CSIRO PUBLISHING

Marine and Freshwater Research
https://doi.org/10.1071/MF21059

Short Communication

Nuclear–follower foraging behaviour between Western Australian common octopus and brown-spotted wrasse

Ruchira Somaweera [A,B,D] *and Rehan Somaweera* [C]

[A]Stantec Australia, 226 Adelaide Tce, Perth, WA 6000, Australia.
[B]School of Biological Sciences, University of Western Australia, 35 Stirling Hwy, Crawley, WA 6009, Australia.
[C]Woodlands Primary School, 7 Bentwood Ave, Woodlands, WA 6018, Australia.
[D]Corresponding author. Email: ruchira.somaweera@stantec.com

Abstract. A common feeding association among reef fishes involves nuclear and follower species, where the former disturbs the bottom, during which the latter opportunistically feeds on items exposed. Here, we report such interactions between Western Australian common octopuses (*Octopus* (cf) *tetricus*) and brown-spotted wrasse (*Notolabrus parilus*) observed on eight occasions while snorkeling at four temperate-water reefs along the coast of Perth in Western Australia. We compare the interactions observed to other octopus-fish nuclear–follower associations known. In general, these interactions usually benefit the follower species and could play a significant role on reef trophodynamics.

Keywords: commensalism, octopi, opportunistic foraging, reef fish, reef trophodynamics.

Received 16 February 2021, accepted 13 May 2021, published online 5 July 2021

Introduction

In marine systems, 'nuclear–following' behaviours are temporary feeding associations, where 'followers' associate with a 'nuclear' species to obtain feeding benefits (Strand 1988). In this relationship, the follower gains foraging advantages from the interaction, while the nuclear host neither benefits nor is harmed. These interactions are particularly common among species that cause bottom disturbances when foraging and others that opportunistically feed on exposed and fleeing prey (Sazima *et al.* 2007). A range of species groups, including echinoderms, octopuses, larger fish and marine reptiles, act as nuclear species (Strand 1988; Pereira *et al.* 2011). In contrast, the following behaviour is mostly shown by smaller and mid-sized reef fishes. A wide range of fishes from multiple taxonomic and trophic groups are associated with nuclear species as followers (Auster and Lindholm 2002). Those nuclear–follower behaviours where the interaction period between the species is brief (<5 min) and the associated species does not move away from their territories are categorised as 'ephemeral foraging associations' (Pereira *et al.* 2012).

Methods

Here, we report a series of opportunistic observations where brown-spotted wrasse (*Notolabrus parilus*) closely followed Western Australian common octopuses (*Octopus* (cf) *tetricus*) in a seemingly 'nuclear–following' behaviour. The observations were made between March 2020 and February 2021, while recreationally snorkelling at Mettam's Pool (–31.8682°, 115.7519°; at depths of 1–3 m) and MAAC reef (–31.839458°, 115.748961°, at depths of 1–3 m) both within the Marmion marine park, Cottesloe reef (–32.0091°, 115.7495°, at depths of 2–4 m) and Omeo boat wreck in Coogee (–32.1056°, 115.7614°; depth of 1–2 m), all off the coast of Perth in Western Australia. Snorkelling trips took place between 0600 hours and 1000 hours on 49 days over the 11-month period.

Results

Octopuses were observed on at least 22 occasions at the four locations over the 49 visits. On eight occasions (4 times at Mettam's Pool, twice at Cottesloe reef and once each at Omeo and MAAC), we observed adult (~20–30-cm body length) brown-spotted wrasse accompanying Western Australian common octopuses. The behaviours shown during each encounter were similar; therefore, they are discussed in common here below.

On all occasions, it was a single wrasse following a single octopus, although the particular species of wrasse is abundant at all four locations. In five instances, the individual wrasses were males (Fig. 1*a–c*), and in the other instances, they were females (Fig. 1*d–e*). The octopuses had an estimated arm span of 60–80 cm. For the entire duration of observations (ranging 5–20 min), the wrasses always remained at <50-cm distance from the octopuses, both while the octopuses were moving and stationary. In two instances, where the octopuses moved into a crevice (once each at Mettam's and Omeo), the wrasses followed them into the cave and remined inside the cave until the octopuses exited (Fig. 1*f*). There were noticeable signs of the wrasses feeding in the presence of the octopus; however, the particular food items were not visible. In one instance at

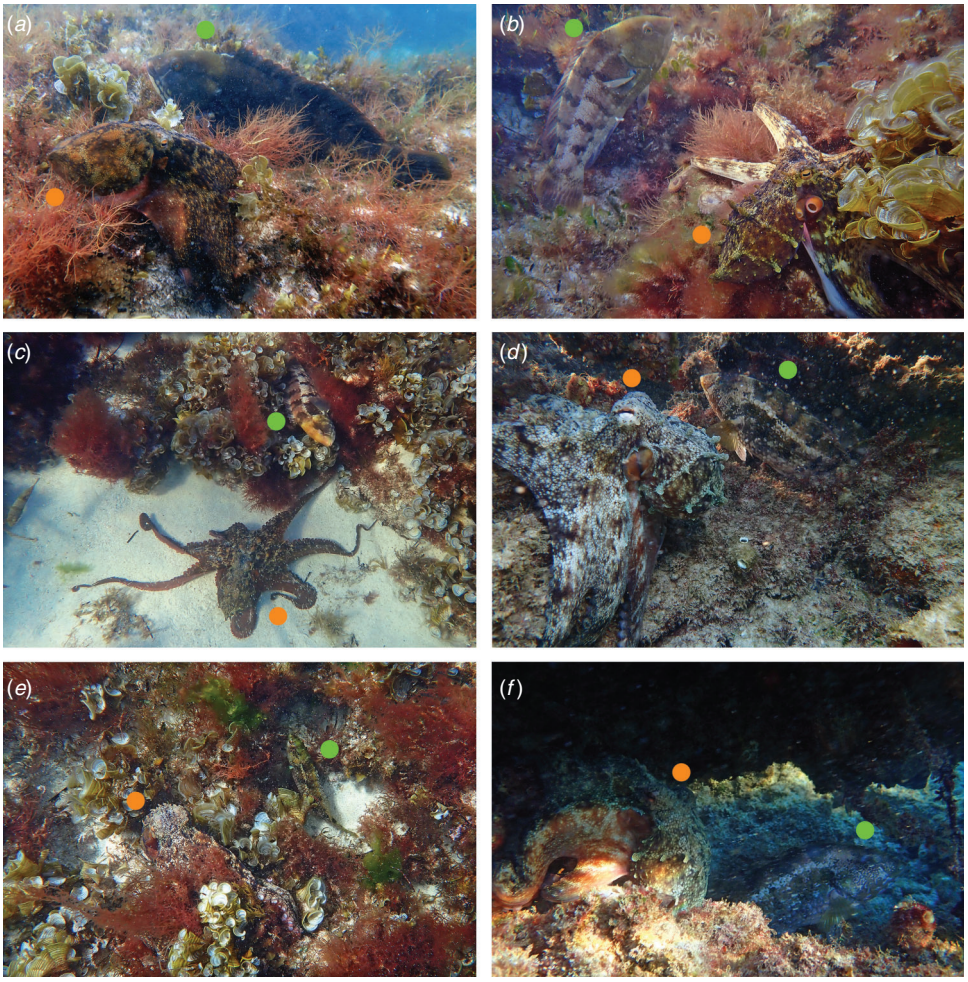

Fig. 1. Close associations between *Notolabrus parilus* and *Octopus* (cf) *tetricus* at (*a*, *c*) Mettam's Pool, (*b*) Cottesloe, (*d*,*f*) Omeo and (*e*) MAAC reef. Position of the octopus marked in orange and that of the fish in green. All photos by Ruchira Somaweera.

Mettam's Pool, where the octopus was disturbed by our presence and fled to a new location ~10 m away, the wrasse closely followed it for the entire distance (Fig. 1*c*). When the octopuses were stationary among the vegetation on the bottom, the wrasses remained stationary with the octopuses, at times lying on the lateral side of the body, which is a characteristic posture for this fish species. The wrasses did not make any physical contact with the octopuses, and there were no obvious signs to assume that the octopuses were disturbed by the presence of the wrasses. No other fish species were observed to follow the octopuses, although multiple species of fish were foraging in the general area. No aggressive behaviour by the wrasses towards other species of fish was observed, nor did we observe the wrasses following other common, bottom-feeding fish at the sites, such as red-lipped morwongs (*Goniistius rubrolabiatus*).

Discussion

The locomotion and feeding behaviours of octopuses, including crawling among the vegetation and inserting tentacles inside crevices, expose hidden prey that are otherwise unavailable or unreachable to their followers. Several species of fish, including groupers (e.g. *Cephalopholis*, *Mycteroperca* and *Epinephelus* spp.), snappers (e.g. *Lutjanus* sp.) and tropical-water wrasse (e.g. *Halichoeres* sp.), have been reported to follow octopuses and opportunistically feed on prey they flush-out during foraging events (Mather 1992; Diamant and Shpigel 1985; Strand 1988; Forsythe and Hanlon 1997; Sazima *et al.* 2007; Pereira *et al.* 2011; Sampaio *et al.* 2020). These hunting associations sometimes involve multiple species of fish following a single octopus at the same time. For example, in the Chagos archipelago, day octopus (*O. cyanea*) formed feeding associations with peacock groupers (*Cephalopholis argus*), brown-marbled groupers (*Epinephelus fuscoguttatus*) and gold-saddle goatfishes (*Parupeneus cyclostomus*; Bayley and Rose 2020). In Bermuda, juvenile common octopus (*O. vulgaris*) were often approached or accompanied by slippery dicks (*Halichoeres bivittatus*), dusky damselfish (*Stegastes adustus*) and hairy blennies (*Labrisomus nuchipinnis*), while feeding (Mather 1992). Brown-spotted wrasse feeds on gastropods, amphipods, isopods, prawns, crabs and echinoids (Bray 2020) that are benthic in habit. Therefore, associating with a nuclear species that drive benthic prey out of hiding places may provide

effortless foraging benefits for the wrasse. However, no other species were noticeably involved in the feeding association.

As a likely mechanism to be less conspicuous within the following fish group, *O. insularis* has been shown to mimic the colour and shape of accompanying coneys (*Cephalopholis fulva*; Krajewski *et al.* 2009). We did not notice such obvious mimicry in *O.* (cf) *tetricus* individuals we observed. Instead, the octopuses observed herein and those without the follower wrasses observed at the same locations, were more so camouflaged against the background colour (Fig. 1).

There is no visible benefit of this interaction to the octopus, and it is likely to be commensalistic to the wrasse. However, octopuses are occasionally known to follow fish such as groupers and goatfishes that use referential gestures to signal prey locations to octopuses (Vail *et al.* 2014) or scrub the sea bottom and crevices, flushing prey out (Bayley and Rose 2020). Therefore, it is possible that some nuclear–follower associations between fish and octopuses are mutualistically beneficial.

Given the frequency of occurrence, these interactions are likely to play a significant role on reef trophodynamics. *Octopus* (cf) *tetricus* is the target of Australia's most significant octopus fishery (Hart *et al.* 2019); therefore, the impact of their harvest on the trophic roles in reef systems warrants further studies.

Conflicts of interest

The authors declare no conflicts of interest.

Declaration of funding

This research did not receive any specific funding.

Acknowledgements

The authors thank Nilu Gunarathne, Nehan Somaweera and Damian Mario for joining the snorkelling visits, and Vinay Udyawer and two reviewers for their feedback on the note.

References

Auster, P. J., and Lindholm, J. (2002). Pattern in the local diversity of coral reef fishes versus rates of social foraging. *Caribbean Journal of Science* **38**, 263–266.

Bayley, D., and Rose, A. (2020). Multi-species co-operative hunting behaviour in a remote Indian Ocean reef system. *Marine and Freshwater Behaviour and Physiology* **53**, 35–42. doi:10.1080/10236244.2020.1746658

Bray, D. J. (2020). *Notolabrus parilus* in Fishes of Australia. Available at http://136.154.202.208/home/species/256 [Verified 16 June 2021]

Diamant, A., and Shpigel, M. (1985). Interspecific feeding associations of groupers (Teleostei: Serranidae) with octopuses and moray eels in the Gulf of Eilat (Agaba). *Environmental Biology of Fishes* **13**, 153–159. doi:10.1007/BF00002584

Forsythe, J. W., and Hanlon, R. T. (1997). Foraging and associated behavior by *Octopus cyanea* Gray, 1849 on a coral atoll, French Polynesia. *Journal of Experimental Marine Biology and Ecology* **209**, 15–31. doi:10.1016/S0022-0981(96)00057-3

Hart, A. M., Murphy, D., Hesp, S. A., and Leporati, S. (2019). Biomass estimates and harvest strategies for the Western Australian *Octopus* aff. *tetricus* fishery. *ICES Journal of Marine Science* **76**, 2205–2217. doi:10.1093/ICESJMS/FSZ146

Krajewski, J., Bonaldo, R., Sazima, C., and Sazima, I. (2009). Octopus mimicking its follower reef fish. *Journal of Natural History* **43**, 185–190. doi:10.1080/00222930802450965

Mather, J. A. (1992). Interactions of juvenile *Octopus vulgaris* with scavenging and territorial fishes. *Marine and Freshwater Behaviour and Physiology* **19**, 175–182. doi:10.1080/10236249209378806

Pereira, P. H. C., de Moraes, R. L. G., Feitosa, J. L. L., and Ferreira, B. P. (2011). 'Following the leader': first record of a species from the genus *Lutjanus* acting as a follower of an octopus. *Marine Biodiversity Records* **4**, e88. doi:10.1017/S1755267211000856

Pereira, P. H., Feitosa, J. L., Chaves, L. C., and de Araújo, M. E. (2012). Reef fish foraging associations: 'nuclear–follower' behavior or an ephemeral interaction? In 'Proceedings of the 12th International Coral Reef Symposium 2012'. pp. 1–5.

Sampaio, E., Seco, M. C., Rosa, R., and Gingins, S. (2020). Octopuses punch fishes during collaborative interspecific hunting events. *Ecology* **102**, e03266. doi:10.1002/ECY.3266

Sazima, C., Krajewski, J. P., Bonaldo, R. M., and Sazima, I. (2007). Nuclear–follower foraging associations of reef fishes and other animals at an oceanic archipelago. *Environmental Biology of Fishes* **80**, 351–361. doi:10.1007/S10641-006-9123-3

Strand, S. (1988). Following behavior: interspecific foraging associations among Gulf of California reef fishes. *Copeia* **1988**(2), 351–357. doi:10.2307/1445875

Vail, A. L., Manica, A., and Bshary, R. (2014). Fish choose appropriately when and with whom to collaborate. *Current Biology* **24**, R791–R793. doi:10.1016/J.CUB.2014.07.033

Handling Editor: Jacob Johansen