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Scientific note

## A new symbiont for the sea anemone *Homostichanthus duerdeni*: the spotted cleaner shrimp *Periclimenes yucatanicus*

(Cnidaria, Anthozoa and Crustacea, Decapoda)

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The conspicuous and colourful sea anemones are marine invertebrates belonging to the phylum Cnidaria, which is characterized by their cnidae, i.e., organelles usually capable of stinging used for defense or capturing prey (Jankowski & Anokhin 2019). One interesting aspect of sea anemone biology is the association with vertebrates and invertebrates (Shick 1991). Surprisingly, while some sea anemones are well known for their symbiotic relationships (e.g. Wirtz 1997, Calado et al. 2007, Huebner & Chadwick 2012), the relationships of eye-catching species such as Homostichanthus duerdeni (Carlgren, 1900) are poorly documented. Homostichanthus duerdeni is a large and colourful sea anemone with a broad distribution ranging from Mexico to Brazil. The few studies dealing with H. duerdeni to date have focused on its taxonomy (see González-Muñoz et al. 2015) and as far as we know, only crabs and shrimp were recorded in association with it (Mercado & Capriles 1982). The shrimps Periclimenes rathbunae Schmitt, 1924, Thor amboinensis (De Man, 1888), and Thor manningi Chace, 1972 are the only ones reported so far as symbionts (sensu lato) of H. duerdeni (Mercado & Capriles 1982). Based on in situ observations, we report the spotted cleaner shrimp Periclimenes yucatanicus (Ives, 1891) as a new symbiont for H. duerdeni. Additionally, we provide biological data on this unprecedented association. The sea anemone was found during low tide in a reef lagoon at Mar Grande beach, Vera Cruz (12°57'52"S, 38°36'17"W), Bahia state – Brazil, at a depth of 2–3 meters, on February 4, 2014.

Homostichanthus duerdeni was easily observed on a gravel substrate among small rocks and macroalgae (Fig. 1A). At first glance, no invertebrate macrosymbionts were seen near H. duerdeni. However, careful observation revealed the presence of two individuals of *P. yucatanicus* (one larger and one smaller) (Fig. 1B). While the large specimen showed a remarkable orange coloration (Fig. 1C), the smaller one was transparent, being hard to observe while it remained on the sandy bottom (Fig. 1D). Even so, they showed a similar spotted pattern (Fig. 1C and D). Both specimens remained on the substratum around the host during the time of observation (30 minutes), except when we tried to catch the shrimps, which made them move quickly toward the sea anemone (Fig. 1E). Several small fishes constantly approached H. duerdeni and P. yucatanius (data not shown), and during one of these approaches, we saw one small fish excreting a whitish substance near *H. duerdeni*. Sea anemones have long been known for their biological associations with cleaner shrimps (Shick 1991), and mutualism has been proposed in some situations (e.g. McCammon & Brooks 2014). Considering the interaction reported here, mutualism may also be the case. Regarding putative advantages for P. yucatanicus, some inferences can be made based on

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**Fig. 1.** *Periclimenes yucatanicus* associated with *Homostichanthus duerdeni*. **A.** General view of *H. duerdeni*; **B.** General view showing two individuals of *P. yucatanicus* (a and b) near *H. duerdeni*; **C.** and **D.** Large and small individuals of *P. yucatanicus* (respectively), highlighting their antennae (1) and main body spots (2–4); **E.** Large individual of *P. yucatanicus* seeking refuge on the oral disc of *H. duerdeni*. Scales: A and B=30 mm, C and E=10 mm, D=5 mm.

our observations. Benefits for shrimps would include protection against predators, provided by the toxic cnidae of the sea anemones (Fautin et al. 1995), as well as the use of these cnidarians as a reference point for cleaning interactions with client fishes (Huebner & Chadwick 2012). Although we did not see any predation attempt on P. yucatanicus, we witnessed it climbing the oral disk of H. duerdeni in response to stressful situations (our attempts to catch it), which suggests it was seeking refuge. Since sea anemones are easier to spot than shrimps, the cnidarians can be used as a reference point of cleaning stations for client fishes (Huebner & Chadwick 2012). Client fishes with a poor visual resolution may have a hard time detecting cleaner shrimps, because of the usual small size and cryptic habit of these animals (Marshall 2000). Periclimenes yucatanicus is a true cleaner shrimp (Titus et al. 2017), and considering its coloration and size, it can be difficult to detect on the bottom, which is especially true for smaller individuals (see Fig. 1C). Thus, considering such characteristics and our observation of fishes approaching H. duerdeni and consequently approaching P. yucatanicus, this sea anemone could be being used as a visual cue for fishes aiming to locate cleaning stations. Nevertheless, we did not observe any cleaning activity of P. yucatanicus, which can be explained by our relatively short period of observation and the fact that only about 15 % of the interactions between P. yucatanicus and client fishes results in cleaning (Titus et al. 2017). Therefore, more observations are needed to confirm these assumptions. Concerning possible advantages for the sea anemone, our data do not allow us to make consistent inferences. However, we cannot ignore that we observed a small fish excreting close to the sea anemone, and some studies indicate that sea anemones are benefited from the nitrogen excreted by the visiting client fishes (Cantrell et al. 2015). Thus, this sea anemone could be nutritionally benefited during this association, which deserves further investigation. Lastly, beyond adding to the knowledge on symbionts of H. duerdeni, this study also increases the number of cnidarians hosts reported for P. yucatanicus to a total of eleven species (Spotte et al. 1991, Vieira et. al. 2012, González-Muñoz et al. 2019), which is

further evidence that this shrimp is as a generalist symbiont. Searching for the possible advantages of this association can be a starting point for future studies with these species.

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