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Mudwhelks (Gastropoda: Potamididae) in mangrove forest of Dedap, Padang Island, Kepulauan Meranti District, Riau Province, Indonesia

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Abstract

Potamididae is most common of the molluscan fauna of mangrove forests in the Indo-West Pacific area and in the past their identification has been problematic. These snails play important role in mangrove ecosystem. In general, the molluscan fauna of Indonesia is not well known and so a study of this kind is necessary. The aim of this study was to determine the species diversity of Potamididae in Dedap, Kepulauan Meranti District, Riau Province, Indonesia and to provide reliable morphological characters for identification, which are simple to use. The study was conducted from January to May 2015 with a random sampling method by handpicking at 10 stations by using 1 x 1 m² the square transects in the mangrove forest. We recorded five species belonging to four genera of mudwhelks, namely *Cerithidea obtusa*, *C. quoyii*, *Cerithideopsis alata*, *Cerithideopsis malayensis* and *Telescopium telescopium*.

Keywords: *Cerithidea*, *Cerithideopsis*, *Cerithideopsis*, Mangrove, *Telescopium*.

Introduction

Gastropods are the largest and most diverse group of molluscs (some 50,000 species have been described). They occur at all levels of the sea, in brackish-water, fresh water and on land [1, 2]. The molluscan fauna of mangrove ecosystem is relatively poor in species, but the family Potamididae is usually present. Members of this family can be very abundant and are easily found on the trunks and roots of mangroves and on the substrate beneath the trees [3-5]. The mangrove ecosystems are rich in organic matter and nutrients [6] and provide food, substrate and shelter for Potamididae [7-9]. These snails may serve as bioindicators of health and ecological changes in the mangrove ecosystem [10, 11] and biofilters in waste water [12]. Some potamidids are also used as a food source for human [13, 14].

Studies of Potamididae have been done based on taxonomic, behavioural and ecological works in many regions. The taxonomy of all the known Indo-Pacific Potamididae is now well understood as a result of recent morphological and molecular work [15-19]. In Indonesia especially, this study have been reported by several researchers based on morphological work [4, 5]. In ecological and behavioural works, study about this snails have been done by several researchers from many regions and also Indonesia [20-23]. However, no study has reported about the mudwhelks in mangrove forest of Dedap, Kepulauan Meranti District, Riau Province, Sumatra, Indonesia. Although taxonomic, behavioural and ecological studies of potamidid snails have been reported in several region in Indonesia, but that there remains a need for local studies in order to test and explain (for regional workers) the taxonomic characters provided by these monographs, and to study the poorly known ecology of the species

Commercial logging of mangroves formerly centered on Riau Provinces. The area under logging concession has increased from 455,000 hectares in 1978 to 877,200 hectares in 1985 or about 35 percent of the remaining area of mangroves at the time. From 1987 until 2005 the mangrove area remaining declined from 470,000 hectares to 259,500 hectares in Riau Province [24, 25]. This reduction of mangrove forest in Riau Province may have an impact on the snail diversity. Therefore to provide data on Potamididae, a field study was conducted in the mangrove forest of Dedap, Kepulauan Meranti District, Riau Province.

The aim of this study was first to determine the species diversity of Potamididae in Dedap and to provide reliable morphological characters for identification, which are simple to use and second to record the habitats of the species.

Materials and Methods

Study Area: The study was conducted from January to May 2015 in mangrove forest of Dedap (latitude 1°17' to 1°18'N and longitude 102°22' to 102°24'E) in Kepulauan Meranti District, Riau Province (Figure 1).

Collection and Environmental Measurements: Sampling was done by handpicking randomly at 10 stations in the mangrove area by using 1 x 1 m² the square transects in every sampling station. Samples were preserved in 70% alcohol. Some environmental parameters were measured at each stations. Salinity was measured using TI-SAT100 (A) TRANS INSTRUMENTS Hand Refractometer; temperature was

measured by mercury thermometer; water acidity (pH) was measured by MERCK universal indicator paper (scale 0-14). Measurement of the shells using a caliper Triple Brand 150 mm/6" x 0.02/1/1000. The shell characters measured were shell length (SL), shell width (SW), spire (SP) and length of body whorl (LBW) (Figure 2).

Mudwelts Identification: Identification of the specimen was done based on several identification books [13, 26-28] and also from the results of several researchers [4, 5, 15-17, 21, 29, 30]. An identification key to genera and species is given below. The descriptions of each species are based on the literatures, which have been modified according to our observations.

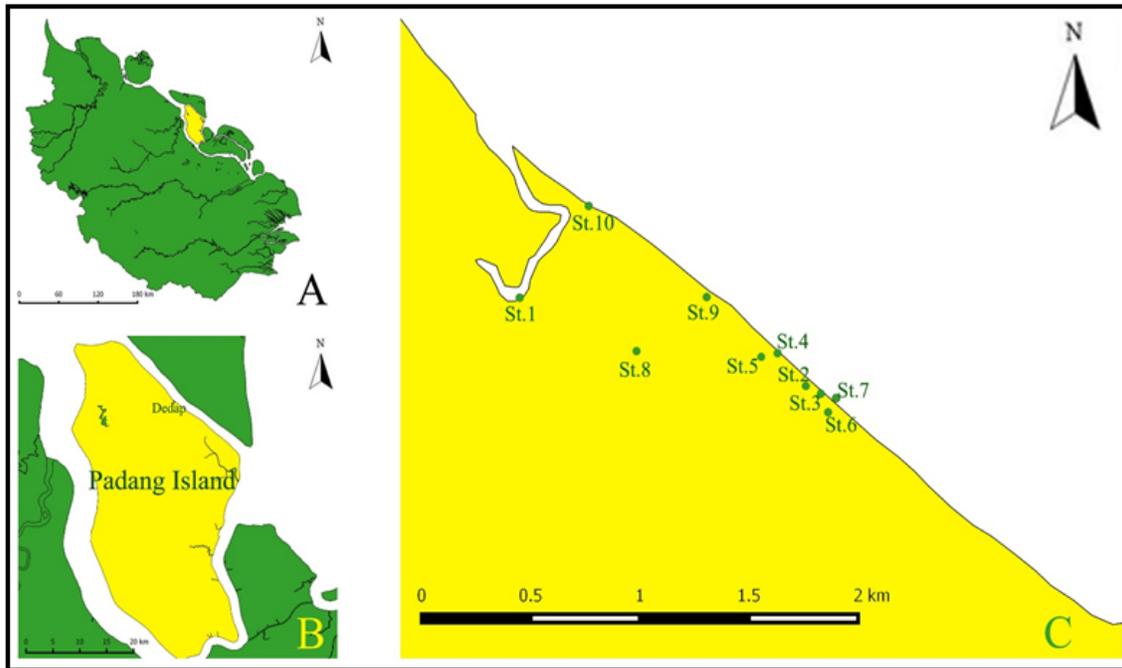


Fig 1: Study site and sampling stations in mangrove forest of Dedap, Padang Island, Kepulauan Meranti District, Riau Province, Sumatra, Indonesia. A. Riau Province, B. Padang Island, C. Detail map of study site at Dedap.

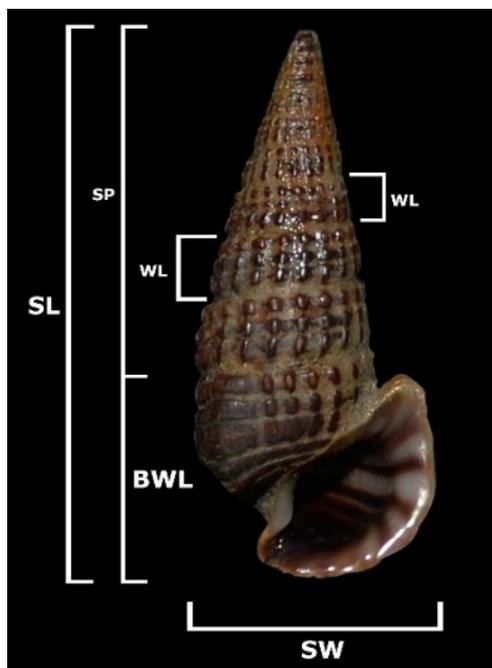


Fig 2: The shell characters of mudwhelks: SL = Shell Length; SW = Shell Width; SP = Spire; BWL = Body Whorl; WL = Whorl.

Table 1: Study site of the mudwhelks and its characteristics.

No.	Stations	Characteristics
1	Station 1 01° 19' 06.3" N 102° 22' 32.6" E	The density of the mangrove is high with 10 species, namely <i>Acrostichum aureum</i> , <i>A. speciosum</i> , <i>Bruguiera gymnorrhiza</i> , <i>B. sexangula</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> , <i>Scyphiphora hydrophyllacea</i> and <i>Sonneratia ovata</i> . High density canopy cover. Salinity 30 ppt, temperature 31 °C, pH 7, dried muddy substrate.
2	Station 2 01° 18' 53.9" N 102° 23' 15.0" E	The density of the mangrove is low with 11 species, namely <i>Acrostichum aureum</i> , <i>A. speciosum</i> , <i>Avicennia alba</i> , <i>Bruguiera gymnorrhiza</i> , <i>B. sexangula</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Lumnitzera racemosa</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> and <i>Scyphiphora hydrophyllacea</i> . Low density canopy cover. Salinity 30 ppt, temperature 32 °C, pH 7, liquid muddy substrate.
3	Station 3 01° 18' 52.8" N 102° 23' 17.2" E	The density of the mangrove is low with 6 species, namely <i>Acrostichum speciosum</i> , <i>Bruguiera gymnorrhiza</i> , <i>Excoecaria agallocha</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> and <i>Scyphiphora hydrophyllacea</i> . Low density canopy cover. Salinity 34 ppt, temperature 29° C, pH 7, liquid muddy substrate.
4	Station 4 01° 18' 58.5" N 102° 23' 10.8" E	The density of the mangrove is high with 9 species, namely <i>Acrostichum speciosum</i> , <i>A. lanata</i> , <i>Bruguiera gymnorrhiza</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> , <i>Scyphiphora hydrophyllacea</i> , and <i>Sonneratia ovata</i> . High density canopy cover. Salinity 31 ppt, temperature 28°C, pH 7, liquid muddy substrate.
5	Station 5 01° 18' 58.5" N 102° 23' 18.3" E	The density of the mangrove is low with 4 species, namely <i>Acrostichum speciosum</i> , <i>Excoecaria agallocha</i> , <i>Rhizophora apiculata</i> and <i>Scyphiphora hydrophyllacea</i> . Low density canopy cover. Salinity 34 ppt, temperature 31 °C, pH 7, liquid muddy substrate.
6	Station 6 01° 18' 50.2" N 102° 23' 18.3" E	The density of the mangrove is high with 9 species, namely <i>Acrostichum aureum</i> , <i>A. speciosum</i> , <i>Bruguiera gymnorrhiza</i> , <i>B. sexangula</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Lumnitzera racemosa</i> , <i>Nypa fruticans</i> and <i>Rhizophora apiculata</i> . High density canopy cover. Salinity 30 ppt, temperature 31 °C, pH 7, liquid muddy substrate.
7	Station 7 01° 18' 52.2" N 102° 23' 19.5" E	The density of the mangrove is low with 6 species, namely <i>Acrostichum speciosum</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> and <i>Scyphiphora hydrophyllacea</i> . Low density canopy cover. Salinity 30 ppt, temperature 29 °C, pH 7, liquid muddy substrate.
8	Station 8 01° 18' 58.2" N 102° 22' 49.9" E	The density of the mangrove is high with 11 species, namely <i>Acrostichum aureum</i> , <i>A. speciosum</i> , <i>Avicennia alba</i> , <i>Ceriops decandra</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> , <i>Scyphiphora hydrophyllacea</i> , <i>Sonneratia alba</i> and <i>Sonneratia ovata</i> . High density canopy cover. Salinity 26 ppt, temperature 31 °C, pH 7, liquid muddy substrate.
9	Station 9 01° 19' 06.4" N 102° 23' 00.3" E	The density of the mangrove is high with 11 species, namely <i>Acrostichum aureum</i> , <i>A. speciosum</i> , <i>Bruguiera gymnorrhiza</i> , <i>B. sexangula</i> , <i>Ceriops decandra</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> , <i>Scyphiphora hydrophyllacea</i> and <i>Sonneratia alba</i> . High density canopy cover. Salinity 26 ppt, temperature 30 °C, pH 7, liquid muddy substrate.
10	Station 10 01° 19' 19.2" N 102° 22' 42.8" E	The density of the mangrove is high with 8 species, namely <i>Acrostichum aureum</i> , <i>A. speciosum</i> , <i>Bruguiera gymnorrhiza</i> , <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , <i>Nypa fruticans</i> , <i>Rhizophora apiculata</i> and <i>Scyphiphora hydrophyllacea</i> . High density canopy cover. Salinity 28 ppt, temperature 28 °C, pH 7, liquid muddy substrate.

Results and Discussion

A total of 5 species belonging to 4 genera and 336 individuals of mudwhelks were collected (Table 2; Figure 3), namely *Cerithidea obtusa*, *C. quoyii*, *Cerithideopsis alata*,

Cerithideopsis malayensis and *Telescopium telescopium*. The environmental characteristics of the 10 stations are given in Table 1.

Table 2: Species diversity and abundance of mudwhelks at sampling stations in mangrove forest of Dedap (N: total number of individuals).

No.	Species	Stations										N
		1	2	3	4	5	6	7	8	9	10	
1.	<i>Cerithidea obtusa</i>	1	-	4	-	8	2	1	17	2	49	84
2.	<i>Cerithidea quoyii</i>	11	-	3	4	4	-	-	18	-	3	43
3.	<i>Cerithideopsis alata</i>	14	1	16	-	7	-	36	50	4	-	128
4.	<i>Cerithideopsis malayensis</i>	1	-	-	-	-	-	-	-	-	-	1
5.	<i>Telescopium telescopium</i>	-	26	14	6	21	11	3	13	9	7	110
Total of individual		27	27	37	10	40	13	40	98	15	59	366
Total of species		4	2	4	2	4	2	3	4	3	3	

Key to genera and species

- 1. a. Shell large, high conical spire, spiral sculpture only, dark reddish brown to almost black colour..... *Telescopium telescopium*
- 1. b. Shell small-large, conical spire, spiral and axial sculpture, several colour (2)
- 2. a. Spire decollate, ventrolateral varix on body whorl, varices almost always absent on spire whorls..... *Cerithidea* (3)
- 2. b. Spire not decollate, ventrolateral varix, no varices on spire whorls *Cerithideopsis* (4)

- 2. c. Spire not decollate, ventrolateral varix absent, varices scattered over spire..... *Cerithideopsis* (5)
- 3. a. Shell large, periphery rounded, aperture thickened and flared; animal with red pattern (fading to dark pink in ethanol-preserved specimens) *Cerithidea obtusa*
- 3. b. Shell medium, periphery angled, aperture flared and quadrangular; animal blackish anteriorly, with small yellowish cream spots, (based on ethanol-preserved specimens) *Cerithidea quoyii*
- 4. Shell small, upper part of aperture not attached but extending as a pointed wing *Cerithideopsis alata*

5. Shell small, brown with one pale spiral band above periphery; animal with yellow pattern (coloration not preserved after storage in ethanol, but pattern visible as absence of black pigment) *Cerithideopsis malayensis*

Description of genera and species

Cerithidea Swainson, 1840.

Diagnostic characters: Shell large (to 61 mm), delicate to solid, elongate, spire decollate; sculpture of axial ribs, one developed as prominent ventrolateral varix on body whorl (rarely weak or absent) and weakening thereafter; varices almost always absent on spire whorls; spiral ridges present on base, present or absent above periphery; aperture circular, peristome flared and thickened in adult, planar or slightly sinuous, with short anterior canal and slight posterior groove; columella straight or slightly twisted, lacking folds; colour often with spiral bands ^[16].

Cerithidea obtusa (Lamarck, 1822) (Figure 3a).

Cerithidea obtusa (Lamarck, 1822). page 32, figure 11 ^[5].

Cerithidea obtusa (Lamarck, 1822): page 449-450, figure 6 ^[13].

Cerithidea obtusa (Lamarck, 1822): page 688, figure 2, image H ^[15].

Cerithidea obtusa (Lamarck, 1822): page 30, figure 8 ^[16].

Cerithidea obtusa (Lamarck, 1822): page 43, plate 7, figure 5 ^[26].

Cerithidea obtusa (Lamarck, 1822): page 93, plate 21, figure 8 ^[27].

Diagnostic characters: Shell medium sized, with a moderately high conical spire and broad rounded base. Spire whorls convex, with moderately deep suture, 6 or 7 rounded spiral cords crossed by stronger, relatively broad axial ridges, and forming a pattern of rounded nodules. Apical part of spire always broken off. Body whorl wide, rounded at periphery, with axial ridges fading away and with 12 to 15 fine spiral cords on base. An indistinct ventrolateral varix present on left ventral side of body whorl. Aperture wide, subcircular in outline, without a wing-like expansion at posterior end. Outer lip thickened and flaring, with a tongue-shaped anterior end produced over the siphonal canal. Columella narrow, without internal spiral ridges. Anterior siphonal canal short, open and oblique. Colour: outside of shell brown or dull purplish brown, with a brighter zone just below the suture; base plain brown or yellowish with a darker brown zone. Aperture brownish, outer lip of mature specimens cream ^[13]. Animal: head and base of tentacles grey with pale yellow spots; snout dark grey with 3 transverse bands of orange red, the 2 posterior bands wavy or interrupted and with a broad black band between; eyes with black surround and red ring; tentacles pinkish grey, darker at base; sides of foot dark grey with red spots and red margin; mantle cream (red colour fading to dark pink in ethanol-preserved specimens) ^[16].

Specimen examined: 84 specimens; SL: 28–43.3 mm (r: 35.15; sd: 3.34), SW: 10–22 mm (r: 18.33; sd: 1.85), BWL: 9–18.45 mm (r: 11.72; sd: 1.58), SP: 15.55–30 mm (r: 22.6; sd: 2.37).

Habitat: Attached to roots and branches of mangrove trees, on firm substrate and also on muddy tidal banks.

Cerithidea quoyii (Hombron & Jacquinot, 1848) (Figure 3b).

Cerithidea quadrata Sowerby, 1866: page 52, figure 1, image G ^[4].

Cerithidea quadrata Sowerby, 1866: page 34, figure 12 ^[5].

Cerithidea quadrata Sowerby, 1866: page 449,454, figure 5 ^[13].

Cerithidea quoyii (Hombron & Jacquinot, 1848): page 37, figure 12, image B-J ^[16].

Cerithidea quoyii (Hombron et Jacquinot, 1848): page 6, figure 3, image 10 ^[21].

Cerithidea quadrata Sowerby, 1866: page 93, plate 21, figure 4a,b ^[27].

Diagnostic characters: Shell medium, elongate conical with spire angle 30–40°. Shell thin but not transparent. Shell color dark brown on base and lighter to apex. Both spiral and axial ribs present on spire, equal in strength. Apex decollate in adult, often eroded. Body whorl rounded. Suture moderate. Aperture quadrangular. Apertural lip flared and slightly thickened. Columella thin, twisted, color brown. Thick ventrolateral varix present ^[4]. Animal: head and base of tentacles pinkish grey with cream spots; anterior half of snout blackish, sometimes with a few yellow spots, if black pigment is less intense then snout and tentacle bases appear more strongly pink; tentacles pale grey with black rings; sides of foot grey, blackish anteriorly, with small yellowish cream spots; sole of foot grey, pinkish towards margin; mantle pale pinkish grey (based on ethanol-preserved specimens) ^[16].

Specimen examined: 43 specimen; SL: 21.59–40.65 mm (r: 29.84; sd: 4.18), SW: 10–19.55 mm (r: 13.2; sd: 2), BWL: 6.35–19 mm (r: 8.77; sd: 2.13), SP: 9–29.51 mm (r: 20.82; sd: 3.67).

Habitat: Attached to roots and trunks of mangrove trees and on substrate.

Cerithideopsilla Thielle, 1929.

Diagnostic characters: Shell medium size, elongate conical, moderately thick 3 spiral ribs on spire whorls. Numerous axial ribs. Spiral and axial ribs equal. Apex sharp and acute. Whorls flattened, Suture shallow. Aperture triangular, flared and thickened. Varices only rarely present on spire. Ventrolateral varix present ^[16].

Cerithideopsilla alata (Philippi, 1849) (Figure 3c).

Cerithideopsilla alata Philippi, 1849: page 52, figure 1, image E ^[4].

Cerithideopsilla alata (Philippi, 1849): page 43, figure 16 ^[5].

Cerithidea alata (Philippi, 1849): page 93, plate 21, figure 5a,b ^[27].

Diagnostic characters: Shell medium size, elongate conical, thick. Shell color yellowish-brown to reddish-brown. 3 spiral ribs, 1 and 2 dark brown and 3 light brown. Numerous axial ribs. Spiral and axial ribs equal. Apex sharp and acute. Body whorl flattened, about 1/3 of total length shell. Suture shallow. Aperture triangular, flared and slightly thickened. Upper part of aperture not attached to body whorl but extending upward and pointed ^[4].

Specimen examined: 128 specimens; SL: 14–29 mm (r: 20.2; sd: 2.91), SW: 7–20.35 mm (r: 9.42; sd: 2.68), BWL: 3.45–17.29 mm (r: 5.87; sd: 1.61), SP: 10–19.3 mm (r: 13.93; sd: 1.93).

Habitat: on substrate under mangrove trees.

Cerithideopsis Thiele, 1929.

Diagnostic characters: Shell moderately large (to 48 mm), delicate to solid, elongate, spire not decollate; sculpture of axial ribs, weakening on body whorl; 1–2 swollen varices may be present anywhere on body whorl (not routinely in a ventrolateral position) and others scattered over spire whorls; spiral ridges present on base, outermost 1–2 strongest with deep groove between, ridges absent or sometimes present above periphery; aperture circular, peristome sometimes flared and thickened in adult, planar or sinuous in side view, with weak anterior canal and slight posterior groove; columella straight or very slightly twisted, lacking folds; colour dark with peripheral white band and sometimes other spiral lines [17].

Cerithideopsis malayensis Reid and Claremont, 2014 (Figure 3d).

Cerithideopsis malayensis: page 71, figures 2F–H, N, O, 3B, 4 [17].

Diagnostic characters: Shell small (to 26 mm), brown with one pale spiral band above periphery; shape elongated conical; not routinely decollate, 7–11 whorls remaining in well preserved shells, but apex and protoconch always eroded. Spire whorls moderately rounded, suture distinct; spire profile slightly convex, slightly concave towards apex; periphery rounded; relatively delicate. Adult lip only slightly thickened, not flared; sometimes 1 previous lip on final whorl; apertural margin sinuous in side view; anterior canal a weak notch. Sculpture on spire of straight axial ribs, usually becoming curved (opisthocyrt) on last 2–3 whorls, ribs rounded, ribs and interspaces of similar width, 20–27(33) ribs on penultimate whorl, ribs becoming weaker and irregular on final whorl; smallest apical whorls with 3 spiral cords if well preserved, increasing to 6 by whorls 5–6, then becoming weak or disappearing, so that only a trace of 8–10 spiral elements is visible above periphery on penultimate whorl; base with 8–10 cords, of which 2 at periphery slightly enlarged, with marked groove between. No ventrolateral varix, but 0–3 indistinct or prominently raised and rounded varices may be present at any point on last whorl. Surface with spiral microstriae on thick periostracum; short periostracal fringe or bristles remaining on larger striae (i.e. 8–10 striae macroscopically visible above periphery) if well preserved; surface sometimes covered by thick black concretion. Colour: brown, with broad cream band above periphery, often concealed by periostracum; band visible by transparency within aperture. Animal blackish, yellow edge to foot, 2 yellow bands across snout, yellow tentacles; yellow coloration not preserved after storage in ethanol, but pattern visible as absence of black pigment. (Only one specimen found, so description taken from original description [17]).

Specimen examined: 1 specimen; SL: 14.3 mm, SW: 6.35 mm, BWL: 4.29 mm, SP: 9.3 mm.

Habitat: on substrate with leaf litter.

Telescopium Montfort, 1810.

Diagnostic characters: Shell large, high-conical on a broad, nearly flat base. With many narrow flat whorls. Thick, sculptured by spiral ridges. Last whorl obtusely angular at the periphery in adult shells. In immature shells sharply angular. There are no varices, but the last whorl of adult shells can bear thin, leaf-like ridges, standing away from the shell and marking previous growth interruptions. A thick spiral fold winds spirally along the columella; another one runs along the base of the whorls. Columella twisted [29].

Telescopium telescopium Linnaeus, 1758 (Figure 3e).

Telescopium telescopium Linnaeus, 1758: page 52, figure 1, image A [4].

Telescopium telescopium Linnaeus, 1758: page 18, figure 8 [15].

Telescopium telescopium (Linnaeus, 1758): page 451, figure 1 [13].

Telescopium telescopium (Linnaeus, 1758): page 688, figure 2, image B [15].

Telescopium telescopium (Linnaeus, 1758): page 93, plate 21, figure 1 [27].

Telescopium telescopium (L., 1758): page 64 [28].

Telescopium telescopium (Linne, 1758): page 445, figure 108 [29].

Telescopium telescopium (Linne): page 293, figure 1 [30].

Diagnostic characters: Shell large, elongate conical with spire angle 30–40°. Shell thick. Shell color dark brown on base and lighter to apex. Only spiral ribs (3) present on spire. Apex often eroded. Body whorl flattened, about 0.26 of total shell length. Suture shallow. Aperture obliquely quadrangular. Apertural lip sinuate but not flared and thickened. Two thickened spiral lines present on the base of apertural lip. Columella thick, twisted, color brown [4]. Animal black-gray with dirty-white sole. Snout large, long, having pair of short board cephalic tentacles, each with tiny black eye at peduncular base. Tentacles sharply constricted at tips. Snout dorso-ventrally compressed. Snout tip with thick, whitish, fleshy pad having vertical slit-like mouth. Foot large with whitish sole, left lateral and ventrolateral sides of foot each with deep, rounded groove. Anterior mucous gland opening a narrow, deep, slit extending halfway around sides of sole and heavily ciliated within. Groove emerging from exhalant siphon long, deep, highly ciliated in both sexes, running down right side of foot in males, ending at edge of sole; in females, ending at oval, sooty-colored, warty ovipositor near sole margin. Inhalant siphon thick and interior edge with one or two orange-pigmented spots, each surrounding black, pit-like light-sensitive organ (eye) containing lens [30].

Specimen examined: 110 specimens; SL: 29.85–83 mm (r: 70.22; sd: 7.2), SW: 29.65–58.87 mm (r: 42.01; sd: 4.41), BWL: 10–75 mm (r: 19.72; sd: 6.51), SP: 21–63 mm (r: 49.13; sd: 4.85).

Habitat: on the surface and partly buried in the muddy substrate.

Conclusion

Five species of Potamididae snail have been found in mangrove forest of Dedap, Padang Island, Kepulauan Meranti district, Riau Province, Indonesia, namely *Cerithidea obtusa*, *C. quoyii*, *Cerithideopsis alata*, *Cerithideopsis malayensis* and *Telescopium telescopium*. All species were identified based on morphological characteristics.

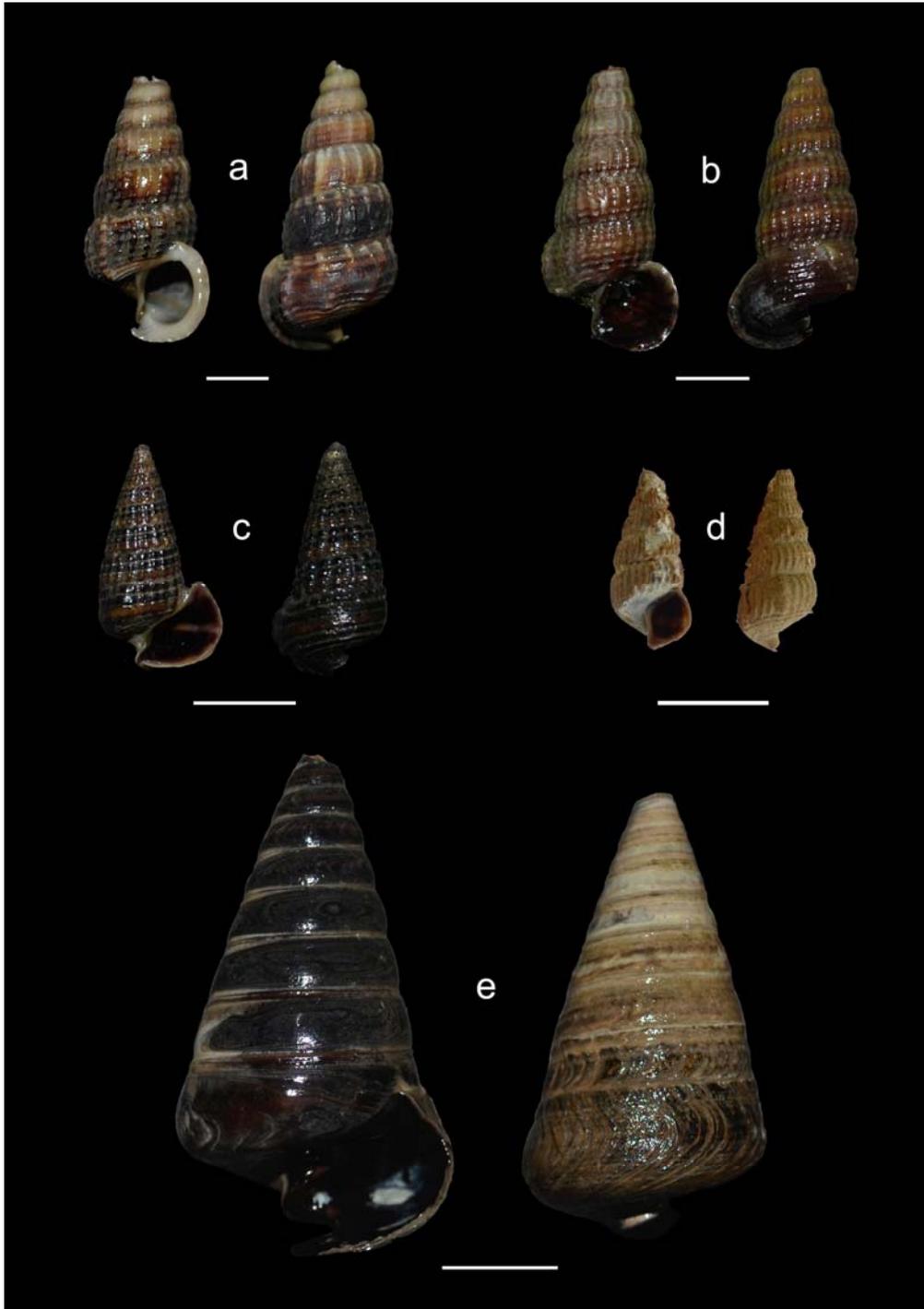


Fig 3: The mudwhelks species from mangrove forest of Dedap. a. *Cerithidea obtusa*, b. *C. quoyii*, c. *Cerithideopsis alata*, d. *Cerithideopsis malayensis*, e. *Telescopium telescopium*. (Scale a-d = 10 mm, e = 20 mm).

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