Observations on the gastropod prey of *Chicoreus capucinus* (Gastropoda: Muricidae) in Darwin Harbour mangroves

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Abstract

Seven opportunistic field observations within mangrove forests in Darwin Harbour revealed that the muricid snail *Chicoreus capucinus* feeds upon relatively large, mobile gastropods and seemingly engages in higher rates of aggregative feeding (prey-sharing) behaviour than its counterparts in Southeast Asia. Field observations and evidence of prey-sharing from drill holes recorded on dead shells indicate that aggregative feeding by *C. capucinus* is associated with at least three gastropod prey species. A record of attempted cannibalism and multiple incidences of aggregative feeding suggest the availability and accessibility to gastropod prey is somehow limited in Darwin Harbour mangroves. Further detailed studies are, however, needed in order to prove this supposition.

Introduction

The predatory muricid snail *Chicoreus capucinus* is a common epifaunal component of Indo-west Pacific mangrove forests (Houart 1992; Wells & Bryce 2000; Lozouet & Plaziat 2008) and is one of the few gastropod predators present in substantial numbers in mangroves (Tan & Oh 2003). Like other muricids, *C. capucinus* feeds by drilling a small, countersunk hole into the shell of its prey through a combination of the scraping action of the radula and softening secretions produced by the accessory boring organ. Field studies from Southeast Asia show that *C. capucinus* is highly skilled in handling prey from both hard (e.g. rocks, mangrove trunks and prop roots) and soft (i.e. mud, muddy sand) substrates (Tan & Oh 2003; Tan 2008), and that its diet consists mainly of barnacles (Nielsen 1976; Tan & Oh 2003; Ng *et al.* 2008) and a variety of bivalve and gastropod molluscs (Gribsholt 1997; Wells *et al.* 2001; Tan & Oh 2003; Tan 2008).

Amongst molluscan prey, epifaunal and shallow infaunal bivalves are typically the largest and principal taxa consumed by *C. capucinus* (Berry 1975; Middelfart 1996; Gribsholt 1997; Tan & Oh 2003; Tan, 2008), and indeed teredinid bivalves are consumed in Darwin Harbour (Richard Willan pers. obs.). The gastropods preyed upon by *C. capucinus* are generally considerably smaller than the bivalves, comprising mainly small, slow moving taxa such as rissooidean, neritoidean and cerithioidean snails (Wells *et al.* 2001; Tan & Oh 2003; Tan & Oh 2008). Among cerithioids, the mud-creeping genus *Pirenella* (previously *Cerithidea*) apparently forms a major dietary component (Wells *et al.* 2001; Tan 2008). Tan

& Oh (2003) noted *C. capucinus* preying upon one of the largest of all mangrove snails *Telescopium telescopium,* but the *Telescopium* was only 11 mm long. Therefore, the earlier report by Wells *et al.* (2001) of *C. capucinus* eating *Pirenella* with shells up to 28 mm in length is apparently the record for the largest gastropod prey item.

Aggregating behaviour is often conspicuous in *C. capucinus* inhabiting mangroves, where snails form breeding clusters under prop roots and on large woody debris (Gribsholt 1997; Wells *et al.* 2001; pers. obs.). However, aggregative feeding or prey-sharing (i.e. multiple predators feeding simultaneously on the one prey item) is seemingly rare (Tan & Oh 2003; Tan 2008), or unreported (Gribsholt 1997; Wells *et al.* 2001) for this species. Both Tan & Oh (2003) and Tan (2008) found from the many hundreds of *C. capucinus* individuals they observed feeding in mangroves and on mudflats directly in front of mangrove forests, less than 1% of all predator-prey interactions involved prey-sharing. Additionally, despite *C. capucinus* being a voracious and versatile predator of molluscs, cannibalism is currently unrecorded (Wells *et al.* 2001; Tan & Oh 2003; Tan 2008).

This note reports *C. capucinus* attacking and consuming large mud-creeping potamidid snails and two other species of gastropods in mangrove forests in Darwin Harbour. Among these records, multiple incidences of aggregative feeding by *C. capucinus* are presented based on field observations and there is evidence of prey-sharing from dead, drilled shells. Furthermore, a record of attempted cannibalism is also reported for the species.

Field observations

During numerous vegetation surveys conducted between May 2015 and November 2019, opportunistic field observations were made of *C. capucinus* actively feeding on gastropod prey in mangrove forests throughout Darwin Harbour. In addition to field observations, dead gastropod shells with evidence of drilling by *C. capucinus* were also collected. During this almost four and a half year period, four gastropod species –*Terebralia semistriata, Telescopium telescopium, Nerita balteata* and *Ellobium aurisjudae* – were recorded as prey of *C. capucinus* (Table 1). Amongst these records, *C. capucinus* was associated in prey-sharing interactions with three of the four species.

Gastropod prey

Of the two incidences of *C. apucinus* preying upon the mud-dwelling potamidid *Terebralia semistriata,* both were recorded in large open stands of *Avicennia marina* trees surround by a *Rhizopora stylosa* mangrove forest. The first observation was of an adult *C. capucinus* drilling the ventral surface of the upper shell spire of an adult *T. semistriata* measuring approximately 65 mm in shell length (SL) (Figure 1). Closer inspection revealed the prey was in the later stages of paralysis, with the head-foot relaxed and the shell aperture partially exposed. The second interaction included prey-sharing, whereby two mature individuals of *C. capucinus* were feeding simultaneously on an adult *T. semistriata*

Table 1. Field observations on the gastropod prey of *Chicoreus capucinus* collected between May 2015 and November 2019 in various mangrove forests throughout Darwin Harbour. Aggregative feeding (prey-sharing) is based on live field observations and drill holes recorded on dead shells (inferred).

Date of observation	Location	Site co-ordinates	Prey species	Aggregative feeding
10 May 2015	Western side of *A. marina* forest, East Point mangrove boardwalk.	12° 24.526'S, 130° 49.837'E	*Terebralia semistriata*	No
15 December 2015	Eastern side of *A. marina* forest, East Point mangrove boardwalk.	12° 24.530'S 130° 49.868'E	*Terebralia semistriata*	2 x *C. capucinus*
8 September 2017	Adjacent to GEP corridor, Wickham Point Road	12° 32.925'S, 130° 53.723'E	*Nerita balteata* (dead shell)	2 x *C. capucinus* (inferred)
5 December 2017	Adjacent to GEP corridor, Wickham Point Road	12° 32.925'S, 130° 53.723'E	*Telescopium telescopium*	No
13 February 2018	Approx. 820 m west of algae farm, Channel Island Road	12° 35.038'S, 130° 55.886'E	*Chicoreus capucinus*	No
			Ellobium aurisjudae (dead shell)	2 x *C. capucinus* (inferred)
25 October 2018	Power & Water access Road, Jones Creek, Channel Island Road	12° 33.935'S, 130° 53.722'E	*Ellobium aurisjudae* (dead shell)	2 x *C. capucinus* (inferred)
11 November 2019	Approx. 200 m NW of Dinah Beach Boat Ramp	12° 26.786'S, 130° 51.073'E	*Nerita balteata*	2 x *C. capucinus*

Figures 1–2. *Chicoreus capucinus* feeding on *Terebralia semistriata* at the East Point mangrove site, Darwin Harbour. **1.** *C. capucinus* drilling the upper shell spire of an adult *T. semistriata* (65 mm SL). **2.** Aggregative predation of an adult *T. semistriata* (67.5 mm SL) by two *C. capucinus* snails simultaneously. (Adam Bourke)

(67.5 mm SL) (Figure 2). This aggregative predation involved one *C. capucinus* attacking the prey through the shell's aperture and the other individual drilling at the suture between the upper whorls on the dorsal shell surface.

The mud-dwelling potamidid *Telescopium telescopium* was the largest prey eaten by *C. capucinus* in Darwin Harbour, with a mature live specimen of 77 mm shell length recorded (Figure 3). This single observation of an adult *C. capucinus* (56 mm SL) drilling the dorsal shell of this prey was recorded within a dense *Ceriops australis*-dominated forest at an estimated tidal elevation of 6.4–6.6 m. This upper tidal zone represents the maximum distributional limit of *C. capucinus* in Darwin Harbour mangrove forests (pers. obs.). Recent anecdotal evidence from field observations on dead, drilled shells

occupied by the mangrove hermit crab *Clibanarius longitarsus* suggests predator-prey interactions between *C. capucinus* and *T. telescopium* are infrequent but do occur in local mangrove forests.

The two records of *C. capucinus* preying upon the tree-climbing nerite snail *Nerita balteata* incorporate a single field observation and an inference of predation from a dead shell. In the same *Ceriops australis*-dominated forest as the previous interaction, a dead shell of a subadult *N. balteata* 34 mm in shell height (SH) was found with two drill holes approximately arranged posteriorly and anteriorly along the centre line of the dorsal shell (Figure 4). Based on the dimensions and architecture of the drill holes, it was deduced that the neritid had been preyed upon by two individuals of *C. capucinus*. The second field observation involved prey-sharing, whereby two mature individuals of *C. capucinus* were seen feeding simultaneously upon a subadult *N. balteata* (27 mm SH) along the upper tidal margin of a partially closed *Rhizophora stylosa* forest. This interaction involved *C. capucinus* attacking

Figure 3. A mature *Chicoreus capucinus* (56 mm SL) preying on *Telescopium telescopium* (77 mm SL) in the *Ceriops australis*-dominated forest. (Adam Bourke)

Figure 4. Evidence of aggregative feeding on a shell of *Nerita balteata* (34 mm SH) collected in the *Ceriops australis*-dominated mangrove forest. (Adam Bourke)

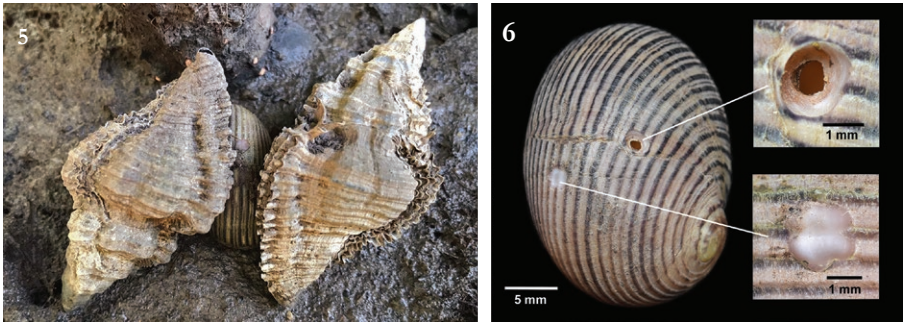

Figure 5–6. Aggregative feeding by *Chicoreus capucinus* on *Nerita balteata* in the *Rhizophora stylosa* mangrove forest. **5.** Two *C. capucinus* individuals simultaneously attacking *N. balteata*; one drilling the dorsal shell surface, the other attacking the prey through the shell aperture. **6.** Shell of the subadult *N. balteata* (27 mm SH) showing the drill hole and an unsuccessful drill mark on the dorsal shell surface. (Adam Bourke)

the prey through the shell aperture at the edge of the shelly operculum while the other individual drilled the dorsal shell surface (Figure 5). Inspection of the *N. halteata* shell showed a fresh, unsuccessful drill hole on the dorsal surface, suggesting one of *C. capucinus* individuals had repositioned itself on the prey (Figure 6).

Two records of *C. capucinus* preying upon the woody debris-associated snail *Ellobium aurisjudae* are inferred from dead shells collected on the mangrove forest floor. In a *Rhizophora stylosa*/*Bruguiera parviflora*-dominated forest a freshly dead shell of a juvenile *E. aurisjudae* (23.7 mm SL) was found within a large, rotting tree trunk with two drill holes on the dorsal shell surface. One hole was positioned at the suture between the penultimate and body whorl slightly towards the aperture while the other was drilled at the midline on one of the apical whorls. Both holes had similar outline diameters, however the perforation of the inner shell wall was markedly different (Figure 7). The second dead shell of *E. aurisjudae* was also a juvenile (21.5 mm SL) specimen and was collected from within a fallen and decaying branch in an open *Rhizophora stylosa*-dominated forest. This old, corroded shell also had two drill holes, one on the ventral shell surface in the centre of the body whorl, and a larger hole set posteriorly on the dorsal surface adjacent the columella. Due to its poor condition, the shell was accidentally destroyed during transportation.

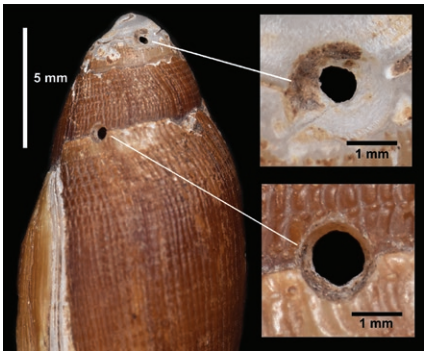

Figure 7. Drill holes on the freshly dead shell of *Ellobium aurisjudae* (23.7 mm SL) collected inside a rotting tree trunk in a *Rhizophora stylosa*/*Bruguiera parviflora* mangrove forest. (Adam Bourke)

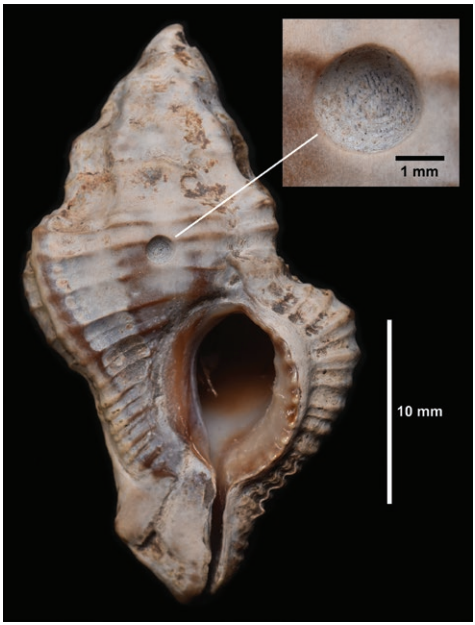

Figure 8. Evidence of attempted cannibalism on the body whorl of small adult *Chicoreus capucinus* (45.2 mm SL) collected from inside a rotting tree trunk in a *Rhizophora stylosa*/*Bruguiera parviflora* mangrove forest. (Adam Bourke)

Cannibalism

In the same rotting trunk as the freshly dead *E. aurisjudae* shell, a small adult *C. capucinus* with evidence of cannibalism was collected alive under a large sheet of peeling tree bark.

The individual had a worn, bleached shell (45.2 mm SL) and possessed a single drill mark 2.2 mm in diameter, positioned almost centrally on the ventral surface of the body whorl (Figure 8). Based on the size and architecture of the drill mark, it was concluded that an unsuccessful attempt of predation by a larger conspecific had occurred.

Discussion

These field observations of *C. capucinus* feeding upon large gastropod prey wonderfully complement Tan & Oh's (2003) and Tan's (2008) assertion that the species is indeed a versatile and successful predator of intertidal molluscs. The current record of *C. capucinus* attacking an adult *T. telescopium* at the upper limit of its tidal distribution not only illustrates the voraciousness of the species, but also demonstrates its ability in overcoming large, mobile prey.

It appears that in Darwin Harbour's mangrove forests, aggregative feeding by *C. capucinus* snails is not uncommon. Prey-sharing is apparently rare amongst populations of *C. capucinus* in Southeast Asia (Tan & Oh 2003; Tan 2008). By contrast, in Darwin Harbour aggregative predation was associated with three gastropod prey species – *Terebralia semistriata, Nerita balteata* and *Ellobium aurisjudae*. These interactions suggest that group feeding by *C. capucinus* is likely to be a recurrent behaviour in the harbour. Prey-sharing has been reported in a number of muricids (e.g. Brown & Alexander 1994; Taylor & Morton 1996) and, in the latter case, aggregative feeding was supposedly a response to shortages in prey items. Tan (2008) noted the opposite among *C. capucinus* in Thailand, proposing that the absence of aggregative feeding was due to high prey abundances and in the species' ability to exploit them.

These arguments suggest that the aggregative feeding behaviour exhibited by *C. capucinus* in Darwin Harbour's mangroves is associated with constraints on the availability and accessibility of gastropod prey. Moreover, the attempted predation of a conspecific further supports the notion that access to gastropod prey items is somehow limited in local mangrove forests. However, field observations often produce biases and overestimations on predatory interactions (Fairweather & Underwood 1983), and the conclusions reached here are based on only a few opportunistic field observations. As such, without further detailed investigation, it is well beyond the capacity of this article to explain these seemingly uncharacteristic behaviours.

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