

FAMILY NOETIIDAE IN THAILAND

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ABSTRACT: Among the bivalve family Noetiidae ten species within five genera were collected from the Gulf of Thailand and the Andaman Sea and identified based on the shell morphology. They are *Didimacar tenebrica*, *Striarca* cf. *symmetrica*, *Striarca aceraea*, *Arcopsis polycymoides*, *Arcopsis minabensis*, *Estellarca olivacea*, *Verilarca pectunculiformis*, *Verilarca thielei*, *Verilarca* cf. *mortenseni*, and *Sheldonella lateralis*.

INTRODUCTION

The Noetiidae is a small family of the Bivalvia and only few species were recorded in Thailand. Lynge (1909) studied the shell specimens from the Gulf of Thailand and reported three species of the subgenus *Fossularca*. He placed them in the family Arcidae. Nielsen (1976) recorded only one species, *Striarca afra* (Gmelin, 1791), from Phuket, Thailand. However, it did not belong to the Indo-Pacific species (Kilburn, 1983 and Oliver, 1985). Tantanasiwong (1979) reported two noetiid species, *i.e.*, *Arcopsis pectunculiformis* and *Striarca afra*, found in Phuket and adjacent area. Kilburn and Hylleberg (1998) reported two new records of noetiids from Phuket Island, *i.e.*, *Striarca symmetrica* (Reeve, 1844) and *Verilarca sinensis* (Thiele and Jaekel, 1931). The genera within the family are still being scrutinized due to the high number of genera and subgenera that are being established from time to time. Noetiids are unique with their vertical ligaments and myophoric flanges, but identification at species level is confused in many studies.

Noetiids inhabit in various habitats and are found attached with byssus under coral crevices or rock, or burrowing in sand and mud in the intertidal zone.

MATERIALS AND METHODS

The specimens were collected from beaches along the coast of Thailand, both the Gulf of Thailand and the Andaman Sea. In addition, a

number of subtidal specimens were collected during the Biodiversity of the Continental Shelf of Andaman Sea Cruises (BIOSHELF) in 1996–2000, using Agassiz trawl (AT) or triangular dredge (TD). The BIOSHELF stations information followed Aungtonya *et al.* (2000). The specimens in this study are kept at the Reference Collection of the Phuket Marine Biological Center. The dimension of specimens were measured as follows: shell length is the antero-posteriorly longest distance parallel to the base line of the ligament area; shell height is the dorso-ventrally longest distance perpendicular to the base line of ligamental area; and convexity is a depth of single valve, either left or right. The family and generic diagnosis followed Newell (1969).

SYSTEMATIC ACCOUNT

Family Noetiidae Stewart, 1930

Genus *Didimacar* Iredale, 1939

Type species: *Didimacar repenta* Iredale, 1939

Diagnosis: The umbones incurved and almost touching the ligamental area. Teeth placed on gently arched hinge plate. The ligament not diamond shape and opisthodetic. The ligamental area narrow.

***Didimacar tenebrica* (Reeve, 1844)**

(Pl. 1, figs. a–b)

Arca tenebrica Reeve, 1844: pl. 16, fig. 104.

Striarca (Didimacar) tenebrica: Kira, 1965, p. 122,

pl. 43, fig. 8.

Didimacar tenebrica: Oliver, 1985, p. 304, fig. 19; 1986, p. 1076–1094, pls. 1–7, figs. 1–7; Scott, 1994, p. 64, pl. 3B.

Material examined: PMBC 20412, Sai Yai Beach, Prachuab Khirikhan, 08.08.99, 10 shells; PMBC 19964, Chai Talae Village, Surat Thani, 20.02.95, 10 shells; PMBC 20413, Noi Bay, Prachuab Khiri Khan, 22.02.95, 9 shells; PMBC 20414, Chao Laou, Chanthaburi, 08.03.1995, 1 shell; PMBC 19965, Brackish Water Fisheries Station, Chor Bay, Trat, 09.03.95, 8 shells; PMBC 19966, Sadang Beach, Trat, 09.03.95, 10 shells; PMBC 19967, Dhammachart Bay, Trat, 09.03.95, 9 shells.

Description: Shell small, occasionally exceeding 20 mm in length, square or quadrate, well inflated slightly depressed at median part, strongly inequilateral, equivalve. Dorsal margin parallel to ventral margin; postero-dorsal margin rounded; posterior margin obliquely truncated. Umbo prosogyrous, low, closed to anterior end. Outer surface entirely ornamented with fine concentric lines interrupted by radial riblets. Radial riblets comprised two series, primary riblets alternated with secondary riblets. Periostracum short foliaceous, long hair along the interstices of ribs. Ligament entirely opisthodetic, occupying from umbo to posterior end; barely anterior end. Anterior teeth series relatively bigger than posterior teeth series, meeting the posterior series with angulation. Five to nine denticles anteriorly and 26–38 in posterior series. Hinge area very narrow. Inner margin smooth. Interior white, smooth. Adductor muscle scars elongate oval, subisomyarian.

Measurement: (in mm)

	Valve	Length	Width	Convexity	
PMBC 19965	1	L	14.40	10.0	3.70
	2	R	15.95	11.2	4.65
	3	R	13.80	10.0	4.00
	4	L	13.55	10.3	4.05
	5	L	12.25	9.0	3.75
	6	L	15.05	9.7	3.45

Valve	Length	Width	Convexity		
PMBC 19966	1	L	17.90	13.5	4.85
	2	L	15.40	11.2	4.00
	3	L	14.80	10.2	3.70

Distribution: Philippines (Reeve, 1844), Thailand (Lyngø, 1909), Hong Kong (Scott, 1994), Taiwan, Yellow Sea, Bohai Sea, and Japan (Bernard *et al.*, 1993).

Remarks: Outline of this species is similar to *Striarca symmetrica* (Reeve, 1844) but the latter species has a dense periostracum and concentric lines cross the ribs (Kilburn, 1983) and the ligament is amphidetic. Hinge teeth characters of *D. tenebrica* are similar to genus *Noetia* in which the anterior series are distinctly large and the ligament occupies most of the posterior part of hinge. Oliver (1986) discussed systematics and functional morphology of genus *Didimacar* and described the generic details.

Genus *Striarca* Conrad, 1862

Type species: *Arca centenaria* Say, 1824

Diagnosis: Costellate shells with relatively long ligament; inner margin of anterior and posterior adductor scars bordered with raised myophoric flange.

***Striarca symmetrica* (Reeve, 1844)**

(Pl. 1, figs. c–e)

Arca symmetrica Reeve, 1844, pl. 17, fig. 117.

Arca zebuensis Reeve, 1844, pl. 17, fig. 120.

Arca (Fossularca) symmetrica: Prasad, 1932, p. 54.

Striarca (Galactella) symmetrica: Kira, 1965, p. 121, pl. 43, fig. 5.

Striarca afra: Nielsen, 1976, p. 2, fig. 7.

Arcopsis symmetrica: Kilburn, 1983, p. 543–546, fig. 56; Okutani, 2000, p. 854–855, fig. 47.

Striarca symmetrica: Oliver, 1985, p. 283–309, pl. 1a, fig. 19.

Material examined: PMBC 1414, Rawai beach, Phuket, 29.06.76, 2 specimens; PMBC 1415,

Family Noetiidae in Thailand

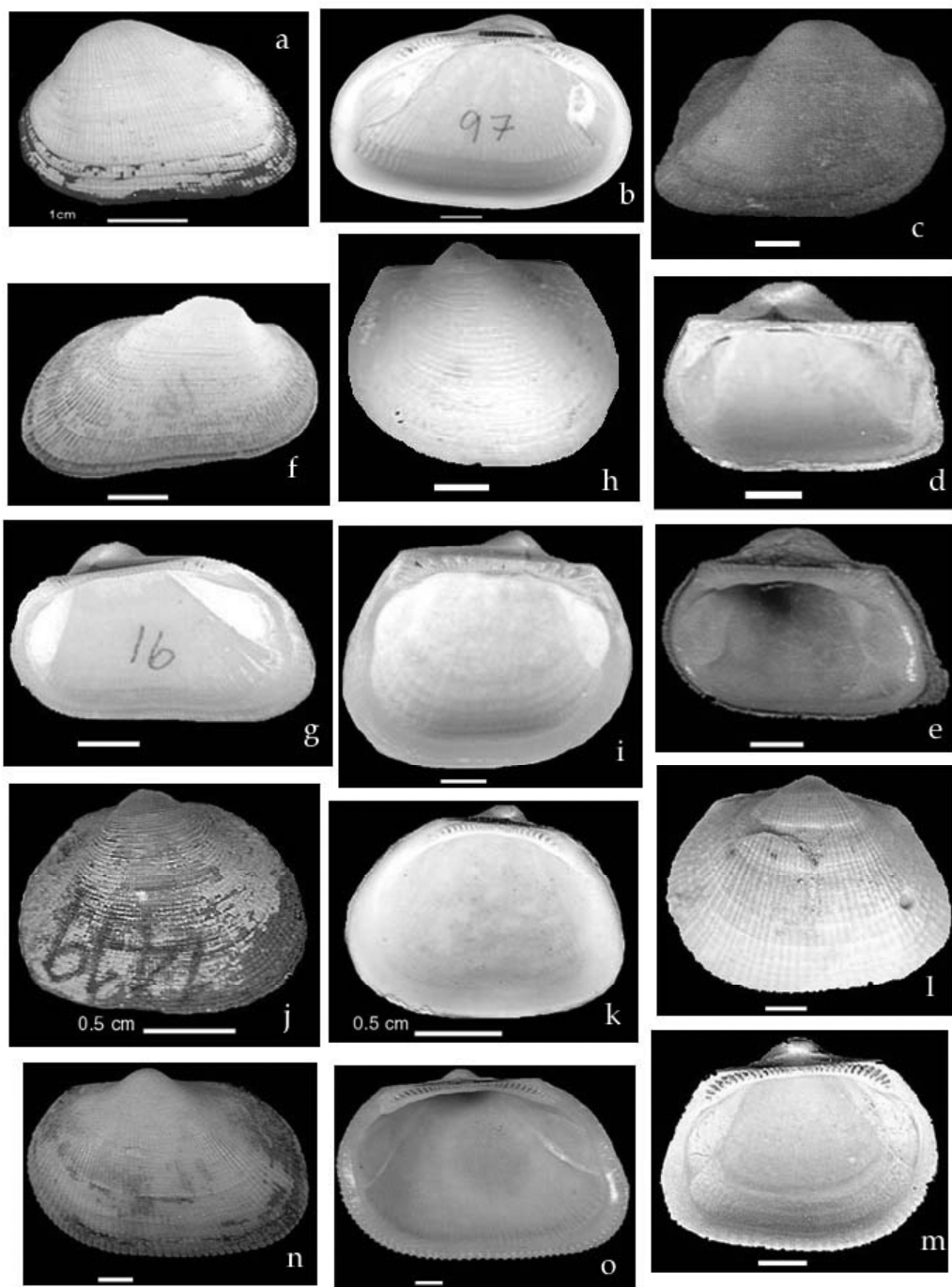


Plate 1. a–b: *Didimacar tenebrica* 17.92 x 13.24 mm, left valve, c–e: *Striarca symmetrica*; c–d: 10.65 x 7.40 mm, right valve, e: 10.30 x 7.10 mm, right valve, f–g: *Striarca* cf. *aceraea* 12.05 x 7.10 mm, right valve, h–i: *Arcopsis polycymoides* 12.36 x 11.10 mm, left valve, j–k: *Verilarca pectunculiformis* 15.65 x 12.35 mm, left valve, l–m: *Verilarca* cf. *mortenseni* 11.50 x 8.84 mm, left valve, n–o: *Verilarca thielei* 19.88 x 14.00 mm, left valve. Scale bar = 1 mm.

Panwa Cape, Phuket, 7.06.76, 7 specimens; PMBC 1416, Nai Yang, Phuket, 4.04.77, 3 specimens; PMBC 1417, Makam Bay, Phuket, 30.06.76, 2 specimens; PMBC 1418, East of Tarutao Island, Satun, 26.03.75, 2 specimens; PMBC 3625, no locality, 23.11.75, 1 specimen; PMBC 20415, Dhammachart Bay, Trat, 09.03.95, 2 shells; PMBC 20416, Panwa Cape, Phuket, 13.06.99, 3 specimens; PMBC 20454, Andaman Sea, 5 specimens, 1 shell; PMBC 20418, 7° N 98° 41' E, 83–81 m, AT, 29.02.00, 4 shells.

Description: Shell small, not exceeding 20 mm in length, square or quadrate, well-inflated, thick, solid, inequilateral, equivalve. Posterior margin obliquely truncated, anterior margin rounded; dorsal margin straight; ventral margin slightly convex at the middle. Byssal gape small and narrow. Shell dirty white. Umbo orthogyrous or slightly prosogyrous, swollen. A sharp carina running from beak to the postero-ventral corner. Prominent brownish periostracum at the postero-ventral part. Outer surface ornamented with low cancellate sculpture. Amphidetic ligament varying from short diamond shape, with wide ligament-free areas anteriorly and posteriorly to relatively long ligament bordered with small ligament-free area. Ligamental area wide and slightly curve upward at the ventral part, making the ligament look like thicker at the ventral part. Hinge plate gently arched; anterior series of hinge teeth continuous to the posterior series. Teeth series 13–19 anteriorly and 16–22 posteriorly. Inner margin slightly serrated. Adductor muscle scars isomyarian, or the posterior scar slightly bigger than anterior one. Myophoric flanges distinct.

Measurement: (in mm)

	Valve	Length	Width	Convexity
PMBC 1414	1 R+L	8.45	5.25	4.90
	2 R+L	8.70	5.15	5.00
PMBC 1415	1 R+L	8.25	5.85	5.65
	2 R+L	8.55	5.15	4.40
	3 R+L	7.30	4.50	4.25*
	4 R+L	6.70	4.40	3.65*
	5 R+L	7.10	4.80	4.35

	Valve	Length	Width	Convexity
	6 R+L	6.95	4.95	3.90*
	7 R+L	6.35	4.00	3.35
PMBC 1416	1 R+L	5.10	3.60	3.30
	2 R+L	5.70	3.50	3.35*
PMBC 1417	1 R+L	8.90	6.20	5.30*
	2 R+L	8.70	5.75	5.05*
PMBC 1418	1 R+L	8.45	5.80	6.55
	2 R+L	7.45	5.65	5.40
PMBC 20418	1 R	12.25	7.50	3.90
	2 R	10.80	7.55	3.60
	3 L	8.55	5.65	2.75
	4 R	11.15	8.15	4.10*
PMBC 20454	1 R+L	10.25	7.00	7.55
	2 R+L	10.35	7.80	7.25
	3 R+L	12.80	10.40	11.70*
	4 R+L	9.40	6.70	6.70*
PMBC 3625	R+L	10.65	7.40	6.45*

(* the specimens with relatively long ligament)

Distribution: Philippines (Reeve, 1844), Japan (Kira, 1965), Hong Kong (Oliver, 1985), Singapore, East China Sea, Australia, Taiwan, Yellow Sea (Bernard *et al.*, 1993), Queensland (Lamprell and Healy, 1998), and Boso Peninsula to tropical western Pacific (Okutani, 2000).

Remarks: This species is distinct in possession of diamond shape ligament with wide ligament-free areas. Kilburn (1983) placed *S. symmetrica* under the genus *Arcopsis*. This species is similar to *S. sculptilis* (Reeve, 1844). Oliver (1985) claimed that Lamy (1900) synonymized *S. sculptilis*, *S. zebuensis* and *S. symmetrica* under *S. afra*, and considered the latter species to have wide distribution from West Africa to East Australia. Reeve (1844) described the first species as having a diamond shaped ligament and very fine soft epidermis but he did not emphasize the ligament character in the latter species. He only explained the wide area of ligament and sculpture. This species is commonly found in the intertidal area, attached to the crevice of rock or dead coral.

Striarca* cf. *aceraea
(Melvill and Standen, 1899)
 (Pl. 1, figs. f–g)

Barbatia (*Acar*) *aceraea* Melvill and Standen, 1899, p. 186, pl. 10, fig. 15.

Mulinarca aceraea: Iredale, 1939, p. 287, pl. 3, figs. 21, 21a.

Striarca (*Mulinarca*) *aceraea*: Oliver, 1985, p. 304–306, fig. 19.

Arcopsis aceraea: Lamprell and Healy, 1998, p. 64–65, sp.103, fig. 104.

Material examined: PMBC 19932, Chai Talae Village, Surat Thani, Thailand, 06.04.00, 3 specimens.

Description: Shell small, about 17.5 mm in shell length, oblong to quadrate, thin. Anterior margin round; posterior margin slightly truncate; ventral margin straight or slightly sinuated. Beak progyrate or slightly orthogyrate. Beak rather small, placed close to the anterior end. Outer surface ornamented with round and fine radial ribs. Interribs narrower than primary ribs. Outer surface covered with light brown periostracum except umbonal area. Ligament amphidetic, posterior ligament narrow but longer than anterior part. Ligamental area rather narrow. Hinge line straight. Teeth series small at the central cardinal area and gradually increasing in size distally. Teeth radiated to the anterior and posterior side. Inner margin smooth. Adductor muscle scars isomyarian.

Measurement: (in mm)

	Valve	Length	Width	Convexity
PMBC 19932	R	12.05	7.10	2.95

Distribution: Torres Straits (Oliver, 1985), and Queensland (Lamprell and Healy, 1998).

Remarks: Only a few valves were collected. The shell is close to *Barbatia tenella* (Reeve, 1844) in the superficial sculpture, however, *Striarca* cf.

aceraea can be separated by the pattern of small ligament beneath the beak. Iredale (1939) gave a good illustration and description of this species but he introduced the species under his new genus *Mulinarca*. Lamprell and Healy (1998) gave the wrong figure number of *Arcopsis aceraea* (Melvill and Standen) with *A. deliciosa* (Iredale, 1939).

Genus *Arcopsis* Koenen, 1885

Type species: *Arca limopsis* Koenen, 1885

Diagnosis: Ligament area narrow and short triangular shape; triangular pit interrupted at the middle of hinge teeth. Beaks slightly opisthogyrate or orthogyrate.

***Arcopsis minabensis* Habe, 1981**
 (Fig. 1)

Arcopsis minabensis Habe, 1981, p. 38–39, pl. 2, fig. 1; Tsuchida, Ikebe and Kitao, 1993, p. 13, pl. 3, figs. 3–4.

Arcopsis polycymoides: Okutani, 2000, p. 854–855, pl. 425, fig. 48.

Material examined: PMBC 19971, 7° 30' N 98°

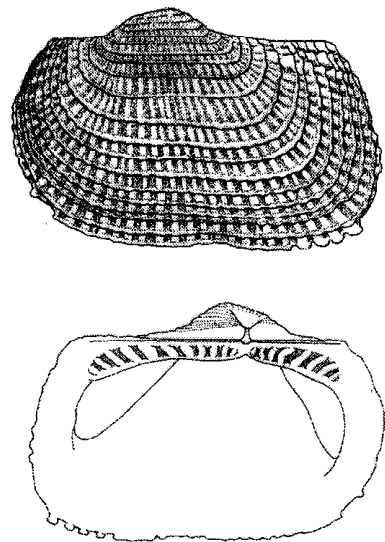


Figure 1. *Arcopsis minabensis*; left valve

01' E, 122–156 m, AT, 16.02.00, 1 specimen; PMBC 19970, 7° 15' N 99° 03' E, 43–40 m, AT, 27.02.00, 7 specimens.

Description: Shell very small, about 7 mm in shell length, delicate, subequilateral. The anterior end rounded; posterior end truncated. Beak prosogyrate and located close to anterior end. Umbo small. Outer surface ornamented with concentric ribs crossed by moderately strong 34–41 radial ribs, which give imbricate appearance. Ligament with distinctly small pit under the beaks. Hinge line rather straight, small notch under umbonal area at the lower part. Anterior and posterior teeth series oblique and bigger distally. Adductor muscle scars calcified, with a low ridge running from beneath the umbo to the muscle scar. Colouration whitish.

Measurement: (in mm)

	Valve	Length	Width	Convexity
PMBC 19970	1 L	5.95	3.85	1.65
	2 L	7.50	4.70	2.10
	3 L	5.75	3.80	1.55

Distribution: Wakayama Prefecture, Japan (Habe, 1981; Okutani, 2000).

Remarks: Except the surface sculpture and ligament pit, the outline of this species is much similar to *Striarca symmetrica*. Small shells may cause confuse in identification.

Arcopsis polycymoides
(Thiele and Jaeckel, 1931)
(Fig. 2; Pl. 1, figs. h–i)

Arca (Fossularca) polycymoides Thiele and Jaeckel, 1931, p. 174, Pl. 1, fig. 8.

Pectunculus ornatus Viader, 1951, p. 130, Pl. 3, figs. 8–9.

Material examined: PMBC 20419, 9° N 97° 31' E, 110–164 m, AT, 02.02.00, 1 specimen; PMBC 19930, 7° 30' N 98° 2' E, 122–137 m, TD, 08.11.99, 1 specimen; PMBC 19931, 7° 30' N 98° 01' E, 120–117 m, TD, 16.02.00, 6 specimens.

Description: Shell thick, small to moderate size, about 12 mm, subquadrate, inflated, inequilateral. Anterior margin rounded, posterior margin wider than anterior one and somewhat truncated; antero-dorsal and postero-dorsal corners sharply angulated. Ventral margin slightly curved. Beak small, rather high, prosogyrate. Sculpture with radial ribs and commarginal ribs giving the small round tubercles appearances. Ligament area narrow, with small vertical pit ligament beneath the beak. Hinge teeth obliquely incline anteriorly and posteriorly. Anterior teeth 8–9 and posterior series 16–21. Inner margin smooth. Outer and inner colouration whitish. Adductor muscle scars rather rounded, equal or slightly subequal.

Measurement: (in mm)

	Valve	Length	Width	Convexity
PMBC 19930	L	12.35	10.80	4.70
PMBC 19931	1 L	11.00	9.25	3.60
	2 L	5.80	4.70	1.75
	3 R	11.90	9.20	3.90
	4 R	9.35	7.70	2.80
	5 R	9.05	7.60	3.10
	6 R	12.55	9.95	4.45
PMBC 20419	L	11.40	6.90	3.50

Distribution: Mauritius (Thiele and Jaeckel, 1931).

Remarks: Only empty shells were found in this study. The species is conspicuous in possessing an inflated shell with distinct concentric lines. The

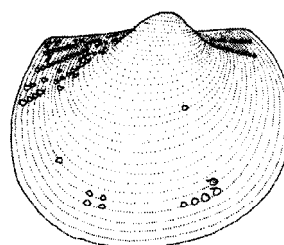


Figure 2. *Arcopsis polycymoides*; right valve

tubercles are not strong and easily removed. The species always possesses a small notch on the hinge line at the umbo position. The figure provided by Thiele and Jaekel (1931) is quite small with no detail for the inner side but the tubercles were clearly demonstrated.

Genus *Verilarca* Iredale, 1939

Type species: *Verilarca bivia* Iredale, 1939

Diagnosis: Shell bilaterally compressed, almost equilateral with plain radial sculptures. Posterior side little produced. Hinge arched. The ligamental covering narrow with broad triangular medial, distinct perpendicular grooves. Hinge teeth arched, decreasing size distally and towards the middle. Muscle scar large, bounded by flanges. The posterior scar more pronounced than the anterior one.

Remarks: *Arca* (*s.l.*) *lamyi* belongs to Arcids. Its sculpture resemble genus *Verilarca* but differs from Noetiids by ligament pattern (pl. 2, figs. p–q).

***Verilarca pectunculiformis* (Dunker, 1866)**
(Pl. 1, figs. j–k)

Arca pectunculiformis: Lamy, 1907, p. 300–301.

Verilarca pectunculiformis: Oliver, 1985, p. 307.

Scelidionarca pectunculiformis: Oliver, 1987, p. 279–288, pls. 26–27.

Material examined: PMBC 1419, Maphroa Island, Phuket, 1 shell, 1 specimen; PMBC 19942, 7° 15' N 99° 03' E, 43–40 m, AT, 27.02.00, 1 shell.

Description: Shell small, maximum size about 16 mm in length, quadrate triangular or trapezoidal, thick and compressed. Anterior margin rounded; ventral margin gently round, posterior margin weakly truncated; dorsal margin short, gently rounded. Low carina running from beak to postero-ventral corner. Beak small, orthogyrate or slightly opisthogyrate. Umbonal area rather smooth. Outer surface ornamented with cancellate sculpture with low, square ribs. Periostracum leaf-like, short,

brownish, firmly covered on the ventral part. No byssal gape. Ligament relatively long, amphidetic, ligament free area located close to the umbo. Hinge plate short, gently curved. Hinge teeth separated by remarkable gap between anterior and posterior series. Inner margin smooth. Adductor muscle scars isomyarian or slightly anisomyarian. Anterior adductor scar slightly bigger than posterior one.

Measurement: (in mm)

		Valve	Length	Width	Convexity
PMBC 1419	1	R+L	15.65	12.35	7.70
	2	R	30.30	22.20	8.15
PMBC 19942	1	L	11.05	7.70	2.70

Distribution: Hong Kong, Karachi (India), Thailand (Oliver, 1985), South China Sea, Hainan and Taiwan (Bernard *et al.*, 1993).

Remarks: Only this species has a slightly opisthogyrate beak. The biggest shell clearly shows the discontinuous dentition, separated the anterior teeth from the posterior teeth by space under the beak. It is hard to observe this character in juvenile shell. Radial riblets seem to be prominent character.

***Verilarca cf. mortenseni* Lyngø, 1909**
(Fig. 3; Pl. 1, figs. l–m)

Arca mortenseni Lyngø, 1909, pp. 24–25, Pl. 2, figs. l–2.

Verilarca sinensis: Oliver, 1985, pp. 283–310, Pl. 3, figs. a–c.

Material examined: PMBC 19951, 8° 15' N 98° 12' E, 36 m, 16.02.98, 5 specimens; PMBC 20420, 8° N 98° 13' E, 20.02.98, 1 specimen; PMBC 19953, 7° 58' N 98° 02' E, 79 m, 20.02.98, 1 specimen; PMBC 19954, 7° 15' N 98° 35' E, 78 m, 23.02.98, 1 specimen; PMBC 19955, 7° N 98° 41' E, 83–81 m, 29.02.00, 4 specimens; PMBC 20421, 7° N 98° 20' E, 108–110 m, 29.02.00, 2 specimens; PMBC 19956, 6° 45' N 99° 21' E, 39–

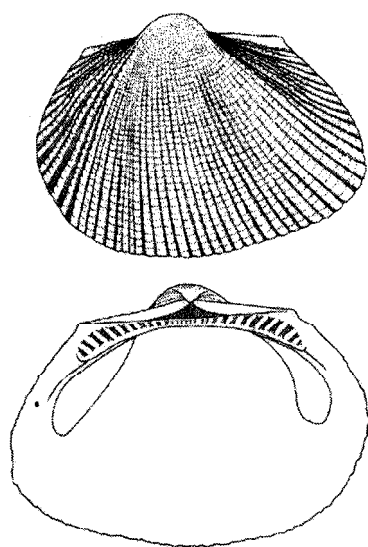


Figure 3. *Verilarca mortenseni*; left valve.

41 m, 28.02.00, 6 specimens; PMBC 19957, 6° 45' N 98° 43' E, 29.02.00, 4 specimens.

Description: Shell quite small, not exceeding 12 mm in length, well-inflated, subquadrate and equilateral. Anterior and posterior margin rounded; ventral margin gently rounded. Beak small, orthogyrate and placed at the middle part of hinge line. Outer surface covered with distinct tubercles wholly. Primary radial riblets alternating with secondary radial riblets. Radial riblets 38–45 in number. Small diamond shape ligament with wide ligament-free area. Hinge plate gently arched. Anterior teeth series with 12–18 denticles and posterior series with 12–19 denticles. Internal ribs close to the hinge line distinct. Inner margin crenulated. Myophoric flanges present. Shell dirty white.

Measurement: (in mm)

	Valve	Length	Width	Convexity	
PMBC 19951	1	L	7.00	5.15	1.85
	2	R	8.80	6.85	2.85
	3	L	8.85	6.65	2.55
	4	R	7.65	5.90	2.10
	5	L	7.95	6.05	2.10

	Valve	Length	Width	Convexity	
PMBC 19953	L	8.65	6.50	2.55	
PMBC 19954	L	8.60	6.35	2.45	
PMBC 19955	1	L	11.50	8.70	3.75
	2	L	8.65	6.55	2.60
	3	L	9.20	6.95	2.85
	4	L	6.80	5.15	2.00
PMBC 19957	1	R	8.90	6.40	2.45
	2	R	8.55	6.55	2.60
	3	L	6.60	5.25	1.85
PMBC 20420	L	6.55	5.25	1.95	
PMBC 20421	L	11.30	8.85	3.90	

Distribution: Thailand (Lyngø, 1909).

Remarks: Small shells of this species are similar to those of *Verilarca thielei*. It differs from *V. thielei* by bearing tubercles along the posterior and anterior carina and more inflated shell. The tubercles at the middle part of outer shell surface are easily worn out.

Verilarca thielei
(Schenk and Reinhart, 1938)
(Pl. 1, figs. n–o)

Striarca thielei Schenk and Reinhart, 1938, p. 306, figs. 1–4, 7, 12.

Verilarca bivia Iredale, 1939, p. 288–289, pl. 3, figs. 23, 23a.

Verilarca thielei: Oliver, 1985, p. 283–310, pl. 3, fig. f.

Arcopsis bivia: Lamprell and Healy, 1998, p. 64–65, fig. 103.

Material examined: PMBC 20422, 9° 30' N 97° 53' E, 59 m, 18.02.98, 1 shell; PMBC 19958, 9° 15' N 97° 42' E, 80 m, 18.02.98, 1 shell; PMBC 20423, 9° N 97° 31' E, 02.02.20, 1 shell; PMBC 20424, 8° 15' N 98° 12' E, 36 m, 16.02.98, 3 shells; PMBC 20425, 8° 15' N 98° 12' E, 59 m, 16.02.98, 1 shell; PMBC 20426, 7° 58' N 98° 02' E, 79 m, 20.02.98, 2 shells; PMBC 20427, 8° 04' N 97° 47'

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E, 173–158 m, 10.02.00, 5 shells; PMBC 20428, 7° 46' N 98° 14' E, 57 m, 20.02.98, 1 shell; PMBC 19959, 7° 30' N 98° 54' E, 43 m, 22.02.98, 19 shells; PMBC 20429, 7° 31' N 98° 30' E, 58 m, 22.02.98, 1 shell; PMBC 20430, 7° 31' N 98° 01' E, 125 m, 16.02.00, 1 shell; PMBC 20431, 7° 15' N 98° 48' E, 63 m, 23.02.98, 22 shells; PMBC 20432, 7° 15' N 98° 35' E, 78 m, 23.02.98, 2 shells; PMBC 19961, 7° N 99° 15' E, 42 m, 24.02.98, 6 shells; PMBC 19962, 7° N 99° 04' E, 55 m, 24.02.98, 5 shells; PMBC 20433, 7° 02' N 98° 49' E, 76 m, 24.02.98, 1 shell; PMBC 19963, 6° 43' N 98° 58' E, 71 m, 25.02.98, 2 shells.

Description: Shell moderately small, attaining 20 mm in length, quadrate or square, bilaterally compressed, equilateral or slightly inequilateral, and equivalve. Anterior margin rounded; posterior margin obliquely subtruncated; dorsal and ventral margin straight, parallel to each other. Beaks orthogyrate, low, amphidetic, placed in the middle of hinge line. Umbonal area rough with nodule-like ornamentations. Outer surface ornamented with fine plain radial ribs, which are about 70–85 in number, and weak growth lines. Thick, filmy, brown periostracum covering the whole shell. Ligament area triangular, long, and narrow. Hinge line straight. Inner colouration white. Thick calcareous adductor muscle scar with myophoric flanges. No byssal gape.

Measurement: (in mm)

	Valve	Length	Width	Convexity
PMBC 19963	L	19.40	14.10	5.30
PMBC 20431	1 R	21.90	15.10	5.40
	2 L	20.30	14.40	4.65
	3 L	17.10	11.50	3.85
	4 R	17.80	12.20	4.10
	5 R	16.75	12.00	3.70
	6 L	19.40	14.25	4.75
	7 R	18.25	12.95	4.70
	8 L	19.40	14.25	4.70
	9 L	21.25	15.45	5.25
	10 L	17.25	11.90	3.85
	11 L	19.25	13.40	4.70
	12 L	19.65	14.15	4.70

	Valve	Length	Width	Convexity
	13 R	16.70	12.00	4.25
	14 R	18.10	12.70	4.50
	15 ?	19.15	13.80	4.15*
	16 L	20.50	14.35	4.65
	17 R	16.90	11.50	3.85
	18 L	19.40	13.35	4.45
	19 L	17.75	12.80	4.10
	20 L	15.95	11.40	3.60
	21 R	16.55	11.35	3.55
	22 L	19.75	13.85	4.85

(* : worn shell)

Distribution: Low Isles (Iredale, 1939), Formosa, Indonesia, Philippines, South China Sea, and Taiwan (Oliver, 1985; Bernard *et al.*, 1993).

Remarks: This species has rather flat shells and prominent crenulations in the inner margin. The shell is rather big compared with other noetiid species in Thailand. Iredale (1939) introduced the new genus *Verilarca* and placed it under the family Arcidae. His diagnosis agreed with the specimen from the Andaman Sea. Oliver (1985) agreed with Iredale (1939) and confirmed the validation of the genus *Verilarca*. However, Bernard *et al.* (1993) decided to include this species in the genus *Striarca*. The ligament in small shells occupies only small triangular area under the beak.

Genus *Estellacar* Iredale, 1939

Type species: *Estellacar saga* Iredale, 1939

Diagnosis: Shell moderate in size, equivalve, inequilateral, elliptical or elongate oval. Anterior area slightly expanded, longer than height. Anterior margin rounded; posterior margin rounded or slightly truncate. No byssal gape or sinus. Umbos low, orthogyrous. Ligament amphidetic with narrow vertical fibrous and lamellar strips. Sculpture of concentric lines crossed by numerous fine radial costellae. Hinge short with small teeth, which are oblique at the anterior and posterior end. Adductor muscle scars subequal, or the anterior scar slightly longer. Inner margin smooth. Periostracum thick, dark brown, fine erect spines at the interstices.

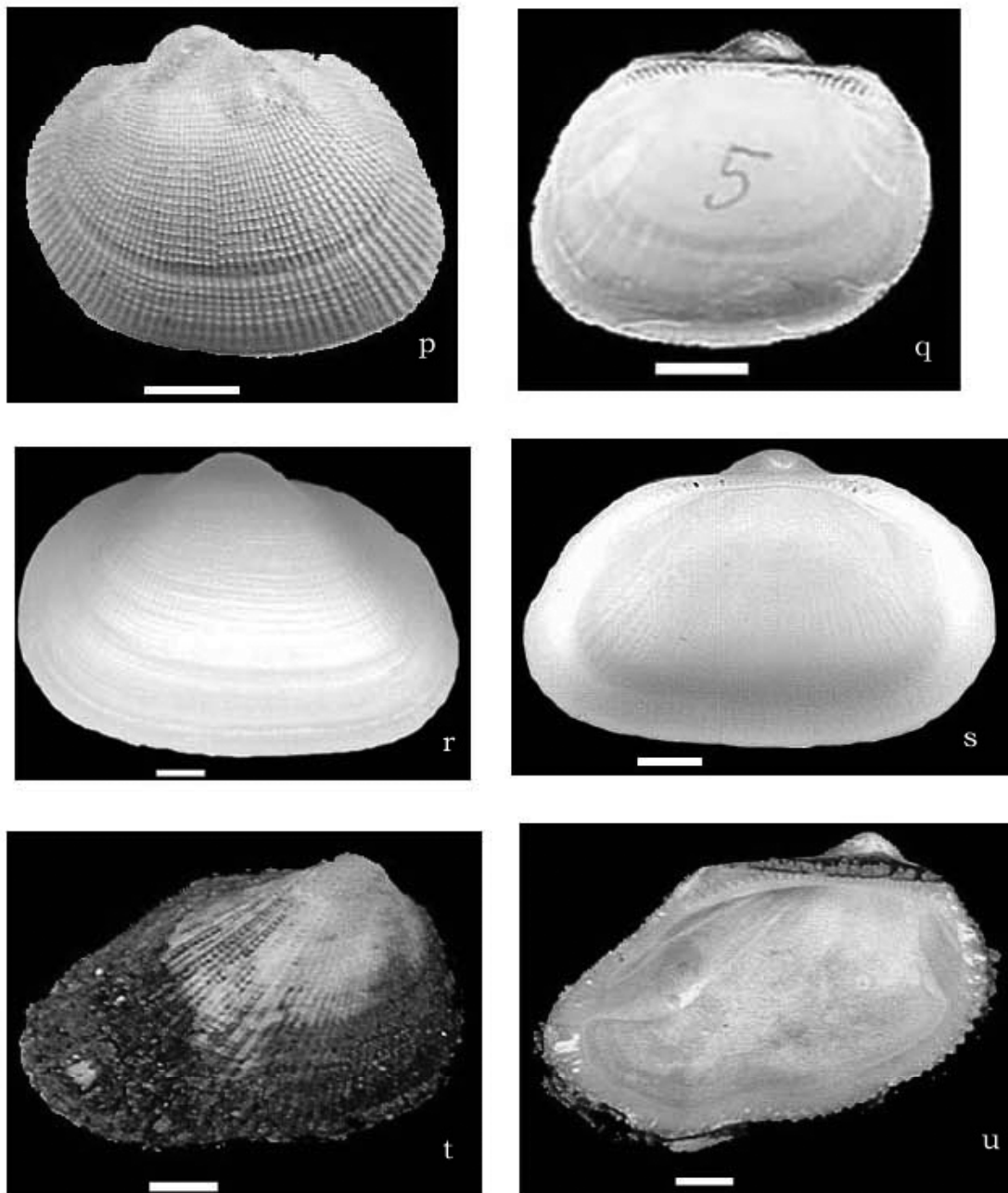


Plate 2. p–q: *Arca (s.l.) lamyi* 10.96 x 8.90 mm, left valve, r–s: *Estellacar olivacea* 11.50 x 10.80 mm, left valve, t–u: *Sheldonella lateralis* 22.16 x 14.40 mm, right and left valve. Scale bar = 1 mm.

***Estellacar olivacea* (Reeve, 1844)**

(Pl. 2, figs. r–s)

Arca olivacea Reeve, 1844: pl. 16, fig. 113.*Estellacar olivacea*: Oliver, 1987, p. 283–285 pl. 27, fig. 2; Carpenter and Niem, 1998, p. 160; Okutani, 2000, p. 854–855, pl. 425, fig. 49.*Striarca olivacea*: Lamprell and Healy, 1998, p. 64, fig. 100.**Material examined:** PMBC 19928, Luang Cape, Phetchaburi, Thailand, 1 specimen.**Description:** Shell moderate, about 18 mm, rather thick, elongate oval, inequilateral. Anterior margin rounded or semicircular; posterior margin slightly truncate; ventral margin straight. Umbo low, small, orthogyrous and placed at the middle of hinge line. Outer surface covered with fine radial riblets crossed with commarginal lines giving the net appearance. Ligamental area narrow, long. Hinge line short and slightly curved downward on both side of hinge. Hinge teeth obliquely radiated. Anterior teeth series with 15 denticles and 19 in posterior series. Adductor muscle scars anisomyarian; anterior adductor scar bigger than posterior one. Inner margin smooth. Colouration whitish.**Measurement:** (in mm)

	Valve	Length	Width	Convexity
PMBC 19928	L	18.40	11.85	4.10

Distribution: San Nicolas, Cebu, Philippines (Reeve, 1844), East China Sea, Taiwan, Japan (Bernard *et al.*, 1993), Southern to Central Queensland (Lamprell and Healy, 1998), and Tokyo Bay to northern Australia (Okutani, 2000).**Remarks:** Only a left valve was found in this study. It lacked periostracum, however, the outline and sculpture establish it is *Estellacar olivacea*.**Genus *Sheldonella* Maury, 1917****Type species:** *Noetia (Sheldonella) maoica* (MacNiel, 1938).**Diagnosis:** Shell elongate, barbatia-like, inequilateral. Umbo swollen, high, prosogyrate to opisthogyrate. Primary, secondary and tertiary costae distinct on the posterior area.***Sheldonella lateralis* (Reeve, 1844)**

(Pl. 2, figs. t–u)

Arca lateralis Reeve, 1844: pl. 17, fig. 115; Lamy, 1907, p. 303–304.*Sheldonella lateralis*: Kilburn, 1983, p. 543, figs. 54–55; Oliver, 1992, p. 40, figs. 2a–2b.*Barbatia cf. martinii* (Recluz, 1852): Scott, 1994, p. 60–62, pl. 2c.*Sheldonella venustopsis* Iredale, 1939, p. 290–291; Lamprell and Healy, 1998, p. 62–63, fig. 99.**Material examined:** PMBC 19943, Fisherman Village, Pakbeer Cape, Phetchaburi, 06.04.00, 20 specimens; PMBC 20434, Cha-um Beach, Phetchaburi, 24.02.95, 4 shells; PMBC 20435, Wanakorn Beach, Prachuab Khiri Khan, 24.02.95, 10 shells; PMBC 20436, Suanson Beach, Rayong, 08.03.95, 1 shell; PMBC 19944, Son Cape, Ranong, 22.03.00, 1 shell; PMBC 20437, Luang Cape, Phetchaburi, 06.04.00, 2 shells; PMBC 19945, 8°15' N 98° 04' E, 59 m, 16.02.98, 1 shell; PMBC 19946, 7° 15' N 98° 48' E, 63 m, 23.02.98, 1 shell; PMBC 19947, 6° 49' N 99° 21' E, 39 m, 24.02.98, 1 shell; PMBC 19948, 8° N 98° 13' E, 46 m, 20.02.98, 1 shell; PMBC 19949, 9° 30' N 97° 53' E, 59 m, 18.02.98, 1 shell; PMBC 20438, 9° 15' N 97° 42' E, 80 m, 18.02.98, 1 shell; PMBC 19950, 7° 51' N 98° 37' E, 21 m, 21.02.98, 1 shell; PMBC 20452, 7° 15' N 98° 35' E, 78 m, TD, 23.02.98, 1 shell; PMBC 20453, 6° 45' N 98° 43' E, 83–84 m, AT, 29.02.00, 1 shell.**Description:** Shell rather big, attaining 20 mm in length, ovate-oblong, inflated, inequilateral,

equivalves. Anterior end rounded and shorter; posterior end expanded with round or semicircular shape. Shell concave at the anterior-median half. Ventral margin with byssal gape. Umbo high, close to anterior end. Beak small, orthogyrous or slightly prosogyrous. Radial ribs and riblets scattered over the whole shell area. Primary radial ribs 34–39 in number, sometime bifurcate at the posterior keel. Whole shell covered with lamellar periostracum. Ligament area narrow. Ligamental area with vertical lamellae. Hinge teeth oblique, 13–17 anteriorly, 19–21 in posterior series. Hinge line short, only half of the ventral margin. Inner margin roughly crenulated. Big calcareous adductor muscle scars distinct.

Measurement: (in mm)

	Valve	Length	Width	Convexity	
PMBC 19943	1	R+L	26.80	17.45	13.90
	2	R+L	34.25	21.45	17.00
	3	R+L	39.00	22.70	16.95
	4	R+L	30.55	19.50	14.65
	5	R+L	21.70	13.00	11.15
	6	R+L	25.60	17.00	12.00
	7	R+L	28.85	16.90	13.50
	8	R+L	36.35	21.80	16.85
	9	R+L	21.20	12.65	11.70
	10	R+L	29.65	17.05	14.70
	11	R+L	33.10	19.55	14.95
PMBC 19945	L	21.10	13.90	5.50	
PMBC 19946	1	R	15.85	10.90	4.20
	2	L	16.60	10.85	5.20
	3	L	15.15	10.70	4.45
	4	L	13.10	9.40	3.55
PMBC 19947	L	16.30	12.25	5.20	
PMBC 19949	L	15.35	11.10	4.35	

	Valve	Length	Width	Convexity	
PMBC 19950	R	13.00	9.40	4.00	
PMBC 20452	L	17.70	12.10	4.65	
PMBC 20453	1	L	27.85	16.00	7.85
	2	R	29.30	18.75	6.75

Distribution: Mozambique, Hong Kong, and Northern Queensland to Northern Territory (Lamprell and Healy, 1998).

Remarks: Scott (1994) identified the Hong Kong shells to *Barbatia cf. martinii* (Recluz, 1852). The illustration of this species in Reeve (1844) is shorter and more globose shape than our specimens. The specimens from Thailand are identical with the shells of Kilburn (1983). This species is widely distributed in the Indian Ocean. Although the specimens from Queensland are identified as *Sheldonella venustopsis* (Iredale, 1939) by Lamprell and Healy (1998), they are coincide with our specimens.

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