

## Managing wetlands for fish and fowl

California Department of Fish and Wildlife, Watershed Branch



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# Agenda

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- Tidal Wetlands – What are they?
- Why are they important?
- Status of wetlands across historical record (i.e., decline)
- Why juvenile salmon are in trouble
- How managed wetlands work
- Restored and managed wetlands
  - Salmon growth study
  - Species diversity study

Jake Sousa

# → What are Tidal Wetlands?

Tidally inundated by water some or all year and dominated by poorly drained soils and hydrophilic plants.

Highly productive aquatic food webs





# Wetlands aren't always pretty!

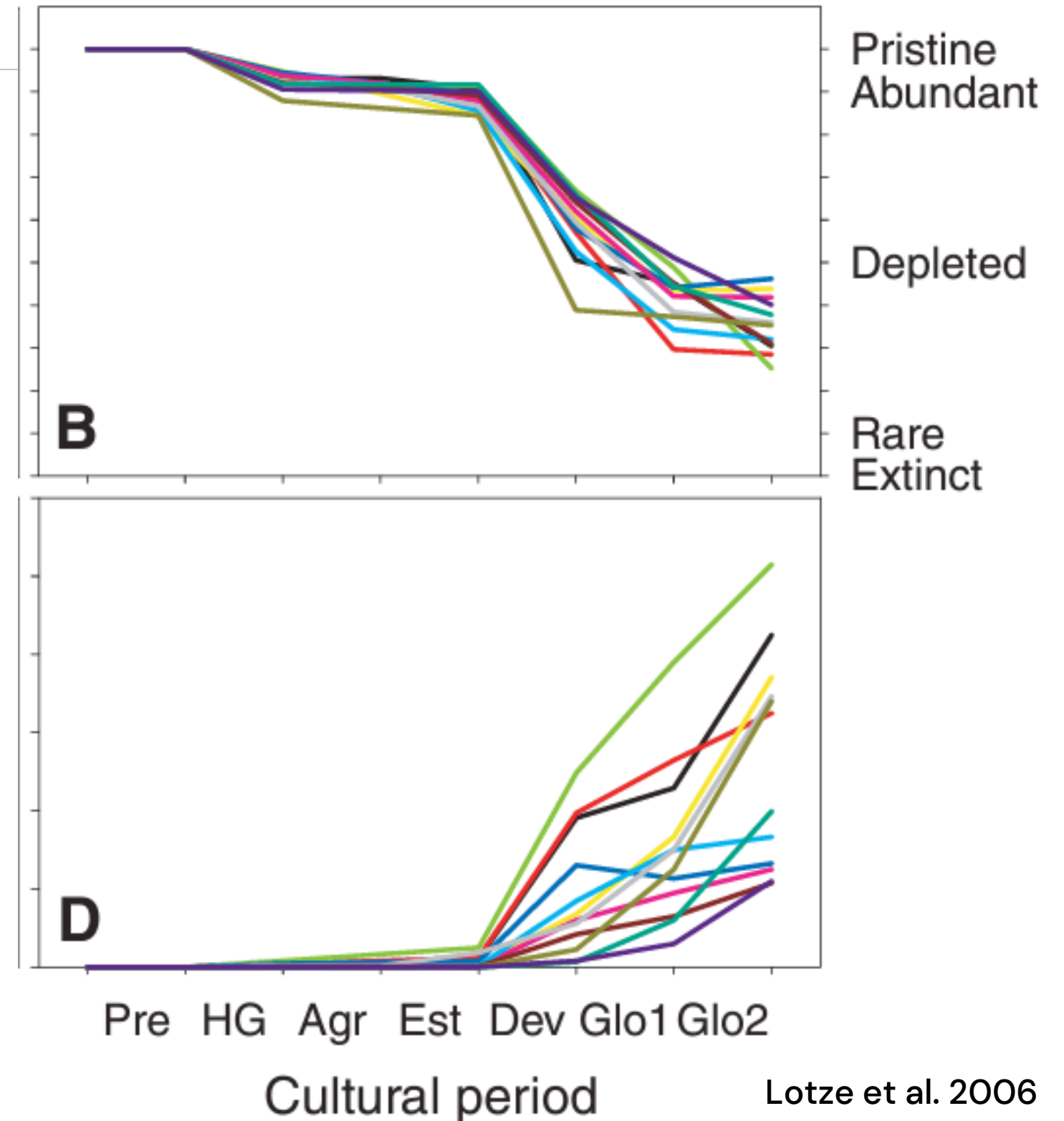
- Often smelly, muddy and full of bugs.
- Highly productive.
- Intense human impacts.





# Wetlands are in trouble worldwide

- 12 estuaries / coastal wetlands
- N. America, Europe, Australia
- B. Relative abundance of 6 taxa
- D. Human population growth by cultural period
- Dark green – SF Estuary



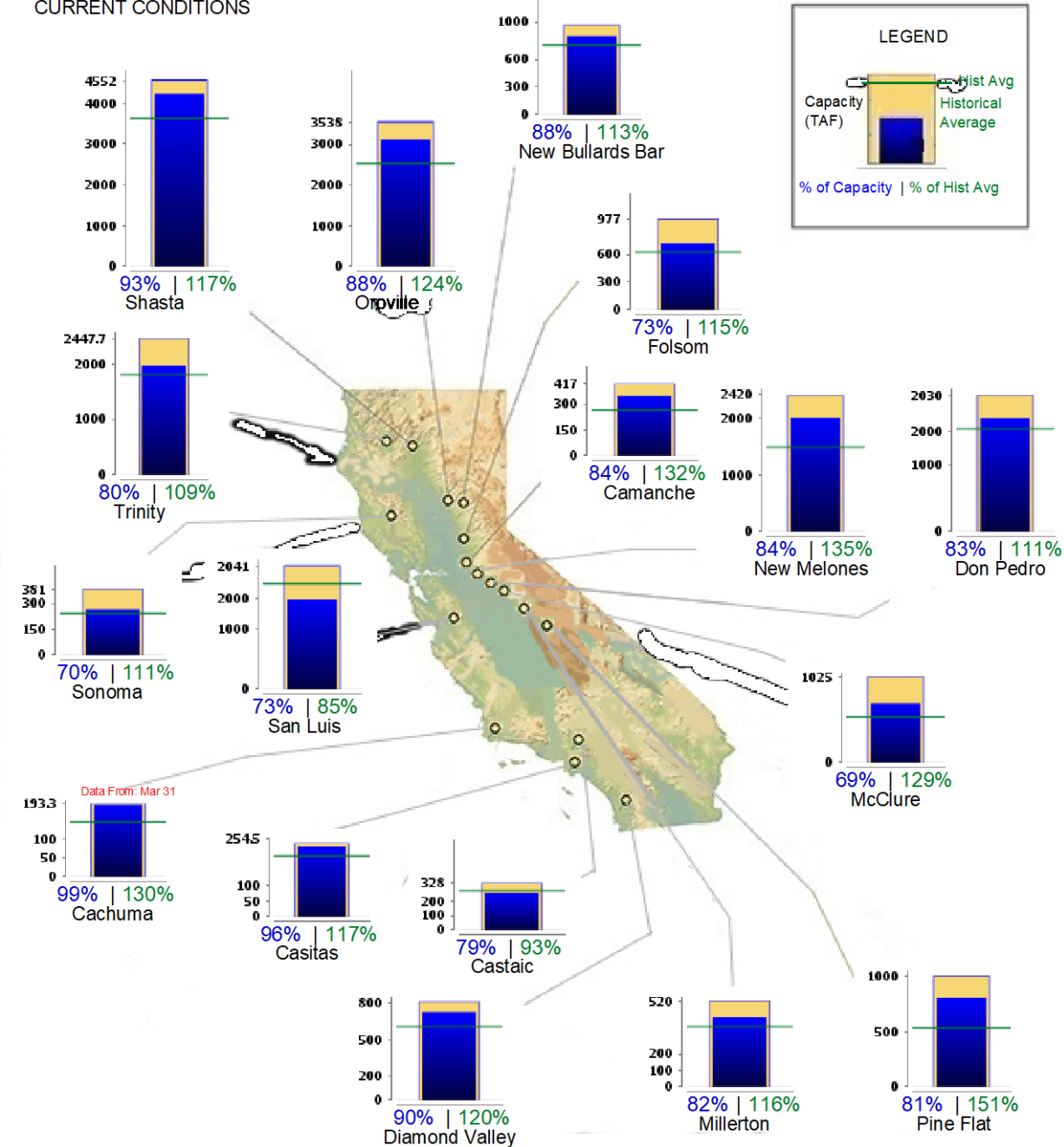


# A highly altered estuary



## CALIFORNIA MAJOR WATER SUPPLY RESERVOIRS CURRENT CONDITIONS

Midnight - April 2, 2024



Updated 04/03/2024 10:48 AM

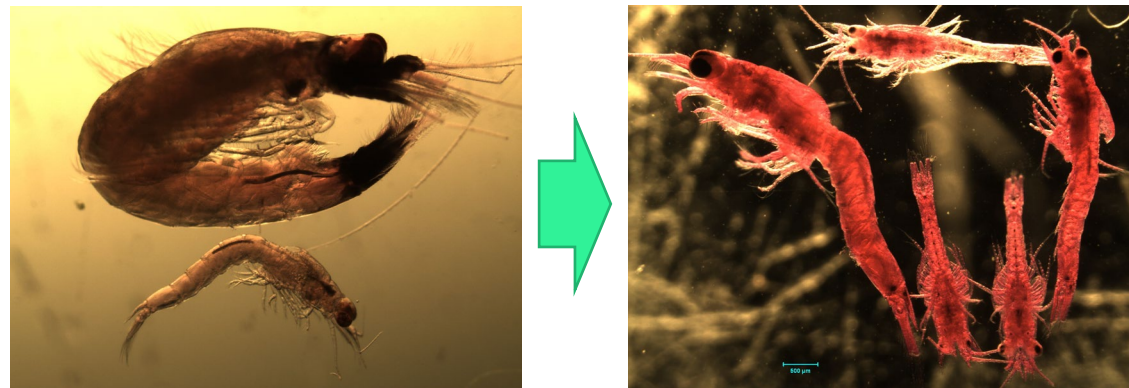




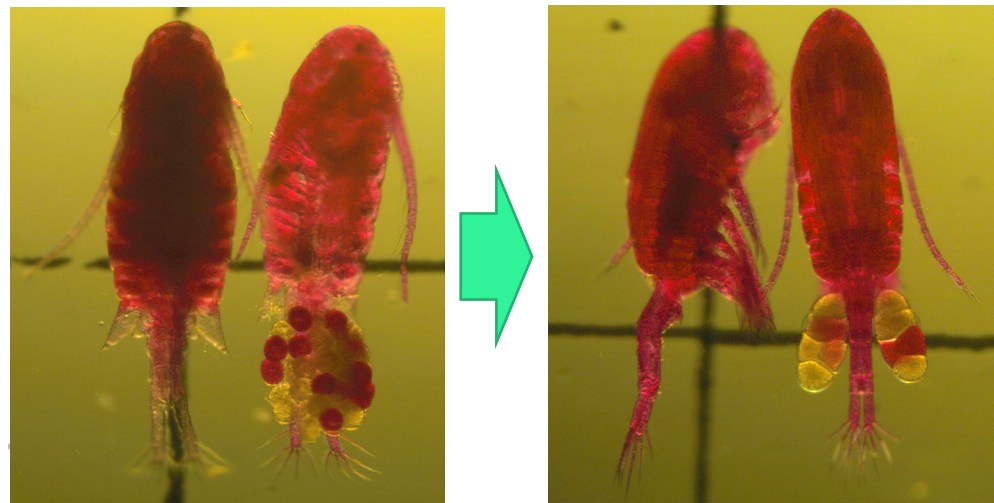
# Pelagic organism decline



- Filter-feeding invasive clams reduce productivity



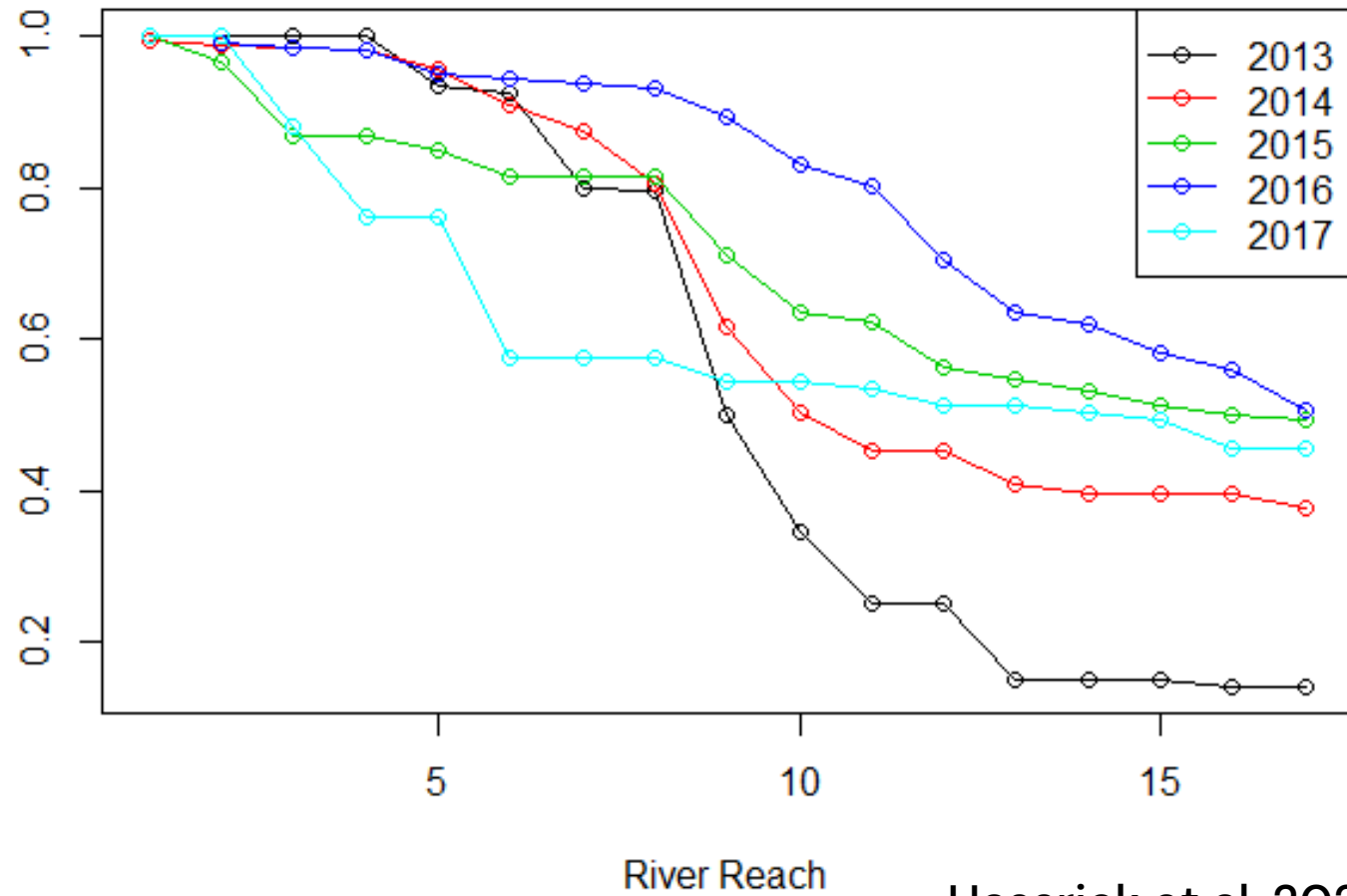
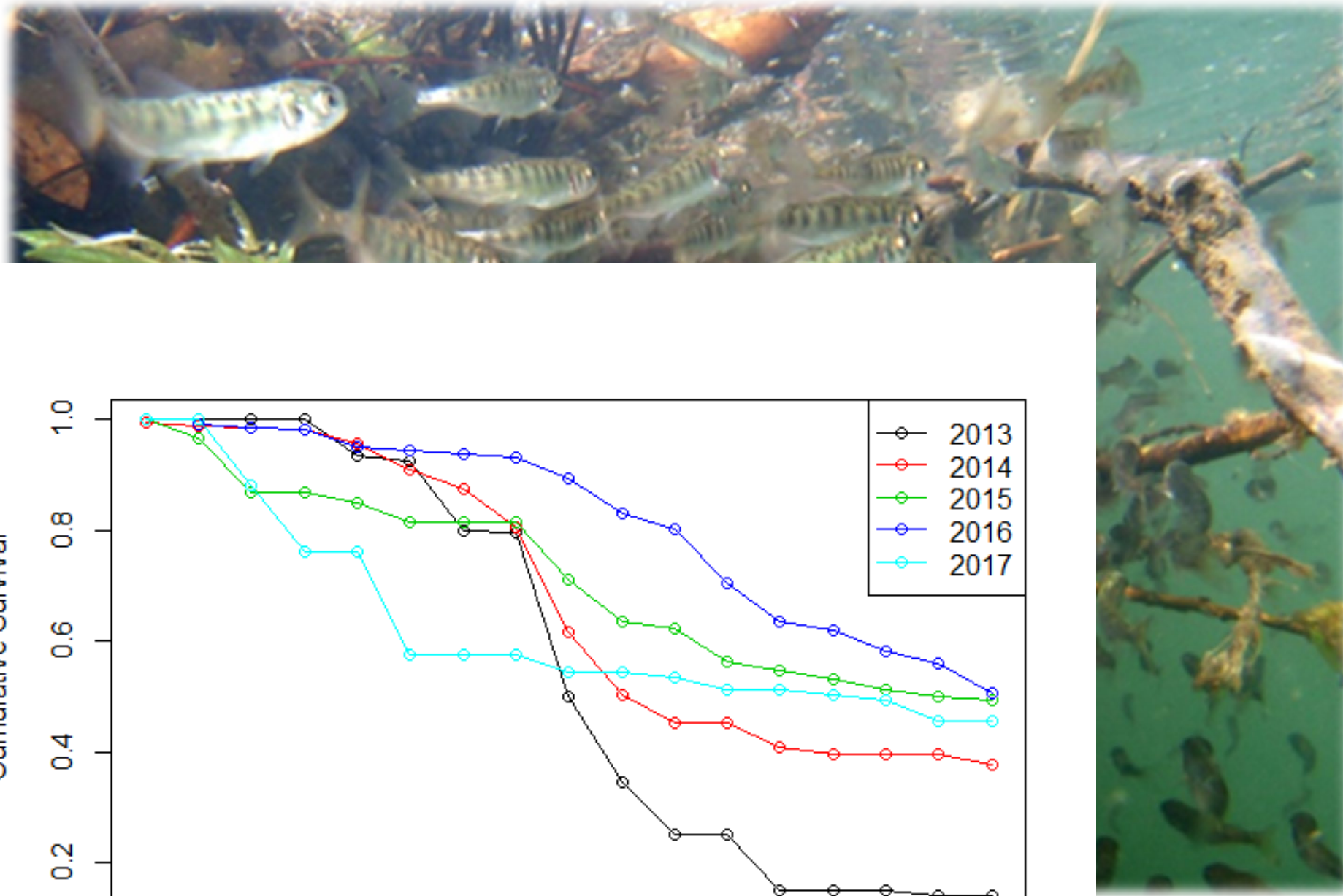
- Larger mysid shrimp are replaced with smaller, less nutritious exotics



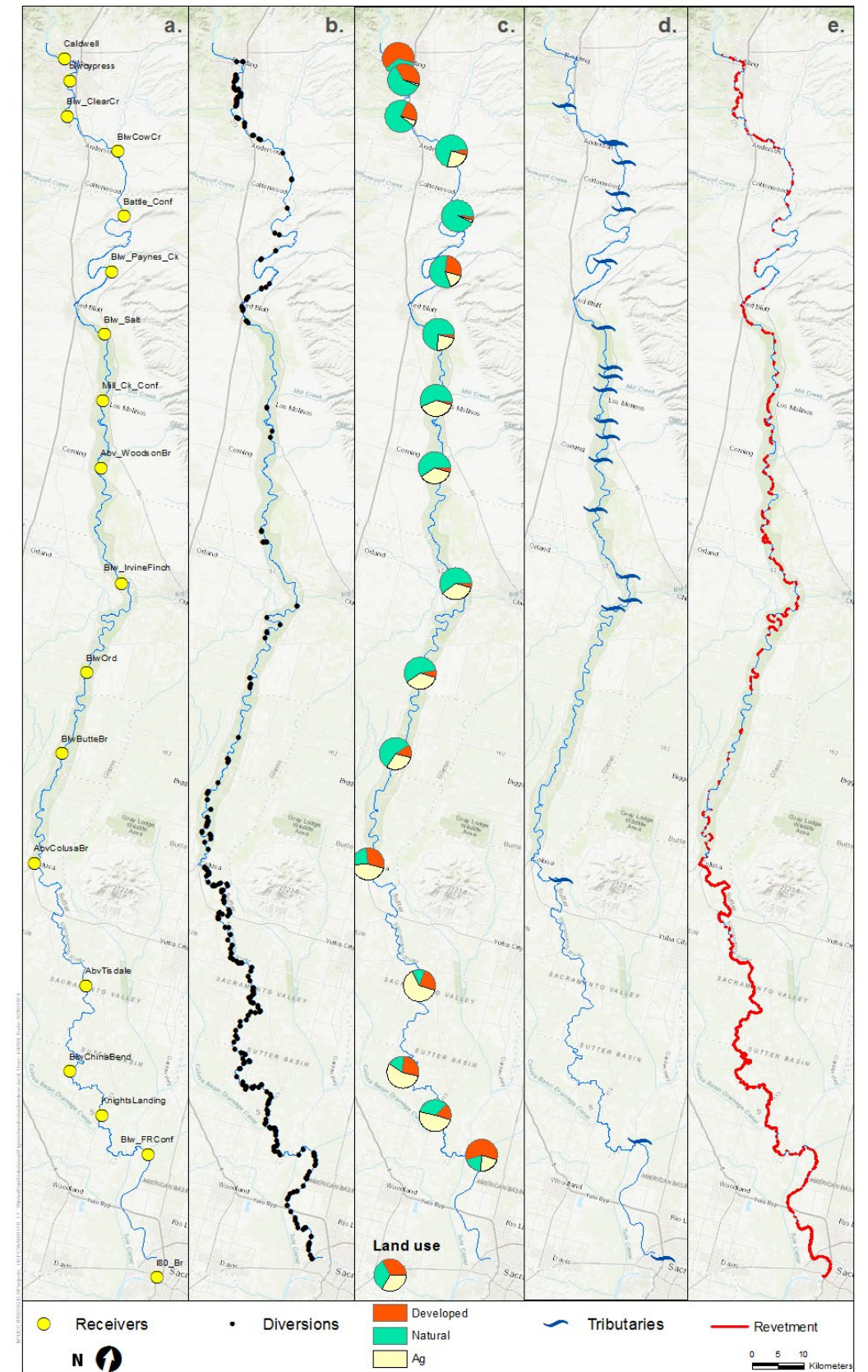
- Highly nutritious zooplankton compete with new exotic species



# Salmon rearing habitat, size selective mortality

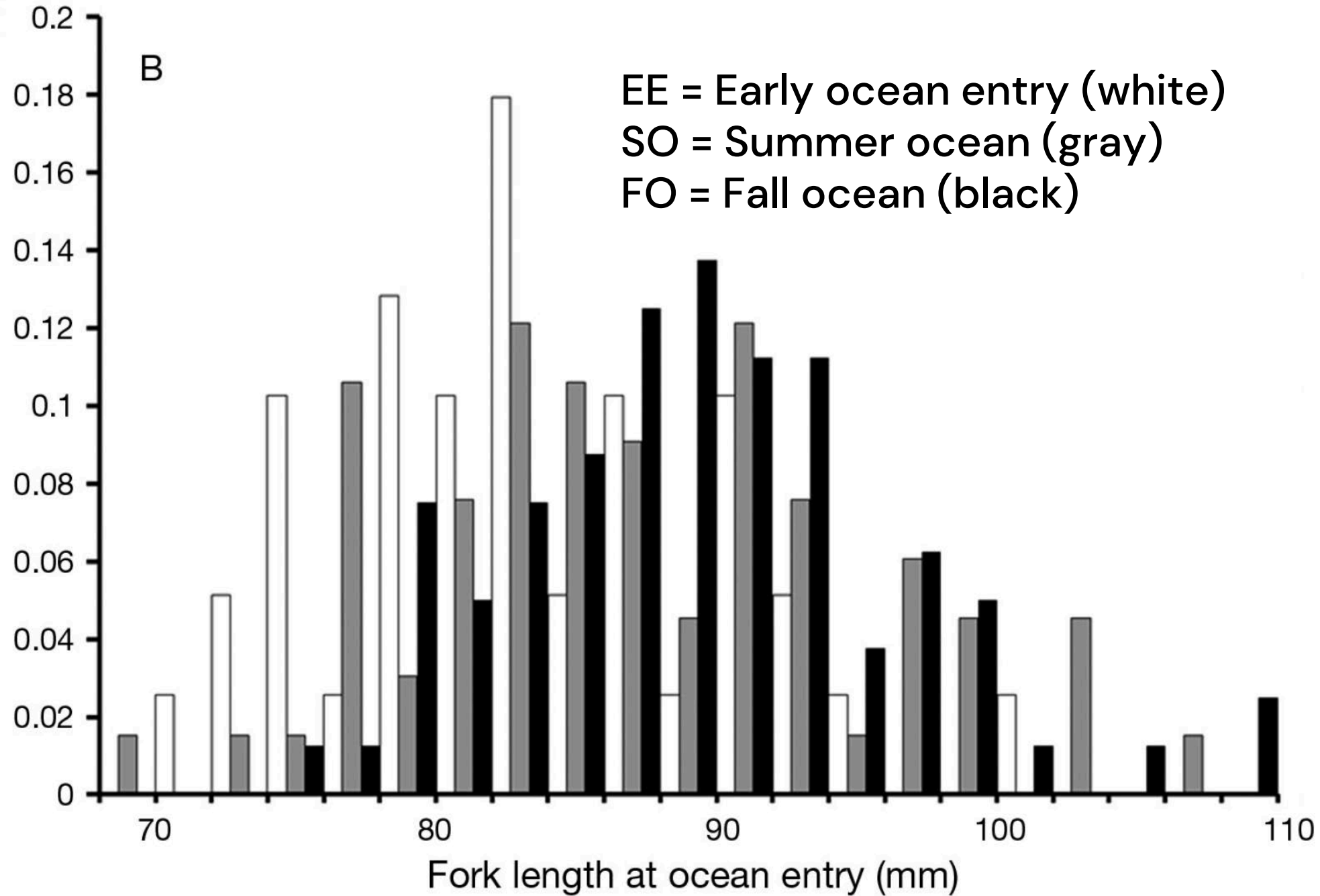
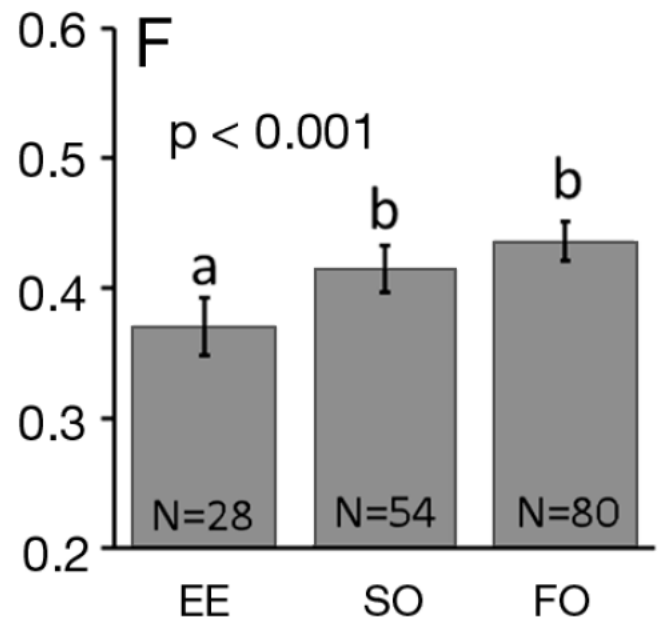
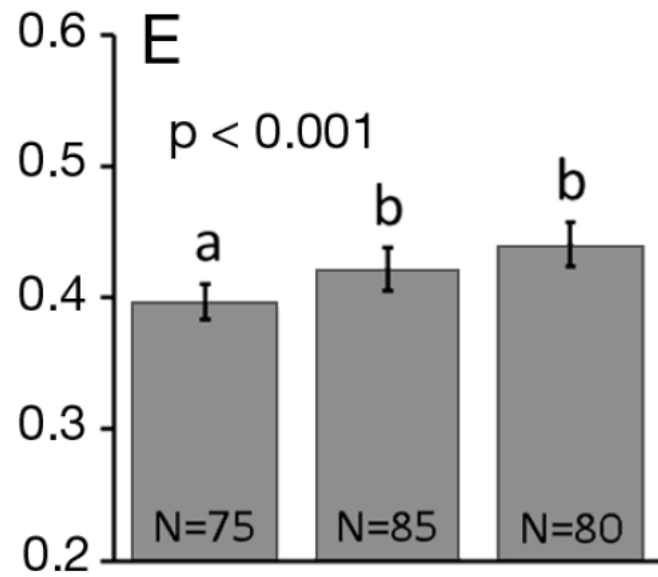


Hassrick et al. 2022 NAJFM





# Size-selective mortality (Woodson et. al 2013 MEPS)

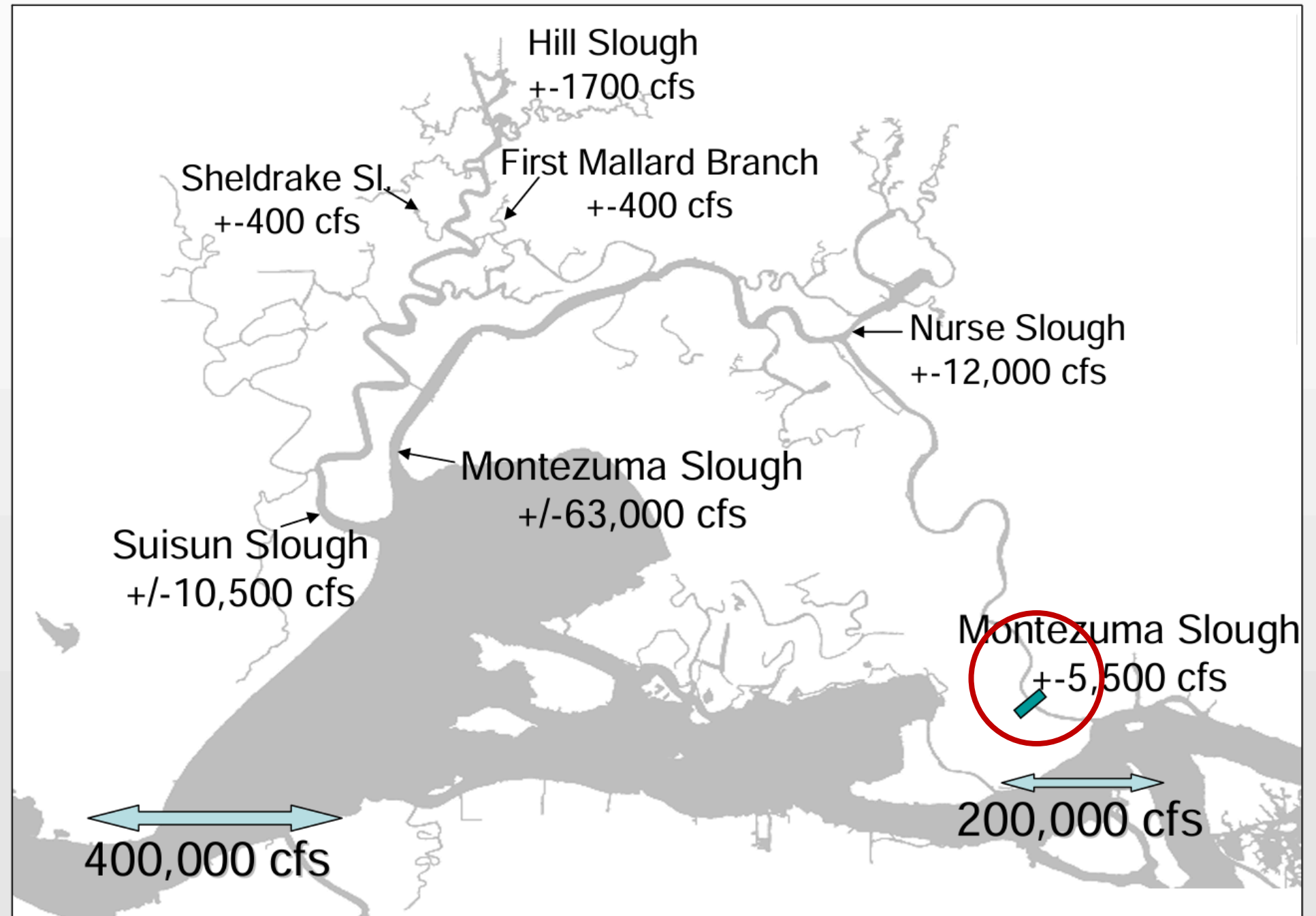




# Suisun Marsh – an oasis

- 116,000 acres
- **Largest** contiguous brackish marsh in the West
- On the **Pacific Flyway**
- Diversity of **native fishes**
- A complex of **tidal wetlands**

## Tidal Time Scale Flows



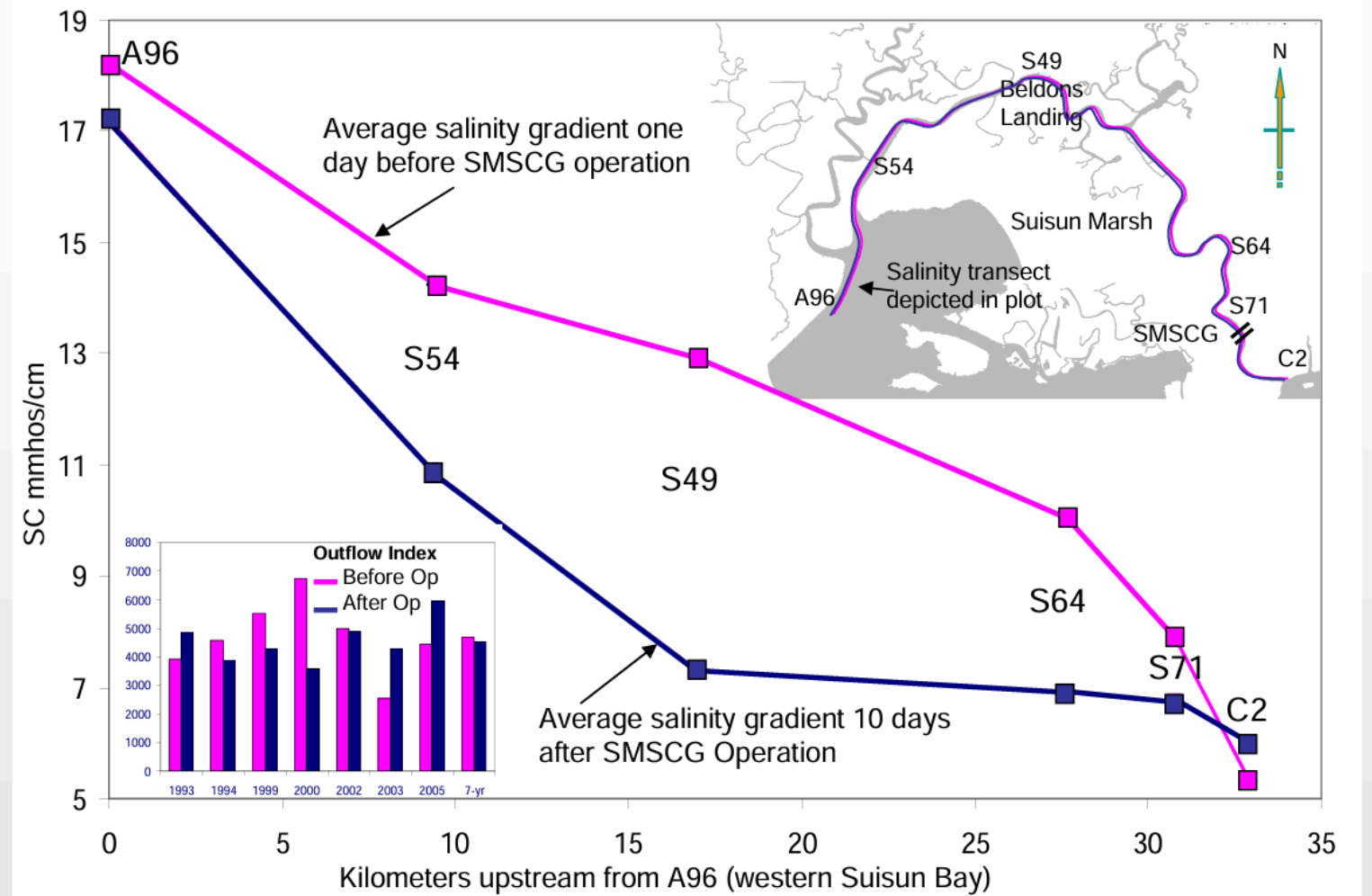


# Controlling salt water intrusion

- Salinity control gates close in Sept-Oct



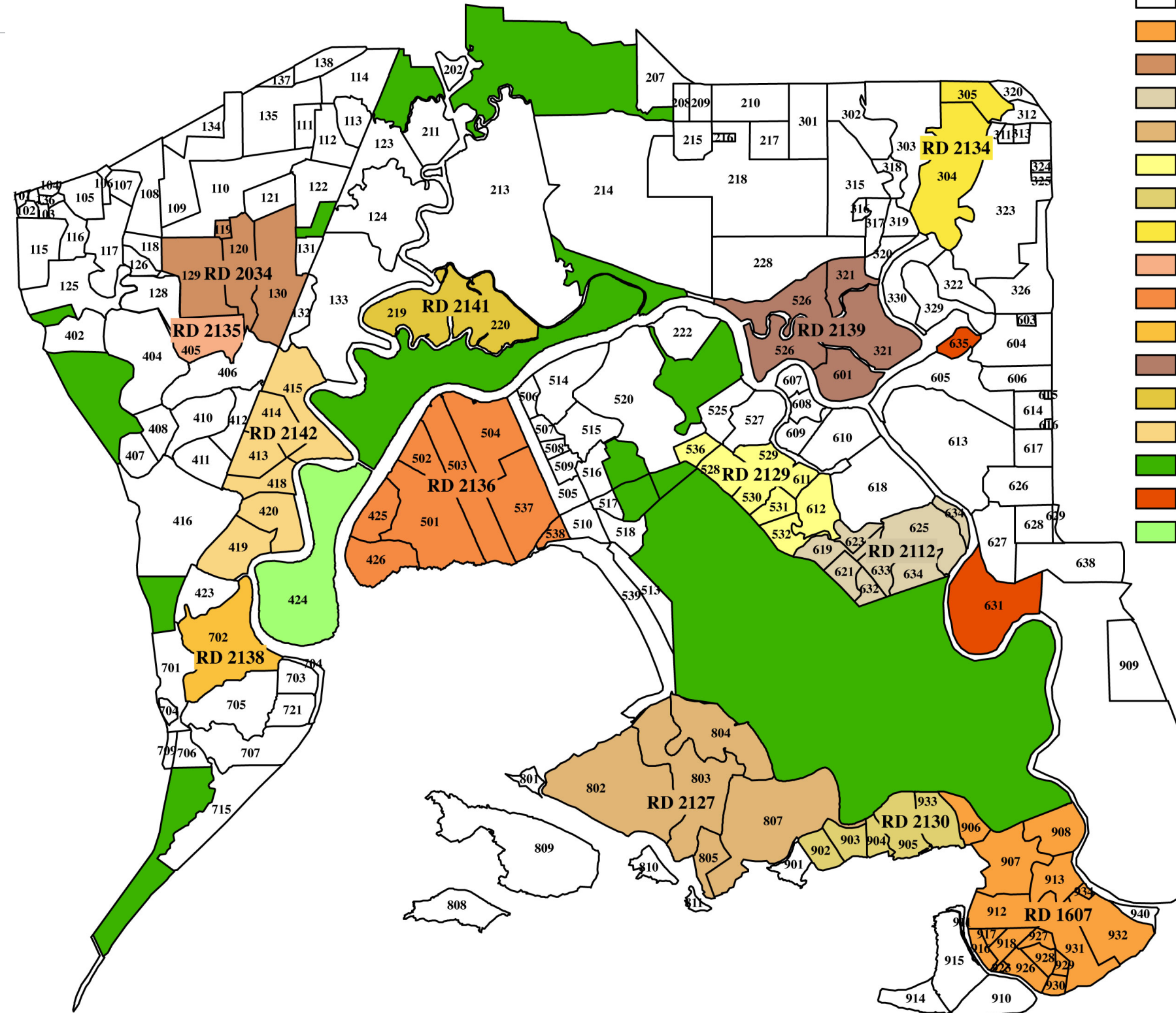
## SMSCG effect on Montezuma Slough





# When restoration opportunities are scarce, go with duck clubs!

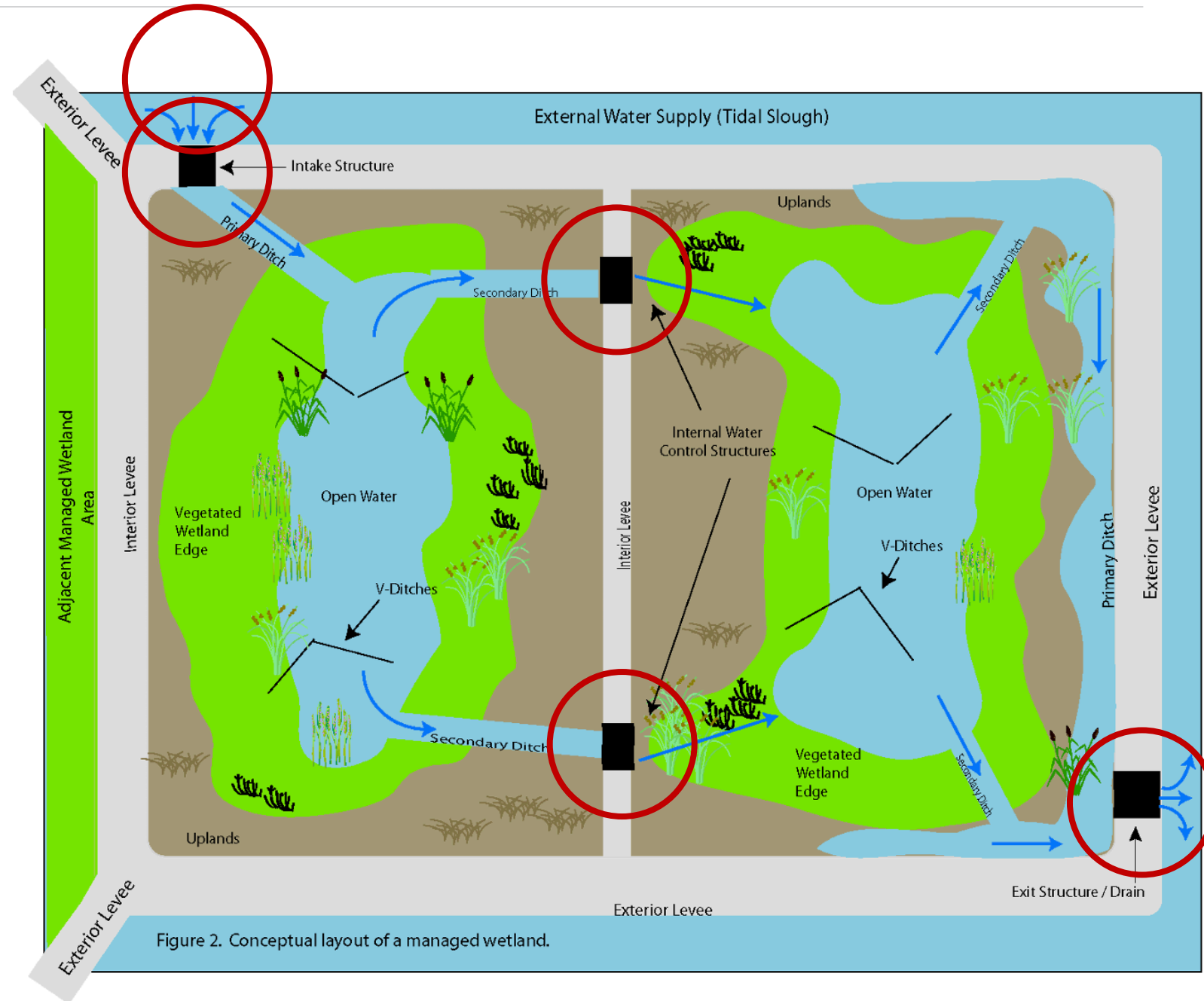
- More than 80% is managed wetlands!
- 158 duck clubs
- 15,000 acres state - managed hunting clubs
- Muted tidal ponds
- Winter flood
- Summer drained - Forbes grow





# How managed wetlands work

1. External supply (tidal slough)
2. Tide gate pulls water in
3. Flaps one way to allow water in but not out
4. Highly controlled water circulation
5. Water circulates during hunting season
6. Ponds are drained (leaching cycles) when season is over





# Creating a benefit out of a potential problem

## Potential problems if mismanaged

- Concentrate salt and heavy metals in soils
- Dumping all at once can produce a plume of toxic sludge
- Can get fish kills from low DO

Regular leaching cycles can handle this problem!

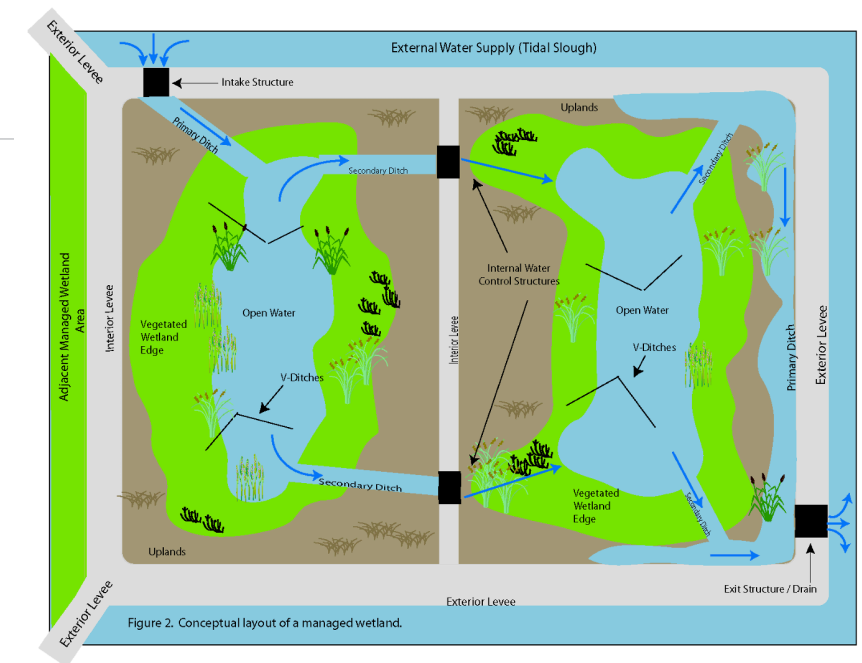
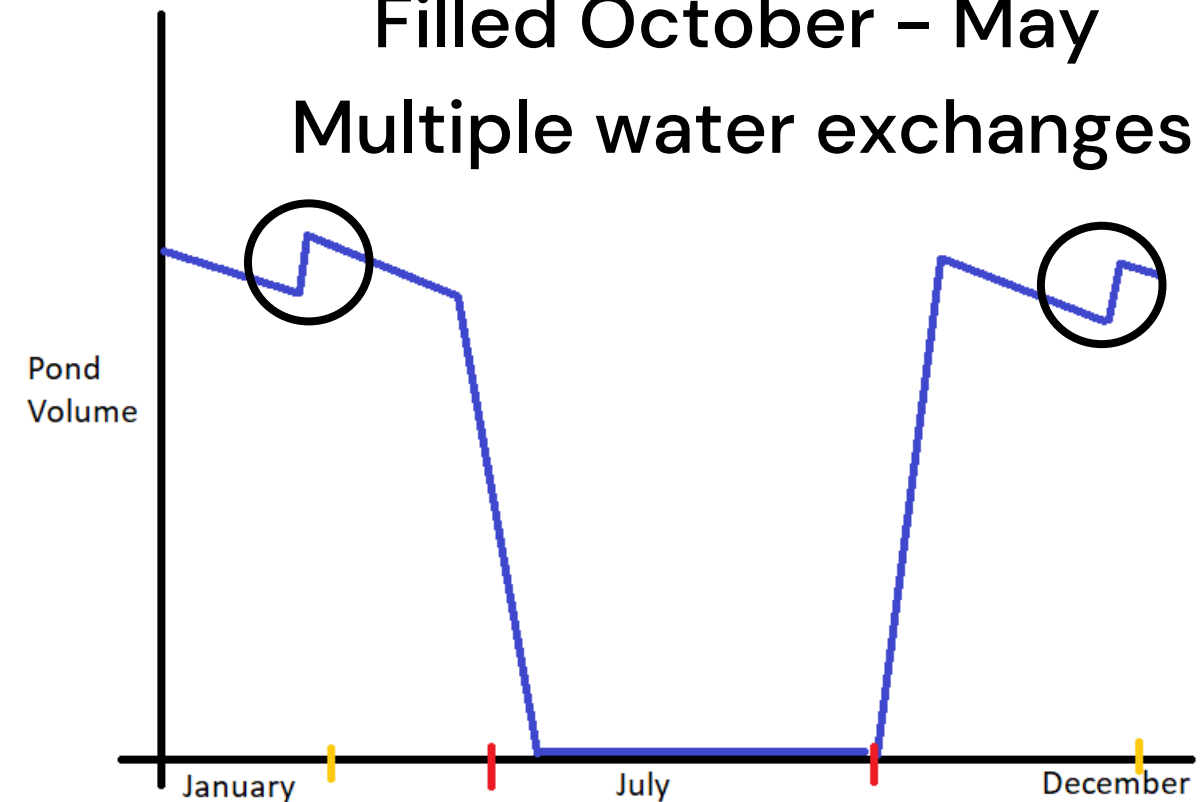


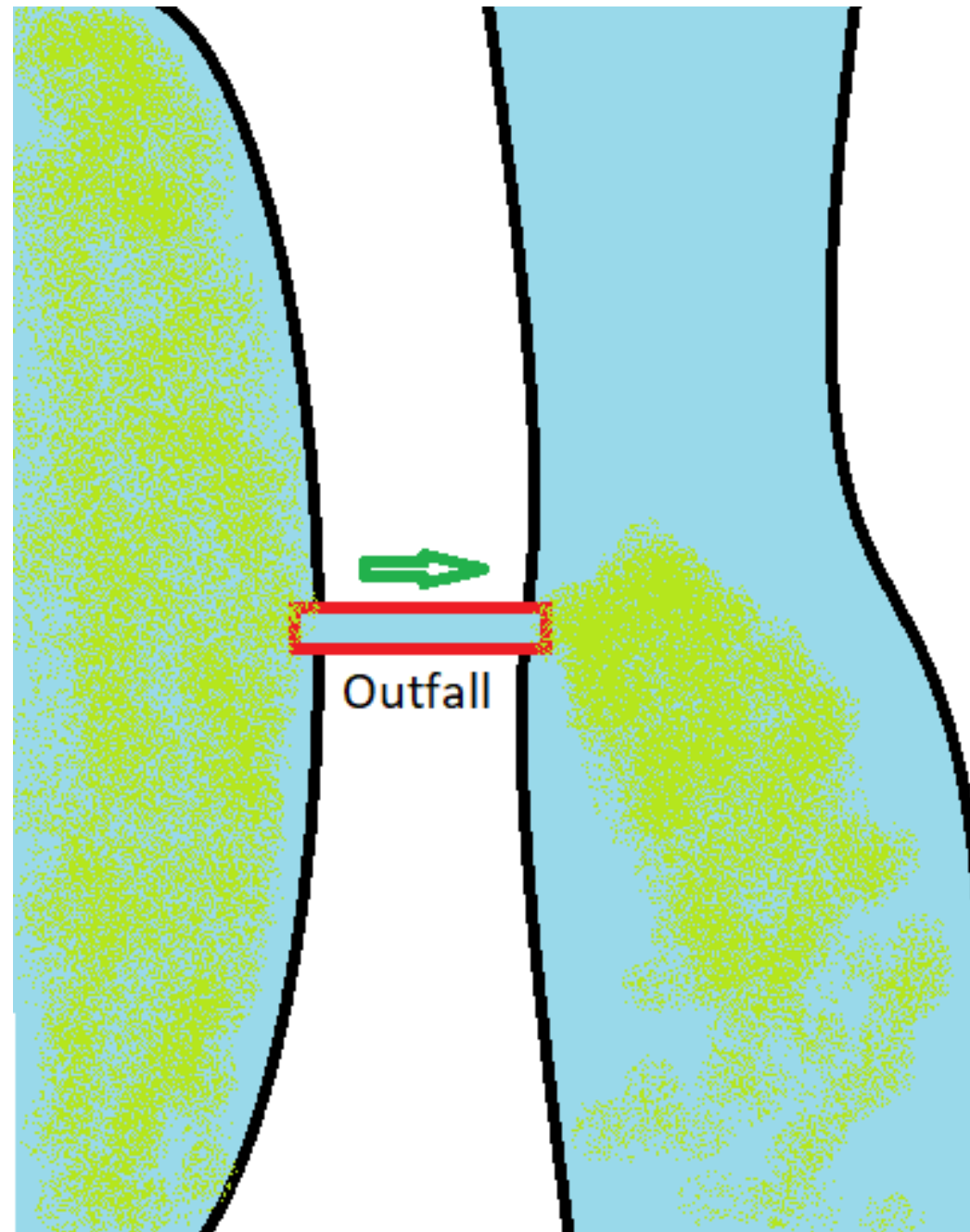
Figure 2. Conceptual layout of a managed wetland.

Filled October – May  
Multiple water exchanges





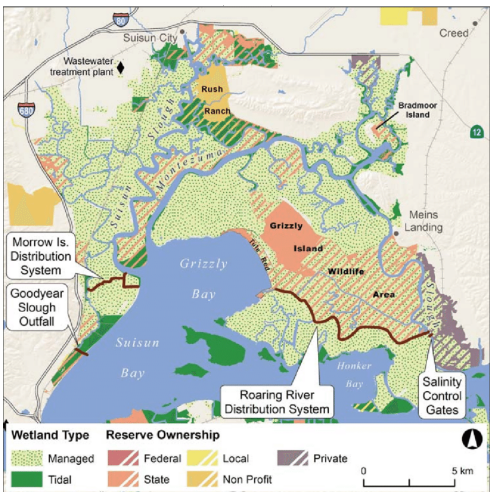
# What about off the ponds?



- Leaching cycles and pond draining subsidize local marsh
- How large are the subsidies, and how long do they last?



# Study goals



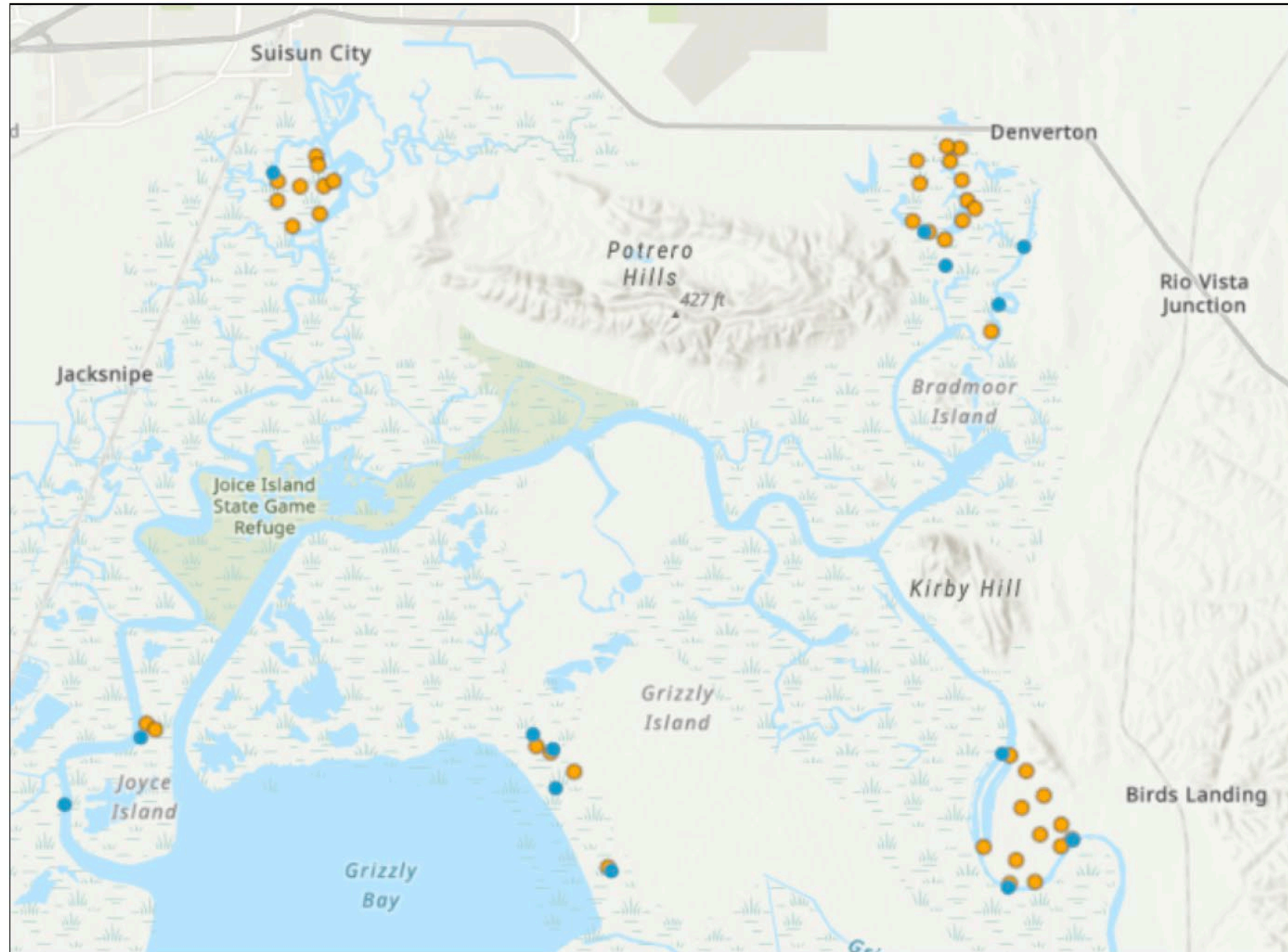
1. Quantify productivity in ponds and adjacent sloughs

2. Identify differences in the ecological community (managed ponds, tidal ponds, and sloughs)

3. Connect productivity and community differences to management strategies



# Sampling stations in Suisun Marsh

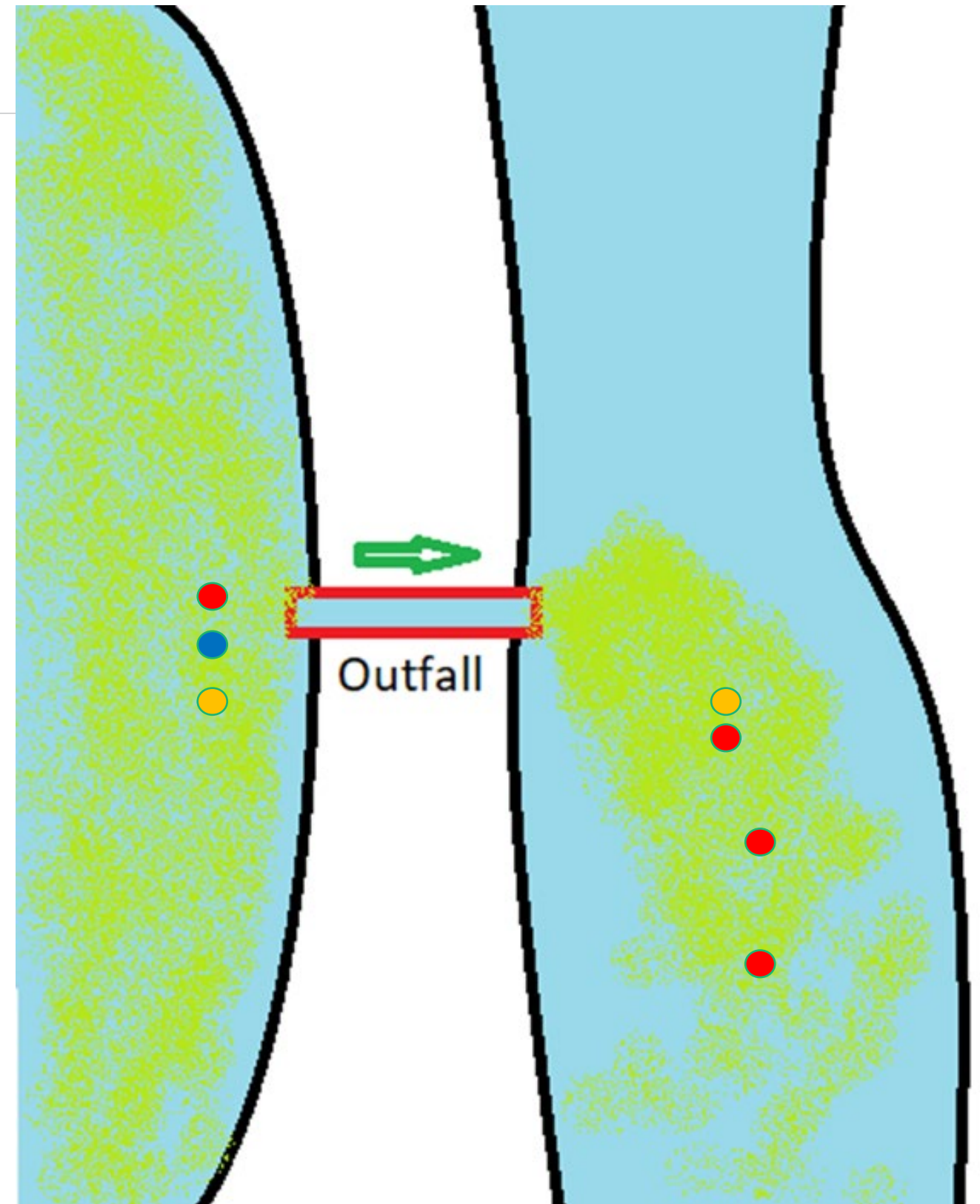


**Figure 4.2.** Sampling stations in Suisun Marsh. Orange dots indicate sampling locations within managed ponds. Blue dots indicate sampling locations in tidal waterways.



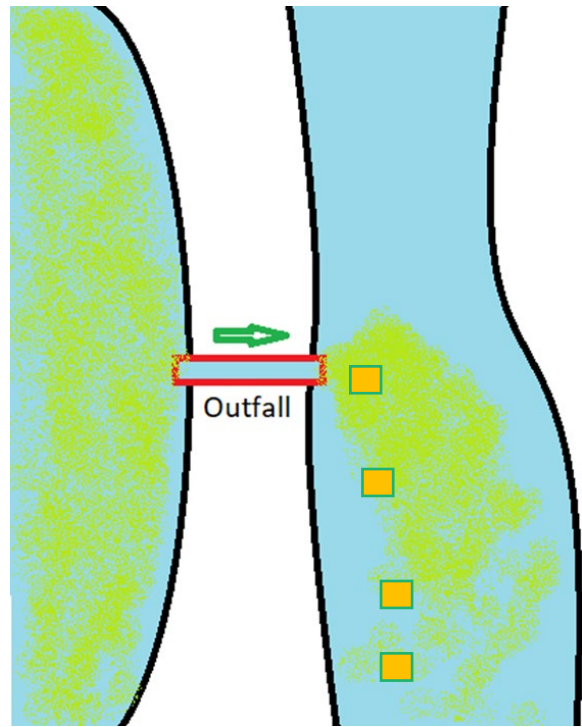
# Outfall subsidies

- Depth loggers – water exchange ●
  - Bathymetry, water height for water drained ●
- Dissolved oxygen – overall productivity ●
  - Whole habitat metabolism inside and out of ponds ●
- Salinity logger – environmental dissipation ●
  - Water dispersion during outfall
  - Concentration gradient
  - proxy for productivity plume



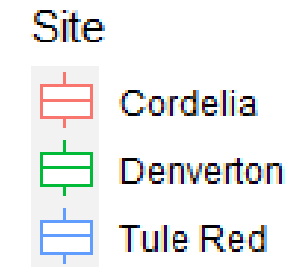
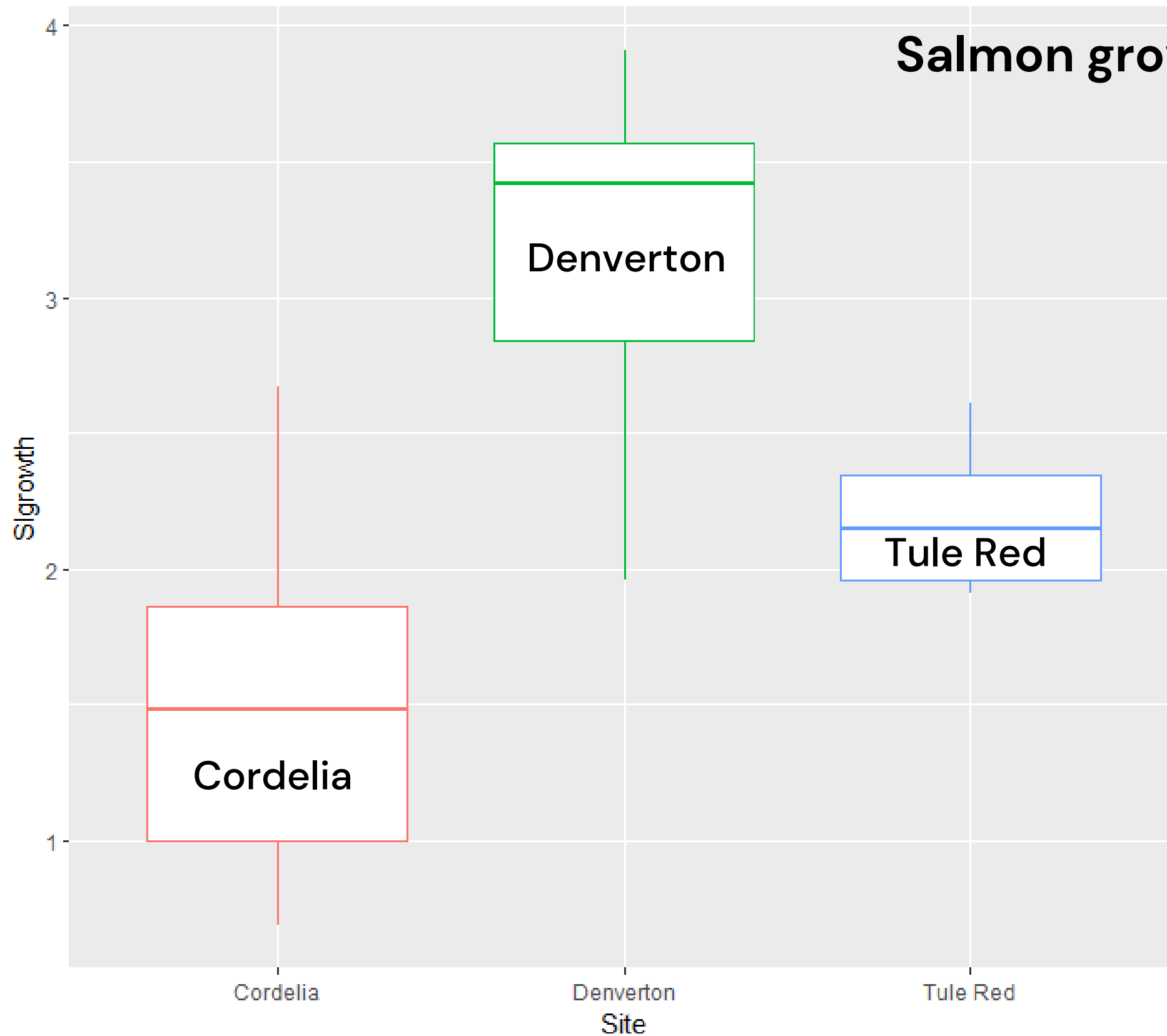


# Outfall subsidies for salmon growth





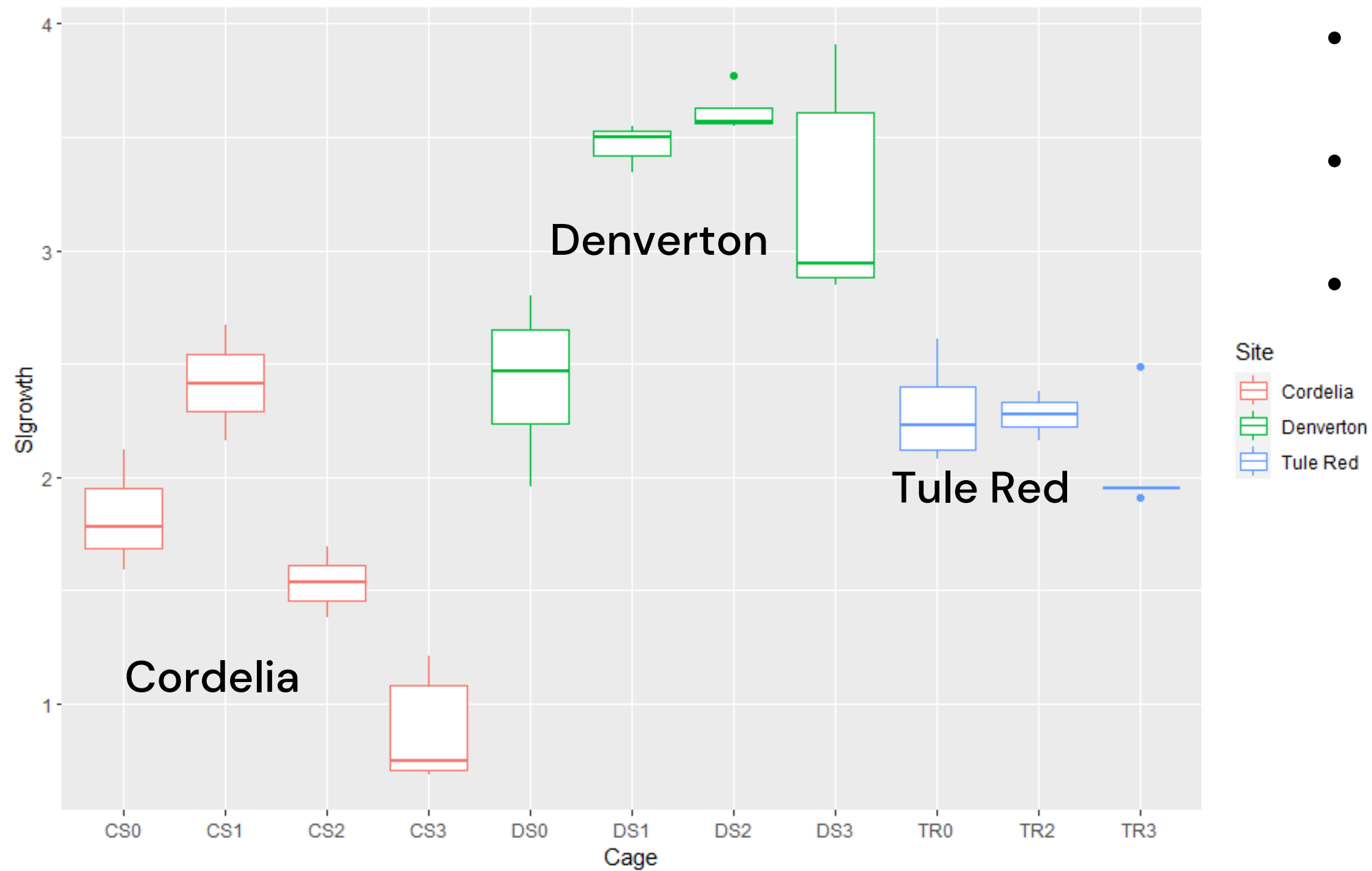
# Salmon growth by pond location



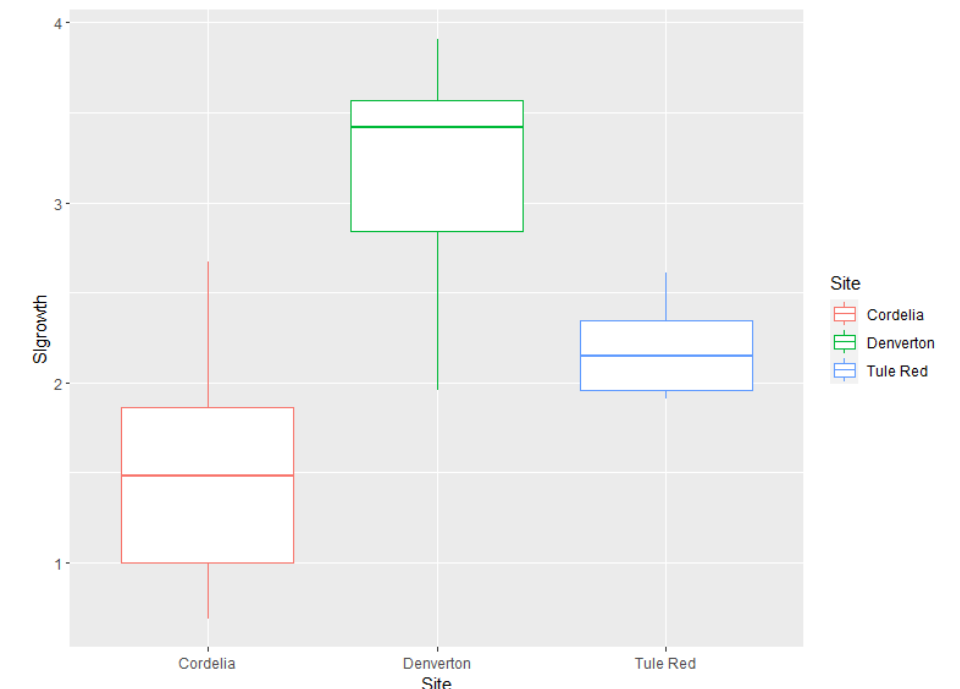
- Pond residence time
- Slough morphology
- Input / output complexity



# Salmon growth by pond and distance from outfall



- Lower at outfall
- Highest just downstream
- Declining with distance





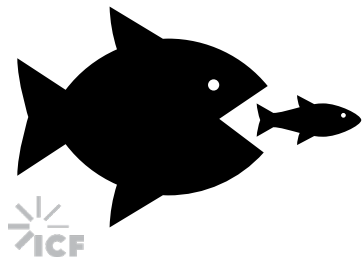
# Differences in fish communities in and outside ponds



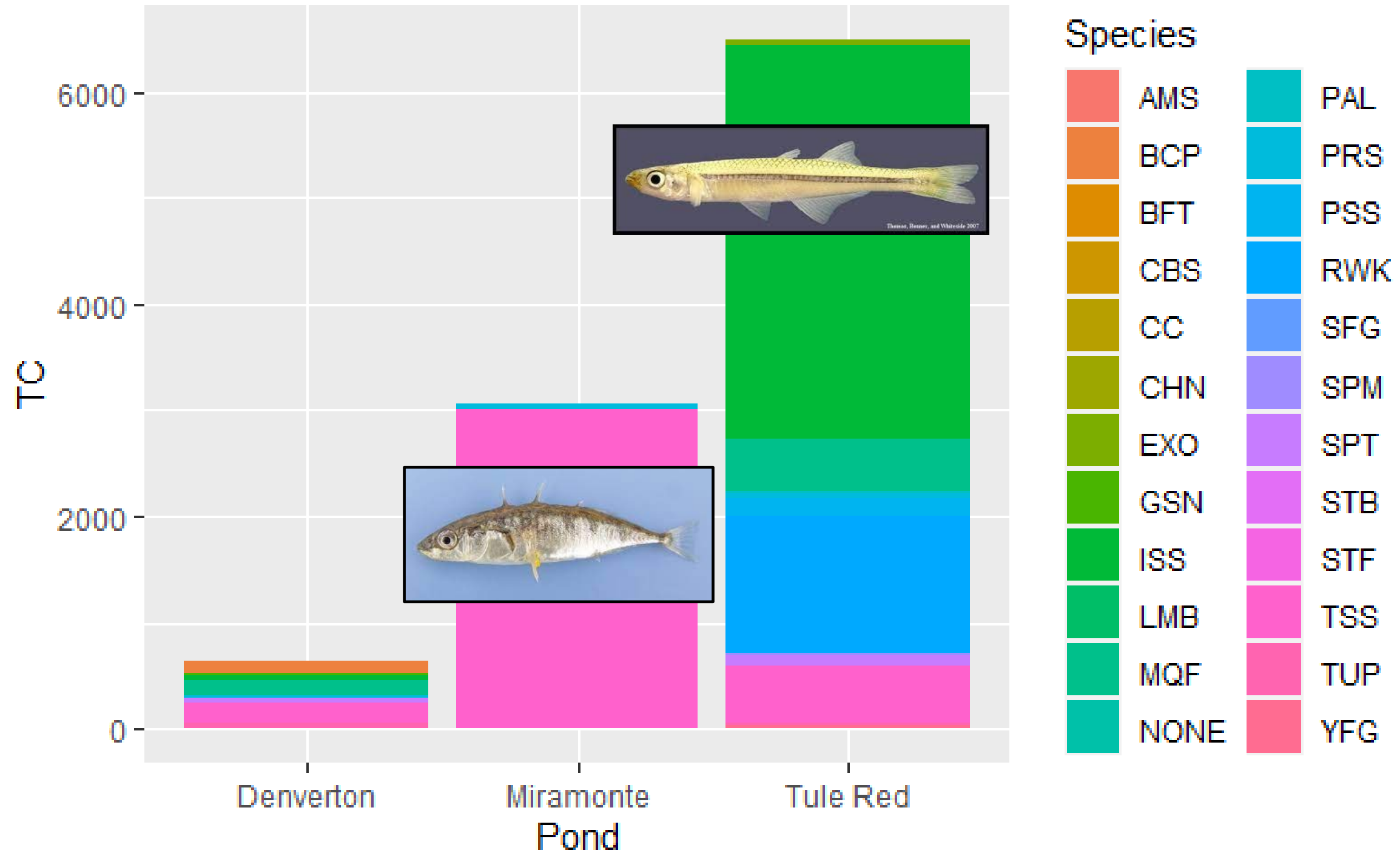
53 pond seines  
23 species



40 trawls in adjacent sloughs  
14 fish species  
Salmon

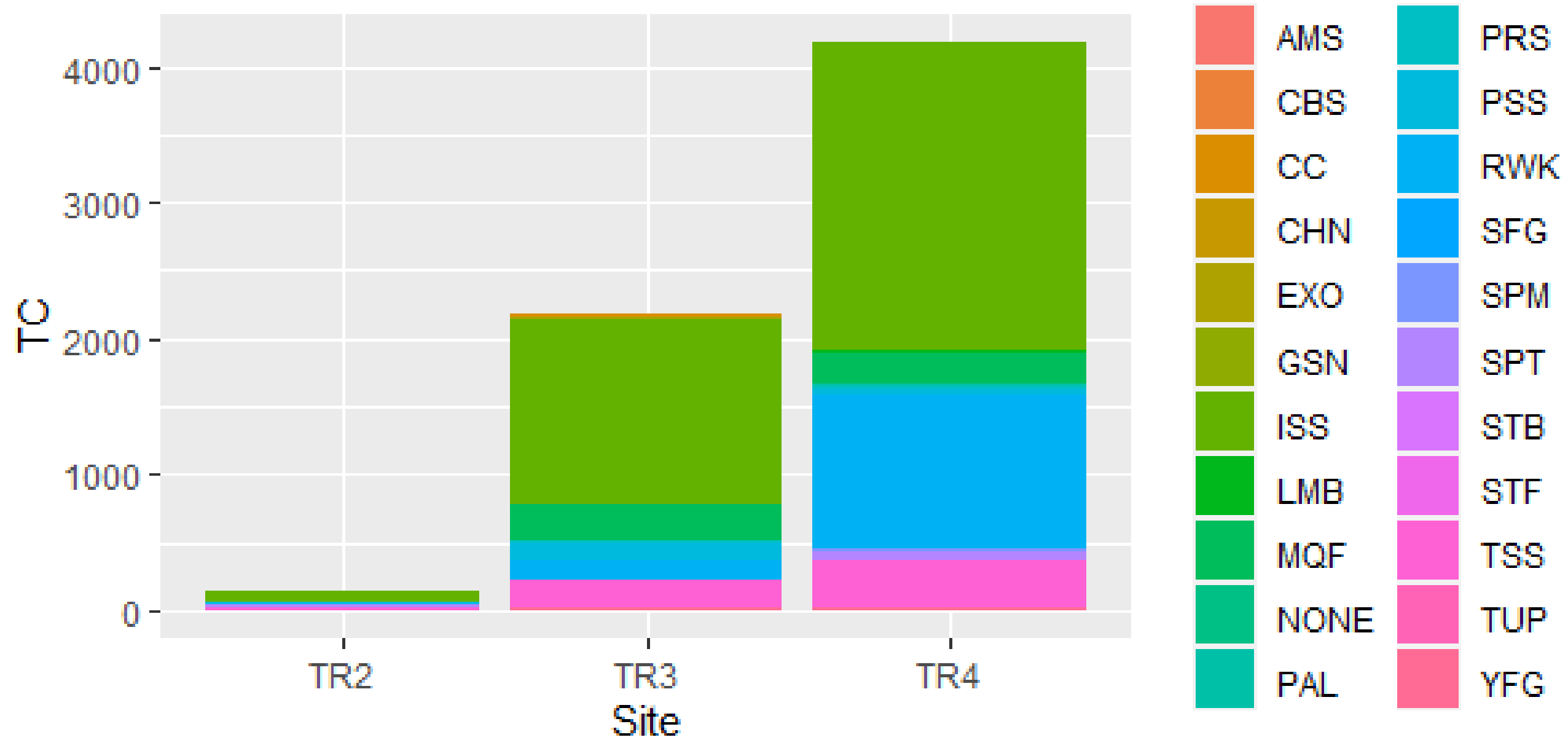


# Comparison of sites with different management strategies





# Tule Red restoration site



# In conclusion

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1. Despite being highly productive, wetlands are in trouble worldwide
2. Salmon are in trouble and need rearing habitat to survive the ocean
3. The muted tidal wetlands of Suisun Marsh support a higher diversity of native fishes than elsewhere in the estuary
4. Tule Red restoration initially supported a large population of natives, but now appears to support more non-native species, particularly inland silversides.
5. Managed wetlands with regular leaching cycles can be more productive for native fishes than restored wetlands!
6. This is a great opportunity to achieve multi-benefits where restoration opportunities are scarce and private lands dominate the marsh.



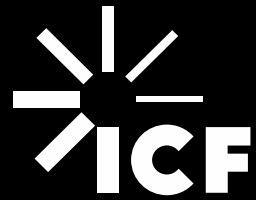
## Get in touch with us:

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