AN ASSESSMENT OF FISHERY RESPONSES TO OYSTER REEF RESTORATION IN THE PIANKATANK RIVER, VA

Stephen McIninch, PhD
Virginia Commonwealth University
Center for Environmental Studies

Danielle McCulloch Prosser, MS
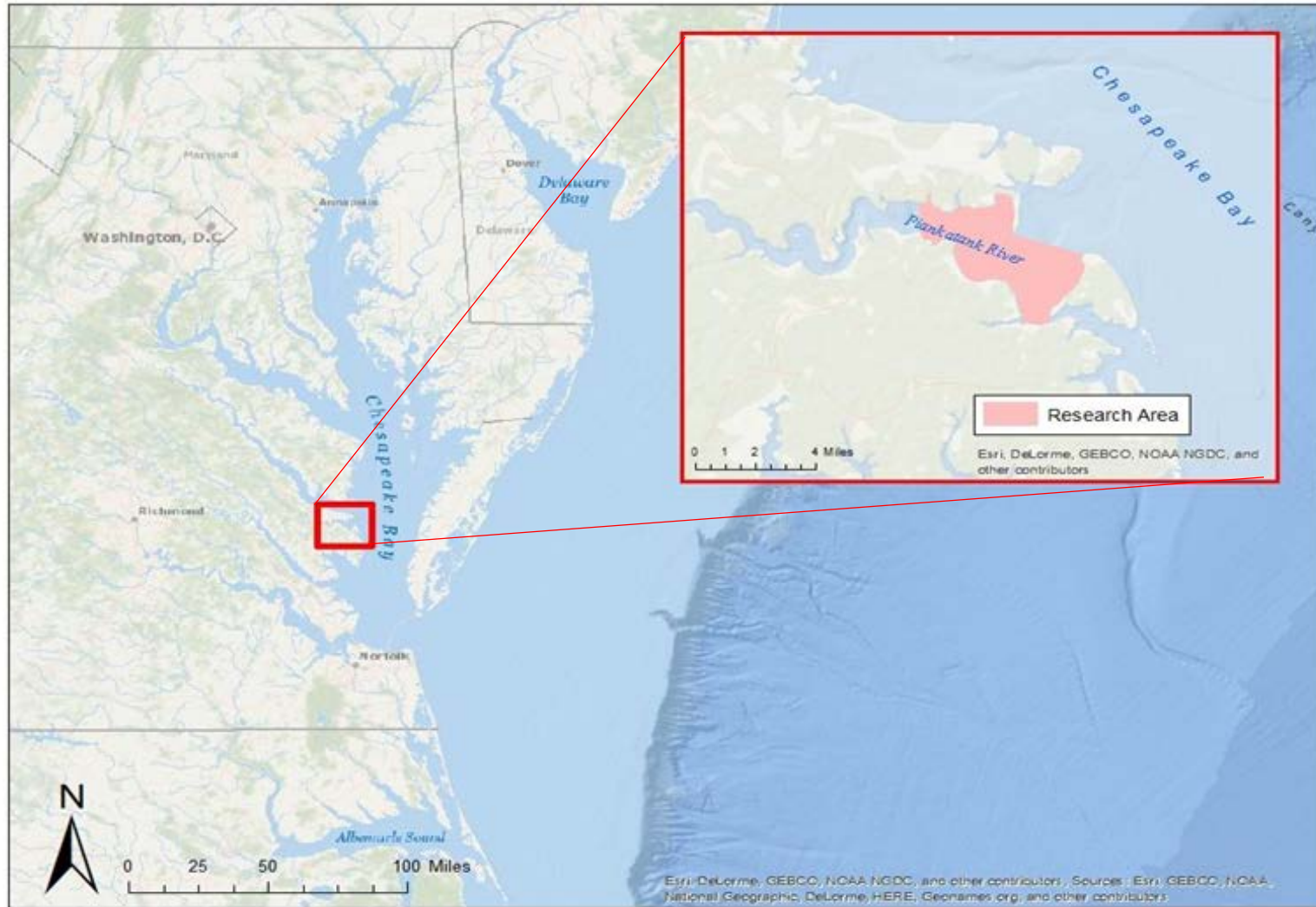U.S. Fish & Wildlife Service
Galloway, NJ

Objectives

- **Compare fish diversity and density on restored reef habitat, off reef habitat, and outside of a reef network**

  - Sample fish on restored reef habitat, off reef habitat and outside of reef network area
  - Use multiple sampling strategies
  - Include nocturnal activity
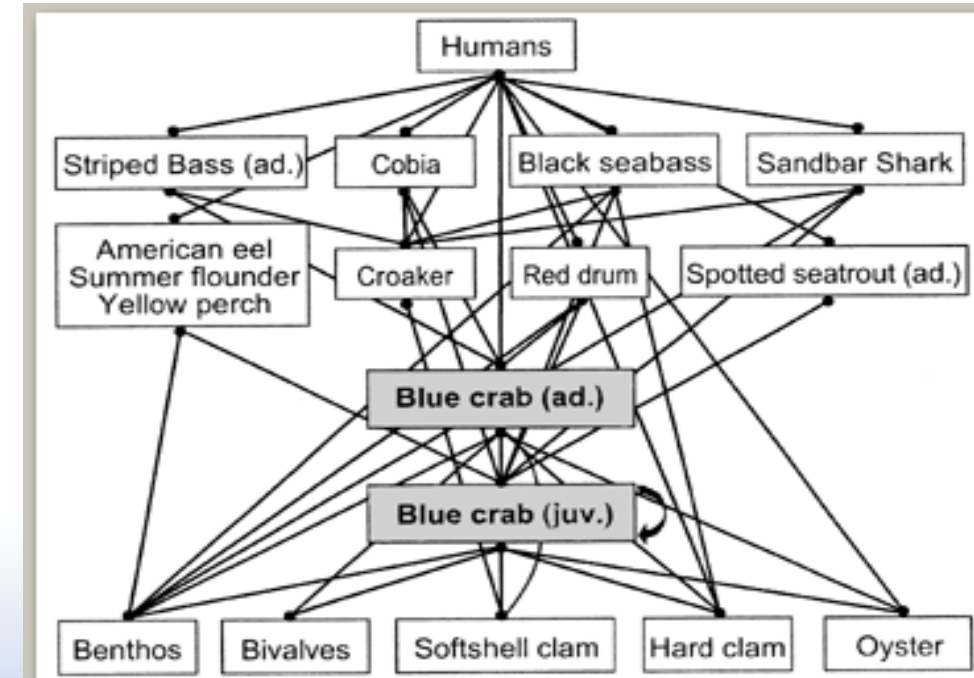
Study Site

- Piankatank River, VA
- Lower-Mid Bay
- Retains spat
- Ideal site for restoration and study

Restoration partners: NOAA, ACOE, TNC, VIMS, VMRC, VCU

Sampling Sites

Reef Complex area

Total area = 5,022 acres

Natural reef= 240 acres

Restored reef = 130+ acres

Palace:

53 acres shell mounds + reef balls

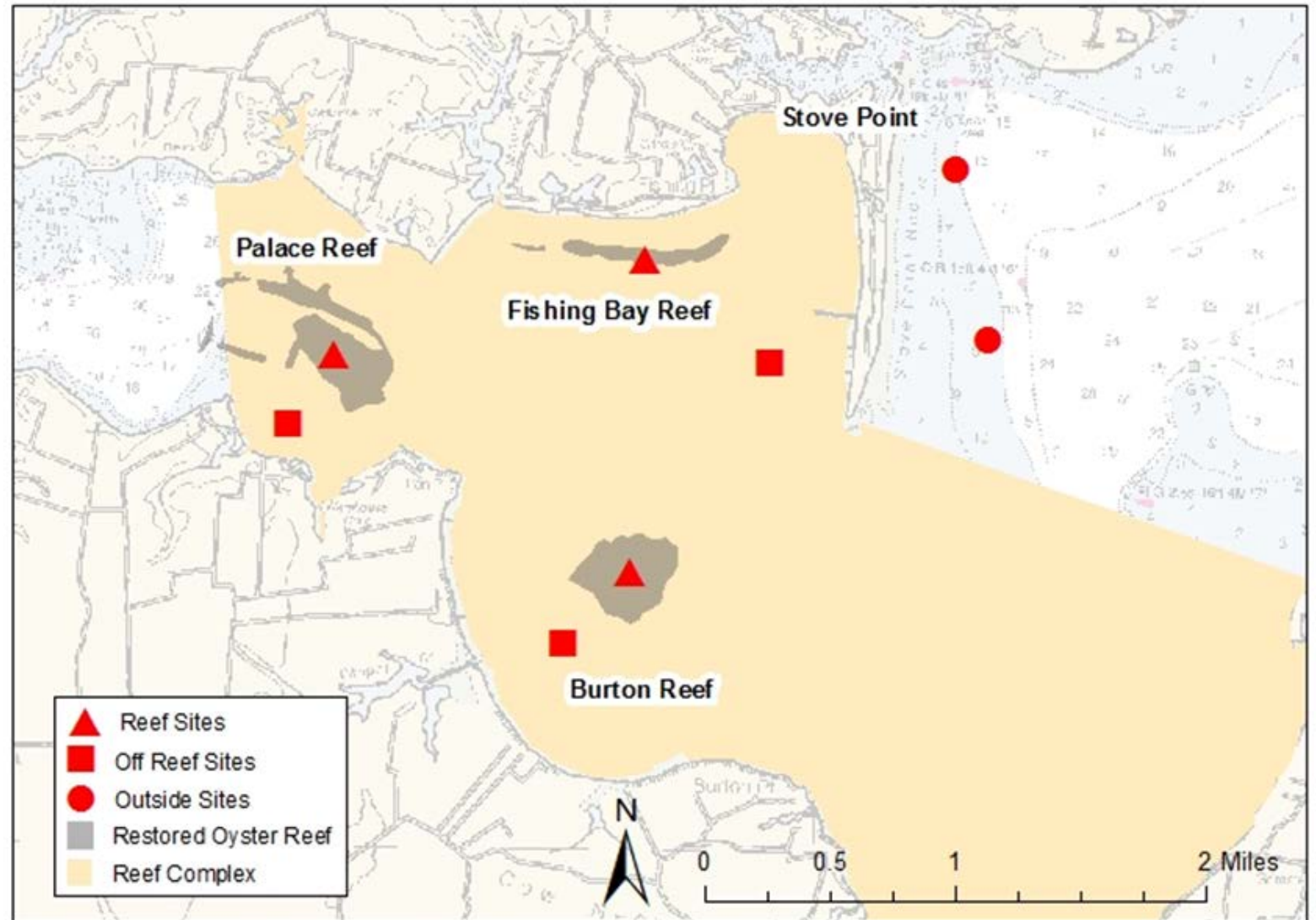Upper most site

Fishing:

20 acres stone rubble, cohesive

Downriver

Burton:

60 acres low-relief

River mouth

Field Methods

- Trap sets
- (Apr)May-September(Oct)
- 2011-2012; 2015-2017
- on reef, off reef, and outside reef complex

- Gillnet sets
  - Day and night, May-September
  - 2011, 2012 and 2015-2017
  - on reef, off reef, and outside reef complex

- Hydroacoustic surveys
  - Day and night, May-September
  - 2016-2017 = set on reef, off reef, and outside reef complex

Peprilus paru
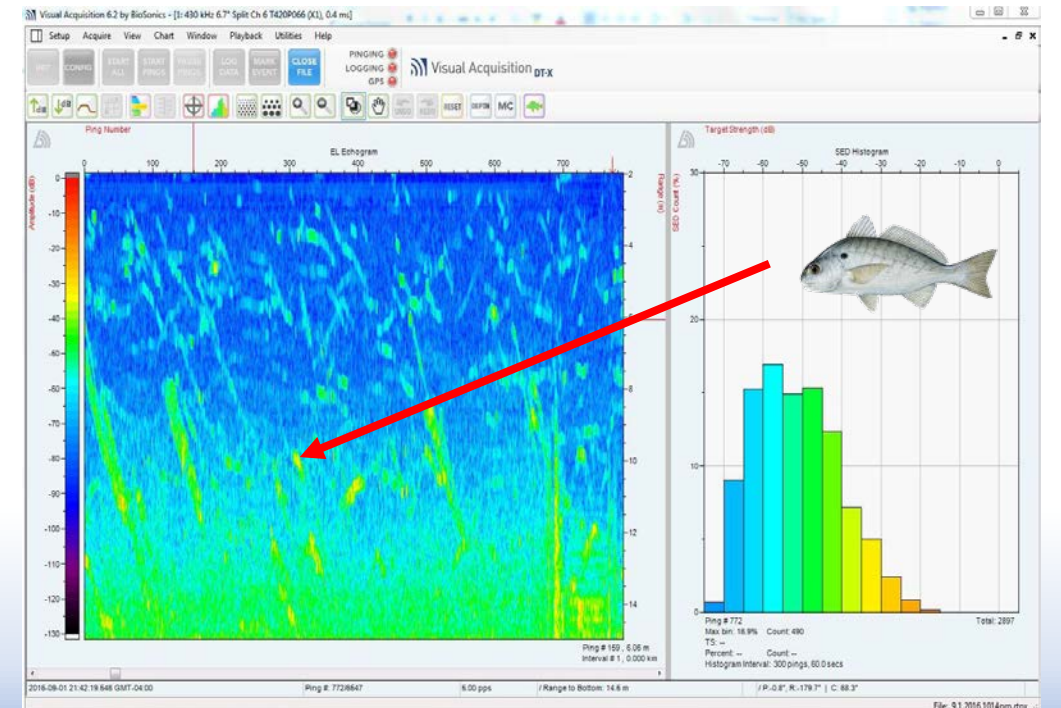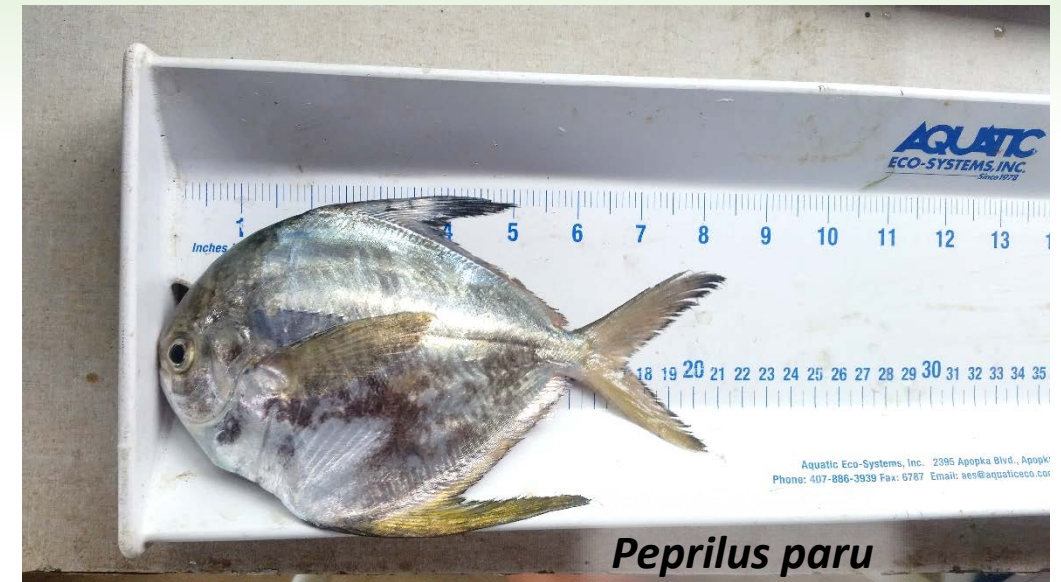
DATA

Hydroacoustic Data

- 54 surveys
- Track size range = 1.5mm to 1076 mm TL
- Gillnet-sized fish vs smaller than gillnet-sized fish
  - TS >-45 dB vs TS <-45 dB

Gillnet Data

- 84 sets
- Fish size range = 46 mm and 1280 mm (TL).
- Clupeid catch vs non-Clupeid Catch

Trap Data

- 120 sets (3 traps/set)
- Fishes, crabs, shrimps

Trapped Fishes- 20 spp. from 15 families

- Naked Goby (46% catch; 49% Freq. Occurrence)
- Silver Perch (15% catch; 12% FOC)
- Skilletfish (14% catch; 28% FOC)
- Oyster Toadfish (12%; 31% FOC)

Total CPUE/ Fish Only CPUE/ Fish Diversity

- Significant Difference among habitat types (CPUE ANOVA; F=10.25, p = 0.002)
  - Reef CPUE different from Off Reef and Outside sites
  - No Sig Difference between non-structured habitat types
- Study site differences for CPUE /Diversity
  - Palaces Reef site differed from all others (CPUE Burton- SE= 3.32; p=0.033; Fishing- SE= 3.46; p=0.004; Outside-SE= 4.69; p=0.036)
  - Differences among other sites were not statistically significant.

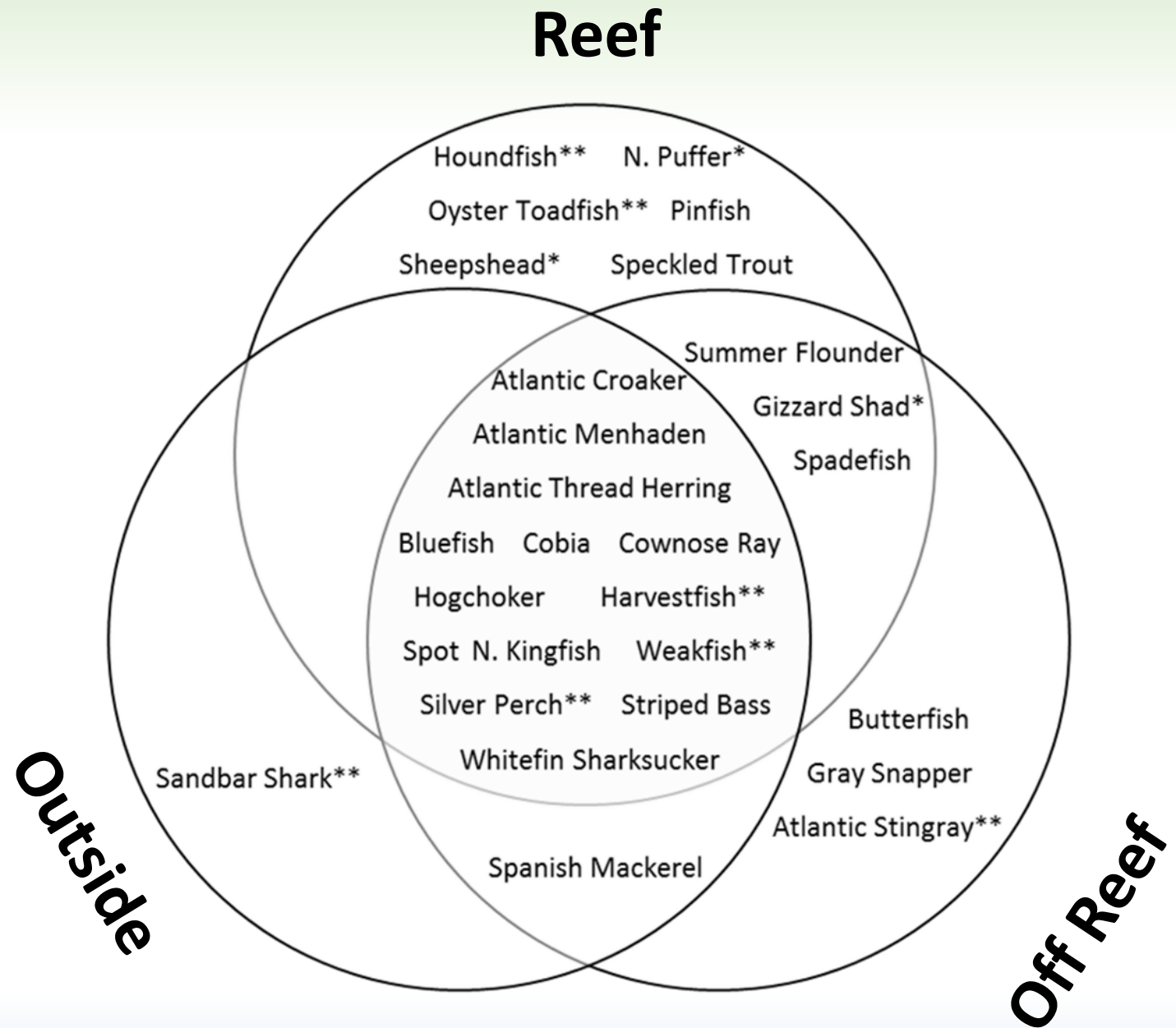# Diversity of trap captured fishes
Age? Distance? Structure?

EffectiveH by Habitat/Reef
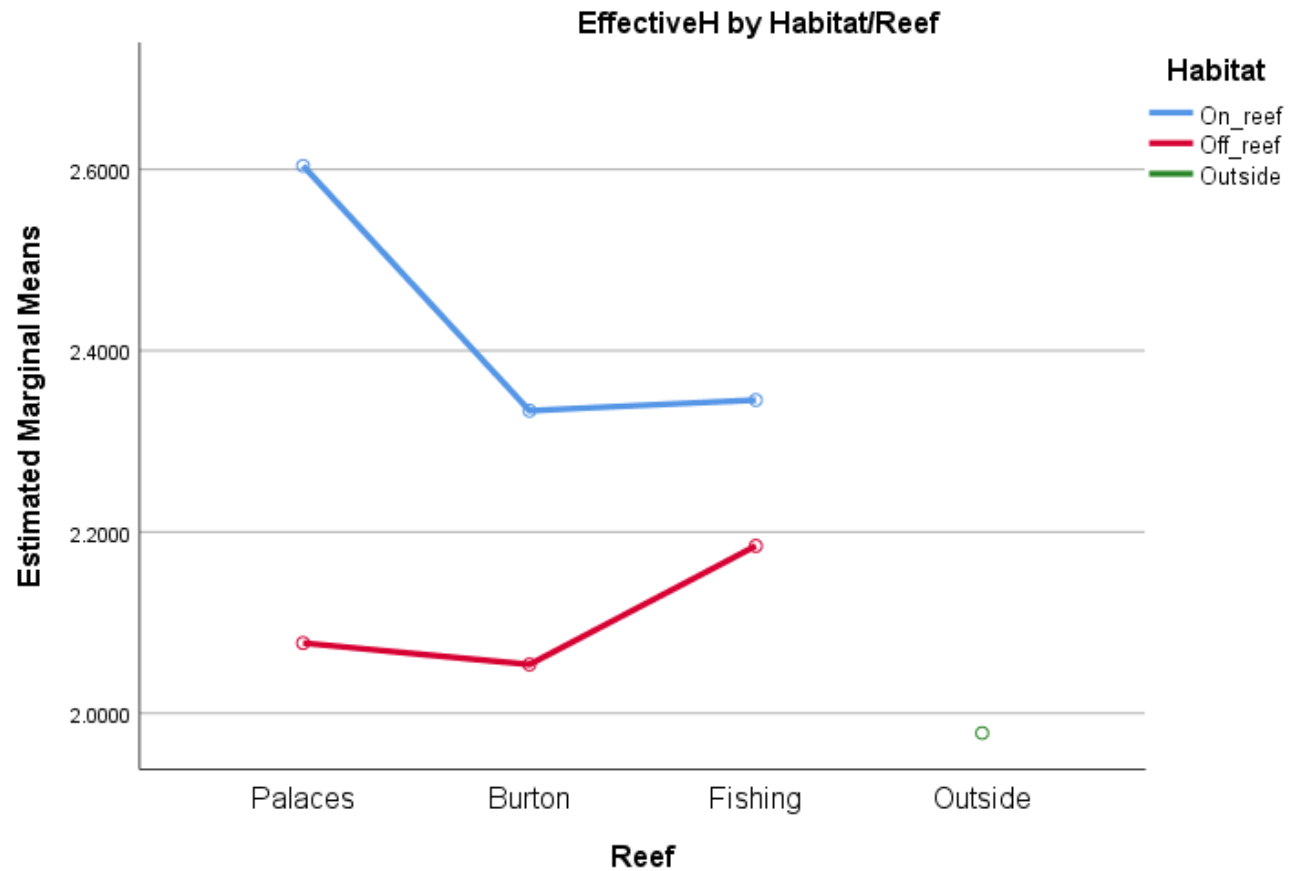
Results

- 2513 fish caught in 84 gill net sets

- 31 fish species, 24 families

- Richness
  - Reef = 23 (6 unique)
  - Off-reef = 20 (3 unique)
  - Outside = 16 (1 unique)

Reef

Outside

Off Reef

Houndfish**   N. Puffer*
Oyster Toadfish**   Pinfish
Sheepshead*   Speckled Trout

Summer Flounder
Atlantic Croaker
Gizzard Shad*
Atlantic Menhaden
Spadefish
Atlantic Thread Herring
Bluefish   Cobia   Cownose Ray
Hogchoker   Harvestfish**
Spot N. Kingfish   Weakfish**
Silver Perch**   Striped Bass
Butterfish
Whitefin Sharksucker
Gray Snapper
Sandbar Shark**
Atlantic Stingray**
Spanish Mackerel
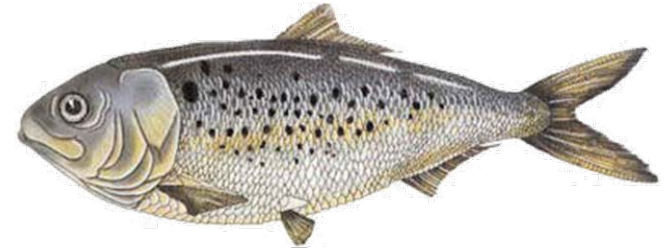
*Denotes species only caught during the day
**Denotes species only caught at night

Piankatank Species Composition

Clupeid Dominance

Atlantic Menhaden = 59%

Atlantic Thread Herring = 10%

Brevoortia tyrannus
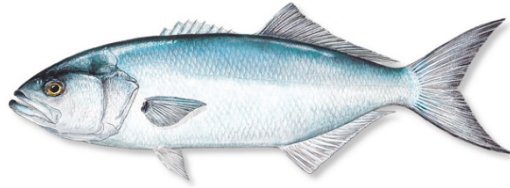
Opisthonema oglinum
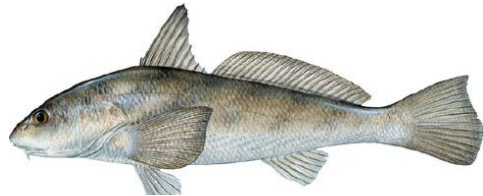
Piankatank Species Composition

Morone saxatilis

Micropogonius undulates

Pomatomus saltatrix

Leisostomus xanthurus

*Menticirrhus americanus*

Rachycentron canadum

Cynoscion regalis

Excluding Clupeids

- Striped Bass (24%)
- Atlantic Croaker (22%)
- Bluefish (15%)
- Spot (12%)
- Southern Kingfish (8%)
- Cobia (3%)
- Cownose Ray (3%)
- Weakfish (3%)
- Silver Perch (2%)
- Harvestfish (2%)
- Spadefish (2%)
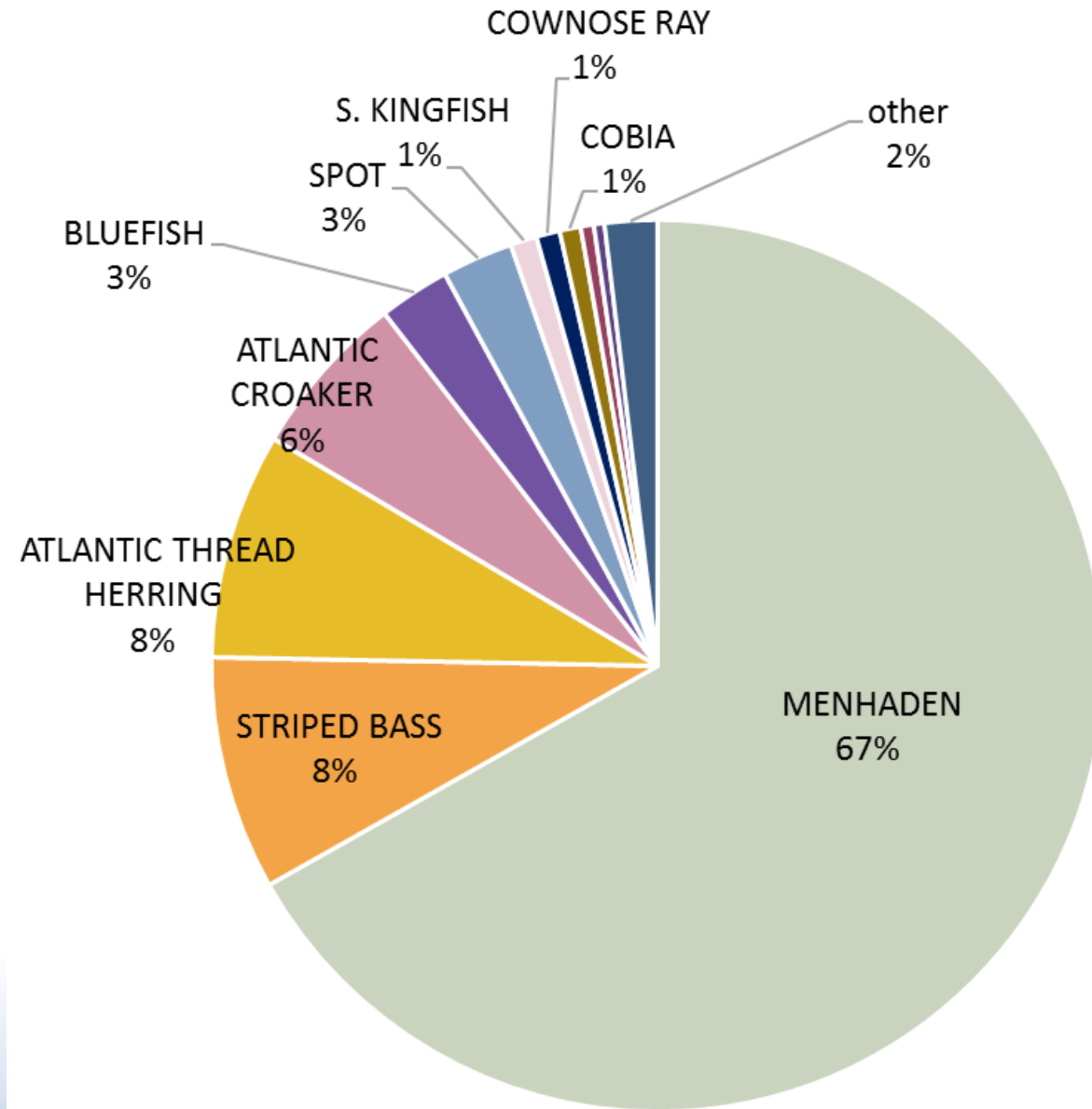- with all other species comprising 1% or less of total catch.

On Reef Community

- Clupeids = 67%
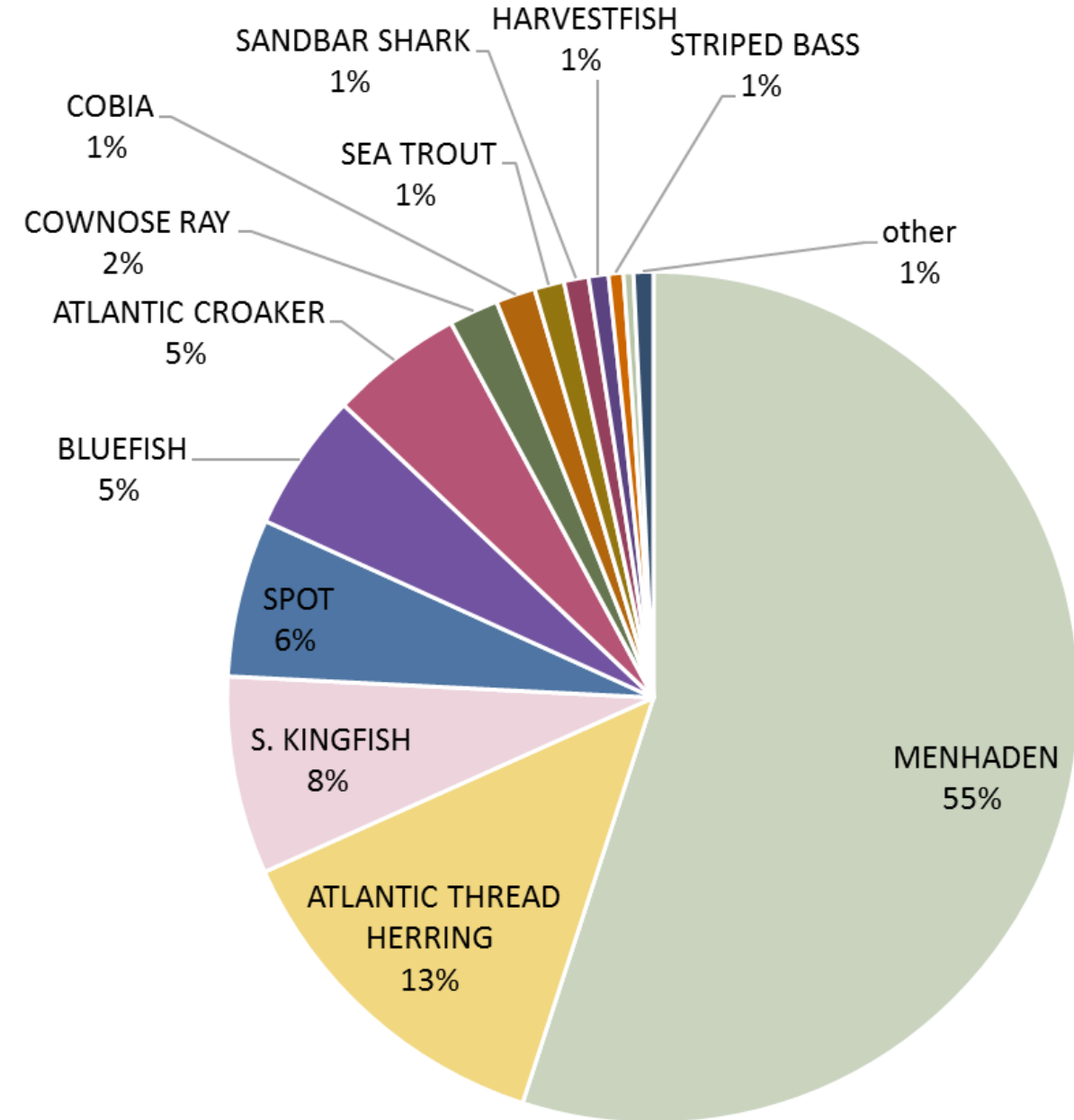- Striped Bass, Atlantic Croaker caught
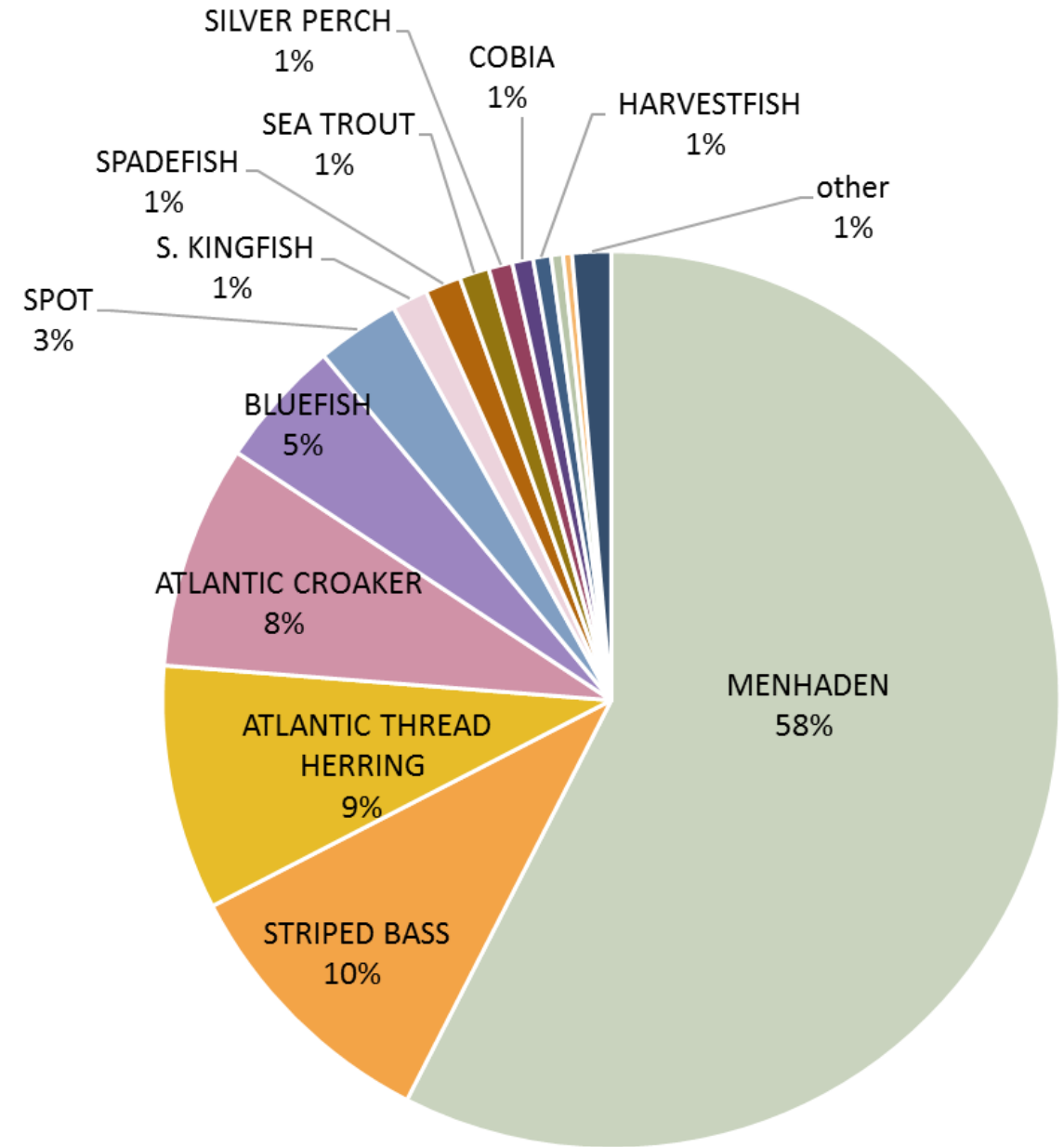
Off Reef Community

- Clupeids = 75%
- Atlantic Menhaden, Atlantic Thread Herring

Outside Reef Complex Community

- Clupeids = 68%
- S. Kingfish, Spot, Bluefish, Cobia

Diversity

Multi-factorial ANOVA on *H'*
- Habitat type
- Day of year
- Day or night

| Source of Variation	df	SS	$\frac{\text{Term SS}}{\text{Total SS}}$	F	p
Diversity (H')					
Habitat	2	1.42	0.06	3.18	0.048
Day of Year	1	0.06	0.00	0.00	0.958
Day or Night	1	2.88	0.13	12.86	0.001
Habitat * Day of Year	2	0.69	0.03	1.54	0.221
Habitat * Day or Night	2	1.07	0.05	2.39	0.099
Day of Year * Day or Night	1	0.00	0.00	0.00	0.973
Habitat * Day of Year * Day or Night	2	0.17	0.01	0.38	0.685
Residuals	72	16.12	0.72		

Residual SE = 0.47 on 72 degrees of freedom
Model $R^2 = 0.29$

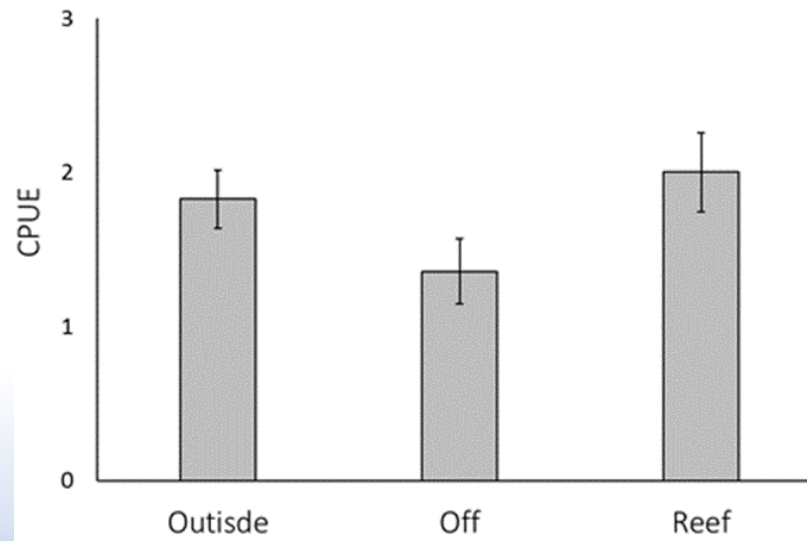# Abundance by Habitat Type

Clupeid Catch

$p = 0.686$
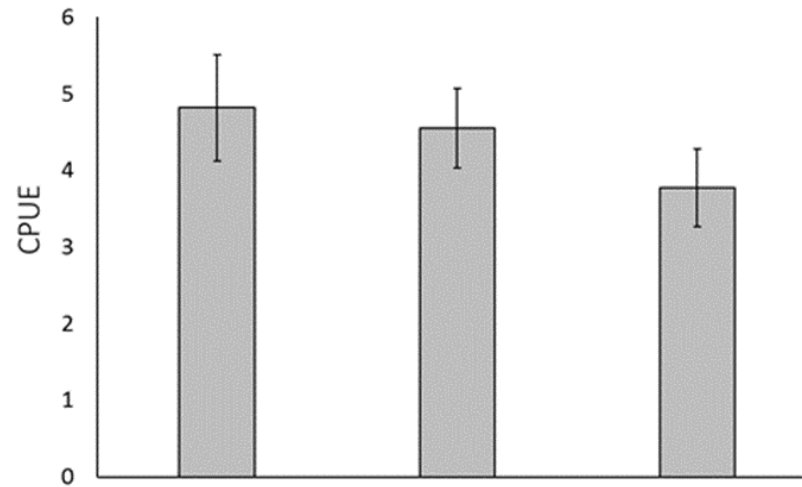
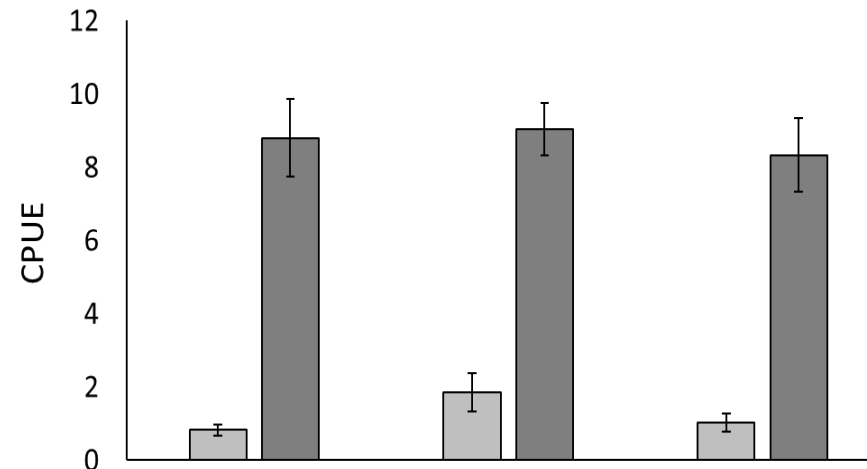Non-Clupeid Catch

$p = 0.416$

Abundance Day and Night by Habitat Type

Clupeid Catch

p = 0.000
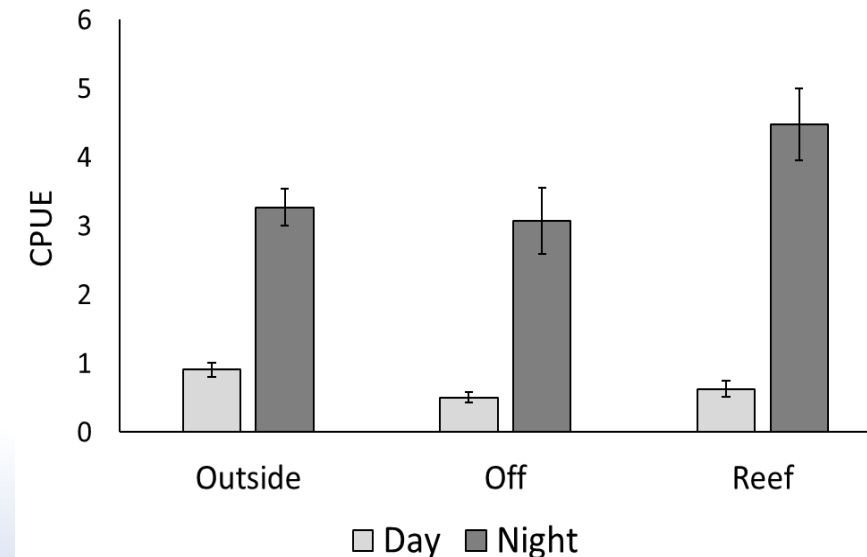Night mean CPUE = 3.63 ± 0.26
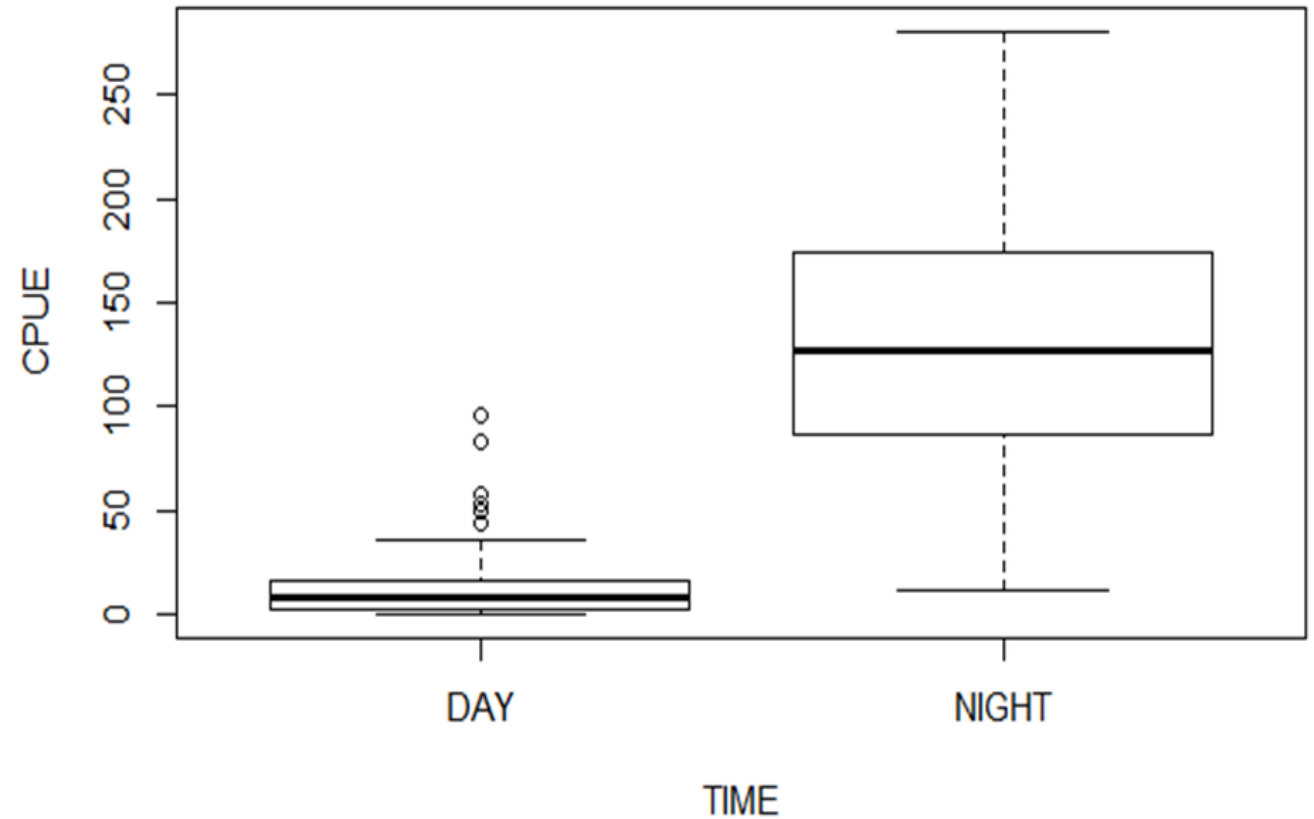Day mean CPUE = 0.63 ± 0.05

Non-Clupeid Catch

p = 0.000
Night mean CPUE = 8.72 ± 0.51
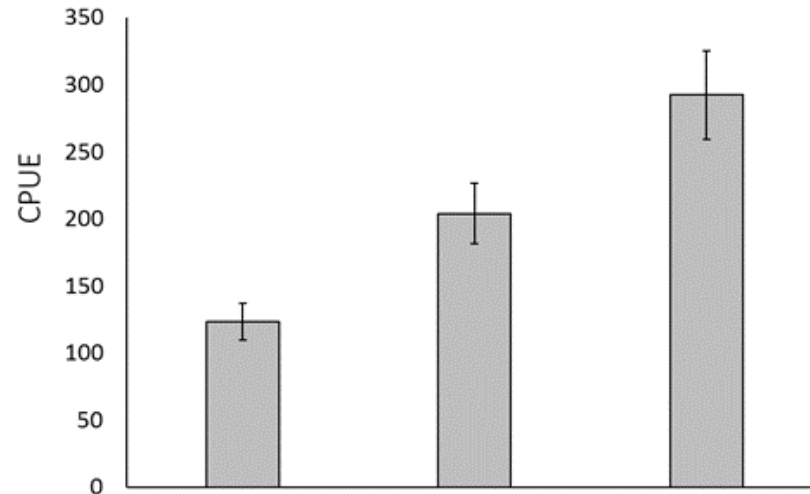Day mean CPUE = 1.32 ± 0.23

Day vs Night

- Night = 89% of total gillnet catch

  - Weakfish (n=20)
  - Harvestfish (n=15)
  - Silver Perch (n=14)
  - Sandbar Shark (n=5)
  - Butterfish, Houndfish (n=1)
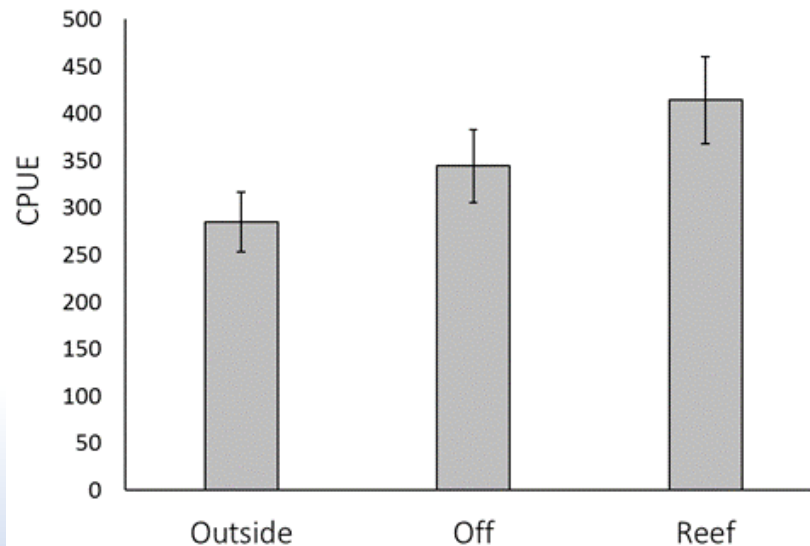
Hydroacoustic Data; Abundance by Habitat

Tracks with TS > -45 dB
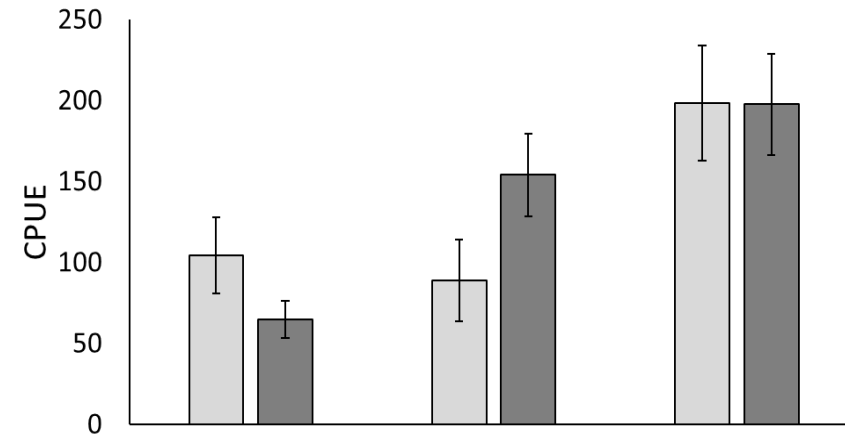
p = 0.073

Tracks with TS < -45 dB
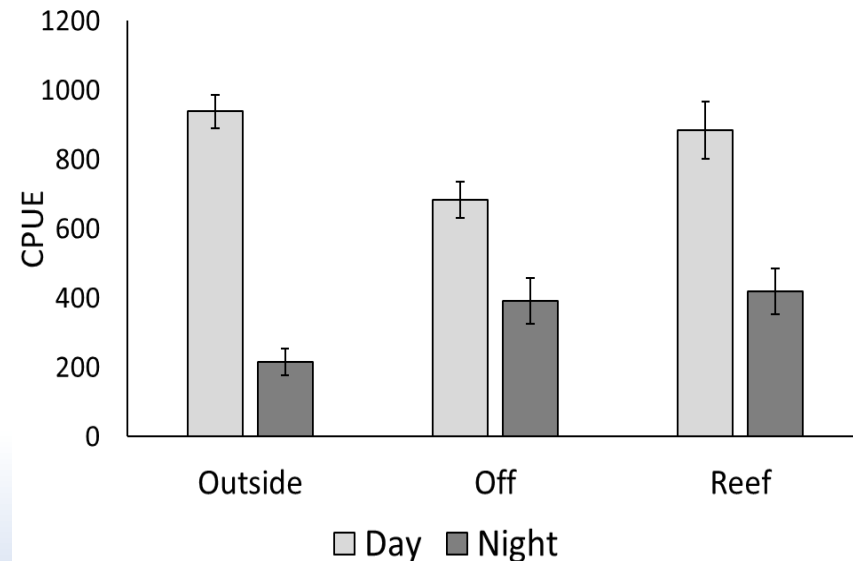
p = 0.138

Abundance Day and Night by Habitat

Tracks with TS > -45 dB

p = 0.106

Tracks with TS < -45 dB

p = 0.667
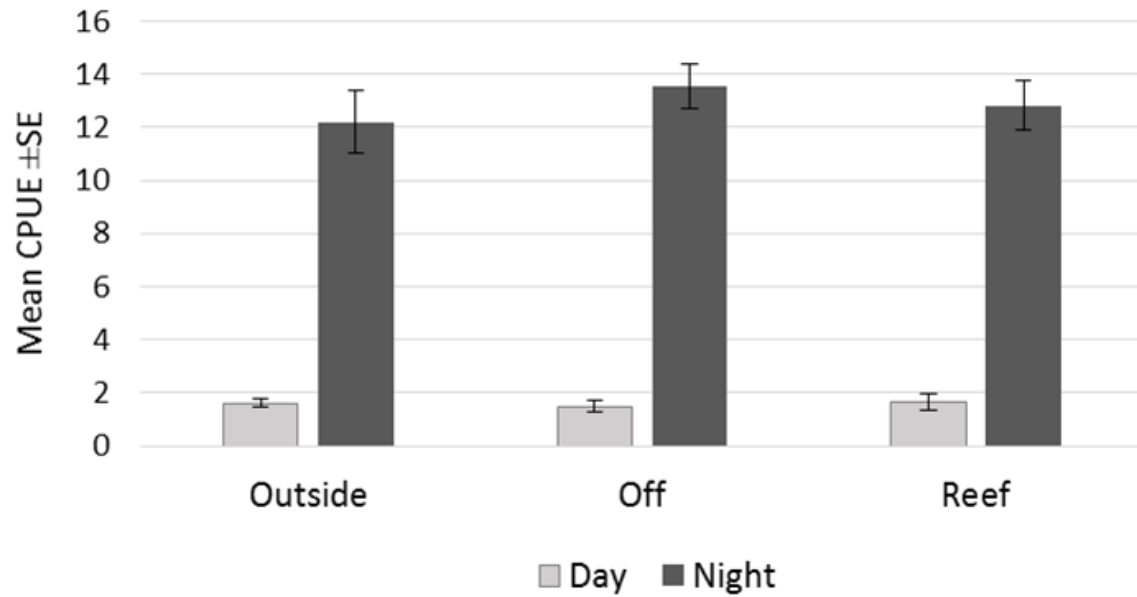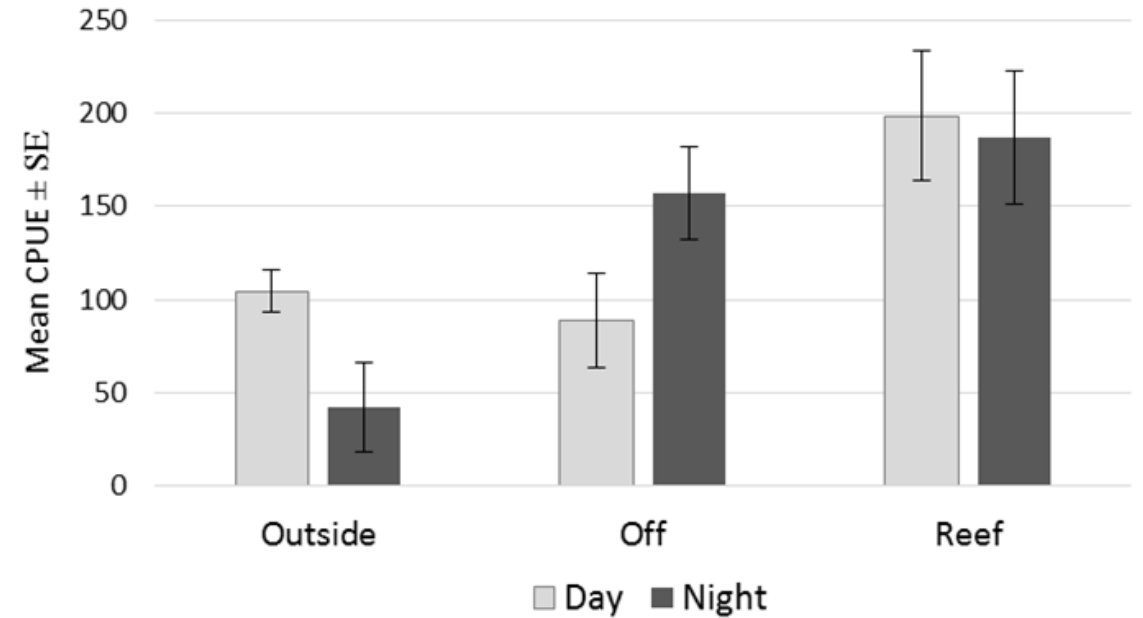
Day vs Night

Caught Fish Day and Night

Fish Tracks Day and Night
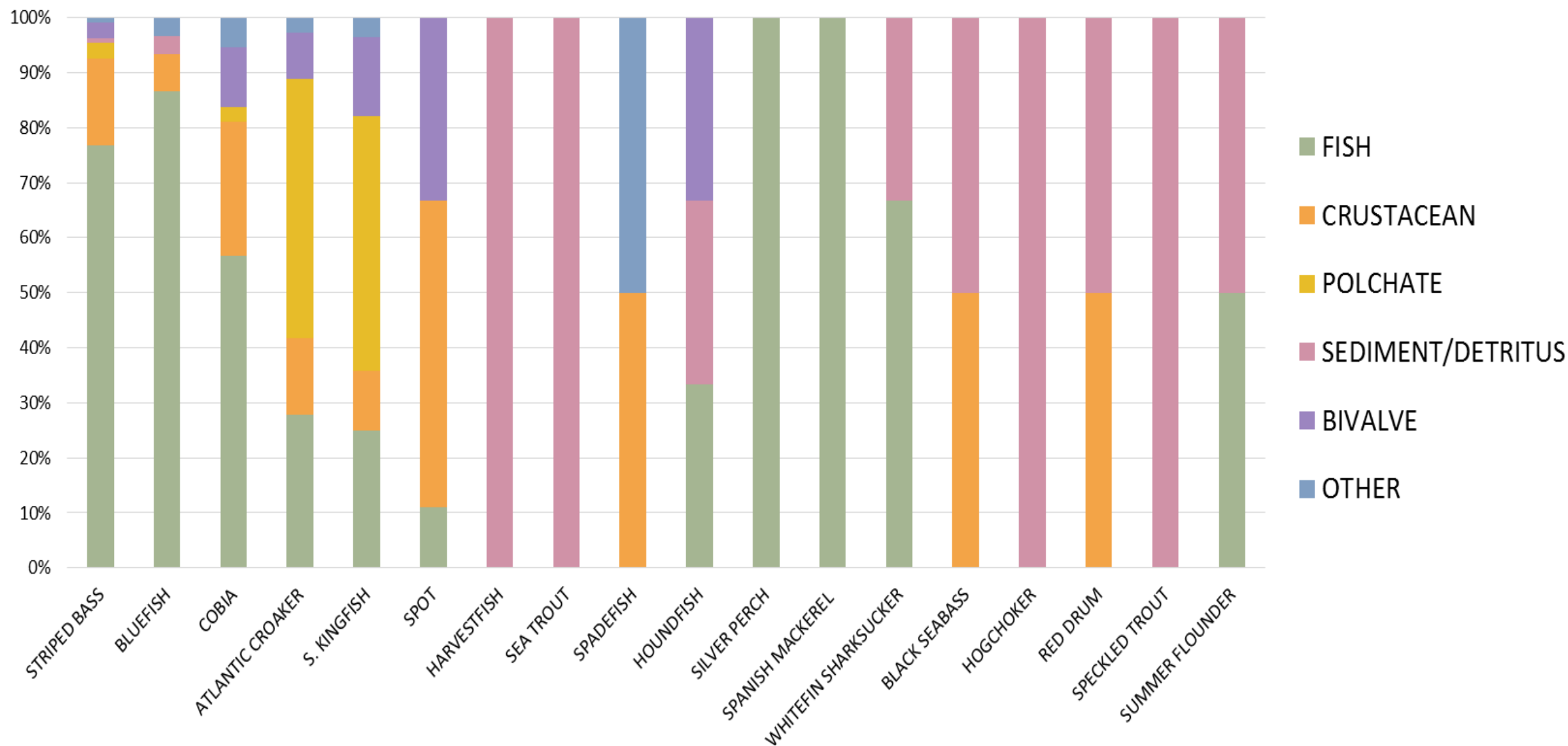
Abundance Conclusions

- Pelagic Fish assemblages not significantly more diverse or dense on reef habitat

- Temporal factors influence fish assemblages more

- Daytime vs nighttime differences in diversity and density are significant

- Gillnet and hydroacoustic results conflicting – Gear bias?

Trophic Connections

- About 600 specimens from 18 species; 25% empty
- Of those with contents- 39% contained fish, 34% -sediment/detritus, 11% -crustaceans, 9% polychaetes, 5% bivalves, and 2% contained (other)
- About 60% of food items could not be identified to any specific habitat type.
- Bluefish and Striped Bass had more mud crab spp. in their stomachs than any other species.

TOTAL CONTENT PERCENTAGE FOR EACH SPECIES

Legend:
- FISH
- CRUSTACEAN
- POLCHATE
- SEDIMENT/DETRITUS
- BIVALVE
- OTHER

Species (x-axis): STRIPED BASS, BLUEFISH, COBIA, ATLANTIC CROAKER, S. KINGFISH, SPOT, HARVESTFISH, SEA TROUT, SPADEFISH, HOUNDFISH, SILVER PERCH, SPANISH MACKEREL, WHITEFIN SHARKSUCKER, BLACK SEABASS, HOGCHOKER, RED DRUM, SPECKLED TROUT, SUMMER FLOUNDER

Stable Isotope Analysis C, N

- Piscivores: Striped Bass, Bluefish, Spanish Mackerel
- Invertivores: Atlantic Croaker, Spot, Kingfish, Cobia
- Planktivores: Atlantic Thread Herring, Atlantic Menhaden,
- Reef Residents: Naked Goby, Striped Blenny, Oyster Toadfish, Skilletfish
- Reef-captured Decapods: Mud Crab spp. and Shrimp spp.
- 149 – 96 samples

δ¹³C and ¹⁵N in fish and decapod tissue from the Piankatank River. Circles represent Mean signatures ± SE by group.

Mean ± SE signatures by group ∂13C and ∂15N
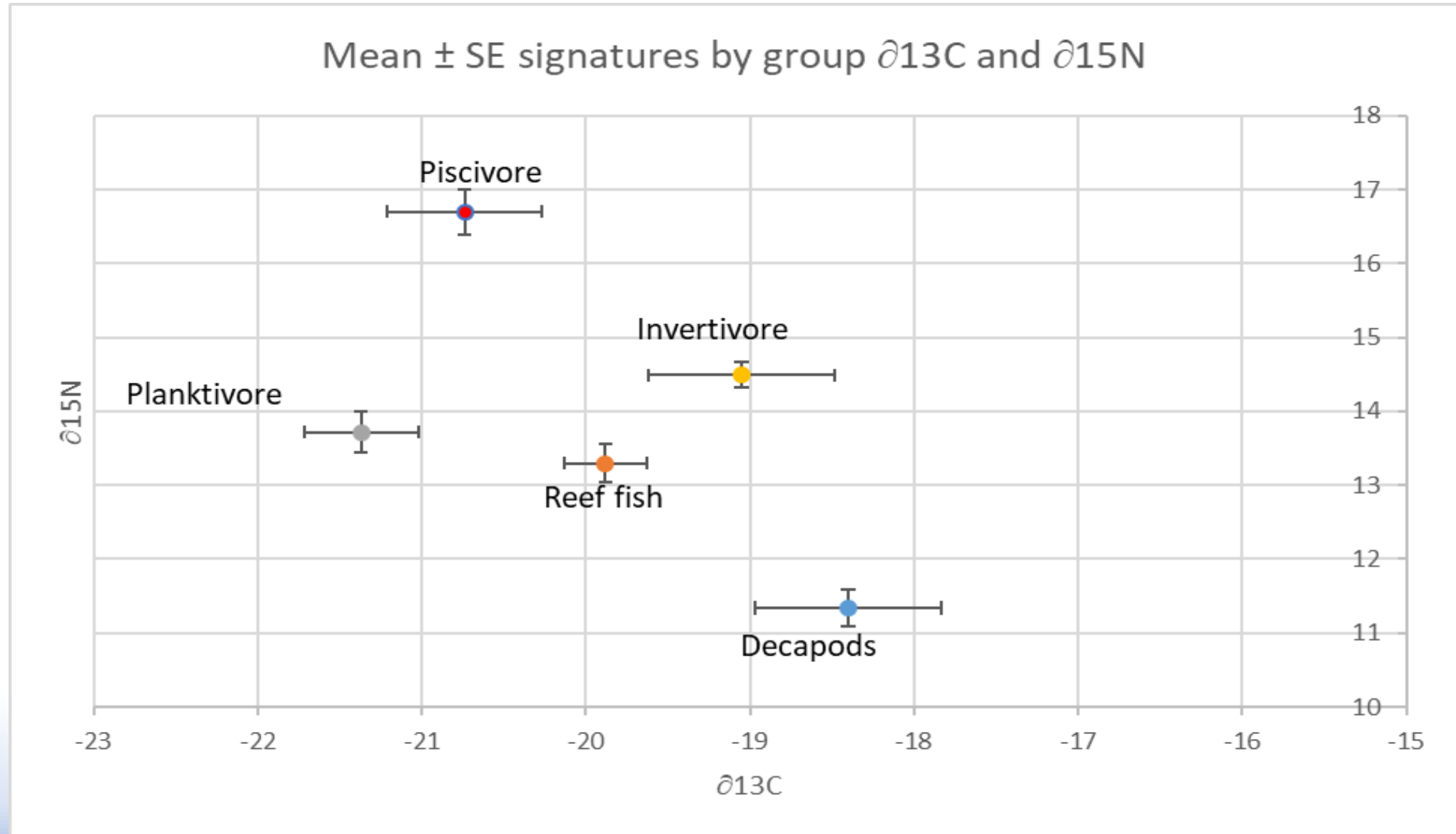
Conclusions

- Restoration of Oyster reef habitat significantly enhances resident, benthic fishes; diversity and abundance.

- Increases in these metrics may be seen with age/complexity of reef

- Pelagic/transient fishes exhibit more temporal variation (day/night, seasonality) in diversity and abundance than habitat linked variation.

- Nocturnal sampling is important to fully understanding community.

- A number of trophic pathways exist within the Lower Piankatank River oyster reef complex.

Thank You!