

Examining Caribbean Spiny Lobster Size at Maturity Using External Reproductive-related Structures in Belize

Examen del Tamaño de la Langosta Espinosa del Caribe en la Madurez Utilizando Estructuras Externas Relacionadas con la Reproducción en Belice

Examen de la Taille du Homard Épinicole des Caraïbes à la Maturité en Utilisant des Structures Externes Liées à la Reproduction au Belize

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EXTENDED ABSTRACT

A basic principle of sustainable fisheries management is to maintain the harvest of only mature individuals thereby allowing a significant proportion of the exploited population at least one opportunity to reproduce (Froese 2004). In so doing, many more individuals will contribute to rebuilding and maintaining healthy spawning stocks, genetic diversity and ecosystem functions as well as increase overall contributions to fisheries livelihoods. A maximum harvestable size may also be implemented in order to protect larger individuals which have a disproportionately higher fecundity or survival of offspring (Froese 2004, Hixon et al. 2014, Gnanalingam and Butler 2017).

The presence of reproductive body parts that develop with maturity or are disproportionately larger in mature individuals may be used to make the determination of size at maturity in spiny lobsters with reasonable confidence (Lipcius and Herrnkind 1987, Minagawa and Higuchi 1997, Robertson and Butler 2003, Kulmiye et al. 2006). In Belize, the Caribbean spiny lobster (*Panulirus argus*) is the primary target of small-scale fisheries operating from skiffs, sailboats and canoes where a minimum carapace length is the primary regulation. However, no empirically derived estimate exists for size-at-50%-maturity in Belize, where the size at maturity has been assumed to be 76 cm carapace length (CL) (Gongora 2010). In an effort to advise on improvements to the spiny lobster fisheries management regime we examined the maturity of lobster captured using hook-sticks by free-divers as well as harvested using traps and artificial structures.

We examined a total of 2,024 whole lobsters (carapace length 55 – 178 mm) harvested during the June 2015 to February 2016 season from three fishing areas in central Belize directly in association with fishers (Southwater Caye and Glover's Reef Marine Reserve), or at the National Fishermen's Cooperative processing facility in Belize City, to determine sex-specific (F = 957, M = 1067) sizes of maturity. External indicators of maturity examined included the length of setae on the second pleopod and the total length of the second pleopod on females and the length of the second pair of walking legs and gonopore diameter on males. We used segmented regression to estimate a break point of maturity where the explanatory variable is carapace length (CL) and the response variable is the size of some body structure (Somerton 1980, Muggeo 2003, DeMartini et al. 2005, Gardner et al. 2005) and principle components analysis to distinguish mature and immature individuals with using two structures for each sex (Anderson et al. 2013).

All estimates of size-at-50%-maturity were above the present national minimum size of 76 mm CL. Female size-at-50%-maturity was reasonably estimated as 85 mm CL and male size-at-50%-maturity was reasonably estimated as 93 mm CL with optimal harvest size to maximize yield-per-recruit being well above the size-at-50%-maturity for both sexes (F = 95 mm, M = 104 mm) (Froese and Binohlan 2000). Mega-spawner size individuals, 10% larger than the optimal size, for both sexes made up less than 20% of the catch (F = 1.3%, M = 3.5%), indicating a potential of overfishing (Froese 2004). However, this may be a consequence of a pattern of exploitation focused in shallow water. We believe this to be the first study to use gonopore diameter to determine sexual maturity in male *P. argus*. Gathering more data from a wider size range of animals across a wider spatial scale will help verify our results and support the long-term sustainability and economic benefits of the fishery through an increase in the minimum carapace size regulation.

KEYWORDS: Lobster, fisheries, maturity, management, Belize

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