

# CORAL REEF FISH & MARINE ZONES

## FLORIDA KEYS NATIONAL MARINE SANCTUARY



Hogfish prefer low relief reef habitats.  
Photo: William F. Precht, FKNMS

### Coral Reef Fish are Vital to Healthy Coral Reef

Coral reef fish have tremendous economic and ecological value in the Florida Keys. They are vital for sustaining a healthy coral reef ecosystem—the foundation of the ocean-based economy of the Florida Keys. Species like grouper and snapper are prized by recreational anglers and support an important commercial fishery, while colorful parrotfish and angelfish benefit tourism by entertaining divers and snorkelers. Herbivorous fish keep seaweeds from overgrowing corals and carnivorous fish keep populations of smaller fish and invertebrates in balance. Healthy populations of diverse reef fish help sustain the productive coral reef so important to the Keys ecology and economy.

### Marine Zones Protect Coral Reef Fish Habitat

Designated by Congress in 1990, Florida Keys National Marine Sanctuary manages nearly 2900 square nautical miles of Florida Keys waters, balancing conservation of sanctuary resources with sustainable human uses. One management tool at the sanctuary's disposal

is marine zones — areas set aside for specific uses ranging from wildlife protection to recreational activities like scuba diving. In 1997, several different types of marine zones, each with a different primary objective, were established in the sanctuary. Sanctuary Preservation Areas (SPAs) and Ecological Reserves were created to protect critical habitat and have restrictions on fishing and other consumptive activities. These highly protected zones\* provided an opportunity for scientists to study the effects of zone protection on reef fish.

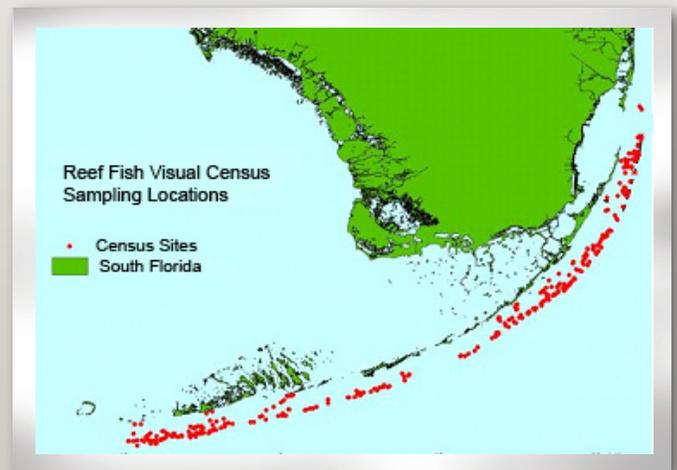
### Scientists Study Long-Term Effects of Marine Zones on Reef Fish

The Florida Keys sanctuary's management plan (1996, 2007) outlines a strategy for scientifically monitoring the long-term effects of marine zones on sanctuary marine life and habitats. Several scientific studies have investigated coral reef fish populations and marine zones, focusing primarily on the SPAs and the two much larger ecological reserves.

Scientists from NOAA Fisheries, the University of Miami and the state of Florida collaborated on a 10-year study that began in 1997 to document the effects of zone protection on reef fish, including both target (fished) species as well as non-target species. To collect data for this study, researchers recorded reef fish size, abundance and diversity over the course of thousands of dives in and around the SPAs and the Western Sambo Ecological Reserve. They used observations from similar dives conducted before the marine zones were established as a baseline for comparison.

### Density of Reef Fish Increases in Protected Zones

Using the data collected, scientists calculated population density — the number of fish in a given area — for each reef fish species. Since the SPAs and the Western Sambo reserve were implemented, the overall average density of several species in these protected zones has increased significantly over the pre-zone baselines. Density increases were seen for yellowtail snapper, gray snapper, mutton snapper, black grouper, red grouper, graysby and hogfish. Essentially, there were significantly more of these fish in 2007 than prior to zone establishment 10 years earlier.



Scientists conducted a visual census at 327 sites in 2007.  
Figure: NOAA Fisheries

<http://floridakeys.noaa.gov/>



## Hurricanes May Have Redistributed Fish

For most years of the study, densities of fished species were also significantly higher in the protected areas in comparison to fished areas, although some declines were observed following severe storms. Storms may have physically disturbed reef fish, causing the redistribution of individual fish. Yellowtail snapper followed a pattern typical of most target fish in the study. Densities inside protected zones were significantly higher during the first several years, then declined following hurricanes in 2004 and 2005 before increasing again in 2007 (see graph on right).

For comparison purposes, two non-target species — stoplight and striped parrotfish — were tracked as part of this study. As might be expected for species that are not fished, densities remained relatively stable in both the highly protected zones and the fished reference sites (see graph on right).

## Density Increases Seen in Fished Areas

Significant density increases were also seen in five target species (gray snapper, mutton snapper, black grouper, red grouper and hogfish) found in fished zones. The magnitude of these increases at the fished sites was much smaller, however, when compared with the increases seen in the protected zones.

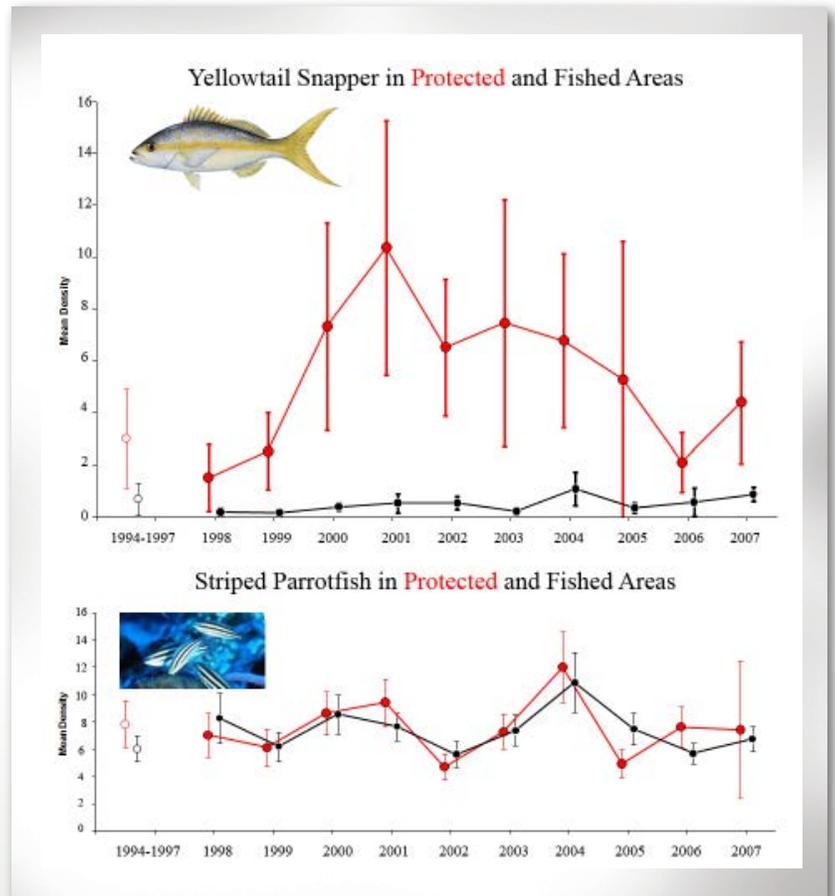
A number of factors could have contributed to the upward trends seen in fished areas. More restrictive fishing measures became effective for several target species. Hogfish, for example, came under a larger minimum size limit in 1994. In 2001, the Tortugas Ecological Reserve, which protects the spawning grounds of reef fish and pink shrimp, was implemented. Years of good recruitment of young fish into the protected zone could also help boost fish densities.

## Protected Areas See Increases in Spawning Stock

From the data, scientists calculated the abundance of reproductive adults, or “spawning stock,” for six target species. Increases in spawning stocks may have positive benefits on fish populations. Significant increases in spawning stocks were observed for yellowtail snapper, black grouper and mutton snapper when compared with their pre-zone baselines. Spawning-sized gray snapper and red grouper were also more abundant inside the zones, but densities were not significantly different. Spawning stock increases were not observed for hogfish, a fish that typically shows a low preference for the high-relief reef formations that were most prevalent.

## Research Shows Marine Zones Contribute to Healthy Reef Fish Populations

This long-term study shows that SPAs and the Western Sambo Ecological Reserve have had positive effects on populations of target reef fish species by increasing the size and densities of snappers and groupers. The abundance of reproductive adults in protected zones has also increased in some instances. Reef fish populations seemed to respond relatively quickly to zone protection in many cases. The benefits of larger protected areas, especially those with diverse habitats and spawning grounds, may not become fully apparent for years because protected fish may live for decades. In the future, scientists will likely revisit these studies to gain further insights into the long-term benefits of zone protection. For more information, visit [http://floridakeys.noaa.gov/research\\_monitoring](http://floridakeys.noaa.gov/research_monitoring) to read the sanctuary’s zone monitoring report.



Observed changes in fish density (number/sample) inside (red) and outside (black) Sanctuary Protected Areas for target yellowtail snapper (top) and non-target striped parrotfish (bottom). Vertical bars show 95% confidence intervals. The four year combined baseline data (1994-1997), collected before reserve protection in 1997, are summarized at the left for sites that eventually were closed to fishing or that continued to be fished.

Figure: NOAA Fisheries

\* Also called No-take Marine Reserves (NTMRs)

Principle Investigator: Dr. James A. Bohnsack, NOAA Southeast Fisheries Center

Written by: Nancy Diersing, Florida Keys National Marine Sanctuary

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