How do stone crab *Menippe mercenaria* fishing practices impact disease and trophic ecology?

¿Cómo impactan las prácticas de pesca del cangrejo moro *Menippe mercenaria* en las enfermedades y la ecología trófica?

Comment les pratiques de pêche au crabe pierre *Menippe mercenaria* ont-elles un impact sur les maladies et l'écologie trophique?

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EXTENDED ABSTRACT

Stone crab *Menippe mercenaria* represent an important and growing fishery in Florida and the Caribbean, but one with unique challenges for managers. It is a trap-based, claw-removal fishery wherein legal-sized claws are removed and live crabs returned to the water. Though laboratory and field studies suggest that only 20–40% of harvested animals survive the trauma of two claw harvest (Gandy et al., 2016), landings suggest that at least a small portion of crabs (it is estimated that 4 –13% of claws landed are regenerated; (Duermit et al., 2017)) survive to regenerate claws and re-enter the fishery. Released crabs, including sublegal individuals, have been in traps for up to a month, where close contact with conspecifics could lead to rapid disease transmission. Crabs that survive harvest have limited access to prey (Duermit et al., 2015), which could be detrimental to their nutritional condition, could lead to a trophic shift, and also could affect disease transmission. To examine disease and trophic structure of fished crabs, we collected stone crabs from Florida Wildlife Research Institute's regularly monitored traps in Cedar Key, FL (n = 155) and Harbor Key, FL (n = 128) in 2019–2020. All crabs were necropsied and screened for parasites/disease via histopathology and molecular diagnostics. Trophic status was assessed through carbon and nitrogen stable isotope analysis of the muscle. Carbon stable isotopes allow us to examine the carbon source of the primary producer at the base of the food chain, while nitrogen stable isotopes allow us to examine the trophic level of the crab (Peterson & Fry, 1987). Hemolymph refractive index was used as a measure of nutritional condition because it is directly proportional to blood serum protein (Cormier et al., 1999). Overall, stone crabs collected here harbored fewer parasites than other crustacean species (cite). The stalked gill barnacle, an *Octolasmis* sp., was more prevalent in crabs from Cedar Key (34.8%) than crabs from Harbor Key (2.3%), but there were no relationships between its prevalence or burden and sex, season, number of claws, claw regeneration status, or nutritional condition. Two female crabs captured in Cedar Key post-season were infected with *Hematodinium perezi*, the cause of bitter crab disease and significant mortality in crustaceans worldwide. This is just the second report of a *Hematodinium* sp. in *Menippe* sp. (Sheppard et al., 2003). Both of these crabs had higher *Octolasmis* sp. burden than other crabs captured post-season in Cedar Key. Nutritional condition was impacted by claw removal, such that intact crabs had higher nutritional condition than one-clawed and clawless crabs (Fig. 1).

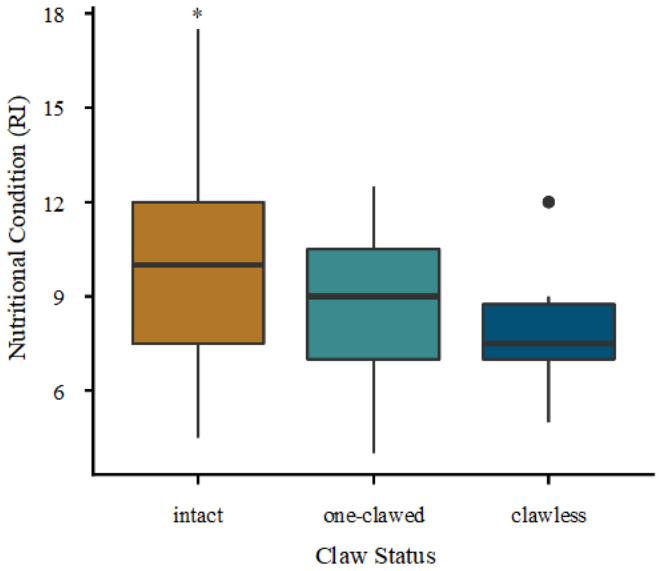

Figure 1. Nutritional condition approximated by refractive index (RI) for stone crab *Menippe mercenaria* captured intact, with one claw, and clawless. Intact crabs have significantly greater nutritional condition than one-clawed and clawless crabs (F = 5.7, p = 0.004).

Preliminary stable isotope analyses indicate no relationships between trophic status and claw removal or claw regeneration. There was a significant negative relationship between carbon and nitrogen stable isotope signatures (Fig. 2), such that crabs with a lower nitrogen signature (i.e. feeding at lower trophic level) had higher carbon signatures (i.e. a different primary producer at the base of the food chain). This relationship was consistent for males and females, though males appear to feed at a slightly lower trophic level. *Hematodinium perezi* infection prevalence was low (1.3% at Cedar Key, 0% at Harbor Key), but infected individuals also were infested with *Octolasmis* sp.

This relationship could indicate that these crabs were immunocompromised and thus susceptible to these infections, or that one infection immunocompromised crabs and allowed for the other infection. Crabs missing claws had depressed nutritional condition, possibly as a result of impaired access to prey items. This study is the first to assess stone crab diet changes after harvest in the wild and will help managers better understand the impacts of harvest and whether returning animals to water affects disease ecology.

KEYWORDS: stone crab, disease ecology, parasitism, trophic ecology, crustacean fishery

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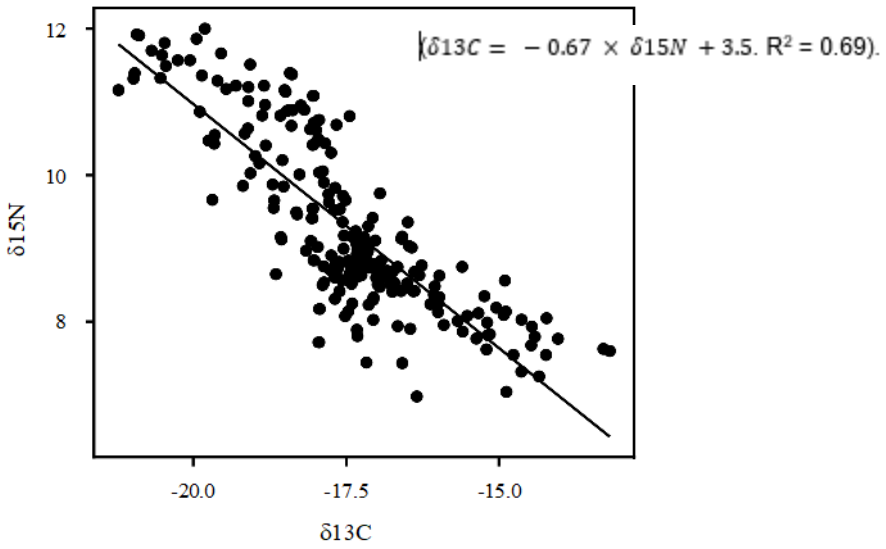

Figure 2. Stable isotope biplot displaying carbon stable isotope signature, which informs the primary producer at the base of the food chain, vs nitrogen stable isotope signature, which informs the trophic level, for stone crabs *Menippe mercenaria* captured in Harbor Key, FL. There is a significant negative relationship between carbon and nitrogen isotopic signatures (. $R^2 = 0.69$).