

South Florida Reef Fish Visual Census (RVC)

Jeremiah Blondeau (NOAA-SEFSC),
David Bryan (UM-RSMAS), Jim Bohnsack (NOAA-SEFSC)

Fish: Size-Structured Abundance of Fish Species

Benthic 1: Benthic Cover (LPI method), Occurrence of ESA Corals

Benthic 2: Size-Structured Abundance of Coral Species
(Demographics)

Brief History



- **Florida Keys**
 - 1979-1993 focus on fore-reef environment (areas that are now sanctuary protected areas (SPAs)
 - 1994-1996 expanded to encompass more habitat types including matching habitats to the proposed SPA's
 - 1997-2000 benthic habitat maps used to iteratively improve survey design
 - 2001- 2012 'modern' survey
 - 2014- every other year
- **Dry Tortugas**
 - 1999-2000, 2004,2006, 2008-2012
 - 2014 – every other year
- **SEFCRI (Miami to Martin County)**
 - 2012-2014
 - 2014- every other year



2014 – 77 divers from 17 agencies participated in the survey



Multi-agency
collaboration

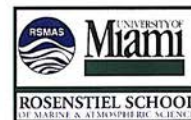
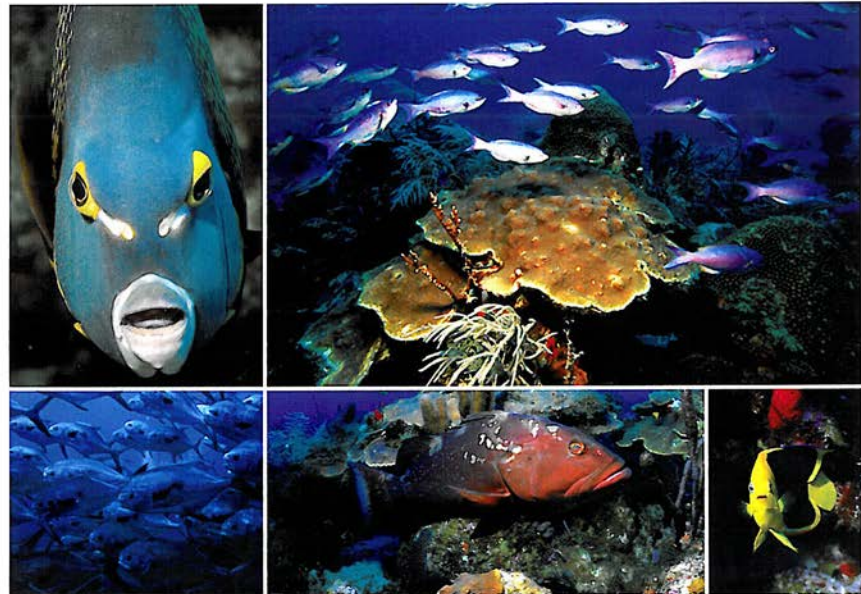
National Park Service
U.S. Department of the Interior

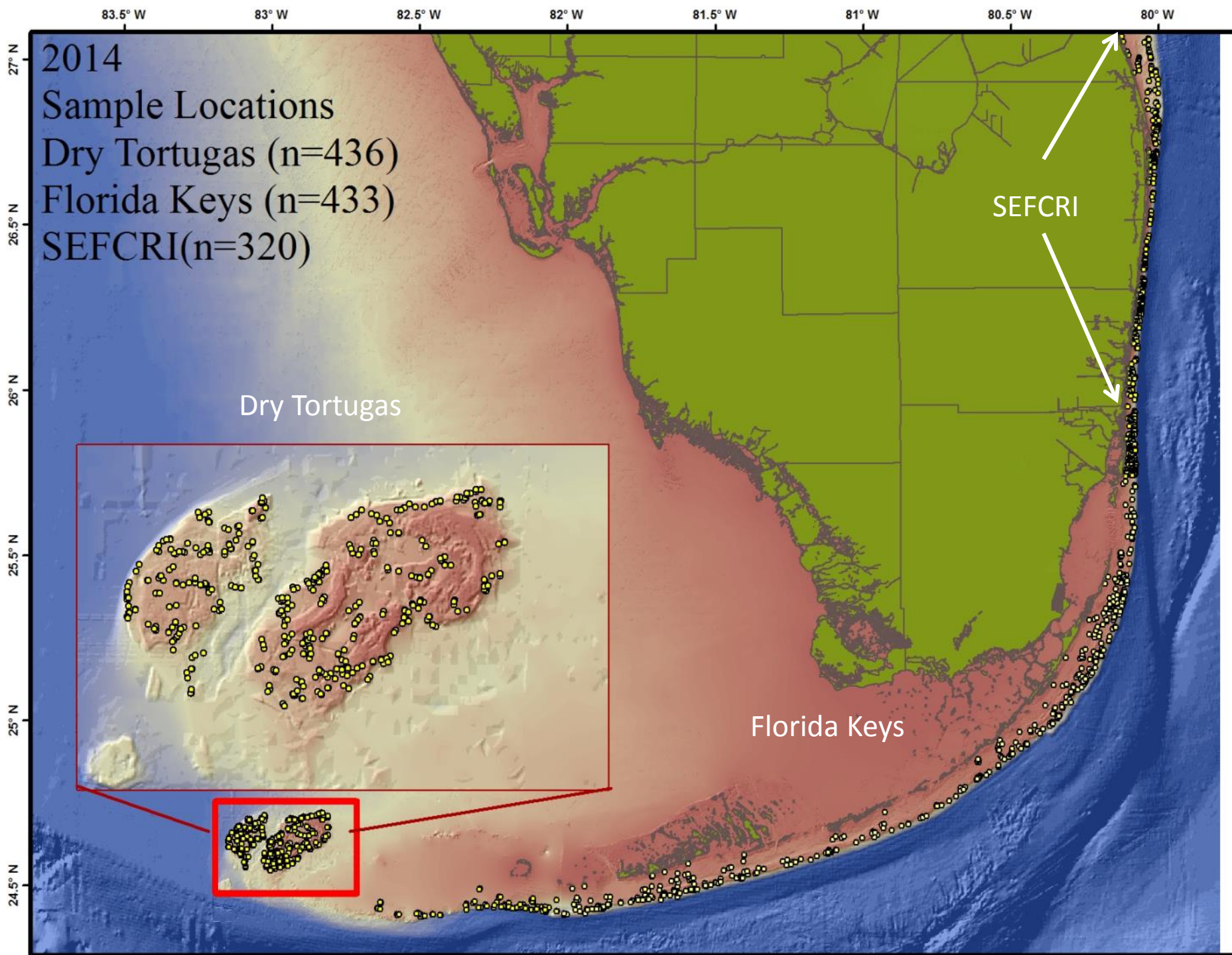
Natural Resource Program Center



A Cooperative Multi-agency Reef Fish Monitoring Protocol for the Florida Keys Coral Reef Ecosystem

Natural Resource Report NPS/SFCN/NRR—2009/150





Sample Frame

South Florida Coral Reef Ecosystem is Diverse

- RVC focuses on hardbottom reef habitat between 1-30m depth.

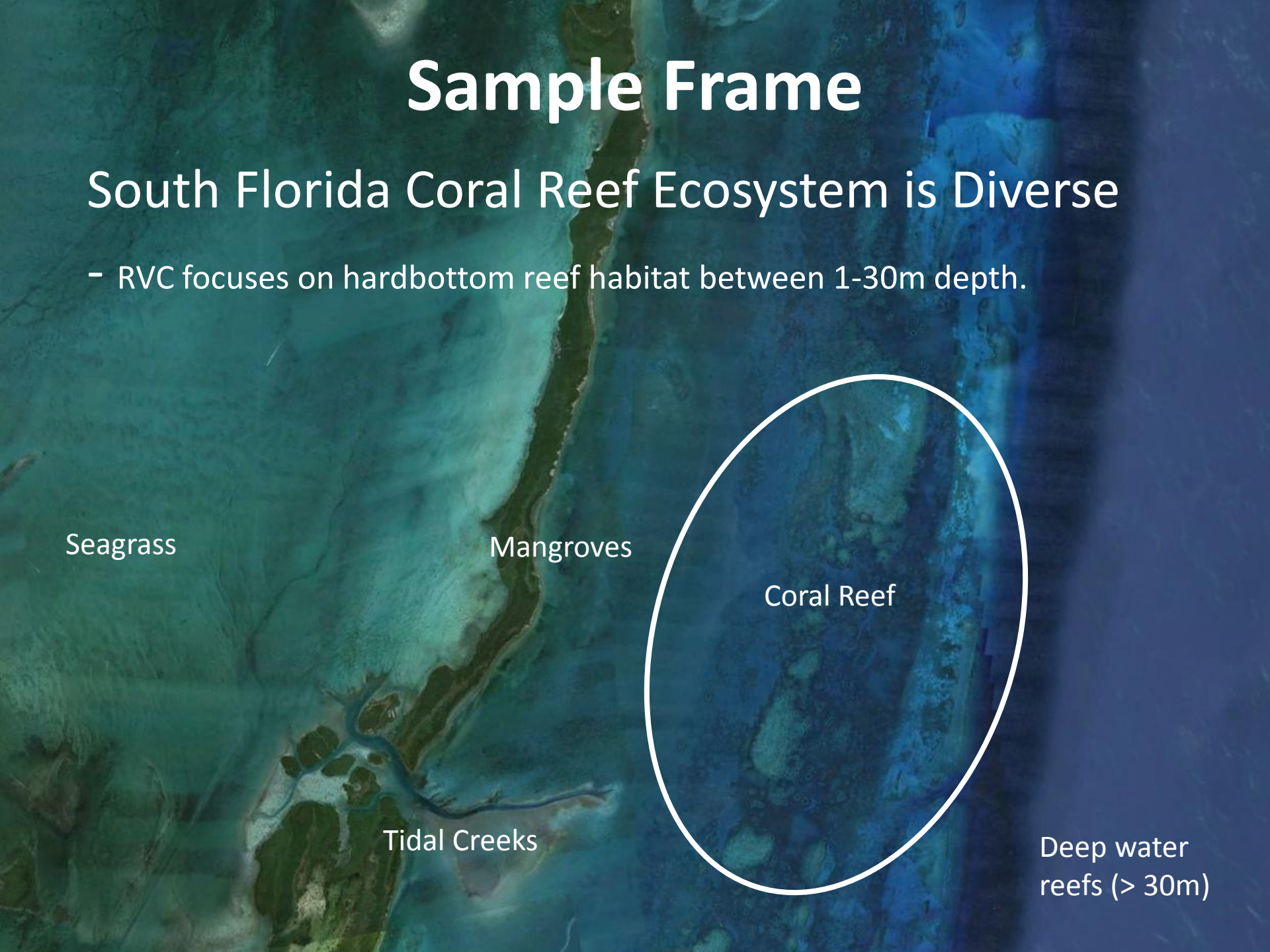
Seagrass

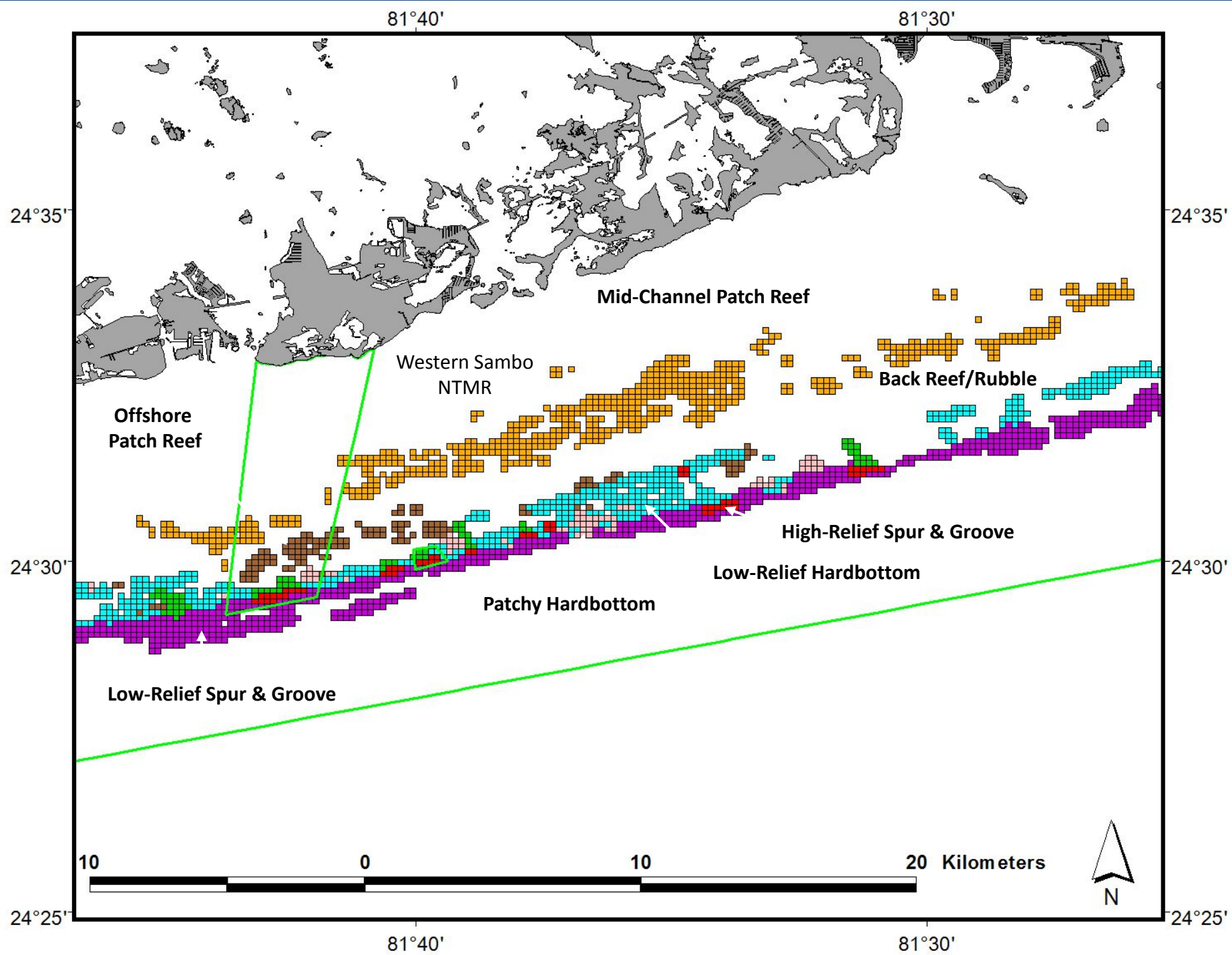
Mangroves

Coral Reef

Tidal Creeks

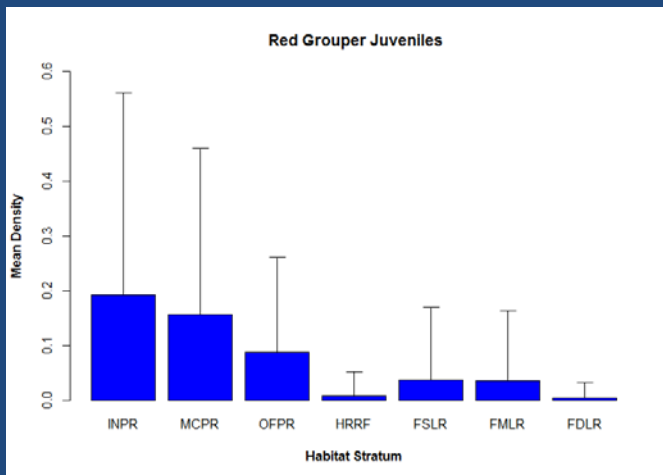
Deep water
reefs (> 30m)



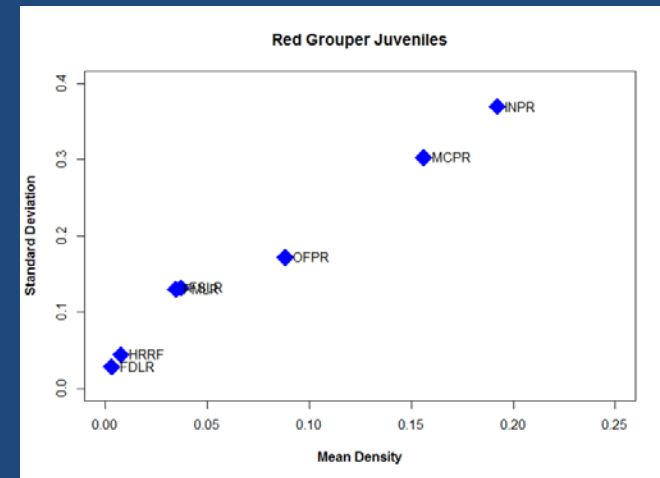


Site Allocation

Not all Habitat is Equal



- Habitats with higher relief/complexity have higher densities of fishes.
- Higher densities = higher variance



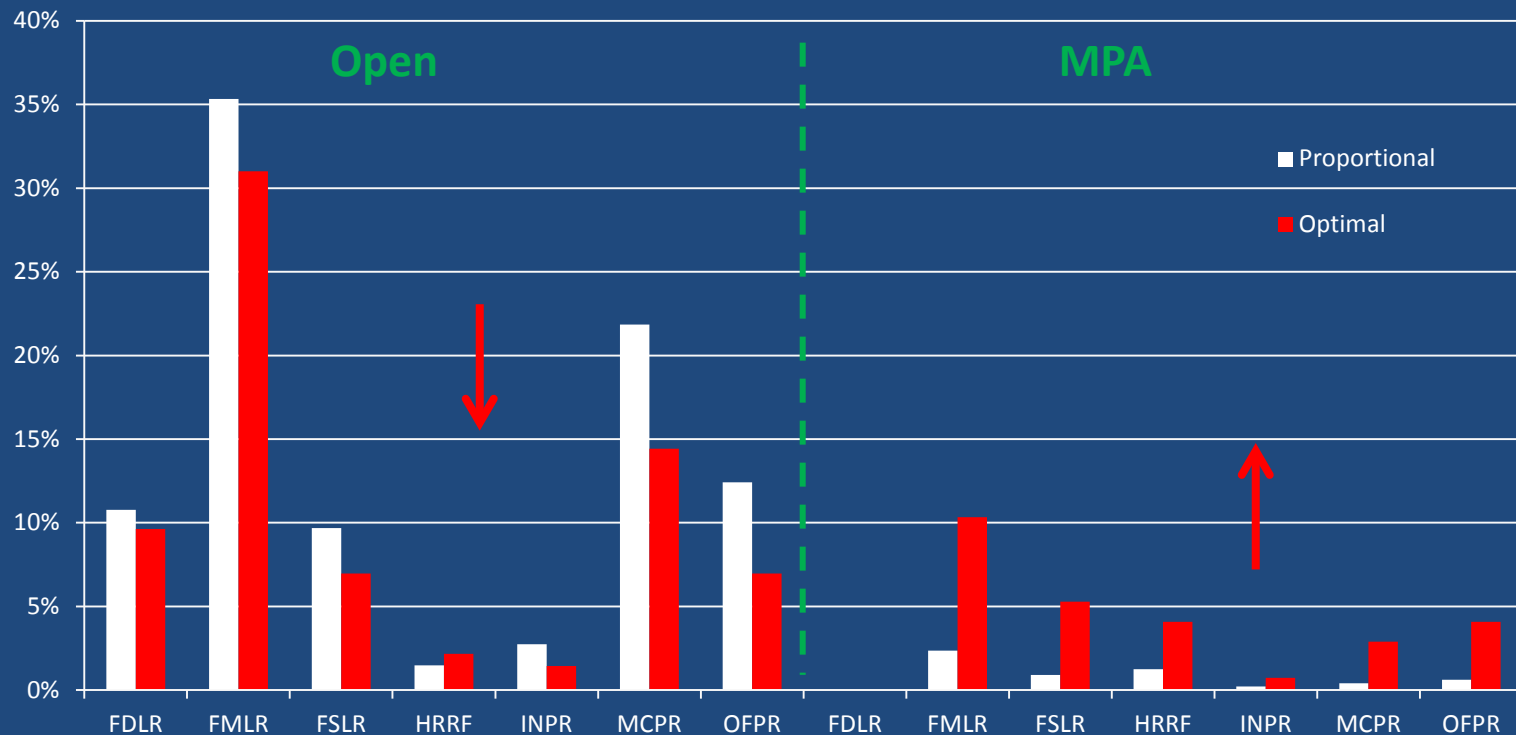
- To improve our survey accuracy we allocated a greater proportion of sites to higher complexity habitats

Site Allocation

Two major considerations:

- 1) Increase domain wide precision by allocating more samples to complex strata with high fish densities
- 2) Detect changes inside and outside of Marine Protected Areas

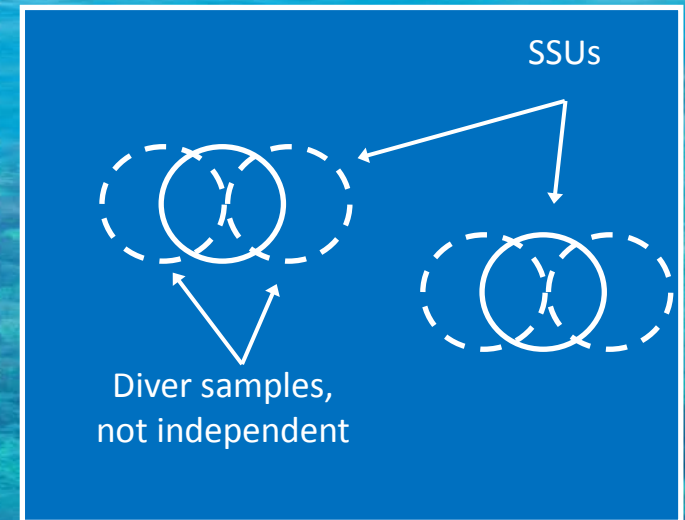
Allocation by Strata (Florida Keys 2012)



Fish Sampling

- 4 divers (2 buddy pairs)
- 15m diameter cylinder (177m²)
- 5 min count, between 5-10 min cryptic species
- Total # of all species present
- Min, max and mean of fork length
- Additional data on benthos collected

Primary Sample Unit (PSU)



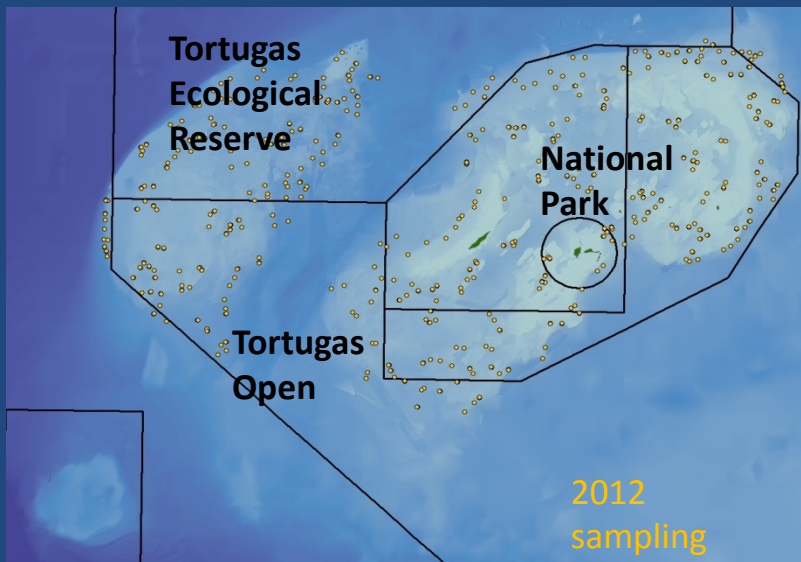
Benthic Sampling

- separate team goes to the same coordinates to conduct the LPI and demographic survey
- same method as Caribbean except 15m instead of 20m LPI

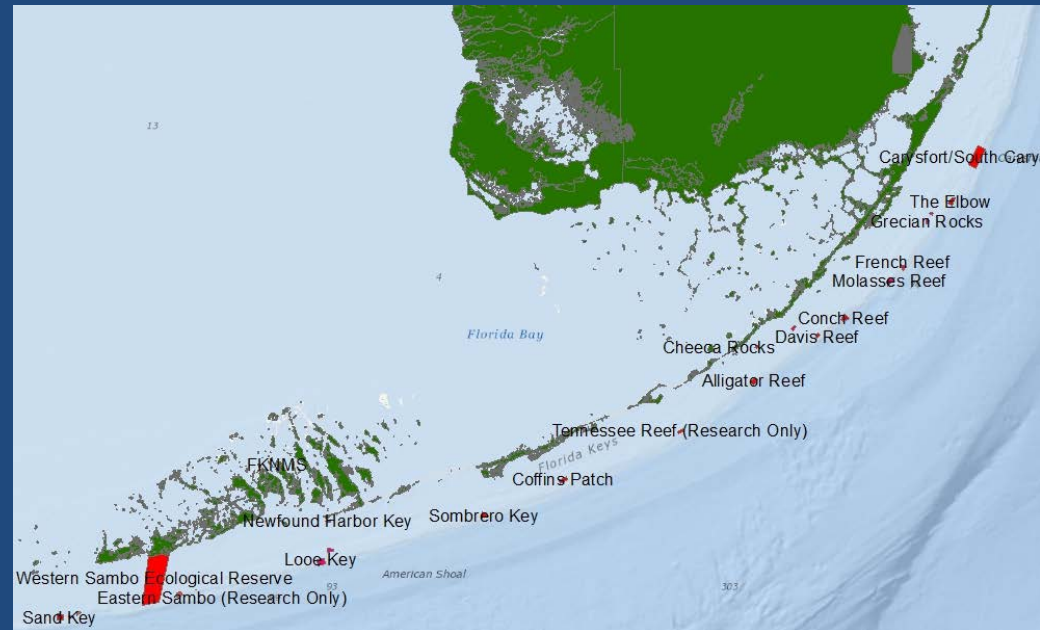
Estimates

- **Calculations:** 1) Get an average (density, occurrence, ect.) for each PSU
2) Calculate a stratum average based on all PSUs in that strata
3) Sum weighted averages (stratum weights) from each strata for a population level estimate
- The survey is designed such that these population level metrics can be generated at several different spatial scales.
 - Strata level estimates (8 strata in Dry Tortugas, 7 strata in FL Keys, 15 in SEFCR)
 - Management levels – eg. unprotected estimates
 - Regional estimates
 - Domain wide

Dry Tortugas region – 3 management levels



Florida Keys– 2 management levels (protected and unprotected)



Estimates

Spatial comparisons

- Different regions (Dry Tortugas, FI Keys & SEFCRI) have different coastal environments. Hence, some species may naturally have a different occurrences and densities among regions unrelated to ecosystem health.

Life history stages

- For most metrics that we (south Florida partner agencies) estimate, life stage is important. Length is used to select only those individuals from the life stage of interest. For example:
 - Mature versus Immature
 - Exploited phase versus non-exploited phase

Diversity

- There are 366 species in our database, most are extremely rare
- For species richness we look at only non-cryptic, coral reef species (ie. no pelagics) that have an equal probability of detection on each count

Types of Metrics

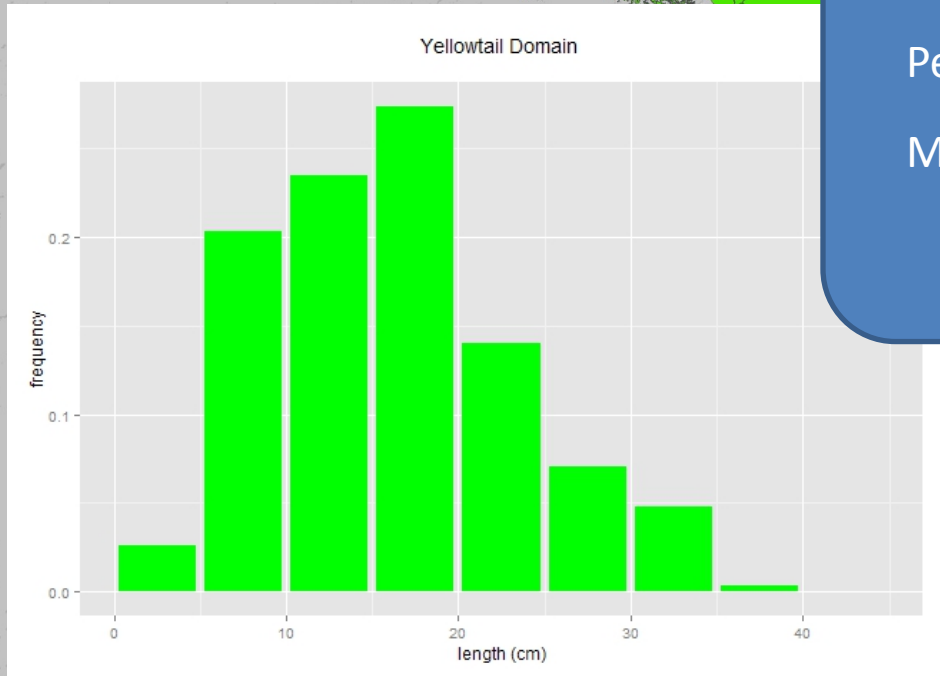
- Percent occurrence, density, relative abundance, species richness, length frequency, biomass, ect. (all with variance terms)

2012

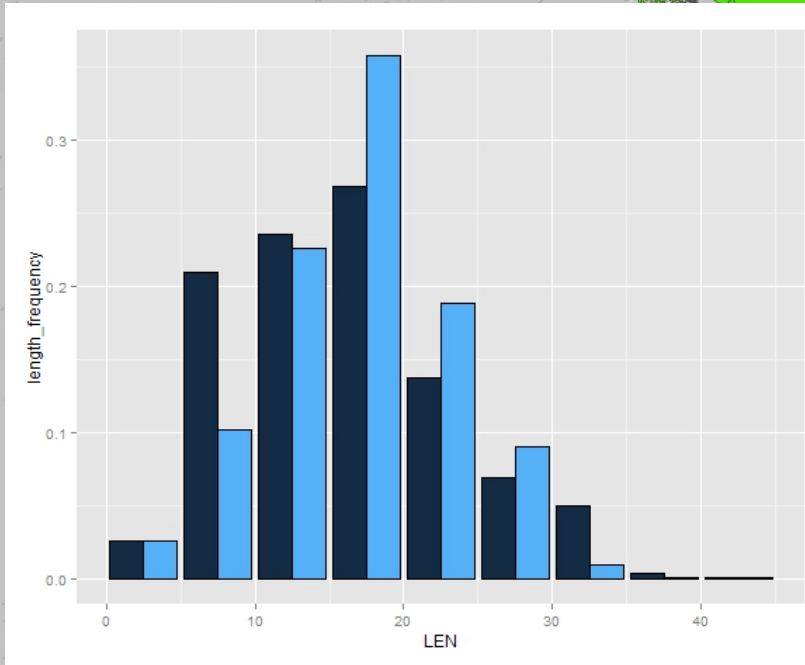
Yellowtail Snapper

Percent Occurrence = 70%

Mean Density = 4.68



2012



Protected

Percent Occurrence = 72%

Mean Density = 7.42

Unprotected

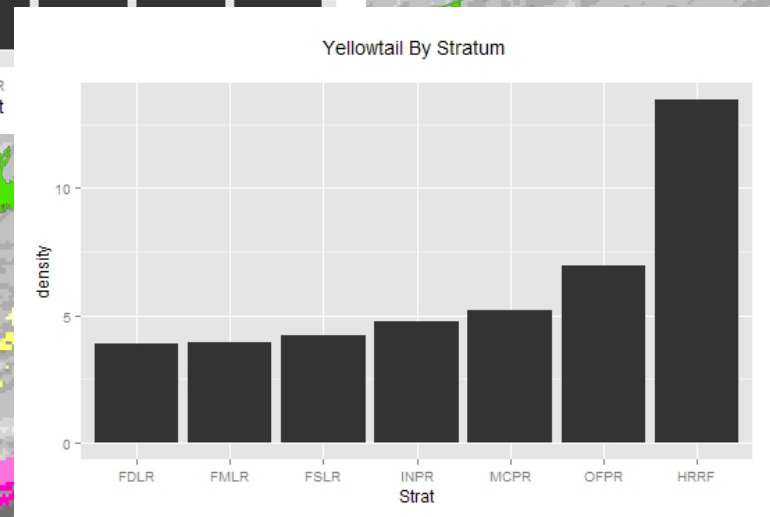
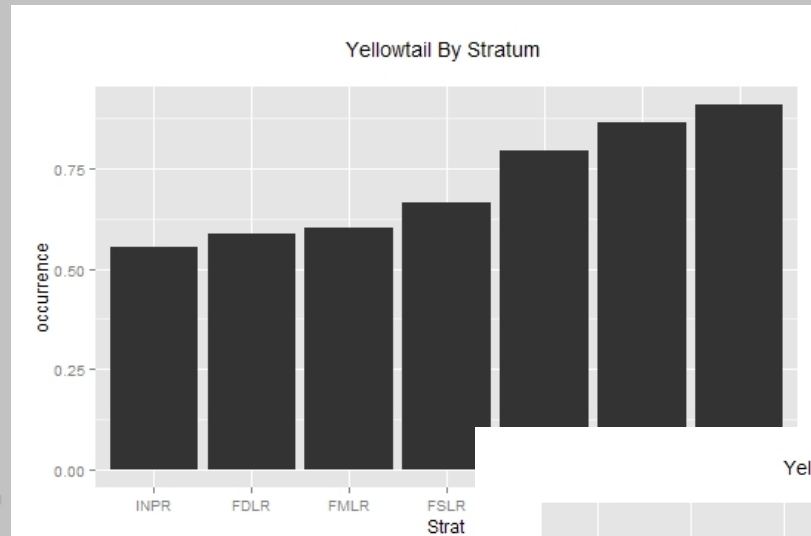
Percent Occurrence = 69%

Mean Density = 4.52

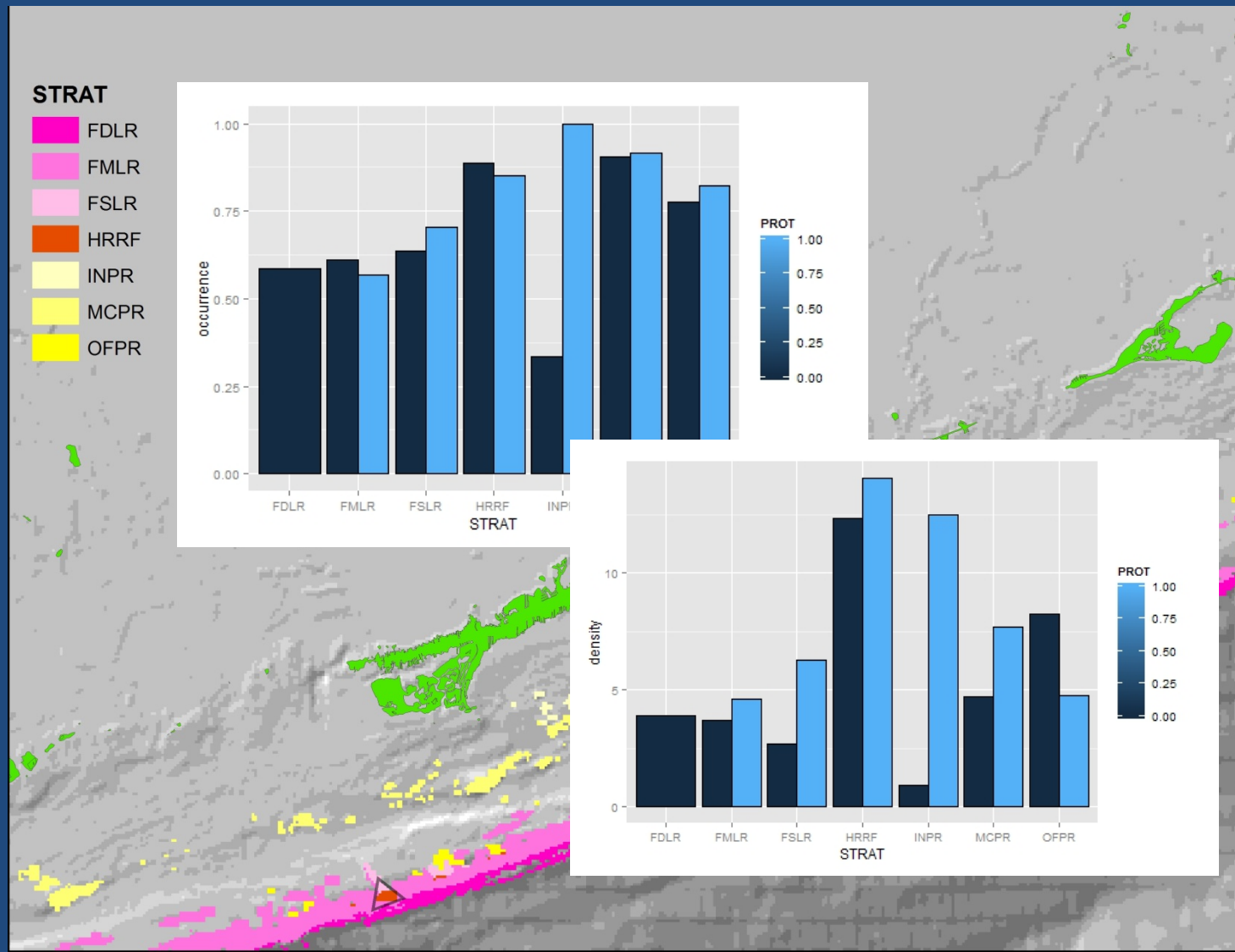
2012

STRAT

- FDLR
- FMLR
- FSLR
- HRRF
- INPR
- MCPR
- OFPR



2012



Roles of Science and Management in Conservation

Aldo Leopold 1949

Health is the sustained ability for self-renewal.

Conservation is the effort to understand and promote the capacity for self-renewal.

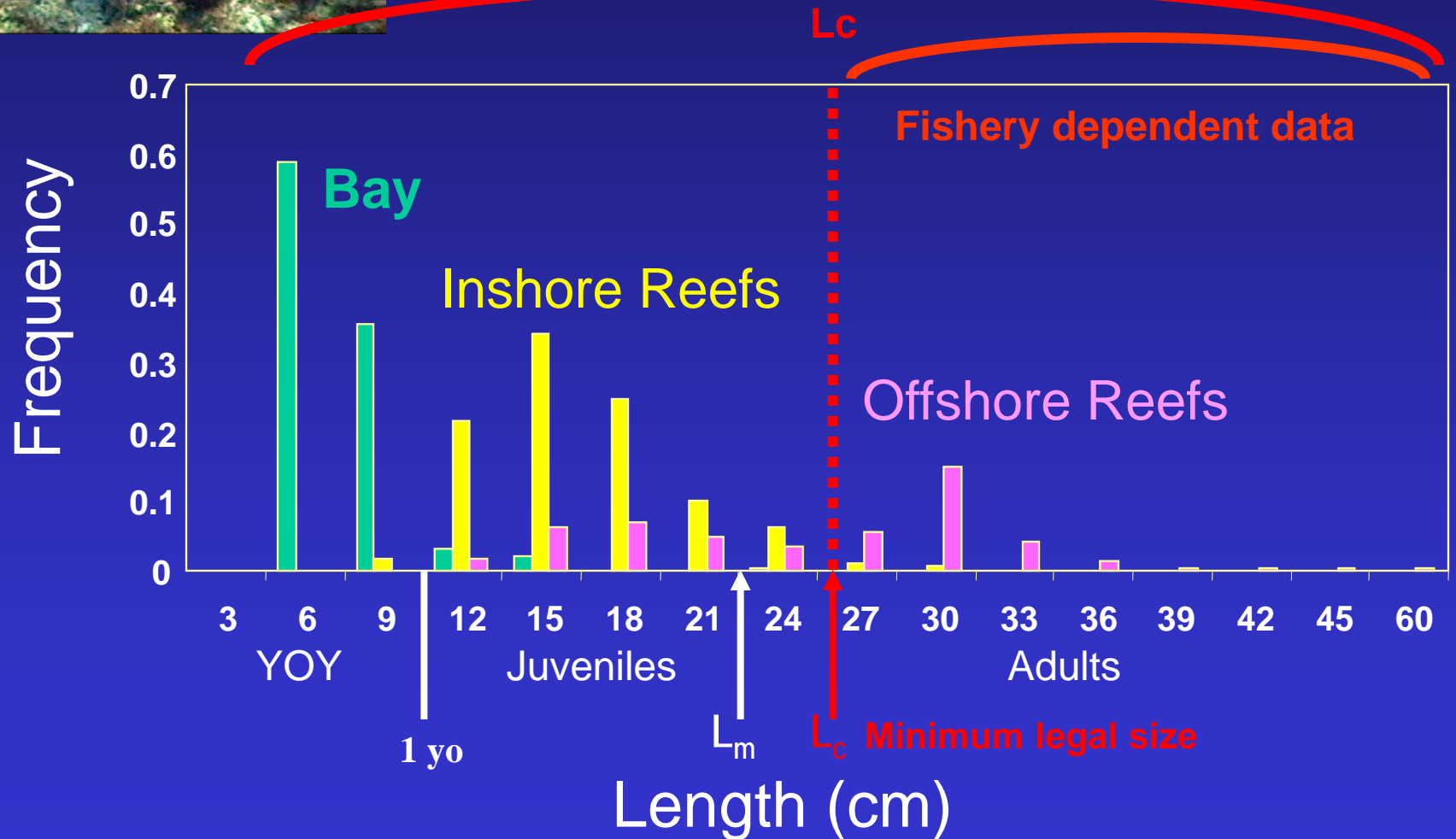
Science's role is to understand the conditions necessary for self-renewal.

Management's role is to create conditions that promote self-renewal based on science.

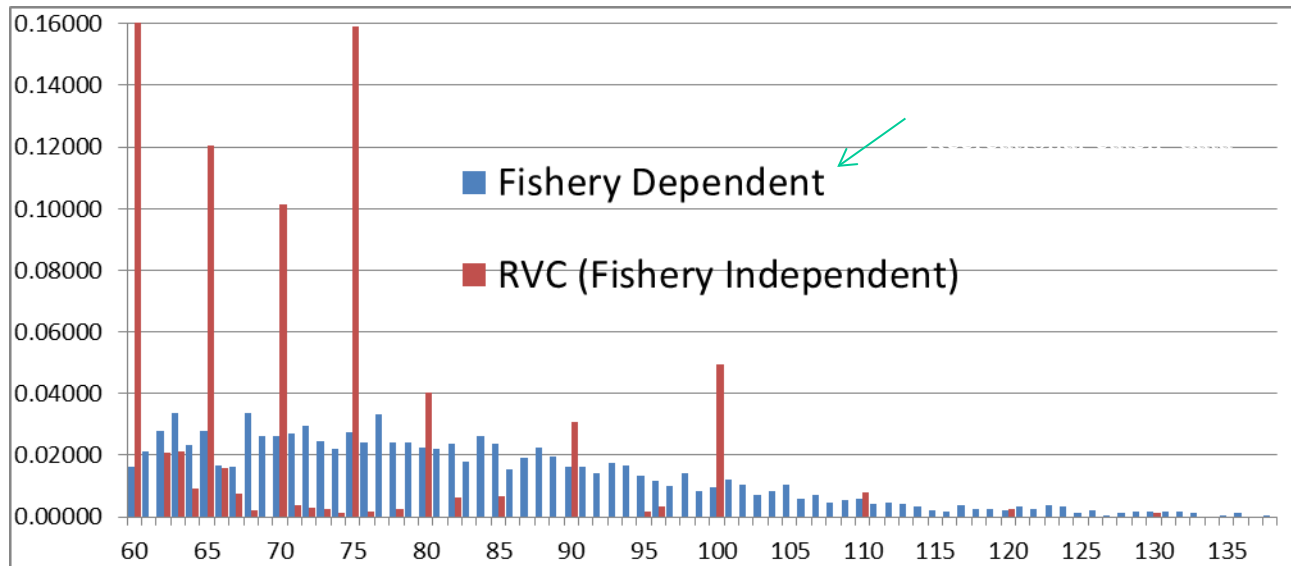
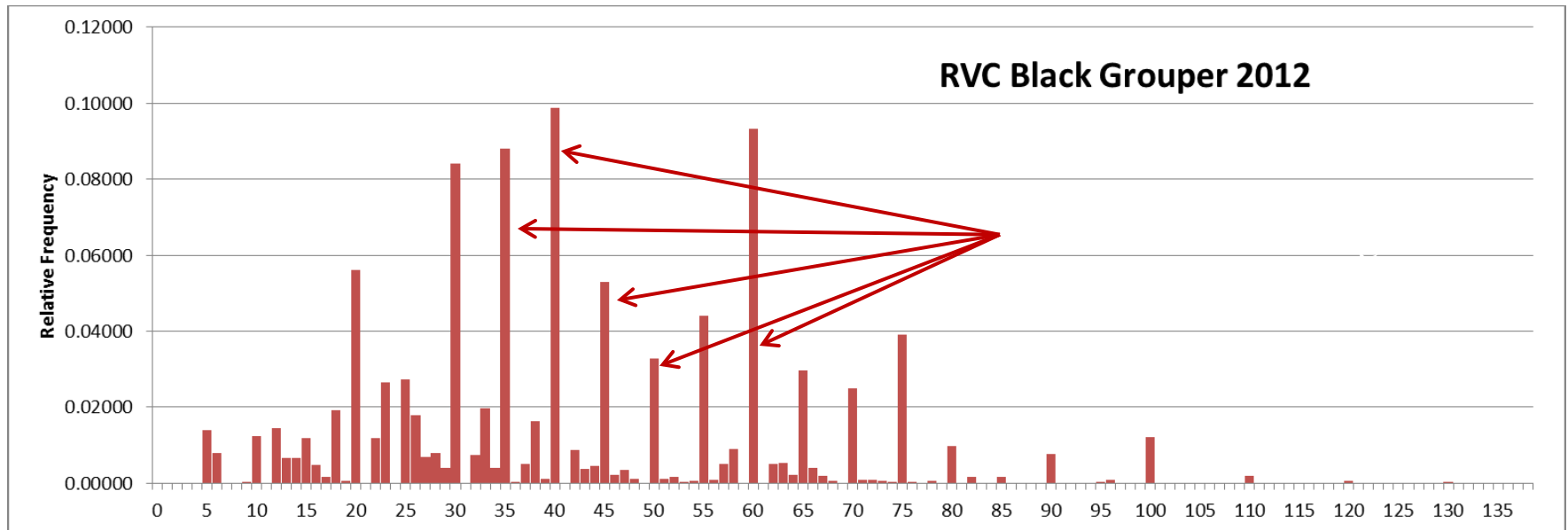


Gray snapper habitat shifts

Fishery independent data

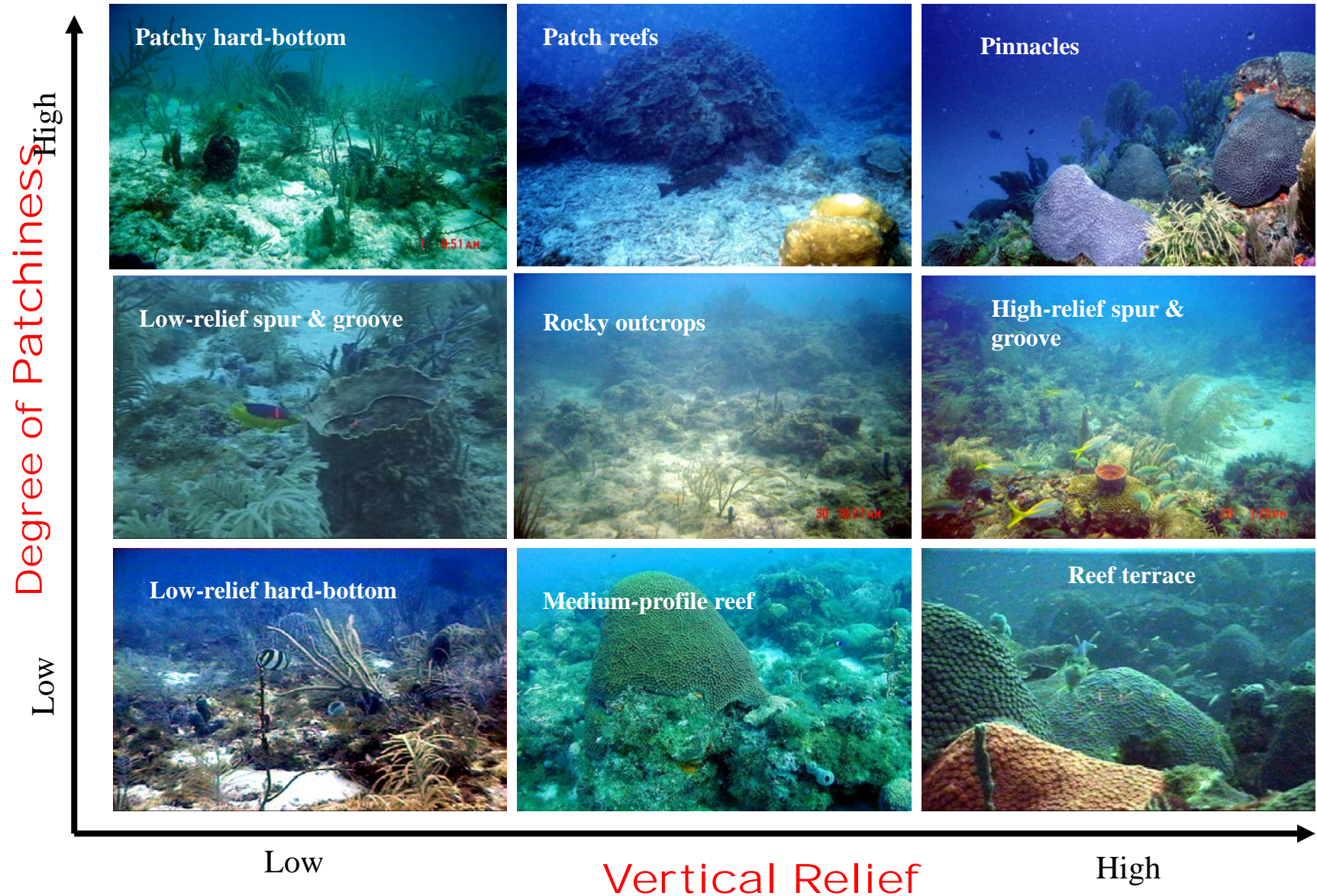


Average Length

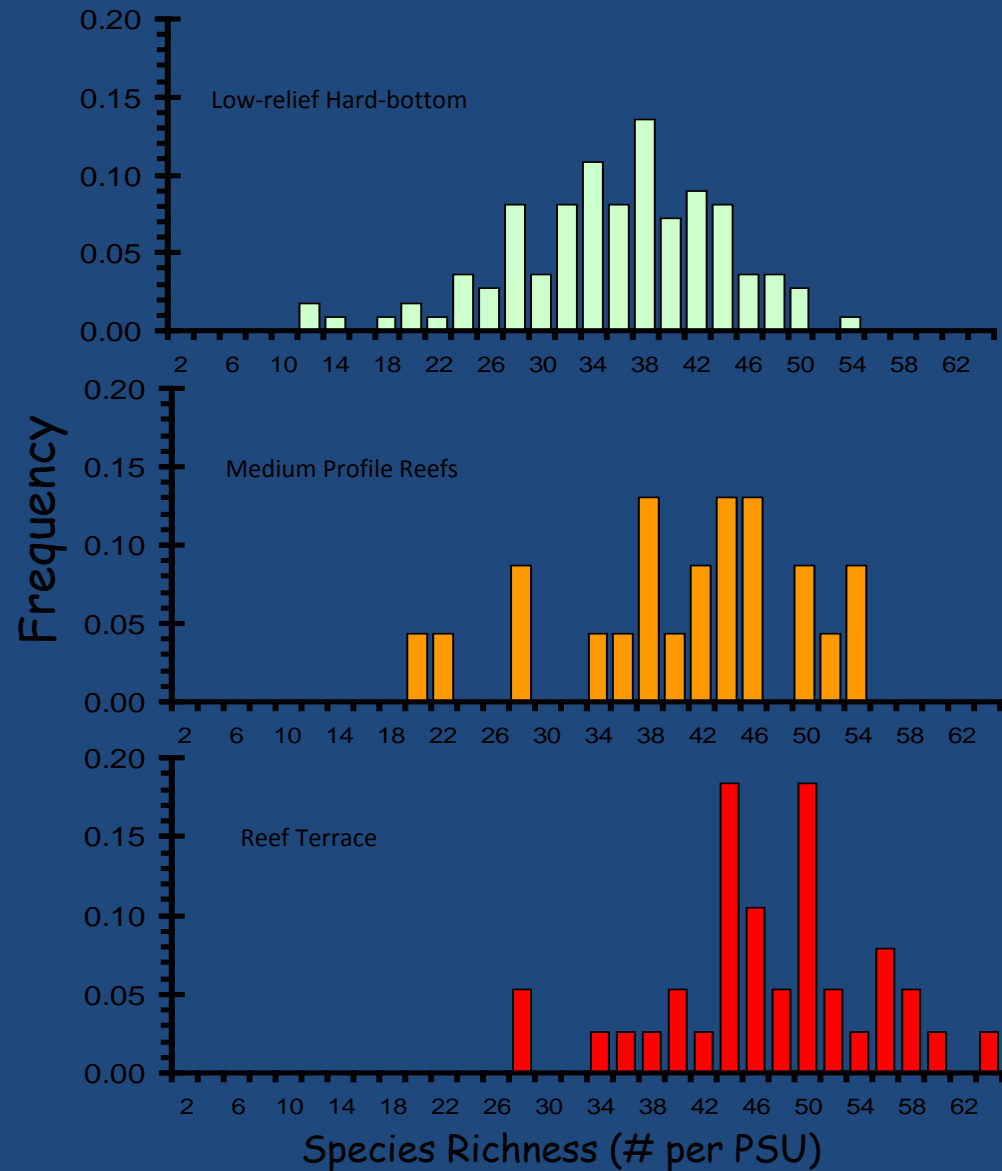


- Notice difference between dependent and independent data sets
- Of interest, the average length is approx. the same.

Linking Reef Fish Spatial Abundance & Benthic Habitats



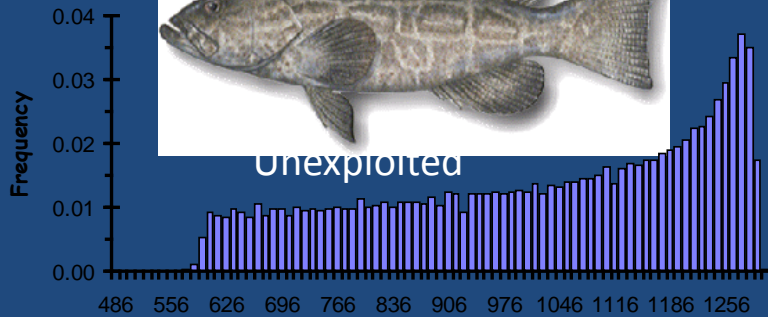
Species richness increases as habitat complexity increases



"Observable" Assessment Indicator Variables



Unexploited

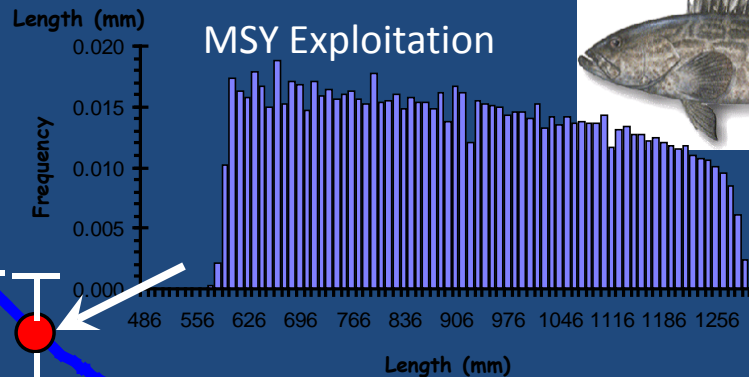


40.6", 42.8 lbs
SPR = 100%

$$\bar{L}(t) = \frac{F(t) \int_{a_c}^{a_\lambda} N(a,t) L(a,t) da}{F(t) \int_{a_c}^{a_\lambda} N(a,t) da}$$

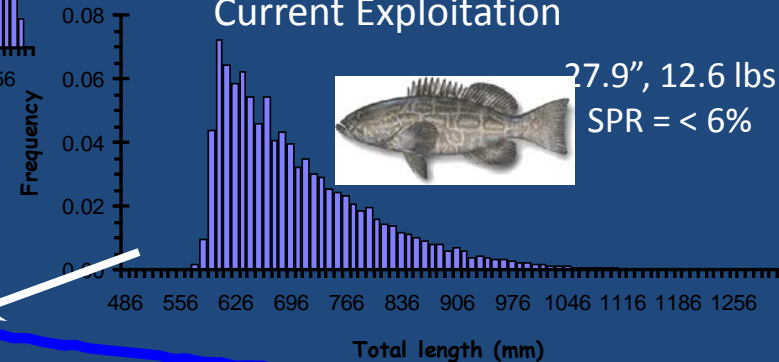


MSY Exploitation



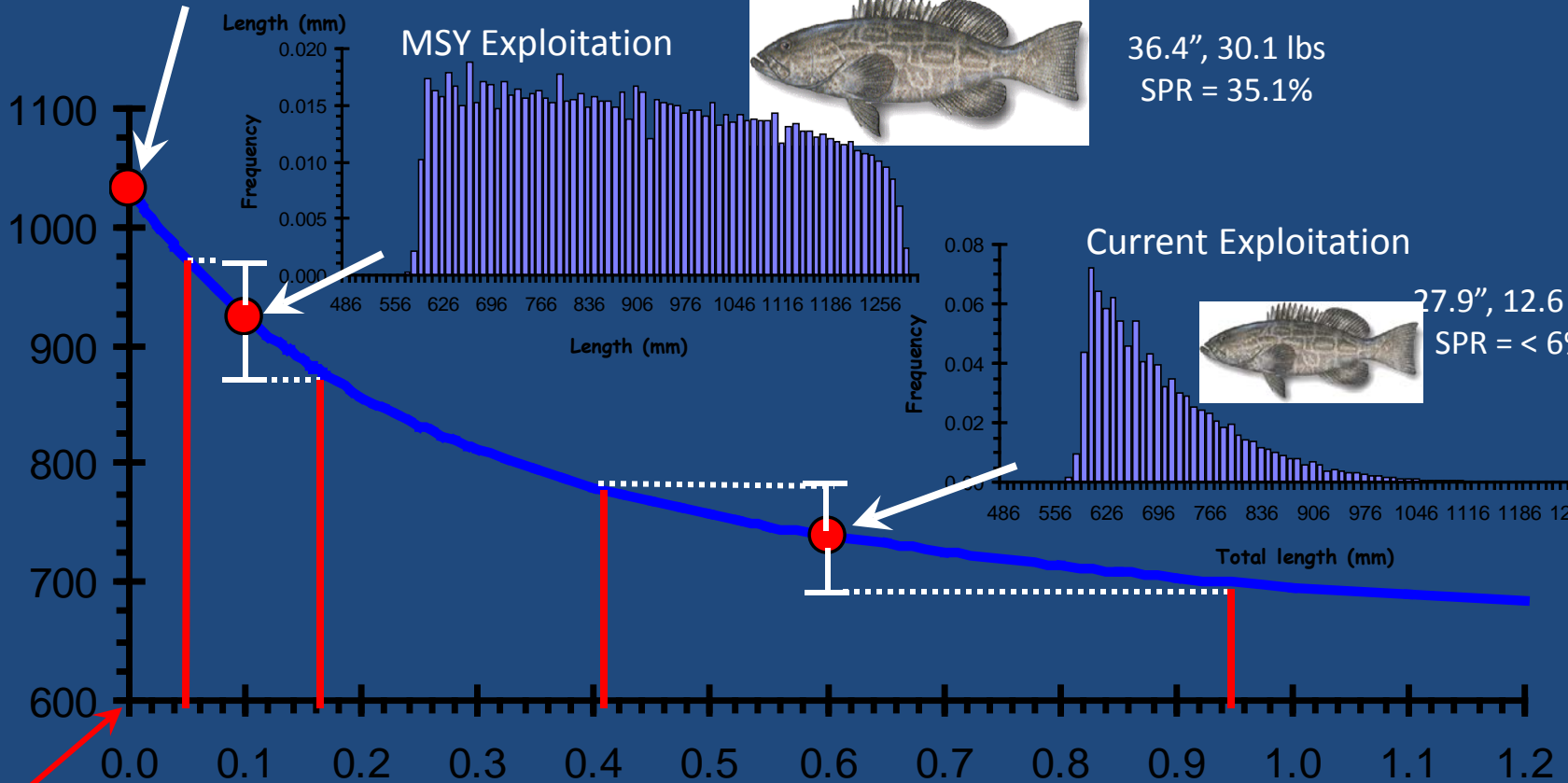
36.4", 30.1 lbs
SPR = 35.1%

Current Exploitation



27.9", 12.6 lbs
SPR = < 6%

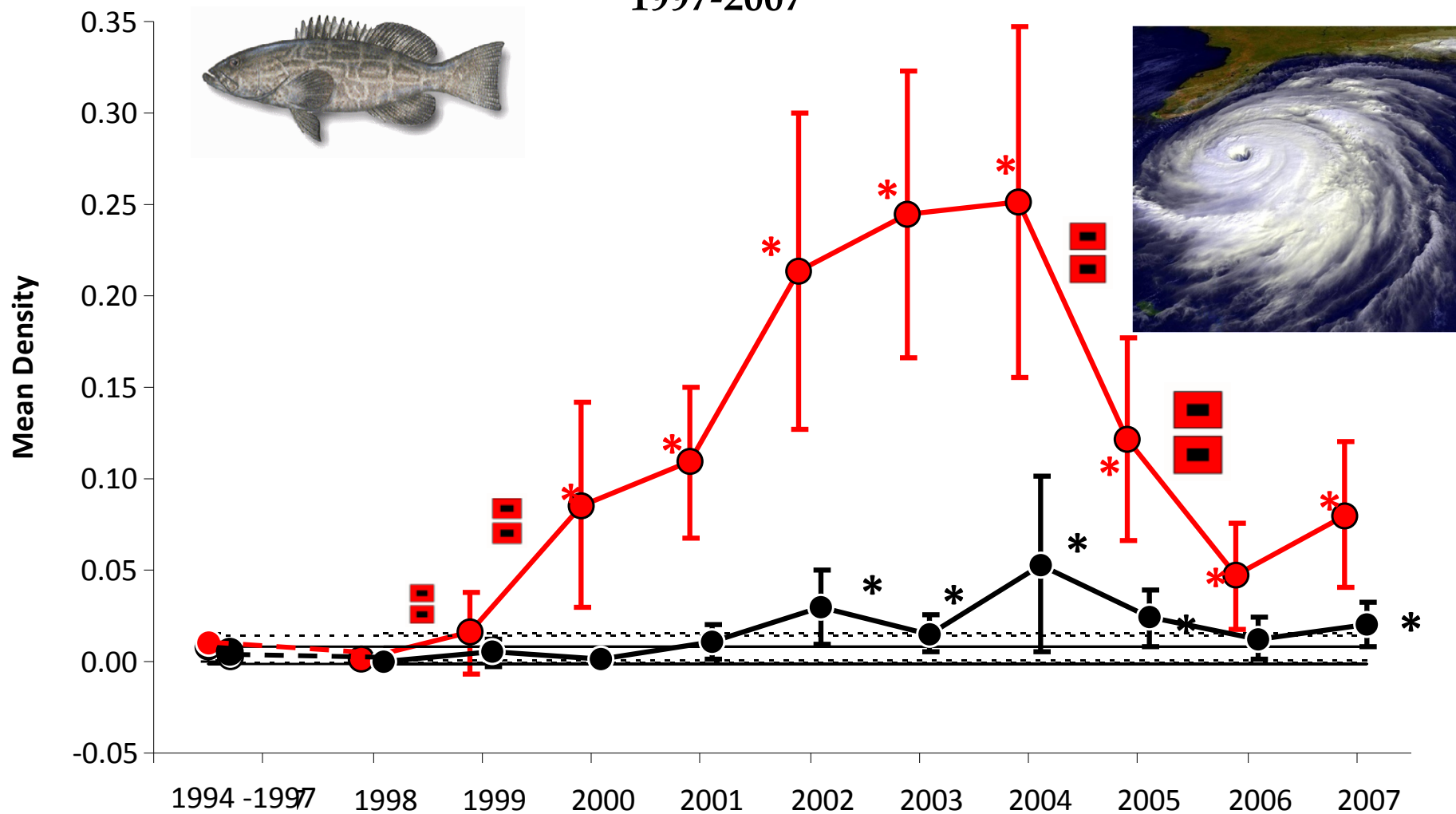
Average Size (TL, mm)



Minimum Legal Size
(24 inches)

Fishing Mortality Rate

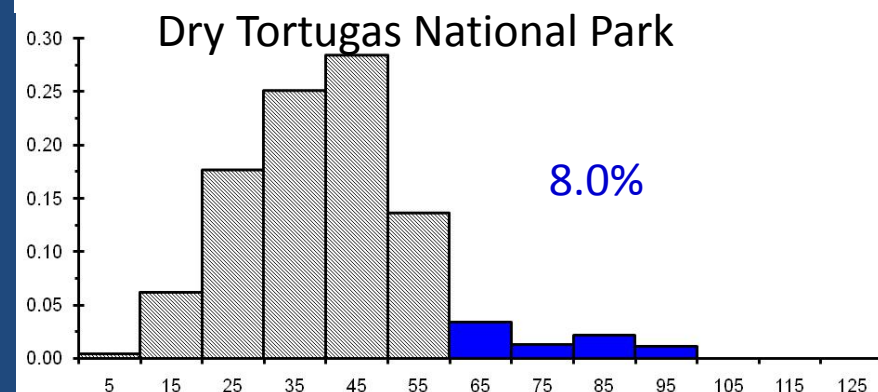
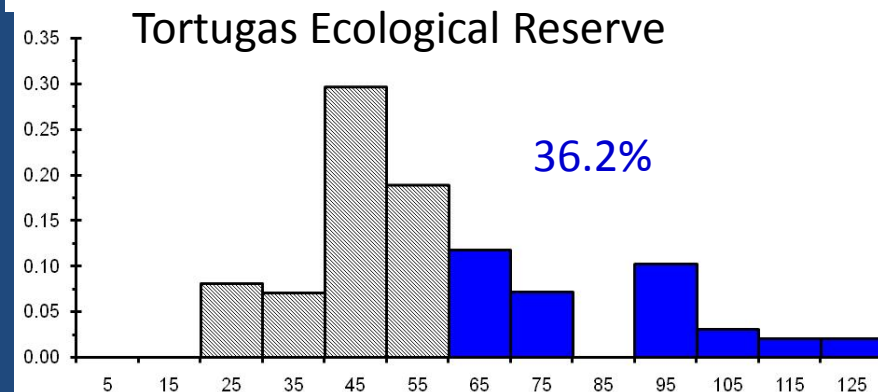
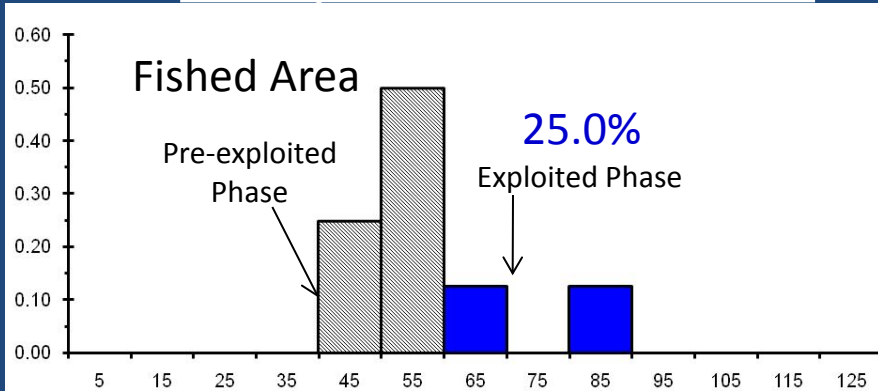
Black Grouper, Exploited and Protected 1997-2007



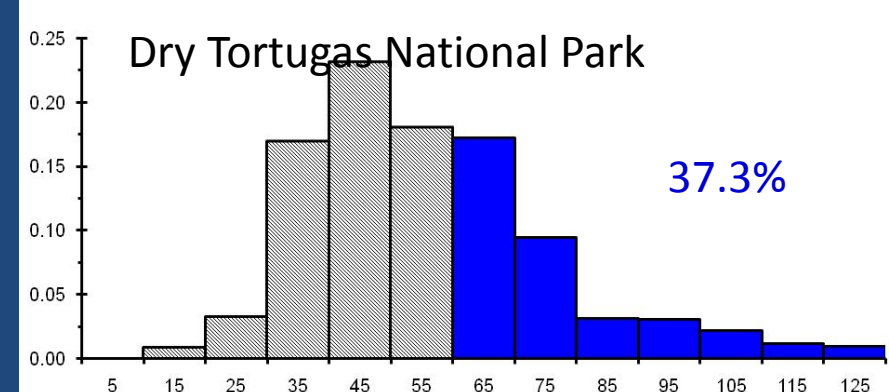
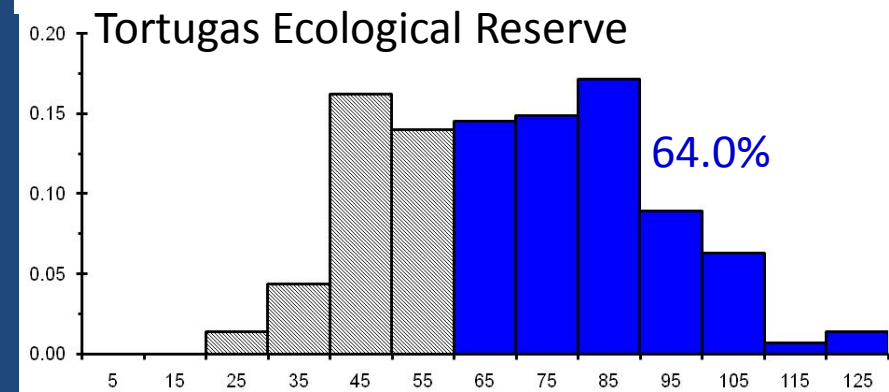
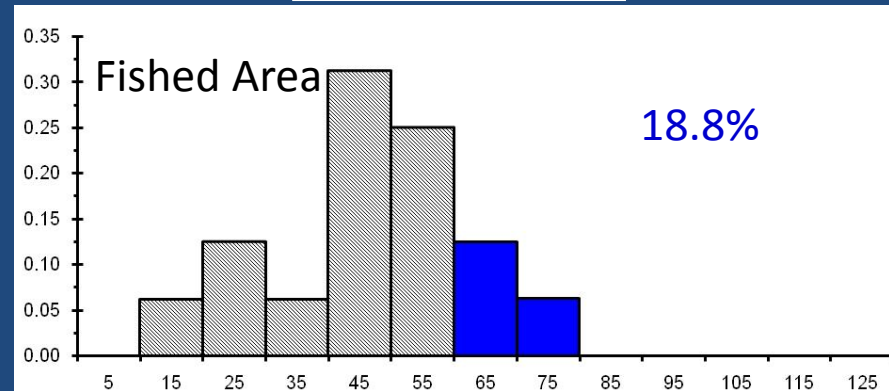
Fishery Regulations minimum length: 1985 - 18", Feb 1990 - 20", Dec 1998- 24", Jan 1 2001 - 22"; 1986 - 5/fisher/day

Response of Tortugas MPAs to Protection

Pre-Implementation: 1999-2000



2008 RVC Survey



Length (cm)

Relative Frequency

Questions ???

