

An underwater photograph of a large, dark rock covered in colorful coral and sponges. A large, brownish fish with a yellow eye is swimming in the foreground, partially obscuring the rock. The background is a deep blue water with some smaller fish visible.

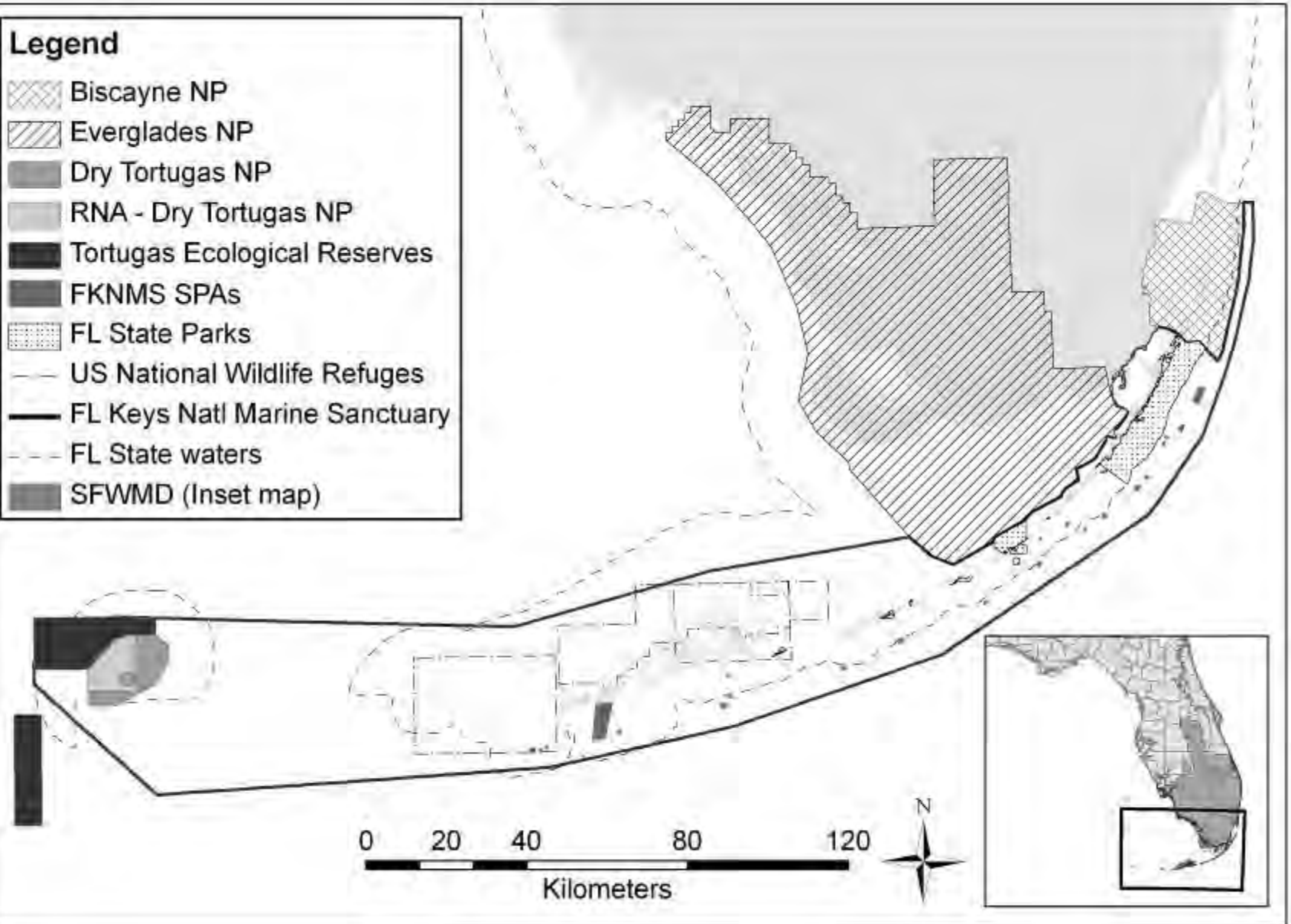
# Thirty Years of Change in Reef Fish Communities in the Florida Keys

FKNMS Sanctuary Advisory Council Meeting  
August 16, 2011

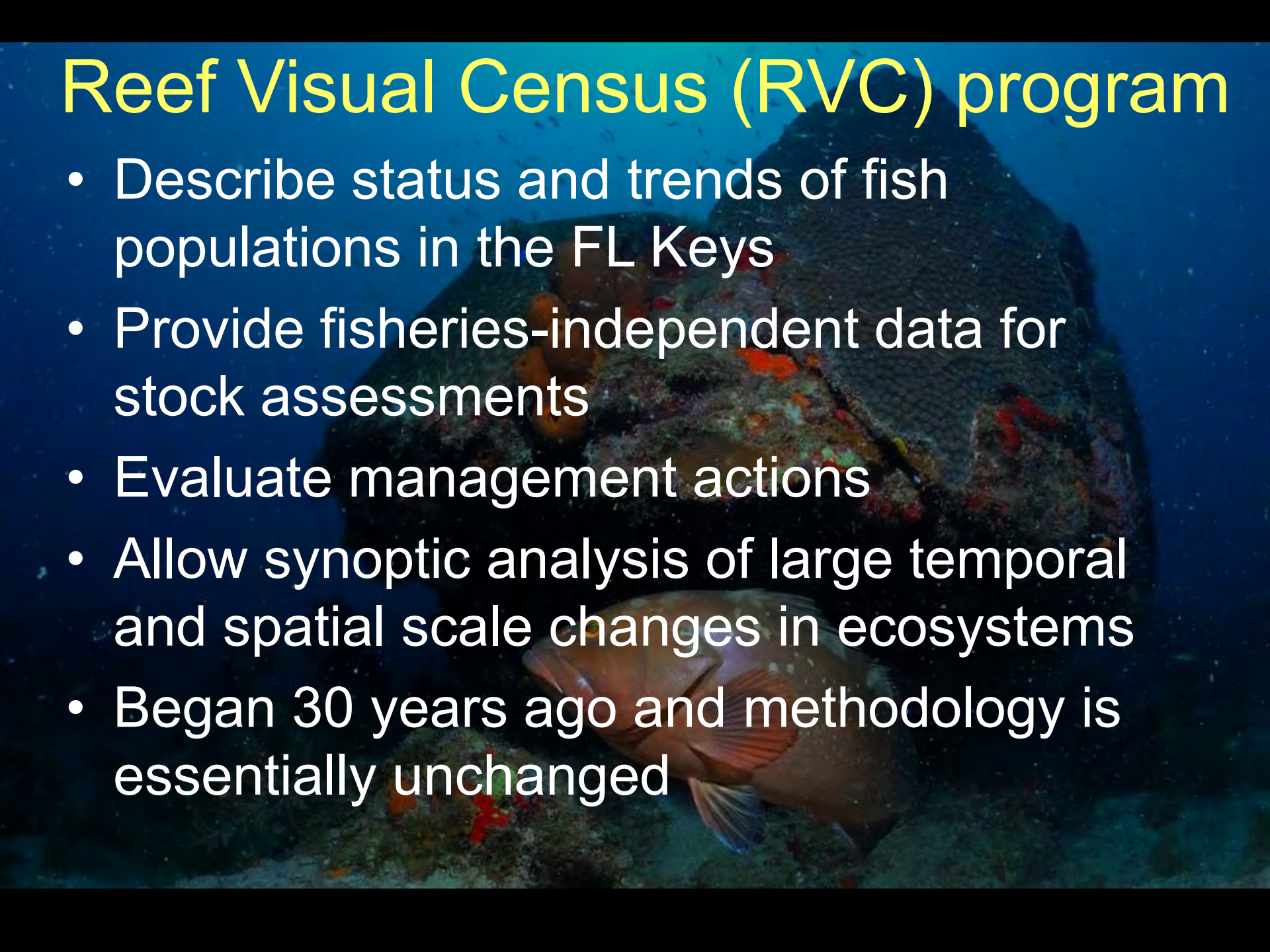
Benjamin Ruttenberg, Ph.D.  
NOAA/NMFS Miami, FL

## Legend

-  Biscayne NP
-  Everglades NP
-  Dry Tortugas NP
-  RNA - Dry Tortugas NP
-  Tortugas Ecological Reserves
-  FKNMS SPAs
-  FL State Parks
-  US National Wildlife Refuges
-  FL Keys Natl Marine Sanctuary
-  FL State waters
-  SFWMD (Inset map)

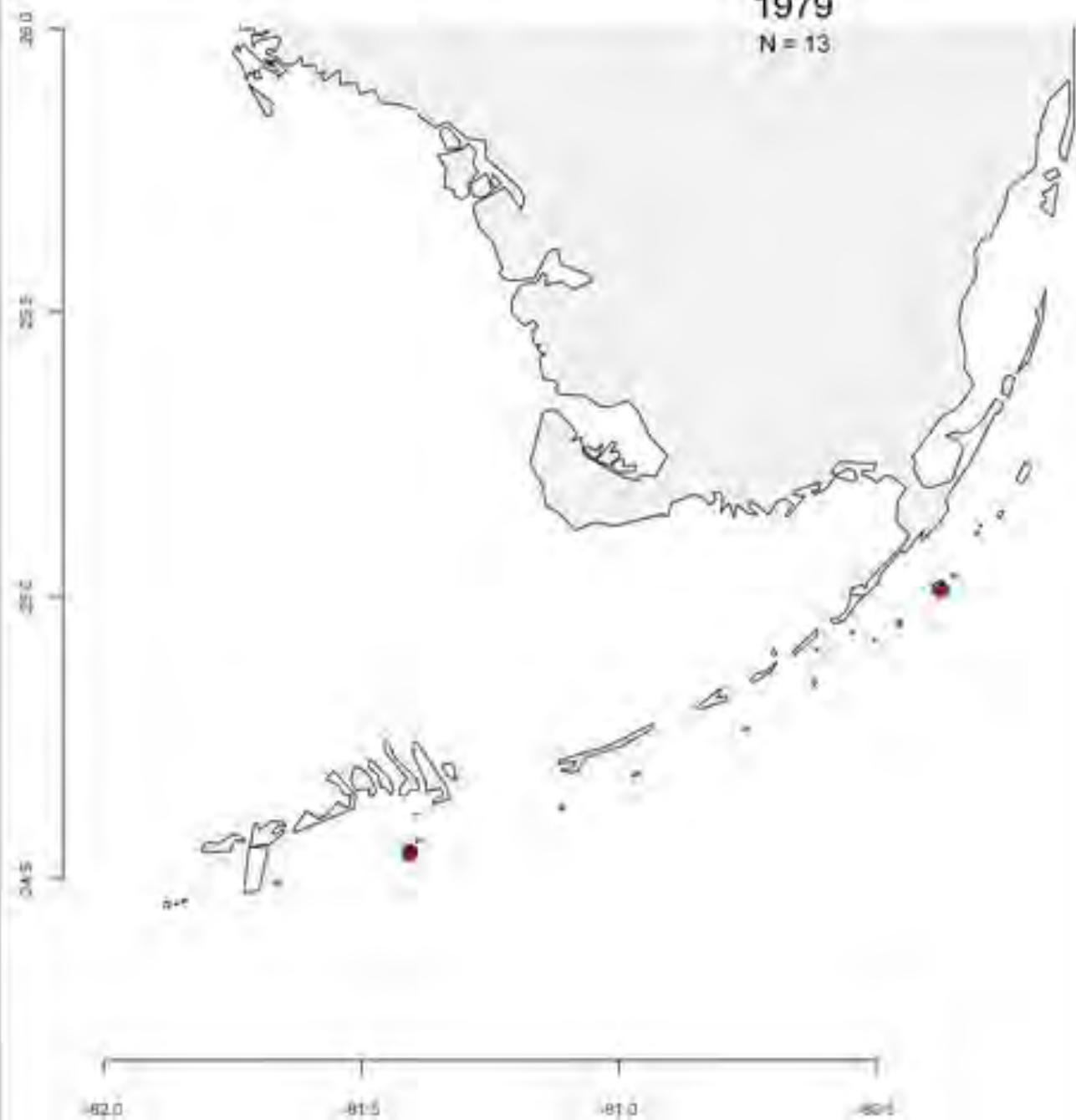


# Reef Visual Census (RVC) program

- Describe status and trends of fish populations in the FL Keys
  - Provide fisheries-independent data for stock assessments
  - Evaluate management actions
  - Allow synoptic analysis of large temporal and spatial scale changes in ecosystems
  - Began 30 years ago and methodology is essentially unchanged
- 
- An underwater photograph of a reef. A large, dark, textured rock is the central focus, covered in various colorful corals and sponges. In the foreground, a reddish-brown fish is swimming towards the left. The background is a deep blue, slightly hazy water.

1979

N = 13



# Rough Timeline

- 1950s-1970s (and before): Heavy fish in Florida Keys
- 1979-1980: Reef fish monitoring begins
- Early 1980s: Sea urchin die-off and rapid coral loss
- 1997: Marine reserves implemented in main FL Keys
- 2001 & 2007: Marine reserves added to Dry Tortugas bank and Dry Tortugas National Park

1957



McClenachen 2009

1965-1979



McClenachen 2009

1980-1985



McClenachen 2009



2007



McClenachen 2009

2007

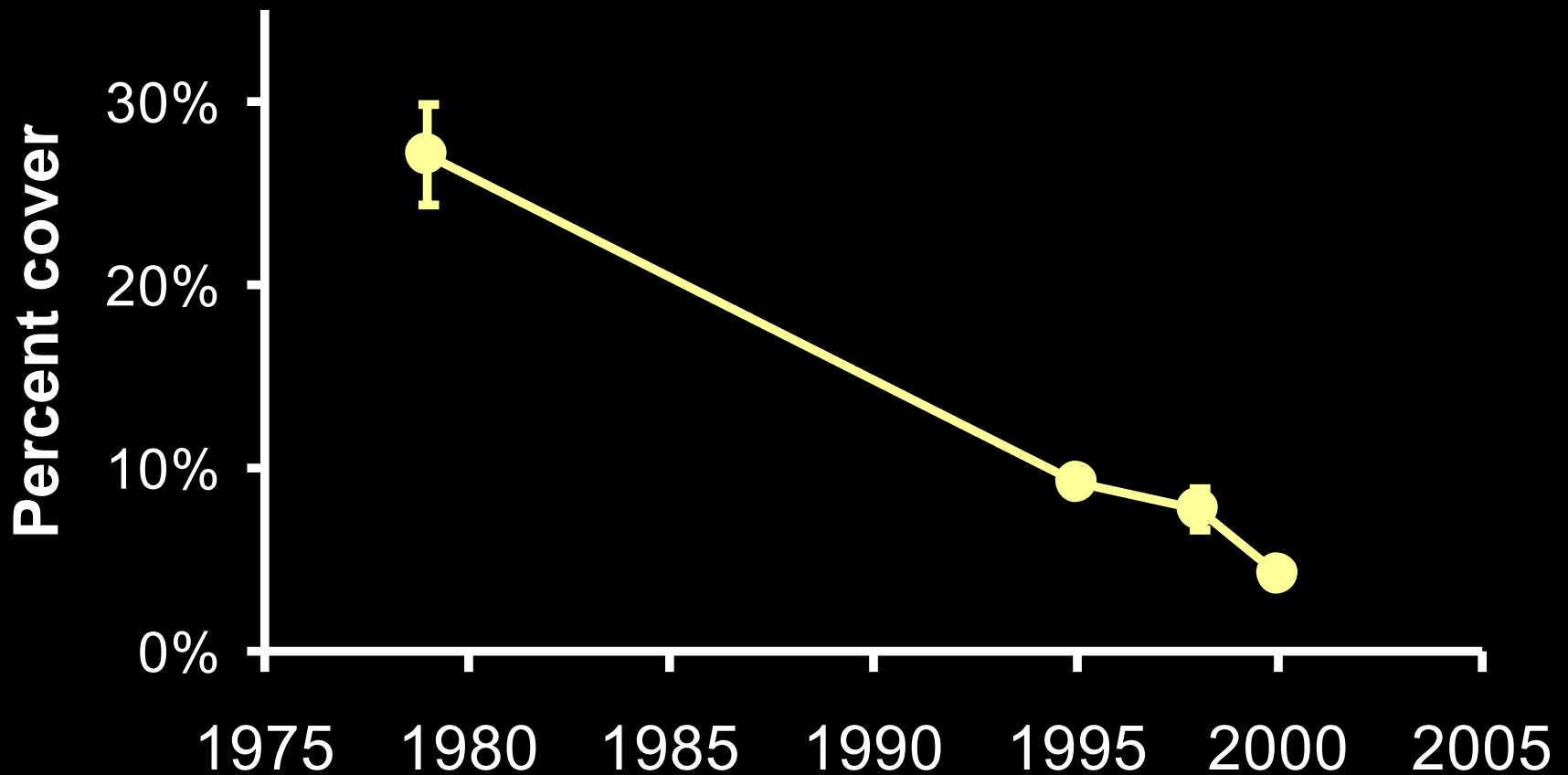


McClenachen 2009

# 50 years of coral decline in the Keys (documented by Gene Shinn)



# Elkhorn Reef Biscayne National Park



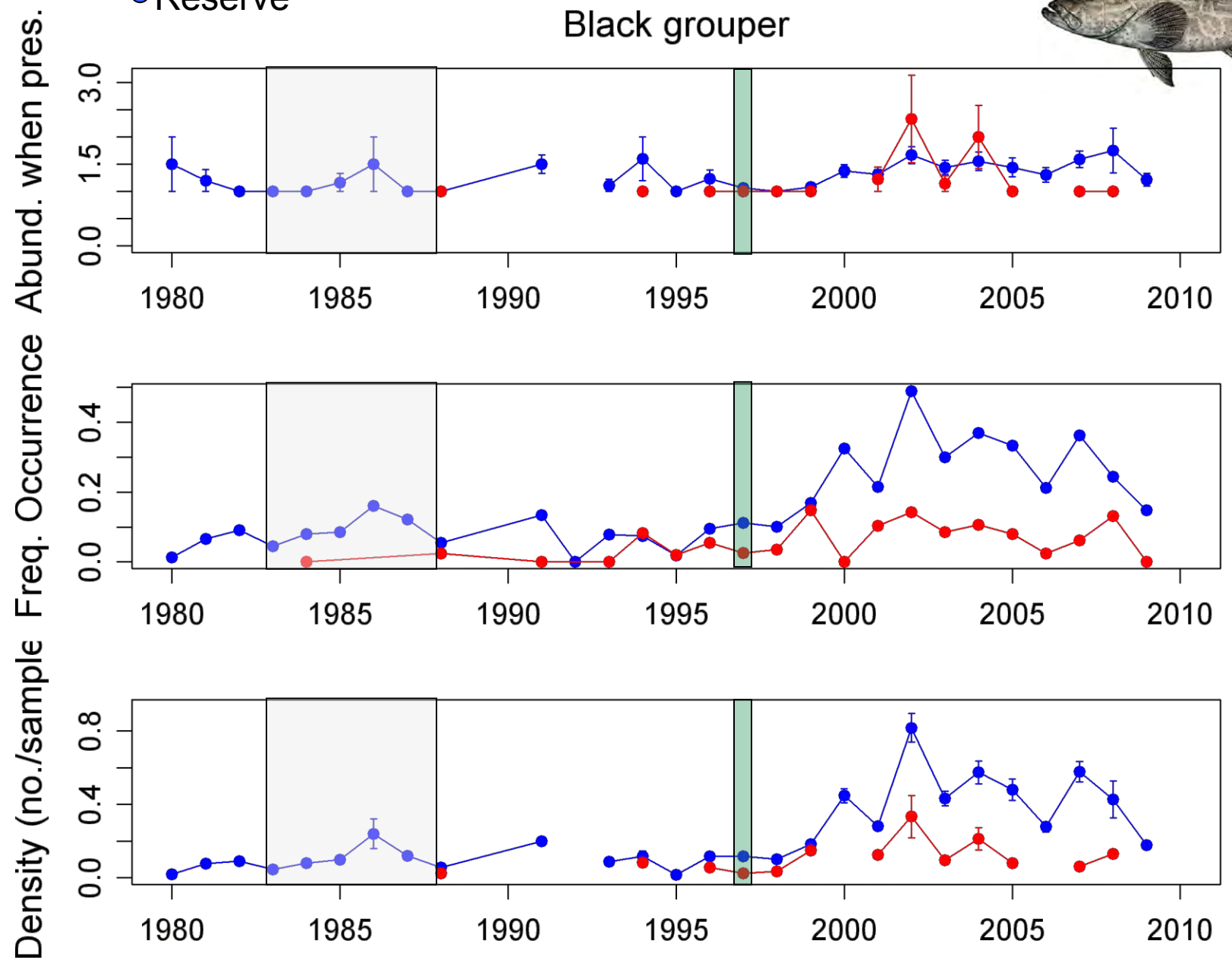
# This analysis

An underwater photograph of a rocky reef structure. The rock is dark and covered in various marine life, including colorful sponges and coral. A large, brownish fish is swimming in the foreground, partially obscuring the lower part of the rock. The background is a deep blue, slightly hazy water.

- Restricted to high-relief spur & groove forereef
- No-take marine reserves implemented in 1997
- Response variables:
  - Abundance when present (i.e. excludes zeros)
  - Frequency of occurrence
  - Density (i.e. includes zeros)

- Non-reserve
- Reserve

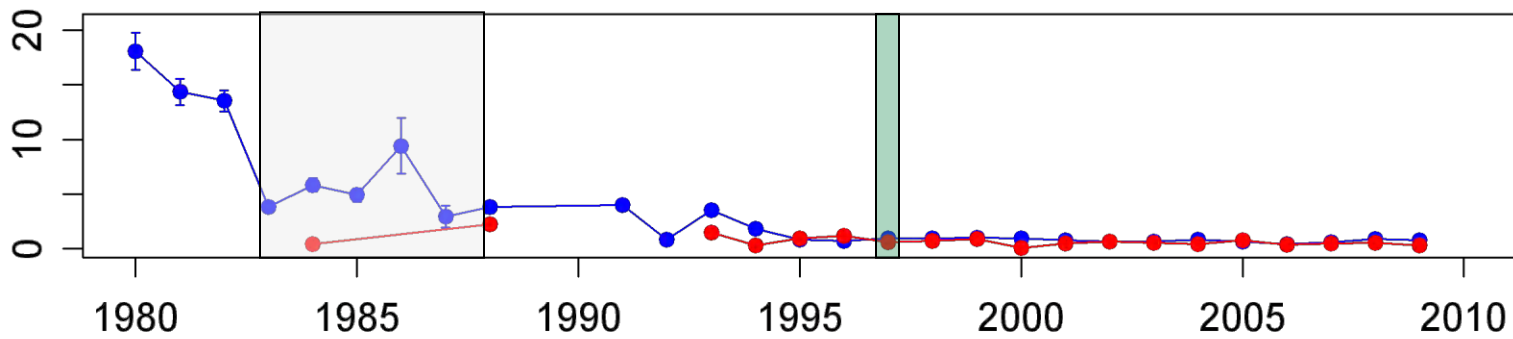
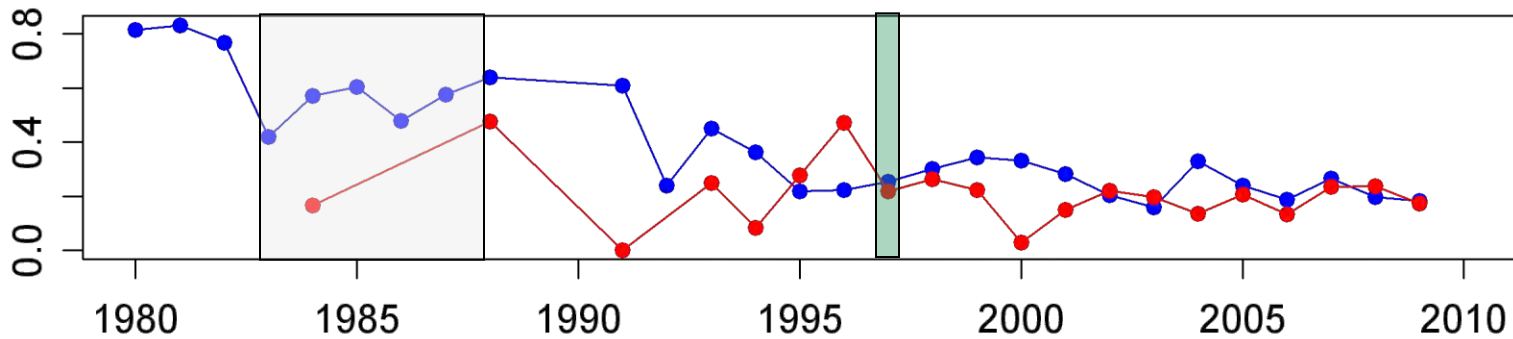
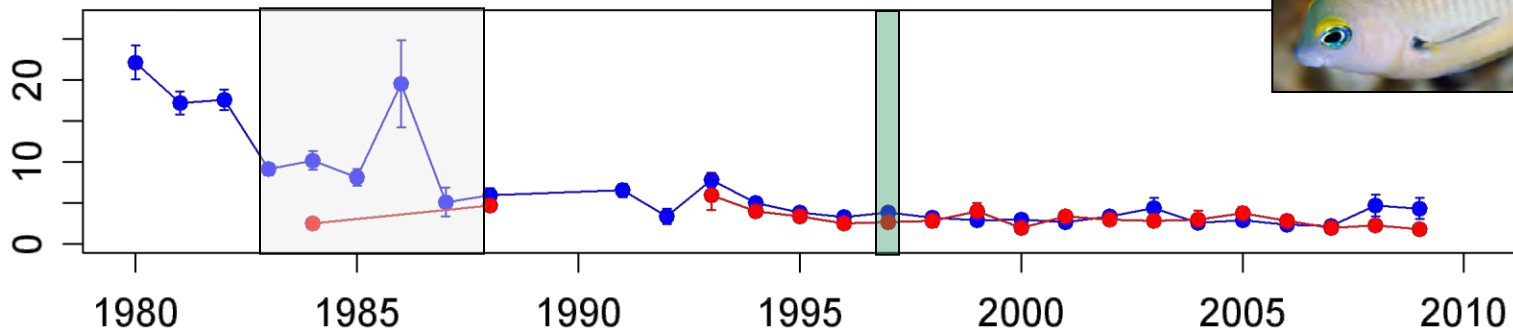
# Black grouper



Density (no./sample Freq. Occurrence Abund. when pres.

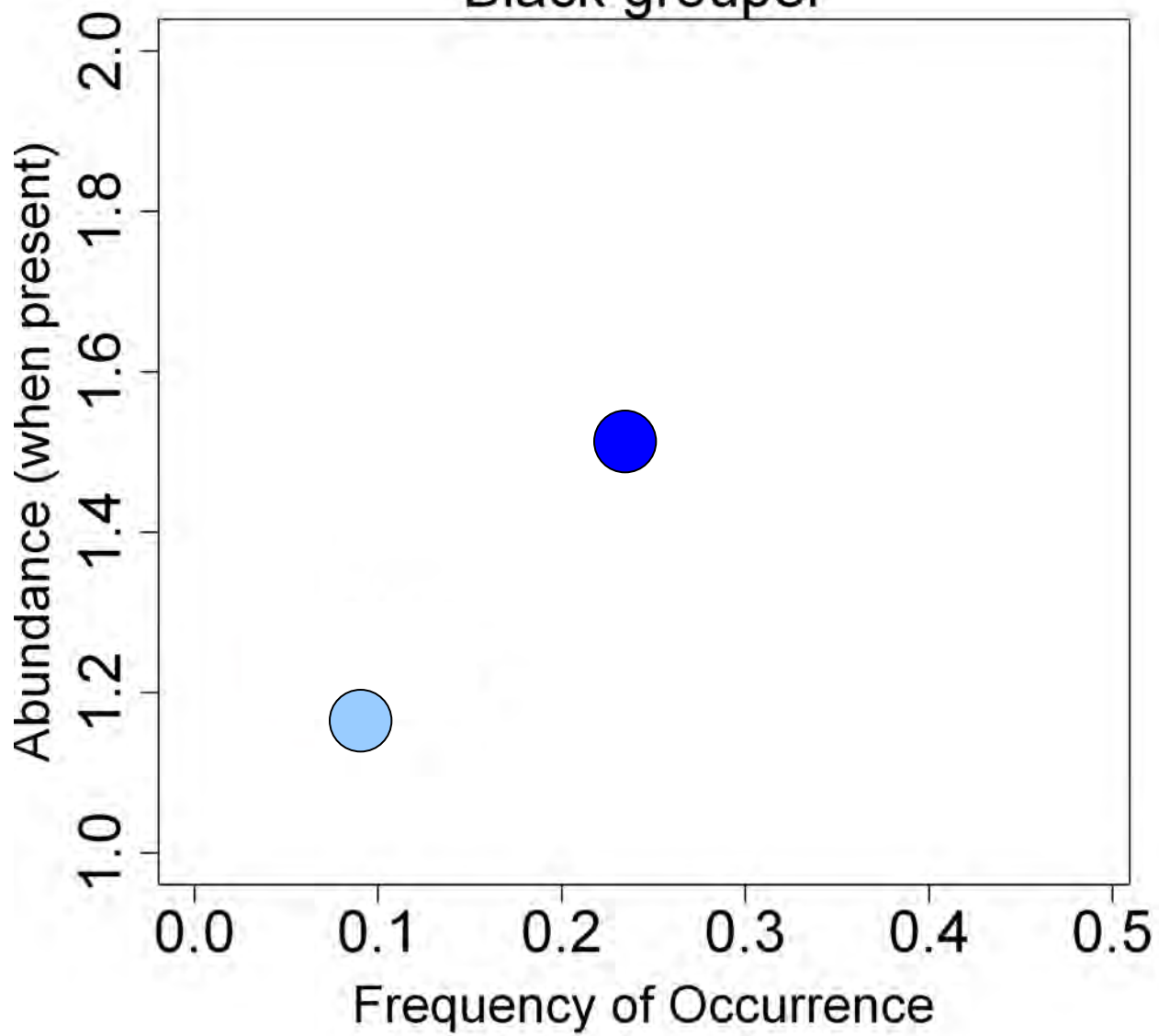
- Non-reserve
- Reserve

### Threespot damselfish





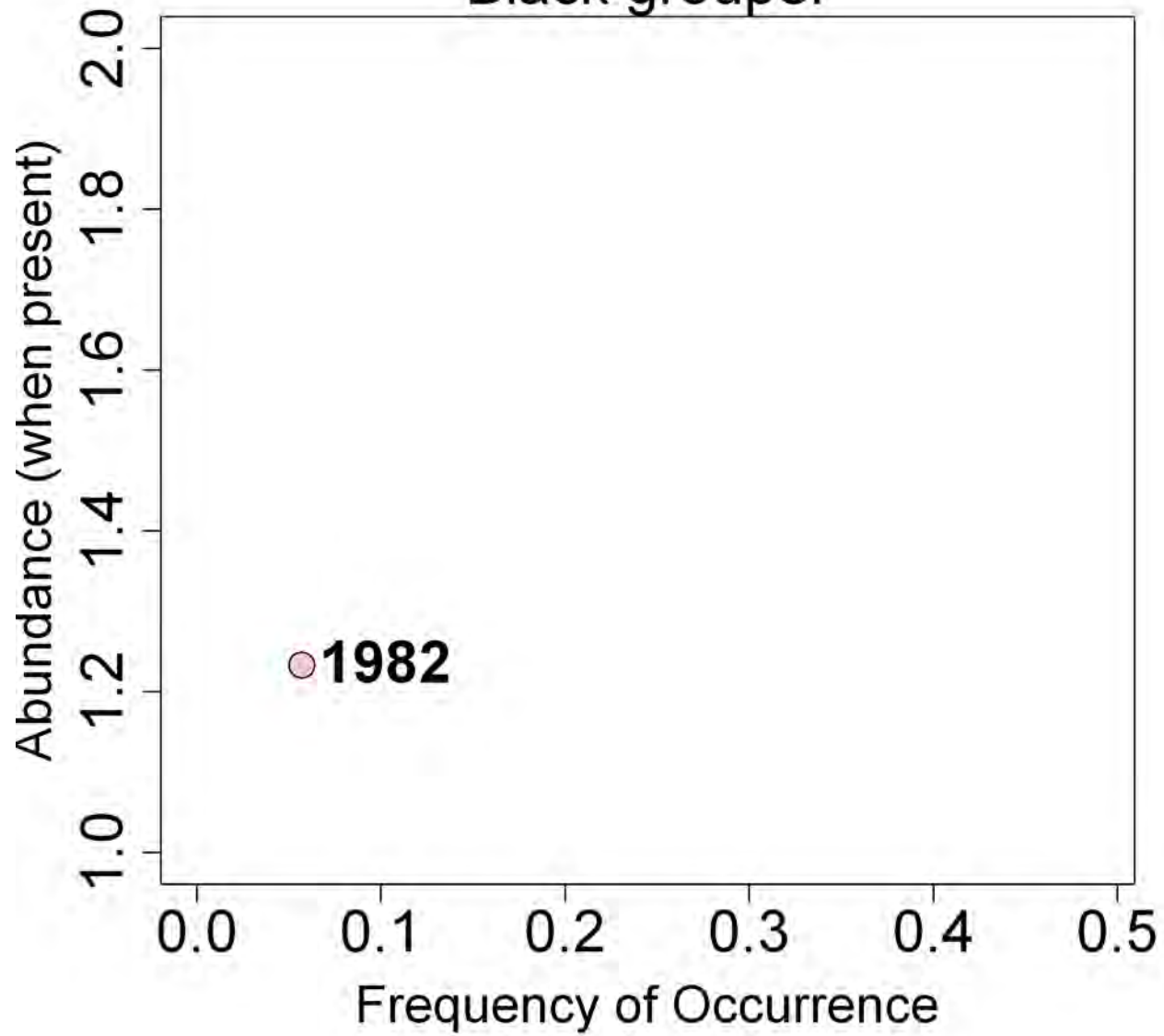
# Black grouper





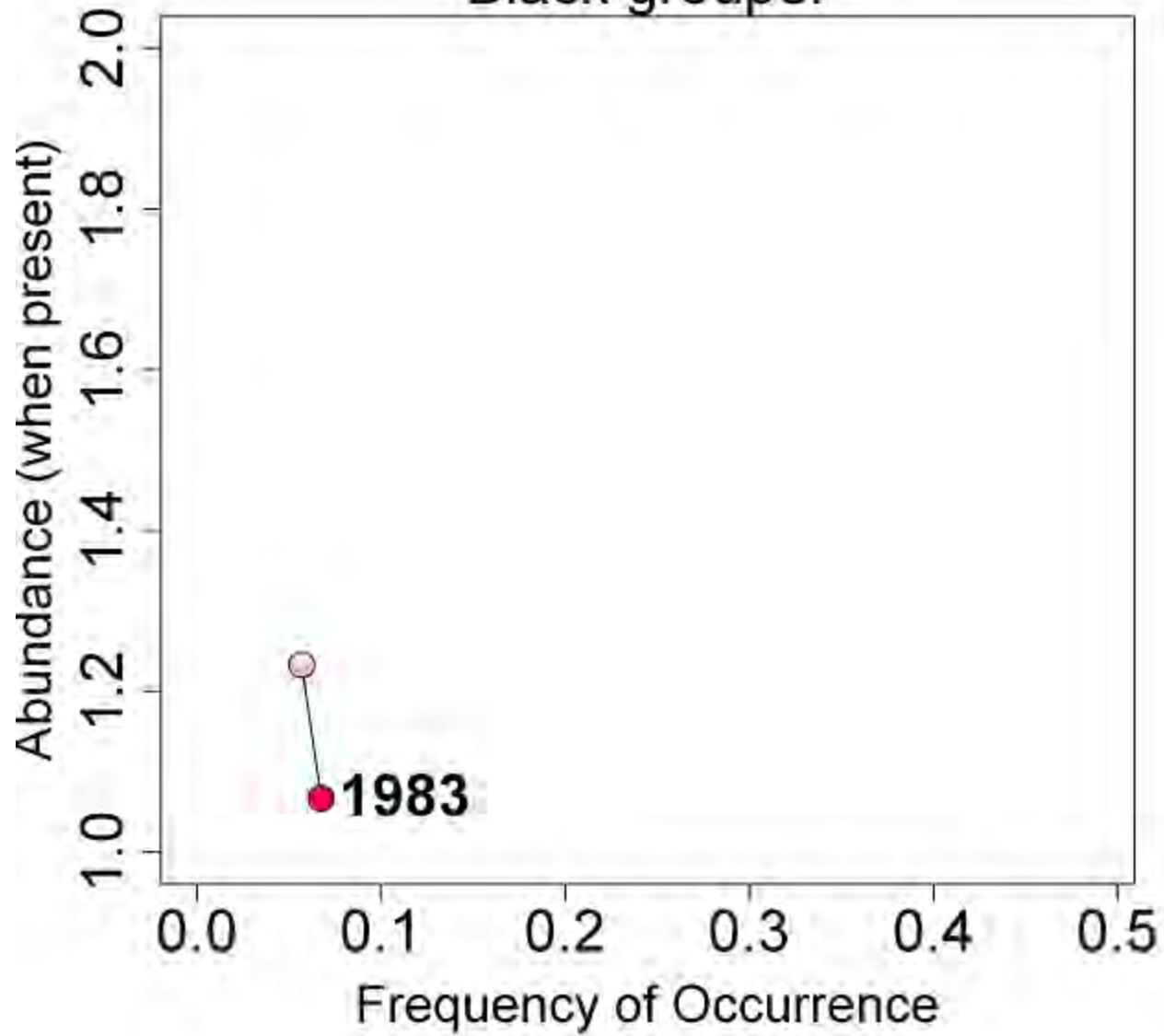


## Black grouper



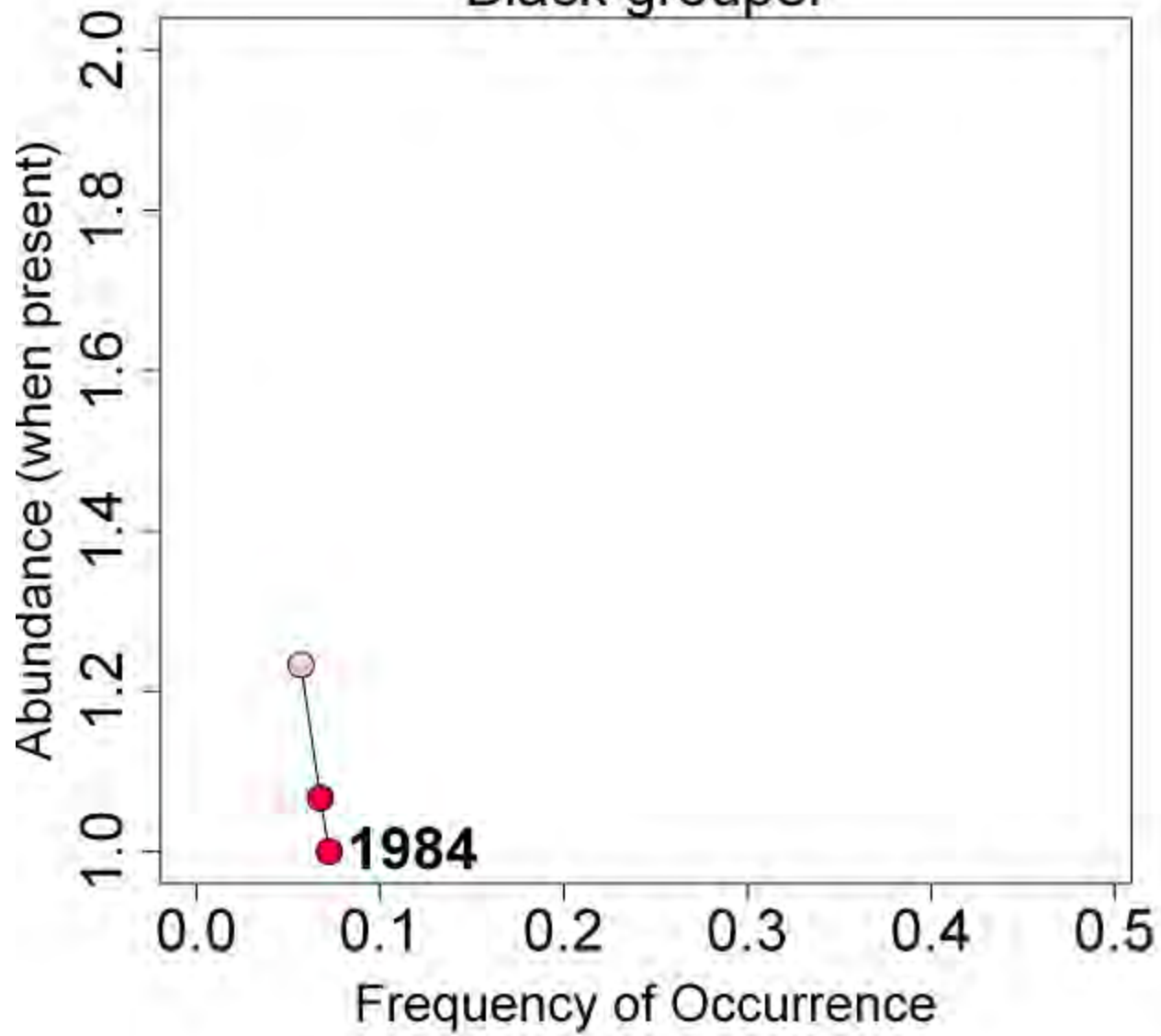


## Black grouper



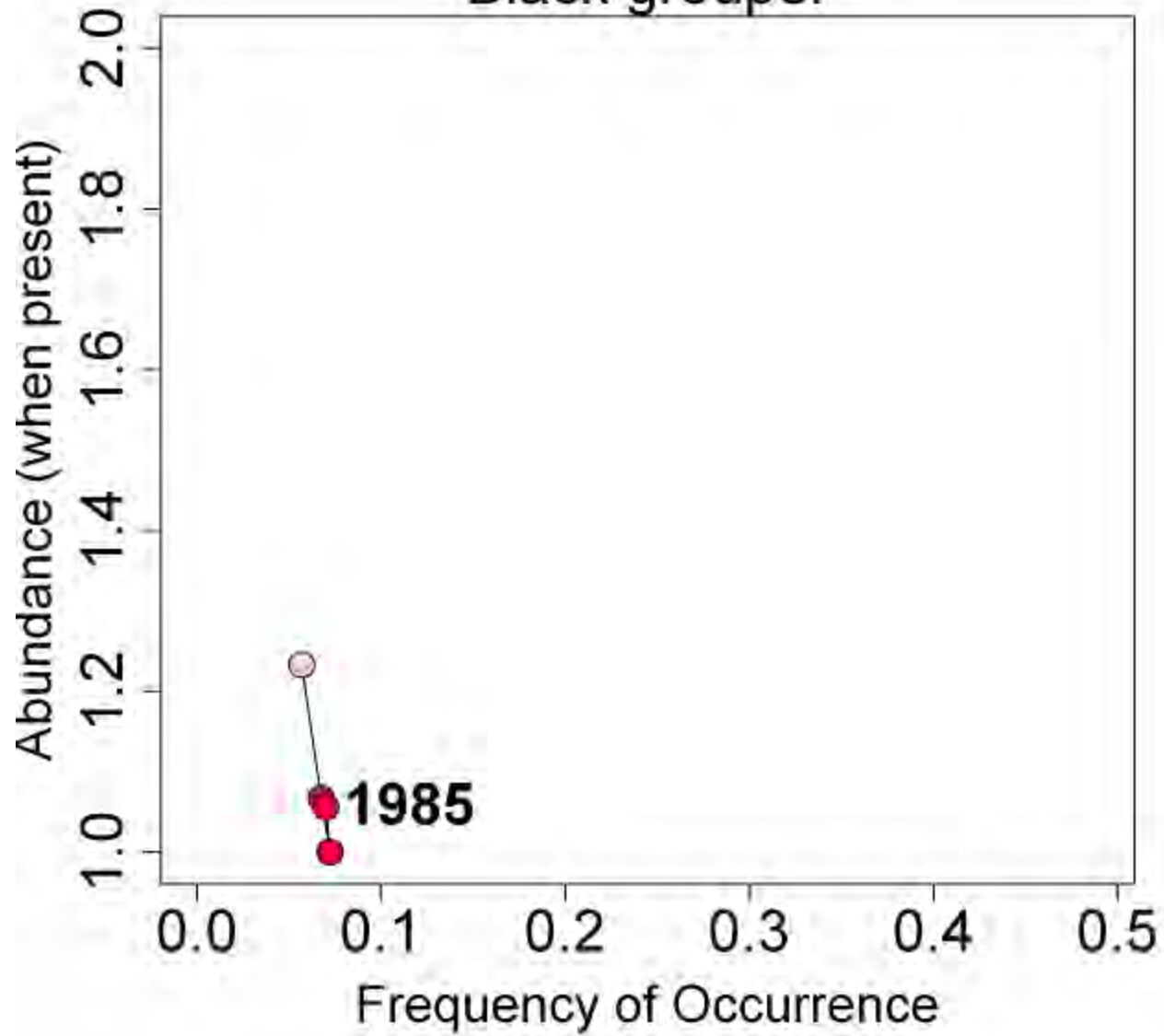


## Black grouper



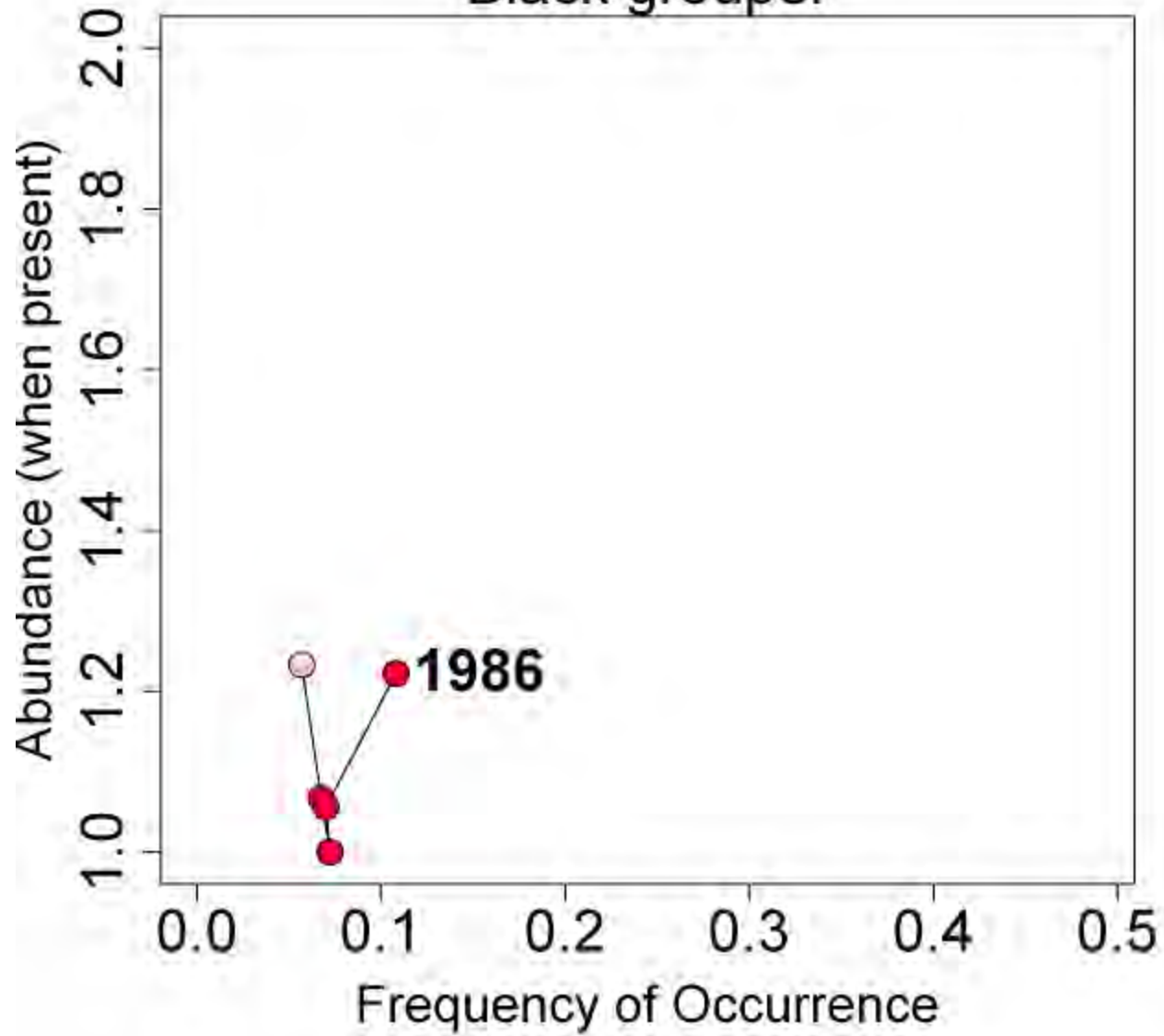


## Black grouper



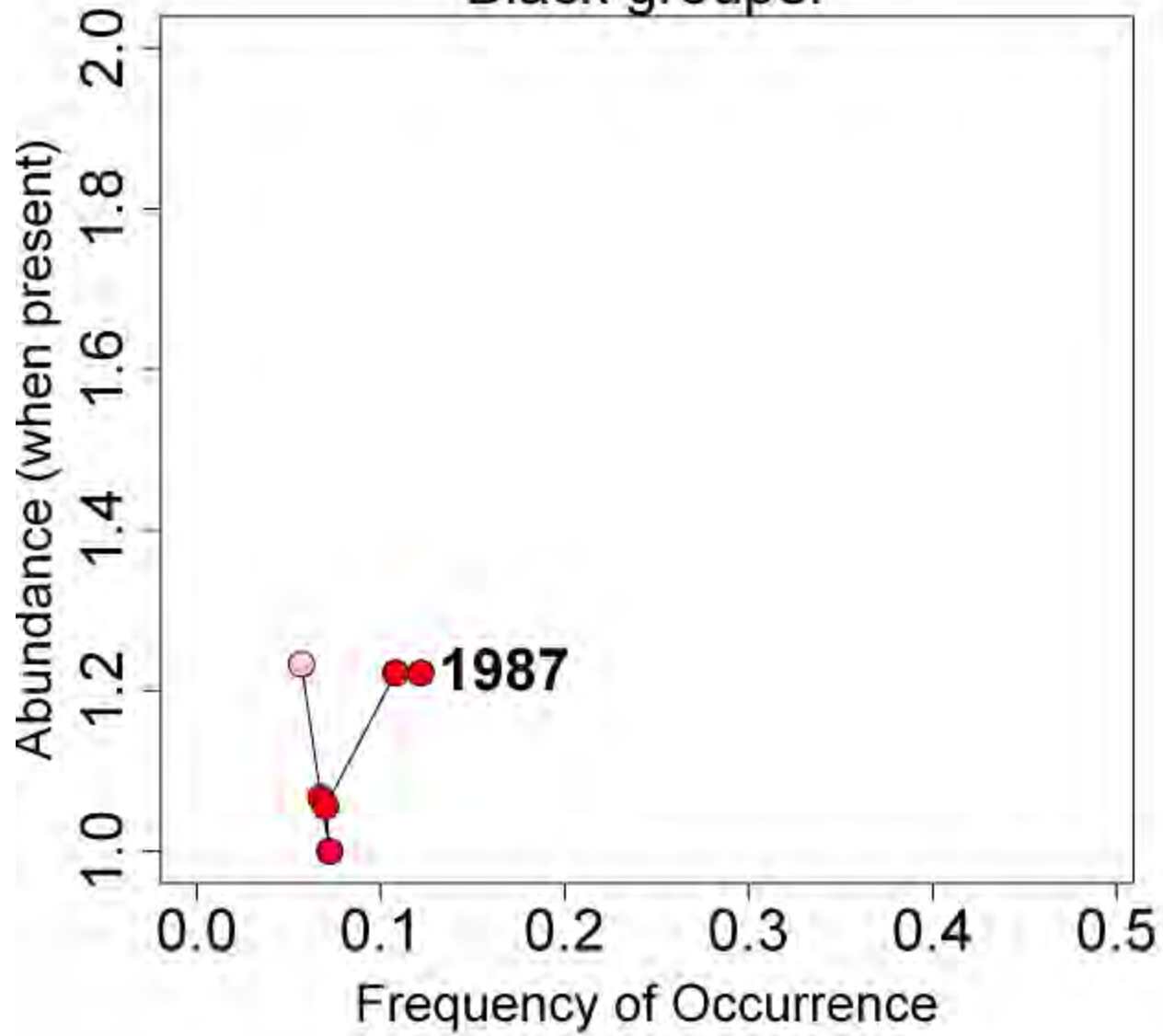


## Black grouper



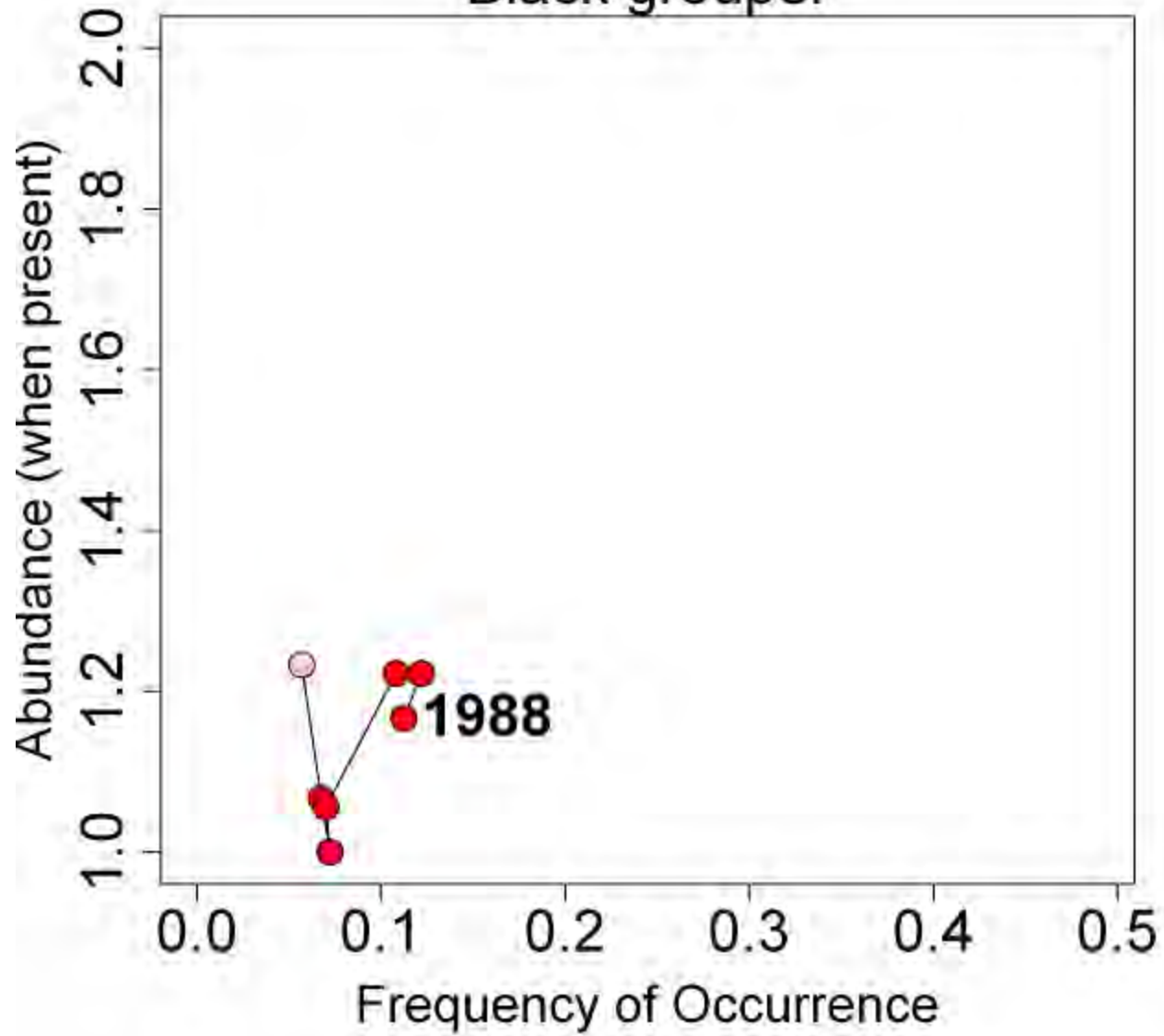


## Black grouper



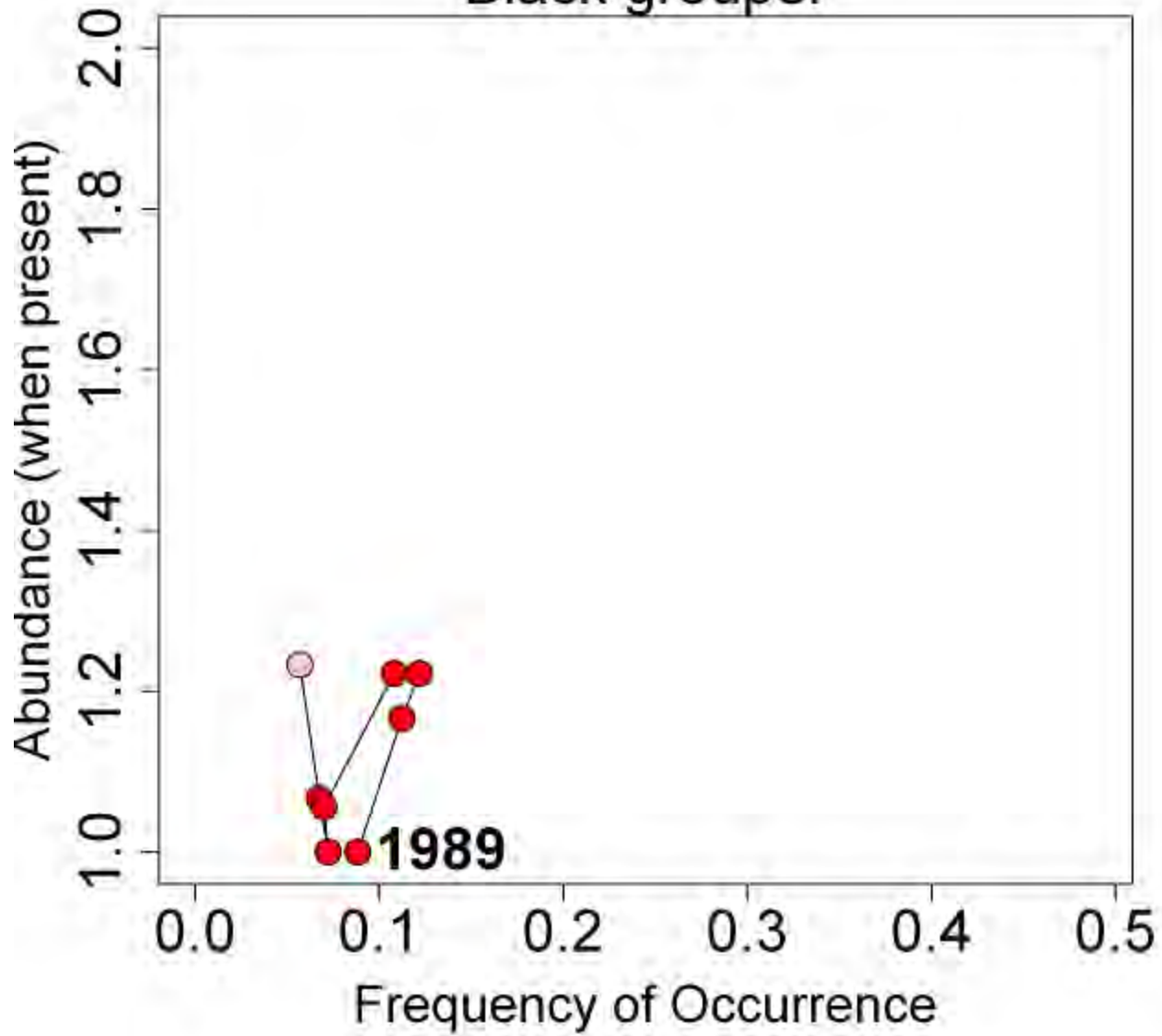


## Black grouper





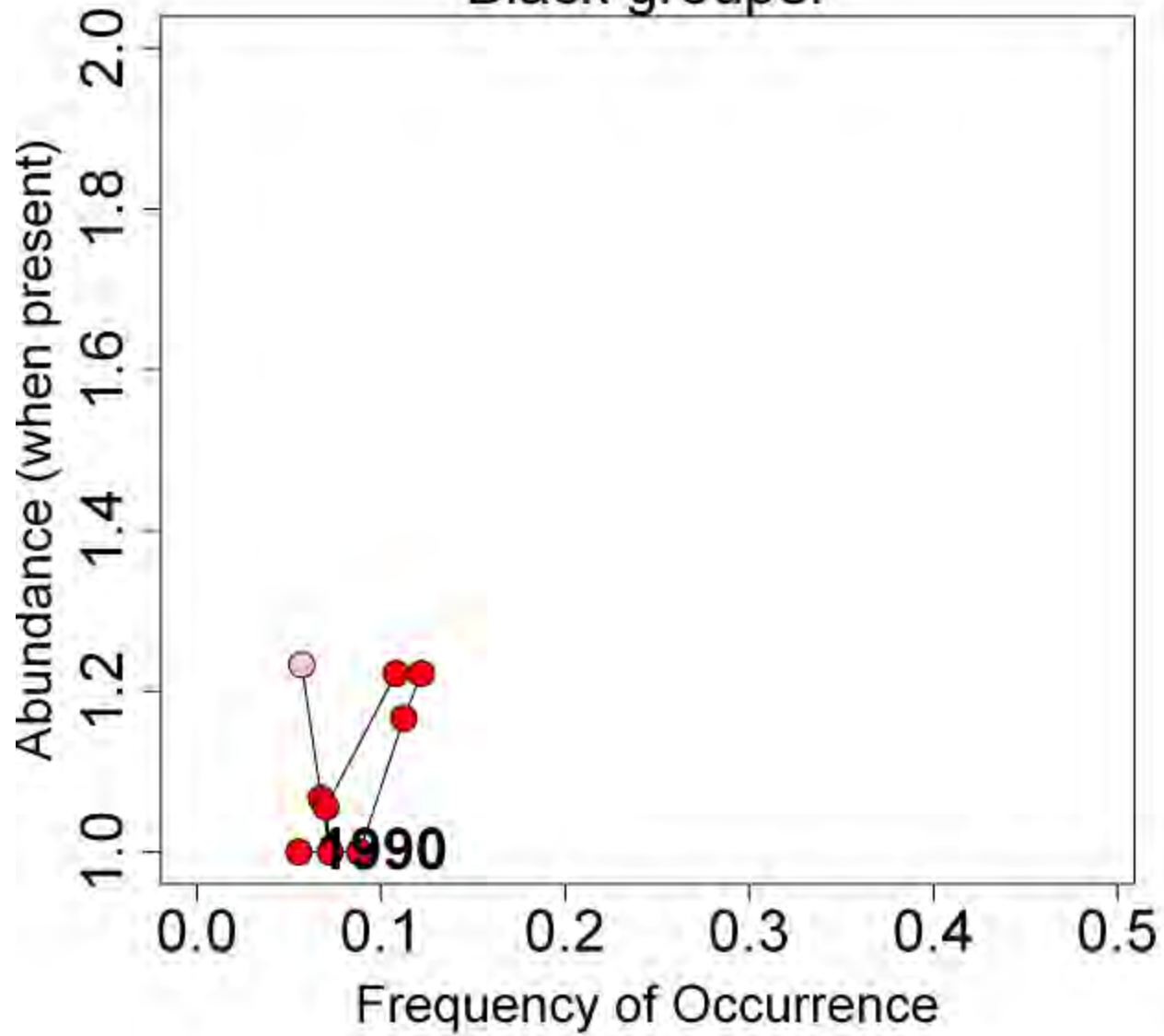
# Black grouper

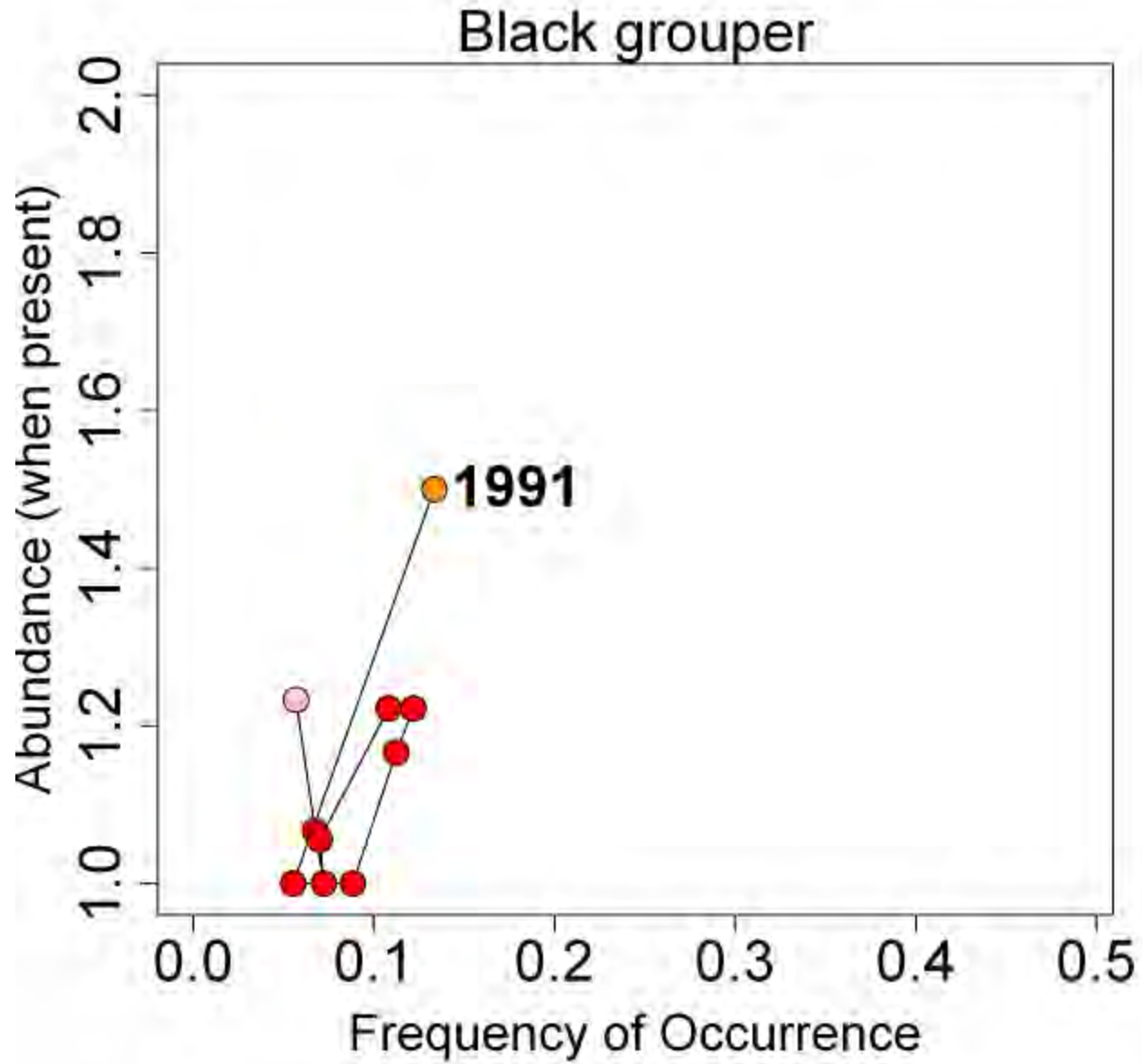






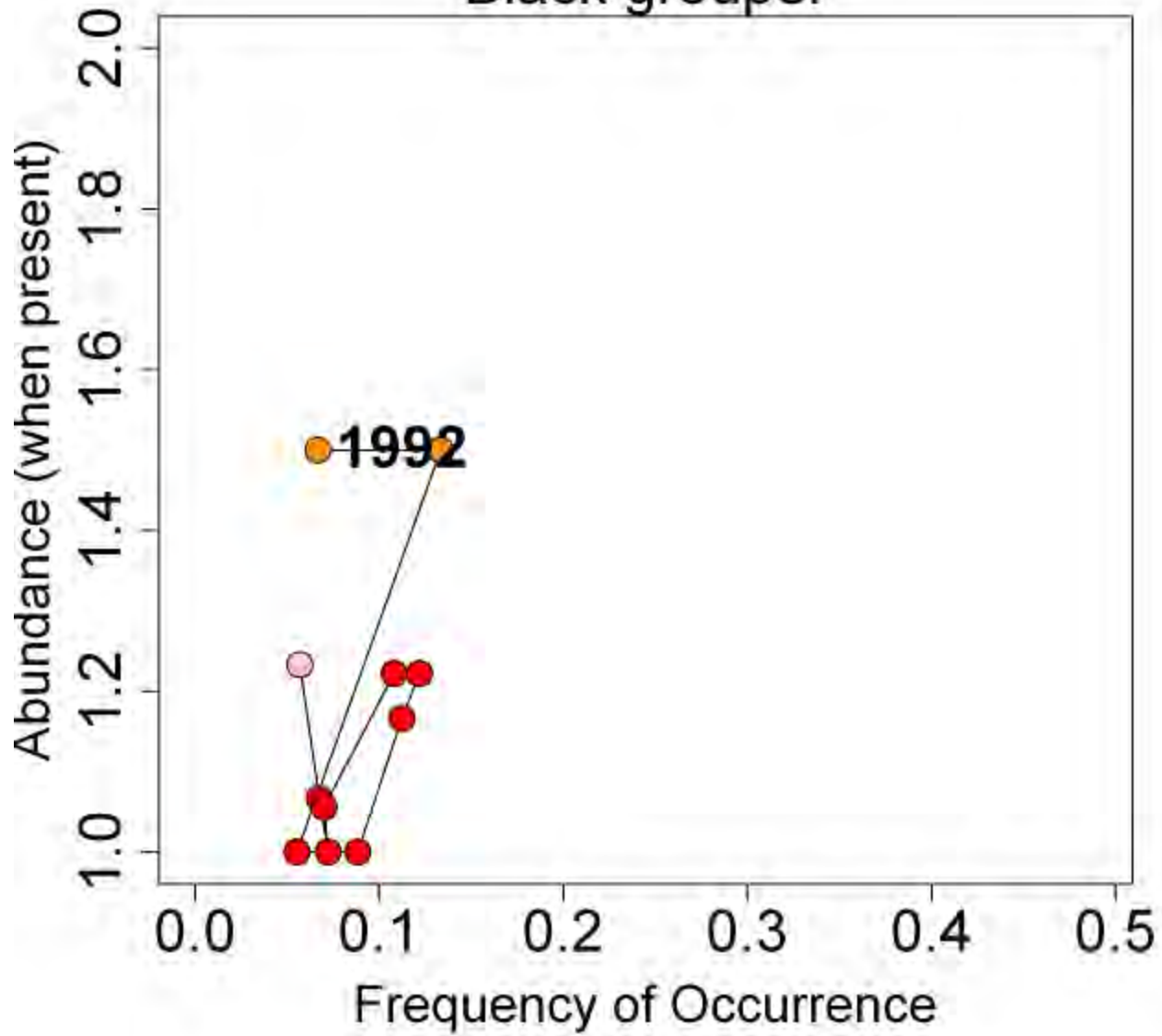
## Black grouper





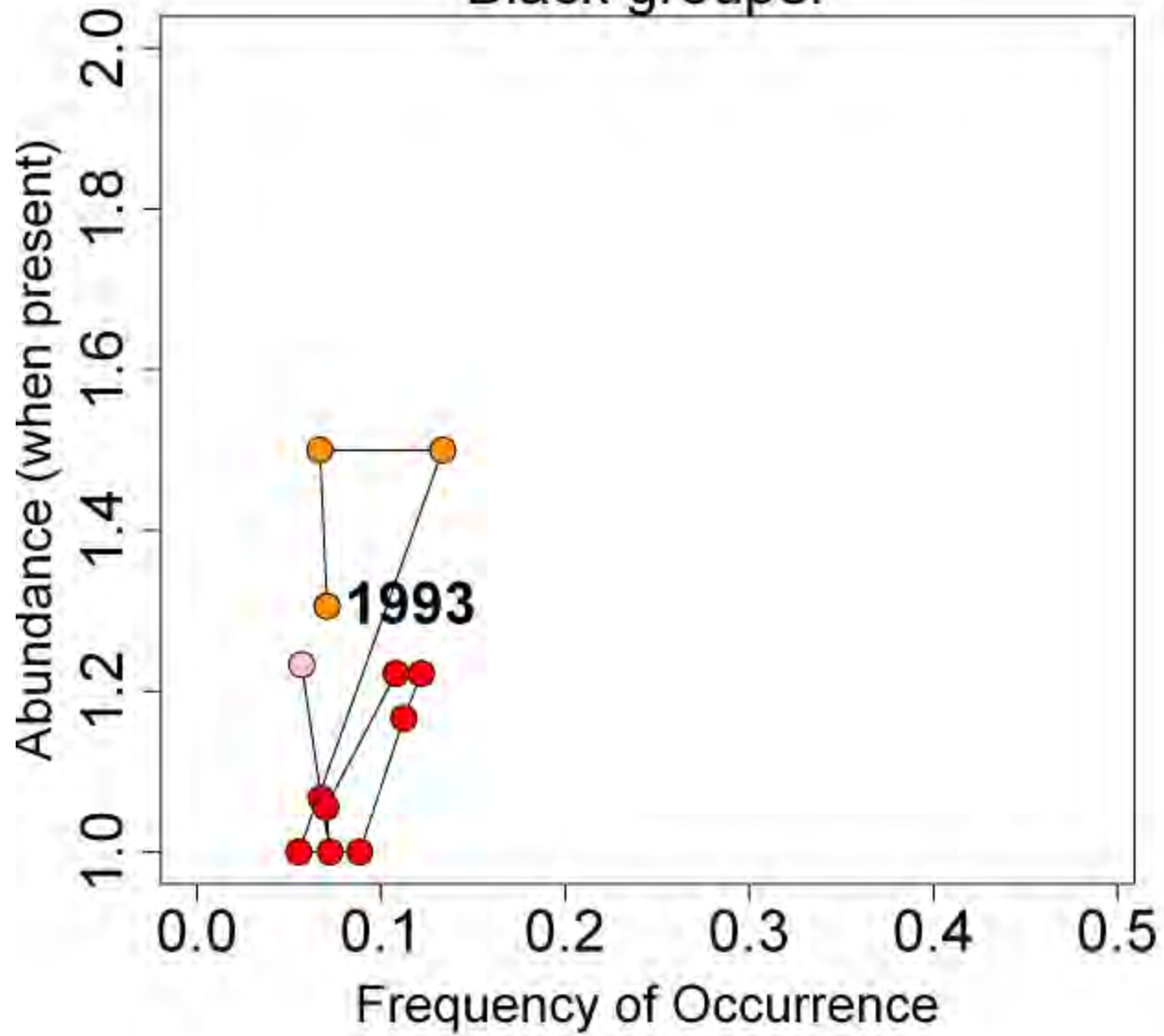


# Black grouper



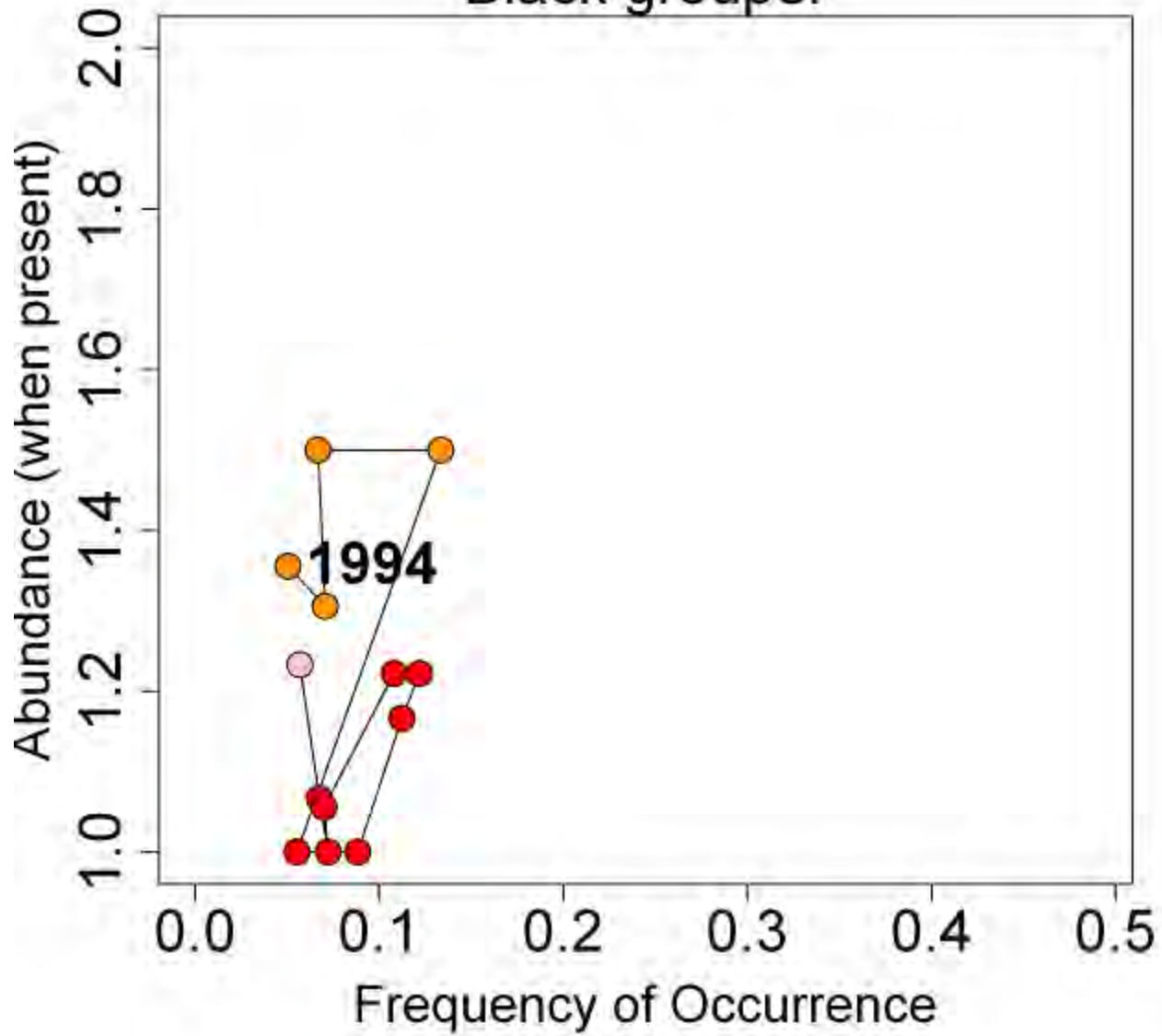


## Black grouper



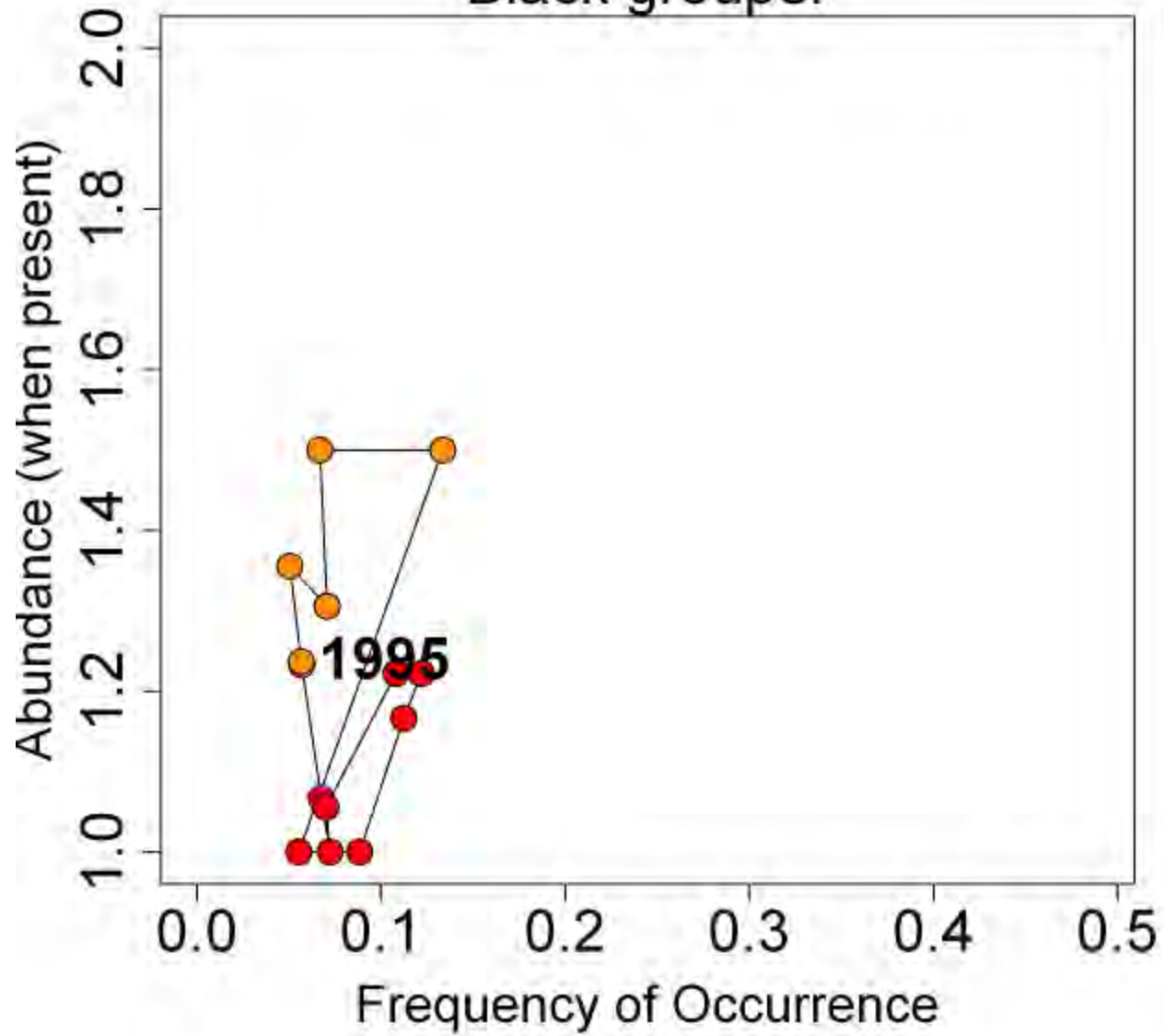


# Black grouper



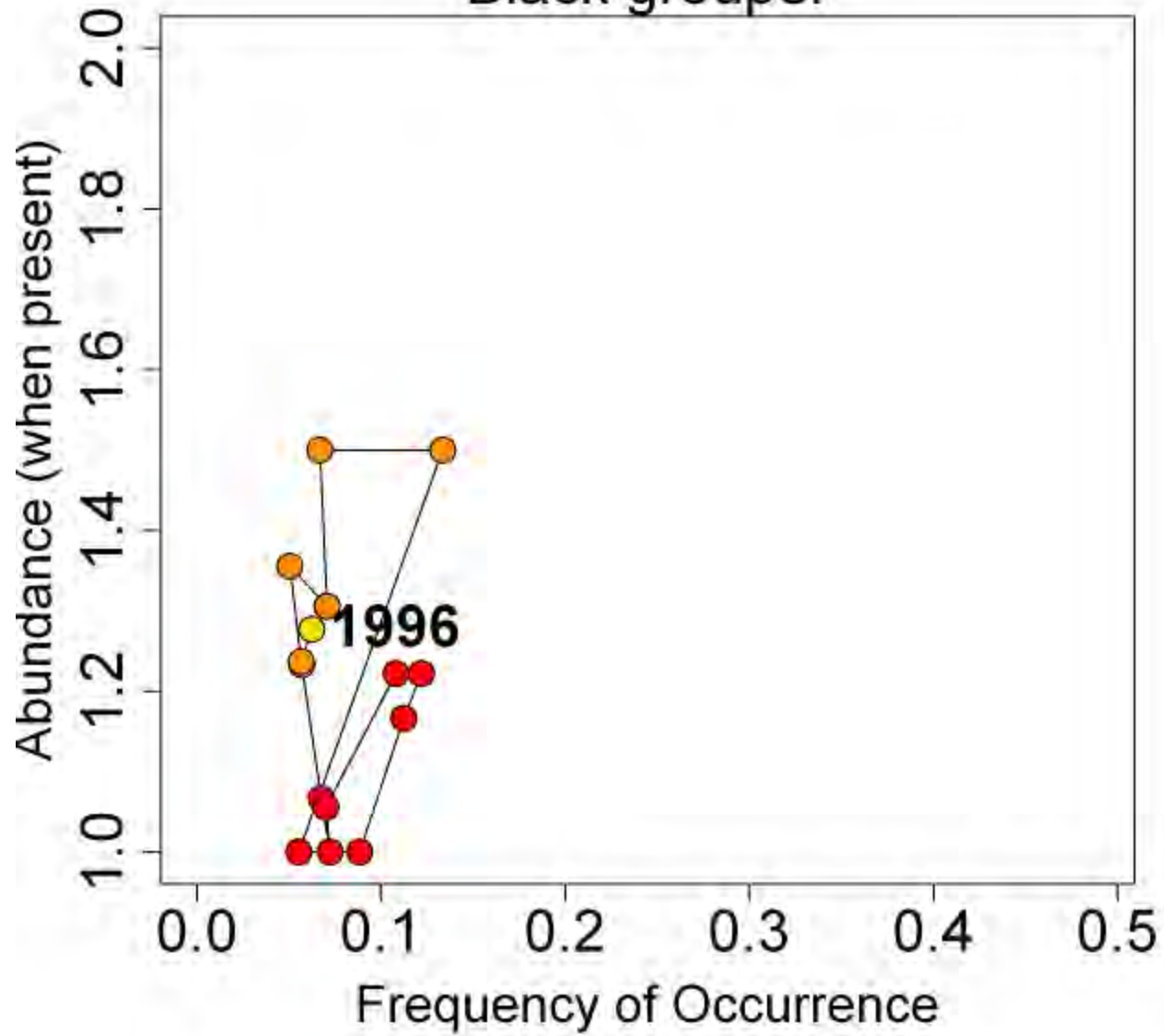


# Black grouper



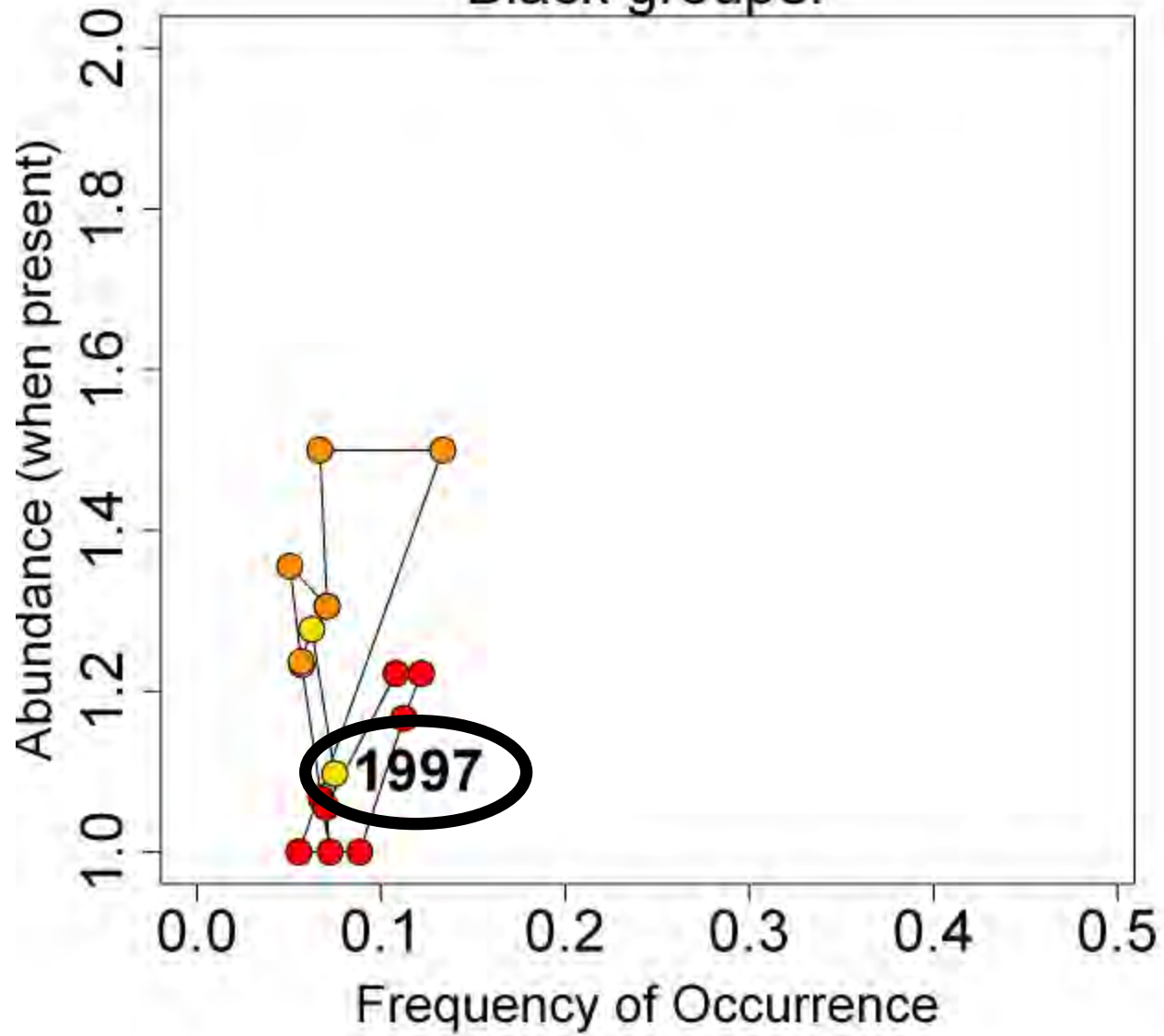


# Black grouper





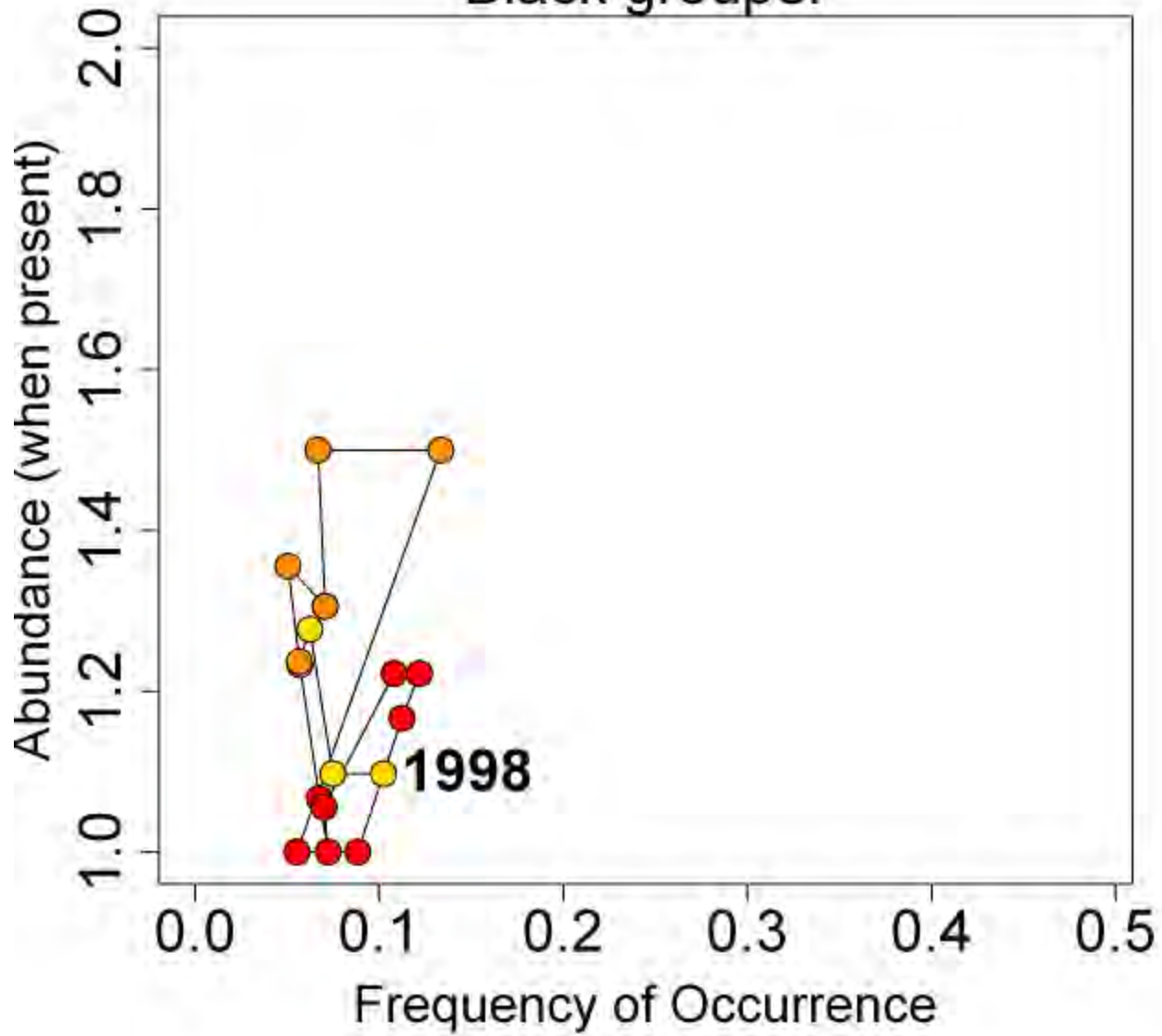
# Black grouper

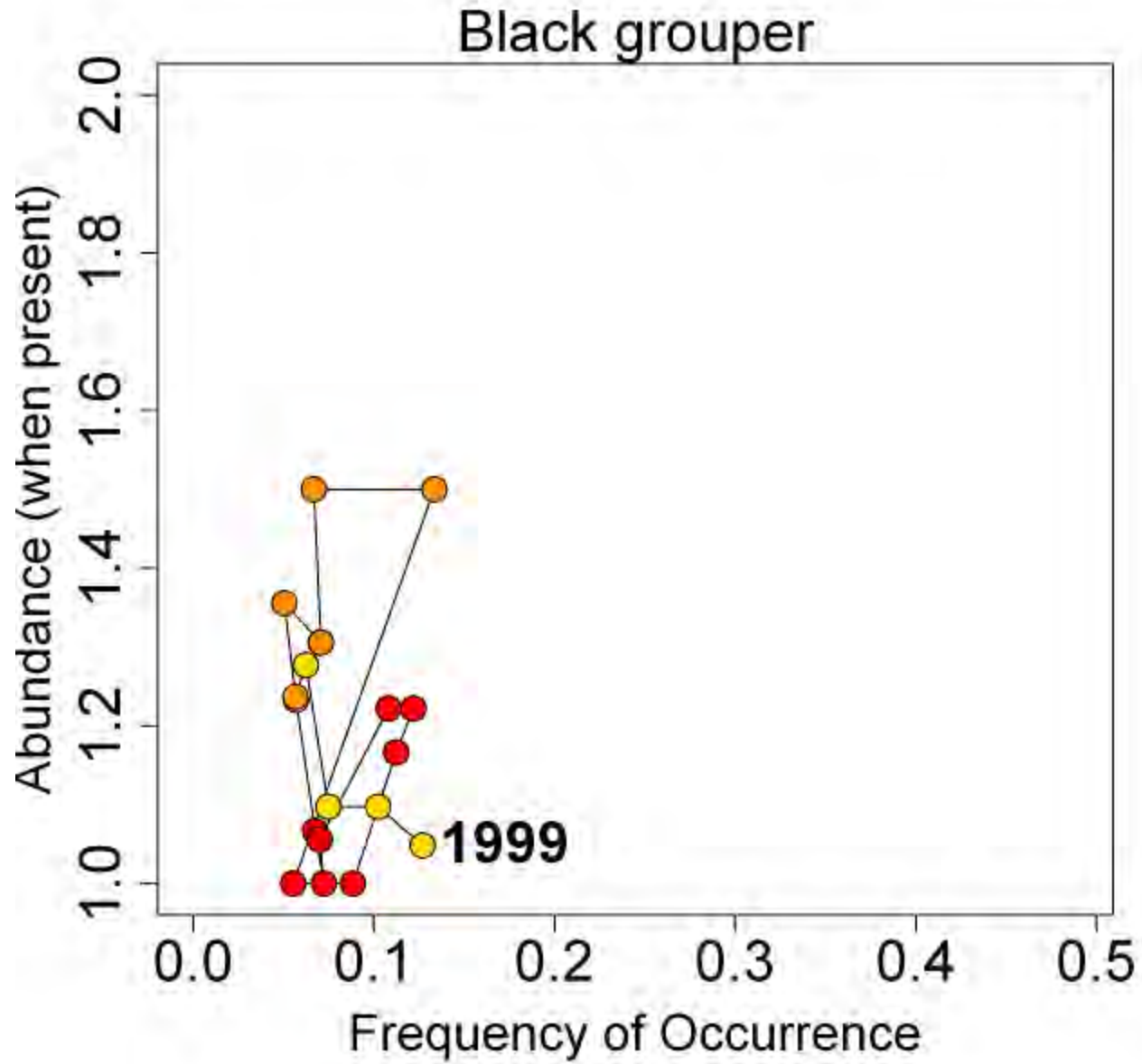






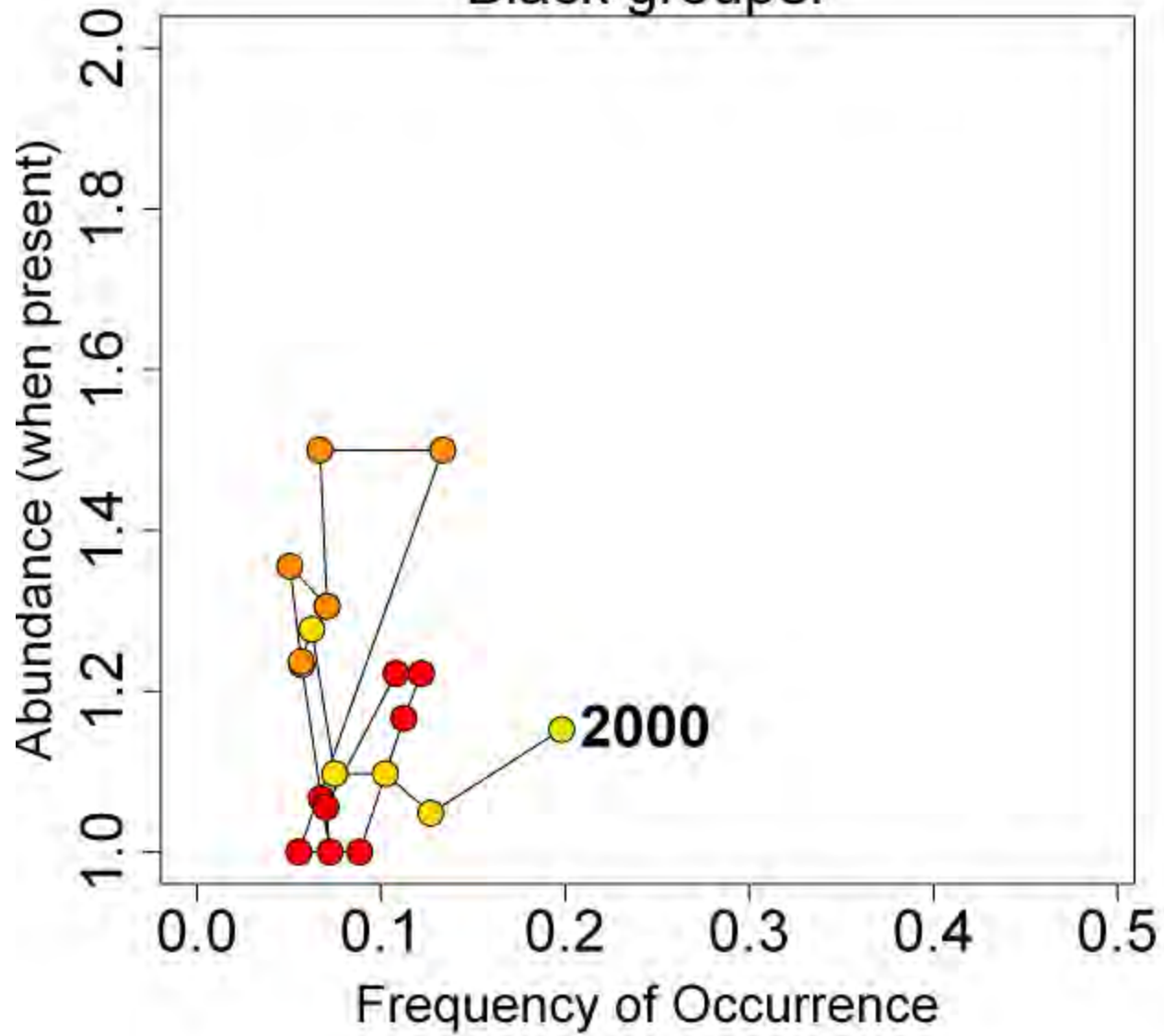
# Black grouper





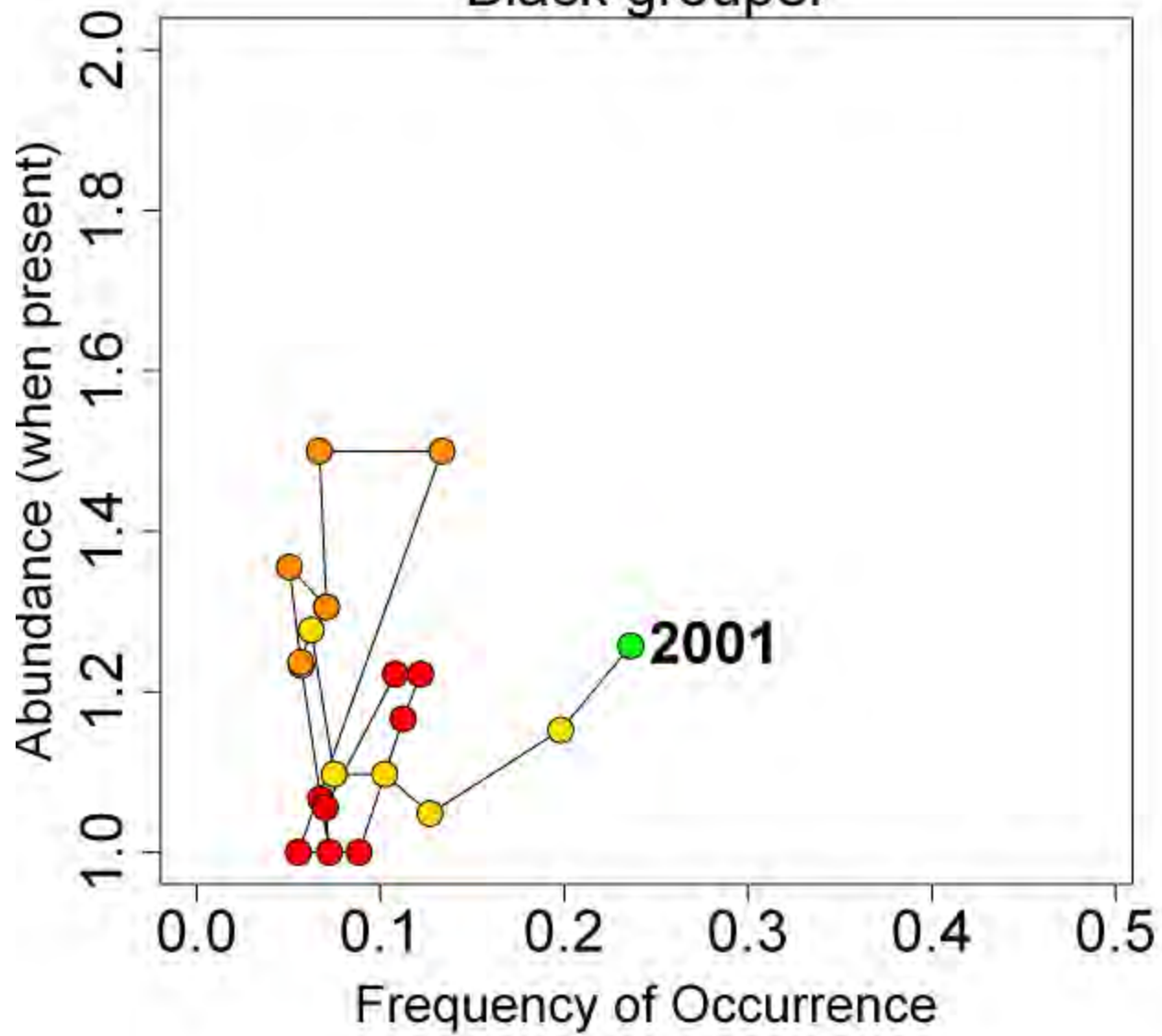


# Black grouper



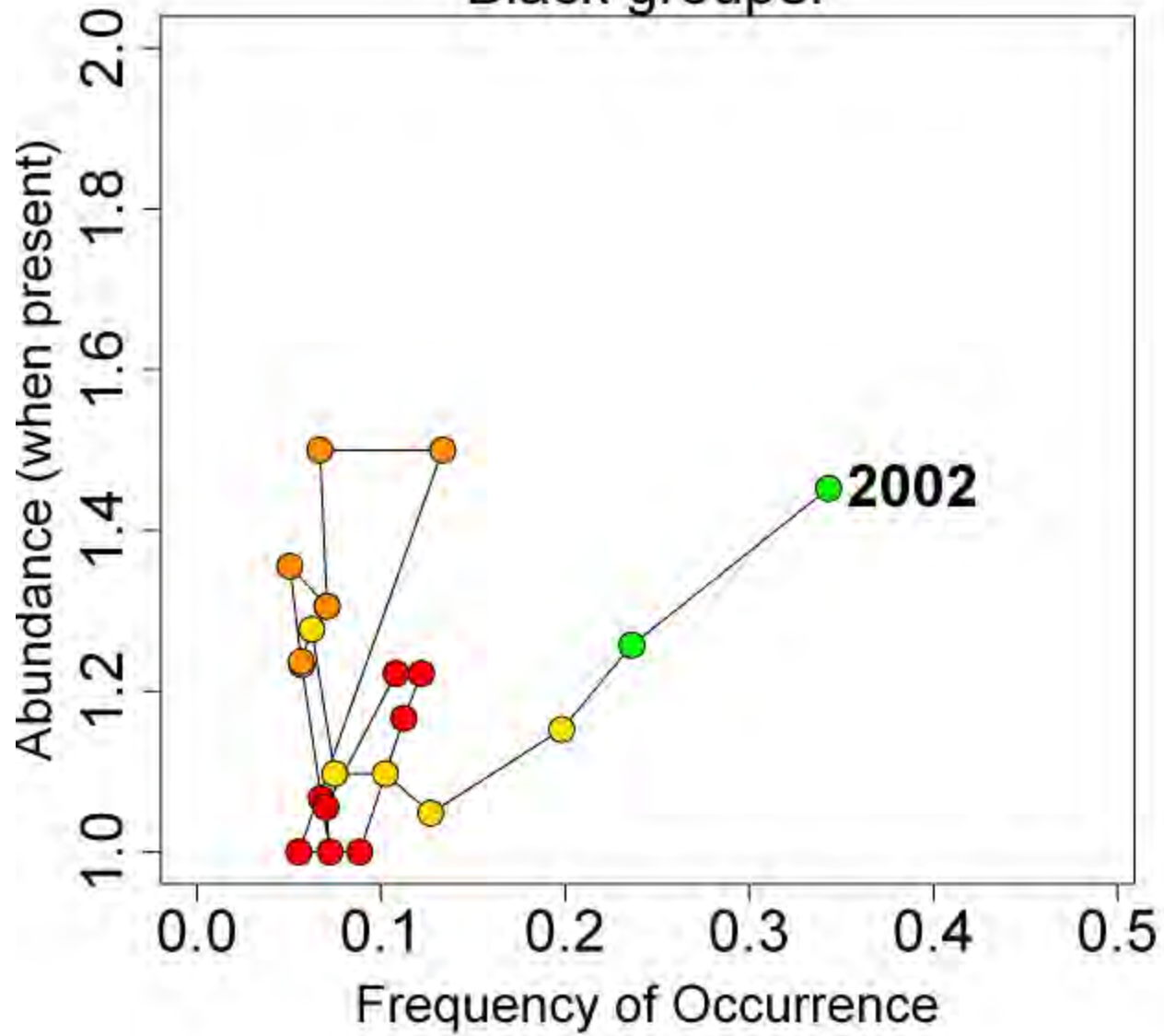


## Black grouper



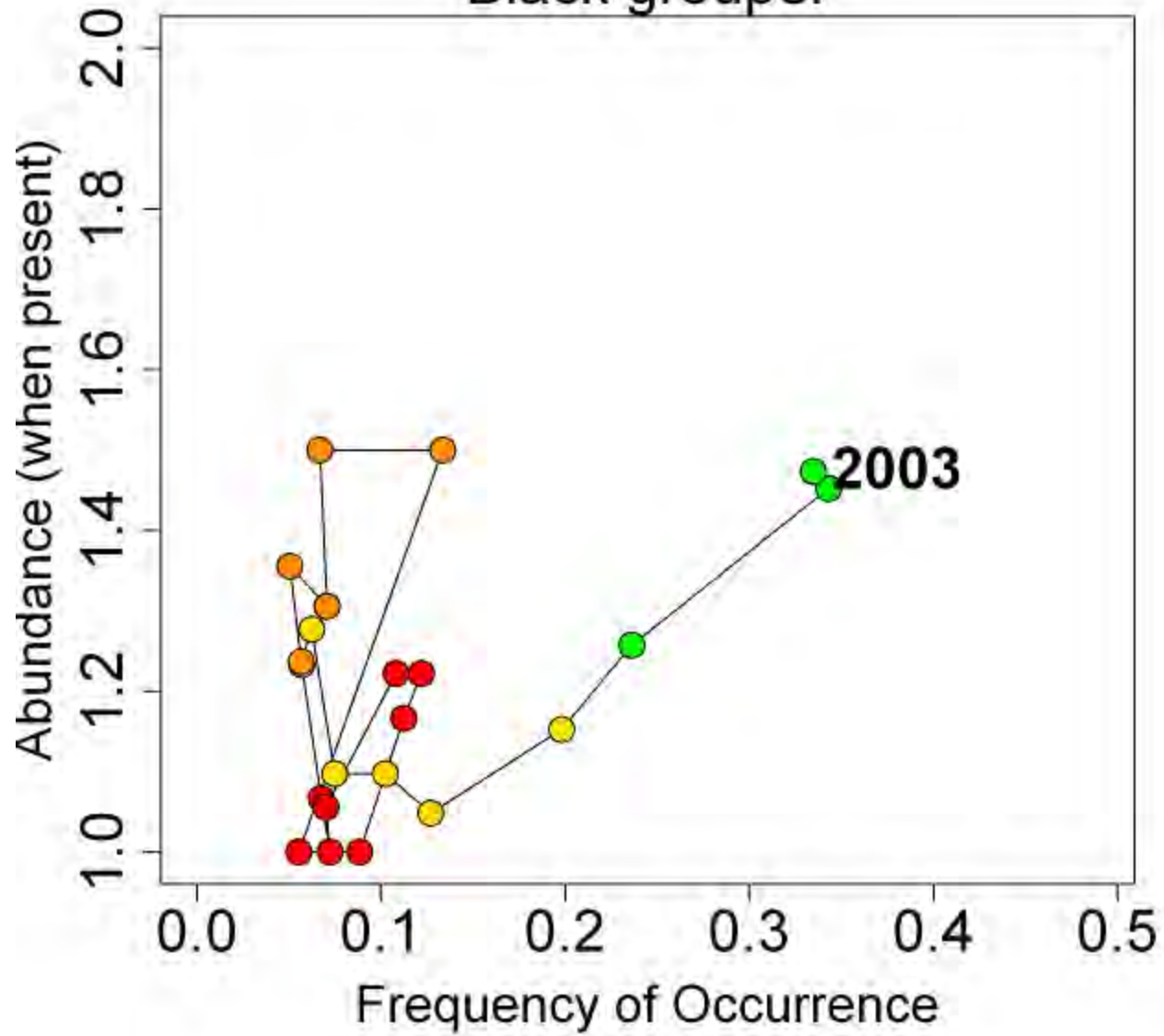


# Black grouper





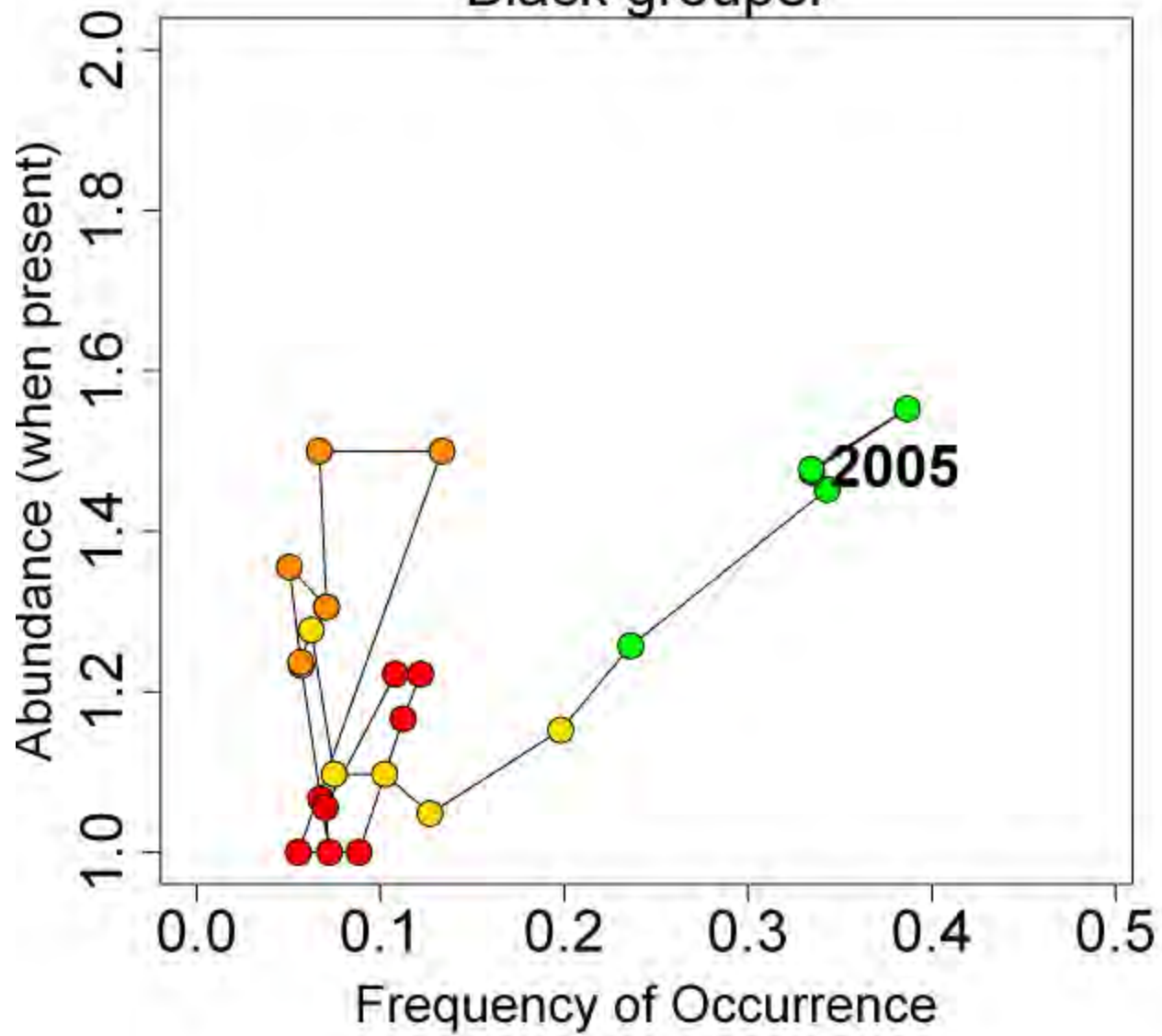
# Black grouper







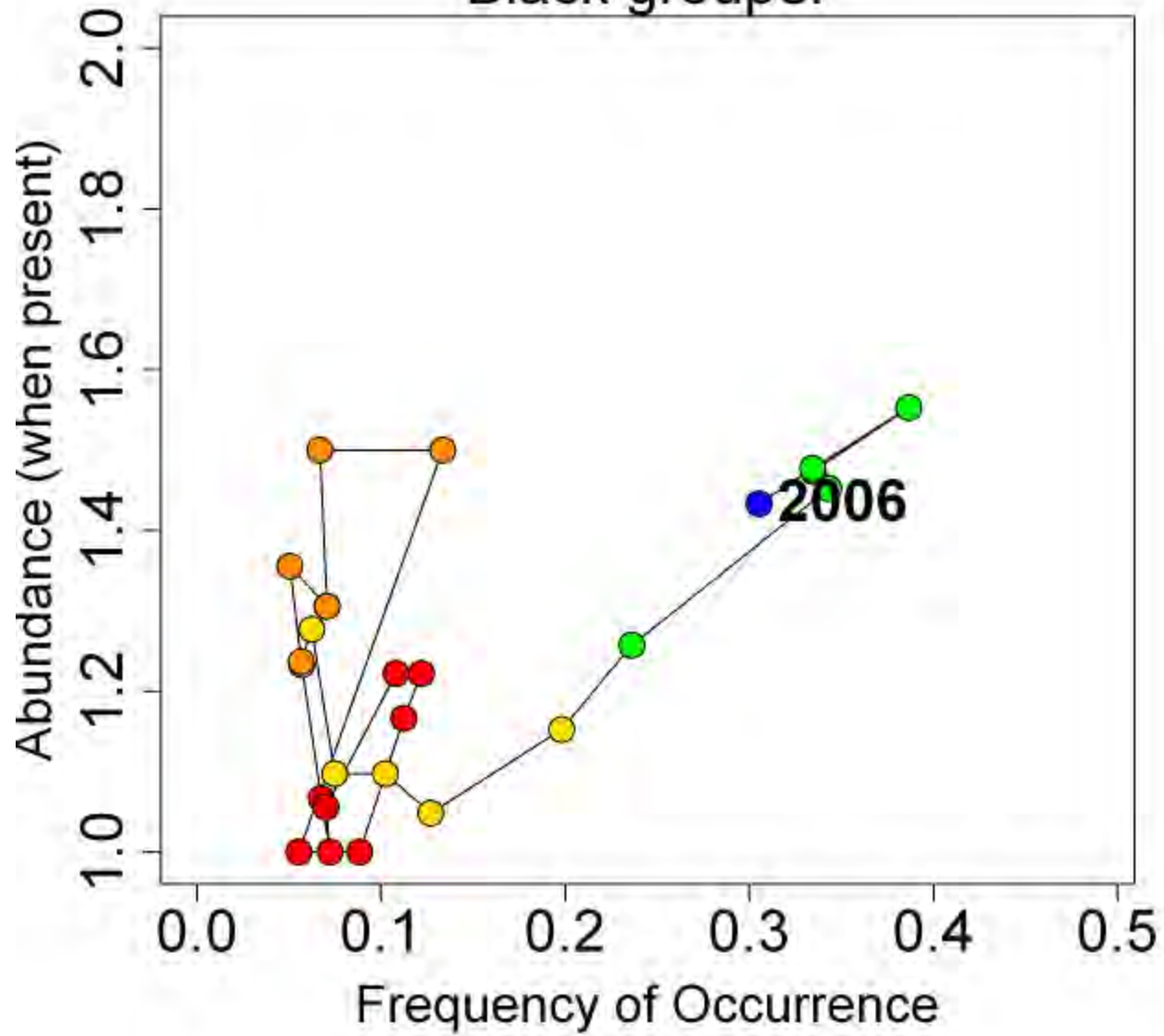
# Black grouper





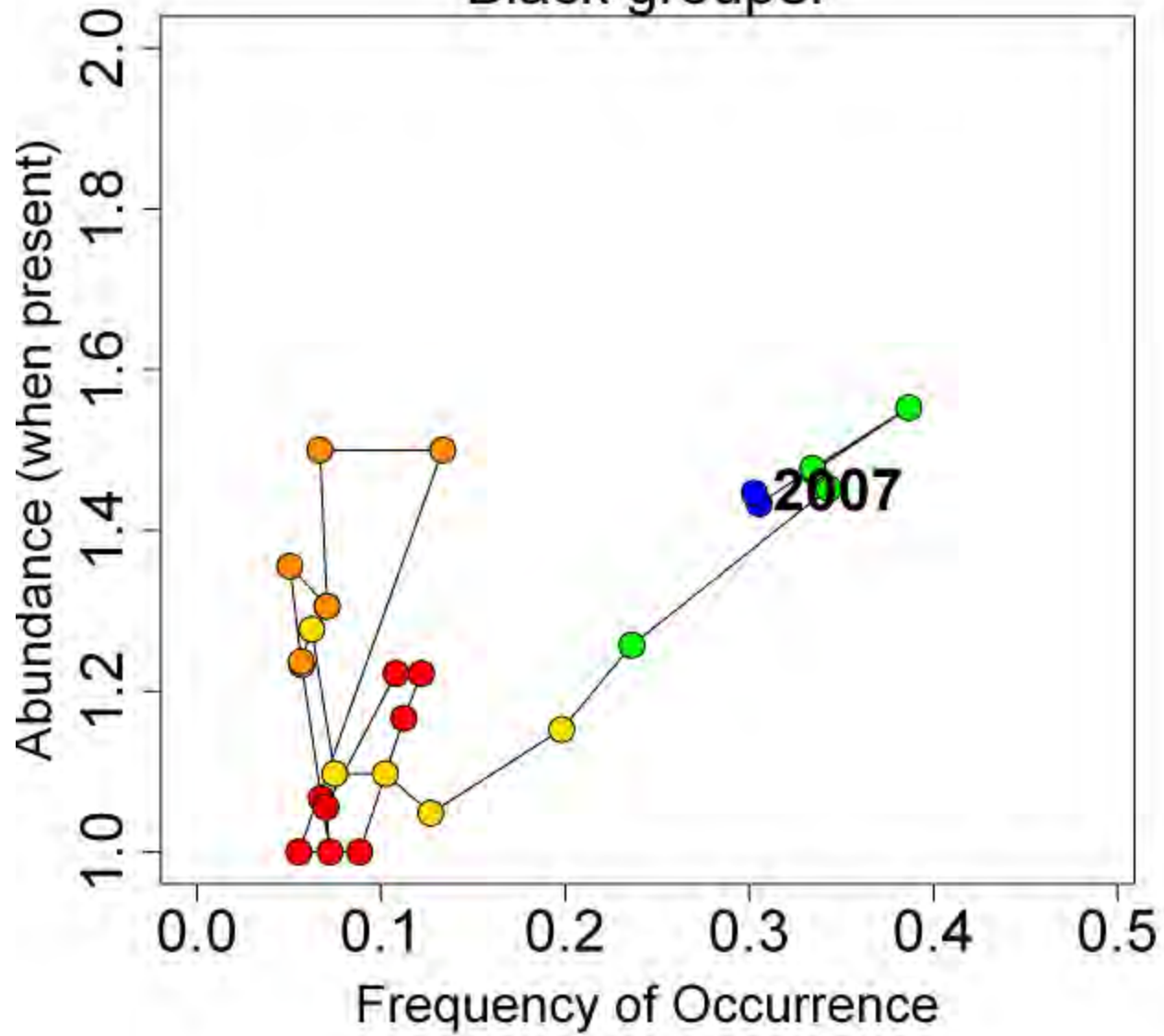


# Black grouper



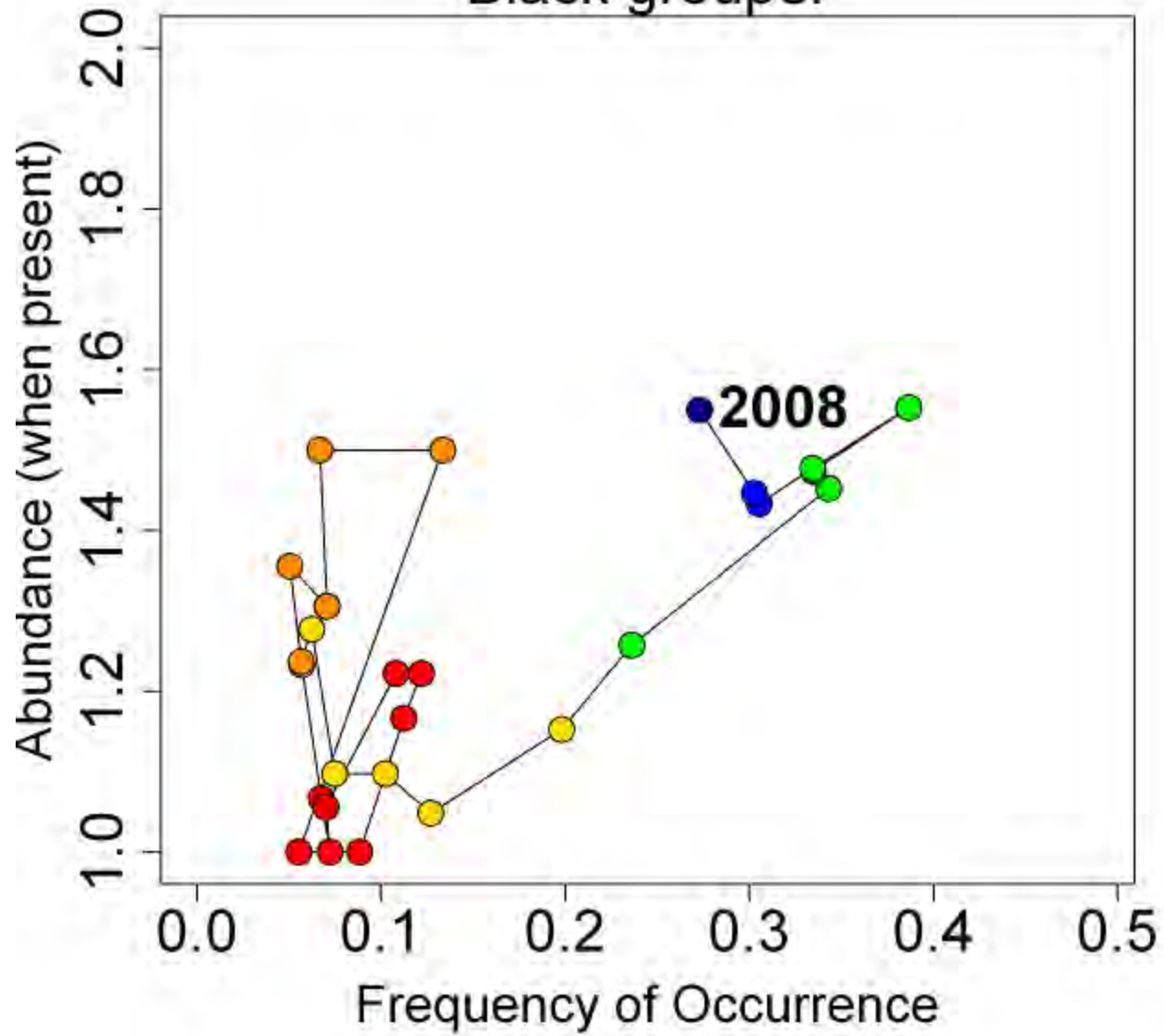


# Black grouper



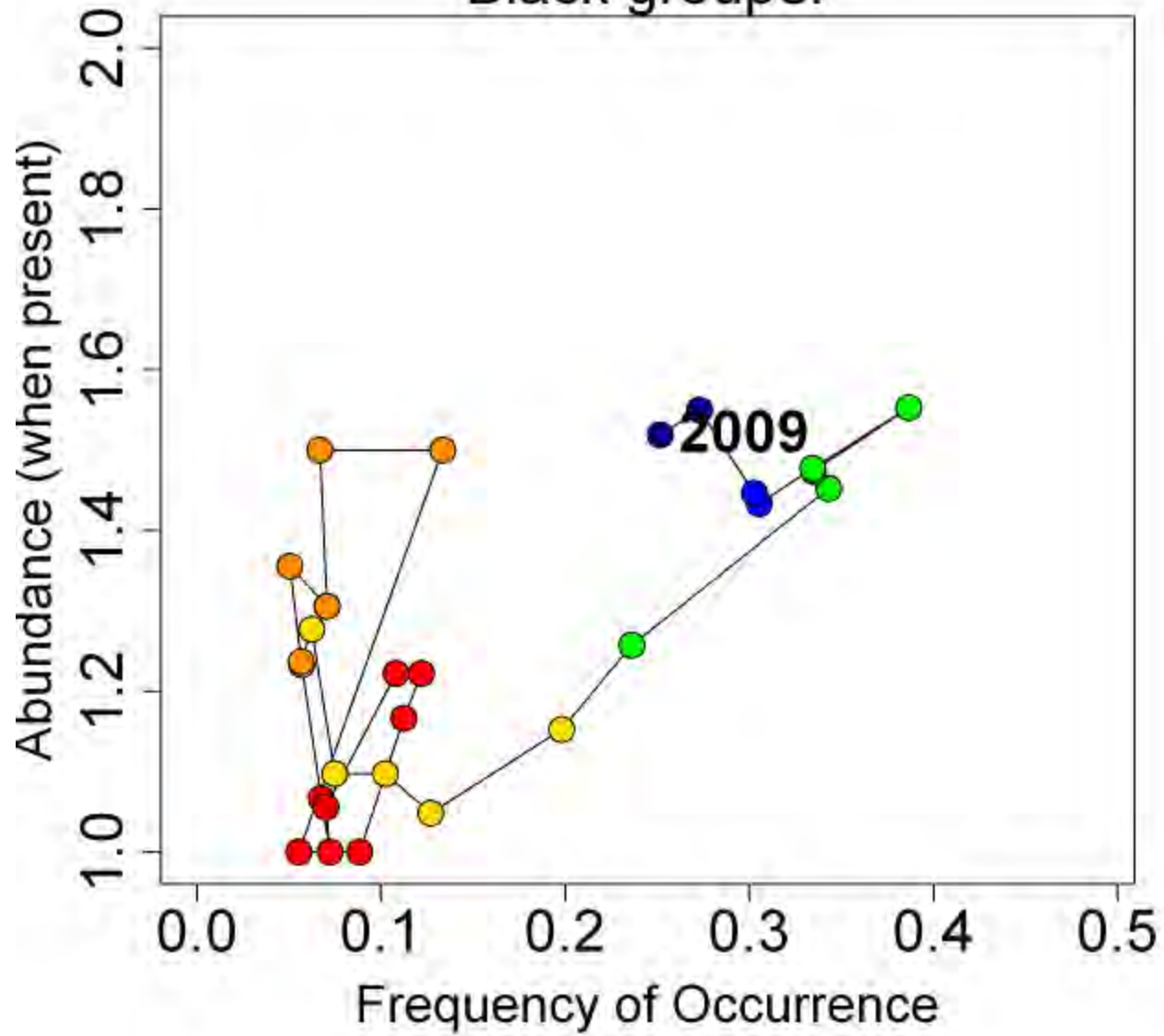


# Black grouper



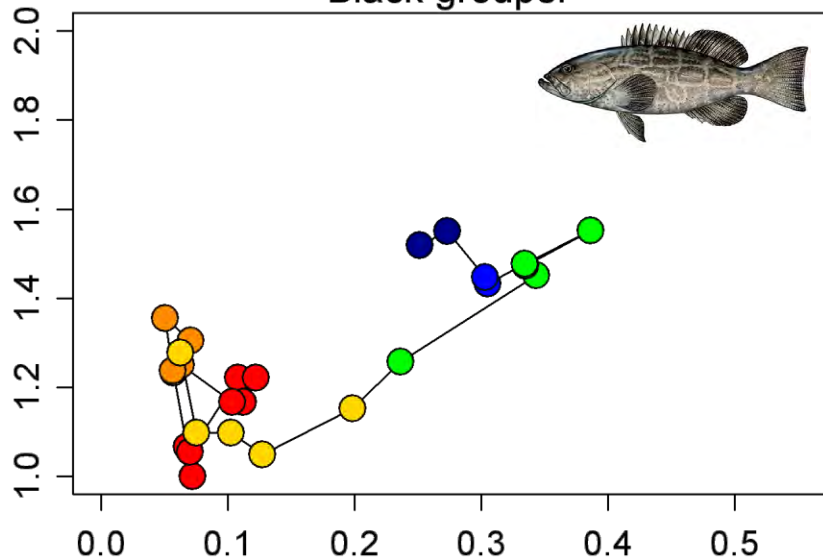


# Black grouper

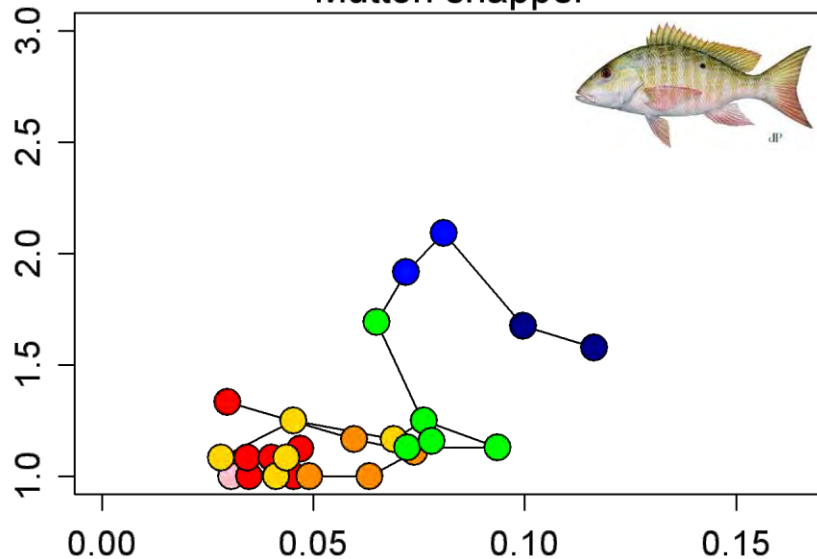


# Reserve Areas

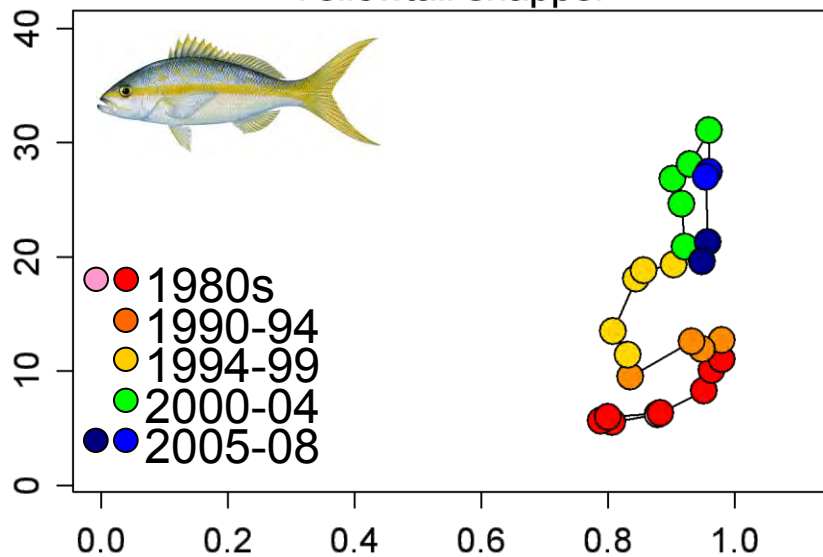
## Black grouper



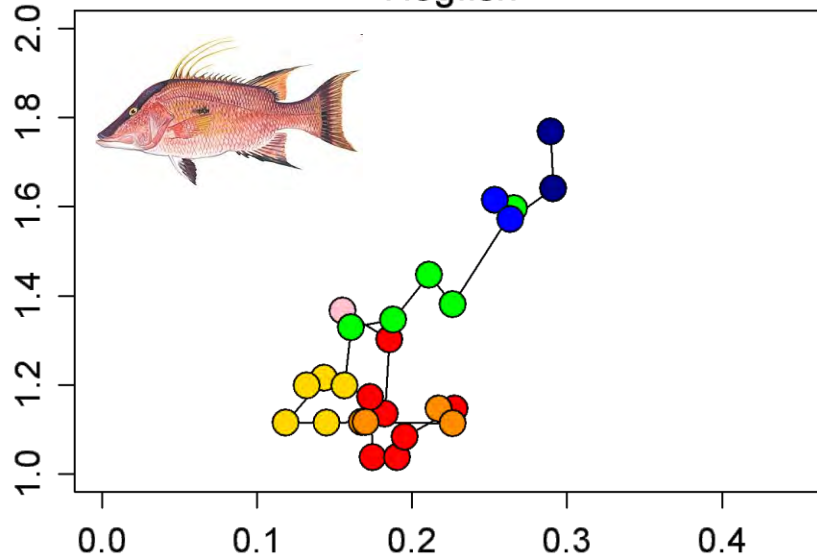
## Mutton snapper



## Yellowtail snapper



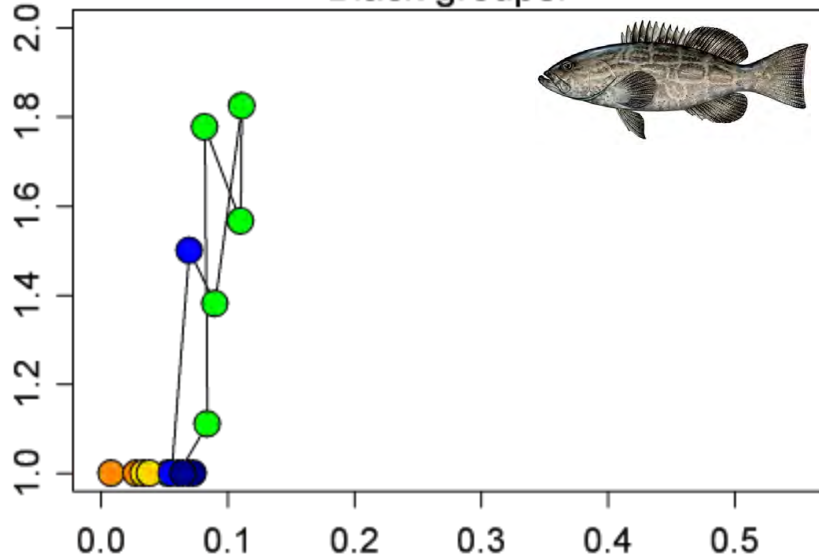
## Hogfish



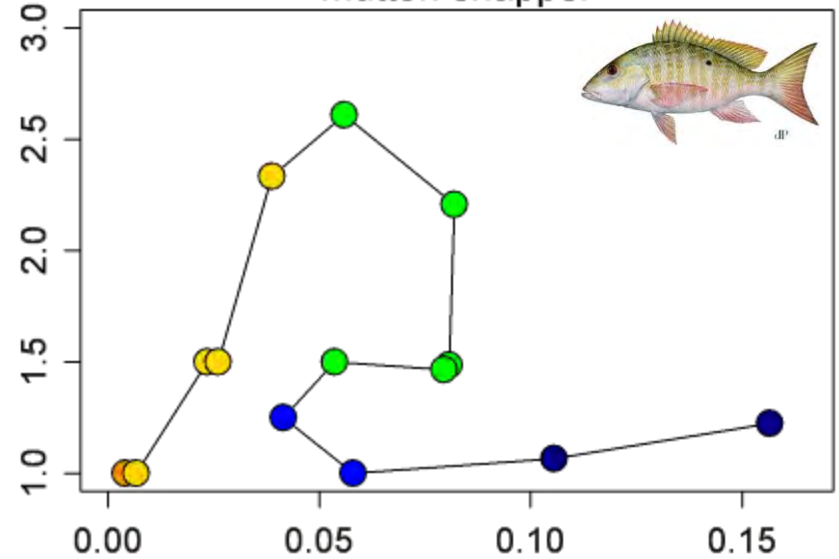
Frequency of Occurrence

# Non-reserve areas

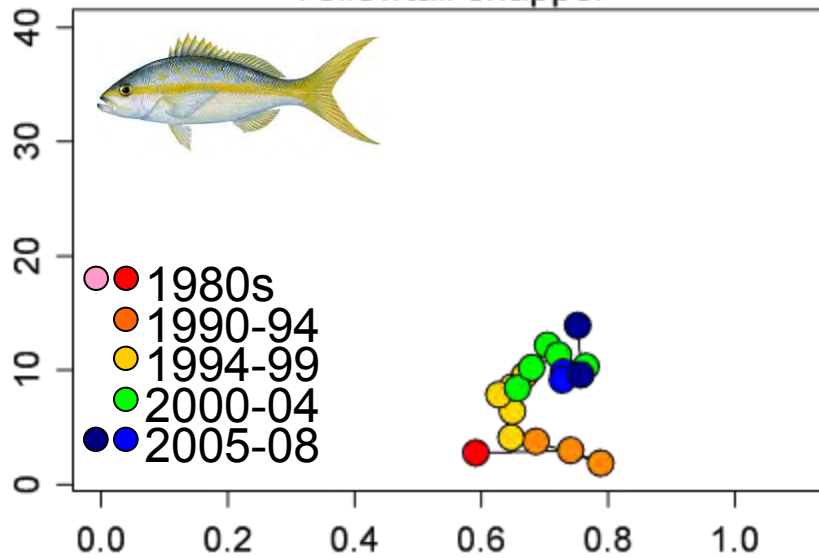
## Black grouper



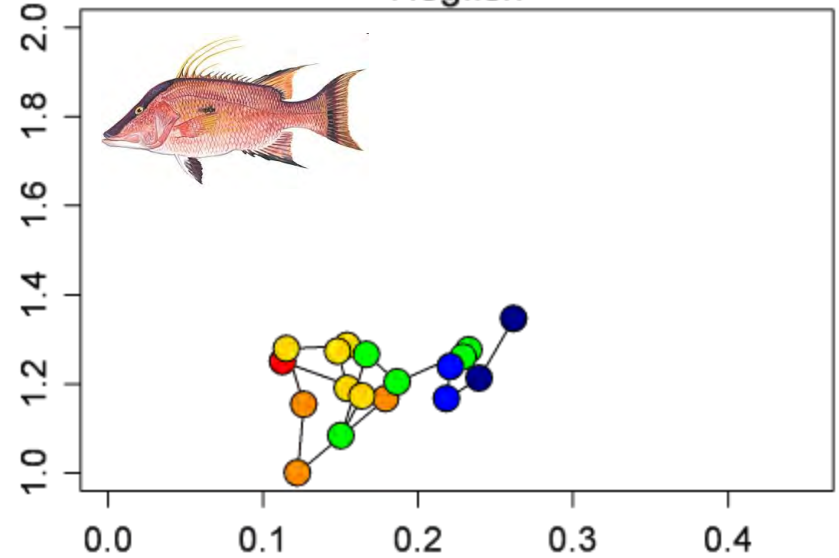
## Mutton snapper



## Yellowtail snapper



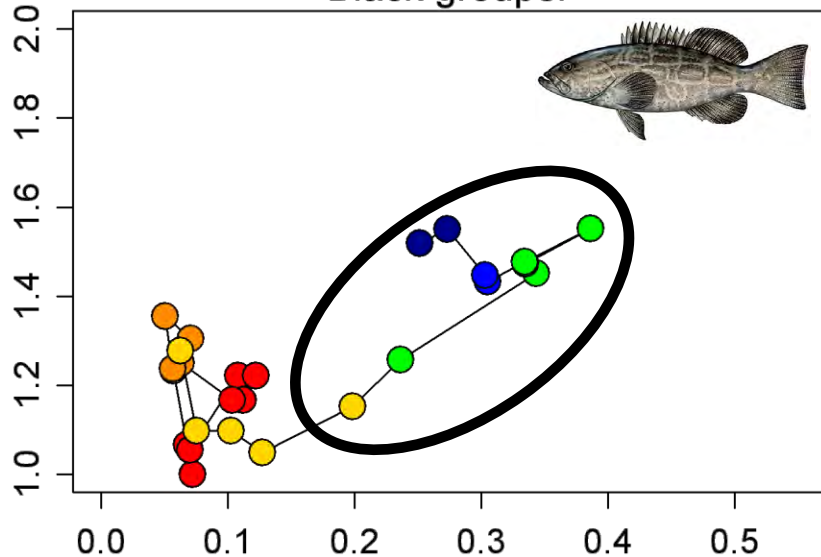
## Hogfish



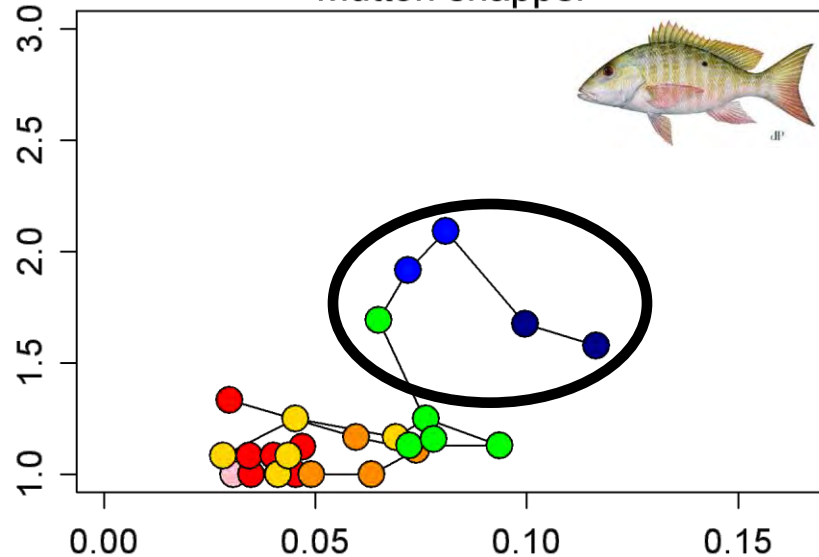
Frequency of Occurrence

# Reserve Areas

## Black grouper

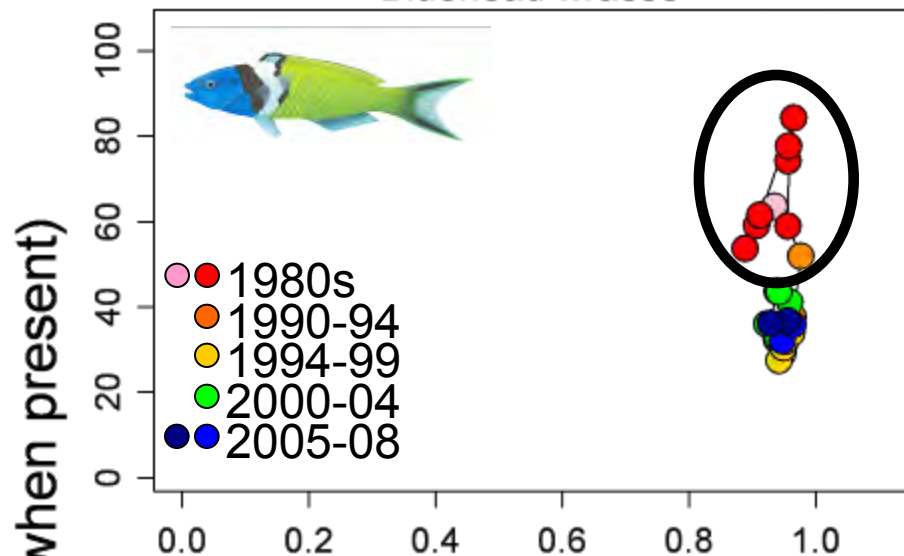


## Mutton snapper

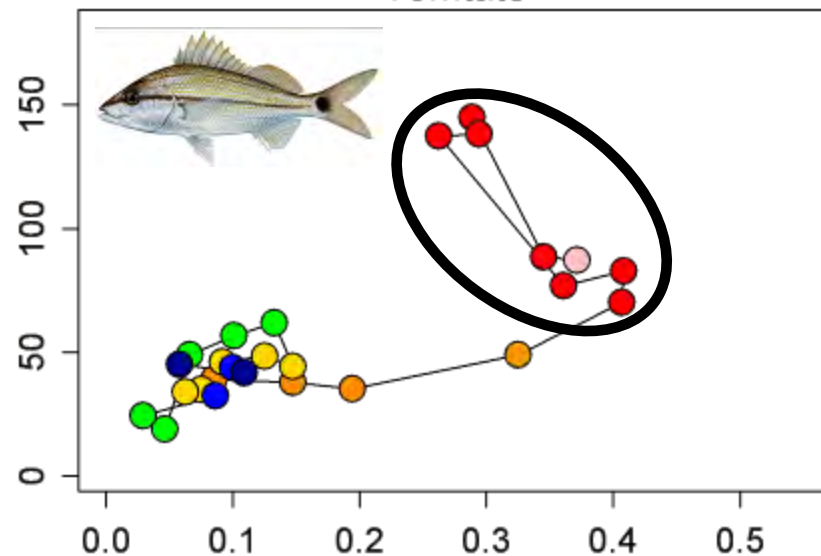


# Reserve Areas

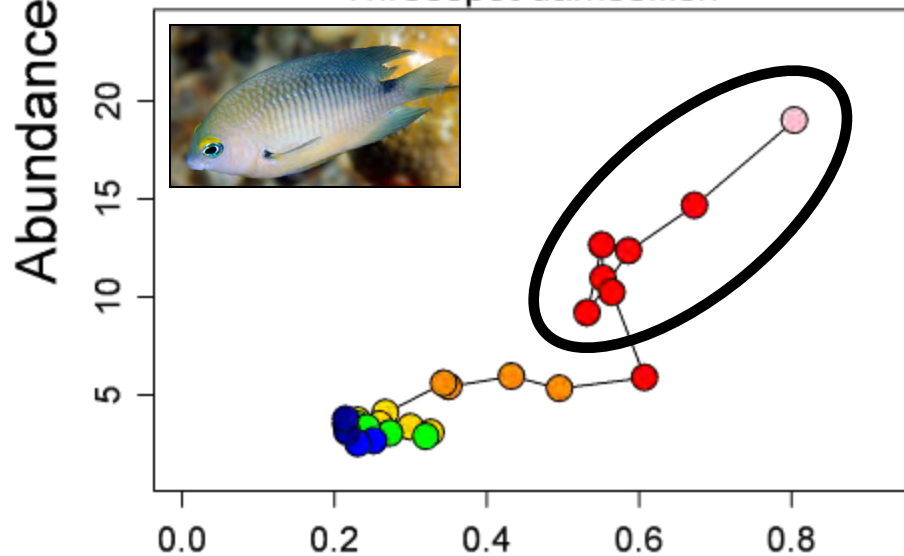
## Bluehead wrasse



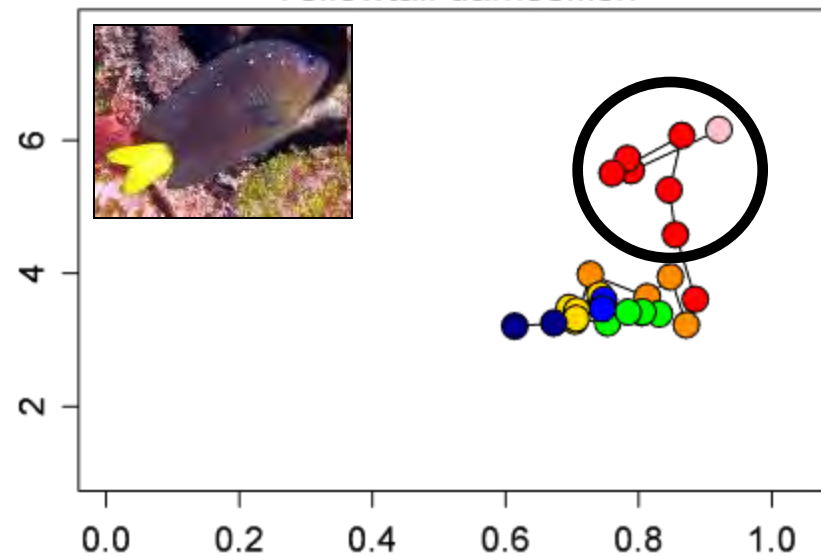
## Tomtate



## Threespot damselfish



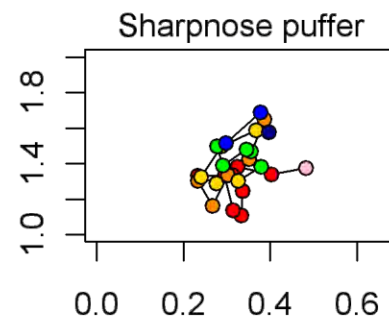
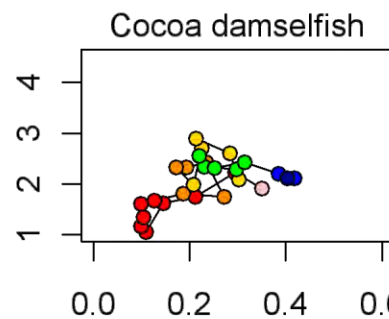
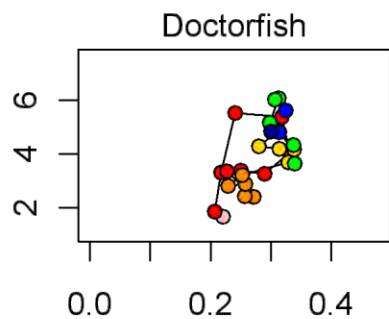
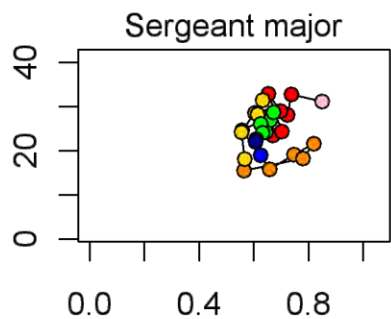
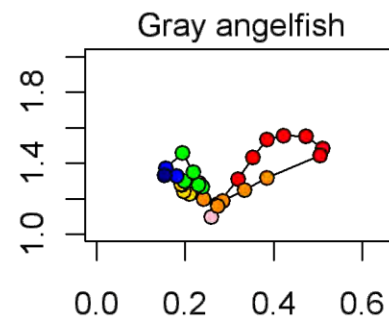
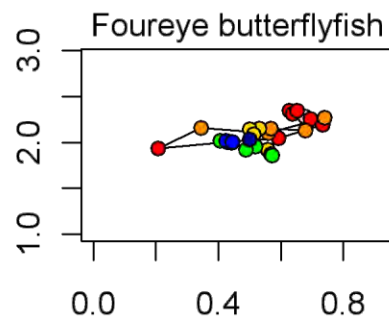
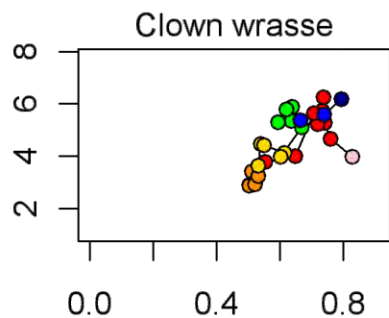
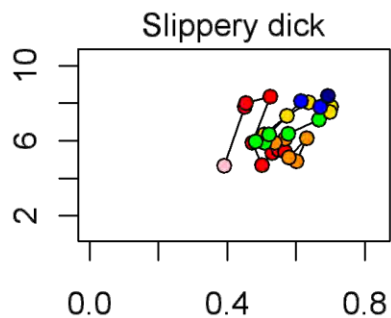
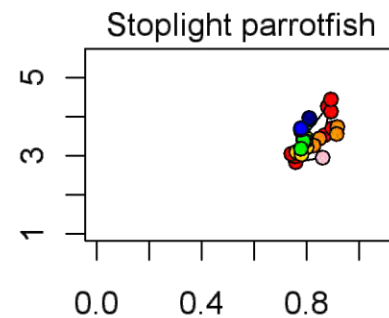
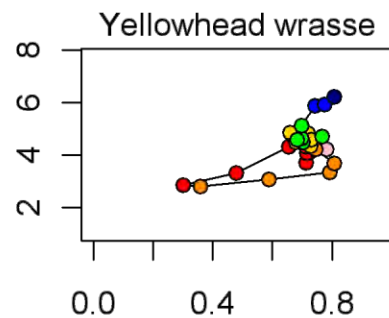
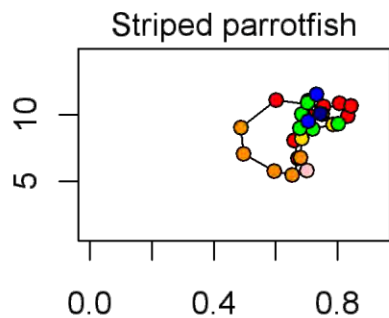
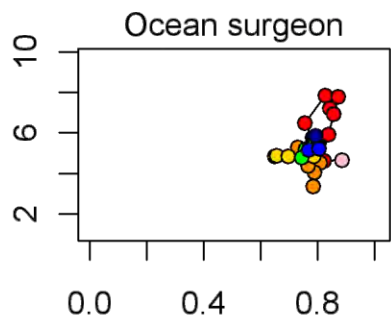
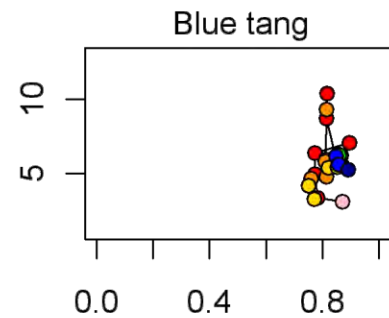
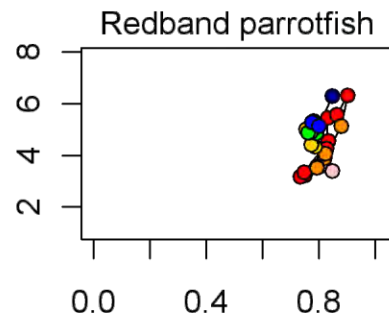
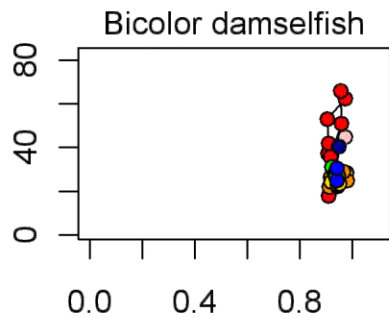
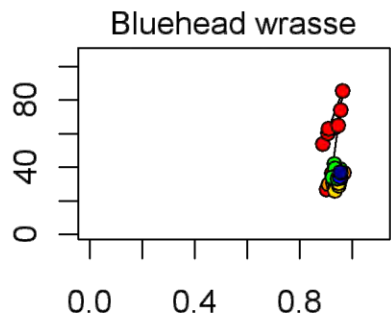
## Yellowtail damselfish



Frequency of Occurrence



Abundance (when present)

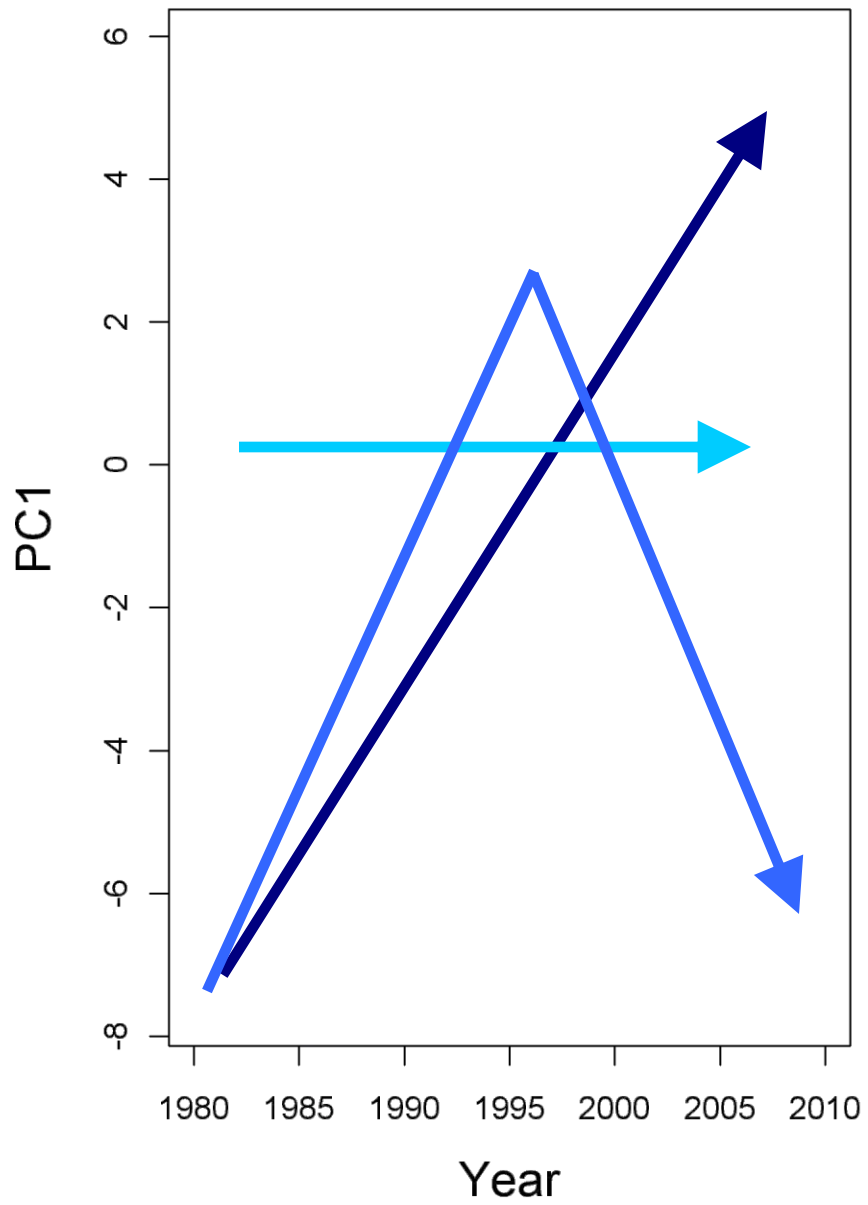


Frequency of Occurrence

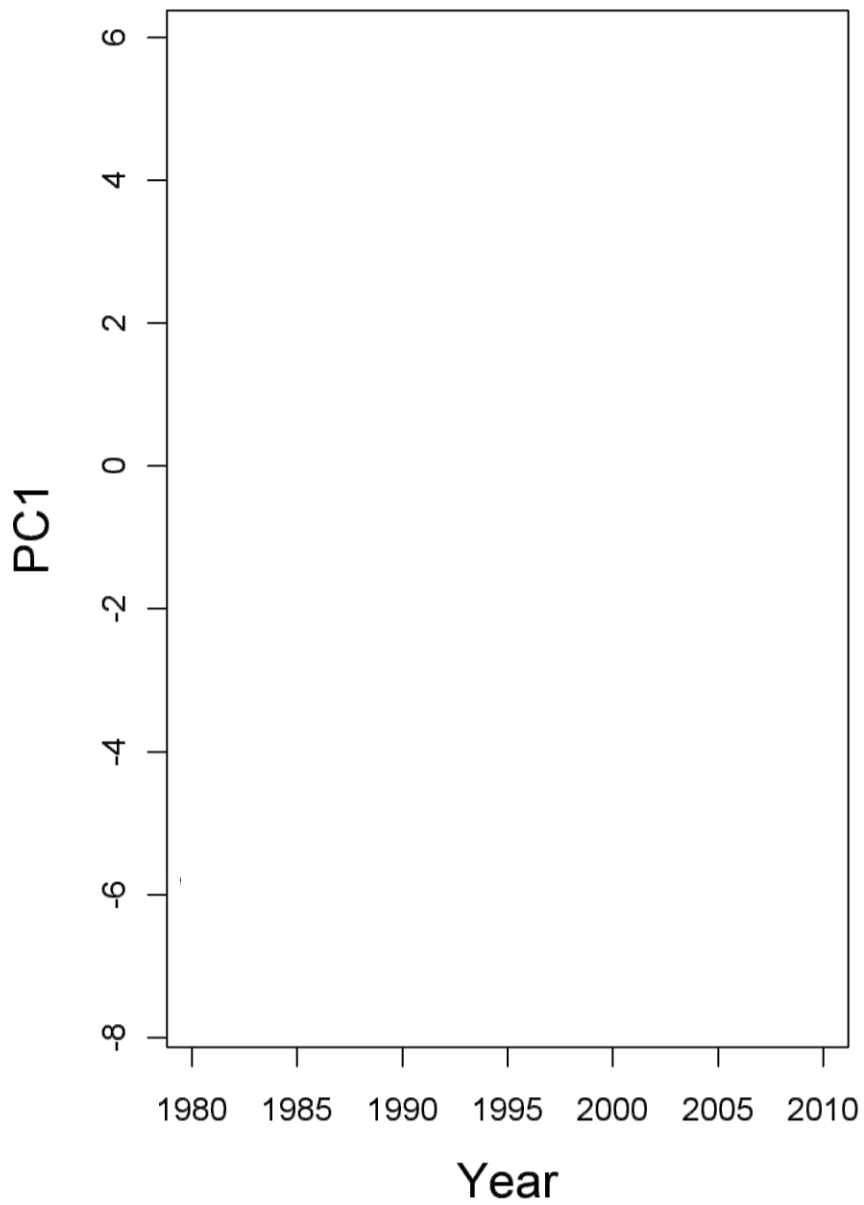
# Community analyses

- Analyze reserves and non-reserves separately
- Included only species  $>5\%$  frequency of occurrence (73 total)

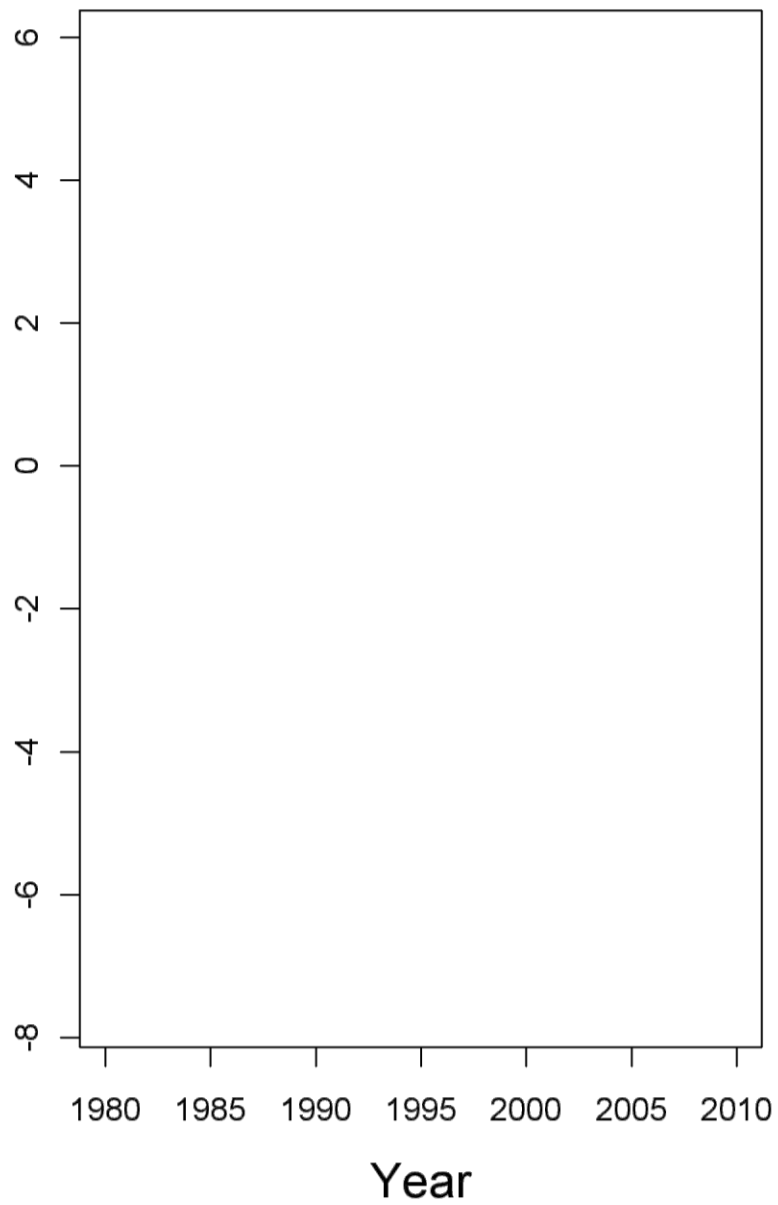




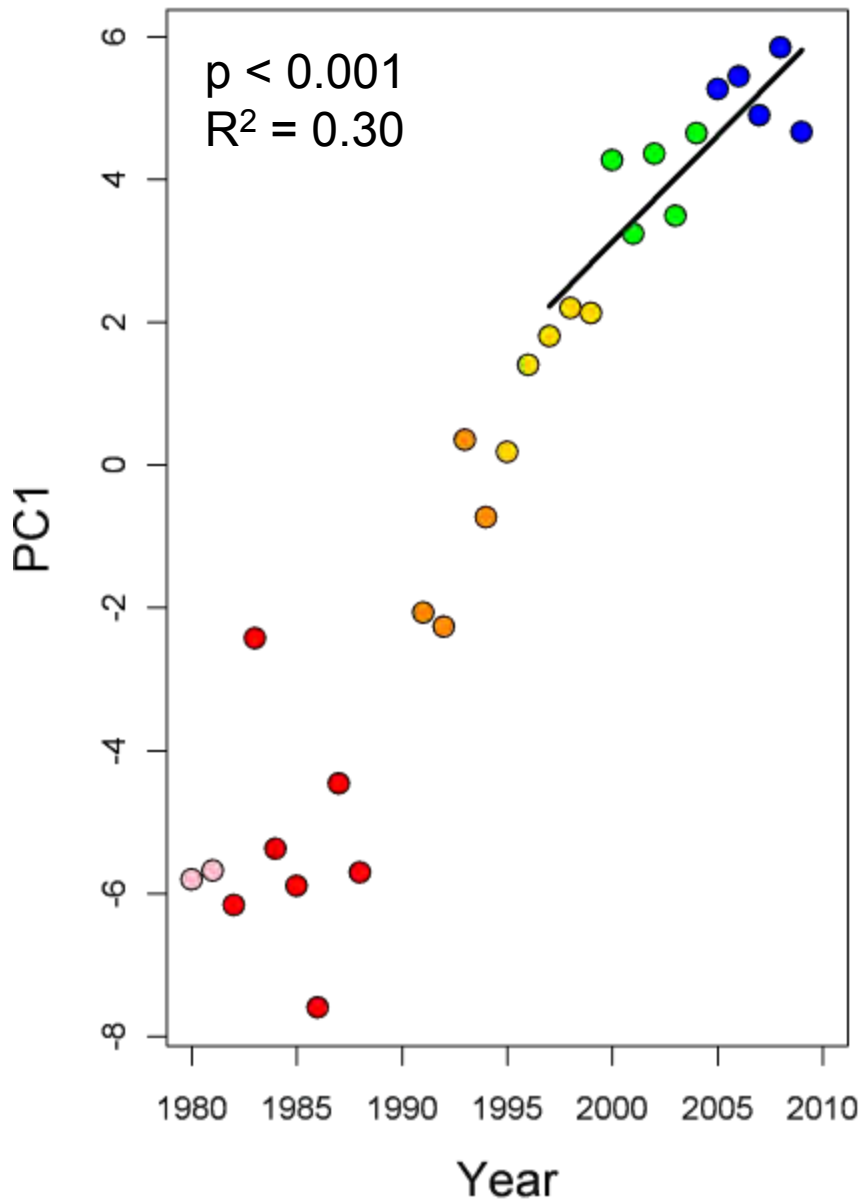
# Reserves



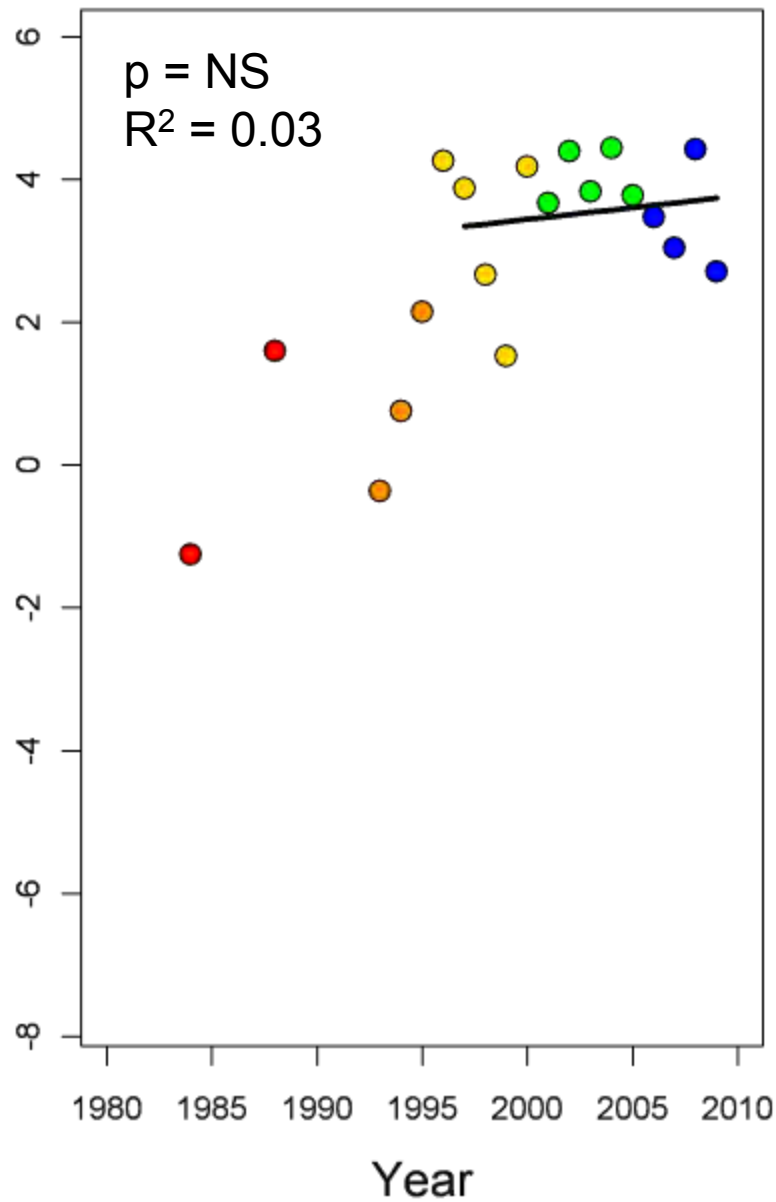
# Non-reserves



### Reserves



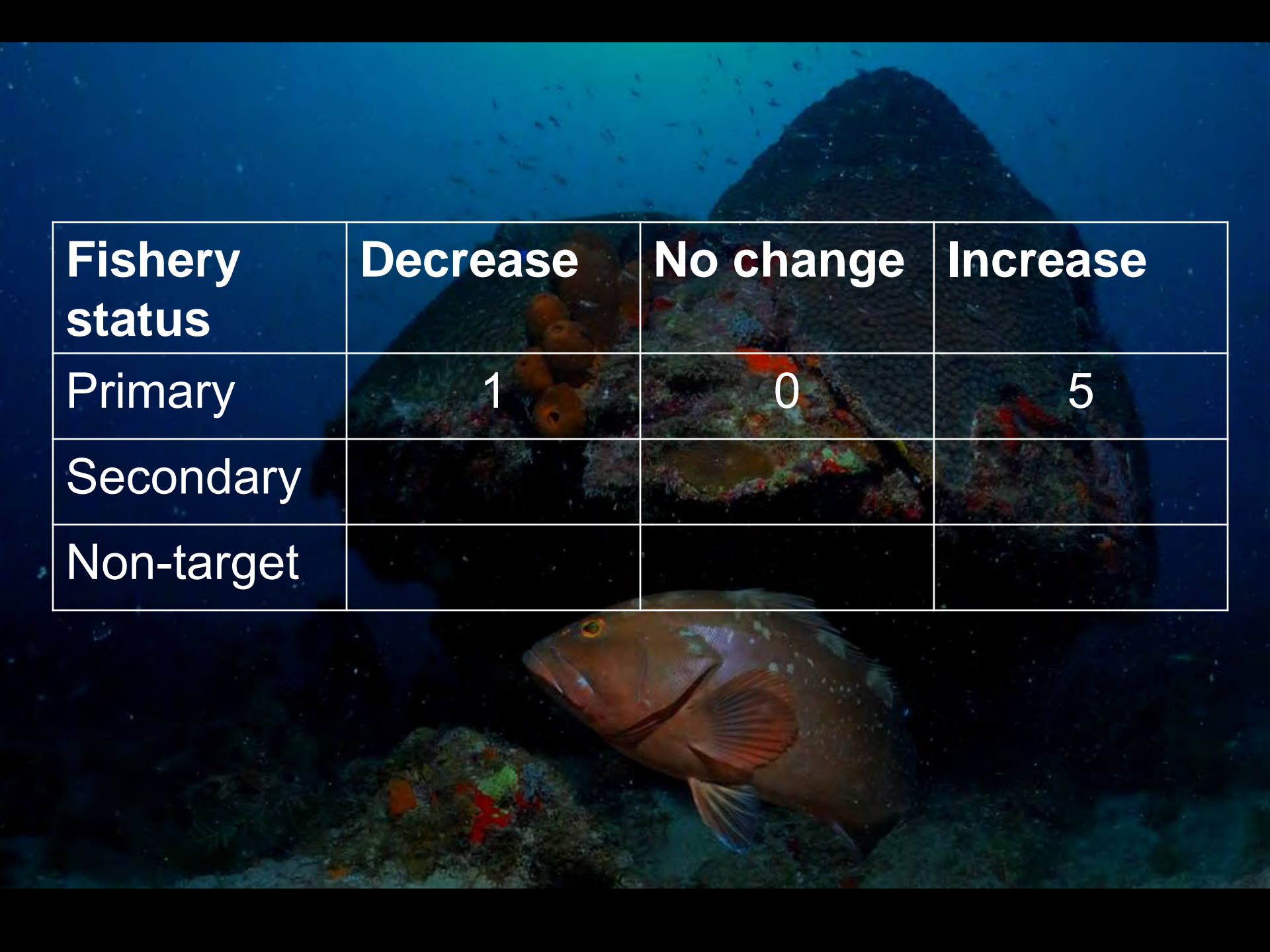
### Non-reserves





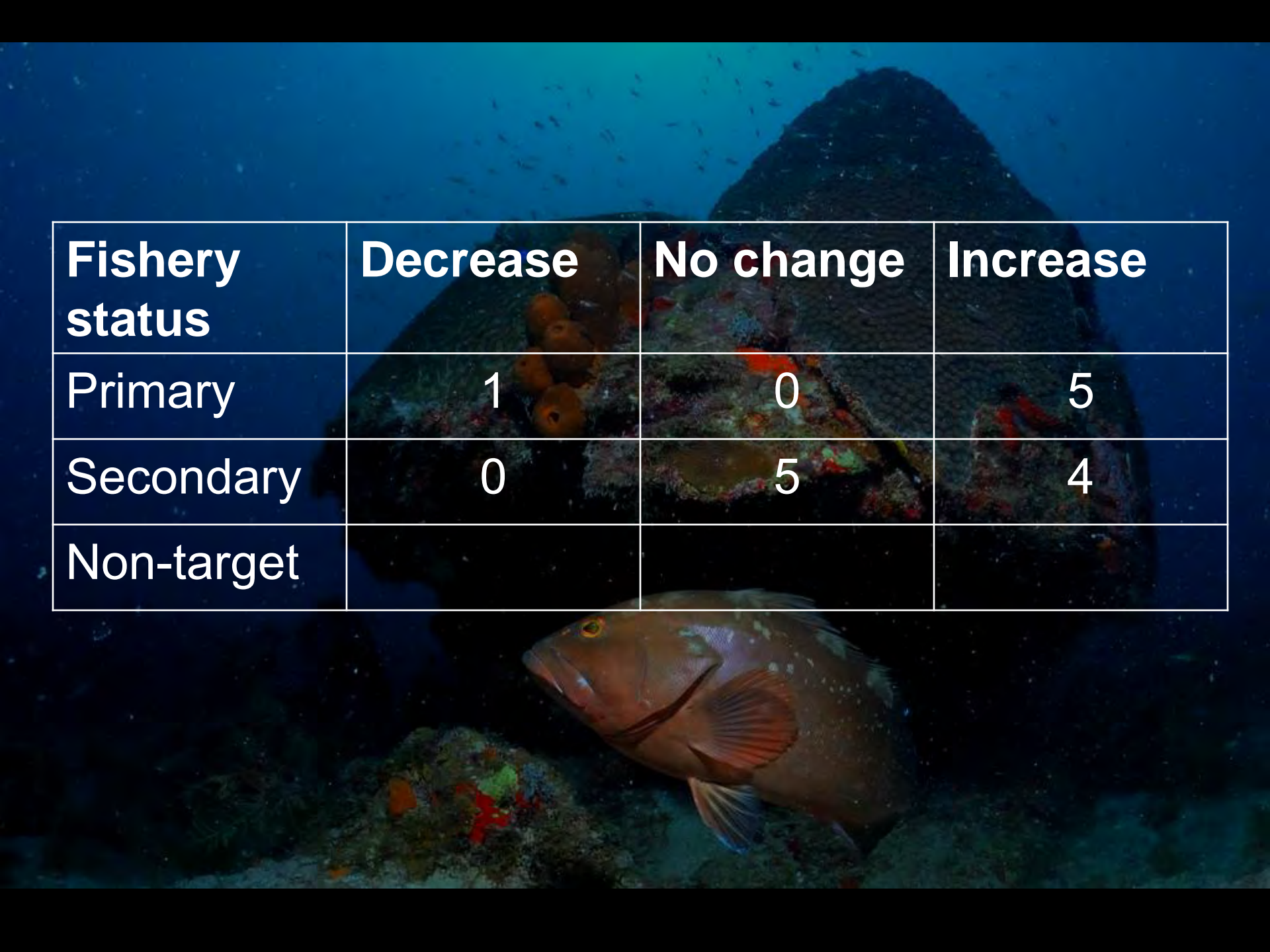
The background image shows an underwater environment with a large, dark rock formation in the center. The water is a deep blue-green color. In the foreground, a large, brownish fish with a yellow eye is swimming towards the left. The rock formation is covered in various marine life, including sponges and coral. The table is overlaid on the left side of the image.

<b>Fishery status</b>	<b>Decrease</b>	<b>No change</b>	<b>Increase</b>
<b>Primary</b>			
<b>Secondary</b>			
<b>Non-target</b>			



The background of the slide is an underwater photograph. In the foreground, a large, brownish fish with a yellow eye is swimming towards the left. Behind it, a large, dark rock formation rises from the seabed, covered in colorful coral and sponges. The water is a deep blue, and many small fish are visible in the distance.

<b>Fishery status</b>	<b>Decrease</b>	<b>No change</b>	<b>Increase</b>
<b>Primary</b>	1	0	5
<b>Secondary</b>			
<b>Non-target</b>			



The background of the slide is an underwater photograph. It features a large, dark, conical rock formation in the center, covered in various colorful corals and sponges. In the foreground, a large, brownish fish with a yellow eye is swimming towards the left. The water is a deep blue, and many small fish are visible in the distance.

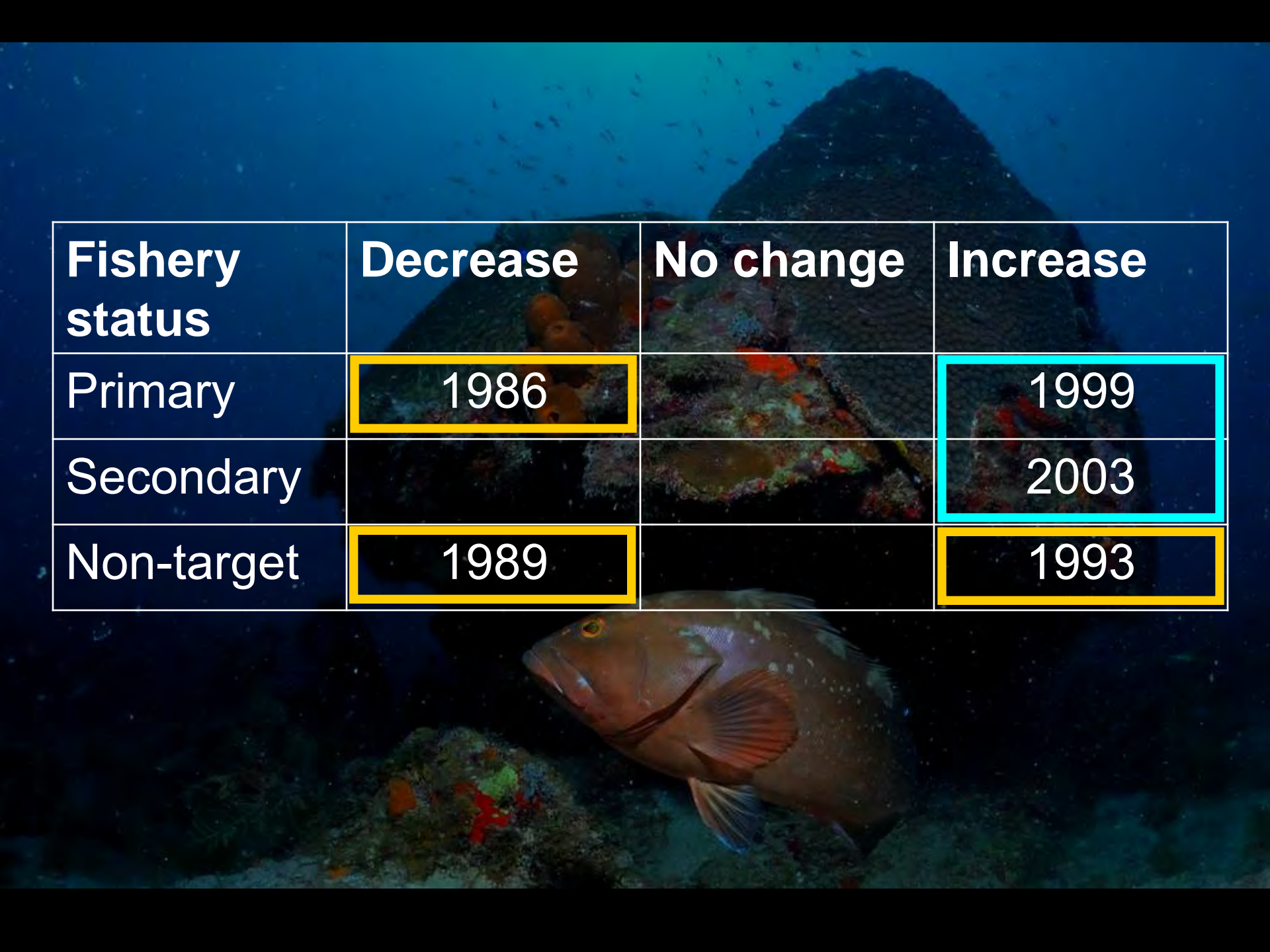
<b>Fishery status</b>	<b>Decrease</b>	<b>No change</b>	<b>Increase</b>
Primary	1	0	5
Secondary	0	5	4
Non-target			





The background of the slide is an underwater photograph. It shows a large, dark, conical rock formation in the center, covered in various marine life like sponges and coral. In the foreground, a large, brownish fish with a yellow eye is swimming towards the left. The water is a deep blue color.

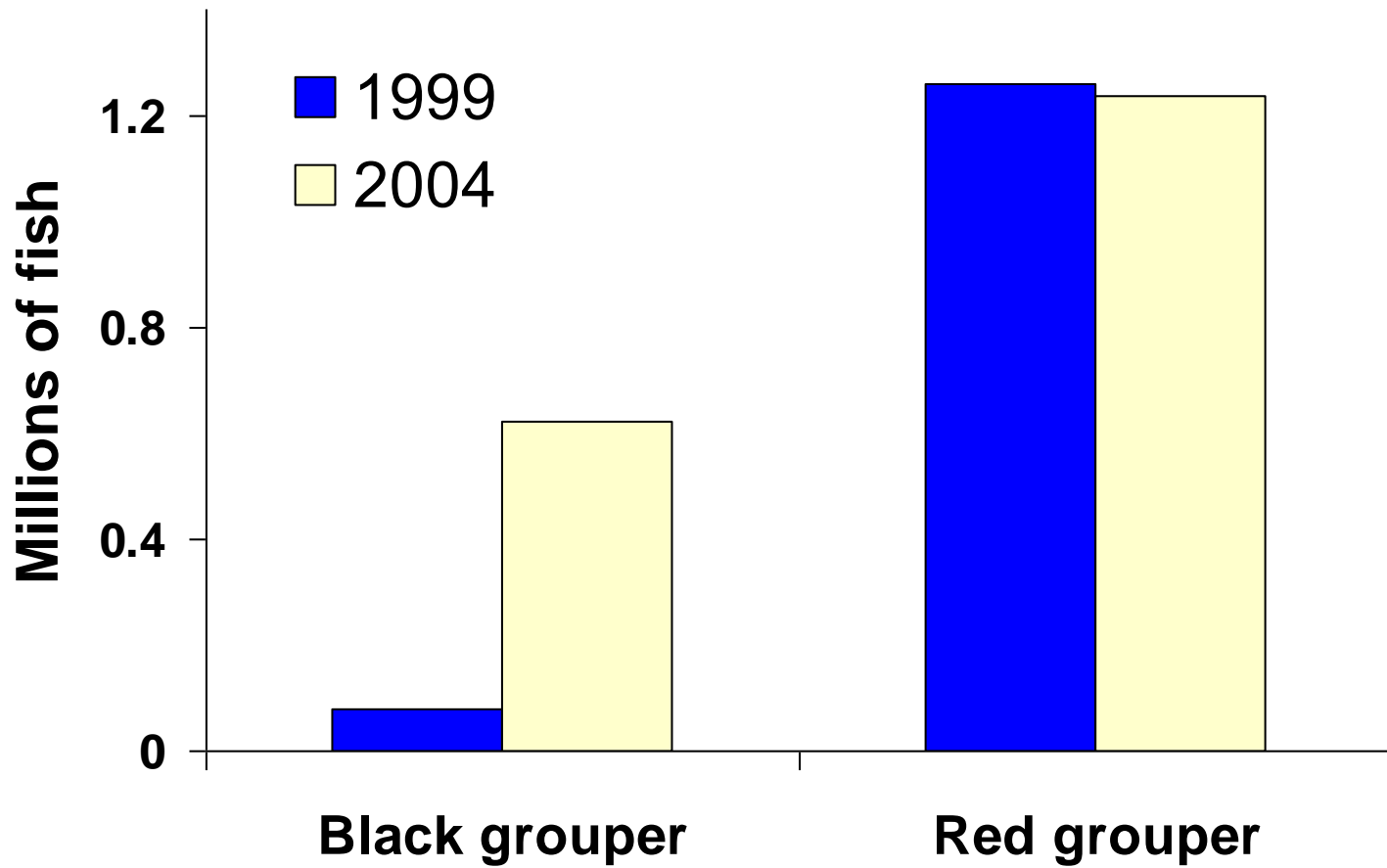
<b>Fishery status</b>	<b>Decrease</b>	<b>No change</b>	<b>Increase</b>
Primary	1	0	5
Secondary	0	5	4
Non-target	26	12	20



<b>Fishery status</b>	<b>Decrease</b>	<b>No change</b>	<b>Increase</b>
Primary	1986		1999
Secondary			2003
Non-target	1989		1993

# What else do we know?

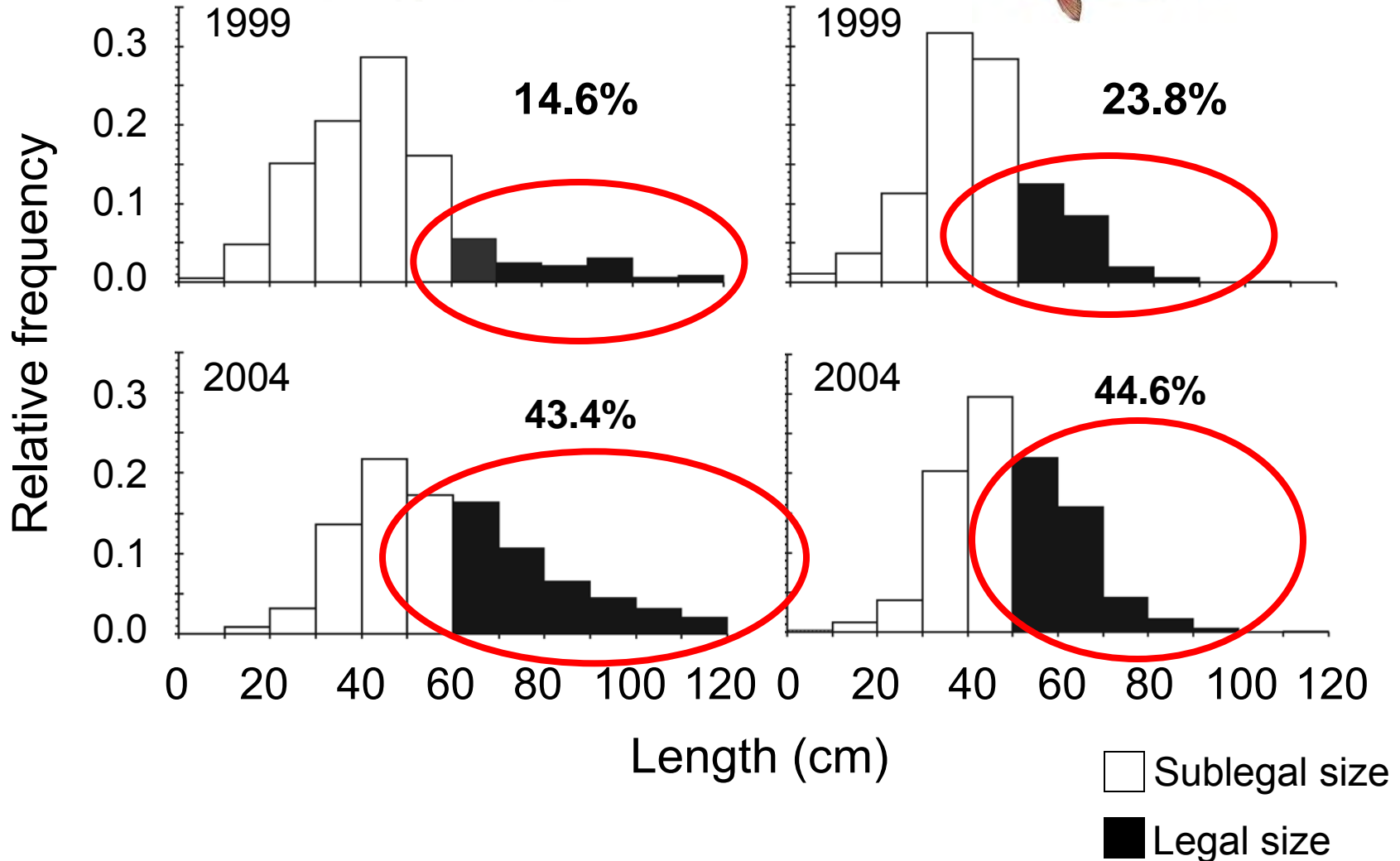
- Some places faring better than others  
e.g. Dry Tortugas



### Black grouper



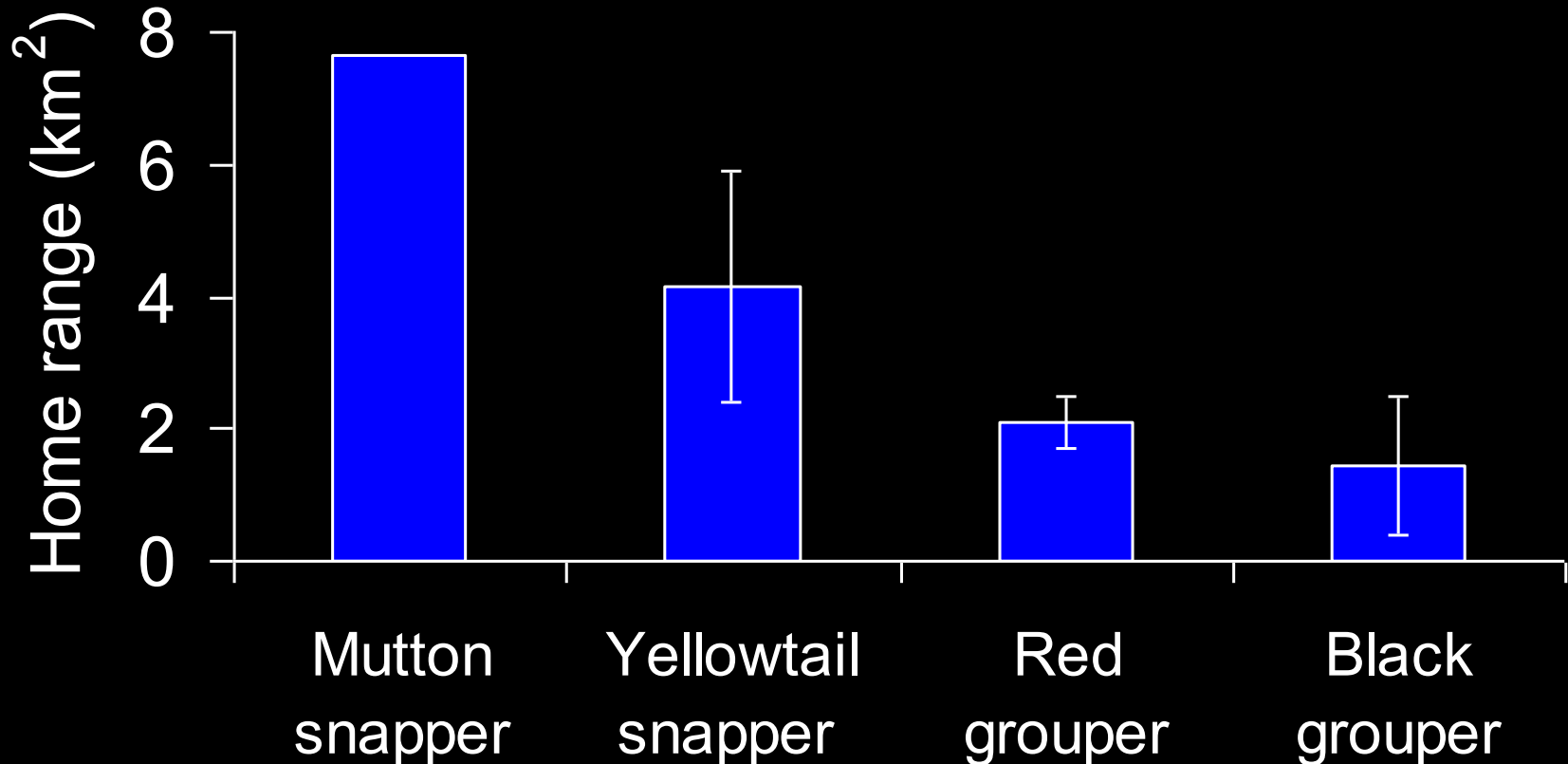
### Red grouper



# What else do we know?

- Some places faring better than others  
e.g. Dry Tortugas
- Movement and home ranges differ by species

# Acoustic fish tracking in the Dry Tortugas

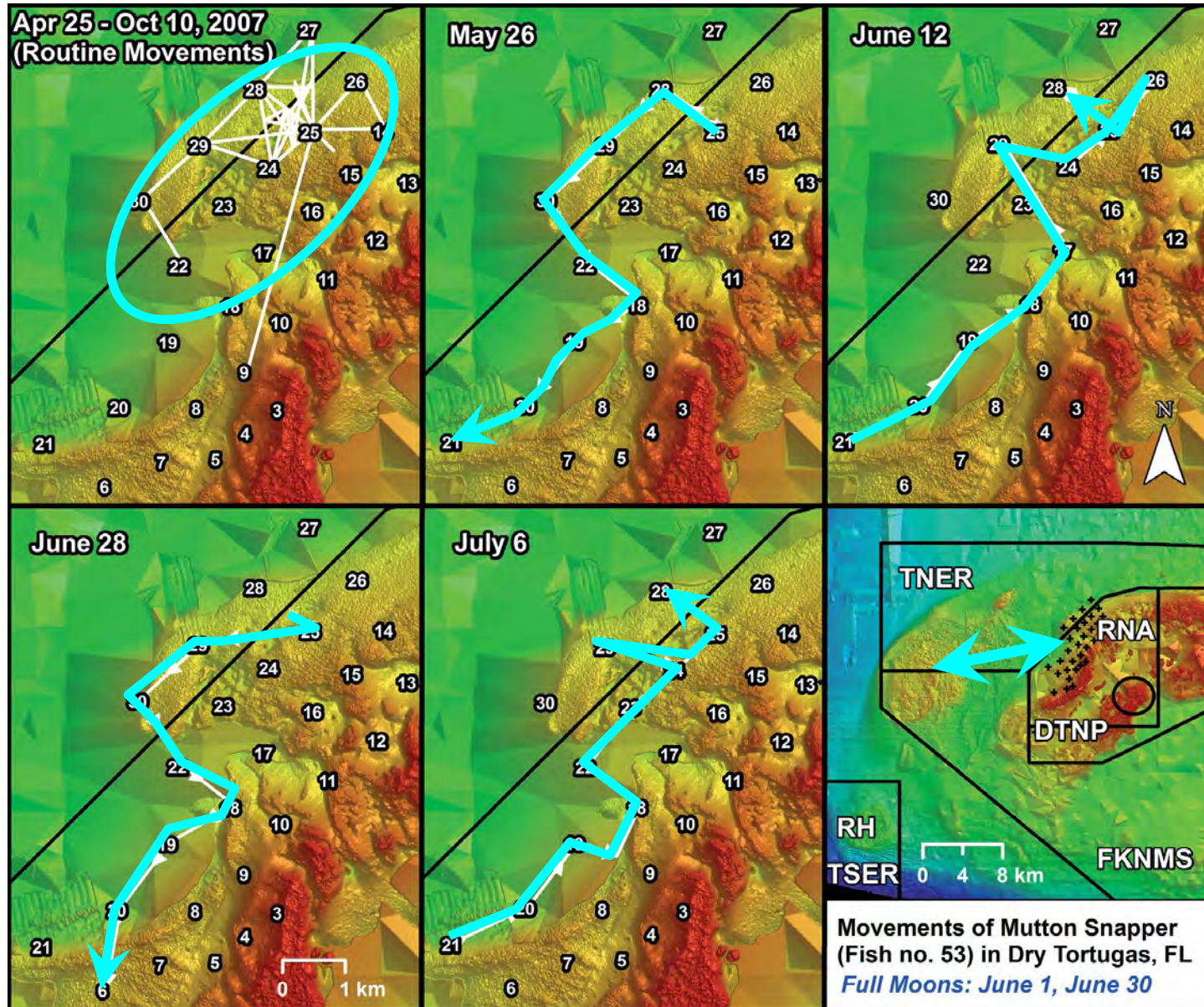


# What else do we know?

- Some places faring better than others  
e.g. Dry Tortugas
- Movement and home ranges differ by species
- Many species use multiple habitats and move miles (Farmer and Ault 2011)



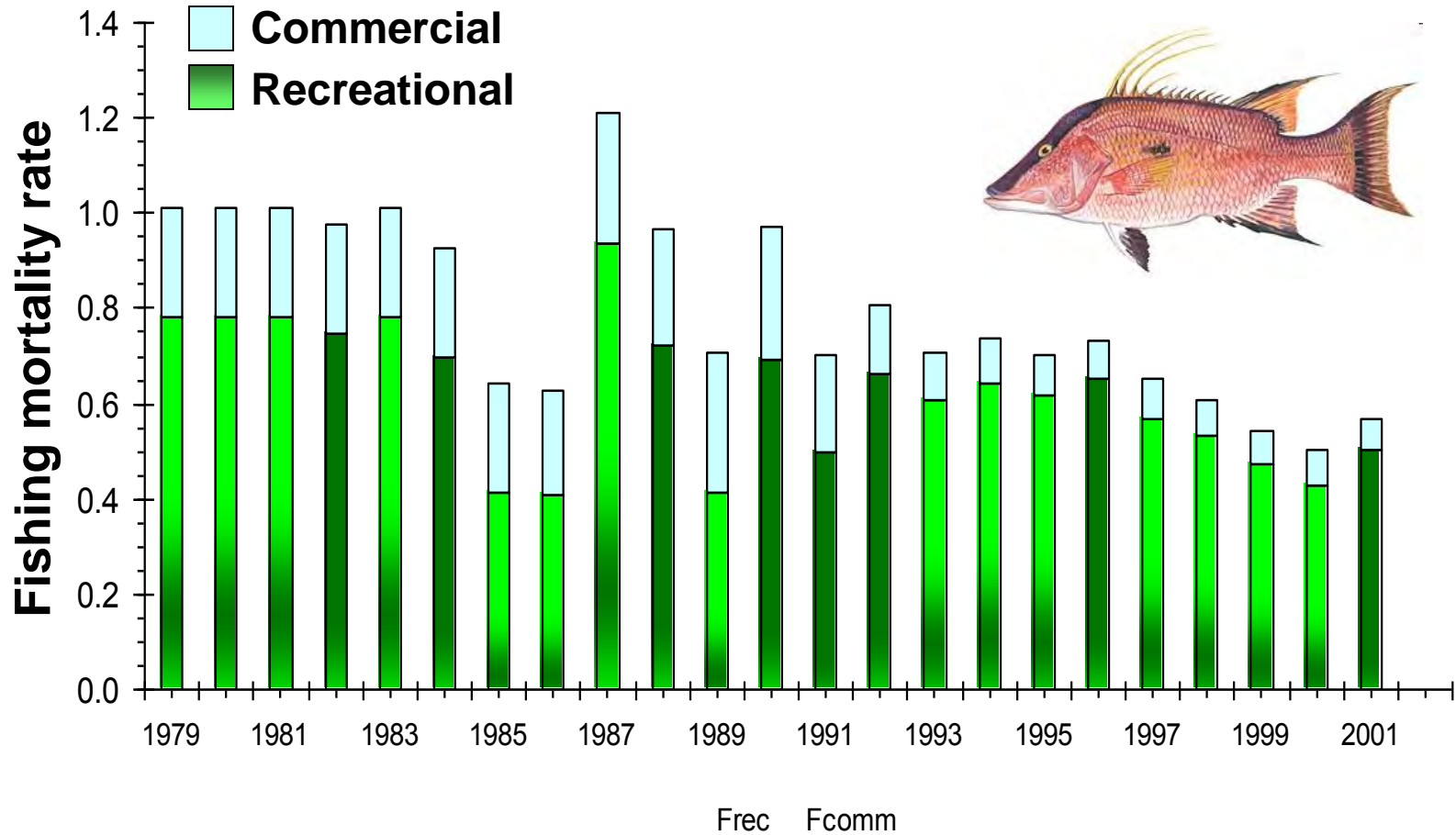
# Acoustic fish tracking in the Dry Tortugas



# What else do we know?

- Some places faring better than others  
e.g. Dry Tortugas
- Movement and home ranges differ by species
- Many species use multiple habitats and move miles (Farmer and Ault 2011)
- Most fishing pressure in the Keys is recreational: e.g. 85% of hogfish take is recreational

# Fishing pressure on hogfish



# Ok, so what are some of the management options?

- Recreational fishing makes market-based incentives difficult to implement
- Increase size limits?
- Increase fishing license fee?
- Seasonal closures (e.g. spawning)?
- Spatial closures/zoning changes (e.g. more home ranges and habitats)?

# Summary

- Broad view of 30 years of trends
- Consistent change in reef fish community over 30 years
- Changes driven by loss of coral and small reserve effects
- Some good news, still a long way to go for fish
- (But mostly bad news for coral)

# Acknowledgements

- Partner agencies and institutions
- The 160+ divers who participated in fieldwork over 30+ years
- Crew of the M/V Spree
- Staff at NOAA, RSMAS, FWC and NPS for discussions, advice, suggestions, and input

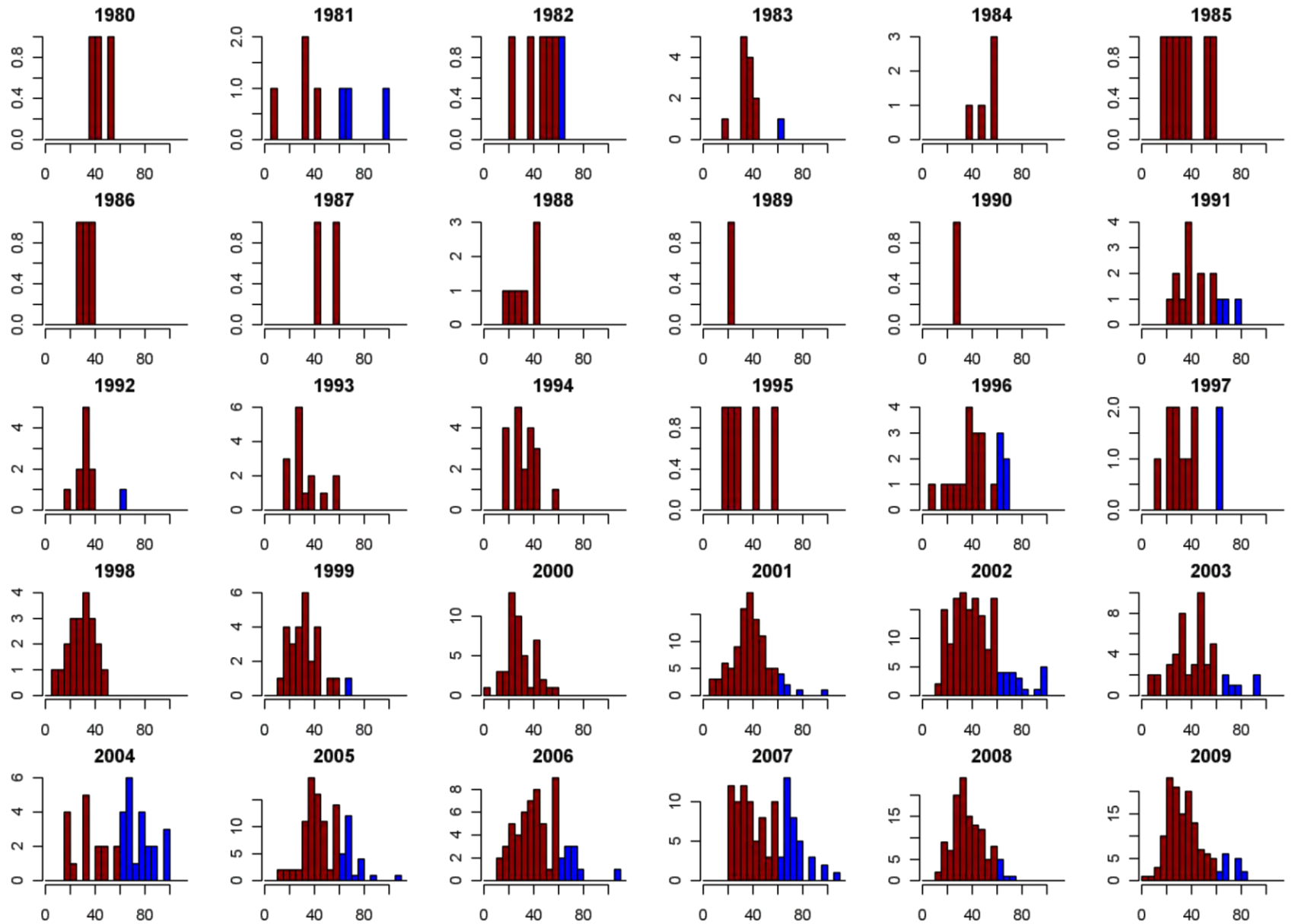




- Sub-legal sized
- Legal sized

# Black grouper, non-reserves

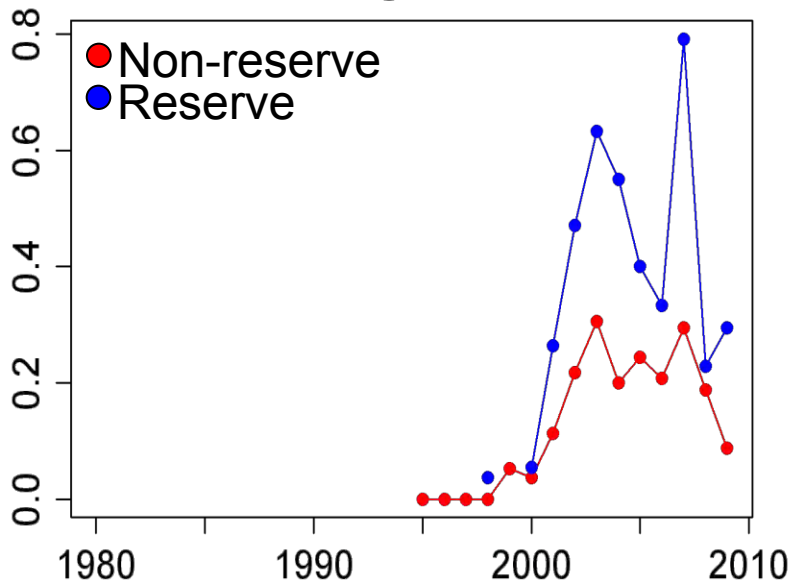
Frequency



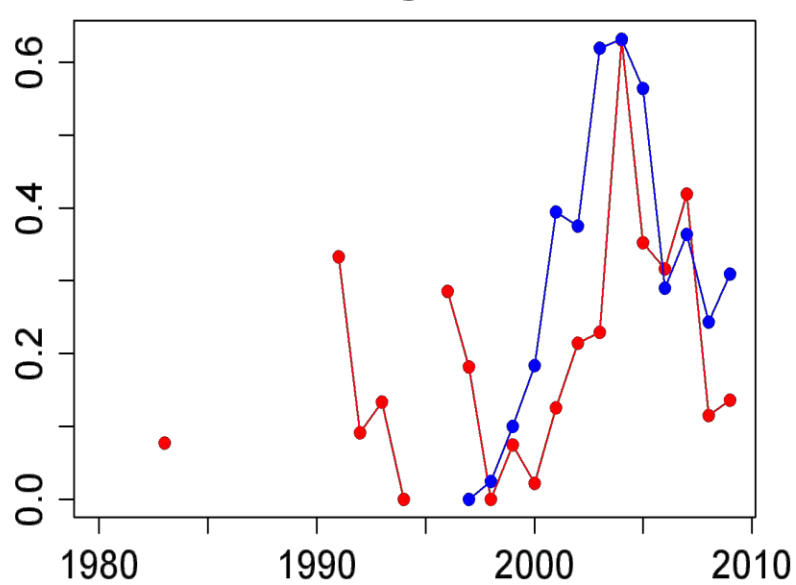


**Proportion legal sized**

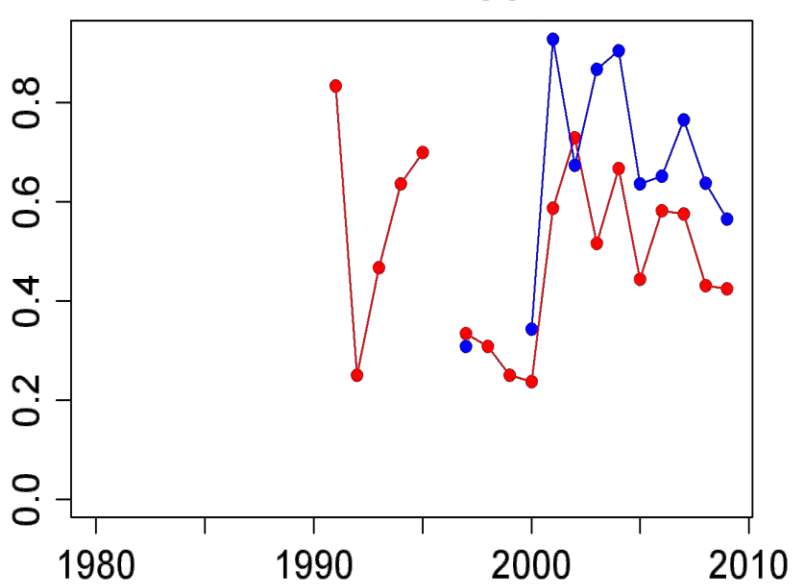
**Red grouper**



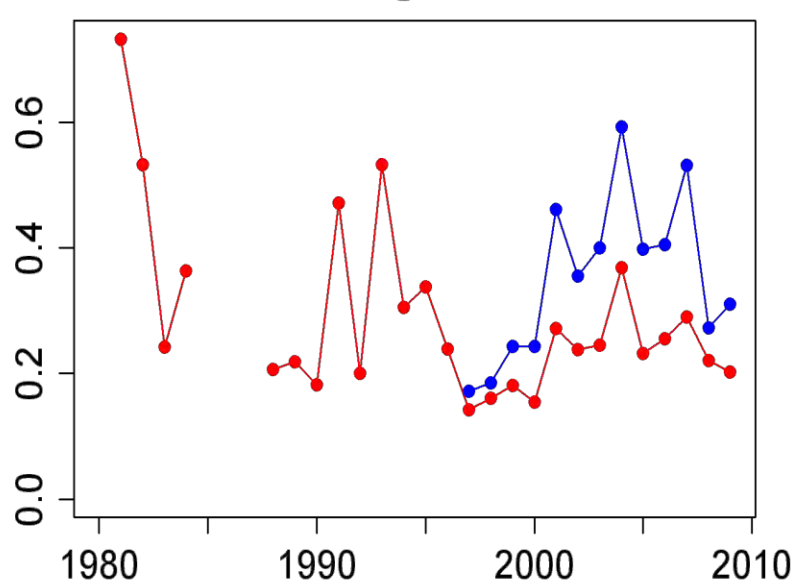
**Black grouper**



**Mutton snapper**



**Hogfish**



# Hogfish reproduction in the FL Keys



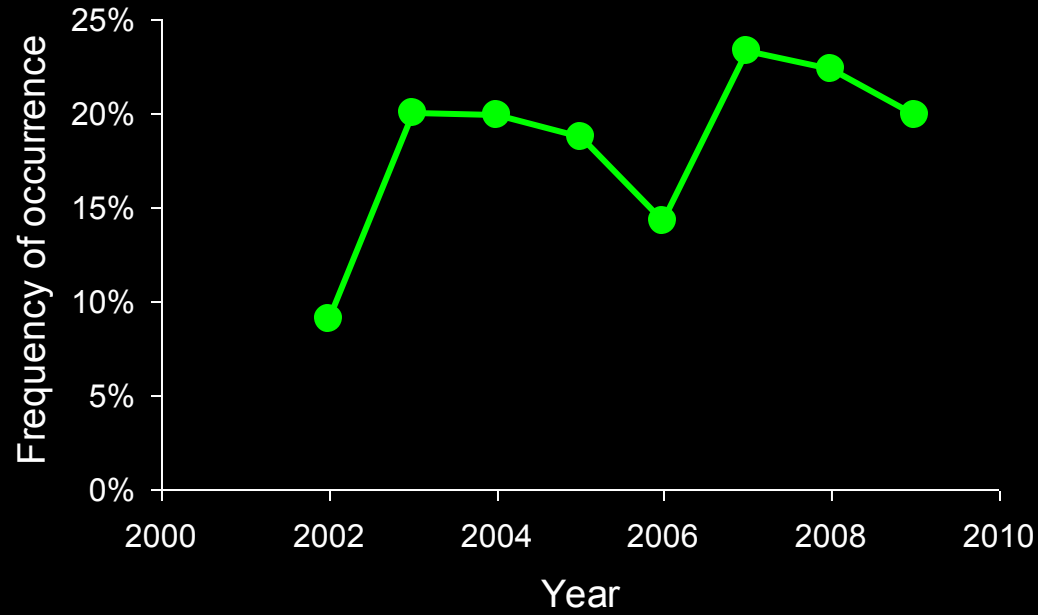
	Marine Reserve	Fished Area
Survey effort	7 hrs	19 hrs
Area surveyed	2.5 ha	9.6 ha
Number of spawns	55	0

# Marine debris

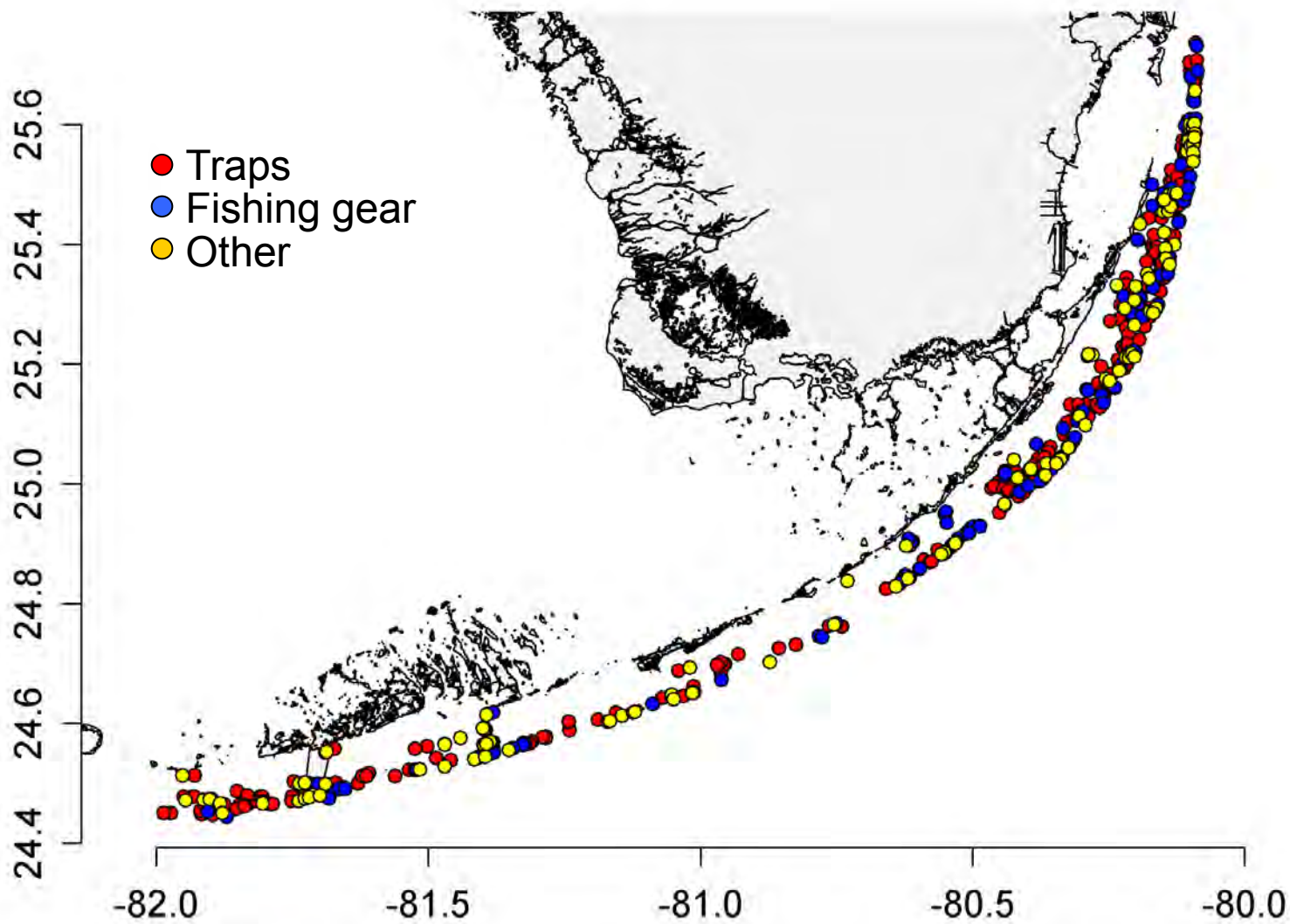
- Beginning in 2002, divers record data on marine debris
- ~10% frequency of occurrence
- Classified by type:
  - 63%: Traps (incl. derelict traps and trap debris)
  - 21%: Fishing (>75% monofilament line)
  - 16%: Other (75% anchor, anchor line and other line)



# Marine debris



# Marine debris



# Lionfish invasion

- Likely aquarium introduction in Florida
- First sightings as early as 1980s
- Rapid increase reported in NC in early 2000s
- Rapid increase in Bahamas in late 2000s
- Recently appeared in FL Keys
- Voracious predators
- No natural enemies in Atlantic



1999







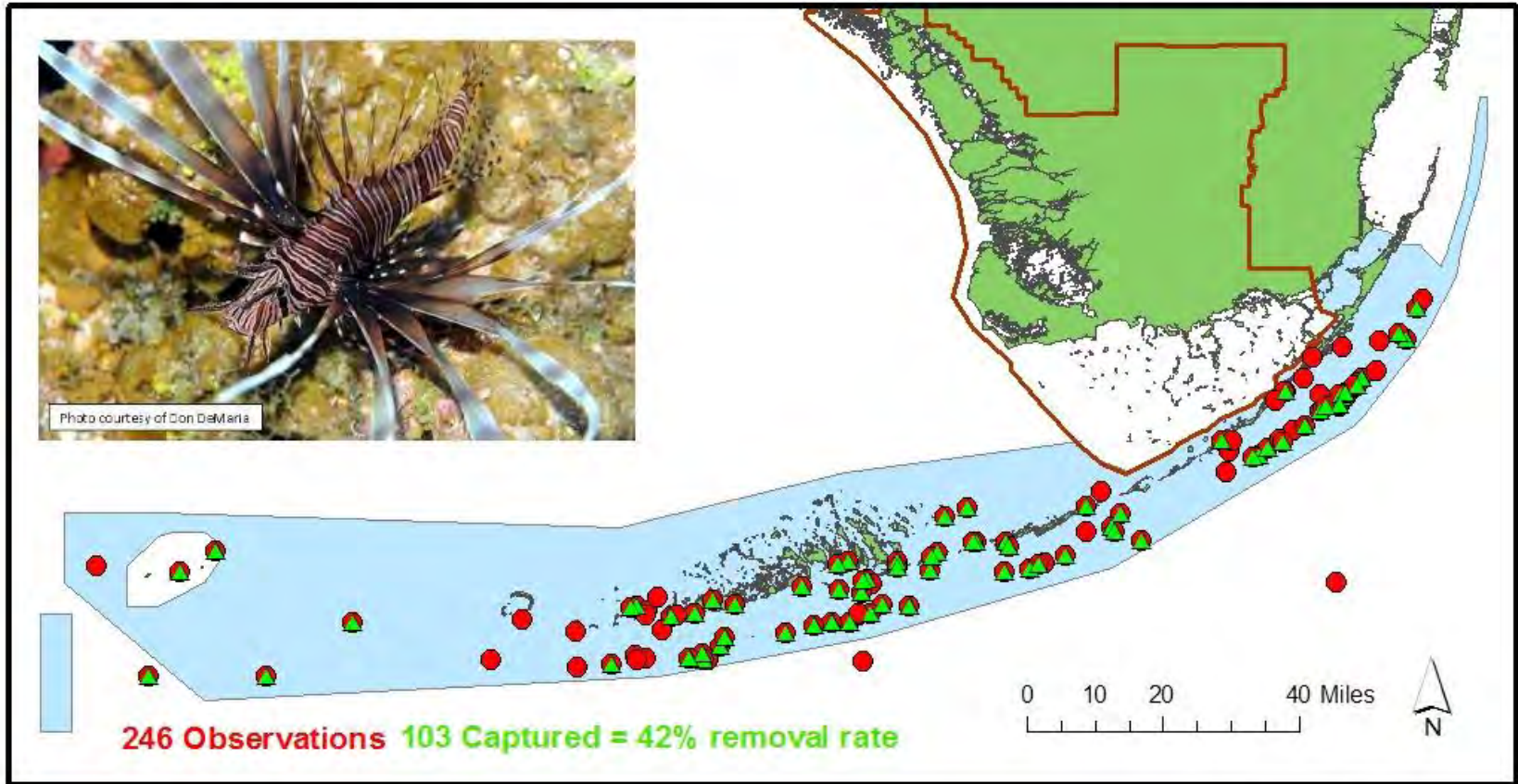








# FL Keys National Marine Sanctuary Lionfish Observations Jan 2009 - June 2010



data collected thru 6/21/2010

