

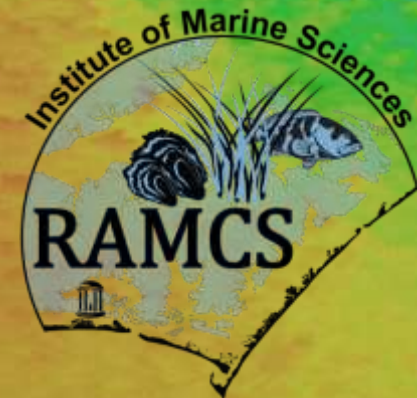
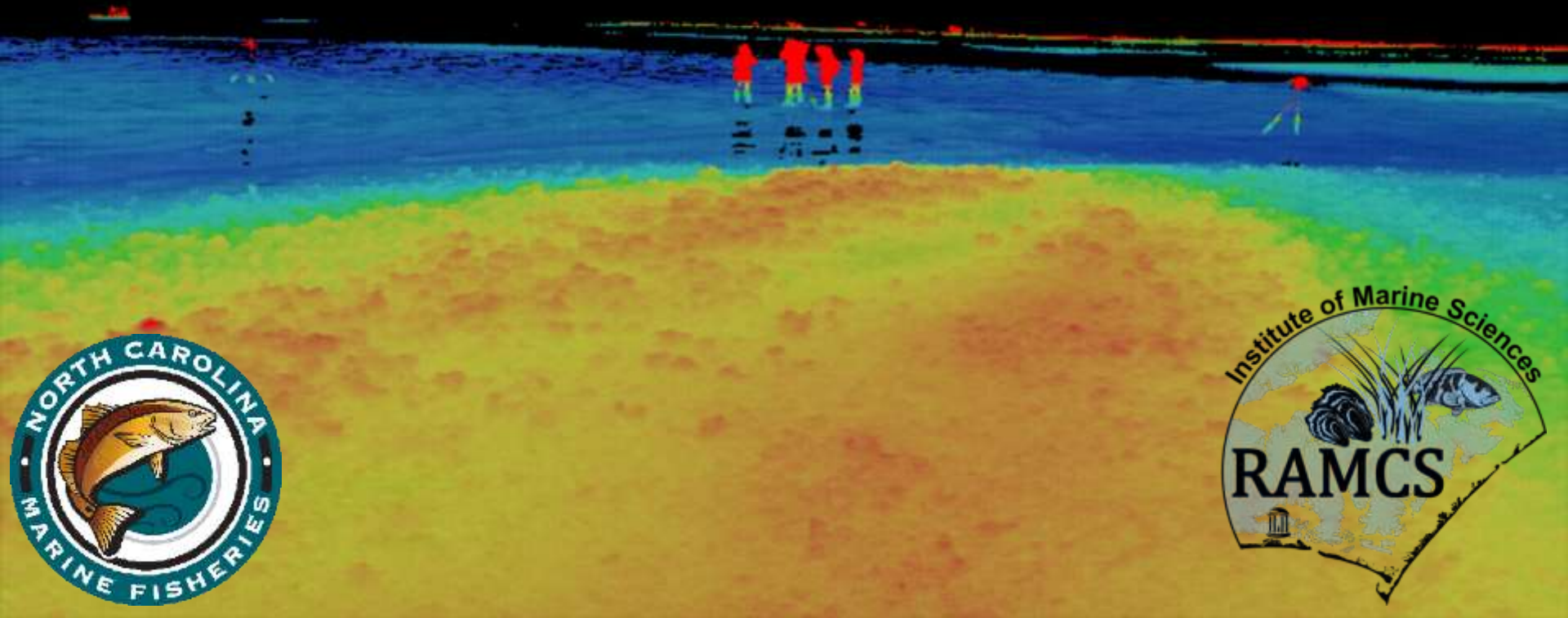
Variations in fish abundance and oyster-reef rugosity at the meter-scale.

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Structural complexity positively correlates with species richness, species diversity, and fish biomass.



e.g. Gratwicke and Speight, 2005; Luckhurst and Luckhurst, 1978; Roberts and Ormond, 1987

More fish on intertidal reefs than sandflats- structural complexity is important at the reef scale ($>10 \text{ m}^2$).

Sandflat; Low complexity

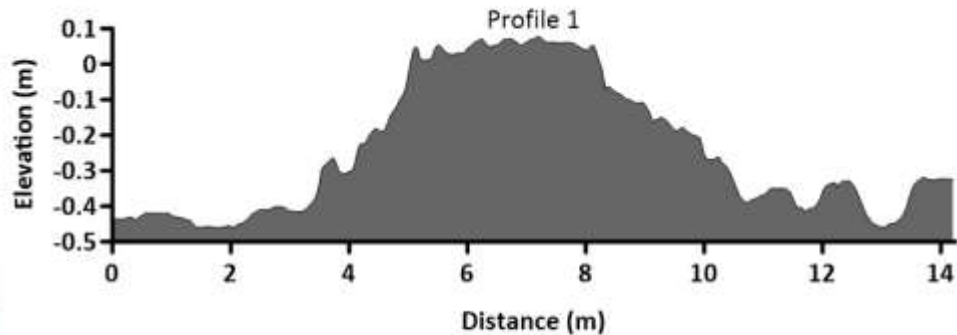
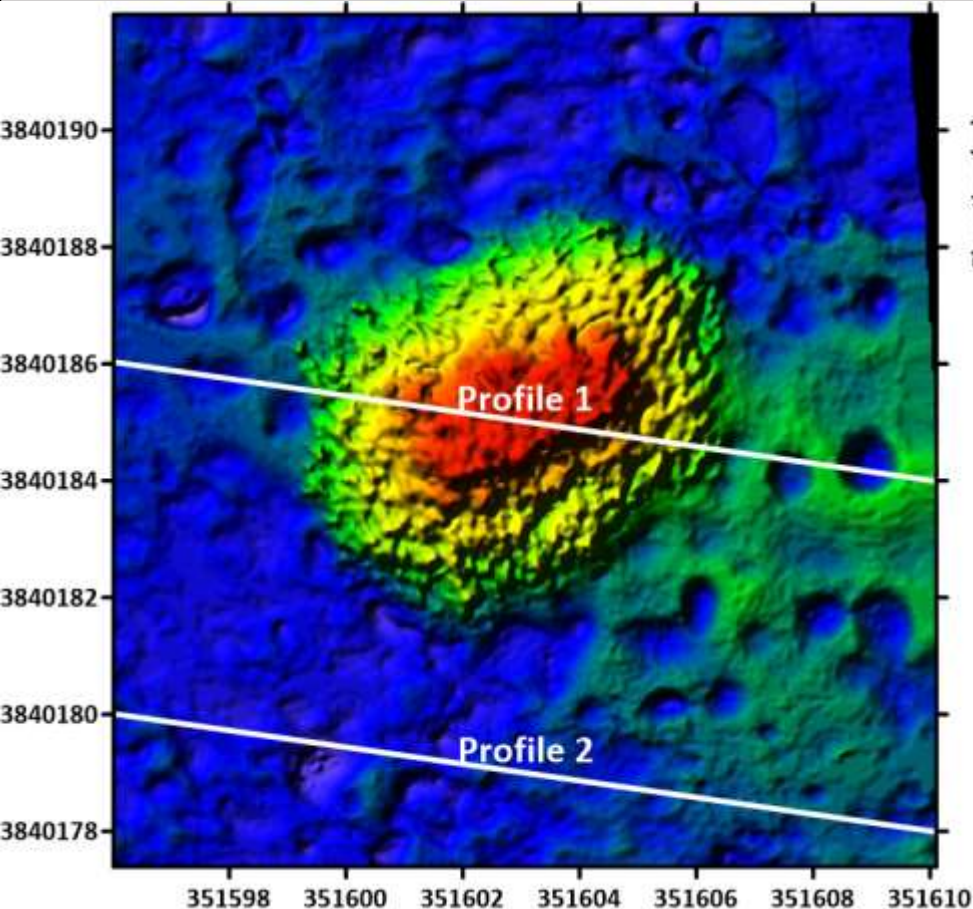


Oyster Reef; High complexity

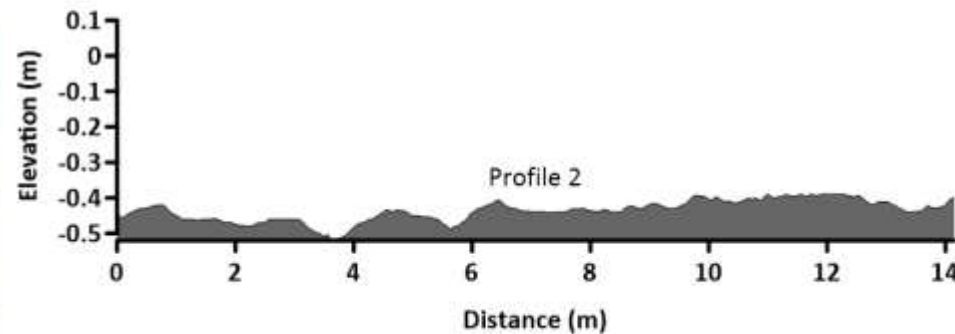


But what about small-scale variations on a reef (1 m^2)?

Rugosity is a common metric for complexity.
Measured in the field using the chain-and-tape
method...literally (Risk, 1972 *Atoll Res Bull*).

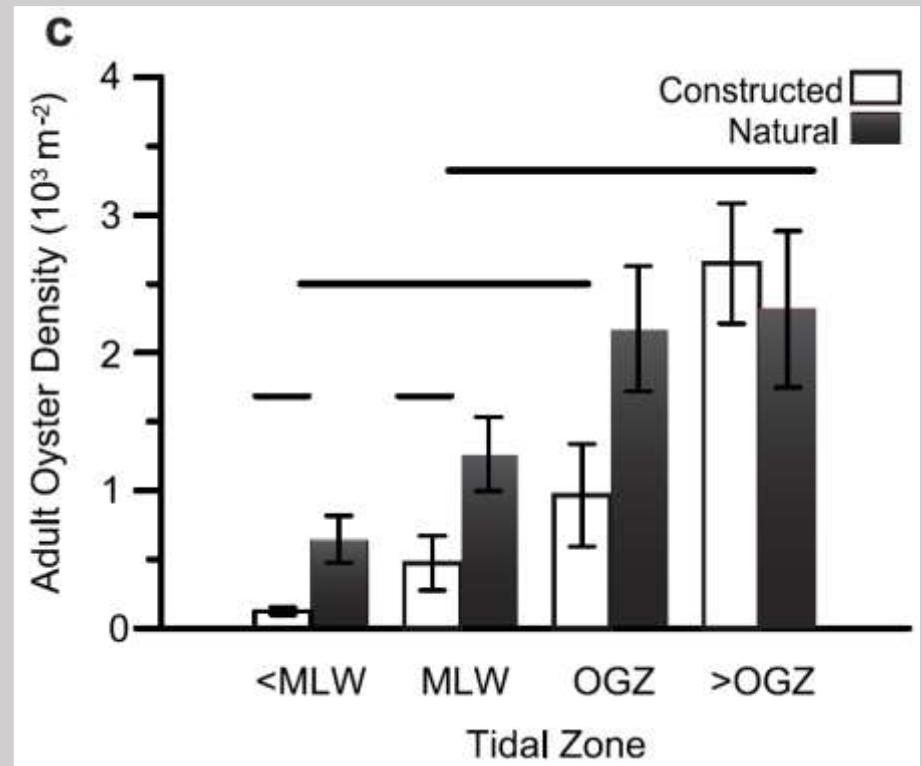
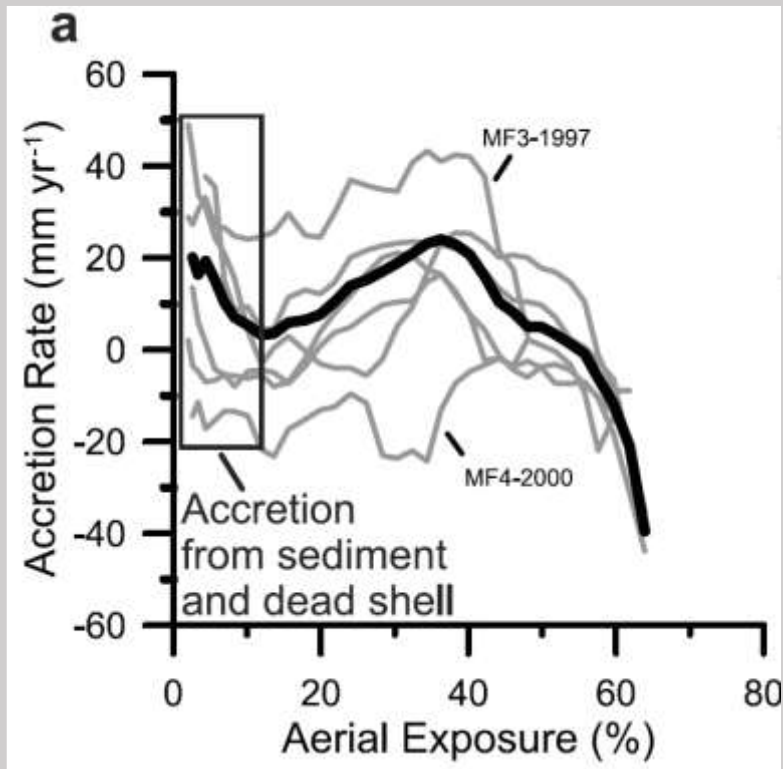


High rugosity: $16 \text{ m} / 14 \text{ m} = 1.14$

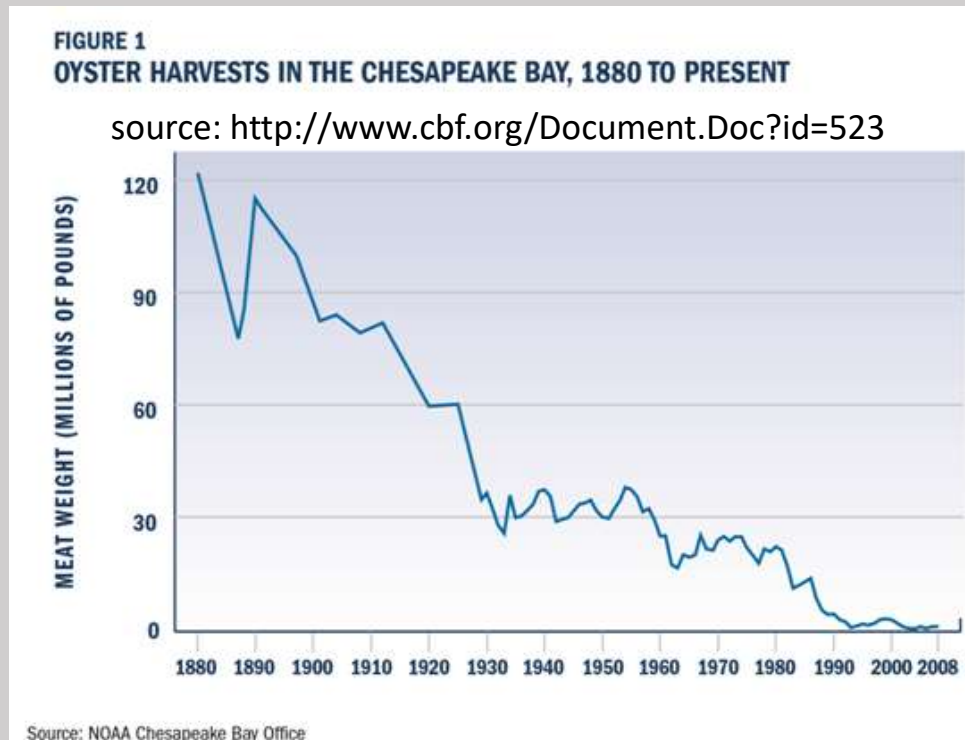
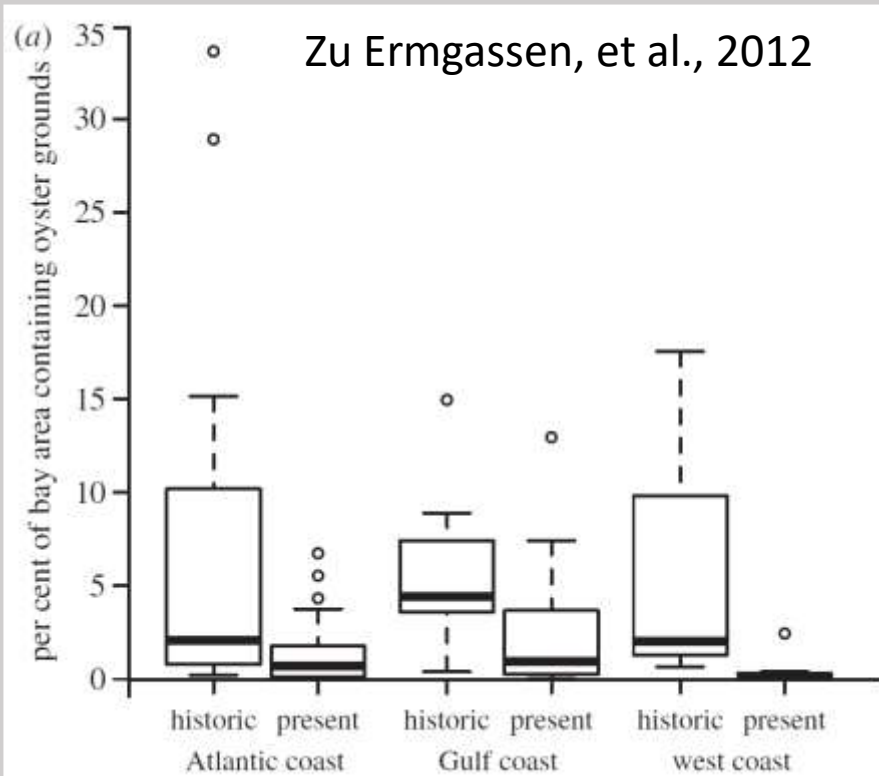


Low rugosity: $14.25 \text{ m} / 14 \text{ m} = 1.02$

There could be a difference in fish utilization across an intertidal reef because reef-growth rates vary with elevation.



Oyster-reef abundance is a fraction of what it was, mainly due to overfishing.

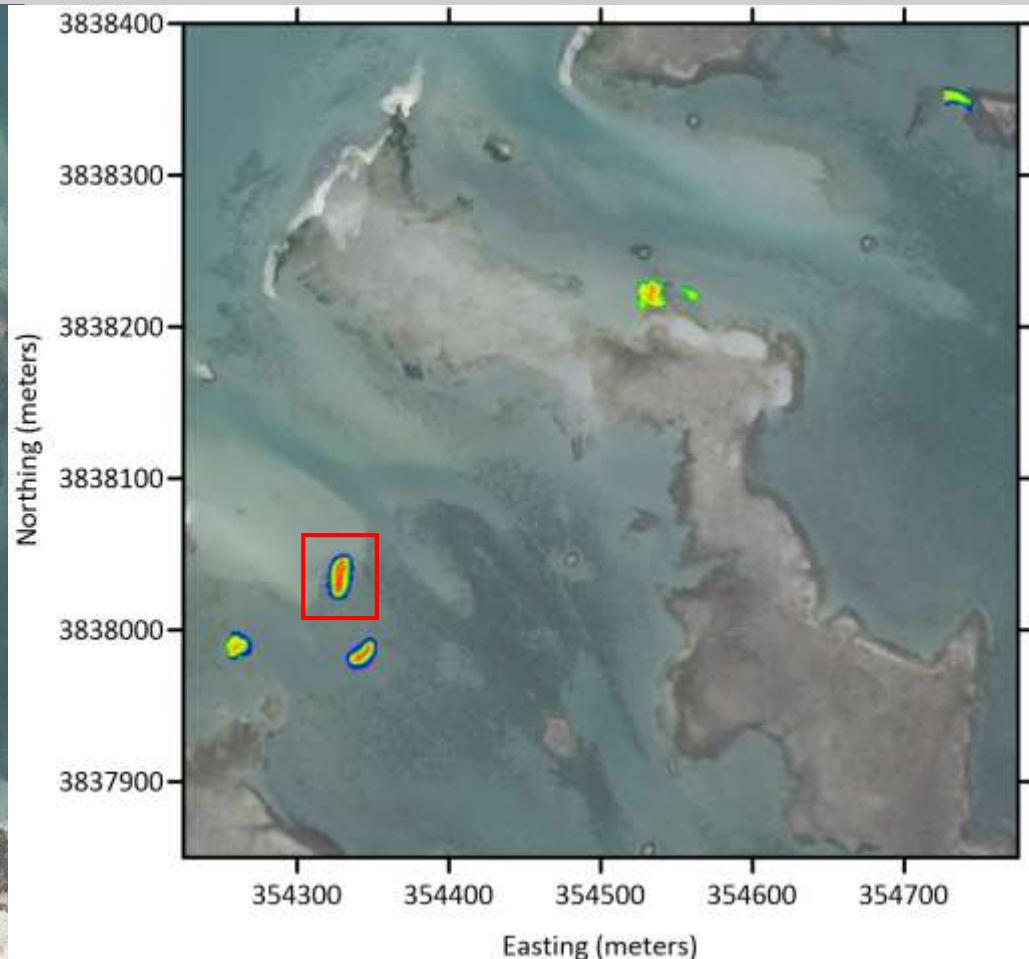


If small-scale variations in structural complexity are important, let's use that information to maximize fish habitat as part of oyster-reef restoration efforts.

Study Area: Back Sound, NC



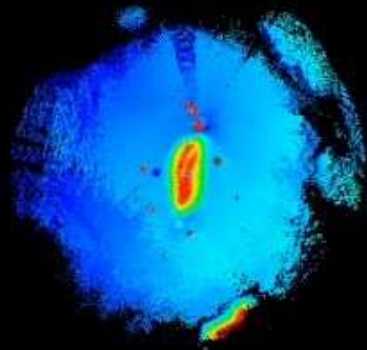
We looked at rugosity and fish density at 3 patch and 3 fringing reefs.





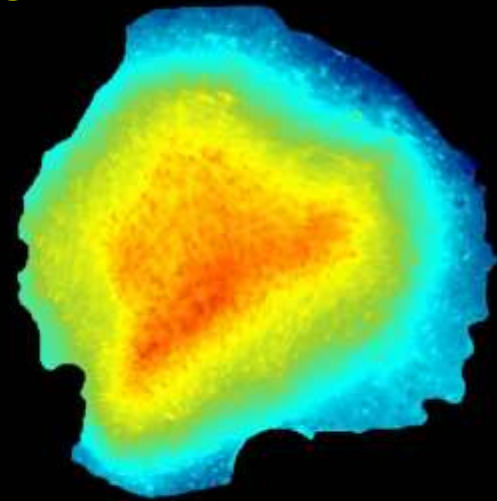
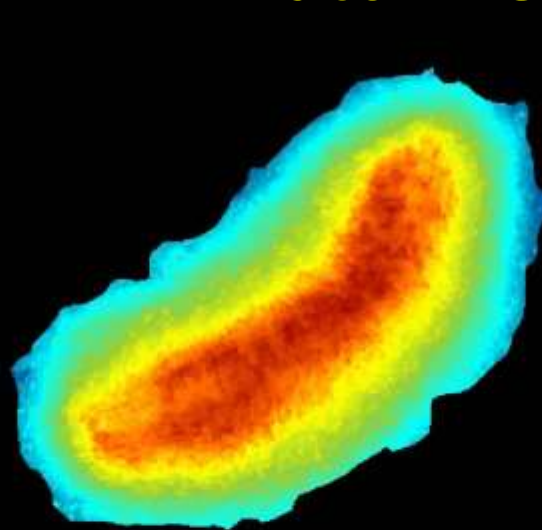
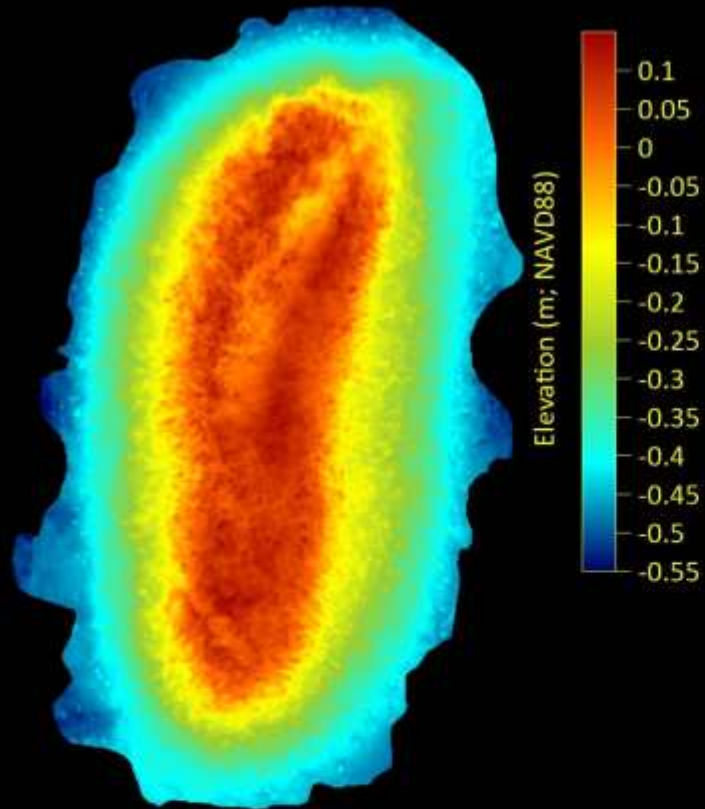
Created DEMs using a terrestrial laser scanner.



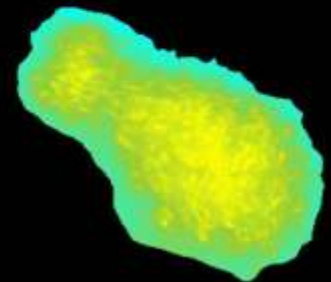
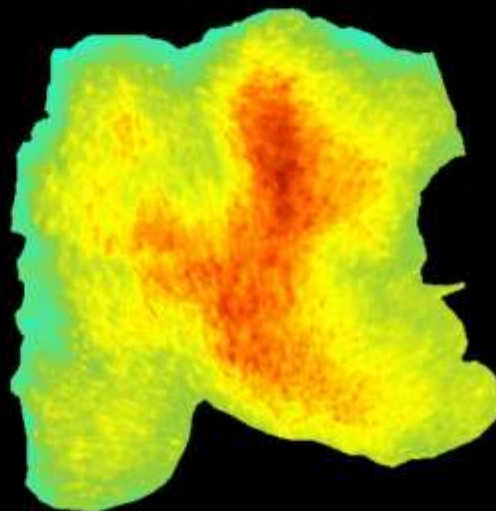
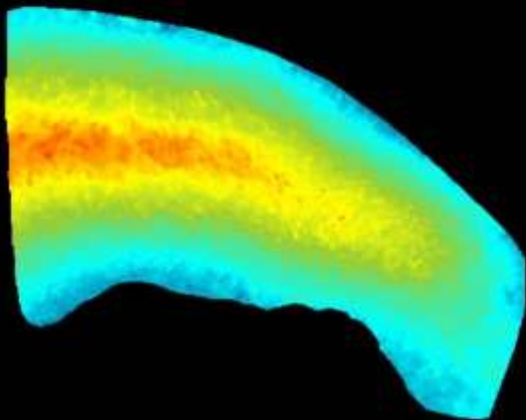


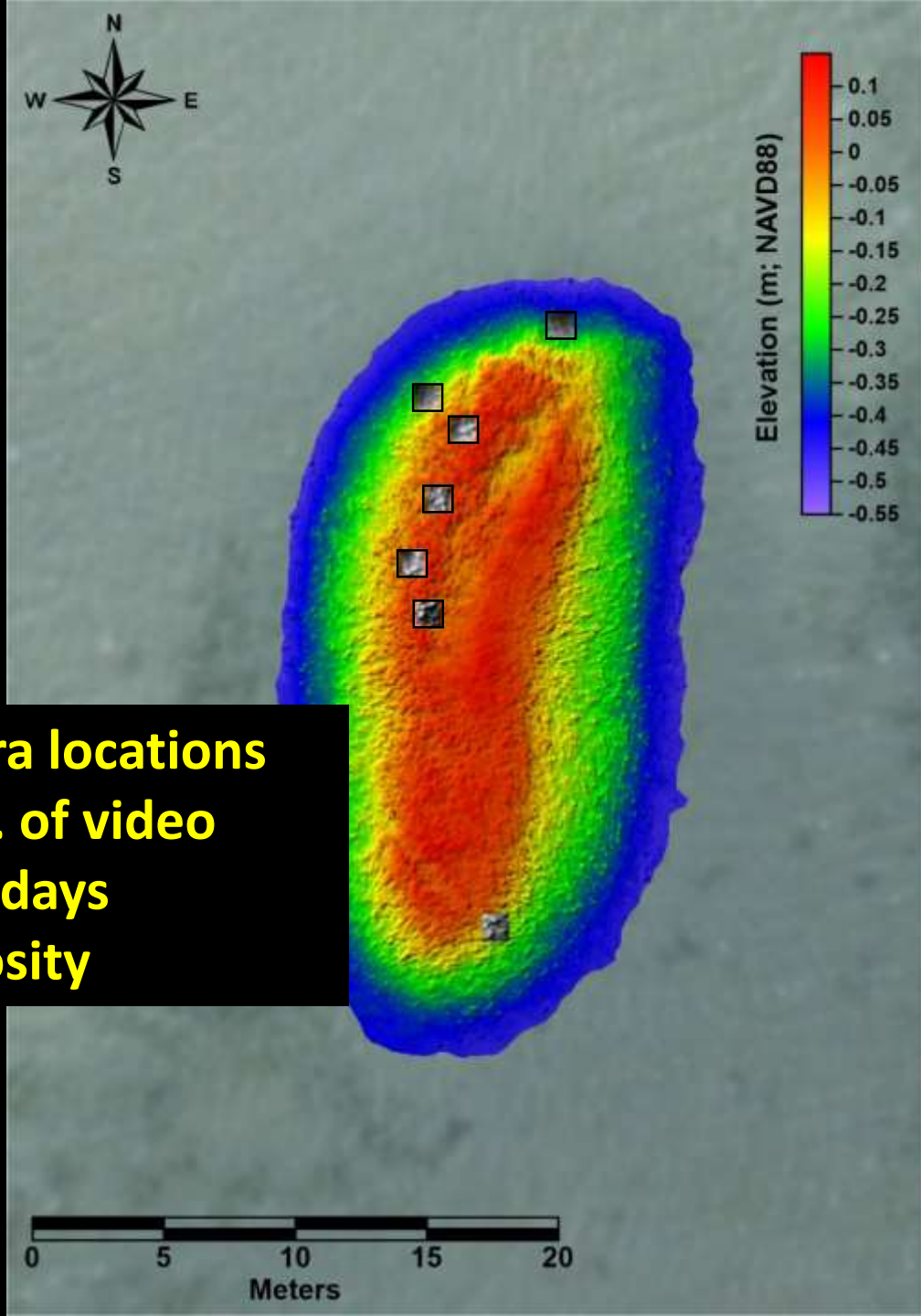
L.

Patch Reefs



Fringing Reefs





- a. Choose camera locations
- b. Capture 2 hrs. of video
- c. Repeat for 14 days
- d. Measure rugosity

Sampling: 14 days- 7 during daylight hours and 7 during night time hours.

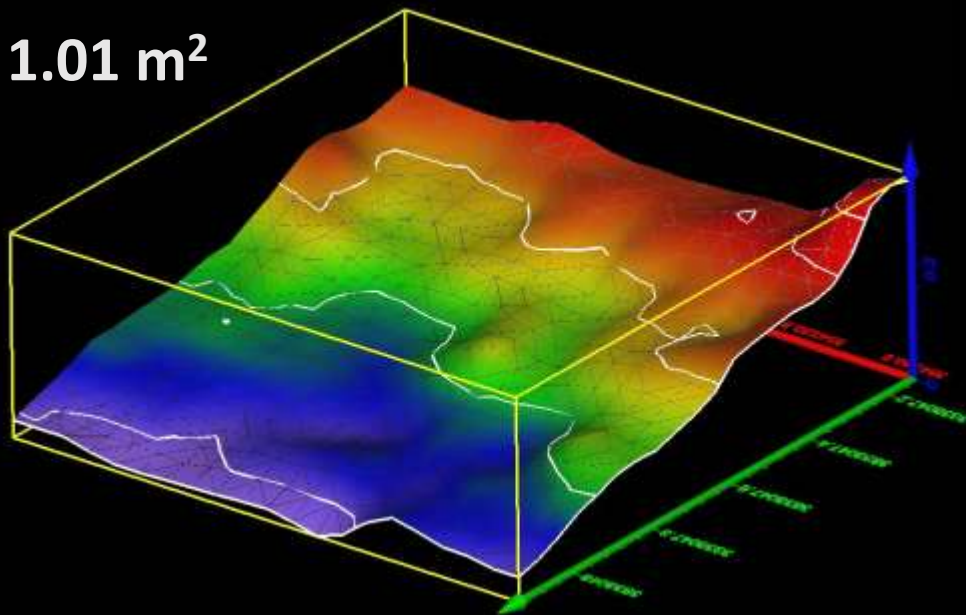
- 8/1/2016 ☀️
- 8/4/2016 🌙
- 9/28/2016 ☀️
- 9/29/2016 🌙

- 6/26/2017 ☀️
- 6/27/2017 🌙
- 6/28/2017 🌙
- 6/29/2017 ☀️
- 7/13/2017 🌙
- 7/17/2017 ☀️
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- 7/28/2017 ☀️
- 8/7/2017 ☀️
- 8/8/2017 🌙

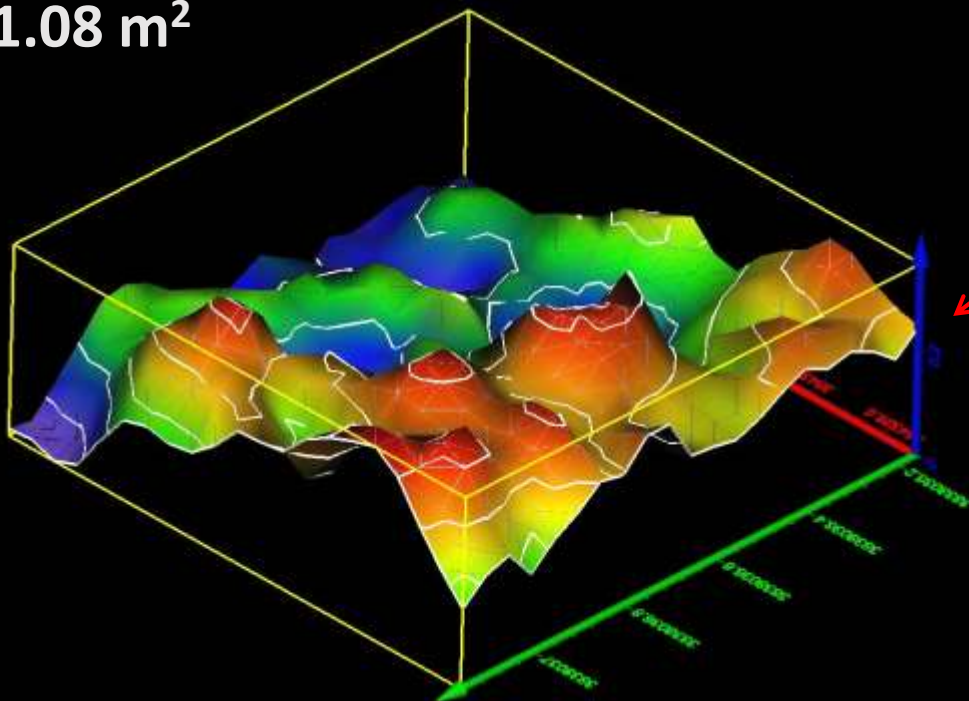
6 or 7 cameras
Randomized
1 hr. pre and
post high tide



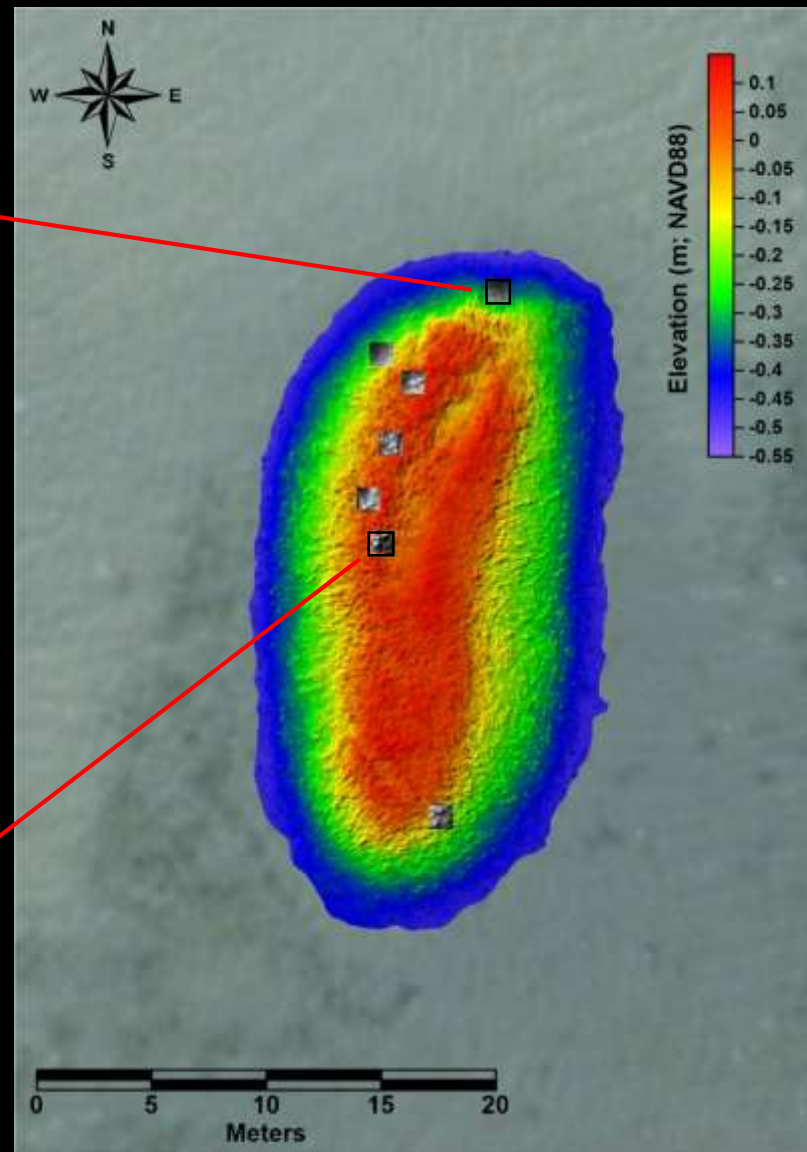
1.01 m²



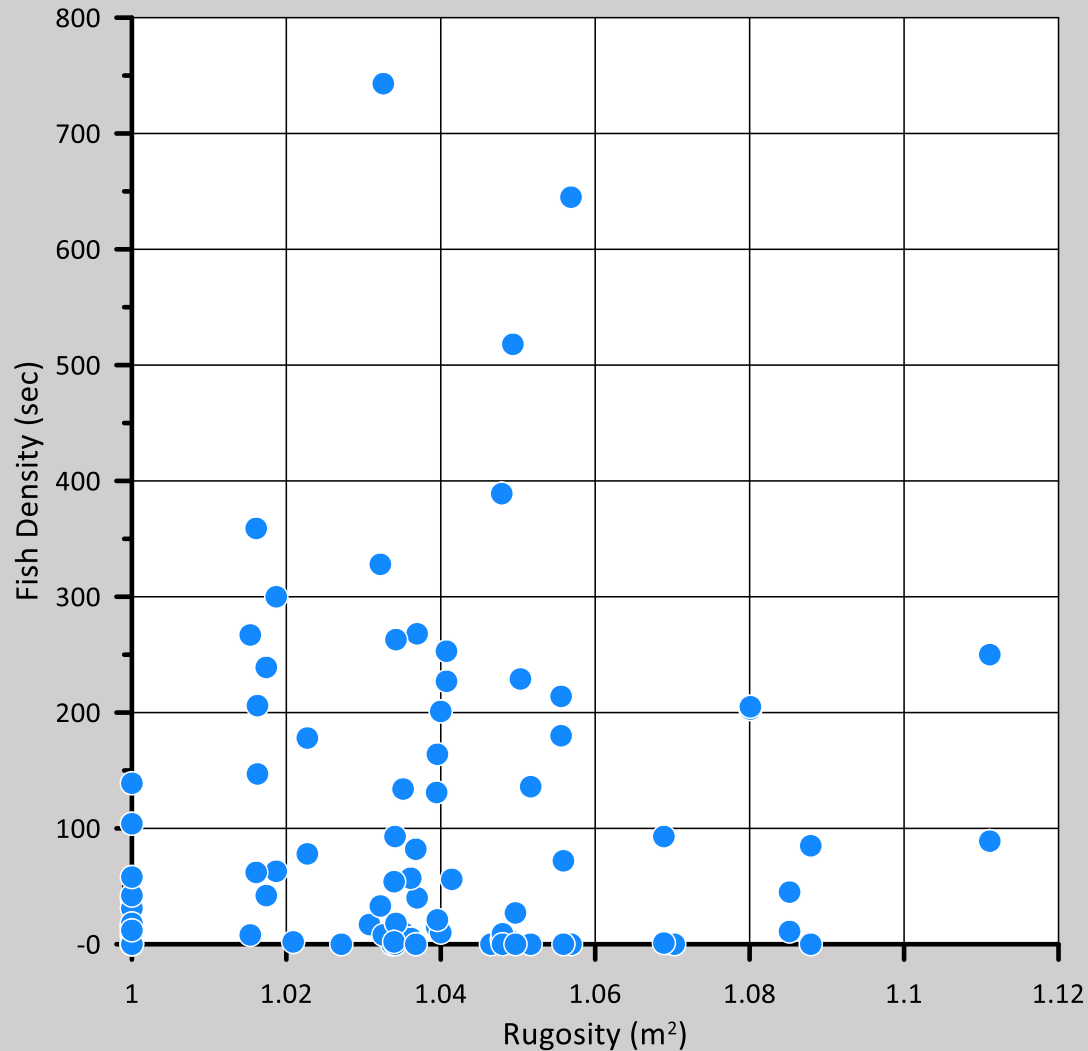
1.08 m²



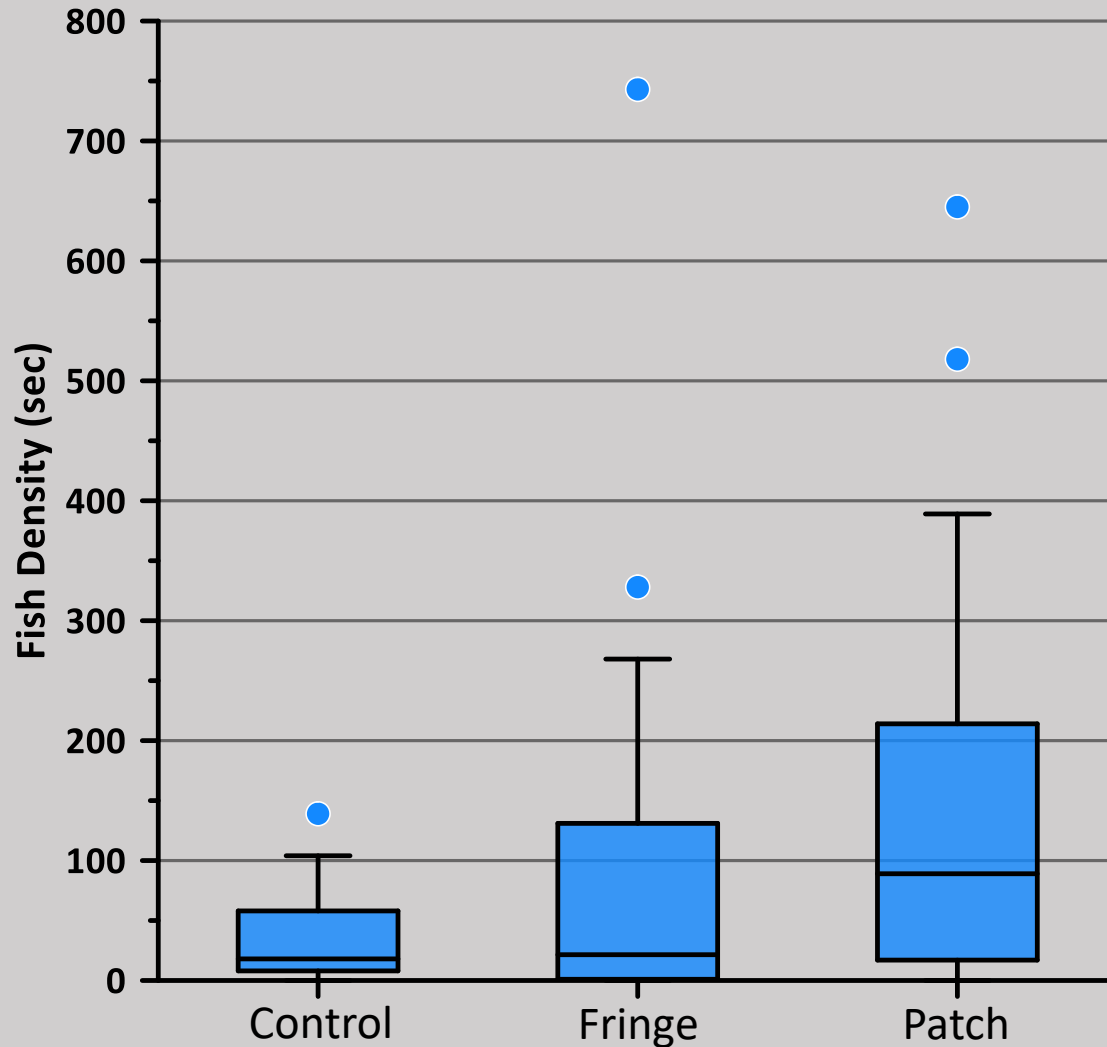
Rugosity is surface area.



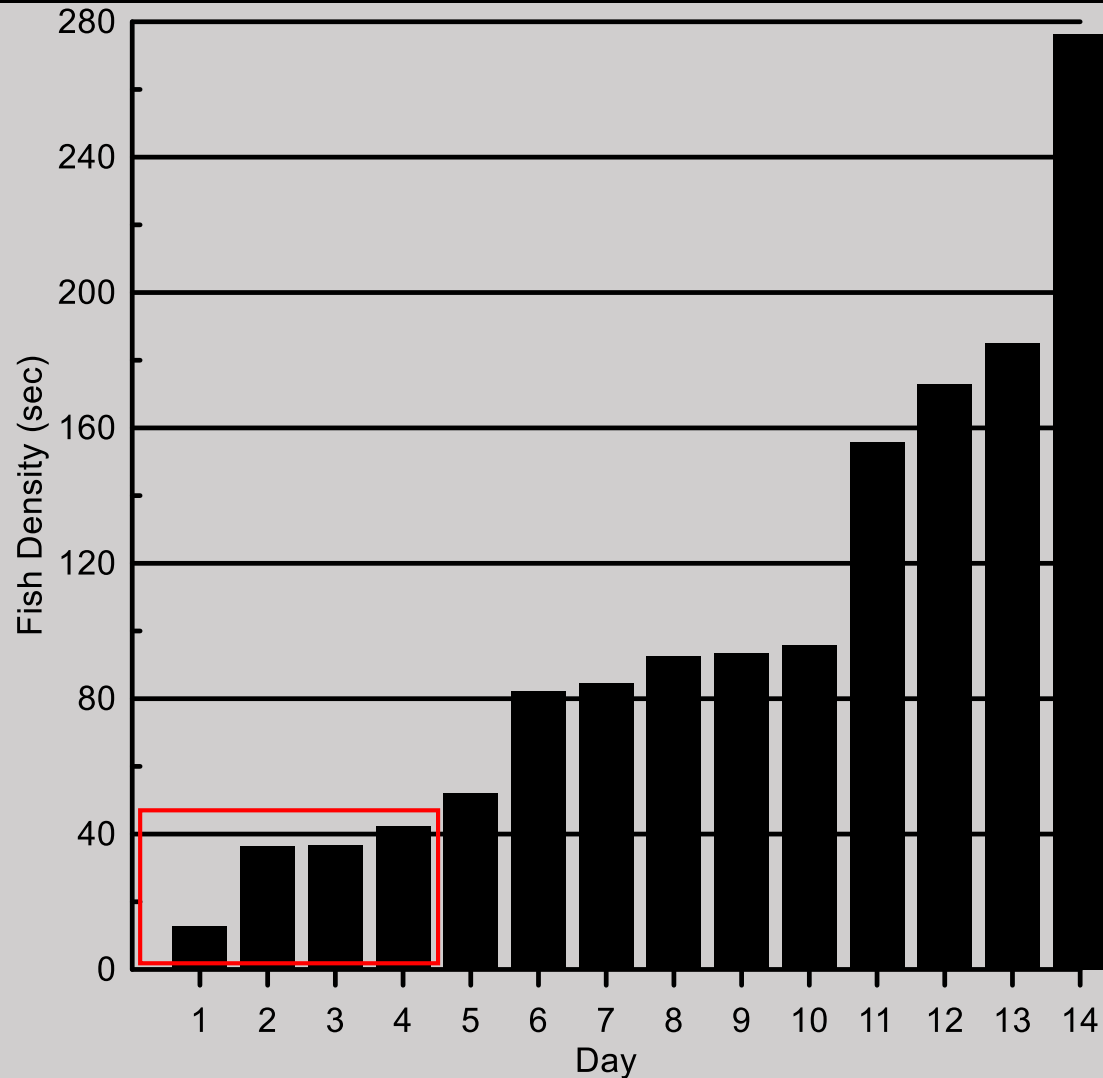
The raw data set is messy. Sometimes the fish are just not out there...



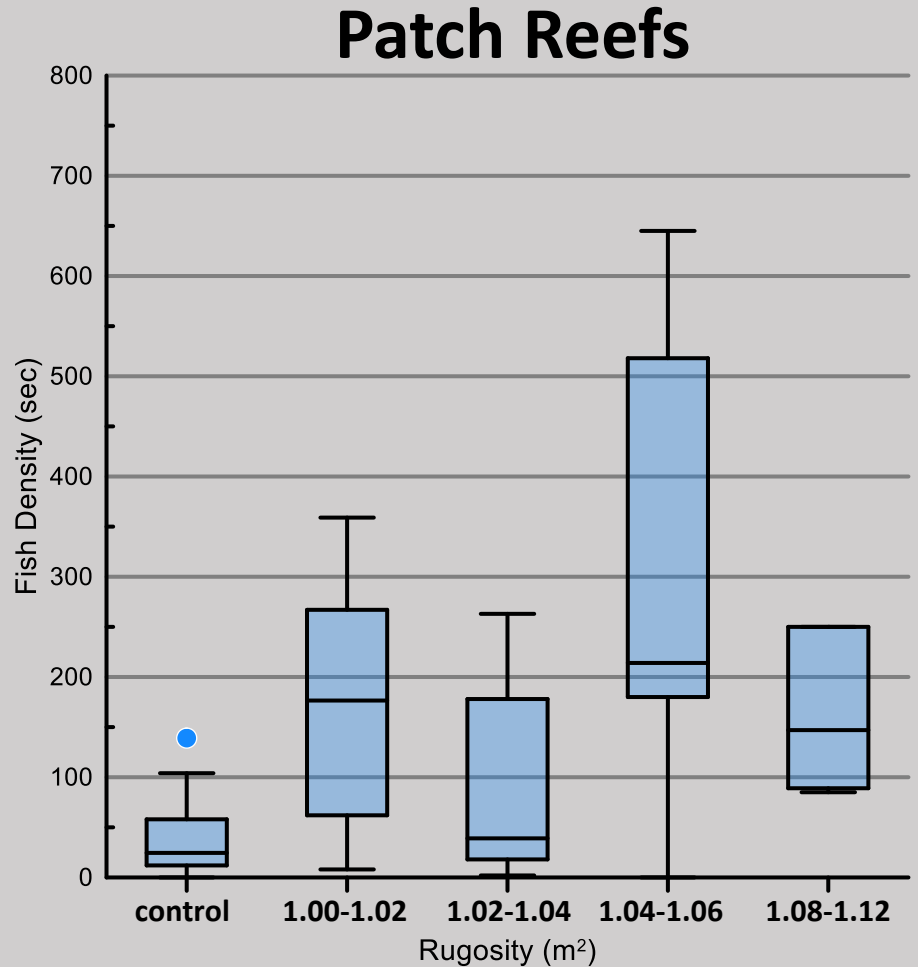
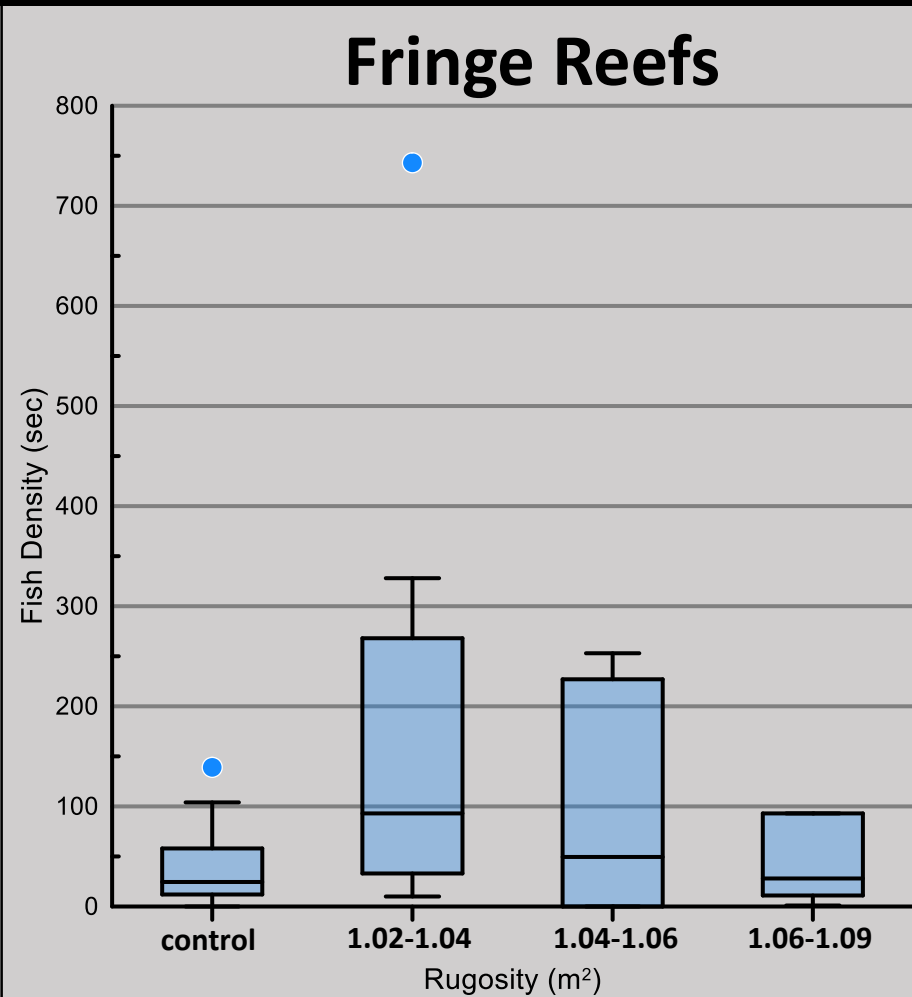
Control, fringe, and patch reefs are significantly different (p-value 0.02).



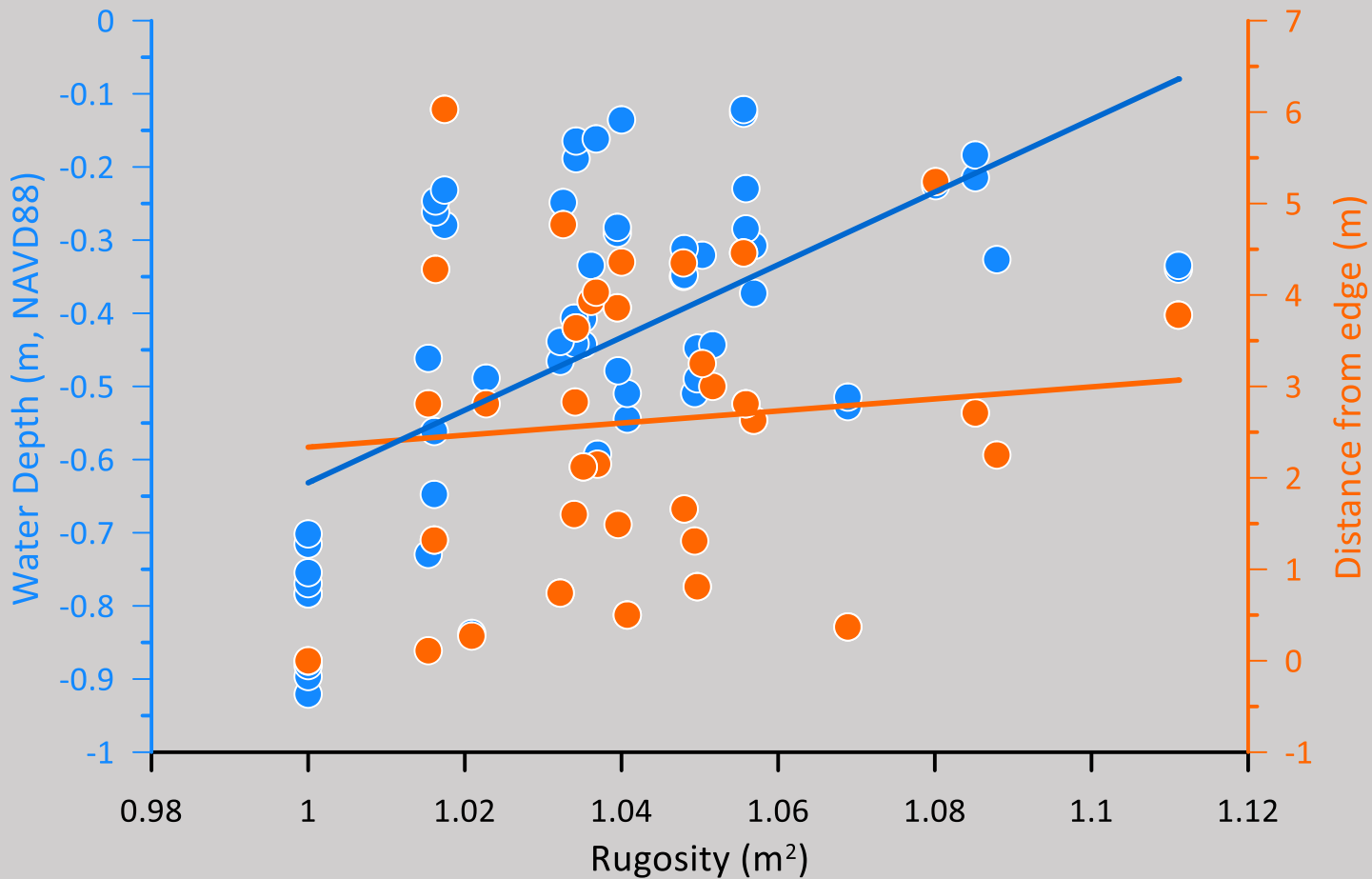
Bad fishing days are below the 95% confidence interval.



Intermediate rugosity maximizes fish density.

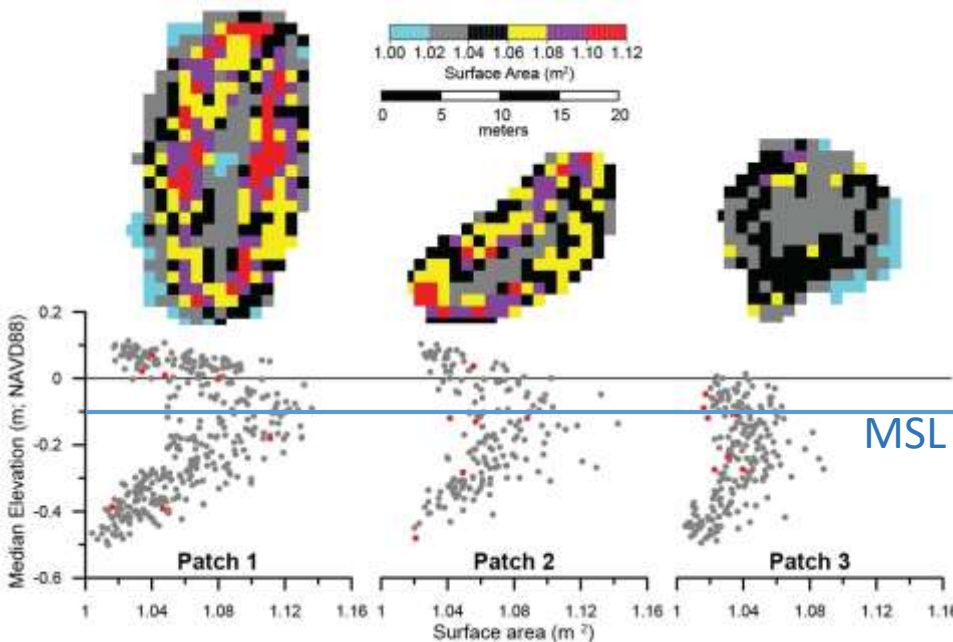


There is a positive relationship between water depth and rugosity. Perhaps a multi-variable approach is better, including reef size, depth, distance from edge...

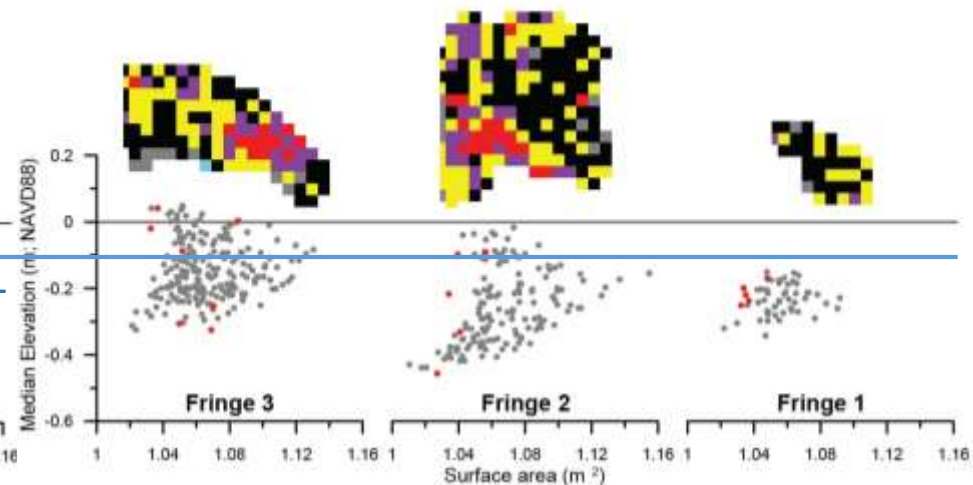


The sides of patch reefs and tops of fringing reefs should be fished. 1.04-1.06 for patch reefs and 1.03-1.05 for fringing reefs.

Patch Reefs



Fringing Reefs



Final thoughts:

- Preliminary data suggests that intertidal oyster reefs with an extensive optimal growth zone area increases the density of fish on the reef.
- Restoring intertidal oyster reefs in a way that maximizes their growth rate is good for fish...and anglers.

Acknowledgements:

- Justin Ridge
- Carson Miller
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