

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

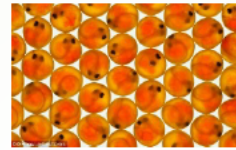
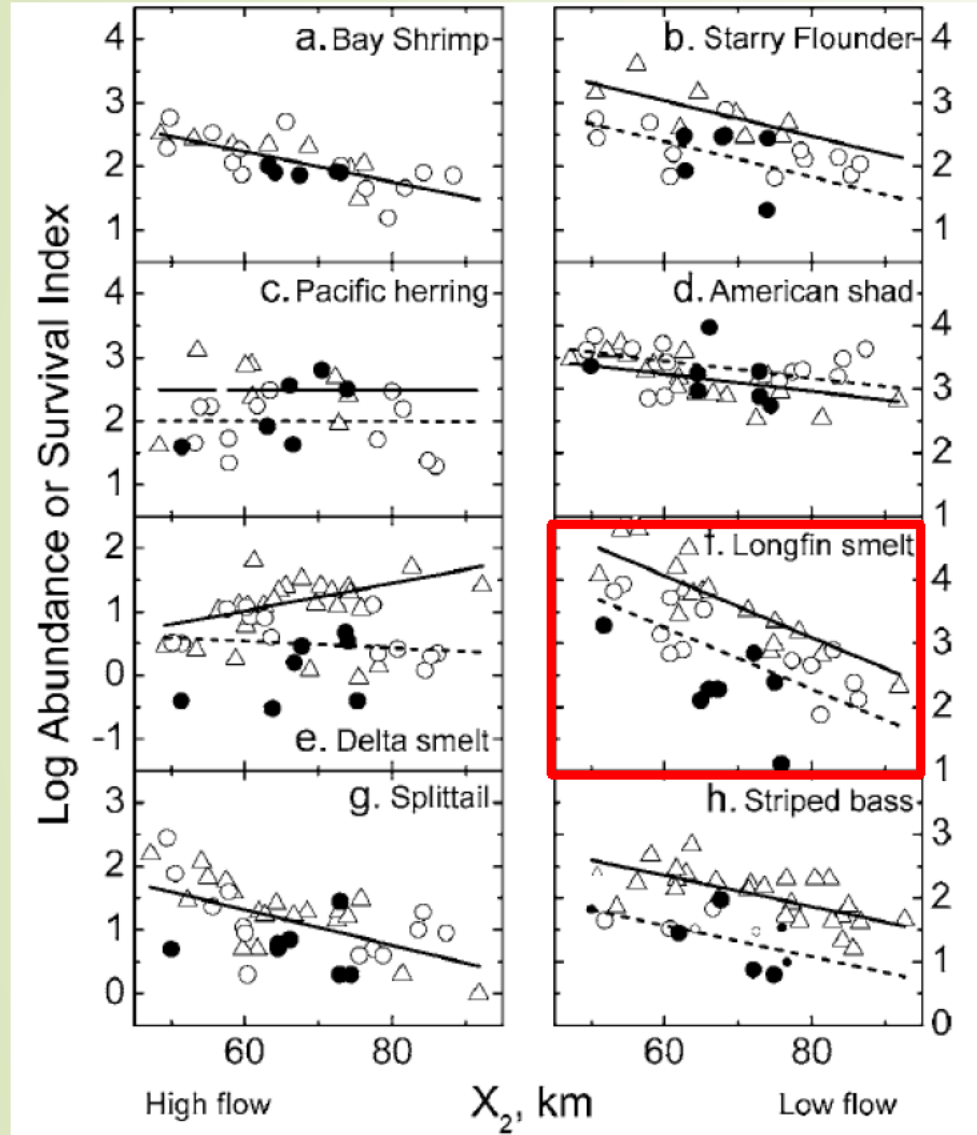
Lenny Grimaldo (ICF), Fred Feyrer (USGS), Jillian Burns (ICF), Donna Maniscalco (ICF), Jason Hassrick (ICF), LeAnne Rojas (ICF), Dave Fullerton (MWD), and Shawn Acuña (MWD)

Background



More spring flow = more fish in the fall

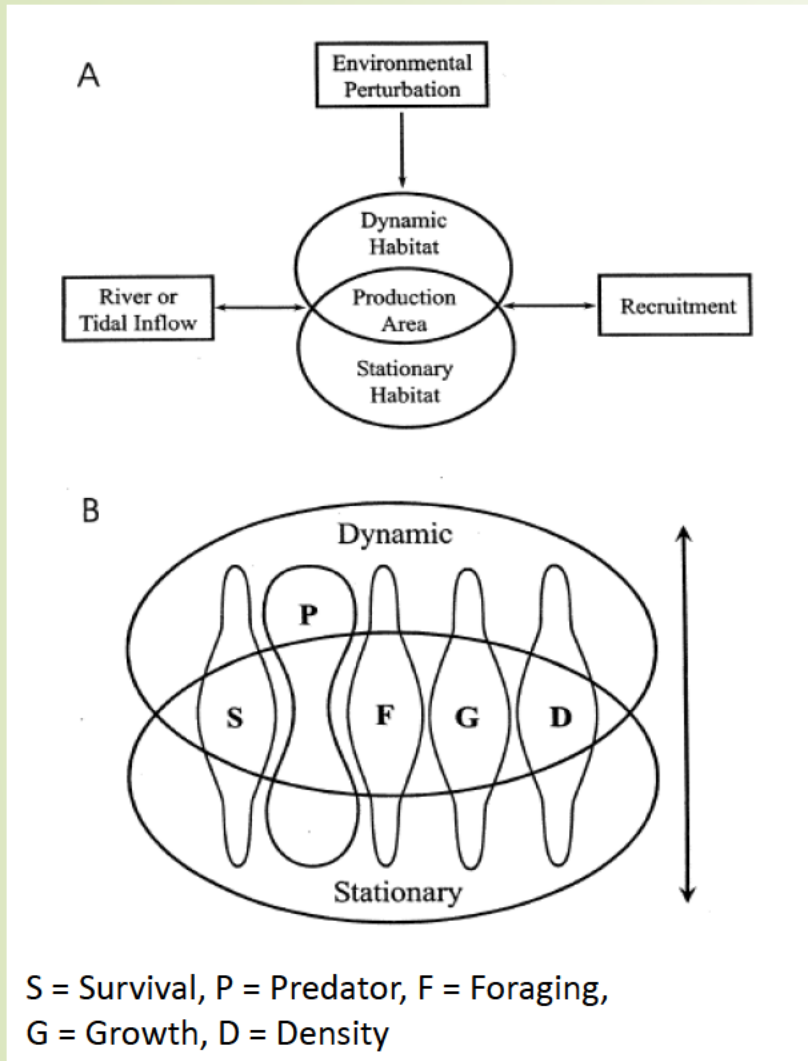
Underlying conceptual model



Spring

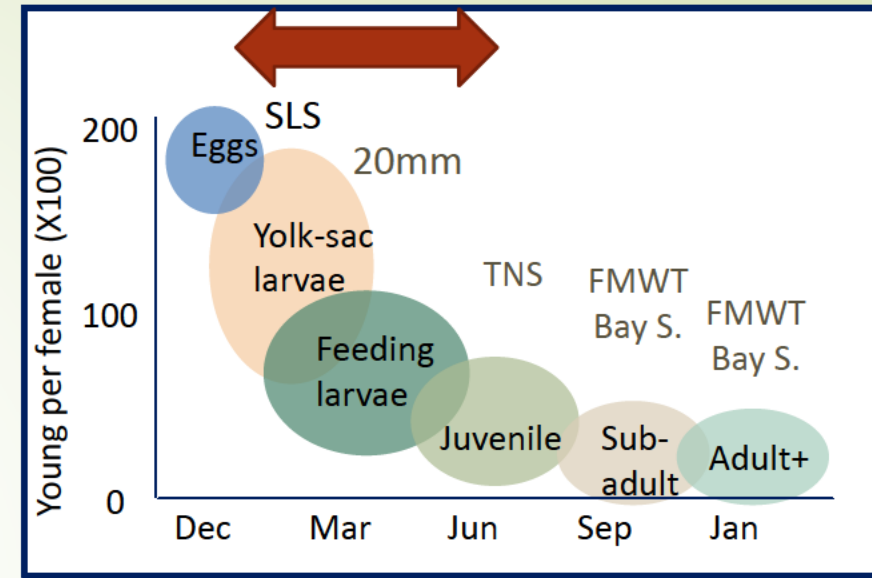


Fall



Peterson 2003

1. CDFW Monitoring Data

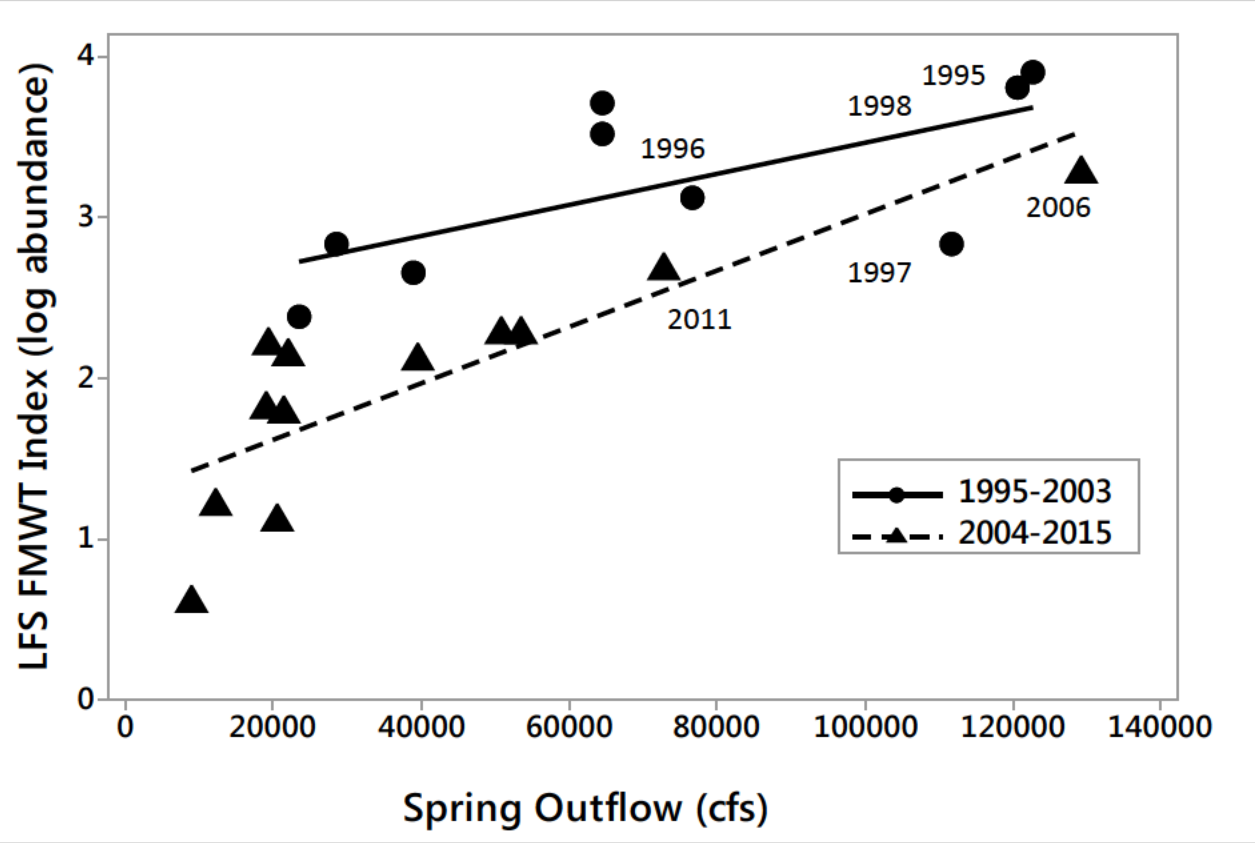


2. Tidal Marsh Study

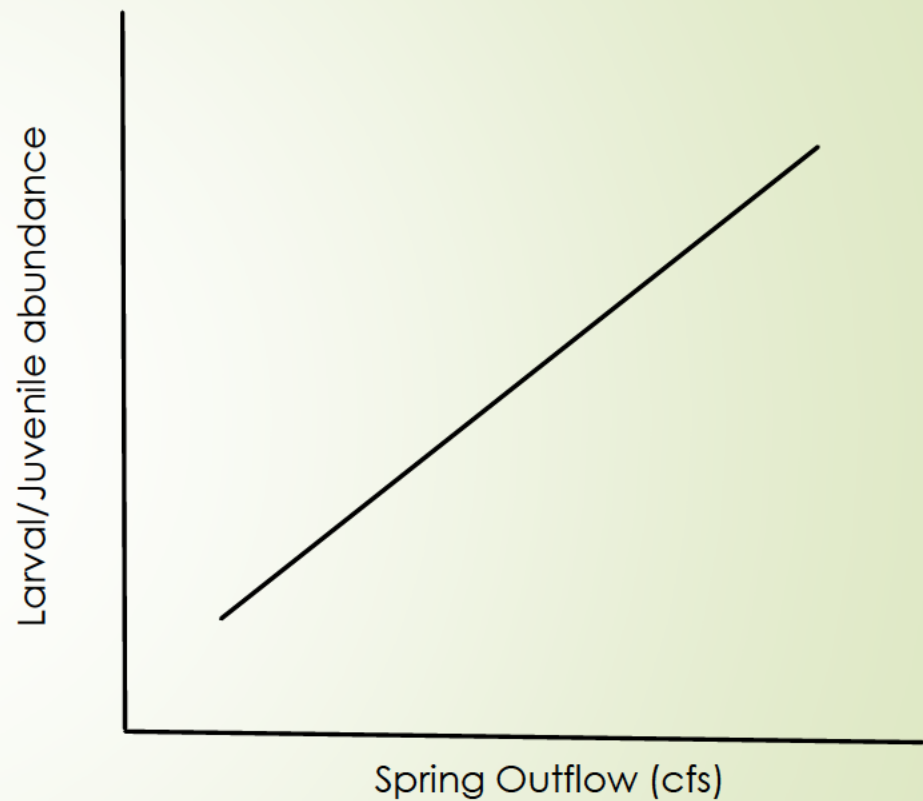


Relationships between flow and larval/juvenile abundance

Fall Abundance vs Spring Outflow

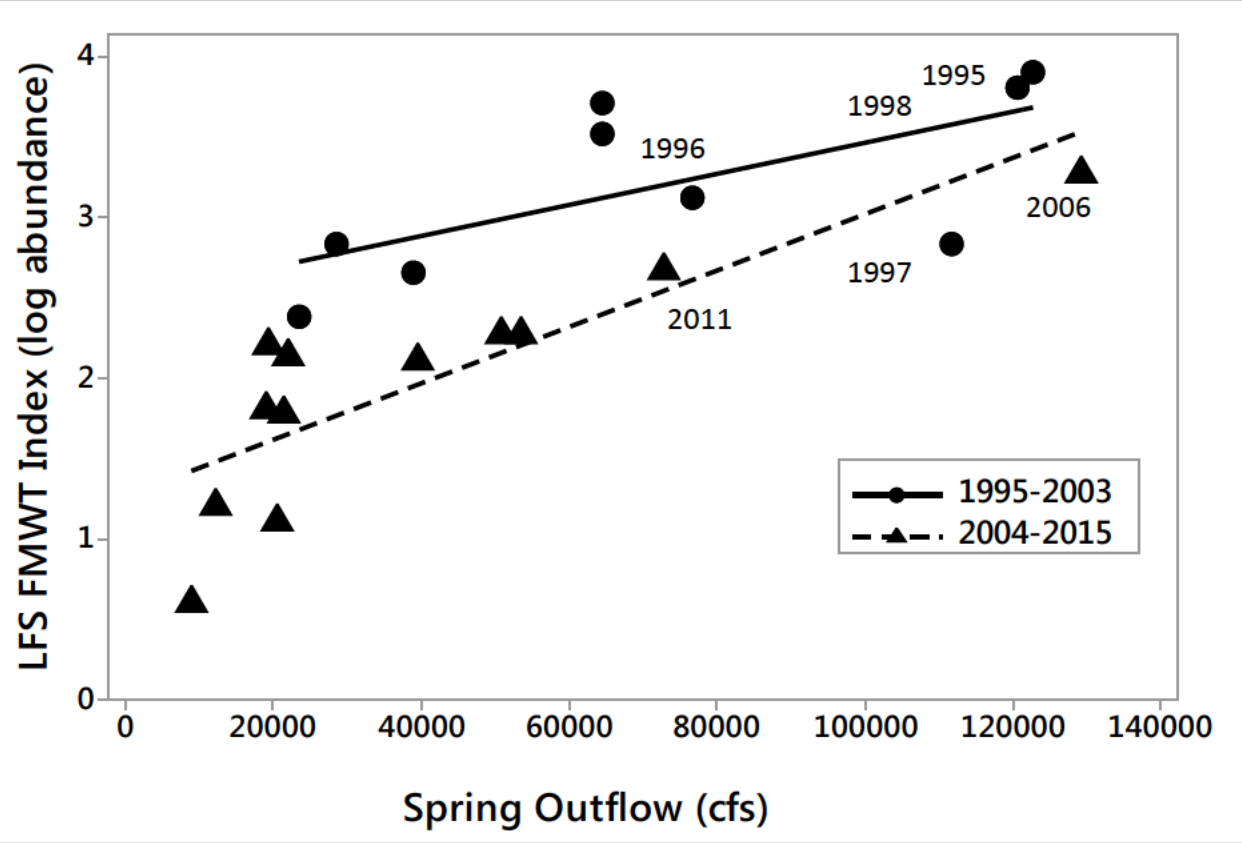


Hypothesis

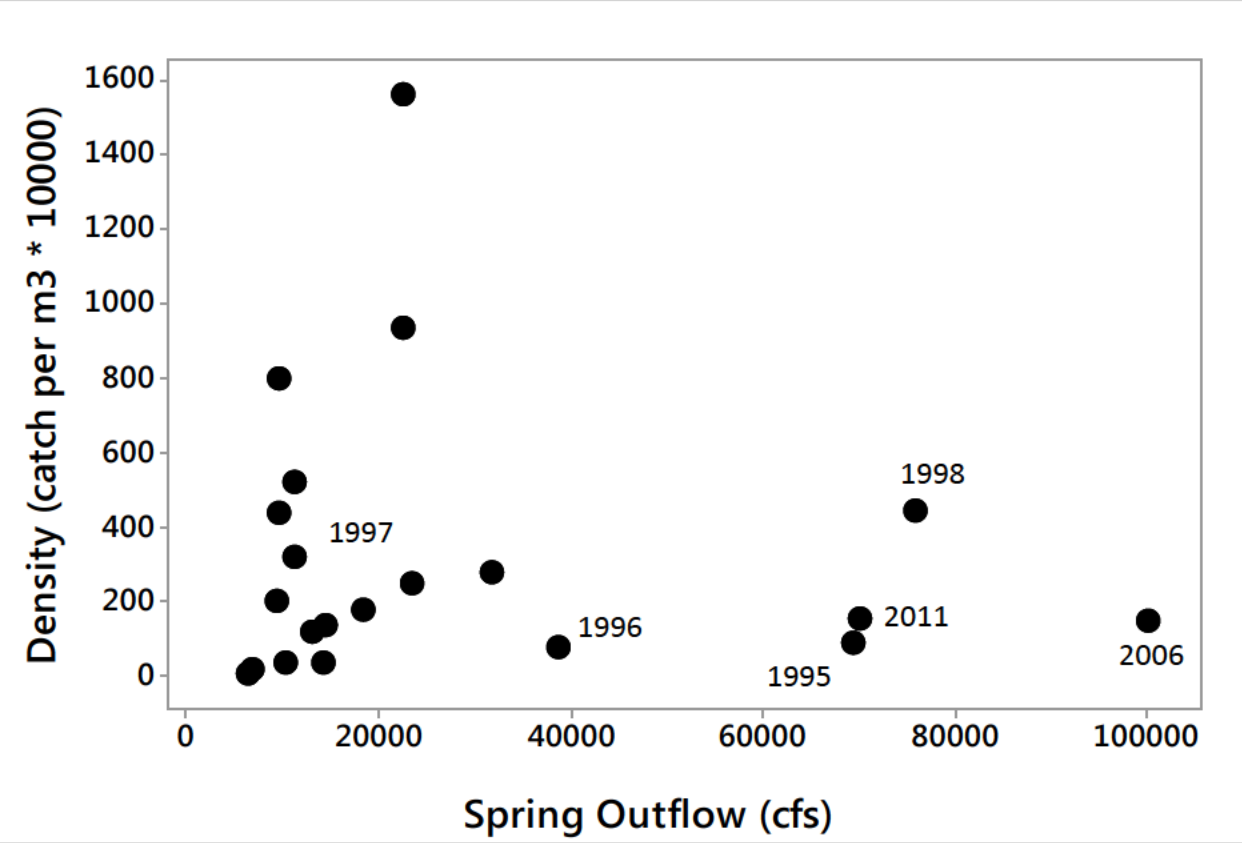


Relationships between flow and larval/juvenile abundance

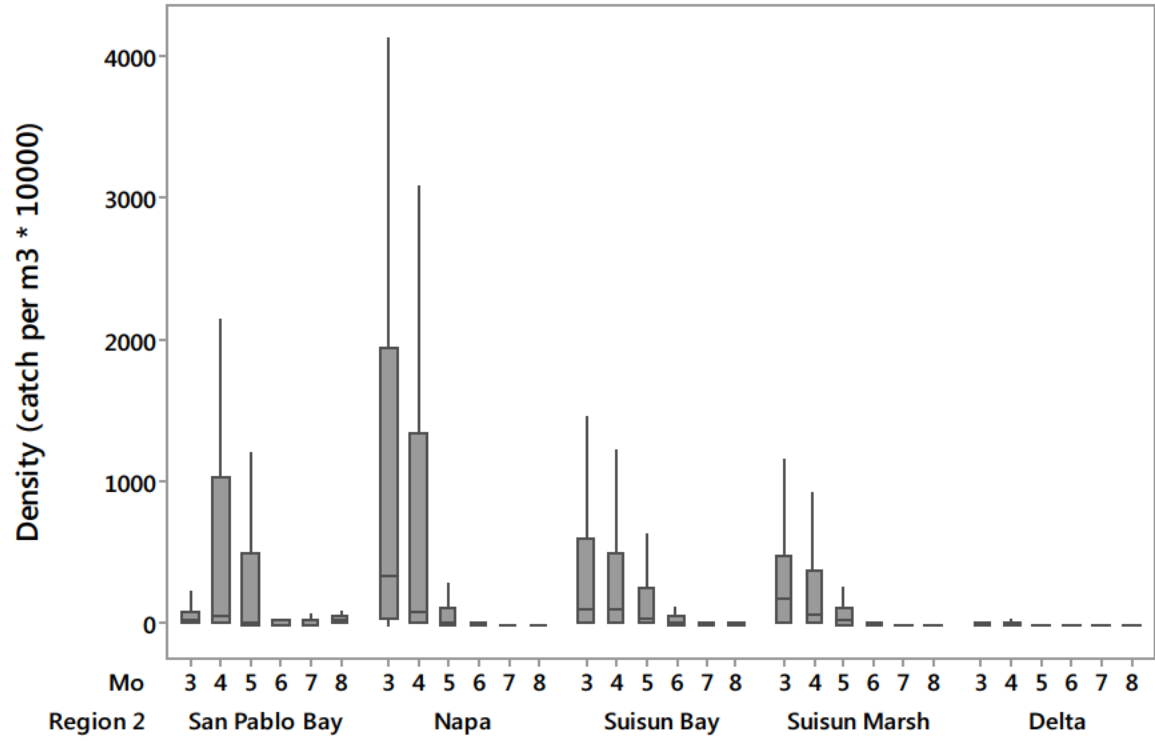
Fall Abundance vs Spring Outflow



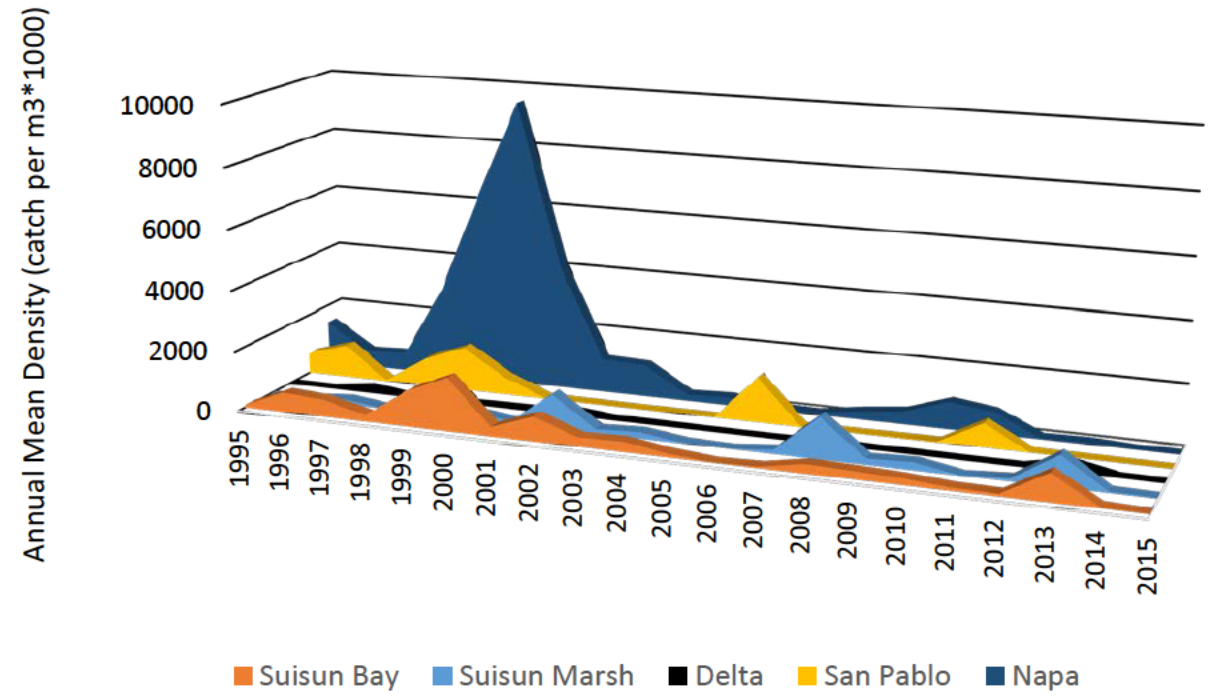
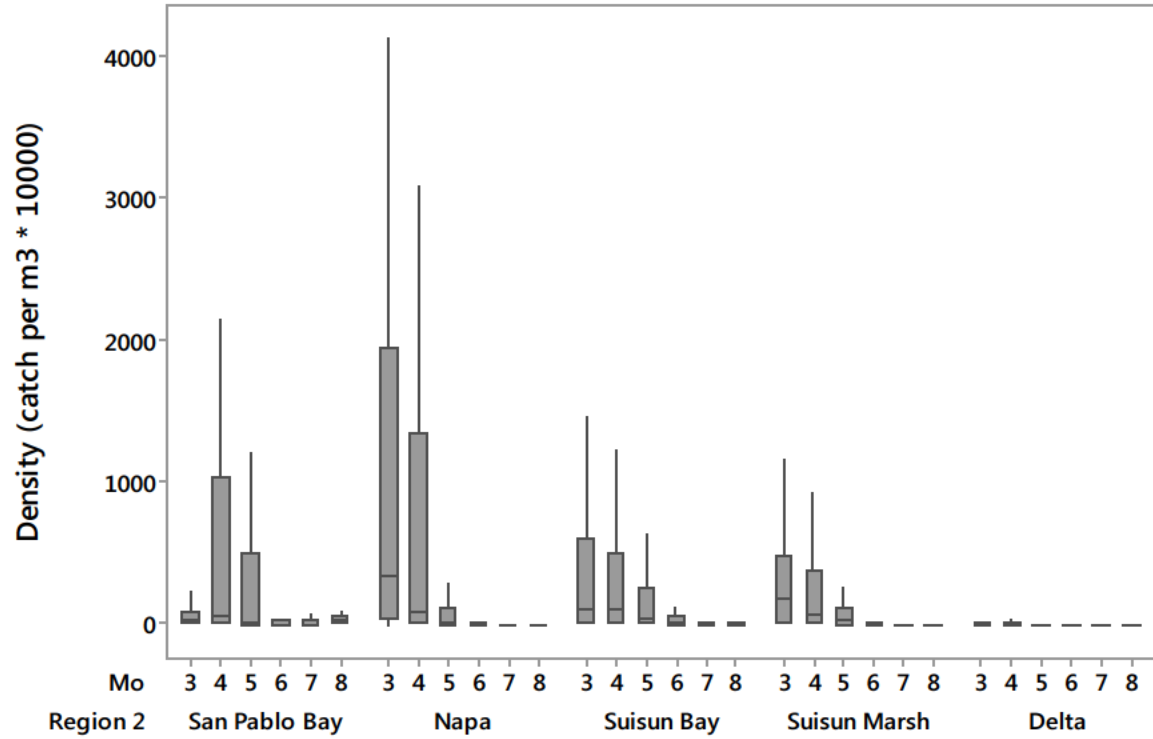
Spring Abundance vs Spring Outflow



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

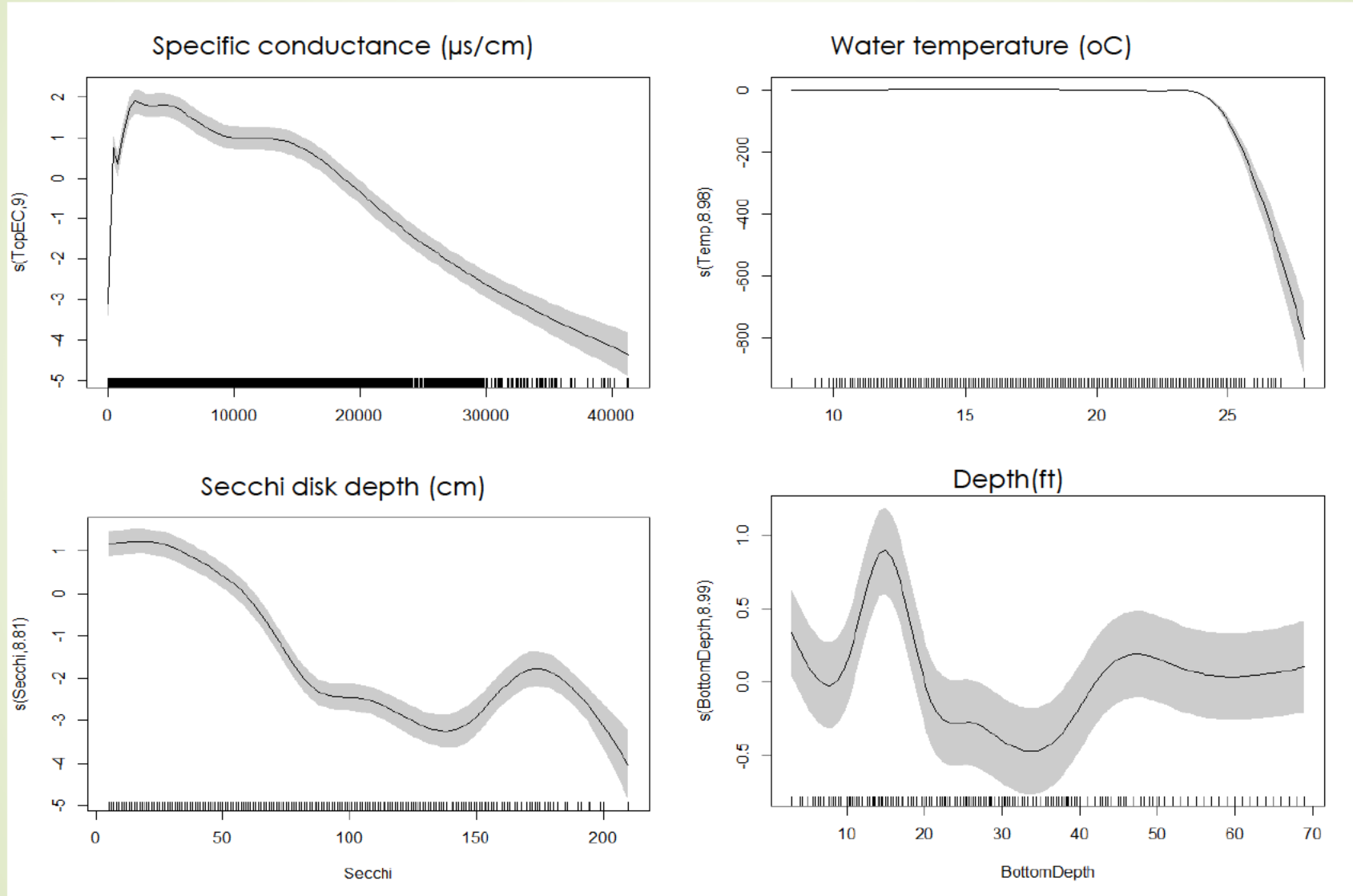


Longfin Smelt Densities By Region 20 mm Survey (1995-2015)



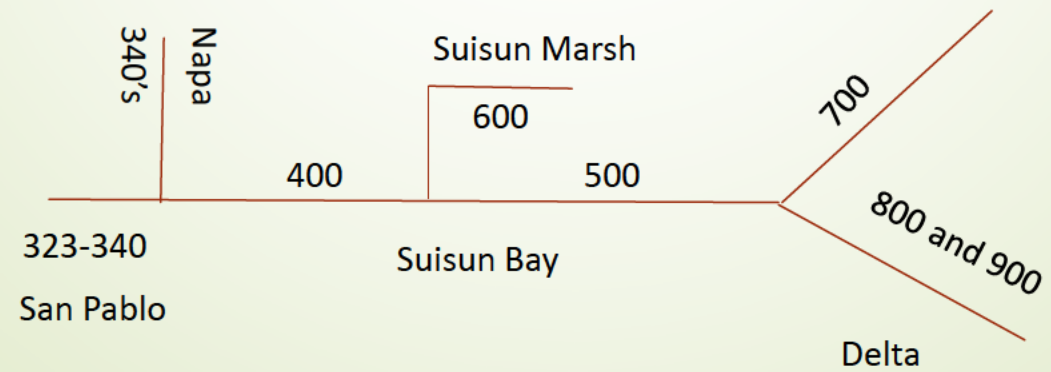
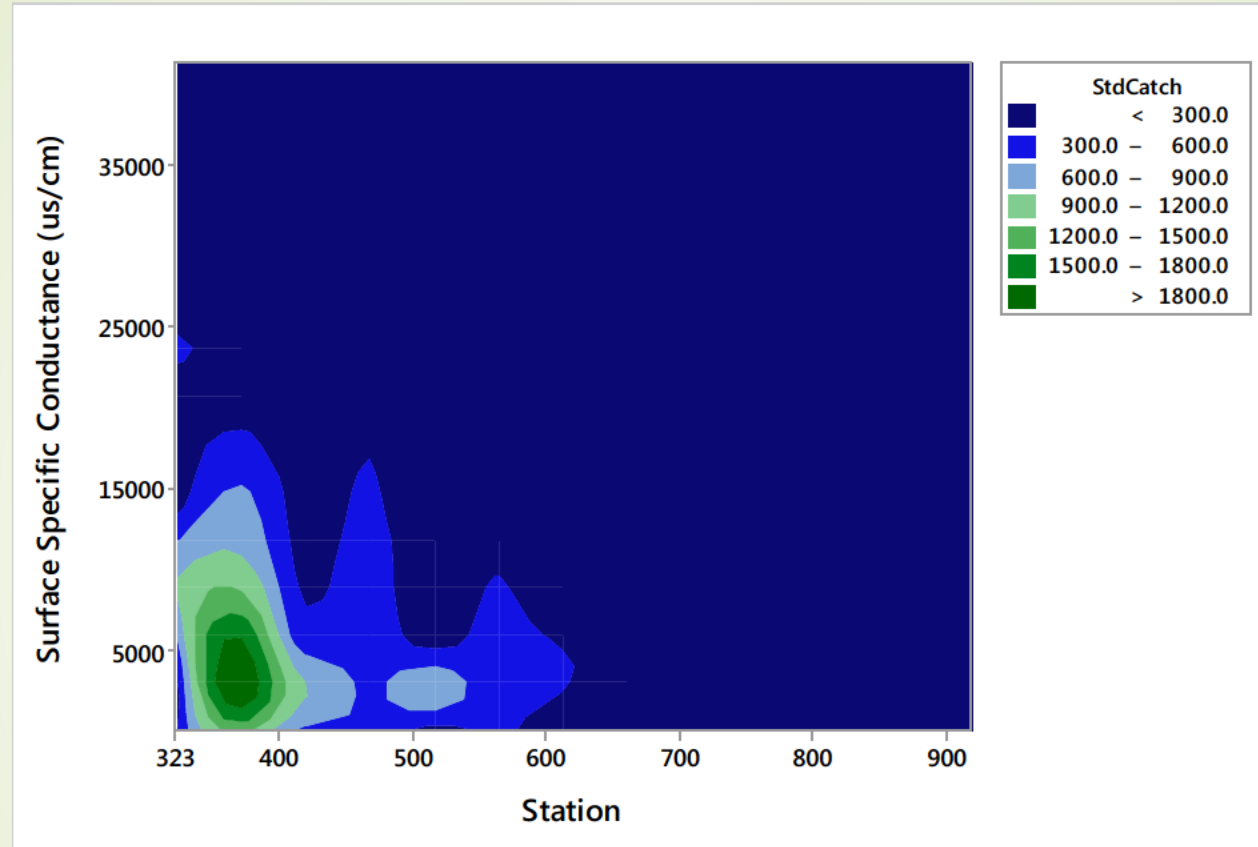
Relationship between Longfin Smelt densities and Environmental Variables

20 mm data (1995-2015)



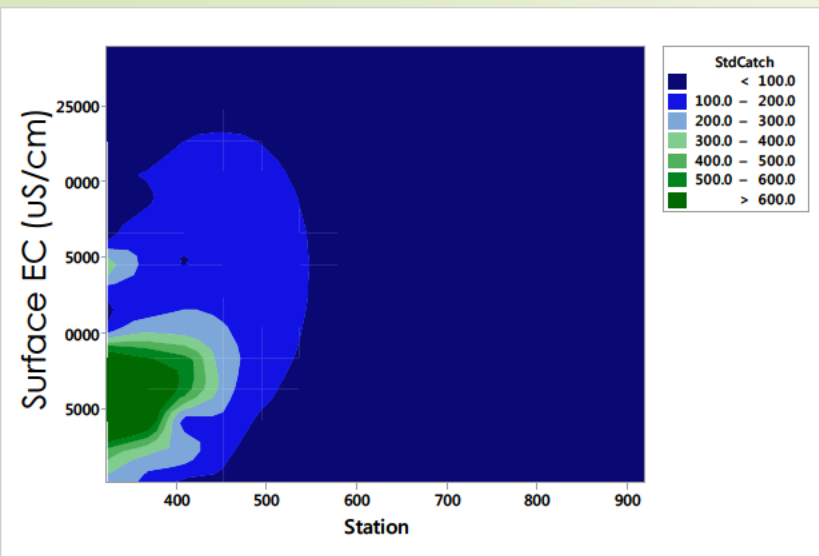
GAM = Count \sim sTemp+ Year + sSecchi,+ s(SurfaceEC)+ s(BottomDepth), offset=log(volume), family=poisson(link=log))

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

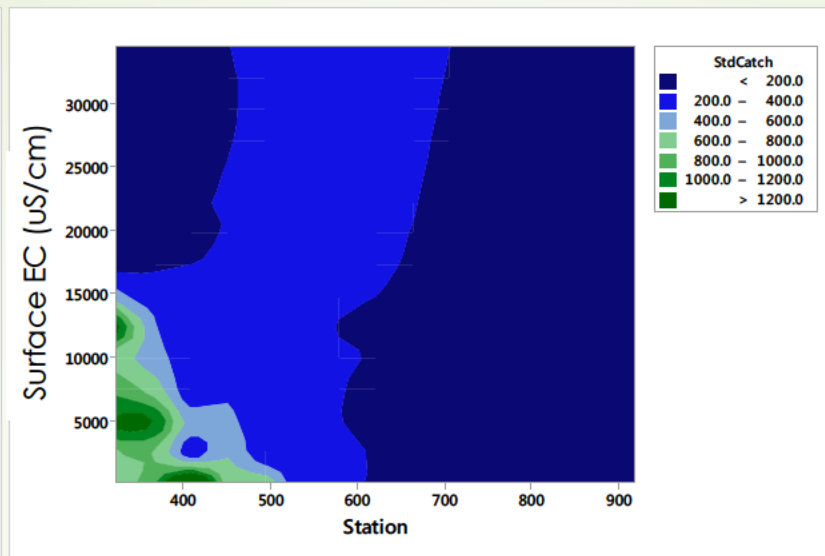


Standardized Longfin Smelt Catch Contours by Station and EC

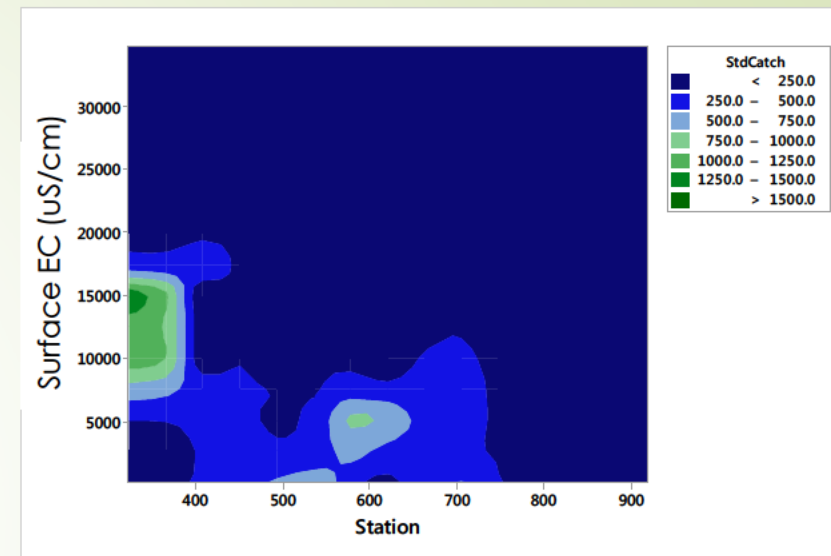
1995



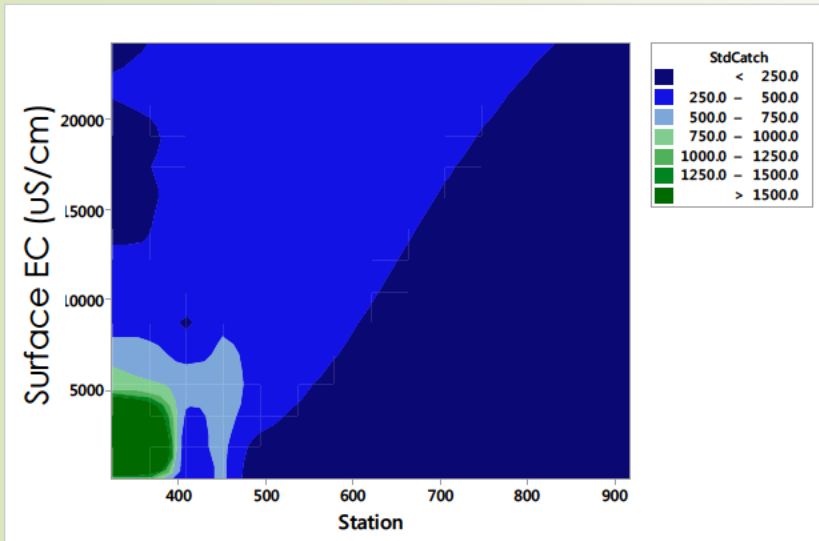
1996



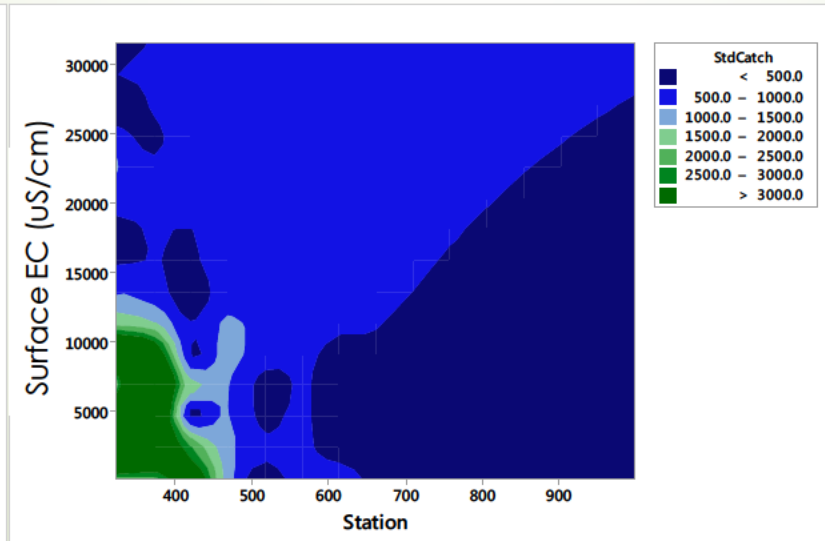
1997



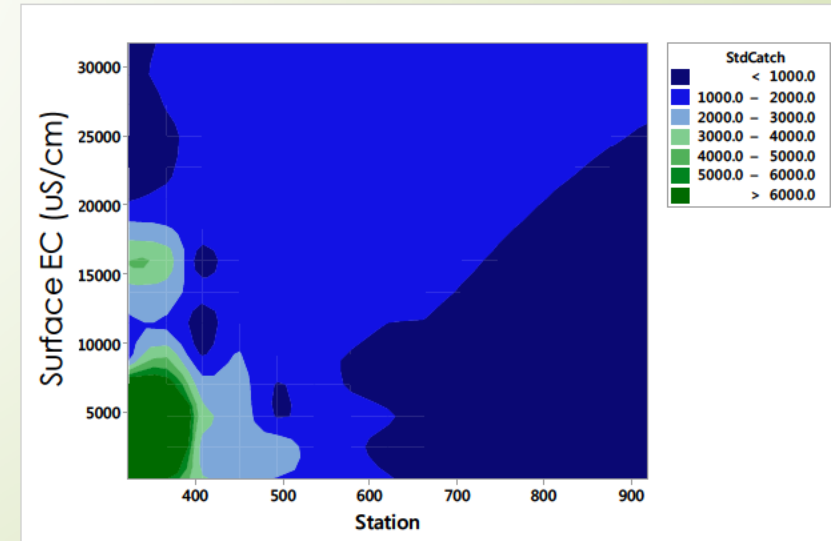
1998



1999

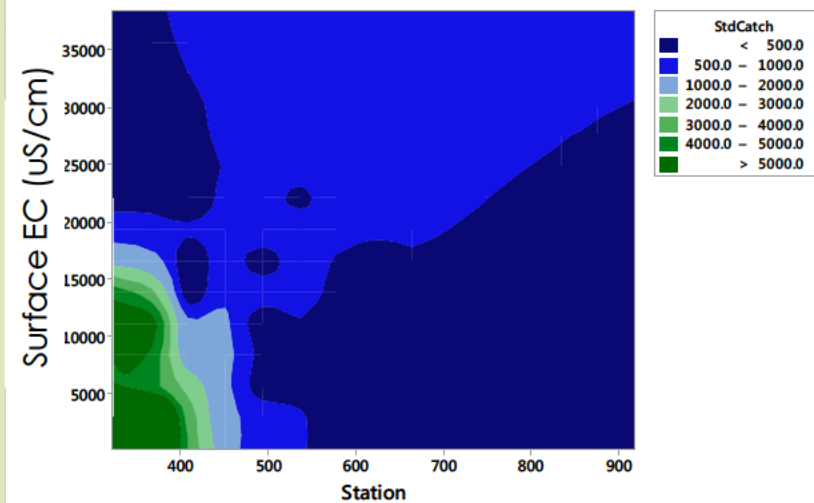


2000

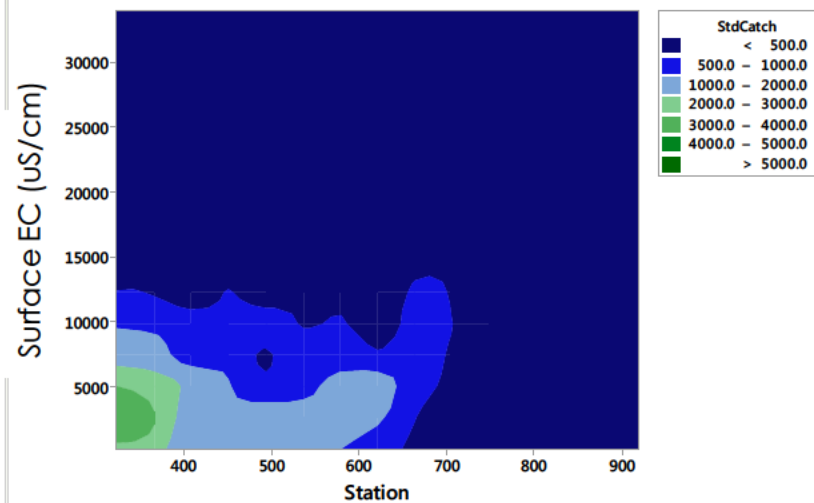


Standardized Longfin Smelt Catch Contours by Station and EC

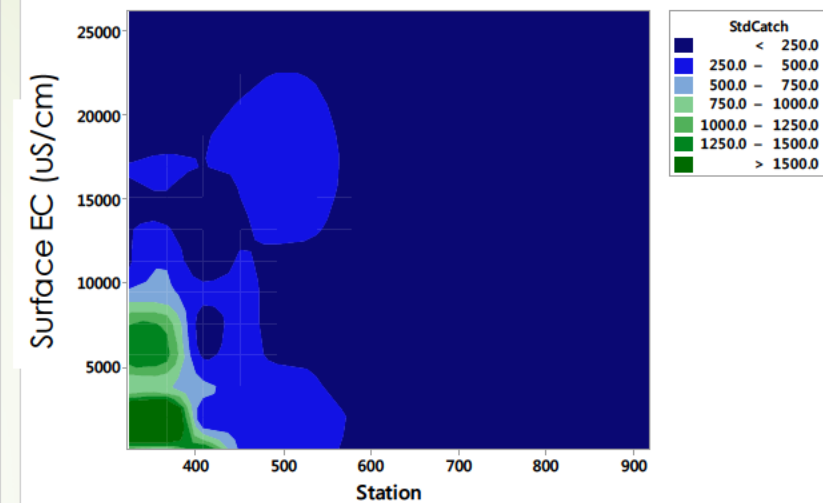
2001



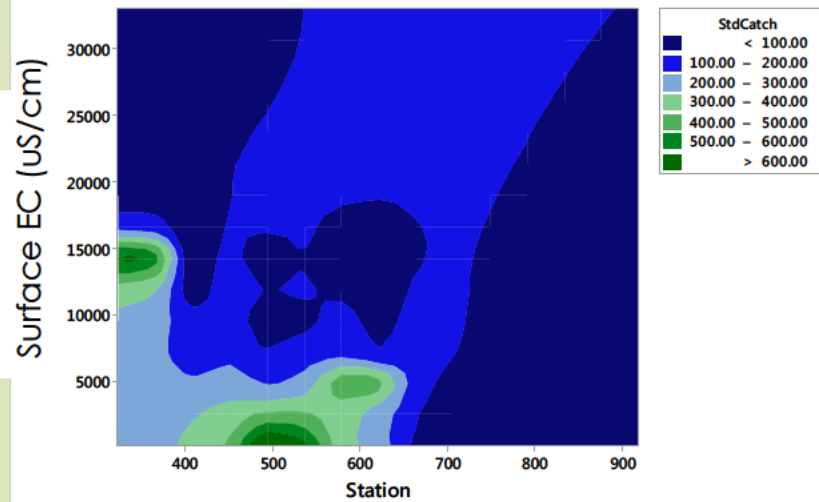
2002



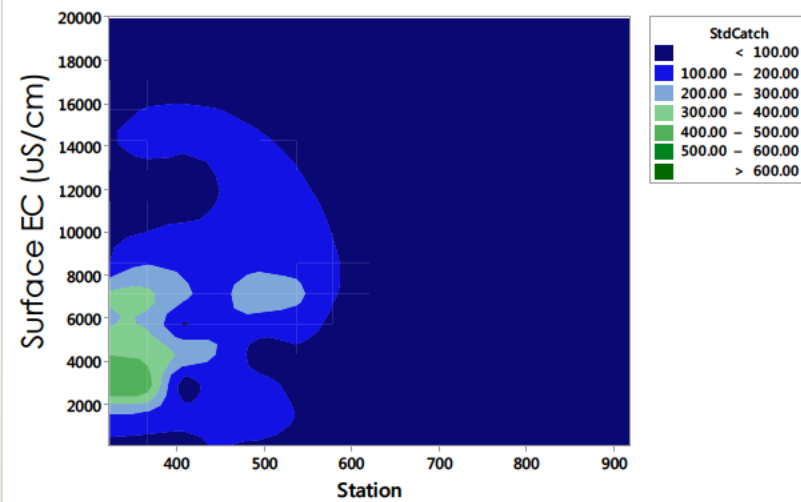
2003



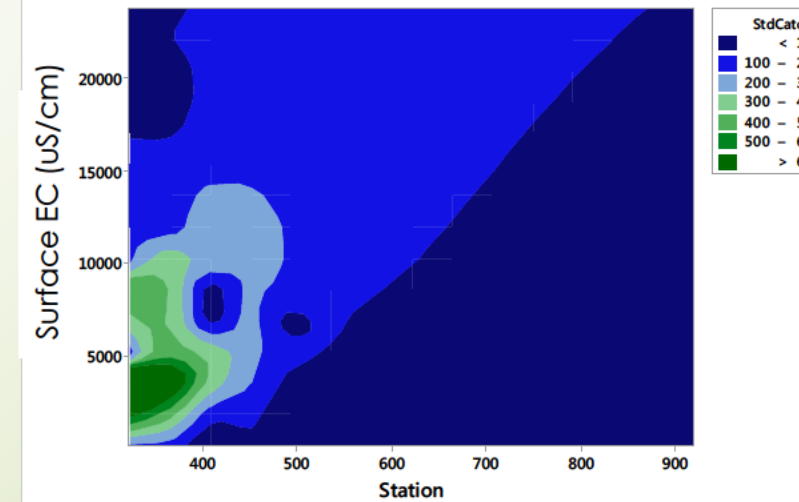
2004



2005

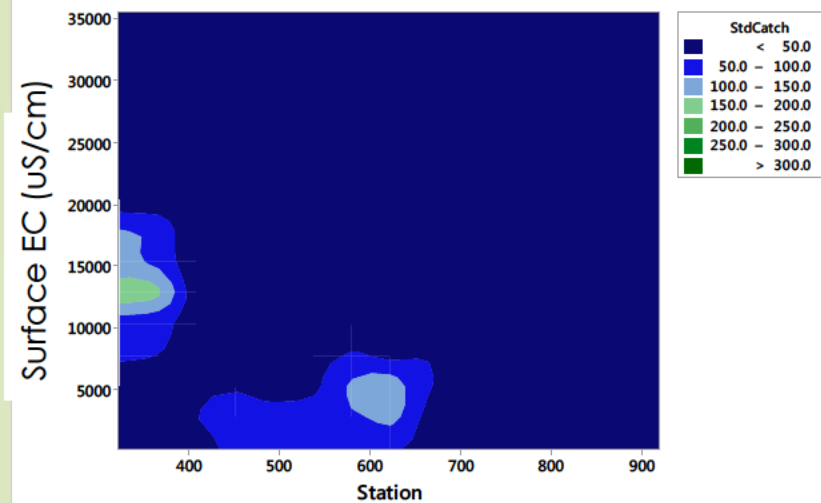


2006

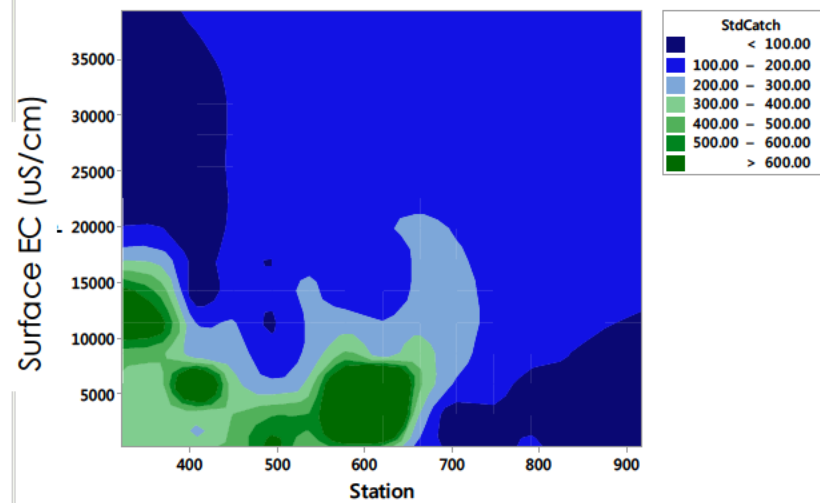


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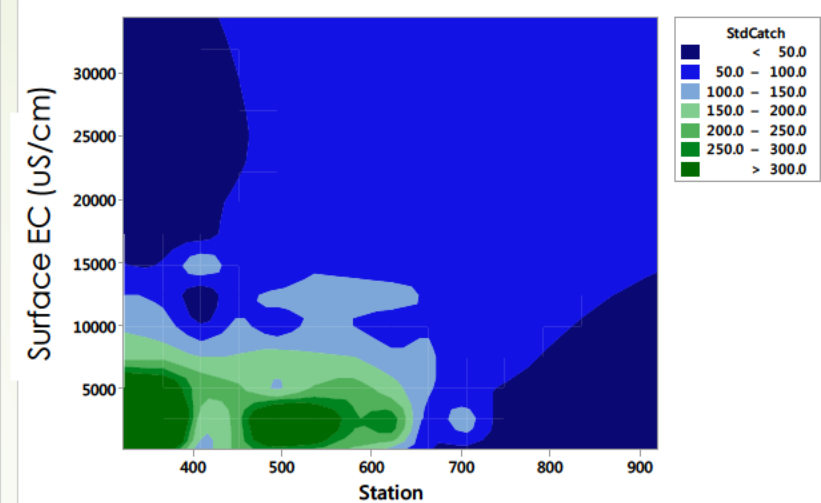
2007



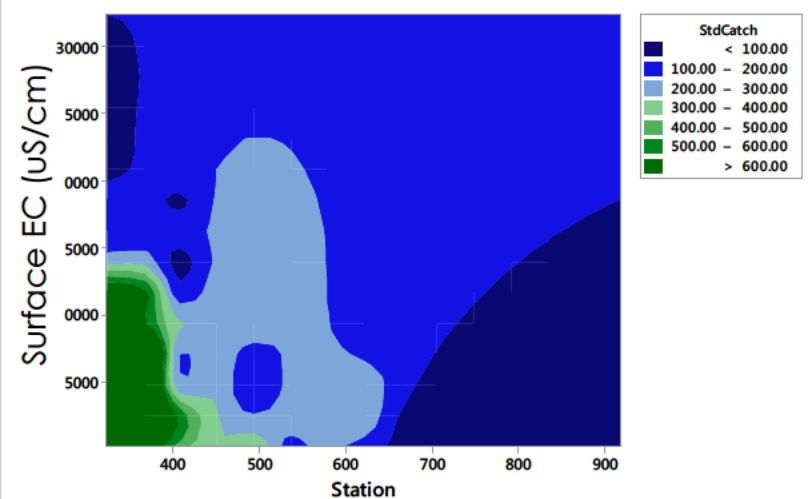
2008



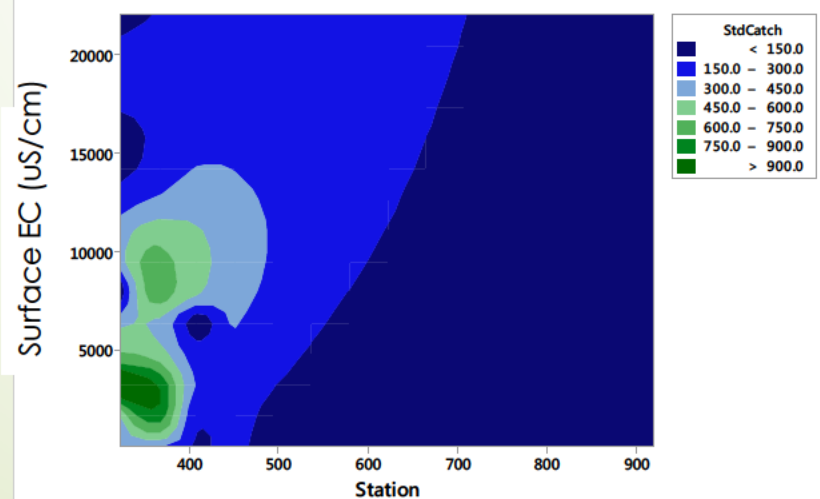
2009



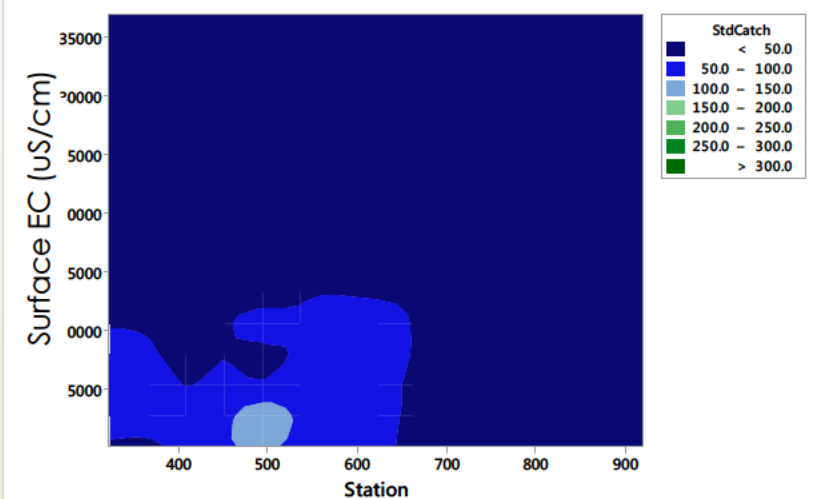
2010



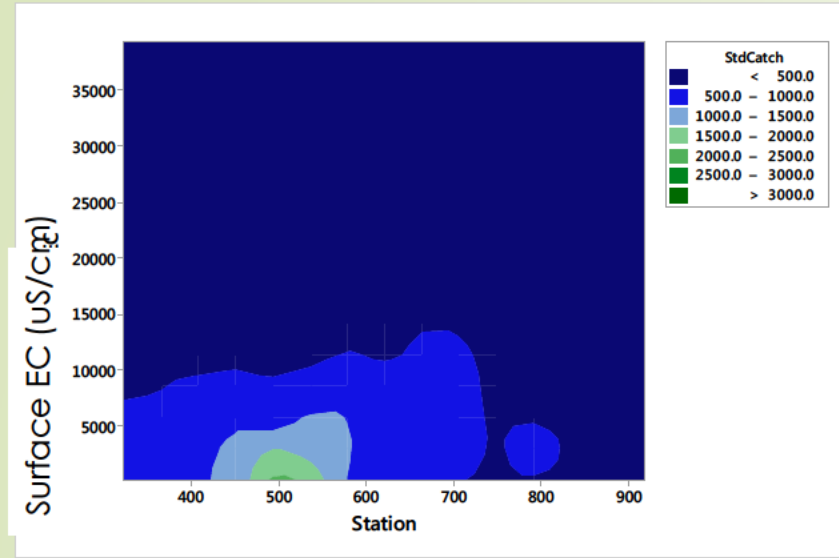
2011



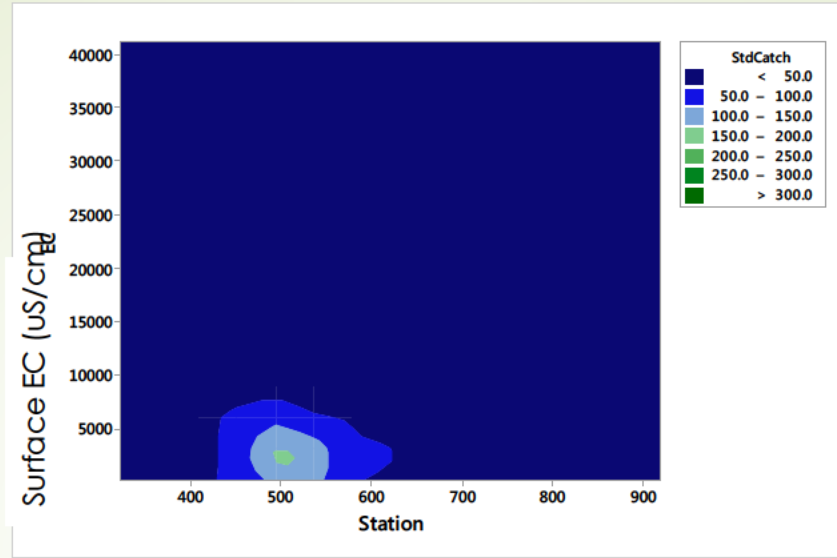
2012



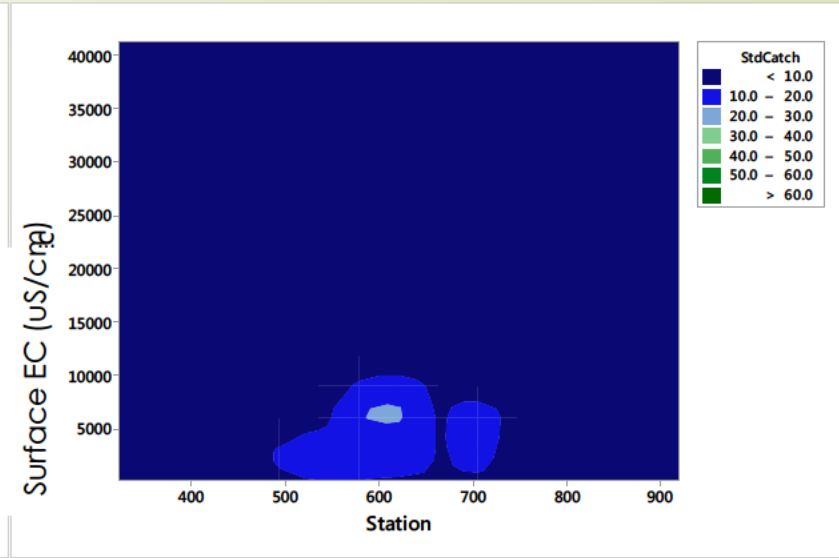
2013



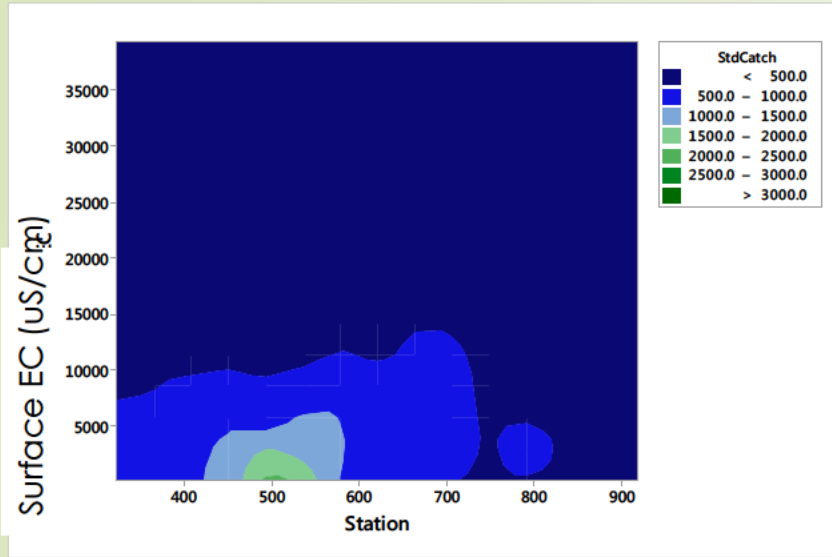
2014



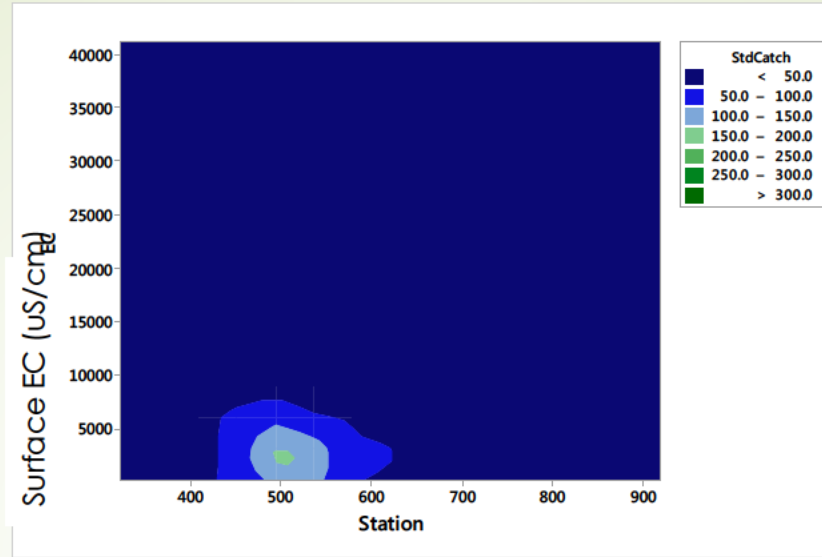
2015



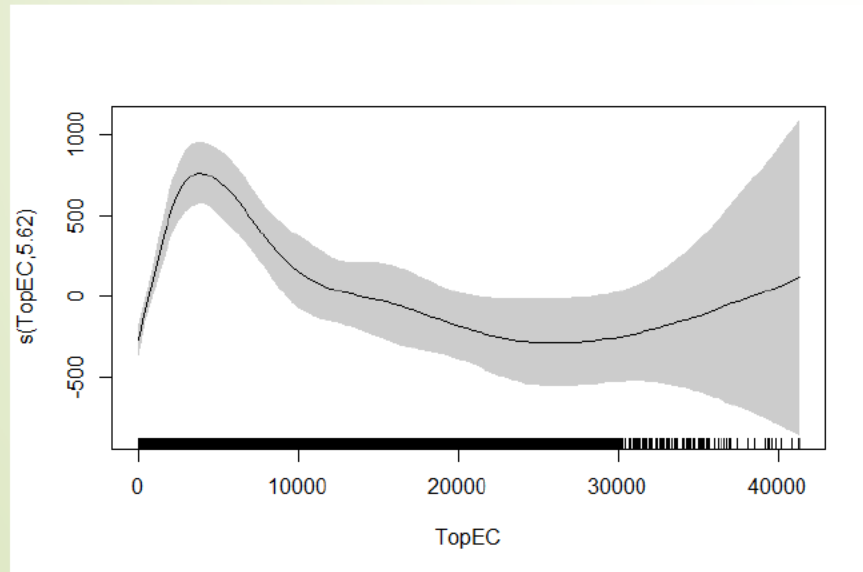
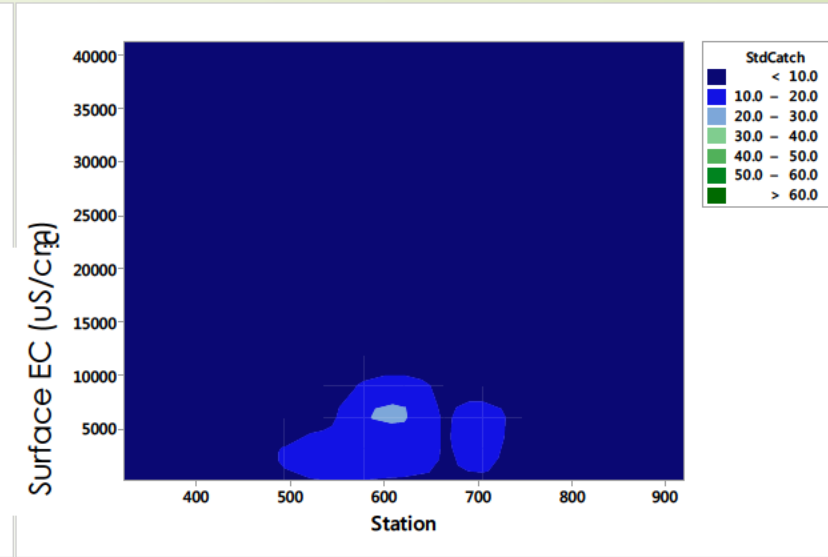
2013



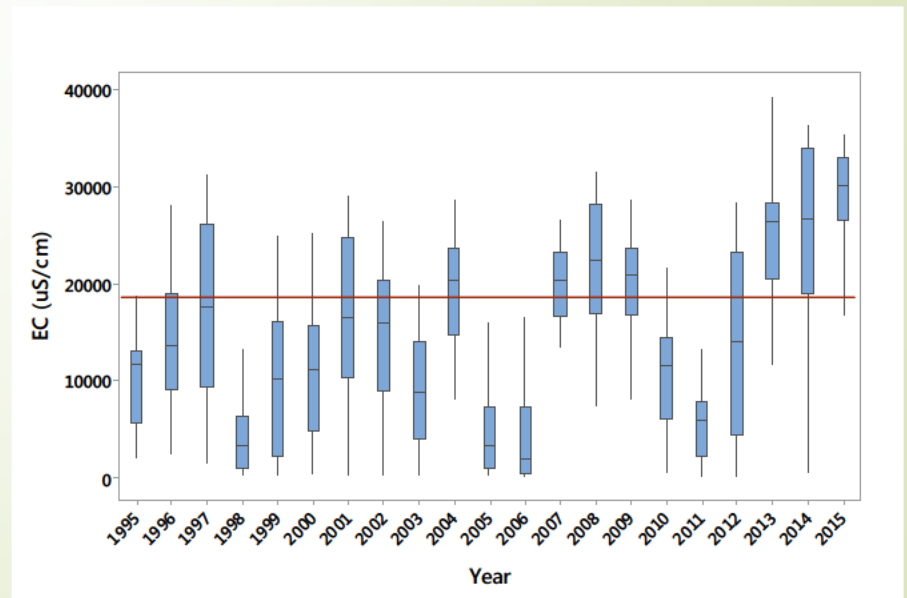
2014



2015



Napa River Specific conductance (us/cm)



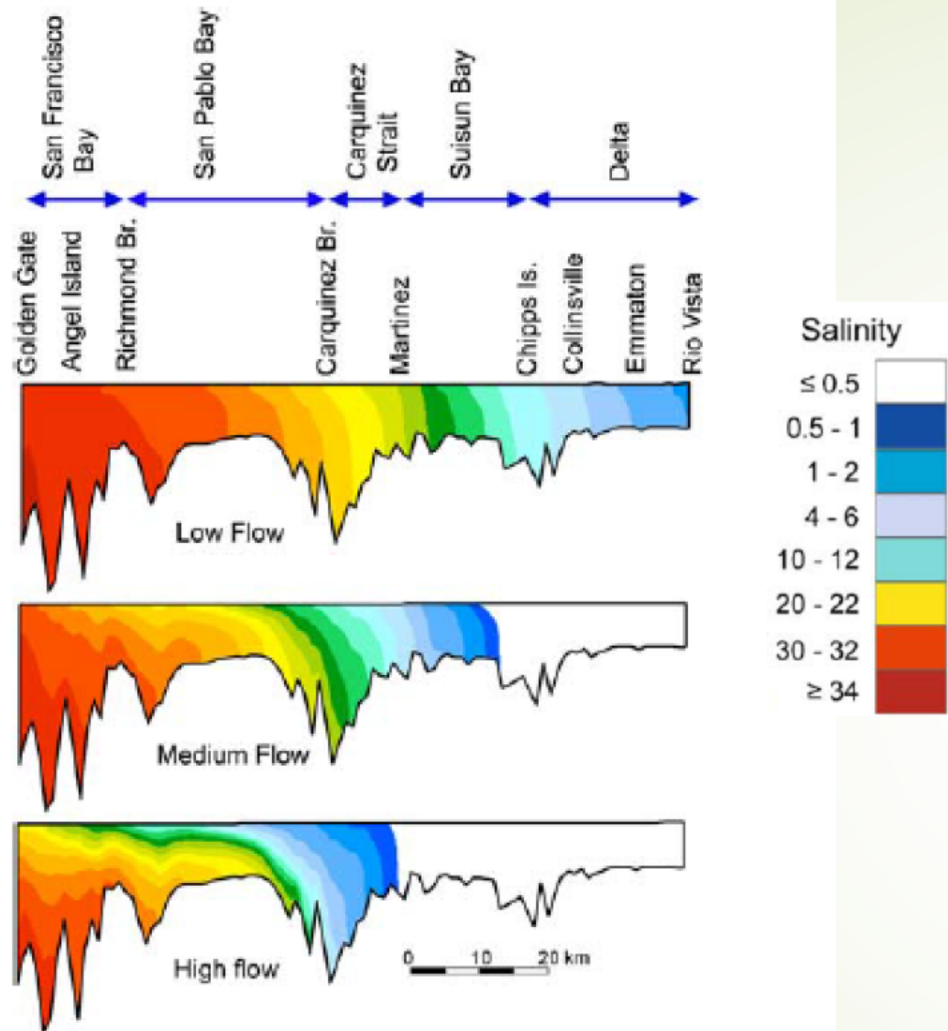


Fig. 6 TRIM3D model output. Tidally averaged salinity along the transect of the main channel from Golden Gate to Rio Vista (river kilometer 100). Locations identified by heavy lines in Fig. 1 and estuarine basins are listed at the top. Model output is given for net Delta outflows of (top to bottom) 110,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

POTENTIAL MECHANISMS

Increased spawning and rearing habitat-

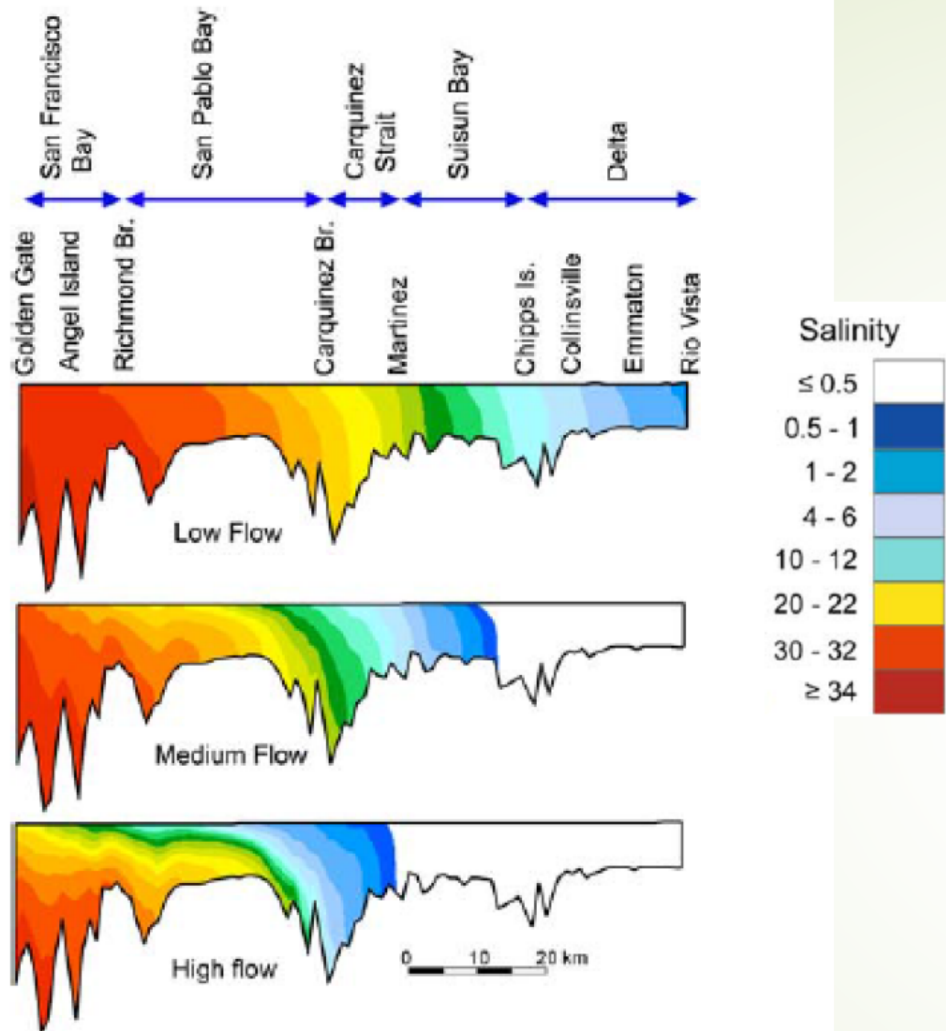
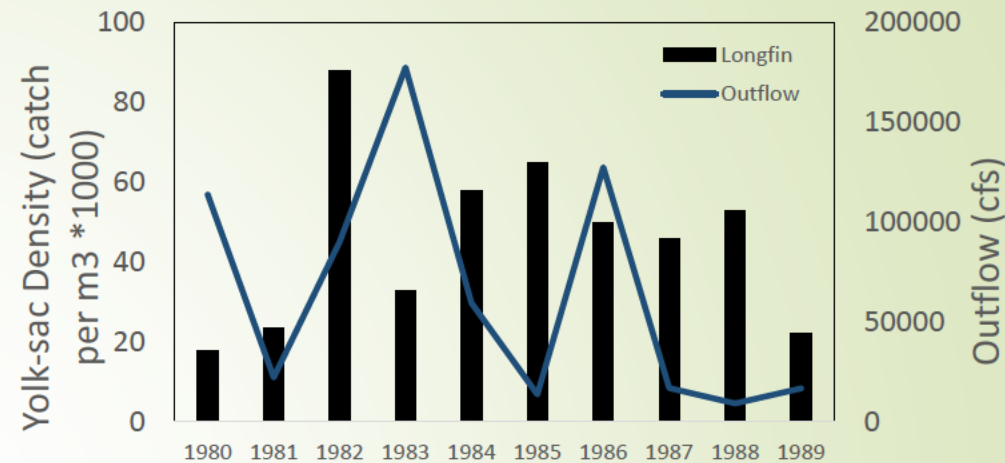
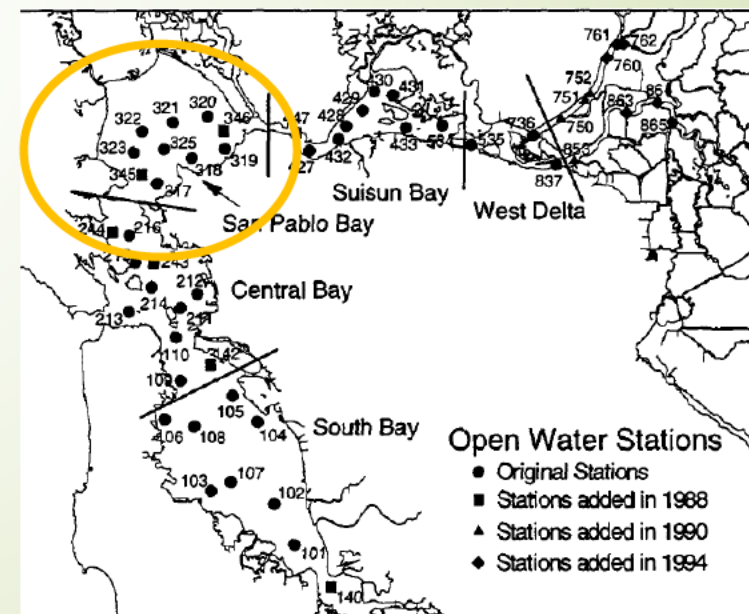


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Kimmerer et al. 2009



Bay Survey E and L Data



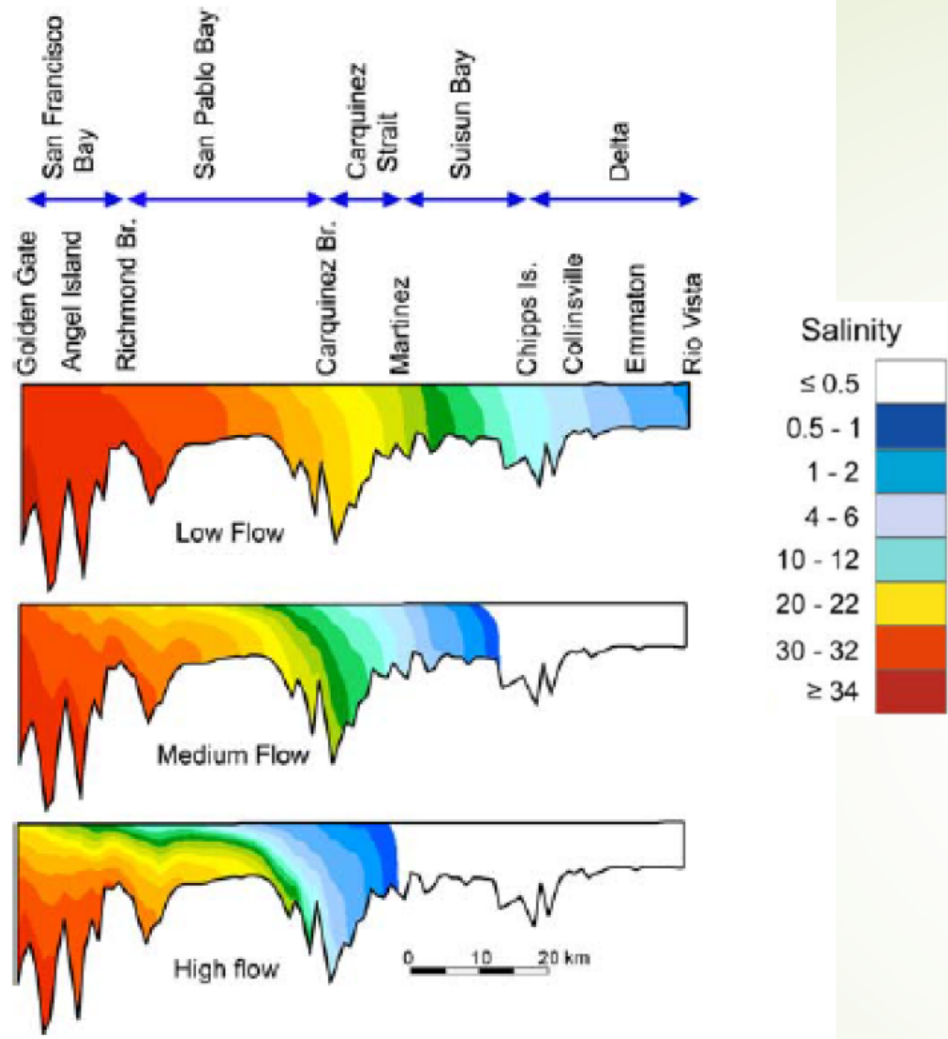
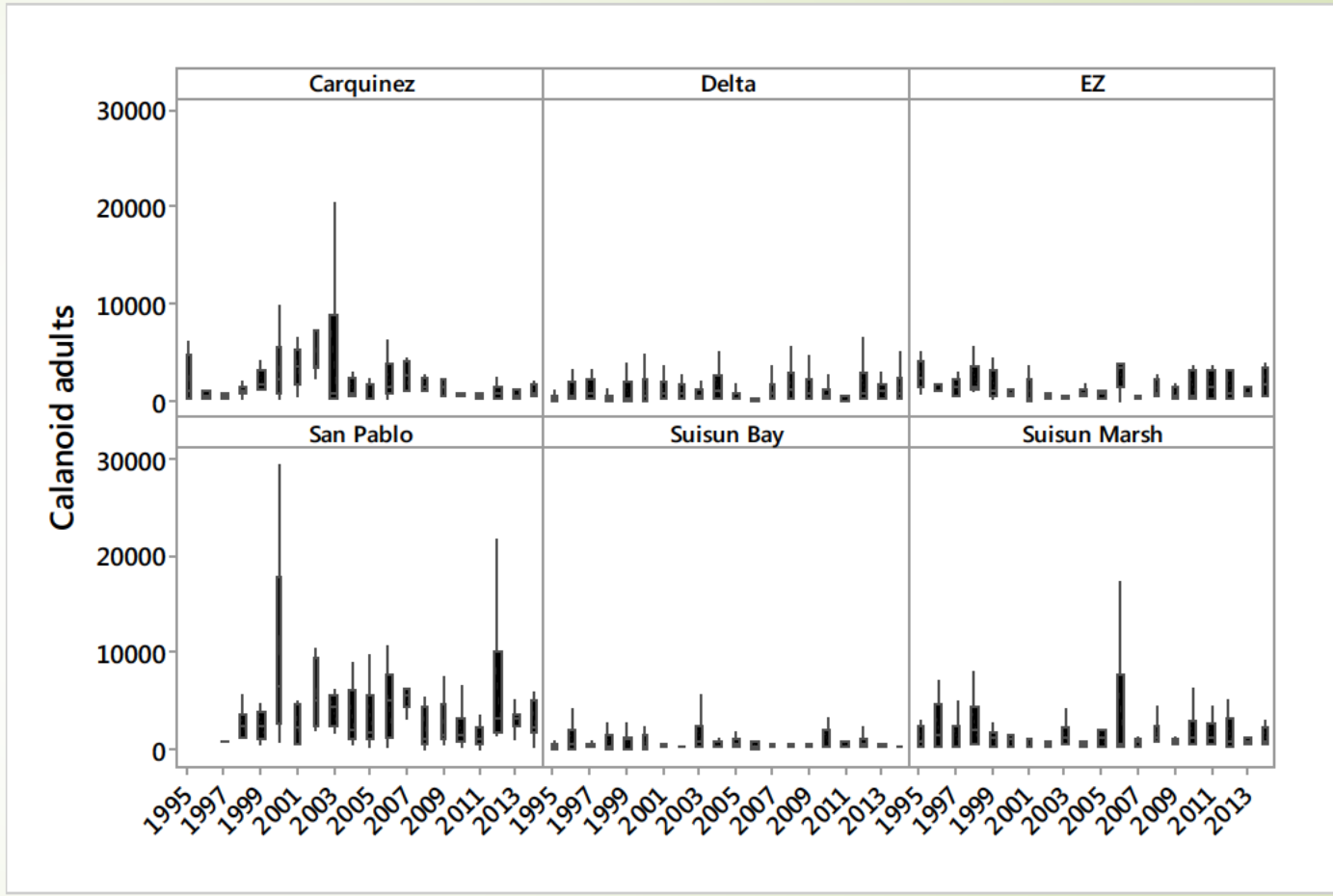


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Kimmerer et al. 2009

Food-

Zooplankton abundance by region



DWR EMP-
Mar-June (1995-2014)

Food-

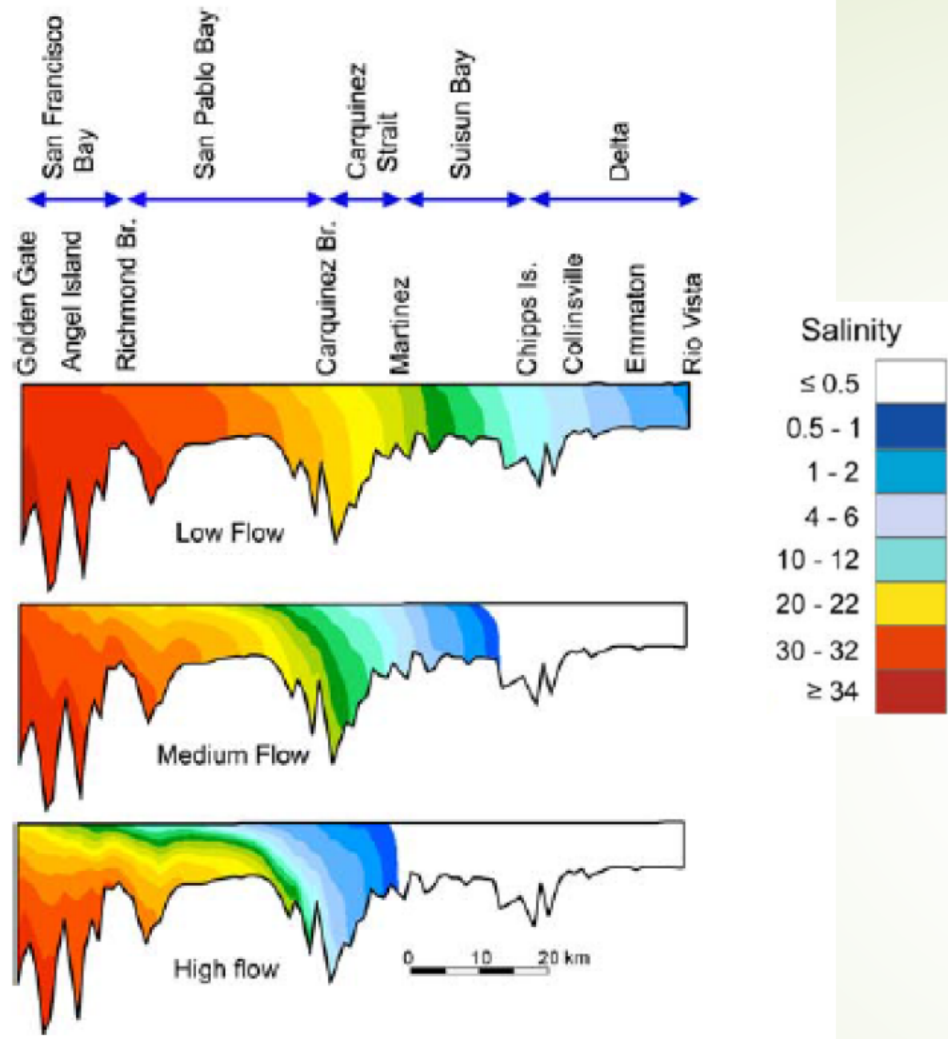
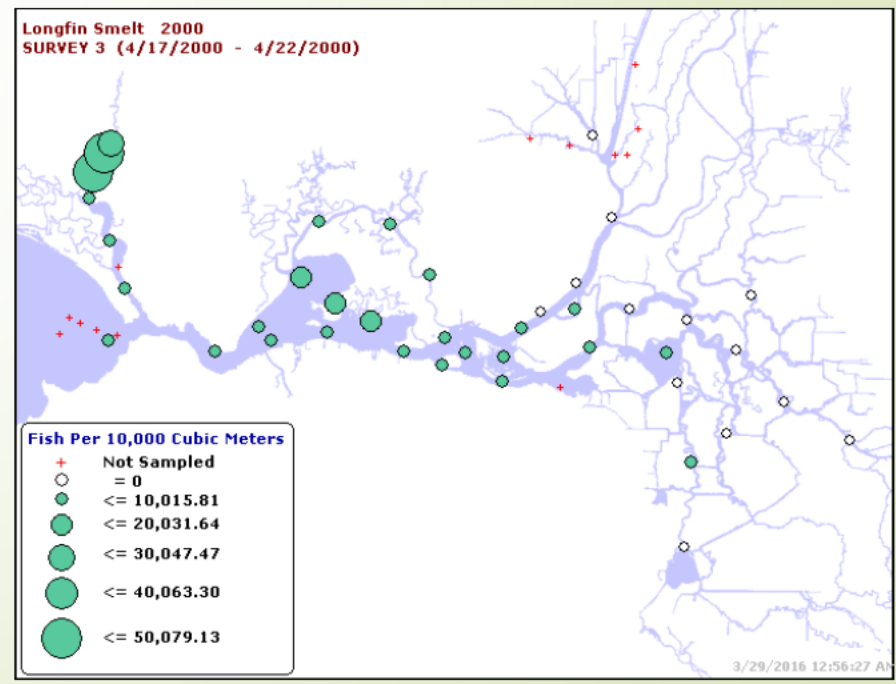
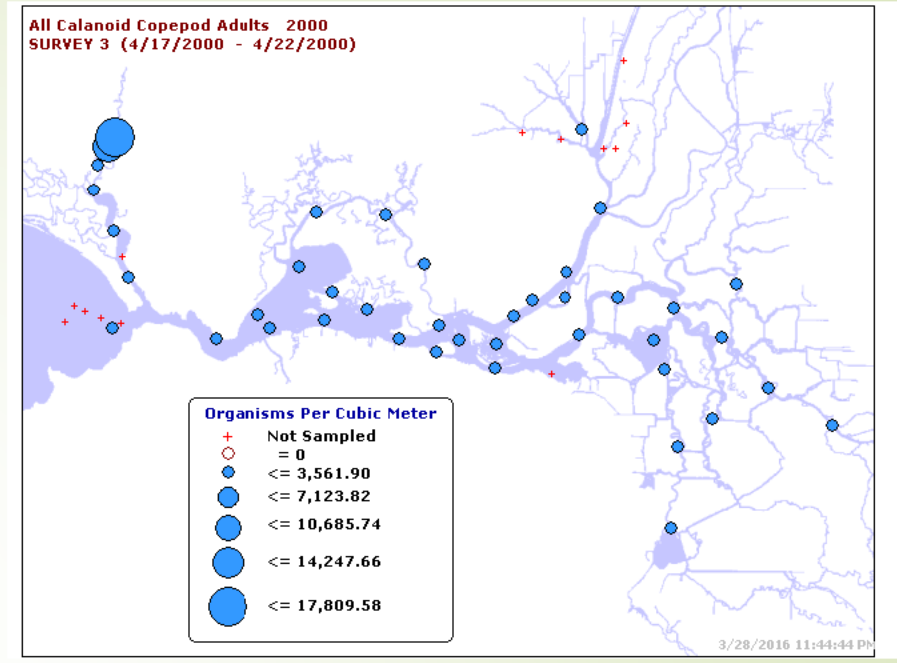


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Tidal Marsh Study



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



Sampled all sites bimonthly;
Feb-May in 2013 and 2014

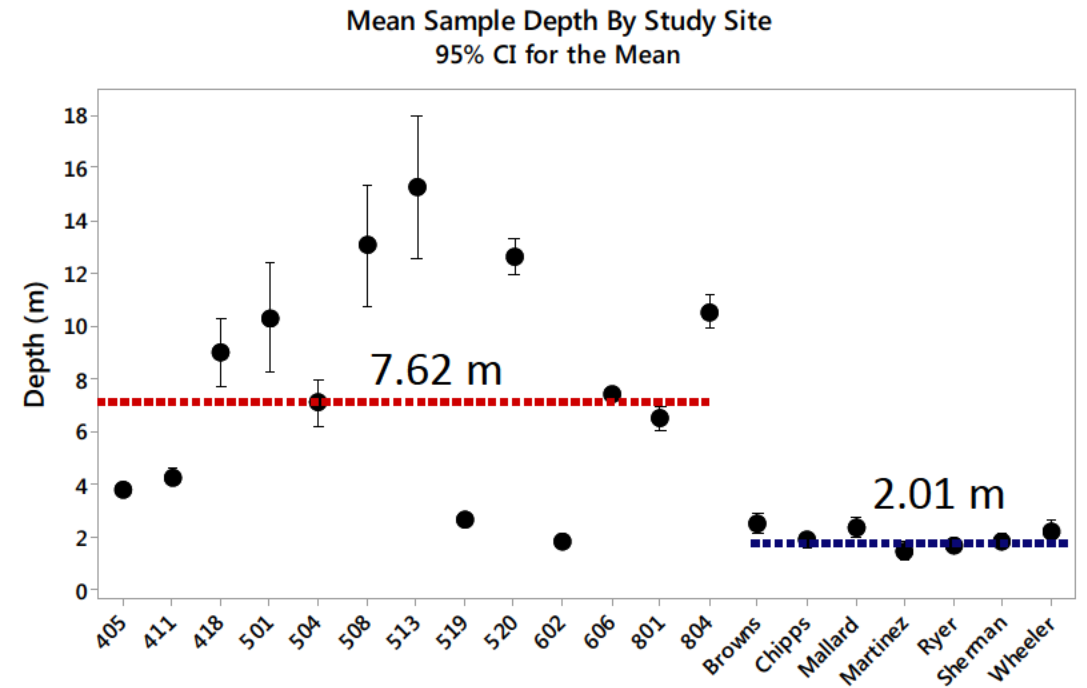
Open water shoals

Tidal Marsh Sloughs

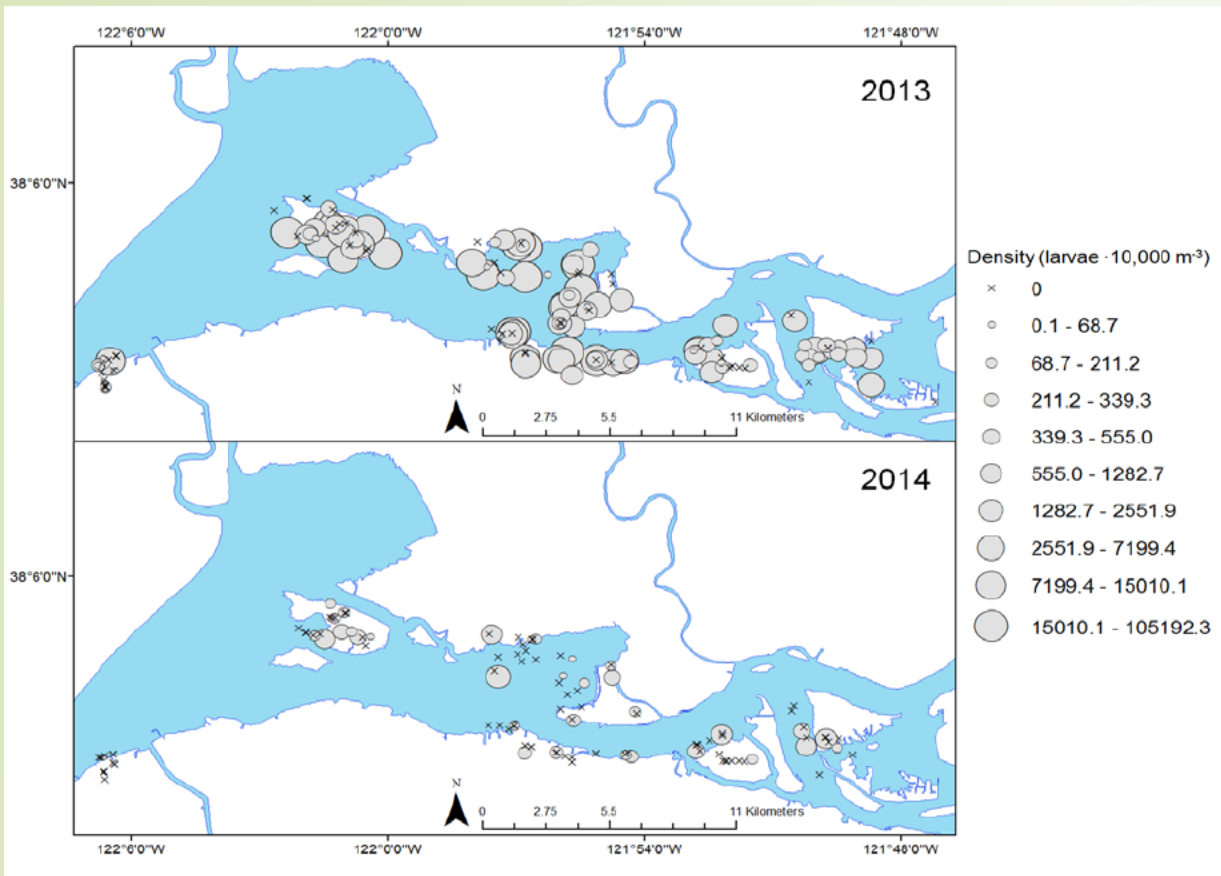
Target depth: 2 m or less



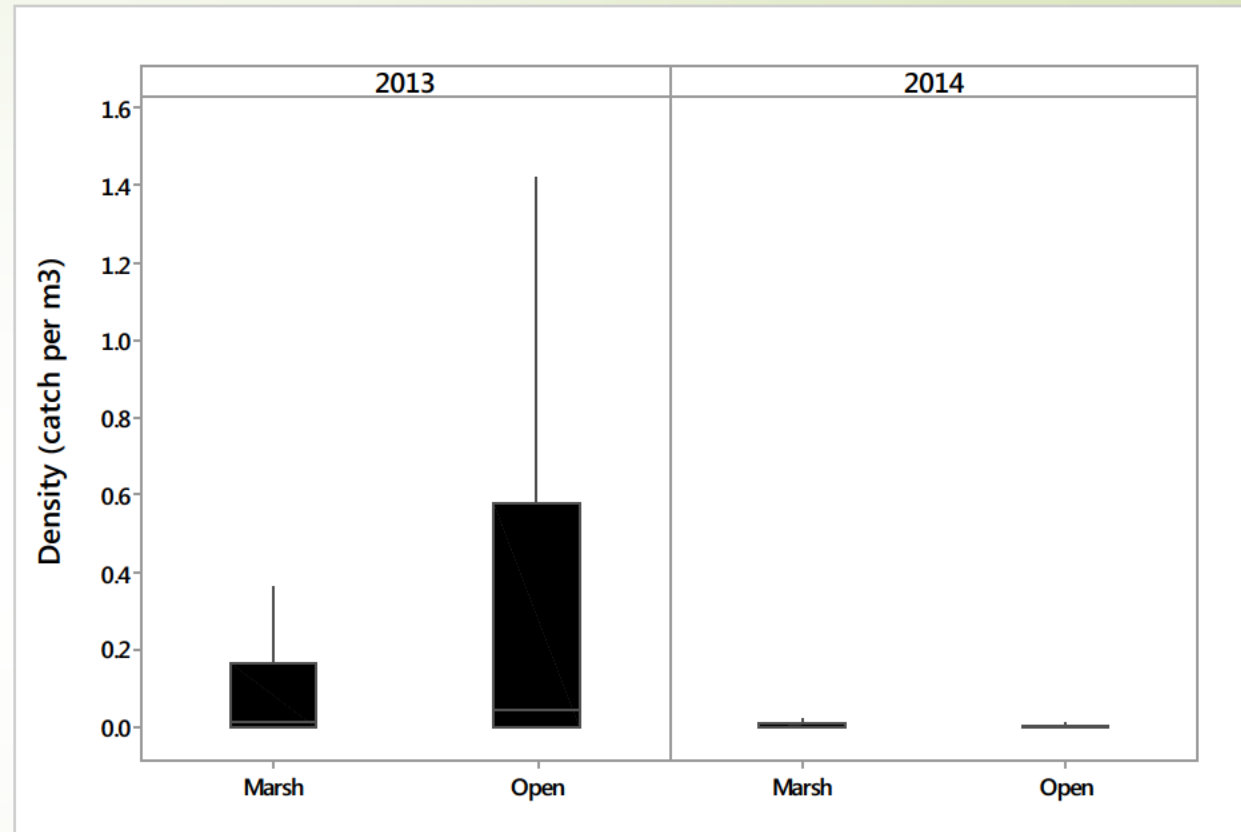
Compared Longfin Smelt Densities between Tidal Marsh Study and CDFW Smelt Larval Survey



More longfin smelt collected in 2013

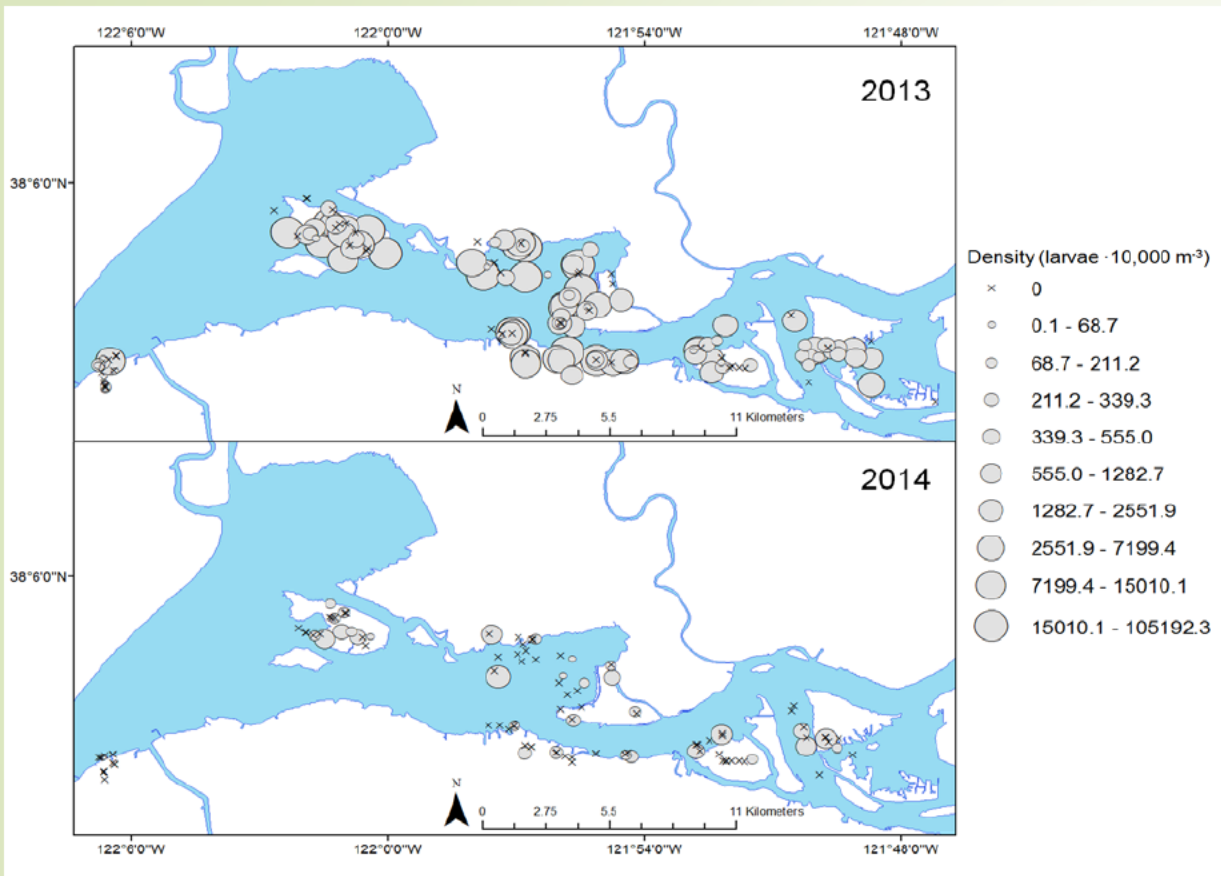


Shallow open water areas supported higher densities of longfin smelt larvae

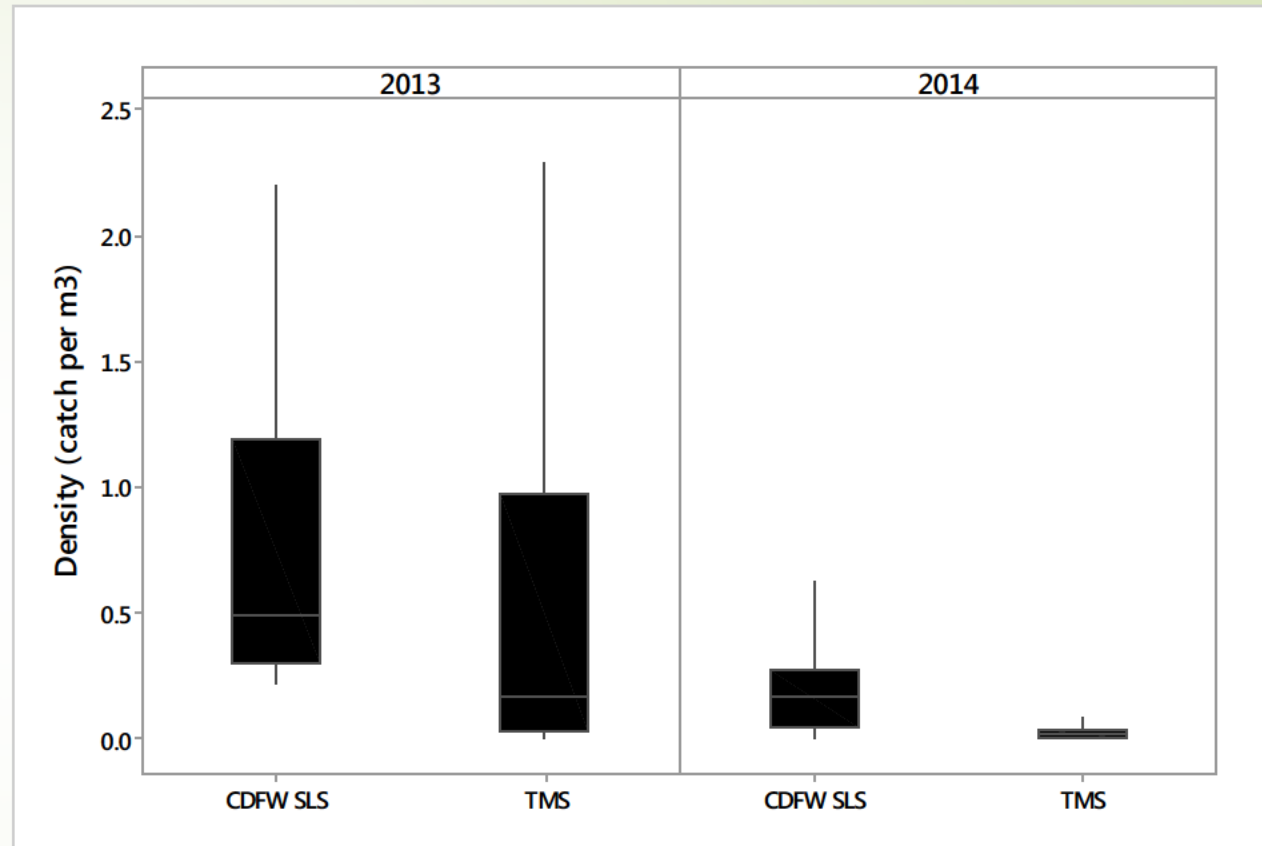


Source	P-value
Habitat	< 0.05
Year	< 0.01
Month	< 0.01

More longfin smelt collected in 2013



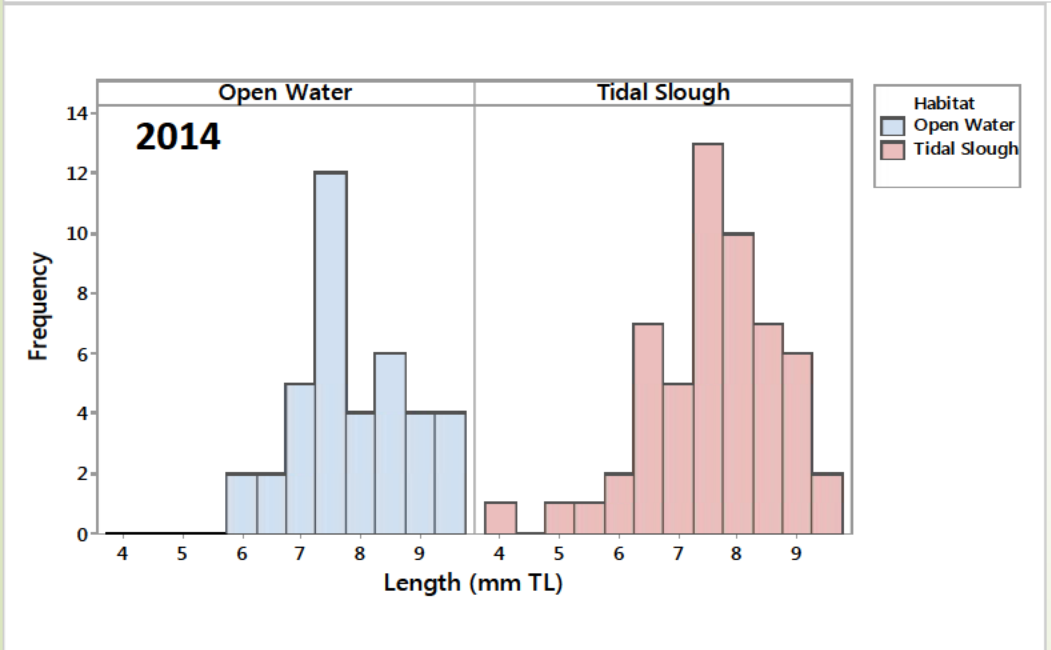
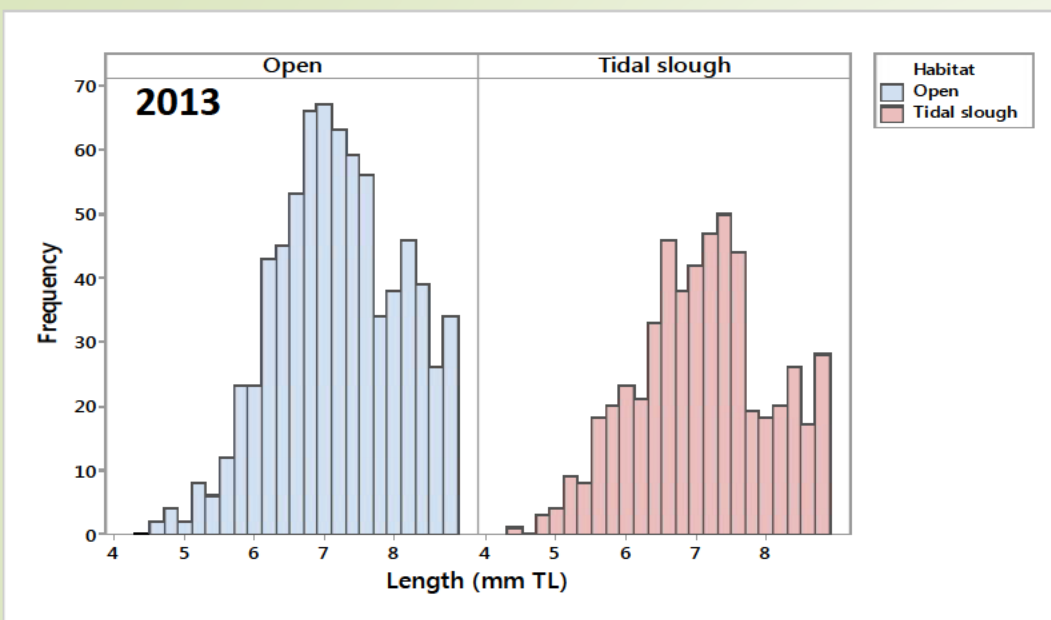
Densities not different between studies (CDFW SLS vs Tidal Marsh Study)



<u>Source</u>	<u>P-value</u>
Habitat	ns
Year	< 0.01
Month	ns

Lot's of yolk-sac larvae were collected

2013

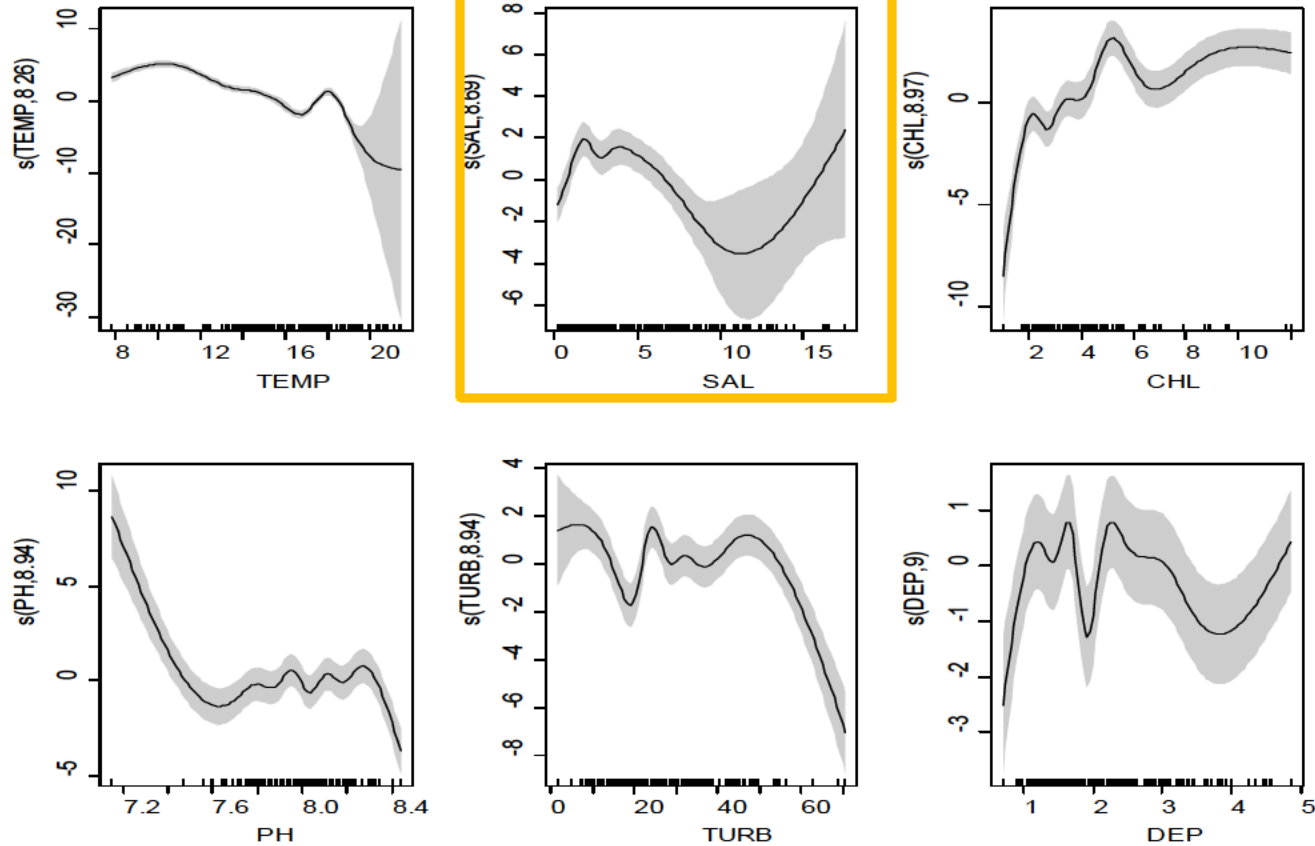


Length at hatch 5 – 8 mm TL; Wang 2007



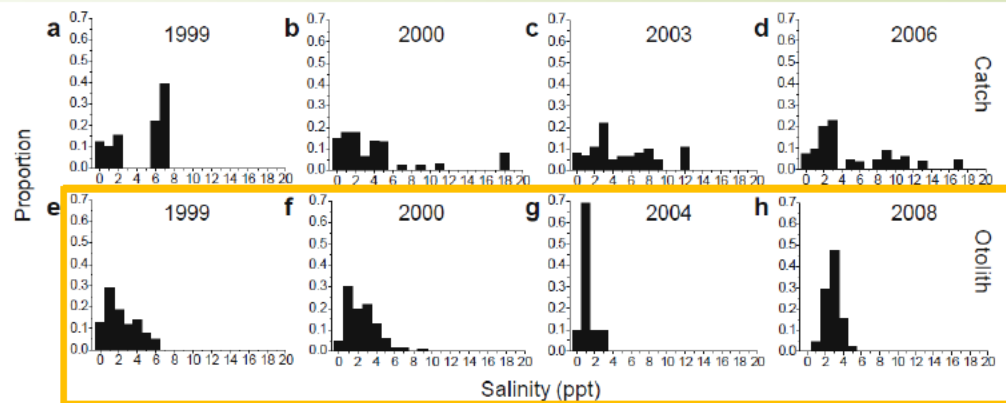
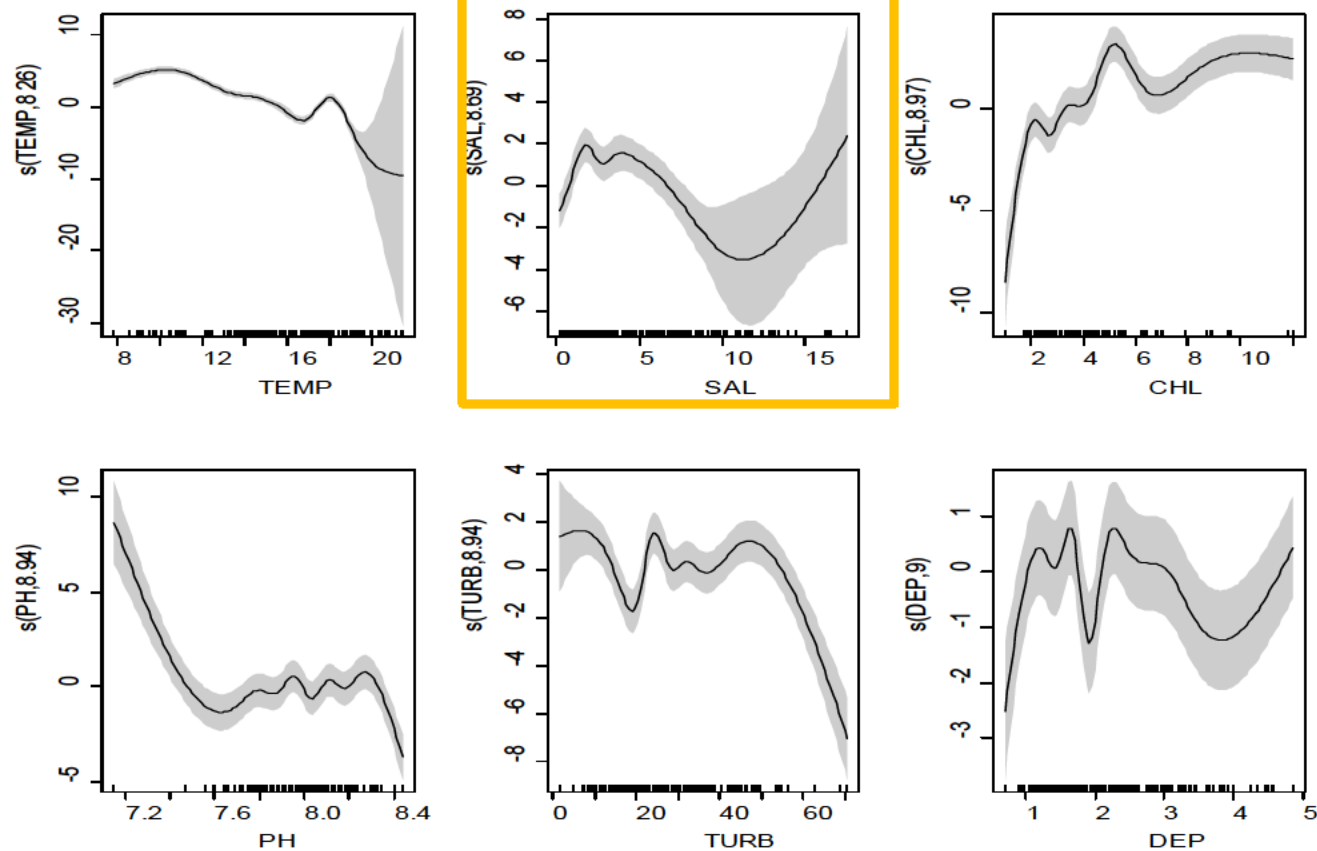
— Yellow line — Tow position/distance recorded in Navionics

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

Funding

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

David van Rijn Eric Sommerauer

Eric Santos Carol Raifsnider

Jim Starr Dave Mayer

Jennifer Pierre Johnson Wang

Erin Gleason Katherine Sun

Folks who came out on boat to help but didn't work very hard

Dan Riordan Carolyn Bragg

Gina Benigno Mary Lee Knecht

Rachel Johnson Shelly Hattleburg

Marin Greenwood Maral Kasparian

Leigh Bartoo

