



# Current and historic migrations of green sturgeon

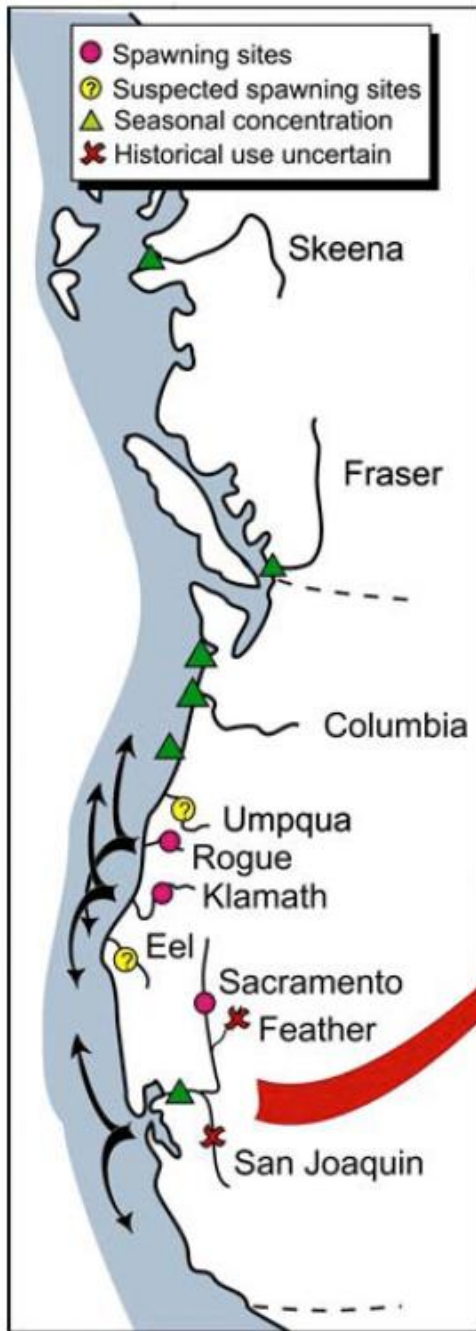
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Diadromous Species Restoration Science  
Workshop

9-10 January 2013



## Spawning

Adults migrate into rivers  
May - June peak  
Annual success likely varies greatly  
depending on conditions

## Estuaries

Large concentrations  
of green sturgeon during  
summer & fall

## Ocean

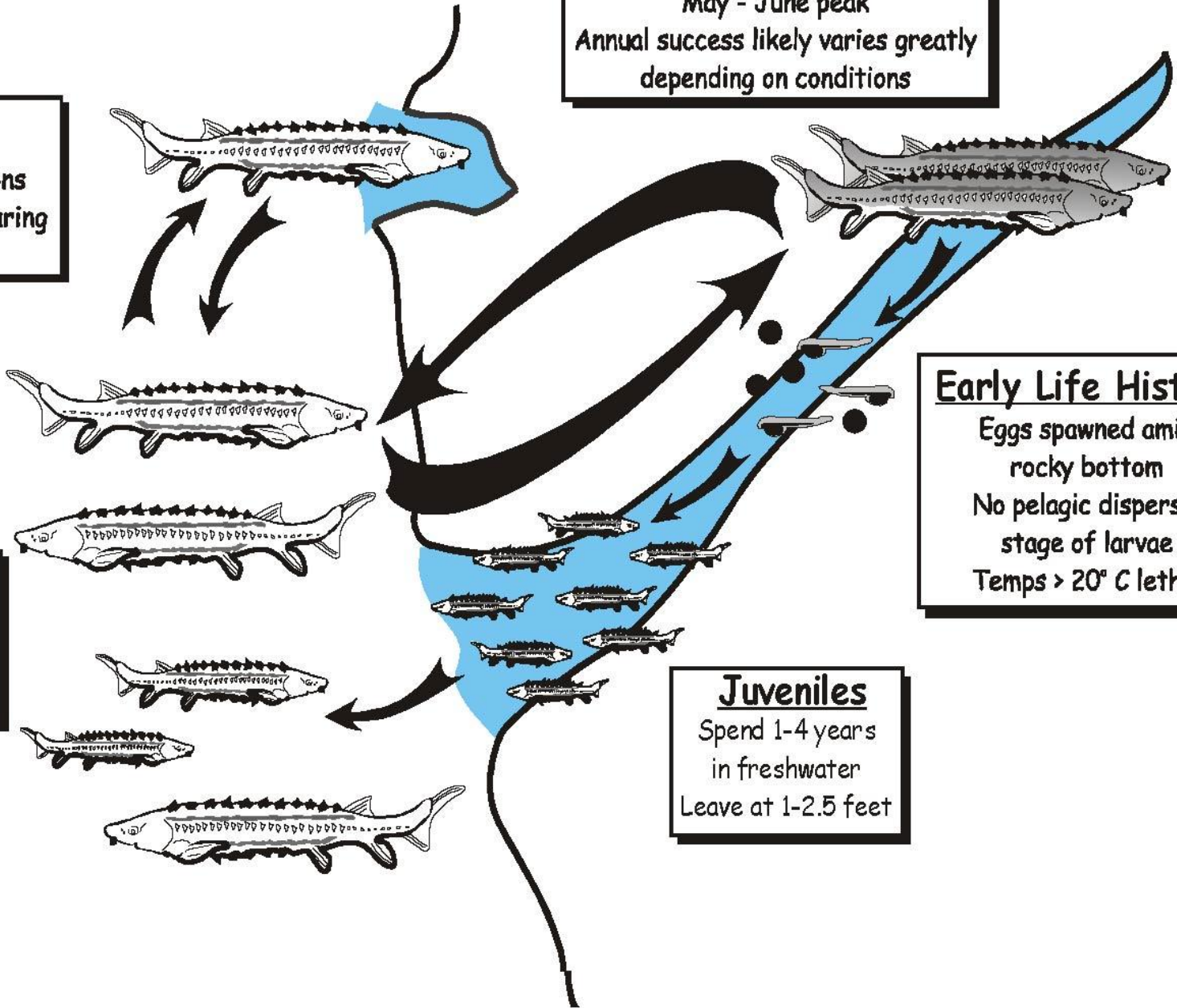
Most of life spent  
in ocean  
Migrate long distance

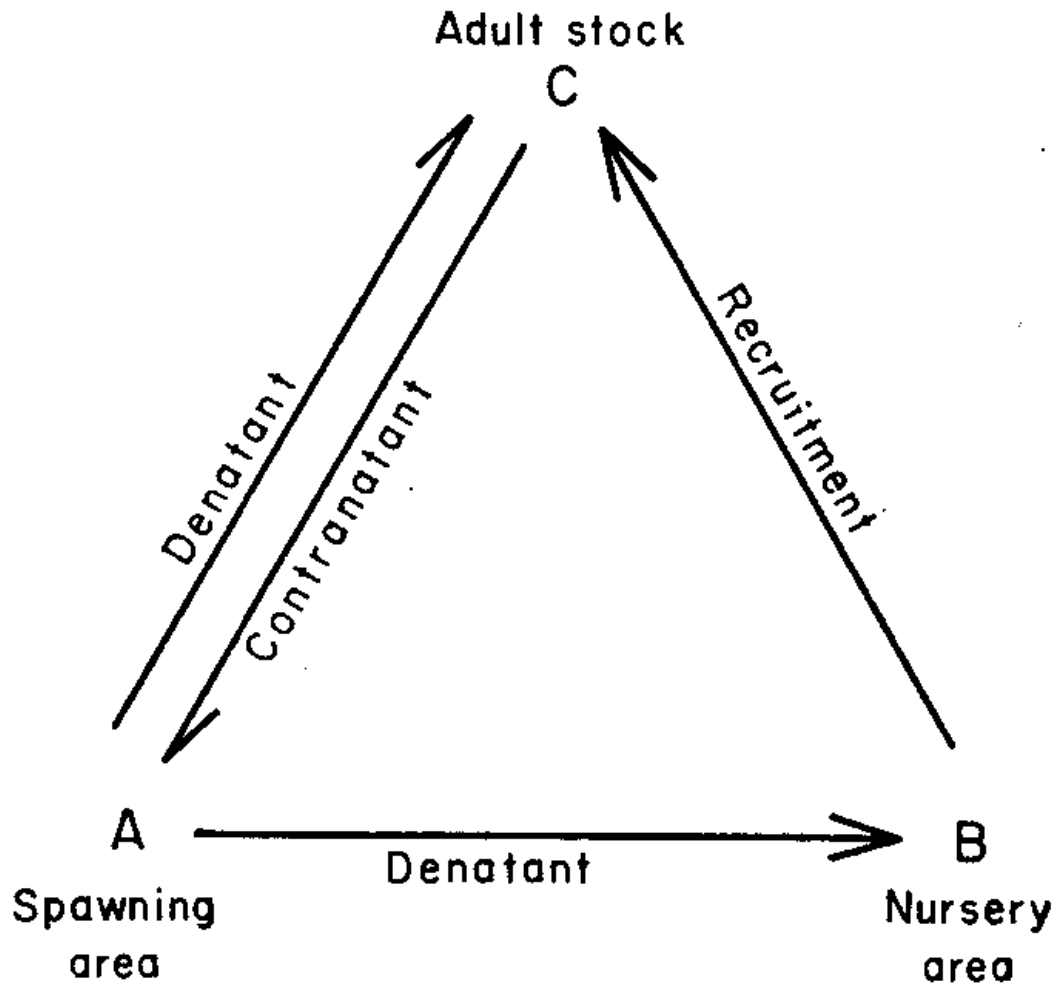
## Early Life History

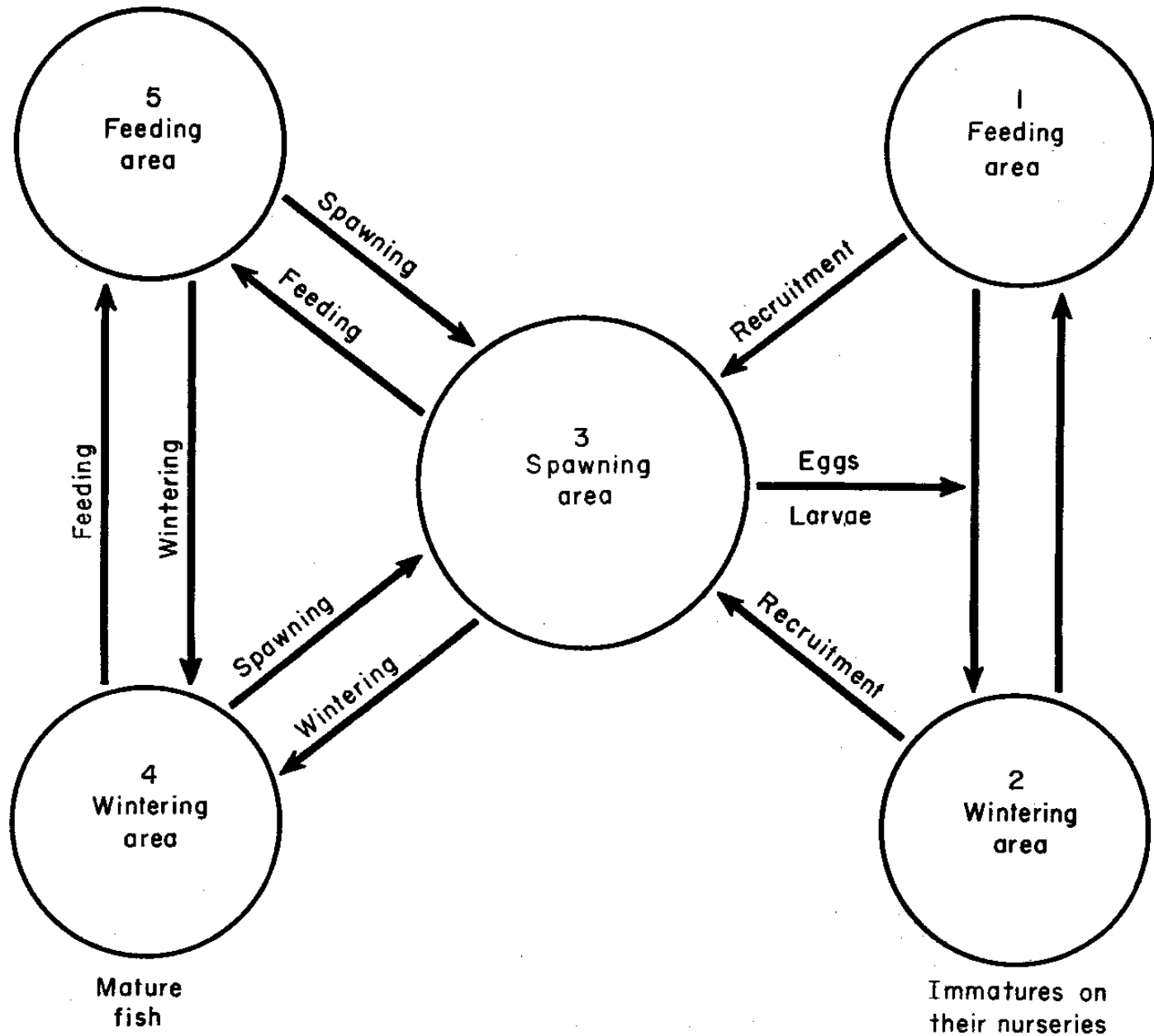
Eggs spawned amid  
rocky bottom  
No pelagic dispersal  
stage of larvae  
Temps > 20° C lethal

## Juveniles

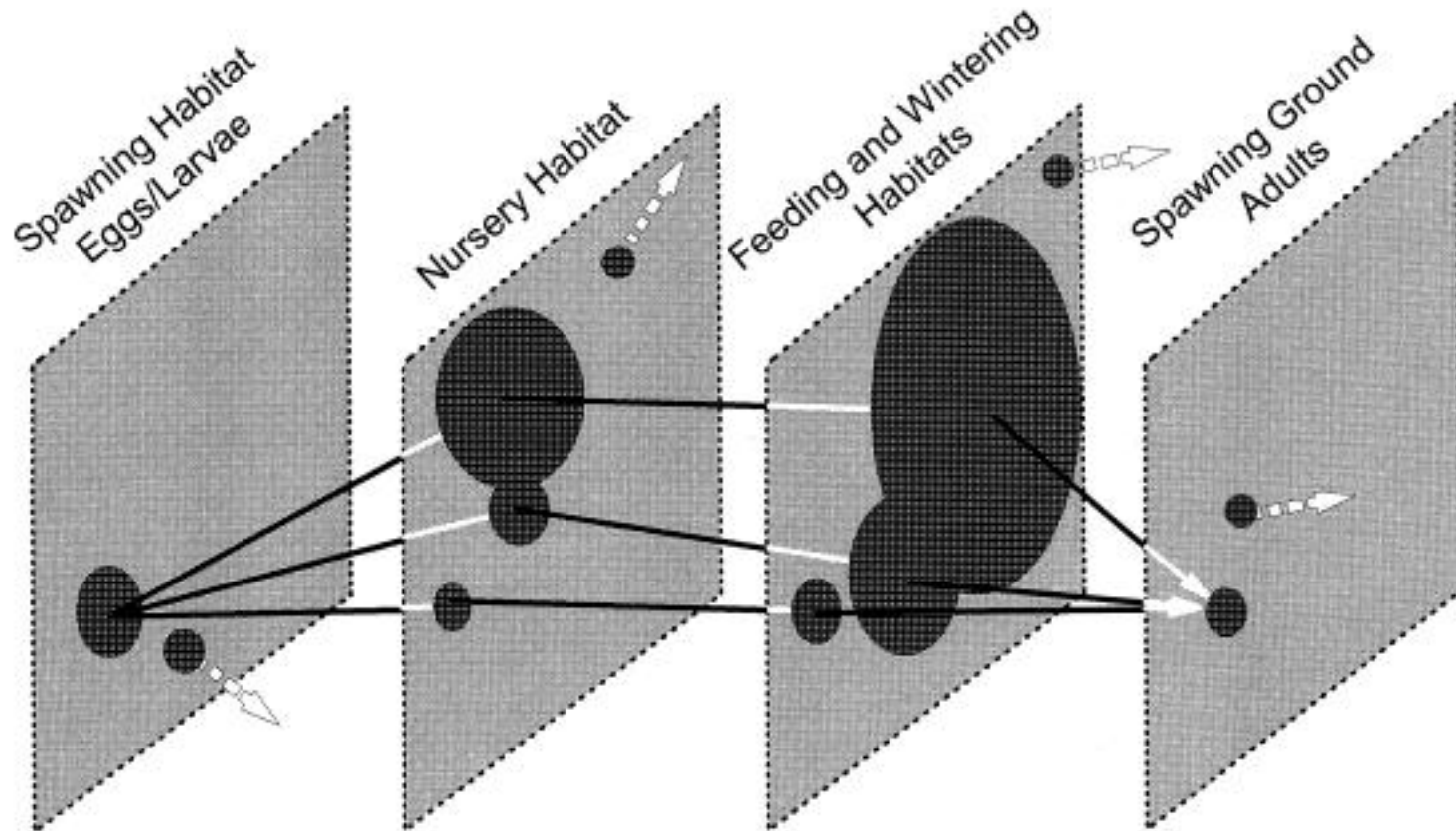
Spend 1-4 years  
in freshwater  
Leave at 1-2.5 feet

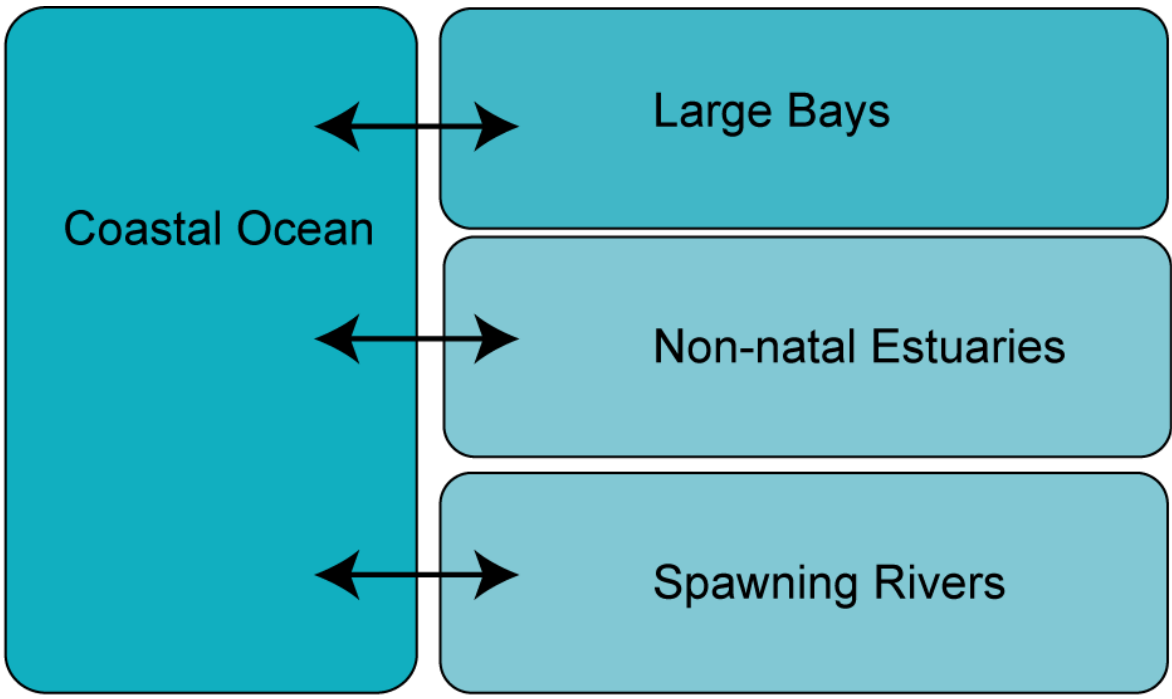






# Migratory Modes



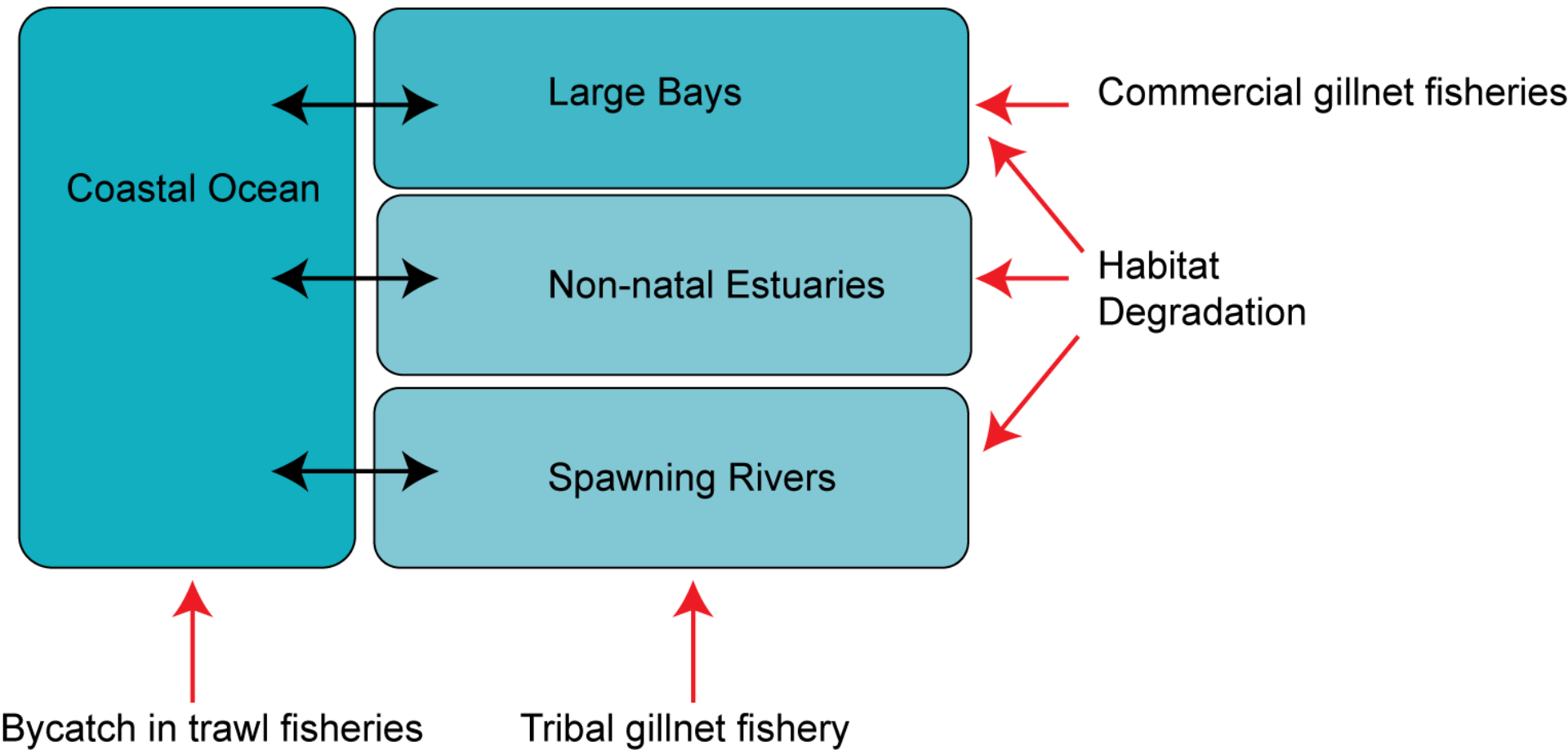


Coastal Ocean

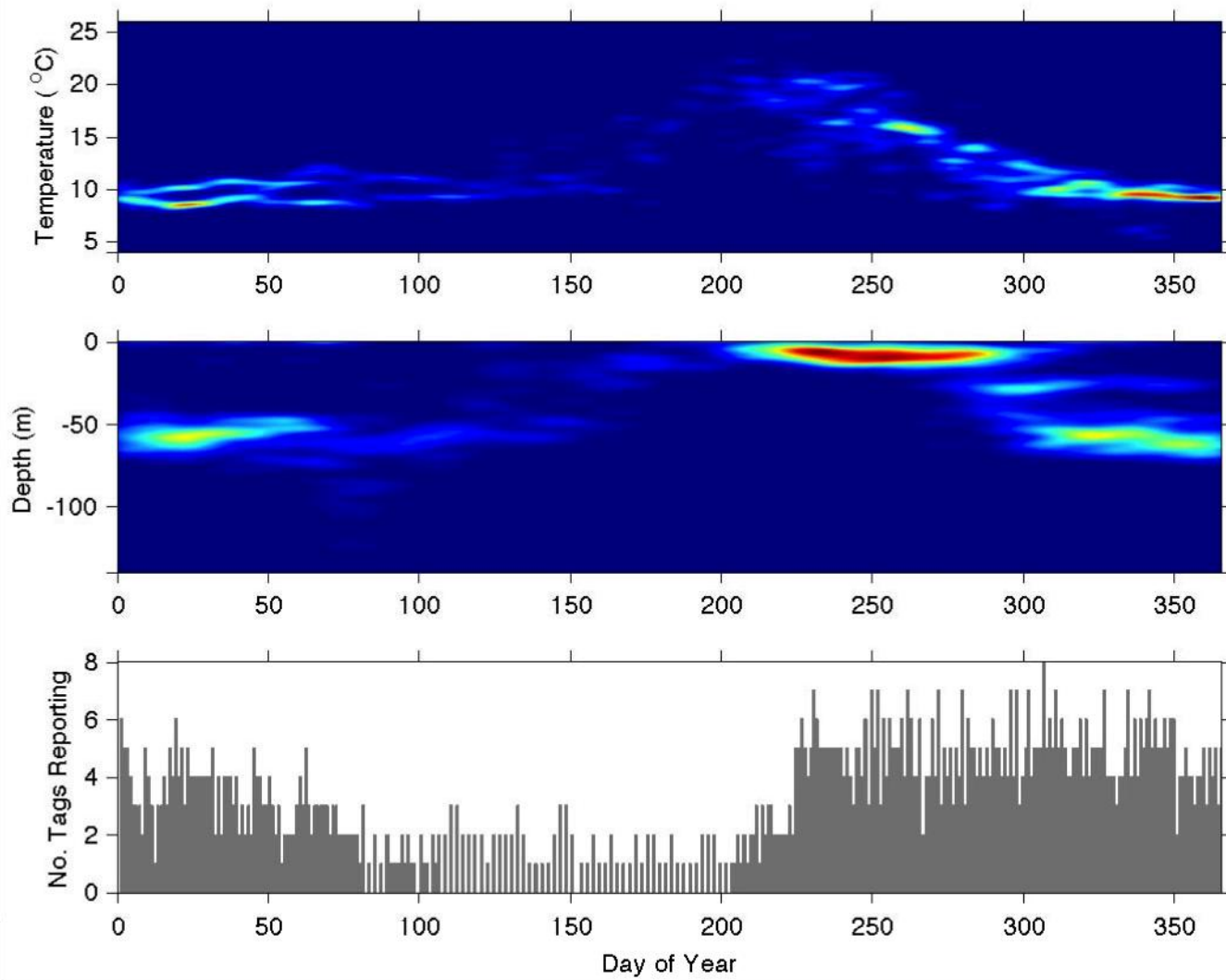
Large Bays

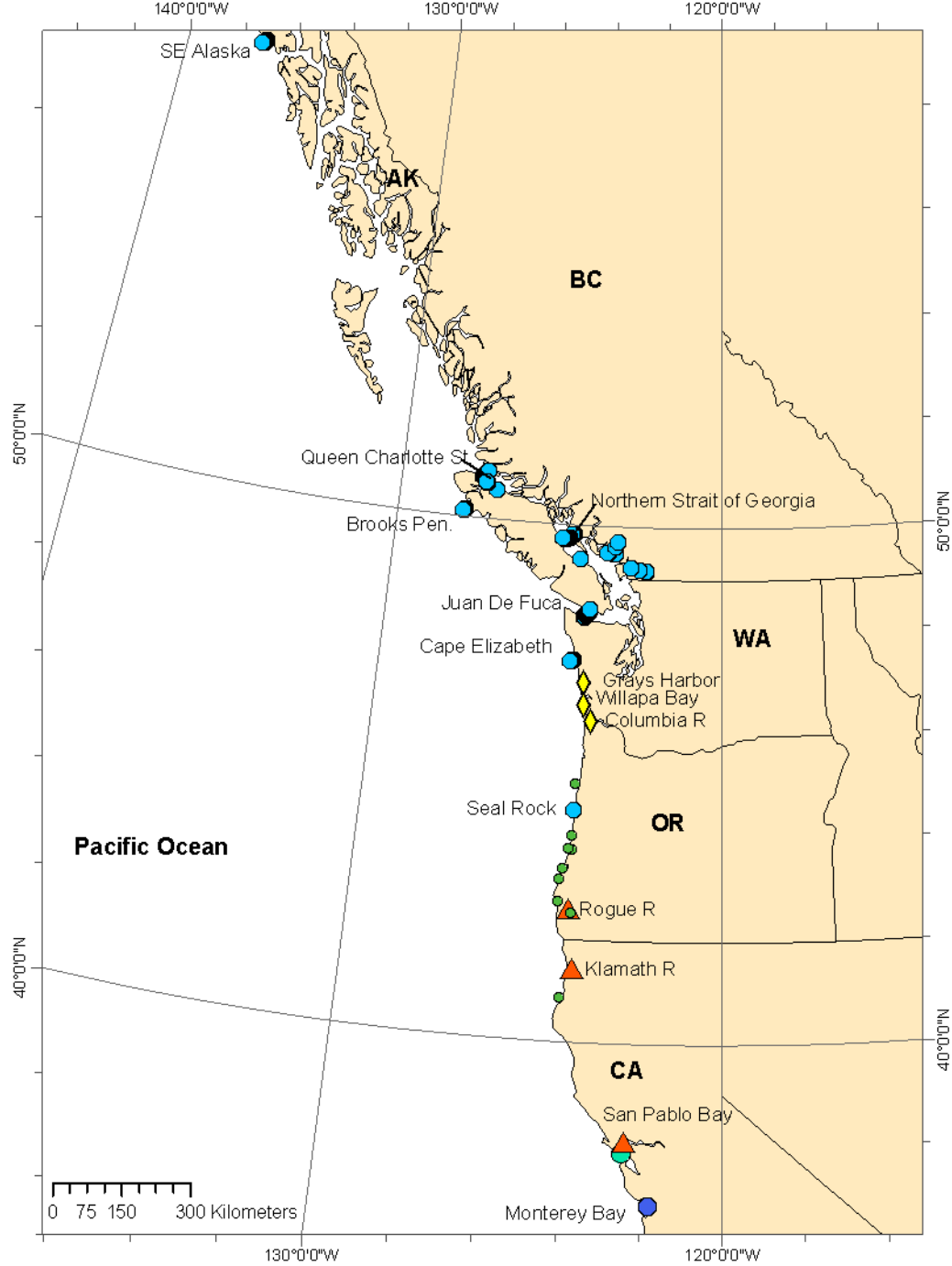
Non-natal Estuaries

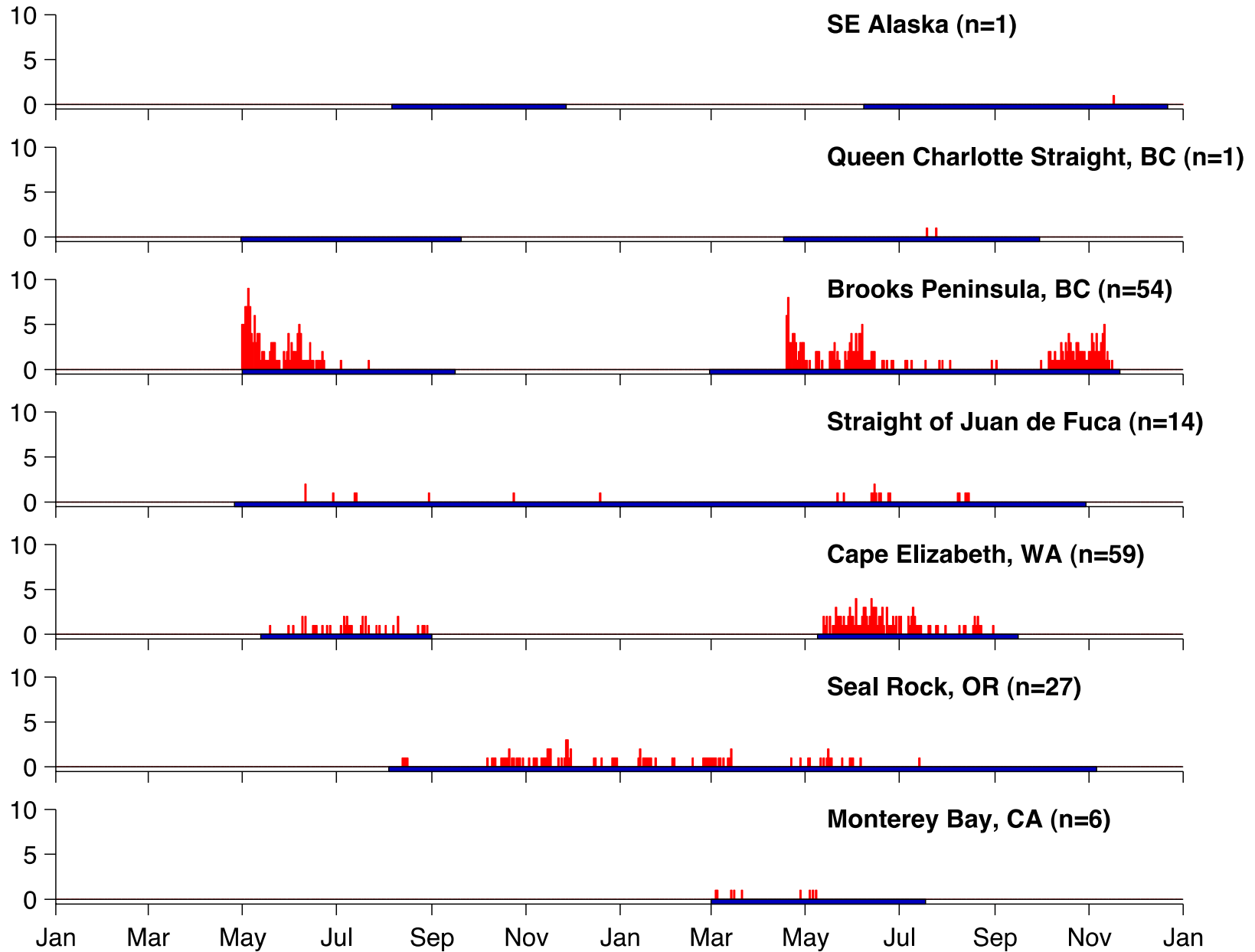
Spawning Rivers

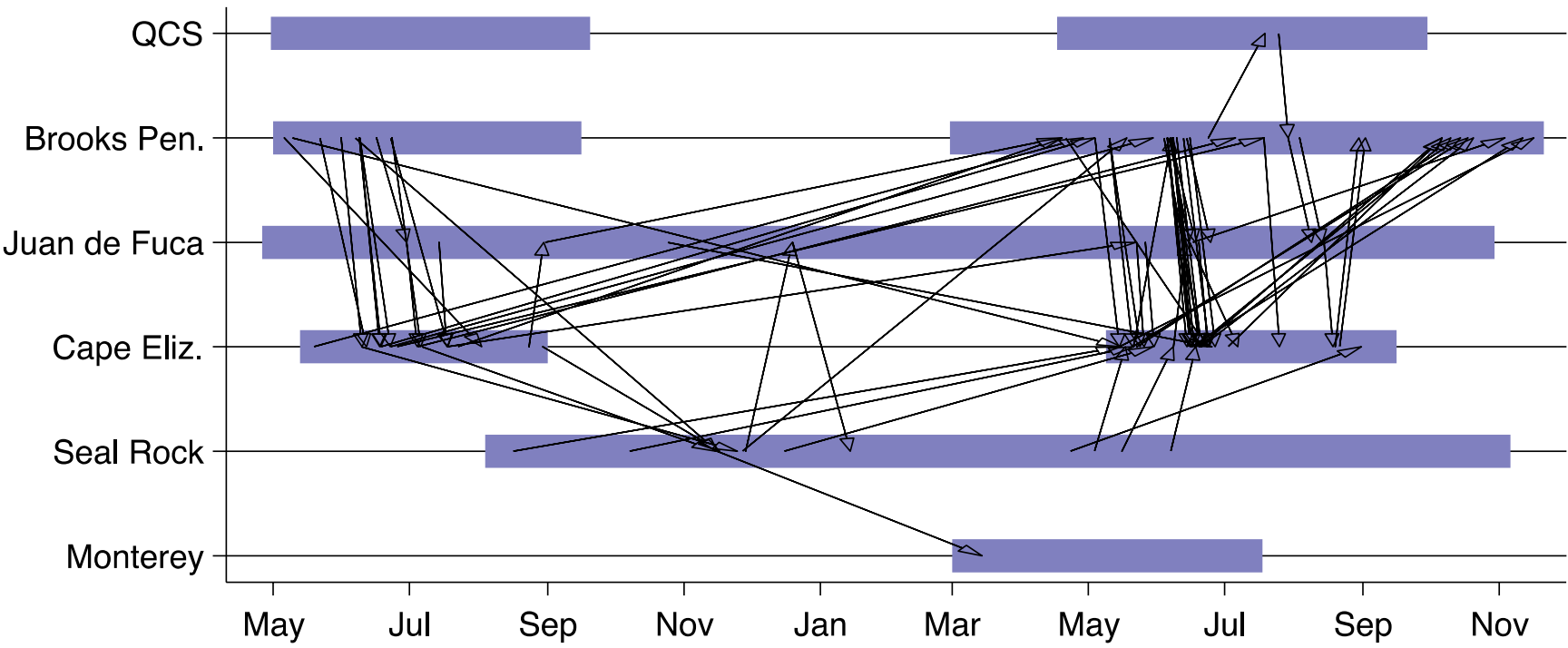


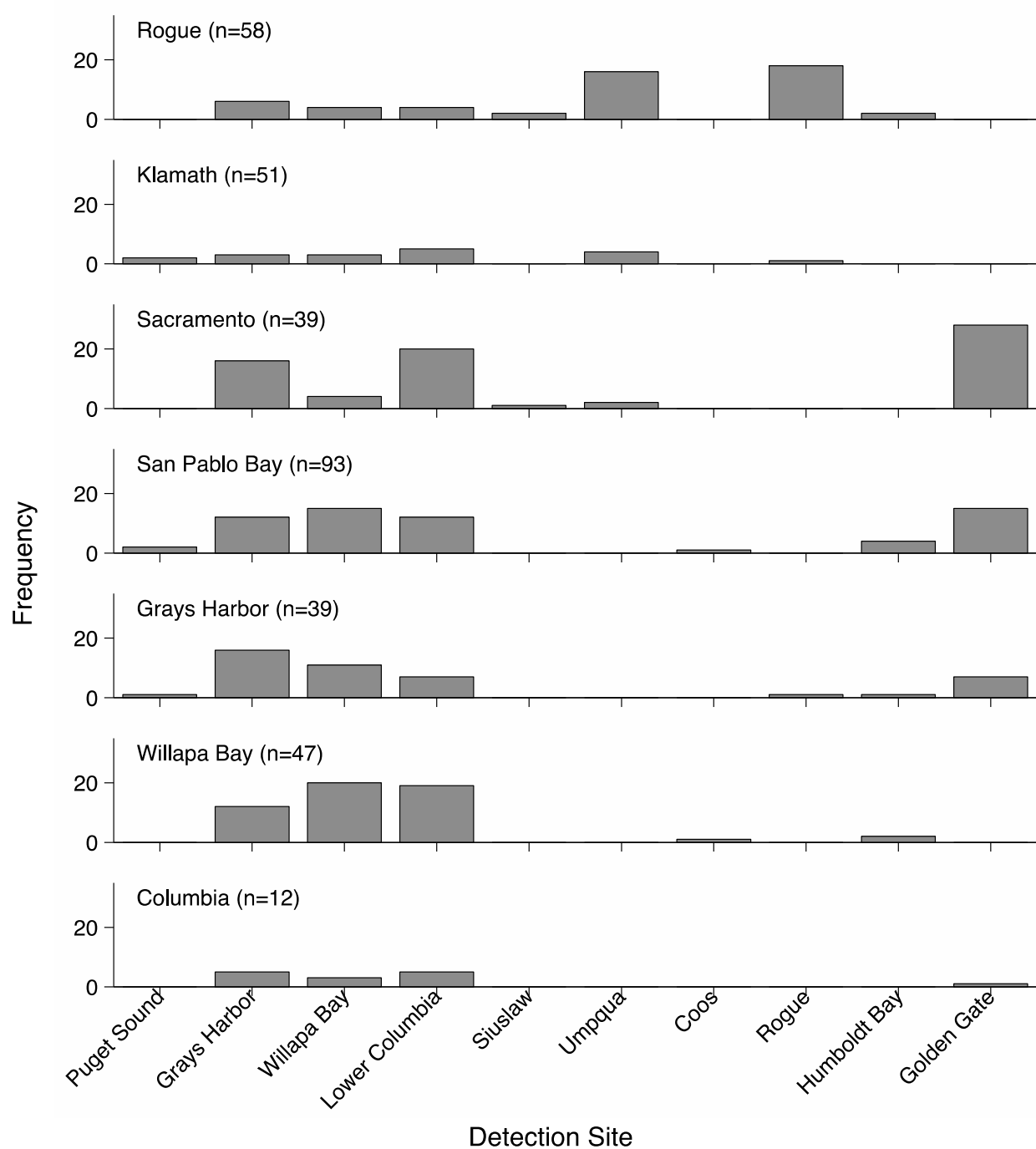
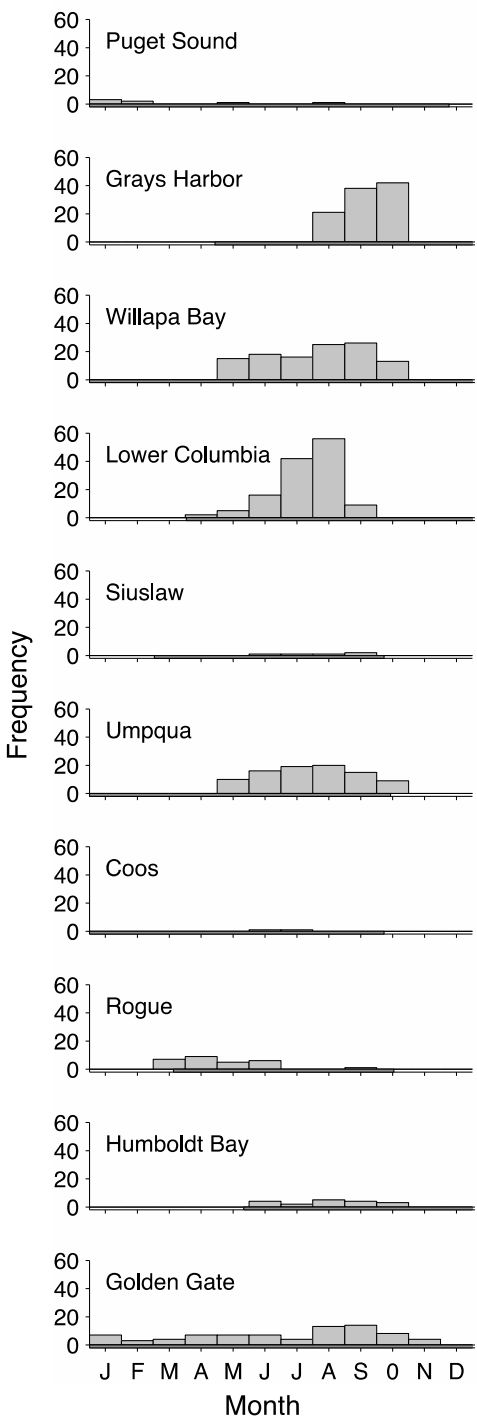












Willapa Bay

Grays Harbor

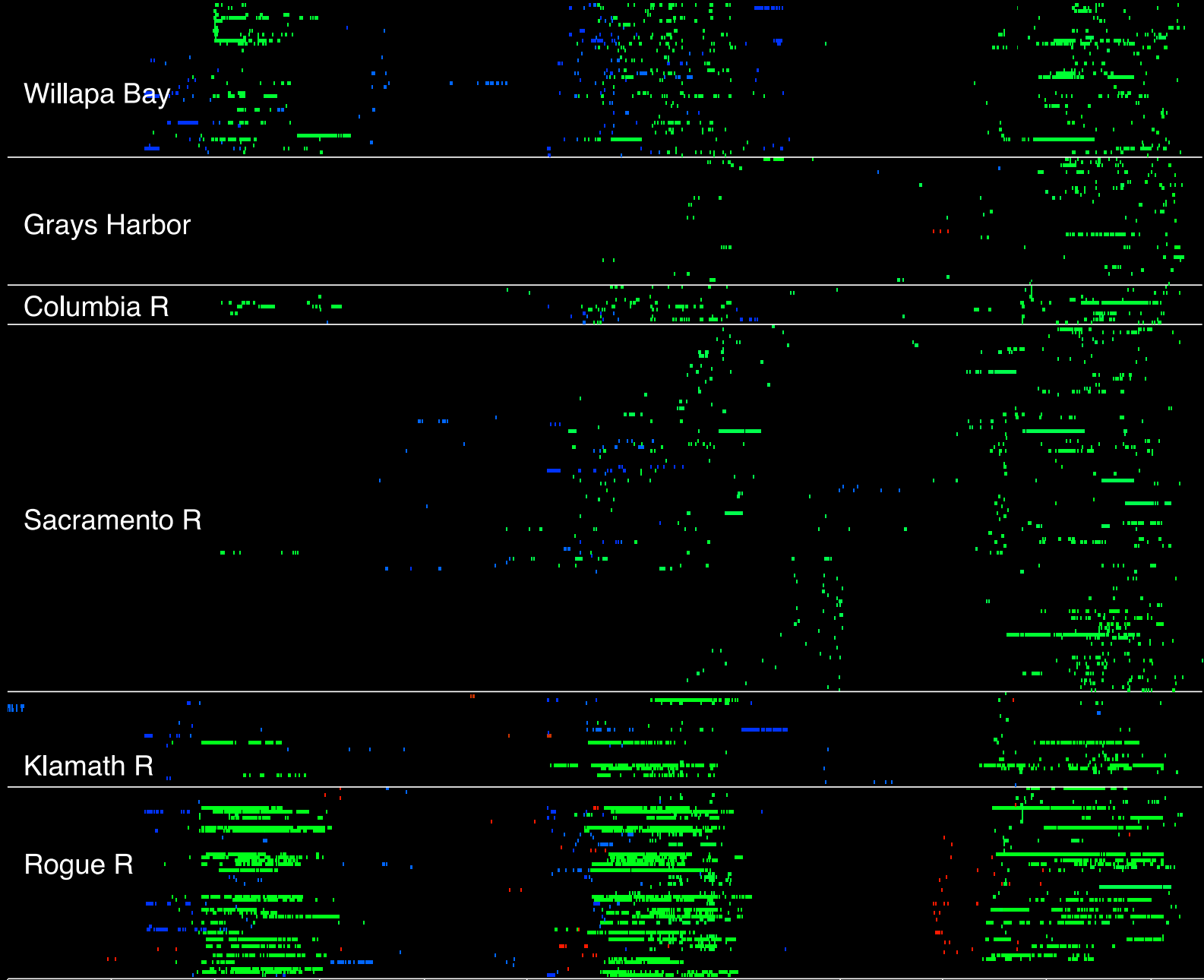
Columbia R

Sacramento R

Klamath R

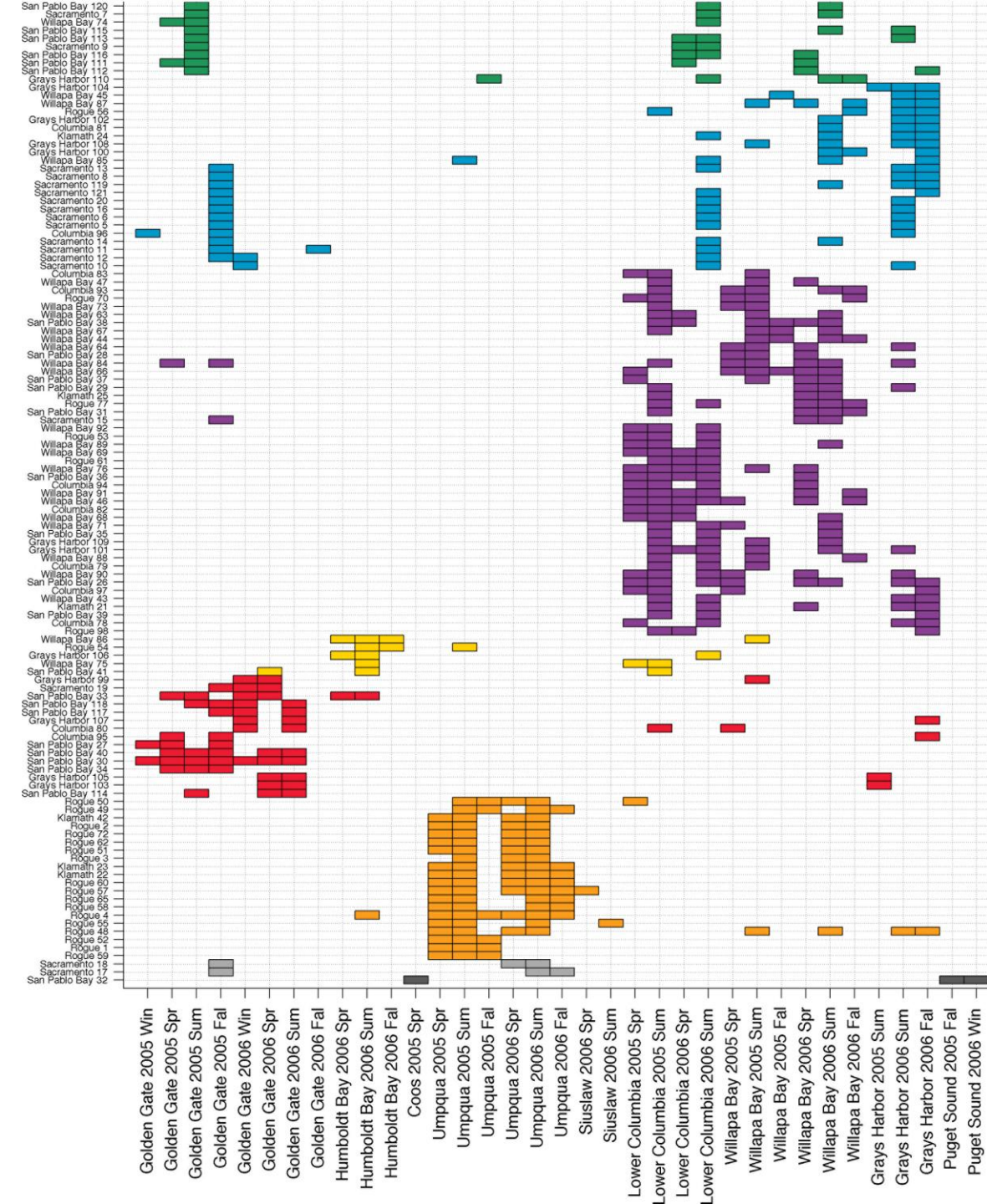
Rogue R

1/1/04 1/4/04 1/7/04 1/10/04 1/1/05 1/4/05 1/7/05 1/10/05 1/1/06 1/4/06 1/7/06 1/10/06 31/12/06  
Date



# Characterizing migration behavior

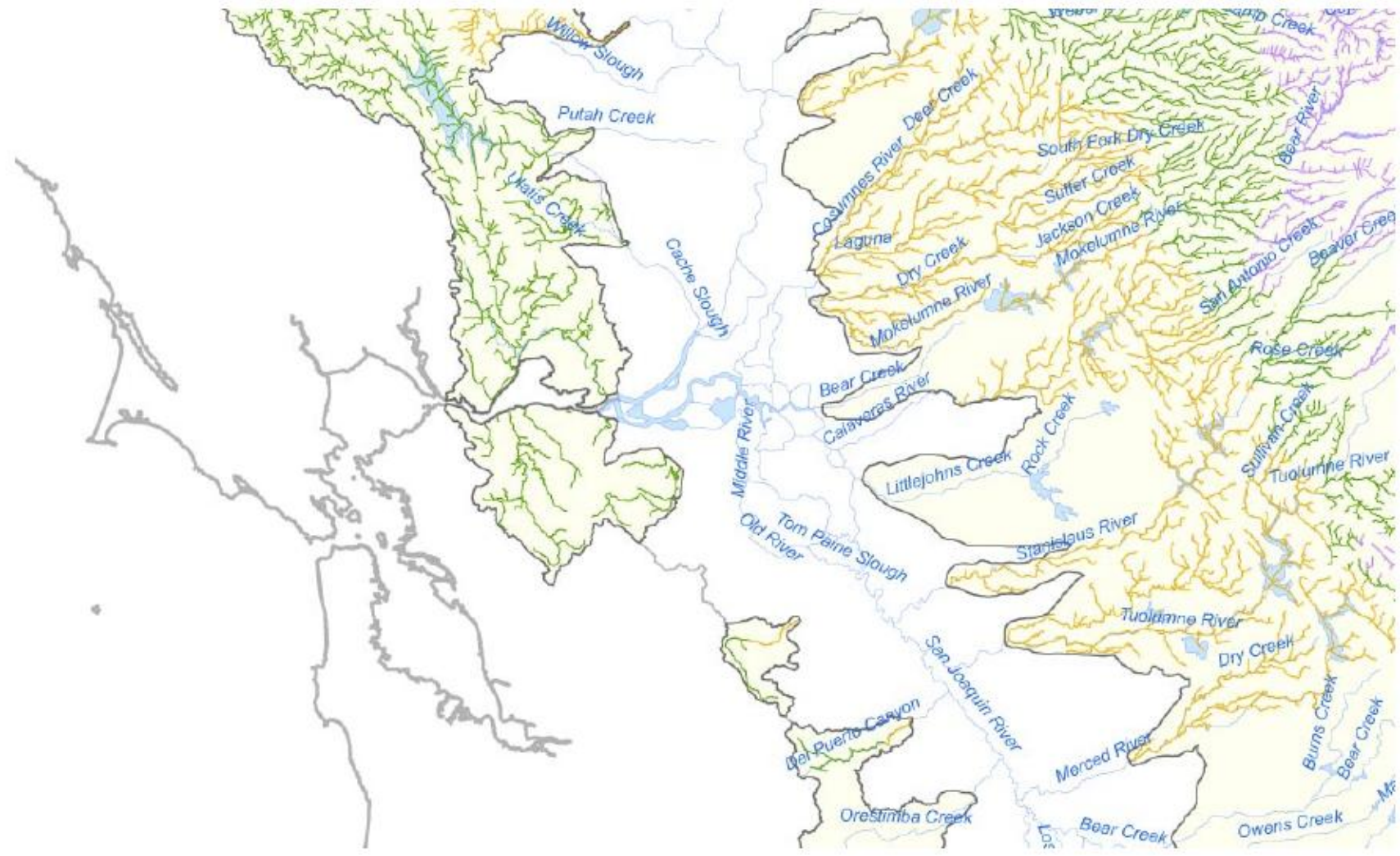
Site 1 Time 1	Site 2 Time 1	Site 3 Time 1	Site 1 Time 2	Site 2 Time 2	Site 3 Time 2
1	0	0	1	0	0
0	0	0	1	0	0
1	1	0	1	0	1
1	1	0	1	0	1

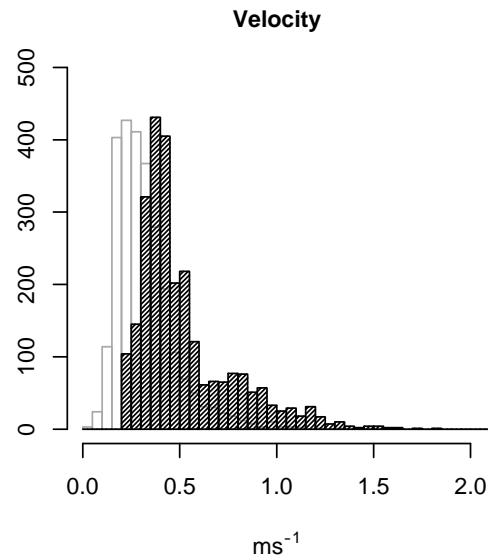
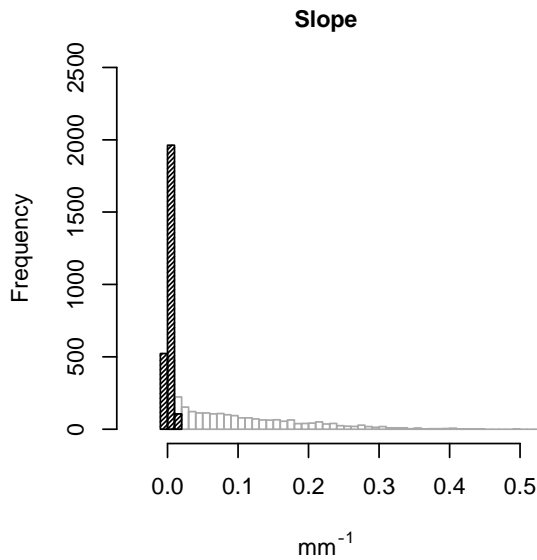
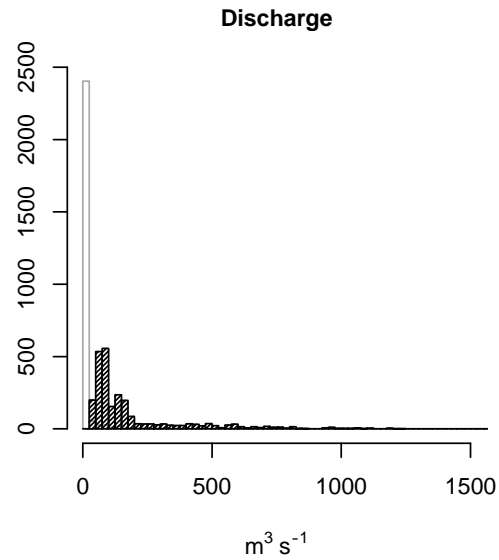
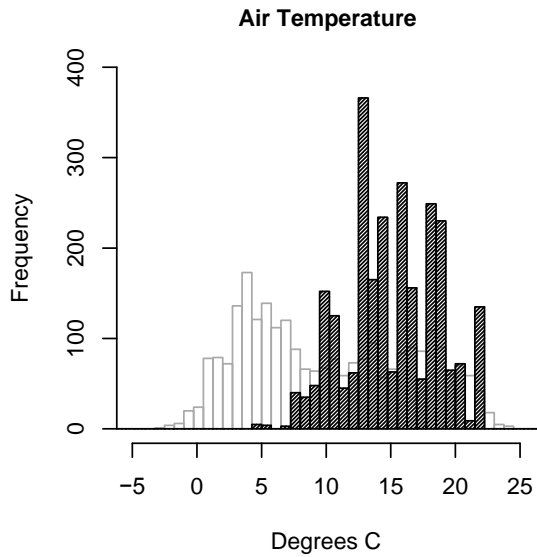


$$J_d = \frac{M_{01} + M_{10}}{M_{01} + M_{10} + M_{11}}$$

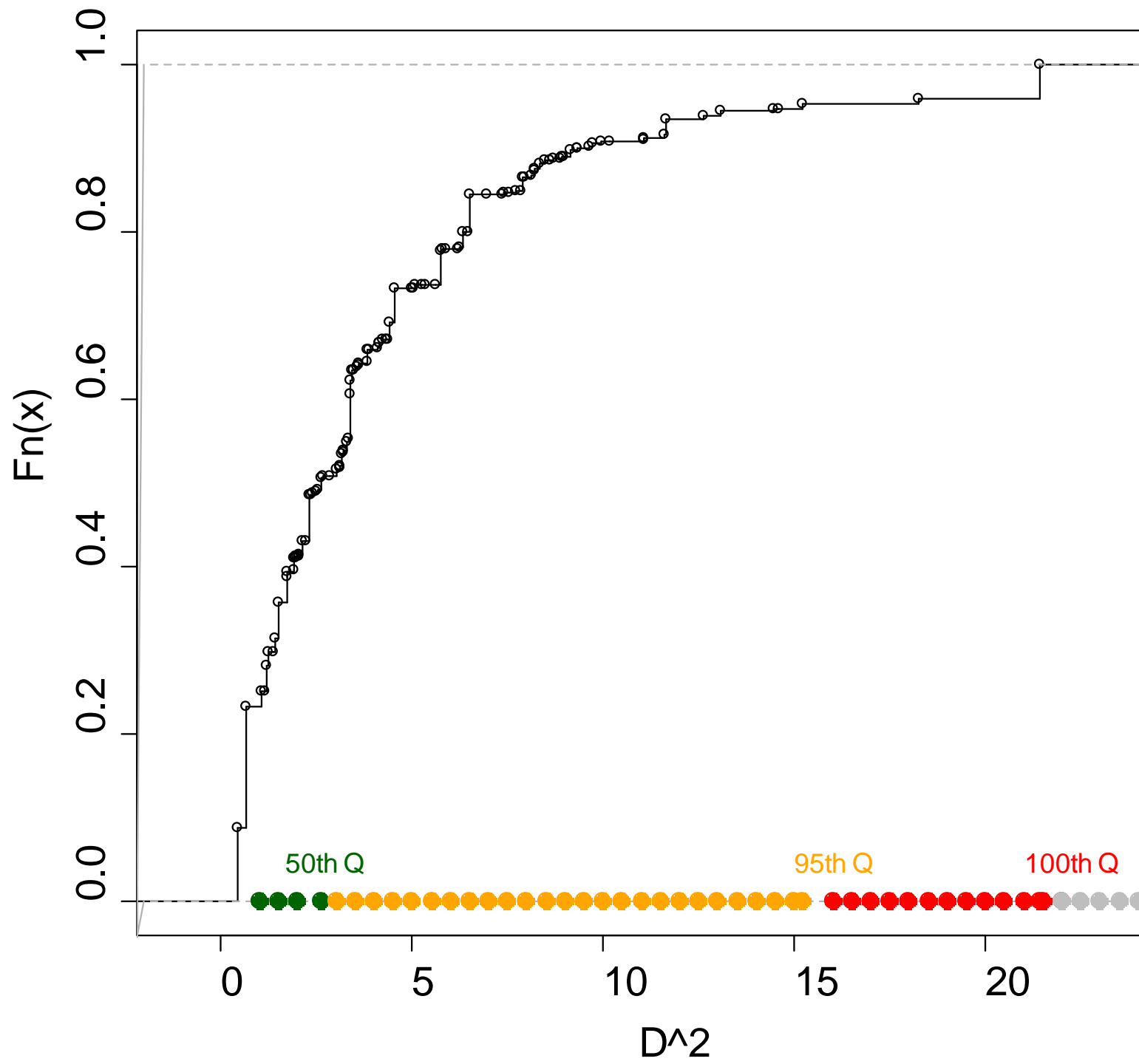


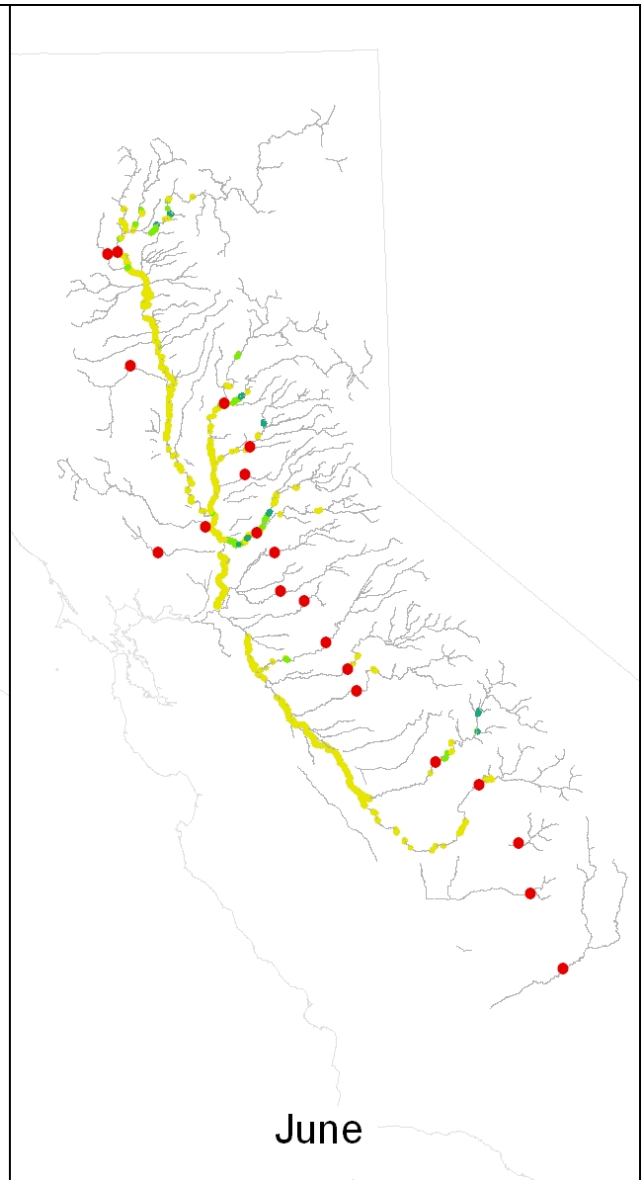
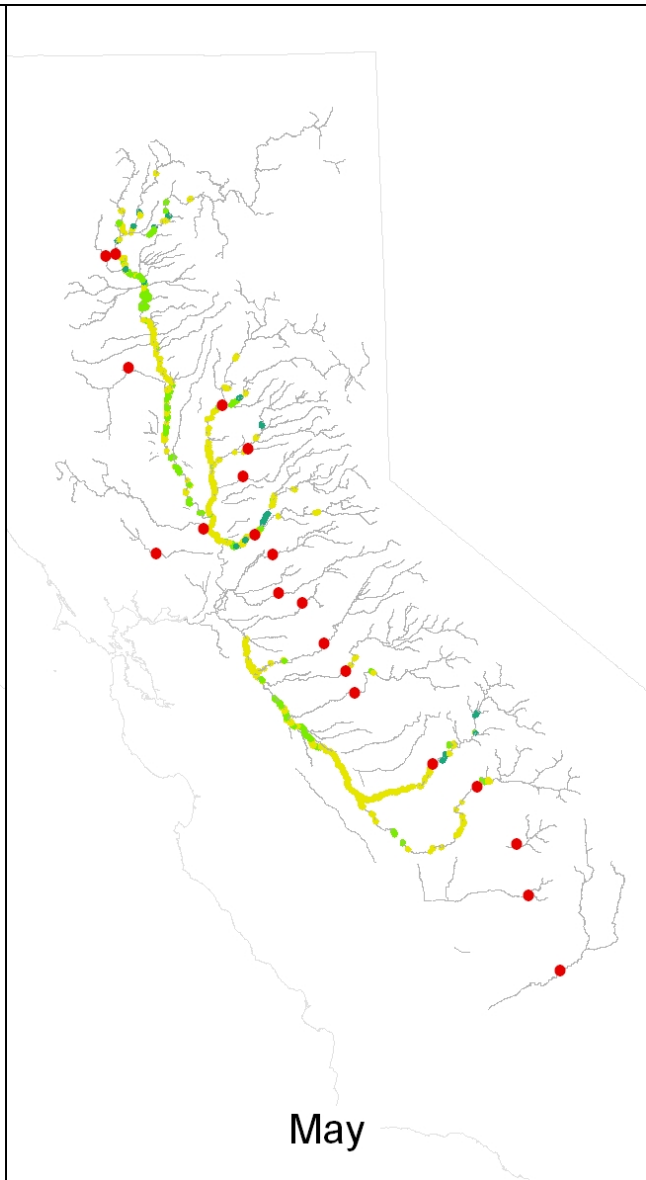
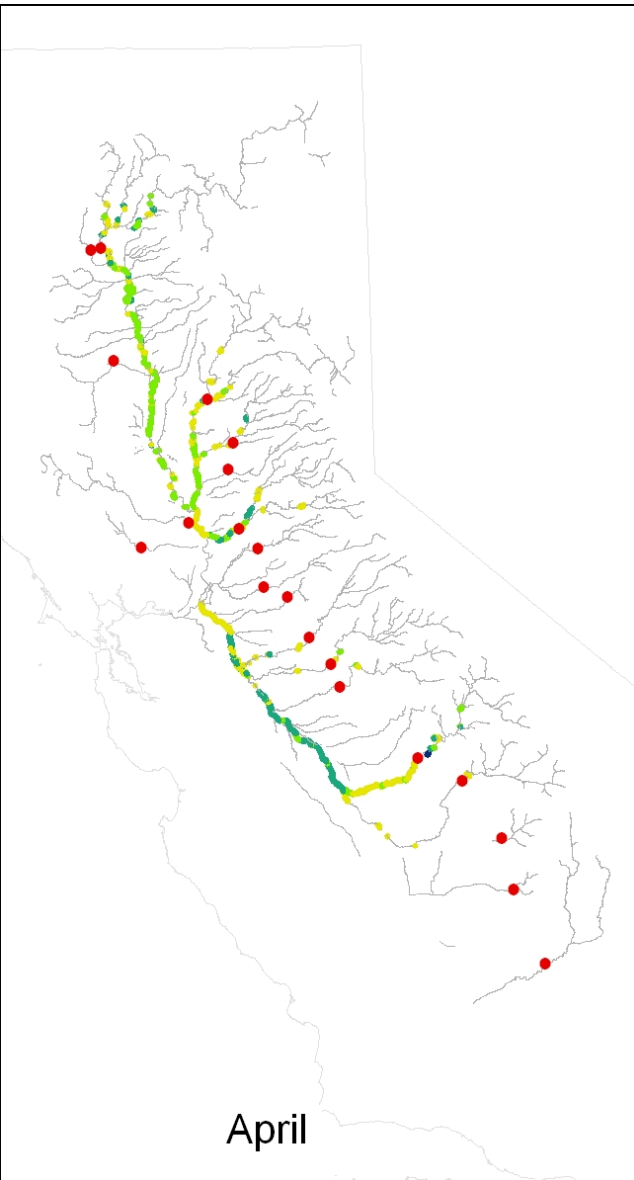
# Do dams block access to sturgeon habitat in the CV?





$$D^2(x) = (x - \mu)^T S^{-1} (x - \mu)$$





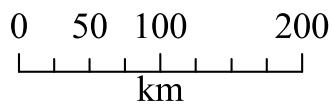
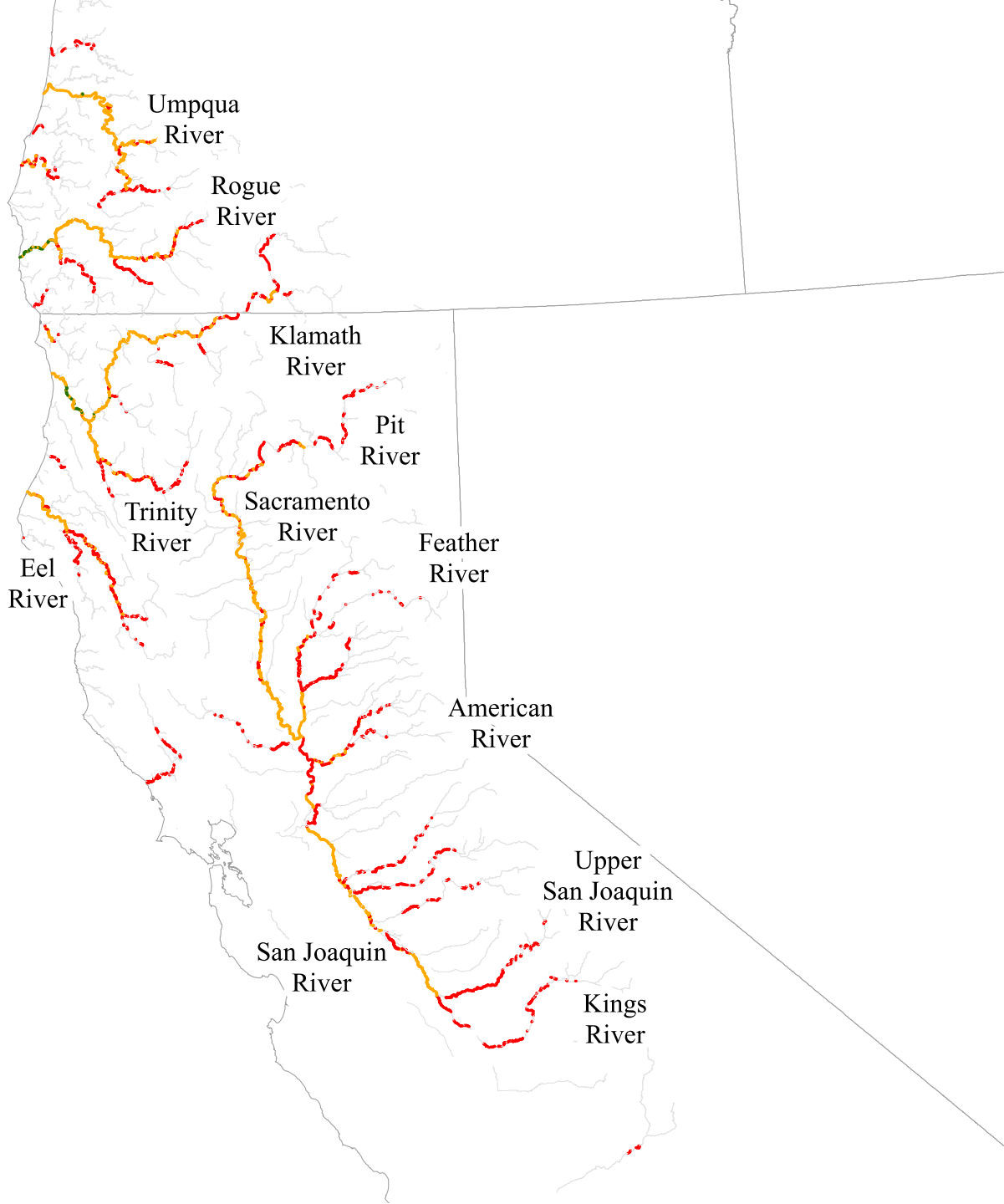
# June

50th Q

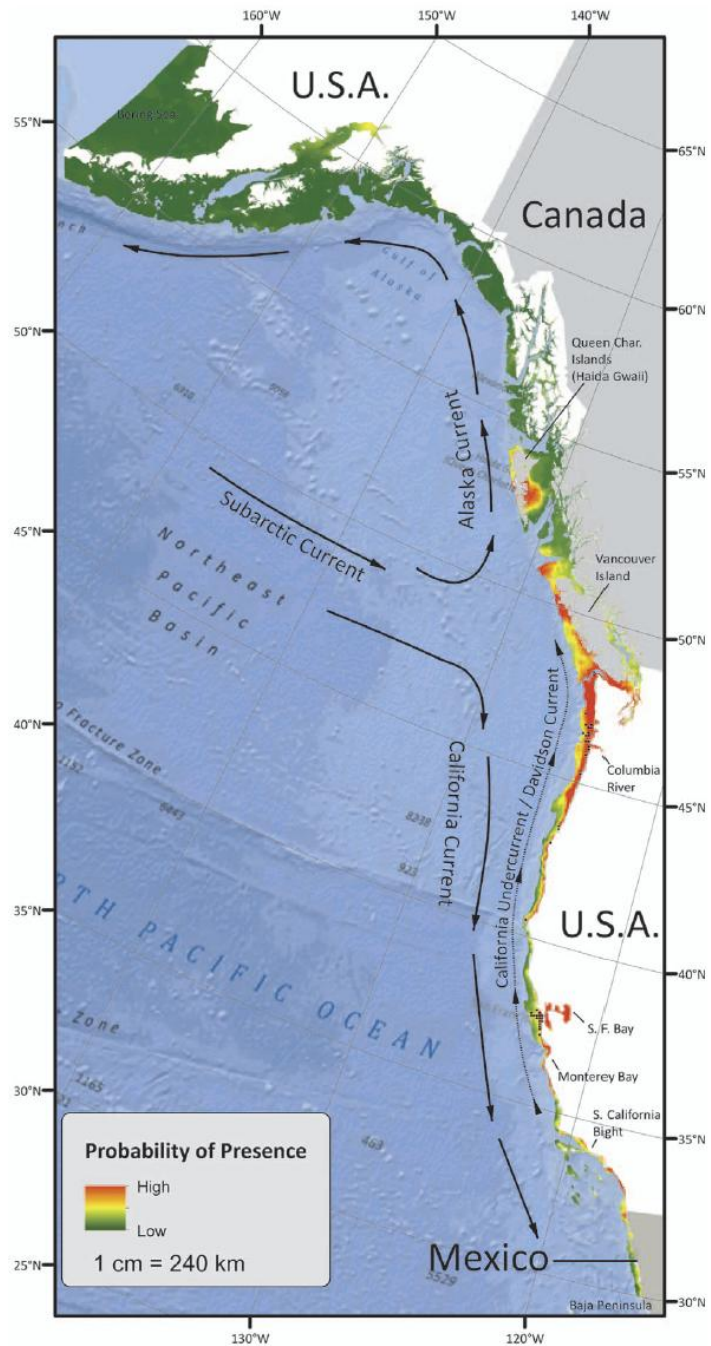
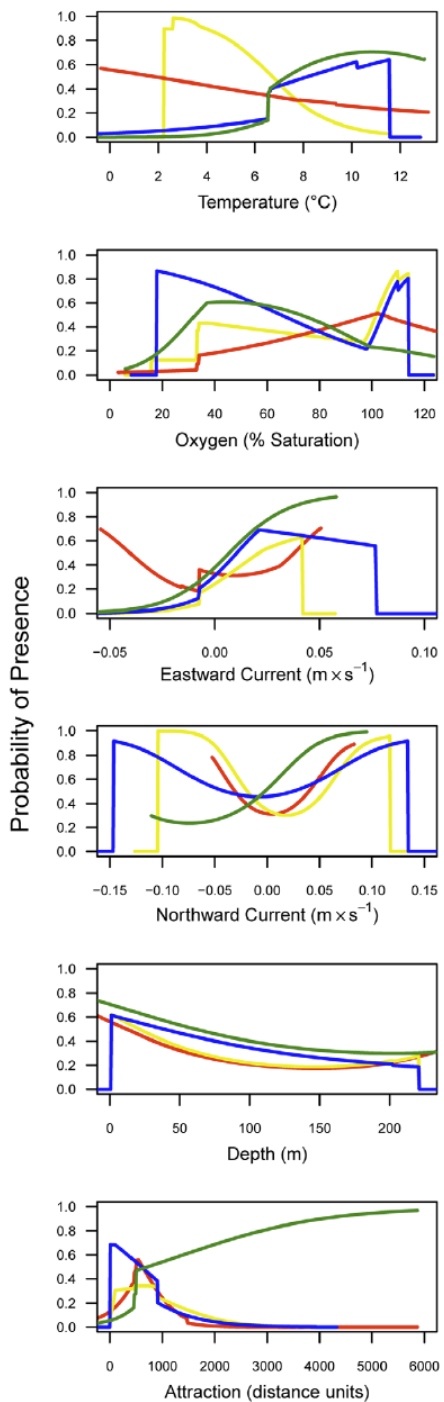
95th Q

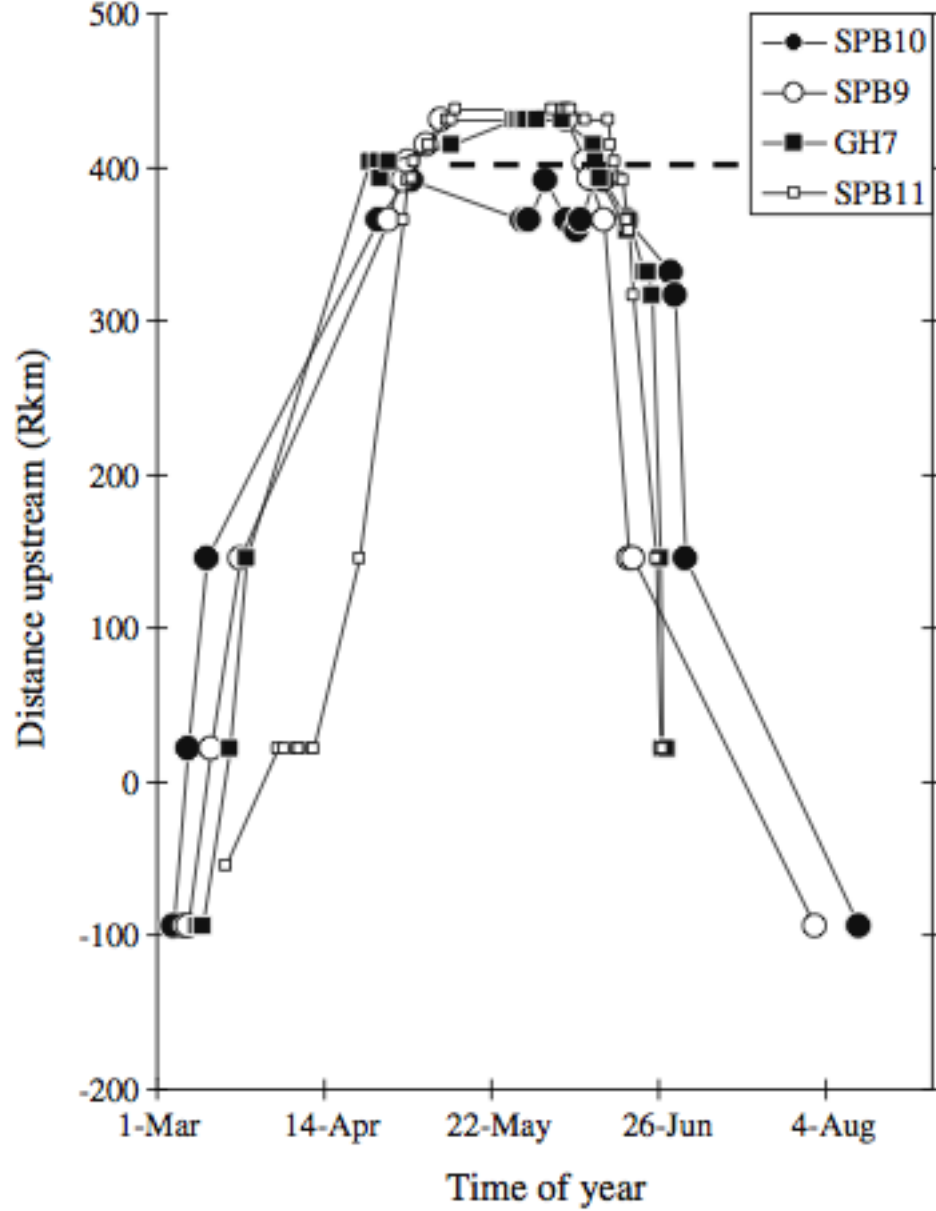
100 Q

Dissimilar



Spring  
Summer  
Autumn  
Winter

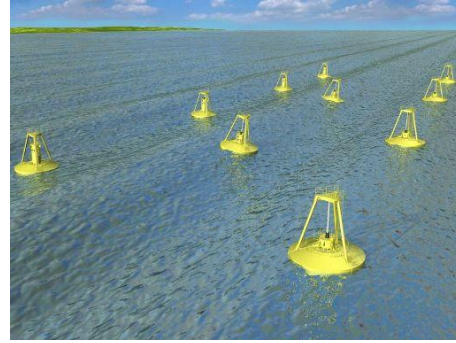
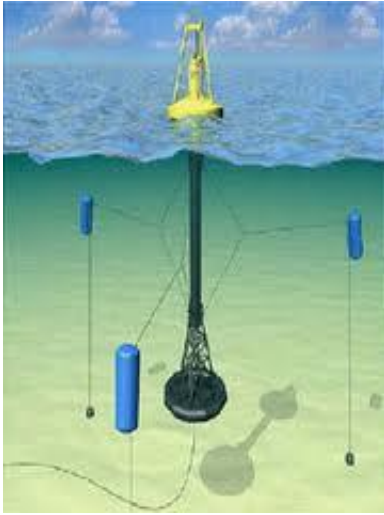




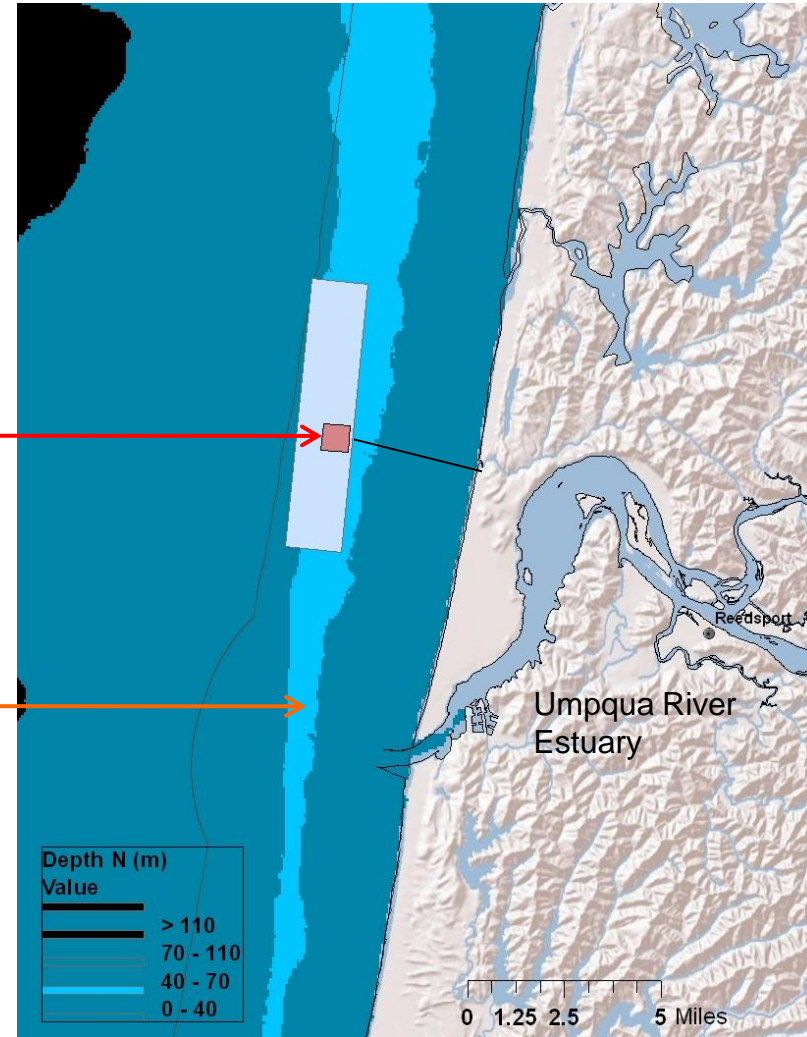
Heublein et al, Env Biol Fish 84:245 (2009)



# Wave energy development



Wave Energy Development



Green Sturgeon Migratory Corridor



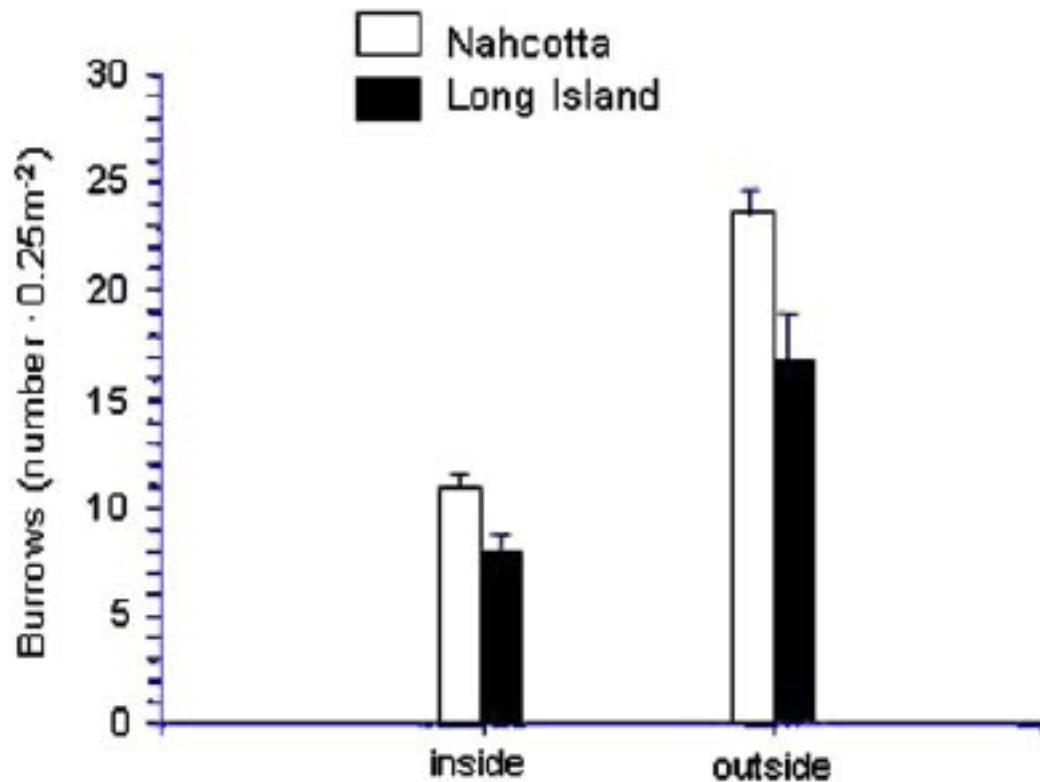
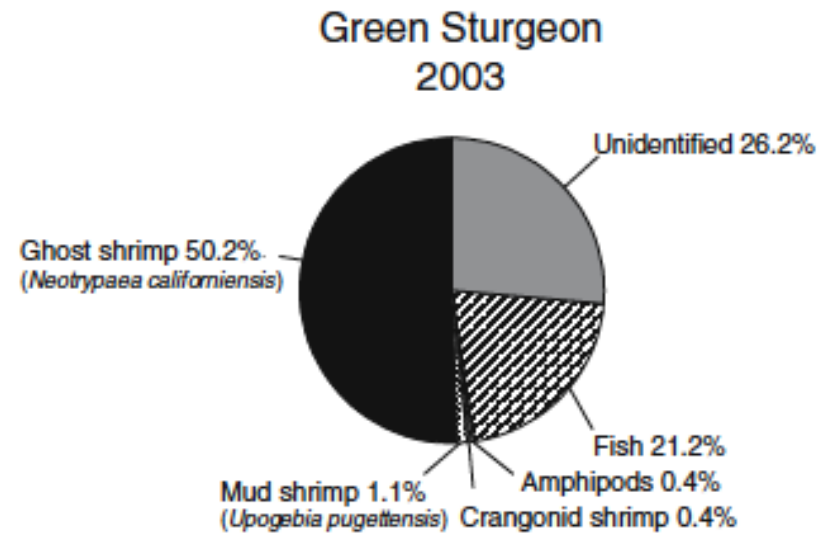
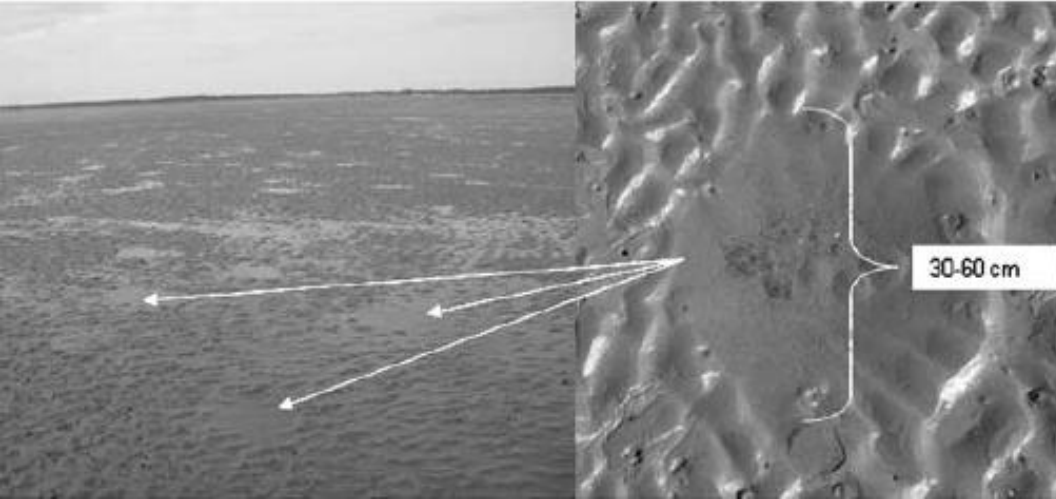
# Cumulative Effects?

## (Active Projects<sup>1</sup>)

- Washington
  - Admiralty Inlet, Puget Sound (2 underwater turbines)
  - Deception Pass, Puget Sound (4 underwater turbines)
- Oregon
  - Offshore, near Tillamook (30 floating wind turbines)
  - Winchester Bay, near Reedsport (1 jetty-based structure)
  - Offshore, near Reedsport (10 – 100 buoys)
- California
  - San Francisco Bay Tidal Project (60 underwater turbines)

<sup>1</sup>Pacific Fishery Management Council. Active West Coast Hydrokinetic Project. August 30, 2012.





*Z. marina*



Sparse *Z. japonica*



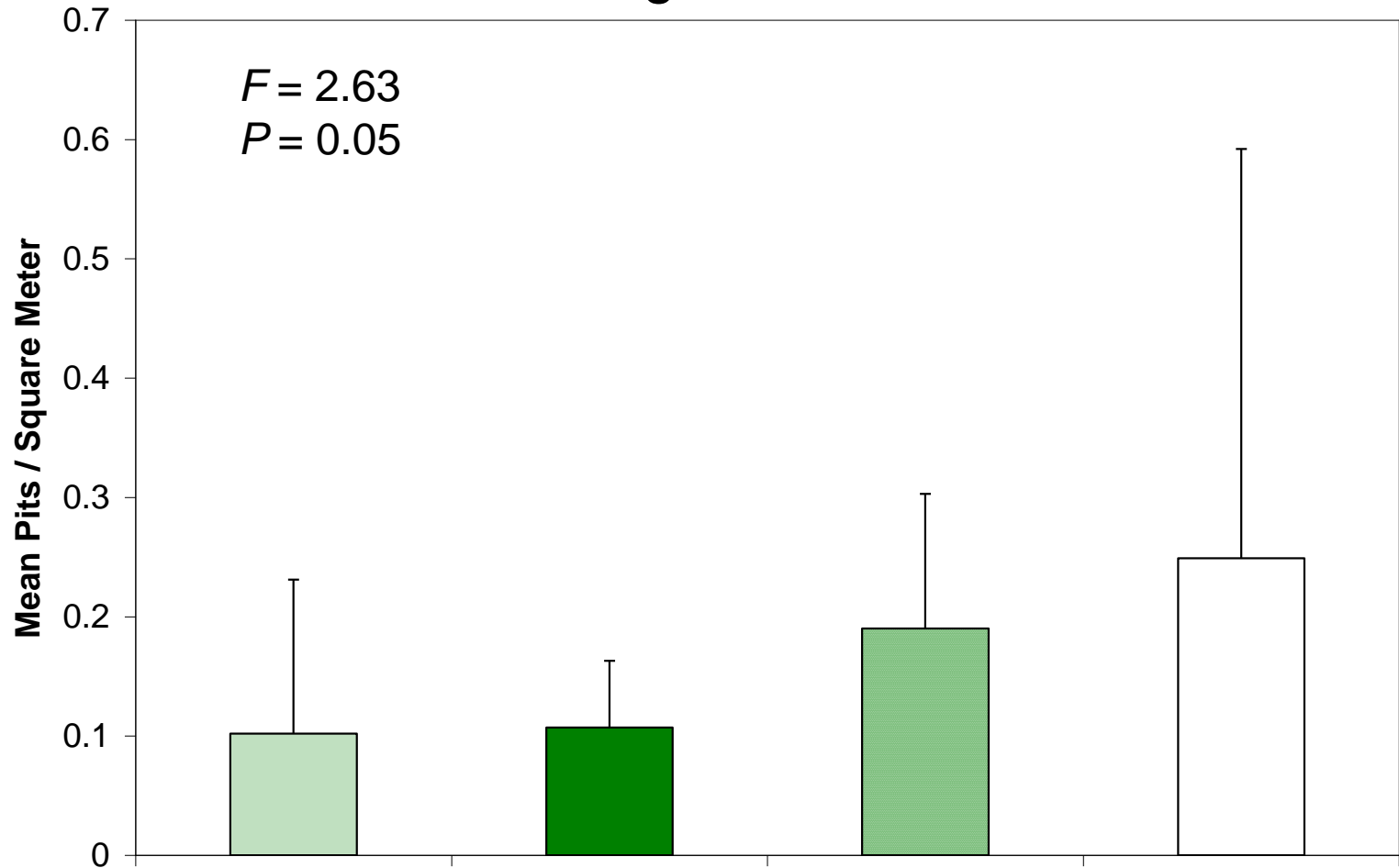
Dense *Z. japonica*



Mud, No vegetation, Dense shrimp



# Vegetation



Z. marina



Dense japonica



Sparse japonica

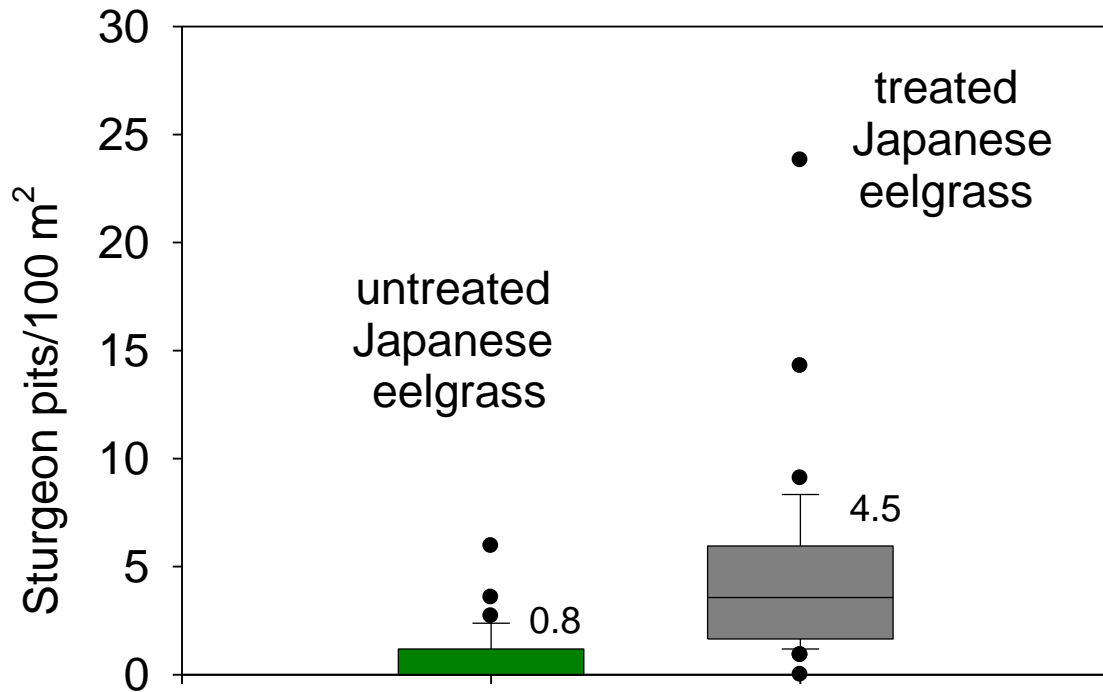


No grass





Sturgeon feeding pits in Japanese eelgrass  
(controlled vs. untreated plots)



parallel strip plots - 84 m<sup>2</sup>, Nahcotta WA Oct 15, 2008, n=36

**Collaborators:**

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Bill Pinnix (USFWS)

David Welch, Erin Rechisky (POST)

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NMFS Species of Concern Program

Census of Marine Life

Gordon and Betty Moore Foundation

Bonneville Power Authority

NOAA Integrated Ecosystem Assessment program

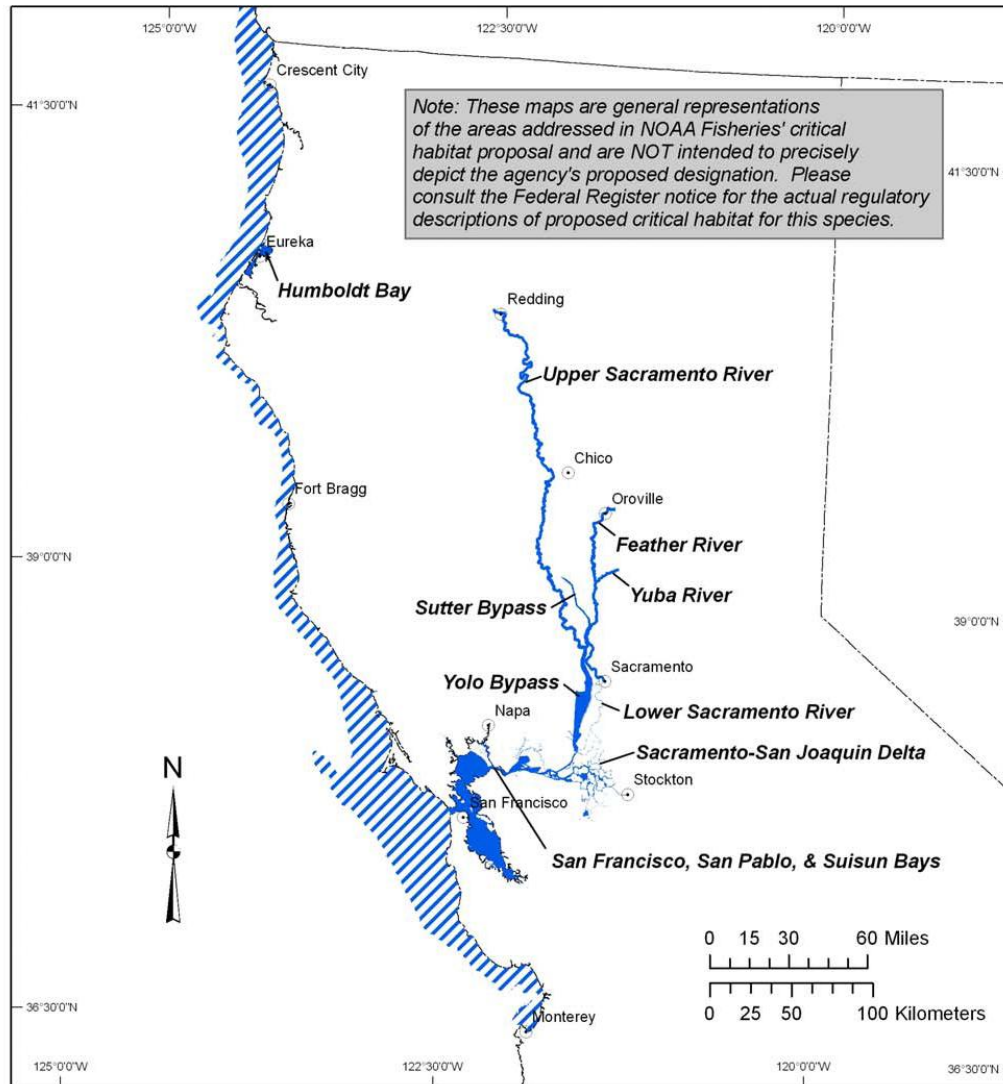
CALFED Science Program





# Proposed Critical Habitat for the Southern DPS of Green Sturgeon

California



## Legend

- Cities / Towns
- State Boundary
- Riverine and Estuarine Areas Proposed as Critical Habitat
- Nearshore Marine Areas Proposed as Critical Habitat (offshore to 110 meters depth)

