Density-Dependent Mortality of Juvenile Queen Conch and the Role of Predator Aggregation

Progress Report

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The aggregative response of predators, *i.e.*, the number of predators as a function of prey density, influences predator-prey dynamics, but has seldom been quantified in the field. We examined predator aggregation and its relationship to prey mortality in the queen conch (*Strombus gigas*) with a field experiment during summer, 1987.

Juvenile queen conch ranging in total shell length from 80 – 100 mm and 120 – 140 mm were tethered in a shallow subtidal seagrass meadow with a resident conch population (average densities of 1.72 conch per m^2). Eight circular plots (3 m radius) were set up in two parallel rows of four, with each plot receiving a fixed number of individually tethered conch. Initial set up and subsequent weekly sampling of plots in the experimental site required the removal of conch from the plots to monitor ambient conch densities. Types, numbers, and various morphometric characteristics of epibenthic predators were also noted.

Experimental plots were monitored weekly for 10 weeks, at which time all conch lost were noted, then replaced with individuals of the respective sizes. The weekly, total number of conch lost due to predation were then converted to proportional mortalities. In turn, these proportional mortalities were analyzed as a function of ambient conch densities:

$$\text{ambient conch density} = \frac{\text{number of experimental + immigrant conch per plot}}{\text{total area of plot}}$$

We also employed various methods of statistical analysis, mainly ANOVA, to determine main and interaction effects for the numbers of predators per plot. Ambient conch densities were sorted and ranked from lowest to highest, then grouped into six levels of 0.50 conch per m^2 intervals with the last level ranging from 2.51 – 3.00 conch per m^2.

The most frequently occurring epibenthic predator was the hermit crab (*Petrochirus diogenes*), followed by the apple murex (*Murex pomum*), and tuplip snail (*Fasciolaria tuplipa*). Remains of previously tethered conch shells, broken monofilament lines, and large (1 – 2 m^2) cropped seagrass areas within and nearby experimental plots indicated the periodic presence of large vertebrate predators, such as sea turtles, sharks, or rays.

Murex usually attacked conch in groups of two or more, but were often sighted attacking singularly. *Murex* were also frequently observed attacking conch along with *Petrochirus*, in some cases apparently feeding on tethered animals that had succumbed to multiple attacks. In some instances, the presence of partially consumed conch appeared to attract *Petrochirus* and *Murex* as scavengers.

Although only observed in low numbers, *Fasciolaria* illicited the most distinct predator evasion response from conch throughout the course of the experiments. Queen conch almost instantaneously began to flee with short, quick, hopping motions when approached by *Fasciolaria*.

Conch size was found to have little effect on mortality rates. Mortality rates of conch were density-dependent. When analyzed as a function of grouped ambient conch densities, proportional mortalities differed significantly across the six levels of grouped ambient densities. These proportional mortalities followed a density-dependent pattern (*i.e.*, at the lower range of prey densities, the proportional mortalities were lower than those at moderate prey densities). Aggregation of epibenthic predators (*i.e.*, the tulip snail, apple murex, hermit crabs, and portunid crabs) was also density-dependent, indicating a potential mechanism underlying the density-dependent mortality of conch. This is the first documentation of density-dependent mortality and predator aggregation in a tropical marine system.

The findings from this investigation have a number of significant implications, one of which bears directly on the mass aggregation of juvenile queen conch recently observed and documented at Lee Stocking Island, Exuma Cays, Bahamas. One of the most striking features of the mass aggregation was the paucity of epibenthic predators within the aggregation itself, and the apparent low level of predation on the juvenile conch comprising the aggregation. These observations, in addition to our experimental results, suggest that juvenile conch occurring in the wild will survive best at either low or high conch densities – in areas of an existing conch population. Certainly there is the need to continue addressing questions such as those addressed in this investigation, in addition to the role of other important factors (*e.g.*, habitat quality and food requirements), in order to better understand queen conch predator-prey interactions and population dynamics.