



Four-dimensional resource partitioning and disturbance at a multi-species reef fish spawning aggregation: Implications for management

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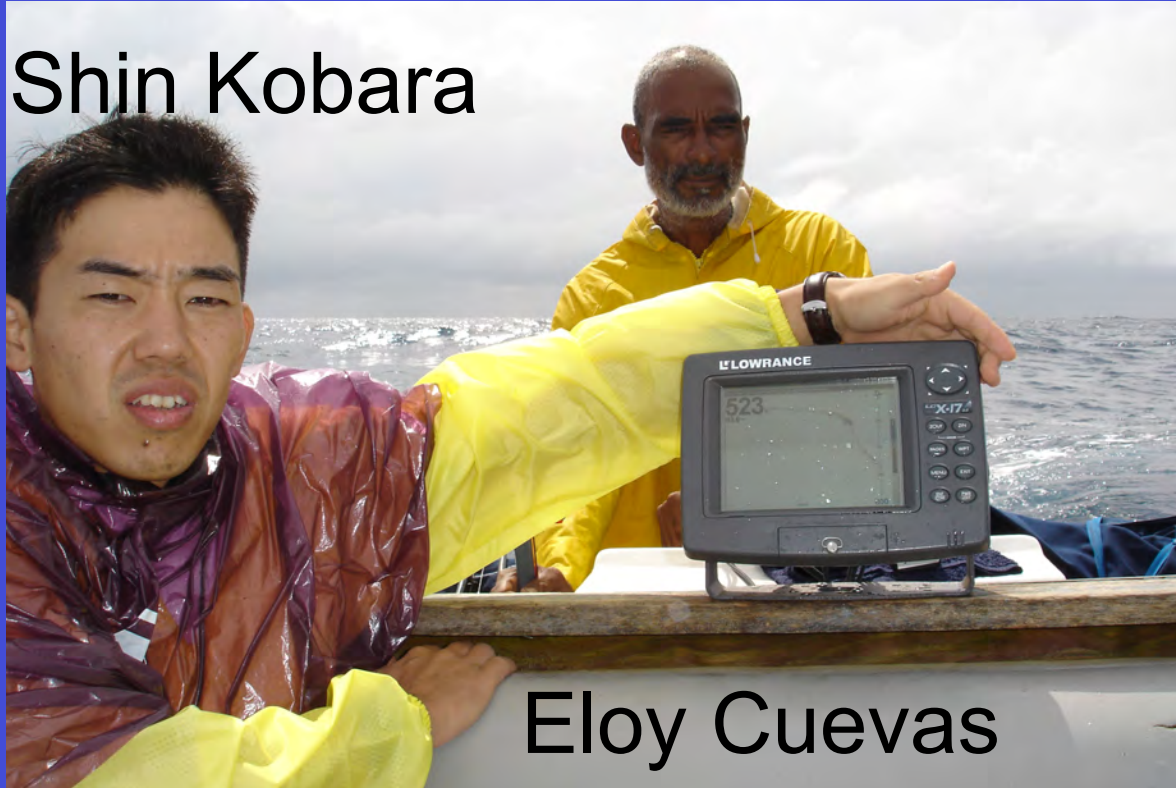
Las Vegas

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Collaborators

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Shin Kobara



Eloy Cuevas

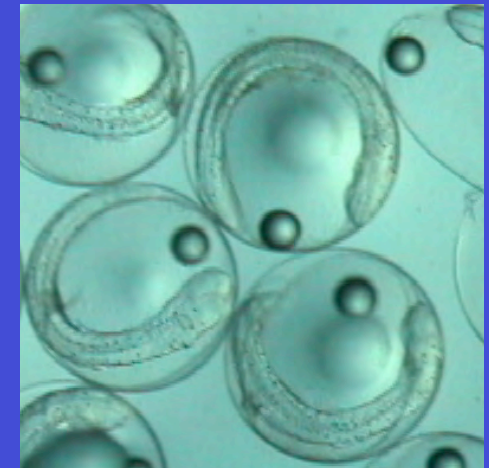


Phil Lobel

Talk Outline

- Reef fish life cycle
- Spawning aggregation vulnerability
- Multi-species spawning aggregations
- 4-D partitioning at Gladden Spit
- Site fidelity and disturbance

Reef Fish Life Cycle



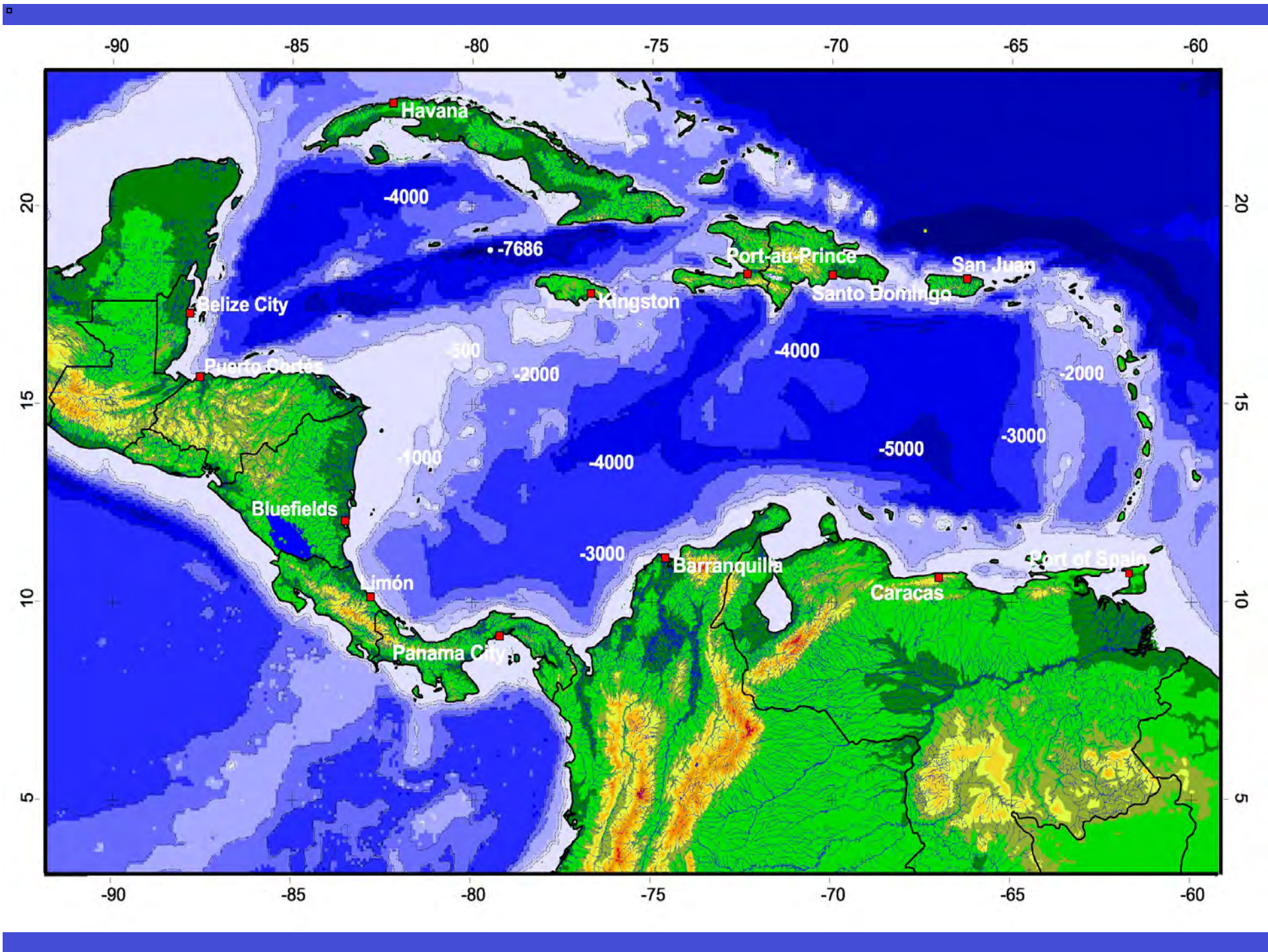
juveniles

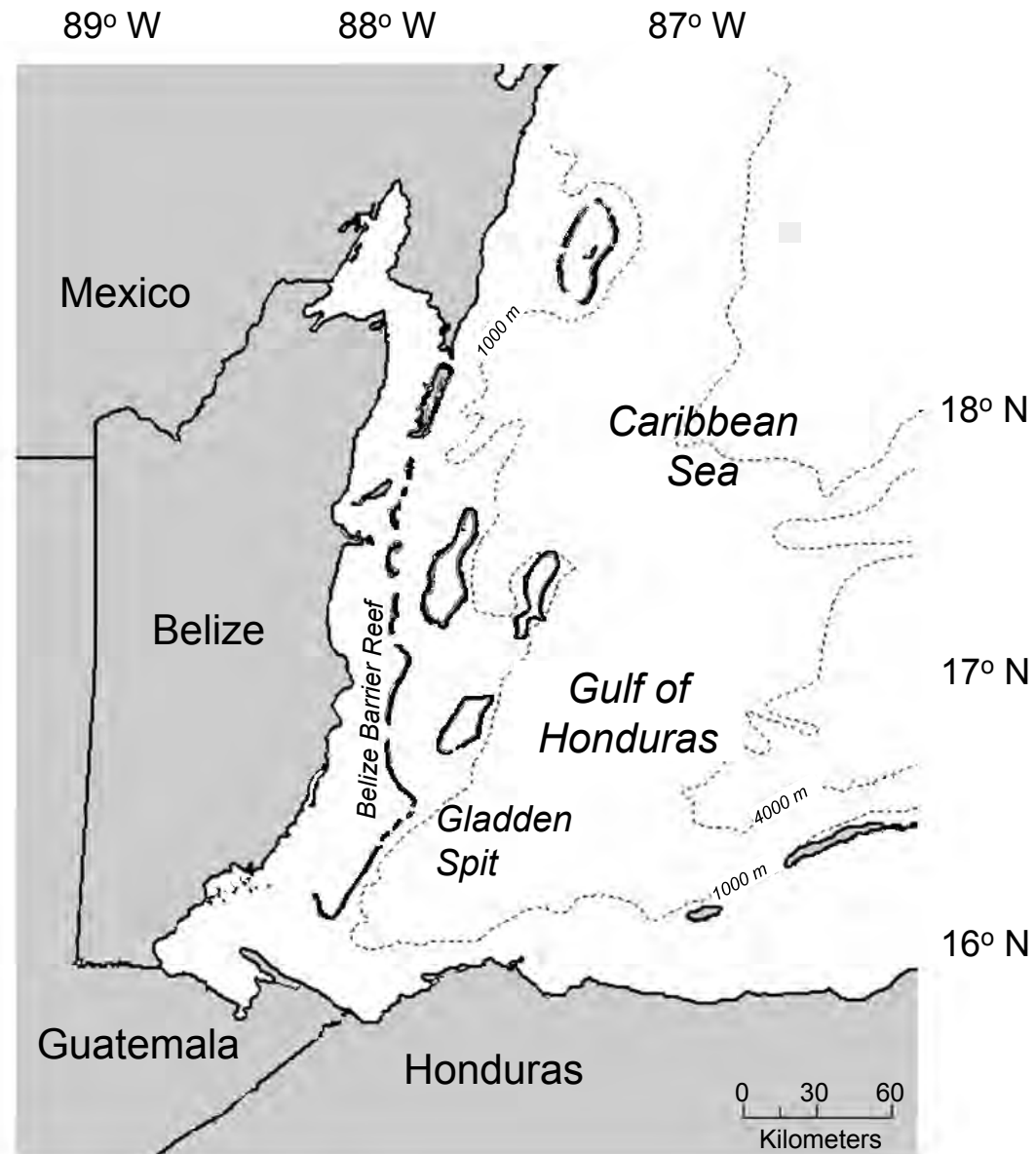


adults



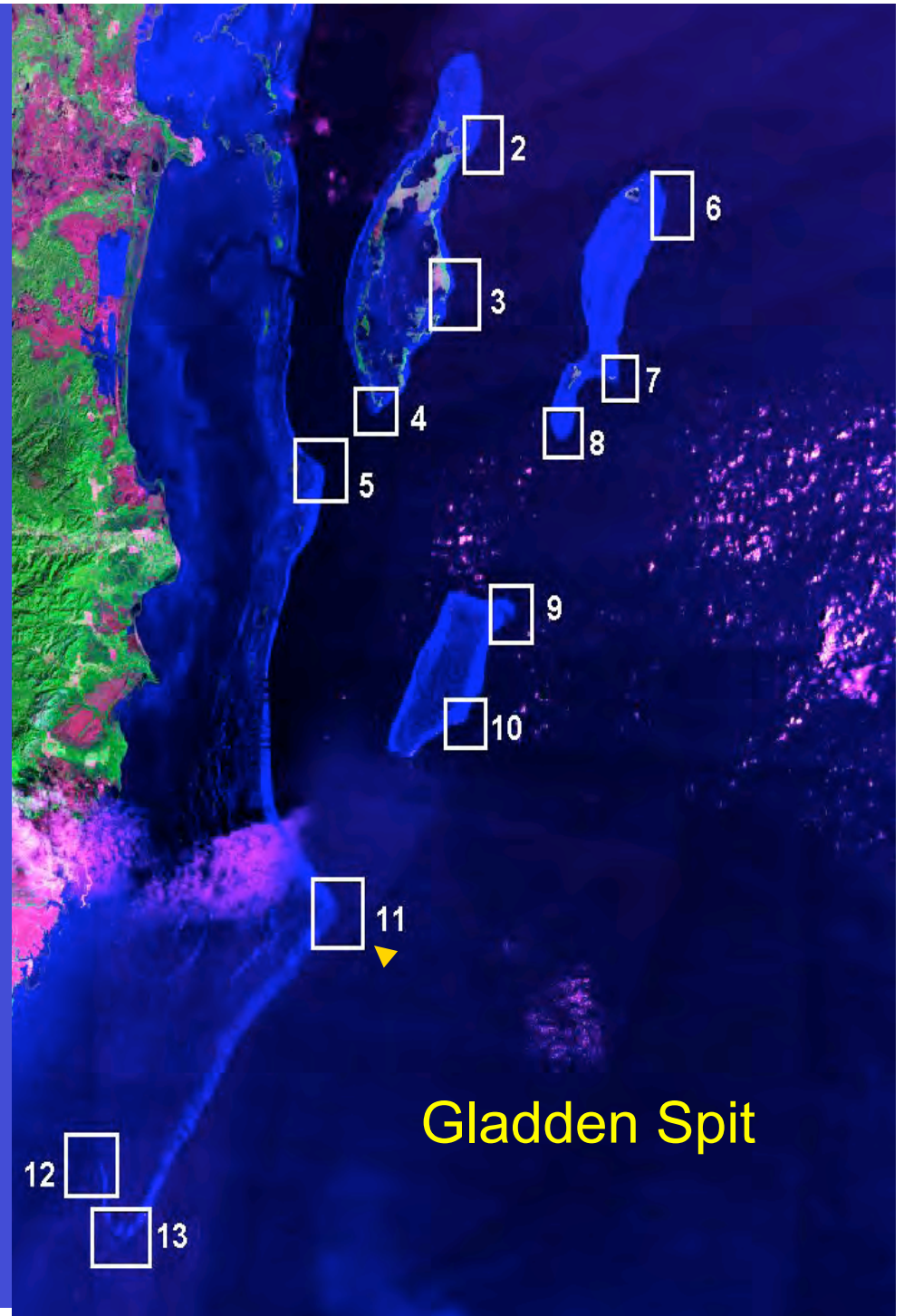
Spawning Aggregations are
highly vulnerable to fishing



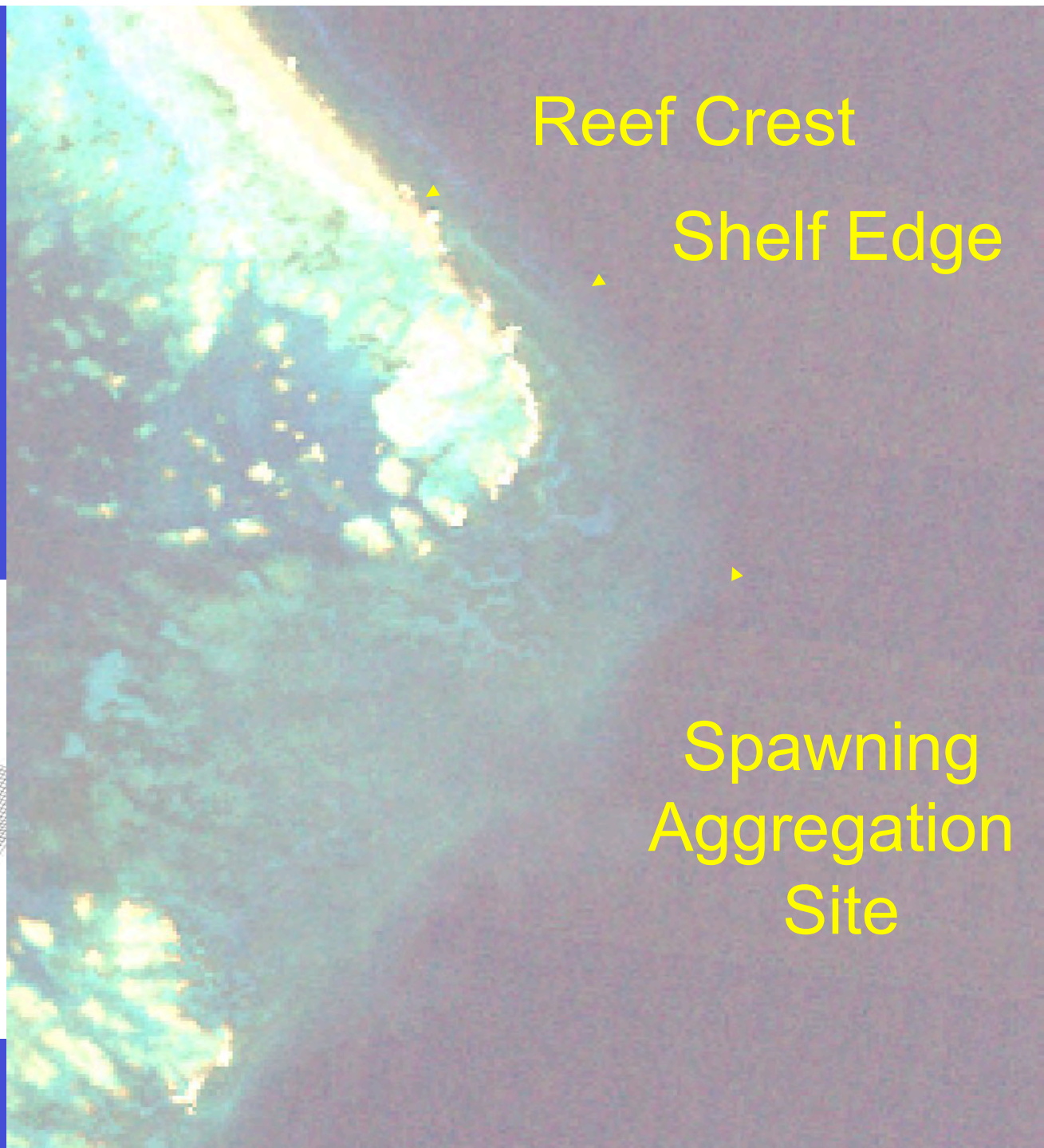
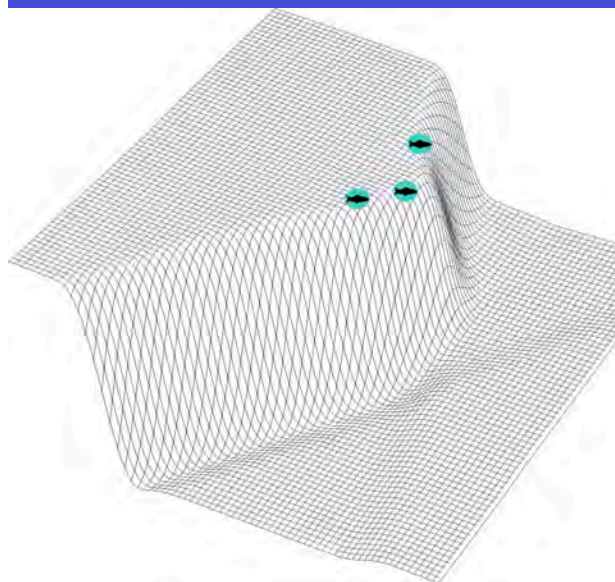


Gladden Spit

Multi-species
spawning
aggregation

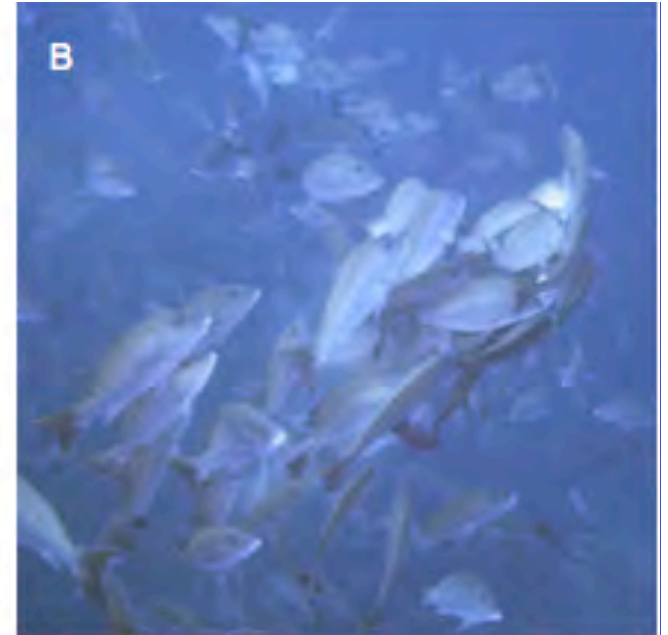
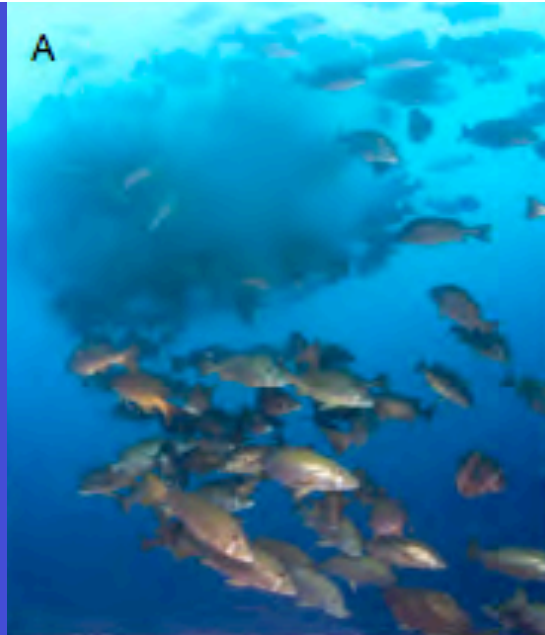


**Gladden Spit
Reef
Promontory
Spawning Site**

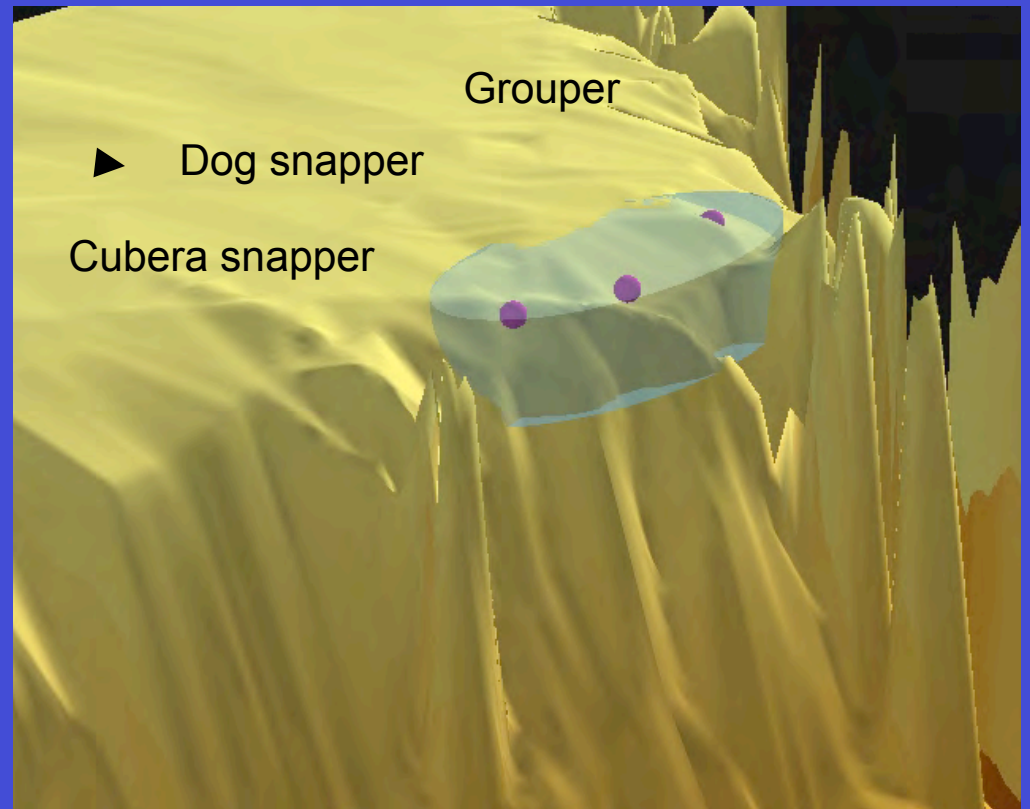
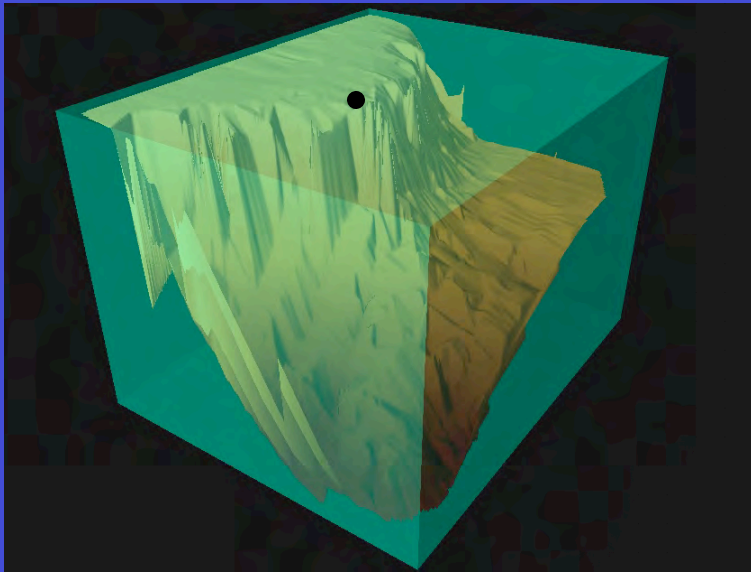


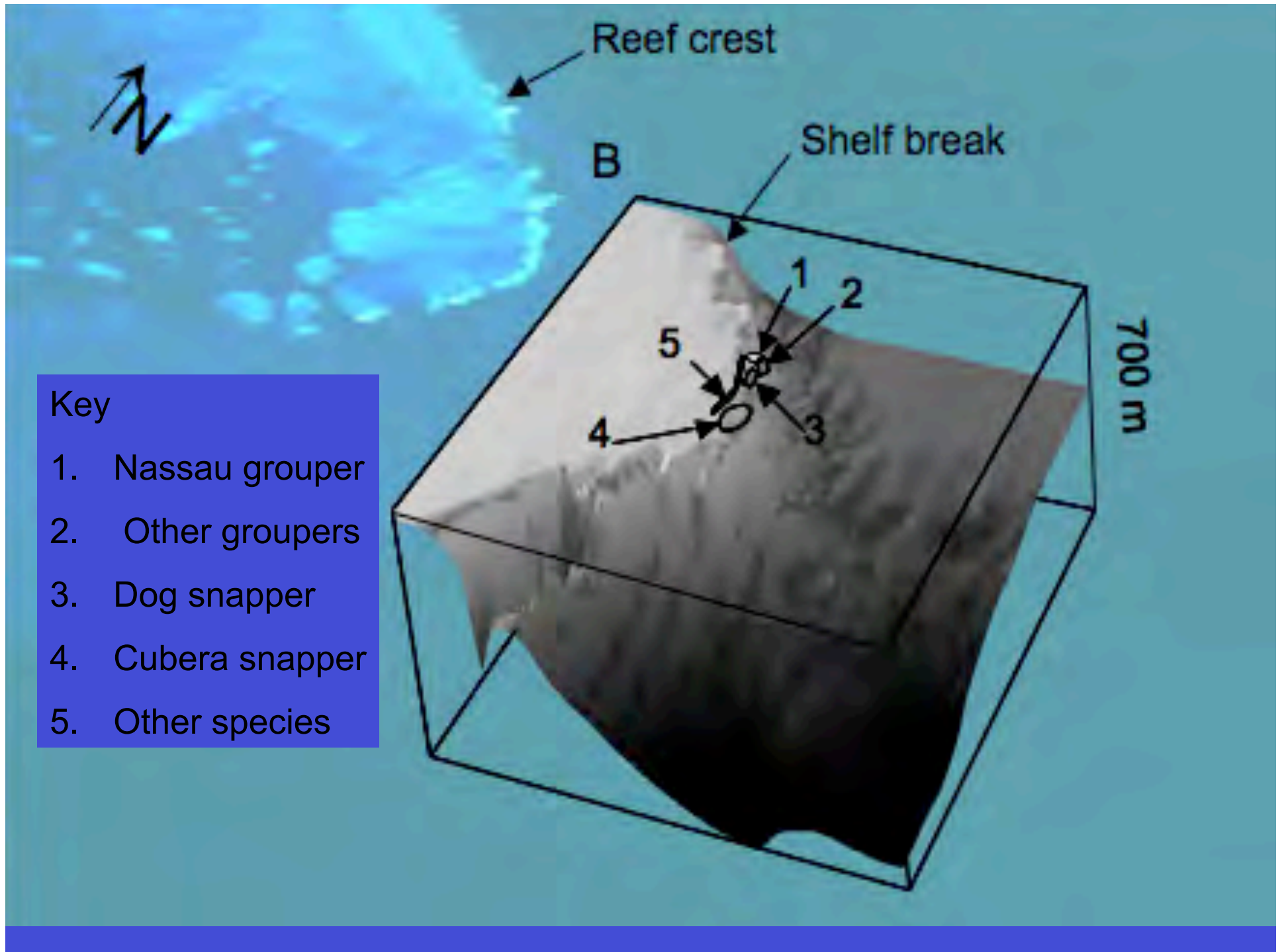
21 reef fish
species

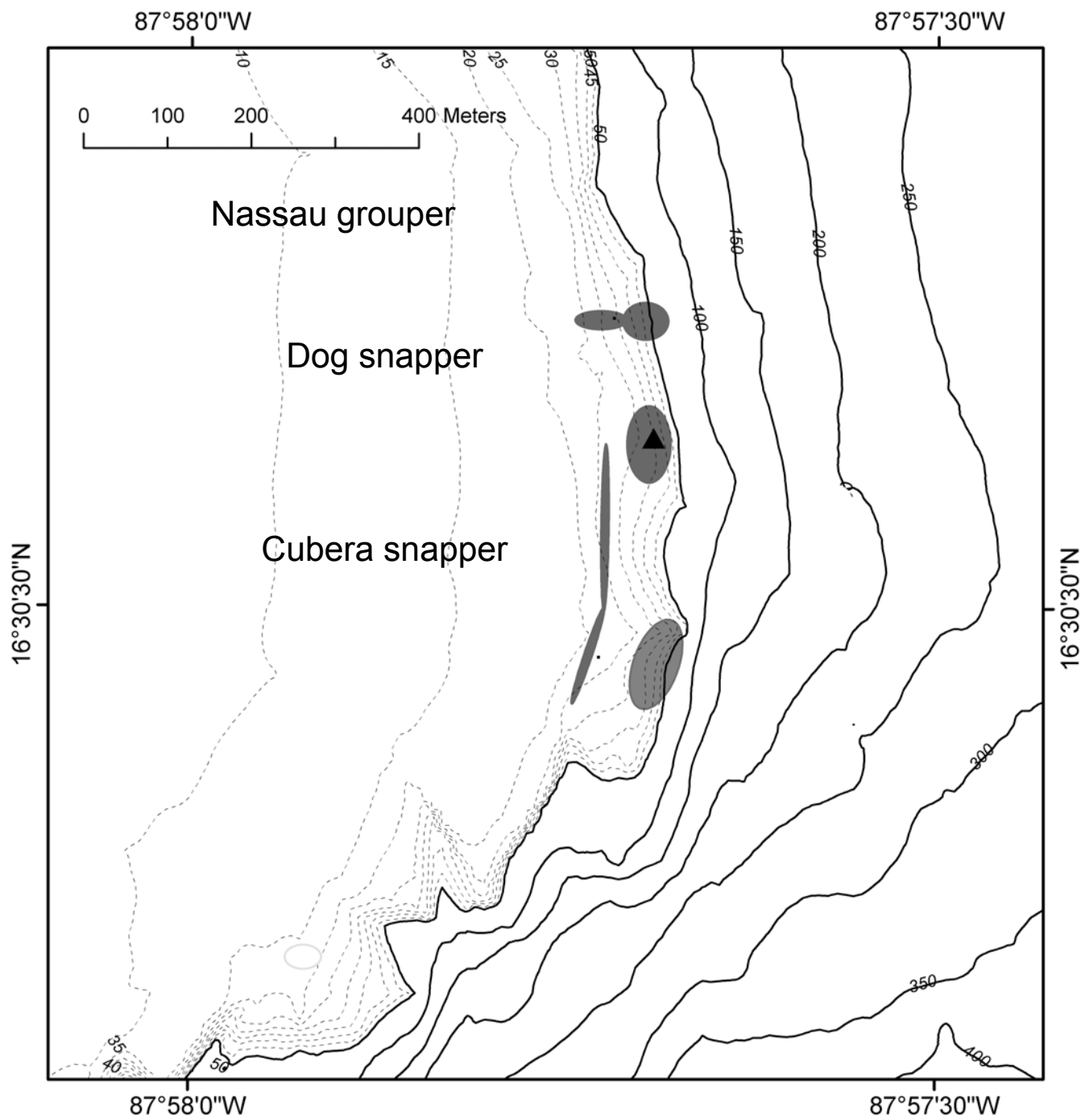
partitioned in
space and
time



Spatial partitioning by species







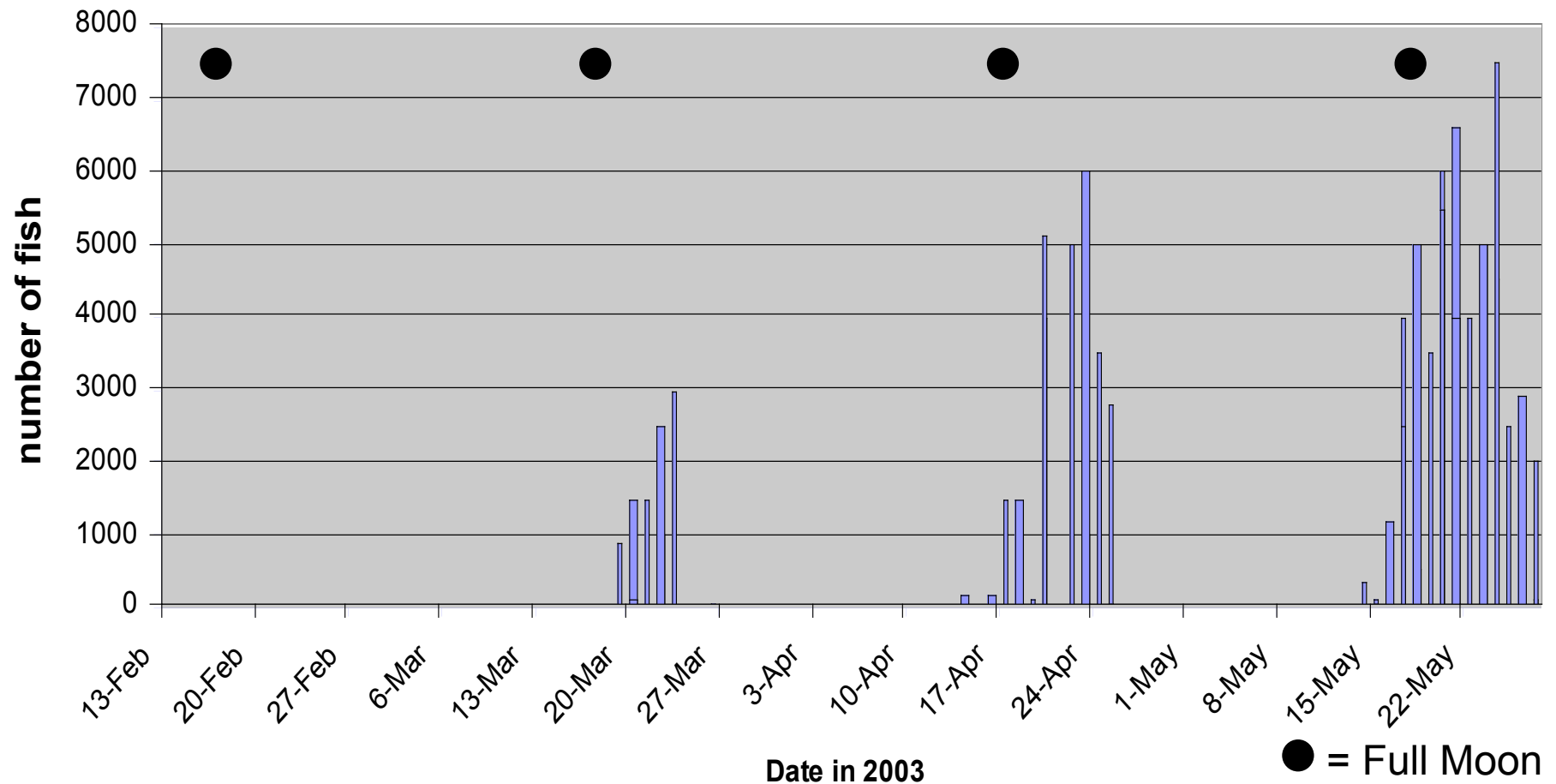
Cubera snapper



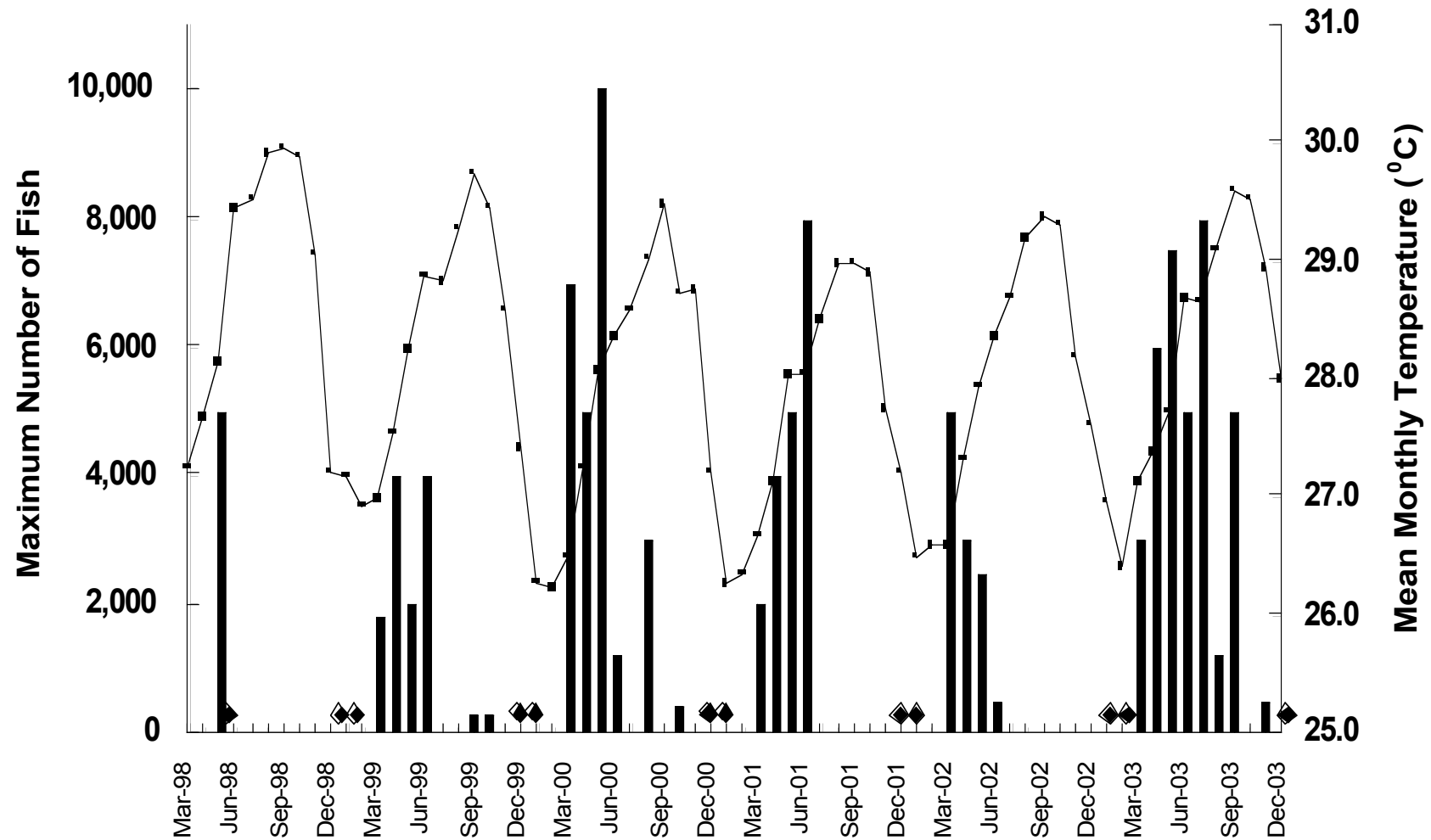
Photo by Douglas Seifert

Temporal partitioning

Cubera Snapper at Gladden Spit, Belize



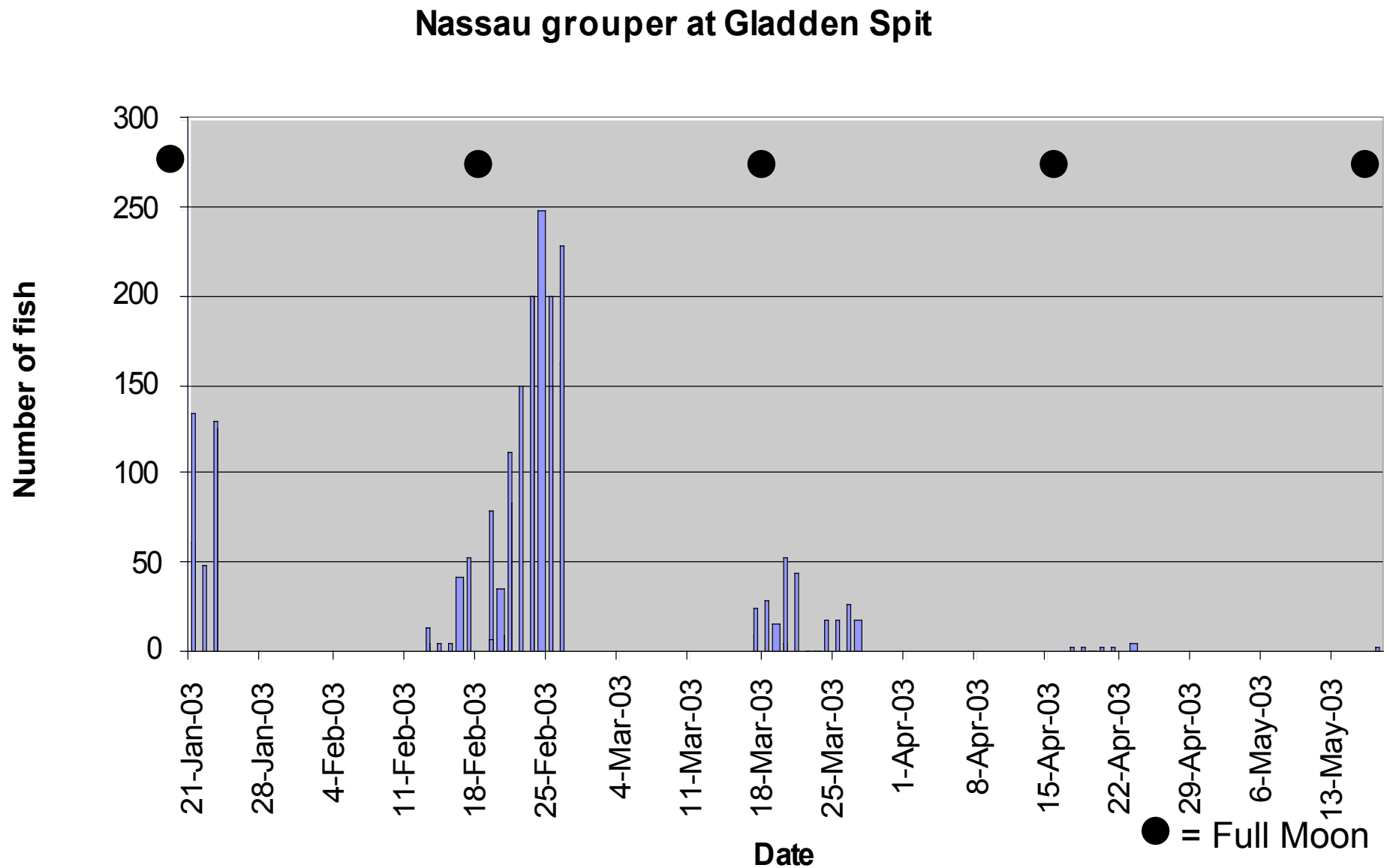
Cubera snapper over 6 years: site and temporal fidelity

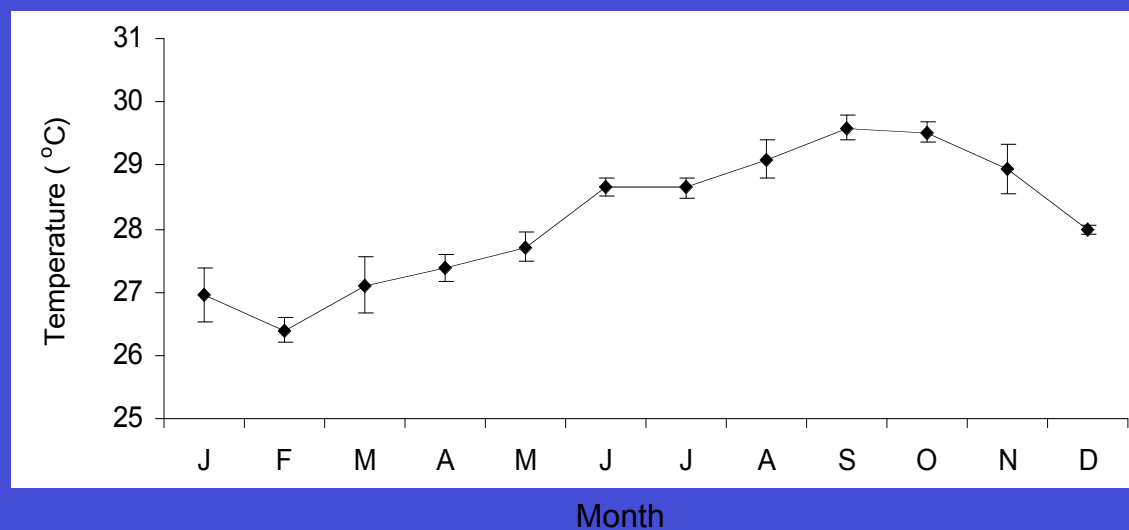
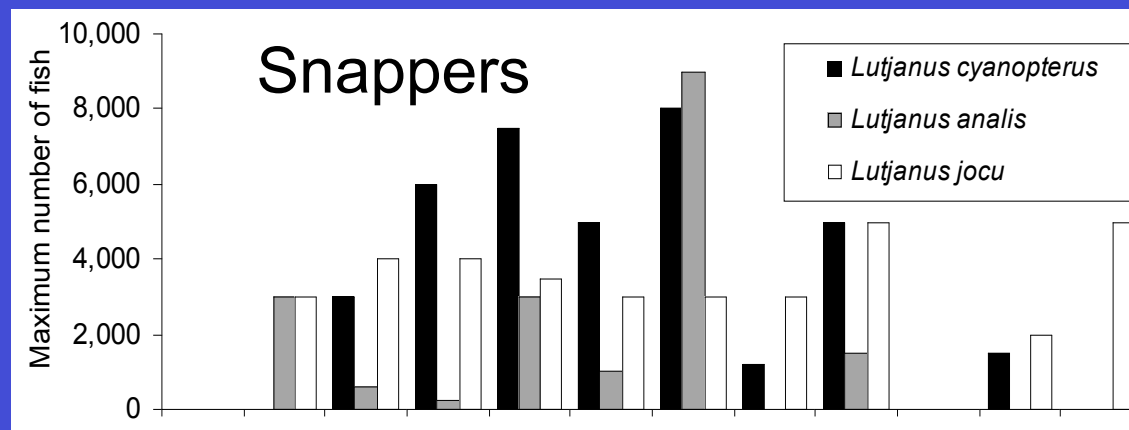
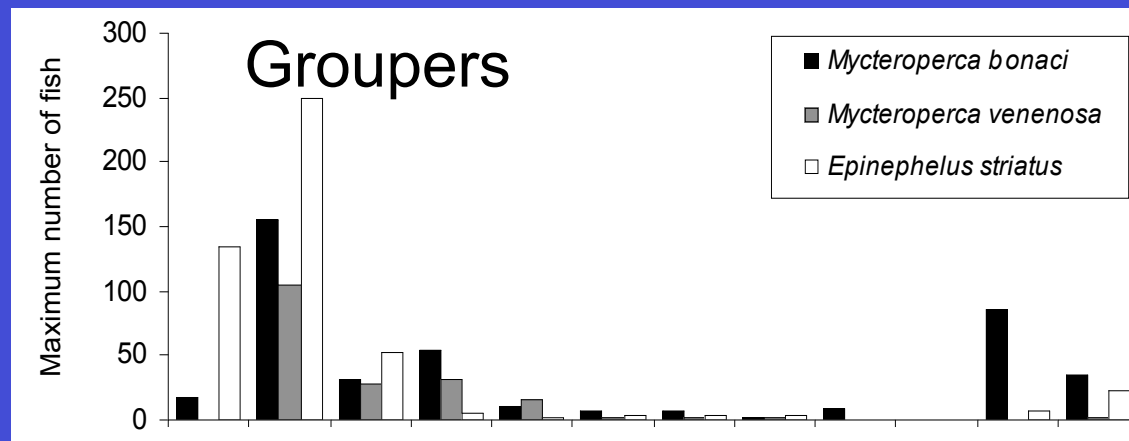


Nassau grouper



Grouper temporal partitioning





Reef promontories as Marine Oases

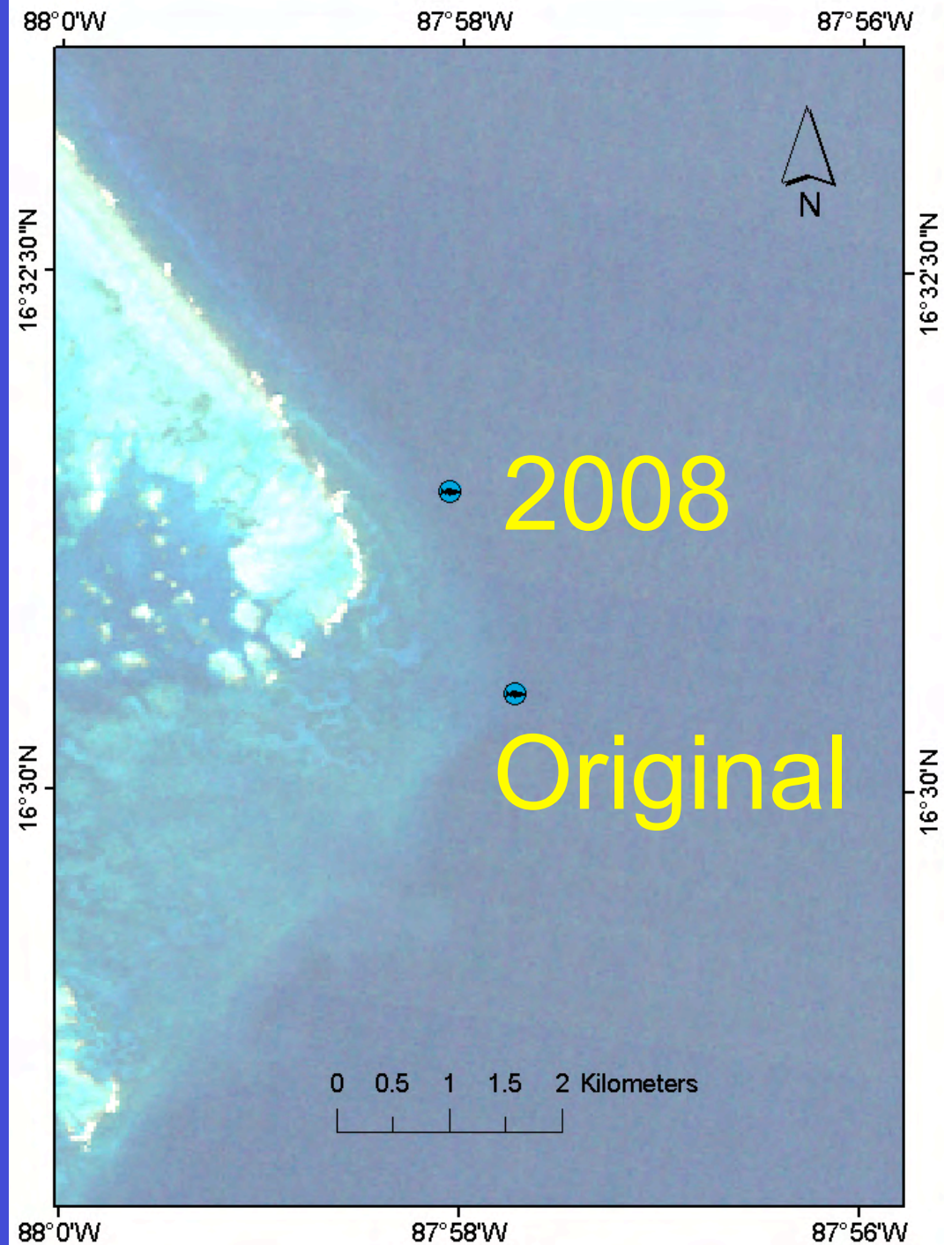
Breeding
Feeding



Photo by Douglas Seifert

Cubera
snapper
spawning site
moved in 2008

Why?



History of Management

- 1920-1980 increasing fishing
- 1995 Tourism begins
- 2002 Marine Reserve declared
 - fishing on Cubera stopped
 - increasing dive tourism
- 2007 Cubera aggregation moves

What are the impacts of
ecotourism on Cubera snapper
spawning behavior?

*Cubera Snapper
(Lutjanus cyanopterus)
Aggregation and Spawning Behaviors
and Diver-Related Disturbances*

*Gladden Spit
Belize, 1999 – 2008*

Video and audio analysis

Divers in aggregations

Quantitative analysis of video
clips show no impact of divers
on behavior

Sounds of spawning Cubera snapper



Sounds of Boats



May disturb
courtship and
spawning
behavior



Next steps

- Present this talk in community meeting next week
- Recommend that diver boats drop divers and do drift dives to reduce sound impacts