



NOAA
FISHERIES

Status and Trends in the Florida Keys - Coral Reef Fish

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NOAA National Marine Fisheries Service

FKNMS Advisory Council Presentation

Southeast Fisheries Science Center

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Marathon, FL

South Atlantic Snapper / Grouper Complex



RED SNAPPER



MUTTON SNAPPER



BLACK SNAPPER



BLACK GROUPE



WARSAW GROUPE



CONEY



QUEEN SNAPPER



SCHOOLMASTER



BLACKFIN SNAPPER



GRAY SNAPPER



TIGER GROUPE



RED HIND



GRAYSBY



ROCK HIND



SILK SNAPPER



DOG SNAPPER



CUBERA SNAPPER



LANE SNAPPER



NASSAU GROUPE



RED GROUPE



YELLOWEDGE GROUPE



VERMILION SNAPPER



MAHOGANY SNAPPER



YELLOWTAIL SNAPPER



BLUELINE TILEFISH



GAG GROUPE



SCAMP



SPECKLED HIND



GREATER AMBERJACK



LESSER AMBERJACK



ALMACO JACK



HOGFISH



GOLIATH GROUPE



BLACK SEA BASS



YELLOWFIN GROUPE



YELLOWMOUTH GROUPE



BANDED RUDDERFISH



OCEAN TRIGGERFISH



TOMTATE



MARGATE



GOLDEN TILEFISH



SAUCEREYE PORGY



WRECKFISH



SNOWY GROUPE



GRAY TRIGGERFISH



QUEEN TRIGGERFISH



FRENCH GRUNT



BLACK MARLIN



SHEEPSHEAD



SCUP



BANK SEA BASS



ROCK SEA BASS



SPADEFISH



BLUE STRIPE GRUNT



WHITE GRUNT



JOLTHEAD PORGY



KNOBBED PORGY



WHITEBONE PORGY



RED PORGY

It is not just about fish

Ecosystem Services:

Aesthetics

Fishing & Diving

Fishing tackle & bait

Charter fees, vessels

Licenses

Hotel/housing

Fuel/gas/oil

Rental Cars

Restaurants, Supermarkets

Tourism & Real Estate

Waterfront properties

Tourism Industry

Ramps & docks

Resident recreation

Non-residents

Supporting Marine Industries

Transportation

Boating

Electronics

Communications

Fishing Tackle

Newspaper, Magazine & TV Media

Dockage, storage



Photo: J.A. Bohnsack 1983 Looe Key Reef

South Florida Reef Economics 2001

28,300,000
person-days spent on reefs

\$ 4,395,000,000
Sales

\$ 2,047,000,000
Income

71,300 **jobs**

Johns et al. 2001



NOAA FISHERIES

Habitat





USGS 2002

The **Shifting Baseline Syndrome** is a change in perception of ecological change from generation to generation as true natural conditions drift away from previous conditions. Pauly, 1995

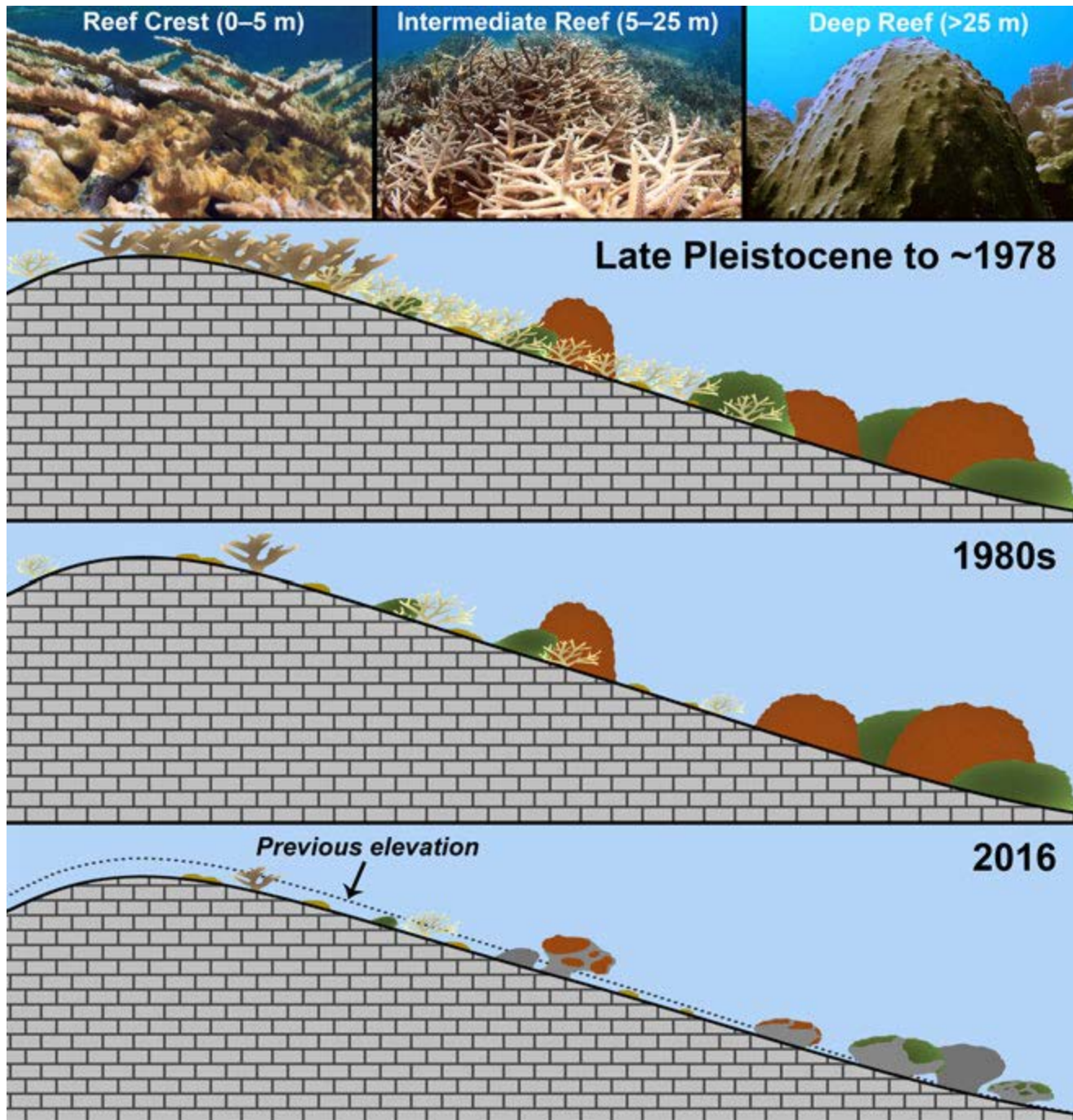
Griffin, Kellog, Garrison & Shinn 2002

1988

1998

2001



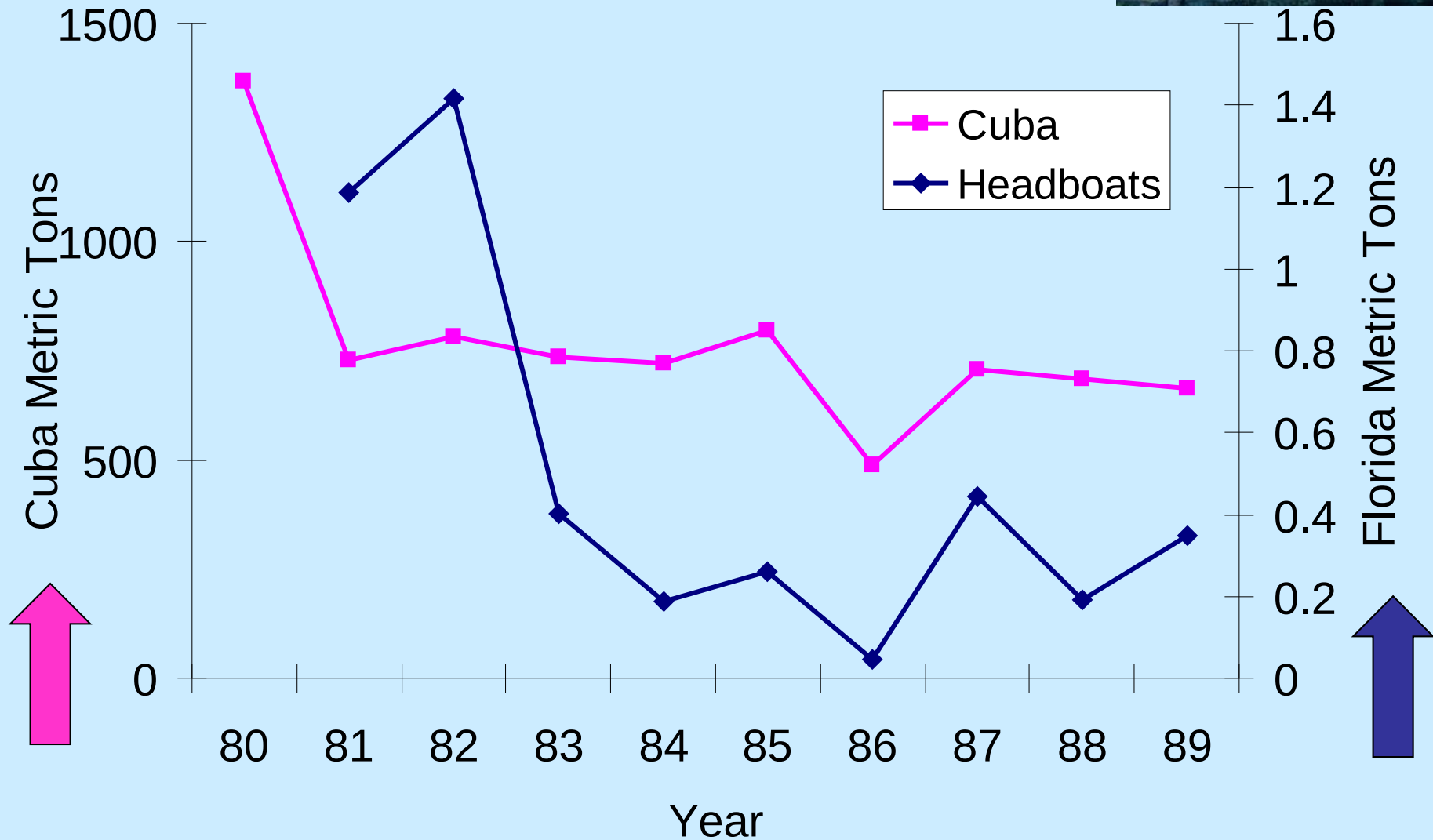


Kuffner and Toth 2016

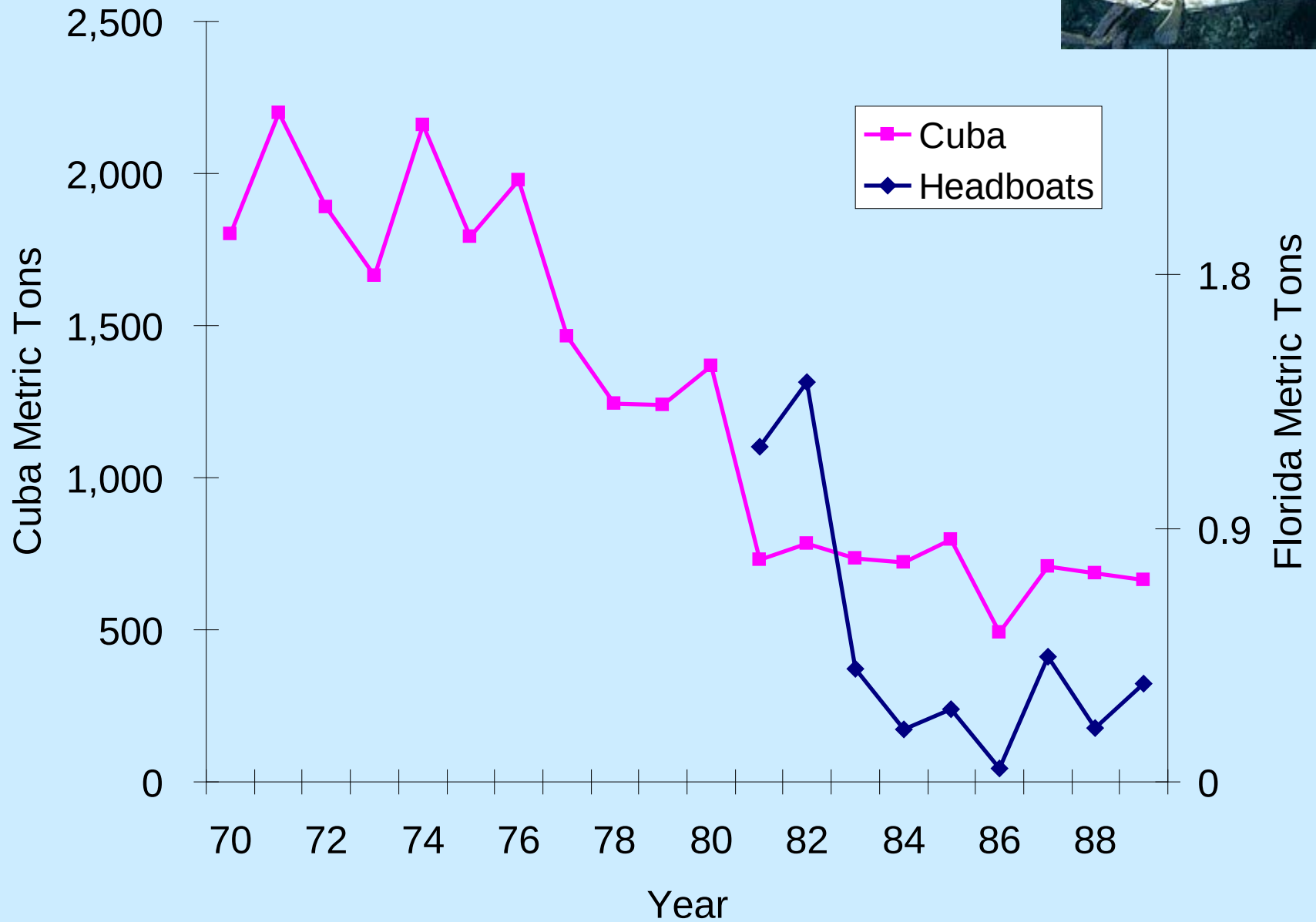
A geological perspective on the degradation and conservation of western Atlantic coral reefs.
Conservation Biology

Shifting Baselines

Nassau Grouper Landings

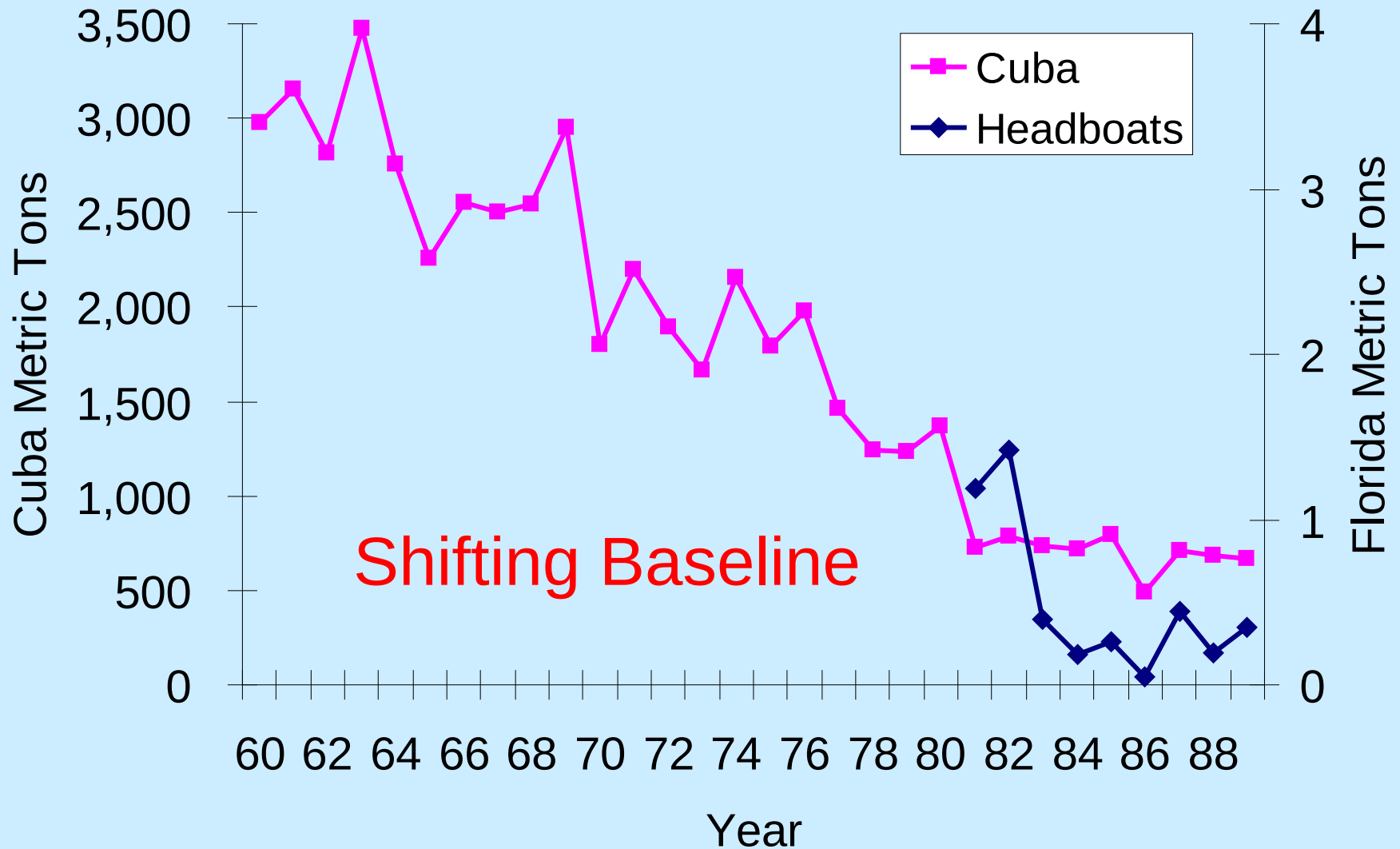


Nassau Grouper Landings



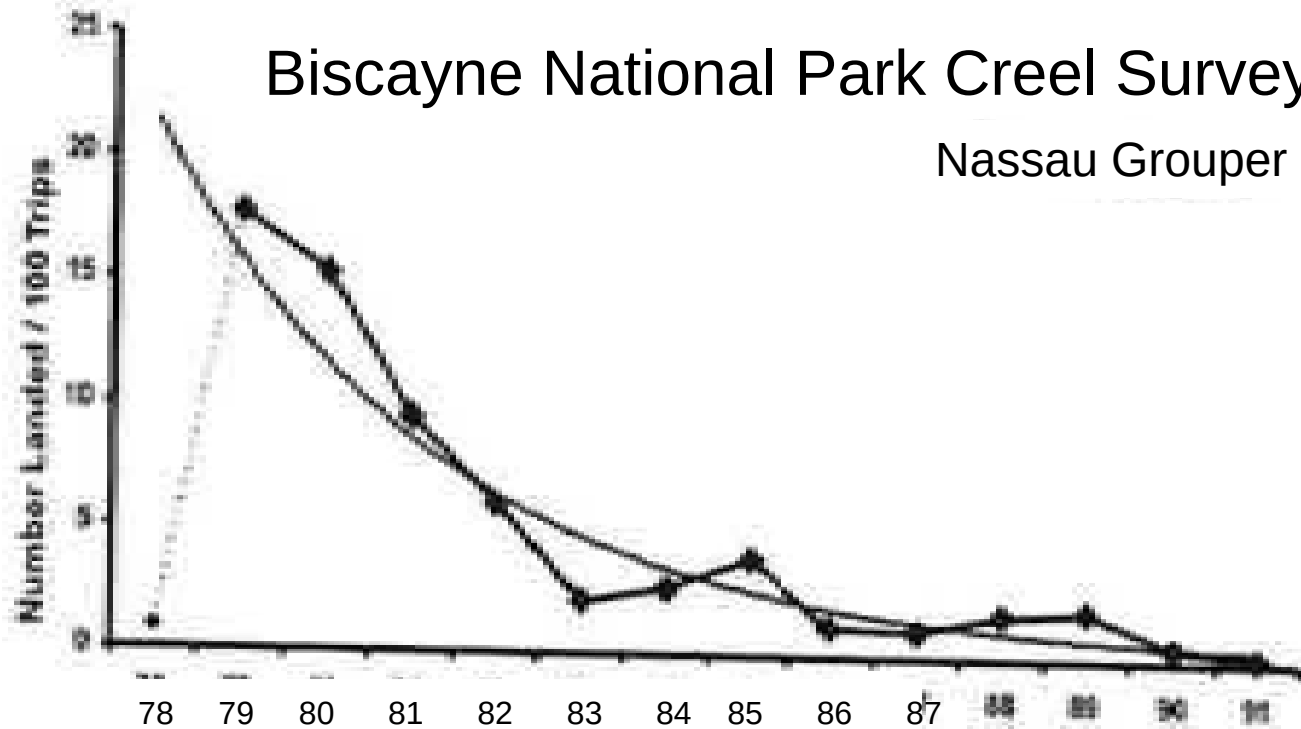


Nassau Grouper Landings

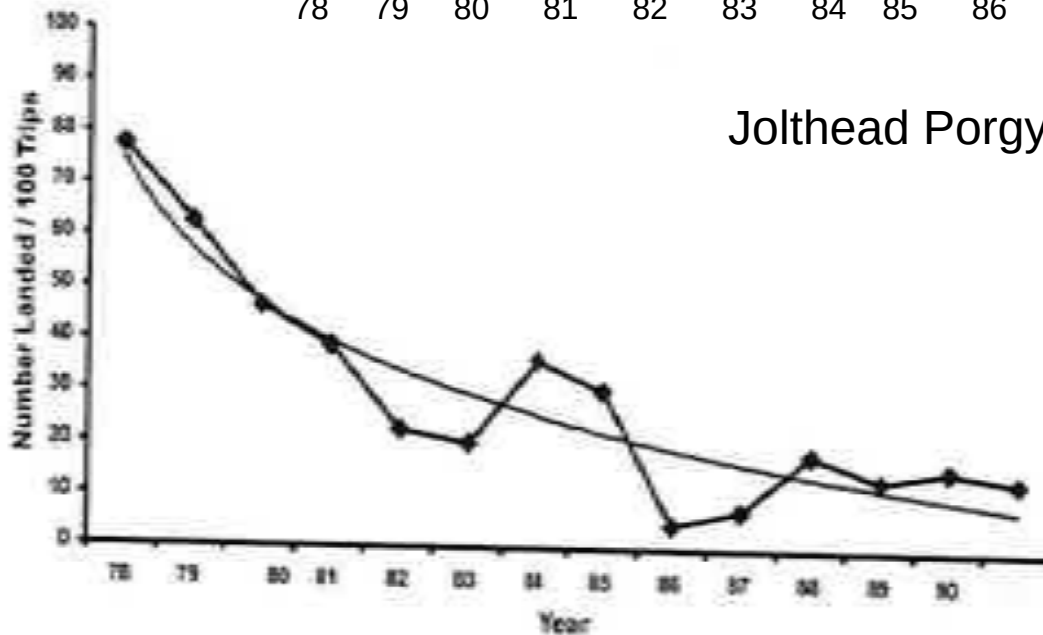


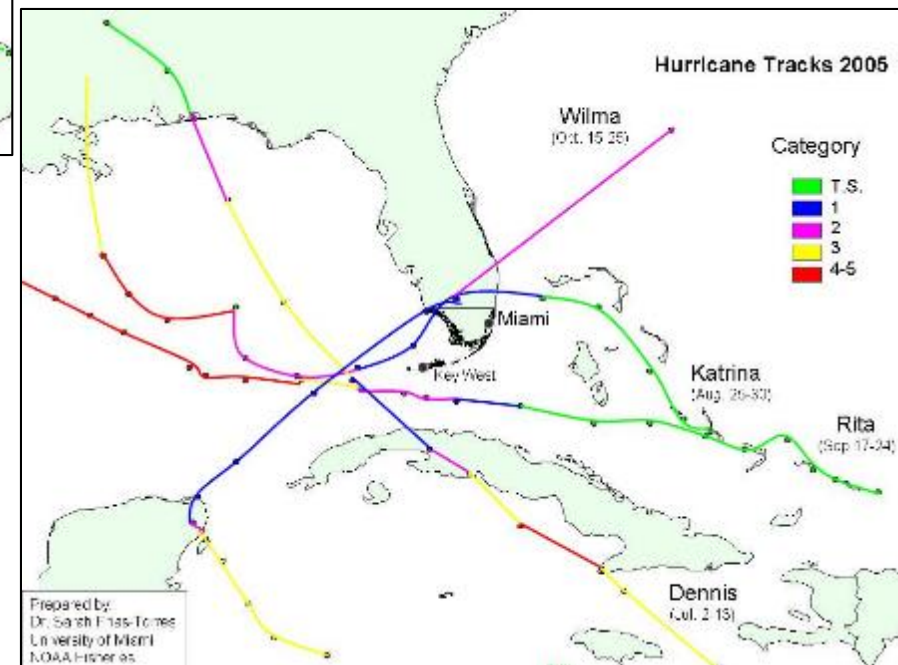
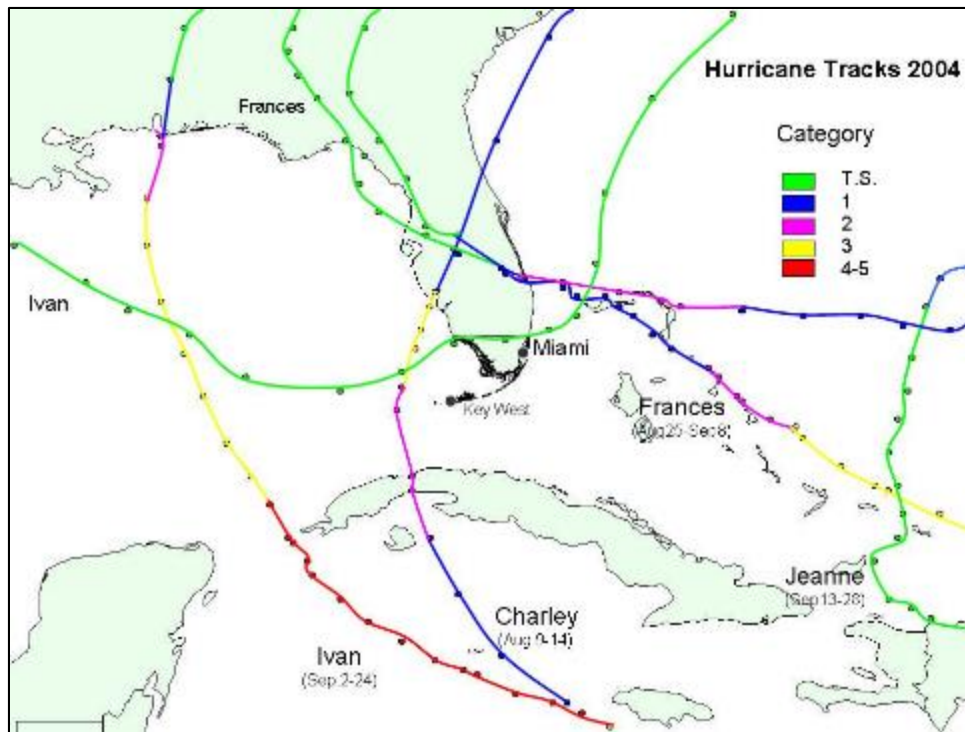
Biscayne National Park Creel Survey

Nassau Grouper



Jolthead Porgy





Extreme Events

2004-2005 – The Florida Keys experienced six Hurricanes or tropical storms in 18 months.

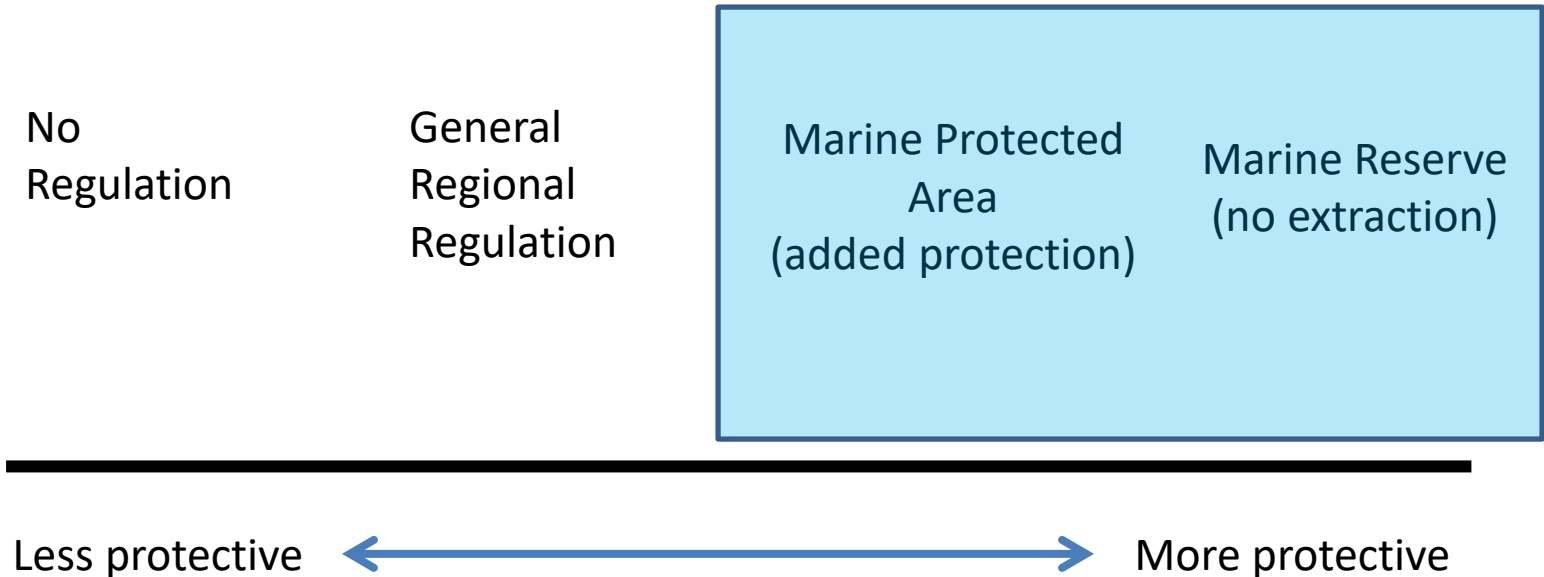
Ecosystem threats

Human population growth and demands

Boaters in Biscayne National Park

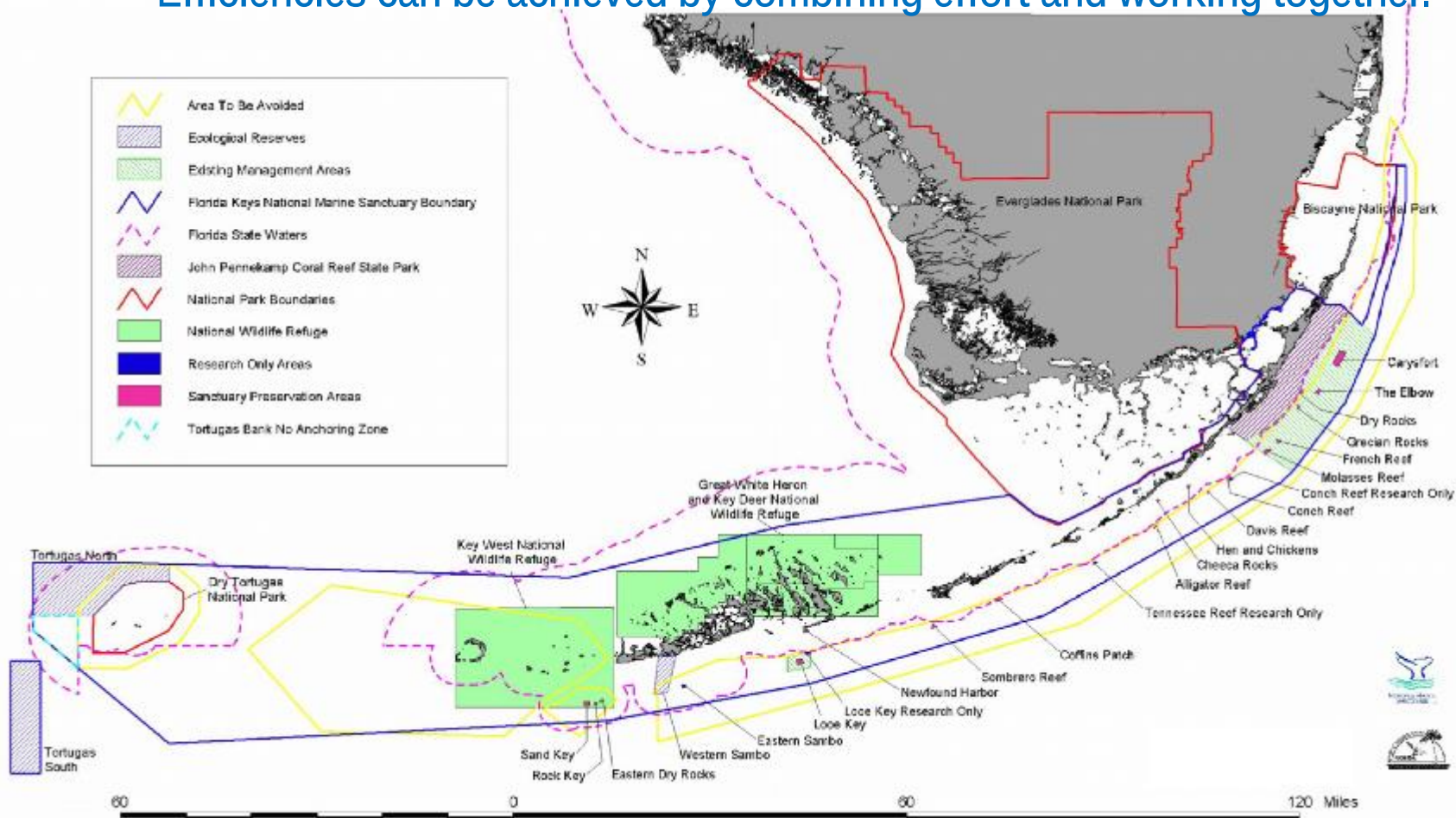


Marine Protected Area Protection Gradient



Examples of spatial management in southern Florida.

The ecosystem is a unifying concept, but no agency can monitor it all.
Efficiencies can be achieved by combining effort and working together.



Prepared by Kevin Kinsch & Ben Richards 11/25/2011

Spatial Based Management (no take)

Ecosystem Function	2001 2007	Ecological Reserve, Tortugas, FKNMS, FL Research Natural Area, Dry Tortugas Nat. Park
Ecosystem Structure	2001 1994	Tortugas South, FKNMS, FL Georges Bank Fishery Closures
Wilderness Value	2001	Tortugas North Ecol. Reserve, FKNMS, FL
Land / Seascape	1990	Fla Keys Nat. Marine Sanctuary, FL
Multiple Habitats	1997	Sambo Ecological Reserve, FKNMS, FL
Special Habitat	2000 1997 1993	Coral Reef Protection Act Sanctuary Protected Areas, FKNMS, FL Oculina HAPC
Special places	1981 1961 1960 1947	Looe Key Nat. Marine Sanctuary, FL Buck Is. National Monument, USVI John Pennekamp CR State Park Florida Bay, Everglades National Park, FL

SE Stocks Overfished and Undergoing Overfishing



NOAA FISHERIES Stock Status as of December 31, 2015

Legend



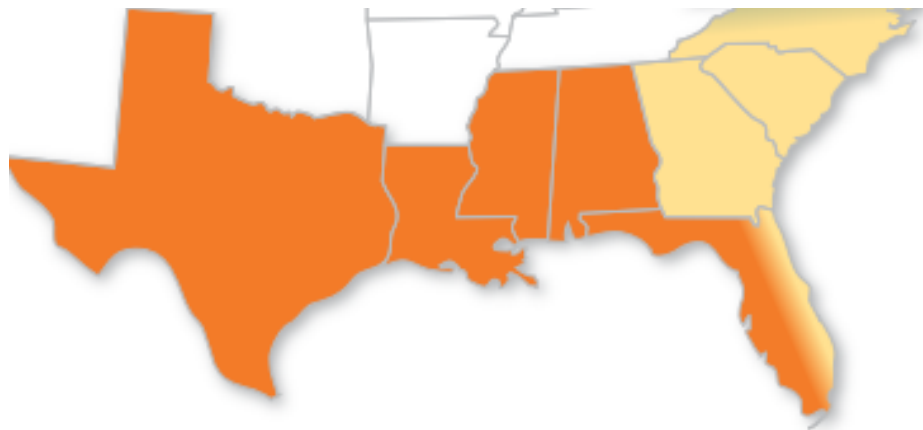
On Overfished List: 38 stocks



On Overfishing List: 28 stocks

1. Non-FSSI stock

2. Stock is fished by US and International fleets



Gulf of Mexico:



Greater amberjack



Gray triggerfish



Red snapper



Caribbean:



Goliath grouper¹



Nassau grouper¹



Queen conch

South Atlantic:



Hogfish - Southeast Florida



Red snapper



Blueline tilefish



Speckled hind



Warsaw grouper



Red porgy



Snowy grouper

Fish Stock Sustainability Index (FSSI):

NOAA Fisheries Quarter 4 Update
Stock Status as of December 31, 2015



NOAA FISHERIES

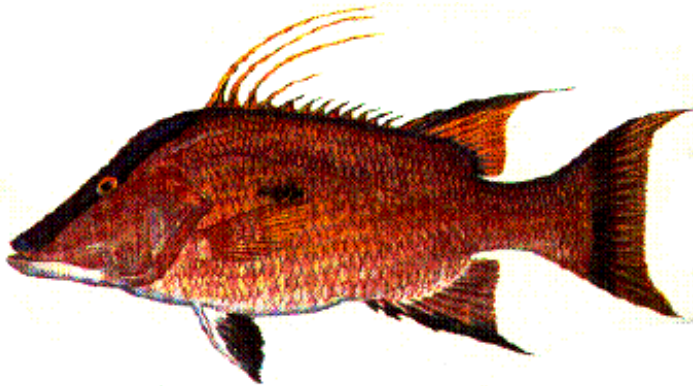
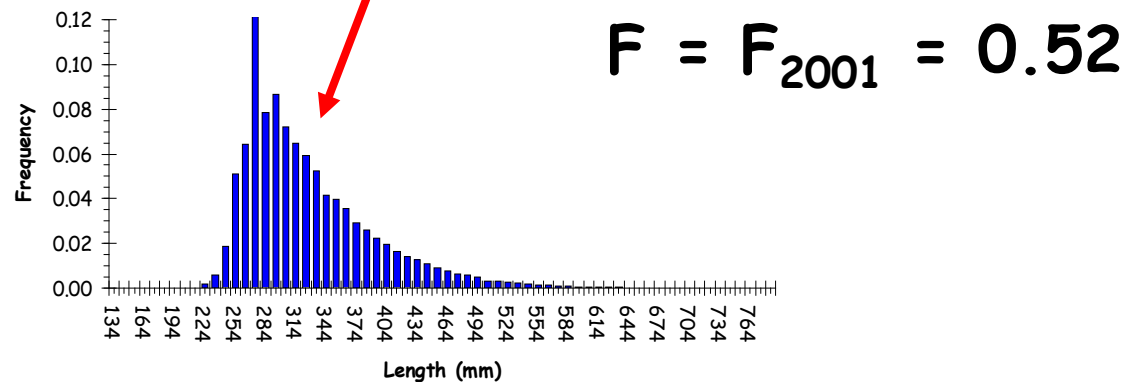
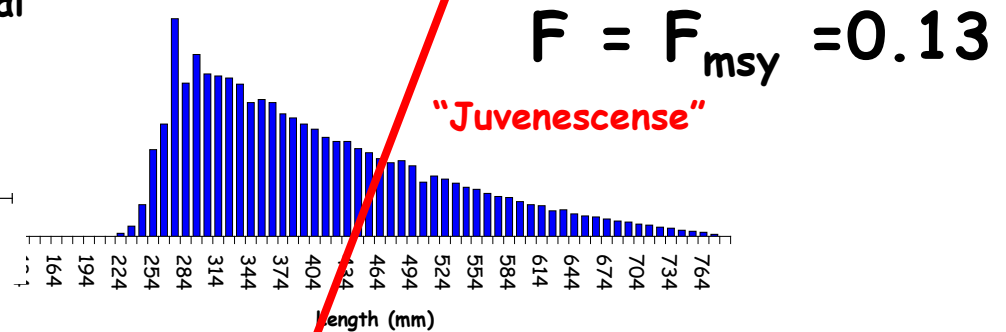
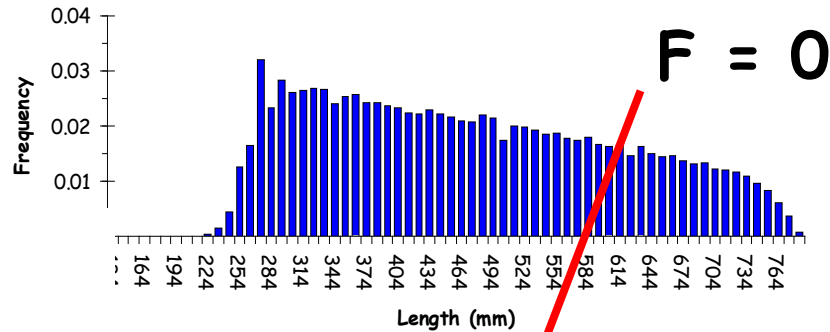
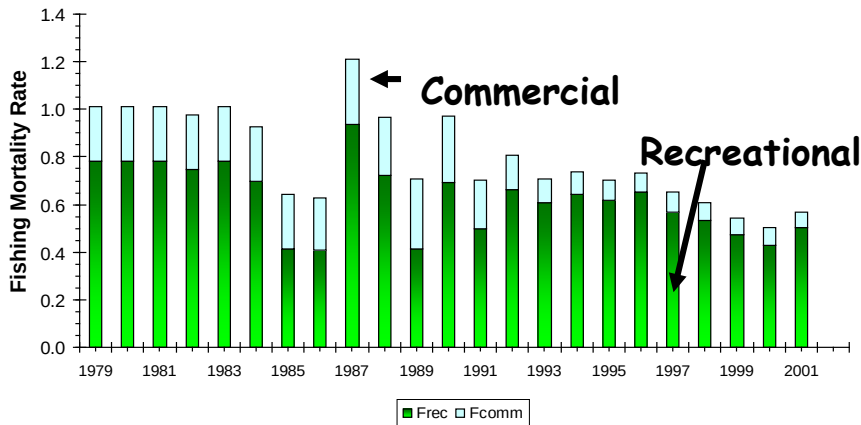
Reef Fish Vulnerability to Fishing

- High value
- Large size
- Long lives (decades)
- Low adult natural mortality
- Delayed reproduction
- Many species
- Many change sex
- Location is predictable in time and space
- Aggressive behavior & No fear of humans
- Vulnerable to fishing gear





Estimated Fishing Mortality Components and Fish Population Effects



“The concept of marine reserves is simple:

If protected from human interference, nature will take care of itself ”

**Deplete Target
Species**



**Cause
Habitat Damage**



**Bycatch
Mortality of target and
non-target species**



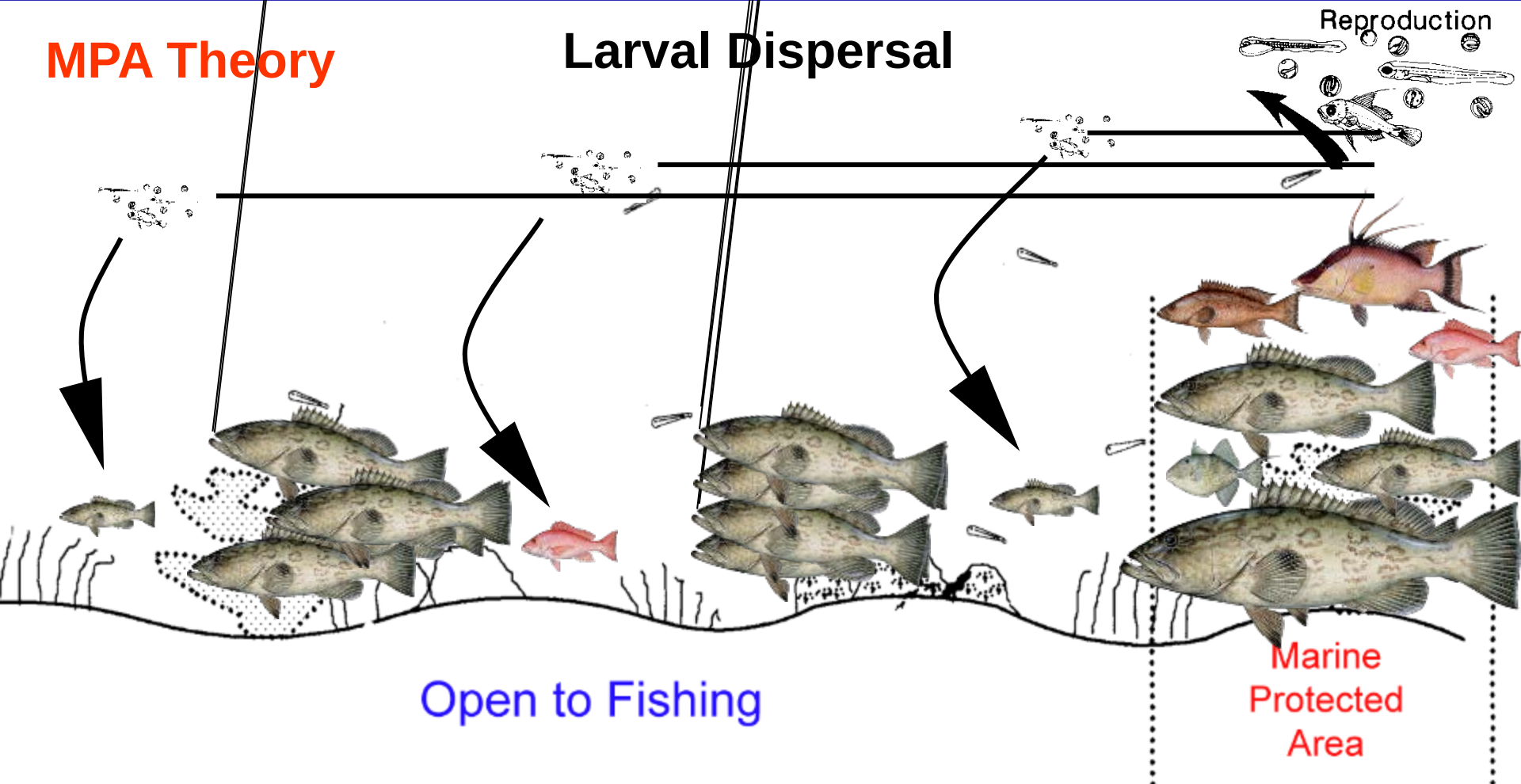
Spillover

Reproduction & Dispersal

MPA Theory

Larval Dispersal

Reproduction



Open to Fishing

Marine
Protected
Area

Colonization & Growth

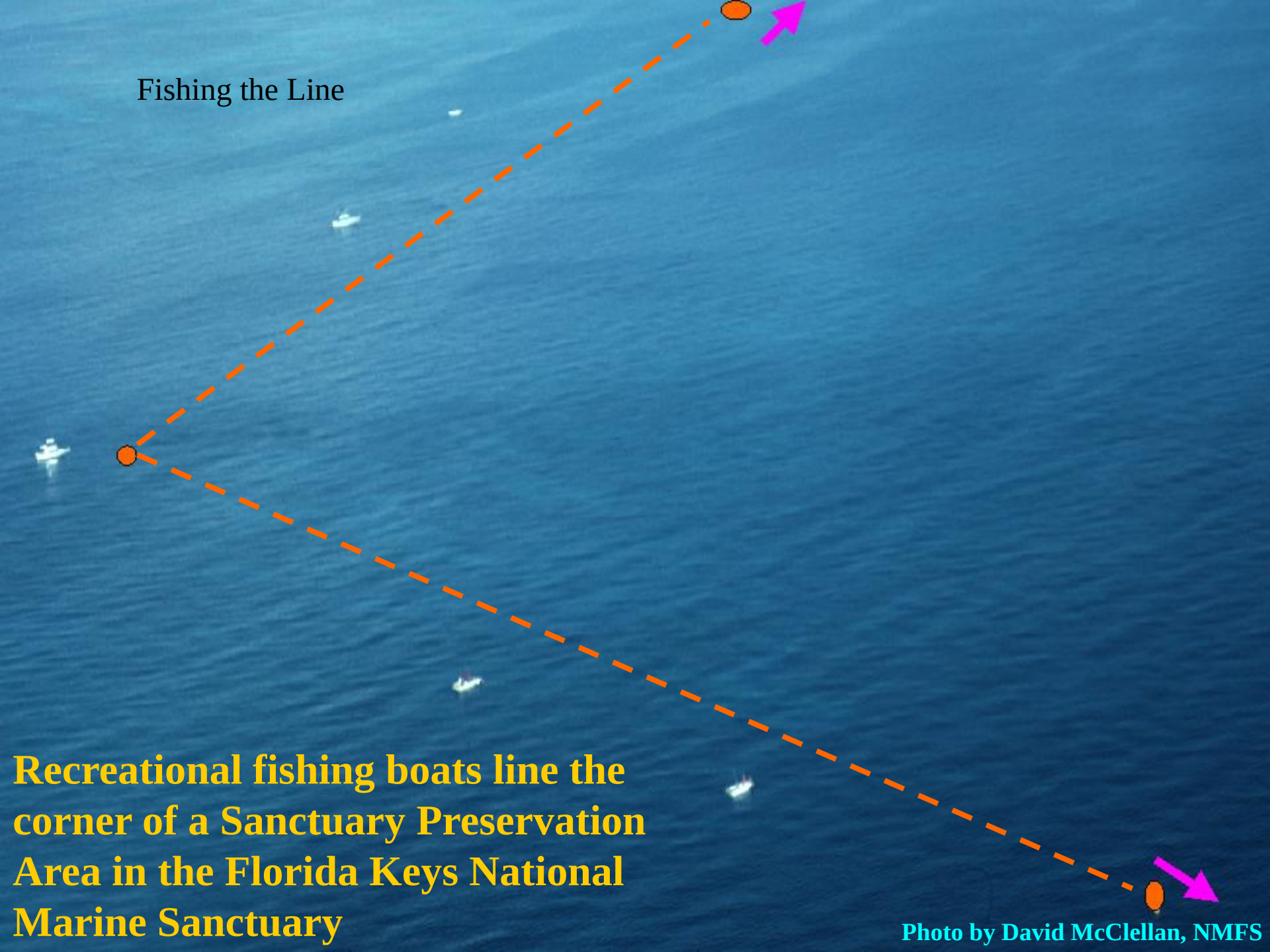
Abundance

Diversity

Fishing the Line

Recreational fishing boats line the corner of a Sanctuary Preservation Area in the Florida Keys National Marine Sanctuary

Photo by David McClellan, NMFS



Benefits of Marine Reserves

- **Protect Ecosystem Structure and Function**
 - (Goods and Services)
- **Provide Fishery Benefits**
- **Increase Scientific Understanding of Marine Ecosystems**
- **Increase Public Education & Appreciation**
- **Enhance Non-Extractive Economic Benefits**



Problems ?

- How Many ?
- What size ?
- Total area ? (20-30% minimum)
- Location ? (NIMBY)
- Fishing Displacement ? (Crowding)
- Highly migratory species ?
- Uncertainty ?
- Acceptance / Compliance / Enforcement ?



Coral reefs are complex and difficult to monitor.

Habitat is spatially heterogeneous.



Reef fishes are highly diverse (>382 species), and despite high site fidelity, are mobile and highly variable in space and time.



Acknowledgments – 35 years of contributions



NMFS -SEFSC

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NPS - DOI

M. Feeley

A. Atkinson

M. Patterson

T. Zigler



RSMAS – U of Miami

J.S. Ault

S.G. Smith

J. Blondeau

J. Luo

D. Bryan



FFWCC

J. Hunt.

A. Acosta

(many others)



New in 2010



B. Walker

K. Kilfoyle



NOS-NCCOS

M. Monaco



FDEP
Our Fla Reefs
J. Walczak

Tactical innovation: circular plot visual censuses in a small increment of space and time based on ambient visibility:



Measured

Derived

Species Observed

Frequency of Occurrence

Species Abundance

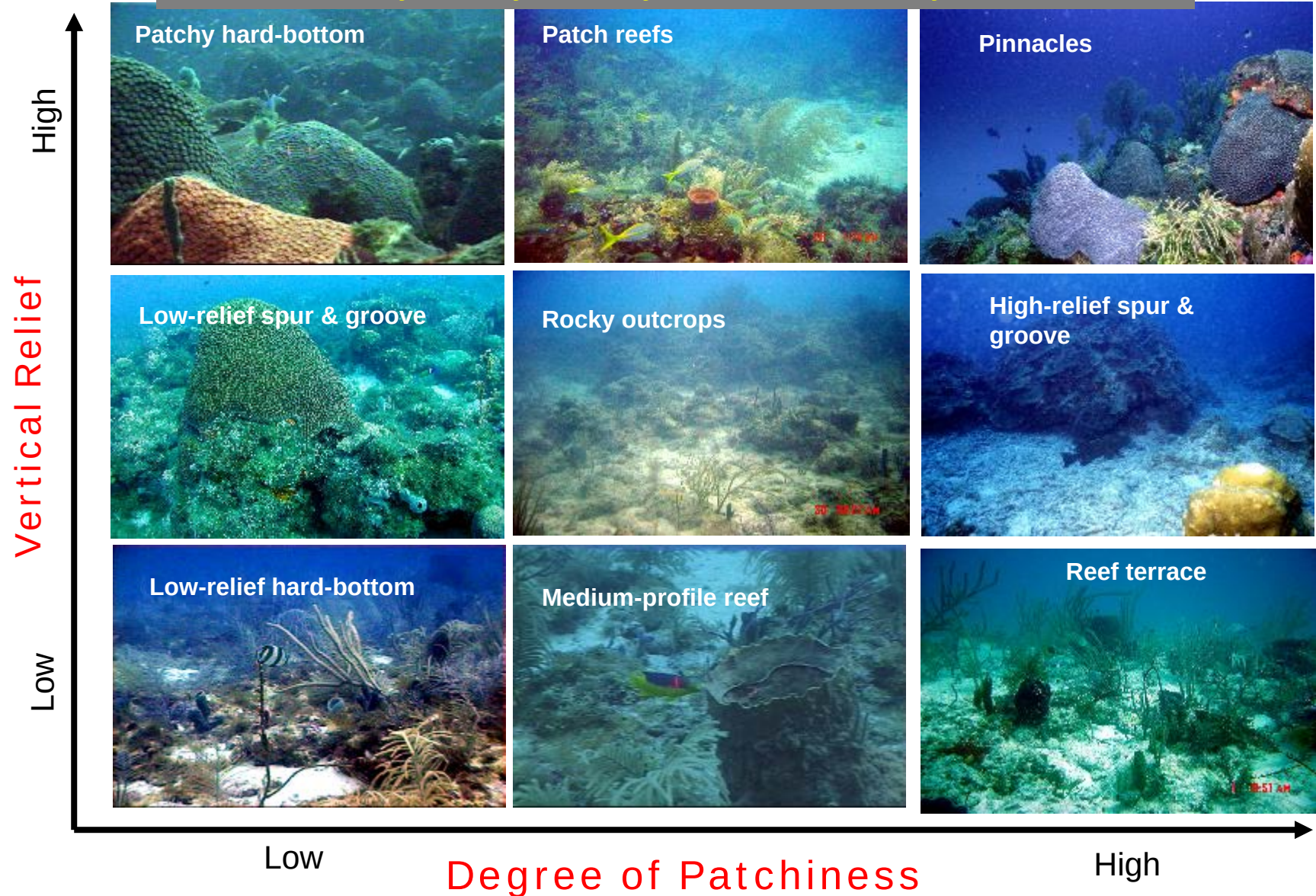
Individual Sizes

Biomass

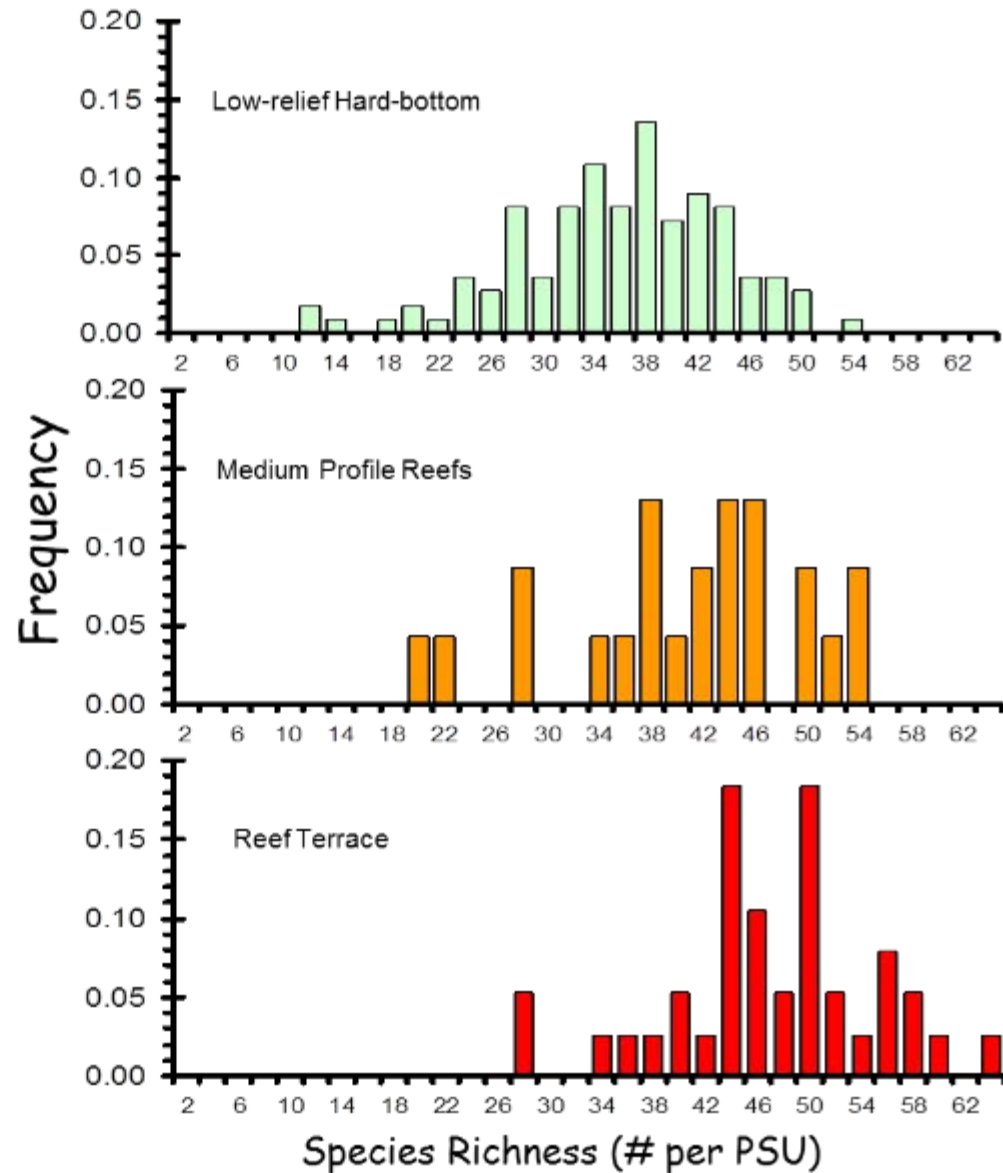
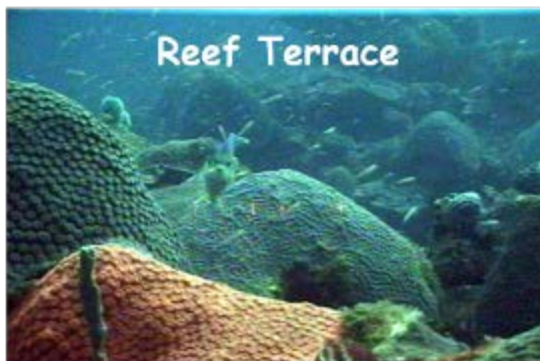
Habitat Type, Depth
%Cover, Relief,
Composition
Profile

Link Reef Fish Spatial Abundance to Benthic Habitats

Innovation: objectively classify all reef habitat by two variables



Each habitat provides a unique biodiversity signature based on composition



Strategic innovation: stratify based on data variance; not habitat area.
Include spatial management zone as a stratum.

Stratified Random Design

Heterogeneous Spatial Distribution

Stratification Variables:

Cross-Shelf Habitat type

Habitat relief and patchiness

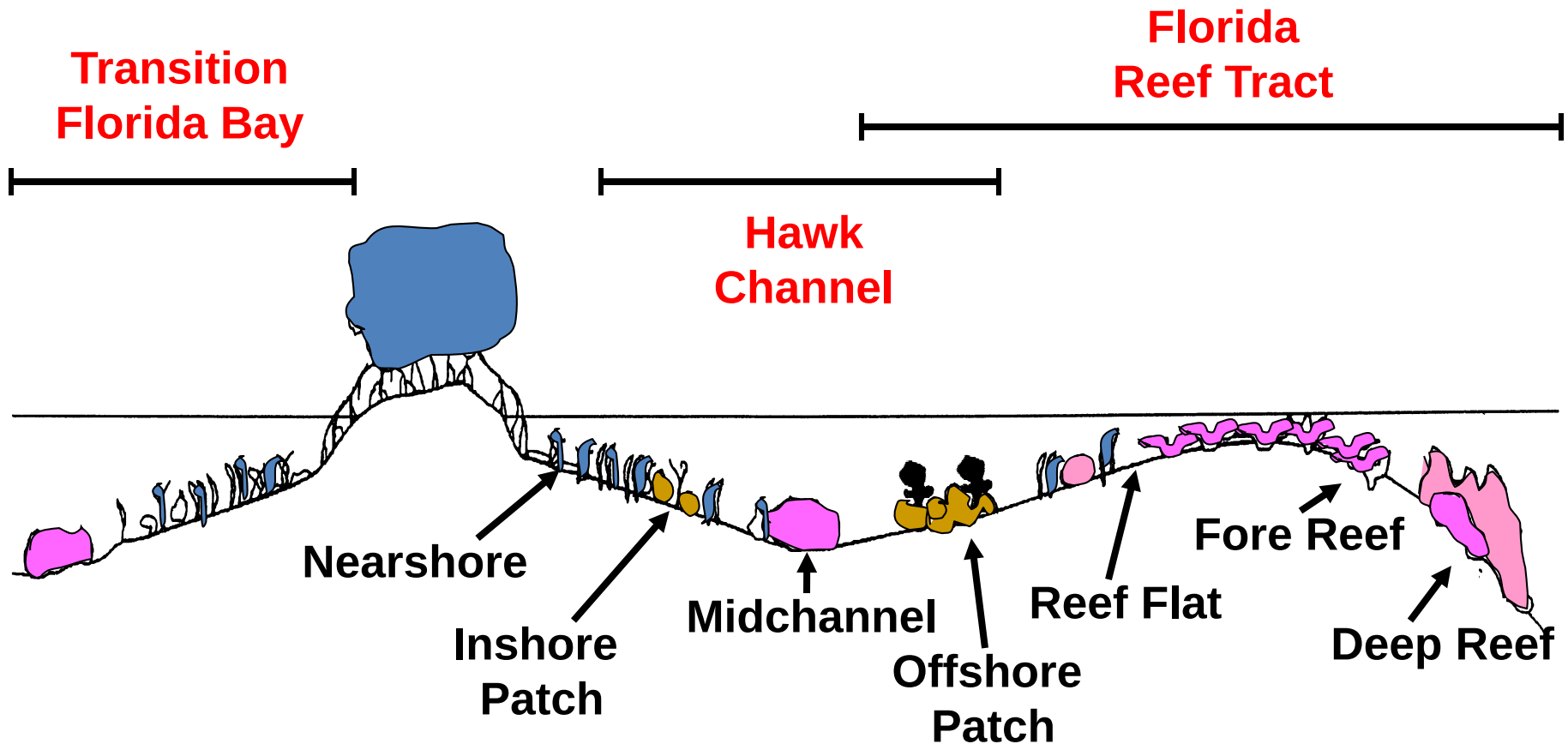
Depth

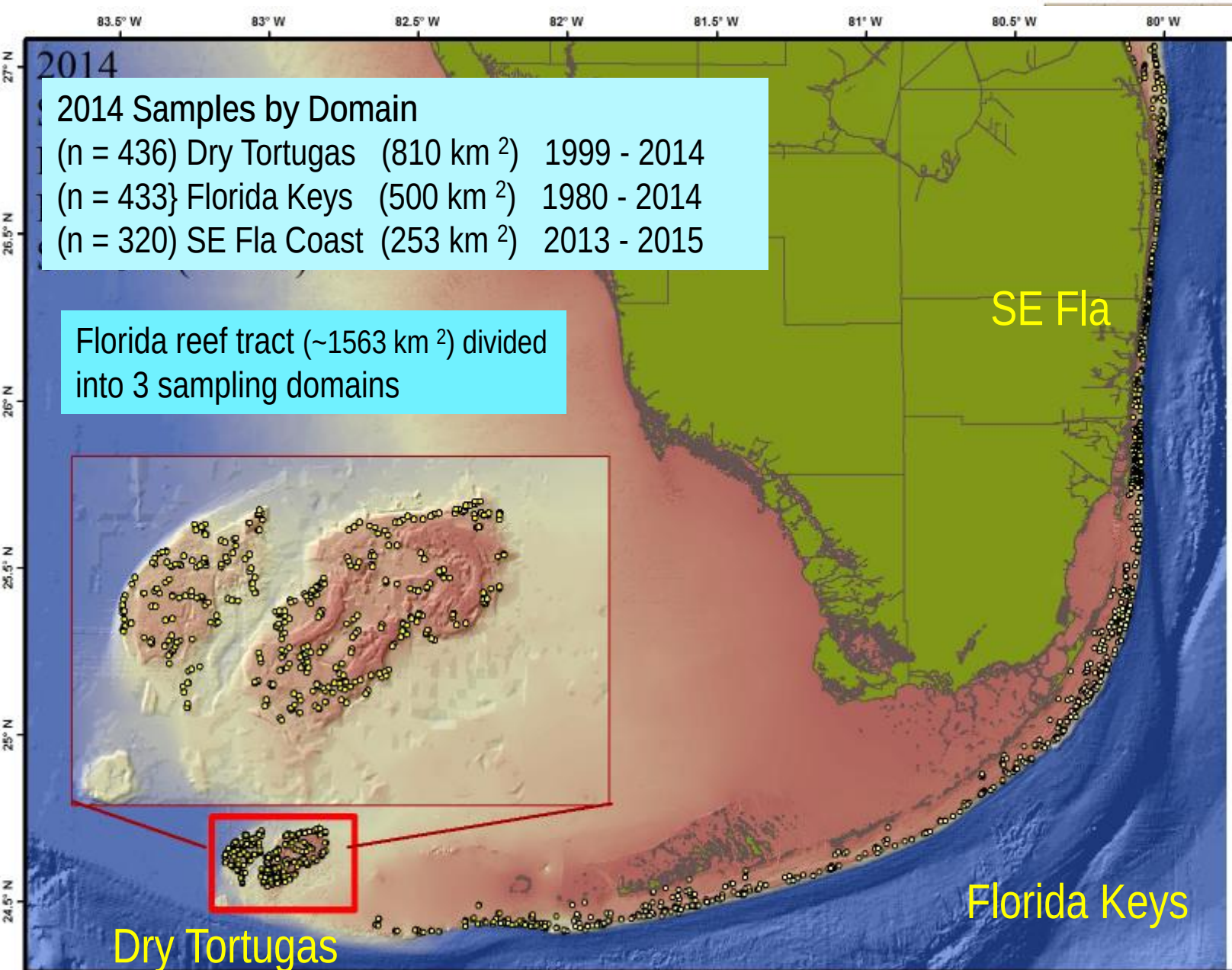
Geographical Subregion

Spatial Management Zone

(e.g, no-take reserves, angling only)

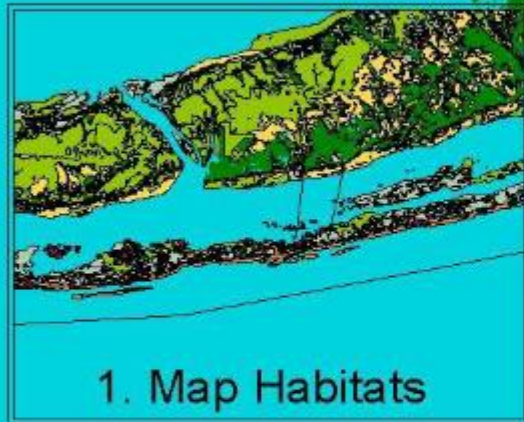
Cross-Shelf Habitat Classification



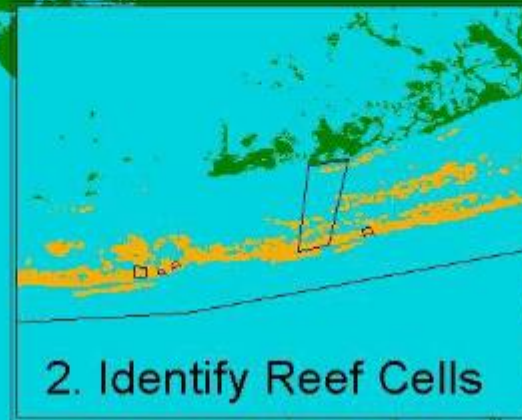


Florida

Miami



Requires accurate & precise habitat maps
(NOS & FWC)



(200 x 200 m cells)

Gulf of Mexico

Innovation: better maps allowed
shift to 100 x 100m cells in 2014

Relative Abundance
of Gray Snapper



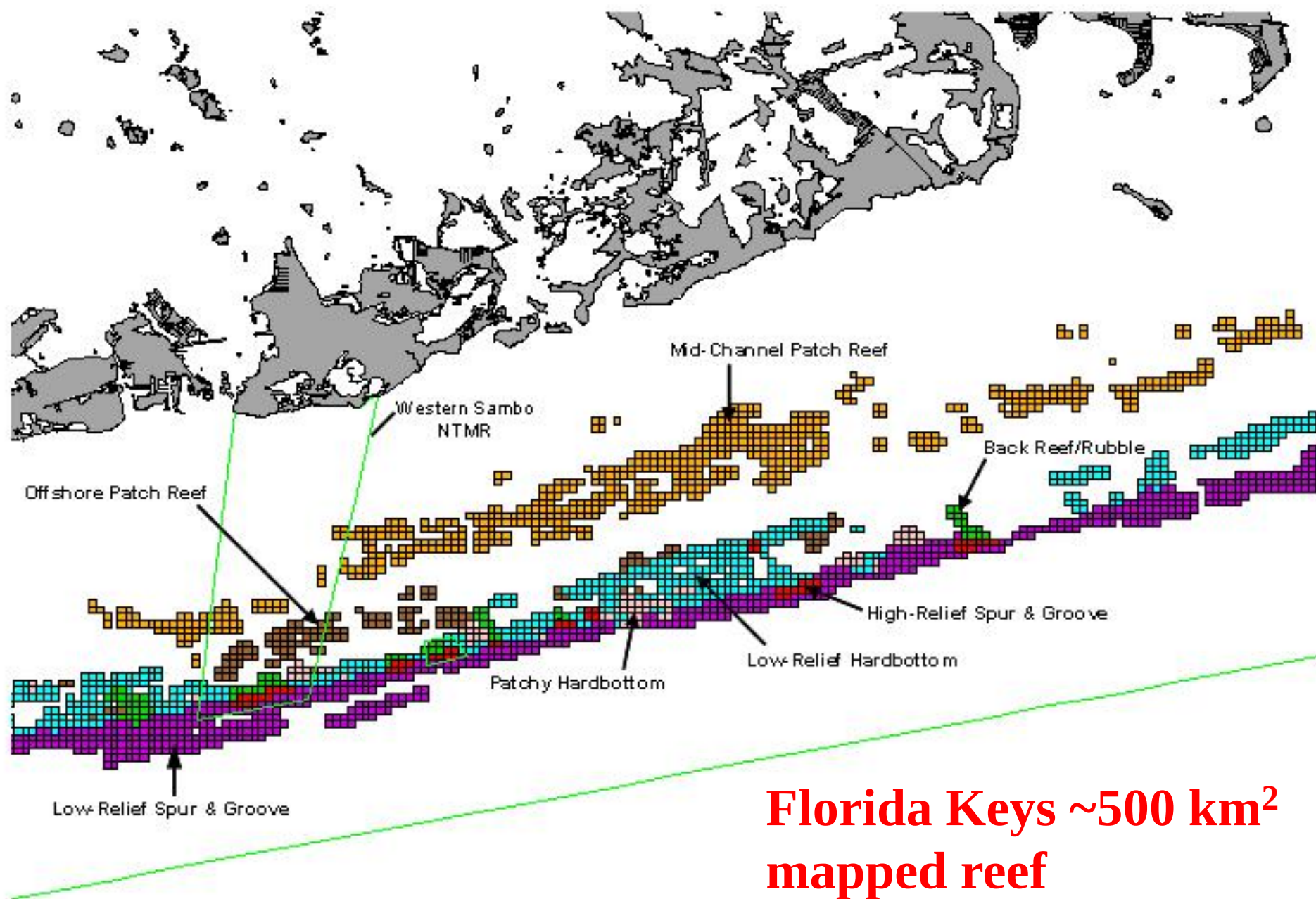
Key West

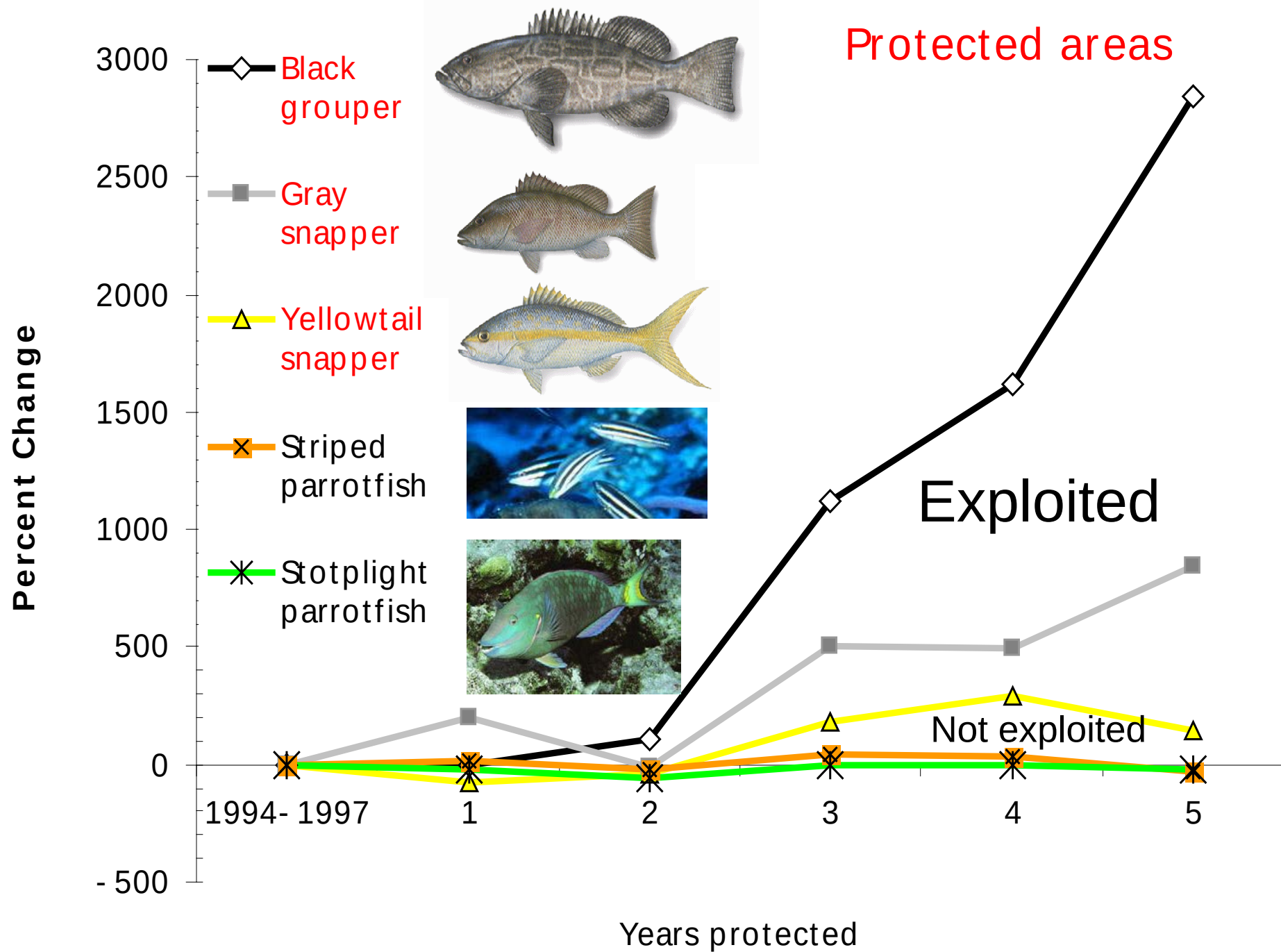


10 0 10 20 30 40 50 Kilometers

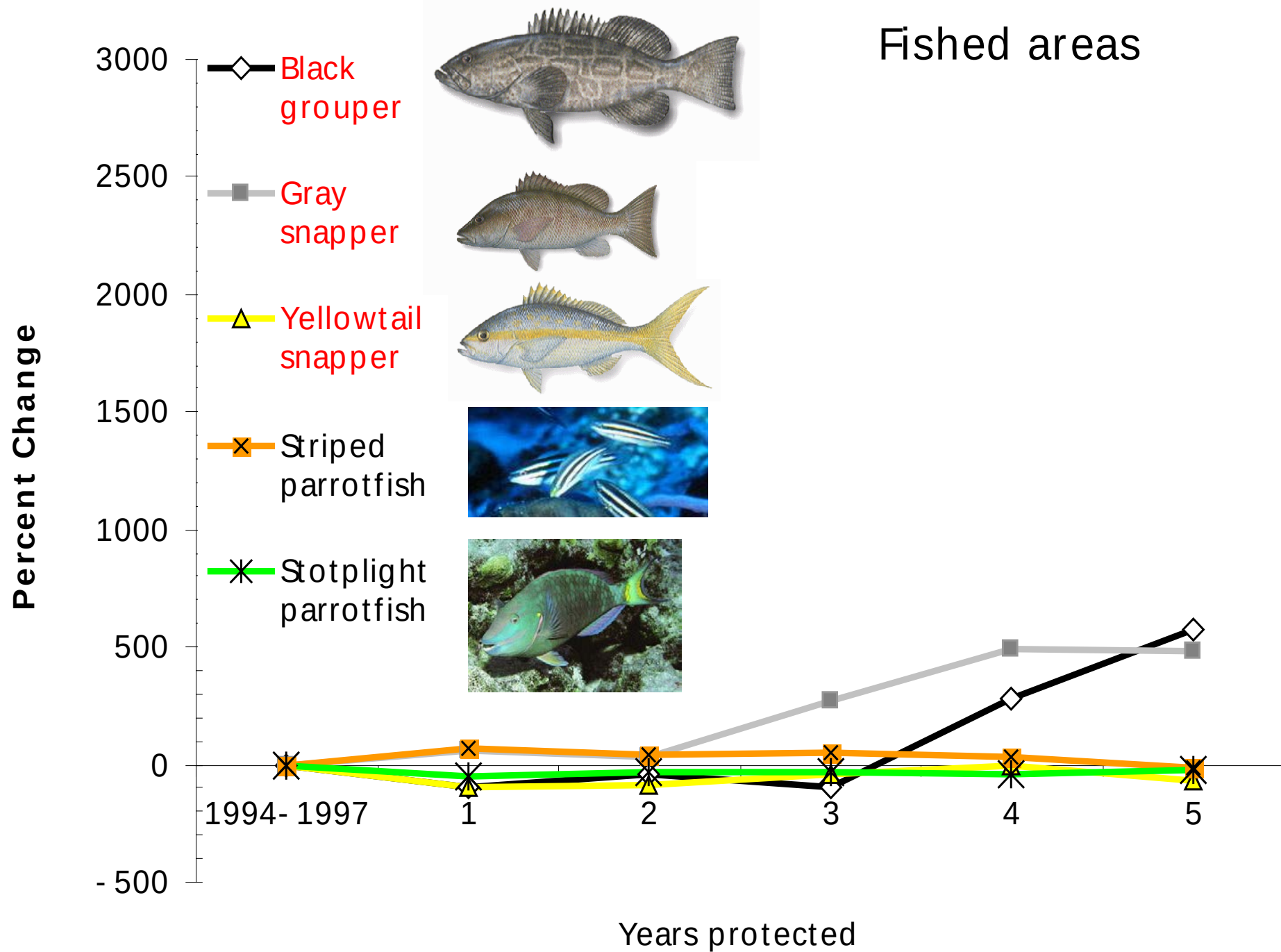


Cross-shelf habitat classification

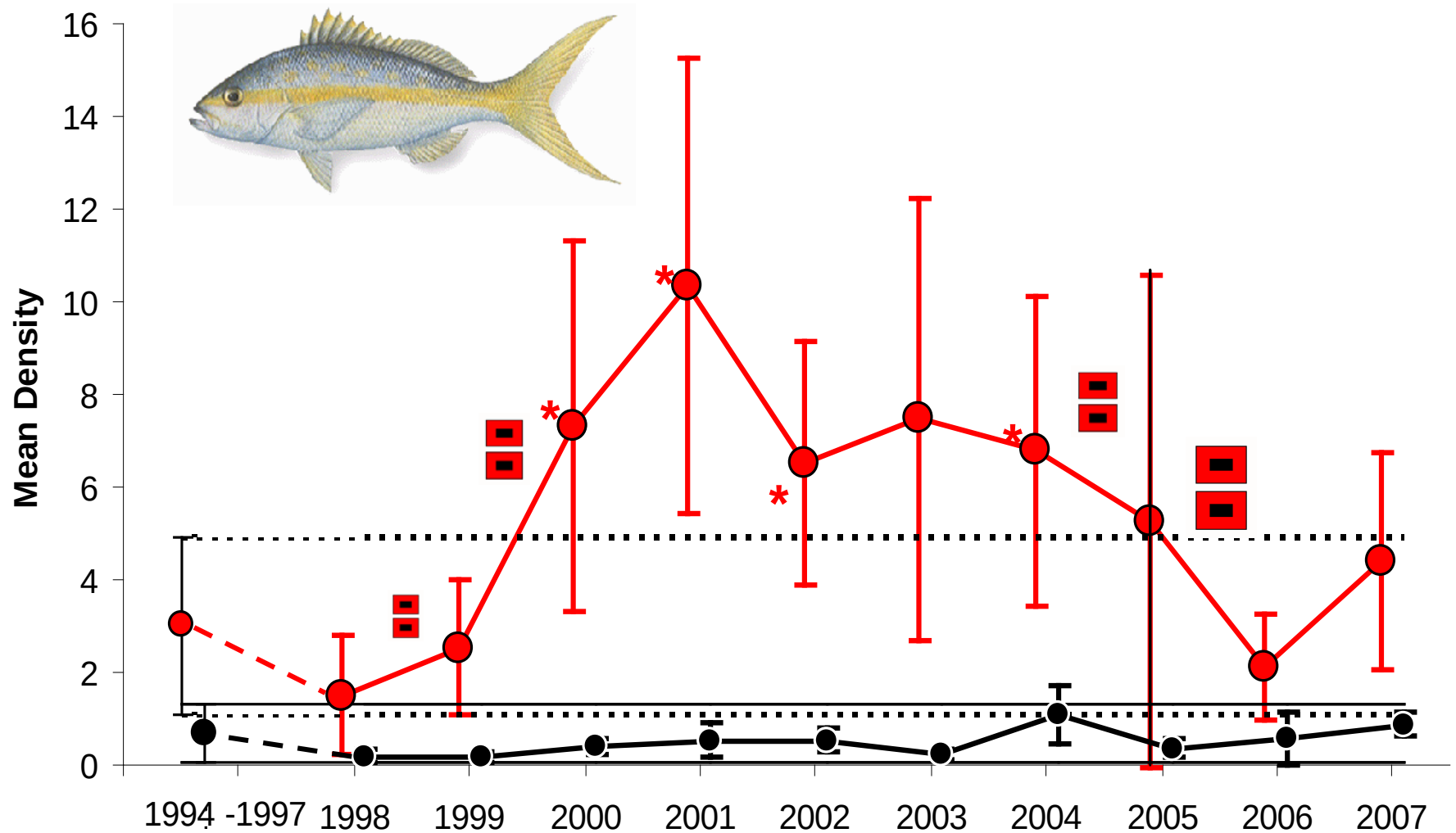




Fished areas

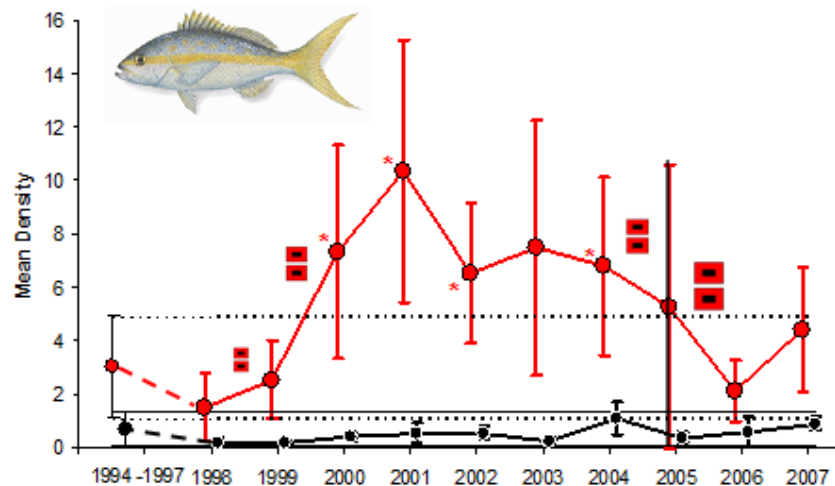


Yellowtail Snapper, Exploited, **Protected** and Fished



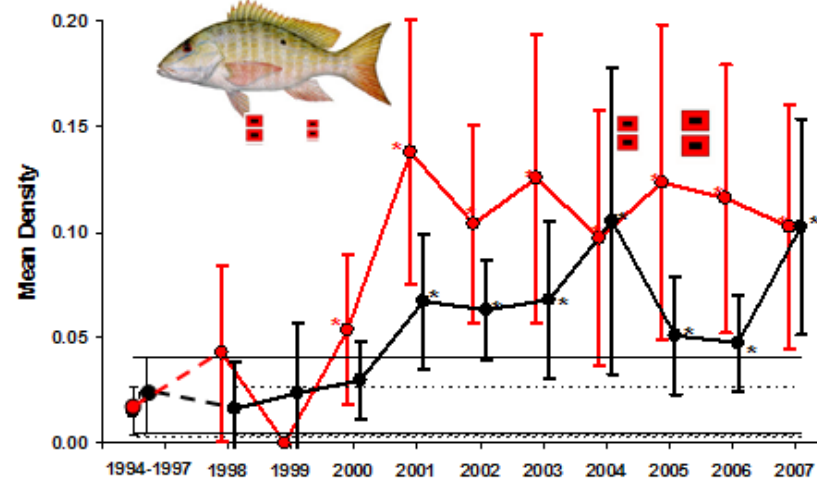
Fishery Regulations: 1985 - 12" Minimum length, 1986 – max 10/day

Yellowtail Snapper, Exploited, Protected and Fished



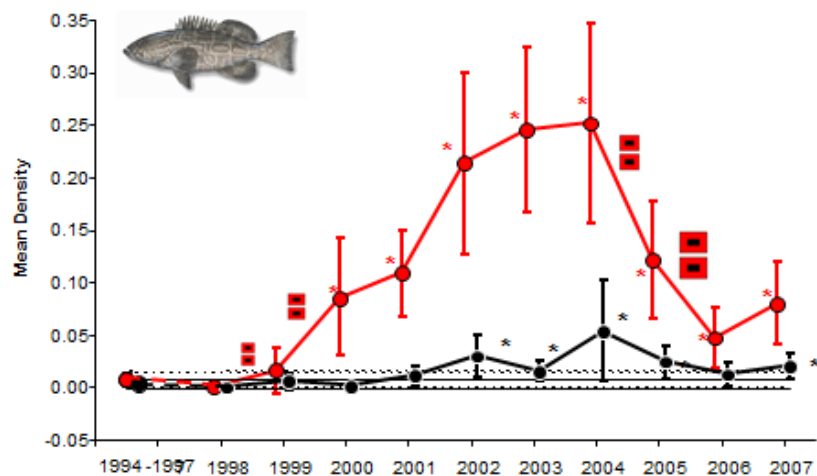
Fishery Regulations: 1985 - 12" Minimum length, 1986 - max 10/day

Mutton Snapper, Exploited, Protected and Fished



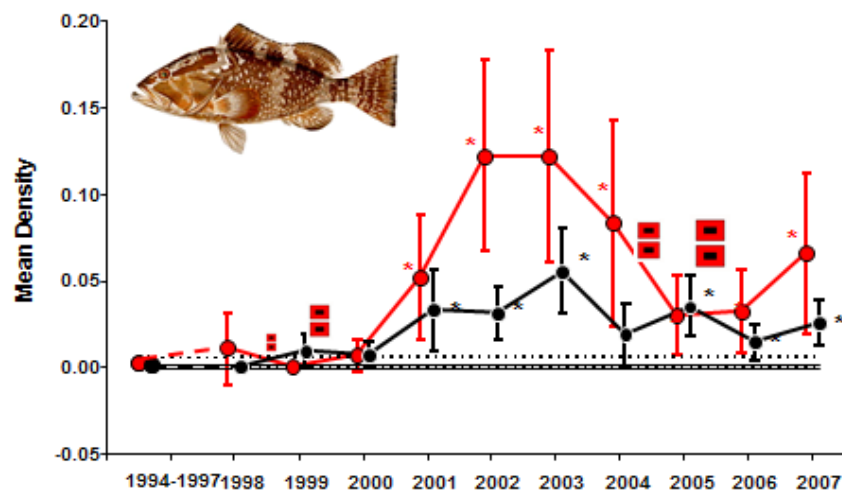
Fishery Regulations: minimum length 1985 - 12", 1994 - 16"; 1986 - 10/fisher/day

Black Grouper, Exploited, Protected and Fished



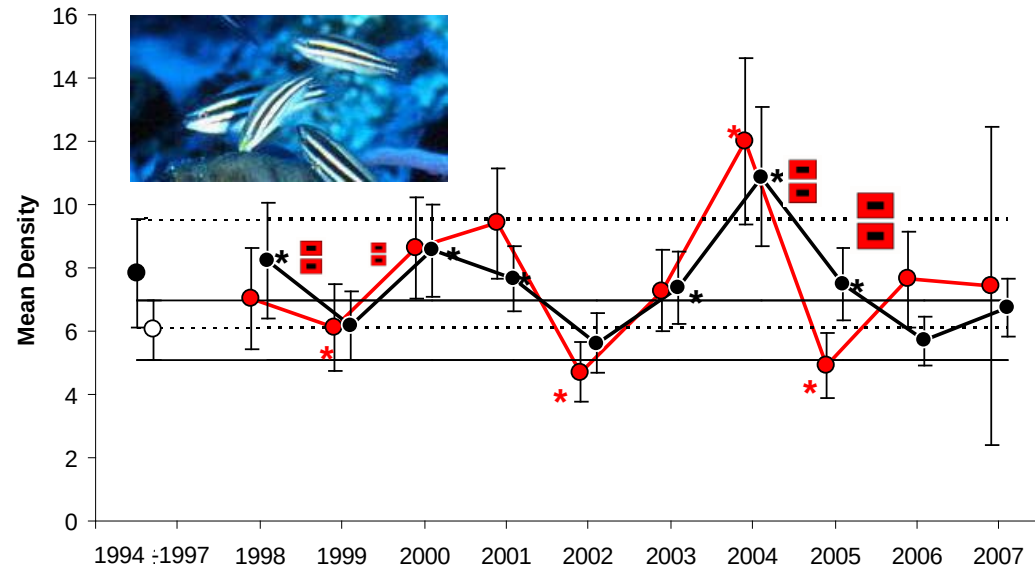
Fishery Regulations minimum length: 1985 - 18", Feb 1990 - 20", Dec 1998 - 24", Jan 1 2001 - 22"; 1986 - 5/fisher/day

Red Grouper, Exploited, Protected and Unprotected

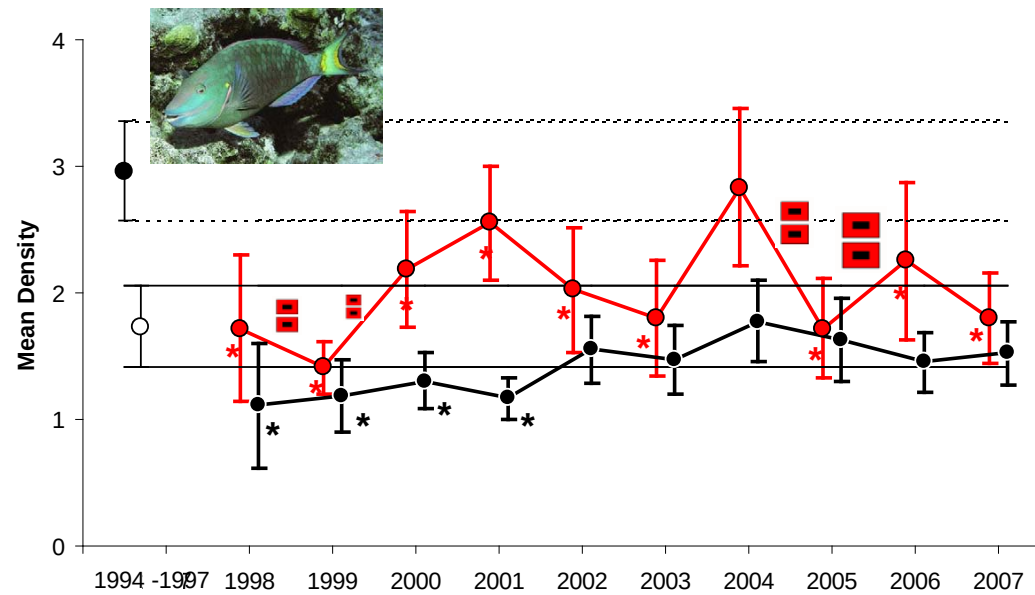


Fishery Regulations minimum length: 1985 - 18"; 1986 - 5/fisher/day

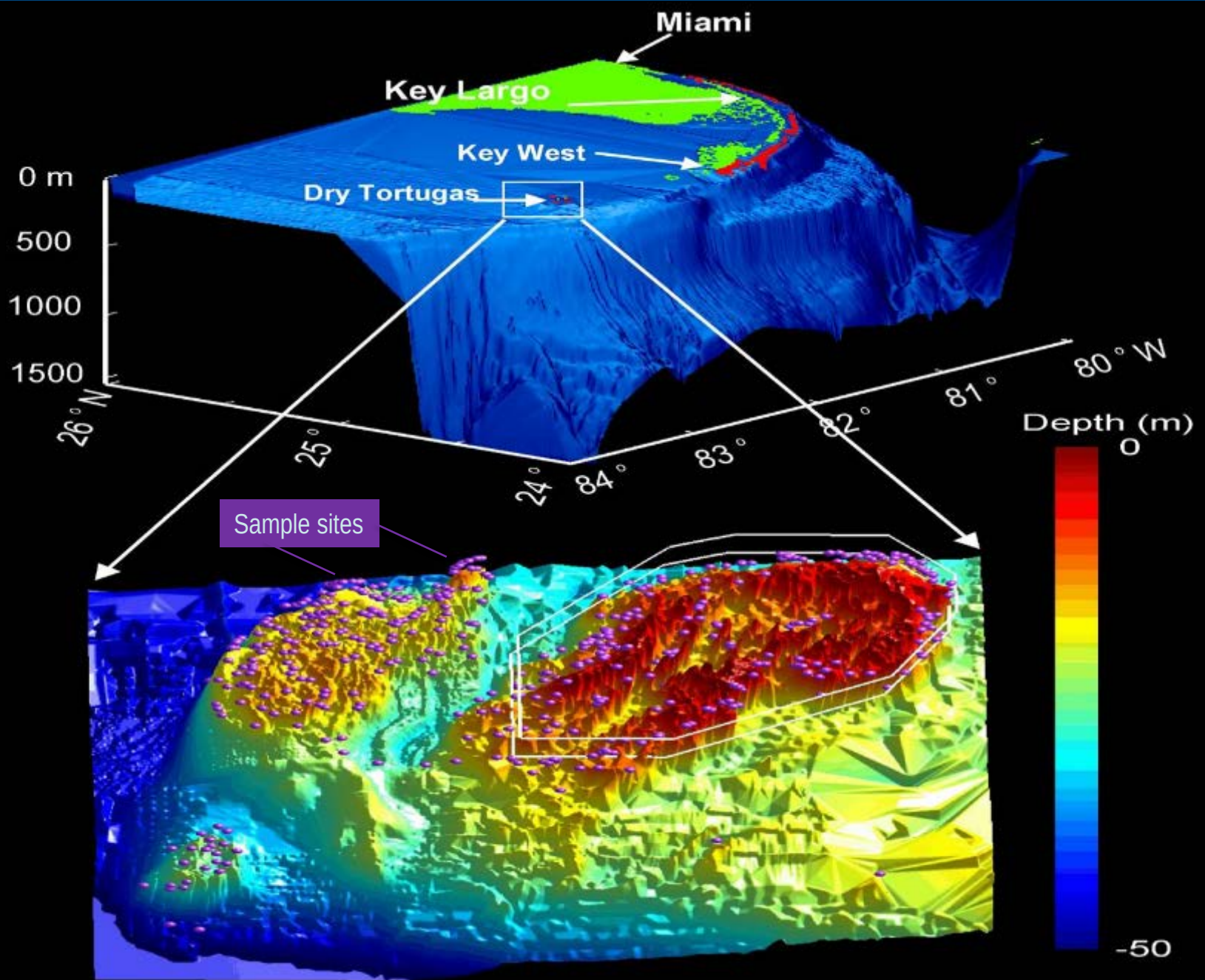
Striped Parrotfish, **Protected** and Fished

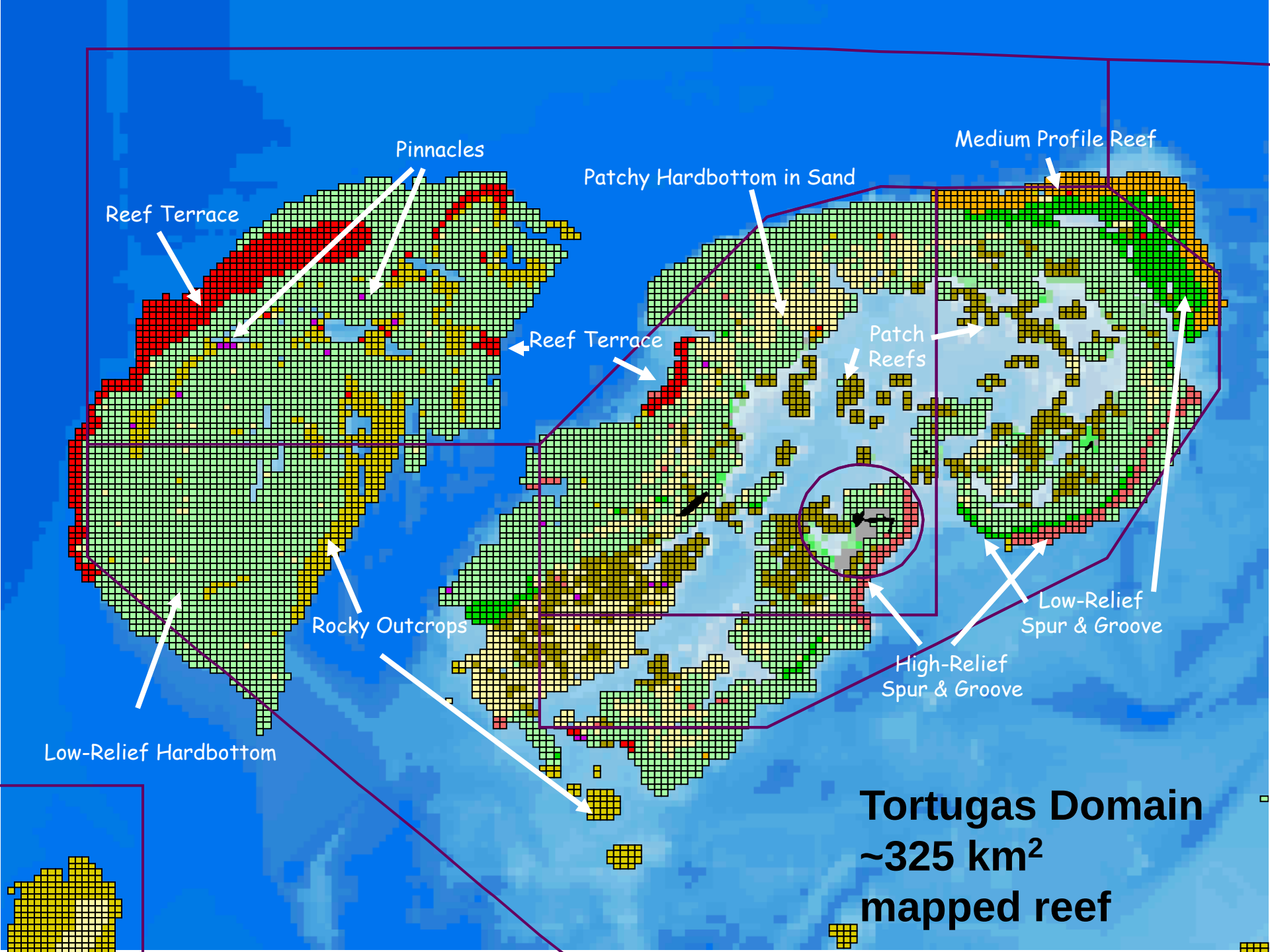


Stoplight Parrotfish, **Protected** and Fished

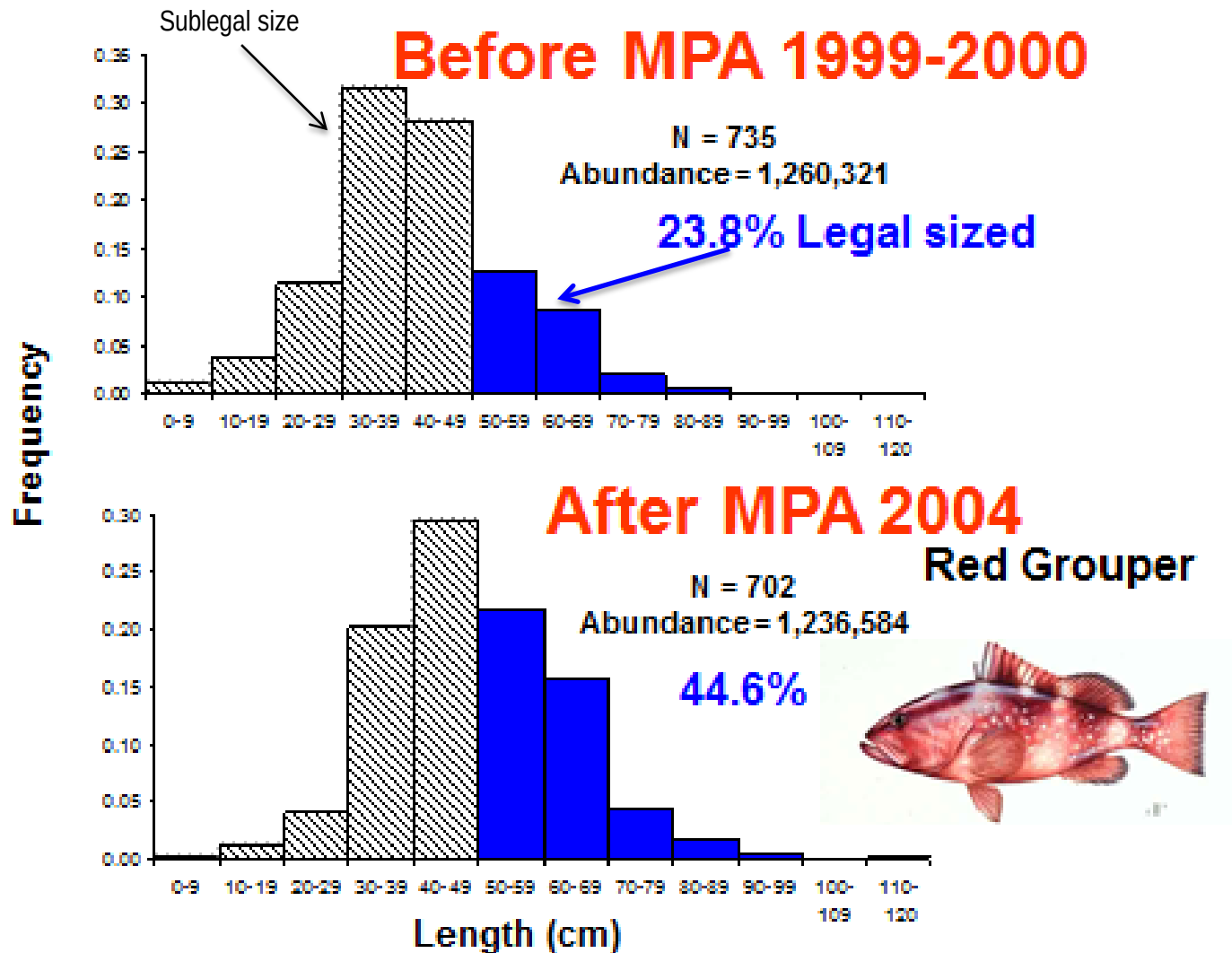


No Fishery Regulations





Tortugas MPA Management Evaluation



Adaptive Management

Tortugas Bank North
Ecological Reserve
(No-take) in 2001



Tortugas Bank
Fished



DTNP RNA
No-take 2007



Dry Tortugas
National Park
—
Recreational
angling only

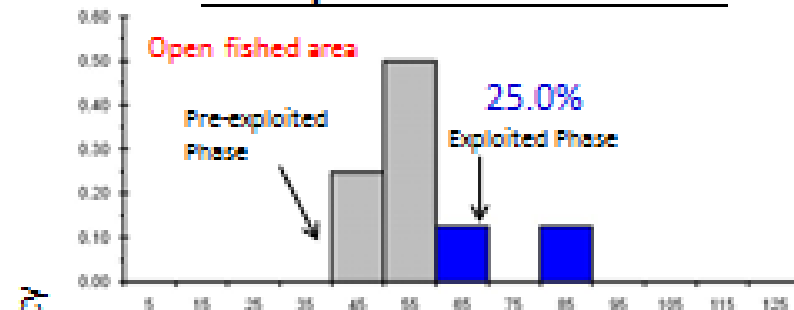


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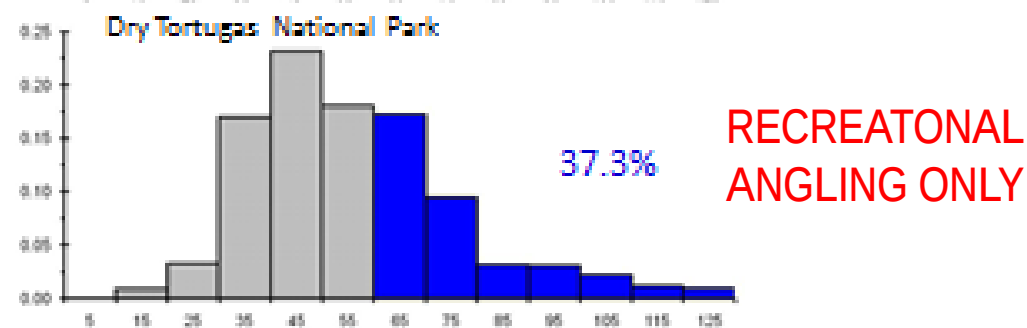
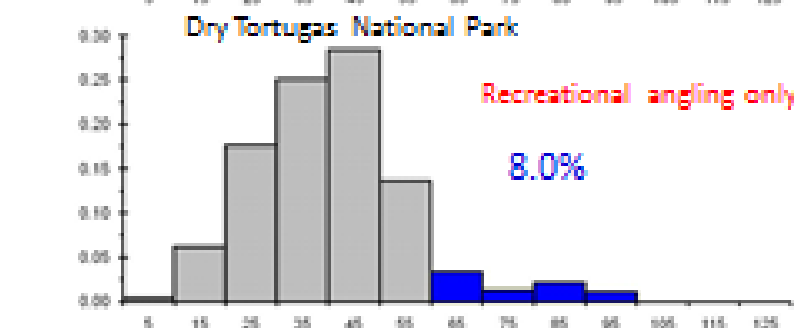
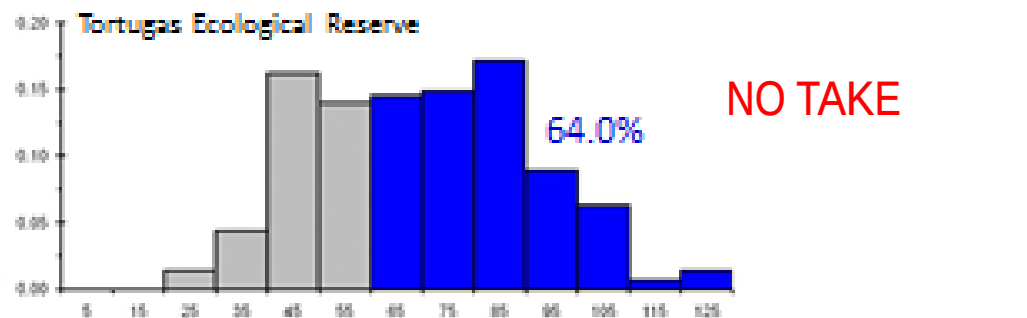
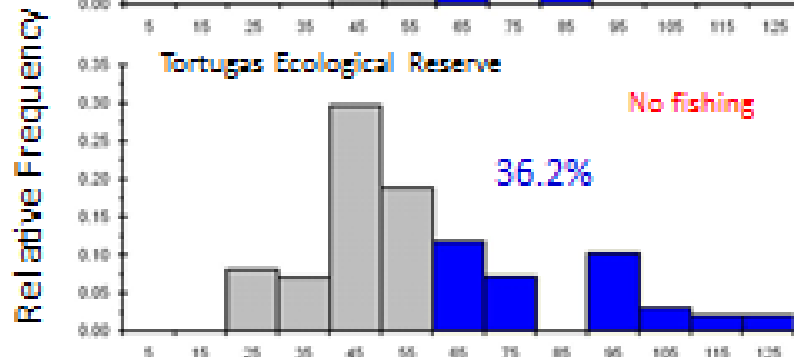
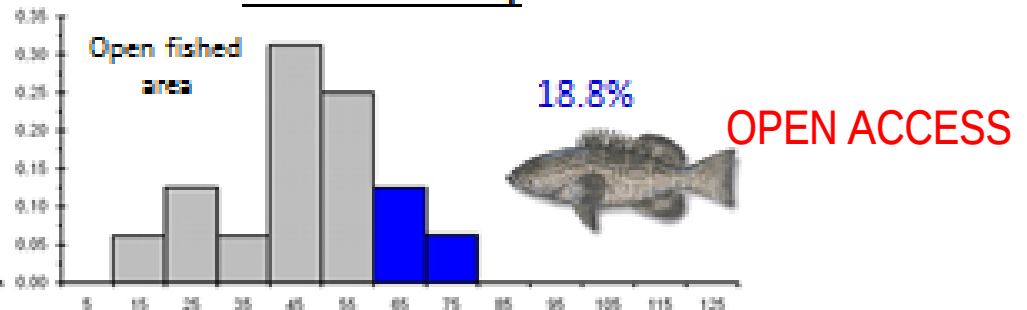
Measure Management Effectiveness MPAs

Black grouper response to Tortugas MPA Protection

Pre-Implementation: 1999-2000



2008 RVC Survey



Fork Length (cm)



Partnerships



MPA Success Attributes

Healthier fish stocks: averaged
2x fish numbers (>25 cm TL)
5x large fish biomass
14x shark biomass
than fished areas

1. No-take rule established
2. Well-enforced
3. Age (>10 yr)
4. Large size (>100 km²)
5. Isolation (deep water or sand)

Di Franco et al 2016. **Five key attributes can increase MPA performance for small-scale fisheries management.**
www.nature.com/scientificreports 6:38135

Healthier fish stocks,
Higher fishermen incomes,
Social acceptance

1. Well-enforced
2. Management plan present
3. Fishermen engagement in MPA management
4. Fishermen represented on MPA Board
5. Sustainable fishing promoted

Graham, E.J., R.D. Stuart-Smith, T.J. Willis, et al. 2014. **Global conservation outcomes depend on MPA with five key features.**
Nature 506:216-220.

Common Beliefs / Myths

- Ocean resources cannot be exhausted.
- Spatial boundaries can't be enforced.
- People can have no significant impact on ocean resources.
 - The solution to pollution is dilution
 - Recreational angling is not a problem
 - Fishing is decoupled from coral health