



PIT Tag Information System Columbia Basin

Newsletter

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We welcome input from the PTAGIS community, so email us at ptagis_newsletter@ptagis.org with your story ideas.

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A Fisheries Data Project of the Pacific States Marine Fisheries Commission

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2015 PIT Tag Workshop

NICOLE TANCRETO (PTAGIS Portland Office)

The Columbia Basin PIT Tag Information System (PTAGIS) and the [PIT Tag Steering Committee](#) are pleased to announce a [PIT Tag Workshop](#) to be held January 27 – 29, 2015, at Skamania Lodge near Stevenson, Washington. The goal of the workshop is to bring together those using PIT tag technology in fisheries management, monitoring, or research to share accomplishments and information.

The workshop is scheduled to start in the afternoon on Tuesday, January 27, and end the evening of Thursday, January 29. A full or half day of training, depending on demand, will be offered on Thursday. The annual PIT Tag Steering Committee meeting will be held on the morning of Friday, January 30.

Call For Presentations

We are soliciting abstracts for presentations and posters on a diverse range of topics related to PIT tag data collection and analysis in fisheries management and research, including, but not limited to:

- Innovative use of PIT tag technologies
- Original research involving PIT tag technology
- Use of PIT tags in fisheries management applications
- Integration of PIT tag technology with other research/management/monitoring methods
- PIT tag data analysis methods
- Problem solving using PIT tag technology

Each speaker will have 20 minutes for his/her presentation, including questions and answers. Posters will be on display throughout the workshop.

If you are interested in presenting at the 2015 PIT Tag Workshop, please [submit an abstract](#) by September 26, 2014. Abstracts will be reviewed and authors notified of a decision by November 1, 2014.

Abstract Requirements

- Full name, organization, mailing address, and email address of presenting author
- Full name, organization, and mailing address of each co-author
- Description of presentation/poster in no more than 500 words
- Specify whether your abstract is for a presentation or a poster
- Submit by September 26, 2014

2015 PIT Tag Workshop - Call for Presentations

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Please use this form to submit your abstract: <http://www.ptagis.org/resources/pit-tag-workshops/2015-abstract-submission-form>.

Registration

Registration cost is expected to be \$250.00 per person, which will include some meals.

Vendor space will be available with an expected cost of \$450.00 for each 10 ft x 10 ft space. In addition to the booth cost, there is a workshop fee of \$250.00 per person staffing the booth. Each booth will be provided with two 72 in x 30 in draped tables, 1-2 chairs, power strip and wastebasket. Any additional items may incur additional cost.

Registration is not yet open, but will be announced via email to the PTAGIS newsletter distribution list ([subscribe here](#)) and on the [2015 Workshop page](#). ☺

MRR Data Model Evolution - Comment Period Extended

NICOLE TANCRETO (PTAGIS Portland Office)

In conjunction with the development of the next generation tagging software (P4), the PIT Tag Steering Committee (PTSC) is reviewing the PTAGIS mark-recapture-recovery (MRR) data model. The recently completed transition to new server technology and the development of the next generation tagging software provides a good opportunity to consider adding to or changing the data model. The opportunity to comment on proposed additions and changes to the data model has been extended until the end of October.

To comment on or propose changes, please use the PTAGIS forums. You need to be logged in to comment, but not to view.

Existing Fields: <http://www.ptagis.org/community/forums/existing-mrr-fields>

Proposed Fields: <http://www.ptagis.org/community/forums/proposed-mrr-fields>

You can view more information about the proposed changes in this online Excel workbook: <http://1drv.ms/1gobPf8> ☺

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The PIT Tag Forecaster: New PTAGIS Feature

JIM GEISELMAN (Bonneville Power Administration) and AL GIORGI (BioAnalysts, Inc.)

The Action Agencies, NOAA and the NPCC are seeking region-wide participation in a PIT tag forecasting tool to enhance and expand the capability of the regional PIT Tag information system. This tool will facilitate efficient planning and increased coordination among the numerous PIT tag-based projects being conducted by an increasingly diverse blend of user groups.

Language in the FCRPS BiOp and the recent NPCC Tagging Forum acknowledges the need for, and utility of, more efficient use of tag resources basin-wide. Improved coordination among user groups is a first step. The PIT Tag Forecaster (PTF) is a database system that has been developed to serve that purpose. It is now ready for implementation. This tool will allow managers and investigators the ability to accomplish multiple objectives:

- Ensure the efficient use of PIT-tagged anadromous fish throughout the Columbia Basin.
- Provide a platform for various investigators and managers to view the collective planned tagging activities throughout the system in an effort to assess-
 - Opportunities for sharing of tagged fish, and
 - Assist with coordinating tag use within and across watersheds
- Maintain adequate stock coverage to satisfy specific monitoring needs (BiOp & FWP) into the future.
- Minimize over-tagging sensitive ESA-listed populations, and inform NOAA take-permits.

The region was first introduced to the prototype database system in 2009. It resided on the Columbia Basin Research website. In 2013, the system was transferred to PSMFC to better integrate it with PTAGIS. The PTF was redesigned and effectively beta-tested during the spring 2014. The tool is now ready for regional implementation. The new redesigned 2014 version of the PTF produced by PSMFC resides on the PTAGIS website. Resource managers and investigators will have access to the query and reporting features associated with the database. The PTF includes an online tutorial to guide users through the streamlined data entry process.

BPA, COE, and NOAA will soon be contacting agencies, tribes, PUDs and corporations using PIT tags and requesting them to populate the PTF database with three- year forecasts. Much of the database has already been populated with information from two of the biggest regional users of PIT tags; the FPC (for the SMP and CSS projects) and the COE (for Walla Walla and Portland District Office projects). The goal is to have the database fully populated in time to make forecasts for the years 2015-2017. ☺

Data Load Notification Enhancements

NICOLE TANCRETO (PTAGIS Portland Office)

Enhancements to the Tag Data Load (TDL) process were rolled out on June 19 and July 11, 2014. Most of the changes were designed to improve efficiency and long-term maintainability. However, data contributors will see that notifications emails have been improved, as well.

Notification emails now show the file name and the status of the load attempt (Failed, Loaded, or Loaded with duplicates) in the subject of the email. For those files that fail, the descriptions of the reason for failing have been clarified. For those files that are loaded successfully, the notifications now include a summary of what was loaded into PTAGIS from that file. The summary shows the number of records that were inserted, updated, removed and disowned. If a file contains duplicate records, those tag codes are listed. An example of the tag file load notification summary is shown below:

Summary of Records Loaded

Data Rows: 20

Mark Records Inserted:0

Mark Records Updated:10

Mark Records Disowned:10

Recap Records Inserted:0

Recap Records Updated:0

Recap Records Deleted:0

Mort Records Inserted:0

Mort Records Updated:0

Mort Records Deleted:0

Dupe Records Inserted:5

Dupe Records Updated:0

Dupe Records Removed:0

DotOut Records:5

Duplicate Tag Codes:

3D9.1C2DAFBED3

3D9.1C2DAFC4EA

3D9.1C2DAFD415

3D9.1C2DAFE8A4

3D9.1C2DB001F1

Definitions

Data Rows: number of detail records in the tag file.

Mark Records Inserted: number of records that were loaded as new mark events.

Mark Records Updated: number of previously loaded mark records that were updated by the information in this file. [Disowned and orphaned records](#) can be updated by any tag file. Mark records can only be updated by the current file if they were initially loaded in a file of the same name.

Mark Records Disowned: number of previously loaded mark records that were dotted out, removed, or changed to recap or mort records in this version of the file.

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Data Load Notification Enhancements

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Recap Records Inserted: number of records that were loaded as new recapture events.

Recap Records Updated: number of previously loaded recap records that were updated by the information in this file.

Recap Records Deleted: number of previously loaded recap records that were dotted out, removed, or changed to mark or mort records in this version of the file.

Mort Records Inserted: number of records that were loaded as new mortality events.

Mort Records Updated: number of previously loaded mort records that were updated by the information in this version of the file.

Mort Records Deleted: number of previously loaded mort records that were dotted out, removed, or changed to mark or recap records in this version of the file.

Dupe Records Inserted: number of records that were loaded as new duplicate mark records. A duplicate record is created if a tag code submitted as a mark event already exists as a mark record and is not orphaned or disowned.

Dupe Records Updated: number of previously loaded duplicate records that were updated by the information in this version of the file.

Dupe Records Removed: number of previously loaded duplicate records that were dotted out, removed, or changed to mark, recap, or mort records.

DotOut Records: number of detail records in the tag file that contain 10 dots in place of a PIT tag code. 

Tag Mask Validation Implemented for MRR Data

NICOLE TANCRETO (PTAGIS Portland Office)

The tag mask validation process described in the [June 2014 newsletter](#) was implemented on August 20. Any mark, recapture, or recovery records with a tag code that does not match the list of known tag masks, or is a registered test/timer tag, is no longer available through the reporting system. You can view these records using the QA/QC report **Unknown and Test Tag Mark Record Summary**, which can be found in Advanced Reporting-Standard Reports-QA/QC.

When a tag file is submitted with a tag code that is not on the list of known tag masks, or is a registered test/timer tag, the data submitter will receive a notification email similar to when a duplicate record is submitted. A tag may be described with the following terms:

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Tag Mask Validation Implemented for MRR Data

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Test = tag is a registered test tag

Timer = tag is a timer tag

Unknown = tag has a tag mask that is not known to be in use in the Columbia Basin

You can find the list of known tag masks on the [Current Validation Codes](#) page. 

Mark Data Coordinators and Projects

NICOLE TANCRETO (PTAGIS Portland Office)

From the early days of the PIT Tag Information System, the importance for data users to be able to obtain the context for mark, recapture and recovery (MRR) data has been recognized. This has been handled by linking all MRR data to a person and providing that person's contact information along with the MRR data. Because PTAGIS is now a 27 year dataset, many of those people to whom data were originally linked are no longer available for various reasons such as retirement, changing jobs, etc. When personnel left, generally a new person took over for them and was assigned a new coordinator ID, but there has not been a method for linking data submitted by the previous coordinator with data submitted by the new coordinator. The solution, as decided by the PIT Tag Steering Committee, is to link MRR data to a project rather than a person.

A project has a single coordinator, the person who is currently responsible for collecting and submitting the MRR data to PTAGIS, but this coordinator can change as personnel move on. The history of coordinators is maintained, so that it is possible to see who was responsible at a specific period in time, but the goal is to always have a contact who is currently available and can answer questions about all data submitted for that project, even historic data. The possibility of including project metadata will also be explored in the future.

PTAGIS has been incrementally transitioning to this project-based model for a number of years, and another small step has recently been taken in the reporting system. Several of the attributes that can be used to filter on and display the tag data coordinator (AKA coordinator ID) for MRR data are being deprecated and new ones are being added to take their place.

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Mark Data Coordinators and Projects

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The primary change is to the Mark Coordinator, Recap Coordinator, Mort Coordinator, and Event Coordinator attributes. These attributes report the 3-letter code and the name of the current coordinator of the project for which the MRR data was submitted. These are deprecated and replaced with Mark Data Project, Recap Data Project, Mort Data Project, and Event Data Project attributes, which will report the 3-letter code and the name of the project, as illustrated in the table below.

This may seem like a small change, but let's look at the MLS code cited as an example in the table above. MLS was the original coordinator ID assigned to Mark Shuck back in 1996. When we began the transition to projects, MLS was given the project name Mark Shuck Projects, and the Mark Coordinator attribute became MLS – Mark Shuck. When Mark retired in 2013, Joe Bumgarner took over for him and the Mark

Deprecated Attribute	Deprecated Value	Replacement Attribute	New Data Value
Mark Coordinator Recap Coordinator Mort Coordinator Event Coordinator	3-letter code of the data project concatenated with the name of the current coordinator (e.g. MLS - Mark Shuck)	Mark Data Project Recap Data Project Mort Data Project Event Data Project	3-letter code of the data project concatenated with the project name (e.g. MLS - Mark Shuck Projects)

Coordinator attribute became MLS – Joe Bumgarner. So, if a data user ran a report in 2012 using the Mark Coordinator attribute MLS – Mark Shuck, they would receive all the data submitted by Mark. That same report run after he retired would return zero results because the Mark Coordinator attribute had been changed to MLS – Joseph Bumgarner. By changing the attribute so it uses the project name, MLS – Mark Shuck Projects in this case, the data retriever won't have to change the Mark Data Project attribute every time a new coordinator takes over the project.

The contact information for the current coordinator of a project has been and will remain available through the Mark Coordinator Info attribute. This attribute shows the 3-letter code, coordinator's name, email, phone, and current status (active or inactive). This information is also available on the [Current Validation Codes page](#) on the main PTAGIS website.

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Mark Data Coordinators and Projects

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Deprecated attributes will still be available through the reporting system for at least a year, in order to give users the opportunity to change any automated process which may be linked to these attributes. They are marked as DEPRECATED in the attribute description, which you can see in the Query Builder 2 prompt pages, and are no longer selected by default to be included in Query Builder 2 reports.

These changes in the reporting system require action on your part if any of your saved reports or subscriptions use the Mark Coordinator, Recap Coordinator, Mort Coordinator, or Event Coordinator as a filter. Unless you update these reports and subscriptions, they will return zero records the next time they are run. Please watch video [#13 How To Update Reports and Subscriptions with Coordinator Changes](#) on how to update your saved reports and subscriptions.

The screenshot displays the '1. Select Attributes (Required)' prompt in the Query Builder 2 interface. The interface is divided into three main sections:

- Index:** A list of 21 attributes on the left side. Item 5, 'Mark Data Project (used to be Coordinator)', is highlighted with a red box.
- Available:** A list of 17 attributes in the center. The 'Mark Coordinator' and 'Mark Coordinator Code' entries are highlighted with a red box. Their descriptions include 'DEPRECATED - USE Mark Data Project INSTEAD'.
- Selected:** A list of 10 attributes on the right side. The 'Mark Data Project' entry is highlighted with a red box. Its description is 'Concatenated 3-letter code and name of the tag data project for which the MRR data were submitted.'

Navigation arrows are visible between the 'Available' and 'Selected' sections.

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Mark Data Coordinators and Projects

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List of All Changes

Deprecated Attribute	New Attribute	Comments
Mark Coordinator	Mark Data Project	Code - Project Name
Mark Coordinator Code	Mark Data Project Code	Code only
Mark Project	Mark Data Project Name	Project name
Recap Coordinator	Recap Data Project	Code - Project Name
Recap Coordinator Code	Recap Data Project Code	Code only
Recap Project	Recap Data Project Name	Project name
Mort Coordinator	Mort Data Project	Code - Project Name
Mort Coordinator Code	Mort Data Project Code	Code only
Mort Project	Mort Data Project Name	Project name
Event Coordinator	Event Data Project	Code - Project Name
Event Coordinator Code	Event Data Project Code	Code only
Event Project	Event Data Project Name	Project name

PTAGIS Field Operations & Maintenance Summary for Fall 2014

SCOTT LIVINGSTON (PTAGIS Kennewick Office)



Summary of O&M for 2014

As in previous years, the juvenile fish bypass facilities on the Snake and Columbia Rivers began operating around April 1st. Prior to these operations, the PTAGIS Kennewick staff performed all the necessary pre-season tuning and maintenance to ensure peak performance of the juvenile fish detection and diversion equipment. Detection and diversion efficiency rates for 2014 are being kept at or above previous years. No data losses have occurred in 2014.

As of April 2014, all PTAGIS maintained facilities are operating exclusively with the M4 interrogation software. The M4 platforms performed all tasks with a high degree of detection and diversion efficiency.

At Bonneville JFF (B2J), emergency repairs had to be made on the sample gate due to mechanical failure. Parts from the SbyC gate at John Day JFF (JDJ) were used to make the repairs, the SbyC gate at JDJ remains out of service but does not impact normal facility operations. Repairs to this gate are scheduled for the winter of 2014.

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PTAGIS Field Operations & Maintenance Summary for Fall 2014

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Other PTAGIS Field Office Projects for 2014

- Update: Deployment of the new Biomark FS2020 transceiver.** PTAGIS has currently deployed 56 of the FS2020 transceivers in target locations previously populated by FS1001A transceivers. The FS2020 will result in fewer trips to remote sites for manual tuning as environmental and hydraulic conditions change. These units also provide an increase in detection efficiency over its predecessor. Other locations slated for the FS2020s will require the installation of electrical conduit used for synchronization cables between transceivers. This work will be completed in the winter of 2014.
- Update: Completion of PIT tag room rewiring at all SbyC sites.** The eight SbyC sites operated and maintained by PTAGIS, have been rewired to accept the M4 platforms. This effort resulted in a complete renovation of the PIT tag rooms along with meticulous labeling and identification of all devices and connections. Currently, comprehensive schematics for each facility are being developed that detail all aspects of the data collection platform and peripheral devices. These schematics are compiled and created with electronic design software (CAD).
- Smart UPSs installed at all SbyC sites.** Each data collection platform is now equipped with two high capacity UPSs. In the event of a power outage, these units will provide long lasting power to all critical devices in the PIT tag rooms. These UPSs also incorporate network management cards that have the ability to send e-mail alerts to PTAGIS when a power event occurs.
- Continued Monitoring of the new adult thin body ferrite tile antennas at Lower Monumental and Little Goose counting windows.** PTAGIS has performed weekly YTD detection efficiency reports for adult detection these locations. Total combined efficiency for these sites, as of March 28, 2014 is 99.57%, which meets or exceeds the efficiency of all other main stem ladders. Below are tables of how the efficiency is calculated. This calculation does not consider the unlikely possibility of missed detections at multiple dams. The .43% loss in detection efficiency is explained by either side by side tagged fish movement through the counting windows, canceling each other out, or fish traveling through the navigation lock which is always possible at all other PTAGIS operated main stem adult sites.

PIT Tag Detection Efficiency at Little Goose				
99.68% Little Goose Dam has detected 4,687 of the 4,702 PIT tags detected at both Ice Harbor & Lower Granite Dams.				
Data Detail				
PIT Tag Detections in the Fish Ladders since March 28, 2014				
This data was last updated September 8, 2014				
ROW	Individual Dam Numbers	Ice Harbor Ladders & Juveniles ICH	Little Goose Ladders (GOA)	Lower Granite Ladders (GRA)
1		Unique PIT Tags Detected: 35,256	Unique PIT Tags Detected: 5,296	Unique PIT Tags Detected: 10,052
ROW	Two Dam Comparisons	Unique PIT Tags detected at both Ice Harbor & Little Goose Dams: 5,119		Unique PIT Tags detected at both Little Goose & Lower Granite Dams: 4,812
2		Unique PIT Tags detected at both Ice Harbor & Lower Granite Dams: 4,702		
ROW	Three Dam Comparison	Unique PIT Tags detected at all three dams: Ice Harbor, Little Goose & Lower Granite Dams: 4,687		
3				

PIT Tag Detection Efficiency at Lower Monumental				
99.49% LoMo Dam has detected 4,678 of the 4,702 PIT tags detected at both Ice Harbor & Lower Granite Dams.				
Data Detail				
PIT Tag Detections in the Fish Ladders since March 28, 2014				
This data was last updated September 8, 2014				
ROW	Individual Dam Numbers	Ice Harbor Ladders & Juveniles ICH	Lower Monumental Ladders (LMA)	Lower Granite Ladder (GRA)
1		Unique PIT Tags Detected: 35,256	Unique PIT Tags Detected: 5,712	Unique PIT Tags Detected: 10,052
ROW	Two Dam Comparisons	Unique PIT Tags detected at both Ice Harbor & Lower Monumental Dams: 5,570		Unique PIT Tags detected at both Lower Monumental & Lower Granite Dams: 4,744
2		Unique PIT Tags detected at both Ice Harbor & Lower Granite Dams: 4,702		
ROW	Three Dam Comparison	Unique PIT Tags detected at Ice Harbor, Lower Monumental & Lower Granite Dams: 4,678		
3				

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PTAGIS Field Operations & Maintenance Summary for Fall 2014

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- **John Day adult PIT tag detection:** PTAGIS O&M staff continue to explore alternate antenna designs for installation at John Day adult ladder , north and south locations.
- **Update: Construction of a tag sorter.** The development of the tag sorter is complete, passing all final testing and evaluation. With the sorter in operation, the PIT tag QA sample rate will increase from 1% to 3 to 5%. PTAGIS continues to provide QA for new and production PIT tags for all BPA funded projects.
- **PTAGIS continues to repair failed transceivers in our Kennewick lab.** The aging FS1001, FS1001A and FS1001B transceivers are repaired in house and are projected to last, at a minimum, another 7 to 10 years. The yearly failure rate for these transceivers has not risen since they were initially installed.
- **Wireless radio upgrade at Prosser facility, Chandler Dam.** The wireless radio modems used to transmit data from the adult fish ladder to the Juvenile Fish Facility have been upgraded to a newer model. This was necessary due to increasing error rates, aging of the equipment and no longer being supported by the manufacture. The transmission error rates were significantly reduced if not eliminated by this upgrade.
- **PTAGIS continues to refine facility controls.** This work includes constantly updating the programmable logic controllers (PLCs) with refined programs based on requests from the USACE, NOAA, state and tribal site operators. PTAGIS designs, installs and operates these systems for site environmental monitoring, sampling and SbyC activities.
- **PTAGIS continues to provide researchers with Separation by Code capabilities.** This work includes many in season ad-hoc requests from researchers to accommodate ongoing and new projects.
- **New transceiver deployed at the Bonneville Corner Collector (B2CC).** The newly designed Biomark FS3001 transceiver has been formally accepted by PTAGIS as a production transceiver. The transceiver has been in operation at the B2CC since March of 2014. A subsequent live fish test was conducted in early May with performance results meeting and or exceeding acceptance criteria . After extensive research, development and evaluation, the reader is currently performing exceptionally well in all areas. The auto tuning functionality and stability of this reader has drastically reduced the maintenance burden that previously plagued PTAGIS O&M.
- **PTAGIS provides continuing technical support for Spillway PIT tag project.** PTAGIS involvement includes design reviews, performance testing of proposed antenna designs and transceiver functionality. PTAGIS field personnel continue to be actively involved in most aspects of this effort. 🌀

Pacific Lamprey Behavior at the Cascade Islands Lamprey Passage System

SIENA LOPEZ-JOHNSTON (Bonneville Power Administration)

In the last 50 years an alarming decline in Pacific lamprey populations returning to freshwater to spawn has become apparent. Lampreys must pass 4 hydropower dams to reach the Snake and upper Columbia rivers, and 5 more to reach spawning grounds in the upper reaches of these rivers. Physical and hydraulic conditions of fishways designed for adult salmonid passage impede lamprey passage. Thus lamprey specific passage structures have been put in place over the last decade to assist in successful migration; many PIT tag studies are being used to evaluate the effectiveness of these structures.

The Cascades Island Lamprey Passage System (LPS) at Bonneville Dam was installed in 2009 and operated until 2012 as an experimental structure consisting of a series of vertical ramps (45° and 60°), 6 resting boxes, and 2 PIT antennas, that ended in a terminal trap at the forebay level. All lamprey captured in the trap were hauled several miles upriver (see Figure 1). Prior to the 2013 migration season, the structure was modified and an extension consisting of a flume, two upwelling boxes, a PVC exit pipe and slide, lamprey-activated counter, and two additional PIT antennas was installed to allow for fish to pass over the height of the dam from the tailrace to the forebay (see Figure 1).

A study was carried out during the 2013 migration season addressing passage efficiency and lamprey use of this new full-elevation volitional passage LPS, which features the longest and highest elevation gain of its type. The study utilized three different treatment groups of lamprey released on five dates spanning the migration season (n=75). Two of these groups were released directly into resting box 3 (see Figure 1) of the Cascades Island LPS. Group 1 (n = 25) was double-tagged with half-duplex PIT tags (4x32 mm, 0.8 g in water, Texas Instruments) and radio tags (NTC-4-2L, 18.33 mm length, 8.33 mm diameter, 2.1 g in water, Lotek Wireless Inc.), while Group 2 (n = 25) was only tagged with HD PIT tags to test for a radio-tagging effect. A third group (n = 25) was released above the structure and is not discussed here. Fish were monitored via PIT receiver arrays on the abovementioned structure.

PIT detector data indicated that overall passage success was 74%. Group 1, which was double tagged, experienced 84% passage success, while group 2, which was PIT tagged only, experienced 64% passage success (note: 3 fish from Group 2 that experienced mortality were included in this analysis). Group 1 spent 0.197 d (median) in the structure and Group 2 spent 0.245 d (median) in the structure (note: not corrected for daylight hours in this analysis). Thus Group 1 moved faster and more efficiently through the structure. These differences are interesting considering that Group 1, which was double tagged (i.e. required a larger incision, suture, and longer surgery), moved faster and more efficiently through the structure.

Over the course of the study, we noticed some issues with missed detections on a previously installed PIT detector - 4B2 (see Figure 1). However, the newly installed PIT detector, 4B3 (see Figure 1) appears to have picked up the tags that were missed. Missed detections could be attributed to collisions from multiple tags, power outages, or simple machine malfunctions.

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Pacific Lamprey Behavior at the Cascade Islands Lamprey Passage System

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Our results indicate PIT technologies and detection arrays can be used effectively to assess the success of Pacific Lamprey conservation and restoration efforts. As technologies advance, and become more affordable, new studies and new ways to look at fish movements and tracking will open doors for new science. Scientists and resource managers can learn more about fish behavior and movements, which will contribute to the growing body of science behind Pacific Lamprey conservation and restoration efforts.

Cascades Island LPS

4B1, 4B2, 4B3 =PIT antennas

RB3 = resting box 3

G1 = Group 1

G2 = Group 2

→ = G1 and G2 portion of LPS traveled

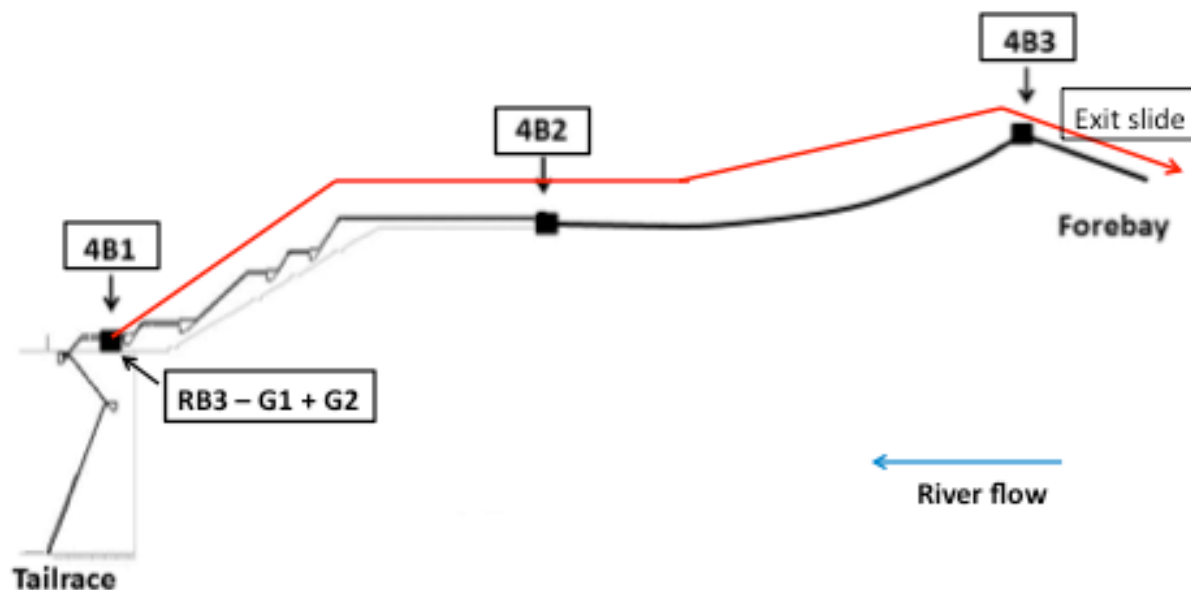
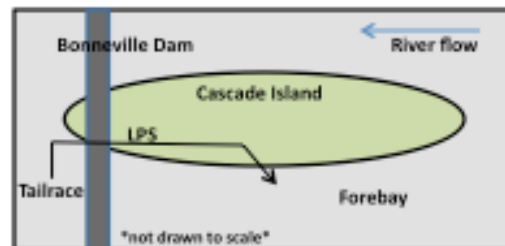


Figure 1. Schematic of Cascades Island LPS (modifications included) and study design characteristics. 

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