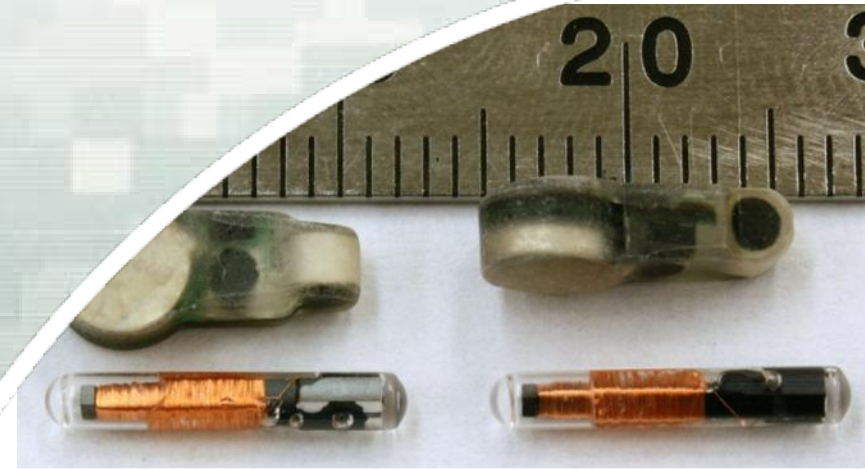


Juvenile Salmon Acoustic Telemetry System

JSATS

Brad Eppard
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Portland, Oregon
December 14, 2011

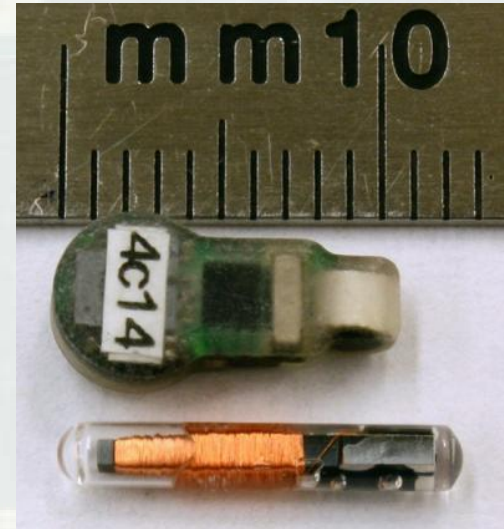


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US Army Corps of Engineers
Portland District

JSATS: Program Overview and Objectives

1. Develop a system for study of subyearling Chinook through the Columbia River estuary
 - ▶ Developed to maximize detection in a riverine environment (fast flowing, shallow, salt water)
2. Adopted as the standard for upriver studies due to advantages of economy of scale
 - ▶ Standardized methods and techniques
3. Is a non-proprietary system that helps to reduce costs by allowing for full and open competitive procurement
 - ▶ Resulted in the smallest and least expensive acoustic transmitter on the open market
4. Further development to miniaturize the transmitter for use in smaller juvenile salmonids and eventually juvenile lamprey



JSATS: Recent and Current Uses

- Dam passage survival (Performance Standard Testing)
 - ▶ LCR Survival Study (2008-2012) (*CH1, CH0, STHD*)
 - ▶ Snake River Survival Study (2012 - ?) (*CH1, CH0, STHD*)
- Dam passage behavior (2d and 3d positioning)
 - ▶ Cougar Dam (2011 – 2012) (*CH1*)
 - ▶ Detroit Dam (2012 - ?) (*CH1, STHD*)
- Survival through the estuary (2005-2010) (*CH1, CH0, STHD*)
 - ▶ Migration behavior and timing into the ocean (2010)
- Survival of transported fish (2010) (*CH1*)
- Migration and fate of adult Pacific Lamprey (*2010-2012*)



JSATS: 2012 Studies

Study	Management Application	N tags
LCR Survival Study (MCN – BON)	BiOp Performance Standard testing (<i>CH1, CH0, and STHD</i>)	24,000
SR Survival Study (LGO-LMN)	BiOp Performance Standard testing (<i>CH1, CH0, and STHD</i>)	24,000
Cougar Dam	Passage behavior for informing downstream passage alternatives (<i>CH1</i>)	1,200
Detroit Dam	Passage behavior for informing downstream passage alternatives (<i>CH1 and STHD</i>)	1,200
Steelhead Kelt passage at BON	Passage behavior to inform decision on BON powerhouse priority	300
Lamprey	Migration timing and fate of adult lamprey in the BON pool	60



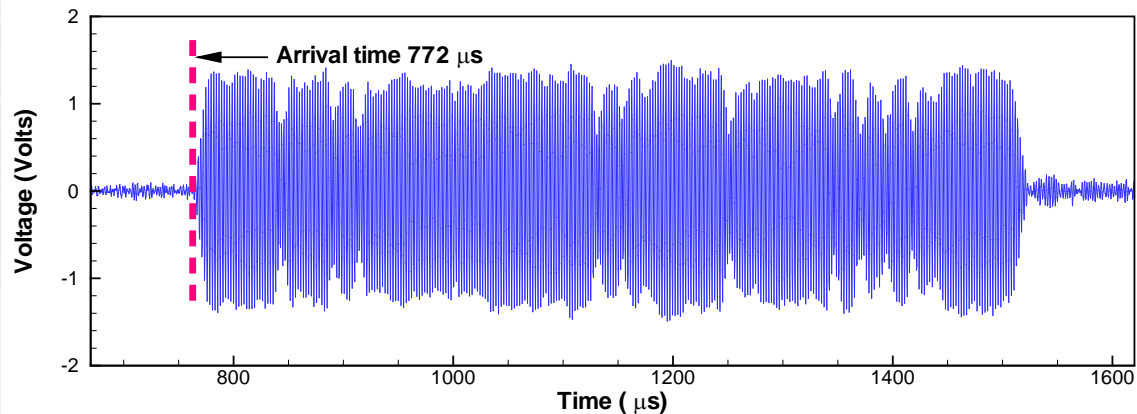
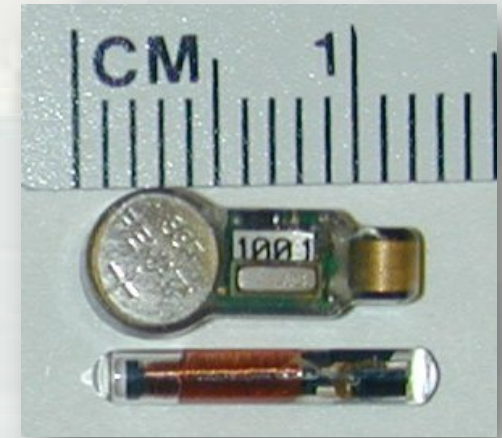
JSATS: Why Acoustic Telemetry

- Why Acoustic Telemetry?
 - ▶ AT is less invasive (no external antenna)
 - ▶ AT allows for 2d and 3d tracking
 - ▶ AT is detectable in brackish and salt water
- Why JSATS?
 - ▶ Non-proprietary specifications allow competitive procurement reducing costs while spurring innovation by the open market
- Why not PIT tags?
 - ▶ Reduced detection range. Doesn't provide passage behavior information
- Why not Radio Telemetry?
 - ▶ Larger tag size needed for equivalent tag life
 - ▶ External antenna and effects on fish
 - ▶ Detection is 1D (presence /absence)



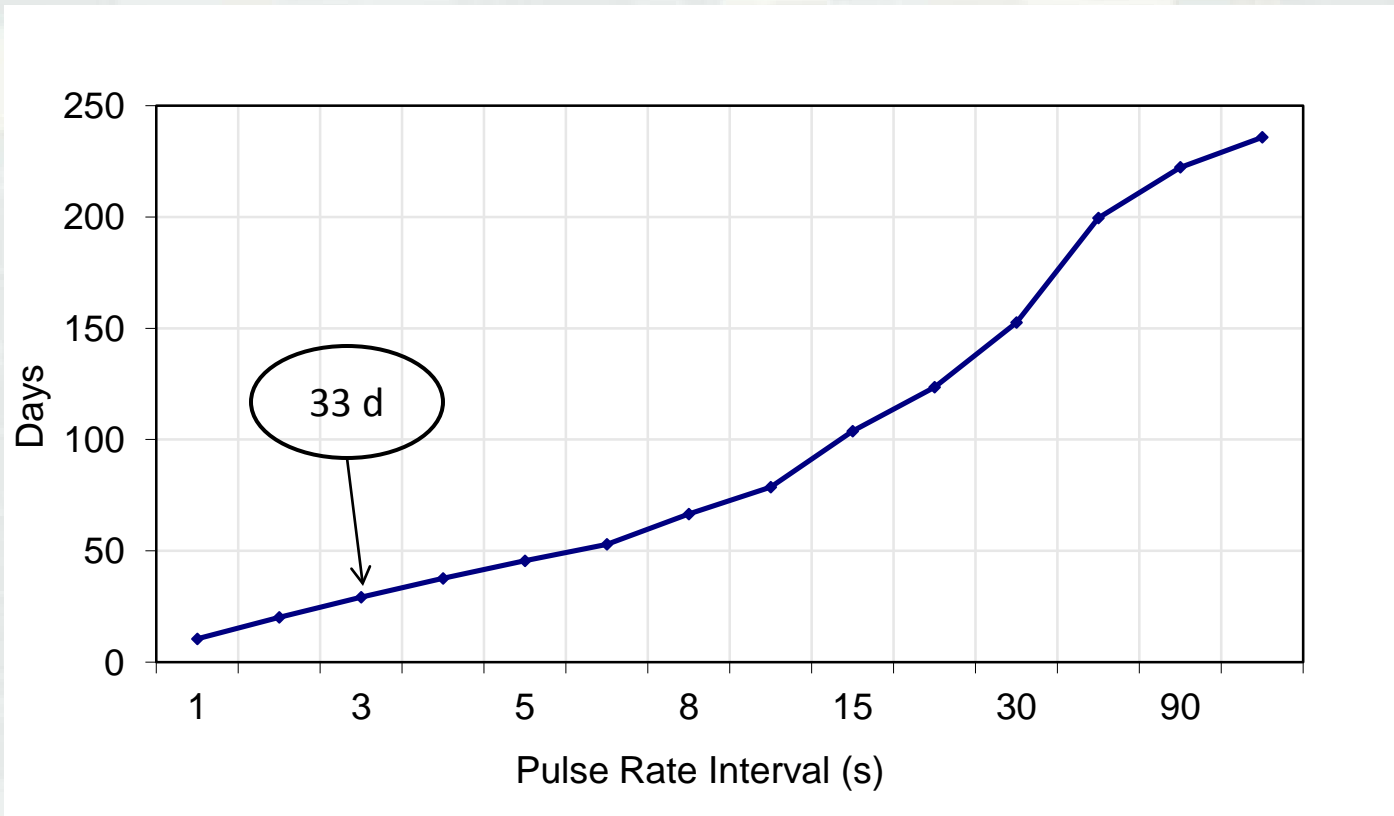
JSATS: Basic Specifications

- 2008-2011 JSATS Transmitter
 - ▶ Frequency: 417 kHz
 - ▶ Mass: 0.43 g in air, 0.29 g in water
 - ▶ Dimensions: 12.00 x 5.21 x 3.77 mm
 - ▶ Source level: 156dB re:1 μ Pa at 1m



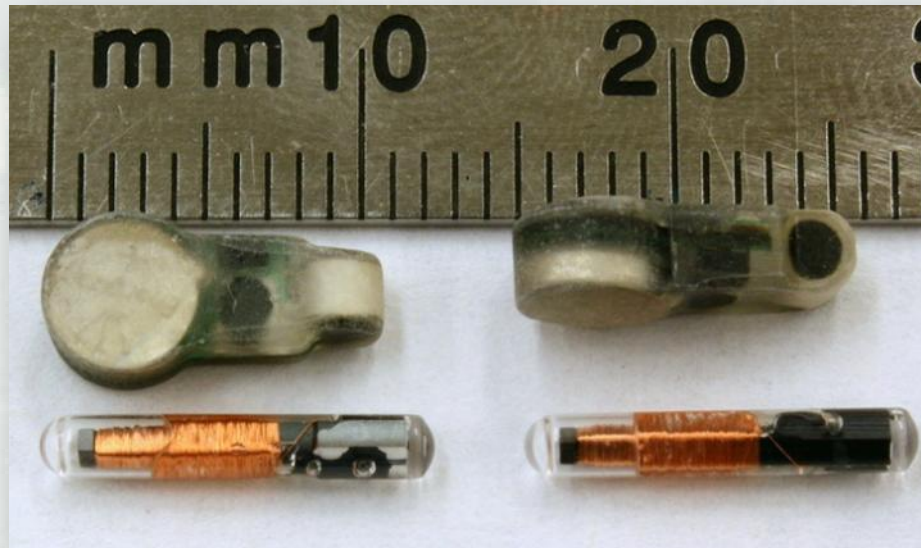
JSATS: Basic Specifications

- 2008-2010 JSATS Transmitter Tag Life



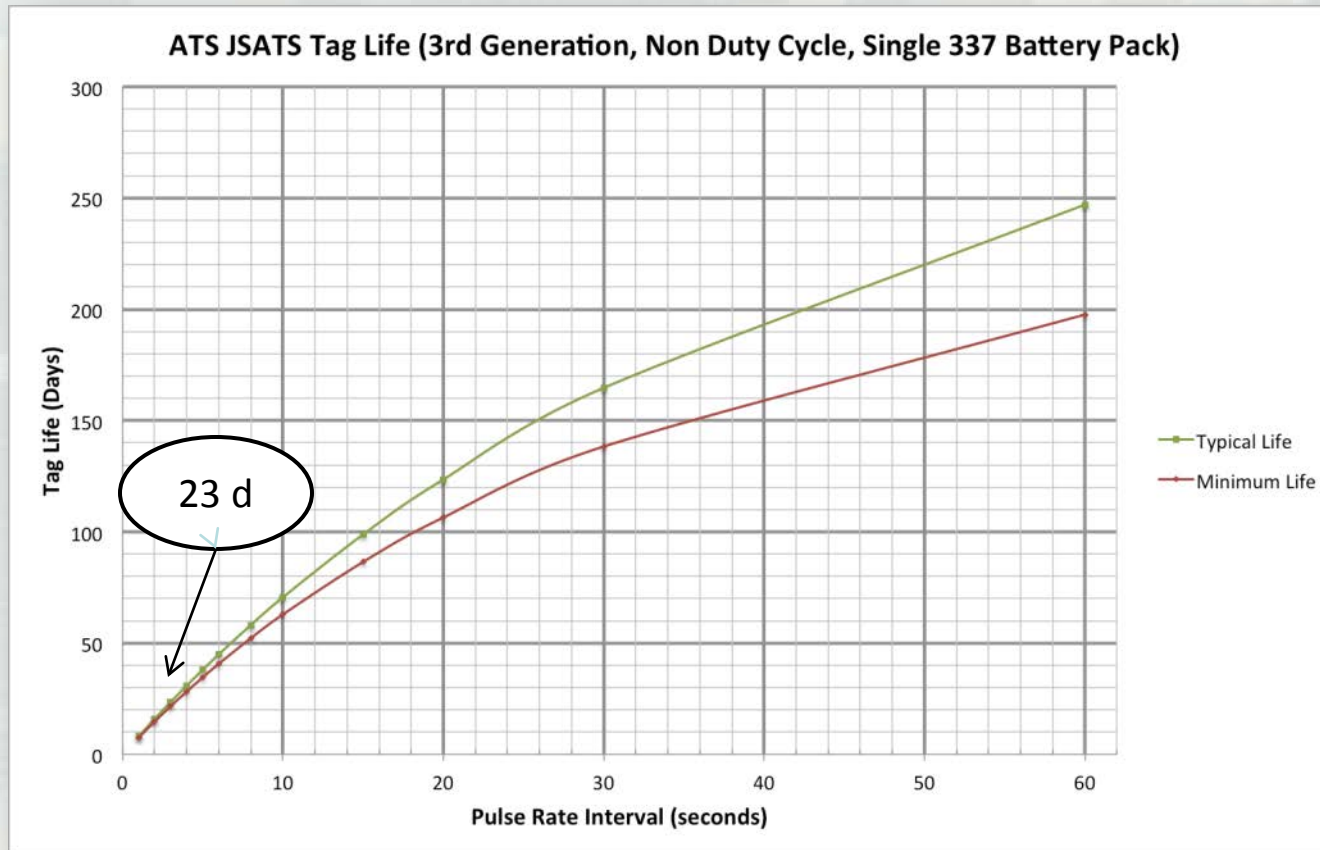
JSATS: Basic Specifications

- 2012 JSATS Transmitter
 - ▶ Mass: 0.30 g in air, 0.19 g in water
 - ▶ Dimensions: 10.8 x 5.2 x 3.4 mm
 - ▶ Source level: 156 dB re:1 μ Pa at 1m



JSATS: Basic Specifications

- 2012 JSATS Transmitter Tag Life





JSATS: Acoustic Telemetry Limitations

- Transmitter life
 - ▶ Not sufficient for estimating smolt-to-adult return rates
- Implantation
 - ▶ Surgical procedure required for implantation
- Signal Detection
 - ▶ Detection range is lessened or difficult (if not impossible) in high velocity, turbulent flows or noisy or extremely shallow environments
 - ▶ In salt water range is less than lower frequency systems
- Transmitter size
 - ▶ Currently too big for the smallest subyearlings (and fry) or juvenile lamprey
- Code Space
 - ▶ Limited number of unique codes



JSATS: Basic Specifications

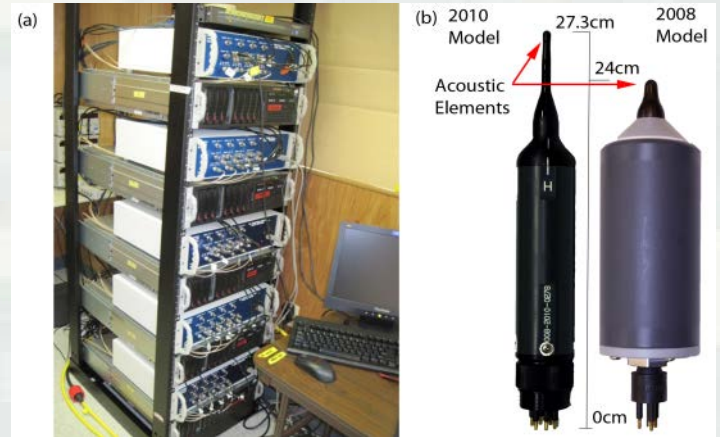
■ 2012 JSATS Receivers

▶ Cabled Receiver

- Detection range in fresh water = 75 – 250 m dependent on ambient noise

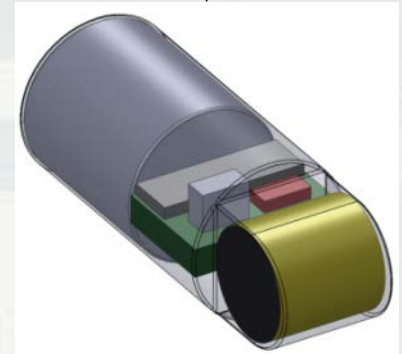
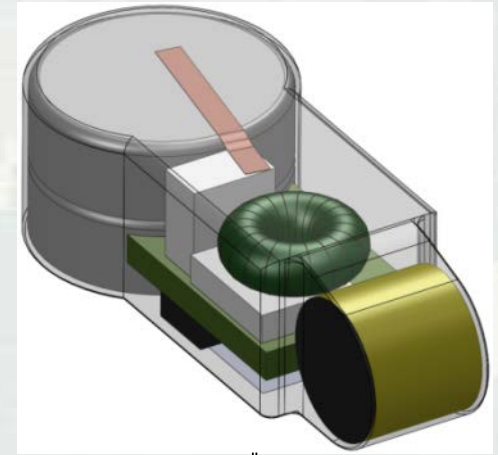
▶ Autonomous Receivers

- Detection range in freshwater = 150 – 300 m dependent on water velocity
- Detection range in saltwater approximately 50% of freshwater



JSATS: Transmitter Downsize Project

- Project Goals
 - ▶ Develop an injectable acoustic transmitter that meets the performance specifications of the current transmitter
 - 0.2 grams dry weight
 - 3.0 mm in diameter
 - 12-15 mm in length
 - Meet current transmitter tag life and source level requirements
 - ▶ First for salmon, then for juvenile lamprey



JSATS: Transmitter Downsize Project

- Project Team
- Project Elements
 - ▶ Acoustic Element (PZT)
 - ▶ Electronics (ASIC)
 - ▶ Battery
 - ▶ Packaging
 - ▶ Manufacturability
- Schedule
 - ▶ On track for completion in March, 2013
 - ▶ Goal is to implement in 2014 studies

