Status of *Acropora palmata* Populations off the Coast of South Caicos, Turks and Caicos Islands

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ABSTRACT

This study is the first detailed assessment of *A. palmata* populations of the Turks and Caicos Islands. A total of 203 individual colonies and 62 thickets were tagged on five shallow reefs. Depth, percentages of living tissue, recent mortality and old skeleton were estimated. Presence of disease and predatory snails was noted, and disease spread and grazing rates of the snails estimated. Colonies were found in depths of 0.2 - 4 m. Living tissue for individual colonies (75.9% ± 2.2 SE) was significantly greater than for thickets (58.6% ± 3.6) and in both cases exceeded old skeleton (individuals: 22.7% ± 2.1 SE, thickets: 38.0% ± 3.4 SE). Percentage of recent mortality was very low (individuals: 1.3% ± 0.3 SE, thickets: 3.4% ± 0.7%). We found WBD (n = 2), white pox disease a (WPDa) (n = 7) and white pox disease b (WPDb) (n = 14) with greatly varying spreading rates. The WBD infected colonies showed an atypical spread from the top of the branch towards the base. *Coralliophila abbreviata* and *C. caribaea* affected 3.7 - 54.7% of the populations (grazing rate: 4.29 cm^2/day/snail ± 1.16 SE). South Caicos' *A. palmata* populations are still in good condition, though increasing human disturbances combined with disease and predatory snails may threaten these populations.

KEY WORDS: *Acropora palmata*, assessment, Turks and Caicos Islands

Estado de las Poblaciones de *Acropora palmata* en la Costa sur de South Caicos, las Islas Turks & Caicos

Durante nuestra investigación marcamos un total de 203 colonias individuales y 64 arbustos (que constituyen varias colonias) de arrecifes someros. Estimamos la profundidad, el porcentaje de tejido vivo y muerto de cada colonia. La presencia de la enfermedad del blanqueo y de caracoles depredadores fueron también anotadas. Estimamos también la tasa de cambio de la difusión de la enfermedad del blanqueo y la tasa de consumos de tejido por parte de los caracoles. Las colonias se encuentran en profundidades entre 0.2 - 4 m. El porcentaje de tejido vivo en las colonias fue de 75.85% (± 2.17 SE) y fue mayor que en los arbustos (58.59% ± 3.63). En ambos casos excede el esqueleto (colonias individuales: 22.73% ± 2.07 SE, arbustos: 38.03% ± 3.38 SE). El porcentaje de mortalidad reciente fue muy bajo (colonias individuales: 1.33% ± 0.26 SE, arbustos: 3.38% ± 0.72%). Encontramos varias enfermedades: WBD (n = 2), WPDa (n = 7) y WPDb (n = 14). Una de las colonias infectadas mostraba una atípica forma de difundirse desde la cabeza del coral hacia la base. Los caracoles *Coralliophila abbreviata* y *C. caribaea* afectaron entre 3.7 y 54.7% de la población de coral. Su tasa de consumo se coral se estimo en 4.29cm^2/dia/caracol ±1.16 SE). La población del sur de la isla de Caicos de *A. palmata* esta aun en buenas condiciones. Sin embargo el aumento del disturbio por actividades humanas y la depredación por caracoles puede amenazar estas poblaciones en el futuro.

PALABRAS CLAVES: *Acropora palmata*, estado de las poblaciones, Islas Turks & Caicos

INTRODUCTION

The Caribbean elkhorn coral (*Acropora palmata*) is one of the main reef-building coral species of the Caribbean and Florida reef tract (Lirman 2002). Colonies prefer exposed reef crest and fore reef environments in depths of less than 6 m (Adey and Burke 1976), although isolated corals may occur to a depth of 18 m (Bruckner 2002). It is the largest of the acroporids with colonies growing up to 3 m in diameter (Bruckner 2002). The three-dimensional shape of this coral species makes it essential for creating habitat for many reef fish and other reef associated organisms (Gladfelter and Gladfelter 1978, Lirman 1999, 2002). The growth of detached fragments in between periods of disturbances creates dense thickets (Adey and Burke 1976). Thicket formation reduces wave energy from offshore and protects seagrass, mangrove habitats and coastline (Bruckner 2002). The loss of thickets results in major losses of reef function and biodiversity (Bruckner 2002). In areas where storm disturbances are low, only isolated colonies occur because of decreased fragmentation (Dustan 1977).

In many areas, the characteristic "*Acropora palmata* zone" has been transformed into rubble fields with a few, isolated living colonies (e.g. Weil et al. 2002). In the early 1970s, *A. palmata* populations were relatively healthy, but subsequent declines were observed in the 1970s to 1980s and again through the 1990s (Kramer 2002). Over the last three decades, the Caribbean has experiences losses of 95% or more of the once dominating *A. palmata* populations (Precht et al. 2002). Paleontological studies show acroporids dominated coral reefs communities throughout the Caribbean from the Pleistocene to the end of the 1970s, suggesting the present mortality rates are without precedent in the Holocene Epoch (Mesolella 1967, Jackson 1992). In most cases, *A. palmata* populations are being affected by a number of different stresses simultaneously resulting in a decreased ability to regenerate (Aronson et al. 2002). In 1999, *A. palmata* was added together with *A. cervicornis* to the Candidate Species List of the Endangered Species Act by National Oceanic and Atmospheric Administration (NOAA)'s National Marine Fisheries Service (Bruckner 2002), and a status review report put together by NOAA Fisheries, Protected Resources Division is expected in March 2005 (J. Moore Pers. comm.).

Until recently White Banding Disease (WBD) was considered the dominant cause of *A. palmata* mortality throughout the Caribbean (Aronson and Precht 2001). The paleontologically unprecedented outbreaks of WBD have led many to speculate anthropogenic stressors are the heart of the disease outbreaks, but no direct evidence of this has yet been found (Richardson 1998, Aronson and Precht 2001). Colonies infected by WBD show a distinctive white band moving from the base to the branches of the colony (Gladfelter 1982). First documented in 1996, the highly contagious and rapidly spreading White Pox Disease (WPD) now rivals WBD as the leading cause of disease related *A. palmata* mortality (Patterson et al. 2002). It has been suggested that WPD is caused by a common human fecal enterobacterium, *Serratia marcescens* (Patterson et al. 2002).

Predation by snails is also a cause of significant concern, as they can quickly consume large quantities of coral (Baums et al. 2003a). In the past few decades, 10 - 20% of *A. palmata* populations have been observed to be infested by the corallivorous snail *Coralliophila abbreviate* in the Florida Keys (Baums et al. 2003a). Additionally, feeding rates as high as 9 cm^2/snail/day have been calculated, indicating that snails have the potential to seriously affect the viability of *A. palmata* (Baums et al. 2003a).

The Turks and Caicos Islands (TCI) have low human population pressure when compared to many other Caribbean islands, and the one study that has been done in the area describes the reefs to be in generally good condition (Riegl et al. 2003). Around the east and south-east side of South Caicos and along the west side of Long Cay, healthy looking colonies and even thickets of *A. palmata* have been observed. The aims of this research project are to collect baseline data of *A. palmata* populations on the reefs around South Caicos and Long Cay and to determine their health status. We expect that *A. palmata* populations on reefs around South Caicos are in very good condition without significant signs of disease and snail predation.

MATERIALS AND METHODS

Study Sites, Depth and Density Estimation

Five different reefs off the coast of South Caicos, TCI, were selected to determine the *A. palmata* population (Figure 1). Shark Alley and Cox Development are fringing reefs. Admirals Aquarium, Tuckers and South End Long Cay are patch reefs.

All research was conducted snorkeling during March and April 2004. The depth the colonies were found in was measured using the base of the colony as a reference point. To estimate density of the different reefs, the size of each reef monitored was measured using 30 m measure tapes that were run in straight lines along the edges of the total reef area (rectangular areas) and divided by the number of colonies found in these areas.

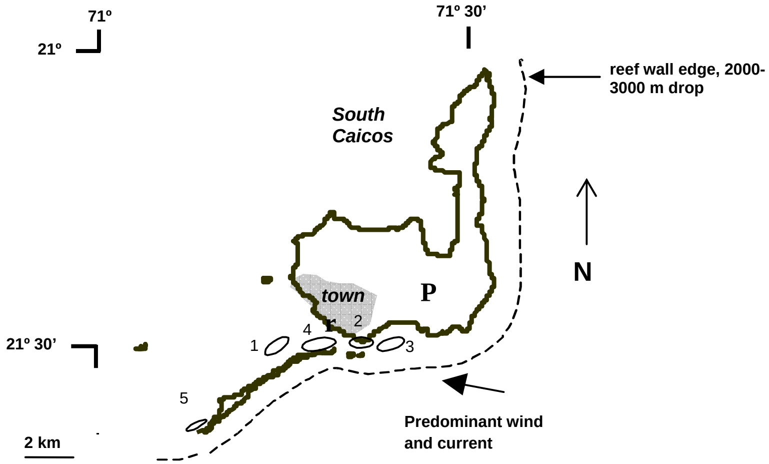

Figure 1. Map of South Caicos with the study sites (1 = Admirals Aquarium, 2 = Cox Development, 3 = Tuckers, 4 = Shark Alley, 5 = South End Long Cay) and showing the predominant wind and current direction.

Health Status

Each colony measured was tagged using a numbered aluminum tag hammered into dead substrate close to the base of the colony. During most of the study period, the sea was very rough. Hence, we were not able to include all colonies in the study since some were too difficult to survey without damaging corals. Smaller individuals may be slightly under-represented because, due to time constrains, we focused on larger colonies to cover a greater survey area. Living tissue, recent mortality, and old dead skeleton of each tagged colony were visually estimated. Areas of recent mortality were evident as white bare skeleton, whereas old dead areas were covered with algae.

Diseases and Their Spread

Each tagged colony was observed for disease. Colonies that showed signs of disease were tagged with a cable tie (if possible it was placed on dead skeleton) as a reference point. Calipers were used to measure the width and length, to the closest millimeter, of either the total recently dead area killed off by WBD or the width and length of each individual pox for White Pox Disease a (WPDa). The course of White Pox Disease b (WPDb) was monitored by counting the number of pox present on one colony and recounting them when revisited. The colonies were revisited one to three times during the study period to calculate the rate the disease proceeded.

Predatory Snails and Their Grazing Rates

Pilot observations showed that the main predators of *A. palmata* of South Caicos' reefs were the two corallivorous snails *Coralliophila abbreviata* and *C. caribaea*. If corallivorous snails were observed on tagged colonies, the quantity of the snails was visually estimated. Individual snails were collected, the species noted, and siphonal length measured to the nearest millimeter using a caliper to determine the size distribution. Some randomly selected snail infested colonies were revisited to estimate approximate rates of grazing. Cable ties were tied at the bases of grazed branches (if possible on dead areas) to determine a reference point. Grazing activity was then calculated measuring the distance from the cable tie to the furthest boundary of living tissue and grazed area and the width of the grazed area to the nearest millimeter using a caliper.

Statistical Analysis

A one-way ANOVA was conducted when data was homogenous (Levene's test) and normal (normal probability plot of residuals), or a non-parametric Kruskal Wallis ANOVA median test was used.

RESULTS

Density and Depth

We surveyed 203 individual colonies and 62 thickets consisting of 280 individual colonies (Table 1). The five reefs surveyed differed in size. We did not measure the reef area of South End Long Cay due to time and weather constrains. The density of *A. palmata* individual colonies, thickets, and total colonies varied between the sites (Table 1). Colonies and thickets were found in very shallow areas on all reefs ranging from 0.2 to 0.5 m. At South End Long Cay, and Admirals Aquarium, colonies were found down to 1 m, whereas at Tuckers colonies were observed down to 4 m depth. The mean depth of *A. palmata* individual colonies and thickets was 1.2 m (± 0.04 SE).

Health Status

Overall, individual colonies and thickets combined had 72.7% (± 1.9 SE) living tissue, 25.5% (± 1.8 SE), old dead skeleton, and 1.8% (± 0.3 SE) recent mortality. There was a significant difference between these three categories (Kruskal-Wallis: $H(1, n = 813) = 505.205$, $p < 0.001$).

We also found significant differences between colonies and thickets in the amount of living tissue (ind. colonies 75.8% (± 2.2 SE), thickets 59% (± 3.7 SE)), old dead skeleton (ind. colonies 22.7% (± 2.1 SE), thickets 36.8% (± 3.4 SE)), and recent mortality (ind. colonies 1.3% (± 0.3 SE), thickets 3.5% (± 0.7 SE)) (Kruskal Wallis: living tissue $H(1, n = 265) = 18.825$, $p < 0.001$; old dead skeleton $H (1, n = 265) = 17.863$, $p < 0.0001$, recent mortality $H(1, n = 265) = 17.044$, $p < 0.0001$).

Table 1. Area (m^2) of reefs, number of individual colonies, thickets with individual colonies in parentheses, total number of individual colonies and thickets' individual colonies) surveyed and density (colonies/m^2) of only individual colonies, thickets and total colonies. Admirals = Admirals Aquarium, Cox = Cox Development, Shark = Shark Alley, SELC = South End Long Cay.

site	area m^2	individual colonies	thickets (colonies)	total colonies	density (colonies/m^2)
Admirals	900	6	0	6	0.007
Cox	8,360	85	24 (99)	184	0.01/0.003/0.02
Shark	9,273	50	31 (146)	196	0.005/0.003/0.02
Tuckers	28,215	50	4 (27)	77	0.002/0.0002/0.003
SELC	-	12	3 (8)	20	-
total	-	203	62 (280)	483	-

Individual colonies at all sites had more living tissue than old dead skeleton, whereas thickets showed much more variation (Figure 2a,b). For thickets at Cox Development and Shark Alley living tissue was significantly greater than old dead skeleton (Kruskal-Wallis: Cox Development H (1, n = 48) = 9.932, p = 0.0016; Shark Alley H(1, n = 62) = 3.895, p = 0.048), whereas at Tuckers Reef old dead skeleton equals the amount of living tissue (Kruskal-Wallis: H(1, n = 12) = 1.283, p = 0.257) (Figure 2b). Shark Alley and Tuckers showed highest percentage of recent mortality (Figure 2b). Admirals was the only site that had 100% living tissue. South End Long Cay did not show any recent mortality.

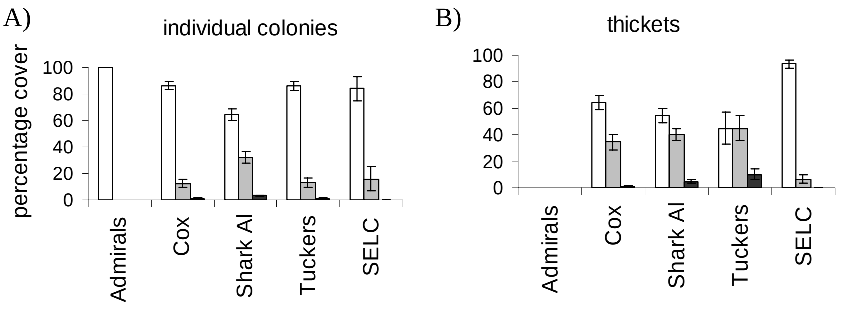

Figure 2. Percentage living tissue, old dead skeleton and recent mortality of a) individual *A. plamata* colonies and b) *A. plamata* thickets for each site. Error-bars represent standard errors. white = living tissue, grey = old dead skeleton, black = recent mortality.

Diseases

Across all sites 11.5% of the individual colonies were found to be infected with WBD (0.5%), WPDa (4.3%), WPDb (6.7%), and WBD and WPDa at the same time (0.5%). Of all thickets 6.3% were observed to have either WPDa (4.7%) or WBD (1.6%). Shark Alley was the only site where WBD occurred, WPDb was observed at Cox Development and Tuckers and WPDa was found at Admirals Aquarium, Cox Development and Shark Alley. The percentage of diseased colonies at the different sites ranged from 0% to 17.9%. At South End Long Cay, none of the tagged colonies were infected by disease. The two colonies that were found with WBD at Shark Alley were in relatively close proximity to each other. Both instances of WBD exhibited atypical spread patterns. On one colony the band appeared to have initially followed a normal spread pattern (from the base to the branches). However, once the end of the second branch was reached, the disease appeared to have spread to the tip of a neighboring branch. The other colony also showed this atypical spread pattern, starting at the tip of the branch and working its way down the branch. Visual surveys showed that WPDb tended to be found on colonies within close proximity to other WPDb colonies; this trend was not nearly as strong with WPDa. The atypically WBD showed a mean spreading rate of 2.80 cm^2/day (± 0.8 SE, n = 3) and a maximum rate of 5.47 cm^2/day. At Shark Alley, WPDa showed a higher progress rate (1.83 cm/day, ± 0.54 SE, n = 13) compared to Admirals Aquarium (0.09 cm/day, ± 0.03 SE, n = 4) and Cox Development (0.20 cm/day, n = 1). WPDb spreading rate was similar between Cox Development (0.54 cm/day, ± 0.71 SE, n = 4) and Tuckers (0.67 cm/day, ± 0.54 SE, n = 6). At Tuckers two colonies with WPDb had decreasing numbers of pox, whereas at Cox Development the numbers of pox on one colony did not change, though two colonies showed first increasing numbers and then decreasing. All other colonies of these sites and the other reefs showed increasing numbers of pox.

Predatory Snails and Their Grazing Rates

Predatory snails, *C. abbreviata* and *C. caribbaea*, were found on 21% of the individual colonies and 28% of the thickets across all sites. Most often there were less than 10 snails followed by 10 - 19 snails per colony or thicket (Table 2). One individual colony and one thicket had more than 50 predatory snails grazing on its tissue (Table 2).

Table 2. Number of predatory snails found on individual colonies and thickets.

	number of snails						
	<10	10-19	20-29	30-39	40-49	50+	total
individual colonies	23	13	3	3	0	1	43
thickets	8	5	2	2	0	1	18
total	31	18	5	5	0	2	61

Snail infestation differed between the reefs and the individual colonies and thickets (Figure 3). At Cox Development only individual colonies were found with predatory snails, whereas at South End Long Cay snails were only observed on thickets. These infestations accounted for less than 10% of the individual colonies and thickets at each site, respectively (Figure 3). Of all sites, colonies at Shark Alley were infested most heavily by predatory snails whereas no snails were found at Admirals Aquarium. At Shark Alley and Tuckers snails of the species *C. abbreviata* were collected to look at the frequency distribution. The smallest snail measured was 2 mm and the largest 35 mm in length. There was no difference in the size distribution between the two sites (one-way ANOVA: F (1, 164) = 0.132, p = 0.716; Tuckers: mean = 17.2 mm ± 0.5 SE; Shark Alley: mean = 17.35 ± 1.3 SE). The mean grazing rate was 4.29 cm/snail/day (± 1.2 SE) for all sites combined. There was no significant difference in the grazing rate between the reefs (one-way ANOVA: $F_{2,12}$ = 0.026, p = 0.801; Tuckers: 2.7 cm/snail/day ± 0 SE, n = 2; Shark Alley: 4.99 cm/snail/day ± 1.6 SE, n = 8; Cox: 3.8 cm/snail/day ± 2.0 SE, n = 5).

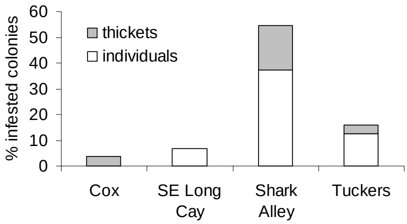

Figure 3. Percentage colonies infested with predatory snails (*C. abbreviata* and *C. caribbaea*) for total individual colonies and thickets per site. The percentage of both categories was calculated from the total number of individual colonies and thickets per site combined. For sample sizes see table 2.

Predatory Snails and Disease Incidences

Only six of all 280 individual colonies and thickets were found to be infected by diseases while simultaneously being grazed on by predatory snails (Table 3). Five of these colonies were found at Shark Alley, where more than 50% of the colonies that we surveyed were found with snails. The remaining snail and disease infected colony was found at Tuckers, where nine more colonies were found with only snails. Hence, there does not seem to be a relationship between disease infection and snail predation.

Table 3. Number of colonies and thickets combined for each site with presence or absence of disease and/or snails.

	Admirals	Cox	Shark Al	SELC	Tuckers
total	6	109	81	15	56
healthy	1	98	34	15	38
disease, no snails	1	7	5	0	9
disease, snails	0	0	5	0	1
snails only	0	4	42	0	8

DISCUSSION

Density and Depth

A study conducted in the Florida Keys found *A. palmata* density ranging from 0.01 to 0.07 colonies/m among different regions (Chiappone et al. 2002). These values differed from our findings (0.0002-0.01 colonies/m). These discrepancies may be caused by an underestimation of colonies in our study, since due to weather limitations and time constrains, some fragments and smaller colonies were ignored. Furthermore, Chiappone et al. (2002) used transects, while we measured total area of the reefs where we surveyed the *A. palmata* populations. Considering that the predominant habitat of *A. palmata* are shallow outer reef slopes exposed to wave action (Vernon 2000), our results may be an underestimation of *A. palmata* density when compared to Chiappone et al. (2002). In the past, most *A. palmata* populations throughout the Caribbean were mainly composed of dense thickets, but now individual colonies are more prevalent (Bruckner 2002). We found both individuals and thickets on the reefs. Because thickets develop during periods between storms (Adey and Burke 1976), the thickets we observed on the reefs off South Caicos may have grown due to the fact that the last hurricane hit the TCI over 14 years ago. Since the high growth rate of *A. palmata* is 5 - 10 cm per year (Adey and Burke 1976), 14 years may be a long enough time period to grow extensive thicket populations.

The depth range of *A. palmata* around South Caicos varied from 0.2 - 3.5 m. However, *A. palmata* grows ideally in depths of 5 - 6 m (Bruckner 2002). Shallow depths could potentially inhibit the growth of *A. palmata* because of the increased risk of sub-aerial exposure and high sea surfaces temperatures, which can cause bleaching and eventually coral mortality. Despite this, we found large, healthy populations in depths less than 5 m. This may be due to the absence of bleaching events in the TCI over the last decades. However, there is no data available supporting this hypothesis.

Health Status

Overall, the *A. palmata* populations of South Caicos are in relatively healthy condition compared to populations at other locations. The amount of live tissue of *A. palmata* colonies in this study ranges from 65% to 100% per site with an average of around 80%. In contrast, a study performed in the Florida Keys, USA found approximately 60% live coral tissue (Miller et al. 2002). Generally, the TCI reefs show very little signs of being negatively impacted from human activities (Spalding et al. 2001). However, there is cause to worry as three hotel construction sites on South Caicos may increase sedimentation to the surrounding waters, and *A. palmata* is very intolerant to sediment pollution as it causes death of the underlying tissue (Rogers 1983). An increased development can also induce eutrophication that increases algal growth competing with corals for space (Lapointe 1997). To date, finfish is not the targeted seafood of the South Caicos fishermen; however, this is expected to change as tourism increases. Intensive fishing in the area could negatively affect the *A. palmata* populations because as herbivorous fish populations decline, algal biomass increases and out-competes the corals (Steneck 1988). In the South Caicos area, fishing can also directly induce negative effects on corals when illegal chemicals such as bleach are used or when lines, nets, plastic bags or other materials get wrapped around the colony branches.

Disease Abundance

Despite the fact that the reefs of the TCI have been reported to be almost pristine (Riegel et al. 2003), we found WBD, WPDa, and WPDb affecting *A. palmata* colonies. Only colonies at South End Long Cay, the site that is furthest away, showed no diseases. Hence, it is possible that the *A. palmata* colonies closer to South Caicos are more affected by human activities.

WBD was only found on two colonies at one of the five sites. Both colonies were in close proximity to each other, which might suggest that their incidence is related. The progression of the band between branches on one of the two infected colonies also suggests that the disease may be contagious. To date there are no instances of WBD on *A. palmata* spreading from the tip of the branch to the base. This was only reported from WBD Type II infected colonies of *A. cervicornis* (Ritchie and Smith 1998). While the mean rate of spread per day (2.80 ±0.81 SE cm^2/day) of WBD found during this study is close to the maximum rate of expansion (2.06 cm^2/day) reported by Davis et al. (1986), the maximum rate of spread found at Shark Alley was much higher. The atypical progression may be the reason for the increased spread rate.

The mean rate of lesion expansion of WPDa was lower than that reported by Patterson et al. (2002) in the Florida Keys. Our results concur with the findings of Patterson et al. (2002) concerning high variability in tissue loss between colonies. However, we also found high variability within colonies. Patterson et al. (2002) found WPD highly contagious within and among reefs. We support their findings, since all WPD incidences we report were found on the four reefs that were within close proximity of each other. The site that was the most remote (South End Long Cay) had no diseases present. This might show a very high frequency of between reef WPD spread. However, of the individual types of WPD we found that WPDa does not appear to have a high within reef rate of transmittance, whereas WPDb is found exclusively in colony clusters, thus exhibiting a very high rate of dispersion.

Snail Predation

The data collected on *C. abbreviata* populations and their grazing rates were similar to those of a study performed in the Florida Keys. According to Baums et al. (2003b), 20% of *A. palmata* populations were infested with snails on the reefs surveyed in 1999, compared to a mean of 24.8 % snail infestation for all locations in this study. Our result for average snail size was 17.7 mm, slightly smaller than the mean size of 21.1 mm for low-density *A. palmata* stands and 26.0 mm for colony thickets reported by Baums et al. (2003b). The mean grazing rate of 3.83 cm^2/snail/day ($\pm$ 0.67 SE) that we found in this study was similar to consumption rates reported from the Florida Keys (Baums et al. (2003b) - 4 cm^2/snail/day , Miller (2001) - 3.37 cm^2/snail/day).

The presence of snails may pose a significant threat to South Caicos *A. palmata* populations. With a mean grazing rate of 3.83 cm^2/snail/day ($\pm$ 0.67 SE), one snail can consume approximately 115 cm^2 coral tissue in a month. Snail infestation on South Caicos ranges from 0% to 54.7% at different sites and more than 50 snails can be present on one single colony. Hence, large populations of *C. abbreviata* have the ability to consume large quantities of coral tissue in relatively short time. However, no relationship was found between disease incidences and predatory snails.

CONCLUSIONS

While the present condition of *A. palmata* populations in South Caicos is good compared to other Caribbean islands, the presence of diseases and snail predation is cause for concern. Studies show that *A. palmata* diseases occur in the end stages of stress induced synergistic effects (Harvell et al. 2001, Richardson 1998, Antonius 1981). It is believed that stressed corals have weakened defense mechanisms and are therefore more susceptible and vulnerable to diseases (Richardson 1998, Harvell et al. 2001, Aronson and Precht 2001). Hence, considering the remoteness of South Caicos' reefs and the relatively low anthropogenic stressors they are facing, it is quite surprising that we observed such a high occurrence of WBD, WPDa and WPDb on these reefs. South Caicos' *A. palmata* populations could potentially be at high risk of mortality, especially when observed snail predation, disease, and potential anthropogenic threats are combined. However, other more global, natural stressors such as global warming have also been linked to *A. palmata* degradation through incidences of bleaching and increased water temperature (Antonius 1981, Richardson 1998, Harvell et al. 2001, Aronson and Precht 2001, Patterson et al. 2002, Gardner 2003). Patterson et al. (2002) reports a causal linkage between bleaching and disease related mortality due to increased opportunistic infections. They further speculate that the increased frequency and intensity of future bleaching events, due to global warming, may lengthen the disease season. However, there are no long-term data neither on coral cover and the status of *A. palmata* populations nor on the temperature of the surrounding water that may explain why South Caicos' *A. palmata* populations experience diseases. Furthermore *C. abbreviata* and *C. caribbaea* infestations are worrying, especially because they have been found on the reefs that have been severely impacted by tropical storm Jeanne in September 2004. Many fragments broken and laying on the benthic substrate are easy prey for snails which may limit the fragments survival rate. This has been reported from Jamaican reefs after hurricane Allen in 1980 (Knowlton et al. 1981). Generally, the reefs can be protected from direct anthropogenic stress, but natural impacts such as hurricanes and storm events, as well as mortality caused by disease is beyond management possibilities. Abundance of predatory snails may be controlled by collecting and eliminating these (Miller 2001). However, the question remains how many snails can *A. palmata* populations withstand? Populations at other locations have been observed to experience periods of decline and rebound, and snail population dynamics fluctuates from year to year (Miller et al. 2002).

This type of survey is very important because it serves as baseline data for future comparisons. Studying the status, trends, and threats of *A. palmata* populations is important for conservation efforts. While our results define the current status of *A. palmata*, studies in the future can be compared to this data to determine if the populations remain stable, increase or decline, and whether changes in disease occurrence or *C. abbreviata* populations affect the status of the coral population. However, if significant disease outbreaks and snail predation are being observed, how can we protect South Caicos *A. palmata* populations?

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