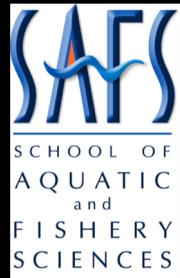
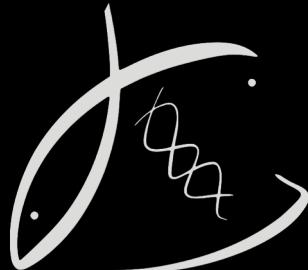


# PARENTAL WINTER EXPOSURES INFLUENCE OLYMPIA OYSTER LARVAE

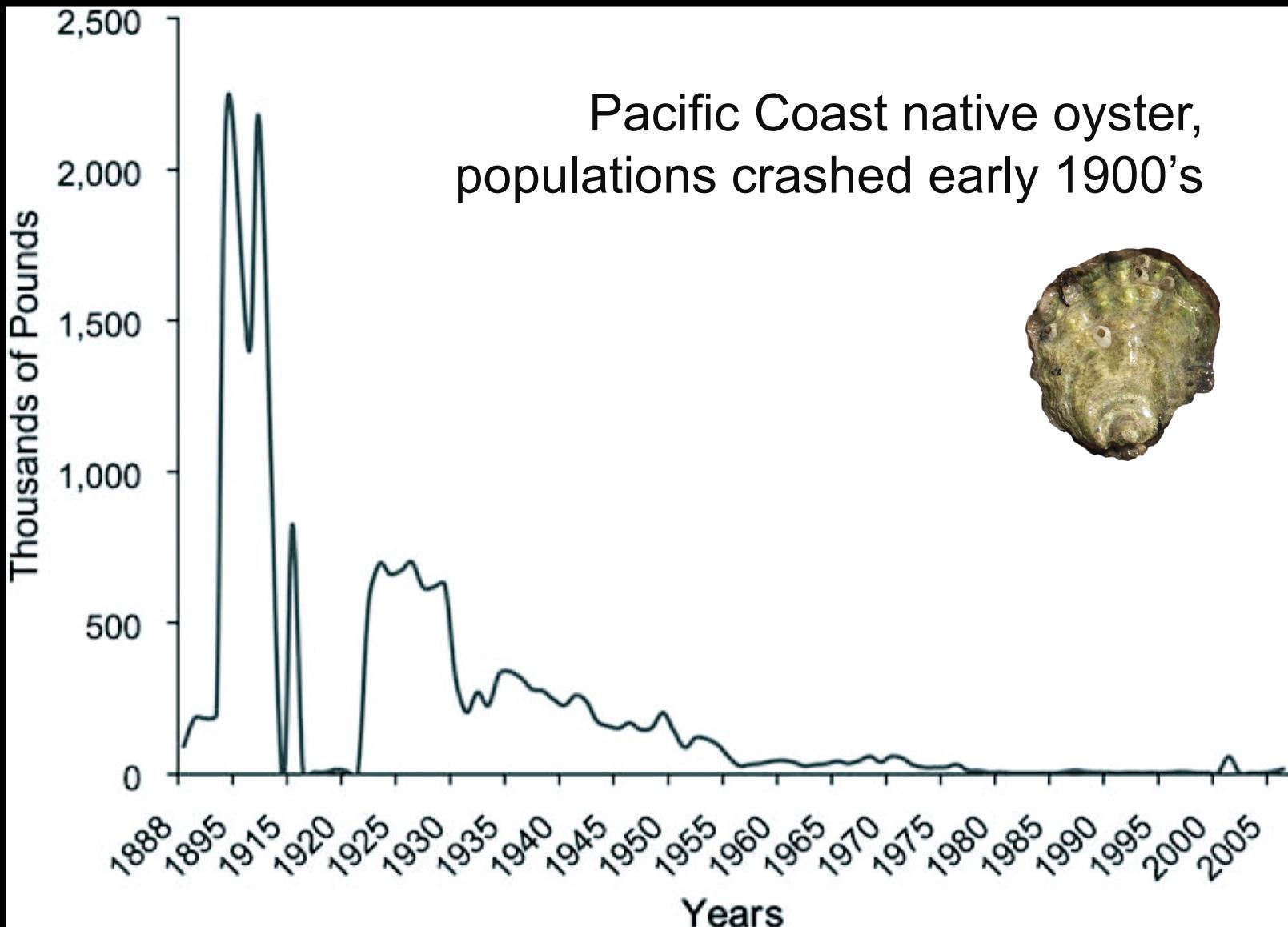
Laura H Spencer  
Roberts Lab

School of Aquatic and Fishery Sciences  
University of Washington  
NSA-PCS/PCSGA 2019 in Portland, OR

<https://laurahspencer.github.io/LabNotebook/>



# THE OLYMPIA OYSTER



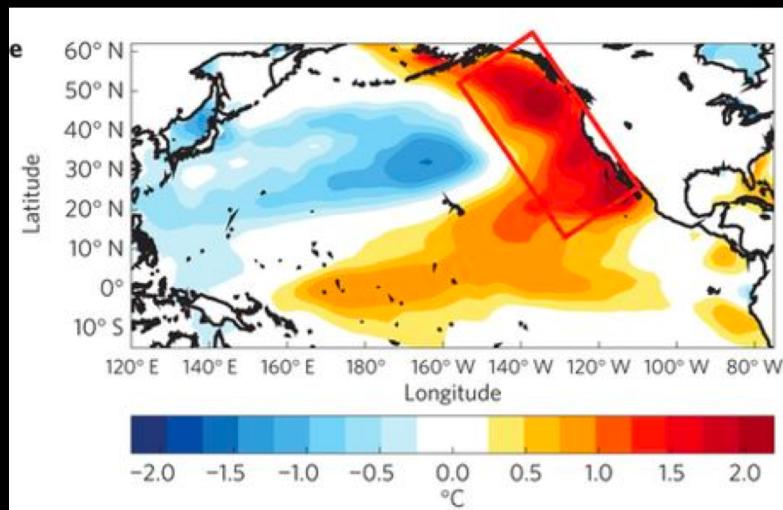
White, Ruesink & Trimble 2009, *J. of Shellfish Research*

# THE OLYMPIA OYSTER

## Potential threats: warming & acidification

Rising temperatures  
*Marine heat waves*  
*Milder winters*

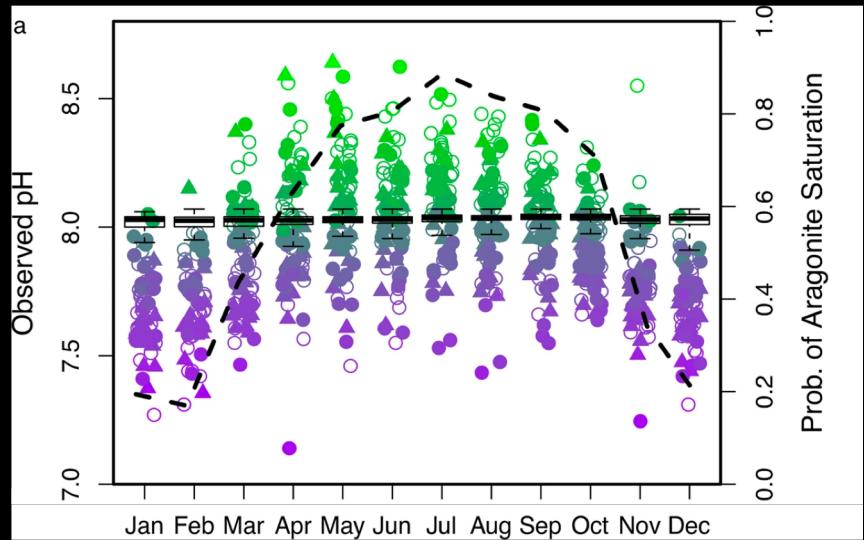
Winter temp. anomaly (JFM) 2015



Di Lorenzo & Mantua 2016  
*Nature Climate Change*

Shifting carbonate chemistry  
*Puget Sound pH lowest in winter*

Puget Sound pH by month, 25-yr dataset



Lowe, Bos & Ruesink 2019  
*Nature Scientific Reports*

# OCEAN ACIDIFICATION, OLYMPIA OYSTER

## Negative impacts of larval exposure

- ↓ Larval growth, survival (Hettinger *et al.* 2013)
- ↓ Juvenile growth after larval exposure  
(Hettinger *et al.* 2012)

Also evidence of larval tolerance  
(Waldbusser *et al.* 2016)

Parental carryover effects?

# PARENTAL CARRYOVER EFFECTS, OTHER OYSTERS

- Pacific oyster = negative carry-over
  - ↓ larval survival (Venkataraman et al. 2019)
- Sydney rock oyster = positive carry-over
  - ↑ larval growth (Parker et al. 2012, 2015, 2017)

Olympia oyster research questions:

Does parental winter environment  
impact larvae?

If so, positive or negative?

# DESIGN

Time	Phase	Conditions
	Adults in temperature treatment (60 days, Dec. & Jan.)	Cold (6°C) Warm (10°C)
	Adults in pH treatment (52 days, Feb. & Mar.)	Low (7.3) Ambient (7.8)
	Adults conditioned / induced to spawn (30 days, Apr.)	Spawning temperature (18°C)
	Larvae collected (60 days, May - June)	Ambient pH (7.8)

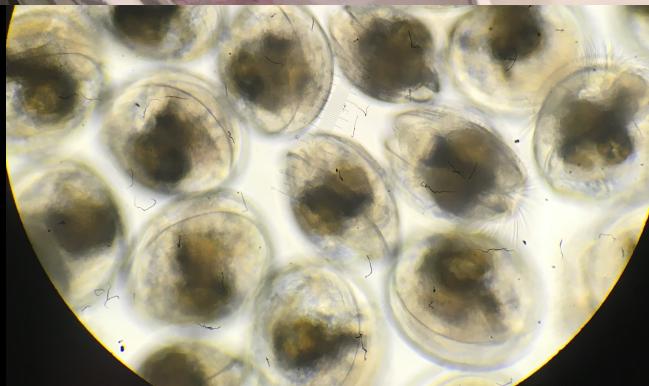
# LARVAE COLLECTED FOR 60 DAYS, MEASURED UPON RELEASED

Adults in  
temperature  
treatment

Adults in pH  
treatment

Adults  
conditioned

Larvae  
collected



# NEWLY RELEASED LARVAE

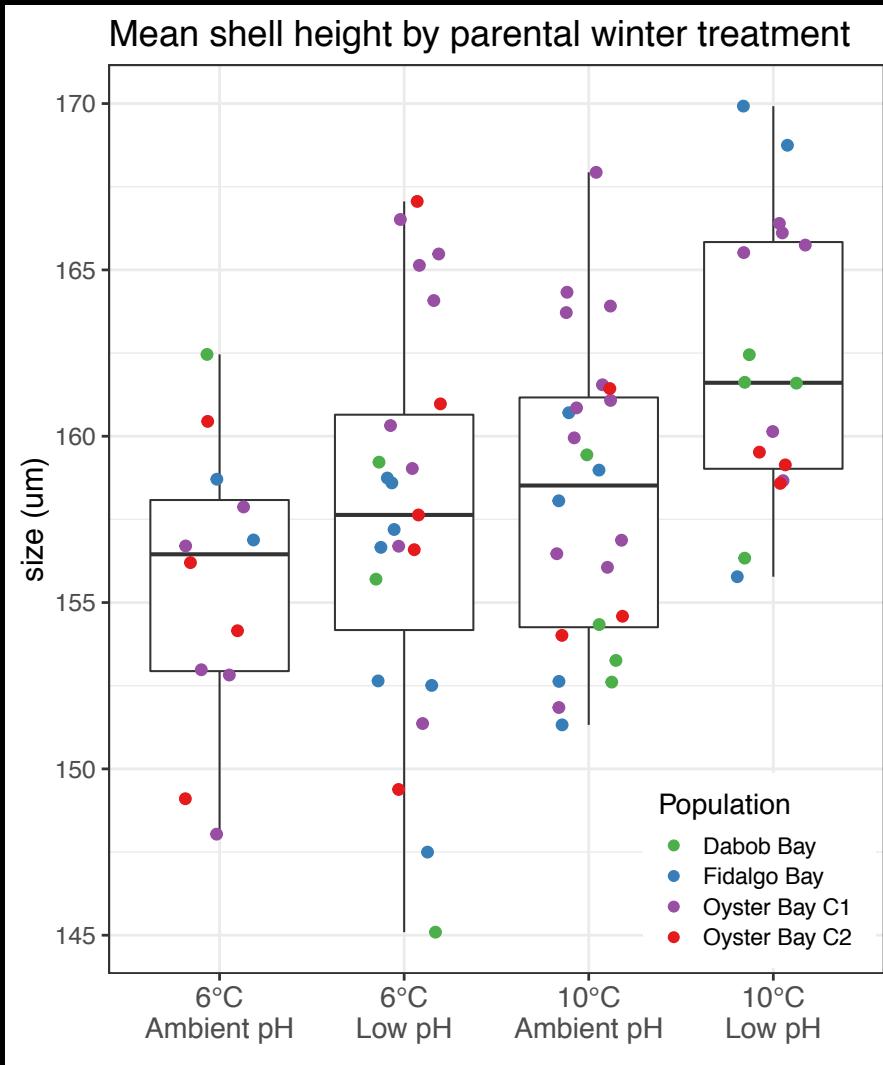
## SHELL SIZE ~ PARENTAL WINTER TREATMENT

Adults in temperature treatment

Adults in pH treatment

Adults conditioned

Larvae collected



Warm = ↑ shell size

Lower pH =  
↑ shell size

Why?

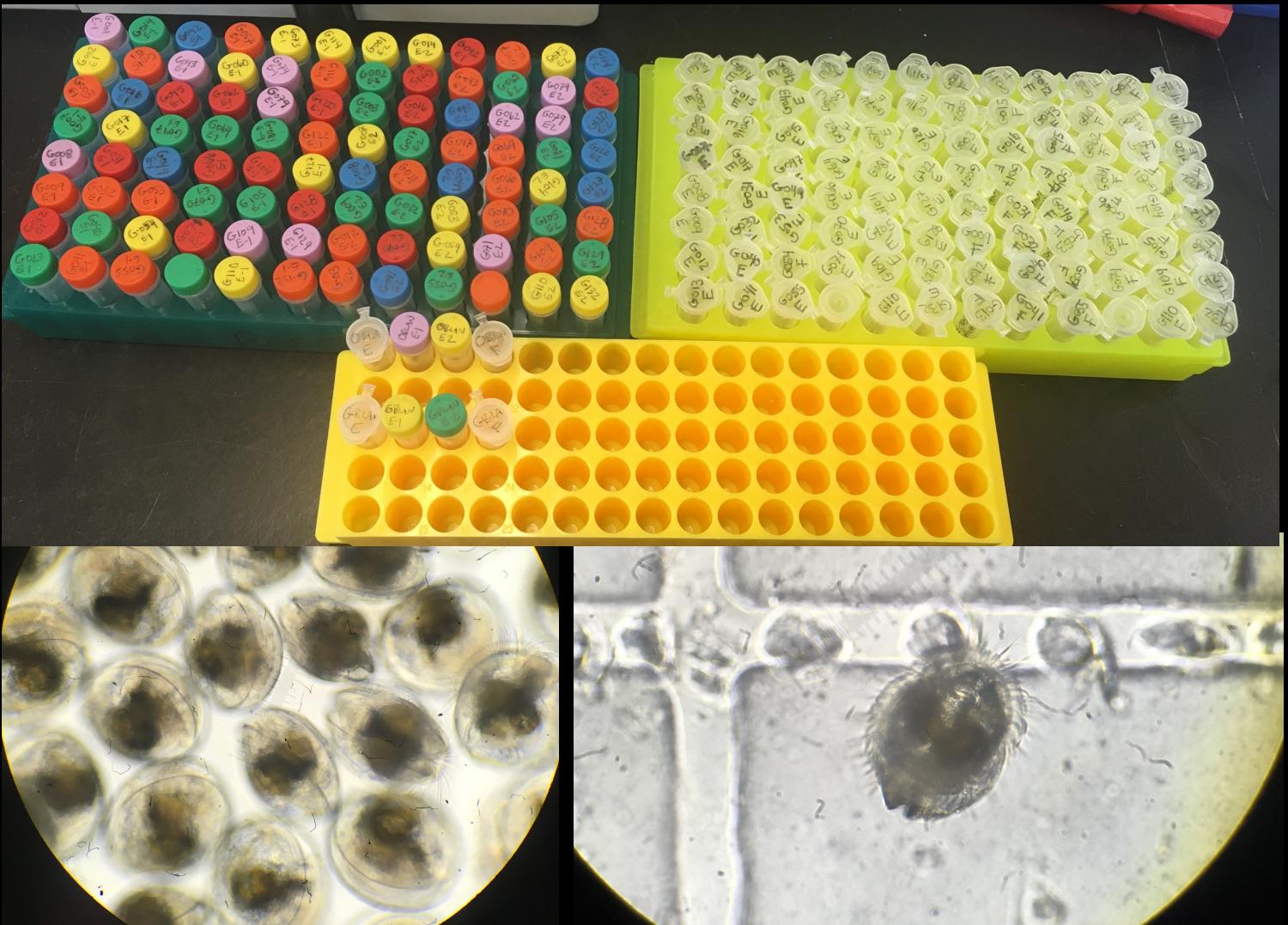
# LARVAL RNA SEQUENCED FOR GENE EXPRESSION

## **Adults in temperature treatment**

## **Adults in pH treatment**

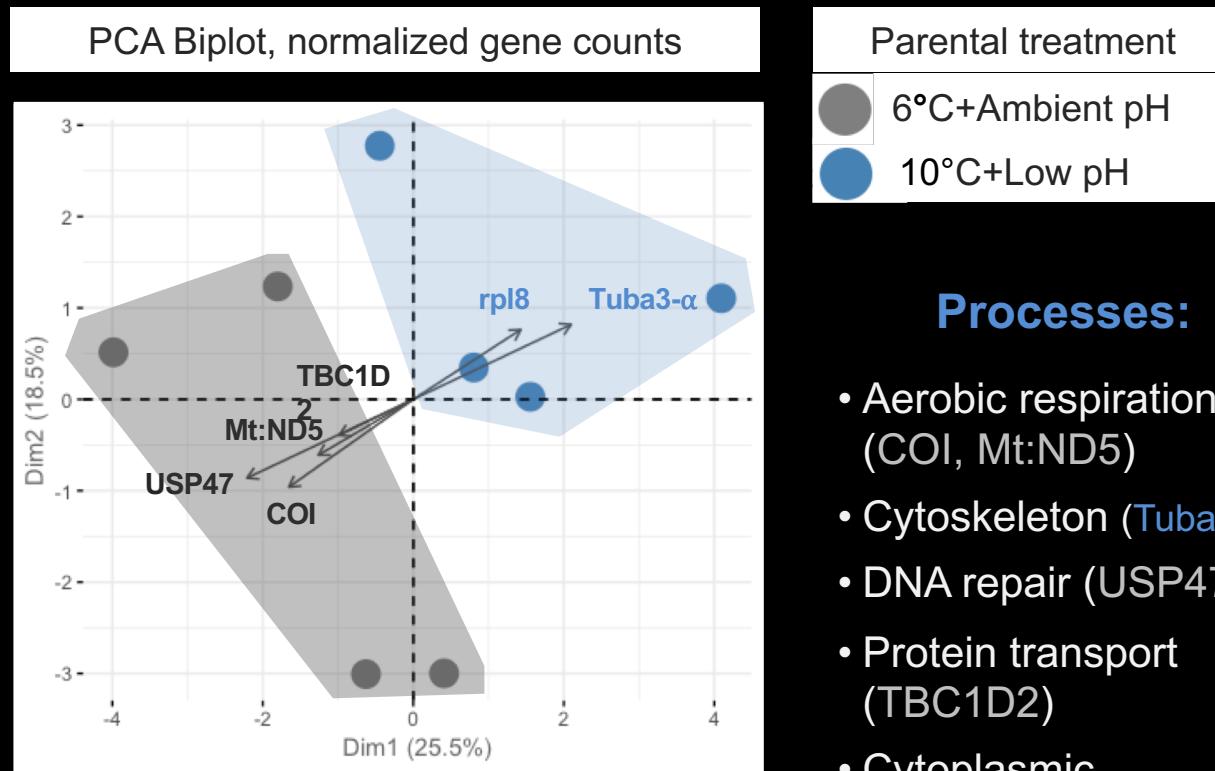
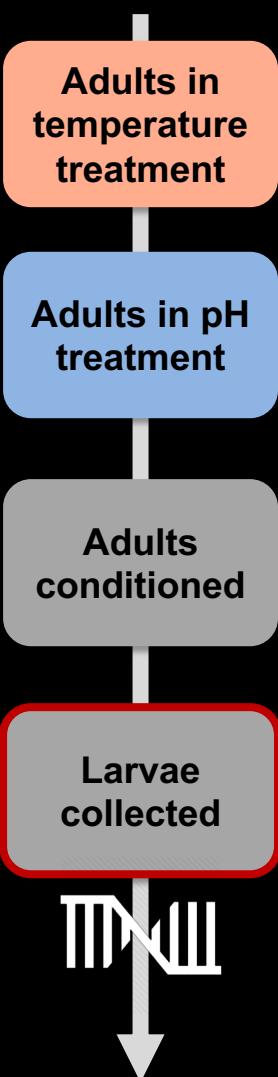
## **Adults conditioned**

## Larvae collected



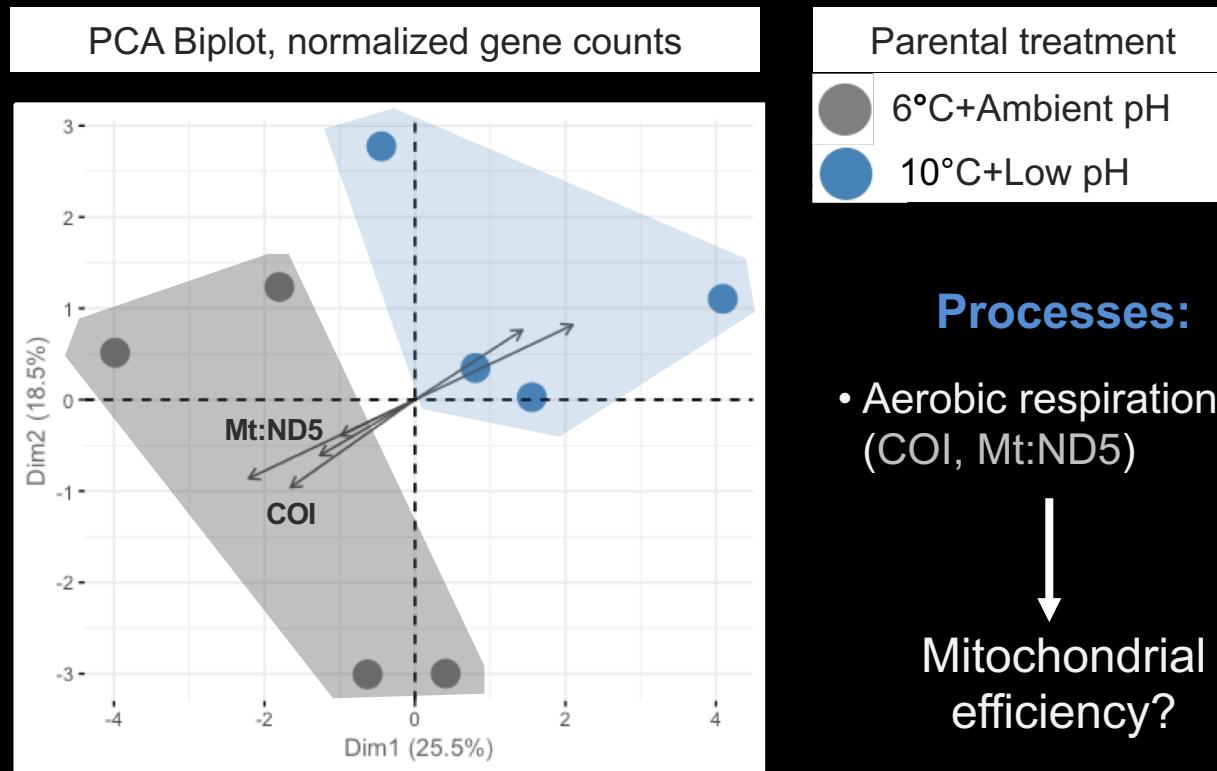
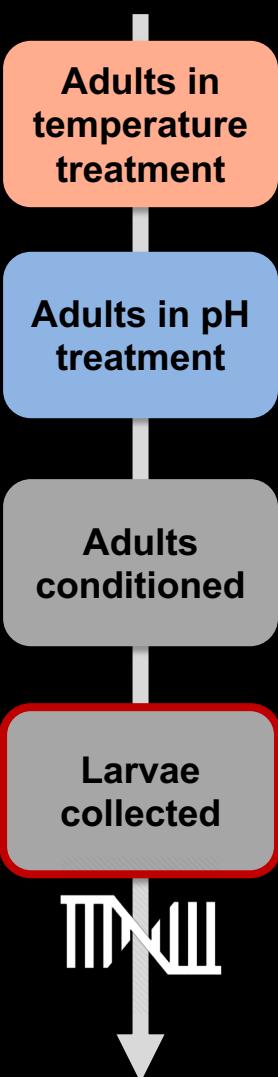
# NEWLY RELEASED LARVAE

## GENE EXPRESSION



# NEWLY RELEASED LARVAE

## GENE EXPRESSION



Mitochondrial efficiency?  
=  
↑ energy for growth

# WHAT DOES THIS MEAN FOR OLYS?

Parental winter exposures alters larval physiology ... Future generations more capable in new/challenging conditions?

Parental winter environment influences larval size ... may alter larval recruitment, dispersal

# NEXT STEPS

## More sequencing!

- Larval samples – all treatments & populations
- Adult gonad & ctenidia tissue – all treatments & populations

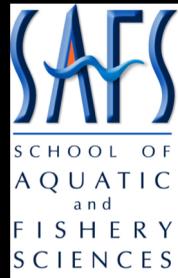
More results in preprint (*in review*)

<https://doi.org/10.1101/616375>

The image shows a screenshot of a bioRxiv preprint page. At the top right, there are links for "HOME" and "ABOUT". Below that is a search bar with the placeholder "Search". The bioRxiv logo is prominently displayed in the center, with "bioRxiv" in a large serif font and "THE PREPRINT SERVER FOR BIOLOGY" in a smaller sans-serif font below it. To the left of the logo is the CSHL (Cold Spring Harbor Laboratory) logo, which consists of a circular pattern of dots and the letters "CSH" next to the text "Cold Spring Harbor Laboratory". On the left side of the main content area, there is a "New Results" link. The main title of the preprint is "Carry-over effects of temperature and pCO<sub>2</sub> across multiple Olympia oyster populations". Below the title, the authors are listed as "Laura H Spencer, Yaamini R Venkataraman, Ryan Crim, Stuart Ryan, Micah J Horwith, Steven B Roberts". The DOI is provided as "doi: <https://doi.org/10.1101/616375>". A note at the bottom states, "This article is a preprint and has not been peer-reviewed [what does this mean?]."

# THANK YOU

- Collaborators: Katherine Silliman, Steven Roberts
- Puget Sound Restoration Fund: Ryan, Stuart, Alice, Erin, Jade, Morgan, Brian, Betsy ...
- On-the-ground: Yaamini, Grace, Olivia, Megan, Rhonda, Kaitlyn, Lindsay, Duncan, Sam, Hollie, Steven, Steven's kids, Brent, Mom & Ian, Rick, Jackie Padilla-Gamino lab

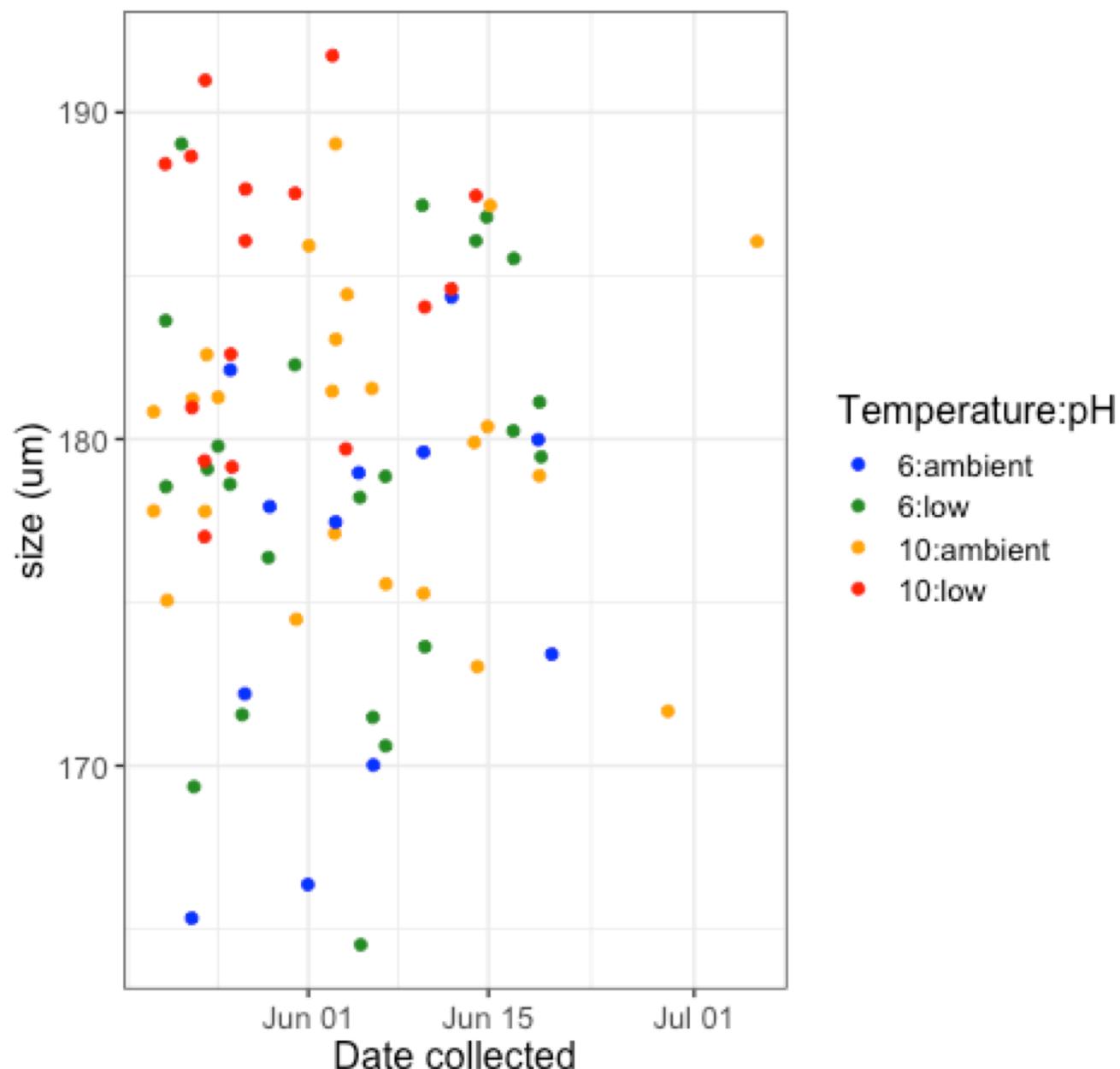


# EXTRA SLIDES

# Mean shell width, by collection date and treatment

Larval size ~  
collection date

*color coded by  
parental  
treatment*



# WHY LARGER LARVAE FROM ADULTS EXPOSED TO ↑ Temp, ↓ pH in winter?

- Direct parental influence – brood time & lipid resources
- Indirect parental influence – change to larval physiology (epigenetic?)

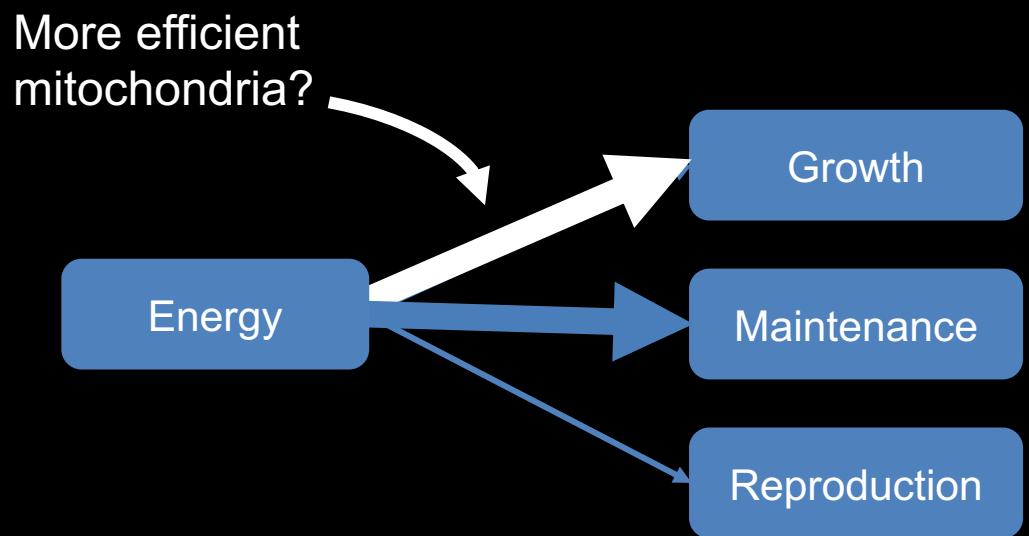
# SHIFT IN LARVAL ENERGY BUDGET?

stressful  
environment  
=

↑ energy for  
maintenance

Not stressful  
environment  
=

↑ energy for  
growth



# ADULT GONAD GENE EXPRESSION

Adults in temperature treatment

Adults in pH treatment

Adults conditioned

Larvae collected

