

THE MACTRIDAE (MOLLUSCA: BIVALVIA) OF EAST COAST PARK, SINGAPORE

H. W. Wong

Tampines Junior College, 2 Tampines Avenue 9,

Singapore 529564, Republic of Singapore

(Email: wong_hoong_wei@moe.edu.sg)

ABSTRACT

An illustrated checklist of the family Mactridae from East Coast Park, Singapore, is presented based on intertidal surveys conducted over five months from Aug to Dec 2008. 15 species from eight genera were identified among the specimens collected. Based on available published material, seven species were recorded previously and eight species are new records for Singapore.

INTRODUCTION

The shells of the family Mactridae, also commonly known as surf or trough clams, are most easily distinguished from other bivalve families by their hinge appearance. The hinge consists of a characteristic internal resilifer in each valve that is broad and placed directly under the umbones. The anterior cardinal teeth form an inverted v-shape, differentiating the family from other members of the superfamily Mactroidea occurring in Singapore, such as the family Mesodesmatidae.

Most of the mactrid specimens in the Zoological Reference Collection (ZRC) before this survey were collected between 1925 and 1940 from various parts of Singapore, including Marina South, the shoreline of the present day East Coast Park, and Changi Beach. Available works on this family in Singapore are limited. Lim (1969a, 1969b) recorded three species belonging to three genera. Chuang (1973) recorded seven species in a catalogue of specimens held in the collection of the Department of Zoology, University of Singapore. Morris & Purchon (1981) recorded seven species belonging to five genera from West Malaysia and Singapore. The checklist by Chou et al. (1994) seems to be a consolidation of these works.

This family has no commercial value in Singapore. However, a number of species (e.g., *Mactra mera*) are regularly collected for food, fished, or marketed in neighbouring countries such as the Philippines (Poutiers, 1998).

MATERIALS AND METHODS

The mactrid fauna of East Coast Park was surveyed from Aug. to Dec.2008. Activities at these locations included sifting through beach drift and shell sand, inspecting by-catch and debris brought up by tangled fishing gear, and combing the shore at low tide for empty shells and live animals. Species were classified as new records based on historical data in Lim (1969a, 1969b), Chuang (1973), Morris & Purchon (1981), and Chou et al. (1994). A description and illustration of the shell is provided for each species. Nomenclatural issues, including synonymy in local checklists and other literature are addressed under "**Remarks**", but no attempt was made here to provide an exhaustive list of synonyms. Voucher specimens of species sampled were deposited in the Zoological Reference Collection (ZRC.MOL.002883–002896). The nomenclature and classification used follows that adopted by Lamprell & Whitehead (1992), namely Smith (1914), Harry (1969) and Keen (1969). Subgeneric placements have not been adopted here.

Not all mactrid specimens from the survey are treated in this paper as some specimens, although markedly unique compared to the species discussed, were either broken, faded, eroded or not identifiable at the present moment.

SYSTEMATIC ACCOUNT

Fifteen species belonging to the family Mactridae are identified in this study. The species are listed in alphabetical order as follows (* indicates species is a new record): *Heterocardia gibbosula* Stoliczka, 1871, *Lutraria* cf. *maxima* Jonas, 1844, *Mactra achatina* Holten, 1802, **Mactra cuneata* Gmelin, 1791, **Mactra dissimilis* Reeve, 1854, **Mactra inaequalis* Reeve, 1854, *Mactra mera* Reeve, 1854, **Mactra violacea* Chemnitz, 1782, **Mactrinula dolabrata* (Reeve,

1852), *Meropesta nicobarica* (Gmelin, 1791), *Meropesta pellicuda* (Gmelin, 1791), **Micromactra angulifera* (Deshayes, 1854), **Raeta pellicula* (Reeve, 1854), **Raeta pulchella* (Adams & Reeve, 1850), and *Spisula transversa* (Reeve, 1854).

Family Mactridae Lamarck, 1809

Subfamily Mactrinae Lamarck, 1809

***Mactra achatina* Holten, 1802**

(Fig. 6a, b; see p. 293)

Material examined. – SL 30 Siglap (ZRC.1975.7.8.1).

Shell description. – The shell is oval, solid, and somewhat compressed. The shell surface is covered with a thin brown periostracum, and the shell exterior light brown to reddish brown and covered with irregular white or brown mottling and occasional darker bands radiating from the umbones toward the ventral edge of varying thickness. The shell exterior is smooth. The anterior dorsal margin is convex and forms part of the rounded anterior end. The posterior dorsal margin is less convex, and the posterior margin is sharp but rounded, gaping weakly. The ventral edge is curved. The umbones are reddish, and placed near the midline slightly toward the anterior, and are rounded and bent inwards. The shell interior is light brown to pinkish and glossy. The anterior and posterior muscle scars are about the same size, and the pallial sinus is rounded, shallow, and non-confluent with the pallial line. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth.

Distribution. – This species was recorded in Singapore by Chuang (1973) and Chou et al. (1994). This species is widespread in the tropical Indo-West Pacific and has been reported from the east coast of Africa, Red Sea, Indonesia, the Philippines, Japan, and Australia (Lamprell & Whitehead, 1992; Poutiers, 1998; Vongpanich, 2000).

Remarks. – The size, shape, and colour patterns of this species resemble *Mactra ornata* Gray, 1837, and are considered synonymous by some authors (e.g., Poutiers, 1998). Vongpanich (2000) distinguished them by the absence of radial bands in the latter.

***Mactra cuneata* Gmelin, 1791**

(Fig. 7a, b; see p. 293)

Material examined. – SL 12-20 ECP (ZRC.MOL.002885).

Shell description. – The shell is equilaterally triangular in outline, and solid. The shell exterior is bluish white to purplish grey, with reddish-brown rays of varying thickness randomly radiating from the umbones to the ventral edge, although some specimens showed only very little trace of this pattern. The shell sculpture consists of very fine concentric striae. The anterior dorsal margin is slightly convex, and the posterior dorsal margin is almost straight. The anterior end is rounded, connected by a curved ventral edge to the posterior end which is more pointed than the anterior. The umbones are prominent, inflated and rounded, and placed near the mid line of the shell. The lunule and escutcheon are large. The shell interior is light brown to dark reddish-brown, and the areas near the ventral edge are always marked white. The anterior and posterior muscle scars are about the same size. The pallial sinus is shallow, about as deep as it is high, and the pallial line is very thick. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth.

Distribution. – This species occurs widely in the tropical Indo-Pacific regions, and has been reported from East Africa (Poutiers, 1998), India, Indonesia, Thailand to the Philippines (Vongpanich, 2000), Japan (Kira, 1965; Okutani, 2000), China (Qi, 2000) and Australia (Lamprell & Whitehead, 1992).

Remarks. – Disjointed valves of this species were found scattered on the middle to high shoreline.

***Mactra dissimilis* Reeve, 1854**

(Fig. 5a, b; see p. 293)

Material examined. – SL 14-24 ECP (ZRC.MOL.002886).

Shell description. – The shell is triangularly ovate. It is solid and covered with a thin brownish periostracum. The shell exterior is glossy, generally purplish-white with darker bluish concentric bands placed randomly. The shell sculpture

consists of strong concentric ribbing, more prominent toward the ventral edge. The anterior dorsal margin is almost straight, and the posterior dorsal margin is only weakly convex. Both the anterior and posterior margins are equally rounded, and they are connected by a curved ventral edge. The umbones are blue in colour, pointed, curved inwards, and placed just about the midline of the shell and slanted toward the anterior. The lunule and escutcheon are large, well defined, and covered with strong concentric ribbing. The hinge line is white. The shell interior is glossy and smooth. The interior ranges from light to dark purple, and appears almost white at the margins. The pallial sinus is rounded, shallow, and about as deep as it is high. The two cardinal teeth in the right valve are disposed divergently at a right angle. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth.

Distribution. – Reeve (1854) mentions the type locality of this species as Australia. This species is harvested in Thailand (Rabanal et al., 1977) and has been reported from Pantai Beserah, Pahang, on the east coast of West Malaysia (S. K. Tan, pers. comm.).

Remarks. – Disjointed valves were commonly found deposited at the high tide mark during the survey. Live shells were less commonly observed.

***Mactra inaequalis* Reeve, 1854**

(Fig. 8a, b; see p. 293)

Material examined. – SL 20 Pulau Pisang, West Malaysia (ZRC.1975.7.8.2); SL 25-38 ECP (ZRC.MOL.002896).

Shell description. – The description of the shell is adapted from Reeve (1854) and Qi (2000) to better match the features of the shell. The shell is ovate subangular, thin and rather compressed. The exterior sculpture consists of very fine growth lines, but the shell surface appears smooth and glossy white, and is covered by a thin straw coloured periostracum. The anterior side is long and attenuated, and the posterior side is rather short and angled, and sometimes darker coloured. The umbones are small but sharp, and placed slightly behind the mid line. The lunule is large and thinly plicated. The shell interior is glossy white, but usually has light brown blotches under the hinge line between the umbonal cavity and the anterior and posterior adductor muscle scars. The pallial sinus is rounded, about as deep as it is high, not reaching the midline. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth.

Distribution. – Reeve (1854) mentioned the type locality of this species to be the ‘China Sea’. Qi (2000) suggested that although common, its distribution was confined to the South China Sea off the Chinese coast.

Remarks. – Reeve (1854) mentioned that this species was peculiar among the members of its genus by having an anterior side markedly longer than the posterior, hence easily distinguishing it from other pale coloured, triangularly ovate Indo-Pacific species such as *Mactra luzonica* Reeve, 1854, *Mactra olorina* Philippi, 1846, and *Mactra lilacea* Lamarck, 1819. Bernard et al. (1993) considered *Mactra virgo* Deshayes, 1854, a junior synonym of this species. Disjointed valves were commonly found scattered along the shoreline during the survey.

***Mactra mera* Reeve, 1854**

(Figs. 3a, b; 4a, b; ; see p. 293; Fig. 20; see p. 295)

Material examined. – SL 51-57 Changi (ZRC.1975.7.8.3-9); SL 65 ECP (ZRC.MOL.002895).

Shell description. – The shell is trigonal to subtrigonal in outline, and almost equilateral in some specimens. The shell is solid, and the exterior of mature specimens is covered with a thin brown periostracum that is thicker nearer the ventral margins and somewhat lacking near the umbones. The colour of the shell is purplish brown, with lighter and darker radial and concentric bands, although this patterning is lacking in larger, more mature specimens. The shell sculpture consists of fine concentric striae which become prominent at the lunule and escutcheon. The anterior and posterior dorsal margins are almost straight to mildly convex. The anterior end is rounded and the posterior end is pointed. The umbones are rounded, pointing inwards, and placed near the midline. The lunule and escutcheon are large, the latter bounded by a weak subangulate ridge that radiates from the umbones to the posterior ventral margin. The shell interior is purplish brown and somewhat glossy. The adductor muscle scars are large and rounded. The pallial sinus is rounded and moderately shallow. The hinge plate is whitish. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth.

Distribution. – This species was reported from the intertidal areas of Mata Ikan and Bedok, presently East Coast Park (Morris & Purchon, 1981; Purchon & Purchon, 1981), and is included in locally published checklists (e.g., Chou et al., 1994, Tan & Chou, 2000). This species occurs widely in the tropical western Pacific, and has been reported from East

Africa, China (Qi, 2000), Thailand, Malaysia, Philippines, Indonesia (Vongpanich, 2000). However, Poutiers (1998) states that the exact distribution is not known owing to confusion with *Mactra grandis* Gmelin, 1791.

Remarks. – *Mactra mera* is perhaps the most commonly encountered member of this family in Singapore. This resembles closely *Mactra grandis* with which it is often confused (Poutiers, 1998; Vongpanich, 2000). Lamprell & Whitehead (1992) states that *Mactra mera* much taller and more triangular than *Mactra grandis*. The collected specimens from East Coast Park vary in shape and intensity of the colouration or radial patterning on the external surface of the shell, but are consistently taller and less elongated than the illustration of *Mactra grandis* published by Lamprell & Whitehead (1992). There seems to be a lack of literature that sufficiently compares the two species in detail, and hence, the collected specimens are herein considered to be *Mactra mera*. Further investigation is needed to determine if *Mactra grandis* is found in Singapore.

***Mactra violacea* Chemnitz, 1782**

(Figs. 1a, b; 2a, b; see p. 293)

Material examined. – SL 20-78 ECP (ZRC.MOL.002887).

Shell description. – The shell is inequilaterally triangular, thin, glossy, and covered with a thin greyish-gold periostracum which is more prominent nearer the ventral margin and lacking toward the umbones. The colour of the shell ranges from deep purple to white. The shell sculpture consists of very fine concentric striae, which tend to be more regular and prominent dorsally and less so toward the ventral margin. The anterior dorsal margin is slightly concave, and the anterior end is broad and round. The posterior dorsal margin is straight to slightly convex and terminates in a pointed but truncated, gaping edge. The umbones are placed near the midline and are high and pointed, bending inwards. The lunule and escutcheon are large but their borders are not well defined. The shell interior is of the same colour as the exterior, but less glossy. Fine, irregular radial grooves emit from the umbonal cavity toward the ventral edge. The muscle scars are small and elliptical, and more rounded in the posterior. The pallial sinus is rounded but shallower than that in *Mactra mera*. The hinge line is white. The anterior cardinal teeth in both valves do not reach the ventral edge of the hinge plate, but are terminated by a transverse septum. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth. The dorsal most anterior lateral tooth in the right valve is reduced to a shortened ridge.

Distribution. – Vongpanich (2000) mentioned that the type locality of this species is Malacca. Its distribution ranges from the eastern Indian Ocean, Indonesia, and the Philippines (Poutiers, 1998; Dharma, 2005).

Remarks. – A number of colour variations exist in Singapore, which range from deep purple entirely (Fig. 2), to purplish-white, to pure white (Fig. 1). Fragments of the fragile shell were found washed up on shore, and complete specimens were rarely encountered during the survey.

***Mactrinula dolabrata* (Reeve, 1852)**

(Fig. 15a, b; see p. 294)

Material examined. – SL 13-26 ECP (ZRC.MOL.002888).

Shell description. – The shell is inequilaterally, triangularly oblong, thin, white in colour and covered with a thin light brown periostracum. The exterior surface is smooth with weak traces of concentric growth lines. The anterior dorsal margin is concave and the posterior end is rounded. The posterior dorsal margin is convex and the posterior end is truncated. There is a weak keel radiating from the umbones and terminating at the postero-ventral margin. The anterior end of the shell is wider than the posterior end. The two ends are connected by a gradually curving ventral edge. The umbones are pointed and curved inwards slightly, and placed after the midline toward the posterior end. The lunule is narrow. The shell interior is glossy white. The pallial sinus is only slightly deeper than it is high, and non-confluent with the pallial line, which is far from the ventral edge. The posterior adductor muscle scar is almost circular, and the anterior more elongated. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth. The lateral teeth are short. The dorsal most anterior lateral tooth in the right valve is reduced to a shortened ridge.

Distribution. – This species has been recorded from Japan (Habe, 1968), China (Qi, 2005), Thailand (Tantanasiriwong, 1979; Vongpanich, 2000), to the northern and western coasts of Australia (Lamprell & Healy, 1998).

Remarks. – This species resembles *Mactrinula reevesii* (Gray, 1837), but the former has a less concave anterior dorsal margin, and weaker, or completely lacking the concentric ribbing around the umbonal area (Vongpanich, 2000).

***Micromactra angulifera* (Deshayes, 1854)**

(Fig. 14a, b; see p. 294)

Material examined. – SL 23 ECP (ZRC.MOL.002891).

Shell description. – The shell is elongated, equilaterally triangular, thin, fragile, translucent, and white in colour. The surface is covered with a thin light brown periostracum. The exterior surface is smooth with weak, closely spaced irregular concentric growth lines that form weak ridges near the umbones. The anterior dorsal margin is almost straight or slightly convex, terminating in a widely rounded anterior margin. The posterior dorsal edge is weakly convex, and the posterior margin is truncated. There is a prominent keel radiating from the umbones and terminating at the postero-ventral margin. The umbones are small, pointed, tilting toward the anterior and placed at the midline. The lunule is narrow. The shell interior is glossy white. The adductor muscle scars are small, the posterior being more rounded than the anterior. The pallial sinus is rounded, almost reaching the midline, about as deep as it is high, and partly confluent with the pallial line. The resilifer is large and deep. The left valve has one anterior and one posterior lateral tooth, both of which are well developed. The right valve has two anterior and two posterior lateral teeth, but the dorsal most anterior lateral tooth in the right valve is reduced to a shortened ridge.

Distribution. – This species occurs widely in the tropical Indo-Pacific region, including China, Japan, the Philippines, and Indonesia (Habe, 1968; Okutani, 2000; Qi, 2005).

Remarks. – Disjointed valves were occasionally encountered among debris deposited at the shore high tide line during the survey.

Subfamily Pteropsellinae Keen, 1866

***Raeta pellicula* (Reeve, 1854)**

(Figs. 11a, b; 12a, b; see p. 294)

Material examined. – SL 32 ECP (ZRC.MOL.002893).

Shell description. – The shell is triangular ovate, inflated, thin, and very fragile. The shell exterior is white, and covered with regular concentric ridges separated by narrow interstices of equal width. The anterior dorsal margin is convex, and the anterior end is widely rounded. The posterior dorsal margin is very concave, and the posterior end is rounded but more attenuated than the anterior, gaping, and compressed. The ventral edge is curved. The umbones are high, pointed, and curved inwards, and placed just before the midline nearer the anterior. The lunule and escutcheon are not well defined. The shell interior is glossy white, and the surface is marked by concentric ridges as per the exterior. The adductor muscle scars are small, and the pallial sinus is rounded and deep, reaching near the midline of the shell, slightly deeper than it is high, and not confluent with the pallial line. The resilifer is deep and round. There is one long posterior lateral tooth and no anterior lateral teeth in the left valve.

Distribution. – This species has been recorded from the Red Sea (Oliver, 1992), China (Qi, 2005), Japan (Habe, 1968; Okutani, 2000) and Australia (Lamprell & Whitehead, 1992).

Remarks. – This species is placed in the subgenus *Raetina* Dall, 1898, which is characterized by the attenuate shell posterior and weakened plications at the area posterior of the umbones (Lamprell & Whitehead, 1992). This species probably burrows into soft sand offshore (Oliver, 1992) and the fragile shells are seldom washed up onto the beach intact.

***Raeta pulchella* (Reeve, 1850)**

(Fig. 16a, b; see p. 294)

Material examined. – SL 11 Tanjong Katong (ZRC.1975.7.8.15); SL 9-11 ECP (ZRC.MOL.002892).

Shell description. – The shell is triangular ovate, thin, fragile, and translucent white in colour. The shell surface is smooth and covered with 13 to 16 wide, rounded, concentric ridges separated by regular interstices of equal width. The anterior dorsal edge is almost straight and terminates into the large rounded anterior margin. The posterior dorsal edge is straight, and the posterior end is either truncated or pointed. The ventral margin is curved. The umbones are placed at the midline. The lunule and escutcheon are weakly defined. The shell interior is white, smooth and glossy, and the exterior sculpture can be seen through the shell. The pallial sinus is rounded and shallow, about twice as high as it is deep and non confluent with the pallial line. There is one long posterior and anterior lateral tooth in each valve.

Distribution. – This species was reported from the intertidal of Titik, on the east coast of Peninsula Malaysia by Morris & Purchon (1981). It is widely distributed throughout the Indo-West Pacific region, and has been reported from Thailand (Lyngé, 1909; Robba et al., 2002), China (Qi, 2005), Japan (Kira, 1965, Okutani, 2000), Siberia (Kira, 1965) and Australia (Lamprell & Healy, 1998).

Remarks. – A single specimen deposited in the ZRC identified as *Standella plicatilis* (Reeve) (ZRC.1975.7.8.15) was found to be *Raeta pulchella*. The former can be differentiated by being “covered with a brownish epidermis”, “impressed in the middle”, and “finely keeled and truncated” at the posterior (Reeve, 1854). Disjointed valves of *Raeta pulchella* were commonly found scattered along the beach from the high tide line to the intertidal regions. Living specimens were not observed during this survey.

Subfamily Lutrariinae H. & A. Adams, 1856

Heterocardia gibbosula Stoliczka, 1871

(Fig. 13a, b; see p. 294)

Material examined. – SL 12-21 ECP (ZRC.MOL.002883).

Shell description. – The shell is ovate, thin, fragile, and somewhat translucent. The shell is white overall, and covered with a thin, straw coloured periostracum. The exterior sculpture consists of irregular concentric striation. The anterior and posterior dorsal margins are both convex. The anterior end is widely rounded, and the posterior end is bluntly truncated. The ventral edge is convex. The umbones are small, slightly prosogyrate, and placed near the midline. The lunule and escutcheon are large and weakly defined. The shell interior is glossy white. The anterior adductor muscle scar is narrow, and the posterior muscle scar is large and rounded. The pallial sinus is deep, reaching about a quarter of the shell length from the anterior, about twice as deep as it is high, and partly confluent with the pallial line. The hinge line is white, and there is a deep triangular resilifer in each valve. The left valve has two very short but prominent anterior lateral teeth, and one posterior lateral tooth that quickly develops into a thin ridge along the inside of the posterior dorsal edge. The right valve has one anterior and one posterior lateral tooth.

Distribution. – This species was reported from the intertidal area of Bedok, presently East Coast Park (Morris & Purchon, 1981; Purchon & Purchon, 1981). This species has also been reported from Australia (Lamprell & Whitehead, 1992), the Philippines and Thailand (Robba et al., 2002).

Remarks. – Similar to the preceding species, disjointed valves of *Heterocardia gibbosula* are found scattered along the beach from the high tide line to the intertidal regions. Complete shells or live specimens were not observed during this survey.

Lutraria cf. maxima (Jonas, 1844)

(Fig. 19a, b; see p. 295)

Material examined. – SL 40-75 ECP (ZRC.MOL.002884)

Shell description. – The shell is elongately oblong, thick and solid. The exterior is white, and the shell sculpture consists of closely spaced concentric striae overlain with wider, more widely spaced irregular concentric ridges. The beach-worn disjointed valves collected presented no hint of a periostracum, but the shell is probably covered with an olive brown epidermis as commonly seen among the species of this genus. The anterior dorsal margin is sloping and the anterior end is evenly rounded. The posterior dorsal margin is almost straight, and along with its large size, distinguishes this species from many other members in the region. The umbones are placed between the midline and the anterior end, and are pointed but small, and hardly raised above the dorsal margin. The ventral edge is parallel with the dorsal margin. The shell interior is glossy white. The anterior adductor muscle scar is elongated and the posterior muscle scar is circular. The pallial sinus is deep, extending to the area under the umbones, almost twice as deep as it is high, looping only slightly before meeting the pallial line. The resilifer is large, and the lateral teeth are weak in both valves.

Distribution. – *Lutraria maxima* was reported from Singapore by Lim (1969a). This species has been reported from Southeast Asia (Vongpanich, 2000), China (Qi, 2000) and Japan (Habe, 1968; Okutani, 2000).

Remarks. – The species of *Lutraria* proved difficult to determine owing to the fact that the shell outline appears to vary even within species, and numerous similar forms have been described from the Indo-Pacific region (Oliver, 1992). The specimens collected from East Coast Park resemble most closely *Lutraria maxima*, although some differed in the following areas: the shells showed different degrees of irregularity in the concentric sculpture; some of the shells had a

posterior dorsal edge that was more arcuated and less parallel with the ventral edge; the umbones were elevated to a greater extent in some shells; some of the shells had slightly deeper pallial sinuses which extended past the anterior cardinal teeth, and other specimens had shallower pallial sinuses which reached the posterior of the resilifer; the degree to which the pallial sinus loops before becoming confluent with the pallial line varied among specimens. Hence, the specimens here are referred to as *Lutraria* cf. *maxima*. A closer inspection will probably reveal that the specimens from East Coast Park represent more than one species.

***Meropesta nicobarica* (Gmelin, 1791)**

(Fig. 10a, b; see p. 294; Fig. 21; see p. 296)

Material examined. – SL 27-40 Siglap (ZRC.1975.7.8.11-13); SL 20-33 ECP (ZRC.MOL.002889).

Shell description. – The shell is elongately ovate, thin (with some specimens appearing translucent), and white in colour. The shell surface is covered with a thin straw-coloured periostracum. The shell surface is covered with numerous upraised, closely spaced radiating ridges crossed by weaker closely spaced concentric ridges. The posterior dorsal margin is almost straight. The anterior dorsal margin is convex. The shell gapes at both ends. The anterior margin is large and rounded, and the posterior margin is narrower and truncated. The umbones are rounded and small, and placed nearer to the anterior end. The lunule and escutcheon are not well-defined. The shell interior is glossy white, and the exterior sculpture of the shell can be seen. The pallial sinus is deep, reaching the midline of the shell, rounded, about one and a half times as deep as it is high, and non confluent with the pallial line. The resilifer is large, rounded, and deep. The hinge line is white. The left and right valves have one anterior and one posterior lateral tooth each. The lateral teeth develop into a thin, straight ridge along the inside of the anterior and posterior dorsal edges.

Distribution. – The type locality is the Nicobar Islands in the Andaman Sea. This species was reported from Singapore by Chuang (1973) and Chou et al. (1994) as *Standella nicobarica*. Morris & Purchon (1981) reported this species from trawl and dredge hauls off present day Marina South. *Meropesta nicobarica* has a wide distribution throughout the tropical Indo-West Pacific, and has been reported from Red Sea (Oliver, 1992), East India (Hylleberg & Kilburn, 2002), Indonesia (Dharma, 2005), the Philippines (Vongpanich, 2000), China (Qi, 2005), Japan (Kira, 1965; Okutani, 2000) and Australia (Lamprell & Whitehead, 1992).

Remarks. – Empty shells were frequently encountered washed up on shore during this survey.

***Meropesta pellucida* (Gmelin, 1791)**

(Fig. 9a, b; see p. 294; Fig. 22; see p. 296)

Material examined. – SL 35-45 Siglap (ZRC.1975.7.8.14-16); SL 27-42 ECP (ZRC.MOL.2890).

Shell description. – The shell is elongately ovate, and thin, becoming thicker in larger, more mature specimens. The shell exterior is white overall, and covered with a thin light brown periostracum. The shell surface is covered with irregular concentric growth lines, crossed by very fine radial striae posteriorly that result in an uneven and rough surface. The shell is somewhat inflated, but some shells had a radial depression running from the umbones to the ventral edge. The posterior dorsal margin is almost straight or slightly concave. The anterior dorsal margin is convex. The shell gapes at both ends. The anterior margin is large and rounded, and the posterior margin is narrower and attenuated. The umbones are rounded and small, and placed nearer to the anterior end. The lunule and escutcheon are not well defined. The shell interior is glossy white. The anterior adductor muscle scar is elliptical and the posterior scar is more rounded. The pallial sinus is deep, extending to past the midline of the shell, and non confluent with the pallial line. The left valve has one anterior and one posterior lateral tooth, both of which are short. The right valve has two anterior and two posterior lateral teeth. The two anterior lateral teeth in the right valve are very short compared to the posterior lateral teeth.

Distribution. – The type locality of this species is “New Guinea”, and it is widely distributed throughout the Indo-West Pacific region, including India, Malaysia, Philippines, Indonesia, Australia (Vongpanich, 2000), Japan (Okutani, 2000) and China (Qi, 2005). This species was reported Singapore by Chuang (1973) and Chou et al. (1994) as *Standella pellucida*.

Remarks. – Lamprell & Whitehead (1992) noted that the generic placement of this species is problematic, as it does not appear to be closely allied to any other mactrid species. However, many authors (e.g., Vongpanich, 2000; Okutani, 2000) agree that it belongs to the genus *Meropesta* Iredale, 1929.

***Spisula transversa* (Deshayes, in Reeve, 1854)**

(Fig. 17a, b; see p. 295; Fig. 18a, b; see p. 295)

Material examined. – SL 31 Telok Kurau (ZRC.1975.7.8.10); SL 19-33 ECP (ZRC.MOL.002894).

Shell description. – The following description is adapted from Reeve (1854) to better match the external features of the shell: The shell is ovately oblong and somewhat equilaterally triangular. It is solid, and whitish, but covered with a dull yellowish periostracum occasionally spotted by fine brown specks. The shell sculpture consists of regular concentric ridges that are narrower near the umbo and more strongly toward the ventral margin. The anterior dorsal margin is almost straight or slightly convex such that the anterior end is sharp but rounded. The posterior dorsal margin terminates obliquely such that the posterior end appears truncated. There is a rounded keel extending from the umbones to the postero-ventral margin. The umbones are small and sharp, and placed near the mid line of the shell. Reeve (1854) does not give any description of the shell interior, but the shell interior of examined specimens is glossy white, and both the anterior and posterior adductor muscle scars are stained dark yellow, fading over time. Both the muscle scars are somewhat large, slightly teardrop shaped anteriorly and more rounded posteriorly. The pallial sinus is rounded, partially confluent with the pallial line, and deep, reaching past the mid line of the shell interior. There are two cardinal teeth anterior of resilifer in each valve, disposed divergently in the right valve. The left valve has one anterior and one posterior lateral tooth, and the right valve has two anterior and two posterior lateral teeth. The ventral lateral teeth in the right valve have tiny ridges on the sides facing the dorsal teeth.

Distribution. – Reeve (1854) and Deshayes (1854) stated that the type locality of this species is unknown, but available literature [Government Museum (Madras), 1867; Chuang, 1973; Chou et al., 1994] reported *Mactra transversa* from Singapore. This species has been collected by fishers in the Malacca Straits (B. Boo, pers. comm.).

Remarks. – The outline and external appearance of this species resembles *Mactra chinensis* Philippi, 1846 and *Mactra sulcataria* Reeve, 1854, but the pallial sinuses in these are shallower, extending just past the posterior adductor muscle scar. This species differs from the other closely related members of the genus such as *Spisula (Oxyperas) coppingeri* (Smith, 1884), and *Spisula (Oxyperas) lentiginosa* Gould, 1852 in that it is more triangular and less elongate, and lacks any obvious spots or markings on the shell exterior and lunule (see Lamprell & Whitehead, 1992). Since Reeve's description, there has not been much information available about this species, except that a specimen of *Mactra transversa* Deshayes from Singapore resides in the Government Central Museum, Madras, India (Government Museum (Madras), 1867). This species should be placed in the genus *Spisula* Gray, 1837 and subgenus *Oxyperas* Mörch, 1853 which is characterized by the following shell characteristics: a trigonal to ovate shell outline, not gaping at the ends, sculpture of concentric ridges, a delimited lunule and escutcheon, and a deep, oval pallial sinus (Lamprell & Whitehead, 1992).

DISCUSSION

All but two of the nine species previously recorded in local checklists (e.g., Morris & Purchon, 1981) were accounted for in the recent survey. This is noteworthy considering that most of the specimens recorded in previous works on the local bivalve fauna were collected prior to the 1960s before extensive coastal reclamation and construction projects along the south eastern coastlines of Singapore left waters surrounding the island with chronic sedimentation levels (after Low & Chou, 1994). *Mactra hepatica*, reported in Singapore by Chuang (1973) and probably referring to the species accredited to Deshayes (1854), was not found either in recent surveys or deposited in the ZRC. *Lutraria ryhnaena* Jonas, 1844, the other species not found in recent surveys, was reported from Pulau Pawai (Morris & Purchon, 1981; Purchon & Purchon, 1981) between 1950 and 1960, and the specimens were deposited into the British Museum (Natural History), London (BMNH). *Lutraria ryhnaena* is more commonly known from the southern coastlines of Australia (Allan, 1950; Iredale & McMichael, 1962; Lamprell & Whitehead, 1992), although it has been mentioned in other regions (e.g., Spry, 1964). It is necessary to inspect the specimens at the BMNH to verify the local record as no *Lutraria* specimens were found in the ZRC.

It is unlikely that the species recorded for the first time in Singapore waters were recently introduced, as Singapore is within their known geographical distributions. The author shares the opinion of Tan & Clements (2008) that the high proportion of new records is probably a result of a lack of taxonomical work and under-sampling of the local malacofauna. It is highly likely that future investigations into the malacofauna of Singapore will turn up even more matrid species that those discussed here, many of which would probably prove to be new local records.

ACKNOWLEDGEMENTS

I would like to thank Lua Hui Kheng, malacology curator at the Zoological Reference Collection, Raffles Museum of Biodiversity Research for granting me access to bivalve collection, and Paul Valentich-Scott of Santa Barbara Museum

of Natural History for suggesting identifications to some of the photographed specimens. I would also like to express appreciation to S. K. Tan and Chan S. Y. Chan for their fruitful discussions about local marine malacofauna that inspired me to embark on this study. I am also grateful to the Chief Executive Officer of the National Parks Board for providing relevant research and collecting permits, and the anonymous reviewer whose helpful suggestions and insightful comments greatly improved this article.

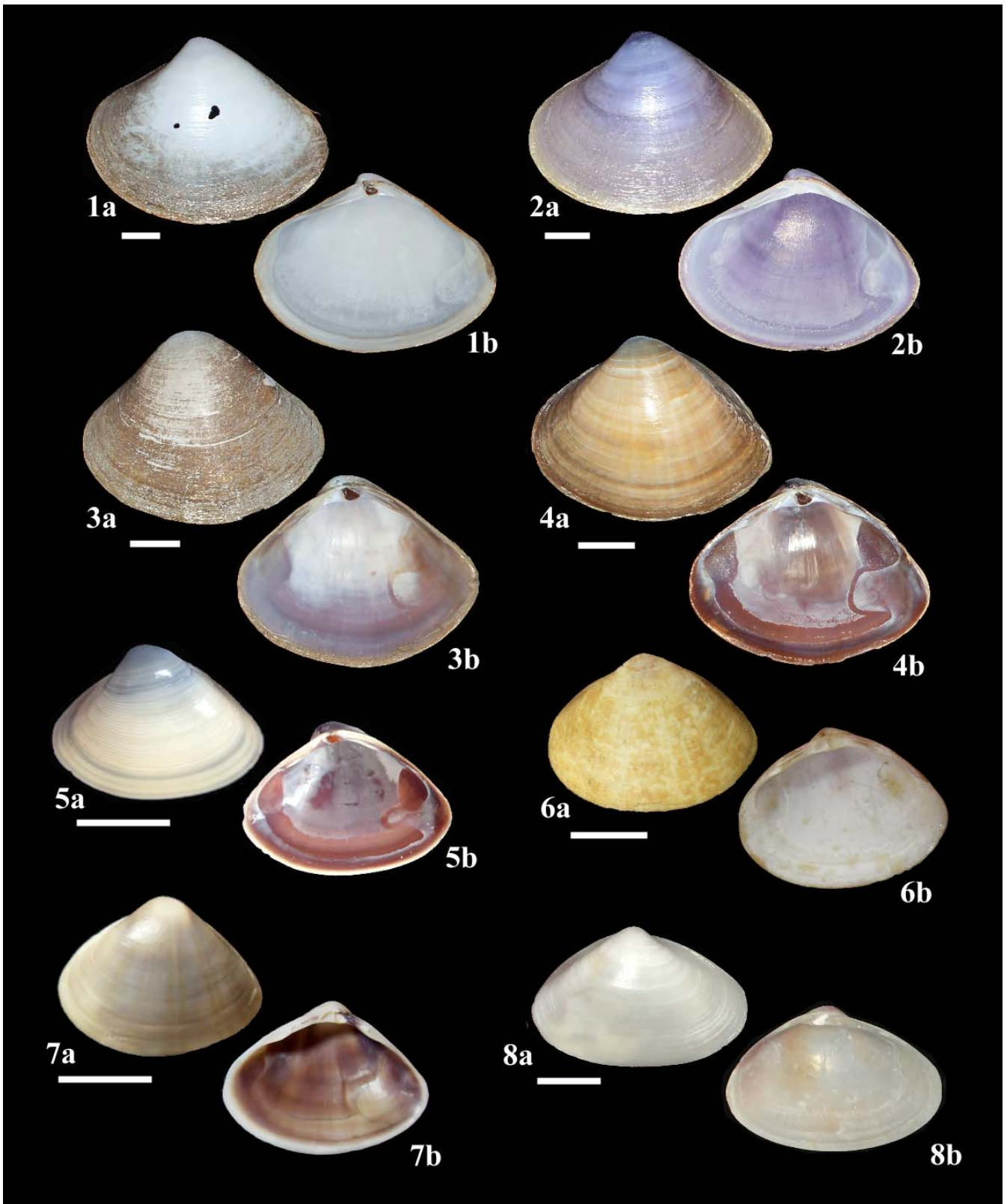
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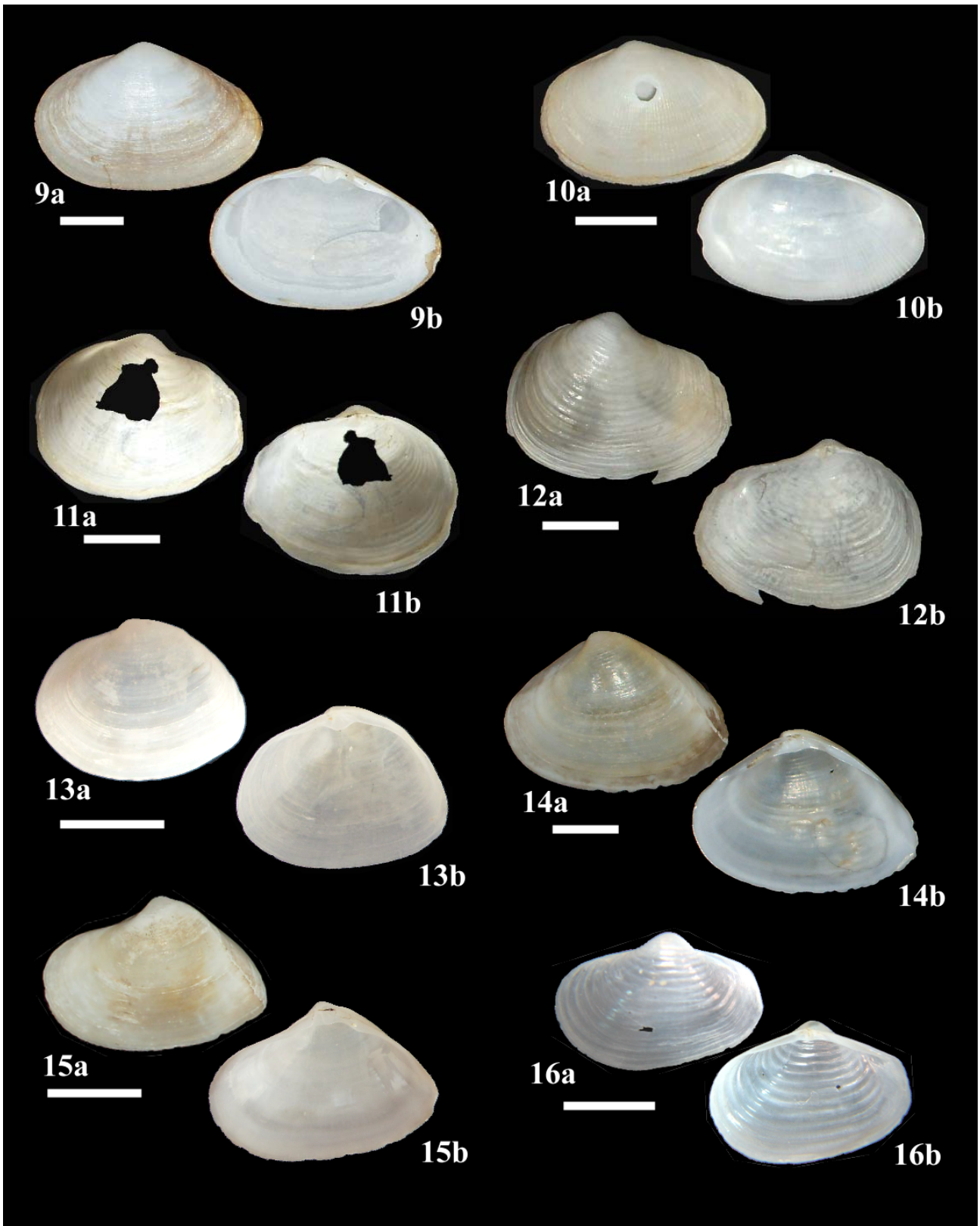
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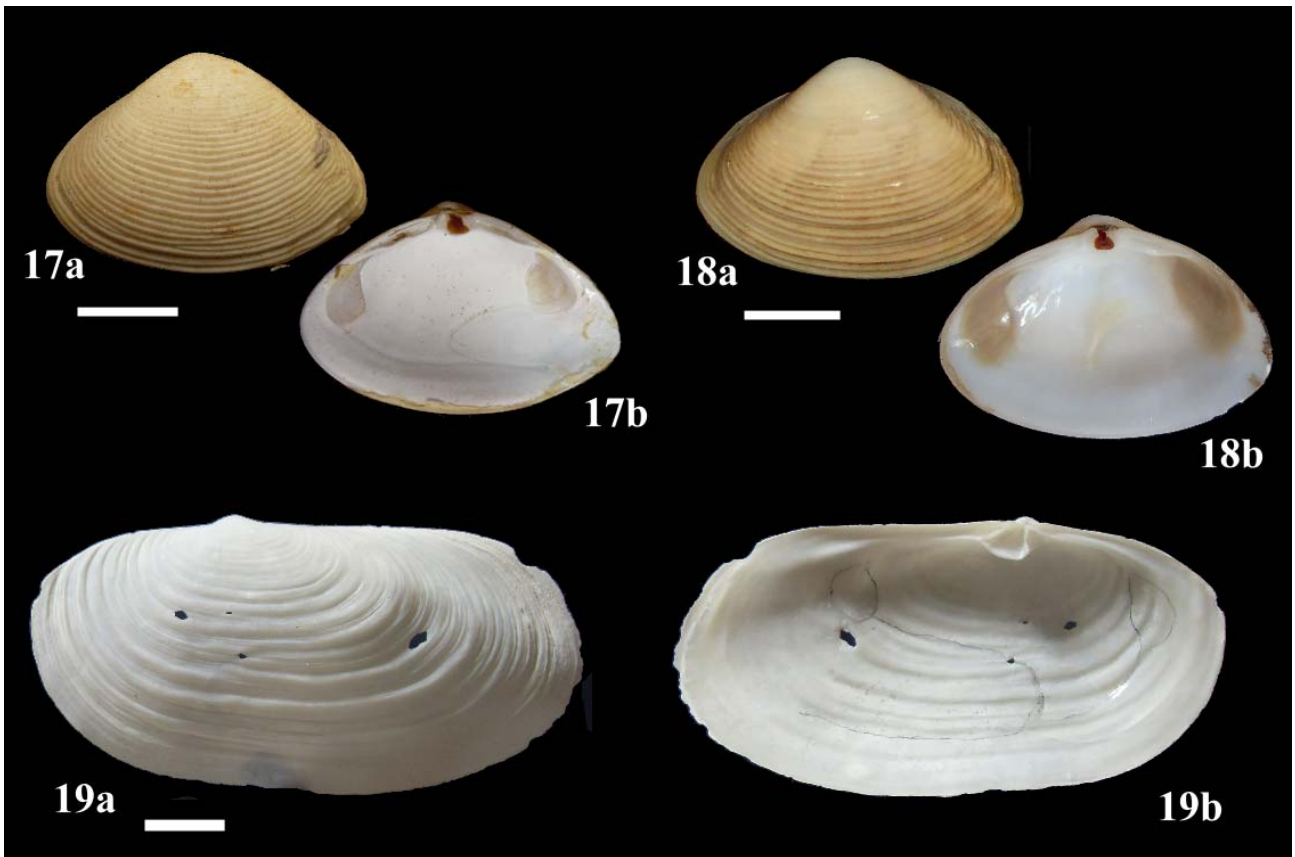
APPENDIX



Figs. 1–8. Subfamily Mactrinae: 1a, b & 2a, b, *Mactra violacea*. 3a, b & 4a, b, *Mactra mera*. 5a, b, *Mactra dissimilis*. 6a, b, *Mactra achatina*. 7a, b, *Mactra cuneata*. 8a, b, *Mactra inaequalis*. Scale bars = 10 mm.



Figs. 9–16. Subfamilies Pteropsellinae & Lutrariinae. 9a, b, *Meropesta pellucida*. 10a, b, *Meropesta nicobarica*. 11a, b & 12a, b, *Raeta pellicula*. 13a, b, *Heterocardia gibbosula*. 14a, b, *Maetrinula angulifera*. 15a, b, *Maetrinula dolabrata*. 16a, b, *Raeta pulchella*. Scale bars = 10 mm.



Figs. 17–19, Subfamily Lutrariinae. 17a, b & 18a, b, *Spisula transversa*. 19a, b, *Lutraria* cf. *maxima*. Scale bar = 10 mm.



Fig. 20. *Maetra mera* burrowed into soft muddy sand in the intertidal area of Changi Beach Park, Jun.2009.



Fig. 21. *Meropesta nicobarica* on muddy sand in the intertidal area of Changi Beach Park, Jun.2009.



Fig. 22. *Meropesta pellucida* on muddy sand in the intertidal area of Changi Beach Park, Jun.2009.