

# High Densities of the Large Bodied Parrotfishes (Scaridae) at Two Venezuelan Offshore Reefs: Comparison Among Four Localities in the Caribbean

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## ABSTRACT

Parrotfishes (Scaridae) are important components of subsistence and commercial fisheries throughout the Caribbean, most notably at locations where piscivorous reef fishes (e.g. snapper, groupers) have been intensively fished. Our aim was to compare the abundance of scarids at four localities (Barbados, Belize, Las Aves Archipelago, and Los Roques Archipelago National Park) with differing fishing intensities. At each locality we surveyed at least five sites separated by kilometers, and across different reef habitats. To estimate densities, counts were made for all species of scarids along 30 x 10 m belt transects, and along 400 x 15 m transects for the large bodied scarids. Los Roques Archipelago (LR), a protected reserve offshore Venezuela where fishing is restricted, supports the highest densities of the large-bodied scarids *Scarus guacamaia* ( $9.30 \pm 3.79$  ind/1000 m<sup>2</sup>,  $X \pm SE$ ), *S. coelestinus* ( $10.73 \pm 3.27$  ind/1000 m<sup>2</sup>), *S. coreuleus* ( $5.23 \pm 1.14$  ind/1000m<sup>2</sup>). However, at the neighboring Las Aves Archipelago, an area heavily fished for predators, densities were also high for *S. coelestinus* ( $7.35 \pm 1.43$  ind/1000 m<sup>2</sup>) and *S. coreuleus* ( $4.32 \pm 1.93$  ind/1000 m<sup>2</sup>). At non protected sites in Belize, the densities of these large bodied parrotfishes were 10-fold lower than at LR, and were absent from all sites at Barbados, where an intensive trap-fishery occurs. In addition, the high average densities among sites at LR of the excavating scarid *Sparisoma viride* ( $3.33-14.97$  ind/1000 m<sup>2</sup>) and the large grazing scarid *Scarus vetula* ( $2.50-45.57$  ind/1000m<sup>2</sup>) reveals that this marine protected area supports the highest parrotfish densities in the Caribbean after Bonaire.

KEY WORDS: Scaridae, overfishing, density, marine reserves, reef fishes

## Altas Densidades de las Especies Grandes de Peces Loros (Scaridae) en dos Arrecifes Oceánicos de Venezuela: Comparación entre Cuatro Localidades del Caribe

Los loros (Scaridos) representan recursos importantes en las pesquerías de subsistencia y comerciales del Caribe, especialmente en localidades donde los peces carnívoros (ej., pargos, meros) han sido intensamente explotados. El objetivo del presente estudio fue comparar la abundancia de loros de cuatro localidades (Barbados, Belice, y dos archipiélagos venezolanos costa afuera), todas con diferentes presiones pesqueras. Cada localidad fue muestreada en al menos cinco sitios, todos separados por kilómetros, y en diferentes hábitats arrecifales. Los estimados de densidad se hicieron mediante conteos a lo largo de transectos de 30 x 10 m para todas las especies de loros, y en transectos de 400 x 15 m para aquellos loros de gran talla. En Venezuela, El Parque Nacional Archipiélago de Los Roques (LR), donde las actividades pesqueras se encuentran restringidas, sostiene altas densidades para los loros de gran talla, como *Scarus guacamaia* ( $9.30 \pm 3.79$  ind/1000 m<sup>2</sup>,  $X \pm SE$ ), *S. coelestinus* ( $10.73 \pm 3.27$  ind/1000 m<sup>2</sup>), *S. coreuleus* ( $5.23 \pm 1.14$  ind/1000 m<sup>2</sup>). De igual modo, en el vecino Archipiélago de Las Aves, un área donde los peces depredadores han sido severamente explotados, las densidades resultaron altas para *S. coelestinus* ( $7.35 \pm 1.43$  ind/1000 m<sup>2</sup>) y *S. coreuleus* ( $4.32 \pm 1.93$  ind/1000 m<sup>2</sup>). En sitios no protegidos de Belice, las densidades de loros de gran talla resultaron 10 veces menores que aquellas en LR, y estuvieron ausentes en todos los sitios de Barbados, donde existe una intensa pesquería con nasas. Adicionalmente, la elevada densidad promedio en todas las localidades de LR para *Sparisoma viride* ( $3.33-14.97$  ind/1000 m<sup>2</sup>) y *Scarus vetula* ( $2.50 - 45.57$  ind/1000 m<sup>2</sup>) revelan que esta área marina protegida sostiene las mayores densidades de loros en el Caribe, después de Bonaire.

PALABRAS CLAVES: Scaridos, sobrepesca, densidad, reservas marinas, peces arrecifales

## INTRODUCTION

Parrotfishes (Scaridae) are ecologically important members of the reef fish community in the Caribbean. They have become the dominant grazers, and are responsible for a significant amount of bioerosion on many Caribbean reefs (Bruggemann *et al.* 1996, van Rooij *et al.* 1996, 1998). Furthermore, they are important components of subsistence and commercial fisheries throughout the region, most notably at locations where piscivorous reef fishes (e.g. snapper, groupers) have been depleted. Recent studies have reported increases in their biomass when fishing mortality is reduced inside marine reserves, particularly on the large-bodied parrotfishes (Mumby *et al.* 2006). Our aim was to compare the densities of scarids

across a set of geographically widely dispersed reefs in the Caribbean exposed to varying patterns of fishing and levels of protection.

## MATERIALS AND METHODS

### Sampling Locations

Within the Caribbean region, four localities (Barbados, Belize, Los Roques Archipelago [Venezuela] and Las Aves Archipelago [Venezuela]) were sampled. At each locality we surveyed at least five sites separated by kilometers, and across different reef habitats (see Robertson *et al.* 2005).

### Abundance Estimates

To estimate densities, counts were made for all species of scarids along 30 x 10m belt transects, and along 400 x 15m transects for the large bodied scarids. At each location counts were made in a minimum of two well separated habitats, with at least five replicate transects separated by distances of at least 100 m in each habitat.

### Fishing Intensities

Barbados (data collection in July 2000) has the greatest number of persons per square kilometers of shallow reef habitat of all the localities investigated, and an extensive trap fishery for reef fishes (Robichaud *et al.* 2000). Furthermore, parrotfishes are prized food fishes in Barbados.

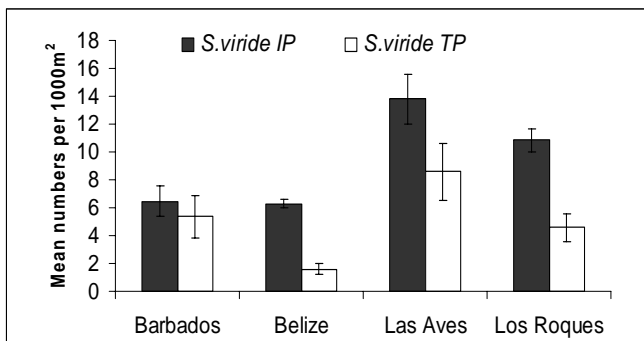
Belize (data collection September 2002) has a relative low human population density and a moderately intense selective fishing directed at predatory reef-fishes and large scarids (Koslow *et al.* 1994). Around our study area in Carrie Bow Cay, fishing is uncontrolled.

In contrast, Los Roques Archipelago (data collection August 2002) has a small human population (1,500 people, 350 km<sup>2</sup> reef) and has had the status of a National Park since 1972. Our study area was in a part of the reserve where no fishing for reef-fishes is allowed.

Las Aves Archipelago (data collection August 2002) is uninhabited (~100 km<sup>2</sup> reef). However, there is an uncontrolled intensive fishing directed mostly to piscivorous reef-fishes by fishers using hook-and-line, traps, nets and spearguns.

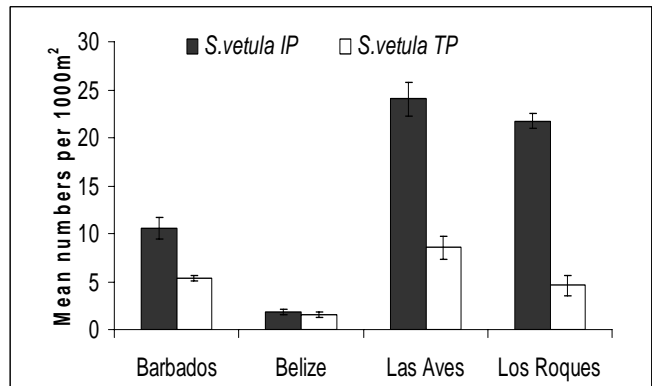
## RESULTS AND DISCUSSION

Of the four localities studied, Los Roques Archipelago (LR) and Las Aves Archipelago (LA) showed consistently high abundances of the larger species of parrotfishes. For the excavating scarid *Sparisoma viride*, average densities of the initial and terminal phases in LR and LA were 10.84-4.60 and 13.79-8.58 ind/1,000 m<sup>2</sup>, respectively (Figure 1).



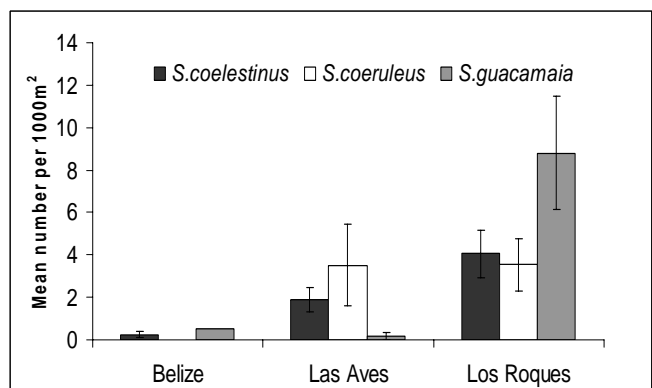
**Figure 1.** Estimates of mean abundance of *Sparisoma viride* obtained from belt-transect counts (30 x 10 m) made at equivalent habitat and depth ranges at the four sampling localities. IP: initial phase; TP: terminal phase. Error bars denote standard error.

Also, for the large grazing scarid *Scarus vetula*, these two localities presented the highest average densities, with 24.07 and 9.37 ind/1,000 m<sup>2</sup> in LA for the initial and terminal phases, respectively and 21.74 and 6.77 ind/1,000 m<sup>2</sup> in LR for both phases, respectively (Figure 2).



**Figure 2.** Estimates of mean abundance of *Scarus vetula* obtained from belt-transect counts (30 x 10 m) made at equivalent habitat and depth ranges at the four sampling localities. IP: initial phase; TP: terminal phase. Error bars denote standard error.

As for the large-bodied parrotfishes, LR supports the highest densities of *Scarus guacamaia* (9.30 ± 3.79 ind/1,000 m<sup>2</sup>, X ± SE), *S. coelestinus* (10.73 ± 3.27 ind/1,000 m<sup>2</sup>), *S. coreuleus* (5.23 ± 1.14 ind/1,000 m<sup>2</sup>) (Figure 3). At the neighboring LA, densities were also high for *S. coelestinus* (7.35 ± 1.43 ind/1,000 m<sup>2</sup>) and *S. coreuleus* (4.32 ± 1.93 ind/1,000 m<sup>2</sup>). At non protected sites in Belize, the densities of these large bodied parrotfishes were 10-fold lower than at LR, and were absent from all sites at Barbados, where an intensive trap-fishery occurs (Figure 3).



**Figure 3.** Estimates of mean abundance of *Scarus coelestinus*, *S. coeruleus* and *S. guacamaia* obtained from 400 x 15m transects made at equivalent habitat and depth ranges at the four sampling localities. Error bars denote standard error.

This study reveals that these two Venezuelan offshore reefs, a protected marine reserve (Los Roques) and an area heavily fished for predators (Las Aves), present a healthy parrotfish community, particularly of the large-bodied species, which are often the more vulnerable to intensive fishing practices, and highlights the importance of conducting regular monitoring studies at these localities.

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