Size-Specific Predator-Prey Relationships Between Queen Conch and Spiny Lobsters

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ABSTRACT

Predator-prey interactions between juvenile spiny lobsters (25-100 mm carapace length [CL]) and juvenile queen conch (28-72 mm siphonal length [SL]) were investigated to determine size refuge for hatchery-reared conch. The mean conch size that spiny lobsters consumed was 41 mm SL (± 2 SE). Conch with a mean shell size of 52 mm SL (± 2 SE) were chipped but in most cases they escaped predation. Lobsters used their mandibles in three different methods (crush, peel, or chip) to open juvenile conch shells in order to consume the animal. The method depended on the relative sizes of the prey and predator. There was a positive correlation between lobster size and the shell thickness of conch damaged but not consumed.

KEY WORDS: *Stombus gigas*, predation, shell, hatchery, *Panulirus argus*.

INTRODUCTION

The rapid decline of queen conch, *Strombus gigas*, stocks throughout the Caribbean region has promoted the idea of stock enhancement through mariculture. Predation is the major obstacle to successful restocking of hatchery-reared juvenile conch (Iversen *et al.*, 1986). Some of the major predators are the tulip snail, octopus, spotted eagle ray, turtles, spiny lobster, and a variety of crabs and fish (Randall, 1964).

The juvenile spiny lobster, *Panulirus argus*, was chosen as the predator for this laboratory study, because it is abundant in juvenile conch habitats and preys on juvenile conch (Randall, 1964; Herrnkind *et al.*, 1975; Herrera *et al.*, In press; B. Rose, pers. comm. 1992). The primary objectives of the study were to: 1). determine the size refuge for hatchery-reared juvenile conch fed to juvenile spiny lobsters of different sizes, and 2). evaluate breakage tactics used by lobsters on juvenile conch shells. This research provides relevant information on predation and size of release for hatchery-reared juvenile conch.

METHODS AND MATERIALS

The experiments were carried out at Caribbean Marine Research Center, Vero Beach, Florida from January 31 to April 15, 1992. Two hundred hatchery-reared juvenile conch (28-72 mm siphonal length [SL]) were grouped into five size classes (28-32, 38-42, 48-52, 58-62, and 68-72 mm SL) and

maintained on flow-through wet tables at an average temperature of 23 °C. A total of twenty juvenile spiny lobsters (25-100 mm carapace length [CL]) were used in the experiment.

Prior to each experiment, four lobsters were placed individually in 140 liter aquaria. They were acclimated and starved for at least 24 hours. Only one conch of a particular size class was offered at a given time to a lobster. The predator's response to the presence of the prey was classified into one of three categories: 1) mortality with shell breakage, 2) survival with shell breakage, and 3) survival without shell breakage. Shells of consumed conch were further classified into one of three breakage patterns used by lobsters: 1) crushed, 2) peeled, and 3) chipped (Figure 1). Shell thickness from category two chipped shells was measured along the leading edge to compare the size of the lobster CL with the maximum shell thickness the lobster can break.

RESULTS

A 3-dimensional relationship between conch size, lobster size, and percent conch mortality (Figure 2), shows that 60-100% of the smallest conch (28-32 mm SL) were consumed by all size classes of lobsters. The larger lobsters (80-100 mm CL) consumed 100% of the conch offered in the first three prey size classes (28-32, 38-42, 48-52 mm SL). As conch size increased and lobster size decreased, an obvious reduction in percent mortality occurred.

The mean conch size that spiny lobsters consumed was 41 mm SL (± 2 SE). Conch with a mean of 52 mm SL (±2) were chipped but in most cases they escaped predation. Conch which survived without shell damage had a mean size of 54 mm SL (±3).

Lobsters used their mandibles in three different methods (crush, peel, or chip) to open juvenile conch shells in order to consume the animal (Figure 1). The mean (± SE) mm SL for conch shells that were crushed was 33 (± 2); this size was crushed by lobsters ranging in size from 37-93 mm CL. For peeled shells the mean was 43 (± 2); the larger juvenile lobsters from 53-93 mm CL used peeling as a breakage tactic. The mean for chipped shells was 48 (± 4); lobsters in the smaller size range 30-60 mm CL used chipping and prying as a method to remove the conch.

Shell thickness and size are the main defenses for conch against this shell-damaging predator. Shell thickness of conch which survived with shell damage correlated positively with lobster size ($p < 0.001$). Thus there is a limit to shell thickness that lobster's mandibles can break.

DISCUSSION

In the Caribbean region, juvenile conch are probably a major food source for spiny lobsters, especially in terms of biomass (Herrera *et al.*, In press). Herrera *et al.* (In press) extrapolated that lobsters (> 90 mm CL) consumed two

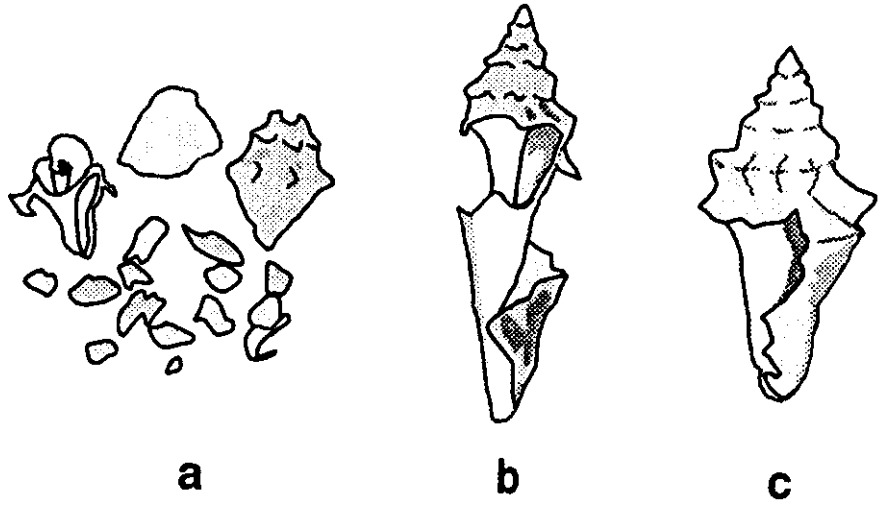

Figure 1. Consumption methods spiny lobsters use on juvenile conch: a) crush, b) peel, and c) chip.

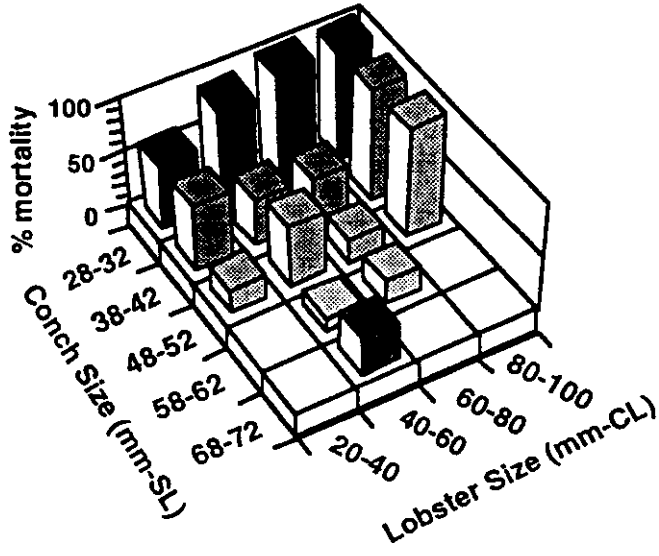

Figure 2. Size refuge results: relationship between conch size, lobster size, and percent conch mortality.

conch (30-70 mm SL) per evening. However, based on opercula data from this present laboratory study, lobsters (20-100 mm CL) may eat as many as four conch (30-70 mm SL) per evening (Davis, 1992). In addition, a preliminary consumption experiment showed that a lobster 66 mm CL consumed 24 conch (mean 38 mm SL) in 72 hours (M. Davis unpubl. data). If a lobster encounters a patch of juvenile conch it could possibly do extensive damage over a short time period.

Traditionally, lobsters have been known to consume conch only in a lip peeling fashion (Randall, 1964; Herrnkind *et al.*, 1975; Jory and Iversen, 1983). Now that it is known that lobsters use different methods to attack the conch it will be more difficult to determine which crustacean or fish predator is causing the damage in the field.

Field studies have determined that the recommended minimum release size of hatchery-reared conch is 50-60 mm SL (Appeldoorn, 1988; Dalton, In press). This study supports this restocking size.

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