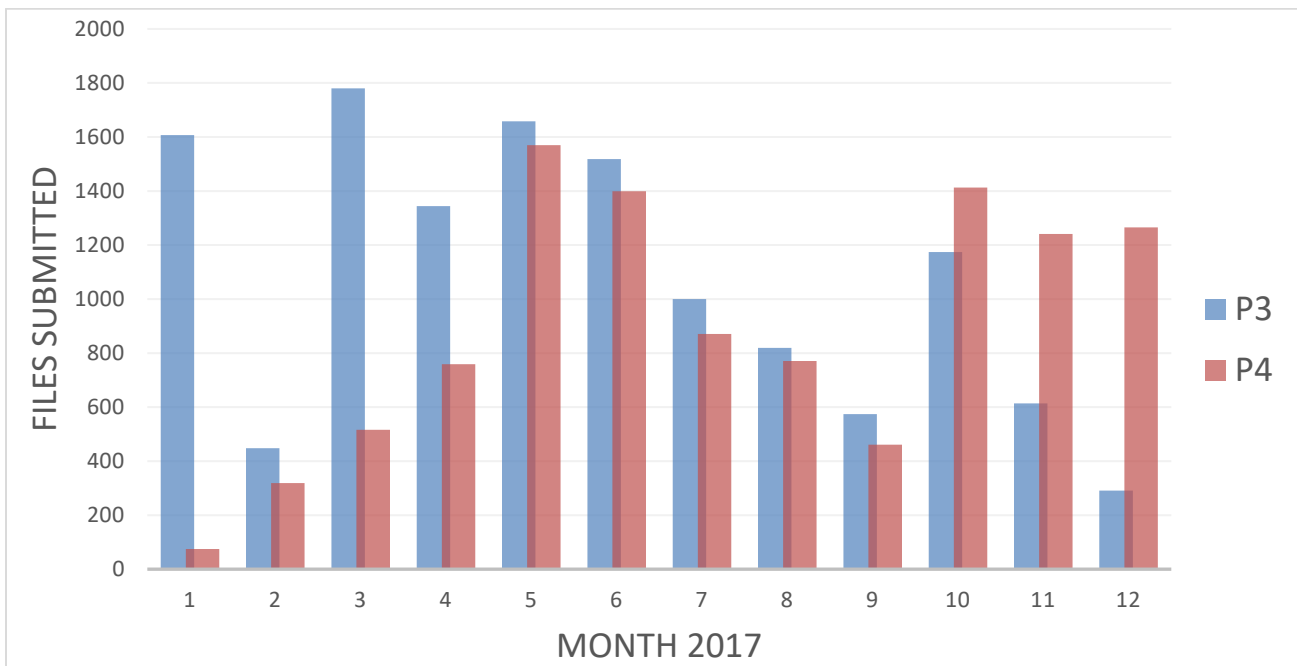


Figure 5. P3 vs P4 data file submissions

Upon request, staff developed a sample application demonstrating how to submit P4 data files to PTAGIS outside of the P4 software. Two agencies integrated the sample application into their custom systems to submit P4 data files to PTAGIS outside of the P4 software system itself. Staff also developed *Peripheral Emulator* software to emulate the variety of hardware devices supported by P4. This utility software promotes regression testing of the more complex features of P4 software.

A second version of the PTAGIS Interrogation File Formatter (PIFF) utility software was released this year. This software converts raw interrogation (aka observation) data output from various PIT tag readers into a formatted file that can be submitted to the PTAGIS database (*Fig 6*).

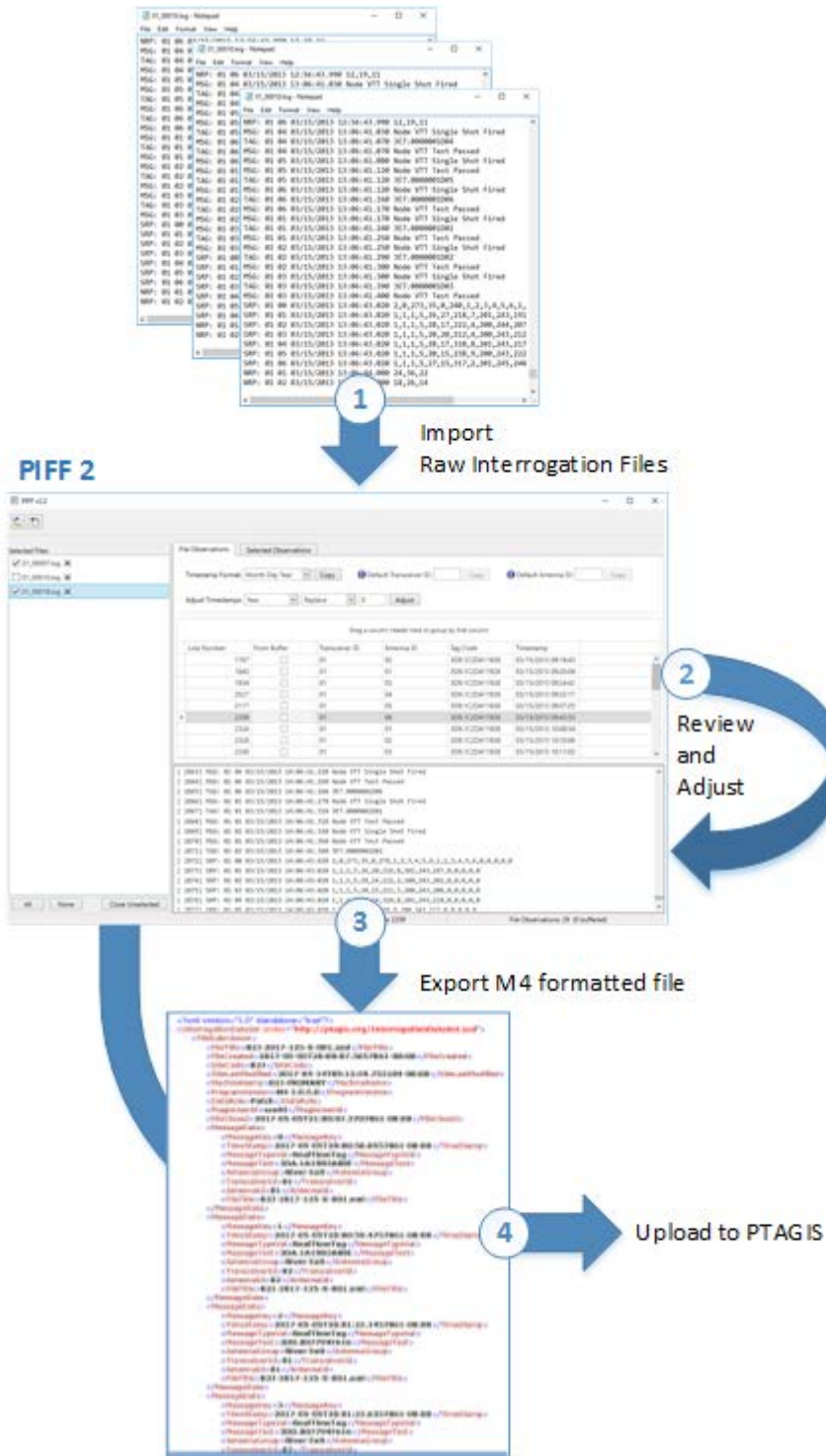


Figure 6. PIFF software utility version 2

New PIFF version 2 features include:

- A streamlined user interface
 - The contents of raw data files are displayed along with the parsed Observation records
 - Selecting an Observation record will highlight where the data was found in the file
 - Observation records can be filtered per file, and files can be opened, closed and selected for export
 - No longer need to select the device type before opening files

- Easily adjust timestamps in a file and modify file parsing options
- Submit M4 Interrogation files to PTAGIS
- Automatic software updates

With upgrades to the automated tag QA/QC systems described in section J: 189 Coordination- Columbia Basinwide, most of the implementation of the software that drives the sorting of tags back into original vials (post-QA) was completed this year. This software (Fig. 7) is the interface between the PTAGIS database and a PLC connected to the tag sorter hardware and drives this automation.

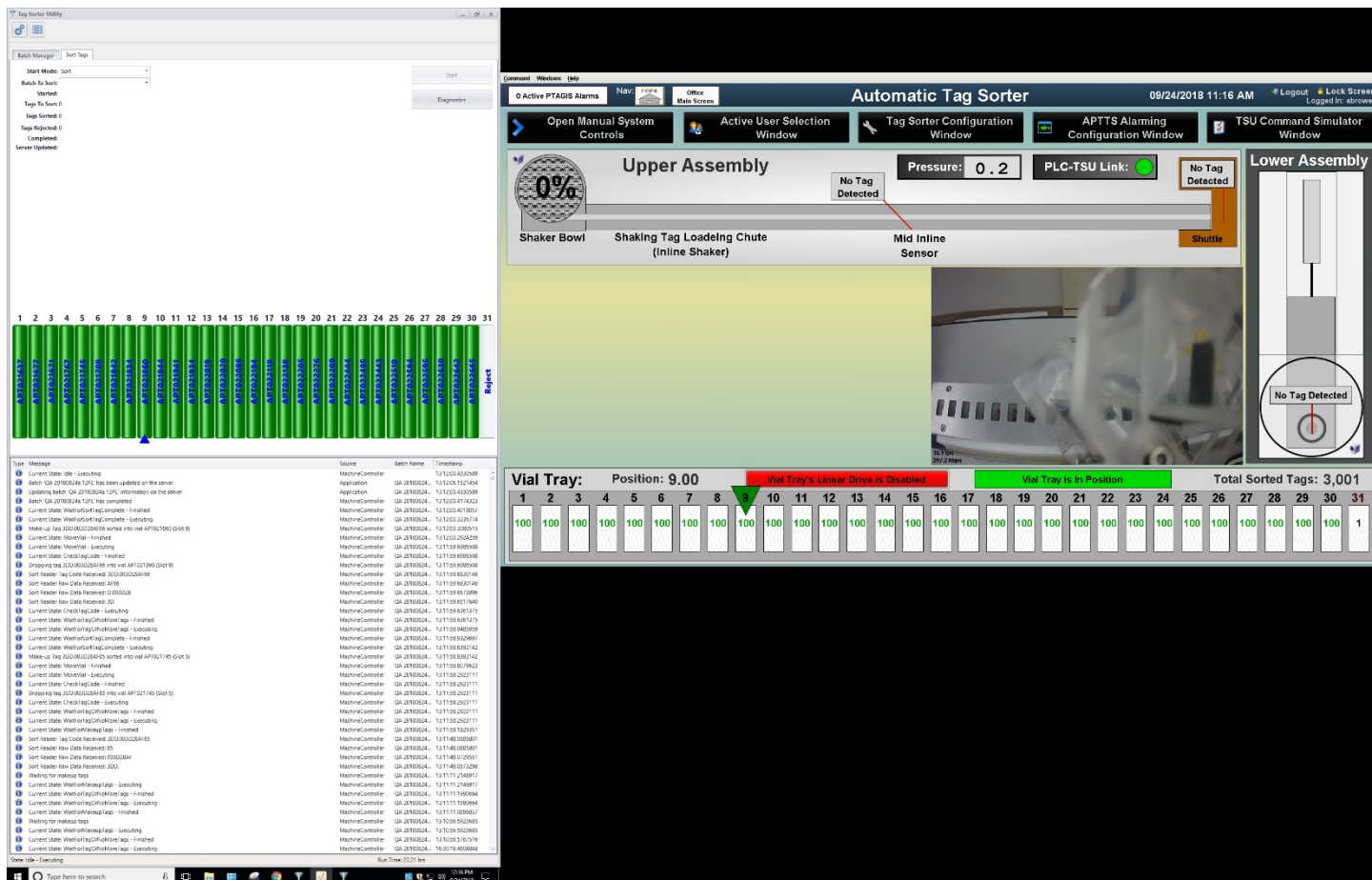


Figure 7. Tag Sorter Software and related SCADA interface

2018 Plans

Staff will continue to enhance P4, M4, and PIFF 2 software as requested. With the support of PTSC, announce an end-of-service date for the legacy P3 tagging software, possibly January 2019. Initiate the development of M5 interrogation software as part of the overall upgrade of the PTAGIS interrogation dataset. After the hardware of the tag sorter automation is completed, test and refine the tag sorter software that drives this system and deploy into production.

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 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 server and related systems.

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

2017 Accomplishments

Initiated the migration of the database to new server hardware purchased in FY17. Extended the warranty of the existing production database server to provide additional time to complete the migration process.

Reengineered the Interrogation Data Loader (IDL) process that validates and loads interrogation data from files making it more efficient and accommodating additional types of data. This effort required operating the new system in parallel (on new server hardware) with existing IDL process to verify results. Refined alerting systems supporting data submission and system high-availability.

Made additional enhancements to complete the MRR dataset upgrade this year, including the identification and alerting of duplicate MRR event records. Upgraded the Wasp inventory system used to track program assets. Continued efforts to maintain the email data file submission system integrated with the PSMFC email server.

Performed general system administration on production, staging and development servers hosting database and related systems.

2018 Plans

Complete database migration to new server hardware purchased in FY17. Review database backup policies with PSMFC IT staff to safeguard high-availability goals of the program. Continue development of new IDL process and deploy into production with support for new interrogation data file formats and data types as part of the overall interrogation dataset upgrade. Continue efforts to discontinue legacy email and FTP data file submission systems with web API using HTTP that is becoming an industry standard; P4 tagging software currently submits data files using PTAGIS web API over HTTPS without issue.

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

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

2017 Accomplishments

The website, principally developed over 6 years ago, continued to function with limited downtime and adequate performance. This year the website had 49 thousand total visits from 9 thousand unique visitors. These enhancements were made to the production website:

- Migrated web server to new hardware purchased in FY17 with minimal downtime for PTAGIS users
 - Previous web server hardware, now out of warranty, was rebuilt and delegated to a testing/staging server role
- Enhanced security via certificate and HTTPS support
- Updated document/video libraries and raw data file explorer
- Migrated to Sitefinity 10.x CMS system
- All maps displayed in the website are hosted via ESRI instead of Google Maps
 - Utilizing PSMFC license for ESRI
 - Potential to leverage Microstrategy integration with ESRI
- Consolidated public FTP server access
- Enhancements to the PTAGIS web API were made upon request

As part of the effort to develop the next generation website, staff evaluated various technologies and vendors to expedite delivery, primarily in the areas of website design and usability. Four vendors responded to an RFP to initiate design and related development of the new website to compliment the software development competencies of PTAGIS staff. After careful consideration of all vendor responses and interviews, it was determined that only one vendor was capable of meeting requirements on schedule, but their quote was significantly over what was budgeted for this effort in FY17. A decision was made to forgo having a subcontractor provide web design and usability features at the start of this project. Instead, staff adapted a new strategy to divide the new website development project into two parts:

- 1) a highly usable, professionally designed public website with limited features catering to casual users
 - a. Features such as news, search, newsletters, documents and quick data reports
- 2) a more functional dashboard website for advanced users (researchers) with limited design
 - a. Requires login to access
 - b. Features such as advanced reporting, requests for PIT tags, SbyC projects, and new validation codes

With this strategy, PTAGIS staff can focus their expertise on developing the 2) dashboard website and postpone the development of 1) public website that will require external efforts to ensure a professional look-and-feel to later next year. This development strategy was adopted in 2017 and will continue into 2018. Staff also decided build the new website upon recently released ASP.NET Core development technology instead of Sitefinity CMS platform as an additional means of expediting delivery.

PTAGIS uses Microstrategy, a leading reporting tool, to power the advanced reporting and quick reports features on the website (Fig. 8). This system was upgraded from version 9.4.1 to 10.4 in October 2017. The rationale for the upgrade is version 10.x is actively being enhanced, while version 9.4.1 will be phased out of support at the end of 2018. The upgraded reporting software runs on new server hardware purchased in FY16 (the out-of-warranty, legacy hardware was repurposed as a development server). In addition to reporting system and hardware upgrades, numerous reports were also enhanced taking advantage of 10.4 reporting features and the upgraded MRR dataset. With diligent effort, the entire reporting upgrade process was transparent to PTAGIS users.

Tag	Event Type	Event Site	Event Species	Event Date	Metrics	CTH Count
384.1B7969BCFD	Mark	ASOTSF - South Fork Asotin Creek	Steelhead	10/4/2010		1
	Passive Recapture	ASOTIC - Asotin Creek, Snake River above Clarkston, WA	Unknown	10/1/2010		1
	Mark	WALLAR - Wala Wala River	Bull Trout	10/23/2008		1
3D9.1BF1FDD3D1	Observation	BGM - Burlingame Dam and Canal	Unknown	10/30/2008		3
				10/31/2008		3
				11/1/2008		4
				11/2/2008		2
	Recapture	WALLAR - Wala Wala River	Bull Trout	11/4/2008		3
				11/5/2008		7
	Recovery	FOUNDI - Foundation Island, Columbia River	Unknown	11/12/2008		12
				10/26/2008		2
				11/23/2008		1
				11/8/2008		1

Figure 8. Microstrategy 10.4 interface used for PTAGIS reporting

Performed system administration on production, staging and development servers hosting website and reporting systems.

2018 Plans

Continue development of new PTAGIS website with goal of releasing in 2019. 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 MRR and interrogation data enhancements, including a new dimensional data model.

D: 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 salmonids, but in 2014 lamprey were also separated.

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.

2017 Accomplishments

This year 19 projects requested 62 target groups (action codes) of fish totaling 1.4 million tags to be separated. Processing of these requests utilized the new SbyC Request Workflow system deployed in early 2016. *Table 2* provides a summary of these projects.

Agency	Project Title	Target Tags
FPC	Comparative Survival Study 2017	437,010
NOAA	Migration timing and parr-to-smolt estimated survival for wild Snake River spring/summer Chinook salmon smolts	31,213
WDFW	2017 Lyons Ferry Hatchery Complex -Snake River, Steelhead Tributary Releases	26,000
USFWS	Effect of Early Spring Release from the Pelton Ladder on C. shasta Infection Rate in Spring Chinook salmon	120
IDFG	SY2017 Lochsa River Adult Radio Telemetry	15

IDFG	SY 2017 Potlatch River wild Steelhead Radio-telemetry	15
IDFG	Travel timing and habitat use of Pahsimeroi Fish Hatchery summer Chinook Salmon - Implications as they pertain to upper Salmon River salmon fisheries.	20
WDFW	Performance Evaluation of PIT tagged subyearling Chinook released at Lyons Ferry Hatchery 2017	20,000
WDFW	Performance Evaluation of PIT tagged yearling Chinook released at Lyons Ferry Hatchery 2017	30,000
WDFW	Snake River Hatchery Fall Chinook Fidelity and Fallback Study 2017	52
NPT	Nez Perce Tribe 2017 Separation by Code Request	33,000
NOAA	Transportation and survival research	706,018
IDFG	Monitoring and evaluation of BY2015 Chinook Salmon smolts released from Idaho hatcheries	95,690
IDFG	Monitoring Upper Salmon River A-run Steelhead Reared in Circular Tanks	12,250
ODFW	Wallowa and Imnaha Stock Steelhead Smolt Monitoring and Evaluation	24,000
IDFG	SY2017 Lochsa River Adult Radio Telemetry	30
IDFG	SY2017 Potlatch River wild Steelhead Radio-telemetry	40
IDFG	SY2018 Dworshak Hatchery Steelhead	60
NPT	B-Run Steelhead Evaluations - #201005700	120
	Total	1,415,653

Table 2. Separation by Code Request Summary

2018 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 (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 230 million observation records contributed to the PTAGIS system have come from large-sites interrogation sites located at Federal Columbia River Power Systems (FCRPS) projects on the Columbia and Snake rivers (Fig. 9). PTAGIS staff operate and maintain the electronic detection systems that collect this information under a *Memorandum of Understanding (MOU)*¹ between BPA and COE. Staff performing these tasks work out of a centrally located office in Kennewick, WA.

¹ 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>

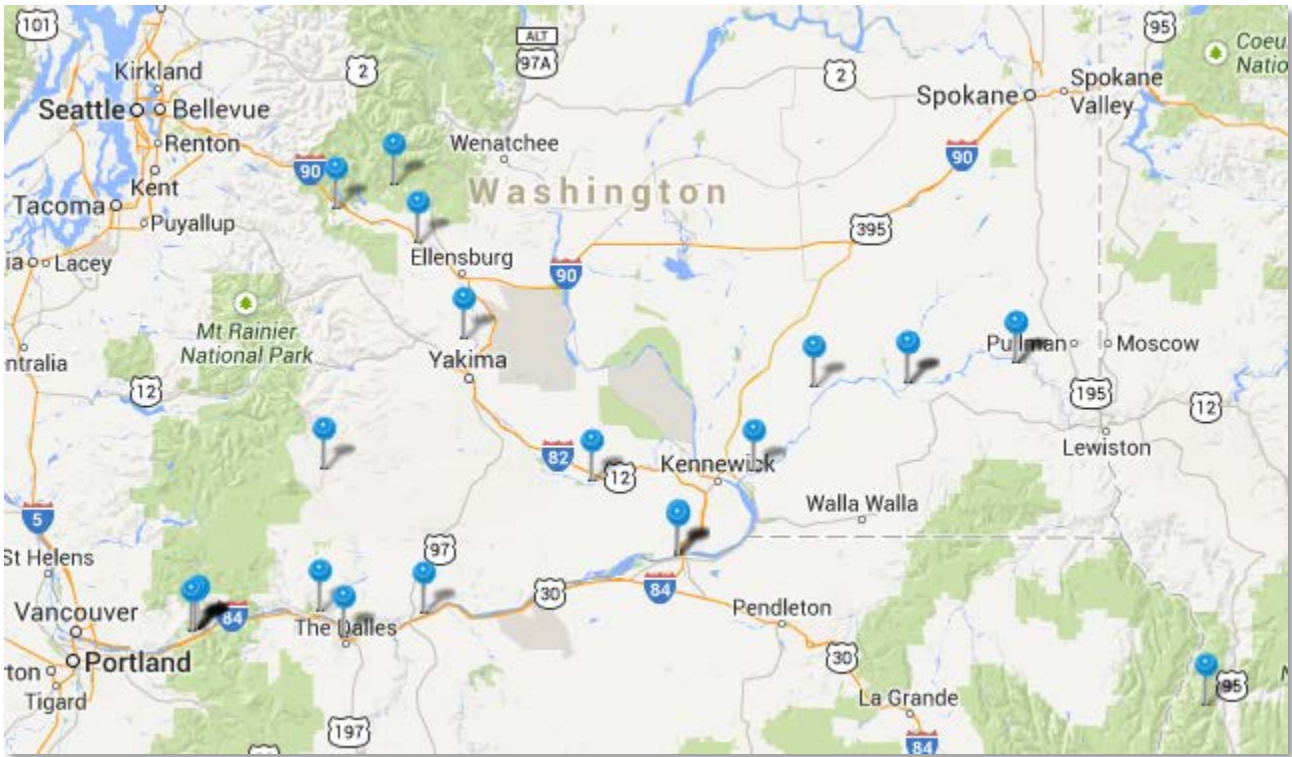


Figure 9. Map of Large-Scale Interrogation Sites Maintained by PTAGIS

E: 70. Support Separation by Code Systems

The SbyC system is composed of fishways 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 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 (*Fig. 10*) 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.

2017 Accomplishments

The diversion gate efficiencies at each SbyC site remain high due to PTAGIS and COE in-year and off-season maintenance programs (Fig. 10).

Diversiion Gate Efficiency Summary

{{Divert Time} (Value) Between 1/1/2017 12:00:00 AM and 12/31/2017 12:00:00 AM)

B2J - Bonneville PH2 Juvenile

Site Code	Diversiion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
B2J	SBYC SEPARATOR GATE	21,074	21,037	34	99.8%

Last Processed at 9/24/2018 8:15:02 AM

GOJ - Little Goose Dam Juvenile

Site Code	Diversiion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
GOJ	A-SEPARATOR GATE	32,271	31,708	540	98.3%
	B-SEPARATOR GATE	44,428	43,347	1,037	97.7%
	DIVERSION SBYC GATE	37,859	37,801	0	100.0%

Last Processed at 9/24/2018 8:15:03 AM

GRJ - Lower Granite Dam Juvenile

Site Code	Diversiion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
GRJ	A-SEPARATOR GATE	75,091	73,999	1,099	98.7%
	B-SEPARATOR GATE	43,518	42,957	500	98.8%
	DIVERSION / SBYC GATE	46,270	46,189	31	99.9%
	RCWY-10 GATE	67,556	65,907	1,499	97.8%
	SBYC GATE	599	0	0	

Last Processed at 9/24/2018 8:15:03 AM

JDJ - John Day Dam Juvenile

Site Code	Diversiion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
JDJ	SBYC GATE	0	0	0	0.0%
	SBYC SEPARATOR GATE	68,607	68,388	197	99.7%

Last Processed at 9/24/2018 8:15:03 AM

LMJ - Lower Monumental Dam Juvenile

Site Code	Diversiion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
LMJ	A-SEPARATOR GATE	29,499	29,217	268	99.1%
	B-SEPARATOR GATE	48,283	47,328	912	98.1%

Last Processed at 9/24/2018 8:15:04 AM

Figure 10. Diversiion Gate Efficiency Summary for 2017

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

2018 Plans

Staff will continue to operate and maintain the SbyC systems in out-going years. Staff will evaluate electrically activated diversion gates to replace the current mechanisms that use compressed air to reduce maintenance costs and improve performance.

F: 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 and transceivers that provides greater read range, and the construction of arrays of PIT tag antennas in close proximity.

2017 Accomplishments

In January 2017, the USACE began Phase 1 installation of the orifice and overflow antennas in the north and south ladders of John Day dam. Each ladder was equipped with 8 antennas covering 2 weir walls (*Fig. 11, 12*). Each weir wall consists of 2 overflow antennas and 2 orifice antennas. Upon completion of the antenna installation, PTAGIS technicians installed the newer FS-2020's transceivers, antenna cables and connectors. At that time, each of the antennas were functionally tested to ensure proper operation and readiness prior to the ladder watering up.

Phase 2 of the project at John Day includes installation of power and communications wiring to the transceivers, construction of the PIT tag electronics room and installation of the data collection platforms. Until this phase is complete, sites JO1 and JO2 cannot be brought online as production interrogation sites. To take advantage of the functioning antennas and transceivers, John Day project personnel provided temporary power to one weir wall in each of the ladders, which allows detections to be collected and stored locally in the transceiver buffers. These detections are being downloaded on a weekly basis and submitted as passive recaptures.



John Day South Fish Ladder (JO1)

Interrogation Site Configuration 100, version 1.0, Created March 2017

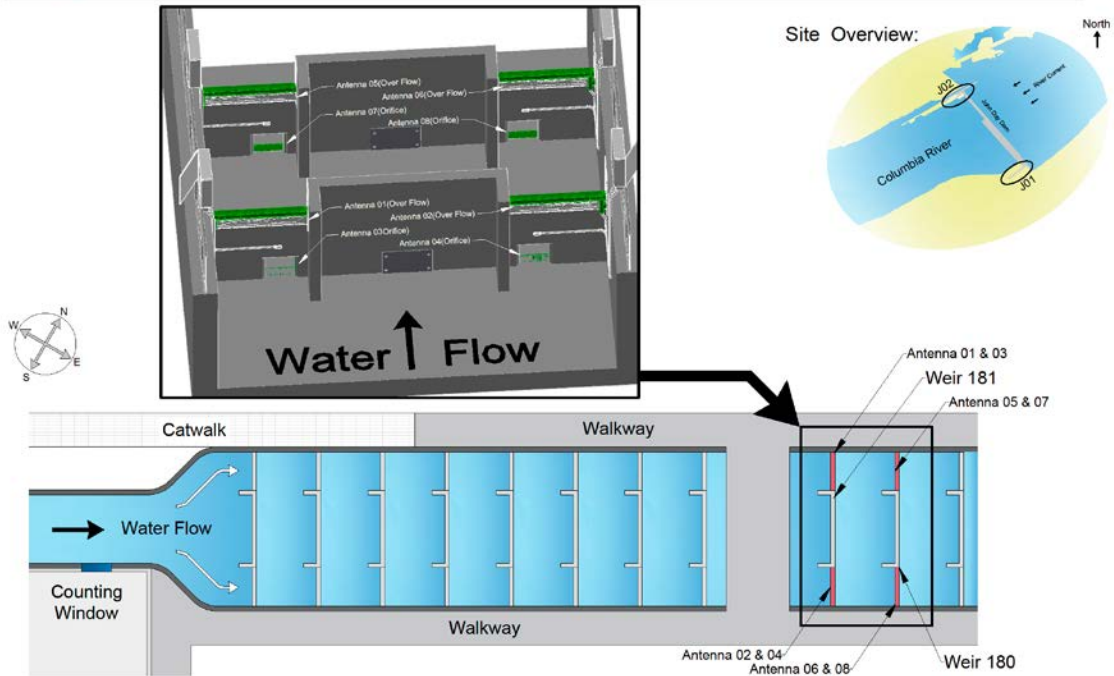


Figure 11. John Day South Fish Ladder (JO1) antenna installation



John Day North Fish Ladder (JO2)

Interrogation Site Configuration 100, version 1.0, Created March 2017

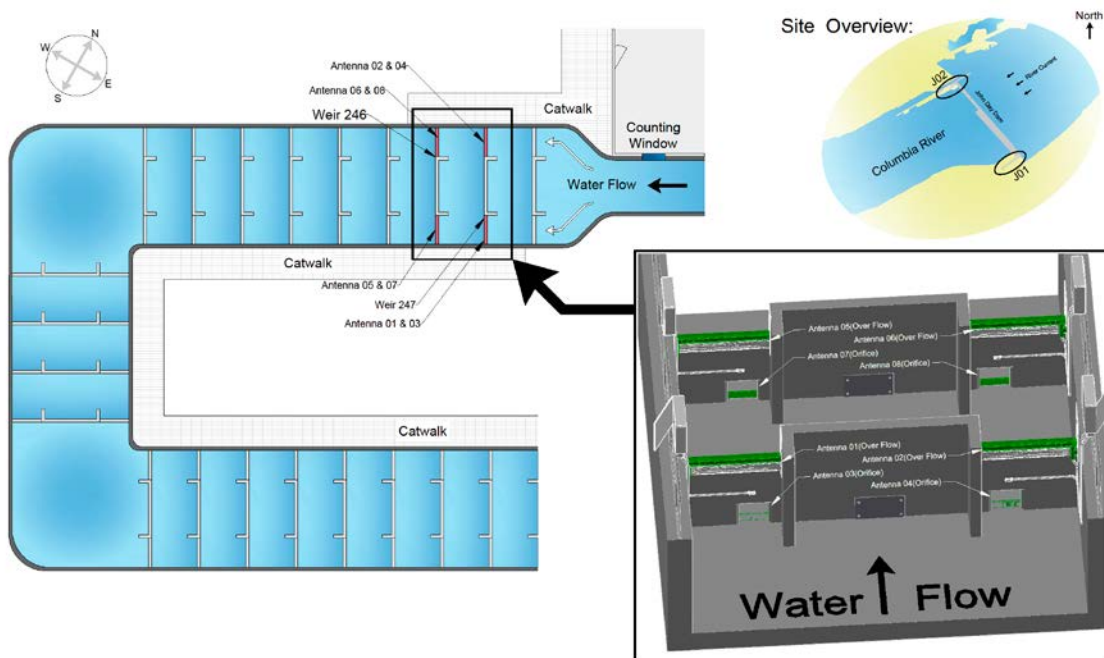


Figure 12. John Day north fish ladder (JO2) antenna installation

The Juvenile Fish Facility at Lower Granite was dewatered on August 2, 2017 for construction of a new juvenile bypass system. PTAGIS O&M continues to provide technical assistance to the US Army Corps of Engineers Walla Walla District with regards to the construction and installation of three PIT tag antennas to be located on the new full flow transport flume (*Fig. 13*). PTAGIS personnel will soon be performing onsite inspections of the antenna shields and associated components to ensure proper operation upon completion. Staff expressed concern about expansion and contraction of HDPE pipe material used for the flume due to temperature changes could cause leaks and damage the attached antennas.



Figure 13. Lower Granite Juvenile Bypass Construction

In mid-June 2017, PTAGIS technicians installed all necessary components for the newly completed LPS system. This included the wrapping of 12 antennas and installation of FS2020 transceivers and associated cabling. Two antennas were integrated into the PTAGIS BO4 data collection platform with antenna IDs of F1 and F2 (shown in red in *Fig. 14*). These two antennas are monitored and maintained by PTAGIS field operations. All 12 transceivers have dual-mode enabled to read half (HDX) and full duplex (FDX) PIT tags.



Figure 14. Antennas maintained by PTAGIS for Lamprey Bypass System at Bonneville Dam

2018 Plans

Operate John Day ladder interrogation sites (JO1 and JO2) upon completion of contract work by USACE contractor. The full flow PIT tag antennas at Lower Granite dam are scheduled to be operational in March for the start of the 2018 out-migration.

G: 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. Maintenance checks are performed 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.

Field staff record general maintenance and anomalous events by submitting event logs to the PTAGIS system. The logs² are publically 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, repair the equipment in-house.

2017 Accomplishments

Juvenile fish bypass facilities on the Snake and Columbia Rivers began operating in March and April. Similar to previous years, the overall detection efficiency rates for 2017 were over 99%. The single antenna in the Bonneville Corner Collector is the exception with an estimated efficiency rate in the seventies based on NOAA live fish testing using 12mm tags.

Adult ladder detection efficiency also remains high. In dam-to-dam comparisons, all sites maintained an approximate 99% detection efficiency over a 12-month rolling report period (Fig. 15). The only exception to this occurred at the Lower Monumental ladders where the efficiency dropped to approximately 97%. The picketed leads were raised after the counting season ended in 2016, which allowed tagged fish to move past the counting window antennas without being detected. To avoid missing these detections in the future, a decision was made at the May 2017 FPOM Meeting to leave the picketed leads in through November each year.

Ladder Site	Bracket Tags	Ladder Tags	Missed Tags	Percent Detected
BON	5,081	5,048	33	99.4
TDA	9,320	9,254	66	99.3
MCN	4,452	4,425	27	99.4
ICH	4,420	4,368	52	98.8
LMA	4,091	4,048	43	98.9
GOA	3,949	3,920	29	99.3
GRA	743	736	7	99.1

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 of tags detected by ladder site

Figure 15. 2017 adult ladder efficiencies in dam-to-dam comparisons

PTAGIS O&M tracks radio frequency (RF) noise data on a continual basis, 365 days per year for the 445 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. Noise sources can come from a multitude of devices, from a defective cell phone charger, to a new type of lighting, or a US Navy beacon in California. Fig. 16 shows an example of two noise events at LMA.

² PTAGIS Event Logs for Interrogation Sites: <http://www.ptagis.org/services/event-logs/view-event-logs>

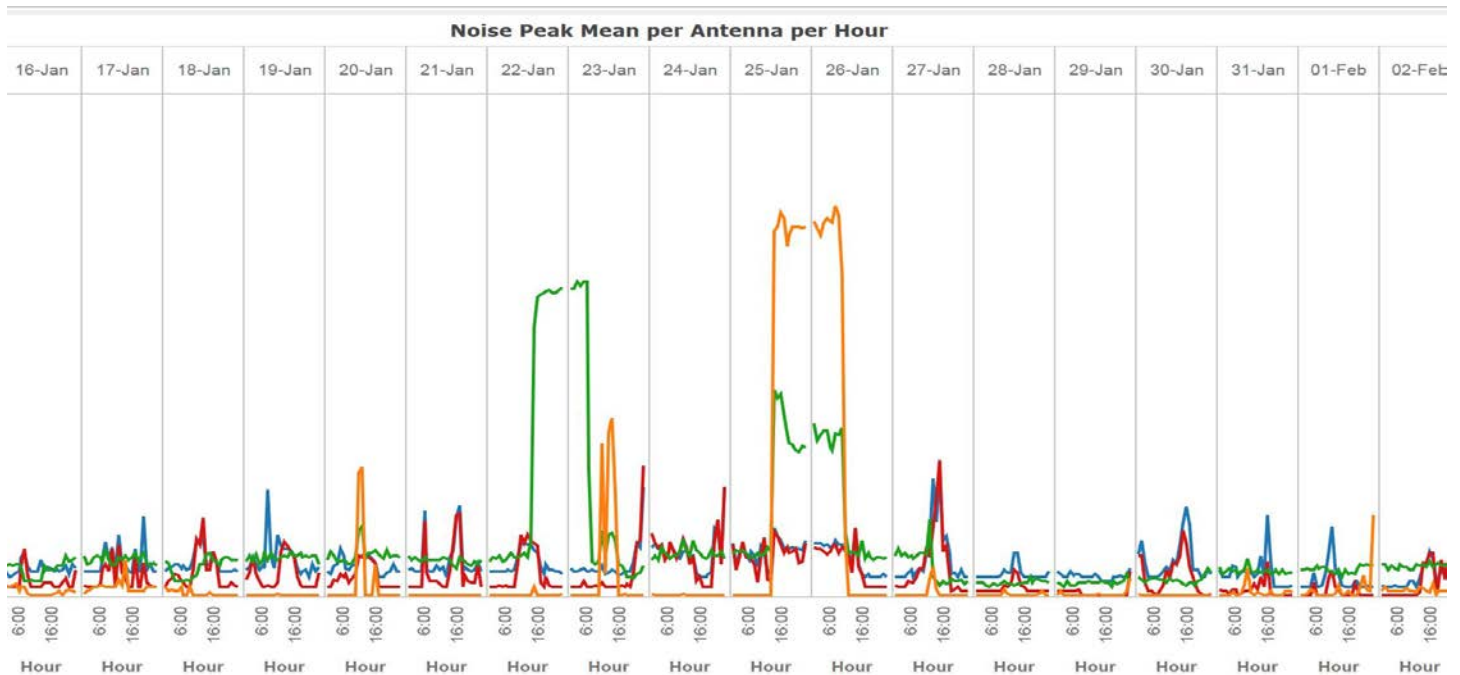


Figure 16. Report of RF noise events at LMA for all antennas

2018 Plans

Operate and maintain interrogation sites per established standard operating procedures (SOP). Continue coordination with COE about picketed leads issue at LMA and other sites affecting PIT tag detection efficiency. Continue coordination with COE regarding sinking PIT tag room at BO2. Adjust GMC and other standard procedures to support operating interrogation sites earlier in 2018 per recent spill recommendations associated with BiOP case³.

I: 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.

³ *Spill Advocates, Federal Agencies Agree To Status Conference Schedule, Protocol In Salmon BiOP Case*
<http://www.cbbulletin.com/438950.aspx>

2017 Accomplishments

The dual mode feature of modern transceivers allows the reading of both full duplex (FDX) and half duplex (HDX) tags without impacting detection efficiency of either tag. As part of a coordination action requested by the PIT Tag Steering Committee (PTSC), PTAGIS staff conducted lab tests which indicated that dual mode should not diminish detection efficiency of either FDX or HDX tags. A field test was conducted at The Dalles fish ladders during the fall of 2017. Both a NOAA statistician and PTAGIS staff monitored detection efficiency during the field test. The O&M reports and statistical analysis agreed that detection efficiency does not appear to be impacted by dual mode operations.

The PTAGIS Kennewick office continues to coordinate with USACE and NOAA personnel as part of the design team for PIT tag detection system for spillways. Commonly referred to as the ogee project, several milestones were reached this year:

- Development of a split antenna prototype in an effort to overcome an unforeseen expansion joint in the ogee surface (*Fig. 17*)
- As requested by the USACE, PTAGIS personnel, in cooperation with the NOAA Pasco Field Office, performed preliminary acceptance testing of the proposed non-ferrous concrete aggregate and composition that will surround the antennas placed in the ogee surface. No adverse effects to the antennas magnetic field was observed during this test
- Staff provided several CAD drawings to support conceptual designs (*e.g. Fig. 17*)

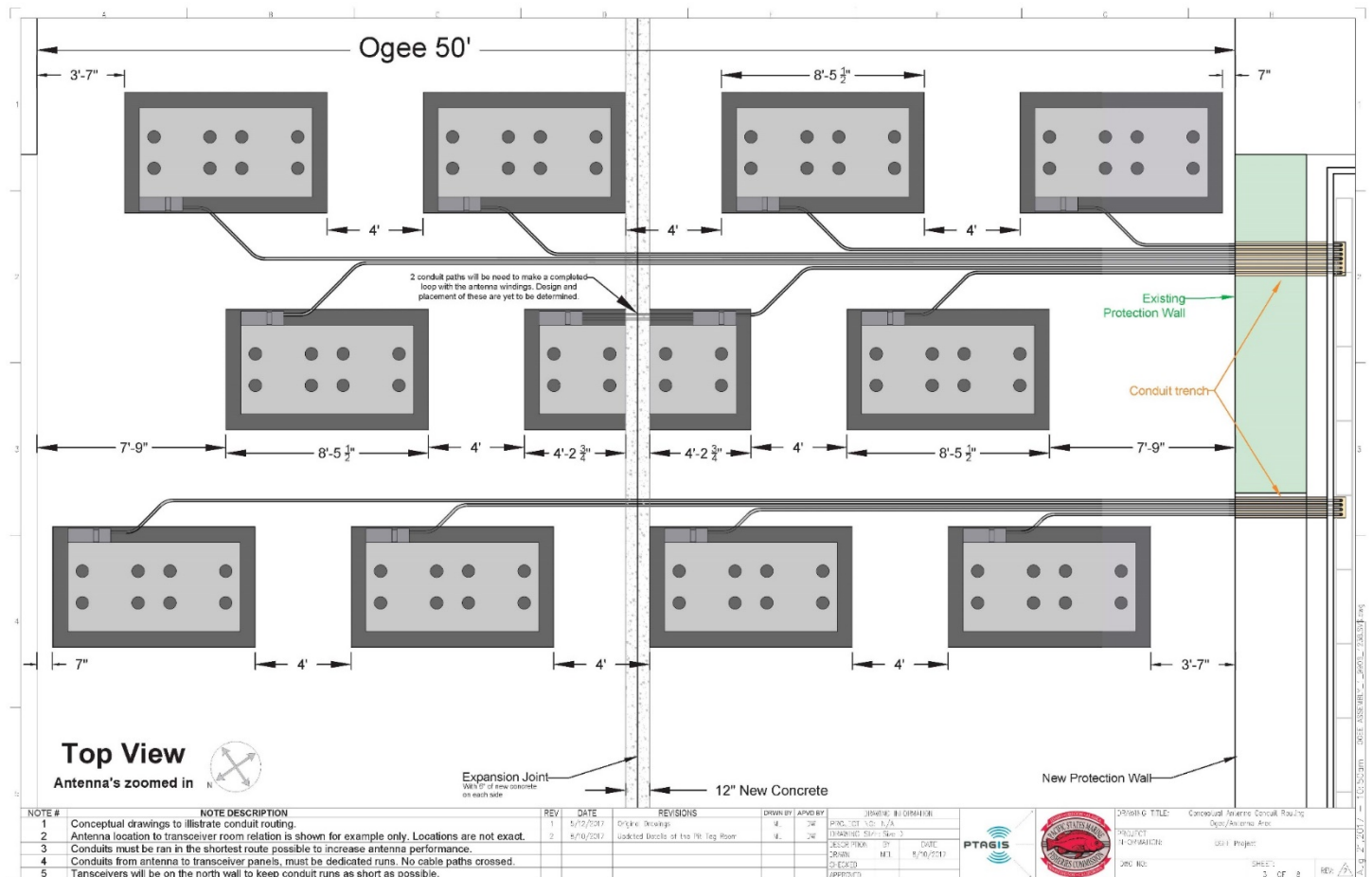


Figure 17. Ogee spillway antenna layout with expansion joint at Lower Granite dam

Staff provided conceptual designs (Fig. 18) upon request from FFDRWG for additional PIT tag detection at Little Goose adult ladders entrance to support research. Continue to team with NOAA to develop antenna designs for the B1 Ice & Trash Sluiceway and a second antenna at BCC.

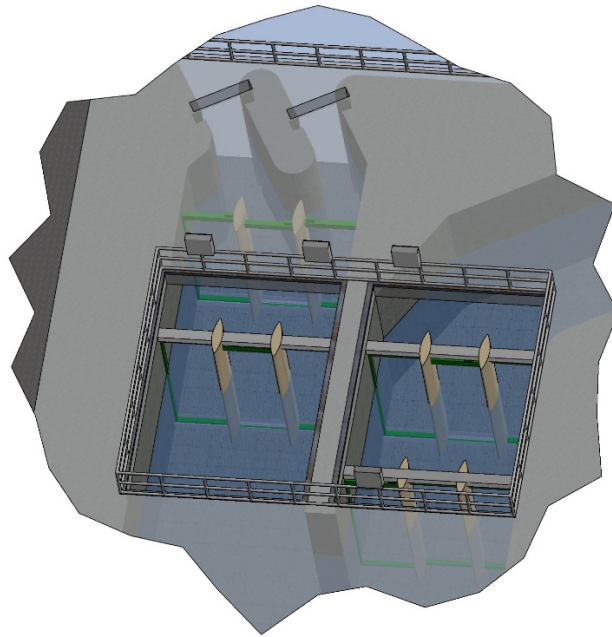


Figure 18. Little Goose adult channel conceptual design

Staff in the Kennewick office evaluated 27 tag types to support the 2017 BPA PIT Tag RFO. The KARRT system (with the ½-scale BCC antenna shown in Fig. 19) paid dividends in the RFO evaluation with consistent and convenient results. Automated read range measurements output from this system saved many technician hours. This year, the evaluation was completed in 778 hours over 3.5 months, compared to 1150 hours over 6.5 months from the previous RFO in 2011.

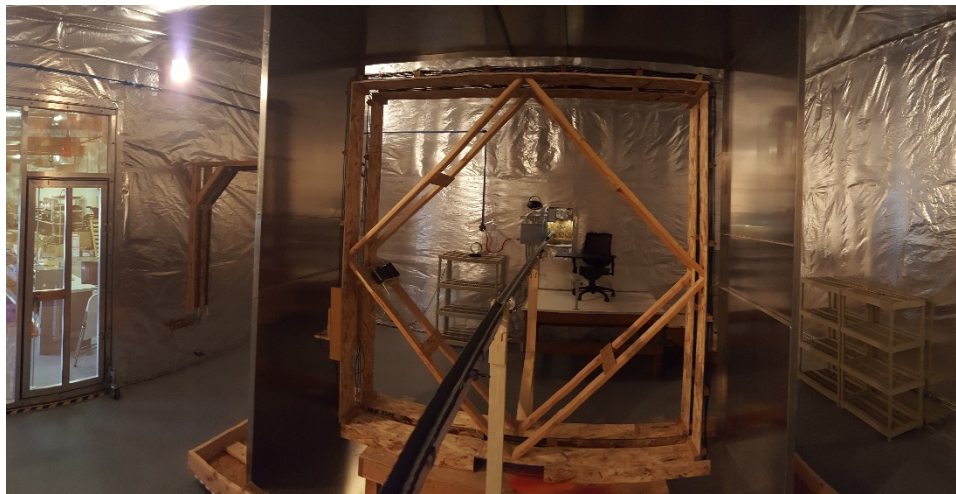


Figure 19. KARRT system used for BPA RFO tag evaluation

2018 Plans

Staff will continue to be members of design teams for multi-year, multi-agency projects described in this section.

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 well defined:

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

B: 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

2017 Accomplishments

Completed all contract-related deliverables such as annual and periodic status reports on schedule. The new funding package for FY18 contract was developed, reviewed and submitted on December 7, 2017. Staff performed an annual inventory audit and the product was loaded into Pisces for the FY18 funding package.

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

2018 Plans

Continue routine administration of the contract as described.

H: 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 publically accessible *PTAGIS Field Data Collection* and *Web Data Management* systems described in previous sections of this document.

2017 Accomplishments

Staff conducted training sessions for the P4 tagging software at five locations throughout the Columbia Basin in addition to a webinar for those unable to travel. Each session consisted of a four-hour walkthrough of new features in P4 and a

guidance for upgrading from the legacy P3 software. The new Mark Recapture Recovery (MRR) data model that provides the foundation of P4 and PTAGIS was also covered. We had over 300 participants attend the training and received positive feedback. The final P4 training session was held via webinar on February 15, 2017, and was recorded for PTAGIS community members that were unable to make it to any of the training sessions. This video is now available on the video tutorials page (<http://www.ptagis.org/support/tutorials>).

Staff provided ad-hoc technical support for various field software and web reporting systems. Continued to utilize Basecamp change tracking software-as-a-service to capture support requests and related software changes. Updated technical documentation and related online videos along with software releases.

2018 Plans

Continue providing technical support for all publically available PTAGIS systems.

J: 189 Coordination- Columbia Basinwide

This objective covers standard regional coordination activities such as:

- Participating and the hosting of PIT Tag Steering Committee meetings⁴
- 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 newsletter⁵
- Providing technical coordination for the PIT Tag Forecasting Service⁶

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 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

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>

⁶ PIT Tag Forecaster Service: <http://www.ptagis.org/services/forecaster>

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 (*Fig. 20*) 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

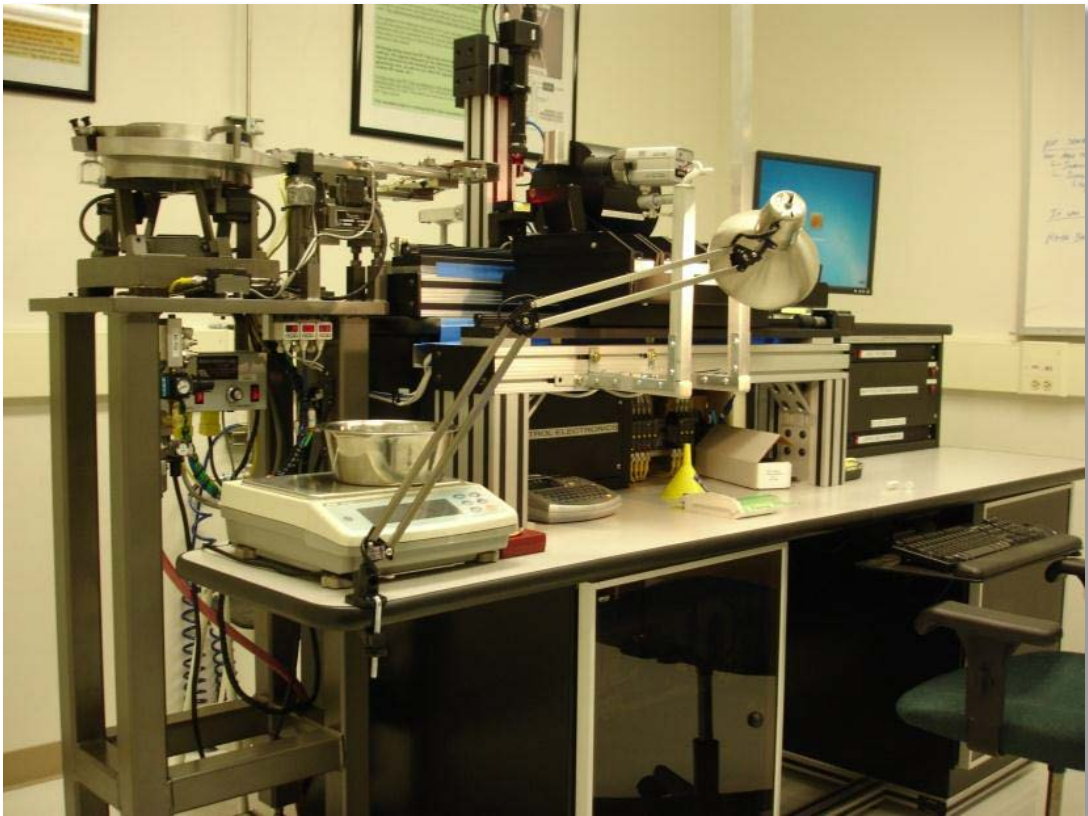


Figure 20. Automated PIT Tag Test System (APTTS) located in the PTAGIS Kennewick laboratory

2017 Accomplishments

Staff initiated coordination with the PTSC to review the decision to remove the ban on full duplex (FDX) tagging of lamprey after an incident at Prosser dam where some marked lamprey attached to both antennas in the ladder, effectively shutting them down for a significant period. The ban was imposed over concerns that an adult lamprey might attach itself close to, or on, one of the orifice antennas in a fish ladder. Such behavior could render the antenna unable to detect passing salmonids due to tag collisions (which occurs when two or more tags are in the field at the same time), and/or by filling the buffer of the transceiver with detections, making it unable to load salmonid detection data. Based on new information and technology, the ban was lifted. The PTSC decided not to reinstate the ban based upon the Prosser incident. Instead, coordination was provided to make the research community aware of this situation to prevent it from happening in the future. PTSC directed PTAGIS staff to evaluate the dual-mode feature in transceivers that could allow the reading of both FDX and half duplex (HDX) tags in adult fishways to promote HDX tags for lamprey research. Staff performed the dual-mode evaluation, described in section I: 122. *Additional Support Actions*, and did not find any significant impacts on detection efficiencies. This coordination and related actions will continue at the next annual PTSC meeting.

Coordinated with the COE Walla Walla District and FFDRWG to change the COE SOP on picketed leads, keeping them in place during adult runs after a detection loss was identified at LMA earlier this year.

Staff conducted a video conference with a large group of instream (tributary) interrogation site data stewards to discuss data management issues and how to improve reporting of observation and related metadata from these sites out of PTAGIS. This coordination resulted in the following plan to be presented at the next annual PSTC meeting:

1. Refine interrogation site metadata stored in PTAGIS
2. Develop web features to allow stewards to update slowly changing site metadata
3. Develop a path in the automated data submission features to accommodate transceiver diagnostics and environmental data in addition to PIT tag observations.
4. Develop reports for site stewards and data users to view those data

PTAGIS staff distributed 1.65 million tags to 79 FWP in FY17. The testing of 3% sample of those tags for quality assurance found no significant manufacturing defects. Staff supervised a subcontractor (St. Bernard Engineering) to perform electronic and software upgrades to the APPTS system (*Fig. 20*) this year and was completed to satisfaction. Staff coordinated with BPA and Biomark to securely house and distribute pre-loaded tag inventory from the Kennewick office.

The following table provides a very brief summary of data contribution coordination:

Data Type	Validation Code Type	Added in 2017	Total Active
MRR	Tag Data Projects	19	192
MRR	MRR Site (mark/release site)	70	1237
Observation	Interrogation Site	17	368

Table 3. Annual Changes in Data Contribution

BPA coordinated with contractors to update their PIT Tag Forecasts via PTAGIS website in December 2017. PTAGIS staff provided technical support to ensure users can complete their forecasts.

Plans for 2018

Continue distribution, inventory and QA sampling of PIT tags to all FWP. Continue coordination with PTSC on revising the PIT Tag Specifications Document⁷ with updated MRR data model, field definitions, and references to new data file formats. Coordinate plan to improve support for instream interrogation sites with PTSC and research community and translate to actions. Coordinate with NOAA, BPA and COE to update the expired MOU defining roles for installing and maintaining PIT tag infrastructure.

⁷ PIT Tag Specification Document 2009: <http://www.ptagis.org/docs/default-source/ptagis-program-documents/pit-tag-specification-document-2009.pdf?sfvrsn=14>