

THE TAXONOMIC STATUS OF FIG SHELLS, WITH NOTES ON *FICUS VARIEGATA* (RÖDING, 1798) (MOLLUSCA: GASTROPODA: FICOIDEA: FICIDAE)

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INTRODUCTION

The family Ficidae (fig shells) is the only known member in the superfamily Ficoidea (Meek, 1864). Although fig shells are closely related to the Tonnididae (tun shells), their shell shape distinguishes them apart (Verhaeghe & Poppe, 2000), hence they are placed in a separate superfamily Ficoidea. To date, there are 12 known species of *Ficus* (Röding, 1798) and one species of *Thalassocyon* (Barnard, 1960) within the Ficidae (Beesley et al., 1998; Liu & Wang, 1999). With numerous synonyms created for this genus (Table 1), the nomenclatural history of the Ficidae has been complex (Boss, 1982; Verhaeghe & Poppe, 2000). In earlier literature such as Rogers (1908), and Thiele (1935), the oldest available synonym for fig shells was Pyrulidae (Swainson, 1840). However, the valid name used in this paper is Ficidae, as suggested by Verhaeghe & Poppe (2000) citing the International Code of Zoological Nomenclature (ICZN) Article 40b as reference. According to Chuang (1973: 191, 196), an occasional *Ficus ficus* (Lamarck, 1758) could be found in the deep sand off the southeast part of Singapore. There were also recent local sightings of live *Ficus variegata* (Röding, 1798) on the shores of Singapore. Upon examination of the fig shell collections from the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity and Research (RMBR), National University of Singapore, together with further reading of the literature, taxonomic information of fig shells was generally disorganised and ambiguous. Hence, the current state of taxonomic nomenclature among some of the *Ficus* species is discussed in this paper.

Table 1. Synonyms of *Ficus* (adapted from Verhaeghe & Poppe, 2000).

Synonym	Author	Reference
<i>Pyrula</i>	Lamarck, 1798	Mém. Soc. Nat. Hist., Paris: 7
<i>Pirula</i>	Monfort, 1810	Conchyliologie Systématique 2: 486
<i>Otus</i>	Risso, 1826	Hist. Nat., L'Europe Méridionale 1: 122
<i>Ficula</i>	Swainson, 1835	Elements of Conchology: 21
<i>Sycotypus</i>	Gray, 1847	Proc. Zool. Soc. London 15: 135

DETAILS OF COLLECTION AND SIGHTINGS

Ficus variegata were first sighted on a sandbar along Marina Way, East Coast, Singapore (1°16'51"N 103°52'35"E) at 1900 hours on 14 Dec.2008. On two occasions, 29 Apr. and 28 May 2009, 18 specimens of *Ficus variegata* (Fig. 1) were collected by hand from the same shore at between 0800–1000 hours. On all occasions, the Ficidae individuals encountered were partially buried. The soft substratum on which specimens were found consisted of very fine top-layered sand (<1 mm grain size) and black anoxic sand below it. The specimens were first relaxed using magnesium chloride solution and then preserved in 90% ethanol. They were deposited in the ZRC under the catalogue number of ZRC.MOL.2956.

The most recent sighting of a live *Ficus variegata* was on 3 Jan. 2010 at 1845 hours (L. Tang, pers. comm.). One specimen (shell length ~100 mm) was observed on another shore in Singapore, at a sandbar in front of the National Service Resort & Country Club, 10 Changi Coast Walk, Singapore (1°18'57"N 103°58'27"E). This individual was found moving along the substrate, revealing its foot and mantle lobes. The soft substratum on which the animal was found consisted of very fine sand (<1 mm grain size).

SPECIMEN DETAILS

Biology and habitat details. – The general habitat of fig shells is the sandy or muddy bottoms in warm temperate and tropical environments, from the intertidal zone to depths of over 1000 m (Lai, 1987; Carpenter & Niemi,



Figure 1. A live specimen of *Ficus variegata* in its natural habitat at East Coast, Singapore. Shell length = 85 mm. (Photograph by: R. Tan).

1998; Verhaeghe & Poppe, 2000). *Ficus variegata* has a size ranging between 65–101 mm, with an average size of 80 mm. The feeding strategy of fig shells is closely related to the structure of buccal organs (Warén & Bouchet, 1990). Their radular teeth are closely packed together, and they lack large accessory salivary glands. Radial muscles of a *Ficus* proboscis is comparatively short and probably cannot stretch very much, which implies that large prey cannot be swallowed (Riedel, 1994). Warén & Bouchet (1990) found cuticles and other remains of polychaetes in the stomach of *Ficus subintermedia* (d'Orbigny, 1852). There were several anecdotal claims that *Ficus* species feed on echinoderms (Wilson & Gillett, 1971; Eichhorst, 1999), but no actual observations were made. The animals are usually completely buried in the sand at low tide. Sexes are separate and fertilization is internal (Arakawa & Hayashi, 1972). Sexual dimorphism occurs in shell length where females are often larger than males (Liu & Wang, 1999).

Shell details. – The shell lengths of 18 specimens obtained from Marina Way, East Coast, ranged between 39.0–78.0 mm (Fig. 2—three specimens shown). Shells are pear-shaped, large, and thin, and conspicuously coiled (Fig. 3). Shells have a low spire consisting of four whorls. The body whorl is inflated and moderately large. The body whorl tapers out anteriorly into a relatively long and recurved siphonal canal. The outer lip of the aperture is thin and smooth, with a sinuous columella, which does not have strong spiral folds. The outer lip expands posteriorly with a curved posterior process but does not extend to the spire. The main body has a distinct latticed surface, crossed by fine striations forming a smooth cancellate surface. Growth striae are usually evident. Shells have a base colour of white, zig-zag patterns of brown running along the length of the body whorl, interrupted by five or six bands, and often but not always alternating broad and thin spaced rows of white interspersed equally with brown spots across the middle. Shell patterns are consistent throughout the entire shell including the ventral side. The aperture is pale mauve with a distinct brown near the anterior end of the siphonal canal.

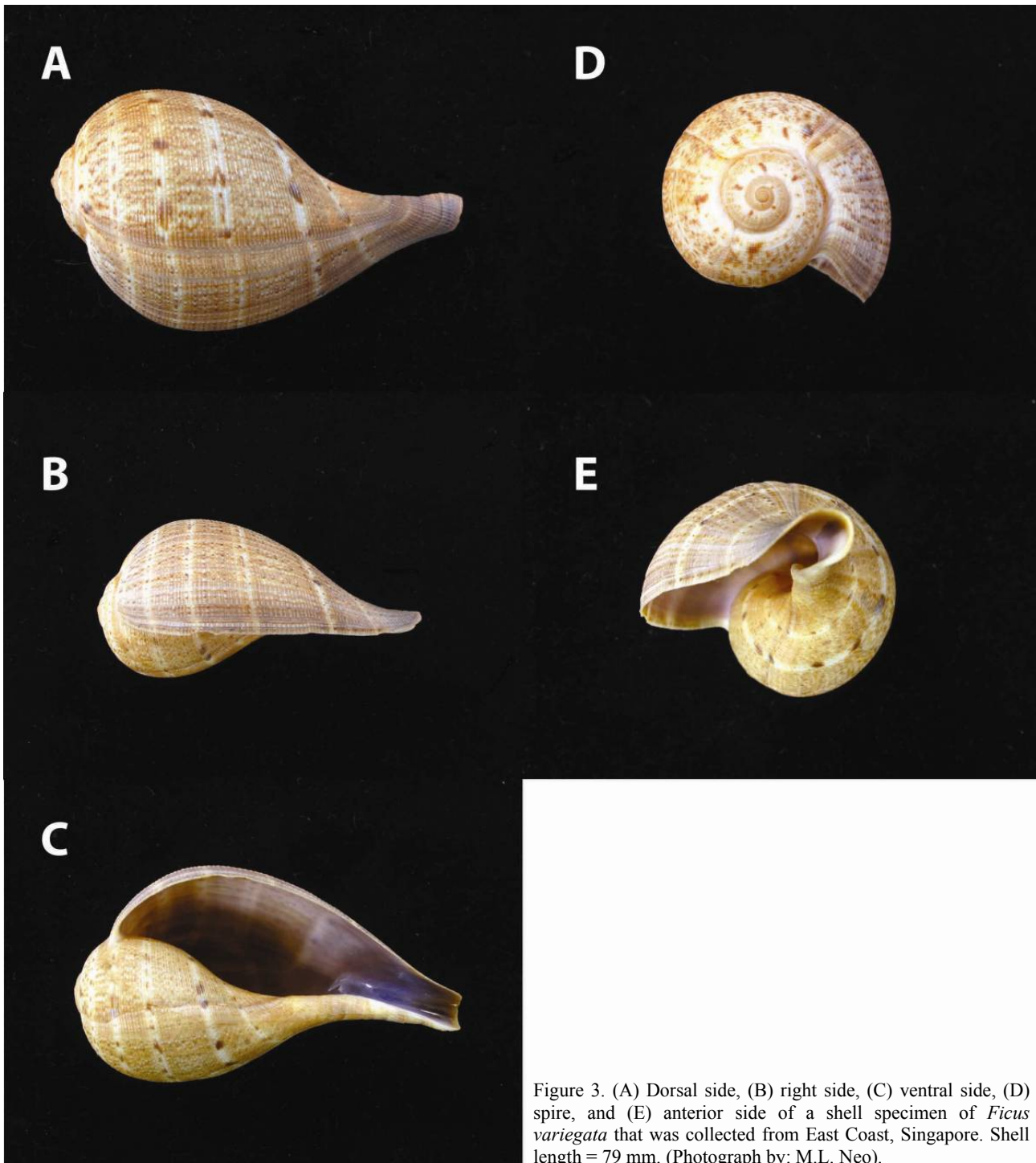
Body details. – The foot is large and somewhat truncate at the front and laterally pointed anteriorly (Figs. 4A, 4C). The base of the foot is brownish-red with scattered yellow spots (Fig. 4C). Mantle lobes partially cover the shell in living specimens, and will retract when gently touched (Fig. 4A). The exposed mantle has a mottled brownish-red and white appearance. The animal has a small head, with a long and narrow siphon, which is either mottled or brownish-red (Fig. 4B). A long proboscis is present. The long pointed tentacles are mottled brownish-red, bearing eyes at their outer bases. The eyes appear simple and look like a pair of brown globular lenses. An operculum is absent.



Figure 2. (A) Ventral and (B) dorsal sides of the three specimens of *Ficus variegata* that were collected from Marina Way, Singapore. Specimens were relaxed using magnesium chloride solution and then preserved in 90% ethanol to show the soft parts of *Ficus variegata*. Catalogue number ZRC.MOL.2956. Scale bar in cm and mm. (Photograph by: M.L. Neo).

DISCUSSION

The distribution of fig shells is widespread in the tropical seas, ranging from Indo-Pacific, Eastern Asia, Japan, Red Sea, and Indian Ocean (Abbott & Dance, 1982; Wye, 1991). Despite the fact that Singapore is within the Indo-Pacific range, several notable local gastropod references failed to note the presence of fig shells (e.g., Lim, 1969; Purchon & Purchon, 1981; Way & Purchon, 1981; Tan & Chou, 2000; Chou & Tan, 2008) with the exception of Chuang (1973).



One could attribute the low sighting rate to the general habit of fig shells, where only a few species are known to occur in the intertidal zones (Verhaeghe & Poppe, 2000). Much of the known recorded sightings of *Ficus variegata* were usually bycatch from bottom trawling at depths of 30–40 m (e.g., Lai, 1987; Carpenter & Niem, 1998), hence explaining its rarity in intertidal zones, but possibly common in deeper sands. Infrequent intertidal surveys conducted could explain the chanced sightings of fig shells in Singapore. These reasons could help explain why these fig shells appear to be ‘rare’, but it is difficult to ascertain which reason specifically.

The fig shell (*Ficus ficus*) observed in Singapore had “a wide open violet aperture and reticulated surface, is mottled with brown dots and dashes” (see Chuang, 1973). This same description can easily be misidentified as the *Ficus variegata* (see *Specimen Details*). It became taxonomically confusing when *Ficus variegata* was once called *Ficus ficus* of Linné, but there was a paucity of information to verify this name (Abbott & Dance, 1982; Abbott, 1991). With recent work by Verhaeghe & Poppe (2000), it is now recognised that *Ficus ficus* is the most variable *Ficus* species known today, and that *Ficus ficus* of Linné is distinguishable from *Ficus variegata* based on their shell structure. Although

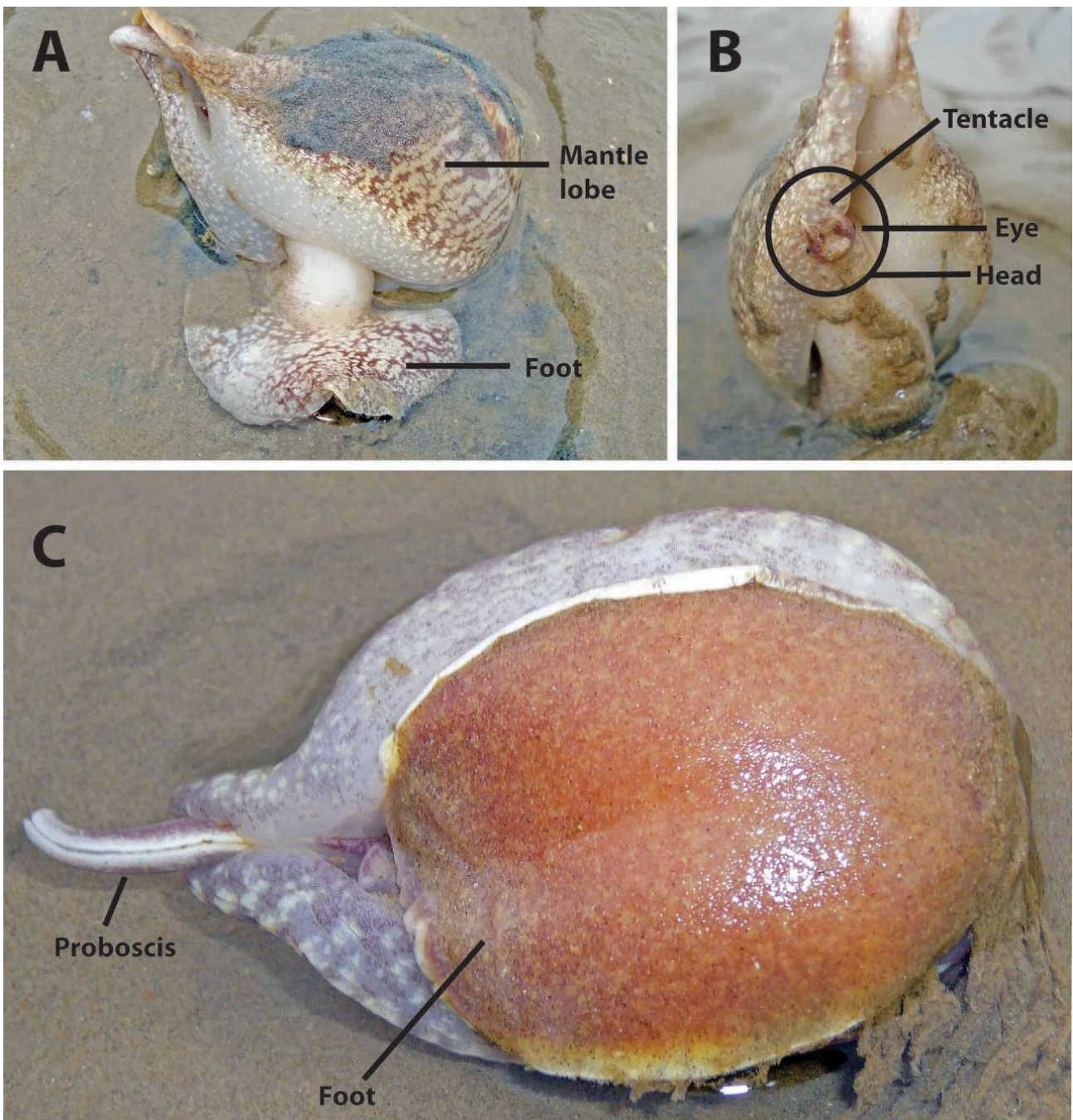


Figure 4. *Ficus variegata*. (A) A live specimen showing the side view, (B) the head from the underside view and (C) the large, round foot to show the soft tissues of *Ficus variegata*. Shell length = 85 mm. (Photographs A & B by: M.L. Neo; photograph C by: K.S. Loh).

Chuang (1973) concluded that the fig shell observed was *Ficus ficus*, we cannot rule out the possibility of misidentification.

Two species of fig shells were collected by the then Biology Department, Nanyang University, Singapore under the catalogue number ZRC 1980.12.19.1 (*Ficus ficoides*) and ZRC 1980.12.19.2-6 (*Ficus subintermedia*) (Fig. 5). Unfortunately, no locality labels were available for those specimens. It is speculated that these specimens might have been from Tuas, Singapore (1°16'26"N 103°38'03"E) (H. K. Lua, pers. comm.), but this cannot be verified. The author noted a problem when verifying the identity of shells—the nomenclature of fig shells being confusing. The widely accepted synonym for *Ficus subintermedia* is *Ficus ficoides* (Lamarck, 1822) (not of Brocchi, 1814) (Wilson, 1993). However, inspection of both shell specimens clearly showed a big contrast in the shell sculpture (Fig. 5), and the ZRC 1980.12.19.1 shell was most likely misidentified. Specimen ZRC 1980.12.19.1 is likely a *Ficus gracilis* (Sowerby I, 1825) that is identifiable by its typical axial brown streaks in the shell pattern and its slightly elevated spire (Fig. 5A, 5B). While verifying the second shell specimen, specimens ZRC 1980.12.19.2-6 appear to have also been misidentified. Based on the shell features, the shells closely resemble those of *Ficus variegata*, with features such as the

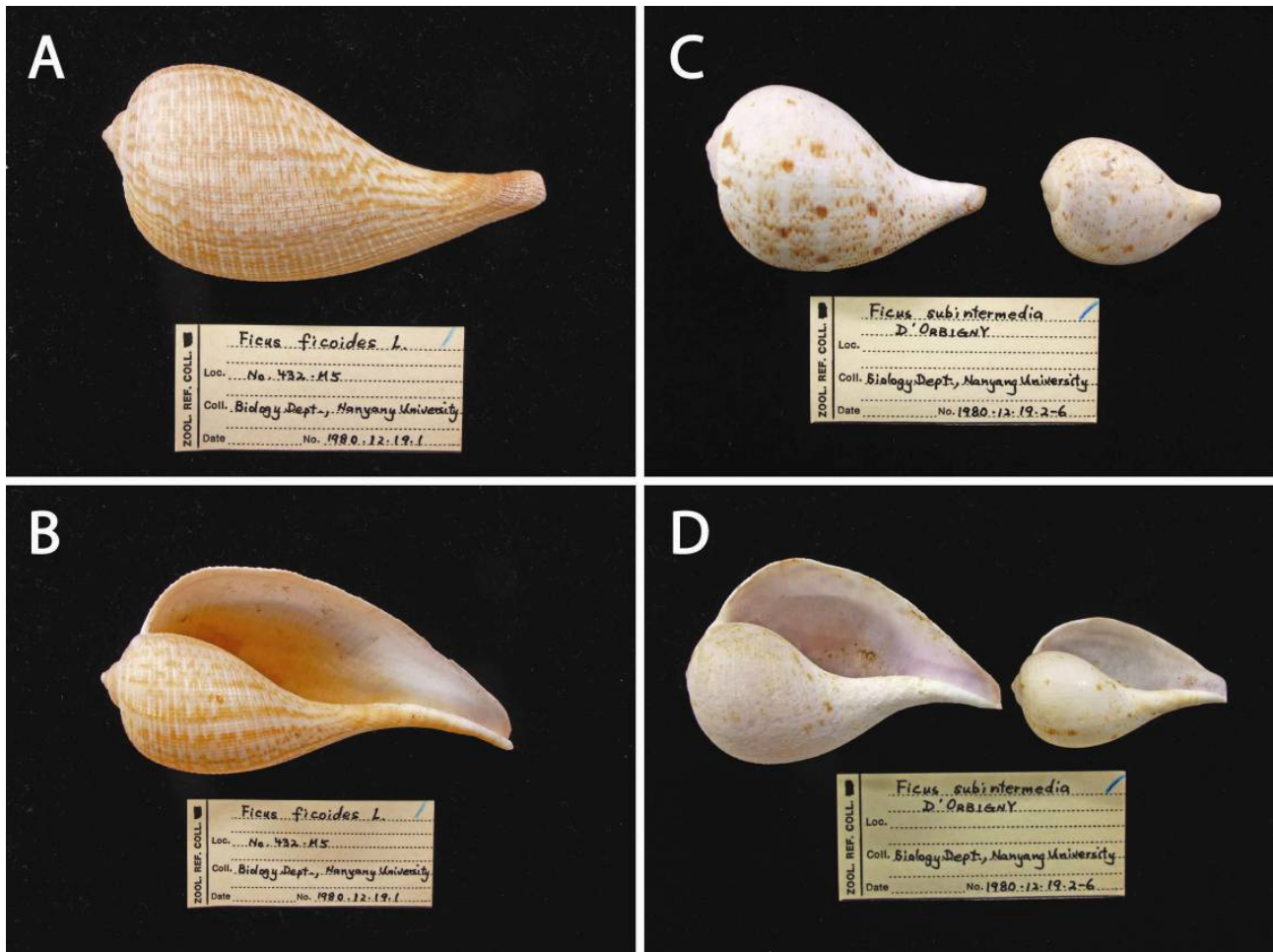


Figure 5. Two different species of fig shells were deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore. A) Ventral and B) dorsal sides of *Ficus gracilis* but misidentified as *Ficus ficoides* (ZRC1980.12.19.1). Shell length = 87 mm. C) ventral and D) dorsal sides of *Ficus variegata* but misidentified as *Ficus subintermedia* (ZRC1980.12.19.2-6). Larger shell length = 53 mm. (Photographs by: M.L. Neo).

fine spiral threads on sculpture, combined with the relatively rotund shape, and recurved siphonal canal. Whilst the shells did not exhibit any features of *Ficus subintermedia*, which has slightly raised spiral threads on the shell sculpture, a less rotund shape, and nearly straight siphonal canal (Wye, 1991). Therefore, both records have been misidentified and should be corrected accordingly.

Within the genus *Ficus*, multiple species have spawned numerous synonyms. An example is the *Ficus ficus* (Linnaeus, 1758) that has seven known synonymms: *Ficus communis* (Röding, 1798); *Ficus decussata* (Sowerby III, 1880); *Ficus ficoides* (Lamarck, 1822); *Ficus intermedia* (Sismonda, 1847); *Ficus margaretae* (Iredale, 1931); *Ficus reticulata* (Reeve, 1847); and *Ficus subintermedia* (d'Orbigny, 1852) (Verhaeghe & Poppe, 2000). This taxonomic confusion has made identification less easy. According to Verhaeghe & Poppe (2000), it is clear that *Ficus ficus* and *Ficus variegata* can be distinguished at once by their particular shell sculpture. It is believed that *Ficus ficus* might be a complex of species rather than just one species but information is lacking to verify this suggestion. It was mentioned by Verhaeghe & Poppe (2000) that *Ficus ficus* is usually labelled as *Ficus subintermedia*, but none of the literature encountered mentioned this arrangement (e.g., Abbott & Dance, 1982; Abbott, 1991; Wye, 1991;) or if the names are synonymised. Therefore, it is clear that *Ficus ficus*, *Ficus variegata*, and *Ficus subintermedia* are three distinct species, and *Ficus ficoides* is synonymised with *Ficus subintermedia*. The number of known *Ficus* species that are recorded for Singapore thus stands at two—*Ficus ficus*, and *Ficus variegata*.

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