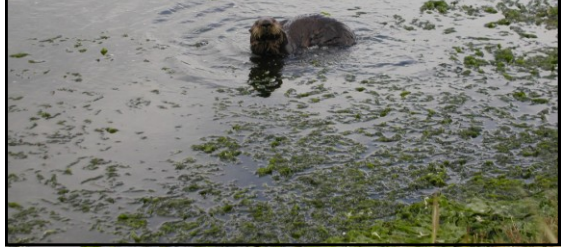
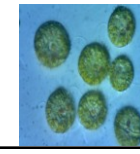
NUTRIENTS AND BIODIVERSITY AT ELKHORN SLOUGH



Elkhorn Slough Plants

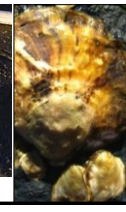




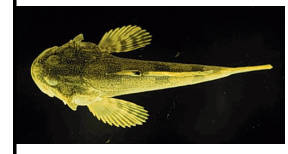

Elkhorn Slough Invertebrates



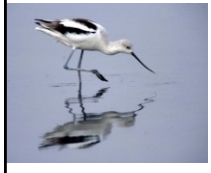


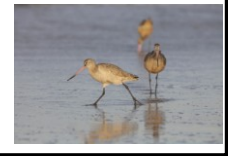



Elkhorn Slough Fish




Elkhorn Slough Birds



Elkhorn Slough Marine Mammals

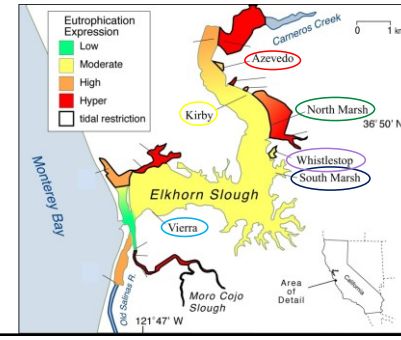

ROAD MAP

How are animals and plants affected by high nutrient levels in the estuary?

How does artificial restriction of tidal exchange interact with effects of nutrients?

- Eelgrass
- Fish
- Oysters
- Overall biodiversity
- Salt marsh

How do fish respond to water quality at different sites?

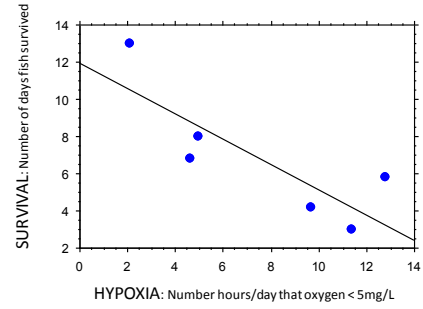


Caging Experiment

•Staghorn sculpin used as highly tolerant indicator species
•Cages deployed next to water quality sondes

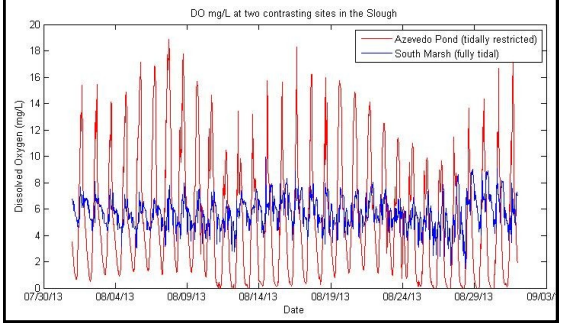
HYPOXIA KILLS FISH

Water quality is inappropriate for fish survival at some wetlands



Jeppesen et al. *In prep*

OXYGEN FLUCTUATES MUCH MORE IN TIDALLY RESTRICTED VS. FULLY TIDAL SITE



Making poor water quality issues tangible through indicator species

ROAD MAP

How are animals and plants affected by high nutrient levels in the estuary?

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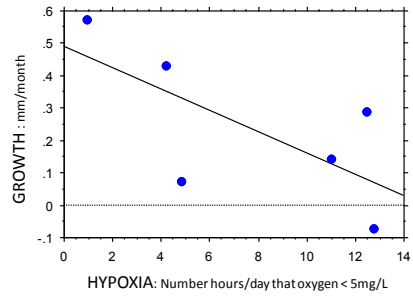
- Salt marsh

Caging Experiment

•Olympia oysters used as highly tolerant indicator species
•Cages deployed next to water quality sondes

HYPOXIA SLOWS OYSTER GROWTH

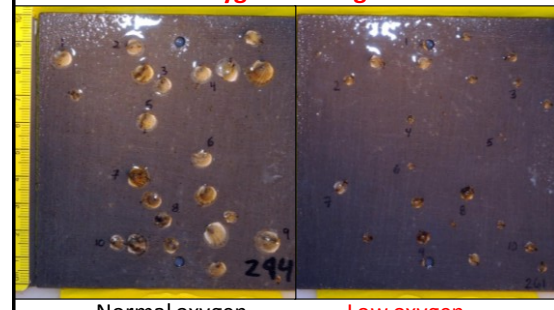
Water quality is inappropriate for shellfish growth in some wetlands



Jeppesen et al. *In prep*

Lab Experiments:

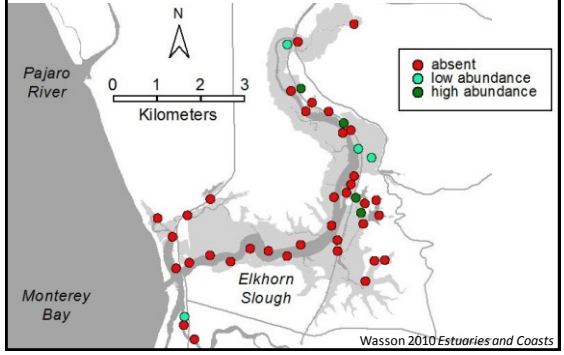
low oxygen slows growth



Normal oxygen Low oxygen

Cheng et al. 2015 *Global Change Biology*

OYSTERS ABSENT FROM MANY WETLANDS WHERE THEY WERE HISTORICALLY PRESENT



Wasson 2010 *Estuaries and Coasts*

EUTROPHICATION AND OYSTERS

Oysters absent from sites with highest nutrients, chlorophyll and turbidity

Wasson 2010 *Estuaries and Coasts*

TIDAL RESTRICTION

Oysters absent from 14/17 sites with water control structures

Wasson 2010 *Estuaries and Coasts*

Only the harbor and main Elkhorn Channel have full tidal exchange

More than 50% of the historic estuary is behind water control structures

ROAD MAP

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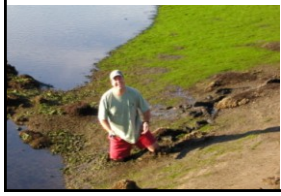
- ➡ Overall biodiversity
- Salt marsh

BIOLOGICAL EFFECTS OF POOR WATER QUALITY BEHIND TIDE GATES

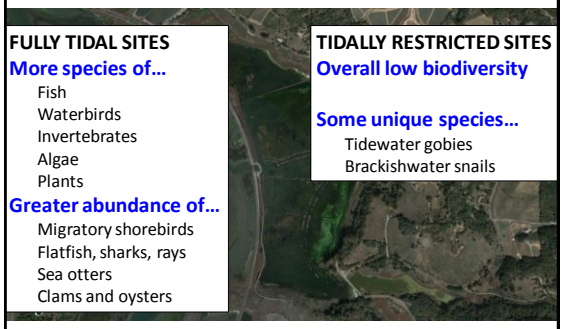
How do communities of plants and animals differ on either side of water control structures?



COMPARISONS OF BIODIVERSITY

Ritter et al. 2008 *Estuaries and Coasts*

COMPARISONS OF BIODIVERSITY



FULLY TIDAL SITES

More species of…
- Fish
- Waterbirds
- Invertebrates
- Algae
- Plants

Greater abundance of…
- Migratory shorebirds
- Flatfish, sharks, rays
- Sea otters
- Clams and oysters

TIDALLY RESTRICTED SITES

Overall low biodiversity

Some unique species…
- Tidewater gobies
- Brackishwater snails

Ritter et al. 2008 *Estuaries and Coasts*

ROAD MAP

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SALT MARSH DIEBACK

Limnol. Oceanogr., 54(5), 2009, 1634–1642
© 2009, by the American Society of Limnology and Oceanography, Inc.

Salt marshes and eutrophication: An unsustainable outcome

R. Eugene Turner,[a,*] Brian L. Howes,[b] John M. Teal,[c] Charles S. Milan,[a] Erick M. Swenson,[a] Dale D. Goehringer-Toner[b]

Nutrients lead to
- Fewer marsh roots
- Less organic matter below ground
- Higher decomposition rates
- Decreased ability to build marsh upward
- Loss of sustainability in the face of sea level rise

ELKHORN SLOUGH MARSH DROWNING

Our marshes are not tracking sea level
- Subsidence measured at our monitoring stations
- We have measured high decomposition rates in our marshes, much higher than we measured in Morro Bay

Nutrients may be culprit

LETTER Nature 2012
doi:10.1038/nature11533

Coastal eutrophication as a driver of salt marsh loss

Linda A. Deegan[1], David Samuel Johnson[1,2], R. Scott Warren[3], Bruce J. Peterson[1], John W. Fleeger[4], Sergio Fagherazzi[5] & Wilfred M. Wollheim[6]

Compelling experiment
- Paired marshes with vs. without nutrient addition

NUTRIENTS CAUSE MARSH LOSS AND BANK EROSION

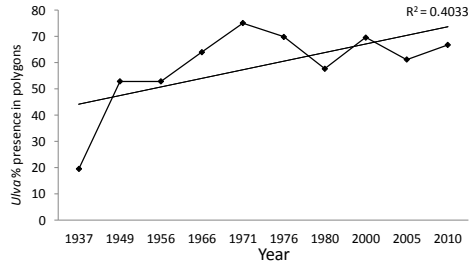
BEFORE and CONTROL SITES

NUTRIENTS MAY CONTRIBUTE TO BANK EROSION AND MARSH LOSS AT ELKHORN SLOUGH

Algal wrack increases marsh loss and bank erosion on edge

Investigation of wrack cover levels over time using aerial photographs

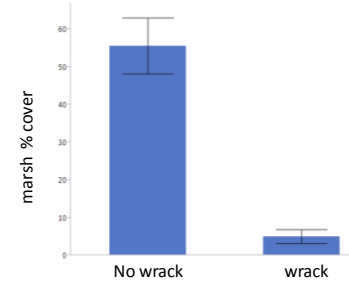
Algal wrack increase over time



Algal mats contribute to marsh loss at edge

Field experiments examining wrack effects

Marsh percent cover, biomass and flowering all lower under wrack



Jeppesen et al. *in prep*

Loss of marsh sustainability in the face of sea level rise may be one of the biggest ecosystem effects of nutrient loading

ROAD MAP

How are animals and plants affected by high nutrient levels in the estuary?

How does artificial restriction of tidal exchange interact with effects of nutrients?

- Fish die and oysters stop growing in Elkhorn Slough wetlands with poor water quality
- Biodiversity is decreased in diked wetlands due to reduced water quality
- Nutrients harm marshes by increasing wrack mats
- Nutrients also decrease marsh sustainability in the face of sea level rise

Improving water quality will help the plants and animals of Elkhorn Slough