

Stock Assessment of Queen Conch, *Strombus gigas*, and Harbour Conch, *S. costatus*, in Bermuda

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ABSTRACT

An assessment of the status of conchs following ten years of protection in Bermuda's waters was conducted during August and September of 1988 using towed diver census. Fifty transects, averaging 2443 m each, were completed at depths to 20 m. Each area was comprised of two swaths of 3 m width each, yielding a total area surveyed of 73.3 hectare and approximating 0.1% of the Bermuda subtidal platform. A total of 39 *S. gigas* were observed for a mean density of 0.52 conch/ha. No juveniles were seen. This value is the lowest reported and indicates a failure of the population to regenerate in the absence of fishing mortality. *Strombus costatus* was more abundant, with 184 being observed (2.60 conch/ha), however only 3.4% of these were juveniles. This species is concentrated in inshore basins (18.10 conch/ha) and appears to be increasing in these areas. Differences in population dynamics between these two species might reflect differences in spawning sites and larval retention mechanisms, which are now being investigated.

INTRODUCTION

Bermuda is formed by a seamount rising from > 4000 m in the Atlantic Ocean, forming a platform of exposed and submerged land encompassing 77.5×10^3 ha; of this 66.5×10^3 ha is shallow (< 20 m depth) reef platform, 5.4×10^3 ha is inshore basins, and the remainder is exposed islands (5.56×10^3 ha, Morris *et al.*, 1977). Within these waters are tropical marine fauna of mainly West Indian origin (Briggs, 1974), including the large marine gastropods *Strombus gigas* and *S. costatus* (Sterrer, 1986). Their abundance over the past 130 years has varied greatly, based upon their presence in shell collections and notes by naturalists (Abbott and Jensen, 1967). This variation may be attributed to natural environmental conditions affecting recruitment processes and, in more recent times, the influence of man through collecting and habitat degradation. The numbers of animals of these two species has become so depleted in recent years that they were given protected-species status 10 years ago (Burnett-Herkes, 1981), but no quantitative survey has been done to estimate their total abundance in Bermuda waters, their distribution, or their age/size demography. We undertook this stock assessment in the summer of 1988 so that we might better understand the population dynamics of both species and thus attempt

managing them effectively.

METHODS

This project was a joint effort of the Bermuda Division of Fisheries and the Florida Marine Research Institute, with additional support from the International Foundation and Florida Institute of Oceanography. Survey methodology is similar to that being done in Florida (Berg *et al.*, 1992) in that it comprises a series of paired-diver underwater towed transects. A total of 50 transects were completed during August and September 1988 (Figure 1). The starting point of each transect was chosen by laying a 5-min latitude by 5-min longitude grid over Bermuda's Admiralty Chart 334. Two random numbers, corresponding to grid x-y positions, were chosen using STSC Statgraphics 2.6 program for uniformly-distributed random numbers. Sites in both reef flat and inshore waters of < 20 m depth were randomly chosen until a total of 50 sites were selected. These chart positions were translated into field locations using sightings of landmarks, water depths, and bottom community characteristics. Transects began within the area designated by the grid and proceeded in the direction that would best keep the divers over a single type of bottom community and in safe working conditions. Two divers were towed behind a boat simultaneously, where they maintained a position approximately 1.5 m above the bottom, so that each was able to scan a separate strip 3 m in width. The length of the strip was determined from sightings plotted on the chart at the beginning and end of each tow. The length of the strip varied with the distance covered during the 30-min transect. Divers counted the number of adult and juvenile conch within the 3 m strip and recorded their observations onto dive sleds at 10-min intervals. These observations were immediately transcribed onto data sheets at the end of each tow. The notes were later codified and entered into a computer for analysis. They were sorted and analyzed using standard statistical methods. Values are presented as means \pm a single standard deviation of the mean.

RESULTS

Fifty transects, averaging 2443 m each, were completed. Each transect was comprised of 2 strips of 3 m width each. A total of 73.28 ha was surveyed, approximating 0.1% of the total submerged platform. A total of 39 adult *Strombus gigas* were observed on 8 of the 50 transects, for a mean density of 0.5 ± 1.6 conch/ha for the entire submerged platform (Table 1). None were seen in the inshore basins. The mean density for the reef flat area alone was 0.6 ± 1.7 conch/ha. The conch were aggregated and most commonly found (7 of 8 transects) on a sand bottom with light cover of the seagrasses *Thalassia* and *Syringodium*.

A total of 184 *Strombus costatus* were observed on 8 of 50 transects, for a

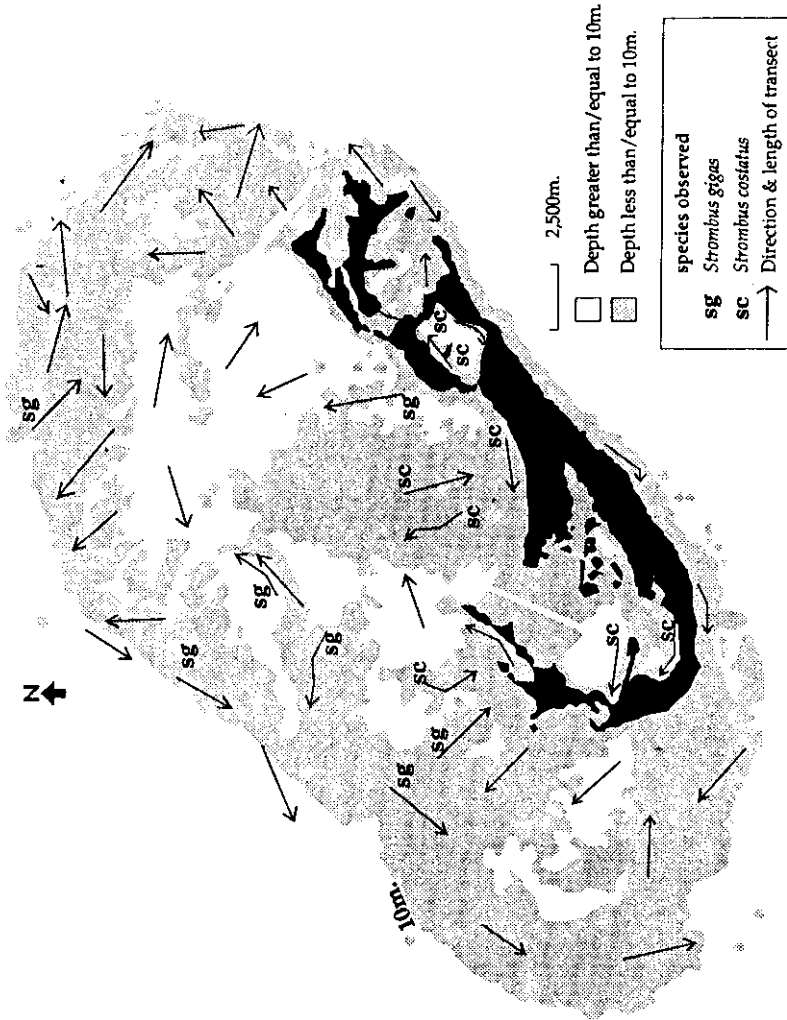


Figure 1. The Bermuda platform to the 10 m depth contour with the locations of towed-diver transects and the presence of conch indicated.

Table 1. Density and abundance of *Strombus gigas* and *S. costatus* in Bermuda waters. Total platform is the submerged portion only (total - islands).

	Total		<i>Strombus gigas</i>			<i>Strombus costatus</i>		
	Transects #	Area ha	Area Surveyed ha	Density conch/ha	Abundance x 10 ⁴	#	Density conch/ha	Abundance x 10 ⁴
BASINS	6	5430	8.31	0	0	0	176	20.8 ± 22.6
REEF FLAT	44	66540	64.97	0.10	0.15	39	0.6 ± 1.7	4.0 ± 2.1
TOTAL				0.10	0.10	39	0.1 ± 0.4	8
PLATFORM	50	71970	73.8	0.10	0.10	39	0.5 ± 1.6	3.8 ± 2.1
						184	2.6 ± 10.3	18.1 ± 12.5

mean density of 2.6 ± 10.3 conch/ha for the entire submerged platform (Table 1). The two species were not seen on the same transects, although *S. costatus* was occasionally found near shore on the reef platform (0.1 ± 0.4 conch/ha). *Strombus costatus* was most abundant in the inshore basins (20.8 ± 22.6 conch/ha) on soft sediment bottoms with a variety of macroalgal species (Morris *et al.*, 1977). Only 6 juveniles were observed (3.4% of the population), which is probably a function of both our difficulty in finding them while they are buried in the sediment and their scarcity.

DISCUSSION

Towed-diver censusing allows the scientist to examine large areas and is the most suitable technique when animals are scarce, but uniformly distributed. Aggregated distributions cause large variances in estimated population densities and total abundance. Because of their aggregated distribution and preference for specific bottom types, conch are non-uniformly distributed. Our estimates of total population abundance (γ) and its 95% confidence limits are based upon mean density, total area, and the relative proportion of the total area that was actually surveyed (Mendenhall *et al.*, 1971). These estimates for Bermuda are based upon a small number of samples covering only 0.10% - 0.15% of the total area and must be used with caution. Our population estimate for *Strombus gigas* on the reef flats is 4.0×10^4 ($\pm 2.1 \times 10^4$) conch and for *S. costatus* in the basins and reef flat combined it is 18.1×10^4 ($\pm 12.5 \times 10^4$) conch.

Differences in abundance between these species probably are related to habitat preferences and the amount of that habitat available, illegal fishing mortality, and the processes of dispersion, retention, and recruitment. The relative abundance of one species to the other has shifted back and forth in the records of shell collectors (Abbott and Jensen, 1967). Harbour conch, *S. costatus*, breed within the inshore basins of Bermuda, and their planktonic larvae may undergo development, settlement, and metamorphosis all within the basins or nearshore waters. Queen conch, however, were only observed breeding near the edge of the reef platform (North Rock, mouth of Castle Harbor) where ocean currents would tend to carry larvae away from the platform. Through studies of ocean/island interactions, nearshore current patterns, and genetic identification of larvae, we hope to develop a better understanding of the processes that affect population dynamics of these two protected species in Bermuda waters.

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