Status of the Queen Conch, *Strombus gigas*, in Florida Waters

A Progress Report

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ABSTRACT

A stratified towed-diver transect research program was conducted for one year to determine *Strombus gigas* abundance in the Florida Keys. Four hundred and twenty-four strip transects at depths to 25 meters were completed. Ten transects per each of eleven charts from Key Biscayne to Boca Grande Key were sampled per season. Different habitats within each chart were sampled relative to their percent coverage. A total of 543.79 ha were sampled ($\bar{x}$ =1.28 ha/transect) with a mean density of 2.84 *S. gigas* per hectare. Chart 7 (Marathon and adjacent waters) contained the highest densities (11.57 conch/ha) whereas chart 4 (Key Largo) and Chart 11 (Boca Grande Key) had the lowest (0.14 conch/ha). Blue-water habitat (defined as being offshore, 12 to 25 meters in depth) had the highest densities of queen conch (11.68/ha) whereas seagrass had the least (1.01/ha). The highest seasonal density occurred during the winter of 1988 (6.73 conch/ha) whereas spring 1987 had the lowest (0.43 conch/ha). Values obtained are far lower than those reported for similar studies in the Bahamas and the Caribbean. Kruskall-Wallis analyses indicate no significant differences in *S. gigas* density either spatially, seasonally, or by habitat.

INTRODUCTION

The State of Florida began a stock assessment program for queen conch, *Strombus gigas*, in March, 1987 because of the obvious decline in conch abundance and the moratorium on all collecting that was enacted in June of 1985. The goal of the program was to provide quality research information for management decisions on how to best manage this living marine resource. We have described our sampling program and initial efforts (Berg and Glazer, 1991) and now present a summary of results for the first year.

METHODS

The study area extended from Virginia Key to Boca Grande Key and constituted approximately 2.4 x 10^5 hectare. An ecological study by Marszalek (1984) produced ten maps loosely identifying seven major benthic marine communities from Miami to Key West. These maps were digitized by our remote-sensing laboratory in St. Petersburg, Florida, and the percent cover of each marine community was determined. Maps were updated using more recent high-altitude airplane and satellite photographs and corrected through ground truthing. One additional map, covering Key West to Boca Grande Key, was added to our survey area, but without community designations.

Because the total extent of the area of concern could not be surveyed, a randomized stratified-sampling program was devised. The sampling program was first divided into four calendar seasons (Spring, Summer, Fall, Winter). Next, the total area of the oceanside of the Florida Keys was divided into the eleven charts mentioned above, and further by the five largest marine communities designated by Marszalek (1984). These are Reef, Sediment, Bedrock, Seagrass, and Blue-water. A total of 10 paired towed-diver transects were to be made on each chart each season. The number of transects made over each community was to be roughly proportional to its relative coverage on that map, with each community surveyed at least once.

Transect starting points were chosen using STSC Statgraphics 2.6 program for uniformly-distributed random-number generation. The charts were marked off in grids based on 30-sec coordinates of latitude and longitude and numbered sequentially. Two random numbers provided x-y designations of each grid position, which was then translated into field location using sightings of landmarks, depth, bottom community, and loran coordinates. Transects began within the area designated by the grid and proceeded in the direction that would keep the divers over the community selected and in safe working conditions. Two independent transects were done simultaneously by towing two divers behind a boat. They maintained a distance approximately 1.5 m above the bottom so that each was able to scan a strip 3 m in depth. In shallow water the divers were not towed, but snorkeled or walked. The width of the strip was altered according to their field of view. The length of the strip was determined from latitude and longitude coordinates obtained using a Raynav–550 Loran C Navigator at the beginning of the tow and at 10-minute intervals. Latitude and longitude positions were converted into distances using the marine navigation program of a Texas Instruments calculator. The length of the strip varied according to the distance covered during the 30-minute period.

Each diver counted the number of adult and juvenile *S. gigas* within his 3 m strip. Notes were written onto slates attached to dive sleds at each 10-min interval, and these were immediately transcribed onto data sheets at the end of each tow. The notes were codified and entered into an IBM AT computer for analysis. The paired-diver observations were combined into one data set for each transect. Notes were also taken of the presence of other species of conch, predators of conch, water temperature, bottom type and other features. These data form the basis of our stock assessment program. They were sorted and analyzed using standard statistical methods. Values presented are mean ± a single standard deviation.

RESULTS

The first sampling year ran from 16 March 1987 to 6 April 1988. A total of 424 diver-transects were completed at an average of 2137 meters (1.15 nautical miles) per transect. Total distance observed was 1.8×10^6 m (approximately 979 nautical miles). A total of 543.8 ha was surveyed. Only 1544 *S. gigas* were observed, giving an overall estimate of 2.84 per hectare. Of these, 17.7% were adults and 82.3% were juveniles (0.2:1 ratio). The largest concentration observed was a herd of juvenile conch (5.3 cm mean length on 23 February 1988) that we estimated to contain over 10^5 individuals. The initial transect over this herd estimated the density at 610 conch/ha and introduced a large variance into our statistical analyses.

The total data set was sorted and analyzed by strata, and each analysis produced an independent estimator of the population abundance and 95% confidence limits (Mendenhall *et al.*, 1971).

Analysis by Chart

Because storms adversely affected both water clarity and diver safety, not all transects were completed and not all charts were sampled equally. Areas covered ranged from 42.5 ha to 53.95 ha, with a mean value of 49.45 ha/chart (±3.38). Conch density also varied from chart to chart, with values ranging from 0.14 for the Key Largo and Boca Grande Key charts, to 11.57 conch/ha for Marathon and adjacent waters. Using the mean value of conch/ha calculated for each chart and multiplying it by the total area of ocean bottom < 20 m depth for that chart, an estimated total abundance is calculated to be 686,026 (± 361,384). Therefore a maximum value, at the 95% confidence limit, would be 1.4×10^6 conch in the Florida Keys.

Analysis by Habitat

Each transect was described by a single habitat, although occasionally more than one were present. Conch were not uniformly distributed in the five categories of habitats. Because of the large herd of juveniles that was encountered, most were located offshore in the Blue-water habitat. This herd was, in fact, in coarse sediment. Greatest densities were found in decreasing order of Blue-water > Sediment > Reef > Bedrock > Seagrass. By multiplying the mean number of conch per hectare for each habitat by the number of hectare in each habitat, the total abundance of conch was estimated by 627,802 (± 330,629). Chart 11 was not included in this estimate because its bottom community structure has not been adequately mapped. Therefore, to estimate the total conch in the entire study area, the mean value should be increased by 9.3%. This brings the total abundance to 686,230 conch.

Analysis by Season

Fewer transects were completed in the Fall season (94) than the other three seasons (110 each) because of heavy sea conditions. The areas sampled ranged from 126.4 to 153.3 ha. More conch were observed as the sampling progressed. This was not due to an increased precision in observing, as many different divers were utilized and values of conch/ha for Spring and Summer of 1987 are not significantly different from those seasons in 1988. Again, estimates of conch/ha were greatly influenced by the large herd observed in the winter season. Multiplying the four estimates of conch/ha/season by total area and averaging for a yearly total gives a value of 686,229 conch (± 361,437).

DISCUSSION

The extensive sampling program has produced preliminary estimates of total conch abundance in the Florida Keys. In overview, there is a greater abundance in areas less impacted by development and tourism, and more animals in offshore habitats (Blue-water, Sediment, Reef) than in nearshore habitats (Seagrass, Bedrock). However, Kruskall-Wallis analyses for differences among values within strata show no significant differences due, we believe, to the aggregated distribution of these animals and the concomitant high variance of estimates of density. Large standard deviations are also reported in the conch density data of Wood and Olsen (1983), Smith and van Nierop (n.d.) and Berg *et al.* (1992).

Total abundance of queen conch in the Florida Keys can be conservatively said to be less than 1.4×10^6, but total adult abundance is less than 2.5×10^5. This represents the stock size that would be suitable for a fishery or recreational collecting and would be quickly reduced by commercial harvesting and/or by the 10^6 tourists that visit the Florida Keys each year.

Comparison of Spring and Summer 1987 conch densities with those seasons in 1988 indicates no increase in the number of animals in Florida waters over that one-year period. The structure of the population is changing, however, with animals maturing into adults and shifting the adult-juvenile ratio for Spring/Summer 1988 to 1.21:1. The discovery of the large heard of juvenile conch gives hope that sufficient annual reproduction and settlement is occurring to increase stock size. We are anxious to see the results of the 1988 Fall and Winter sampling seasons to determine if annual recruitment is also increasing.

Similar survey techniques were used in the U.S. Virgin Islands (Wood and Olsen, 1983), the Bahamas (Smith and van Nierop, n.d.), Puerto Rico (Torres Rosado, 1987), and Bermuda (Berg *et al.*, 1992). The densities that we report here for Florida waters are approximately one-third those reported for the Virgin Islands and Puerto Rico, and one-tenth those of the Little Bahamas Bank. Values for Bermuda are even lower than those in Florida (0.53/ha, Berg *et al.*, 1992). Conch are now protected around St. Thomas and St. John, Bermuda, and in

Florida waters, but not yet in the Bahamas. Abundance data must be combined with estimates of recruitment, growth, and mortality (natural and fishing) in order to develop appropriate management programs.

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