Klamath Basin Fisheries Collaborative

WiFi “Tech Guest”

Username: fish0001

Password: RkwJ1

KBFC Annual Meeting Spring 2026

19 May 2026

Klamath Falls

Agenda

10:00 am	Welcome & Overview
10:15 am	Research & Monitoring of Fish and Other Aquatic Organisms - PIT and Telemetry Tagging
12:30 am	Lunch
1:30 pm	Research & Monitoring of Fish and Other Aquatic Organisms - Life History and Population Health
2:30 pm	Suckers Discussion - Data methodologies, standardization, and needs
2:45 pm	Thermal Refugia - Temperature and Fish Behavior
3:05 pm	Break
3:15 pm	Dam Passage & Removal - Fish Monitoring Post-Dam Removal
4:35 pm	Salmon Discussion - Data methodologies, standardization, and needs
4:50 pm	Wrap-Up & Adjourn

Klamath Basin Fisheries Collaborative

Research & Monitoring of Fish and Other Aquatic Organisms – PIT and Telemetry Tagging

Environmental and Fish-Specific Drivers of Juvenile Chinook Salmon Migration Rates and Ocean Arrival Timing in the Klamath River

Summer Burdick, Russ Perry, Collin Smith, Chris Pullano, Chad Martel, and Tyson Hatton

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

USGS

Presentation for Western Division American Fisheries Society

Please contact Summer Burdick at sburdick@usgs.gov for more information

Distribution and Apparent Minimum Survival of Radio-tagged Juvenile Lost River and Shortnose Suckers in Upper Klamath Lake (2022–2025)

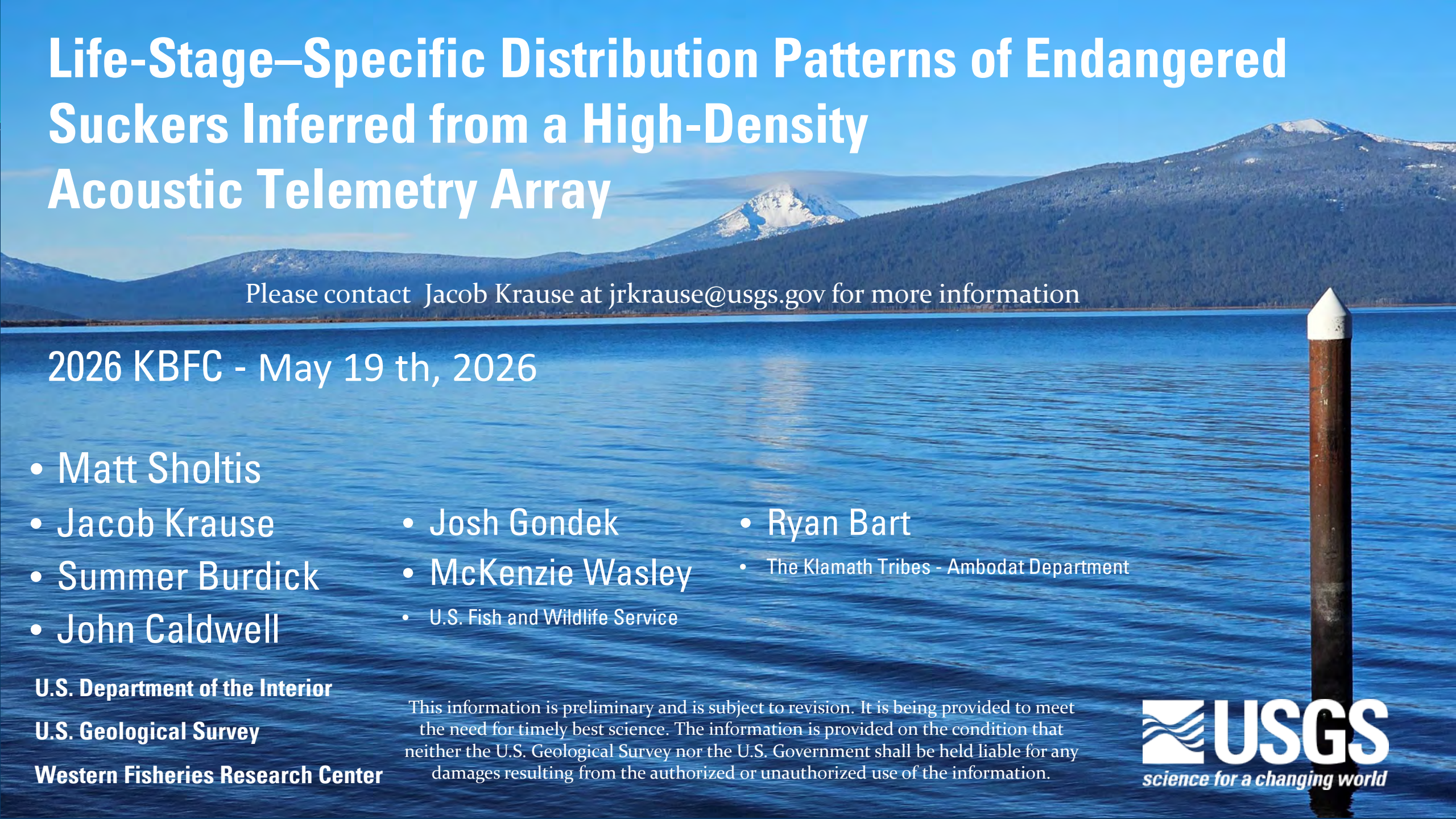
McKenzie Wasley [1*], Nathan Banet [2], Quinn Payton [2], Allen Evans [2], Mike Hawbecker[2], Christina Kruse [1], Christie Nichols [1], and Rodger Gwiazdowski [1]

[1] U.S. Fish and Wildlife Service, Klamath Falls Office, Klamath Falls, OR

[2] Real Time Research, Bend, OR

Please contact McKenzie Wasley at mckenzie_wasley@fws.gov for more information

Life-Stage–Specific Distribution Patterns of Endangered Suckers Inferred from a High-Density Acoustic Telemetry Array



Please contact Jacob Krause at jrkrause@usgs.gov for more information

2026 KBFC - May 19 th, 2026

- Matt Sholtis
- Jacob Krause
- Summer Burdick
- John Caldwell
- Josh Gondek
- McKenzie Wasley
  - U.S. Fish and Wildlife Service
- Ryan Bart
  - The Klamath Tribes - Ambodat Department

U.S. Department of the Interior

U.S. Geological Survey

Western Fisheries Research Center

USGS
science for a changing world

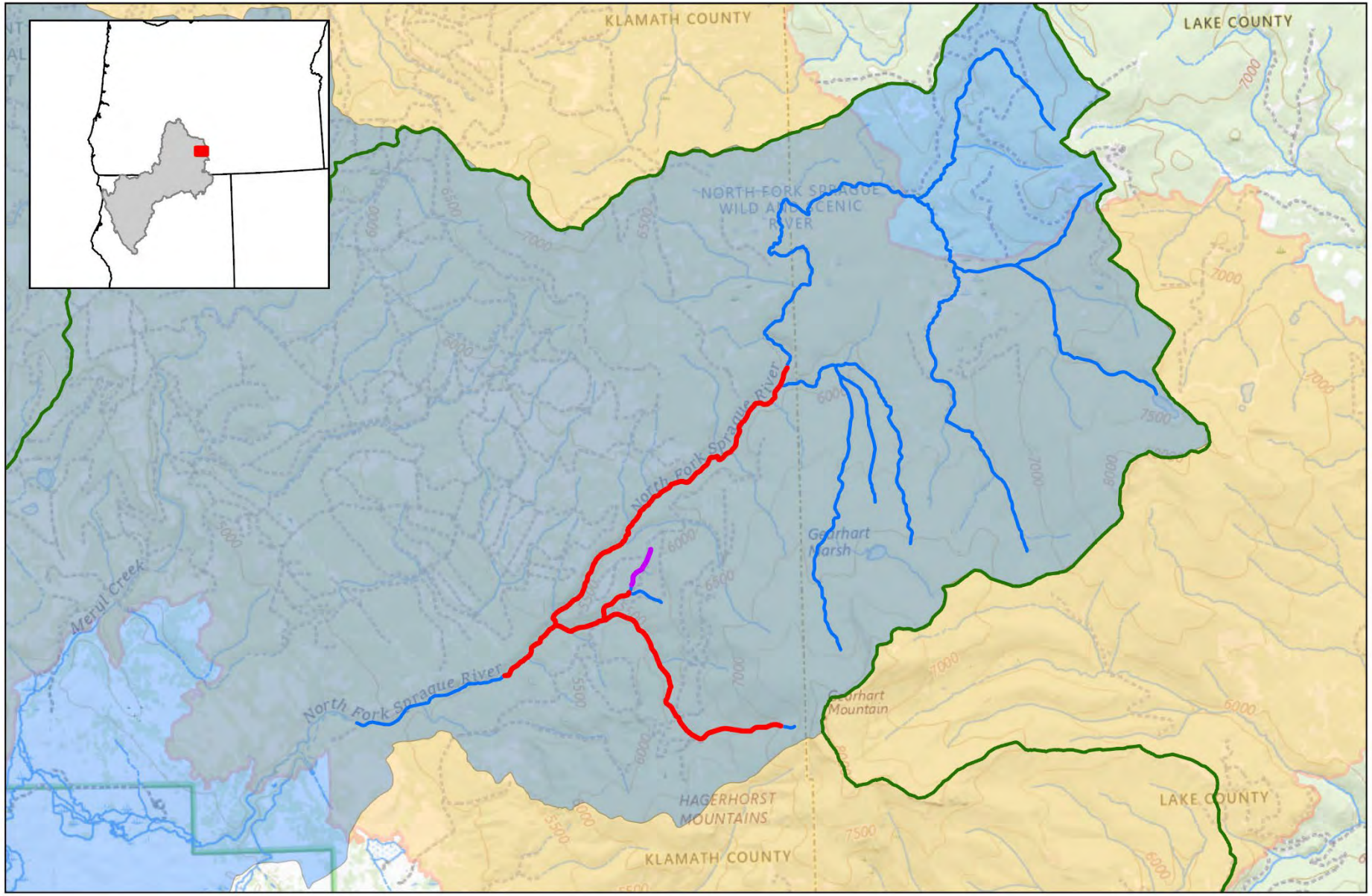
Can Bull Trout Navigate Non-wicker Weave Beaver Dam Analogs? A Case Study of Fish Passage at Beaver Dam Analogs Constructed Using Modern Techniques in the Upper Klamath Basin, Oregon

Charlie Erdman, Tommy Cianciolo, Dave Hering

Salmonid Restoration Federation - 2026

TROUT UNLIMITED

NATIONAL PARK SERVICE

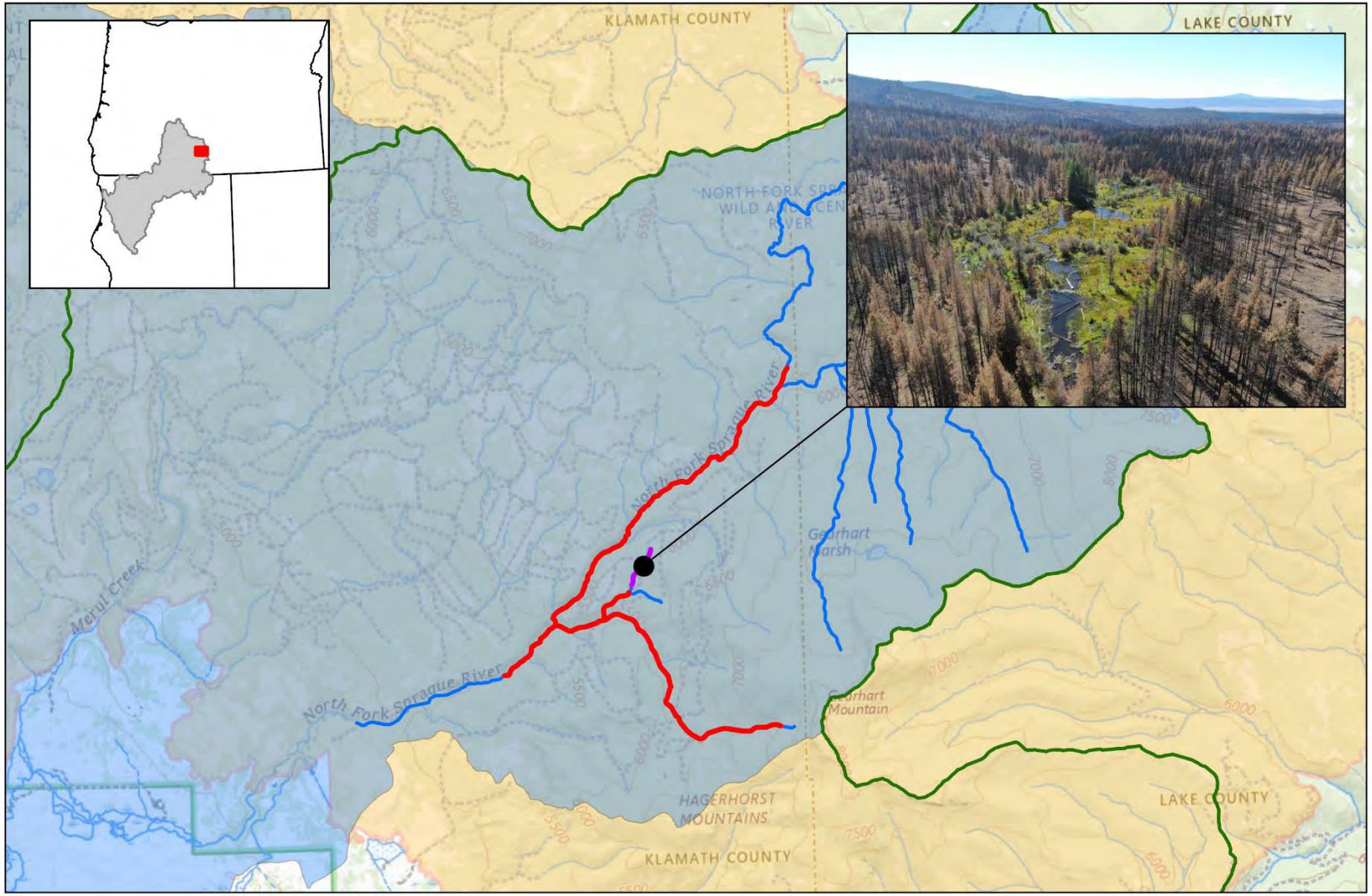


Bull Trout in the NF Sprague River Watershed

- Recently Extirpated
- Currently Occupied
- Bull Trout Critical Habitat
- Upper Sprague Core Area
- NF Sprague River Watershed
- Bootleg Fire

N

0 2 4 8 Kilometers



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N

0 2 4 8 Kilometers

Bull Trout and Beaver and Beaver-Related Restoration

Habitat:

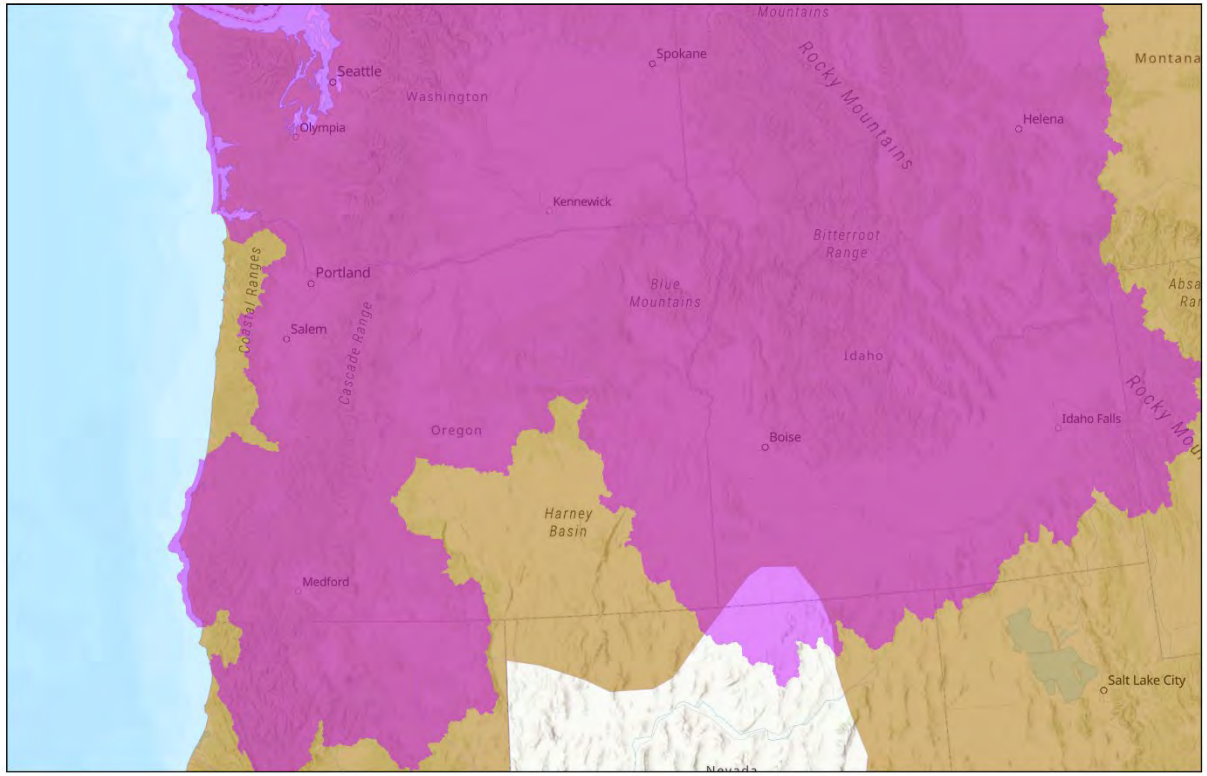
- Overwinter in beaver ponds (Jakober et al. 1998)

Passage:

- Detected upstream of dams (Boag 1987; Wolf et al. 2024)
- Redds detected above dams (Bustard 2017; Wolf et al. 2024,)
- Beaver dams can delay downstream migration, especially during periods of unusually low precipitation (Dupont et al. 2007)

LTPBR:

- Minimal increase in density (Mackey 2025)



Sun Creek

Extensive habitat and BLT recovery efforts since 1989

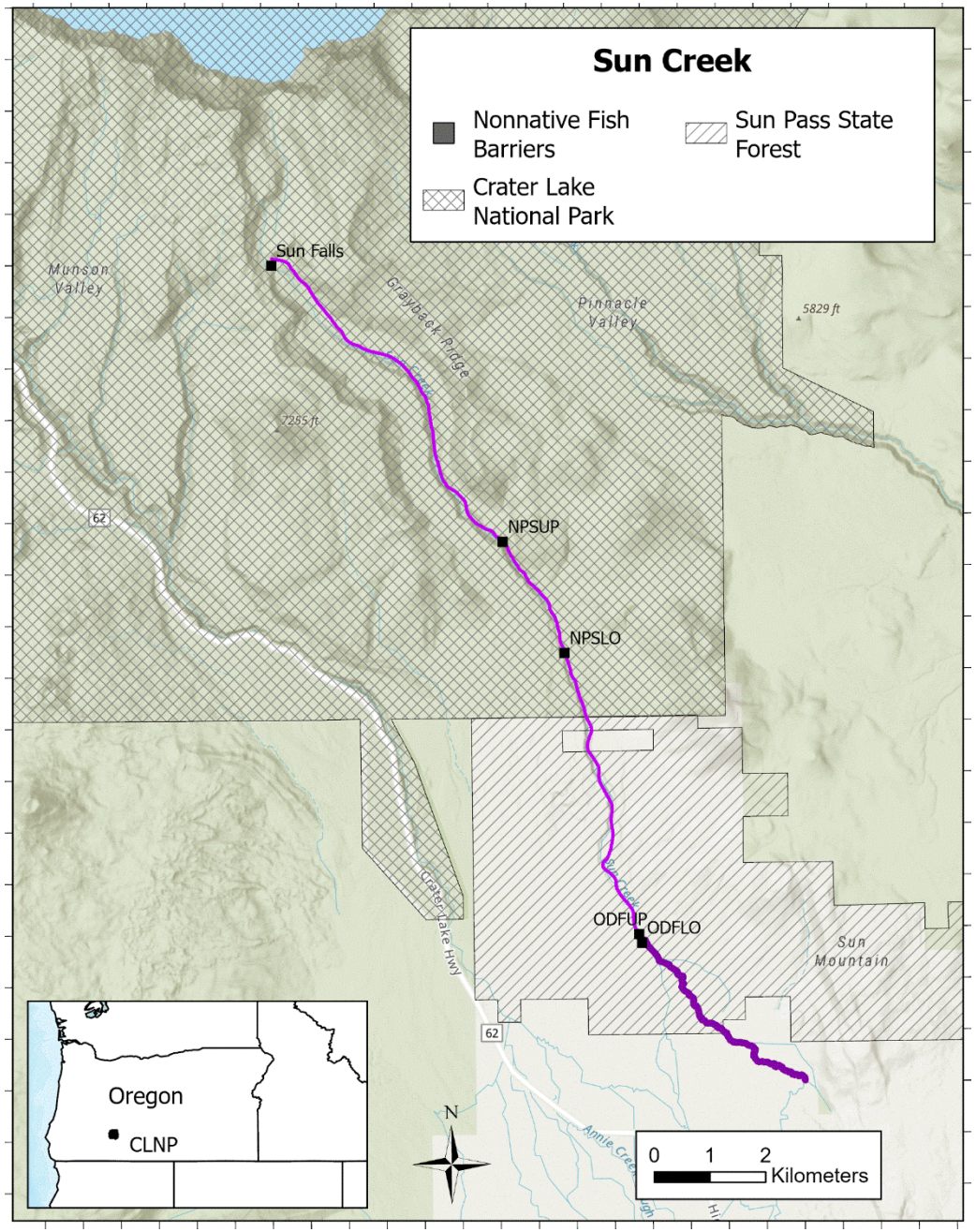
- Barrier construction
- Fish screen installation
- Brook Trout removal
- Instream water right transfer
- Channel reconnection
- LTPBR

Collaborative long-term restoration project

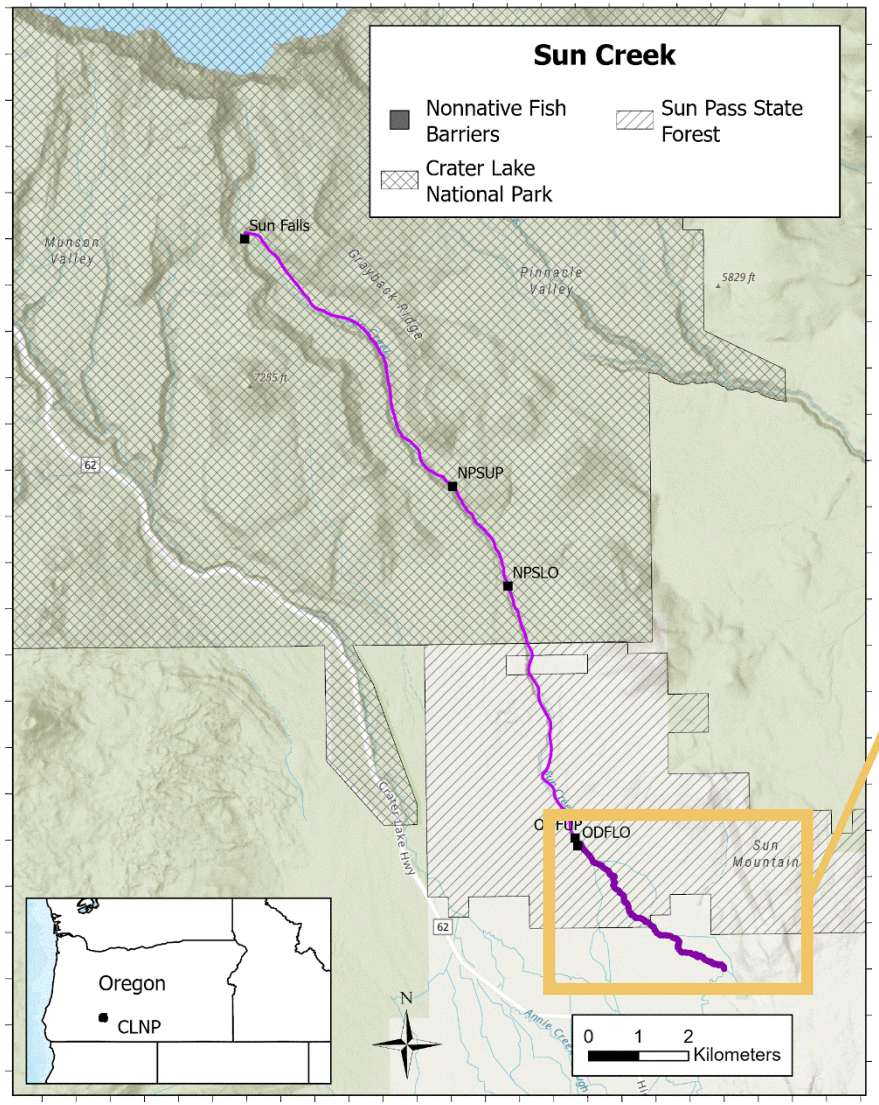
- Led by NPS with assistance from state, NGOs, private landowners

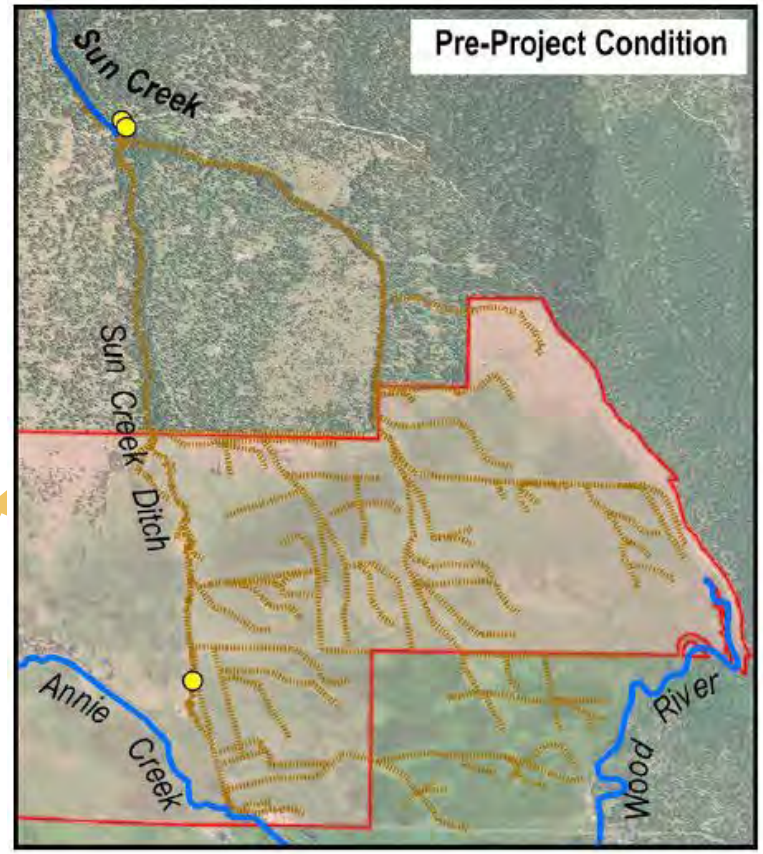
Ongoing population monitoring by NPS, including PIT-tag capture-recapture since 2008

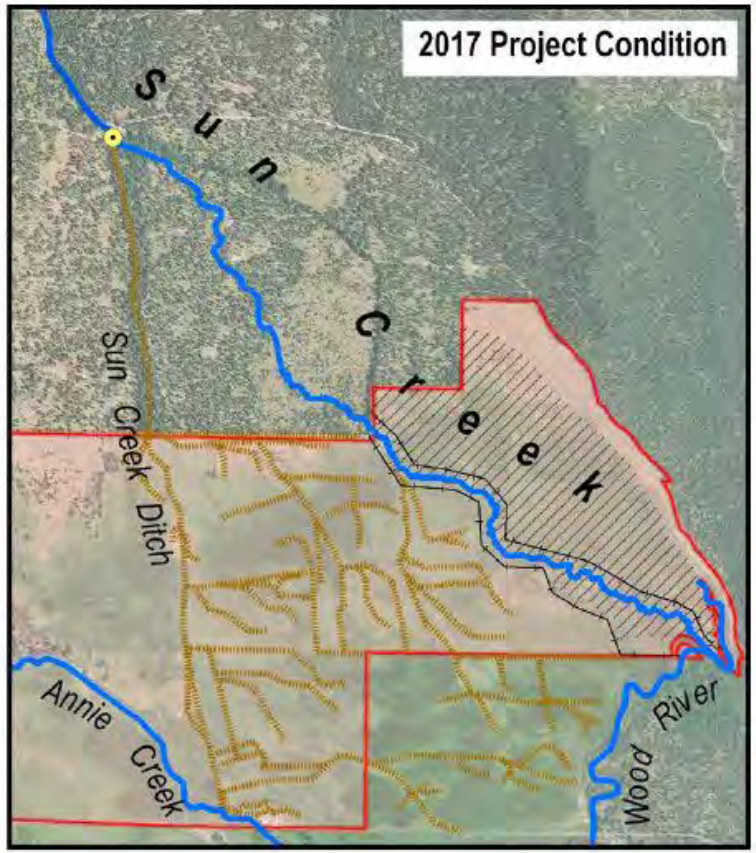
More information: Buktenica et al. 2018



Reconstructed Channel of Lower Sun Creek







Points of Diversion (POD)
Fish Screen and Consolidated POD
Irrigation Delivery
Riparian Fence
Private Land In Project Area
Instream Transfer Acreage
0 0.25 0.5 1
Kilometers
N


July 2014


June 2025

LTPBR Build – Lower Sun Creek (2.1km)

Fall 2022

- 32 BDAs, 20 PALS installed

Fall 2024

- Maintenance on 18 BDAS

All with posts but using the postless method (Appendix E; Wheaton et al. 2019)

BDA.20


May 2023


September 2024


291°W (M) 42.747824°N, 121.995093°W ±9ft
September 2025
BDA
Sun Creek
Sep 30 2025


March 2026

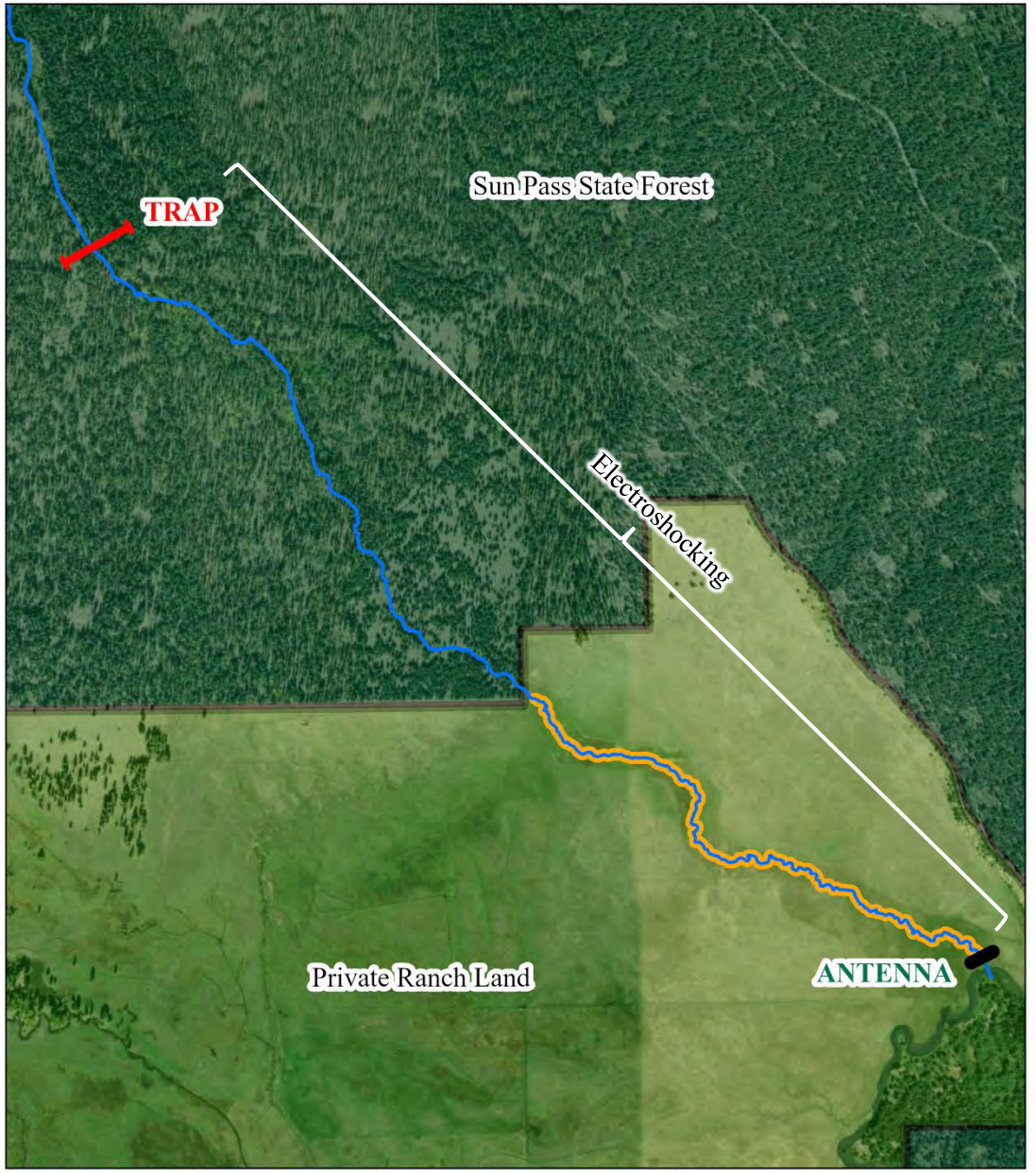
Methods

Bull Trout collected and PIT-tagged at trap and during electrofishing surveys

- Trap operated from 2021-2025
- Spring and fall electrofishing surveys from 2017-2025

Dual antenna array at mouth

- Operated from 2018-2025



Lower Sun Creek - Bull Trout Sampling Framework

Sun Creek
LTPBR Treatment Reach
Lower ODF Barrier and Trap
PIT Antenna
Private Ranch Land
Sun Pass State Forest (ODF)

N

0 0.13 0.25 0.5 Miles

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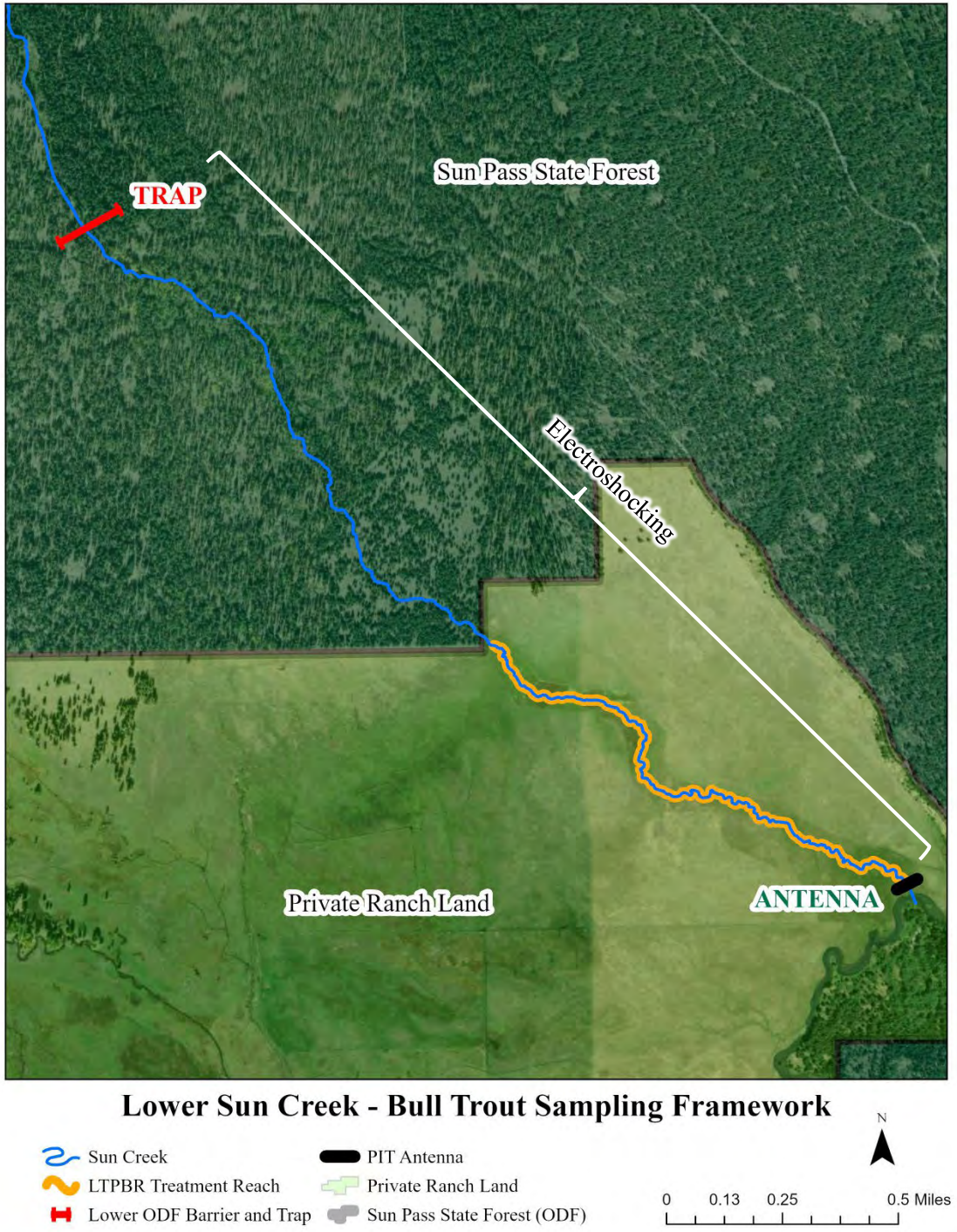

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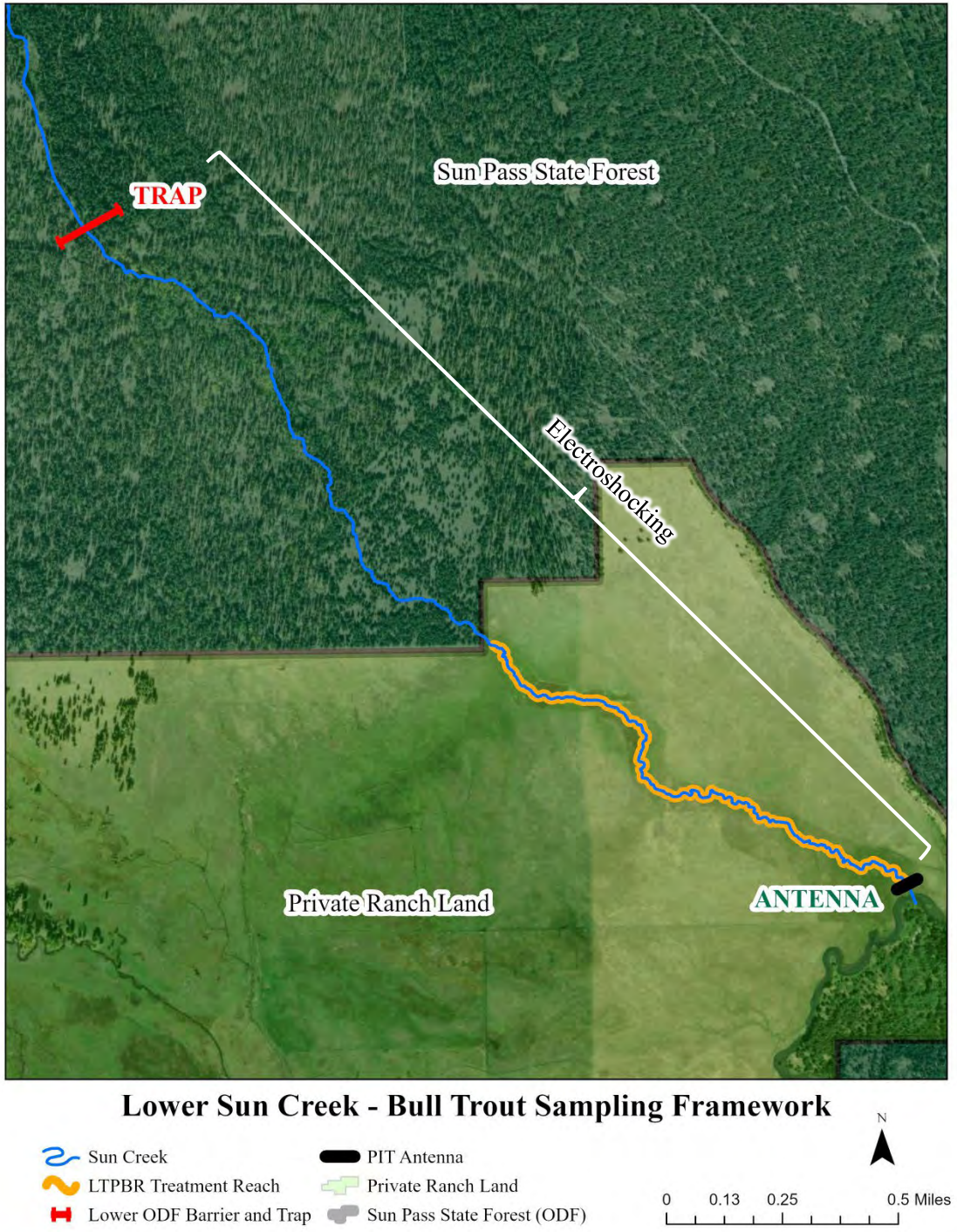
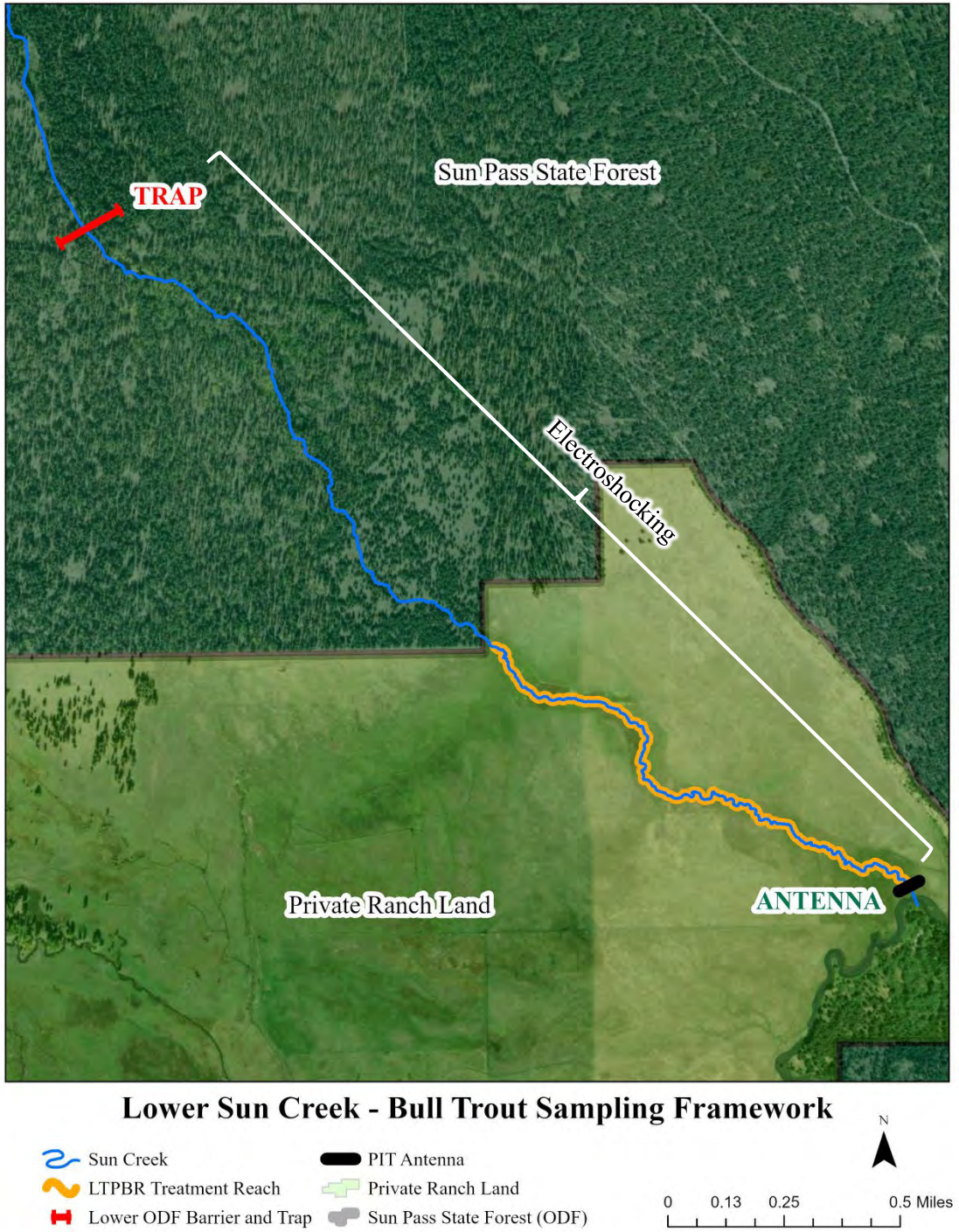
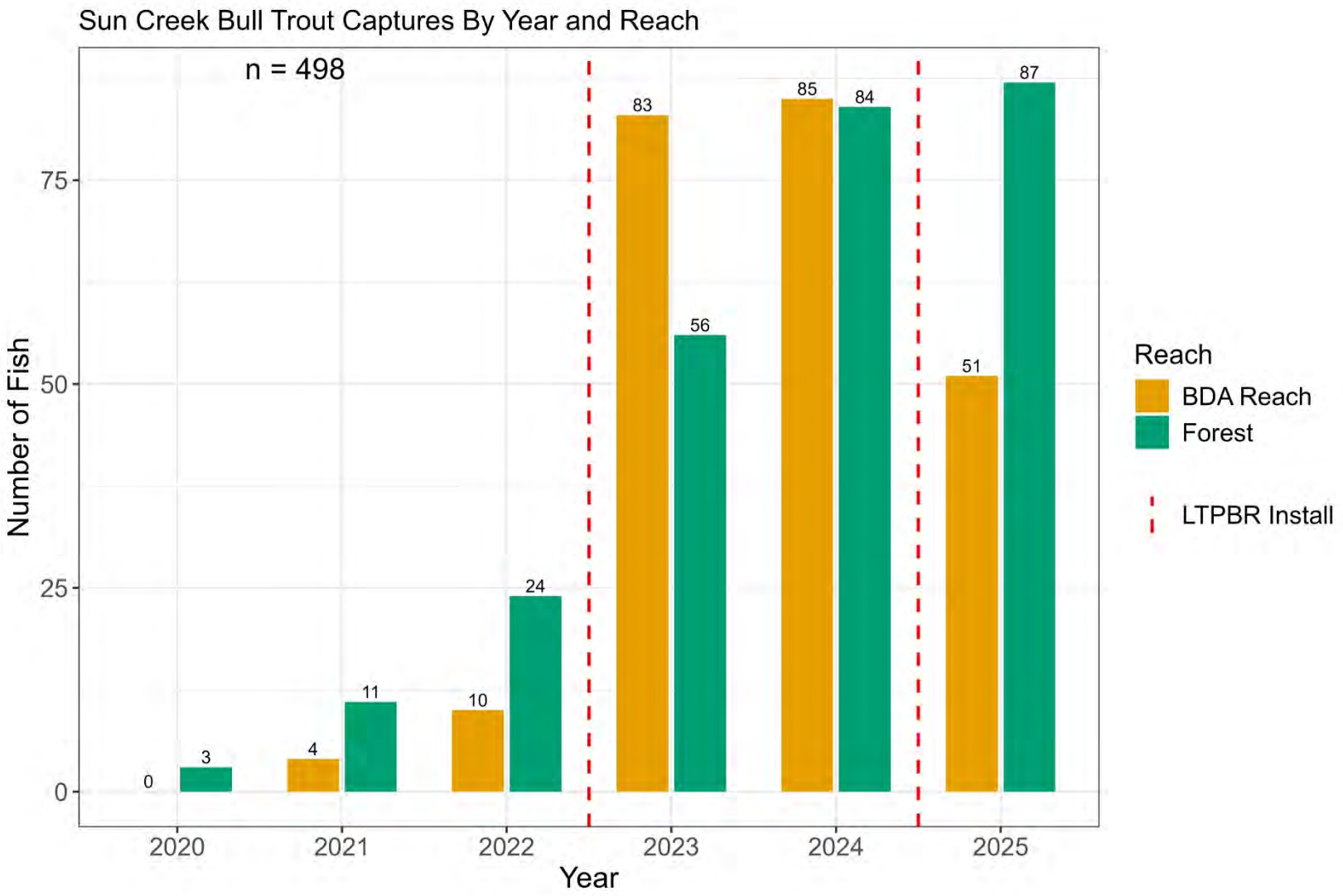
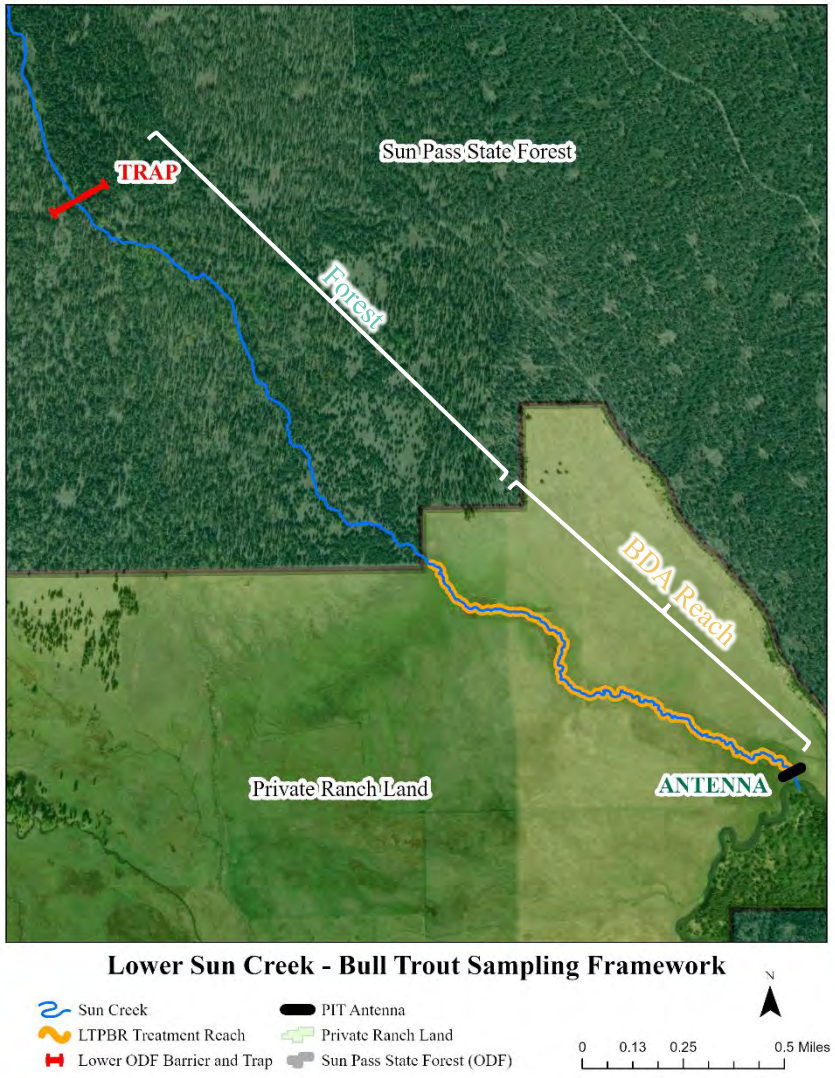


Methods


TRAP
Sun Pass State Forest
Electroshocking
Private Ranch Land
ANTENNA
Lower Sun Creek - Bull Trout Sampling Framework
Sun Creek
LTPBR Treatment Reach
Lower ODF Barrier and Trap
PIT Antenna
Private Ranch Land
Sun Pass State Forest (ODF)
N
0
0.13
0.25
0.5 Miles

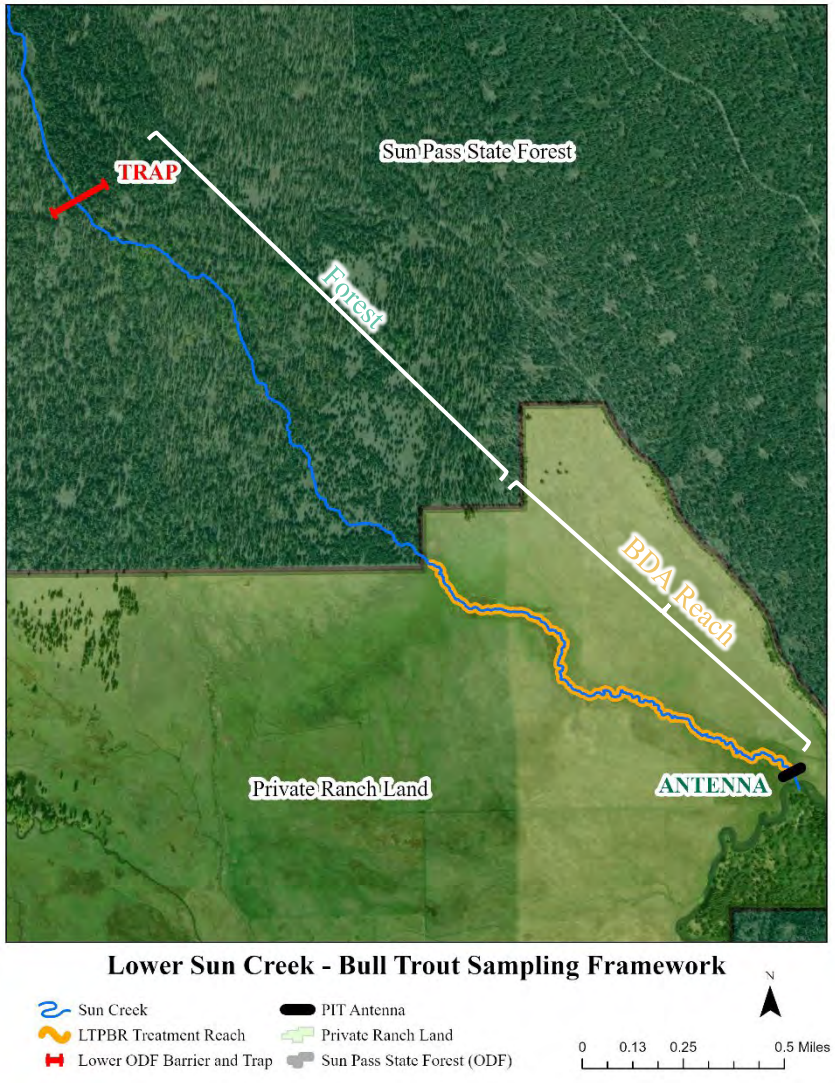
Are Bull Trout in the reconstructed reach?



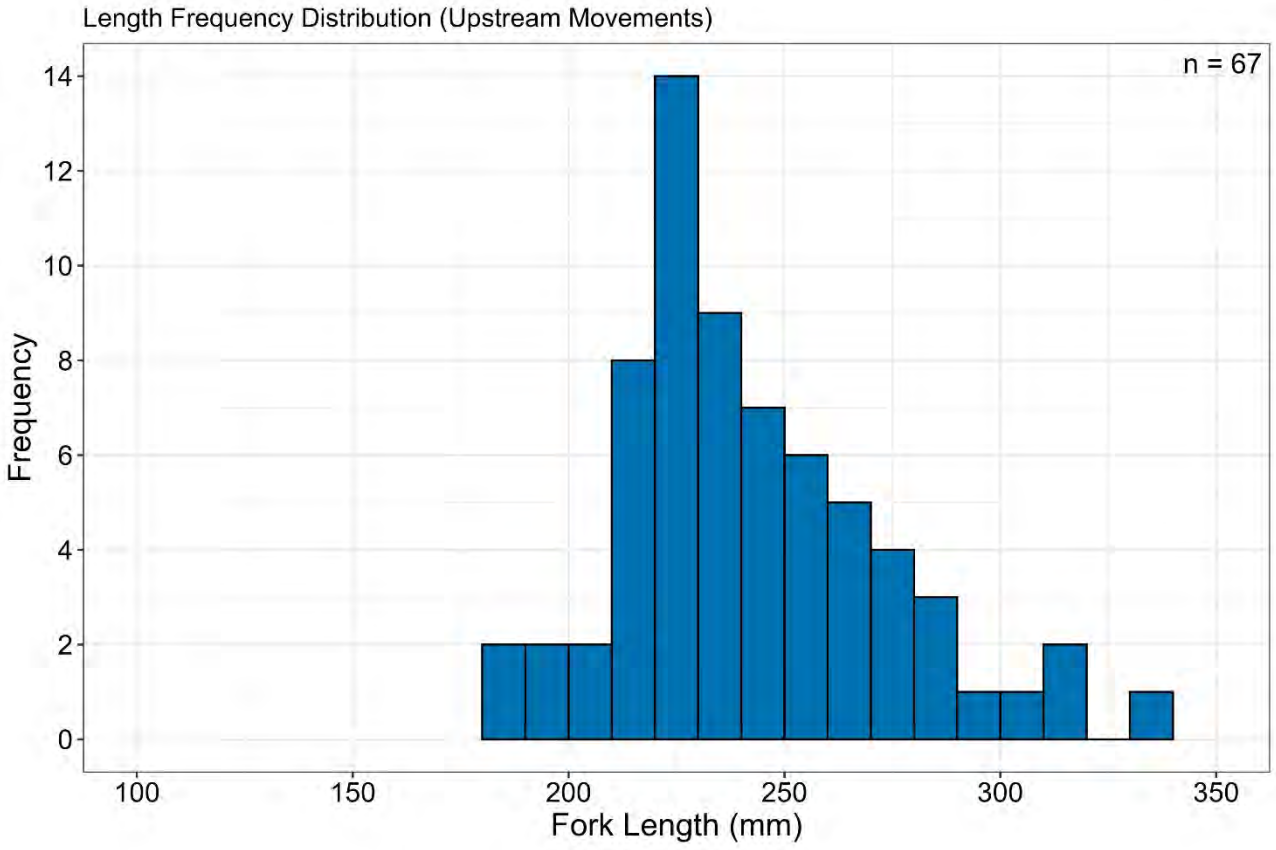


Are Bull Trout moving upstream and downstream through the BDA reach?

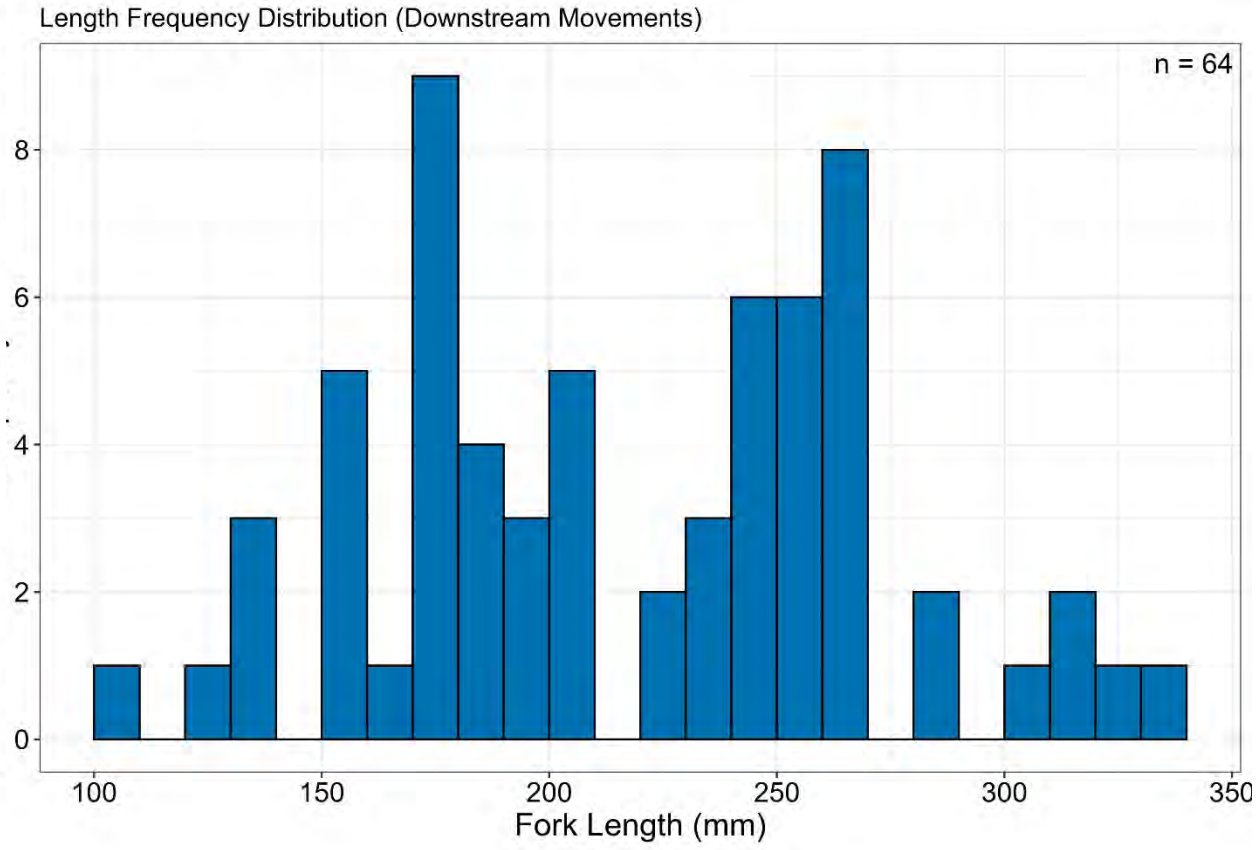
- **67** BLT passed at least 1 BDA during upstream movement (detected at mouth or during electroshocking and then at trap)
- **64** BLT passed at least 1 BDA during downstream movement (detected at trap or during electroshocking and then at mouth)



What size are Bull Trout that make upstream and downstream movements through the BDA reach?

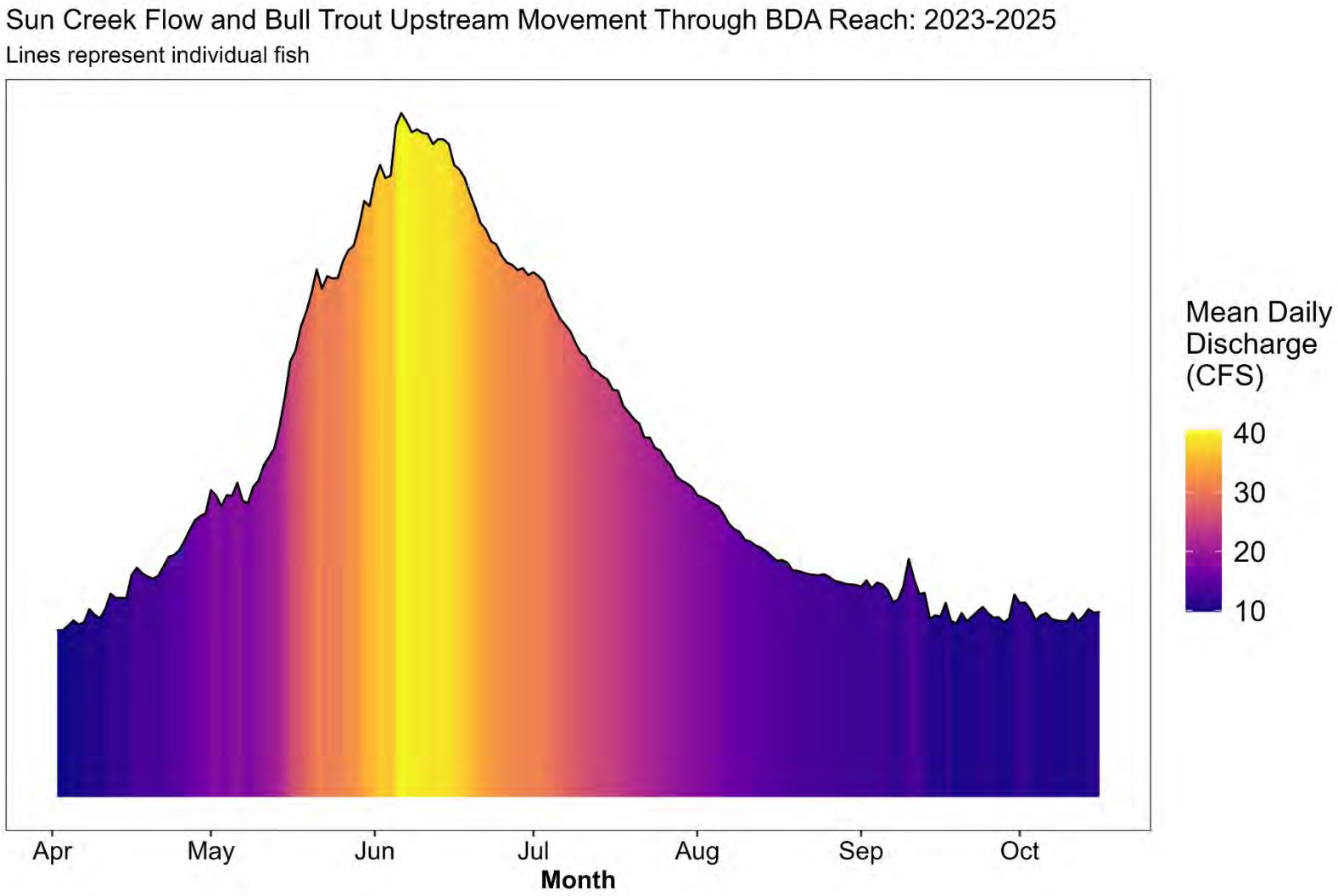


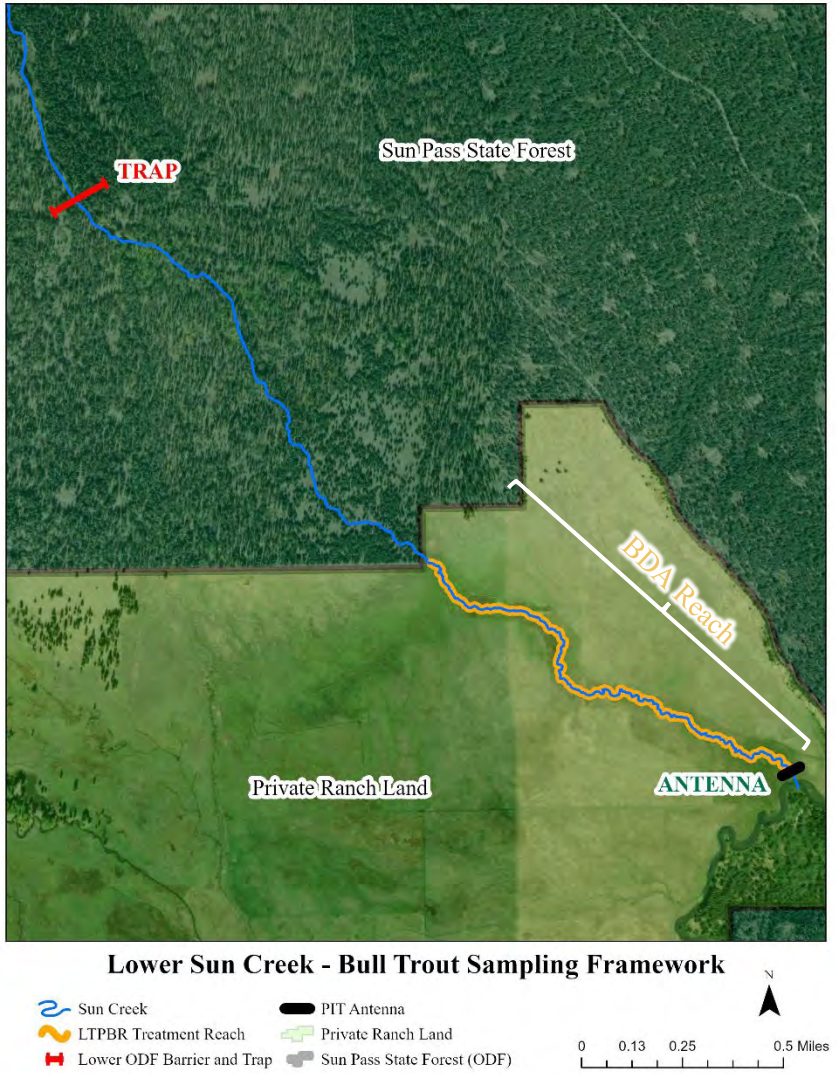
Upstream Movements



Downstream Movements

When are Bull Trout moving upstream through the BDA reach?





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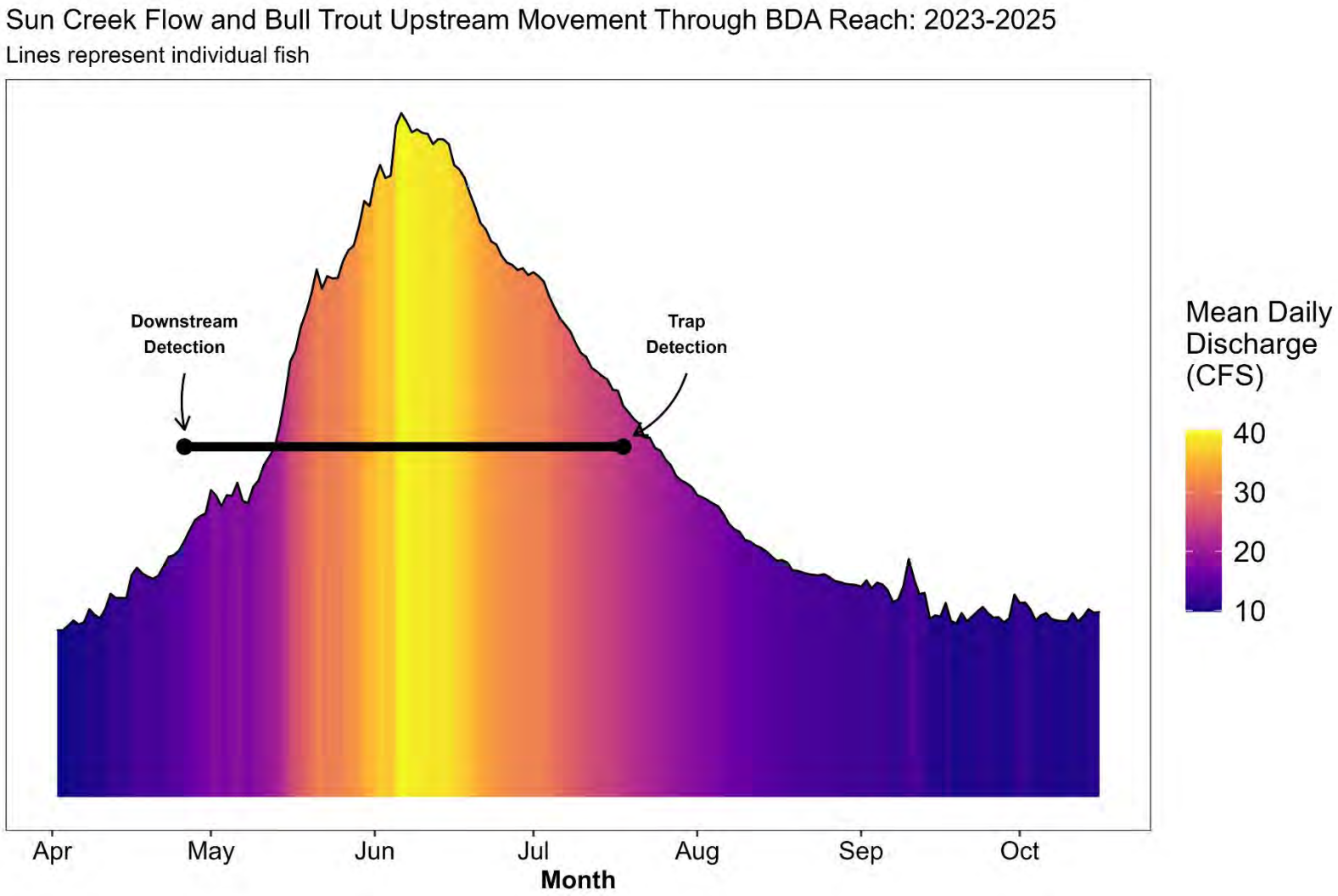

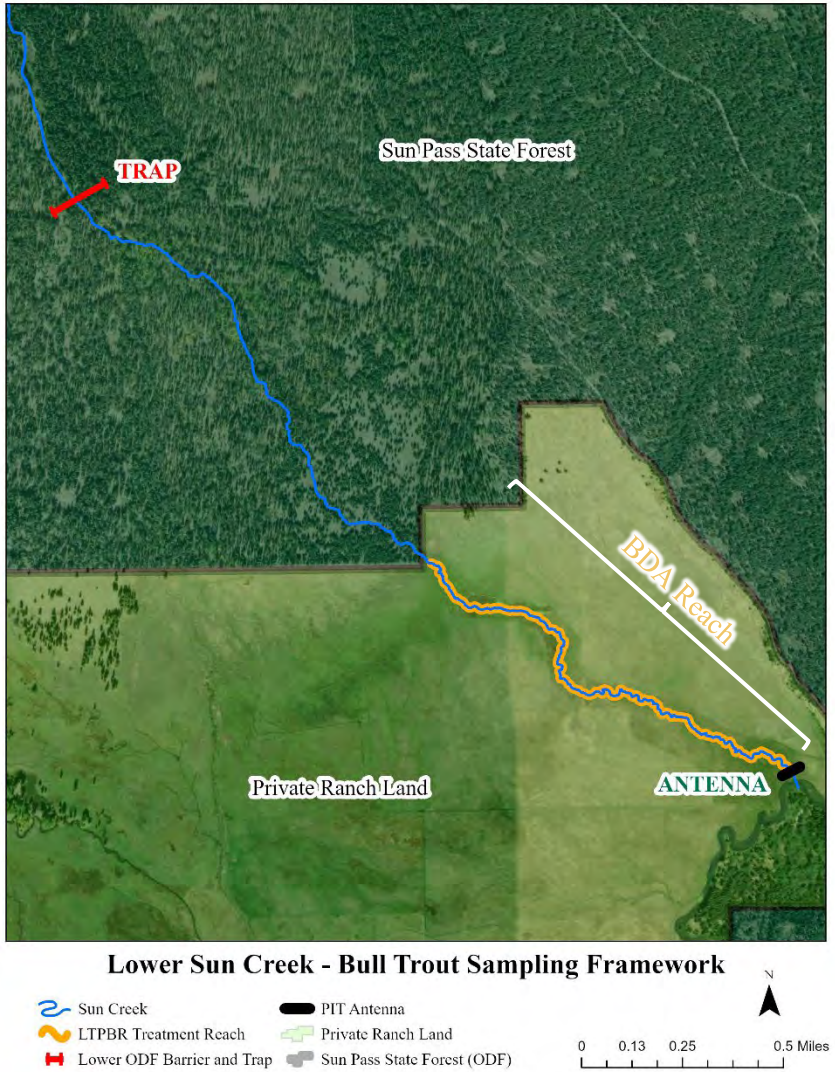

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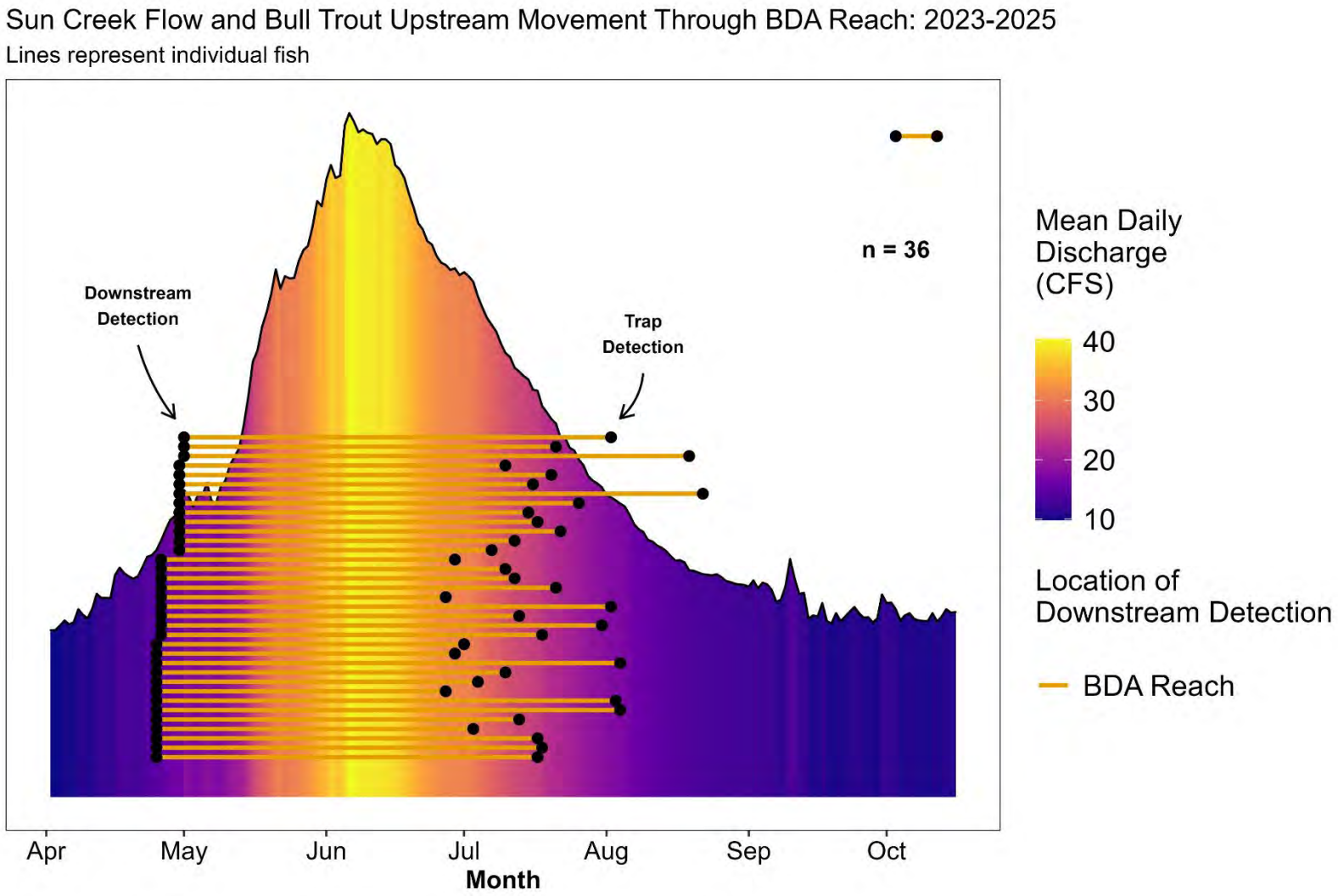

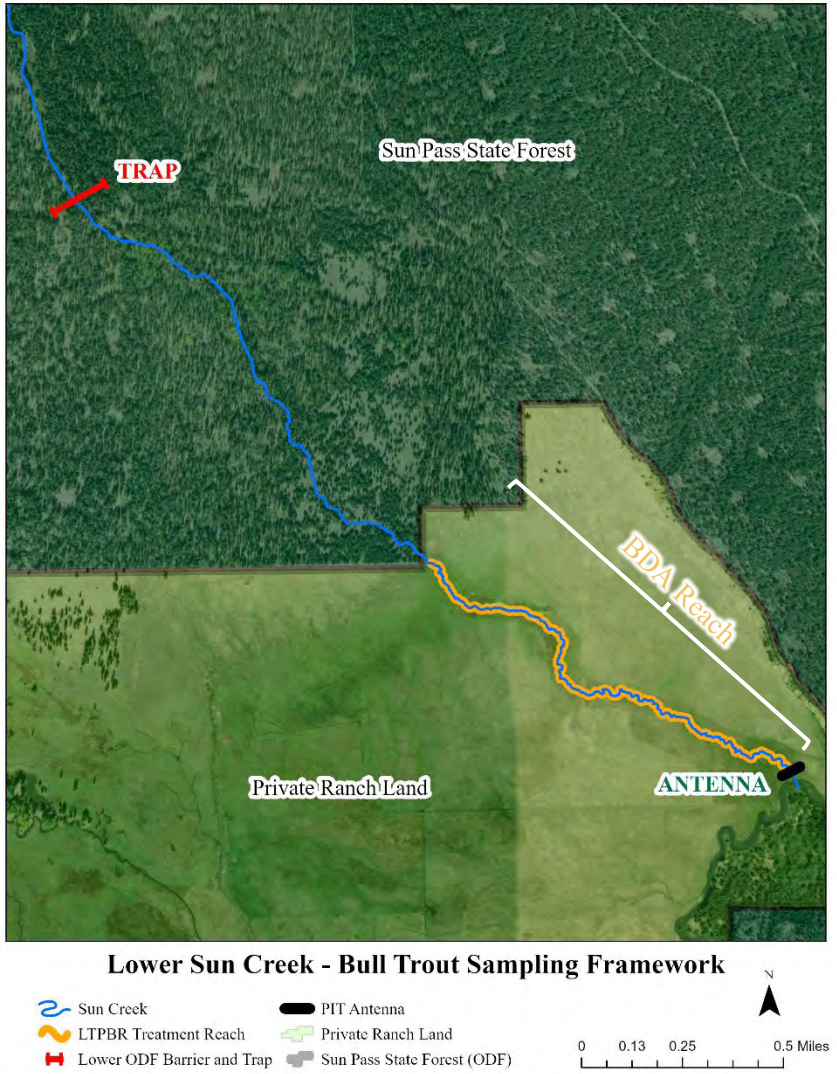

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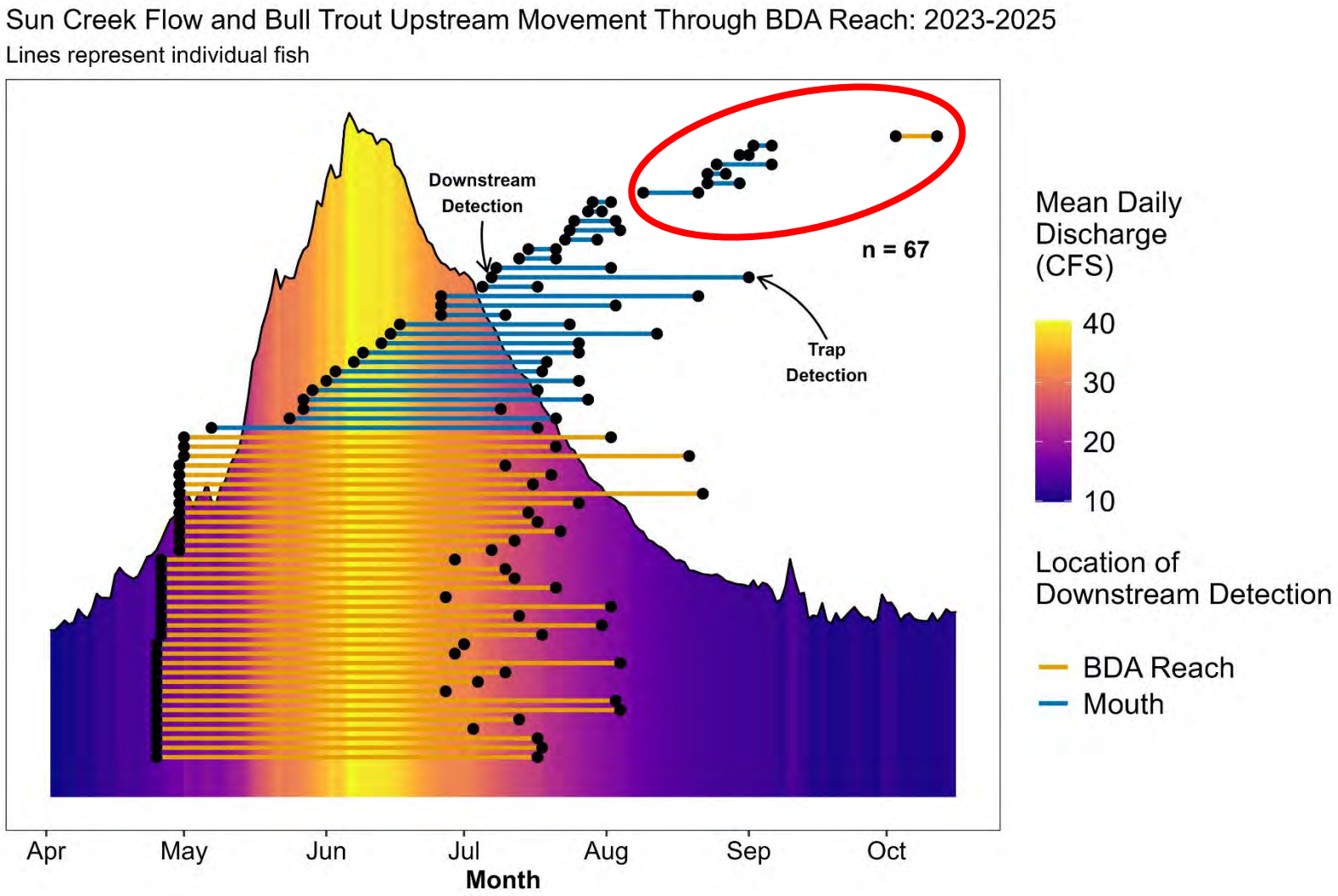
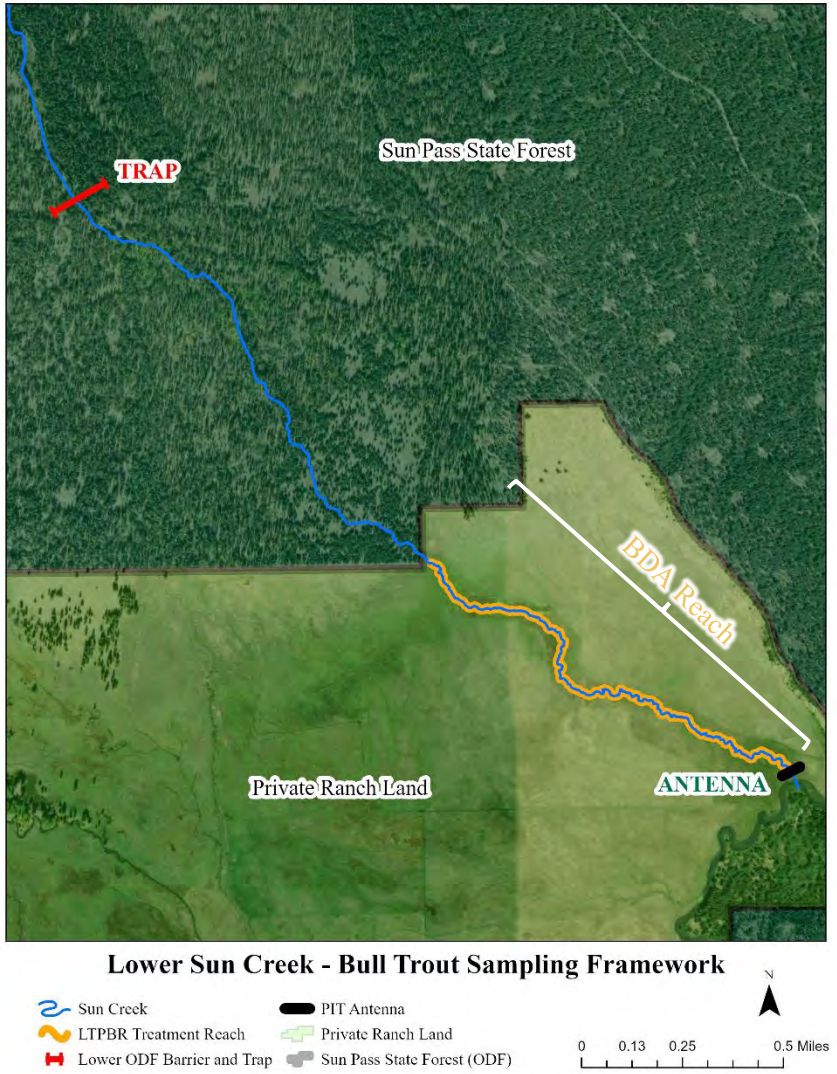
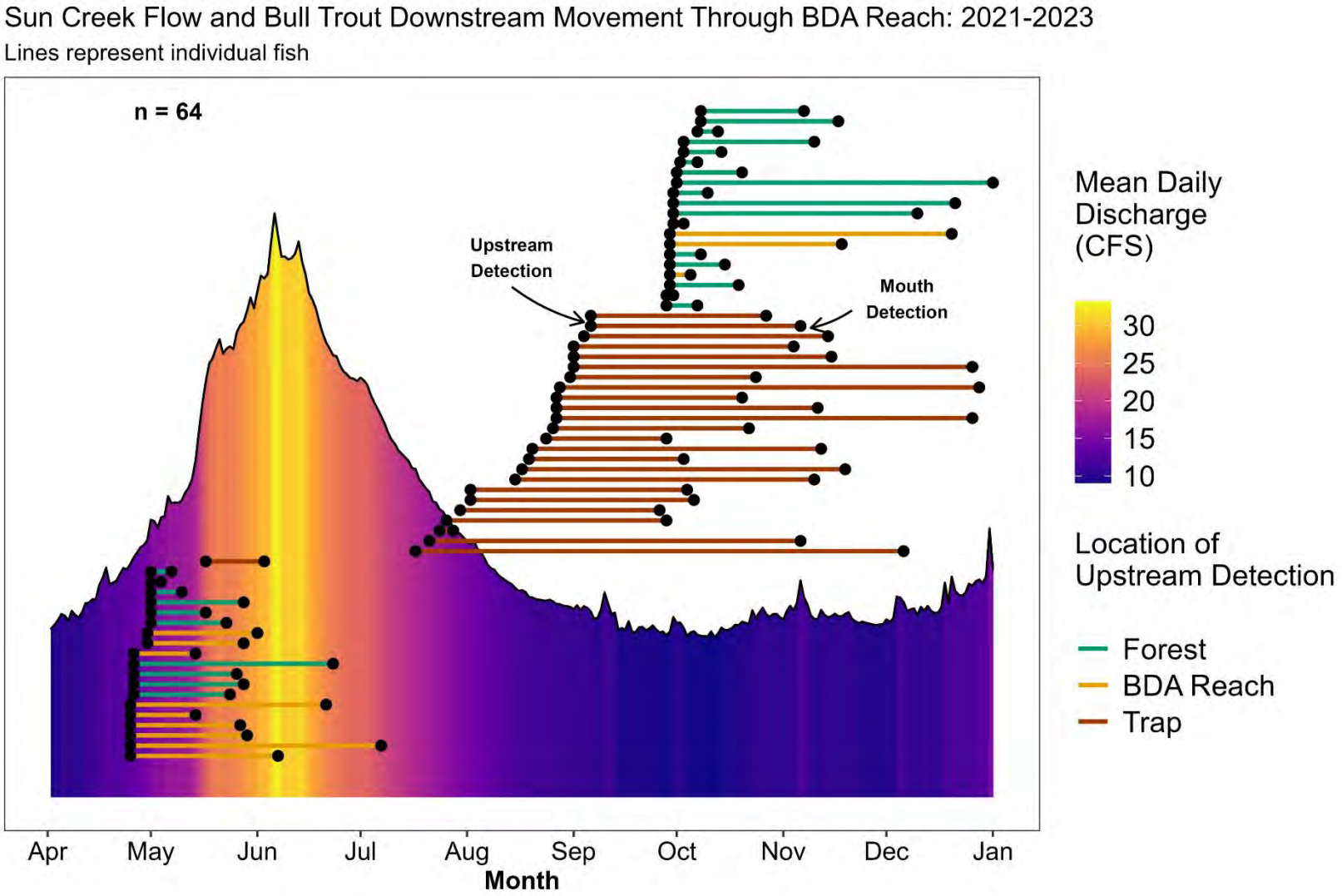
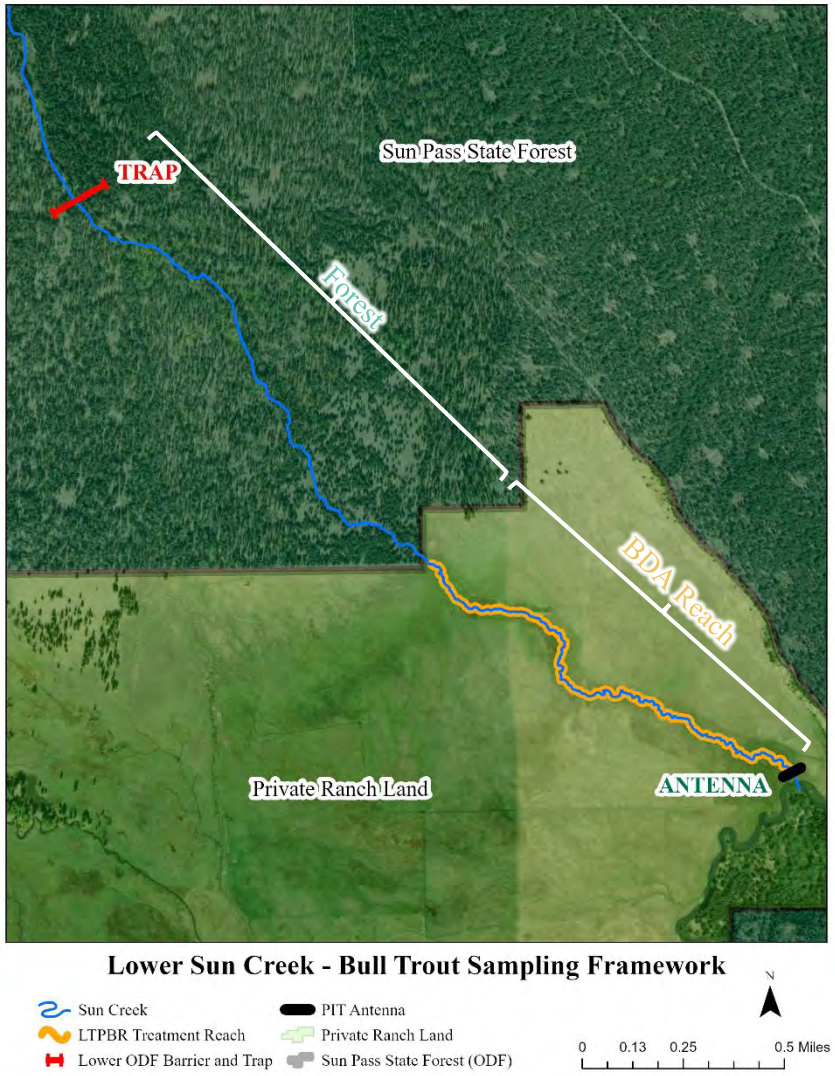




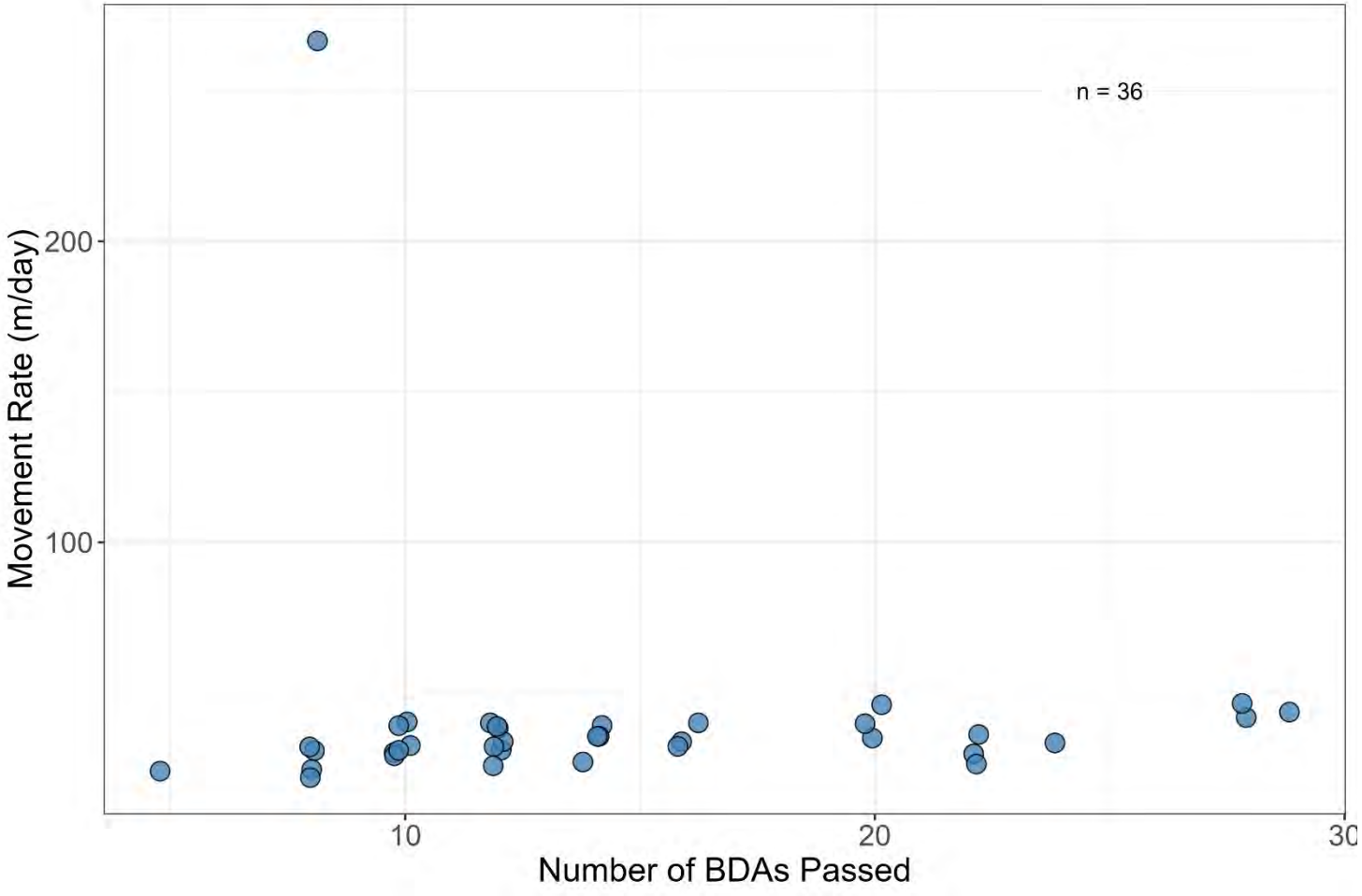
When are Bull Trout moving downstream through the BDA reach?

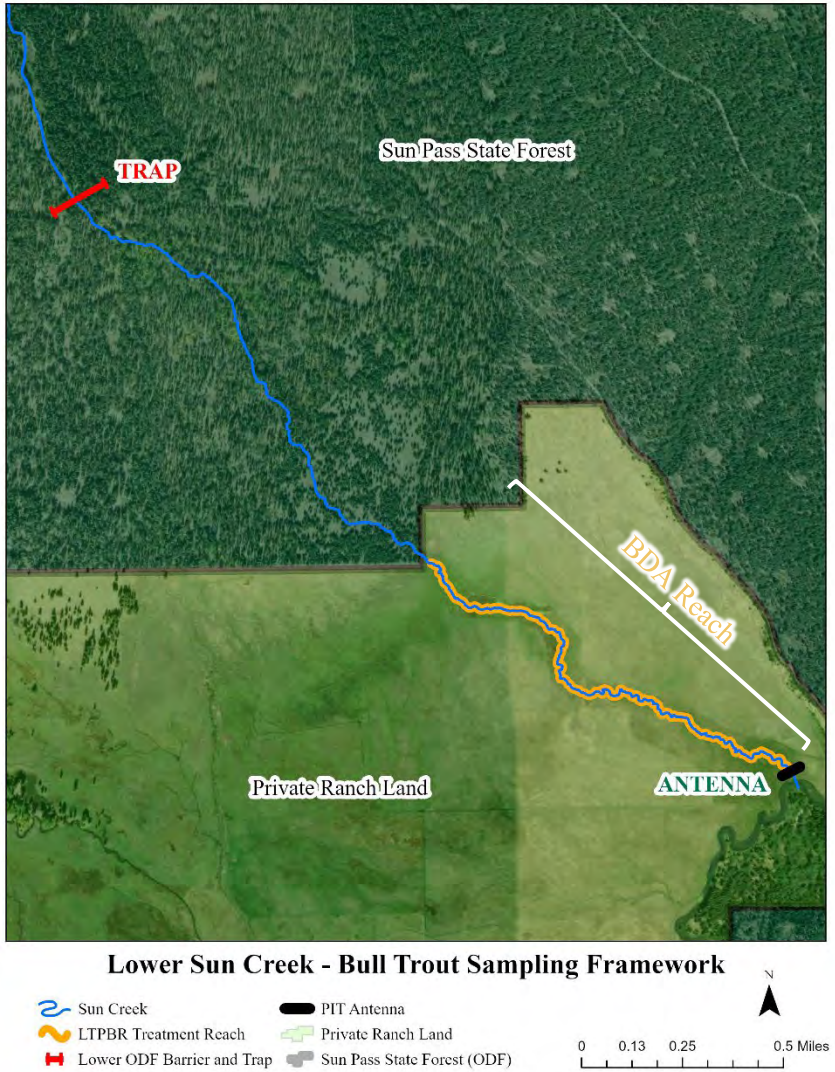




Does the number of BDAs passed impact movement rate (m/day)?

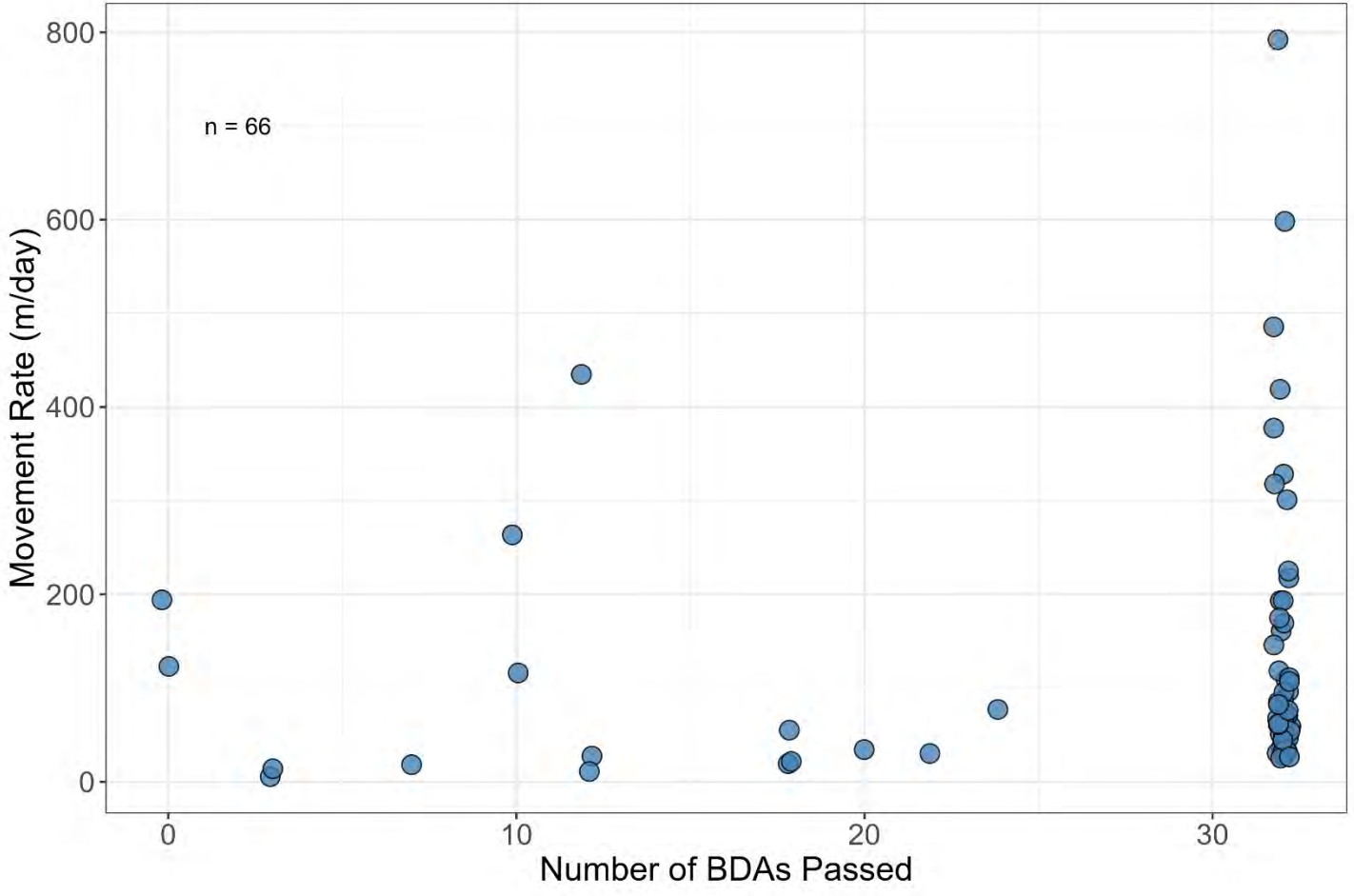
- No clear evidence that passing more BDAs slowed **upstream** movement (*only observed in 2024 and 2025)

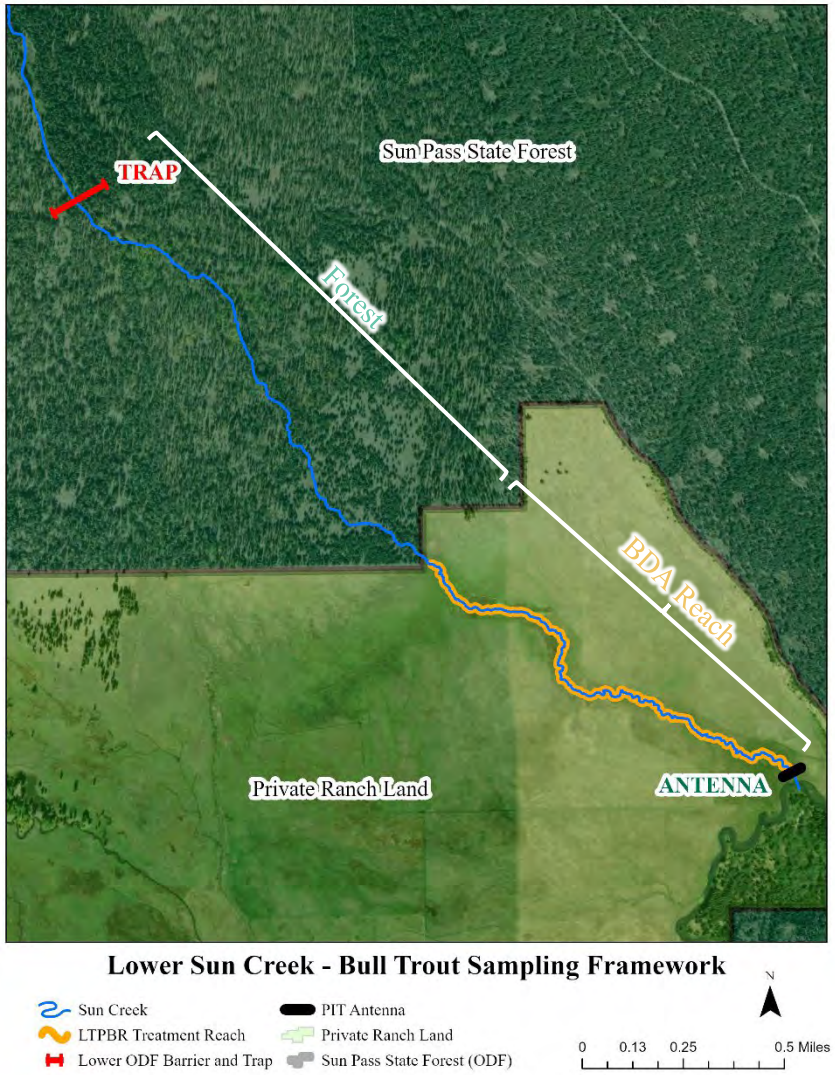




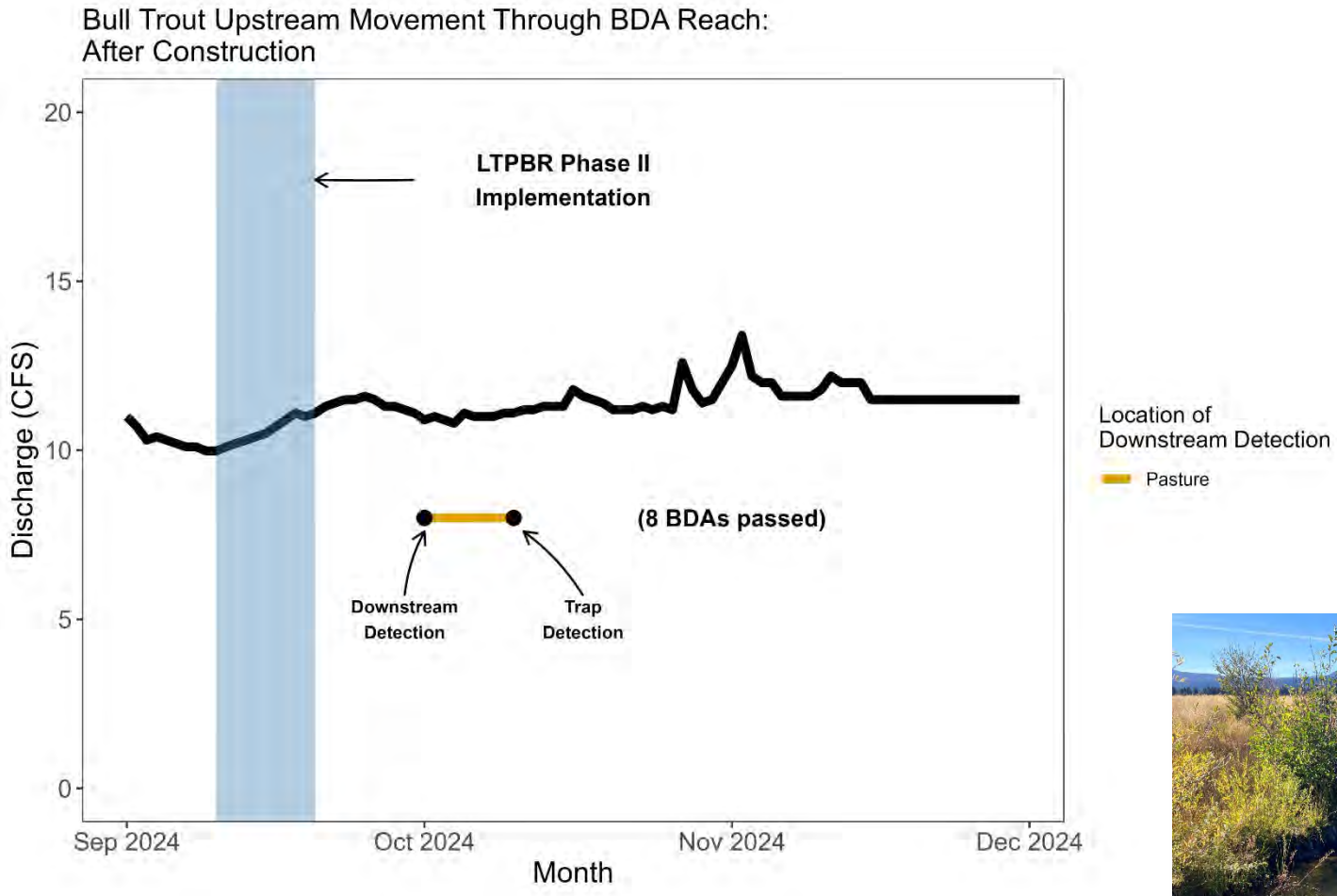
Does the number of BDAs passed impact movement rate (m/day)?

- No clear evidence that passing more BDAs slowed **downstream** movement (*observed in 2021-2025)





Can fish move during low flows and immediately after implementation?



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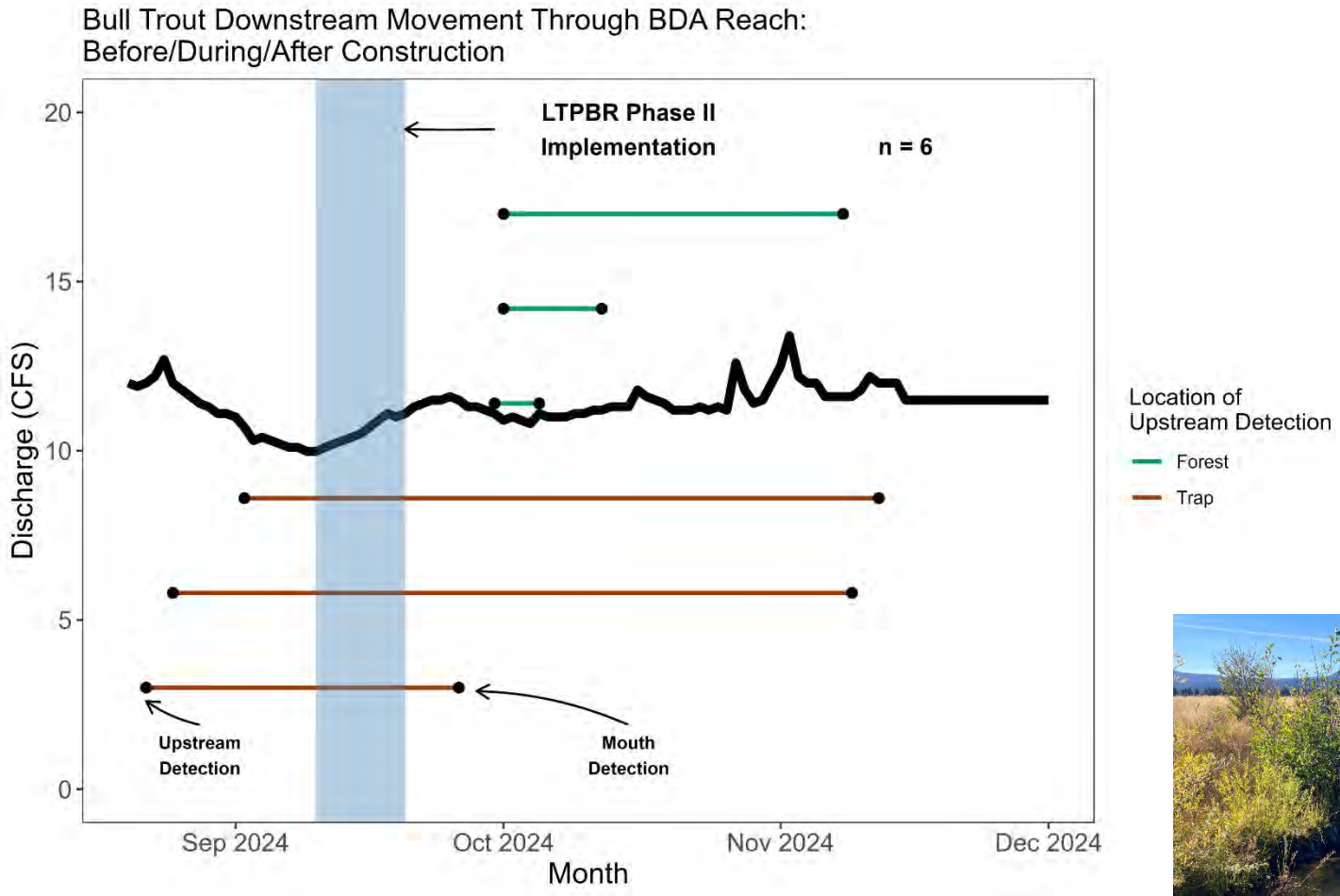
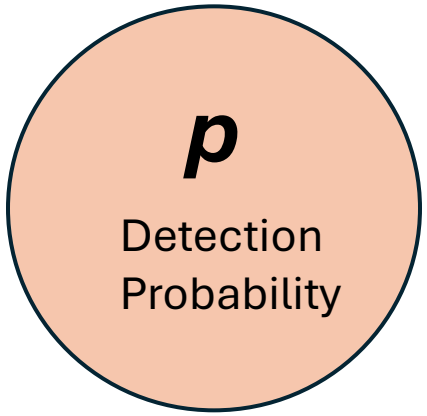
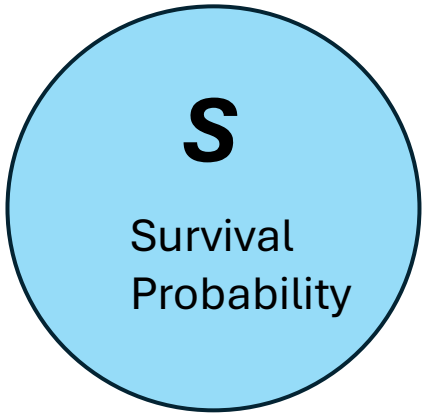


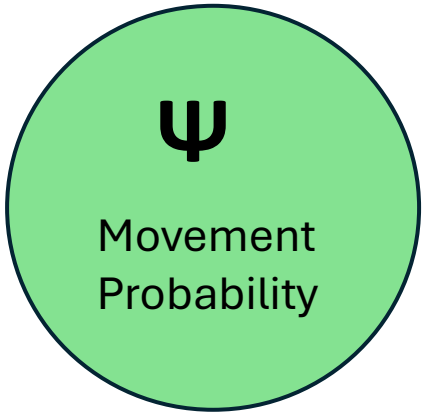
Summary Findings

- Bull Trout documented moving upstream and downstream throughout entire BDA reach in all years post-builds
- Bull Trout passed BDAs in all flow conditions
- No clear evidence that passing more BDAs slowed movement
- Low flows did not slow movement rates
- Bull Trout moved upstream and downstream immediately after a build
- **Previously collected data can be re-purposed to address a new unanticipated question!**

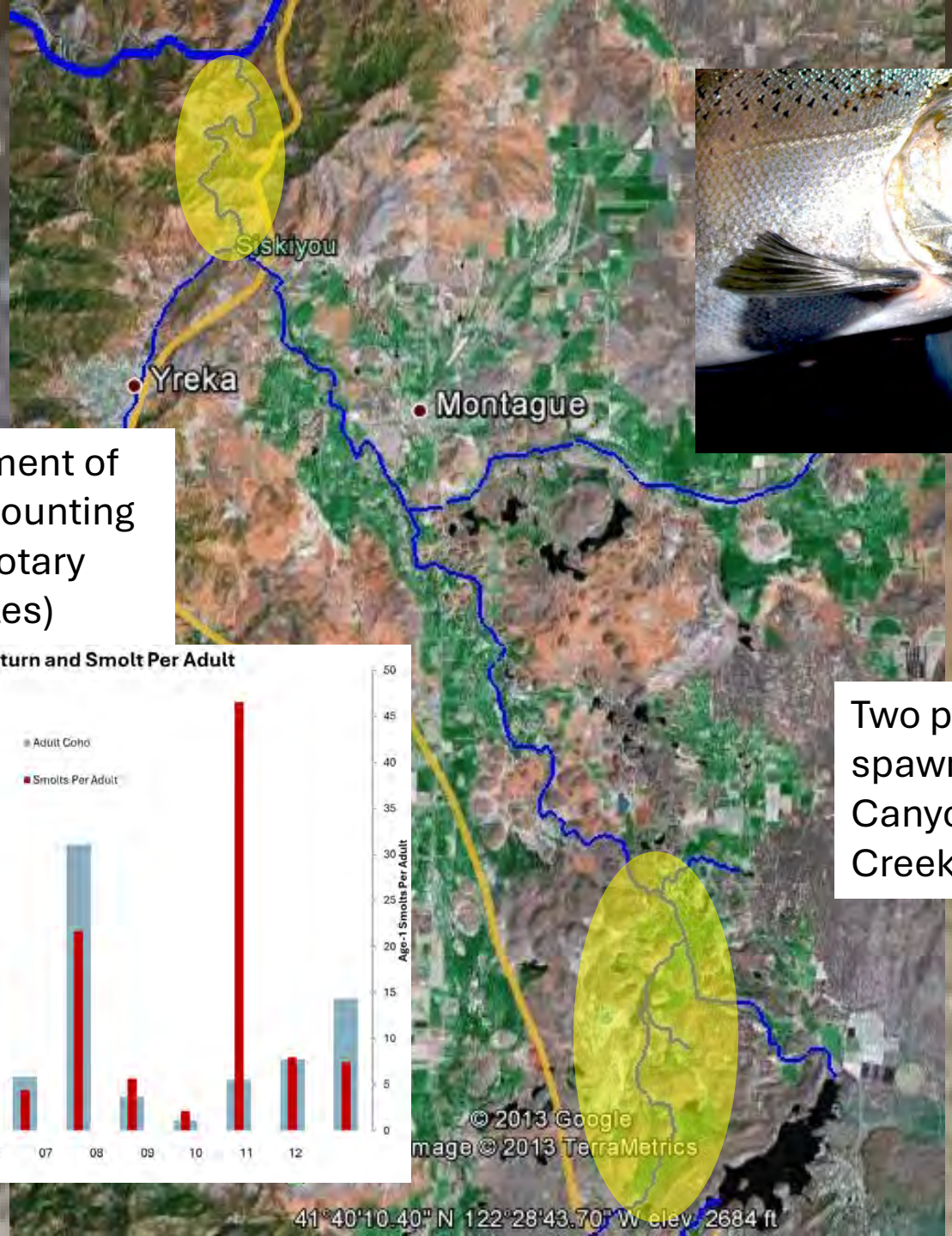
Estimating seasonal movement and survival using multi-state mark-recapture models: Shasta River Coho Salmon and Pilgrim River Brook Trout





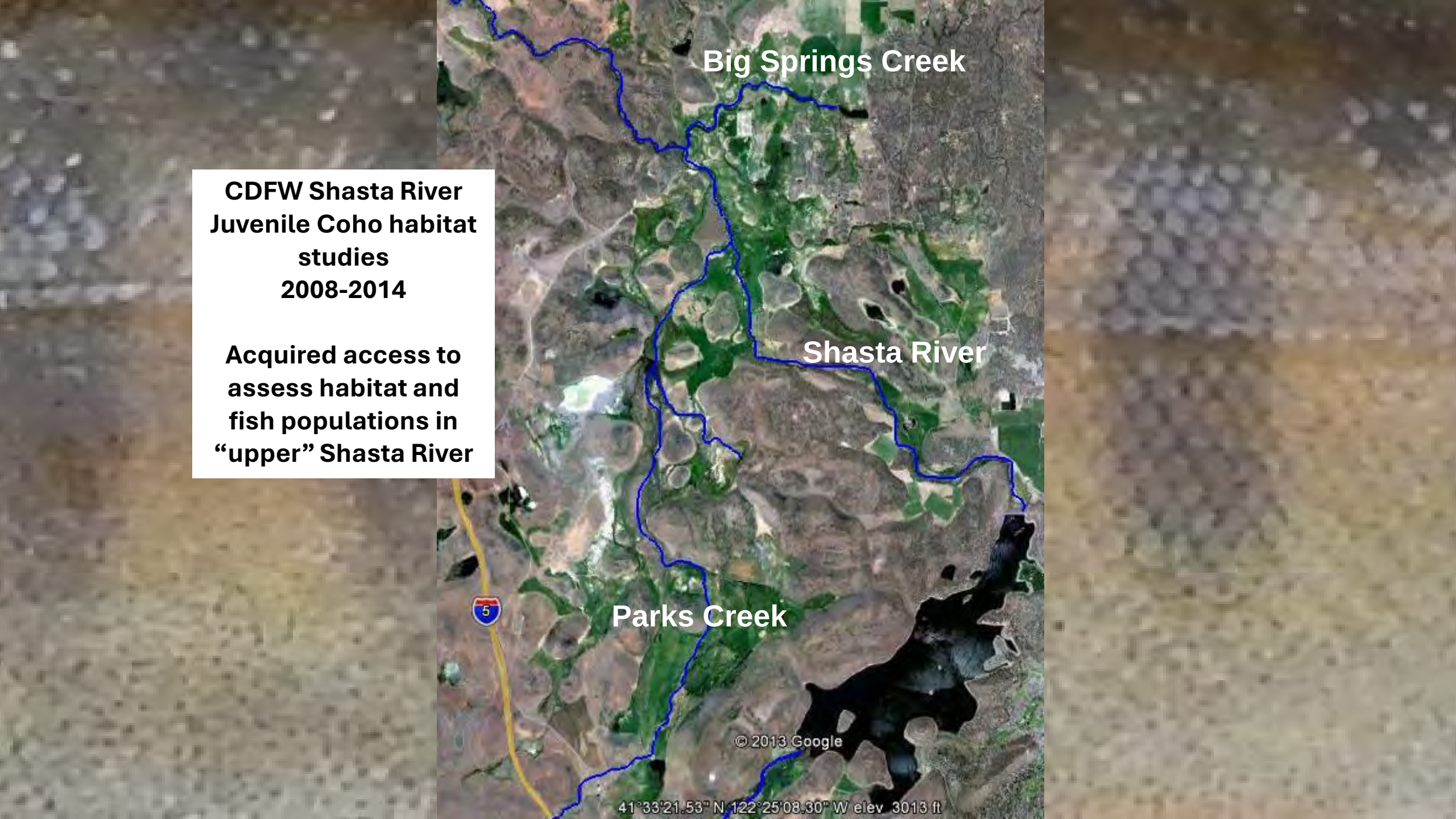


Christopher Adams, PhD
California Department of Fish and Wildlife
Fish Wiz LLC
Michigan Technological University



California Department of Fish and Wildlife counting weir (adults) and rotary screw trap (juveniles)

Two primary Coho spawning areas: Canyon and Big Spring Creek Complex

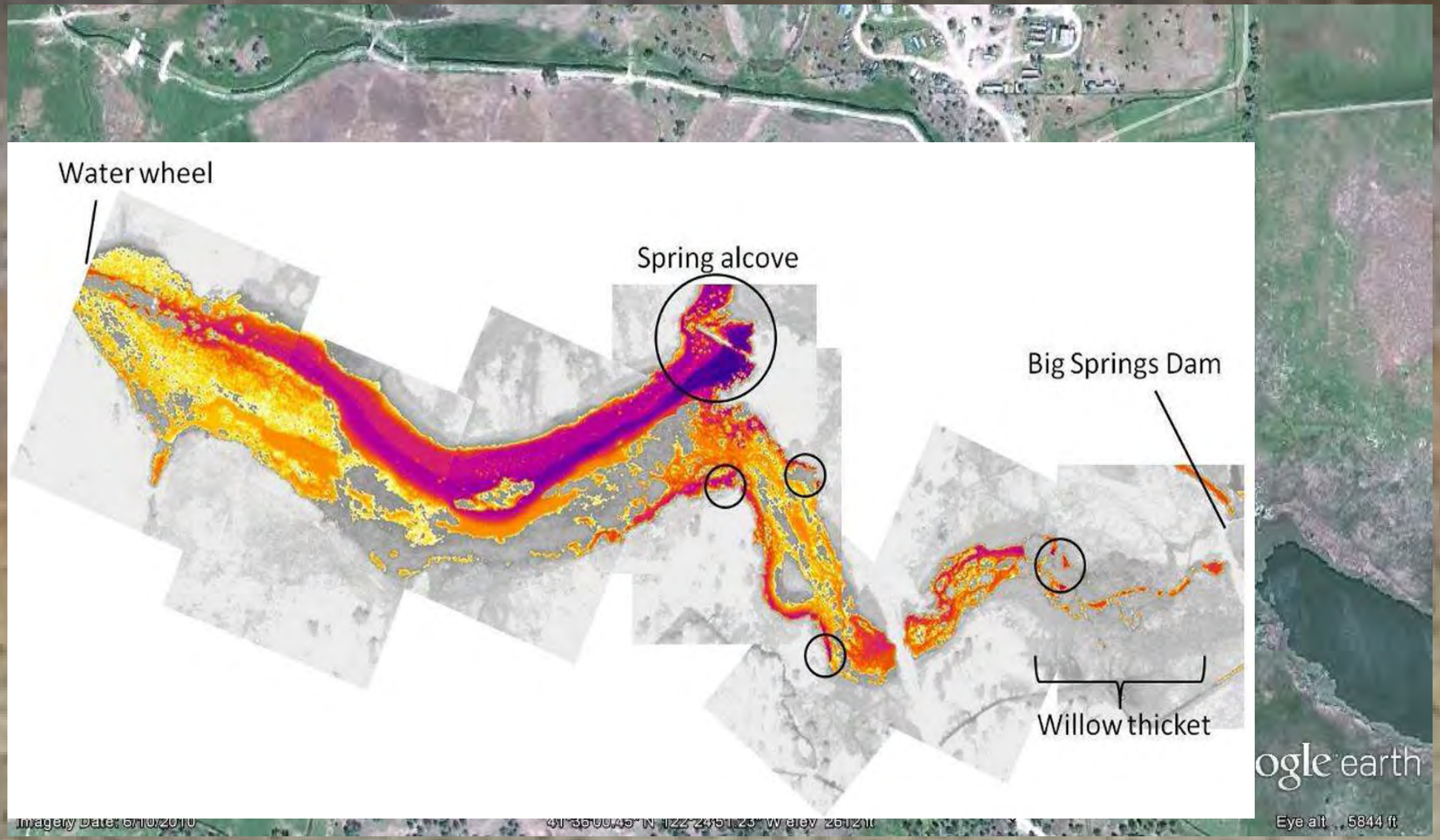


CDFW Shasta River Juvenile Coho habitat studies 2008-2014

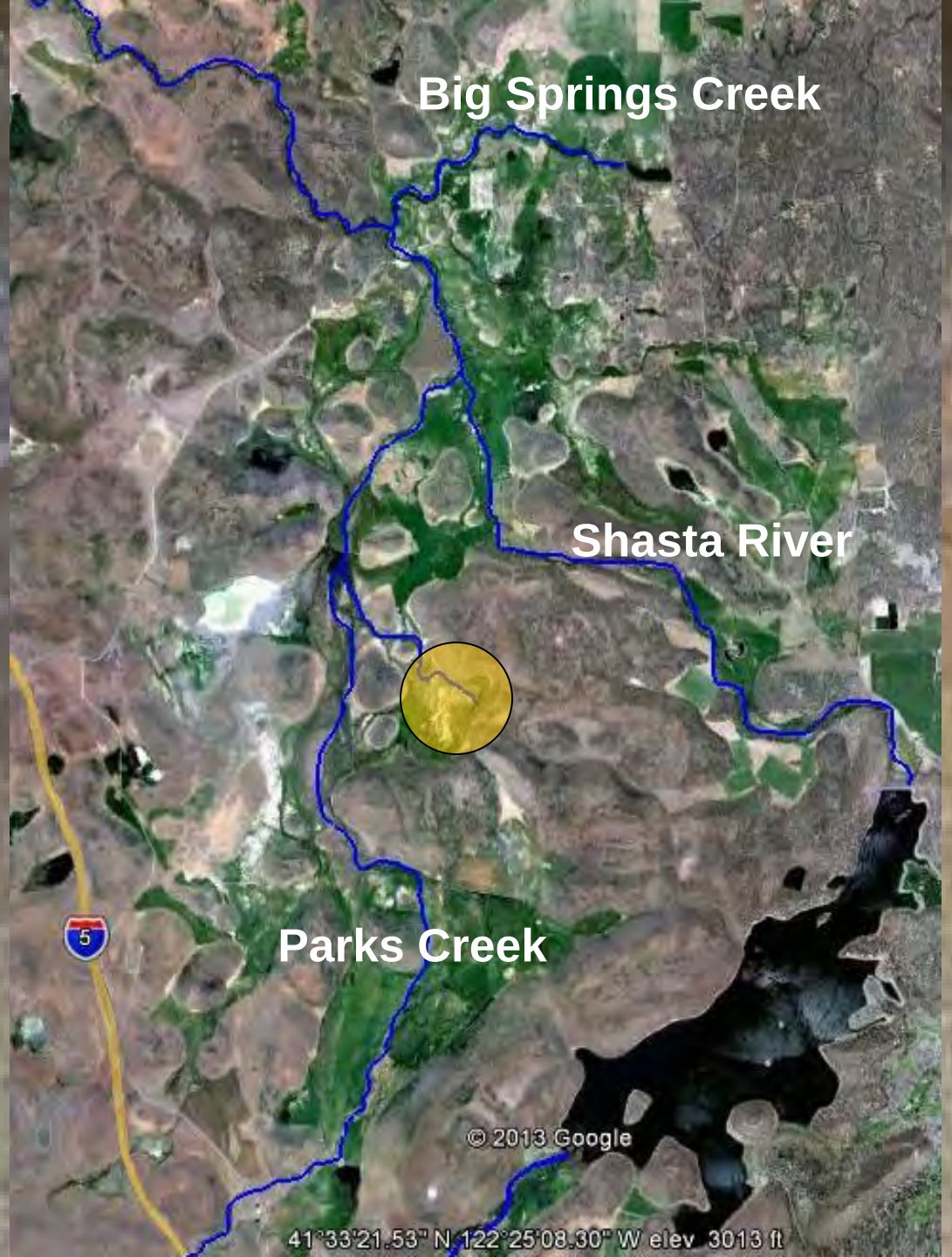
Acquired access to assess habitat and fish populations in "upper" Shasta River

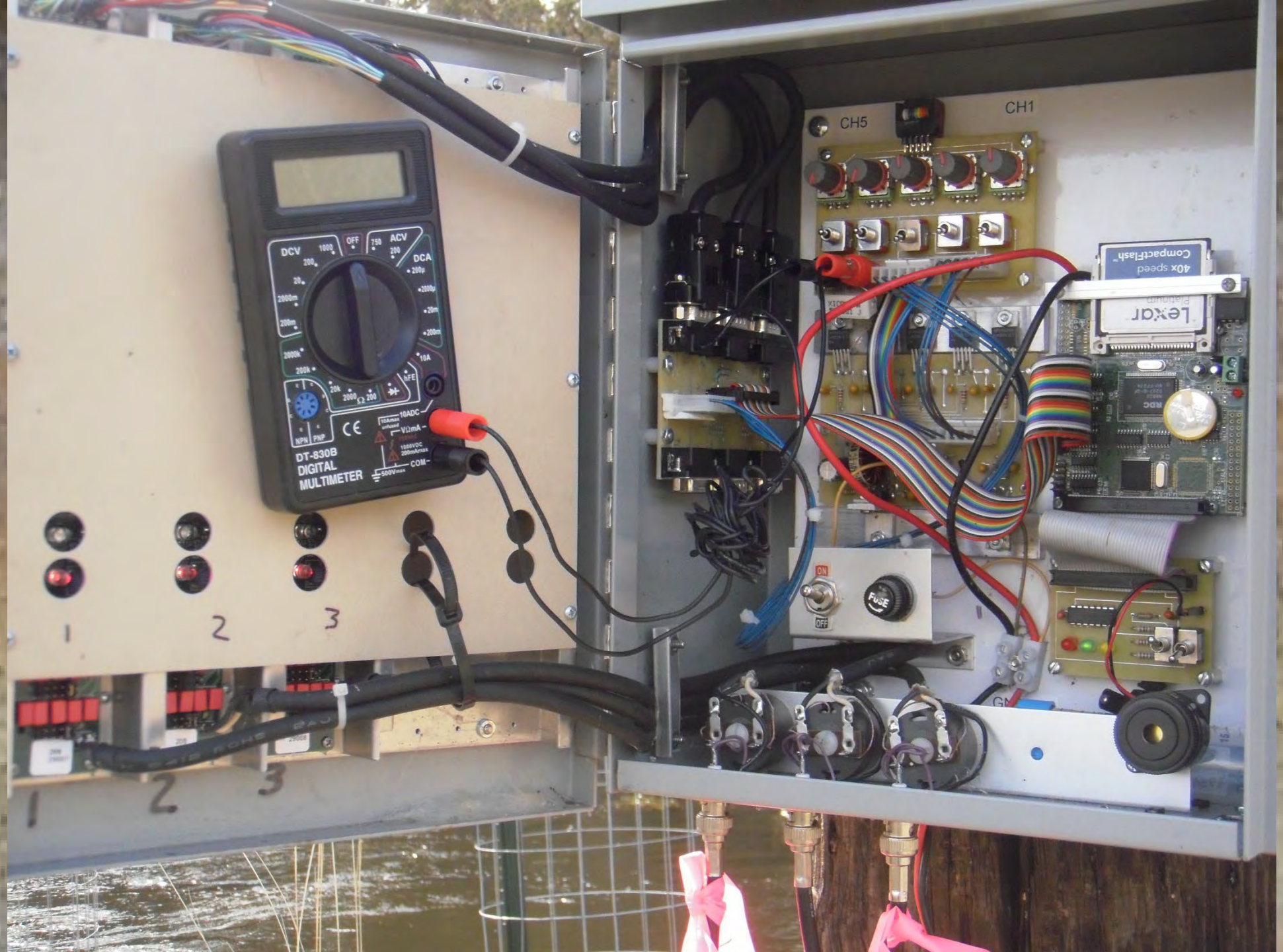

Big Springs Creek
Shasta River
Parks Creek
5
© 2013 Google
41°33'21.53" N 122°25'08.30" W elev 3013 ft


BSC RKM 1 Bridge looking downstream 9/16/14


Water wheel
Spring alcove
Big Springs Dam
Willow thicket
ogle earth
Eye alt 5844 ft


Big Springs Creek
Shasta River
Parks Creek
5
© 2013 Google
41°33'21.53" N 122°25'08.30" W elev 3013 ft


Big Springs Creek
Shasta River
Parks Creek
5
© 2013 Google
41°33'21.53" N 122°25'08.30" W elev 3013 ft


CH5
CH1
DT-830B
DIGITAL
MULTIMETER
ON
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1
2
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1
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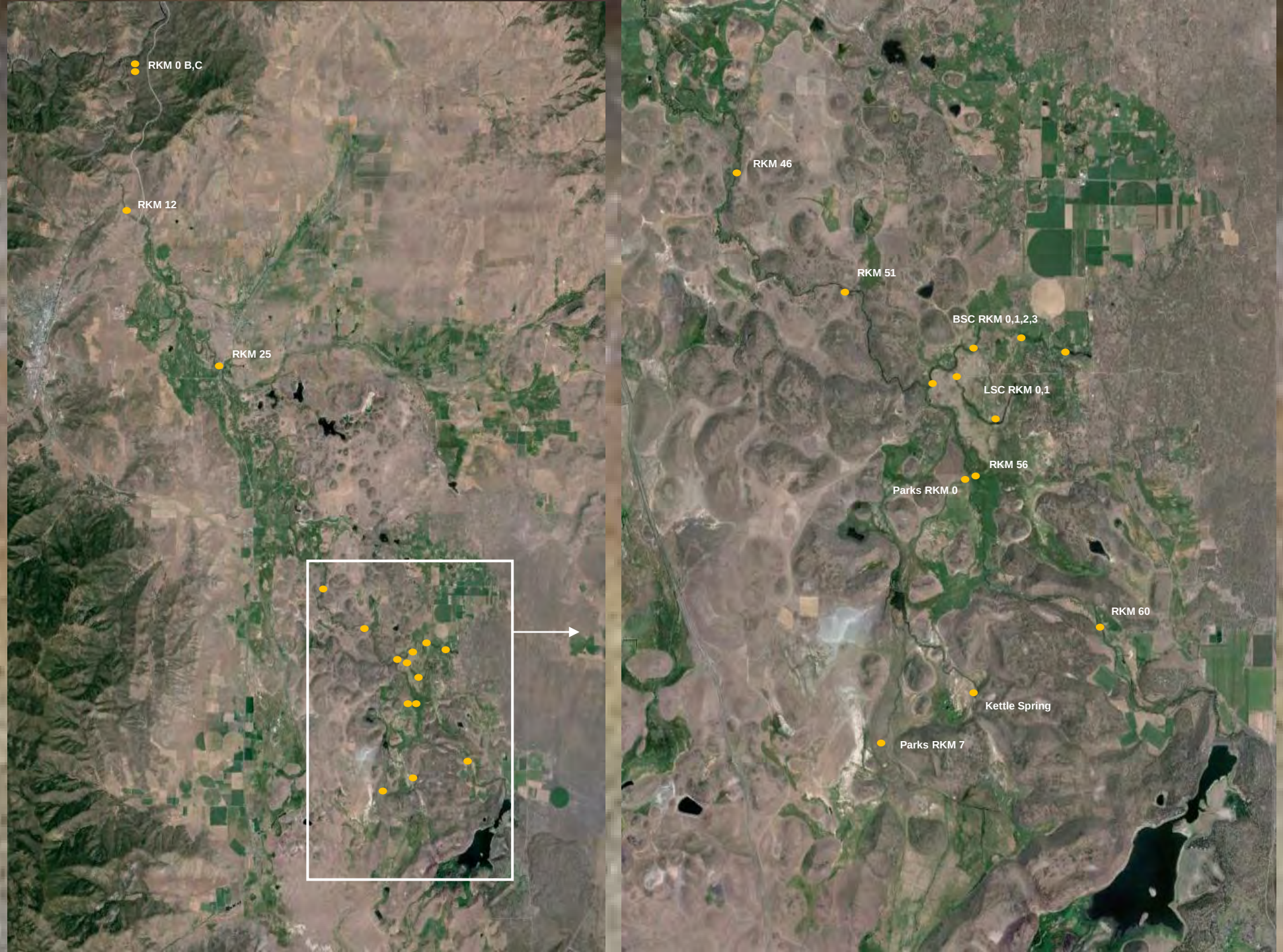
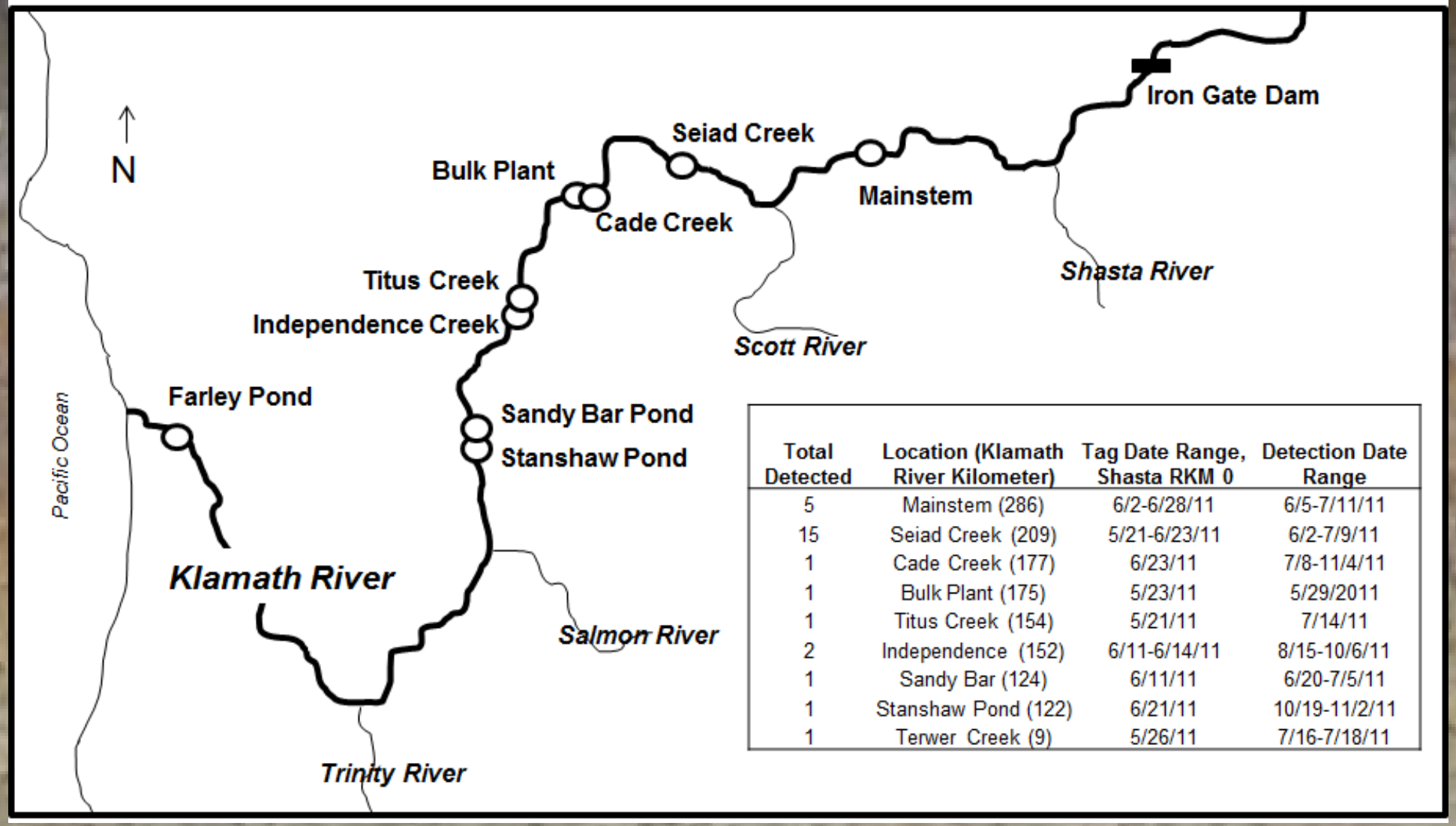
RKM 56 5-12-14


RKM 0 5-8-14


RKM 0 B,C
RKM 12
RKM 25
RKM 46
RKM 51
BSC RKM 0,1,2,3
LSC RKM 0,1
RKM 56
Parks RKM 0
RKM 60
Kettle Spring
Parks RKM 7

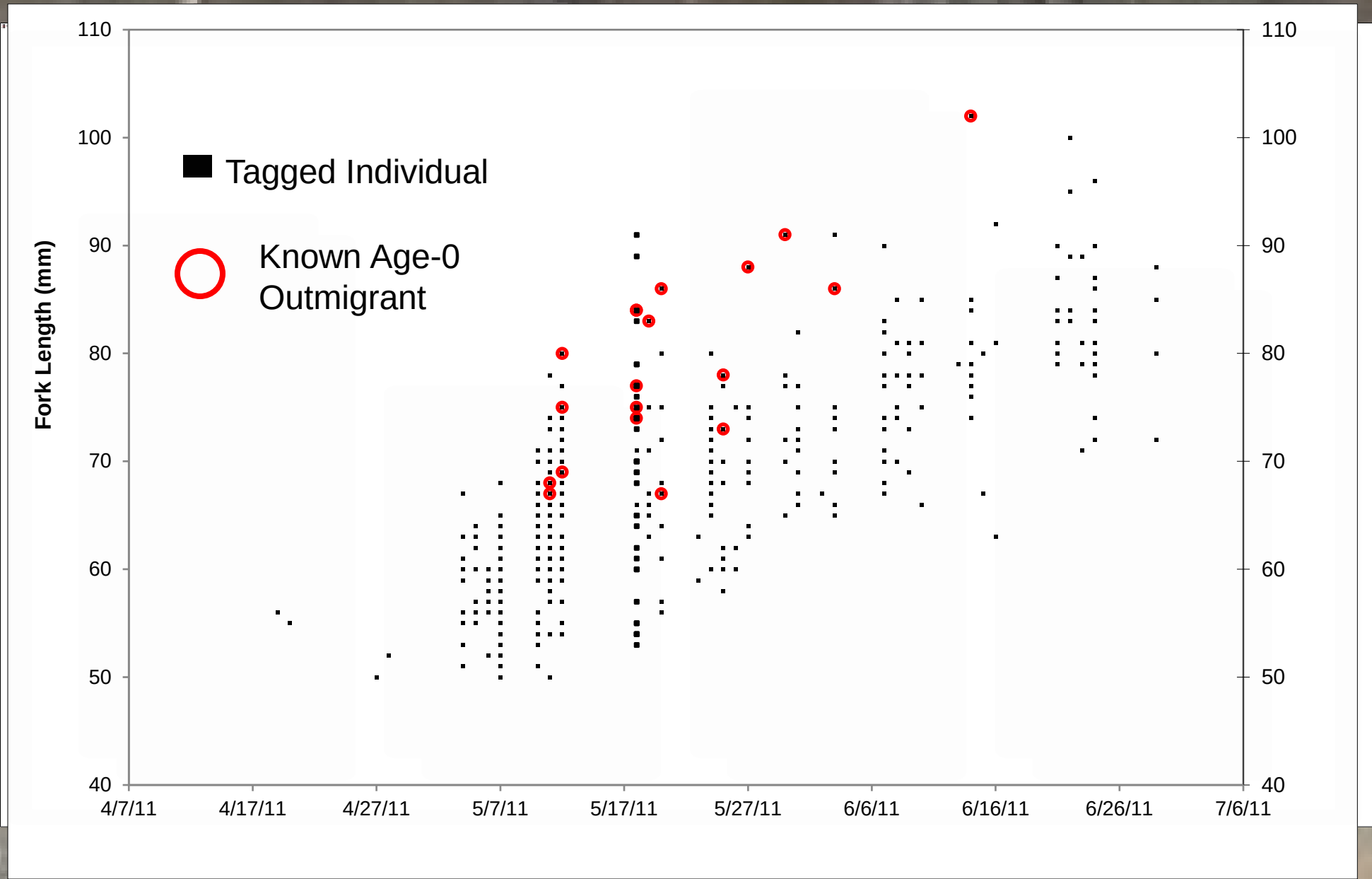

Siskiyou
Yreka
Montague
5
© 2013 Google
Image © 2013 TerraMetrics

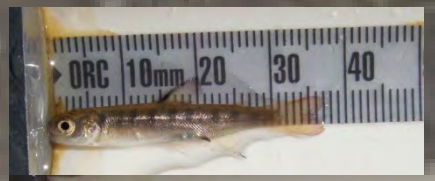


Total Detected	Location (Klamath River Kilometer)	Tag Date Range, Shasta RKM 0	Detection Date Range
5	Mainstem (286)	6/2-6/28/11	6/5-7/11/11
15	Seiad Creek (209)	5/21-6/23/11	6/2-7/9/11
1	Cade Creek (177)	6/23/11	7/8-11/4/11
1	Bulk Plant (175)	5/23/11	5/29/2011
1	Titus Creek (154)	5/21/11	7/14/11
2	Independence (152)	6/11-6/14/11	8/15-10/6/11
1	Sandy Bar (124)	6/11/11	6/20-7/5/11
1	Stanshaw Pond (122)	6/21/11	10/19-11/2/11
1	Terwer Creek (9)	5/26/11	7/16-7/18/11


Siskiyou
Yreka
Montague
5
© 2013 Google
Image © 2013 TerraMetrics

Upper Shasta River PIT Tagged Coho Salmon





March

April

May

June

June

Spring Movement to Rearing Locations

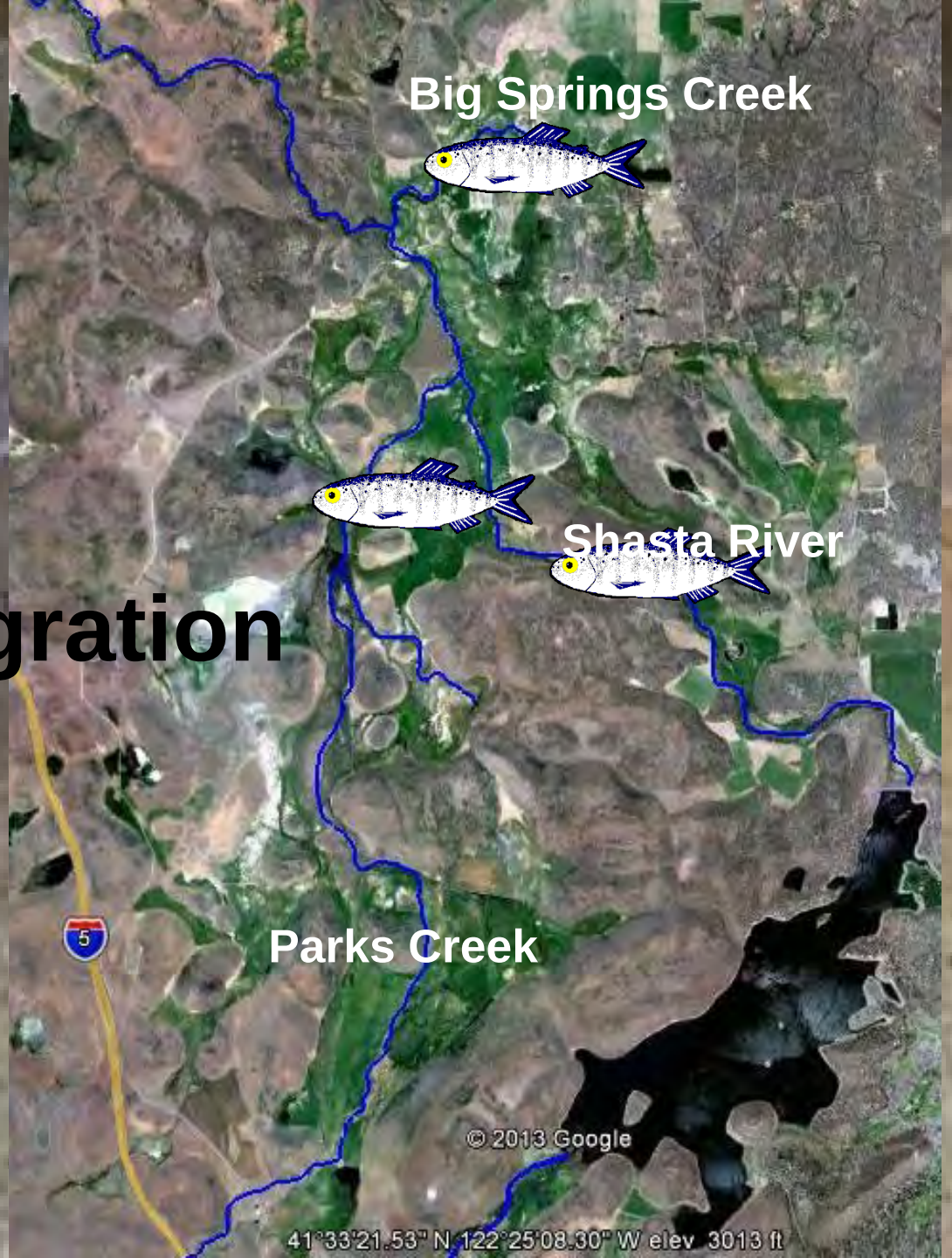
Summer Rearing

Fall Rearing

Adult Distribution

Winter Rearing

Spring Outmigration



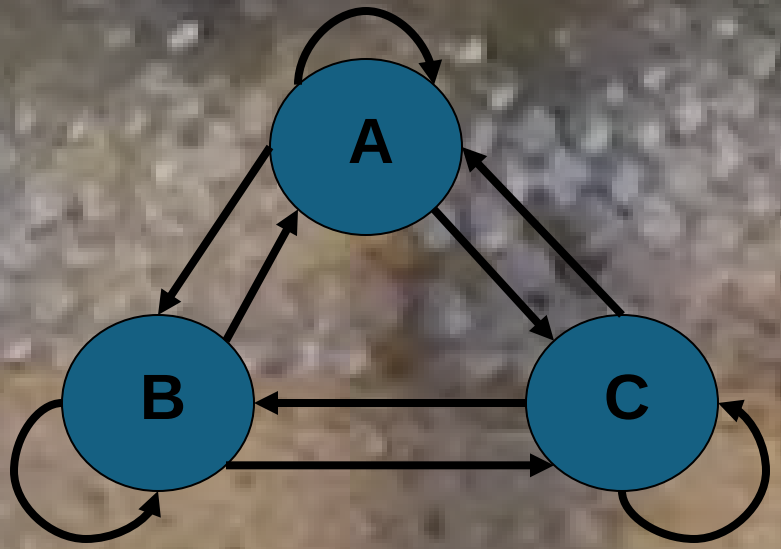
Mark-recapture Modeling

Individually mark an animal	Sample for the individual again	Sample for the individual again
1	1	1
1	0	1
1	0	0

Alive, but not detected

Capture History Matrix

Multi-state Mark-recapture Model



Mark an animal in a state

A

B

C

Sample for the individual in all states

B

0

A

Sample for the individual in all states

B

A

0

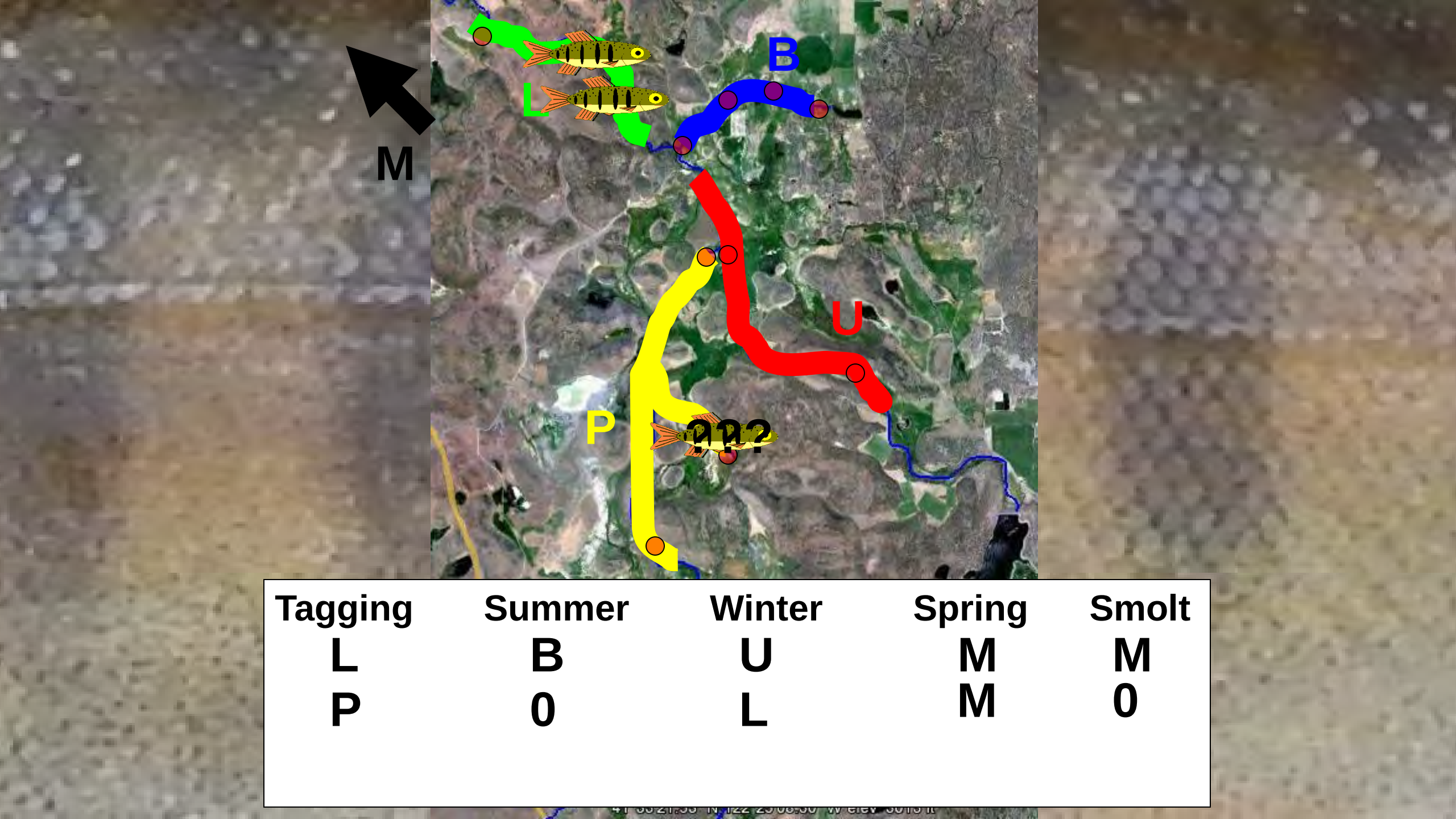
Multi-state Probability Estimates

p Detection in each state at each occasion

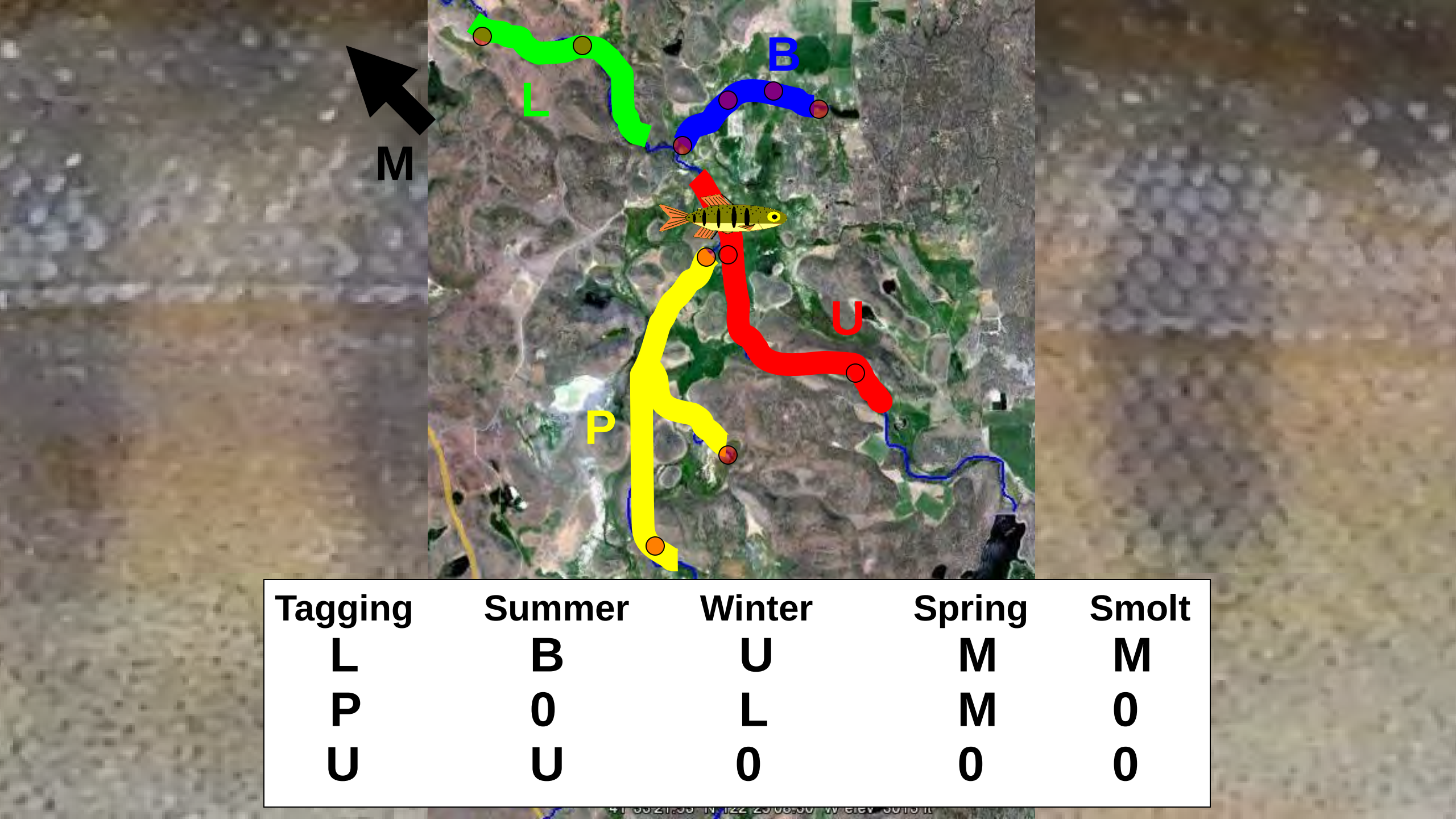
S Apparent survival in each state over each interval

Ψ Transition from each state to each other state over each interval

Host of assumptions…..



Tagging	Summer	Winter	Spring	Smolt
L	B	U	M	M
P	0	L	M	0



Tagging	Summer	Winter	Spring	Smolt
L	B	U	M	M
P	0	L	M	0
U	U	0	0	0

Program MARK

Input capture history

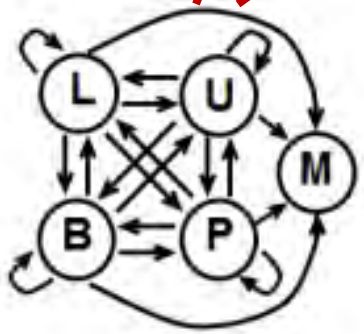
Construct models

Frequency of each capture history for maximum likelihood estimate of *apparent* **Φ** and ***p***

Compare models using AIC

Movement Parameters

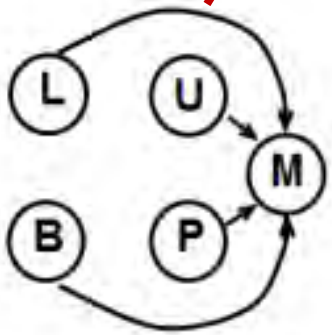
Tagging	Summer	Winter	Spring	Smolt
L	B	U	M	M
P	0	L	M	0
U	U	0	0	0



t1-t2: tag to summer

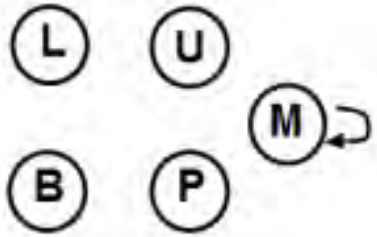
t2-t3: summer to winter

All ψ from M fixed to 0



t3-t4: winter to upper basin smolt

All ψ to M fixed to 1

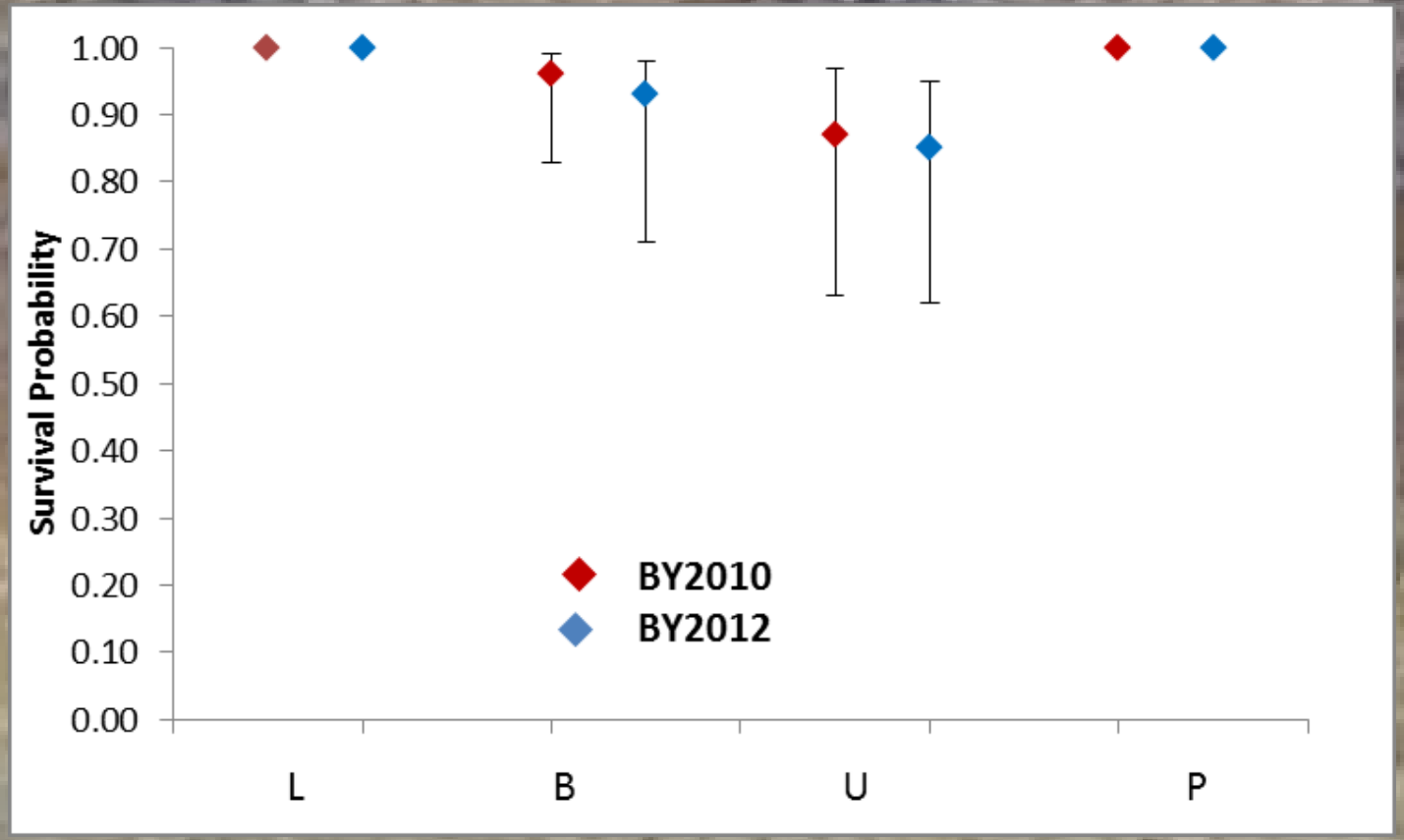


t4-t5: upper basin smolt to RKM 0 C

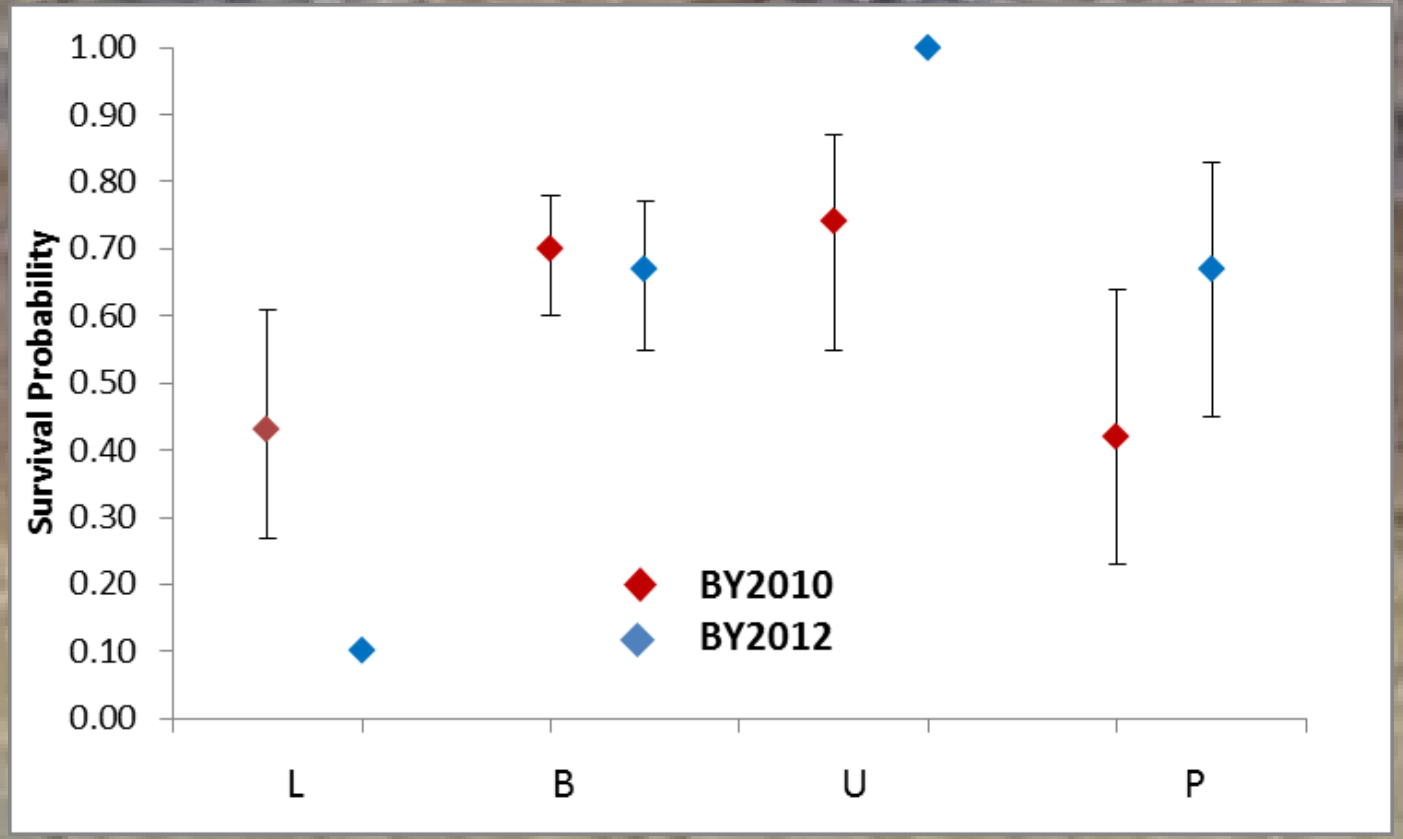
t5-t6: RKM 0 C to RKM 0 B, RST, A

ψ M to M fixed to 1

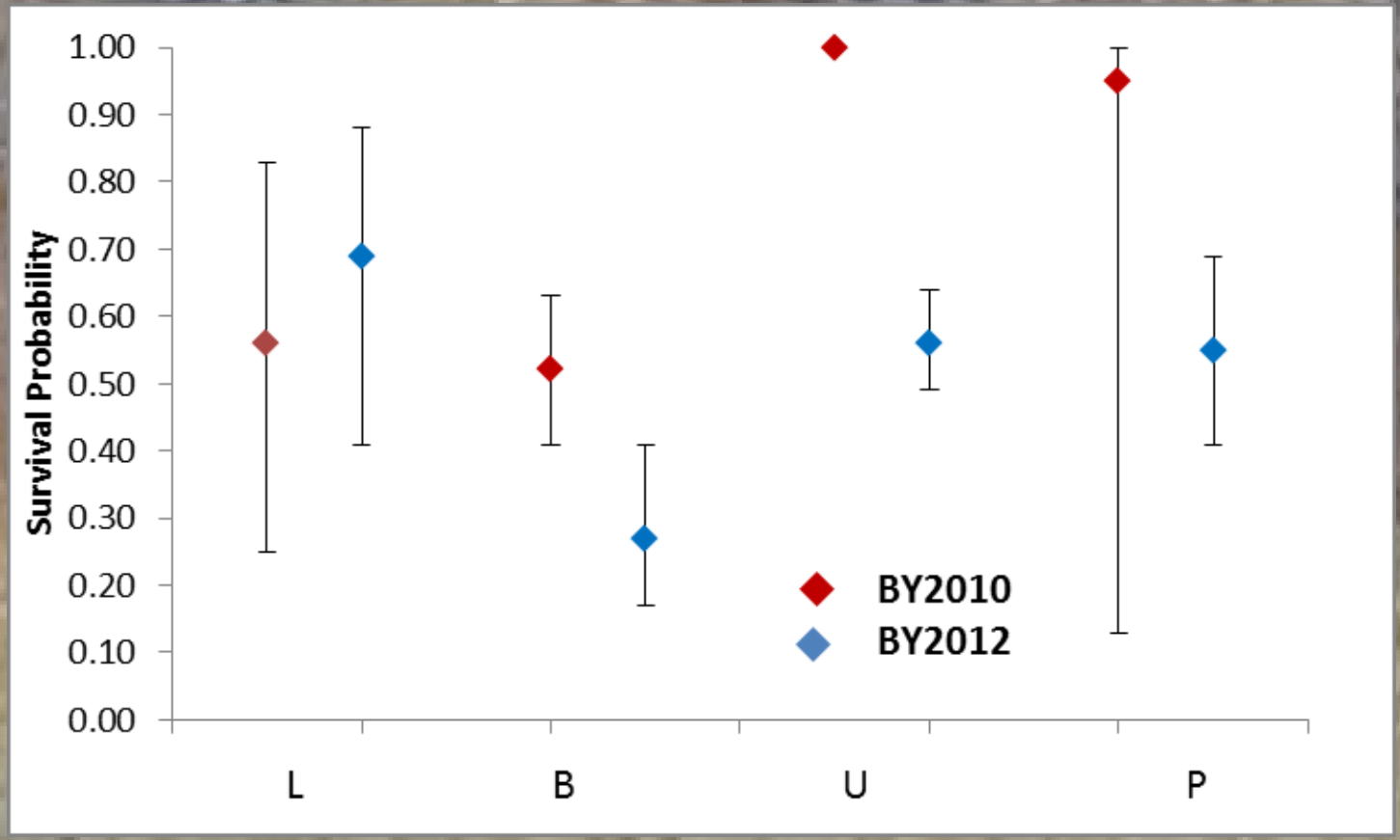
Survival from Tagging to Summer Rearing Location



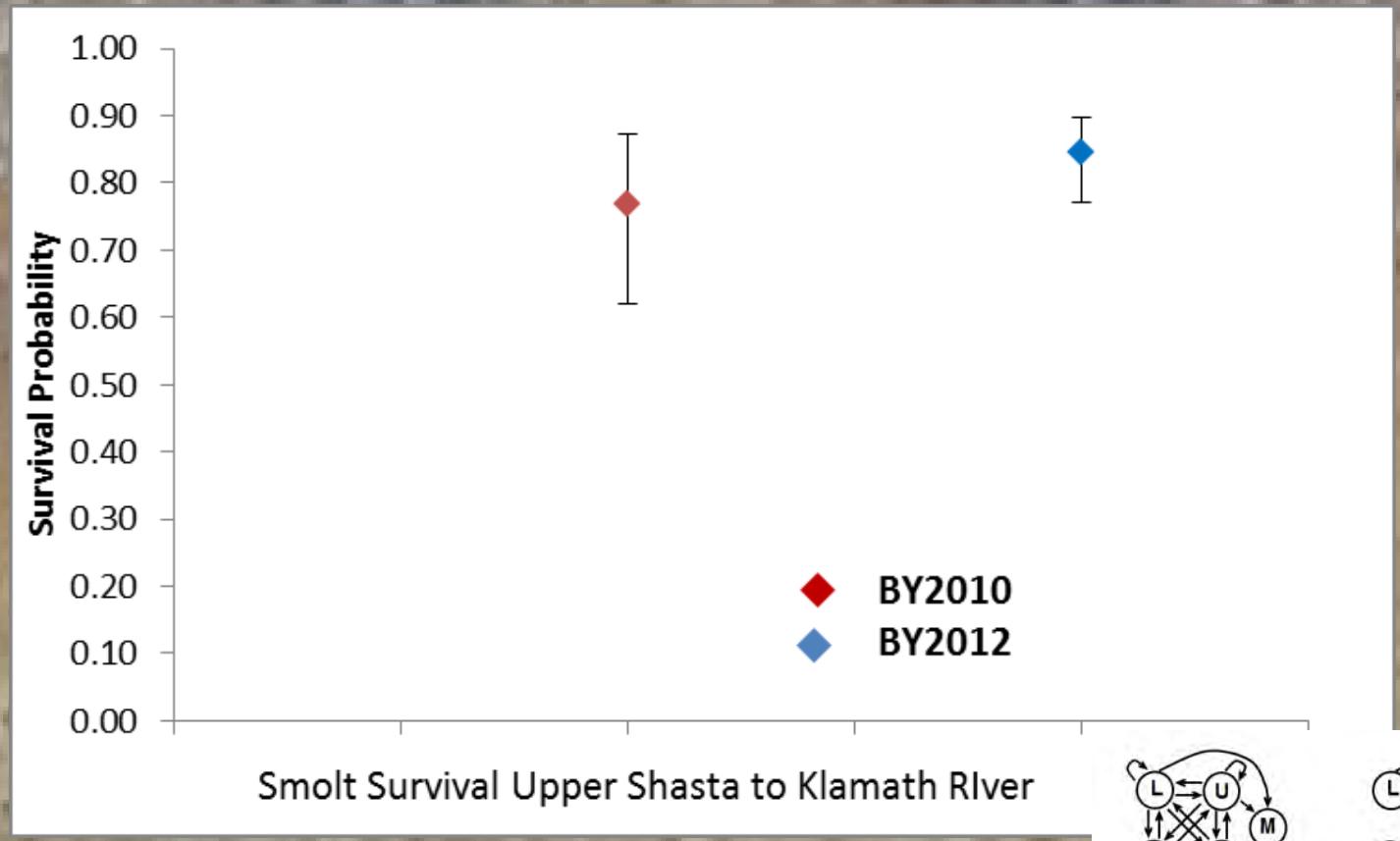
Summer Survival Estimates

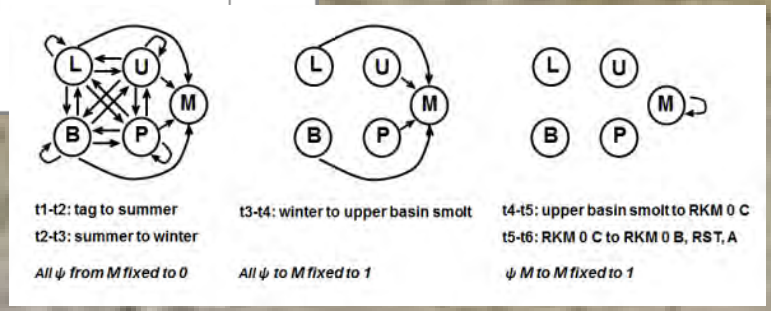


Winter Survival Estimates

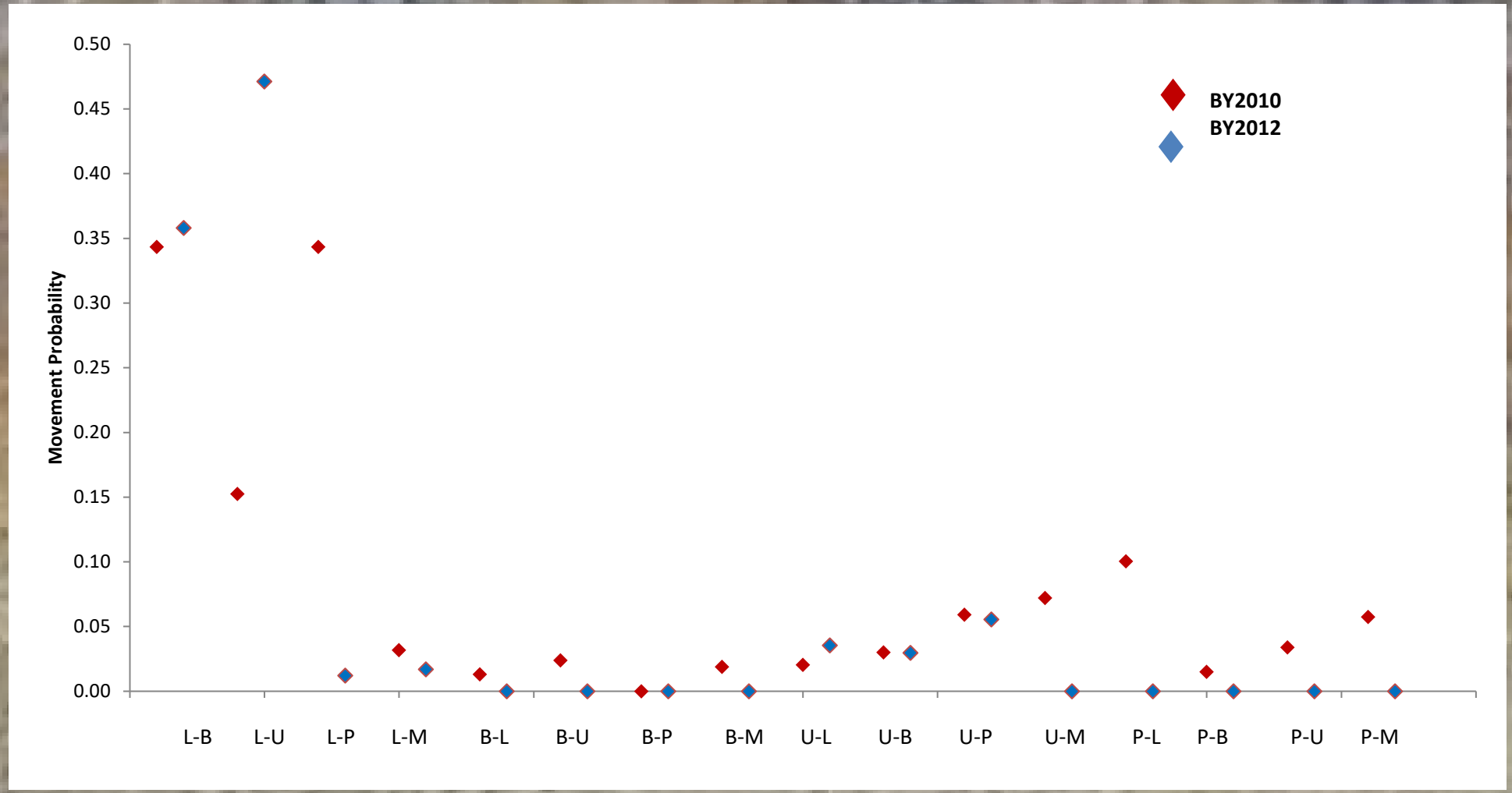


Smolt Survival Upper Shasta to Klamath River

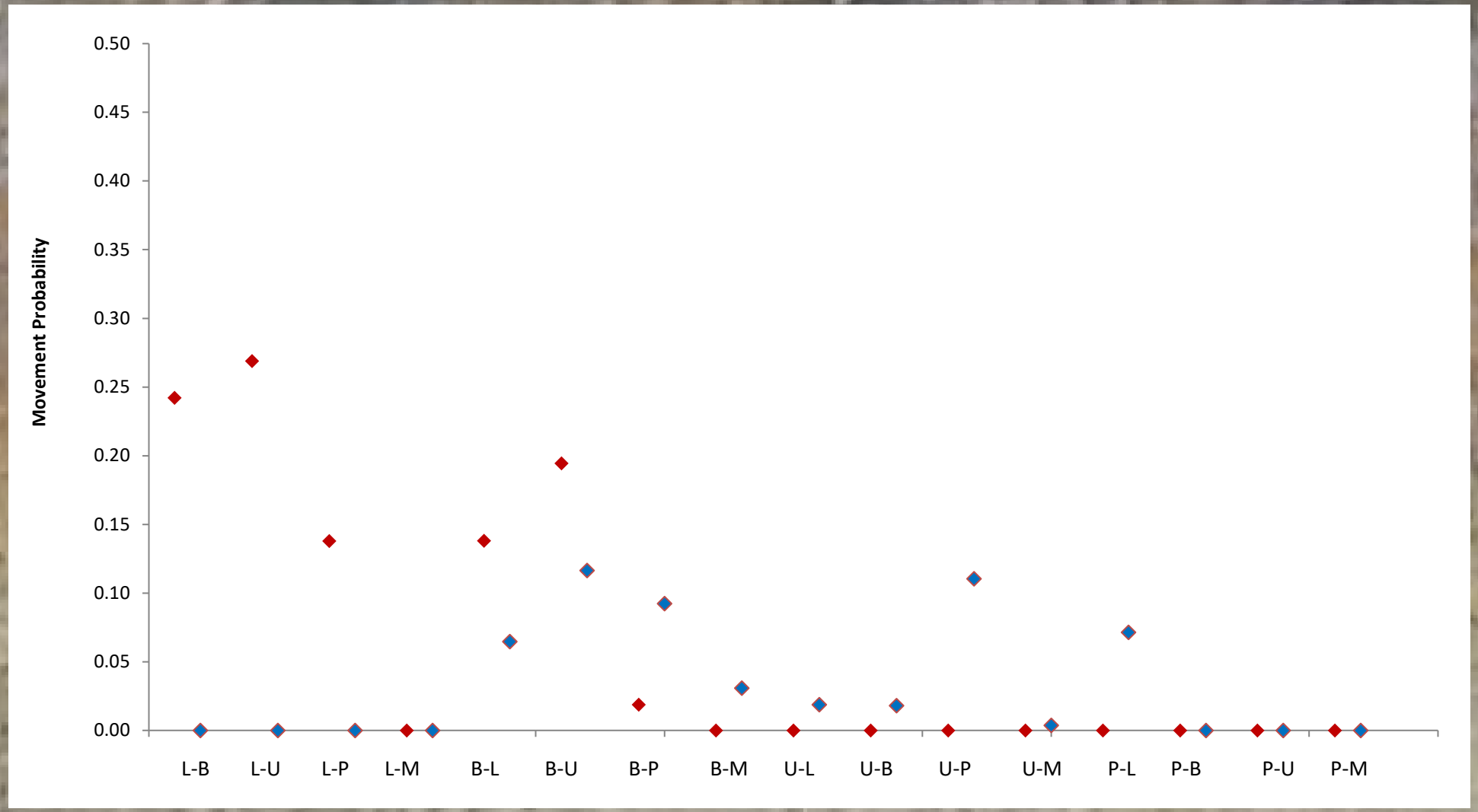




Movement Probability:
Tagging to Summer Rearing Location



Movement Probability: Summer to Winter Rearing Location



Next Steps

BY2013 Dataset

Include downriver sites in analysis

Closer look at temperature/movement relationships

Investigate causes of low survival

Movement and Survival of a Previously Undocumented Adfluvial Brook Trout Population in a Southern Lake Superior Tributary

Christopher C. Adams[1], Casey J. Huckins[1], Amy M. Marcarelli[1], Troy G. Zorn[2], Henry R. Quinlan[3]


Image NOAA
Image Landsat / Copernicus
Google earth


No 22.

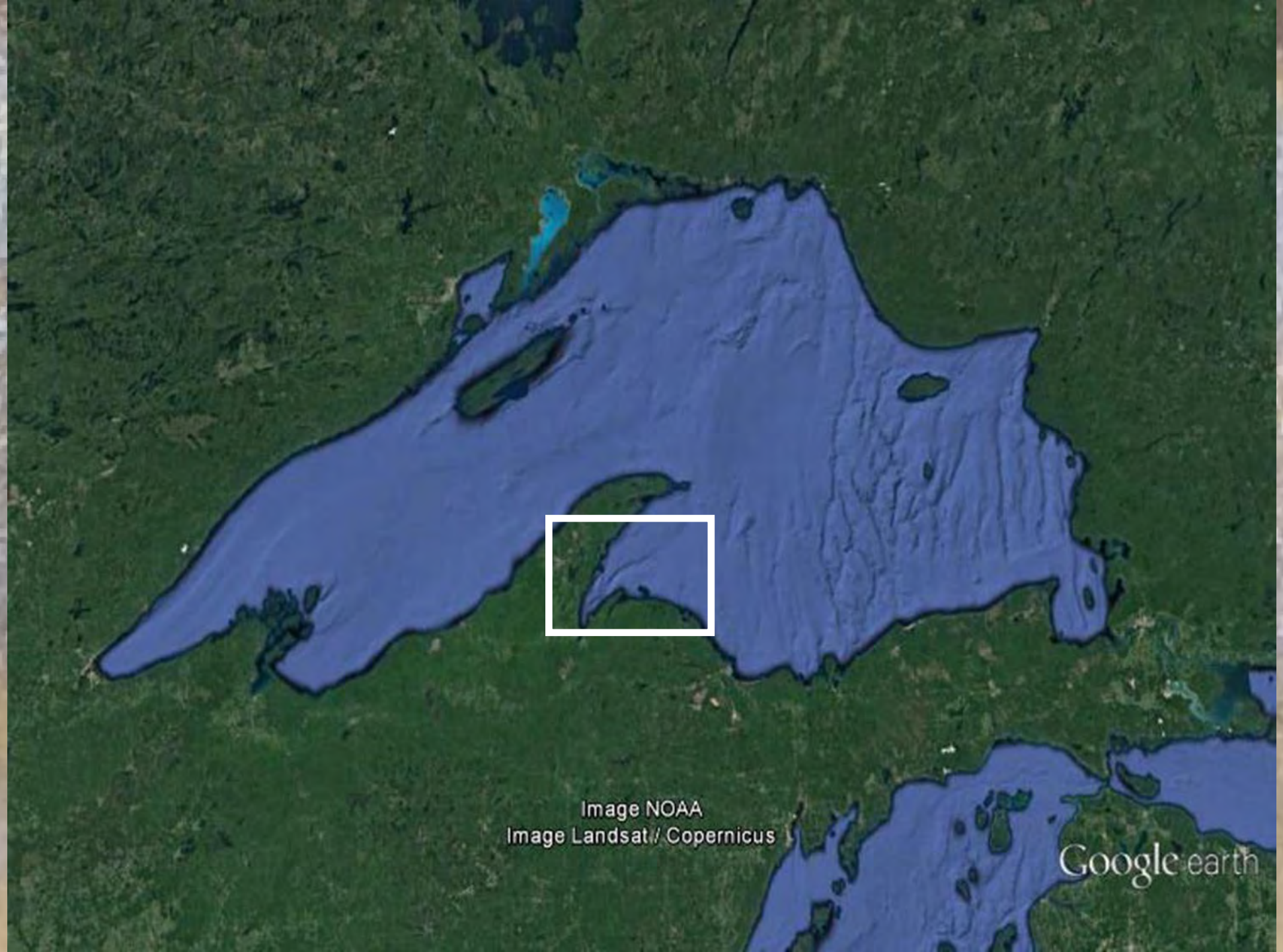
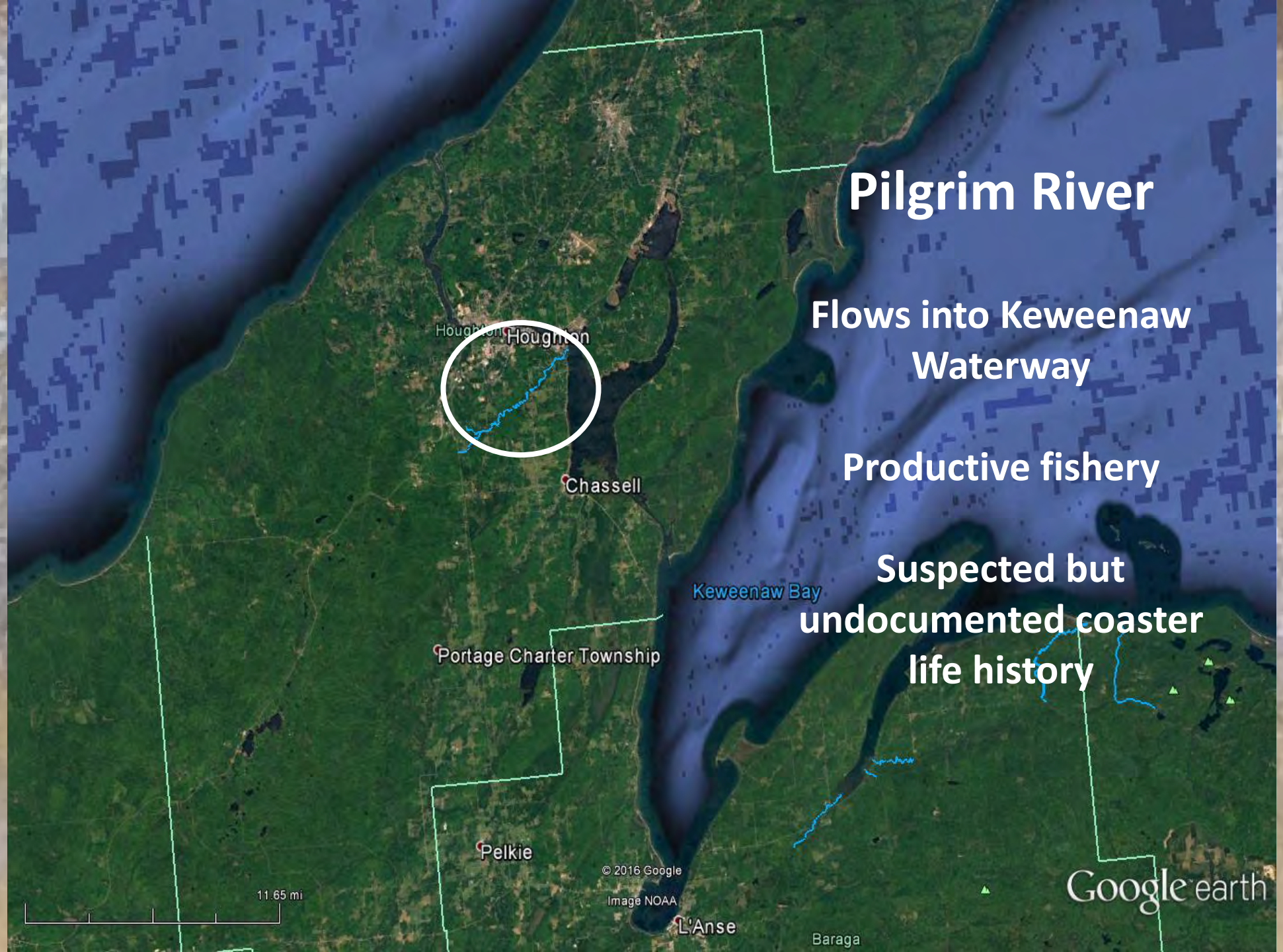


Image NOAA
Image Landsat / Copernicus
Google earth



Pilgrim River

Flows into Keweenaw Waterway

Productive fishery

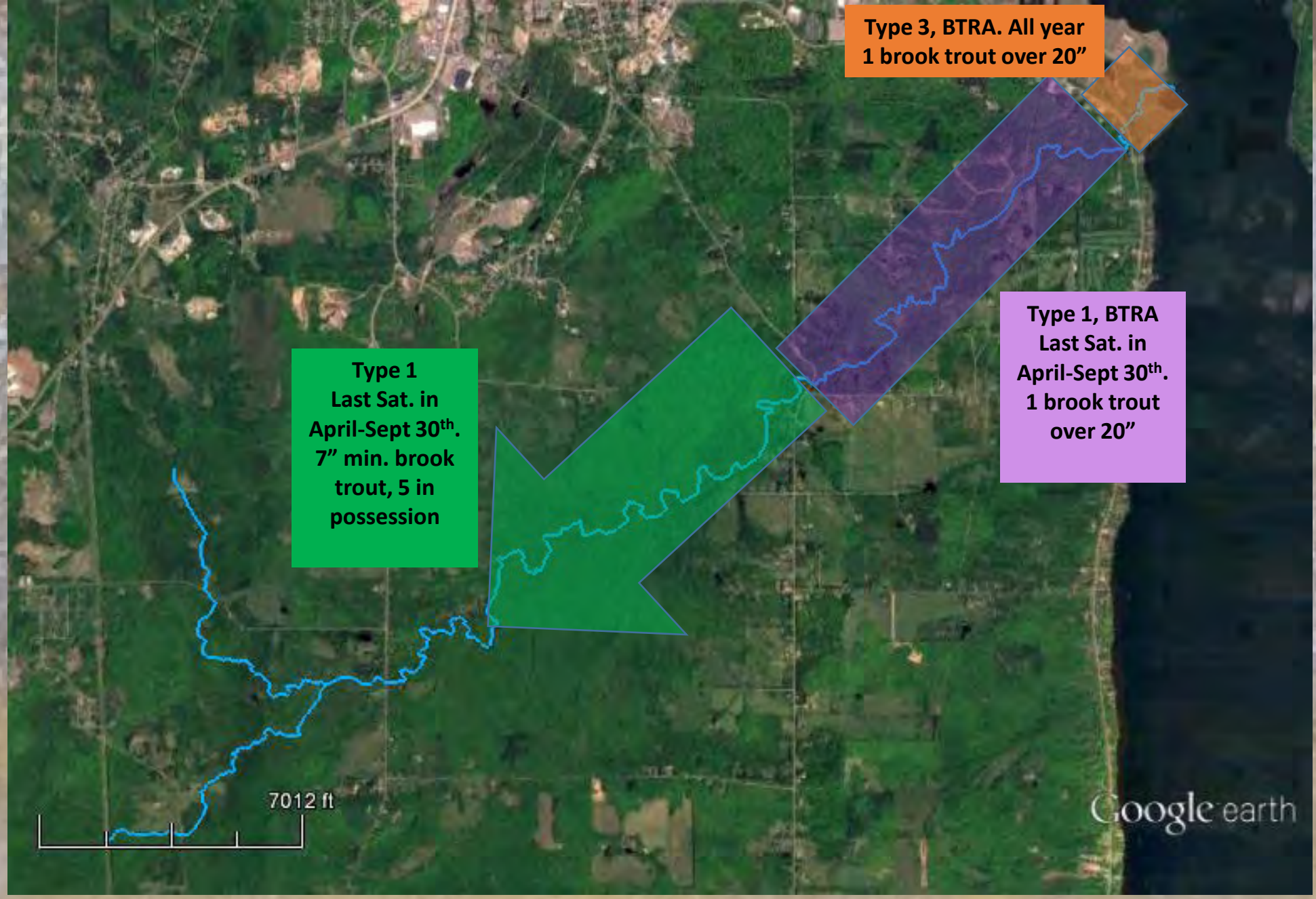
Suspected but undocumented coaster life history

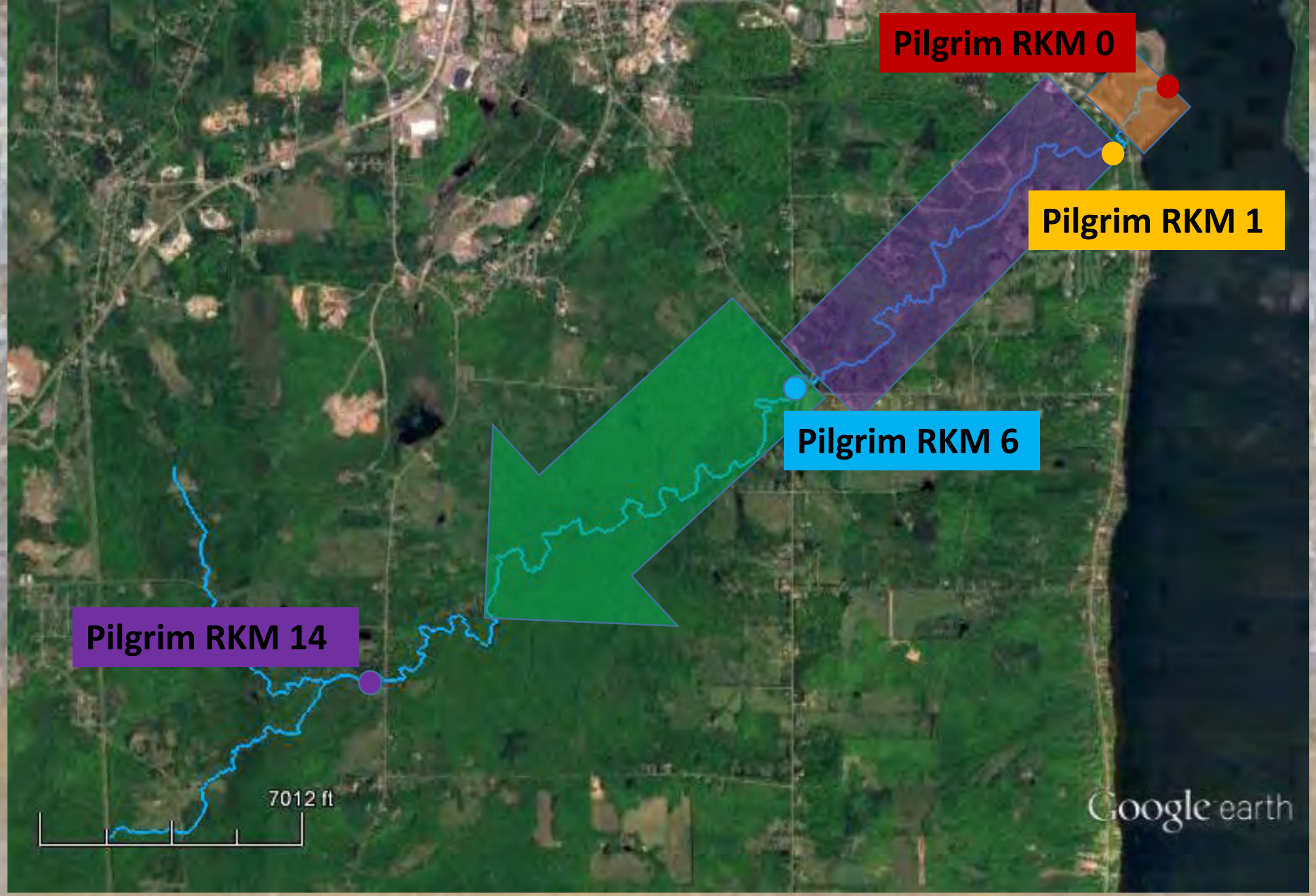
Objectives

Determine if brook trout in the Pilgrim River make adfluvial migrations

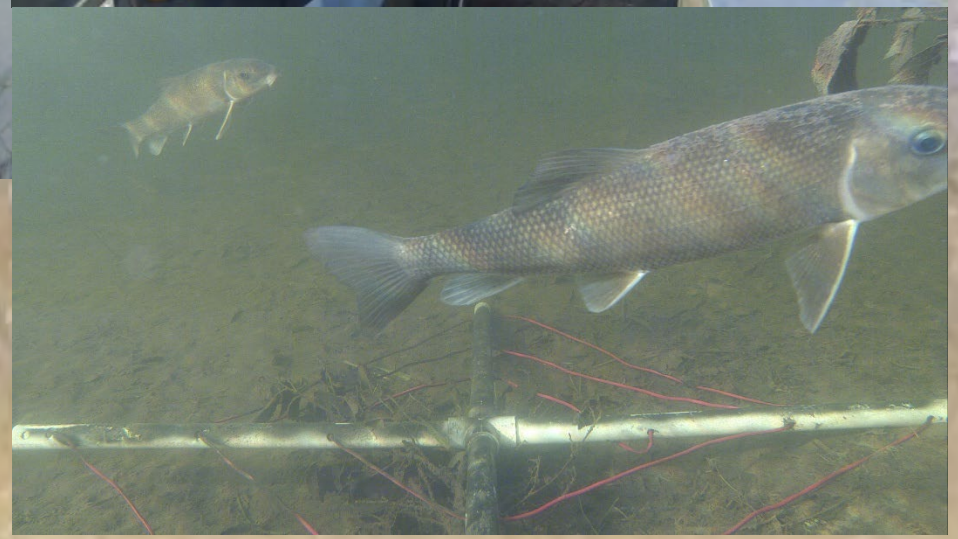
Estimate seasonal movement and survival probabilities

Determine if movement and survival differs between years and between size/age classes

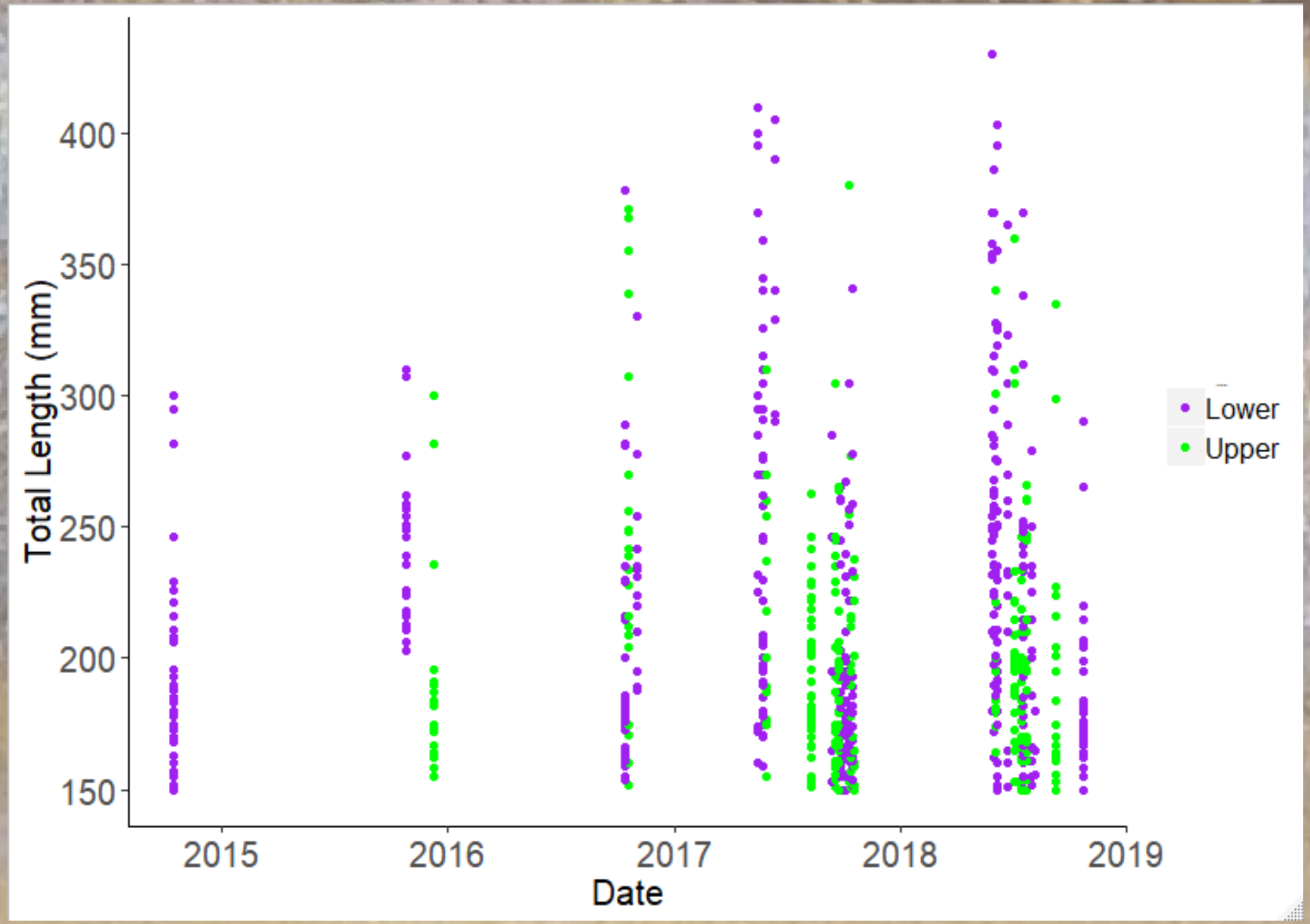

Type 3, BTRA. All year
1 brook trout over 20”
Type 1, BTRA
Last Sat. in
April-Sept 30th.
1 brook trout
over 20”
Type 1
Last Sat. in
April-Sept 30th.
7” min. brook
trout, 5 in
possession
7012 ft
Google earth


Pilgrim RKM 0
Pilgrim RKM 1
Pilgrim RKM 6
Pilgrim RKM 14
7012 ft
Google earth

Remote PIT Tag Antenna Stations

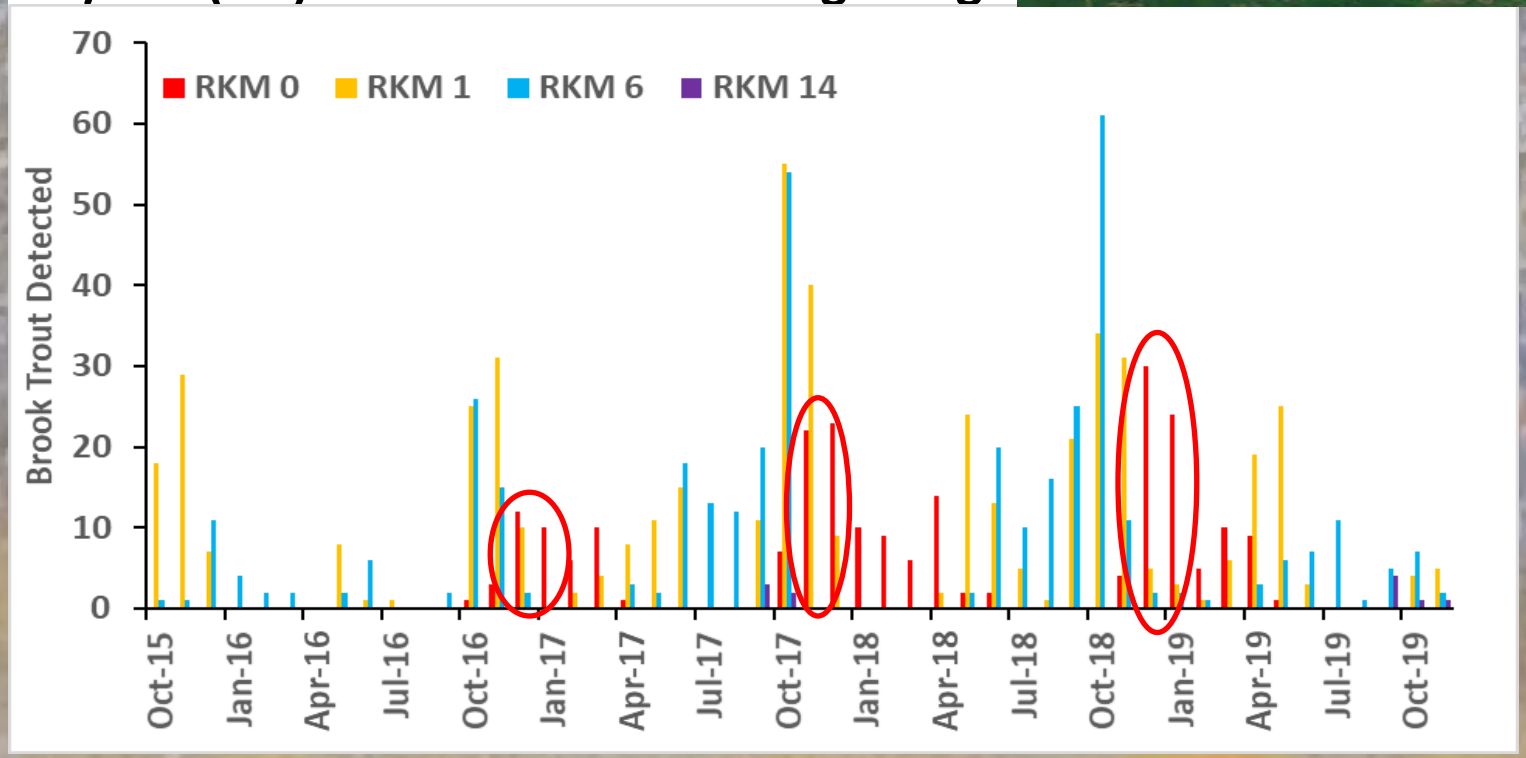


23mm HDX


Total Length (mm)
400
350
300
250
200
150
2015
2016
2017
2018
2019
Date
Lower
Upper

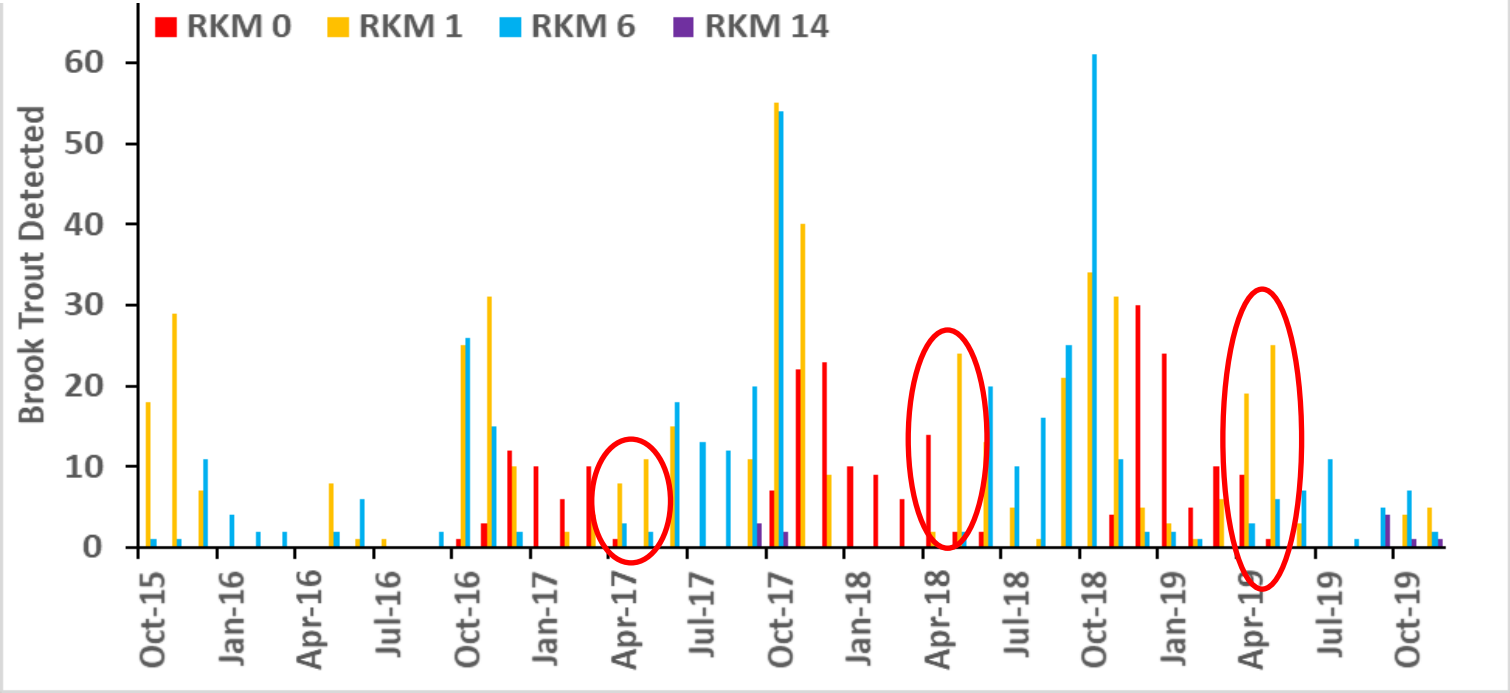
General movement pattern:

Out-migrate to Keweenaw waterway after spawning in Nov/Dec
228/763 (30%) detected out-migrating
14/763 (2%) confirmed not out-migrating



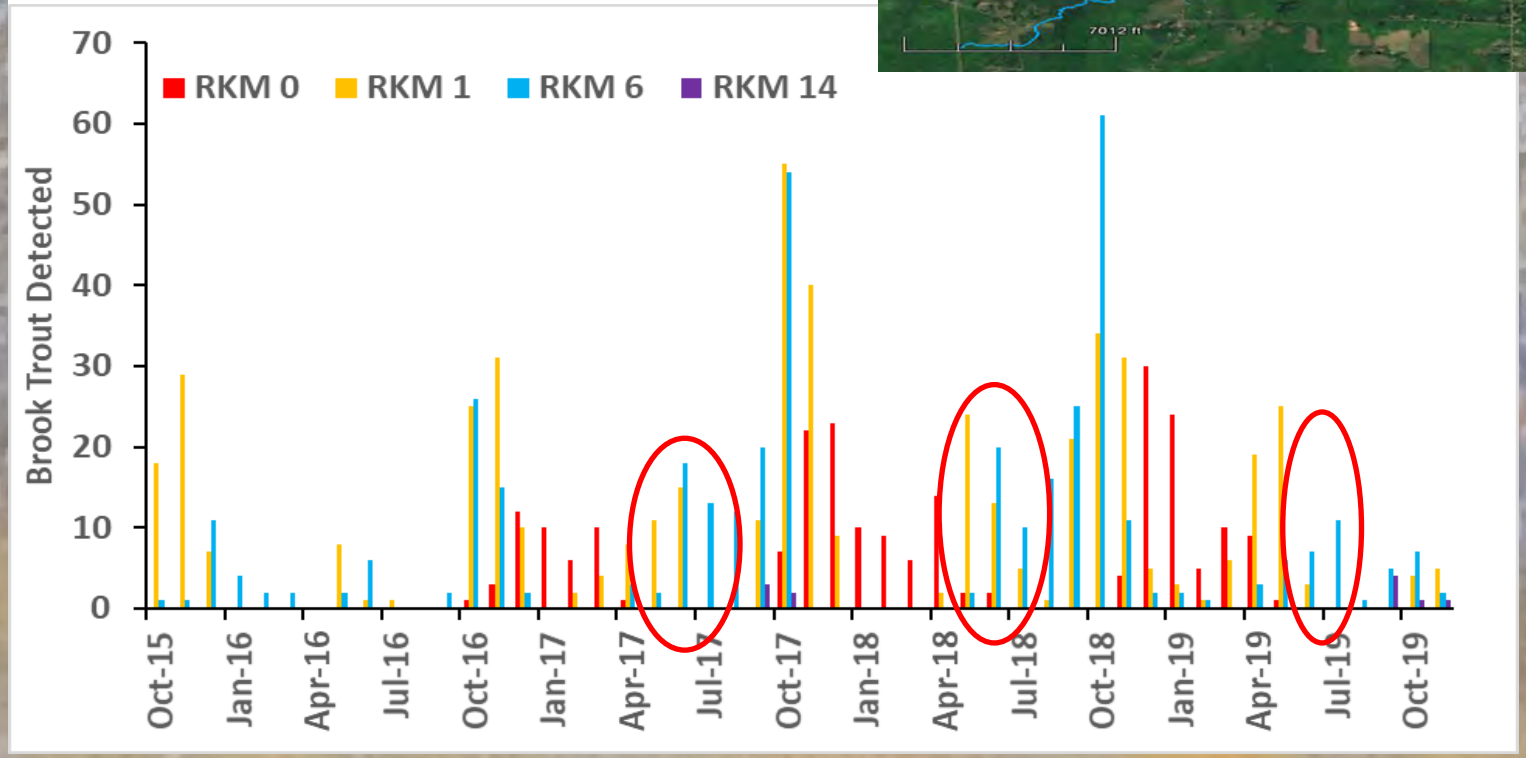
General movement pattern:

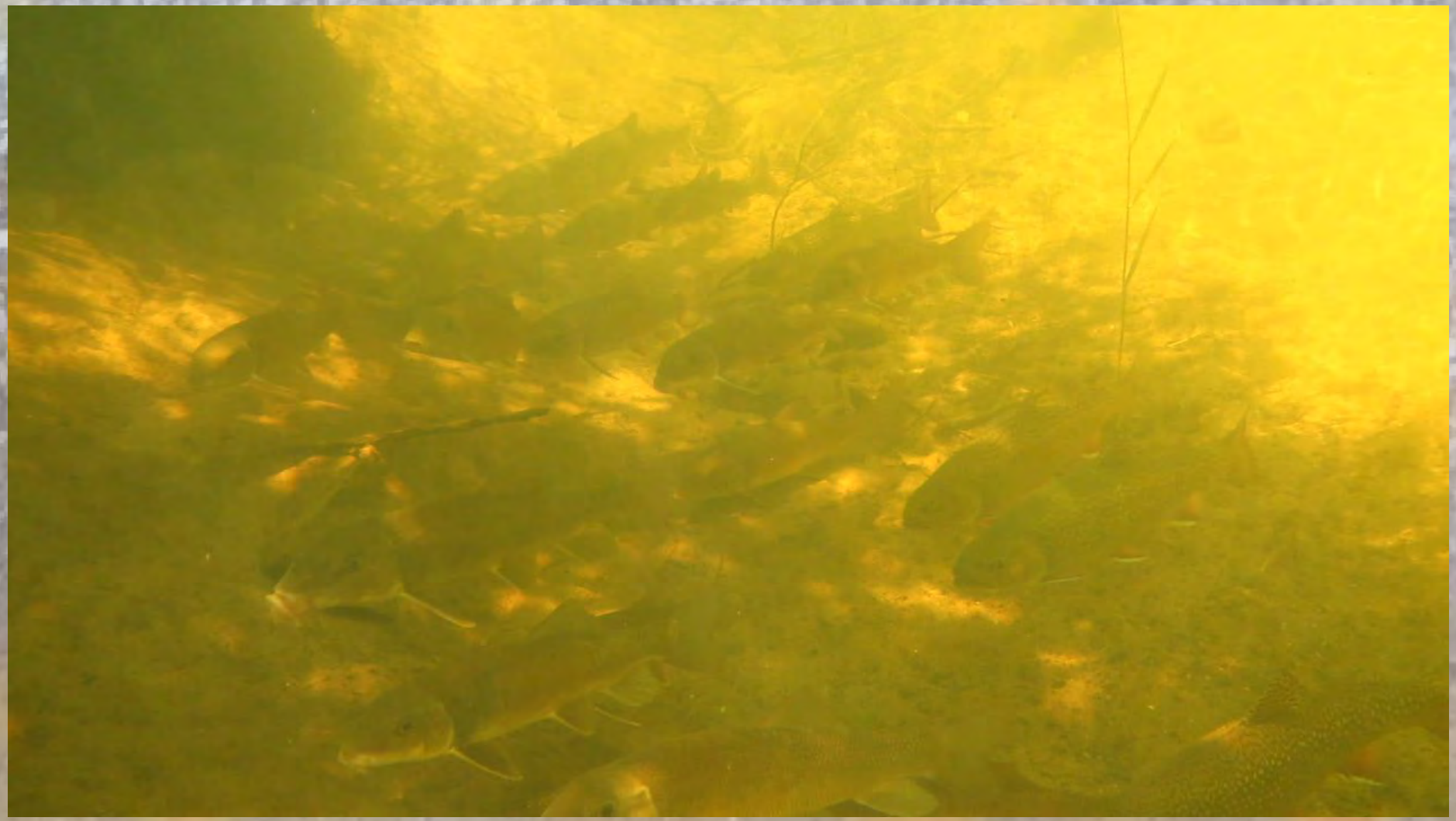
Re-enter lower river in April/May
None known to remain in lake habitat longer than one winter



General movement pattern:

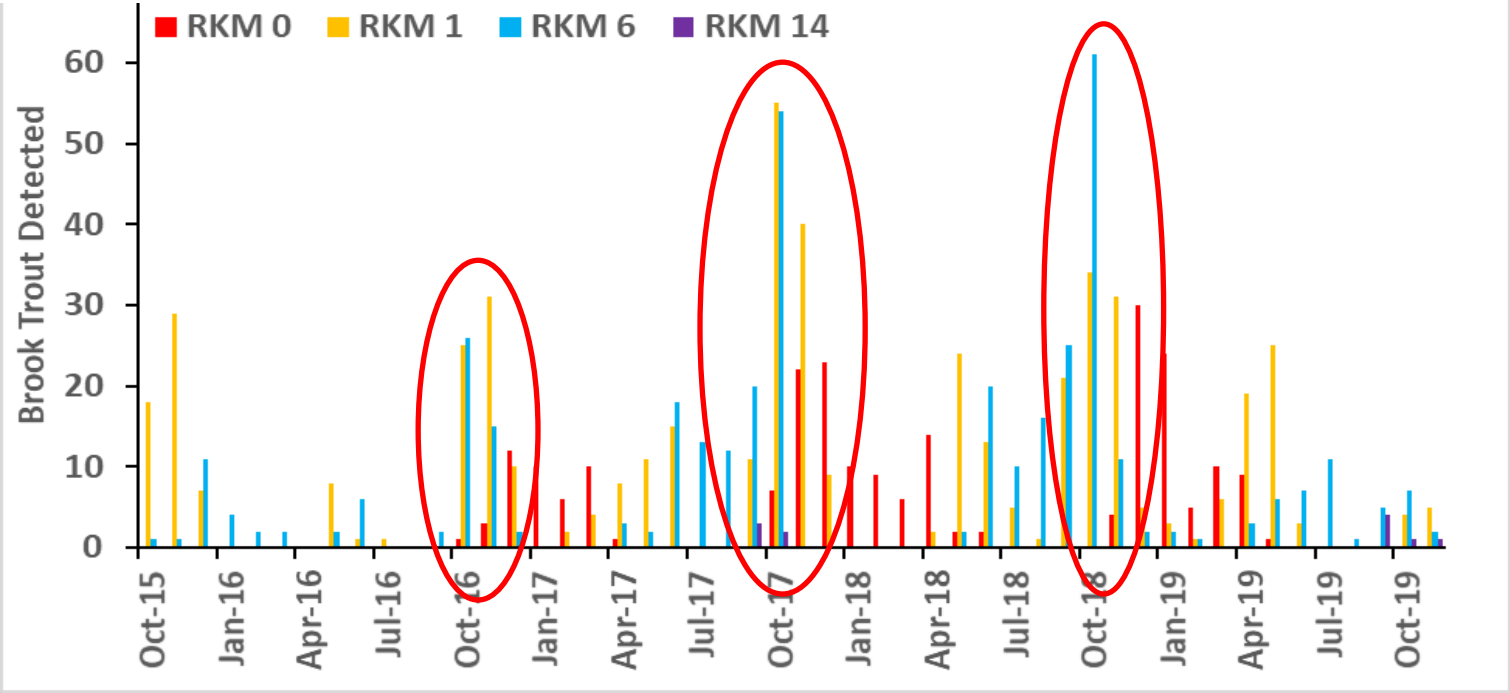
Move to upper section in mid-summer (into unprotected reach)





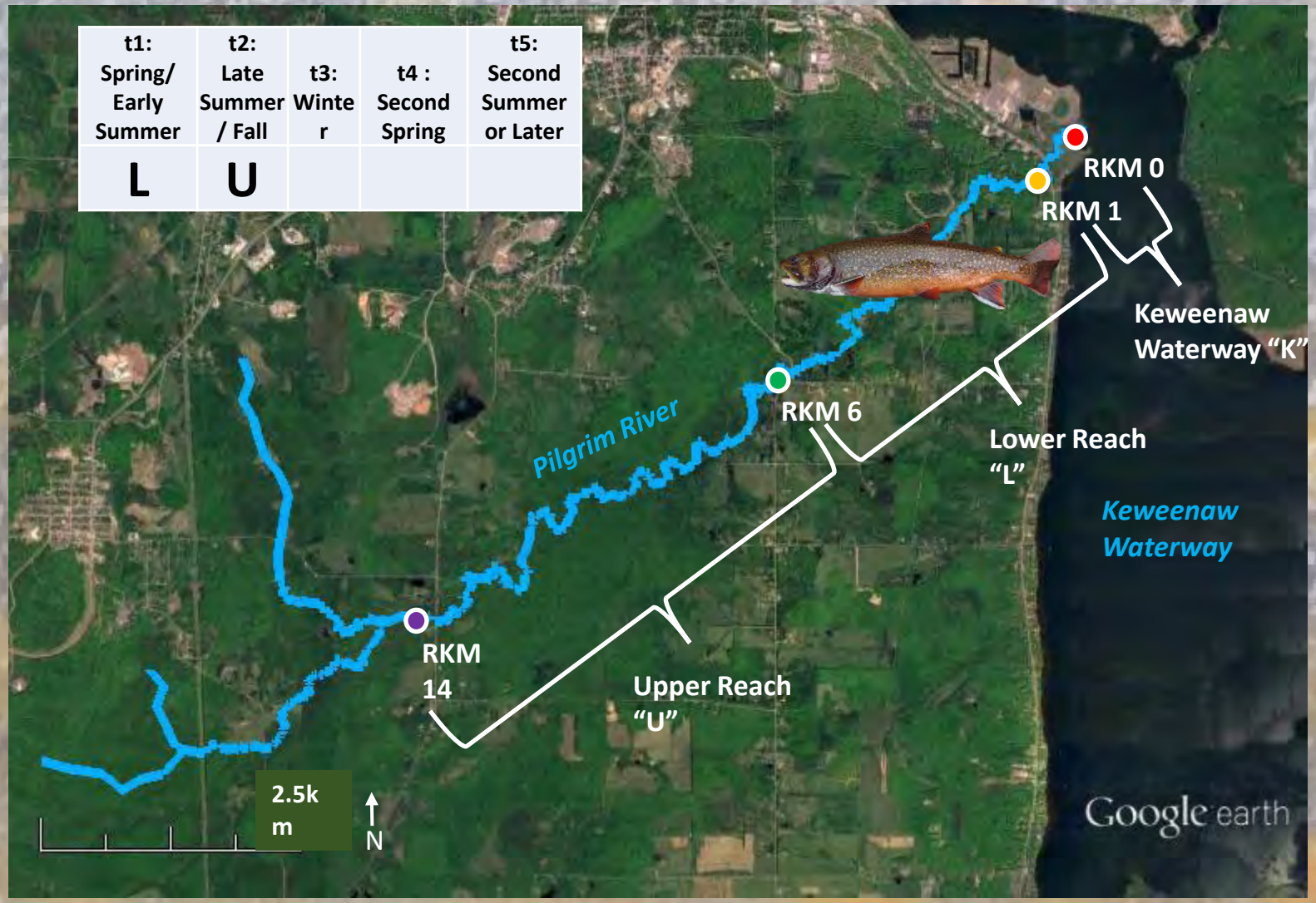
General movement pattern:

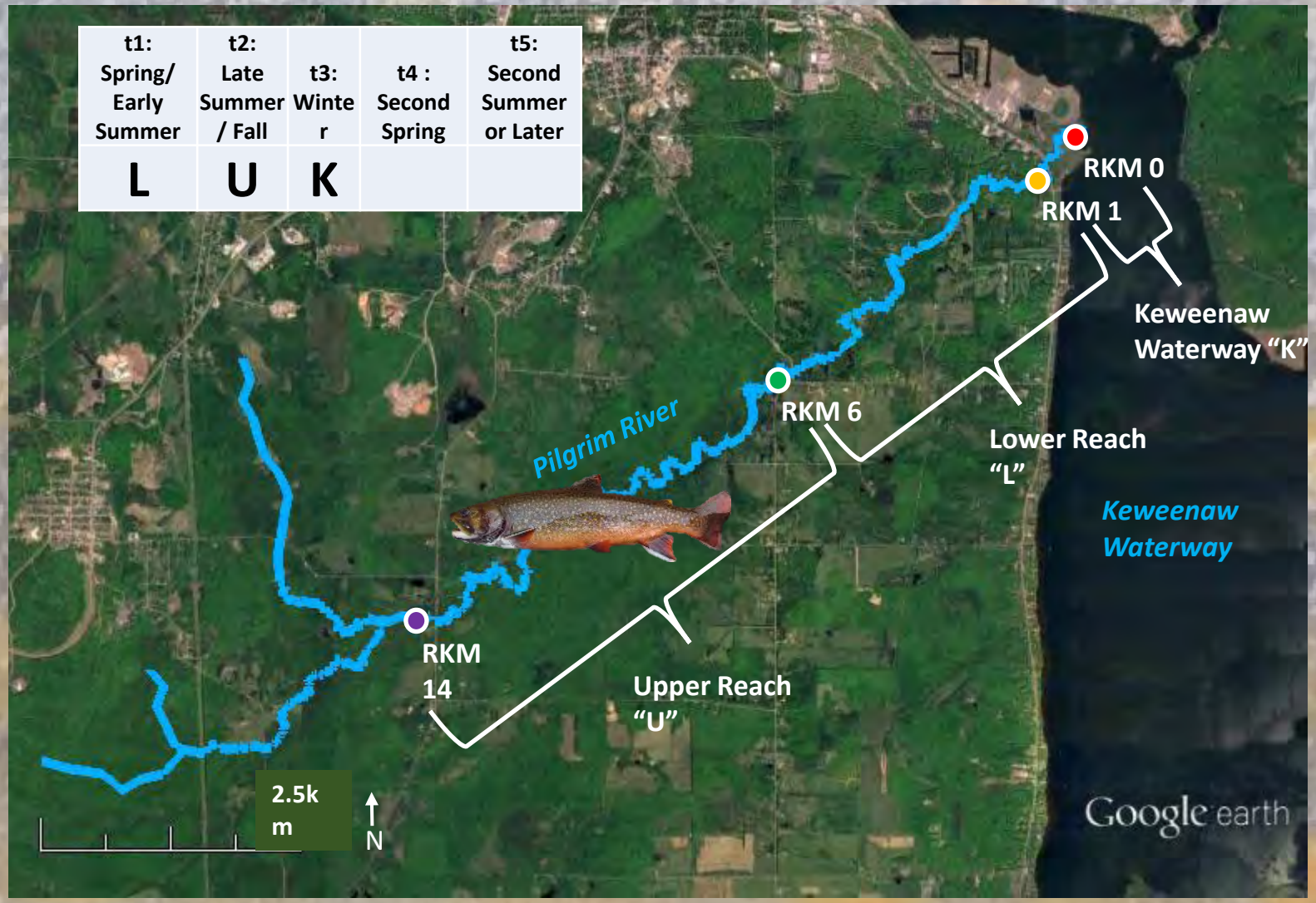
Long distance bi-directional movement during fall spawning season

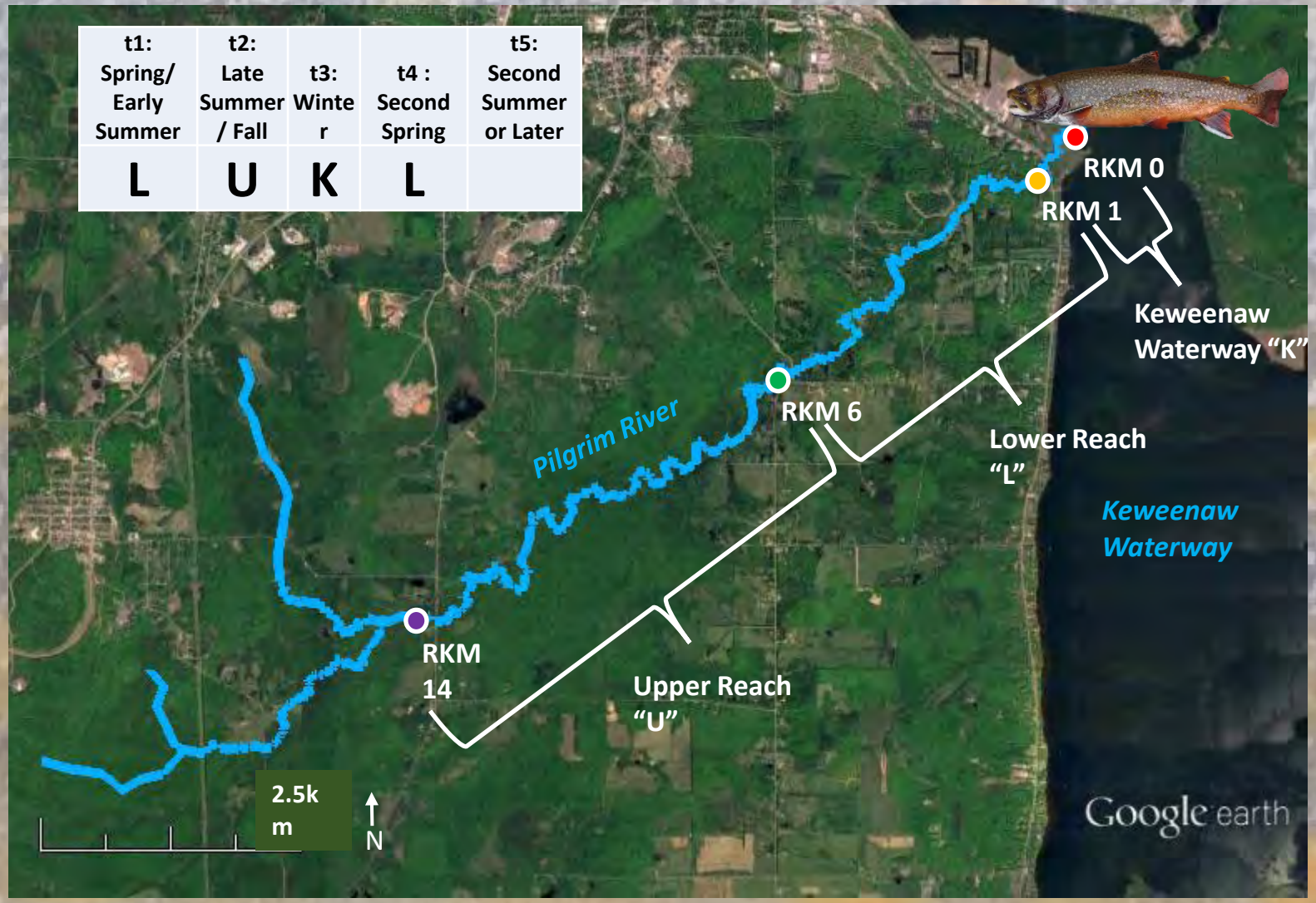


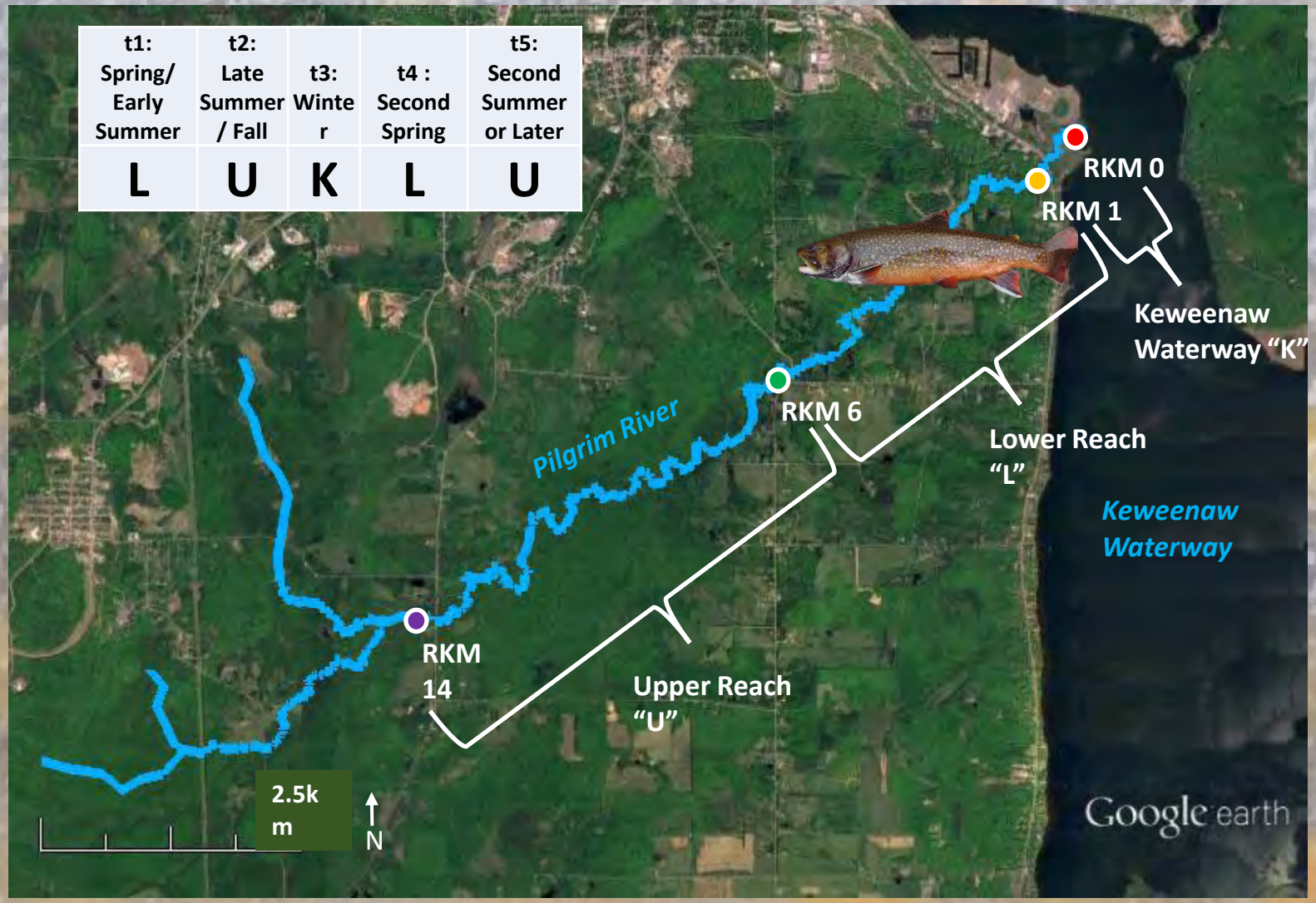

t1: Spring/ Early Summer
t2: Late Summer / Fall
t3: Winter
t4 : Second Spring
t5: Second Summer or Later
RKM 0
RKM 1
Keweenaw Waterway "K"
RKM 6
Pilgrim River
Lower Reach "L"
Keweenaw Waterway
RKM 14
Upper Reach "U"
2.5km
N
Google earth


t1: Spring/ Early Summer
t2: Late Summer / Fall
t3: Winter
t4 : Second Spring
t5: Second Summer or Later
L
RKM 0
RKM 1
Keweenaw Waterway "K"
Pilgrim River
RKM 6
Lower Reach "L"
Keweenaw Waterway
RKM 14
Upper Reach "U"
2.5km
N
Google earth

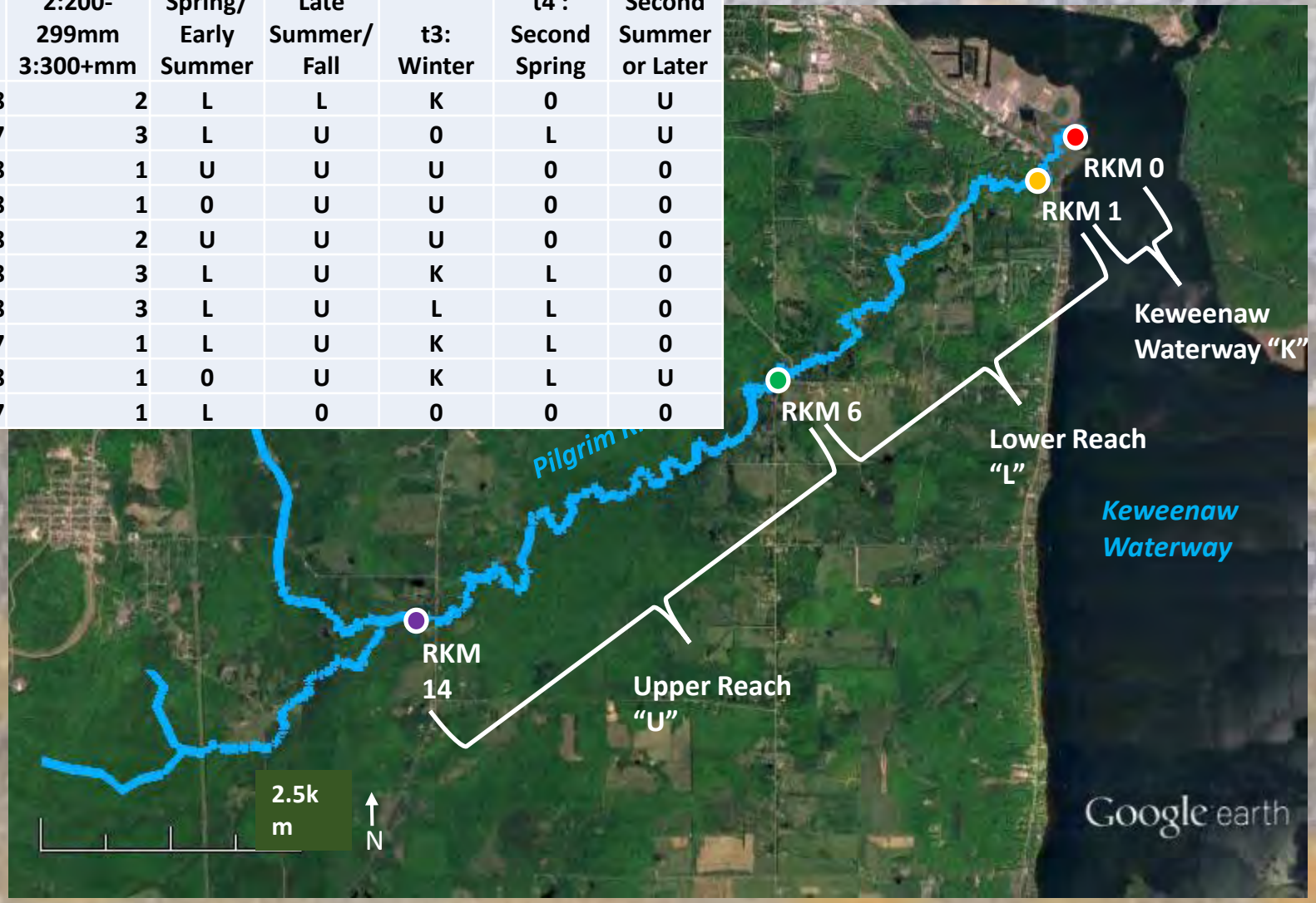

t1: Spring/ Early Summer
t2: Late Summer / Fall
t3: Winter
t4 : Second Spring
t5: Second Summer or Later
L
U
RKM 0
RKM 1
Keweenaw Waterway "K"
Pilgrim River
RKM 6
Lower Reach "L"
Keweenaw Waterway
RKM 14
Upper Reach "U"
2.5km
N
Google earth


t1: Spring/ Early Summer
t2: Late Summer / Fall
t3: Winter
t4 : Second Spring
t5: Second Summer or Later
L
U
K
RKM 0
RKM 1
Keweenaw Waterway "K"
RKM 6
Pilgrim River
Lower Reach "L"
Keweenaw Waterway
RKM 14
Upper Reach "U"
2.5k m
N
Google earth


t1: Spring/ Early Summer
t2: Late Summer / Fall
t3: Winter
t4 : Second Spring
t5: Second Summer or Later
L
U
K
L
RKM 0
RKM 1
Keweenaw Waterway "K"
RKM 6
Pilgrim River
Lower Reach "L"
Keweenaw Waterway
RKM 14
Upper Reach "U"
2.5km
N
Google earth


t1: Spring/ Early Summer
t2: Late Summer / Fall
t3: Winter
t4 : Second Spring
t5: Second Summer or Later
L
U
K
L
U
RKM 0
RKM 1
Keweenaw Waterway "K"
RKM 6
Pilgrim River
Lower Reach "L"
Keweenaw Waterway
RKM 14
Upper Reach "U"
2.5km
N
Google earth

Release Year	Size Class 1:150-199mm 2:200-299mm 3:300+mm	t1: Spring/ Early Summer	t2: Late Summer/ Fall	t3: Winter	t4 : Second Spring	t5: Second Summer or Later
2018	2	L	L	K	0	U
2017	3	L	U	0	L	U
2018	1	U	U	U	0	0
2018	1	0	U	U	0	0
2018	2	U	U	U	0	0
2018	3	L	U	K	L	0
2018	3	L	U	L	L	0
2017	1	L	U	K	L	0
2018	1	0	U	K	L	U
2017	1	L	0	0	0	0



2018

First tested for differences in detection probability and survival in 2016, 2017, 2018

Detection probability and survival not different between years

Model	QAICc	Delta QAICc	AICc Weights	Model Likelihood	Num. Param.
{No Grp Effect}	802.03	0.00	0.84	1.00	19
{Grp 3 S diff}	807.00	4.97	0.07	0.08	27
{Grp 3 p diff}	807.88	5.85	0.05	0.05	25
{Grp 2 p diff}	809.24	7.20	0.02	0.03	25
{Grp 2 S diff}	809.40	7.36	0.02	0.03	27
{Grp 1 p diff}	813.28	11.24	0.00	0.00	25
{Grp 1 S diff}	816.57	14.54	0.00	0.00	27
{All p diff}	819.98	17.94	0.00	0.00	31
{All S diff}	834.71	32.68	0.00	0.00	41

Release Year	Size Class 1:150-199mm 2:200-299mm 3:300+mm	t1: Spring/ Early Summer	t2: Late Summer/ Fall	t3: Winter	t4 : Second Spring	t5: Second Summer or Later
2018	2	L	L	K	0	U
2017	3	L	U	0	L	U
2018	1	U	U	U	0	0
2018	1	0	U	U	0	0
2018	2	U	U	U	0	0
2018	3	L	U	K	L	0
2018	3	L	U	L	L	0
2017	1	L	U	K	L	0
2018	1	0	U	K	L	U
2017	1	L	0	0	0	0

Tested for differences in movement and survival among three size (age) classes

Group1: 150-199mm

Group2: 159-200mm

Group3: 300+mm

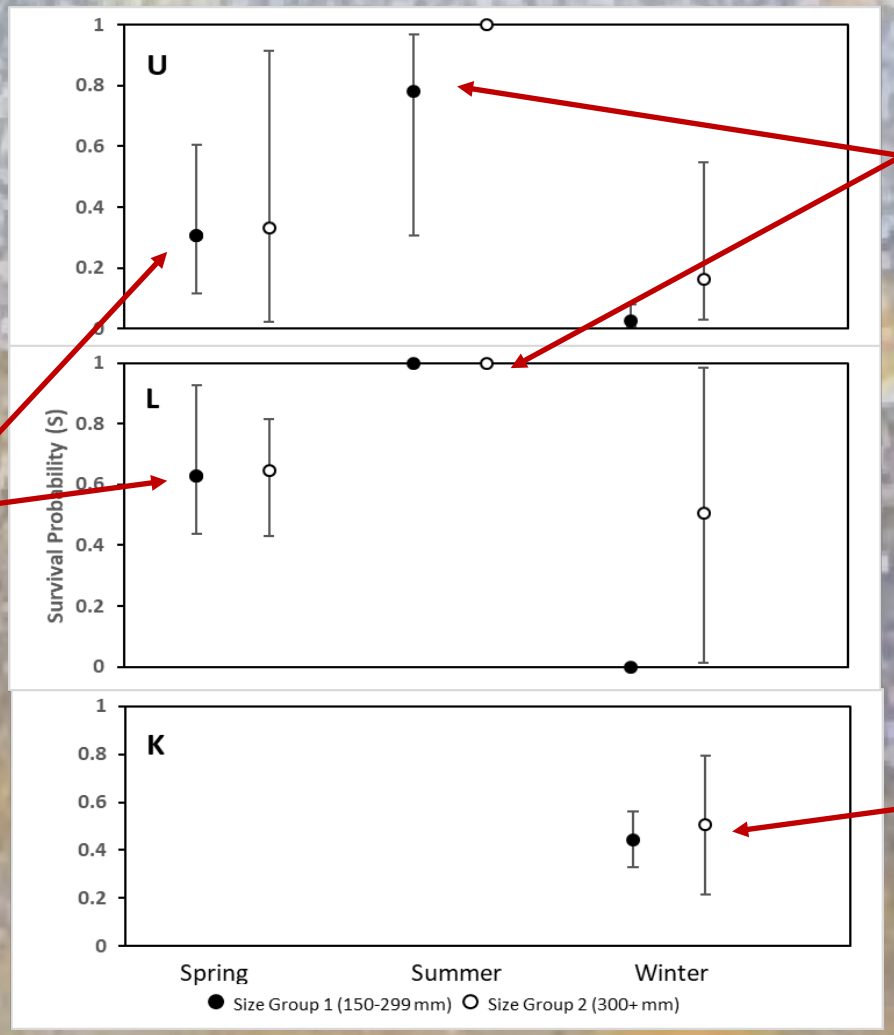
Different survival for 300+mm BKT

Different movement probability for 150-199mm BKT

Model	QAICc	Delta QAICc	AICc Weights	Model Likelihood	Num. Param.
{Grp 3 S diff Grp1 psi diff}	1188.84	0.00	0.41	1.00	32
{Grp 3 S diff}	1188.85	0.01	0.41	1.00	24
{Grp 3 S psi diff}	1191.87	3.02	0.09	0.22	32
{No Group Effect}	1193.11	4.27	0.05	0.12	19
{Grp 3 S diff all psi diff}	1193.54	4.70	0.04	0.10	38
{Grp 1 S diff}	1196.90	8.05	0.01	0.02	24
{All S diff}	1207.88	19.04	0.00	0.00	33

Release Year	Size Class 1:150-199mm 2:200-299mm 3:300+mm	t1: Spring/ Early Summer	t2: Late Summer/ Fall	t3: Winter	t4 : Second Spring	t5: Second Summer or Later
2018	2	L	L	K	0	U
2017	3	L	U	0	L	U
2018	1	U	U	U	0	0
2018	1	0	U	U	0	0
2018	2	U	U	U	0	0
2018	3	L	U	K	L	0
2018	3	L	U	L	L	0
2017	1	L	U	K	L	0
2018	1	0	U	K	L	U
2017	1	L	0	0	0	0

Parameter Estimates from AIC Top Model
Survival Group 3 Different, Movement Group 1 Different

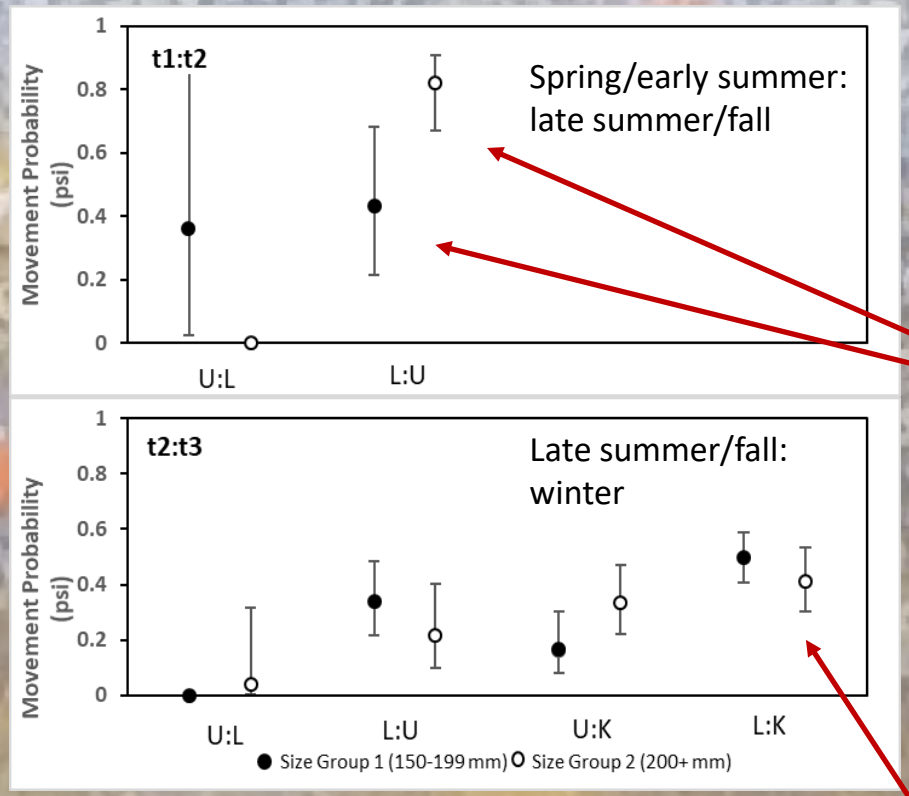


Late summer/fall Survival almost 100%, but many were tagged in late fall

Spring/early summer survival lower in upper section

Approx. 40% winter survival of outmigrants

Parameter Estimates from AIC Top Model
Survival Group 3 Different, Movement Group 1 Different



Spring/early summer: late summer/fall

Late summer/fall: winter

Approx. 40% of fish 150-299 mm move to upper section in summer, 80% of fish 300+mm

Over 40% of fish move from lower section to Keweenaw waterway in winter

Conclusions

The Pilgrim River does support adfluvial brook trout (pending genetic confirmation), with over 40% of the population out-migrating

Confirmed residency uncommon, but many habitats unsampled. Migrants have higher detection probability

80% of large brook trout move to upper section in summer

Estimated survival lower in upper section, detection probability may be lower

Questions!

ccadams@mtu.edu

Scott River Watershed-Wide Restoration Project Validation Monitoring Program

California Department of Fish & Wildlife

U.S. Fish & Wildlife Service

Klamath Basin Fisheries Collaborative

National Oceanic and Atmospheric Administration — NOAA — U.S. Department of Commerce

UC Davis — University of California

Humboldt State University

cbec eco engineering — A Verdantas Company

Siskiyou County Farm Bureau

California Water Boards

Prunuske Chatham, Inc.

The Wildlands Conservancy — Behold the Beauty

The Nature Conservancy — Protecting nature. Preserving life.

Quartz Valley Indian Reservation

Great Seal of the Karuk Tribe

Scott River Watershed Council

Forest Service — U.S. Department of Agriculture

Lazuli Eco

Study Framework

Evaluate whether restoration shifts habitat conditions and juvenile life history traits toward those associated with higher survival rates

Core Hypothesis

Restoration that increases year-round slow-water habitat will increase juvenile growth rates, reduce risky redistribution, and increase the proportion of fish outmigrating as smolts - traits strongly associated with improved survival and population performance

Study Design (BACI)

- Before / After - we will compare:
  - Pre-restoration conditions at treatment sites where available
  - Post restoration habitat and biological response over multiple years
  - Across varying water year types
- Control / Impact - we will monitor:
  - Impacts sites: beaver influenced and restoration reaches (BDAs, floodplain reconnection)
  - Control sites: comparable untreated reaches within the same watershed

Tracking Change vs Background

- Compare treatment vs control sites within the same water year
- Evaluate changes over multiple water years / environmental conditions
- Track habitat capacity relative to juvenile density
- Compare life-history expression (resident vs redistributing)
- Evaluate whether restored reaches buffer temperature and flow extremes

*If restored sites consistently produce higher growth rates or higher smolt proportions than controls within the same year, that indicates treatment effect.

Parameters to be Monitored

Physical habitat parameters

Wetted habitat area	Habitat volume
Depth and velocity profiles	Instream cover
Winter slow water availability	Water temperature
Groundwater/surface water interaction	Duration of summer surface flow

Biological parameters

Juvenile density	Growth rates
Size distribution	Site fidelity / seasonal occupancy
Redistribution timing and frequency	Proportion outmigrating as smolts
Overwinter survival	Life-history expression

Sampling Scheme

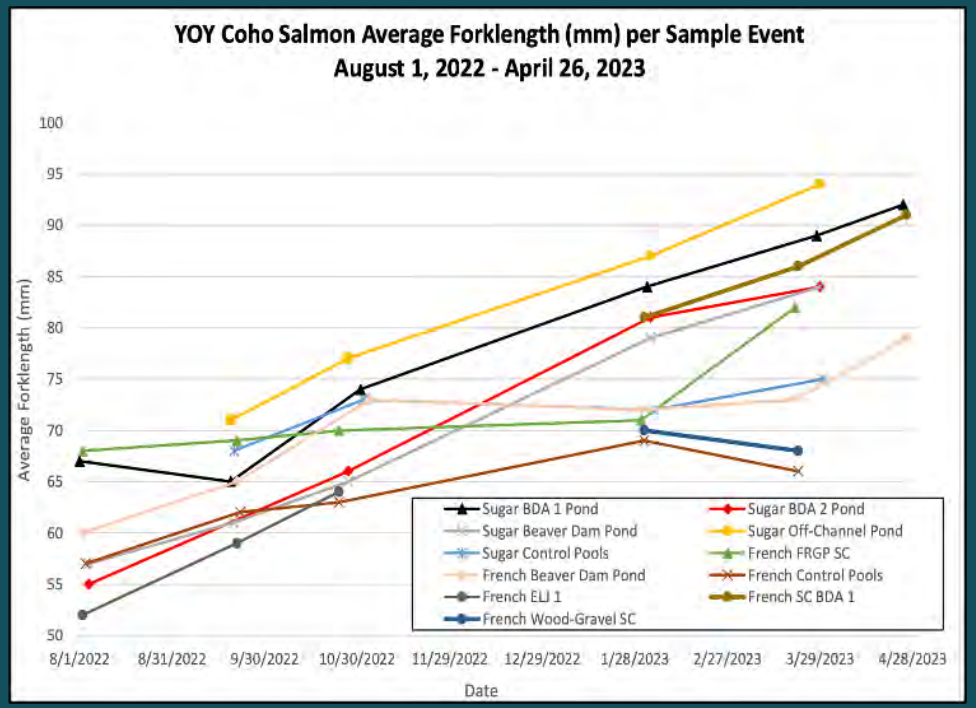
- Mark Recapture
  - Summer tagging of juveniles
  - Repeated sampling to estimate population size and growth
- PIT Tag Arrays
  - Installed at treatment and control sites
  - Continuous detection of movement
  - Seasonal redistribution quantified
  - Outmigration timing documented
  - Overwinter survival inferred
- Seasonal Monitoring
  - Summer (growth and density)
  - Fall redistribution period
  - Winter occupancy
  - Spring smolt outmigration

**This allows us to detect whether restored habitats reduce fall emigration, increase overwinter occupancy, and produce larger smolts*

Measured Biological Indicators are Supported by Science

- Larger size at outmigration is positively correlated with marine survival (Beamish et al. 2010)
- Faster summer growth reduced predation risk and increases smoltification success (Ebersole, et al. 2006)
- Slow-water over winter habitat increases juvenile survival (Ebersole et al 2009)
- Redistribution carries elevated mortality risk (Gormon 2016, Bennett et al. 2015)
- Habitat capacity models link depth/velocity/cover to smolt production (Goodman et al.)

**We are not assuming survival increases, we are testing whether restoration produces traits known to increase survival probability*



Opportunities to Collaborate and Learn Beyond the Study

- **Fish passage at BDAs and/or natural beaver dams**
  - *Juvenile and adult passage rates, timing*
  - *Evaluate passage under different flow conditions*
- **Otolith and growth reconstruction studies (Lusardi)**
  - *Use otolith and eye lens microchemistry to reconstruct rearing history*
  - *Distinguish natal vs non-natal rearing contributions*
  - *Evaluate habitat specific growth signatures*
- **Redistribution dynamics basin-scale**
  - *Collaboration with Karuk and Yurok to detect tagged fish from Scott River*

Scott River Watershed Council

Klamath Basin Fisheries Collaborative

UC Davis University of California

California Department of Fish & Wildlife

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA
DEPARTMENT OF
FISH & WILDLIFE

Minimum Instream Flow (SB 263)

cbec
eco engineering
A Verdantas Company

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

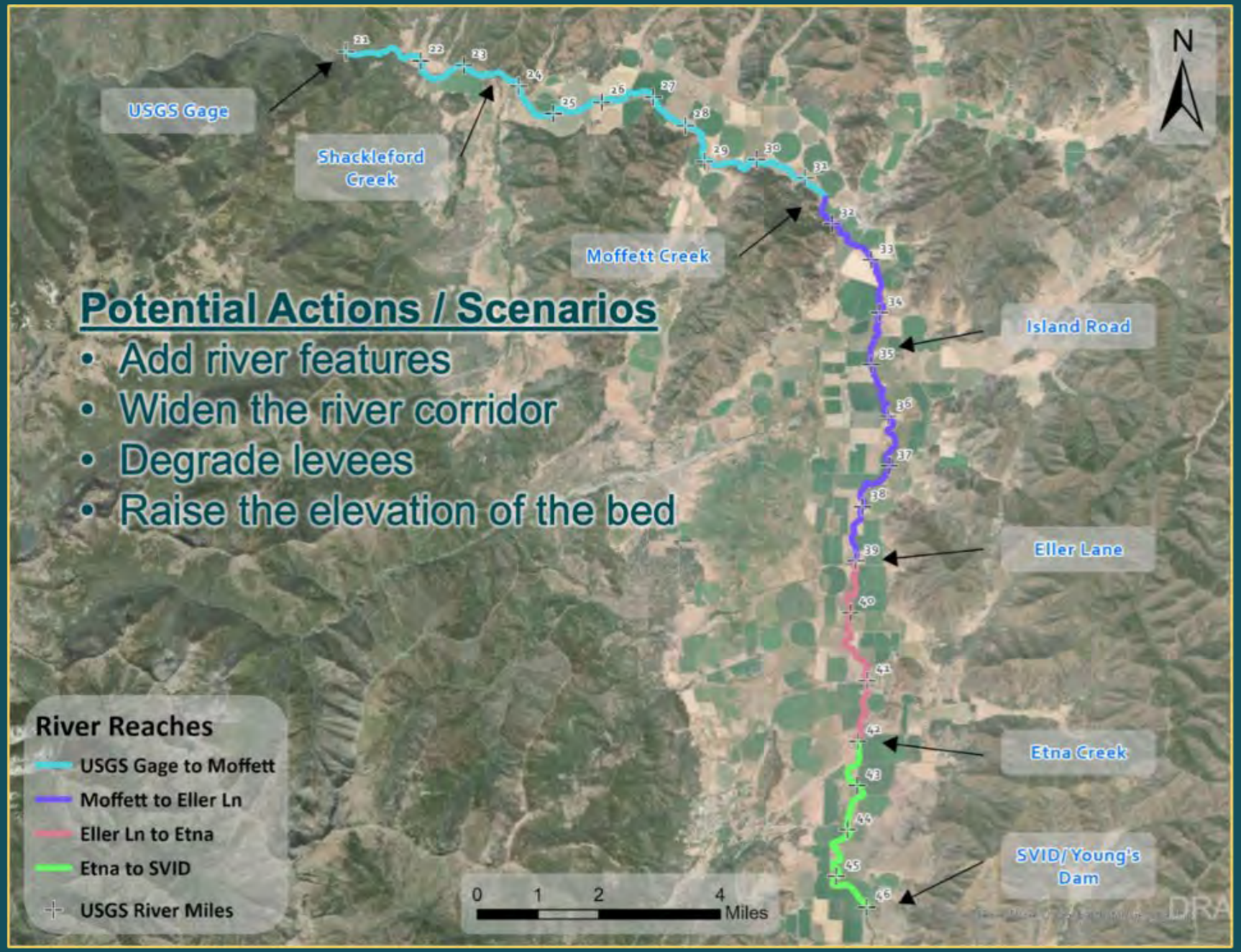
Caltrans

The Nature Conservancy
Protecting nature. Preserving life.

RESOURCES LEGACY FUND

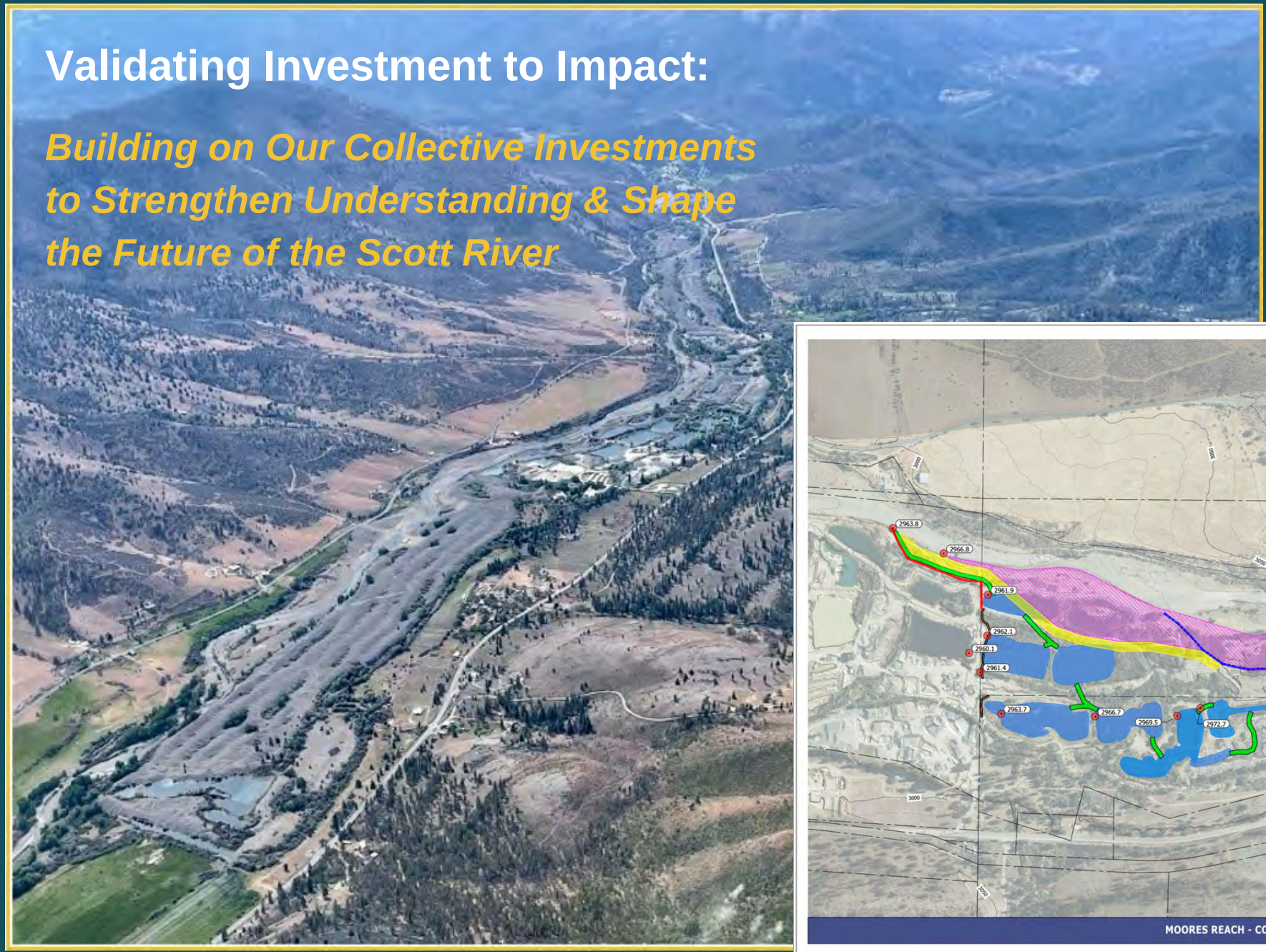
Maine Community Foundation

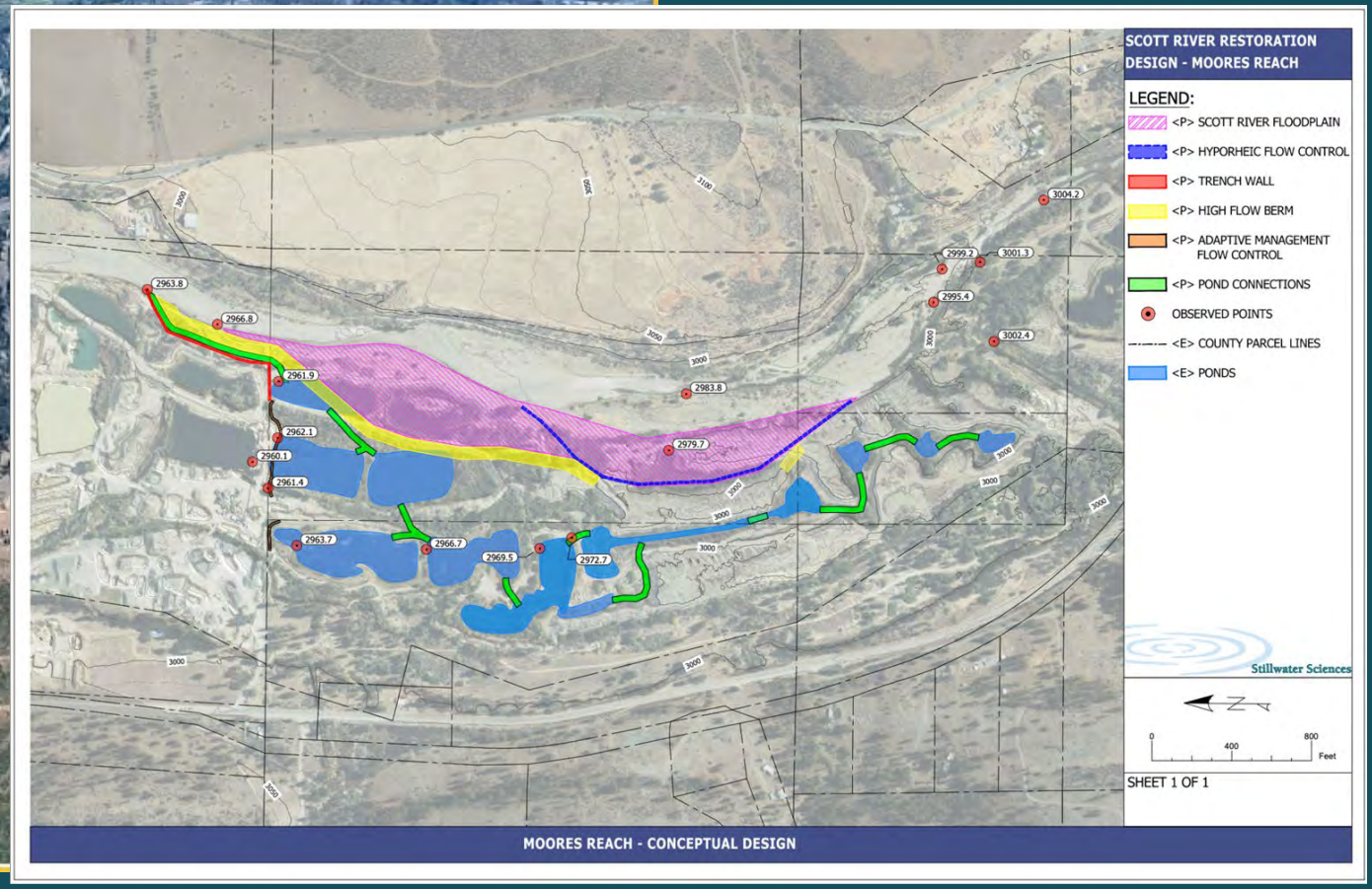
SCOTT RIVER WATERSHED COUNCIL



Validating Investment to Impact:

Building on Our Collective Investments to Strengthen Understanding & Shape the Future of the Scott River





Longstanding Fisheries Monitoring:

- *Counting Weir*
- *Outmigration trapping*
- *PIT Tag program*
- *Extensive Spawning Surveys*
- *Direct observation dives*

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

U.S. FISH & WILDLIFE SERVICE

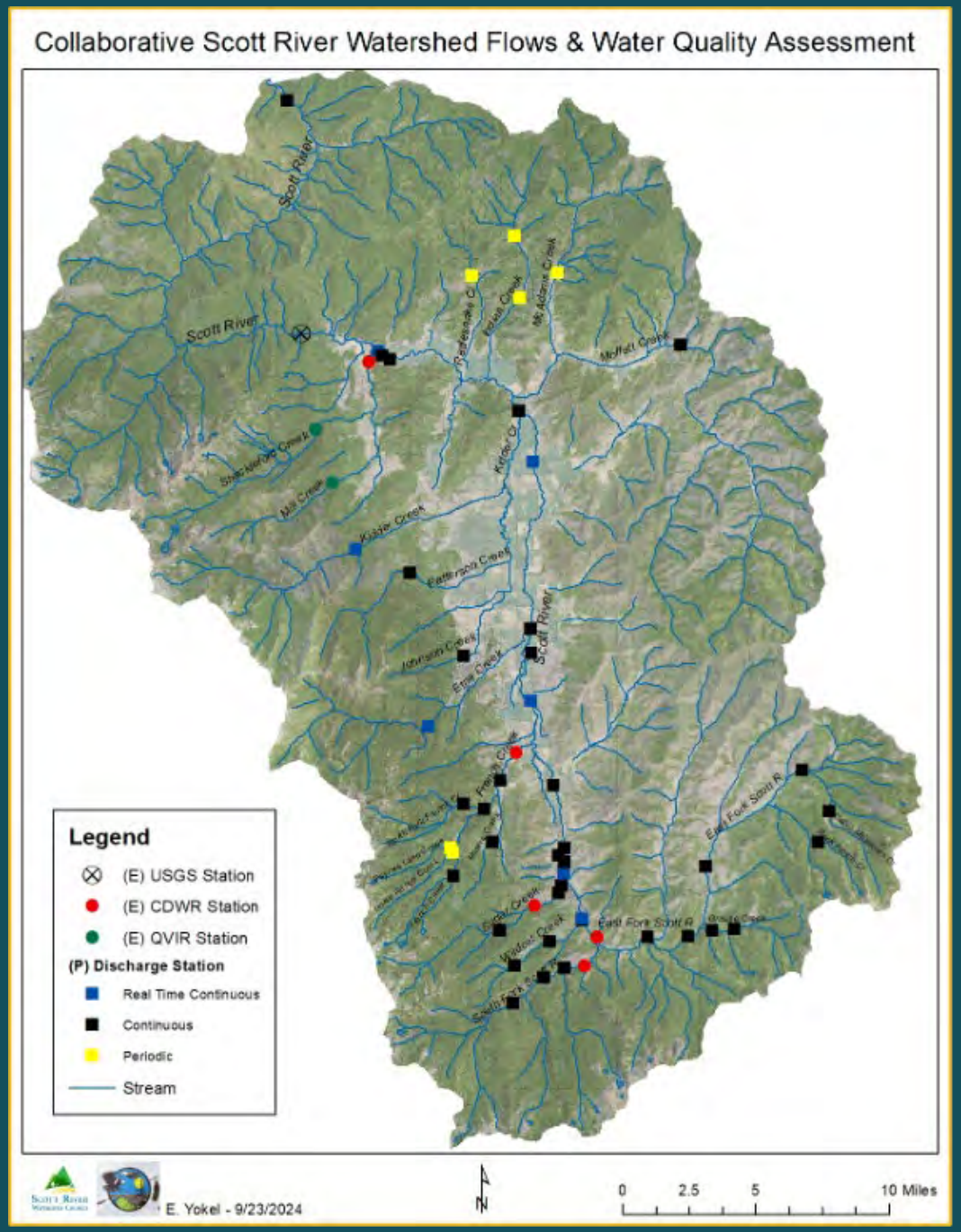
FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Quartz Valley Indian Reservation

GREAT SEAL OF THE KARUK TRIBE

SCOTT RIVER WATERSHED COUNCIL

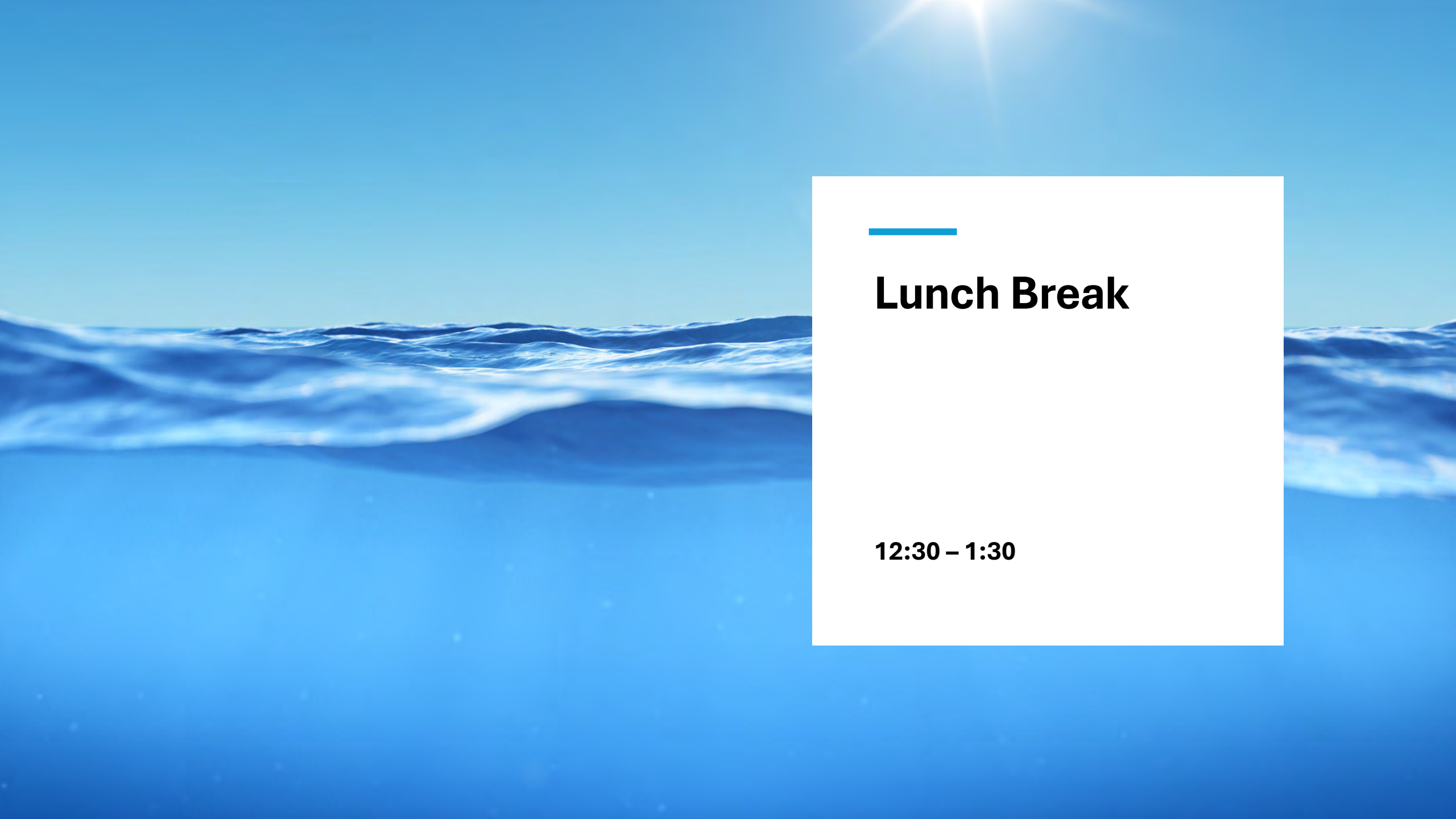


Other Monitoring Efforts:

- 30 Streamflow Discharge Stations
  - 10 - High flow
- ~300 Water Surface Elevation (WSE) stations
- Numerous temperature, DO and other water quality parameters

Questions We're Wrestling With

- How do we document movement if fish redistribute before they reach taggable size?
- What is a healthy proportion of a population that redistributes?
- What can we learn from historical data sets regarding redistribution? Did CDFW capture a larger proportion of age 0+ fish at the outmigrant trap pre-restoration or in specific water year types?
- Are there locations in the mainstem Scott River where a PIT tag antenna could be installed and effectively detect redistributing fish?



Lunch Break

12:30 – 1:30