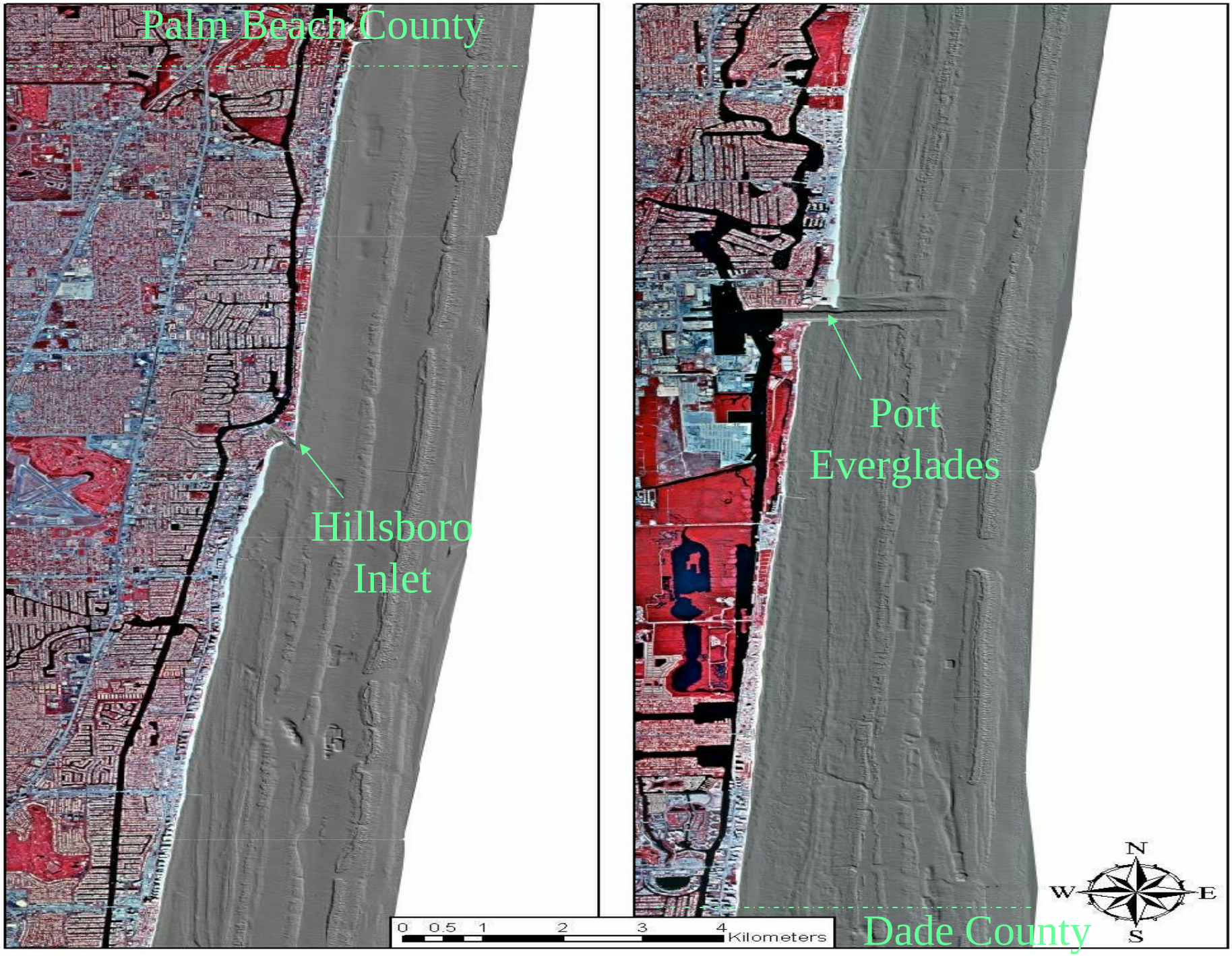
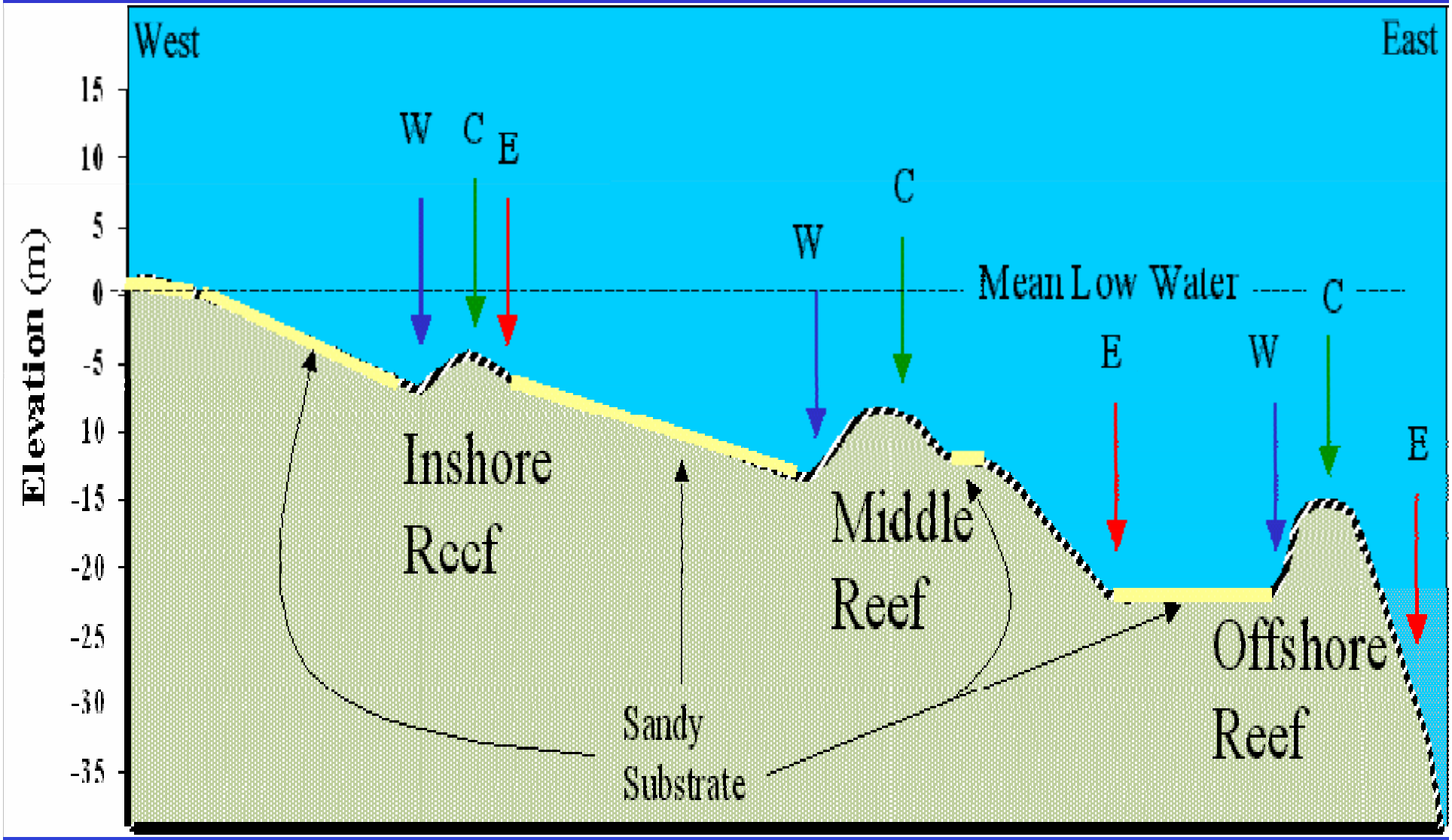
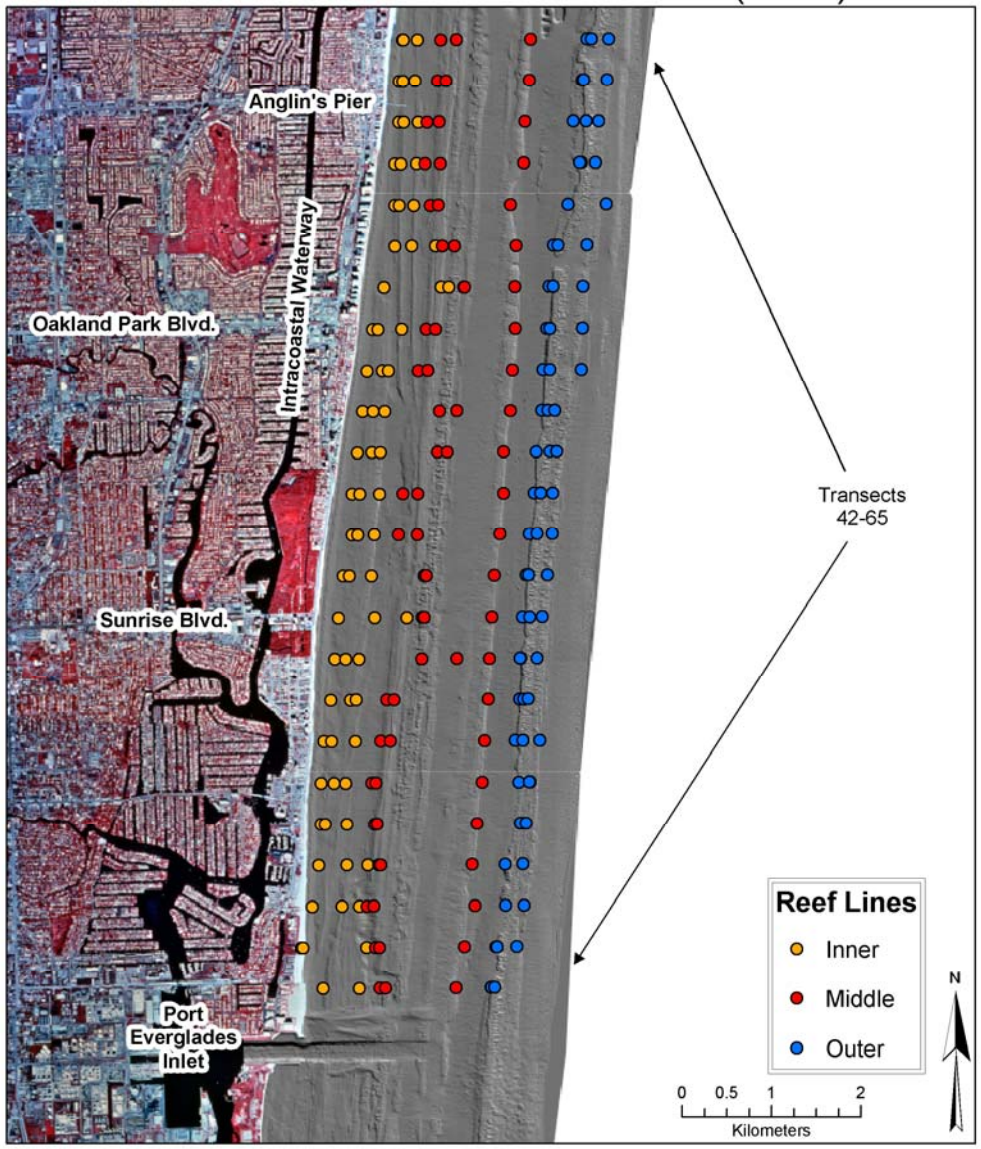
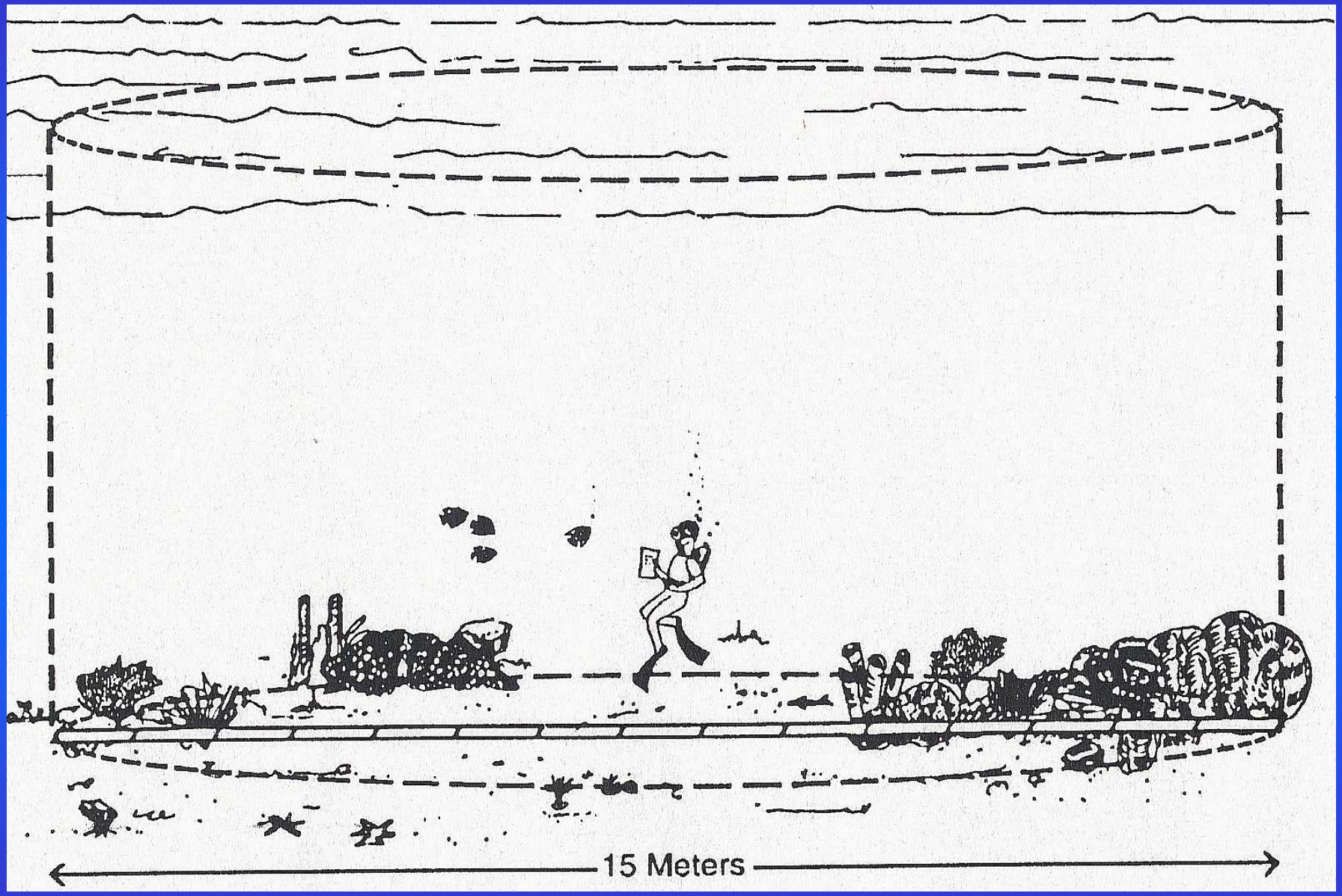
Coral Reef Fish Census Offshore Broward County, Florida


Palm Beach County
Hillsboro
Inlet
Port
Everglades
Dade County
0 0.5 1 2 3 4
Kilometers
N
W
E
S


West
East
Elevation (m)
15
10
5
0
-5
10
-15
-20
-25
-30
-35
W
C
E
W
C
Mean Low Water
C
E
W
E
Inshore
Reef
Middle
Reef
Offshore
Reef
Sandy
Substrate

NOAA North Broward Fish Transects (42-65)

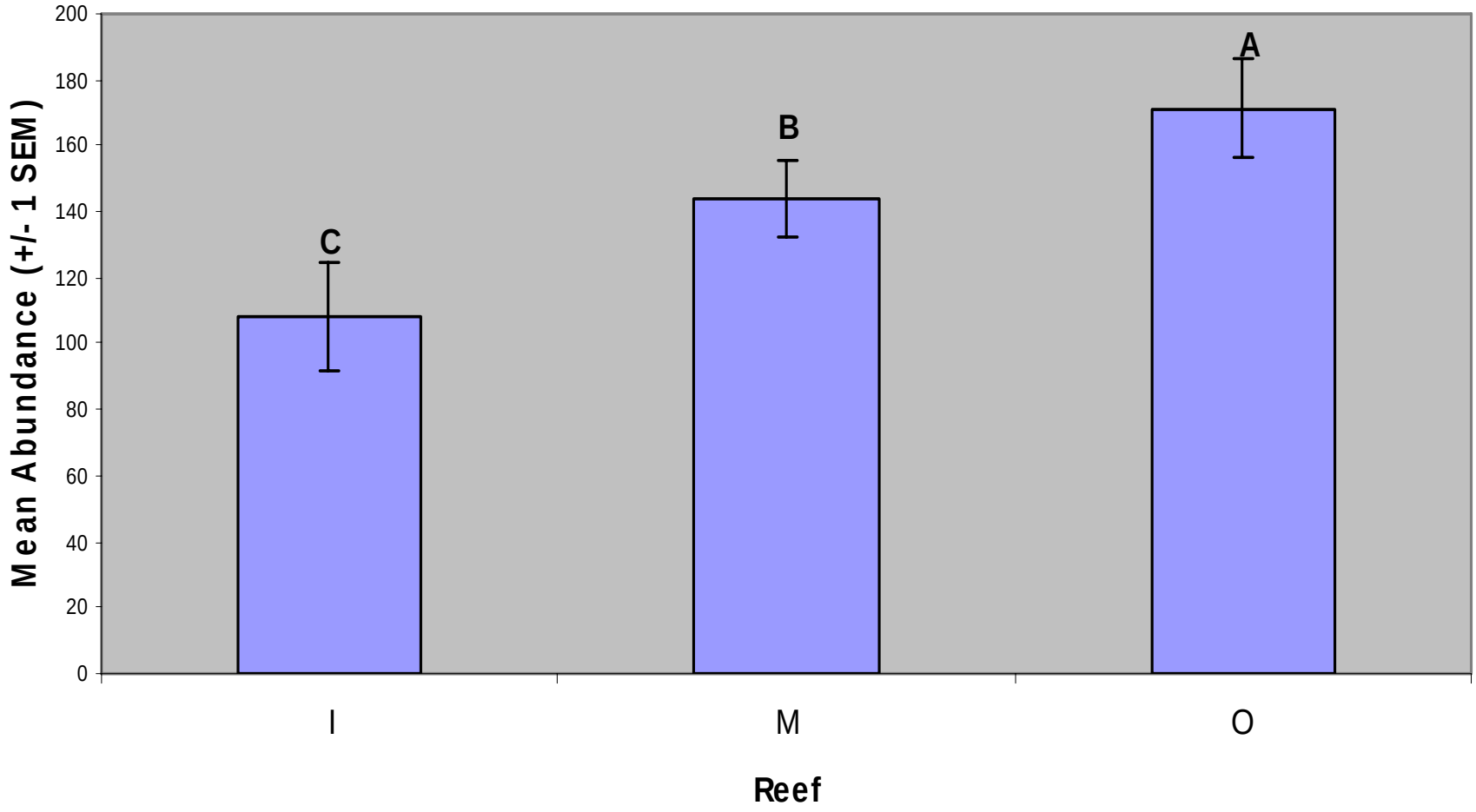



15 Meters

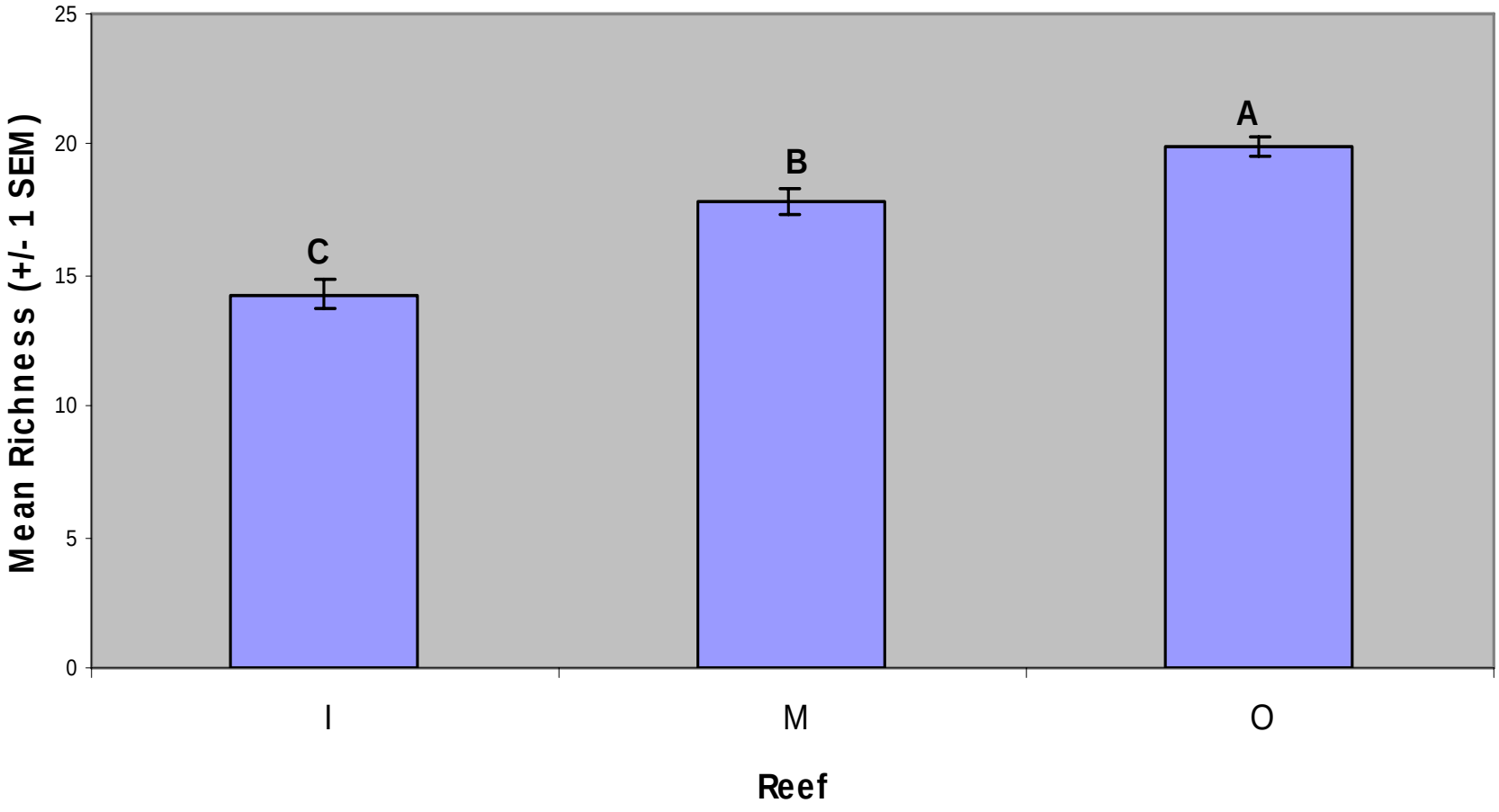
Fish Assemblage Structure

- 667 sites between August ’98 & November ’02
- 86,463 total fish
- 52 families
- 208 species
- Inshore Reef: 143 spp. (11 exclusively)
- Middle Reef: 169 spp. (8 exclusively)
- Offshore Reef: 173 spp. (18 exclusively

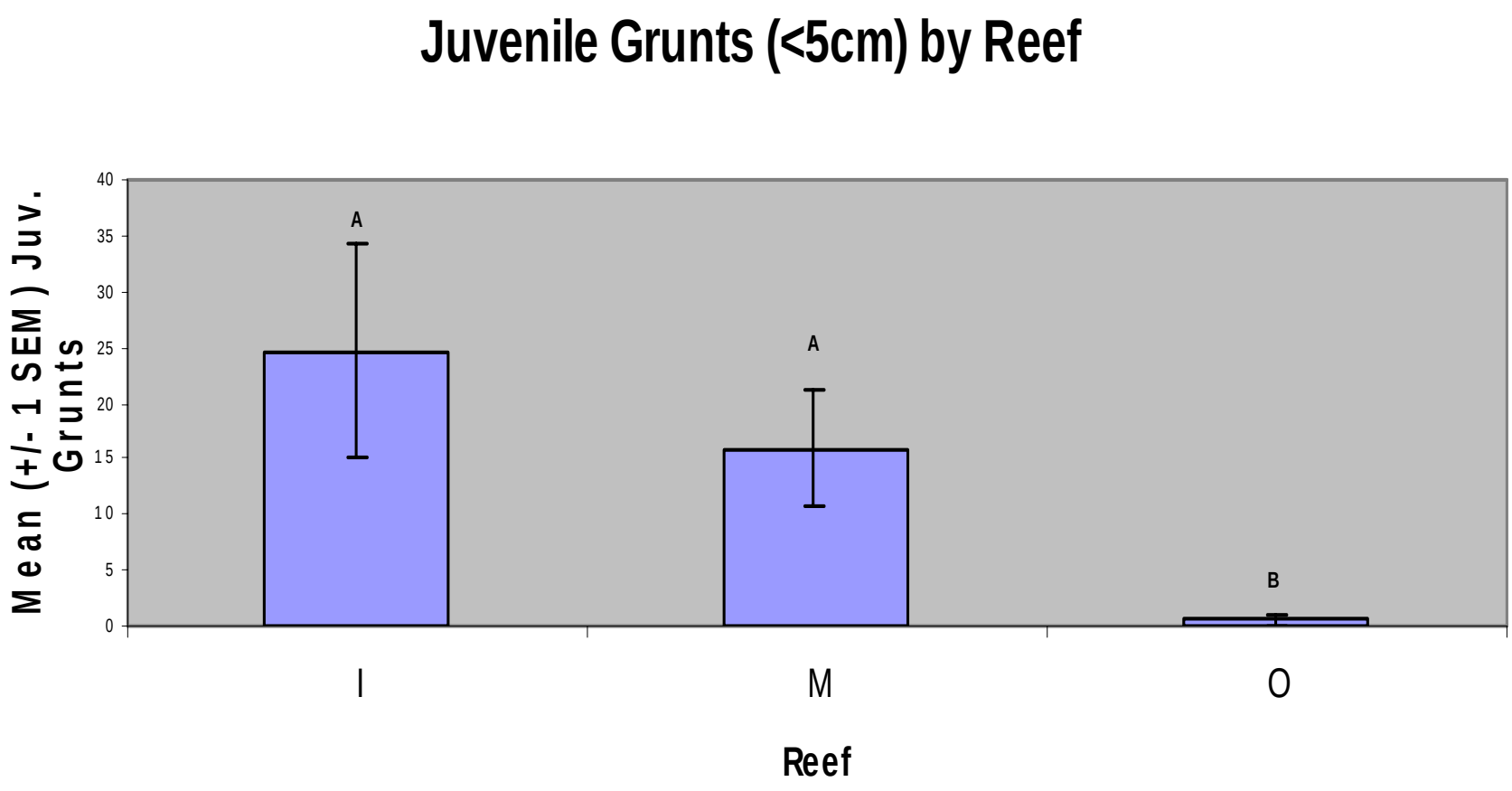
Abundance by reef



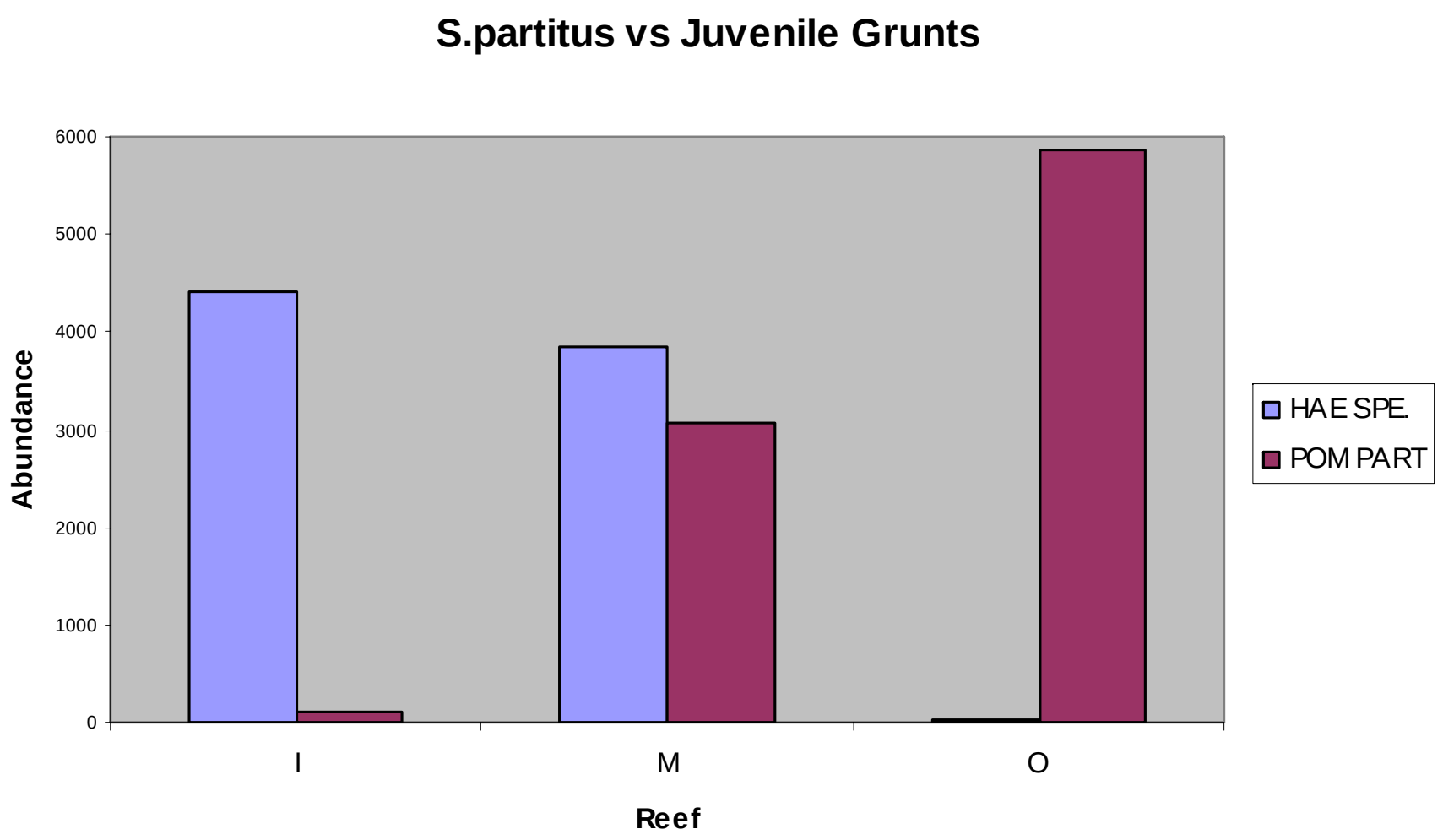
Mean (+/- 1 SEM) abundance for each reef tract. Different letters (A,B,C) indicate significantly different reefs ($p<0.05$, ANOVA, SNK).



Mean (+/- 1 SEM) species richness for each reef tract. Different letters (A,B,C) indicate significantly different reefs ($p<0.05$, ANOVA, SNK).



Mean (+/- 1 SEM) juvenile grunts (<5cm) by reef. Different letters (A, B) indicate significantly different means.



Graph of total juvenile Haemulids and *S. partitus* by reef.

Serranidae

- Commercially and recreationally important
- 393 total groupers counted
- I= 87, M= 158, O=148

Species	# **Total**	# **Legal**
Epinephelus adscensionis	4	0
Epinephelus cruentatus	127	18
Epinephelus fulvus	2	0
Epinephelus guttatus	8	3
Epinephelus morio	232	2
Mycteroperca interstitialis	1	0
Mycteroperca phenax	8	0
Mycteroperca venenosa	1	0

Lutjanidae

- Commercially and recreationally important
- 718 total snappers counted
- I= 294, M=256, O=168

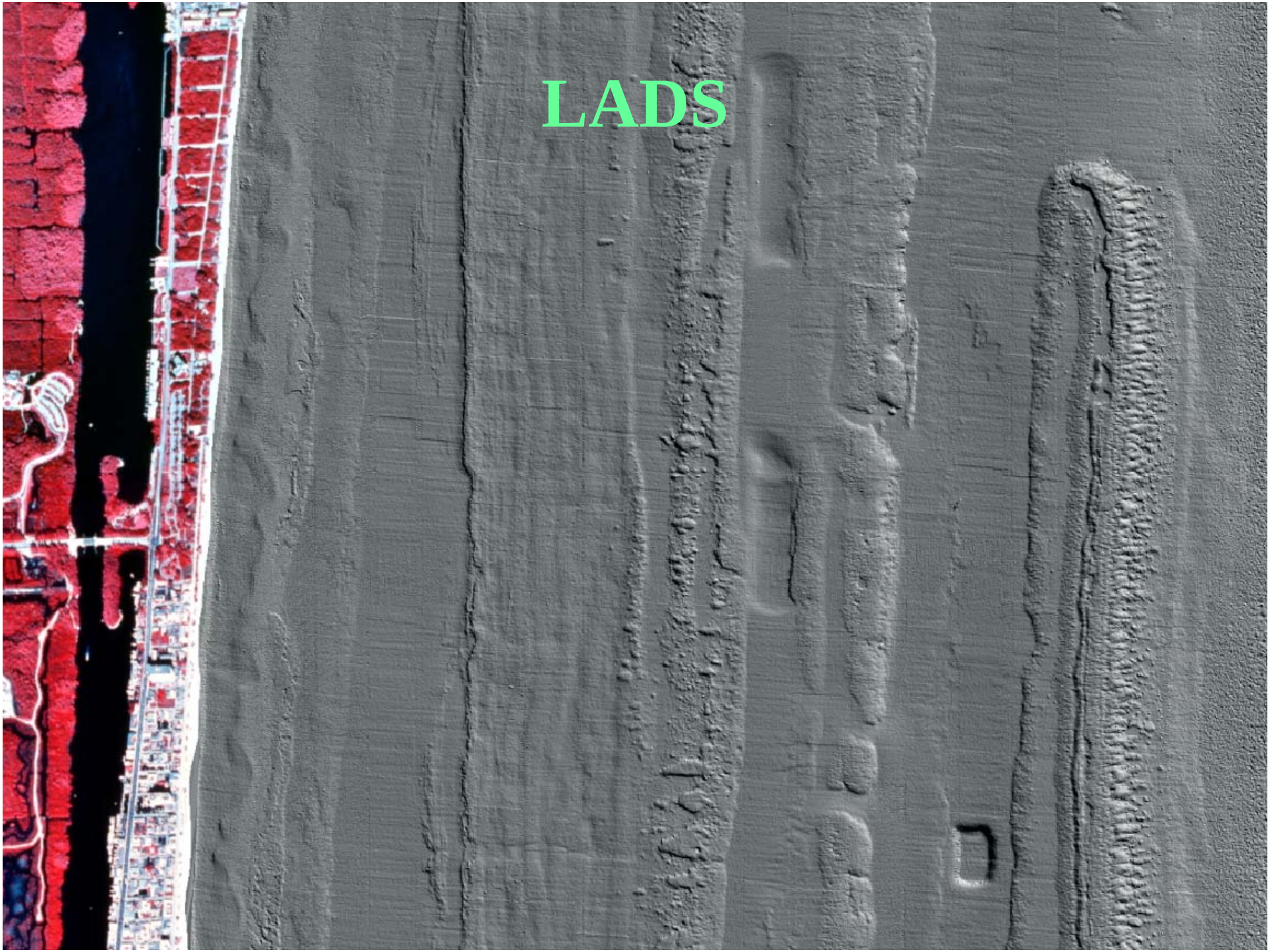
Snappers		
Species	# Total	# Legal
Lutjanus analis	84	16
Lutjanus apodus	34	27
Lutjanus griseus	188	72
Lutjanus synagris	99	71
Ocyrus chrysurus	312	33
Lutjanus jocu	1	0

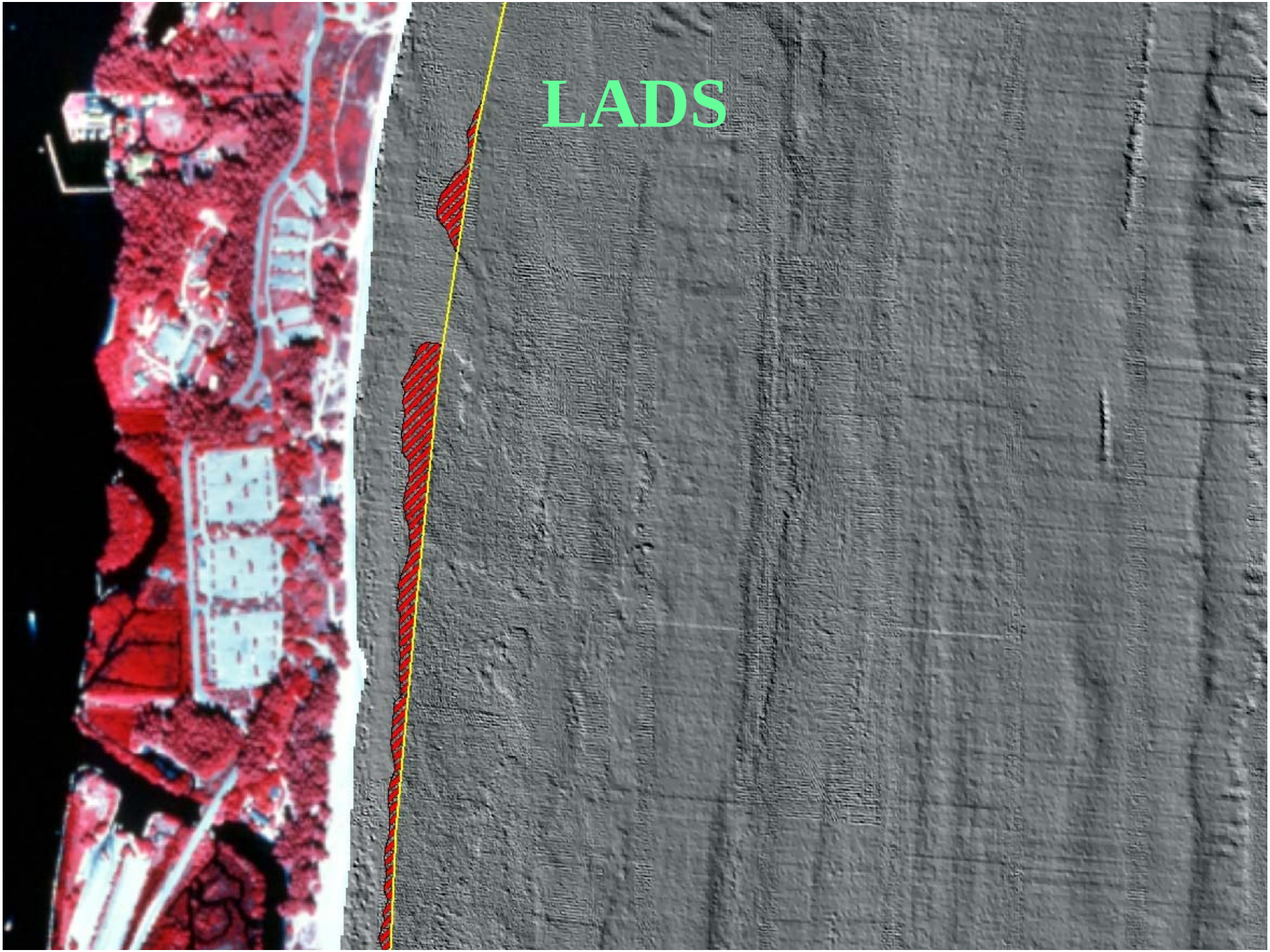
Total and legal size snappers counted.

Conclusions

- Baseline data for determining change
- Management decisions
- Starting point for more detailed studies

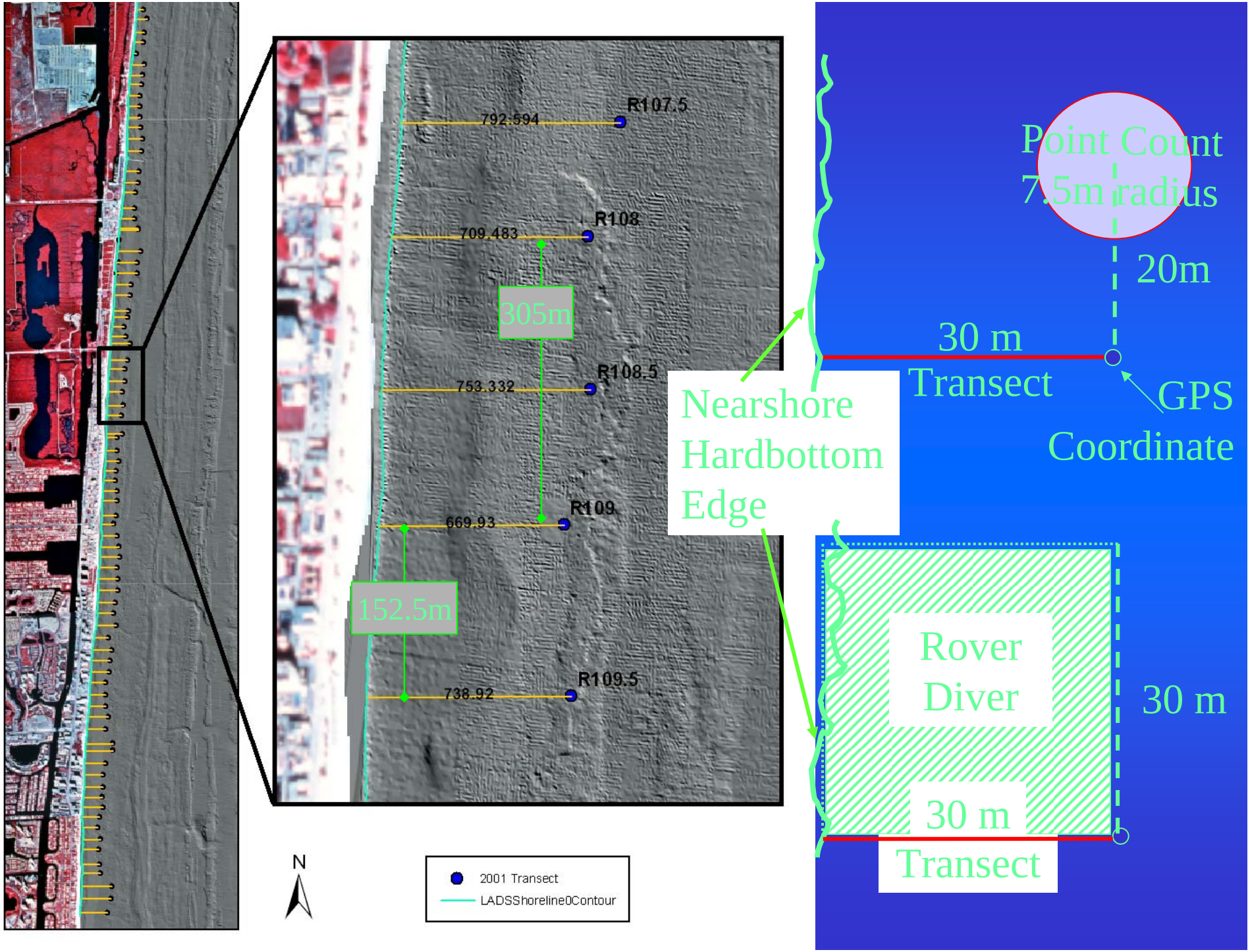
Implications of Natural Variation of Fish Assemblages to Coral Reef Management


LADS


LADS

Purpose

- Assess Nearshore Hardbottom Fish Community
- Establish ‘Baseline’
- Determine Effect of Anthropogenic Influence (Post-Construction)


R107.5
792.594
R108
709.483
305m
R108.5
753.332
R109
669.93
152.5m
R109.5
738.92
N
2001 Transect
LADSShoreline0Contour
Point Count
7.5m radius
20m
30 m
Transect
GPS
Coordinate
Nearshore
Hardbottom
Edge
Rover
Diver
30 m
30 m
Transect

Methods

- June-August 2001- 200 sites
  - North and South of Port Everglades
- August 2003- 89 Sites
  - South of Port Everglades Only

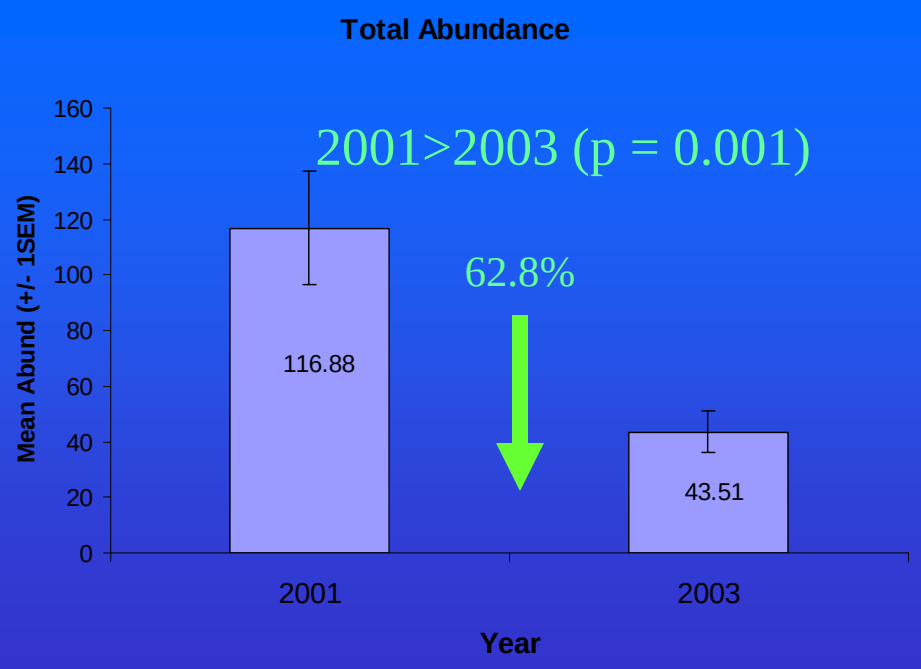
- Compare South Only to Examine Variation
  - Univariate
  - Multivariate

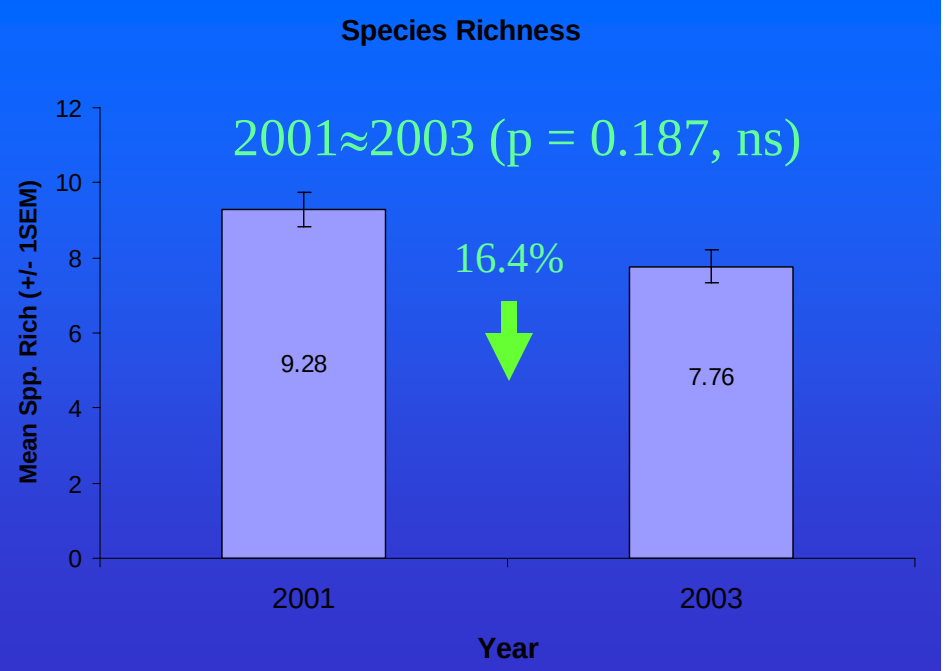
Results

- General
  - 30685 Fishes and 163 Species
  - Major Species
    - **Juvenile (<5cm TL) *Haemulon* spp. (Haemulidae)**
    - ***Halichoeres bivittatus* (Labridae)**
    - ***Haemulon aurolineatum* (Haemulidae)**
    - ***Haemulon plumierii* (Haemulidae)**
    - ***Haemulon flavolineatum* (Haemulidae)**
    - ***Stegastes variabilis* (Pomacentridae)**
    - ***Sparisoma radiatus* (Scaridae)**

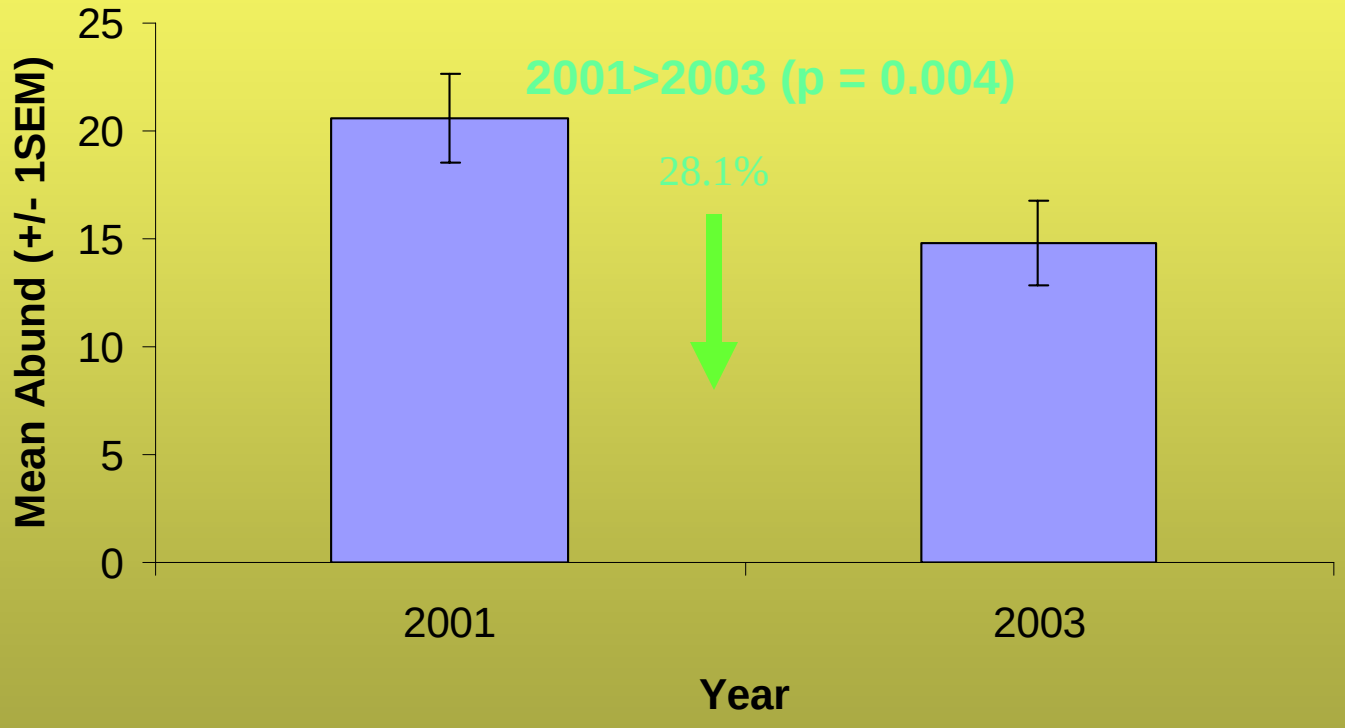
Results

- Univariate (t-test)
  - Point-Count
  - **Transect-Count**
    - More Effective in this Habitat (Baron et al., 2004)



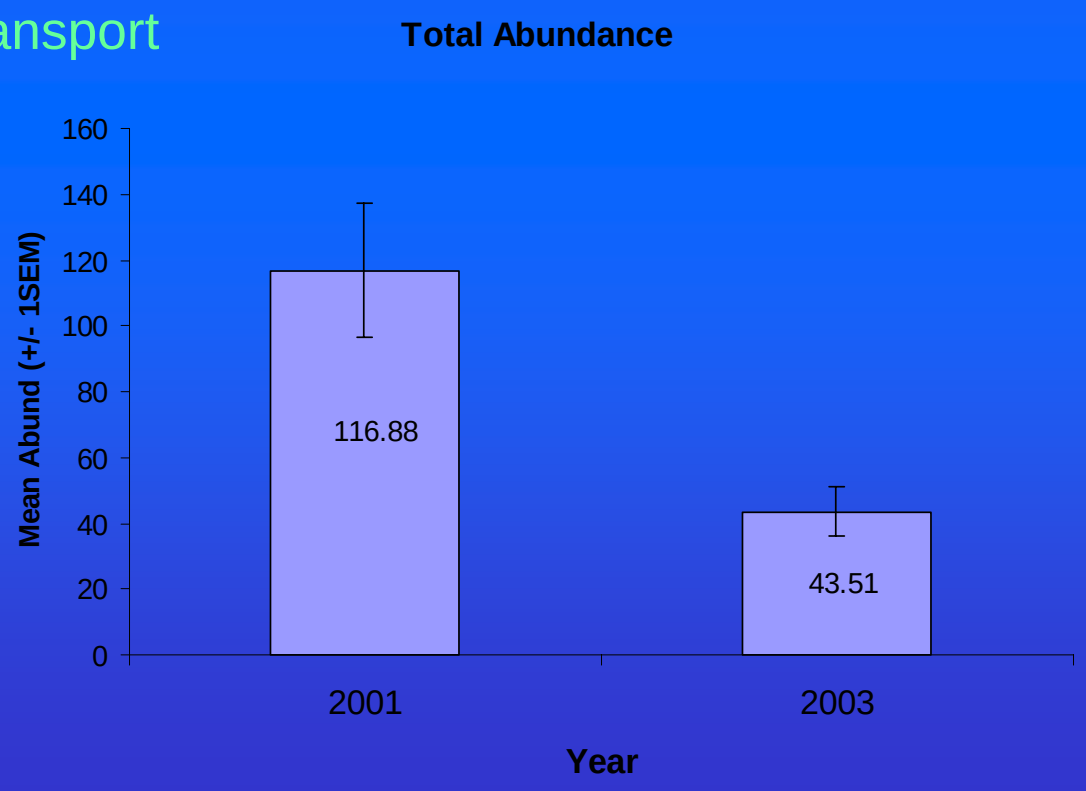


Total Abundance Excluding Juvenile *Haemulon* spp. and *Halichoeres bivittatus*



Summary

- Dynamic Habitat
  - Physically
    - Close to Shore
    - Longshore Sand Transport
  - Biologically
    - Recruitment
    - Emigration

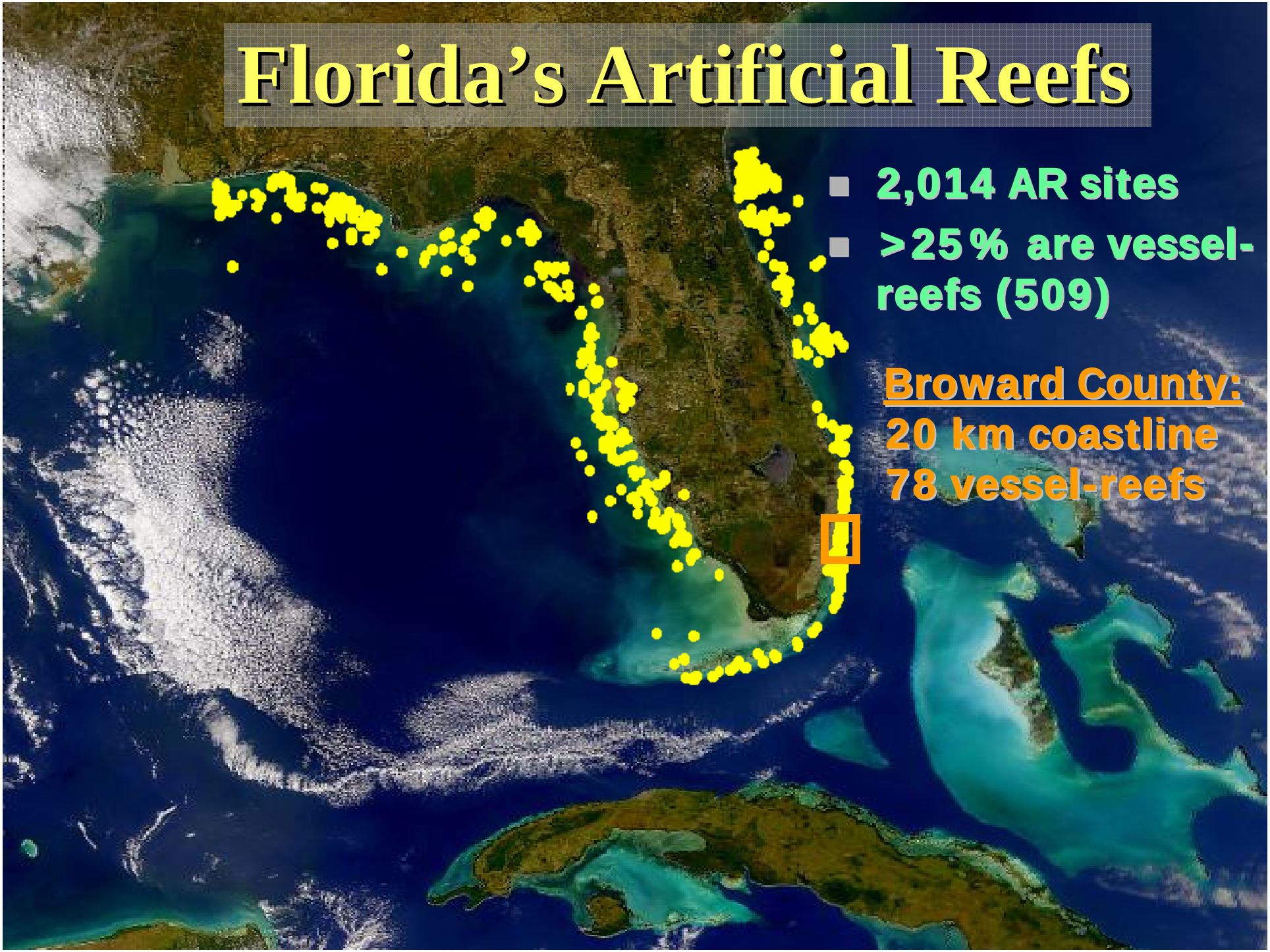


The “Take-Home”

- Use All Available Methodologies
- Some Species and Size-classes Are Highly Variable
- The More Pre-impact Data, the Better
- The Need for Caution When Attempting to Correlate Assemblage Change to a Anthropogenic Event

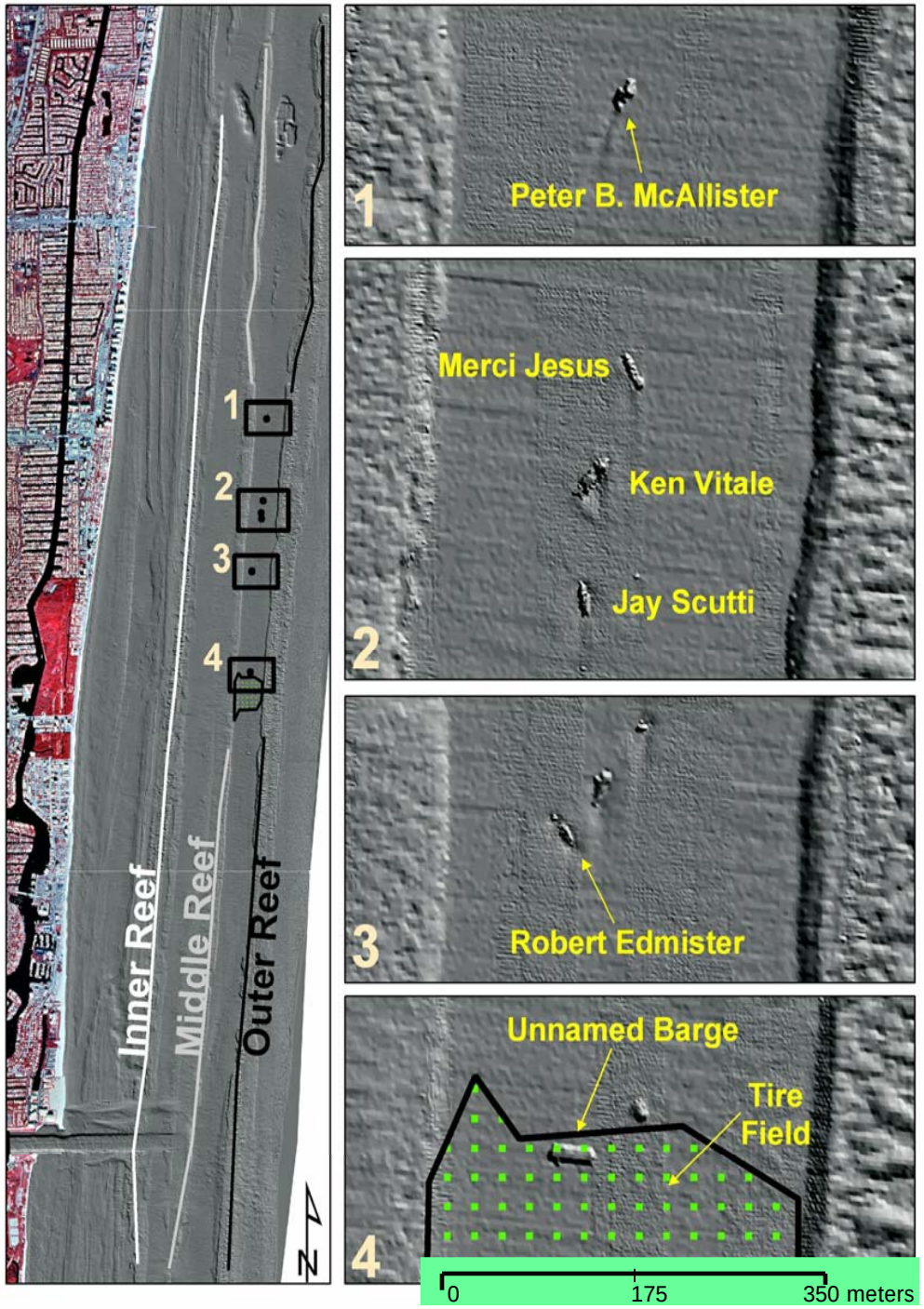
Fish Assemblages on Sunken-Vessels and Natural Reefs in Southeast Florida, U.S.A.

Florida's Artificial Reefs



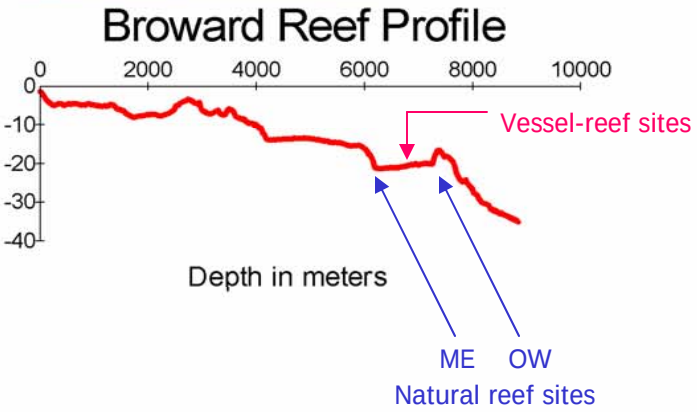
- 2,014 AR sites
- >25% are vessel-reefs (509)

Broward County:
20 km coastline
78 vessel-reefs



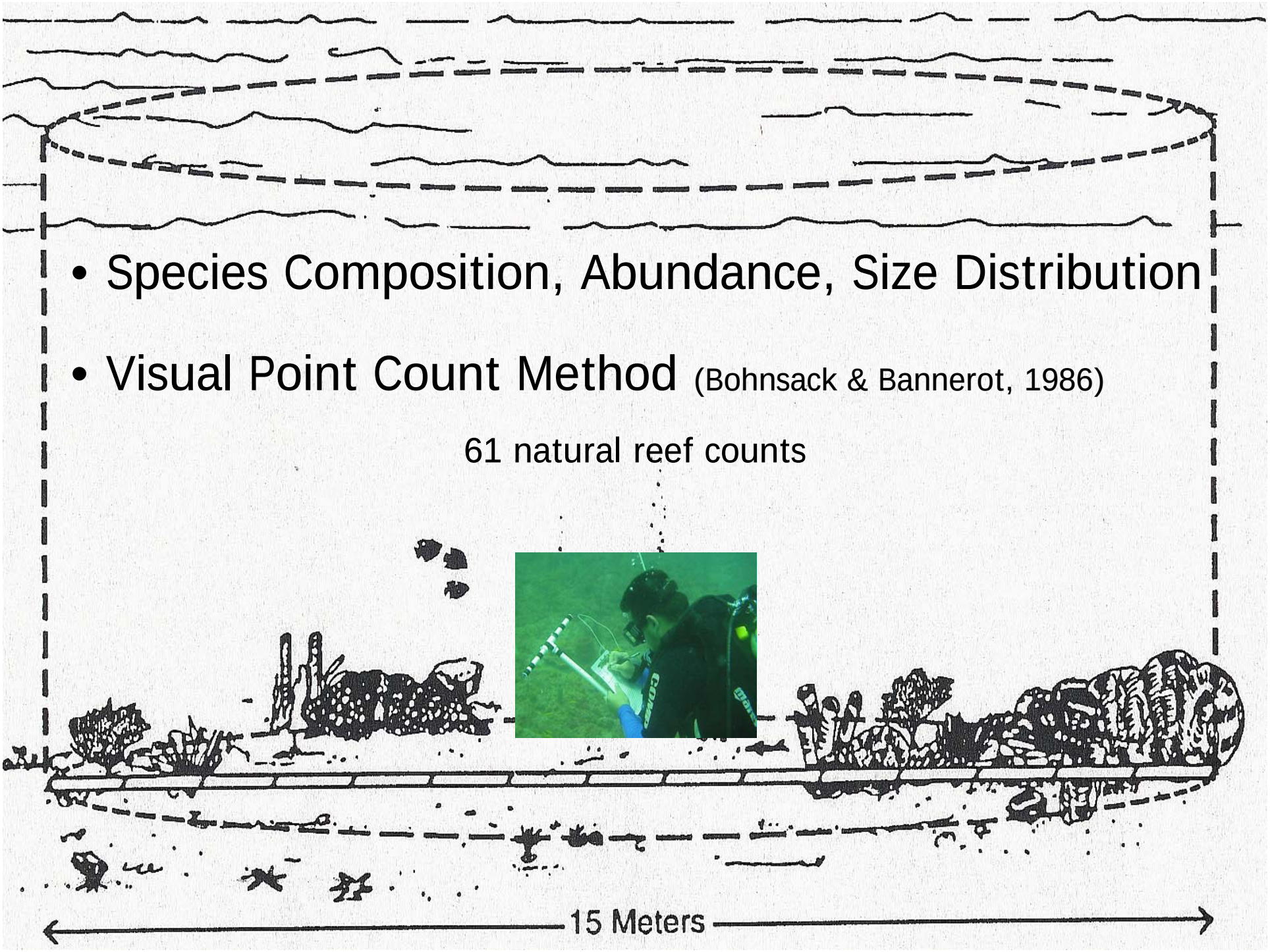
McAllister --------- **Tugboat**
Merci Jesus ------- **Freighter**
Tracy/Vitale ------ **Freighter**
Scutti ---------- **Tugboat**
Edmister ---------- **USCG Cutter**
Unnamed Barge -- **Barge**

	Year Sunk	Relief (m)	Length (m)
McAllister	1998	6.9	25.5
Merci Jesus	1998	5.4	27.0
Tracy/Vitale	1999	8.1	40.0
Scutti	1986	9.0	29.0
Edmister	1989	3.0	28.5
Unnamed Barge	*c1970*	3.0	24.0

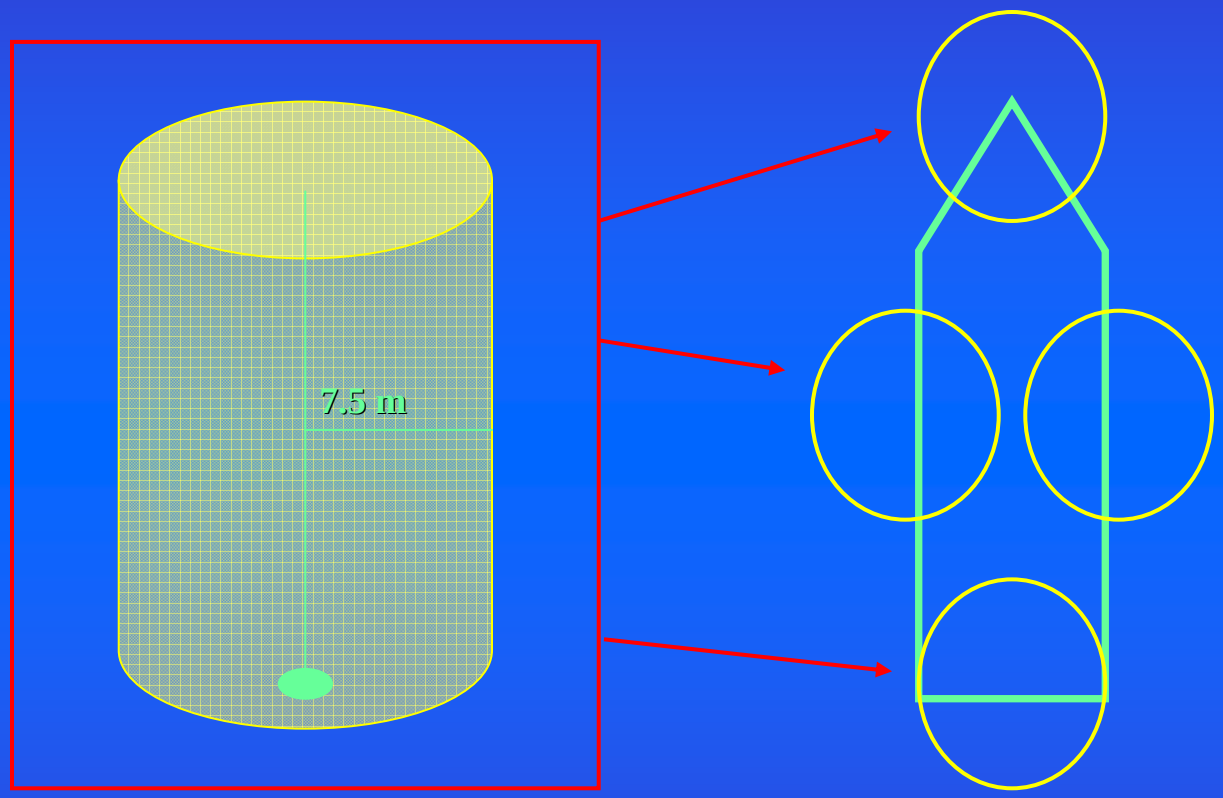


- Species Composition, Abundance, Size Distribution
- Visual Point Count Method (Bohnsack & Bannerot, 1986)

61 natural reef counts



Modified Bohnsack & Bannerot (1986) Point Count Method



Top view of typical vessel-reef

<u>Vessel Reef Census</u>

Four times/year

Two VR's/month

Four point counts/VR

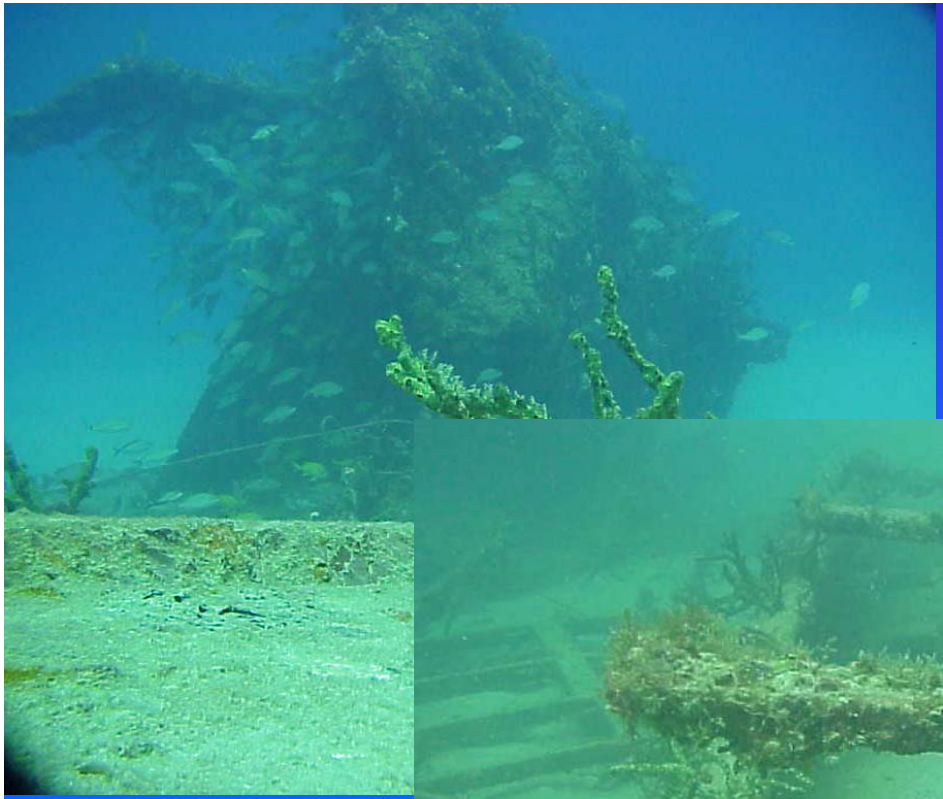
<u>Study Sample Periods</u>

1.Mar. 2000 – Mar. 2001

2.Mar. 2002 – Feb. 2003

Diver allowed to swim within the 15 m diameter cylinder

218 vessel-reef counts

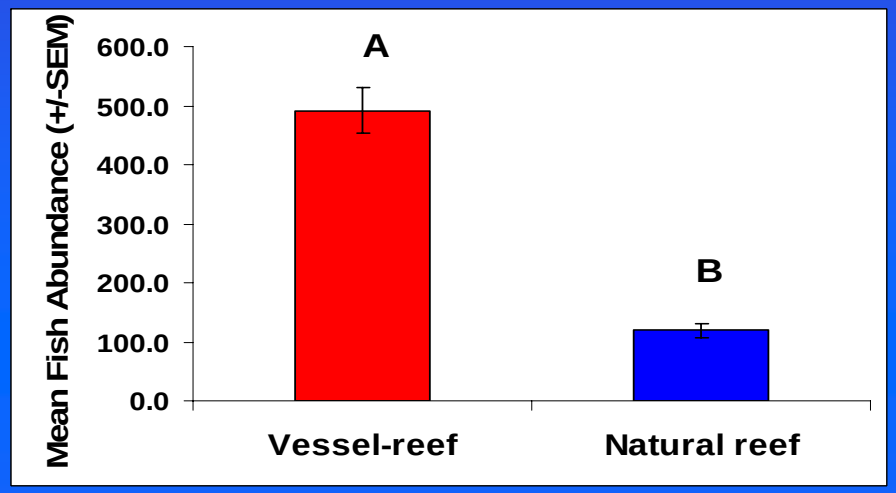


Edmister

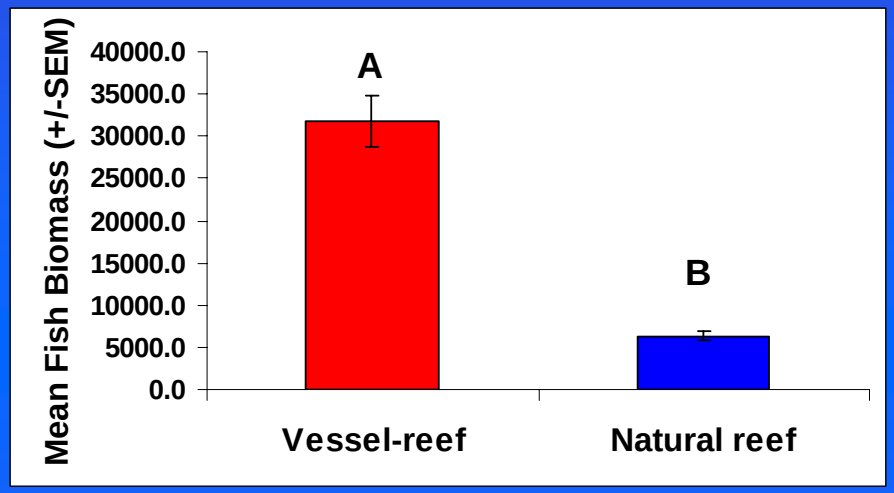
Six point counts due to its extensive footprint

RESULTS

Abundance:



Biomass:



Vessel-reefs = 491 ± 39
Natural reef = 119 ± 13

Vessel-reefs = 31709 g
Natural reef = 6373 g

-Abundance & Biomass Data SNK Groupings from Analysis of Log-transformed Data

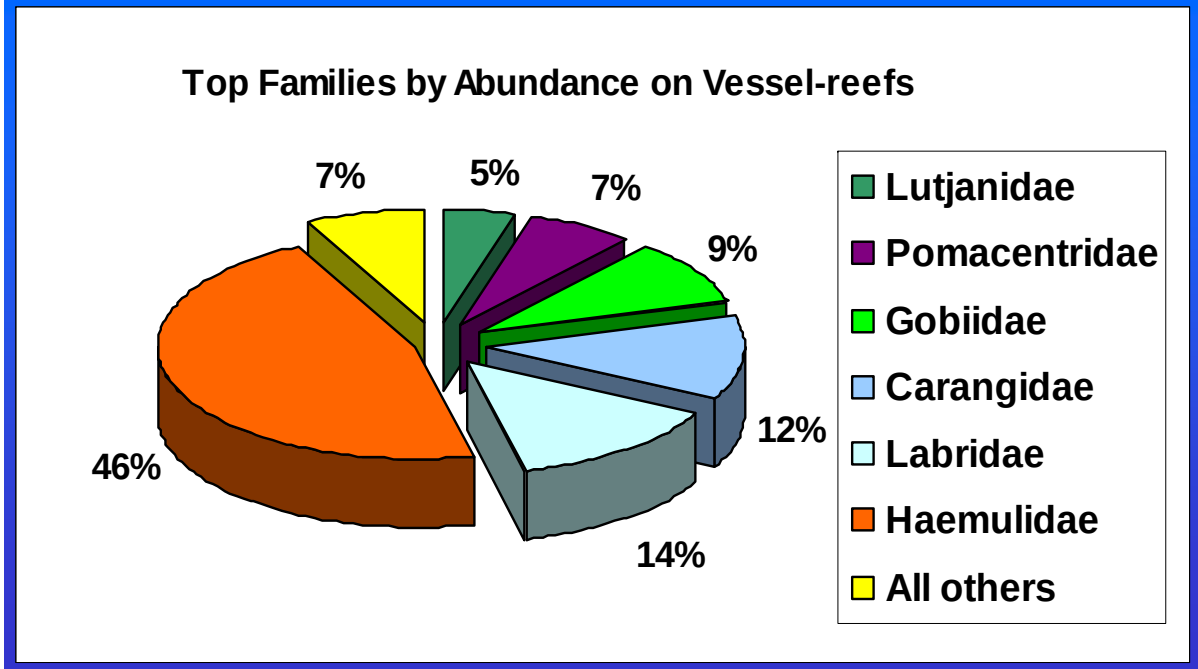
Vessel-reefs

Total fishes = 106989
Total species = 159
Total families = 43
Total counts = 218

Top 5 species:

Haemulon aurolineatum -- 25895 = 24%
Thalassoma bifasciatum -- 9854 = 9%
Coryphopterus punctipectophorus -- 9599 = 9%
Decapterus punctatus -- 8849 = 8%
Clepticus parrae -- 3466 = 3%

[*Haemulon* juveniles -- 9854 = 15%]

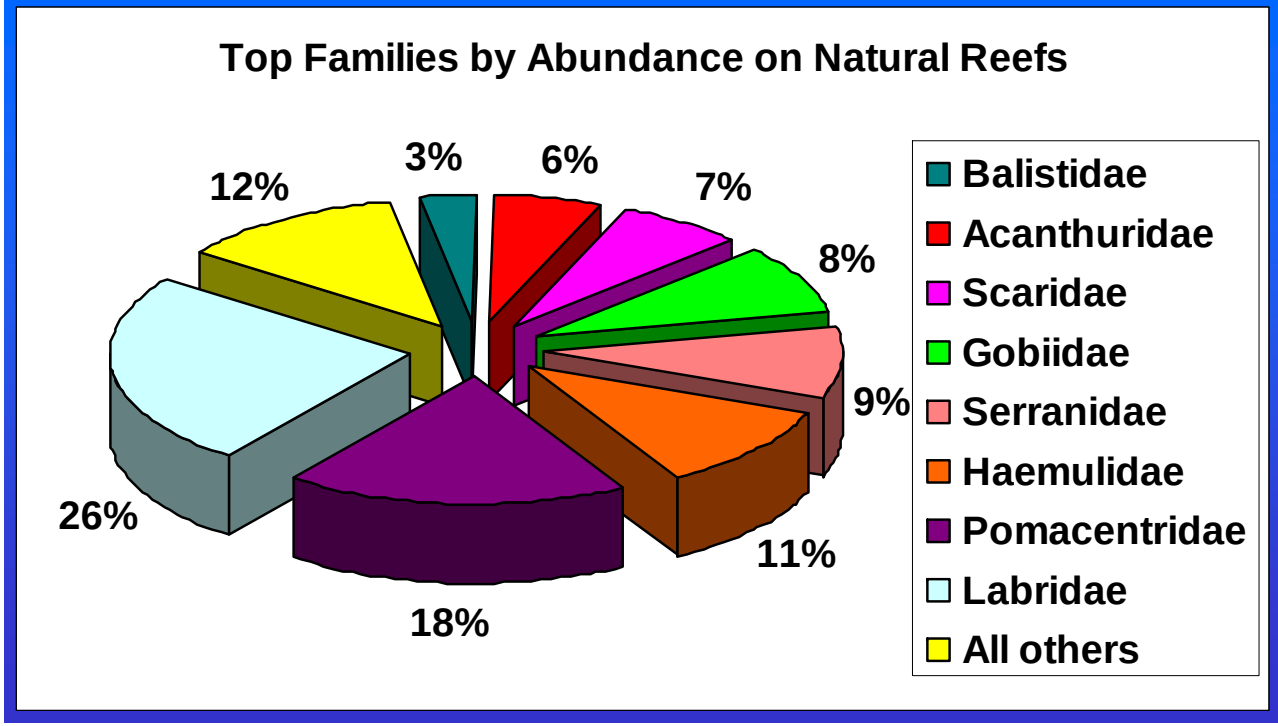


Natural Reef

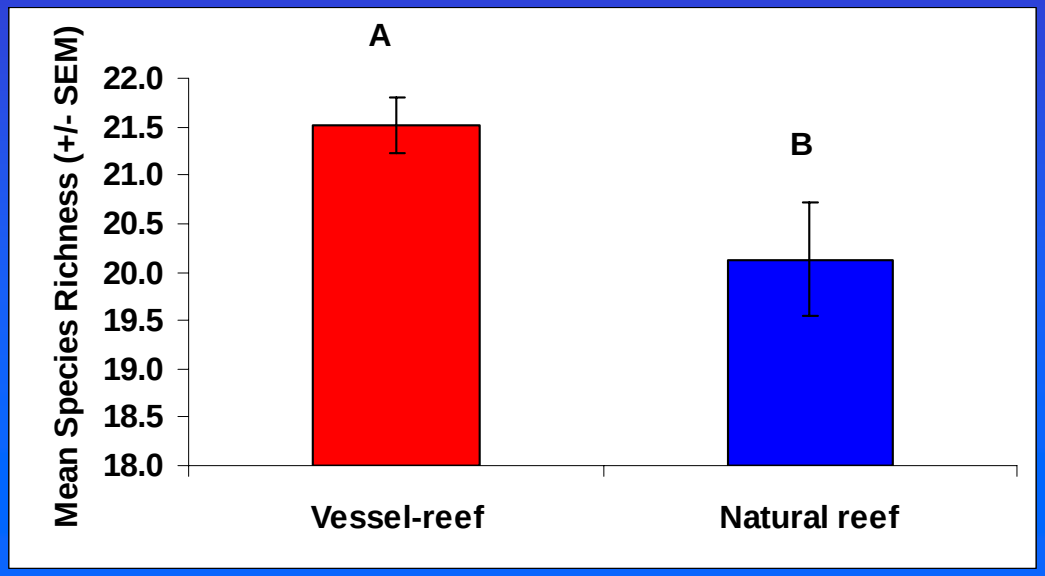
Total fishes = 7263
Total species = 118
Total families = 35
Total counts = 61

Top 5 species:

Stegastes partitus -- 1219 = 17%
Thalassoma bifasciatum – 924 = 13%
Halichoeres garnoti – 550 = 8%
Coryphopterus punctipectophorus – 452 = 6%
Haemulon aurolineatum – 350 = 5%



Species Richness



Vessel-reefs:

59 exclusive species

16 spp. Rare; 12 spp. Cryptic

13 fisheries important species

Natural reef:

18 exclusive species

10 spp. Rare

1 fisheries important species

Recreational and Commercial Importance

Blackfin Snapper, *Lutjanus buccanella*

Over 1100 fish surveys performed by NSU Oceanographic Center on natural reefs in Broward County from 1995-2002

NO BLACKFIN SPAPPER EVER RECORDED!

Vessel-reefs:

Observed in 60 counts (28%)

Total abundance = 597 individuals

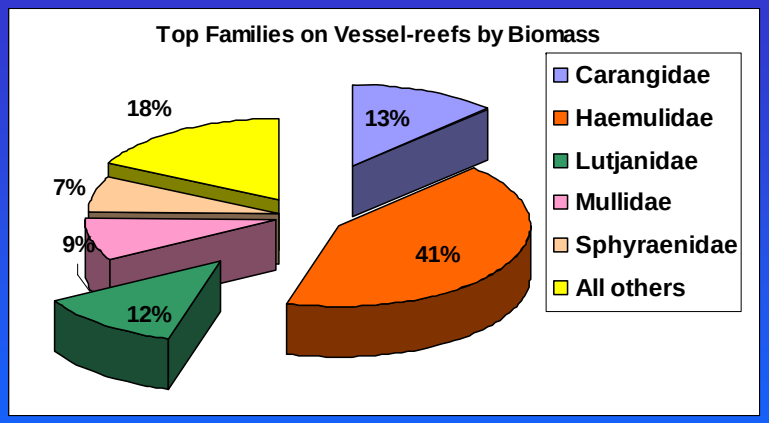
Mean size = 19 cm; Max = 40 cm; Min = 4 cm

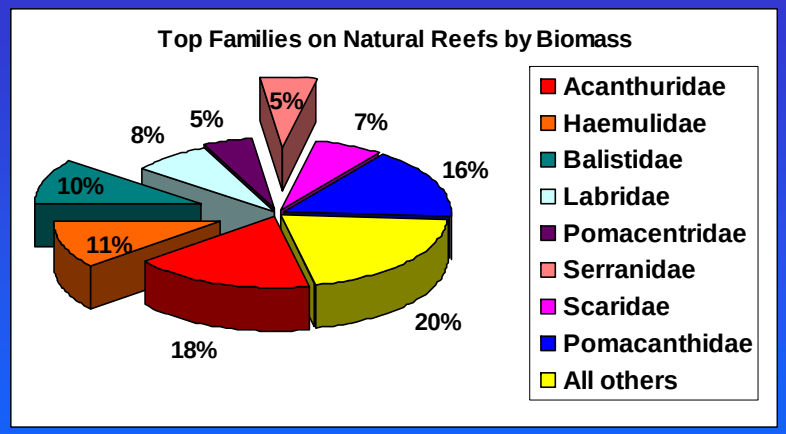
90% in the 15-20 cm size class

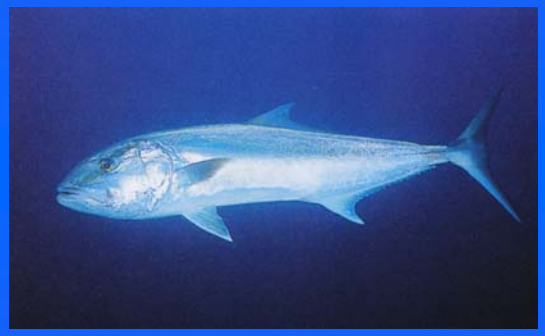
ONTOGENETIC MIGRATIONS?

JUVENILE HABITAT LIMITATIONS?

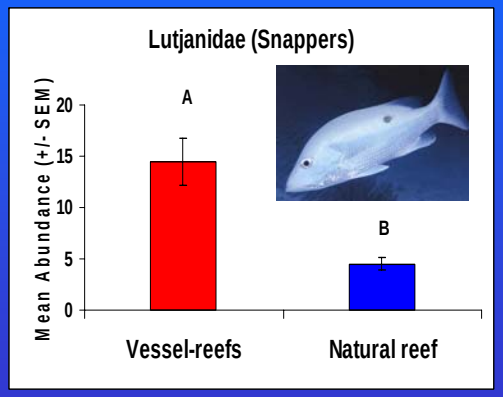
Recreational and Commercial Importance

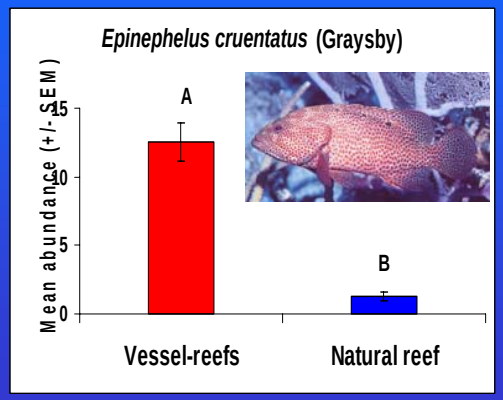






Seriola spp.
164 individuals
Recorded 45x ~ 21%
Vessel-reef exclusive





Epinephelus morio, Red Grouper
44 individuals
Recorded 30x ~ 49%
Natural Reef Exclusive

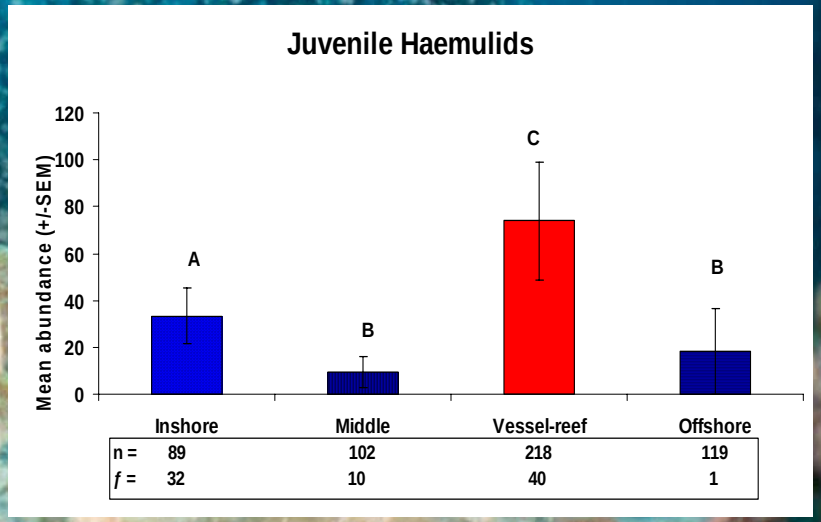
Juvenile Abundance

	Vessel-reefs	Natural reef
Total juveniles =	26%	25%
Dominant juvenile spp. =	*Haemulon* spp.(58%)	*Stegastes partitus* (58%)

Unnamed Barge & Edmister

80% of *Haemulon* juveniles

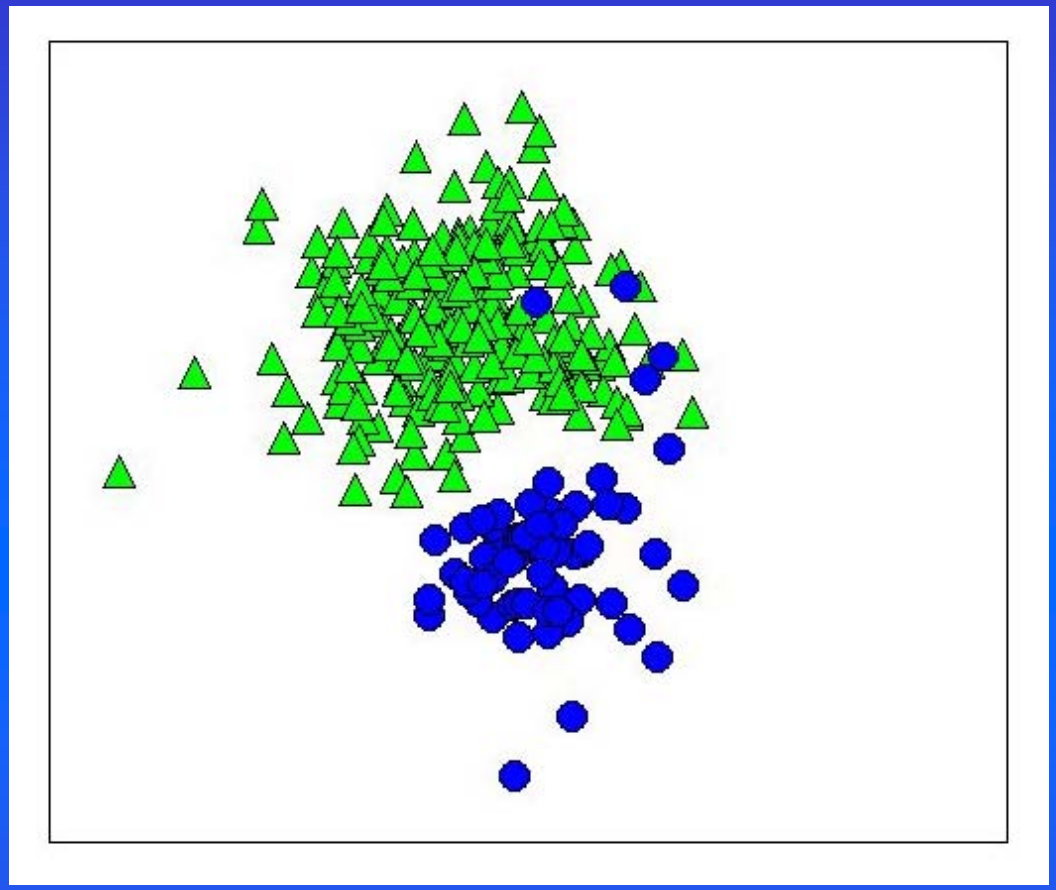
↑Complexity; ↓Relief



Important Prey Species

MDS of Bray Curtis between reefs

▲ Vessel-reefs
● Natural Reef



ANOSIM

Groups	R-Statistic
Vessel-reefs vs. Natural reef	0.718*

R>0.75: Well Separated

R>0.50: Overlapping but Clearly Different

R<0.25: Barely Separable

SIMPER

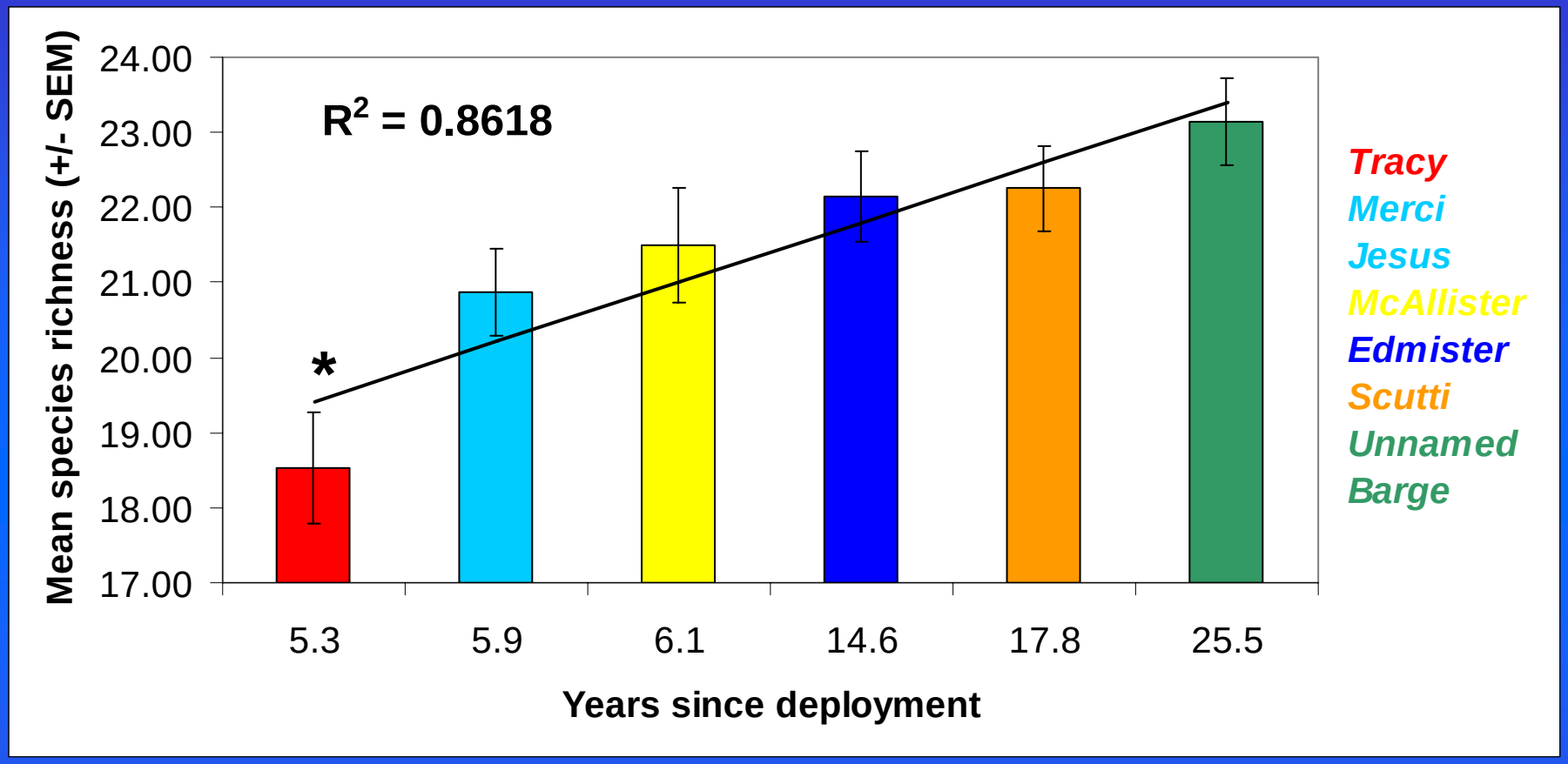
Groups Vessel-reef & Natural reef

Average dissimilarity = 74.18 25.82% Similar

Species	Vessel-reef Av.Abund	Natural reef Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Tomtate *	118.75	5.74	4.49	1.33	6.05	6.05
Mask Goby	44.03	7.41	3.10	1.05	4.18	10.23
Purple Reeffish	14.25	0.30	2.75	1.33	3.70	13.93
Yellowhead Wrasse	2.36	9.02	2.32	1.53	3.13	17.06
Bicolor Damselfish	9.27	19.98	2.26	1.33	3.05	20.11
Creole Wrasse	15.90	2.18	2.23	0.95	3.00	23.12
Bluehead Wrasse	44.97	15.23	2.15	1.18	2.90	26.02

- Tomtate utilizing shelter in feeding grounds
- Planktivores dominated on Vessel-reefs (54%) and contributed at least 24% to total dissimilarity

Increasing species richness and similarity with age



SIMPER

Unnamed Barge vs. Natural Reef = ↑est similarity (29%)

Richer Fouling Community = ↑food ↑refuge

↑Age = ↑ Larval Interactions

Summary

- Vessel-reefs have greater abundance, biomass, and species richness

- Vessel-reef fish assemblages are clearly different from natural reefs

- Vessel-reefs may provide ancillary juvenile habitat for deepwater species

- Vessel-reefs harbor more recreationally and commercially important species

- Data do not support a simple aggregation hypothesis