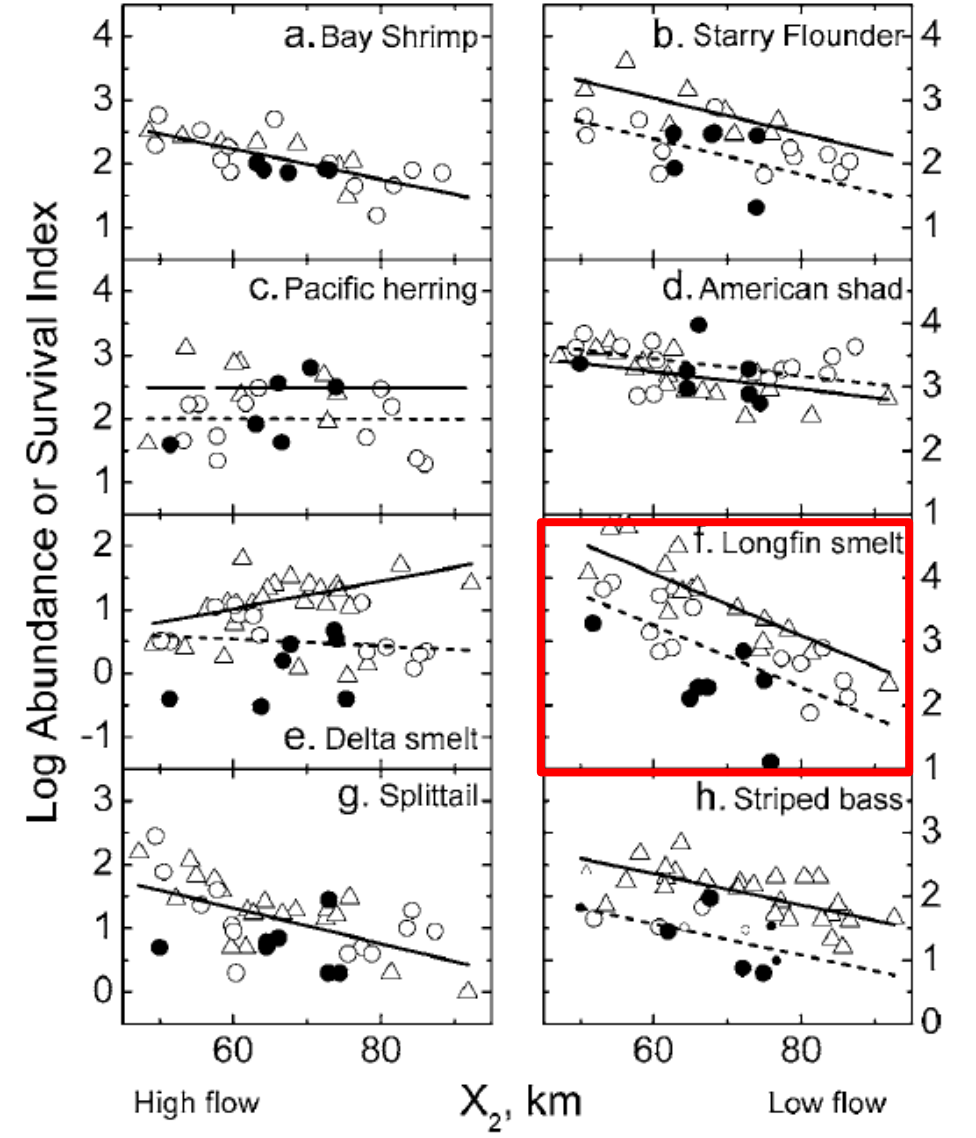
Examining Rearing Habitat of Larval and Juvenile Longfin Smelt in the Upper San Francisco Estuary: A Case to Move to Uncharted Waters

Lenny Grimaldo (ICF), Fred Feyrer (USGS), Jillian Burns (ICF), Donna Maniscalco (ICF), Jason Hassrick (ICF), LeAnne Rojas (ICF), Dave Fullerton (MWD), and Shawn Acuña (MWD)

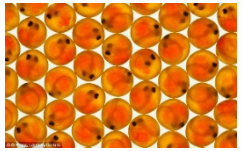
Background

More spring flow = more fish in the fall



Kimmerer et al. 2009

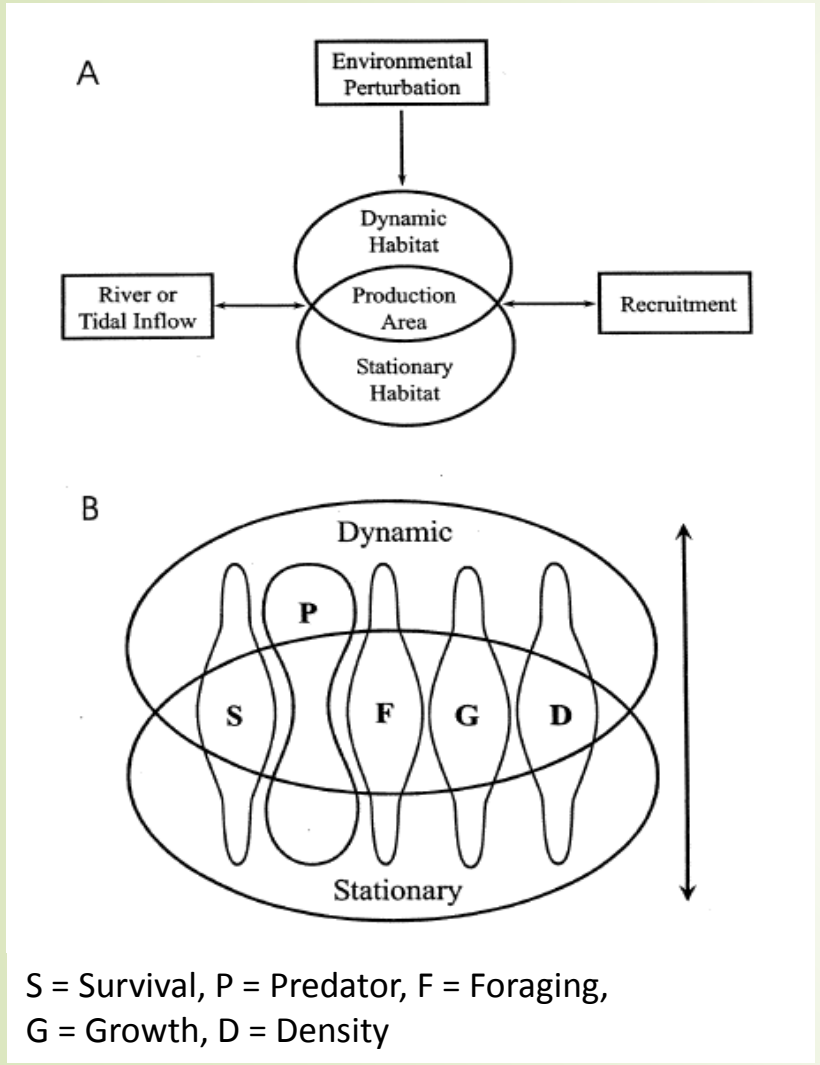
Underlying conceptual model



Growth
Survival

Spring

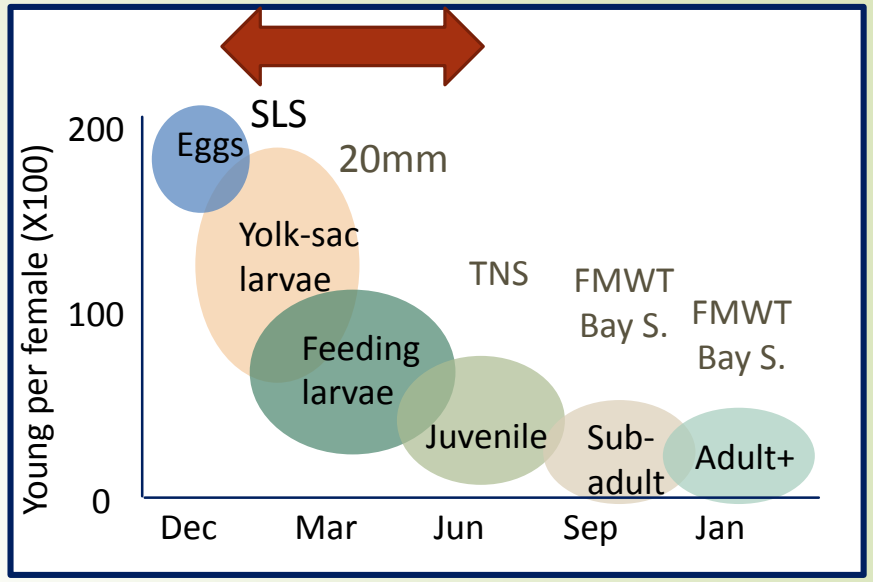
Fall



S = Survival, P = Predator, F = Foraging,
G = Growth, D = Density

Peterson 2003

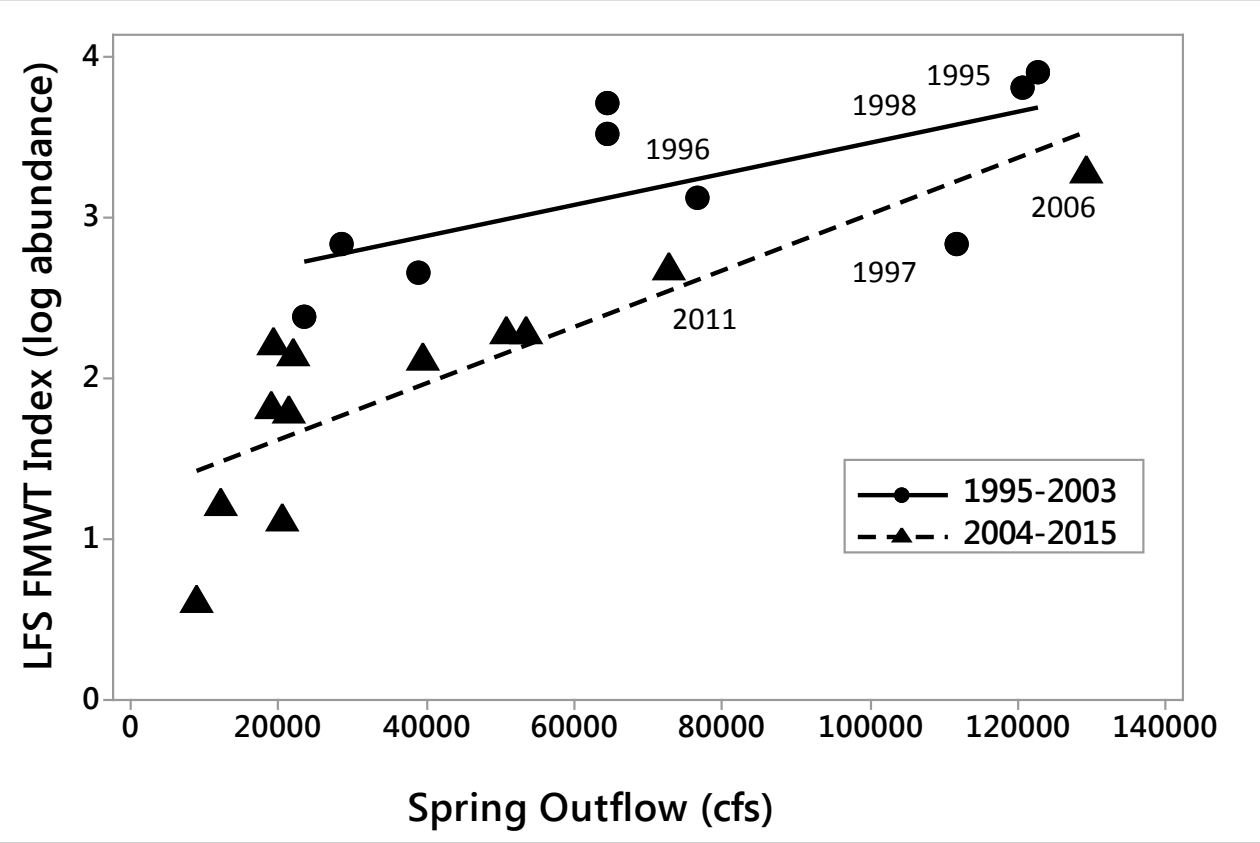
1. CDFW Monitoring Data



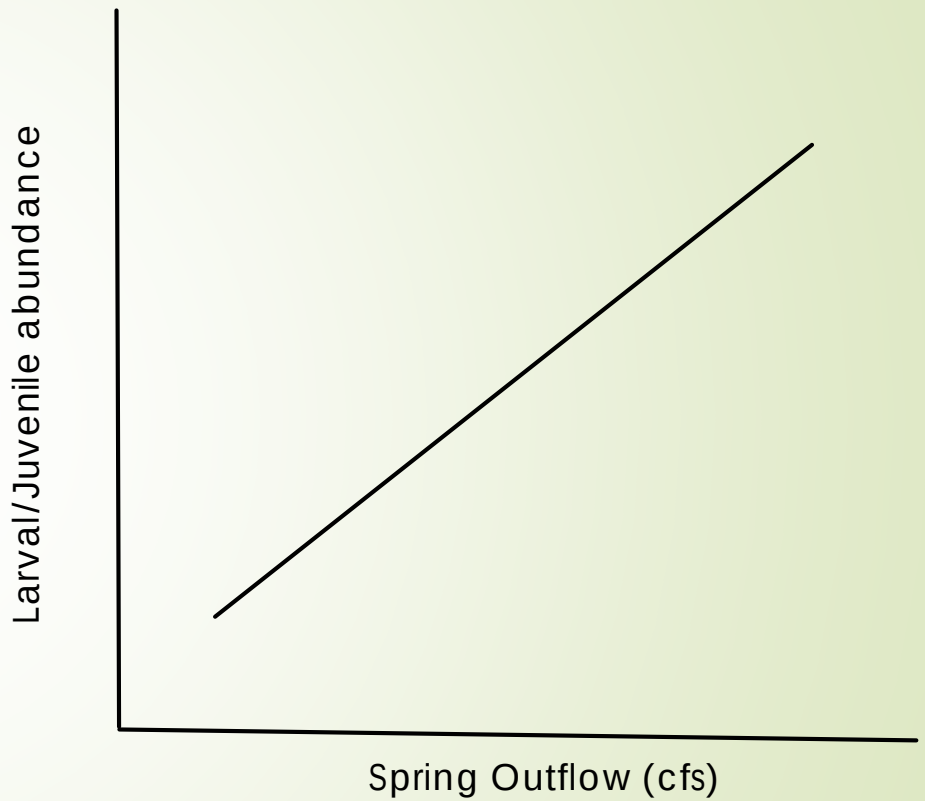
2. Tidal Marsh Study

Relationships between flow and larval/juvenile abundance

Fall Abundance vs Spring Outflow

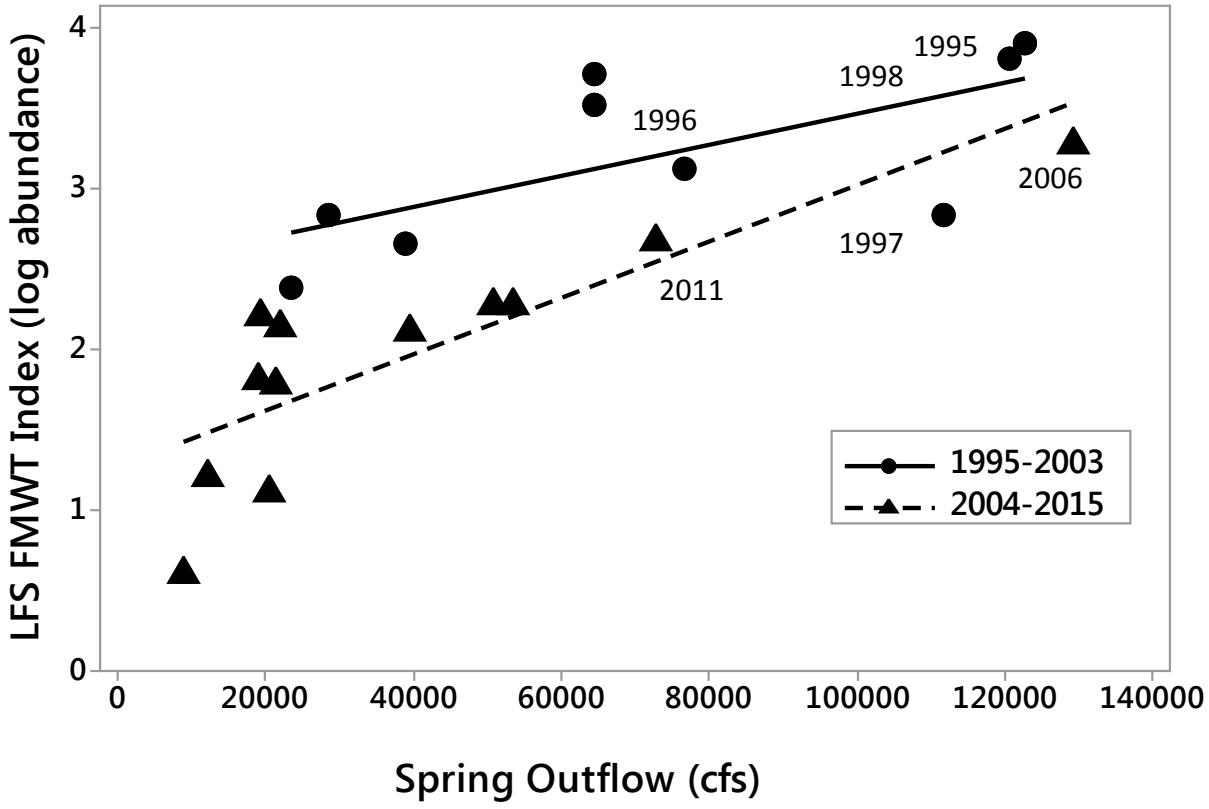


Hypothesis

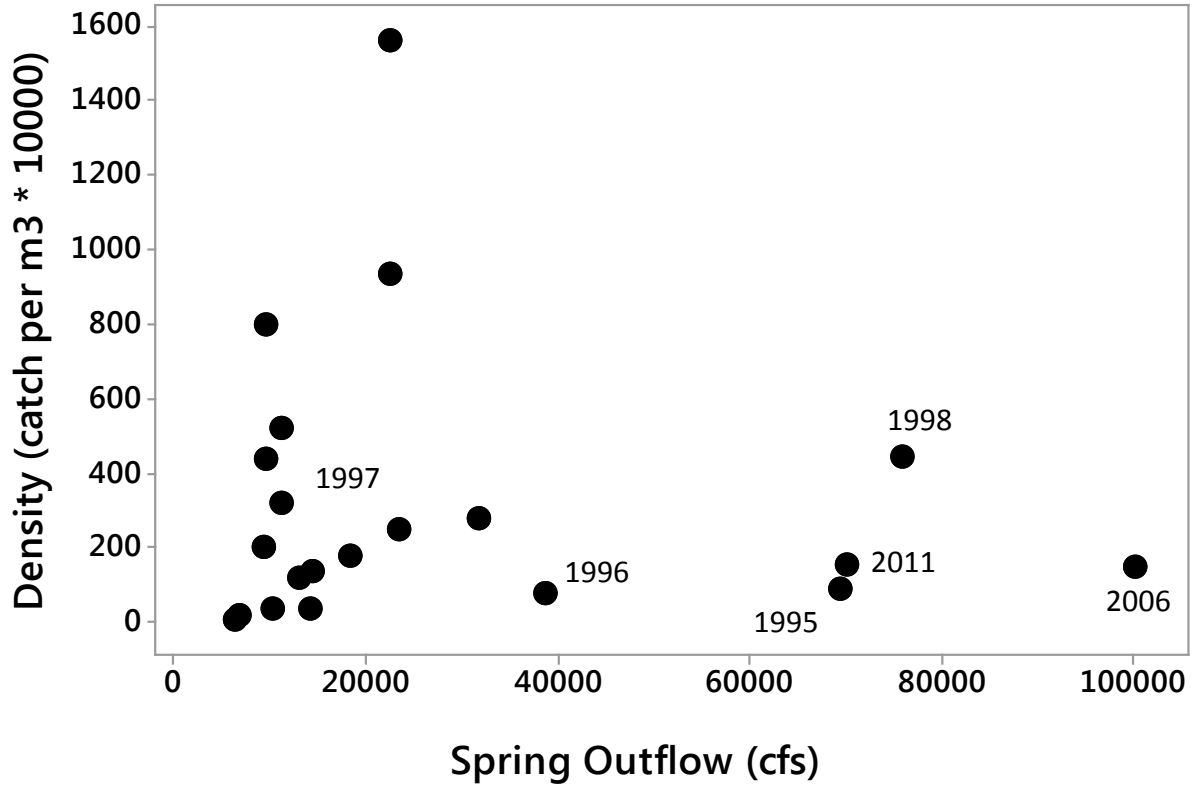


Relationships between flow and larval/juvenile abundance

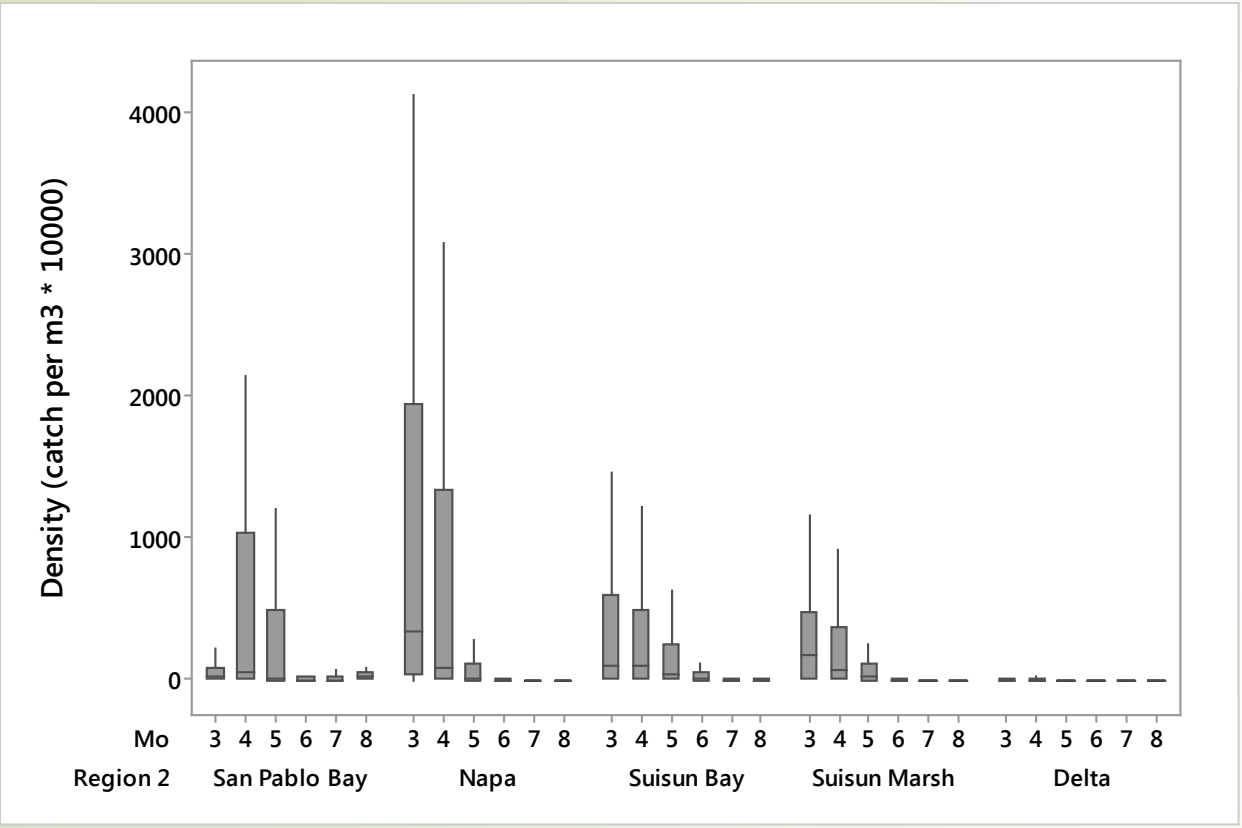
Fall Abundance vs Spring Outflow



Spring Abundance vs Spring Outflow



Longfin Smelt Densities By Region
20 mm Survey (1995-2015)



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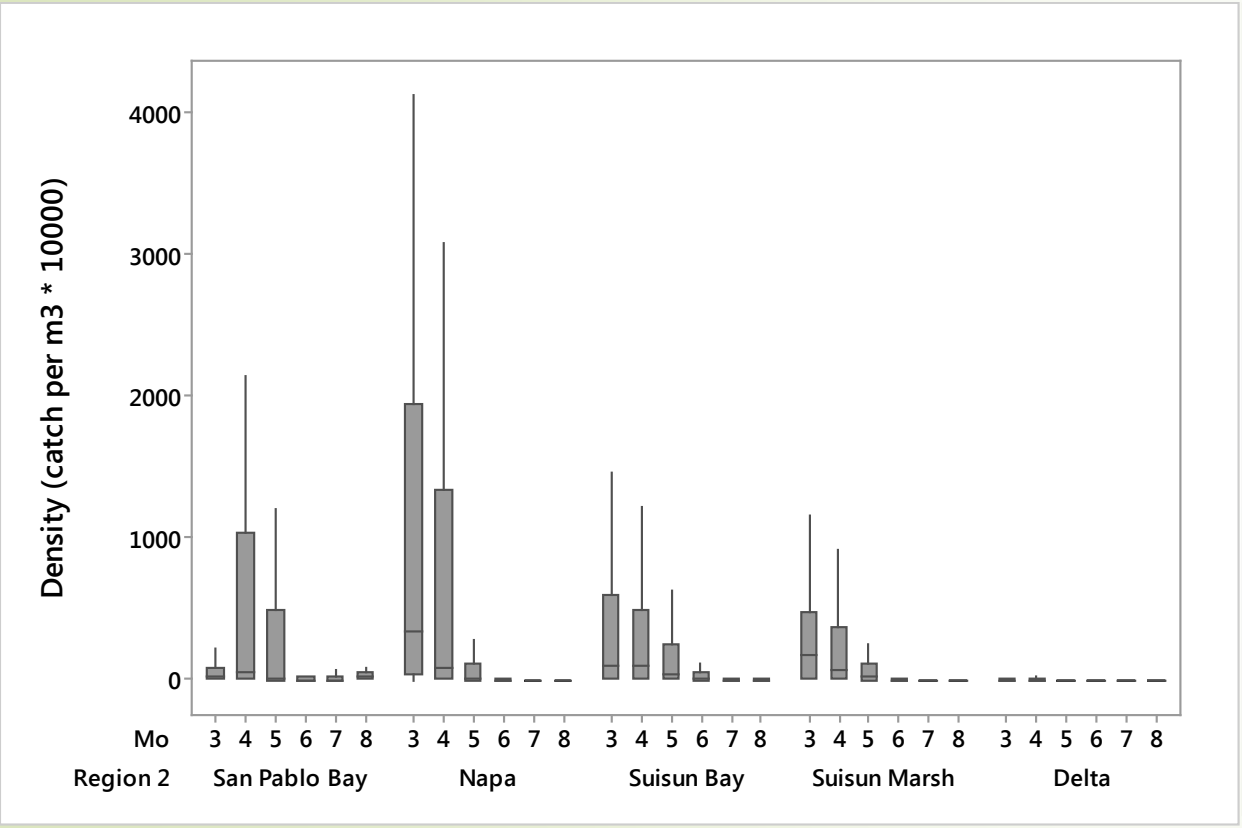
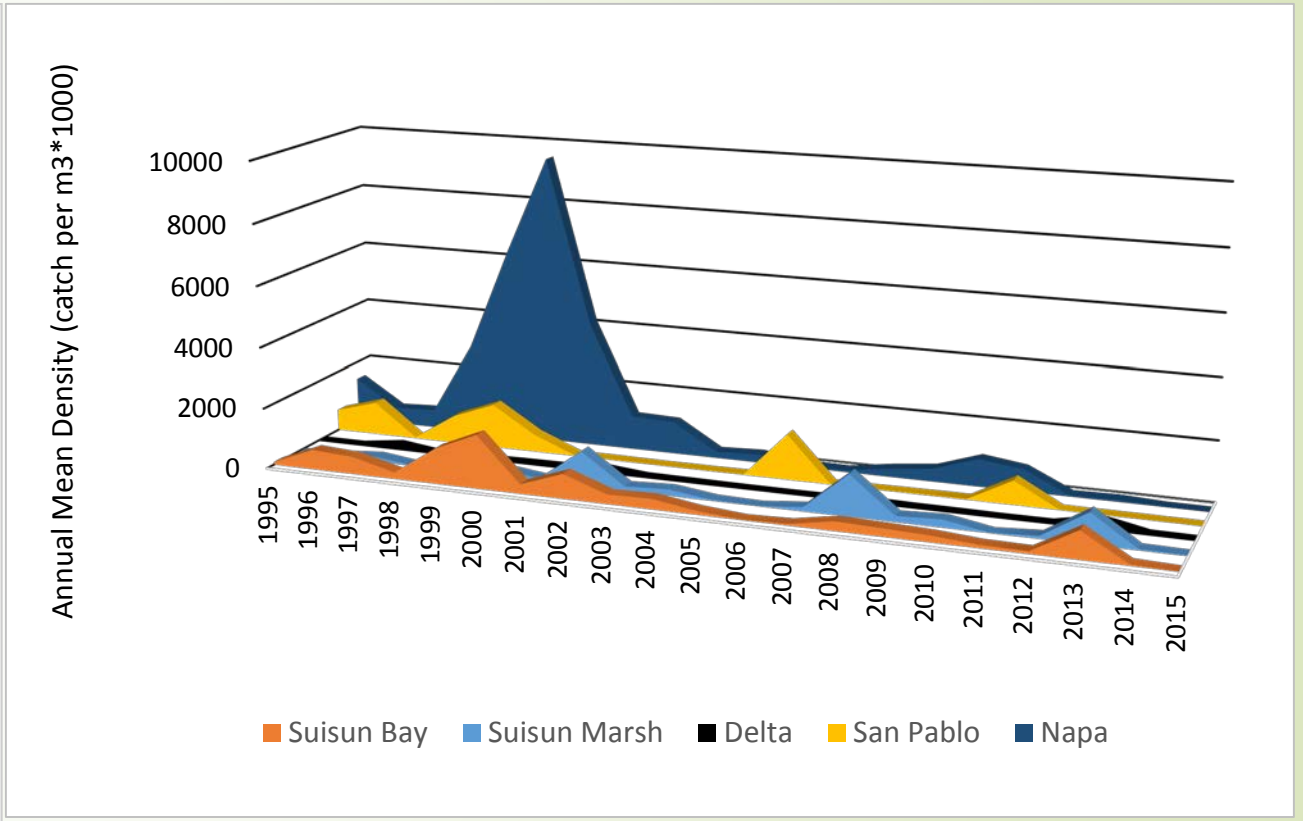
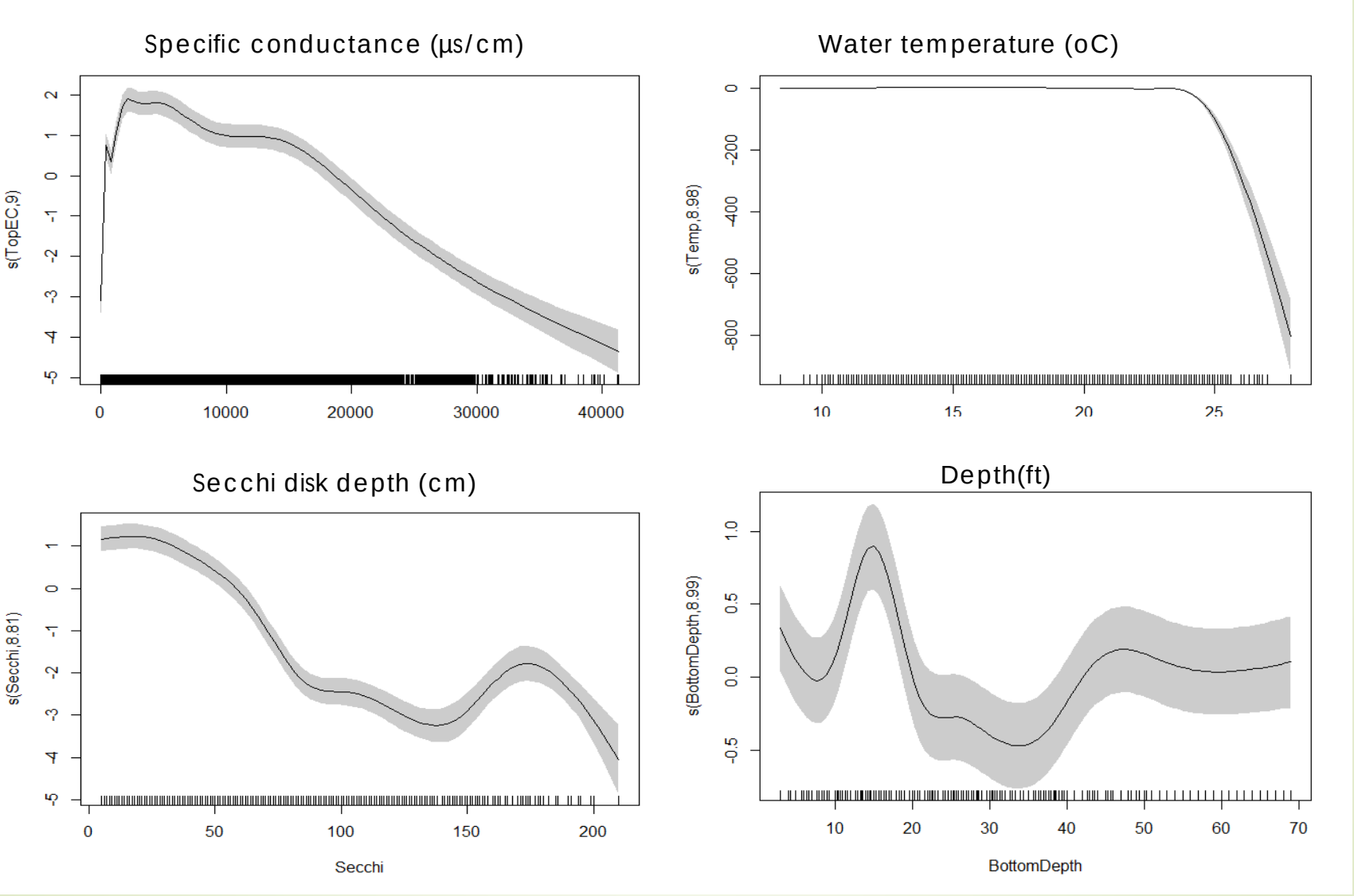


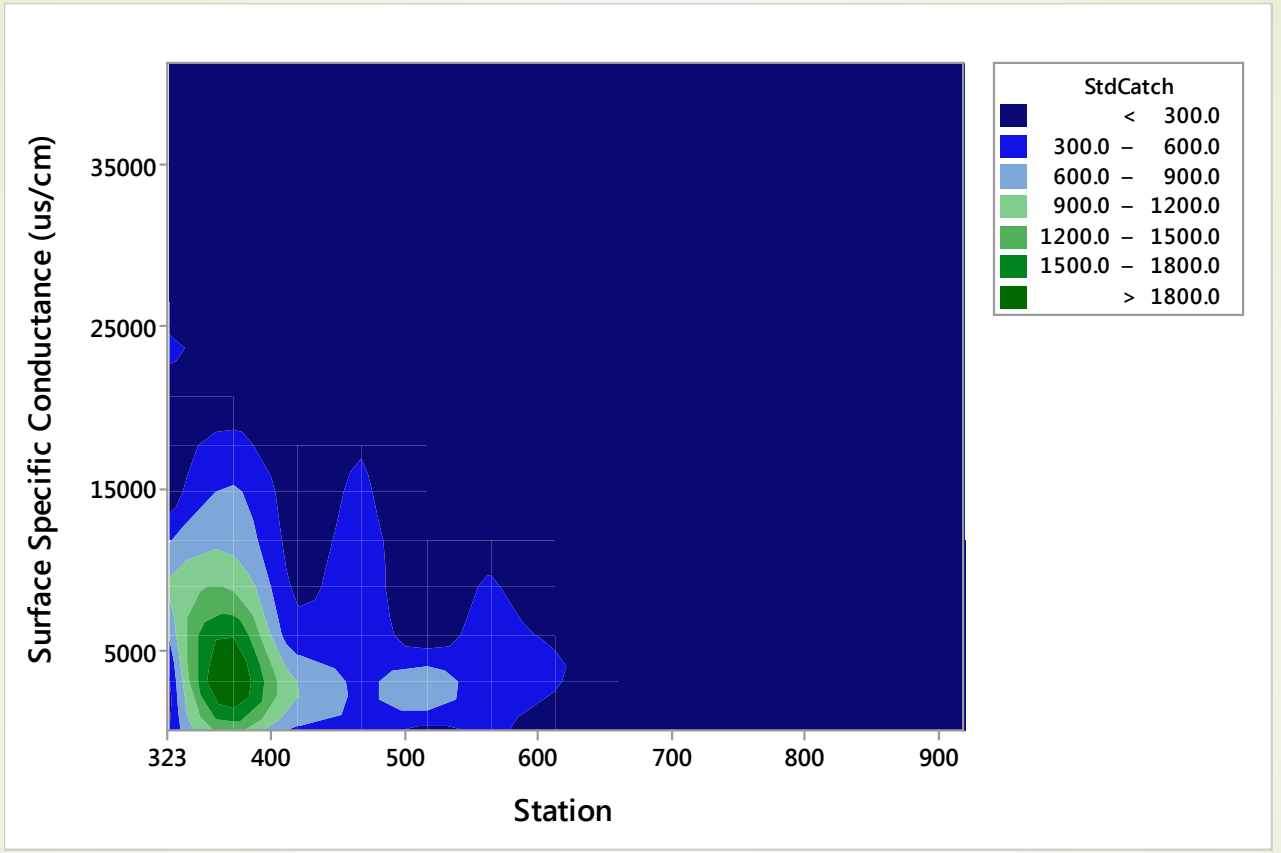


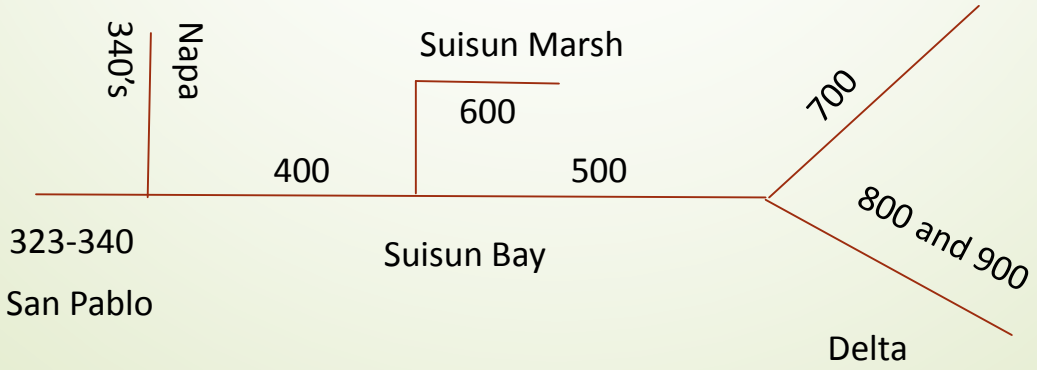
Relationship between Longfin Smelt densities and Environmental Variables
20 mm data (1995-2015)



GAM = Count ~ sTemp+ Year + sSecchi,+ s(SurfaceEC)+ s(BottomDepth), offset=log(volume), family=poisson(link=log))

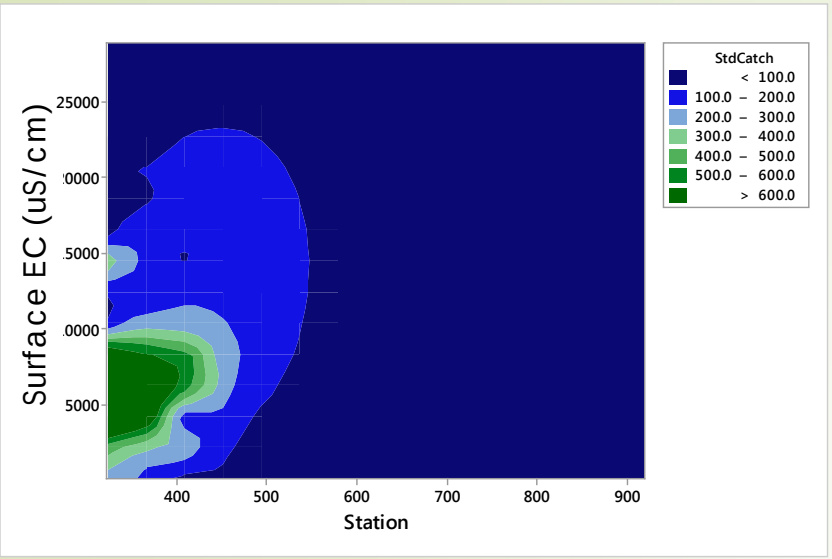
Longfin Smelt Density by Station and Surface Specific Conductance 20 mm (1995-2015)



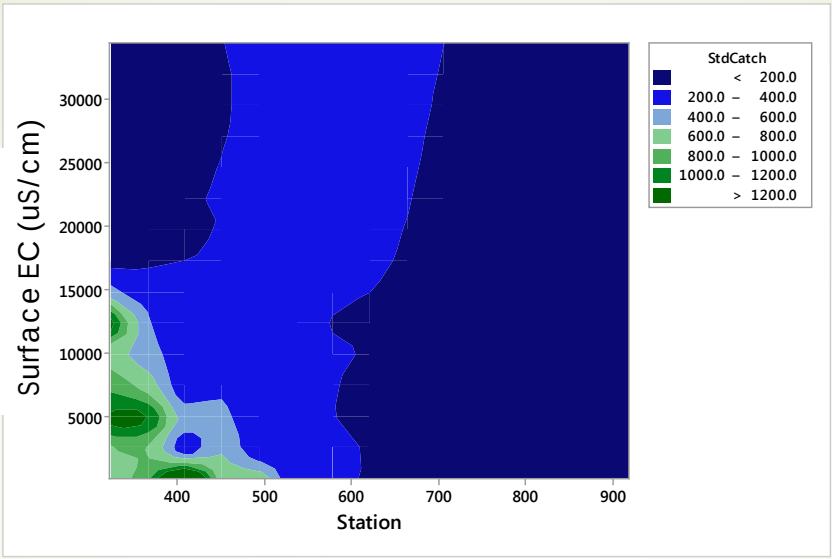


Standardized Longfin Smelt Catch Contours by Station and EC

1995



1996



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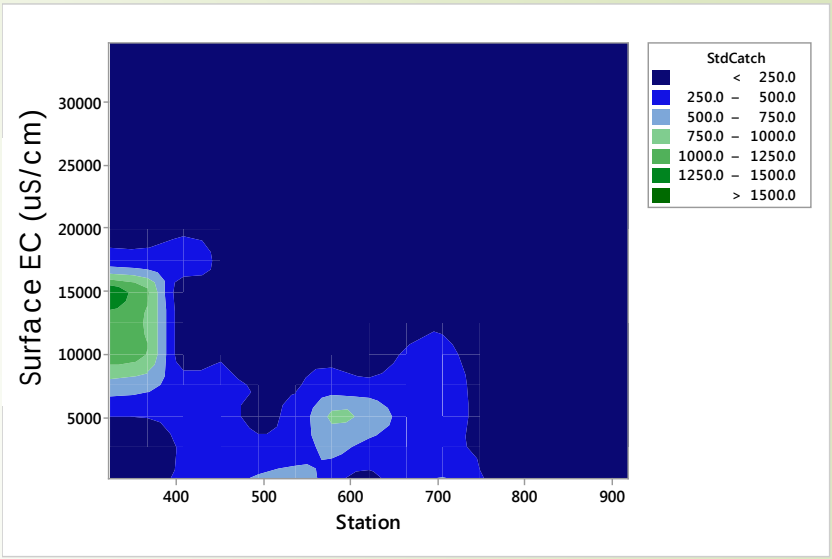
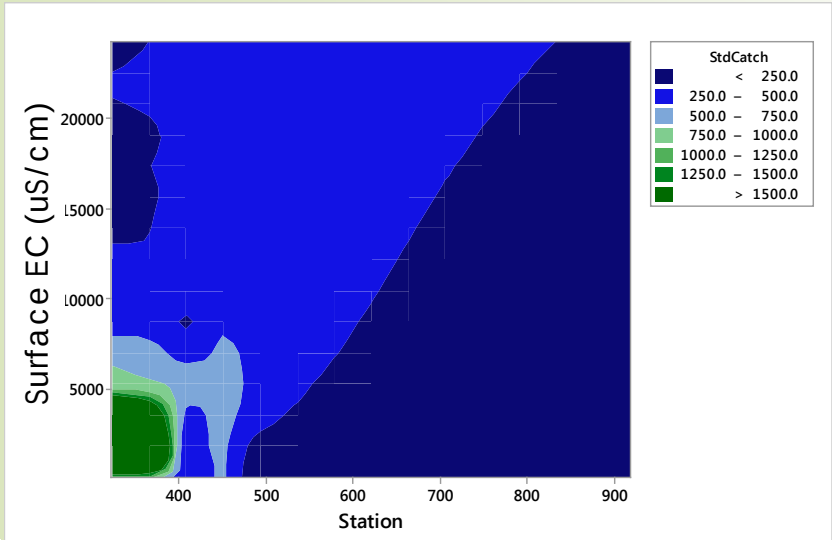


1998



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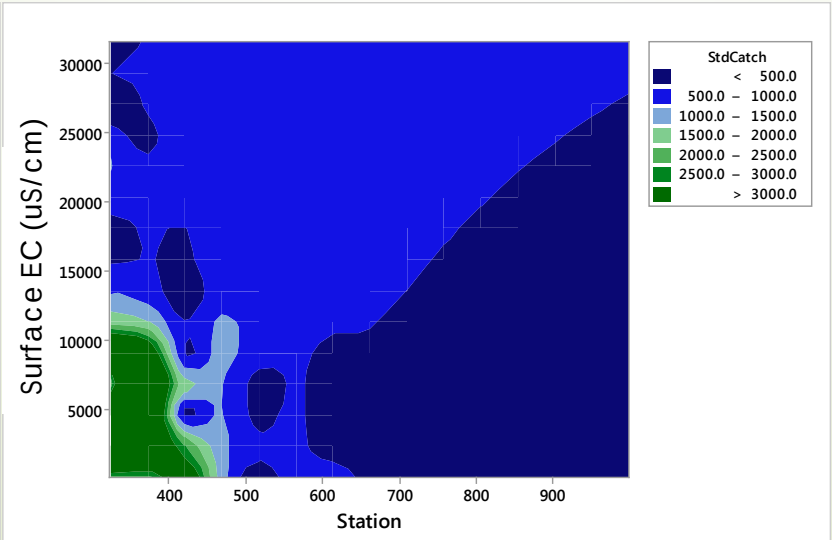

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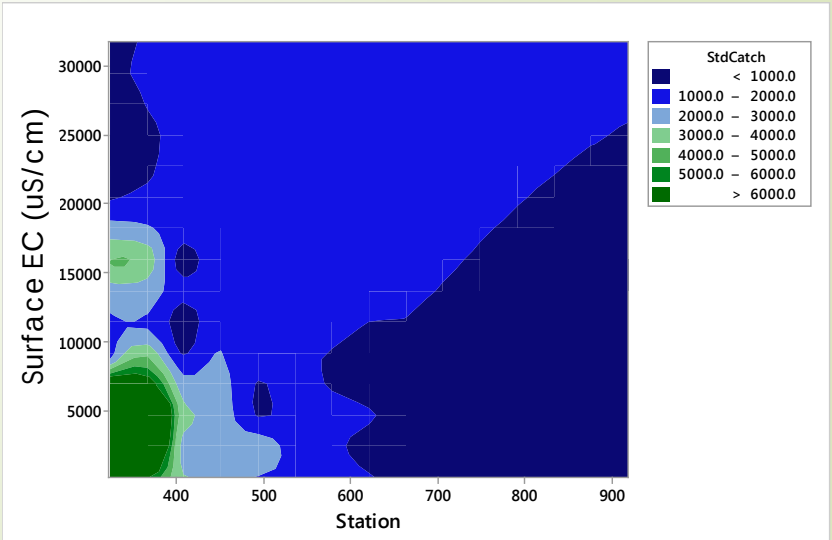

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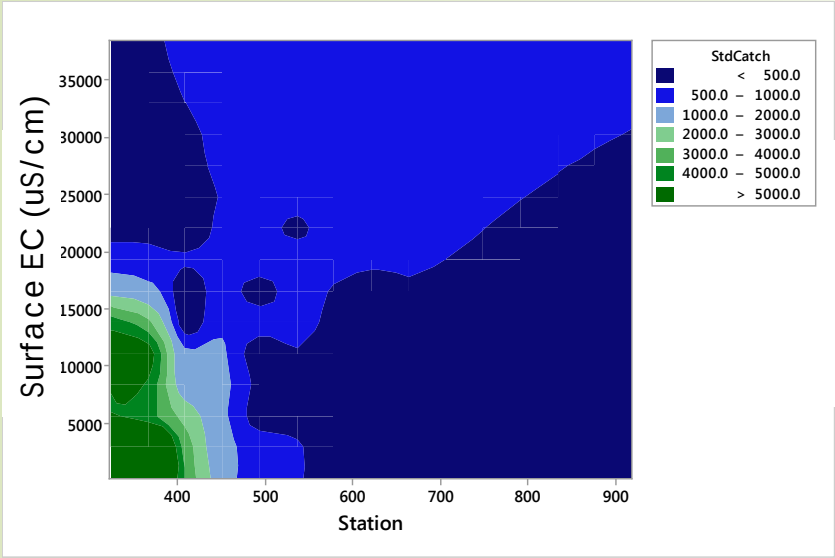
2001



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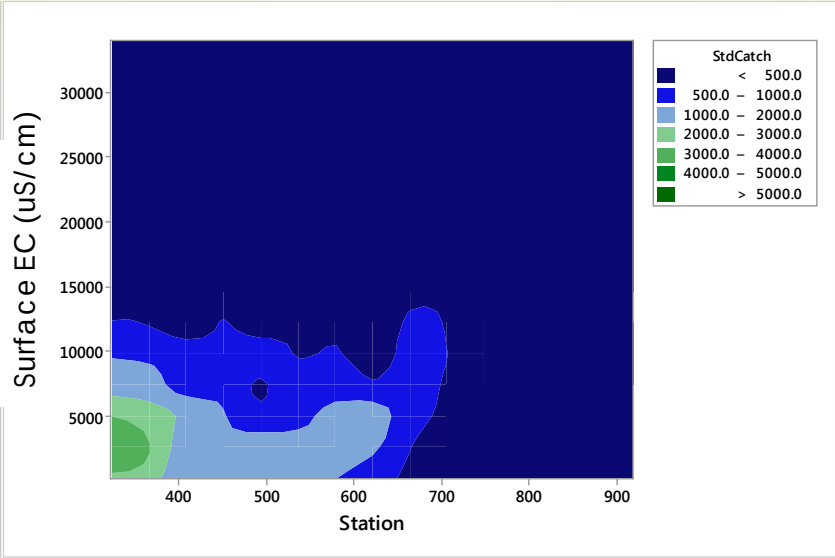

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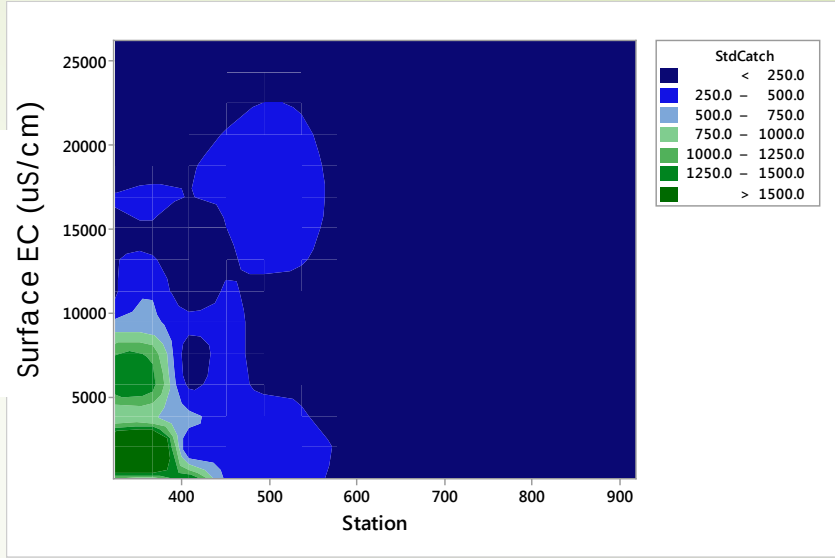

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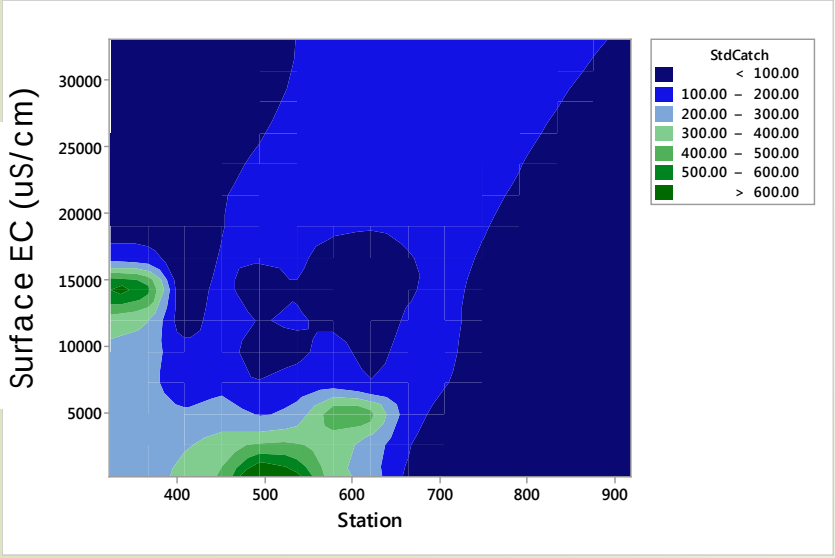

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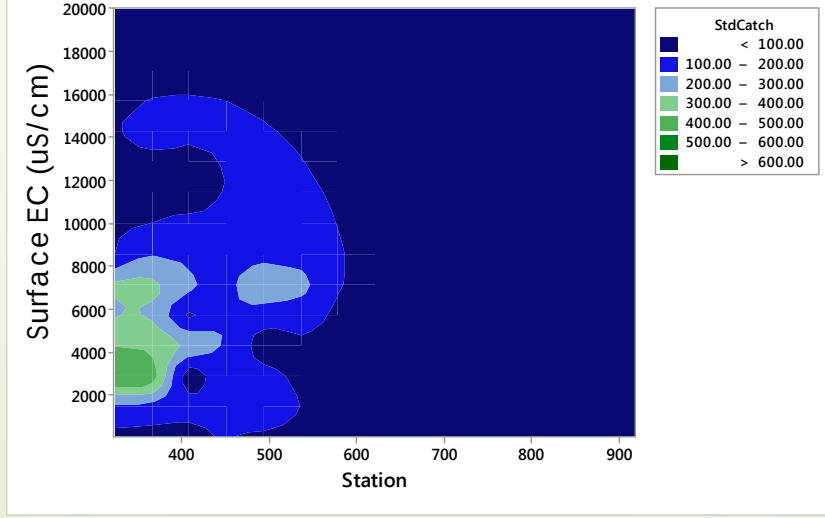

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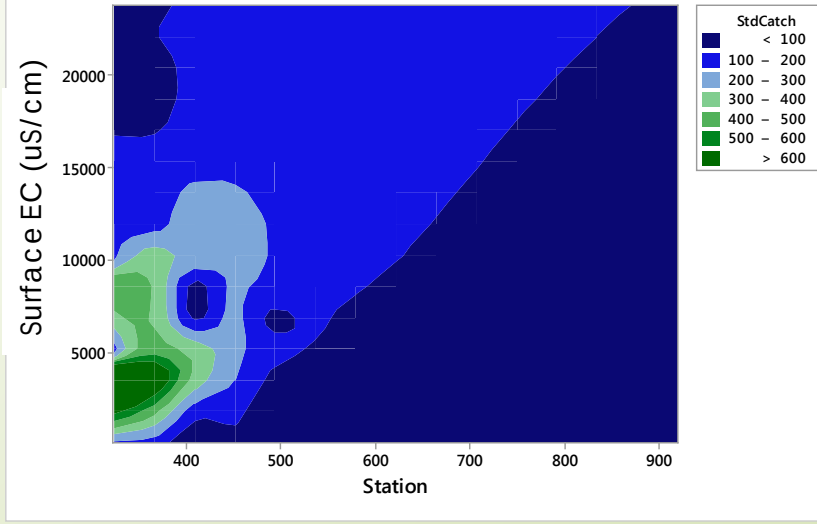
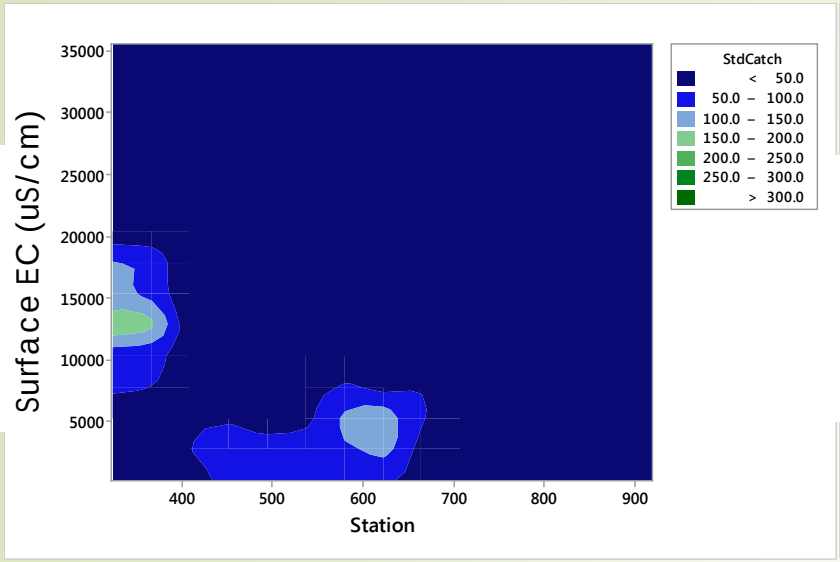


Standardized Longfin Smelt Catch Contours by Station and EC

2007



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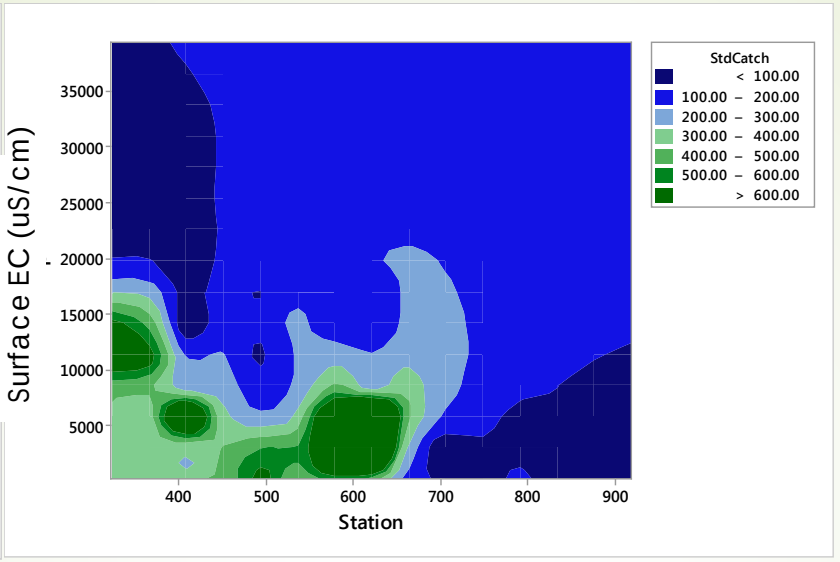
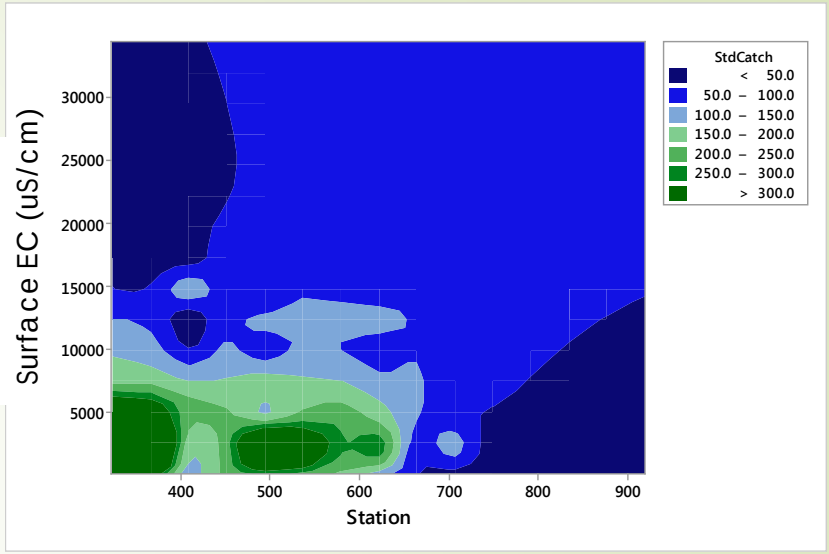
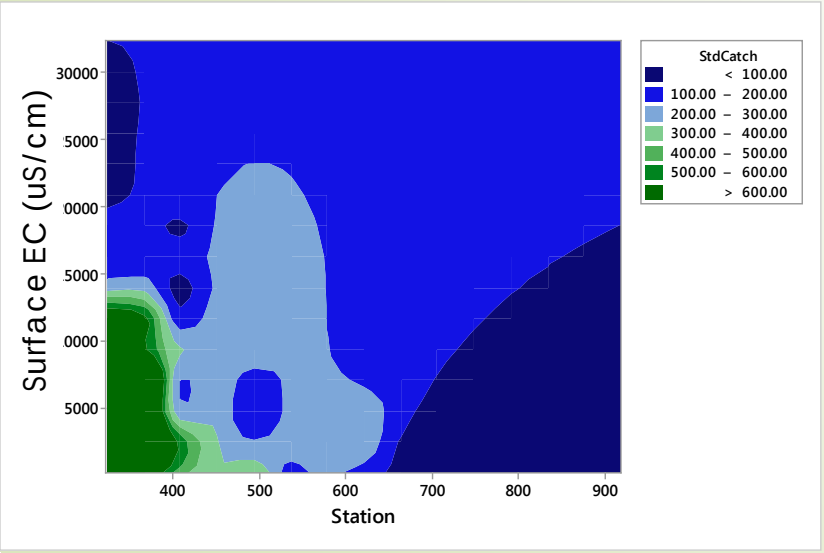


2009



2010



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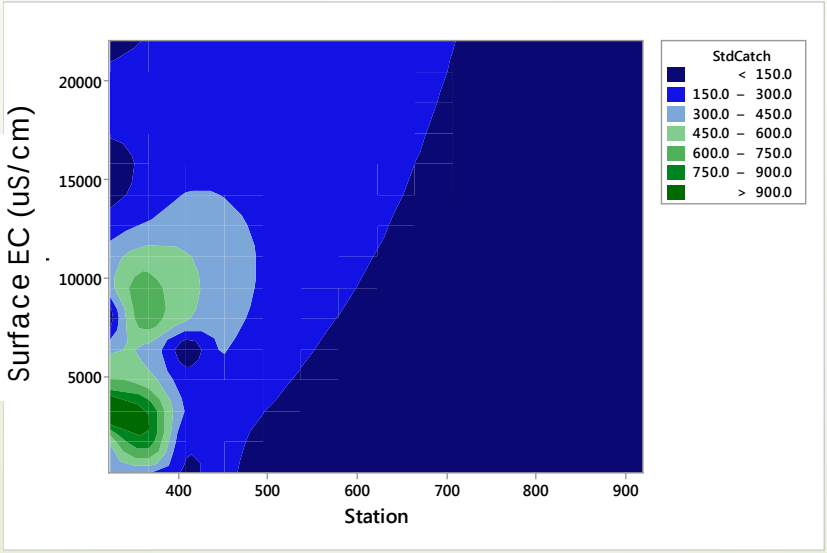
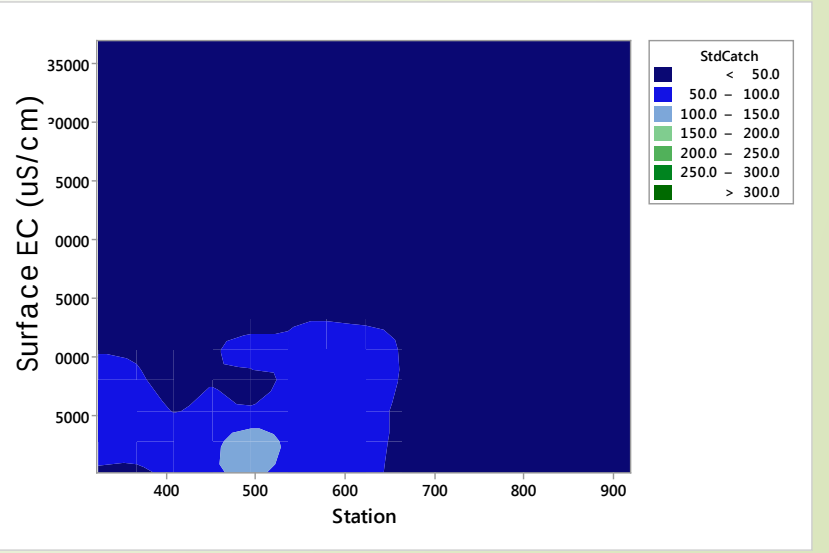
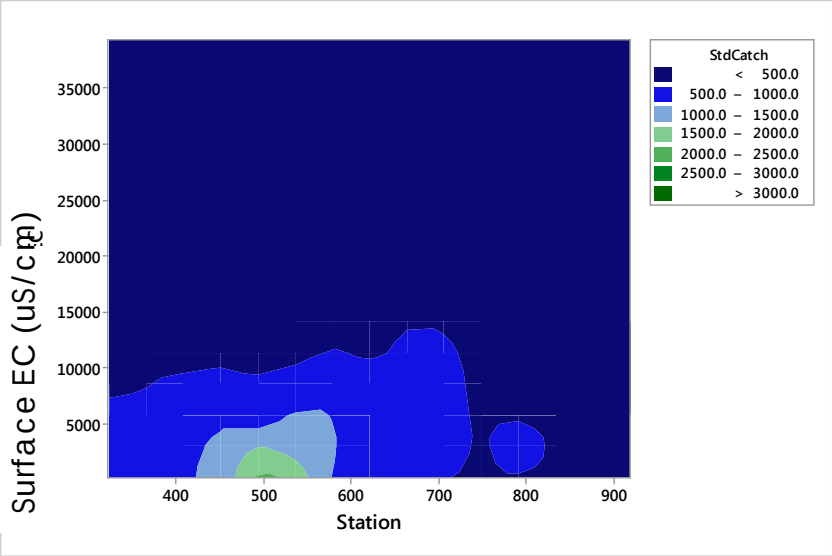


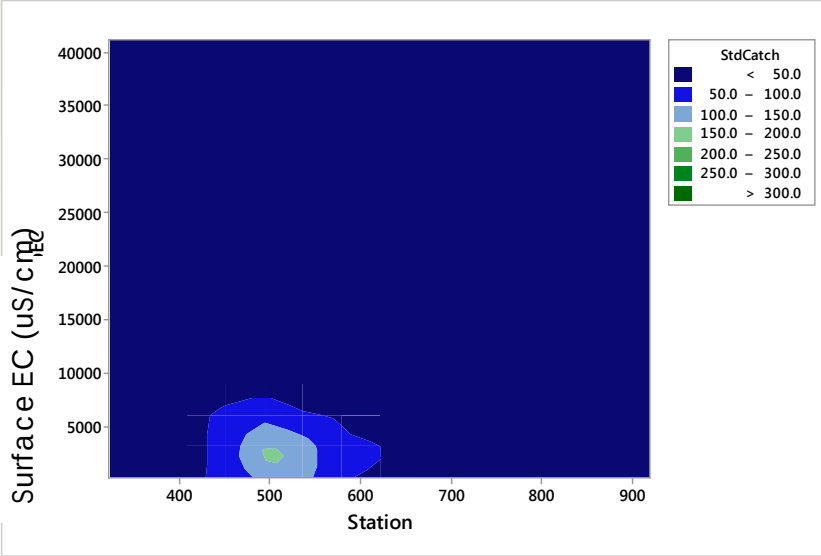
2012



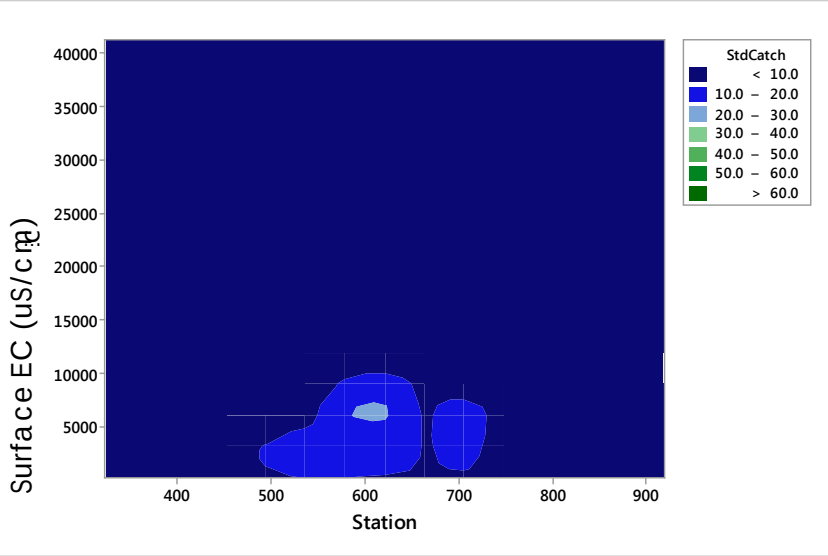
2013



2014



2015



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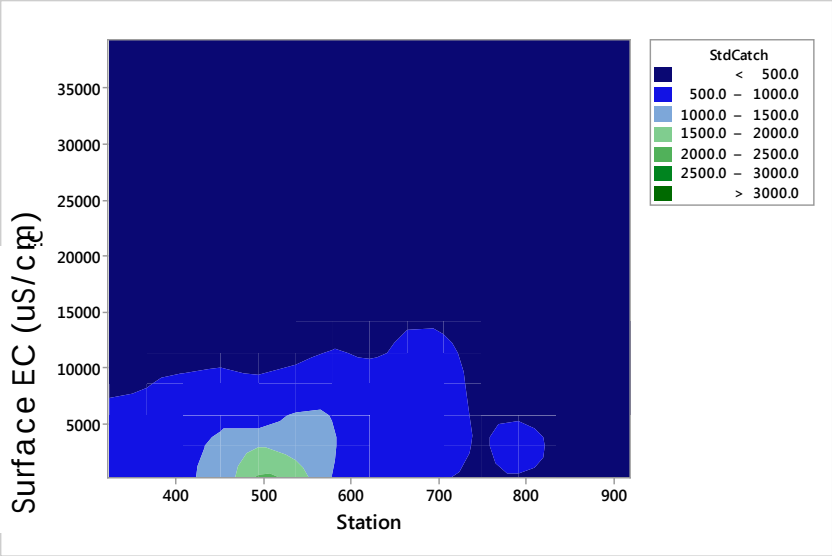

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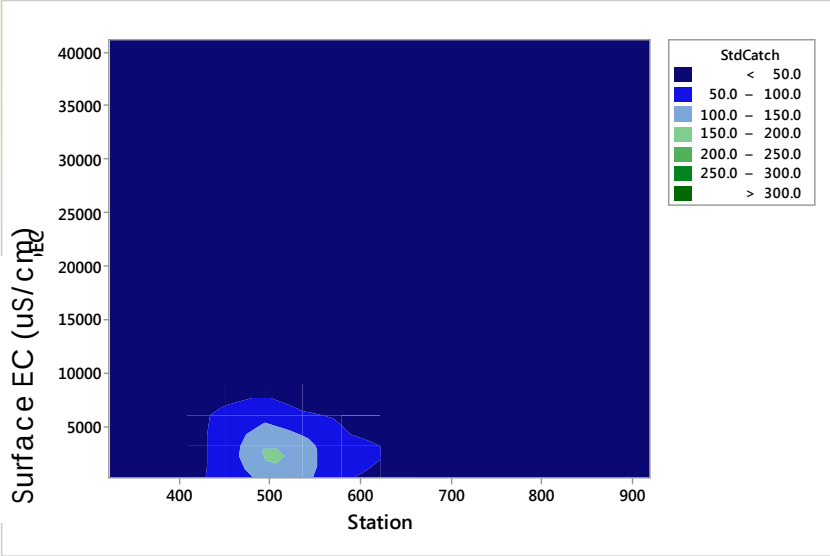
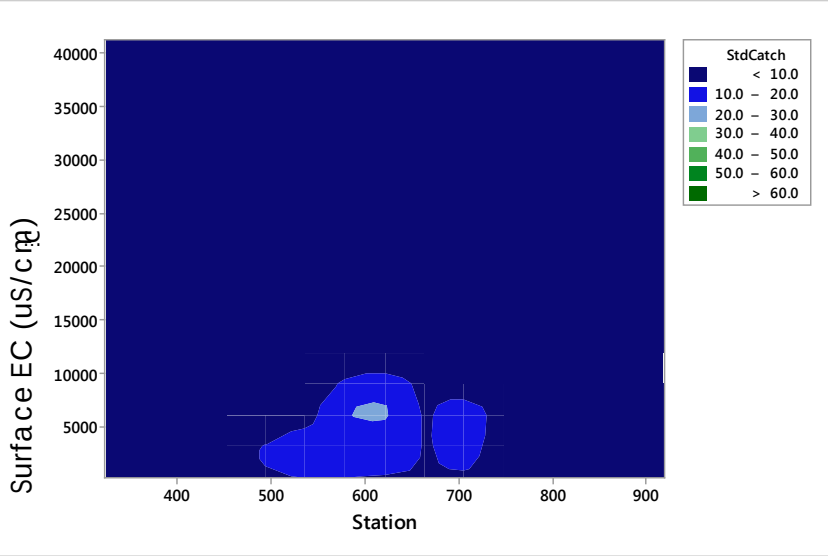
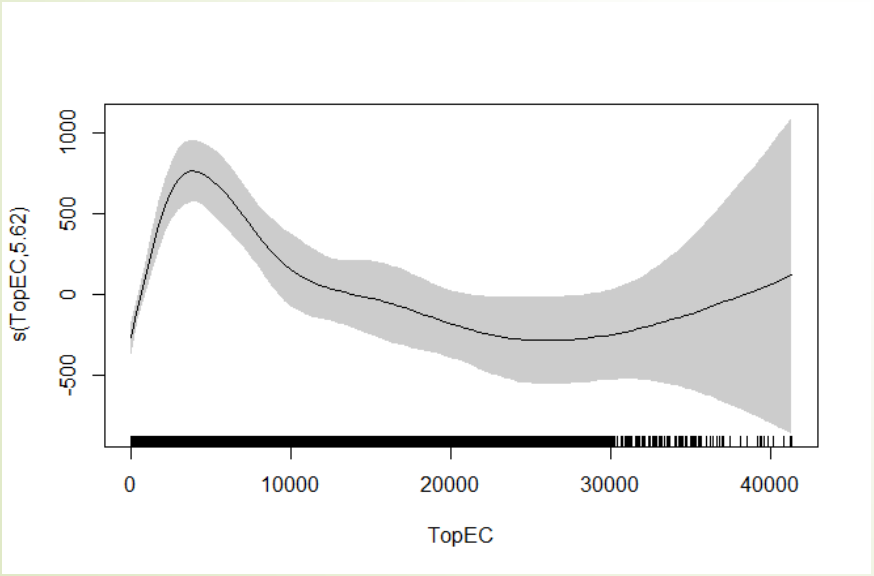
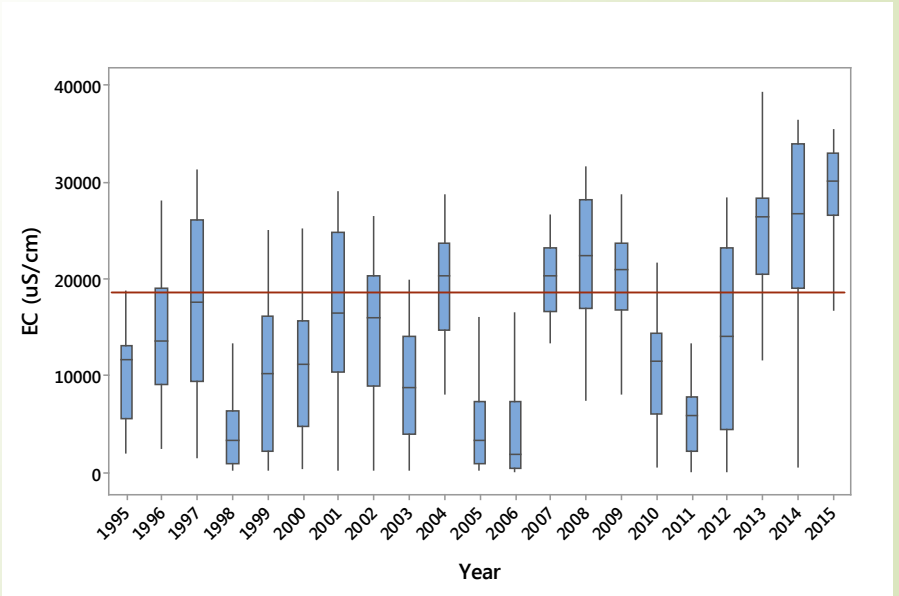


2015





Napa River Specific conductance (us/cm)



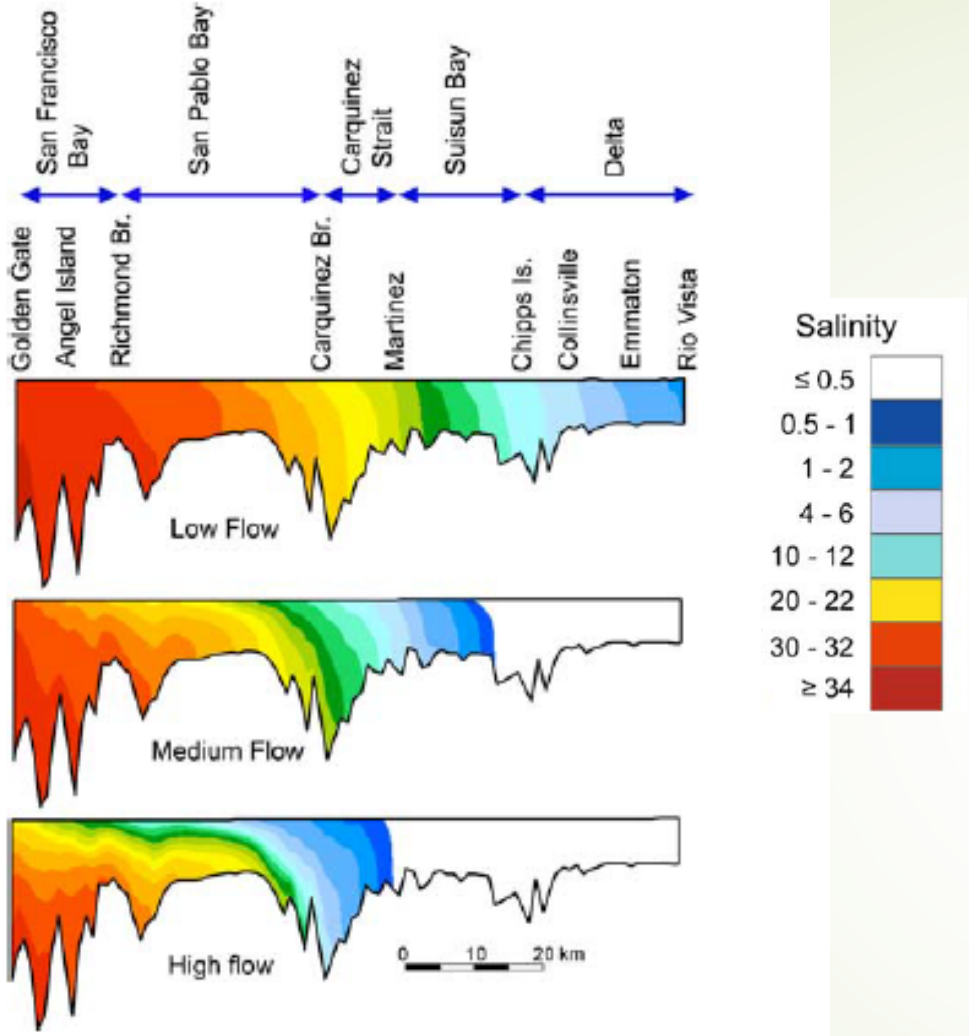
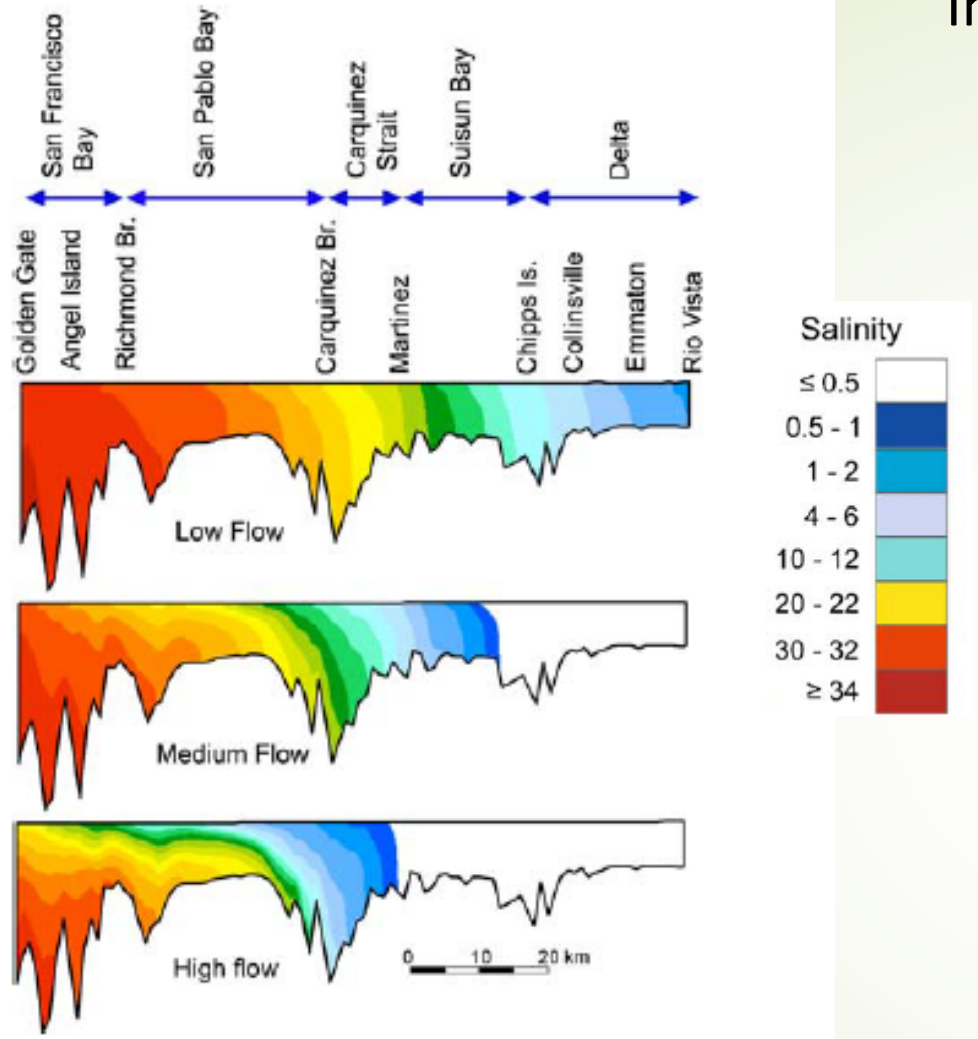


Fig. 6 TRIM3D model output. Tidally averaged salinity along the transect of the main channel from Golden Gate to Rio Vista (river kilometer 100). Locations identified by heavy lines in Fig. 1 and estuarine basins are listed at the top. Model output is given for net Delta outflows of (*top to bottom*) 110, 630, and 2810 $m^3 s^{-1}$ (lowest, middle, and highest flow)

Kimmerer et al. 2009

POTENTIAL MECHANISMS

Increased spawning and rearing habitat-



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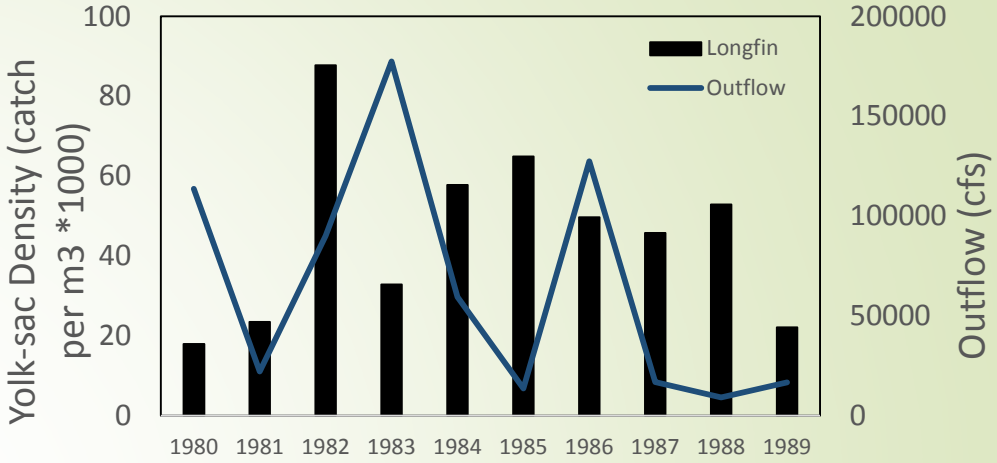
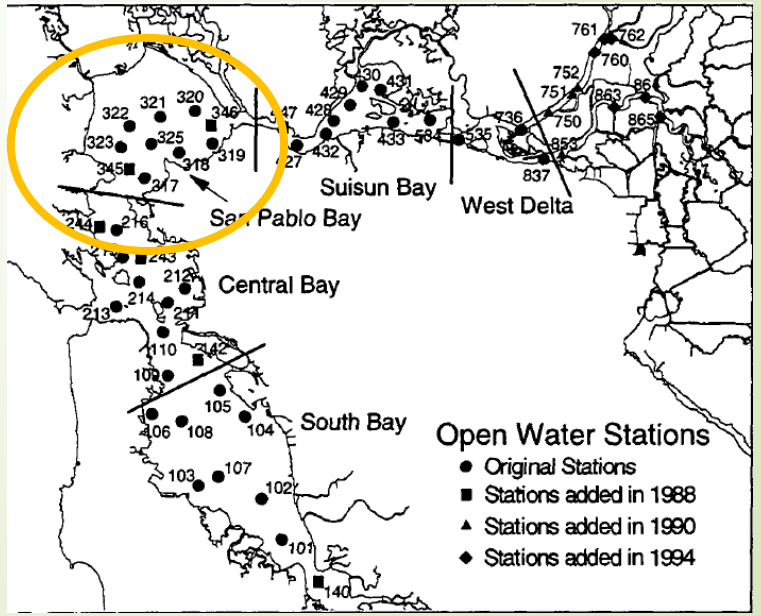
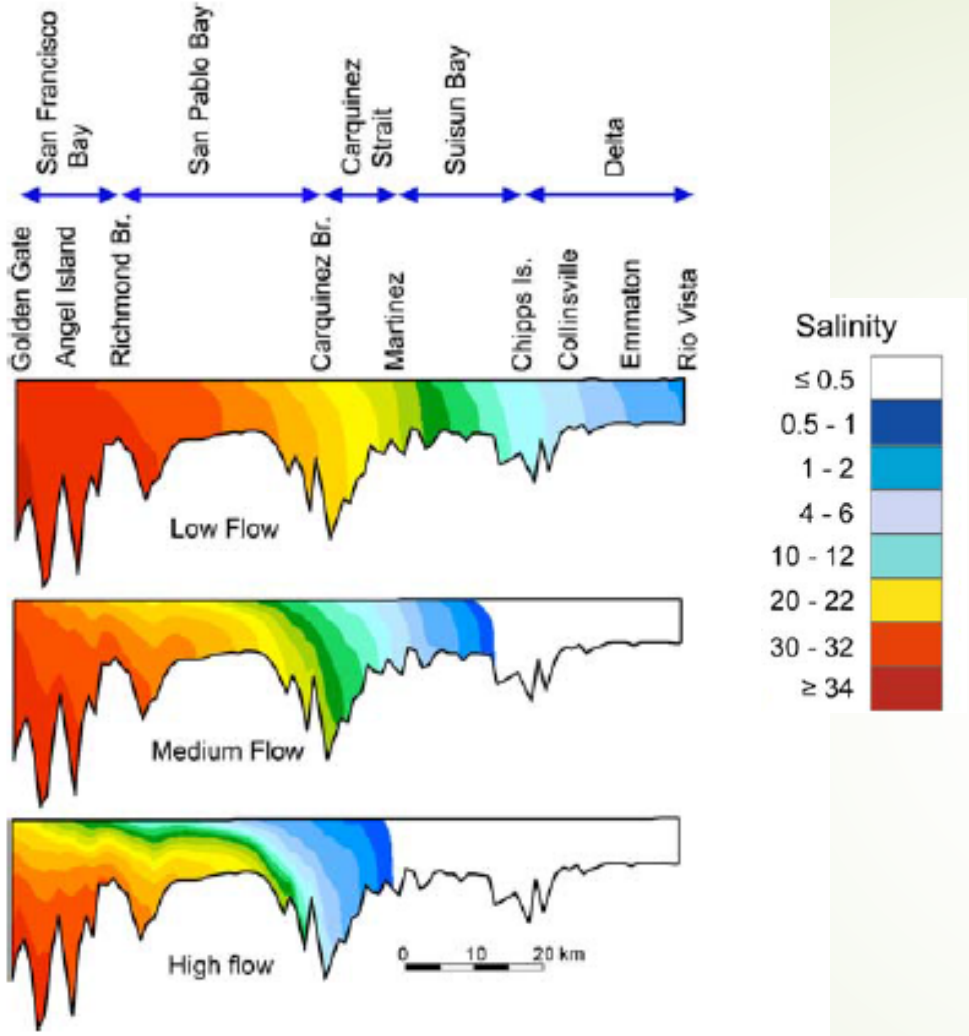


Bay Survey E and L Data



Food-



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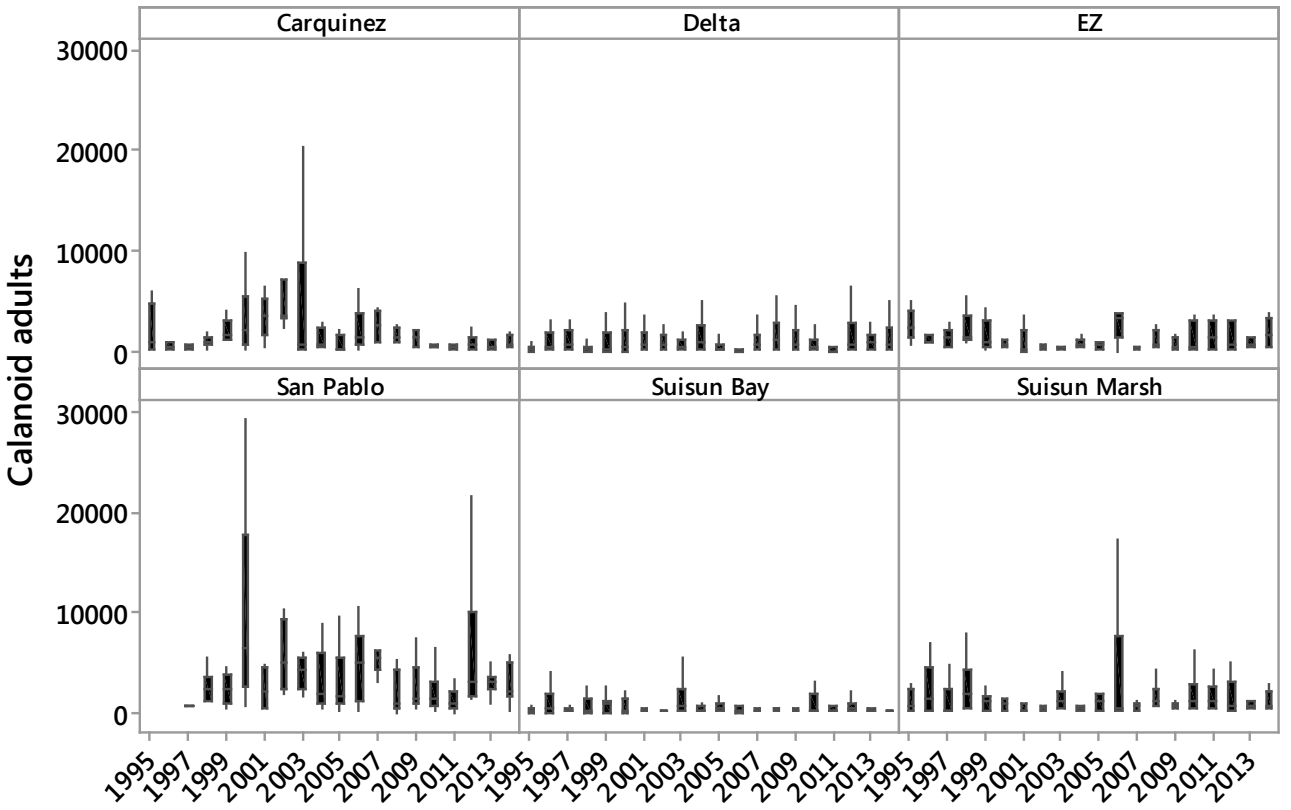
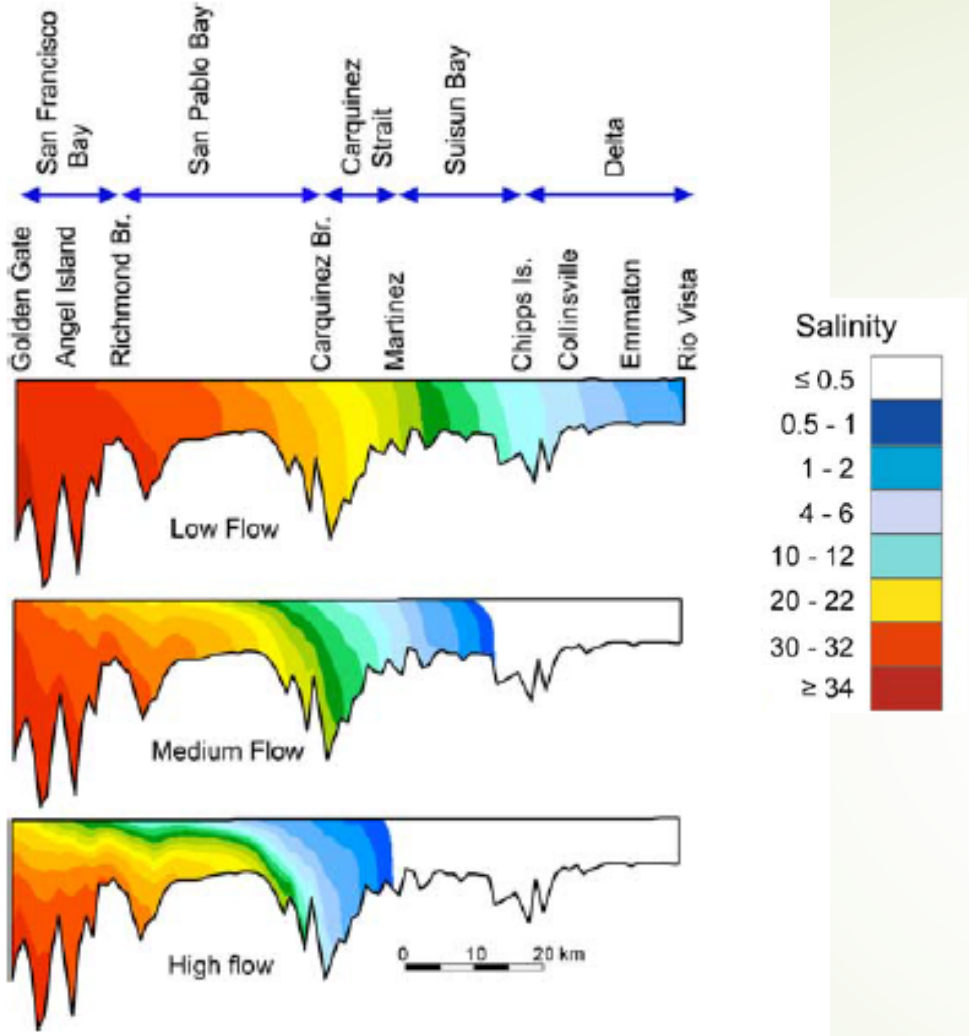
Kimmerer et al. 2009

Zooplankton abundance by region



DWR EMP-
Mar-June (1995-2014)



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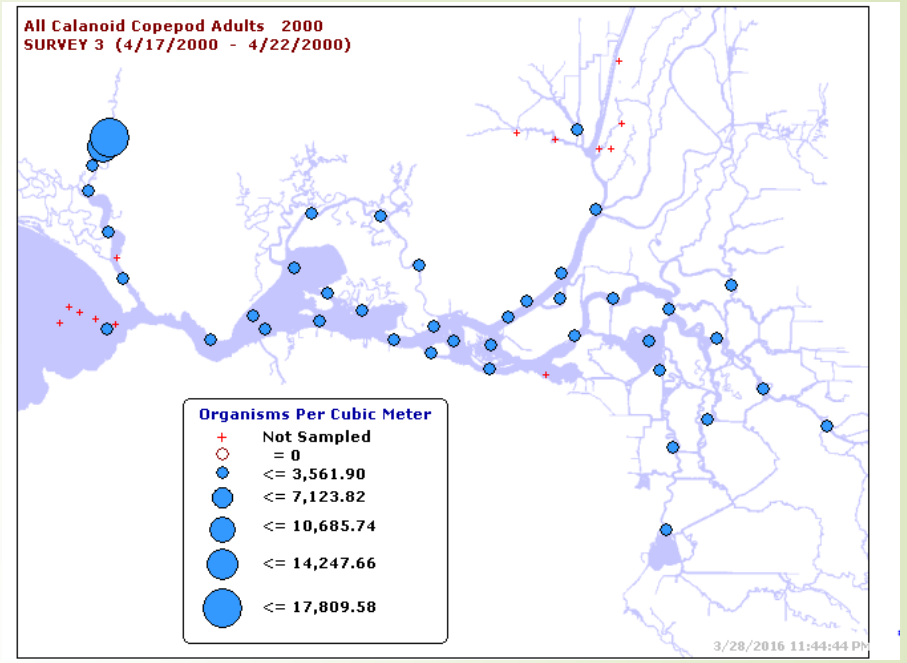
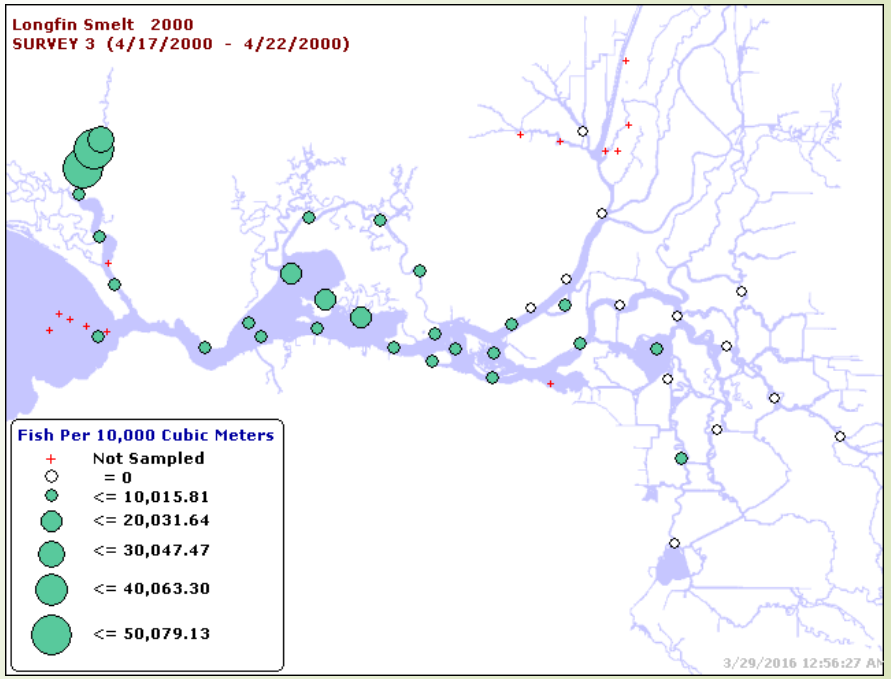
Food-





Tidal Marsh Study

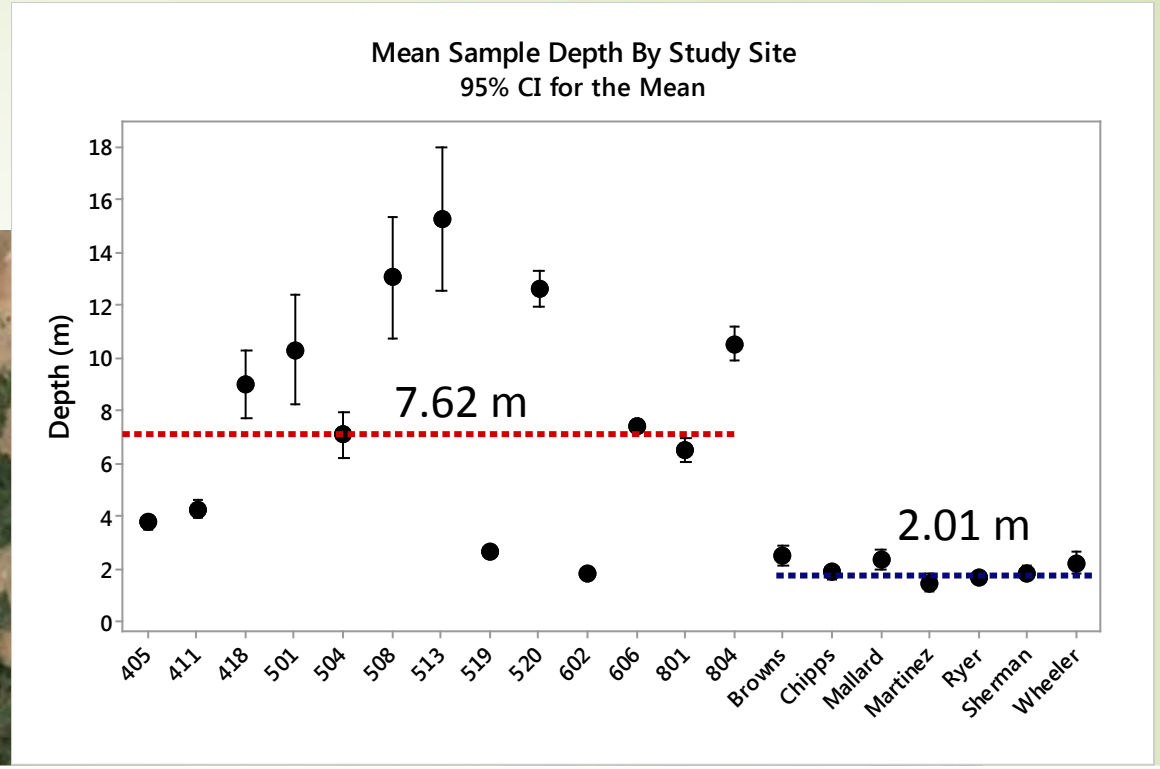
Study Sites

1. No name (Martinez)
2. Ryer Island
3. Wheeler Island
4. Mallard Island
5. Chipps Island
6. Browns Island
7. Sherman Island

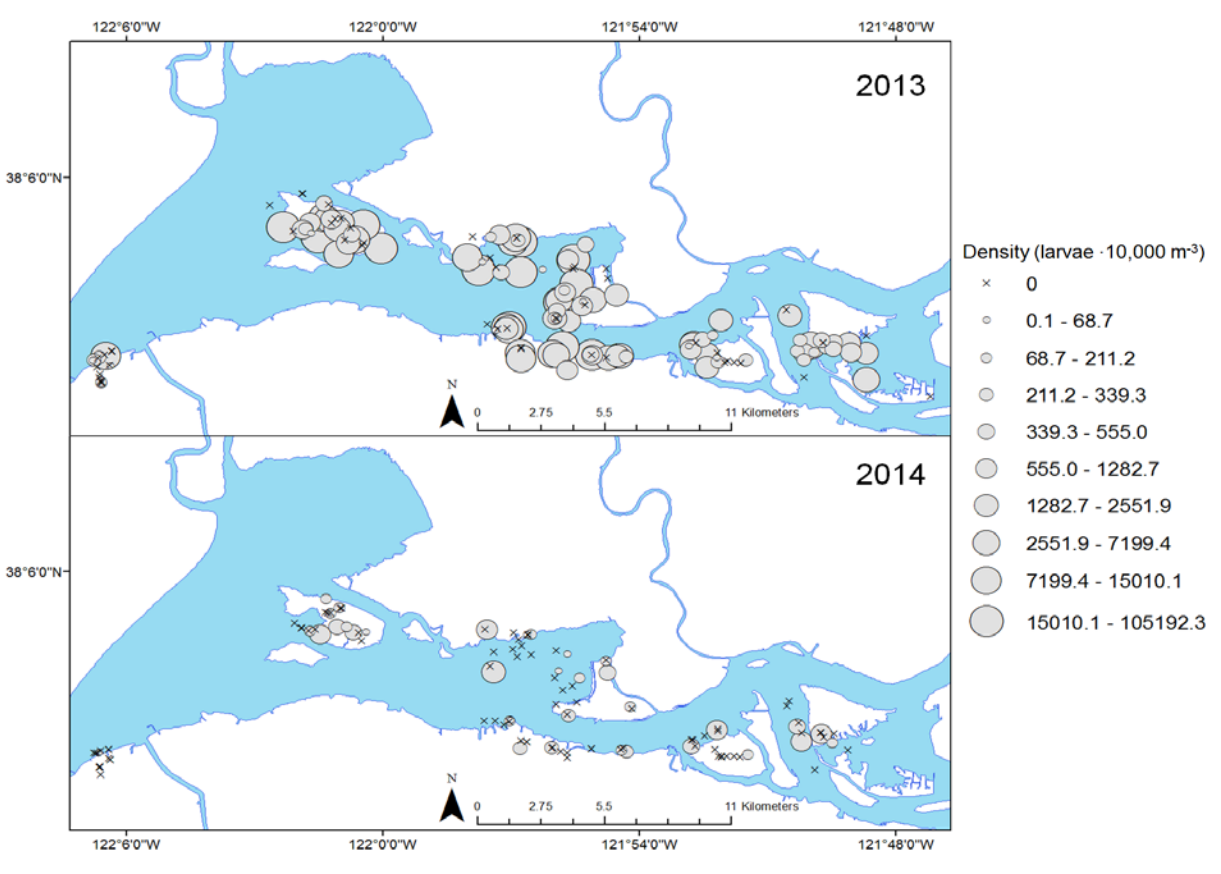
Conducted a tidal marsh study in actual tidal marshes

Conducted a tidal marsh study in actual tidal marshes

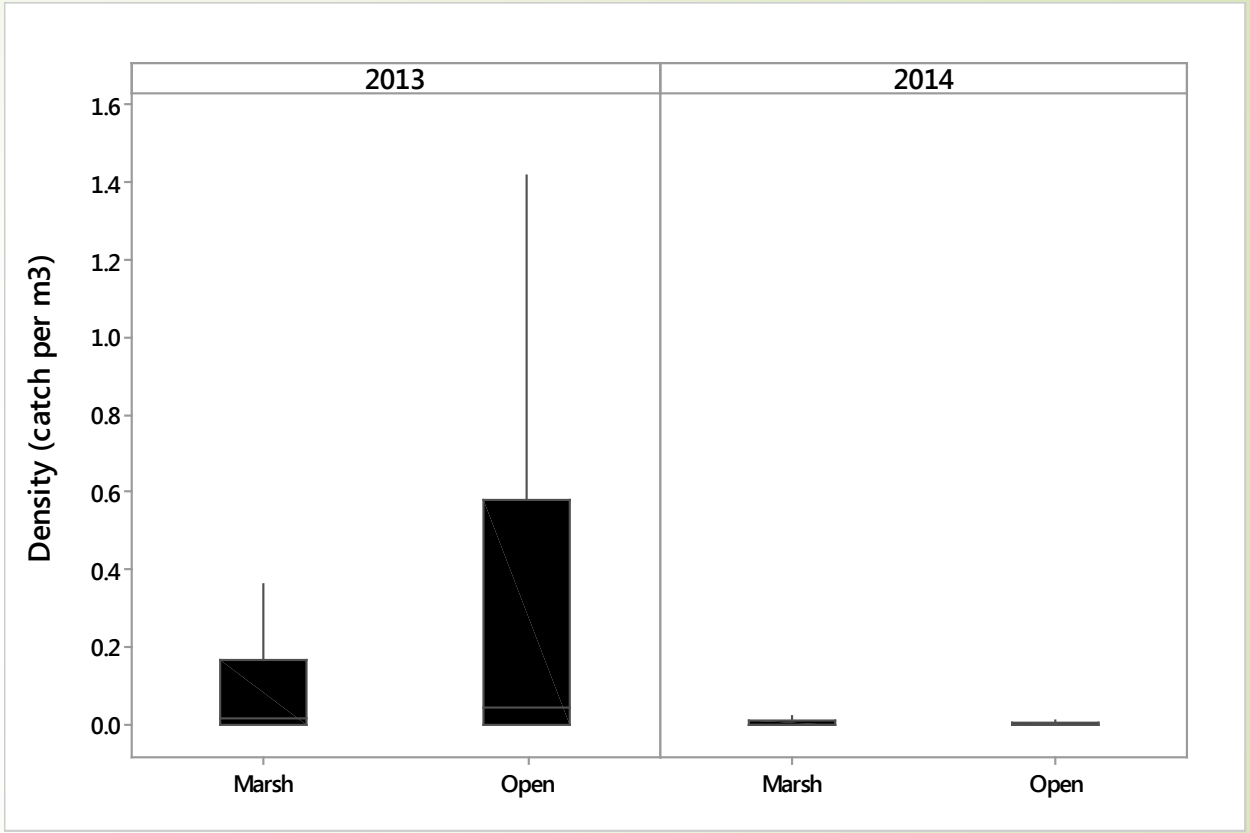
Compared Longfin Smelt Densities between Tidal Marsh Study and CDFW Smelt Larval Survey



More longfin smelt collected in 2013

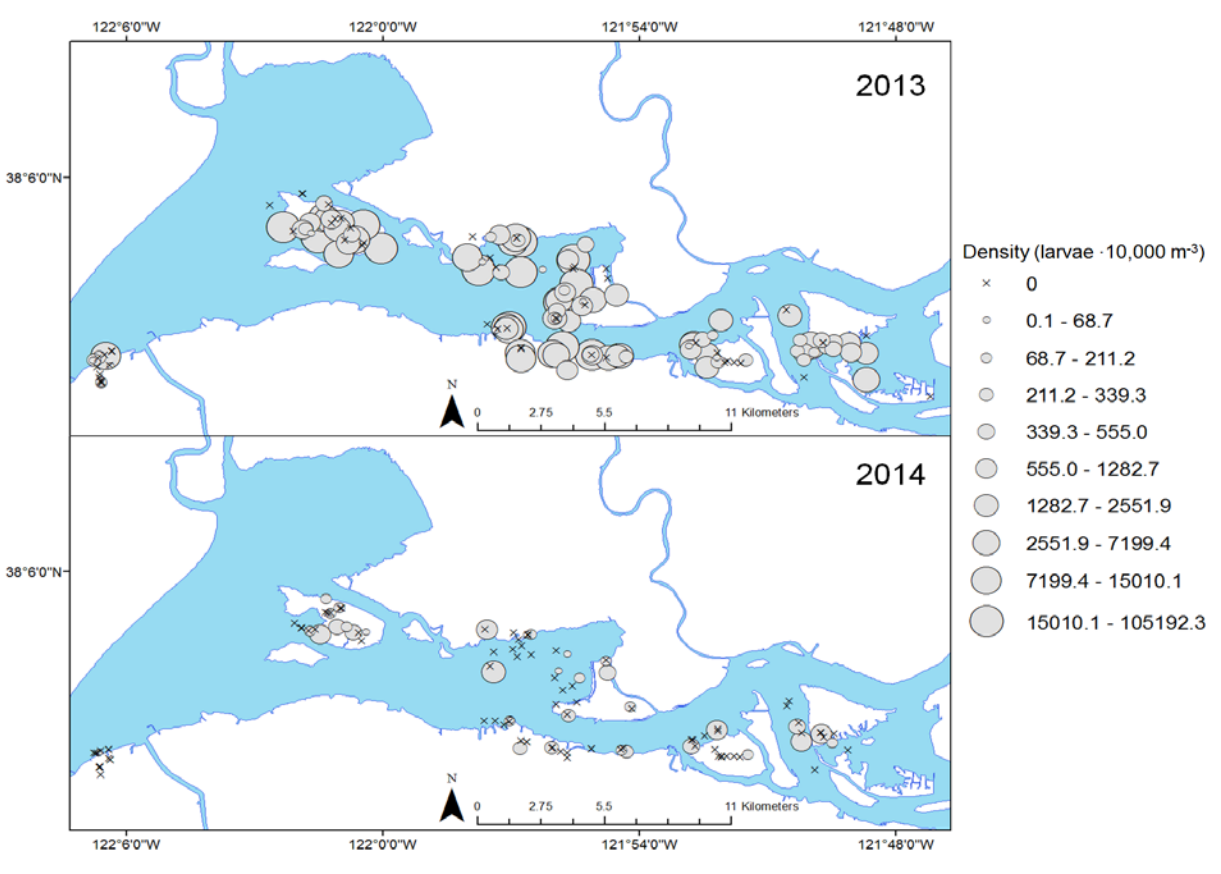


Shallow open water areas supported higher densities of longfin smelt larvae

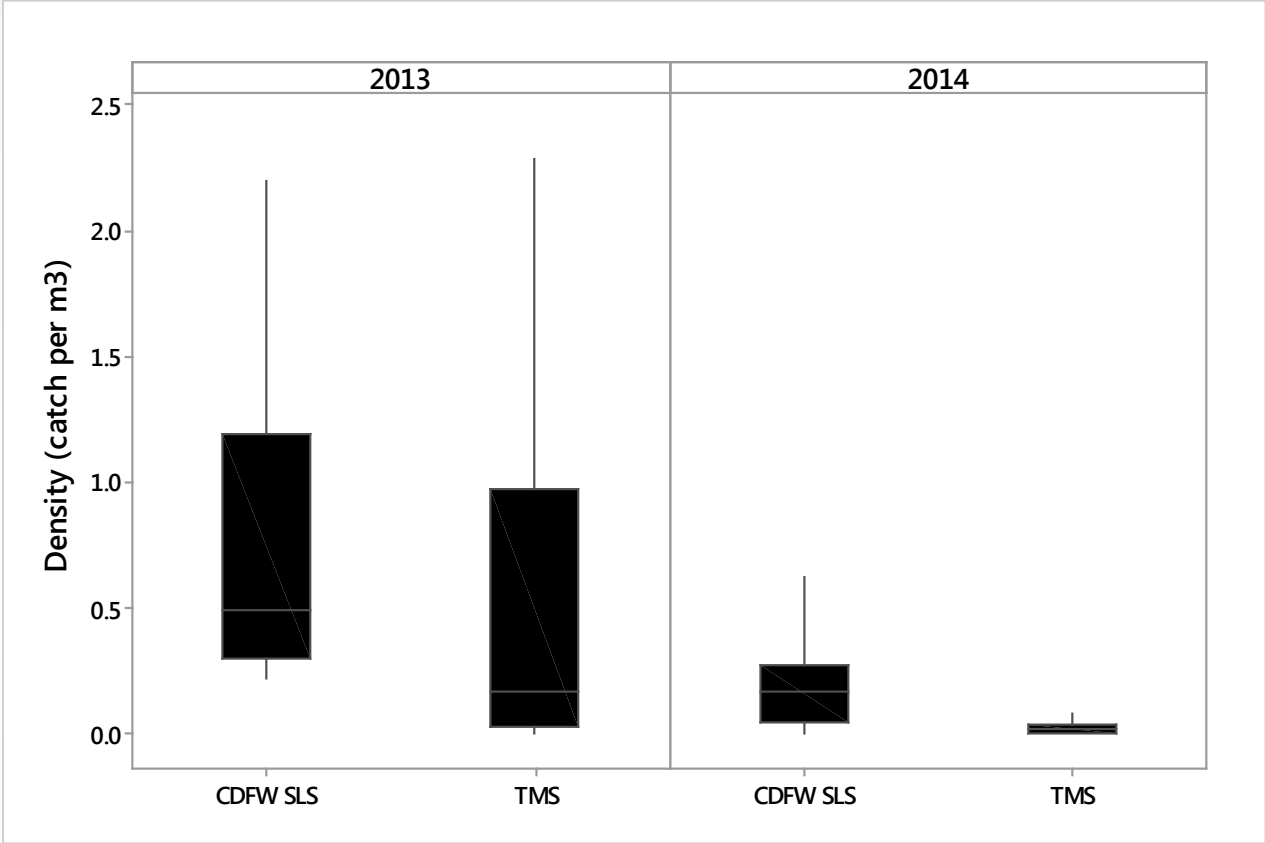


Source	P-value
Habitat	< 0.05
Year	< 0.01
Month	< 0.01

More longfin smelt collected in 2013

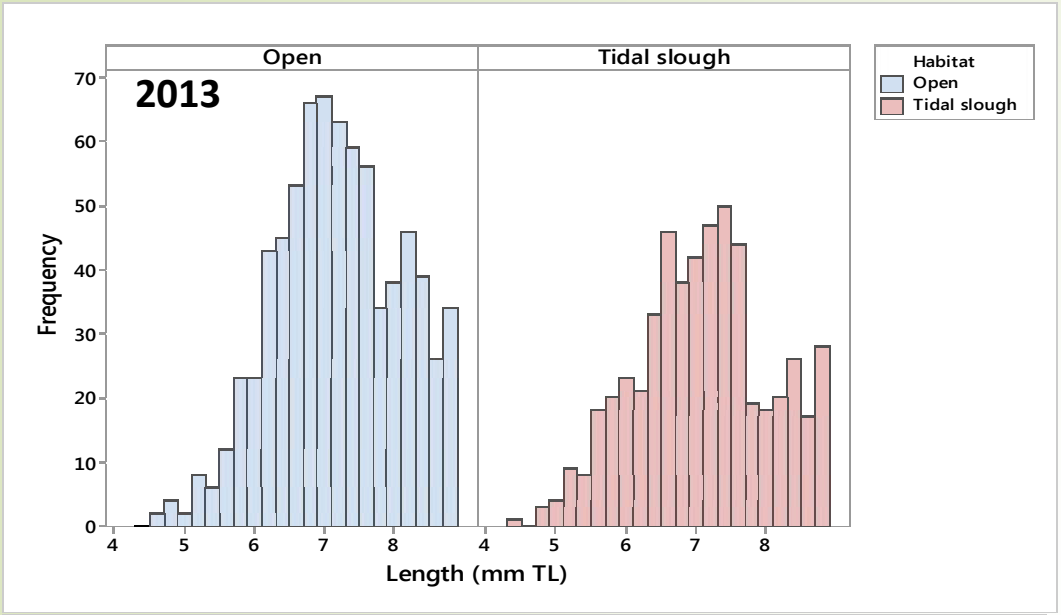


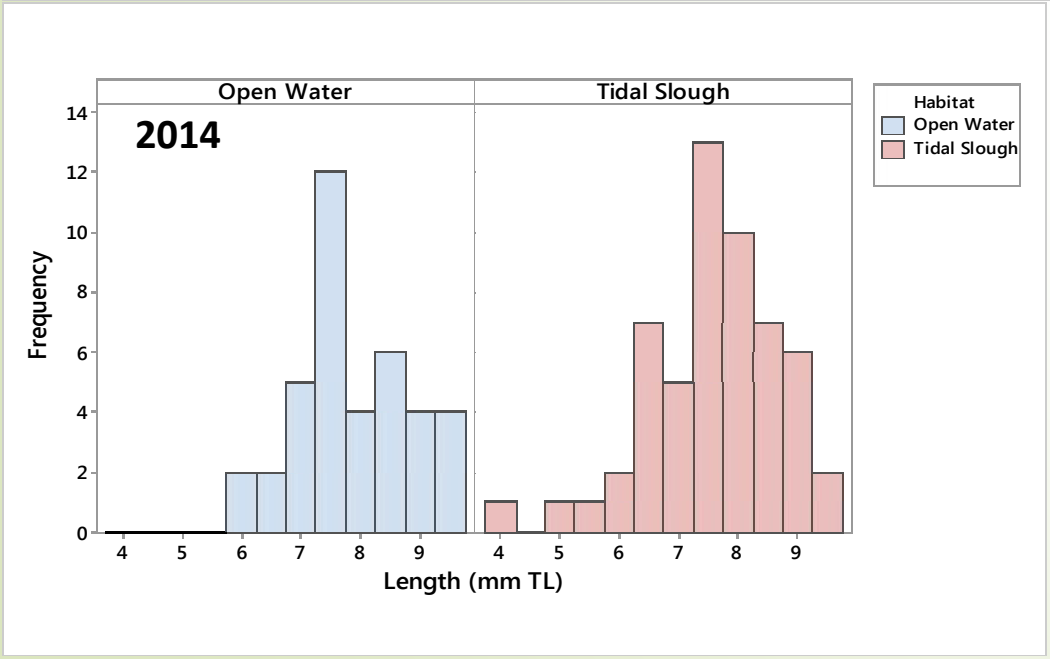
Densities not different between studies
(CDFW SLS vs Tidal Marsh Study)



Source	P-value
Habitat	ns
Year	< 0.01
Month	ns

Lot’s of yolk-sac larvae were collected



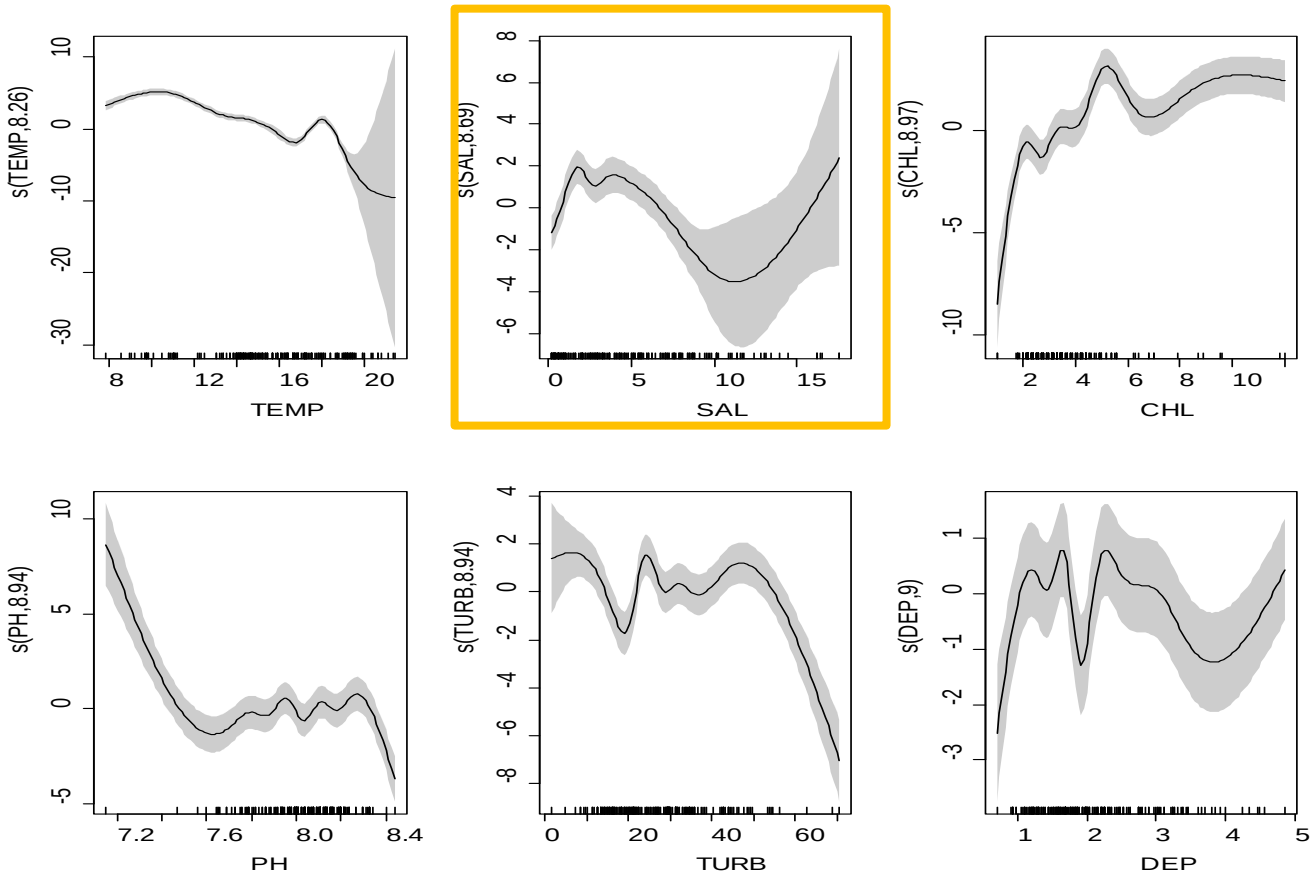


Length at hatch 5 – 8 mm TL; Wang 2007

2013

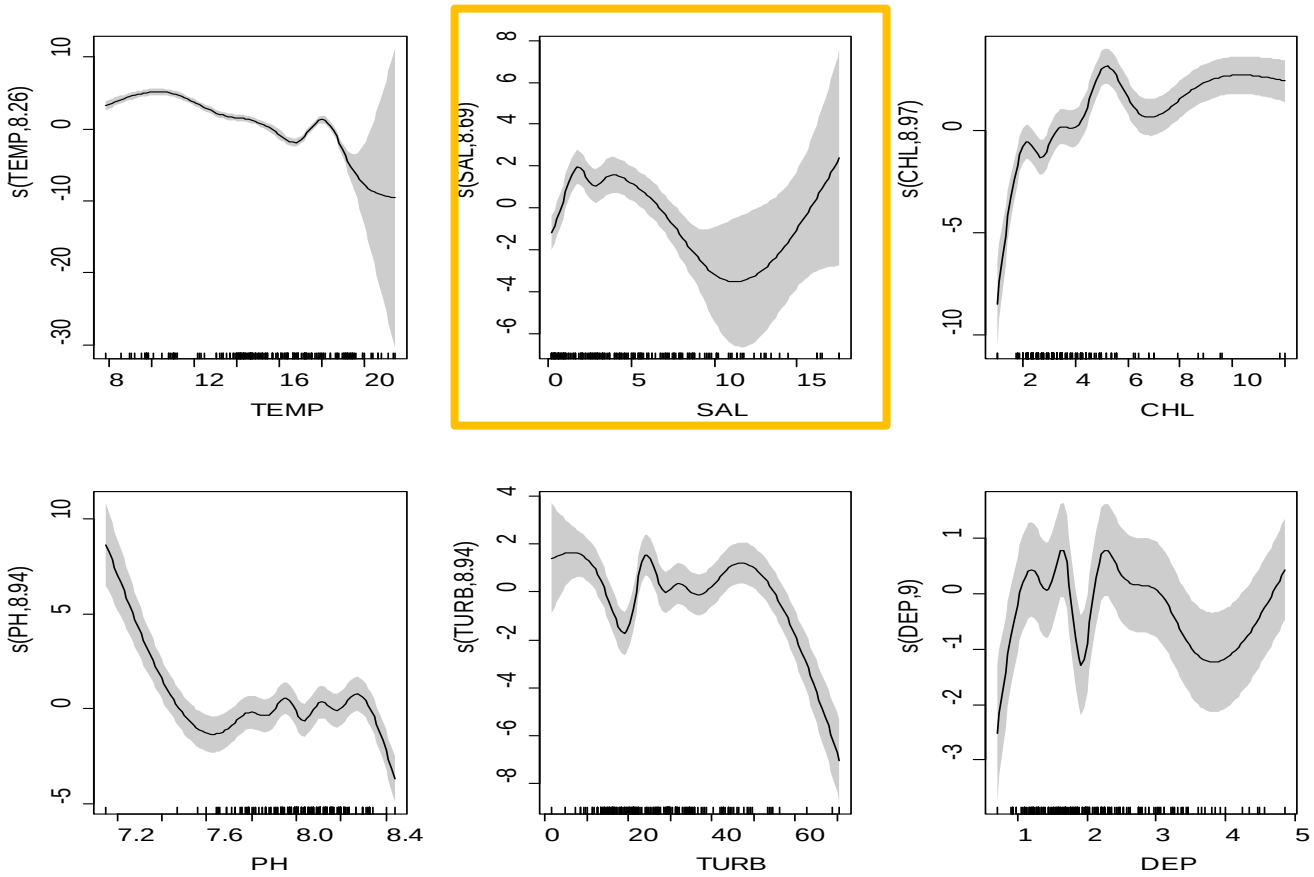
Tow position/distance recorded in Navionics

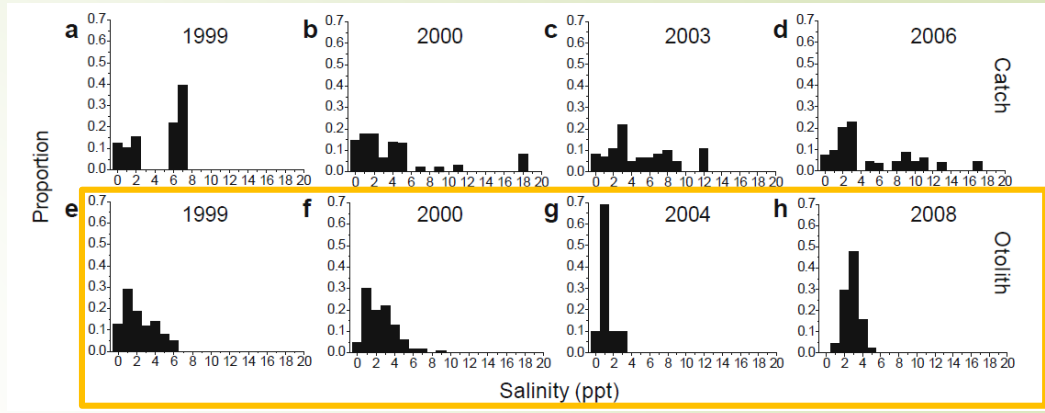
Relationship between larval catch and environmental variables during tidal marsh survey



GAM(COUNT ~ s(TEMP')+ YEAR + s(SAL)+ s(CHL)+ s(PH)+ s(TURB) + s(DEP) + HAB, offset=log(VOL), gamma=1.4, family=poisson(link=log))

Relationship between larval catch and environmental variables during tidal marsh survey





Hobbs et al. 2010

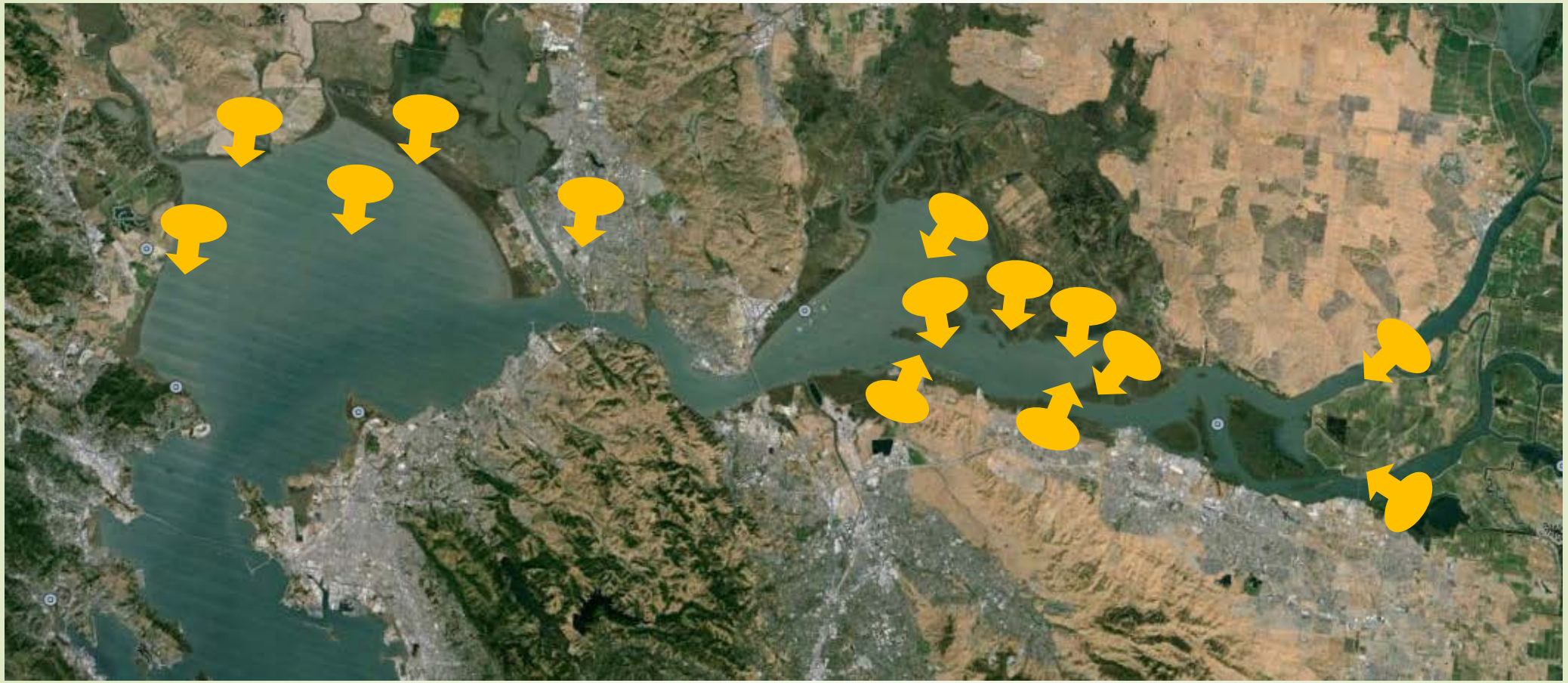
GAM(COUNT ~ s(TEMP')+ YEAR + s(SAL)+ s(CHL)+ s(PH)+ s(TURB) + s(DEP) + HAB, offset=log(VOL), gamma=1.4, family=poisson(link=log))

Existing Paradigm-

Longfin smelt spawn in freshwater and are transported into Suisun Bay (Rosenfield and Baxter 2007; Kimmerer et al. 2009, CDFW 2009)

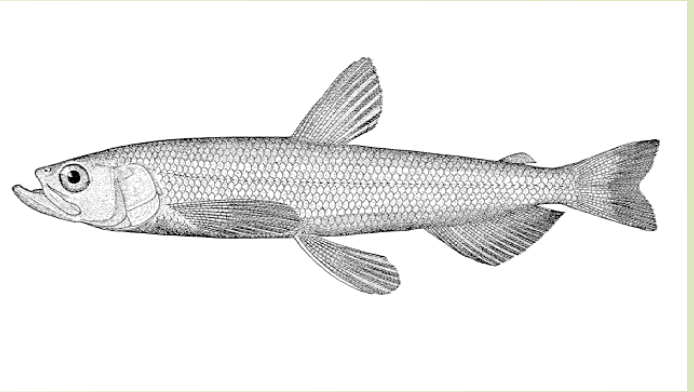
Emerging Paradigm-

Longfin smelt spawn in fresh water and low salinity water. Available spawning habitat increases from east to west



Plenty of restoration opportunities throughout the low salinity and brackish regions of the estuary

Acknowledgments



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2013 IEP (Management Team)
2014 MWD (David Fullerton , Shawn Acuna, and Russell Ryan)

Instrumental helpers (i.e., operators, lab assistance, fish identification, permits)

Nick Sakata	Tenera Environmental
Nick van Ark	Colin Brennan
Kari Ambrosia	Dan Abbott
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Eric Santos	Carol Raifsnider
Jim Starr	Dave Mayer
Jennifer Pierre	Johnson Wang
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