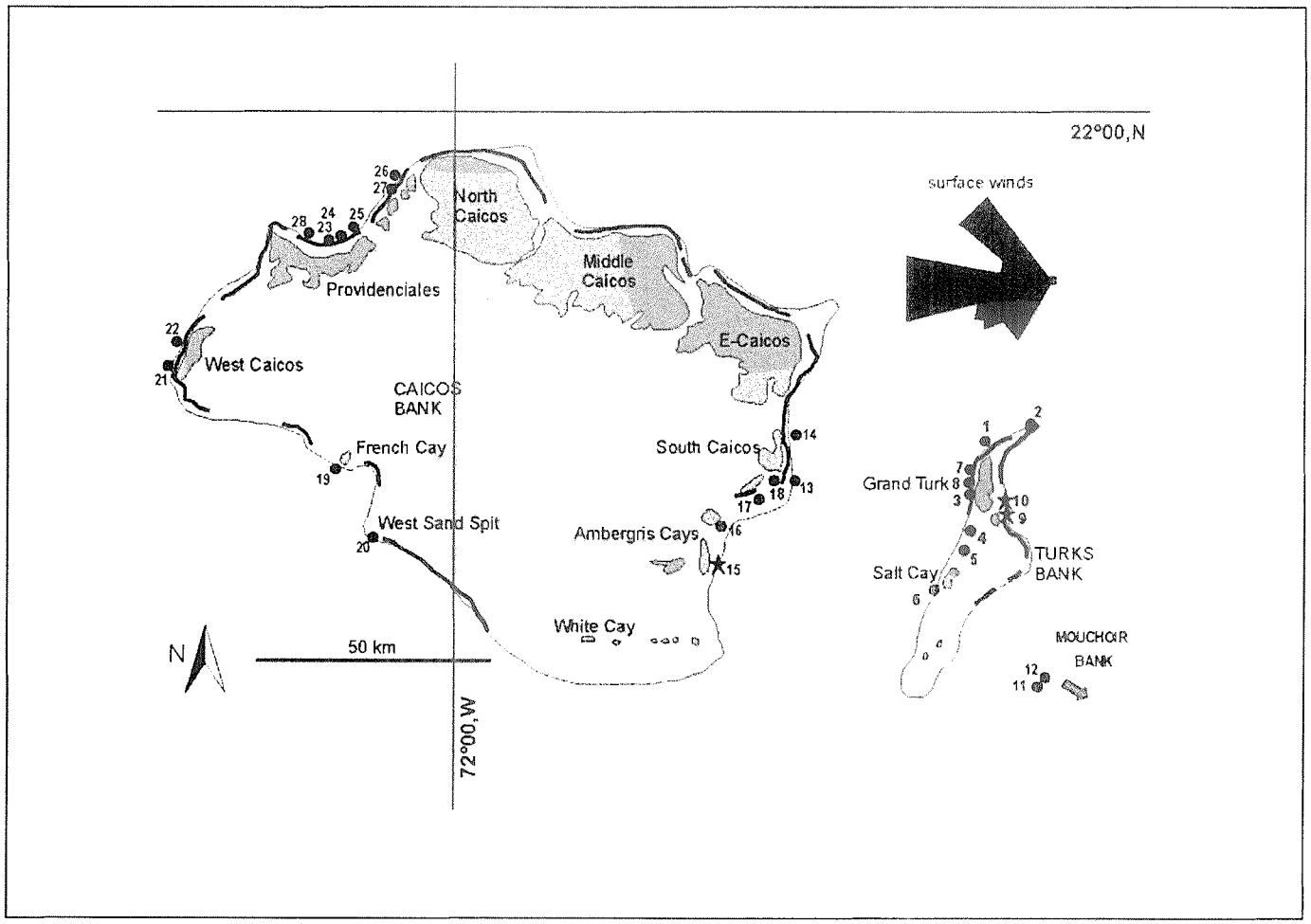


**Figure 1.** AGRRA survey sites in the Turks and Caicos Islands. See Table 1 for site codes. Wind rose for the southern Bahamas, from R.N. Ginsburg in P.A. Scholle, and N.P. James (1995).

# ASSESSMENT OF THE CORAL REEFS OF THE TURKS AND CAICOS ISLANDS (PART 2: FISH COMMUNITIES)

BY

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## ABSTRACT

Ecologically and commercially significant coral reef fishes were surveyed at 28 sites in the Turks and Caicos Islands during August 1999. Our results constitute the first quantitative census of these fishes and can serve as baseline information for subsequent studies. Their density and size generally were highest off West Caicos and lowest in Mouchoir Bank. Herbivore density overall showed no correlation with macroalgal index (a proxy for biomass) or live stony coral cover, but surgeonfish density was positively correlated with macroalgal index. Species richness of these select fishes was positively correlated with the species richness of stony corals that were ≥10 cm in diameter. Current fishing pressures overall were low, and the reef-fish communities appeared relatively intact on the Turks and Caicos Banks. However, overfishing and destructive fishing practices have negatively impacted the reef fish communities on Mouchoir Bank.

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## INTRODUCTION

Fish are known to occur at high species diversity and density in undisturbed coral reefs. Although their exact numbers are unknown (Sorokin, 1993), they play important roles in reef ecosystems as herbivores and as top predators (e.g., Hatcher and Larkum, 1983; Hay, 1997). Reef fishes can be sensitive indicators of general reef condition (Pattengill-Semmens and Semmens, this volume). Furthermore, certain large-sized predators such as groupers (serranids) have been historically targeted by commercial as well as sport fishers and they are known to be particularly susceptible to fishing pressure (Russ, 1991; Sluka et al., 1998). Therefore, their relative abundance should serve as a good indicator of fishing pressures.

The Turks and Caicos Islands (TCI), which comprise the southeastern extent of the Bahamian Archipelago, lie between 21° and 22° N latitude and 71° and 72° 30′ W longitude (Fig. 1). There are seven inhabited islands, one uninhabited island, and approximately 40 low-lying coral limestone cays distributed on two banks (Turks and Caicos). Part of the entirely submerged Mouchoir Bank, which is located approximately 65 km southeast of Turk Bank between the Mouchoir Passage and the Dominican Republic, also belongs to the TCI. The prevailing easterly trade winds keep sea conditions on the eastern sides of the banks and islands choppy, while the western sides are generally calm. Currents generally run to the north. Over 300 km of coral reef are reported to exist in the TCI (Wells, 1988; Turks and Caicos National Parks Advisory Committee, 1998, report).

The TCI's coral reefs are essential resources for tourism and provide seafood for local consumption. Fisheries, often directly reef-related, are economically important with lobster and conch being the only national exports (Woodley et al., 2000). The tourism industry has developed rapidly during the past decade, particularly for recreational diving. Increased development, population increase, and illegal fishing may in future be challenges for the integrity of the TCI's coral reefs; however, at present they are still remote from intense human impacts.

In 1975, a National Parks Ordinance established 19 marine protected areas with three levels of protection (Woodley et al., 2000) which collectively cover about 700 $km^2$. Active management is currently restricted to protected areas near Providenciales, where much of the TCI's populace resides (Woodley et al., 2000). Nevertheless, given its total land area of 505 $km^2$, the TCI government has legislated proportionately more protected areas than any other country in the world. In addition, the government has established a self-financing system called the Conservation Fund to ensure long-term sustainability of the national park system.

The major objective of this study was to document fish community composition and structure in the TCI in a snapshot fashion with the Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocols. Because of their remote locality, these islands afforded

an opportunity to study relatively "pristine" reef fish communities with few anthropogenic impacts. Relative to many other tropical western Atlantic ecosystems, the reef communities in the TCI are understudied (Chiappone et al., 1996). Our results represent the first systematic census of key fish species and provide baseline data for future monitoring and research in the TCI.

## METHODS

A total of 28 sites (Fig. 1) were studied: two on Mouchoir Bank; 10 on Turks Bank; and 16 in three major localities on the larger Caicos Bank (4 near West Caicos and French Cay, 6 near Providenciales, and 6 near South Caicos). We selected sites that were representative of special interests (i.e., reported to be heavily impacted or of touristic, fisheries and/or conservation value) and strategically accessible (at established dive sites with mooring buoys). An effort was made to space the sites as evenly as possible within all available exposures and reef types, but the small size of the dive boats and prevailing sea conditions restricted surveys to areas of moderate exposure and/or short traveling distance. Although the northern side of Caicos Bank and much of Mouchoir Bank were not exhaustively investigated, a relatively even mix of exposed and sheltered reefs was obtained. Three shallow (<8 m) patch reefs dominated by *Acropora palmata* were sampled (TC9, TC10, TC1); however, a continuous *Acropora palmata* reef crest was not observed in the surveyed areas. The remaining 25 reefs were located on the outer margin of the upper shelf-edge reefs in low-relief (<5 m, n=16) and high-relief (>5 m. n=9) habitats with relatively dense coral growth (Table 1).

The surveys were carried out following the AGRRA Version 2.2 fish protocol (see Appendix One, this volume) by a team of four divers who generally spent between one and two hours underwater at each site. Each belt transect was 30 m x 2 m. Counts of groupers were restricted to species of *Epinephelus* and *Mycteroperca*; scarids (parrotfishes) and haemulids (grunts) less than 5 cm in length were not tallied due to the difficulty in accurate identification. Each diver also performed one 20-minute-long Roving Diver Technique (RTD) survey at every site. One day of consistency training using plastic fish models of varying sizes (10 cm, 20 cm, 40 cm) was completed prior to initiating the surveys.

Field identifications were based on Humann (1994). While we attempted to identify all species as accurately as possible, some errors are likely to have occurred, particularly with the smaller parrotfishes and grunts. Fish in these size classes were not very common, however, and are believed to have introduced little bias into the dataset.

The belt-transect data were used to compare the mean density (as numbers/100 $m^2$) and size distribution (in cm) of selected fishes among the five geographic areas using Analysis of Variance (ANOVA). The relationship between key herbivore density and

macroalgal index (absolute macroalgal abundance x macroalgal height) was analyzed using Kendall's rank correlation test, as was the relationship between total AGRRA fish diversity and the diversity of stony corals >10 cm in diameter (select stony corals). Relationships between fish density and other benthic habitat variables (live stony coral cover; height, diameter and mortality of select stony corals; depth) were investigated using linear and multiple regressions. (The AGRRA benthic survey data are summarized in Riegl et al., this volume.) Whenever necessary, the data were transformed prior to performing a parametric statistical analysis (e.g., log-transformation was used for fish size, square-root transformation for fish density, and arcsine transformation for percentile data).

## RESULTS

### Belt Transects

*Species richness.* A total of 4,597 fishes belonging to 46 of the species in the AGRRA fish list, including seven each of groupers and parrotfishes, were counted in 279 belt transects (Tables 1, 2). Mean AGRRA species richness/site in the five geographic locations varied from 17 in Mouchoir to 25 in West Caicos, averaging 22 for the TCI as a whole (Fig. 2). The West Caicos Wall (site TC22) had the highest record (30 species) for species richness (Table 1). Pairwise comparisons (Mann-Whitney U-test) revealed that the species richness of the AGRRA fishes in Mouchoir Bank was significantly lower than in Turks Bank ($p=0.0417$), Providenciales ($p=0.0318$), and West Caicos ($p=0.0301$). Moreover, the AGRRA fish species richness in the belt transects was positively correlated (Fig. 3; Kendall's rank correlation, $0.01<p<0.05$) with the species richness of the select stony corals assessed concurrently by Riegl et al. (this volume).

*Density.* Mean pooled fish densities (as numbers/100 $m^2$) for select species in eight families are shown for all shallow (≤8m; n=3) reefs and all deeper (>8m; n=25) reefs in Figure 4. Angelfish (pomacanthids), butterflyfish (chaetodontids) and triggerfish (balistids) were significantly more abundant in the deeper reefs (ANOVA, $p<0.05$), whereas surgeonfish (acanthurid) densities were significantly higher in the shallow reefs (ANOVA, $p<0.05$).

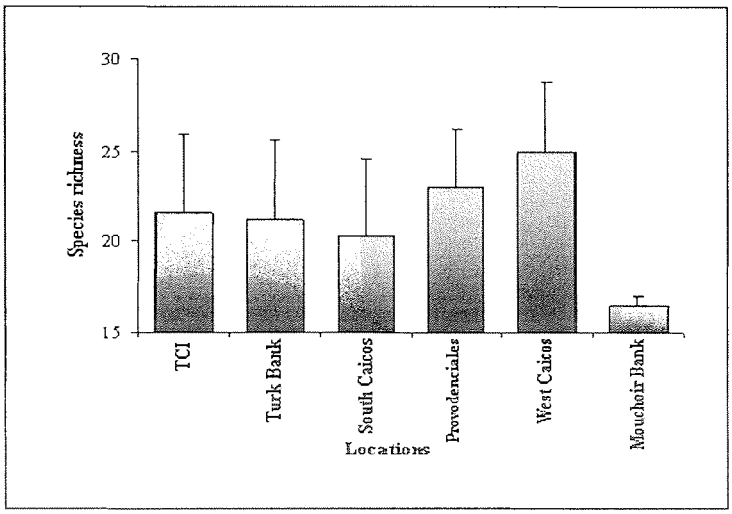


Figure 2. Species richness (mean/site ± standard deviation) of AGRRA fishes for the Turks and Caicos Islands (TCI, 4,597 fishes, 28 sites) and five geographic areas: Turk Bank (1,524 fishes, 10 sites), South Caicos (972 fishes, 6 sites), Providenciales (1,198 fishes, 6 sites), West Caicos (691 fishes, 4 sites), Mouchoir Bank (275 fishes, 2 sites).

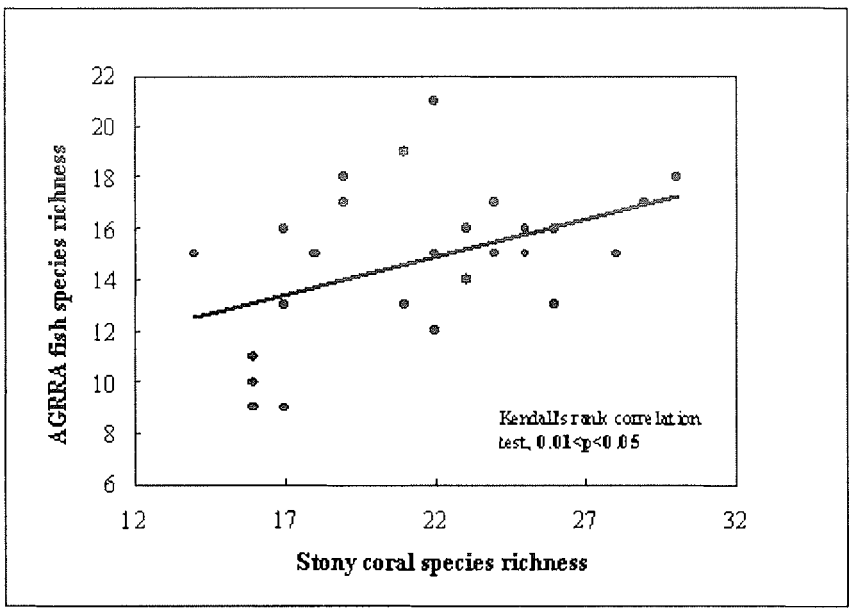


**Figure 3.** Correlation plot between species richness of all stony corals (≥10 cm diameter) and all AGRRA (belt-transect) fishes by site in the Turks and Caicos Islands.

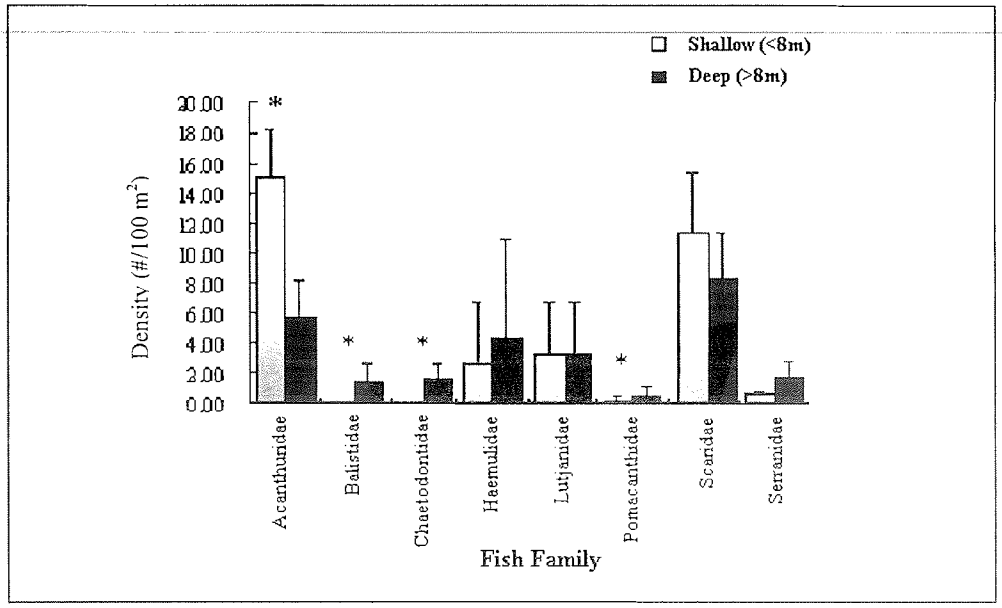


**Figure 4.** Mean fish abundance (no. individuals/100 $m^2$ ± sd) for AGRRA fishes at <8m (629 fishes, 3 sites) and >8 m (n=3,968 fishes, 25 sites) in the Turks and Caicos Islands. * = statistically significant difference (ANOVA, $p<0.05$) between shallow and deep sites.

The average density of the select fishes in each of these eight families in the TCI as a whole and in the five geographic locations (Table 3A) are shown in Figure 5. A statistically significant difference among geographic areas was found in mean snapper (lutjanid) density (ANOVA, P=0.0234), with the highest value occurring in the reefs around West Caicos. Mean densities of grunts, snappers and triggerfishes were significantly lower (Mann-Whitney U-test, p=0.0405, 0.0246, 0.0405 respectively) in Mouchoir Bank than means for the pooled data in the remaining TCI reefs (Fig. 6A).

The average density for five of these families in each reef is given in Table 4. There were no significant differences in the densities of parrotfish [Kruskal-Wallis (K-W) H Test p=0.16], snappers (K-W H-Test, p=0.91), and grunts (K-W H-Test, p=0.19) among the three types of investigated reefs, but significant differences were found in the densities of surgeonfishes (K-W H Test, p=0.02) and groupers (K-W H Test, p=0.028). Parrotfish and surgeonfish densities were higher in the shallow *Acropora palmata* patch reefs than in the deeper reefs. Groupers had higher densities in high-relief shelf-edge reefs.

*Size.* The size (as total length) distributions of herbivores (parrotfish ≥5 cm, surgeonfish, the yellowtail damselfish *Microspathodon chrysurus*) and carnivores (snapper, select grouper) at shallow (<8 m) and deeper (>8 m) reefs are summarized in Figure 7. Shallow and deeper reefs differed significantly for both of these important trophic groups (G-test, both $p<0.001$) with deeper reefs generally having larger fishes. Average sizes were higher in carnivores than herbivores at both depths even though the modes for both groups were in the 11-20 cm-size class in the deeper reefs.

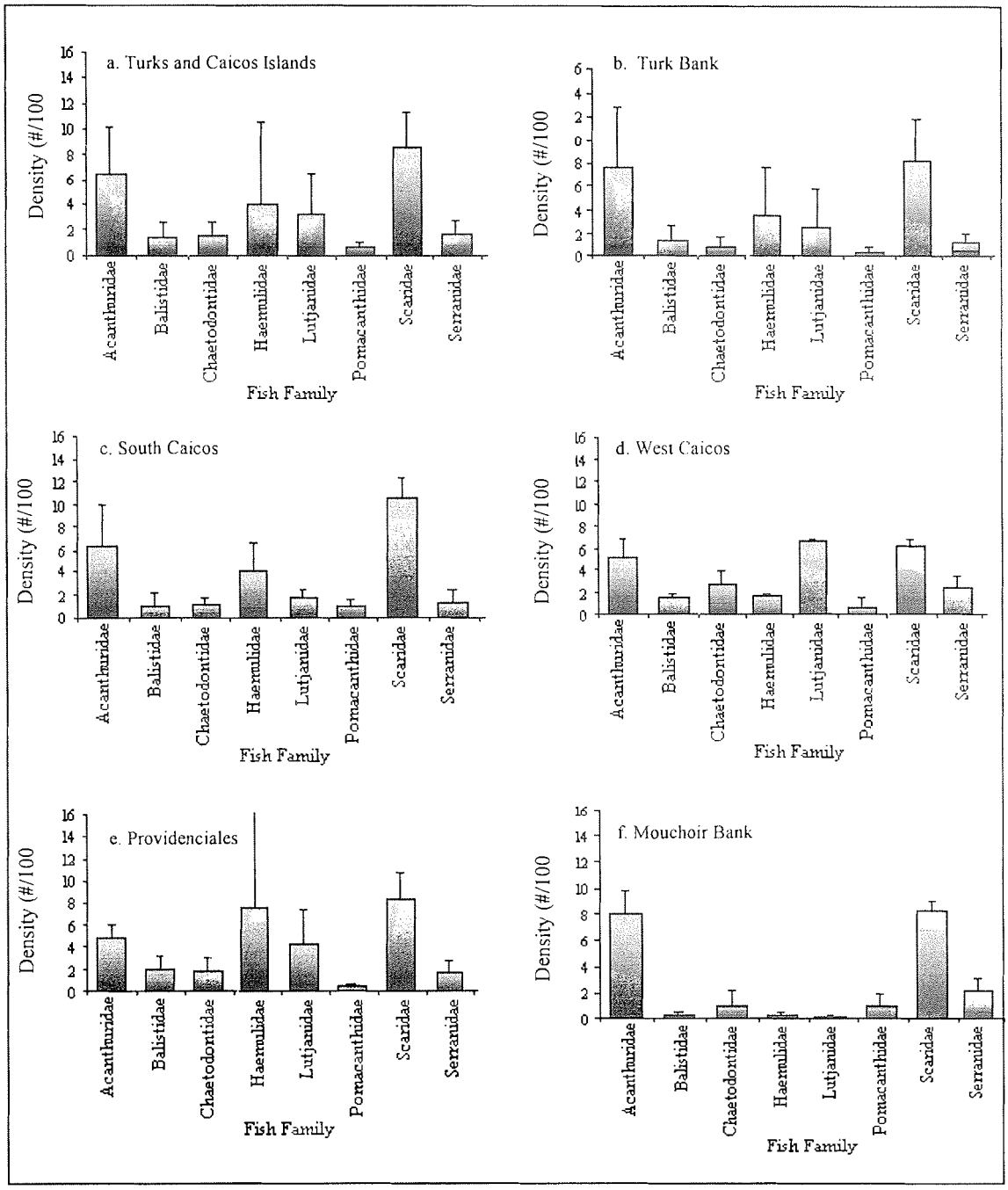


**Figure 5.** Mean fish density (no. individuals/100 $m^2$ ± sd) for AGRRA fishes in (**A**) the Turks and Caicos Islands, and five of its geographic areas: (**B**) Turk Bank, (**C**) South Caicos, (**D**) West Caicos, (**E**) Providenciales and (**F**) Mouchoir Bank.

The mean size of grunts was significantly different among the five locations (ANOVA, p=0.0312) with the largest being found in West Caicos (Table 3B) where the largest fishes in three other families (angelfish, butterflyfish and triggerfish) were also found. The average sizes of grunts and groupers were significantly smaller on the Mouchoir Bank (Mann-Whitney U-test, p=0.0477, 0.0445, respectively) when compared with the pooled data from the other TCI locations (Fig. 6B).

*Relationships.* Neither key herbivore (parrotfish ≥5 cm and surgeonfish) nor surveyed parrotfish density was correlated with macroalgal index (Fig. 8 A, B; Kendall's rank correlation tests, p>0.1). However, surgeonfish density was positively correlated with macroalgal index (Fig. 8C; Kendall's test, 0.01<P<0.05). A multiple regression analysis revealed that the size (diameter and height) of the select stony corals had the

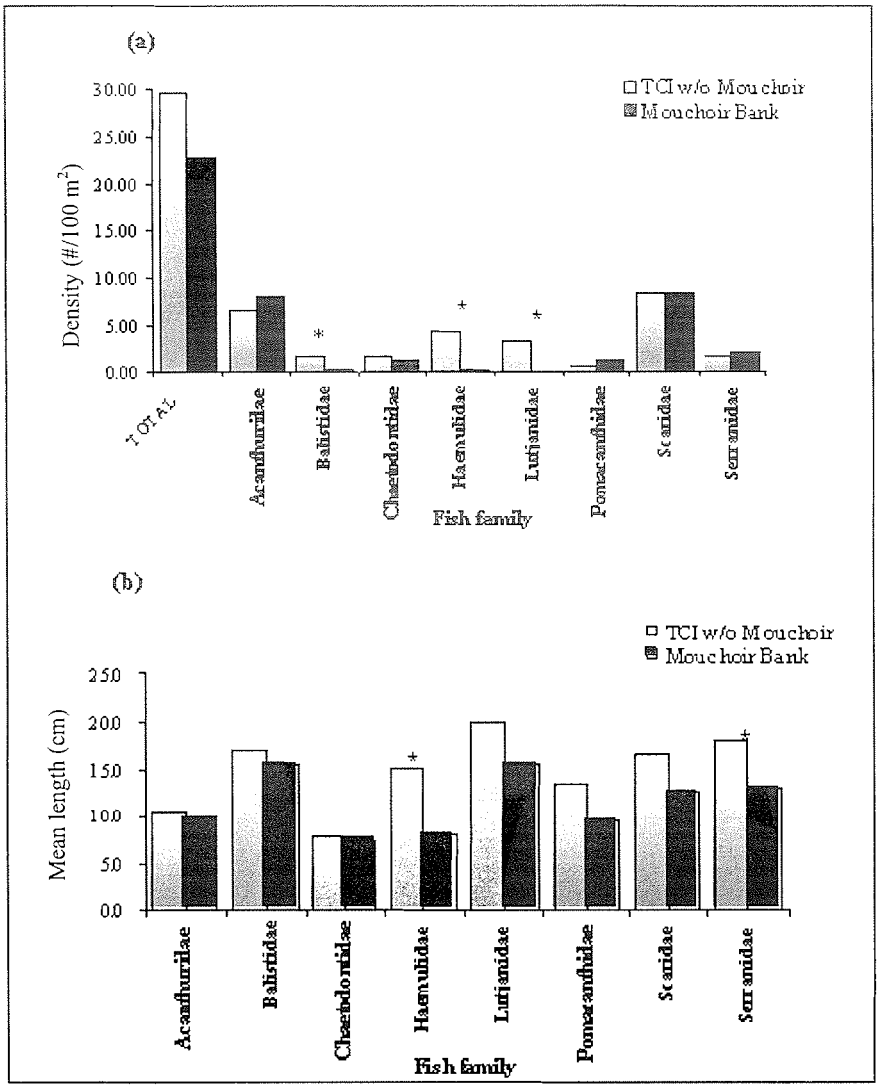


**Figure 6.** Mean (**A**) density (no. individuals/100 $m^2$) and (**B**) length (cm) for AGRRA fishes in Mouchoir Bank (2 sites) versus the remainder of the Turks and Caicos Islands (26 sites). * = statistically significant difference.

highest relative importance for fish density (Kruskal's index, diameter=0.0772, height=0.0502), although the overall result was not statistically significant (multiple regression, $p>0.1$). Neither the average density of the key herbivores nor the average total fish density showed a significant relationship with percent live stony coral cover (linear regression, $p>0.1$, Fig. 9A, B).

## Roving Diver Surveys

The total number of species observed during the RTD surveys was 120. The 25 most commonly seen species, along with their sighting frequency in the REEF (2000) database, are shown in Table 5. The highest total species richness occurred in West Caicos and Providenciales, while the lowest was in Mouchoir Bank. Parrotfishes were the

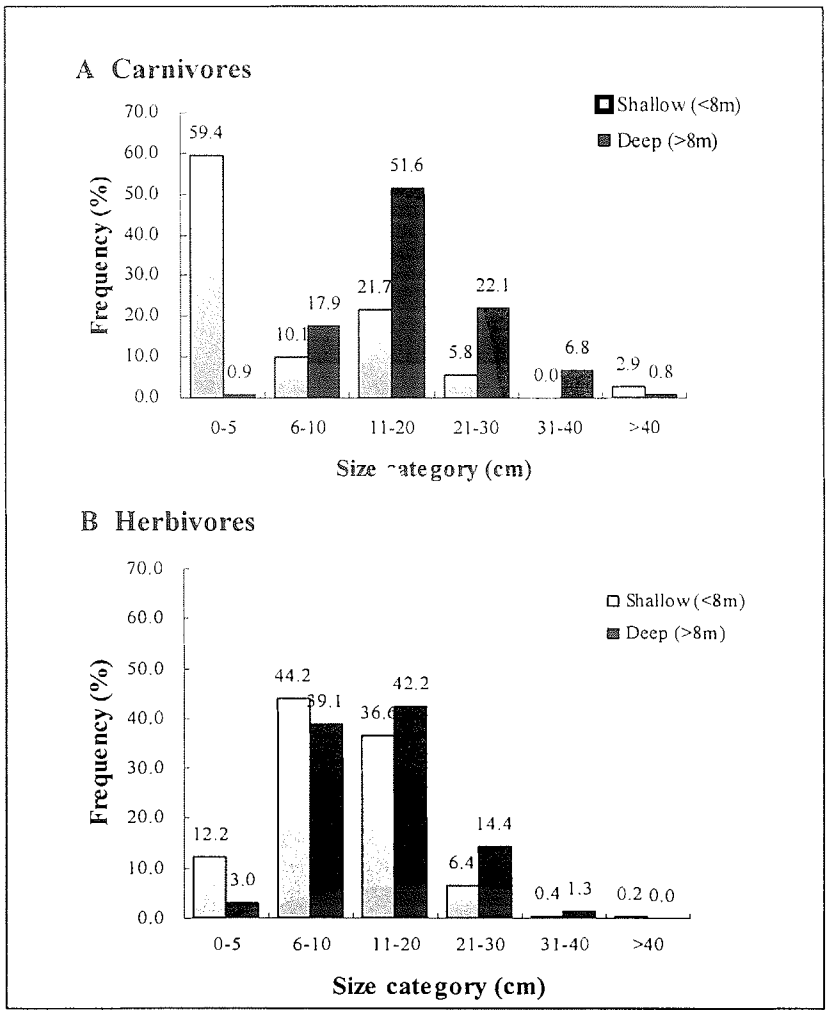


**Figure 7.** Size frequency distribution of (**A**) carnivores (lutjanids, select serranids) and (**B**) herbivores (acanthurids, scarids ≥5 cm, *Microspathodon chrysurus*) at <8m (629 fishes, 3 sites) and >8 m (3,968 fishes, 25 sites) in the Turks and Caicos Islands.

most common of the AGRRA fishes seen in the Turks and Caicos. Butterflyfish and angelfish were the least commonly encountered, with the exception of Mouchoir Bank where grunts and snappers were seen least frequently.

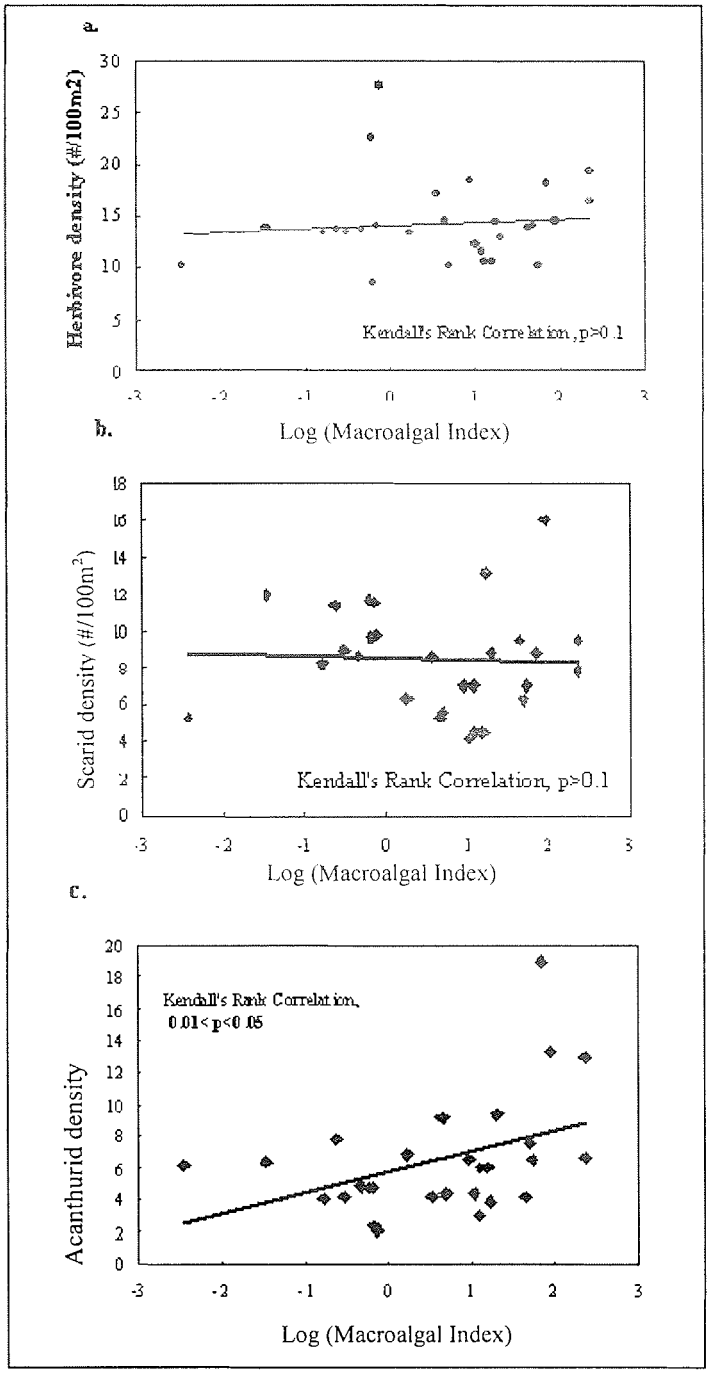


**Figure 8.** Correlation plots between mean log macroalgal index and mean density (no. individuals/100 $m^2$) of (**A**) herbivores (acanthurids, scarids ≥5 cm), (**B**) scarids ≥5 cm, and (**C**) acanthurids by site in the Turks and Caicos Islands.

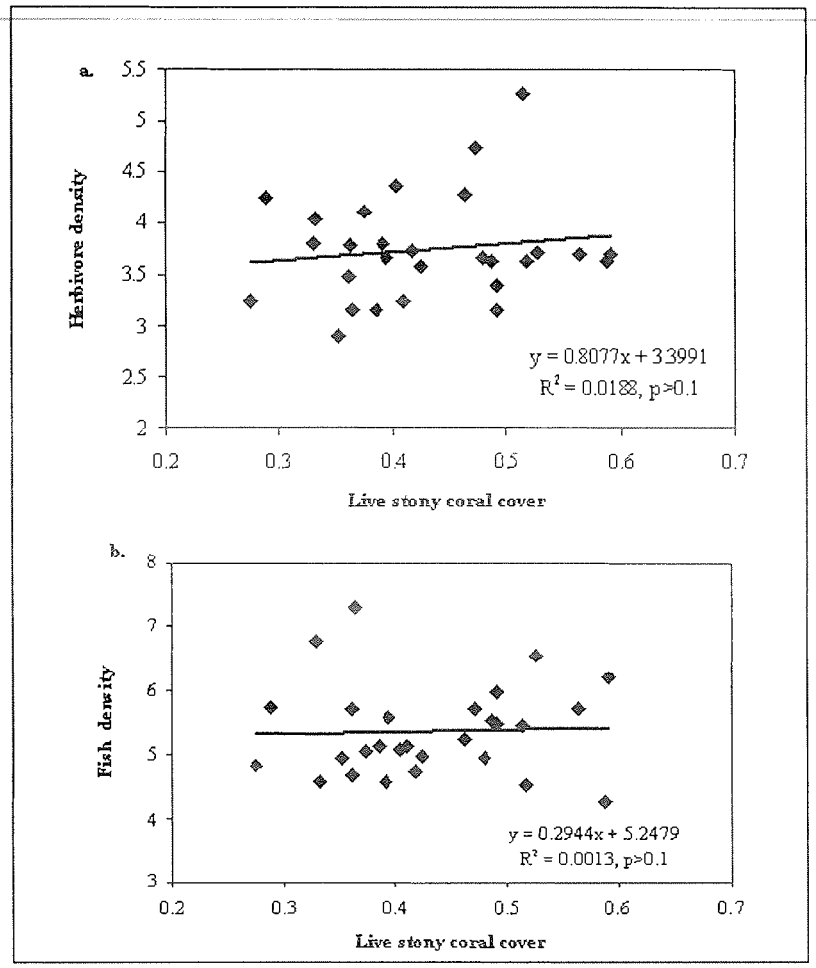


**Figure 9.** Relationship between mean live stony coral cover (%, arcsin-squareroot transformed) and mean density (no. individuals/100 $m^2$, squareroot transformed) of (A) Key AGRRA herbivovres and (A) all AGRRA fishes, by site in the Turks and Caicos Islands.

## DISCUSSION

The average grouper density in the TCI (1.62/100 $m^2$, Table 3A) was higher than Sluka et al. (1998) had found in the Florida Keys (0.01-0.13/100 $m^2$) and the Exuma Cays, Bahamas (0.10-0.90/100 $m^2$). Although comparisons must be made with caution due to the different methodologies used, it would appear that current fishing pressures on the Turks and Caicos Banks are relatively low. That groupers had higher densities in high-relief shelf-edge reefs may reflect some correlation between density and habitat complexity. The large numbers of grunts, particularly in Aquarium West (TC 28), were mainly small individuals and likely to have resulted from active recruitment.

The average length of groupers in the TCI was 17.5 cm. While smaller species like coney *(Epinephelus fulvus)* and graysby *(E. cruentatus)* were the most abundant, larger species such as Nassau *(Epinephelus striatus)* and black *(Mycteroperca bonaci)*

groupers were also recorded in the belt transects in eight reefs. Only two percent (6/271) of the groupers in the belt transects were larger than 40 cm in length. Equally large groupers were also sighted during several dives outside our belt transect areas. Since much of the area, whether protected or unprotected, is subject to some spearfishing, it is likely that large groupers are either so shy or so rare as to be seldom seen (Woodley et al., 2000, refer to "uncontrolled fishing in the marine parks" of the TCI.)

Illegal poaching appeared to be prevalent on Mouchoir Bank, probably due to its remote locality. We observed the use of spearguns. We deduced possible remnants of destructive fishing practices, such as chemicals and dynamite, from the peculiar way that stony corals had lost tissues and the way rubble from broken colonies was strewn on the reefs. Supporting information of such abuses was verbally provided by local fishery patrol officers. Notwithstanding our small sample size [two sites (TC11 and TC12), 20 transects], significantly lower species richness for the AGRRA fishes (Table 1), plus significantly lower densities for three of these families and smaller sizes for two families, of the AGRRA fishes (Fig. 6A,B), were recorded here. In summary, the Mouchoir Bank reefs appeared to suffer from overfishing and destructive fishing practices.

The number of species found during the RDT surveys (120) was much lower than the total number (319 as of May 2000) reported from the TCI in the Reef Environmental Education Foundation (REEF) database in 2002. No new species records resulted from our surveys; however, with a more extended sampling effort, it is likely that some new records could have been obtained.

The AGRRA belt transects are focused on ecologically and commercially important fishes to enhance the efficiency of the surveys; therefore, the data only provide species richness and diversity within a selected group of species. The RDT census provides supplementary data on the entire fish assemblage. The number of species recorded can differ substantially depending on the total number of divers, their level of experience, and the search time as seen in the REEF survey reports (at www.reef.org) which clearly show different results between expert and novice divers. Since the objectives of the AGRRA project is to obtain a regional perspective on the status of Caribbean coral reefs based on a standardized methodology, the results of the RDT surveys should be treated with some caution.

The overall results from the 1999 AGRRA survey revealed that the TCI reef fish communities are relatively diverse and healthy, except on Mouchoir Bank. Although reefs accessible from Providenciales (i.e., Providenciales, West Caicos) receive the largest number of snorkelers and scuba divers, currently their fish communities appear to be in relatively good condition. This may be due to the fact that most of the area is designated as marine parks in which fishing is prohibited. Similar designations are either lacking or not well enforced in South Caicos and Turk, which historically have had higher levels of fishing activity. That fish density and diversity showed nearly significant positive relationships with the size (as diameter and height, proxies for substratum

architectural complexity) of the ≥10 cm stony corals is in general agreement with previous findings by Ault and Johnson (1998a, 1998b) and Chabanet et al. (1997). The relationships found in the TCI between the diversity of these stony corals and the diversity of ecologically and commercially important fishes are rarely addressed in the literature (but see Chabanet et al., 1997). Hence the AGRRA project will provide an excellent opportunity for continued exploration of this topic.

## ACKNOWLEDGMENTS

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Table 1. Site information for AGRRA fish surveys in the Turks and Caicos Islands.

| Site Name | Site code | Latitude (° ' N) | Longitude (° ' W) | Survey date | Depth (m) | ≥10 cm stony corals (#/10 m) | % live stony coral cover (mean ± sd) | 30 m fish transects (#) | AGRRA fish species (#) |
|---|---|---|---|---|---|---|---|---|---|
| ***A. palmata patch reefs*** | | | | | | | | | |
| b/w Round and Gibbs Key | TC9 | 21 26.307 | 71 06.628 | Aug 17 99 | 3.5 | 8 | 10.5 ± 3.0 | 10 | 17 |
| E.of S. end of Grand Turk | TC10 | 21 27.534 | 71 06.818 | Aug 17 99 | 3.0 | 7 | 8.0 ± 4.0 | 10 | 16 |
| Ambergris Cay 1 | TC15 | -- | -- | Aug 20 99 | 6.0 | 9 | 15.5 ± 6.5 | 10 | 16 |
| ***High relief shelf-edge reefs*** | | | | | | | | | |
| Lighthouse Point (anchor) | TC1 | 21 31.139 | 71 08.037 | Aug 14 99 | 17.5 | 11 | 16.0 ± 9.0 | 11 | 18 |
| North Point (anchor) | TC2 | 21 32.220 | 71 06.553 | Aug 14 99 | 16.0 | 10.5 | 16.5 ± 6.0 | 12 | 19 |
| Coral Garden | TC3 | 21 27.493 | 71 09.301 | Aug 14 99 | 11.0 | 14 | 25.5 ± 7.0 | 10 | 29 |
| N. of Salt Cay (anchor) | TC5 | 21 22.408 | 71 12.078 | Aug 15 99 | 12.0 | 8.5 | 7.5 ± 2.0 | 10 | 21 |
| Mouchoir Bank | TC11 | 20 59.159 | 70 47.008 | Aug 18 99 | 23.0 | 11.5 | 10.5 ± 4.0 | 10 | 16 |
| The Arch | TC13 | 21 28.996 | 71 31.062 | Aug 19 99 | 11.0 | 12.5 | 20.5 ± 5.0 | 10 | 25 |
| Ambergris Cay 2 | TC16 | 21 22.359 | 71 35.949 | Aug 20 99 | 20.0 | 10 | 12.5 ± 8.5 | 10 | 22 |
| The Pinnacles (Grace Bay) | TC23 | 21 48.841 | 72 11.219 | Aug 26 99 | 10.0 | 12.5 | 31.0 ± 9.5 | 10 | 26 |
| Football Field | TC26 | 21 54.381 | 72 06.916 | Aug 27 99 | 19.0 | 16.5 | 28.5 ± 7.5 | 10 | 23 |
| ***Low-relief shelf-edge reefs*** | | | | | | | | | |
| West of Little Sand Key | TC4 | 21 23.658 | 71 10.088 | Aug 15 99 | 10.0 | 10.5 | 14.5 ± 6.0 | 10 | 19 |
| Casey's Wall (anchor, W. of Salt Cay) | TC6 | 21 18.201 | 71 13.388 | Aug 16 99 | 11.5 | 14.5 | 24.5 ± 6.5 | 10 | 21 |
| Black Forest | TC7 | 21 28.754 | 71 09.211 | Aug 16 99 | 11.5 | 13 | 21.0 ± 4.5 | 10 | 24 |
| Chief Minister's House | TC8 | 21 26.443 | 71 09.294 | Aug 16 99 | 16.0 | 12.5 | 24.0 ± 8.5 | 10 | 28 |
| Mouchoir Bank | TC12 | 21 01.369 | 70 49.108 | Aug 18 99 | 14.0 | 14 | 17.0 ± 6.0 | 10 | 17 |
| Airplane | TC14 | 21 32.762 | 71 27.348 | Aug 19 99 | 16.5 | 11.5 | 13.5 ± 3.5 | 6 | 14 |
| (No Name) | TC17 | 21 28.029 | 71 33.125 | Aug 21 99 | 15.0 | 11 | 14.5 ± 2.0 | 10 | 23 |
| Fish Hole | TC18 | 21 29.072 | 7130.629 | Aug 21 99 | 13.0 | 10.5 | 12.0 ± 3.0 | 10 | 22 |
| French Cay | TC19 | 21 29.357 | 72 13.456 | Aug 23 99 | 14.5 | 0 | 22.0 ± 6.0 | 10 | 22 |
| West Sand Spit | TC20 | 21 23.285 | 72 08.637 | Aug 23 99 | 13.5 | 12 | 20.0 ± 10.0 | 10 | 26 |
| Spanish Anchor (West Caicos wall) | TC21 | 21 38.739 | 72 28.473 | Aug 24 99 | 15.5 | 8 | 12.5 ± 4.0 | 10 | 22 |
| West Caicos Wall-middle | TC22 | 21 39.890 | 72 28.211 | Aug 24 99 | 18.0 | 12 | 22.0 ± 4.5 | 10 | 30 |
| Coral Gables (North side of Provo) | TC24 | 21 49.080 | 72 11.010 | Aug 26 99 | 11.0 | 12.5 | 22.0 ± 8.5 | 10 | 24 |
| Grace Bay (North of TC24) | TC25 | 21 49.809 | 72 10.395 | Aug 26 99 | 10.0 | 10.5 | 14.0 ± 6.0 | 10 | 23 |
| Grouper Hole | TC27 | -- | -- | Aug 27 99 | 12.0 | 15 | 31.0 ± 7.0 | 10 | 17 |
| Aquarium West | TC28 | 21 48.518 | 72 13.542 | Aug 27 99 | 17.0 | 11 | 12.5 ±3.5 | 10 | 25 |

Table 2. List of the AGRRA fish species observed in the belt transects in the Turks and Caicos Islands.

| Scientific name | Common name |
|---|---|
| **Acanthuridae** | **Surgeonfish** |
| *Acanthurus bahianus* | Ocean Surgeonfish |
| *Acanthurus chirurgus* | Doctorfish |
| *Acanthurus coeruleus* | Blue Tang |
| **Balistidae** | **Leatherjacket** |
| *Balistes vetula* | Queen Triggerfish |
| *Cantherines macrocerus* | Whitespotted Filefish |
| *Cantherines pullus* | Orangespotted Filefish |
| *Melichthys niger* | Black Durgon |
| **Chaetodontidae** | **Butterflyfish** |
| *Chaetodon aculeatus* | LongSnout |
| *Chaetodon capistratus* | Foureye |
| *Chaetodon ocellatus* | Spotfin |
| *Chaetodon striatus* | Banded |
| **Haemulidae** | **Grunt** |
| *Anisotremus virginicus* | Porkfish |
| *Haemulon album* | Margate (White) |
| *Haemulon aurolineatum* | Tomate |
| *Haemulon carbonarium* | Caesar |
| *Haemulon flavolineatum* | French |
| *Haemulon parra* | Sailors Choice |
| *Haemulon plumieri* | White |
| *Haemulon sciurus* | Bluestriped |
| **Lutjanidae** | **Snapper** |
| *Lutjanus analis* | Mutton |
| *Lutjanus apodus* | Schoolmaster |
| *Lutjanus mahogani* | Mahogany |
| *Ocyurus chrysurus* | Yellowtail |

| Scientific name | Common name |
|---|---|
| **Pomacanthidae** | **Angelfish** |
| *Holocanthus ciliarus* | Queen |
| *Holocanthus tricolor* | Rock Beauty |
| *Pomacanthus arcuatus* | Gray |
| *Pomacanthus paru* | French |
| **Scaridae** | **Parrotfish** |
| *Scarus croicensis* | Striped |
| *Scarus taeniopterus* | Princess |
| *Scarus vetula* | Queen |
| *Sparisoma aurofrenatum* | Redband |
| *Sparisoma chrysopterum* | Redtail |
| *Sparisoma rubripinne* | Redfin |
| *Sparisoma viride* | Stoplight |
| **Serranidae** | **Grouper** |
| *Epinephelus adscensionis* | Rock Hind |
| *Epinephelus cruentatus* | Graysby |
| *Epinephelus fulvus* | Coney |
| *Epinephelus guttatus* | Red Hind |
| *Epinephelus striatus* | Nassau |
| *Mycteroperca bonaci* | Black |
| *Mycteroperca tigris* | Tiger |
| **Other** | **Other** |
| *Bodianthus rufus* | Spanish Hogfish |
| *Caranx ruber* | Bar Jack |
| *Lachnolaimus maximus* | Hogfish |
| *Microspathodon chrysurus* | Yellowtail Damselfish |
| *Sphyraena barracuda* | Great Barracuda |

Table 3A. Mean density of AGRRA fishes, by area in the Turks and Caicos Islands.

| Area | Density (#/ 100 $m^2$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Herbivores | | Carnivores | | | | | | |
| | Acanthuridae | Scaridae (≥5 cm) | Haemulidae (≥5 cm) | Lutjanidae | Serranidae[1] | Balistidae | Chaetodontidae | Pomacanthidae | Other[2] |
| Providenciales | 4.86 | 8.28 | 7.50 | 4.28 | 1.69 | 1.97 | 1.86 | 0.56 | 2.28 |
| W Caicos | 5.08 | 6.29 | 1.63 | 6.75 | 2.42 | 1.58 | 2.75 | 0.58 | 1.71 |
| S Caicos | 6.36 | 10.66 | 3.99 | 1.74 | 1.38 | 1.05 | 1.15 | 0.90 | 1.48 |
| Grand Turk | 7.70 | 8.20 | 3.60 | 2.50 | 1.30 | 1.40 | 1.00 | 0.40 | 2.60 |
| Mouchoir | 8.00 | 8.33 | 0.17 | 0.08 | 2.17 | 0.17 | 1.00 | 1.08 | 1.92 |
| **All TCI** | **6.45** | **8.47** | **4.00** | **3.16** | **1.62** | **1.37** | **1.47** | **0.61** | **2.11** |

[1] *Epinephelus* spp. and *Mycteroperca* spp.
[2] Other = *Bodianus rufus, Caranx rubber, Lachnolaimus maximus* and *Sphyraena barracuda.*

Table 3B. Mean size of AGRRA fishes, by area in the Turks and Caicos Islands.

| Area | Length (cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Herbivores | | Carnivores | | | | | |
| | Acanthuridae | Scaridae (≥5 cm) | Haemulidae (≥5 cm) | Lutjanidae | Serranidae[1] | Balistidae | Chaetodontidae | Pomacanthidae |
| Providenciales | 10.92 | 18.28 | 14.46 | 23.37 | 16.20 | 18.15 | 7.65 | 11.46 |
| W Caicos | 10.68 | 17.17 | 19.46 | 22.72 | 16.54 | 18.42 | 8.11 | 18.08 |
| S Caicos | 10.62 | 16.58 | 13.92 | 18.19 | 20.03 | 16.80 | 6.92 | 13.81 |
| Grand Turk | 10.08 | 15.30 | 14.40 | 17.00 | 18.50 | 15.90 | 8.00 | 12.90 |
| Mouchoir | 10.04 | 12.66 | 8.00 | 15.50 | 13.02 | 15.50 | 7.45 | 9.49 |
| **All TCI** | **10.46** | **16.27** | **14.83** | **19.65** | **17.65** | **17.05** | **7.66** | **13.12** |

[1] *Epinephelus* spp. and *Mycteroperca* spp.

Table 4. Mean density of select AGRRA fishes, by site in the Turks and Caicos Islands.

| Site Code | Density (# /100 $m^{-2}$) | | | | |
|---|---|---|---|---|---|
| | Herbivores | | Carnivores | | |
| | Acanthuridae | Scaridae (>5 cm) | Haemulidae (>5 cm) | Lutjanidae | Serranidae[1] |
| ***A. palmata patch reefs*** | | | | | |
| TC9 | 13.33 | 16.00 | 7.50 | 7.33 | 0.50 |
| TC10 | 18.83 | 8.83 | 0.33 | 0.83 | 0.83 |
| TC15 | 13.00 | 9.50 | 0.17 | 1.33 | 0.67 |
| **Mean ±sd** | **15±3.2** | **11.4±3.9** | **2.7±4.2** | **3.2±3.6** | **05±0.83** |
| ***High-relief shelf-edge reefs*** | | | | | |
| TC1 | 6.00 | 4.50 | 4.00 | 0.17 | 1.00 |
| TC2 | 7.64 | 6.25 | 1.53 | 0.56 | 0.97 |
| TC3 | 2.33 | 11.50 | 13.00 | 8.00 | 0.83 |
| TC5 | 6.00 | 4.50 | 4.00 | 0.17 | 1.00 |
| TC11 | 6.67 | 7.83 | 0 | 0 | 1.50 |
| TC13 | 4.67 | 11.67 | 5.17 | 2.50 | 1.83 |
| TC16 | 3.83 | 13.17 | 6.50 | 2.33 | 1.33 |
| TC23 | 6.33 | 12.00 | 3.50 | 7.00 | 2.17 |
| TC26 | 4.17 | 9.50 | 4.33 | 3.83 | 0.67 |
| **Mean ±sd** | **5.2±1.6** | **8.9±3.3** | **4.7±3.6** | **2.7±3.01** | **0.7±2.2** |
| ***Low relief shelf-edge reefs*** | | | | | |
| TC4 | 9.17 | 5.33 | 0.33 | 0 | 1.33 |
| TC6 | 6.83 | 6.33 | 1.83 | 0 | 2.33 |
| TC7 | 4.83 | 8.67 | 0.50 | 1.67 | 1.67 |
| TC8 | 2.00 | 9.83 | 3.17 | 6.50 | 2.33 |
| TC12 | 9.33 | 8.83 | 0.33 | 0.17 | 2.83 |
| TC14 | 4.17 | 8.61 | 6.94 | 1.94 | 0.28 |
| TC17 | 7.83 | 11.33 | 1.67 | 1.50 | 3.33 |
| TC18 | 4.67 | 9.67 | 3.50 | 0.83 | 0.83 |
| TC19 | 6.50 | 7.00 | 0.67 | 4.67 | 0.67 |
| TC20 | 6.50 | 7.00 | 1.00 | 3.67 | 2.50 |
| TC21 | 4.33 | 4.17 | 1.00 | 4.83 | 5.00 |
| TC22 | 3.00 | 7.00 | 3.83 | 13.83 | 1.50 |
| TC24 | 4.00 | 8.17 | 3.67 | 8.50 | 1.67 |
| TC25 | 6.17 | 5.33 | 0 | 3.67 | 3.50 |
| TC27 | 4.17 | 9.00 | 0.17 | 1.33 | 1.17 |
| TC28 | 4.33 | 5.67 | 33.33 | 1.33 | 1.00 |
| **Mean ±sd** | **5.4±2.1** | **7.62±1.9** | **3.8±8.1** | **3.4±3.7** | **0.3±5** |

[1] *Epinephelus* spp. and *Mycteroperca* spp.

Table 5. Twenty-five most frequently sighted fish species during roving diver surveys in the Turks and Caicos Islands, with mean densities for species recorded in belt transects.

| Scientific name | Common name | Sighting frequency[1] (%) | Density (#/100m$^2$) |
|---|---|---|---|
| *Thalassoma bifasciatum* | Bluehead Wrasse | 97 | - |
| *Halichoeres garnoti* | Yellowhead Wrasse | 97 | - |
| *Scarus taeniopterus* | Princess Parrotfish | 97 | 1.32 |
| *Sparisoma viride* | Stoplight Parrotfish | 94 | 2.08 |
| *Chromis cyanea* | Blue Chromis | 91 | - |
| *Stegastes partitus* | Bicolor Damselfish | 88 | - |
| *Gramma loreto* | Fairy Basslet | 88 | - |
| *Acanthurus coeruleus* | Blue Tang | 88 | 3.65 |
| *Scarus croicensis* | Striped Parrotfish | 88 | 1.84 |
| *Epinephelus fulvus* | Coney | 88 | 1.27 |
| *Chaetodon capistratus* | Foureye Butterflyfish | 88 | 1.38 |
| *Holocanthus tricolor* | Rock Beauty | 85 | 0.59 |
| *Haemulon flavolineatum* | French Grunt | 82 | 2.83 |
| *Caranx ruber* | Bar Jack | 82 | 0.80 |
| *Acanthurus bahianus* | Ocean Surgeonfish | 79 | 2.72 |
| *Melichthys niger* | Black Durgon | 76 | 1.67 |
| *Ocyurus chrysurus* | Yellowtail Snapper | 73 | 2.13 |
| *Sparisoma aurofrenatum* | Redband Parrotfish | 70 | 1.32 |
| *Pseudupeneus maculatus* | Spotted Goatfish | 67 | - |
| *Bodianthus rufus* | Spanish Hogfish | 67 | 0.33 |
| *Chaetodon striatus* | Banded Butterflyfish | 67 | 0.43 |
| *Haemulon sciurus* | Bluestriped Grunt | 64 | 1.53 |
| *Aulostomus maculatus* | Trumpetfish | 64 | - |
| *Stegastes planifrons* | Threespot Damselfish | 61 | - |
| *Scarus vetula* | Queen Parrotfish | 61 | 1.89 |

[1]Sighting frequency for the AGRRA surveys from the REEF database at http://www.reef.org/data/twa/surveys/index.shtml