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

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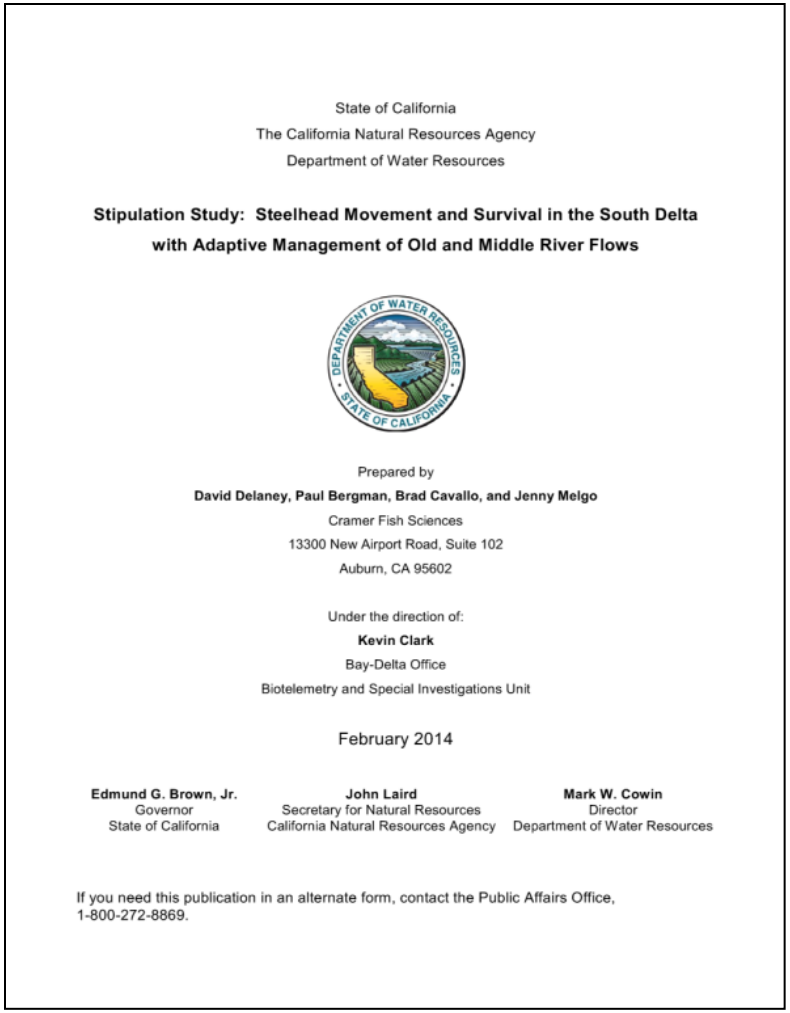
Outline

- 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



State of California
The California Natural Resources Agency
Department of Water Resources

Stipulation Study: Steelhead Movement and Survival in the South Delta with Adaptive Management of Old and Middle River Flows

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Edmund G. Brown, Jr.	**John Laird**	**Mark W. Cowin**
Governor	Secretary for Natural Resources	Director
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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

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Overview

When:

- Spring of 2012

What:

- Collaborative acoustic telemetry study

Study species:

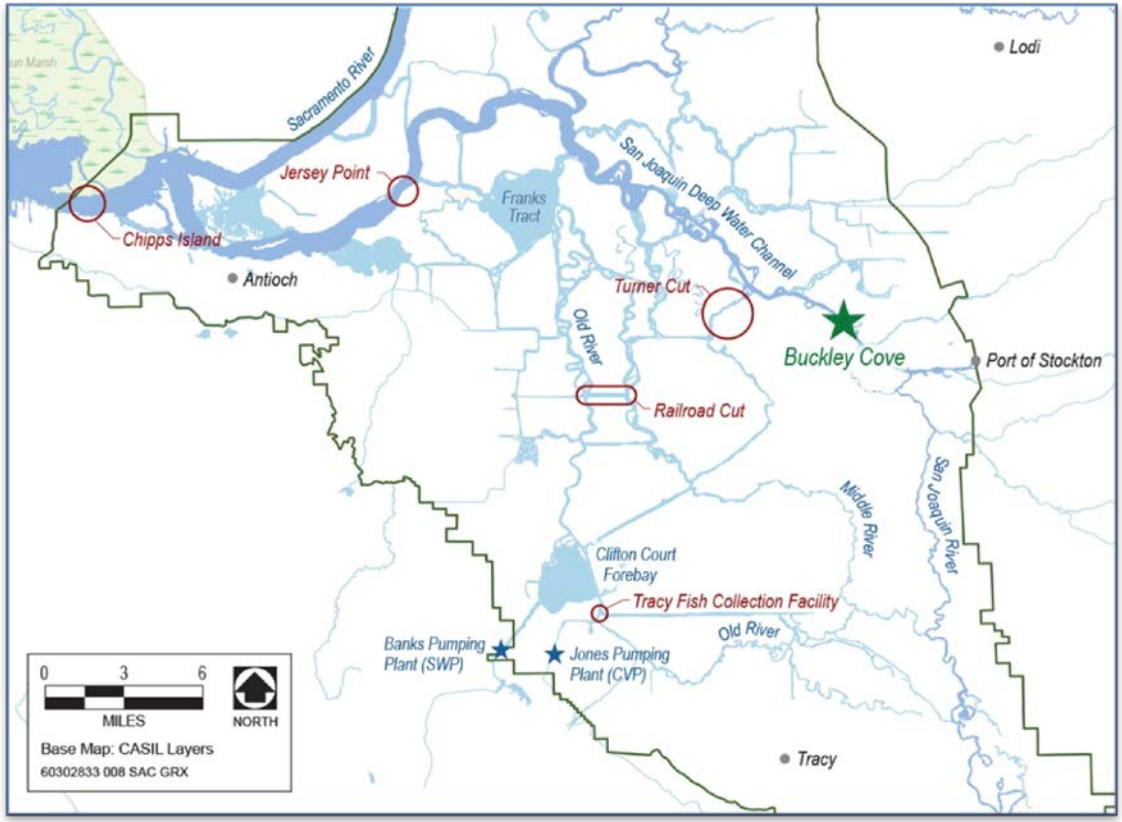
- Hatchery-raised juvenile steelhead

Release site:

- Buckley Cove

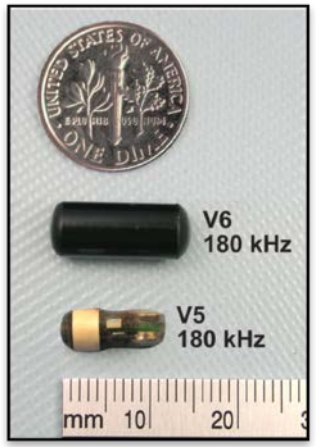
Data collected for:

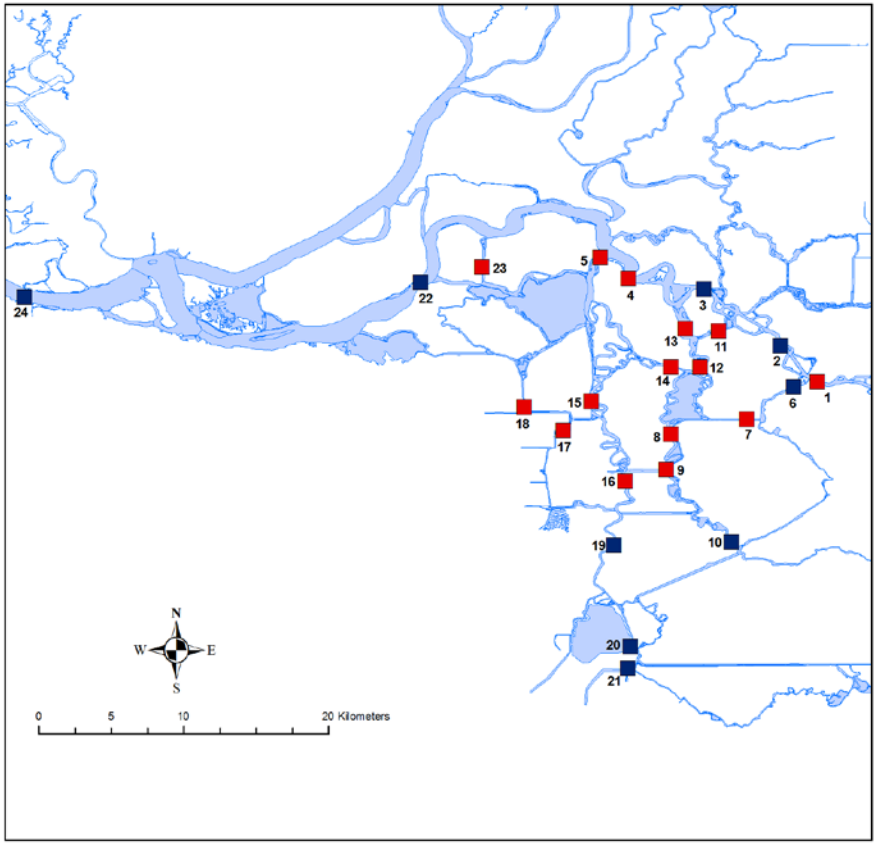
- Central and south Delta



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

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- **Observed average OMR flows:**
  - Release group 1: -2,446 cfs
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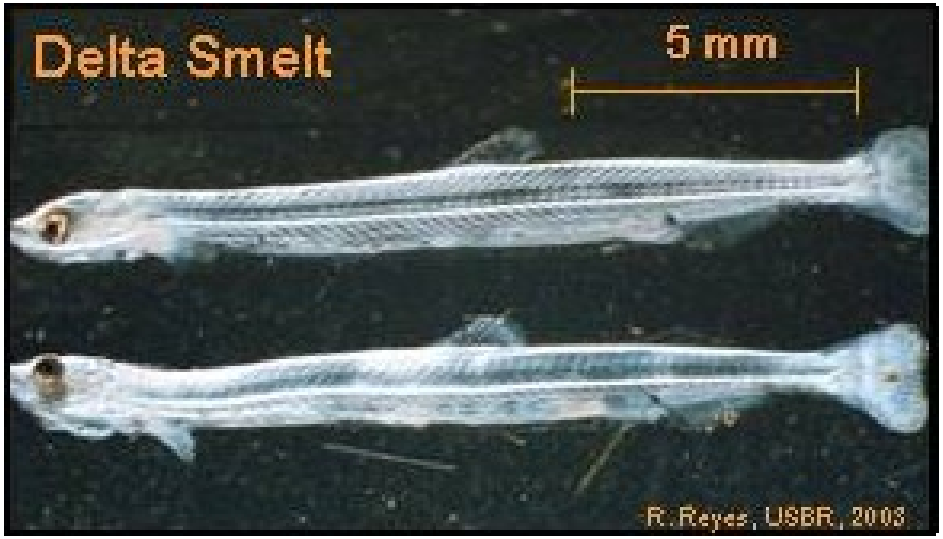
  - Release group 3: -5,038 cfs
- **Compare data from release groups 1 and 2 to release group 3**
  - **Less negative OMR flows**
    - Release groups 1 and 2
  - **More negative OMR flows**
    - Release group 3

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?

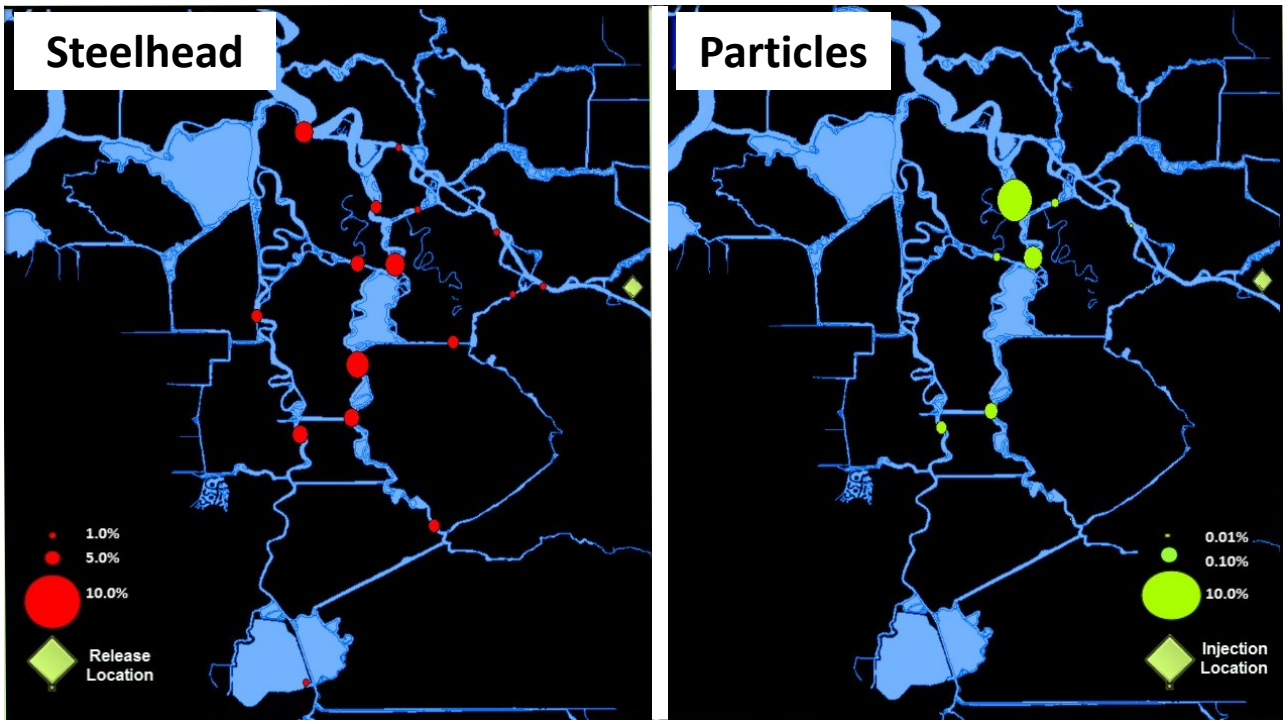
- Null hypothesis:
  - Distance traveled by steelhead tags not significantly different than distance traveled by particles



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

Can the particle tracking model predict the movement of steelhead?

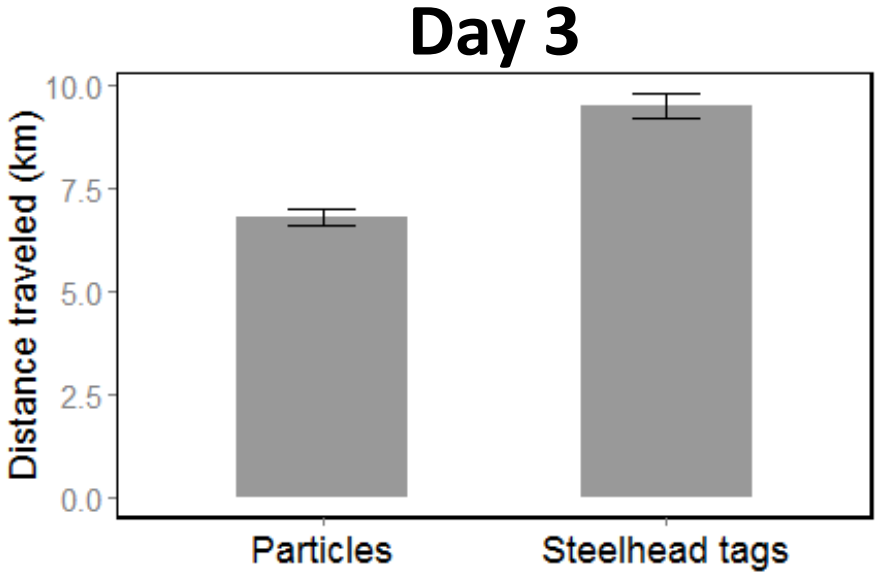
- Approach:
  - Distance traveled 3 and 7 days after release
  - Euclidean distance
  - Each day analyzed with a t-test



Results for comparing particle to tag data

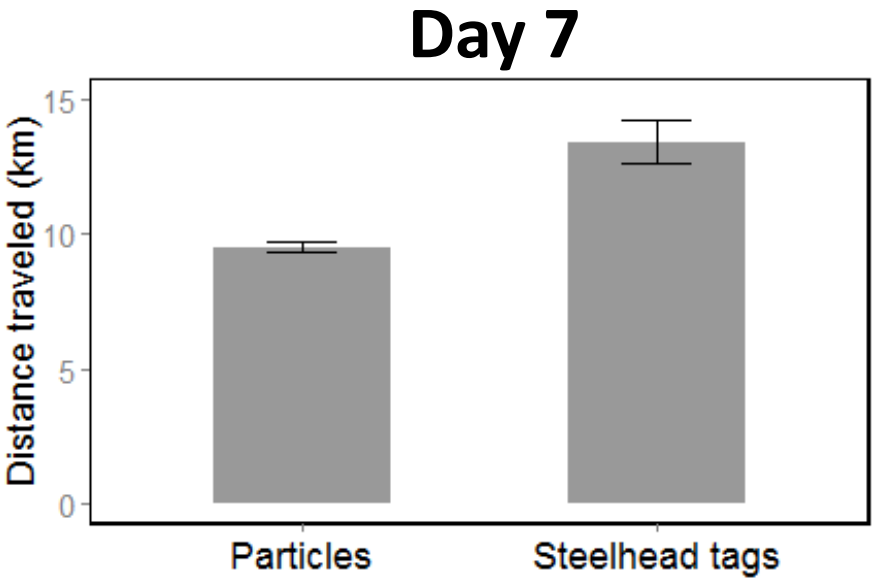
Day 3:

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

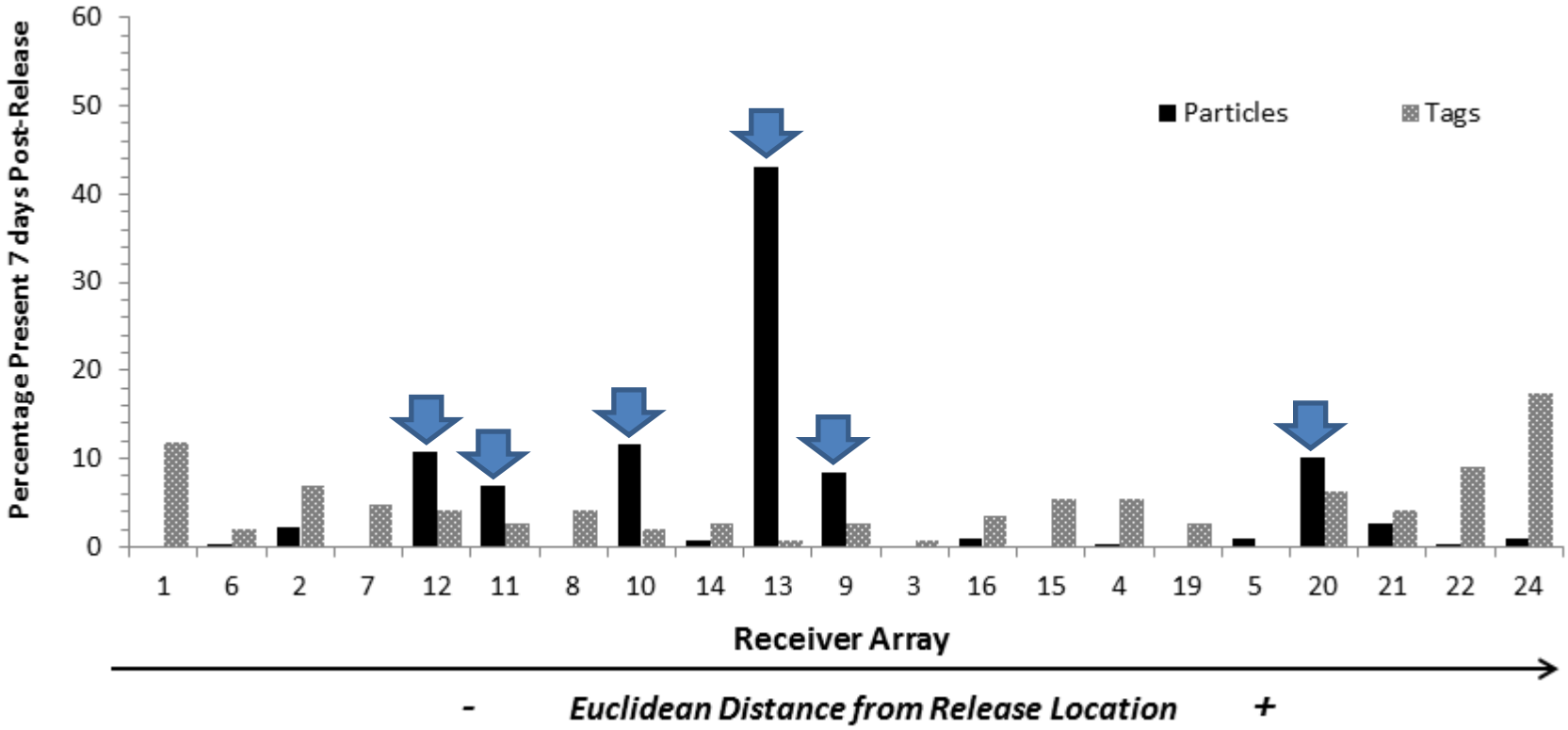


Day 7:

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

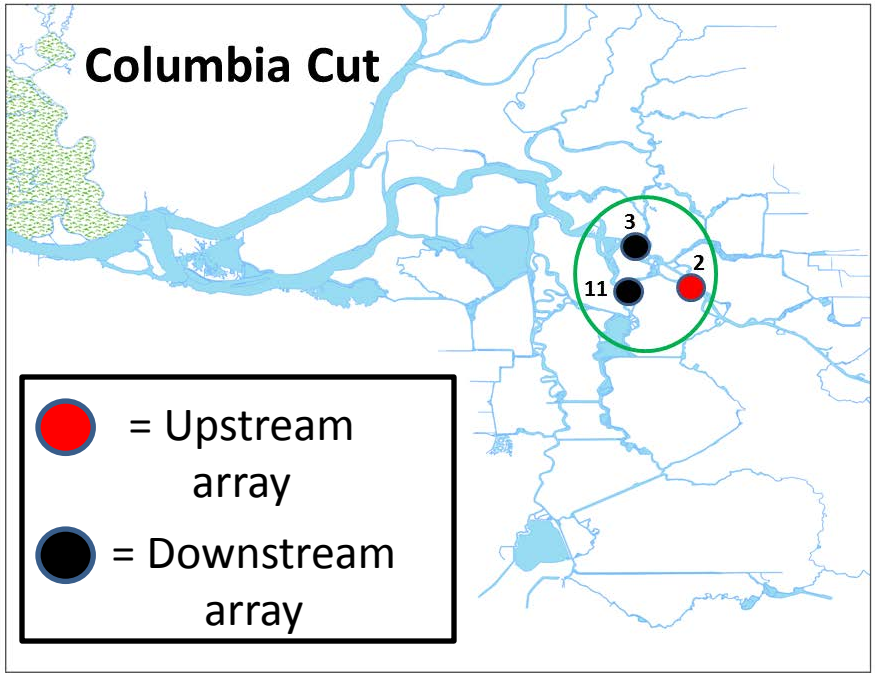


Results for day 7

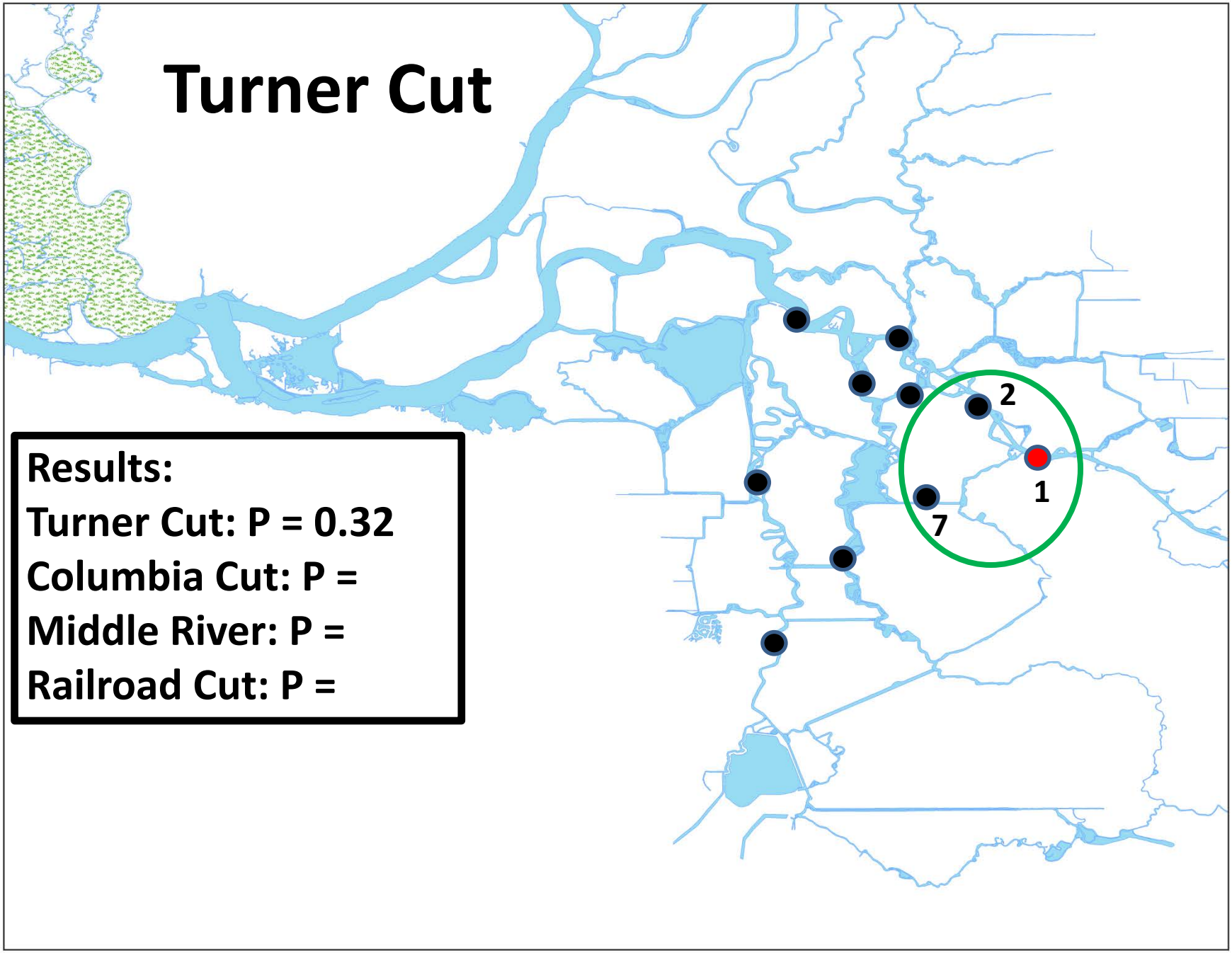


Methods for the junction analyses

- 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:

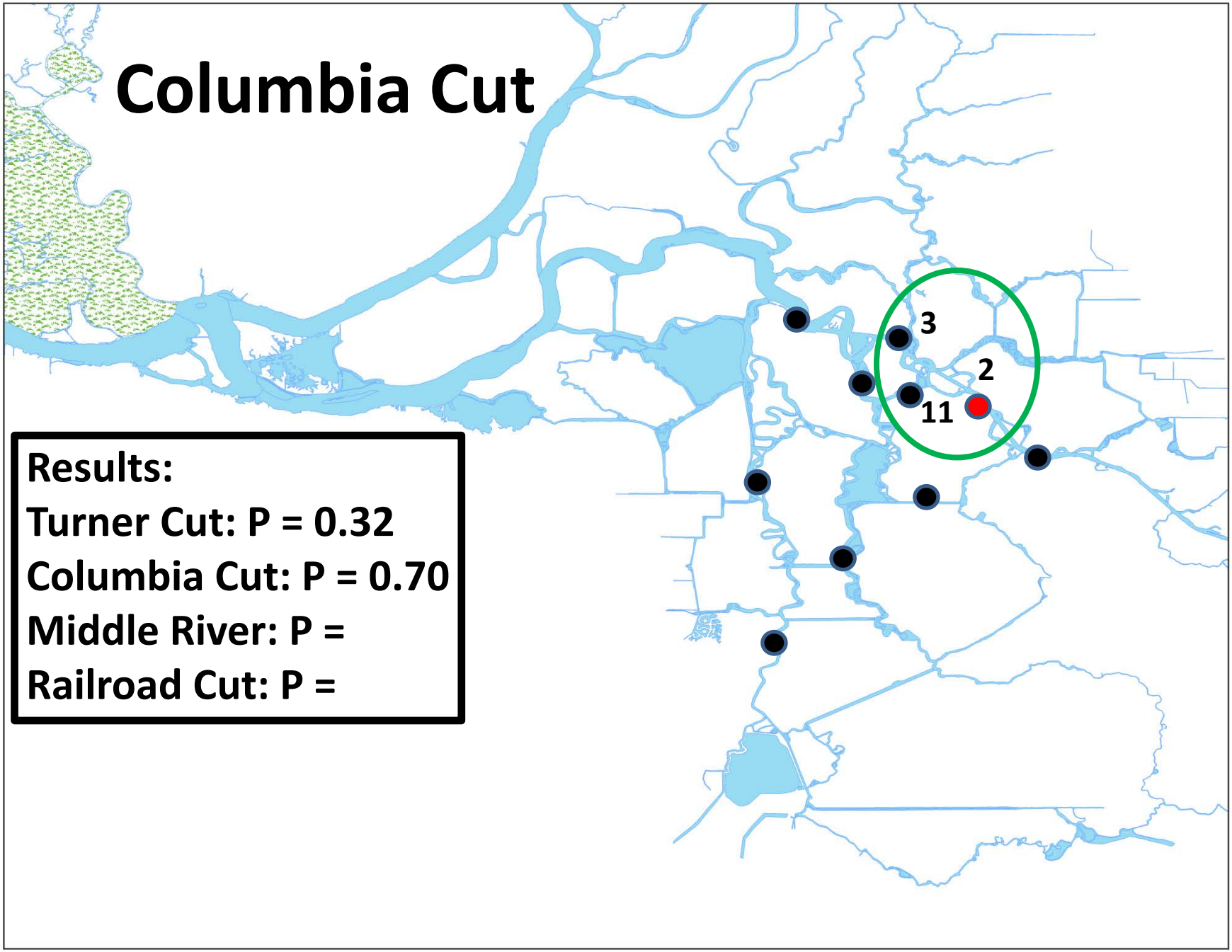
Turner Cut: P = 0.32

Columbia Cut: P =

Middle River: P =

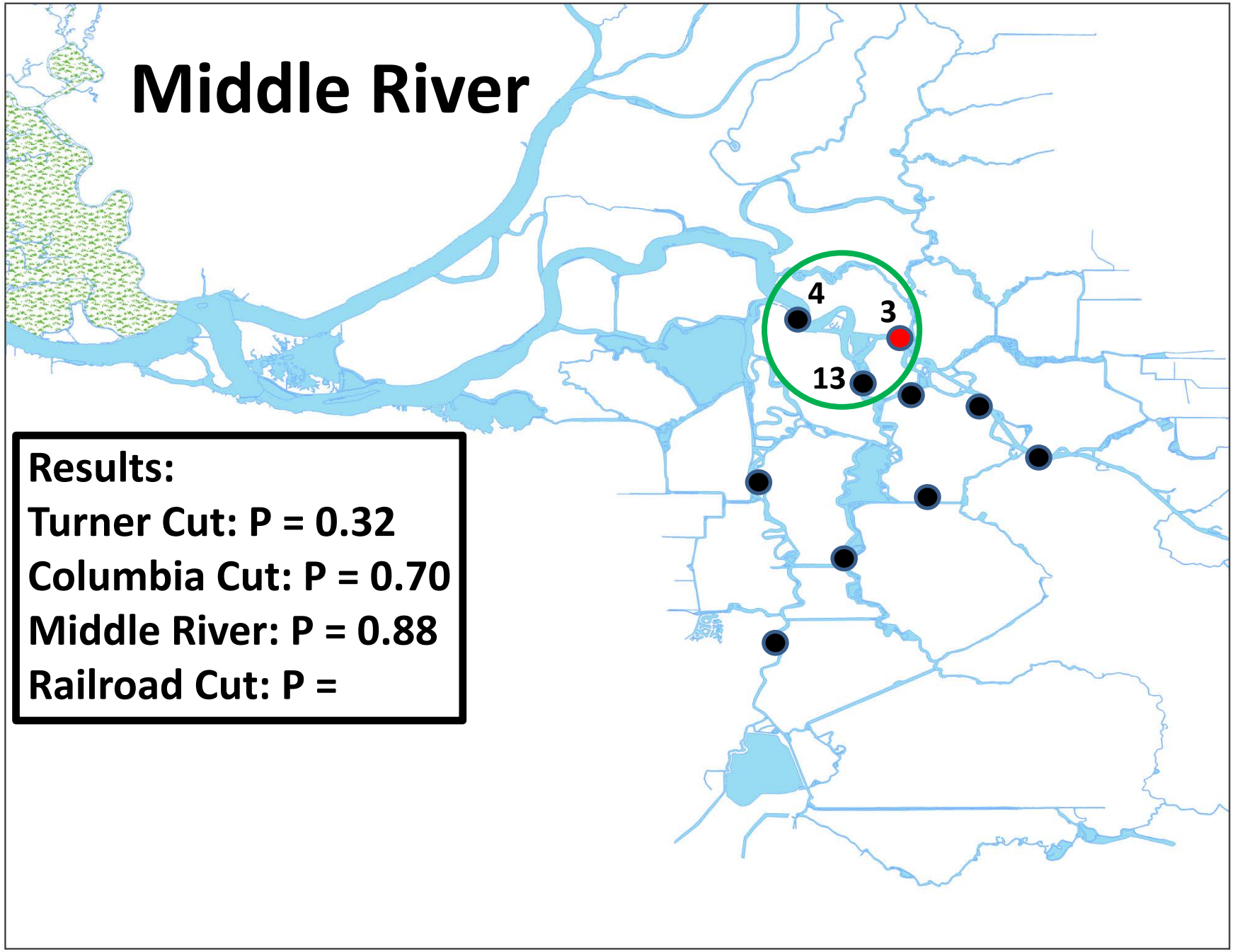
Railroad Cut: P =

Columbia Cut



Results:
Turner Cut: P = 0.32
Columbia Cut: P = 0.70
Middle River: P =
Railroad Cut: P =

Middle River



Results:

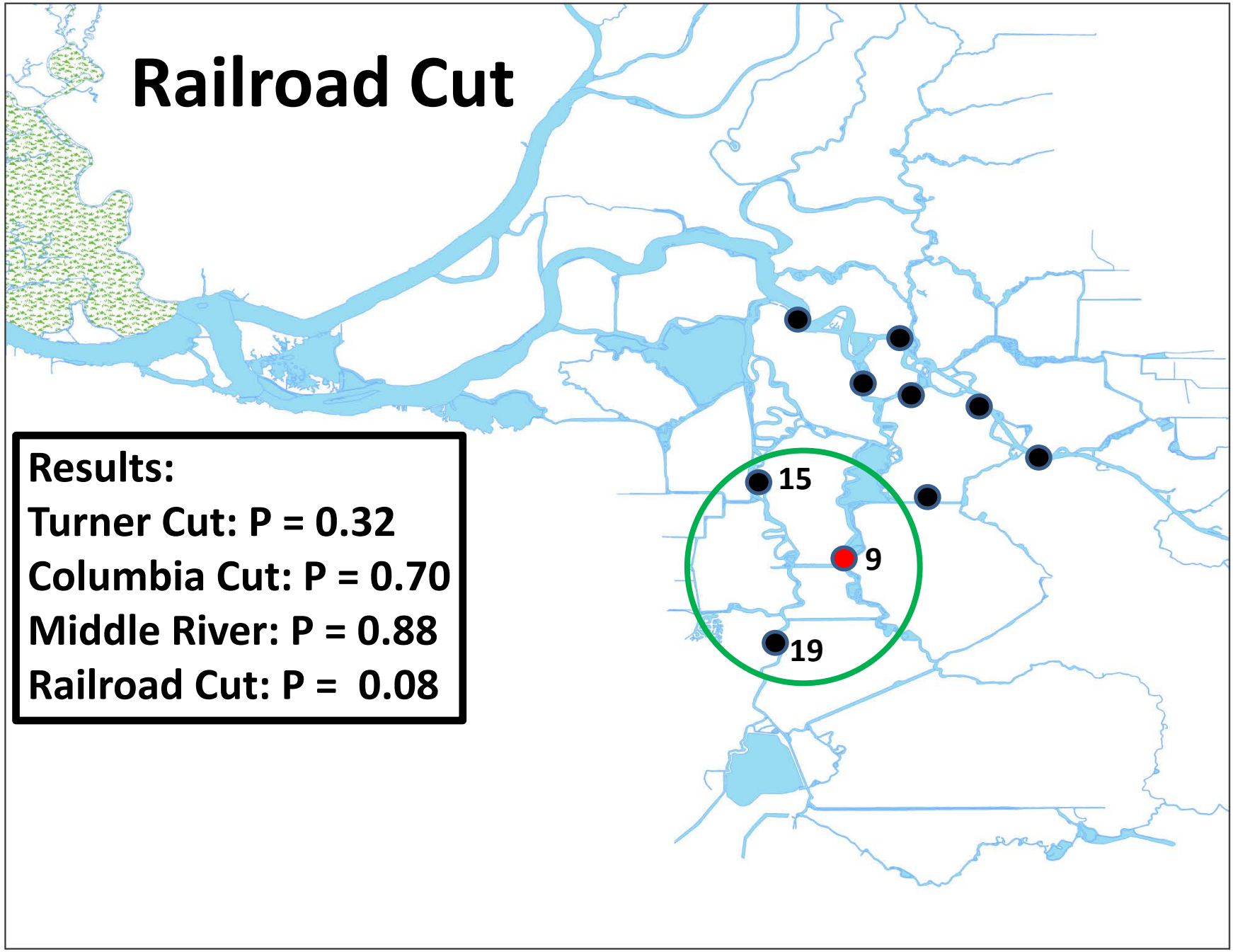
Turner Cut: P = 0.32

Columbia Cut: P = 0.70

Middle River: P = 0.88

Railroad Cut: P =

Railroad Cut



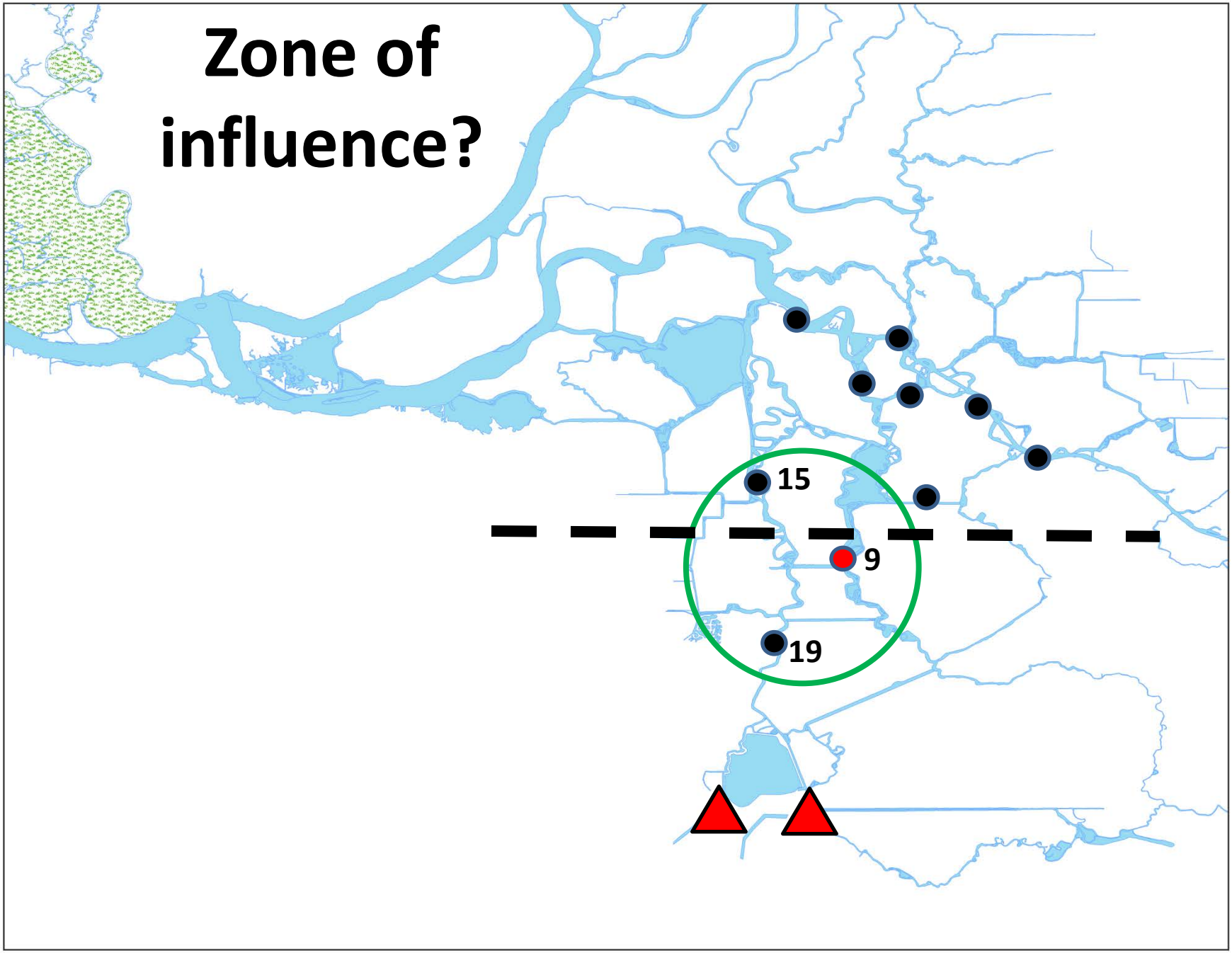
Results:

Turner Cut: P = 0.32

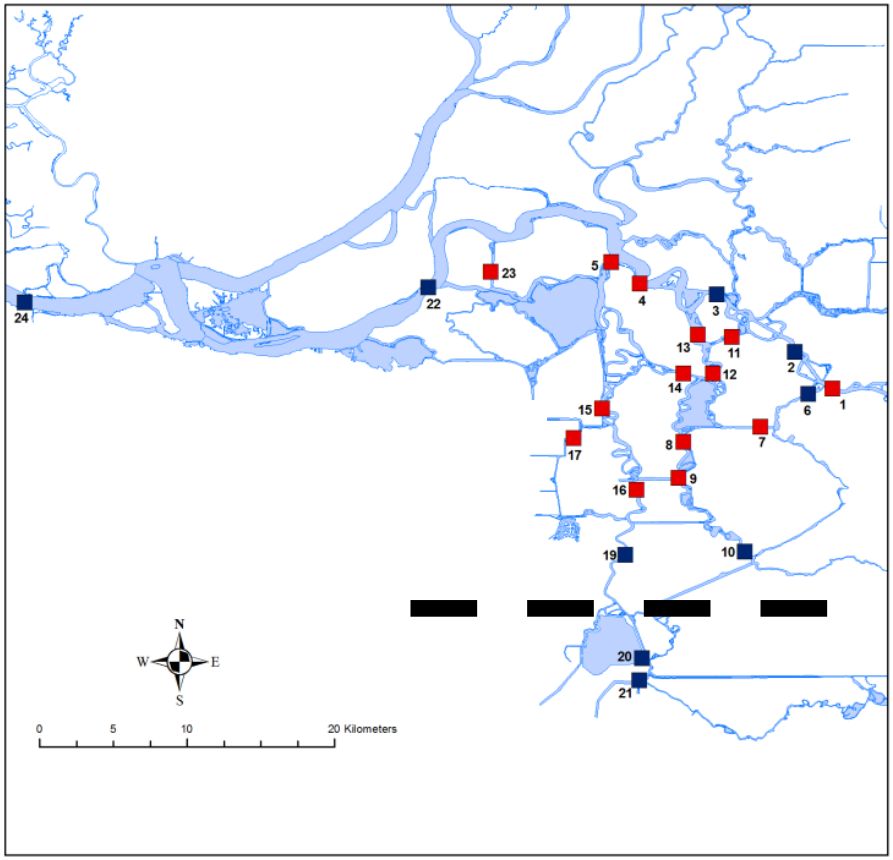
Columbia Cut: P = 0.70

Middle River: P = 0.88

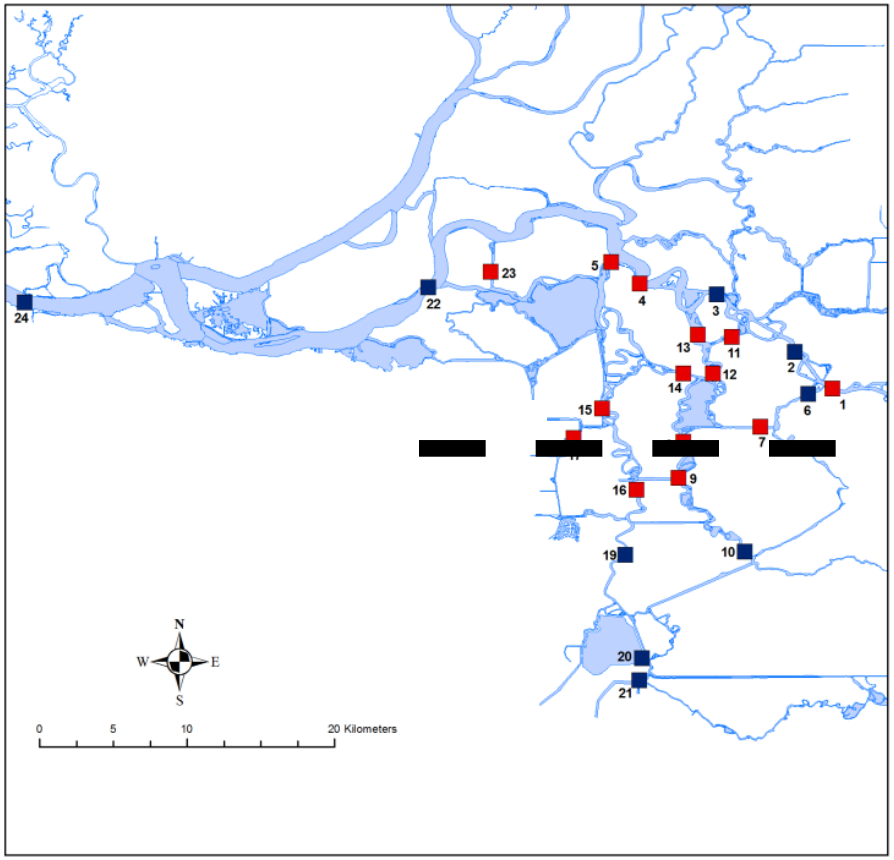
Railroad Cut: P = 0.08


Zone of influence?
15
9
19

Expected results with zone of influence defined by OMR

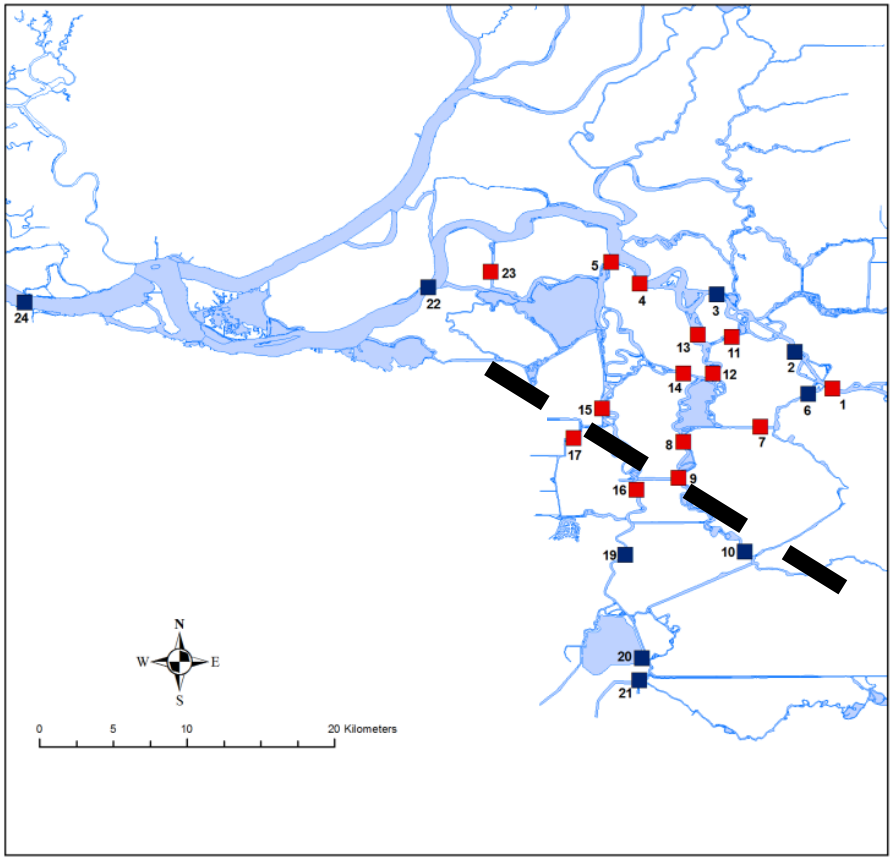


Less negative OMR flow (release groups 1 and 2)

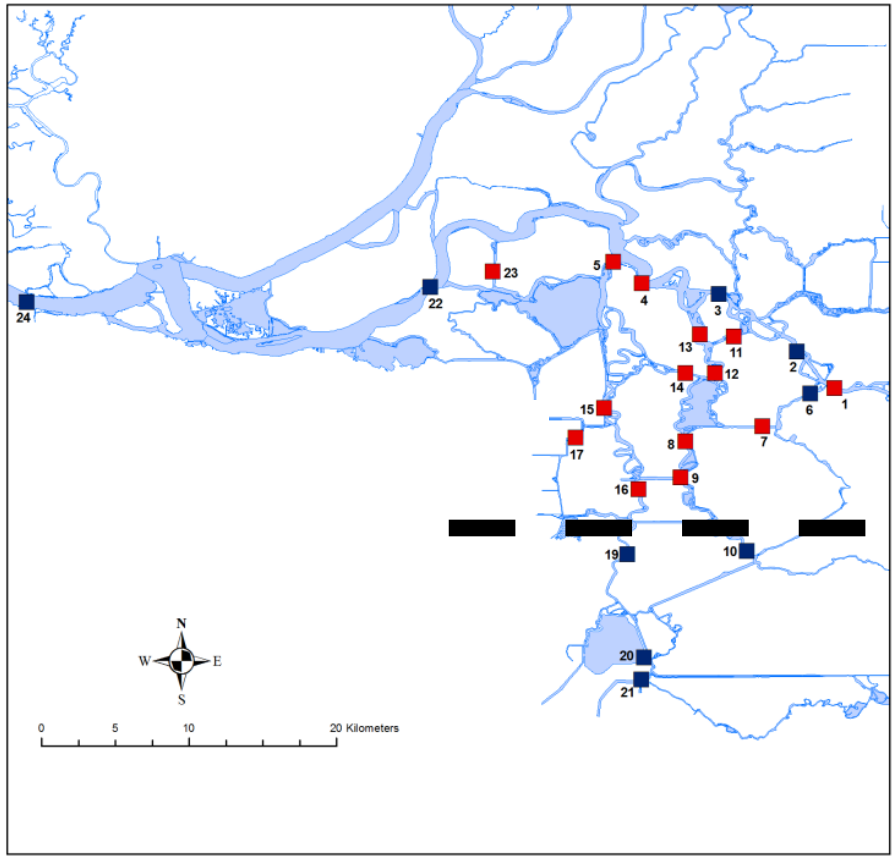


More negative OMR flow (release group 3)

Observed results



Less negative OMR flow (release groups 1 and 2)



More negative OMR flow (release group 3)

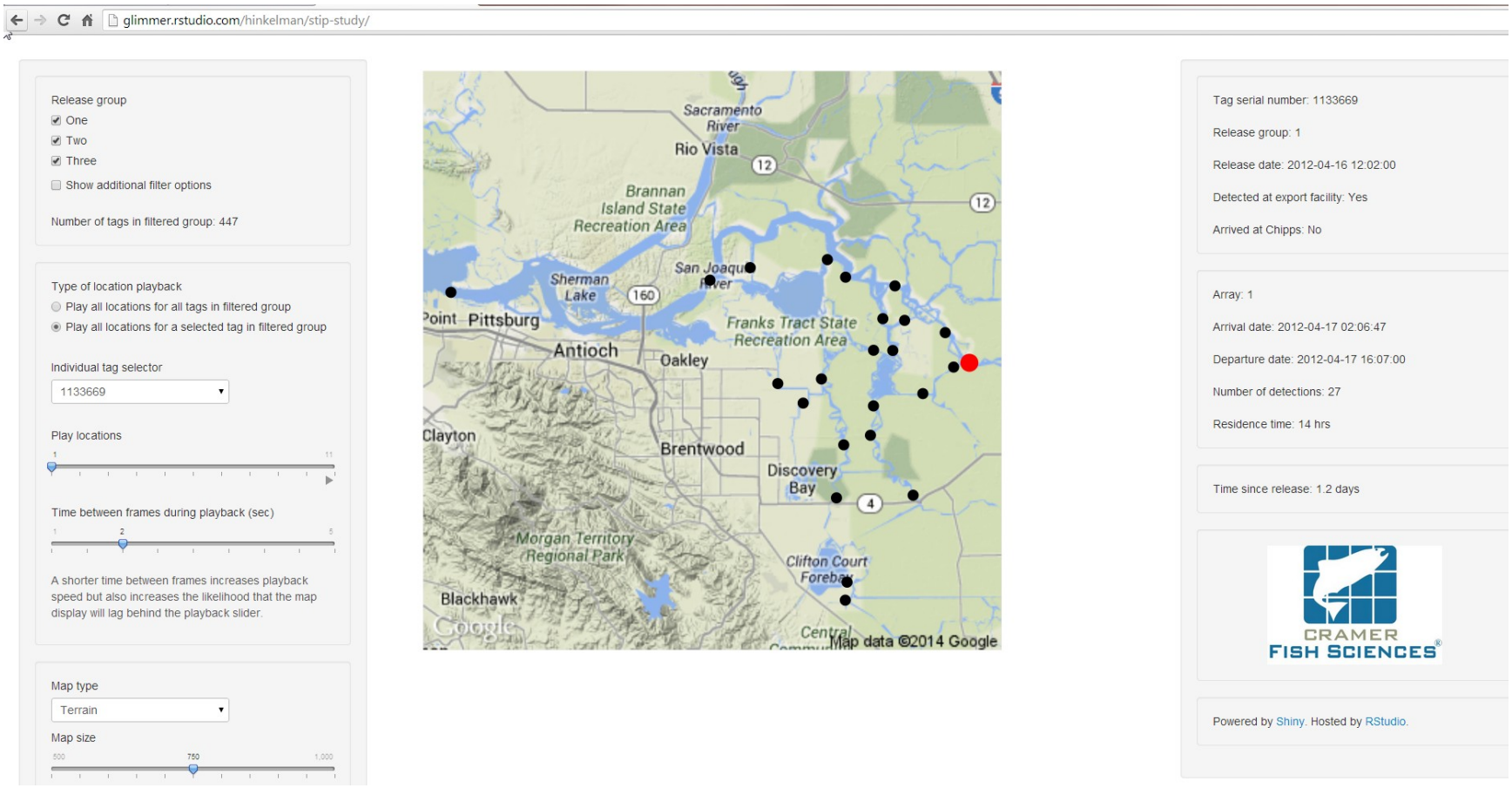
Conclusions

- 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/



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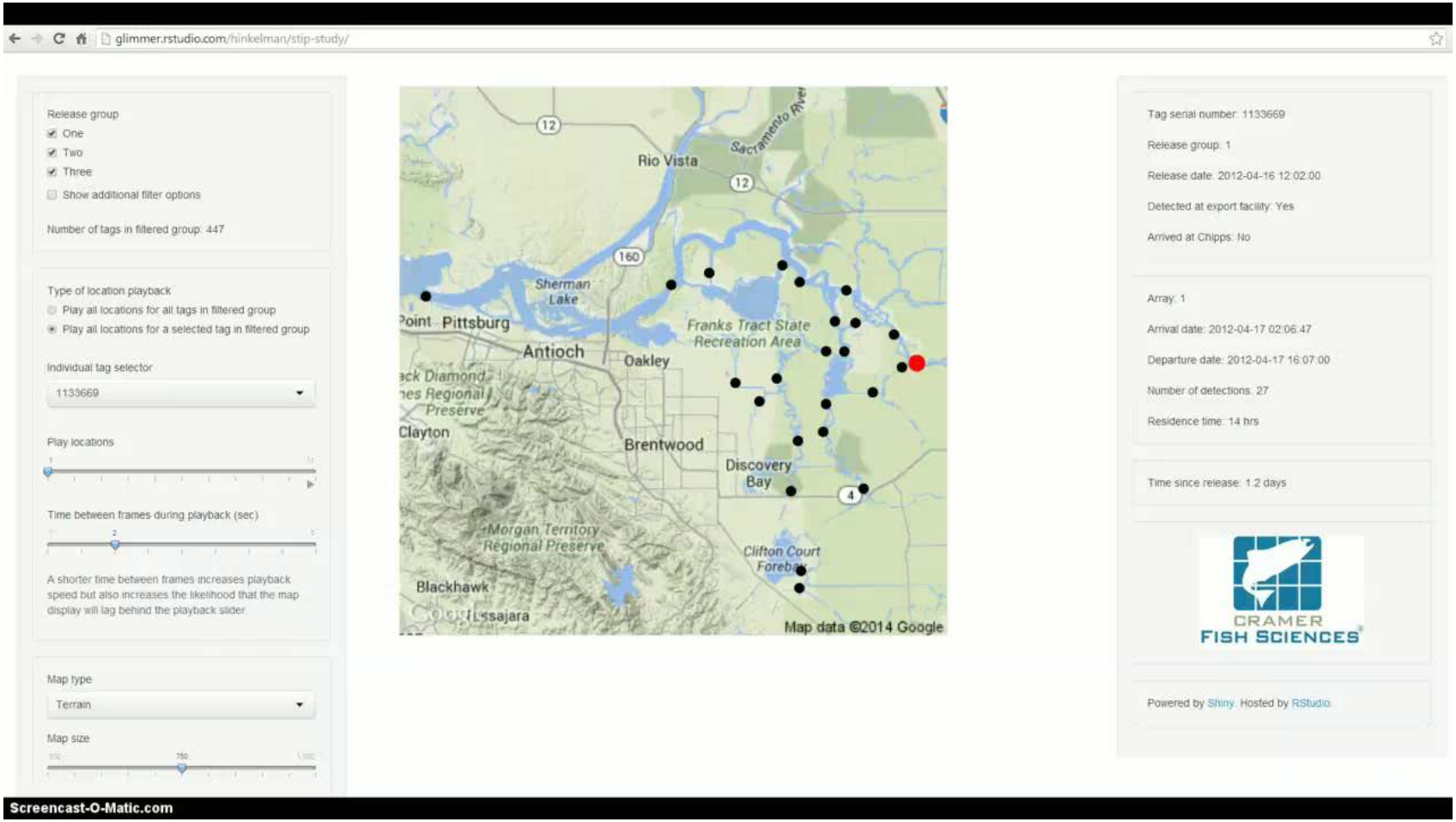

Acknowledgements

Agencies

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