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Biodiversity Record: Estuarine molluscs with aberrant shells in a drain at East Coast Park

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Subjects:
1) Waved nerite, *Nerita undata* (Mollusca: Gastropoda: Neritidae) (Fig. 5);
2) Lined nerite, *Nerita balteata* (Mollusca: Gastropoda: Neritidae) (Fig. 6);
3) Guamanian nerite, *Clithon oualaniense* (Mollusca: Gastropoda: Neritidae) (Figs. 2, 3);
4) Bean nerite, *Clithon faba* (Mollusca: Gastropoda: Neritidae) (Fig. 7);
5) Belitong snail, *Terebralia sulcata* (Mollusca: Gastropoda: Potamididae) (Fig. 4);
6) Lantern clam, *Exolaternula spengleri* (Mollusca: Bivalvia: Laternulidae) (Fig. 8);
7) Elongate sunset shell, *Gari elongata* (Mollusca: Bivalvia: Psammobiidae) (Fig. 10);
8) Egg-shaped lucine, *Euanodontia ovum* (Mollusca: Bivalvia: Lucinidae) (Fig. 9).

Subjects identified by: Lau Wing Lup.

Location, date and time: Singapore Island, East Coast Park (ECP), Area B; 26 December 2020, around 1350 hrs.

Habitat: Estuarine. Concretised monsoon drain about 1 m wide and 2.5 m deep, in coastal urban parkland (Fig. 1). Section of drain inundated with sea water during high tide, and brackish to fresh water during mid to low tides. New aluminium railings were recently installed along the drain perimeter. Rusty residues of replaced steel railings were noted on concrete depressions, and some nuts, bolts and washers were seen in the drain, presumably discarded after installation works.

Observer: Lau Wing Lup.

Observations:
On a visit to the location, shell abnormalities were observed in the subjects in the drain. These include—
1) Stepped spire on *Clithon oualaniense* (Figs. 2, 3).
2) Reddish to orange-brown shell discolouration on *Nerita undata* (Fig. 5), *Nerita balteata* (Fig. 6), *Clithon oualaniense* (Figs. 2, 3), *Terebralia sulcata* (Fig. 4) and *Gari elongata* (Fig. 10).
3) Blister formation on *Nerita balteata* (Fig. 6) and *Exolaternula spengleri* (Fig. 8).
4) Scarring, furrowed and thickened shell margin on *Exolaternula spengleri* (Fig. 8) and *Euanodontia ovum* (Fig. 9).
5) Shell pattern disruption on *Clithon oualaniense* (Figs. 2, 3), *Nerita undata* (Fig. 5) and *Clithon faba* (Fig. 7).
6) Unusual soft body colour of *Nerita undata* (Fig. 5).

Fig. 1. The drain at East Coast Park on 7 September 2019, with remnants of the old metal railings visible in the form of rust spots at the lower right corner of the image. (Photograph by: Lau Wing Lup).

Remarks: The molluscs featured herein are common in Singapore's mangroves (see Ng et al., 1999; Tan & Chou, 2000; Tan & Gopalasamy, 2008; Tan & Woo, 2010; Glover et al., 2016). These resilient species appear to be able to adapt and thrive in urban concretised waterways devoid of mud and vegetation. In the absence of proof, is it possible that the abnormalities observed on the molluscs featured are responses to anthropogenic disturbances?

Pollutants have consistently been reported to cause shell aberrations in coastal and estuarine areas (e.g., Stephenson et al., 1986; Batley et al., 1989; Alzieu et al., 1990; Sokolowski et al., 2008). Shell thickening and chamber formation in bivalves

have been attributed to the potent effect of organotin, the main component of anti-fouling paints (Page et al., 1989), and sometimes heavy metals such as copper (see Wilson & McMahon, 1981).

Scars occurring around the shell margin could be the result of natural re-burrowing activities (Lomovasky et al., 2005), while shell blisters and pattern disruption are associated with shell breakage and subsequent regeneration, an indirect result of sub-lethal predatory attacks (Mapes & Sneck, 1987). Shell alteration with orange to brown colouration on the shell's interior surface—with concurrent, irregular carbonate deposition, and probably resulting in calcium carbonate concretions—is associated with the presence of metacercariae of gymnophallid parasites (Lomovasky et al., 2005). Another plausible explanation for the reddish to orange-brown shell discolouration in the ECP drain molluscs is iron oxide (rust) leeching from the soil or from the rusty old steel railings and washers, nuts and bolts. Sightings of 'rusty' shells remain unrecorded in Singapore despite being commonly reported on websites, nature blogs, eBay, shell auction websites and shell collecting books (e.g., Dharma, 2005; Poppe, 2016; personal observations).

The soft body of *Nerita undata* is stated to be grey in Tan & Gopalasamy (2008), but specimens found at ECP are pale yellow. It is not known if the seemingly different colouration is due to environmental factors or if the molluscs could have unwittingly ingested iron oxide, and whether these could have an effect on body colouration. Similar differences have been reported in *Faunus ater* and *Orania bimucronata* at the same featured ECP drain and other localities in Singapore (see Chan & Lau, 2019; Lau & Chan, 2019), but no studies have been done to offer possible explanations.

Molluscs can be useful bio-indicators. For example, *Nerita balteata* accumulates cadmium, nickel and lead in its shell and copper, zinc and iron in its soft tissues (Yap & Cheng, 2009). Observations of perceived abnormalities in several species in this locality are thus possibly interesting enough to warrant future studies.

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Fig. 2. Three different views of a *Clithon oualaniense* shell with stepped spire and disrupted colour pattern.

Fig. 3. Three different views of a *Clithon oualaniense* shell with abnormal rusty orange shell colouration.

Fig. 4. *Terebralia sulcate*. The bottom two examples have abnormal-looking rust-coloured apertures.

Fig. 5. *Nerita undata*. Live example with unusual yellowish soft body and rusty orange layer on the shell (left). Two shells with various degree of rust coating (middle), and pattern disruption (right).

(Photographs by: Lau Wing Lup).

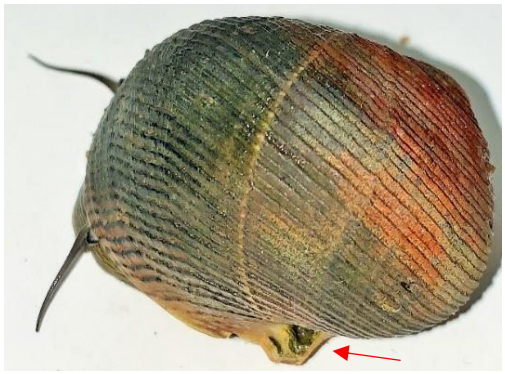

Fig. 6. *Nerita balteata* with blister growth (red arrow) and rust-coloured discolouration on the shell.

Fig. 7. Two different views of a *Clithon faba* shell with colour pattern disruption.

Fig. 8. *Exolaternula spengleri*. In situ dorsal view of live example in shallow water (left). Rusty pearl-like blister (arrow) on shell lip (bottom right). Side view showing abnormally thick and multi-layered shell margin, with the bottom valve thicker than the top one (bottom left).

Fig. 9. *Euanodontia ovum* shell with ‘double lips’. 1 mm between bars.

Fig. 10. *Gari elongata* shell with rusty discolouration on the edge of the valves. 1 mm between bars.

(Photographs by: Lau Wing Lup).