

Carry-over effects of parental pH exposure in the Olympia oyster

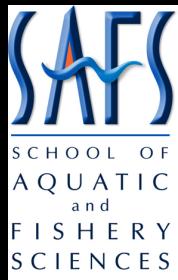
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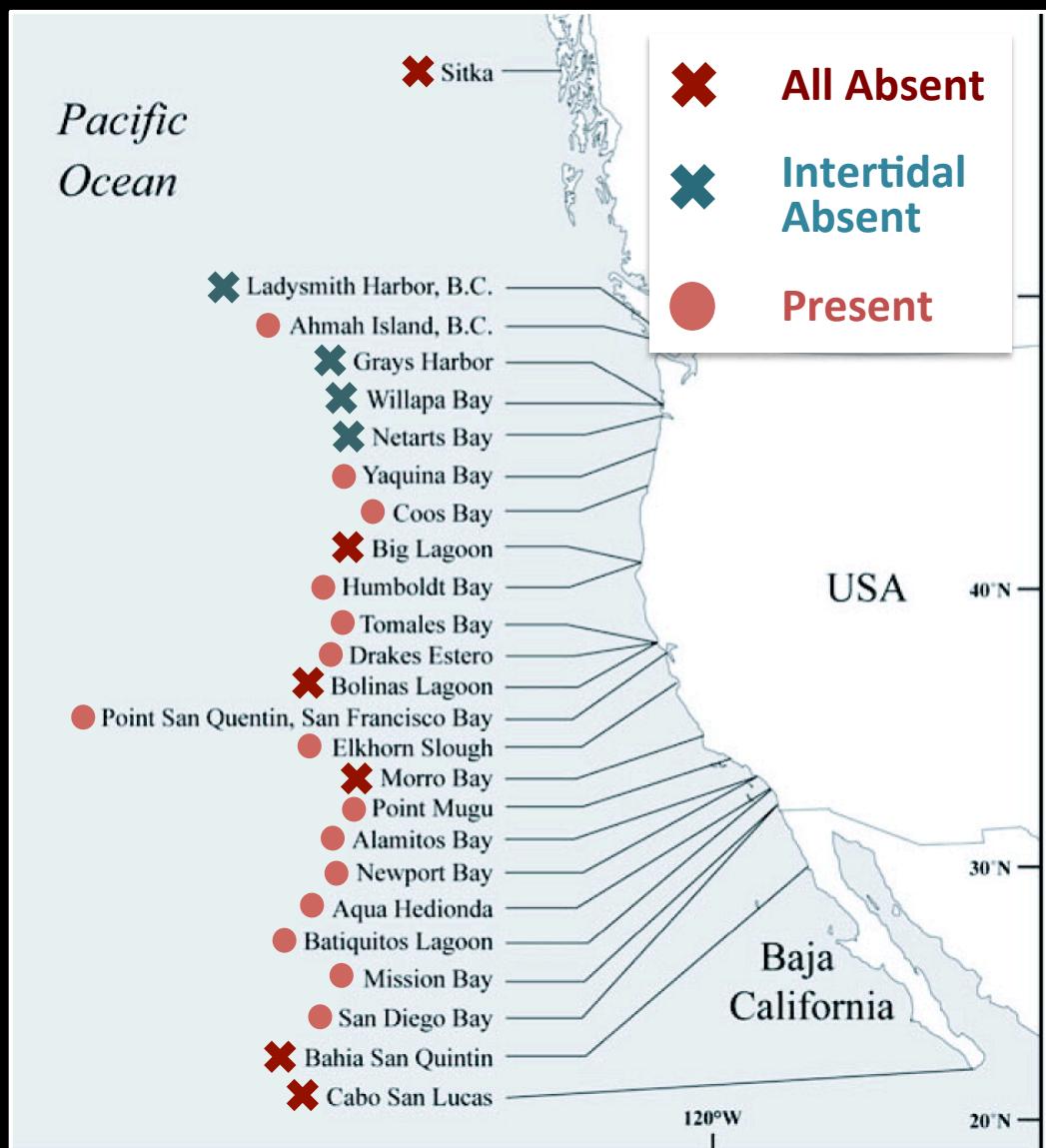
University of Washington

NSA/PCSGA 2018



THE OLYMPIA OYSTER

- Pacific Coast's only native oyster
- Populations are ~2% historic
 - Overharvest
 - Habitat loss ...
- Restoration investments along the coast
- New threat:
ocean acidification



Adapted from Polson & Zacherl, 2009

OCEAN ACIDIFICATION, WHAT WE KNOW



Early life stages are vulnerable

- ↓ Larval growth, survival (Hettinger et al. 2013)
- ↓ Juvenile growth after larval exposure (Hettinger et al. 2012)
- ↑ Juvenile predation rate (Sanford et al. 2013)
- Also evidence of tolerance (Waldbusser 2016)

Parental exposure?

CAN OYSTERS “ADAPT” TO OA?



Parental exposure can influence offspring response to stress (e.g. Parker et al. 2012)

This may allow oyster populations or lines to quickly respond to changing ocean

PARENTAL EXPOSURE, OTHER OYSTERS



- Negative carry-over:
 - ↓ larval survival, maternal Pacific oyster (Venkataraman in press)
 - ↓ fecundity, sex ratio change, Sydney rock oyster (Parker 2018)
- Positive carry-over:
 - ↑ growth, Sydney rock oyster larvae (Parker 2012, 2015, 2017)

Olympia oyster?

QUESTIONS



HOW DOES ADULT LOW pH EXPOSURE AFFECT:

- Reproduction - gonad stage, # larvae produced
- Offspring viability – survival, growth
- Offspring response to pH – juvenile survival under stress, in low pH

DESIGN

Time

Phase

pH

Metric

Adults in pH treatment
(7 weeks)

Low (7.2)
Ambient (7.8)

Gonad stage

Adults spawn, larvae collected
(7 weeks)

Ambient
pH

larvae
produced

Larvae reared
(to post-set)

Juveniles grown
(10 months)

Juveniles in pH treatment
(3 months)

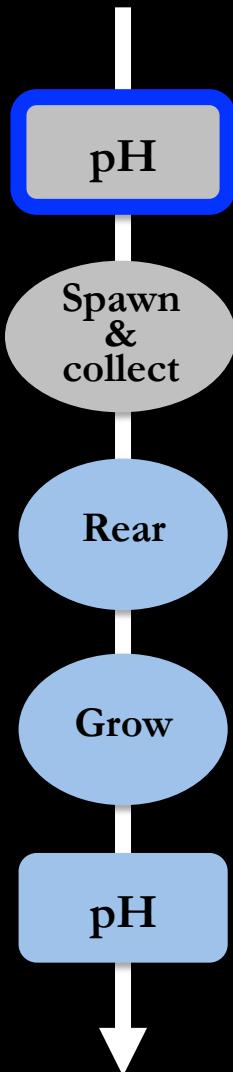
Survival

Growth

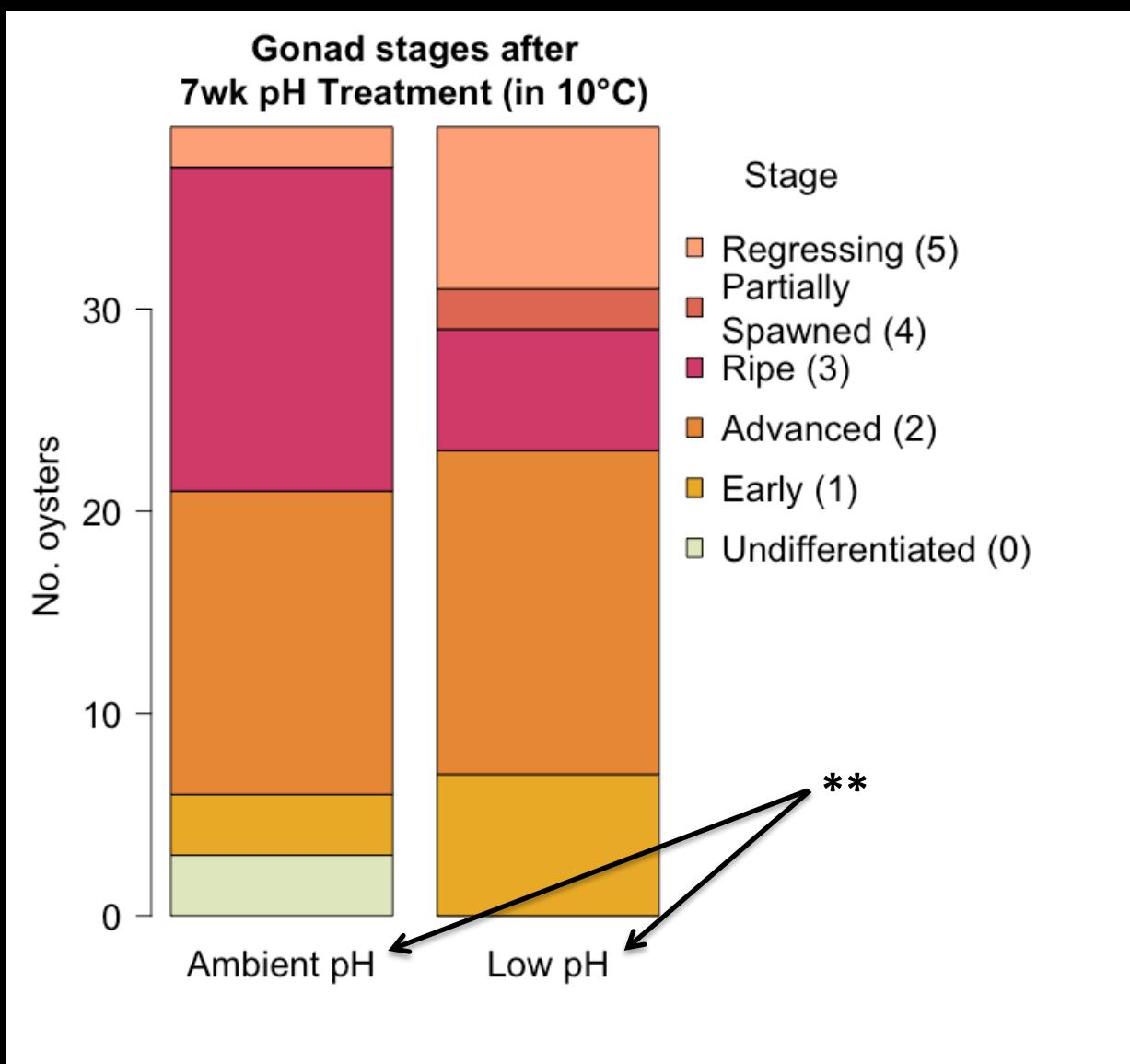
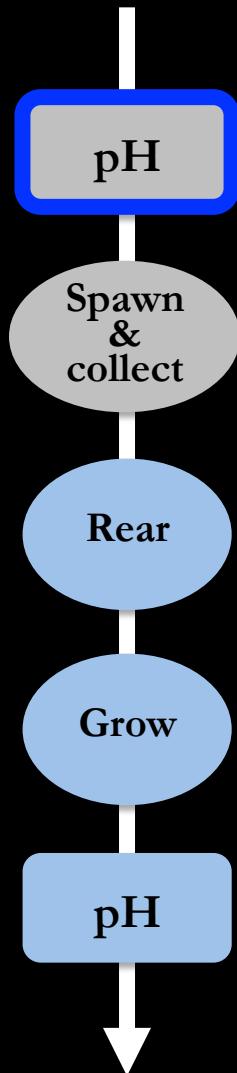
Survival



ADULTS HELD IN LOW pH (7.2), AMBIENT pH (7.8), AT 10°C



GONAD LESS DEVELOPED IN LOW pH



LARVAE COLLECTED & COUNTED FOR 7 WEEKS

pH

Spawn
&
collect

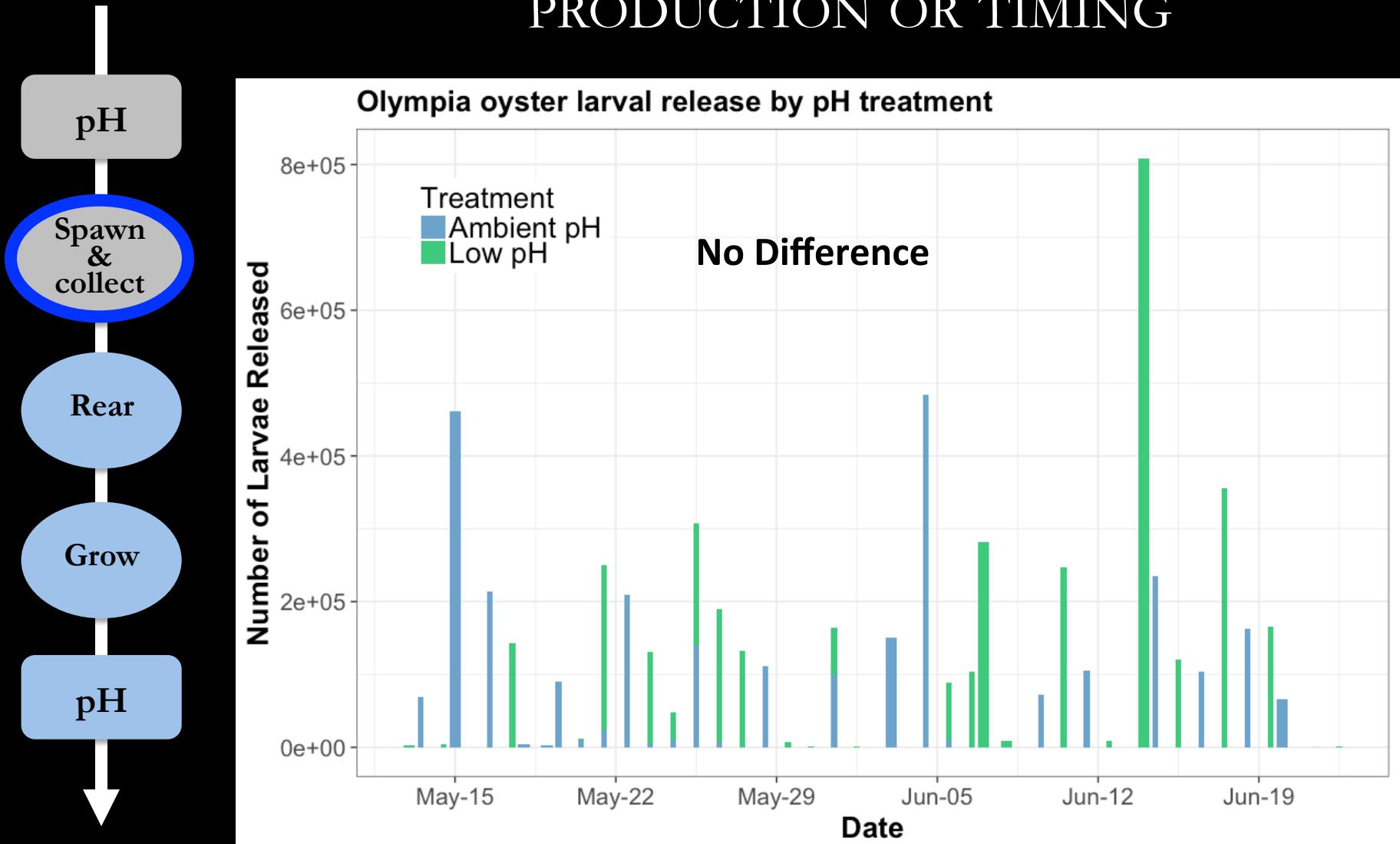
Rear

Grow

pH



NO pH EFFECT ON LARVAL PRODUCTION OR TIMING



LARVAE REARED IN TREATMENT & SPAWNING GROUPS

pH

Spawn
&
collect

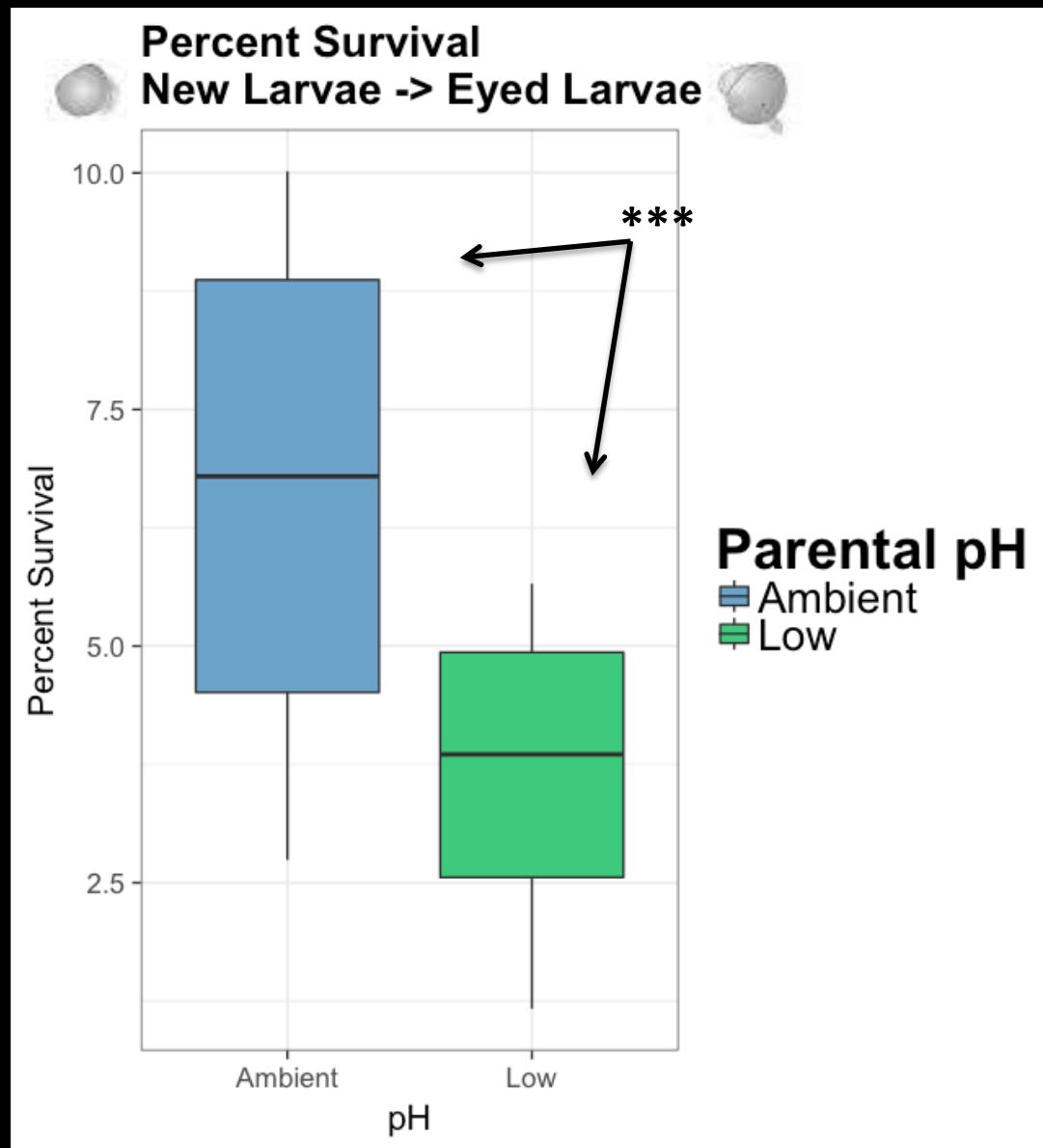
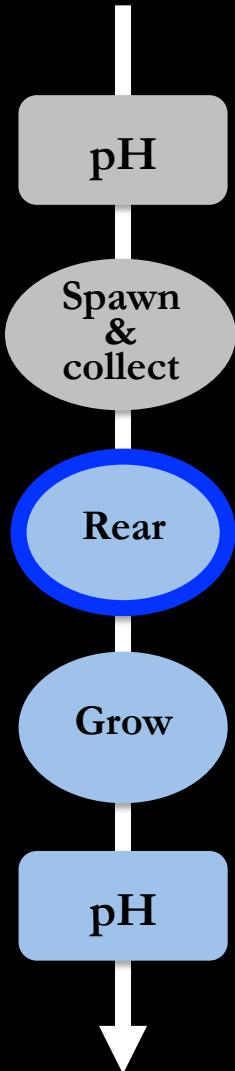
Rear

Grow

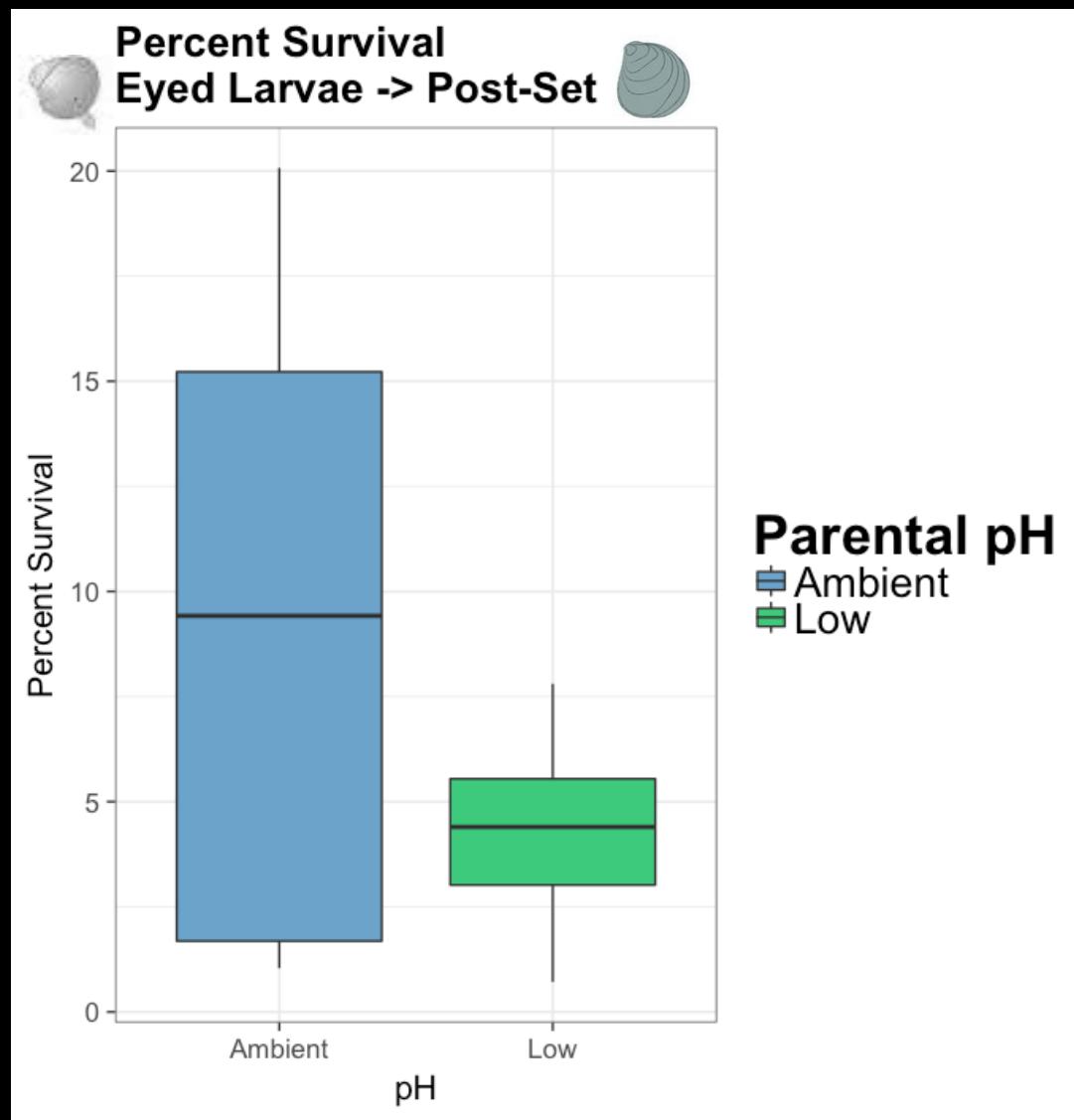
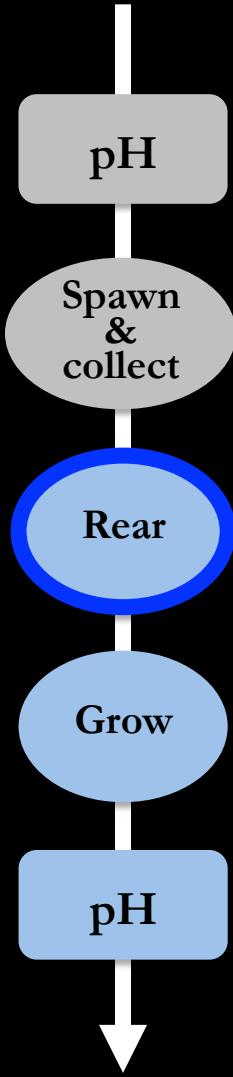
pH



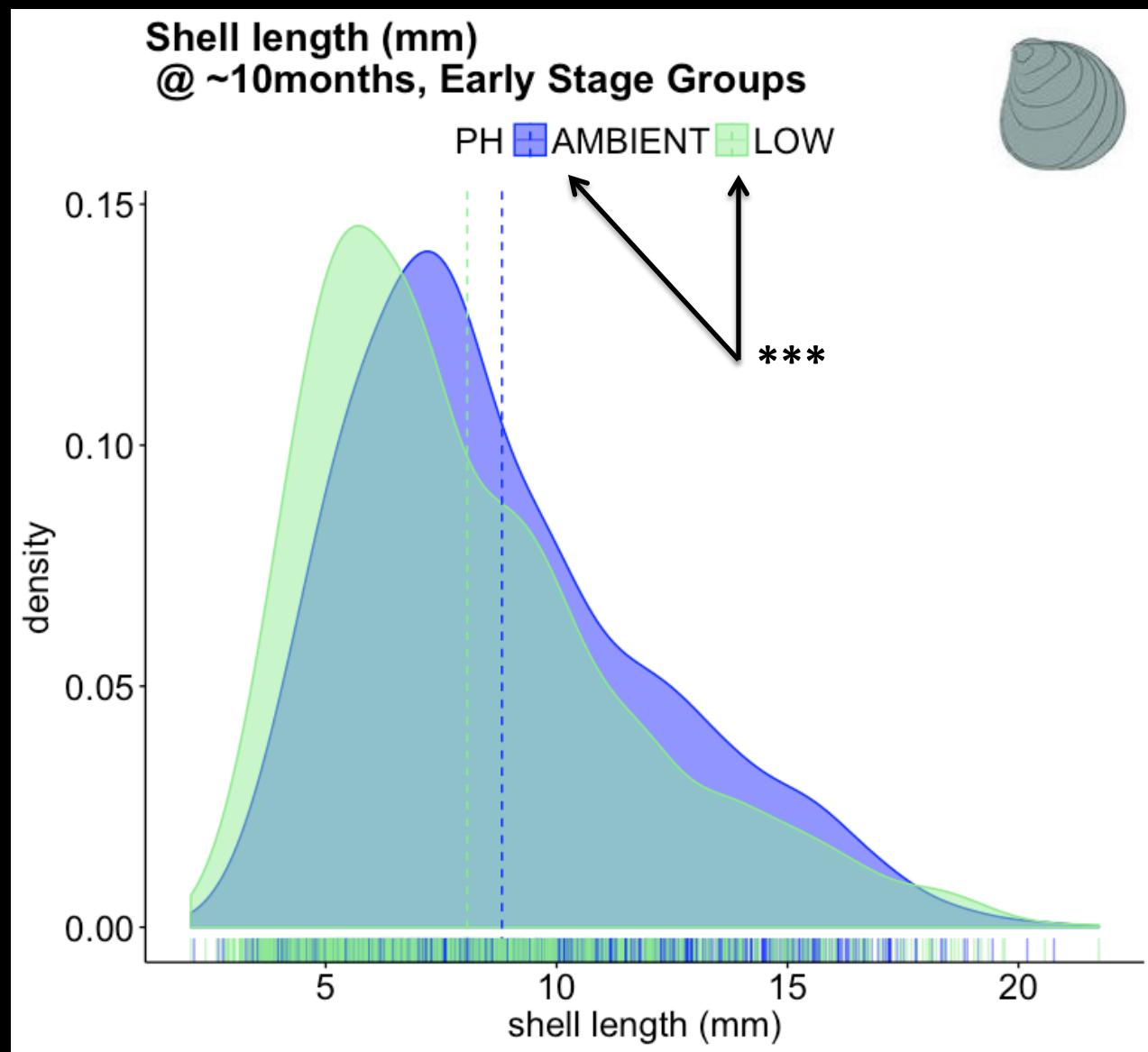
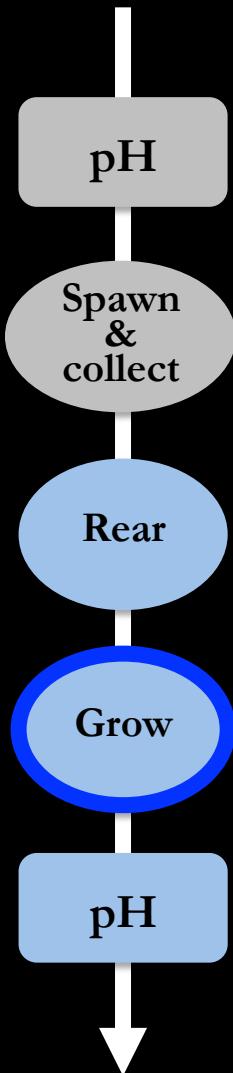
ADULT EXPOSURE = ↓ LARVAL SURVIVAL



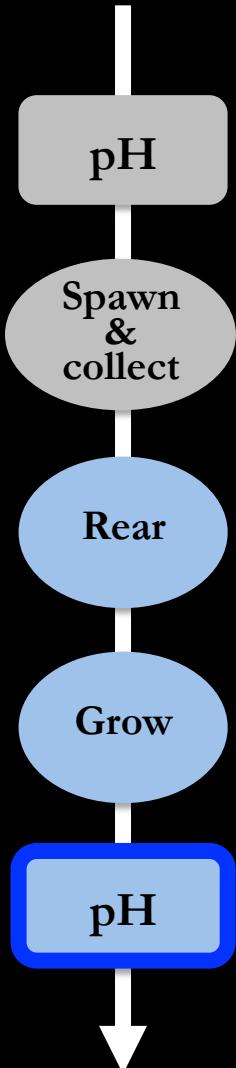
ADULT EXPOSURE = ↓ LARVAL SURVIVAL



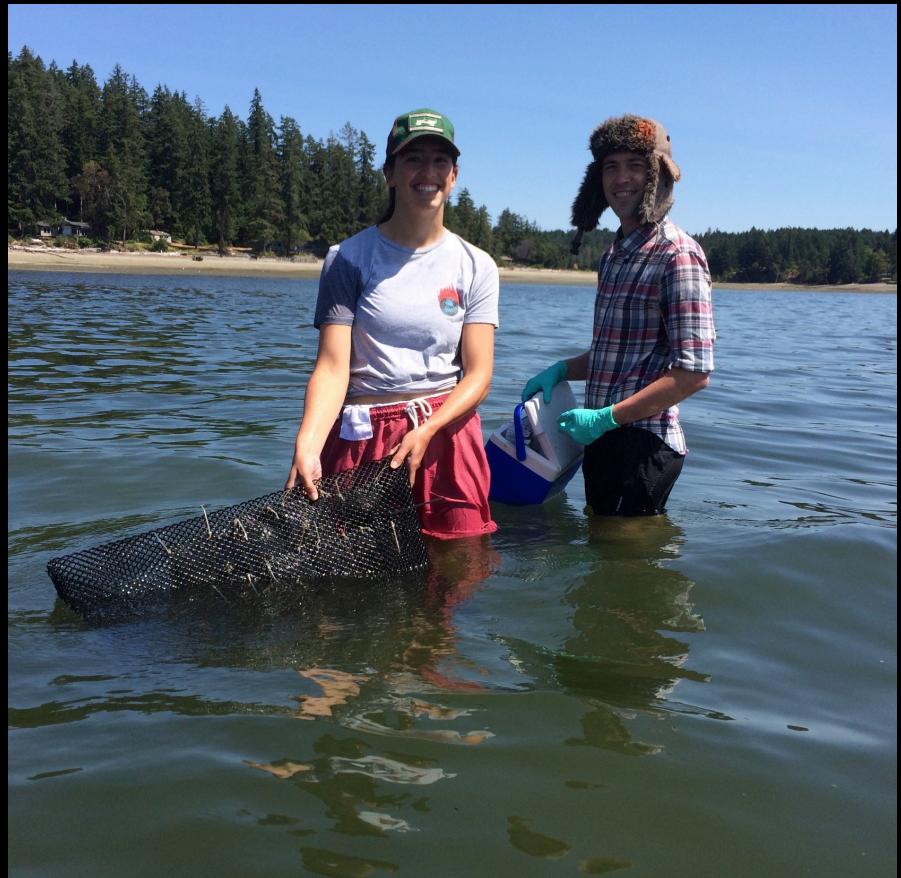
ADULT EXPOSURE = ↓ JUVENILE SIZE



JUVENILE DEPLOYMENT

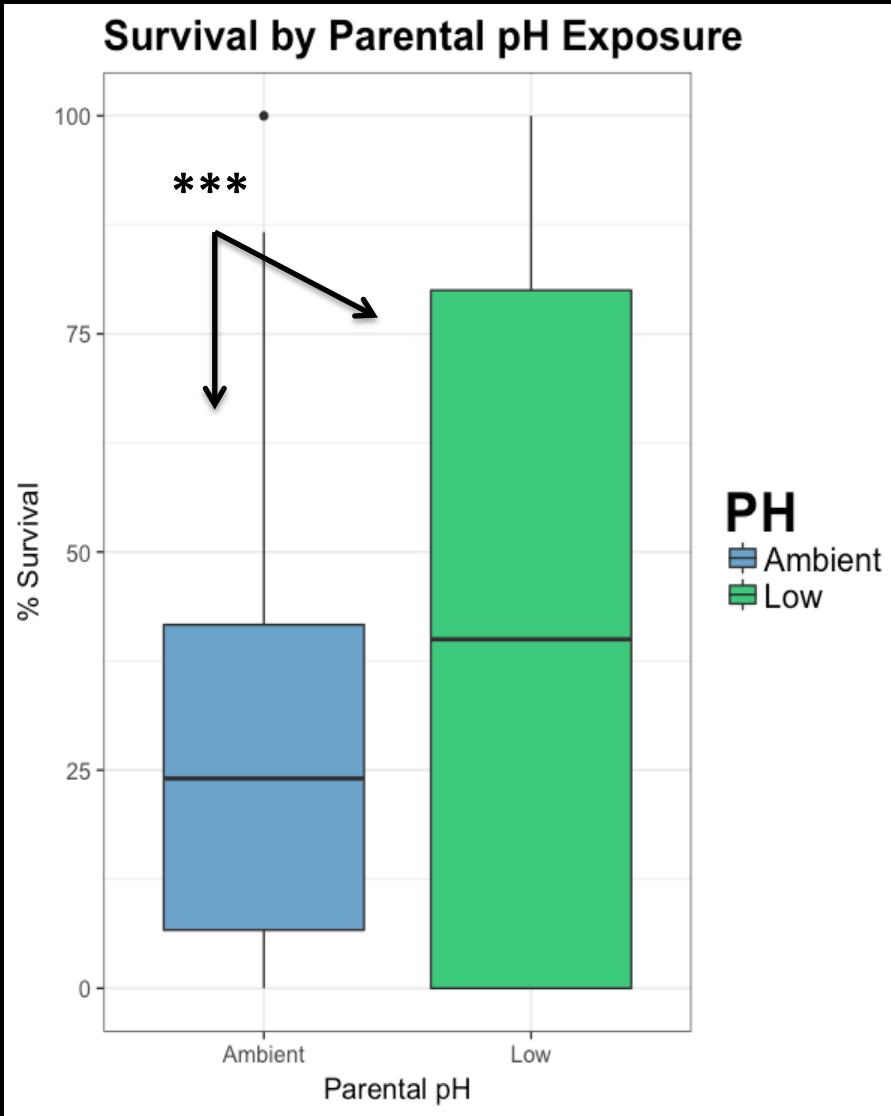
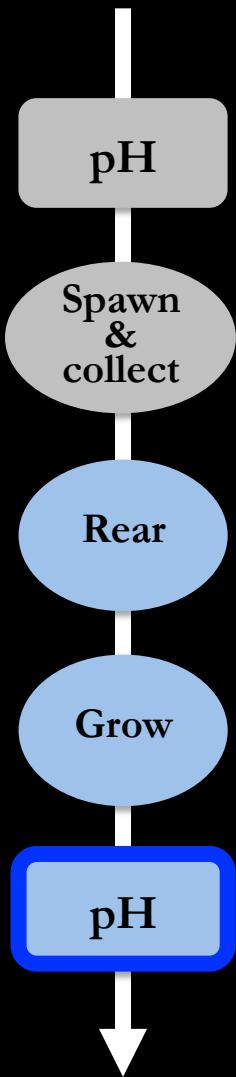


- Eelgrass (7.8 pH)
- Unvegetated (7.5)
- 4 subbasins in Puget Sound
- 670 oysters per parental pH history
- 3 months



ADULT LOW pH EXPOSURE =

↑ OFFSPRING SURVIVAL UNDER STRESS



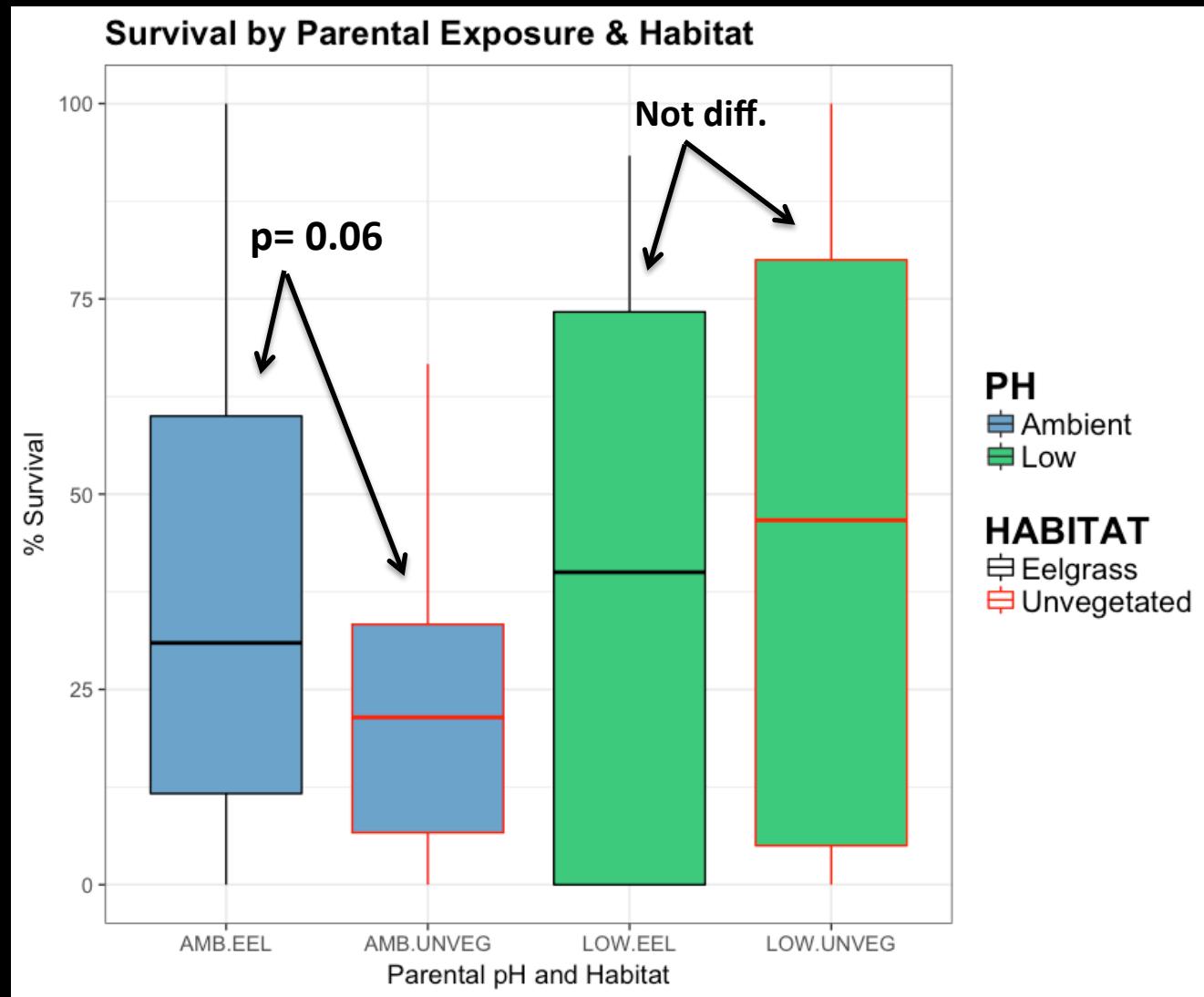
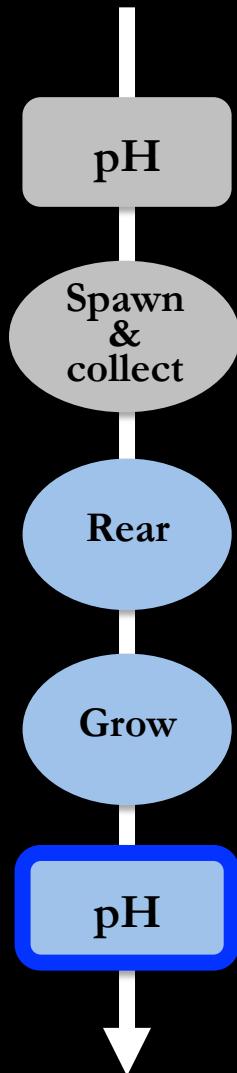
Overall mean survival between pH history:

AMB PH: 27%

LOW PH: 44%

ADULT LOW pH EXPOSURE =

↑ OFFSPRING SURVIVAL UNDER STRESS



CONCLUSIONS:

PARENTS EXPOSED TO LOW pH

- An effect
 - Less ripe gonad
- No effect
 - Reproductive output, timing
- Negative carryover
 - Larval survival lower
 - Juveniles smaller (10 months)
- Positive carry-over:
 - Survival higher during field deployment

NEXT STEPS

Explore mechanisms ...

- Gene expression in gonad, newly released larvae
- Different response to acute low pH shock if parent was exposed?
- Genetic and/or epigenetic? (see Yaamini's talk!)

THANK YOU

- Puget Sound Restoration Fund: Ryan, Stuart, Alice, Erin, Jade, Morgan, Brian, Betsy ...
- Helpers: Yaamini, Grace, Olivia, Megan, Rhonda, Kaitlyn, Lindsay, Duncan, Sam, Hollie, Steven, Steven's kids, Brent, Mom & Ian
- WA DNR: Micah, Emily
- Committee: Steven, Rick, Jackie

