



EFFECTS OF OCEAN ACIDIFICATION ON THE OLYMPIA OYSTER

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SHELLFISH ARE POTENTIALLY VULNERABLE
TO THE EFFECTS OF ACIDIFICATION

But responses are highly variable

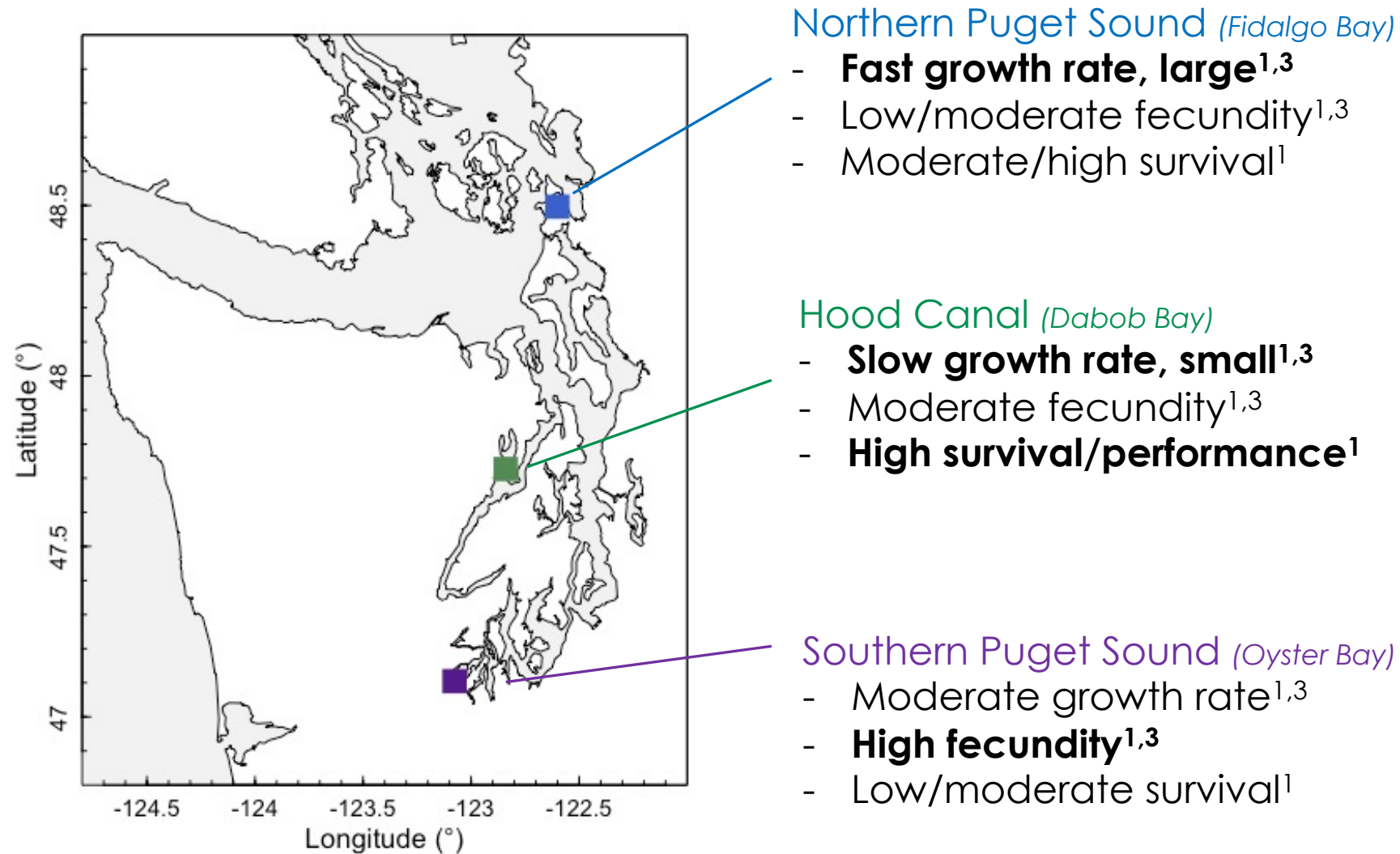
among species

within species



How will ocean acidification affect populations of the Olympia oyster?

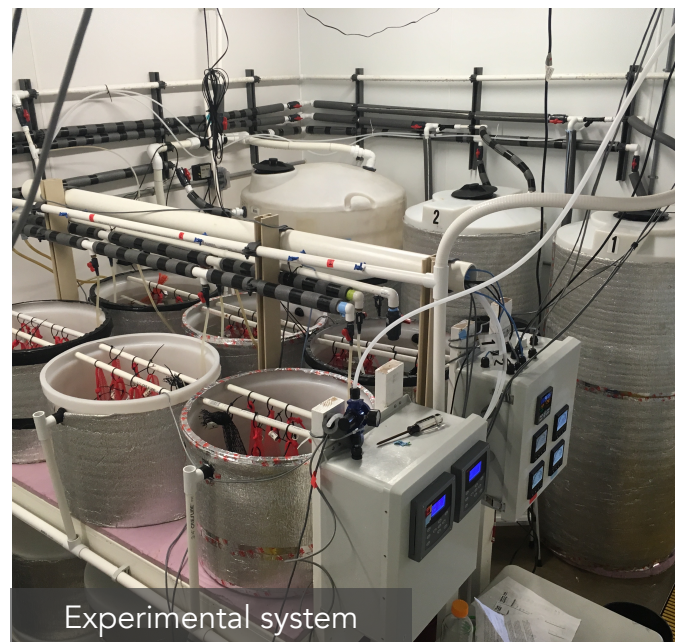
Olympia oyster populations – Puget Sound, WA



(1) Heare et al. 2017 (2) Heare 2018 (3) Silliman et al. 2018 (4) White et al. 2017



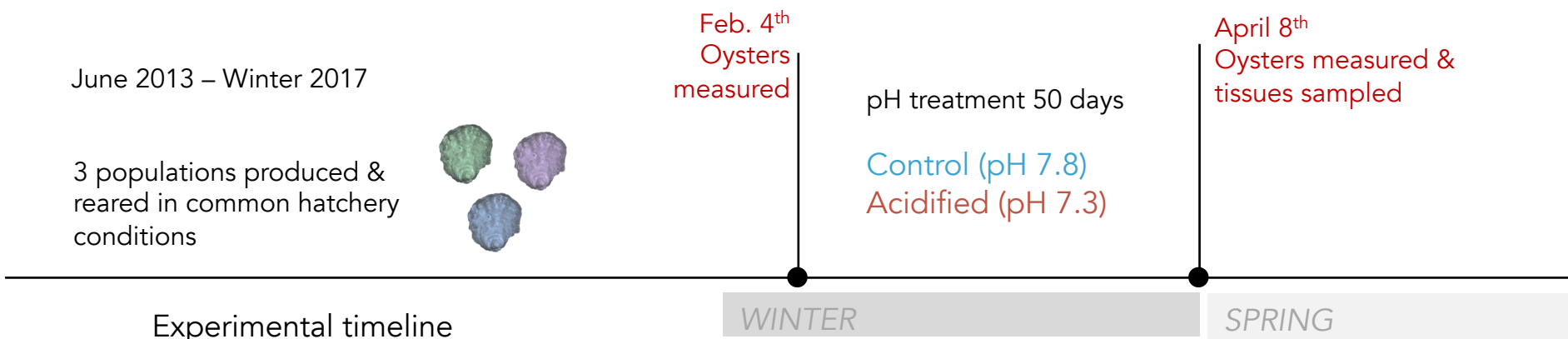
Adult Olympia oysters



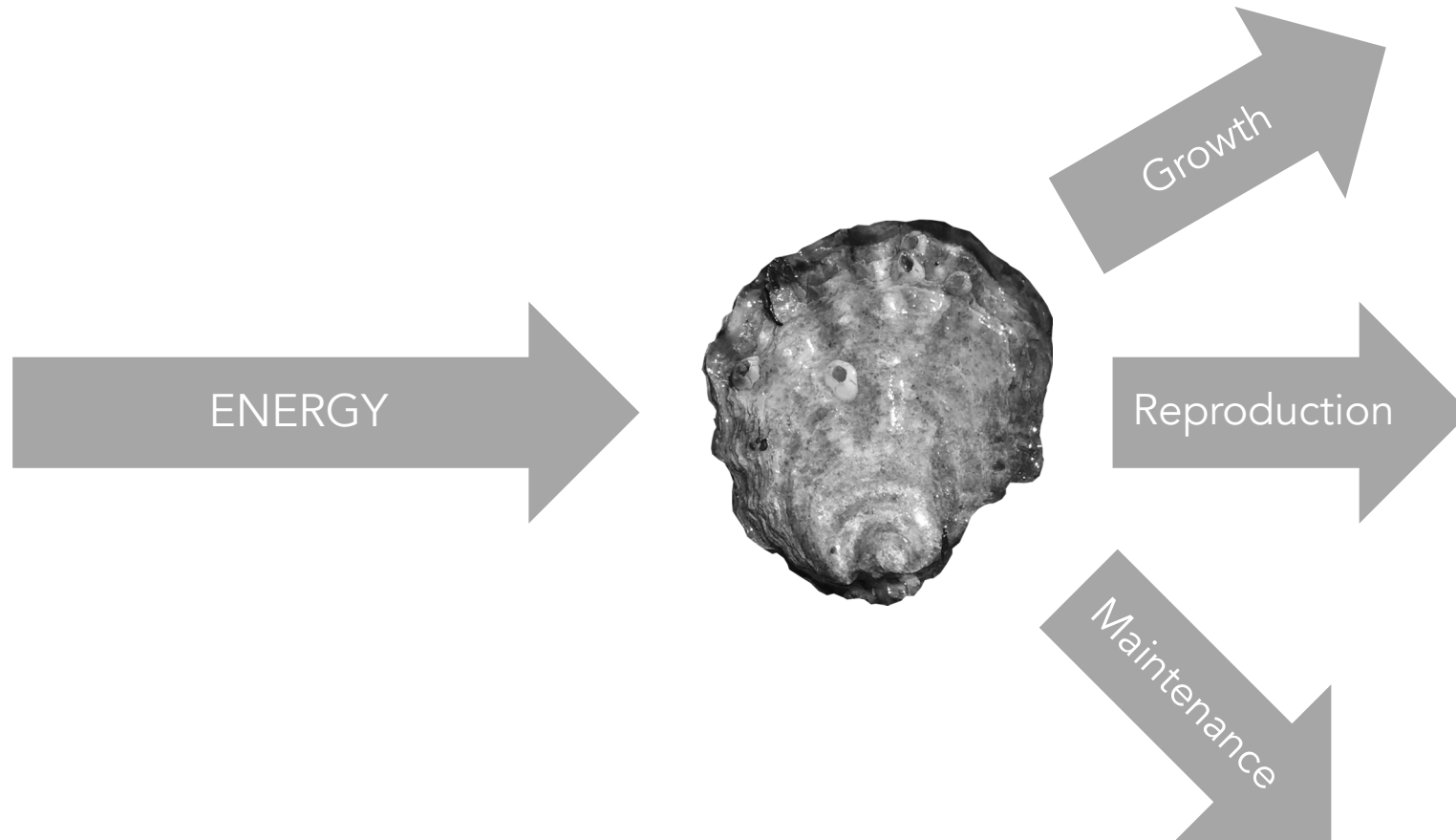
Experimental system



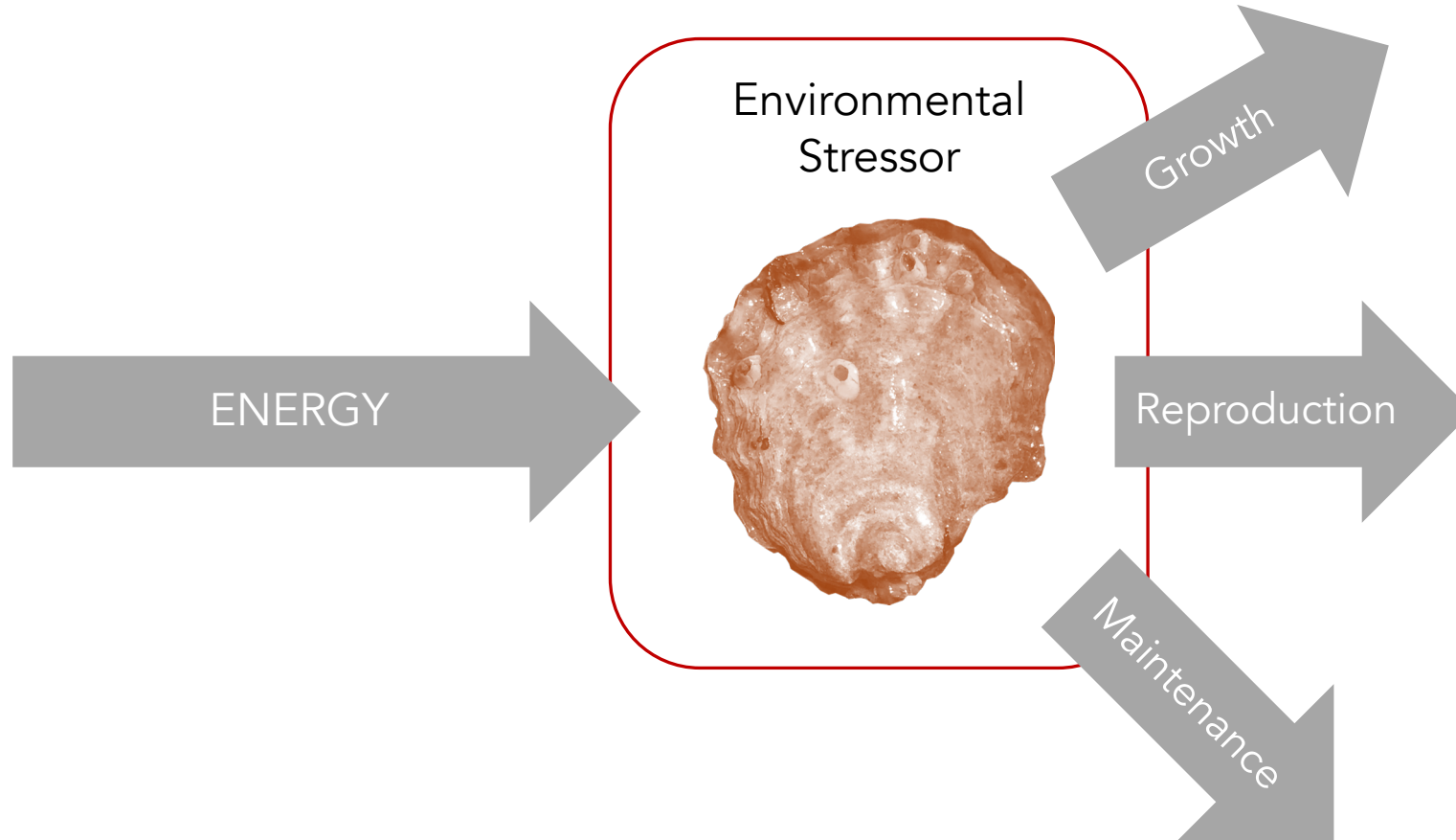
Sampling day



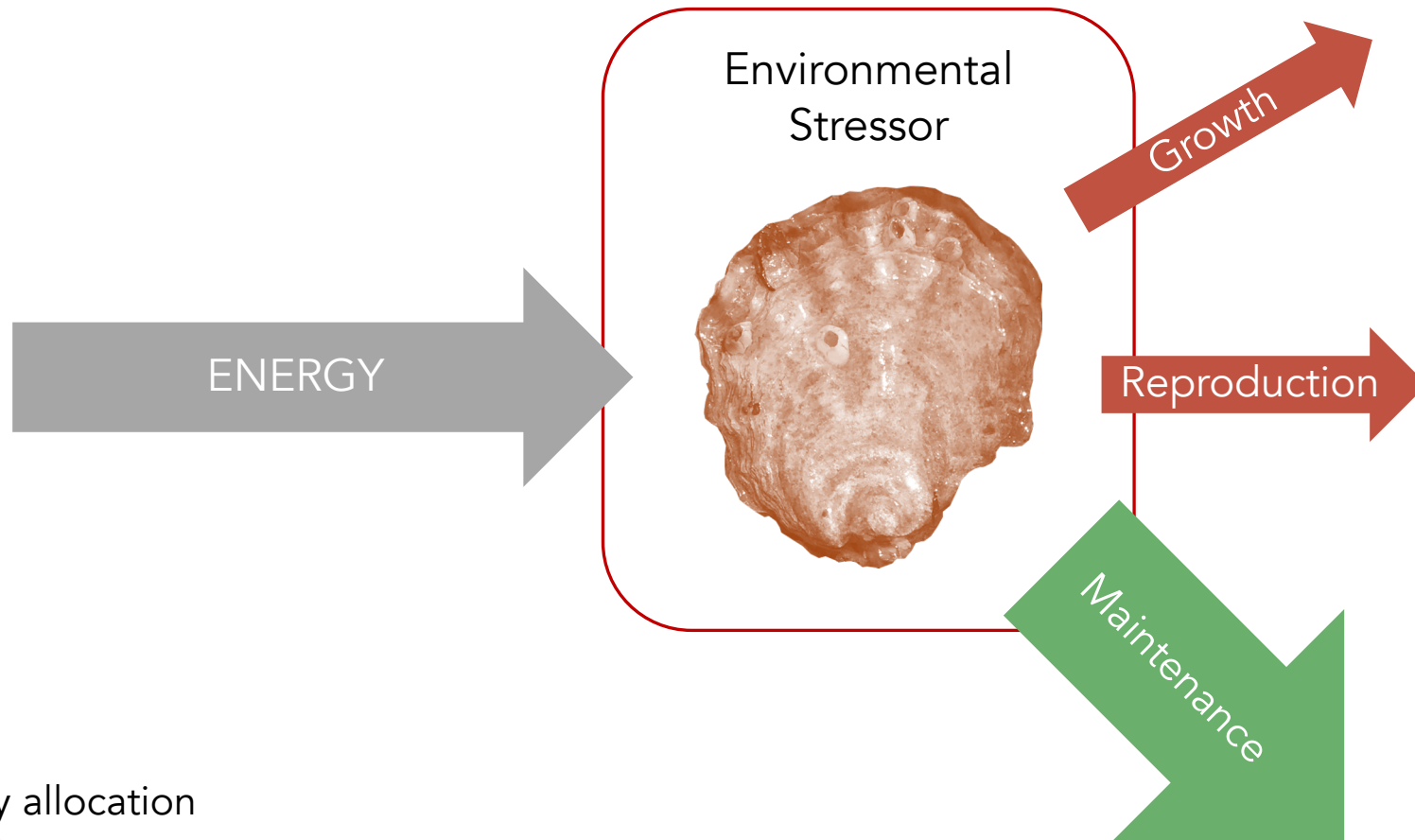
DYNAMIC ENERGY BUDGET



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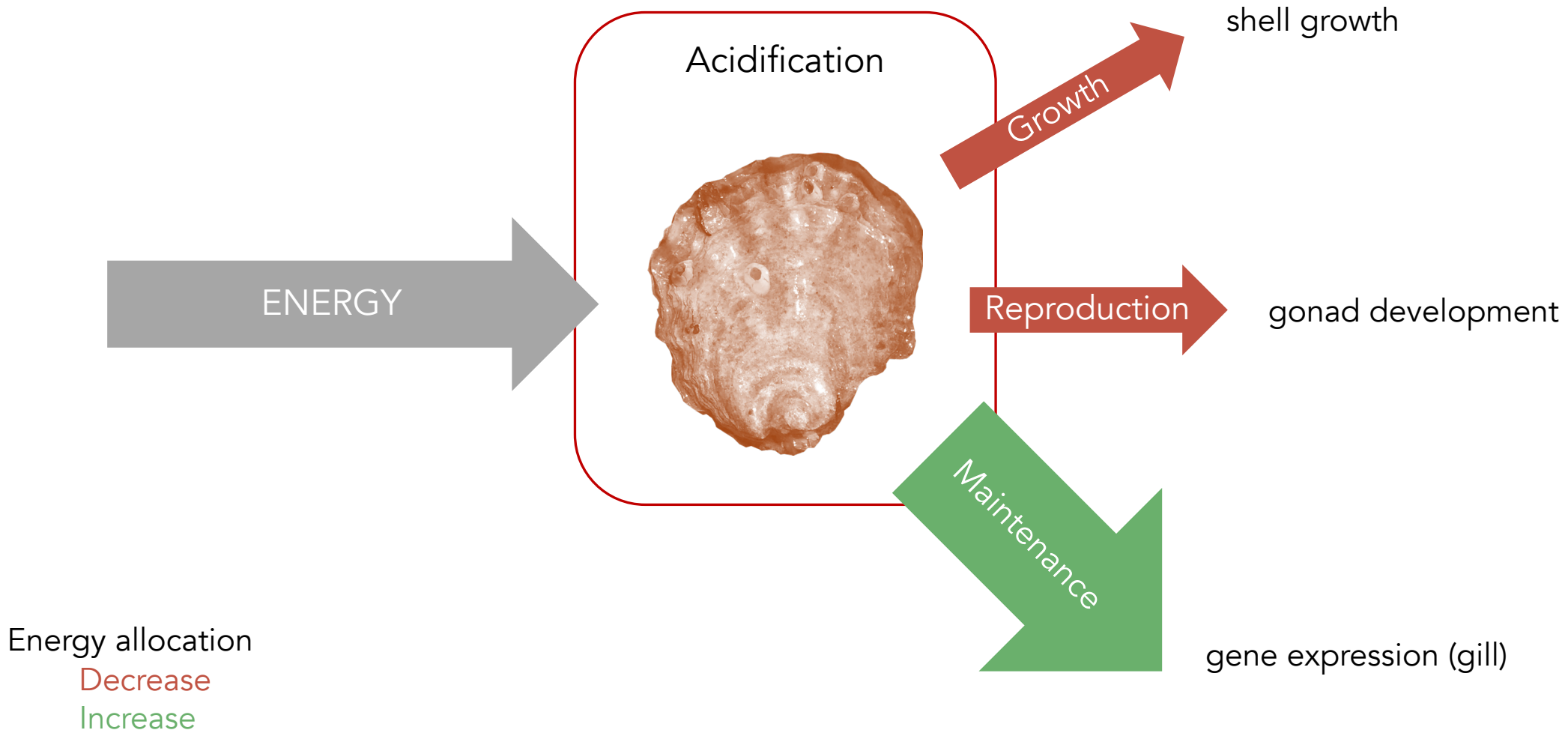


Energy allocation

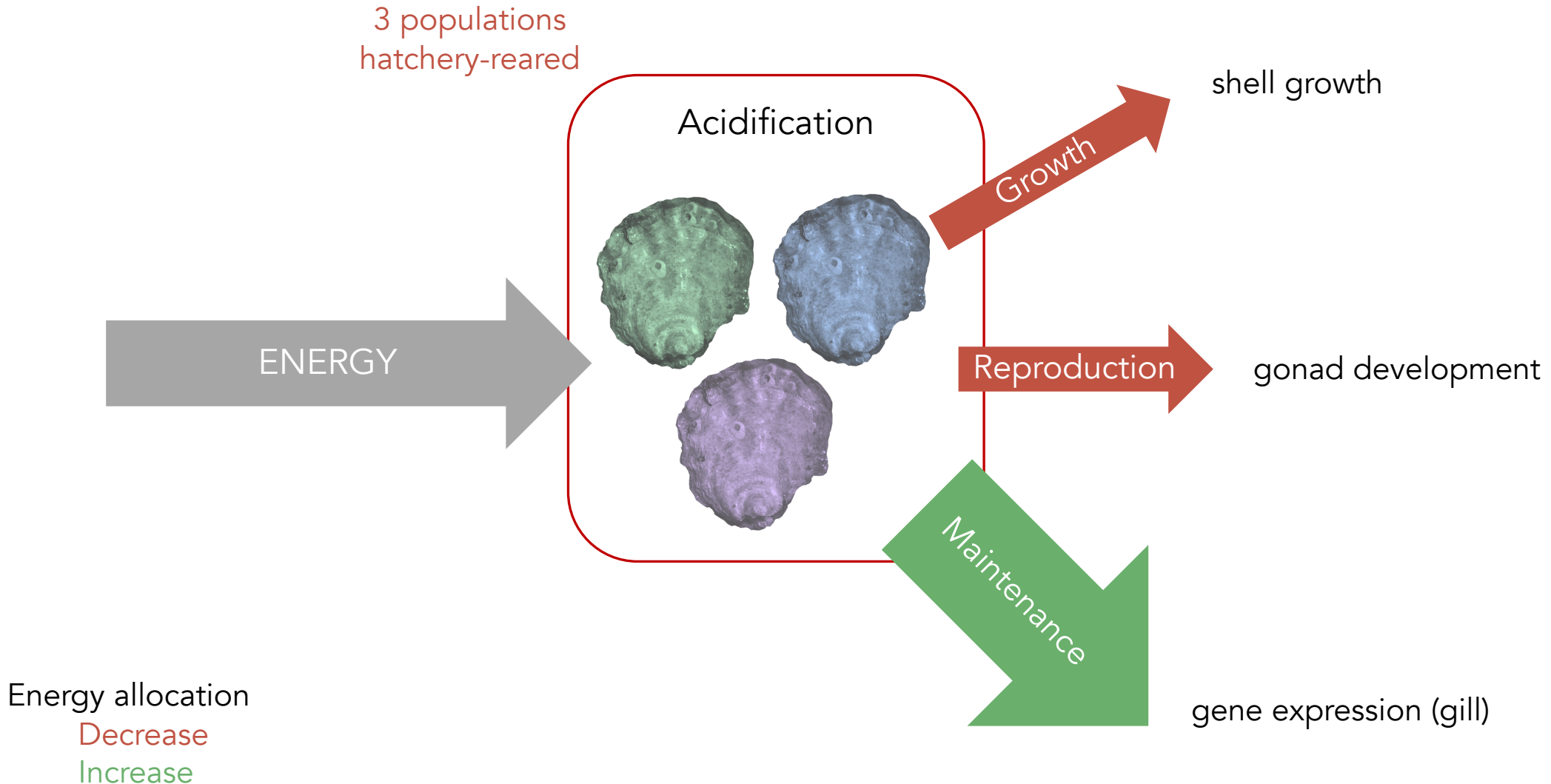
Decrease

Increase

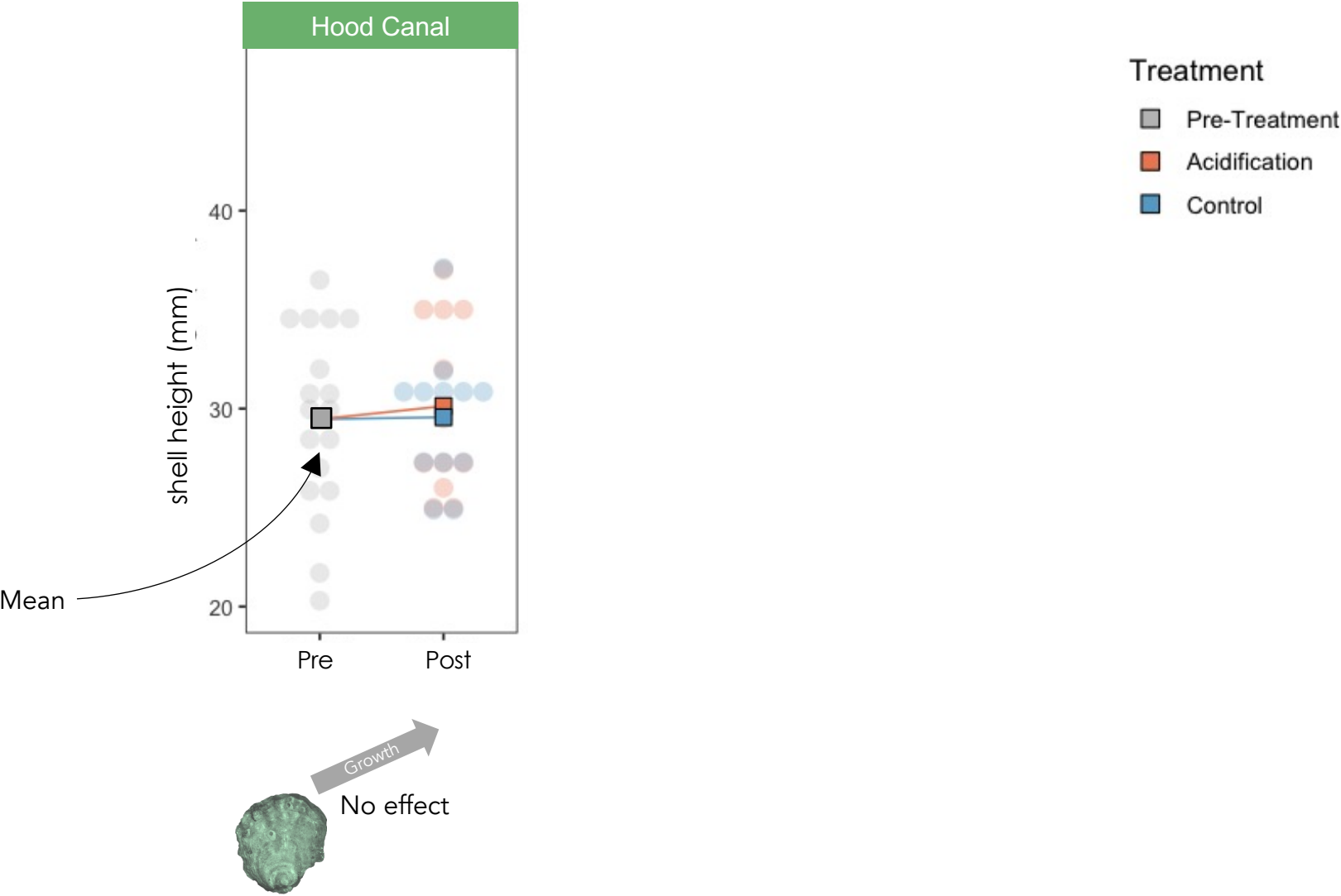
THEORETICAL EFFECTS OF ACIDIFICATION



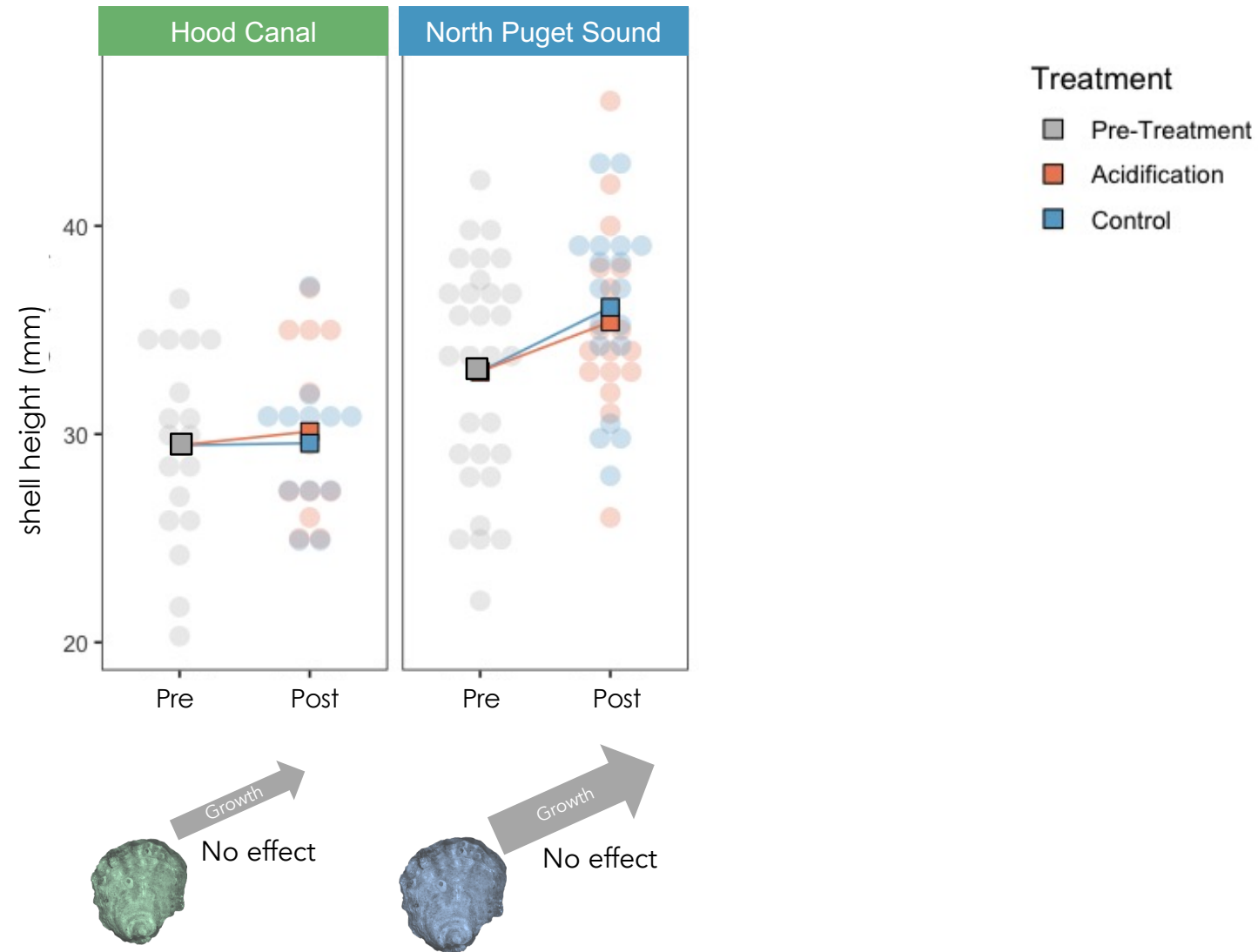
THEORETICAL EFFECTS OF ACIDIFICATION



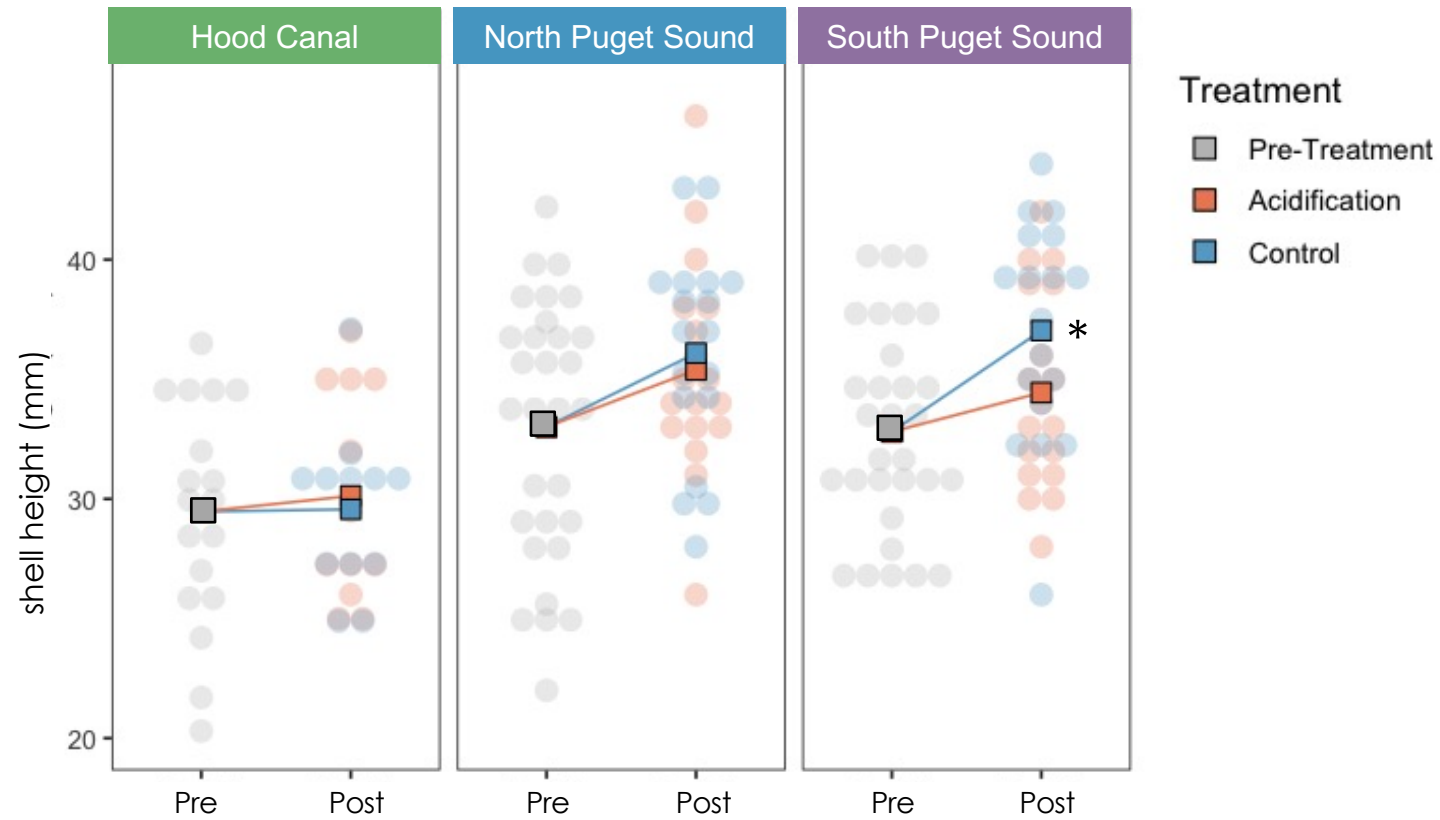
Shell growth by population over 50 days in pH treatments



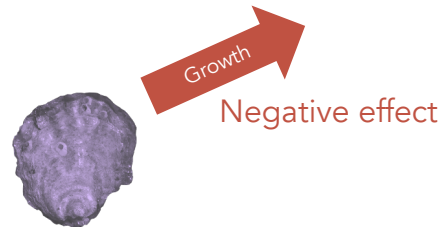
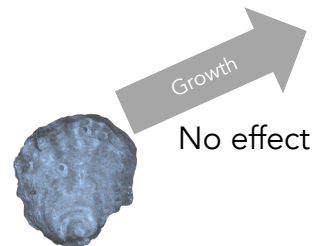
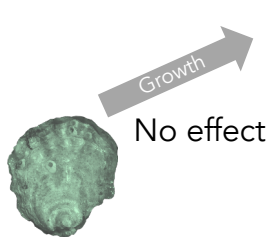
Shell growth by population over 50 days in pH treatments



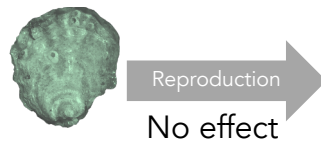
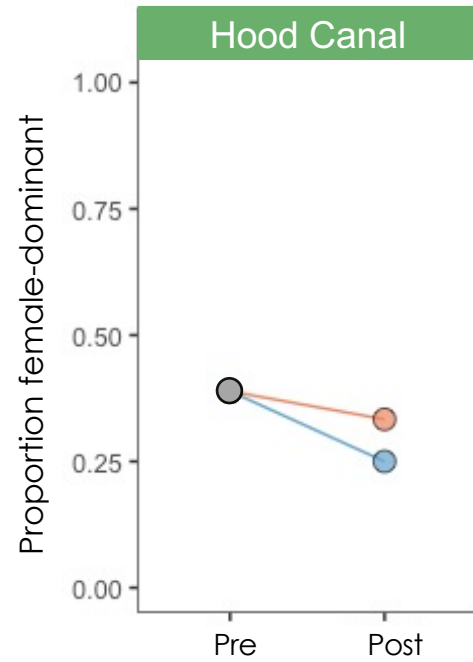
Shell growth by population over 50 days in pH treatments



Effect of acidification on growth is population-dependent



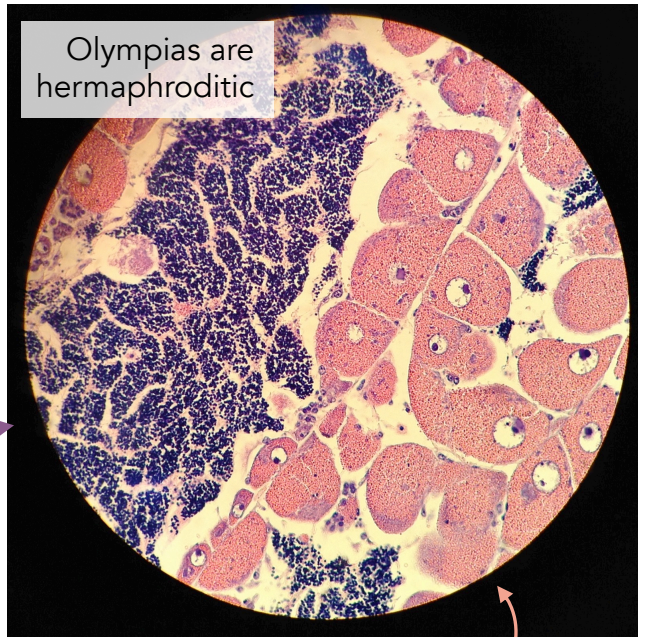
Prevalence of females by population and pH treatments



Treatment

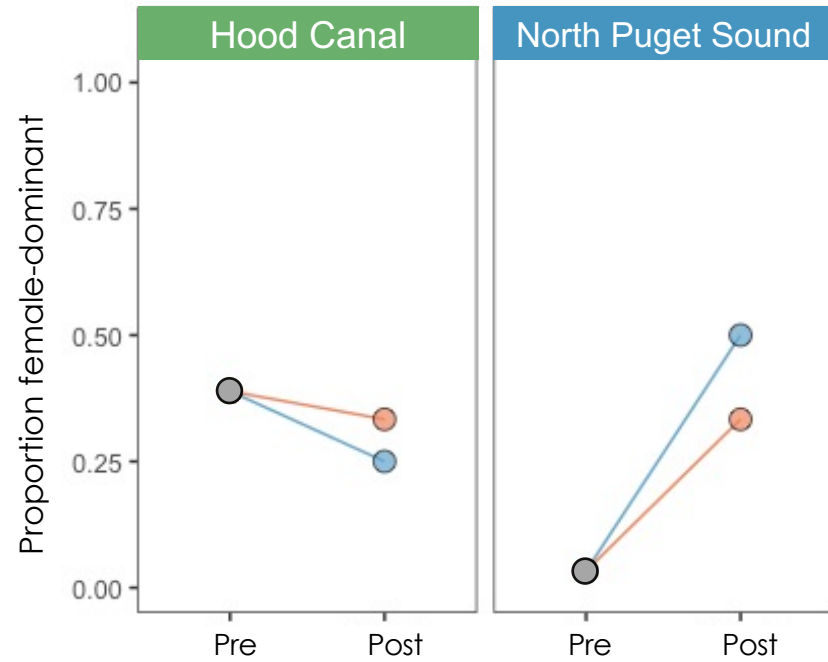
- Control
- Acidification

sperm



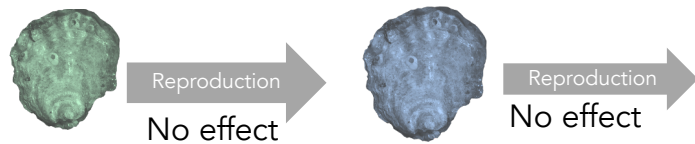
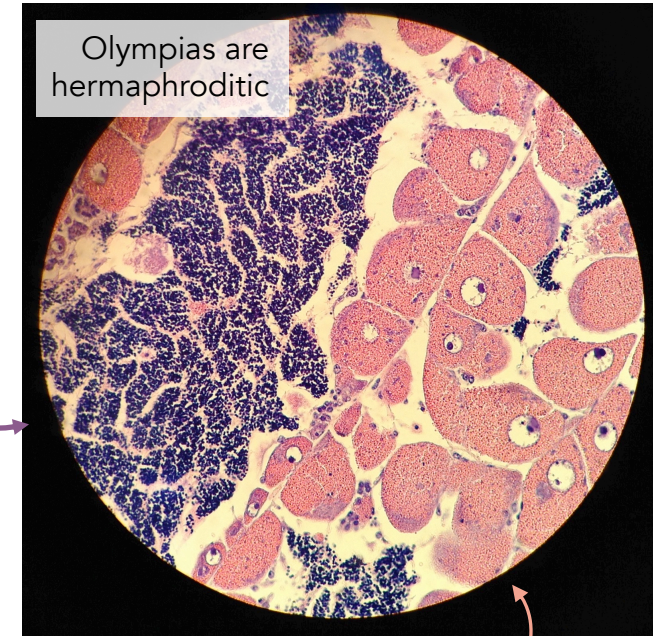
eggs

Prevalence of females by population and pH treatments

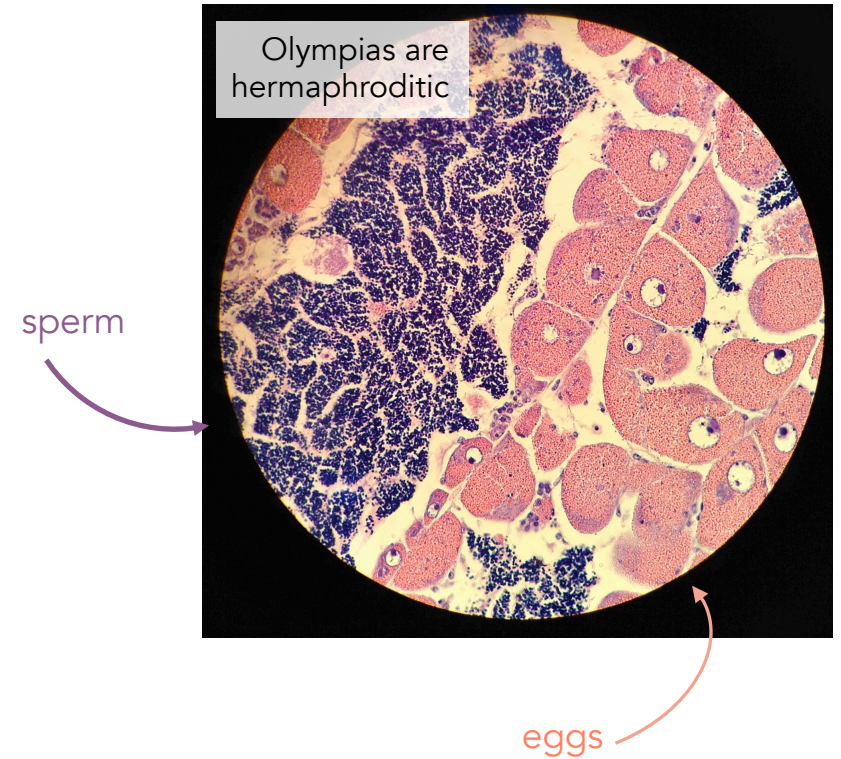
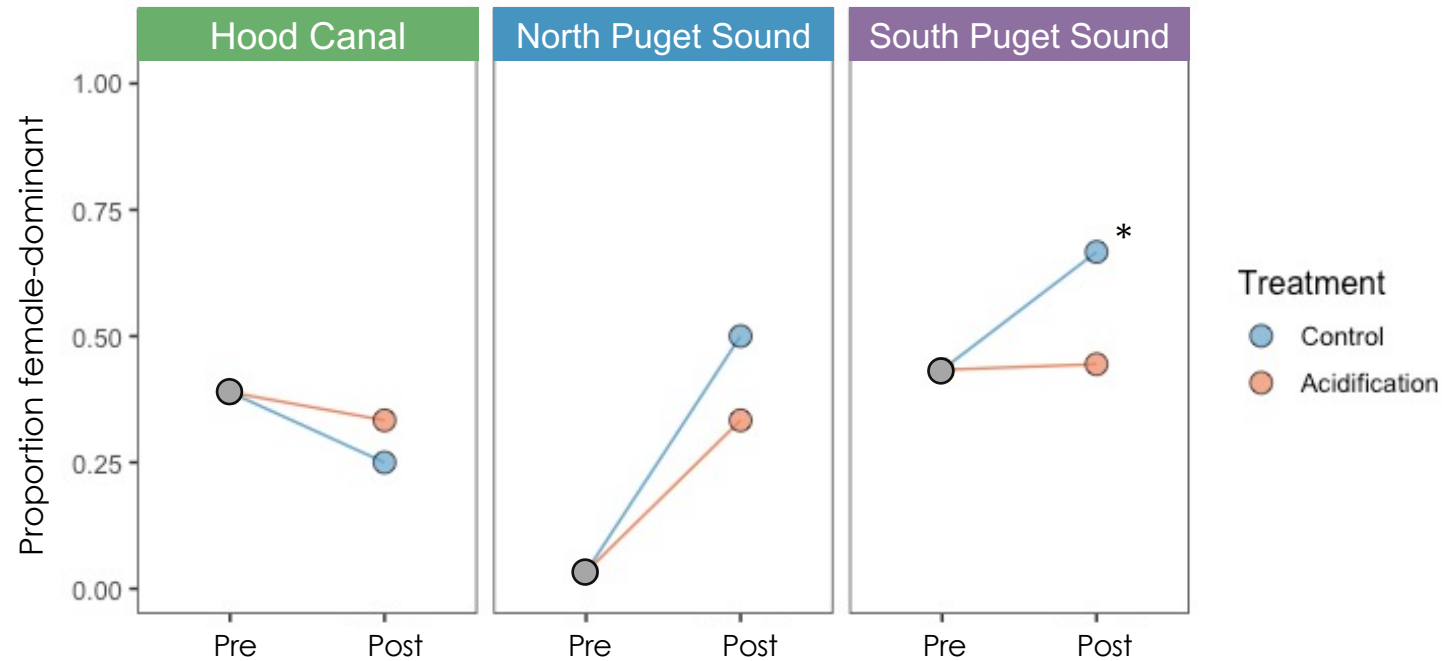


Treatment

- Control
- Acidification



Prevalence of females by population and pH treatments

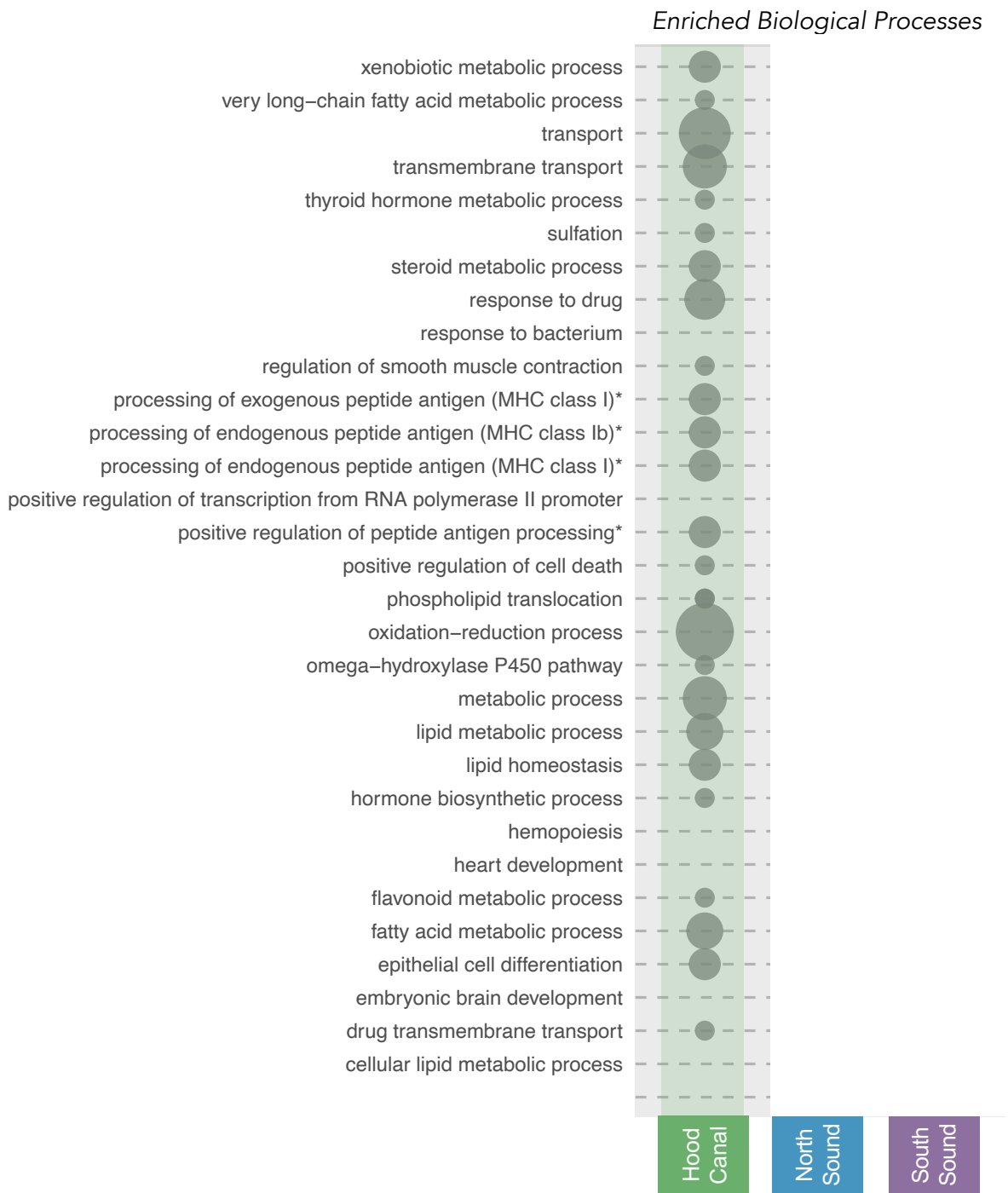


Effect of acidification on reproductive development is population-dependent



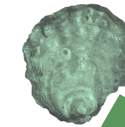
- xenobiotic metabolic process
- very long-chain fatty acid metabolic process
- transport
- transmembrane transport
- thyroid hormone metabolic process
- sulfation
- steroid metabolic process
- response to drug
- response to bacterium
- regulation of smooth muscle contraction
- processing of exogenous peptide antigen (MHC class I)*
- processing of endogenous peptide antigen (MHC class Ib)*
- processing of endogenous peptide antigen (MHC class I)*
- positive regulation of transcription from RNA polymerase II promoter
- positive regulation of peptide antigen processing*
- positive regulation of cell death
- phospholipid translocation
- oxidation-reduction process
- omega-hydroxylase P450 pathway
- metabolic process
- lipid metabolic process
- lipid homeostasis
- hormone biosynthetic process
- hemopoiesis
- heart development
- flavonoid metabolic process
- fatty acid metabolic process
- epithelial cell differentiation
- embryonic brain development
- drug transmembrane transport
- cellular lipid metabolic process

Effect of acidification on gene expression is population-dependent



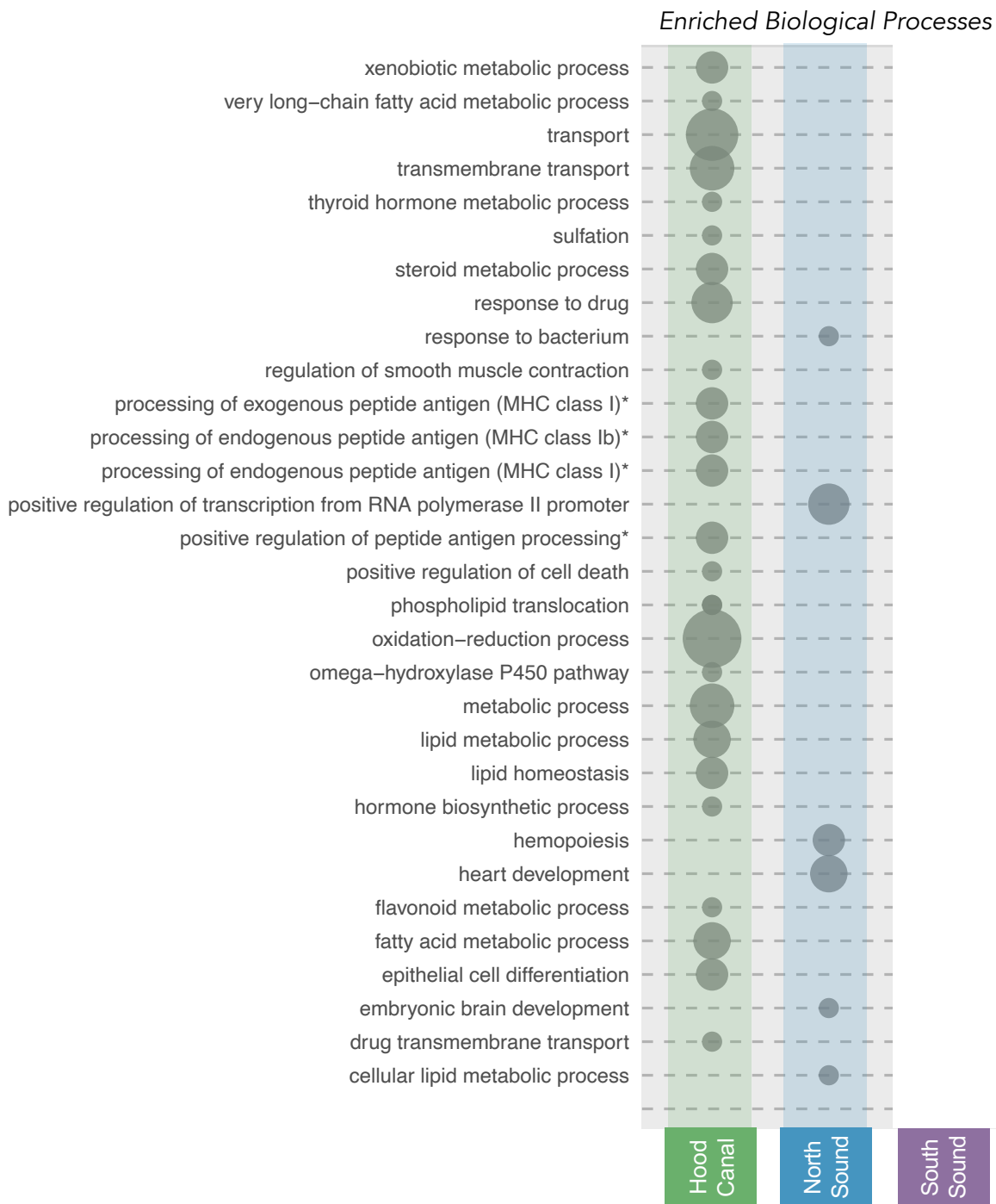
Effect of acidification on gene expression is population-dependent

Large response
in *Hood Canal*
132 genes



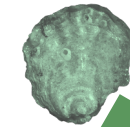
Maintenance

Robust cellular
defense system



Effect of acidification on gene expression is population-dependent

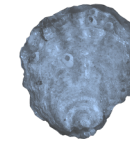
Large response
in *Hood Canal*
132 genes



Maintenance

Robust cellular
defense system

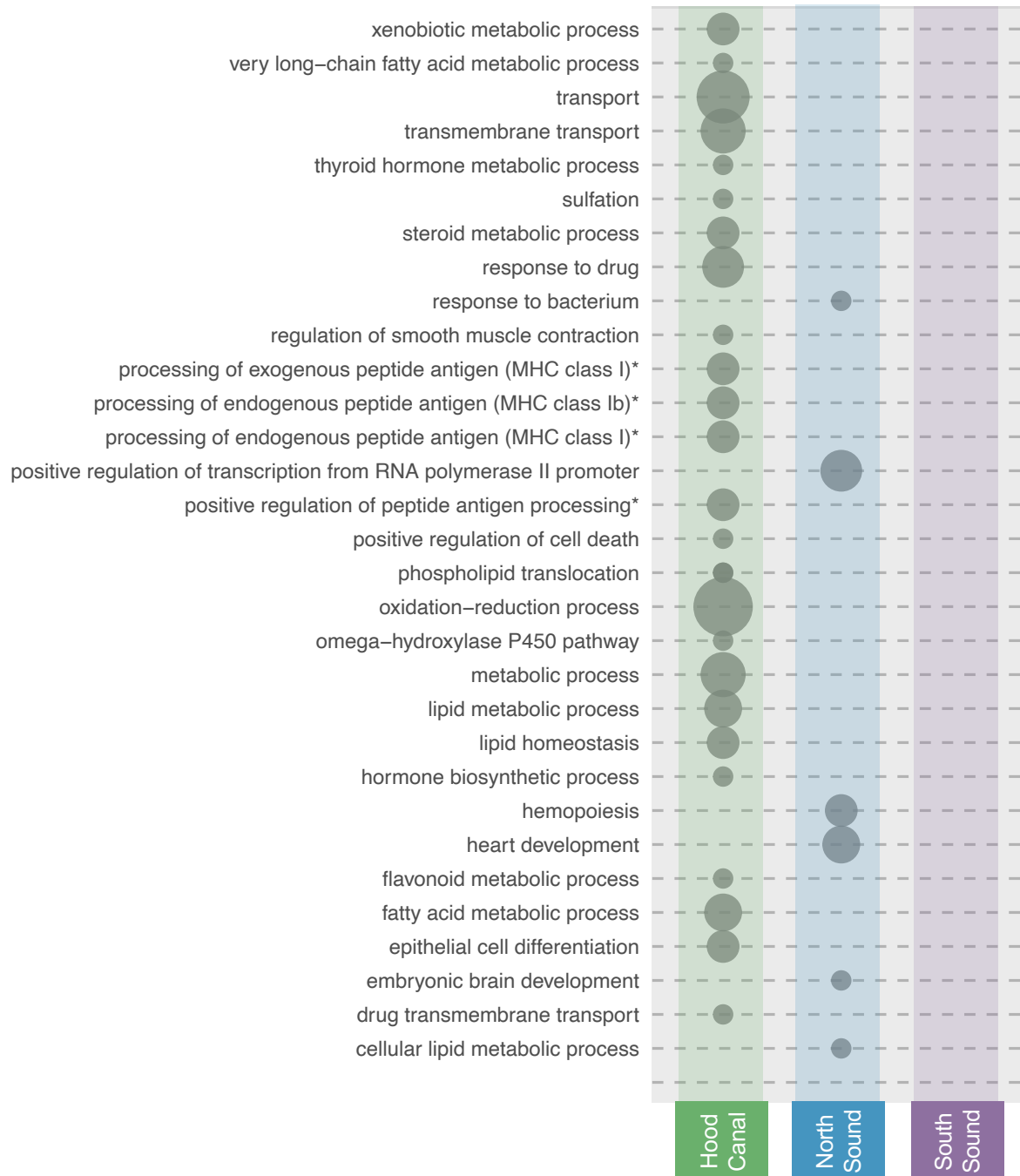
moderate
response in
North Sound
76 genes



Maintenance

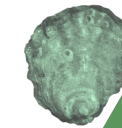
Moderate cellular
defense system

Enriched Biological Processes



Effect of acidification on gene expression is population-dependent

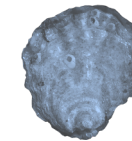
Large response
in **Hood Canal**
132 genes



Maintenance

Robust cellular
defense system

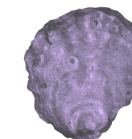
moderate
response in
North Sound
76 genes



Maintenance

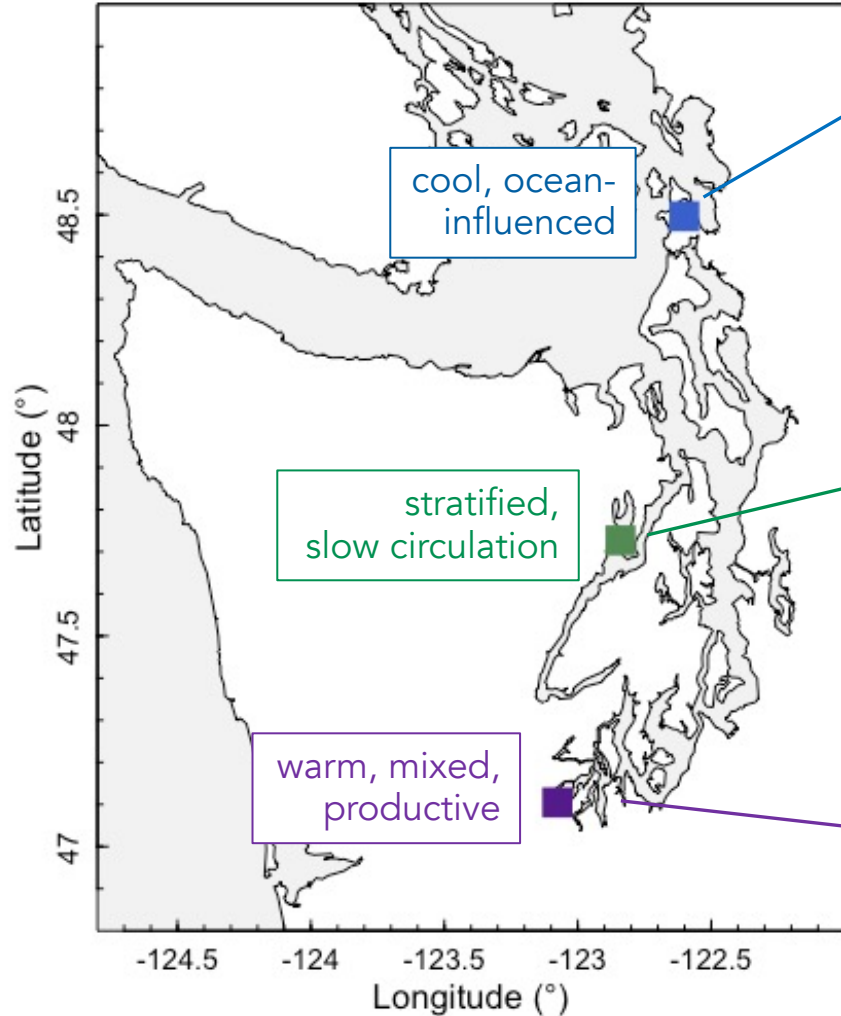
Moderate cellular
defense system

No differential
expression in
South Sound
no genes



Maintenance

Weak cellular
defense system



Northern Puget Sound (*Fidalgo Bay*)

- Fast growth rate, large
- Low/moderate fecundity
- **Moderate/high survival**

Hood Canal (*Dabob Bay*)

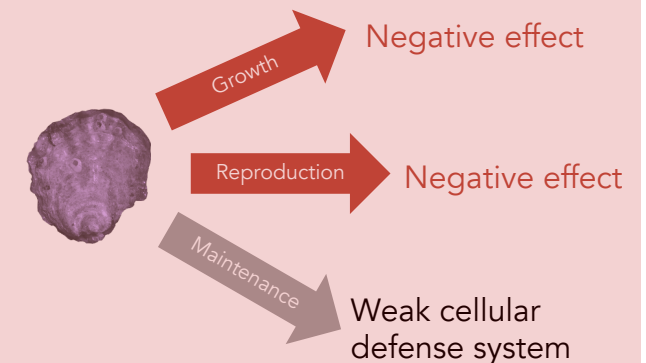
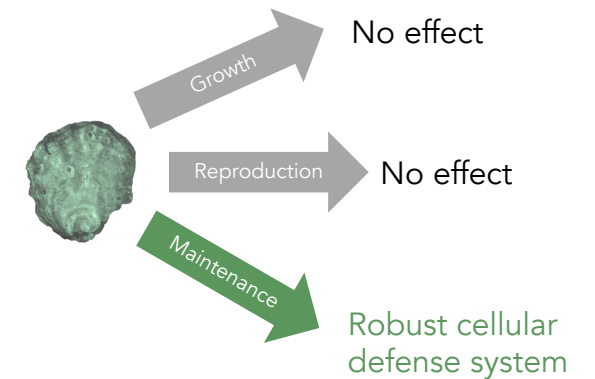
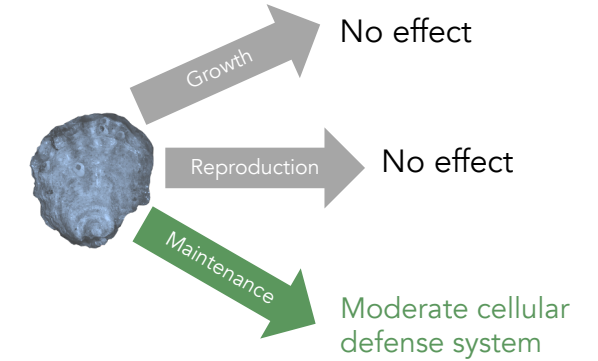
- Slow growth rate, small
- Moderate fecundity
- **High survival/performance**

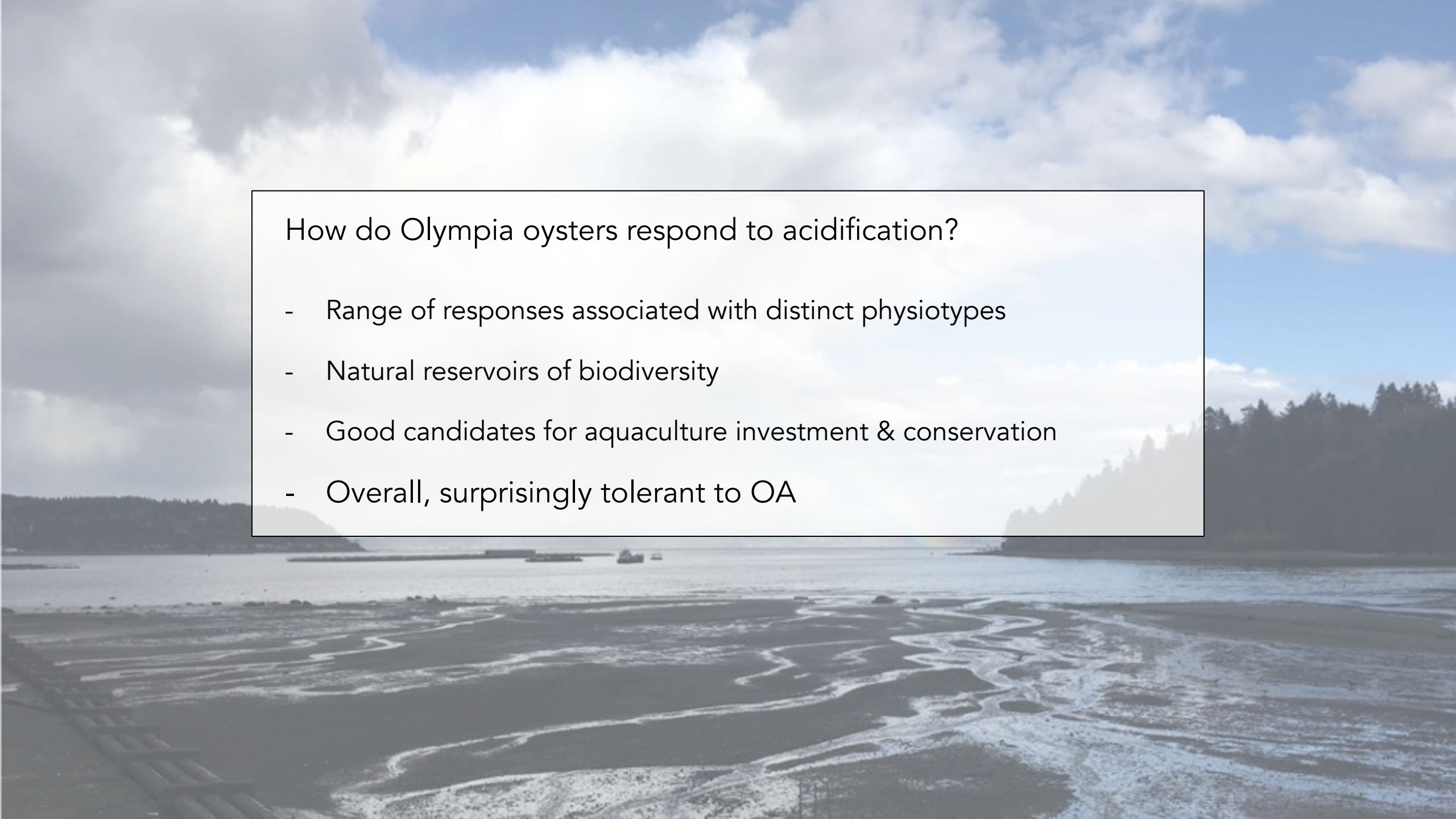
Southern Puget Sound (*Oyster Bay*)

- Moderate growth rate
- High fecundity
- **Low/moderate survival**

stressor

Response to Acidification





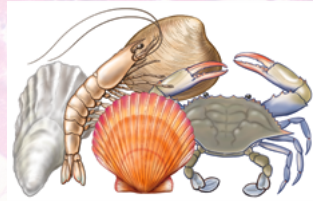
How do Olympia oysters respond to acidification?

- Range of responses associated with distinct phenotypes
- Natural reservoirs of biodiversity
- Good candidates for aquaculture investment & conservation
- Overall, surprisingly tolerant to OA

THANK YOU TO FUNDERS & COLLABORATORS



**PUGET SOUND
RESTORATION FUND**



National Shellfisheries Association
Established 1908



QUESTIONS?

Ostrea sp. reproductive tissue

200 μ m