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

2016 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 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. The production release of new P4 tagging software in 2016 was a significant milestone for the program. This software combined with recent database enhancements make data collection efforts more efficient and allows linking to other research such as genetic and coded-wire studies. Staff planned a series of training sessions to be

conducted in 2017 to promote adoption and provide guidance for upgrading from legacy software, which will remain in use until the majority of users are able to migrate.

Researchers from 34 organizations contributed over 2.49 million fish marked with a PIT tag to the PTAGIS database in 2016 with a cumulative total approaching 43 million records over the lifetime of the program. The 326 interrogation sites contributing data to PTAGIS detected 934 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; 13.8 million detections were reported to PTAGIS in 2016 totaling 207 million detections since 1987. To give additional scope to the overall data management efforts in 2016: PTAGIS processed 399 thousand data files with 117.3 million database rows updated or inserted; 490 users executed 356 thousand queries resulting in 6.2 billion rows of data returned.

PTAGIS O&M staff, based out of Kennewick, Washington, provide direct operations and maintenance (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 207 million observation events available in the database system. PTAGIS also maintains the Separation by Code (SbyC) 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. New interrogation sites in the ladders at John Day Dam are online but require manual operation until the construction is fully completed by the Corps of Engineers (COE) next year. The design team for the Lower Granite Spillway Detection Project reached two major milestones: The flat plate antennas and the transceivers that power them have proceeded beyond the design phase and are now being prototyped and tested. The schedule for installation of this system is winter of 2018 - 2019.

PTAGIS O&M staff also completed the BCC Simulator system in the Kennewick lab to emulate the largest antenna (the 17'x17' antenna at the Bonneville Corner Collector) at ½ scale, allowing tag and transceiver testing within a controlled and automated environment. This system will be heavily utilized to evaluate PIT tags submitted from various vendors in support of the next BPA procurement contract.

Radio interference from the US Navy, Dixon California facility did not materialize in 2016 as it did in late 2015. This interference had a significant impact on all PIT tag antennas throughout the region. A letter of concern sent to the Navy from the PIT Tag Steering Committee (PTSC) and PTAGIS may have helped to resolve this.

In 2016, PTAGIS continued to provide high quality data collection, validation, management and reporting services, while meeting several large milestones in the release of new tagging software, installation of new interrogation sites at John Day Dam, and passing the design phase and entering the prototype and testing phase for the Lower Granite Spillway Detection project. 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 Columbia River basin.

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 2016 and further describes work elements of the PTAGIS project related to collection, management and web delivery of all PTAGIS data.

Researchers contributed over 2.49 million fish marked with a PIT tag to the PTAGIS database in 2016 with a cumulative total approaching 43 million records (*Fig. 1*). These records came from 34 organizations as they released the fish into 355 site locations throughout the Columbia Basin. The composition of marked species was similar to previous years (*Fig. 2*).

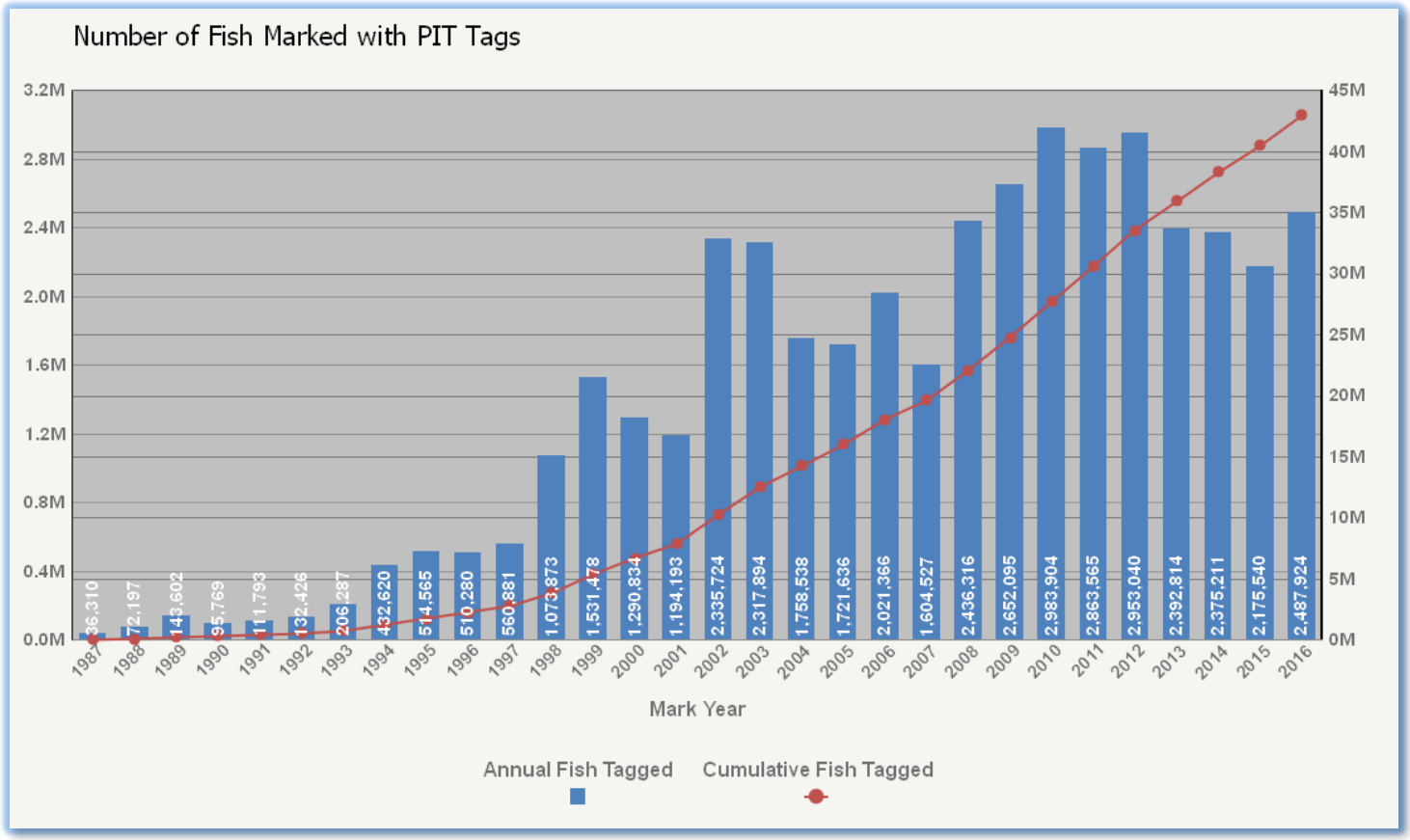

Figure 1. Annual and Cumulative Number of Fish Marked with PIT Tags

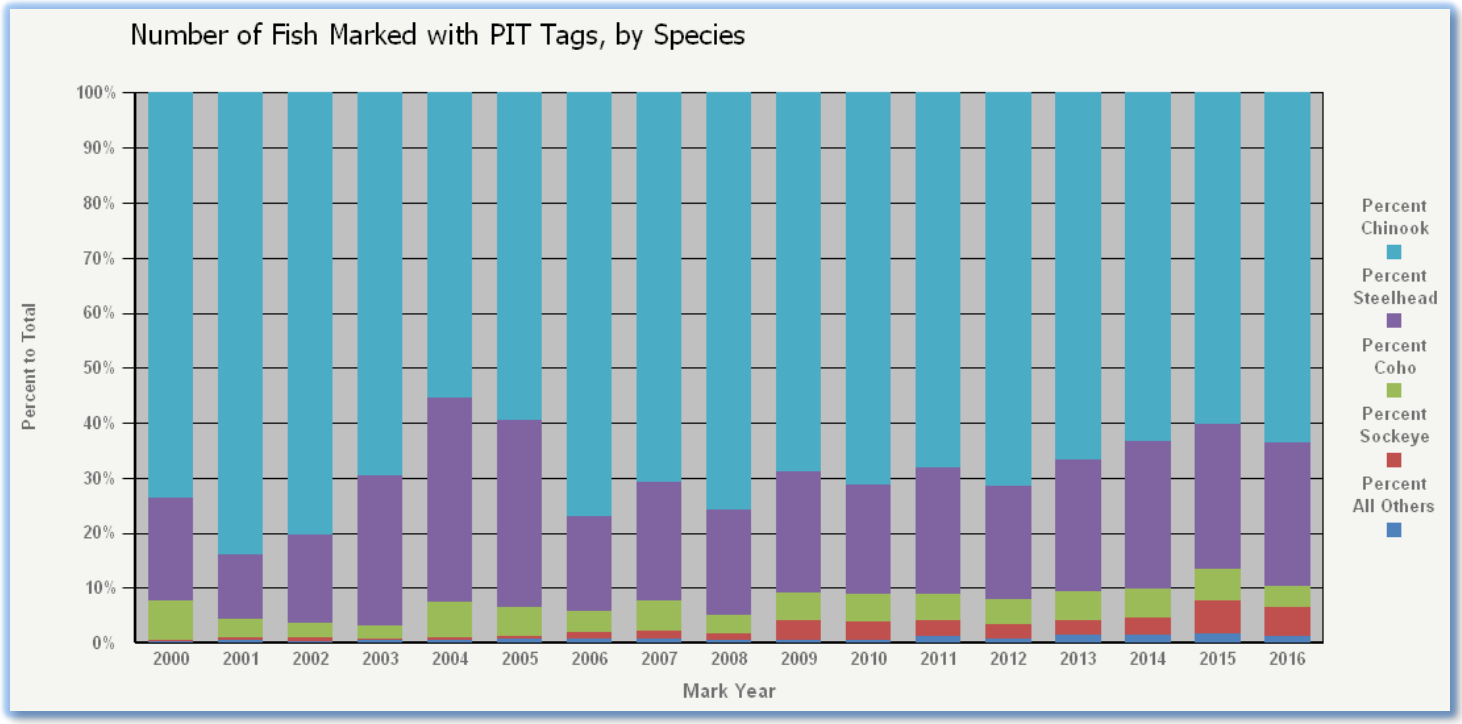

Figure 2. Number of Fish Marked with PIT Tags, by Species

The number of marked fish reported as *recaptured and re-released* approached 80 thousand. The 39 thousand mortality/recovery events submitted this year is lower than previous years (93 thousand in 2014 and 94 thousand in 2015).

The 326 interrogation sites contributing data to PTAGIS detected 934 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; 13.8 million detections were reported to PTAGIS in 2016 totaling 207 million detections since 1987 (Fig. *4*). Annual detections are trending upwards in recent years as additional interrogation sites come online.

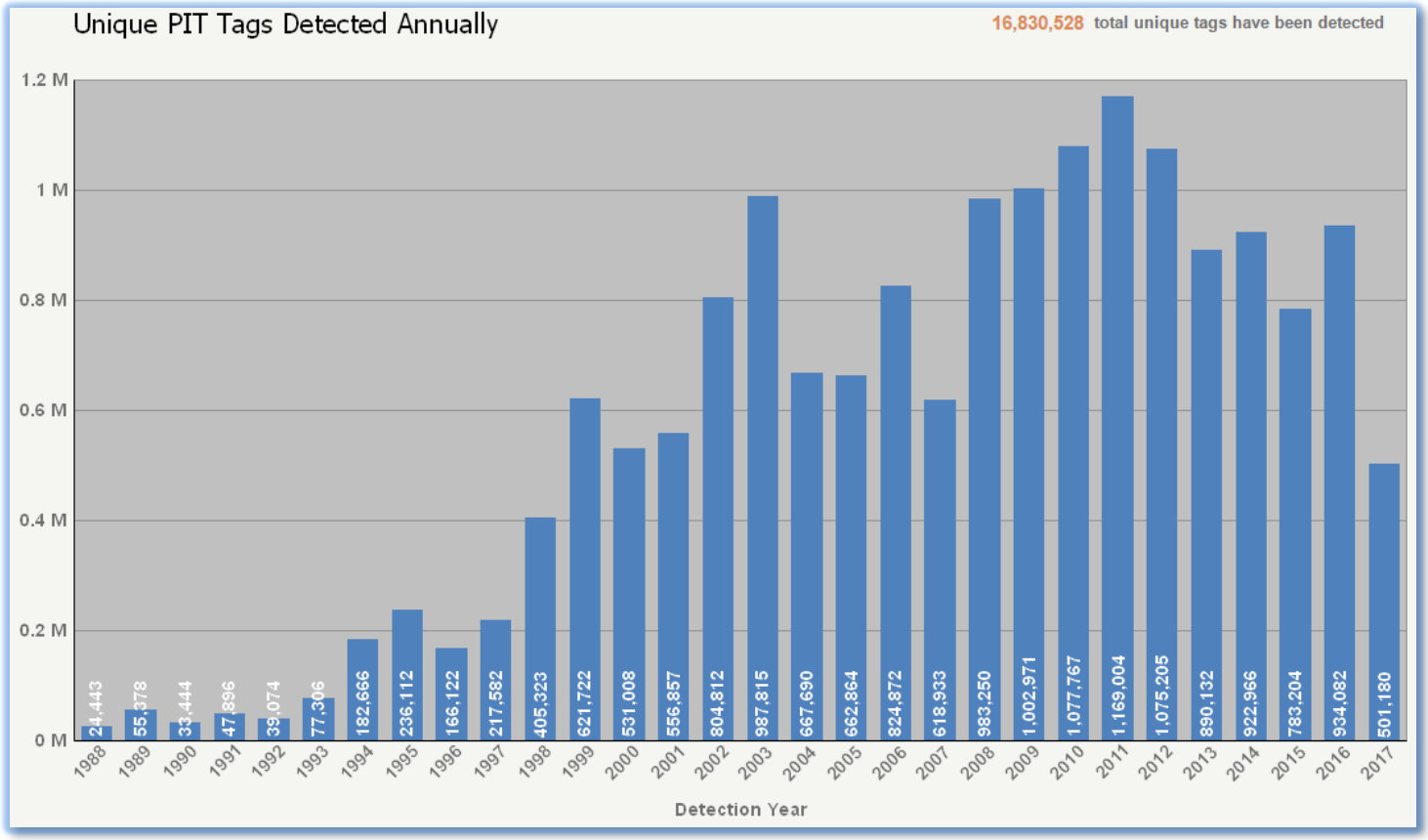

Figure 3. Unique PIT Tags Detected Annually

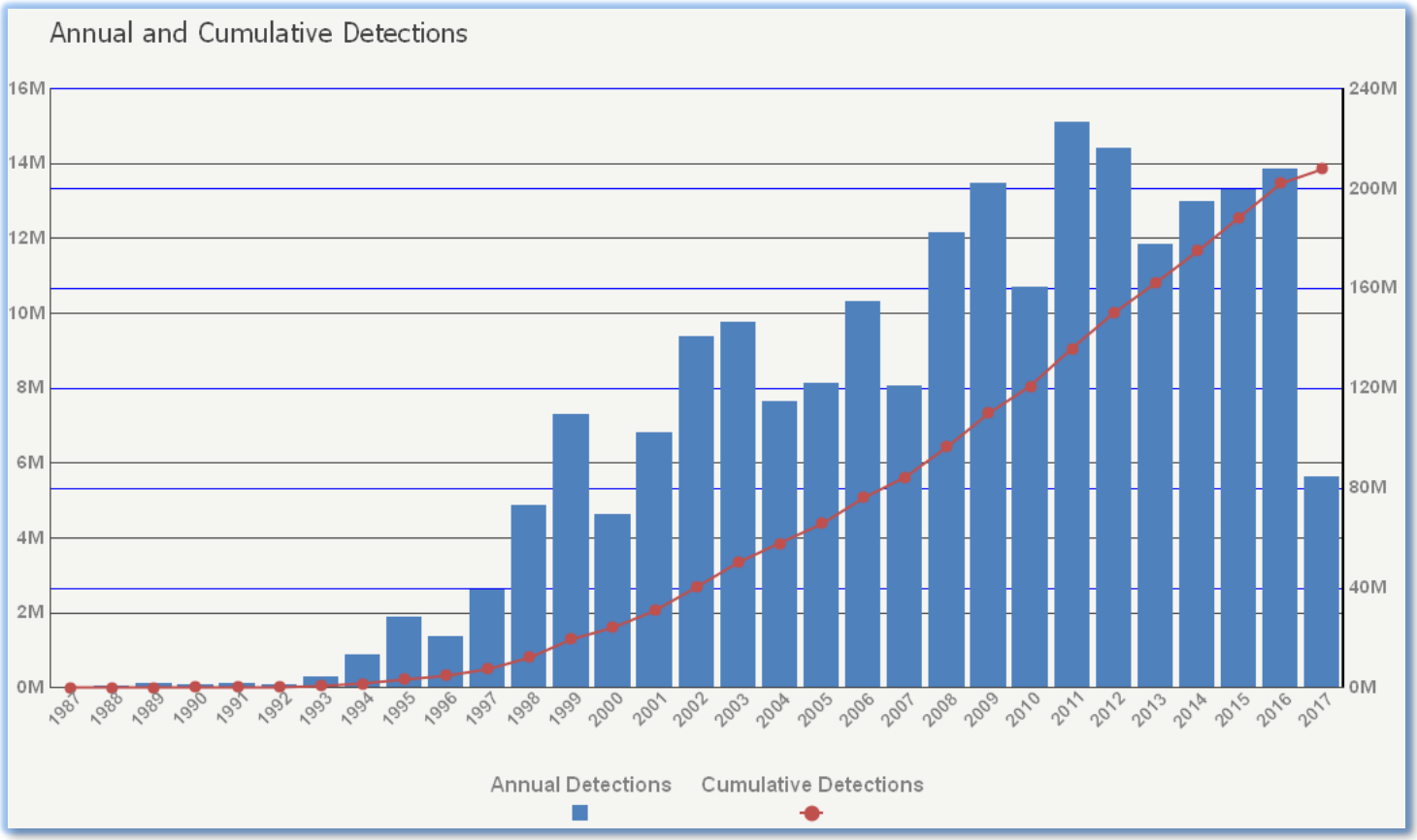

Figure 4. Annual and Cumulative Detections

To give additional scope to the overall data management efforts in 2016: PTAGIS processed 399 thousand data files with 117.3 million database rows updated or inserted; 490 users executed 356 thousand queries resulting in 6.2 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

This year, the primary focus for this objective was to continue a multi-year effort to enhance the Mark-Recapture-Recovery (MRR) data model with additional fields, validation and processes to align PTAGIS with the current needs of the research community. 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.*

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, LoadEmulator, 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

2016 Accomplishments

The first production release of P4 tagging software came in September with three additional releases by year's end (see http://www.ptagis.org/software/p4-release-notes). Working with a focus group, the software was tested and refined to ensure it would meet the needs of the larger community once released. Over a dozen projects used P4 to collect and submit production data on 16 thousand newly marked fish as well as 3 thousand recaptures and 1 thousand recoveries.

A summary of P4 features implemented or refined in 2016:

- Integrated help documentation and published a home page (https://www.ptagis.org/software/p4)
- Improved portability of system configuration between P4 instances and from legacy P3 software
- Enhanced data entry and application control features via digitizer tablet device
- Enhanced data management features:
    - Two or more sessions can be joined seamlessly into one
    - Date and time adjustment
    - Update values in one or more sessions based upon records in another, joined by tag code
- Built-in notification feature to announce new releases of the software and other alerts
- Added *Tally* event type to support collecting data on untagged fish
- Query feature allows the building and saving of custom queries against the local P4 database
- Custom Validation configuration tool allows the user to create validation routines specific to their research or project
- Enhanced portability of data between P4 instances, legacy P3 and common file formats

The deferment of work related to other field software, including the scoping of next generation interrogation software M5, allowed staff to focus on delivering P4 this year.

2017 Plans

Staff will conduct regional training seminars on P4 early next year to promote adoption and eventually retire support for legacy P3 software. Additional releases of P4 will continue with a slowing cadence as the system becomes more mature.

The scoping of next generation software M5 will start later in 2017 with requirements analysis and the evaluation of emerging technologies to guarantee system performance and high availability.

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 *field data collection systems*. 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

2016 Accomplishments

Production processing of new MRR datasets coincided with the release of P4 field software in September. Modified the P4 file format specification (XSD) to support versioning and simplify ongoing maintenance. Improved the validation routines performed on the database server for new and existing MRR data fields and ensured alignment with P4 software. Resolved issues linking data files in the legacy format with corrected versions submitted in the new format with different naming conventions. Implemented support for submitting and validating new *Passive Recapture* and *Tally* event types. Further enhancements were required to continue support for the submission of legacy P3 data files.

Upgraded the database server to SQL Server 2014 on new hardware without any significant downtime. Implemented *Always On Availability Groups*[1] on database server as a first step in automated failover and disaster recovery improvements. Finalized system backup and recovery procedures with PSMFC IT staff. Consolidated FTP servers to a single instance to handle both M4 and legacy P3 data submissions.

2017 Plans

Continue refinement of database and other systems in support of MRR data model and revised validation. Update the Interrogation Data Loader (IDL) to support M5 development. Continue consolidation of production databases to new server system to make ongoing maintenance activities more efficient. Perform ongoing maintenance of database infrastructure and update system documentation.

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

[1] See https://docs.microsoft.com/en-us/sql/database-engine/availability-groups/windows/always-on-availability-groups-sql-server

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 industrial best practices
- Interoperation with server data management systems and field data collection systems
- Support high-availability and security goals of the program

2016 Accomplishments

The website continued to function with limited downtime and adequate performance. This year the website had 51 thousand total visits from 10 thousand unique visitors. Staff evaluated other web platforms and determined the current Sitefinity platform continued to be a good fit after a corporate merger last year. In addition to typical maintenance and administrative tasks involving the web, reporting, and API systems, the following tasks were also completed:

- Completed enhancements to the SbyC Request workflow as requested by FPAC and researchers submitting the requests
- The online Tag Distribution Request form (*Fig. 5)* has been simplified to a single page and is much more intuitive
- Additional improvements were made to the Validation Code request system
- Promoted portions of the PTAGIS Web API (api.ptagis.org) into production to support data submissions from P4
- Continued upgrading PTAGIS website components using MVC architecture on the latest Sitefinity platform
- Evaluation of Microstrategy 10 with roadmap for upgrading in 2017
- Reporting system updated to make exporting to text file formats consistent across the system and export methods with regards to using double-quotes around field value
- Updated File Load Status reporting with improved formatting and other features

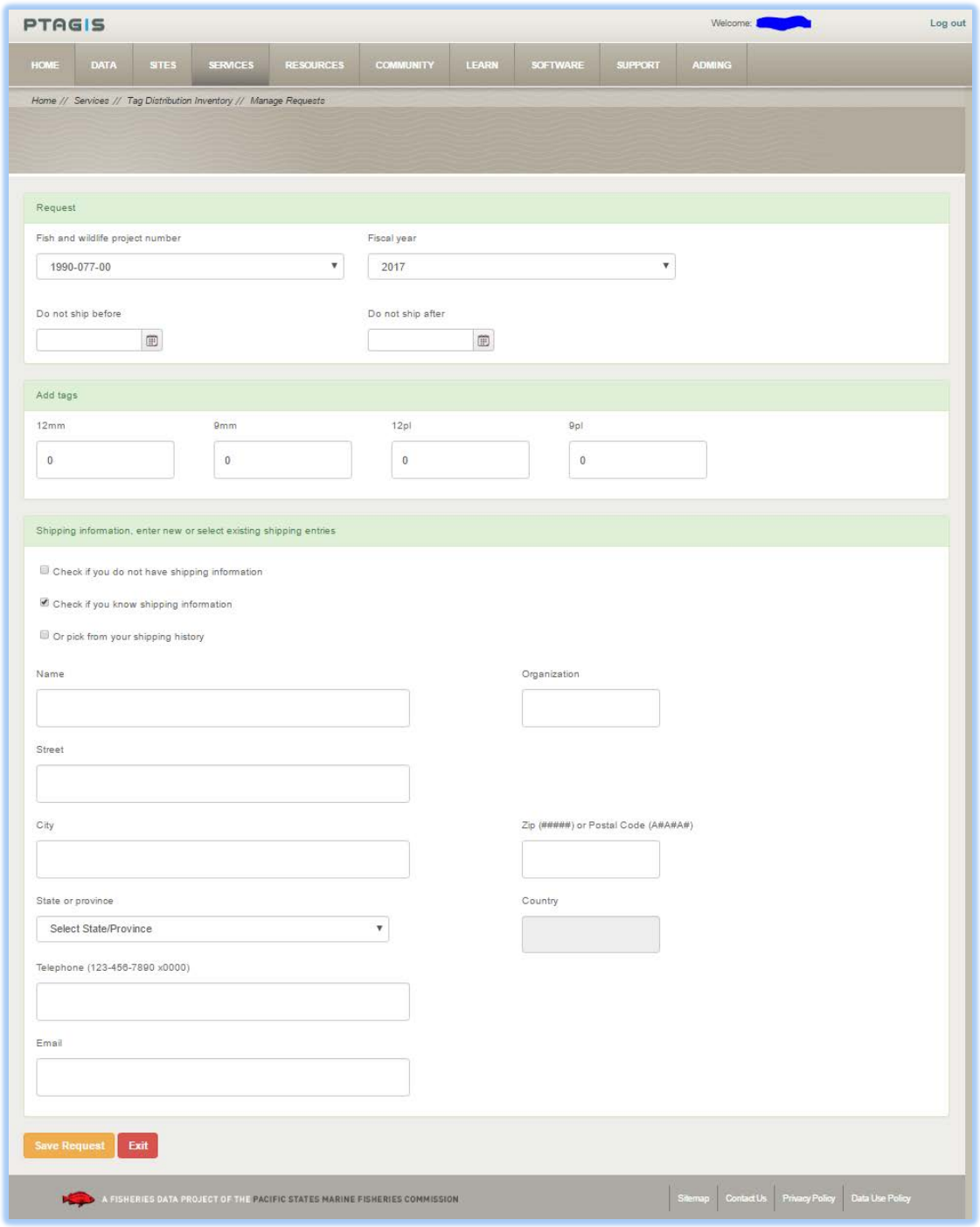

Figure 5. Upgraded Online Tag Distribution Request Form

2017 Plans

Continue development of new PTAGIS website that will support:

- Responsive user interface
- Modern browsers
- MVC architecture
- Industry standard security practices

Update reporting system with new MRR fields and validation reporting, including the *Complete Tag History* report. Complete upgrade of reporting system to Microstrategy 10 on new hardware. Refine dimensional model to continue support for MRR data model. Review and initiate design of an enhanced *Interrogation Site Metadata* web portal (see https://www.ptagis.org/sites/interrogation-site-metadata?IntSiteCode=18N) with steward management settings and ad hoc field data submission features.

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

Before Separation by Code (SbyC) projects can be implemented by PTAGIS, 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:

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

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.

2016 Accomplishments

This year 19 projects requested 65 target groups (action codes) of fish totaling 2.1 million tags to be separated. Processing of these requests utilized the new SbyC Request Workflow system deployed in early 2016. Below is a summary of these projects.

Agency	Project Title	Target Tags
FPC	Comparative Survival Study 2016	460,230
IDFG	Measure Dworshak and Upper Salmon hatchery origin adult steelhead	488
IDFG	Monitoring and evaluation of BY2014 Chinook Salmon smolts released from Idaho hatcheries	95,805
IDFG	Monitoring Upper Salmon River A-run Steelhead Reared in Circular Tanks	12,310
IDFG	Potlatch River wild Steelhead Radio-telemetry	28
IDFG	Radio tagging adult Chinook salmon at Lower Granite Dam to determine migration patterns and behavior in the Lemhi River, Idaho	24,093
IDFG	SY2017 Dworshak Hatchery Steelhead	198
IDFG	SY2017 Lochsa River Adult Radio Telemetry	38
IDFG	Travel timing and habitat use of Sawtooth and Pahsimeroi Fish Hatchery spring and summer Chinook Salmon - Implications as it pertains to upper Salmon River salmon fisheries.	82,996
NMFS	Migration timing and parr-to-smolt estimated survival for wild Snake River spring/summer Chinook salmon smolts	28,640
NMFS	Transportation and survival research	1,326,226
NPT	B-Run Steelhead Evaluations - #201005700	72
NPT	Nez Perce Tribe 2016 Separation by Code Request	19,426
ODFW	Wallowa and Imnaha Stock Steelhead Smolts	21,014
USFWS	Effect of Early Spring Release from the Pelton Ladder on C. shasta Infection Rate in Spring Chinook salmon	10,000
WDFW	2016 Lyons Ferry Hatchery Complex -Snake River, Steelhead Tributary Releases	25,984
WDFW	Performance Evaluation of PIT tagged subyearling Chinook released at Lyons Ferry Hatchery 2016	20,000
WDFW	Performance Evaluation of PIT tagged yearling Chinook released at Lyons Ferry Hatchery 2016	30,000
WDFW	Snake River Hatchery Fall Chinook Fidelity and Fallback Study 2016	281
	Total	**2,157,829**

Table 2. Separation by Code Request Summary

2017 Plans

Continue processing SbyC Requests in a similar manner as this year. The scoping of M5 interrogation software may present opportunities to enhance reporting, analysis and validation by joining the request process with actual implementation details in a more systematic fashion. Continue the consolidation of historical requests with target tag codes into existing system.

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 207 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. 6*). 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.

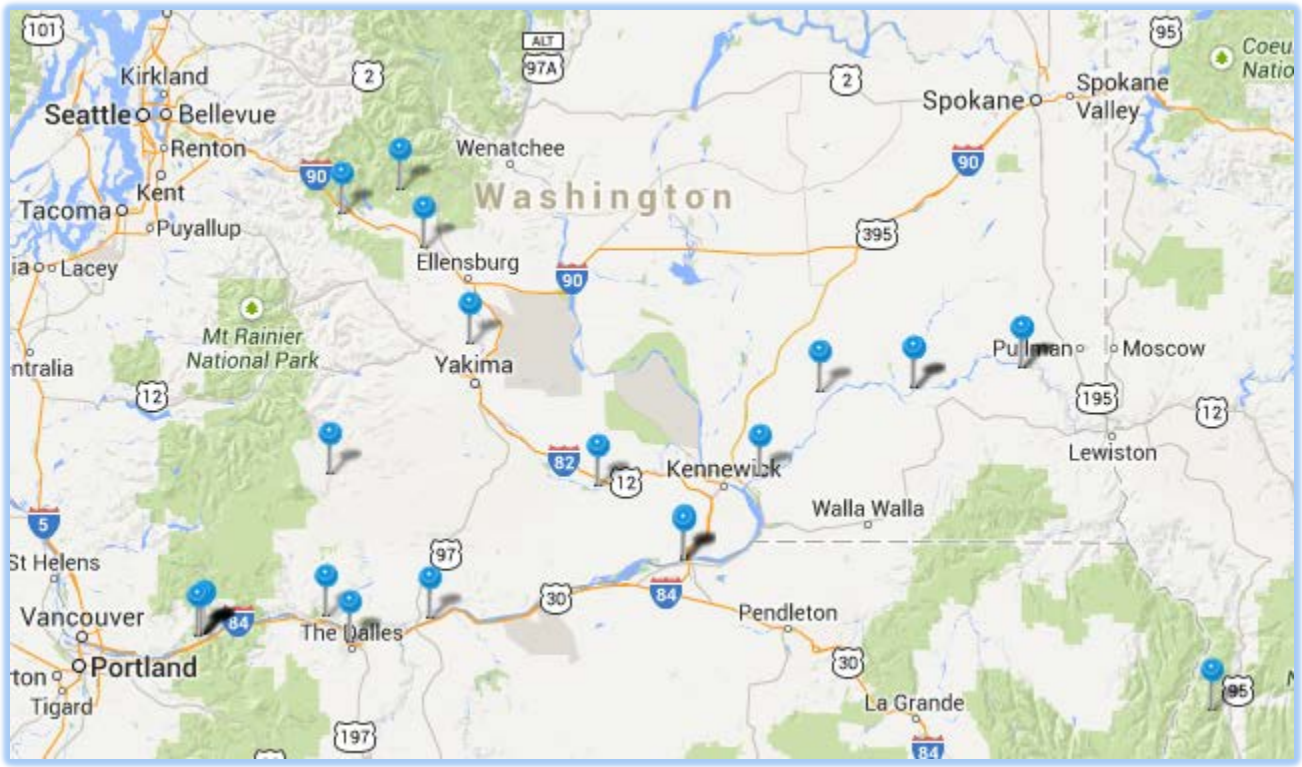

Figure 6. Map of Large-Scale Interrogation Sites Maintained by PTAGIS

[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

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.

Figure 7. A slide gate diverting a test PIT tag.

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 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.

2016 Accomplishments

The diversion gate efficiencies at each SbyC site remain high due to PTAGIS and COE in-year and off-season maintenance programs (*Fig. 8*).

B2J - Bonneville PH2 Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
B2J	SBYC SEPARATOR GATE	52,504	52,409	85	99.8%

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GOJ - Little Goose Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
GOJ	A-SEPARATOR GATE	98,375	96,596	1,710	98.3%
	B-SEPARATOR GATE	115,116	112,541	2,436	97.9%
	DIVERSION SBYC GATE	106,308	106,188	0	100.0%

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GRJ - Lower Granite Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
GRJ	A-SEPARATOR GATE	188,040	184,569	3,153	98.3%
	B-SEPARATOR GATE	98,001	96,615	1,201	98.8%
	DIVERSION / SBYC GATE	113,561	113,276	122	99.9%
	RCWY-10 GATE	157,145	154,962	1,848	98.8%
	SBYC GATE	1,480	0	0	

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JDJ - John Day Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
JDJ	SBYC GATE	4	4	0	100.0%
	SBYC SEPARATOR GATE	103,135	102,825	277	99.7%

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LMJ - Lower Monumental Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
LMJ	A-SEPARATOR GATE	57,279	56,528	711	98.8%
	B-SEPARATOR GATE	78,703	77,123	1,513	98.1%

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MCJ - McNary Dam Juvenile

Site Code	Diversion Gate Antenna Group	Total Fish	Success Count	Failure Count	Percent
MCJ	SBYC A-RACEWAY RIVER GATE	42,032	41,999	0	100.0%
	SBYC A-SEPARATOR GATE	43,070	42,309	0	100.0%
	SBYC B-RACEWAY RIVER GATE	46,139	46,087	0	100.0%
	SBYC B-SEPARATOR GATE	46,544	46,521	0	100.0%

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Figure 8. Diversion Gate Efficiency Summary for 2016

Note: the diversion efficiency of the gate labeled *SBYC GATE* at GRJ cannot be measured because it does not have a downstream detection point.

2017 Plans

Staff will continue to review the overall SbyC process to look for opportunities to enhance the system in coordination with M5 interrogation software development.

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.

2016 Accomplishments

Continued consulting with the COE for adding new thin-body ferrite-tile antennas at the **Lower Granite Adult Ladder** (*Fig. 9 and 10*). Completed in 2016, the purpose of the installation was to evaluate the impacts of construction noise on fish traveling through the ladders. Going against the recommendations of PTAGIS staff, the contractor did not ground the antenna shields. As a result, the antennas became noisy during the season and failed to read tags for extended periods.

Figure 9. New overflow antenna installed in Lower Granite Adult Ladder

Figure 10. New orifice antenna installed in Lower Granite Adult Ladder

Staff coordinated the fabrication of 16 antennas under FWP contract #71944 installed at **John Day Adult Ladder** in winter of 2016. Staff ensured the antennas met specifications before coordinating the installation with COE Portland district engineers. The antennas are arranged on two weir walls per ladder with four antennas per weir wall. Each weir wall will have two overflow antennas and two orifice antennas (*Fig. 11*). To maximize antenna drivability, the design called for shortened conduit runs. A second phase of the project to build two new PIT tag electronic rooms (also designed by staff, *see Fig. 12*) at the site later next year will allow the new antenna arrays to become fully operational PTAGIS interrogation sites.

Figure 11. New overflow and orifice antennas installed at North Shore John Day Ladder

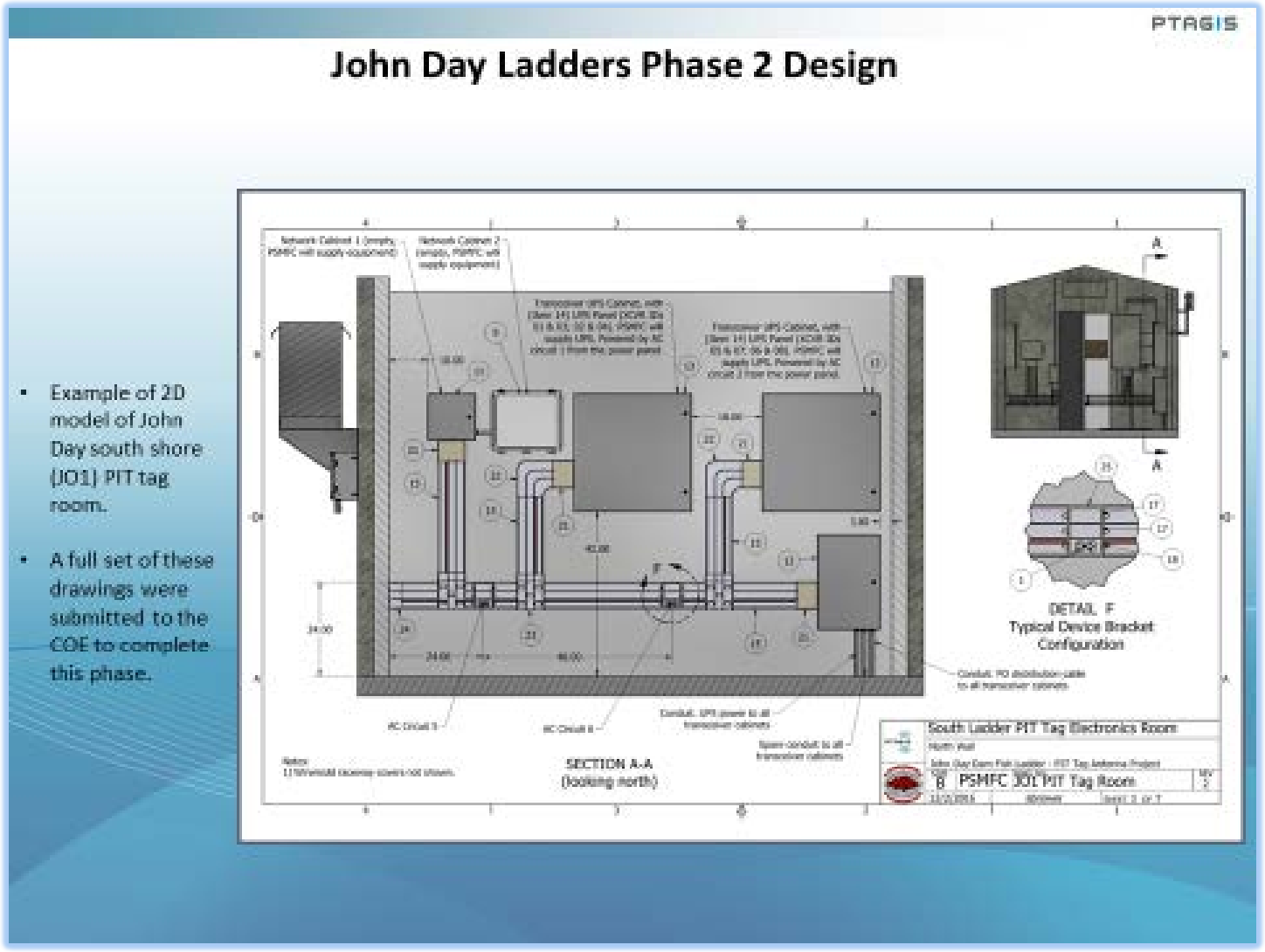

Figure 12. Design of JO1 PIT Tag Room for John Day Ladder Project Phase 2

2017 Plans

Staff will work with COE to resolve noise issues with new antennas installed at GRA ladders. Staff will continue to coordinate the installation of two new PIT tag rooms at the John Day Ladder next year. Temporary operation of the new antennas will be required until the rooms are completed and additional infrastructure installed. Staff will download memory buffers from each of the sixteen transceivers and manually submit the data to PTAGIS on a weekly basis.

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 logs[3] 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 *(Fig. 13).*

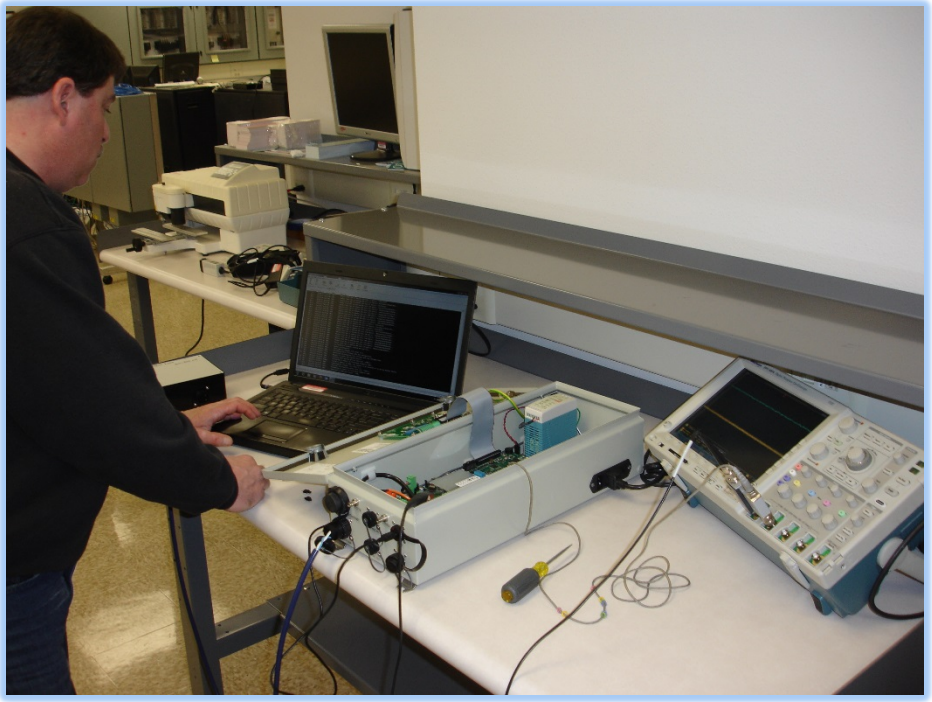

Figure 13. PTAGIS staff repairing a transceiver device.

2016 Accomplishments

Antenna efficiencies remain high (nearly 100%) at the Juvenile Fish Facilities (JFF), Full Flow Bypasses and Acclimation Pond exits. The majority of the JFF transceivers (FS1001) are into their 17th year of continuous operation with no

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

increase in failure rates. Staff continue to repair all failed transceiver in-house using spare parts from obsolete units (FS1001A). Staff are evaluating Biomark IS1001 transceivers as a potential long-term replacement.

Average detection efficiencies for adult ladders were above 99% (*Table 3*). The exception was at LMA (97.3%) due to a change in COE protocol raising picketed leads that drive the fish closer to antennas installed near the counting window. Staff will coordinate with COE to determine if this will procedure will continue.

Ladder Site	Bracket Tags	Ladder Tags	Missed Tags	Percent Detected
BON	5,445	5,441	4	99.9
TDA	11,898	11,862	36	99.7
MCN	6,680	6,646	34	99.5
ICH	6,545	6,492	53	99.2
LMA	6,157	5,990	167	97.3
GOA	6,070	6,031	39	99.4
GRA	1,120	1,111	9	99.2

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

Table 3. 2016 adult ladder efficiencies in dam-to-dam comparisons

The discovery of a large sinkhole at Cascade Island Adult Fishway at Bonneville Dam (BO2) required restricted access that affected general maintenance of this site. Staff coordinated with COE and PTSC to identify scope of problem and potential solutions, such as moving the PIT tag room and transceiver infrastructure to stable ground.

The FS3001 transceiver installed at Bonneville Corner Collector (BCC) site last year had excellent performance compared to previous generation of transceivers developed specifically to drive the largest of antennas. Staff rotated four units throughout the season to ensure performance of each. With minor modifications, this transceiver model will power the ogee antennas installed at Granite next year.

Staff completed the installation of new data collection platforms at all interrogation sites. The new platforms include solid-state hard drives (SSD) and four-hour UPS systems to enhance reliability and performance. System policy

management was consolidated and additional security enhancements implemented. M4 supports automated synchronization of all transceiver clocks and the ability to download transceiver memory buffers without stopping real-time data collection. These new features added in 2015 provide an additional layer of data redundancy and proved to be useful this season in maintaining continuous datasets.

To reduce overall operating costs, the goal of the Kennewick Field Office has always been to recycle, repurpose and repair older equipment while developing labor savings electronic innovations. The July 2016 PTAGIS Newsletter[4] provides detail on these efforts:

- FS1001 virtual timer tag (VTT)
- FS2020 full auto tune PCB
- FS1001A auto tune concept
- FS1001A recycling
- Legacy transceiver and UPS repairs

2017 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 case[5].

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.

2016 Accomplishments

Staff assisted the COE Portland district with design of the Lamprey Passage System (LPS) for adding PIT tag evaluation at Bonneville and John Day dams. The LPS systems will consist of separate full (FDX) and half-duplex (HDX) PIT tag detection systems. The consolidation of the new full-duplex LPS systems with existing PTAGIS interrogation sites would

[4] https://www.ptagis.org/docs/default-source/ptagis-newsletter-archive/ptagis-newsletter-july-2016-vol-14-issue-1.pdf?sfvrsn=8
[5] *Spill Advocates, Federal Agencies Agree To Status Conference Schedule, Protocol In Salmon BiOP Case* http://www.cbbulletin.com/438950.aspx

provide cost savings and operational efficiency. Other research entities will operate and maintain the half-duplex systems and collect the data outside of PTAGIS.

Working with NOAA and Biomark, the design and testing of the Granite ogee prototype systems continued this year. This system will target the FS3001 transceiver operating at Bonneville Corner Collector (BCC). NOAA conducted a *live-fish* test at the BCC site as part of the evaluation. Continued prototyping and testing of antenna designs to ensure detection in high water velocities (up to 75 FPS) and sub-concrete installation within the spillway. Staff developed a half telegram tag specification that could mitigate performance issues with this system.

The following are other multi-year projects staff assisted as members of a design team:

- PIT tag detection system for helix bypass at Cle Elum Dam (BOR)
- Full Flow PIT Tag system design for GRJ Juvenile Fish Facility (JFF) Remodel (COE)
- Antenna design for B1 Ice & Trash Sluiceway and second BCC antenna (BPA)

Staff completed the BCC Simulator system in the Kennewick lab (*Fig. 14, 15, 16 and 17*). This system will emulate the largest antenna (1/2 scale of the 17’ x 17’ antenna at BCC) allowing tag and transceiver testing in a controlled and automated environment.

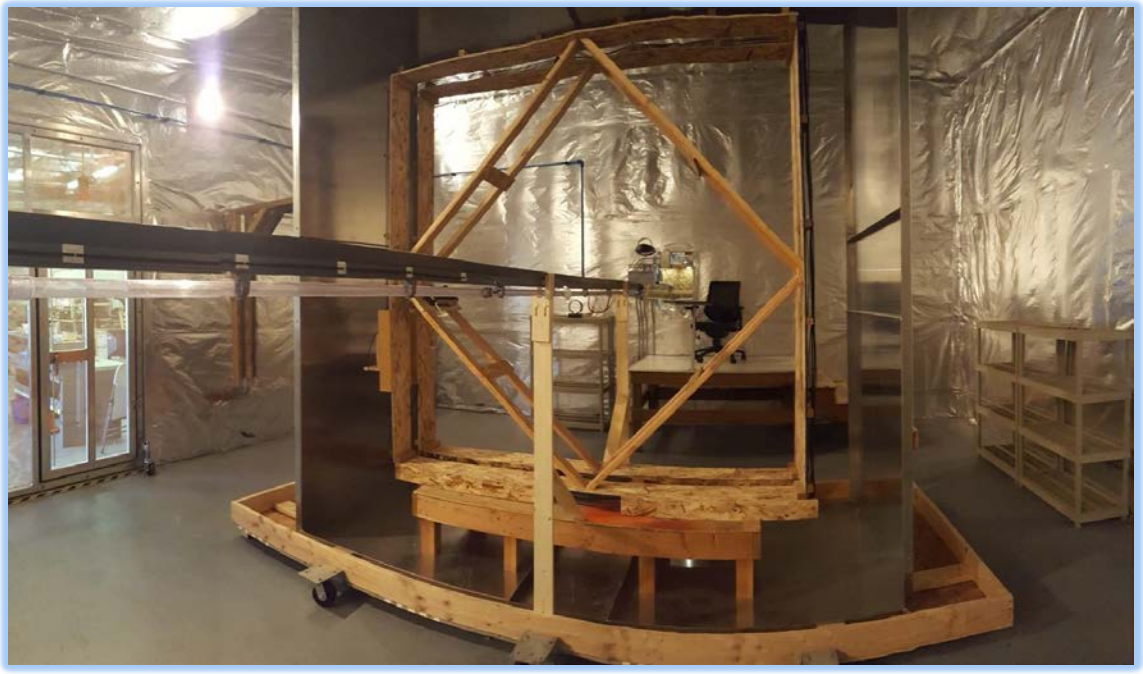

Figure 14. BCC Simulator in Kennewick Lab

Figure 15. Motorized, PLC-controlled tag transport located outside of the room

A custom Human Machine Interface (HMI) controls the different operating modes of the system (*Fig. 16 and 17*):

- Manual read-range testing.
- Automated read-range testing.
- Pneumatic shuttle can send tags through the field at >80'/second.

Figure 16. BCC Simulator Control Station

Figure 27. BCC Simulator transceivers, external HMI, and other equipment

This BCC Simulator will be highly utilized in evaluating tags for the BPA RFO and new systems design such as the ogee project at GRA. Previous efforts required staff to travel to the BCC site and the variability of environmental factors frequently compromised test results. Controlled BCC Simulator evaluations combined with live-fish tests at established interrogation sites will provide the most robust and efficient validation process to-date.

2017 Plans

Staff will continue to be members of design teams for multi-year, multi-agency projects described in this section. Development of baseline measurements and standard operating procedures for the BCC Simulator in anticipation of the BPA RFO and other projects.

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

2016 Accomplishments

Completed all contract-related deliverables such as annual and periodic status reports on schedule. The new funding package for FY17 contract was developed, reviewed and submitted on December 2, 2016. Staff performed an annual inventory audit and the product was loaded into Pisces for the FY17 funding package.

Staff performance plans and reviews were completed and submitted on schedule per PSMFC guidelines. The new staff member hired last year to replace a vacant field technician position announced their resignation in February 2016. The primary duty of this position is to maintain PLC and other automated systems primarily used for SbyC processes described in this document. Reclassification of the position as an *Instrumentation Technician* better fit the job description and helped with recruitment efforts. In April, the program hired a qualified candidate and began training them on the unique technical aspects of the job. SbyC and related systems under the responsibility of this position continued to function at high standards required by the program.

Submission of a revised FY16 line item budget (LIB) in November 2016 to PSMFC fiscal and BPA CO/COTR mitigated the following unplanned events:

- Support for BPA Tag RFO announced post FY16 contract
- Scheduling conflicts with subcontractor for Automated PIT Tag Test System (APPTS) upgrade
- Due to high demand for P4 technical support, staff will conduct live training events before 2017 marking season
- Announcement of support expiration for current version of Microstrategy reporting server

Further description of these events and supporting rationale are included in the revised FY16 LIB uploaded to Pisces as part of the funding contract.

The following are subcontracts within the FY16 performance period:

Subcontractor	Performance Period	Description of Work
Falafal Software	FY16	Mockup designs supporting responsive UI for new website. Port users, content and other artifacts to new Sitefinity platform version. Hours reduced to support other higher-priority tasks.
Biomark	FY16	Maintain the detection equipment at Rapid River Hatchery for 2016.

Table 4. Summary of subcontracts used by PTAGIS related to technical activities

2017 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.

2016 Accomplishments

Staff provided ad-hoc technical support for various field software and web reporting systems. The number of support requests were consistent with previous years with the exception of P4 tagging software.

Staff continued working with a P4 focus group coordinated last year to test and refine beta releases of the software. The Basecamp online forum service (www.basecamp.com) continued to be useful for capturing and communicating feedback within the large group. The focus group made significant contributions to the refinement and usability of this software culminating in a production release that aligned with the needs of the larger community.

The integration of context-sensitive help documentation was included with the P4 production release. Users can simply press a help button or F1 key anywhere within the application to launch a specific help topic (*Fig. 18*) guiding them with the current task or feature. The entire help documentation can also be downloaded from the PTAGIS website as a PDF document (http://www.ptagis.org/docs/default-source/ptagis-software/p4-help.pdf?sfvrsn=2). This documentation includes technical reference of the new MRR data model and related fields.

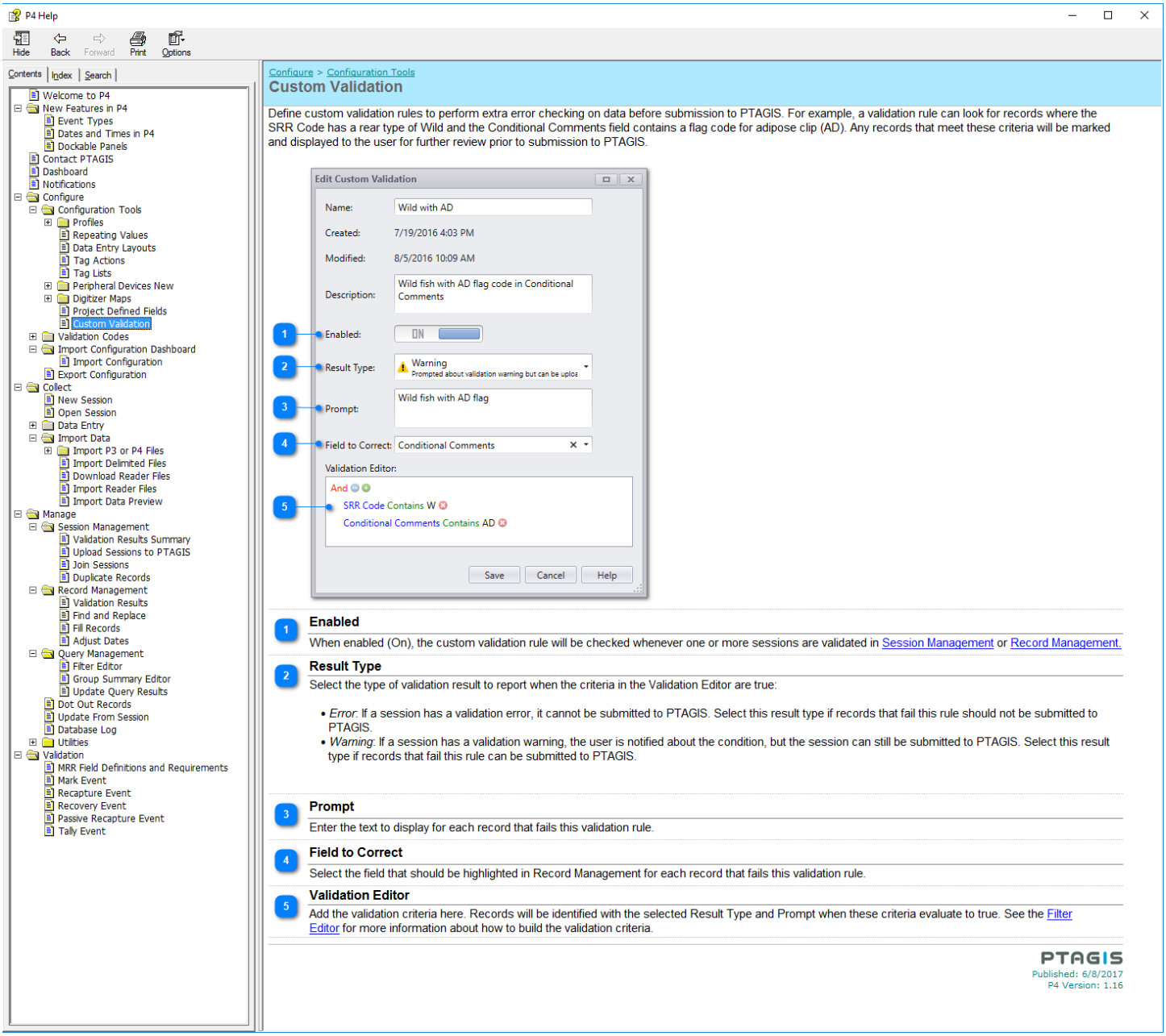

Figure 38. P4 Help Documentation

The development and publication of a home page (https://www.ptagis.org/software/p4) added to the PTAGIS website allows users to download the P4 application installer and other related artifacts such as release notes and PDF help file. Staff can push notices about new software releases, tutorials, and other important information to all P4 users using a built-in notification feature. A flag at the top of the P4 Dashboard indicates when new notifications are available for viewing and then once viewed the user can choose to dismiss the notice. A button also located at the top of the P4 Dashboard allows the submission of technical support requests to PTAGIS via email. A database log contains a history of actions recorded by P4 during the lifetime of the application. This feature helps with technical support and potential recovery of misapplied data. Users can easily send a backup of the entire P4 local database to PTAGIS for inspection with a push of a button.

Staff provided on-site technical support to Yakama researchers marking of 40K fish using the first production release of P4 at Cle Elum Fish Hatchery. Based upon the amount and type of technical support requests for P4 at the end of the

year, it became obvious that local training seminars would be needed to offset complications of migrating from the legacy P3 system and to promote wide adoption before the start of the 2017-marking season. Working with PSMFC front office staff, a series of P4 training sessions were coordinated throughout the region using an online registration process and scheduled for the early months of 2017. The training sessions may mitigate the need for a defect tracking system to handle an increasing load of technical support requests with the availability of both P4 and P3 tagging software.

2017 Plans

Conduct P4 training seminars at five locations around the Columbia Basin Region. Also, provide the training via webinar for those unable to attend in person. Recording the webinar will allow users to review portions of the training via the PTAGIS website. Continue providing ad-hoc technical support for all publically available PTAGIS systems. Consider further evaluation of defect tracking systems if needed to offset increasing support loads.

J: 189 Coordination- Columbia Basinwide

This objective covers standard regional coordination activities such as:

- Participating and the hosting of PIT Tag Steering Committee meetings[6]
- 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[7]
- Providing technical coordination for the PIT Tag Forecasting Service[8]

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

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:

[6] PIT Tag Steering Committee Meeting Notes Archive: https://www.ptagis.org/resources/document-library/meeting-notes
[7] PTAGIS Newsletter Archive: http://www.ptagis.org/resources/document-library/ptagis-newsletter-archive
[8] PIT Tag Forecaster Service: http://www.ptagis.org/services/forecaster

- 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. 19*) 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

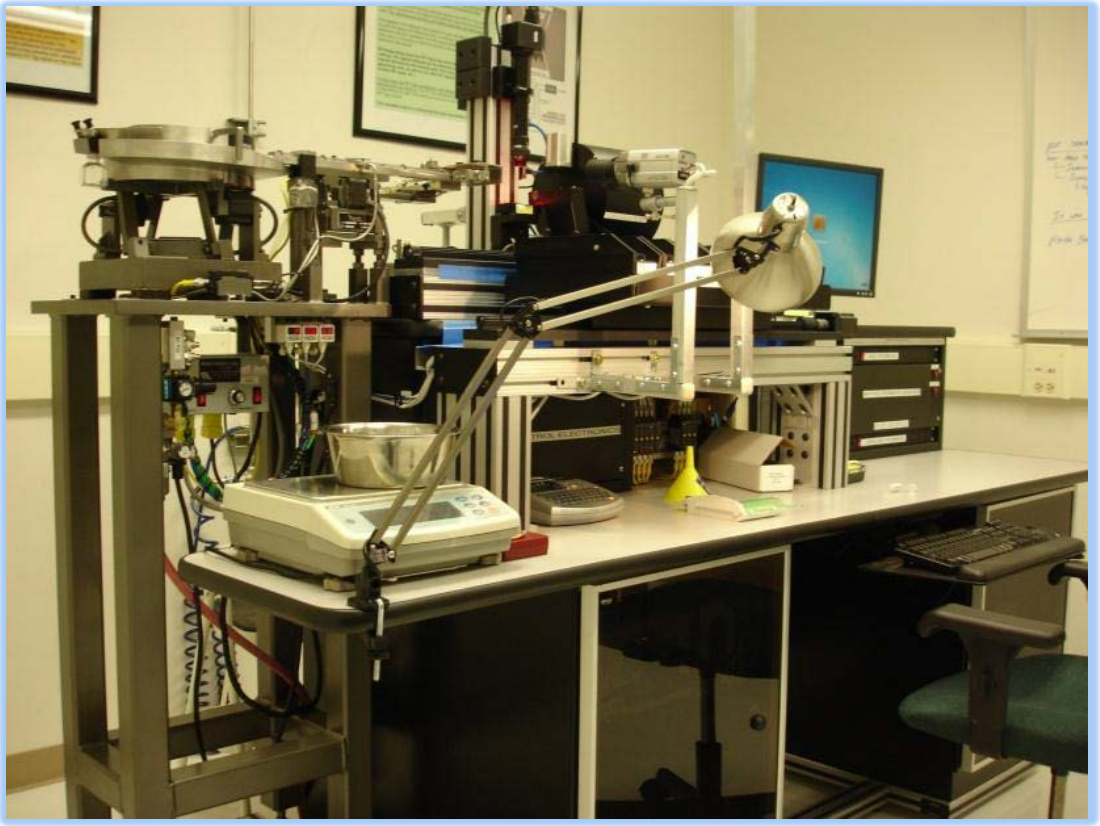

Figure 19. Automated PIT Tag Test System (APTTS) located in the PTAGIS Kennewick laboratory

2016 Accomplishments

Radio interference from the US Navy, Dixon California facility did not materialize in the first half of 2016 as it did in late 2015. This interference had a significant impact on all PIT tag antennas throughout the region. Staff coordinated with PTSC and the action agencies to identify a solution. A letter of concern forwarded to the Navy from the PIT Tag Steering Committee (PTSC) and PTAGIS may have helped to resolve this.

PTAGIS staff distributed 1.7 million tags to 73 FWP in FY16. The testing of 3% sample of those tags for quality assurance found no significant manufacturing defects. The system components of the APPTS are nearing obsolescence and staff completed a plan for modernization this year. A subcontractor (St. Bernard Engineering) to perform this work could not meet schedule and pushed the subcontract into FY17.

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

Data Type	Validation Code Type	Added in 2016	Total Active
MRR	Tag Data Projects	13	159
MRR	MRR Site (mark/release site)	28	1167
Observation	Interrogation Site	29	393

Table 5. Annual Changes in Data Contribution

Other significant events involving technical coordination:

- No projects updated their forecasts via the PIT Tag Forecasting Service[9] due to lack of coordination from the action agencies
- Presented an overview of PTAGIS and training of the reporting system at the *2016 Monitoring Support Meeting Upper Columbia Monitoring and Data Management Committee*

2017 Plans

Continue distribution, inventory and QA sampling of PIT tags to all FWP. Coordinate with PTSC on revising the PIT Tag Specifications Document[10] with updated MRR data model, field definitions, and references to new data file formats. Coordinate with a select group of instream interrogation site stewards to review and revise PTAGIS metadata and data collection/submission efforts to promote the veracity of these data contributions.

[9] PIT Tag Forecaster Service: http://www.ptagis.org/services/forecaster

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