

# Predator Diet and Movement Patterns in the Lower Feather River and Their Effects on Hatchery Smolts

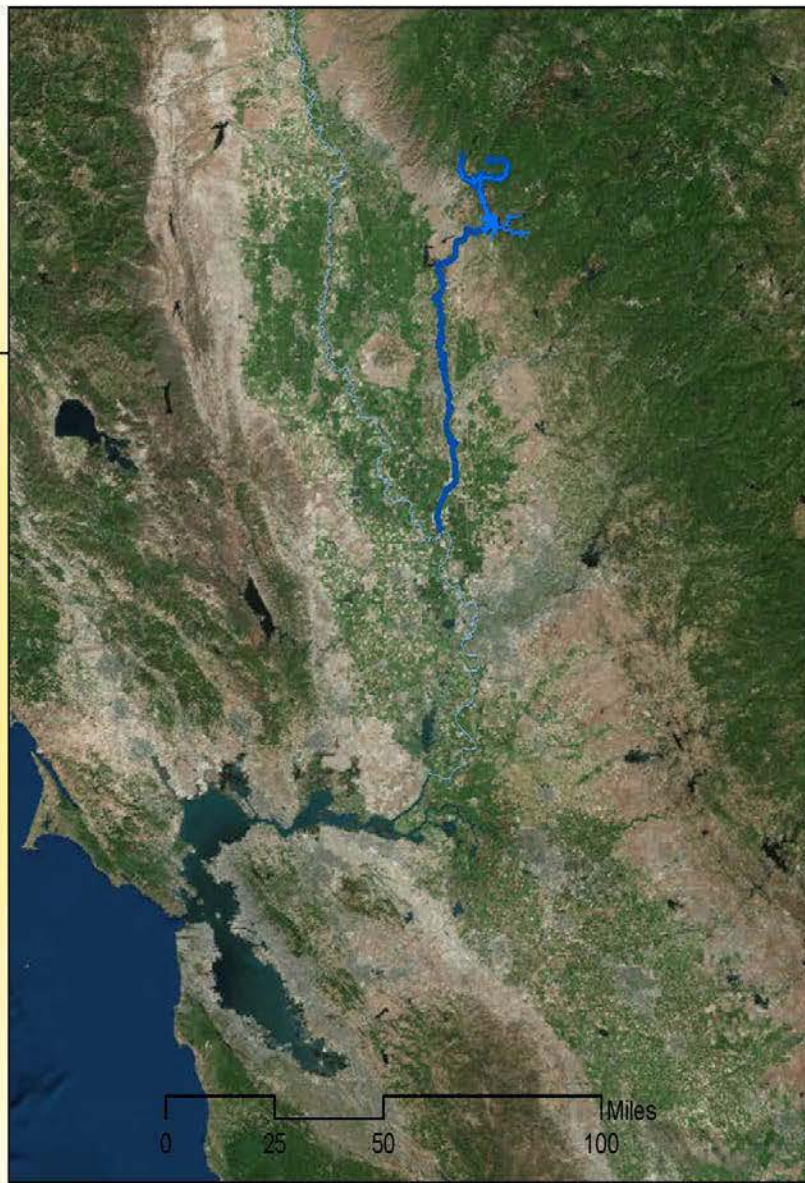
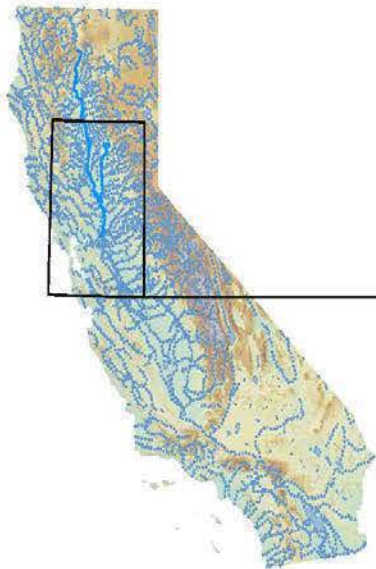
Andrew Hampton and Ryon Kurth



# Outline

- Area
- Background
- Previous Studies
- Planned Study
- Methods
- Tagging/Movement
- Stomach Sampling
- Future Considerations



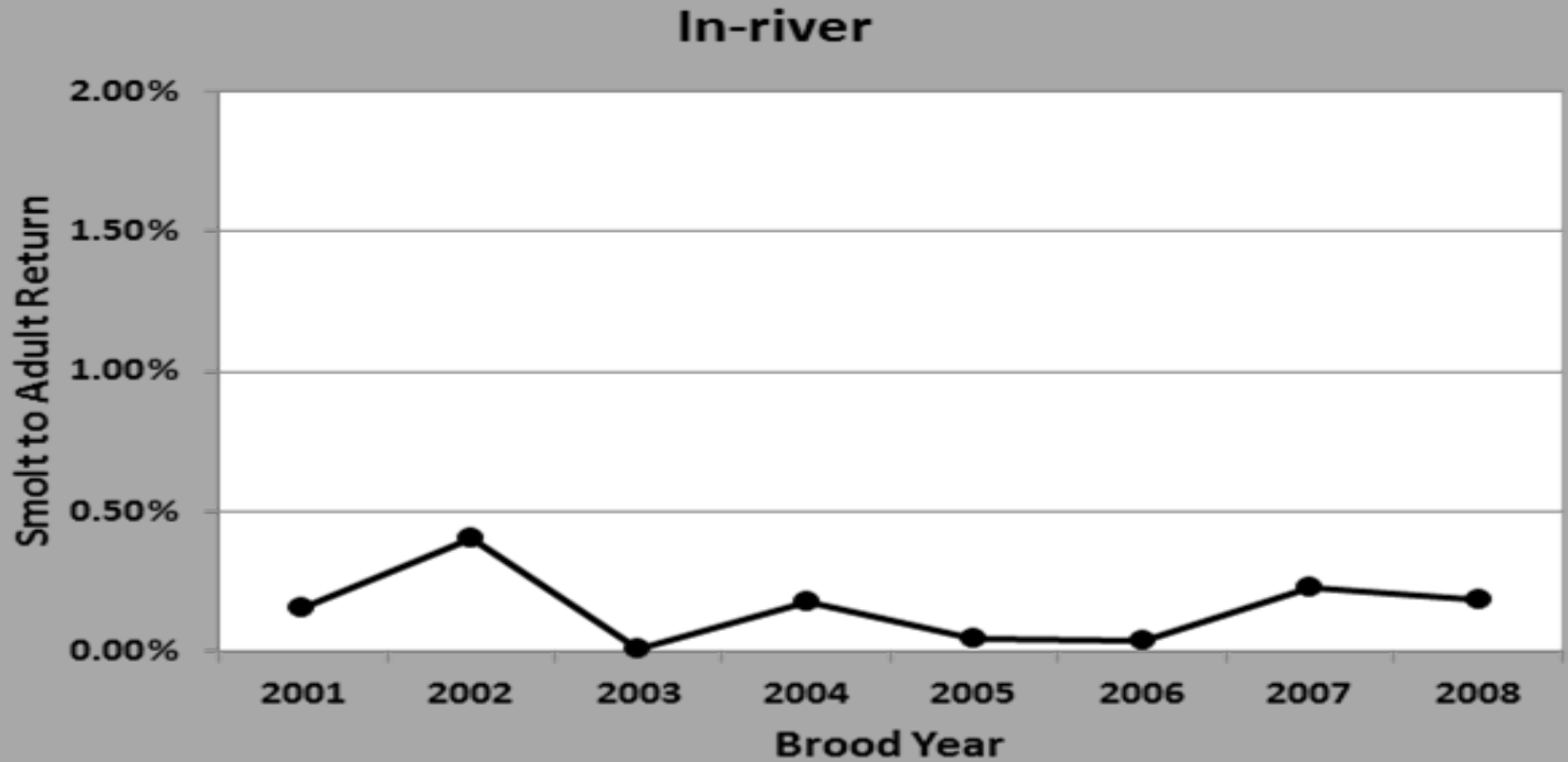


Cartographer: Katie Lentz, November 2016  
Source: California Department of Water Resources, Feather River Fisheries Program, 2016  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEK, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

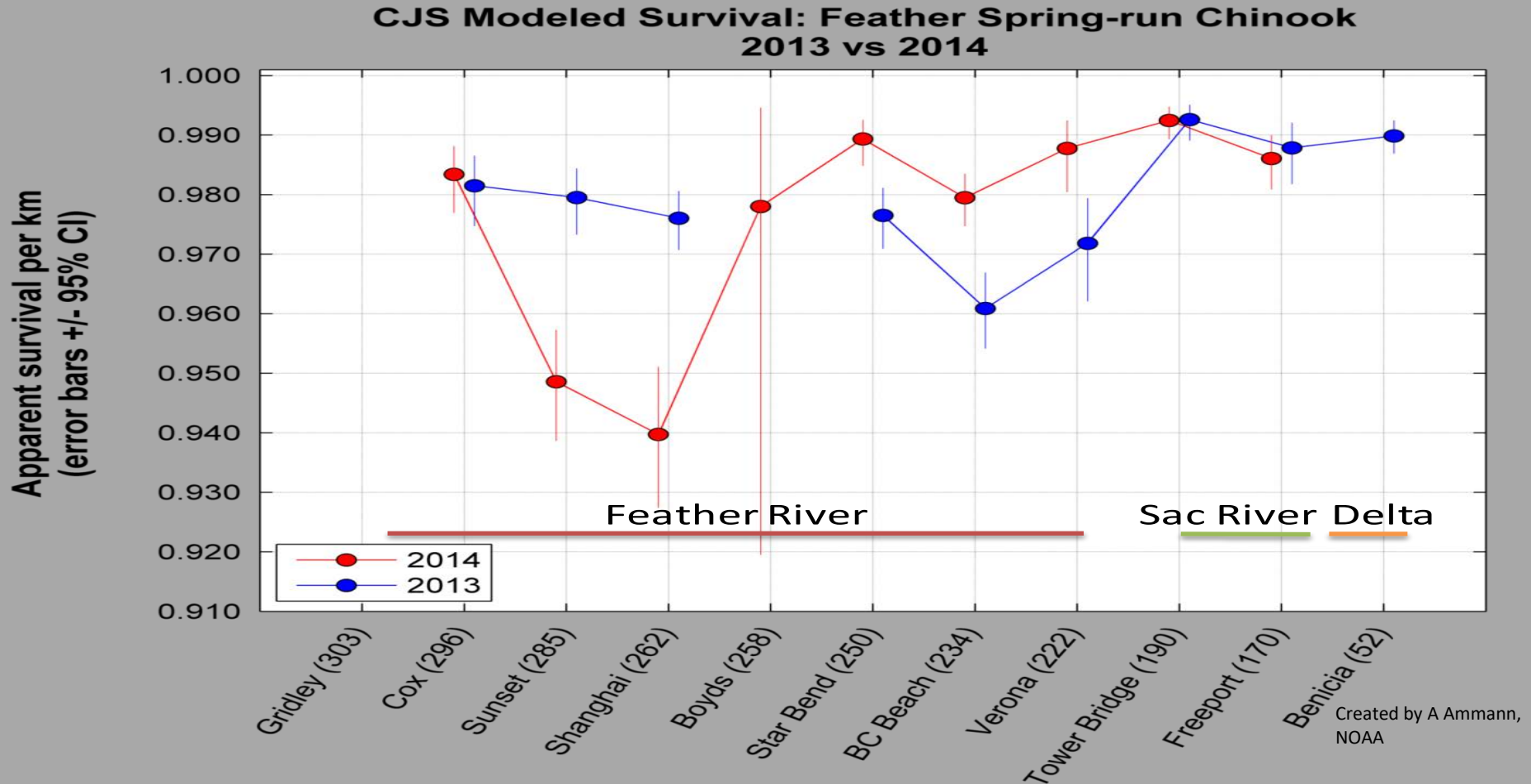
# Why take a look at predators?

- Already know of poor return rate to hatchery for CVST and Spring run Chinook
  - Both of which are in river released juveniles
  - Observed high estimates of mortality in previous studies
- Patterns in mortality varied annually
  - River conditions at release?
  - Predator presence and/or abundance?

# Smolt to adult return rate of in-river released spring run salmon.



# Apparent survival of out migrating JSAT tagged spring run smolts.



# Original Study Plan

- Mark-recapture study on predators over three years
  - Predator population size
  - Consumption rates
  - Bioenergetics model
- Look at the relationship between acoustic tagged predators and in-river released acoustic tagged juvenile spring run salmon
- Look at diet composition of predators
- Target in-river hatchery release of juvenile salmonids to study predator impact



# ~~Original Study Plan~~ Actual Study

- ~~Mark-recapture study on predators over three years~~ Low catch numbers
- ~~Predator population size~~ we were not able to capture/recapture enough fish to make an estimate
  - ~~Consumption rates~~ could not calculate
  - ~~Bioenergetics model~~
- ~~Look at the relationship between acoustic tagged predators and in-river released acoustic tagged juvenile spring run salmon~~ Low number of acoustic tagged predators the first year and no funding for further JSAT studies on the Feather moving forward
- Look at diet composition of various predator species throughout the river and across seasons
- Target hatchery release of juvenile salmonids to study impact of predators



# Methods

- Acoustic Tagging
  - Captured fish by fyke and angling
    - Targeting Striped Bass
    - Fished January - May
  - Track predator movements

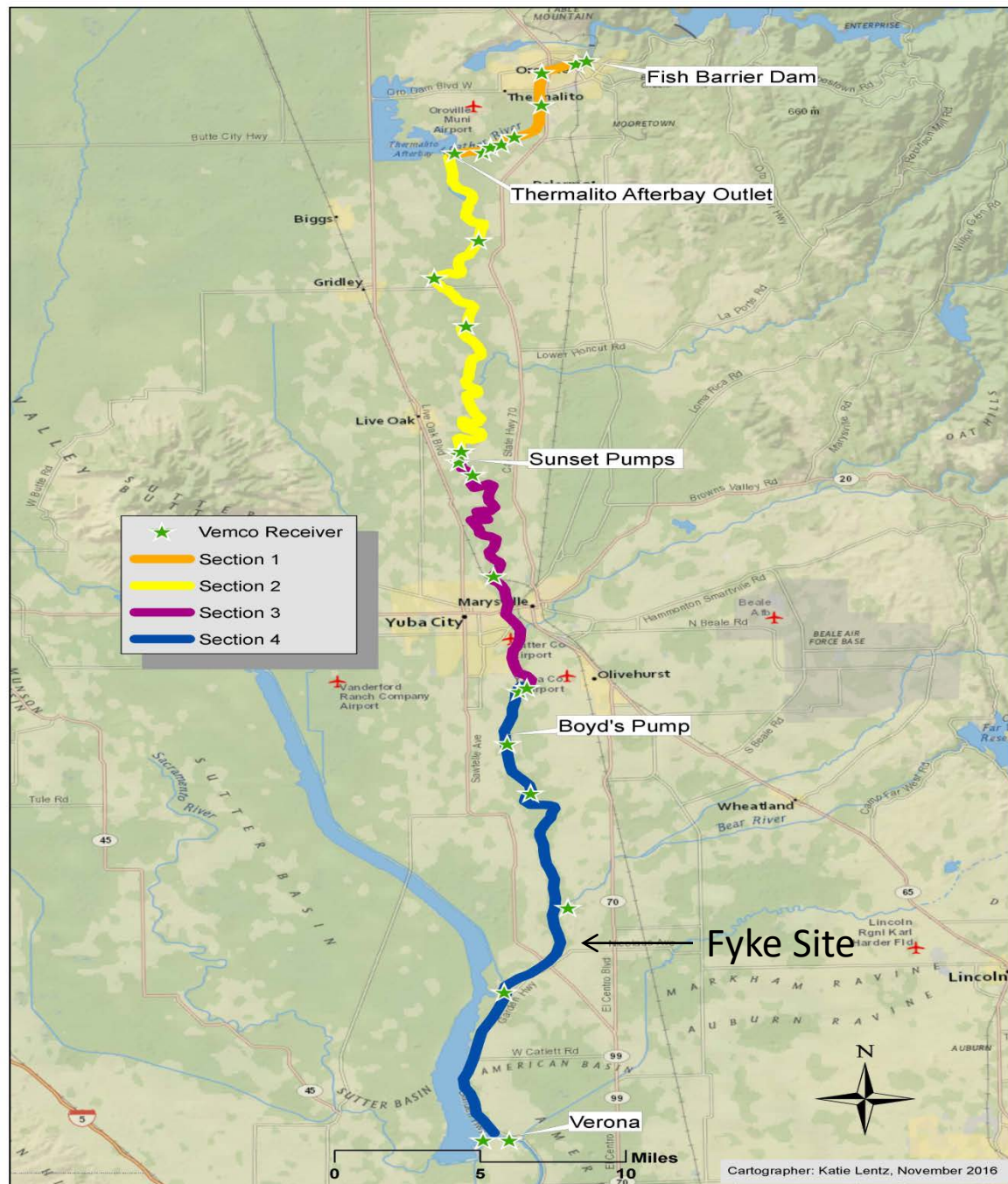


# Methods

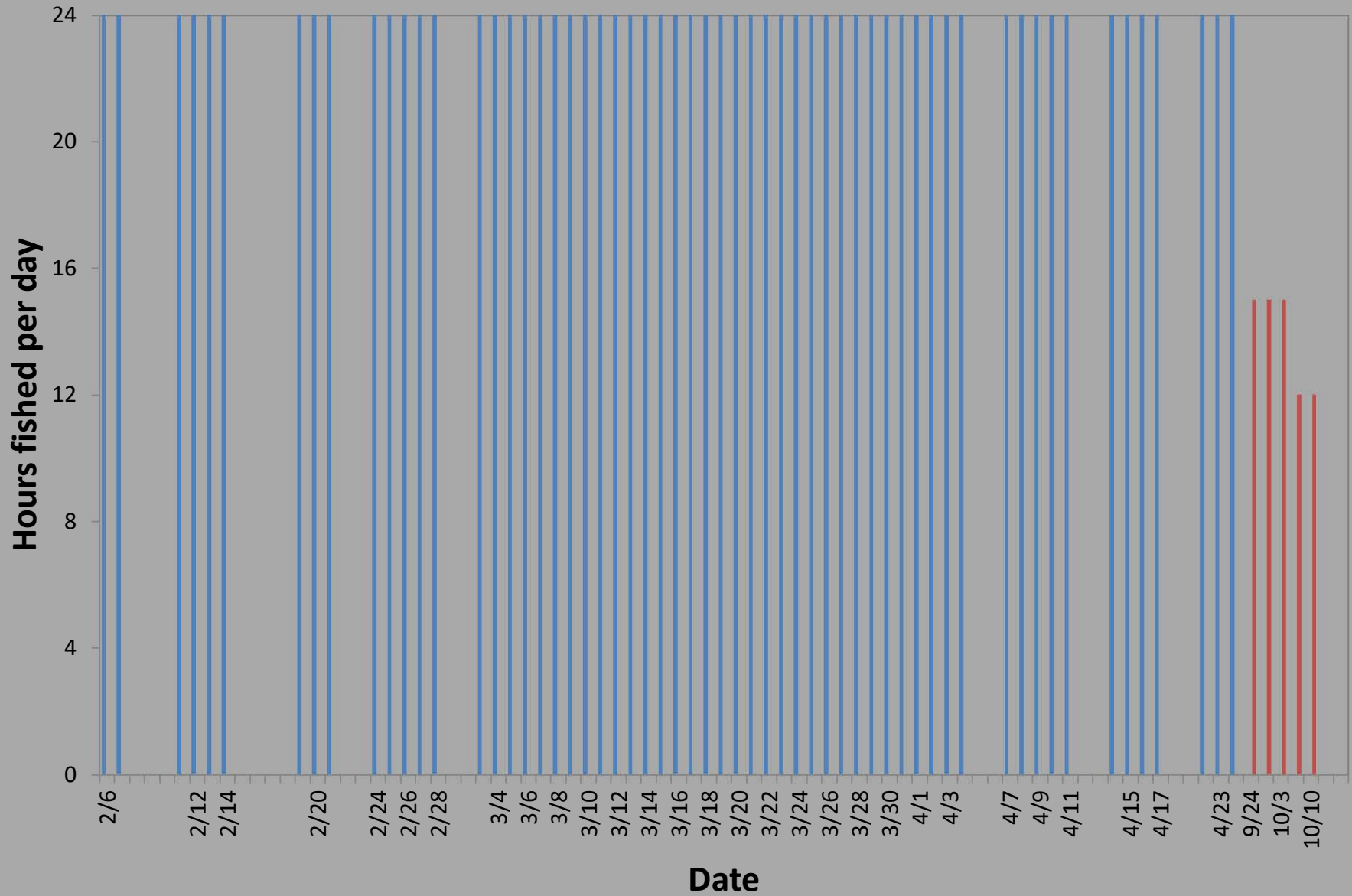
- Diet and Relative Predator Abundance
  - Only angling
  - Seasonal sampling in multiple reaches (2015/2016) & pilot study (2014)
  - ESA permit restrictions on traditional sampling



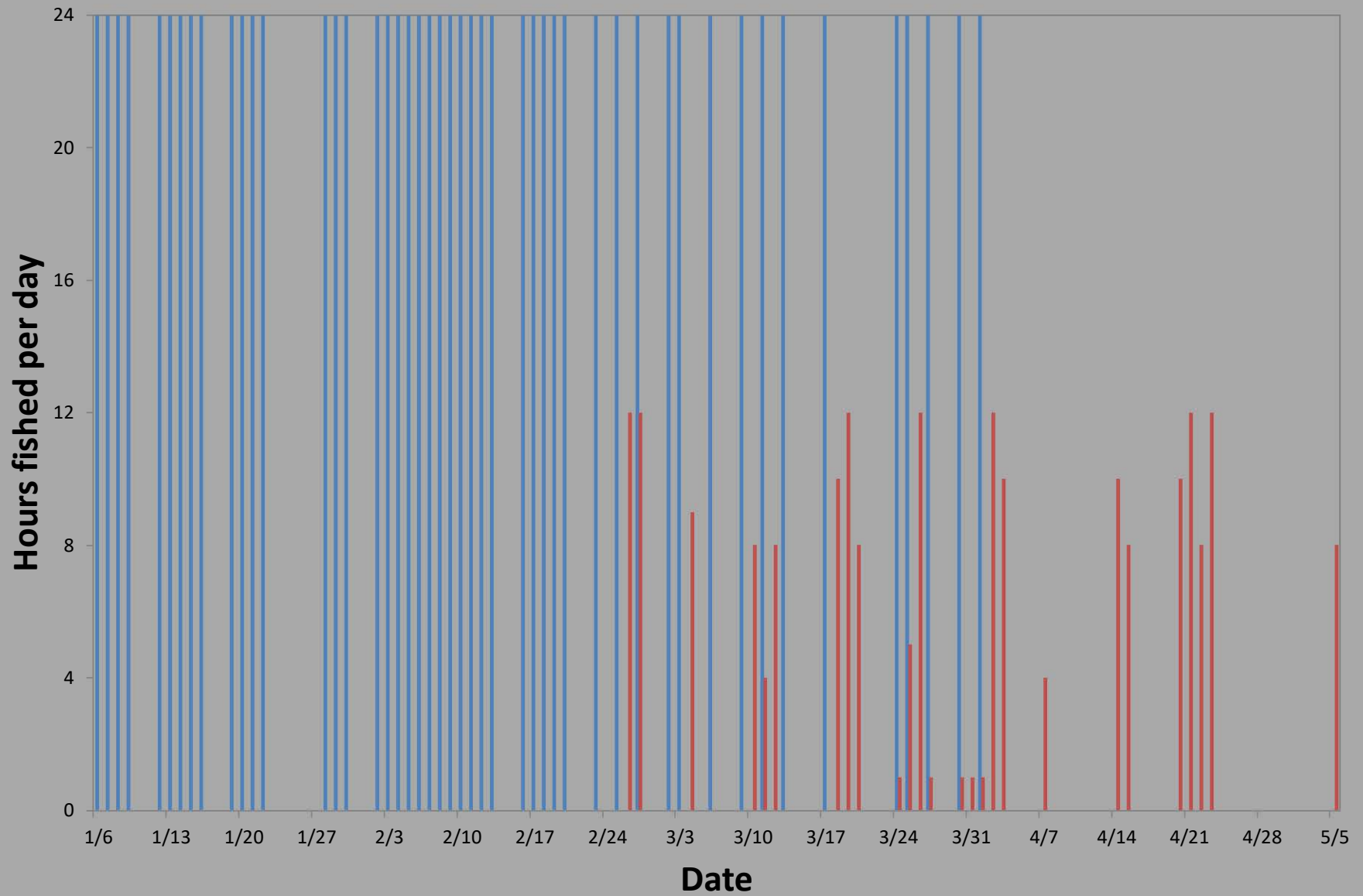




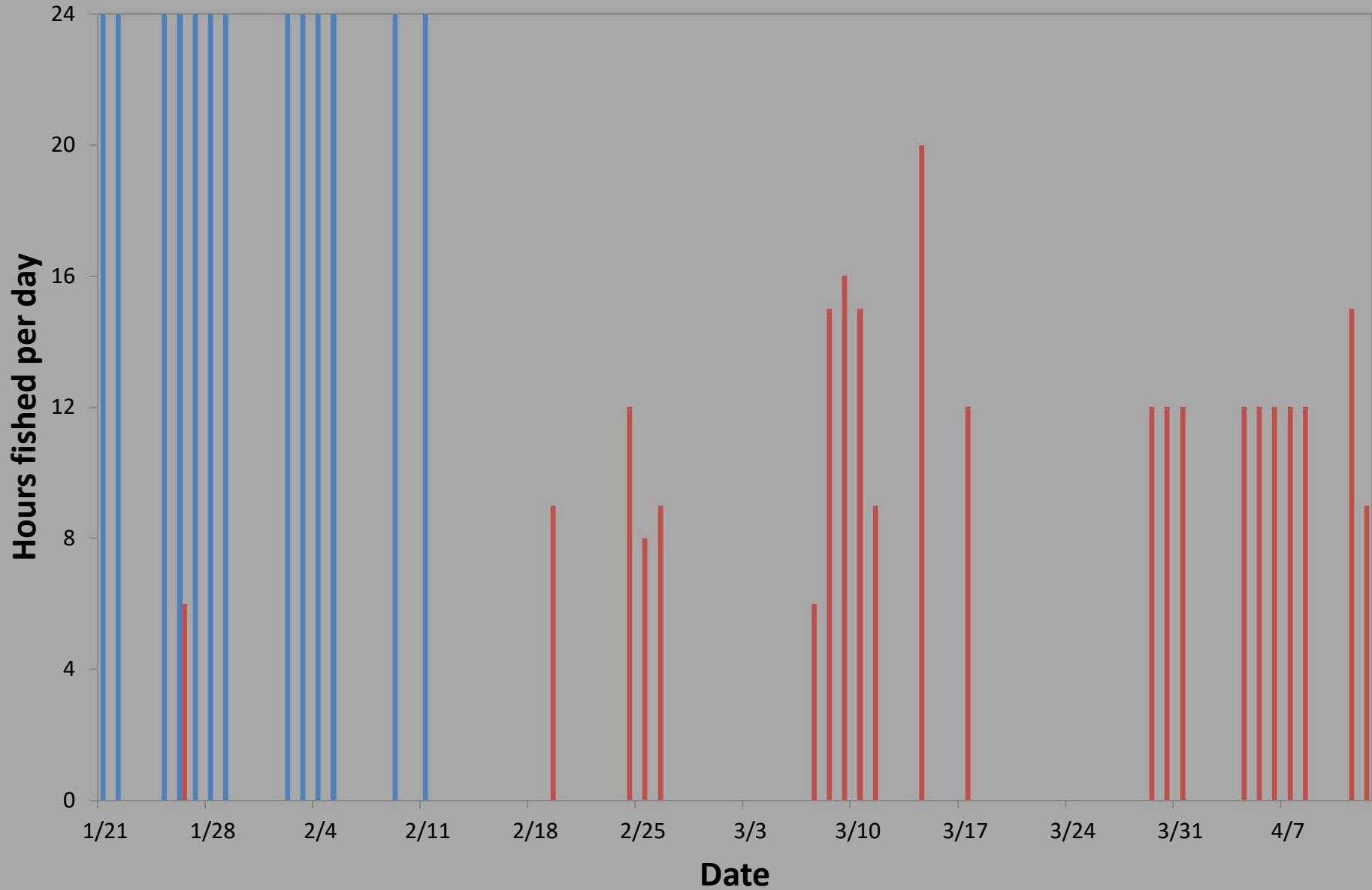
## Fyke and Angling Fishing Effort for 2014



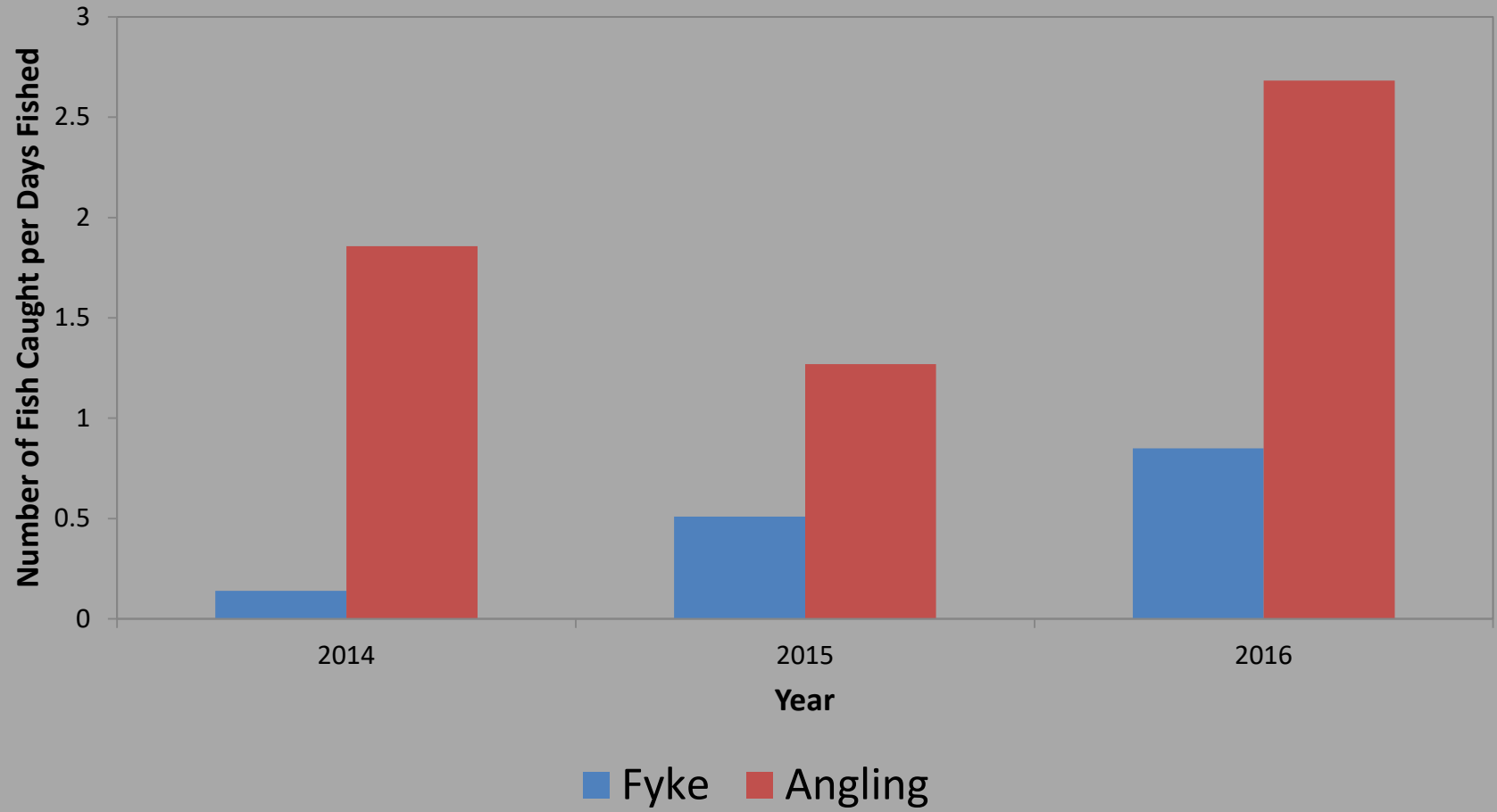
## Fyke and Angling Fishing Effort for 2015



## Fyke and Angling Fishing Effort for 2016



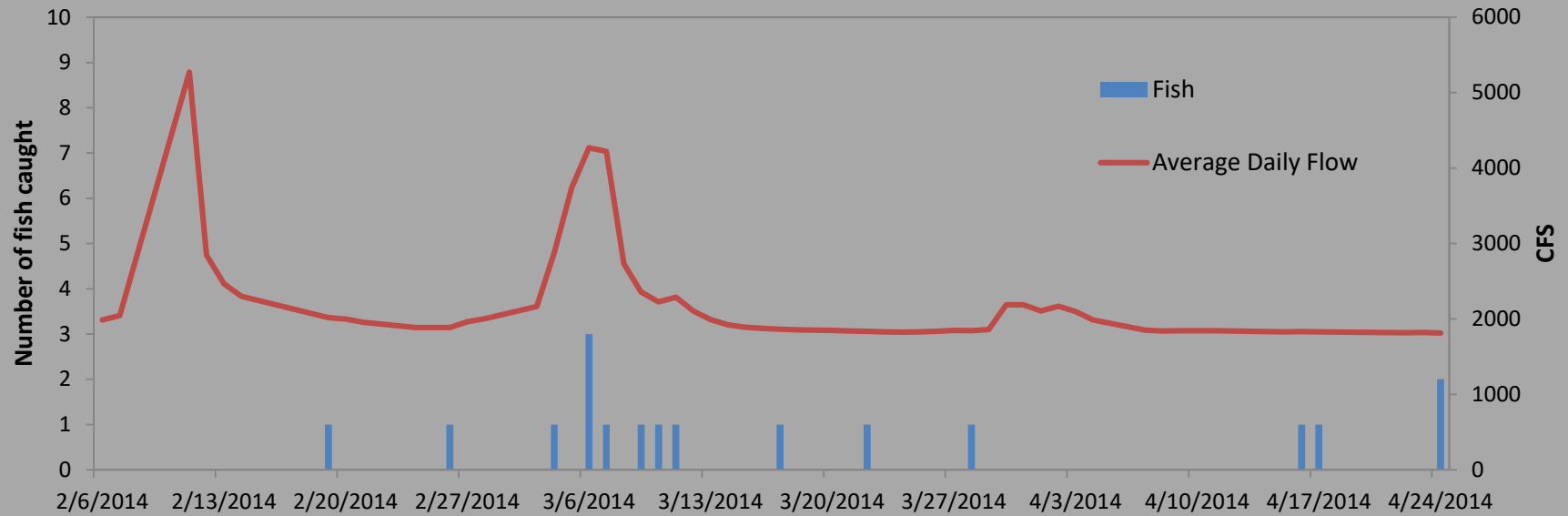
# Comparing Catch per Year



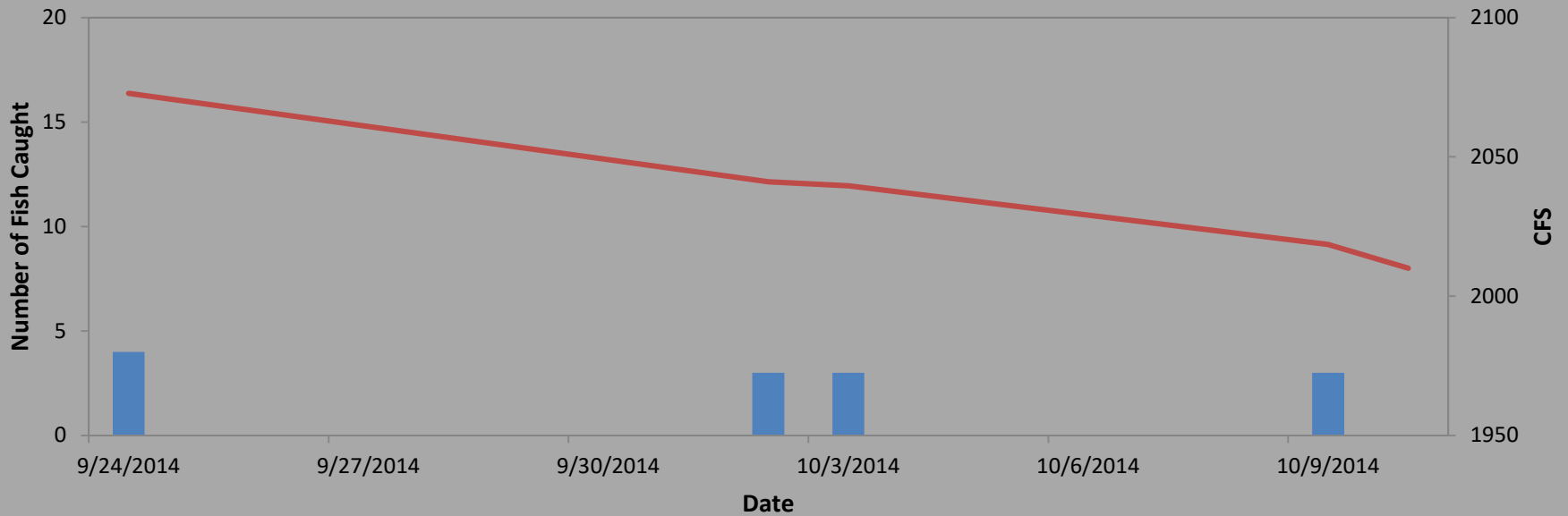


# 2014 Results for fish caught via Fyke and Angling and associated flow at time of catch

F

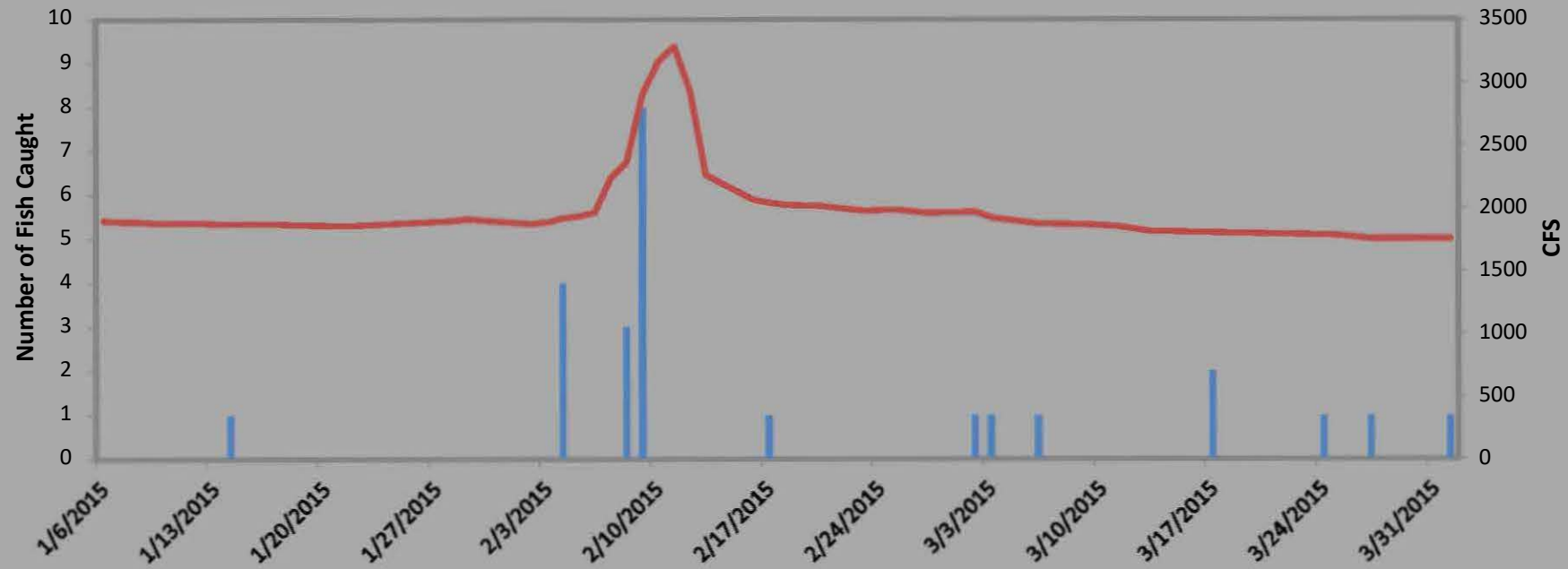


A

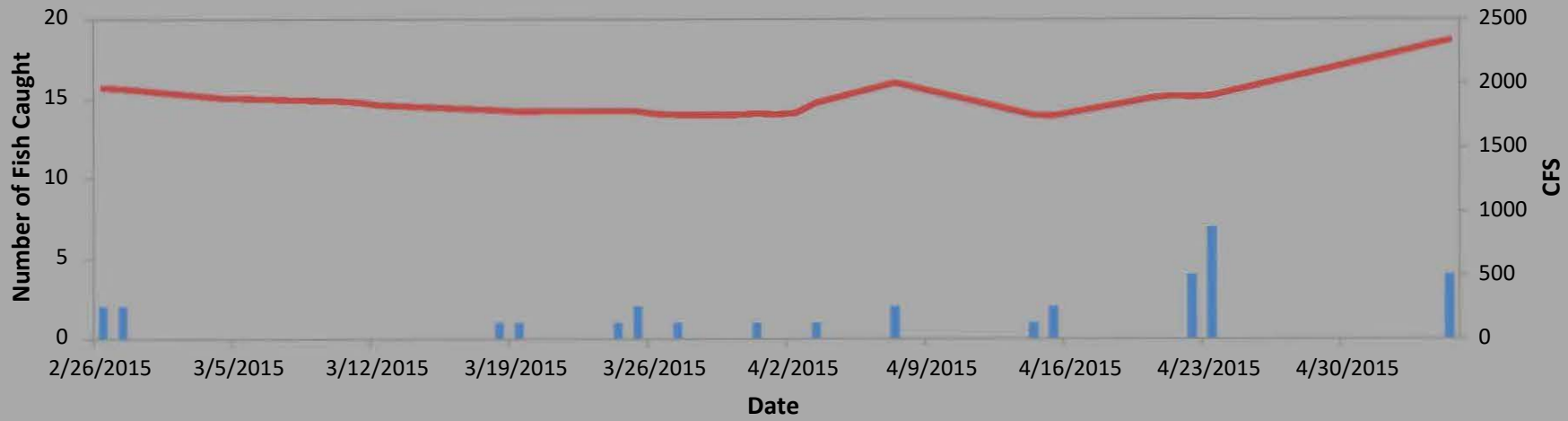


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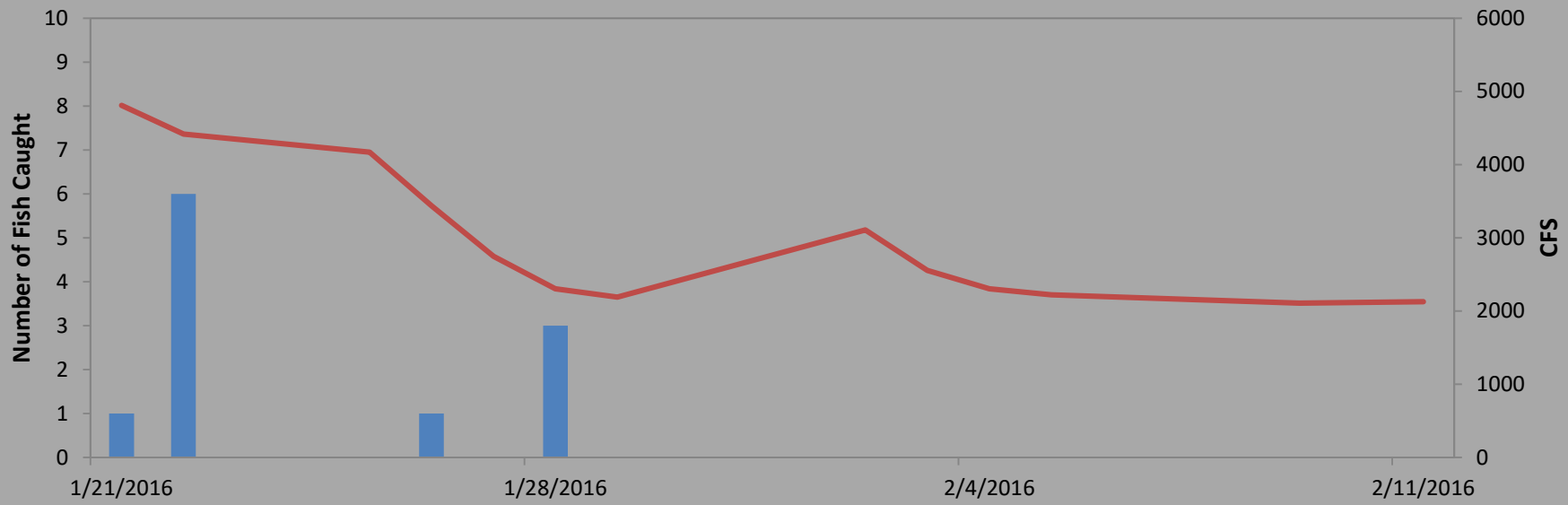


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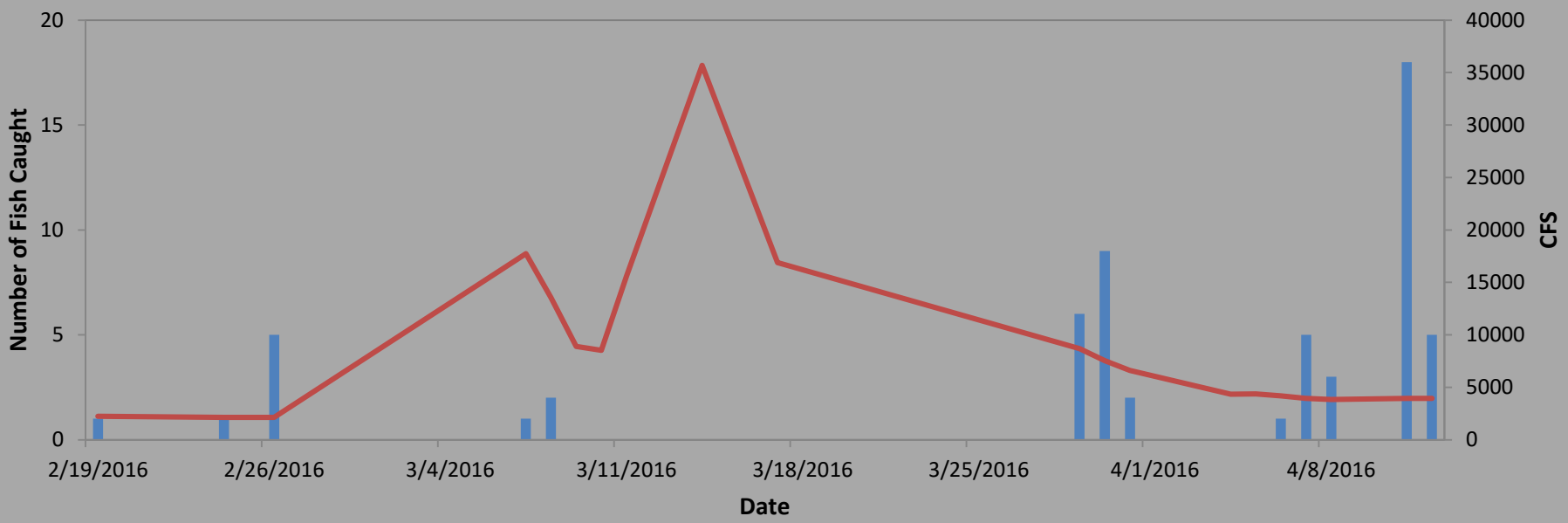


# 2016 Results for fish caught via Fyke and Angling and associated flow at time of catch

F



A



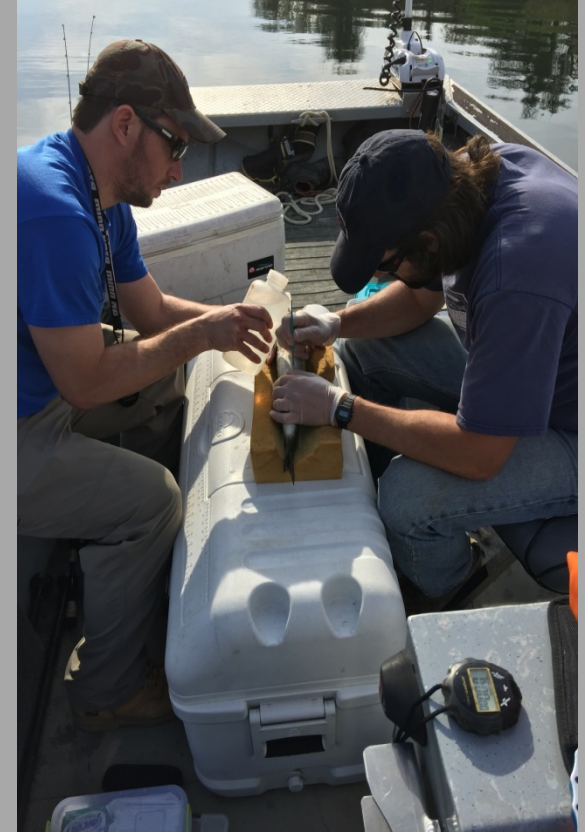
# Acoustic Tagging

- 2 year Vemco V13 tags with unique ping rate
  - 60 days at high ping rate, 50-110 seconds
  - 305 days at low ping rate, 120-240



# What did we end up tagging?

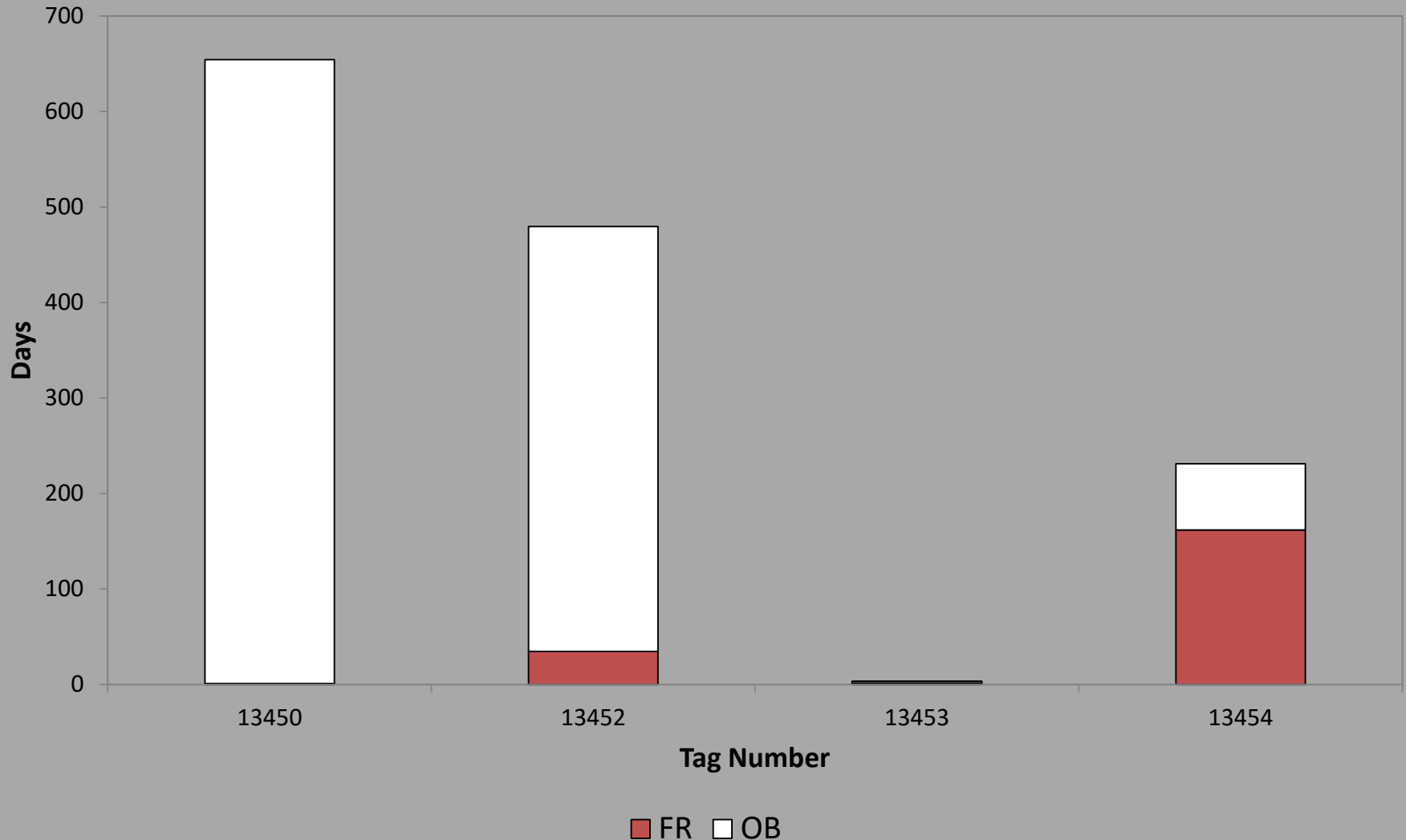
- 64 total fish
  - 49 striped bass (77%)
  - 7 largemouth bass (11%)
  - 6 Sacramento Pikeminnow (9%)
  - 2 catfish(3%)



# Predator Movement

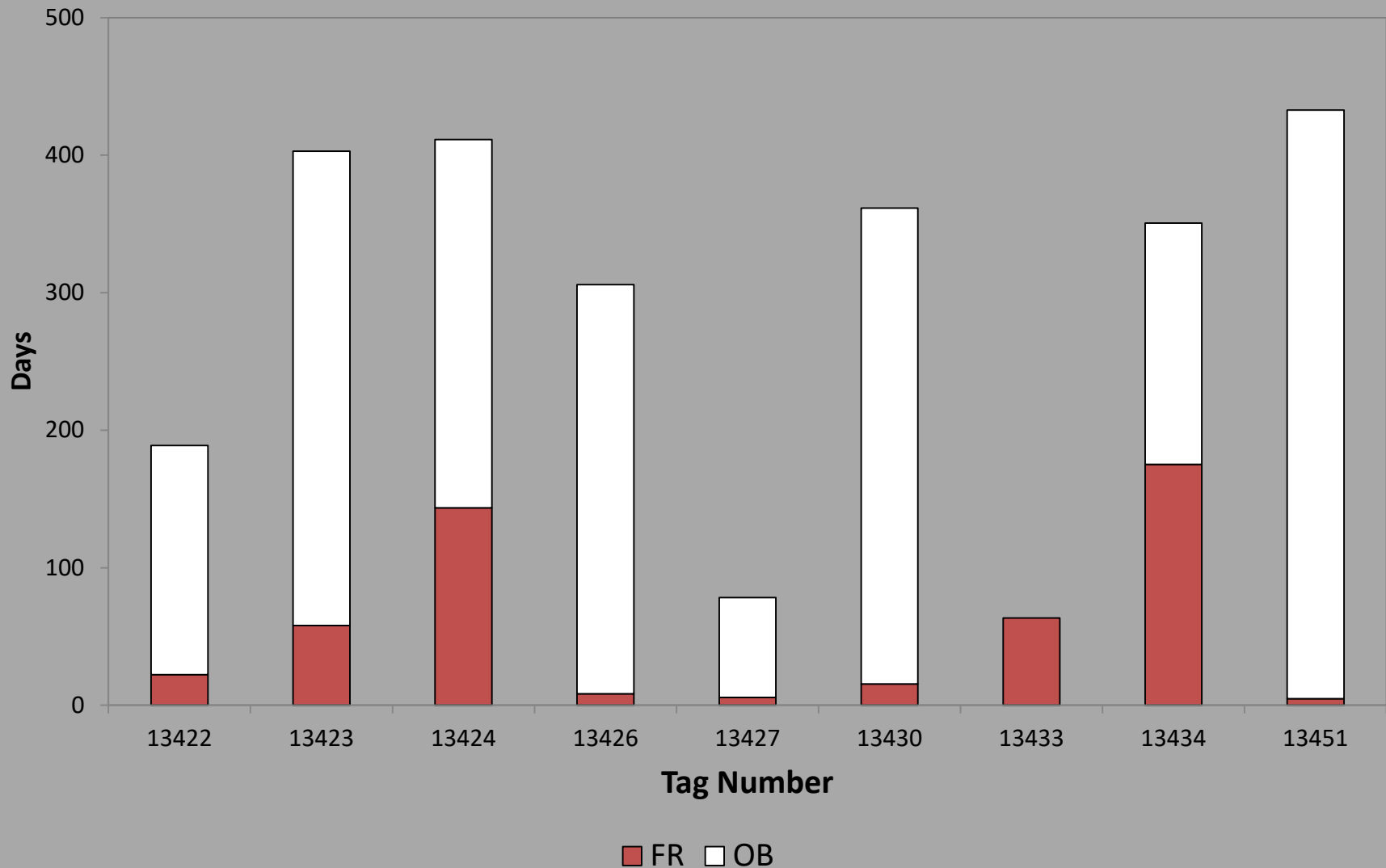
- Most Striped bass moved out of the Feather quickly after being tagged
- Primarily caught and stayed in the lower river
- Other predators traveled very short distances and for the most part stayed within the reach they were tagged

# Amount of total time at liberty Striped bass spent within the Feather River in **2014**.

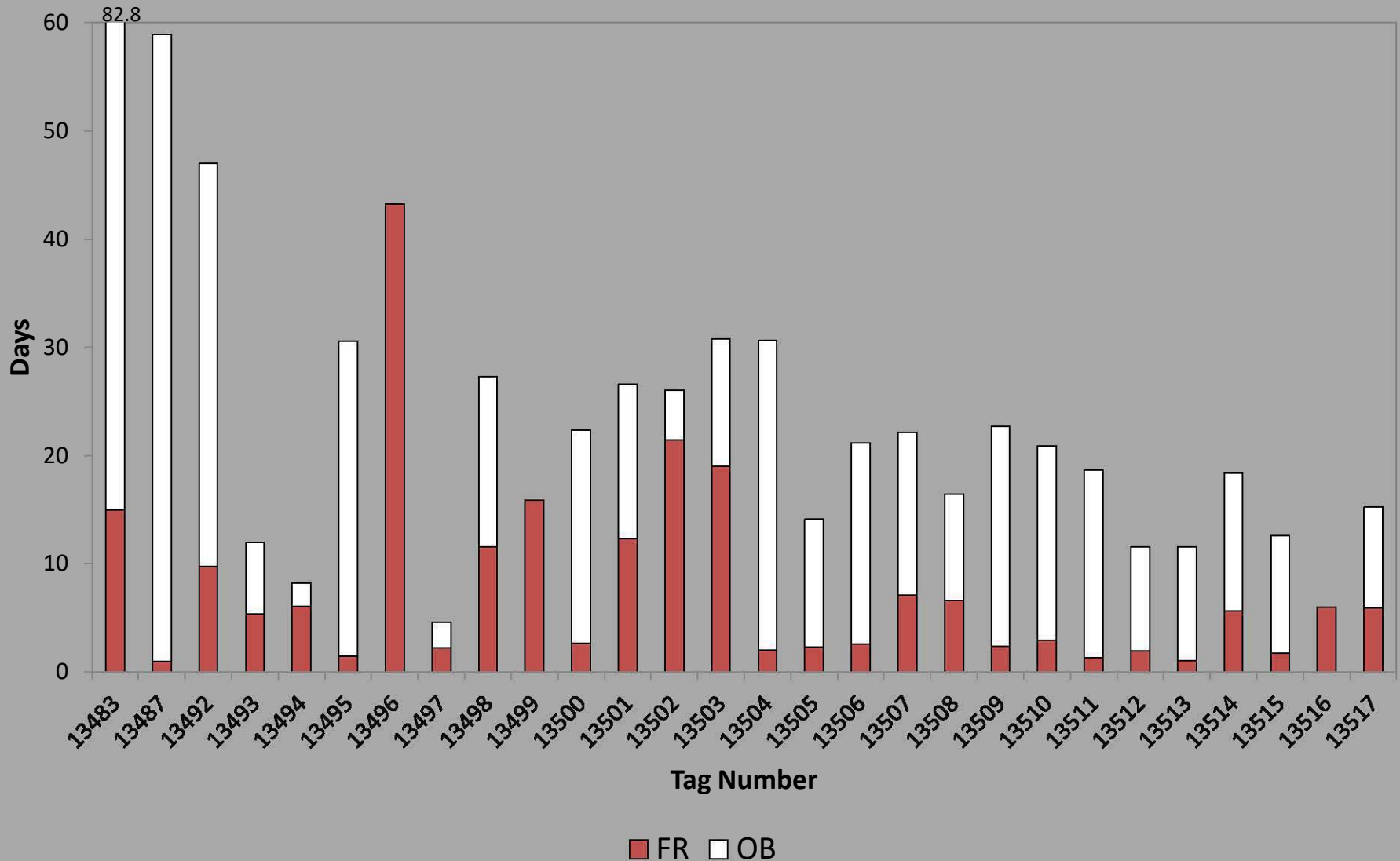




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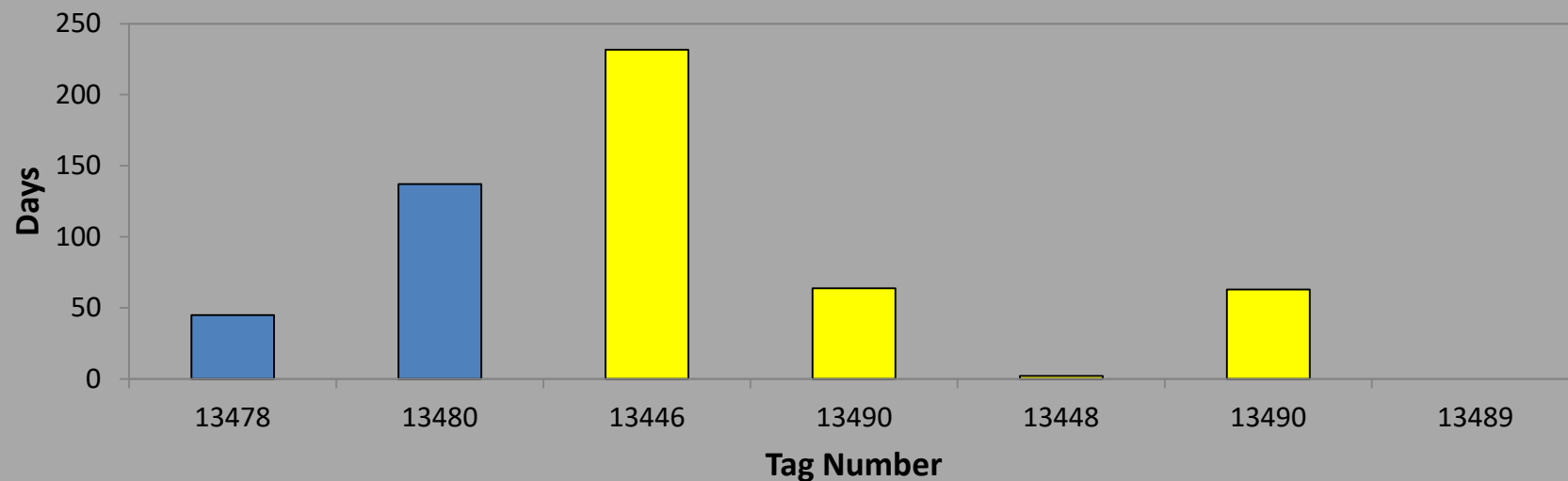


# Amount of total time at liberty Striped bass spent within the Feather River in **2016**.

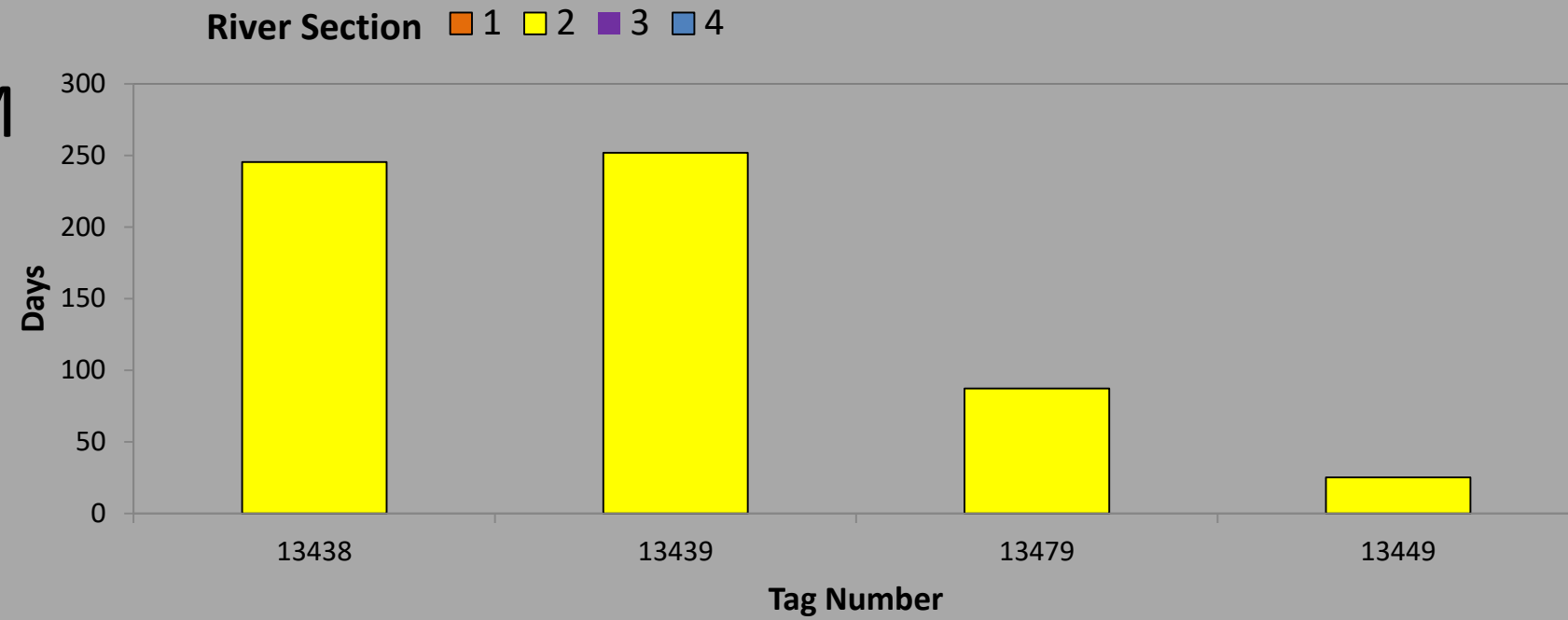


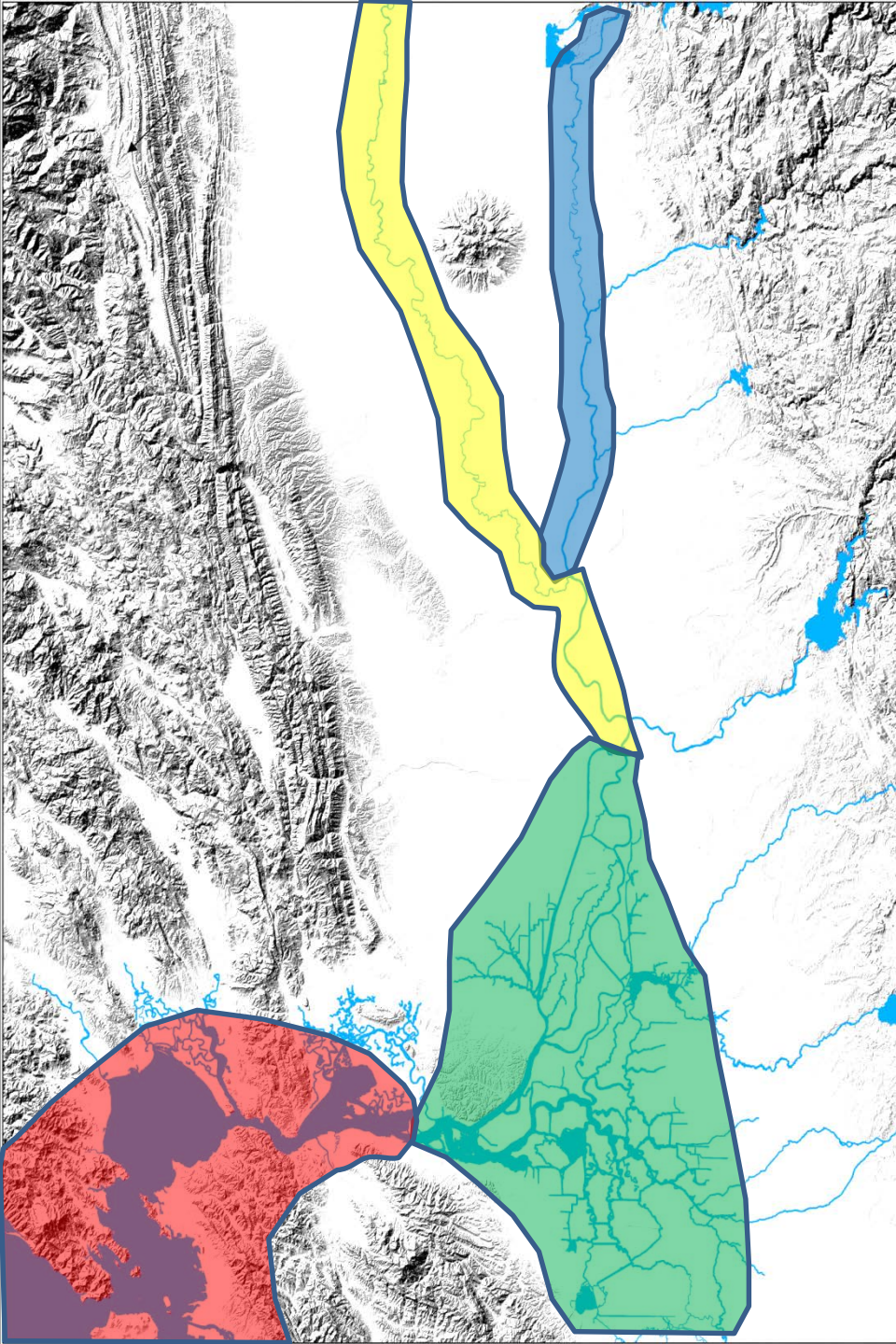
Amount of total time at liberty Large Mouth bass and Sacramento Pikeminnow spent within the Feather River and the areas they inhabited.

BB

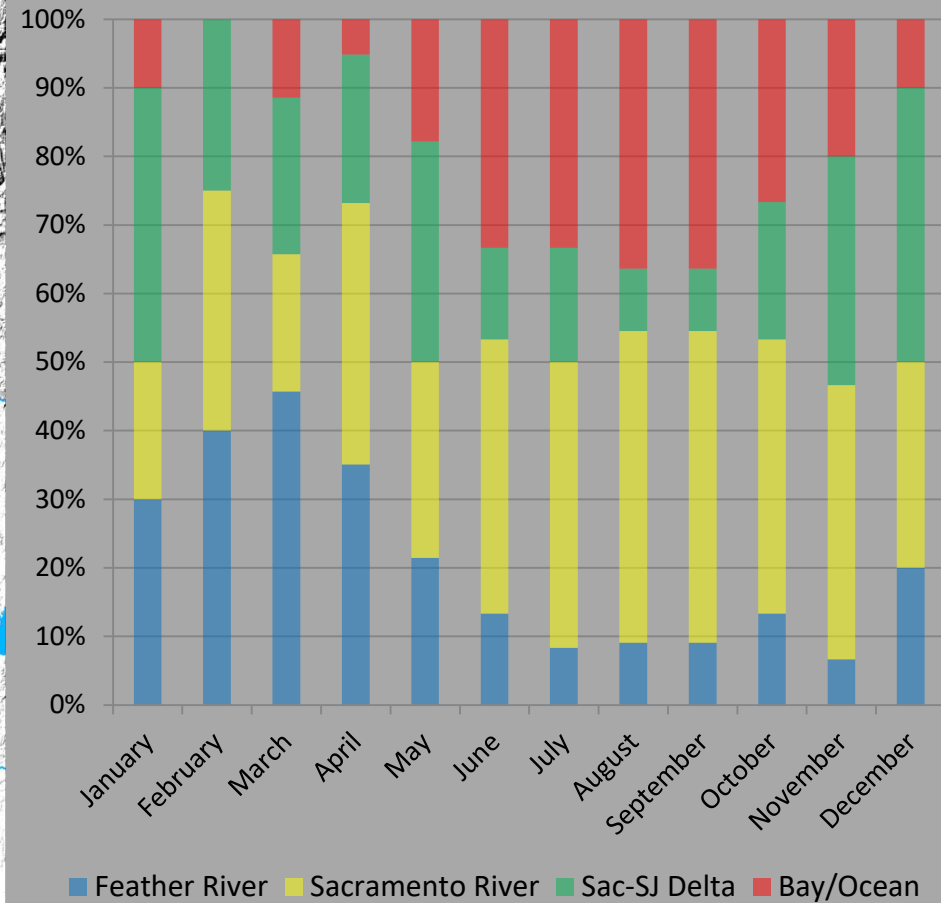


PM



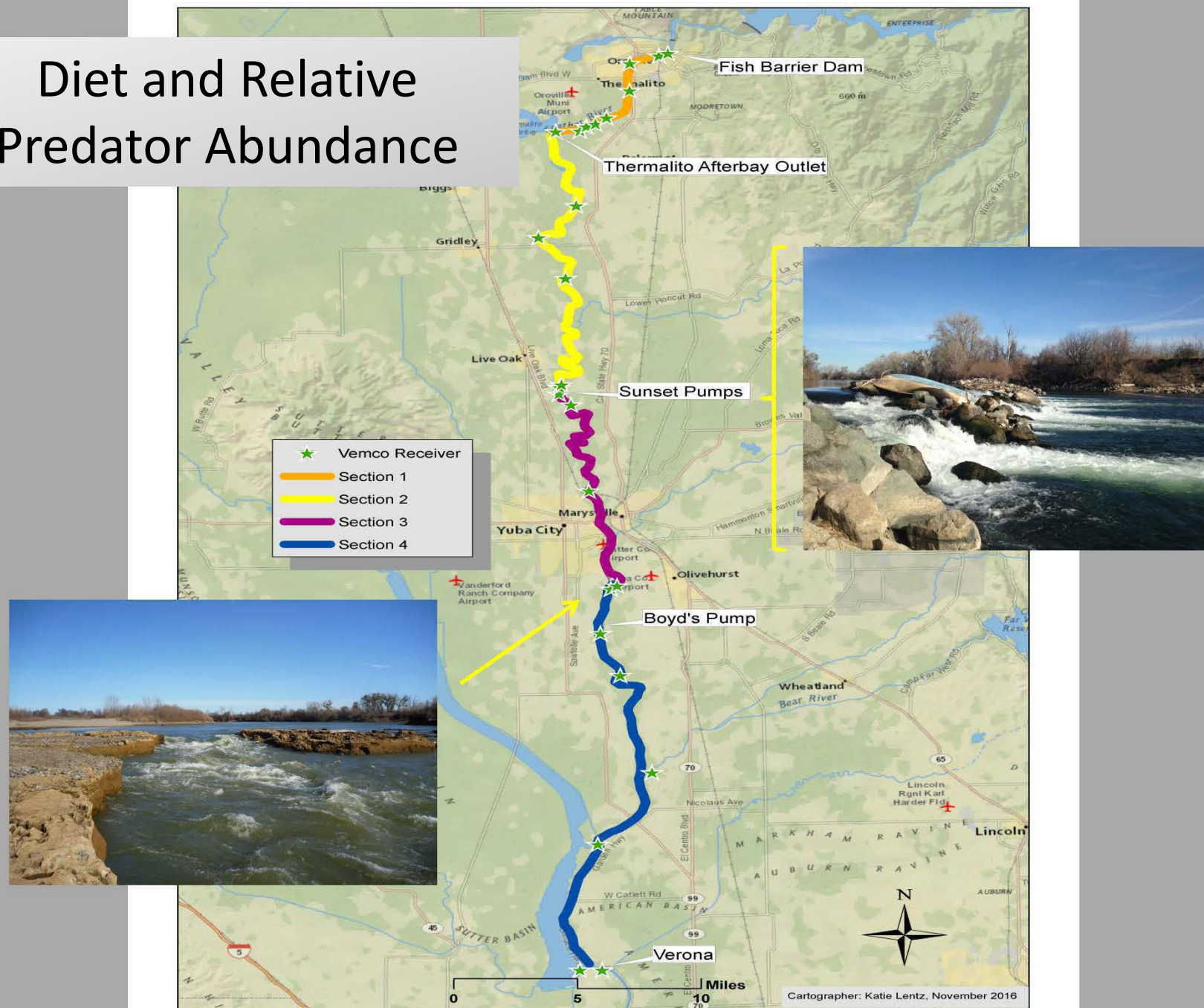


Percentage of tagged Striped bass which were found in separate sections per month and how long they were in those sections.





# Diet and Relative Predator Abundance



# Percent occurrence of catch per species by **section**.

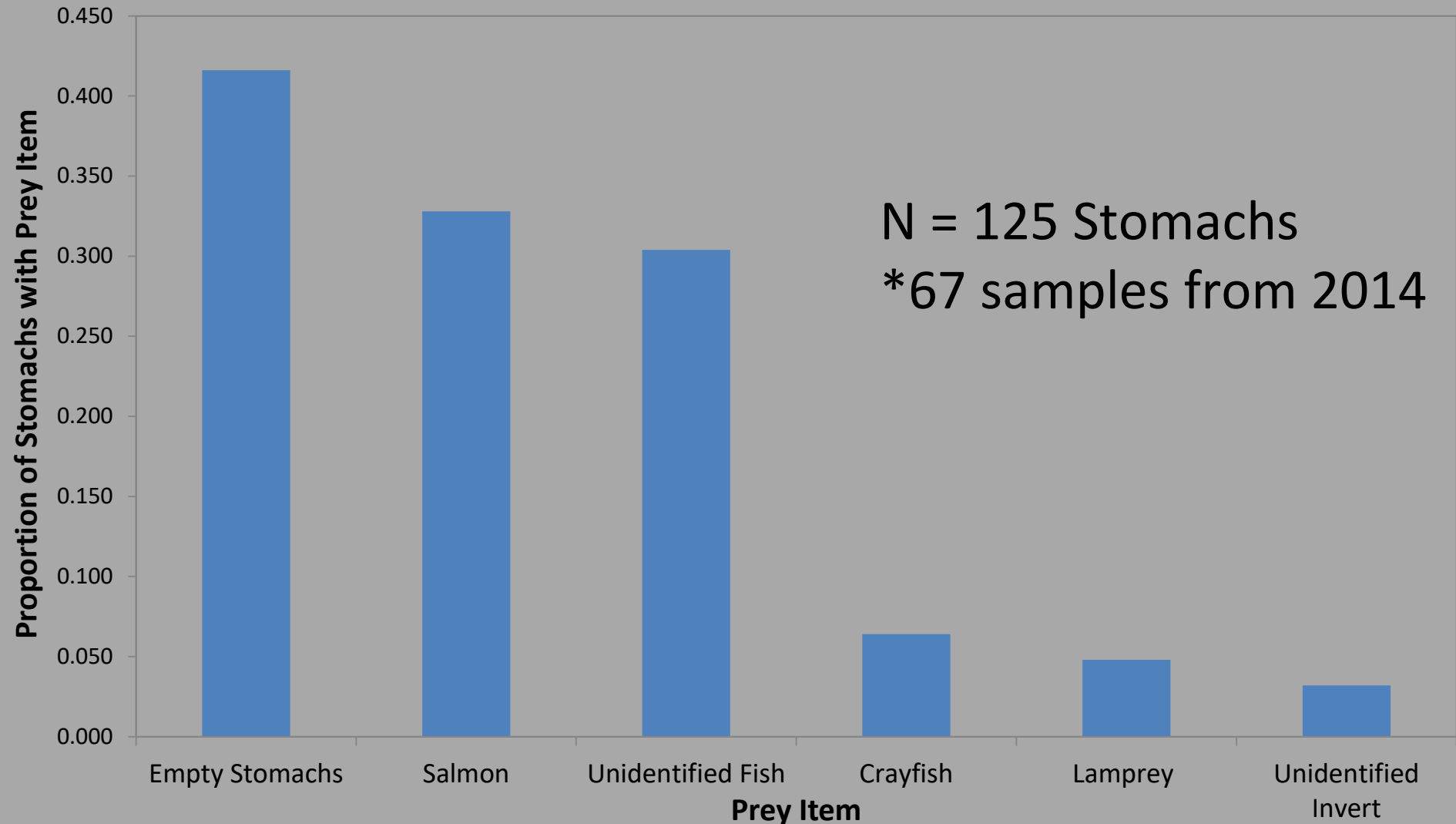
| Species                        | Section |     |     |      | Total number of fish caught: |
|--------------------------------|---------|-----|-----|------|------------------------------|
|                                | 1       | 2   | 3   | 4    |                              |
| Striped Bass                   | 0       | 0   | 5%  | 95%  | 60                           |
| Micropterus                    | 2%      | 54% | 18% | 27%  | 56                           |
| Sacramento Pikeminnow          | 7%      | 77% | 14% | 2%   | 43                           |
| Ictaluridae                    | 0       | 0   | 0   | 100% | 3                            |
| Central Valley Steelhead Trout | 100%    | 0   | 0   | 0    | 12                           |

# Percent occurrence of catch per species by **season**.

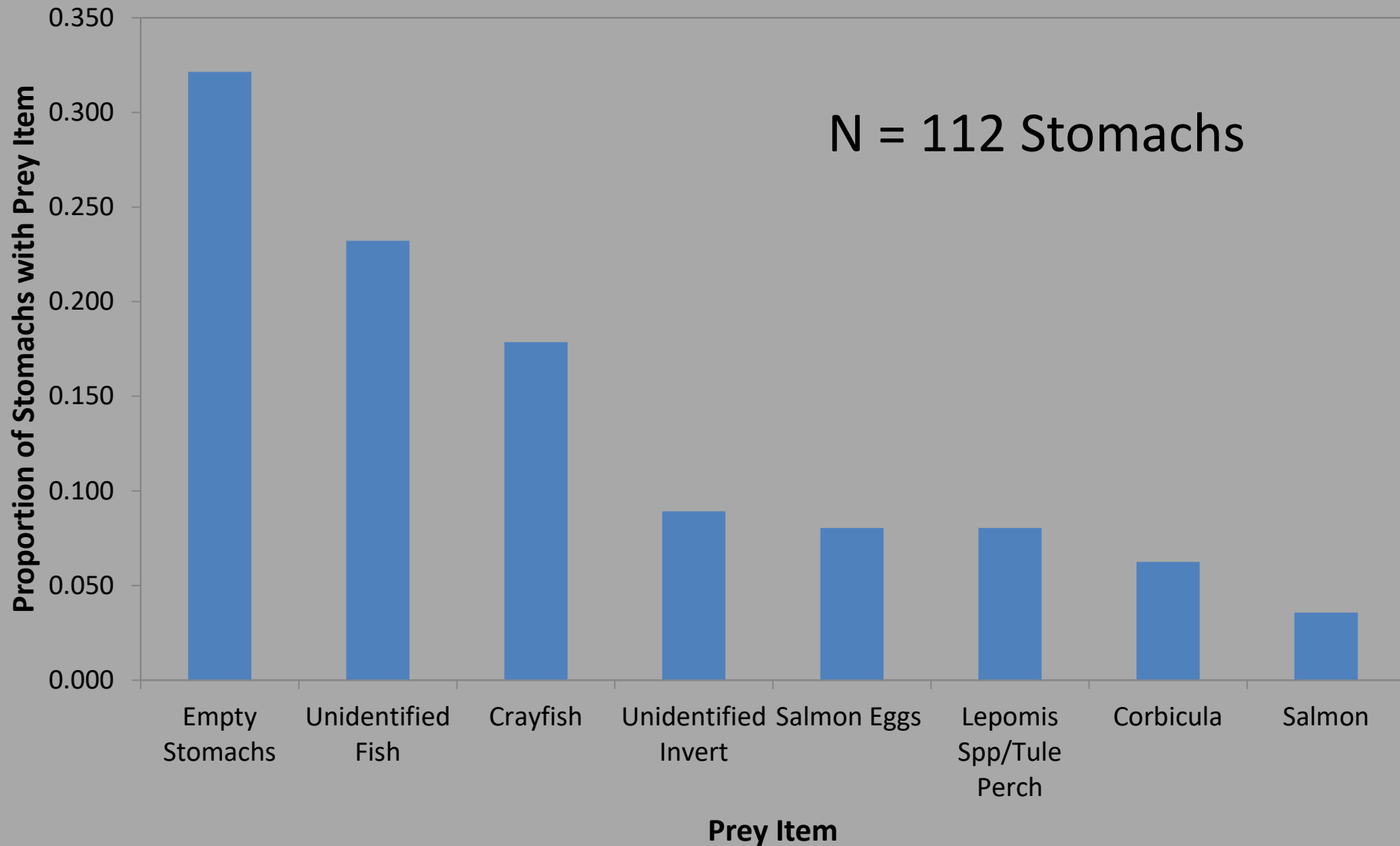
|                                   | Summer | Fall | Winter | Spring | Total number of fish caught:<br>174 |
|-----------------------------------|--------|------|--------|--------|-------------------------------------|
| Striped Bass                      | 29%    | 2%   | 0      | 69%    | 60                                  |
| Micropterus                       | 29%    | 39%  | 21%    | 11%    | 56                                  |
| Sacramento Pikeminnow             | 44%    | 33%  | 2%     | 21%    | 43                                  |
| Ictaluridae                       | 33%    | 0    | 67%    | 0      | 3                                   |
| Central Valley Steelhead<br>Trout | 0      | 75%  | 8%     | 17%    | 12                                  |



# Food item occurrence in Striped bass (*Morone saxatilis*) from 2014-2016



# Food item occurrence in non Striped bass predators from 2014-2016.





# Hatchery Releases

- Spring sampling effort in the lower river sections coincided with hatchery release
- 1-2 Million hatchery origin spring run Chinook young of the year
- 100% CWT marked





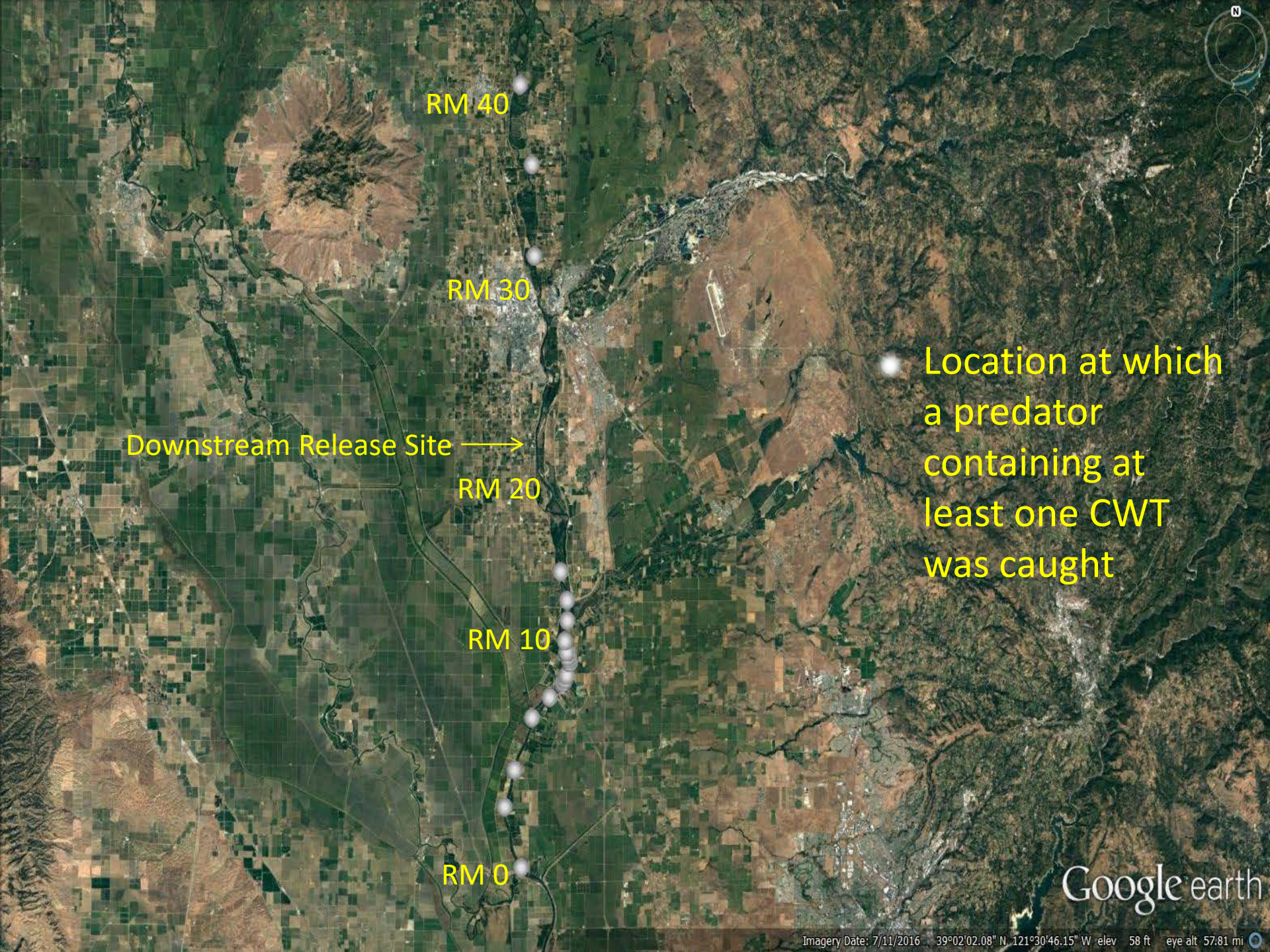
# CWT Recovery



# Breakdown of CWT recovery by predator species.

| <b>Species</b>               | <b>Percent of stomachs that contained CWTs<br/>(# of tags)</b> |
|------------------------------|--|
| <b>Striped Bass</b>          | <b>24% (140)</b>   |
| <b>Micropterus</b>           | <b>3% (3)</b>  |
| <b>Ictaluridae</b>           | <b>0</b>   |
| <b>Sacramento Pikeminnow</b> | <b>0</b>   |





RM 40

RM 30

Downstream Release Site →

RM 20

RM 10

RM 0

Location at which  
a predator  
containing at  
least one CWT  
was caught

Google earth



Non Striped Bass  
Predators

RM 40

RM 30

Downstream Release Site →

RM 20

RM 10

Striped Bass

RM 0

Location at which  
a predator  
containing at  
least one CWT  
was caught

Google earth



# Summary table for the six spring run salmon releases from which we recovered CWT's.

| Release Location | River Mile at Release | Number of CWTs recovered | Average distance in miles from release caught (rm) | Average time from release caught(days) |
|------------------|-----------------------|--------------------------|--|--|
| Gridley          | 50.5                  | 4                        | 22.5 (28)  | 7                                      |
|                  | 50.5*                 | 1                        | 45.7 (4.8)   | 6                                      |
| Boyd's Pump      | 22.5                  | 5                        | 11.7 (10.8)  | 1                                      |
|                  | 22.5*                 | 16                       | 23.6 (1.1)   | 5                                      |
|                  | 22.5                  | 1                        | 11.5 (11)  | 22                                     |
|                  | 22.5                  | 114                      | 11.7 (10.8)  | 1                                      |

\* Indicates fish caught in 2014



Non Striped Bass  
Predators

RM 40

RM 30

Downstream Release Site →

RM 20

RM 10

Striped Bass

RM 0

Location at which  
a predator  
containing at  
least one CWT  
was caught

Google earth



# Conclusions

- Striped bass did not reside in the Feather River year round
- Upper reaches dominated by Micropterus and Pikeminnow while lower reaches dominated by Striped bass
- Striped bass were main consumer of hatchery and natural origin salmon
- Lower river is a dangerous place to be a smolt during the years that we sampled

# Looking Forward

- How can we alter releases of hatchery fish to reduce effects of predators?
  - Release timing
  - Discharge
- Is there a discharge that would be beneficial for juvenile emigration but not Striped bass migration?

# Thank You





# Thank You

