

2012 Stipulation Study: OMR flows and movement of steelhead in the interior Delta

David Delaney¹, Paul Bergman¹, Brad Cavallo¹,
Jenny Melgo¹, and Kevin Clark²

¹Cramer Fish Sciences, 13300 New Airport Rd.
Suite 102, Auburn, CA 95602

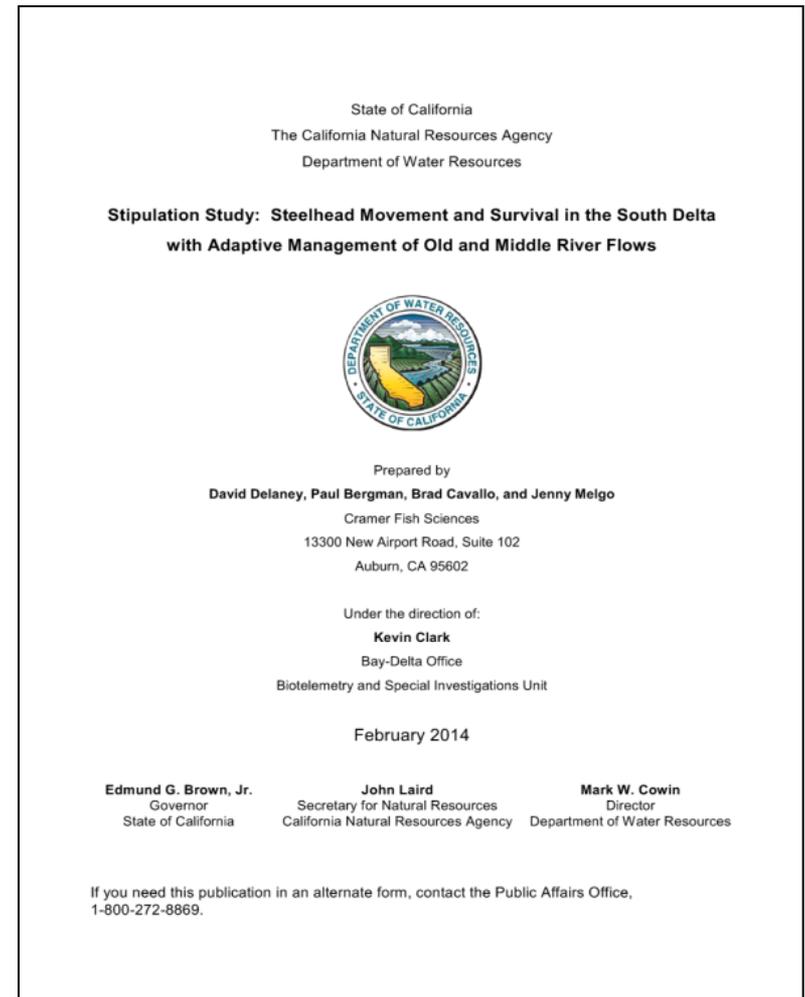
²Department of Water Resources, 1416 9th
Street, Sacramento, CA 94236



Cramer Fish Sciences
Auburn, CA
david.delaney@fishsciences.net

Outline

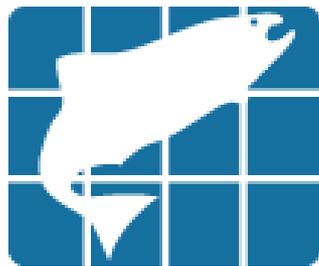
- Introduction
- An overview of the Stipulation Study
- Examine predictions of DSM2 Hydro Particle Tracking Model (PTM)
- Examine if OMR flows tested affected routing
- Zone of influence?
- Conclusions
- Future studies



Report available at:
http://www.fishsciences.net/email/va01/Stipulation_Study_Report.pdf

Institutional mission statement

- Apply science to help understand and resolve challenging resource management issues
- My qualifications:
 - Previously was Director of Research
 - Ph.D. from McGill University's Department of Biology
 - Involved with passive and active acoustic telemetry studies



CRAMER
FISH SCIENCES®

Oregon • California • Washington • Idaho • Alaska

Overview

When:

- Spring of 2012

What:

- Collaborative acoustic telemetry study

Study species:

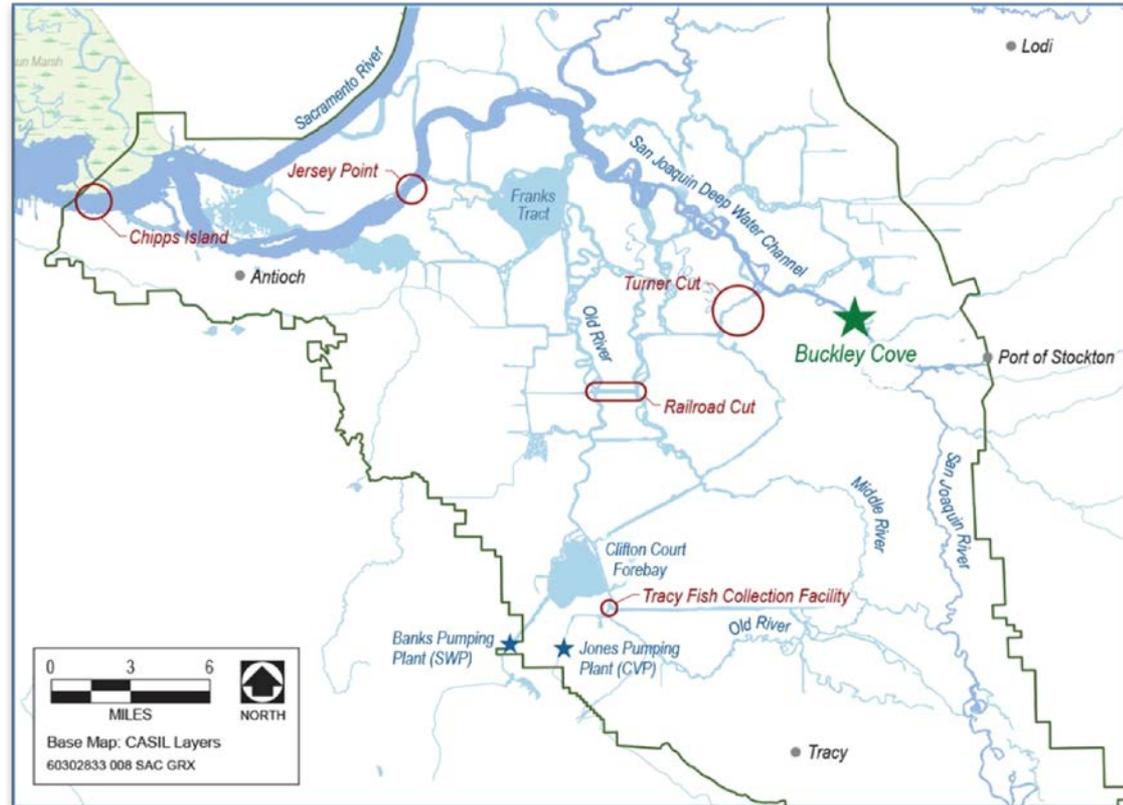
- Hatchery-raised juvenile steelhead

Release site:

- Buckley Cove

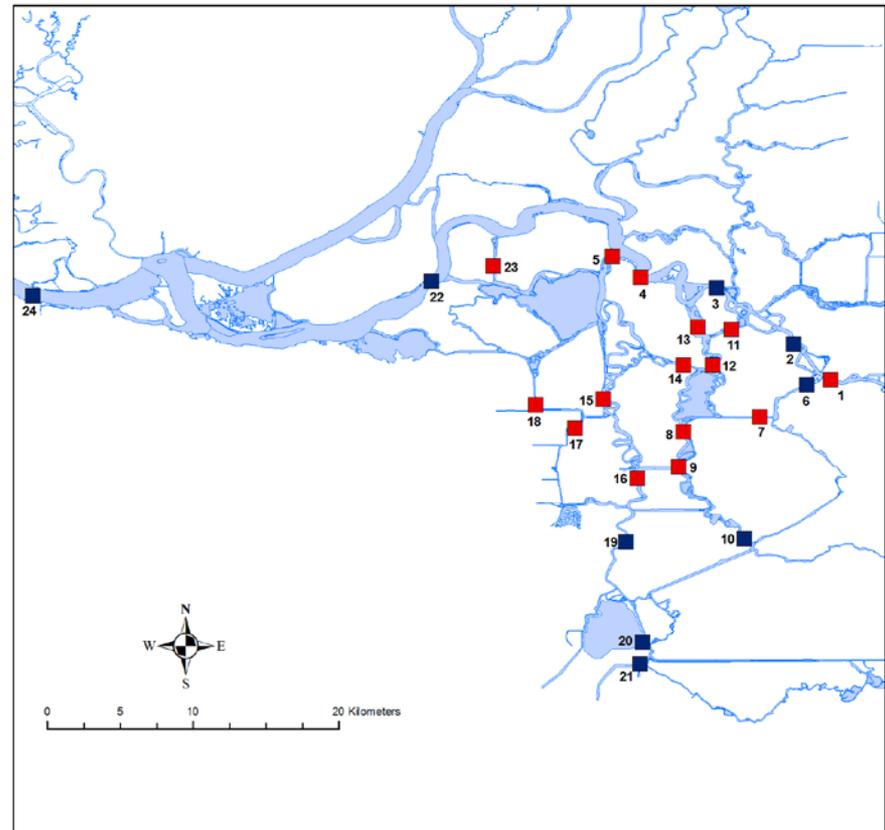
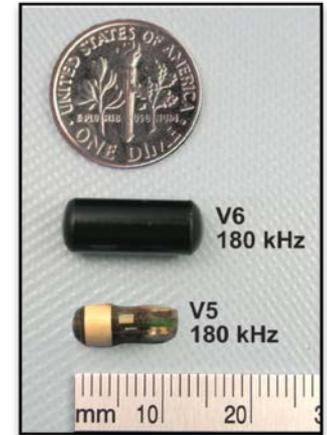
Data collected for:

- Central and south Delta



Methods of Stipulation Study

- 501 acoustically tagged juvenile steelhead
- Transmitters (tags):
 - VEMCO model V6
- Receiver arrays were deployed for the Stipulation Study (red squares) and Six-Year Study (blue squares)



Release groups

- Releases every 2 weeks
 - April 15 – May 16, 2012
 - 3 releases of ≥ 166 steelhead
- Target average OMR flows:
 - Release group 1: -3,500 cfs
 - Release group 2: -1,250 cfs
 - Release group 3: -5,000 cfs
- Observed average OMR flows:
 - Release group 1: -2,446 cfs
 - Release group 2: -2,933 cfs
 - Release group 3: -5,038 cfs



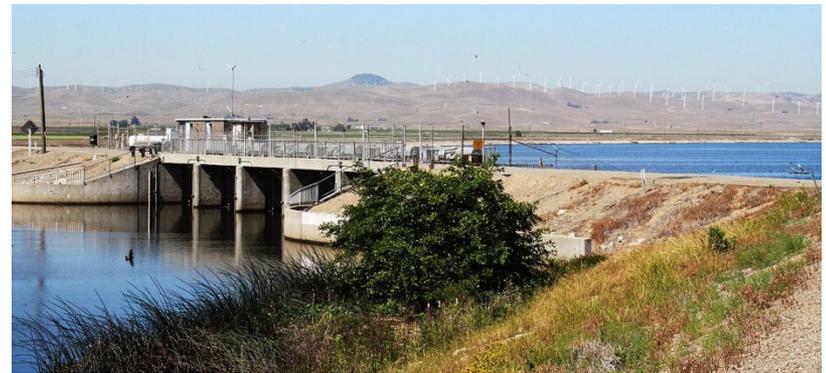
Release groups

- Releases every 2 weeks
 - April 15 – May 16, 2012
 - 3 releases of ≥ 166 steelhead
- Target average OMR flows:
 - Release group 1: -3,500 cfs
 - Release group 2: -1,250 cfs
 - Release group 3: -5,000 cfs
- **Observed average OMR flows:**
 - Release group 1: -2,446 cfs
 - Release group 2: -2,933 cfs
 - Release group 3: -5,038 cfs
- **Compare data from release groups 1 and 2 to release group 3**
 - **Less negative OMR flows**
 - Release groups 1 and 2
 - **More negative OMR flows**
 - Release group 3



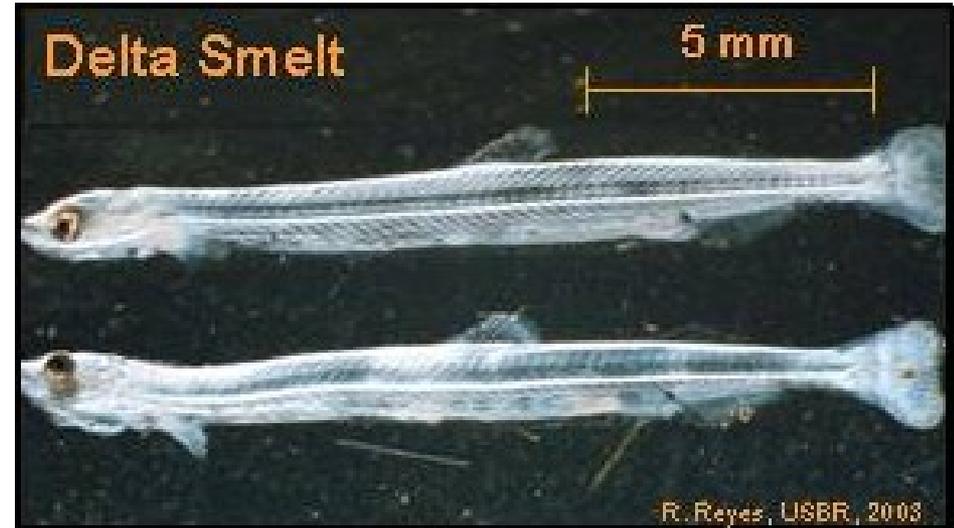
DSM2 Hydro Particle Tracking Model

- Effects of various barriers
 - Head of Old River Barrier
- Entrainment
 - Export facilities
- Rationale for spring OMR restrictions intended to protect ESA-listed anadromous fish
 - 2009 NMFS OCAP BiOp



Can the particle tracking model predict the movement of steelhead?

- Null hypothesis:
 - Distance traveled by steelhead tags not significantly different than distance traveled by particles

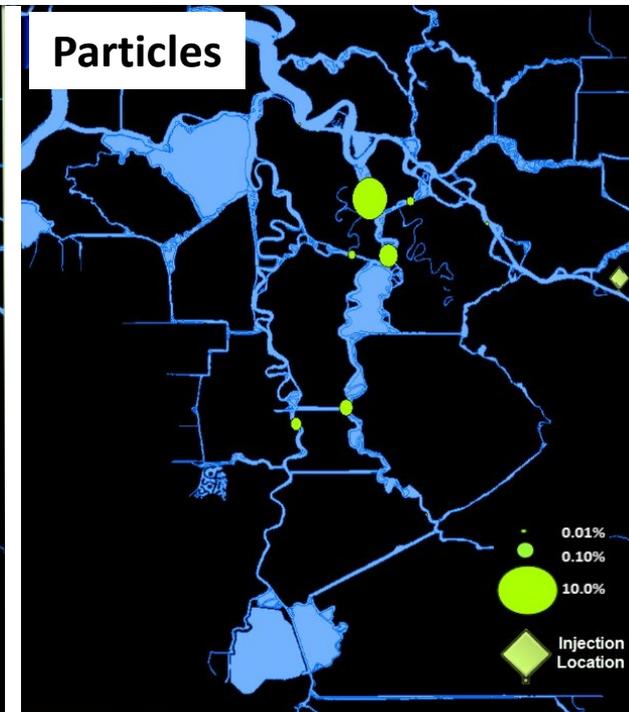
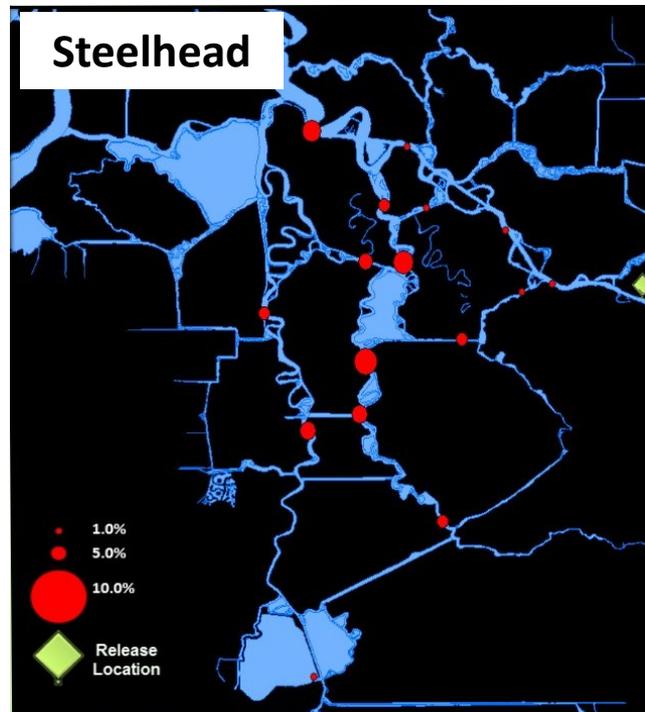


Source: <http://www.dfg.ca.gov/delta/data/nba/NorthBayAqueduct.asp>



Can the particle tracking model predict the movement of steelhead?

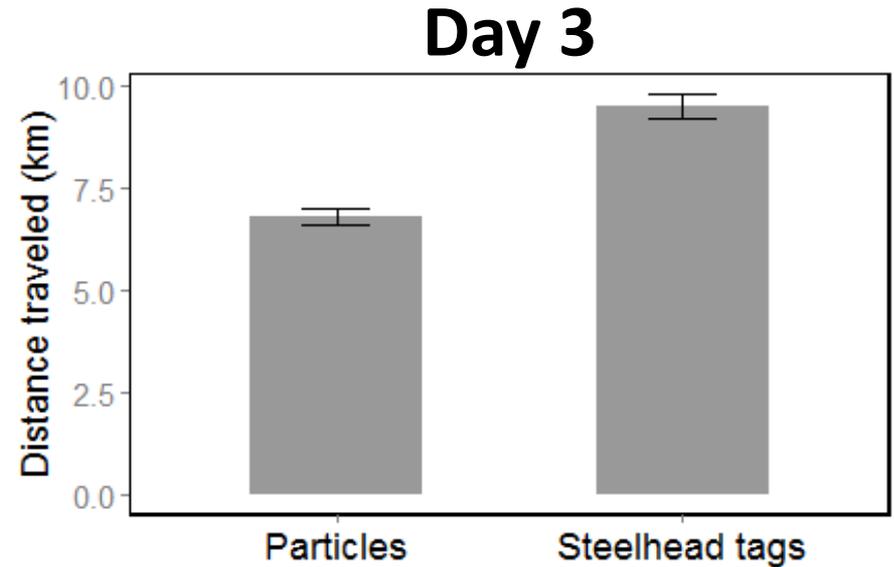
- Approach:
 - Distance traveled 3 and 7 days after release
 - Euclidean distance
 - Each day analyzed with a t-test



Results for comparing particle to tag data

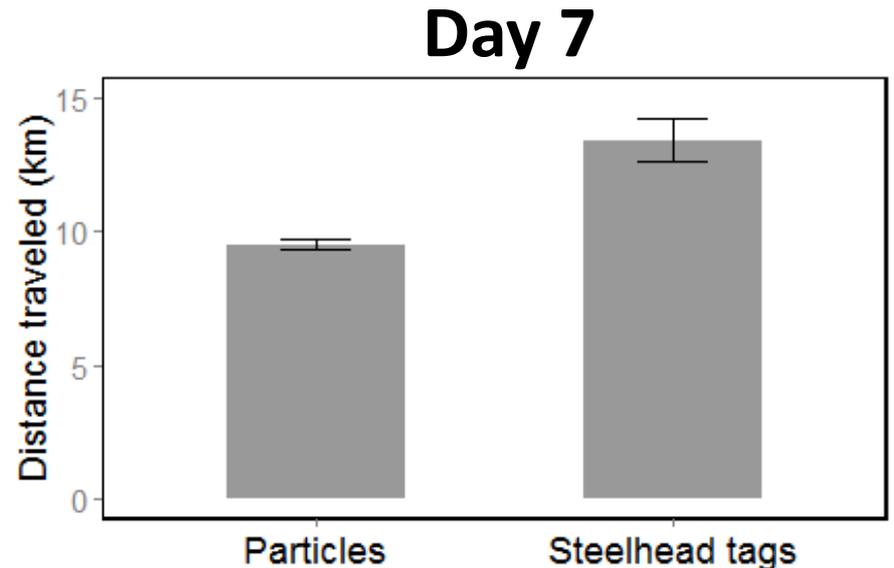
Day 3:

- Particles traveled 71.6% of the distance traveled by steelhead tags
- $P < 0.01$

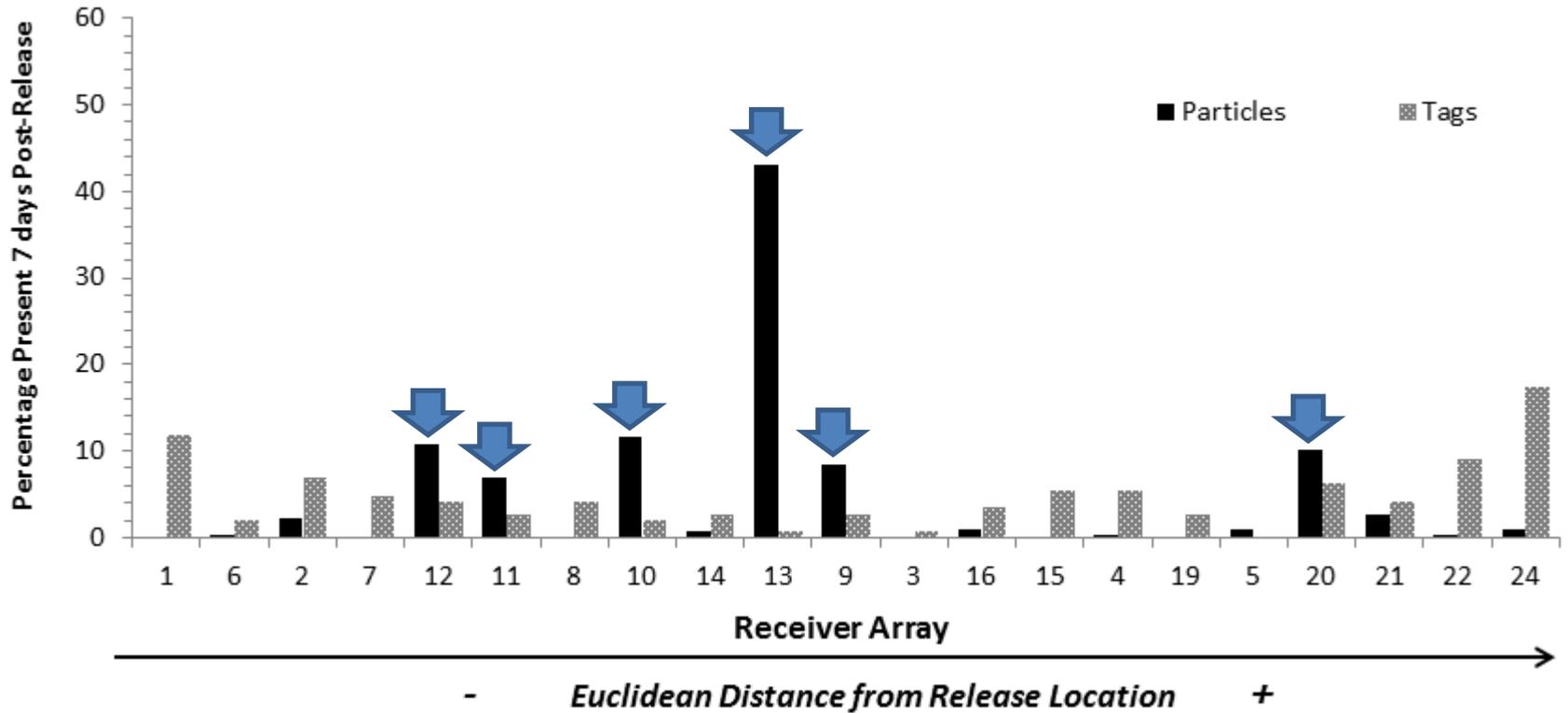


Day 7:

- Particles traveled 70.9% of the distance traveled by steelhead tags
- $P < 0.01$

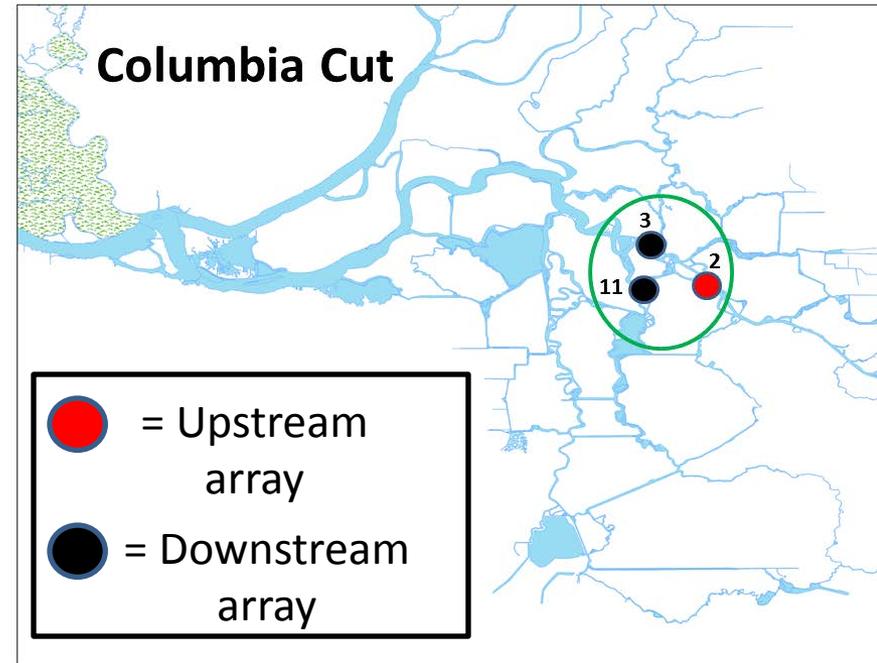


Results for day 7



Methods for the junction analyses

- Null hypothesis:
 - Probability of steelhead tags moving south not related to OMR flows
- Expected more steelhead tags to move south with more negative OMR flows
- Conducted analysis at four Delta junctions
- Generalized linear model for each junction



Turner Cut

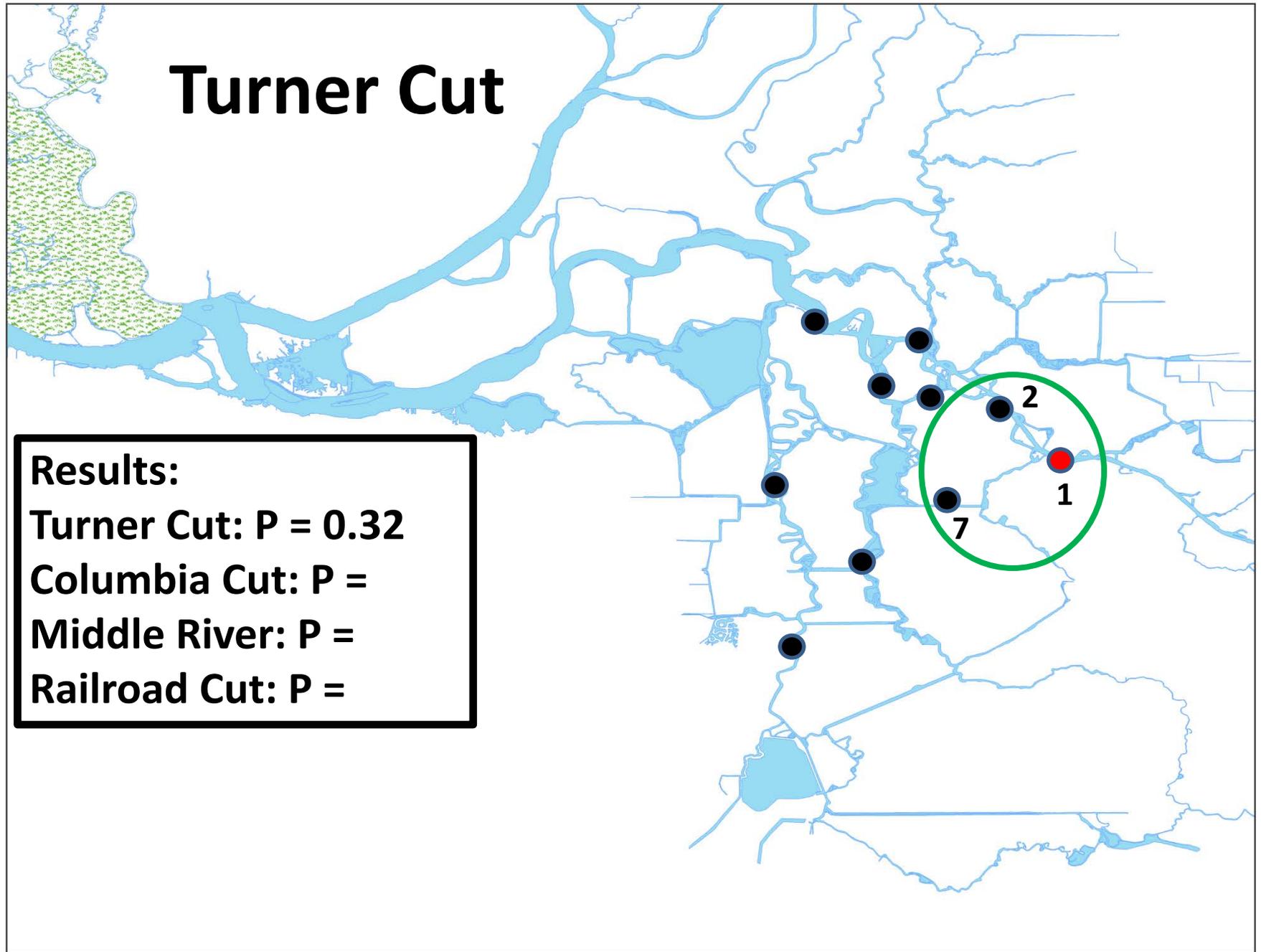
Results:

Turner Cut: $P = 0.32$

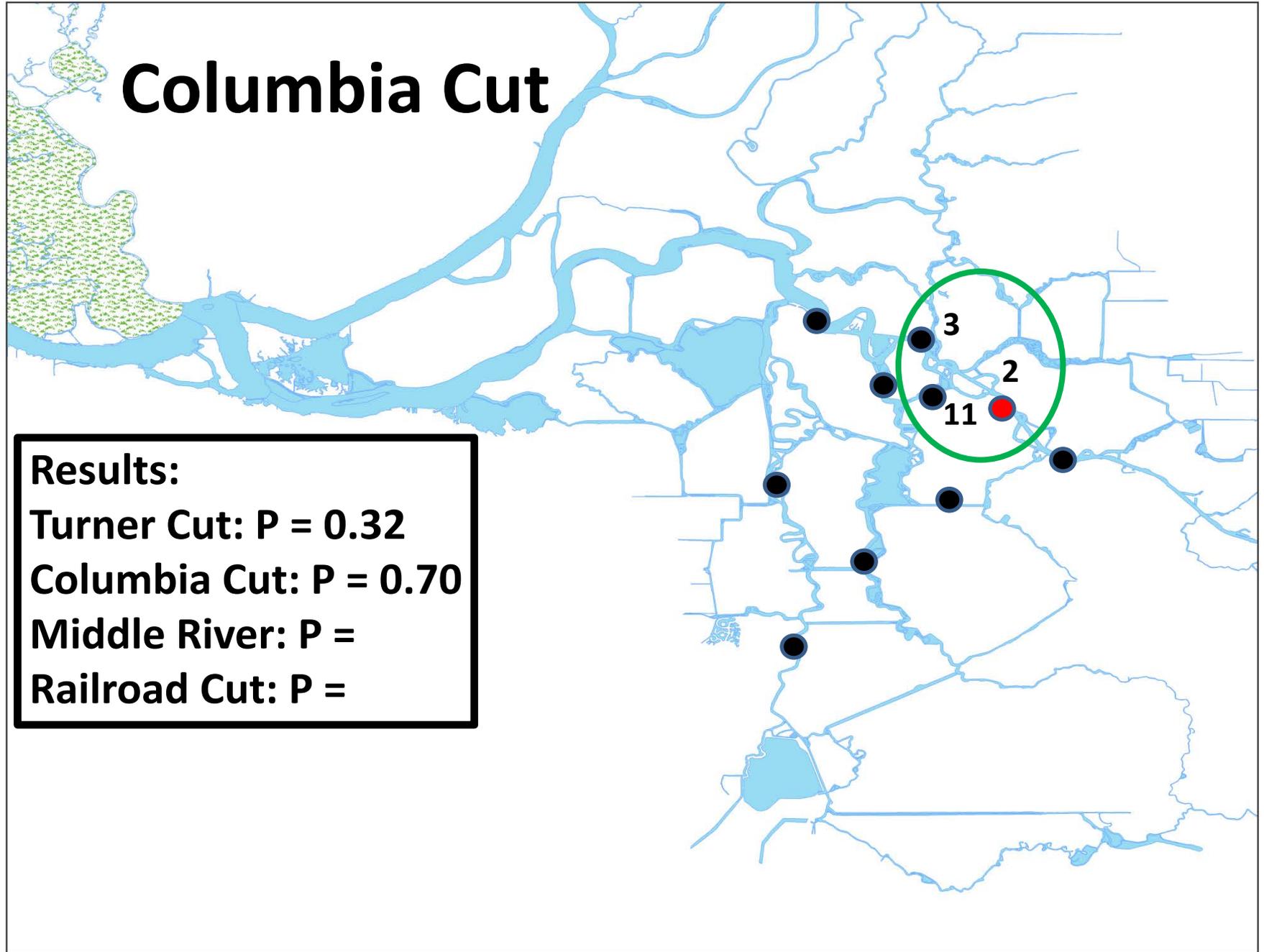
Columbia Cut: $P =$

Middle River: $P =$

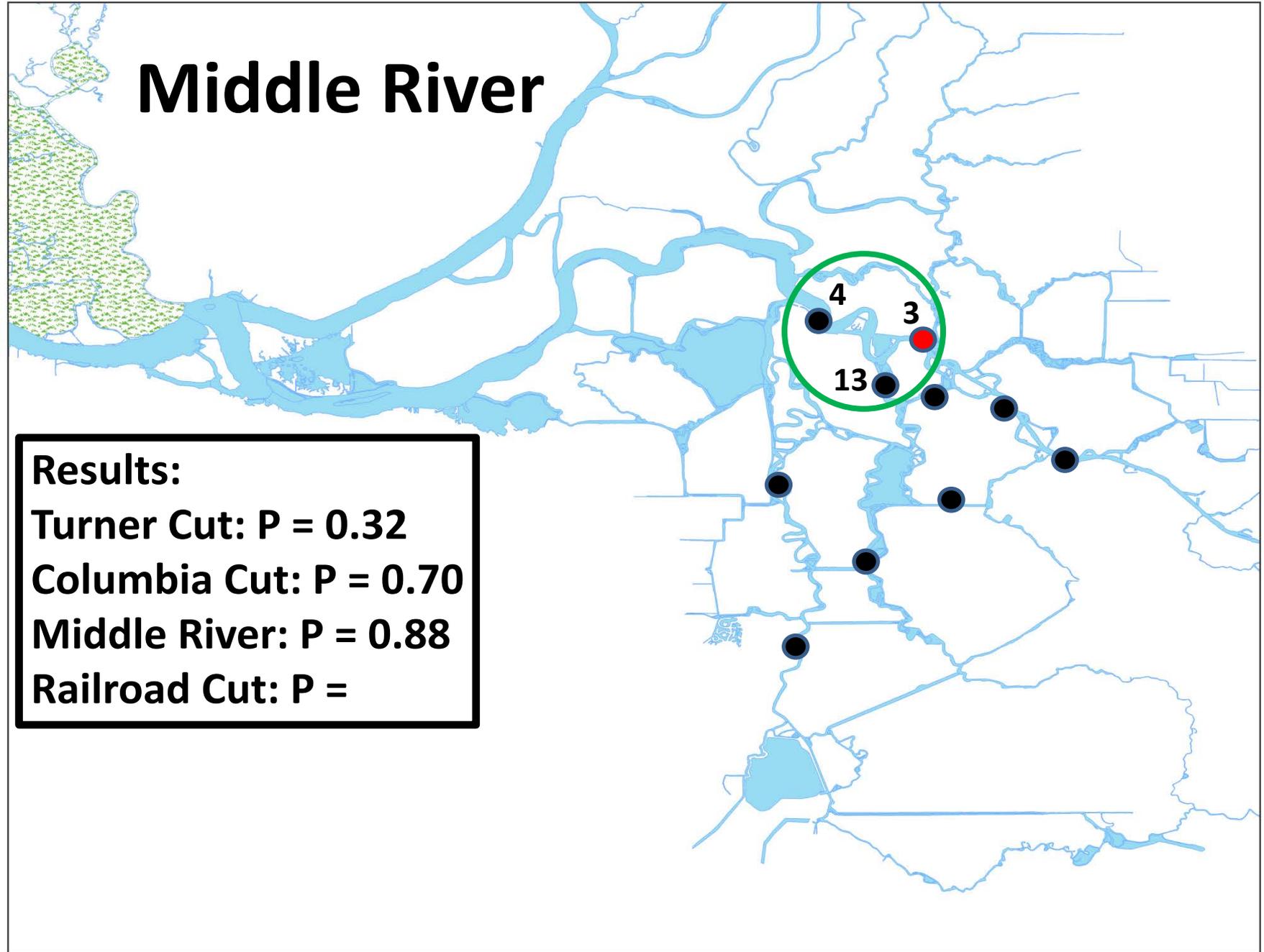
Railroad Cut: $P =$



Columbia Cut



Middle River



Results:

Turner Cut: $P = 0.32$

Columbia Cut: $P = 0.70$

Middle River: $P = 0.88$

Railroad Cut: $P =$

Railroad Cut

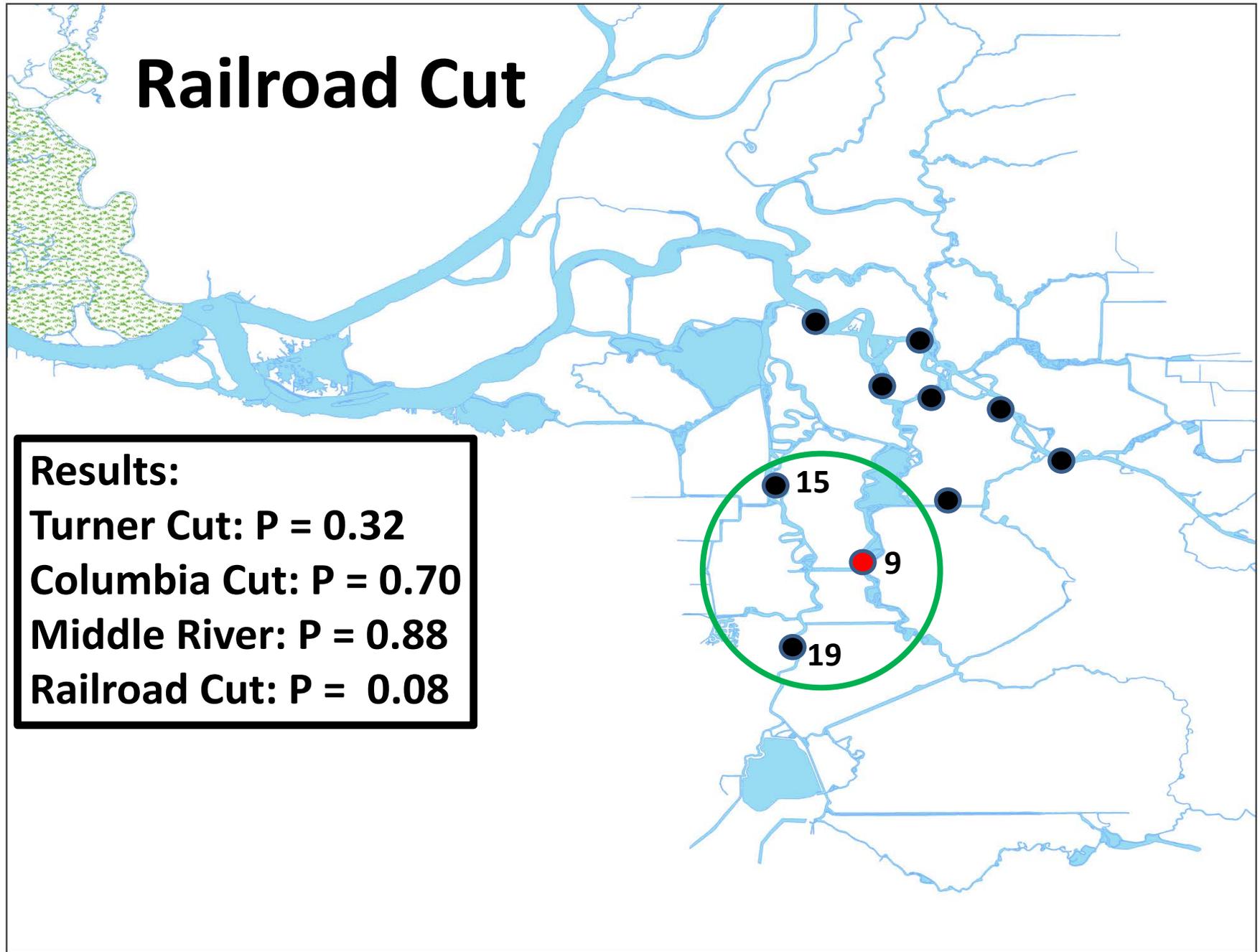
Results:

Turner Cut: $P = 0.32$

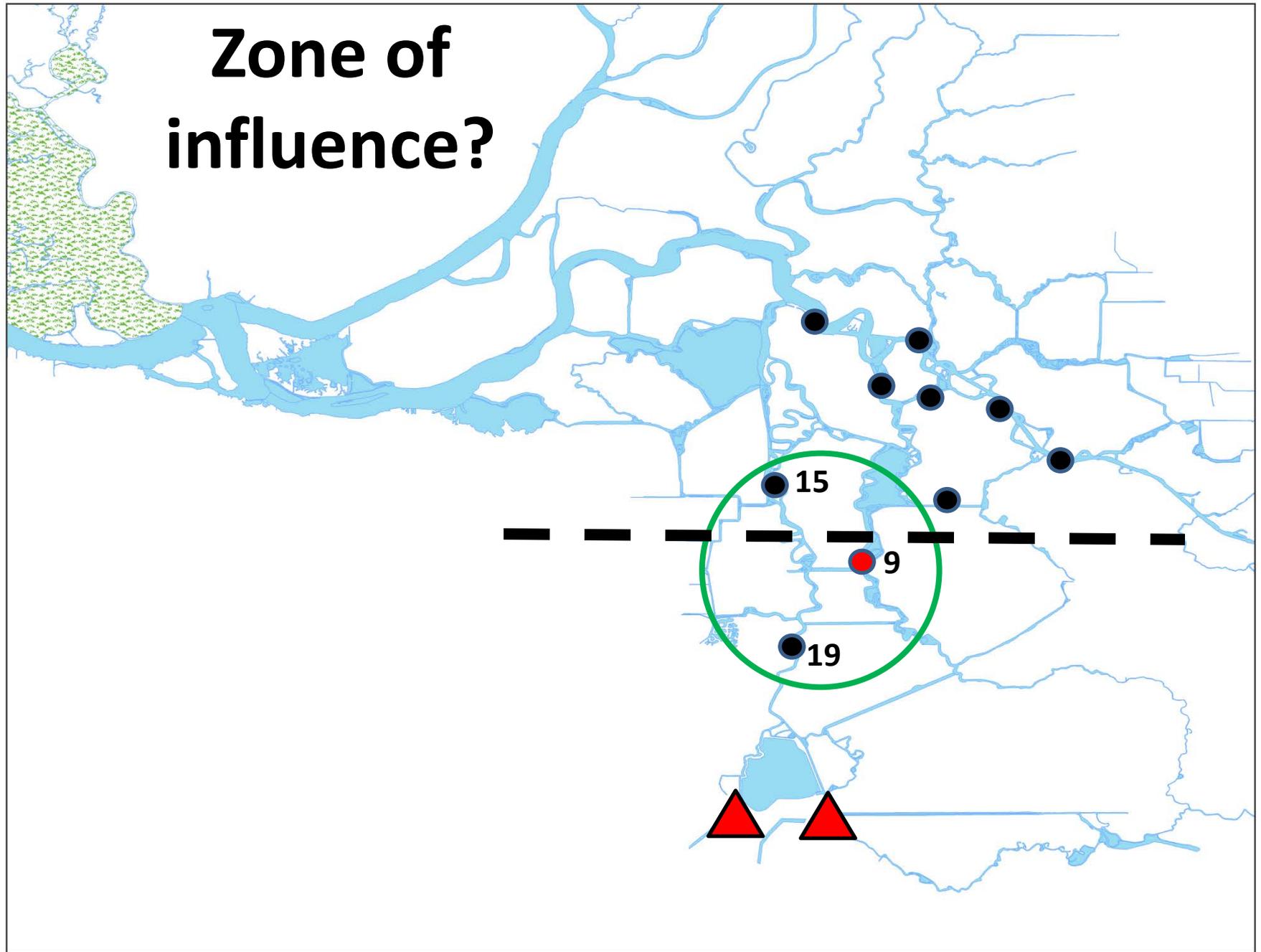
Columbia Cut: $P = 0.70$

Middle River: $P = 0.88$

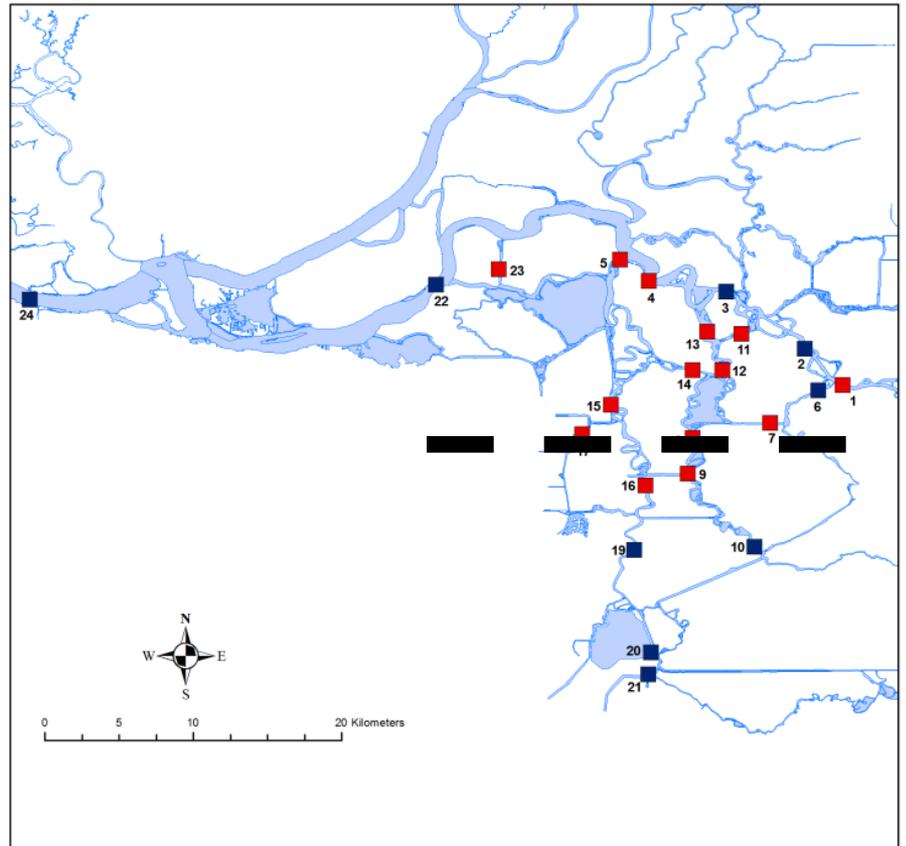
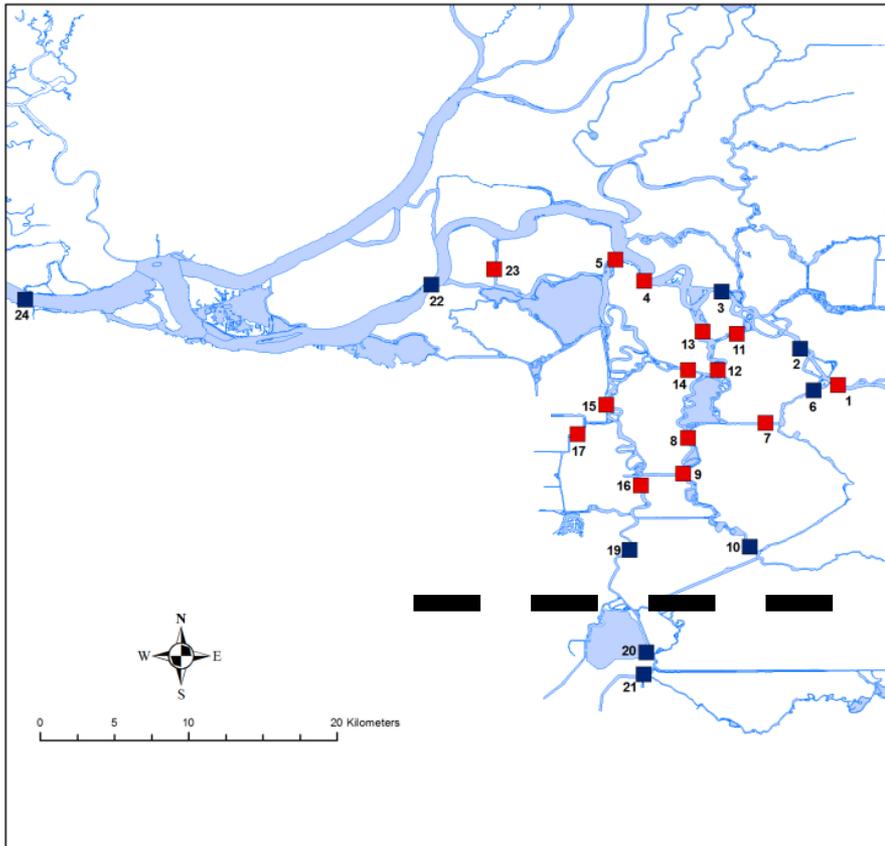
Railroad Cut: $P = 0.08$



Zone of influence?



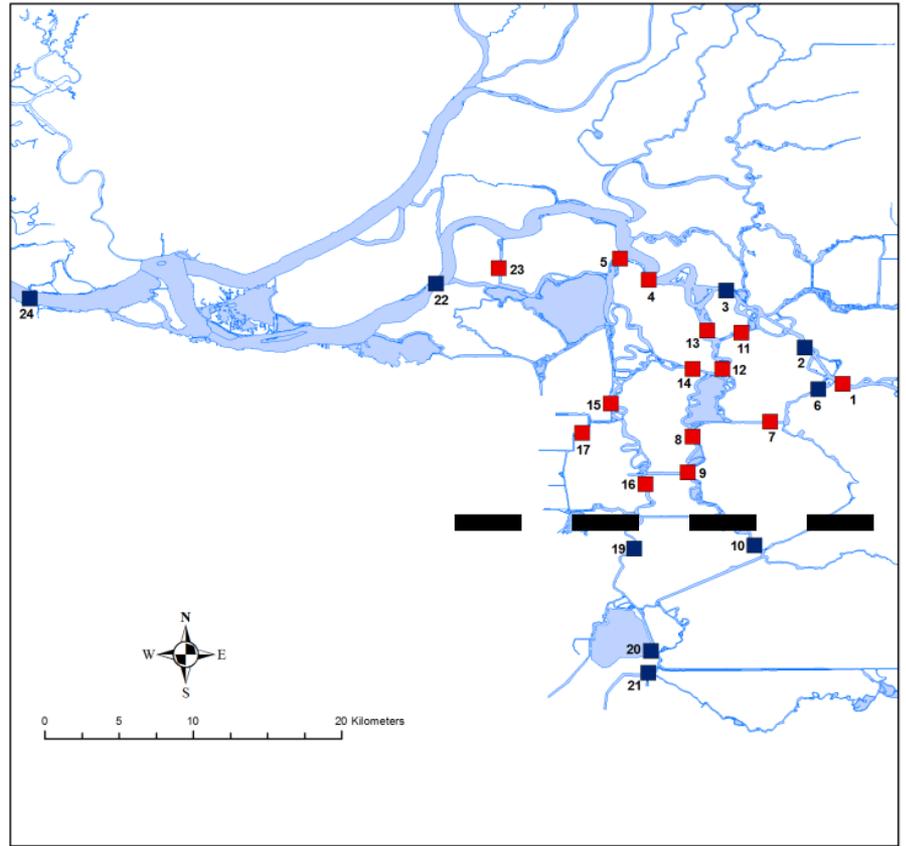
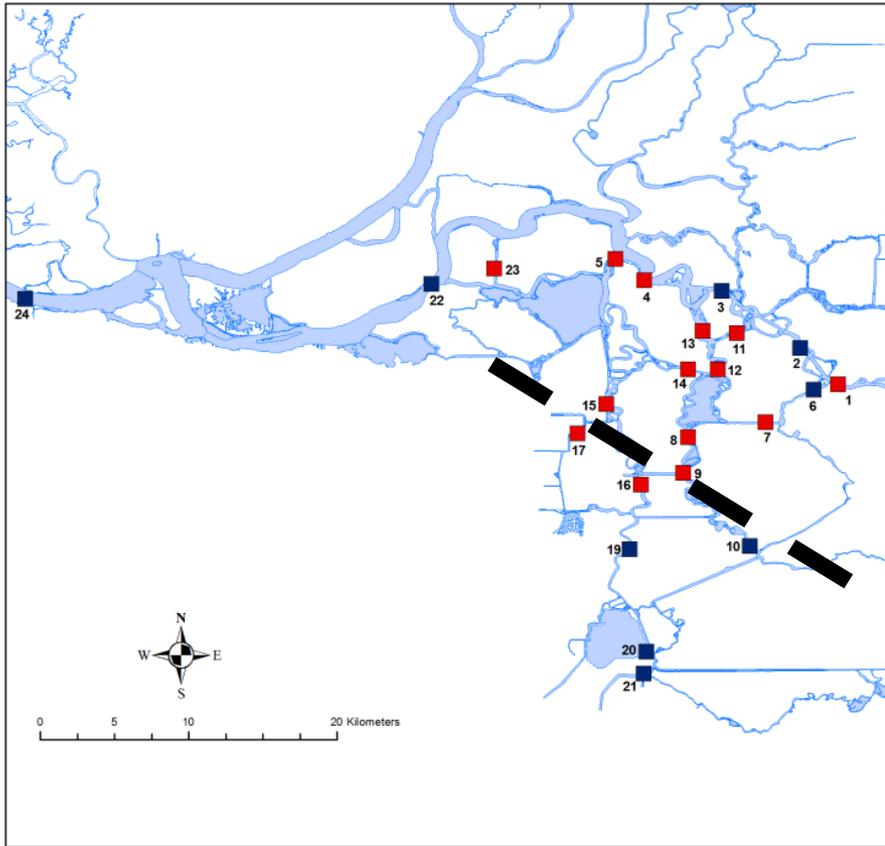
Expected results with zone of influence defined by OMR



**Less negative OMR flow
(release groups 1 and 2)**

**More negative OMR flow
(release group 3)**

Observed results



**Less negative OMR flow
(release groups 1 and 2)**

**More negative OMR flow
(release group 3)**

Conclusions

- Particle tracking model did not accurately predict the movement of steelhead tags
- No evidence OMR affected routing of steelhead tags at three San Joaquin junctions examined
- Weak evidence OMR influenced southward movement of steelhead tags at Railroad Cut
- Suggests localized zone of influence in the south Delta

Future studies

- Explore wider range of OMR flows
 - Larger sample size
 - Focus on areas closer to export facilities
 - Predation detector tags
- Meta-analysis



Web-based tool to display acoustic telemetry data:

<http://glimmer.rstudio.com/hinkelman/stip-study/>

The screenshot shows a web browser window displaying the URL <http://glimmer.rstudio.com/hinkelman/stip-study/>. The interface is divided into three main sections:

- Left Sidebar (Filters):**
 - Release group:** Three radio buttons are selected: "One", "Two", and "Three". There is an unchecked checkbox for "Show additional filter options". Below, it says "Number of tags in filtered group: 447".
 - Type of location playback:** Two radio buttons are present. The second one, "Play all locations for a selected tag in filtered group", is selected.
 - Individual tag selector:** A dropdown menu shows "1133669".
 - Play locations:** A horizontal slider ranging from 1 to 11.
 - Time between frames during playback (sec):** A horizontal slider ranging from 1 to 5.
 - Map type:** A dropdown menu shows "Terrain".
 - Map size:** A horizontal slider ranging from 500 to 1,000.
- Central Map:** A Google Maps view showing a region in California. The Sacramento River and San Joaquin River are visible. Key locations include Brannan Island State Recreation Area, Franks Tract State Recreation Area, Sherman Lake, Point Pittsburg, Antioch, Oakley, Brentwood, Discovery Bay, and Clifton Court Forebay. Numerous black dots represent tracking points, with one red dot indicating the current location of tag 1133669.
- Right Sidebar (Tag Details):**
 - Tag serial number: 1133669
 - Release group: 1
 - Release date: 2012-04-16 12:02:00
 - Detected at export facility: Yes
 - Arrived at Chipps: No
 - Array: 1
 - Arrival date: 2012-04-17 02:06:47
 - Departure date: 2012-04-17 16:07:00
 - Number of detections: 27
 - Residence time: 14 hrs
 - Time since release: 1.2 days

At the bottom right, there is a logo for **CRAMER FISH SCIENCES** and a footer that reads "Powered by Shiny. Hosted by RStudio."

Web-based tool to display acoustic telemetry data: <http://glimmer.rstudio.com/hinkelman/stip-study/>

The screenshot shows a web browser window displaying the Glimmer tool interface. The browser address bar shows the URL: glimmer.rstudio.com/hinkelman/stip-study/.

Left Panel (Filters and Playback Controls):

- Release group:** One, Two, Three (all checked). Show additional filter options. Number of tags in filtered group: 447.
- Type of location playback:** Play all locations for all tags in filtered group. Play all locations for a selected tag in filtered group.
- Individual tag selector:** Dropdown menu showing "1133669".
- Play locations:** A horizontal slider with a blue marker at approximately 10%.
- Time between frames during playback (sec):** A horizontal slider with a blue marker at approximately 2 seconds. Below the slider, text reads: "A shorter time between frames increases playback speed but also increases the likelihood that the map display will lag behind the playback slider."
- Map type:** Dropdown menu showing "Terrain".
- Map size:** A horizontal slider with a blue marker at approximately 750.

Center Panel (Map):

A map showing the Sacramento River region. The map includes labels for Rio Vista, Sherman Lake, Point Pittsburg, Antioch, Oakley, Brentwood, Discovery Bay, Clifton Court Forebay, Blackhawk, and Morgan Territory Regional Preserve. A red dot on the map indicates the location of tag 1133669. The map data is attributed to ©2014 Google.

Right Panel (Tag Details):

- Tag serial number: 1133669
- Release group: 1
- Release date: 2012-04-16 12:02:00
- Detected at export facility: Yes
- Arrived at Chippis: No
- Array: 1
- Arrival date: 2012-04-17 02:06:47
- Departure date: 2012-04-17 16:07:00
- Number of detections: 27
- Residence time: 14 hrs
- Time since release: 1.2 days

Bottom Right Panel:

- Logo for CRAMER FISH SCIENCES.
- Text: Powered by Shiny. Hosted by RStudio.

Footer: Screencast-O-Matic.com

Acknowledgements

Agencies



Consultants



HANSON ENVIRONMENTAL, INC.

