The Existence of Queen Conch Mega-spawner Refuges on Glover's Atoll, Belize

La Existencia de Refugios de Caracola Reina Mega de Reproductores en el Atolón de Glover, Belice

L'existence de la Reine Refuges Conque Méga - géniteurs sur Glover Atoll, Belize

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EXTENDED ABSTRACT

A natural refuge provides an inaccessible area that can protect populations from exploitation (Karpov et al. 1998, Tyler et al. 2009). This concept has been adopted by marine resource management to identify and protect habitats that preserve species and provide sources of replenishment to fisheries beyond no-take areas (Rowley 1994, McClanahan and Mangi 2000, Roberts et al. 2001). In Belize, a broad network of marine reserves has been established to protect environmental health and support socio-economic needs and where the extraction of Queen conch (*Lobatus gigas*) by free-diving fishers provides significant revenue (Acosta 2006, Babcock et al. 2015, Dahlgren and Tewfik 2015). In order to understand the distribution of conch resources, especially mega-spawners (large, mature and highly fecund individuals) (Bertelsen and Matthews 2001, Stoner et al. 2012, Hixon et al. 2014), and support the overall management of the fishery, we surveyed a number of habitats across Glover's Reef Marine Reserve in May and June of 2015. In addition, we conducted assessments of shells and extracted soft tissues, with fishers, to determine the maturity of harvested conch with reference to three important indicators (Froese 2004). Fifty percent maturity was established at 5 mm shell lip thickness with a corresponding 160 g market clean meat mass (Babcock et al. 2015). Existing regulations consist of a minimum shell length of 178 mm (7 inches), no minimum shell lip thickness lip and a market clean meat mass of 85 g (3 ounces). Optimal size range and mega-spawner minimum, both at 100% maturity, were calculated to be 11 to 13 mm and 14 mm shell lip thickness respectively (Babcock et al. 2015). Although the densities of conch did vary between habitats and management zones (Figure 1), our assessments revealed that most harvested conch were juveniles or sub-adults (lip thickness < 5 mm) (Babcock et al. 2015). Immature conch were most abundant in shallow (1.6 +/ 0.4 m) patch reef (N = 11) and sand flat (n = 14) sites (Figure 2) where fishing effort is concentrated and matches the known life history for this species (Stoner and Sandt 1992). In contrast high proportions of mega-spawners occurred in deeper fore-reef (13.3 +/- 0.6 m, n = 12) and seagrass (10.2 +/- 1.2 m, n = 13) sites around patch reefs (Figure 2). These habitats, outside no-take zones, may provide additional refuges for mega-spawners given more limited accessibility by free-divers due to depth as well as high turbidity (seagrass) and wave exposure (fore-reef) (Karpov et al. 1998, Tewfik 2014). However, these refuges are subject to harvest and should be considered for

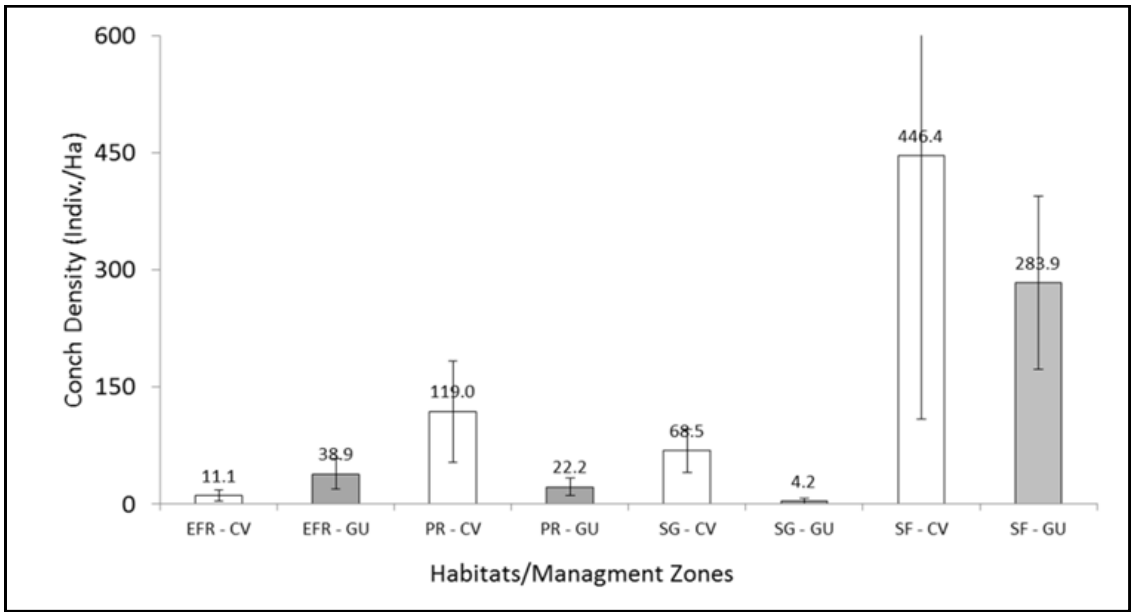

Figure 1. Density (Indiv./Ha) of all conch size/age classes across habitats (EFR = Eastern fore-reef, PR = patch reef, SG = seagrass, SF = sand flats/back-reef) and management zones (CV = conservation/ no-take, GU = general use/extraction) at Glover's Reef Marine Reserve, Belize. Error bars = standard error.

the application of specific management measures given the low overall density of adults and their importance to the maintenance of recruitment. One such measure could be the total prohibition of fishing conch outside the reef crest thereby protecting fore-reef refuges where the largest individual mega-spawners were found.

KEYWORDS: Queen conch, mega-spawner, fishery, free-diver, accessibility

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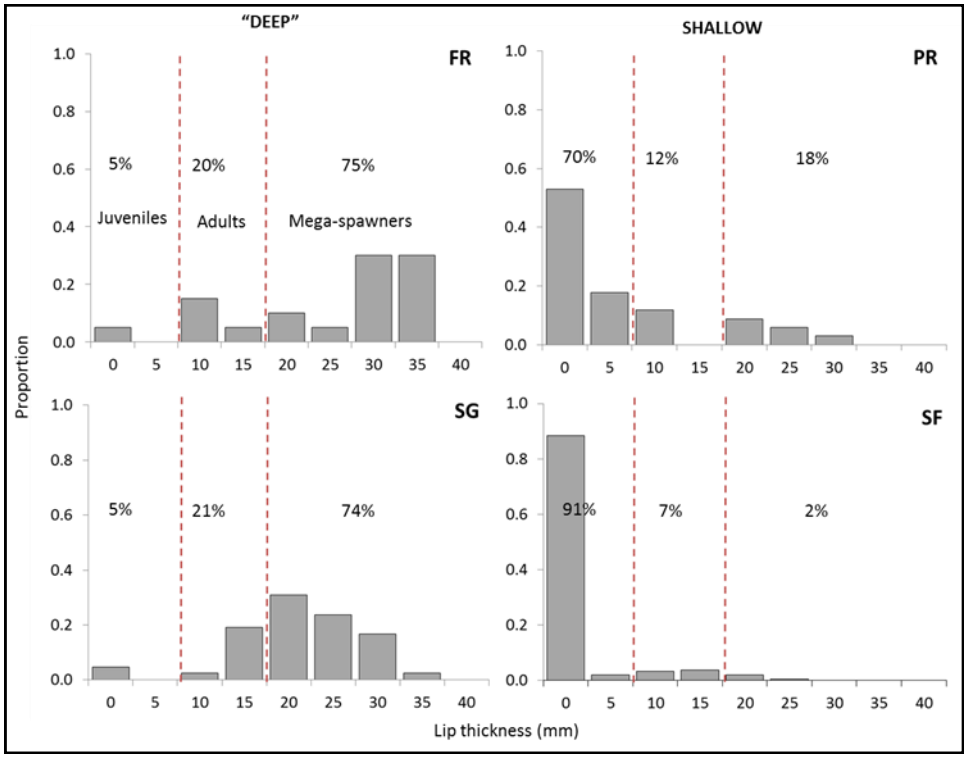

Figure 2. Proportional distribution of juveniles including sub-adults (shell lip < 5 mm), adults (shell lip 5 - 13 mm) and mega-spawners (shell lip 14 mm and greater) in four habitats surveyed (Deep: FR = Eastern fore-reef, SG = seagrass; Shallow: PR = patch reef, SF = sand flats/back-reef) at Glover's Reef Marine Reserve, Belize.