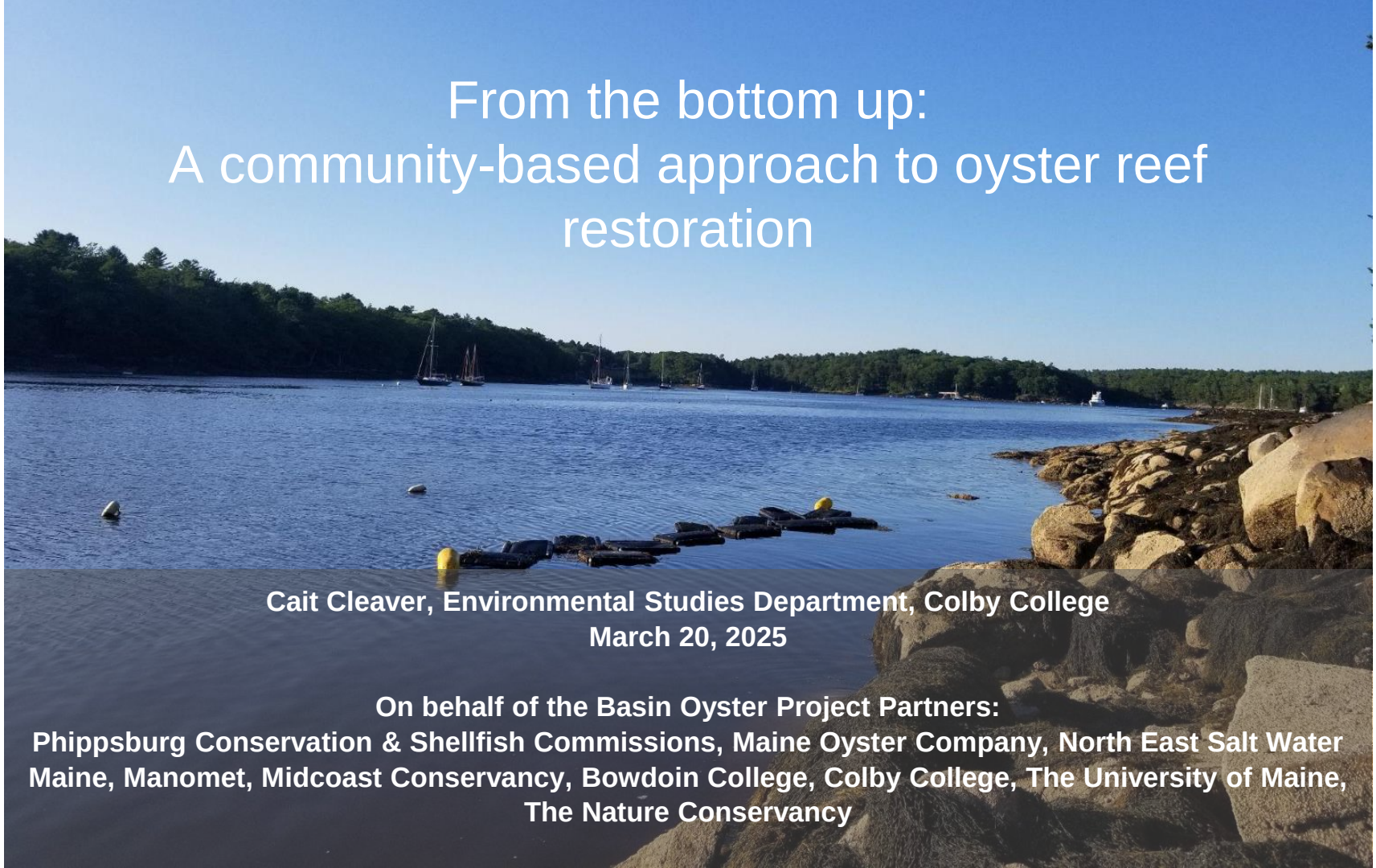

From the bottom up:
A community-based approach to oyster reef restoration

Cait Cleaver, Environmental Studies Department, Colby College
March 20, 2025

On behalf of the Basin Oyster Project Partners:
Phippsburg Conservation & Shellfish Commissions, Maine Oyster Company, North East Salt Water Maine, Manomet, Midcoast Conservancy, Bowdoin College, Colby College, The University of Maine, The Nature Conservancy

Overview

- Why oyster reefs?
- Brief history of BOP
- Questions & methods
- Benefits, challenges, the big picture
- Looking ahead

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- Dot Kelly, Conservation Commission
- Marissa McMahan & Jessie Batchelder, Manomet
- John Herrigel, Maine Oyster Company
- Joe Jerome, North East Salt Water Maine
- Dean Doyle, Shellfish Commission
- Rebecca Schultz, Basin landowner
- Cait Cleaver, Dan Sweeney, Annabelle Warren, add'l students, Colby College
- Michele Lavigne + students, Bowdoin College
- Sarah Risley, Kate Liberti, Tom Kiffney, The University of Maine
- Melissa Cote, Midcoast Conservancy
- Helena Tatgenhorst, Maine TNC
- New Meadows River Shellfish Co-op

Funding: TNC's SOAR Resiliency Fund & Purchase Program, Maine Sea Grant Program Development, Davis Conservation Foundation, Ferris Olson Family Foundation for Ocean Stewardship, Maine Community Foundation & individual donations

NEW MEADOWS RIVER MAINE GROWN SHELLFISH CO-OP

manomet

Town of Phippsburg
Conservation Commission
Shellfish Commission

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MAINE OYSTER COMPANY
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What's an oyster reef?

Figure 3: A variety of oyster reefs including: (a) restored reef in FL, P. Frederick. Natural eastern oyster reefs in: (b) FL, B. Hancock, (c) RI, S. Brown, (d) FL, A. Birch, and (e) a natural Olympia oyster bed in Canada, M. Beck.

igure 4: Images of a variety of intertidal and subtidal oyster reefs. (a) FL, A. Birch (b) RI, M. Griffin (c) VA, B. Lusk (d) RI, B. DeAngelis.

Source: zu Ermgassen, P., Hancock, B., DeAngelis, B., Greene, J., Schuster, E., Spalding, M., Brumbaugh, R. 2016. Setting objectives for oyster habitat restoration using ecosystem services: A manager's guide. The Nature Conservancy, Arlington VA. 76pp.

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Decline due to overexploitation & habitat degradation

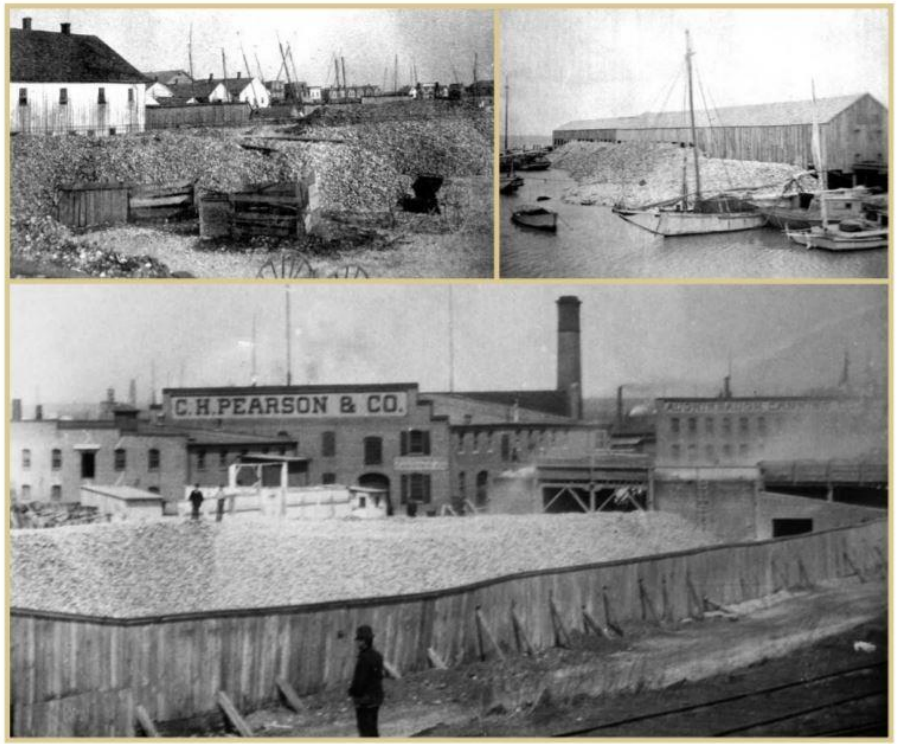

Figure 6: The scale of oyster fishing in the early 1900's. Photos: NOAA National Marine Sanctuaries, Courtesy of National Archives.

Figure 9: Traditional oyster harvest using tongs. Photo: NOAA National Marine Sanctuaries. Courtesy of National Archives.

Source: zu Ermgassen, P., Hancock, B., DeAngelis, B., Greene, J., Schuster, E., Spalding, M., Brumbaugh, R. 2016. Setting objectives for oyster habitat restoration using ecosystem services: A manager's guide. The Nature Conservancy, Arlington VA. 76pp.

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Why restore?

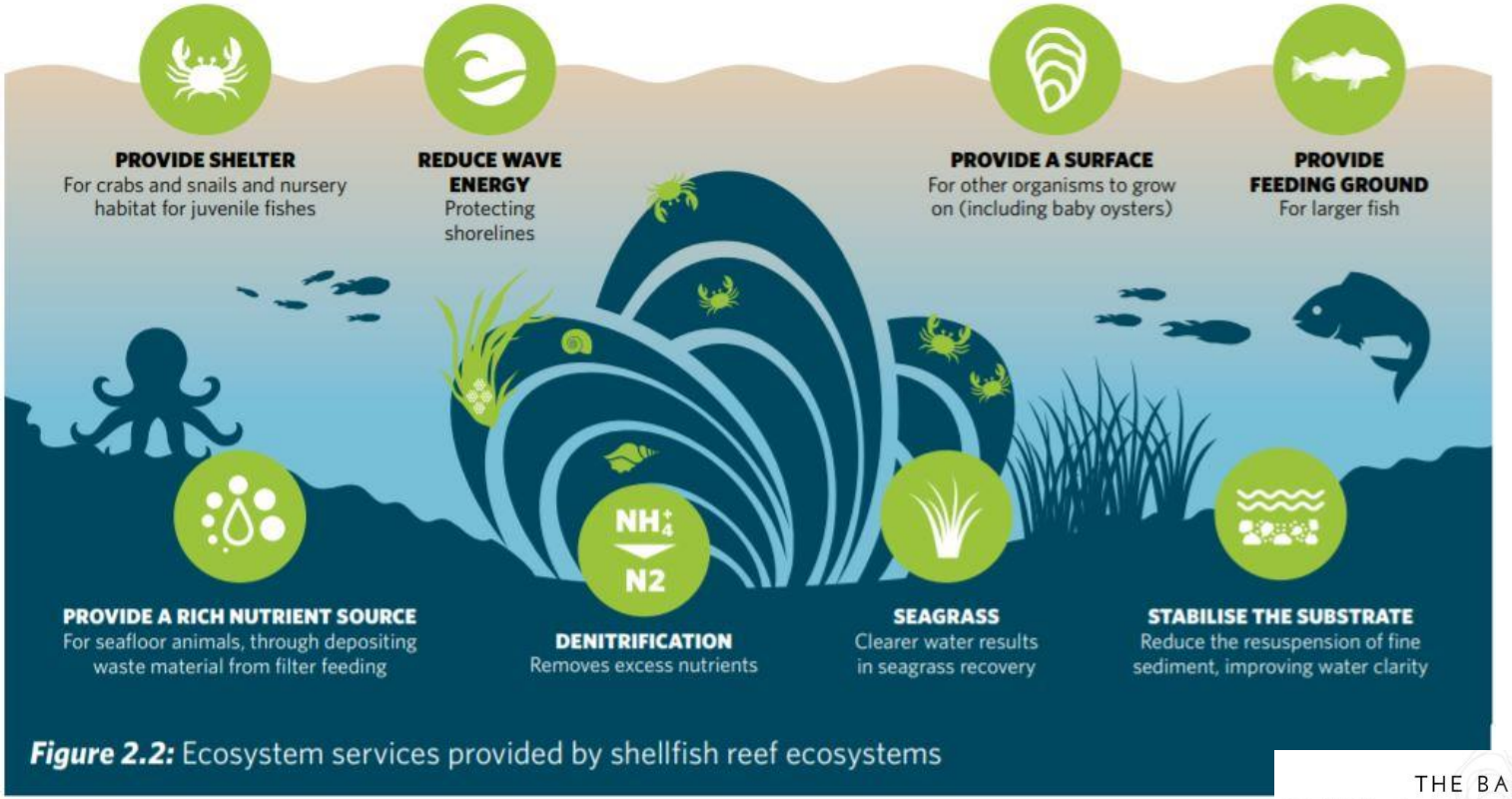

Figure 2.2: Ecosystem services provided by shellfish reef ecosystems

Zu Ermgassun, P. and Brumbaugh, R.D. (2019). The Case for shellfish reef restoration and finance. In: Restoration Guidelines for Shellfish Reefs (eds. J. Fitzsimons, S. Branigan, R.D. Brumbaugh, T. McDonald and P.S.E. zu Ermgassen), pp. 2-6. The Nature Conservancy, Arlington VA, USA.

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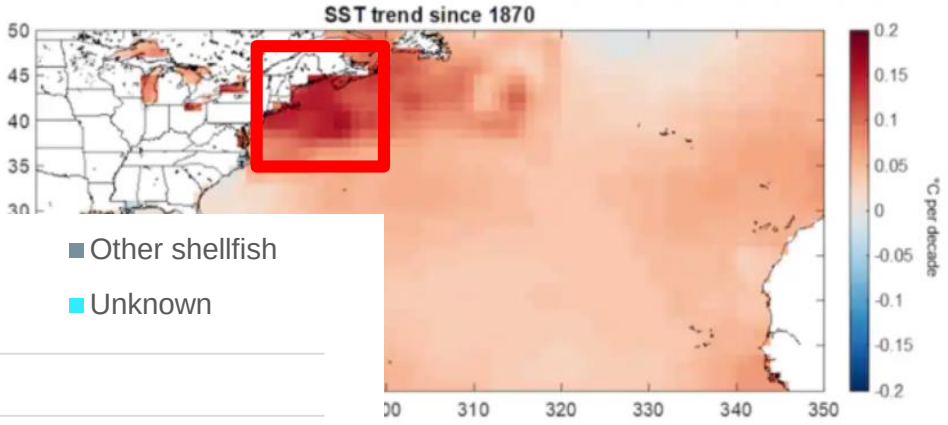
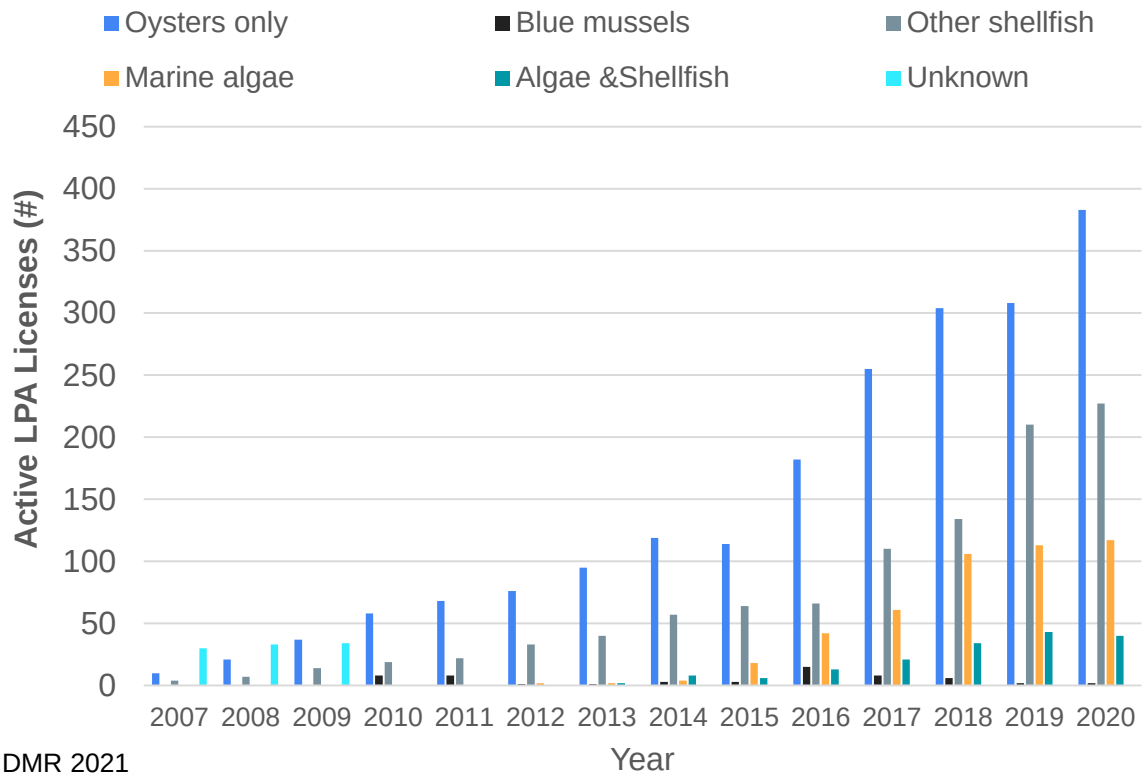
Why Maine?



om Dr. Kris Karnauskas from the Oceans and Climate
r. The area off the northeast U.S. coast is warming
n, indicated by the darker red.



DMR 2021

In summary:

With warming: Expansion of Eastern oyster habitat

With aquaculture: Increase in the Eastern oyster population

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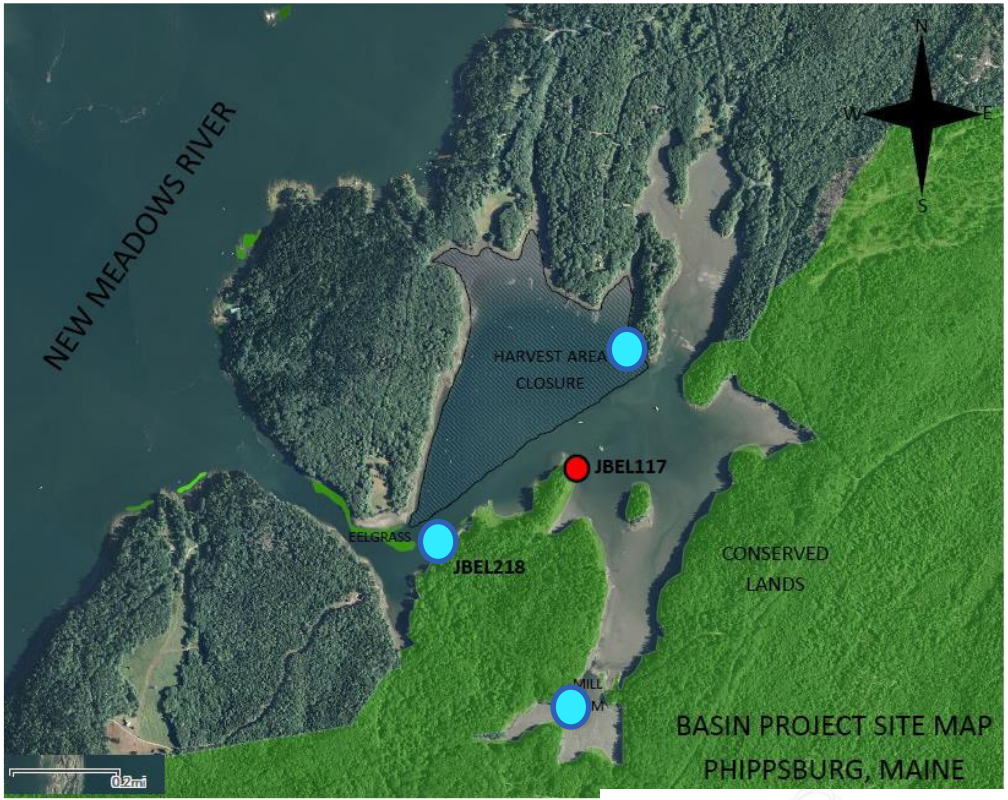
Is oyster reef building possible?

If so….

- Can a reef be built?
  - Ecological perspective: Can a reef survive, be sustained?
  - Social perspective: Community perception, permitting process
- What are the effects?
  - Marine biodiversity
  - Reef structure/ substrate
  - Oyster dynamics (e.g., Spawning, growth, mortality)
  - Water quality
- Outcomes:
  - Synthesize lessons learned
  - Create guidance documents



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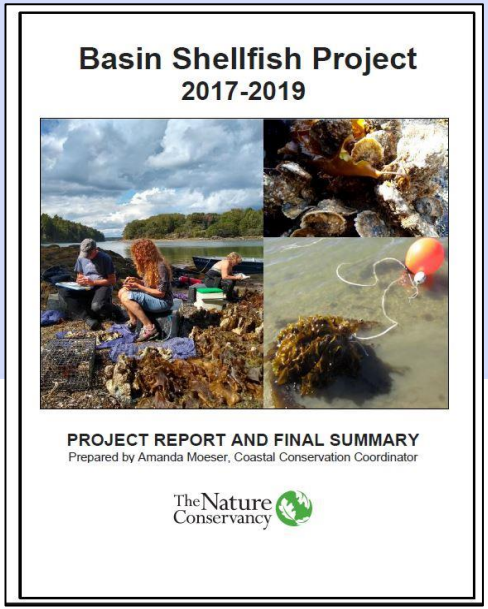
Reef building how-to:

2017-2019

- Limited Purpose Aquaculture License (LPA)
- Oysters & blue mussels
- Tested reef balls, tiles, shell hash



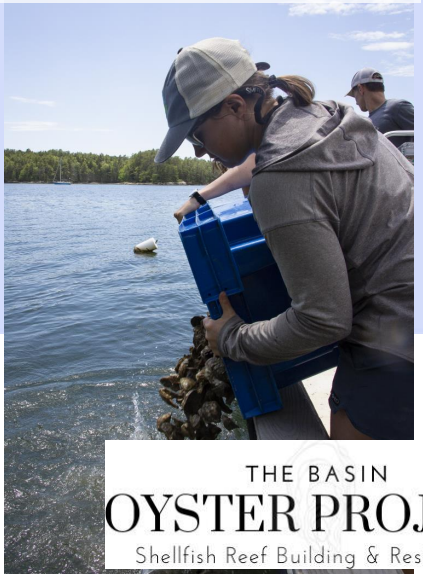
2020-2023

- Transferred LPA to BOP team
- 2nd LPA secured
- Spat on shell, seed, uglies
- Monitoring

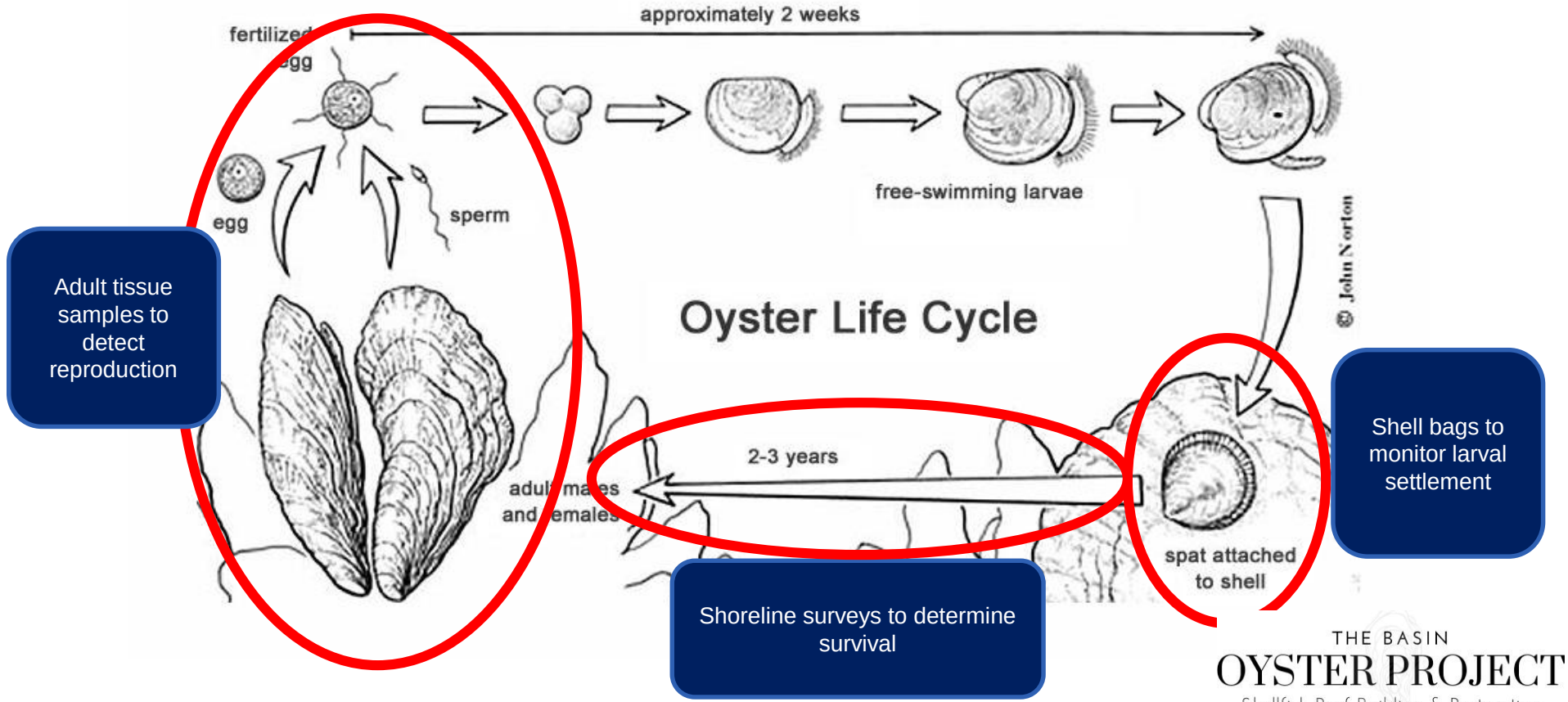
2024…

- Continuing similar work
- Purchase program
- Comparison to reference bed, Sheepscot & Damariscotta

Photo: Tate Clark, TNC



Self-sustaining? Monitoring reproduction, settlement & survival



Adult tissue samples to detect reproduction

Shell bags to monitor larval settlement

Shoreline surveys to determine survival

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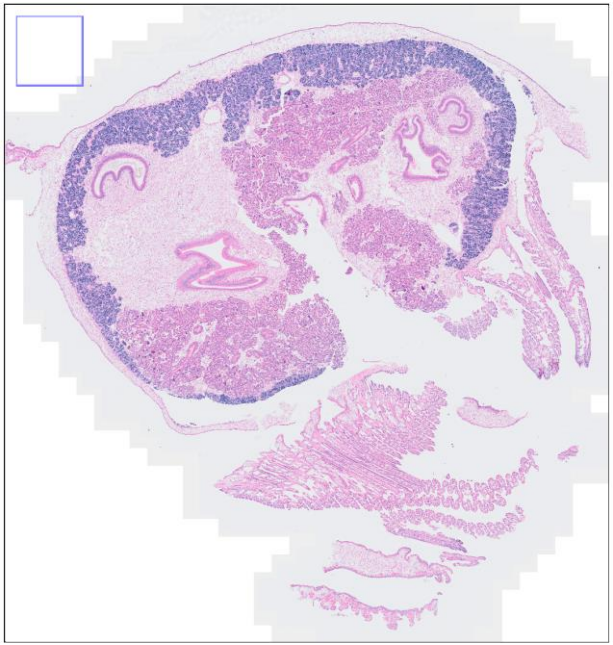
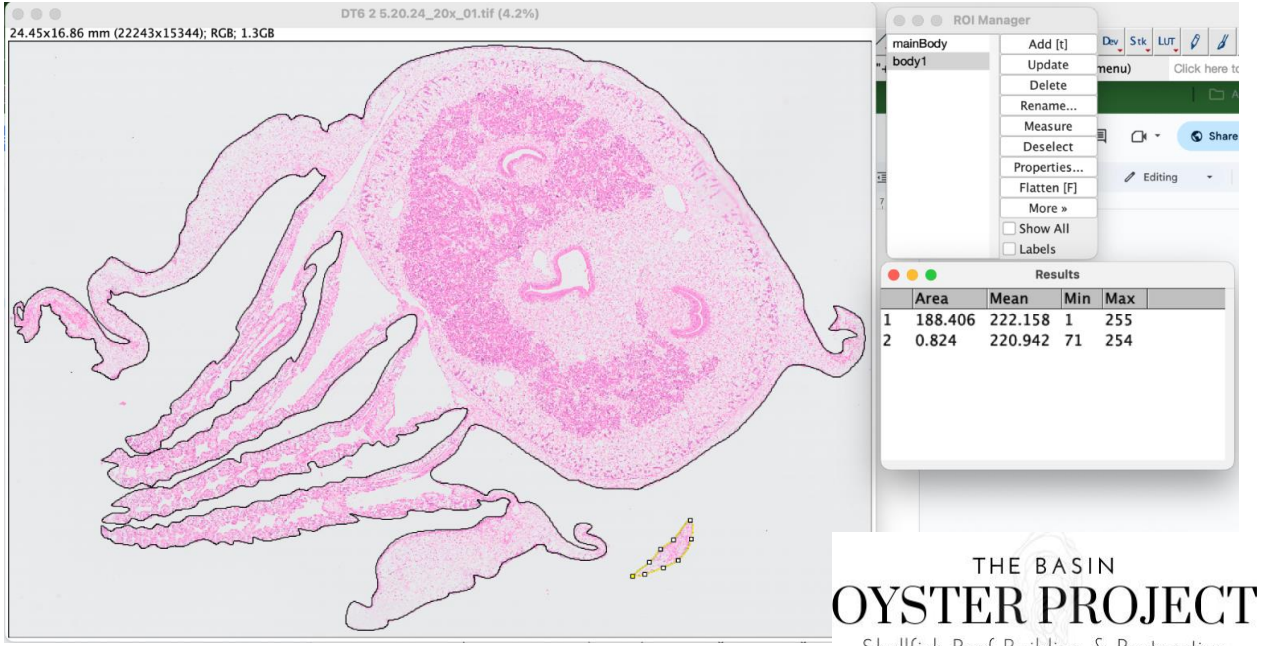
Self sustaining? Adult oyster reproduction

- May - September: Collected 15 adult oysters on a monthly basis per estuary
- In ImageJ: Estimate area of gonads to total tissue area





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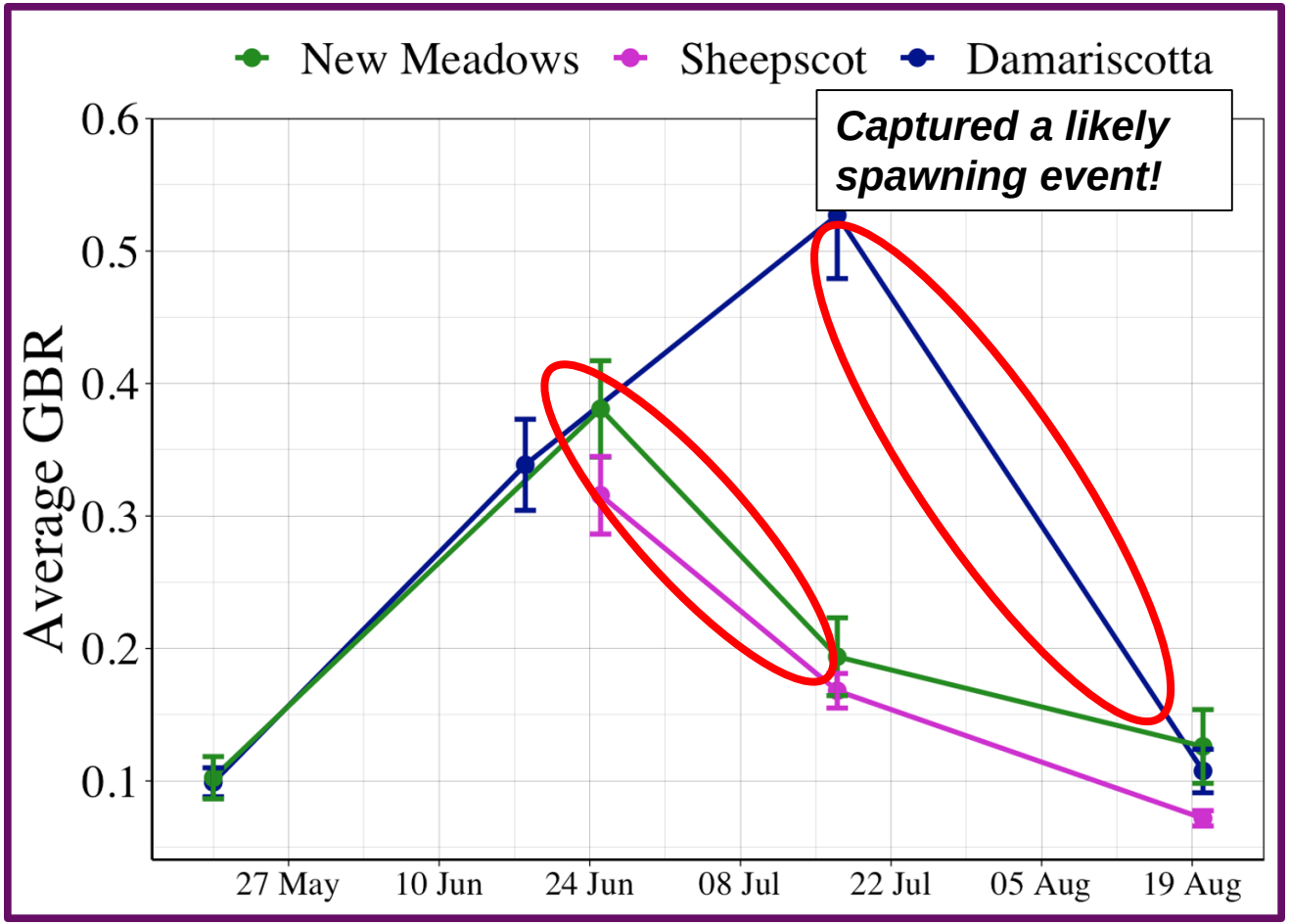
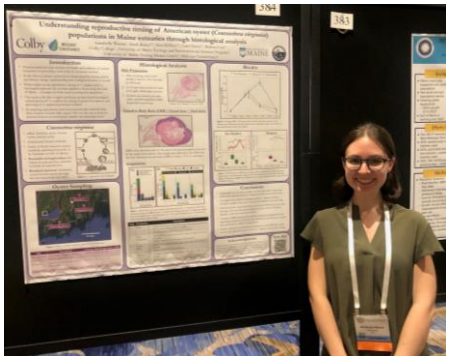
Self sustaining? Reproduction – initial results





Annabelle Warren, Colby senior, presenting thesis results at Aquaculture 2025 in New Orleans

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Self-sustaining? Oyster settlement – shell bags

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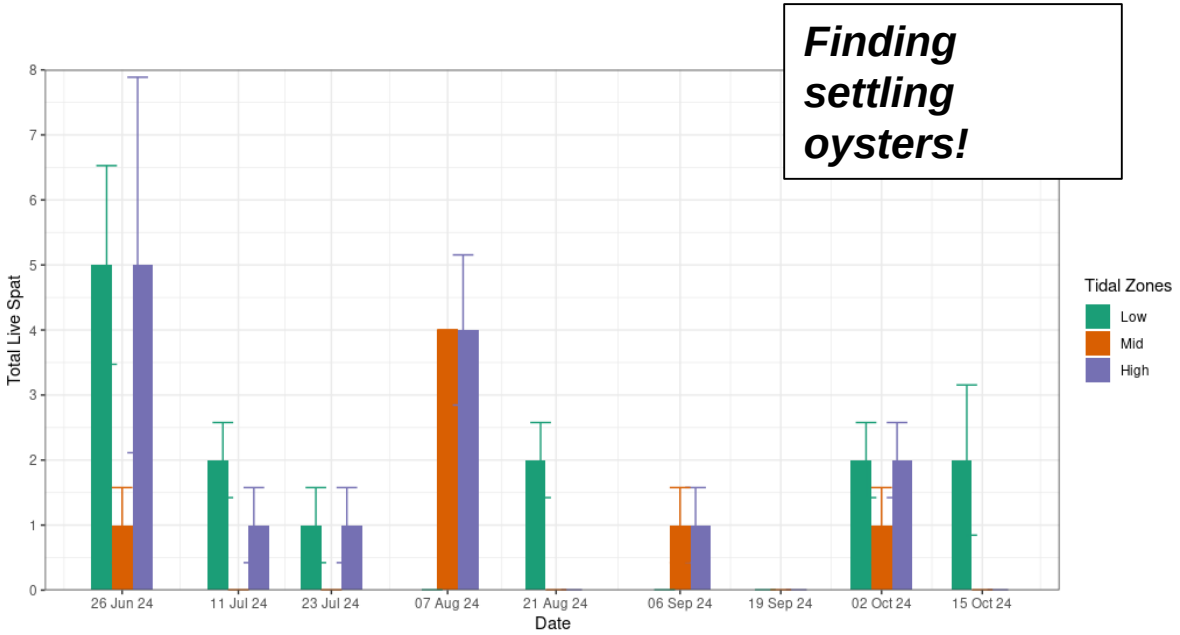
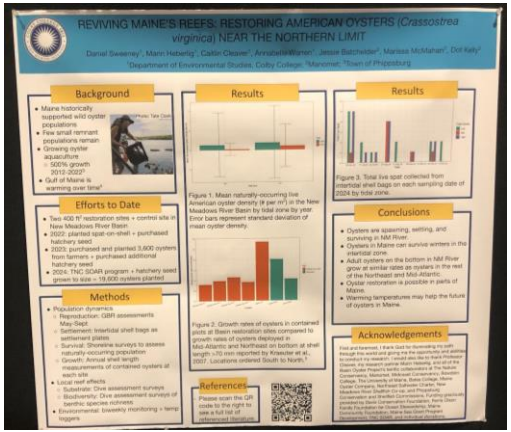
Self-sustaining? Settlement – shell bags initial results





Dan Sweeney, Colby senior, presented results at Milford Aquaculture Seminar (Milford, CT), Maine Fishermen's Forum (Rockport, MzE), & Aquaculture 2025 (New Orleans, LA)

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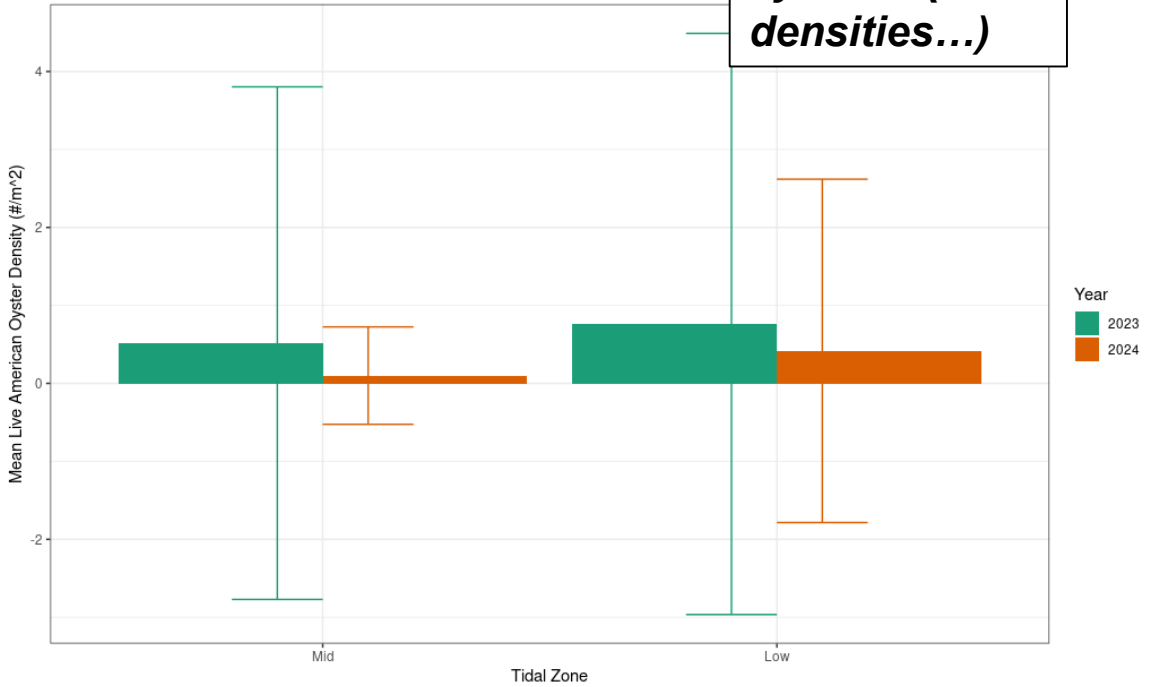
Self-sustaining: Do the oyster settlers survive? Shoreline surveys

Photos: Helena Tatgenhorst, TNC

Finding live oysters! (Low densities…)



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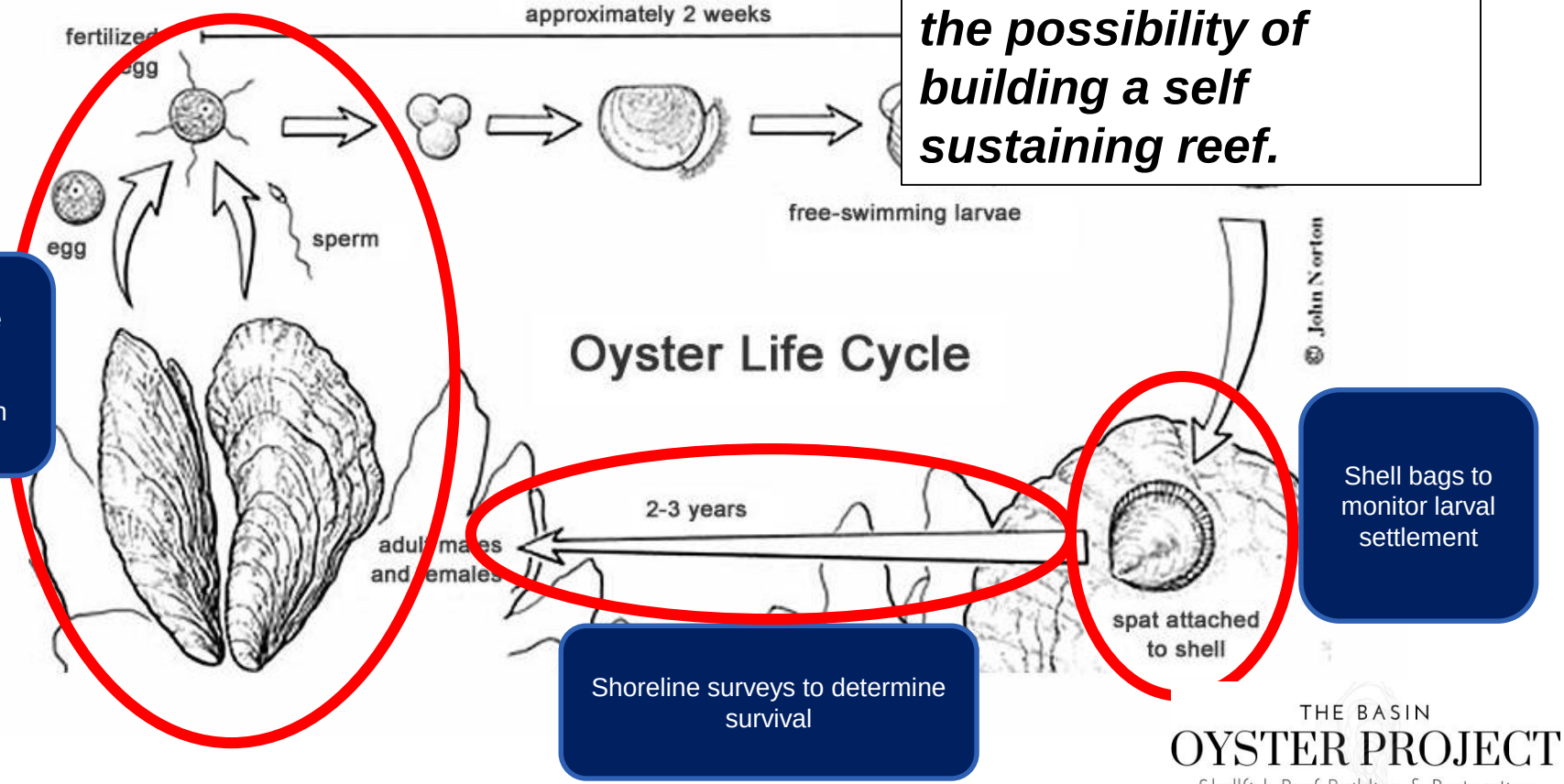
Self-sustaining? Monitoring reproduction, settlement & survival

Initial results point to the possibility of building a self sustaining reef.



Adult tissue samples to detect reproduction

Shoreline surveys to determine survival

Shell bags to monitor larval settlement

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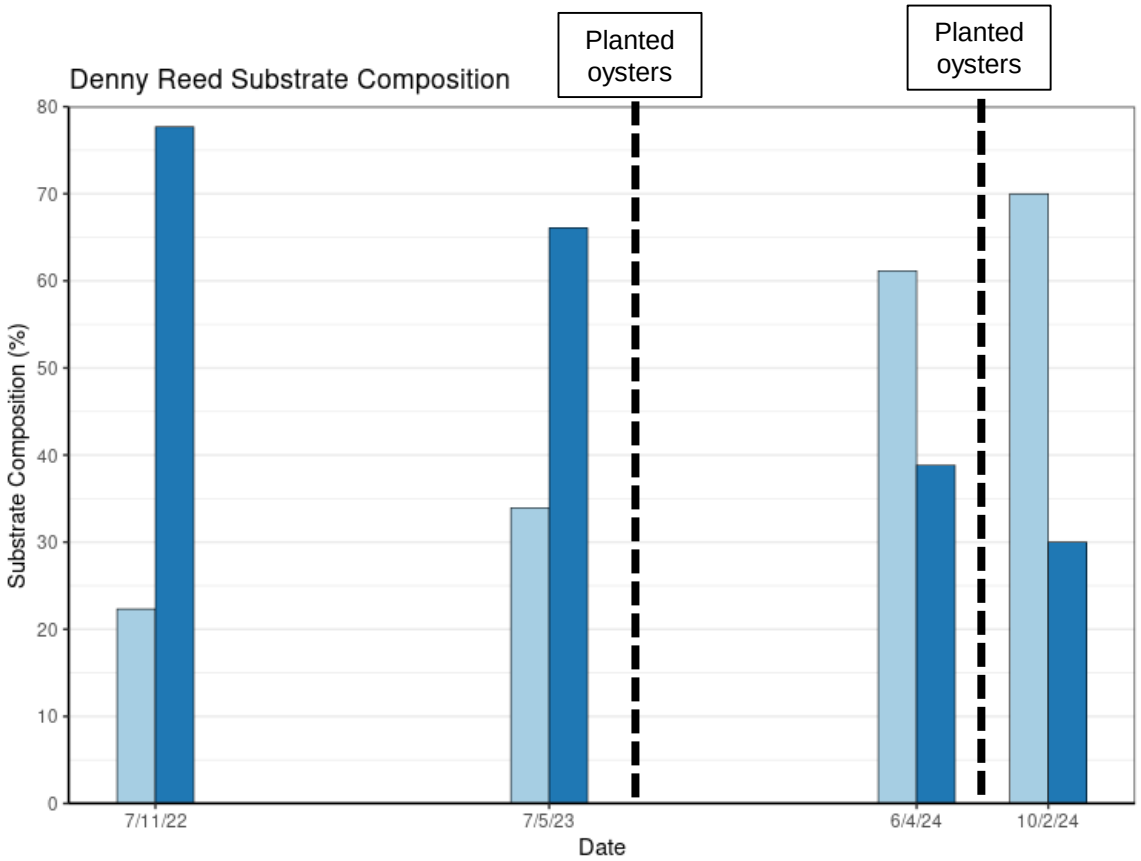
Monitoring ecological effects: Substrate changes



Habitat is shifting – likely due to our efforts in planting adult oysters.

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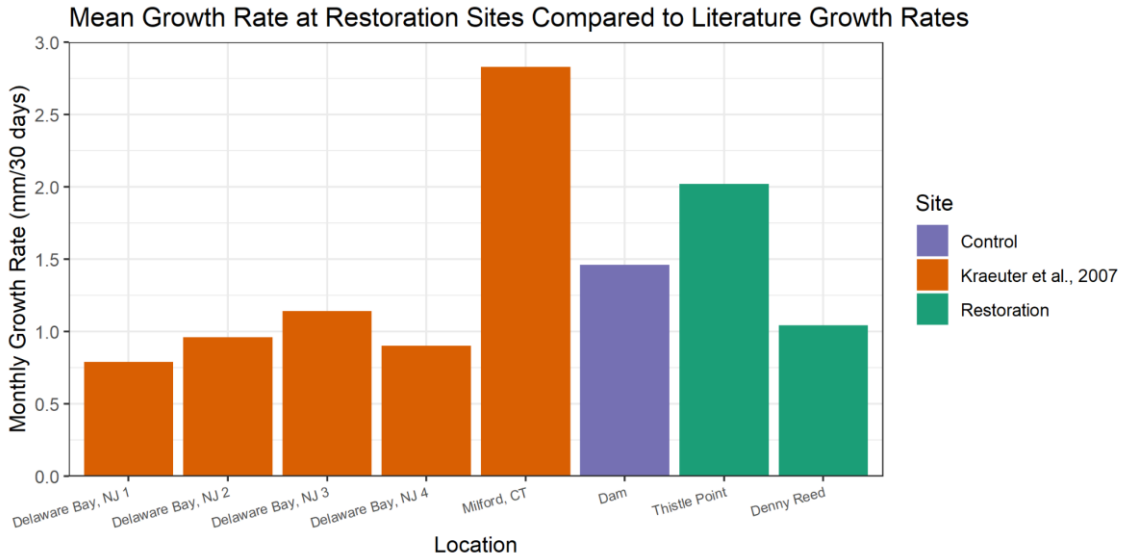
Monitoring ecological effects: Oyster dynamics



Over one year:

- ***Growth rates higher than some southern sites***
- ***Mortality between 6.5- 10%***
- ***Evidence of new settlers***

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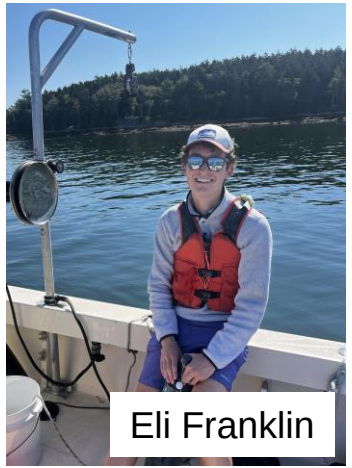
Susceptibility to ocean acidification: Bowdoin

- Biweekly sampling: June –October
- Sites: Basin Oyster Project LPA lease sites, behind the dam & Kennebec Estuary Land Trust's site (Bas68)

  -carbon chemistry
  -nutrients
  -temperature
  -salinity
  -oxygen



Eli Franklin

Fall SCSC class: "Ocean Acidification"

Caroline Vauclain

Henry Zucco

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Susceptibility to ocean acidification: Bowdoin

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- Carbon chemistry consistent across Basin sites.
- Enclosed nature of the Basin makes conditions different from New Meadows.
- Conditions were above, but at times close to, the threshold for bivalves.
- Current conditions likely not a stressor for oyster growth in vulnerable early life stages (July-Aug).
- Future changes in freshwater runoff, ocean acidification, or biological productivity could change.

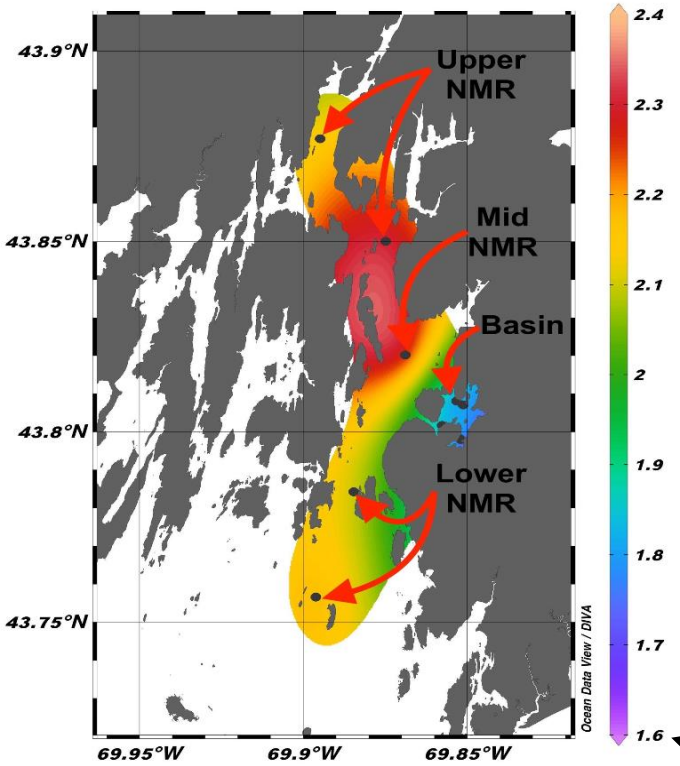
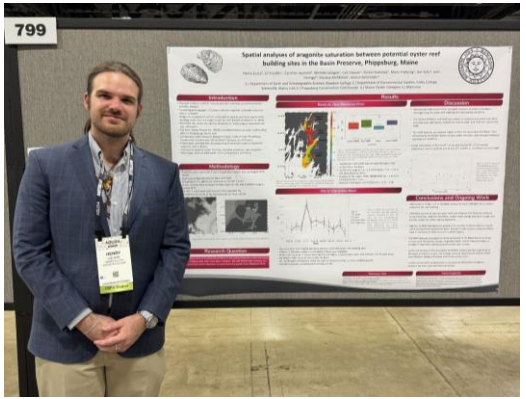


Figure 2: Surface map of sampling sites on New Meadows River and Basin Preserve with average surface Ωa interpolated using DIVA gridding. Data presented in box plot (fig 3) are indicated by arrows.

Threshold for optimal shell growth ~1.6



Henry presenting results at American Geophysical Union Conference Washington, D.C. in December

Benefits: Community building

Purchase program

- Bought oysters from most farmers on the New Meadows
- Farmers contributing to collaborative research

Outreach & education

- Engaged school and community groups
- Opportunity to highlight ecosystem services
- Prompts conversation about aquaculture

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Challenges: Regulatory/ permitting

Interviews with state regulators to document different approaches

Use of cured oyster shell

- Shell considered solid waste; requires DEP site permit
- Using cured shell requires a DEP special projects permit

For reef building

- Requires a DMR aquaculture lease or license
- Aquaculture = Food ≠ Siting in prohibited waters (i.e., areas of poor water quality)

Photos: Tate Clark, TNC

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Big picture: Human dimension

Concerns:

- Competition between oysters and clams
- Reefs may harbor predators, disease, etc.
- Riparian landowners uncertain

Opportunities:

- Connecting shell recycling, purchase programs & restoration
- Community-building through conservation

Interviews and focus groups with Maine stakeholders to identify important social factors

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Big picture: Ecological dimension

Concerns:

- Potential negative impact on current ecological interactions and functions?

Opportunities:

- Provisioning of ecosystem services: demonstrated elsewhere but will those translate to Maine?

- Potential to improve coastal resilience: Can oyster reefs facilitate restoration of other habitats (e.g., salt marshes, eelgrass)?

Check out Caroline and Eli's tik tok for a climate change communication course:

https://www.tiktok.com/@elifranklin45/video/7467759338581527851

Tate Clark, TNC

Looking ahead

- Continuing to analyze data collected to date
- Social factors: Finalizing interview guide to conduct interviews & summarizing findings from focus groups
- Plan for 2025 field season

Thank you! Questions?

For project updates:
Email basinoysterproject@gmail.com

Project funding: Davis Conservation Foundation, Ferris Olson Family Foundation for Ocean Stewardship, Maine Community Foundation, Maine Sea Grant Program Development, TNC SOAR, and individual donations.

Photo: Tate Clark, TNC