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# Nocturnal Predation of Christmas Tree Worms by a Batwing Coral Crab at Bonaire (Southern Caribbean)

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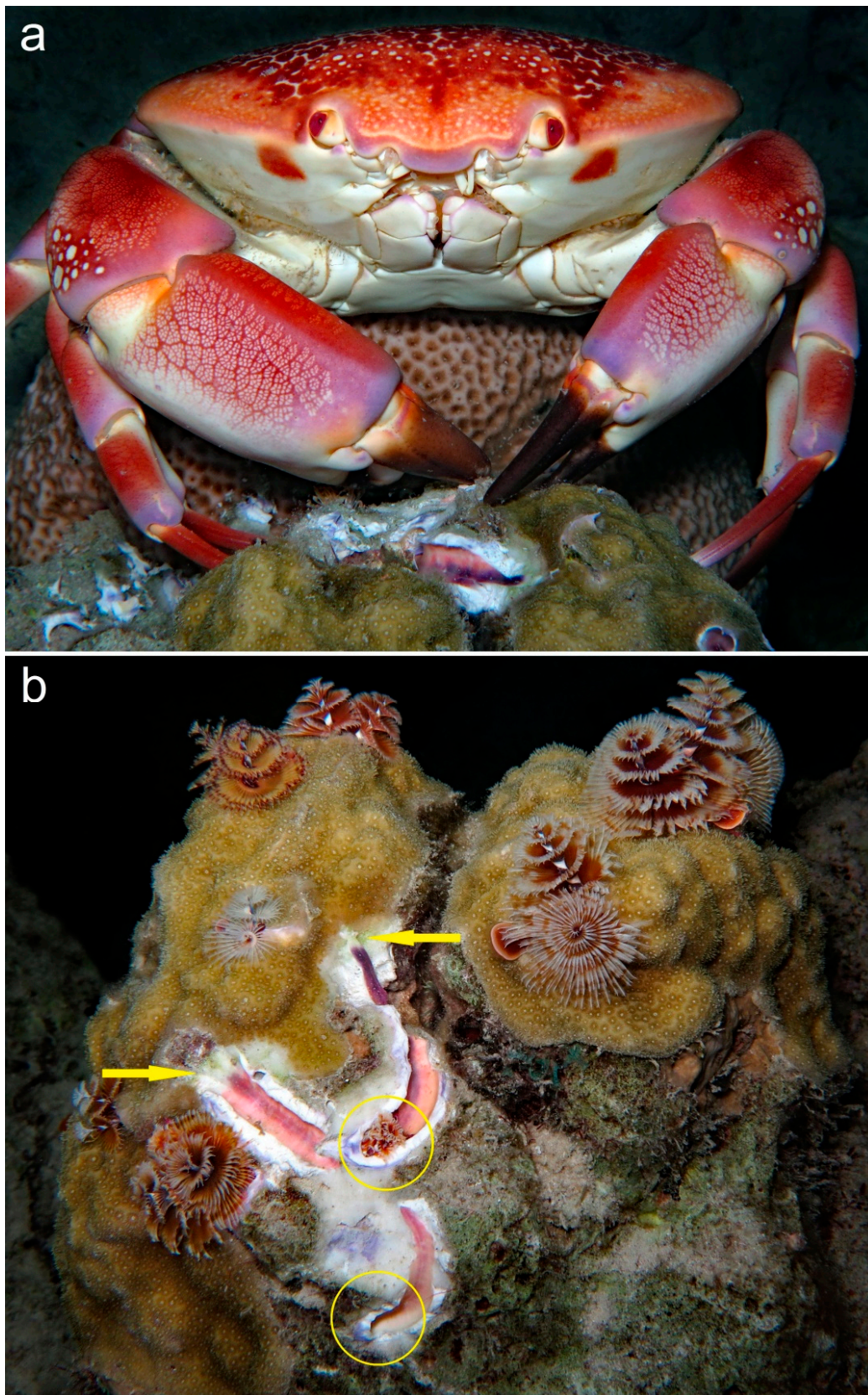
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Christmas tree worms (Serpulidae: *Spirobranchus*) occur in shallow parts of coral reefs, where they live as associates of a large number of stony coral species [1,2]. They dwell inside a calcareous tube, which is usually overgrown by the host coral and partly embedded deep inside the coral skeleton, except for the tube's opening and the worm's operculum [3]. Even if host corals and worm tubes become overgrown by other invertebrates, the worms continue to grow and are able to keep their tube openings free [4,5].

Despite their wide distribution, high densities, and the damage these tube-dwelling worms may cause to corals [6,7], little is known about their natural enemies. They appear well protected by the tube, which is armed by a long spine on the opening margin. Although they may live up to 40 years [3], mortality of *Spirobranchus* worms in dense populations is not uncommon, and most obvious when their vacated tubes are inhabited by small fish and crustaceans [6,8]. There are a few reports on attempted feeding of Christmas tree worms by fish and on *Spirobranchus* remnants found in fish stomachs ([9], references therein), but no information is available on other predators.

Therefore, it is surprising that a West Atlantic batwing coral crab, *Carpilius corallinus* Herbst, 1783, was observed preying on two individuals of *Spirobranchus giganteus* (Pallas, 1766) during a night dive at Playa Pabou (12°09'41.8" N, 068°17'01.0" W), Kralendijk, Bonaire on 18 October 2020; time 18:45–21:15 (Electronic Supplementary Material). The worms were living in a colony of the scleractinian coral *Porites astreoides* Lamarck, 1801, at a depth of 7 m. The crab was using its slender left claw to break away the thick calcareous tubes of the worms, which resulted in a deposit of limestone debris aside the coral (Figure 1a). The crab seemed to extract soft parts of the worm from the tube and manipulate them by using its second pair of pereopods, which are the first pair of walking legs (Electronic Supplementary Material). The use of walking legs during feeding is not uncommon in other brachyuran lineages. Some spider crabs (Majidae) use walking legs to pry and wedge open gastropod and bivalve shells [10] and box crabs (Calappidae) can be seen to use the first two pairs of walking legs to rotate prey shells to find an opening for easier access and grip for their specialized right claw (W.d.G. pers. obs.).



**Figure 1.** Predation of Christmas tree worms (*Spirobranchus giganteus*) in a coral of *Porites astreoides* by a Batwing coral crab (*Carpilius corallinus*) at Bonaire: (a) the crab foraging on worms; (b) two days later, two damaged worm tubes with one worm still alive. Arrows: position of worm tube openings. Circles: position of worm tubes exiting the coral skeleton. Photo credit: Ellen Muller.

During another night dive, two days later, the crab was no longer present but the extent of damage to the worm tubes and the coral was evident (Figure 1b). The worm in the longest of the two tubes was gone, while the other worm had survived in a part of the tube that was inside the host coral. Its operculum appeared lost (Figure 1b).

This observation is interesting because little is known about species preying on Christmas tree worms (see above), while also hardly anything has been published on the diet of the Batwing coral crab. *Carpilius corallinus* is well known for its nocturnal activities [11] and it is the only West Atlantic member of Carpiliidae, a family of three congeneric species [12]. All three species possess an enlarged right cheliped (claw-bearing leg), with a blunt molariform tooth found proximally on the cutting edge of the pollex, which is the fixed ‘finger’ of the claw.

In laboratory conditions in Guam, the Indo-West Pacific species *C. convexus* (Forskål, 1775) and *C. maculatus* (Linnaeus, 1758) have been observed to use their major claw to crush shells of various species of gastropods [13]. The latter crab species has also been reported as predator of a commercially important abalone, *Haliotis asinina* Linnaeus, 1758, in the Philippines [14], and was found in the field between the remains of freshly-killed gastropods on two separate occasions in Guam [15].

Individuals of the West Atlantic *C. corallinus* were also found to be feeding on gastropods in captivity, while they were also fed with sardines [16]. In another case, a female individual in an aquarium was observed to break apart shells inhabited by hermit crabs in an attempt to remove them from their homes [11]. Only one published record was found on the diet of *C. corallinus* in its natural environment, consisting of *Diadema* sea urchins [11]. There is also unpublished data concerning *C. corallinus* feeding on sea urchins, as well as on a topshell, *Calliostoma javanicum* (Lamarck, 1822), all from Bonaire (E.M., pers. obs.).

It seems that information on the diet of *Carpilius* species is rare, but considering the armor of previously reported prey species, the crushing of serpulid worm tubes seems to be within their capacity when they use their right claw. The crab at Bonaire was, however, using its slender left claw to feed from the worm tube. We do not know if the crab had initially crushed the tube using its specialized right claw and continued feeding using its left claw, or if the crab initially used its left claw to break the tube.

The extent of damage on worm tubes is striking (Figure 1). In spite of many dives on Bonaire, this kind of harm was not reported before. Because *Spirobranchus* tubes may easily become covered by coral tissue and algae [3,6,7], it is possible that damaged worm tubes may get unnoticed due to similar overgrowth. All in all, we do not expect *Spirobranchus* to be a regular part of the diet of *Carpilius corallinus*. The present observation and previously published information suggest that *Carpilius* species are not prey specific. More research on the diet and foraging behavior of these commercially important crab species will teach us more about their role in the food chains of coral reefs.

**Supplementary Materials:** The following is available online at <http://www.mdpi.com/1424-2818/12/12/455/s1>. Video footage (Batwing crab video) of the same Batwing coral crab (as in Figure 1) foraging on Christmas tree worms, destructing the worm tubes.

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## References

1. Hoeksema, B.W.; ten Hove, H.A. The invasive sun coral *Tubastraea coccinea* hosting a native Christmas tree worm at Curaçao, Dutch Caribbean. *Mar. Biodivers.* **2017**, *47*, 59–65. [[CrossRef](#)]
2. Perry, O.; Sapir, Y.; Perry, G.; ten Hove, H.; Fine, M. Substrate selection of Christmas tree worms (*Spirobranchus* spp.) in the Gulf of Eilat, Red Sea. *J. Mar. Biol. Assoc. UK* **2018**, *98*, 791–799. [[CrossRef](#)]
3. Nishi, E.; Nishihira, M. Age-estimation of the Christmas tree worm *Spirobranchus giganteus* (Polychaeta, Serpulidae) living buried in the coral skeleton from the coral-growth band of the host coral. *Fish. Sci.* **1996**, *62*, 400–403. [[CrossRef](#)]
4. García-Hernández, J.E.; Hoeksema, B.W. Sponges as secondary hosts for Christmas tree worms at Curaçao. *Coral Reefs* **2017**, *36*, 1243. [[CrossRef](#)]
5. Hoeksema, B.W.; García-Hernández, J.E.; van Moorsel, G.W.N.M.; Olthof, G.; ten Hove, H.A. Extension of the recorded host range of Caribbean Christmas tree worms (*Spirobranchus* spp.) with two scleractinians, a zoantharian, and an ascidian. *Diversity* **2020**, *12*, 115. [[CrossRef](#)]
6. Hoeksema, B.W.; van der Schoot, R.J.; Wels, D.; Scott, C.; ten Hove, H.A. Filamentous turf algae on tube worms intensify damage in massive *Porites* corals. *Ecology* **2019**, *100*, e2668. [[CrossRef](#)] [[PubMed](#)]
7. Hoeksema, B.W.; Wels, D.; van der Schoot, R.J.; ten Hove, H.A. Coral injuries caused by *Spirobranchus* opercula with and without epibiotic turf algae at Curaçao. *Mar. Biol.* **2019**, *166*, 60. [[CrossRef](#)]
8. Böhm, T.; Hoeksema, B.W. Habitat selection of the coral-dwelling spinyhead blenny, *Acanthemblemaria spinosa*, at Curaçao, Dutch Caribbean. *Mar. Biodivers.* **2017**, *47*, 17–25. [[CrossRef](#)]
9. Hoeksema, B.W.; ten Hove, H.A. Attack on a Christmas tree worm by a Caribbean sharpnose pufferfish at St. Eustatius, Dutch Caribbean. *Bull. Mar. Sci.* **2017**, *93*, 1023–1024. [[CrossRef](#)]
10. Woods, C.M.C. Natural diet of the crab *Notomithrax ursus* (Brachyura: Majidae) at Oaro, South Island, New Zealand. *N. Z. J. Mar. Freshw. Res.* **1993**, *27*, 309–315. [[CrossRef](#)]
11. Pequegnat, L.H.; Ray, J.P. Crustaceans and other arthropods. In *Biota of the West Flower Garden Bank*; Bright, T.J., Pequegnat, L.H., Eds.; Gulf Publishing: Houston, TX, USA, 1974; pp. 231–288.
12. Wetzler, R.; Martin, J.W.; Trautwein, S.E. Phylogenetic relationships within the coral crab genus *Carpilius* (Brachyura, Xanthoidea, Carpiliidae) and of the Carpiliidae to other xanthoid crab families based on molecular sequence data. *Mol. Phylogenet. Evol.* **2003**, *27*, 410–421. [[CrossRef](#)]
13. Vermeij, G.J. Interoceanic differences in vulnerability of shelled prey to crab predation. *Nature* **1976**, *220*, 135–136. [[CrossRef](#)]
14. Aspe, N.M.; Cabales, R.G.; Sajorne, R.E.; Creencia, L.A. Survey on the predators of abalone *Haliotis asinina* from the perspective of the local fisherfolks in selected sites of Palawan, the Philippines. *J. Shellfish Res.* **2019**, *38*, 463–473. [[CrossRef](#)]
15. Zipser, E.; Vermeij, G.J. Crushing behaviour of tropical and temperate crabs. *J. Exp. Mar. Biol. Ecol.* **1978**, *31*, 155–172. [[CrossRef](#)]
16. Laughlin, R.A. Some observations on the occurrence, reproduction and mating of the coral crab *Carpilius corallinus* (Herbst, 1783) (Decapoda, Xanthidae) in the Archipelago Los Roques, Venezuela. *Crustaceana* **1982**, *43*, 219–221. [[CrossRef](#)]

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