

# The abundance and distribution of juvenile queen conch (*Strombus gigas*) in The Schooner Cays

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## Introduction

Queen conch (*Strombus gigas*) is a marine gastropod mollusk found from southern Florida through the Caribbean to northern, South America. Queen conch are important to the culture, economy, and ecosystem of the Bahamas. Culturally, conch are an iconic symbol of The Bahamas and are located on the Bahamas national crest. They are also a staple in many traditional dishes. Economically, fishing is the third largest industry in The Bahamas and conch fishing provides jobs and income. Conch produce six to seven million dollars in exports, annually. Ecologically, conch are bottom feeders that graze the ocean floor and maintain algae levels.

Conch have density dependent reproduction and lay egg masses. Egg masses drift with ocean currents and develop into their larval stage called a veliger. Veligers drift until they come into contact with *Laurencia*, a seaweed containing nutrients that allow veligers to metamorphosis into juvenile conch. A juvenile is classified as a conch that does not have a flared lip. Juveniles inhabit shallow waters close to shore (Stoner et al 1998). A sub-adult conch has flared lip that is thinner than 15mm. A sexually mature adult has a fully flared lip with a thickness of >15mm (Clark et al 2005). Adults inhabit depths from 1m to 100m.

Past data shows that the Schooner Cays was the largest nursery ground with an average density of 228 conch/hectare (Stoner et al. 1998), but it is suspected that conch populations have declined since then. Data collected from shell middens has shown that in 2003, 32% of midden piles were illegally harvested juvenile conch. In 2014, the percent of juveniles illegally harvested increased to 49.2%, so there has been a 17.2% increase in the illegal harvesting of juveniles (Thomas et. al unpublished 2015). The purpose of this study is to determine if the Schooner Cays are still a nursery ground, by quantifying the densities of juvenile conch per hectare and determining where the distributions are to establish the boundaries of a nursery ground.

### Research questions:

- How many juvenile queen conch are in The Schooner Cays?
- What are the boundaries of the juvenile queen conch nursery in The Schooner Cays?



Image 1. Juvenile conch buried in the sea grass bed.



Image 2. A satellite photo of The Schooner Cays, South Eleuthera, The Bahamas and surrounding area. The grid depicts the area surveyed where the tows will be conducted.

## Methodology

### Methods:

- Two snorkelers are towed behind a boat using a manta tow board.
- Snorkelers count and identify conch by life stage.
  - A juvenile conch is < 10 centimeters
  - A sub-adult is > 10 centimeters
  - An adult is > 10 centimeters with a fully flared lip
- Snorkeler signal to the boat when they observe an aggregation of conch, (more than one conch per 10m<sup>2</sup>), and aggregations are marked by waypoints on a GPS
- The survey area was divided into a grid system contain 24 sections.
- Five 200m tows are conducted inside of each section of the grid in a random direction.
- The numbers of juvenile, sub-adult, and adult are recorded at the end of each tow.
- Depth and water temperature are recorded at the start and end of each tow.



Image 3: Juvenile queen conch



Image 4: Two swimmers conducting a 200m tow and quantifying lifestage and number of conch

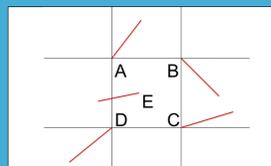


Image 5: Grid with 5 tows

## Results

Data was analyzed using descriptive statistics including the mean and standard error. Maps were created using ArcGIS to show the surveyed area, delineate the boundaries of the conch nursery, and show juvenile conch densities for tows in each grid.

GRID	Mean Juv Conch	SEM Juv Conch	Mean depth (ft)	Mean Temp (°F)	N
20_51	0	0	14.85	86	5
20_52	0.2	0.2	17.34	84.92	5
20_53	0	0	10.66	86.74	5
20_54	0	0	6.22	86.77	5
20_55	0	0	7.52	84.95	5
20_56	0	0	9.29	87.17	5
21_51	0	0	19.7375	86.675	4
21_52	0	0	13.29	87.17	5
21_53	2.4	2.4	16.63	90.32	5
21_54	0	0	12.05	86.89	5
21_55	0.2	0.2	13.07	83.49	5
21_56	0	0	10.29	86	5
22_51	0	0	19.21	87.53	5
22_52	5	5	14.6	82.76	5
22_53	5.6	5.114684741	5.32	86.36	5
22_54	0.8	0.583095189	13.27	87.258	5
22_55	0	0	7.0875	87.125	4
22_56	0.2	0.2	7.67	89.42	5
23_51	0.25	0.25	21.1375	89.0375	3
23_52	0.4	0.4	16.23	80.96	6
23_53	2	1.549193338	9.18	86.55	5
23_54	1	0.547722558	10.75	86.36	5
23_55	6.8	6.55286197	10.42	89.06	5
23_56	0	0	10.69	89.09	5

Table 1. The surveyed area of The Schooner Cays was divided into a grid system each grid had a sample size between three to six, 200-meter tows. The table shows mean values of juvenile conch, standard error of the mean (SEM) of juvenile conch, mean values of depth and temperature. N represents the number of 200m tows conducted within the grid.

Surveys were conducted from September 23, 2015 to October 30, 2015. A total of 124 juvenile conch were observed. The mean number of juvenile conch observed per grid ranged from 0–6.8 individuals. The mean depth of juvenile queen conch found ranged from 5.32 feet to 21.14 feet. Conch were found in depths ranging from 1 to 17 feet. Aggregations specifically were found in depths ranging from 6 to 17 feet. Mean temperatures ranged from 80.96°F to 90.32°F and conch were found from mean temperatures 82°F to 90.32°F. Aggregations were specifically found in temperatures ranging from 82.4°F to 89.6°F. Four tows were conducted in two of the grids and five tows were conducted in 19 of the grids. In one grid three tows were conducted as the area of the grid included a section of deep sea. In one grid six tows were conducted.

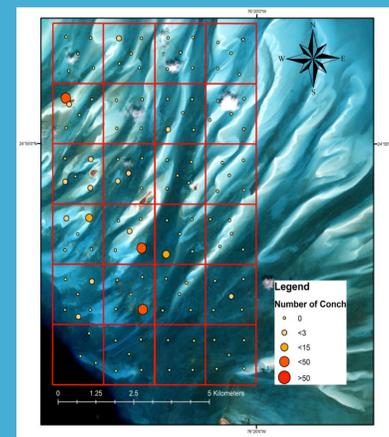


Figure 1. A map of The Schooner Cays, Cape Eleuthera, The Bahamas, delineating the surveyed area shown in a grid system. Three to five tows were completed per grid, 117 tows were completed within the total surveyed area. The size and color of circles correlates to the densities of juvenile conch observed within a grid.

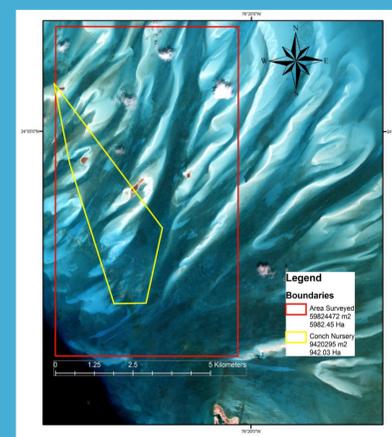


Figure 2. A map of The Schooner Cays, Cape Eleuthera, The Bahamas. The red line represents the area surveyed. The yellow line is a minimum convex polygon showing the boundaries of juvenile conch nursery grounds.

While some aggregations were observed in the survey area, 13 grid sectors had no recorded queen conch. Total densities within each grid ranged from 0 to 34 conch. Each grid included three to six tows of 200m in a randomly selected direction. Densities observed within the 200m tows range from 0 to 33 conch.

The area surveyed and the boundaries of juvenile conch aggregations are shown in figure 2. Throughout the surveyed area a total of 124 conch were found. The mean number of conch per grid was 1.059 (4.65 SD). The standard error was 0.098. Figure 3 shows the nursery grounds from 1993. The current study covered less area, but comparing the two maps show the decrease in area of the conch nursery boundaries.

## Discussion

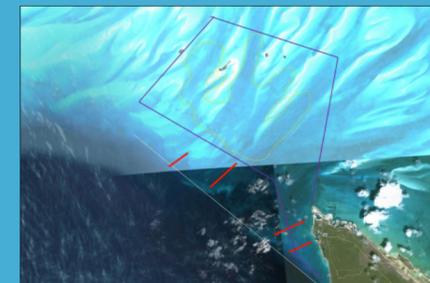


Figure 3. From A. Stoner (personal comm.) a map of The Schooner Cays, ~5km NW of Cape Eleuthera. The blue polygon represents the original area of the schooner Cays nursery grounds (ca 1993), the light yellow line represents the path of the survey boat, weaving back and forth to mark the boundaries of the nursery.



Image 6. A conch shell midden in Cape Eleuthera.

The densities and distributions of juvenile queen conch in The Schooner Cays have decreased since 1993 due to an increase in fishing pressure. In 1993, Stoner et al. found a density of 228 juvenile conch per hectare in The Schooner Cays, while current data identified 8.24 juvenile conch per hectare. The current surveyed area is smaller than the surveyed area in 1993. This study will continue to expand the area surveyed. Clark et. al, 2005 discussed how there has been an increase of fishing pressure, which has resulted in an increase in the harvesting of juvenile conch.

Comparing data from 1993 to 2014 shows how the increase in fishing pressure has resulted in a decrease of juvenile queen conch in the Schooner Cays. Data from shell middens has also shown an increase in the illegal harvesting of juveniles from 2003 to 2014.

If illegal harvesting of juvenile conch continues, declining populations will impact the culture, economy, and ecosystem of The Bahamas. Conch are culturally important because they are an iconic symbol of The Bahamas and are served in many traditional dishes. Economically, fishing is the third largest industry in the Bahamas and conch produce six to seven million dollars in exports annually. If conch populations continue to decline, many Bahamians will lose their source of income. Ecologically, conch are bottom feeders that graze algae and clean the ocean floor. Without conch, the ecosystem would become imbalanced.

Current data identifies the aggregations of juvenile queen conch and the range of depths that juvenile conch are found, which can be used to potentially help to inform future marine resource management decision-making. This study will be continued by expanding the grid to incorporate area northwest of the Schooner Cays and southeast toward Cape Eleuthera. Future studies can include examining the genetic samples of conch and running DNA sequencing to further understand genetic variation among conch populations. Ocean modeling could also help predict where conch originate from because larva are dispersed by the currents.

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