AGE-SPECIFIC HABITAT PREFERENCE BY THE QUEEN CONCH, *STROMBUS GIGAS*, AT LITTLE CAYMAN ISLAND

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Abstract: Many Caribbean nations regulate harvesting of the queen conch, *Strombus gigas*, but not all regulations are based on reliable local data. It is not known if the conch of Little Cayman Island exhibit the same habitat preferences as do conch on other Caribbean islands. I measured live conch at four sites with depths from < 1m to *c.* 17 m. Shallow sites had a high percentage of juveniles, while deep sites lacked juveniles. At sites in deeper water, adult conch had thicker shell lips (and were thus older), but there was no increase in adult age beyond 3m depth. Since the conch of Little Cayman Island exhibit the same age-specific habitat preferences as do conch studied elsewhere in the Caribbean, conch research throughout this region may be relevant to management decisions about the conch of Little Cayman.

Key Words: fisheries management, spillover effect

INTRODUCTION

The Queen Conch, *Strombus gigas*, supports locally important commercial fisheries throughout the Caribbean. While the science of conch fisheries management is imperfect, some conch populations have been so depleted by over-harvesting that Caribbean governments are taking action to regulate the industry (Aiken et al 1999). Along with many other Caribbean nations, the Cayman Islands have designated areas of conch habitat where harvesting is either seasonally regulated or forbidden entirely (Collins and Harrison 2007). This approach to fisheries management utilizes the "spillover principle," whereby protected areas may act as sources for supplying new recruits to fished areas, protecting local populations from collapse caused by over-fishing (Tewfik 2003).

Determining which habitats are most important for population maintenance and growth is difficult because benthic conch are highly mobile, and different ages may prefer different habitats. Three factors complicate how to maximize reproduction via habitat protection: 1) reproducing adult conch occupy deeper waters, while larvae metamorphose into young conch in the shallows (Ray and Stoner 1995); 2) conch fecundity increases with age (Gascoigne and Lipcius 2004); and 3) since conch larvae are pelagic, the conch population of any one island may derive varying proportions of recruits from local conch or from

breeding conch of islands upstream (Roberts 1997).

Since no data have been published describing age-specific habitat use by conch on Little Cayman, I wished to determine if the same patterns of age distribution with depth observed at other sites in the Caribbean occurred here as well. I predicted that 1) proportionally more juvenile conch would be found in shallower waters than in deeper waters, and that 2) lip thickness (and thus age) of adult conch would progressively increase with water depth across habitats. My findings may help determine whether management strategies developed elsewhere are applicable locally.

METHODS

Study organism

Juvenile conch grow by shell elongation. Once sexual maturity is reached at 3.5 to 4 years, a flange grows on the leading edge (lip) of the shell, and elongation ceases. Further growth occurs via thickening of the shell, which continues throughout the lifespan of the conch (6 to 7 years) (Ray and Stoner 1995).

Study sites

I sampled four study sites, two on the north side of Little Cayman Island and two on the south side. All were in areas where conch harvesting is illegal year-round, with the possible exception of the Grape Tree Bay site. This site straddles the actual legal boundary between protected and unprotected waters; however, the onshore signs that mark park boundaries indicate that this site lies completely within protected waters. Thus, we assume that no conch fishing legally occurs in any of the sample areas (though some poaching may occur). See Table 1 for descriptions of each site.

Table 1: Live conch shells were measured at four sites around Little Cayman Island. All sites were contained within no-take zones, with the possible exception of Grape Tree Bay.

Site	Proximity to protected areas	Habitat Description
South Hole Sound	Within South Hole Sound Replenishment Zone	Max depth 1 m, back reef lagoon, substrate sand & reef rubble, some T. testudinum and algal turf
Grape Tree Bay	Eastern boundary of Bloody Bay Marine Park, abuts Little Cayman Research Centre, park signage inaccurate	Max depth 2 m, back reef lagoon, substrate rubble, algal turf, Thalassia testudinum beds
Jackson Bay	Within Bloody Bay Marine Park	Max depth 3 m, no barrier reef, flat uneven hardpan pocked with sinkholes, substrate sandy/rocky algal turf
Preston Wreck	Within Preston Bay Marine Park	Max depth 17 m (bare sand), min depth 8 m (reef top), seaward of barrier reef

Sampling

At Jackson Bay and Grape Tree Bay, conch were sampled along belt transects 4 m wide, perpendicular to the shoreline. Four transects were done at Jackson Bay and 7 at Grape Tree Bay. Each transect was between 90 and 120 m long, extending from the shore to the barrier reef (if present). No transects were laid out in South Hole Sound or near the Preston Bay wreck; due to time constraints, conch were sampled haphazardly and opportunistically at these sites. The following data were recorded for each live conch found: shell length from apical spiral to siphonal groove to the nearest cm, lip thickness to the nearest mm, and whether the conch was an adult or a juvenile, indicated by presence or absence of a flange (Collins and Harrison 2007).

Statistical Analyses

Percentages of juveniles and adults found at each site were compared, and mean lip thicknesses of adults were compared for all sites with >1 adults, both using ANOVA.

RESULTS

In South Hole Sound and Grape Tree Bay, the two shallowest sites, 38.1% and 96.5% of the conch sampled were juveniles, respectively (only one adult was found in Grape Tree Bay). In Jackson Bay, the site of intermediate depth, 96.9% of the conch sampled were adults (only 1 juvenile was found), and at the deepest site, around Preston Wreck, all conch sampled were adults (Figure 1).

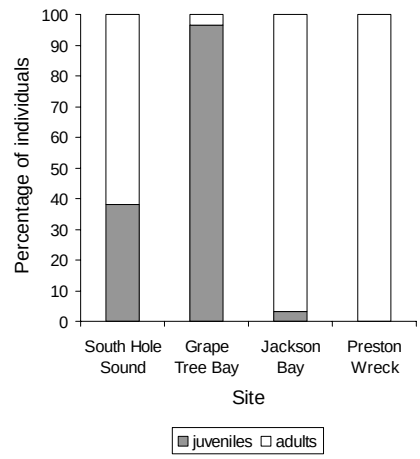

Figure 1: Percentages of juvenile v. adult conch found differed among four different habitats around Little Cayman Island, with higher percentages of juveniles occurring at shallow sites and few to no juveniles found in the deeper sites. See Table 1 for site descriptions. South Hole Sound: 16 juveniles, 26 adults; Grape Tree Bay: 28 juveniles, 1 adult; Jackson Bay: 1 juvenile, 31 adults; Preston Wreck: 0 juveniles, 20 adults.

Mean lip thickness of adults was lowest (12.2 mm) at South Hole Sound (the shallowest site), greatest (26.2 mm) at Jackson Bay, and intermediate (20.7 mm) around Preston Wreck. All differences in adult lip thickness among sites were statistically significant (Figure 2, ANOVA, $F_2 = 55.31$, $P < 0.0001$).

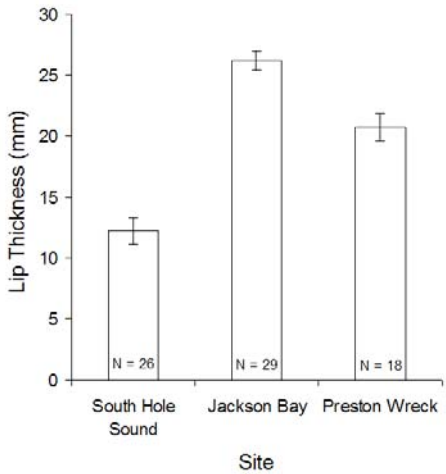

Figure 2: Mean lip thicknesses (± 1 SE) for adult conch in three different habitats around Little Cayman Island were significantly different. Mean thickness was lowest for the shallowest site (South Hole Sound), intermediate for the deepest site (Preston Wreck), and highest for the site of intermediate depth (Jackson Bay). See Table 1 for site descriptions.

DISCUSSION

A higher proportion of the conch found in the shallow sites were juveniles (Figure 1), as has been found elsewhere in the Caribbean. However, the higher percentage of adult conch at South Hole Sound compared to Grape Tree Bay was surprising since both sites are of comparable depth. These results may be due to differences in benthic substrate type, food availability, water temperature, predation, or water flow regime. Since time constraints caused me to shift from sampling transects to sampling opportunistically part way through the study, it is also unclear which sites contain the highest absolute abundance of conch.

The adult conch of South Hole Sound have the lowest mean lip thickness, so they are younger than the adult conch found in Jackson Bay and near Preston Wreck. This supports my hypothesis that as the conch of Little Cayman Island mature, they leave the shallows for deeper waters. However, I cannot rule out the possibility that large adults are absent from the shallow waters of South Hole Sound because they are illegally harvested. If large numbers of juvenile conch were tagged in the shallows, a multi-year study could observe their movements and determine exactly where the conch go as they age.

The greater mean lip thickness (and thus age) of the conch at Jackson Bay (the site of intermediate depth) compared to Preston Wreck (the deepest site) suggests that there may be a threshold beyond which conch age does not increase with depth. While the large conch of Preston Wreck would only be accessible to harvesting by SCUBA, the larger conch of Jackson Bay would be easily harvestable by free diving. Conch fecundity increases with age (Gascoigne and Lipcius 2004), so the fertile adults near Preston Wreck would be protected from harvesting by depth, but the larger (and presumably more fecund) conch of Jackson Bay would not be. Thus, management decisions for the conch of Little Cayman Island must

account for the fact that reproductive adults can be found in water as shallow as 3 m or as deep as 17 m, remembering that juvenile conch require shallow water habitats as well.

LITERATURE CITED

Aiken, K., G. Kong, S. Smikle, R. Mahon, and R. Appeldoorn. 1999. The queen conch fishery on Pedro Bank, Jamaica: discovery, development, management. Ocean & Coastal Management 42: 1069-1081.

Collins, P. and T. Harrison. 2007. Population structure and size distribution of queen conch in Grape Tree Bay, Little Cayman Island. In press.

Gascoigne, J. and R. Lipcius. 2004. Conserving populations at low abundance: delayed functional maturity and Allee effects in reproductive behavior of the queen conch *Strombus gigas*. Marien Ecology Progress Series 284: 185-194.

Ray, M, and A. W. Stoner. 1995. Growth, survivorship, and habitat choice in a newly settled seagrass gastropod, *Strombus gigas*. Marine Ecology Progress Series 123:83-94.

Roberts, C. 1997. Connectivity and Management of Caribbean Coral Reefs. Science 278: 1454-1457.

Tewfik, A. and C. Béné. 2003. Effects of natural barriers on the spillover of a marine mollucs: implicatiosn for fisheries reserves. Aquatic Conservation: Marine and Freshwater Ecosystems 13: 473-488.

APPENDIX I

Table 2: Descriptive statistics for all live conch measured at four sample areas around Little Cayman Island, encompassing shallow and deep habitats (Table 1).

Site	Age class	N	Mean Lip Thickness (mm)	Range (mm)	± 1 SE	Mean Shell Length (cm)	Range (mm)	± 1 SE
Grape Tree Bay	**All**	29	0.9	0.3 – 6.8	0.22	15.9	11 – 23	0.59
	Juveniles	28	0.7	0.3 – 1.6	0.057	15.8	11 – 23	0.59
	Adults	1	6.8	N/A	N/A	30	N/A	N/A
Jackson Bay	**All**	32*	25.4	2 – 32	1.1	23.1	12 – 25	0.41
	Juveniles	1	1.5	N/A	N/A	12.0	N/A	N/A
	Adults	31*	26.2	15 – 32	0.80	23.5	20 – 25	0.22
Preston Wreck	**All**	20*	20.7	16 – 31	1.1	21.0	18 – 25	0.37
	Juveniles	0	N/A	N/A	N/A	N/A	N/A	N/A
	Adults	20*	20.7	16 – 31	1.1	21.0	18 – 25	0.37
South Hole Sound	**All**	42	8.7	2 – 23	0.98	18.2	9 – 22	0.62
	Juveniles	16	2.9	2 – 5	0.27	15.5	9 – 21	1.0
	Adults	26	12.2	4 – 23	1.1	19.9	11 – 22	0.58

*A pair of conch were found mating at Jackson Bay, and another pair were found mating near Preston Wreck. To avoid disturbing them, the lip thicknesses of these conch were not measured. Thus, the N values used for mean lip thickness at these sites are as follows: Jackson Bay (All 30, Juveniles 1, Adults 29), Preston Wreck (All 18, Juveniles 0, Adults 18).