Preliminary Analysis of FKNMS Reef Fish Monitoring Through 2002

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Goal

The goal of this monitoring is to assess changes in reef fish populations in zones under different levels of protective management. On July 1, 1997 the FKNMS established 18 fully protected ("no-take") Sanctuary Preservation Areas (SPAs) and one Ecological Reserve in the Western Sambo region of the lower Keys. Field studies since then have been directed at comparing changes in Fully Protected Marine Zones (FPMZs) to nearby reference areas with fishing.

Methods

Sampling continued through 2002, the fifth full year of protection. The sampling design was improved in 1999 to include a habitat-based, stratified random sampling design and expanded into other habitats to more efficiently monitor reef fish populations throughout the Florida Keys and to better assess habitat preferences by different species. This expanded effort added two classes of data (random samples of low-relief habitat in protected and fished areas) in addition to the high-relief protected and fished sites previously sampled. In 2002, field sampling was successfully completed for a total of 306 reef blocks and 1,224 dives from Dade County through the lower Keys (Fig. 1). These sites include a total of 278 stratified random blocks and 28 historical reference reef sites. Each block represents four stationary fish counts.

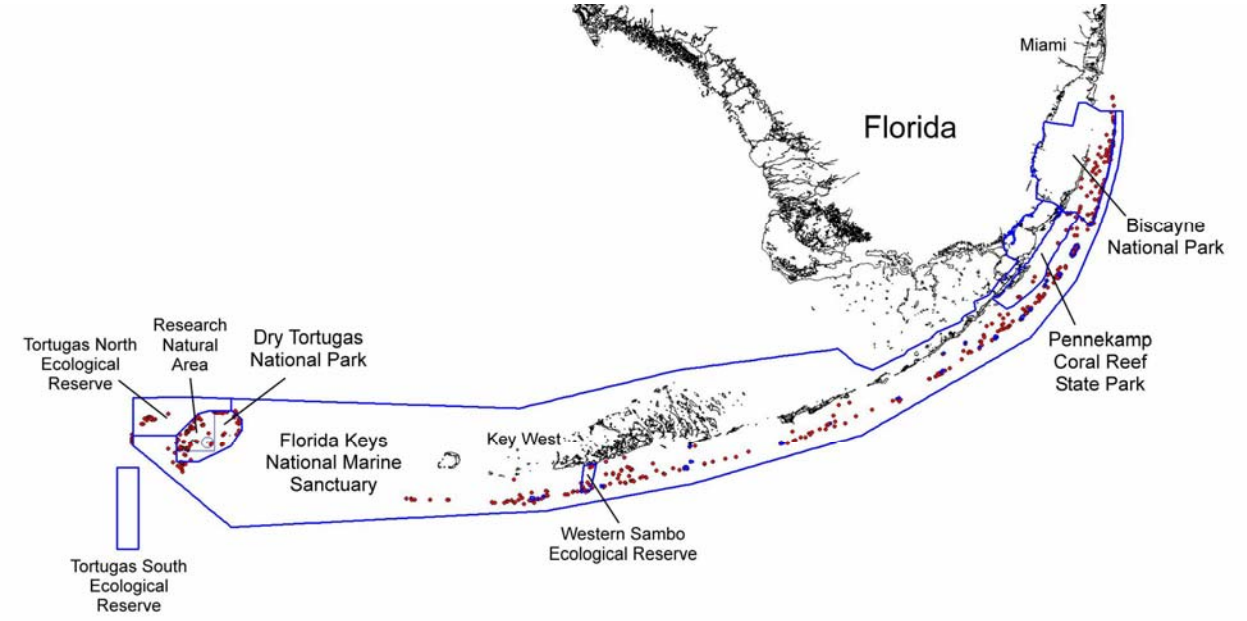

Figure 1. Location of stationary fish sample sites in the Florida Keys National Marine Sanctuary, Biscayne National Park, and Dry Tortugas National Park sampled during the 2002 Keys-wide cruise.

Findings to Date

Below we show trend analyses of raw data from fished and unfished areas for selected targeted and non-targeted species. In the fall of 1998 Hurricane Georges, a large hurricane, and Hurricane Mitch, a small hurricane hit the Florida Keys. In 1999 Hurricane Irene, a small hurricane passed over the lower Keys. Yellowtail Snapper mean density continued to be significantly higher in FPMZs than fished sites and further increased above the long-term 1994-1997 performance range relative to fished reference areas (Fig. 2).

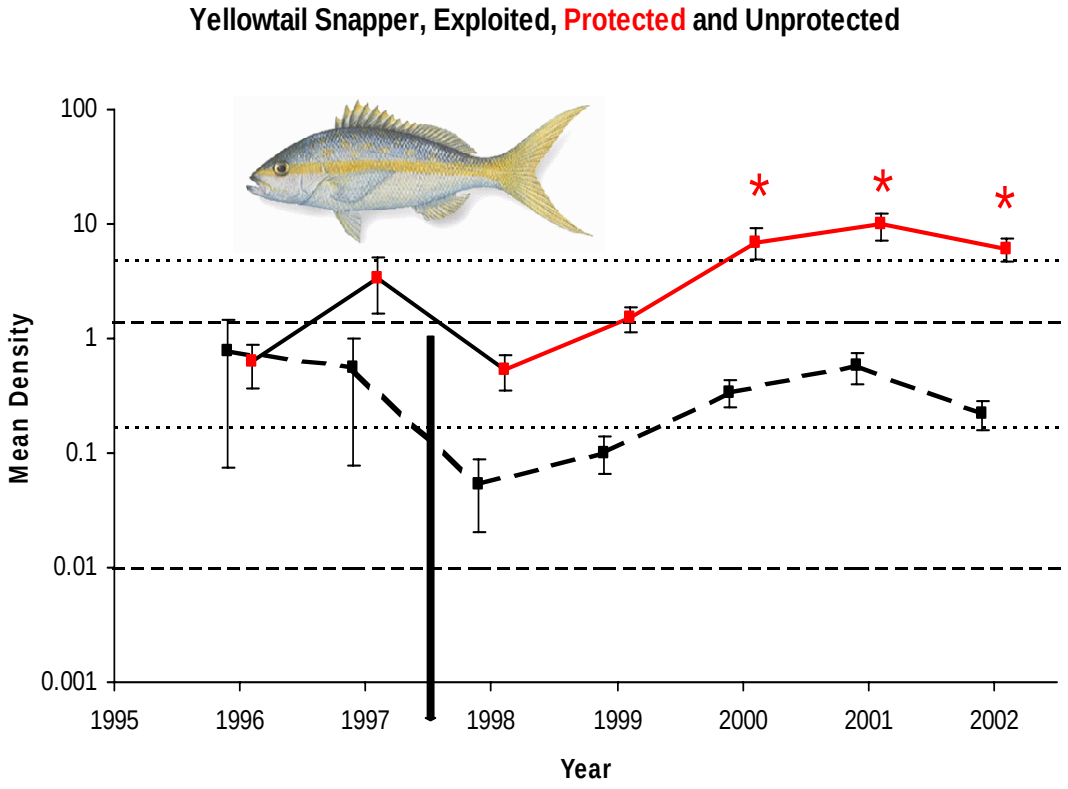

Figure 2. Comparison of Yellowtail Snapper density (log scale) trends in fully protected "no-take" Sanctuary Preservation Areas (SPAs) (solid upper line) and exploited reference areas (dashed lower line). Vertical line shows when no-take protection initiated. Horizontal finely dashed (SPAs) and darker dashed (reference areas) bands show null model predictions based on 1994-1997 95% annual performance measures projected to 2003. Whiskers show 95% confidence intervals. Asterisks denote significantly different densities from the "no significant change" projection.

Mean Black Grouper density has increased in both fished reference areas and FPMZs since 1997 and currently is approximately an order of magnitude higher than that in the baseline period. Densities in FPMZs have increased faster that in fished reference areas (Fig. 3).

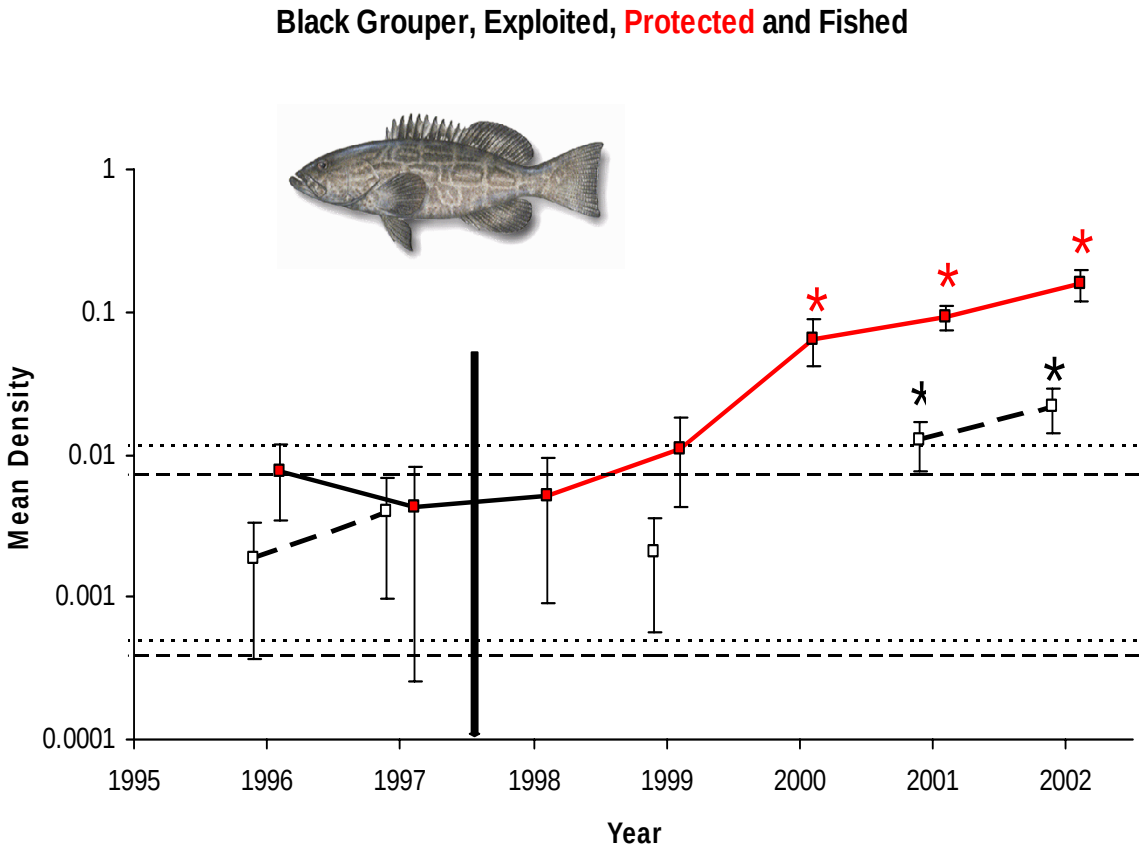

Figure 3. Comparison of Black Grouper density (log scale) trends in fully protected "no-take" Sanctuary Preservation Areas (SPAs) (solid upper line) and exploited reference areas (dashed lower line). Vertical line shows when no-take protection initiated. Horizontal dotted (SPAs) and dashed (reference areas) bands show null model predictions based on 1994-1997 95% annual performance measures projected to 2003. Whiskers show 95% confidence intervals. Asterisks denote significantly different densities from the "no significant change" projection.

Gray Snapper density also increased in both fished reference areas and FPMZs since 1997. Densities have remained higher in fully protected zones than in fished reference areas every year since 1997 and were somewhat higher prior to this (Fig. 4).

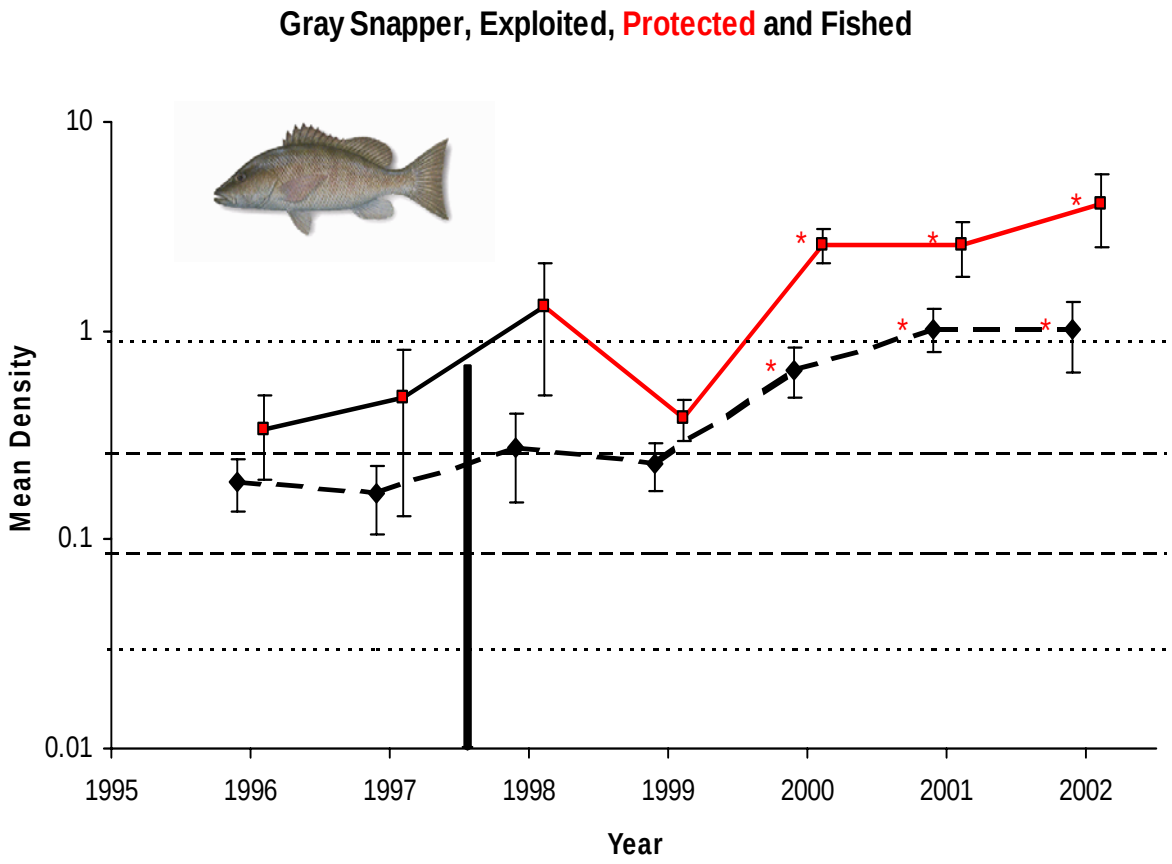

Figure 4. Comparison of Gray Snapper density (log scale) trends in fully protected "no-take" Sanctuary Preservation Areas (SPAs) (solid upper line) and exploited reference areas (dashed lower line). Vertical line shows when no-take protection initiated. Horizontal dotted/dashed (SPAs) and dashed/dotted (reference areas) bands show null model predictions based on 1994-1997 95% annual performance measures projected to 2003. Whiskers show 95% confidence intervals. Asterisks denote significantly different densities from the "no significant change" projection.

Stoplight Parrotfish, a large herbivore not normally targeted by fishing, have fluctuated in both fished and unfished areas (Fig. 5). Mean density was higher in unfished areas than in fished areas. Densities in FPMZs were generally within the long-term, 1994-1997, performance range, but generally remained slightly below the performance range in fished zones.

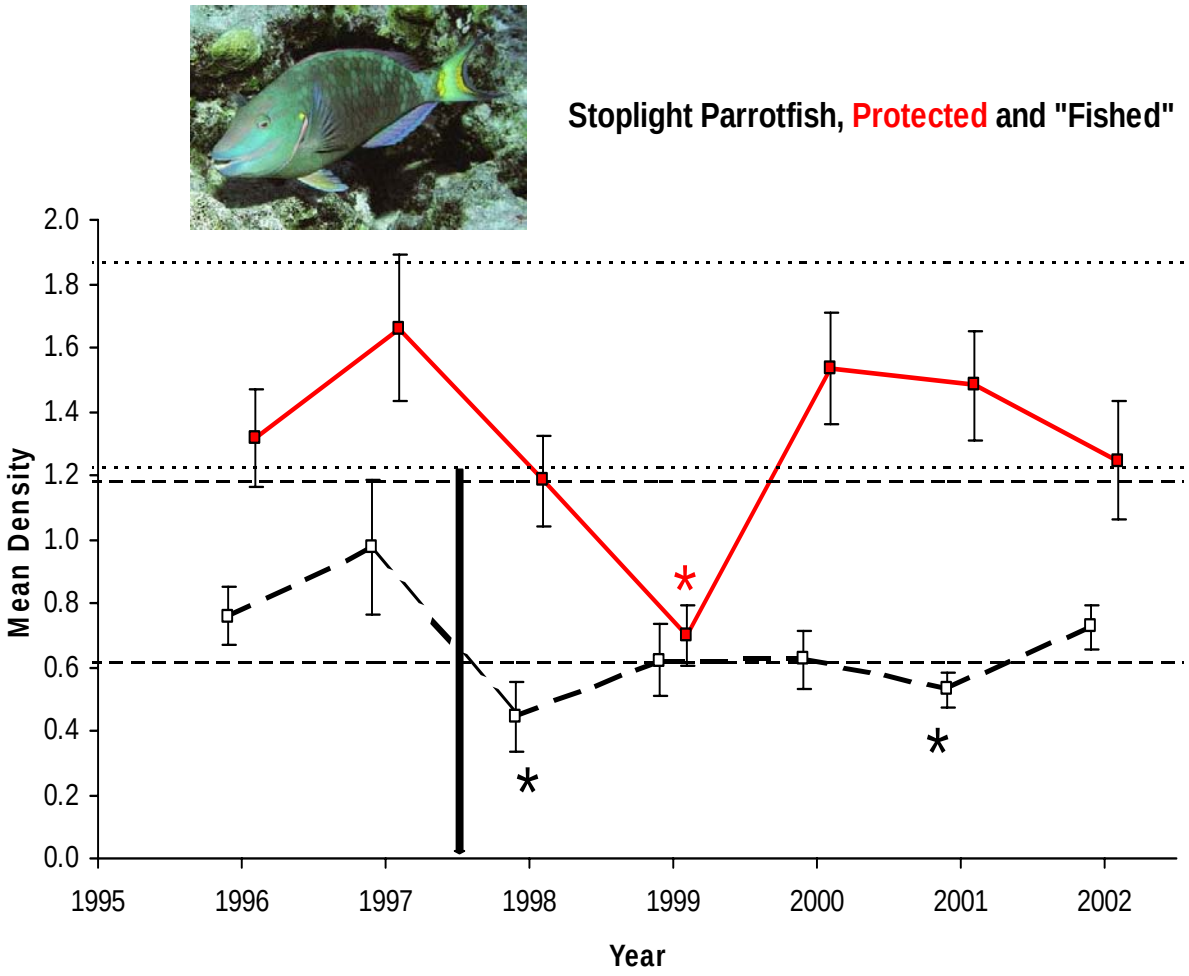

Figure 5. Comparison of Stoplight Parrotfish density trends in fully protected "no-take" Sanctuary Preservation Areas (SPAs) (solid upper line) and exploited reference areas (dashed lower line). Vertical line shows when no-take protection initiated. Horizontal dotted (SPAs) and dashed (reference areas) bands show null model predictions based on 1994-1997 95% annual performance measures projected to 2003. Whiskers show 95% confidence intervals. Asterisks denote significantly different densities from the "no significant change" projection.

Striped Parrotfish, a small herbivore not targeted by fishing, showed high concordance in mean density (number of individuals per sample) in both fished and unfished areas over the study period (Fig. 6). Density is slightly above the long-term performance range in FPMZs, but similar in fished and unfished areas.

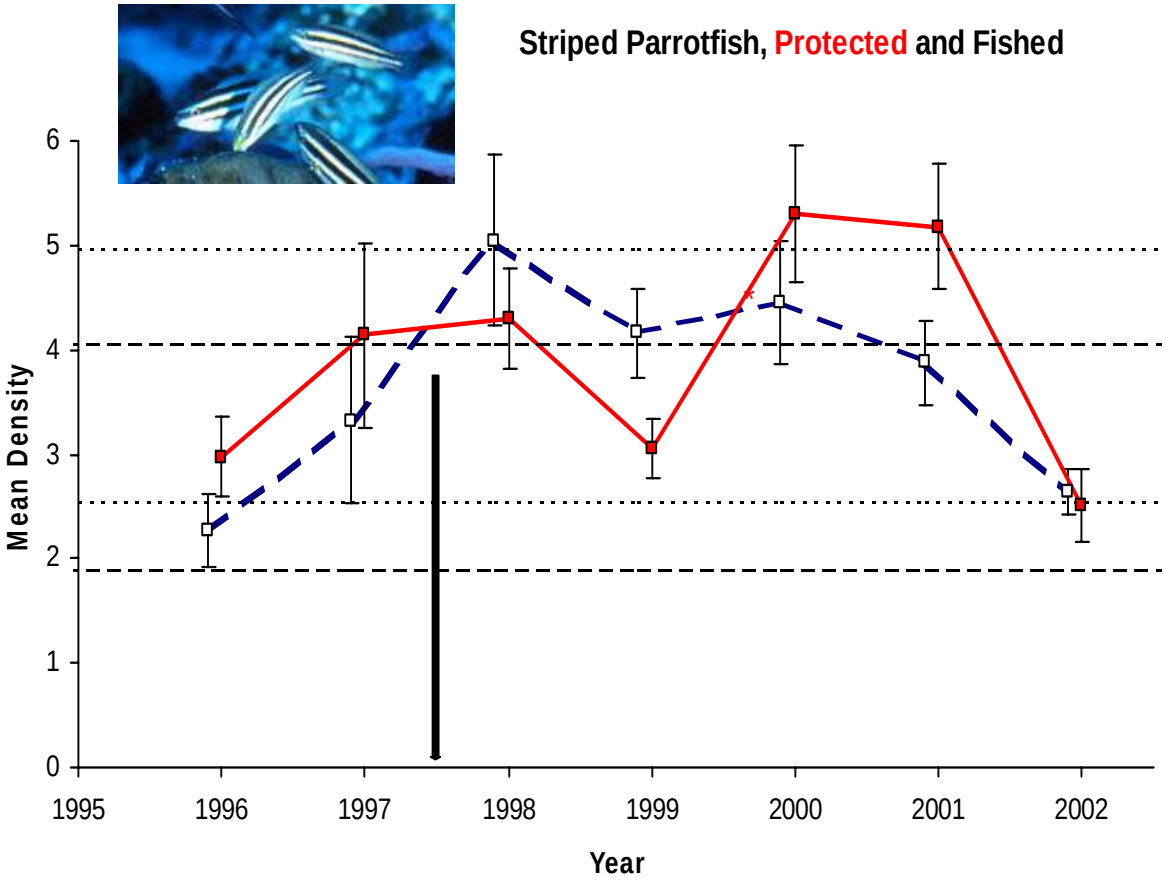

Figure 6. Comparison of Striped Parrotfish density trends in fully protected "no-take" Sanctuary Preservation Areas (SPAs) (solid upper line) and exploited reference areas (dashed lower line). Vertical line shows when no-take protection initiated. Horizontal dotted (SPAs) and dashed (reference areas) bands show null model predictions based on 1994-1997 95% annual performance measures projected to 2003. Whiskers show 95% confidence intervals. Asterisks denote significantly different densities from the "no significant change" projection.

Summary

Since no-take protection was initiated in 1997, significant density increases were observed for several exploited species in FPMZs compared to fished reference areas. Among exploited species, mean densities were higher in FPMZs for Gray Snapper, Black Grouper, and Yellowtail Snapper. Concordance was observed in changes in density for Stoplight Parrotfish and Striped Parrotfish, two species not directly exploited. The passage of Hurricane Georges (a strong hurricane) and Mitch (a weak hurricane) in the fall of 1998 resulted in declines of mean density at both fished and unfished sites in 1999 for the two non-exploited parrotfishes and Gray Snapper. No detrimental impacts on fish densities were noted following the passage of Hurricane Irene, a weak hurricane that passed over the Lower Keys in the fall of 1999.