

PARENTAL WINTER EXPOSURES INFLUENCE OLYMPIA OYSTER LARVAE

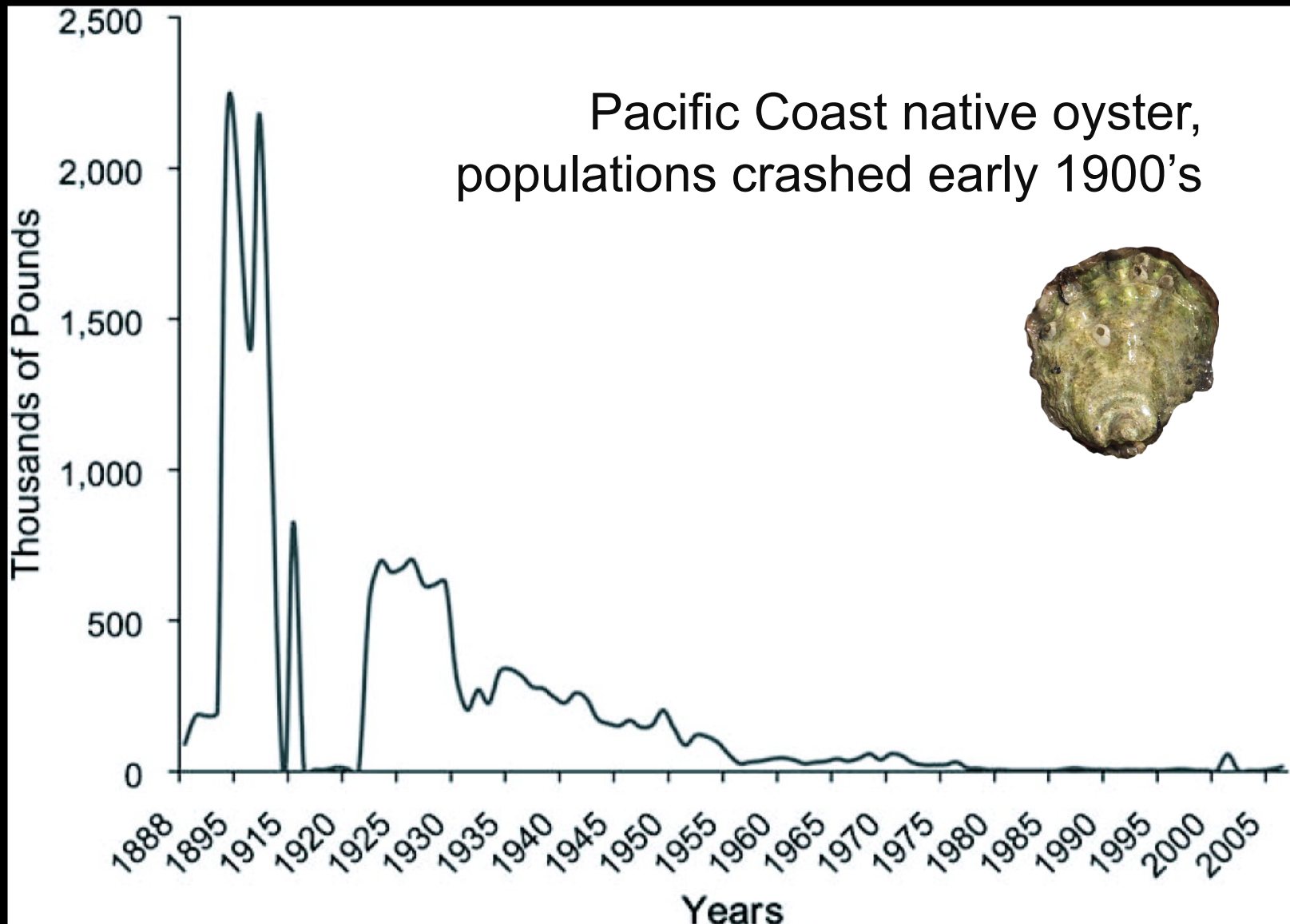
Laura H Spencer
Roberts Lab

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

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



THE OLYMPIA OYSTER



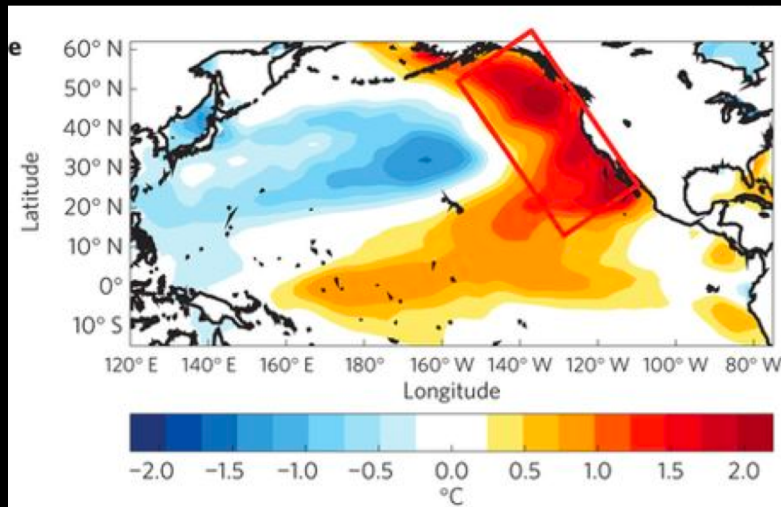
THE OLYMPIA OYSTER

Potential threats: warming & acidification

Rising temperatures
Marine heat waves
Milder winters

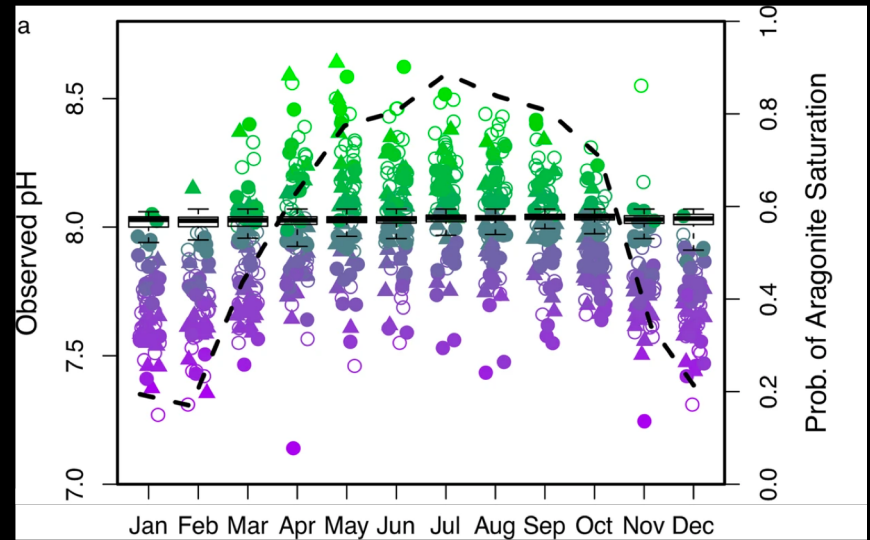
Shifting carbonate chemistry
Puget Sound pH lowest in winter

Winter temp. anomaly (JFM) 2015



Di Lorenzo & Mantua 2016
Nature Climate Change

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?

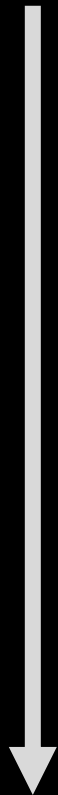
If so, positive or negative?

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)**

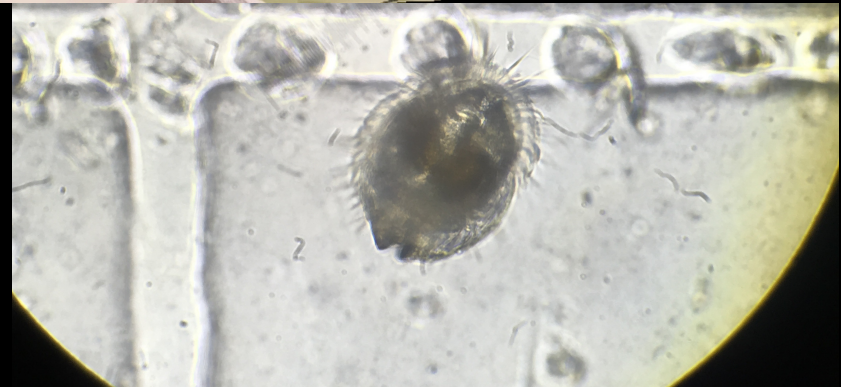
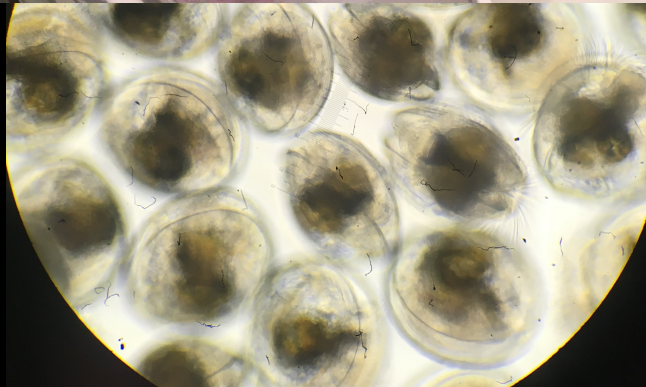
LARVAE COLLECTED FOR 60 DAYS, MEASURED UPON RELEASED

Adults in
temperature
treatment

Adults in pH
treatment

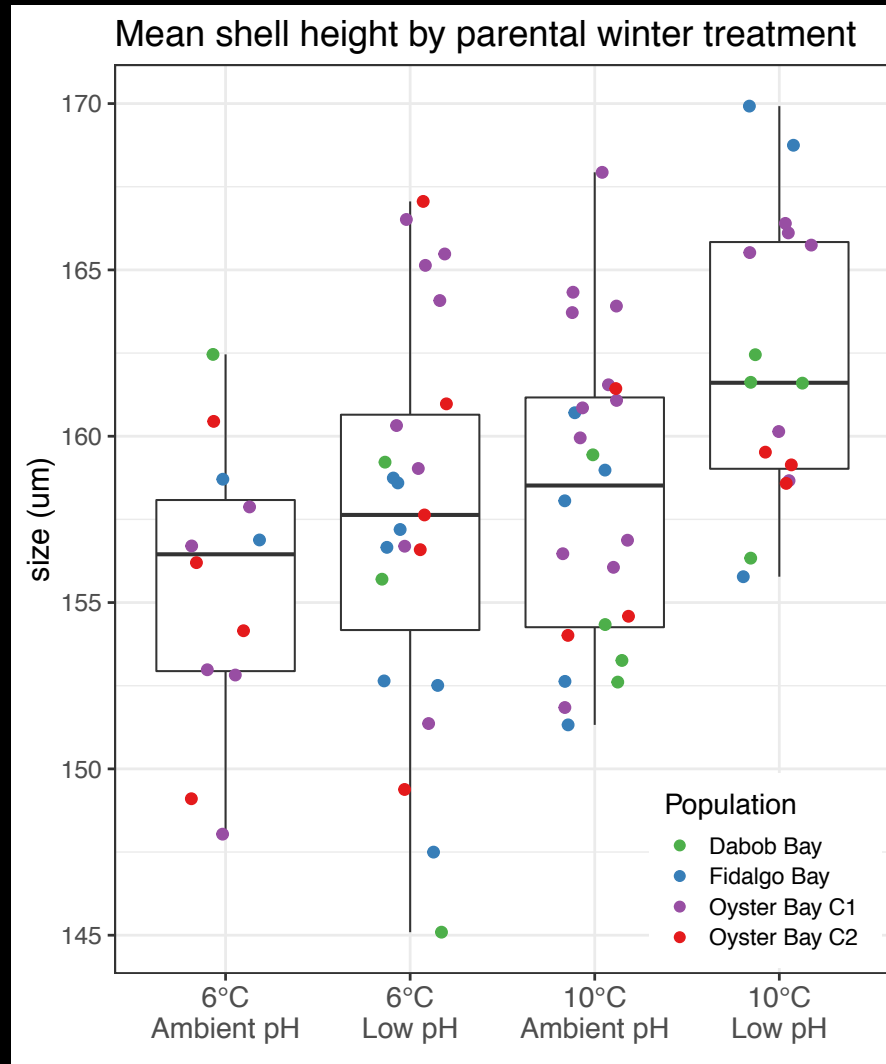
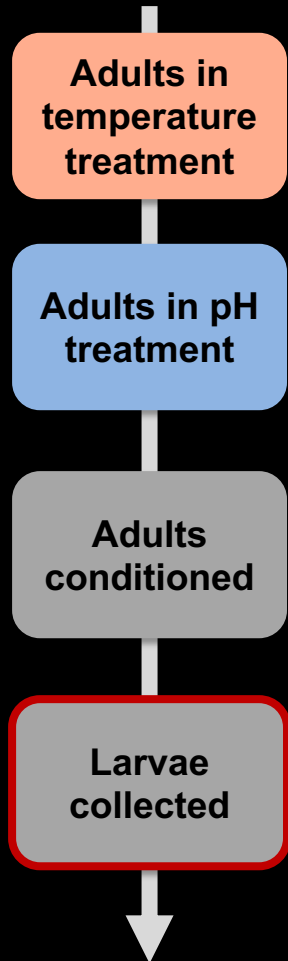
Adults
conditioned

Larvae
collected



NEWLY RELEASED LARVAE

SHELL SIZE ~ PARENTAL WINTER TREATMENT



Warm = ↑
shell size

Lower pH =
↑ shell size

Why?

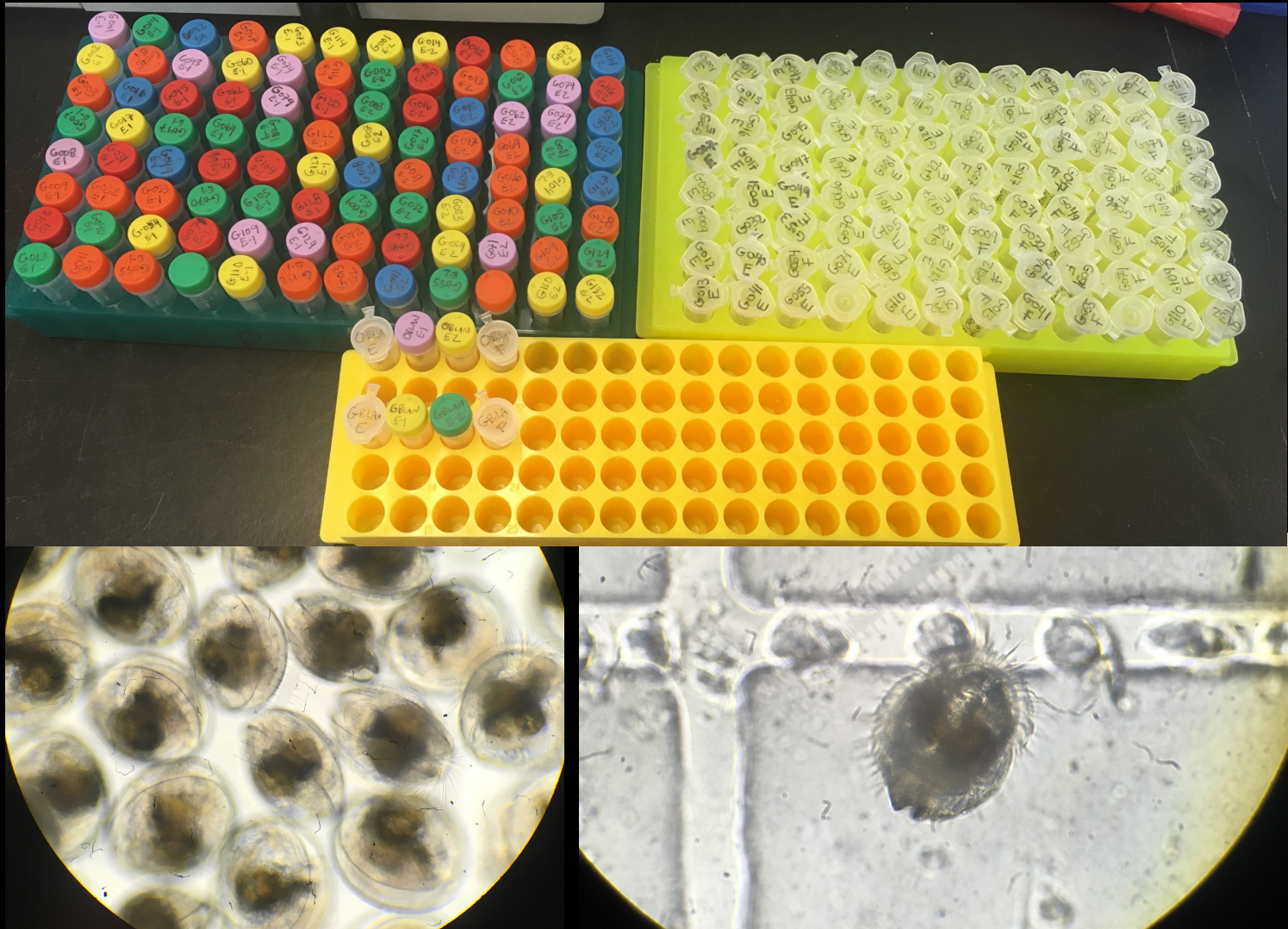
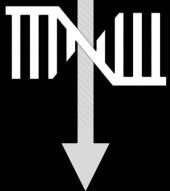
LARVAL RNA SEQUENCED FOR GENE EXPRESSION

Adults in
temperature
treatment

Adults in pH
treatment

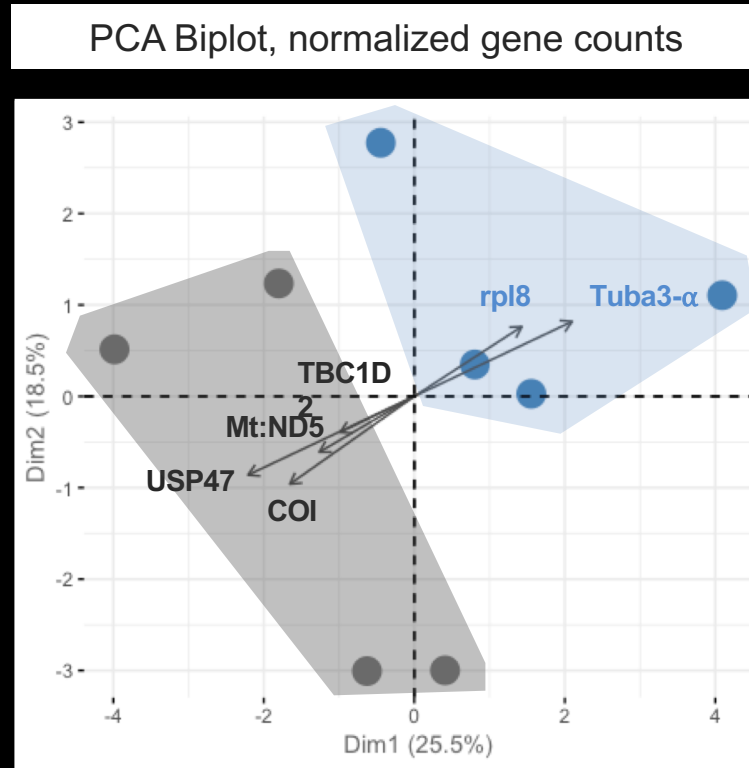
Adults
conditioned

Larvae
collected



NEWLY RELEASED LARVAE

GENE EXPRESSION



Parental treatment

- 6°C+Ambient pH
- 10°C+Low pH

Processes:

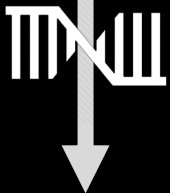
- Aerobic respiration (COI, Mt:ND5)
- Cytoskeleton (*Tuba3-α*)
- DNA repair (USP47)
- Protein transport (TBC1D2)
- Cytoplasmic translation (*rpl8*)

Adults in temperature treatment

Adults in pH treatment

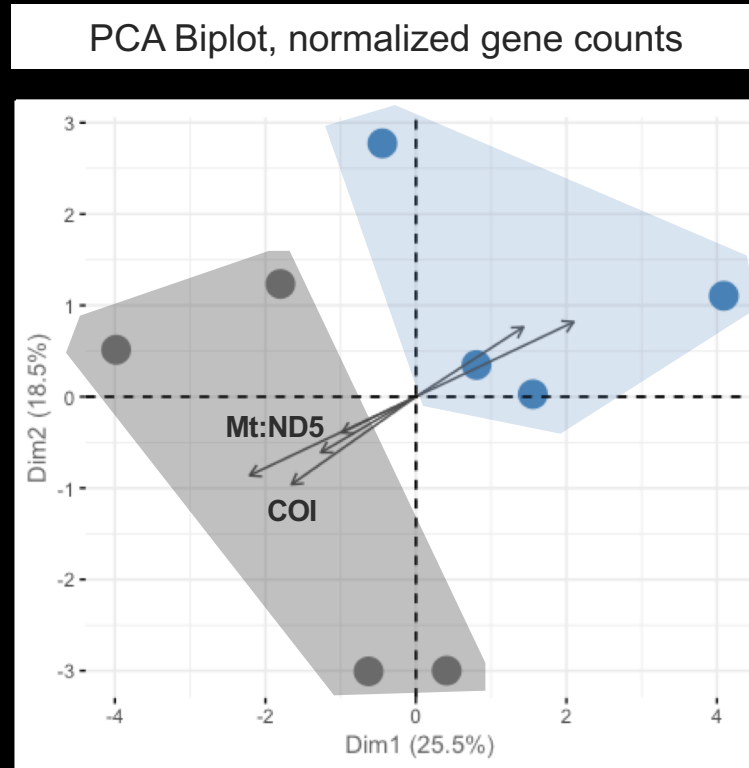
Adults conditioned

Larvae collected



NEWLY RELEASED LARVAE

GENE EXPRESSION



Parental treatment

- 6°C+Ambient pH
- 10°C+Low pH

Processes:

- Aerobic respiration (COI, Mt:ND5)

Mitochondrial efficiency?

=

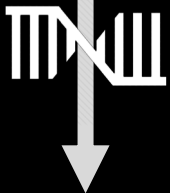
↑ energy for growth

Adults in temperature treatment

Adults in pH treatment

Adults conditioned

Larvae collected



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

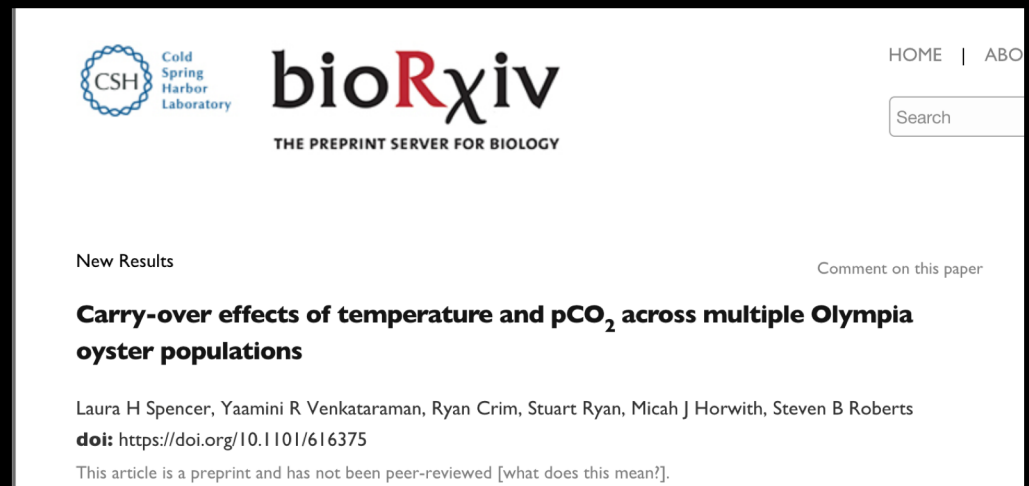
NEXT STEPS

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 screenshot shows the bioRxiv preprint server interface. At the top left is the CSH Cold Spring Harbor Laboratory logo. The bioRxiv logo is prominently displayed in the center, with the tagline 'THE PREPRINT SERVER FOR BIOLOGY' below it. In the top right corner, there are links for 'HOME' and 'ABOUT', and a search bar. The main content area features the text 'New Results' on the left and 'Comment on this paper' on the right. The title of the preprint, 'Carry-over effects of temperature and pCO₂ across multiple Olympia oyster populations', is centered. Below the title, the authors are listed: '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'. At the bottom, a disclaimer states: 'This article is a preprint and has not been peer-reviewed [what does this mean?]'.

CSH Cold Spring Harbor Laboratory

bioRxiv
THE PREPRINT SERVER FOR BIOLOGY

HOME | ABOUT

Search

New Results

Comment on this paper

Carry-over effects of temperature and pCO₂ across multiple Olympia oyster populations

Laura H Spencer, Yaamini R Venkataraman, Ryan Crim, Stuart Ryan, Micah J Horwith, Steven B Roberts

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

This article is a preprint and has not been peer-reviewed [what does this mean?].

THANK YOU

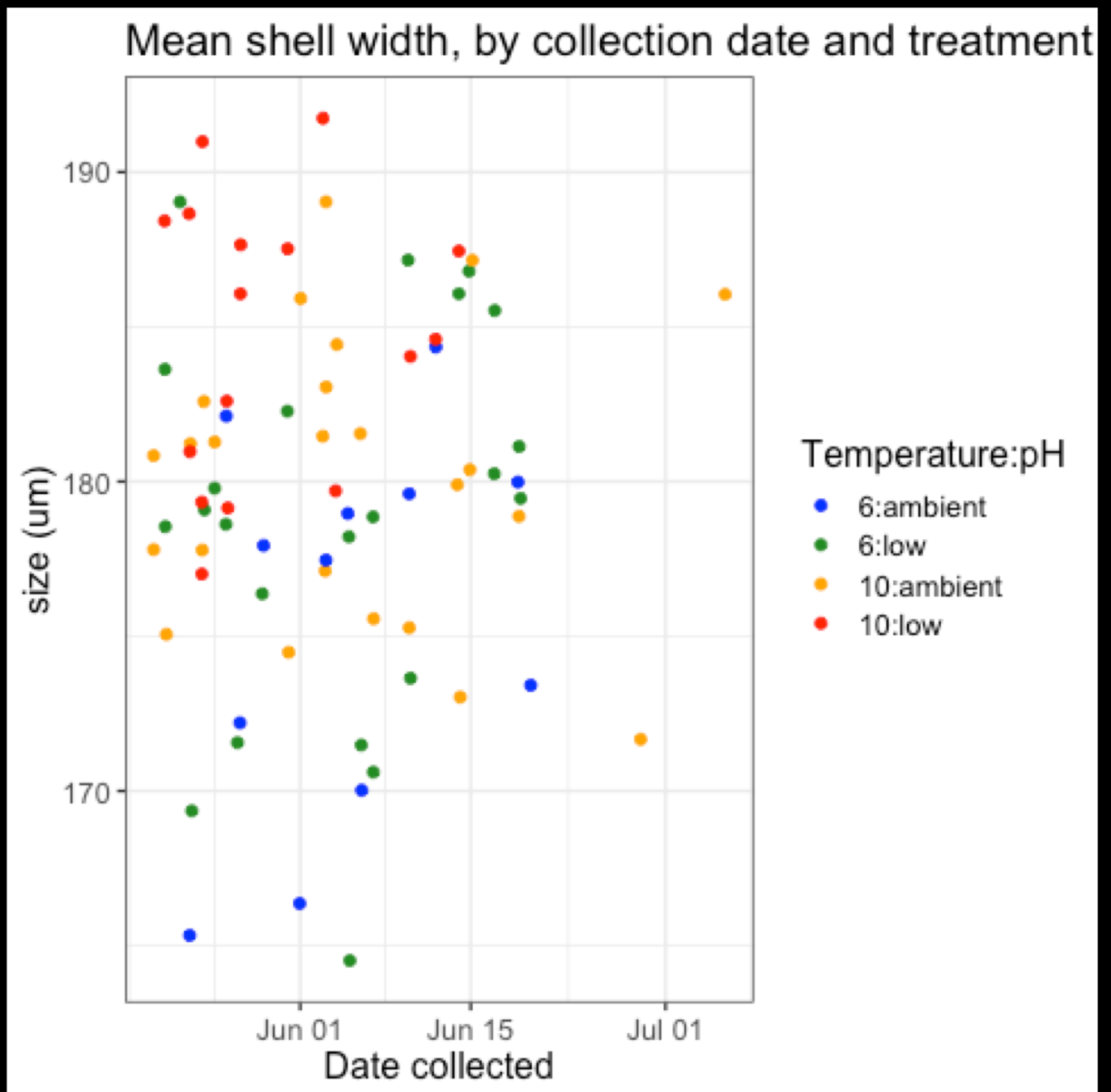
- Collaborators: Katherine Silliman, Steven Roberts
- Puget Sound Restoration Fund: Ryan, Stuart, Alice, Erin, Jade, Morgan, Brian, Betsy ...
- On-the-ground: Yaamini, Grace, Olivia, Megan, Rhonda, Kaitlyn, Lindsay, Duncan, Sam, Hollie, Steven, Steven's kids, Brent, Mom & Ian, Rick, Jackie Padilla-Gamino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



EXTRA SLIDES

Larval size ~
collection date

*color coded by
parental
treatment*



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

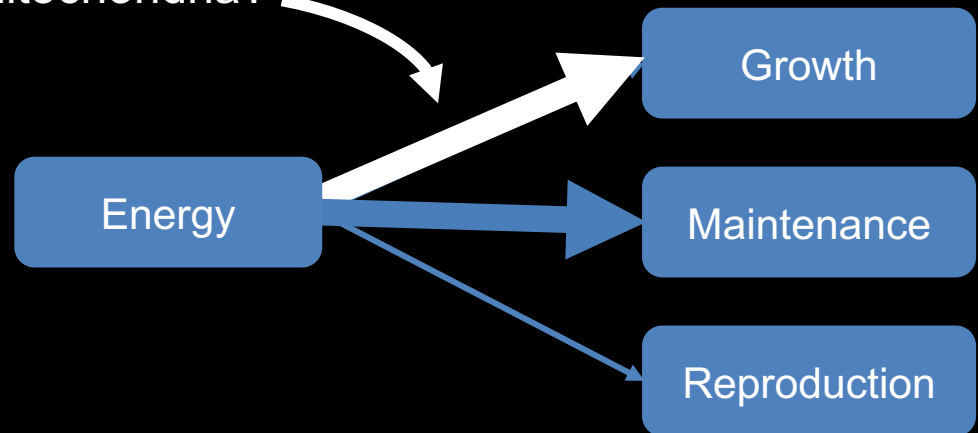
- Direct parental influence – brood time & lipid resources
- Indirect parental influence – change to larval physiology (epigenetic?)

SHIFT IN LARVAL ENERGY BUDGET?

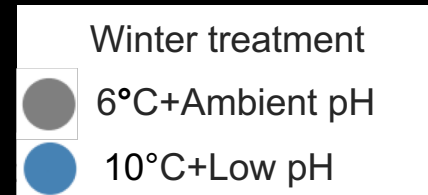
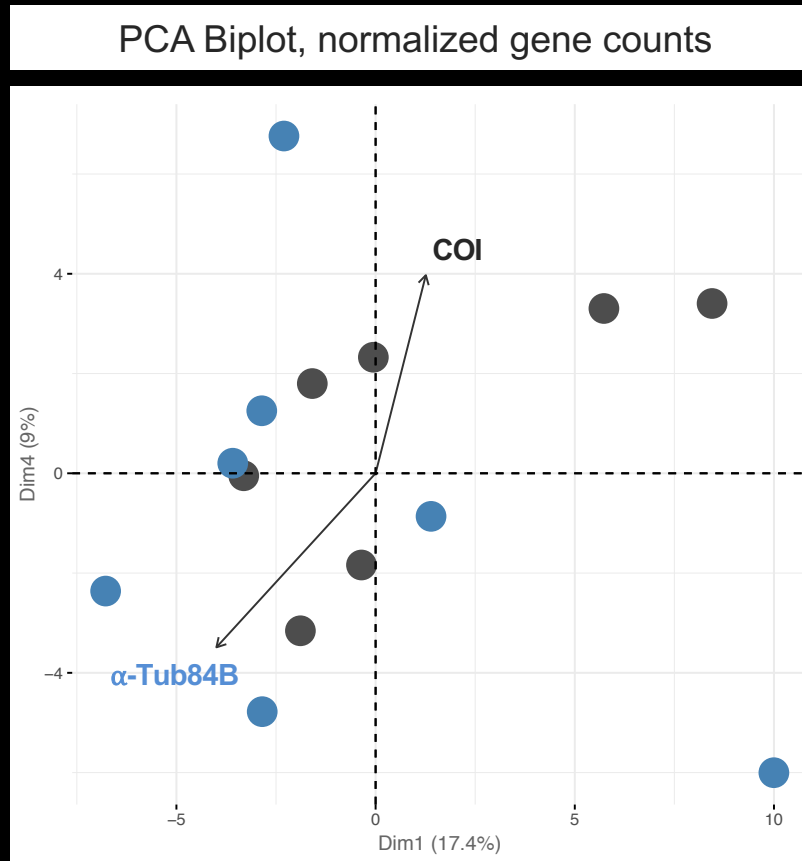
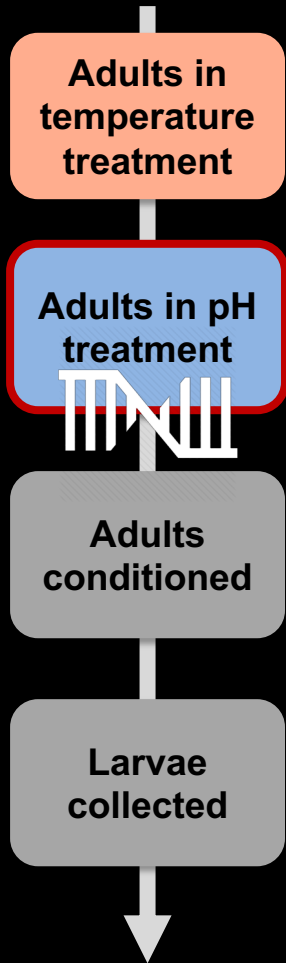
stressful
environment
=
↑ energy for
maintenance

Not stressful
environment
=
↑ energy for
growth

More efficient
mitochondria?



ADULT GONAD GENE EXPRESSION



Processes:

- Aerobic respirationz (COI)
- Cytoskeleton (α -Tub84B)