Queen Conch Aggregations:Differential Growth, Survivorship, and Habitat Suitability Within a Nursery

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ABSTRACT

Juvenile queen conch aggregations in the Bahamas occupy discrete areas at any given time, though these areas continually expand and shrink. Enclosure experiments showed that conch had high growth rates outside aggregation peripheries. Rates of predation on unprotected conch, however, were higher on the peripheries than in the aggregation center. Proximity to conspecifics undoubtedly enhances individual survivorship, and juvenile conch may sacrifice high growth rate for increased survivorship in aggregations. Two possible mechanisms explain the absence of conch in suitable habitats adjacent to occupied nursery. 1) Conch may graze only a portion of suitable habitat at one time and move on to another portion, allowing macroalgae to recover in the grazed area. 2) Conch populations may be recruitment-limited, and, therefore, nursery habitats may be undersaturated in certain years. Assessing the extent of suitable conch habitat, determination of density-dependent survivorship, and evaluation of the role of larval supply in queen conch will be fundamental to management strategies that include release of hatchery-reared conch.

KEY WORDS: *Strombus gigas*, aggregation, habitat suitability.

INTRODUCTION

Much of the research on the queen conch, *Strombus gigas*, at the Caribbean Marine Research Center is related to answering questions concerning why juvenile conch live where they do. Juvenile conch aggregate in nursery areas in densities > 0.1 conch m^{-2}, and historically important conch nurseries occupy the same general areas year after year. In the Exuma Cays, Bahamas, these areas all share common attributes (Stoner *et al.*, 1993) and are ecologically unique in terms of physical and biological features. However, aggregation peripheries continually expand and shrink, and, at any given time, juvenile conch may only occupy portions of the suitable habitat available.

METHODS

The Shark Rock juvenile conch aggregation is located in a tidal flow field west of Lee Stocking Island on the Great Bahama Bank in moderate density seagrass. It represents a typical nursery and has been the subject of much study since 1989. In terms of depth, substrate, and seagrass cover, portions of the flow field which were not occupied by conch appeared to be similar to portions of the flow field which were occupied by conch. These observations suggested that, in spite of apparent similarity, habitat quality for conch varies within the flow field. During the summer of 1991, one-year old conch were tethered and enclosed at an inside-aggregation station (where conch had occurred in high densities for over two years) and at an outside-aggregation station (where small juveniles were rarely, if ever, observed) to determine differences in survivorship and growth rate, a good indicator of habitat quality (Stoner and Sandt, 1991). Early in 1991, aggregation peripheries had substantially shifted, and another tether experiment was conducted at the same two stations. In this experiment, the inside-aggregation station of the previous year was outside the aggregation. In addition to these experiments, the aggregation peripheries were frequently mapped, and an herbivory experiment was conducted using conch enclosures and exclosures.

RESULTS AND DISCUSSION

After five weeks, conch outside the aggregation grew as well as, if not better than, conch enclosed within the aggregation, suggesting that areas actively occupied by conch are not necessarily ecologically-unique or "superior" to unoccupied areas.

Both sets of tethering experiments have shown clearly that predation is dependent on density. It is not advantageous for conch in low densities to exploit a good food patch because there is safety in numbers. Although they may grow very well outside of the aggregation where competition is less, they also suffer much higher mortality. Conch may actually sacrifice some fitness for increased survivorship in aggregations.

The herbivory experiment showed clearly that conch grazing substantially decreased the biomass of macroalgal foods. Nearly all *Batophora oerstedii*, an important conch food source (Stoner and Waite, 1991), was consumed in enclosures stocked with densities of 1 conch/m^2 and 3 conch/m^2. In the exclosures, however, this alga flourished in high quantities. Conch tend to be found in areas where algal productivity is high, and algal productivity varies over time and space (Stoner *et al.*, 1993). High growth at the outside station was accompanied by higher algal productivity than had been observed there in a previous year (Stoner and Hanisak, unpub. data).

Conch are capable of choosing optimal seagrass habitat (Stoner and Waite, 1990). They may graze only a portion of the total area of suitable habitat at one time and then move on to another portion, allowing macroalgae to recover in the grazed area. Or perhaps variable food productivity influences conch to exploit portions of the area accordingly. In both cases, total required conch pasture includes occupied areas and unoccupied areas which they need to occupy in the future.

Within the aggregation, habitat suitability is dynamic, changing with time and population shifts. Peripheries within which conch occurred at densities higher than 0.1 conch m^{-2} were constantly shifting. However, between August, 1989 and October, 1991 there were always conch at the inside-aggregation station in densities of at least $0.2/m^2$, and we considered it an aggregation center. Clearly, this status changed over time, and what had been defined as an inside-aggregation station for over two years became an outside station.

By January 1992, density at the inside-aggregation station had dropped an order of magnitude to < 0.02 conch/m^2. We speculate that this portion of the flow field was either beginning a recovery from a long grazing period while conch grazed elsewhere in the flow field, or that the previous year's larval supply was low and resulted in undersaturation. High growth rates outside the aggregation may also be an indication that the nursery was undersaturated.

CONCLUSIONS

Juvenile conch distribution is a function of larval supply, habitat suitability, intraspecific competition for food, and density-dependent survivorship. Although general areas of suitable conch habitat are ecologically unique, not all habitat with characteristics conducive to conch growth appear to be occupied. Portions of the vast seagrass flats throughout the Exuma Cays, Bahamas, may offer suitable habitat that could be used as grow-out areas for conch transplants if stocking densities that minimize predation are determined. Also, established nurseries may be undersaturated and limited by the availability of larvae. Therefore, stock enhancement programs may benefit by transplanting conch to the peripheries of these nurseries.

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