Apr 30th, 1:30 PM - 3:00 PM

Oyster recruitment and climate change: do higher summer temperatures mean earlier and greater settlement in Pacific oysters?

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Valdez, Stephanie; Gross, Collin; and Ruesink, Jennifer, “Oyster recruitment and climate change: do higher summer temperatures mean earlier and greater settlement in Pacific oysters?” (2014). *Salish Sea Ecosystem Conference*. 79.  

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Oyster recruitment and climate change: do higher summer temperatures mean earlier and greater recruitment in Pacific oysters?

Stephanie Valdez
Collin Gross
Water properties show variability at multiple timescales
Water properties show variability at multiple timescales

• Long-term trends

Race Rocks August Water Temperature (C)

http://www.racerocks.com/racerock/data/seatemp/seatemppast.htm
Water properties show variability at multiple timescales

- Long-term trends
- Decadal oscillations

http://jisao.washington.edu/pdo/PDO.latest
Water properties show variability at multiple timescales

- Long-term trends
- Decadal oscillations
- Extreme events

[ENSO Index chart]

http://www.esrl.noaa.gov/psd/enso/mei/
Water properties show variability at multiple timescales

- Long-term trends
- Decadal oscillations
- Extreme events
- Interannual variation

http://www.pfel.noaa.gov/products/PFEL/modelled/indices/upwelling/NA/data_download.html
Biological “fingerprints” of climate change in marine systems

- “Responder” species shift their peaks in abundance earlier in the year
- Some species shift later

**Context**

**Questions**

**Methods**

**Results**

**Conclusions**

Edwards and Richardson 2004 Science
Test for a biological fingerprint of climate change in Pacific oysters (*Crassostrea gigas*), a commercially-valuable non-native species in the Salish Sea.
Temperature Effects on the Pacific Oyster Life Cycle

Context

Questions

Methods

Results

Conclusions

Spawning

Conditioning

Fertilization

Larval Development

Settlement (Spatfall)

Recruitment density

Development time

Spawning time

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Are temperature trends distinguishable despite other scales of variability in these oyster-setting regions?

Has oyster recruitment changed over time?

Does oyster recruitment vary with temperature?
• Three main regions where Pacific Oysters are established
• Commercial spatfall has been monitored.
Fishery and aquaculture data sets extracted from historic records

0.5 mm Pacific oyster spat
### Water Temperatures Rising

#### Context

Average Monthly Temperature for July and August (°C)

#### Questions

- Willapa Bay
- Hood Canal
- Pendrell Sound

#### Methods

#### Results

- **Willapa Bay**: $R^2 = 0.0698$
- **Hood Canal**: $R^2 = 0.135$
- **Pendrell Sound**: $R^2 = 0.0507$

#### Conclusions
Increasing or Steady Trend in Recruitment over Time

**Willapa Bay**

- Maximum Seasonal Recruitment
- $R^2 = 5E-0$

**Hood Canal**

- Maximum Seasonal Recruitment
- $R^2 = 0.280$

**Pendrell Sound**

- Maximum Seasonal Recruitment
- $R^2 = 0.033$
Recruitment Increases with Temperature

Average Monthly Temperature for July and August (°C)

Context
Questions
Methods
Results
Conclusions
1) Are temperature trends distinguishable despite other scales of variability in these oyster-setting regions?

Yes, warming in Hood Canal and Willapa Bay

2) Has oyster recruitment changed over time?

Also Yes, increasing in Hood Canal and Pendrell Sound

3) Does oyster recruitment vary with temperature?

Yes, higher recruitment in warmer years!

**Temperature variability \(\rightarrow\) easier to detect “responders” but harder to detect trends**
Non-native species may be better able to take advantage of warmer aquatic systems than are native species

• Non-native aquatic species respond more positively (or less negatively) than natives

Sorte et al. 2013 Ecology Letters
Thanks!
Any Questions?

Special Thanks to Dr. Jennifer Ruesink, University of Washington
Data provided by: Washington State Department of Fisheries and British Columbia Department of Fisheries and Oceans
Positive correlation between late-stage larval counts and spatfall counts in Pendrell Sound

\[ R^2 = 0.3784 \]
In Willapa Bay, native oysters have similar recruitment regardless of water temperature.
In Willapa Bay, warmer years have earlier recruitment (lower day of year when “set” occurs)