Proceedings of the Inter-Agency PIT Tag Detection Workshop

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Table of Contents

I. Introduction

II. Abstracts and Presentations (click title for link)

- ***Big Sheep Creek Bull Trout: An Application of PIT Tag Technology in a Remote Low-flow Environment - J.M. Hudson and J.R. Cook.....4***

- ***Walla Walla Basin Bull Trout: Basin-wide PIT Interrogation for a Variable Fluvial Environment - M. Barrows, D. Gallion, C. Newlon, and R. Koch.....40***

- ***Evaluate Bull Trout Migration Between The Tucannon River And The Mainstem Snake River Using Streamwidth Passive Integrated Transponder Tag Interrogation Systems - C.B. Bretz and S. Anglea.....76***

- ***Duplexing Our Way Through PIT Tag Technology: Success, Failures and Frustrations of Using Full- and Half-duplex PIT Tags to Track Salmonid Movements in Three Oregon Watersheds - S. Starcevich and S. Jacobs 109***

- ***Guide to Half-duplex RFID: Lessons Learned Tracking Bull Trout in the Upper Willamette Basin, since 2001- – V. Tranquilli.....143***

- ***Springers, Fallers, and Collisioners: Full Duplex PIT Technology for a Hatchery Release Strategy Evaluation – J. Hogle 189***

- ***Trial and Error: Deployment Methods for Instream PIT-Tag Interrogation Systems– K. Martens, N. Zorich and I. Jezorek..... 224***

- ***Evaluating Distribution, Survival, Growth, and Movement of Coastal Cutthroat Trout at Watershed Scales Using Half-duplex Passive Integrated Transponder Tags - D.S. Bateman and D.W. Leer.....245***

- ***PIT Tag Interrogation in a Tributary of the Lower Columbia River and Diversion Canals of the Umatilla River – J. Gasvoda.....297***

- ***Lower Columbia River Channel Improvement: Assessment of Salmonid Populations and Habitat on Tenasillahe and Welch Islands - J.R. Johnson, J. Poirier, J.R. Horal, and R. Sollee.....340***

- ***Feasibility of Full-duplex PIT Detection for Monitoring Sub-yearling Salmon in Brackish Estuarine Marsh Channels - D. Hering, K. Jones, D. Bottom, and E. Prentice..... 358***

- ***PIT Tag Array Analysis on the upper Shasta River: A Pilot Study – N. Selvage and K. Mauro 389***

III. Contact List ***413***

I. Introduction

The goal of this workshop is to provide a forum for information sharing on non-mainstem Columbia River basin PIT tag detection approaches in tributaries, estuaries and hatchery facilities. Multiple entities across the region are using this technology through various approaches. This workshop will serve to raise the regional awareness of different approaches being taken and develop a network of contacts that can serve as future resources. Information will be presented from multiple agencies across a diverse geographical area, and will address the following questions:

- Type of tag? (size of tag, half-duplex v. full-duplex)
- Physical parameters of habitat/site?
- Accessibility?
- Design and construction?
- Installation?
- Maintenance?
- Power source?
- Problems and solutions?

We expect that the majority of the audience will be somewhat familiar with how the technology works. We hope that the information shared will provide insight into how others have gotten the technology to work under various circumstances. Presenters will be allowed 25 minutes (15-20 minutes to talk and 5-10 minutes for discussion).

The purpose of these proceedings is to provide summary information to interested parties on presentations made at the workshop, and, ultimately, provide an information resource for utilizing this technology in fish research, monitoring and evaluation applications. These proceedings represent a wealth of information on how this technology has been applied in the Pacific Northwest through 2006. But, it by no means represents all of the capabilities of this technology or those who apply it, which are both expanding continuously. The end of the proceedings includes a contact list of presenters and attendees. If you are currently using this technology or considering its use in the future and would like more detailed information on something you see in a presentation, would like feedback on a design idea, or seek solutions to a challenging application, please contact the presenting author. If you have problems contacting anyone through the information on the contact list, please contact Michael Hudson (michael_hudson@fws.gov).

Return to top

II. Abstracts and Presentations

Big Sheep Creek Bull Trout: An Application of PIT Tag Technology in a Remote Low-flow Environment

J.M. Hudson and J.R. Cook

The US Fish and Wildlife Service-Columbia River Fisheries Program Office-Native Trout Program began investigations on potentially isolated resident populations of bull trout in the Imnaha River subbasin in 2005. Populations of bull trout in the headwaters of Big Sheep Creek and its tributaries, such as Little Sheep Creek and McCully Creek, were potentially isolated by the construction of the Wallowa Valley Irrigation Canal (WVIC) and its diversions over 100 years ago. Full-duplex PIT tag technology was utilized to address one of the objectives of these investigations, to determine connectivity among populations.

PIT tag antenna arrays were installed at three diversion structures along the WVIC beginning in 2006 and bull trout were tagged to assess passage. A series of antennas (array) was installed at the Big Sheep Creek diversion which is the beginning of the canal. A second array was installed 5.9 km below Big Sheep Creek on the WVIC at the Salt Creek Summit spillway. A final antenna was installed 21.4 km below Big Sheep Creek on the WVIC at the intersection with McCully Creek.

There were four antennas at Big Sheep Creek, six antennas at Salt Creek Summit and one antenna at McCully Creek. All antennas were constructed in a rigid PVC design. Arrays at Big Sheep Creek and Salt Creek Summit were suspended above the water flowing over the structures to detect fish passing by. The antenna at McCully Creek was attached to the diversion structure to detect fish passing through. Destron-Fearing FS1001M's were used at Big Sheep Creek and Salt Creek Summit. An FS1001A was used at McCully Creek. The Big Sheep Creek and Salt Creek Summit Arrays were powered by 220W thermoelectric generators fueled by propane, while the McCully Creek antenna was powered off the grid. All sites used PDAs to log and store detections.

Each site presented its own set of challenges.

Return to top

Big Sheep Creek Bull Trout:
An Application of PIT Tag Technology in a Remote Low-Flow Environment

Inter-Agency PIT Tag Detection Workshop

Native Trout Program

USFWS – Columbia River Fisheries Program Office

Objectives

- Determine connectivity among populations
- Determine genetic structure within and among populations
- Estimate abundance of isolated populations
- Determine effective population size of isolated populations and define N_e/N ratio

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- Determine connectivity among populations
- Determine genetic structure within and among populations
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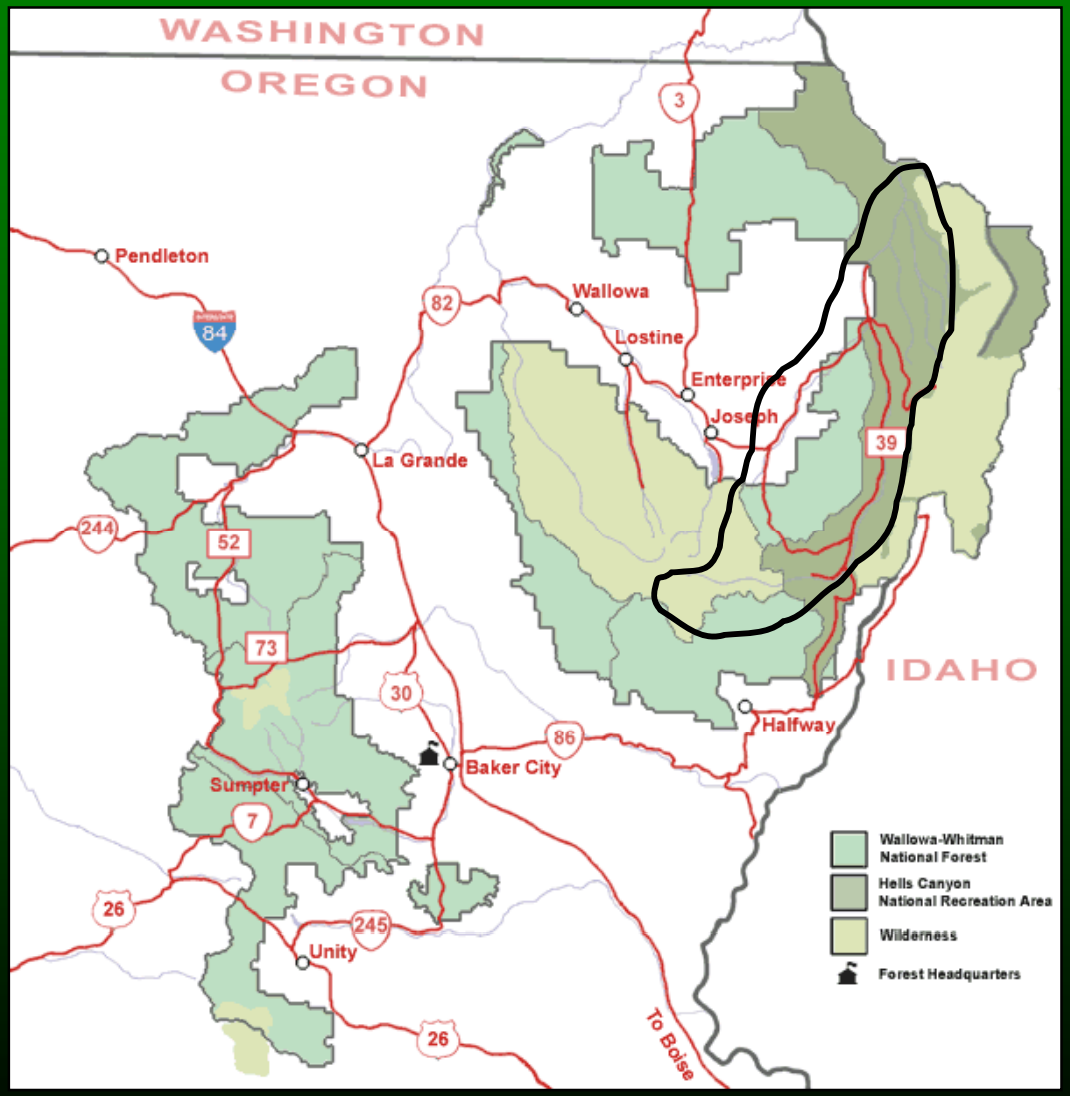
- Determine effective population size of isolated populations and define N_e/N ratio

Background

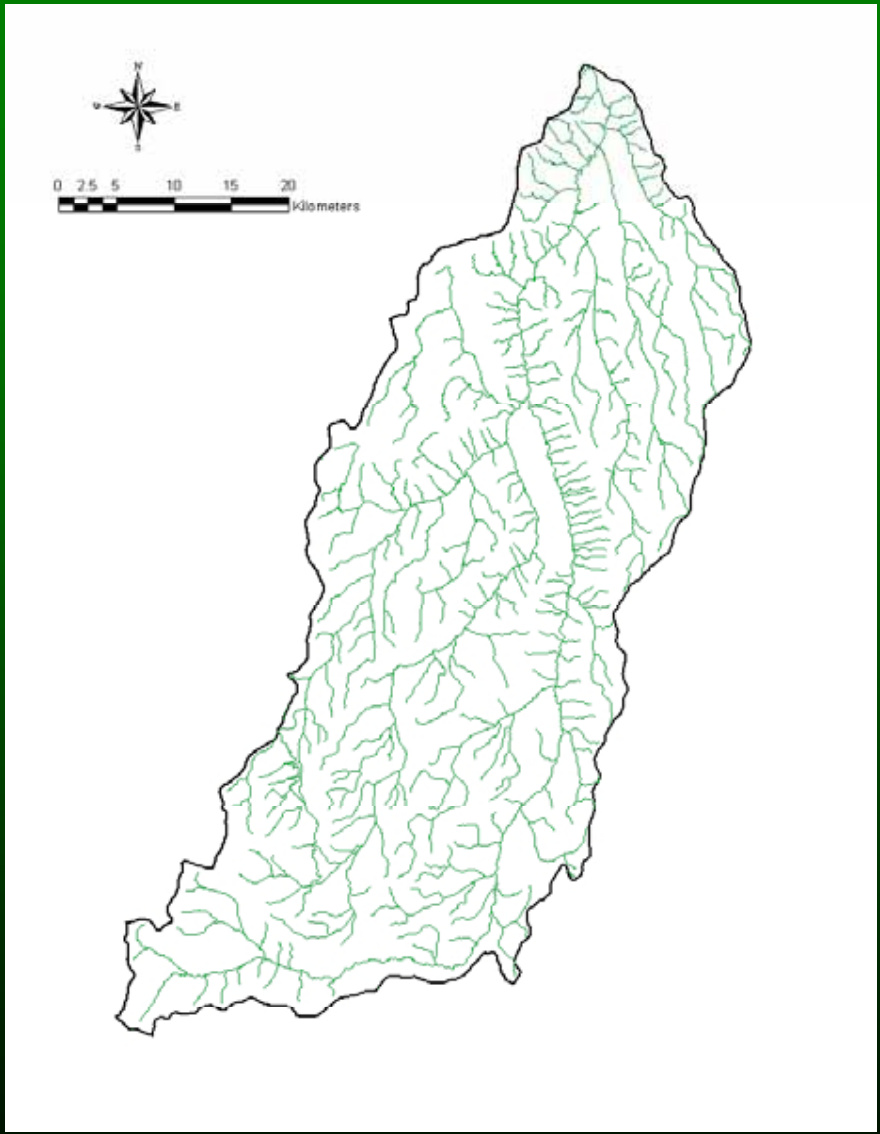
- Imnaha River Subbasin – Wallowa Valley Improvement Canal (WVIC)

Imnaha River Subbasin

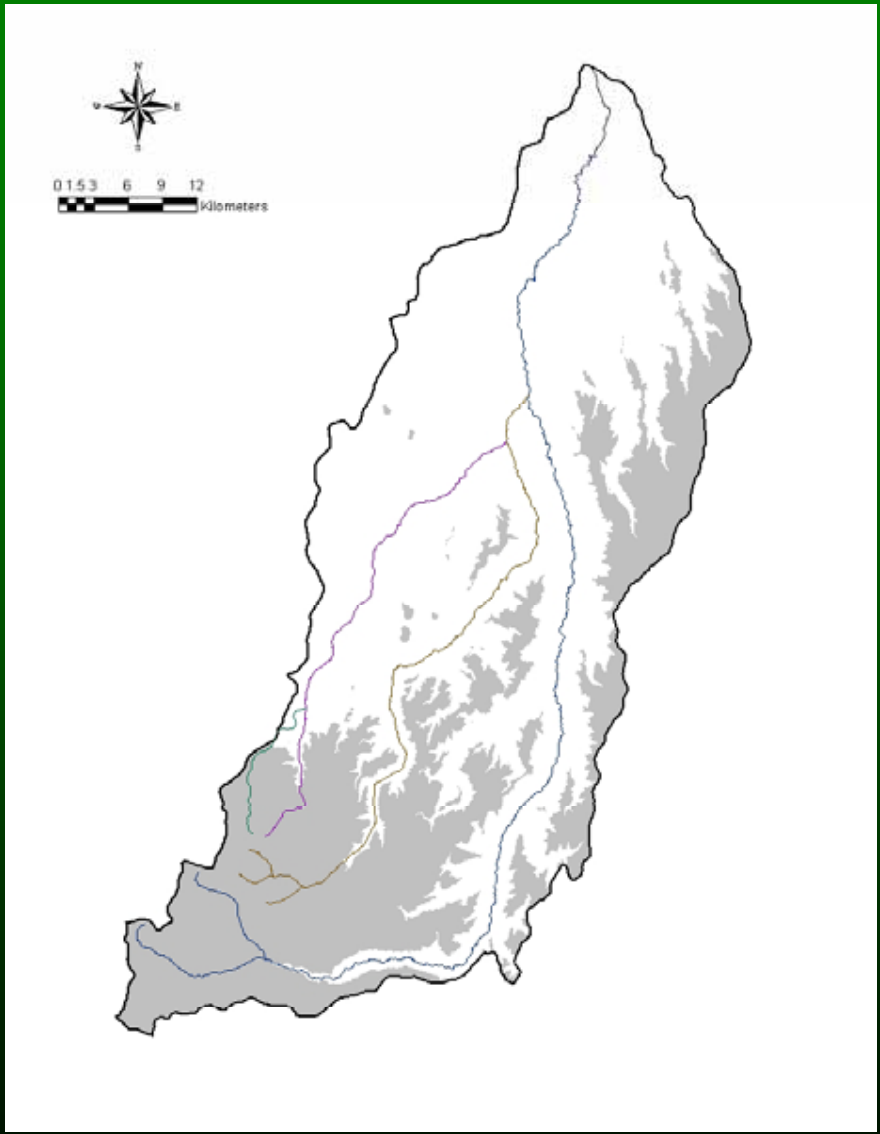
Imnaha River Subbasin



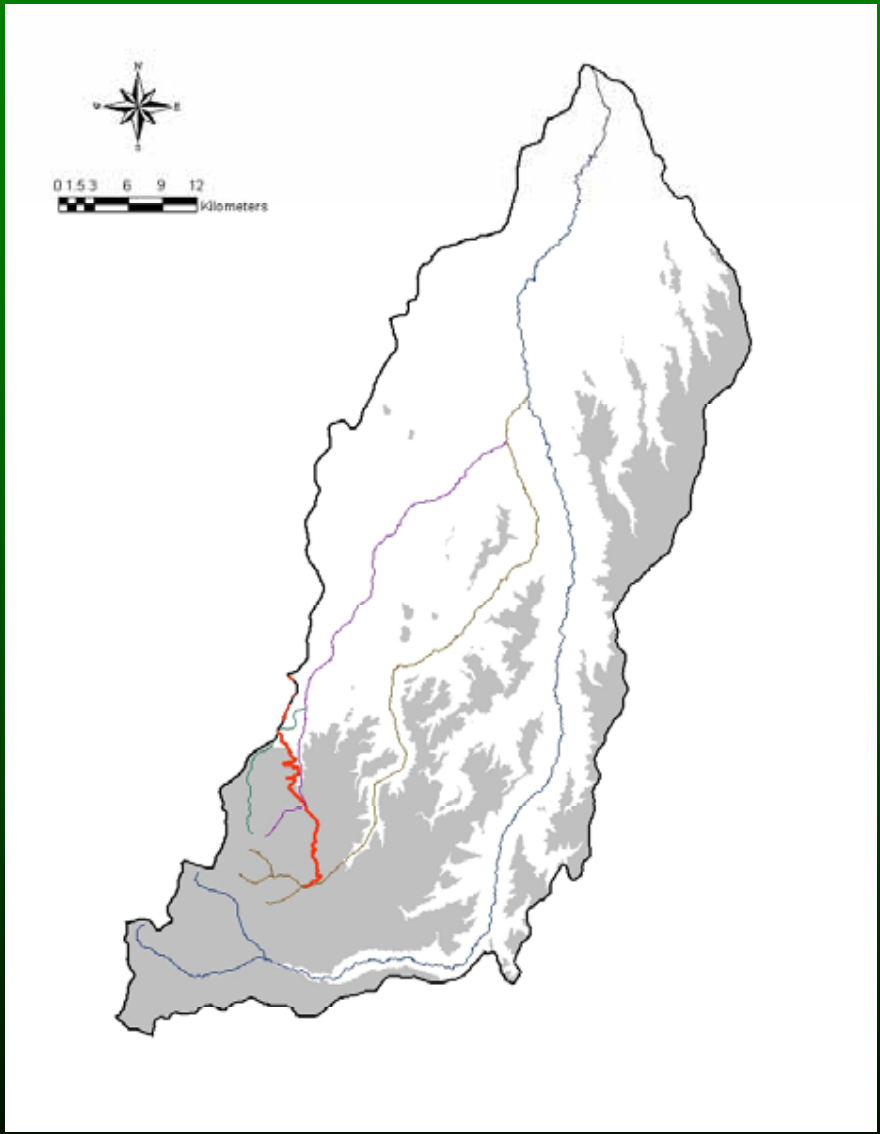
Imnaha River Subbasin



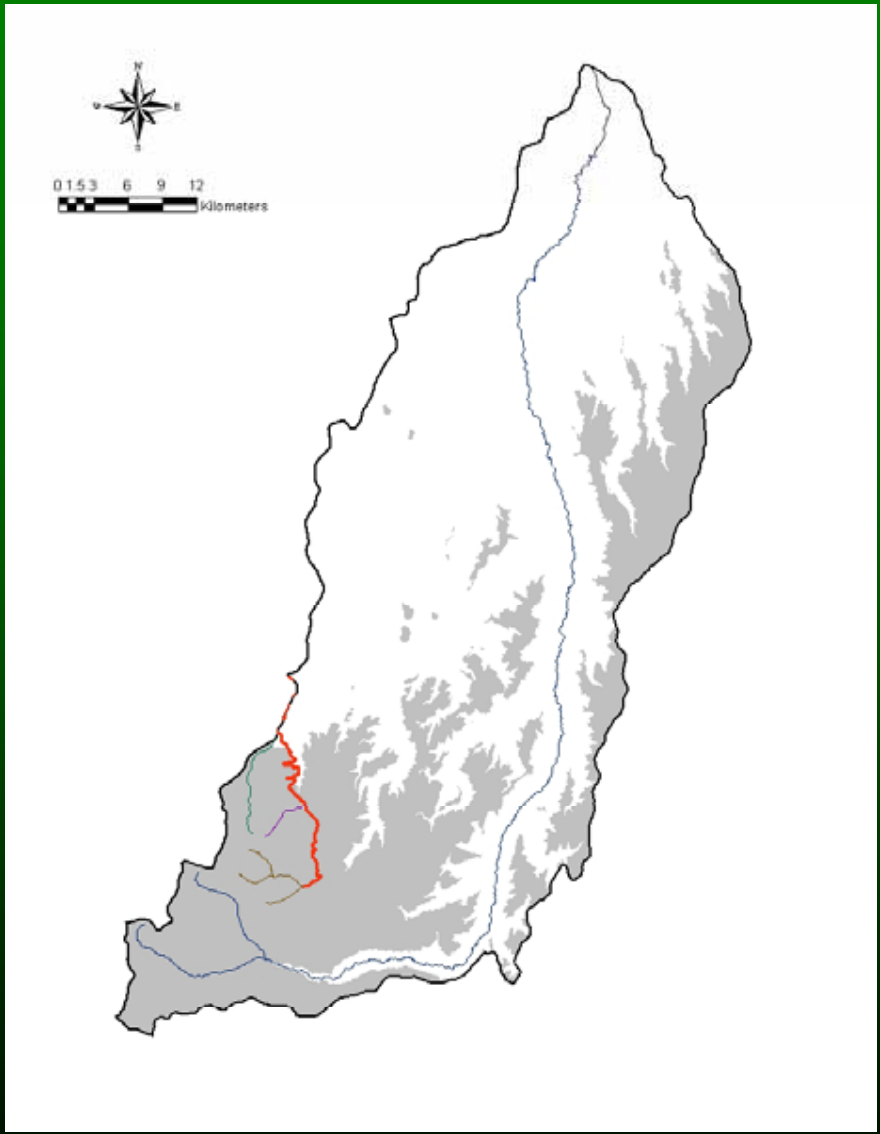
Imnaha River Subbasin



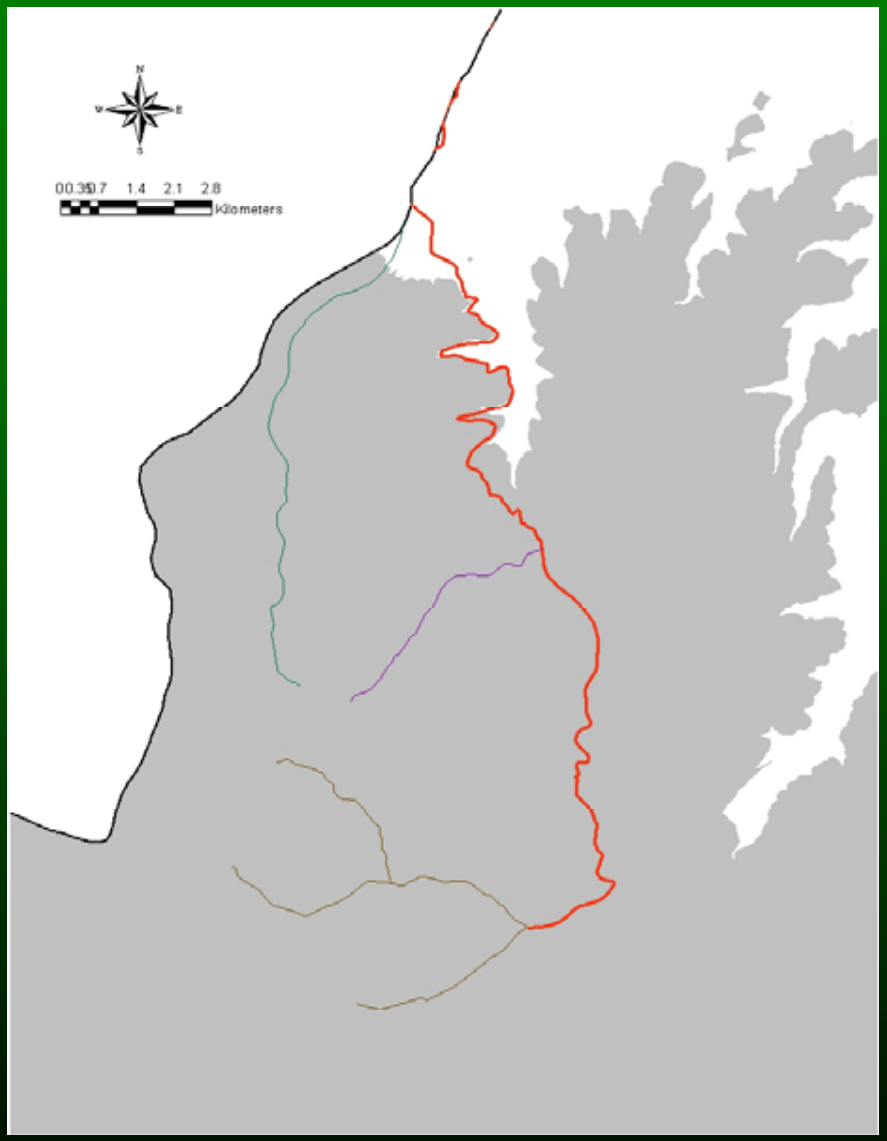
Imnaha River Subbasin



Imnaha River Subbasin



Imnaha River Subbasin

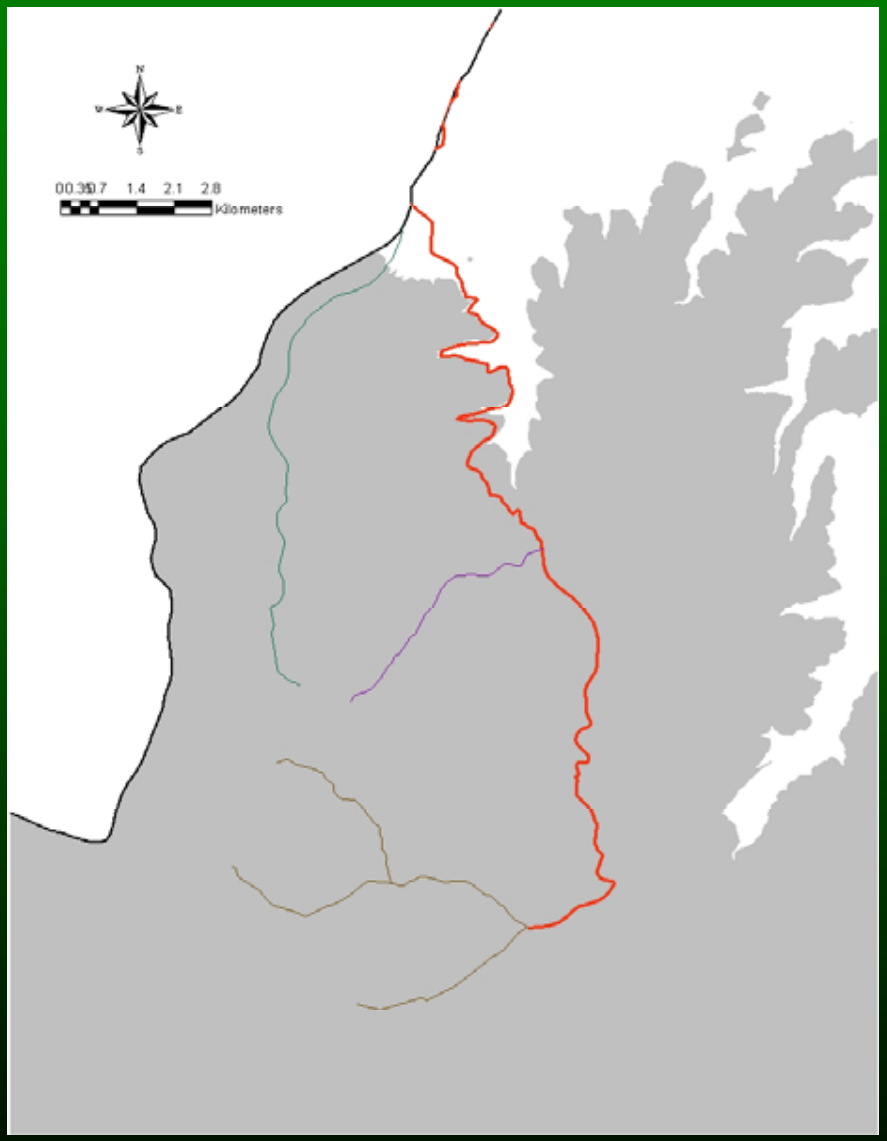


Imnaha River Subbasin – BSC

Imnaha River Subbasin – BSC

Imnaha River Subbasin – BSC

Imnaha River Subbasin – WVIC



Imnaha River Subbasin – MC

Approach

- Connectivity
  - Use of PIT tag technology at points of suspected isolation to confirm lack of connectivity
  - 23 mm tags – full duplex

Physical Parameters of Sites

McCully Creek

McCully Creek

Problems

Big Sheep Creek and Salt Creek Summit

~42 ft wide

~25 ft wide

Design and Construction

Installation

I 275584

Installation

Installation

Power Source

Power Source

Accessibility

- Salt Creek Summit – County road/paved Forest Service road open all year to site
- Big Sheep Creek – graded Forest Service road not passable approximately 6 months of the year

Maintenance

- Currently requires refueling once a month

Maintenance

Maintenance

Problems

- Failure of Cable Supports
  - Do not use coated cable rope
- Physical Integrity Failure of Entire Array
  - Design to support additional weight
  - Alternative design that can be mounted to structure surface below water level
- Accessibility – Big Sheep Creek
  - Larger propane tanks
  - ATV access

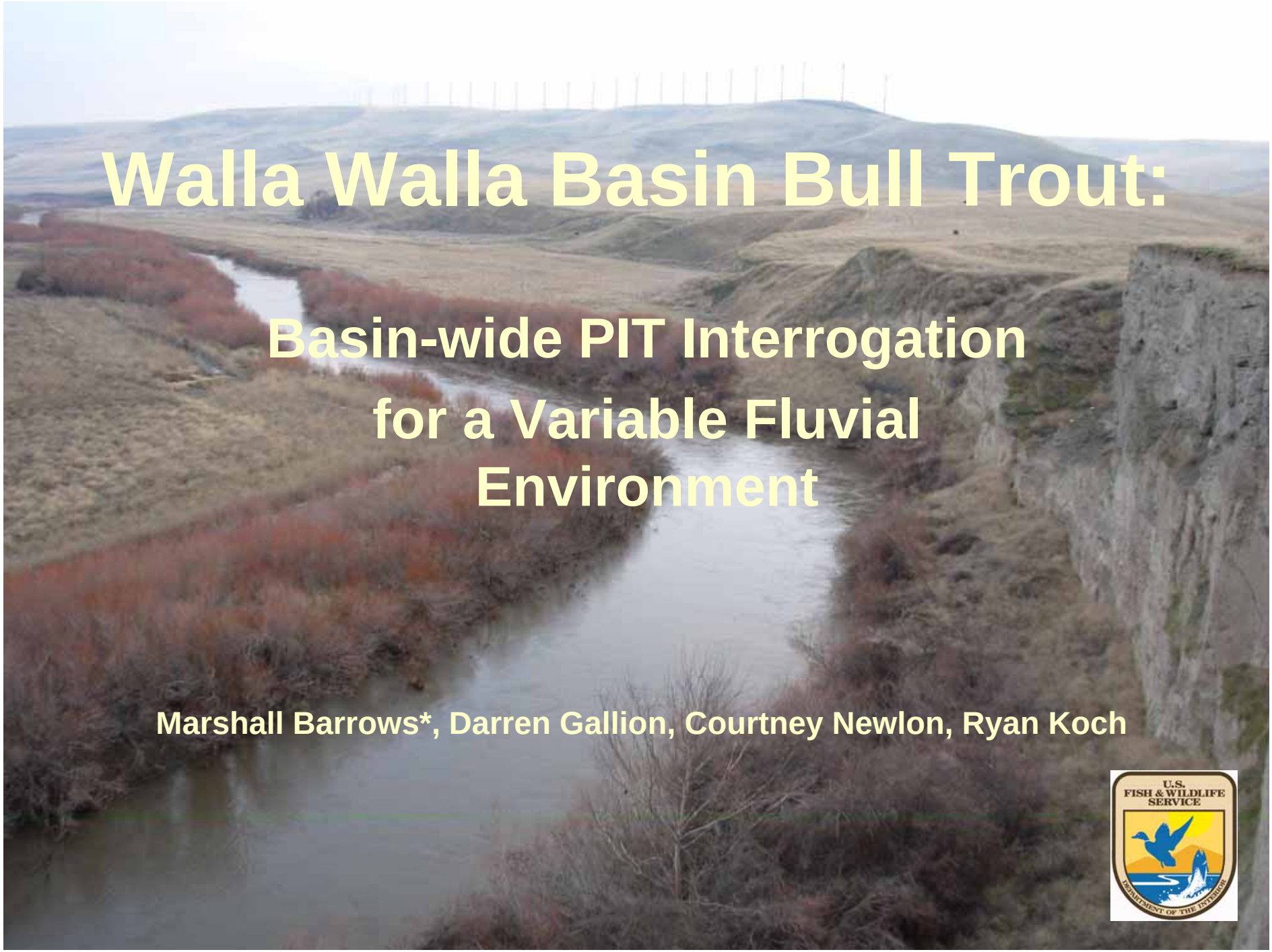
EAGLE
CAP
WILDERNESS
WALLOWA-WHITMAN
National Forest
National Forest
WILDERNESS

Walla Walla Basin Bull Trout:
Basin-wide PIT Interrogation for a Variable Fluvial Environment

M. Barrows, D. Gallion, C. Newlon, and R. Koch

For over 100 years, a portion of the Walla Walla River near Milton-Freewater, OR had been completely or nearly dewatered for primarily agricultural purposes. After bull trout were listed as threatened under the Endangered Species Act in 1998, a settlement agreement between the US Fish and Wildlife Service and irrigation districts in the area resulted in minimal, year round surface flow through the previously dewatered portion of the Walla Walla River. By utilizing PIT tag technology, innovative PIT antenna designs and unique methodology, we are able to maintain eight strategically located PIT interrogation sites consisting of 31 separate antennas to monitor bull trout movement into and out of headwater spawning areas, subadult downstream dispersal, connectivity between populations and the use of the Mainstem Columbia River by fluvial individuals.

Return to top



Walla Walla Basin Bull Trout:

Basin-wide PIT Interrogation for a Variable Fluvial Environment

Marshall Barrows*, Darren Gallion, Courtney Newlon, Ryan Koch

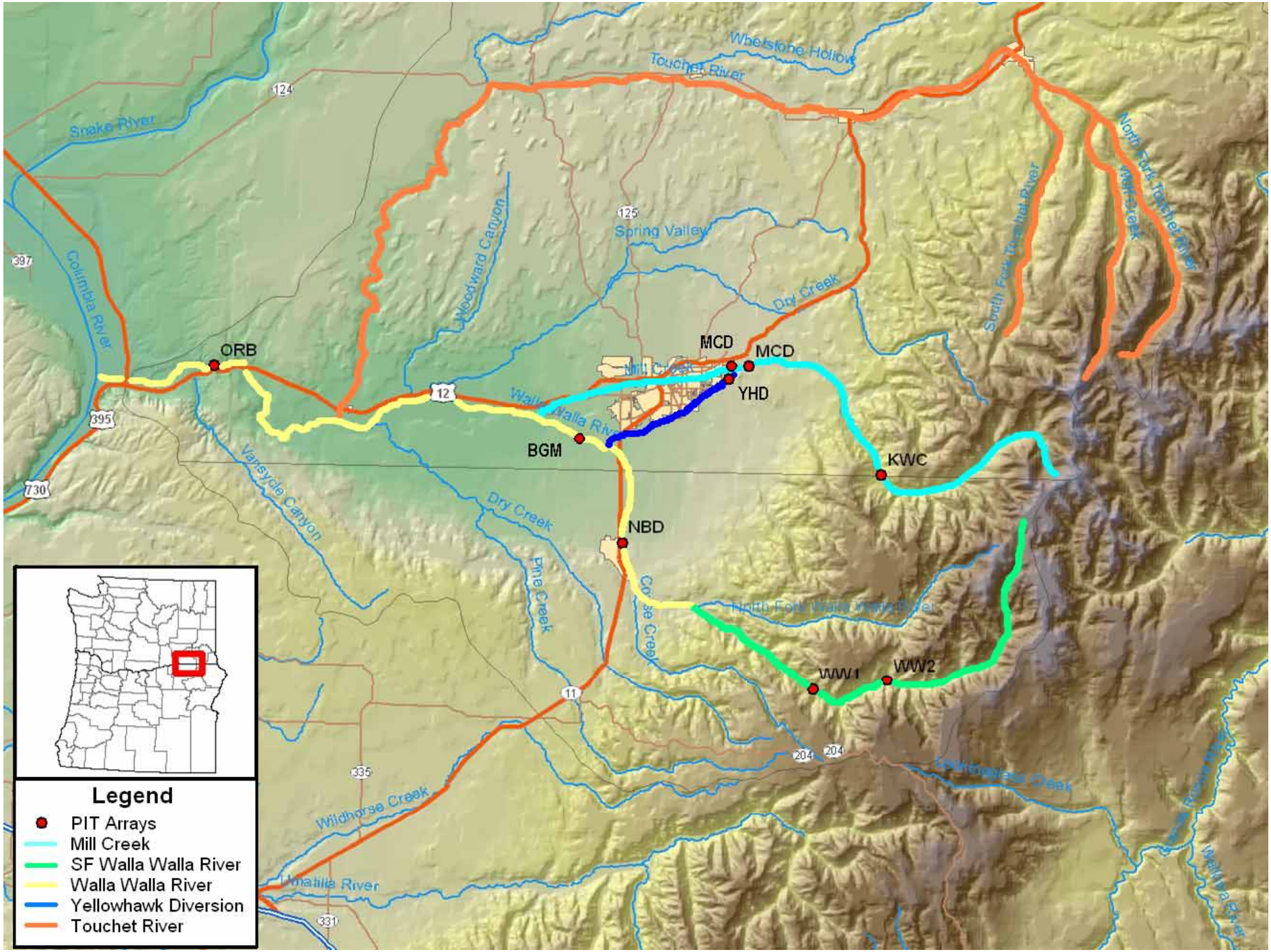
Background

- Seasonally dewatered for ~ 100 years
- Bull trout listed under ESA in 1998
- Settlement Agreement
- Bull Trout Recovery Plan

RECOVERY GOAL AND OBJECTIVES

- **The goal of the bull trout recovery plan is to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted.**

- To achieve this goal the following objectives have been identified:
  - Maintain the current distribution of bull trout within the core areas and reestablish bull trout in previously occupied habitats.
  - Maintain stable or increasing trends in abundance of bull trout
  - Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.
  - Conserve genetically diverse bull trout populations


Legend
PIT Arrays
Mill Creek
SF Walla Walla River
Walla Walla River
Yellowhawk Diversion
Touchet River
ORB
MCD
MCD
YHD
BGM
KWC
NBD
WW1
WW2
Snake River
Columbia River
Touchet River
Whetstone Hollow
Spring Valley
Woodward Canyon
Dry Creek
South Fork Touchet River
North Fork Touchet River
Vansycle Canyon
Pine Creek
Coose Creek
North Fork Walla Walla River
Wildhorse Creek
Umatilla River
Tucannon River
Walla Walla River
124
125
397
395
730
12
11
335
331
204

PIT Tags Deployed in the Walla Walla Basin

Agencies Deploying PIT Tags

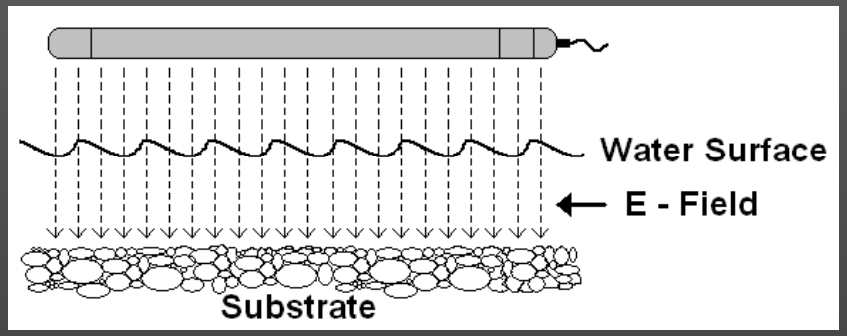
- US Fish and Wildlife Service
- US Forest Service
- Utah State University
- Confederated Tribes of the Umatilla Indian Reservation

PIT Tags Being Deployed

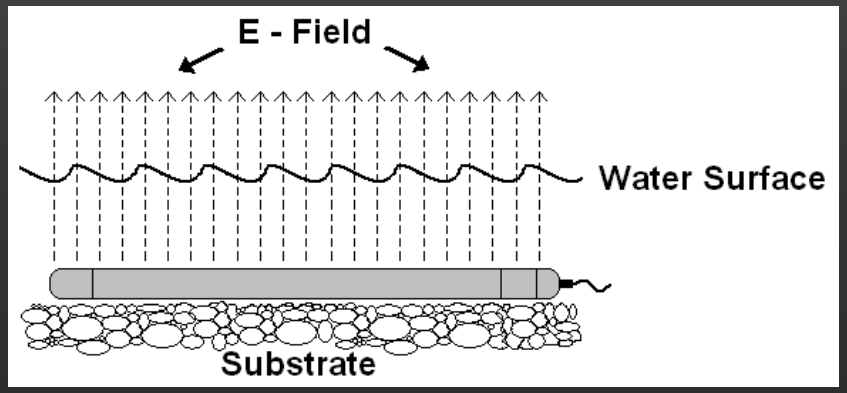
- 23 mm ST (Bull trout)
- SGL (Bull trout)
- 12 mm SST (Bull trout)
- 12 mm ST (Bull trout, Chinook, Steelhead)

PIT Antenna Designs

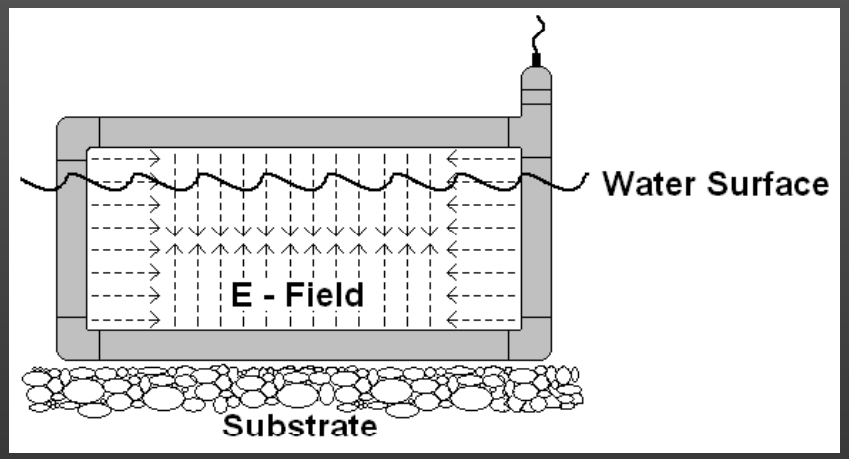
Suspended Flat Plate Antenna



Conventional Flat Plate Antenna

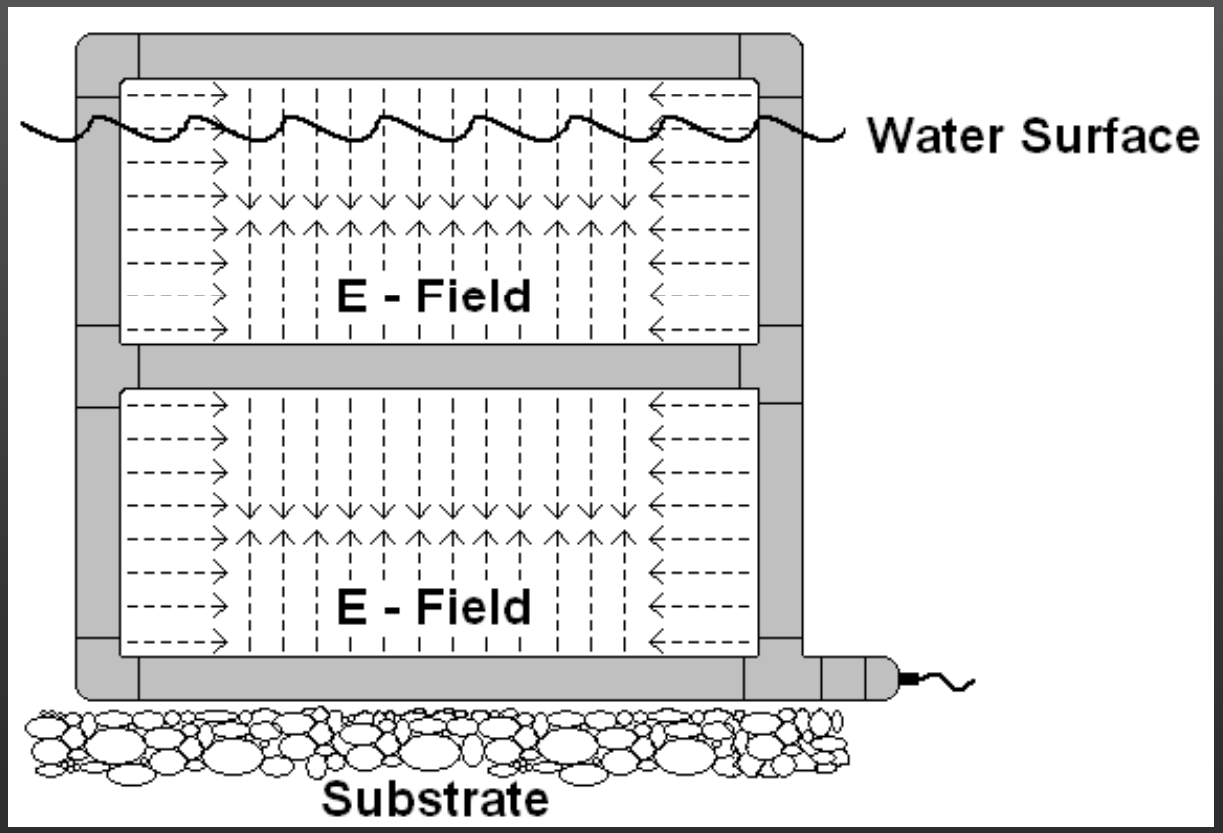


Conventional Pass Through Antenna (Front View)

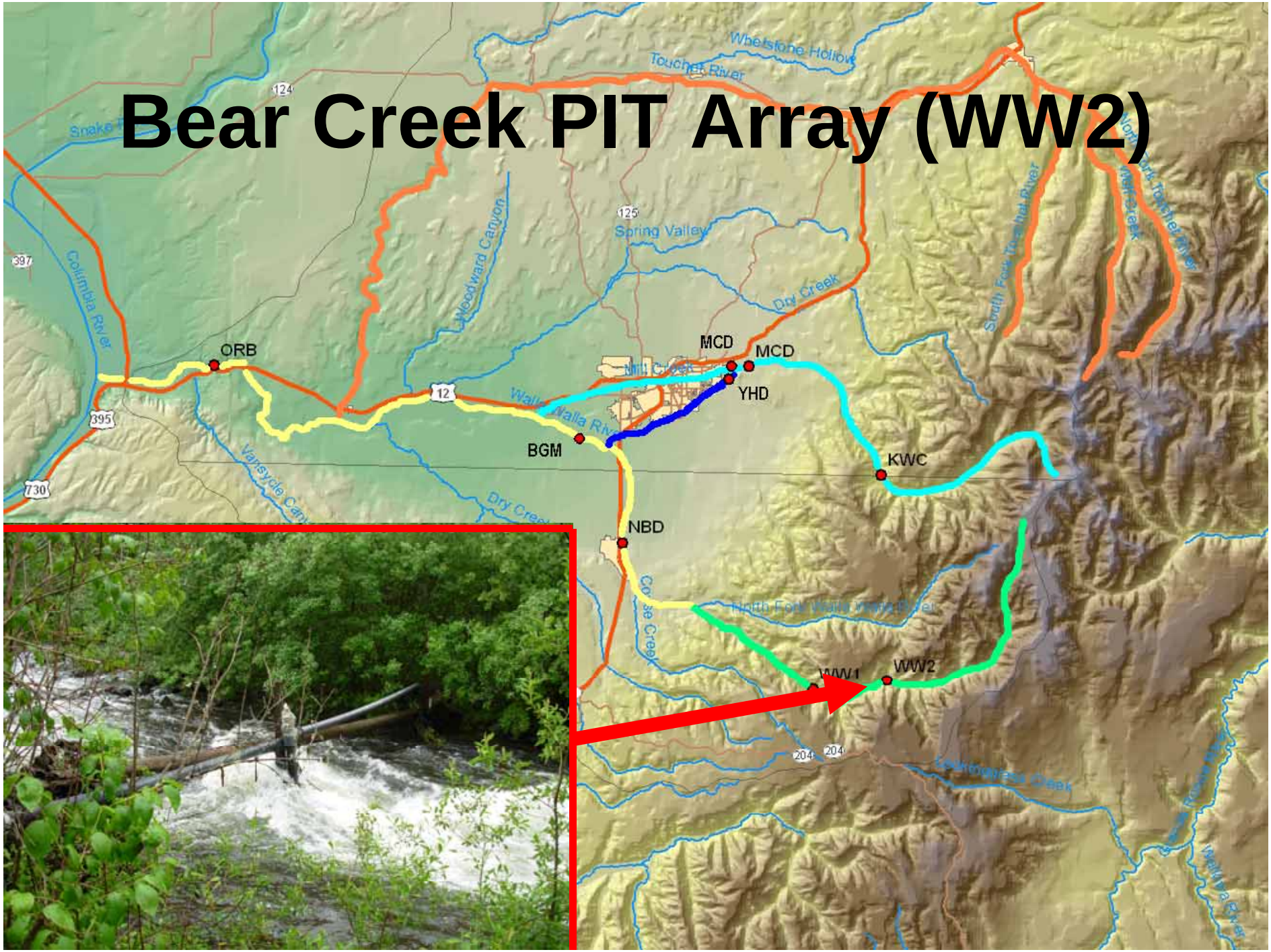


PIT Antenna Designs

Dual Loop Pass Through Antenna



Bear Creek PIT Array (WW2)

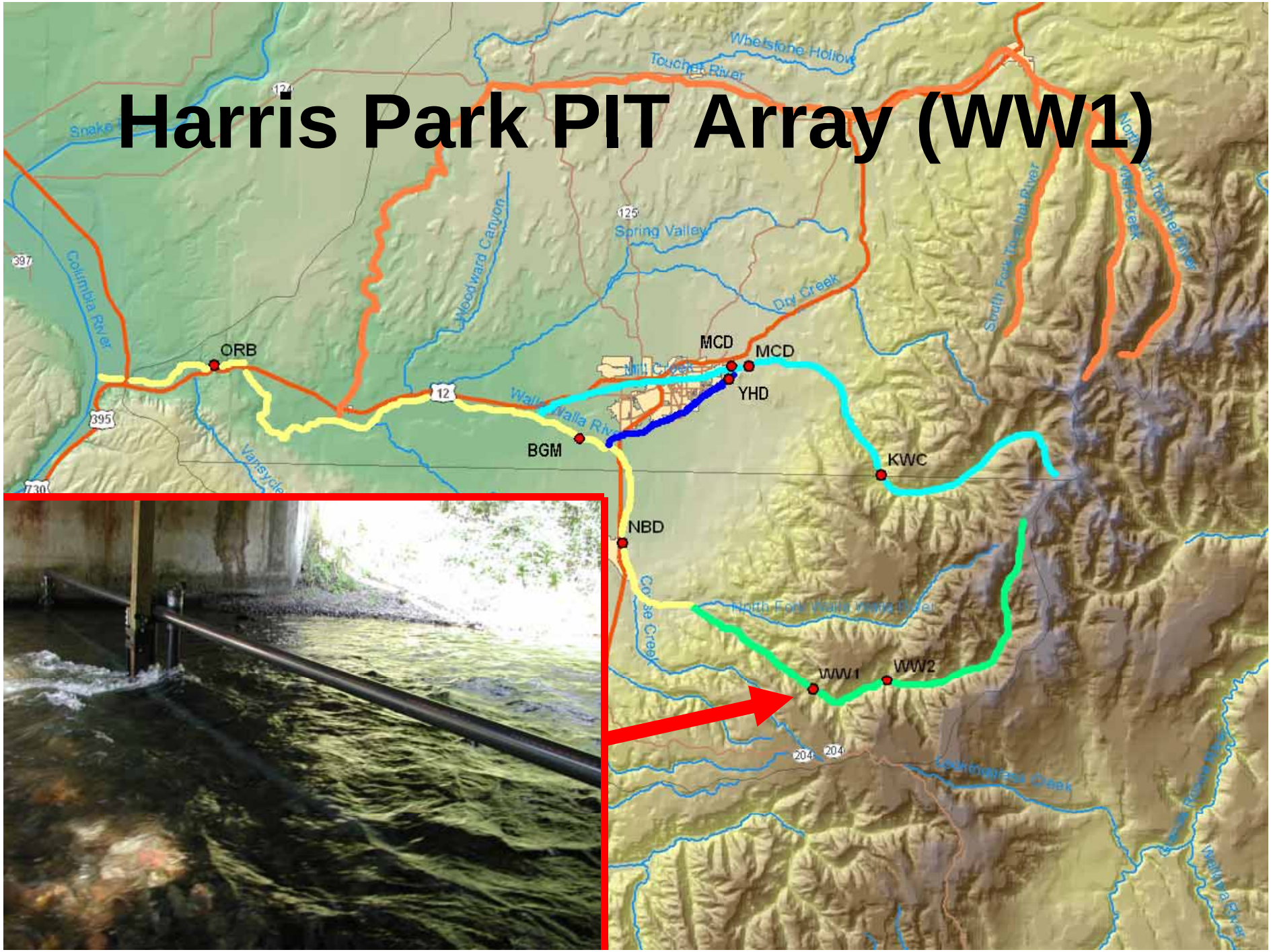


Bear Creek PIT Array (WW2)

Established 2002

- Design: 15’ x 4’ Pass Through (2)
- Transceiver: 1001M
- Construction: 4” PVC
- Communication: Satellite
- Power: Thermoelectric Generator and Solar Panels
- Accessibility: Trail

Harris Park PIT Array (WW1)



Harris Park PIT Array (WW1)

Established 2003

Design: 19’ x 3.5’ Pass Through (2) and 11’ x 2’ Flat Plates (3)

Transceiver: 1001M

Construction: 4” PVC

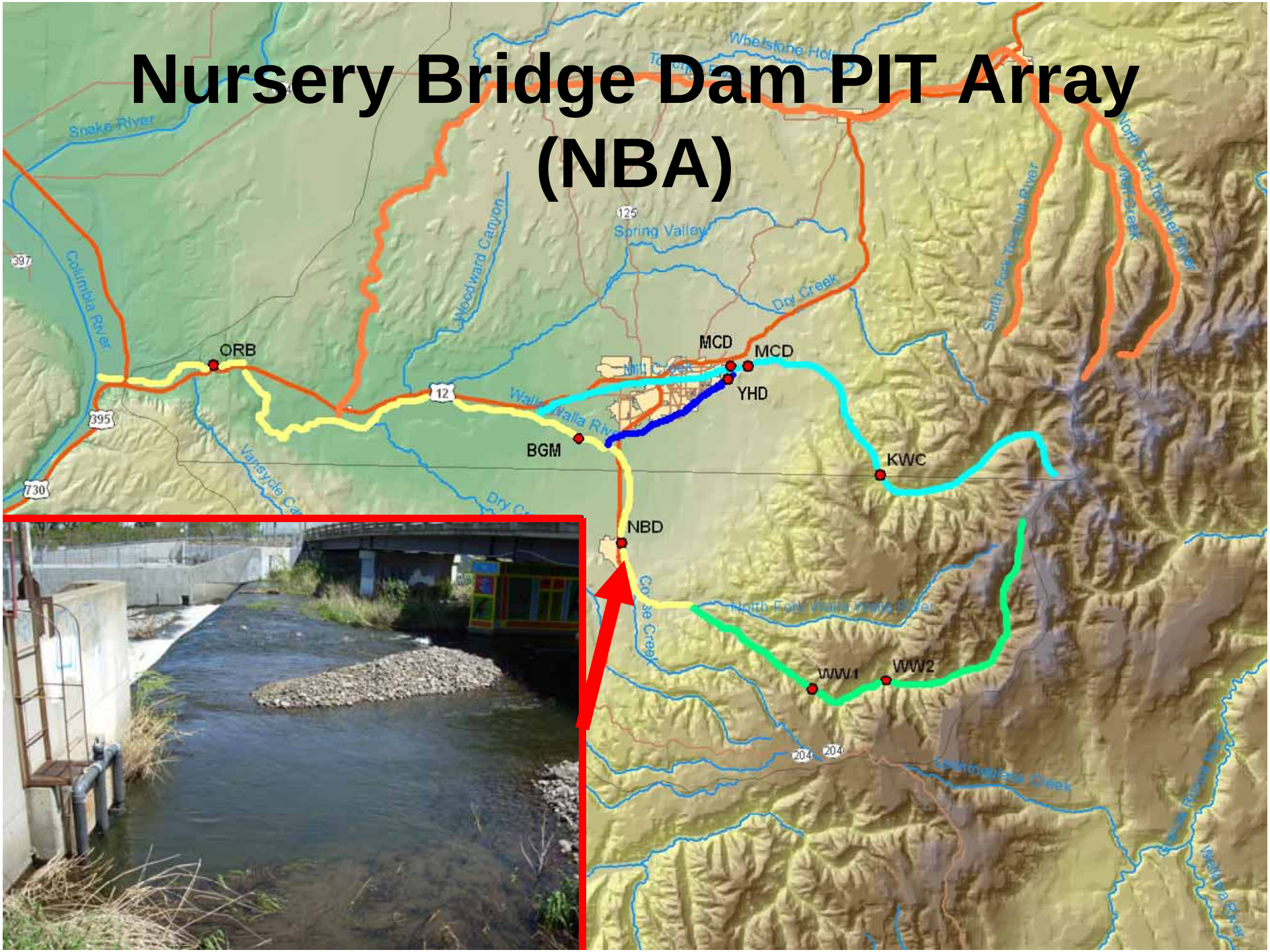
Communication: Dial up

Power: AC

Accessibility: Vehicle

Harris Park PIT Array (WW1)

Nursery Bridge Dam PIT Array (NBA)



Nursery Bridge Dam PIT Array (NBA)

Established 2003

East Ladder Antenna

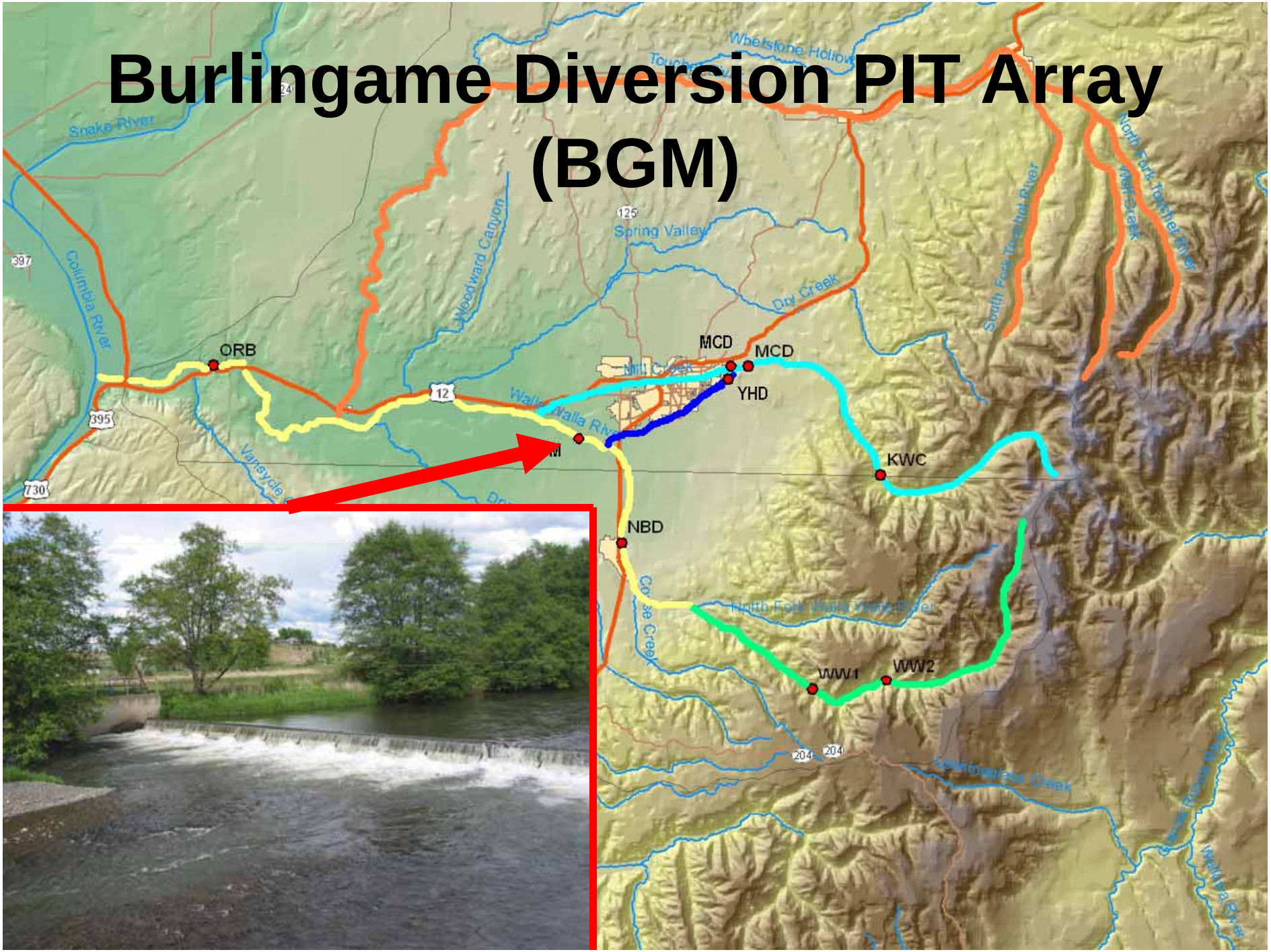
- Design: Pass Through 6.5’ x 2’ (2) and 5.5’ x 3’ (1)
- Transceiver: 1001A (3)
- Construction: 4” PVC
- Communication: Dial up
- Power: AC
- Accessibility: Vehicle

Nursery Bridge Dam PIT Array (NBA)

West Ladder Antenna
Dual Loop (5.5’ x 5’)

West Ladder Antenna
Pass Through (3’ x 5’)

Burlingame Diversion PIT Array (BGM)



Burlingame Diversion PIT Array (BGM)

Established 2007

Ladder Antennas (3’ x 8’)

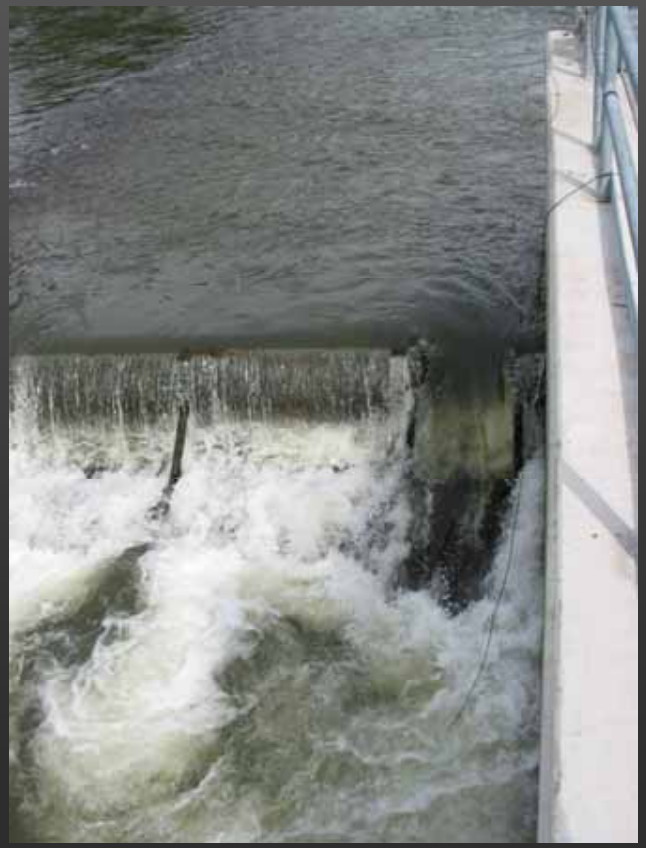
- Design: Pass Through (4) and a Suspended Flat Plate
- Transceiver: 1001M
- Construction: 4” PVC (4) and 2” PVC (1)

- Communication: NA
- Power: AC
- Accessibility: Vehicle

Canal Antennas (5’ x 12’)

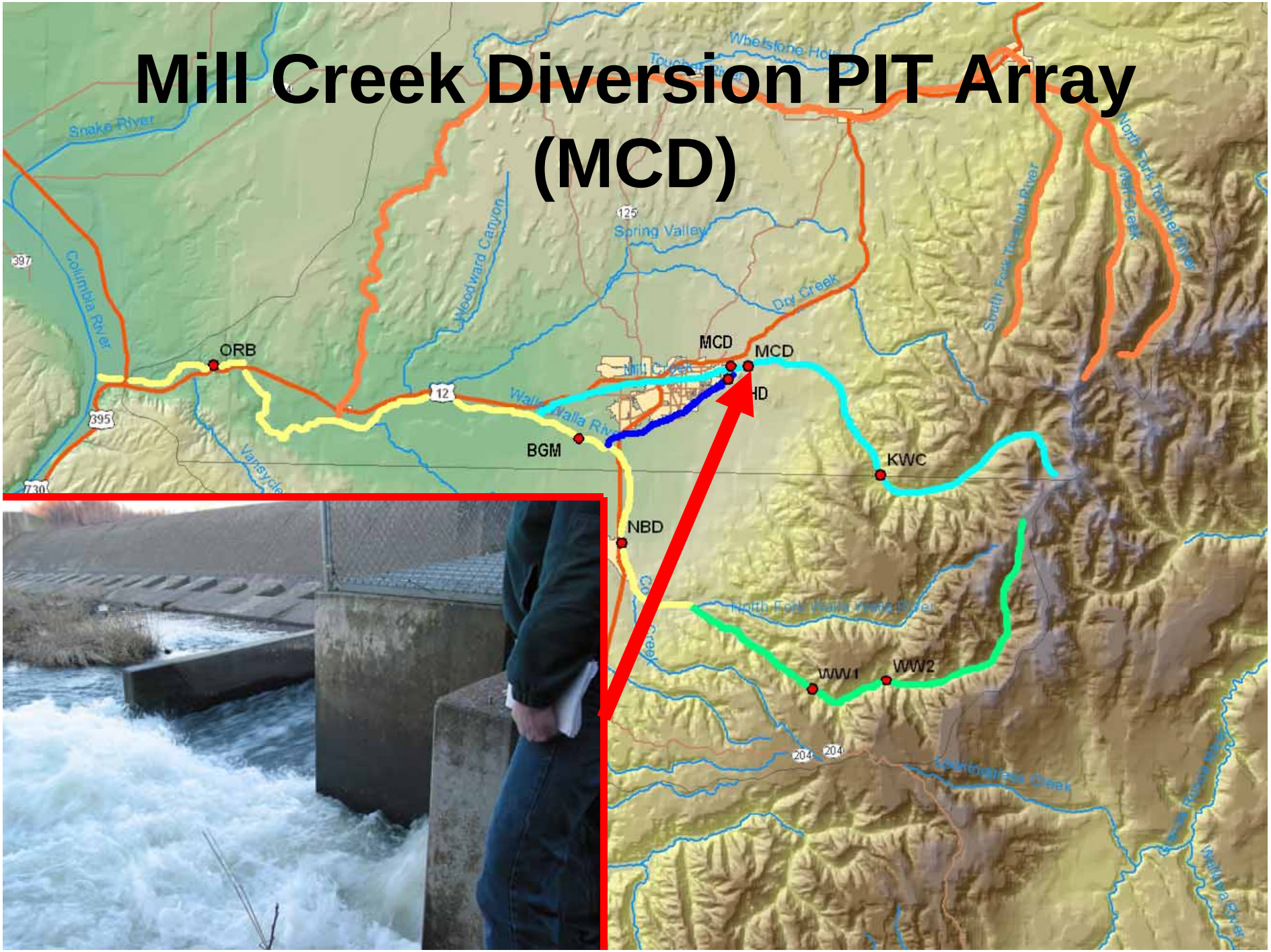
Burlingame Diversion PIT Array (BGM)

Fish Passage Slot



Suspended Flat Plate Slot Antenna (2’ x 2’)

Mill Creek Diversion PIT Array (MCD)



Mill Creek Diversion PIT Array (MCD)

Established 2005

- Design: Pass Through 7’ x 2’ (2) and Suspended Flat Plate (1)
- Transceiver: 1001M
- Construction: 4” PVC (2) and 2” PVC (1)
- Communication: Dial up
- Power: AC
- Accessibility: Vehicle

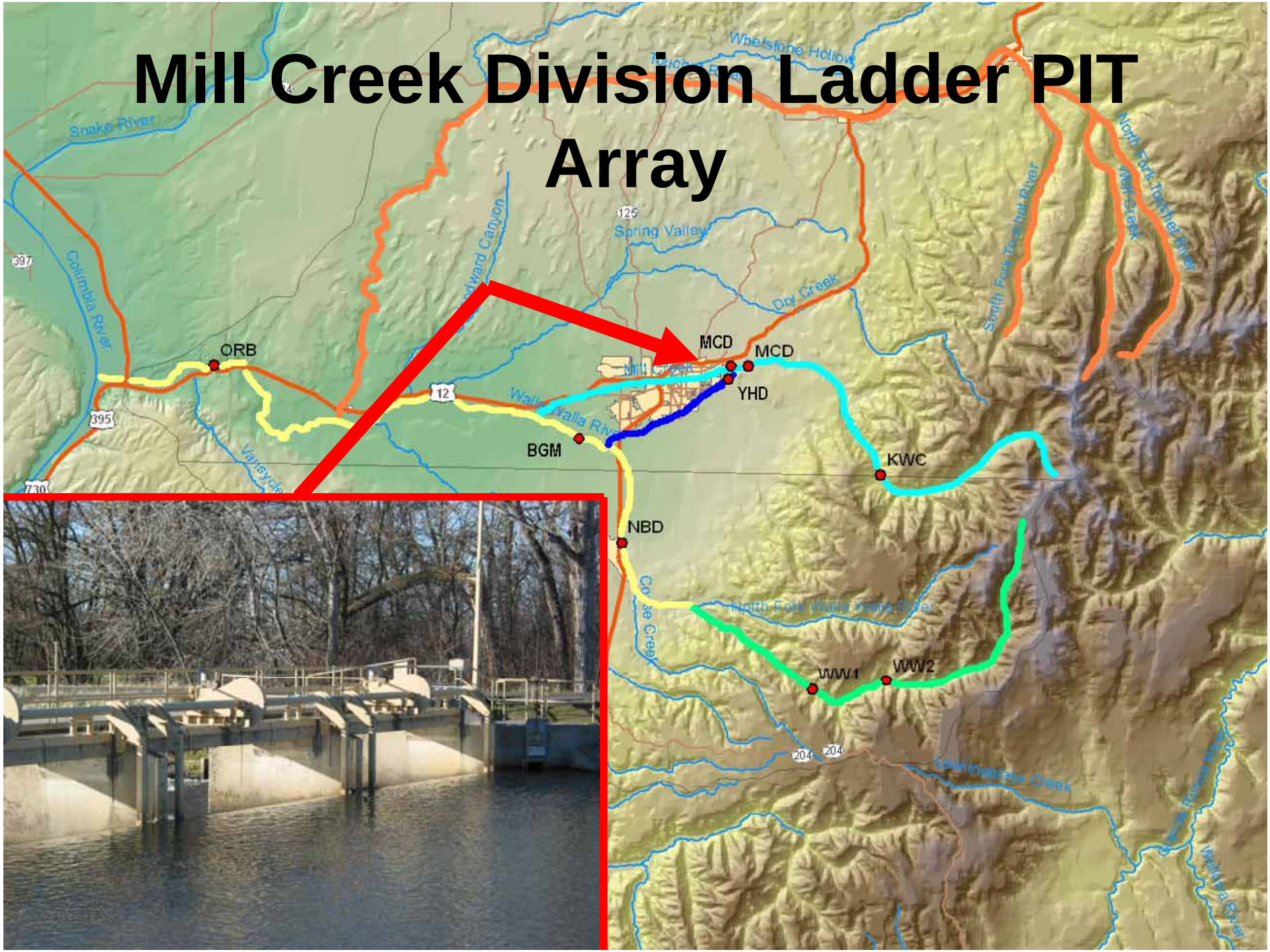
Mill Creek Diversion PIT Array (MCD)

Low Flow Outlet 1st attempt (8’ x 8’)

Mill Creek Diversion PIT Array (MCD)

Mill Creek Diversion PIT Array (MCD)

Mill Creek Division Ladder PIT Array

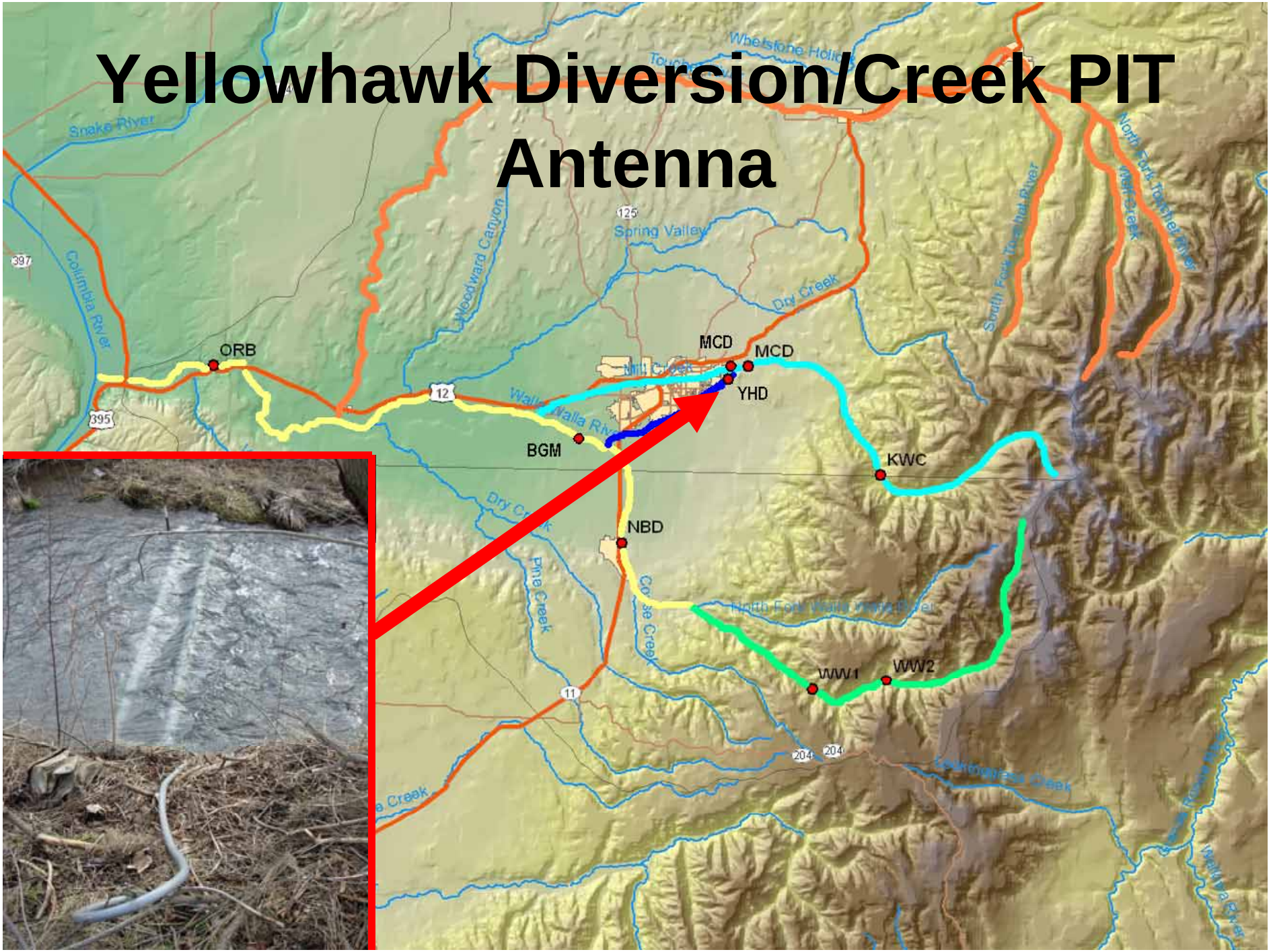


Mill Creek Division Ladder PIT Array

Established 2007

- Design: Pass Through (1)
- Transceiver: 1001A
- Construction: 4” PVC
- Communication: NA
- Power: AC
- Accessibility: Vehicle

Yellowhawk Diversion/Creek PIT Antenna

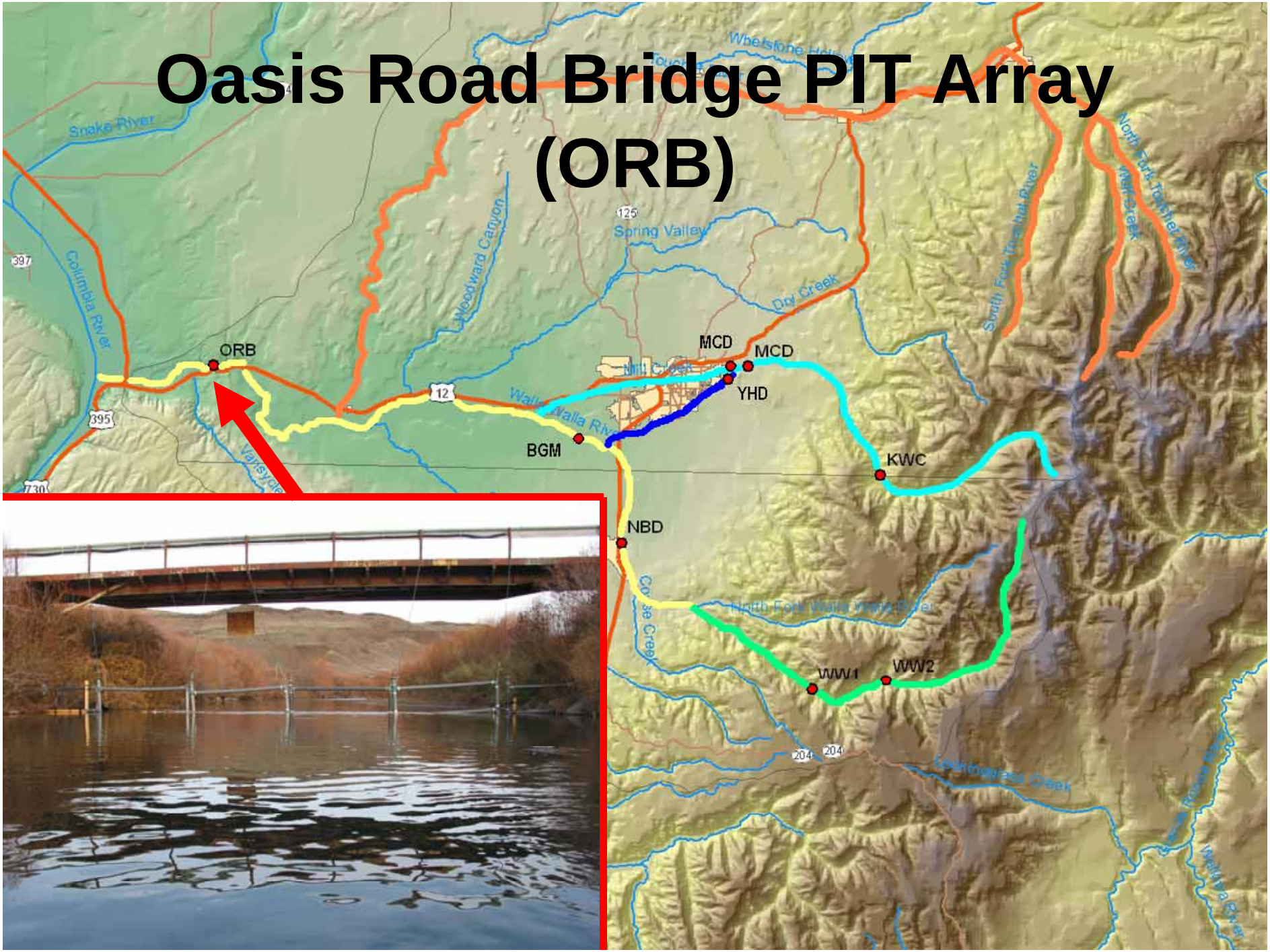


Yellowhawk Diversion/Creek Antenna

Established 2006

- Design: Flat Plate Antenna
- Transceiver: 1001A
- Construction: 4” PVC
- Communication: NA
- Power: AC
- Accessibility: Vehicle

Oasis Road Bridge PIT Array (ORB)



Oasis Road Bridge PIT Array (ORB)

Established 2005

- Design: Dual Loop Pass Through (4) and Pass Through (2)
- Transceiver: 1001M
- Construction: 4” PVC
- Communication: Satellite
- Power: Thermoelectric Generator
- Accessibility: Vehicle

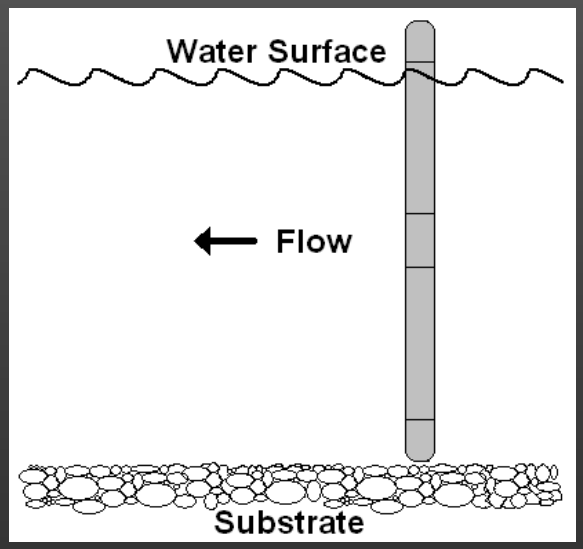
Oasis Road Bridge PIT Array (ORB)

Abolished 2005

Oasis Road Bridge PIT Array (ORB)

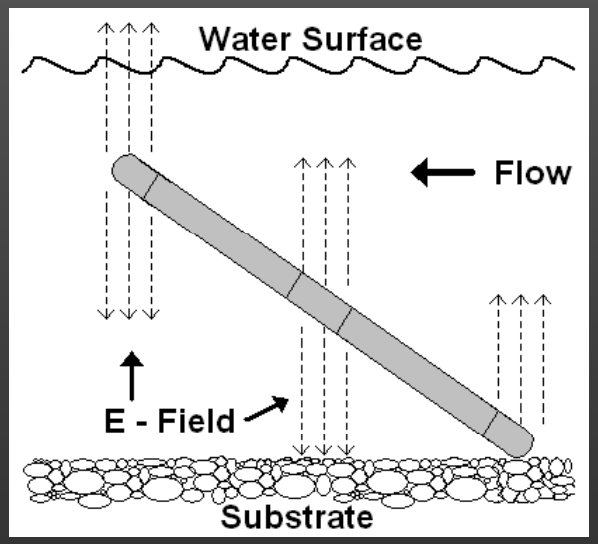
Dual Loop Hybrid

(Side View – Upright)



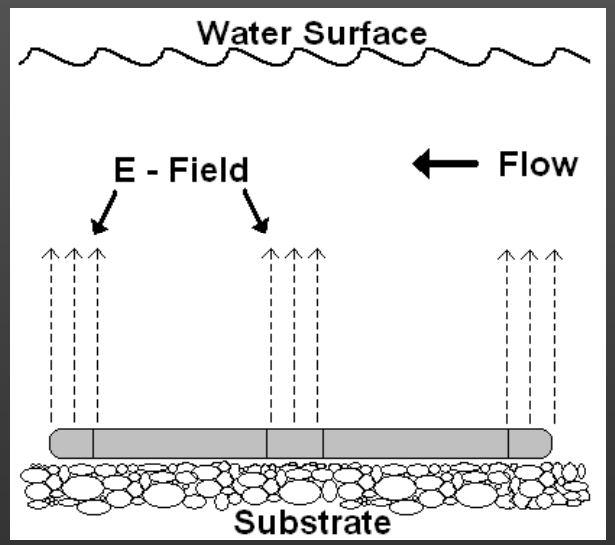
Dual Loop Hybrid

(Side View – Not Upright)



Dual Loop Hybrid

(Side View – Flat)



Oasis Road Bridge PIT Array (ORB)

Reestablished 2006

Oasis Road Bridge PIT Array (ORB)

- Design: Dual Loop Pass Through (4), Pass Through (2) and Flat Plates (6)
- Transceiver: 1001M (2)
- Construction: 4” PVC
- Communication: Satellite
- Power: Thermoelectric Generators (2)
- Accessibility: Vehicle

Site Maintenance

- PIT Array Log
  - Diagnostics (Amps, Phase, Signal)
- Performance Evaluations
- Antenna Replacement
- Communication
  - Transceiver
  - Computer / Minimon
  - Modem

Evaluate Bull Trout Migration Between The Tucannon River And The Mainstem Snake River Using Streamwidth Passive Integrated Transponder Tag Interrogation Systems

C.B. Bretz and S. Anglea

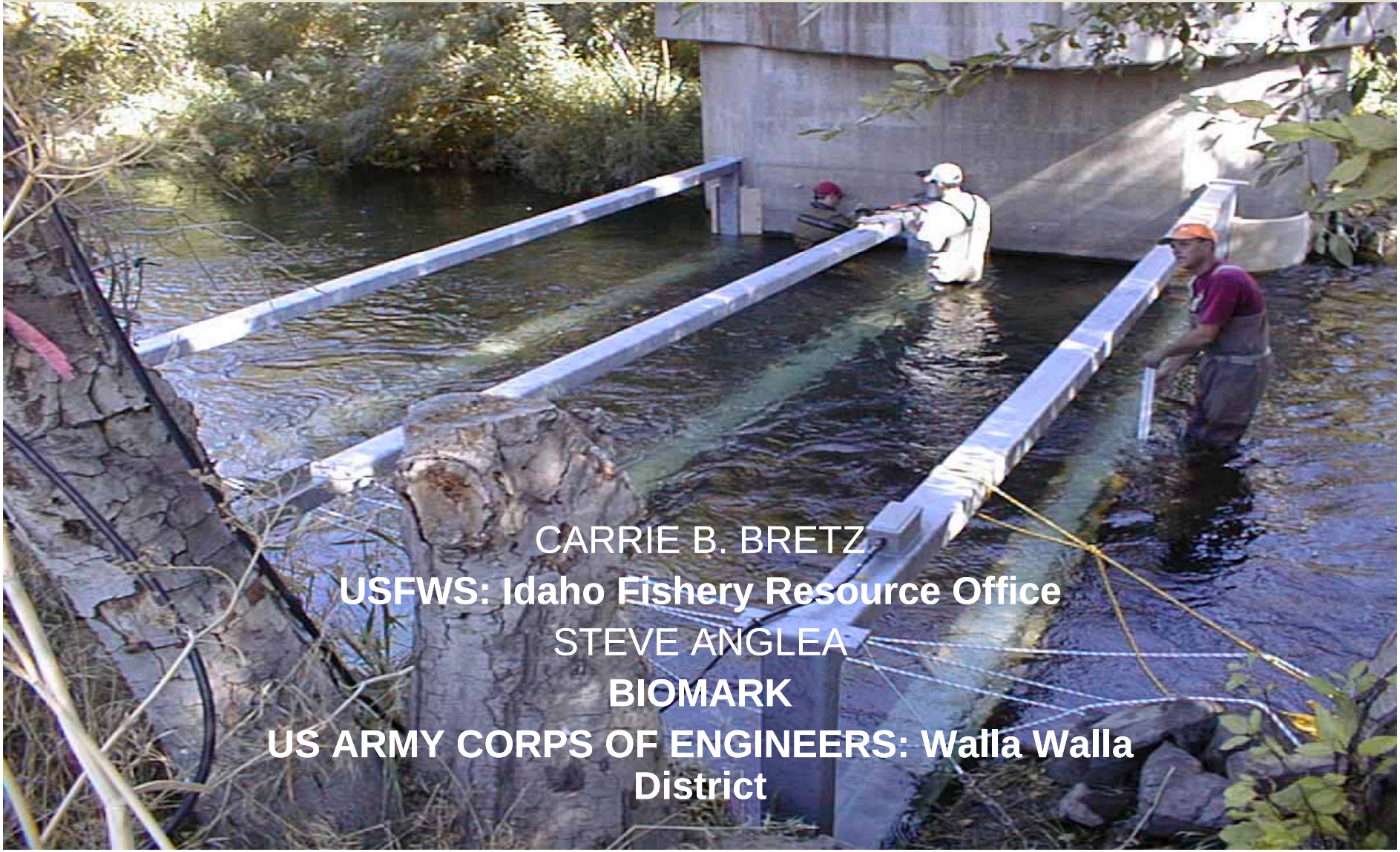
Data on the migration timing and distribution of PIT-tagged bull trout (*Salvelinus confluentus*) was collected by streamwidth PIT tag interrogation systems installed in the lower reaches of the Tucannon River in October, 2005.

From 2002 to October, 2007, 1,158 bull trout representing adult, subadult and juvenile life stages were PIT tagged and released within the Tucannon River basin. Between October, 2005 and October, 2007, 30 unique bull trout interrogations were recorded within Lake Herbert G. West, suggesting that the Tucannon River population of bull trout contains a migratory component that utilizes the Snake River. The number of interrogations in 2007 (n=8) was substantially less than in 2006 (n=27). The greatest number of fish was detected in December (n=10) and March (n=18), which coincide with immigration into the mainstem Snake River and the return migration to the Tucannon River. At least seven bull trout remained in the mainstem Snake River for three months; two remained for over five months.

Forty-seven percent of the bull trout detected within Lake Herbert G. West subsequently returned to the spawning grounds within the Tucannon River headwaters. Two bull trout made repeated, consecutive year migrations between the mainstem Snake River and the Tucannon River. No bull trout originating from the Tucannon River have been observed using the fishways of lower Snake River dams.

Return to top

EVALUATE BULL TROUT MIGRATION BETWEEN THE TUCANNON RIVER AND THE MAINSTEM SNAKE RIVER USING STREAMWIDTH PASSIVE INTEGRATED TRANSPONDER TAG INTERROGATION SYSTEMS



CARRIE B. BRETZ

USFWS: Idaho Fishery Resource Office

STEVE ANGLEA

BIOMARK

US ARMY CORPS OF ENGINEERS: Walla Walla District

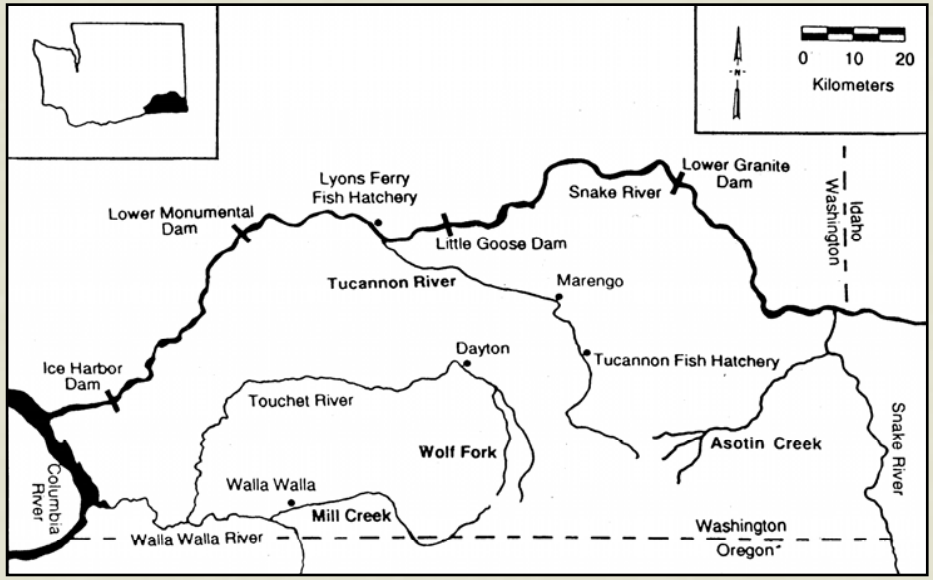
TUCANNON RIVER BULL TROUT

- **Tucannon River population of bull trout contains a migratory component that may utilize Snake River for adult rearing.**
- Observations at Lower Snake dams led to 2000 BiOp call for investigation into the presence in/use of the mainstem Snake River by bull trout.

TUCANNON RIVER BULL TROUT

- Tucannon River population of bull trout contains a migratory component that may utilize Snake River for adult rearing.
- **Observations at Lower Snake dams led to 2000 BiOp call for investigation into the presence in/use of the mainstem Snake River by bull trout.**

TUCANNON RIVER ORIENTATION



STUDY OBJECTIVES

- **Determine if bull trout migrate between the Tucannon River and the mainstem Snake River.**
- Determine the relative proportion of the Tucannon River bull trout population that travels into the mainstem Snake River.
- Determine the migration timing of bull trout traveling between the Tucannon River and the mainstem Snake River.
- Determine the usage of Snake River dam adult and juvenile fish facilities by bull trout originating from the Tucannon River.

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SAMPLING: TUCANNON HATCHERY WEIR

- 2002-2006
- returning adults
- March – July
- dorsal sinus PIT tag placement
- 604 PIT tagged

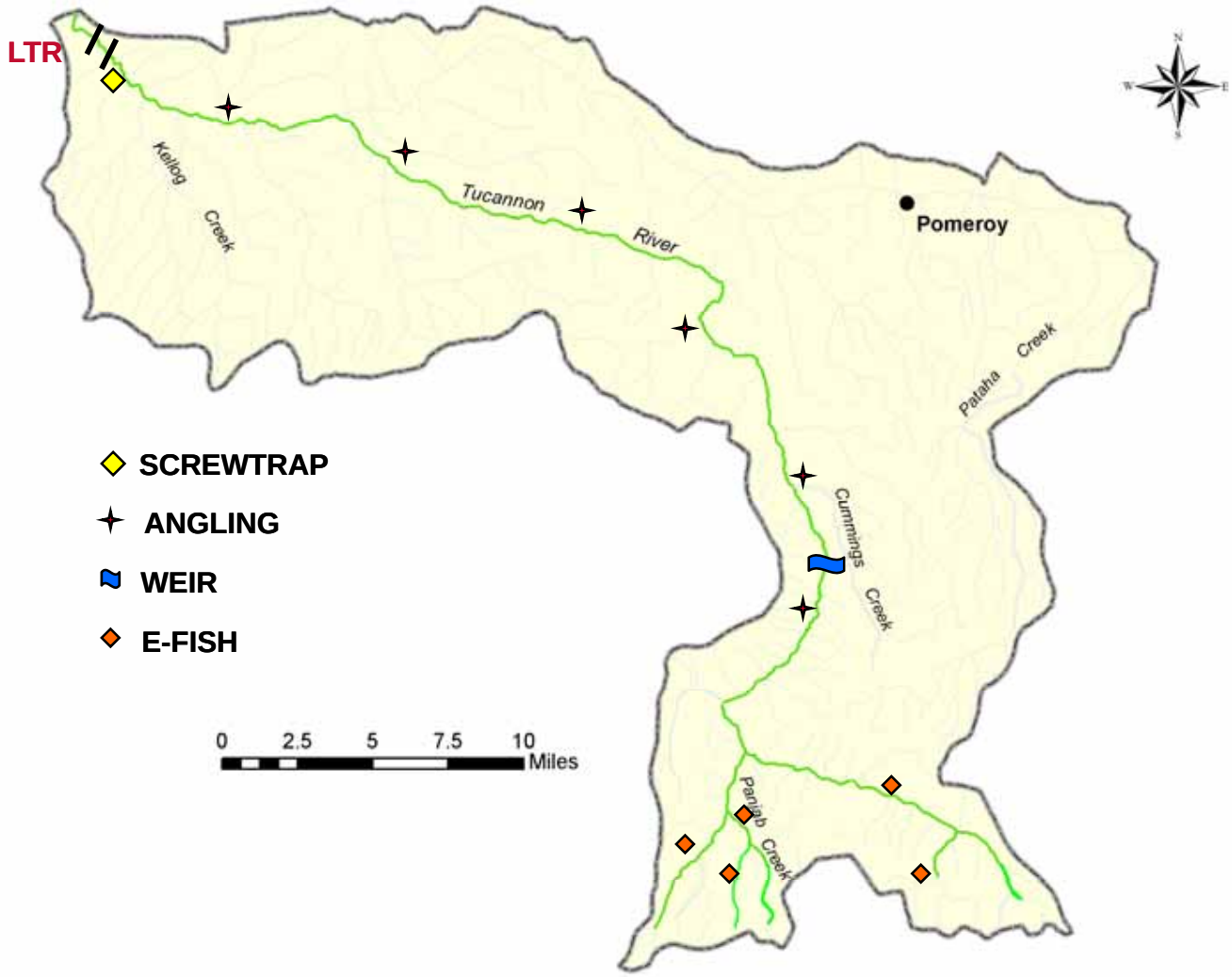
SAMPLING: ELECTROFISHING

- 2005-2006
- juveniles
- 4 tributaries and upper mainstem
- single pass of randomly chosen reaches
- 70mm minimum size requirement
- 307 PIT tagged

SAMPLING: ANGLING

- 2004-2006
- fall outmigrants
- September – February
- single barbless hooks with spoons or plastic-bodied jigs
- 49 PIT-tagged

SAMPLING SITES

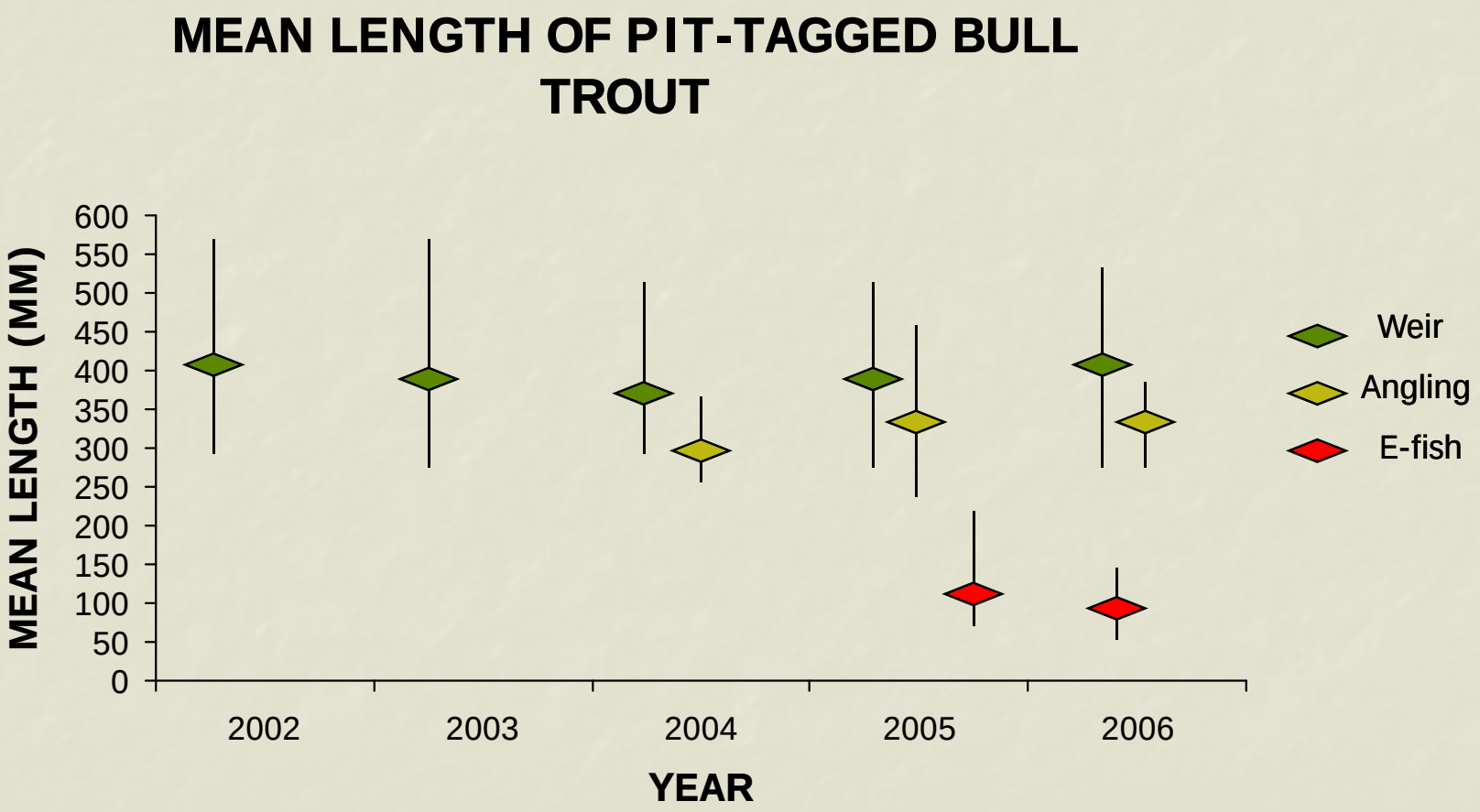


Map Date: July 2001
Data Source: Washington Dept of Fish and Wildlife
Subbasin Planning

PIT tags

- 2002-2004 TX1411ST
- 2004-2006 TX1411SGL
  - increased read range
  - larger diameter
- 2007 TX1400SST
  - read range of SGL
  - reduced diameter

Results


MEAN LENGTH OF PIT-TAGGED BULL TROUT
MEAN LENGTH (MM)
600
550
500
450
400
350
300
250
200
150
100
50
0
2002
2003
2004
2005
2006
YEAR
Weir
Angling
E-fish

TUCANNON RIVER BRIDGE SITE

(2) 20 x 3.5 ft pass-through antennas

(3) 6 ft (Crump) weir antennas

October 11, 2005

(1) FS1001M transceiver

(1) thermoelectric generator

LOWER TUCANNON RIVER SITE

(2) 6-10 ft “log” antenna

October 27, 2005

(2) FS1001M transceiver

(2) thermoelectric generator

HIGH FLOW EVENT
(April 1-7, 2006) (377 ft^3/s)

TUCANNON RIVER BRIDGE SITE

(3) 25 x 4 ft pass-through antennas

October 6, 2006

(1) FS1001M transceiver

(1) thermoelectric generator

LOWER TUCANNON RIVER SITE

(1) 6-10 ft “log” antenna

October 20, 2006

(1) FS1001M transceiver

(1) thermoelectric generator

DETECTION EFFICIENCY

Release Date	N	TRB	LTR	TRB & LTR	COMBINED
12/07/2005	40	14 (35%)	1 (2%)	0	15 (37%)
12/12/2005	29	10 (34%)	2 (6%)	1 (3%)	13 (44%)
12/22/2005	36	14 (38%)	4 (11%)	0	18 (50%)

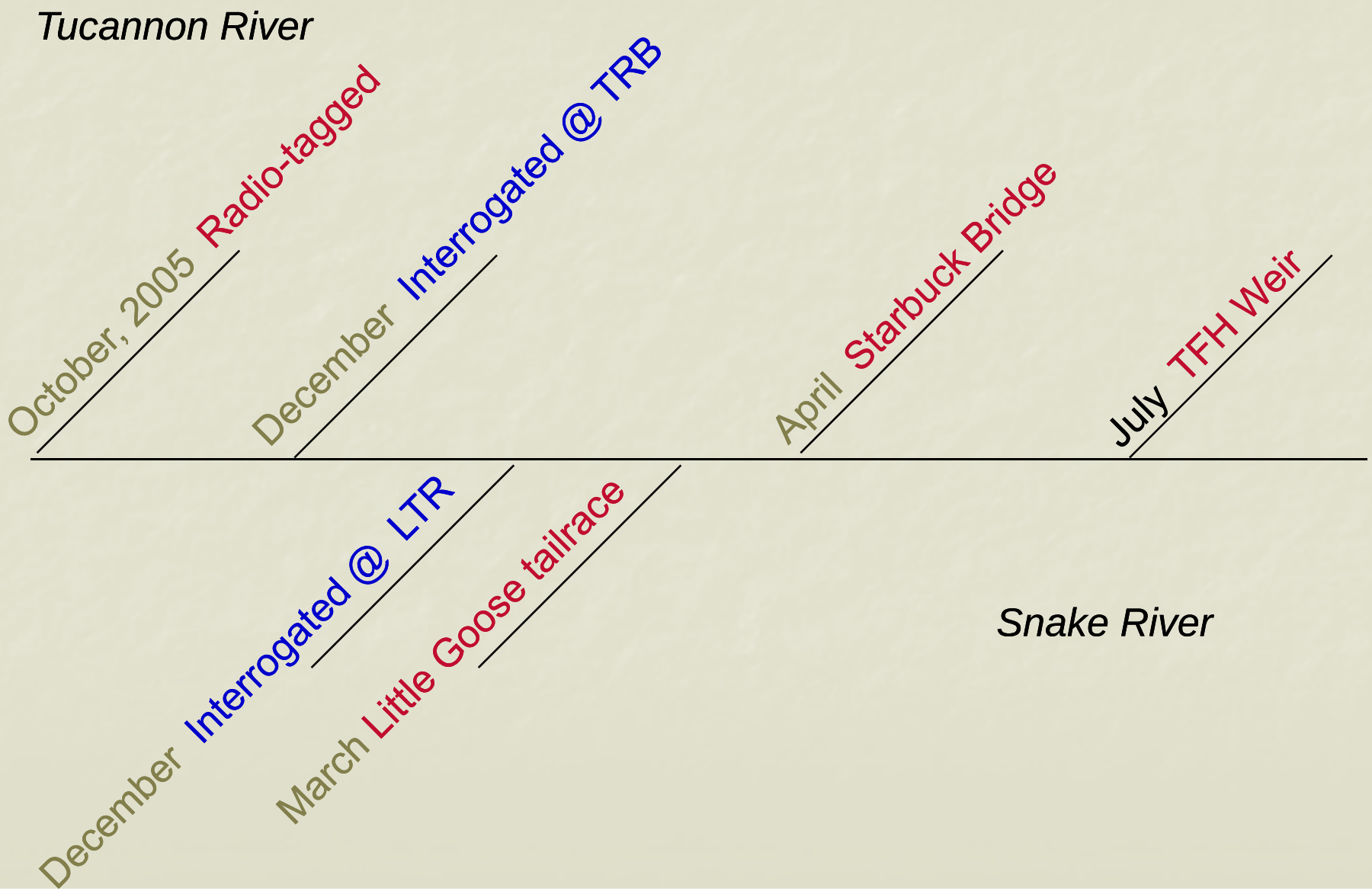
RESULTS

N=27

TRB or LTR and TFH weir	TRB and LTR	TRB or LTR
Confirmed travel between the reservoir influence zone and the Tucannon River	Able to determine directionality	Unable to determine directionality
48%	30%	22%

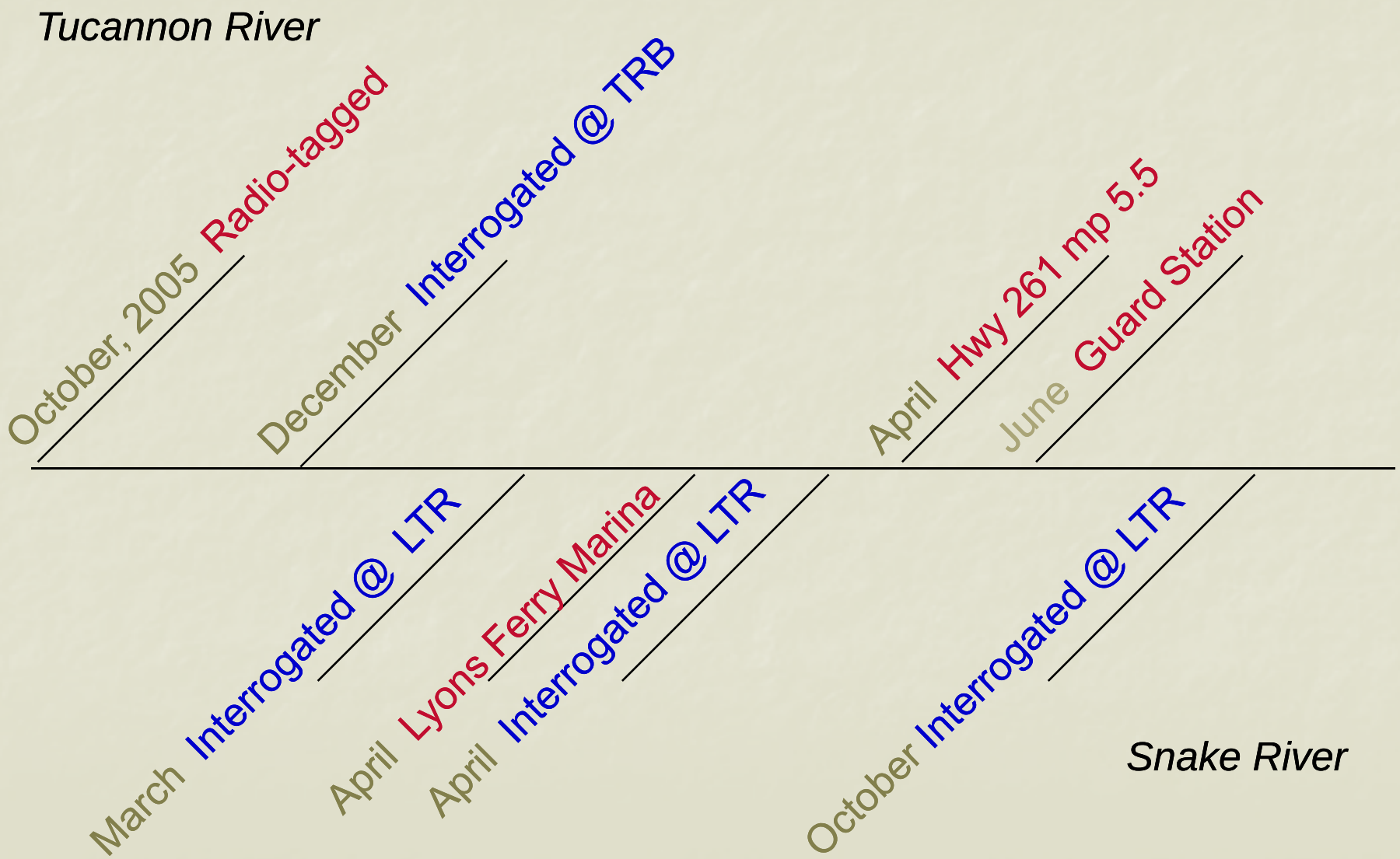
RADIO TAG DATA

Code 106



RADIO TAG DATA

Code 121



RESULTS

	TFH WEIR		ANGLING		ELECTROFISH	
	TAGGED	DETECTED	TAGGED	DETECTED	TAGGED	DETECTED
2004	205	7	18	0	0	0
2005	78	15	19	4	217	0
2006	57	0	16	1	90	0
TOTAL	340	22 (6.5%)	53	5 (9.4%)	307	0 (0%)

RETURNING ADULTS (UNDERESTIMATION?)

OUTMIGRANTS

JUVENILES

OBJECTIVES

DETERMINE IF BULL TROUT MIGRATE BETWEEN THE TUCANNON RIVER AND THE MAINSTEM SNAKE RIVER

- BULL TROUT COLLECTED IN THE TUCANNON RIVER HAVE BEEN DETECTED PASSING THE ANTENNA ARRAYS WITH SUBSEQUENT COLLECTION AT THE TFH WEIR (N=13).

OBJECTIVE

DETERMINE IF BULL TROUT MIGRATE BETWEEN THE TUCANNON RIVER AND THE MAINSTEM SNAKE RIVER

- BULL TROUT COLLECTED IN THE TUCANNON RIVER HAVE BEEN DETECTED PASSING THE ANTENNA ARRAYS WITH SUBSEQUENT COLLECTION AT THE TFH WEIR (N=13).
- RADIO-TAGGED BULL TROUT HAVE BEEN DETECTED AT THE ARRAYS. MOBILE TRACKING HAS CONFIRMED PRESENCE IN THE SNAKE RIVER (N=3).

OBJECTIVE

DETERMINE THE MIGRATION TIMING OF BULL TROUT TRAVELING BETWEEN THE TUCANNON RIVER AND THE MAINSTEM SNAKE RIVER

- THE MOST DETECTIONS OCCURRED IN DECEMBER (N=9) AND MARCH (N=11).
- ADDITIONAL DETECTIONS IN APRIL, MAY, OCTOBER AND NOVEMBER.

OBJECTIVE

DETERMINE THE RELATIVE PROPORTION OF THE TUCANNON RIVER BULL TROUT POPULATION THAT TRAVELS INTO THE MAINSTEM SNAKE RIVER

- ESTIMATE VARIES WITH FISH LENGTH AND TAGGING SEASON.
- RANGES FROM 6.4% (HIGH MORTALITY ASSOCIATED WITH SPAWNING) TO 10% (OUTMIGRATION).

OBJECTIVE

DETERMINE THE USAGE OF SNAKE RIVER DAM FISHWAYS BY BULL TROUT ORIGINATING FROM THE TUCANNON RIVER.

- NO BULL TROUT HAVE BEEN DETECTED WITHIN ADULT LADDERS OR JUVENILE BYPASS FACILITIES.

OBJECTIVE

DETERMINE THE USAGE OF SNAKE RIVER DAM FISHWAYS BY BULL TROUT ORIGINATING FROM THE TUCANNON RIVER.

- NO BULL TROUT HAVE BEEN DETECTED WITHIN ADULT LADDERS OR JUVENILE BYPASS FACILITIES.
- ONE RADIO-TAGGED BULL TROUT WAS DETECTED IN THE LITTLE GOOSE DAM TAILRACE.

INCIDENTAL DETECTIONS

- 1849 INCIDENTAL UNIQUE FISH
- 4 SPECIES : SPRING CHINOOK
  SUMMER CHINOOK
  FALL CHINOOK
  SUMMER STEELHEAD
- GRANDE RONDE, IMNAHA, SALMON, TOUCHET, WALLA WALLA AND CLEARWATER RIVERS

ACKNOWLEDGEMENTS

- US ARMY CORP OF ENGINEERS: Walla Walla District
- WASHINGTON DEPARTMENT OF FISH AND WILDLIFE: Division of Fish Management and the Snake River Lab
- BIOMARK
- US FISH AND WILDLIFE SERVICE: Idaho Fishery Resource Office

Duplexing Our Way Through PIT Tag Technology: Success, Failures and Frustrations of Using Full- and Half-duplex PIT Tags to Track Salmonid Movements in Three Oregon Watersheds

S. Starcevich and S. Jacobs

The Oregon Department of Fish and Wildlife's Native Fish Investigations Project has been using full-and half-duplex PIT tag technology to examine life history patterns of various salmonid populations in basins across the state. Beginning in 2005, in Mill Creek, a Walla Walla River tributary, juvenile (>112 mm) and adult (>300 mm) bull trout were caught in traps (Rkm 42) and given full-duplex PIT tags. A PIT tag detection array was constructed across the river at a private bridge (Rkm 34.9), which was comprised of five individual antennae, each about 2.5 m wide and 1.5 m tall, and multipled through a Destron Fearing FS1001M Transceiver. Power for this array was provided by the local rural electric grid. Data from this site were remotely uploaded via phone modem to the PTAGIS database. Problems included a persistent and unidentifiable source of noise, which led to an early season site change for the array, and antennae damage caused by high water events. Our specific research objectives included examining the detectability of 12 mm and 23 mm tags; bull trout movement timing (diel and seasonal) and location (channel cross-section and basin); movement and distribution in relation to stream temperature; the feasibility of backpack PIT tag reader and recapturing fish while snorkeling; and juvenile to adult survival rates.

In 2005, half-duplex PIT tag technology (Oregon RFID multiplexing reader) was used to examine life history patterns of juvenile and adult redband trout in relation to JC Boyle Dam on the Klamath River. One PIT tag detection array was installed across Spencer Creek, 30 m from its confluence with the Klamath River. It consisted of a single antenna 11 m wide and 0.25 m tall, made of 1-0 welding cable and 8 gauge speaker cable, with 0.7 m read range, and using about 0.7 amps. Another detection array was installed in the Klamath River 300 m downriver of J. C. Boyle Dam. It consisted of an antenna 25 m wide and 1 m tall, made of 2-0 and size 1 welding cable, with 0.3 m read range, and using about 1.0 amp. Each reader was powered by 18 volts to maximize read range; three 12-volt 120-amp/hour marine batteries and two 6-volts at each station were changed out every week. Problems included losing data from battery power draining out and sudden loss of read range, difficulties in tuning partly because of a poor connection between the PalmPC and the reader, and unannounced spilling at J.C. Boyle Dam that increased discharge from 150 ft^3/s to 1,500 ft^3/s in three hours and damaged the antenna. Our specific objectives were to gain a better understanding of juvenile redband trout dispersal and passage downriver over J.C. Boyle Dam and Keno Reach adult life history, and to supplement and validate radio-tracking data.

In 2006-07, half-duplex PIT tag technology was used in Hood River basin to examine life history patterns, passage problems at irrigation diversions and natural barriers, and population status of bull trout. In 2006, the new version of OregonRFID reader was field tested and failed to function properly. The problems were corrected in 2007, field tests were successful, and Oregon RFID readers were installed at three sites in the Hood River basin: Middle Fork Hood River at Dee, Middle Fork Hood River at its confluence with Tony Creek, and at the Clear Branch/Coe Branch confluence. The largest antenna is 17 m wide and 0.8 m tall, made of 2-0 welding cable and 8 gauge speaker cable, with 0.6 m read range, and using about 1.2 amps. The smallest antenna was 11 m wide and 0.5 m tall, made of 10 gauge speaker cable, with read range

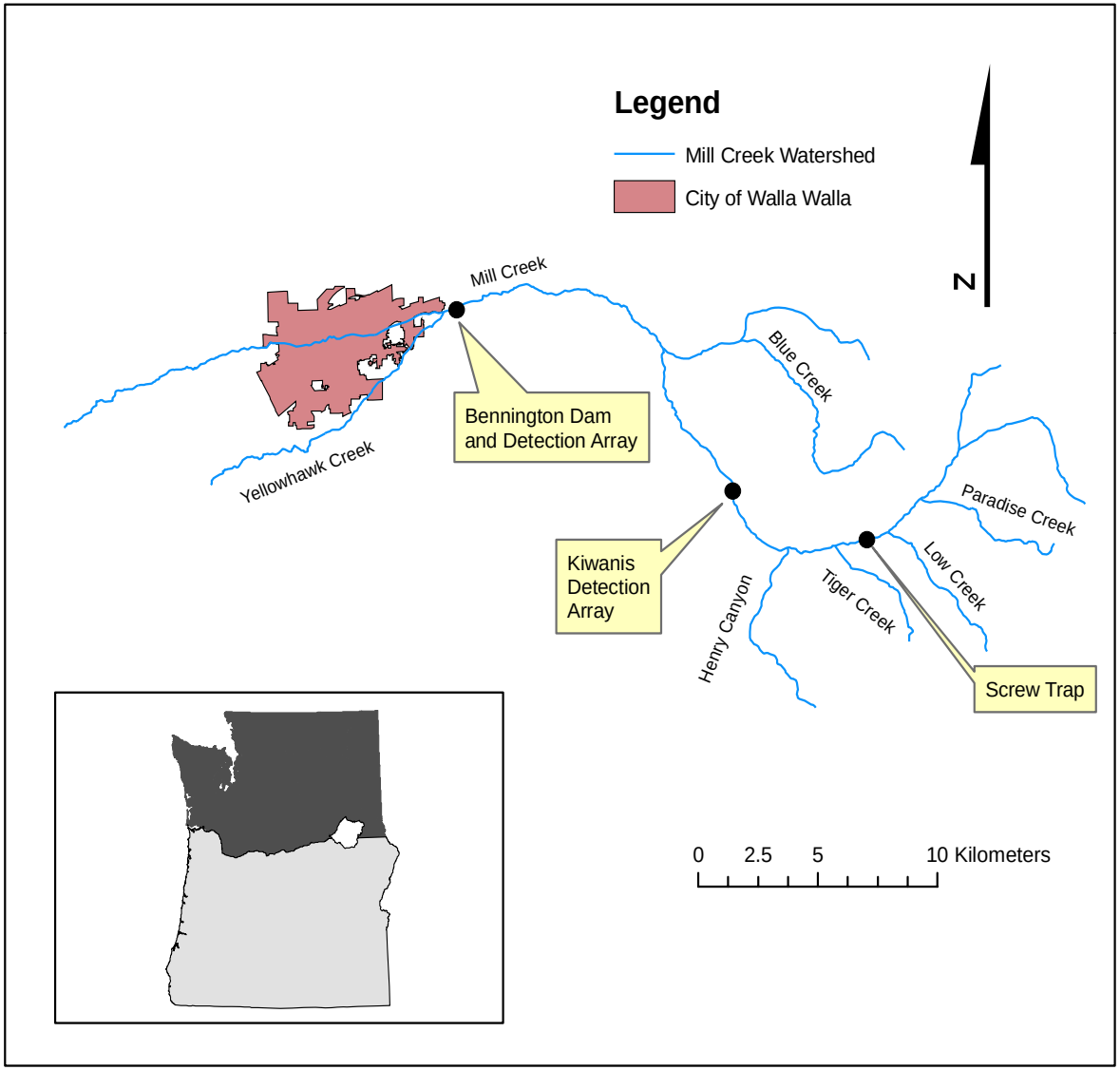
of 0.8 m, and using 0.6 amps. Each site is powered by three 12-volt batteries attached to a solar charger (SunSaver 6) and 12-volt solar panel (Shell). The 2007 version of the Oregon RFID reader requires little maintenance, is simple to install, and the internal datalogger and SD memory card is easy to program and upload by PC or PDA.

Return to top

Mill Creek Subadult Bull Trout

- What are the seasonal movement patterns?
- Relationship to Stream Temperature
- Survival to Adults

Mill Creek Watershed



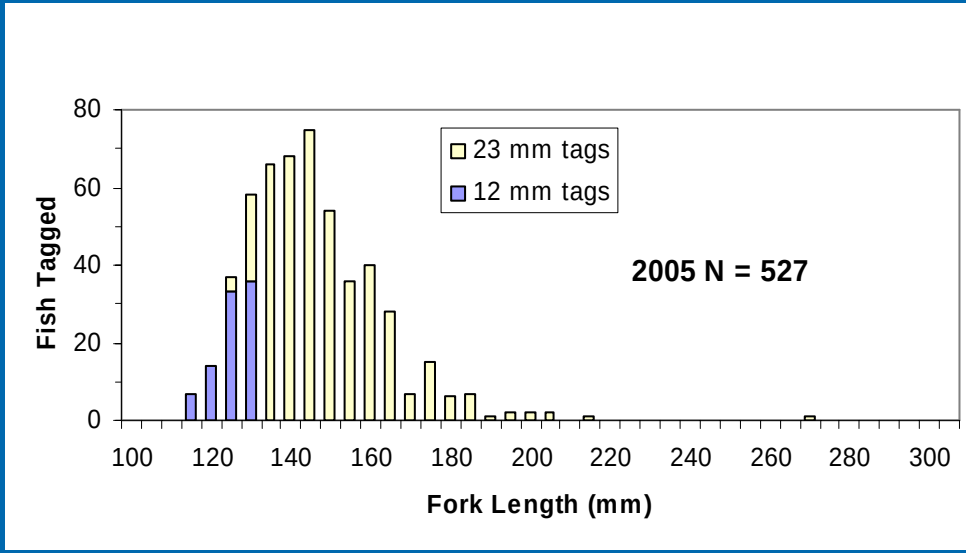
IN GOD WE TRUST
LIBERTY
2003
D

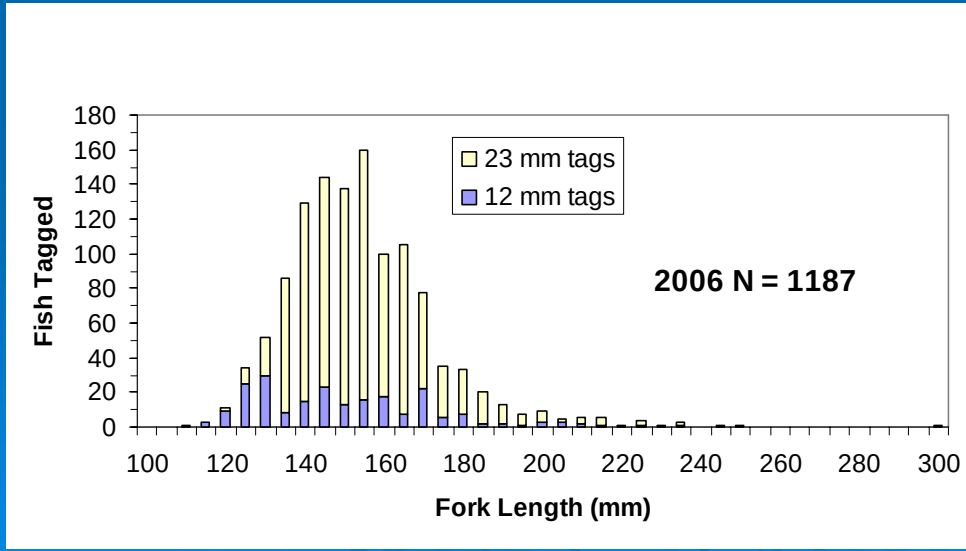
First Attempt

Second Try

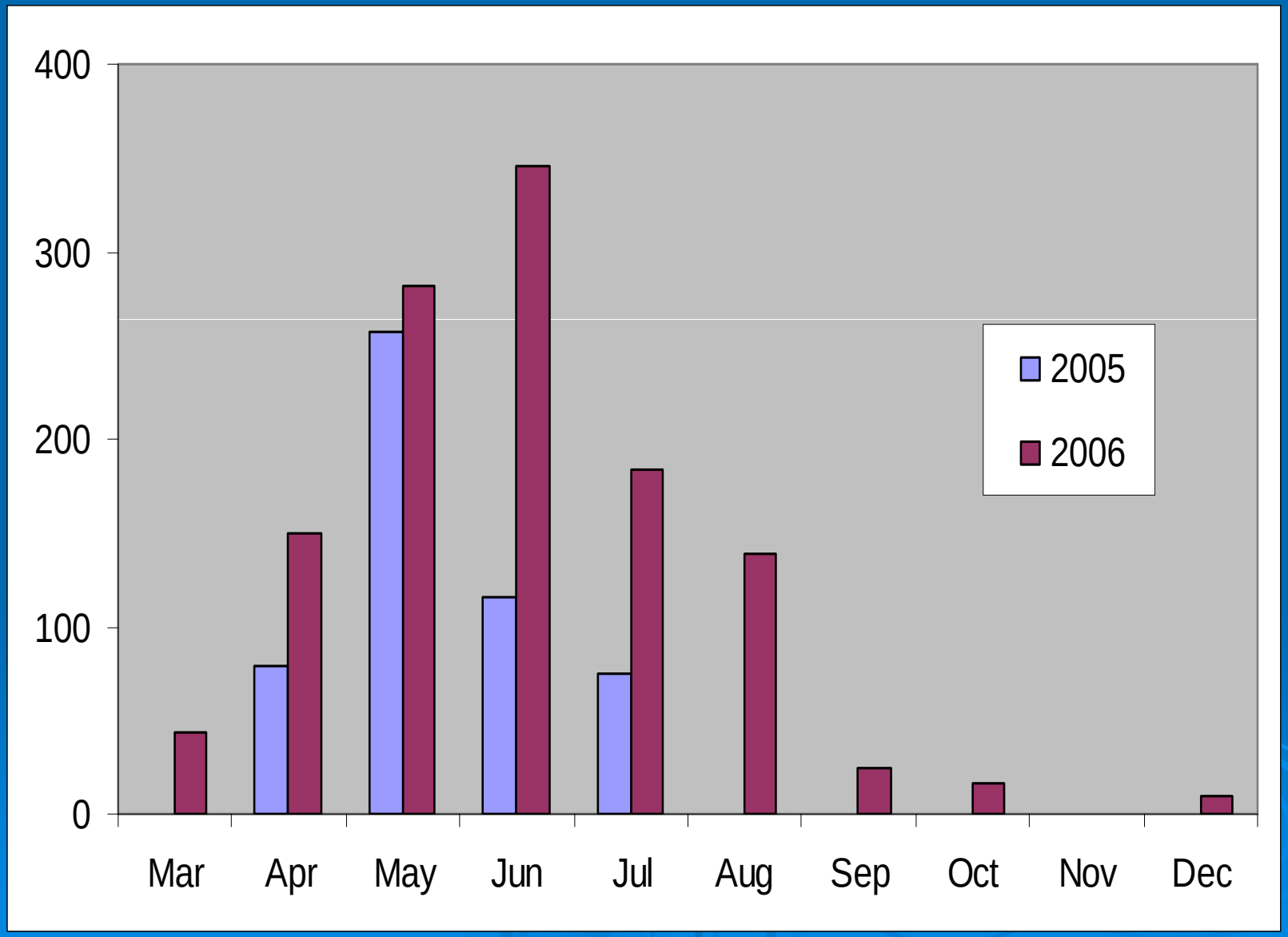
Successful Operation of Flexible Antenna Mount

Pit Tagged Subadults

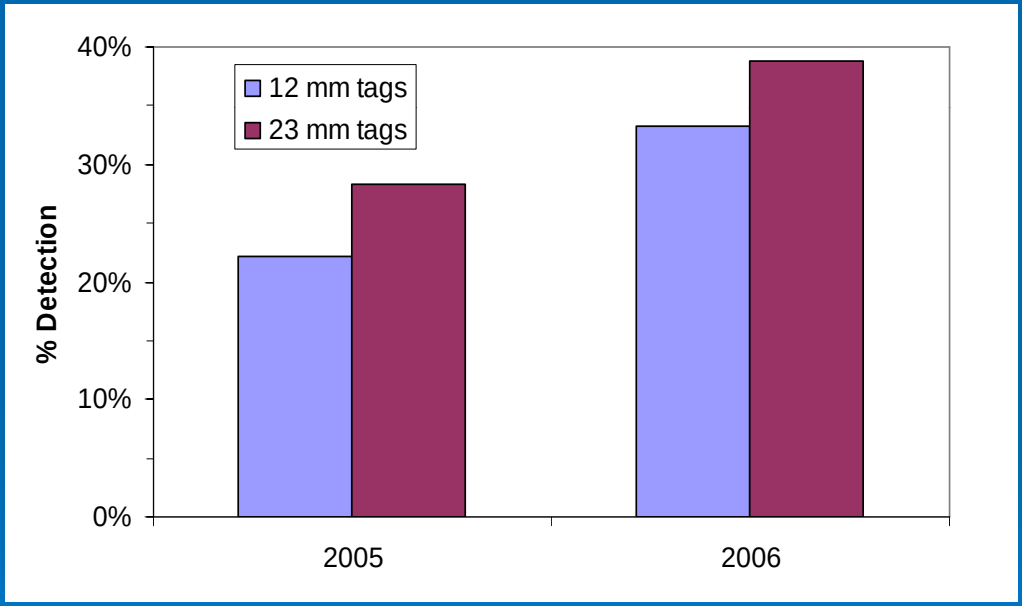




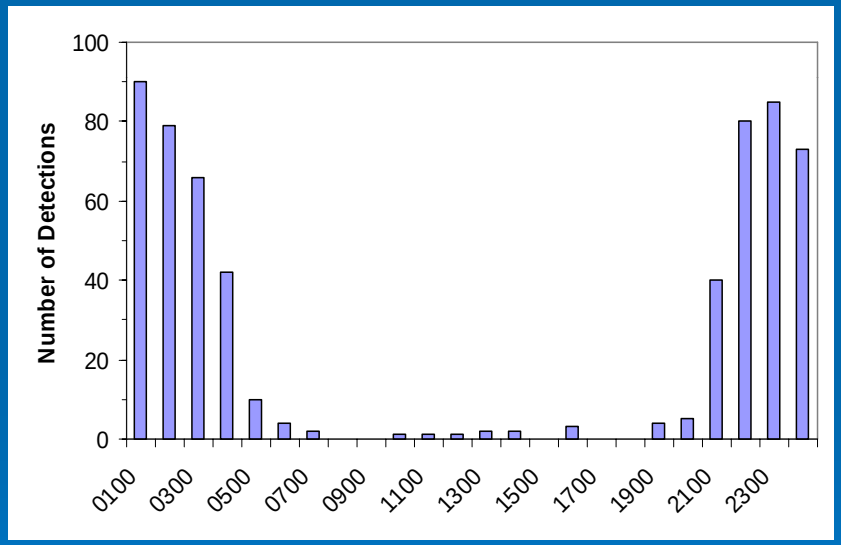
Timing of PIT Tagging

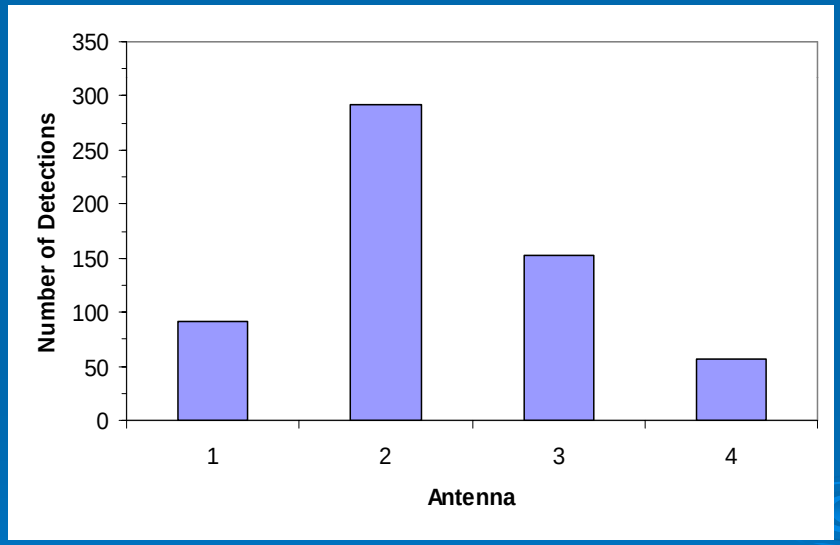


Detection Rate of 12 and 23 mm Tags



Diel Movement Timing and Channel Location



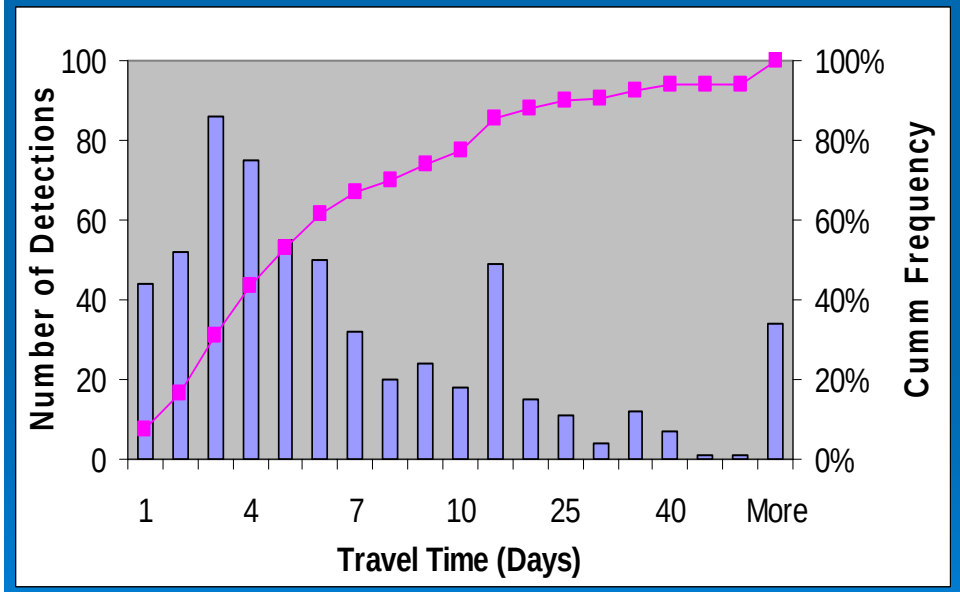


Location First/last detected	Number detected	% of tagged (1,729)	Travel Time 1			Travel Time 2		
			Min	Max	Median	Min	Max	Median
Kiwanis	590	34	0	348	5	-	-	-

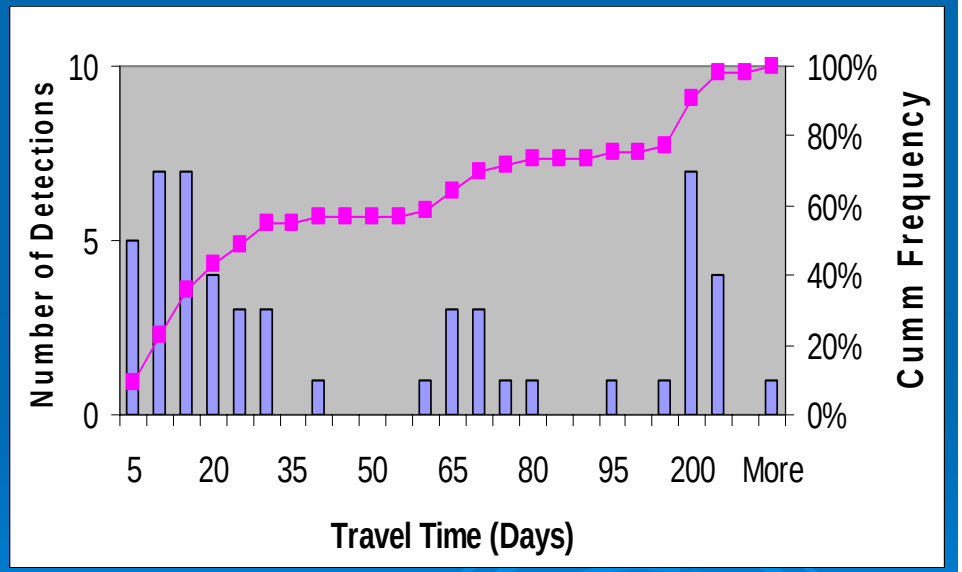
Location First/last detected	Number detected	% of tagged (1,729)	Travel Time 1			Travel Time 2		
			Min	Max	Median	Min	Max	Median
Kiwanis	590	34	0	348	5	-	-	-
Kiwanis/Kiwanis (>7 days)	20					8	418	62
Kiwanis/Bennington	40	2				0	242	12
Bennington only	12	1	4	250	26			

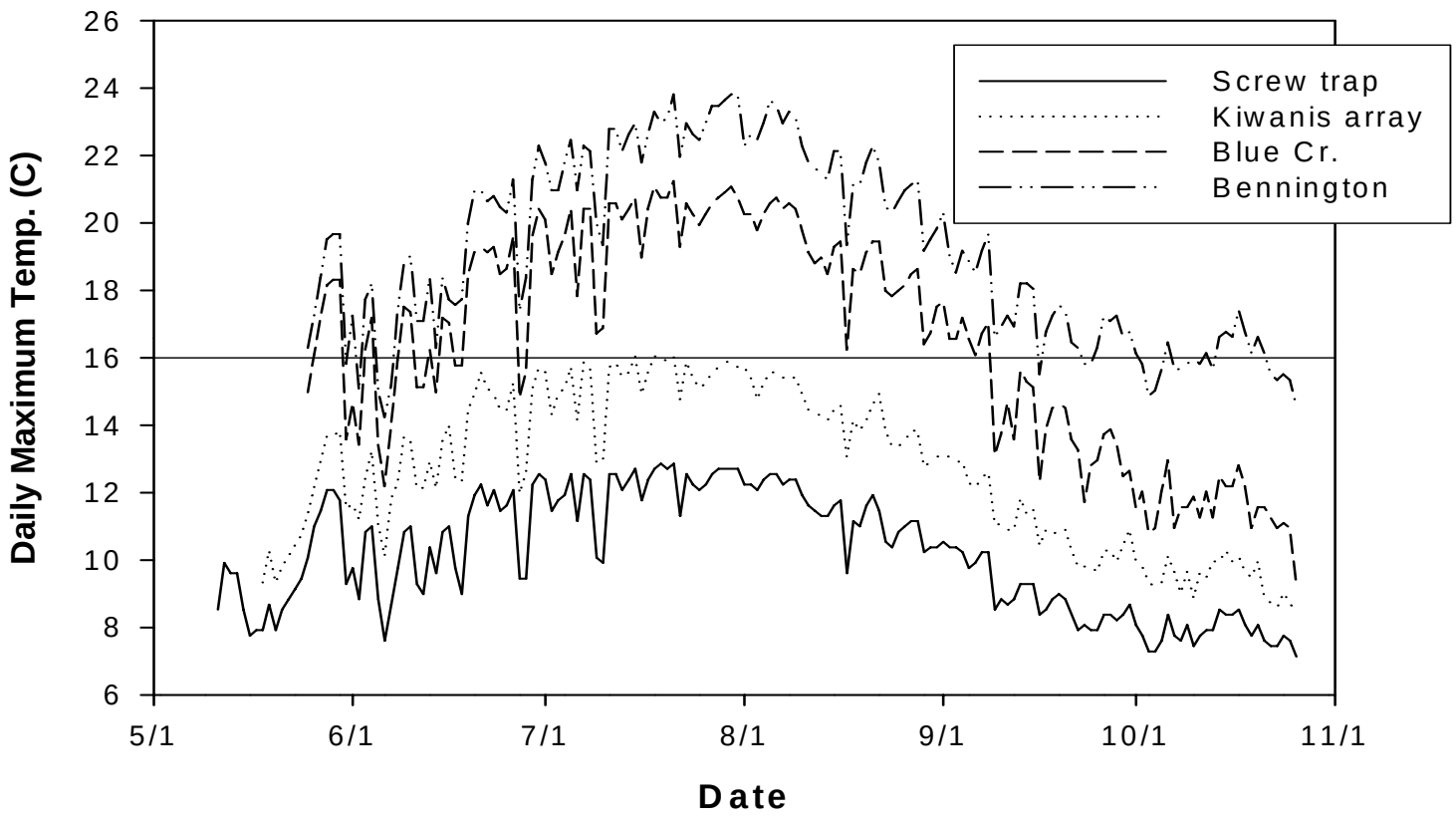
Travel Time to PIT Tag Arrays

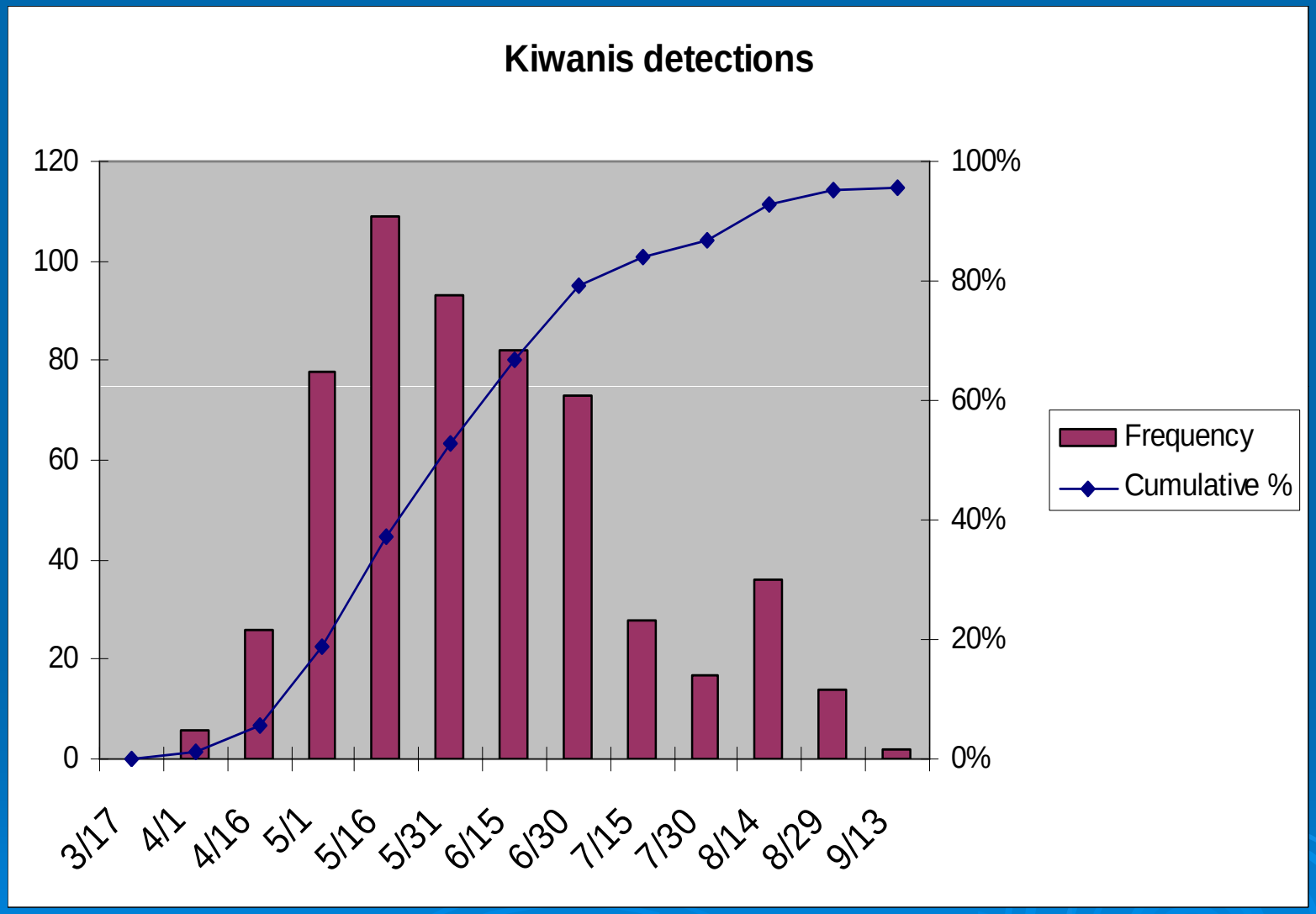
Kiwanis 7.3 Km

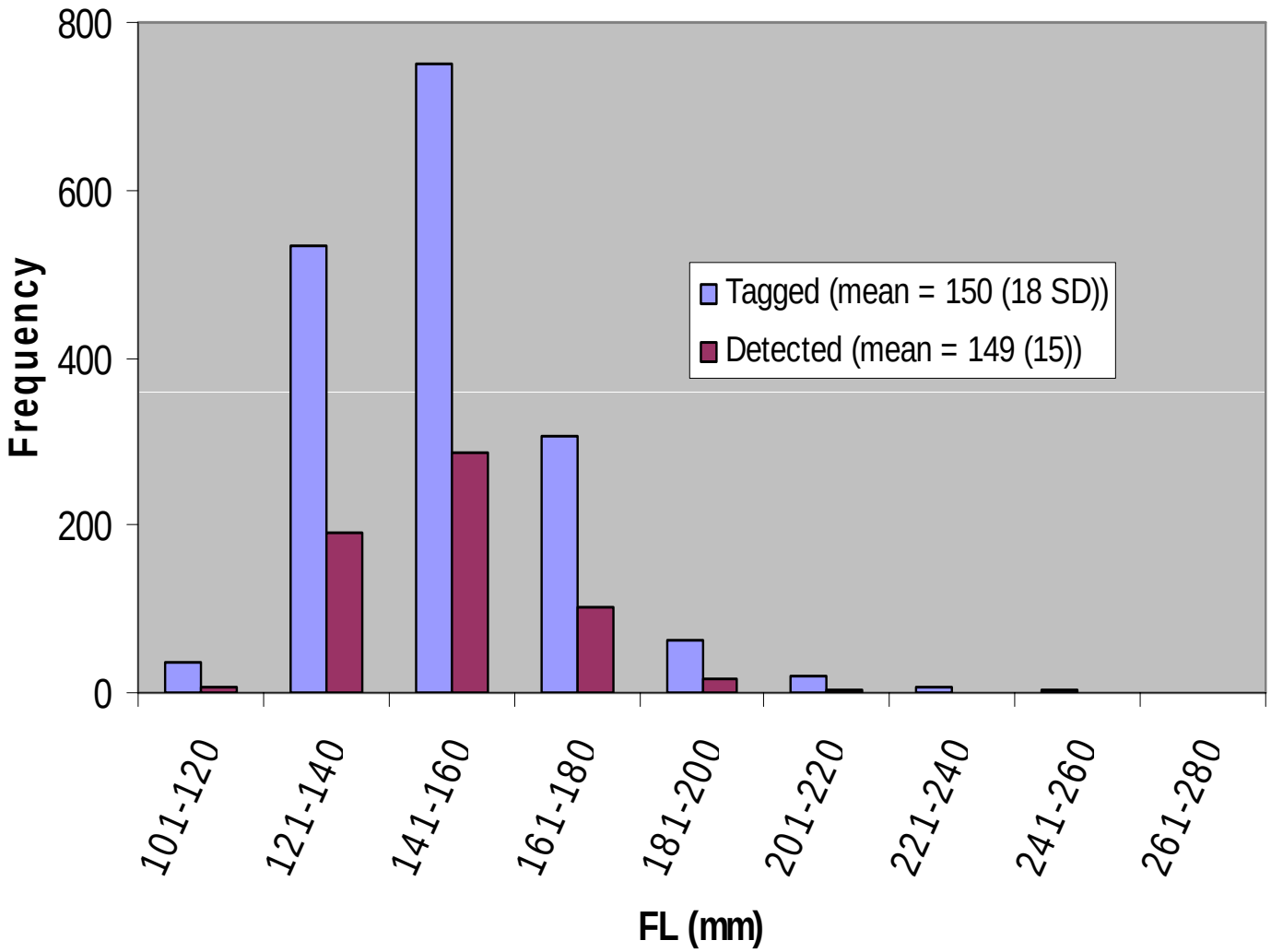


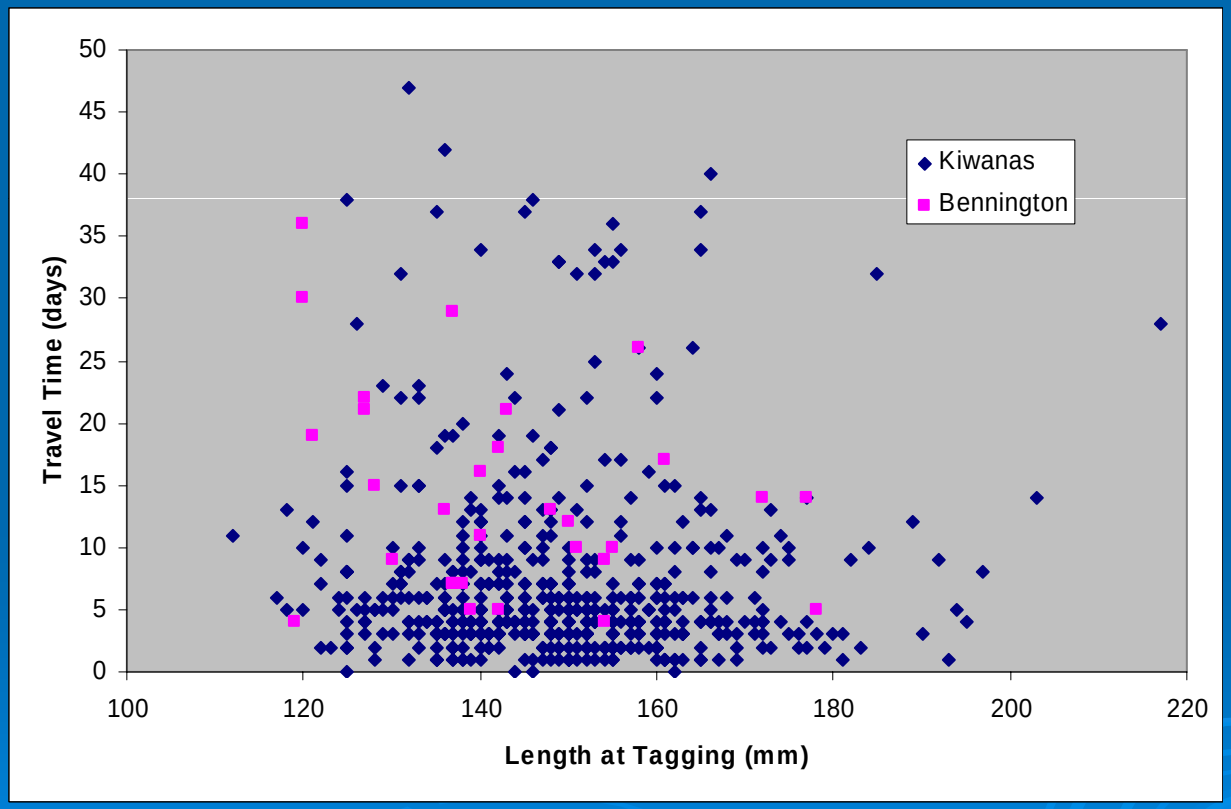
Bennington 23.5 Km




Mill Cr. Temperatures 2005
Daily Maximum Temp. (C)
26
24
22
20
18
16
14
12
10
8
6
5/1
6/1
7/1
8/1
9/1
10/1
11/1
Date
Screw trap
Kiwanis array
Blue Cr.
Bennington


Kiwanis detections
120
100
80
60
40
20
0
100%
80%
60%
40%
20%
0%
3/17
4/1
4/16
5/1
5/16
5/31
6/15
6/30
7/15
7/30
8/14
8/29
9/13
Frequency
Cumulative %

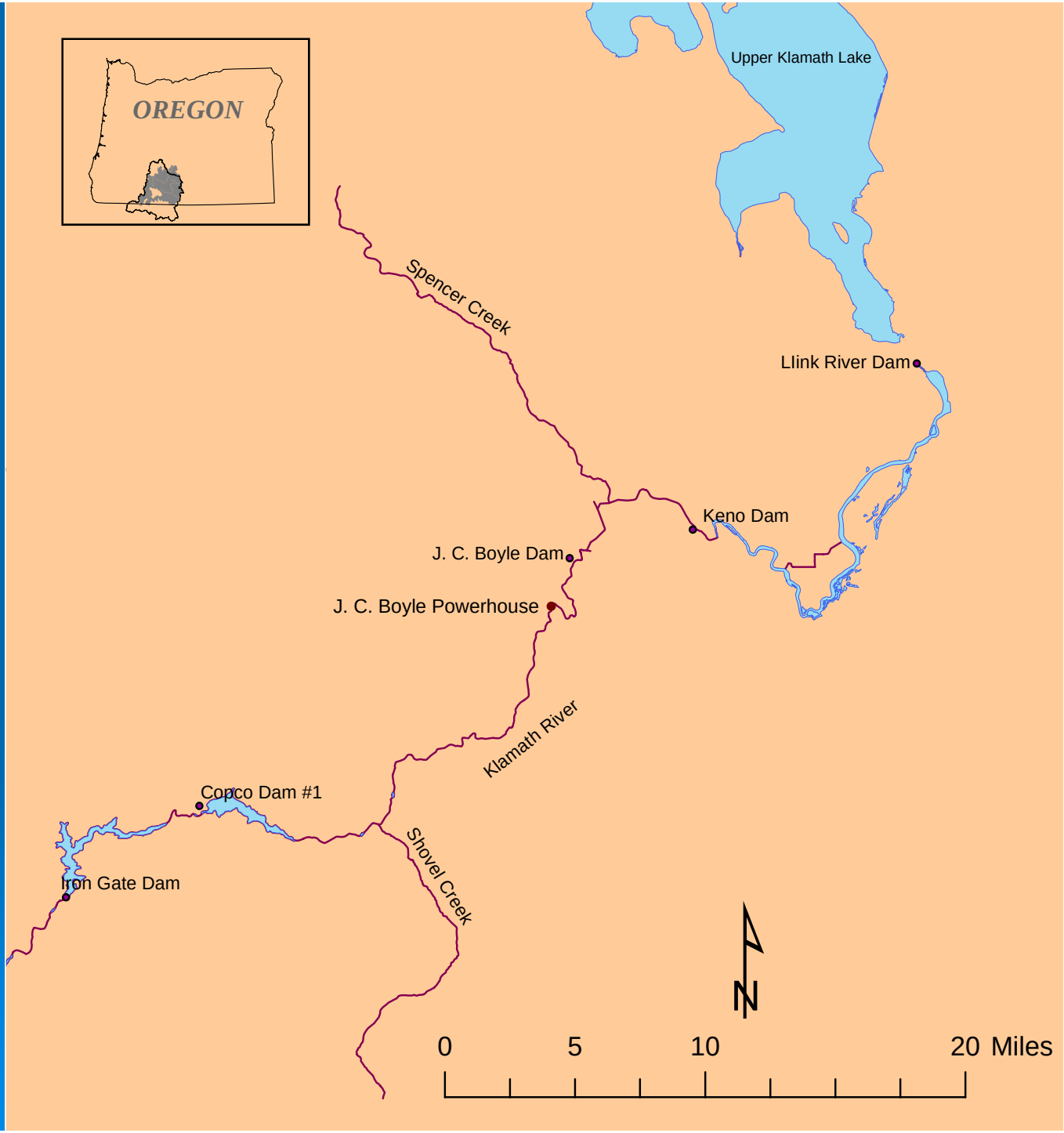

800
600
400
200
0
Frequency
Tagged (mean = 150 (18 SD))
Detected (mean = 149 (15))
101-120
121-140
141-160
161-180
181-200
201-220
221-240
241-260
261-280
FL (mm)


Travel Time (days)
50
45
40
35
30
25
20
15
10
5
0
100
120
140
160
180
200
220
Length at Tagging (mm)
Kiwanas
Bennington

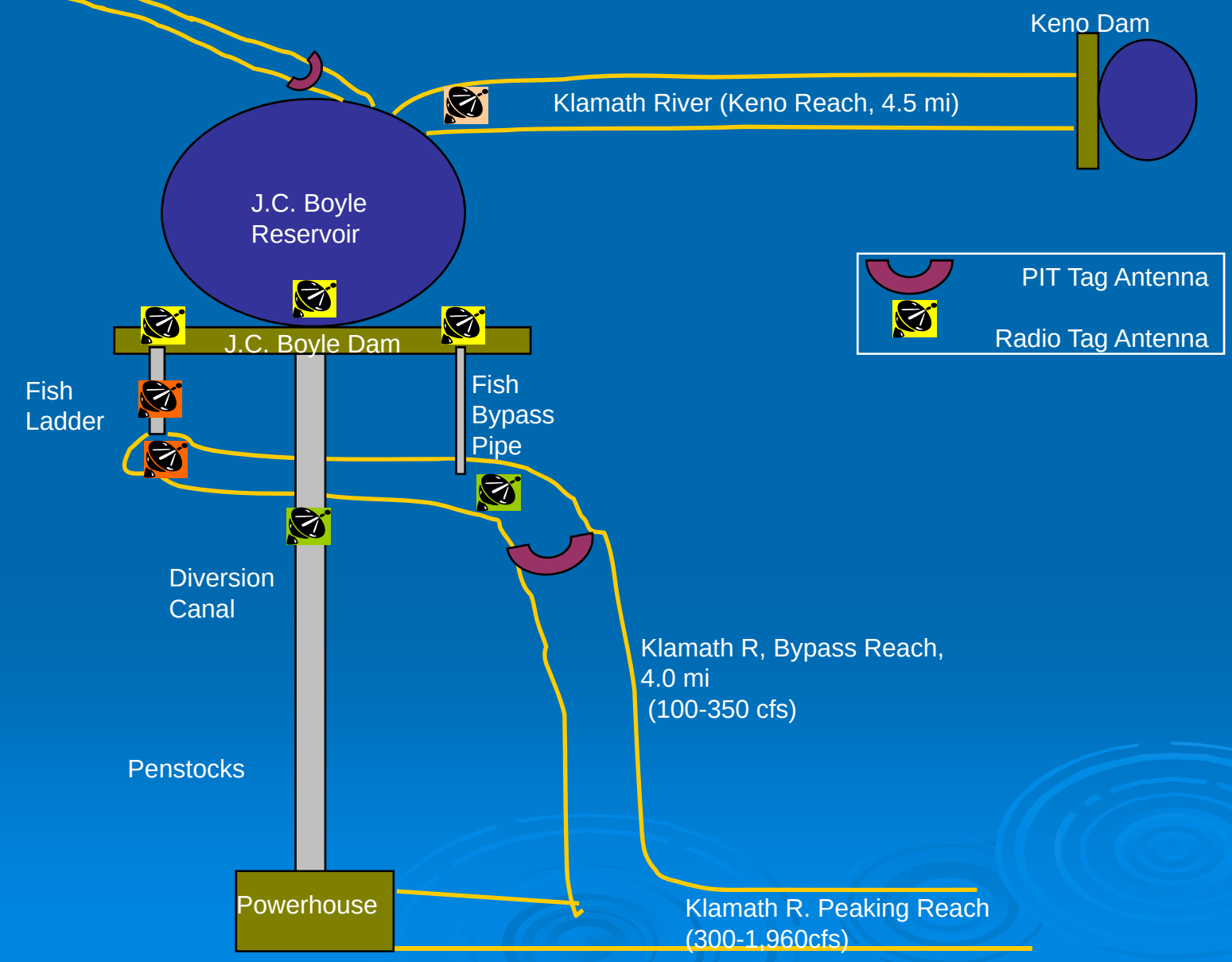
Half Duplex Tags

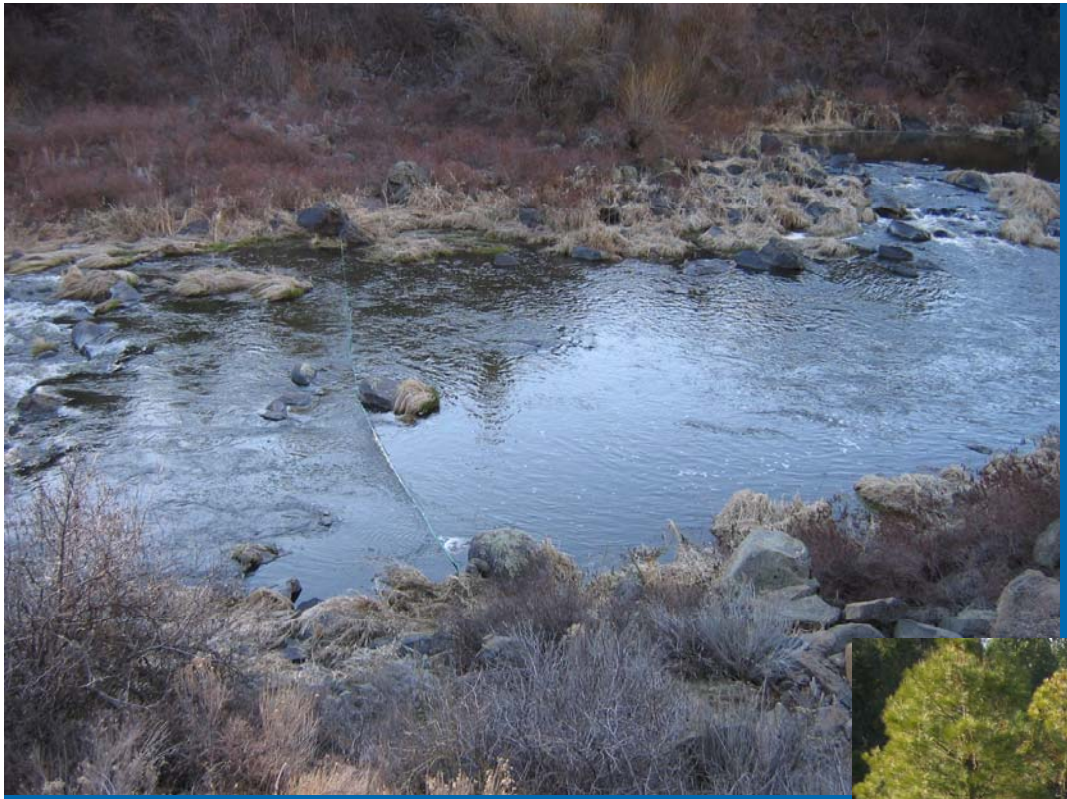
- Klamath Redband Trout
  - Migration patterns of adults and juveniles
  - Influence of J C Boyle Dam
  - Validate radio tagging results
- Hood River Bull Trout
  - Life history of fluvial population
  - Passage/entrainment at irrigation diversions

Study Area


OREGON
Upper Klamath Lake
Spencer Creek
Llink River Dam
Keno Dam
J. C. Boyle Dam
J. C. Boyle Powerhouse
Klamath River
Copco Dam #1
Shovel Creek
Iron Gate Dam
N
0
5
10
20 Miles

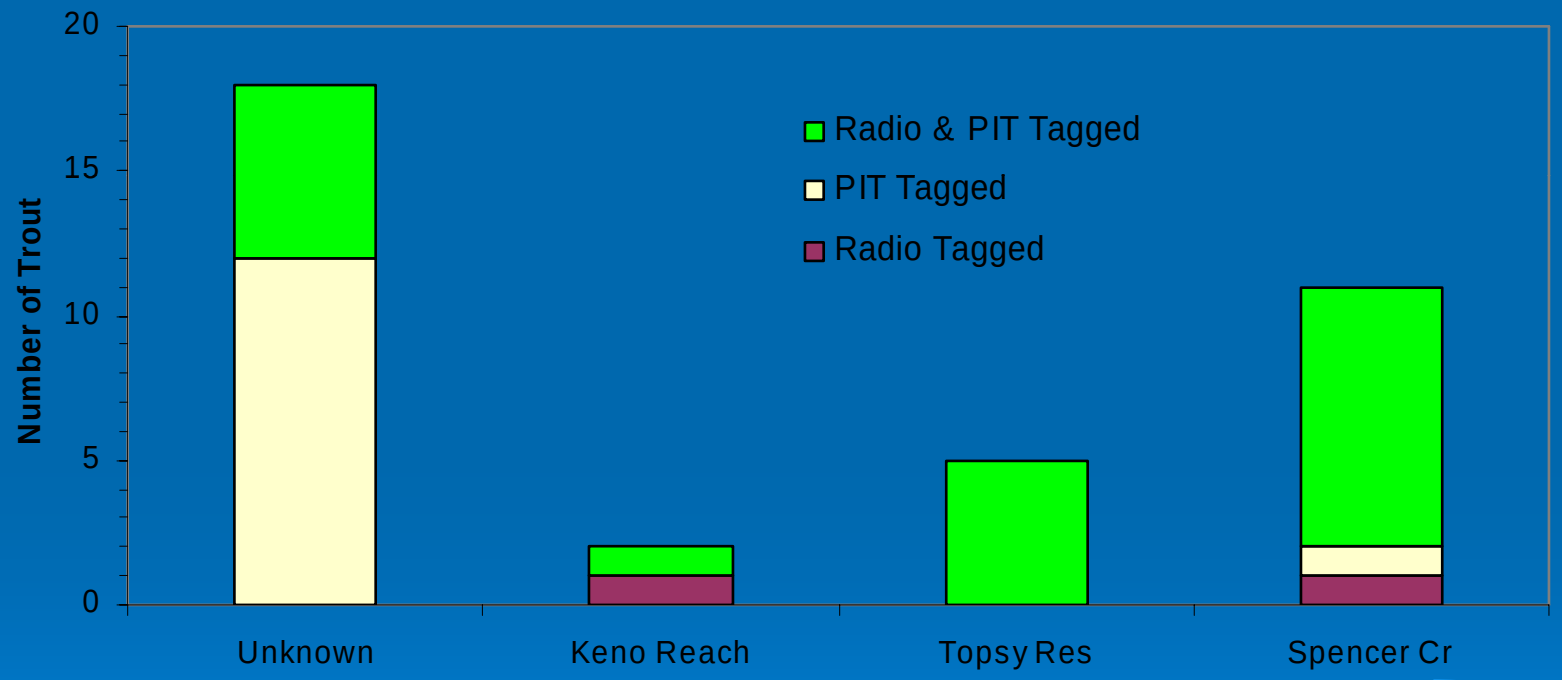
Study Schematic





PIT-tag antenna arrays

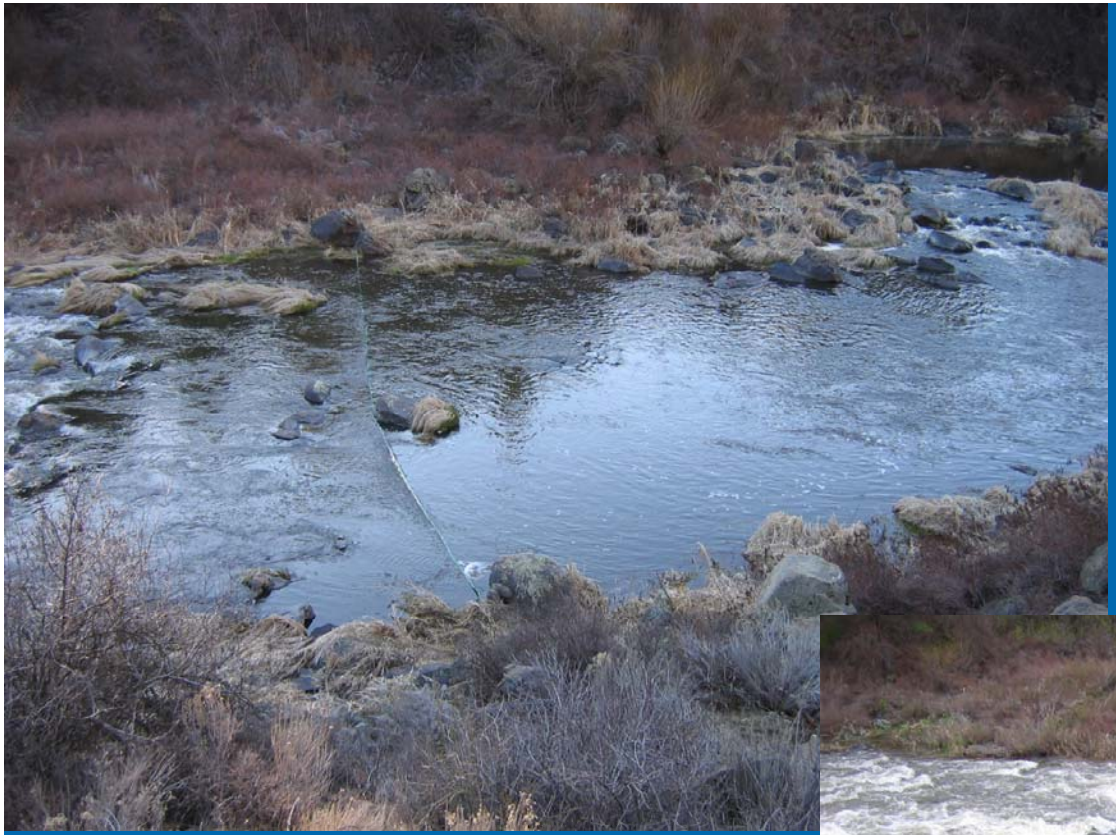
Location of Keno Reach Trout During Spawning Season



Detections of Adult Trout at Spencer Creek Array

Tagging		PIT-tag	Length	Weight	Observations (Date, Time)	
Date	RM	code	(mm)	(g)	First	Last
9/27/04	229.5	26967298	495	NA	4/15/05 19:59	4/29/05 4:42
10/21/04	229.5	33230179	371	691	3/19/05 20:42	4/27/05 23:55
10/21/04	229.5	33230216	459	1341	4/17/05 20:50	NA
10/22/04	231.5	33230192	397	704	4/16/05 19:17	5/5/05 22:24
3/14/05	229.5	33230224	414	966	4/7/05 20:08	5/1/05 3:41
3/14/05	229.5	38074696	372	635	3/23/05 19:14	4/3/05 3:10
3/15/05	231.5	33230200	414	1010	NA	4/16/05 2:37

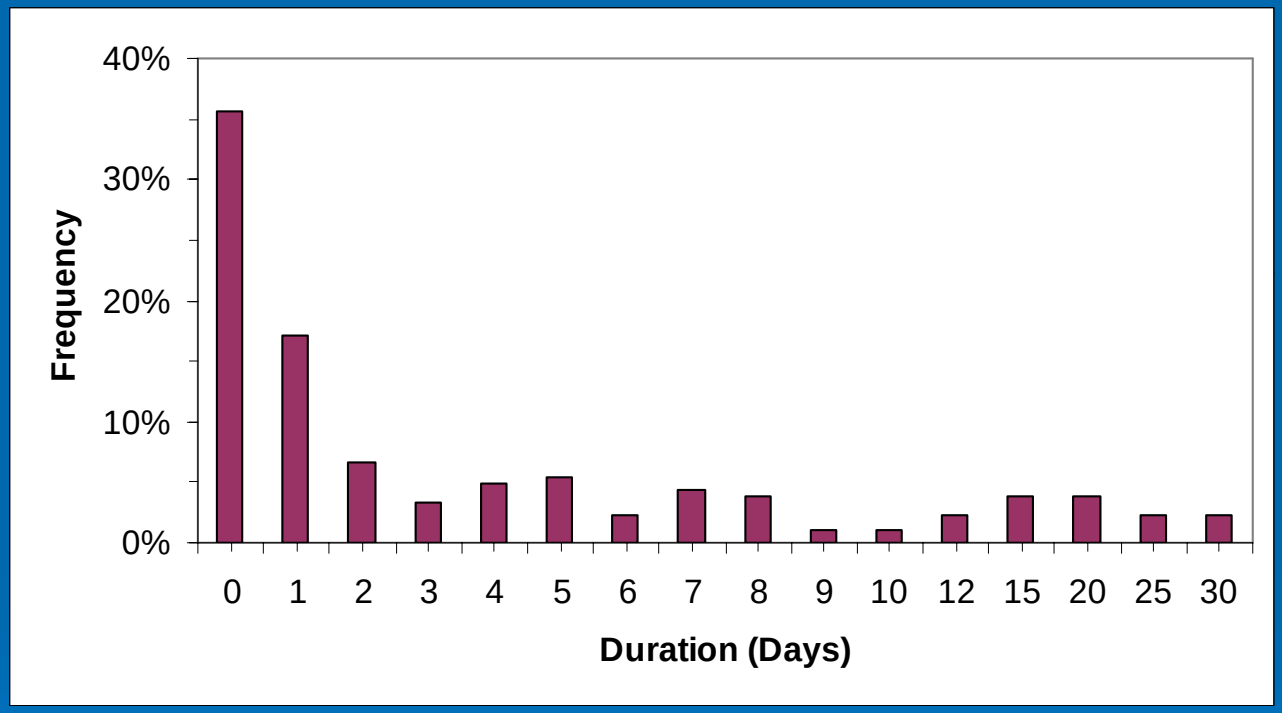
J.C. Boyle Spill



Bypass reach PIT-tag array

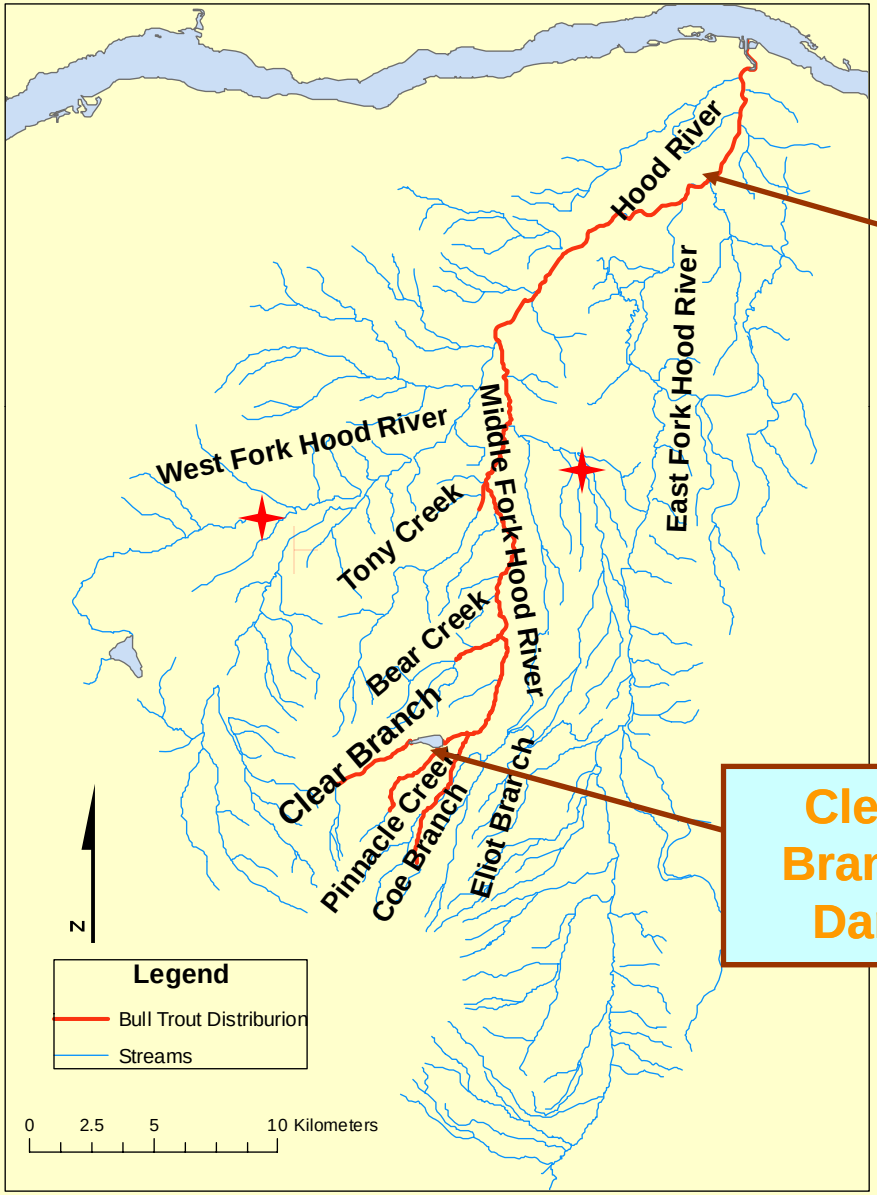
PIT-tag recoveries

- Outmigrated from Spencer Creek: 183 (60%)



- Klamath Bypass: 3*
  - 36, 20, 27 days

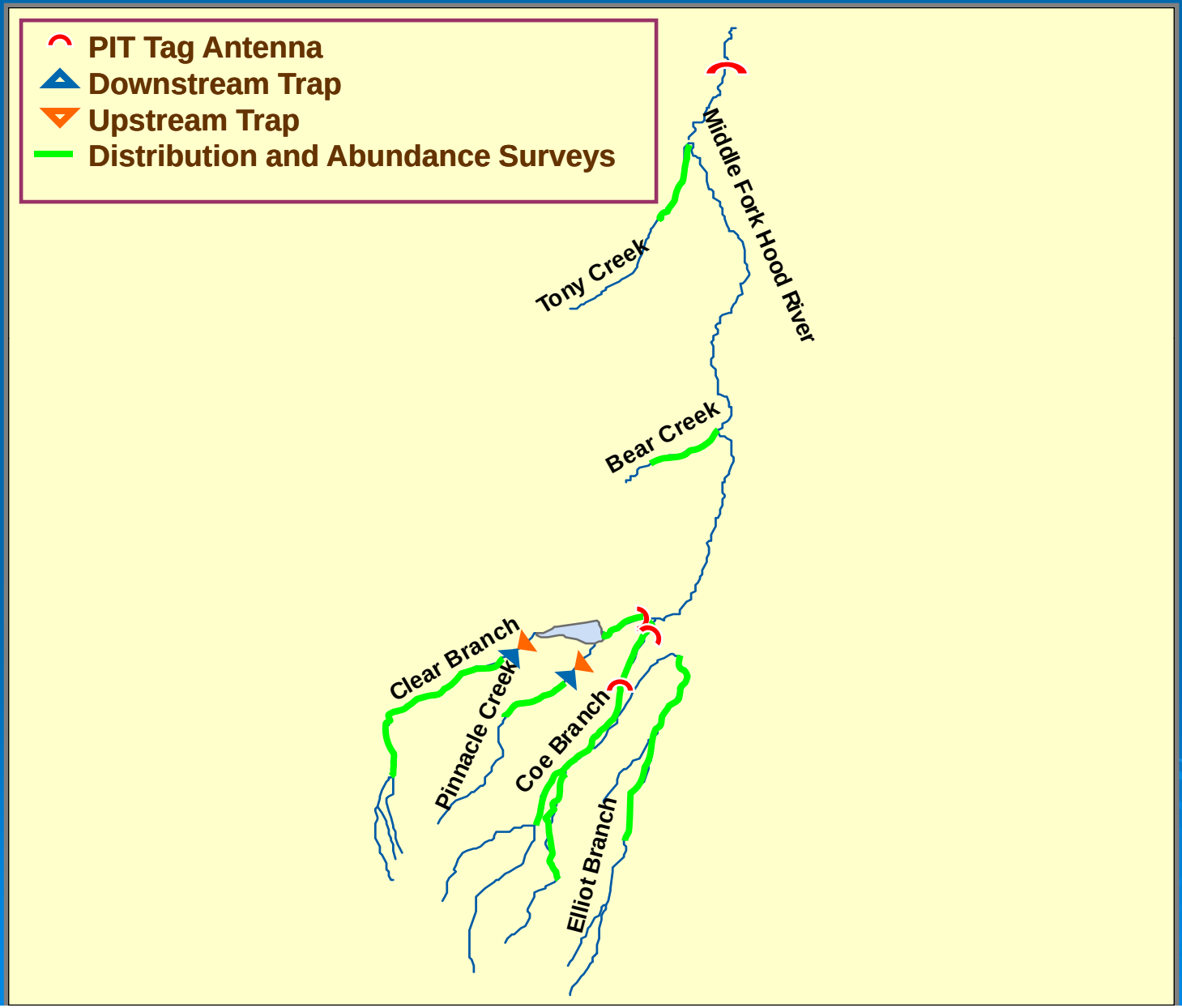
Suspected Bull Trout Distribution in Hood River



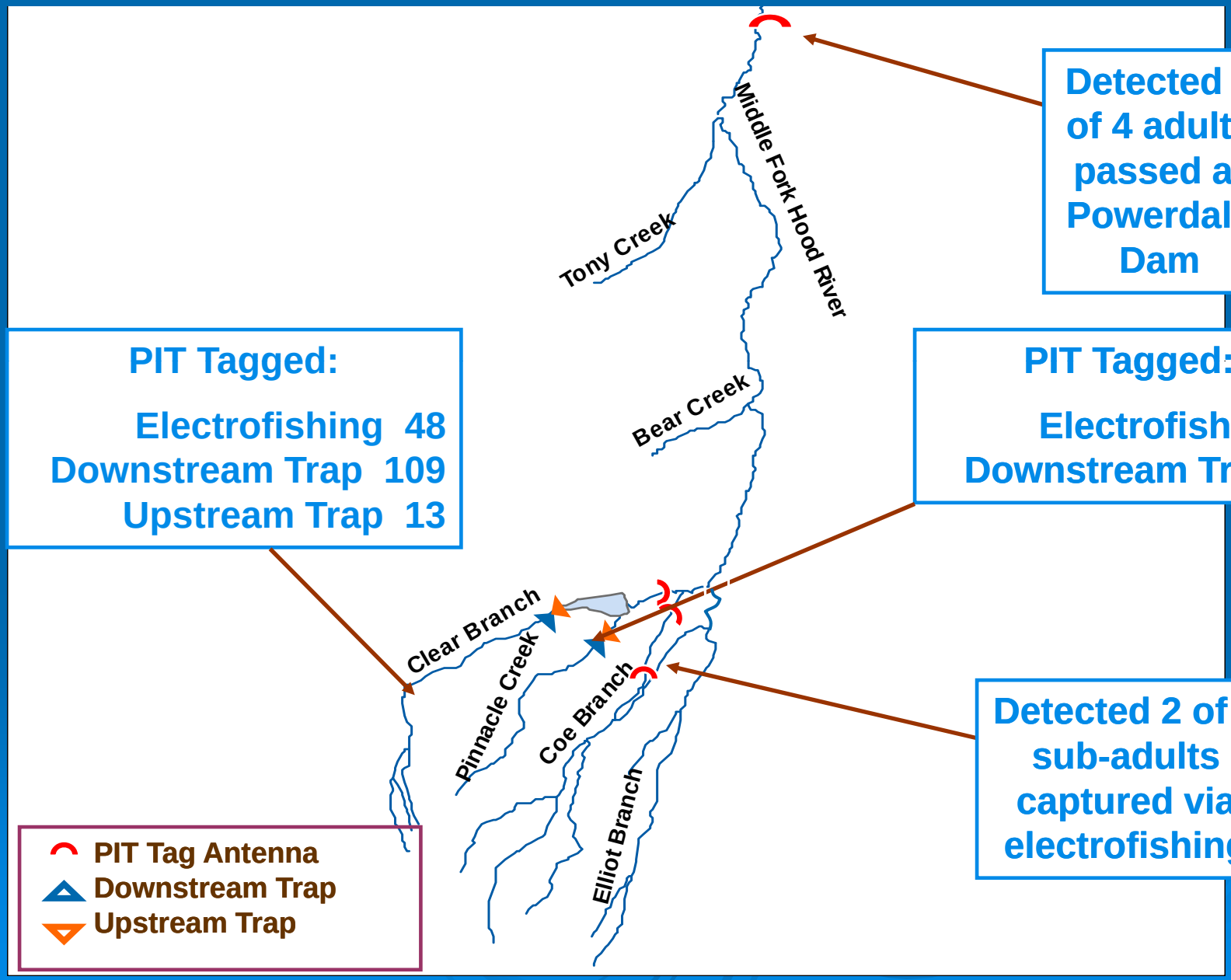
Powerdale Dam

Clear Branch Dam

Study Area


PIT Tag Antenna
Downstream Trap
Upstream Trap
Distribution and Abundance Surveys
Middle Fork Hood River
Tony Creek
Bear Creek
Clear Branch
Pinnacle Creek
Coe Branch
Elliot Branch

PIT Tagging



Detected 3 of 4 adults passed at Powerdale Dam

PIT Tagged:

Electrofishing	48
Downstream Trap	109
Upstream Trap	13

PIT Tagged:

Electrofishing	4
Downstream Trap	10

Detected 2 of 4 sub-adults captured via electrofishing

Issues

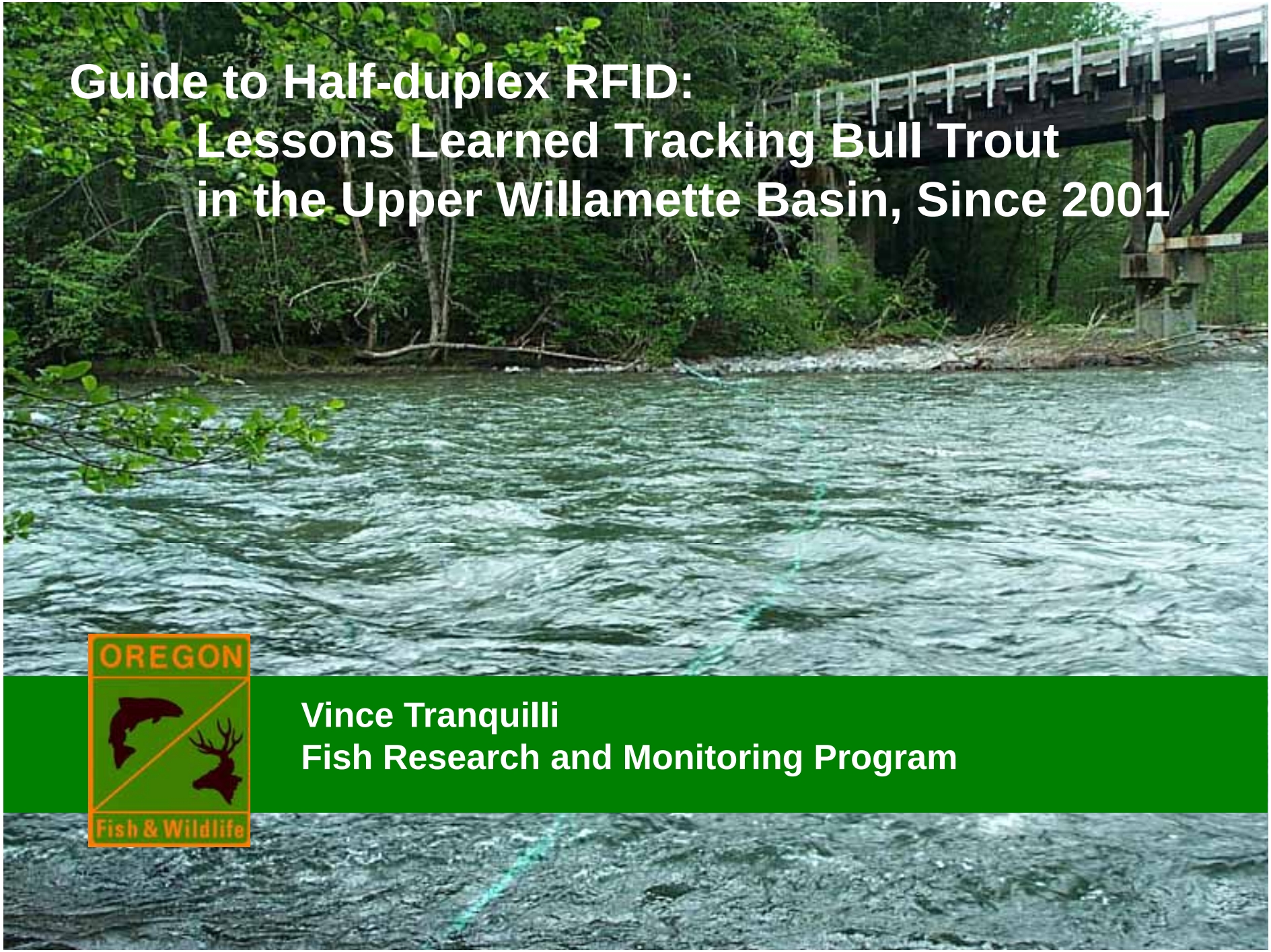
- Not knowing how to build your own reader…
  - Plug-n-play reader is nice, but relatively expensive, possessing a backup may be prohibitively expensive.
  - Vince and Mark may not always have and extra reader lying around.
  - If something goes wrong with your plug-n-play reader, it may be too complicated for you to fix.
- Open source DIY pit-tag readers

Guide to Half-duplex RFID: Lessons Learned Tracking Bull Trout in the Upper Willamette Basin, since 2001

V. Tranquilli

We use Texas Instruments Series 2000 low frequency systems to build stream-width interrogation sites for 23 mm long, half-duplex, passive integrated transponders (or PIT tags). We use these systems in conjunction with other methods to track juvenile and adult bull trout migrations, determine the number of times an individual spawns, determine the earliest dam passage dates, estimate abundance, individual growth rates, juvenile-to-adult survival, and to identify habitat use. This system also makes it possible to evaluate fish passage routes through dams and fish behavior around weirs, ladders, and trapping sites. In this presentation, I review the basic system components, building materials, parameters, common problems, general relationships, and advantages of a swim-through versus a swim-over antenna configuration. I describe the basic steps involved in building site-specific antennas, emphasizing the importance of establishing an antenna performance baseline for comparison before adding complexity to the system, such as different system configuration, a non-battery power supply, data logger, additional antenna, or installing the system at a site which may have other sources of radiated noise. I provide detailed schematics, which can be used to build at least ten different half-duplex antennas. These antenna designs include the wire type, antenna shape, size, number of loops (or wraps), wire orientation, wire spacing, and recommended operating voltage. I also show how we use these antenna types for various applications, including large rivers, fish ladders, culverts, baited or fish attraction stations, and portable backpack systems. I demonstrate two methods we have used to increase the interrogation volume at a site. One method involves adding a resonant antenna to the system, and another involves building a single antenna with multiple detection fields. I also demonstrate two ways to determine the direction of movement. One involves multiplexing antennas at an interrogation site and other involves creating a network of interrogation sites within a basin.

Return to top



Guide to Half-duplex RFID: Lessons Learned Tracking Bull Trout in the Upper Willamette Basin, Since 2001

Vince Tranquilli
Fish Research and Monitoring Program

Goals

- Answer most common questions
- Provide antenna designs we know work

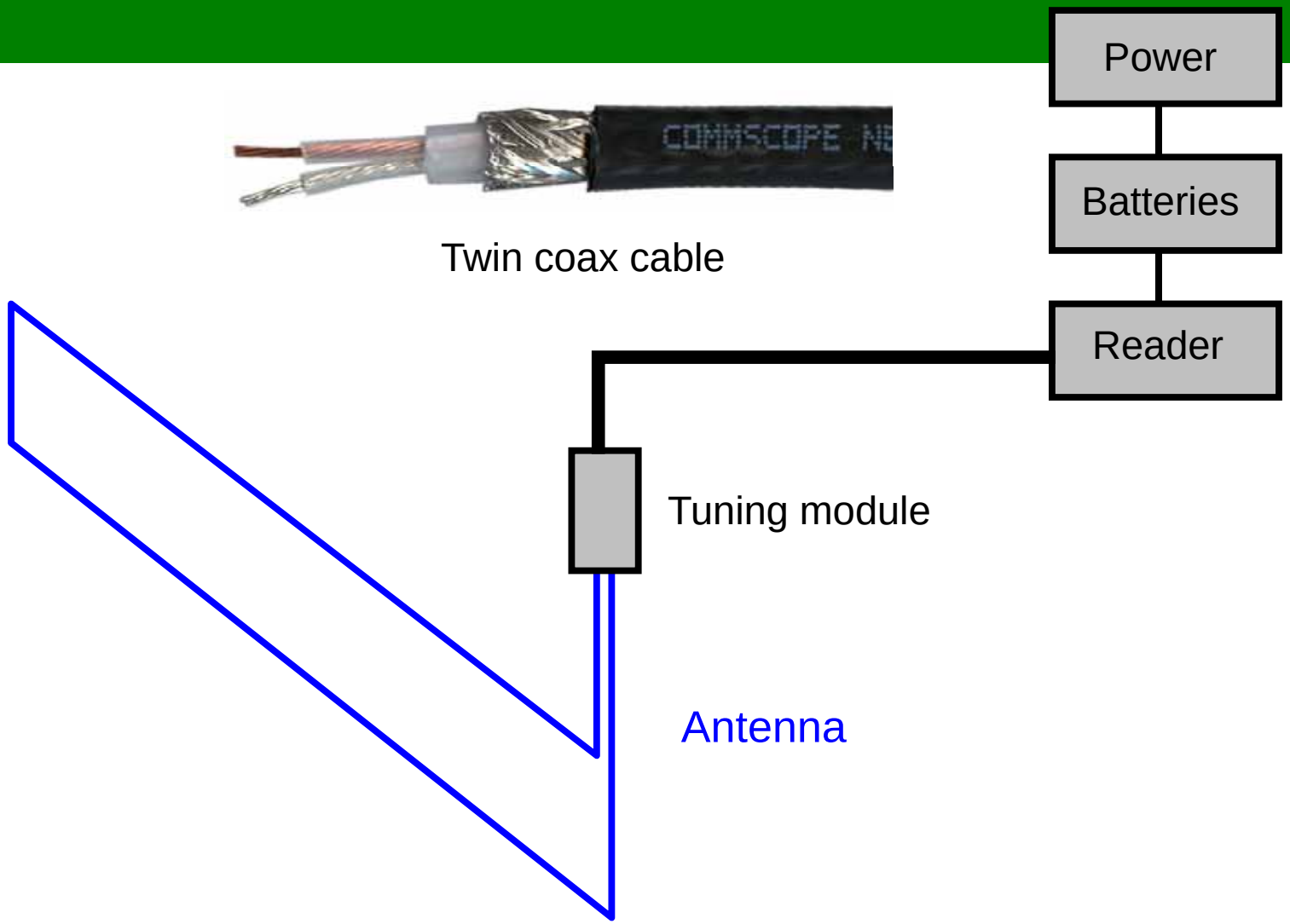
FDX
12 mm

HDX
23 mm

23 mm HDX
Texas Instruments

Image by Warren Leach

Basic System



Wire types we use

- 12 gauge (THHN) house wire
- 8 gauge speaker wire
- 1-2/O welding wire

Building Half-duplex Antennas

Parameters

- Inductance
- Resistance
- Capacitance
- Impedance

Building Half-duplex Antennas

What really matters

- Wire diameter and length
- Antenna shape
- Number/direction of wraps (or loops)
- Space between wires
- Proximity/relationship to other metals

Large trial-and-error component

General Relationships

Smaller antenna
More wire wraps
Smaller diameter wire

⟷

Larger antenna
Fewer wire wraps
Larger diameter wire

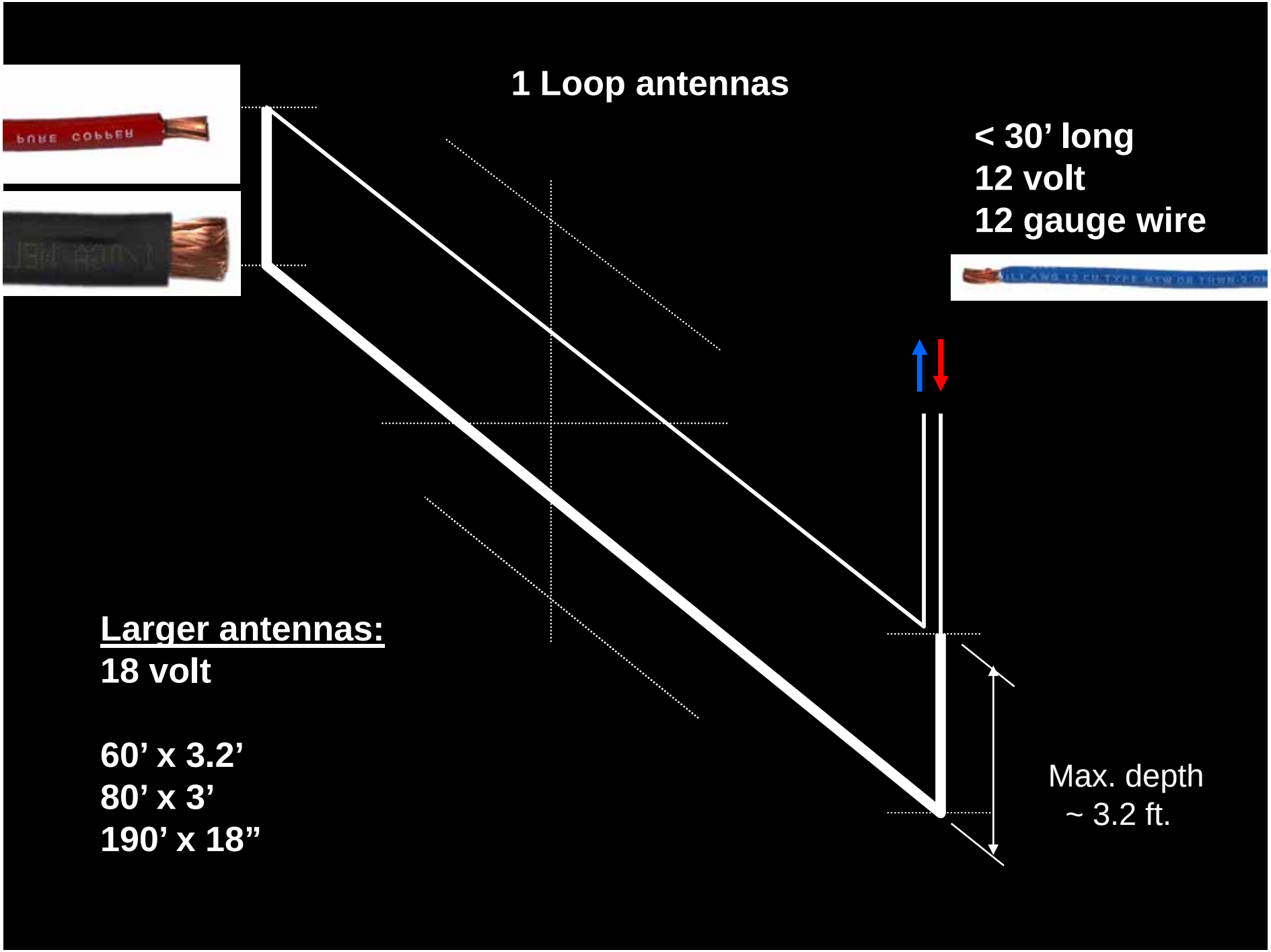
Steps to Building Antennas

- Choose site
- Site-specific size requirement
- Build full size mock-up
- Measure read distance - connected to battery - no data logger

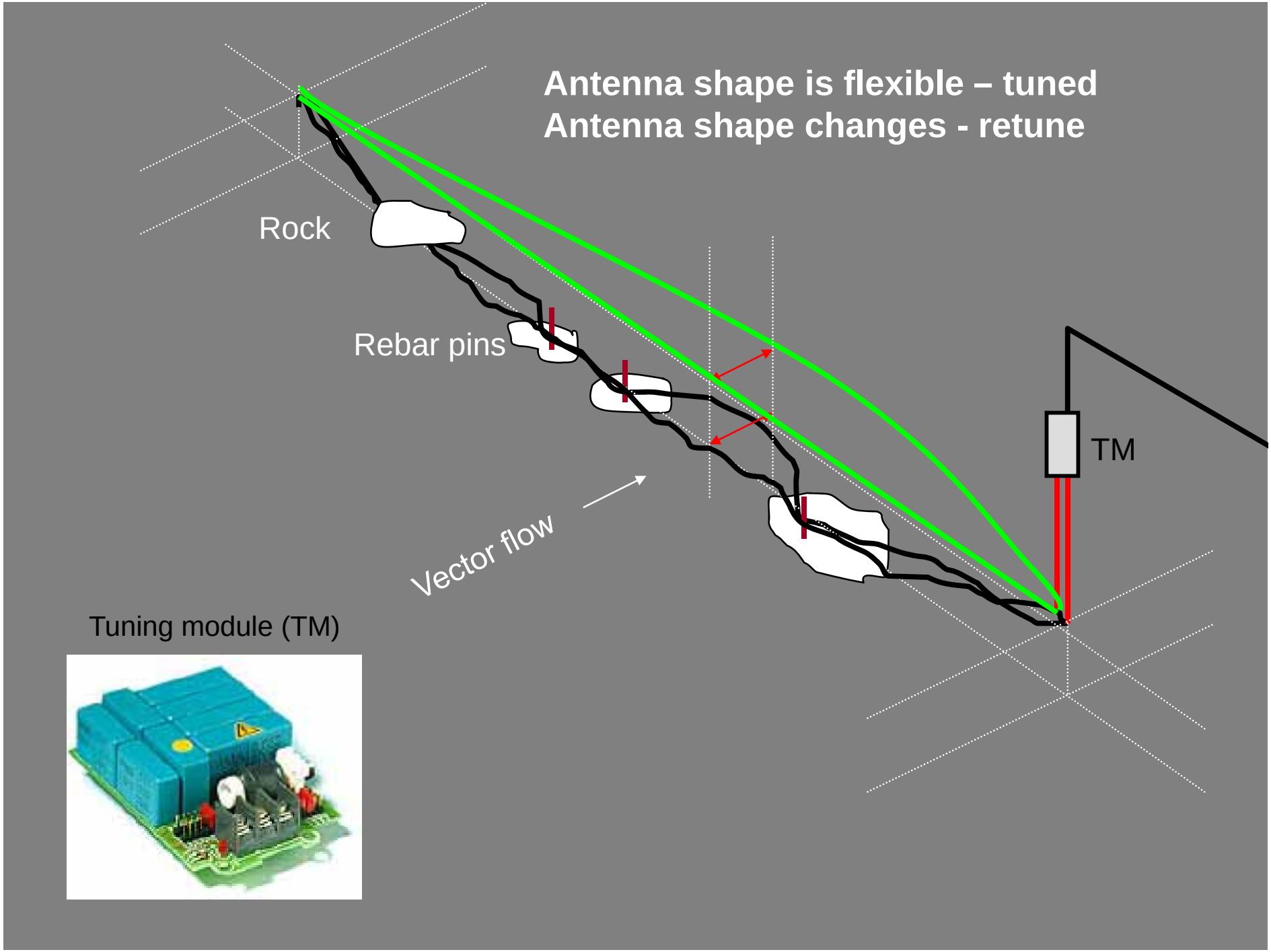
Baseline for comparison

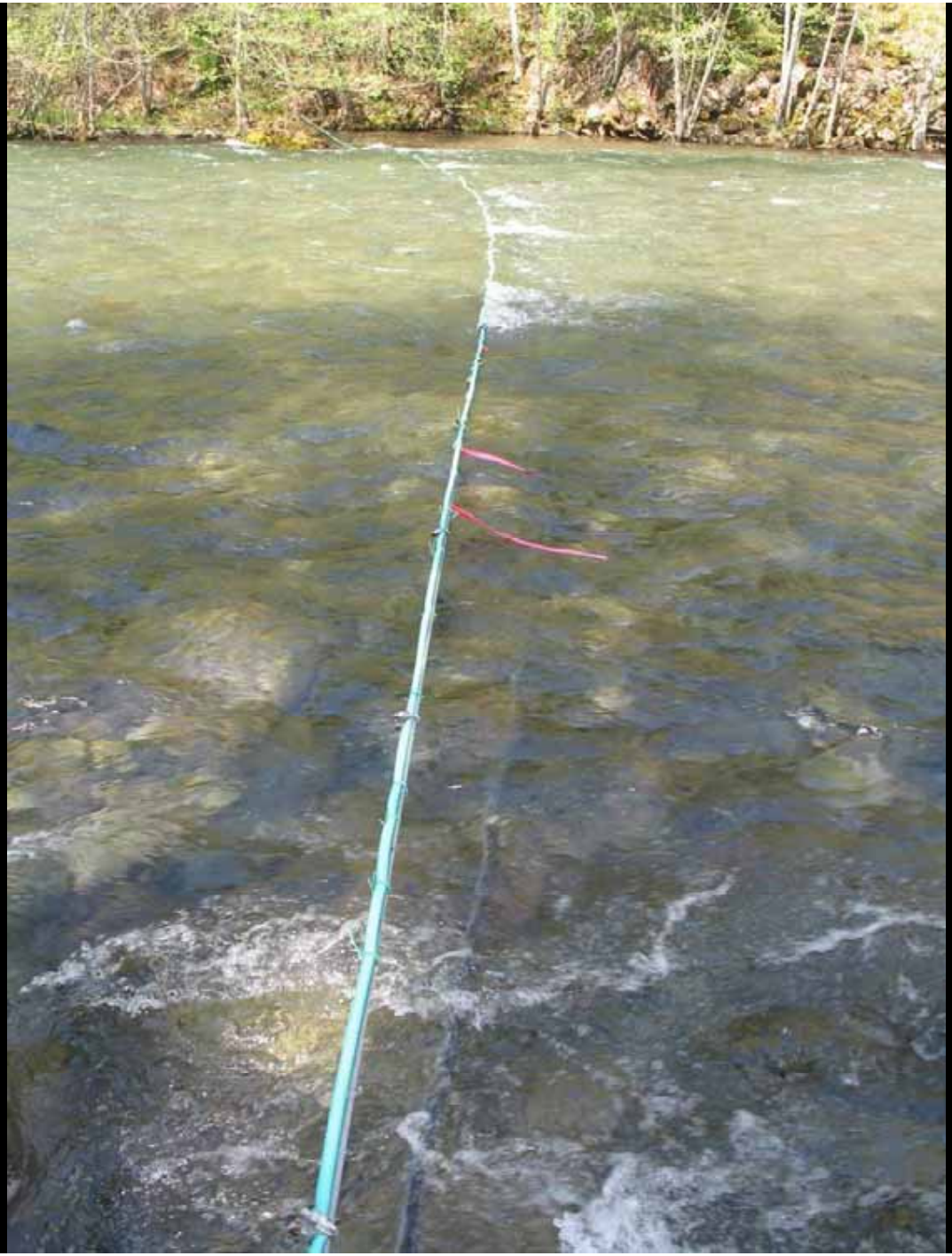
Steps to Building Antennas

- Make changes (power source, site, no. antennas, or read rate)
- Any reduction in read distance - know source of interference

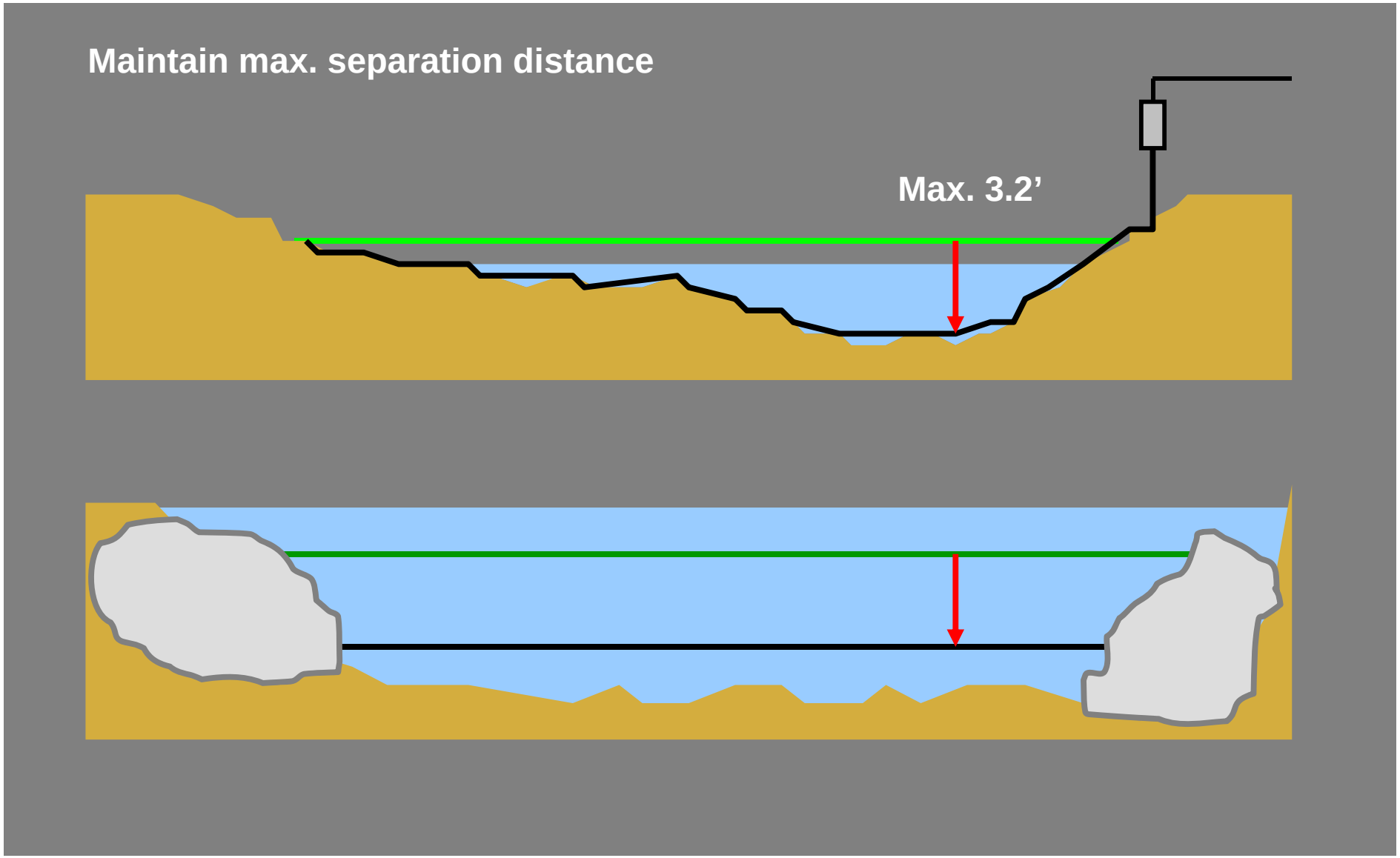

1 Loop antennas
< 30’ long
12 volt
12 gauge wire
Larger antennas:
18 volt
60’ x 3.2’
80’ x 3’
190’ x 18”
Max. depth
~ 3.2 ft.

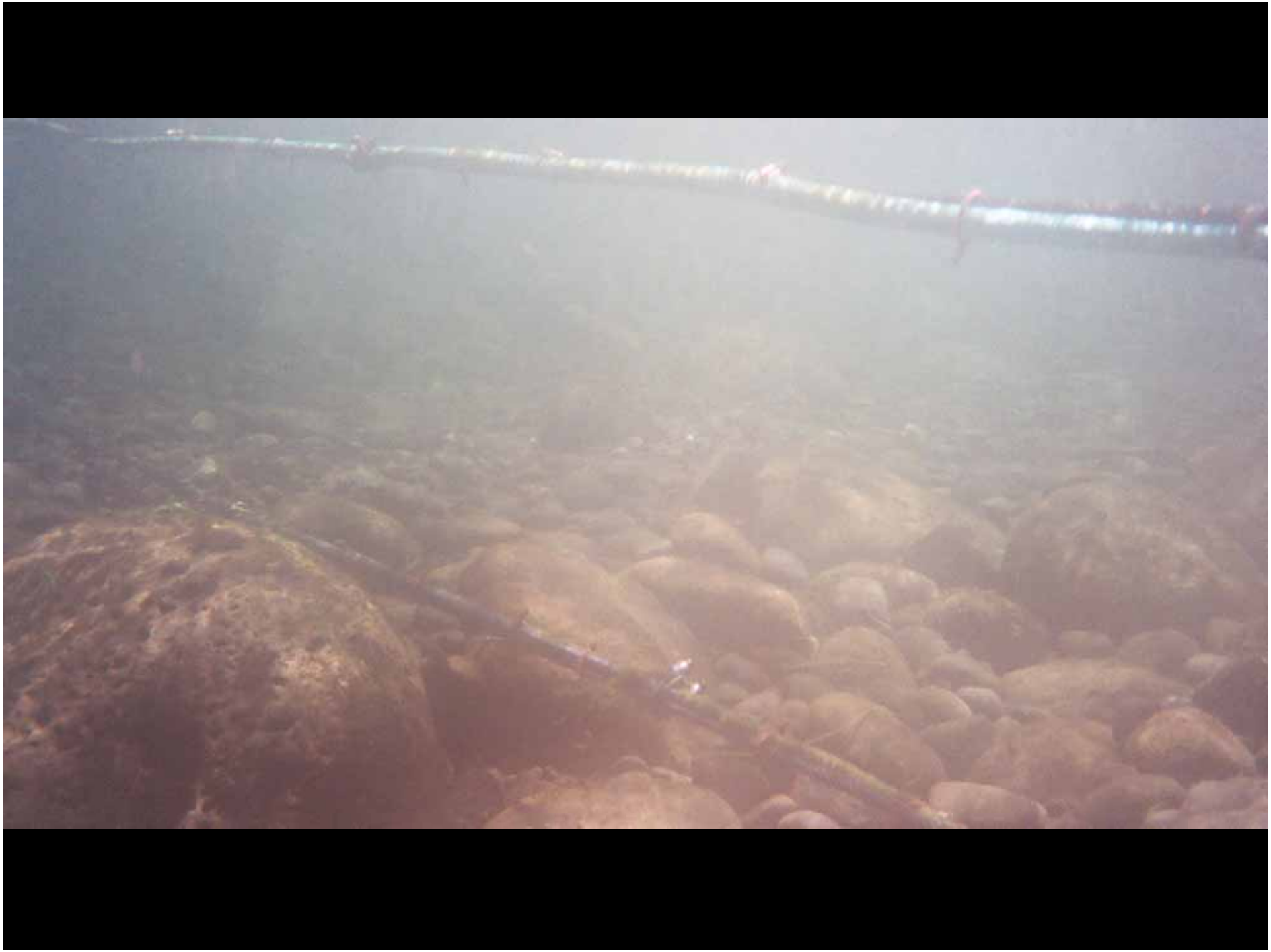
~190’ x 18”


Antenna shape is flexible – tuned
Antenna shape changes - retune
Rock
Rebar pins
TM
Vector flow
Tuning module (TM)



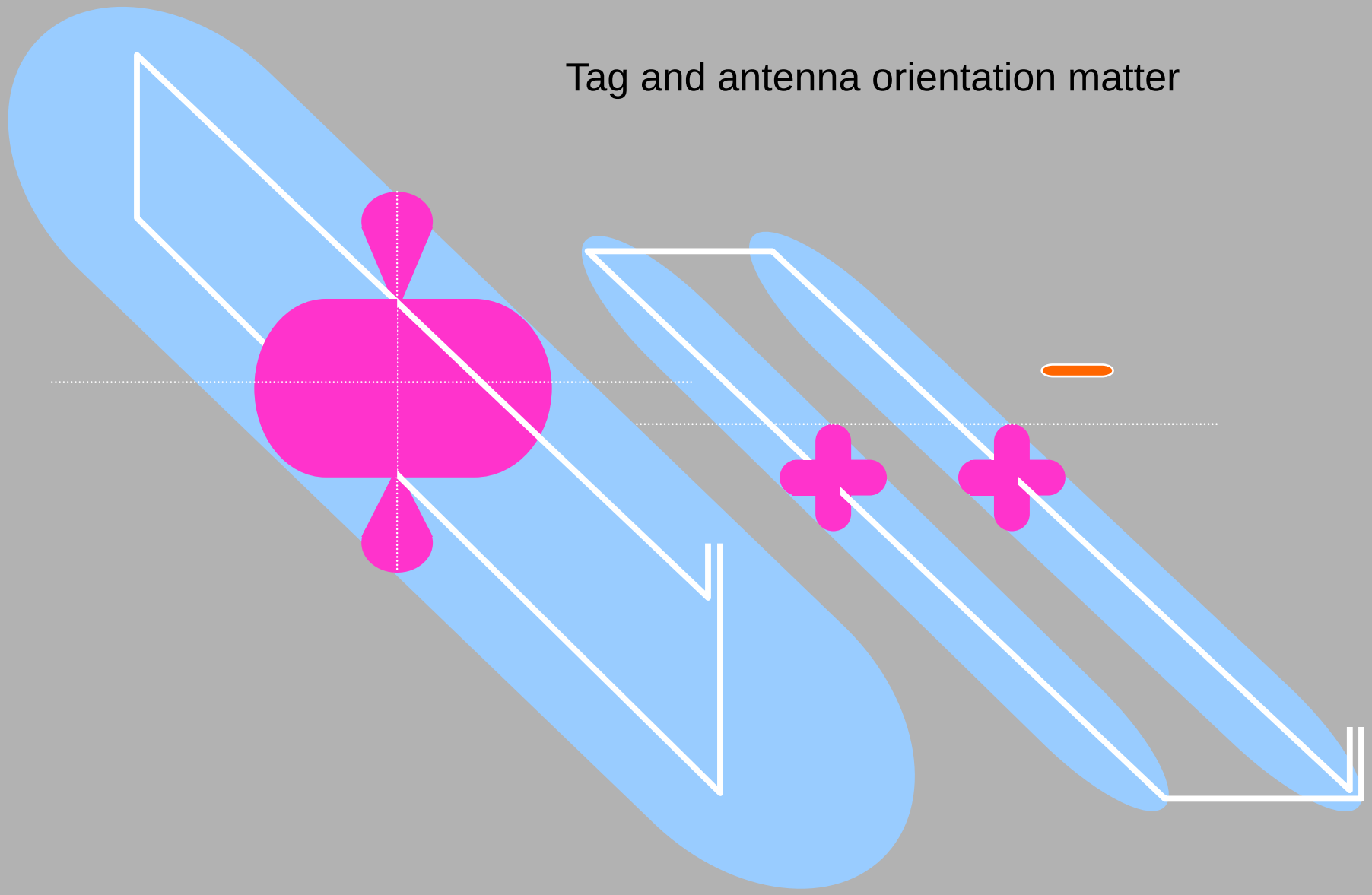
Stream Profile





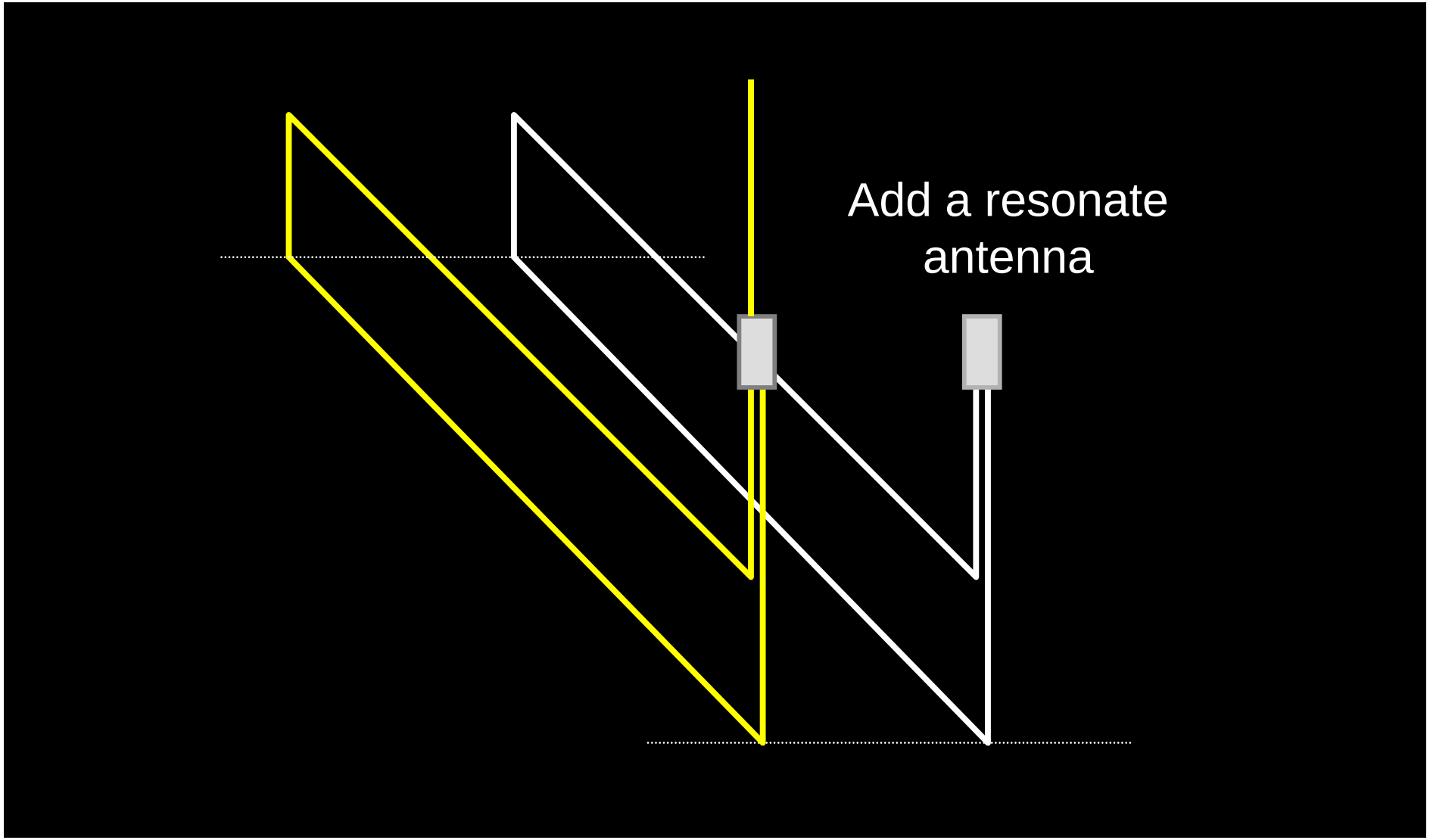
Swim-thru antenna vs. Swim-over antenna

Tag and antenna orientation matter



Materials

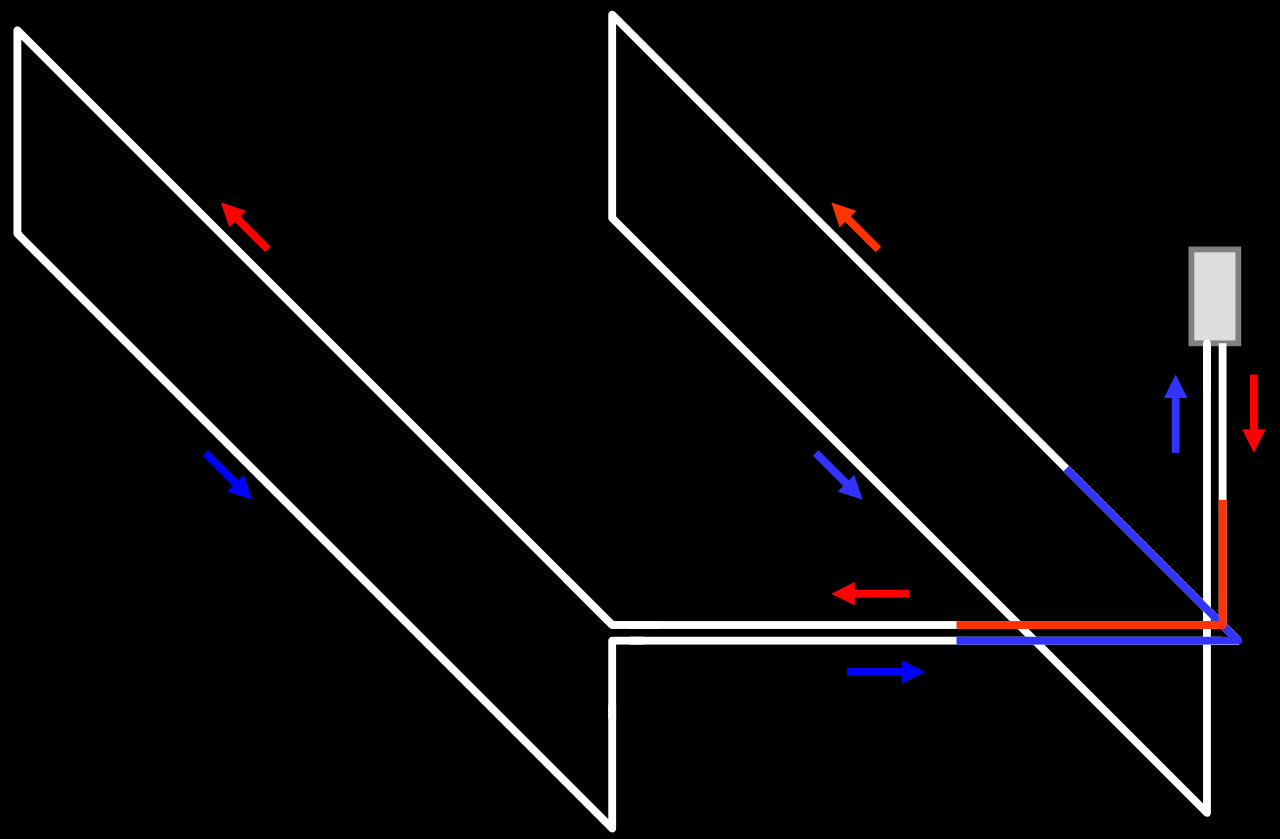
How can I increase detection efficiency?



Resonant Antenna

How can I increase detection efficiency?

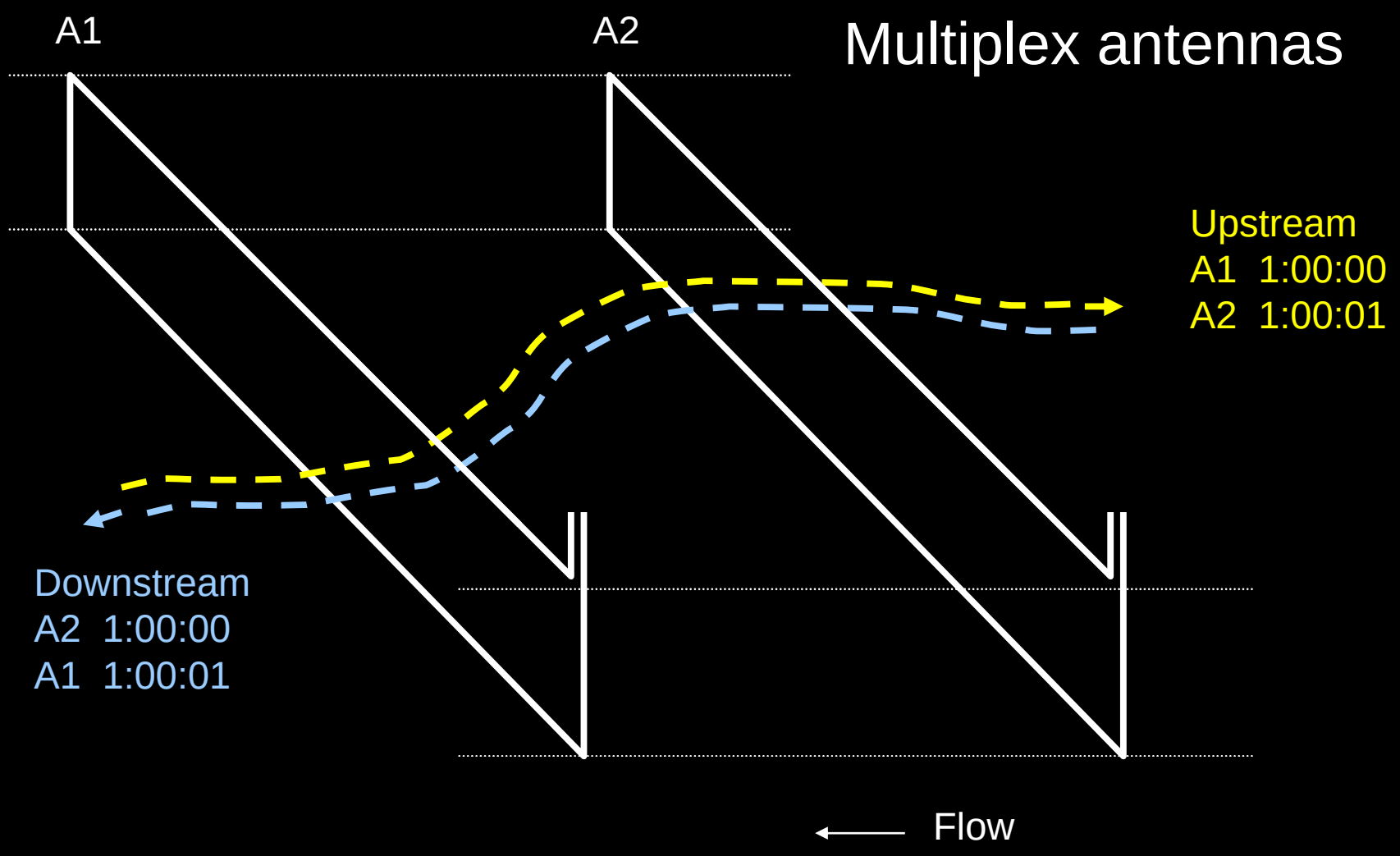
Cross stream multiple times



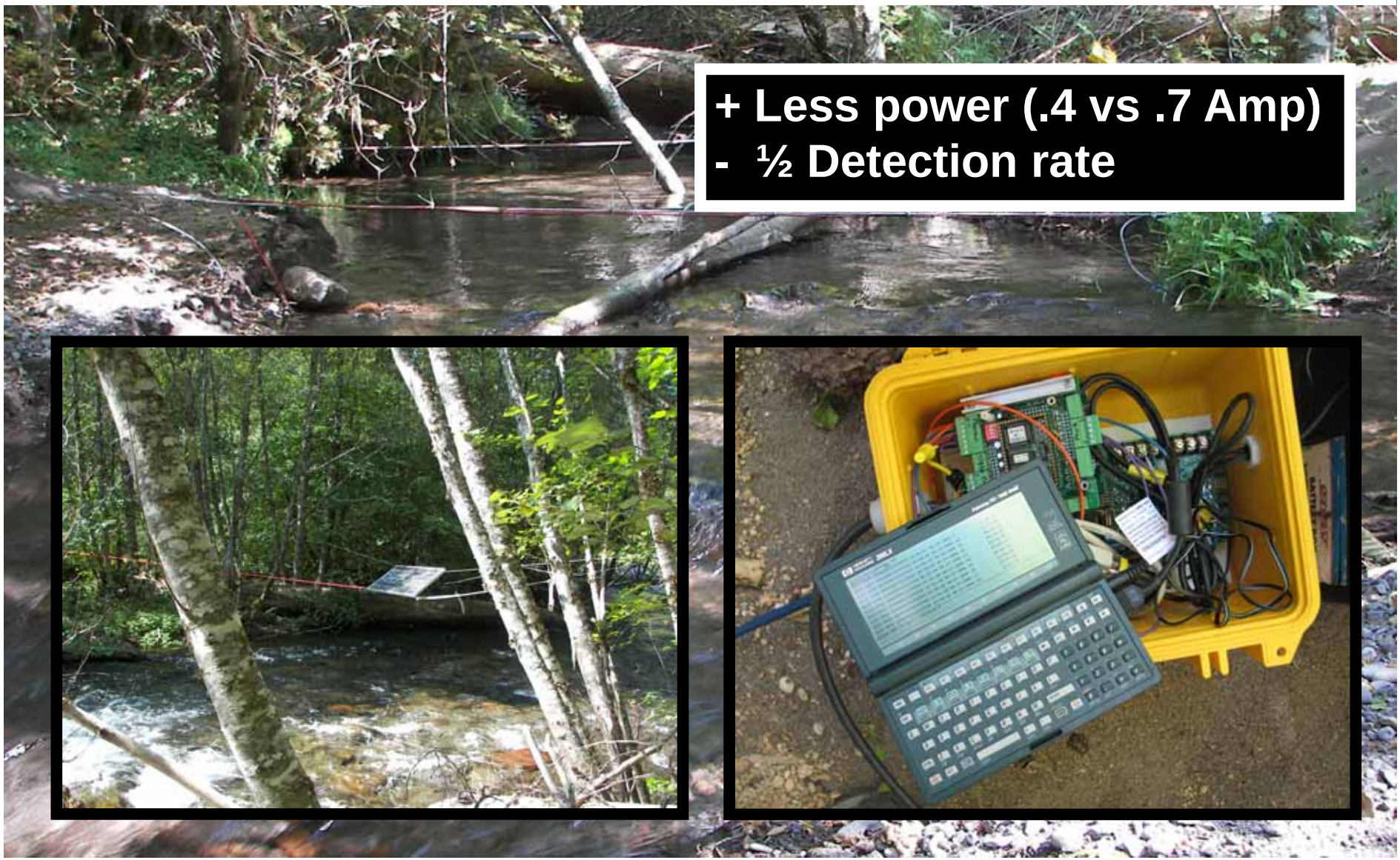
1 antenna
1 loop
10-12 gauge
3’ x 15’

Cross stream multiple times

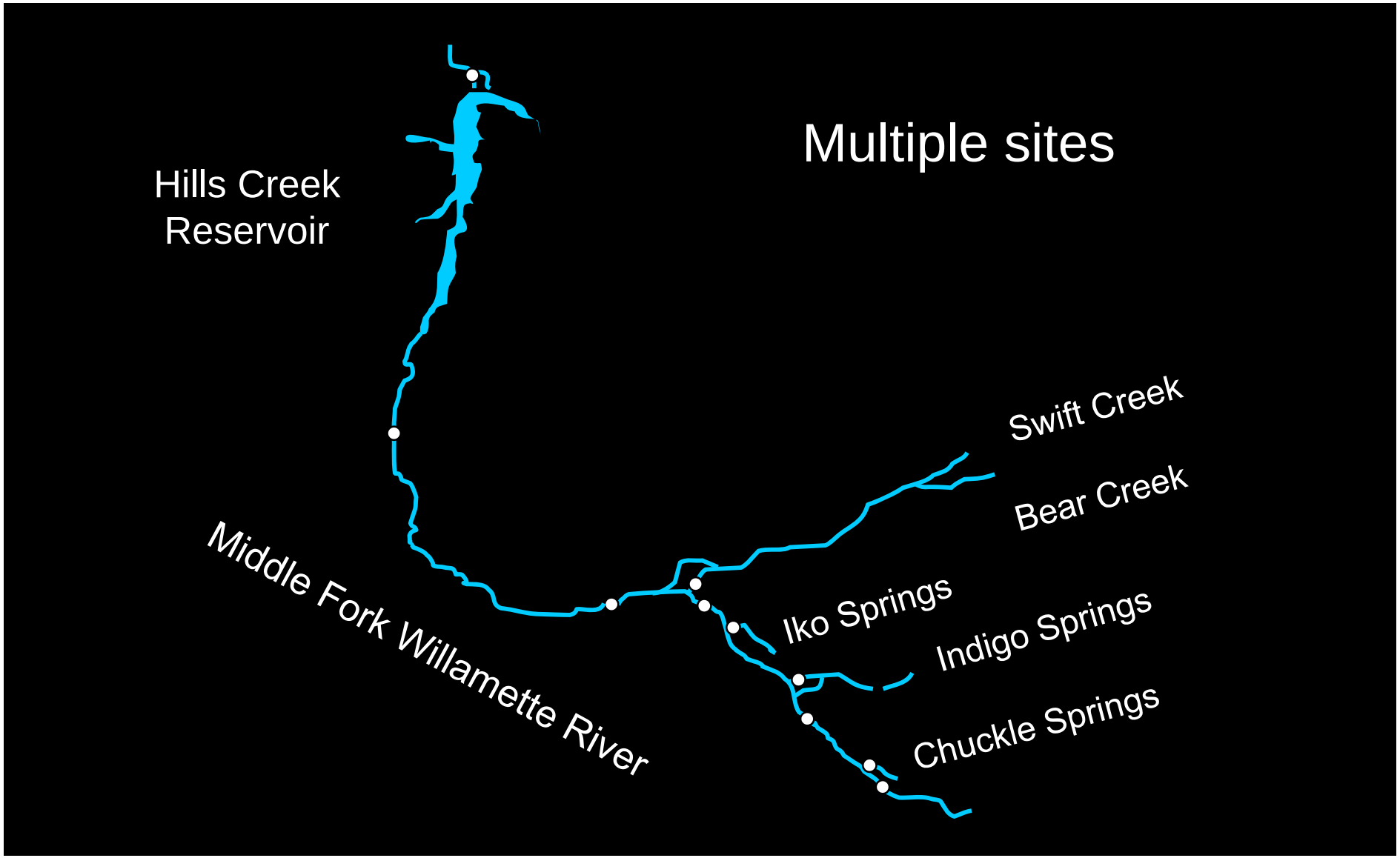
How can I determine directional movement?



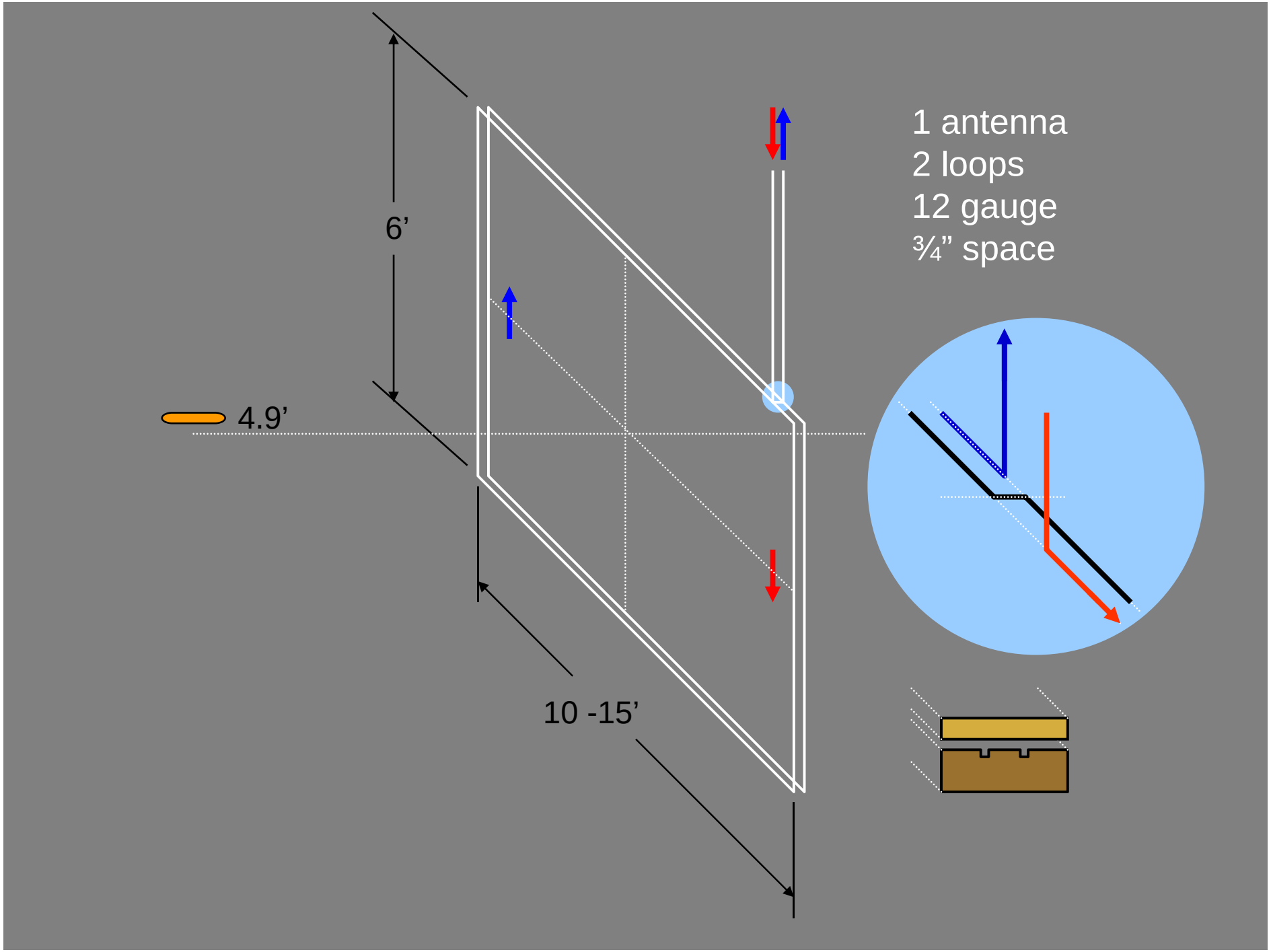
Multiplex Antennas

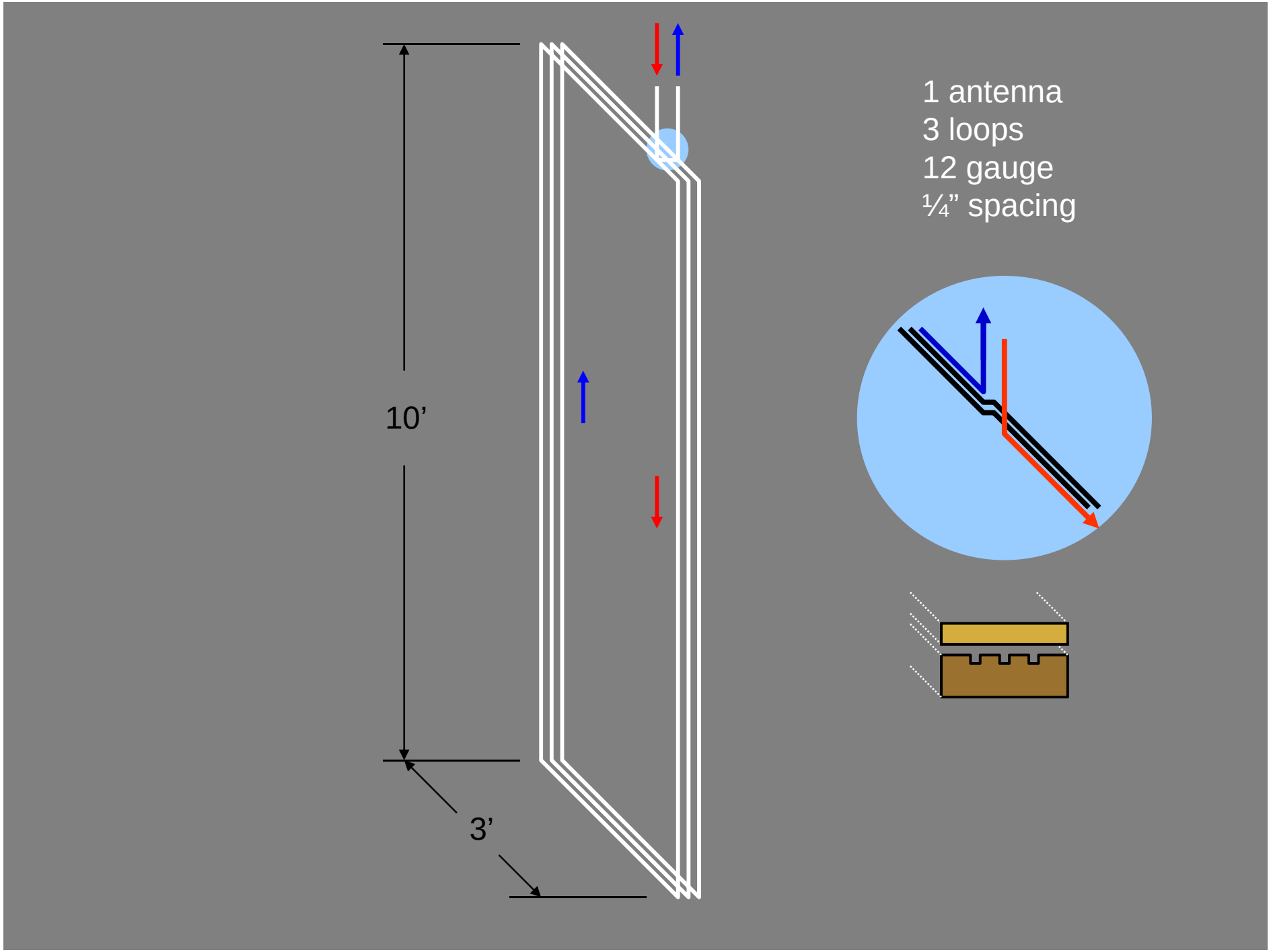


How can I determine directional movement?

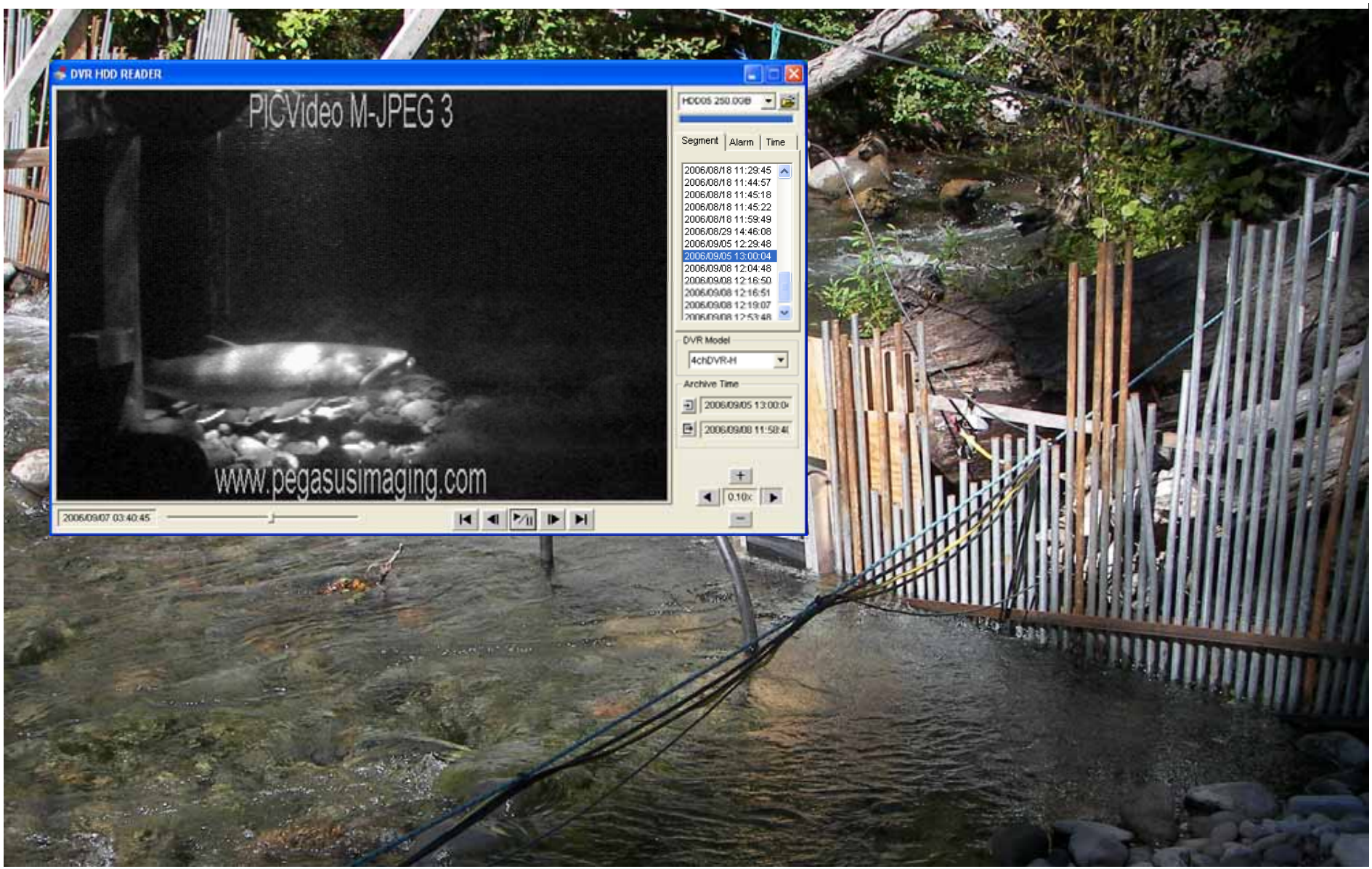


Fish Ladders

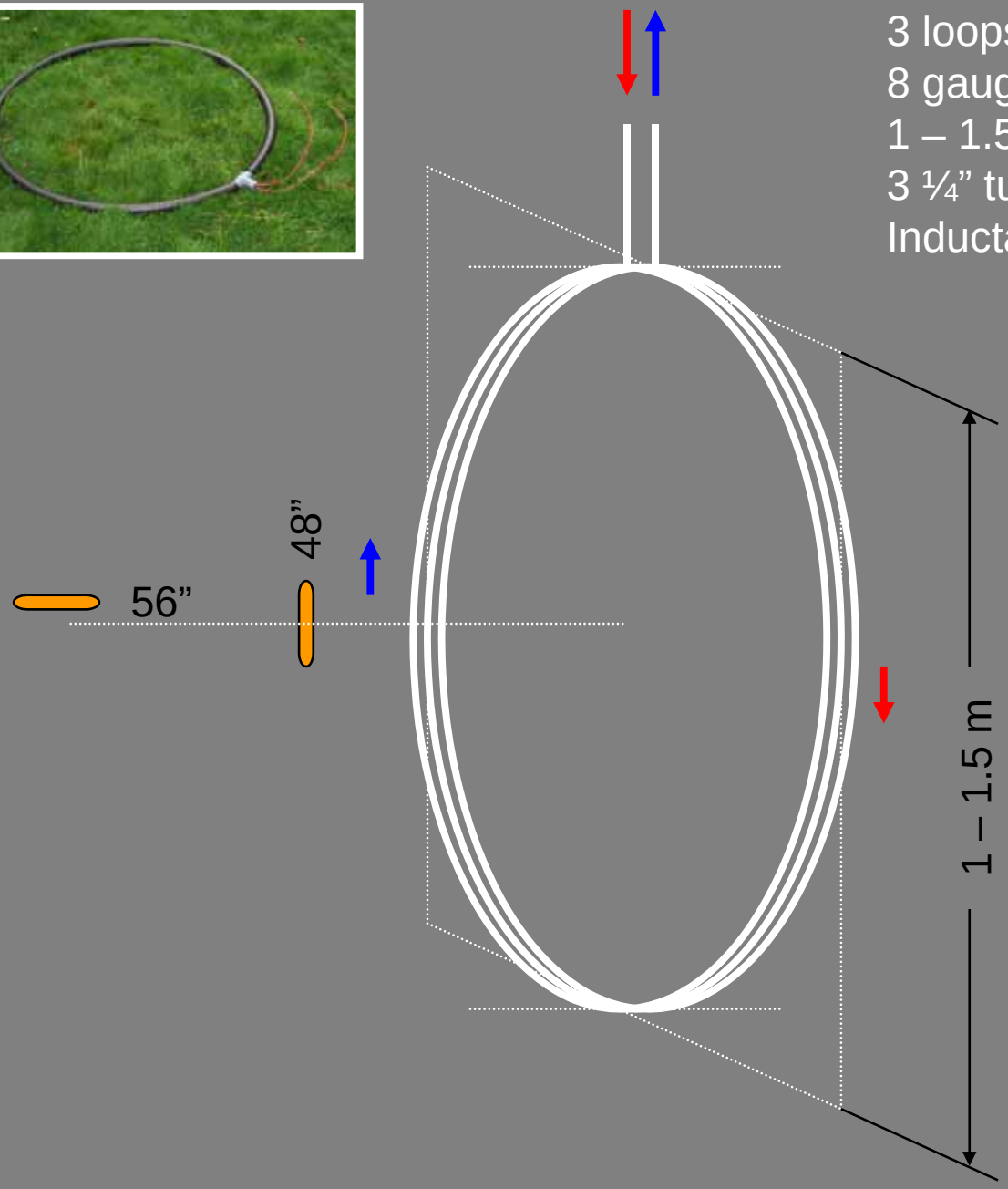

1 antenna
2 loops
12 gauge
¾” space
6’
4.9’
10 -15’


1 antenna
3 loops
12 gauge
¼” spacing
10’
3’

Fish Weir


DVR HDD READER
PICVideo M-JPEG 3
www.pegasusimaging.com
Segment
Alarm
Time
2006/08/18 11:29:45
2006/08/18 11:44:57
2006/08/18 11:45:18
2006/08/18 11:45:22
2006/08/18 11:59:49
2006/08/29 14:46:08
2006/09/05 12:29:48
2006/09/05 13:00:04
2006/09/08 12:04:48
DVR Model
4chDVR-H
Archive Time
2006/09/07 03:40:45

3 loops
8 gauge
1 – 1.5 m diameter
3 ¼” tube
Inductance 26 - 27.9 µH



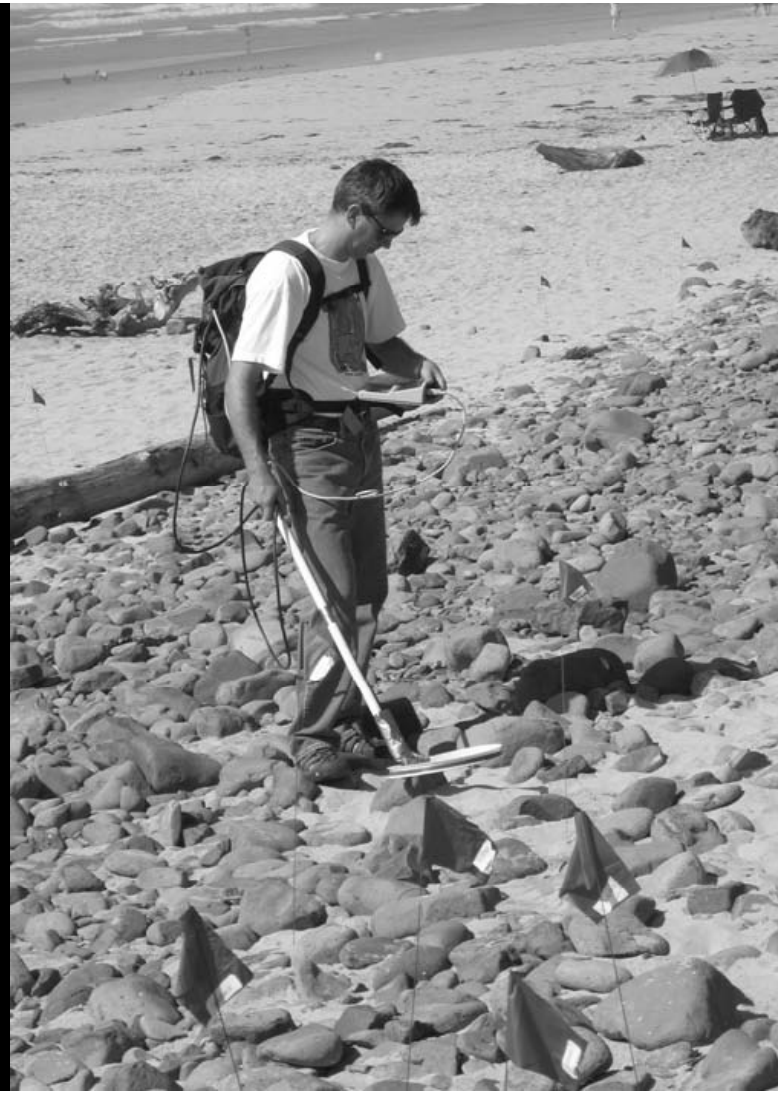
Culverts

Space to reduce interference from metal

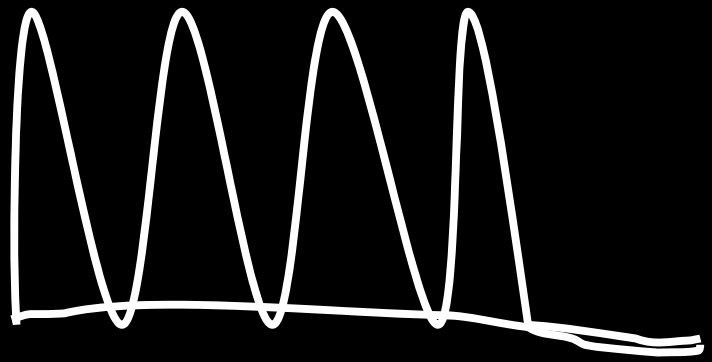
Handheld Antennas

5 loops
18 gauge wire
0.3 m diameter
Inductance 26 – 27.9 µH

Tag and antenna orientation matter



Stand Alone Antennas



Helix – attractor (light, bait,habitat)
Add video for untagged fish
1 antenna
8 gauge wire
Variable size, loops, spacing

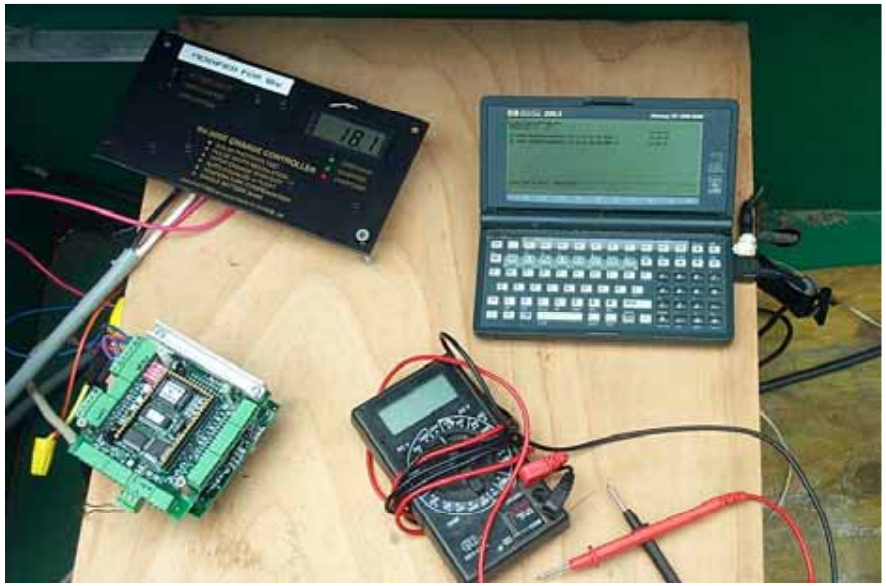
How do I cover a larger area and increase the depth?

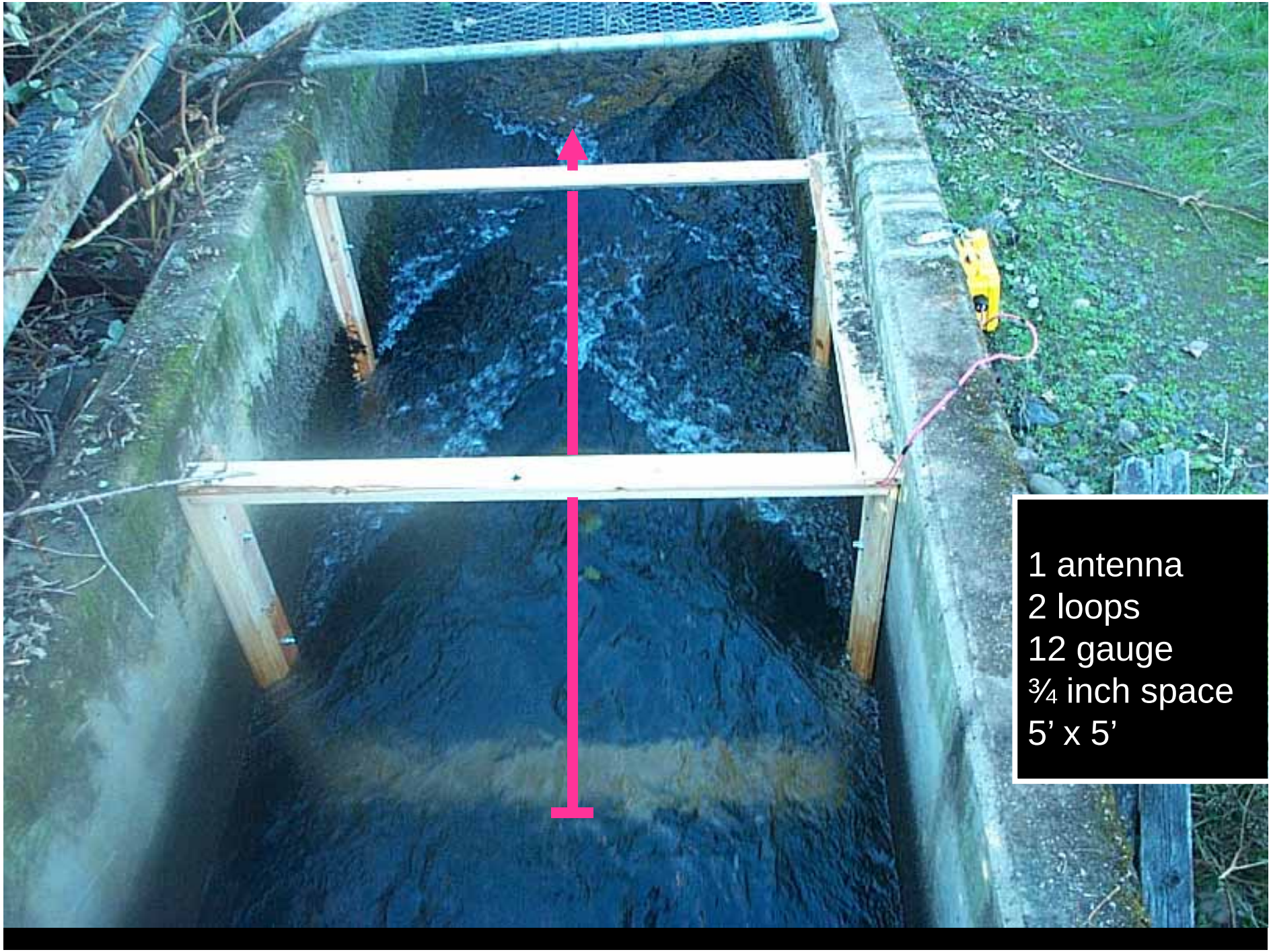
Power

- Solar
- Paddle wheel
- Swapping batteries

12 or 18 VDC
~ .75 – 1.2 Amp

Detune to 1 Amp

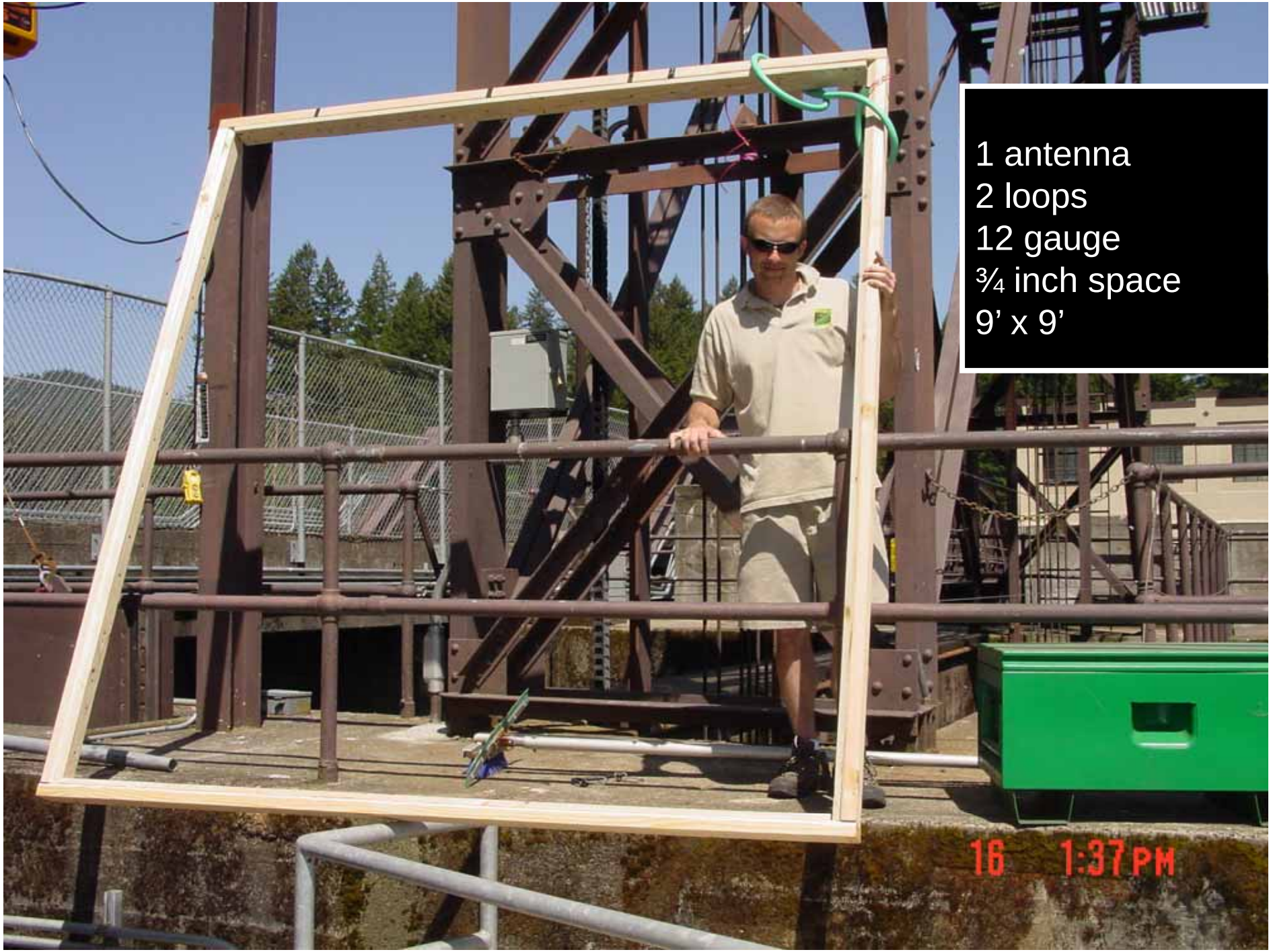



1 antenna
2 loops
12 gauge
¾ inch space
5’ x 5’

http:/www.ti.com TI-RFid Series 2000 - Low Frequency

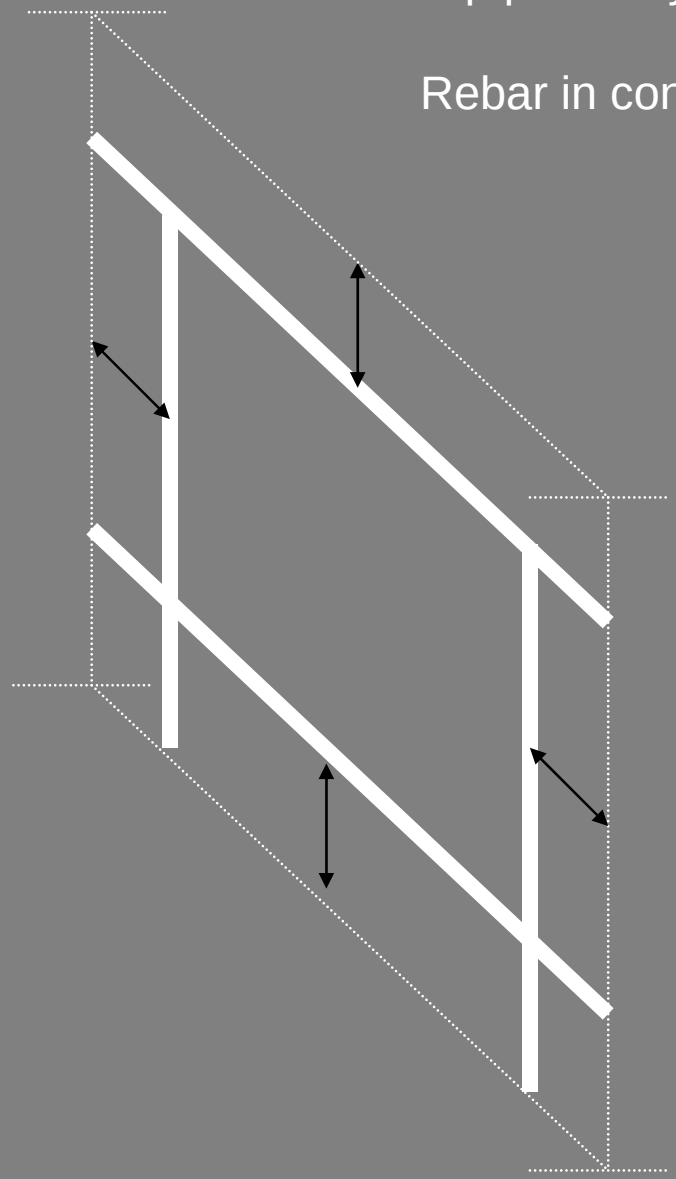
http://www.dfw.state.or.us/ODFWhtml/springfield/PIT_tag.html

E-mail: vince.tranquilli@state.or.us


1 antenna
2 loops
12 gauge
¾ inch space
9’ x 9’
16 1:37PM

Relationship/proximity to other metals

Rebar in concrete



Springers, Fallers, and Collisioners: Full Duplex PIT Technology for a Hatchery Release Strategy Evaluation

J.S. Hogle

To evaluate a Chinook salmon *Oncorhynchus tshawytscha* smolt release strategy at Warm Springs National Fish Hatchery, we developed a unique pass-through antenna to determine the number and timing of PIT tagged smolts exiting a raceway. During smolt release periods, an opening in the 32" x 8" diameter, standing tube is the sole outlet for smolts to move from a raceway to the Warm Springs River. Two flexible antennas were inserted into the removable, aluminum release tube. Inside the tube, antenna inductance measured 118 μH which was matched with capacitance of 20,000 pF. For each of the two raceways studied, 10,000 smolts were tagged with full duplex, 12mm SST PIT tags and released among 15,000 untagged smolts. In one raceway, during an October 11 to November 15, 2006 release, 44% of tagged fish were detected by the in-tube antennas indicating those fish exited the raceways. Different antennas were then placed in the raceway to detect remaining tagged fish. To date (February 20, 2007), 39% of tagged fish have been detected in the raceway for a total of 83% or 8,267 of 10,000 tagged fish. Of these detections, only three fish have been detected both leaving and remaining in the raceway. This indicates the in-tube antennas are adequately shielded by the aluminum of the release tube to prevent the numerous tagged fish that swim against the outside of the tube from being detected and recorded as having left the raceway. Given PIT tag detections at a downstream screwtrap, not all fish that exited the raceway were detected by the in-tube antennas. Most likely reasons for tags undetected by in-tube antennas include poor tag orientation and tag collisions. These results show our newly developed, unique antennas are an effective tool for evaluating Warm Springs National Fish Hatchery smolt release strategies.

Return to top

Springers, Fallers, and Collisioners

Full Duplex PIT Technology for a Hatchery Release Strategy Evaluation

United States Fish &Wildlife Service
Columbia River Fisheries Program Office
Vancouver WA
360-696-7605
http://columbiariver.fws.gov

Confederated Tribes of the
Warm Springs Reservation of Oregon
Warm Springs OR
541-553-2045

Today's Presentation

- History of antennas at this office
- Warm Springs National Fish Hatchery application – UNIQUE!
  - Antenna construction & deployment
- Performance to date
- Considerations

PIT System Components

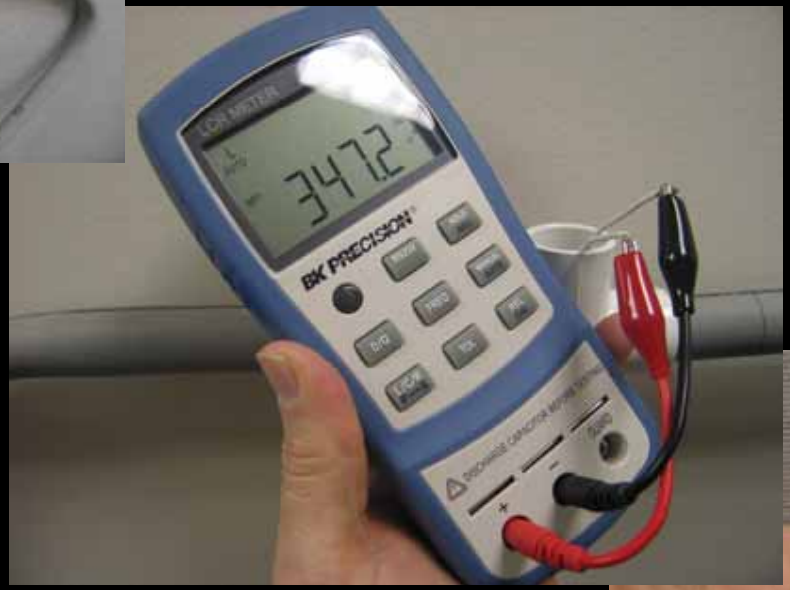
Cable

Transporter

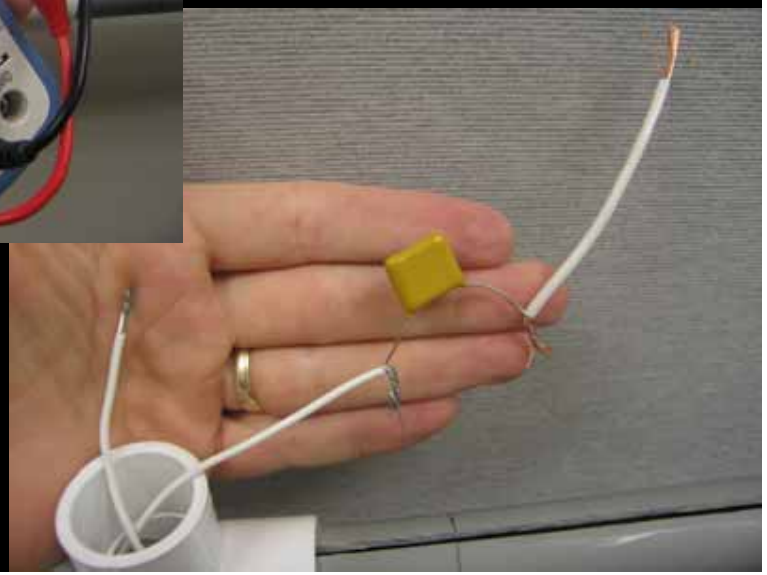
Antenna Construction

Cut & loop wire

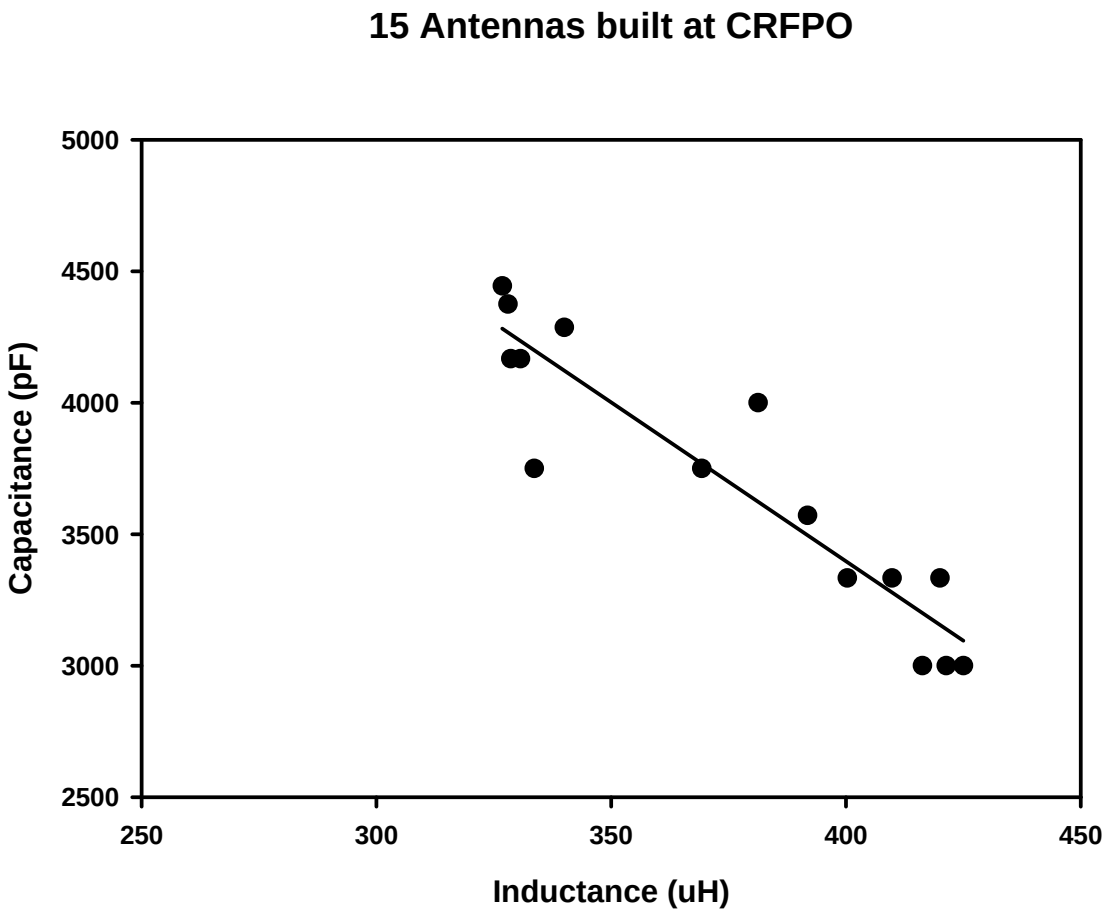
Measure Inductance



Add matching Capacitance

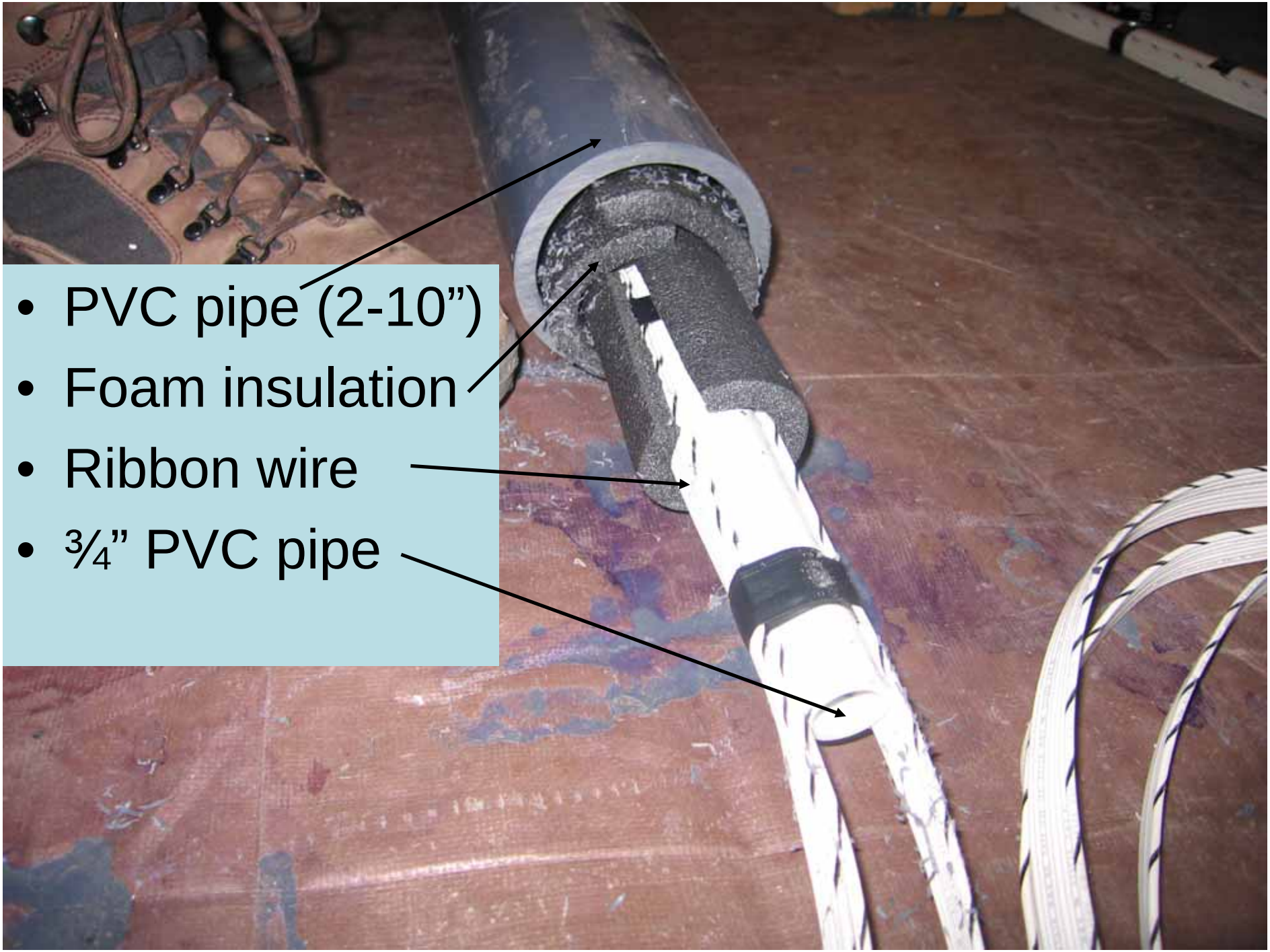


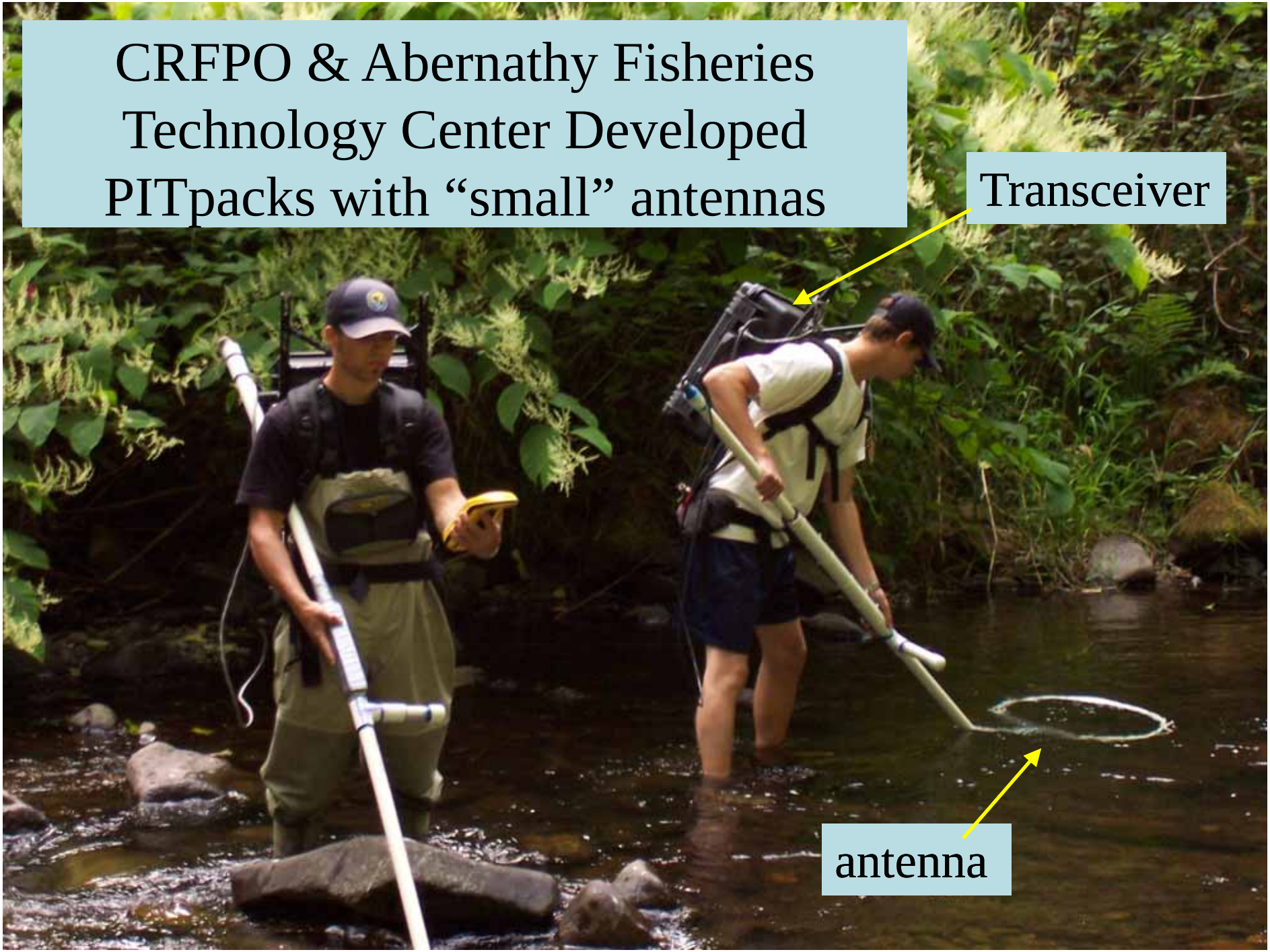
Matching Capacitance to Inductance



120 “large” antennas since 2001

IRWIN

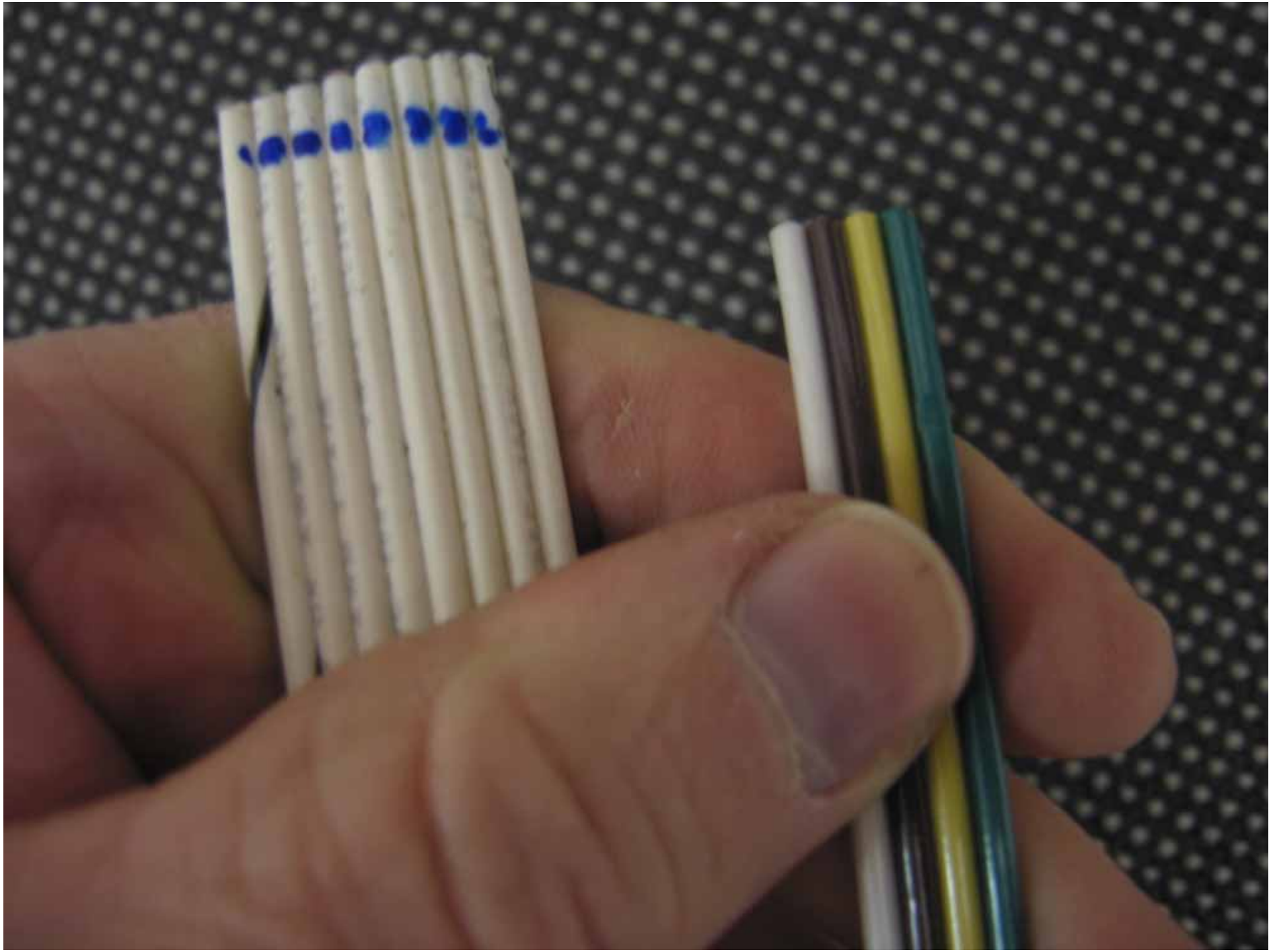

• PVC pipe (2-10”)
• Foam insulation
• Ribbon wire
• ¾” PVC pipe

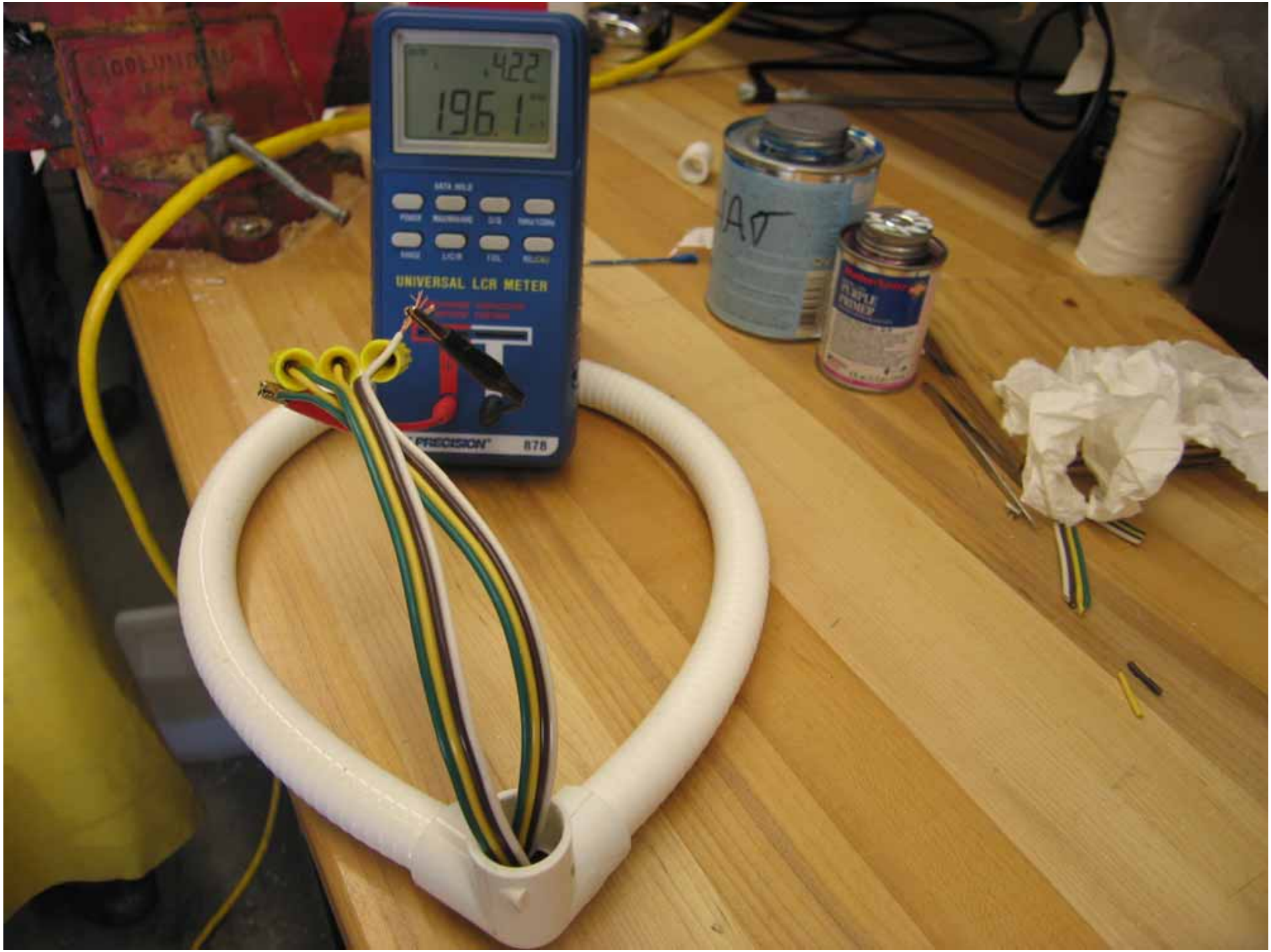

CRFPO & Abernathy Fisheries Technology Center Developed PITpacks with “small” antennas
Transceiver
antenna

Columbia River
Deschutes River
Warm Springs River

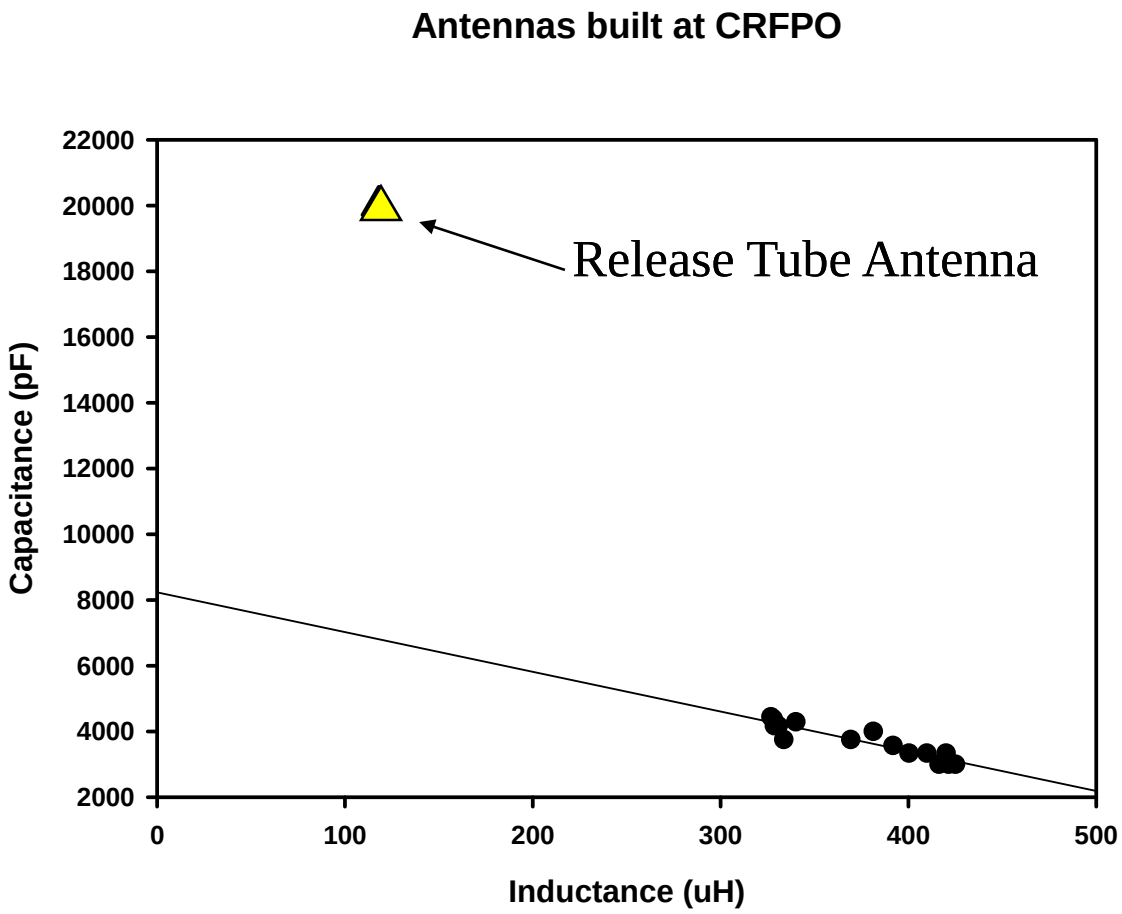
Warm Springs National Fish Hatchery

LEVEL & TOOL MFG. CO. INC.



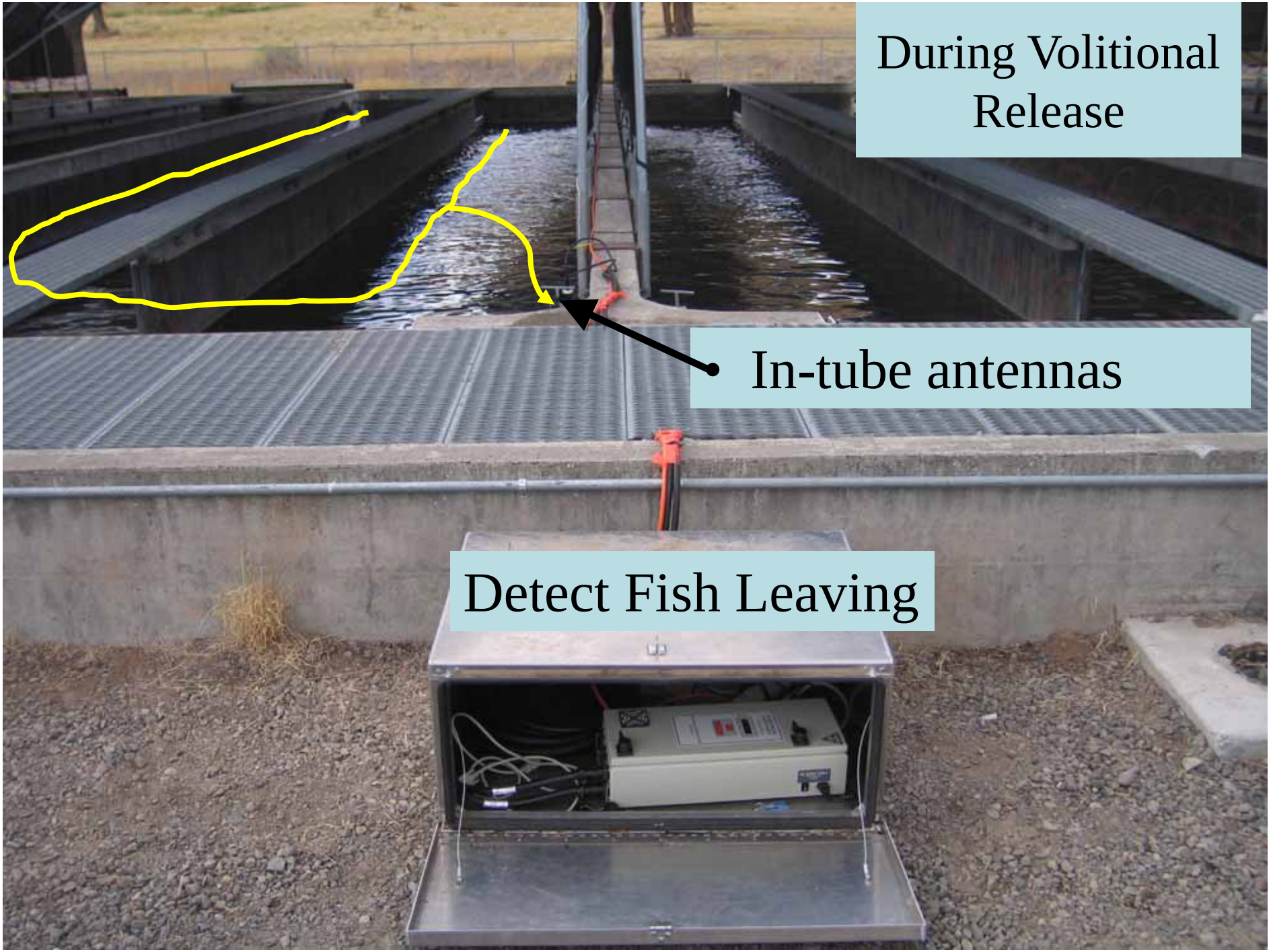

.422
196.1
UNIVERSAL LCR METER
PRECISION
878

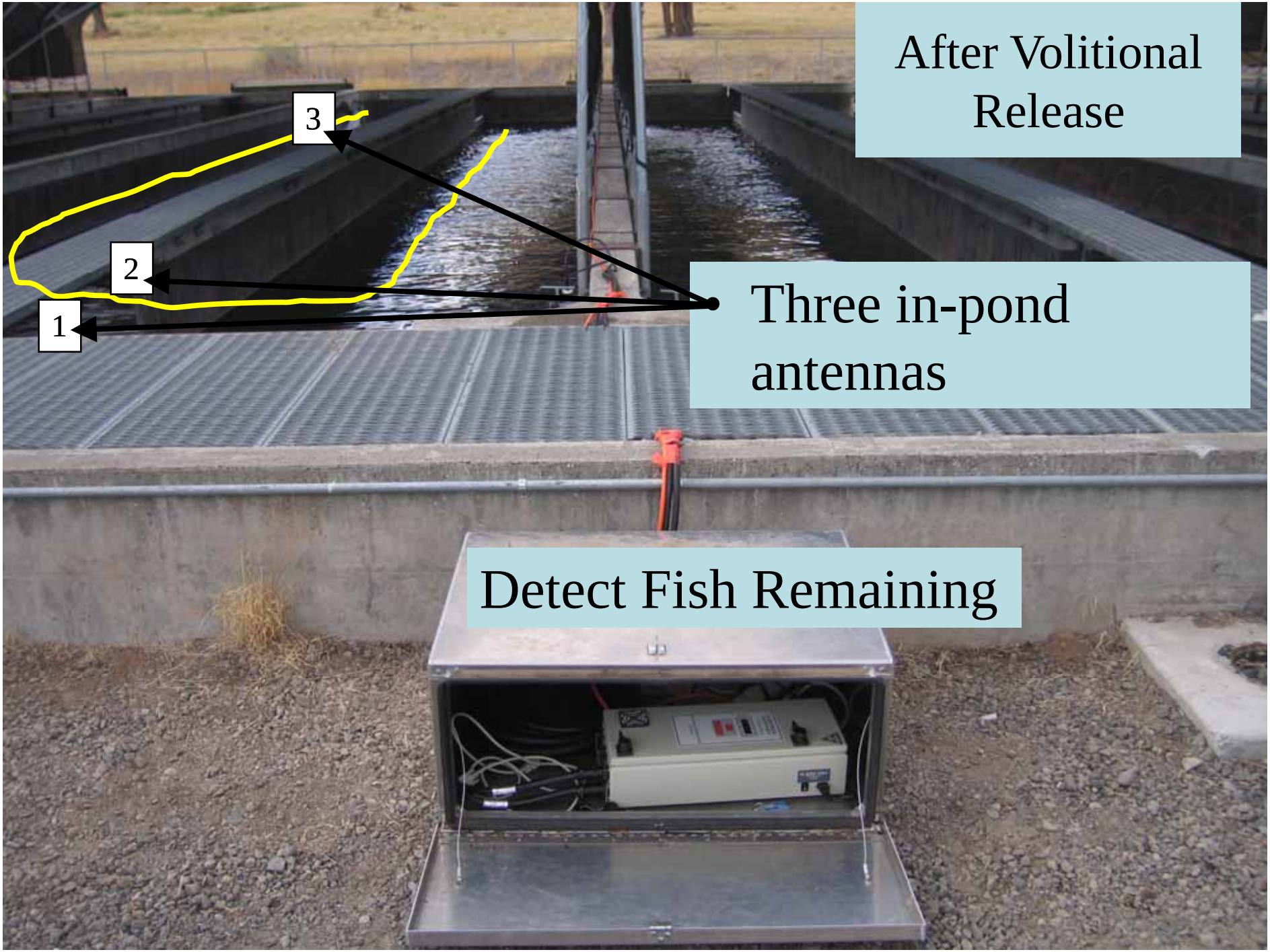
AUTO
L
2.09
118.7
DATA HOLD
POWER
MAX/MIN/AVG
D/Q
1kHz/120Hz
RANGE
L/C/R
TOL
UNIVERSAL LCR METER
878

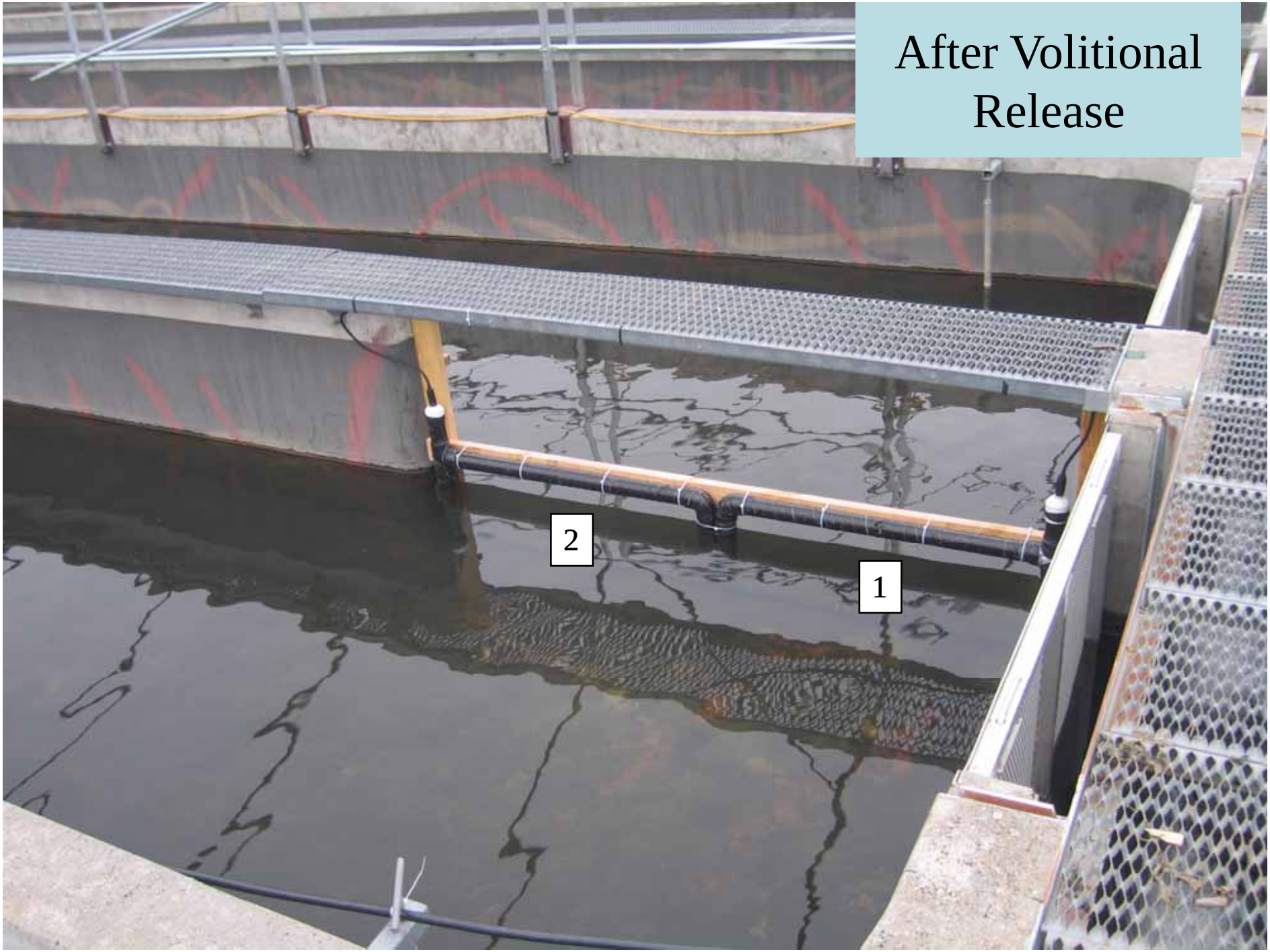

Antennas built at CRFPO
Release Tube Antenna
Capacitance (pF)
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
100
200
300
400
500
Inductance (uH)

During Volitional Release

During Volitional Release

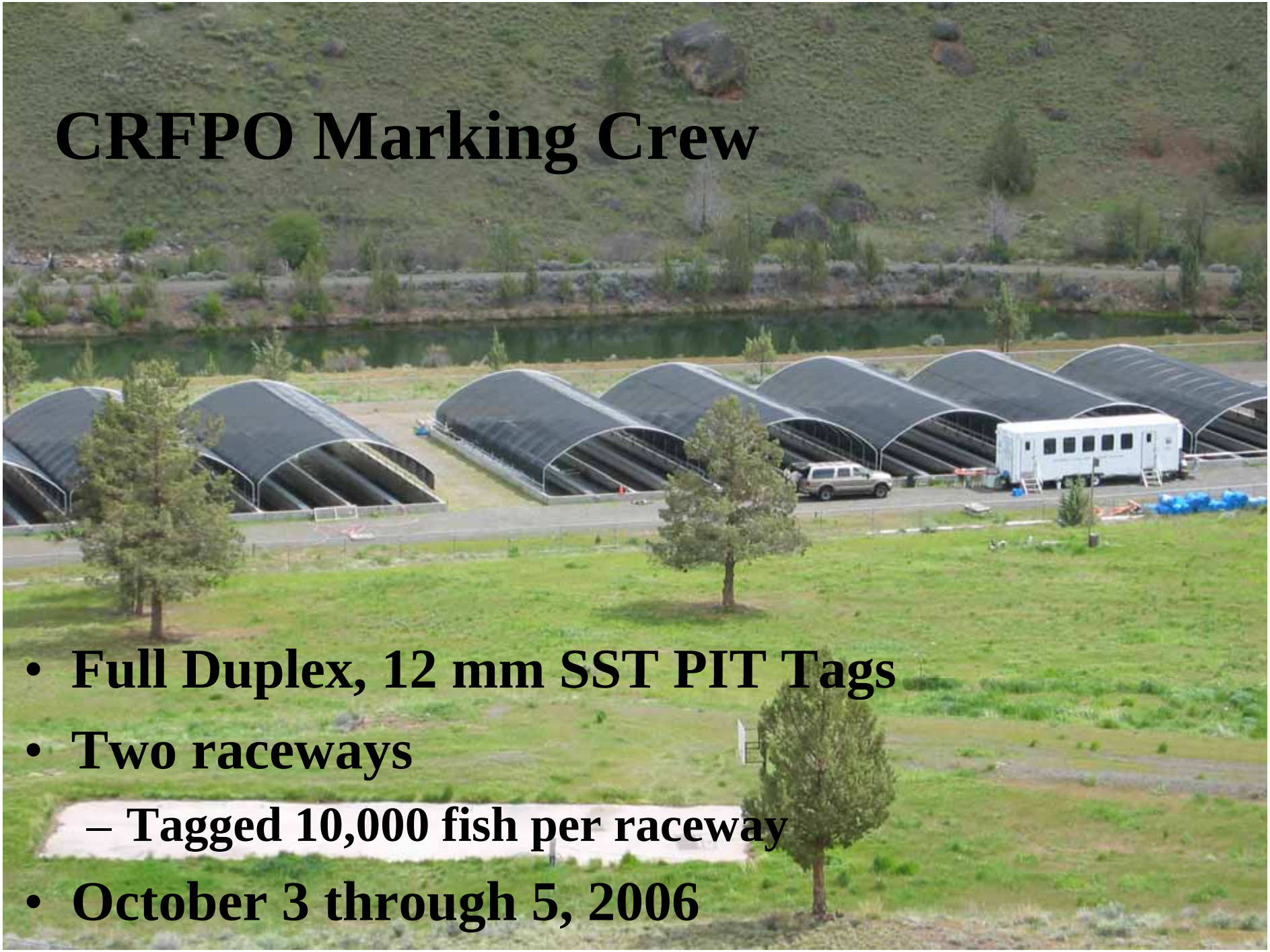

During Volitional Release
In-tube antennas
Detect Fish Leaving


After Volitional Release
3
2
1
Three in-pond antennas
Detect Fish Remaining


After Volitional Release
2
1

After Volitional Release
3

After Volitional Release
3



CRFPO Marking Crew

- Full Duplex, 12 mm SST PIT Tags
- Two raceways
  - Tagged 10,000 fish per raceway
- October 3 through 5, 2006

Performance to date

Volitional Release Oct.11 to Nov.15, 2006

- 44% of tagged fish detected leaving

After Volitional Release December, 2006 to present

- 39% of tagged fish detected remaining

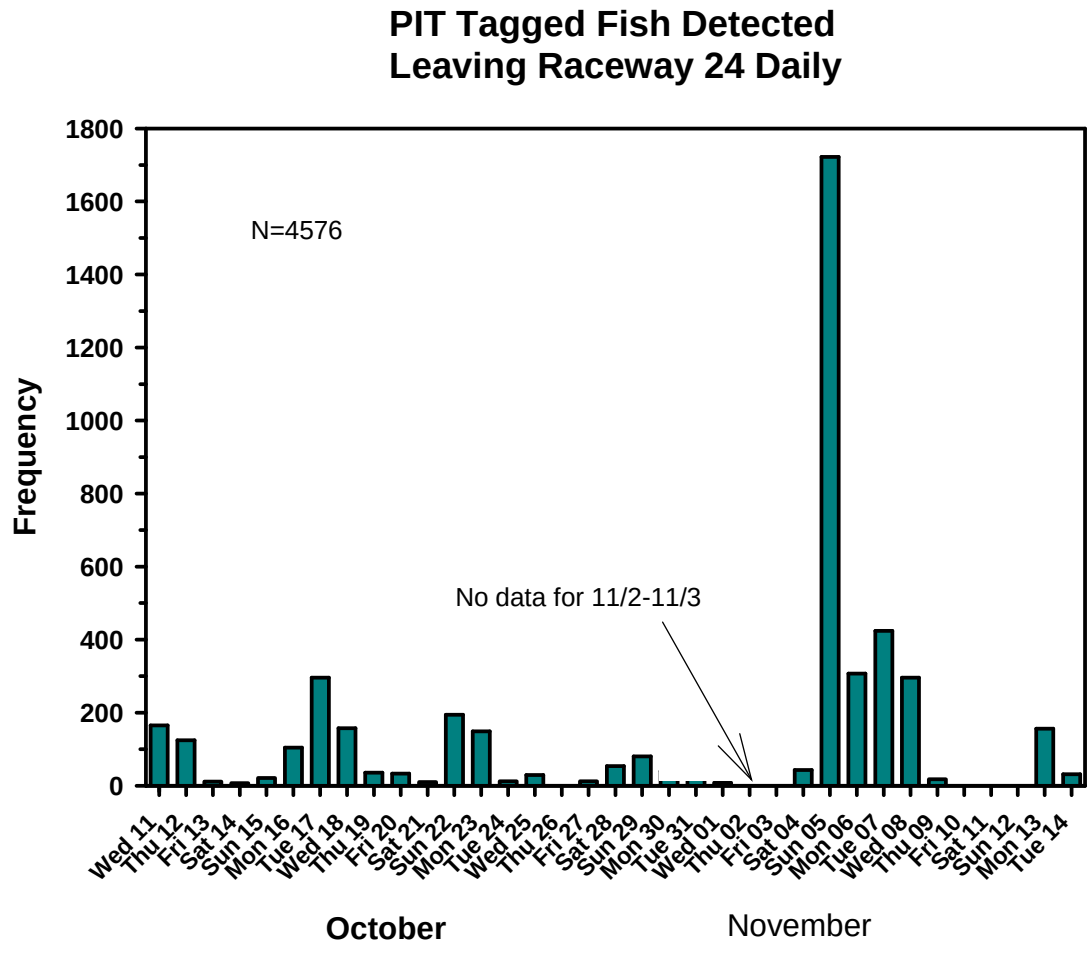
PIT System Performance to Date

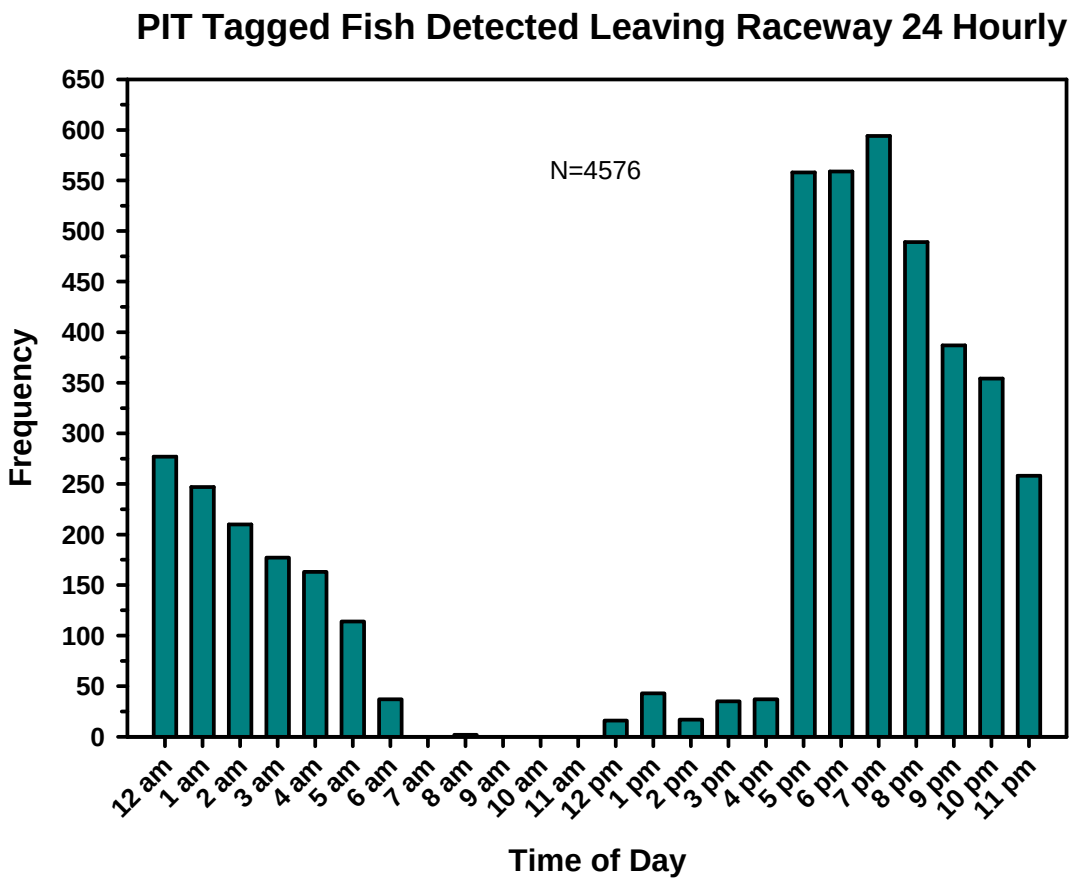
- 83% of tags detected to date
- Among these 8,267 detections, 3 repeats
- Of 4,576 in-tube code detections, 169 were antenna two only
- In-tube detections were as high as 4 per fish
- In-tube detections ranged up to 5,200 per download
- In-pond detections ranged up to 400,000 per download

Considerations

- Data overload
  - 400 to 500 detections (1 detection = 1 fish?)
- Predation
- Antenna avoidance by in-pond fish
- 2007 Spring release = more detections?
- Springers Fall through antenna undetected
  - Rate of fall too great?
  - Poor tag orientation
  - Tag collisions

[redacted]


PIT Tagged Fish Detected
Leaving Raceway 24 Daily
N=4576
No data for 11/2-11/3
Frequency
1800
1600
1400
1200
1000
800
600
400
200
0
Wed 11
Thu 12
Fri 13
Sat 14
Sun 15
Mon 16
Tue 17
Wed 18
Thu 19
Fri 20
Sat 21
Sun 22
Mon 23
Tue 24
Wed 25
Thu 26
Fri 27
Sat 28
Sun 29
Mon 30
Tue 31
Wed 01
Thu 02
Fri 03
Sat 04
Sun 05
Mon 06
Tue 07
Wed 08
Thu 09
Fri 10
Sat 11
Sun 12
Mon 13
Tue 14
October
November


PIT Tagged Fish Detected Leaving Raceway 24 Hourly
N=4576
Frequency
650
600
550
500
450
400
350
300
250
200
150
100
50
0
12 am
1 am
2 am
3 am
4 am
5 am
6 am
7 am
8 am
9 am
10 am
11 am
12 pm
1 pm
2 pm
3 pm
4 pm
5 pm
6 pm
7 pm
8 pm
9 pm
10 pm
11 pm
Time of Day

Trial and Error: Deployment Methods for Instream PIT-Tag Interrogation Systems

K. Martens, N. Zorich and I. Jezorek

The USGS Columbia River Research Lab has been using full-duplex PIT tags and instream PIT tag interrogation systems (PTIS) since the summer 2001. We have run eight PTIS (FS1001M reader) and nine single-antenna PTIS (FS2001F-ISO reader) in five watersheds. The antennas ranged in size from 3 to 20 ft, and were installed using three different configurations: pass-through, hybrid, and pass-by. The antennas were anchored to the stream bed using a combination of bolts, weights, cables, and rebar. Interrogators were powered by grid, solar panels, thermoelectric generators, and batteries. The use of multiple-antenna arrays and an increased number of anchors has helped to reduce the loss of data due to antenna loss. These interrogation systems have proven to be a reliable method for tacking fish movement.

Return to top

Trial and Error: Deployment Methods for Instream PIT-tag Interrogation Systems

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U.S. Department of the Interior
U.S. Geological Survey

Acknowledgements

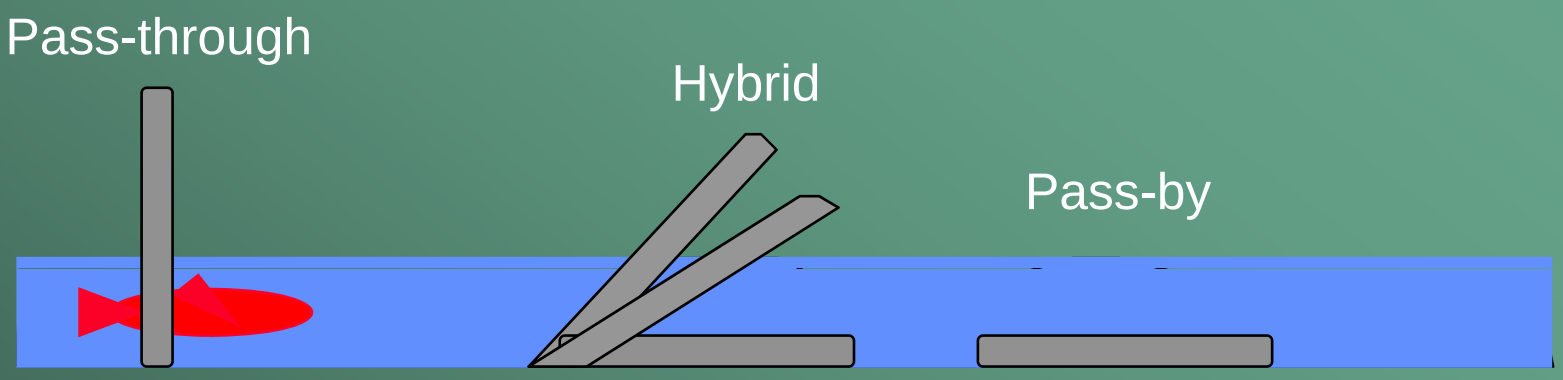
We would like to give credit to Earl Prentice for building and leading the installation team on Rattlesnake Creek, Beaver Creek, and Gold Creek sites.

PIT-tag Interrogators

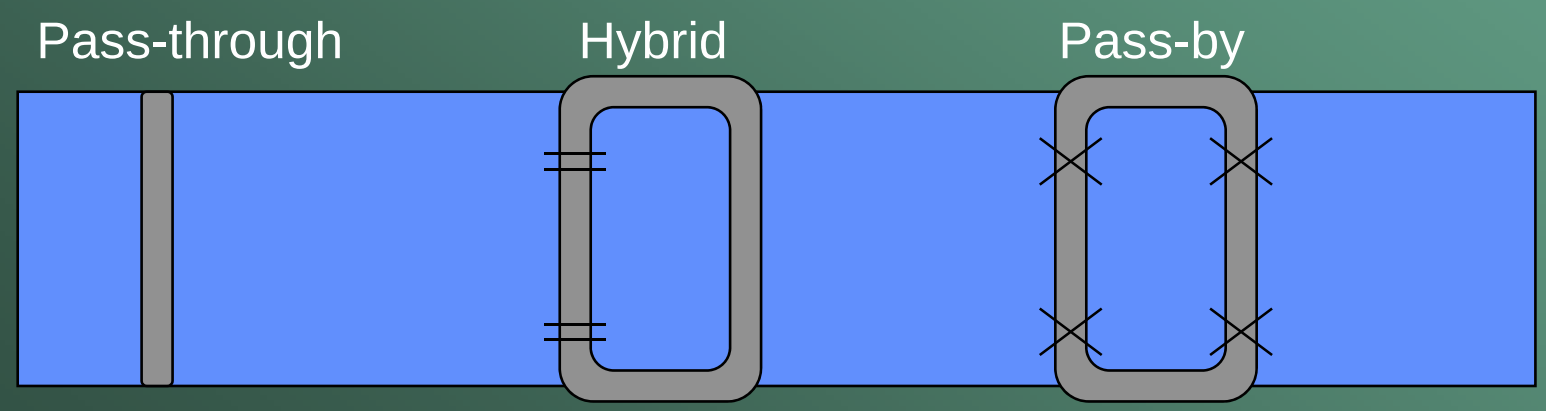
- Rattlesnake Creek, Washington (one 1001M)
- Wind River, Washington (two 2001F)
- Methow River, Washington (two 1001M, eight 2001F)
- Jarbidge River, Nevada (two 1001M , one 2001F)
- Cedar River, Washington (three 1001M)

USGS

Side View



Top View

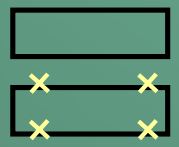


USGS

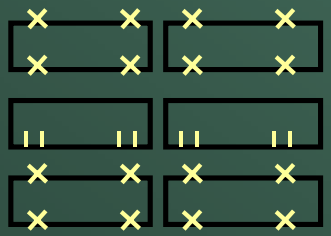
PIT-tag Antennas for 1001M and 2001F Destron Fearing Readers (3-20 ft)

Rattlesnake Creek

Original Design
one pass-through
one pass-by

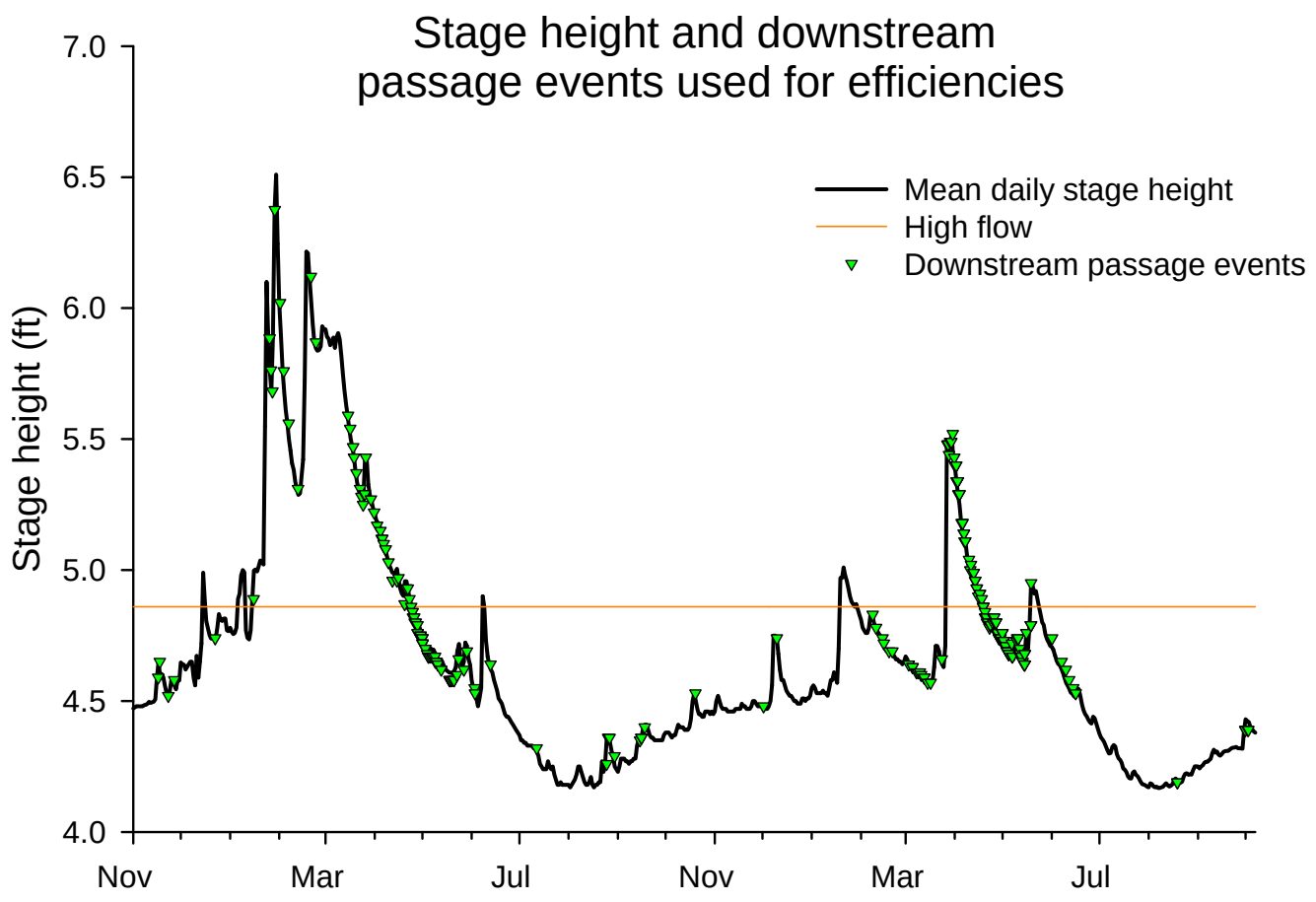


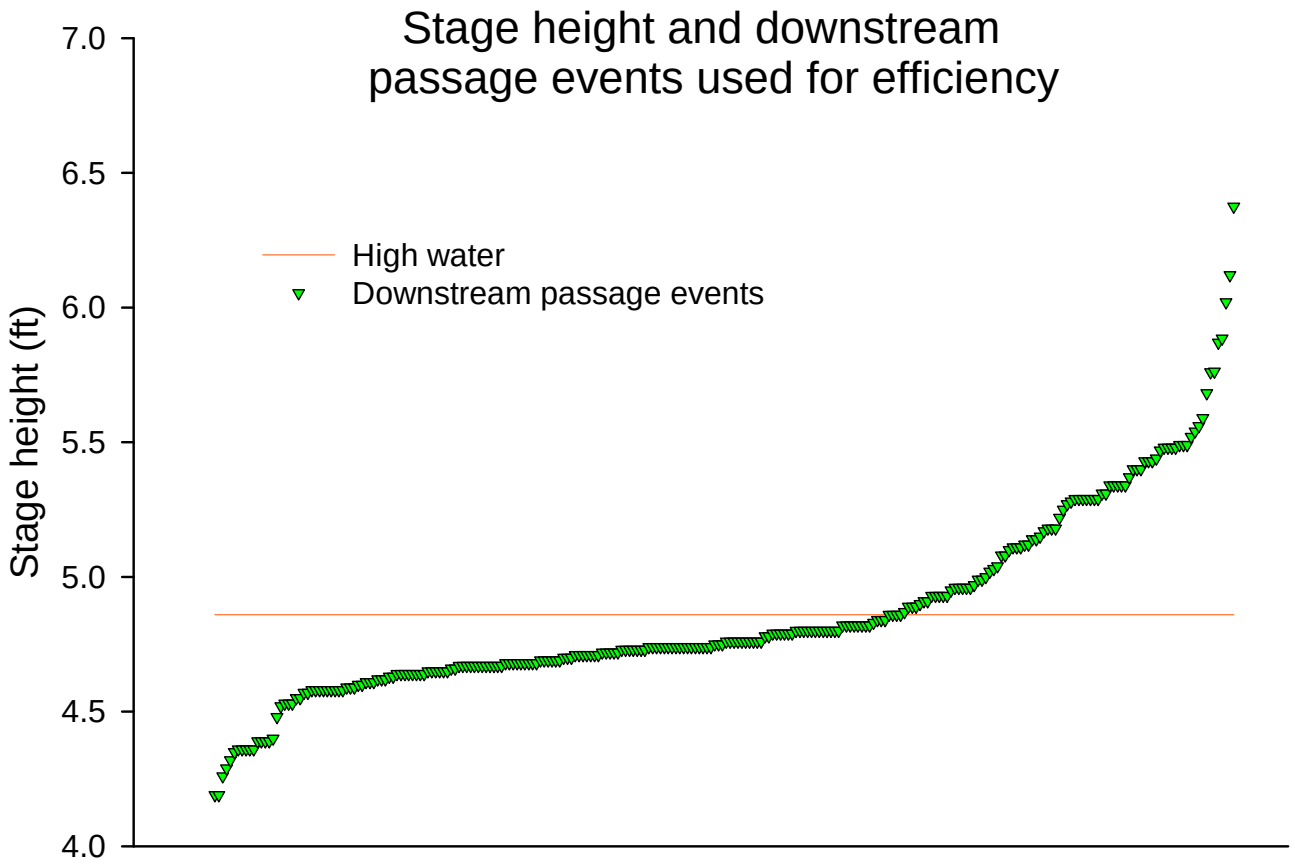
Optimal Design
four pass-by
two hybrid



Current Design
two pass-by

USGS


Stage height and downstream passage events used for efficiencies
Stage height (ft)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Nov
Mar
Jul
Nov
Mar
Jul
Mean daily stage height
High flow
Downstream passage events


Stage height and downstream passage events used for efficiency
Stage height (ft)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
High water
Downstream passage events

Trout Creek
(Hemlock Dam)
Wind River

two 2001F with Biomark antennas

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Power Sources

Grid Power

Solar

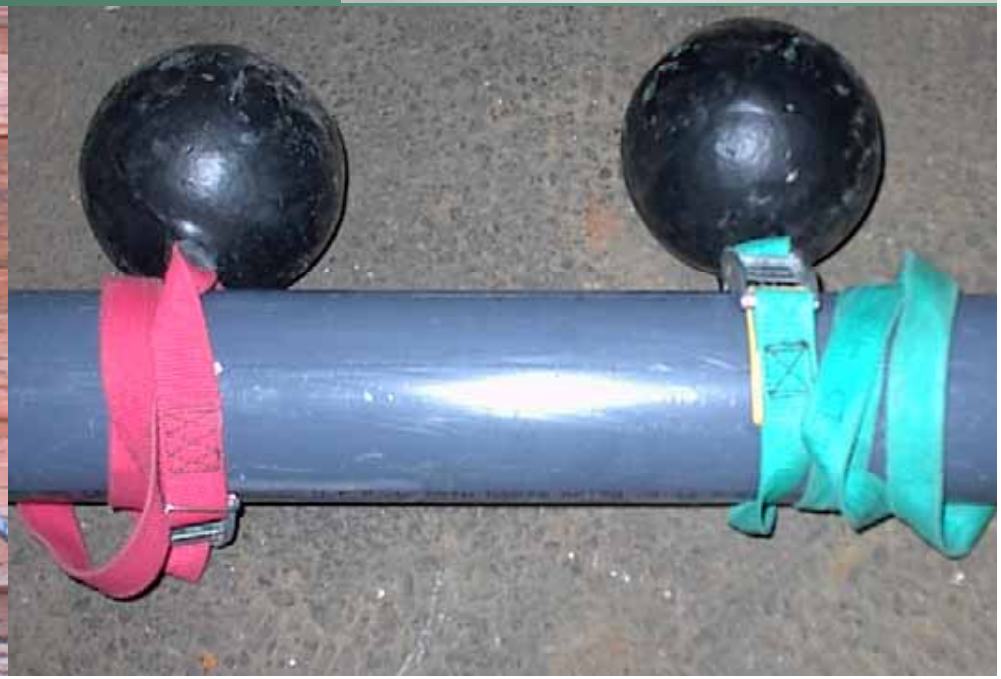
Thermoelectric

Batteries

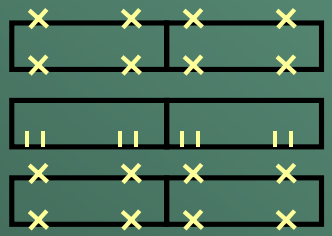
USGS

Anchor Systems

½” Anchor bolts
Weights
Cable
½ - ¾” Rebar

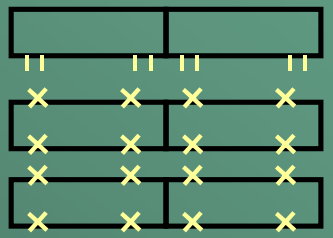


Beaver Creek
(Methow River)
four pass-by, two hybrid
(6-10 ft)



Gold Creek
(Methow River)

two Hybrid
four Pass-by
(6-10 ft)



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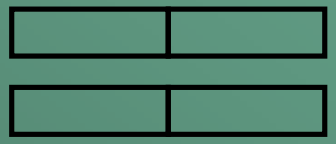
Methow Basin

2001F Interrogators (2-4 ft)

USGS

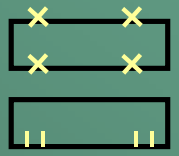
East Fork Jarbidge

four pass-through (13-20 ft)



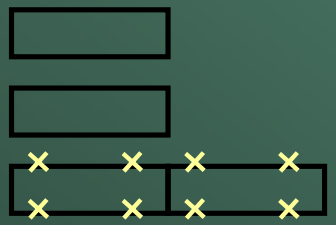
West Fork Jarbidge

one pass-by
one hybrid
(20 ft)

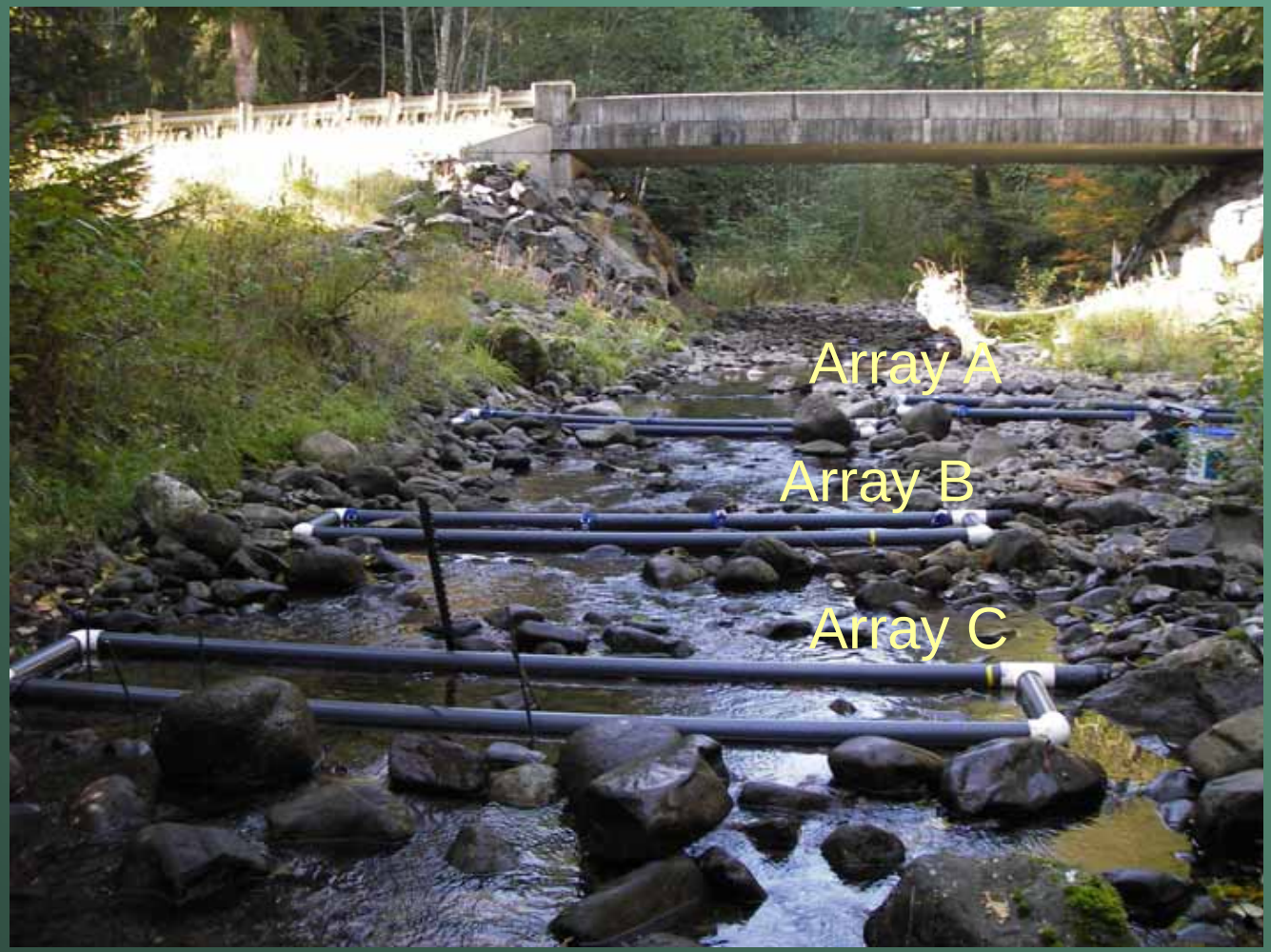


Rack Creek
(Cedar River)

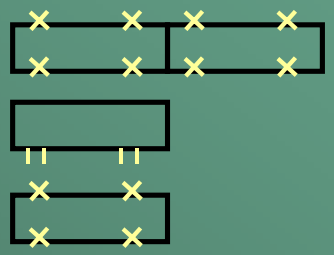
two pass-through
two pass-by
(5-10 ft)



Boulder Creek
(Cedar River)



3 Pass-by
1 Hybrid
(12 ft)



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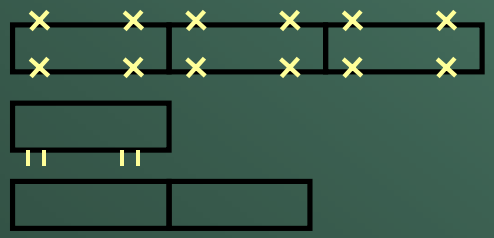
Cedar River

(20 ft)

Three pass-by

one hybrid

two pass-through



Conclusions and Questions

- Installation techniques are site dependant. You will need to look at what you have available and adapt to the site (Bridges and pinch points are desirable locations).

- Can we keep a system running at all flows? No What is more important, keeping a system in as long as possible or getting the system back in as soon as possible?

- What do you want to break? Anchor, Antenna or Connector.

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Evaluating Distribution, Survival, Growth, and Movement of Coastal Cutthroat Trout at Watershed Scales Using Half-duplex Passive Integrated Transponder Tags

D.S. Bateman and D.W. Leer

We have been using 23-mm HDX tags to monitor distribution, growth, survival, and movement of coastal cutthroat trout in Hinkle Creek since 2002. Fish movement has been evaluated using a series swim-through antennas and from quarterly continuous sampling with mobile pit antennas (December, March, June) and electrofishing (August/September). Swim through antennas are located at the downstream end of both the North and South Forks of Hinkle Creek and additional antennas are located at downstream end of each fish-bearing tributary and the adjacent mainstem immediately upstream from the tributary junctions within each watershed. At all tributary junctions, a total of four antennas are present, two in the tributary and two in the mainstem. Antennas are operated by a single reader with a multiplexor. Additional swim through antennas are located a few hundered meters downstream from the confluence of the North and South Forks of Hinkle and were Hinkle Creek joins Calapooya Creek.

A total of 30 antennas are operated at Hinkle Creek and antennas widths and heights range from 1.9- 14.9 m and 0.4-1.2 m respectively. Most antennas are constructed from 8 awg 735 strand copper wire with the top leg attached to 6mm dia nylon rope which spans the stream and the lower leg is buried in the naturally occurring stream substrate. Average amperage draw of individual antennas has ranged from 0.419-1.31 amps. Most sites are powered by two Trojan SCS225 130 AH deep cycle lead acid batteries. Data are downloaded from each site and batteries replaced every seven days. Two sites are operated using solar panels. At each of these sites two 60 watt panels were installed in near by trees approximately 20 m above the ground. During the February- November period the panels provide plenty of power to operate the sites. However, due to topographic shading, the panels need battery augmentation during the November to February period. At our sites, we have observed 100% detection rates of tags floated through antennas, regardless of flow, when the antenna has been able to detect tags at distances of 0.25 m or greater in on one side in the center of the antenna . We have subsequently used this distance as a minimum read range for our antennas. If read ranges equal or exceed this value and the amperage draw of the antenna is within reason the antenna is not retuned. If the read range is less than this value or the amperage draw is excessive we attempt to retune the antenna. Using this criteria, over time the average single-side read ranges individualantennas has ranged from 0.24-0.53 m.

Major problems encountered through time have been: 1) non-responsive antennas i.e. antenna does not respond to tuning and currently this is thought to be due to sporadic interference, 2) large read range differences in identical paired antennas, 3) antennas which work well individually but when connected to the a multiplexor only a single antenna will work effectively, and 4) lost data due to poor connection between palm pilot and the rest of the system.

Return to top

Evaluating distribution, survival, growth, and movement of coastal cutthroat trout at watershed scales using half-duplex passive integrated transponder tags

Douglas S. Bateman
Department of Forest Sciences, Oregon State University, Corvallis, OR

David W. Leer
Department of Forest Sciences, Oregon State University, Corvallis, OR

USGS
science for a changing world

CFER Cooperative Forest Ecosystem Research

Douglas County

ROSEBURG FOREST PRODUCTS

OREGON STATE UNIVERSITY

OREGON DEPARTMENT OF FORESTRY

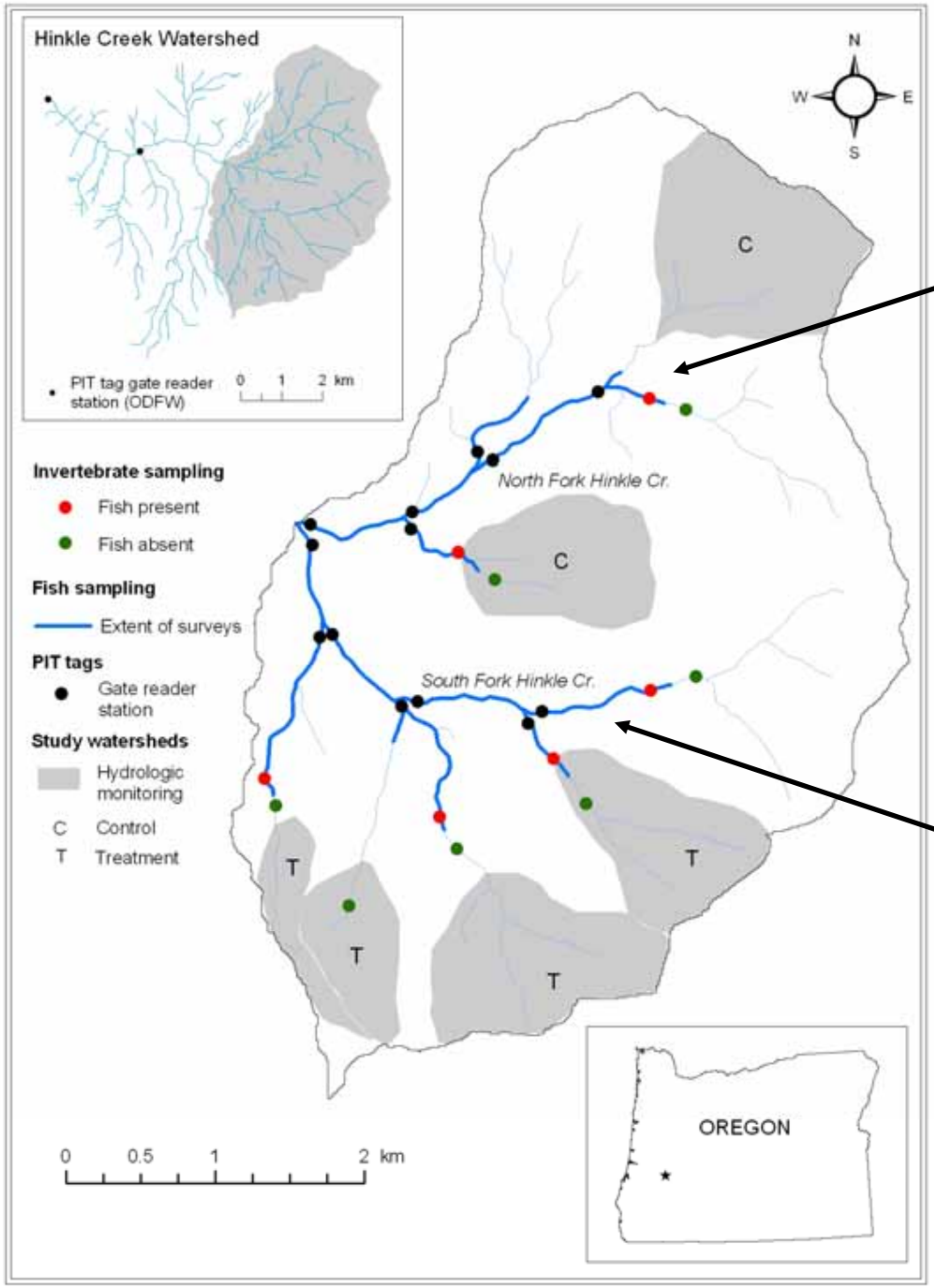
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ncasi

OREGON DEPARTMENT OF FISH & WILDLIFE

Electrofishing: occurs annually during summer low-flow period

Mobile Tracker
Half-duplex 23-mm tags
Gate Readers



N.F Hinkle
Drainage Area 858 ha
Channel Length 21.4 km
Fish Bearing Channel 4.7 km
Average Gradient 9.4%

S.F. Hinkle
Drainage Area 1083 ha
Channel Length 25.6 km
Fish Bearing Channel 7.6 km
Average Gradient 8.8%

Solar Power

Two 60 watt panels per installation

South Fork Site:

- Four antennae
- Provides all power February-Mid November
- Requires supplementation December and January

North Fork Site:

- Two antennae
- Provides all power April-Mid November
- Requires supplementation December, January, February, and March
- Supplement with generator

Antenna Materials

- 8 AWG 735 Strand Copper Wire
- ¼" dia nylon rope
- shielded twin-axial cable
- aluminum posts (optional)
- Pelican case (tuning module)
- Zip ties

Typical Antenna Setup

Inside the Box

Antenna Characteristics: Hinkle Creek

- 30 Antennas @ 9 different sites
- Antenna widths - 1.9 - 14.9m
- Antenna heights - 0.4 - 1.2m
- Average tuning level (long term) 0.419 - 1.310 amps
- Tuning Level as of 1/31/07 - 0.384 – 2.130
- Target RR (one side) at each antenna 10 in or greater with tag in air and optimally oriented to field.
- Average RR (long term) 9.5 – 20.7 in
- RR as of 1/31/07 10 – 24 in

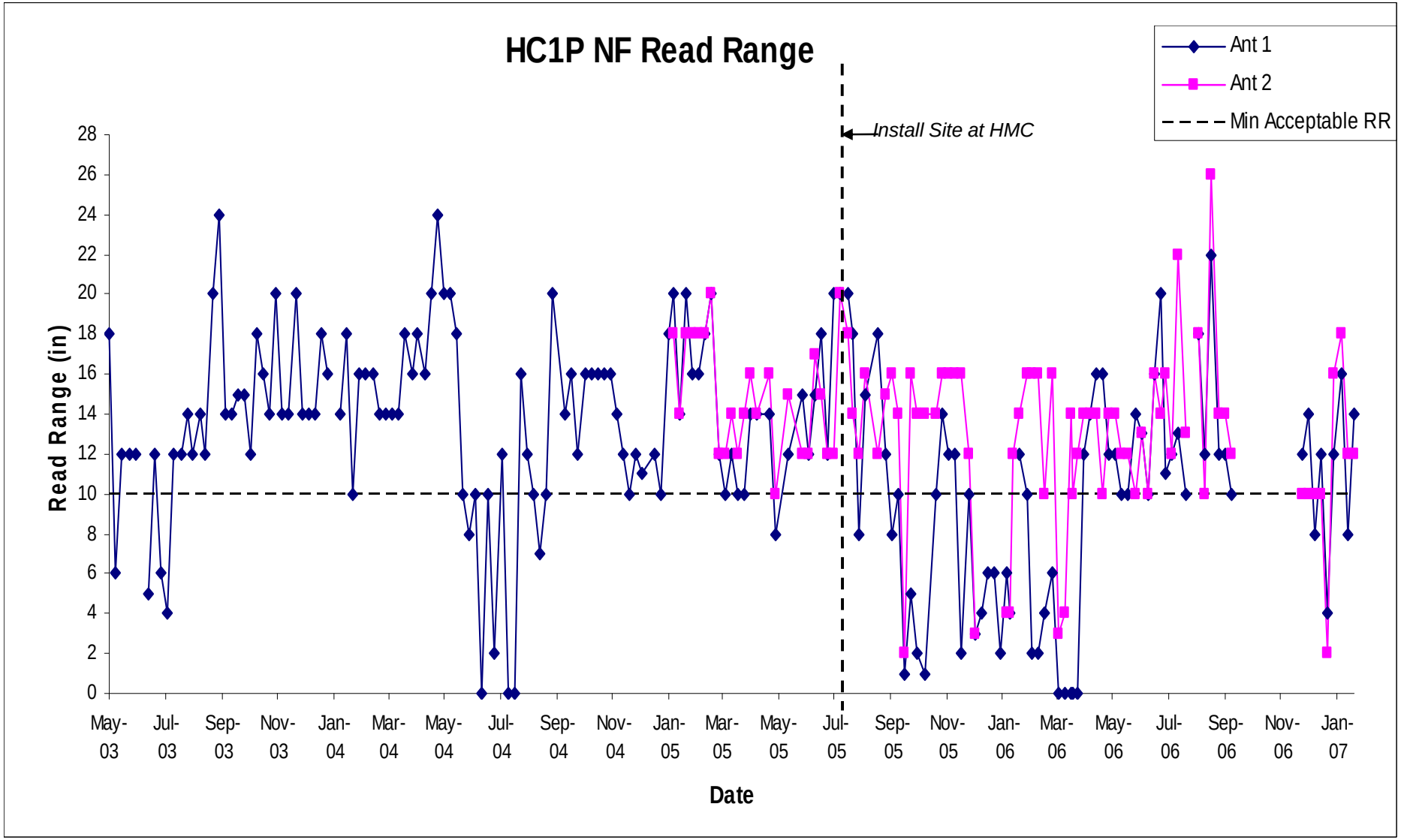
Battery Power !

(these things are heavy)

Trojan SCS225 130 AH
Deep-Cycle lead acid
Two per site

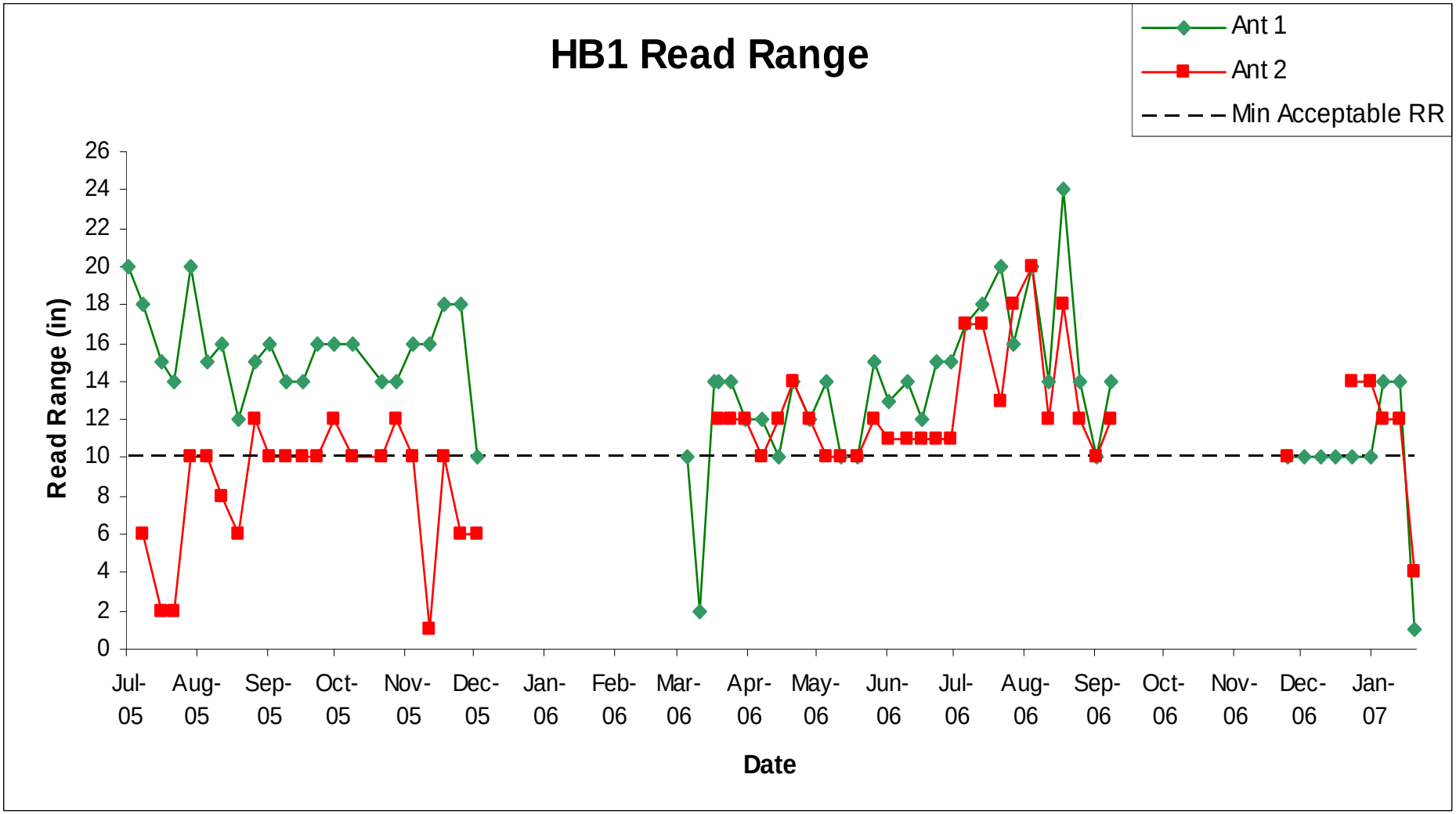
Problems

- Non-responsive antenna


HC1P NF Read Range
Ant 1
Ant 2
Min Acceptable RR
Install Site at HMC
Read Range (in)
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Date

Problems

- Non-responsive antenna
- Large read range differences in identical paired antennae

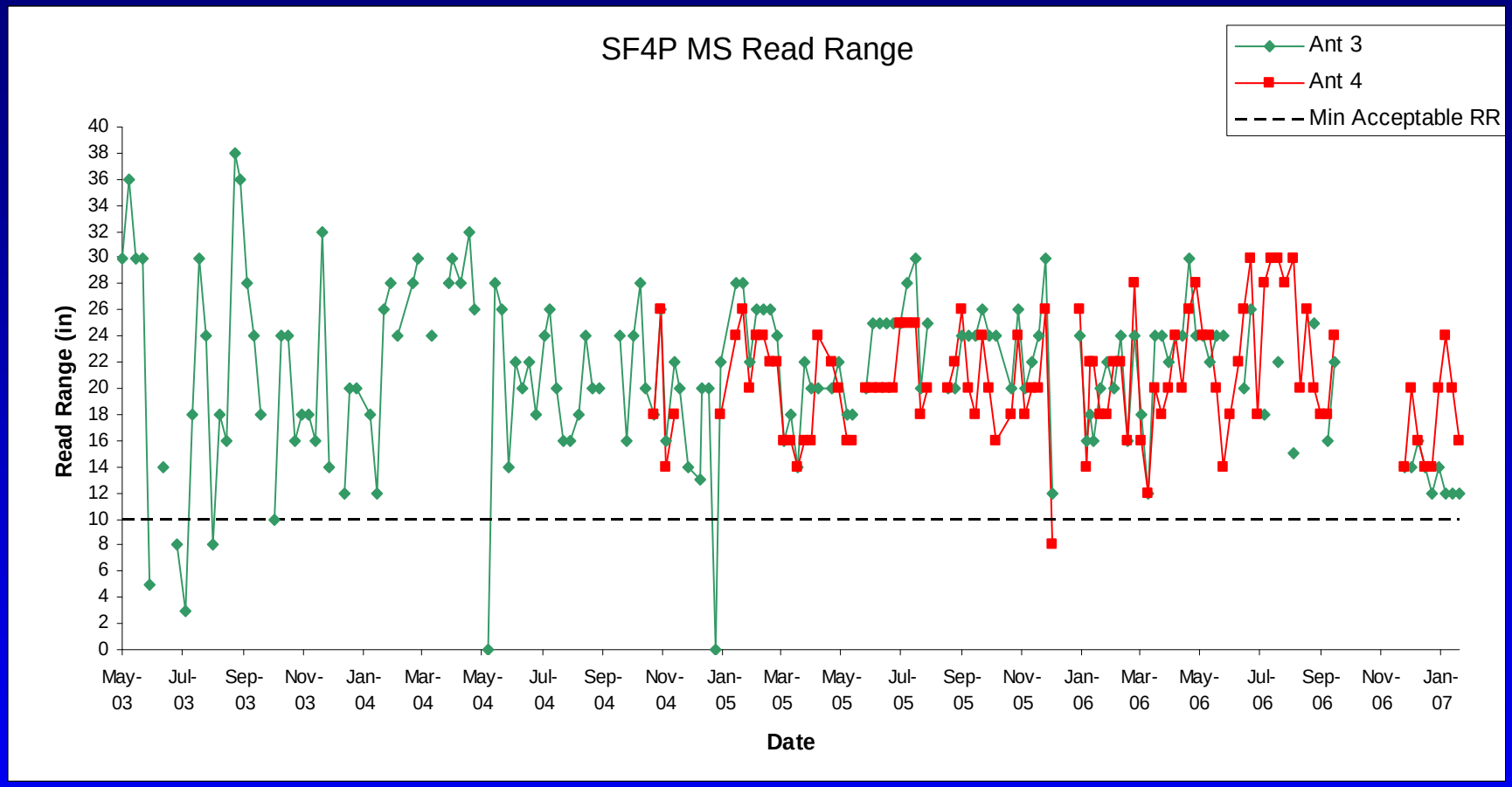

HB1 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Date

Problems

- Non-responsive antenna
- Large read range differences in identical paired antennae
- Lost data due to poor connection between palm and rest of system

Questions

- Why are read ranges relatively stable at some sites and cyclical at others?


SF4P MS Read Range
Ant 3
Ant 4
Min Acceptable RR
Read Range (in)
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
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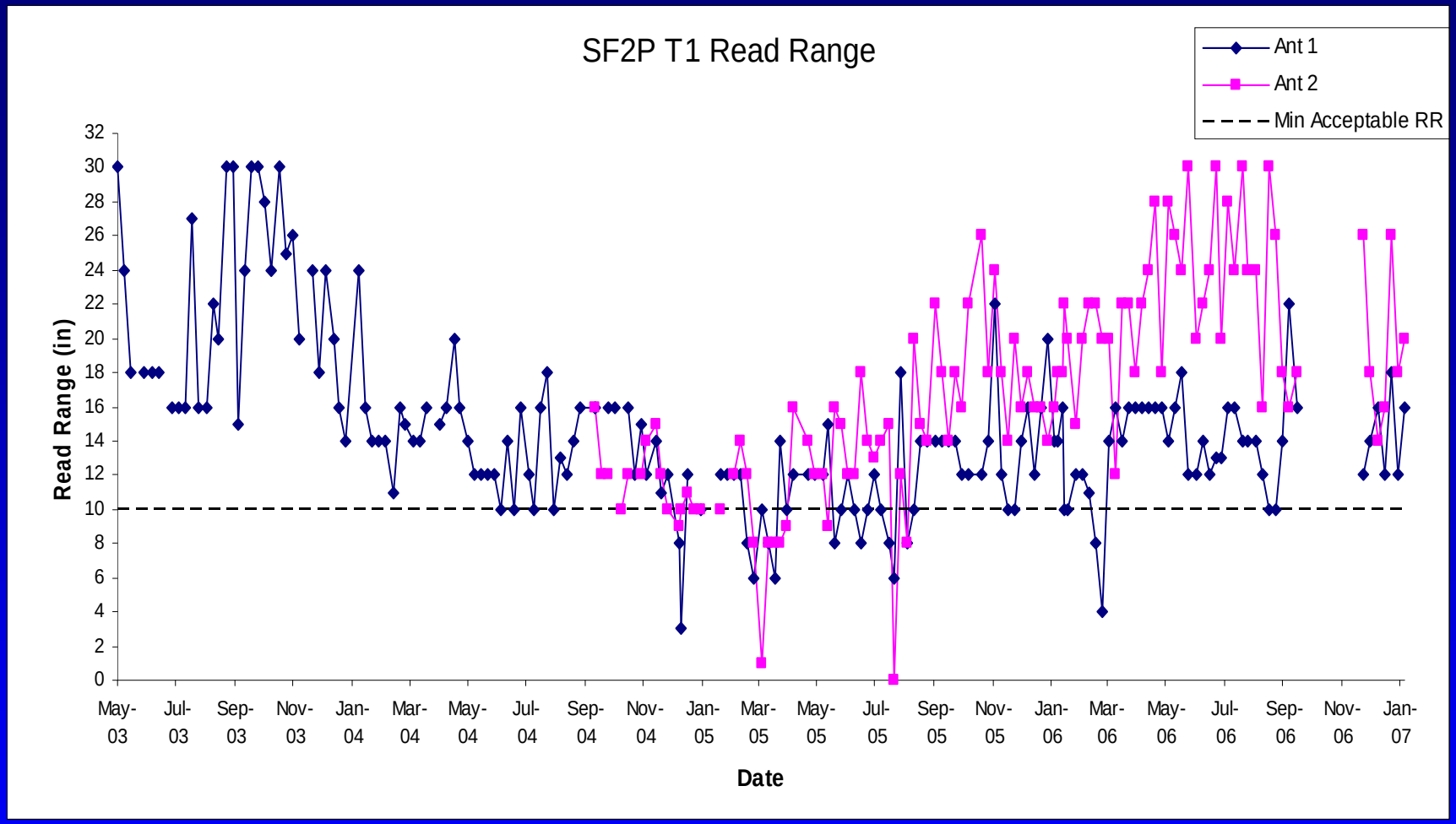
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Date


SF2P T1 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Date

Questions

- Why are read ranges relatively stable at some sites and cyclical at others?

- Why do you get different results with equal capacitance but different jumper settings?

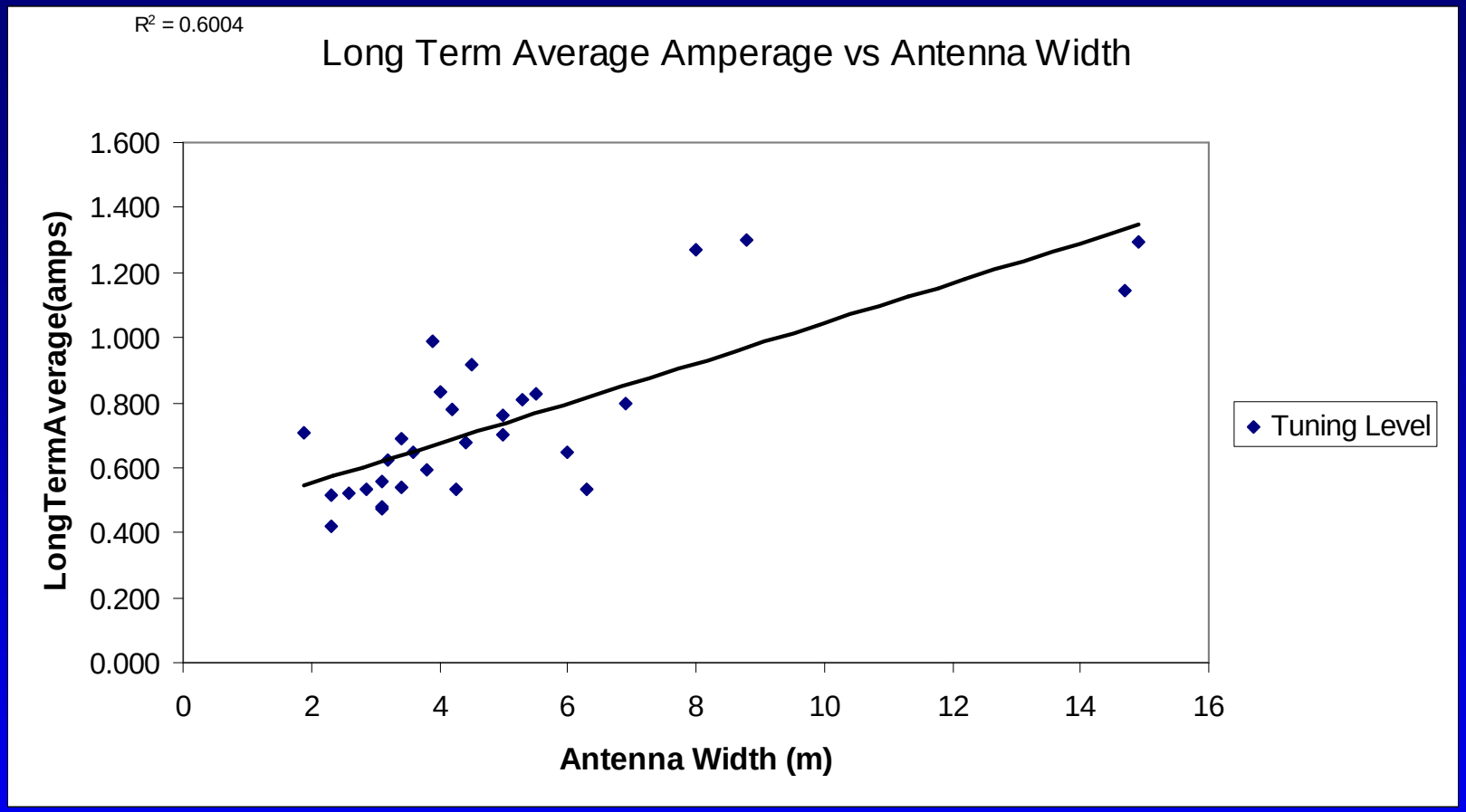
- HB1 Original (2005) Amperages .75 (ant 1) and .49 (ant 2) Same antennas now require 1.9 and 1.8 amps respectively. What possible causes for this?

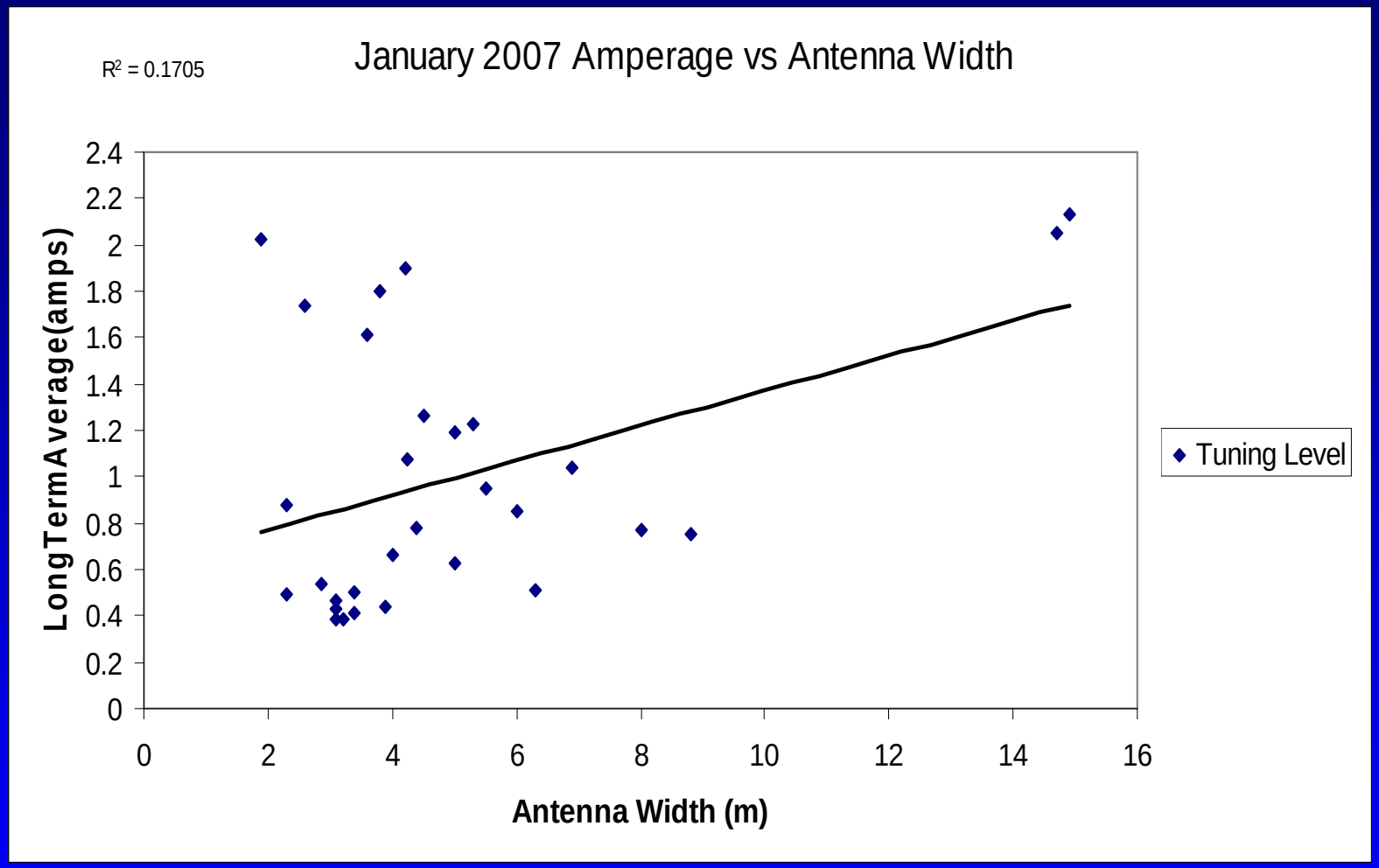
Problem Solving

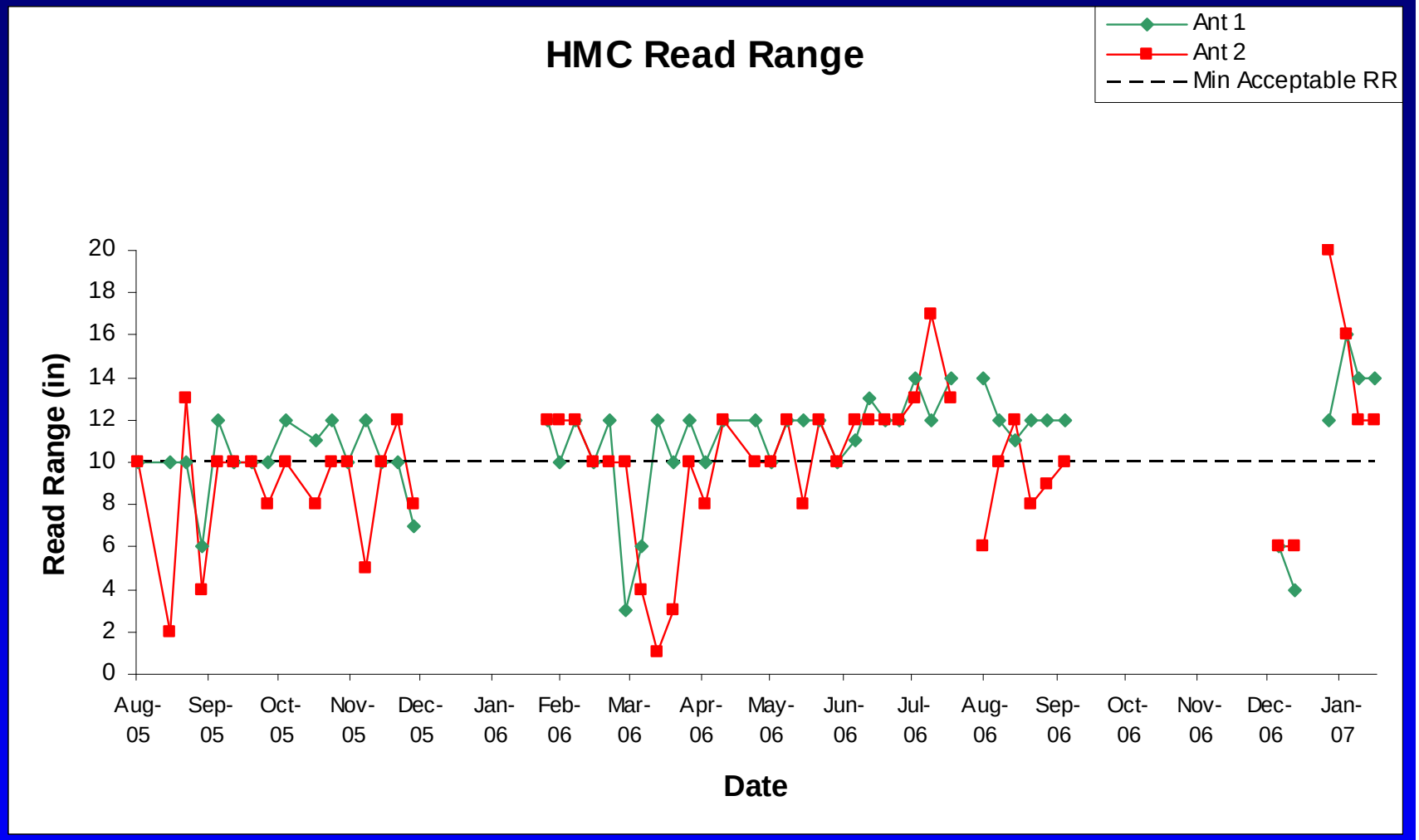
- Carry a complete set of spare parts
- Systematically swap parts out
- Last resort…rebuild the antenna
- Really the last resort…move the antenna
- Really really the last resort…replace the coax

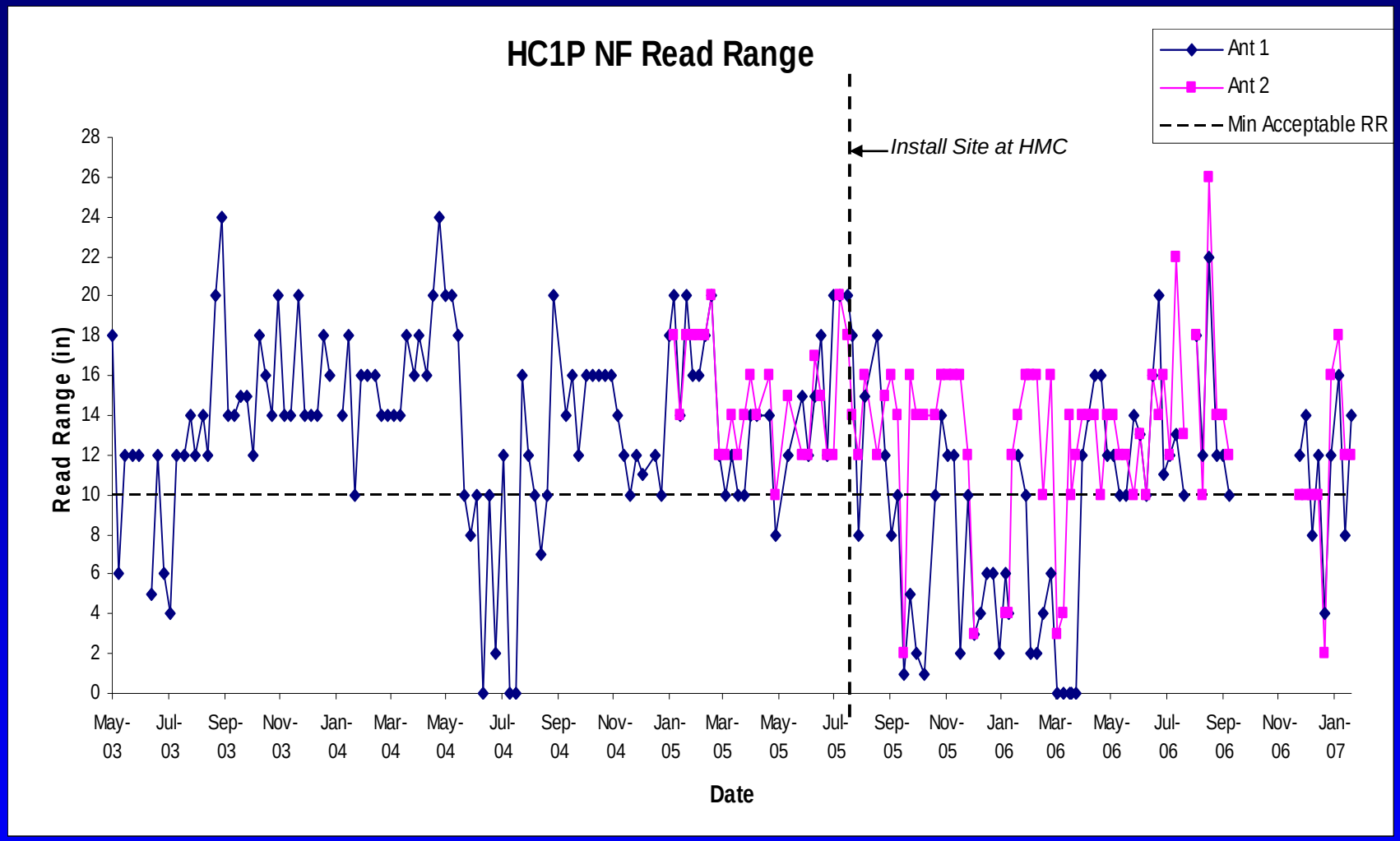
C.A.T. 01-00

O. clarkii, 210mm, F.L.
CAMP CREEK COASTAL CUTTHROAT


R² = 0.6004
Long Term Average Amperage vs Antenna Width
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
LongTermAverage(amps)
0
2
4
6
8
10
12
14
16
Antenna Width (m)
Tuning Level


January 2007 Amperage vs Antenna Width
R² = 0.1705
Long Term Average (amps)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14
16
Antenna Width (m)
Tuning Level


HMC Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
20
18
16
14
12
10
8
6
4
2
0
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Date


HC1P NF Read Range
Ant 1
Ant 2
Min Acceptable RR
Install Site at HMC
Read Range (in)
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
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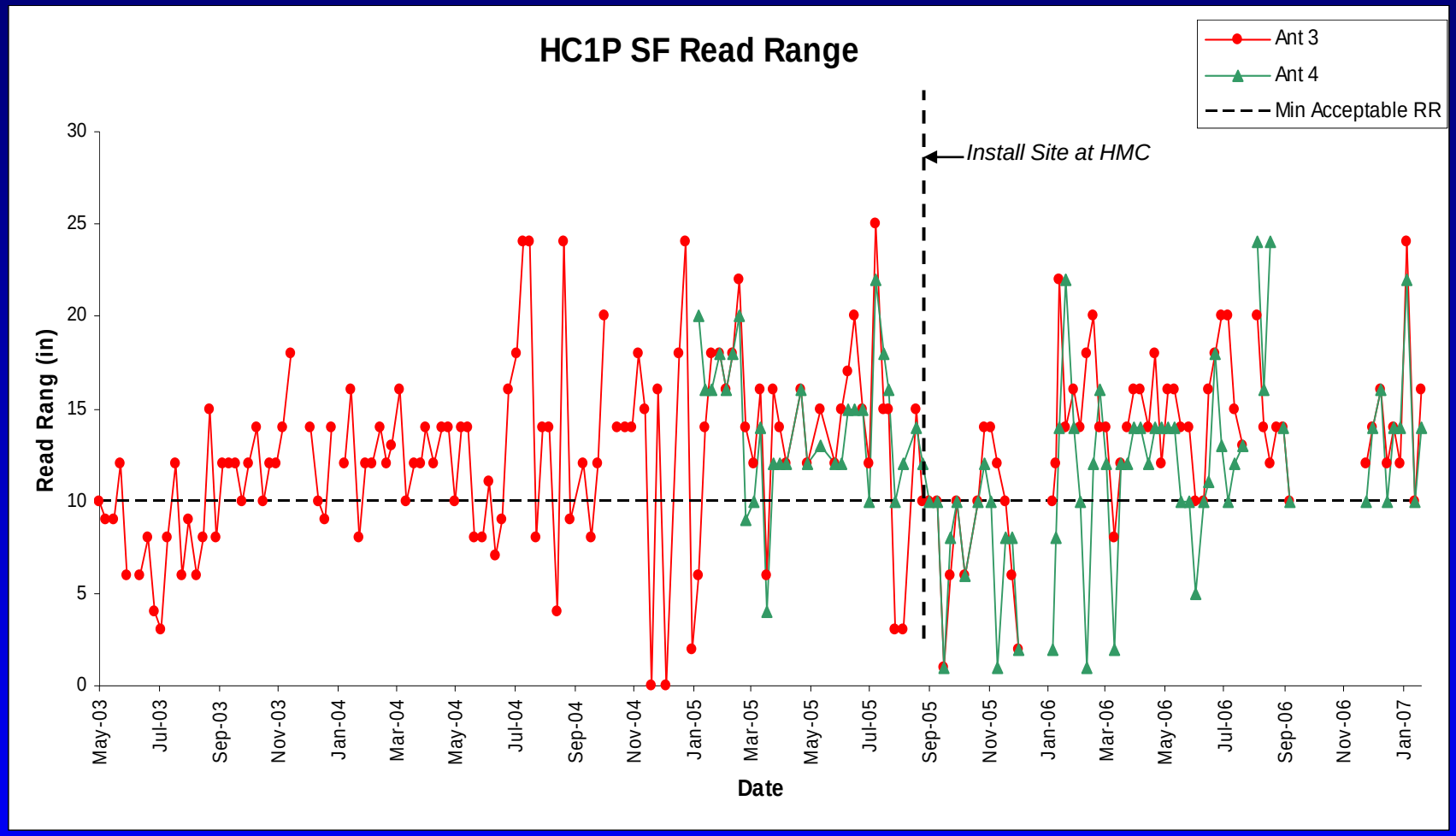
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Date


HC1P SF Read Range
Ant 3
Ant 4
Min Acceptable RR
Install Site at HMC
Read Rang (in)
30
25
20
15
10
5
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
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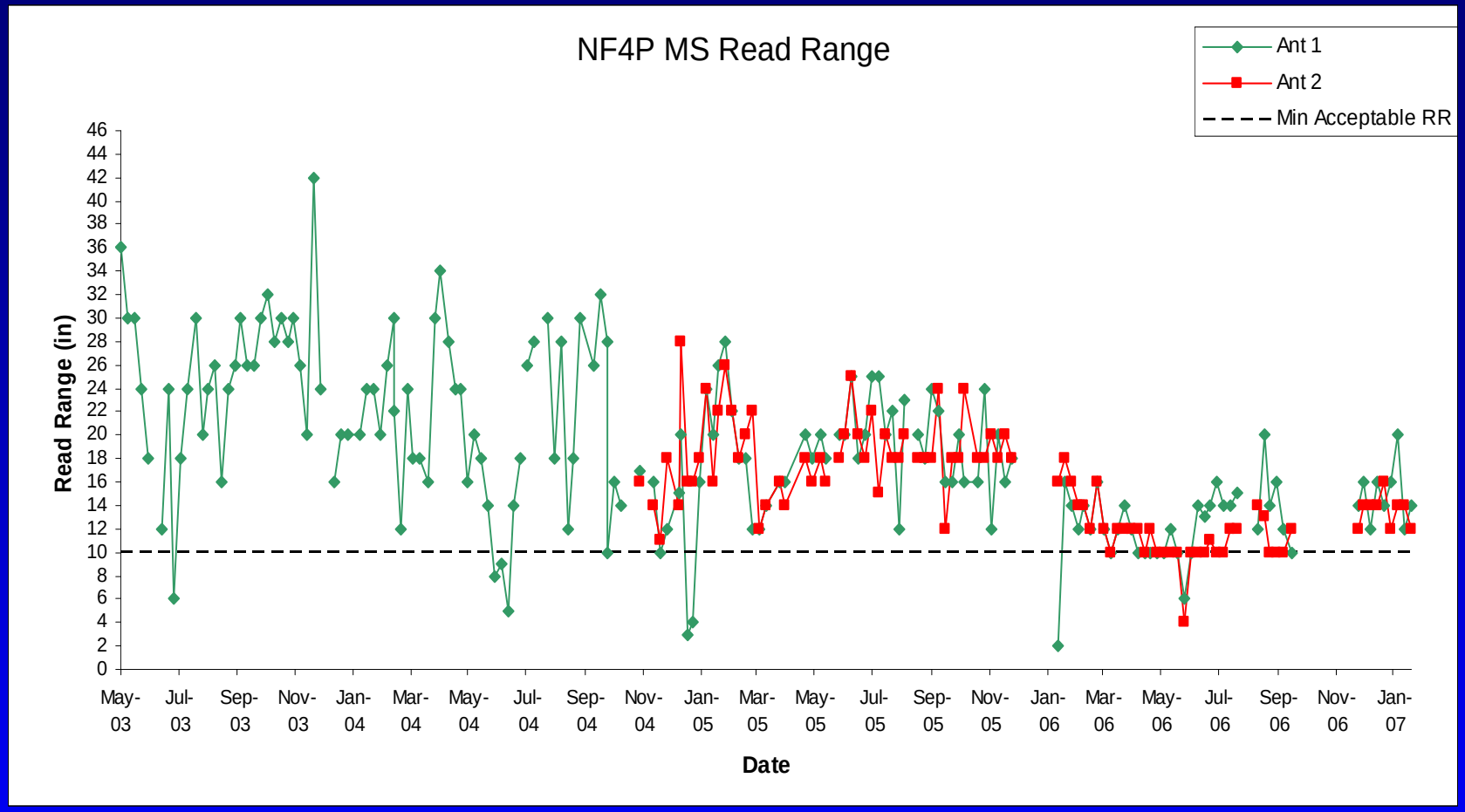
Jul-06
Sep-06
Nov-06
Jan-07
Date


NF4P MS Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
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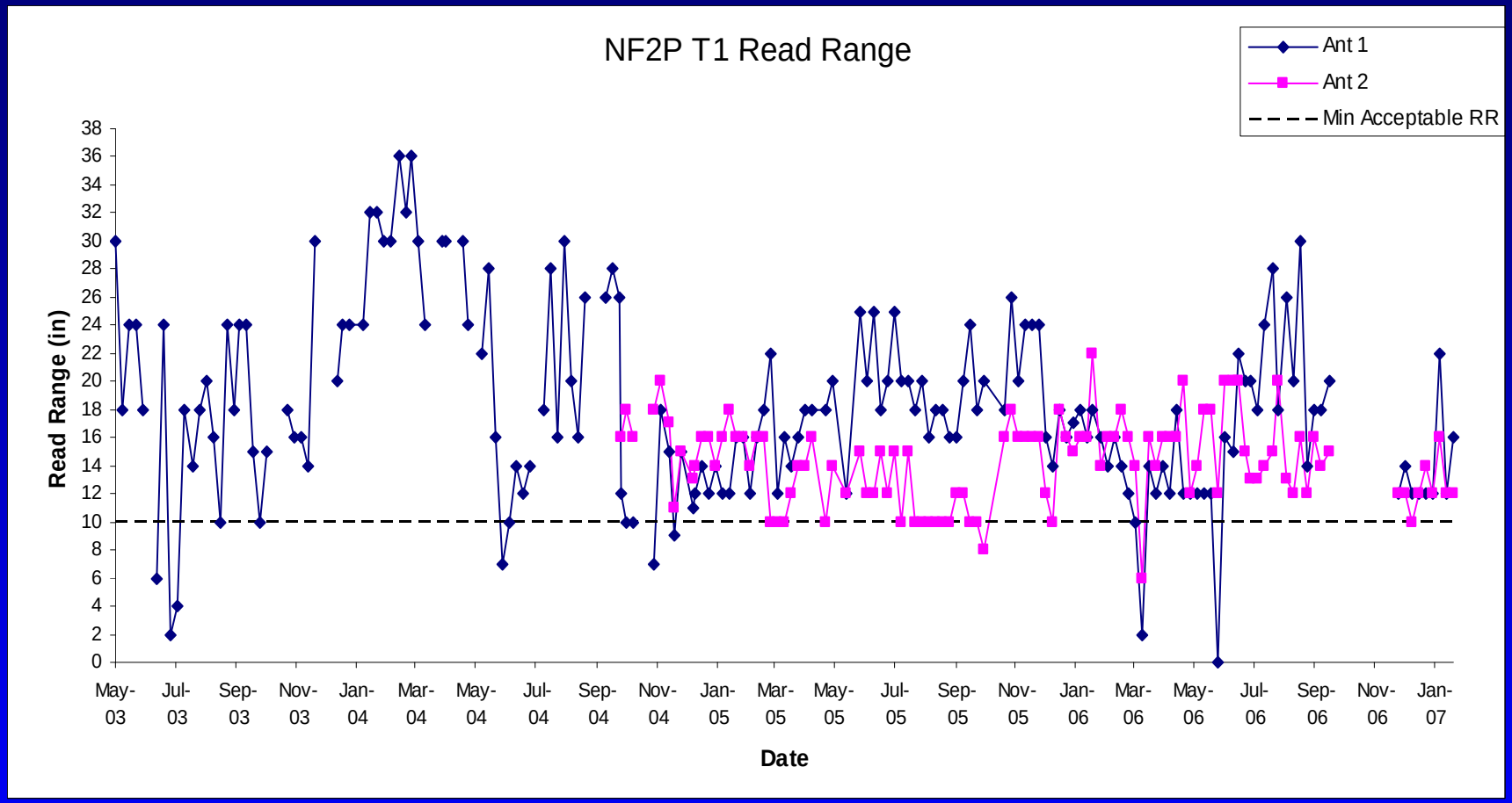
Sep-06
Nov-06
Jan-07
Date


NF2P T1 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
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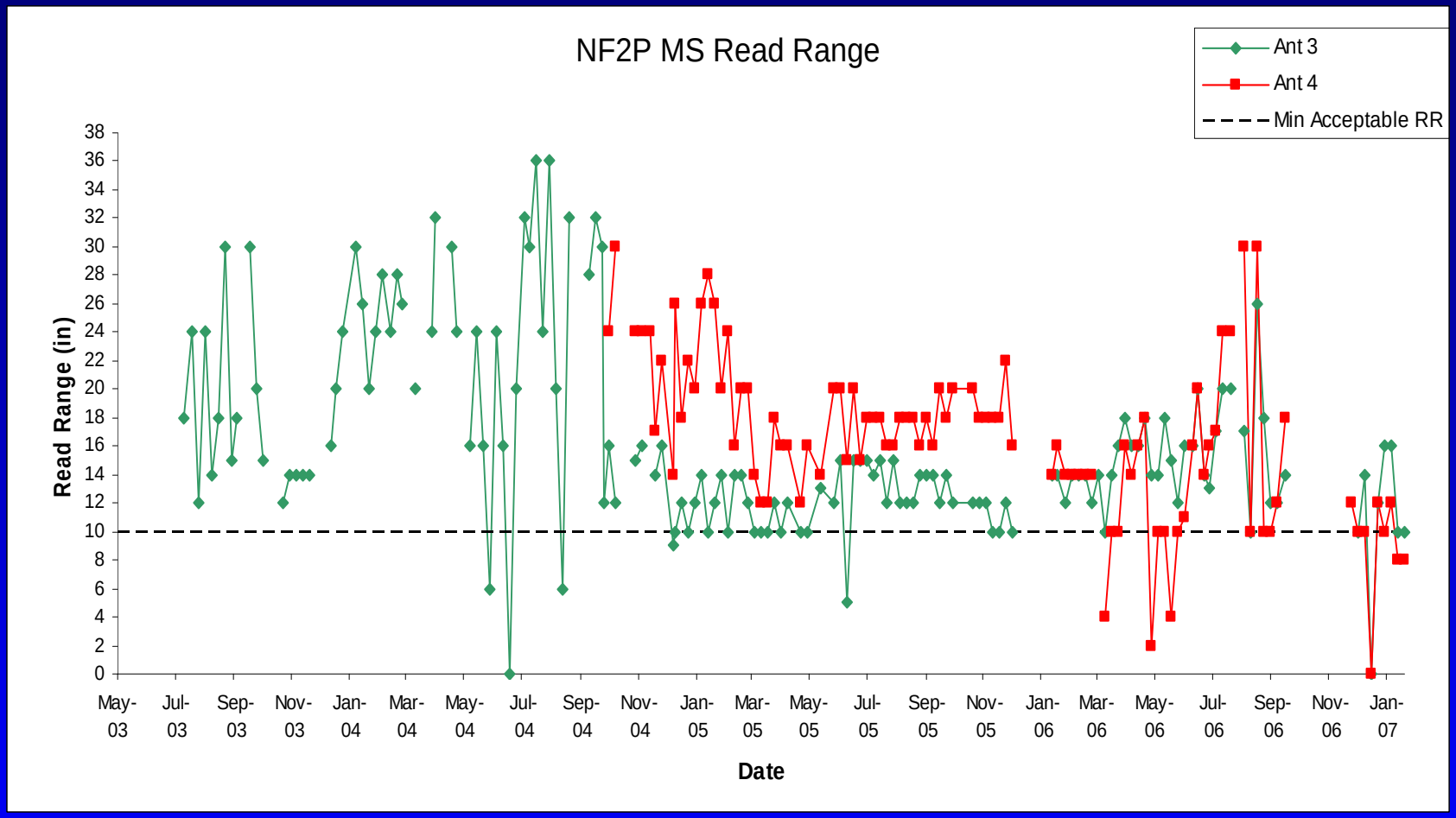
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Date


NF2P MS Read Range
Ant 3
Ant 4
Min Acceptable RR
Read Range (in)
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
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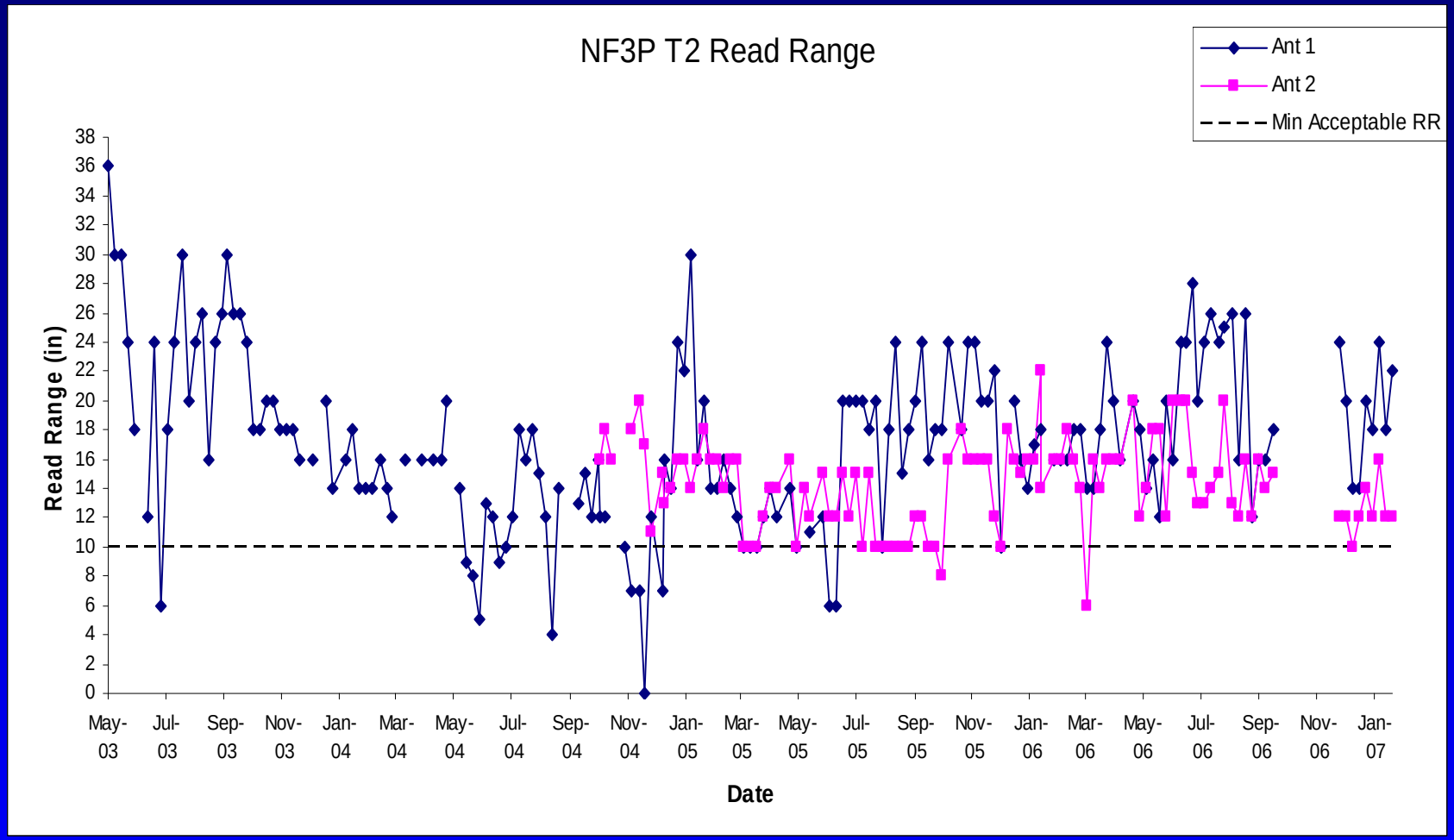
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Date


NF3P T2 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
38
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2
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May-03
Jul-03
Sep-03
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Nov-04
Jan-05
Mar-05
May-05
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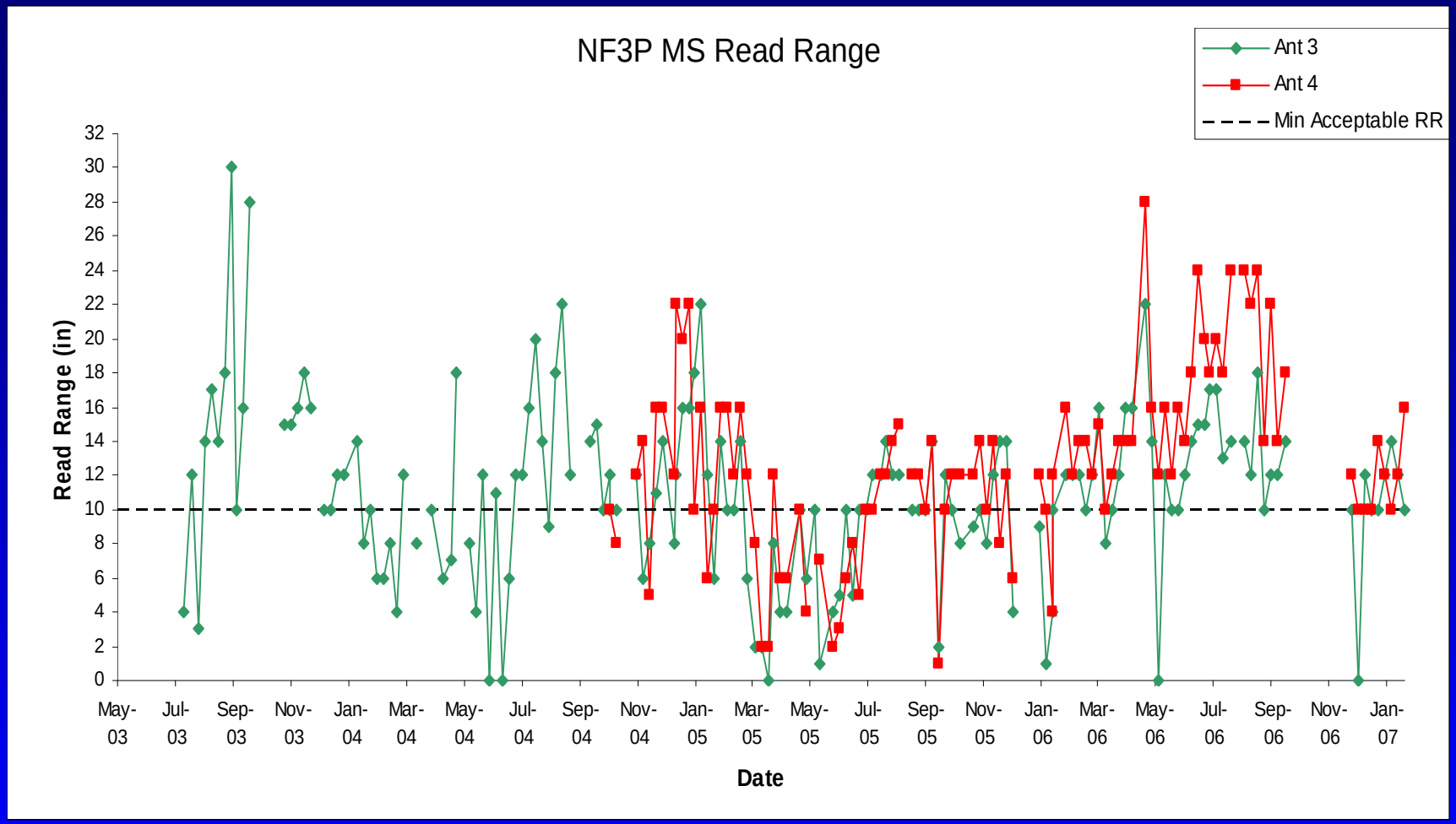
Jul-06
Sep-06
Nov-06
Jan-07
Date


NF3P MS Read Range
Ant 3
Ant 4
Min Acceptable RR
Read Range (in)
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30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
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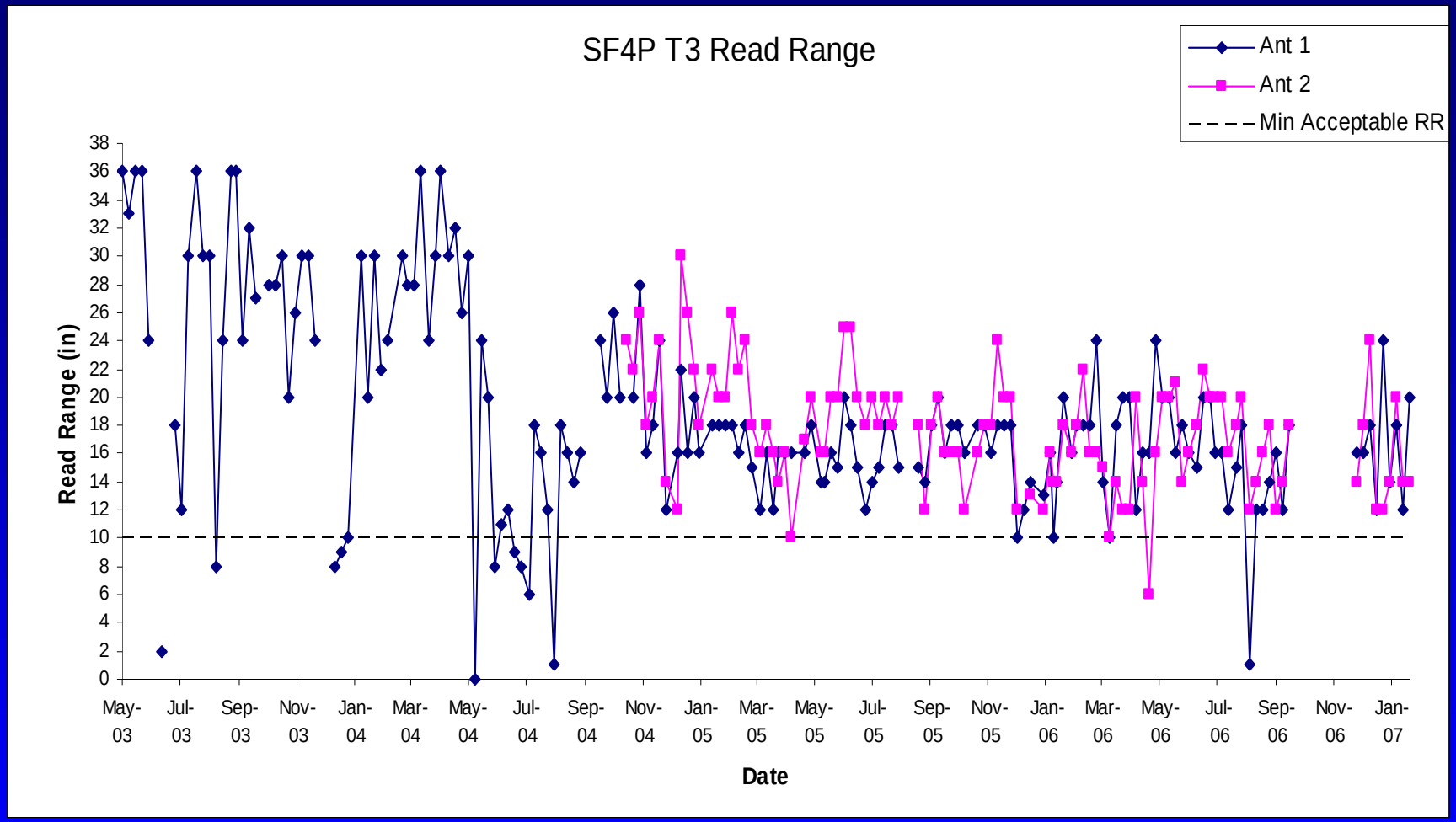
Nov-06
Jan-07
Date


SF4P T3 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
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36
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32
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28
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May-03
Jul-03
Sep-03
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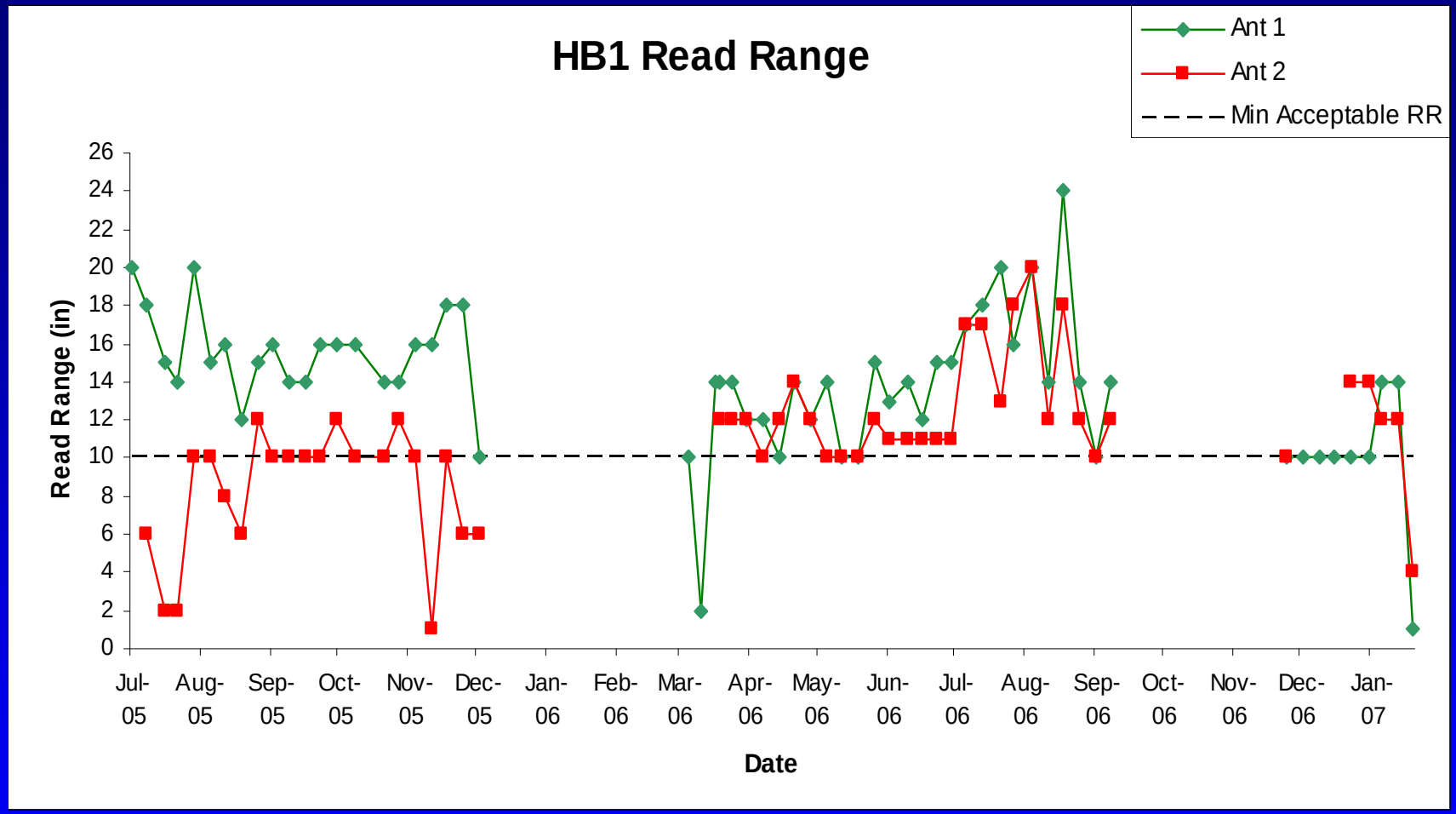
Nov-06
Jan-07
Date


HB1 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
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24
22
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Aug-05
Sep-05
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Nov-05
Dec-05
Jan-06
Feb-06
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Jun-06
Jul-06
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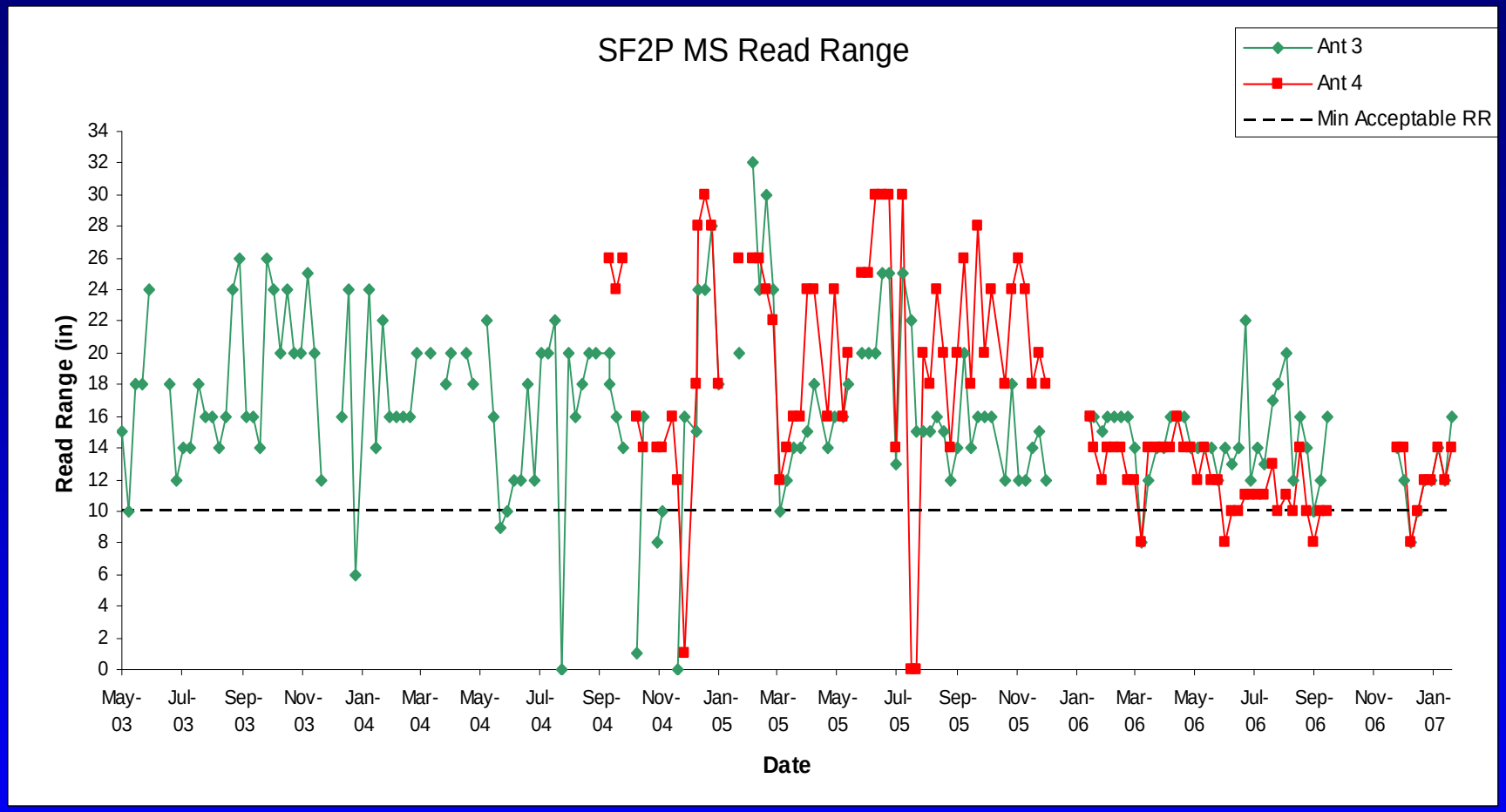
Nov-06
Dec-06
Jan-07
Date


SF2P MS Read Range
Ant 3
Ant 4
Min Acceptable RR
Read Range (in)
34
32
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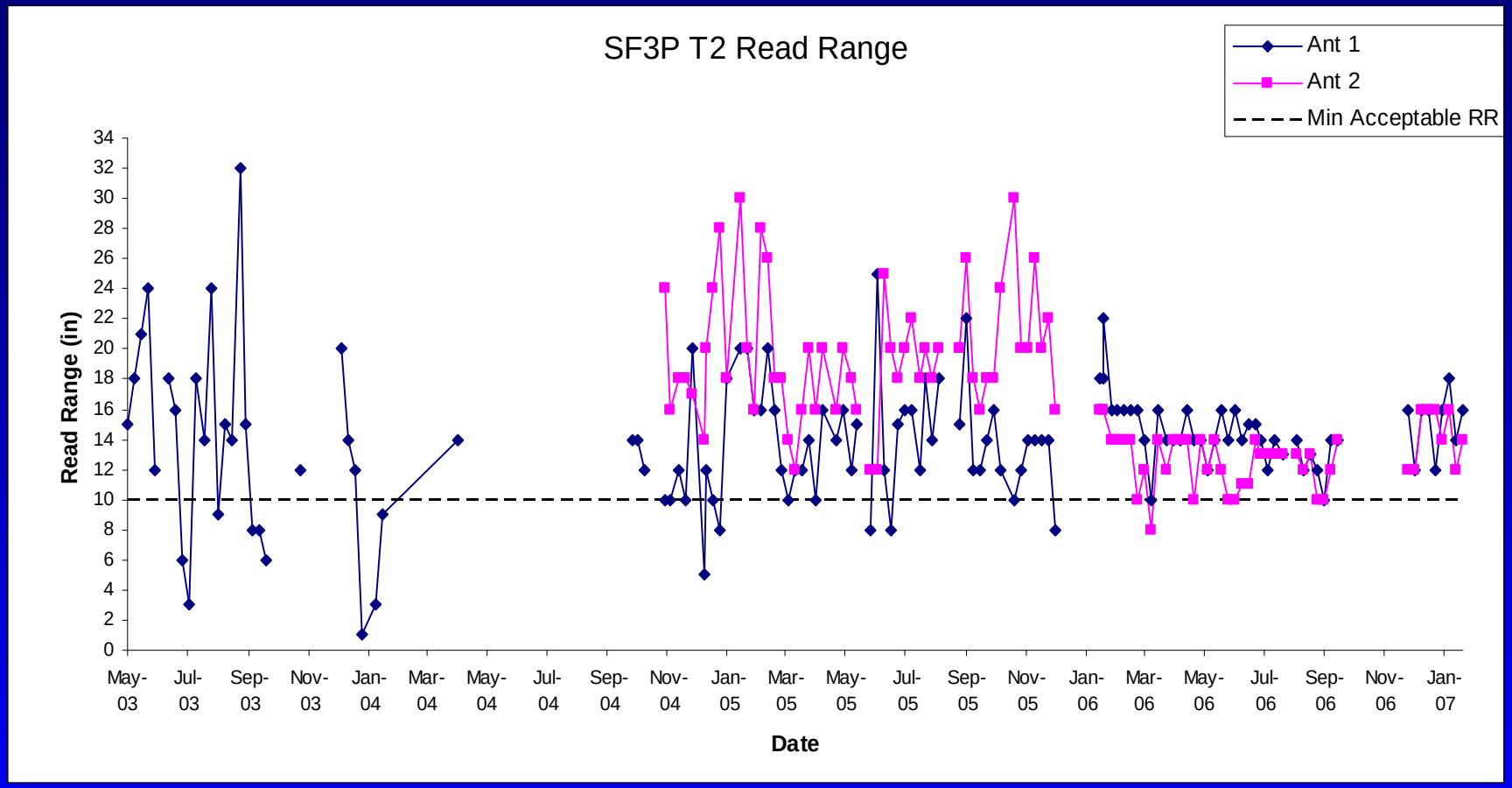
Sep-06
Nov-06
Jan-07
Date


SF3P T2 Read Range
Ant 1
Ant 2
Min Acceptable RR
Read Range (in)
34
32
30
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22
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May-03
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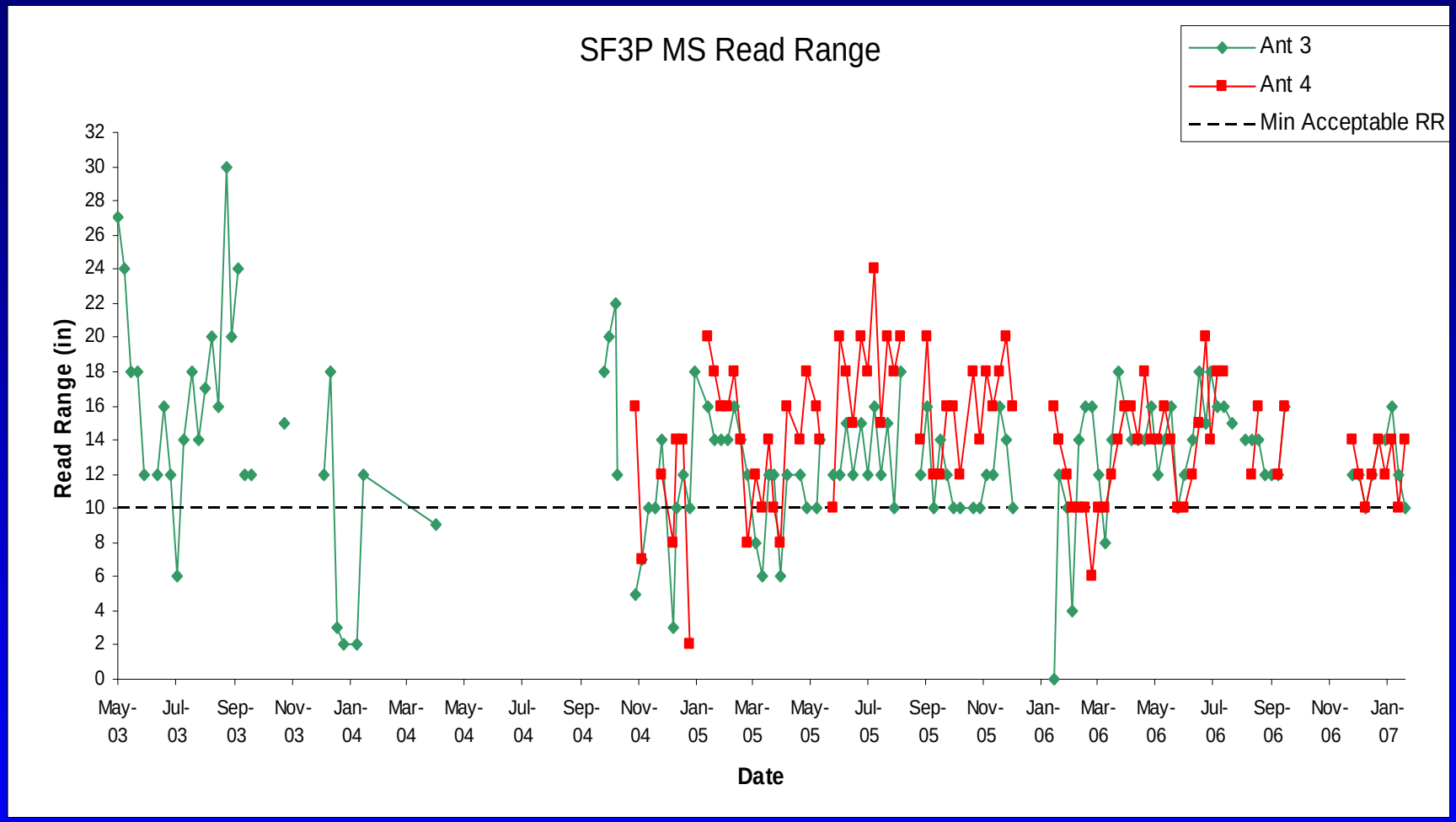
Sep-06
Nov-06
Jan-07
Date


SF3P MS Read Range
Ant 3
Ant 4
Min Acceptable RR
Read Range (in)
32
30
28
26
24
22
20
18
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12
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8
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4
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May-03
Jul-03
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Nov-03
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Jul-05
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Jan-06
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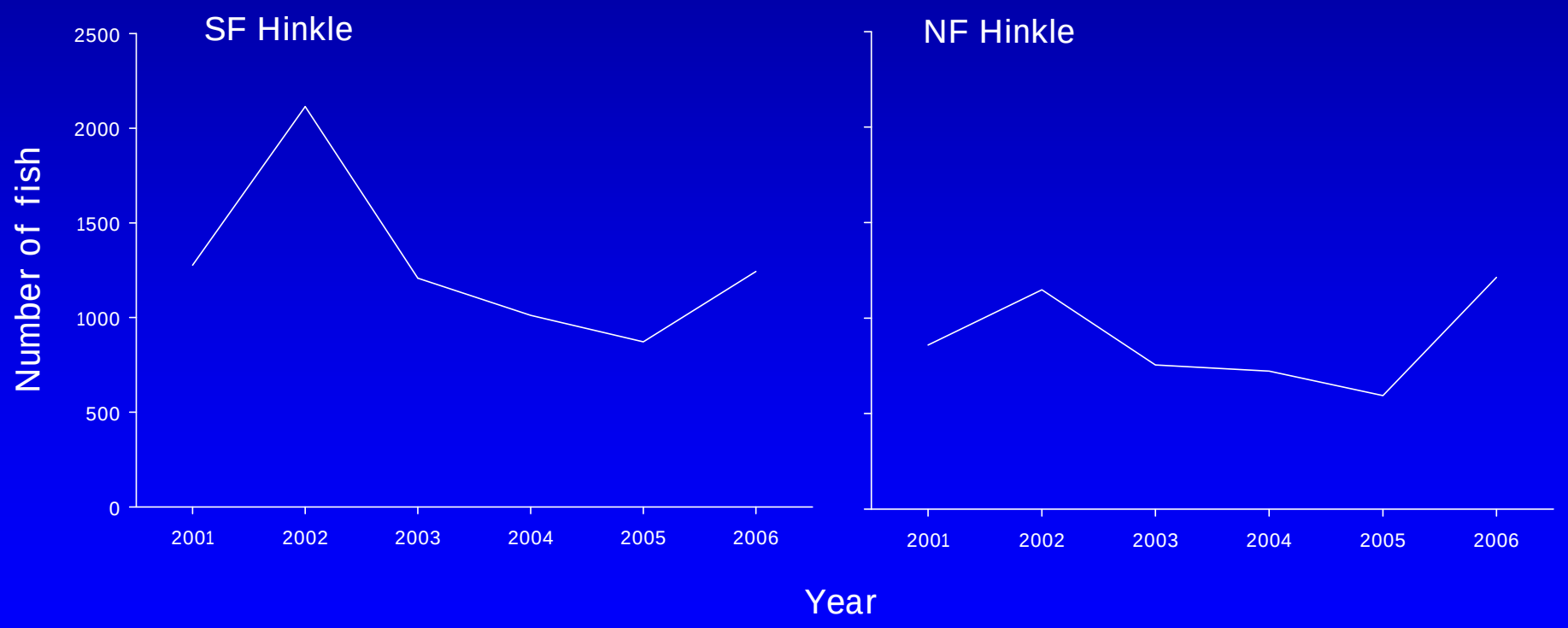
Jul-06
Sep-06
Nov-06
Jan-07
Date

Questions:

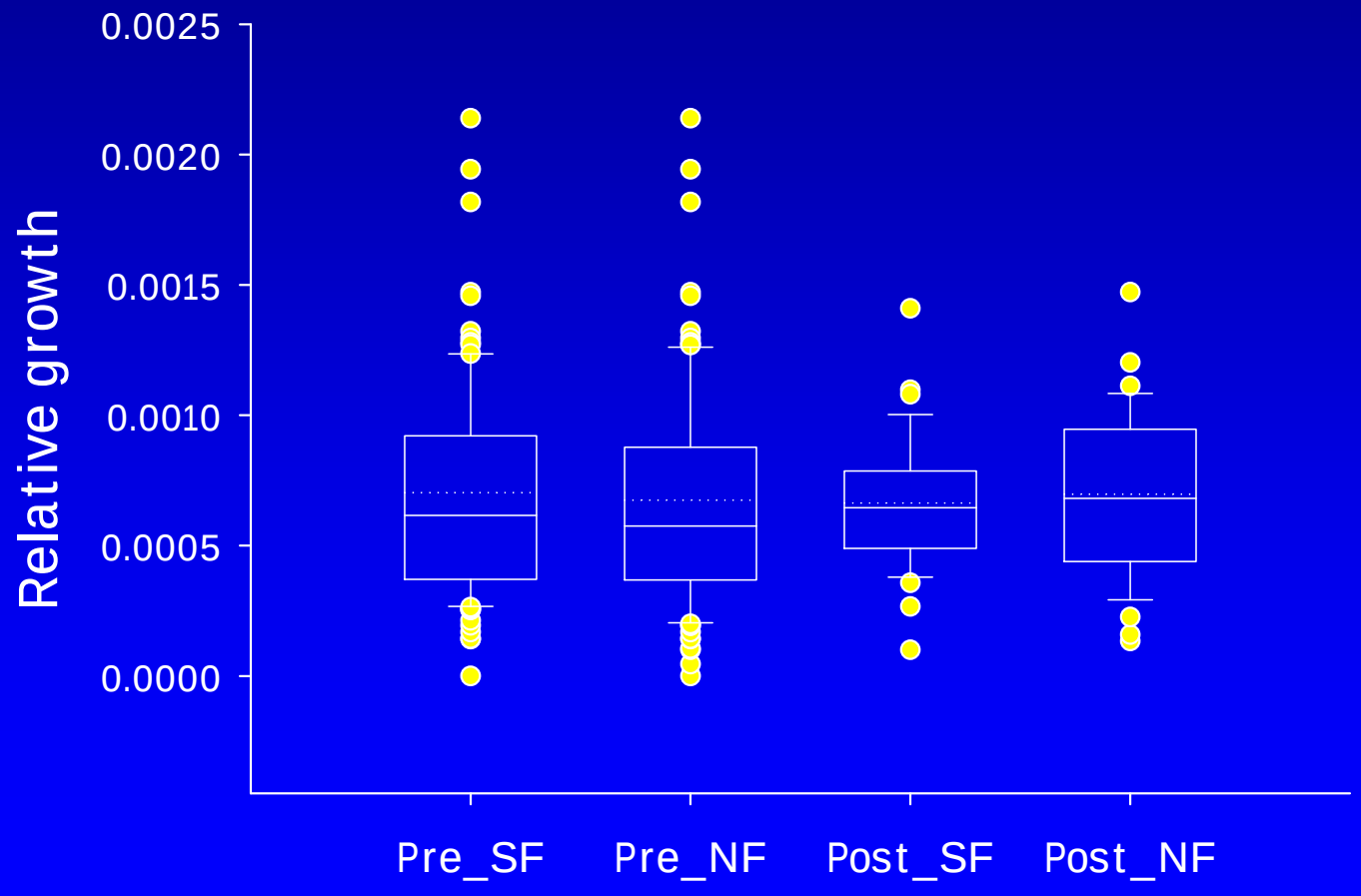
- We know that amperage drifts through time, but…
- HB1 Original (2005) Amperages .75 (ant 1) and .49 (ant 2) Same antennas now require 1.9 and 1.8 amps respectively. What possible causes for this?

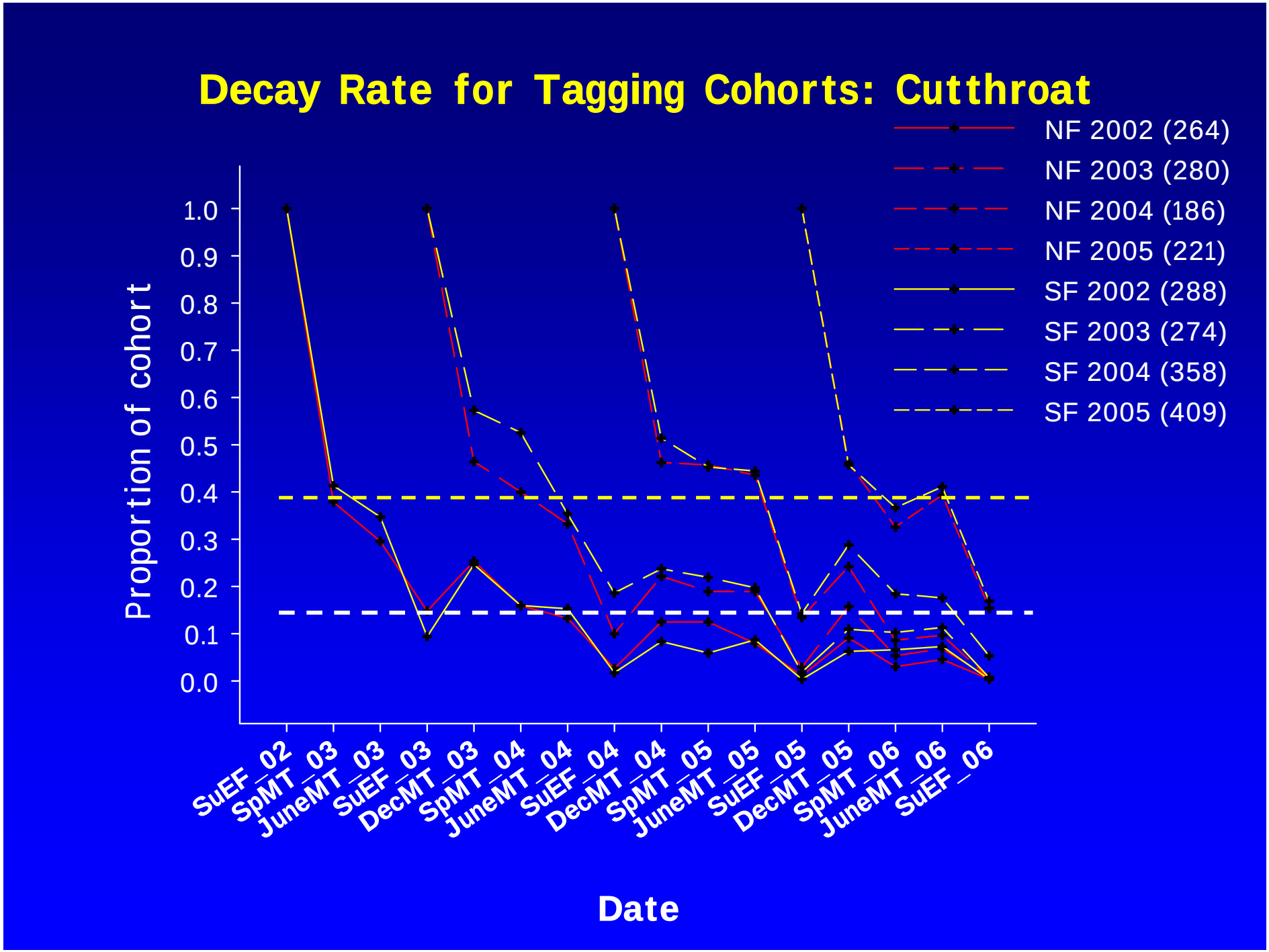
Capacitance, Inductance, and Jumpers….. What's the scoop? i.e The Complete List of Tuner Jumper Settings isn't.

Total Catch: All Fish Combined 2001-2006



Growth (mm/mm/day) for PIT Tagged Cutthroat North and South Fork Hinkle 2002-2005



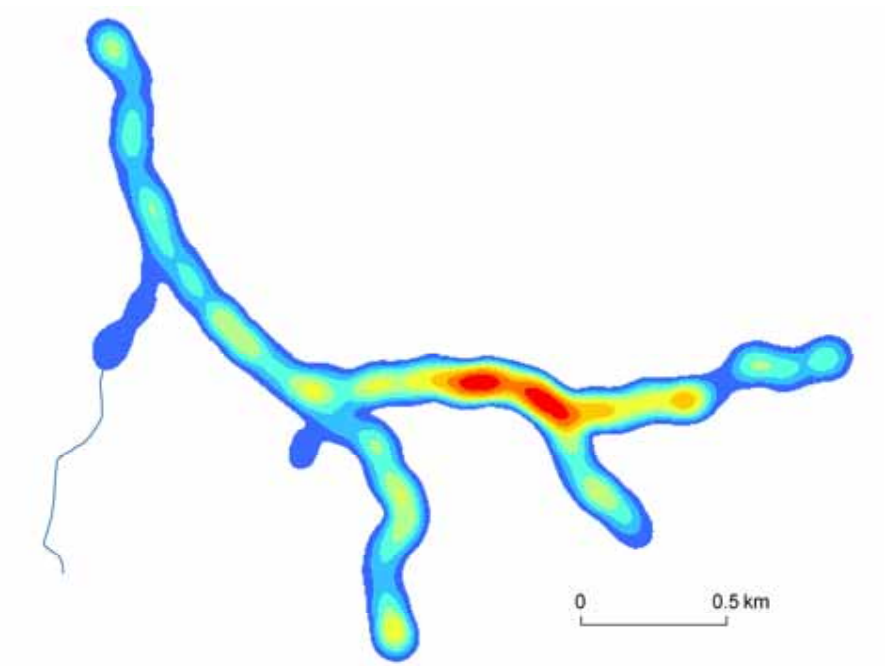

Decay Rate for Tagging Cohorts: Cutthroat
NF 2002 (264)
NF 2003 (280)
NF 2004 (186)
NF 2005 (221)
SF 2002 (288)
SF 2003 (274)
SF 2004 (358)
SF 2005 (409)
Proportion of cohort
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
SuEF_02
SpMT_03
JuneMT_03
SuEF_03
DecMT_03
SpMT_04
JuneMT_04
SuEF_04
DecMT_04
SpMT_05
JuneMT_05
SuEF_05
DecMT_05
SpMT_06
JuneMT_06
SuEF_06
Date

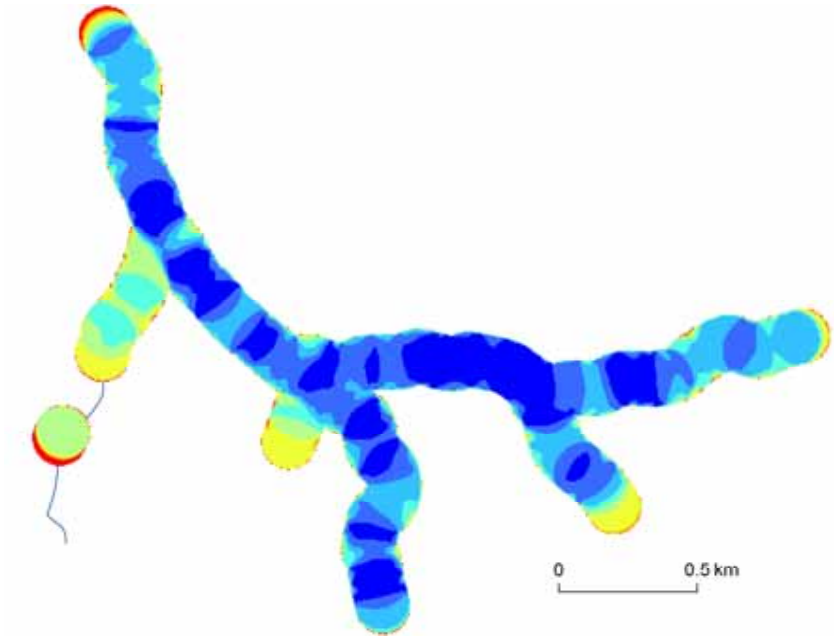
Predation

- Mink?
- Otter?
- Raccoon?

SF Hinkle 2002-2005 Mean and CV

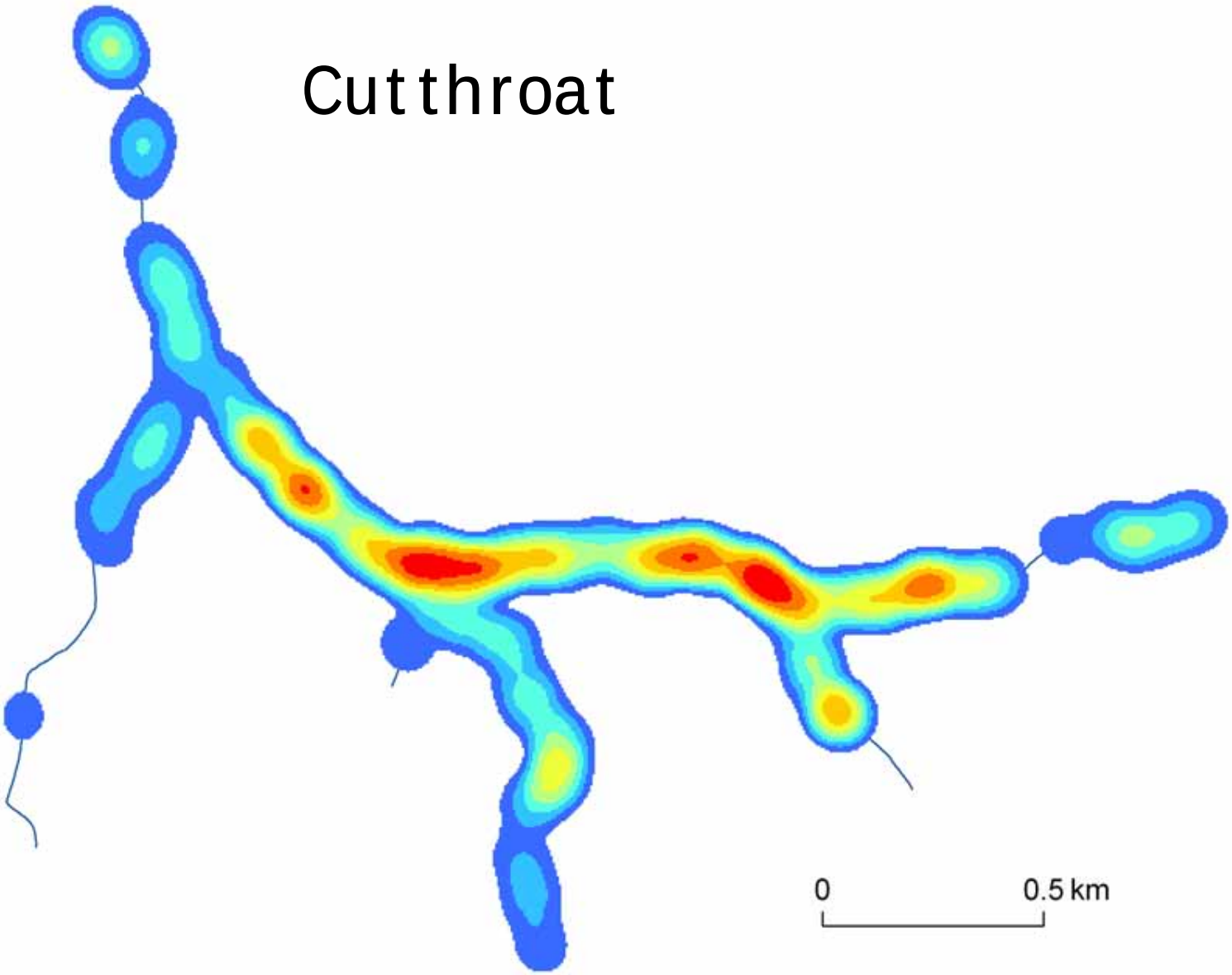
Cutthroat





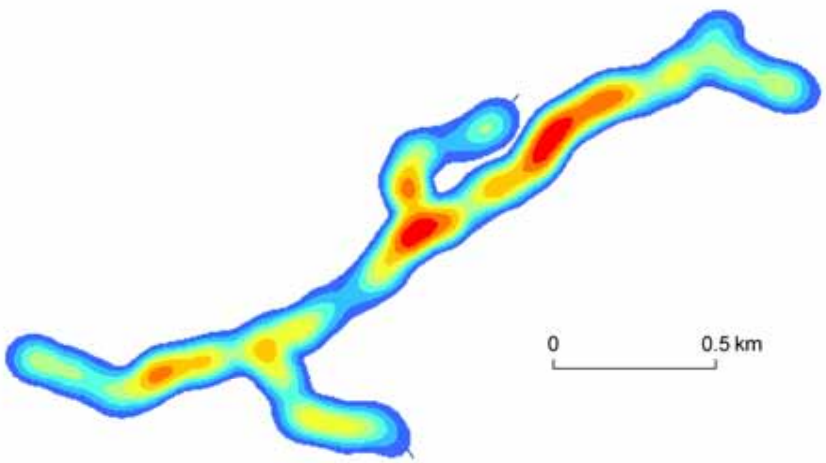
SF Hinkle Initial Tagging 2006

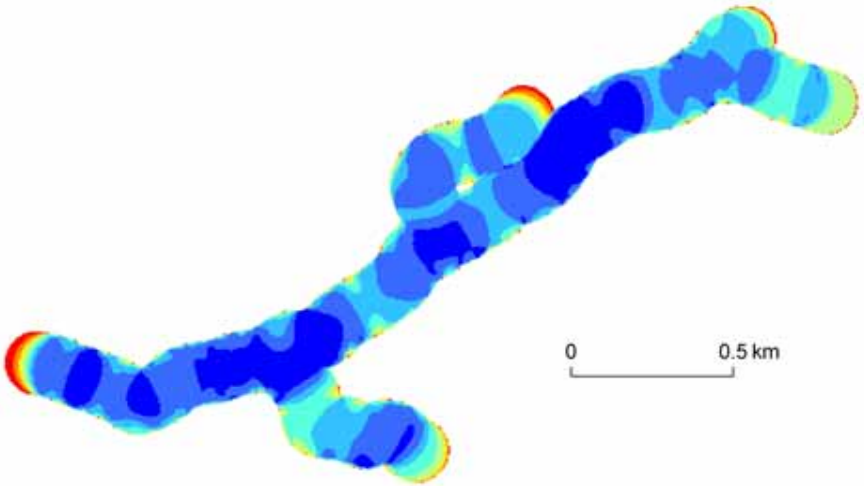
Cutthroat



NF Hinkle 2002-2005 Mean and CV

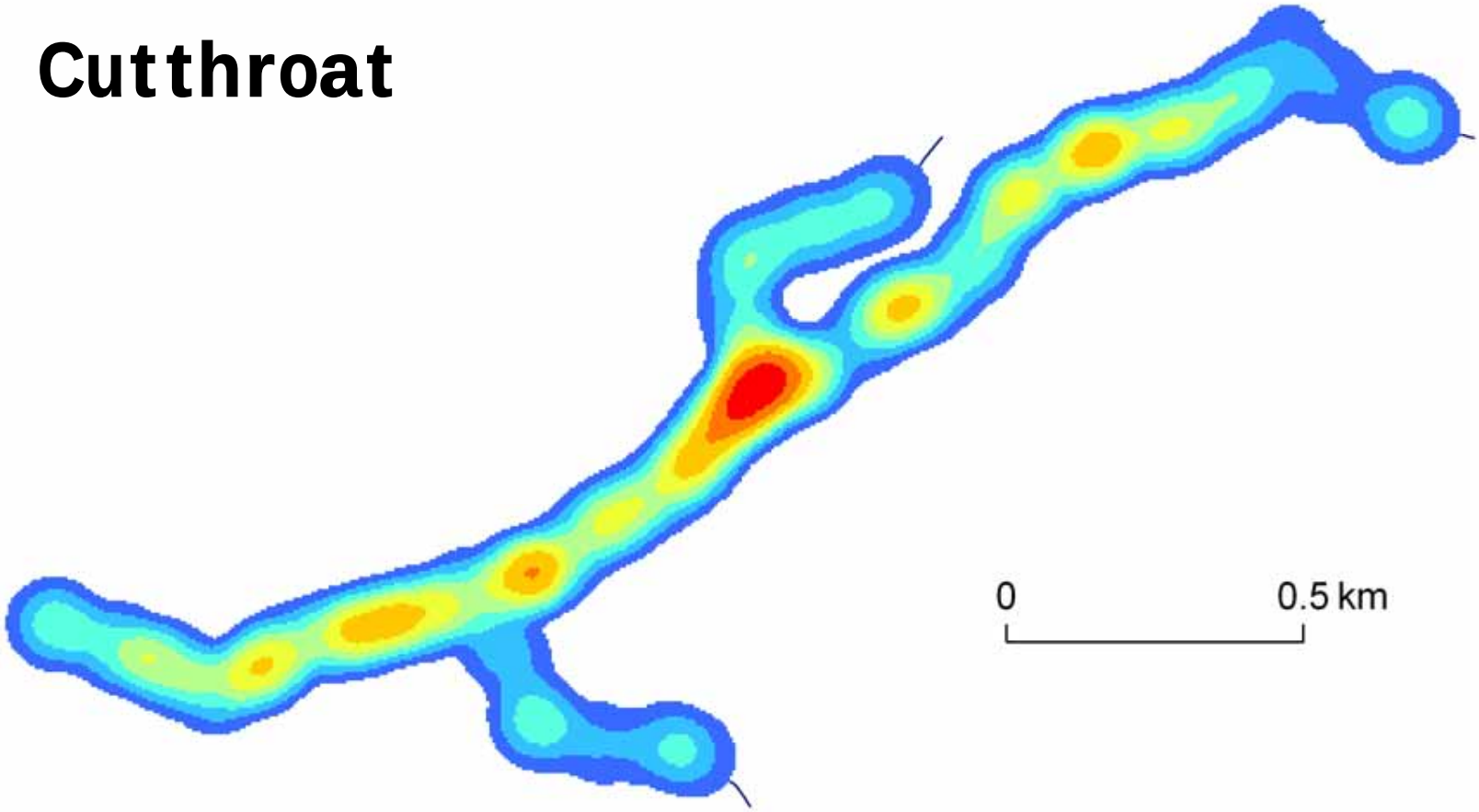
Cutthroat



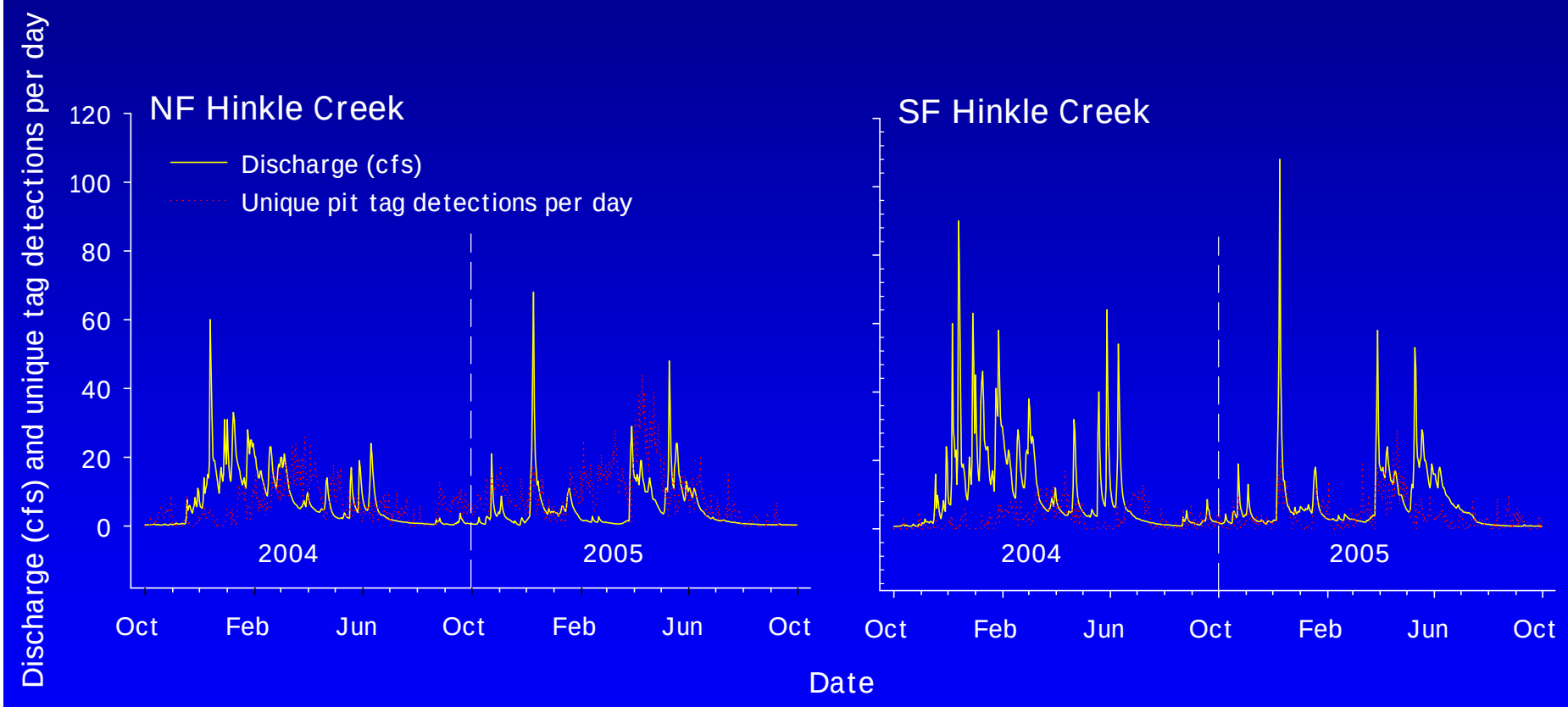


NF Initial Tagging 2006

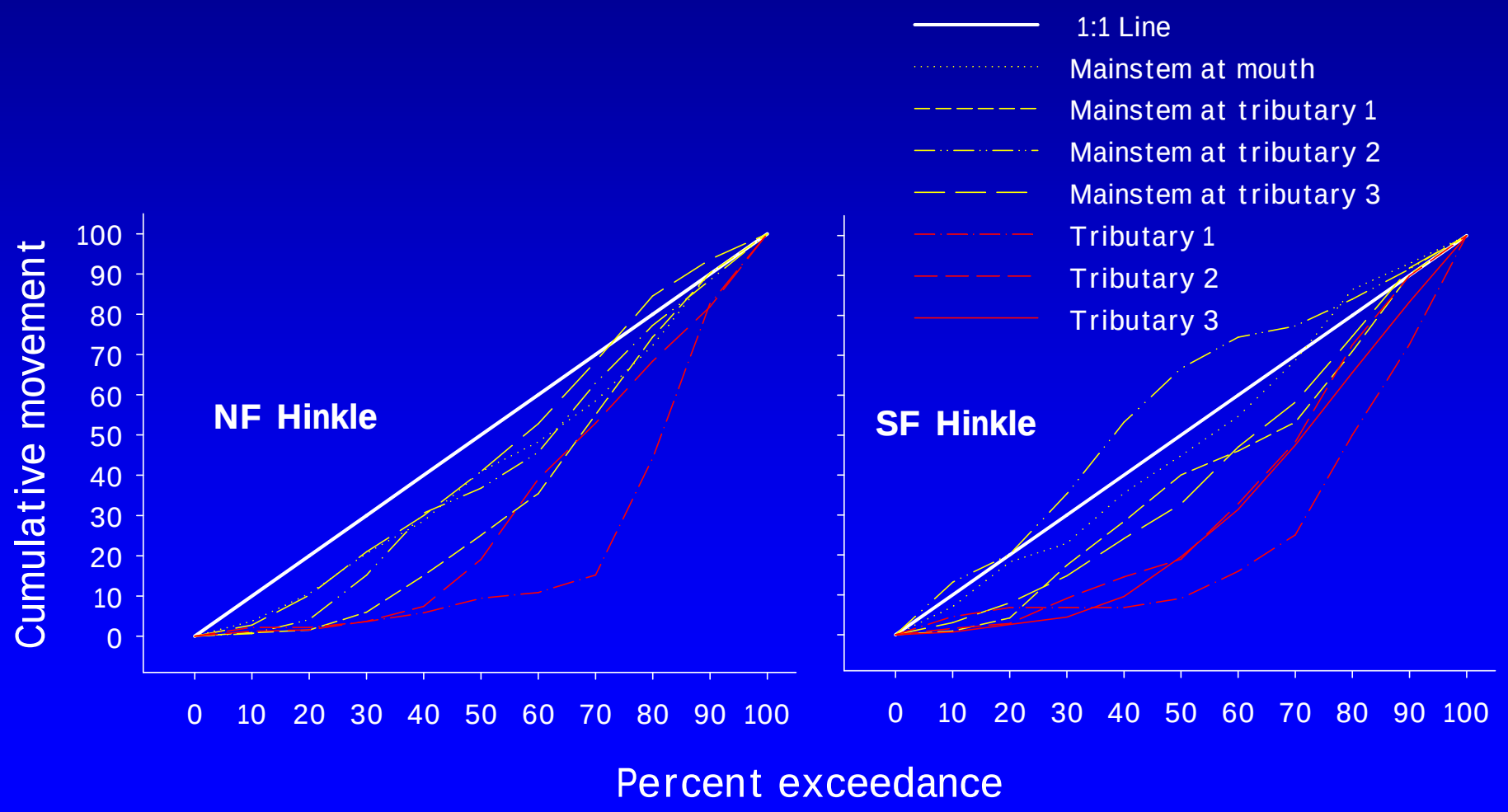
Cutthroat



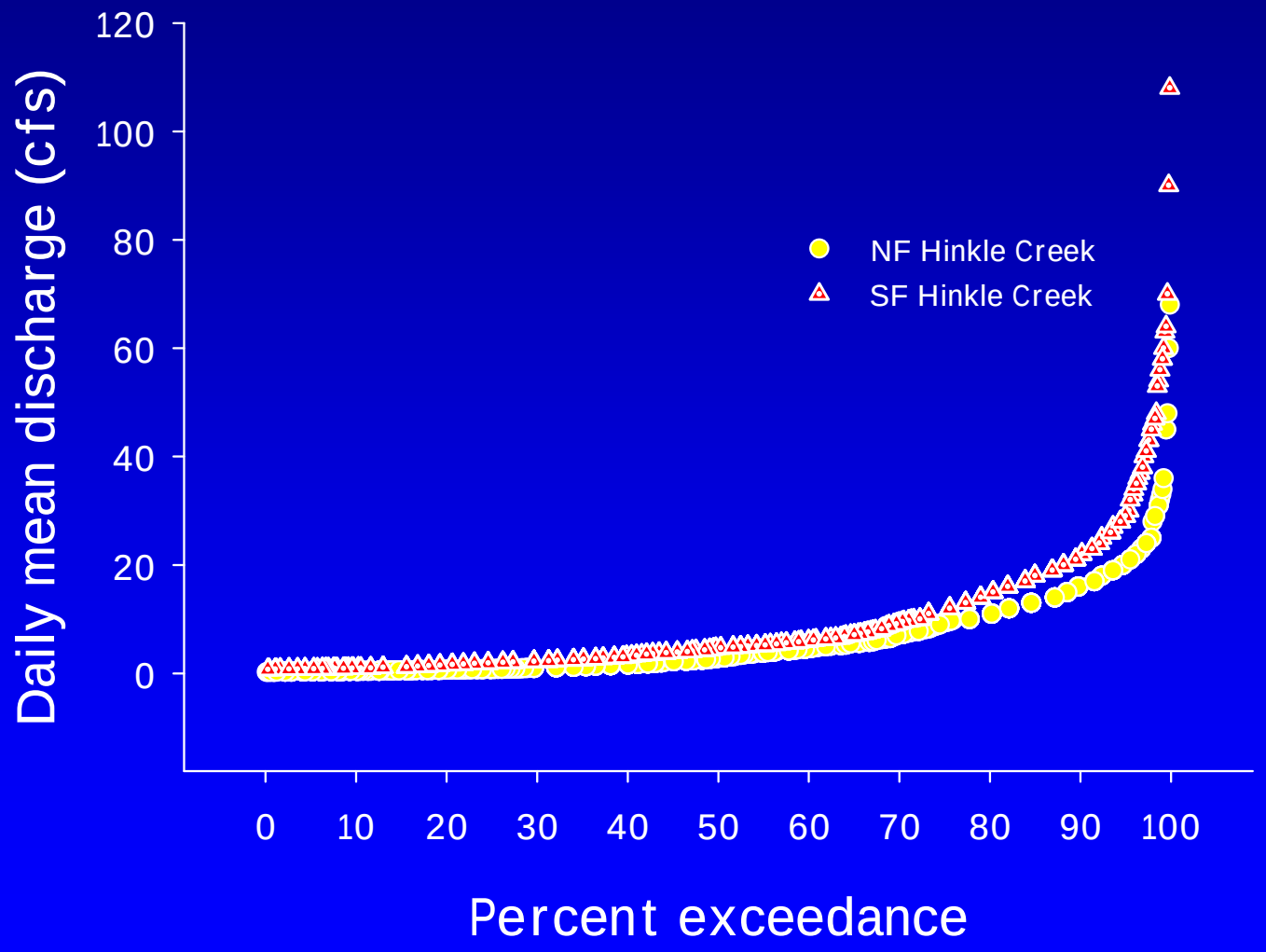
Unique Tag Detections per Day vs Mean Daily Discharge (cutthroat)



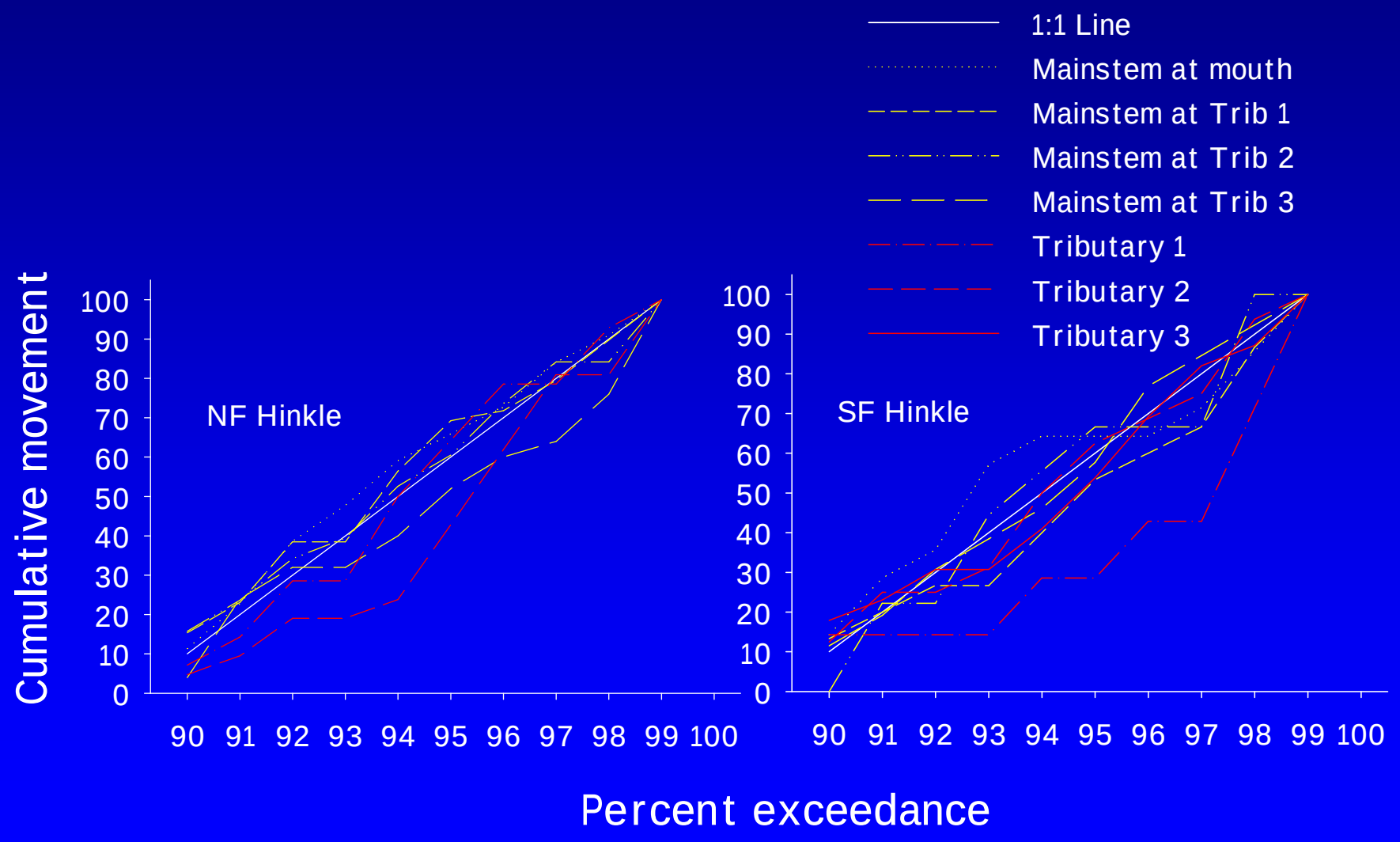
Cumulative Movement vs Percent Exceedance Of Mean Daily Discharge



Flow Distribution for 2004 and 2005 Water Years



Cumulative Movement for Flows Exceeding the 90th Percentile



PIT Tag Interrogation in a Tributary of the Lower Columbia River and Diversion Canals of the Umatilla River

J. Gasvoda

Abstract not available

Return to top

Abernathy Fish Technology Center

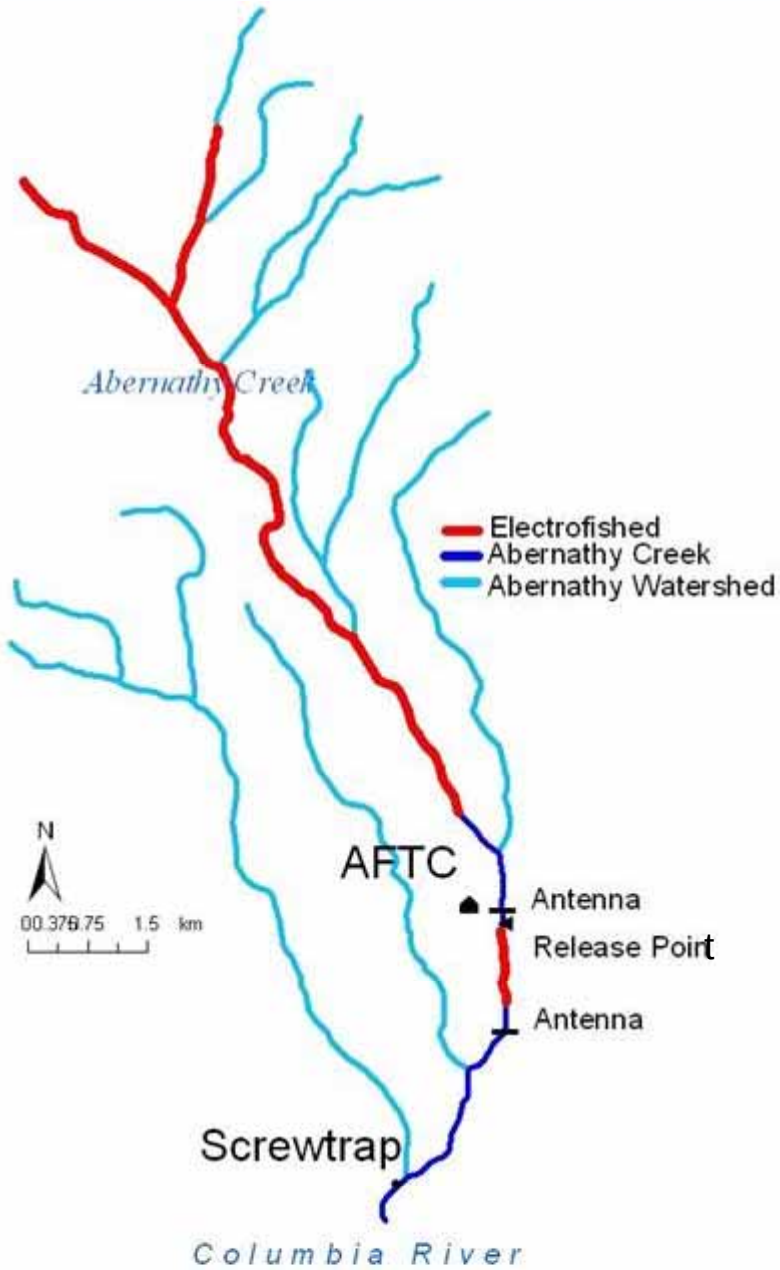
Jim Gasvoda

PIT Tag Arrays

- Abernathy

- Bureau of Reclamation
  Umatilla River Canals

Abernathy
N
W
E
S
Image © 2007 DigitalGlobe
© 2007 Europa Technologies
Image © 2007 TerraMetrics
©2005 Google
Pointer 46°14'23.50" N 123°16'13.49" W elev 811 ft
Streaming |||||||||| 100%
Eye alt 92.24 mi


Abernathy Creek
Electrofished
Abernathy Creek
Abernathy Watershed
N
0 0.375 0.75 1.5 km
AFTC
Antenna
Release Point
Antenna
Screwtrap
Columbia River

Tagged Fish (Annual Averages)

- Steelhead (23mm tags – Full Duplex)
    - 1500 Natural/Wild
    - 1500 Hatchery

- Cutthroat (23mm tags – Full Duplex)
    - 600 Natural/Wild

- Coho (12mm SGL/SST – Full Duplex)

Sites on Abernathy Creek

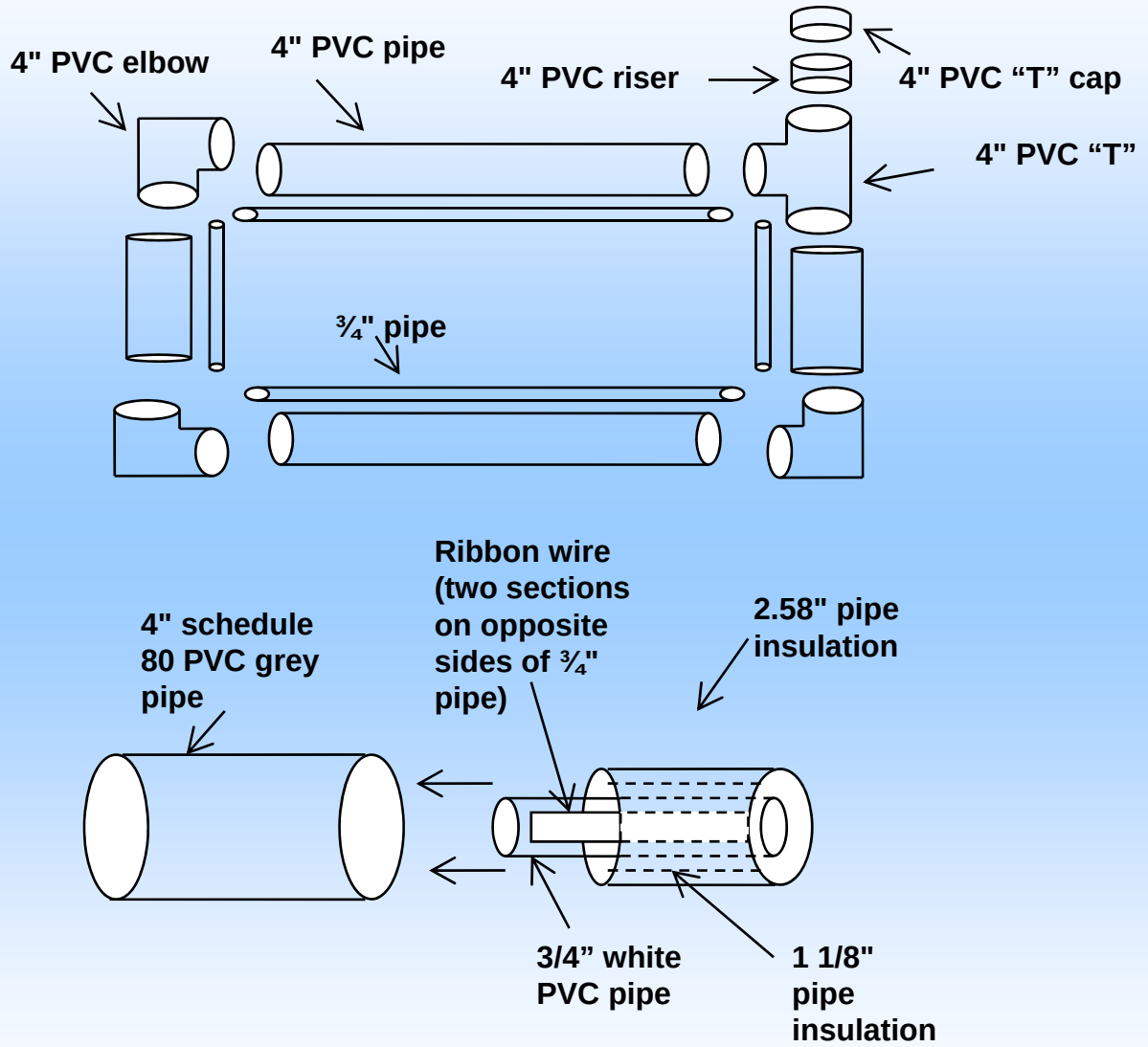
- AFTC Bridge (AB1)

- Davis Bridge (AB2)

- Hatchery Adult Ladder Outflow
    - Temporary During Forced Release

AB1 Antenna Array

Antenna Construction



AB1 Transceivers (old)

AB1 Transceivers (new)

AB2 Array

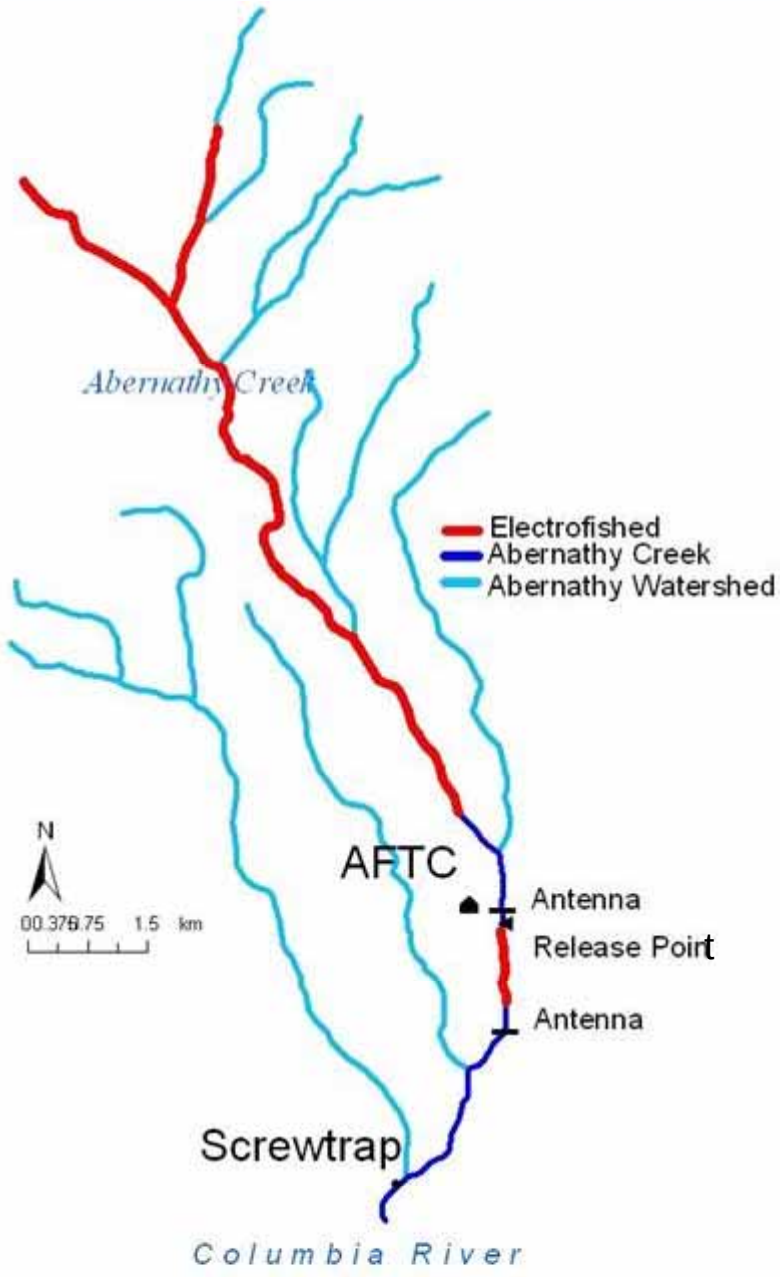
AB2 Transceivers

Adult Ladder Outflow Antenna

Issues at Sites

- Noise at AB1 due to Equipment at Tech Center

- High Water Damaging Antenna Arrays


Abernathy Creek
Electrofished
Abernathy Creek
Abernathy Watershed
N
0 0.375 0.75 1.5 km
AFTC
Antenna
Release Point
Antenna
Screwtrap
Columbia River

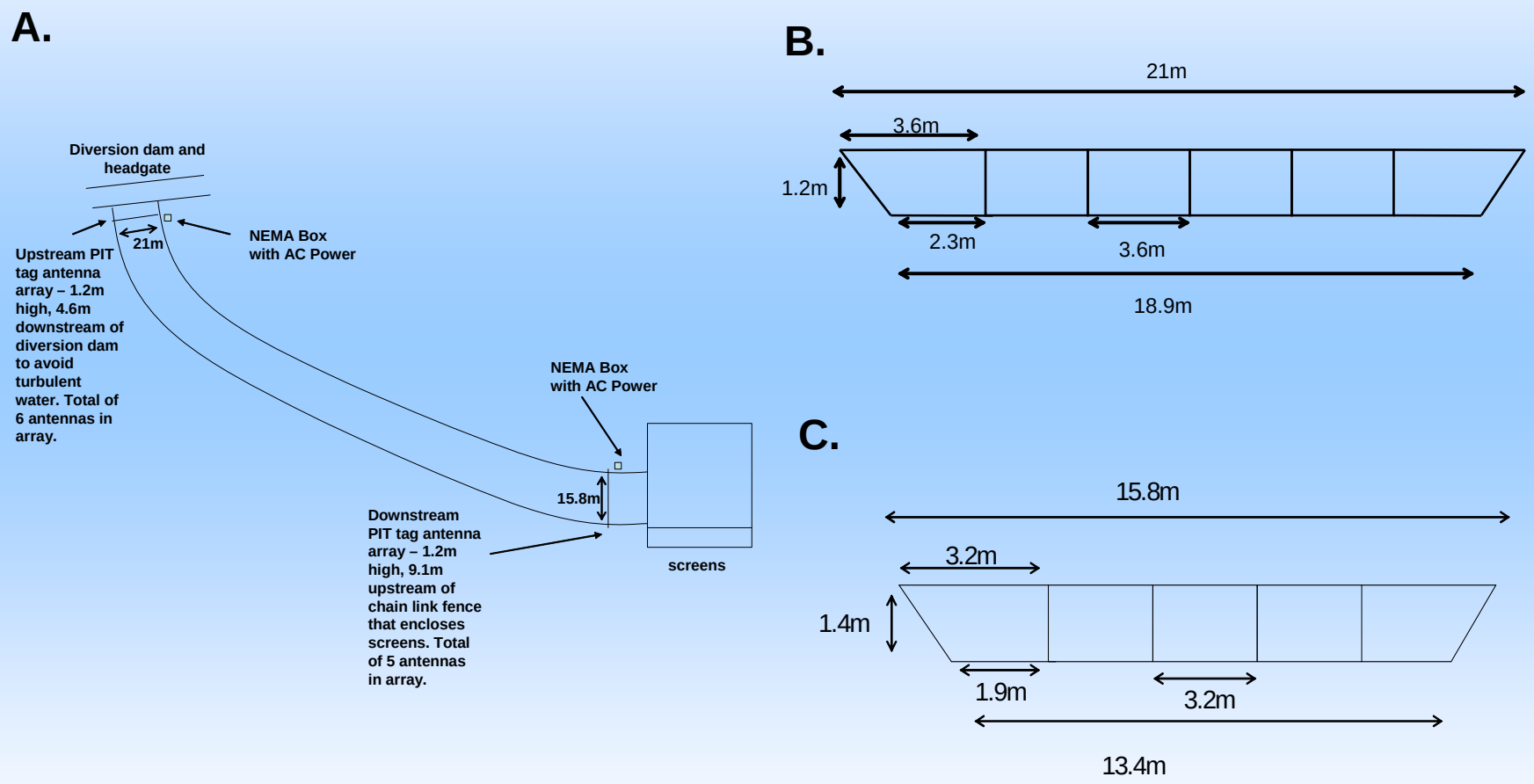
Bureau of Reclamation Project
Umatilla River
Feed and Maxwell Diversion Canals

Methods-Volitional Migrants

- **PIT tag detections from Feed and Maxwell Diversion Canals used to estimate:**
  - **Entrainment (estimate of steelhead that actively or passively enters each surface diversion)**
  - **Bypass (estimate individuals that successfully pass through each surface diversion to the screen bypass)**
  - **Residual/mortality (estimate of steelhead entrained in the canals that do not volitionally exit)**

MCN
TMD
MXWLCN
FEEDCN
N
W
E
S
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
©2005 Google

Feed Diversion Canal PIT tag Antenna Arrays



FEEDCN
N
W
E
S
Image © 2006 DigitalGlobe
©2005 Google
Pointer lat 45.721431° lon -119.176948° elev 651 ft
Streaming 100%
Eye alt 1792 ft

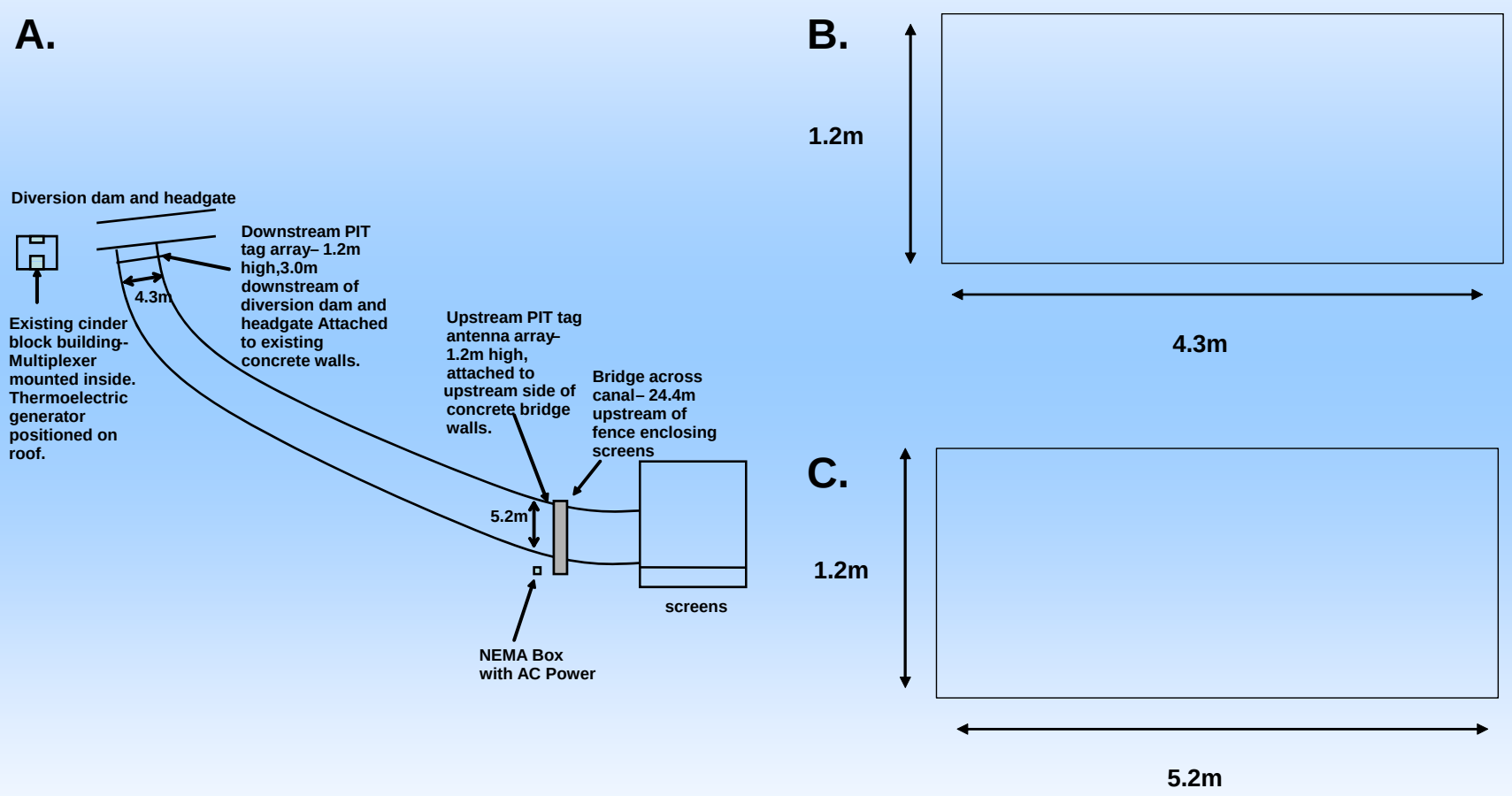
Feed Diversion Canal PIT tag Antenna Arrays

PIT Tag Interrogation Equipment

- **Multiplexor-Deston Fairing Model #FS1001M**
  - **120 VAC line voltage**
  - **PDA** with Mobile Monitor Software(Manual Download Data)

NEMA Box
Feed Diversion Canal

Maxwell Diversion Canal PIT tag Antenna Arrays



MXWLCN
N
W
E
S
Image © 2006 DigitalGlobe
©2006 Google

Maxwell Diversion Canal PIT tag Antenna Arrays

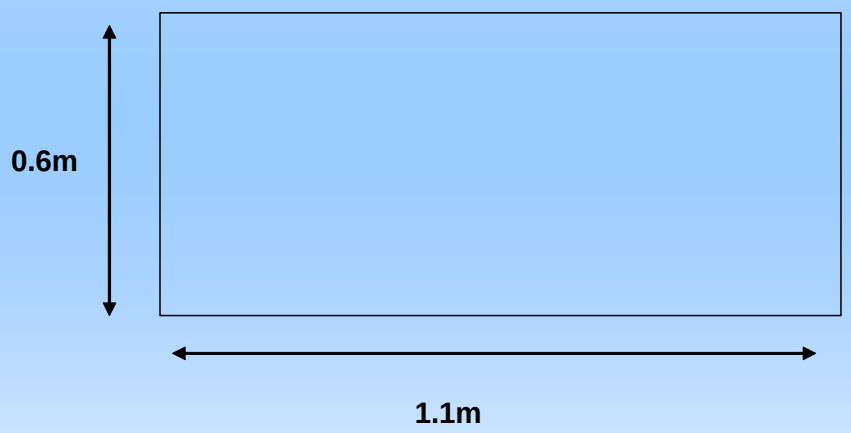
PIT Tag Interrogation Equipment

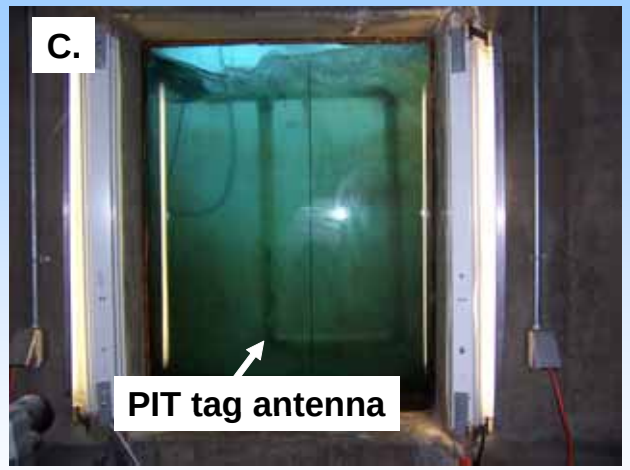
- **Multiplexor-Deston Fairing Model #FS1001M**
  - **Thermoelectric generator (TEG)**
  - **PDA** (Manual Download Data)

Cinder block building Maxwell Diversion Canal

Three Mile Falls Diversion Dam PIT tag Antenna Array

A.





Methods-Volitional Migrants

- **Juvenile hatchery origin steelhead (N = 130,876)**
  - **HOR PIT tagged (N = 5,969)**
  - **Stocked (Bonifer Springs, Minthorn Springs, or Pendelton ponds)**
- **HOR fish allowed to migrate naturally downstream**

Entrainment Results: Volitional Migrants

- **HOR PIT tagged fish entrained**
  - **Maxwell (N = 547)**
  - **Feed (N = 65)**
- **Estimated HOR fish entrained**
  - **Feed (N = 1,440, 1%)**
  - **Maxwell (N = 13,994, 10.7%)**
- **Estimated Natural Origin (NOR) fish entrained**
  - **Feed (N = 507, 1.5%)**
  - **Maxwell (N = 4,917, 14.4%)**

Bypass Results: Volitional Migrants

- **HOR PIT tagged fish bypassed**
  - **Maxwell (N = 433)**
  - **Feed (N = 57)**
- **Estimated HOR fish bypassed**
  - **Feed (N = 1,265, 88%)**
  - **Maxwell (N = 13,535, 97%)**
- **Estimated Natural Origin (NOR) fish bypassed**
  - **Feed (N = 455, 88%)**
  - **Maxwell (N = 4,756, 97%)**

Bypass Results: Volitional Migrants

- **Travel time Feed**
  - **N = 5**
  - **Mean ✂ SE = 17.5 ✂ 5.7 hours**
- **Travel time Maxwell**
  - **N = 258**
  - **Mean ✂ SE = 3.7 ✂ 0.3 hours**

Residual/Mortality Results: Volitional Migrants

- **HOR PIT tagged fish residual/mortality**
  - **Maxwell (N = 114)**
  - **Feed (N = 8)**
- **Estimated HOR fish residual/mortality**
  - **Feed (N = 176, 12%)**
  - **Maxwell (N = 459, 3%)**
- **Estimated Natural Origin (NOR) fish residual/mortality**
  - **Feed (N = 62, 12%)**
  - **Maxwell (N = 162, 3%)**

Results:
Volitional Migrants

- 8 of the 5,969 were detected at both Feed and Maxwell
- All eight left the canal
- 4 of the 8 were detected at Three Mile Falls (TMF) Dam
- After leaving Maxwell it took them 2 days to reach TMF.

Canal Insertion Experiment

- **Juvenile hatchery origin steelhead (N = 2,179)**
  - **Feed (N = 200)**
  - **Maxwell (N = 1,979)**
- **Stocked over two 5-day intervals at Maxwell**
- **Stocked during 1-day interval at Feed**
- **During each day groups (N ≈ 38 fish per group) were stocked during day and at night**

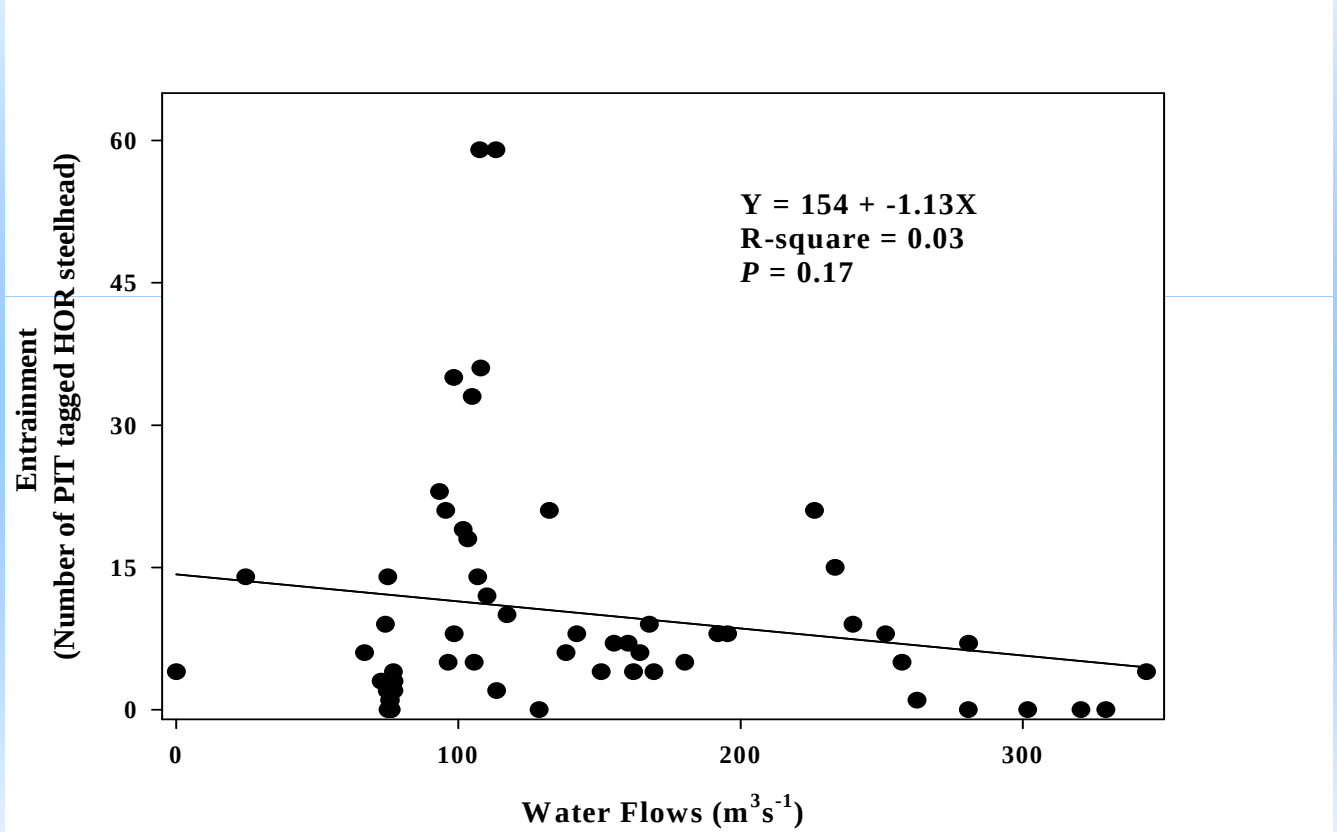
Canal Insertion Experiment

- PIT tag detections used to estimate
  - If bypass rates through Feed vs. Maxwell Diversion Canals differ
  - If bypass rates differ between fish released during daylight or evening hours
  - If bypass rates differ between groups released early (i.e., first 5 day interval) or late (i.e., second 5 day interval)

Canal Insertion Experiment

- Travel times did not differ between canals
- Travel times did not differ between fish stocked during day or night
- Fish stocked earlier in season migrated quicker than those stocked later in the season in Maxwell

Entrainment vs. Water Flows



Summary: Fisheries monitoring system

Lower Columbia River Channel Improvement: Assessment of Salmonid Populations and Habitat on Tenasillahe and Welch Islands

J.R. Johnson, J. Poirier, J.R. Horal, and R. Sollee

Restoring tidal wetlands and improving fish access to them are major components of recovery strategies for anadromous salmonids. Although much effort and capital has been invested, considerable uncertainty exists concerning benefits derived from these restoration actions. This is due in part to the difficulty in monitoring and evaluating fish use prior to and after restoration activities take place. Passive integrated transponder (PIT) technology is one tool available that can help in understanding slough habitat use by providing fish movement data at low personnel effort. In this study, PIT technology was used to evaluate juvenile salmonid use of a lower Columbia river tide gate controlled slough.

Tenasillahe Island (rk35) is part of Julia Butler Hanson NWR. It is a diked island of 2000 acres that contains two tide gate controlled sloughs. Replacement with "fish friendly" tide gates is planned for both sloughs in summer of 2007. An evaluation of habitat changes as a result of tide gate replacement began in 2006.

One objective of this study was to determine at what rate juvenile chinook could survive and emigrate from Tenasillahe Island slough. Secondary was to determine the effect of distance on survival and emigration rate. The study design consisted of releasing one thousand hatchery fall chinook smolts that were implanted with 12mm full duplex PIT tags in the larger of the two island sloughs and monitoring passage at the tide gates. On May 8, between 250 and 390 fish each were released at three locations each a different distance from the tide gates, 330m, 595m and 1500m. Ten fish at each site were contained in enclosures to estimate mortality caused by transport and release. All fish were alive after 96 hours and were subsequently released 2800m from the tide gates. Movement of tagged fish through the tide gates was monitored with a three-antenna array utilizing a FS1001M multiplexing transceiver. The antennas were built with two overlapping wire loops contained within four inch PVC. The result is a seven-foot square antenna with an additional crosspiece in the center where the two loops overlap. The array was powered with a 56W thermoelectric generator fueled with propane. Data from the transceiver was collected and saved on a pocket PC using MobileMonitor software (PCMFC).

Tide gates were interrogated continuously from May 8 to July 15. Between 60 percent and 77 percent of each release group were detected passing the tide gates. Fish released furthest from the tide gates exhibited the lowest emigration success. Fish from the closer three release points had similar emigration success (72% to 77%). For the closer three release points to the tide gates, the duration of time between release and detection ranged from one day to 67 days (330m and 1500m release points) and 68 days (595m release point). The median number of days between release and detection was twenty-six for these release groups. Fish released 2800m from tide gates were detected from 13 to 40 days after release. The median day to detection was 27 days.

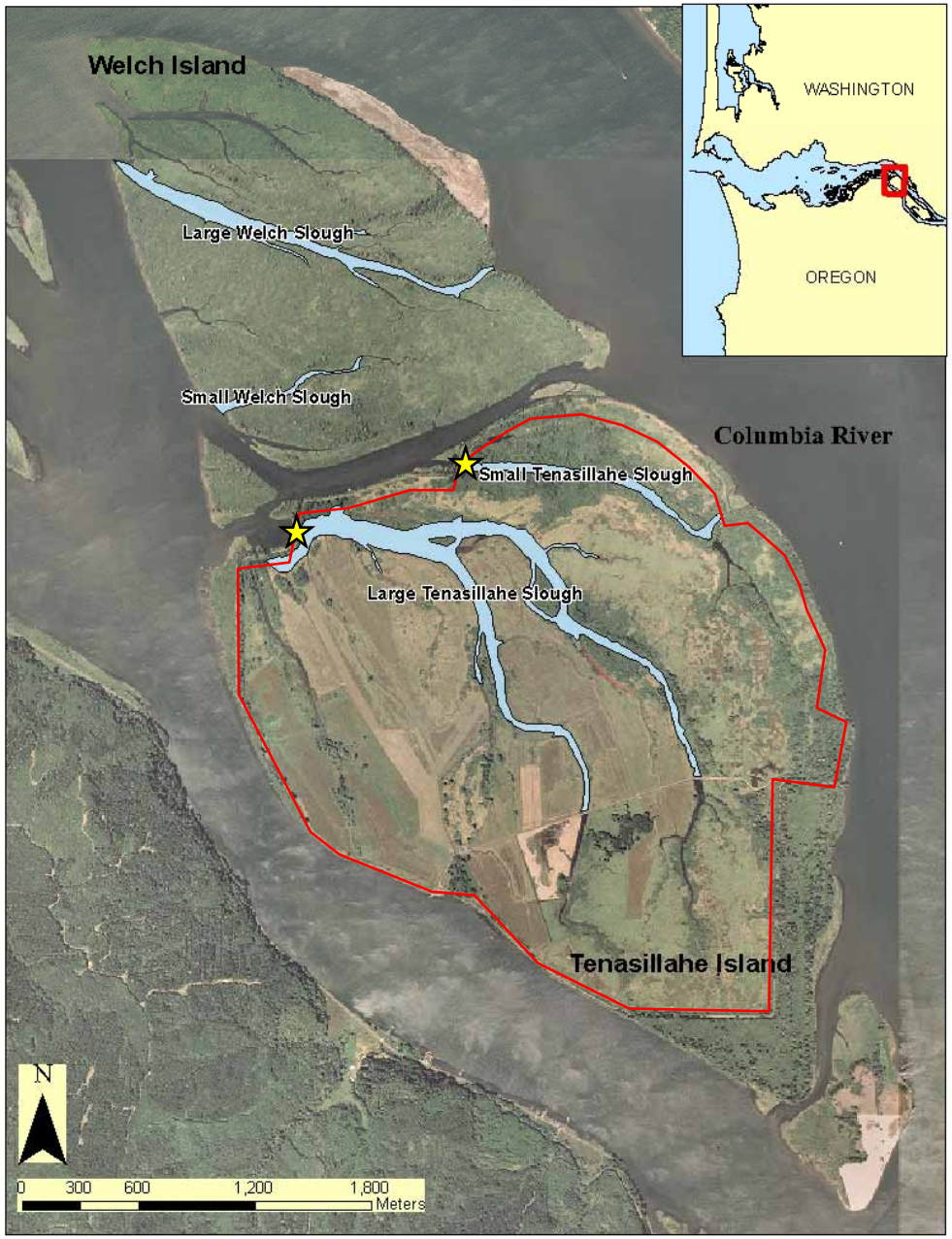
It was determined from the study that juvenile Chinook salmon can survive the lower 1500 meters of Tenasillahe Island slough at similar rates. Fish beyond 1500 meters appear to have lower survival. Regardless of distance to tide gates, release groups exhibited similar trends of in-slough duration and pattern of emigration. The antenna array operated without incident throughout the field season (March though July). The novel antenna design provided satisfactory efficiency without the need to build an additional antenna to interrogate fully each tide gate.

Return to top

Lower Columbia River Channel Improvement: Assessment of Salmonid Populations and Habitat on Tenasillahe and Welch Islands

Study goal: Evaluate the overall effectiveness of Tenasillahe island slough habitat restoration

- Pre and post restoration evaluation
- Reference and treatment study areas



Lewis and Clark NWR

Julia Butler Hanson NWR

Objectives

1. Assess frequency and duration of time that tidegates are likely to allow passage by juvenile salmonids.

2. Describe presence, distribution, and biological characteristics of salmonids inhabiting sloughs on Tenasillahe (treatment) and Welch (reference) Islands.

3. Characterize habitats in the sloughs on Tenasillahe Island and compare it to that observed at the reference sloughs on Welch Island.

4. Describe the movement of juvenile salmon in and out of the sloughs as well as their residence in and use of the sloughs on Tenasillahe and Welch Islands.

Objective 1: Assess frequency and duration of time that tidegates likely allow passage by juvenile salmonids.

Objective 4: Describe the movement of juvenile salmon in and out of the sloughs as well as their residence in and use of the sloughs on Tenasillahe and Welch Islands.

- Release PIT tagged fish into Large Tenasillahe Slough
  - Determine exit time and survival
- Monitor run-of-river PIT tagged fish

AFTC Littering NWR???

- **Tagged hatchery fall chinook**
  - **Tagged April 6, 2006**
  - **Released May 8, 2006**
  - **SST 12mm (full-duplex)**

- **Large Tenasillahe Slough Tidegate**
  - **7 ‘ gates**
  - **Empty into catchments, drain though culvert**

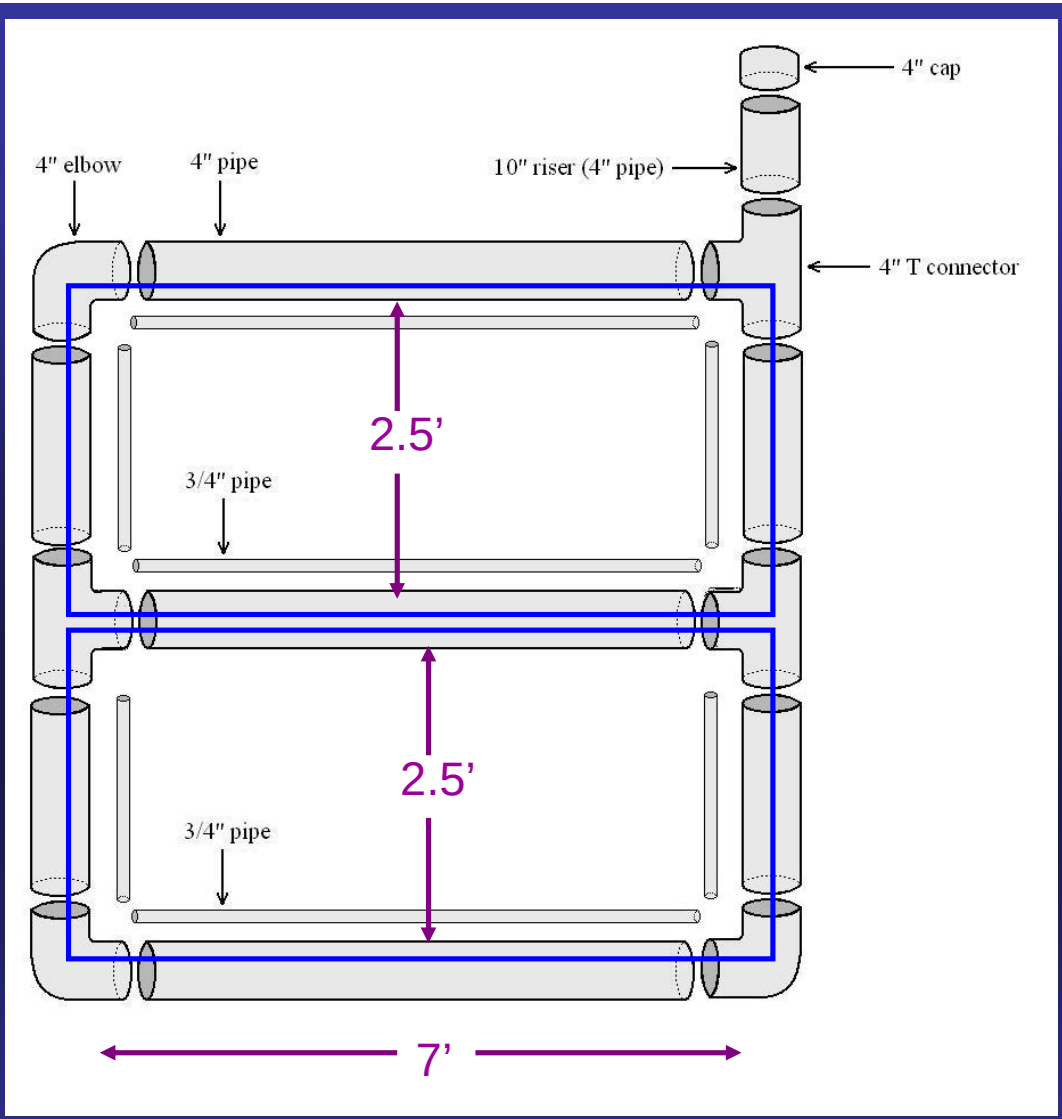
- FS-1001m multiplexer
- Two 12V batteries
- Pocket PC w/Mobile Monitor software
- SD cards

Power?

Thermoelectric generator

11 volts converted to 25 volts

Propane and valves



"DUAL-LOOP" design

Efficiency

100% (?)

Design: Dual-Loop

Transceiver: FS1001m

Construction: 4” PVC

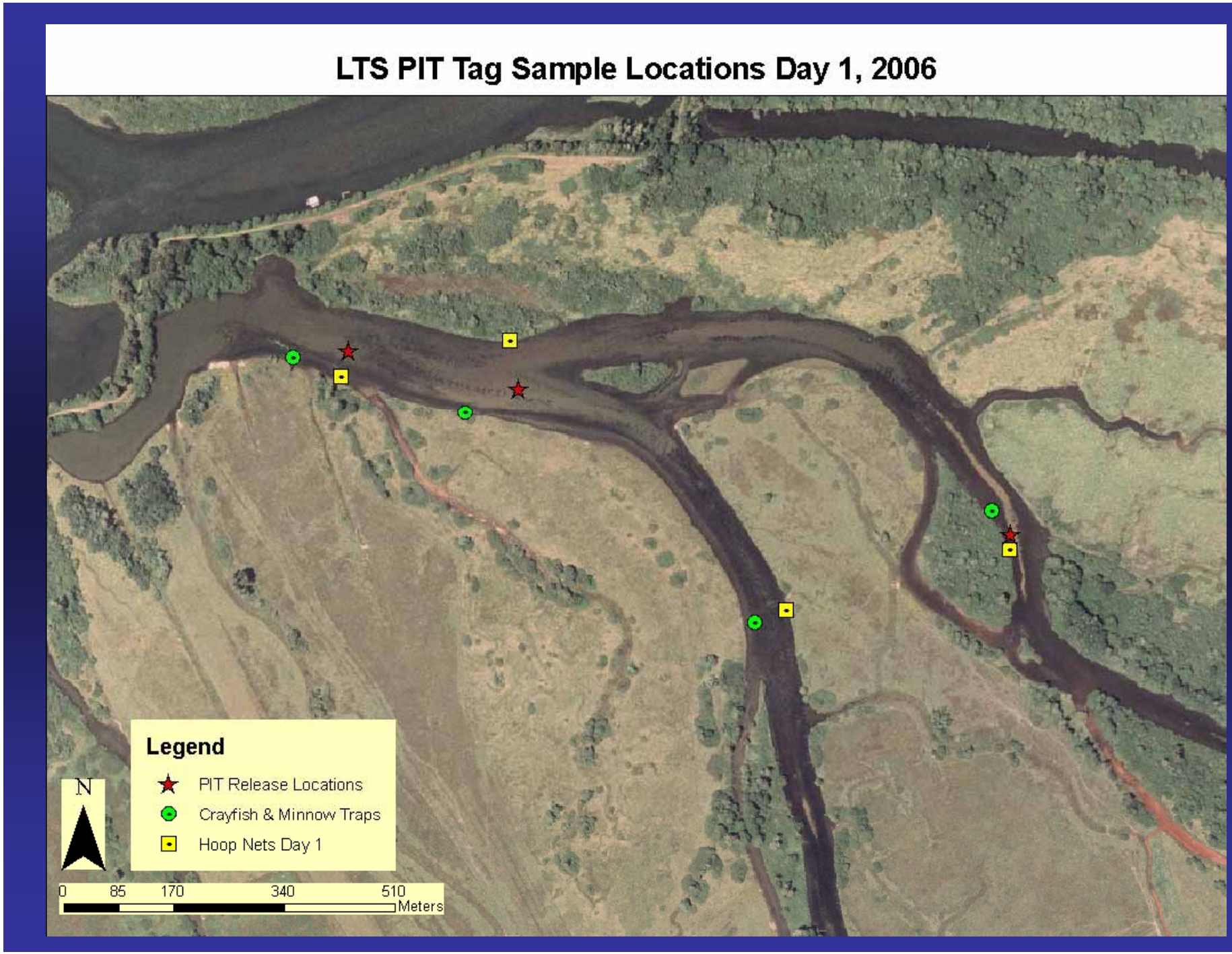
Communication: “walk-up”

Power: TEG

Accessibility: boat

Maintenance:

- 2x/month
-Propane tanks
-data download (SD card)
-efficiency


LTS PIT Tag Sample Locations Day 1, 2006
Legend
PIT Release Locations
Crayfish & Minnow Traps
Hoop Nets Day 1
N
0
85
170
340
510
Meters

LTS PIT Tag Sample Locations Day 2, 2006

PIT tagged fall Chinook in LTS

	Reach 1	Reach 2	Reach 4	Reach 8
Distance to TG (m)	330	595	1500	2800
# fish	390	252	249	30
% detected	72	77	75	60
Release date	8 May	8 May	8 May	12 May
Days to detection median (range)	26 (1 – 67)	26 (1 – 68)	26 (1 – 67)	27 (13 – 40)

Problems/drawbacks

- No directional data
- Heavy propane tanks
- MUX battery failure
- No remote data download

Feasibility of Full-duplex PIT Detection for Monitoring Sub-yearling Salmon in Brackish Estuarine Marsh Channels

D. Hering, K. Jones, D. Bottom, and E. Prentice

Understanding of juvenile salmon behavior in estuarine wetlands is based almost entirely on conventional capture methods, which are not readily adapted to studies of fine-scale movement by individual fish. Although remote interrogation of full-duplex Passive Integrated Transponder (PIT) tags offers advantages for studying behavior of small fish in freshwater, attenuation of radio frequencies in high-salinity water has largely limited application of the technique in marine or estuarine habitats. To evaluate the feasibility of full-duplex PIT telemetry for studying age-0 salmon in estuaries, we operated a stationary PIT interrogation system within an intertidal salt marsh channel of the Salmon River estuary, Oregon, and passively monitored movements of individually tagged age-0 Chinook salmon (FL ≥60mm) during the summers of 2004 and 2005.

The interrogation system was battery powered and included an FS1001A transceiver in 2004 and an FS1001M multiplexing transceiver in 2005. Two aluminum-shielded antennas, originally constructed for use at McNary Dam on the Columbia River, were anchored in the marsh channel. As expected, exciter current measured at the transceiver decreased during flooding tides as water level and salinity increased. We found, however, that the aluminum-shielded, pass-through antennas (interior dimensions 50cm by 157cm) maintained sufficient current to detect 12mm full-duplex tags efficiently when salinity was as high as 25-30psu. The auto-tuning feature of the FS1001M transceiver improved performance of the system by adjusting to accommodate tidal variation.

Tagged salmon detection peaked between one and two hours before high slack tides and between three and four hours after high slack tides, corresponding with movement of fish into the tidal channel on flooding tides and out of the channel on ebbing tides. Few fish were detected when water depth was less than 0.4 meters, and no fish remained in the channel during low slack tide. Median residence time of individual salmon within the study channel was 4.9 hours per tidal cycle, and individuals were detected using the study channel over periods up to 109 days.

Our findings demonstrate that PIT interrogation can be effective for monitoring small tidal channels in Pacific Northwest estuaries. This novel application of full-duplex PIT technology allowed us to describe volitional movements of individual subyearling salmon into and out of tidally flooded salt marsh habitat and may facilitate understanding of estuarine rearing behavior by other fishes too small to be tracked by conventional radio or acoustic telemetry.

Return to top

Feasibility of full-duplex PIT detection for monitoring sub-yearling salmon in brackish estuarine marsh channels.

Dave Hering[1, 2], Kim Jones[1], Dan Bottom[3], and Earl Prentice[3]

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28655 Hwy 34, Corvallis, OR 97333

[2]Oregon State University, Department of Fisheries and Wildlife

[3]NOAA Fisheries, Northwest Fisheries Science Center, Hatfield Marine Science Center
2030 SE Marine Science Dr, Newport, OR 97365

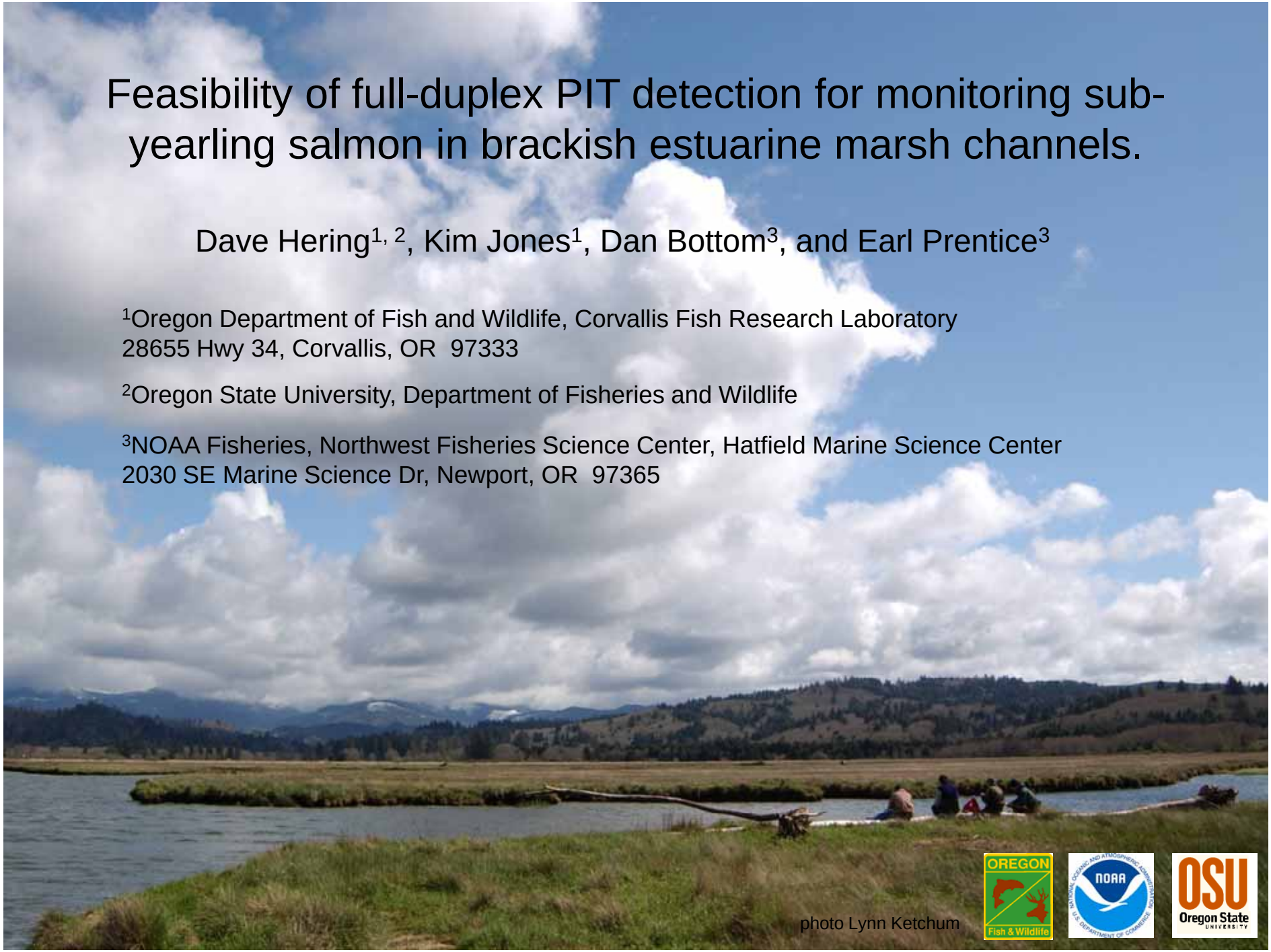
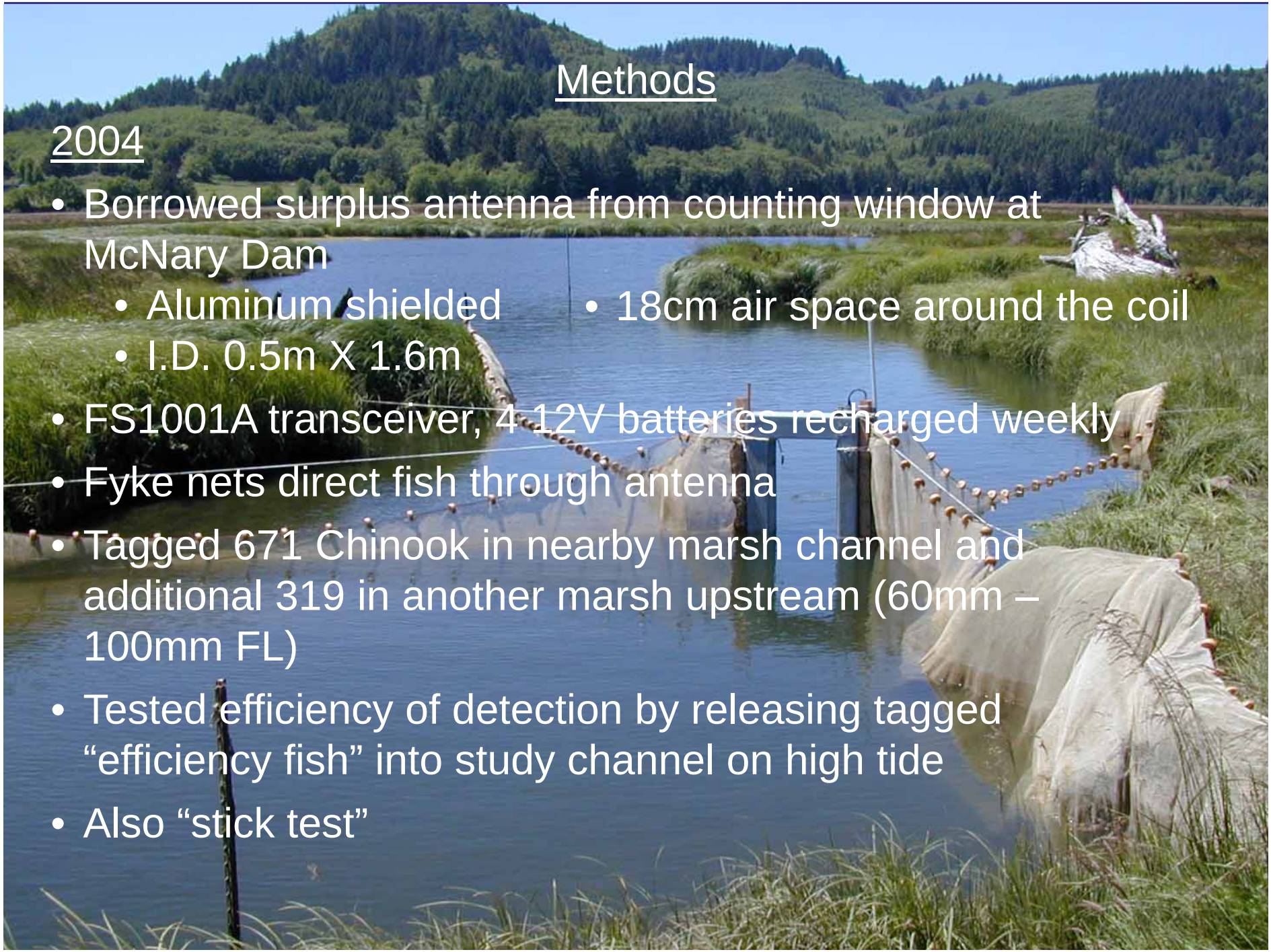


photo Lynn Ketchum

Background

- Subyearling Chinook salmon (40-100mm FL) may rear for months in intertidal marsh channels despite twice daily retreat to sub-tidal areas.
- Only a small portion of historic estuarine wetland area is accessible to fish today.
- Restoring the function of these wetland habitats requires understanding the patterns of channel use by salmon.

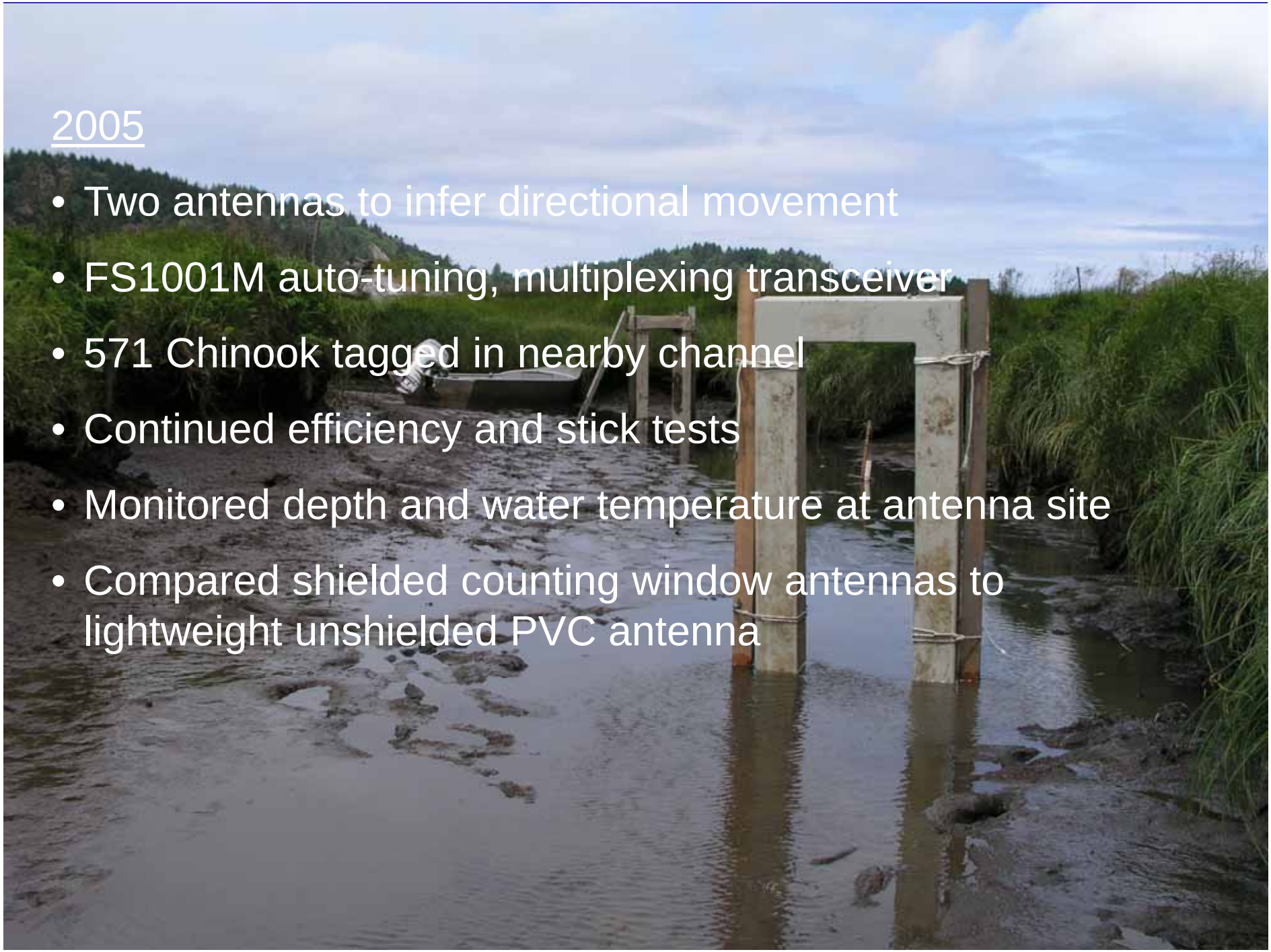
Conventional sampling methods are inadequate to describe fine-scale patterns of habitat use by individuals.
• low resolution in space and time
• labor-intensive
• may modify fish behavior



Methods

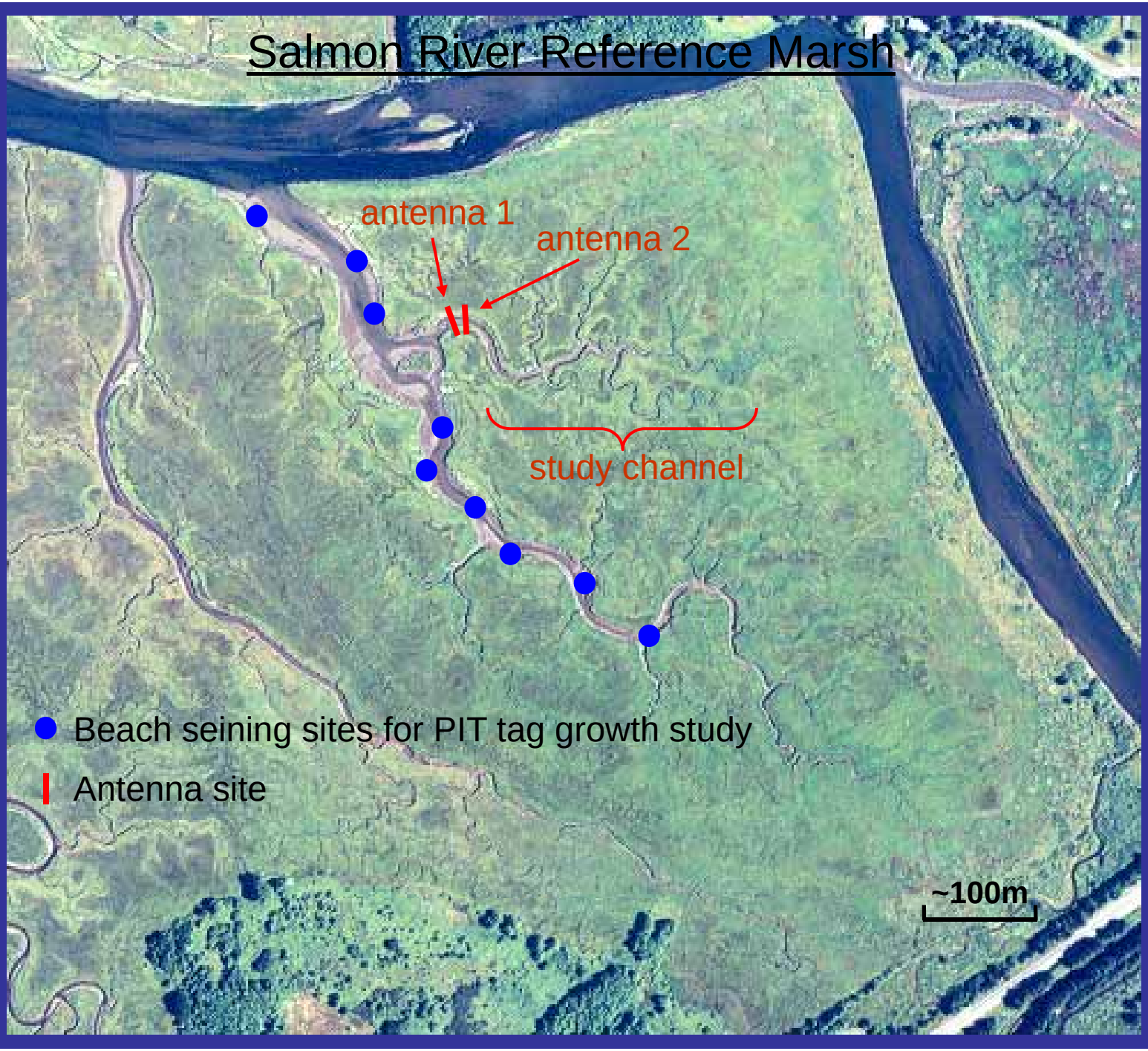
2004

- Borrowed surplus antenna from counting window at McNary Dam
  - Aluminum shielded
  - I.D. 0.5m X 1.6m
  - 18cm air space around the coil
- FS1001A transceiver, 4 12V batteries recharged weekly
- Fyke nets direct fish through antenna
- Tagged 671 Chinook in nearby marsh channel and additional 319 in another marsh upstream (60mm – 100mm FL)
- Tested efficiency of detection by releasing tagged "efficiency fish" into study channel on high tide
- Also "stick test"

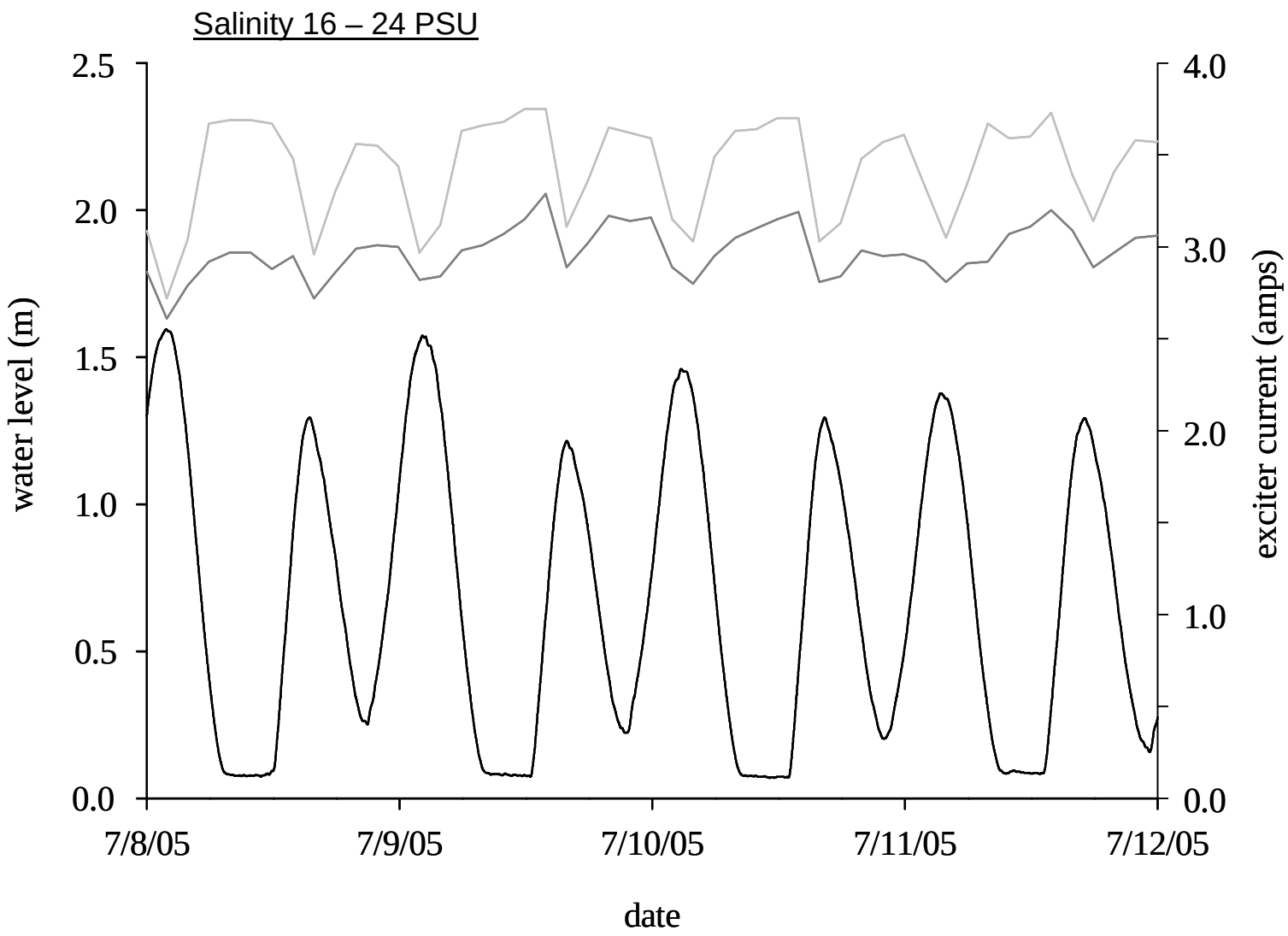


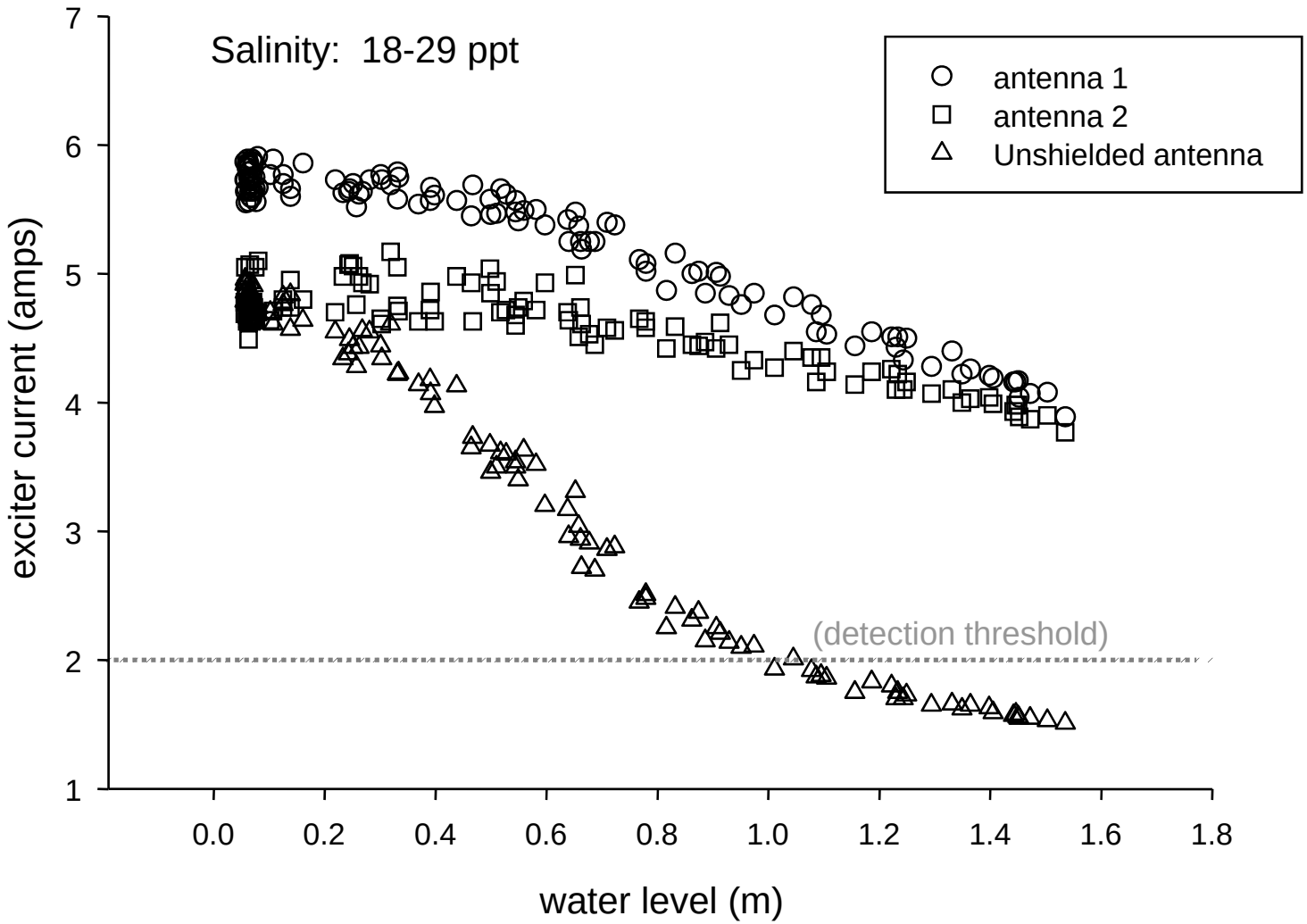
2005

- Two antennas to infer directional movement
- FS1001M auto-tuning, multiplexing transceiver
- 571 Chinook tagged in nearby channel
- Continued efficiency and stick tests
- Monitored depth and water temperature at antenna site
- Compared shielded counting window antennas to lightweight unshielded PVC antenna


Salmon River Reference Marsh
antenna 1
antenna 2
study channel
Beach seining sites for PIT tag growth study
Antenna site
~100m

CHAIRMAN
CHAIRMAN
CHAIRMAN
CHAIRMAN


Salinity 16 – 24 PSU
2.5
2.0
1.5
1.0
0.5
0.0
water level (m)
4.0
3.0
2.0
1.0
0.0
exciter current (amps)
7/8/05
7/9/05
7/10/05
7/11/05
7/12/05
date

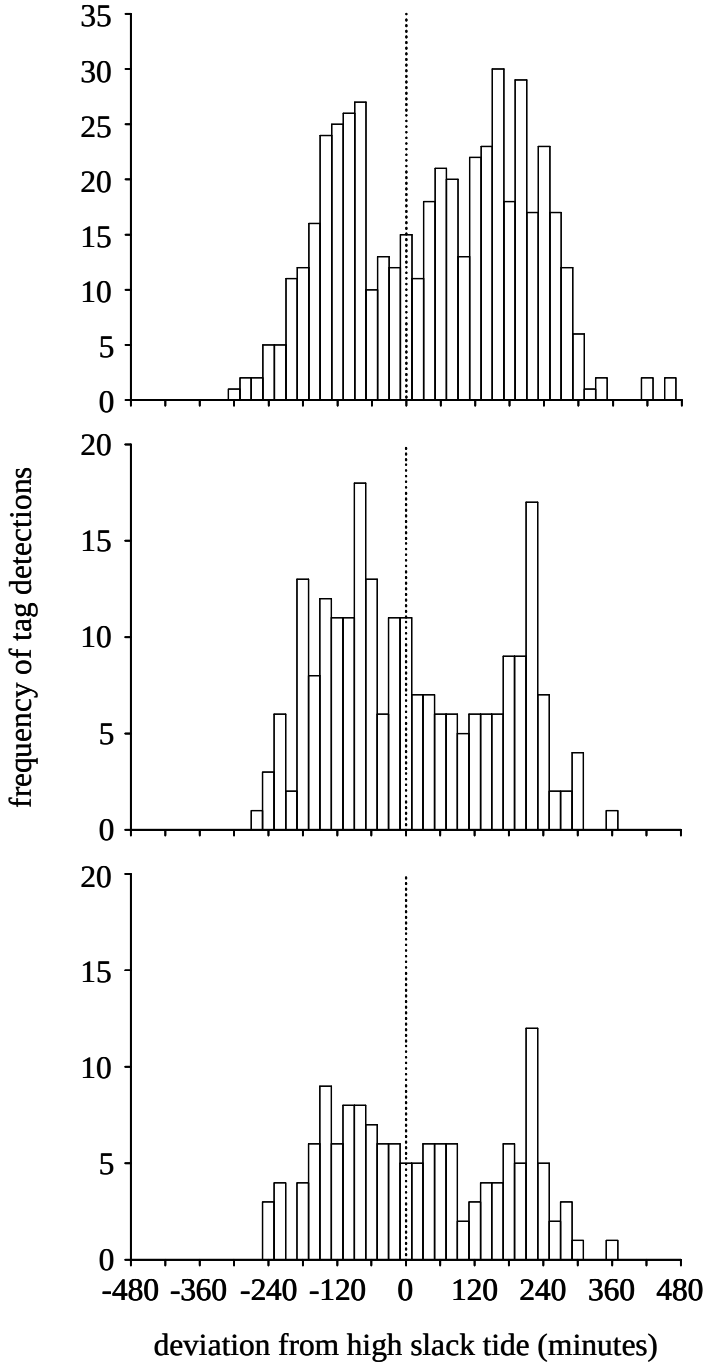

Salinity: 18-29 ppt
antenna 1
antenna 2
Unshielded antenna
(detection threshold)
exciter current (amps)
water level (m)
7
6
5
4
3
2
1
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8

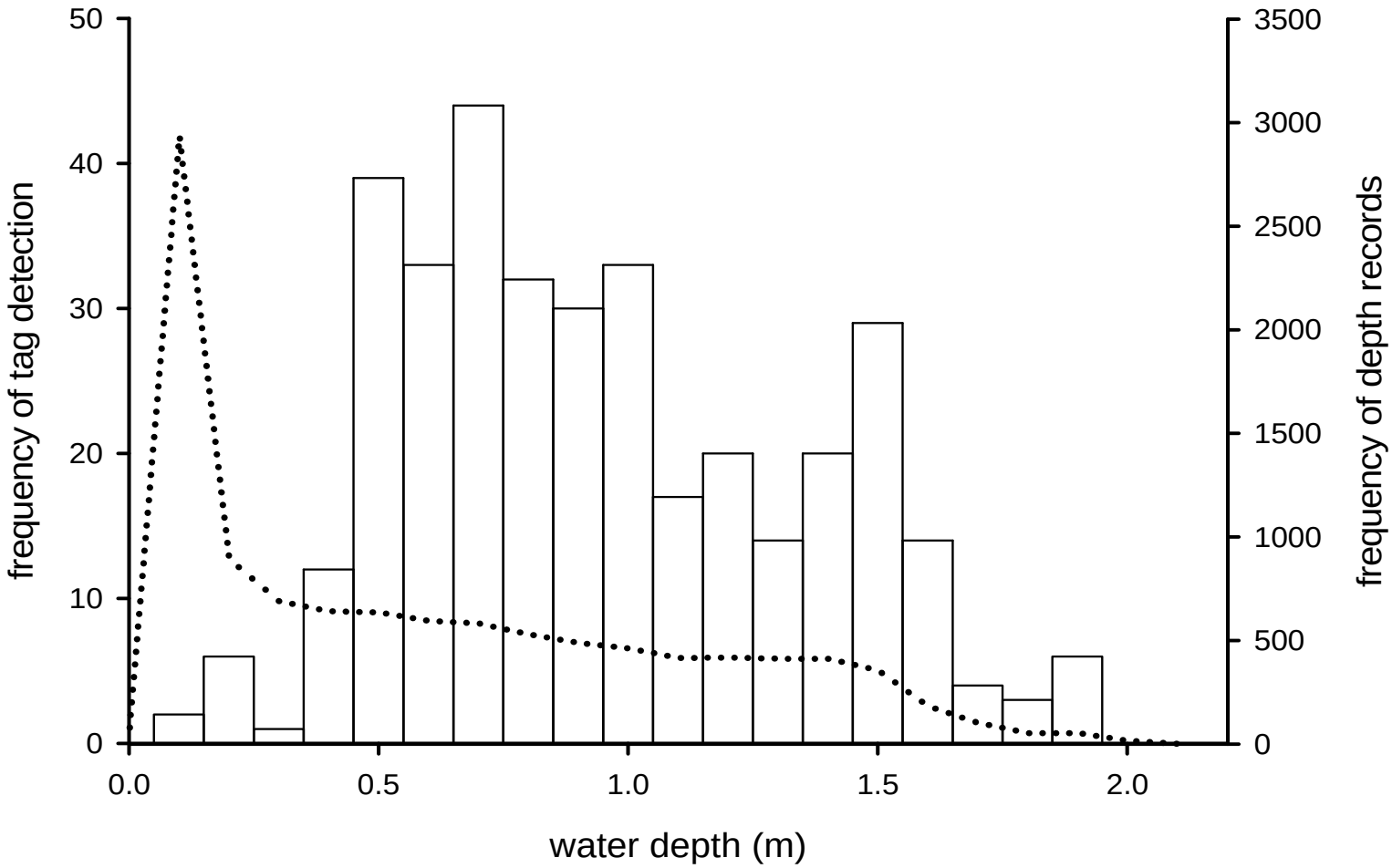
Fish Detections

2004
- 493 total detections of 123 individuals
- 23 efficiency fish 91 additional detections
- 18% of tagged fish detected at least once

2005
- 226 total detections of 75 individuals on antenna 1
- 143 detections of 53 individuals on antenna 2
- 70 efficiency fish added 226 additional detections
- 15% of tagged fish detected at least once

- Average efficiency over both years 92%
- Most individuals were detected few times – median number of detections was 2 per individual

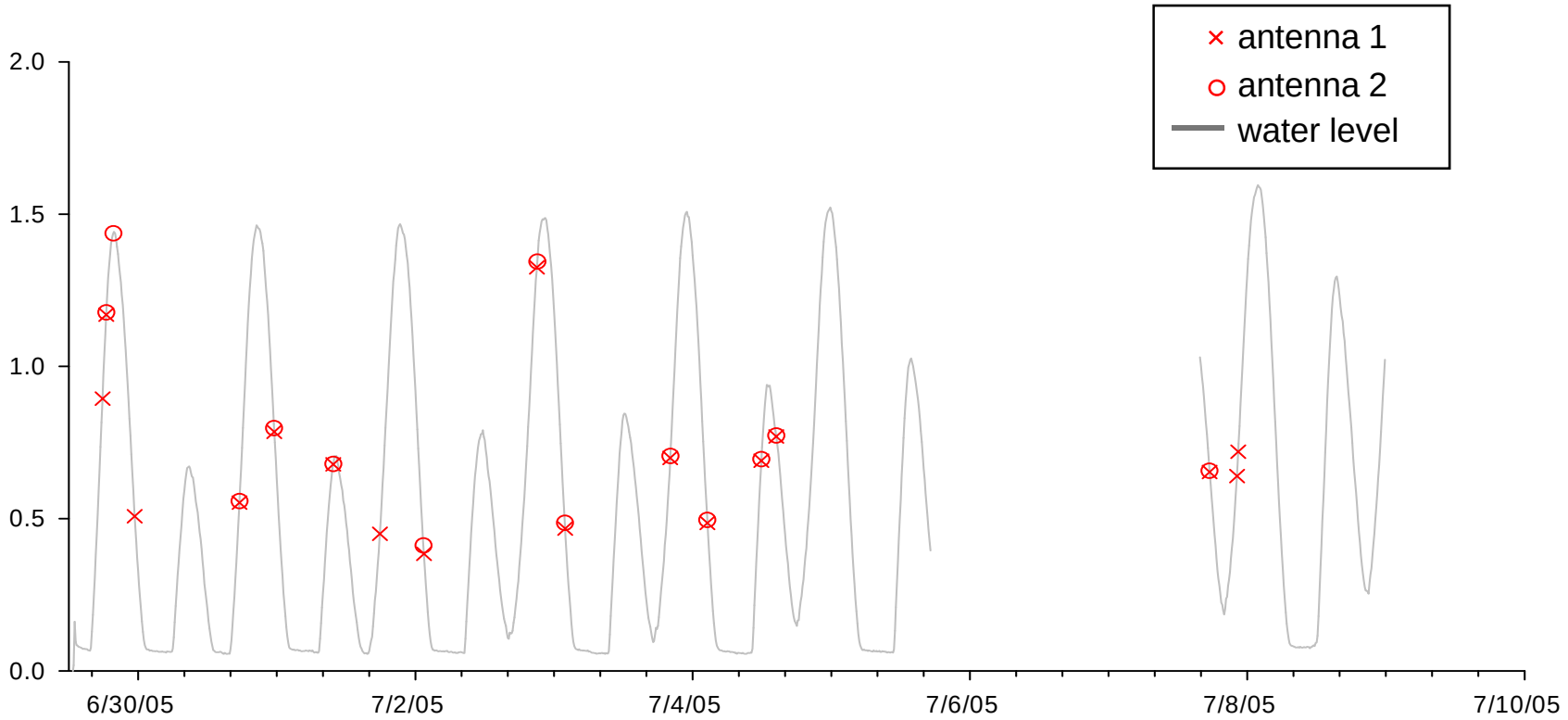

35
30
25
20
15
10
5
0
20
15
10
5
0
20
15
10
5
0
frequency of tag detections
-480 -360 -240 -120 0 120 240 360 480
deviation from high slack tide (minutes)


50
40
30
20
10
0
frequency of tag detection
3500
3000
2500
2000
1500
1000
500
0
frequency of depth records
0.0
0.5
1.0
1.5
2.0
water depth (m)

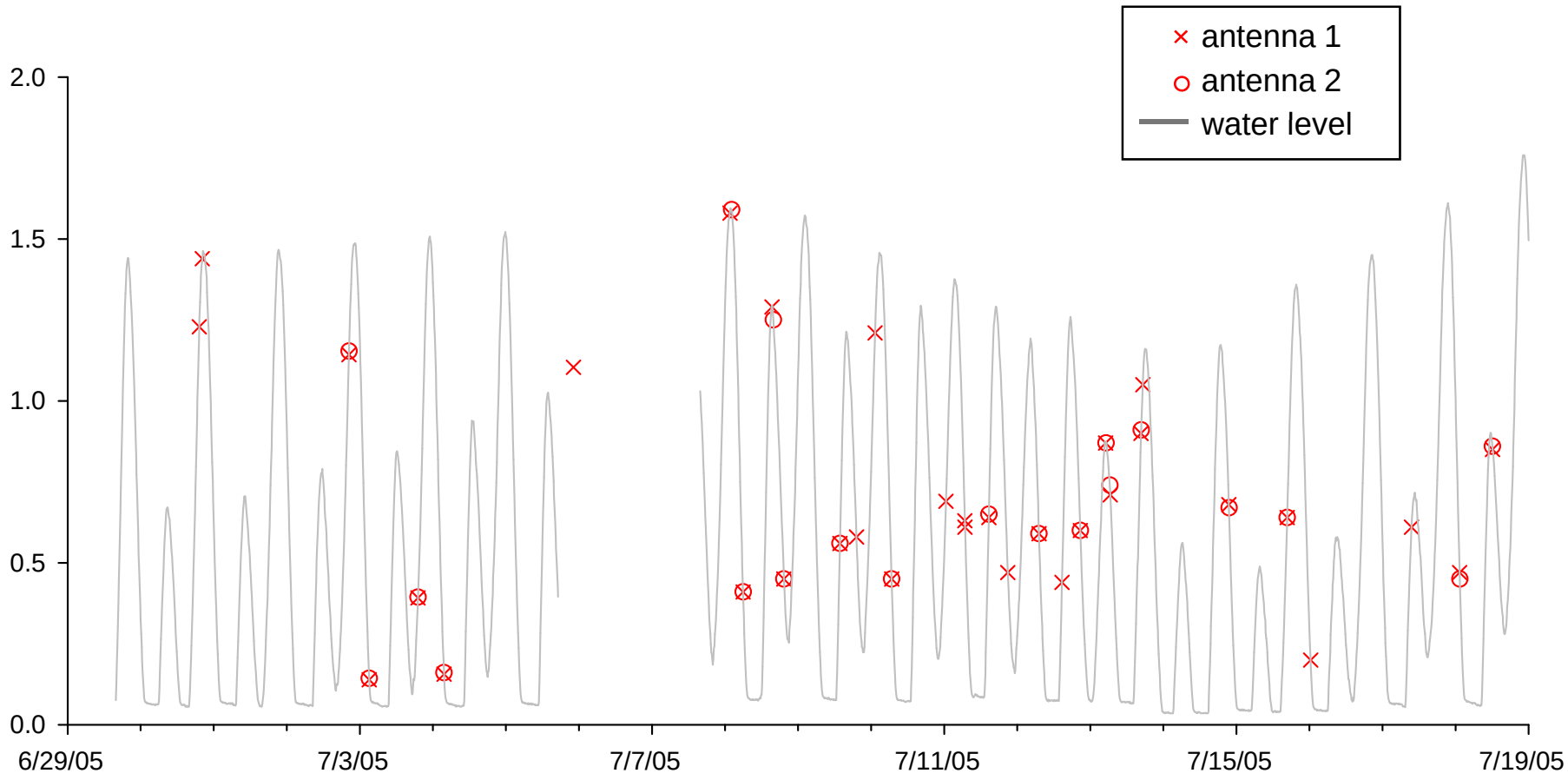
Patterns of Individual Fish

- Some individuals demonstrated fidelity to study channel over several days.
- Others enter channel sporadically over residence of weeks to months

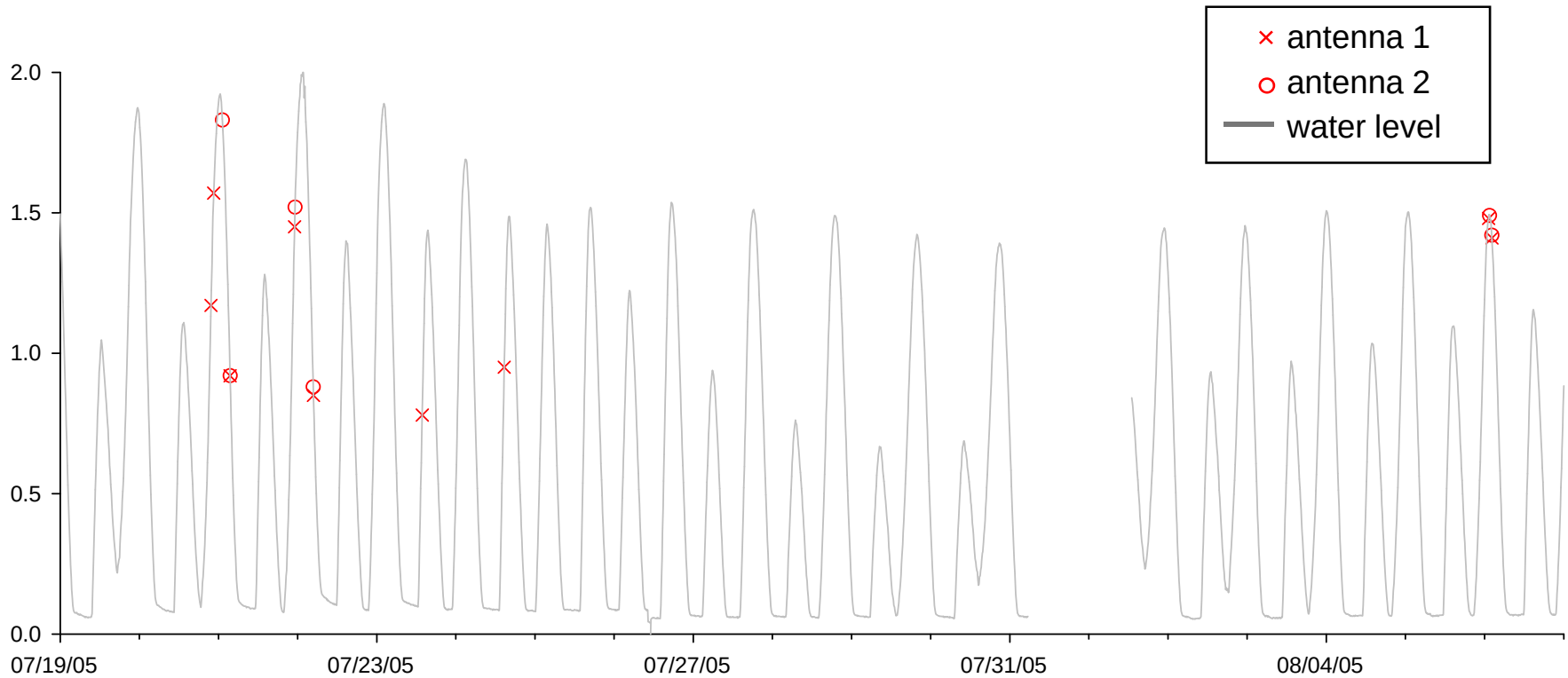
Example 1. Strong site fidelity, tagged 6/28/05 -- 86mm, 7.3g



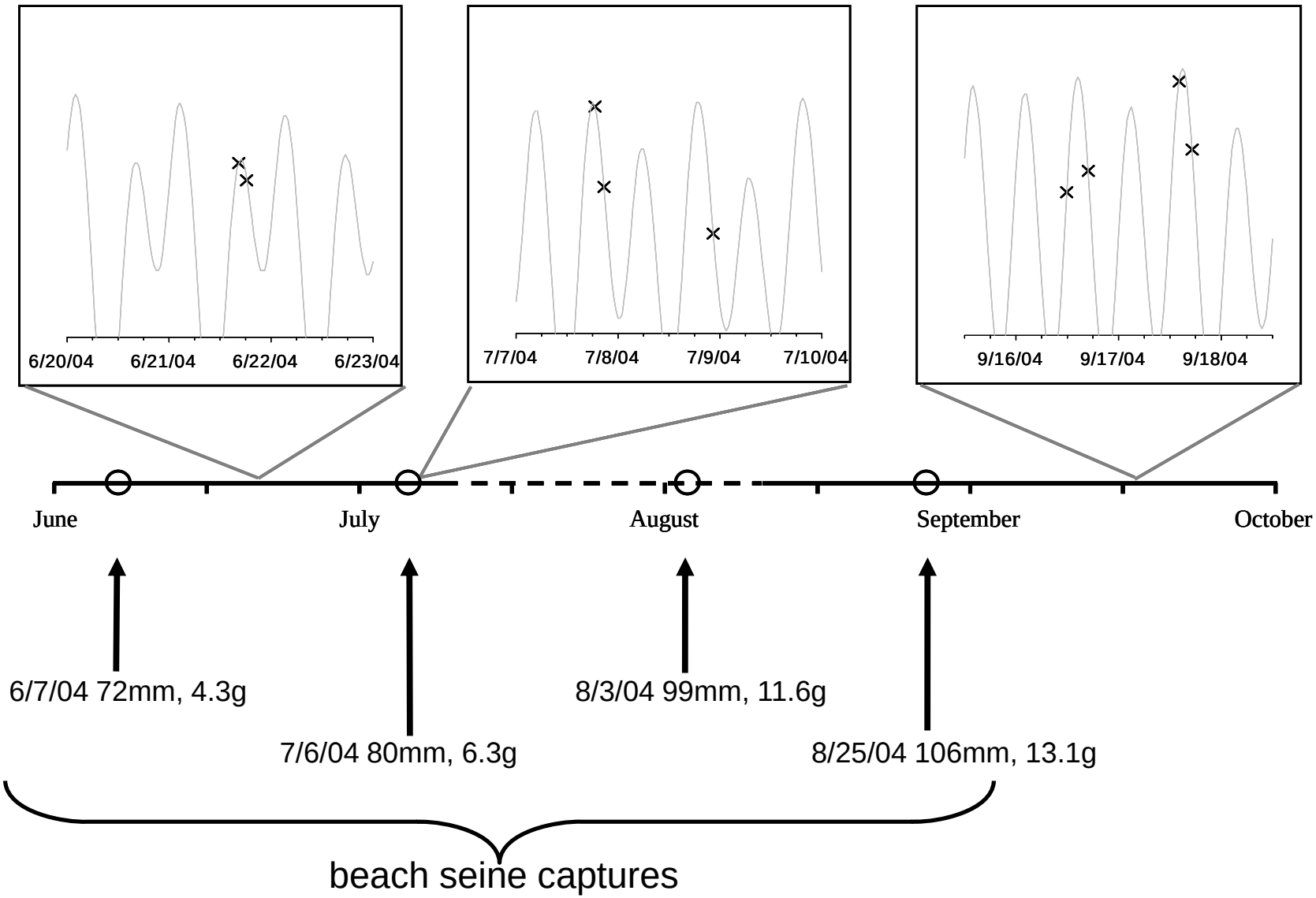
Example 2. Strong site fidelity, tagged 6/30/05 -- 74mm, 4.2g



Example 3. More typical fish, tagged 6/30/05 -- 79mm, 5.5g

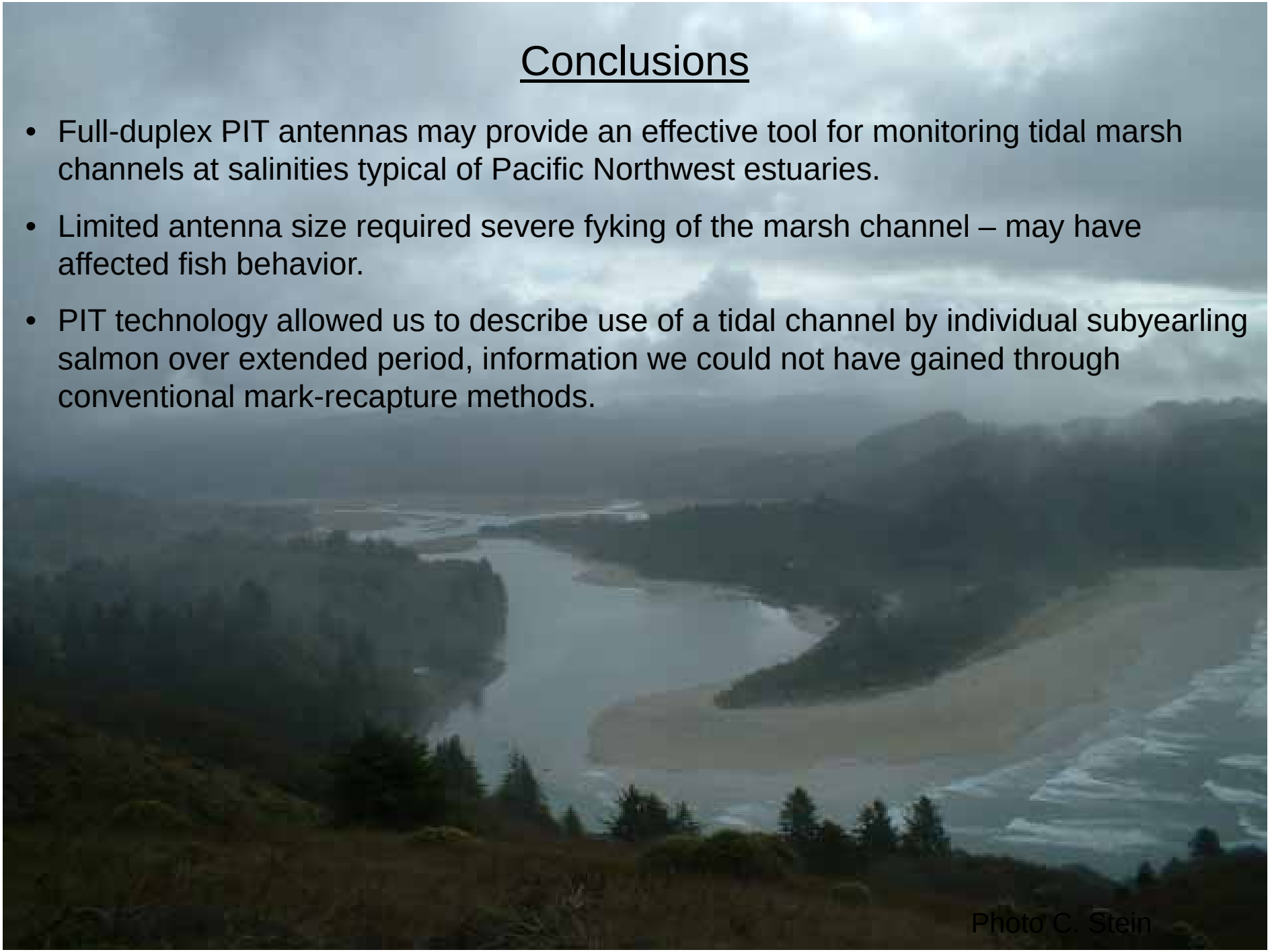


Example 4. Sporadic use over prolonged marsh residence, tagged 6/7/2004 – 72mm, 4.3g



Conclusions

- Full-duplex PIT antennas may provide an effective tool for monitoring tidal marsh channels at salinities typical of Pacific Northwest estuaries.
- Limited antenna size required severe fyking of the marsh channel – may have affected fish behavior.
- PIT technology allowed us to describe use of a tidal channel by individual subyearling salmon over extended period, information we could not have gained through conventional mark-recapture methods.



PIT Tag Array Analysis on the upper Shasta River. A Pilot Study

N. Selvage and K. Mauro

A pilot study was conducted fall of 2006 to determine the feasibility and functionality of the use of PIT tagging and antenna arrays to track the migration and preferred rearing habitat of juvenile salmonids in the Shasta River.

Two arrays were built and tested. One upstream from the rotary screw trap in a slow, shallow stretch measuring 64' across, and approximately 35" deep, and the other positioned in a fast, deep run 34' across, and 51" deep.

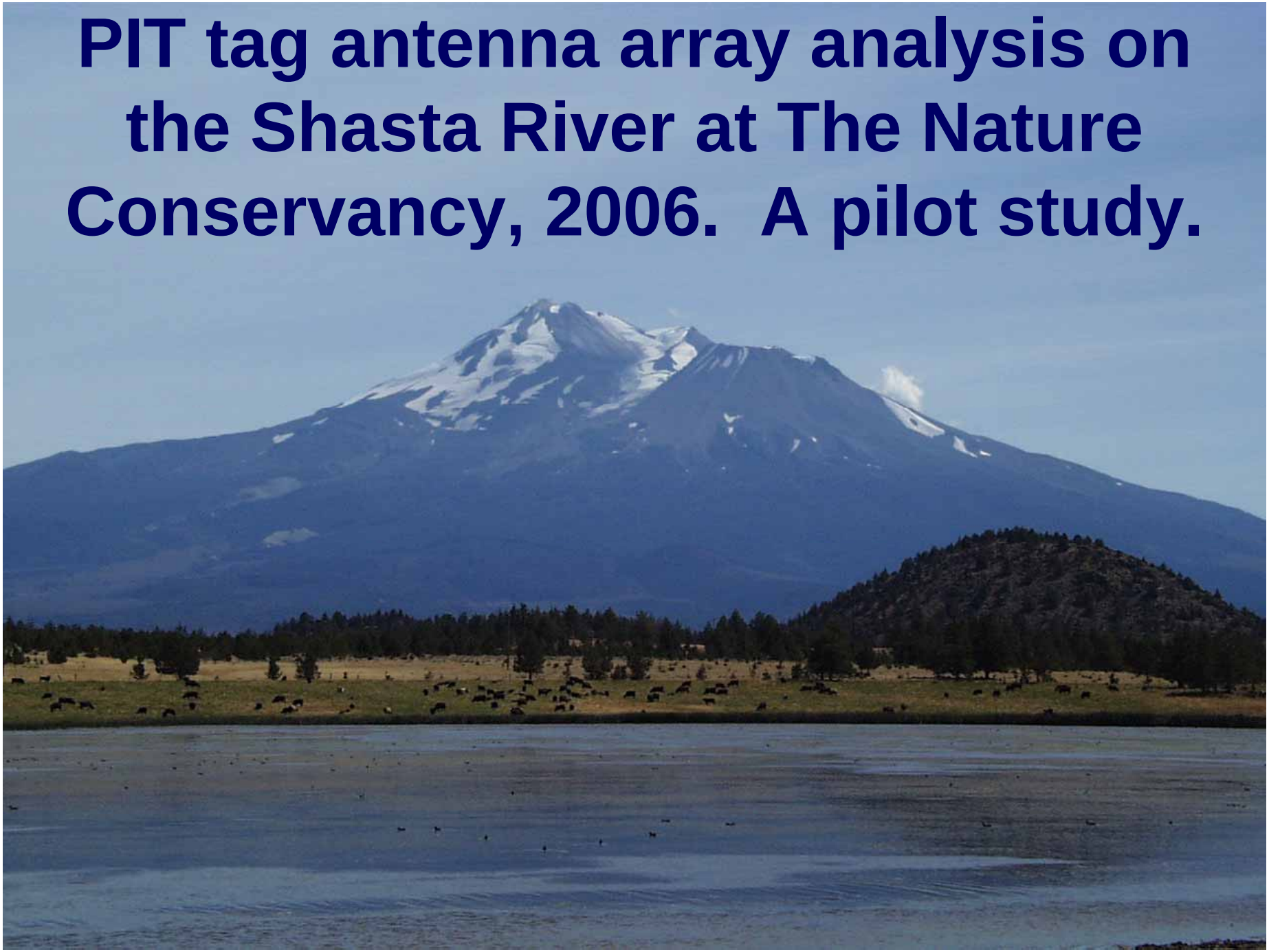
Biomark 12mm, full-duplex PIT tags were used to tag coho, chinook and steelhead down to 55mm. The design of the antennas was modeled after those used by the USGS in Klamath Falls. Coils were made from a pair of 7-strand, 28 gauge ribbon cable centered in 1½" ABS pipe on balsa wood. Readers used were AllFlex panel readers. Transceivers were made in-house. Data was logged to a SD card which was downloaded twice per week. Power from a 110 watt solar panel and two 12-volt, deep cycle, 31 AGM marine batteries supported each system.

Noise interference and debris were the biggest problems encountered. The antennas read between 30% and 80% efficiency depending on the interference. Debris was maintained on a daily basis.

We are currently working on designing small habitat specific arrays incorporating a noise level and efficiency recording system.

Return to top

PIT tag antenna array analysis on the Shasta River at The Nature Conservancy, 2006. A pilot study.



Overview

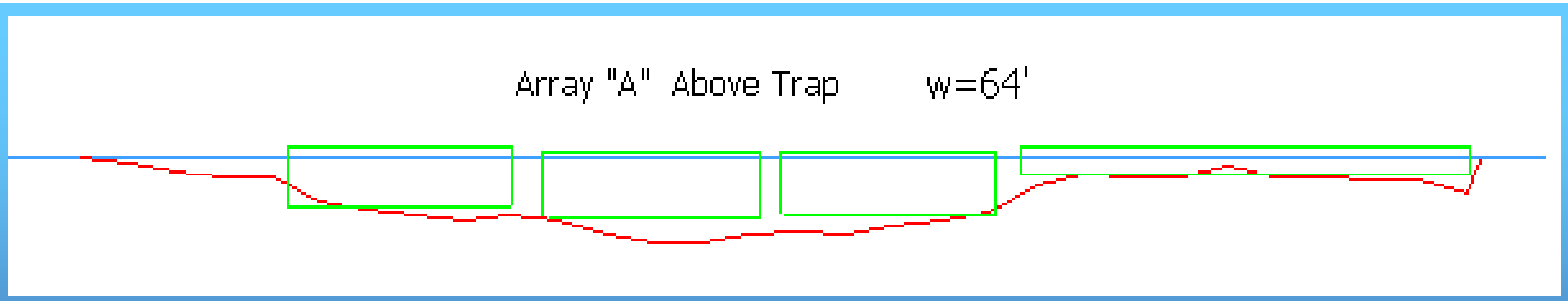
- A pilot study was conducted September to November, 2006, to determine the feasibility and functionality of the use of PIT tagging and antenna arrays to track the migration and preferred rearing habitat of juvenile salmonids in the Shasta River.

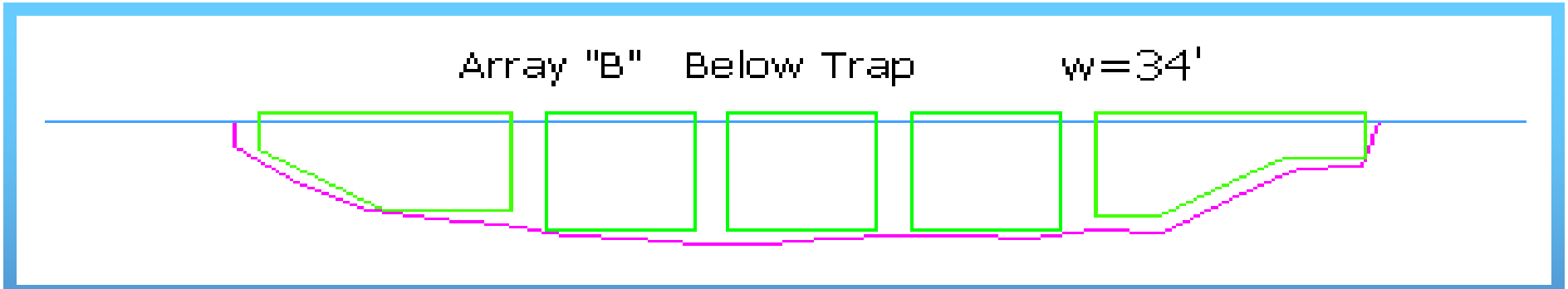
PIT TAGS

Biomark **TX1400SST** tags

- 12.45mm X 2.02mm
- 134.2kHz ISO
- 0.1067g
- Full-duplex

Location


Array "A" Above Trap w=64'


Array "B" Below Trap
w=34'

Array Design

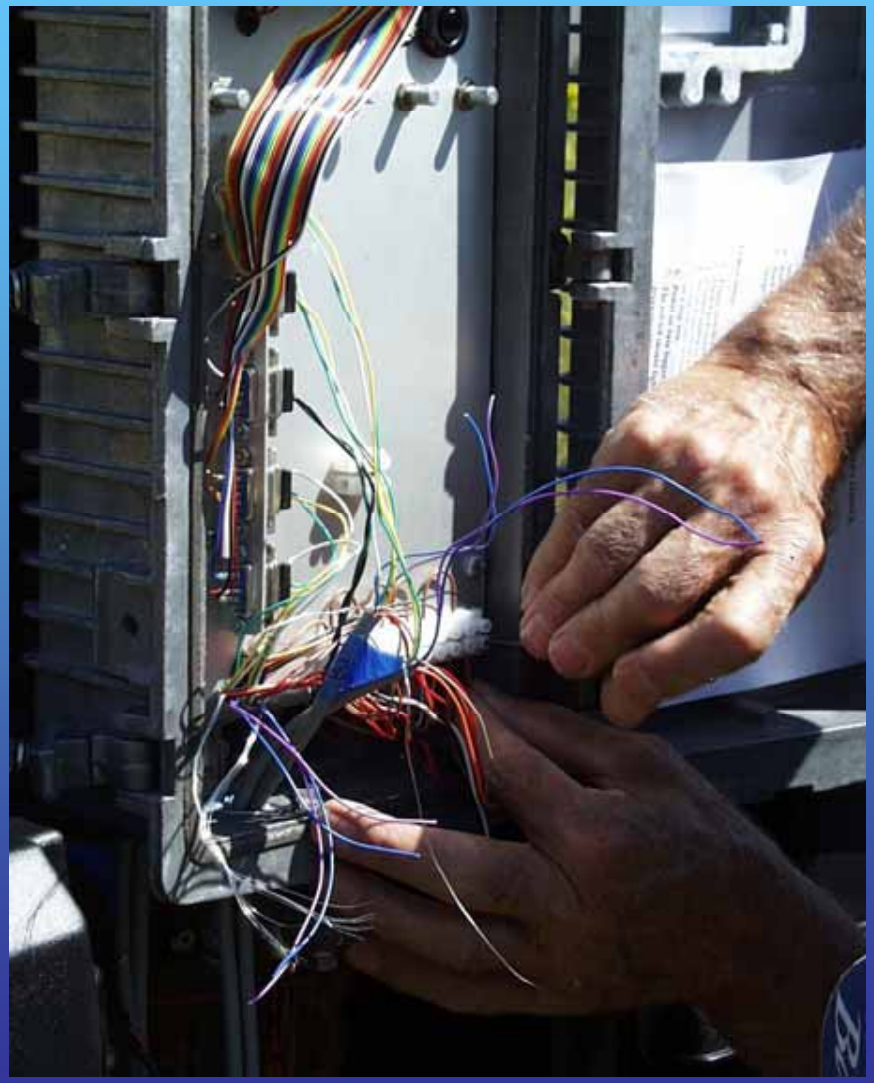
Antennas

- Wood support
- 1½” ABS pipe
- Pair of 7-strand, 28 gauge ribbon cable

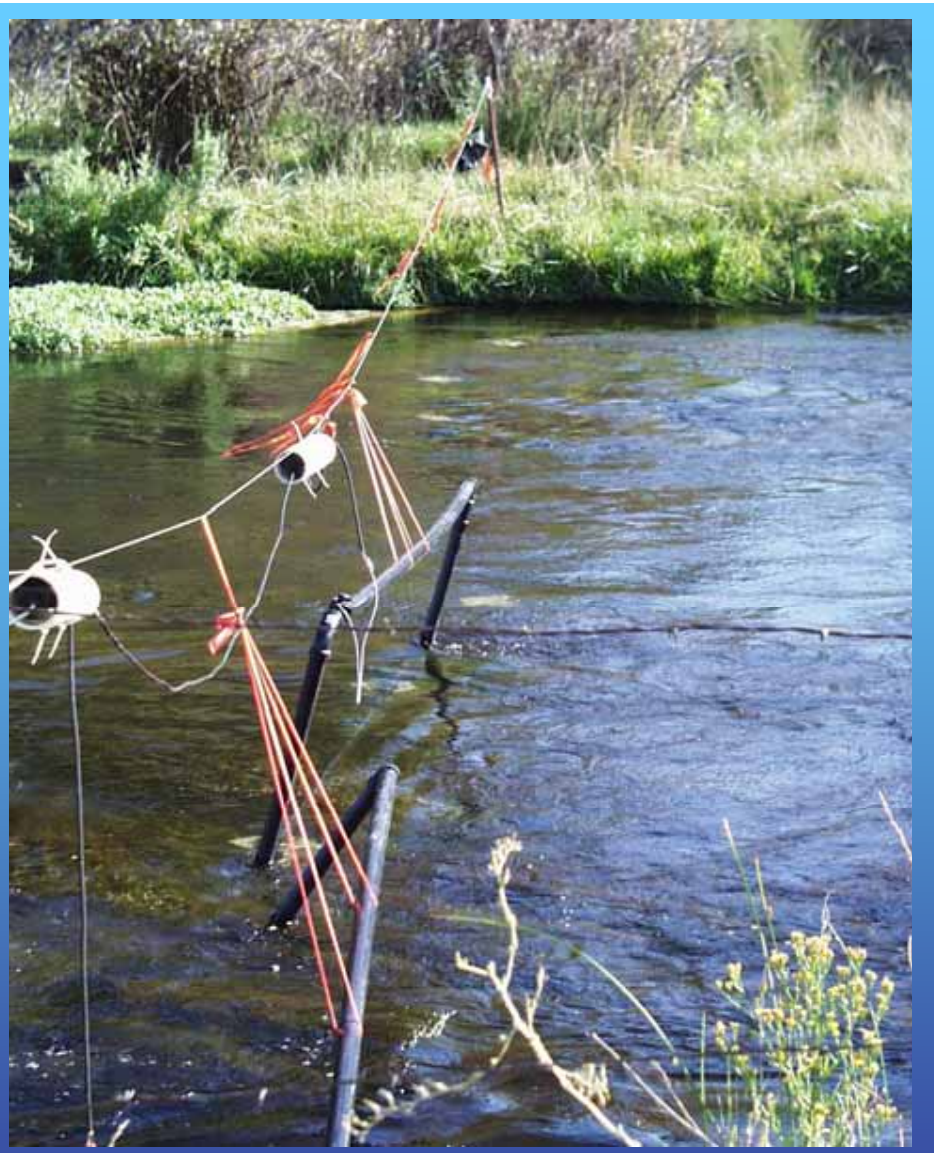
Additional features

- Circuit boards
- Schraeder valves
- Quick release connection

Data Logger



INSTALLATION
Break-Away System
Plastic T-Posts
Steel T-Posts



Break-Away

Plastic T-Posts

Steel T-Posts

Power

A power station made up of a 110 watt solar panel and two 12 volt, deep cycle, 31 AGM marine batteries connected in parallel, was built to support each system.

•Each antenna and reader used approximately 2½ amps per day.

•Batteries were exchanged every 2-3 days to be fully charged.

•Power was monitored by a battery meter and solar controller.

•Physical checks of the battery charge were made daily.

HIGH

(a a

Debris

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

NOISE

- **Tremendous amount of inconsistent**

  NOISE
- **Varying frequencies from multiple sources**

  NOISE
- **Location of origin is unknown**

  NOISE
- **Just under the water's surface reads were sporadic**

  NOISE
- **100% noise = <40% read efficiency**

  NOISE

Mysterious

Array A	TIME	DATE	Number
3	02:08:04	9/13/2006	BEL044023448064
3	04:43:00	9/13/2006	547026970454021
2	07:01:42	9/15/2006	NAM026719862945
4	16:46:25	9/16/2006	046273806560320
4	11:25:04	10/8/2006	AFG000000000129
4	03:42:33	10/14/2006	210000638142756
5	07:41:28	10/14/2006	JOR017817508388
1	05:24:00	10/16/2006	000005871206401
5	09:50:07	10/16/2006	701032368537892
3	23:11:10	10/16/2006	GNQ175070701636
1	03:42:03	10/20/2006	000034233956515
2	06:30:07	10/24/2006	LBR029374301800
4	12:08:32	10/24/2006	AFG034398273536
5	22:02:37	10/31/2006	928139459174416
5	13:22:55	11/6/2006	134066683106962
1	22:38:17	11/6/2006	103249371764285
5	02:01:46	11/9/2006	644103133609979
Array B			
1	15:36:42	9/28/2006	MNP000943032642
1	9:50:51	10/27/2006	CUB051791266112

Reads

Future Ideas

- Stronger reading field
- Auto tuning
- Array efficiency
- Noise level recorder
- Habitat specific
- “disposable” arrays

III. Contact List

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Return to top