SMALL OIL AND GAS PLATFORMS OF THE NEARSHORE COASTAL ZONE OFF LOUISIANA: HABITAT FOR FISHES AND OTHER BIOTA

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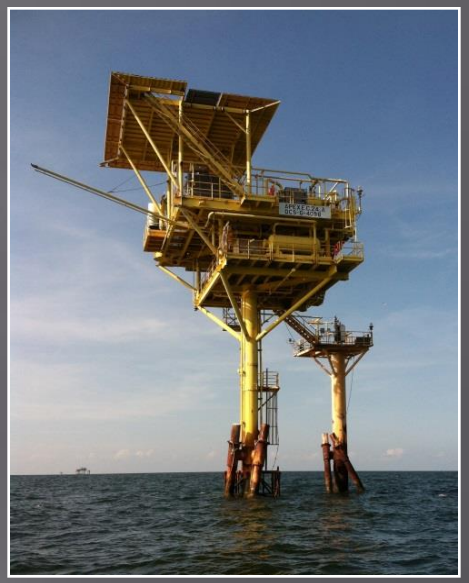
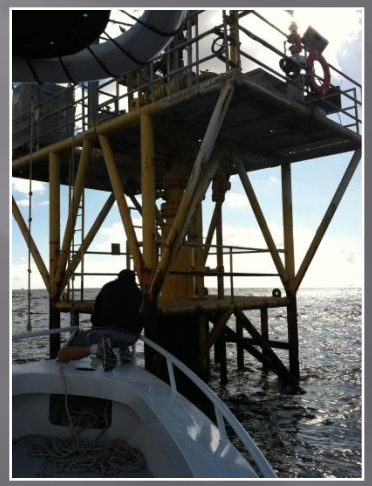
Project Objectives

- Understand the habitat value of small O&G platforms in the nearshore zone off Louisiana for juvenile snapper and other reef associated fishes.
- Rationale: Small platforms are abundant and most previous studies of platforms focused on larger ones in deeper waters.

What is a small O&G structure?



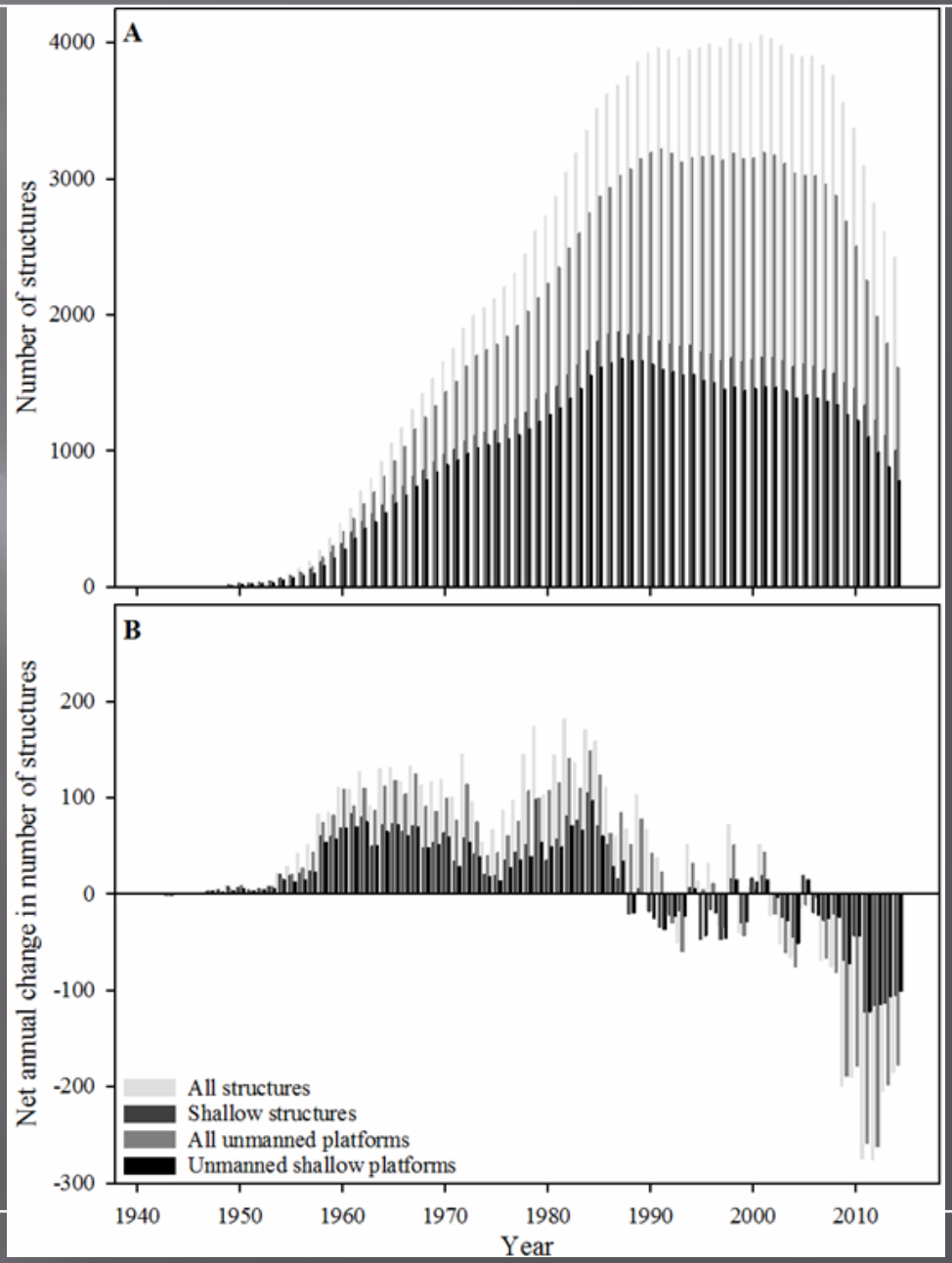
Caissons, well protectors and unmanned fixed platforms



Changing Patterns of Platform Distribution and Abundance

These statistics reflect data through 03-13-2017 11:14:22 AM (CST) and will be updated weekly.			
Water Depth in Meters	Active Leases	Approved Applications to Drill	Active Platforms
0 to 200	1,015	36,371	2,034
201 to 400	67	1,134	20
401 to 800	140	904	10
801 to 1000	129	584	9
1000 and Above	1,678	2,211	31

2104 platforms as of March 13 2017. Source: BOEM

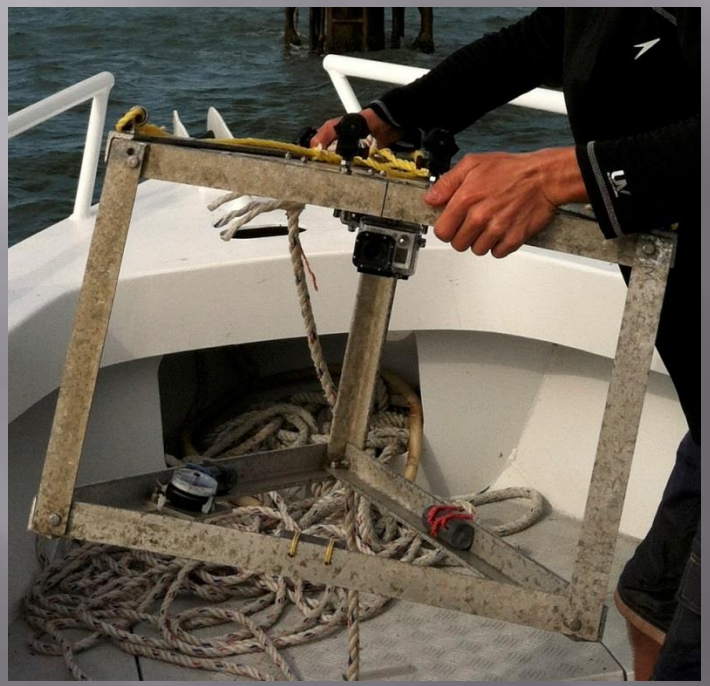


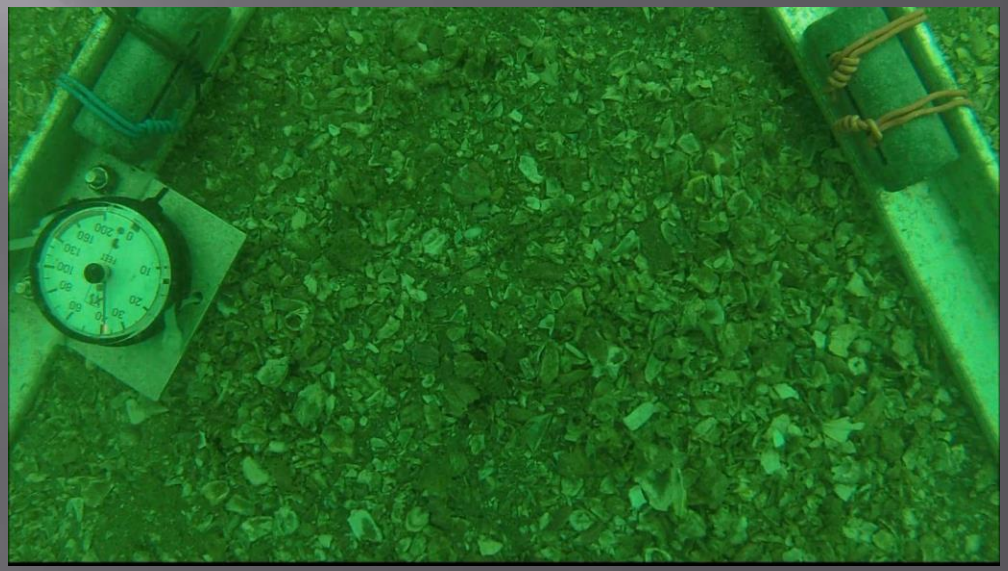
2013–2014 Survey methods

- Video camera array
- Hydrographic profiles with YSI 6820 (D.O., salinity, temp, pH, turbidity
- Divers recorded fish and other fauna that were not necessarily captured electronically

Dropcam array

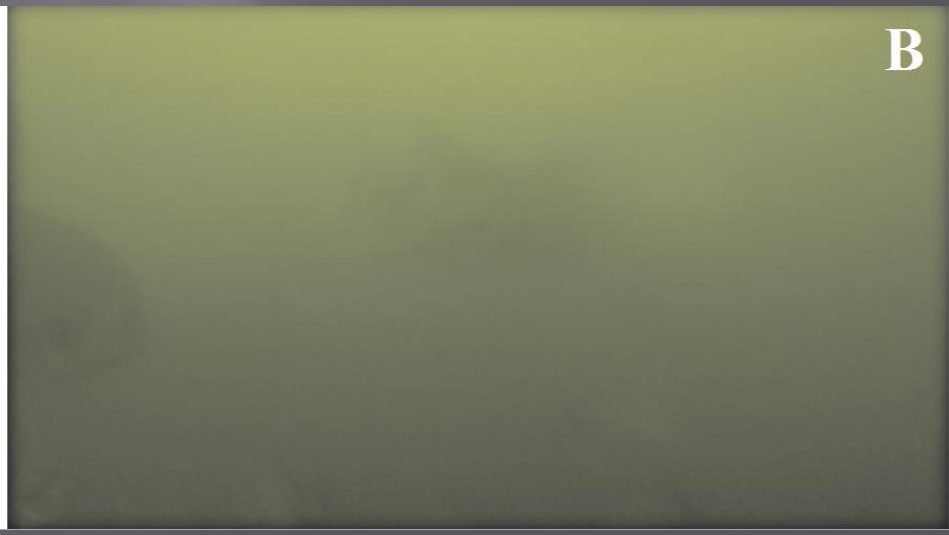
- 4 WiFi capable GoPro™ Hero 3 cams mounted to an aluminum frame with two underwater lasers and a depth gauge mounted to the frame in view of a bottom facing camera.





Visibility criteria for video samples

- How did we overcome poor visibility?
- Videos were considered to have adequate visibility if the submerged structure was clearly visible and in focus.
- Fifty-nine percent of the 2013-2014 videos met this standard.



2013–14 SMALL PLATFORMS SURVEYS

- A total of 54 species of fishes were associated with small platforms in the nearshore zone
- Eleven species made up 93% of fish fauna.
- The assemblage(s) included juveniles of 29 species
- Goliath Grouper and Lionfish were observed both by divers and on drop cam.

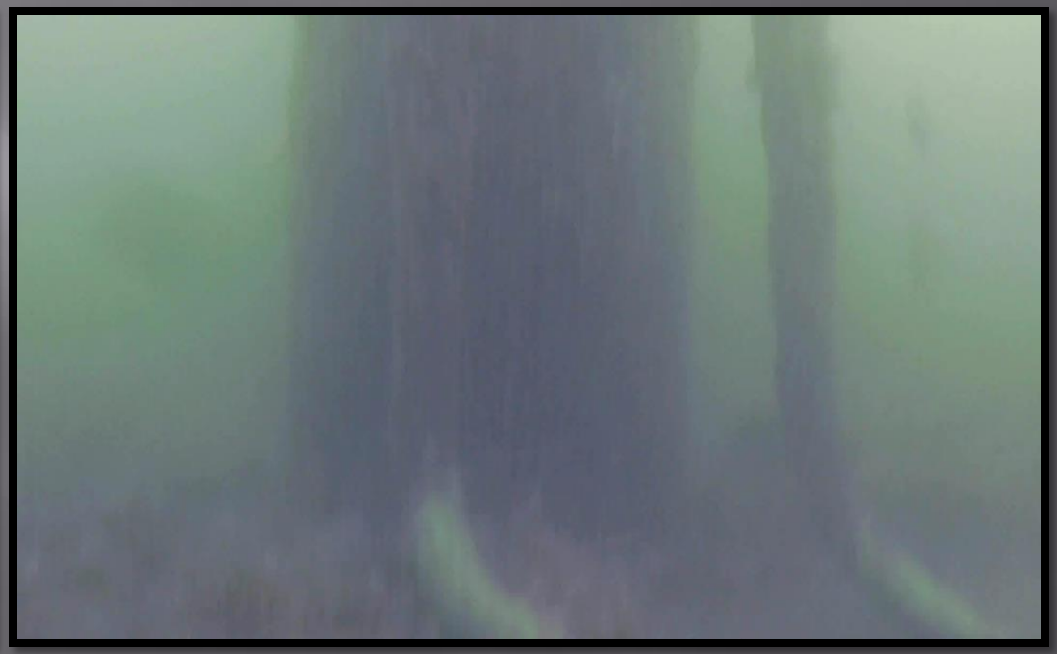
Platform-associated fishes of nearshore waters (n = 150)

- Diver observations indicated that the video array under-sampled cryptic species.
- Young-of-the-year red and lane snapper were observed at 42% of platforms selected for diving in 2013, and 57% in 2014, often in large numbers during the late summer when YOY snapper recruitment peaks.
- Young-of-the-year gag grouper were observed at 26% of platforms selected for diving in 2013 and 7% in 2014.

Snapper Juveniles mostly occurred around small platforms located on sandy sediments off Louisiana

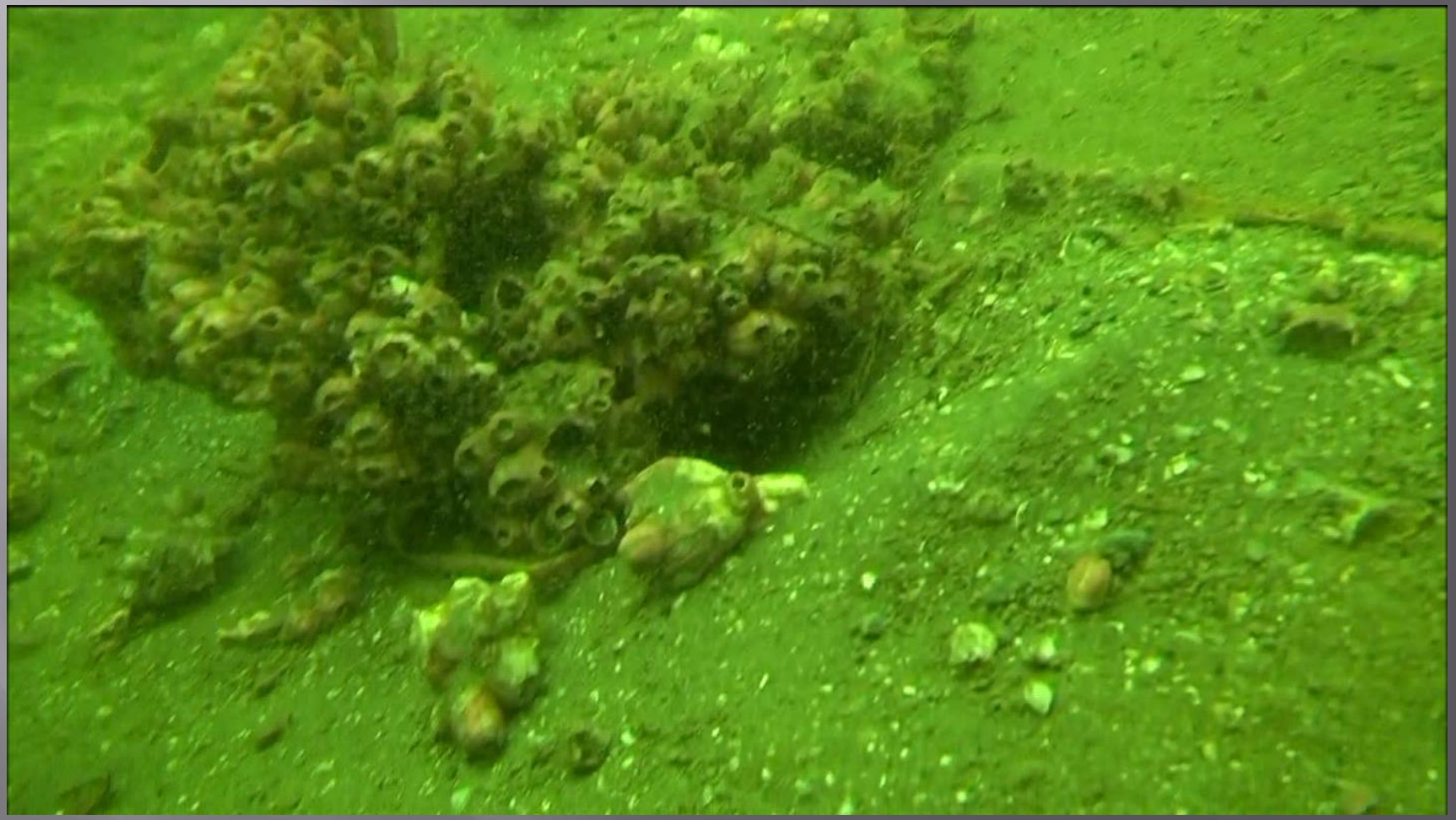
- SS platform in 2001

- SS platform in 2016



Platforms shed shell rubble and rubble attracts YOY snapper

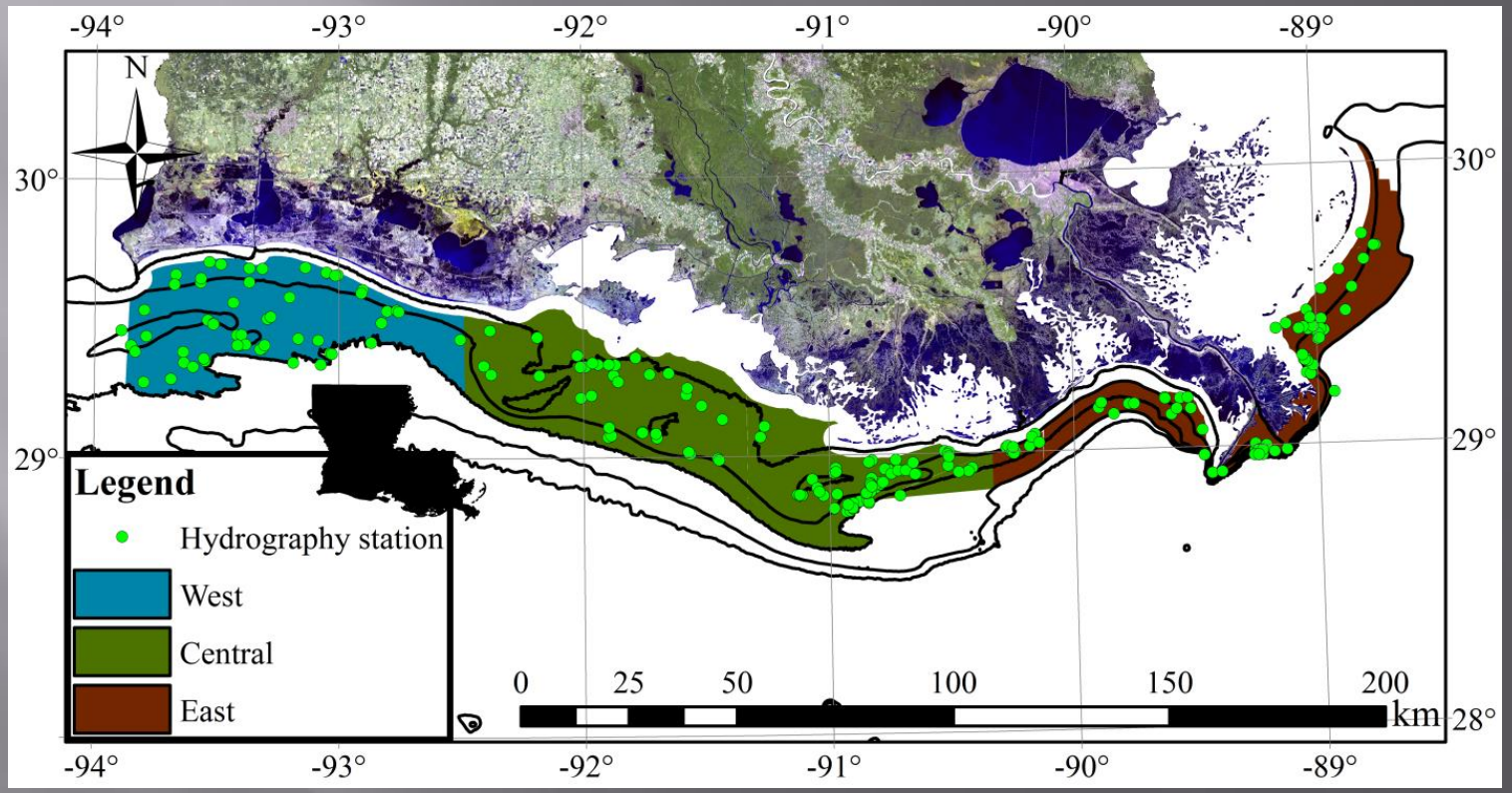
YOY snapper hide in Stone crab burrows



Our observation suggest that rubble only builds up on sandy substrates.

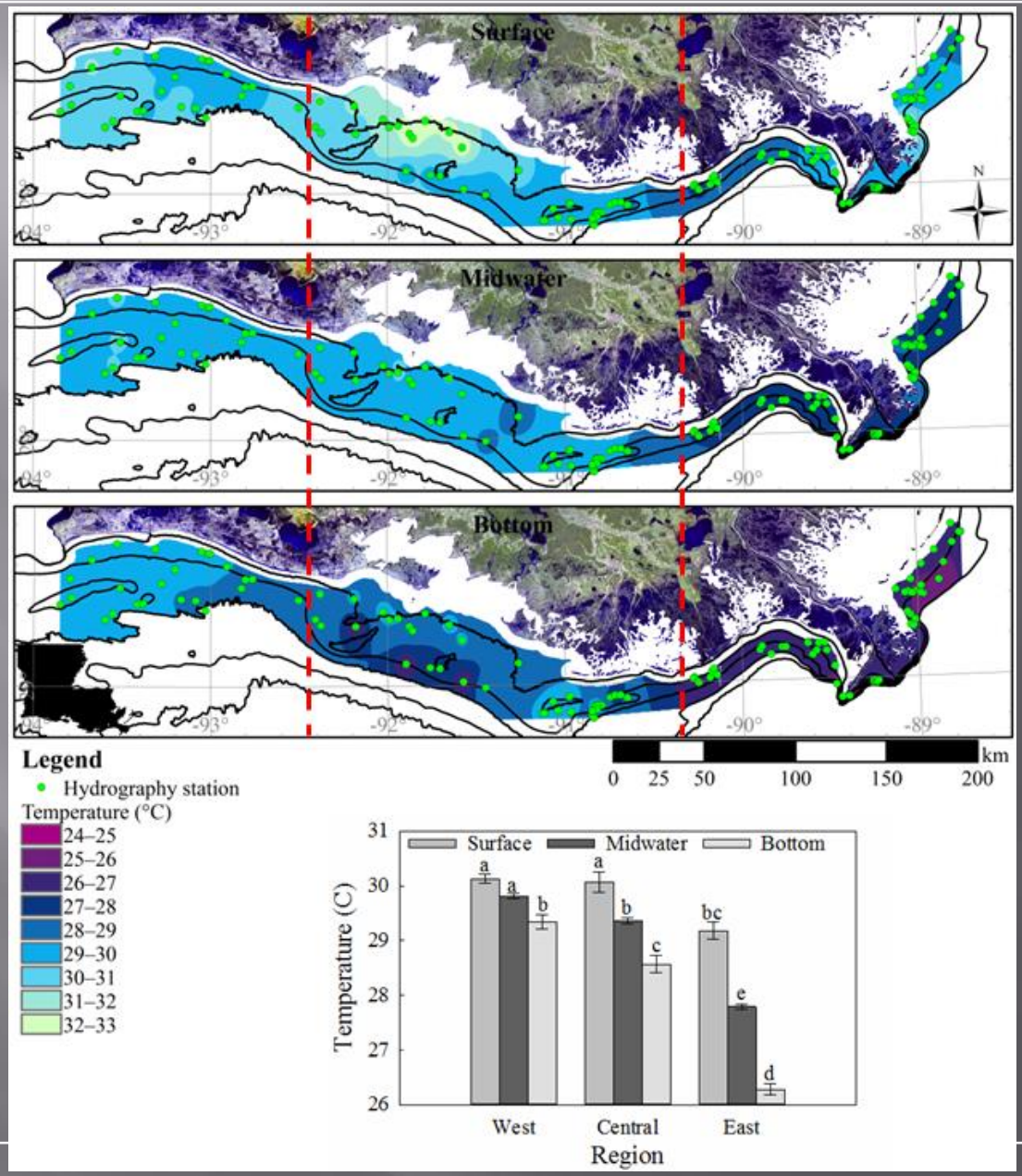
Nearshore hydrography in 3–18 m water depth (n = 343)

Continuous hydrographic profiles were reduced to surface, midwater and bottom hydrographic variables for simplicity.

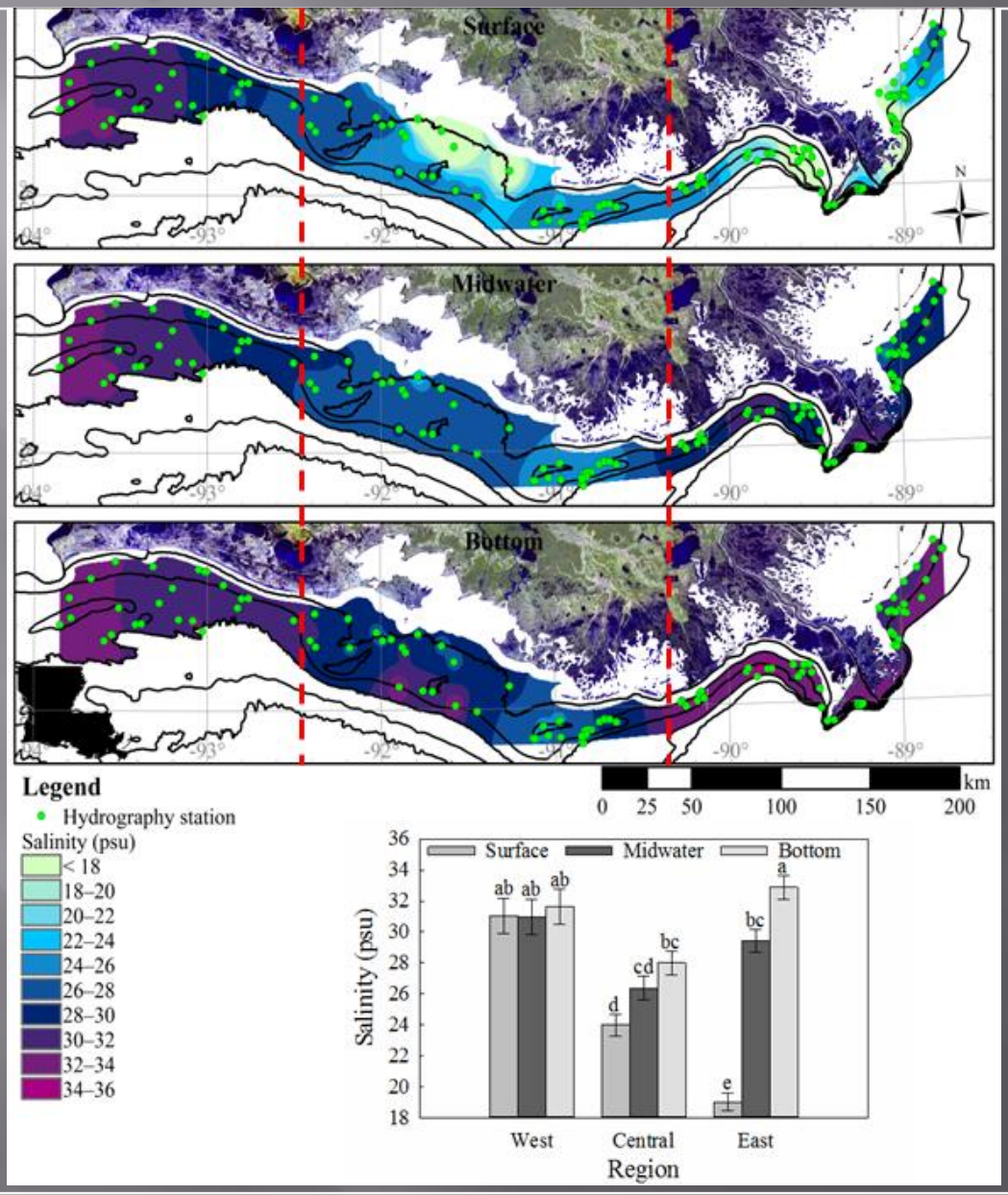


Based on 343 hydrographic samples we then subdivided the coast into three hydrographically distinct regions

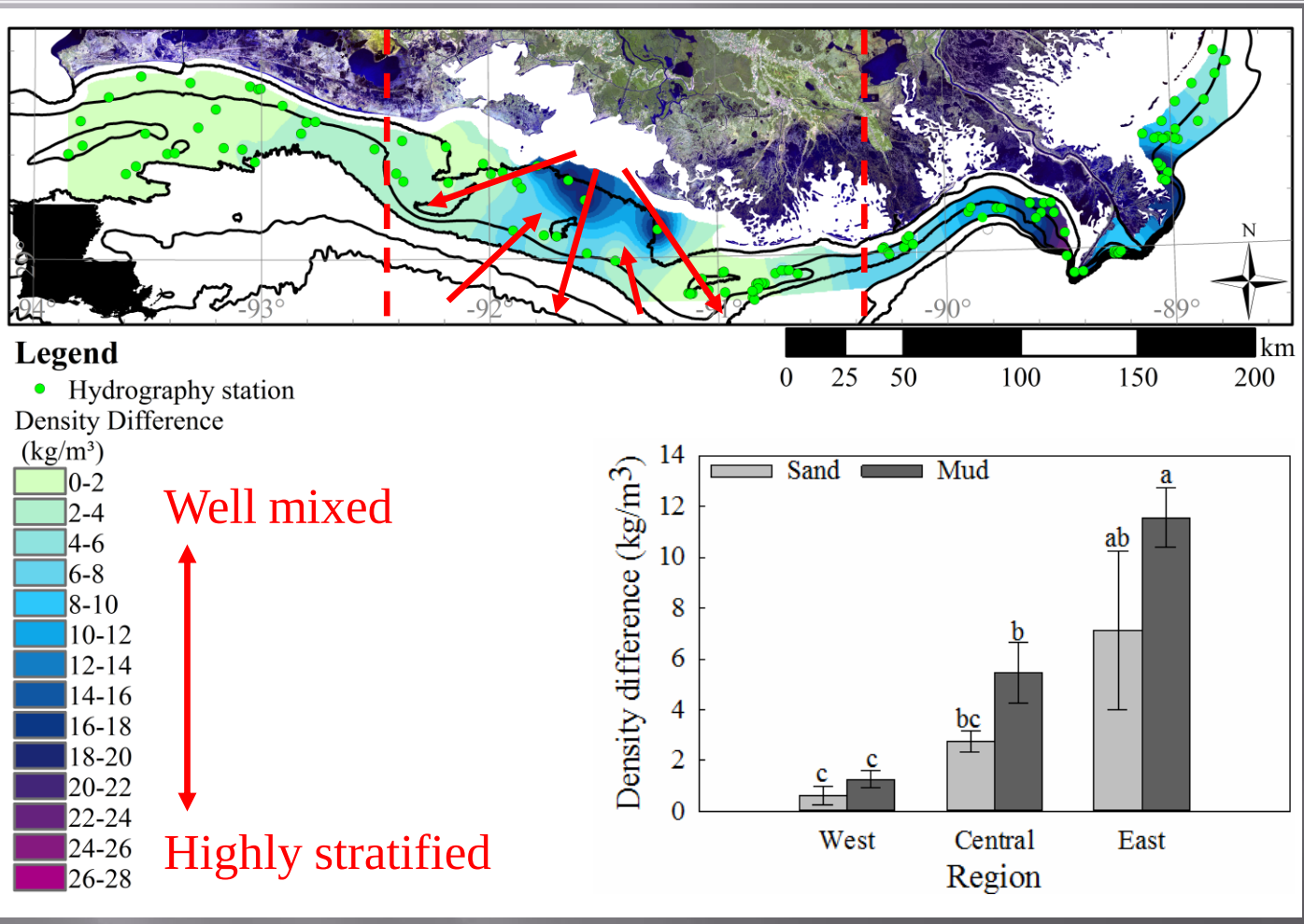
Temperatures cooler in the East (n = 343 per strata)



Surface Salinity Lower in the East (n = 343 per strata)



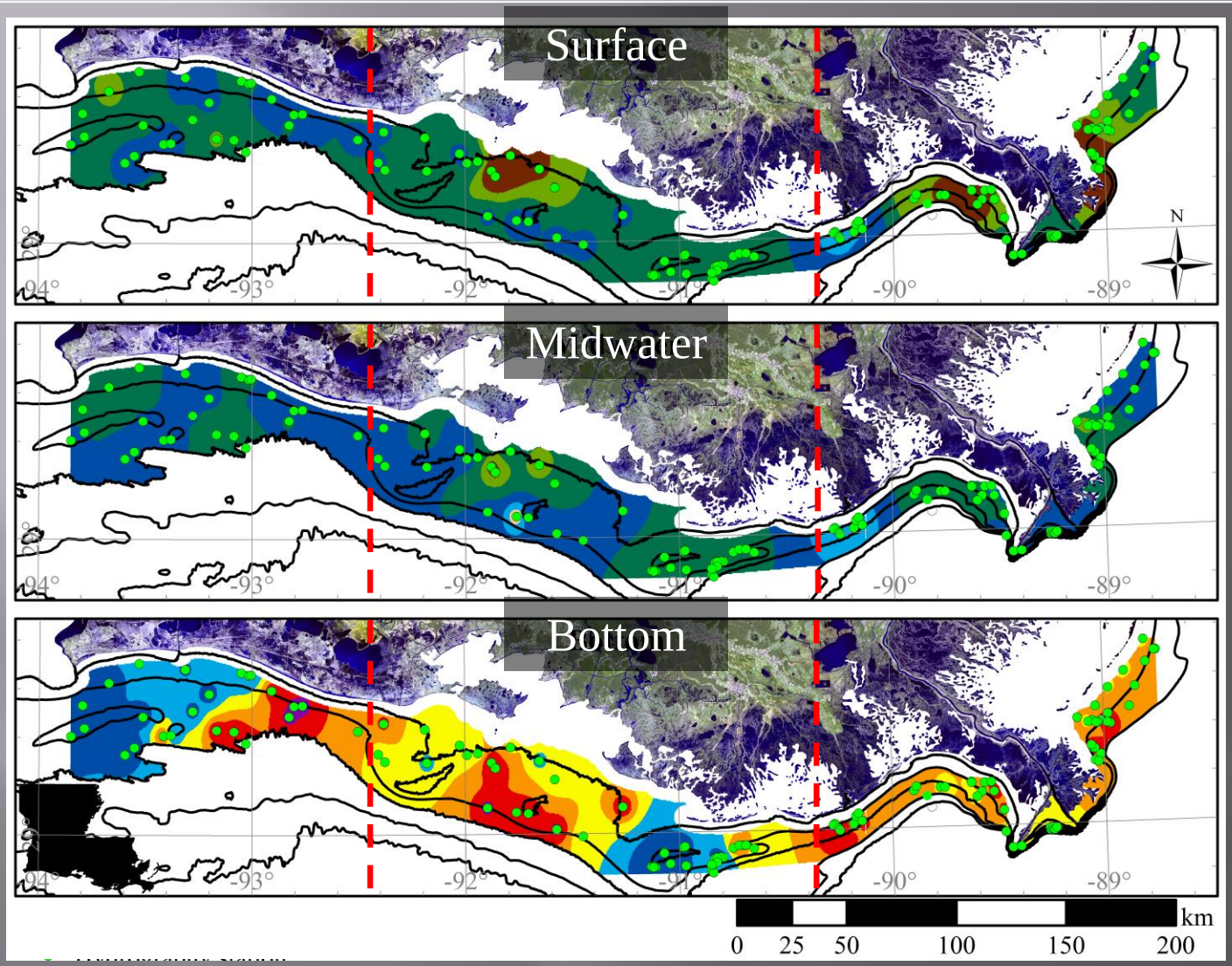
Stratification highest in the East and Central Regions



An interpolated subset of 125 water-quality profiles collected over a 21 day period

Region and dominant sediment type were both significant effects on density differences throughout the nearshore zone ($P < 0.0001$ and $P = 0.0268$).

Dissolved oxygen variation (n = 125)



The second largest hypoxic area on Earth occurs on the Louisiana-Texas Shelf.

A typical level for hypoxia is 2.0 mg l^{-1}.

This study used < 50% DO saturation

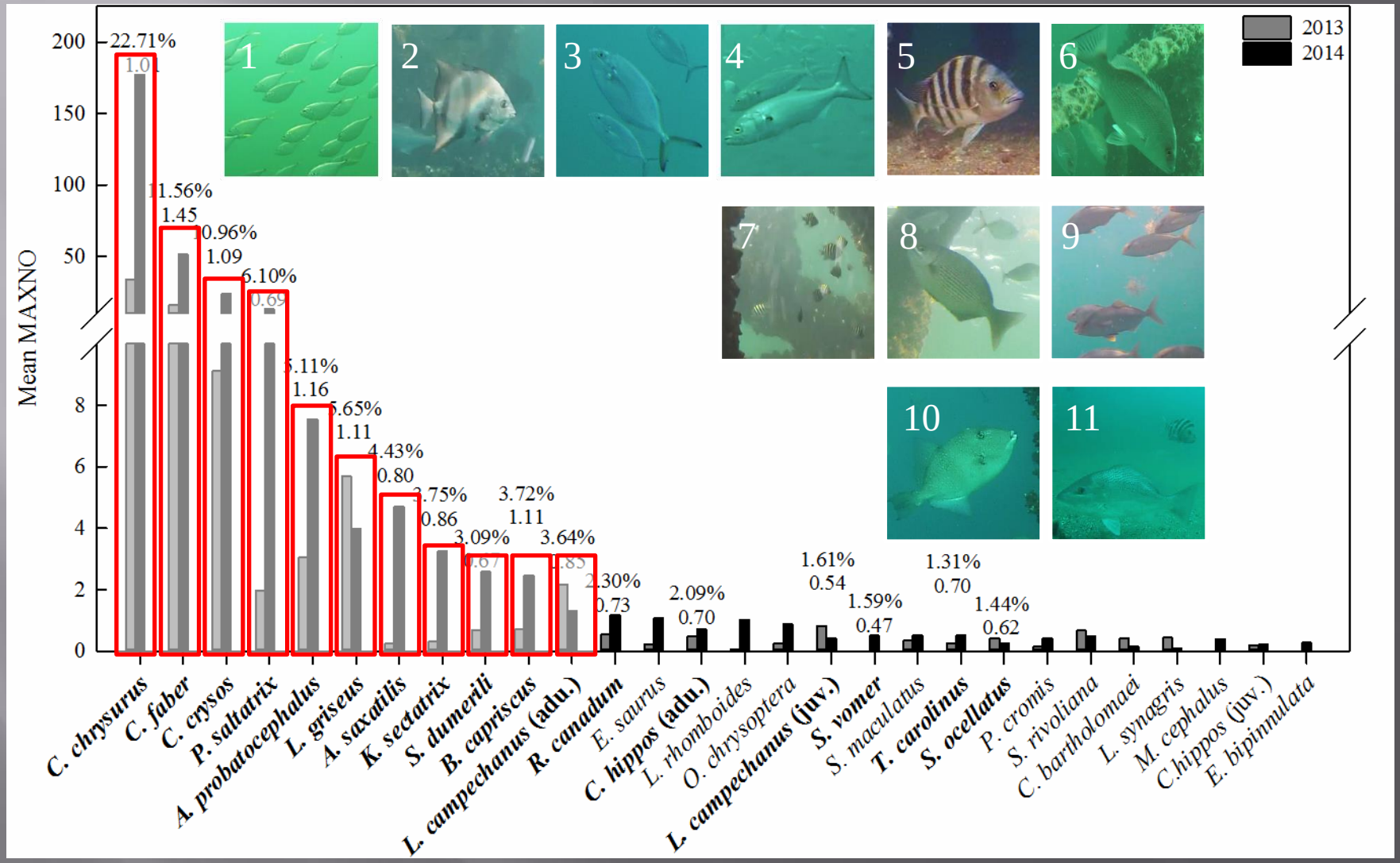
Legend

- Hydrography station

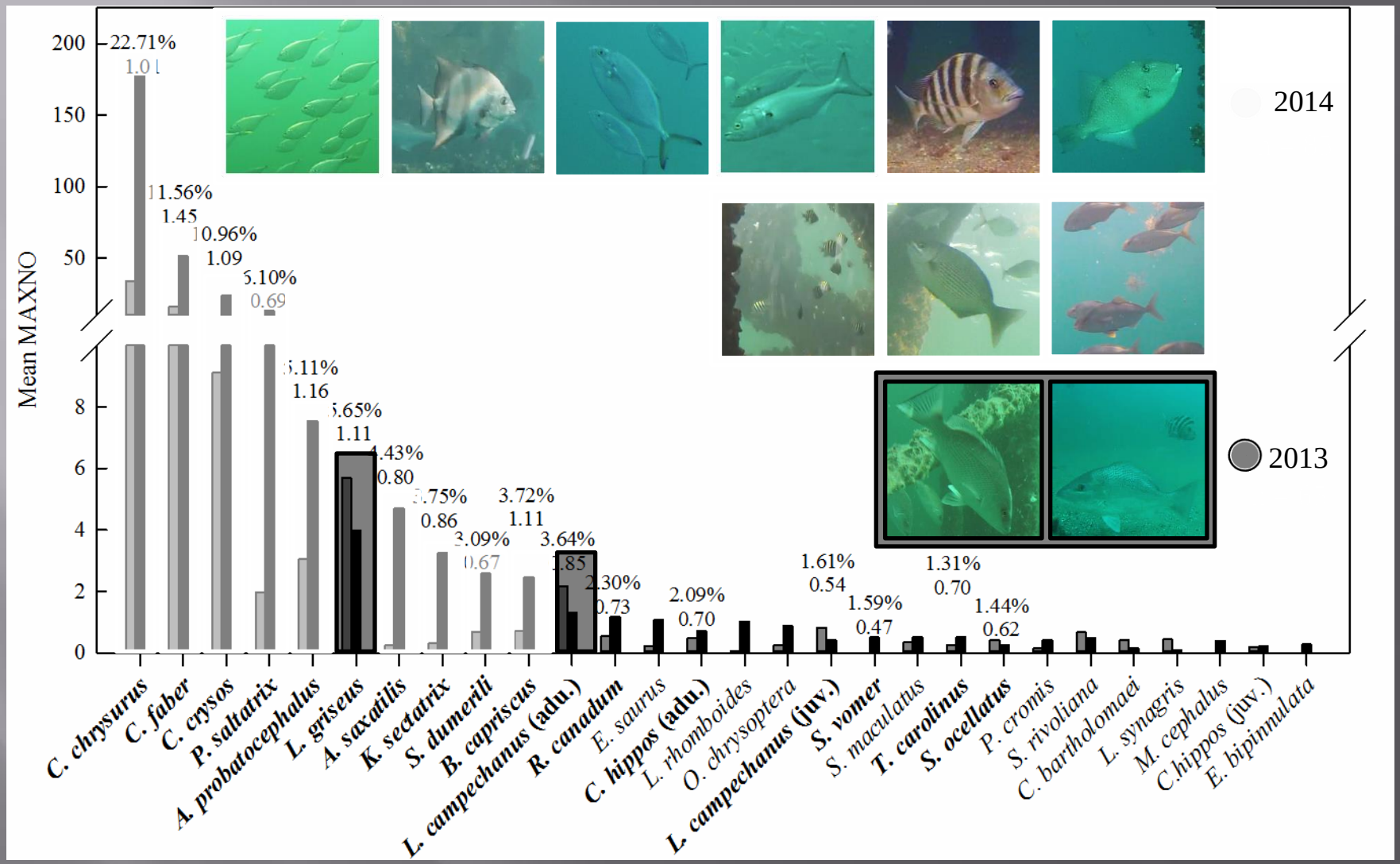
DO (% saturation)

- < 10
- 10-30
- 30-50
- 50-70
- 70-90
- 90-110
- 110-130
- 130-150
- > 150

Eleven fish species dominated assemblages

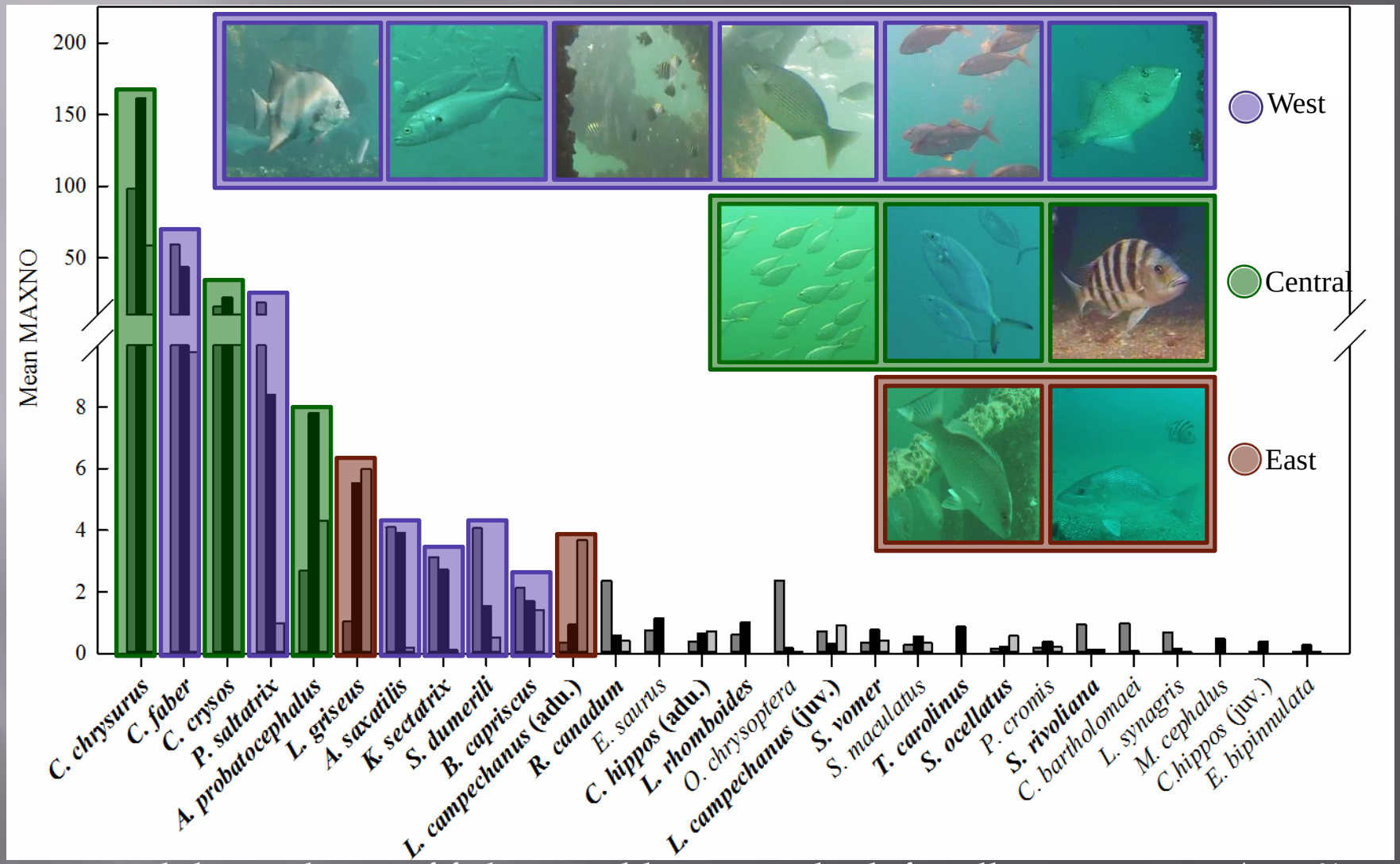


Fish assemblages differed between years



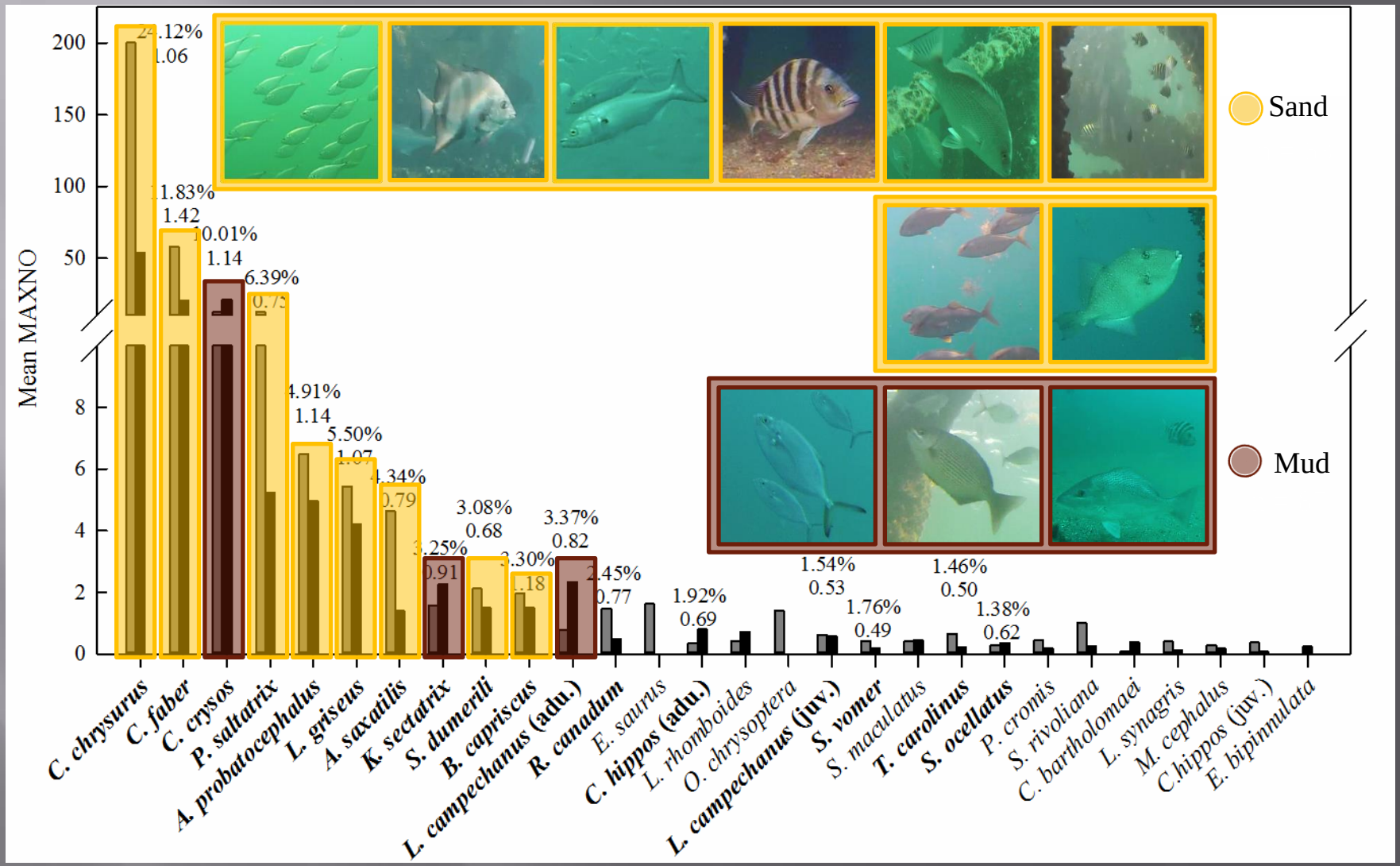
SIMPER: Annual and intraregional comparisons of dissimilarity were high at 64.1% between 2013 and 2014

Fish assemblages differed among regions



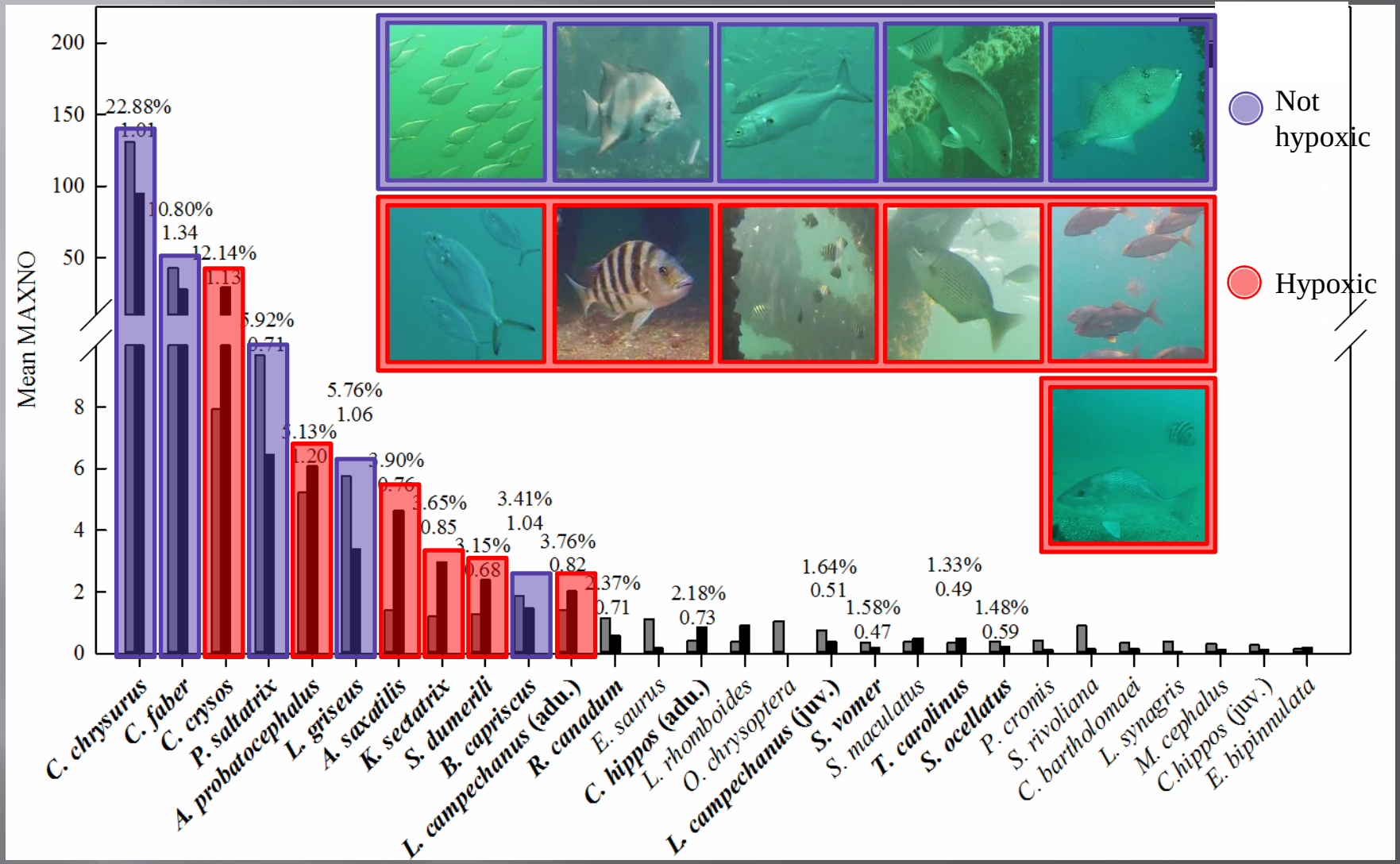
Regional dissimilarity of fish assemblages was high for all comparisons (60.3%, 64.2%, and 68.4%)

Fish assemblages differed over sediment types



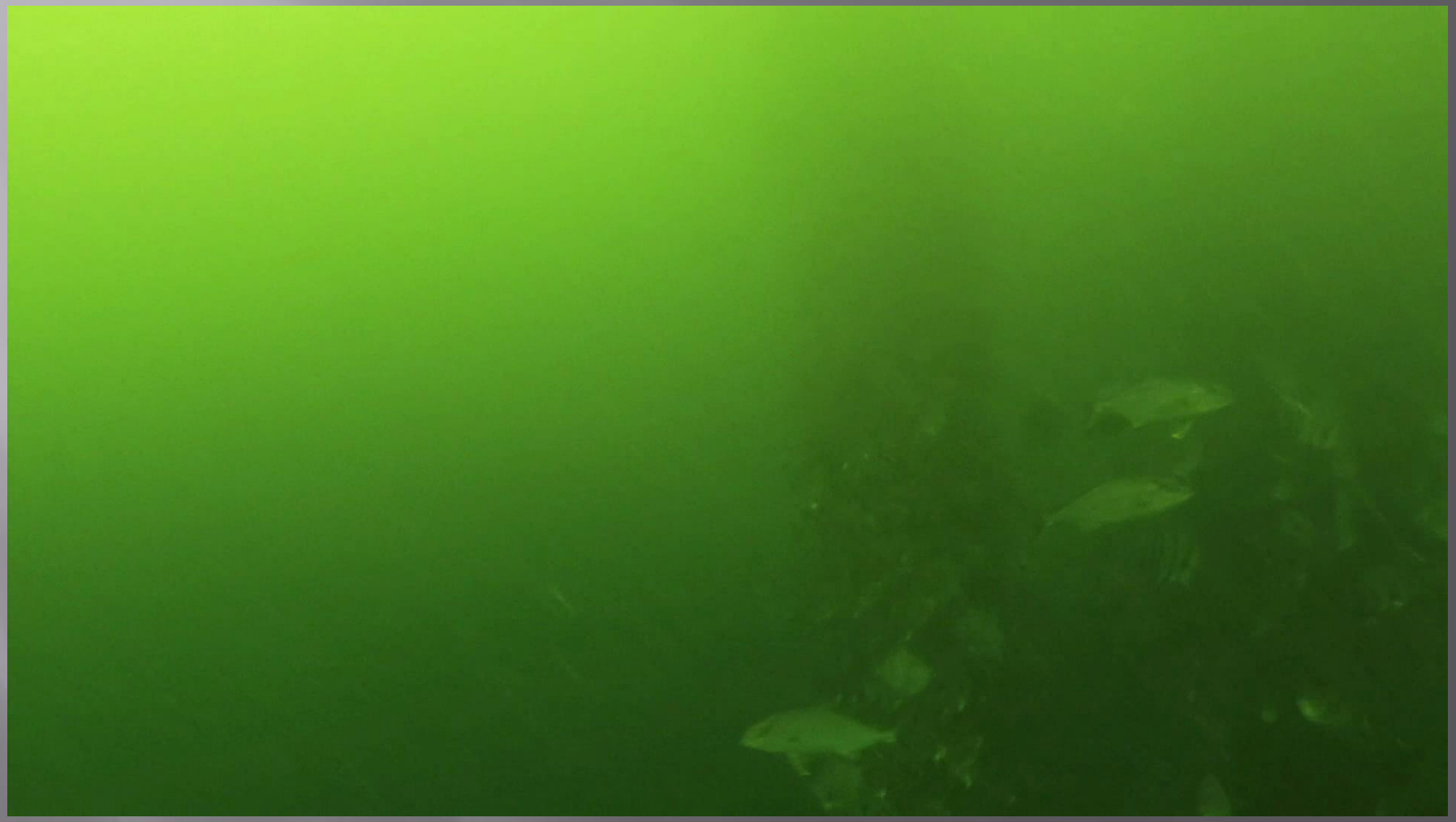
SIMPER: Fish assemblages over sand and mud were 62.7% dissimilar.

Fish assemblages differed in the presence of hypoxia

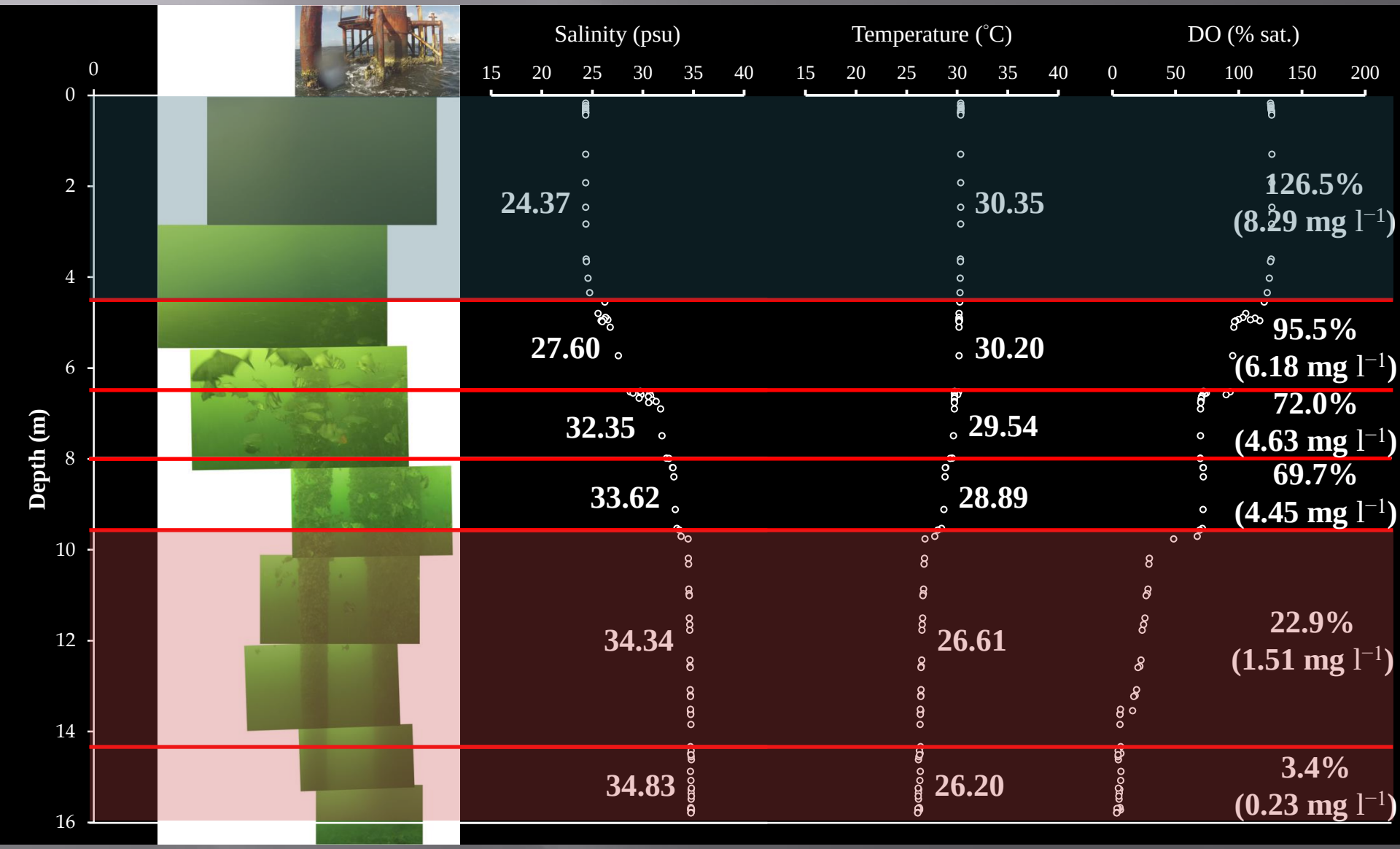


Fish assemblages over hypoxic and non-hypoxic waters were 61.8% dissimilar

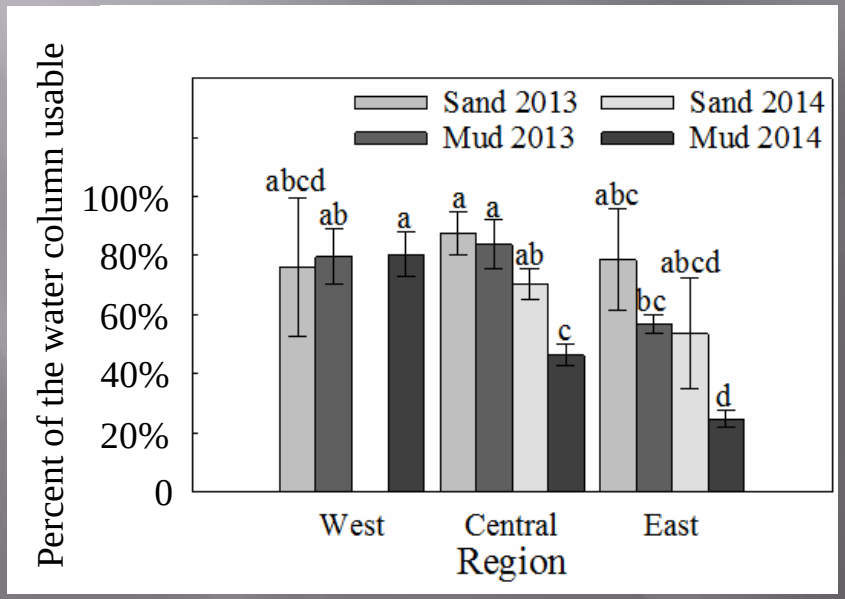
An example of habitat compression (ST 21-GC)



Habitat compression under DO stress (ST 21-GC)

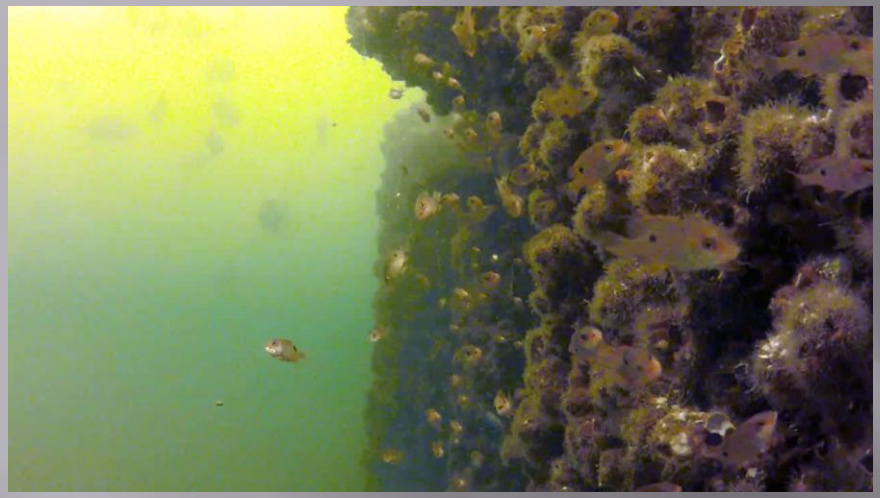


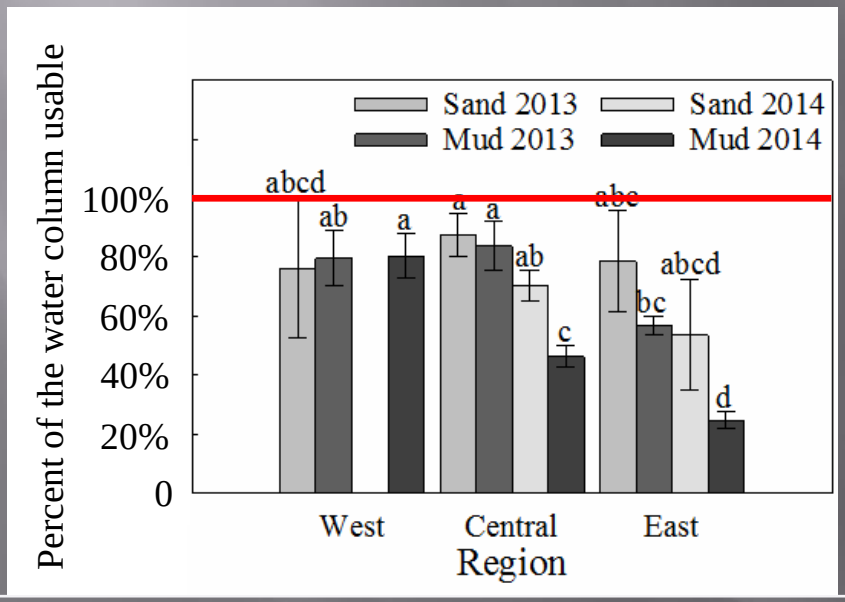
Extent of compression for all hypoxic sites (n = 131)



- 3 way ANCOVA by region, year, and dominant substrate.
  - Significant sediment effect (P = 0.0174).
  - Significant depth effect (P < 0.0001).
  - Significant interaction for region and year (P = 0.0002).

Extent of compression for all hypoxic sites (n = 131)





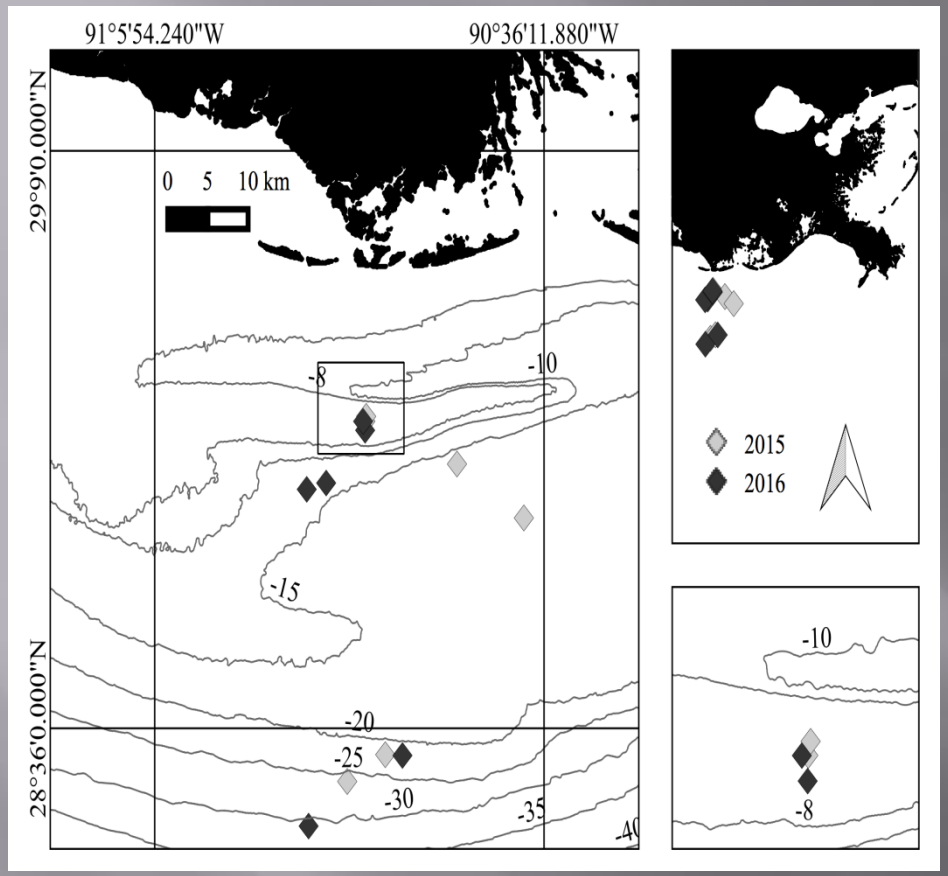
3 way ANCOVA by region, year, and dominant substrate.

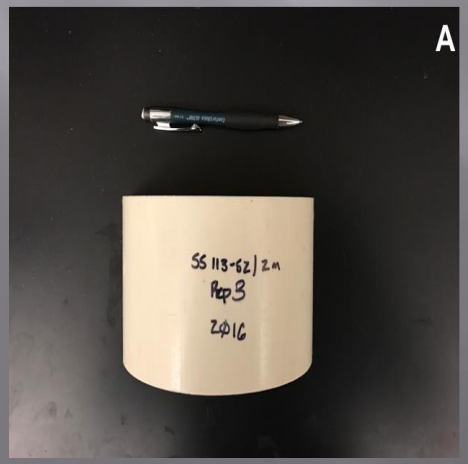
- Significant sediment effect (P = 0.0174).
- Significant depth effect (P < 0.0001).
- Significant interaction for region and year (P = 0.0002).

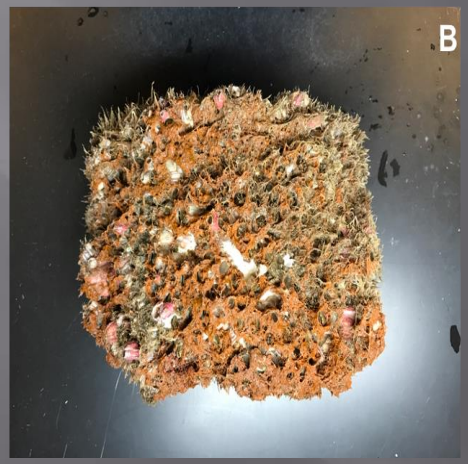
Habitat compression from hypoxia and surface blooms often restricted substantial portions of the water column.

IN 2015–16 WE SHIFTED OUR FOCUS TO SHIP SHOALS BLOCKS AND FUNCTIONAL ASPECTS OF SMALL PLATFORMS AS HABITAT

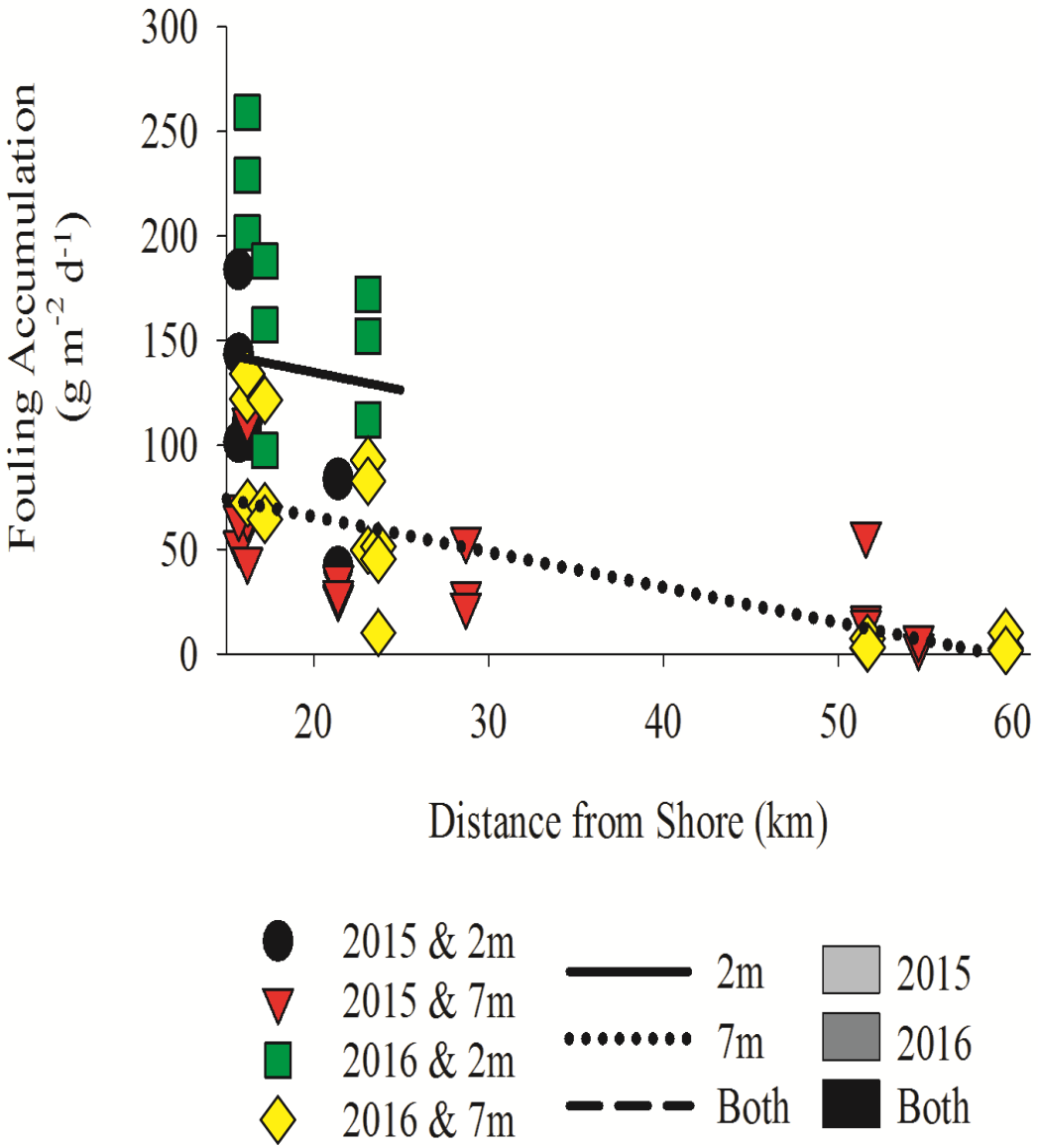
- Settlement plate studies
- Observations of grazing on platforms by fishes
- Stable isotope studies



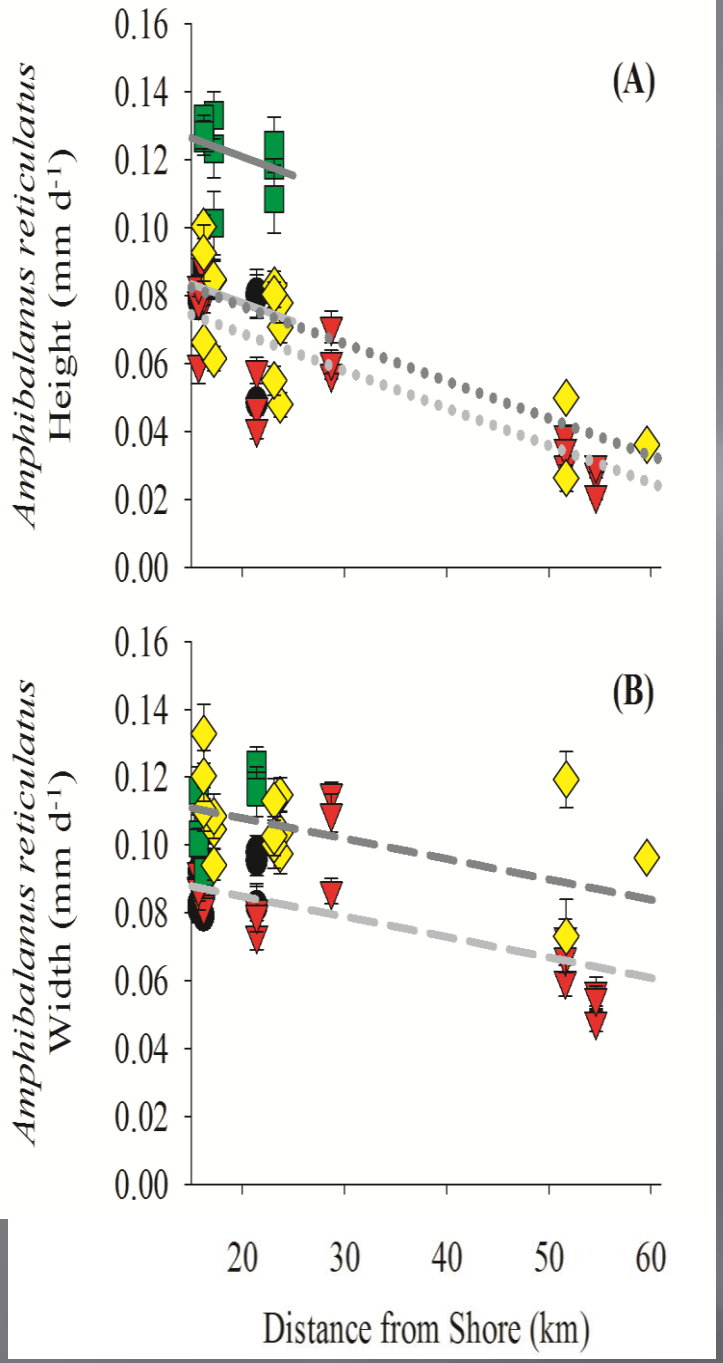




- Placed 72 settlement plates at 12 platforms along a 45 km landward seaward transect
  - 6 platforms in 2015 and 6 in 2016
- Two sets of the settlement plates were placed at 2 and 7 meters
- Deployment times were ~3 months

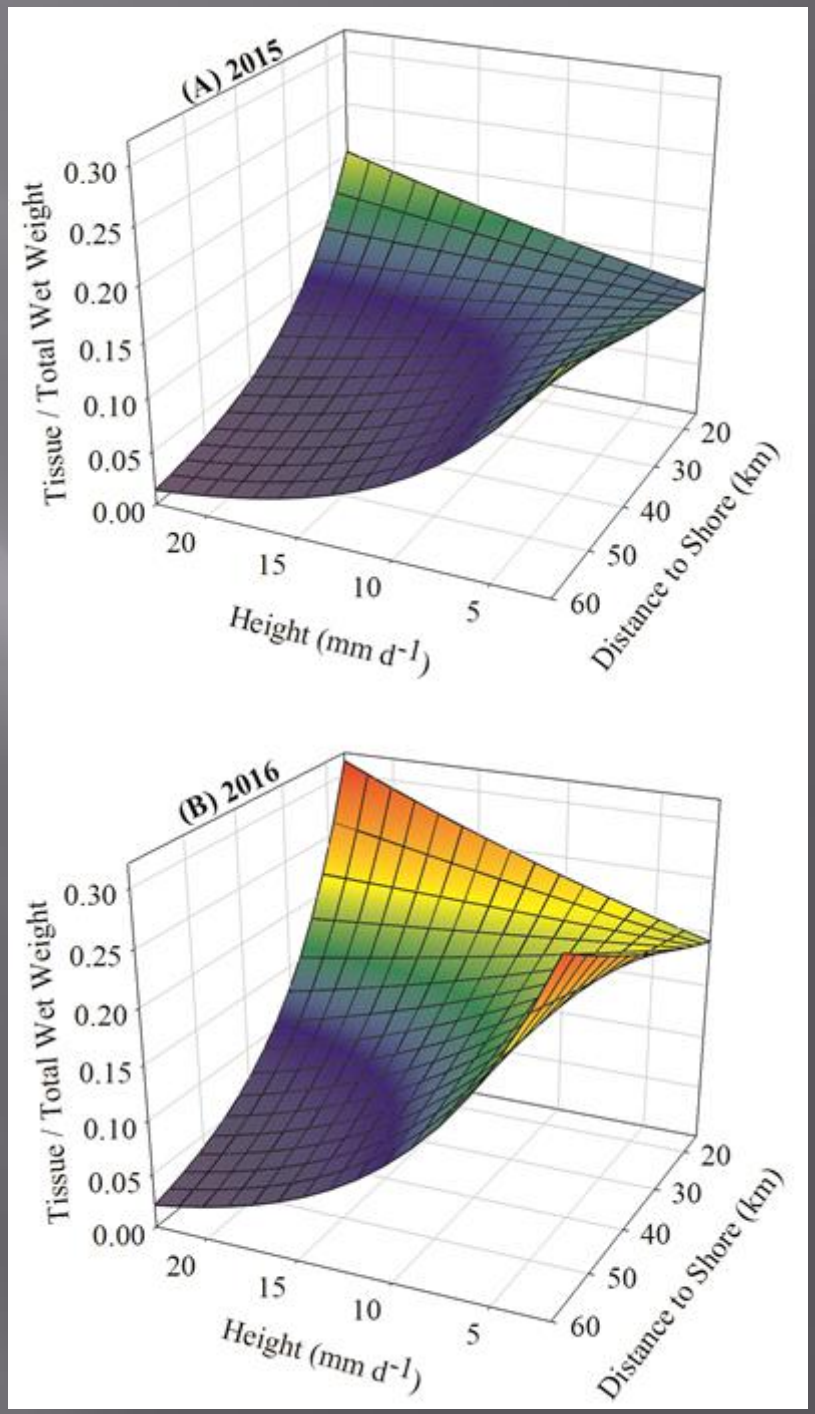


- Fouling accumulation decreased with distance from shore at a rate of 1.7 g m^{-2} d^{-1} km^{-1}
- Fouling accumulation was generally 69.0 g m^{-2} d^{-1} greater at 2 vs. 7m of water depth on small platforms
- Similar results across years



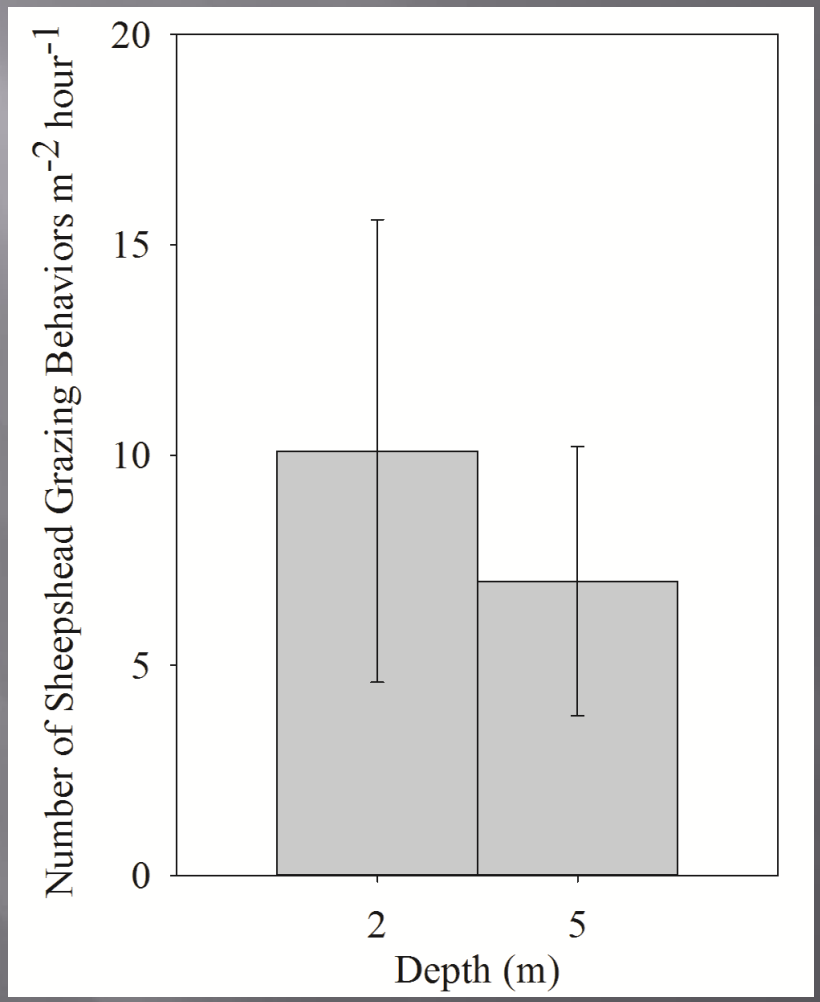
- *Amphibalanus reticulatus* represented >93% of barnacles
- Heights decreased with distance from shore, but the significant depth-by-year interaction indicated that the effect of depth was larger in 2016 vs. 2015
- Widths significantly decreased with distance and were 0.02 mm d^{-1} greater in 2016. vs. 2015, but depth was not a significant effect

Barnacles settlement and growth rates varied between years. Barnacles settling closer to the surface and closer to shore grew faster on platforms.

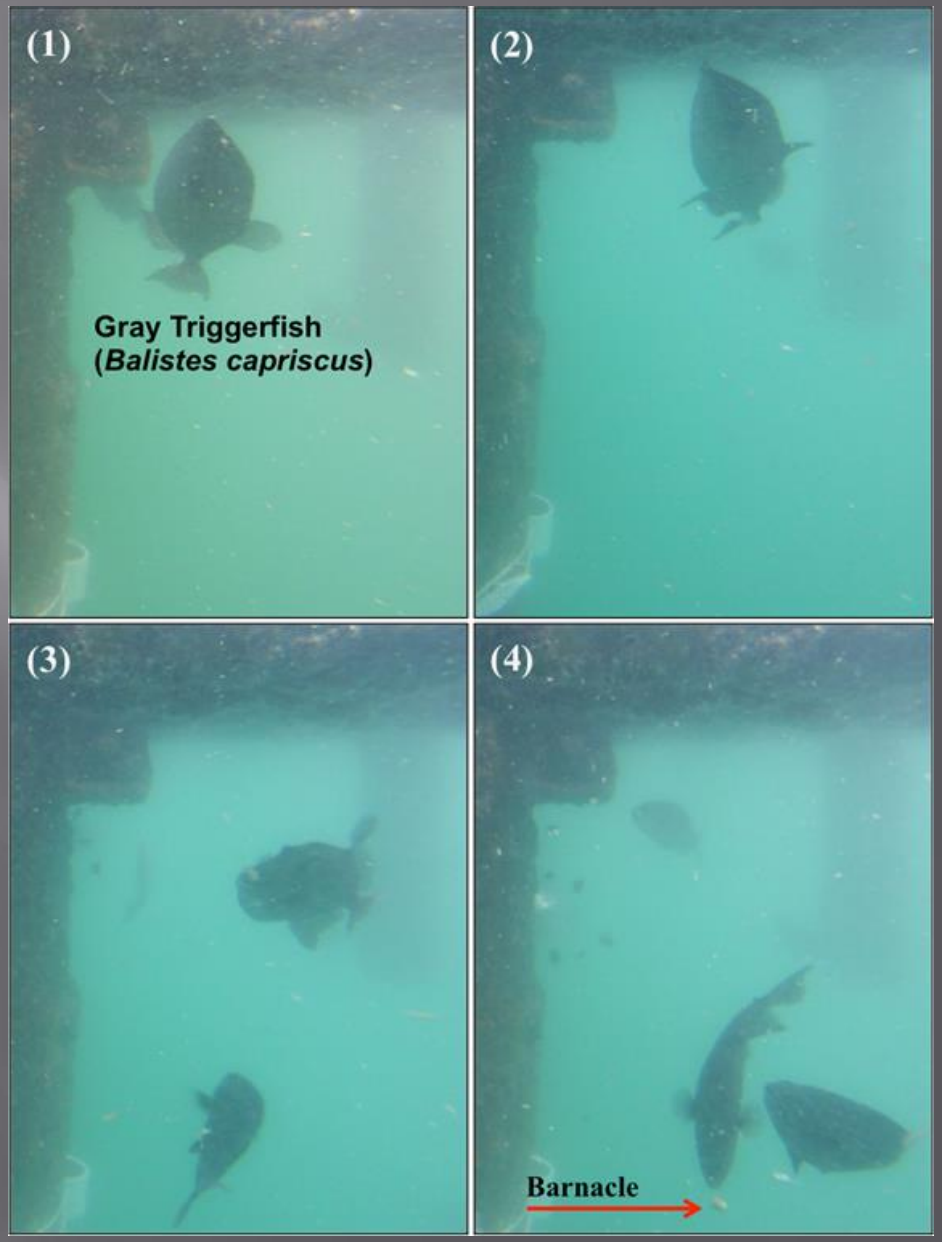


What is grazing Barnacles on nearshore platforms?

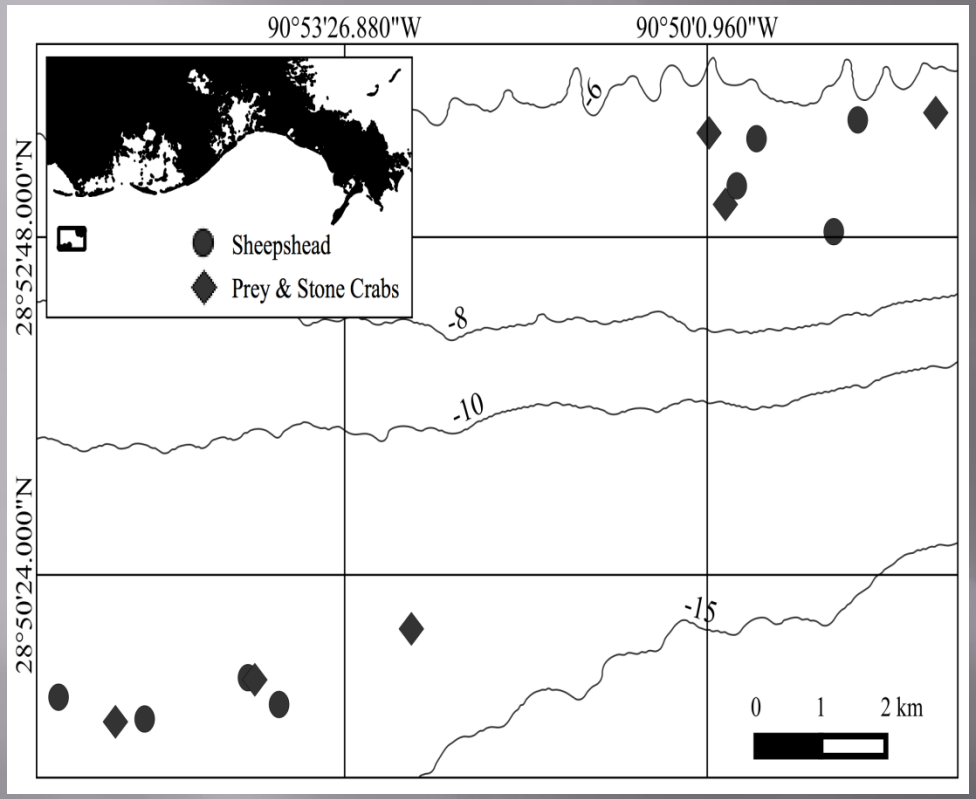
Grazing rates of sheepshead on small platforms



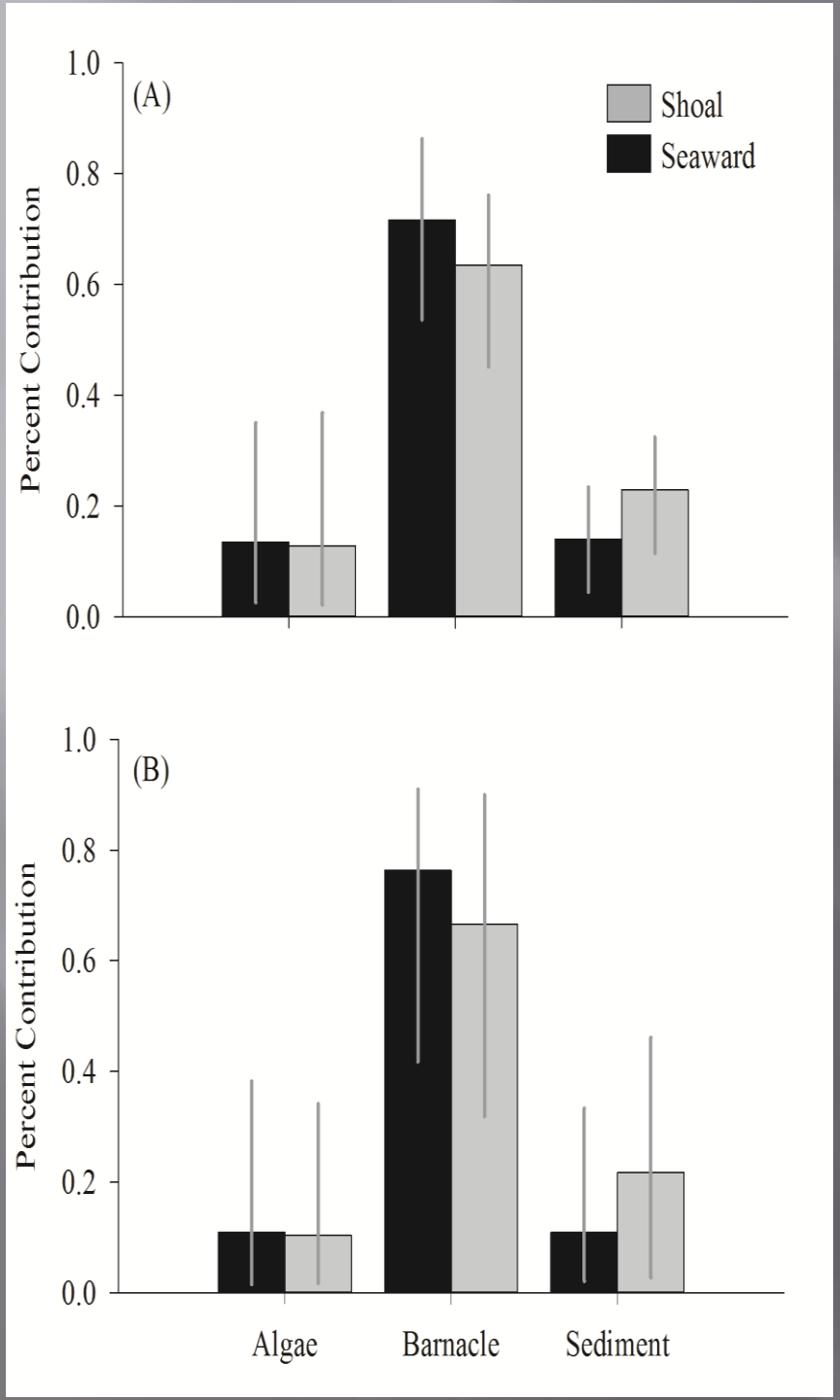
A 4 second time lapse of video frames of a triggerfish grazing, dropping and then chasing a barnacle taken off a small platform



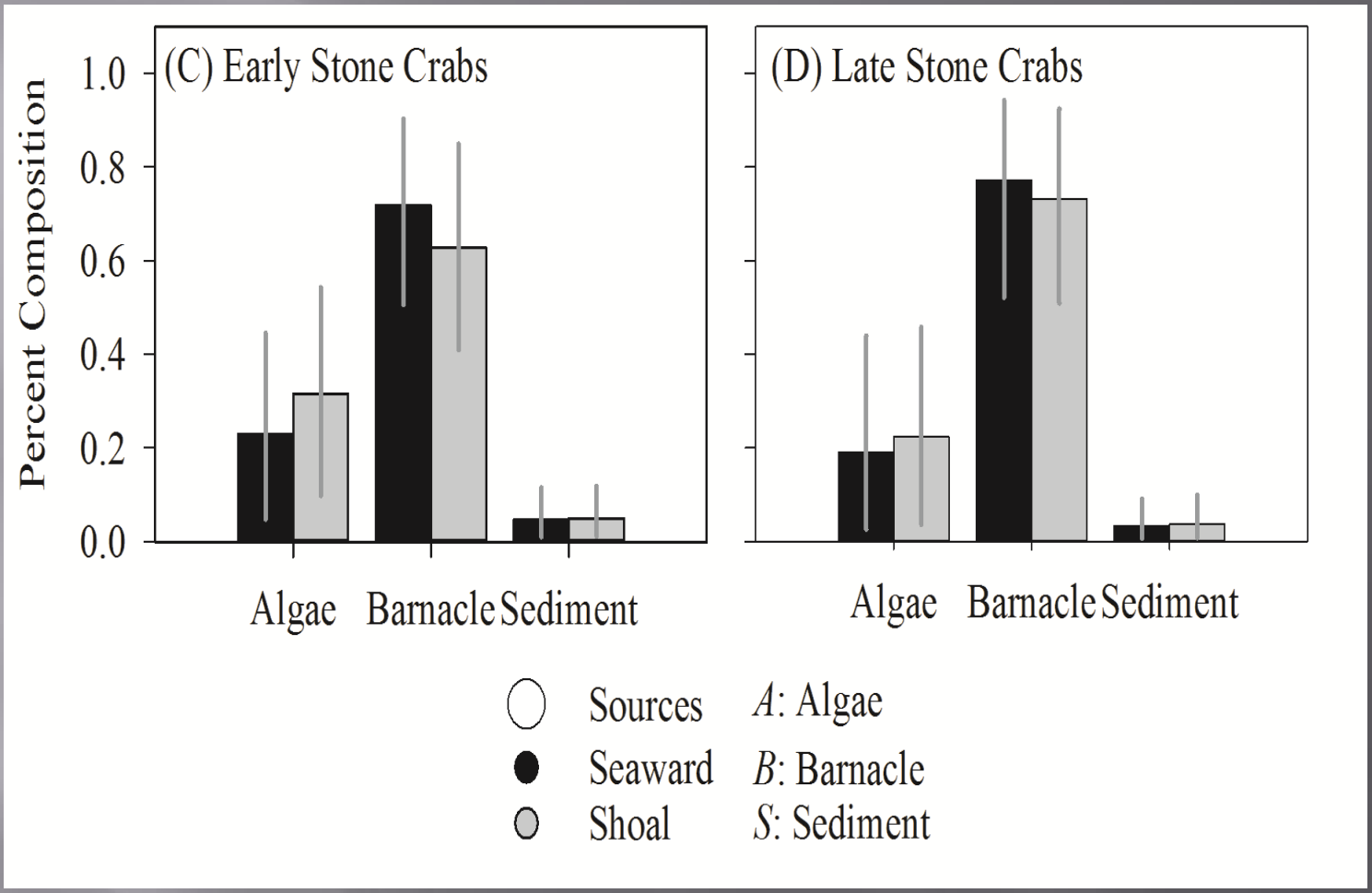
Time-lapsed video of Black Drum grazing on small platform biota



- Sampled sheepshead, stone crabs, barnacles, platform macroalgae, and surface sediments during early (May–June) and late (July–September) summer of 2016
- Analyzed $d^{13}C$ and $d^{15}N$ of all samples
- Used Bayesian mixing models to determine contribution of barnacles, algae, and benthic resources (sediment) to sheepshead and stone crab diets



- Mixing models indicate that sheepshead on and off Ship Shoal have similar diets
- Diets are also similar during the early (top) and late summer (bottom)
- Mixing models and gut contents analyses also indicate that sheepshead primarily feed on barnacles
- However, algae and sediment also made substantial contributions



- **Stone crabs also primarily feed on barnacles, but sediment makes a smaller contribution and algae makes a larger contribution than sheepshead**
- **Diets were similar on and off Ship Shoal and and during the early and late summer**

Take Home Messages

- There are a number of species and life stages that utilize small platform for grazing, shelter or both.
- Nearshore platforms and the rubble around the platforms provide valuable habitat for a variety of reef associated fishes including YOY red and lane snapper.
- Nearshore waters of Louisiana are spatially and temporally dynamic. Consequently the hydrography has a strong influence on the biota on and around small platforms in the nearshore zone off Louisiana.
- Nearshore platforms shunt more primary and secondary production to reef associated biota than those farther offshore because of influence of the rivers on PP.
- This has consequences for habitat value for standing vs toppled platforms.

Acknowledgements

- Funding for this study was provided by the Bureau of Ocean Energy Management and Louisiana State University Coastal Marine Institute.
- The Louisiana Department of Wildlife and Fisheries funded a sister project focused on platforms on Ship Shoal that provided match.