DWR-1160

# Examining Rearing and Distribution of Larval Longfin Smelt (Spirinchus thaleichthys) During Low and High Freshwater Flows: Insights Gained into Mechanism Underlying Flow-Abundance Relationships

2018 IEP Workshop March 8th, 2018

Lenny Grimaldo (ICF)
Jillian Burns (ICF and SFSU EOS)
Jason Hassrick (ICF)
Andrew Kalmbach (ICF)
Robert Miller (ICF)

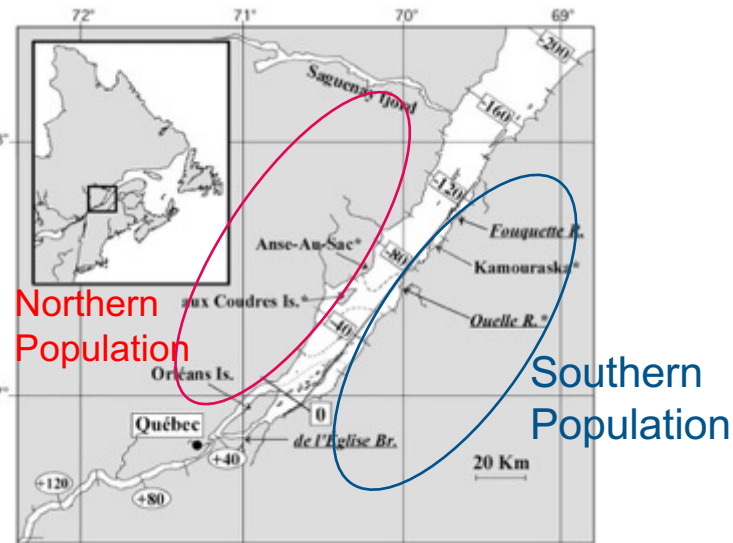## Estuarine Ecosystems Are Shaped by the Intersection of Freshwater Flow with other Dynamic and Stationary Habitat Features

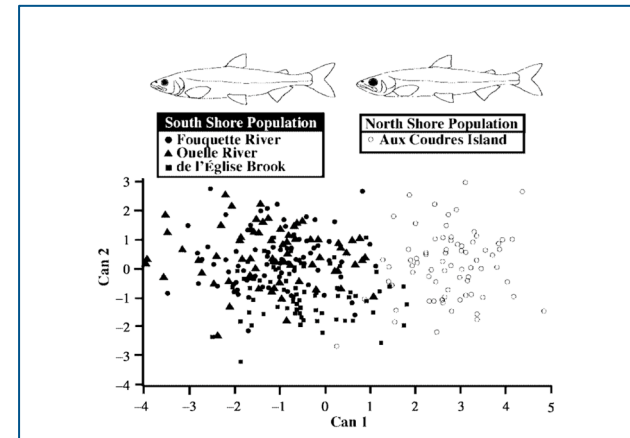S = Survival, P = Predator, F =Foraging, G= Growth, D = Density
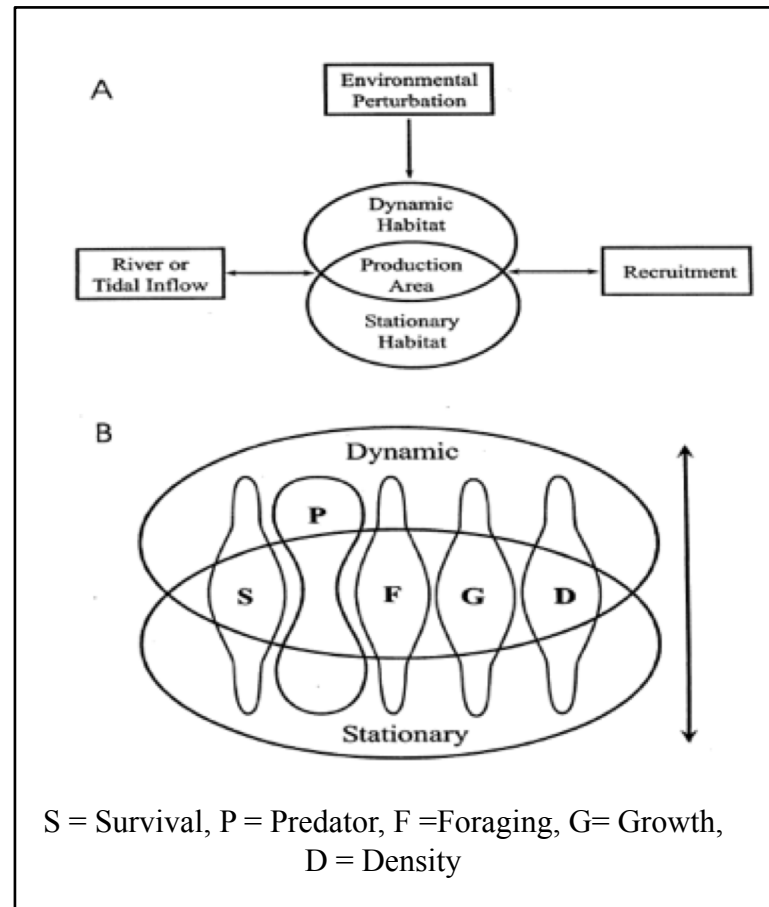
Peterson 2003

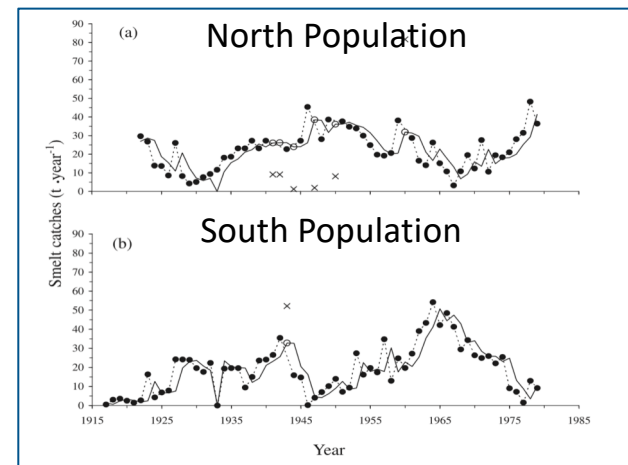# Case Study From the St. Lawrence Estuary:

Sympatric Rainbow Smelt populations are segregated by north and south *shorelines*
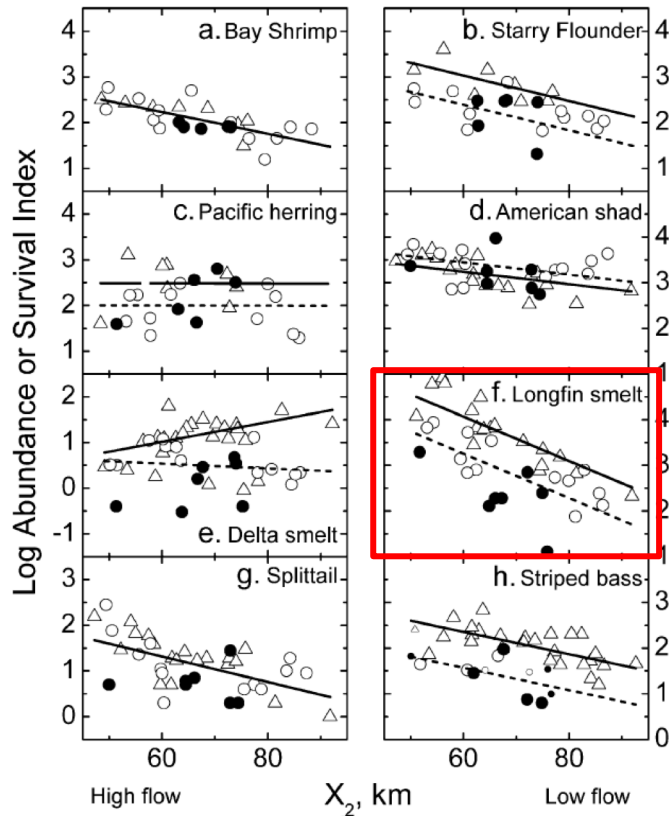

Lecomte and Dodson 2004

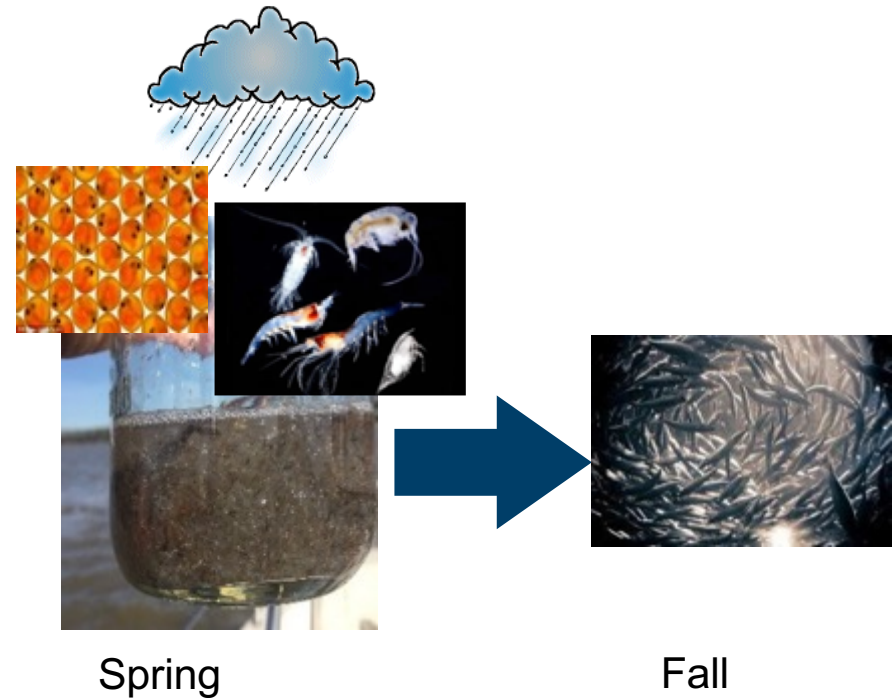*Lecomte and Dodson 2004*

Mingelbier et al. 2001

Follow Rainbow Smelt updates on Research Gate: https://www.researchgate.net/project/Rainbow-smelt-population-dynamic-management-and-conservation

Long-standing relationships between fish and flow
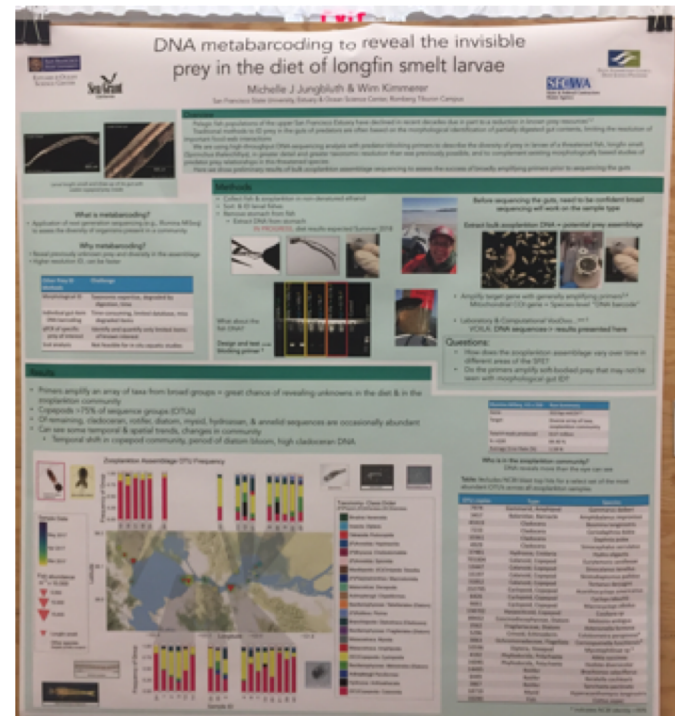

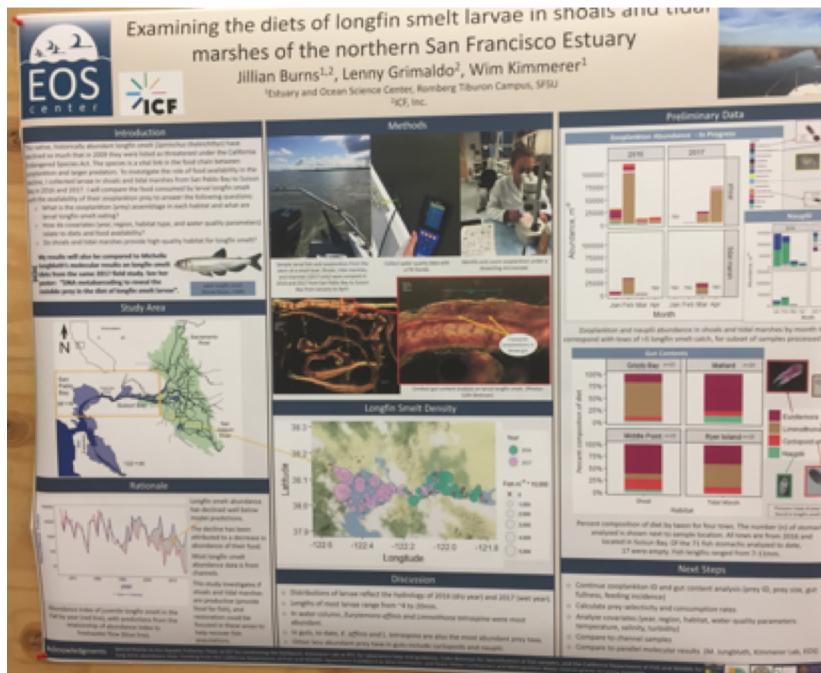Estuaries and Coasts (2009) 32:375–389

Kimmerer et al. 2009

Underlying conceptual model

Spring

Fall

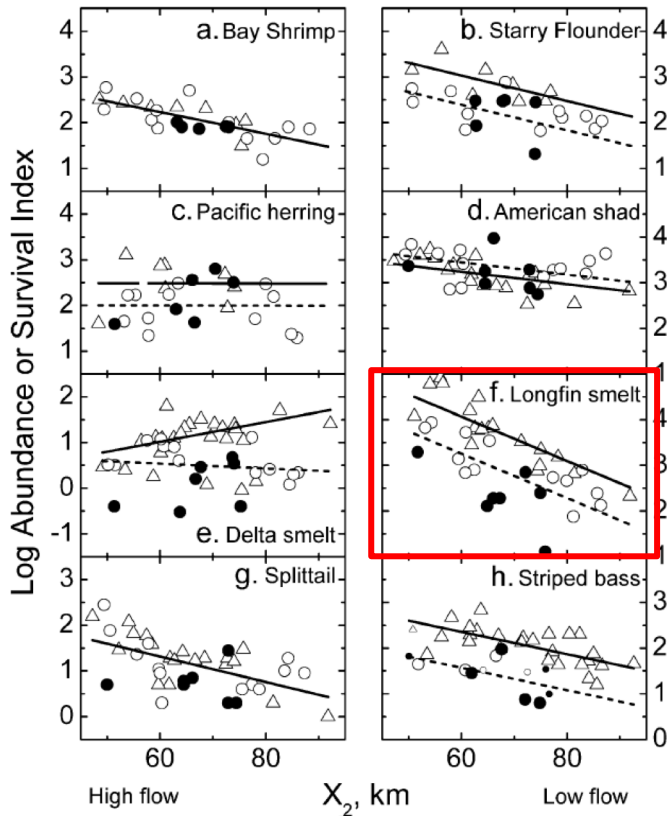*Food may be important*

Longfin Smelt Diet Investigations

See posters by Jillian Burns and Michelle Jungbluth from SFSU Estuary and Ocean Science Center
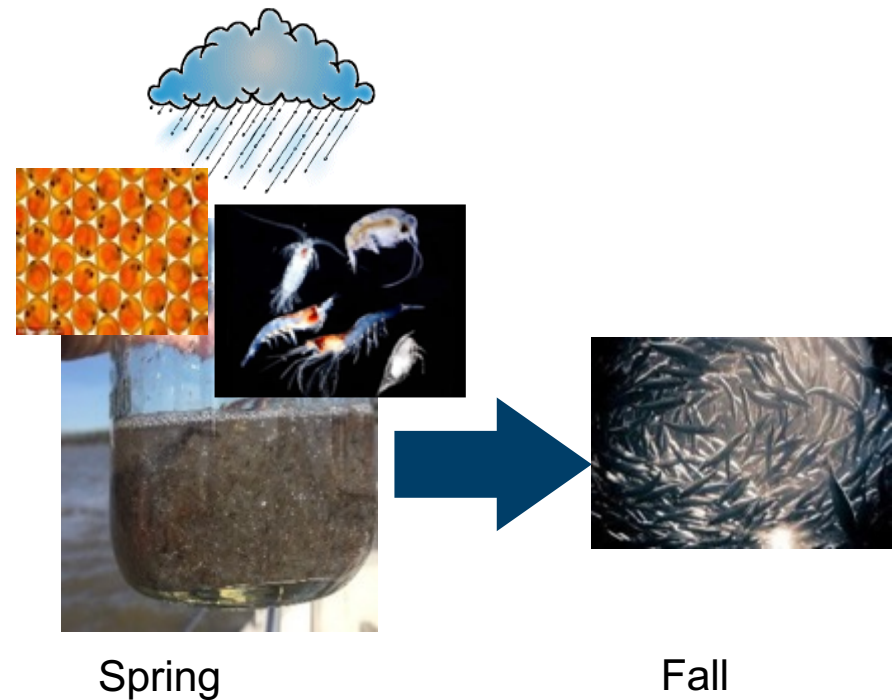
Long-standing relationships between fish and flow

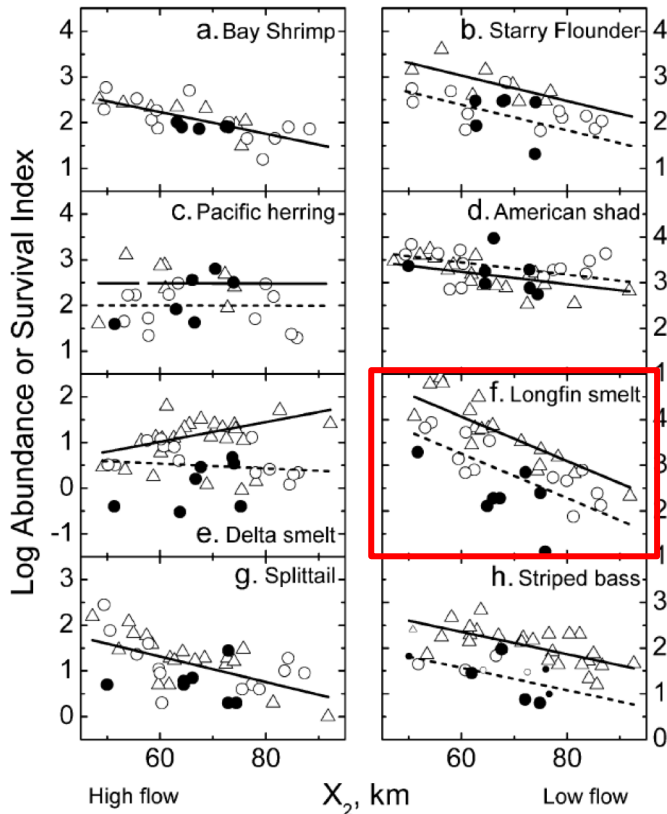Estuaries and Coasts (2009) 32:375–389

Kimmerer et al. 2009

Underlying conceptual model

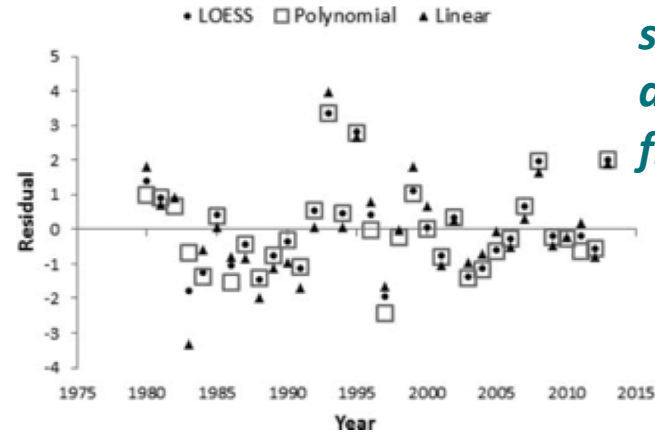Spring   Fall

….but what are the potential mechanisms?

Potential mechanisms that have been investigated

Estuaries and Coasts (2009) 32:375–389

Kimmerer et al. 2009

Recruits-per-spawners increase as a function of freshwater flow

Nobriga and Rosenfield 2016

Habitat, at best, weakly responsible for abundance

Kimmerer et al. 2009

What is the relationship between spring flow and larval Longfin Smelt abundance *during the spring?*

Program focused on Delta Smelt
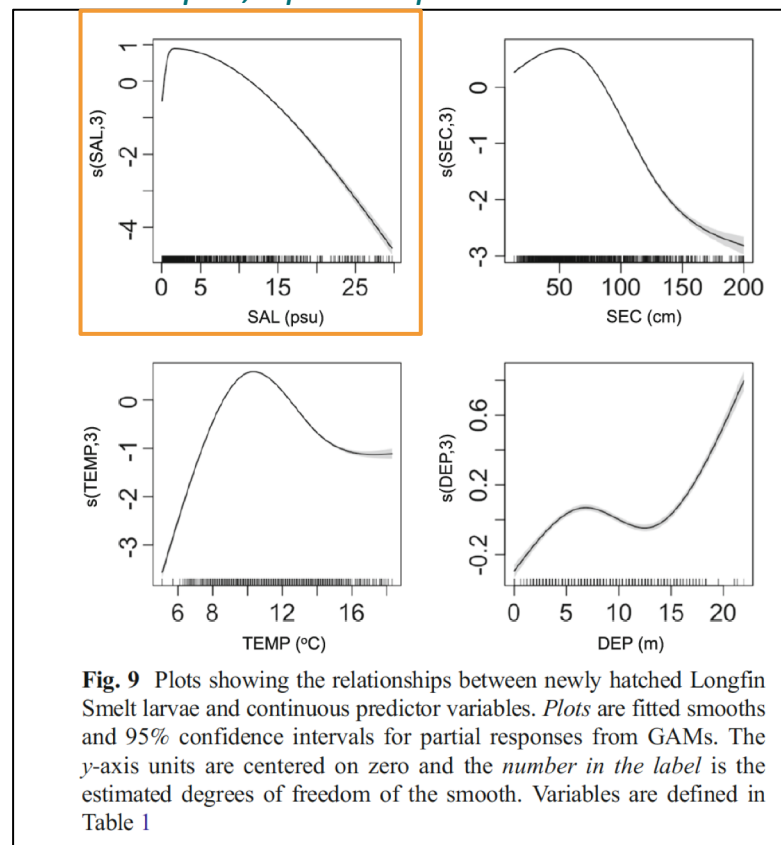(*Hypomesus transpacificus*)
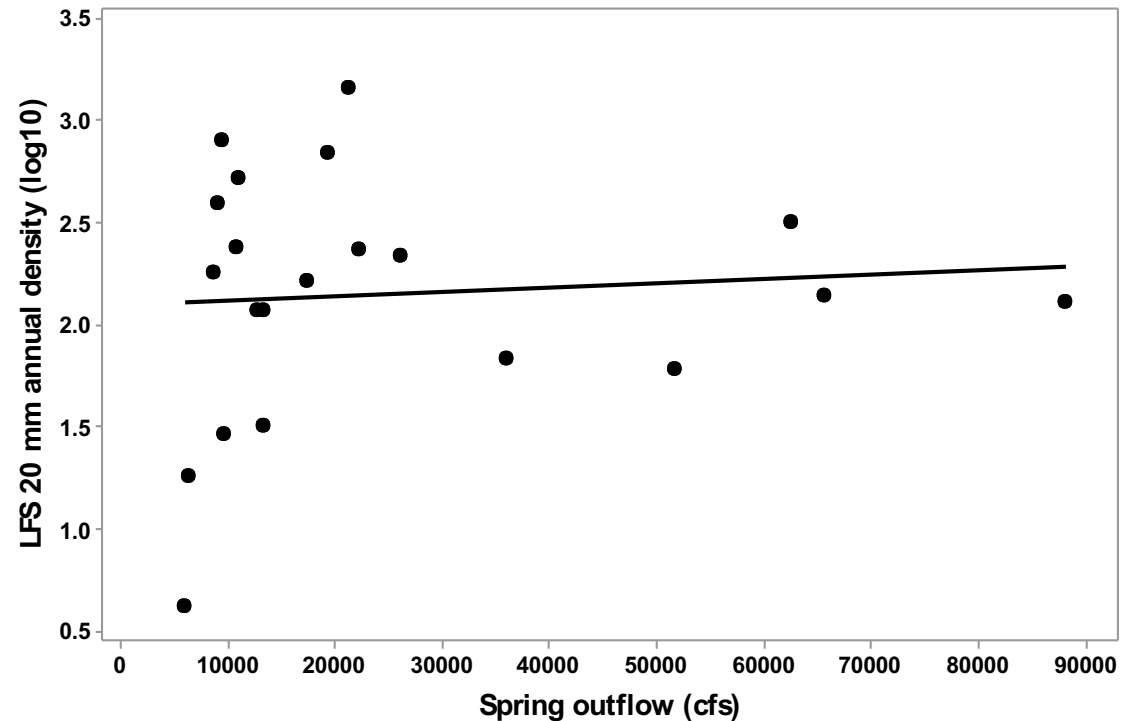
Habitats downstream of the monitoring programs are key rearing habitat in wetter years

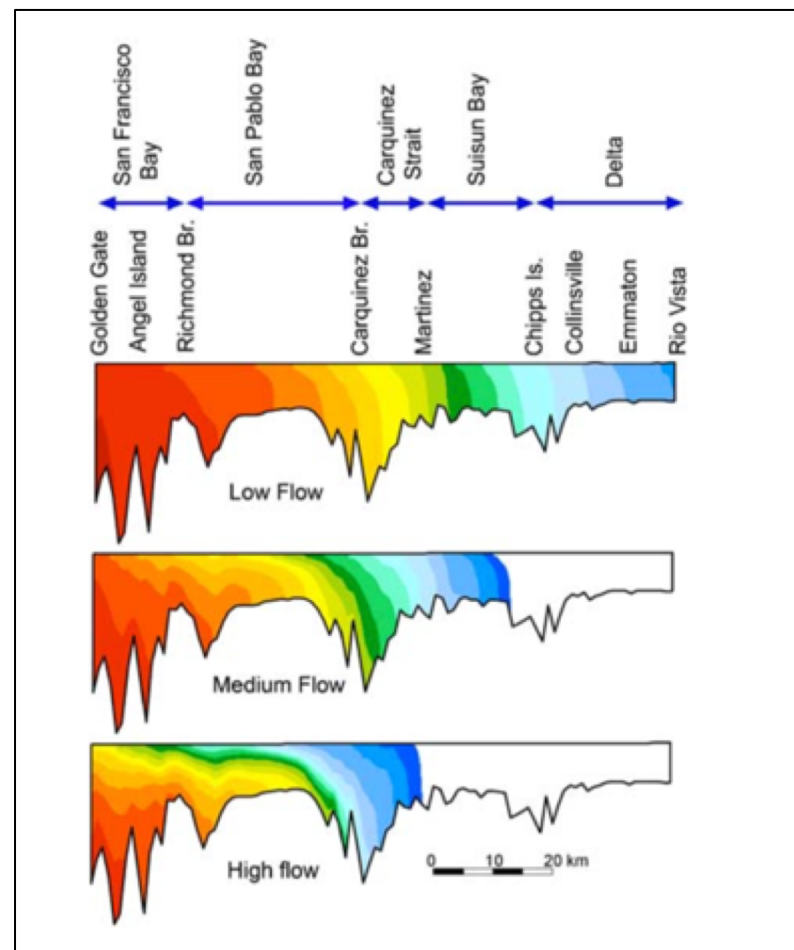*Transport from upstream to downstream habitats important*

Longfin Smelt have high survival during wet years

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Larval Longfin Smelt salinity relationship suggests rearing habitat is available downstream of Carquinez Bridge during wetter years

2-5 psu, up to 12 psu

Fig. 9 Plots showing the relationships between newly hatched Longfin Smelt larvae and continuous predictor variables. *Plots* are fitted smooths and 95% confidence intervals for partial responses from GAMs. The *y*-axis units are centered on zero and the *number in the label* is the estimated degrees of freedom of the smooth. Variables are defined in Table 1

Grimaldo et al. 2017

Kimmerer et al. 2009

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Our Study: Examine Linkages Between the Upper Estuary and Lower Estuary and Rearing Habitat for Larval Longfin Smelt, Pacific Herring, and Mysid Shrimp

Our Study: Examine Linkages Between the Upper Estuary and Lower Estuary and Rearing Habitat for Larval Longfin Smelt, Pacific Herring, and Mysid Shrimp
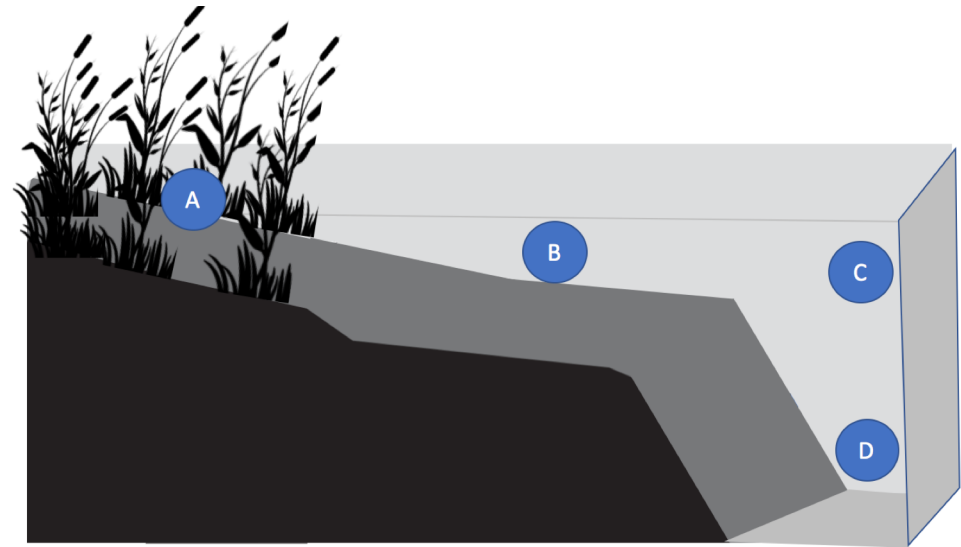
Our Study: Examine Linkages Between the Upper Estuary and Lower Estuary and Rearing Habitat for Larval Longfin Smelt, Pacific Herring, and Mysid Shrimp
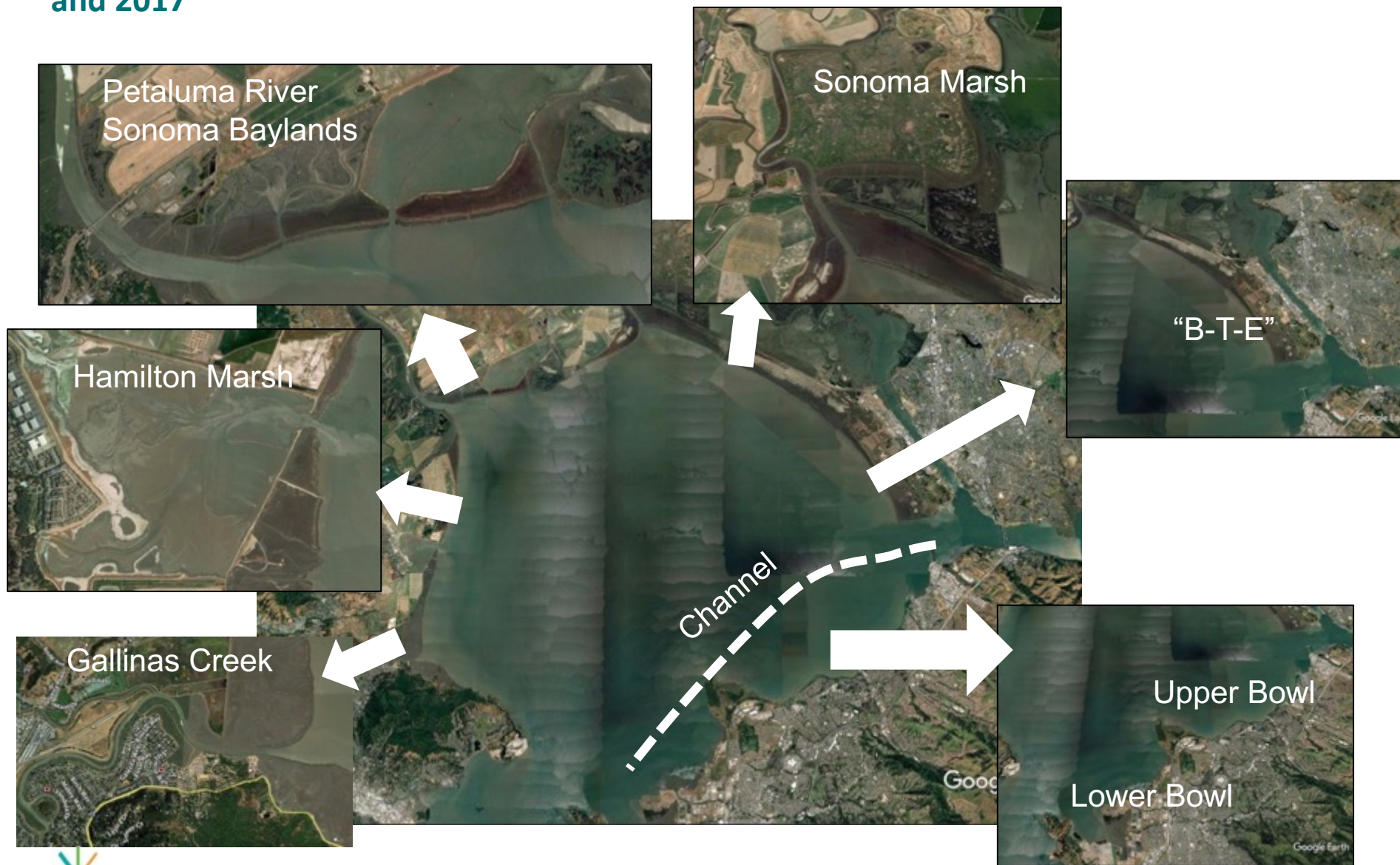

2017 only

A-Tidal marsh, B-Shoal, C-Channel surface, D-Channel bottom
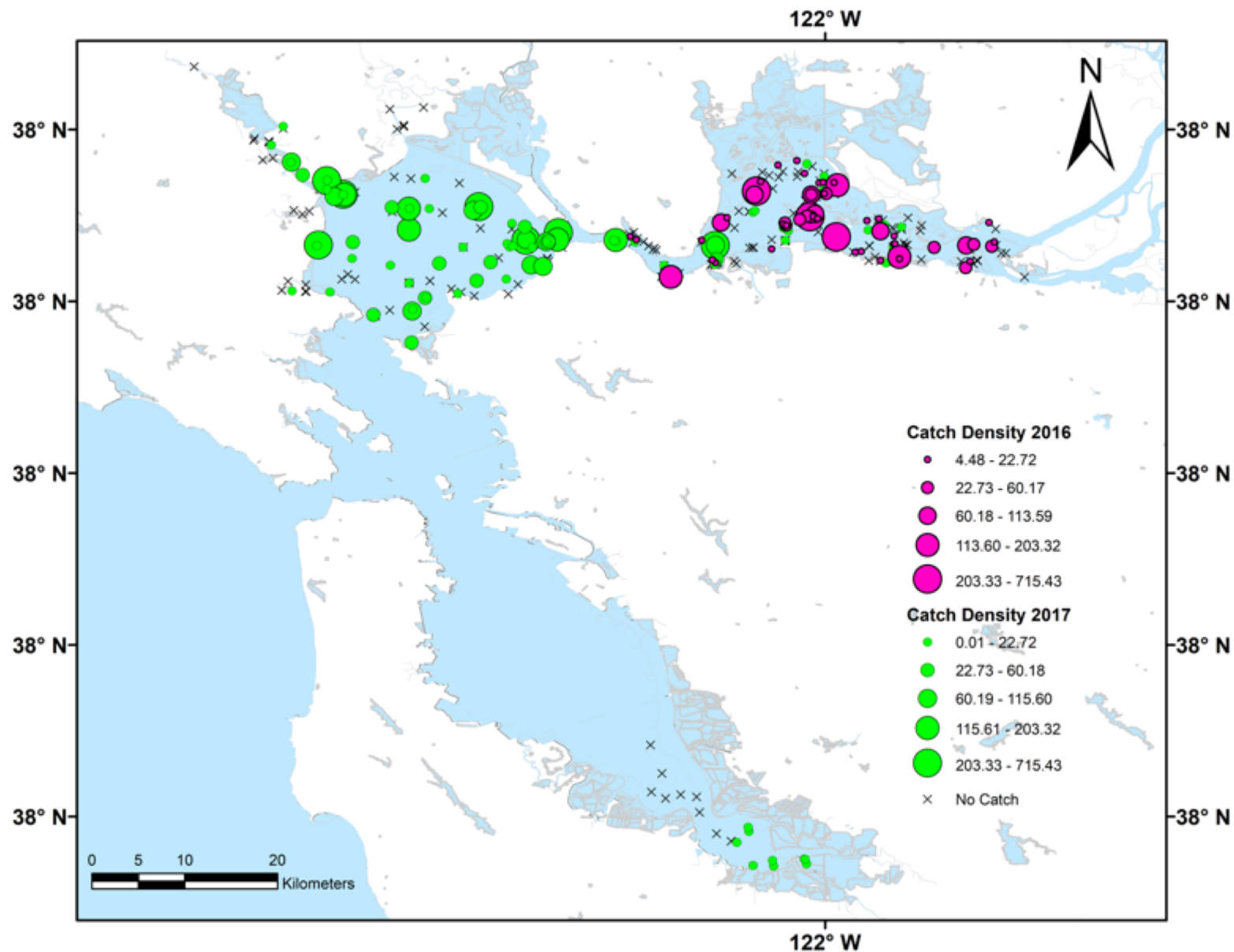
Key questions:

1. How does larval Longfin Smelt abundance and distribution vary along the longitudinal gradient of the estuary?

2. How does larval Longfin Smelt abundance and distribution vary with habitat?

3. How does larval Longfin Smelt feeding and growth change with habitat and region?
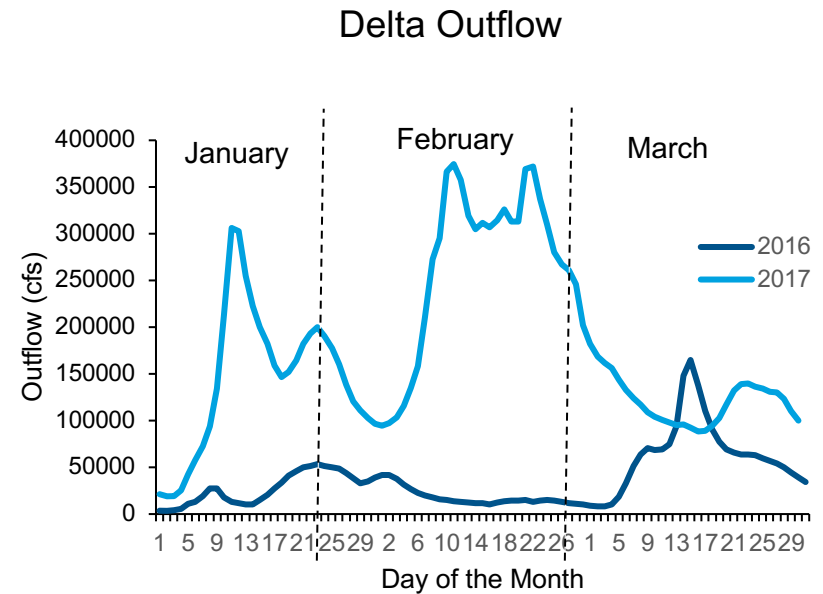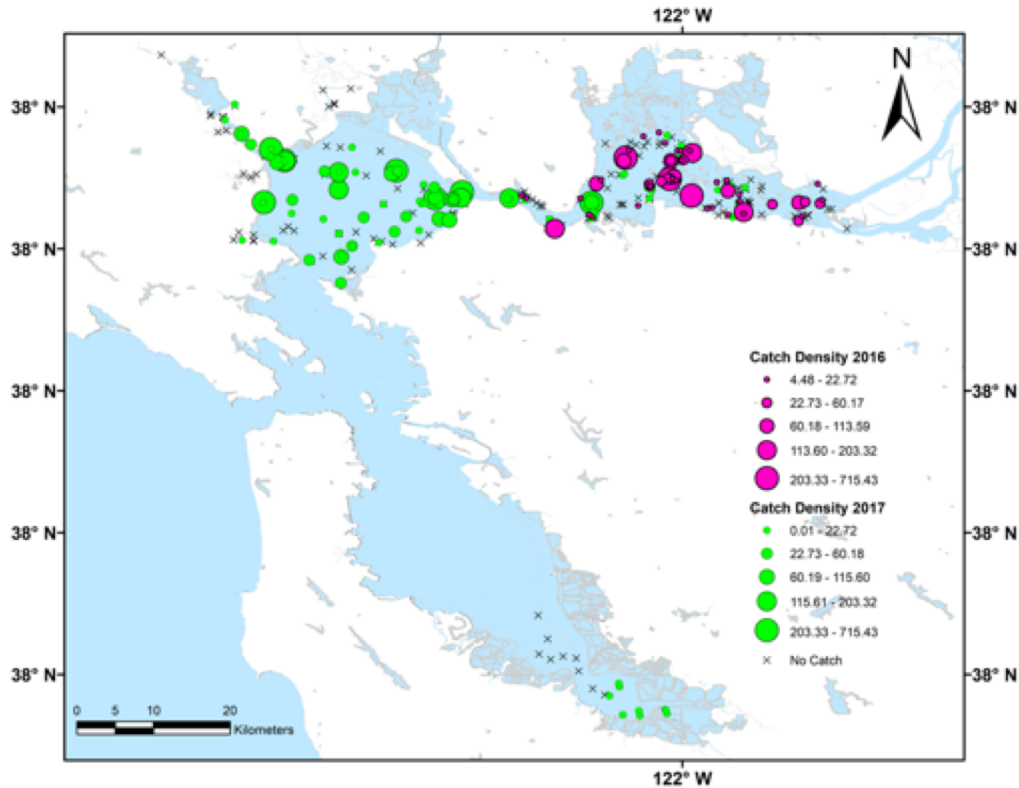
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We sampled the heck out of the San Pablo Bay and Suisun Bay in 2016 and 2017

Petaluma River
Sonoma Baylands

Sonoma Marsh

"B-T-E"

Hamilton Marsh

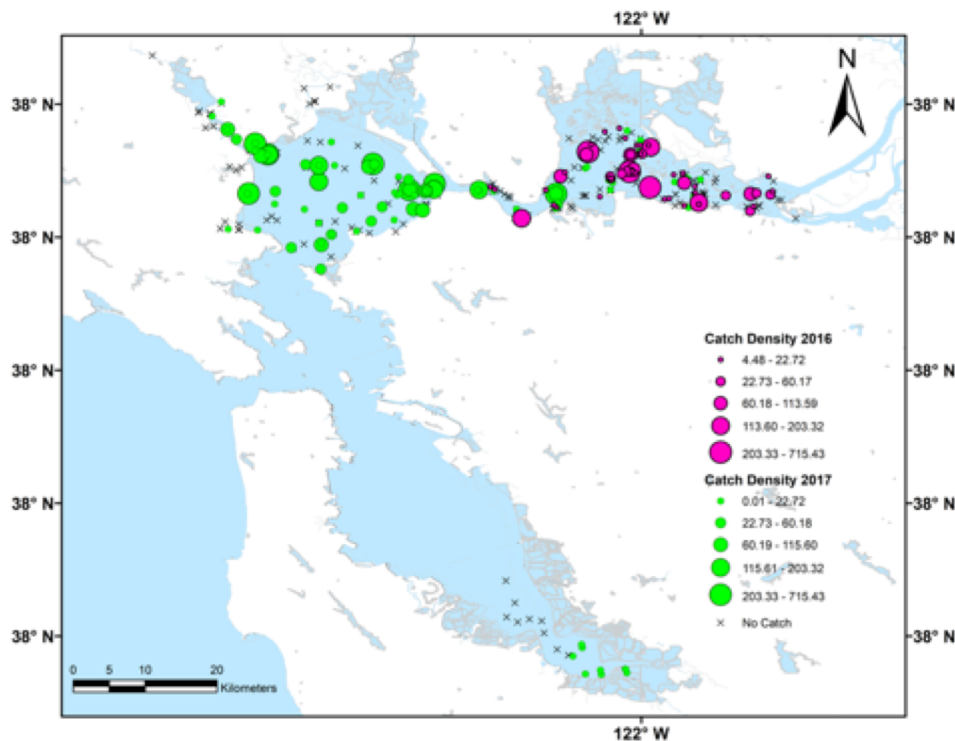Channel

Gallinas Creek

Upper Bowl

Lower Bowl

Results: Larval Longfin Smelt distribution more seaward during 2017
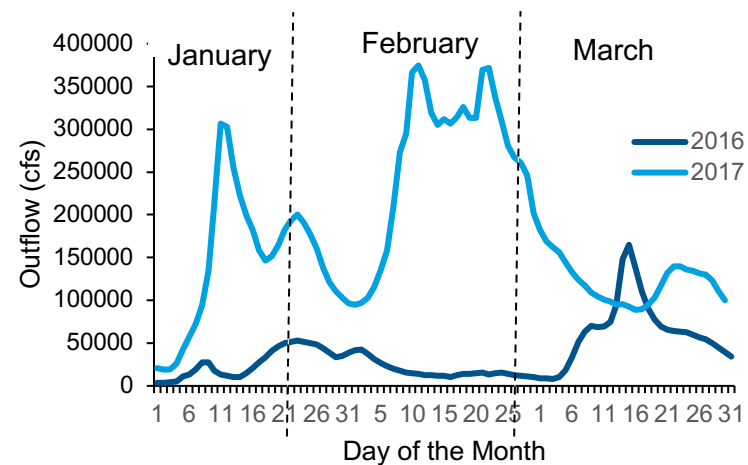
Results: Larval Longfin Smelt distribution more seaward during 2017

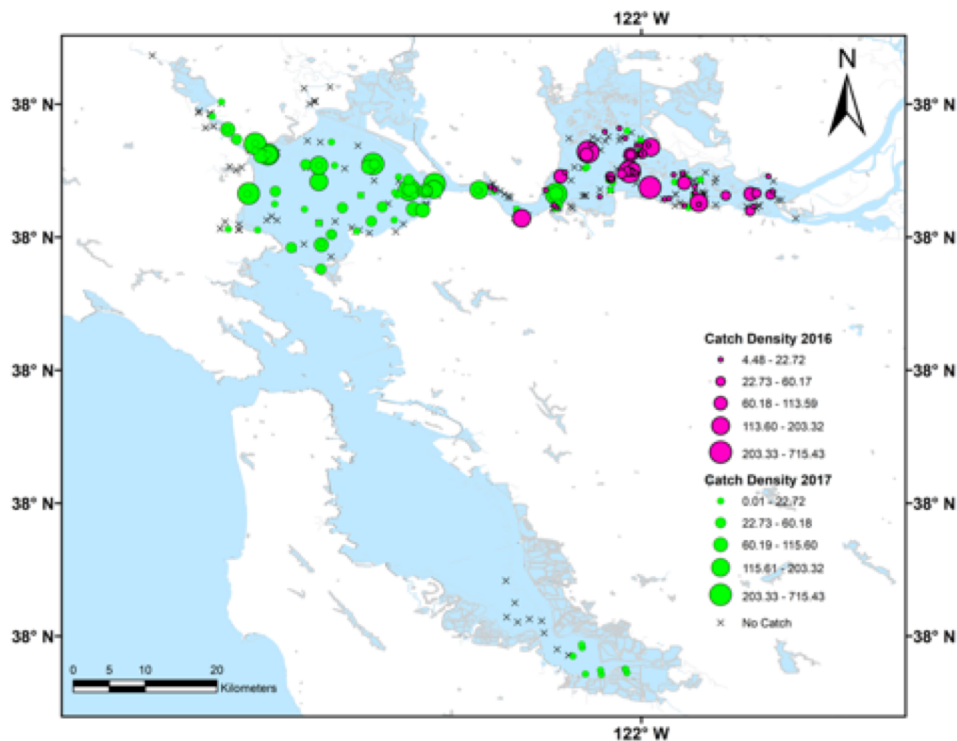# Results: Larval Longfin Smelt distribution more seaward during 2017

Delta Outflow

Tributary	2016 (Jan-May)	2017 (Jan-May)
Novato Creek	12.70	60.20
Sonoma Creek	31.80	92.04
Napa River	351.40	668.57
San Ramon Creek	6.57	31.50
San Lorenzo Creek	51.26	139.16
Alameda Creek	166.28	1217.20
Guadalupe River	65.60	438.75
Corte Madera Creek	52.03	159.25
San Fransiquito Creek	47.80	139.62
Coyote Creek	39.62	na
San Mateo Creek	12.40	72.28

Source: USGS https://waterdata.usgs.gov/ca/nwis/rt

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Results: Larval Longfin Smelt distribution more seaward during 2017

Estuaries and Coasts (2009) 32:375–389

San Pablo Bay and adjacent tributaries may be important during wetter years
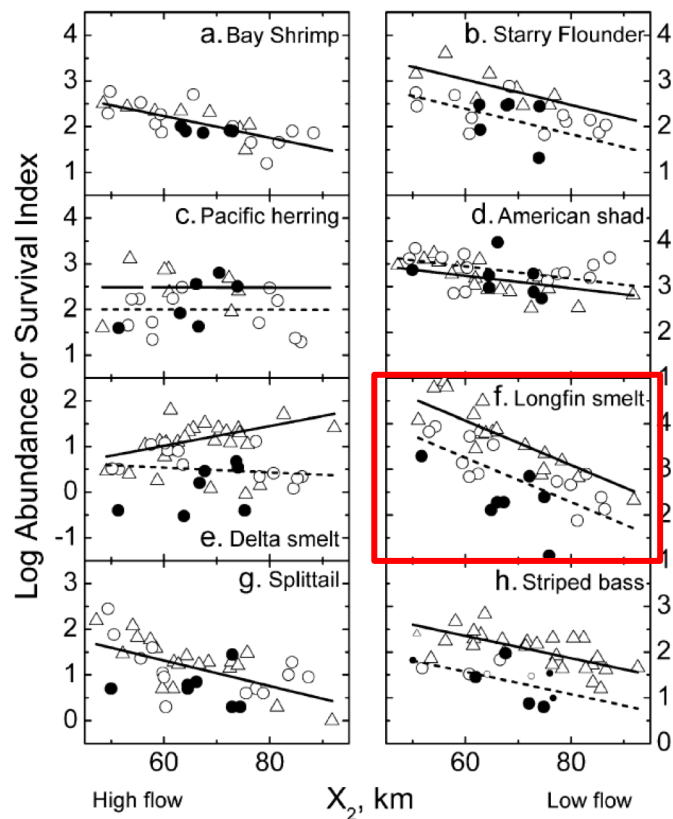
Yolk-sac Larval Longfin Smelt distributed more seaward during wetter periods-CDFW Bay Survey (1980-1989)
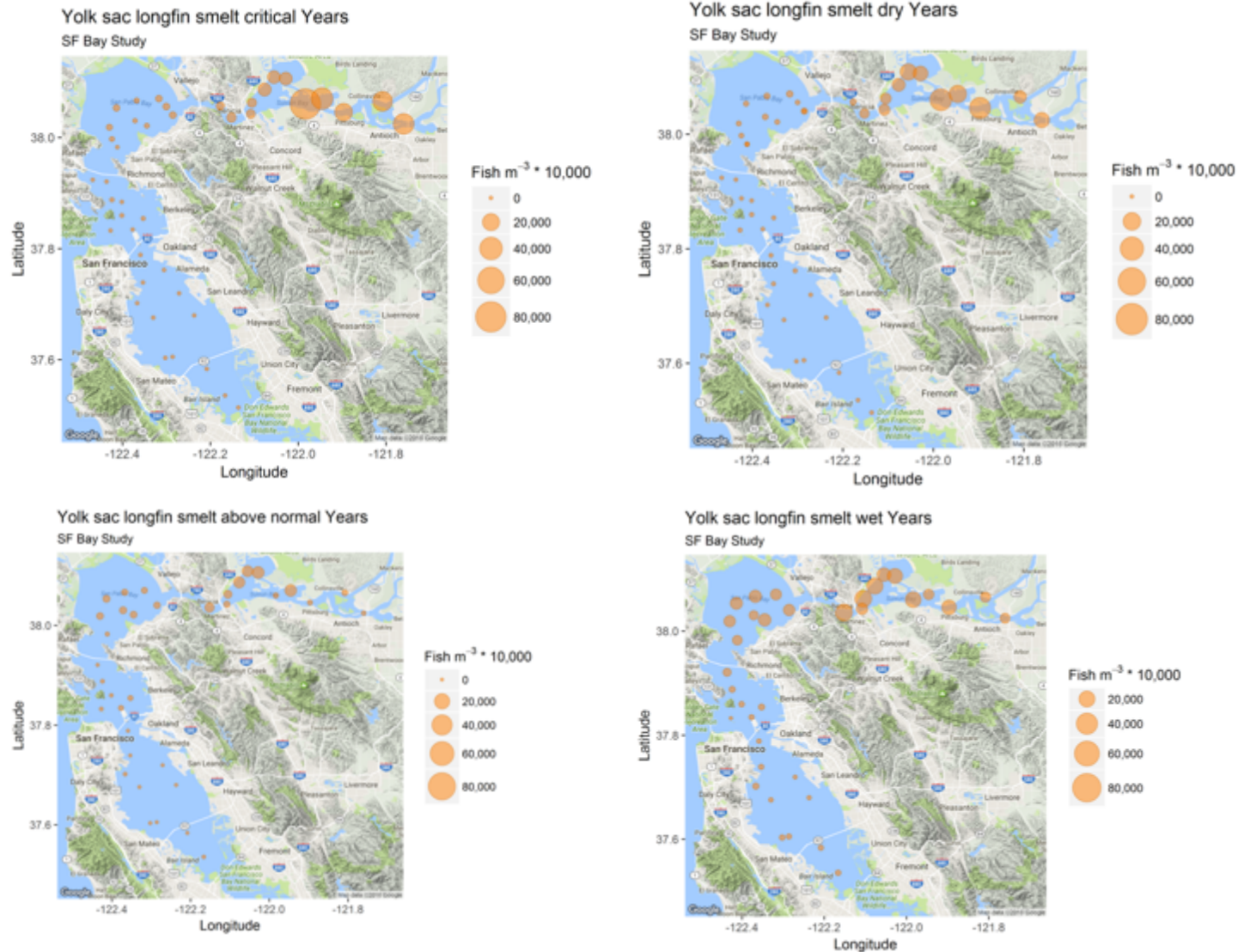
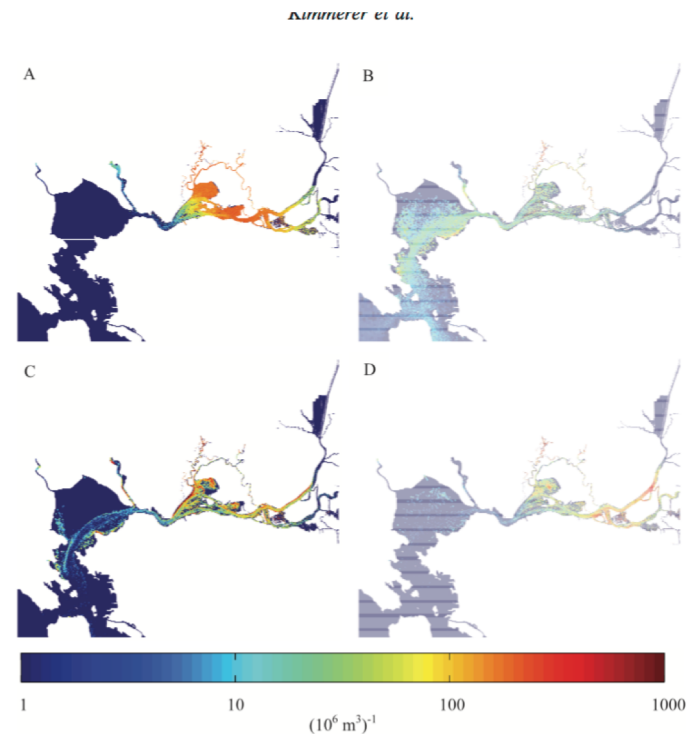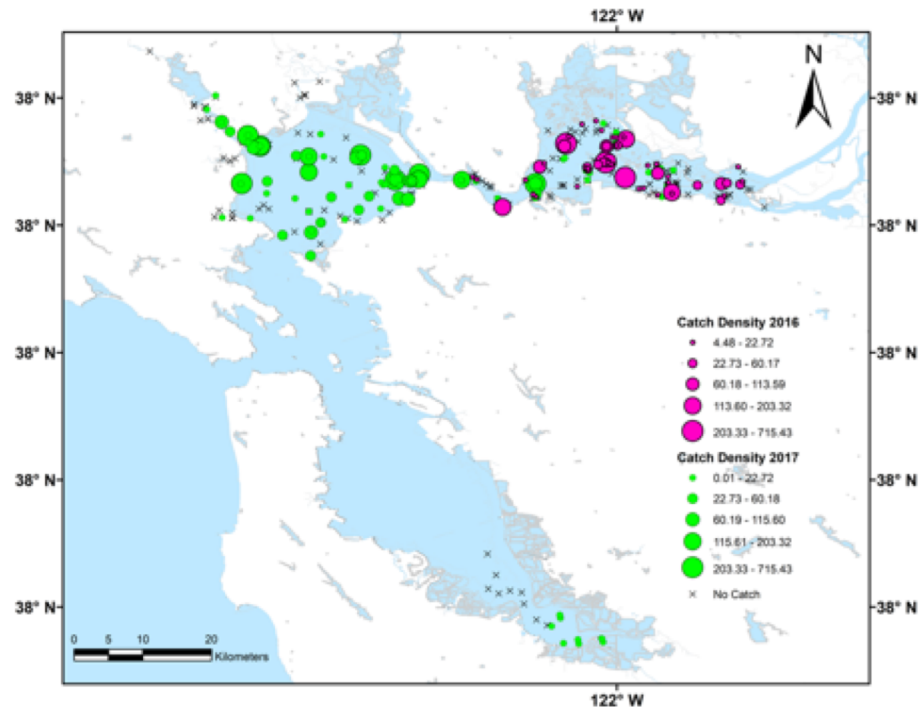# PTM may shed light on transport and residence time mechanisms

Fig. 5. Initial and final distributions of particles as concentrations on a log scale (right) under the low-flow scenario. (A) initial particle distributions. (B) Passive behavior. (C) Sink at 0.5 mm s⁻¹ (Down 0.5). (D) Tidal migration biased downward, speed 0.25 mm s⁻¹ up on flood and 0.75 mm s⁻¹ down on ebb (Tidal B 0.5).

Kimmerer et al. 2014

***Wim Kimmerer (SFSU EOS) and Ed Gross (RMA) will examine larval Longfin data to provide more certainty on hatching and rearing locations***

Results: Larval Longfin Smelt Abundance Varies by Habitat

Larval Longfin Smelt Catch by Habitat (2017)
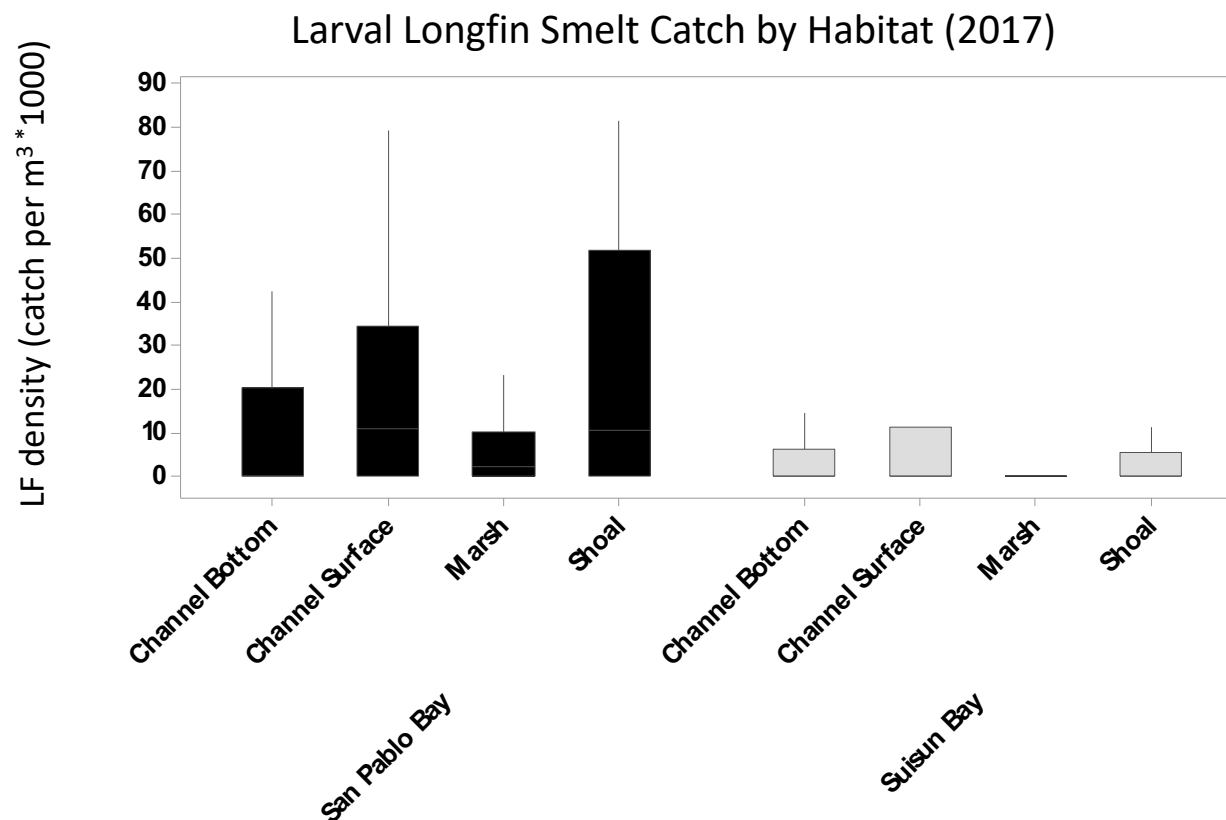
Retention mechanisms may be important in San Pablo Bay....but maybe not the ones we were expecting....

Larval Longfin Smelt Catch by Habitat (2017)
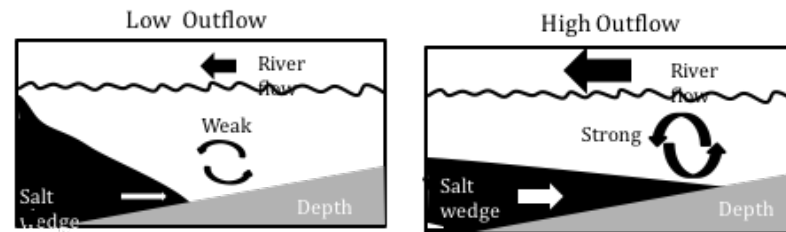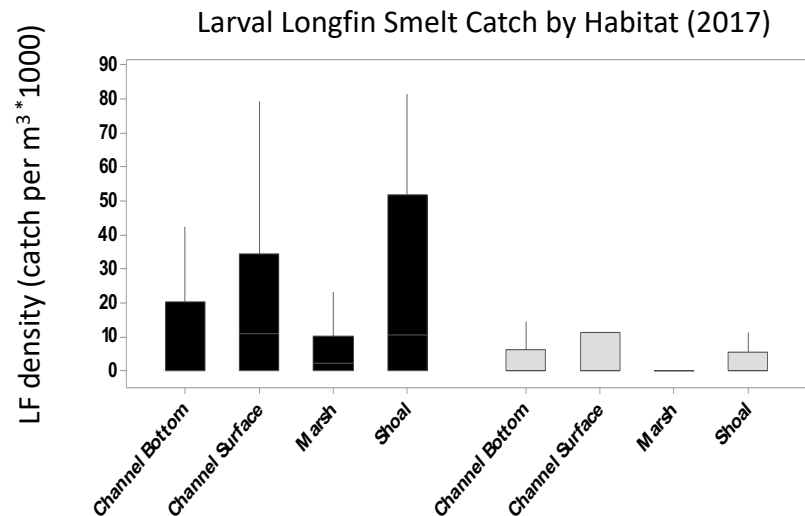
Acknowledgements

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Taxonomy: Colin Brennan (ICF) and Tenera Environmental (Carol Raifsnider)

IEP Lead Scientist, Dr. Culberson hard at work

ICF