Shifting Baselines: Effects of seagrass loss on fish communities in Southwest Florida tidal creeks

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Tidal creeks: why they matter

- Nursery habitat
  (Beck et al. 2001)
- Pathways of energy transfer from adjacent habitats (e.g., salt marsh) to open estuary
  (Stevens et al. 2006)
- Nutrient cycling and sequestration
  (Bai et al. 2012)
- Environmental aesthetics

Especially vulnerable to effects of coastal development

Photo Credit: FWC

Photo Credit: K. Chase


Photo Credit: Betty Staugler, FL SeaGrant
2006


Photo Credit: FWC
2019

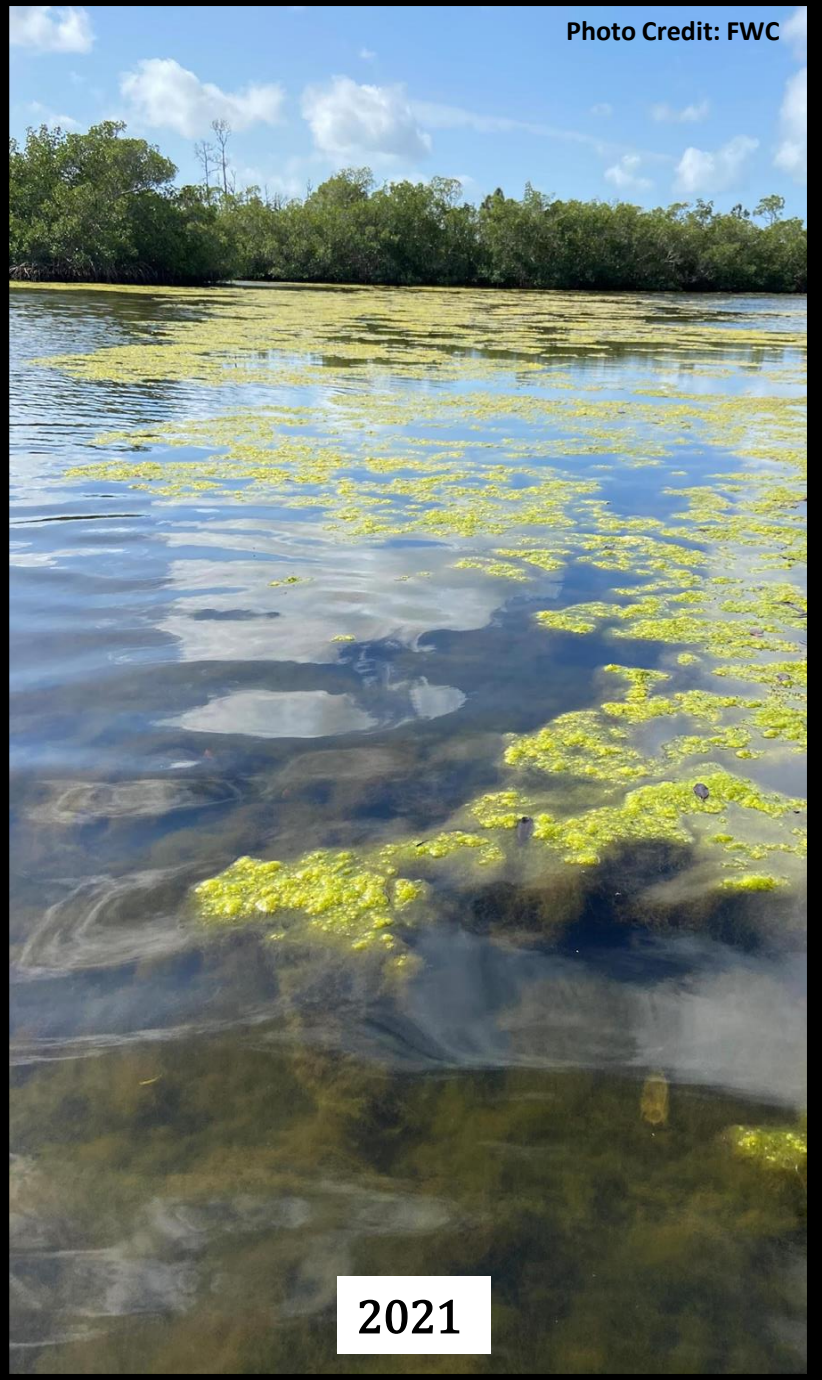


Photo Credit: FWC
2021

Sampling from July 2014-June 2022 (8 years)

Fisheries independent monitoring (FIM) stratified random sampling design

Coral Creek divided into 3 ‘creeks’

Monthly sampling per creek

21 m seine set along shoreline

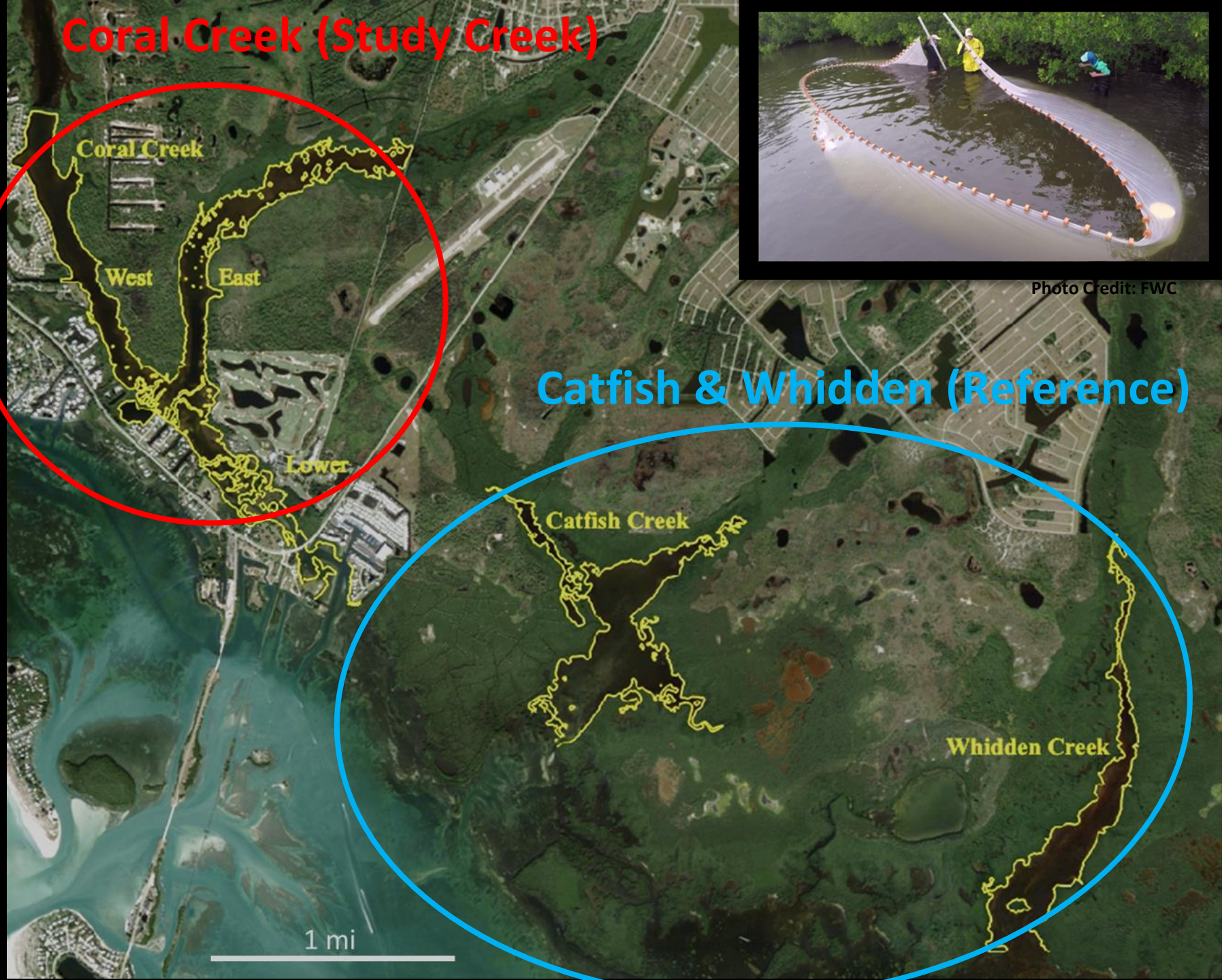
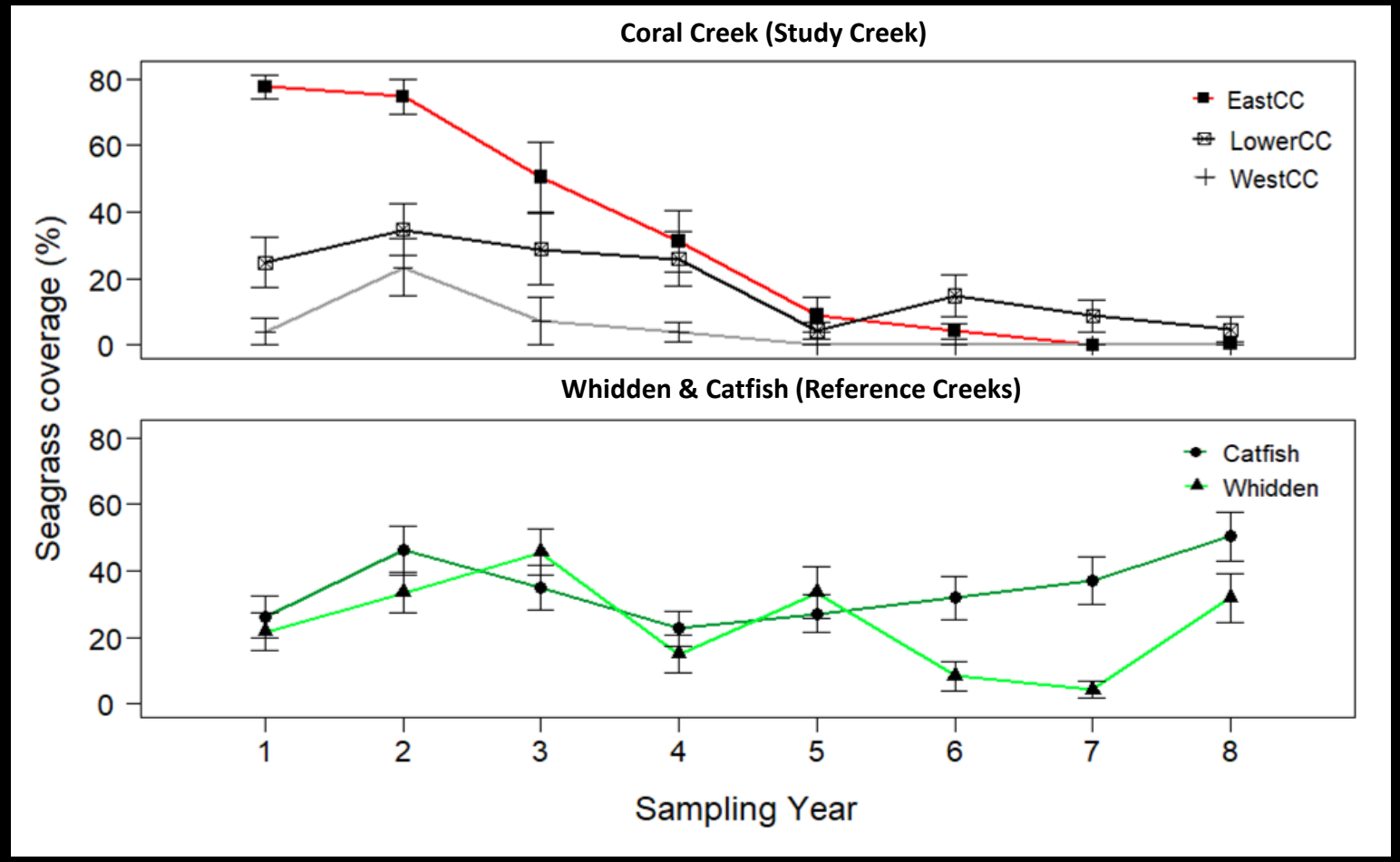


Photo Credit: FWC

Coral Creek Seagrass Die-off



Seagrass die-off stage

Yrs. 1-2 = Pre

Yrs. 3-5 = Transition

Yrs. 6-8 = Post

Study Questions:

1. Do communities differ between creeks and seagrass die-off stages?

2. Is there a relationship between fish community structure and seagrass coverage in the creeks?

Seagrass loss

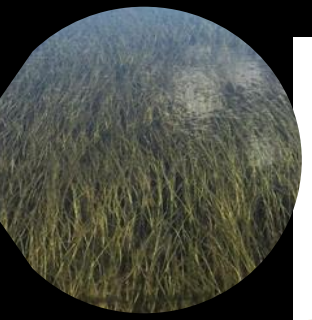
1. Do communities differ between creeks and seagrass die off stages ?

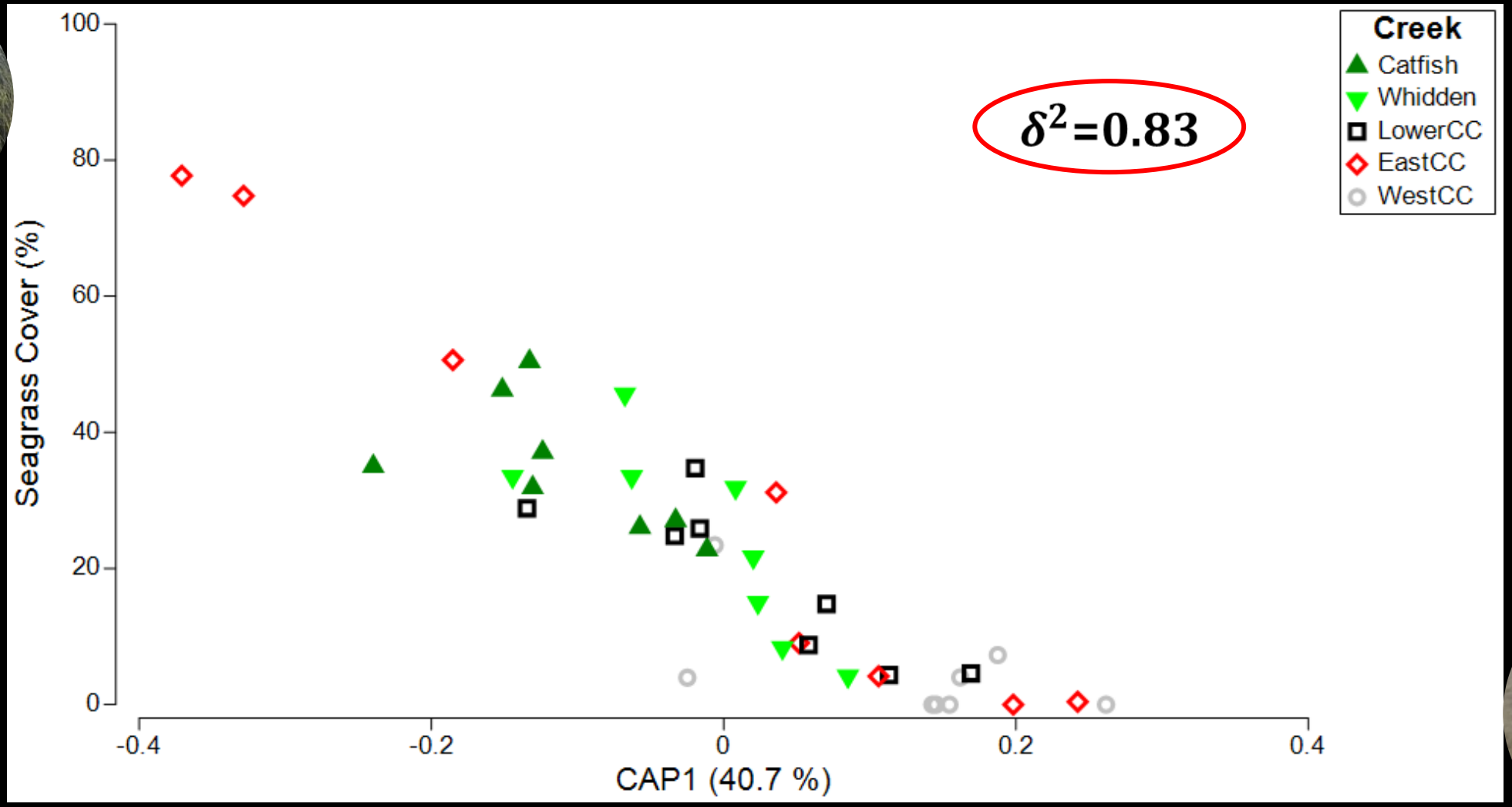
PERMANOVA Results

Source	Significance (95% CL)	Contribution to Variance
Creek	P < 0.001	19.33%
Seagrass die-off stage	P = 0.013	6.51%
Creek x Seagrass die-off stage (interaction term)	P < 0.001	6.77%

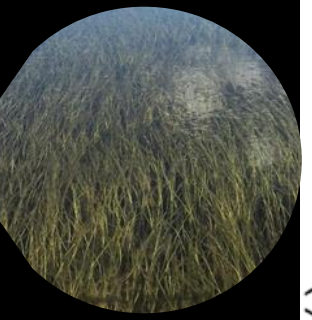
Effect of seagrass die-off stage (i.e., temporal trends) on fish communities different between creeks

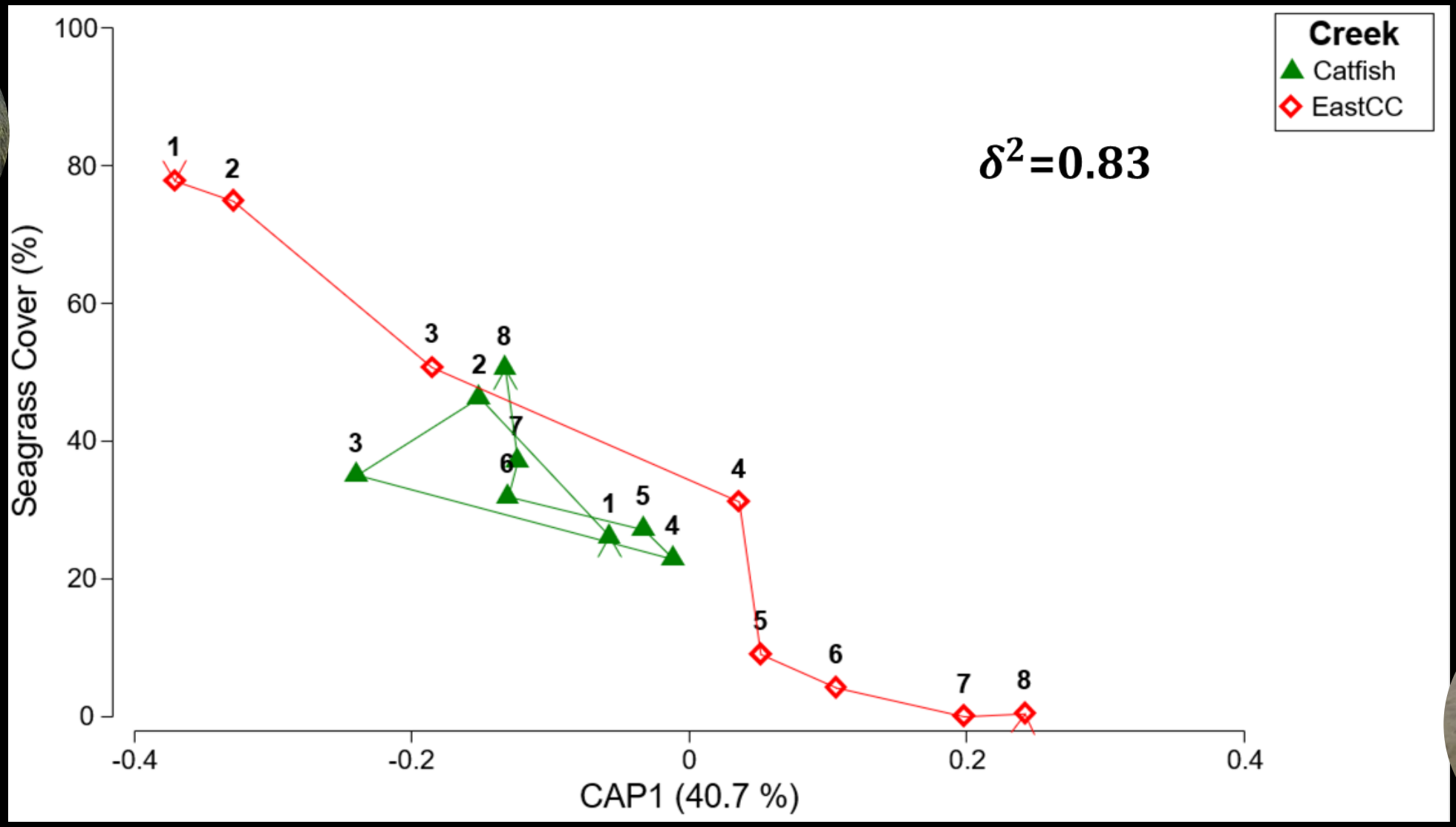
2. Is there a relationship between fish community structure and seagrass coverage in the creeks?



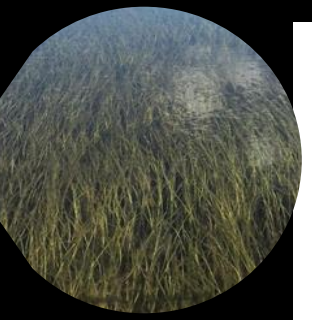


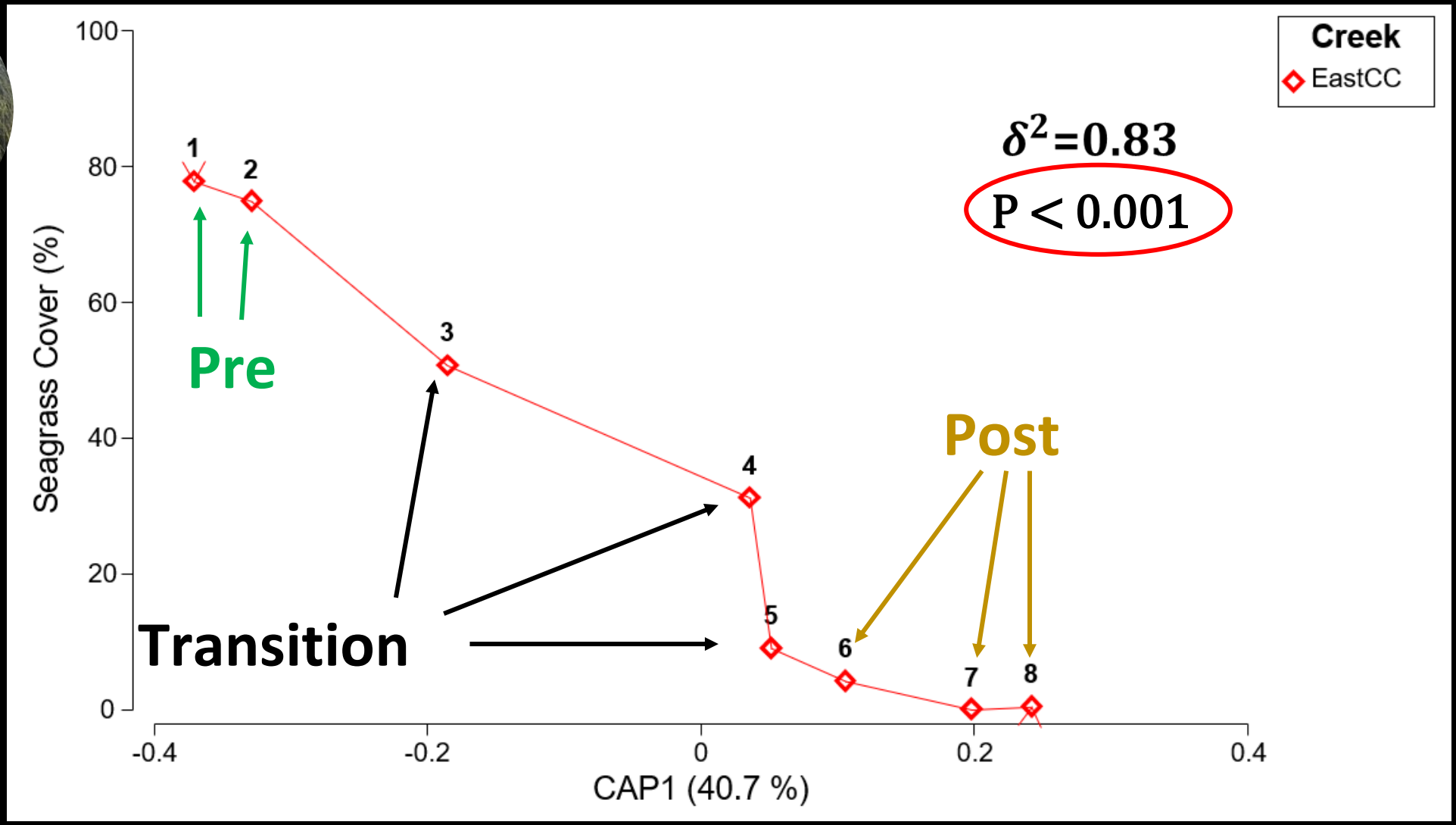
Temporal trends?





Temporal shift in East Coral Creek communities

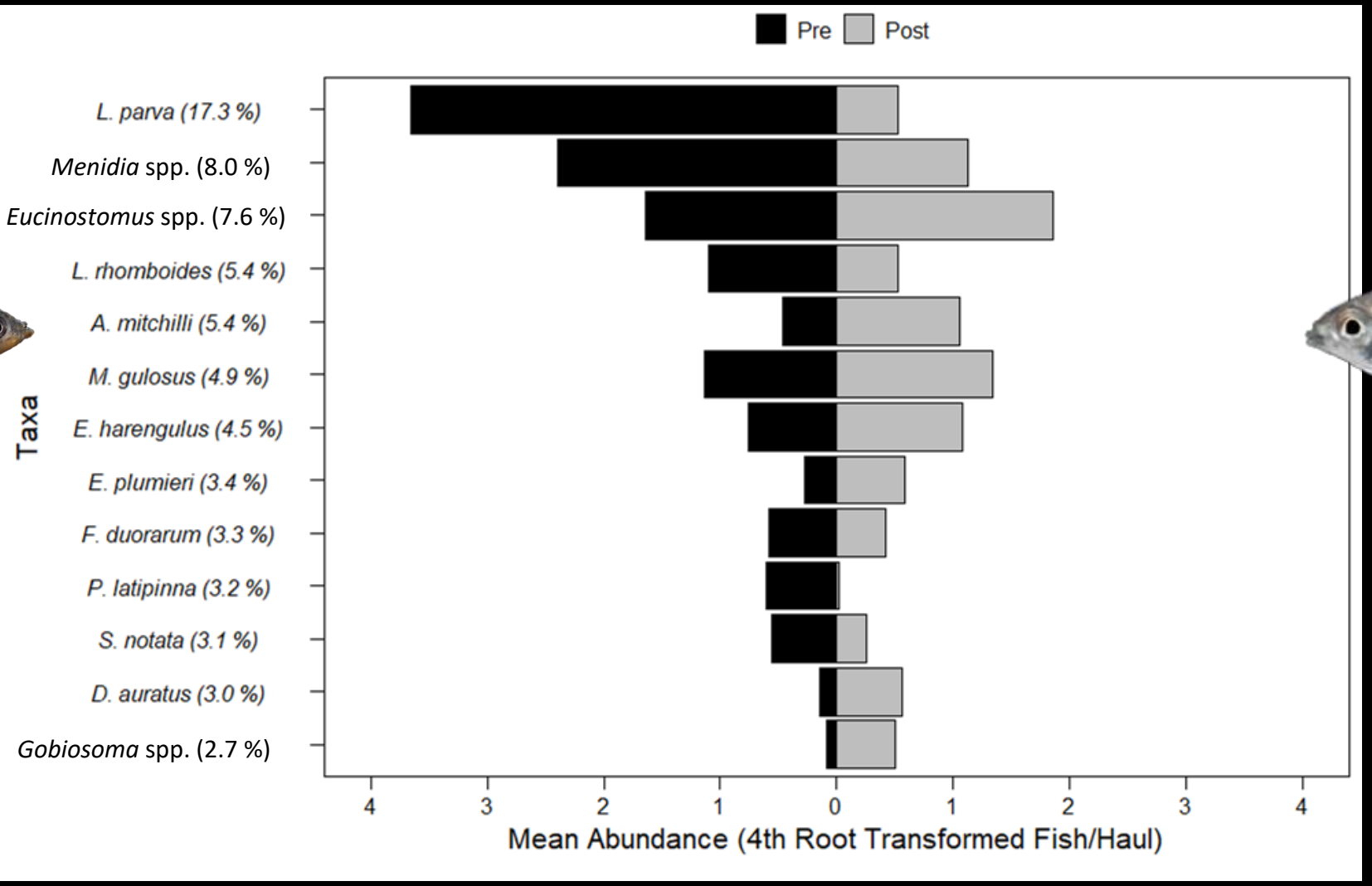




Pre

East Coral Creek Seagrass loss

Post

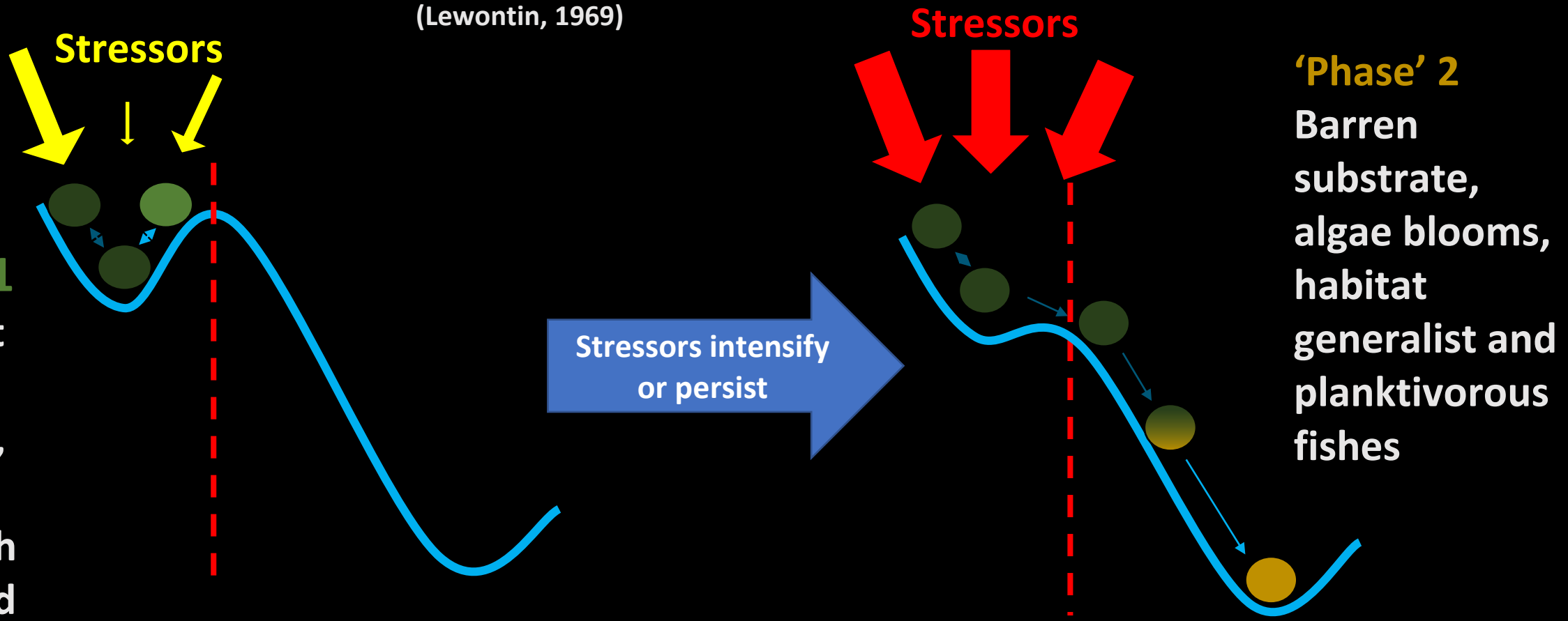


Marsh/seagrass associated, benthivores

Habitat generalists, planktivores

Phase Shift(?) A change in dominant populations of an ecological community in response to an environmental gradient (Dudgeon et al. 2010).

"Rolling ball model"
(Lewontin, 1969)



'Phase' 1
Abundant seagrass, clear H_2O, Seagrass and marsh associated fishes

'Phase' 2
Barren substrate, algae blooms, habitat generalist and planktivorous fishes

Possible Implications of a fish community shift

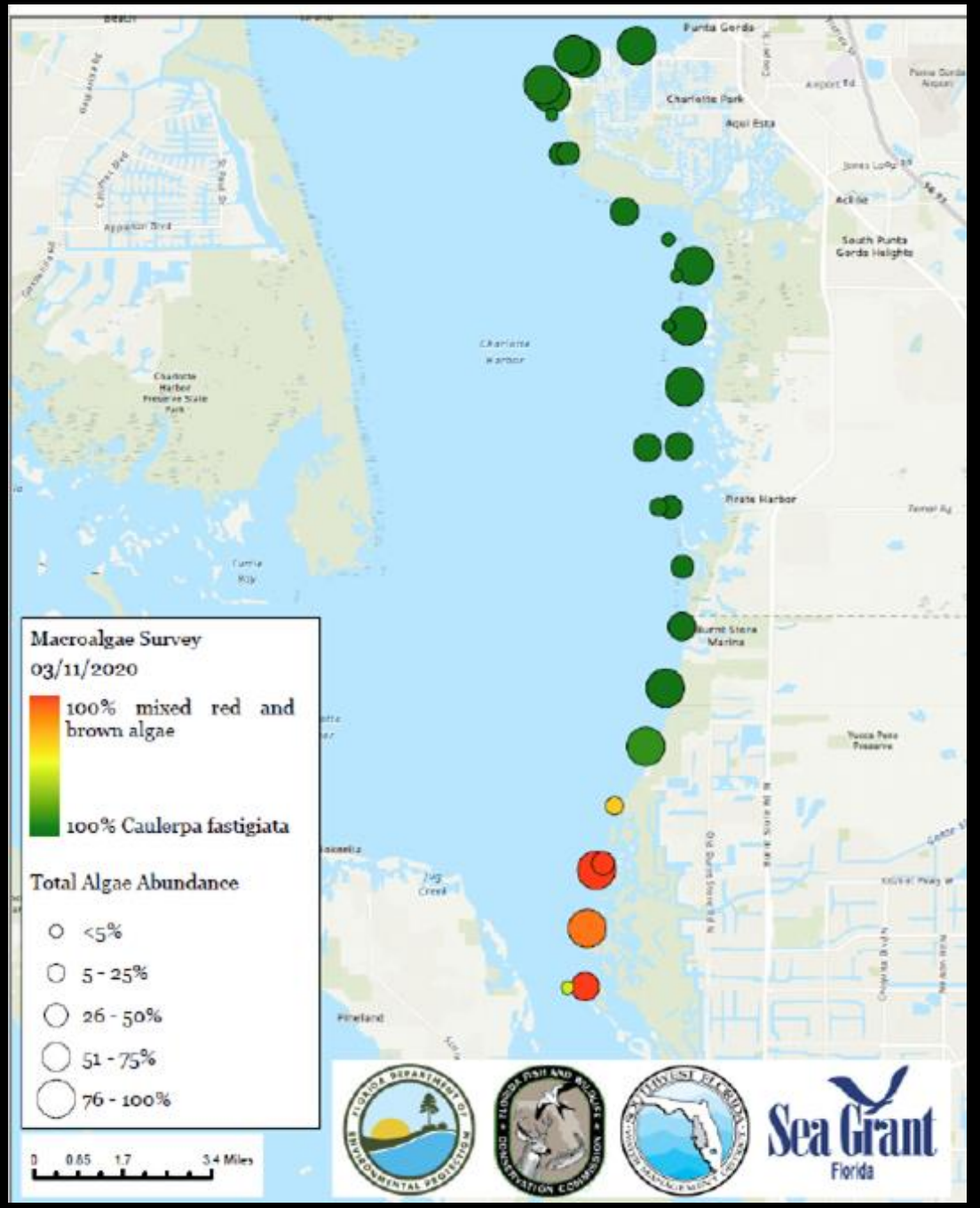
- Restructuring of food web
  (Adams et al. 2009, Frelat et al. 2022)
- Altered resilience and response to other disturbance
  (Worm et al. 2006)
- Changes in productivity
  (Valentine-Rose and Layman, 2009)

Requires future research

Photo Credit: FWC

Anastasiou, C. (2022). The Hangover Effect: Seagrass Loss and Macroalgal Growth in Charlotte Harbor Following the 2017-2018 Red Tide Event

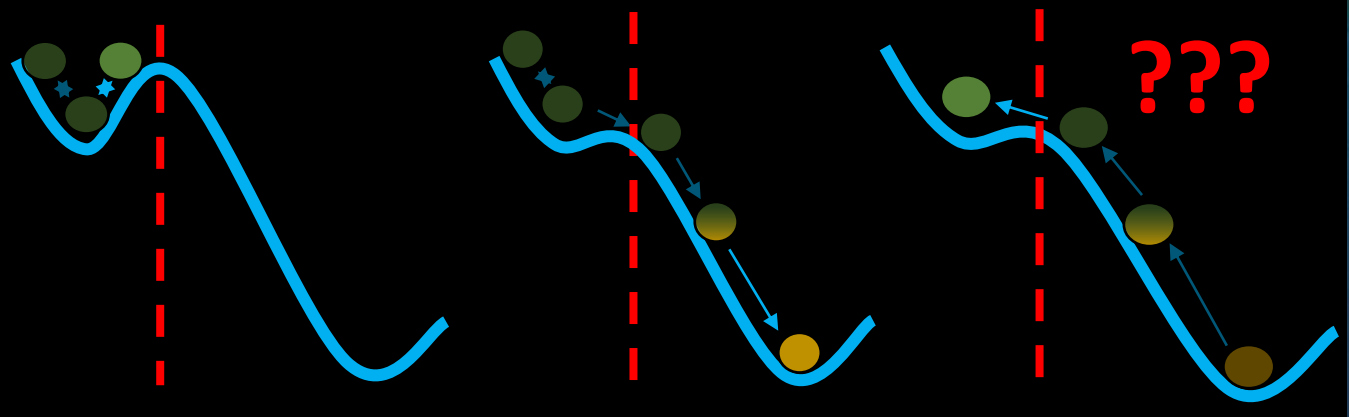
‘Harbinger’ for estuary wide change?



Future directions: What now?

Scale is important!

- Coral Creek
  - *Restoration* focus + conservation, preservation, mitigation
  - Identify drivers of seagrass loss
  - Continued monitoring & research
  - Stakeholder cooperation



Future directions: What now?

Scale is important!

- Estuary wide
  - Conservation, preservation, mitigation focus + restoration
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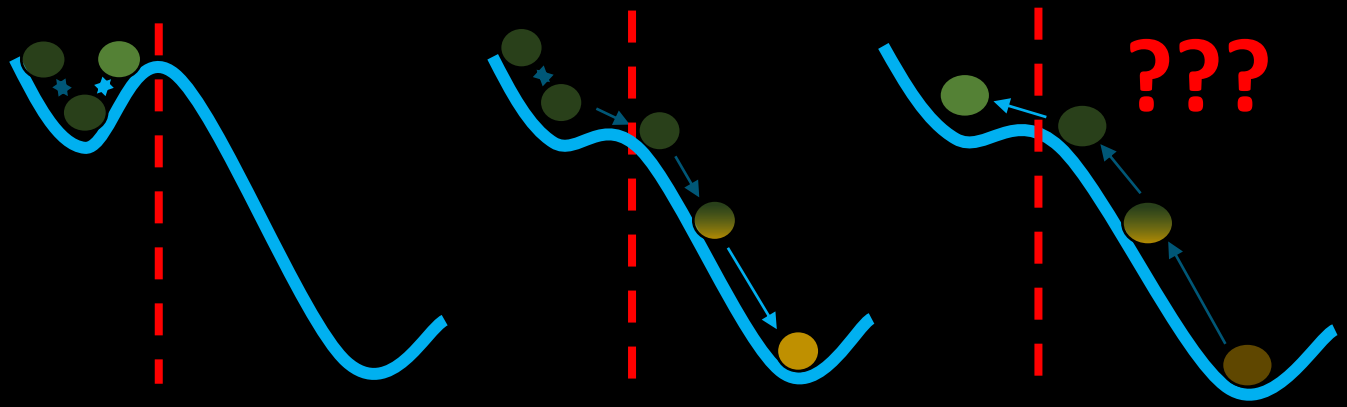
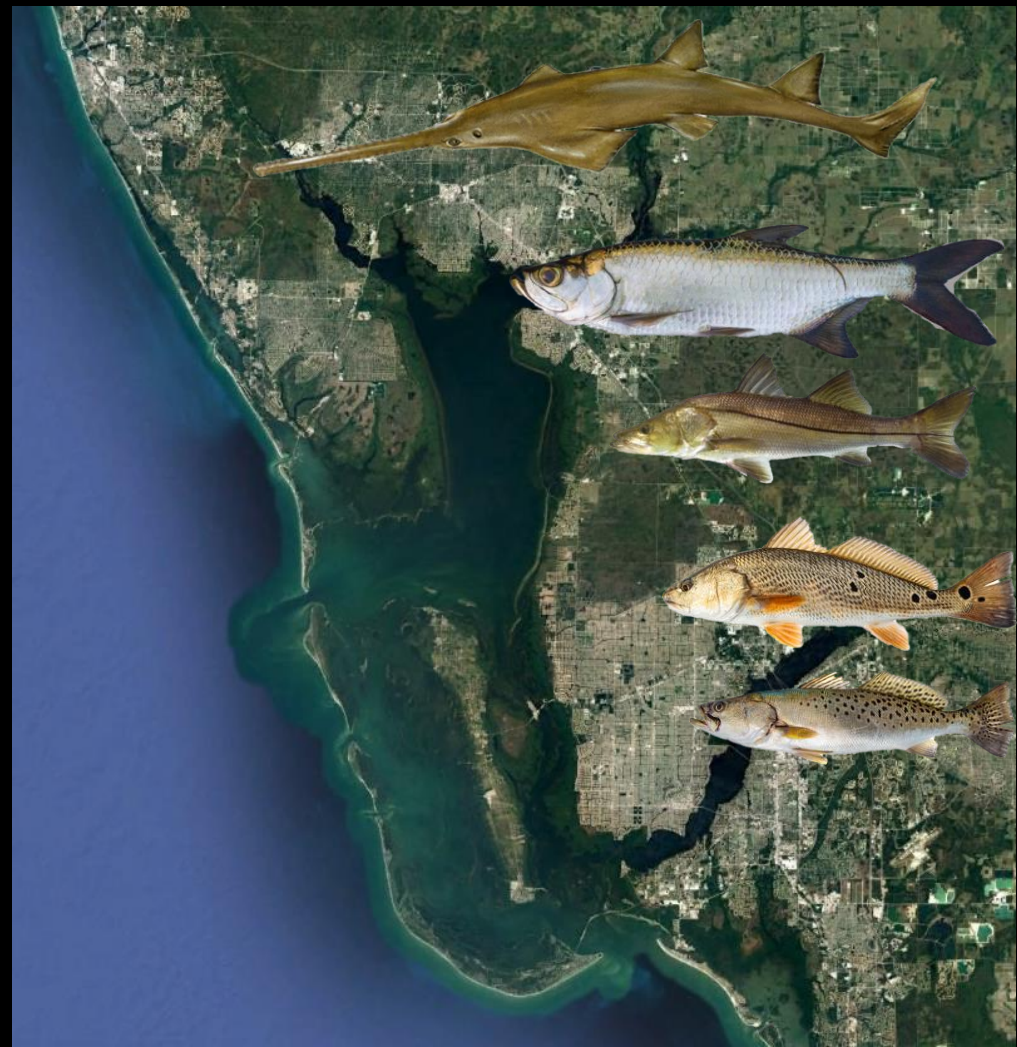


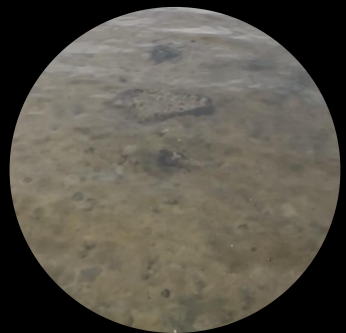







Summary

- Temporal shifts in Coral Creek fish communities are related to seagrass loss. Possible signature of a phase shift?
- Localized small scale shifts may be a warning of estuary wide change.
- Scale is an important consideration moving forward in terms of focusing conservation and restoration efforts.
- Stakeholder cooperation is critical in accomplishing future goals, regardless of scale!

Questions?

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References

- Adams, A.J., Wolfe, R.K. and Layman, C.A., 2009. Preliminary examination of how human-driven freshwater flow alteration affects trophic ecology of juvenile snook (Centropomus undecimalis) in estuarine creeks. *Estuaries and Coasts*, *32*, pp.819-828.
- Anastasiou, C., 2022. The Hangover Effect: Seagrass Loss and Macroalgal Growth in Charlotte Harbor Following the 2017-2018 Red Tide Event. Available at: https://www.youtube.com/watch?v=X6eIwmhYZLI.
- Bai, J., Gao, H., Xiao, R., Wang, J., and Huang, C., 2012. A Review of Soil Mineralization as Affected by Water and Salt in Coastal Wetlands: Issues and Methods. *Clean-Soil, Air, Water. 40*(10), pp.1099-1105.
- Beck., M.W., Heck, JR, K.L., Able, K.W., Childers, D.L., Eggleston, D.B., Gillanders, B.M., Halpern, B., Hays, C.G., Hoshino, K., Minello, T.J., Orth, R.J., Sheridan, P.F., and Weinstein, M.P., 2001. The identification, Conservation, and Management of Estuarine and Marine Nurseries for Fish and Invertebrates. *BioScience, 51*(8), pp.633-641.
- Dudgeon, S.R., Aronson, R.B., Bruno, J.F. and Precht, W.F., 2010. Phase shifts and stable states on coral reefs. *Marine Ecology Progress Series*, *413*, pp.201-216.
- Frelat, R., Kortsch, S., Kröncke, I., Neumann, H., Nordström, M.C., Olivier, P.E. and Sell, A.F., 2022. Food web structure and community composition: a comparison across space and time in the North Sea. *Ecography*, *2022*(2).
- Google., n.d. *Cape Haze Peninsula, FL.* (Accessed: 17 February 2023)
- Lewontin RC., 1969. The meaning of stability. In: Woodwell GM, Smith HH (eds) Diversity and stability in ecological systems, Vol 22. Brookhaven National Laboratory, Upton, NY, p 13–24.
- Stevens, P.W., Montague, C.L., and Sulak, K.J. 2006. Fate of Fish Production in a Seasonally Flooded Saltmarsh. *Marine Ecology Progress Series, 327, pp.*267-277.
- Valentine-Rose, L. and Layman, C.A., 2011. Response of fish assemblage structure and function following restoration of two small Bahamian tidal creeks. *Restoration Ecology*, *19*(2), pp.205-215.
- Worm, B., Barbier, E.B., Beaumont, N., Duffy, J.E., Folke, C., Halpern, B.S., Jackson, J.B., Lotze, H.K., Micheli, F., Palumbi, S.R., and Sala, E., 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science*, *314*(5800), pp.787-790.