



Apr 5th, 1:30 PM - 1:45 PM

## Warm water temperature regimes in eelgrass beds (*Z. marina* and *Z. japonica*) of Padilla Bay, WA

Heath Bohlmann

*Padilla Bay Research Reserve, United States, hbohlmann@padillabay.gov*

Jude K. Apple

*Padilla Bay Research Reserve, United States, japple@padillabay.gov*

Nicole Burnett

*Padilla Bay Research Reserve, United States, nburnett@padillabay.gov*

Suzanne Shull

*Padilla Bay Research Reserve, United States, sshull@padillabay.gov*

Follow this and additional works at: <https://cedar.wwu.edu/ssec>



Part of the [Fresh Water Studies Commons](#), [Marine Biology Commons](#), [Natural Resources and Conservation Commons](#), and the [Terrestrial and Aquatic Ecology Commons](#)

---

Bohlmann, Heath; Apple, Jude K.; Burnett, Nicole; and Shull, Suzanne, "Warm water temperature regimes in eelgrass beds (*Z. marina* and *Z. japonica*) of Padilla Bay, WA" (2018). *Salish Sea Ecosystem Conference*. 313.

<https://cedar.wwu.edu/ssec/2018ssec/allsessions/313>

This Event is brought to you for free and open access by the Conferences and Events at Western CEDAR. It has been accepted for inclusion in Salish Sea Ecosystem Conference by an authorized administrator of Western CEDAR. For more information, please contact [westerncedar@wwu.edu](mailto:westerncedar@wwu.edu).

**Warm water temperature regimes in eelgrass  
beds (*Z. marina* and *Z. japonica*) of  
Padilla Bay, WA.**



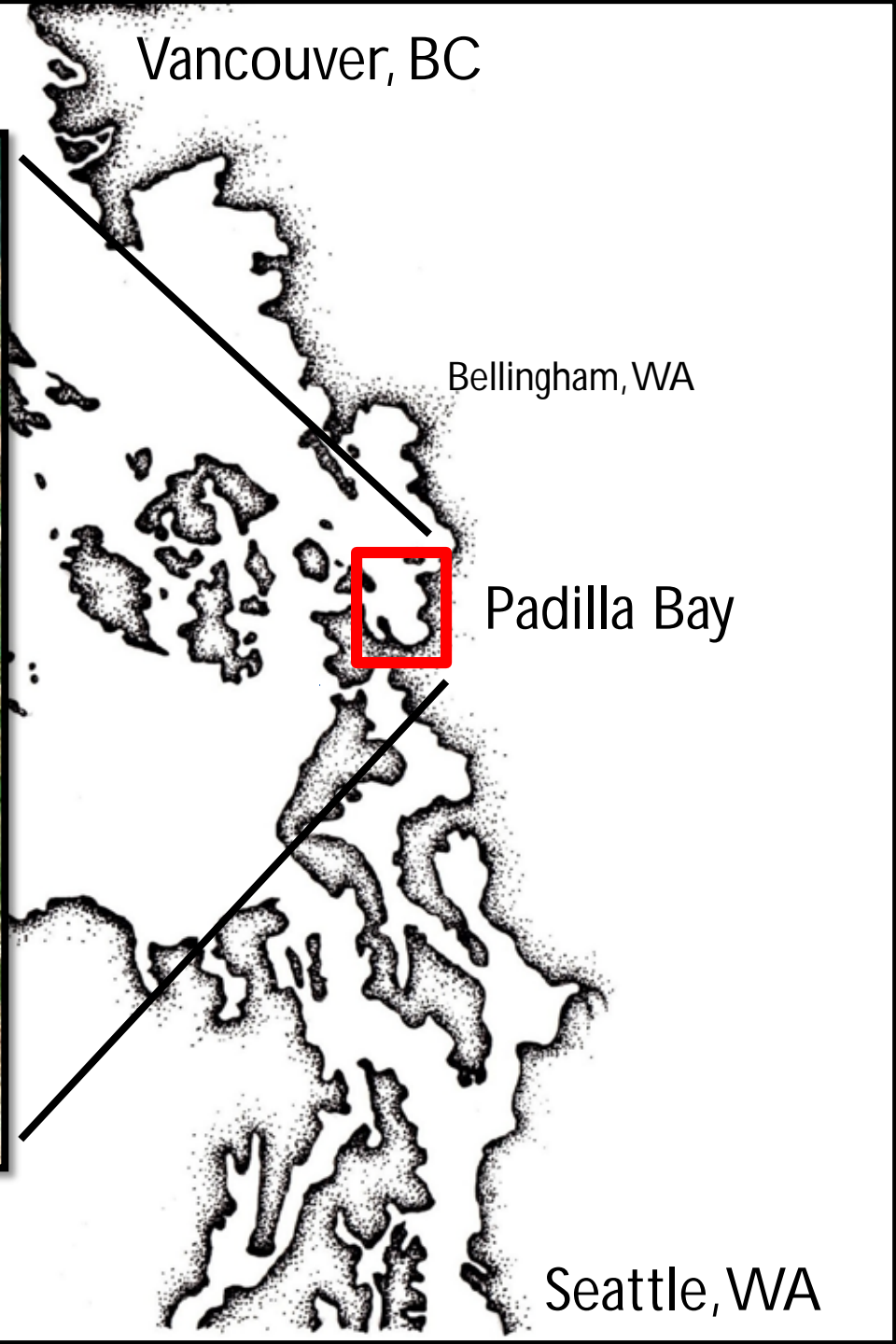
**Heath Bohlmann\*, Jude Apple, Nicole Burnett, Suzanne Shull**

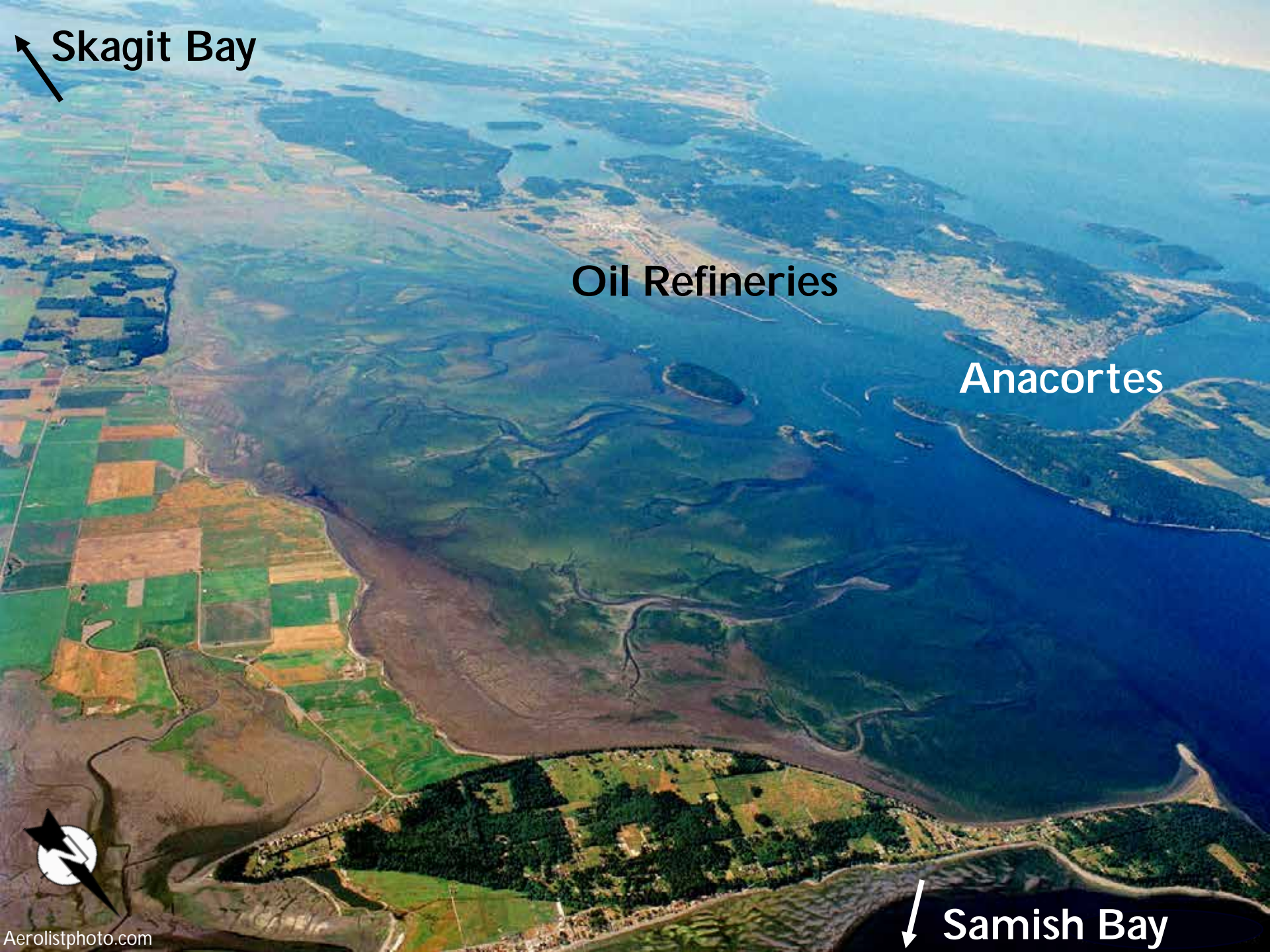
Vancouver, BC

Bellingham, WA

Padilla Bay

Seattle, WA





Skagit Bay

Oil Refineries

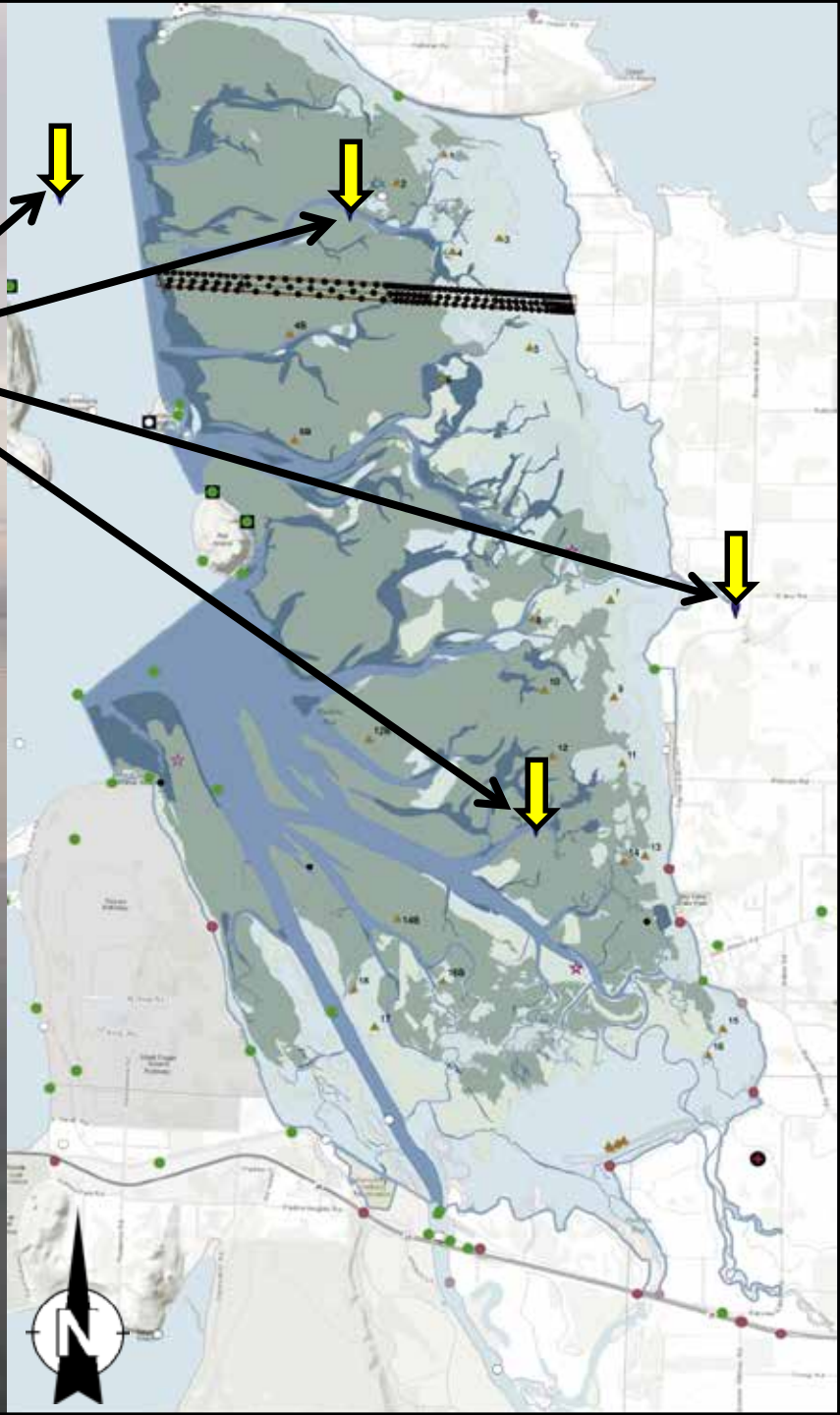
Anacortes

Samish Bay



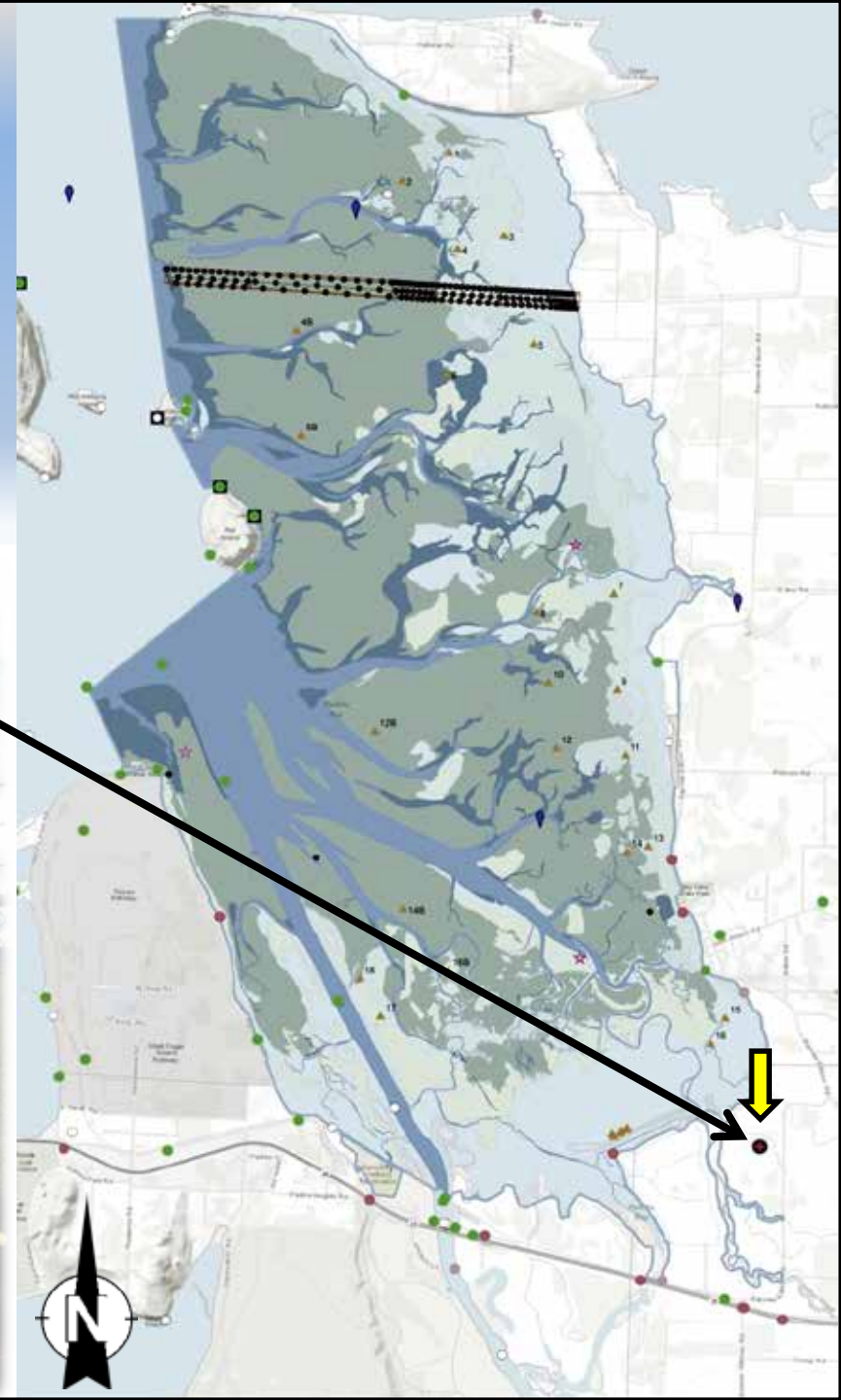
# Long Term Monitoring

- Water Quality
- Nutrients
- Weather
- Eelgrass



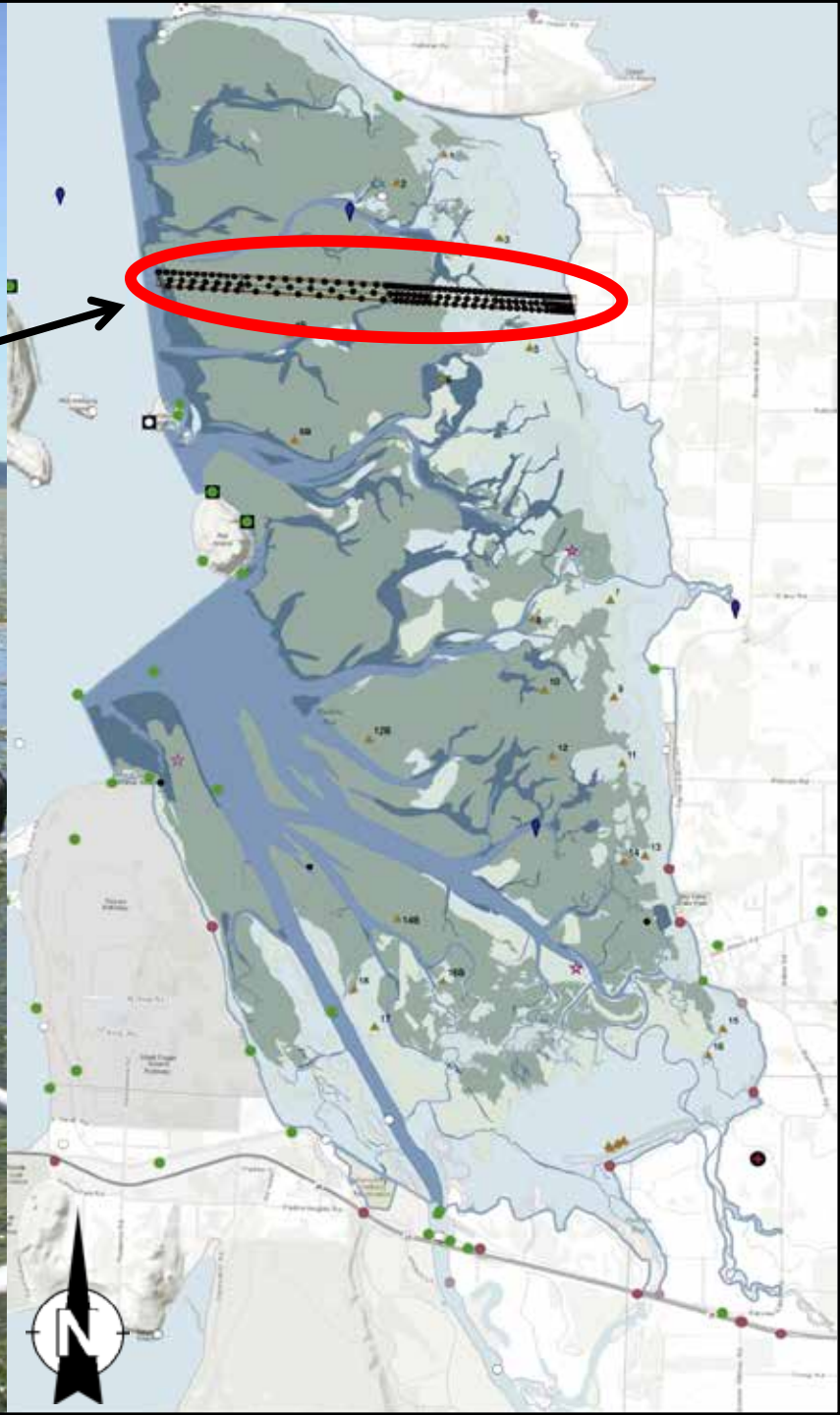
# Long Term Monitoring

- Water Quality
- Nutrients
- Weather →
- Eelgrass



# Long Term Monitoring

- Water Quality
- Nutrients
- Weather
- Eelgrass →



# Ecological drivers of eelgrass health:

**Temperature**

**Light availability**

**Nutrients**





# Optimal eelgrass temperatures PNW and worldwide

Marina:

PNW: Optimal

7 - 13 °C (Thom

7 - 12 °C (Thom

6 - 10 °C (Thom

PNW: Str

PNW P max 11

Temperature

Worldwide

Photosynthe

Japonica

PNW/world:

<8 °C inhibits

Tolerates short

Chronic exposure over 35 °C = death.

(Lee et al., 2007; Shafer et al., 2008; Shafer et al., 2011, Kaldy 2015)

## Optimal temps for growth from literature

### PNW

**Z. marina 5-13 °C**

**Z. japonica 18.5-20 °C**

### Worldwide

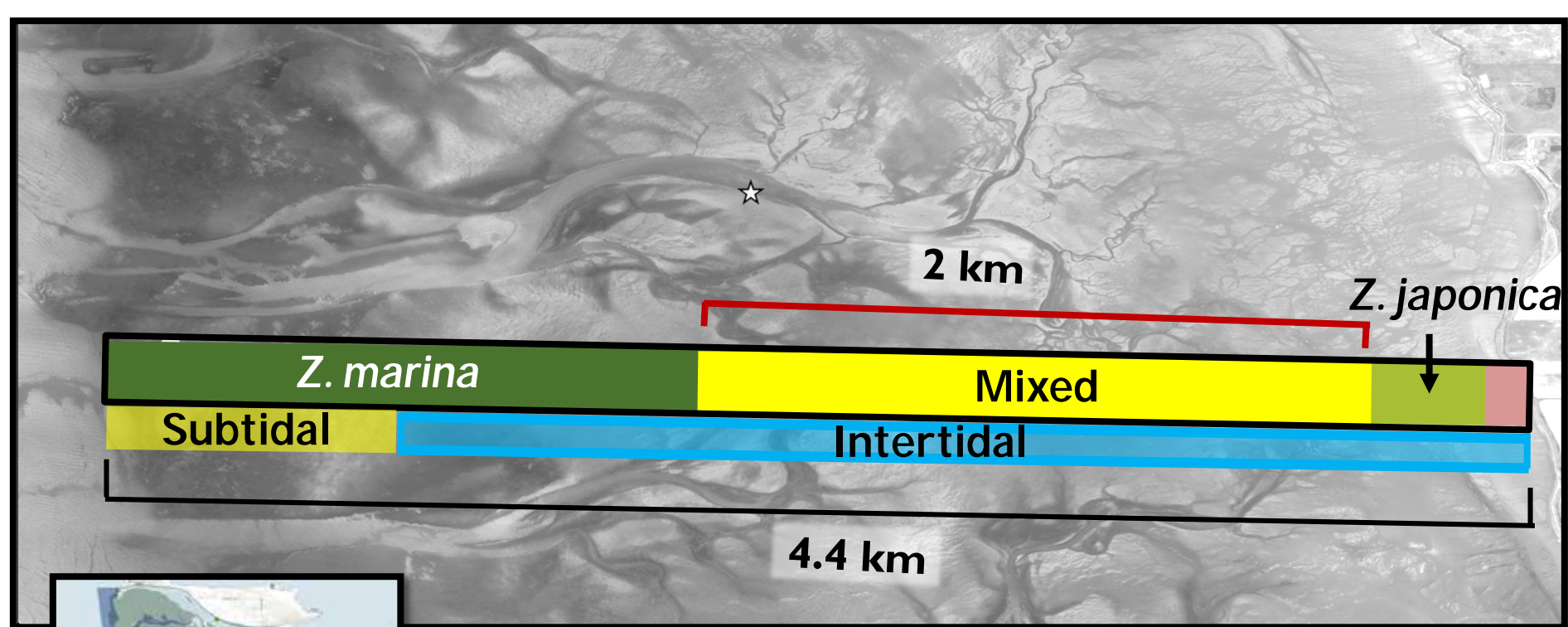
**Z. marina 15.3 ( $\pm$ 1.6) °C**

**Z. japonica 18.5 ( $\pm$ 3.5) °C**

Thom *et al.* 2001-2008, Lee *et al.* 2007, Shafer *et al.* 2008,  
2011; Kaldy *et al.* 2015

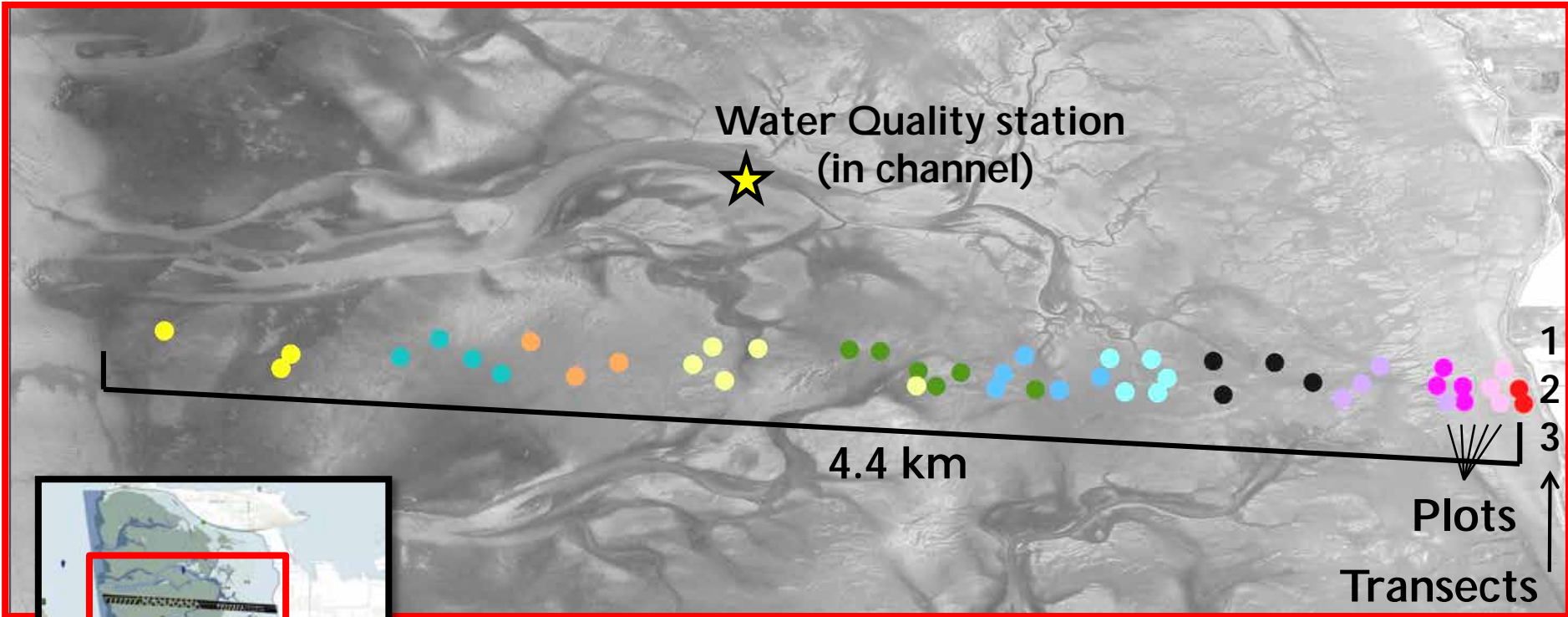
# Questions:

- What are the temperatures regimes experienced by eelgrass in Padilla Bay?
- How do temperatures in Padilla Bay compare to the literature and to other areas (locally/regionally)?
- How might future warming influence eelgrass in Padilla Bay?



**Eelgrass species distribution within the long term monitoring area.**

# Temperature Logger Locations



3 transects  
4.4 km in length  
Intertidal through subtidal  
48 temperature loggers  
15 min sample interval

Hobo Pendant loggers  
( $\pm 0.5^{\circ}\text{C}$ )

Mounted on screw anchors

Radiation shield  
(on intertidal loggers)



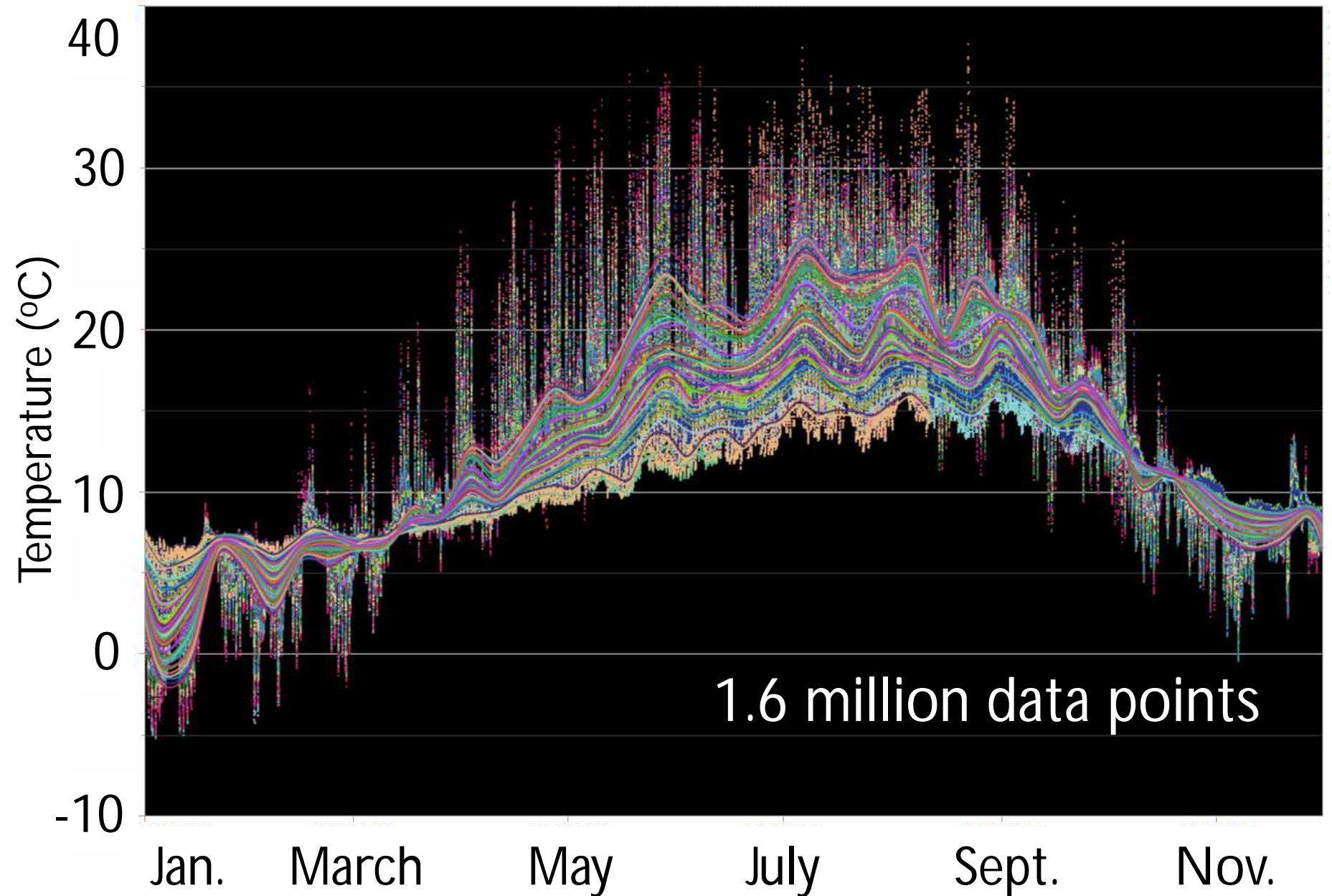
The image shows a wide, flat beach covered in dark, wet sediment and seaweed. Two cylindrical samplers are placed on the surface. The one on the left is white with a grid of small holes and is partially buried in the sediment. The one on the right is clear plastic with an orange band and is also partially buried. The background shows a distant shoreline with trees and mountains under a blue sky with light clouds.

**Without radiation shield**

**With radiation shield**

**Installed level with sediment surface**

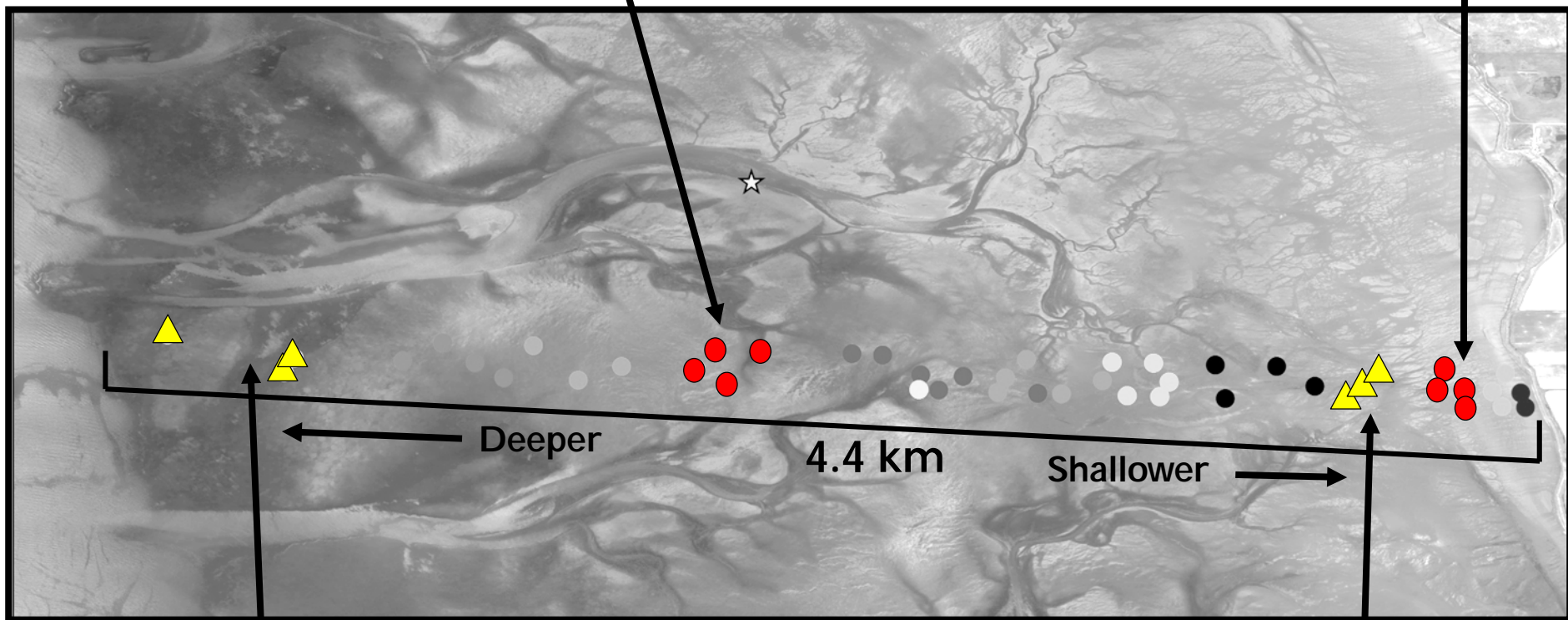
# 2017 Temperature Data



# Select locations of data:

Lowest  
*Z. japonica*

Highest  
*Z. japonica*

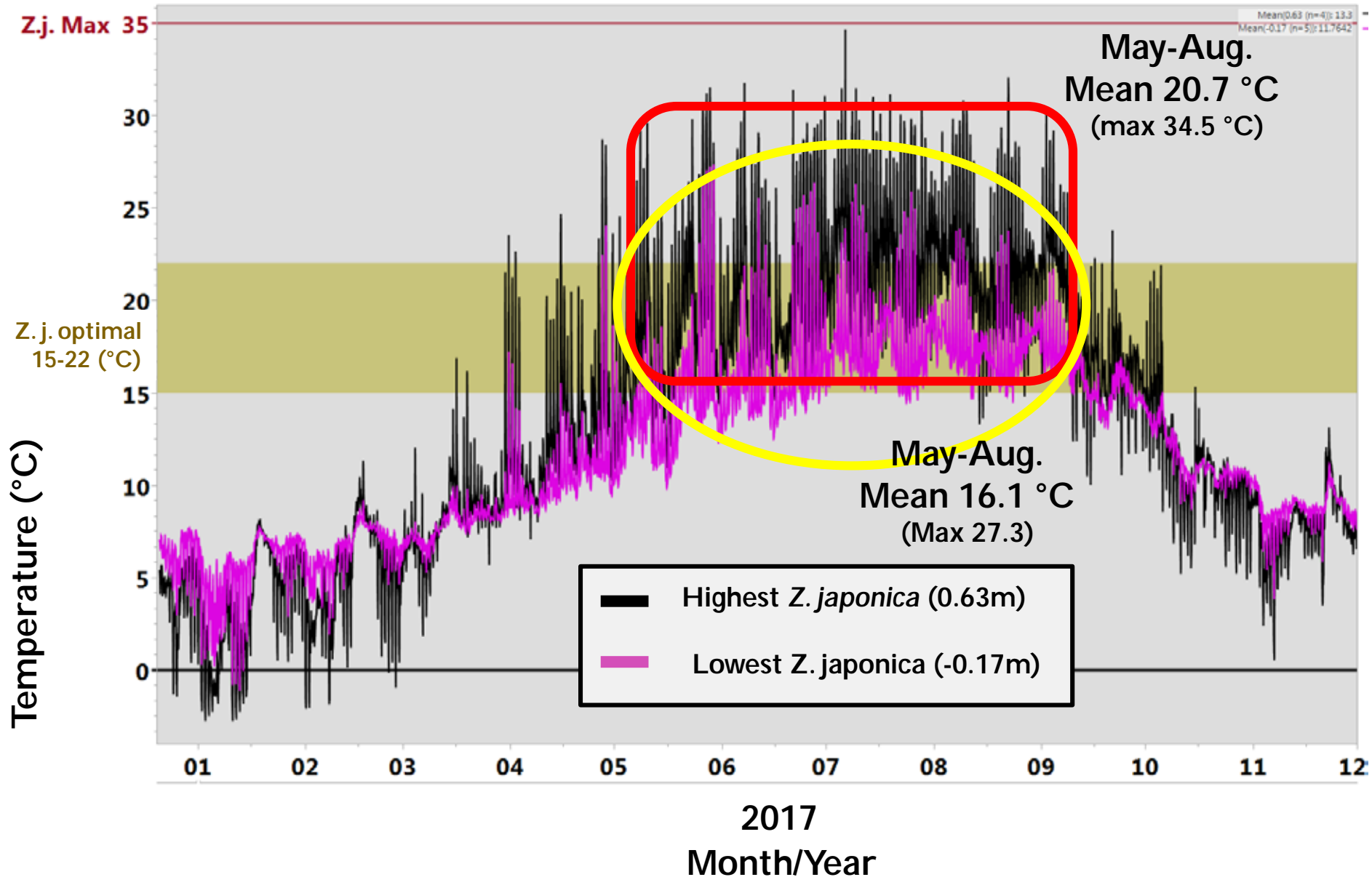


Subtidal  
*Z. marina*

Highest  
*Z. marina*

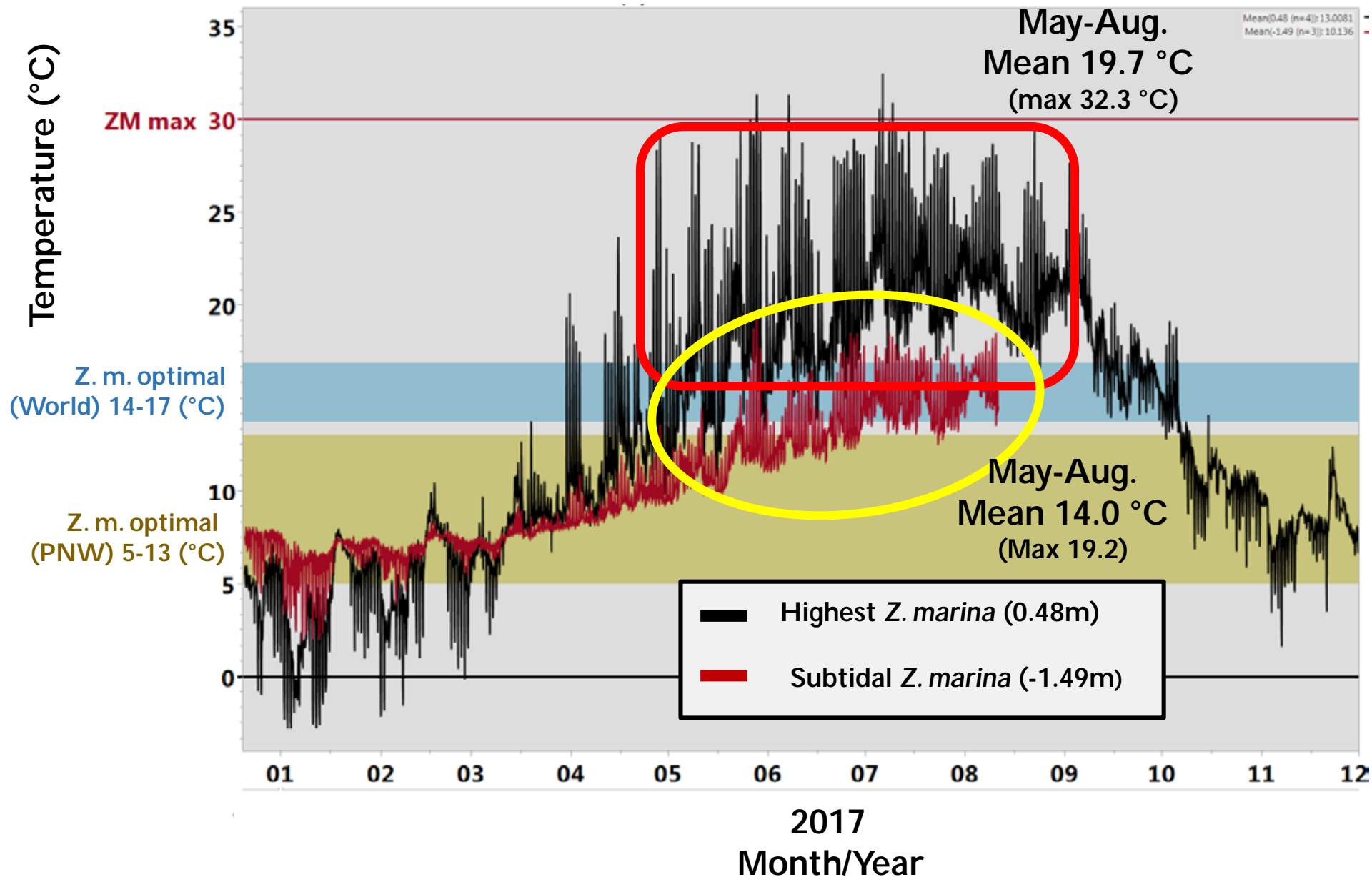


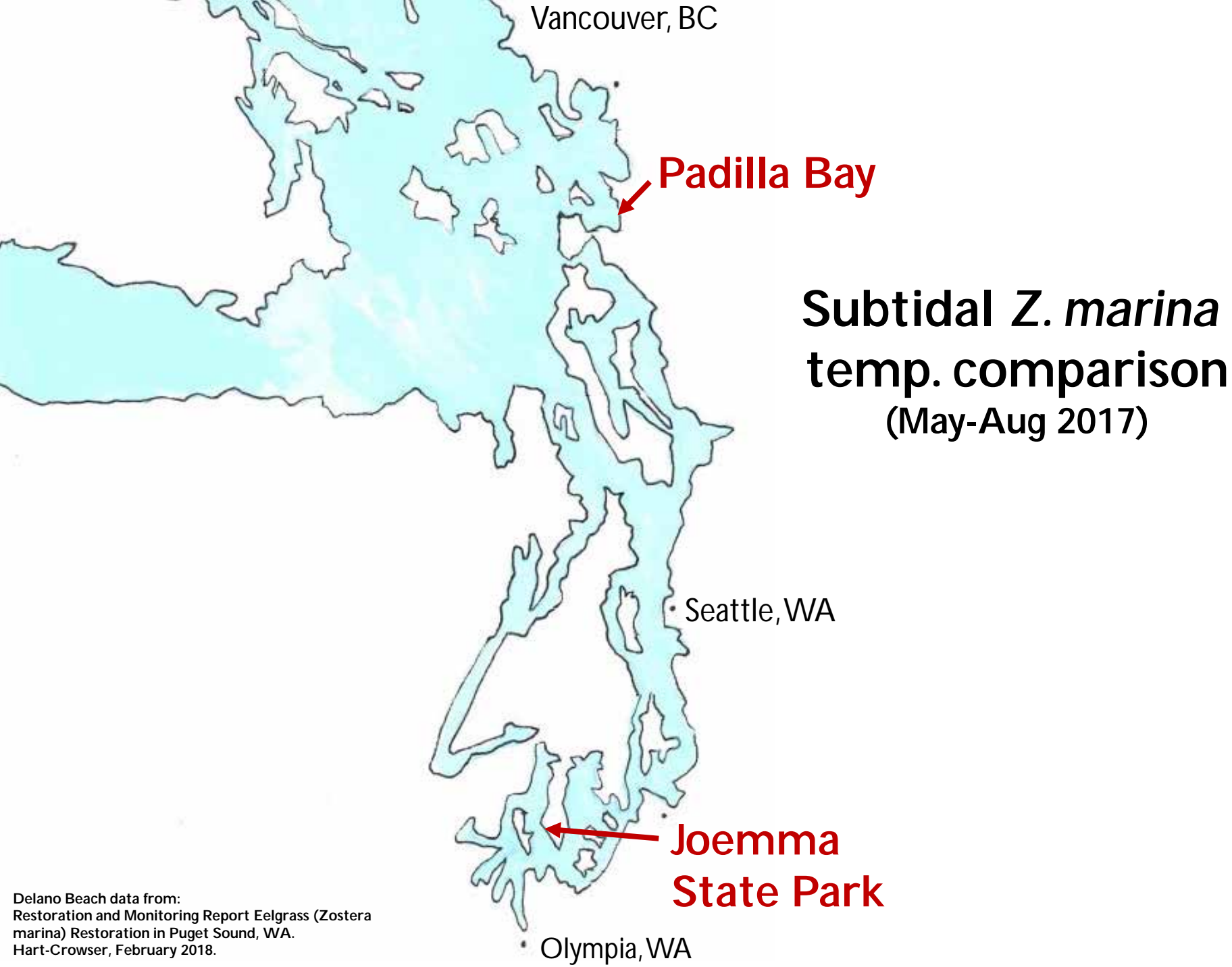
# *Zostera japonica* mean temp. by elevation (relative to MLLW)



# *Zostera marina* mean temp. by elevation

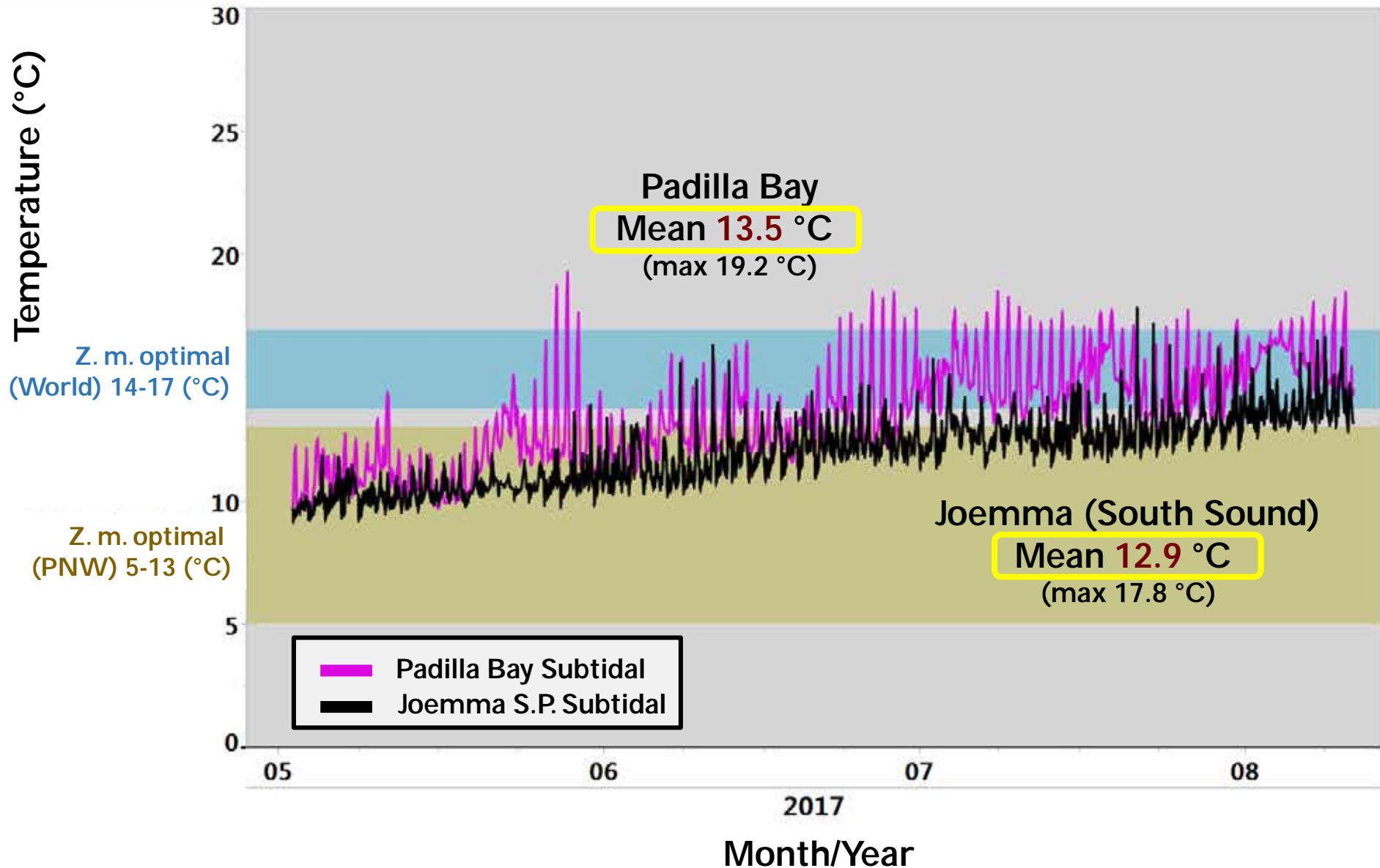
(relative to MLLW)



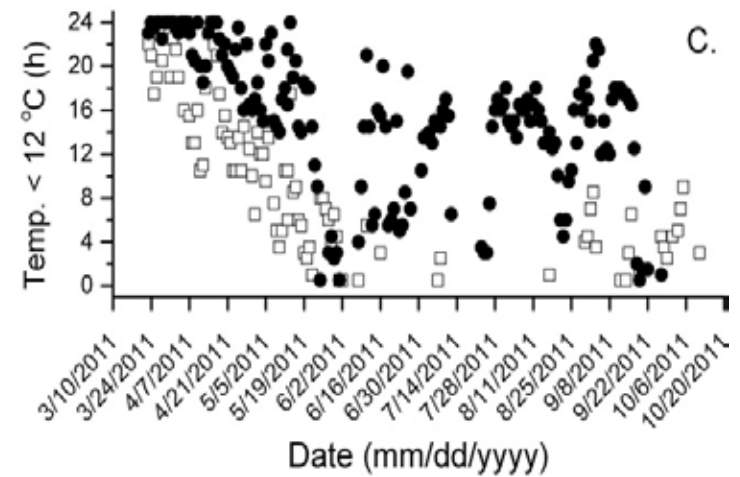
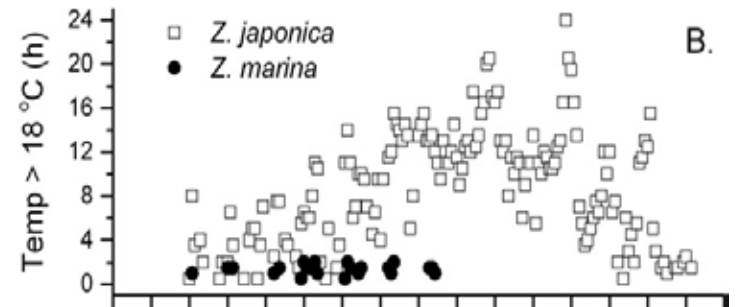
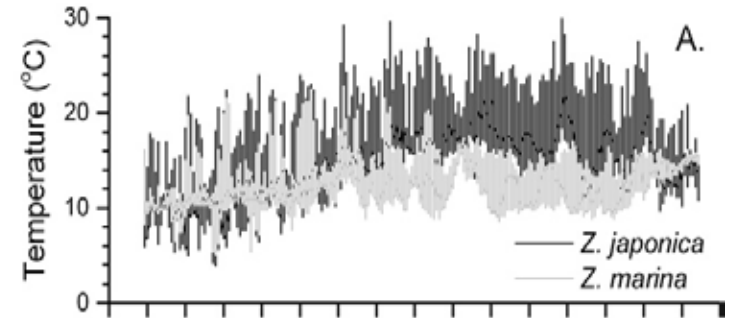
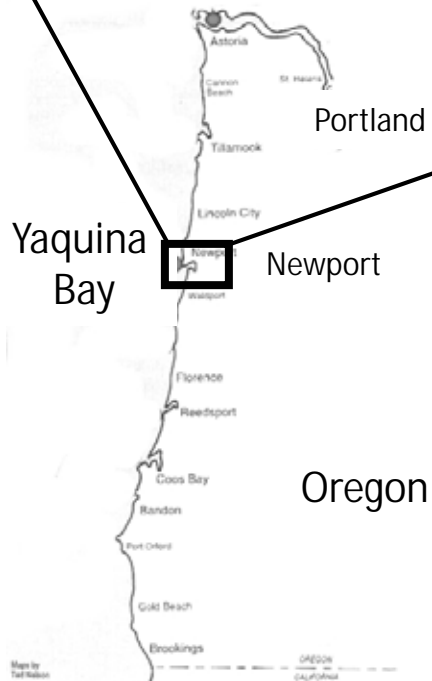
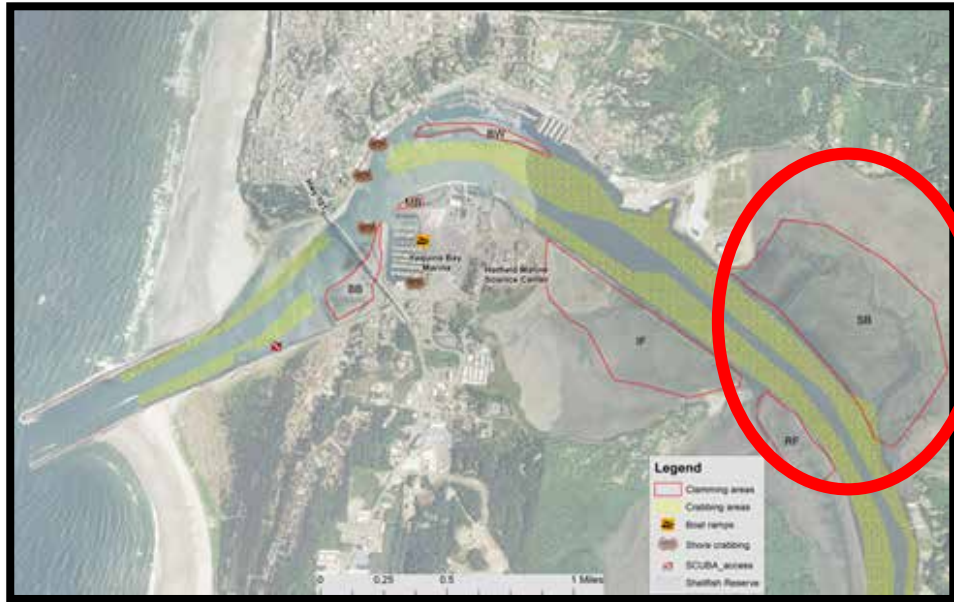


Delano Beach data from:  
Restoration and Monitoring Report Eelgrass (*Zostera marina*) Restoration in Puget Sound, WA.  
Hart-Crowser, February 2018.

# Subtidal *Z. marina* (temperatures recorded May 2 - Aug 11, 2017)



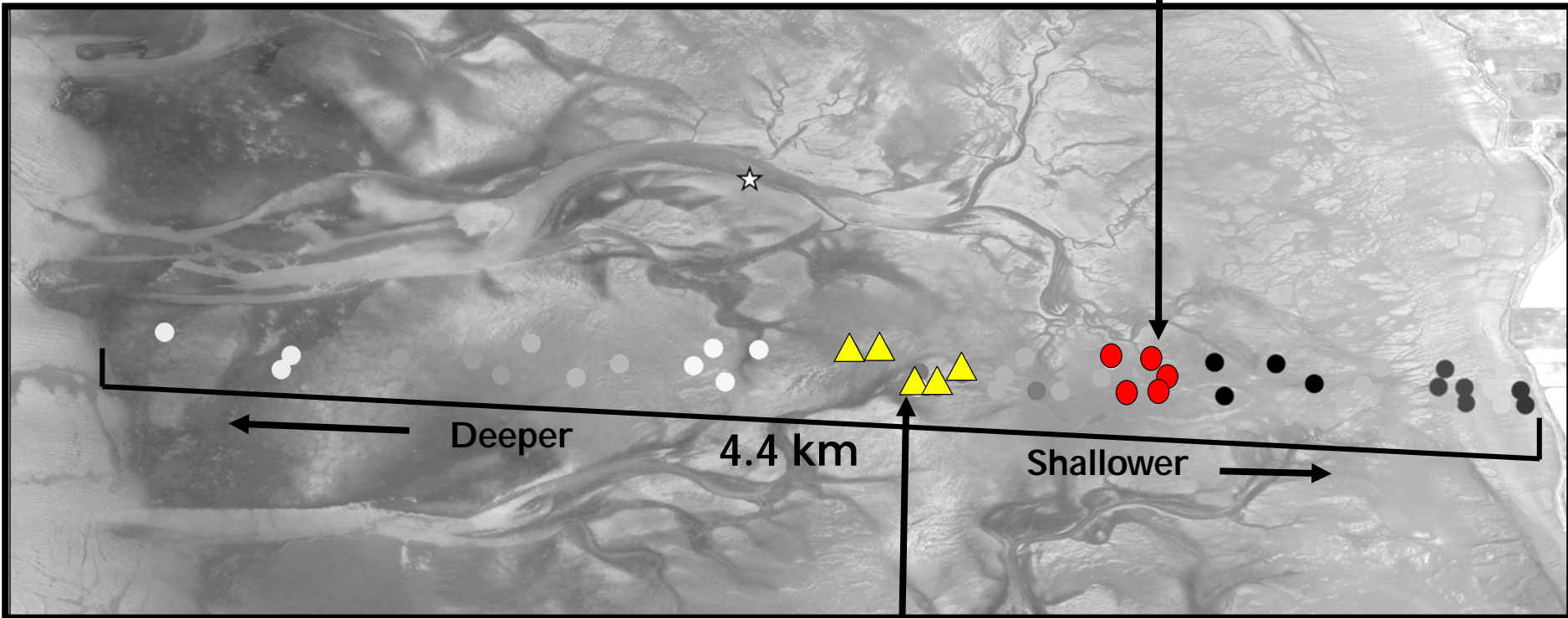
# Yaquina Bay, OR (Sally's Bend)



Kaldy et al. 2015

# Select locations of Padilla Bay data:

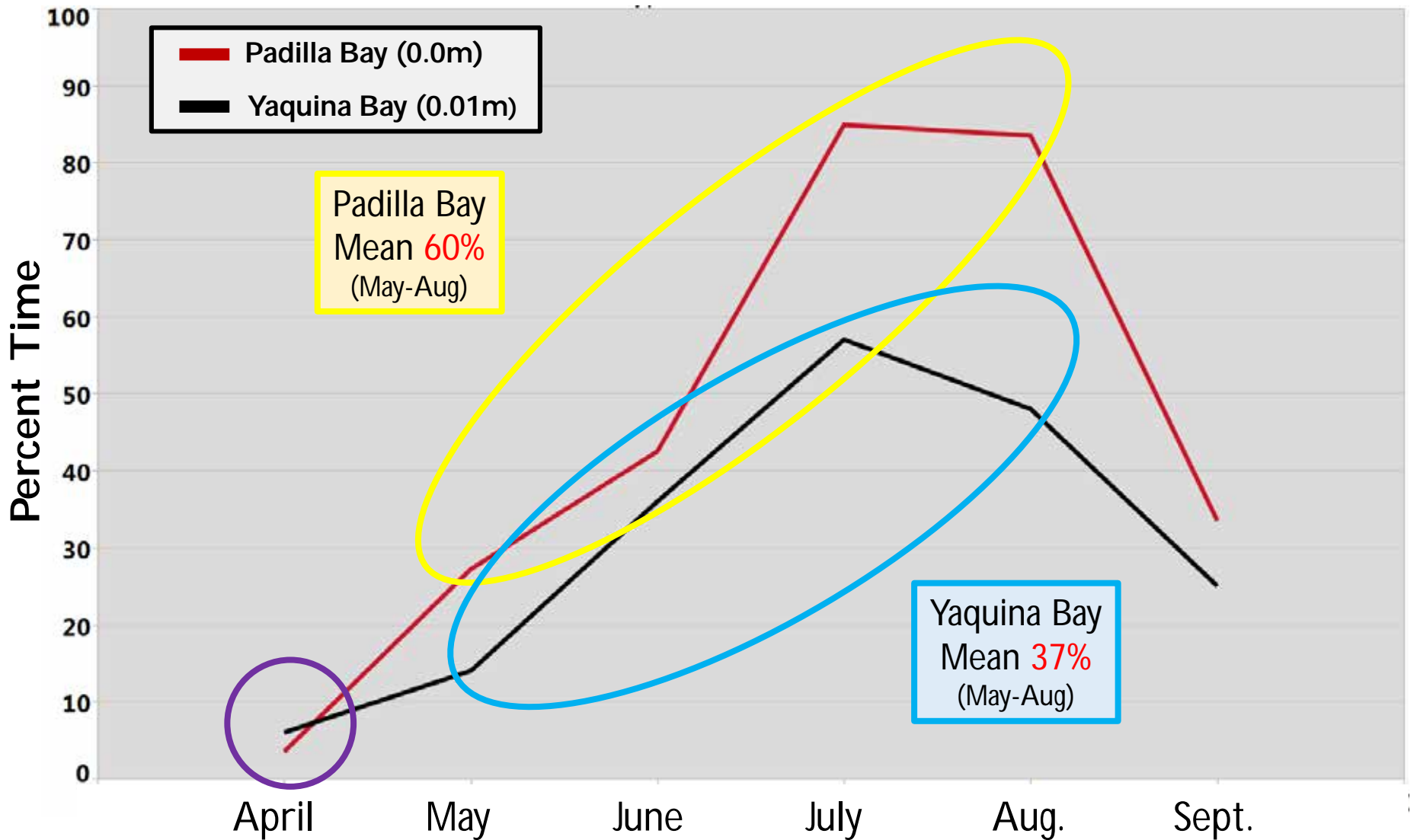
Highest density  
*Z. japonica*



Highest density  
*Z. marina*

# Percent time above 18 °C

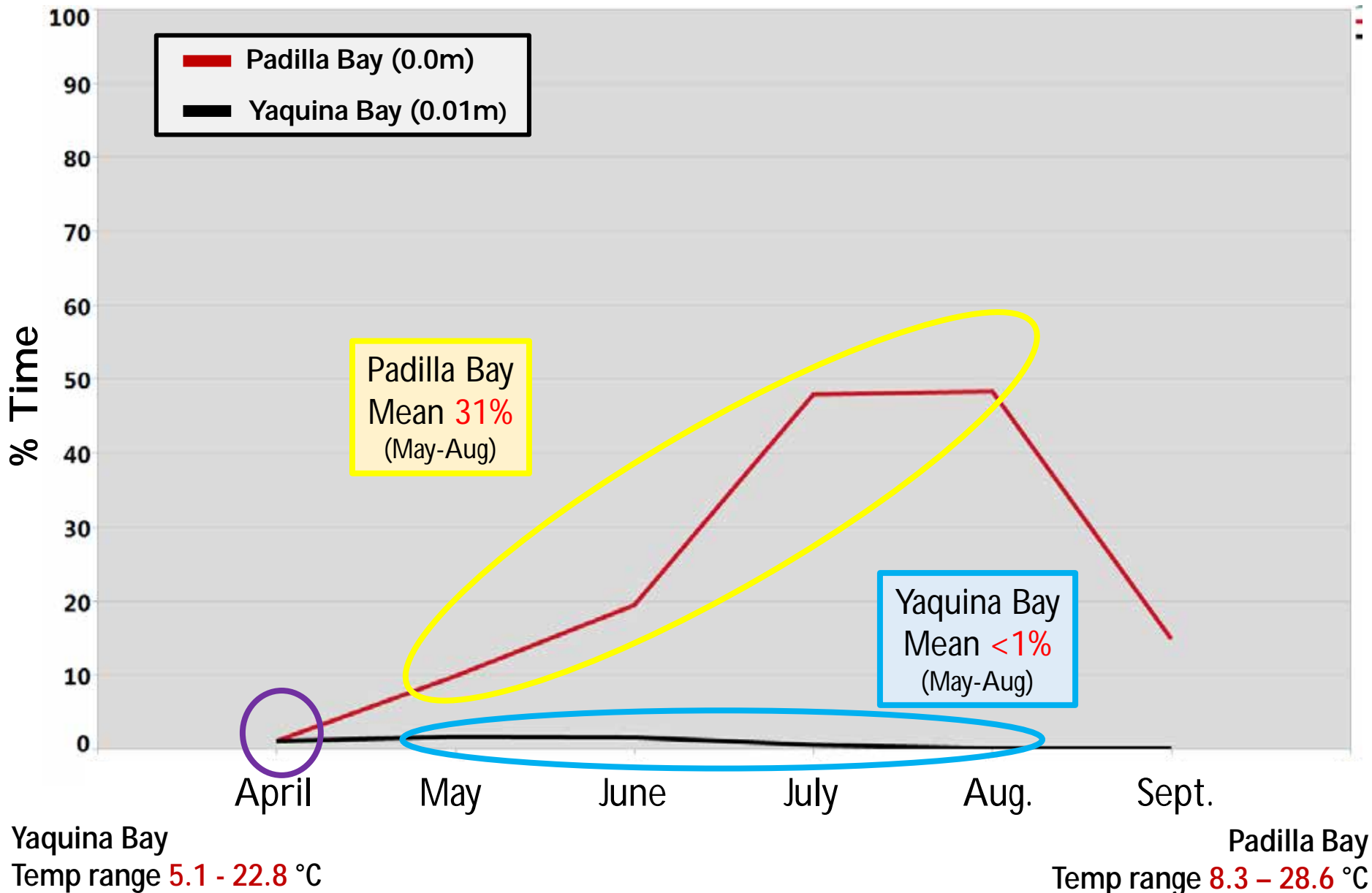
## Intertidal *Z. japonica*



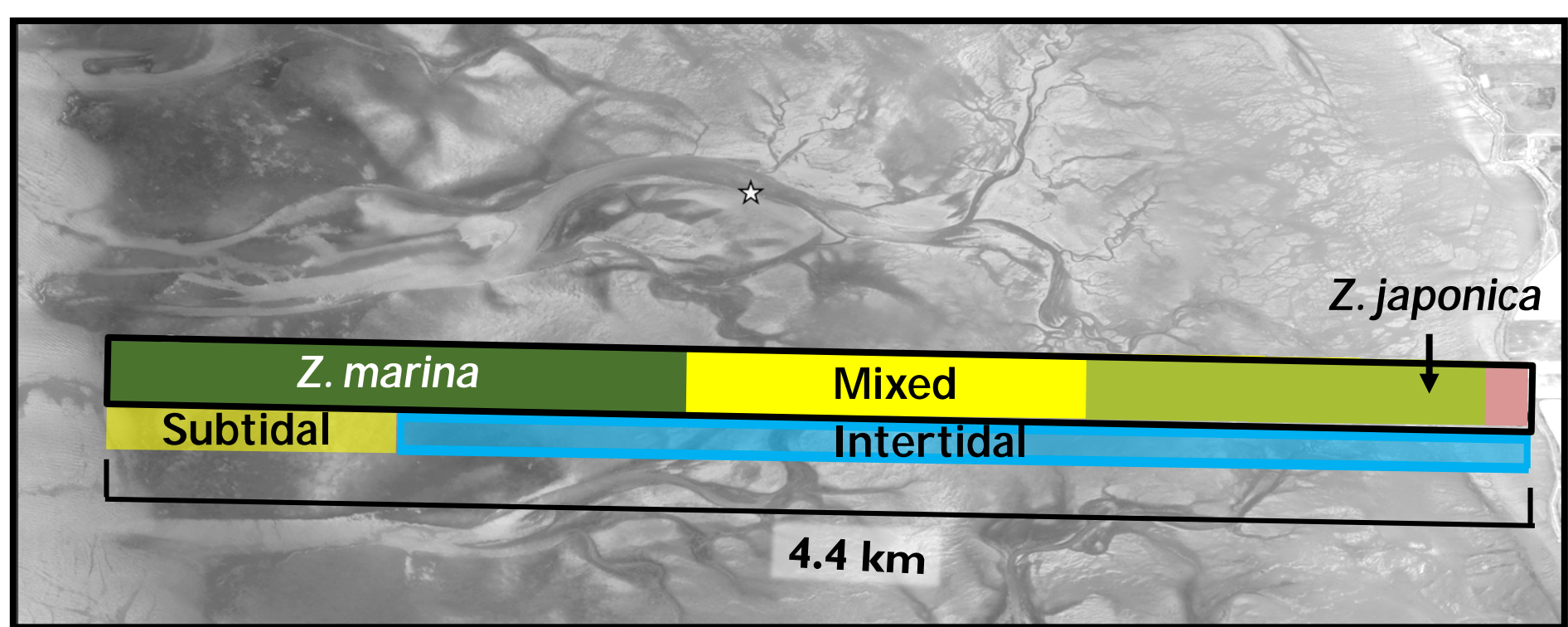
Yaquina Bay  
Temp range 3.9 - 29.9 °C

Padilla Bay  
Temp range 8.4 - 31.9 °C

# Percent time above 18°C Intertidal *Z. marina*



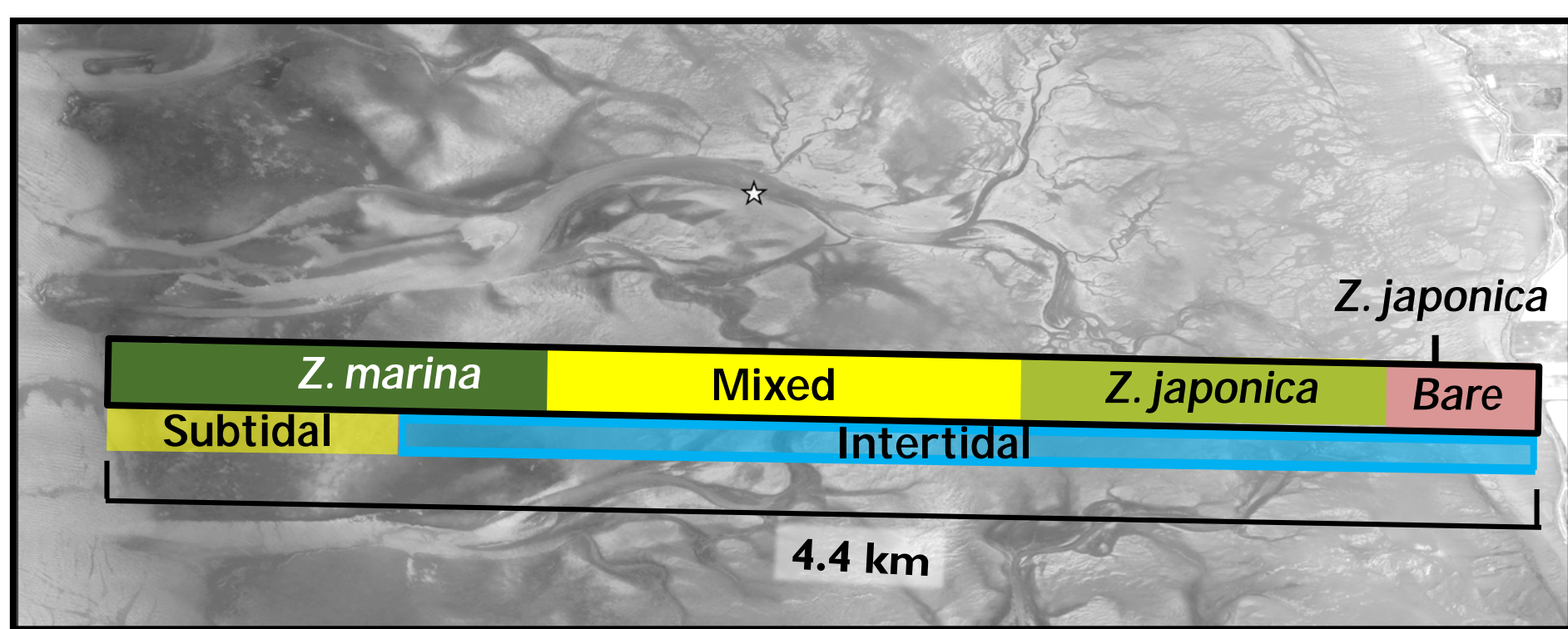




## Z. marina in warming temps.

Intertidal plants may be living near upper temp. range or have higher tolerance for summer heat stress.

Plants may be forced lower in the intertidal to mitigate for warmer temps.



## Z. japonica in warming temps.

Currently within their optimal summer temp. range

Plants may expand lower in the intertidal with warmer conditions but may be excluded from the highest elevations.

# Summary

## Z. japonica:

Mean temperatures in Padilla Bay during the summer are near optimal temps from the literature.

## Z. marina:

Temperatures in Padilla Bay during the summer are warmer than optimal temps from the literature.

Mean subtidal temps from Padilla Bay are similar to those from southern Puget Sound.

## Overall:

Probably a lot of variability of temps. both between and within eelgrass beds in the PNW, be thoughtful when comparing temperature regimes from different areas.

# Thank you!



**Jude Apple, Nicole Burnett, Suzanne Shull, WCC Interns, Padilla Bay Staff and Volunteers. Jeff Gaeckle, DNR/Hart-Crowser Staff and Kaldy et al. for comparative data.**



Contact info:

Heath Bohlmann

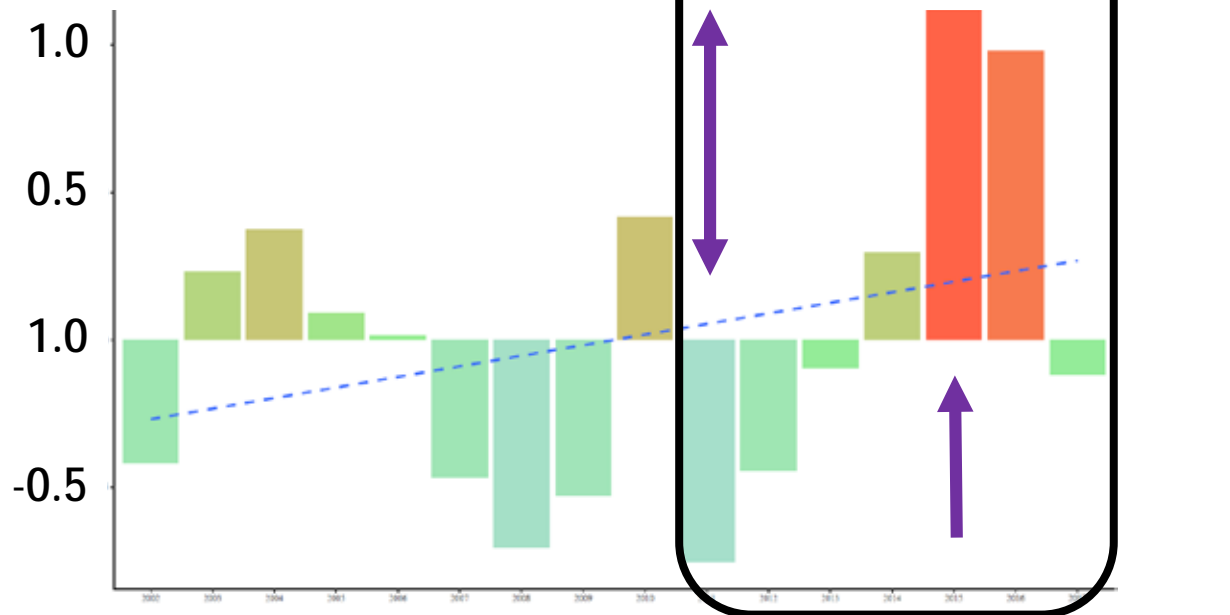
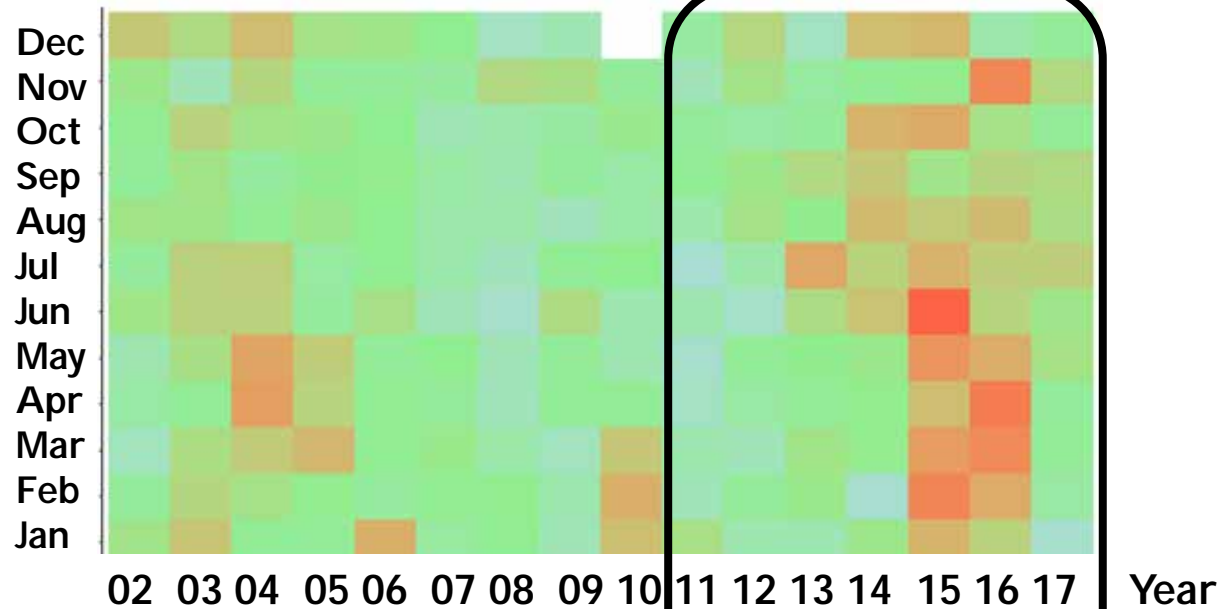
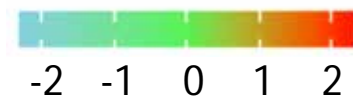
[hbohlmann@padillabay.gov](mailto:hbohlmann@padillabay.gov)

Long term monitoring data  
[nerrsdata.org](http://nerrsdata.org)

Padilla Bay Research Reserve  
[padillabay.gov](http://padillabay.gov)

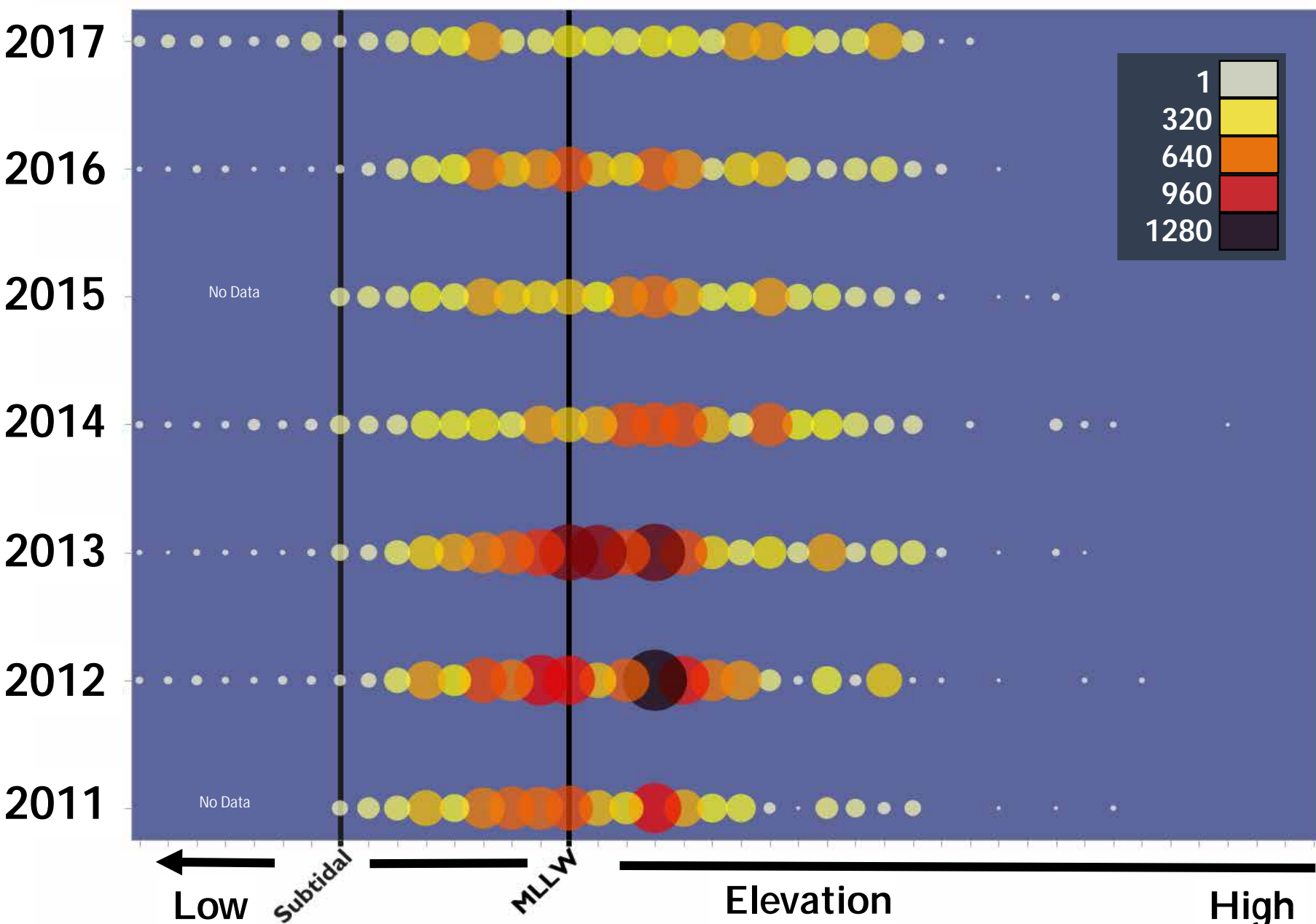


# Monthly water temp. anomalies



# Annual water temp. anomalies

# Z. marina mean density (m<sup>2</sup>) by year and elevation





**Warm water temperature regimes in eelgrass beds (*Z. marina* and *Z. japonica*) of Padilla Bay, WA.**

Heath Bohlmann, Jude Apple, Nicole Burnett, Suzanne Shull

Padilla Bay, WA has over 3300 hectares of eelgrass with vast areas of intermixed beds of the native *Zostera marina* and non-native *Zostera japonica*. Water temperature is thought to be one of the primary influences on eelgrass distribution, and long term monitoring shows that temperatures in Padilla Bay have increased substantially (mean increase >2°C) from 2011 through 2016. We were interested to see if changes in eelgrass distribution were correlated with the changes we observed in water temperature in Padilla Bay, however, our long term temperature monitoring station is located in a shallow channel within the eelgrass beds. Because of this sensor placement, we first needed to determine if these data were representative of temperatures experienced by eelgrass on the vegetated flats. To test this, we deployed 45 temperature loggers throughout the intertidal and subtidal distribution of *Z. marina* and *Z. japonica*. We found that temperatures recorded at our long term monitoring site greatly underestimated the high temperatures experienced by the intertidal eelgrass. In Padilla Bay, *Zostera marina* was exposed to temperatures above 8°C, the optimal temperature reported for *Z. marina* growth in the PNW, for over 90% of the time during the peak growing season (March – Sept.). Furthermore, *Z. marina* experienced extended periods of time above 15°C, temperatures thought to cause stress to local plants. Despite these elevated temperatures, *Z. marina* remain robust, suggesting that *Z. marina* in Padilla Bay may have a higher tolerance for warmer water temperatures than other beds in the PNW or may be living near the upper limits of tolerance for PNW plants. This study characterizes – on a fine spatial scale – the duration and intensity of temperatures extremes that eelgrass experience in shallow systems and ultimately provides insight into the health and performance of eelgrass in a warmer future ocean.

The premise is:

What are the temperatures experienced by eelgrass in Padilla Bay?

Are the temps we are recording at Ploeg are representative of the temps experienced by eelgrass on flats.

How does this compare to other areas with published temp data?

What are the implications for eelgrass in Padilla Bay knowing that temps are warmer than other areas in the PNW. Is this one of the reasons eelgrass is so productive here? Does this make Padilla more susceptible to warming water temps? What might we see if temps start becoming more unfavorable for eelgrass in Padilla (bi modal growth pattern with a drop in the summer)?