

# Effects of hypoxia on fish survival and oyster growth in a highly eutrophic estuary

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# Eutrophication and hypoxia

- ✓ Eutrophication in Elkhorn Slough
- ✓ Algal growth
- ✓ Effects of water quality on important slough species



# Eutrophication and hypoxia

- Eutrophication in Elkhorn Slough
- Algal growth
- Effects of water quality on important slough species





# Research question

- ˆ Eutrophication in Elkhorn Slough
- ˆ Algal growth
- ˆ Effects of water quality on slough species:
  - ˆ Fish, bivalve





# Background



- ˆ Eutrophication can contribute hypoxia (Vitousek et al. 1997)
- ˆ Hypoxia more severe when water movement is restricted (Caffrey et al. 2003)
- ˆ Fish experience stress in high and low oxygen conditions (Ross et al. 2001)
- ˆ Hypoxia can limit oyster growth; Olympia oyster declining (Cheng et al. 2015, Wasson 2010)

# Study system

Elkhorn Slough,  
Central California



# Study system

- Elkhorn Slough, Central California
- Two stress tolerant species

- Olympia oyster



# Study system

- Elkhorn Slough, Central California
- Two stress tolerant species

- Staghorn sculpin





# Approach

- 2 sites with unrestricted tidal flow



# Approach

- 4 sites with restricted tidal flow



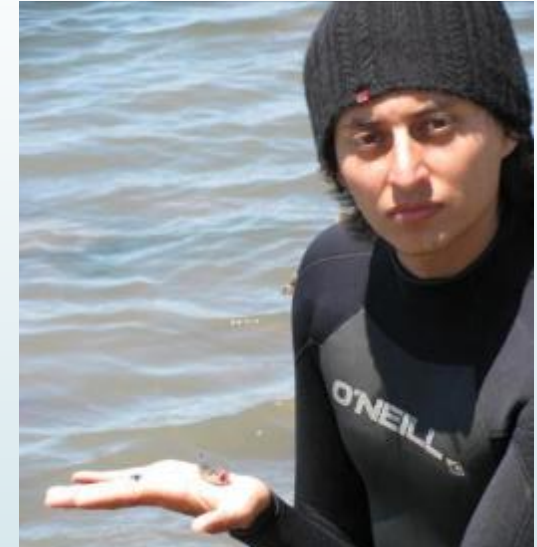
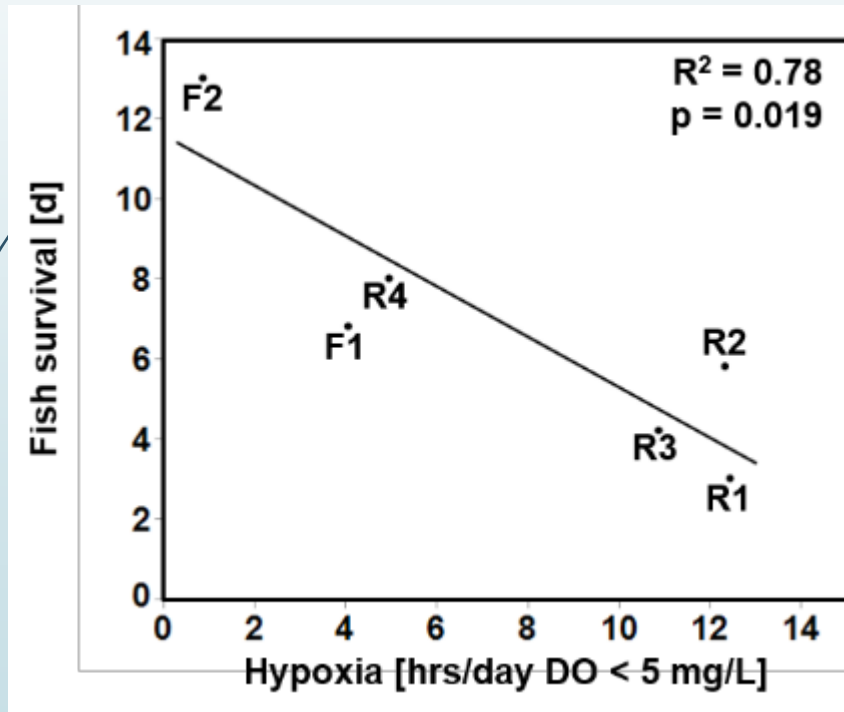
# Approach

- Deploy in cages
  - Olympia oyster
  - Staghorn sculpin
- Measured
  - Oyster growth
  - Fish survival
  - Water quality
  - Nutrient concentrations



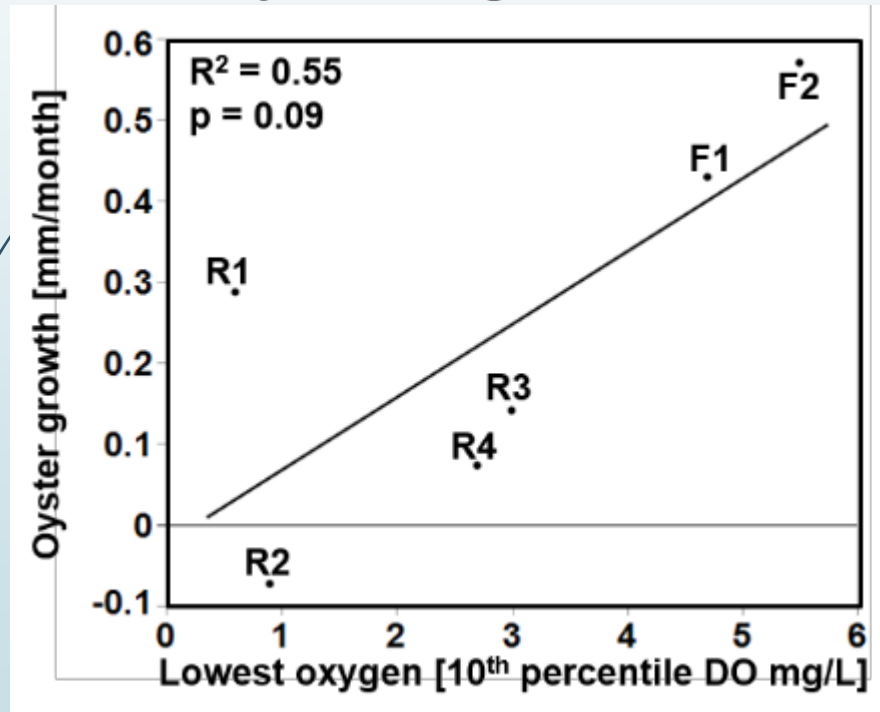
# At tidally restricted sites

ˆ Fish died



# At tidally restricted sites

Oysters grew less



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# Significance

- ˆ Extended and frequent events of hypoxia
  - ˆ is lethal for fish
  - ˆ limits oyster growth
- ˆ Staghorn sculpins are prey for crabs, leopard sharks, shorebirds
- ˆ Oysters improve water quality, provide refuge
- ˆ Nutrients and hypoxic conditions alter estuarine system

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# Management implications

- ˆ Protect habitats by preventing further degradation
- ˆ Decrease eutrophication by working with local community
- ˆ Increase water flow in restricted areas
- ˆ Protect valuable habitats for fish, birds, mammals

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# QUESTIONS?




# Additional

Estuaries and Coasts  
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## Effects of Hypoxia on Fish Survival and Oyster Growth in a Highly Eutrophic Estuary

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**Abstract** Human land use activities around estuaries can result in high levels of eutrophication. At Elkhorn Slough estuary, a highly eutrophic California estuary, we investigated the effects of impaired water quality on two stress-tolerant estuarine species, a common fish, the staghorn

diurnal fluctuations in dissolved oxygen and extended nighttime hypoxia can have lethal and sub-lethal effects even on stress-tolerant organisms in the estuary. While laboratory experiments have often shown such effects, it is relatively rare to demonstrate negative effects of oxy-