Queen Conch Stock Assessment
Historical Fishing Grounds
Andros Island, Bahamas
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The Nature Conservancy
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Project Sponsors and Volunteers

Project Sponsors

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The mission of Community Conch is to affect sustainable harvest of conch in the Bahamas through research, education and collaboration with local communities, the Bahamian government and other non-governmental organizations (NGOs). Community Conch is a fiscal sponsorship fund project of Rachel's Network, a 501(c)(3) organization based in Washington, DC.

Project Volunteers

Ms. Alannah Vellacott, a Bahamas Environmental Steward Scholar (BESS), donated a week of field time to the project. Marc Vandenrydt, captain of the support vessel was the chief engineer on the project.

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1.0. INTRODUCTION

1.1. Focus of study

This queen conch stock assessment for Andros Island is part of the GEF-IWCAM Andros Island Resource Management Plan. Upon completion, this plan which integrates information and planning for both terrestrial and marine resources will be presented for adoption to the Bahamas Government.

The goal of this assessment was to quantify queen conch resources in the eight principle conch fishing grounds specified in the 2007 Andros Island Conservation Assessment (CAP) (TNC, 2007). The study sites are described in Appendix 1 of the CAP in Conservation Target Descriptions for Conch and a key map of their locations is presented in Figure 1 of this report. The eight discrete areas were delineated on the basis of information provided to The Nature Conservancy by local fishers based upon the presence or former presence of conch spawning aggregations. All of the study areas are on the east and windward side of Andros Island inshore of its barrier reef.

The individual study areas are referred to in this report as follows:

1- Conch Sound
2- Mastic Bay
3- Stafford Creek
4- Young Sound
5- North Bight
6- Middle Bight
7- South Bight
8- Grassy Creek Cays

2.0. METHODS

2.1 Timing of Surveys

The surveys were conducted from May 23 through June 5, 2010. This survey period was selected by The Nature Conservancy for project coordination purposes and also corresponds with the beginning of conch mating season in the Bahamas (Stoner et al., 1992). Future comparison surveys would best be completed during a similar period or a little later.

2.2. Survey protocol

This stock assessment of queen conch for Andros Island followed the methods developed by Community Conch for a 2009 assessment in the Berry Islands (see Stoner et al., 2009). The use of the similar protocols allows for direct comparison of data on conch density and reproductive behavior from Andros and the Berry Islands, and with future studies.

Maps of each study site were overlaid with a grid of one minute latitude and longitude, yielding blocks approximately one nautical mile on a side (1855 m in the north-south dimension, 1673 m in the east-west dimension) and 310 hectares (ha) in surface area.

Each block, identified by the latitude/longitude coordinate of the southeast corner, was surveyed by towing a snorkeler on the surface over standard distance of 1000 m (determined with GPS). The general approach was to tow the diver from one corner of the block in a diagonal downwind direction to near the block's center. A transect 6 m wide was surveyed for conch and habitat features yielding a standard survey unit of 6000 m^2. Some tows were limited by shallow water or by reef and were altered as needed to accommodate these factors. If a tow at the one nautical mile scale yielded significant results, additional tows were added at the ¼ mile scale to better describe the extent of the population. This was done in both North and Middle Bight sites.

Small scale mapping of the initial study areas and limited field time (2 weeks) constrained the survey to depths < 10 m inside the barrier reef where observations could be conducted by snorkelers. In fact, most of the study sites occurred in locations where depths did not exceed 5 m (Table 1). Surveys with scuba require significant, additional time and boat support. Furthermore, earlier studies in the Berry Islands showed that the conch populations in the region are concentrated in depths < 10 m and the small areal extent of shelf between 10 and 20 m depth generally yields few conch in absolute terms.

The conch off Andros Island were surveyed for:

- Number of adult queen conch, identified by a flared lip; 3-4 years and older
- Number of subadults (rollers) - > 10 cm shell length, estimated to be 2-3 years old
- Number of juveniles - < 10 cm shell length, 1 and 2 year olds
- Number of mating pairs – where two individuals are in copulation orientation

Where adult conch were abundant, sample populations were measured opportunistically for:

- shell length (± 0.1 cm) with large Vernier calipers, and
- for shell lip thickness (± 1 mm) using small Vernier calipers. The latter provides a relative index of conch age.

Substratum and depth zones:

For each tow the percentage of bottom covered by bare sand, seagrass (primarily *Thalassia testudinum*), and algae-covered hard bottom was estimated.

Depth zones considered for systematic analysis (Stoner et al., 2009) were:

A: 0 – 2.5 m
B: 2.5 – 5.0 m
C: 5.0 – 10.0 m

The results were standardized to number of conch per hectare (10,000 m^2) for each age group and for comparison with earlier studies. Where conch were abundant (Grassy Creek Cays), adult and subadult densities were summarized by depth zone. Total numbers of conch in a block were extrapolated from the density estimate for that block and its surface area. These numbers were summed to yield the total number of conch at each study site. Reproductive behavior was summarized as the percentage of adult conch observed on an individual tow.

2.3 Survey Boat

One 17 foot motorboat dispatched from a larger support vessel was used to conduct the towing surveys. A Garmin GPS 441S unit was installed on the boat. The position of grid corners for the conch grounds were uploaded into the GPS units for easy location in the field. Coordinates from each day's sampling were downloaded from the GPS to computers at the end of each day.

3.0. RESULTS

3.1. Densities and habitat associations

One hundred forty survey tows were made over a 14 day period to provide estimates of queen conch density near Andros Island (Table 1). Observations were made on more than 12,000 conch, including 4250 adults, 5363 subadults, and 2653 juveniles. The vast majority of adults and highest average densities were observed in the Grassy Creek Cays area (Table 2); however, relatively high densities of subadult conch were observed in North and Middle Bights. Among the sites surveyed, juveniles (< 2 years old) were only abundant in North Bight, where at least one nursery site was apparent. Highest densities of juveniles were associated with habitats that had 100% seagrass coverage on the bottom. High densities of juveniles (> 20/m^2) were always found in depths < 4.1 m, and none were found deeper than 6.3 m. In contrast, highest densities of subadult and adult conch were observed in a wide variety of habitats ranging from mostly hard-bottom to mostly seagrass, and mixtures of sand, seagrass, and hard-bottom. Subadults were abundant (>50/m^2) in a range of depth 1.2 to 7.0 m, and highest densities of adults (> 100/m^2) were observed in depths 3.0 to 9.3 m. While adults and subadults both occurred over the entire range of depths surveyed and in water as shallow as 1.0 m, analysis considering depth zones used in earlier studies (Stoner and Ray 1996; Stoner et al., 2009) showed that densities of the larger conch increased with depth (Table 3). Only 22 individual tows (15.7% of total) yielded densities > 100 adults/ha. This is important in terms of reproductive potential (see Discussion).

3.2. Size data

Shell length and lip thickness data were collected for adult conch at three sites (Table 4), but primarily at the Grassy Creek Cays site where adults were most abundant. The largest conch were found in South Bight where average shell length was 24 cm. Smaller conch (near 18 cm) were observed in North Bight and near the Grassy Creek Cays. Adults at the latter site, however, were highly variable in shell size ranging from just 14 cm to > 24 cm depending upon the exact location.

Shell lip thickness was also highly variable in the Grassy Creek Cays site (3-30 mm) with no obvious relationship to shell length or water depth. While few shells were measured at the more northern sites, lip thicknesses tended to be lower (i.e., thinner), but also highly variable.

In addition to the range measurements described above, it should be noted that the vast majority of adult conch in the Grassy Creek Cays area are of a smaller size characterized by shell lengths and lip thicknesses averaging about 17 cm and 15 mm, respectively (right, middle cover photo). These phenotypes are known variously as samba or chicken conch. They are the same phenotype that dominate the Berry Islands southern bank and are not preferred by fishers due to their tough shell and lower quantity of meat production. Although exact statistics were not gathered in this study, our impression was that these smaller conch represent at least 85% of the population in the Grassy Creek Cays area.

3.3. Reproductive behavior

Reproductive behavior was observed on 16 of the 58 tows made near the Grassy Creek Cays (Table 5). Most reproductive behavior occurred where densities were > 100 adults/ha. Nevertheless, mating frequencies were low (< 5.0% of adults) at all but two locations. Half of the observations of mating involved just one mating pair, and no more than five pairs were ever observed on a 1 km tow. Mating occurred over a wide range of depth.

3.4. Overall stock assessment

The surveys conducted near Andros Island in late May and early June 2010 represented eight sites identified as historically important fishing grounds and comprised a total area of approximately 31,535 ha. Estimated total numbers of conch at these locations were about 2.11 million adult conch and 1.56 million subadults (Table 6). More than 97% of the adults were located in the Grassy Creek Cays area. North Bight was the second most important site for adult conch, with ~36,000 individuals representing ~1.7% of the total numbers. Subadults were most abundant in the North Bight area (685,000 conch), representing nearly 45% of the total. Grassy Creek Cays areas had ~40% of the subadults, and Middle Bight had ~16%. While Grassy Creek Cays, North Bight, and Middle Bight were the largest sites surveyed, all other sites had relatively low numbers of adult and subadult conch.

4.0. DISCUSSION

The distribution of queen conch along the east and southeast coast of Andros Island is similar to that observed at other locations in The Bahamas. Juveniles were observed only in shallow areas with seagrass present, and subadults and adults were most abundant in somewhat deeper areas, closer to the reef but not in it. Average adult densities were very low (< 3 adults/ha) at six of the eight survey sites, with higher densities (117 adults/ha) at only the Grassy Creek Cays site. The latter site accounted for > 97% of the total adult population in the study range. Highest densities of subadults occurred in the North and Middle Bights where shallow seagrass habitats likely provide important nursery grounds for queen conch. This was particularly obvious in North Bight where highest average densities of juveniles were observed.

There is substantial evidence that populations of queen conch in the northern section of the survey have been reduced by fishing. First, persons with local knowledge of

fishing in Conch Sound indicated that area had been fished out. Also while a total of just two live adults and three subadults were observed in the Stafford Creek site, large conch piles were found on Pigeon Cay (upper left cover photo). Despite low numbers of living conch, many dead conch were found in the Young Sound site. Also, the relatively thin-lipped adults observed in North and South Bights suggest that most adult (and possibly subadult) conch are removed by fishing before they reach reproductive age. The conch population at the Grassy Creek Cays site appeared to be in somewhat better condition, with a mixture of young and old adults, and a much higher average density of adults, but not subadults.

Sustainable fishing depends upon reproductive potential of a queen conch population. Stoner and Ray-Culp (2000) showed that mating and egg-laying in conch populations of the central Exuma Cays, Bahamas, ceased when local populations fell below 50 adults/ha, and substantial significant levels of reproduction occurred only when the populations reached 100 adults/ha. Logistic regression based upon surveys in the Berry Islands conducted in 2009 (Stoner et al., 2009) showed that a 50% probability of mating occurred at 335 adults/ha and a 90% probability required 500 adults/ha. In the Andros surveys only one site, Grassy Creek Cays, had average adult densities >100) individuals/ha and, as in previous studies, most reproduction was observed in these areas. Consequently, very little reproductive potential is expected at the seven northern-most sites surveyed. While the Grassy Creek Cays area may have a sustainable population of queen conch, it is likely that the other sites are currently at an overfished level.

This survey was conducted in late May and early June. Based upon earlier research on queen conch reproduction in the Exuma Cays (Stoner et al., 1992), the Andros surveys may have occurred during a period when conch mating is still rising, and the proportion of reproductive conch may have been below maximum. However, Stoner et al. (1992) showed that maximum conch pairing occurred in the Exuma Cays during June, and egg-laying was very high from April through August. Therefore, we conclude that the reproductive proportions observed are representative for the Andros area. Furthermore, reproductive potential is determined primarily by the density of adults in a local area, and density data are less sensitive to seasonal variation than reproductive behavior.

Also, the conch population at Grassy Creek Cays is made up primarily of a smaller, less desirable variety of conch and local fishermen have indicated that these are only fished if the weather is so harsh that they cannot get to more remote locations such as the Ragged Islands and Jumentos or the Sand Bores areas. Local fishers indicated that the larger, preferred variety of conch occurred in higher numbers in the Grassy Cays in years past. Our estimate of 15% for large conch in the 2010 assessment may represent the remnants of the earlier and probably healthier population structure. The reproductive role and fecundity of samba conch compared with the larger variety is still unknown.

5.0 Management Recommendations

5.1 Overview

Results of the 2010 survey indicate that the queen conch fisheries of Andros Island are no longer viable or occur at unsustainable levels, depending upon location. New management practices that will allow a return to sustainable fishing are needed now. The four northern sites and South Bight no longer have functional conch populations and it would take decades of protection for natural restoration to occur. Rather, management emphasis should be aimed at the existing populations in North and Middle Bights and the Grassy Creek Cays. Changes in management that could lead to stock restoration include:

A) Close the nursery grounds in North and Middle Bights to fishing.
B) Close the Grassy Cays area to fishing or reduce the total fishing effort (or mortality) at that location.

5.2 North and Middle Bights

Both North and Middle Bights have substantial populations of sub adults and juveniles that would benefit from protection until at least a portion of the population reaches reproductive age. Historically, both areas were considered but rejected for inclusion in the Central Andros National Park The new data indicate that inclusion in a park or establishment of a marine protected area would be prudent to protect the existing conch nurseries.

The aggregations of subadults and juveniles in North and Middle Bights could also be protected as the basis of a multidisciplinary educational project for local schools. Boundaries of these populations in each Bight could be flagged by students, buoyed for protection and made known to local fishermen. The conch in these areas would then serve as the basis for a year long educational project involving, biology, socioeconomics and fisheries management options for conch. Initially the goal would be to protect each area for 2-3 years until the conch mature to reproductive status, usually at four years of age. If the Bights continue to function as conch nurseries, this could become an ongoing project in the local schools.

5.3 Grassy Creek Cays

The conch population at the Grassy Creek Cays site appeared to be in better condition than in North and Middle Bights having a mixture of young and old adults, and a much higher average density of adults, but not subadults. However, the vast majority of the higher density populations found there were comprised of the non preferred, small phenotype conch and even in this area where average density is 117 adults/hectare, logistic regression (Stoner,2009) indicates that reproduction will occur with a probability of only about 10%. Given the small shell length and small volume created by a thick shell, it is likely that in addition to a low rate of reproduction, samba conch also have lower fecundity than the larger conch preferred by conch fishers. This means that fishing

is and has been concentrated on the most fecund adults. We make two recommendations relative to this particular issue. First, effort should be made to evaluate possible differences in the reproductive potential (fecundity, mating and spawning frequency, etc.) between samba and non-samba conch. Second, if significant differences are found, fisheries managers might consider protecting the larger, non-samba conch. This would be counter to the general practice of protecting undersized conch (juveniles and subadults) but, as with fishes, large females are particularly valuable in producing larvae in depleted and recovering populations.

As with the Middle and North Bight conch grounds, Grassy Creek Cays should be considered for inclusion in the Central Andros National Park or a marine protected area. This would give the area full protection and potential for recovery to a larger population of large phenotype conch with full reproductive potential. Once these areas have recovered to higher productivity and a more natural size structure, the grounds could be considered for re-opening of fisheries at controlled levels.

Another management option would be to reduce fishing pressure by implementing a closed season during the reproductive months of July through September. The Bahamas has not established a closed season for conch in order to accommodate fisherman who would have nothing to fish if conch and lobster fisheries are closed at the same time. Interestingly, in all other countries where the Convention on International Trade in Endangered Species (CITES) lists the queen conch as a species of least concern or of possible concern (USVI, Turks & Caicos, Jamaica, and Belize), there is a three month closed season with start dates ranging from July1 to August 1. A closed season could be implemented in the Grassy Creek Cays thus protecting some of the conch spawning season (July through September) and allowing fishermen to continue to catch conch during the highest yielding months of April, May and June.

6.0. REFERENCES CITED

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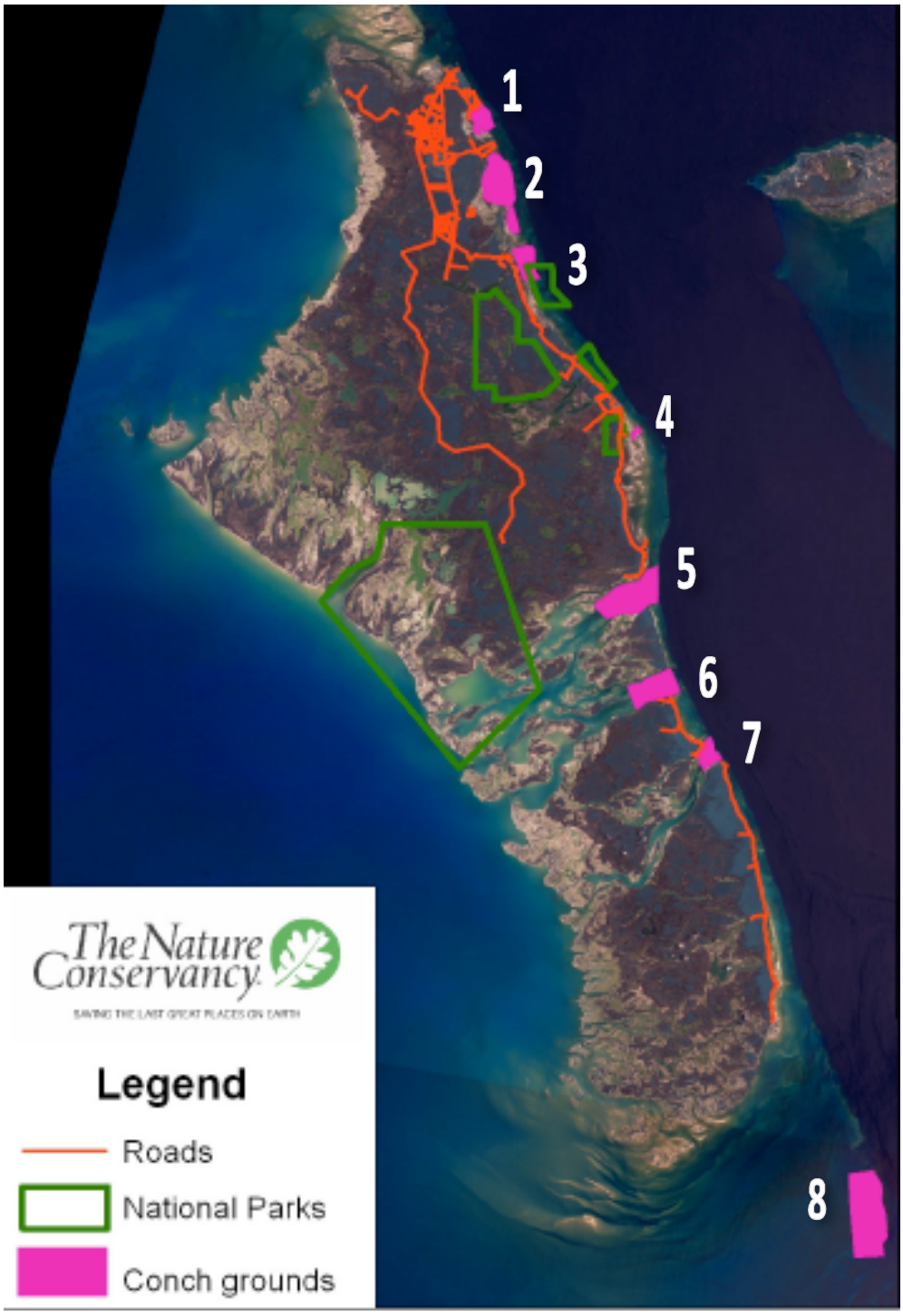
Figure 1. Study Areas



1. **Conch Sound**
2. **Mastic Bay**
3. **Stafford Creek**
4. **Young's Sound**
5. **North Bight**
6. **Middle Bight**
7. **South Bight**
8. **Grassy Creek Cays**

Table 1. Summary of the survey effort and queen conch counts conducted at Andros Island, May-June 2010. Sites are in north to south order.

Site	No. of tows	Dates surveyed (2010)	Depth range surveyed (m)
Conch Sound	8	4 Jun	0.5 - 4.1
Mastic Bay	14	3 & 5 Jun	0.3 - 4.6
Stafford Creek	8	3 Jun	0.6 – 5.0
Young Sound	6	1-2 Jun	0.5 – 4.7
North Bight	19	31 May – 1 Jun	0.5 – 4.9
Middle Bight	17	23 May	0.5 – 3.9
South Bight	10	24 & 30 May	0.7 – 3.6
Grassy Creek Cays	58	25-29 May	1.8 - 9.1
Overall	140	23 May – 5 Jun	0.3 – 9.1

Table 2. Summary of conch densities observed in eight survey locations near Andros Island, May-June, 2010. The sites are in north to south order. All density values are reported as mean and standard deviation for the numbers of individuals per hectare (no./10,000 m^2).

Site	No. of tows	Adult Density	Subadult Density	Juvenile Density
Conch Sound	8	0.21 ± 0.59	0 ± 0	0 ± 0
Mastic Bay	14	0.71 ± 1.08	0.95 ± 2.33	0 ± 0
Stafford Creek	8	0.42 ± 1.18	0.63 ± 1.77	0 ± 0
Young Sound	6	2.50 ± 2.30	5.83 ± 6.48	1.11 ± 2.72
North Bight	19	9.99 ± 14.49	223.1 ± 601.6	226.2 ± 897.6
Middle Bight	17	2.35 ± 2.57	151.4 ± 499.2	6.08 ± 9.07
South Bight	10	3.33 ± 4.44	3.50 ± 2.77	0.50 ± 1.12
Grassy Creek Cays	58	117.1 ± 162.4	35.14 ± 60.07	0.14 ± 0.90
Overall	140	50.6 ± 118.3	63.8 ± 288.2	31.6 ± 332.2

Table 3. Densities of adult and subadult queen conch at Grassy Creek Cays. Densities were analyzed by depth zones employed in earlier stock assessment surveys. Density values are reported as mean and standard deviation for the numbers of individuals per hectare (no./10,000 m^2). Very few juveniles were observed at this study site, and only one tow was conducted in a depth range < 2.5 m (Zone A).

Depth Zone	No. of Tows	Adult Density	Subadult Density
B: 2.5 to 5.0 m	20	51.67 ± 77.25	24.08 ± 59.40
C: 5.0 to 10 m	37	153.3 ± 186.7	41.71 ± 61.04

Table 4. Shell length and lip thickness data for adult queen conch collected from three locations near Andros Island. n is the number of conch measured. Values for shell length and lip thickness are mean and standard deviation, followed by the total range (parentheses).

Site	n	Shell Length (cm)	Lip Thickness (mm)
North Bight	3	18.1 ± 1.1 (17-19.2)	9 ± 4 (6-13)
South Bight	3	24.0 ± 3.5 (22-28.1)	8 ± 9 (3-19)
Grassy Creek Cays	30	17.7 ± 2.7 (14-24.5)	15 ± 7 (3-30)

Table 5. Reproductive behavior observed in surveys for queen conch near Andros Island, May-June, 2010.

Site	Date	Depth (m)	Adult Density (no./ha)	Number of Mating Pairs	% of Adults Mating
Grassy Creek Cays	25 May	5.8	630	7	3.7
Grassy Creek Cays	25 May	6.2	643	3	1.6
Grassy Creek Cays	25 May	7.2	262	3	3.8
Grassy Creek Cays	26 May	4.4	255	2	2.6
Grassy Creek Cays	26 May	7.4	318	1	1.0
Grassy Creek Cays	26 May	9.1	123	1	2.7
Grassy Creek Cays	26 May	7.2	128	1	2.6
Grassy Creek Cays	26 May	7.4	172	1	1.9
Grassy Creek Cays	27 May	4.0	130	1	2.6
Grassy Creek Cays	27 May	3.2	202	3	4.9
Grassy Creek Cays	28 May	5.0	130	1	2.6
Grassy Creek Cays	28 May	5.9	412	5	4.0
Grassy Creek Cays	28 May	5.6	140	5	11.9
Grassy Creek Cays	28 May	1.8	85	1	3.9
Grassy Creek Cays	28 May	4.6	78	1	4.2
Grassy Creek Cays	28 May	8.0	270	3	3.7

Table 6. Estimated total abundance of adult and subadult queen conch in the survey sites near Andros Island, **May-June 2010**.

Site	No. of Tows	Area (ha)	No. of Adults	% of Adults	No. of Subadults	% of Subadults
Conch Sound	8	1767	258	0.01	0	0
Mastic Bay	14	3239	2,220	0.10	4,030	0.26
Stafford Creek	8	1564	257	0.01	385	0.02
Young Sound	6	697	1,858	0.09	4,702	0.30
North Bight	19	3999	36,407	1.72	685,203	43.37
Middle Bight	17	2354	5,472	0.26	250,993	15.89
South Bight	10	958	3,113	0.15	2,932	0.19
Grassy Creek Cays	58	16957	2,066,460	97.7	631,625	39.98
Overall	140	31,535	2,116,045	100	1,579,870	100