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.

If you have questions regarding the contents of this publication, or about the PTAGIS program, please contact PTAGIS Staff.

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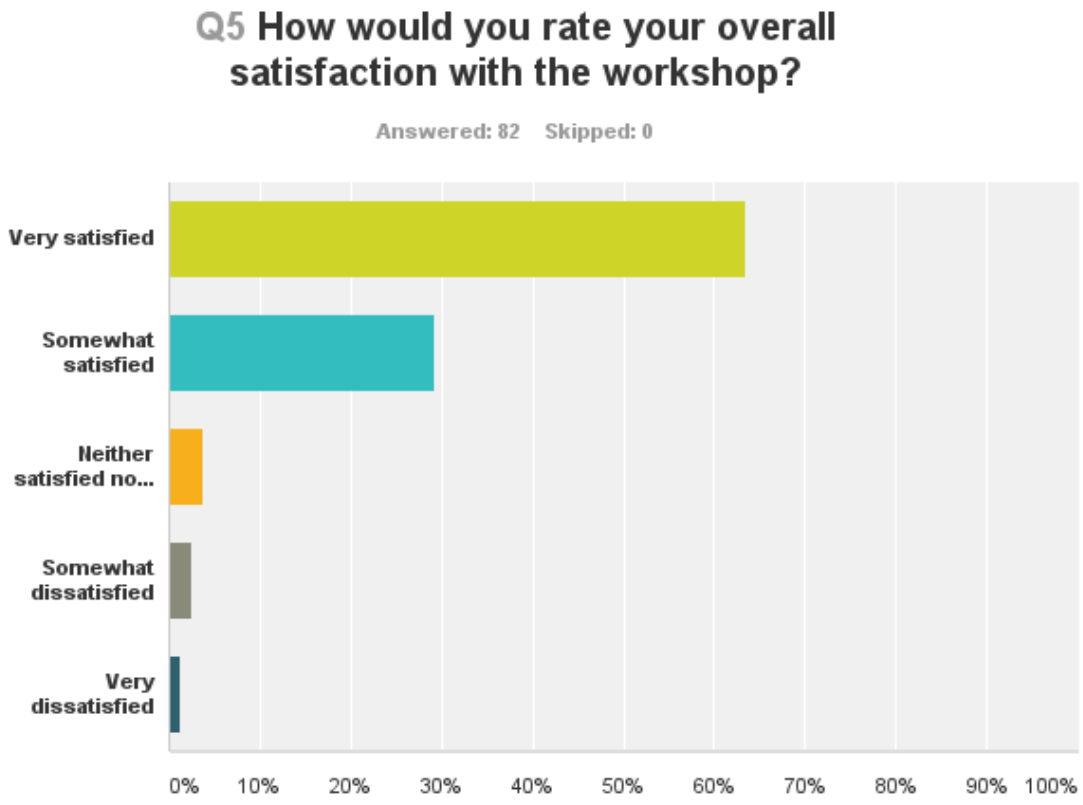
IN THIS ISSUE

2015 PIT Tag Workshop

NICOLE TANCRETO (PTAGIS Portland Office)

The 2015 PIT Tag Workshop was held January 27-29 at Skamania Lodge. Thank you to all participants and presenters for making it another great event and sharing your work and results with the PIT tag community. The response to the workshop was overwhelmingly positive, and we have some ideas to make it even better next time around.



All workshop materials, including the final agenda, abstracts and presentations, have been posted to the 2015 Workshop page on the PTAGIS website. The full post-workshop survey results are also available to view.

Annual PIT Tag Steering Committee Meeting

NICOLE TANCRETO (PTAGIS Portland Office)

The annual PIT Tag Steering Committee (PTSC) meeting was held on Friday, January 30, after the workshop. The primary topics covered during that meeting are as follows:

- The use of full-duplex PIT tags in lamprey. Please see the Removal of FDX Ban for Lamprey Tagging article for more information.
- PIT tag validation, testing and guidance for researchers. Please see the PIT Tag Selection for Researchers article for more information.
- Reviewed and approved proposed changes to the MRR data model. Please see the Mark-Recapture-Recovery Data Model Changes article for more information.

Full notes from this meeting (and all previous PTSC meetings) are available in the PTAGIS Document Library Meeting Notes section.

Removal of FDX Ban for Lamprey Tagging

TIFFANI MARSH (NOAA)

When lamprey researchers first approached the PIT Tag Steering Committee (PTSC) regarding the PIT-tagging of lamprey (August 2003), we asked that they not use FDX-B tags. The PTSC's concerns were 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 fill the buffer of the transceiver with detections, making it unable to load salmonid detection data.

The original plan proposed by the lamprey researchers was to use 125 kHz FDX-A tags, but the transceivers at the time wouldn't read them. With nowhere else to go, the researchers turned to HDX technology in 2004. The use of HDX tags led to the installation of HDX detection systems in adult fish ladders of the mainstem hydropower dams. Initially, these unshielded detection systems generated a tremendous amount of RF noise in the FDX detection systems already in the ladders, affecting detection of adult salmonids. Despite several years of improvements in location and installation techniques, the HDX systems still affect the FDX systems in some ladders.

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Removal of FDX Ban for Lamprey Tagging

CONTINUED FROM PAGE 3

With the introduction of smaller FDX-B tags, researchers began tagging juvenile lamprey in 2013 for testing new passage structures and to monitor migration patterns. This led researchers and the BPA to request the PTSC re-examine the original ban on the use of FDX tags in adult lamprey research and monitoring. Lifting the ban would remove the need to pay for the upkeep on two, often conflicting, detection systems in the adult ladders and would allow for the detection of adult lamprey on the ever increasing number of FDX instream detection systems operating in the Columbia River Basin.

Recent evidence indicates lamprey generally pass through salmonid orifices in three minutes, on average. In addition, the COE has cut lamprey orifices in the weirs of adult ladders within the basin to facilitate passage, which may decrease the likelihood of lamprey impacting salmonid detection even more.

At the 2015 annual PTSC meeting, BPA formally requested the ban be lifted. BPA was asked if folks currently using HDX technology, such as on the lamprey passage structures (LPS), would be forced to switch to more expensive FDX detection systems, and the committee was told BPA would work with researchers on this issue.

Given the evidence that lamprey would not likely impact adult salmonid detection in the ladders, and the increasing number of juvenile lamprey being tagged with FDX tags, the PTSC agreed to lift the ban and allow FDX tagging of adult lamprey. The committee would like to hear from both salmonid and lamprey researchers who feel this decision may impact their research. A Forum thread has been created on the PTAGIS website for you to provide comments. If lamprey researchers have questions regarding the switch to FDX technology, you can contact Scott Bettin at BPA (swbettin@bpa.gov).

PIT Tag Selection for Researchers

ALAN BROWER (PTAGIS KENNEWICK OFFICE) AND NICOLE TANCRETO (PTAGIS PORTLAND OFFICE)

With the increased variety of PIT tags available to Columbia Basin researchers, it is important to recognize not all PIT tags have the same performance characteristics. Performance characteristics of PIT tags can impact your projects and the projects of other researchers using PIT tag infrastructure in the Columbia Basin. If a tag has less of a chance of being detected, then research results could be skewed. If a tag is too powerful and overwhelms tags already in the system, it could affect others' research.

The PIT Tag Steering Committee and PTAGIS strongly recommends tag performance be evaluated before researchers decide to purchase and release new PIT tags in the Columbia Basin.

PIT Tag Selection for Researchers

CONTINUED FROM PAGE 4

Comprehensive PIT Tag Evaluations

Some organizations that purchase large amounts of PIT tags every year have contracted with PSMFC-PTAGIS to conduct rigorous testing of candidate PIT tags to inform the procurement process. The most recent Comprehensive PIT Tag Evaluations (CPTE) were conducted in 2011 and 2014. The tags that were selected for purchase as result of these CPTEs are listed in Table 1.

General Tag Size	Tag Model Selected for Purchase
9 mm	RFID Solutions PT300-1
12 mm	Destron-Fearing SST-1
12 mm	Biomark HPT12

Table 1. Tags selected for purchase by organizations who contracted with PSMFC for Comprehensive PIT Tag Evaluations. Table will be updated as new CPTEs are completed and new tags are selected.

These are not the only tags in use in the Columbia Basin, and it is not required that you use one of these tags. It is recommended that you carefully select a tag that meets your project needs and will perform well in current PTAGIS infrastructure.

If you are interested in working with PSMFC-PTAGIS to conduct CPTEs for your procurement process, please contact Don Warf at dlwarf@psmfc.org.

If you elect to purchase and use a tag that is new to the Columbia Basin, please be aware that you will need to request that the new tag mask be added to the PTAGIS tag mask validation codes. The tag mask validation codes are used to screen misreads and spurious tags from the reporting system. Please see article # 7 in the June 2014 PTAGIS newsletter for more information about tag mask validation in PTAGIS.

PIT Tag Performance Characteristics

Due to the variable nature of RFID equipment, it is impossible to provide specific read range or detection efficiency numbers for researchers to use when selecting a PIT tag to purchase. For example, the read range of a PIT tag will be different when detected on different antennas, in different noise conditions, at different orientations, traveling at different velocities and in the presence of other tags.

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PIT Tag Selection for Researchers

CONTINUED FROM PAGE 5

If the intended use of the new PIT tag is to be detected on existing mainstem interrogation equipment in juvenile bypass facilities and adult ladders, you should use a tag that has the following general characteristics:

- Performs well in high noise and high velocity environments
- Can be read several feet from an antenna (in stream)
- Performs well with less than optimal orientation to the antenna
- Able to be read in close proximity (within a foot) to other tags
- Does not overwhelm other tags when in close proximity (within a foot)
- Lightweight, small, and physically robust
- Manufactured with consistency
- Can be detected in very large antennas (e.g. BCC)
- Tag must be Full Duplex (FDX) for detection at mainstem interrogation sites

Evaluating Candidate Tags

Because antenna, RF, and noise conditions are so variable, it is impossible to provide specific numbers, such as read range or percent detected values, on how a tag should perform on tests. Tests as they are conducted in the PTAGIS Kennewick facility would likely result in different numbers than tests conducted elsewhere. If you choose to test a tag independently, we recommend comparing the candidate tags to the comparably sized tags selected as a result of the most recent CPTEs (Table 1). If the tag you are testing performs similarly, then it has a good chance of performing well within the current PTAGIS interrogation infrastructure.

If your organization is considering purchasing tags other than those selected as a result of the most recent CPTEs, please keep the following guidelines in mind when evaluating those PIT tags:

- Ask the manufacturer if the candidate tag has been tested by PSMFC-PTAGIS Kennewick; if it has, request that they share the results with you
- Performance of the tag in different noise conditions and tag orientations should be comparable to the tags that were purchased under the most recent CPTEs (see how PTAGIS tests this)
- Performance of the tag when in close proximity to other tags should be comparable to the tags that were purchased under the most recent CPTEs (see how PTAGIS tests this)
- Durability of the tag (see how PTAGIS tests this)

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PIT Tag Selection for Researchers

CONTINUED FROM PAGE 5

If you are unable to perform similar tests of candidate PIT tags, please contact Don Warf of PSMFC-PTAGIS (dlwarf@psmfc.org) about conducting CTPEs for the tags you are considering purchasing. The CPTEs include electrical parameter testing using the Automated PIT Tag Test System (APTTS) which shows manufacturing consistency and testing in a very large scale antenna to estimate the tag's performance at BCC.

For field researchers unable to coordinate with PSMFC-PTAGIS Kennewick, the following sub-set of tests (with the results compared to tags that were purchased under the most recent CPTEs) would be a good indicator of tag performance.

Orientation and Noise Immunity Test

This procedure is conducted in the RF-screen room using a 4' x 4' antenna and a Biomark FS2020 transceiver. A belt with distances marked in quarter inch increments is installed to run through the center of the antenna. The transceiver is set in diagnostic mode so that it displays the hit rate (the number of times a tag is read out of 100 opportunities). The read range is recorded for each tag in two different orientations and two different noise levels, as illustrated by the table below.

		10% Hit Rate	100% Hit Rate
Tag Orientation	Total Noise	Read Range (inches)	
0 degrees	0%		
	10%		
45 degrees	0%		
	10%		

This test is conducted on a random sample of 30 PIT tags. Each PIT tag is placed on the belt as far from the center of the antenna as possible. The tag is moved toward the antenna by hand pausing at 0.25 inch increments until the hit rate is displayed on the transceiver (~1 second). The distance from the center of the antenna is recorded when the hit rate registers as 10% and again at 100%.

If the tag does not reach the 10 or 100% hit rates, then the highest hit rate is recorded.

The noise for the tests is created using a function generator outside of the RF room that is connected to a noise antenna inside the RF-screen room. The noise antenna is driven with a 132.2 kHz sine wave and the amplitude was varied to provide controlled noise.

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PIT Tag Selection for Researchers

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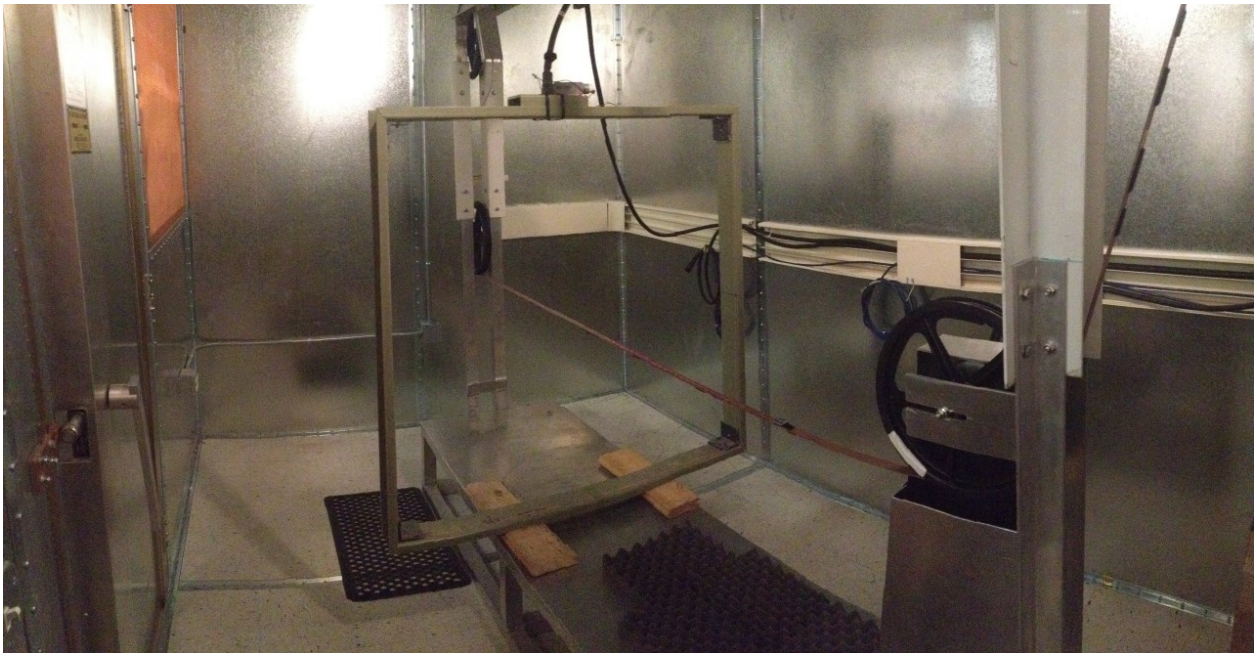

Figure 1. Configuration of antenna and belt for read range testing.

Figure 2. Laser alignment of the belt through the antenna for read range testing.

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PIT Tag Selection for Researchers

CONTINUED FROM PAGE 8

Separation Test

This test determines reading efficiency of grouped tags separated by different distances at a fixed speed. The tests are conducted with the belt in the center position and with tags in 0° orientation relative to the Z-axis of the antennas (see Figure 3). Antennas are configured in the standard shielded 12" antenna configuration used at sites for juvenile facility separators (two 12" coils wrapped 18" apart within a 48" aluminum shield) powered by a Destron-Fearing FS1001 transceiver.

There are five replicate tag groups. Within each tag group, set distances separate the tags (e.g., candidate tag-test space-candidate tag) and then each tag group is separated from the next group by a non-interfering distance. The distance between tags in each group is measured from the leading tip to leading tip (see Figure 4). The belt is run at a speed of 13 feet per second and efficiencies are calculated out of a minimum of 2,000 detections. Results are recorded for each of the two coils separately and combined.

2-Same-Tag Test
This tests reading efficiency when two of the same tags are separated by 6 inches and by 3 inches.

3-Same-Tag Test
This tests reading efficiency when three of the same tags are separate by 12 inches and by 8 inches. Efficiencies are calculated for the outside tags and the middle tag.

3-Mixed-Tag Test
This is the same as the above test, except that the middle tag is the current CPTE production tag model (candidate tag– CPTE 12mm tag – candidate tag). Efficiencies are calculated for the candidate tags and for the CPTE tag.

2-Same-Tag	
6" Reading Efficiency	3" Reading Efficiency

3-Same-Tag			
12"		8"	
Outside Tag Reading Efficiency	Middle Tag Reading Efficiency	Outside Tag Reading Efficiency	Middle Tag Reading Efficiency

3-Mixed-Tag			
12"		8"	
Outside Tag Reading Efficiency	Middle Tag Reading Efficiency	Outside Tag Reading Efficiency	Middle Tag Reading Efficiency

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PIT Tag Selection for Researchers

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Figure 3. Configuration of belt, antennas, and tag groups for separation test.

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PIT Tag Selection for Researchers

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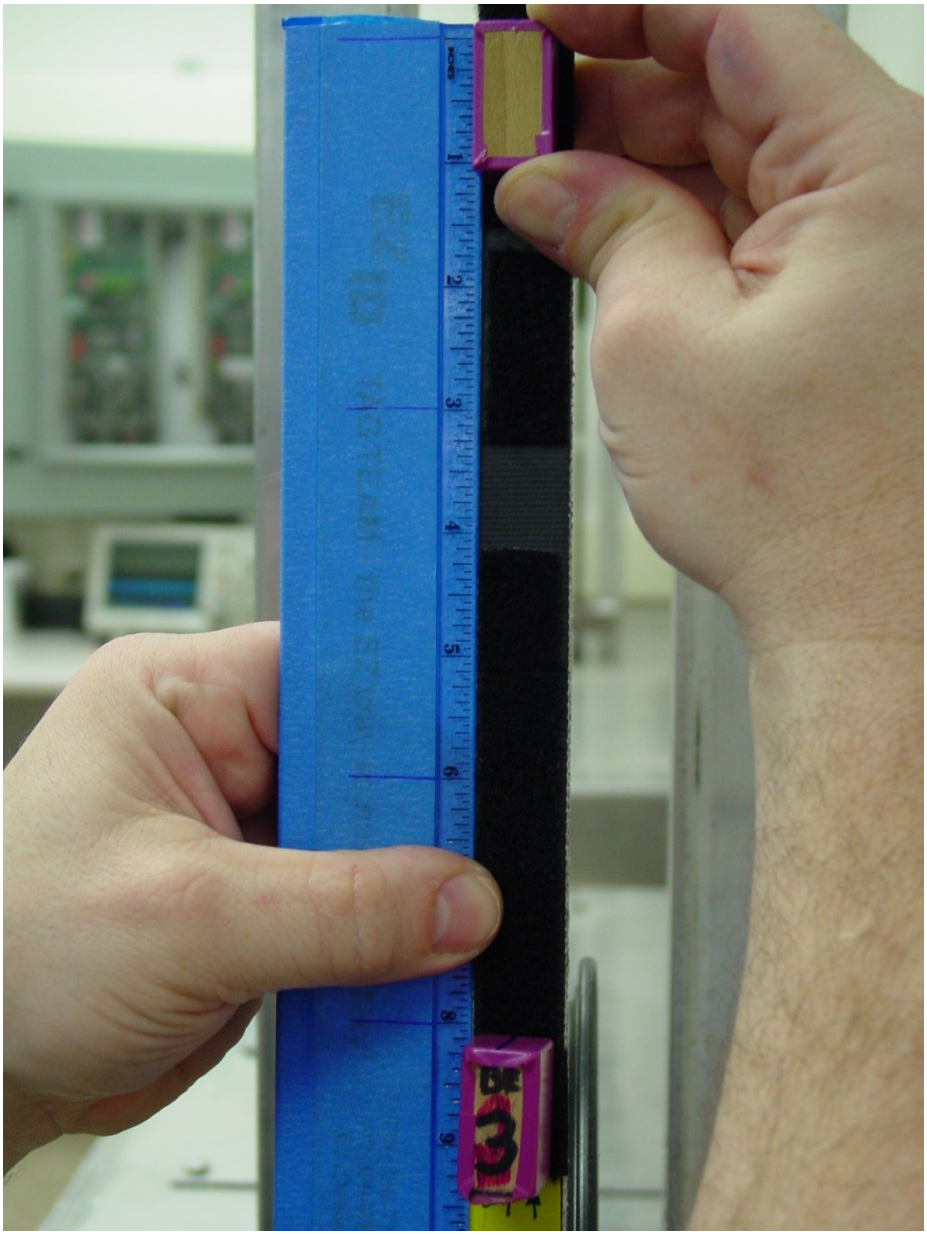

Figure 4. Distance between PIT tags in each group for the separation test is measured from the leading tip to leading tip.

Drop Test

This test is conducted on a random sample of 30 PIT tags. Each tag is dropped three times from a height of 42 inches onto a tiled concrete floor. It is read before and after each drop with a Destron Fearing FS2001F reader. If the glass breaks or the tag stops reading, it is recorded as a failure.

Mark-Recapture-Recovery Data Model Changes

CRAIG WHITE (PTAGIS Portland Office)

After reviewing user requests and comments the PIT Tag Steering Committee working with PTAGIS has approved expansions to the Mark-Recapture-Recovery data model. These expansions will advance the effectiveness of the dataset while maintaining the data integrity that has made PTAGIS a leading research dataset for over 25 years. Implementation is expected to coincide with P4 tagging software.

Modifications to existing fields

File Name: The name will follow the format TDP-YYYY-DOY-EXT.xml

Where TDP = Tag data project ID; YYYY = year of the first event date in the file; DOY = the day of year of the first event date in the file; EXT = user-entered alphanumeric string analogous to the extension in the current tag file name.

Tag Date: The name will be changed to Event Date and it will be recorded in date/time offset format which will be converted to PST for reporting.

Session Message: The length will be expanded from 76 characters to 200 characters.

Raceway/Transect/Tank: The length will be expanded from 10 characters to 20 characters. A more descriptive definition will be added to make it clear this field can be used for any holding apparatus (e.g. buckets, etc.) and isn't just for use at hatcheries.

Session Note: Will be loaded into the database from P4.

Detail Note: Will be loaded into database from P4.

New fields

Release Latitude and Longitude: Optional fields. More details to come (format, coordinate system, datum, etc.).

Event Type: Required field. Used to specify whether the record is a mark, recapture, or recovery.

Life Stage: Optional field. The domain values will be limited to adult or juvenile.

Spawn Year: Optional field. A precise definition will be established.

Project specific fields: Optional field(s). More details to come.

Additional tag code: Optional field. Additional tag codes associated with the PIT-tagged fish.

Additional tag code type: Required if additional tag code is entered. The domain values will be limited to CWT, Elastomer, Acoustic, Radio and PIT.

History and Rationale for Redundant Antennas on the Mainstem

DON WARF AND SCOTT LIVINGSTON (PTAGIS Kennewick Office)

Early History of Establishing the Redundancy Standards

During the 1990's, the 400 KHz PIT tag equipment required an extensive effort to operate and maintain to achieve the highest level of detection efficiency possible.

For this and other reasons, the National Marine Fisheries Service outlined an antenna redundancy scheme, meaning, how many antennas should be installed within a single or serial path within a juvenile or adult fish monitoring facility. This would help ensure that, while the system wasn't optimal, redundant antennas would boost the detection efficiencies to an acceptable level.

In 2000, the Columbia River Basin PIT tag system underwent a complete transformation from the 400 KHz system, to a new transceiver design operating at 134.2 KHz. **Although this new system was well engineered, the overall reliability and performance was still unknown, therefore the amount of redundant antennas was not reduced.**

Why is there redundancy?

Multiple factors are involved when determining how many antennas are necessary for an antenna group.

The following conditions are considered when defining a redundant antenna group:

- **Condition:** Two PIT tagged fish in the detection field at the same time.
    - **Effect:** When this occurs, the two individual PIT tag signals collide, or cancel out one another therefore resulting in no detection of either tag.
    - **Solution:** Multiple antennas allow fish to further separate as they pass through the antenna group reducing tag collisions.
- **Condition:** Fish moving through the detection field sideways.
    - **Effect:** When this occurs, the PIT tag is not being placed in the detection field at the optimal angle, therefore reducing the possibility of the tag being decoded. The number of hits per tag will be significantly reduced or potentially not read at all.
    - **Solution:** Redundant antennas create more opportunity for fish to reorient to an optimal position in the detection field.
- **Condition:** Poor hydraulic conditions upstream of a detection field.
    - **Effect:** Causes poor tag orientation.
    - **Solution:** Redundant antennas provide multiple opportunities for detection in less than desirable hydraulic conditions.

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History and Rationale for Redundant Antennas

CONTINUED FROM PAGE 13

- **Condition:** Speed of the PIT tagged fish as they pass through a detection field.
    - **Effect:** Water velocities, in some instances, could exceed the rate in which the transceiver would be able to decode the PIT tag.
    - **Solution:** Redundant antennas create multiple opportunities for PIT tag to read within an antenna group.
- **Condition:** Single point of failure.
    - **Effect:** If the one antenna fails, all PIT tag data for that detection location is lost.
    - **Solution:** Install a minimum of two antennas to eliminate the single point of failure.
- **Condition:** Determining the directionality.
    - **Effect:** A single antenna will not provide directionality information.
    - **Solution:** Install redundant antenna arrays, minimum of two and if possible three.
- **Condition:** Maximizing diversion gate efficiencies.
    - **Effect:** An inadequate number of redundant antennas will result in poor diversion efficiencies.
    - **Solution:** Install redundant antenna arrays, minimum of two or more depending on conditions.

Can antenna redundancy be reduced within the current system?

- There would be little savings in reducing the number of antennas in the current system. The cost of installation, equipment and infrastructure has been absorbed.
- Maintenance personnel are still required to visit a site on a scheduled basis regardless of the number of antennas.
- No antenna group should be reduced to less than 2 antennas. If one antenna fails, then the antenna group is reduced to one therefore creating a single point of failure.

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History and Rationale for Redundant Antennas

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Can antenna redundancy can be reduced in future systems? Yes!

- Current transceiver technology has vastly improved detection capabilities.
- Newly designed PIT tags improve overall detectability.
- Transceiver and data collection equipment has become more reliable.
- New antenna designs facilitate higher detection rates.
- More attention given to hydraulic conditions surrounding the detection area allows for less antennas.

Due to all the above, new adult antenna groups have been installed at TD1, TD2, LMA and GOA and have only two serial antennas, yet are as efficient as older antenna groups with 4 serial antennas. Some researchers have stated that 3 antennas in series is still preferable for directionality confirmation.

Biomark News

KIRSTYN MCKAY (BIOMARK)

Announcing the End of Service of FS2001 and FS1001 (MUX)

Due to the age of product and lack of availability of key parts Biomark will no longer be able to provide repair support for these units after 5/1/2015.

We will do our best to repair readers sent in within the next 90 days based on parts availability.

In order to ease the transition of the older generation product to the new state-of-art reader platform we are offering a limited time **TRADE-IN SPECIAL. Send in your old FS2001 or FS1001M (MUX) and receive $400.00 (USD) off your purchase of one HPR Plus Reader or IS1001 Master Controller** (MUX controller replacement). Biomark makes every effort to recycle all parts of the used readers sent in. There is no limit to the number of readers that may be traded in, however only one trade in credit can be used per new reader purchased. Offer will expire on 1/31/2016.

If you have any questions please call our office (208) 275-0011 or email customerservice@biomark.com

New PTAGIS Employee

JOHN TENNEY (PTAGIS Portland Office)

Last December, Daniel Wilson joined the PTAGIS team in Portland to fill a new software engineer position. Daniel has a diverse background in software engineering, having worked on both desktop and web projects across industries ranging from business server hosting to machine automation. His primary responsibilities are to expand the functionality of our field data collection and other related systems. We are looking forward to leveraging Daniel's talents toward building the next-generation tagging software, P4.