Movement and Population Dynamics of Wild Brook Trout in the Swift River Tailwater

Project Timetable May 2023 – September 2026

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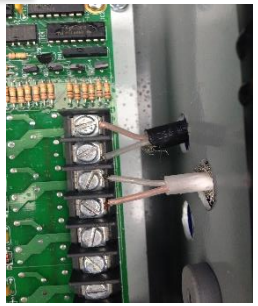
Presentation Outline

- Overview of research project
- What are PIT Tags, why use them?
- How to read PIT Tags
- Different Designs in Antennas
- Where to put Antennas and Why
- Logistics in Getting Started
  - Building the Array
  - Tagging the Fish
- Data, Batteries, and Maintenance
- Project Workflow
- Volunteer Opportunities



Research Overview

- Track movement of tagged Brook Trout
  - Seasonal habitat use, spawning locations/timing, overall magnitude of movement
- Mark-recapture surveys
  - Estimates of population, recruitment, mortality, and growth/trends over the course of the study

Methods

- Passive Integrated Transponder (PIT) Tags
  - Individually Identifiable RFID Tags
  - Can be read by semi-permanent in-stream arrays and handheld readers (recapture events)
  - Relatively easy to apply
  - Cost effective ($1.65 per tag) means to individually mark fish
  - Arrays placed at significant locations, record tag passage data indefinitely

Outcomes/Products

- Understand movement and population dynamics of wild Brook Trout in the Swift River tailwater to:
  - Pinpoint areas of critical habitat
  - Identify population trends and factors that influence these trends
  - Understand seasonal movement patterns and factors that influence movement
  - Inform potential regulation changes to maintain current high quality of fishery
  - Communicate findings with anglers (in the field, presentations, www.mass.gov/swift-trout) and colleagues (conference presentations, peer-reviewed journal article)

Project Details

Passive Integrated Transponder Tags (PIT Tags)

- Same technology as pet “microchips”
- Commonly used to track fish movement, growth, and survival
- Tags are available in a variety of sizes and configurations, most quite small
- All tags have a unique 10-15 digit alpha numeric code (i.e. individuals can be tracked)
- No battery or in-tag power source, tag is effective and readable for life of the fish
- Tag is activated and “read” by instream antenna or handheld reader
- Antennas allow for fulltime remote monitoring of movement at each site

Passive Integrated Transponder Tags (PIT Tags)

- PIT tags are PASSIVE, small radio transponders. They only transmit data while activated by the electromagnetic field of an in-stream antenna or a hand held tag reader.
- There are different “charge” vs. “listen” technologies
- Full Duplex (FDX) vs Half Duplex (HDX)
  - FDX transmits and receives data simultaneously
  - HDX transmits, pauses, and then receives

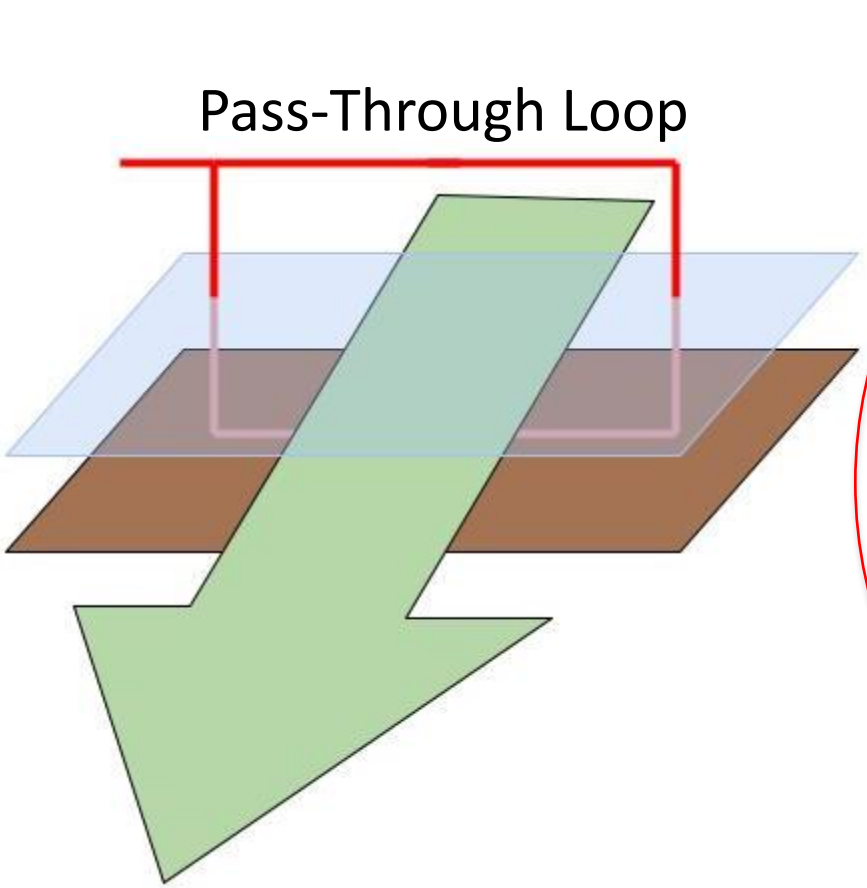
FDX Array	HDX Array
Faster ping rate (30 per sec max)	Slower Ping rate (14 per sec max)
No capacitor, smaller tag (8.5mm)	Larger tag w/ capacitor (12-23mm)
Shorter read range	Stronger signal, longer read range
Prone to noise interference	Can build larger antenna, w/ common components
Optimized for confined area, like a fish ladder, pipe etc	Less noise/interference

PIT Tag Monitoring

- Each PIT tag monitoring site contains:
  - RFID Reader
  - Antenna
  - Power source

- HDX antennas can be constructed from a wire loop inside a protective support (PVC etc)
- Antenna designed to maximize read range
  - Scan and read the full water column at the chosen site to ensure that the maximum number of fish that pass by are detected by system
- Several Types of antenna designs, including, pass-over loop, and pass-through loop

Antenna Type Comparison



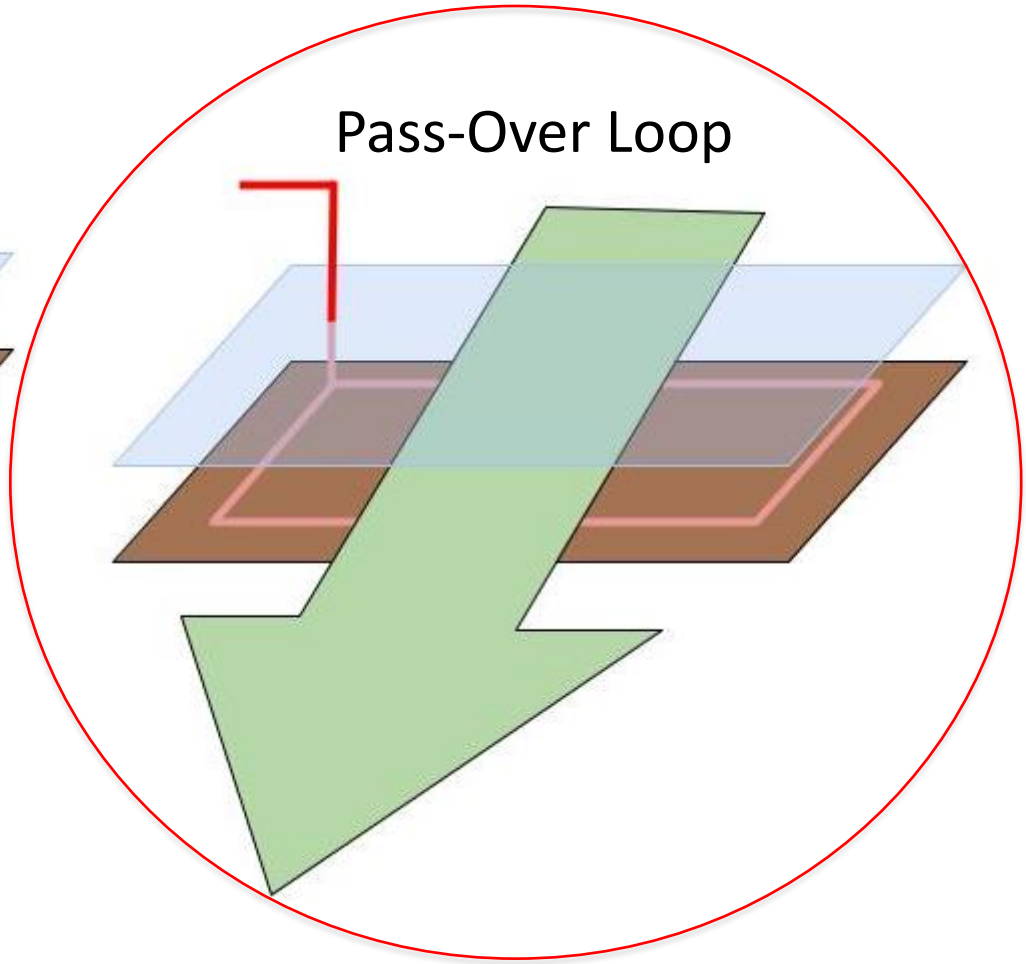
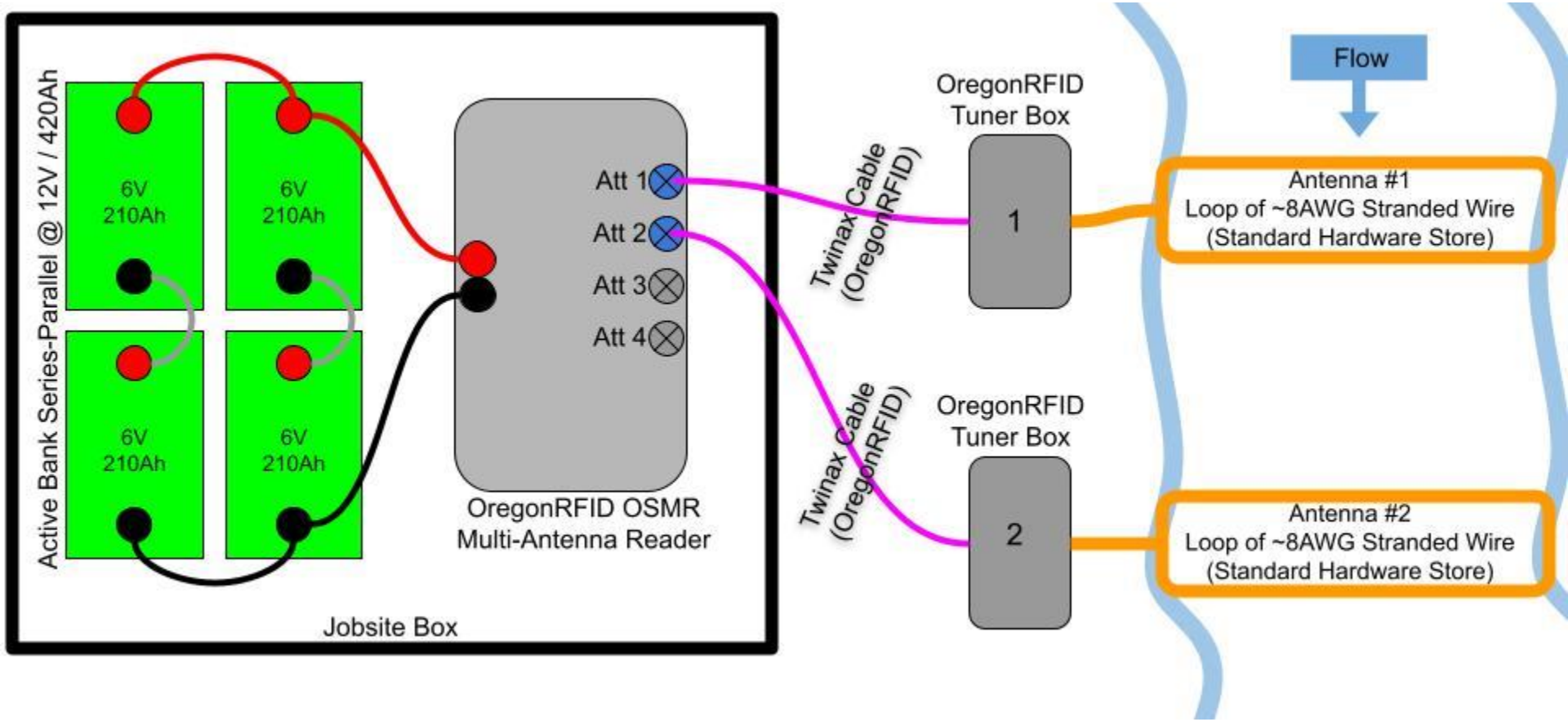
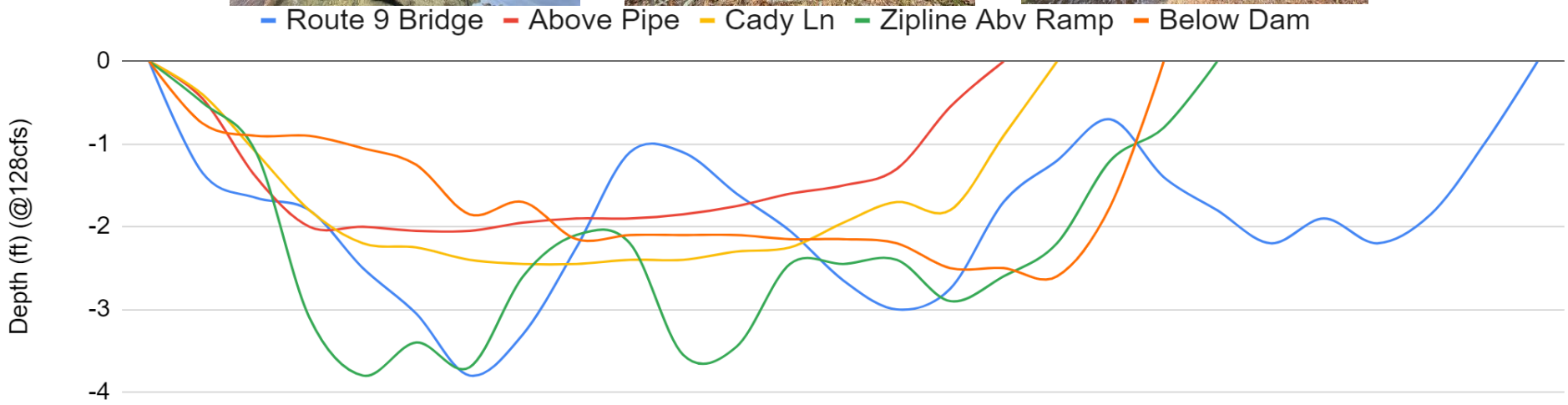


Diagram of HDX Instream Pass-Over Antenna



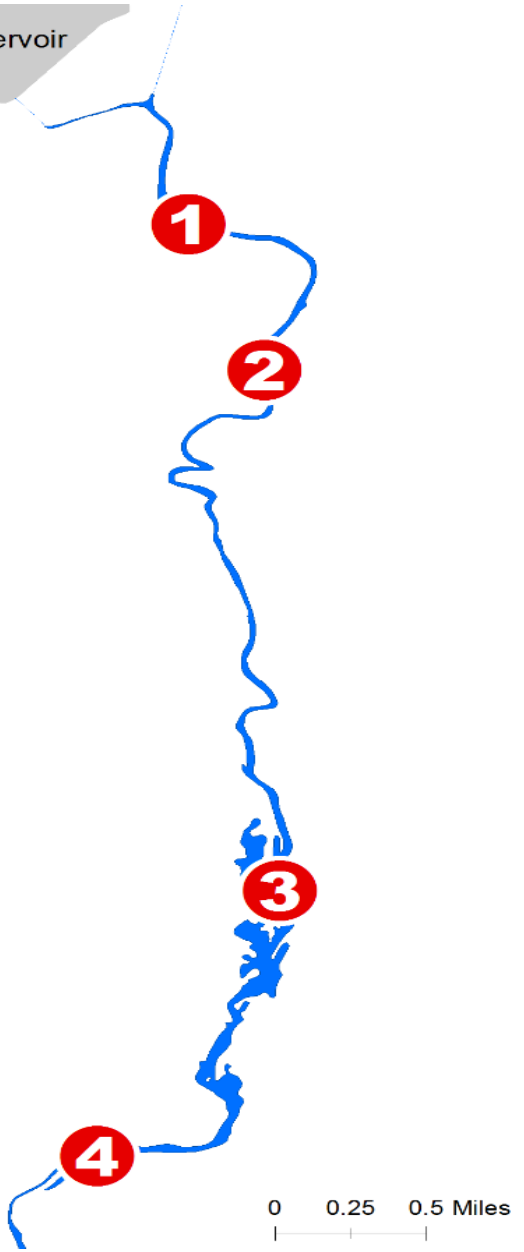
Antenna Site Selection

- Sites are of ecological or regulatory importance
- Minimize water depth and channel width (natural choke points)
- Feasibility of construction and long-term access



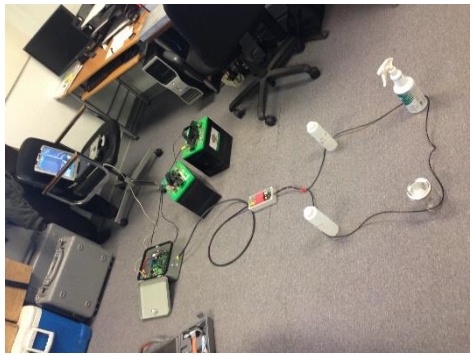
Antenna Site Selection

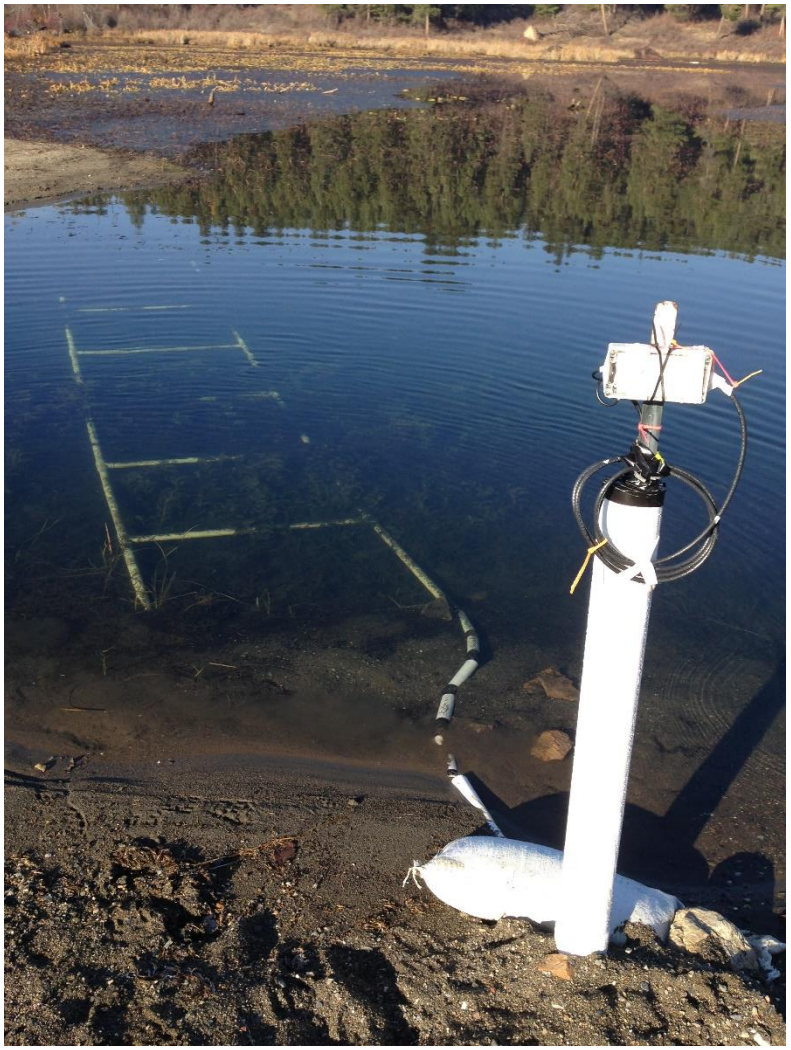
- Locations of Significance/Potential array sites
  1. Route 9 Bridge
  2. Cady Lane
  3. Riverine to Impoundment Interface
  4. Below the Bondsville Dam



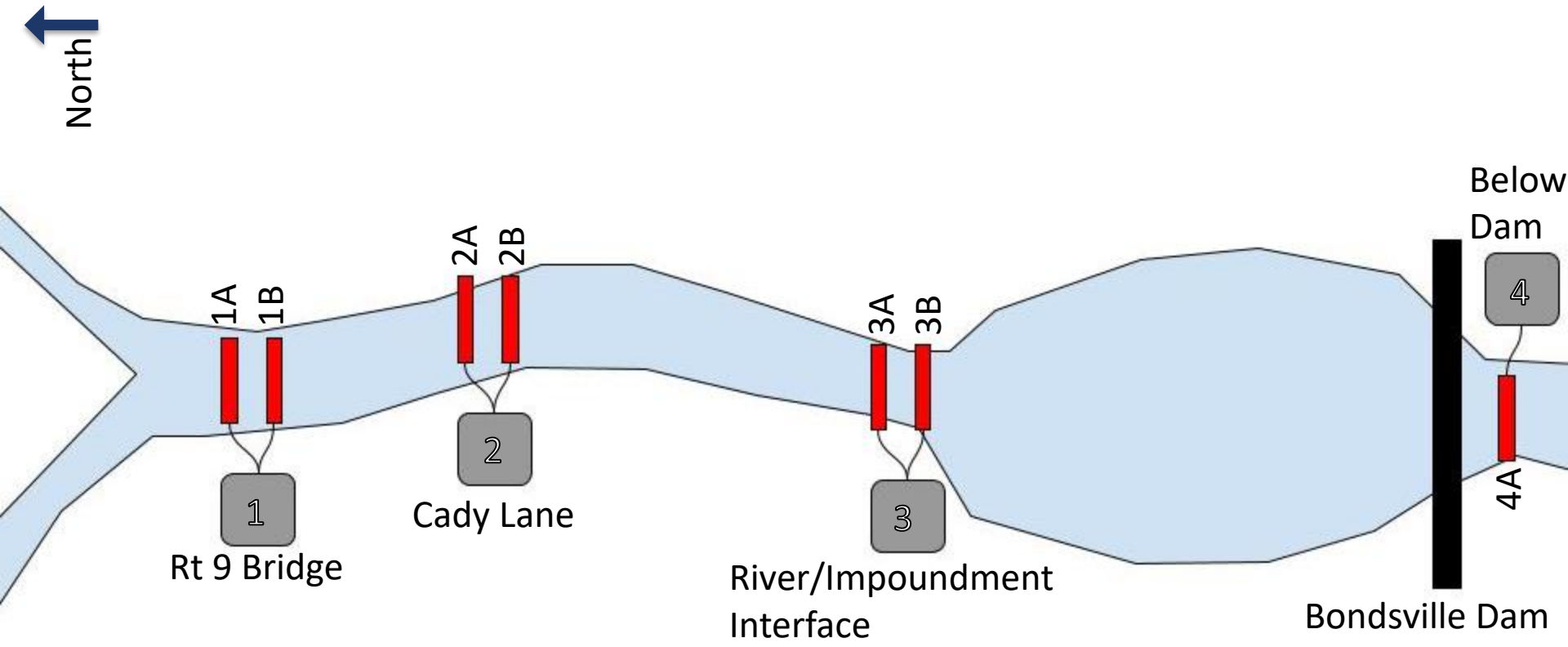
Building the Antenna Array

- Proposed plan consists of 4 instream PIT Tag Monitoring Sites
  - 3 sites above the dam are double antenna
  - 1 site below the dam are single antenna
- Each antenna is built specifically for the conditions at the location (width, depth, surroundings)
- Most of the components are available at the hardware store





Array Simplified Overview

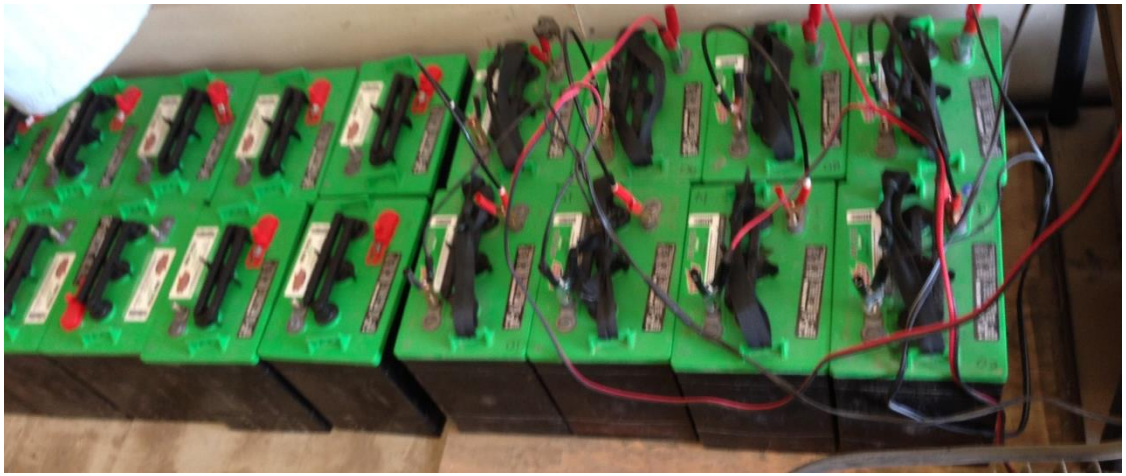


Tagging Wild Fish

- Fish collected at regular intervals throughout the project period
- Fish captured using electrofishing gear (boat, raft, and backpacks)
- Fish measured and implanted with PIT tag onsite and immediately released
- Immobilize fish using electronarcosis tank for tag implantation

Maintenance and Power

- Estimated battery life is a factor of the specific setup and site conditions. Maximize a balance between ping rate and battery life (hopefully around 2 weeks with one charge).
- Site maintenance, potential for vandalism or environmental (weather and animals) damages. Quick timely repairs for uninterrupted data collection.



Data Downloads and Storage

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=-=-=-=-=-=-=-=-=-=-=-=-=-=-= PuTTY log 2014.07.14 13:18:09 =-=-=-=-=-=-=-=-=-=-=-=-=-=-=
g^
Oregon RFID Datalogger Version 4.06
07/14/2014 13:09:39.00

>supply power ok 12.5V
database file opened
starting reader after power up
ad
                          supply                supply     clock
                           amps                  volts     volts

Rx 0.18 Tx A1 1.12 A2 1.22                EA 0.67   12.5 V     3.3 V   13:09:50.43

Rx 0.19 Tx A1 1.10 A2 1.20                EA 0.66   12.5 V     3.3 V   13:09:50.93

Rx 0.21 Tx A1 1.12 A2 1.22                EA 0.68   12.5 V     3.3 V   13:09:51.45

Rx 0.17 Tx A1 1.09 A2 1.19                EA 0.65   12.5 V     3.3 V   13:09:51.96

Rx 0.17 Tx A1 1.06 A2 1.19                EA 0.64   12.5 V     3.3 V   13:09:52.48

Rx 0.18 Tx A1 1.12 A2 1.19                EA 0.66   12.5 V     3.3 V   13:09:52.00

>up
upload #36 start: 06/30/2014 12:33:14.68
Site code: chann
--------- upload 36 start ---------
06/30/2014 12:33:14.69 upload 35 complete
06/30/2014 12:40:18.24 supply power ok 13.0V
06/30/2014 12:40:18.24 database file opened
06/30/2014 12:40:18.24 starting reader after power up
06/30/2014 18:31:22.46  00:00:01.22 A 900_228000122802 A1    7 65534
06/30/2014 18:31:24.89  00:00:01.21 A 900_228000122802 A1    7     5
06/30/2014 18:31:58.91  00:00:00.80 A 900_228000122802 A1    5   162
06/30/2014 18:32:01.72  23:59:59.61 A 900_228000122802 A1    4     4
06/30/2014 19:13:53.46  00:00:00.60 A 900_228000123945 A1    4 12481
06/30/2014 19:14:14.99  00:00:00.41 A 900_228000123945 A1    3   103
06/30/2014 19:14:19.23  00:00:00.00 A 900_228000123945 A1    1    18
06/30/2014 19:14:19.63  00:00:01.82 A 900_228000123945 A1   10     1
06/30/2014 19:14:22.66  00:00:01.42 A 900_228000123945 A1    8     5
06/30/2014 19:14:48.03  00:00:01.21 A 900_228000123945 A1    7   118
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- Basic data download will contain tag ID # with the date and time of detection
- More tag detections = more data
- Each site generates its own data, stored internally until downloaded
- An array with 4 sites will generate a large amount of data over time
- Data will be downloaded regularly (at least in time with battery swaps) and stored multiple places and online (cloud)

Project Workflow

Build
- Acquire Components
- Build Each of the 4 Antenna Sites

Tag
- Capture Wild Fish
- Implant First Tags

Maintain
- Monitor Data
- Battery Changes
- Maintain Sites

Recap
- Capture Additional Fish
- Recapture previously tagged fish

Collaboration and Volunteer Assistance

- Array Construction
  - Likely at least 2 days of work per Antenna Site if everything goes smoothly
- Tagging fish
  - Recurring work, small # of people for each event
  - Electrofishing, processing, and tag implantation
    - Initial batch of marked fish
    - Successive recapture efforts
    - New fish tagged throughout project timeline
- Maintenance and Battery Changes
  - Likely done every 2 weeks at each antenna site for the duration of the project timeline
- Site Inspections and Information Sharing
  - General knowledge sharing with fellow anglers
  - Site checks for any obvious exteral issues so they can be repaired in a timely manner (vandalism, natural damage, etc)