Assessing vulnerability of the U.S. Atlantic sea scallop fishery to climate change:

IDENTIFYING LIFE STAGE SENSITIVITIES & STRESS THRESHOLDS

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BACKGROUND

- The Northeast U.S. Atlantic sea scallop fishery is valued at $500+ million/year
- Managers & industry stakeholders are concerned that changing ocean conditions will cause declines in harvest & revenue

METHODS

- Literature synthesis → life stage sensitivity scores & stress thresholds for OA and warming *(methods adapted from Hodgson et al. 2016 & Berger et al. 2021)*

KEY FINDINGS

1. Scallop life stages are sensitive to both warming and OA
2. Hard to pinpoint thresholds from lab experiment treatment levels
3. More multi-stressor studies needed for early & late life stages

NEXT STEPS

- Vulnerability estimated from sensitivity scores & exposure scores derived from regional ocean models, larval transport, & benthic adult distributions under present & future conditions

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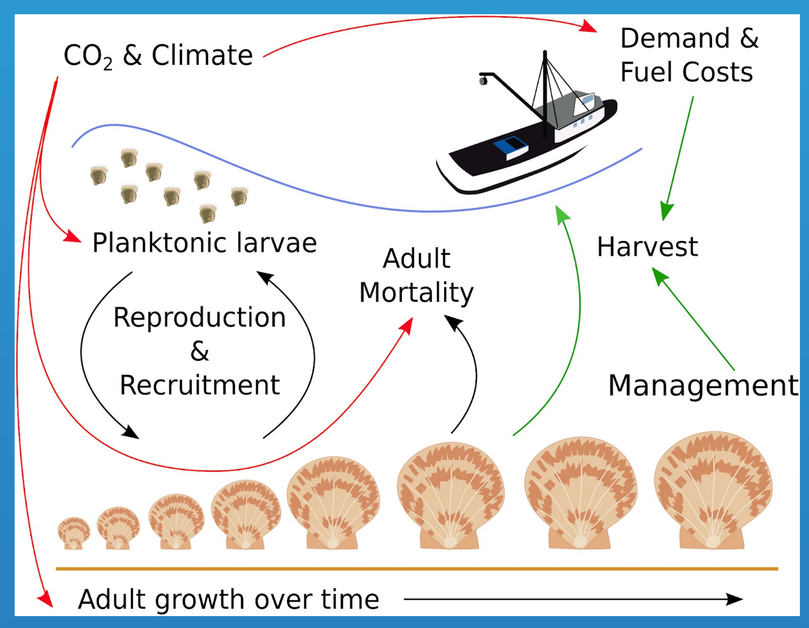
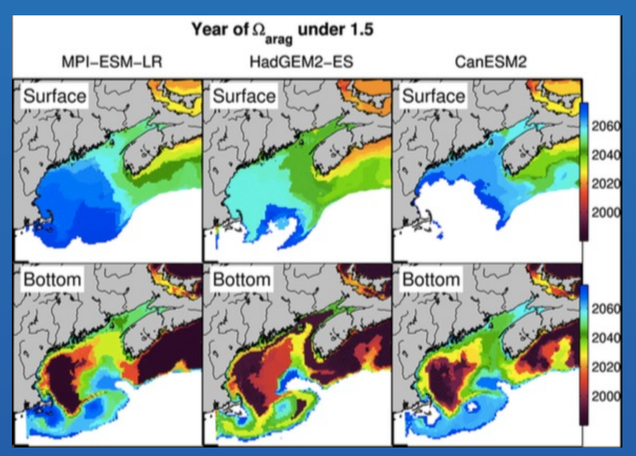
***PROJECT GOAL** = quantitatively relate changing ocean conditions to sea scallop population vulnerability to identify vital life stages & candidates for future fishing zones*

Societal, biological, physical & chemical factors comprise the multiple drivers that influence the vulnerability of the sea scallop fishery to change—habitat and life history likely play a key role *(Rheuban et al. 2018)*



Sea scallop habitats currently experience suboptimal carbonate conditions that are projected to worsen under climate change despite partial compensation from warming *(Siedlecki et al. 2021)*



PRELIMINARY LITERATURE SYNTHESIS RESULTS ↓

purple & red = medium & high sensitivity
? = unknown or based on related species

**Please let me know if I'm missing any key papers!*

Life stage	Warming	OA	Interaction
Gametes/ Embryo	?	Reduced fertilization & development? *(pH 7.4, pCO_2 3600 µatm, Ω_{arag} 0.9; Barros et al. 2013)*	?
Larva	Increased growth until maximum reached *(17°C; Munroe et al. 2018)*	Reduced growth *(pH 7.5, pCO_2 1400 µatm, Ω_{arag} 0.7; Milke et al. in prep)*	?
Juvenile	Increased growth until maximum reached *(15°C; Coleman et al. 2022)*	Reduced growth *(pH 7.3, pCO_2 1200 µatm, Ω_{arag} 0.7; Cameron 2020 & Pousse et al. in prep)*	Reduced energy – nonlinear *(12°C x pH 7.3, pCO_2 1200 µatm, Ω_{arag} 0.7; Cameron 2020 & Pousse et al. in prep)*
Adult	Increased gametogenesis *(12°C; MacDonald et al. 1986)*	Reduced gametogenesis? *(pH 7.1, pCO_2 5600 µatm, Ω_{arag} 0.3; Boulais et al. 2017)*	?

References

Barros et al. 2013, *J. Exp. Mar. Biol. Ecol.*
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