Stingrays alter seagrass meadows as predators and habitat engineers

April – August 2022-2023 experimental study

Presented by Enie Hensel, PhD

Coastal Estuarine Ecology Lab Project

presentation for 18th October, 2023 SAV WG

VIMS | William & Mary
Virginia Institute of Marine Science

Photo by Contest Winning Desiree Groff

Megafauna have shaped our ecosystems on Earth for over a millennium

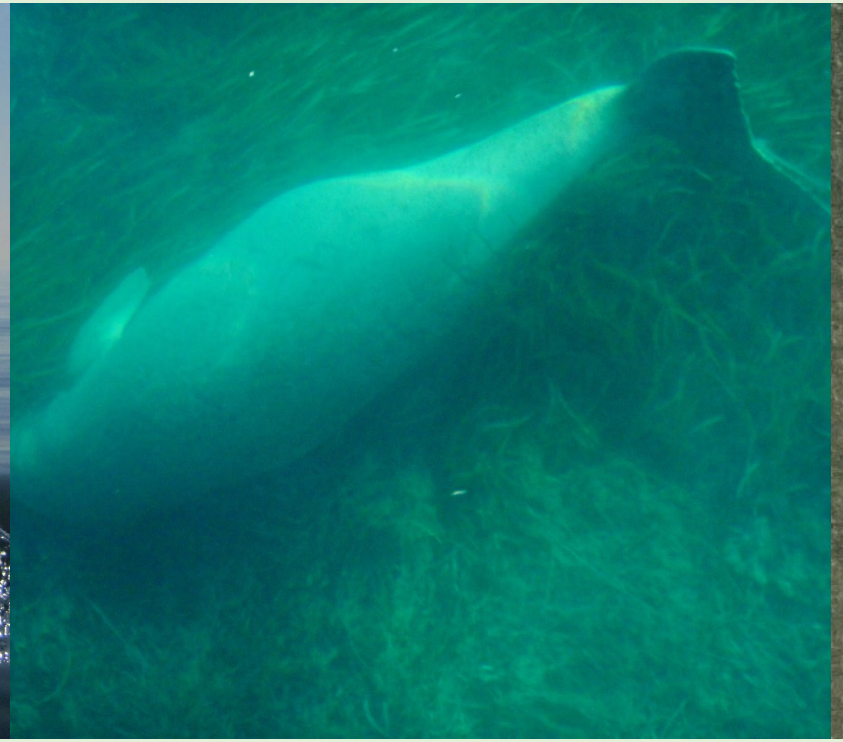
presented by Enie Hensel (she/her)

Long-lived and wide-ranging marine consumers are functionally relevant regulating …

food webs

habitat heterogeneity

assimilate, transport nutrient

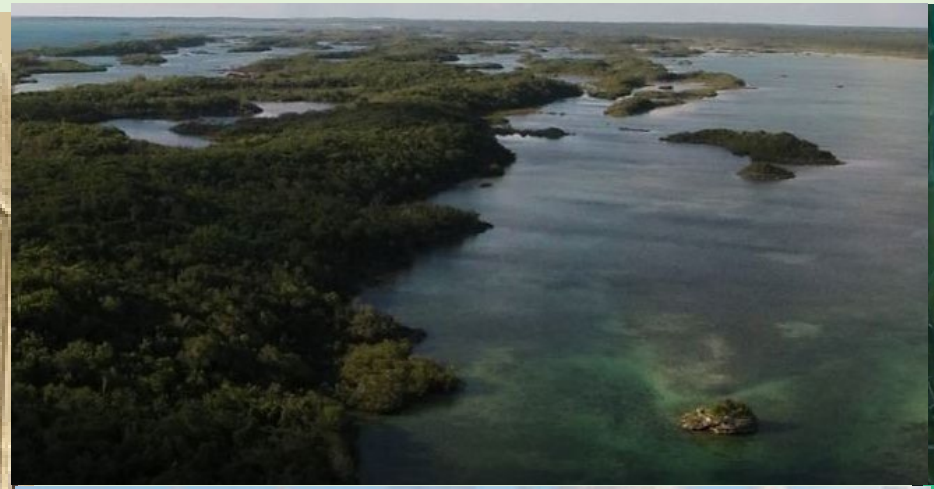


presented by **Enie Hensel** (she/her)

48% of marine megafauna are at risk of extinction from rapid global change

overharvest

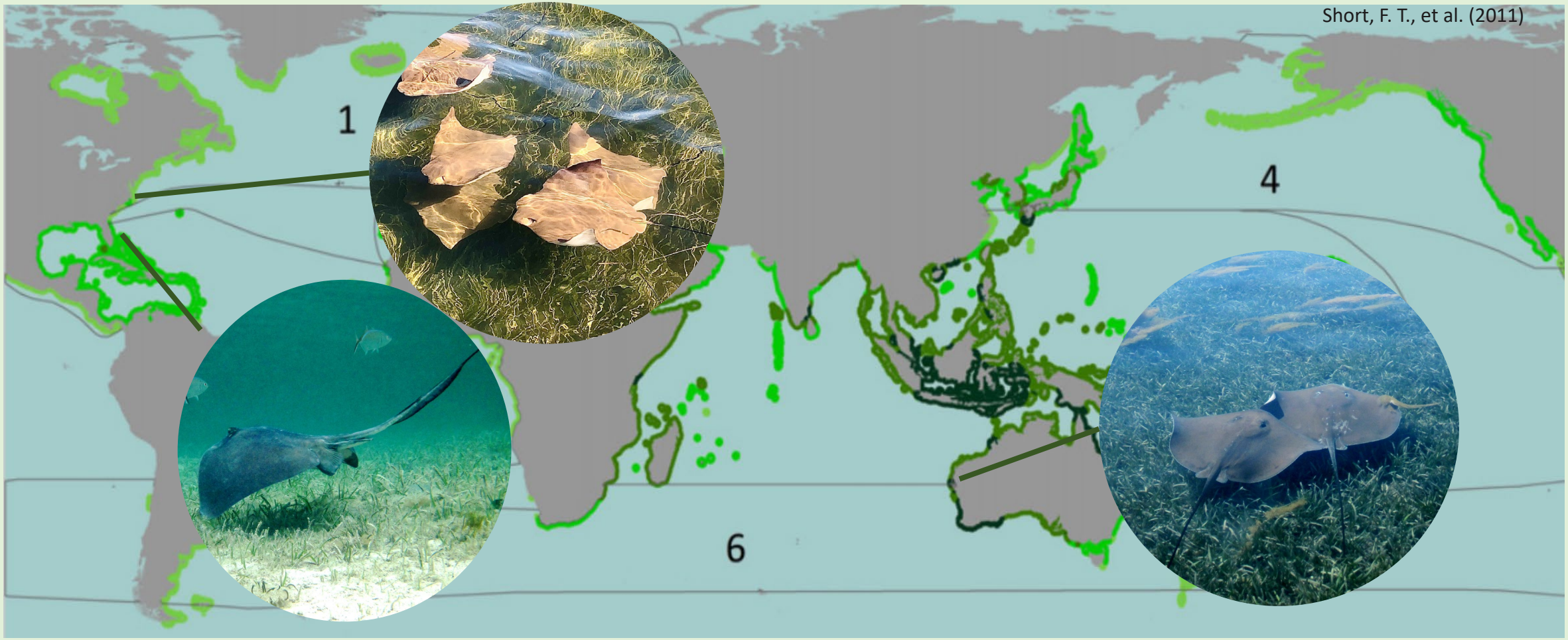
habitat loss



climate change

presented by **Enie Hensel** (she/her)

Large-bodied stingrays in seagrasses are a model system for quantifying the trophic and non-trophic role of large consumers across levels of ecological organization



presented by Enie Hensel (she/her)

Assumed to be important for their seagrass disturbances, yet their role hasn't been holistically quantified

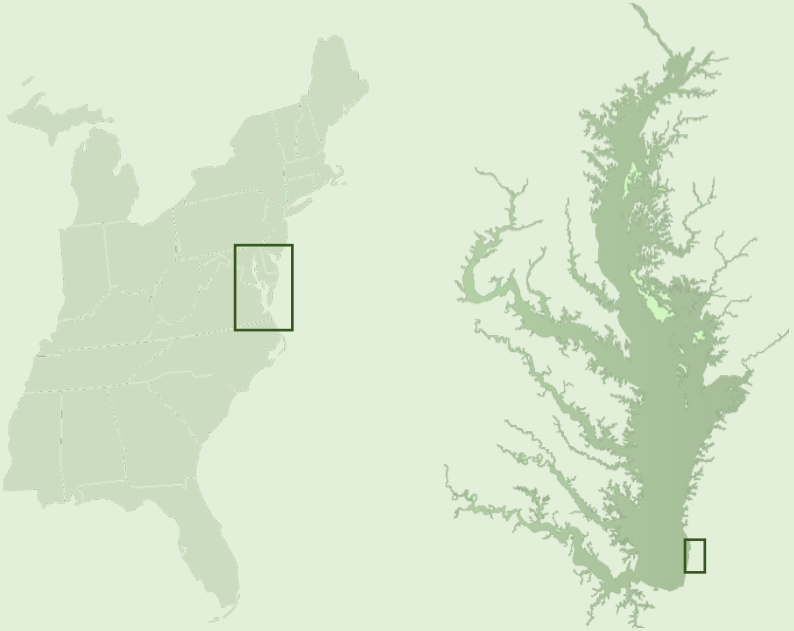

Georgia Aquarium

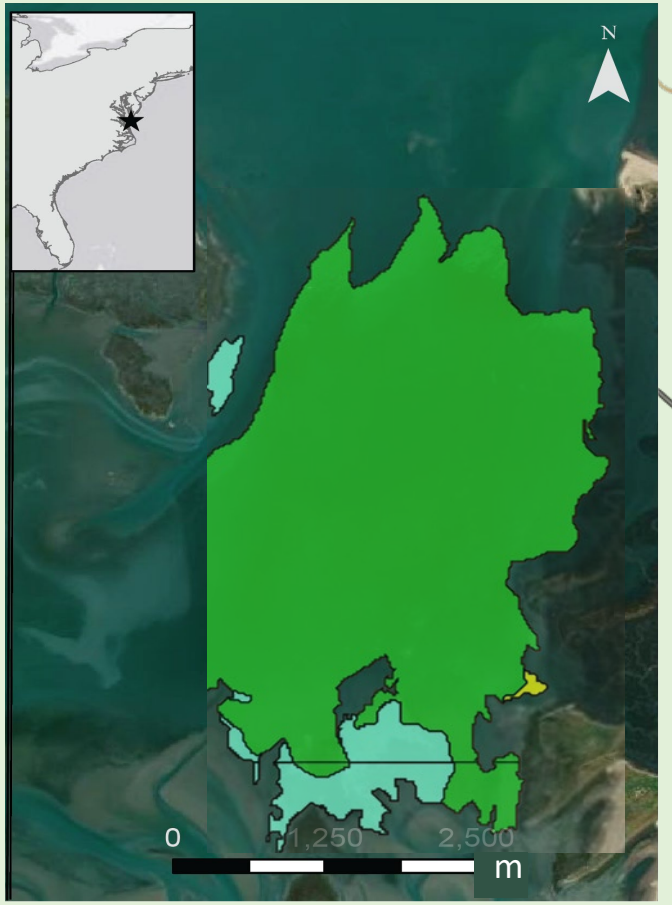

Shane Gross

Stingrays have economic impacts and now being targeted as a pest in the Bay, understanding their broad role on the functioning of seagrasses is urgent

presented by **Enie Hensel** (she/her)

Here we explore the role of benthic foraging stingrays on a sub-temperate, restored eelgrass meadow, located in the coastal bays of Virginia.



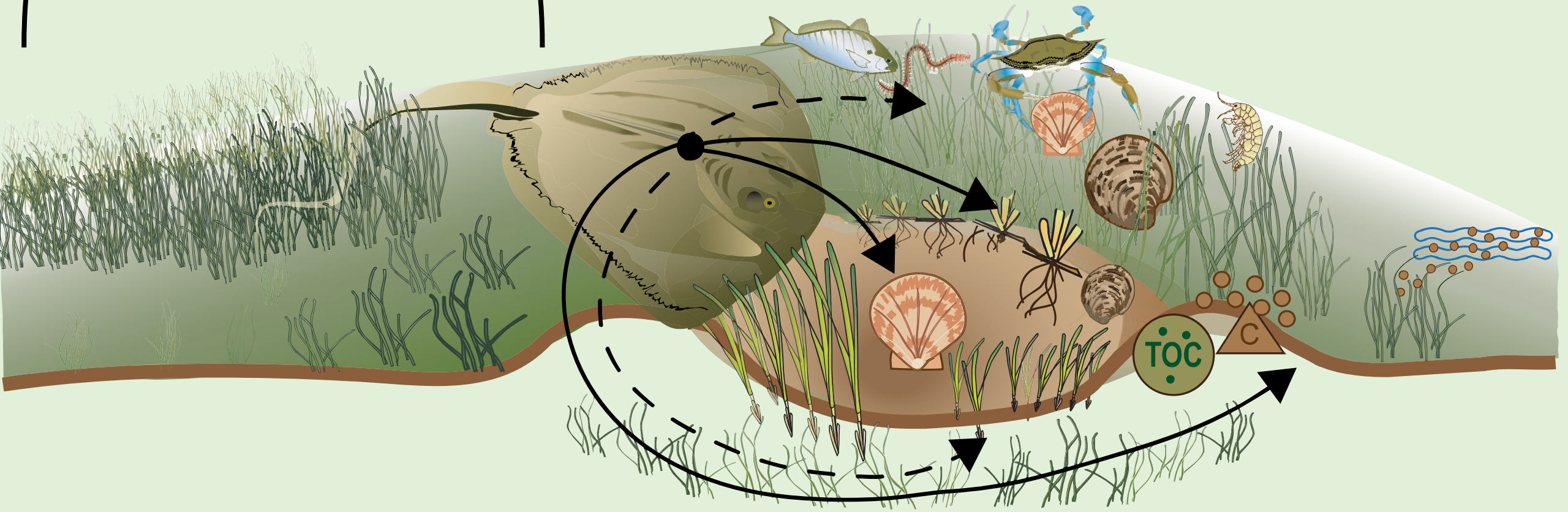


- **history is known**
- **luscious, pristine**
- **Few physical disturbances**

presented by **Enie Hensel** (she/her)

Q1 What predicts variation in the intensity of ray foraging on seagrass meadows?

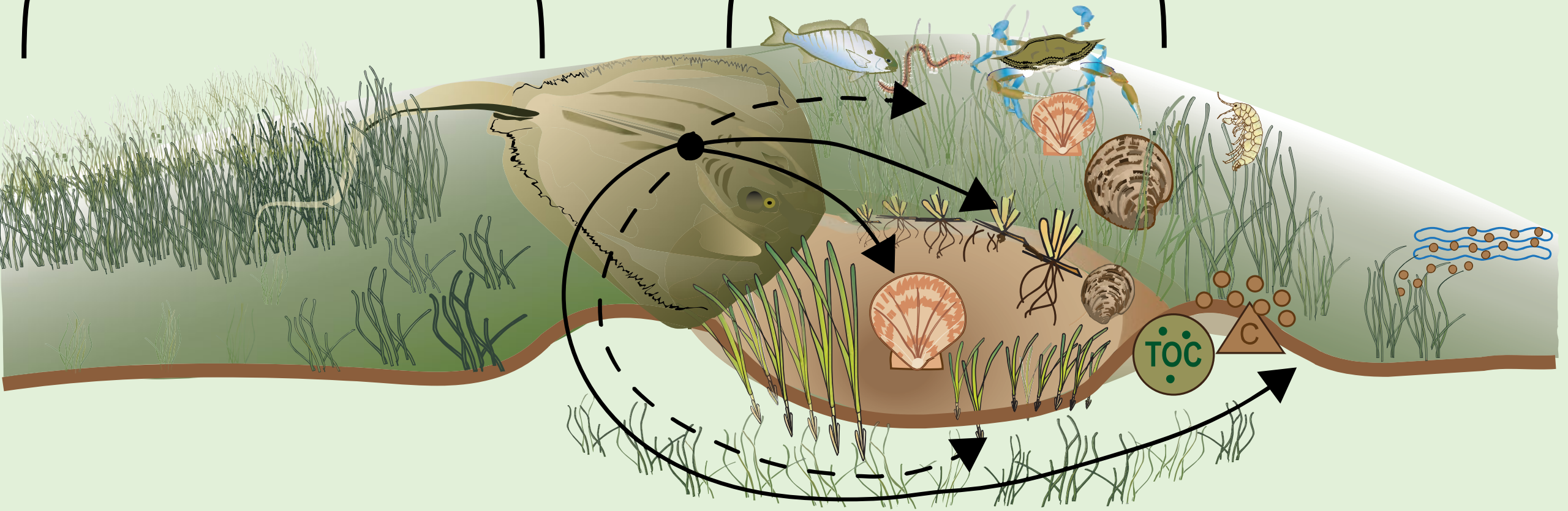
Q1 ray preference?



Q2 What are the effects of ray foraging holes on seagrass community structure?

Q1 ray preference?

Q2 ray Δ structure?

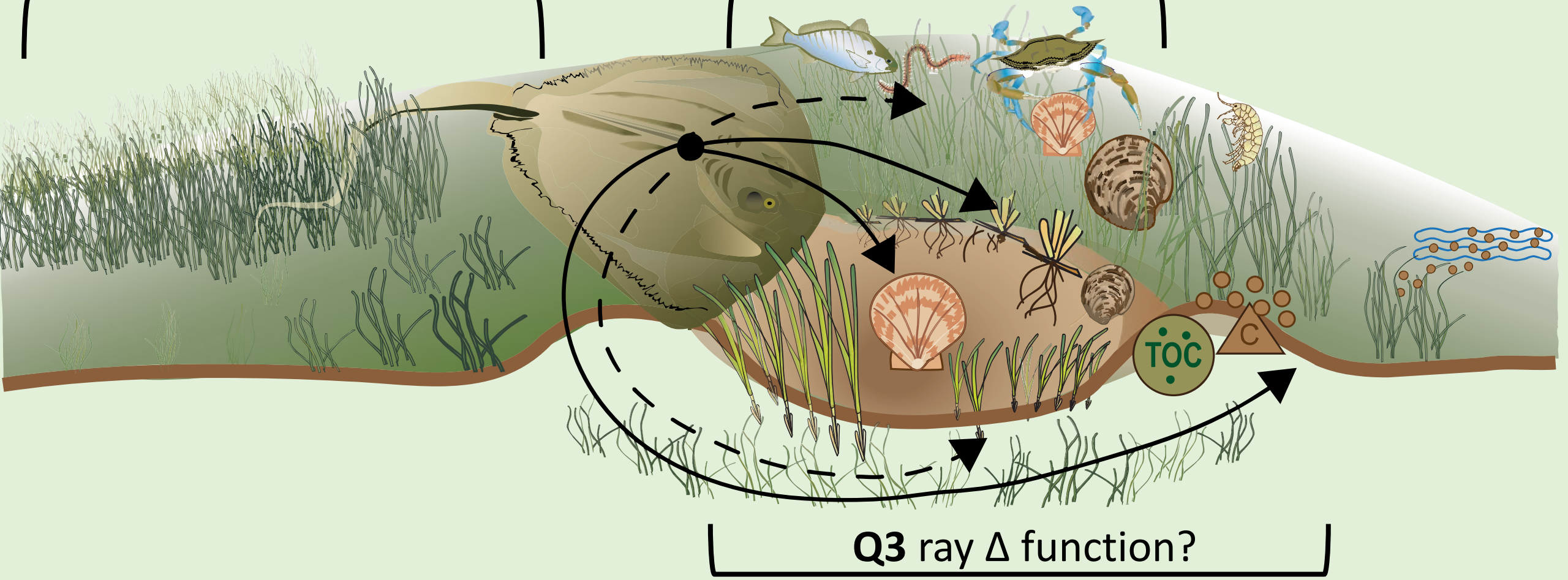


presented by **Enie Hensel** (she/her)

Q3: What are the effects of ray foraging on basic ecosystem functions?

Q1 ray preference?

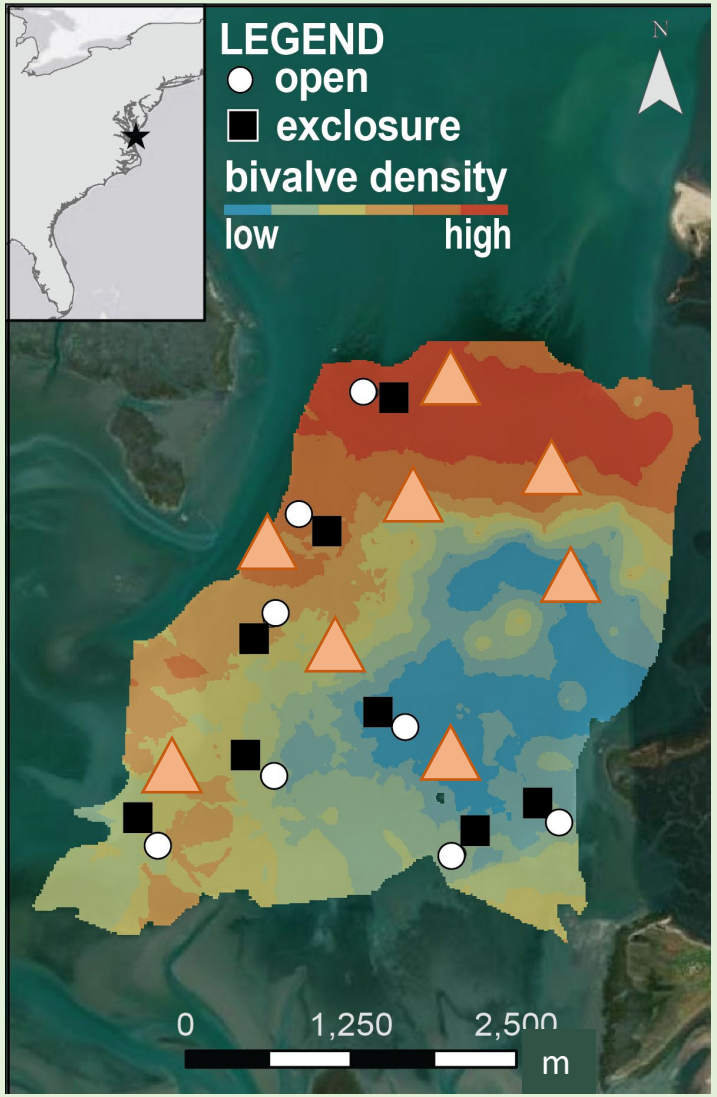
Q2 ray Δ structure?

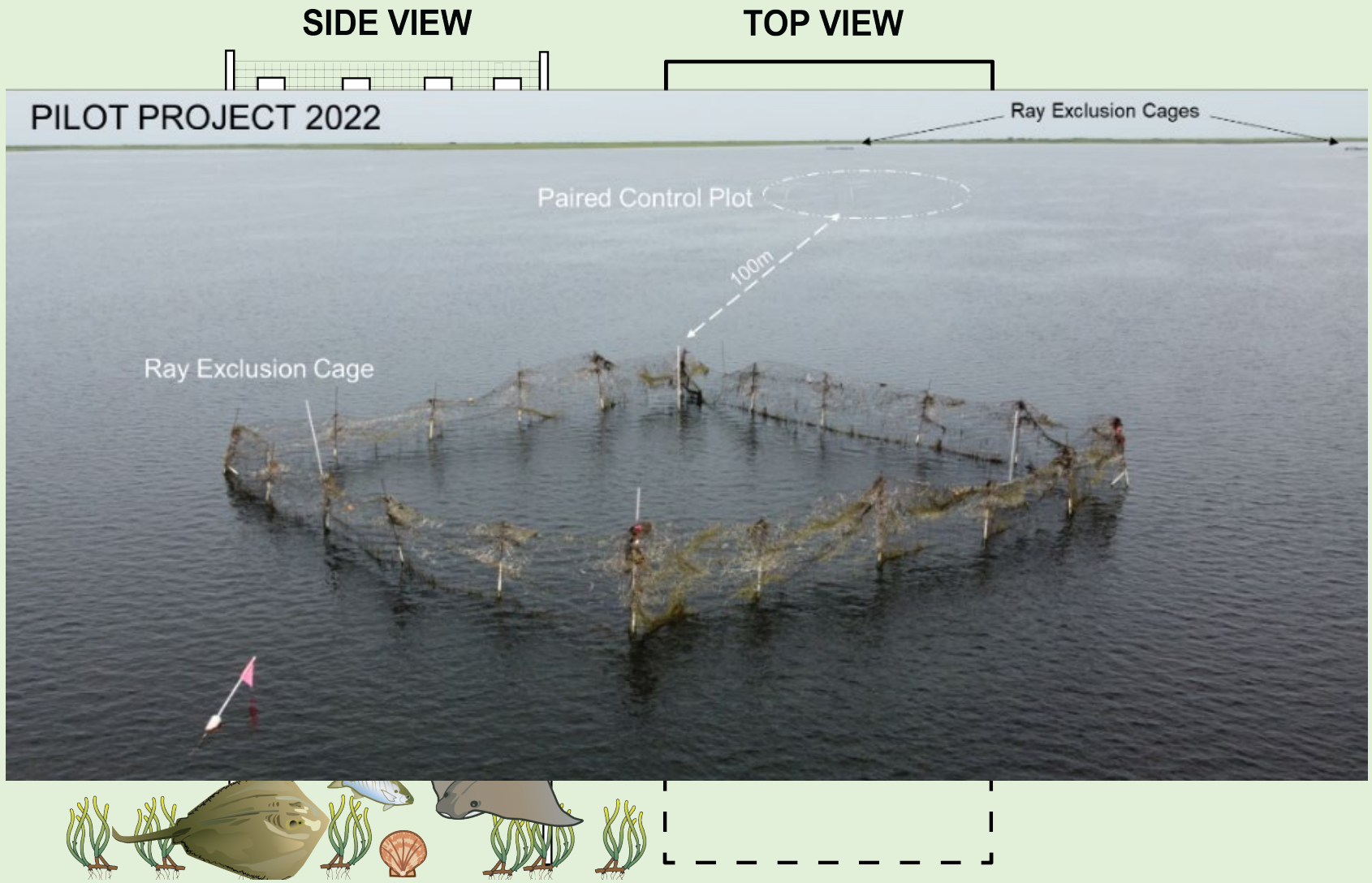


Q3 ray Δ function?

presented by **Enie Hensel** (she/her)

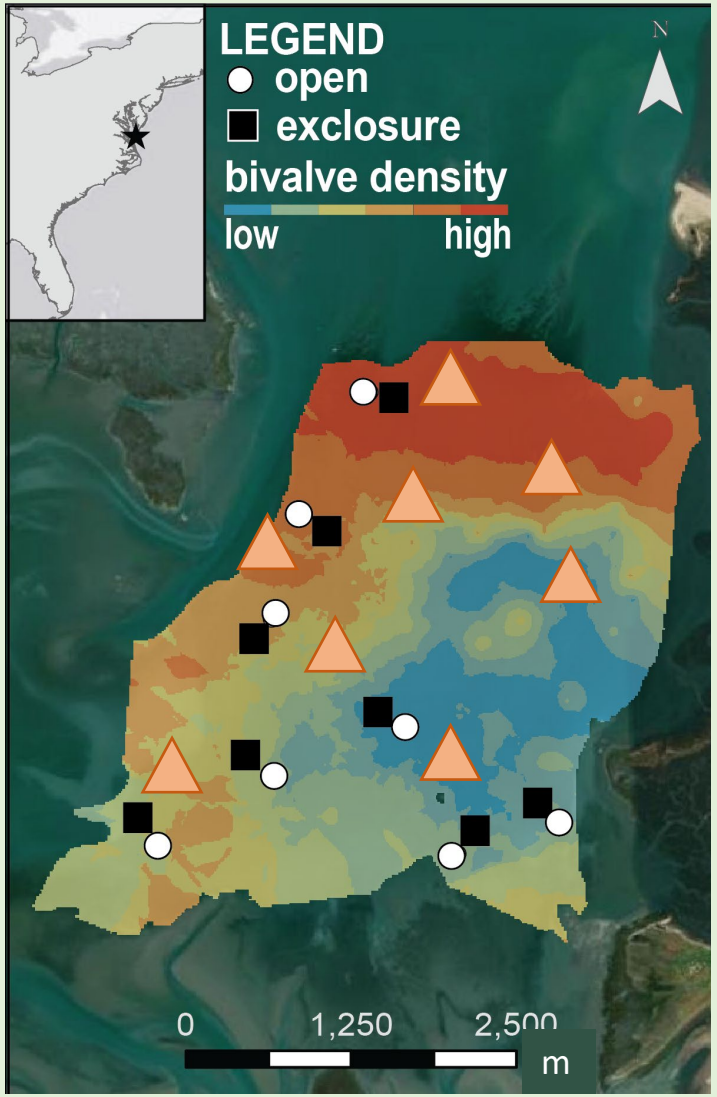
Paired-plot exclosure experiment + surveys

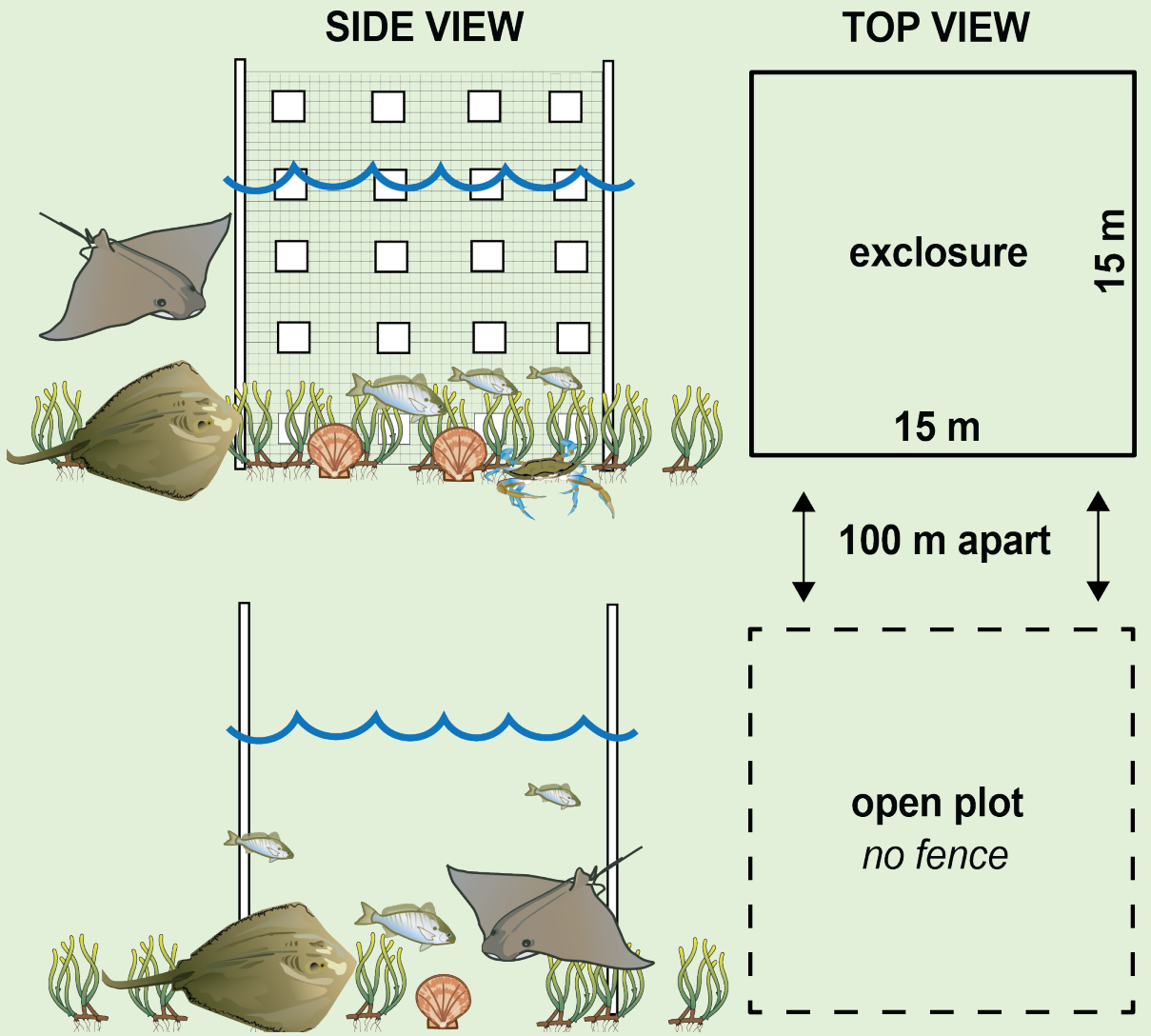




presented by **Enie Hensel** (she/her)

Paired-plot exclosure experiment + surveys

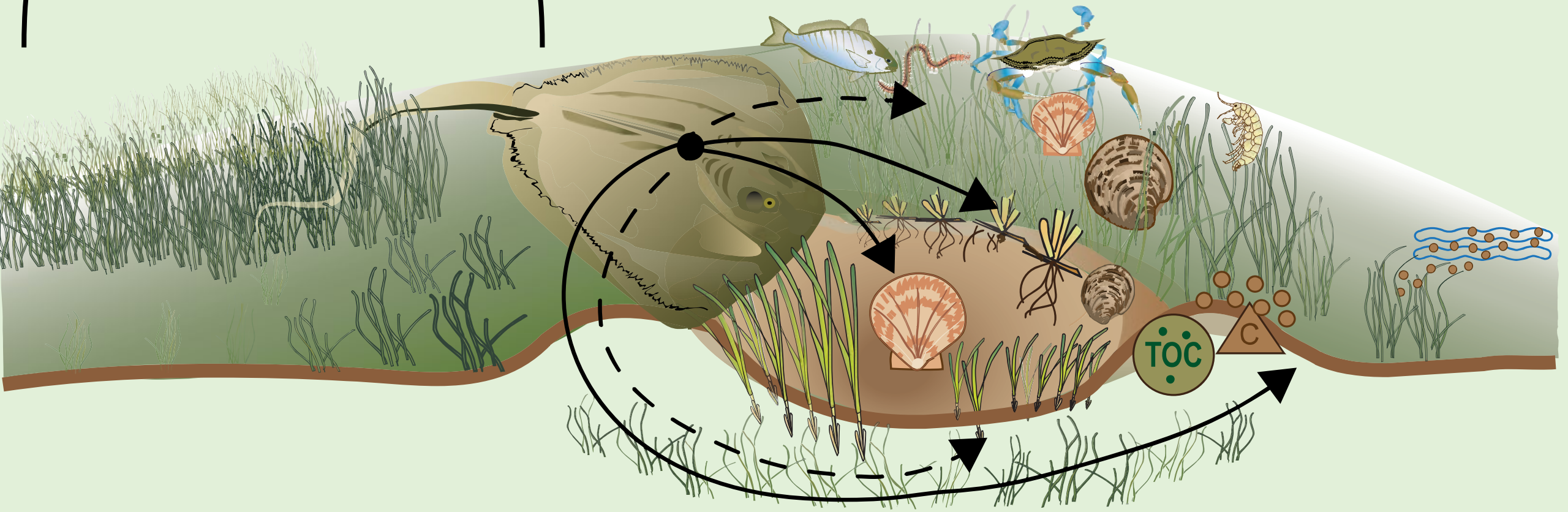




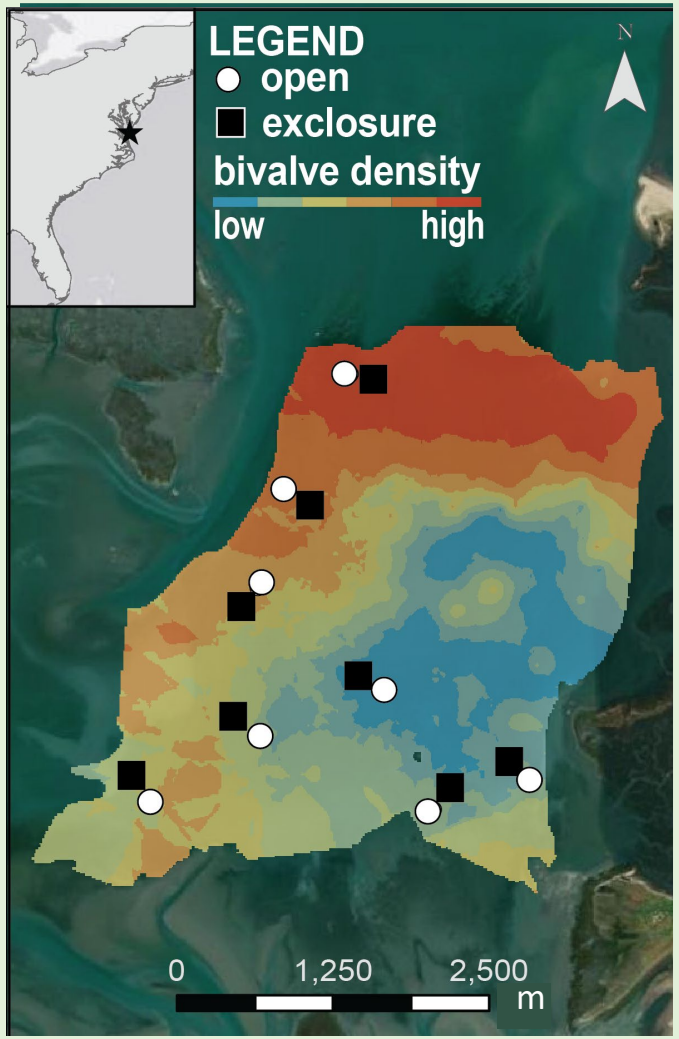
presented by Enie Hensel (she/her)

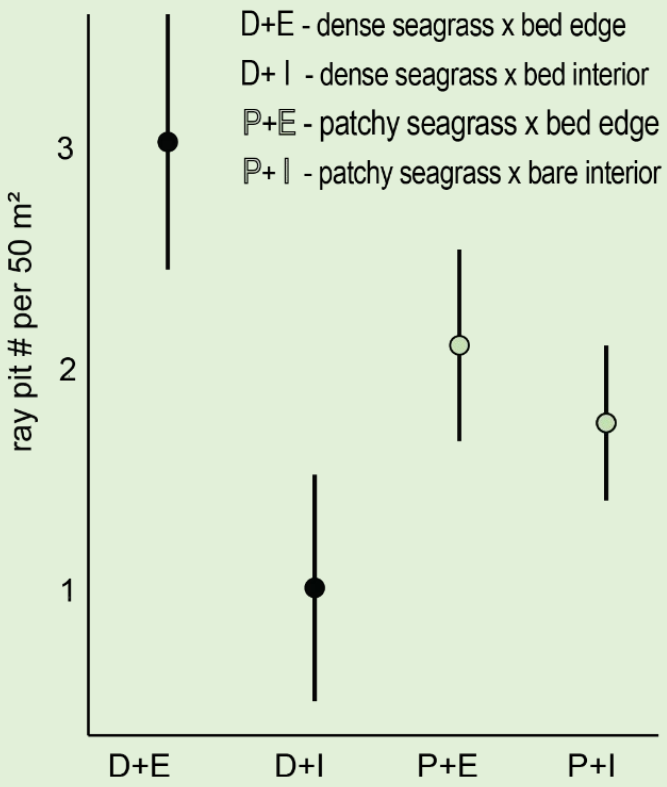
Q1 What predicts variation in the intensity of ray foraging on seagrass meadows?

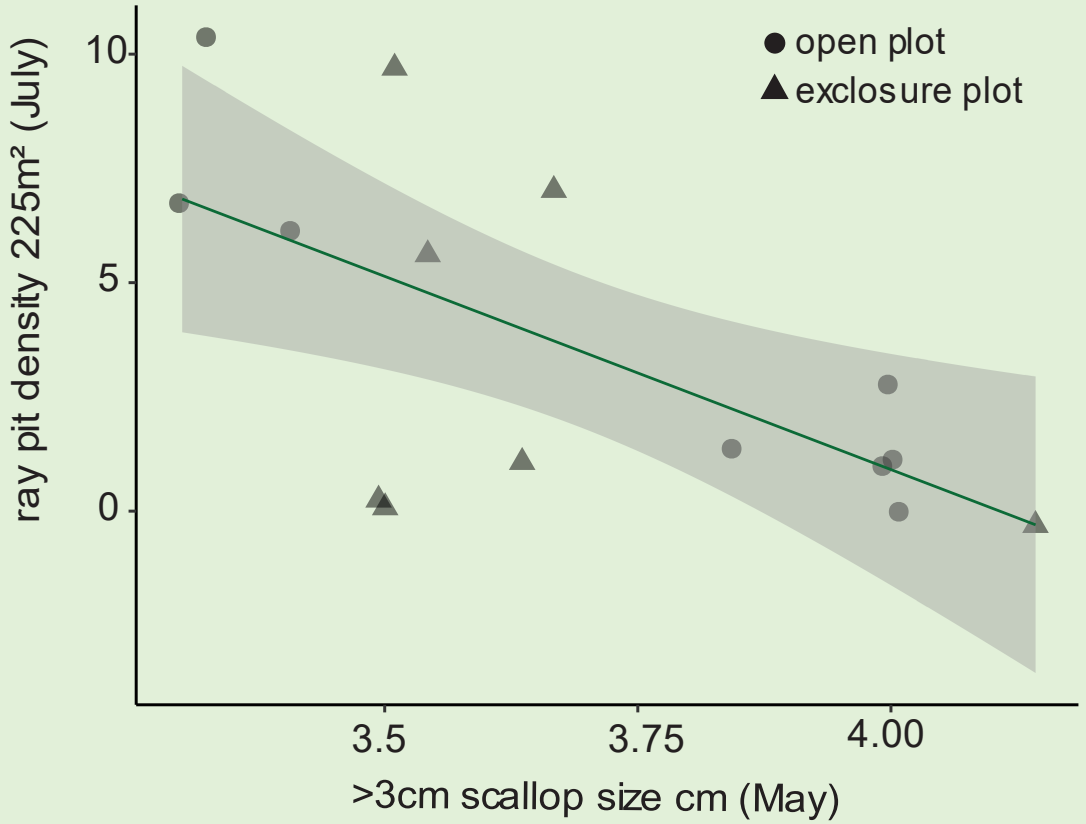
Q1 ray preference?



best predictor for where rays forage in seagrass is … complex, random, requires more investigation





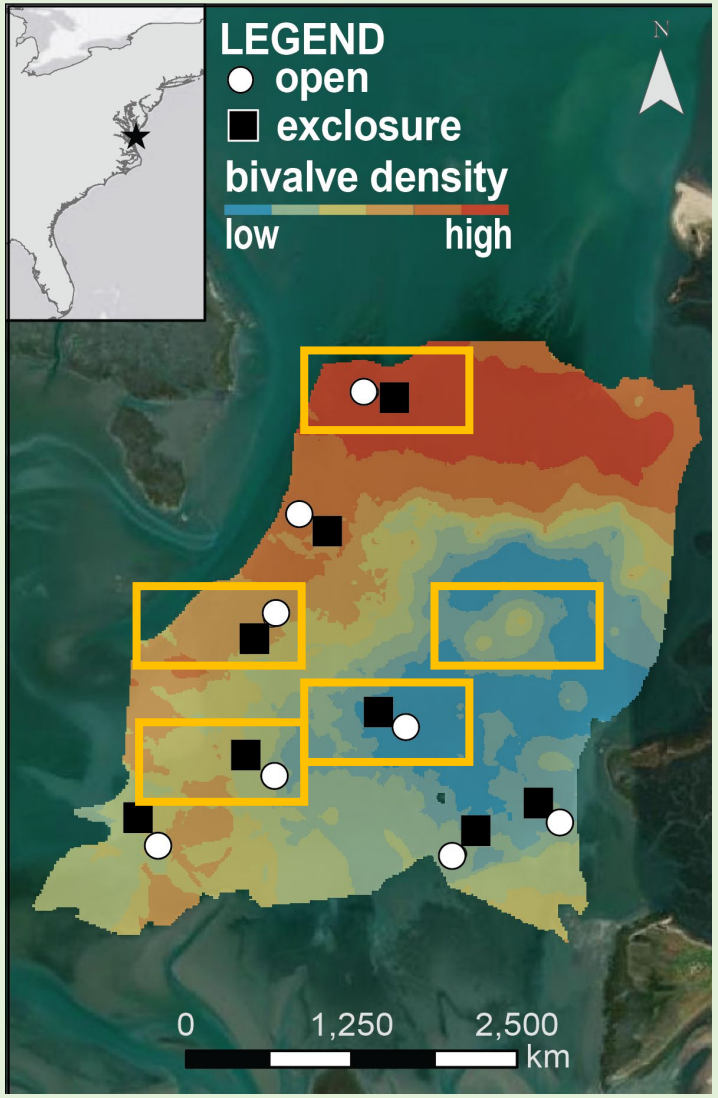


Adj. R^2 = 0.36 F(1,13) = 8.87 p = 0.01

presented by **Enie Hensel** (she/her)

Where do rays forage in seagrasses?

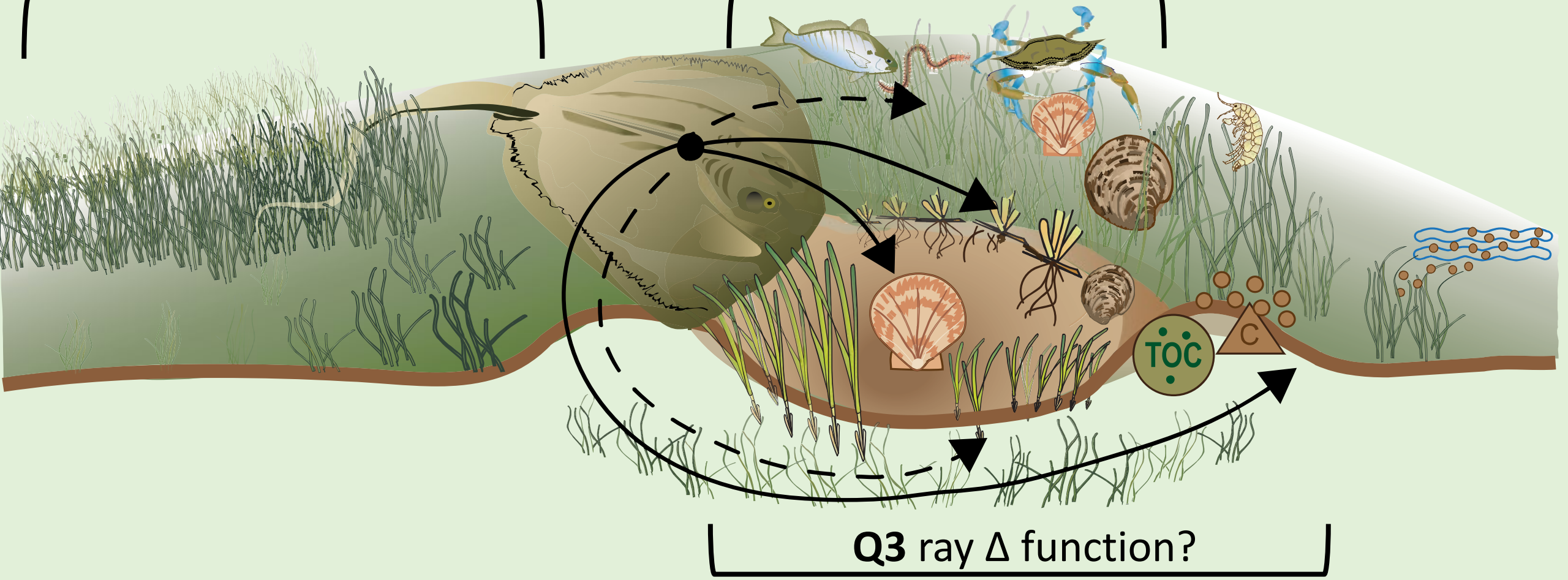
Mickie Edwards (PhD student)



Q3: What are the effects of ray foraging on basic ecosystem functions?

Q1 ray preference?

Q2 ray Δ structure?

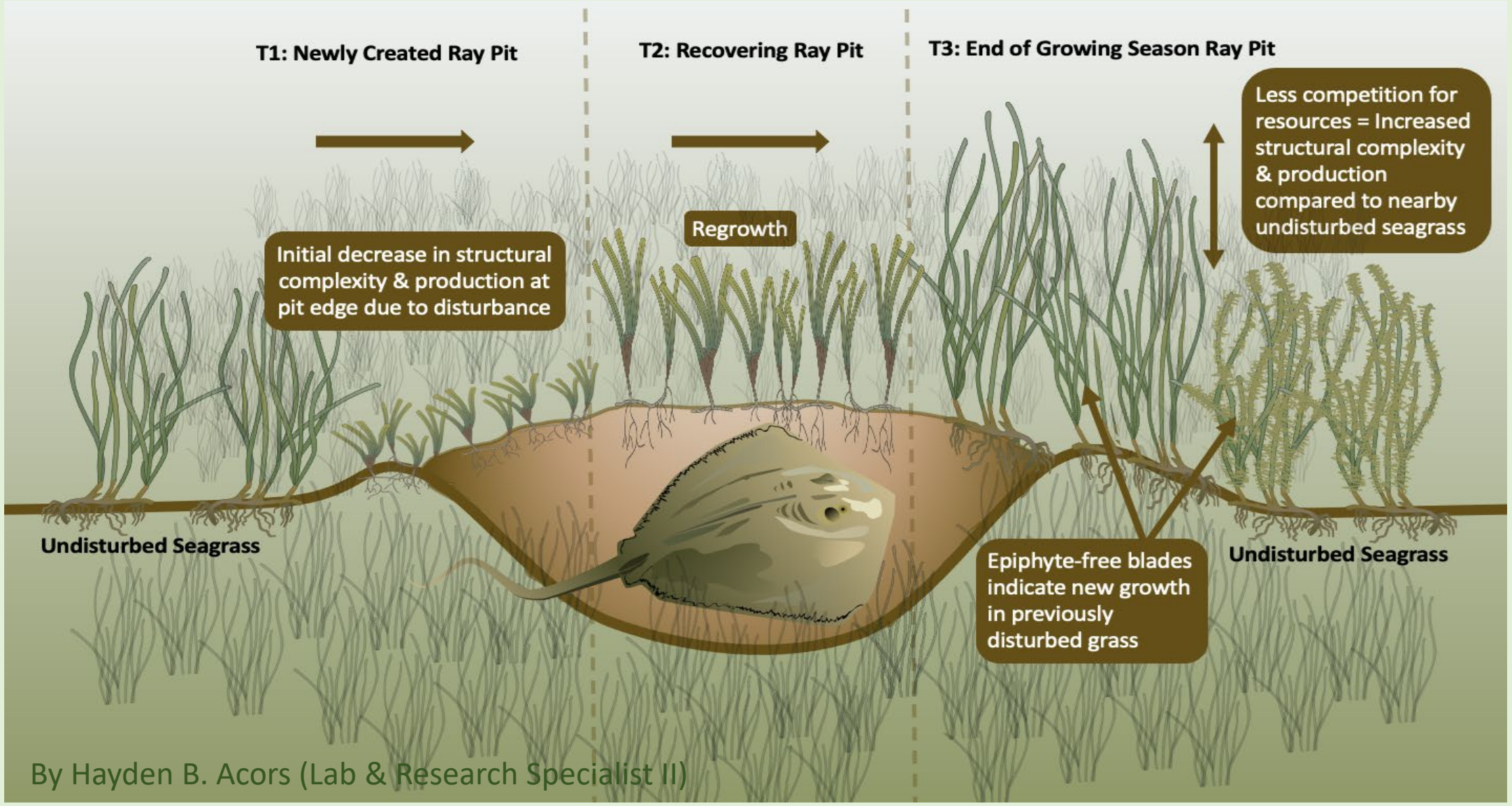


Q3 ray Δ function?

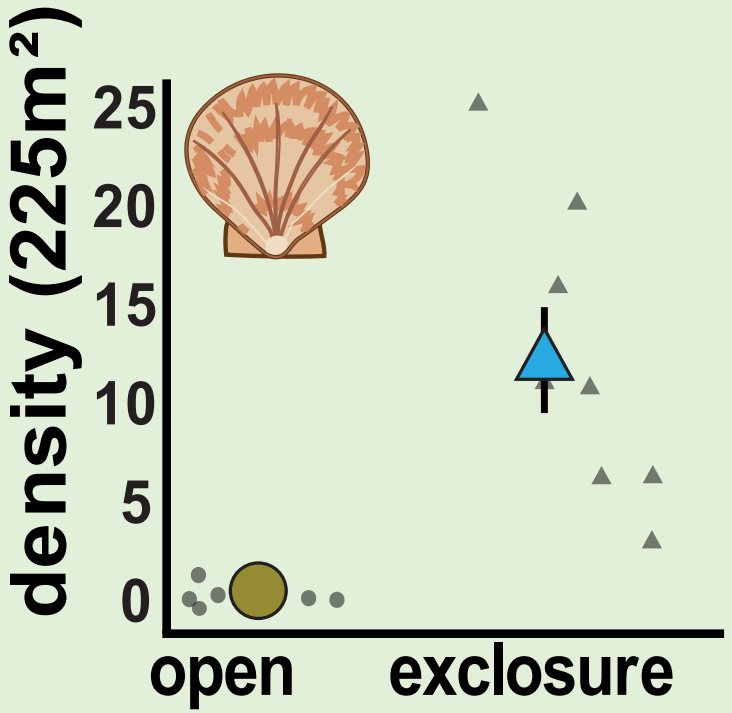
presented by **Enie Hensel** (she/her)

ray pits do not alter extant seagrass ‘production’, but do turnover sediment and remove carbon

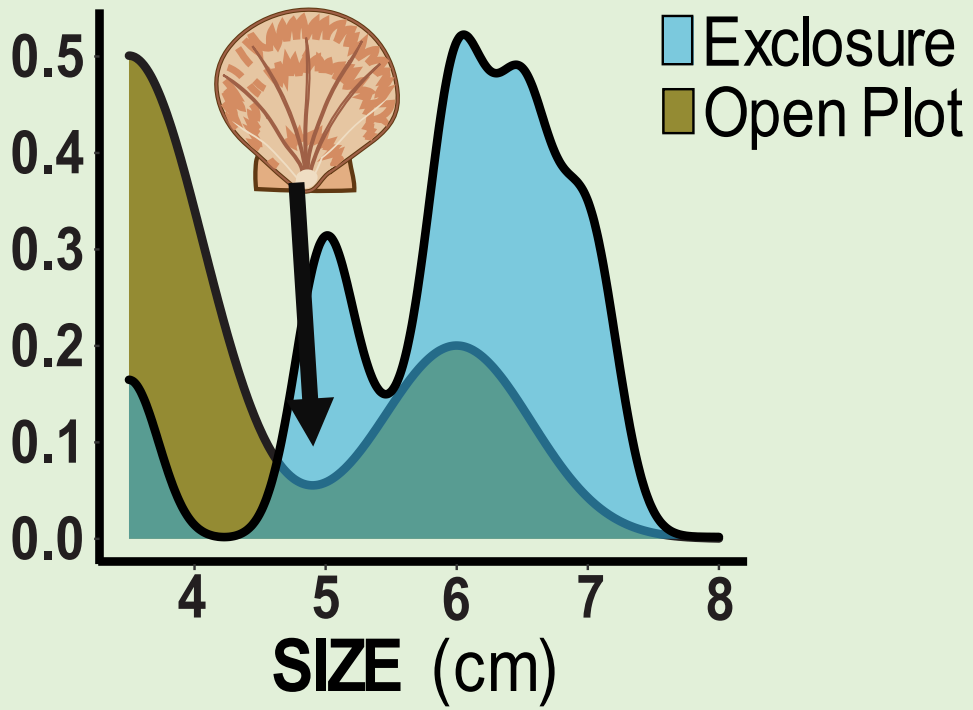
Q2 ray Δ structure?



Ray predation & habitat modification change scallop demographics & predator-prey interactions, respectively



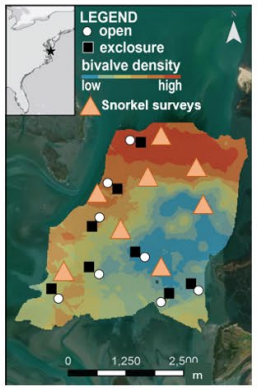
Adj. R^2 = 0.56 F(1,14) = 819.9 ***p* < 0.01**

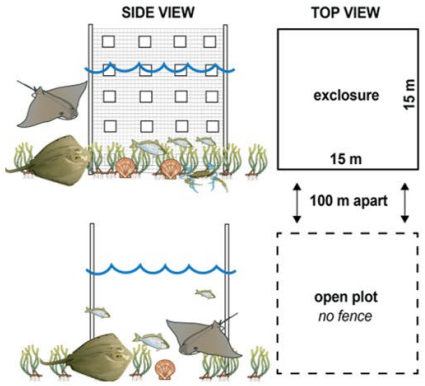


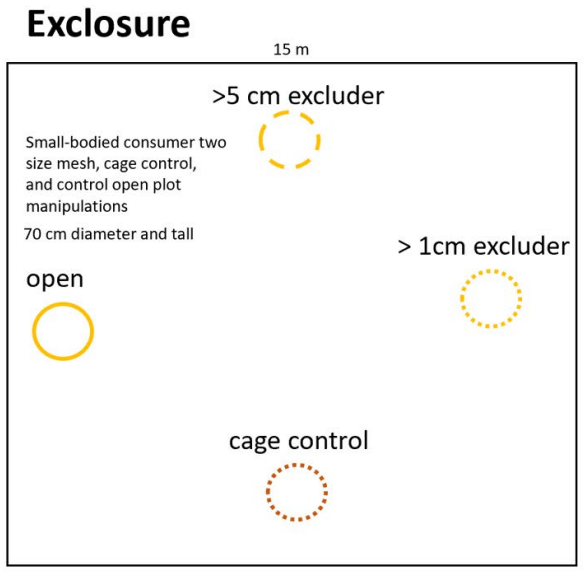
Adj. R^2 = 0.04 F(1,39) = 2.8 *p* = 0.09

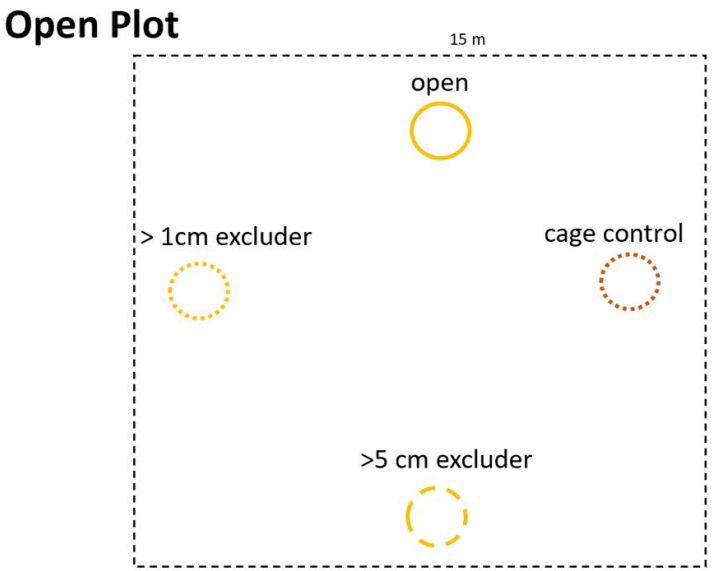
How consumer body size alters seagrass community composition under the absence and presence of fearscape?

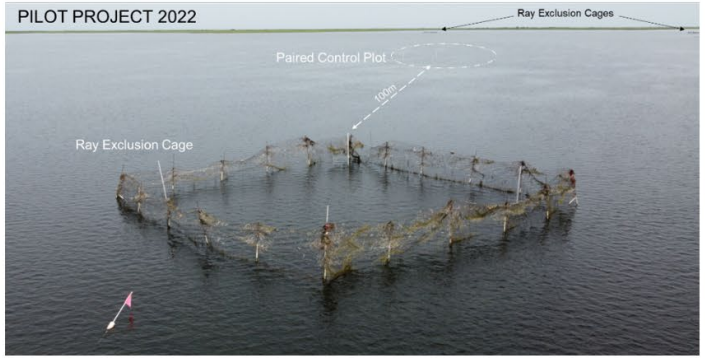
Hayden B. Acors (Lab & Research Specialist II)

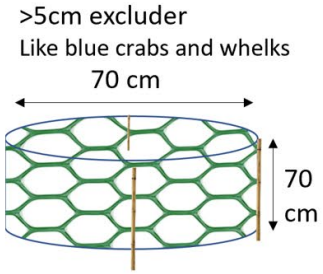


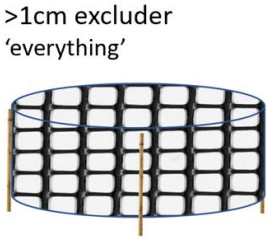


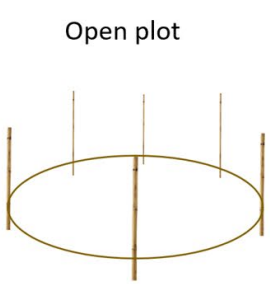








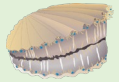




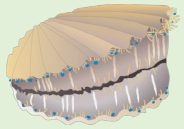
Does do large-bodied consumers alter mollusc prey growth and survival?

- Measure changes in growth, growth organ/shell allocation
- Measure predation rate for two weeks with cage top off

12x oyster spat

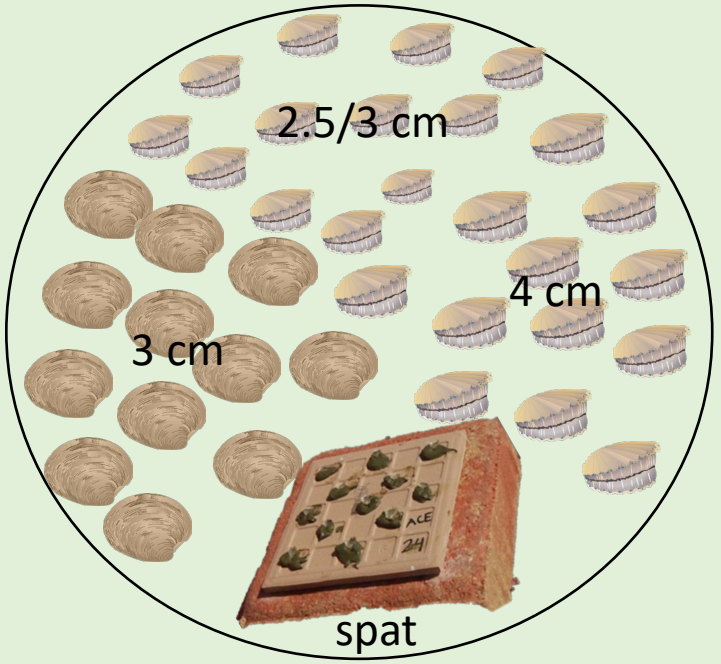


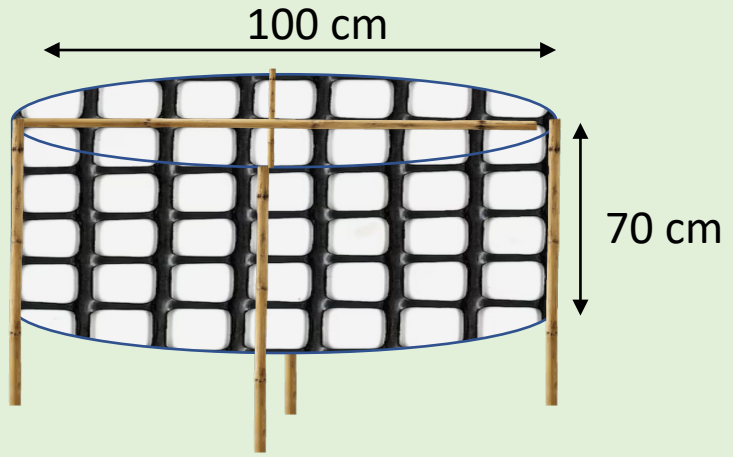
12x 2.5 -3 cm scallops Fall 2022



12x 3-5 cm scallops Spring 2022

12x ~ 3.5 cm Mercenaria



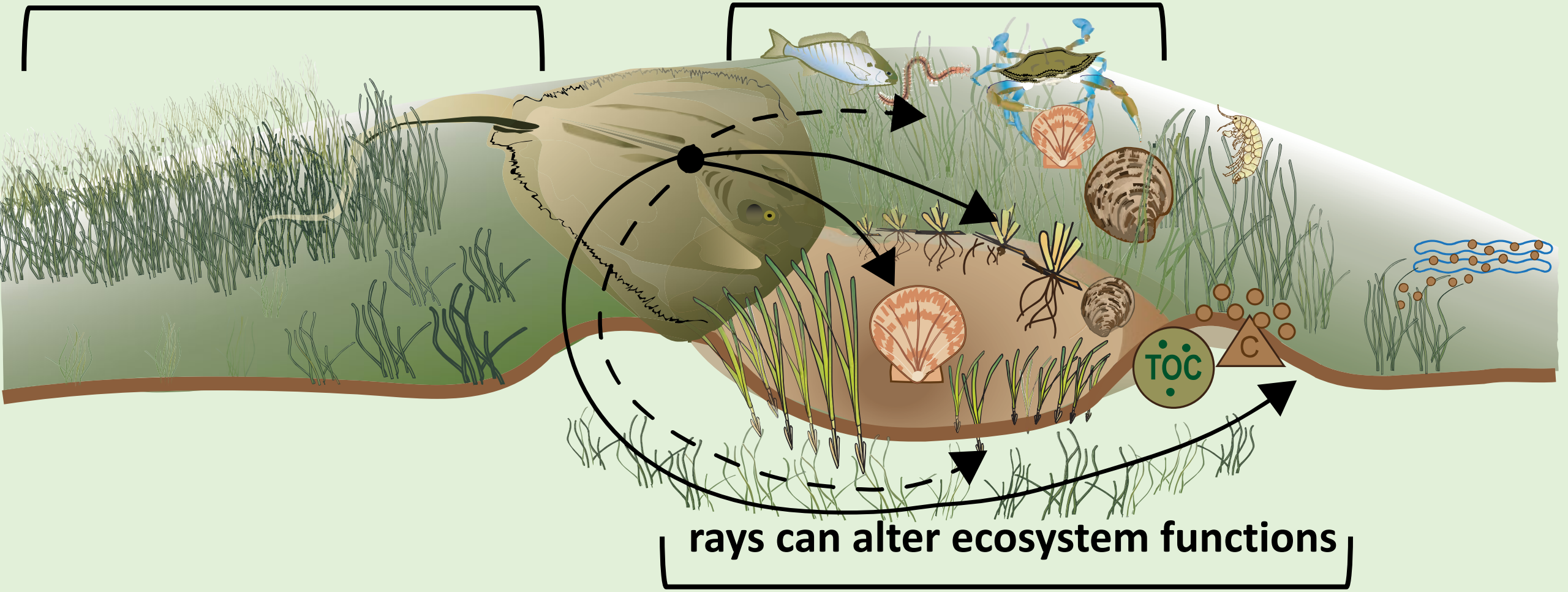


hole-size is 1cm x 1cm

stingrays are ubiquitous seagrass fauna

ray preference is complex

ray change seagrass structure



rays can alter ecosystem functions

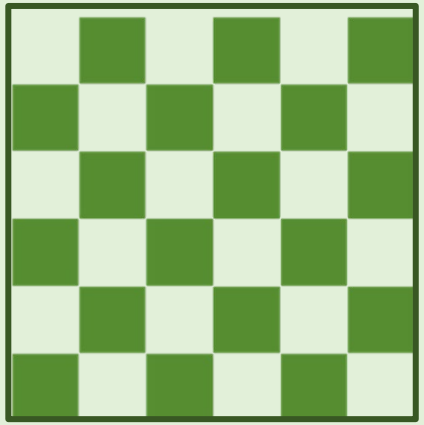
presented by **Enie Hensel** (she/her)

Incorporating marine megafauna effects on coastal ecosystem processes is essential for both coastal conservation and management

Eat a Ray, Save the Bay

Stingray Feeding

Restoration decisions



presented by Enie Hensel (she/her)

Acknowledgements

THANK YOU TO

CEEL-SAV LAB at VIMS

Reba T. Smith (VIMS Eastern Shore Lab, Scallop Hatchery)

Bowdoin Lusk (The Nature Conservancy Va)

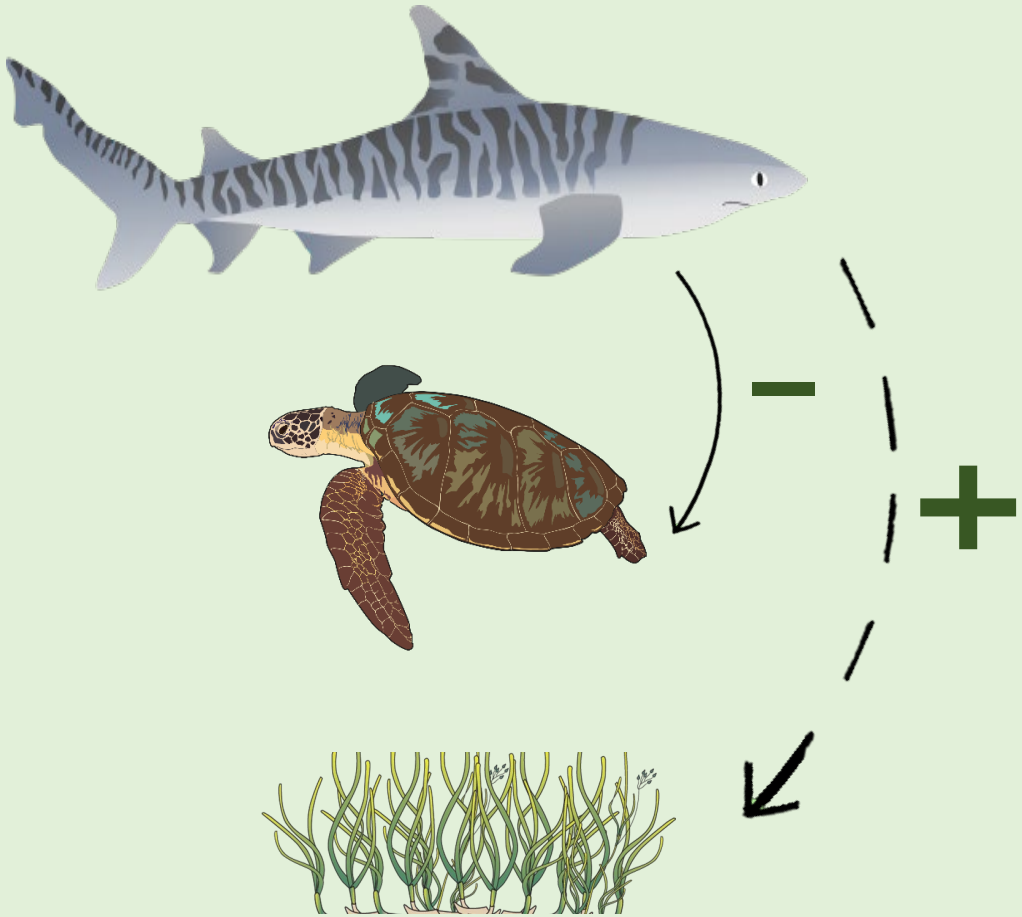
Cherrystone Creek Clam Company

VIMS REU 2022 Program

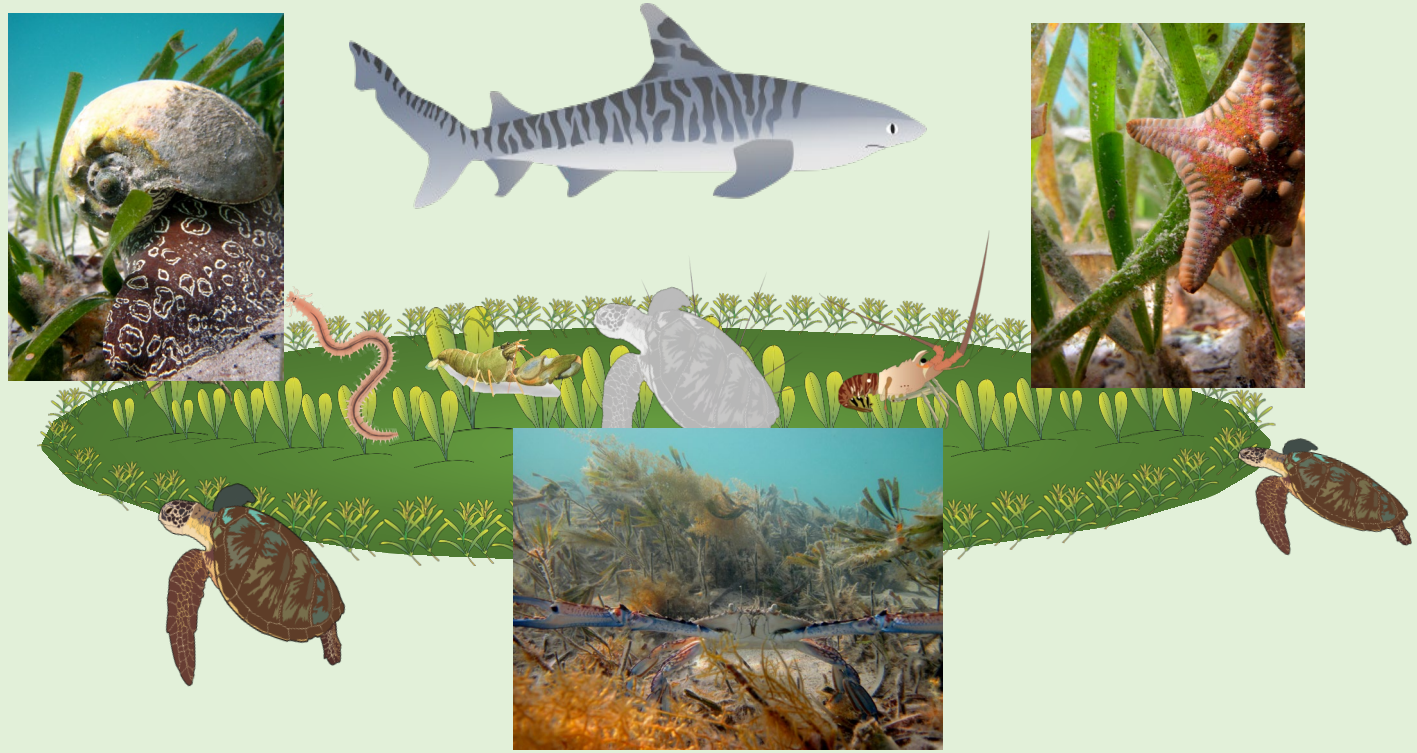
Symbols by ian.umces.edu

Image by **Shane Gross** – A FINtastic environmental and conservationist photographer to incorporate into your next grant proposal for science communication!

Marine megafauna are functionally relevant consumers regulating food webs & engineering ecosystems



Shark Bay Ecosystem Research Project



simplified summary of Heithaus et al. 2007, 2008 y many more

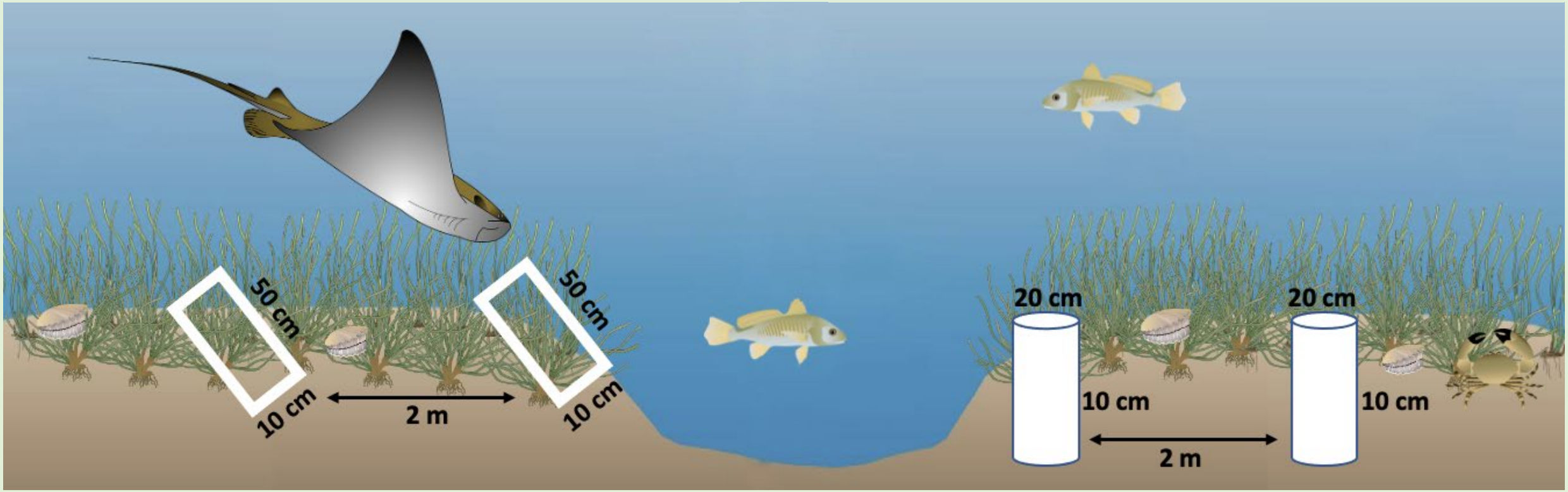
We used a paired plot, survey design to measure differences in structure & primary production

Structure

- June (paired ray pits, open seagrass)
  August (paired ray pits, open seagrass, recovering pits)
- Measured canopy height and shoot density

Primary Production

- August (paired ray pits, open seagrass, recovering pits)
- Used biomass cores as a proxy for primary production



Using a paired design, we measured differences in predation and bulk carbon – Tiffany Hwang REU student

Tether experiment

- n = 10 paired holes, open seagrass
- 24-hr soak, repeated 3 days
- GoPro footage, repeated 2 days

Bulk carbon storage

- n = 10 paired holes, open seagrass
- Benthic core 20 cm down from bed's surface
- Organic and inorganic material separated and processed