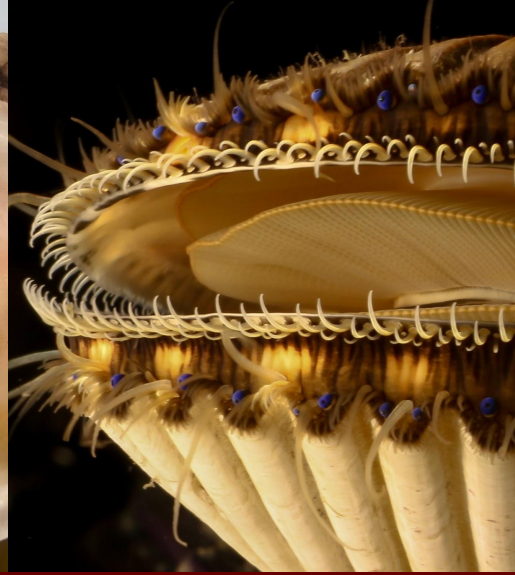


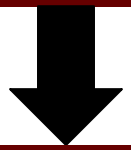



Seas the Day: Restoring Shellfish, Restoring Coasts

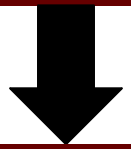
Emily Fuqua
Morgan Hawkins
FSUCML Conservation Lecture Series
November 14, 2024

Outline

History about shellfish and aquaculture



Restoration aquaculture

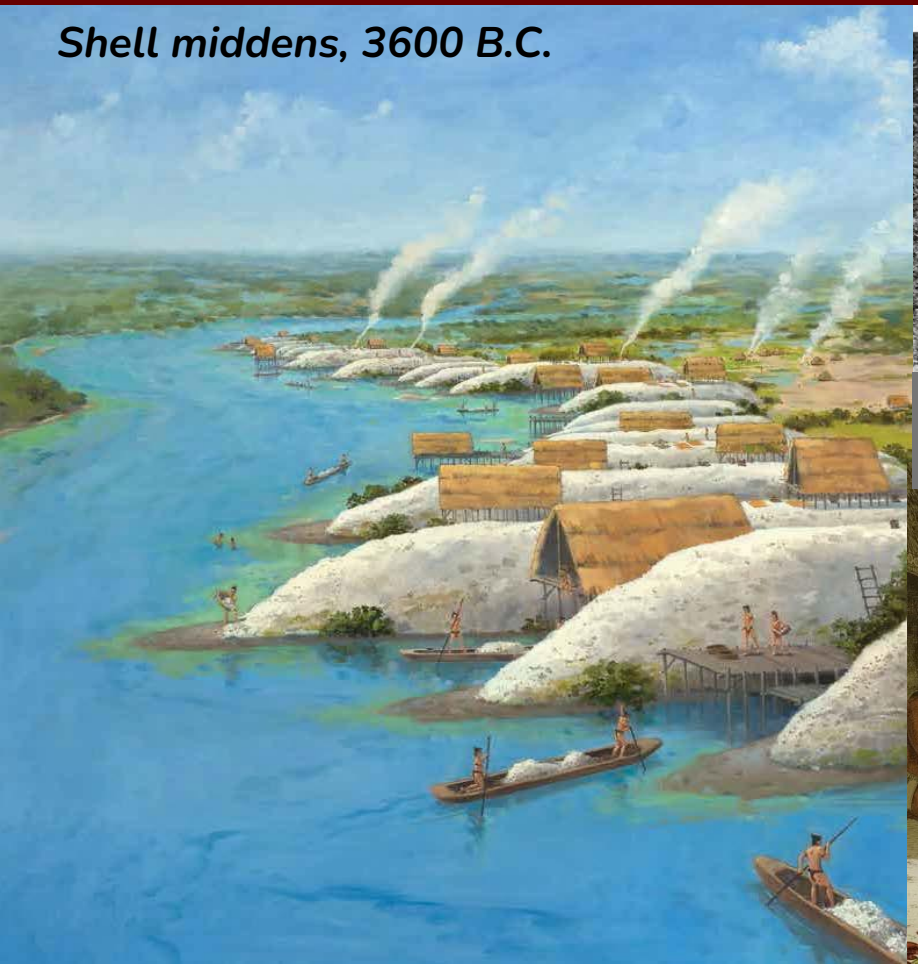


Research in Restoration Aquaculture

- Changing environments and carry-over effects
- Probiotics in shellfish hatcheries

A bit of history

Shellfish in Florida's History



Fort George Island Cultural State Park

Cedar Key

A Boom to Bust for Shellfish

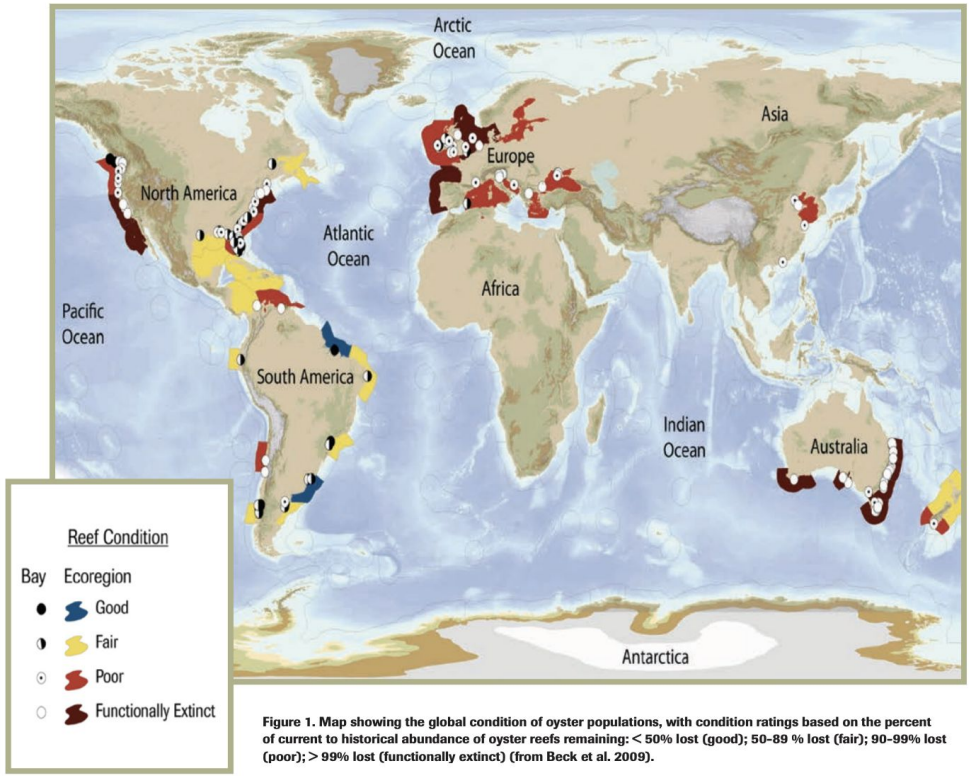
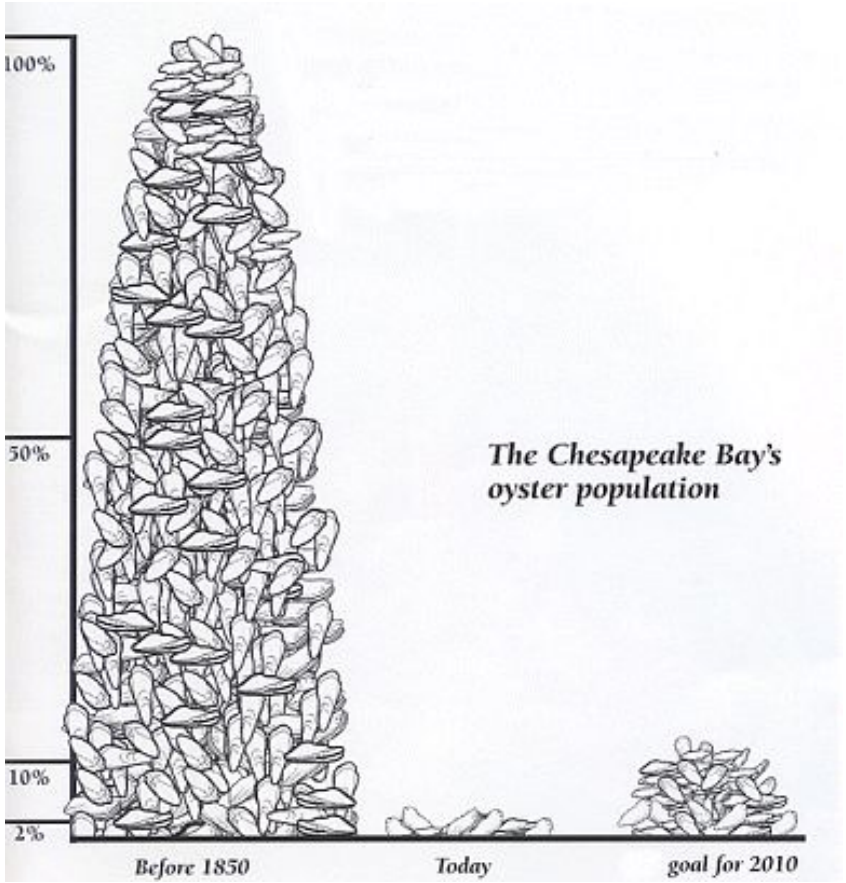


Figure 1. Map showing the global condition of oyster populations, with condition ratings based on the percent of current to historical abundance of oyster reefs remaining: < 50% lost (good); 50–89 % lost (fair); 90–99% lost (poor); > 99% lost (functionally extinct) (from Beck et al. 2009).

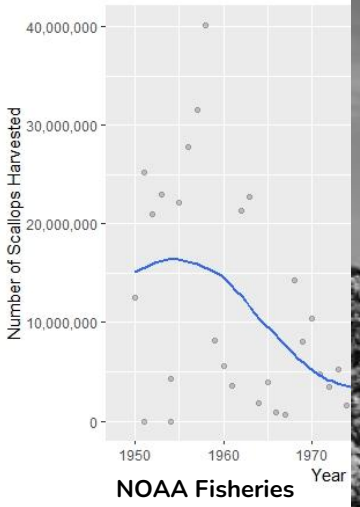
Map: TNC



Graphic source: SCARCE

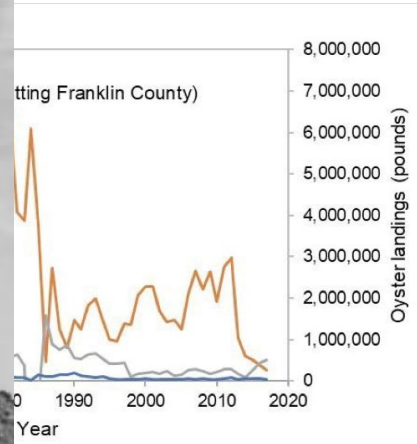
A Boom to Bust for Shellfish in Florida

Bay Sca



NOAA Fisheries

n Oyster



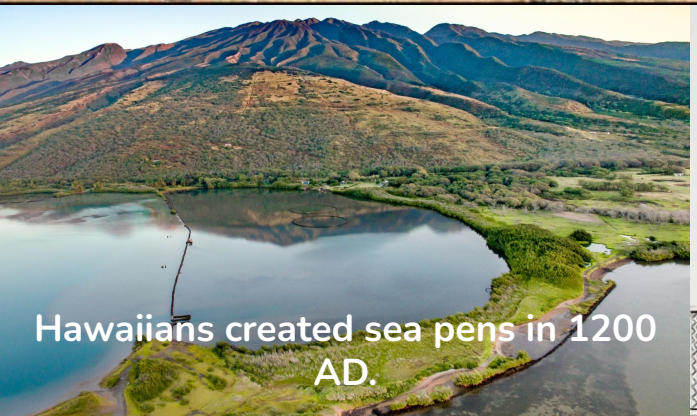
Many ecor

cross Florida

Aquaculture is actually ancient.

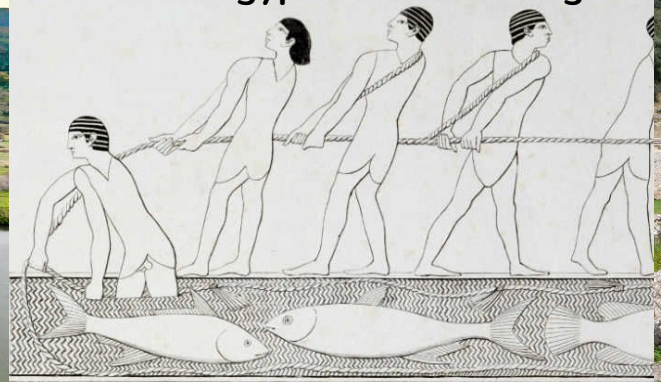
Depiction of aquaculture from China, which started in 3200 BC.

Aquaponics in Central America in 1000 AD.



Hawaiians created sea pens in 1200 AD.

Ancient Egyptian fish farming.

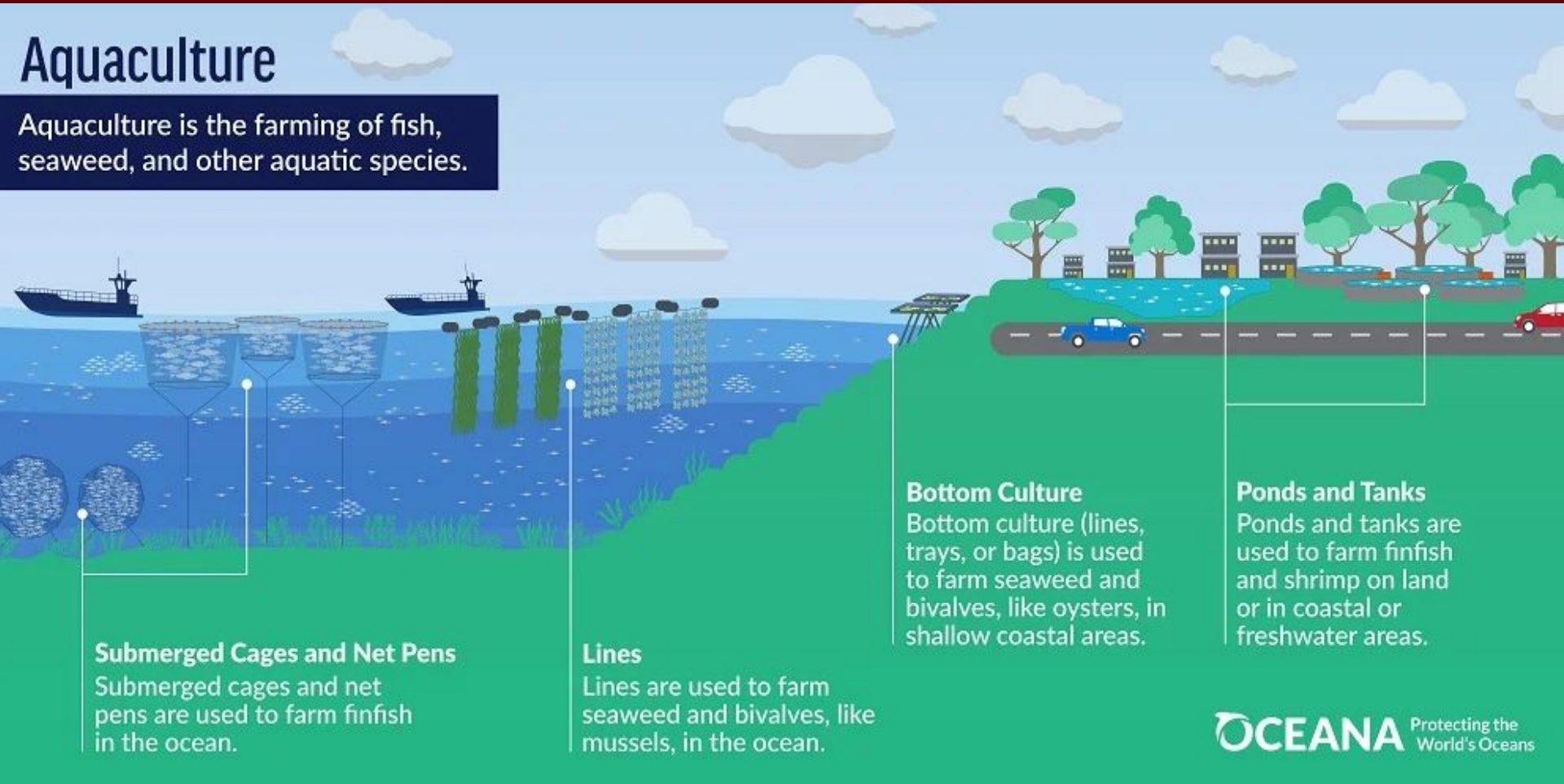


Ponds from Rome, for food and ornamental culture.

Modern approaches to aquaculture in the 1800s.

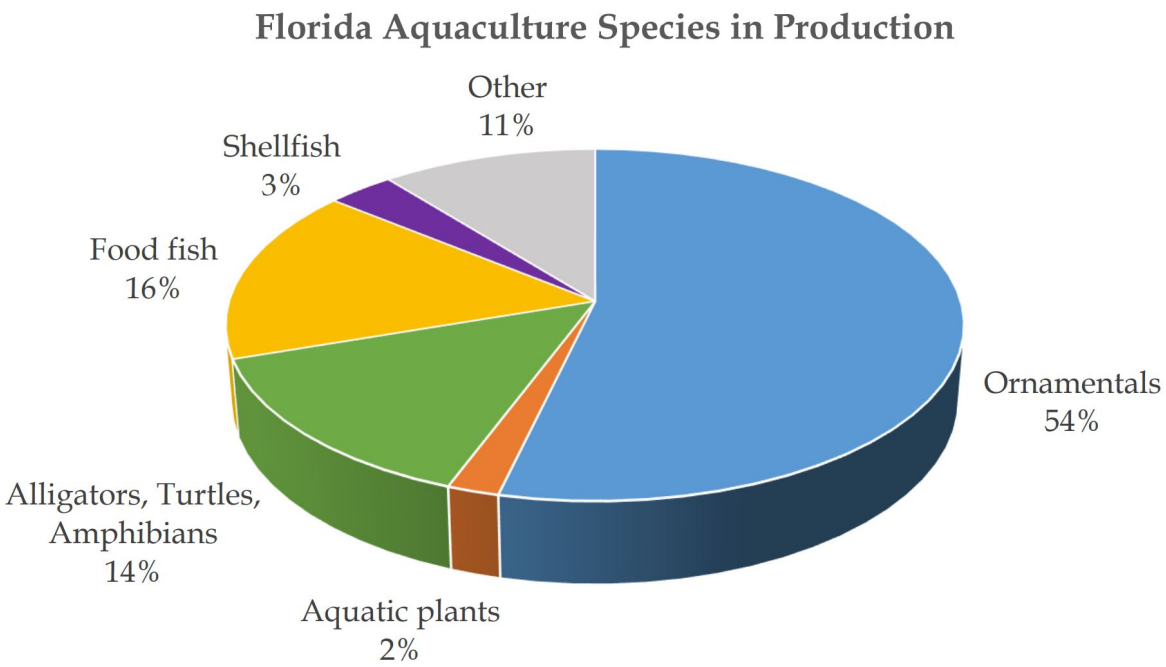
The New York Caledonia Fish Hatchery founded in 1864 by Seth Green (the "Father of Fish Culture") is believed to be the oldest hatchery in the United States.

Any of these look familiar?



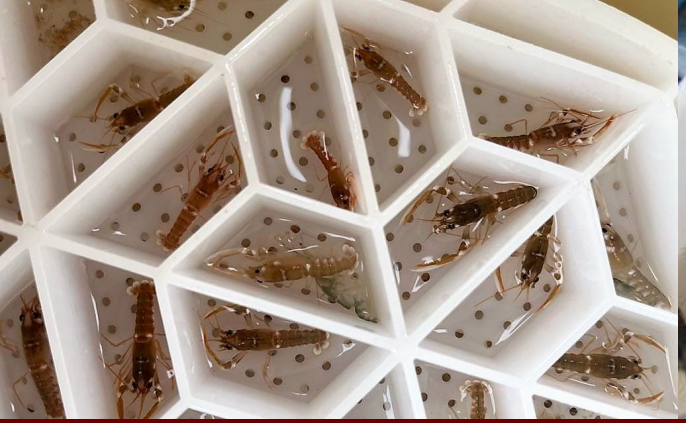
Main uses for aquaculture: *Food*

Main uses for aquaculture: *Ornamentals*



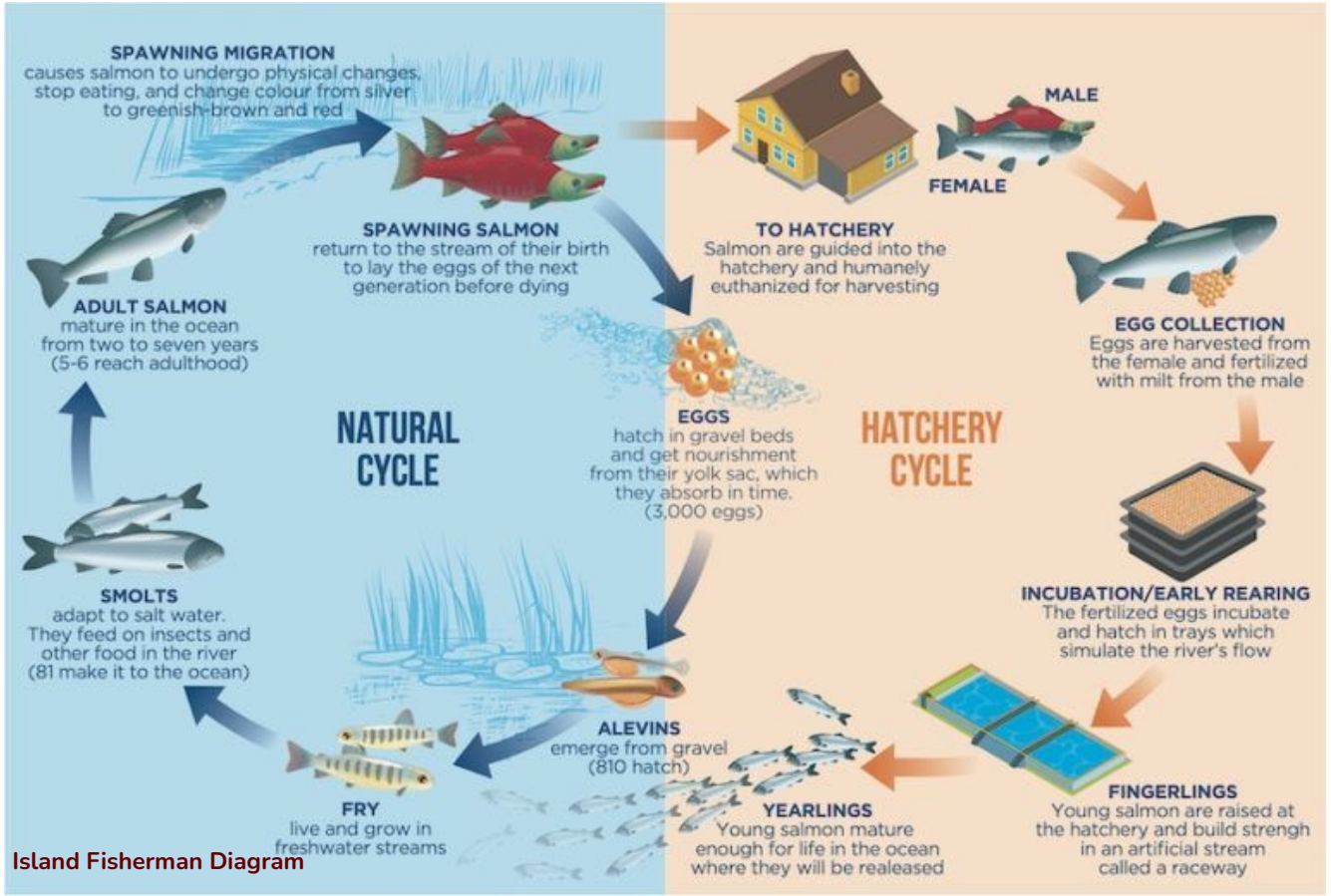
Graphic source: FDACS

Main uses for aquaculture: *Restoration*



Restoration Aquaculture

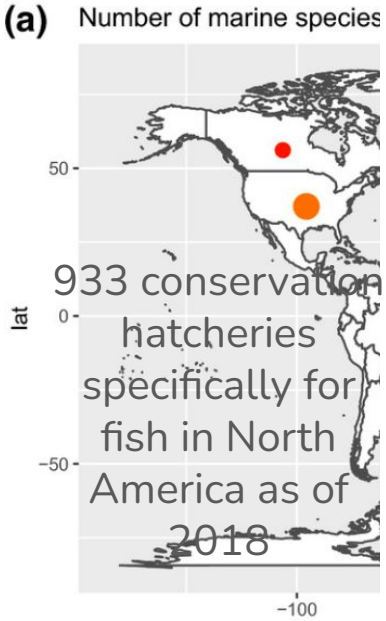

Conservation Hatchery Process

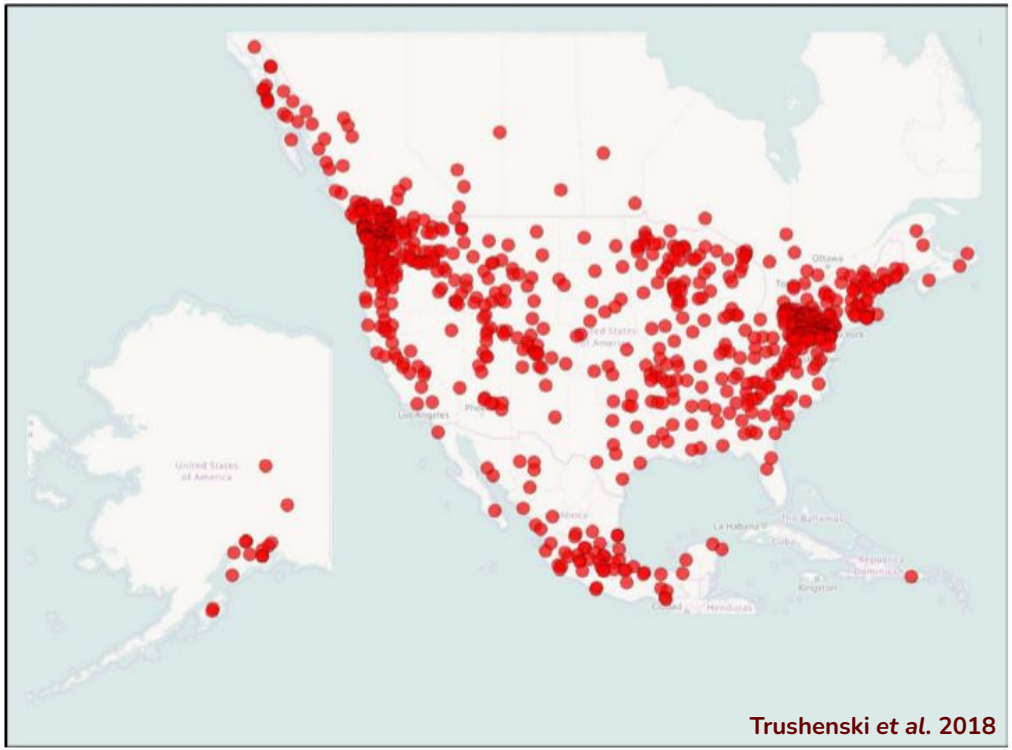


Island Fisherman Diagram

A technique used worldwide - for a variety of species

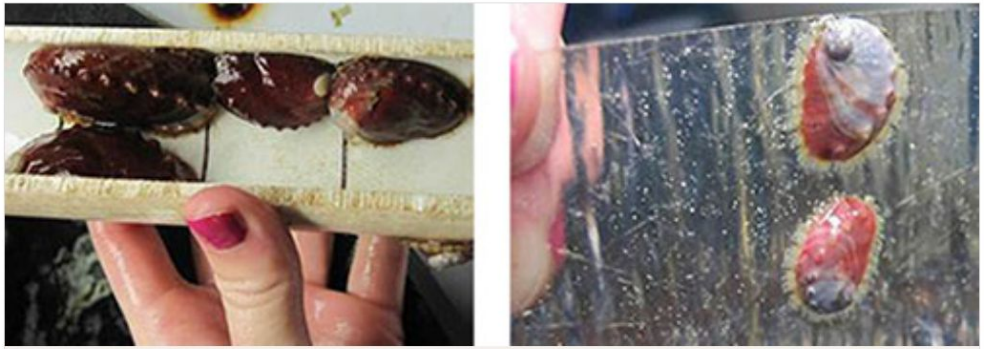
Restoration aquaculture is a <u>widely used</u> conservation and management technique that has successful programs <u>worldwide</u>.





Kitada 2018

Imperiled species: Bringing back the White Abalone



Juvenile white abalone, the result from successful spawns in 2012 and 2013, respectively.

The three photographs above show a captive wild-origin white abalone undergoing wax treatment to kill shell-boring organisms that eroded its shell.

UCDAVIS
Coastal and Marine
Sciences Institute

Fishery closed in 1996. Yet, first marine invertebrate to make the endangered species list in 2001. Suffered recruitment failure for 15 years. Modeled to go extinct in 25 years without human intervention

Is this strategy for everyone?

No! - Restoration aquaculture is an advanced, expensive, and timely strategy. Also should be accompanied by biological and genetic assessments!

Is restoration

Are conditions

Is survival

Is recruitment

Geiger *et al.* 2023

Wasson *et al.* 2020

Why do we love bivalves?

Ecosystem services: *Brita filters*

Gobler *et al.* 2022

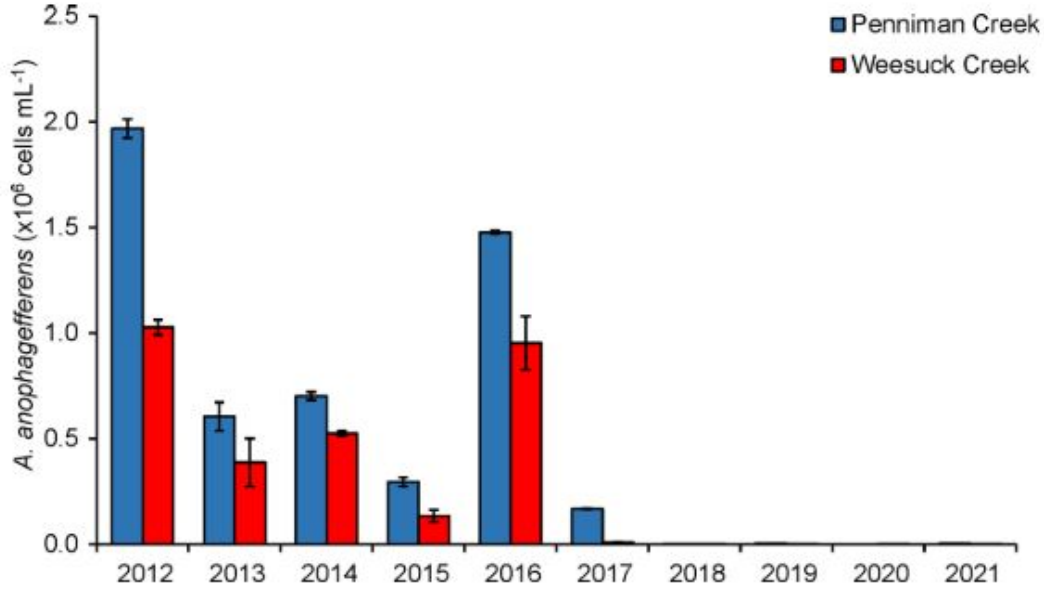
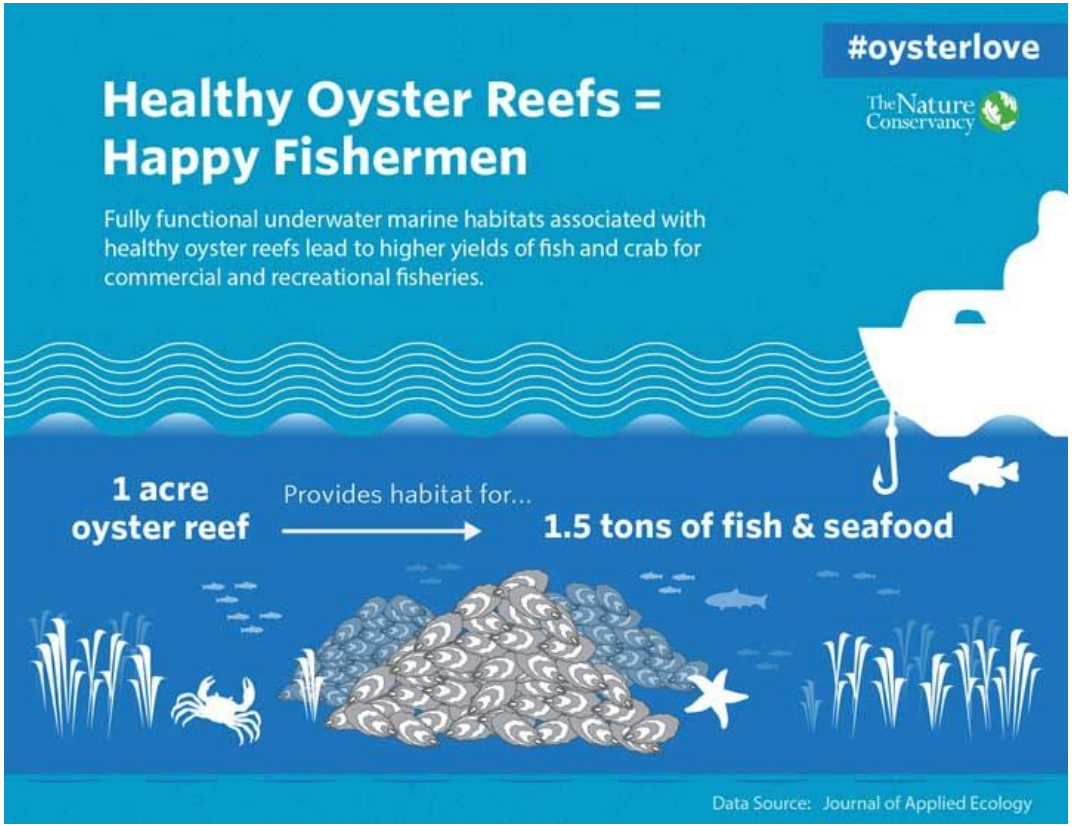
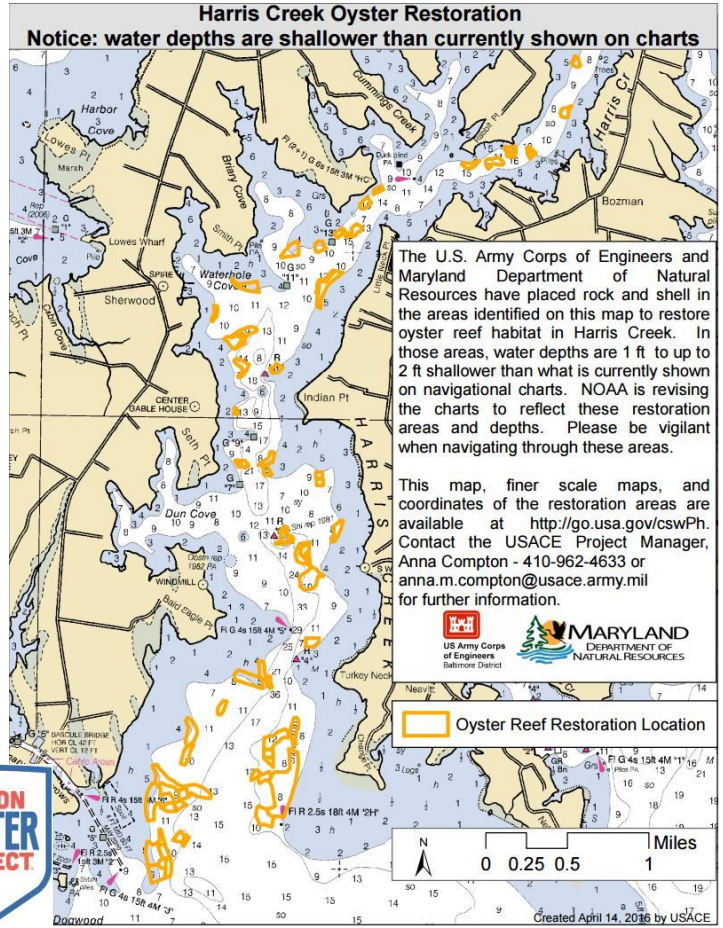


FIGURE 9 | Maximal densities of brown tide (*Aureococcus anophagefferens*) in Penniman Creek and Weesuck Creek, western Shinnecock Bay, from 2012 – 2021.

Ecosystem services: *Habitat*



Oyster Restoration

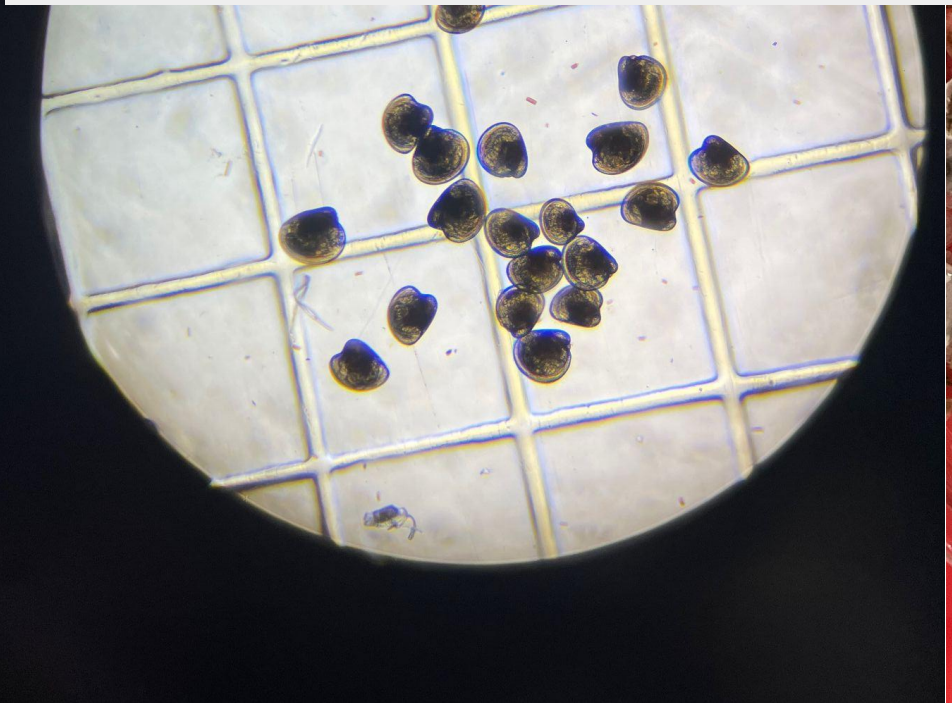


1,220 acres have been restored in Chesapeake Bay

5.4 billion spat on shell deployed so far in Maryland

Restored reefs estimated to remove an amount of nitrogen equivalent to 20,000 bags of fertilizer —a service valued at more than $1.7 million.

How the past affects the future: Changing environments and carry-over effects



Environmental change: an obstacle to restoration

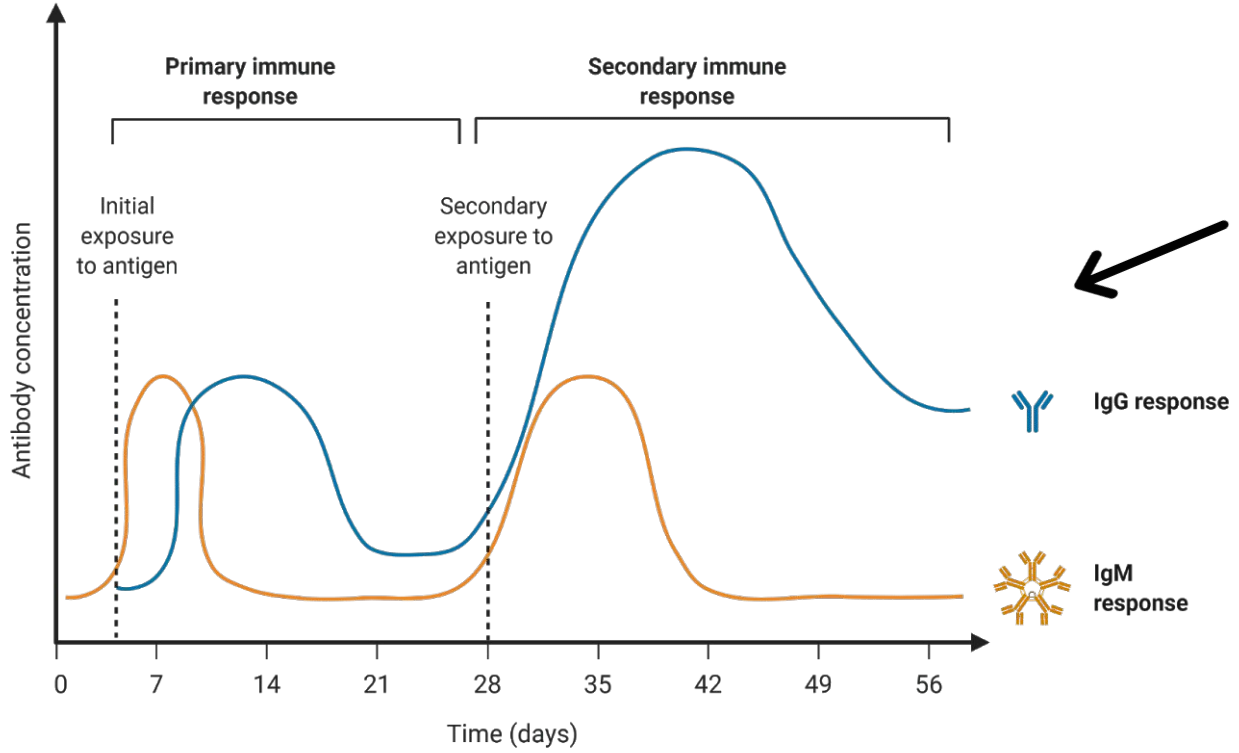
2023 Marine Heat Wave →

Record high temperatures →

Restoration aquaculture will need <u>resilient</u> animals.

Carry over effects–when an early life experience affects later life responses

Physiological carry over: human immune response



Not usually as sick the second time

Carry over effects and restoration

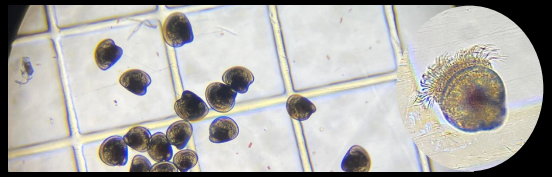
Carry over effects change:

Important types:

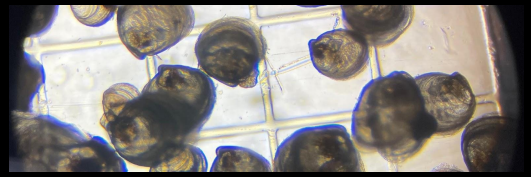
Repercussions in the wild:

Overview

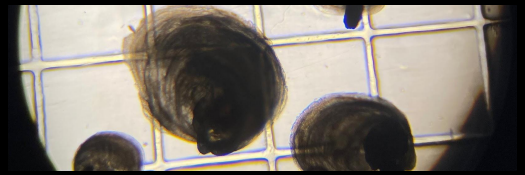
Early life environment



10 salinities (10 – 28 ppt)

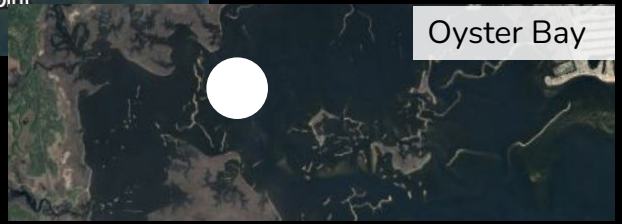


Post-set environment

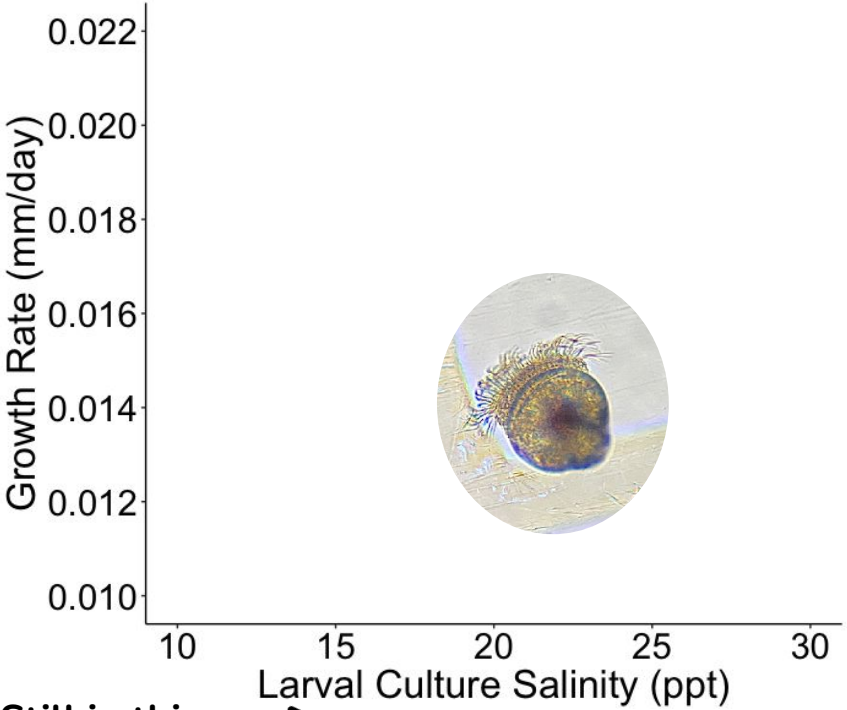


Grow-out

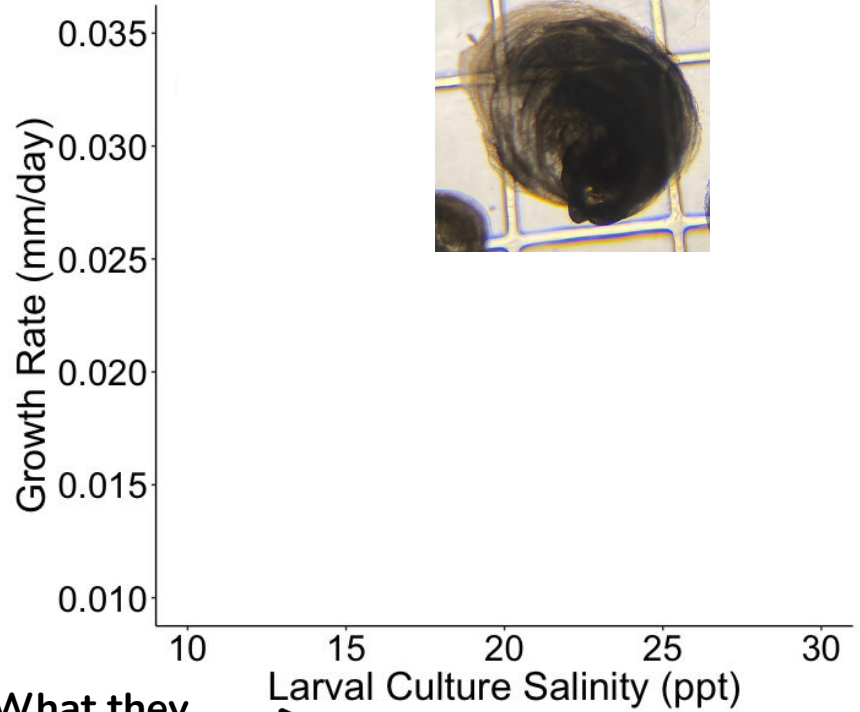
Field Site Environments



Larval and early spat growth



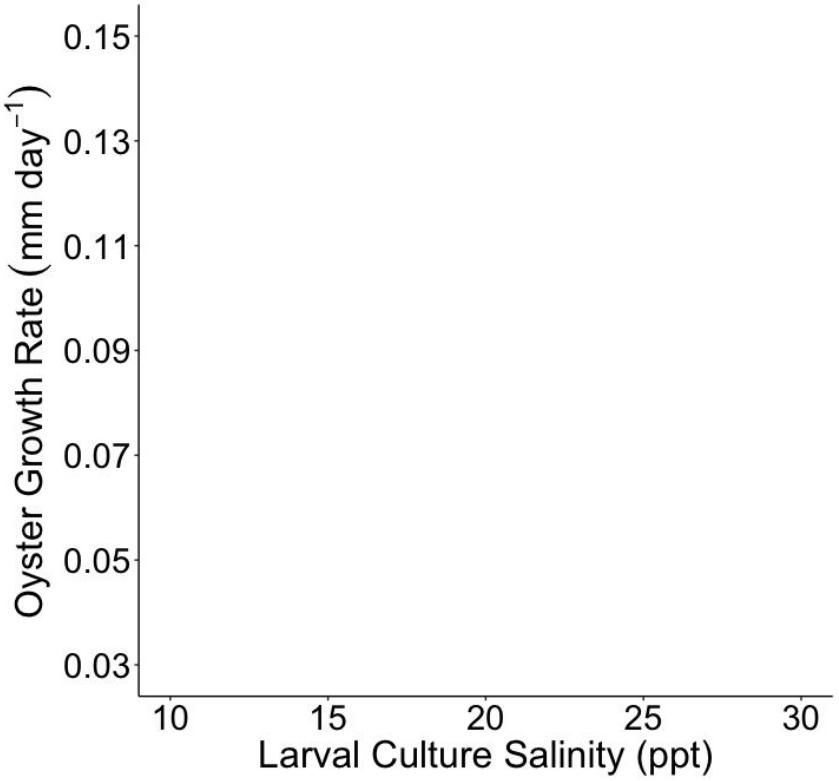
Still in this environment

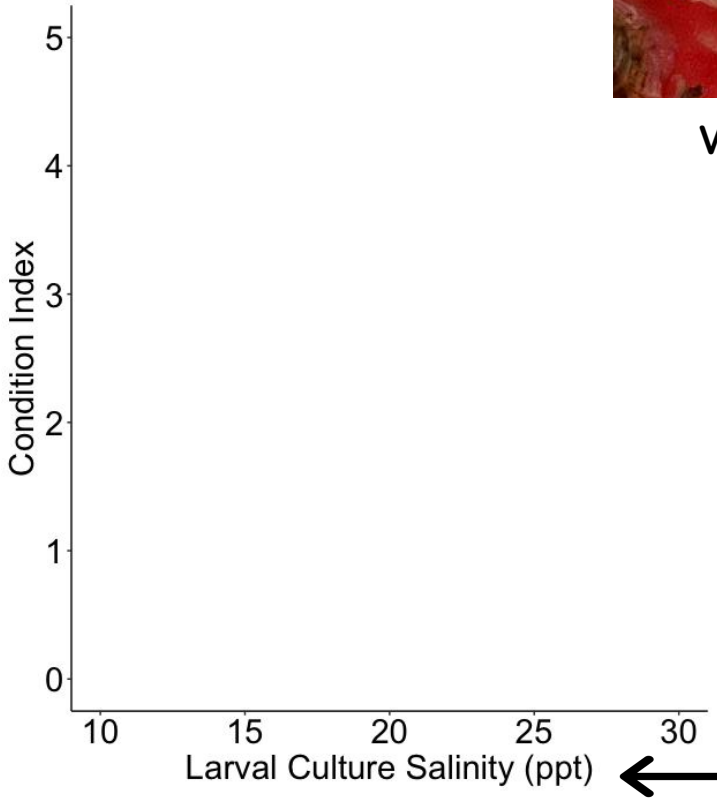


What they were in ~2 weeks ago

Later spat growth and condition index

What they are in now

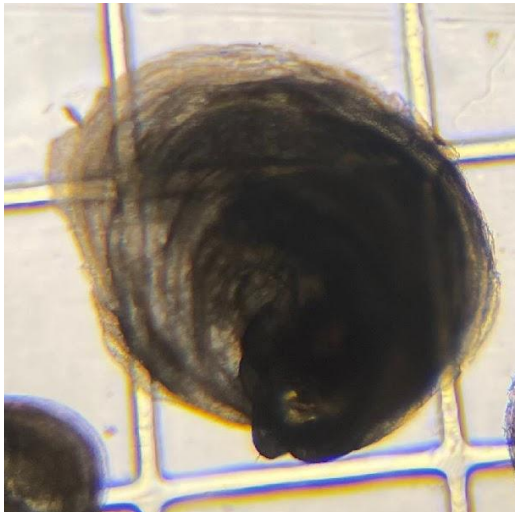


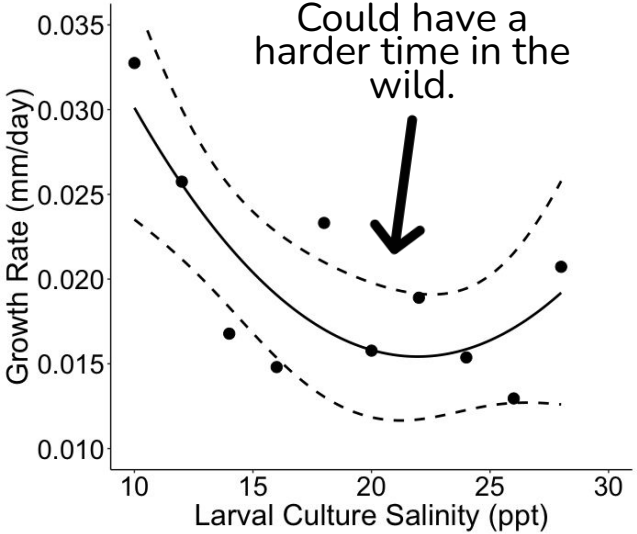


What they were in 4 months ago

Some conclusions:

For restoration, oysters are usually put out into the field shortly after metamorphosis.

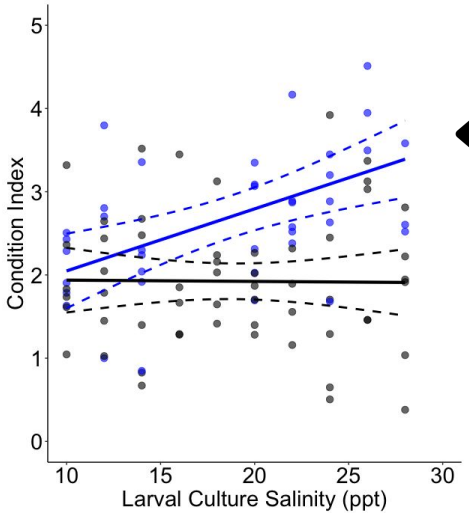




Smaller/slower growing oysters are more susceptible to predation and competition.

Some conclusions:

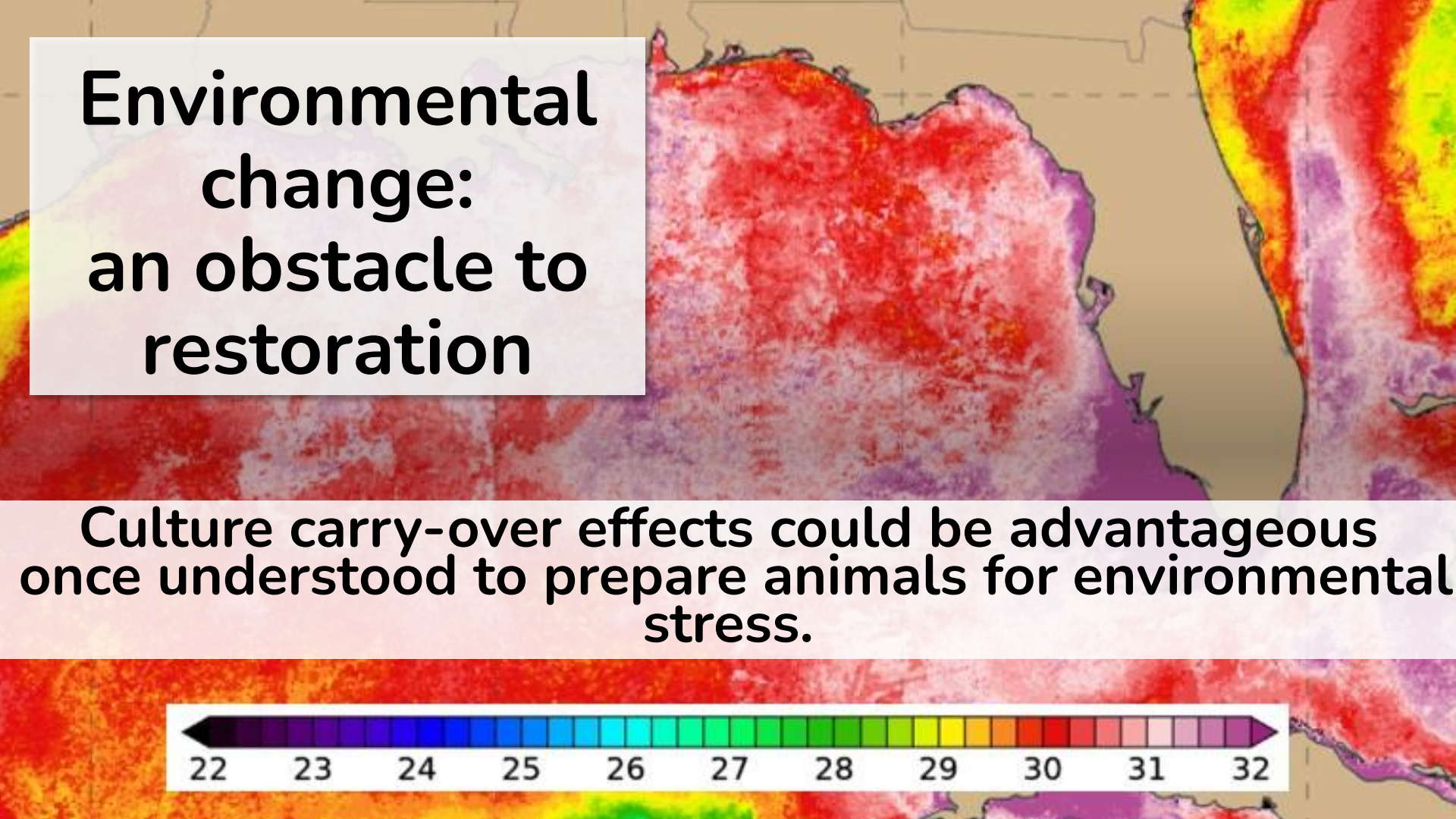
Early environment and later environment interacted to shape oyster physiological condition.



Could be better at handling environmental change in the wild.

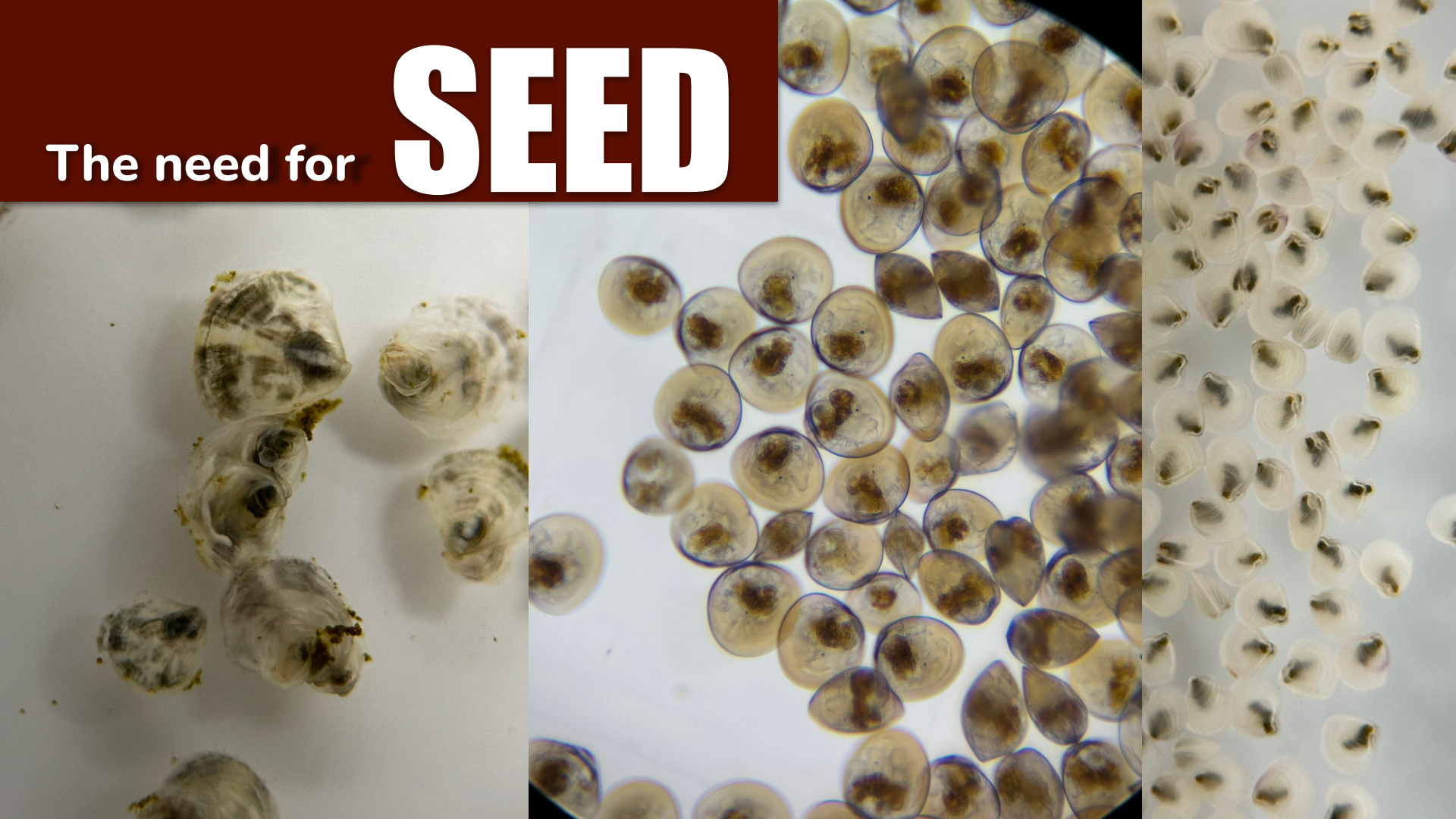
Larger energetic stores can help oysters survive stressful conditions for longer periods of time.

Environmental change: an obstacle to restoration

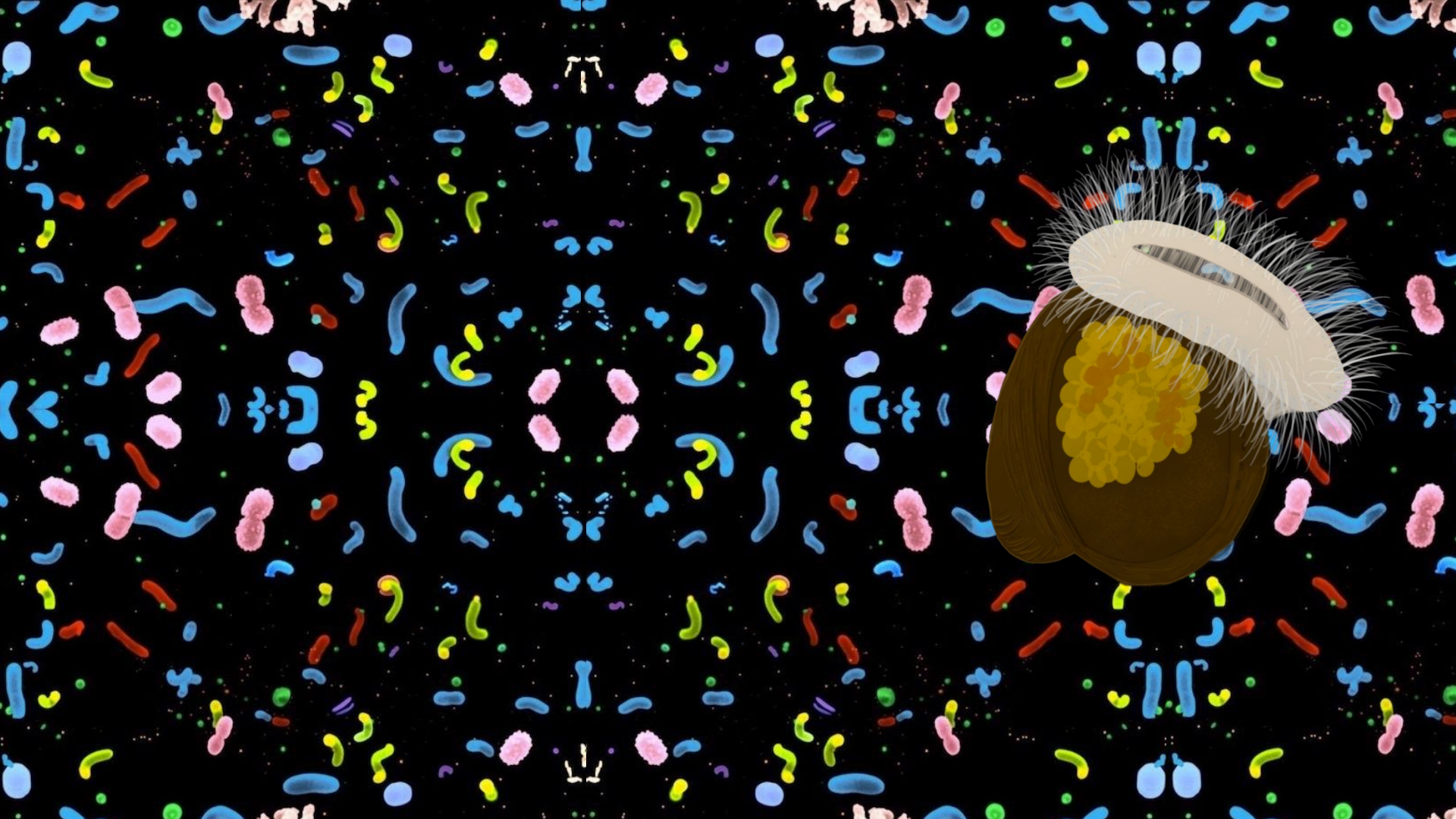


Culture carry-over effects could be advantageous once understood to prepare animals for environmental stress.

The need for SEED



Life cycle

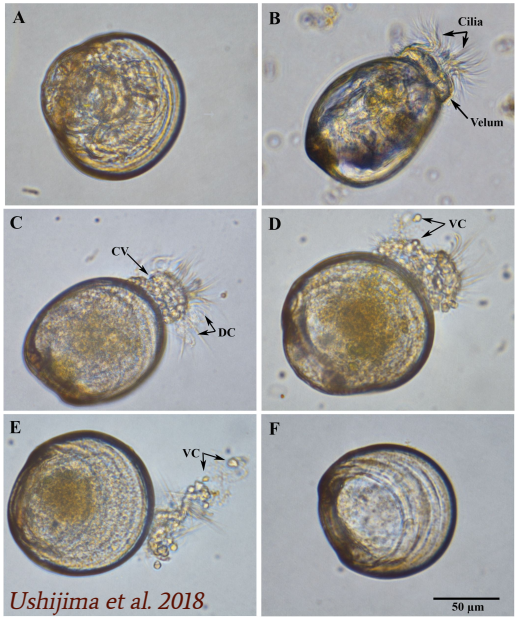


An example of a common pathogenic bacteria: *Vibrio*

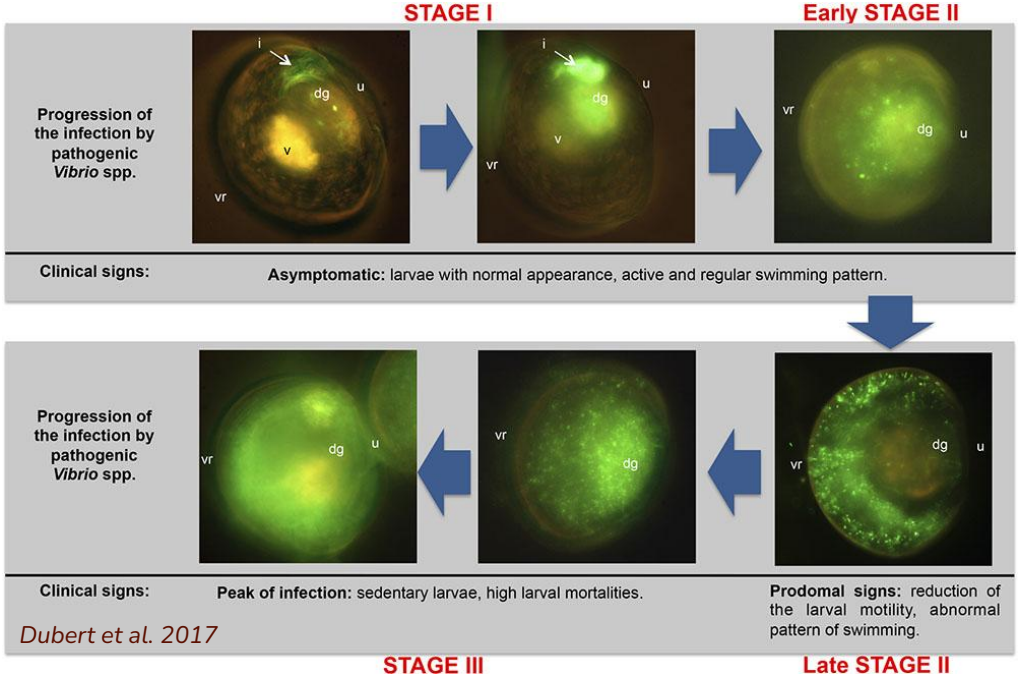
CV: Clumped vellum

DC: Disorganized cillia

VC: Velar cells



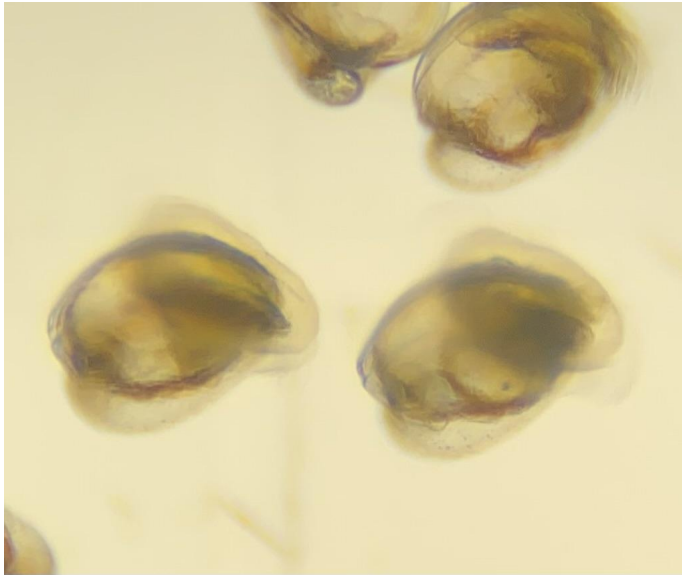
Ushijima et al. 2018



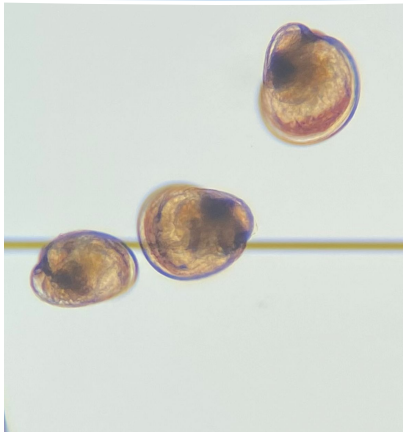
Dubert et al. 2017

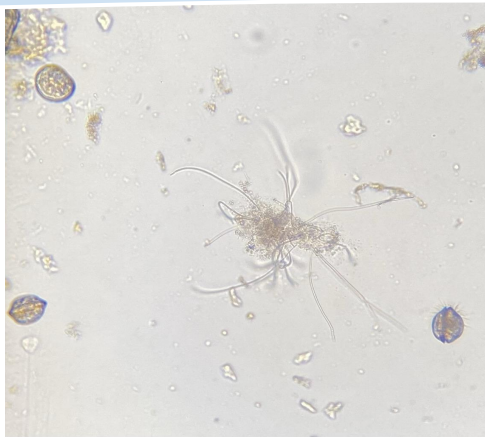
***Vibrio coralliilyticus* was shown to cause 76-100% mortality of the eastern oyster (*Crassostrea virginia*)**

Effects of unbalanced microbiome in FSUCML hatchery

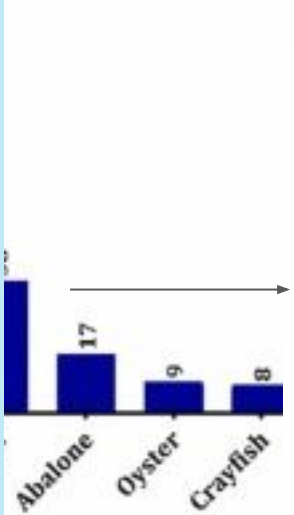


MOH





Prevention: *Probiotics*

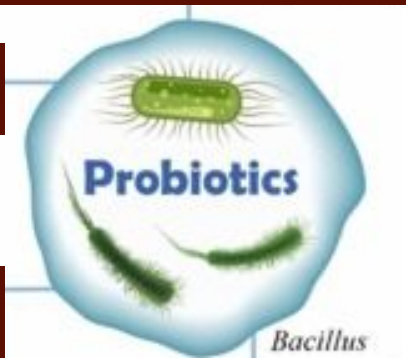


Suman et al. 2022

Prevention: *Probiotics*

Outcompetes pathogenic microorganisms

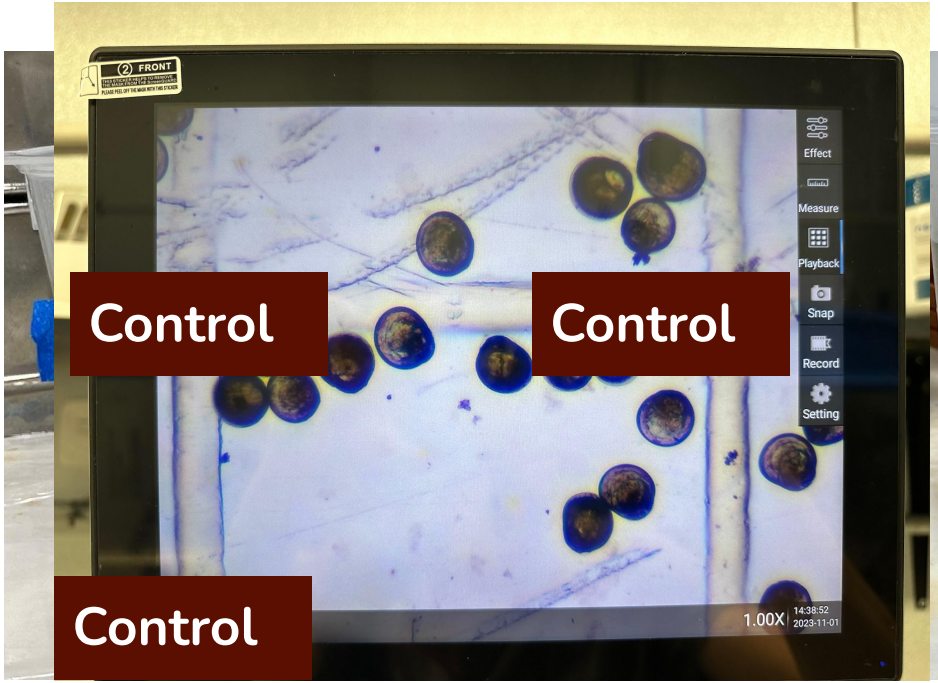
Enhances growth and survival

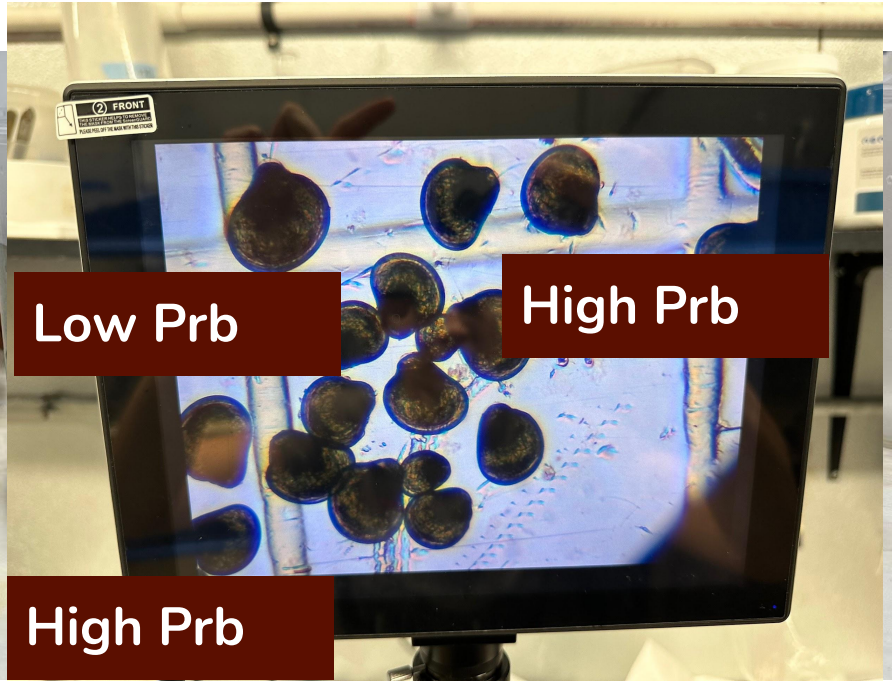


Increases host

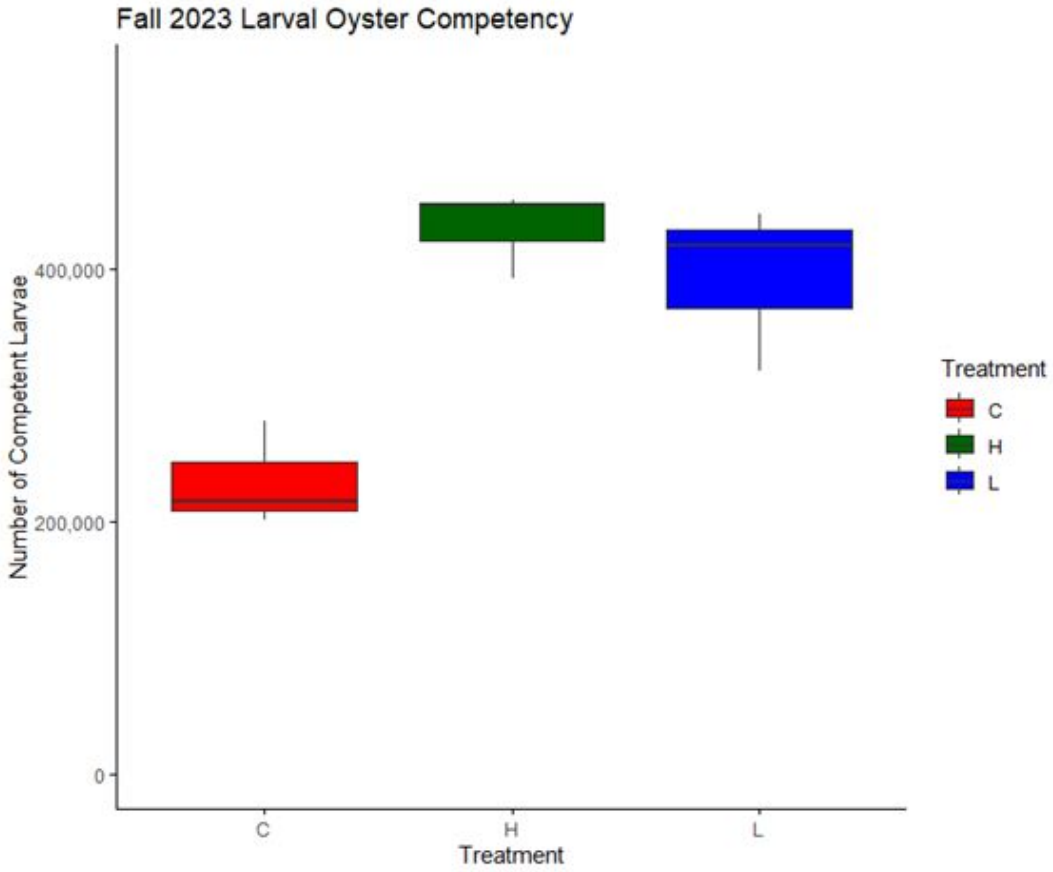
Suman et al. 2022

Visual results





Statistically significant results



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Dr. Don Levitan
Dr. Janie Wulff

PhD Committee Members

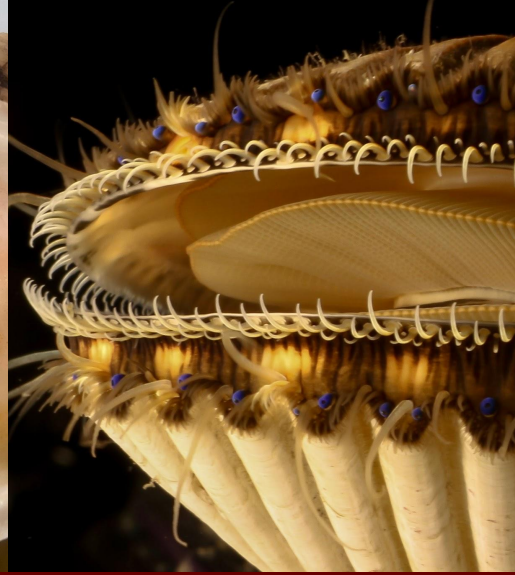
FSUCML Hatchery Crew & Field Team

FSUCML Staff and Faculty

Labmates, family, and friends

Project Number 69:
Apalachicola Bay System Initiative



Thank you!

Emily Fuqua
efuqua@fsu.edu
Morgan Hawkins
mhawkins@bio.fsu.edu

FLORIDA STATE UNIVERSITY
FSUCML
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COASTAL & MARINE LABORATORY