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THE GENUS *PERNA* ALONG THE COASTS OF INDIA WITH THE DESCRIPTION OF A NEW SPECIES *PERNA INDICA*

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ABSTRACT

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The green and brown mussels hitherto described from the coasts of India as *Mytilus* have been brought under the genus *Perna*. The green mussel recorded and described as *M. viridis* by earlier workers has been renamed as *P. viridis*. The brown mussel exhibits characters which separate it from the green mussel (*P. viridis*) and hence has been subjected to a detailed study on the basis of which it has been assigned to a new species *P. indica*.

INTRODUCTION

Literature dealing with the taxonomy of the green and brown edible mussels of the Indian coasts shows that these are treated invariably under the genus *Mytilus* (Annandale, 1916; Hornell, 1917, 1921; Gravely, 1941; Paul, 1942; Jones, 1951; Satyamurty, 1956; Kundu, 1965; Menon, Sareen & Tanden, 1966). Extensive collection and study of these mussels from all along the Indian coasts failed to provide a single specimen conforming to the generic characters of *Mytilus*. On the contrary they fully agree with the generic characters of *Perna*. This indicates that the forms occurring along the coasts of India and described hitherto as *Mytilus* are in fact *Perna* and the purpose of the present communication is to bring this important information to the notice of all concerned.

The holotype will be deposited in the Indian Museum, Calcutta, and the paratypes in the Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum.

MATERIAL AND METHODS

For the purpose of generic comparison of *Perna* and *Mytilus*, specimens of the former collected from the Indian coasts (Fig. 11. *P. viridis* and *P. indica*), specimens received from Valvis Bay, South Africa (*P. perna*) and New Zealand (*P. canaliculus*); and those of the latter received from New Foundland, Canada (*M. edulis* and *M. californianus*); Chatham Massachusetts, California (*M. edulis*); Santiago, Chile (*M. chilensis*); Lowestoft, England (*M. edulis*); and New Zealand (*M. edulis*) were examined.

DESCRIPTION OF SPECIES

A close comparative study of the material before us clearly shows that the previous identifications of the different species of the brown and green mussels from Indian waters under *Mytilus* are all erroneous. *Perna* is characterised by the presence of only one or two well developed hinge teeth; the absence of anterior adductor muscle, the wide separation of the two posterior byssal retractors, the recurrent loop of the mid-gut lying at the left lateral side of the stomach and in the separation of the crystalline style-sac from the mid-gut. But in the case of *Mytilus*, the hinge area consists of 4–6 teeth, anterior adductor muscle well developed, posterior byssal retractors of 5–7 muscle bundles which are closely arranged along the dorsal shell margin in front of the posterior adductor, the recurrent loop of the straight intestine lies at the ventral side of the stomach and making a dorsal loop at the region of the oesophagus, and the crystalline style-sac and the mid-gut conjoint (Table 1). *Perna* has a somewhat restricted distribution being confined to the Atlantic coast of South America, African coasts, India, the Philippines and New Zealand whereas *Mytilus* has a universal distribution.

TABLE I

DIAGNOSTIC CHARACTERS SEPARATING GENUS *PERNA* FROM GENUS *MYTILUS*

Diagnostic characters	*Perna*	*Mytilus*
External colour	Green or brown	Green, blue or bluish-green
Shape of the anterior end	Pointed, straight or little down-turned	Pointed, more down-turned
Size of the hinge plate	Small, situated anteriorly	Broad, extends antero-ventrally
Hinge teeth	One or two	Four to six
Resilial ridge	Pitted	Compact
Anterior adductor muscle	Absent	Present
Posterior byssal retractors	Thick, split into two main bundles, widely separated	Thin, six to eight form a single bundle
Course of the pedal retractor before insertion to the shell	Through the antero-medial aspects of posterior retractor	Through antero-lateral aspects of posterior retractor
Course of the recurrent intestine	Through the left lateral side of the stomach	Through the ventral side of the stomach and makes a dorsal loop near oesophagus
Crystalline style-sac and mid-gut	Widely separated	Both conjoint
Colour of ventral mantle margin	Brown or greenish-purple	Brownish-violet or whitish-brown
Incurrent aperture	Opens along the whole ventral surface, walls thick, provided with thick branched tentacles or without tentacles	Opens along the whole ventral surface, walls thick, always provided with long branching tentacles
Excurrent aperture	Opening into the mantle cavity restricted or very wide	Opening into the mantle cavity, very wide

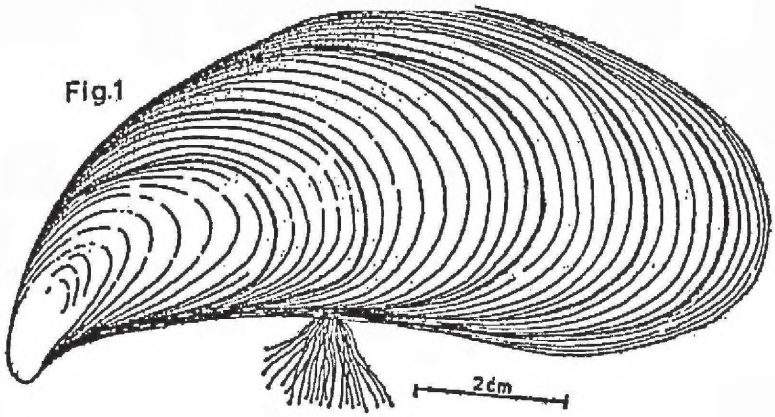
The synonyms, descriptions and nature of distribution of the two species of *Perna* that occur along the east and west coasts of India are presented below.

Perna viridis Linnaeus 1758
Figs. 1–4

Mya perna Linnaeus, 1758, p. 671.
Mytilus (Chloromya) viridis Lynge, 1909, p. 23; Lamy, 1937, p. 139.
Mytilus smaragdinus Annandale, 1916, p. 358; Hornell, 1917, p. 4; Rao, 1941, p. 74.
Mytilus viridis Hornell, 1921, p. 156; Gravely, 1941, p. 35; Paul, 1942, p. 4; Jones, 1951, p. 510; Satyamurti, 1956, p. 42; Kundu, 1965, p. 89; Menon *et al*, 1966, p. 317.

Description

Shell thick, equivalve, inequilateral, elongate, triangularly ovate in outline reaching 173 mm in length and 52 mm in height. Umbos terminal, hinge plate well developed, extending slightly ventrally, provided with two small teeth on the left valve and one large on the right valve. Dorsal ligamental margin curved; mid-dorsal margin arcuate; posterior margin rounded and ventral margin highly concave. Periostracum thick, smooth and shining. Sculpture consisting of irregularly spaced concentric ridges and growth lines. Ligament very thick, internal, extending from the umbo to one third of the dorsal shell margin; resilial ridge thick, white and pitted. External colour beautiful green, but in older specimens bluish-green at the anterior half. Interior of the shell margaritaceous and shining; muscle scars deeply impressed.



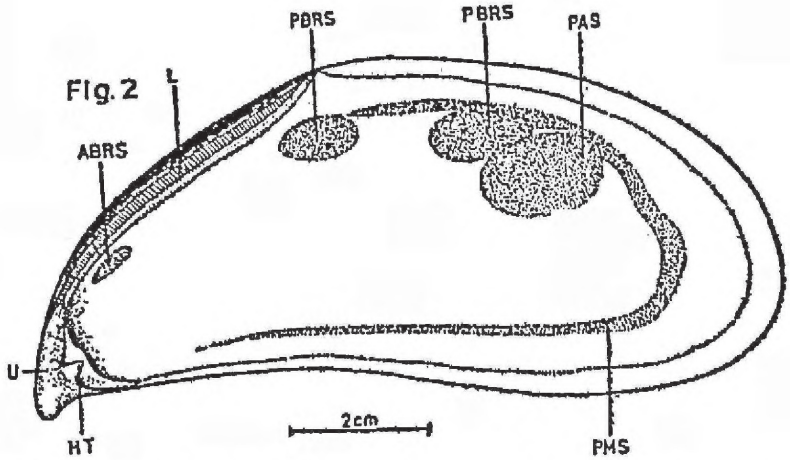
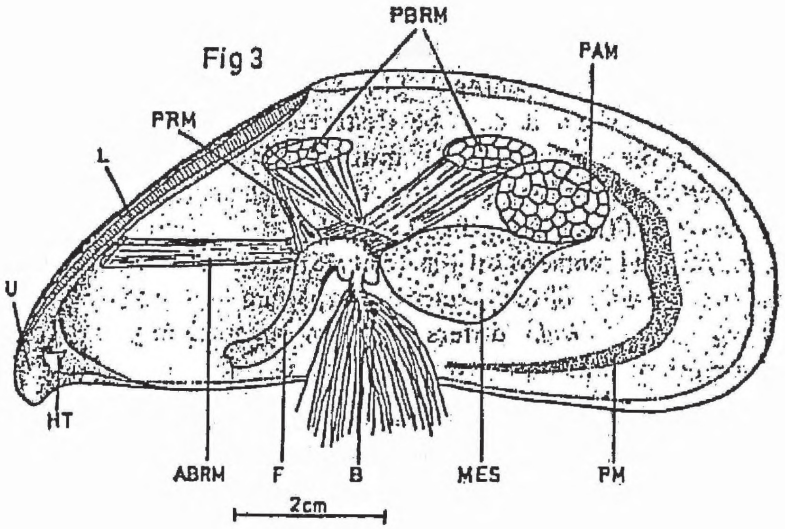


Fig. 1–2 *Perna viridis*. 1. lateral view of the animal ; 2. inner view of the right valve showing muscle impressions, ligament and hinge teeth.



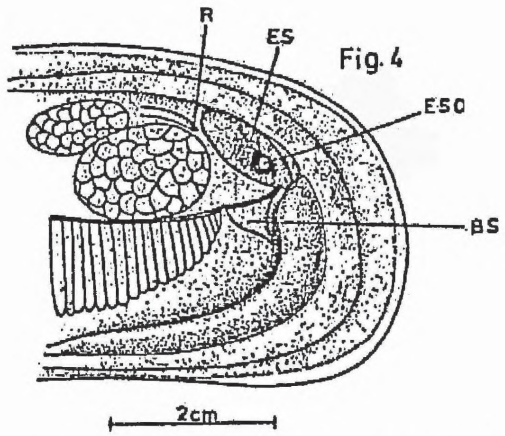


Fig. 3–4. *Perna viridis*. Internal view showing the arrangement of the muscles, foot and byssus apparatus; 4. Internal view of the posterior part of the animal showing the mantle margin and opening of the excurrent aperture into the mantle cavity

Anterior adductor muscle absent. Posterior adductor large, cylindrical, surface silghtly elongate and located in the posterior half of the shell a little above the antero-posterior axis of the body. Anterior byssal retractors cylindrical, thin, elongate, and join the shell a little behind the umbonal cavity posterior byssal retractors arise as a common bundle from the base of the byssus apparatus which splits into two short, thick bundles and diverge in the form of 'V', the anterior bundle inserting the shell below the posterior termination of the ligament and the posterior bundle joining the shell along with the posterior adductor bundle at its antero-dorsal side. Pedal retractor muscle thin, elongate, arises from the base of the foot and inserts the dorsal shell margin after crossing through the anteromesial aspect of the anterior bundle of the posterior retractor. Mid–gut or straight intestine lies at the left lateral side of the stomach: Crystalline style–sac and mid–gut widely separated; the former lying at the left ventral side of the latter. Mantle margins bordering the incurrent aperture thick, the inner fold of the mantle margin smooth, thin, slightly extensible and tentacles or papillae absent.

The mouth of the excurrent aperture oval, wide and the passage into the mantle cavity very small being restricted by a septum; rectum and posterior adductor not visible through the opening. Foot finger-shaped, thick, and extensible. Byssus apparatus large situated at the posterior base of the foot; byssus threads emanate from the byssus stem. The threads are long, thick, strong with a well developed attachment disc at their distal ends.

Material examined

East coast :— Vizhagapatnam, 28 specimens of length range 23–79 mm; Madras, 164 specimens 12–127 mm; Pondicherry, 96 specimens 26–127 mm; Cauddalore, 58 specimens 21–89 mm and Pamban, 18 specimens 32–73 mm.

West coast:— Bombay, 9 specimens of length range 46–97 mm; Goa, 38 specimens 74–173 mm; Mangalore. 163 specimens 4–108 mm; Cannanore, 55 specimens 11–121 mm; Calicut, 93 specimens 17–149 mm; Narakkal (Cochin), 813 specimens 4–123 mm; Alleppey, 26 specimens 5–113 mm; and Quilon, 132 specimens 16–109 mm.

Distribution

Northern Indian Ocean and around the mainland coast of South-East Asia and the Philippines, South Africa and New Zealand (Barry Wilson, 1968, Personal communication,) China and Siam (Lamy, 1937).

Distribution in India

Chilka Lake, Vizhagapatnam, Madras, Pondicherry, Cauddalore, Pamban, Quilon, Alleppey, Cochin, Calicut, Cannanore, Mangalore, Goa, Bombay and Gulf of Kutch (Fig. 5).

Habitat

Perna viridis is usually found in the intertidal zone but may occur to a depth of 10 fathoms, attached to rocks, pilings and other hard objects. The bivalves attach firmly to the substratum by means of byssus threads.

Remarks

P. viridis, the large green mussel found in the Indian waters is readily distinguished from the common brown mussel *P. indica* n. sp. by its beautiful green colour; pointed, down-turned and beak-like anterior end; large and wide hinge plate; presence of two small hinge teeth on the left valve and one large on the right valve; arcuate dorsal shell margin; and lack of tentacles or papillae in the ventral margin bordering the incurrent aperture. The inner lobe of the posterior ventral mantle margin of *P. viridis* is very thin, smooth and slightly extensible and the opening of the excurrent aperture into the mantle cavity is very small restricted by a septum formed by the fusion of the inner lobe of the mantle margins (Table II). *P. indica* n. sp., the brown mussel is characterized by its deep brown colouration; pointed and straight anterior end; small, narrow hinge plate located terminally; a single large tooth on the left valve and a corresponding depression on the right valve with straight dorsal ligamental margin meeting with a hump or mid-dorsal

TABLE II

DIAGNOSTIC CHARACTERS SEPARATING THE SPECIES OF *PERNA*

Diagnostic characters	*Perna viridis*	*Perna indica* n.sp.	*Perna perna*	*Perna canaliculus*
Shape of anterior end	Pointed, beak-like, down-turned	Pointed and straight	Pointed straight	Pointed almost straight or little down-turned
Size of hinge plate	Thick, broad, extends slightly to the ventral border	Thick narrow, terminal	Thin narrow, terminal	Thick broad
Number and size of hinge teeth	Two, small on the left valve and one on the right valve	One large on the left valve a corresponding depression on the right valve	Two small on the left valve and one on the right valve	Two large on the left valve and one on the right valve
Dorsal ligamental margin	Curved	Straight.	Curved	Arcuate
Mid-dorsal shell margin	Arcuate	A distinct dorsal angle or hump present	Arcuate	Arcuate
Ventral shell margin	Highly concave	Almost straight	Convex at the anterior half and concave at the posterior half	Concave
Shell thickness	Very thick	Thick	Very thick	Thick
External colour	Green	Dark brown	Golden brown	Blue or bluish-green
Value or mean length / mean height	1.80	1.91	1.62	1.96
Maximum size (recorded Length)	173 mm	121 mm.	74 mm	230 mm
Mantle margin colour	Yellowish-green	Brown	Straw brown	Blue or bluish-green
Excurrent aperture opening	Mouth oval and wide ; passage into the mantle cavity small ; restricted by septum and rectum and posterior adductor not visible through the opening	Mouth and passage into the mantle cavity are of same width rectum and posterior adductor prominently visible through the opening	Mouth oval, wide, passage into the mantle cavity narrow rectum and posterior adductor not visible through the opening	Mouth wide and oval, passage into mantle cavity restricted, rectum and posterior adductor not visible through the opening
Ventral mantle margin	Inner fold of the posterior ventral mantle margin thin, extensible, smooth tentacles or papillae absent	Inner fold of the posterior mantle margin very thick not extensible ; provided with 18–22 thick branching tentacles	Inner fold of the mantle margin thick provided with 12–16 short tentacles.	Inner fold of the ventral mantle margin thick non-extensible provided with 20–30 long tentacles
Size of the posterior adductor	Large slightly elongated	Large rounded	Small rounded	Large egg-shaped
Posterior byssal retractors	Two, short, thick bundles ; anterior bundle arises from the posterior and diverges in the form of 'V'	Two short thick bundles ; anterior bundle arises from the posterior and diverges in the form of 'V'	Two thin elongate muscles, both arise from a commmon base and run parallel	Two, thick, short bundles, anterior bundle arises from the posterior and diverges in the form of 'V'

angle. The mantle margins bordering the incurrent aperture of *P. indica* are provided with 18–22 branched, thick brown, pigmented tentacles and the opening of the excurrent aperture into the mantle cavity is very wide and oval. The rectum and posterior adductor muscle can be seen through the opening. The closest relative of *P. viridis* is *P. canaliculus* of New Zealand, from which it can be distingulshed by the green flush; absence of tentacles or papillae in the ventral mantle margin bordering the incurrent aperture and the presence of a well developed septum for the small opening of the excurrent aperture into the mantle cavity (Table II) *P. canaliculus* is characterized by the bluish tint; presence of well developed tentacles on the ventral mantle margin bordering the incurrent aperture, further the opening of the excurrent aperture into the mantle cavity is wider than that in *P. viridis*. *P. viridis* differs both morphologically and anatomically from *P. perna* the characters of which are given in Table II.

P. viridis was first described from Indian waters as *M. smaragdinus* by Blanford (1867) based on material collected from the delta of the Iravady. Lamy (1937) described *M. (Chloromya) viridis* from material deposited in the Paris Museum (type collected from Bombay by Roux 1836 and Pondicherry by Belanger, 1828) According to Lamy this species which spread into the Indian Ocean from the Persian Gulf has its shell oval, elongated, arched at summit inclined in front; and covered by a brown periostracum (epidermis) of beautiful green colour. Its interior is whitish due to nacreous iridescence and there are two cardinal teeth on the left valve and one on the right valve. Specimens from both Bombay and Pondicherry collected by us agree well with the descriptions of the external characters given by Lamy Since Soot-Ryen (1955) has established the generic status of *Perna*, Lamy's (1937) *M. (Chloromya) viridis* is referable to *P. viridis*. Hornell (1921), Gravely (1941), Paul (1942), Jones (1951), Satyamurthi (1956), Kundu (1955) and Menon, Sareen and Standen (1966) have described the green mussel as *M. viridis* following Lamy (1937) Their descriptions are very brief and concerned only with the external shell characters.

TABLE III

MEAN WEIGHT AND RATIO OF MEAN LENGTH TO MEAN HEIGHT IN *PERNA VIRIDIS* AND *PERNA INDICA* n.sp.

(Both species collected from Quilon, same locality and same habitat)

	Perna indica n. sp. (*Number in sample*, 185)				*Perna viridis* (*Number in sample*, 126)			
Length group (*cm*)	*Mean length* (*cm*)	*Mean height* (*cm*)	*Mean length* / *Mean height*	*Mean weight* (*gm*)	*Mean length* (*cm*)	*Mean height* (*cm*)	*Mean length* / *Mean height*	*Mean weight* (*gm*)
0.5–1.4	1.12	0.76	1.47	0.72	1.00	0.83	1.25	0.80
1.5–2.4	2.05	1.12	1.53	1.55	1.87	1.33	1.31	1.80
2.5–3.4	3.12	1.78	1.75	2.30	2.85	1.81	1.57	2.70
3.5–4.4	4.12	2.17	1.90	3.30	3.90	2.25	1.73	7.50
4.5–5.4	5.21	5.53	2.05	8.10	5.21	2.80	1.86	10.53
5.5–6.4	5.97	2.70	2.21	13.00	6.20	3.20	1.94	16.20
6.5–7.4	7.10	3.10	2.26	23.00	7.15	3.50	2.04	30.10
7.5–8.4	8.05	3.41	2.40	29.50	8.18	3.88	2.11	42.12
8.5–9.4	9.20	3.60	2.60	47.10	9.25	4.20	3.21	55.56
9.5–10.4	10.40	4.00	2.60	49.52	10.36	3.50	2.53	59.82

Perna indica n. sp.

Figs. 6–10

Description

Shell thick, equivalve, inequilateral, elongate, triangularly ovate in outline reaching 121 mm in length and 48 mm in height. Umbos terminal; umbonal beaks poorly developed, terminal or slightly downturned in adults; hinge plate narrow and thin with a well developed tooth on the left valve fitting into a corresponding depression on the right valve. Dorsal ligamental margin straight; mid-dorsal margin highly angular with a well developed hump where the shell measures the maximum height; posterior margin rounded and the ventral margin straight. Ligament long, thick and internal; resilial ridge white and highly pitted. Periostracum thick, shining; sculpture consisting of concentric ridges and growth lines. External colour dark brown and the interior highly margaritaceous and shining. Muscle scars deeply impressed.

Anterior adductor muscle absent. Posterior adductor muscle rounded, located towards dorsal shell margin at about mid-way between the posterior termination of the ligament and posterior shell margin. Anterior byssal retractors elongate, thin and insert at a little behind the umbonal cavity; posterior retractors arising as a single bundle from the base of the byssus apparatus and split into two thick, short bundles which diverge in the form of a V. The anterior bundle inserts the dorsal shell margin below the posterior termination of the ligament and the posterior bundle inserts the shell together with the posterior adductor at its antero-dorsal side. Mid-gut or straight intestine reaches posteriorly over the posterior adductor and recurrent loop of straight intestine lies at left lateral side of the stomach. Crystalline stylesac and mid-gut widely separated. Mantle margins bordering incurrent aperture very thick non extensible; inner fold of the mantle margins with 18–22 long, stout and brown branching tentacles. Excurrent aperture oval and wide; its mouth and passage into the mantle cavity of uniform width; rectum and posterior adductor muscle prominently seen through the aperture. Foot finger-shaped, byssus apparatus large, located close to the base of foot. Byssus threads emanating from the byssus stem, are elongate and strong, with attachment discs at their distal ends.

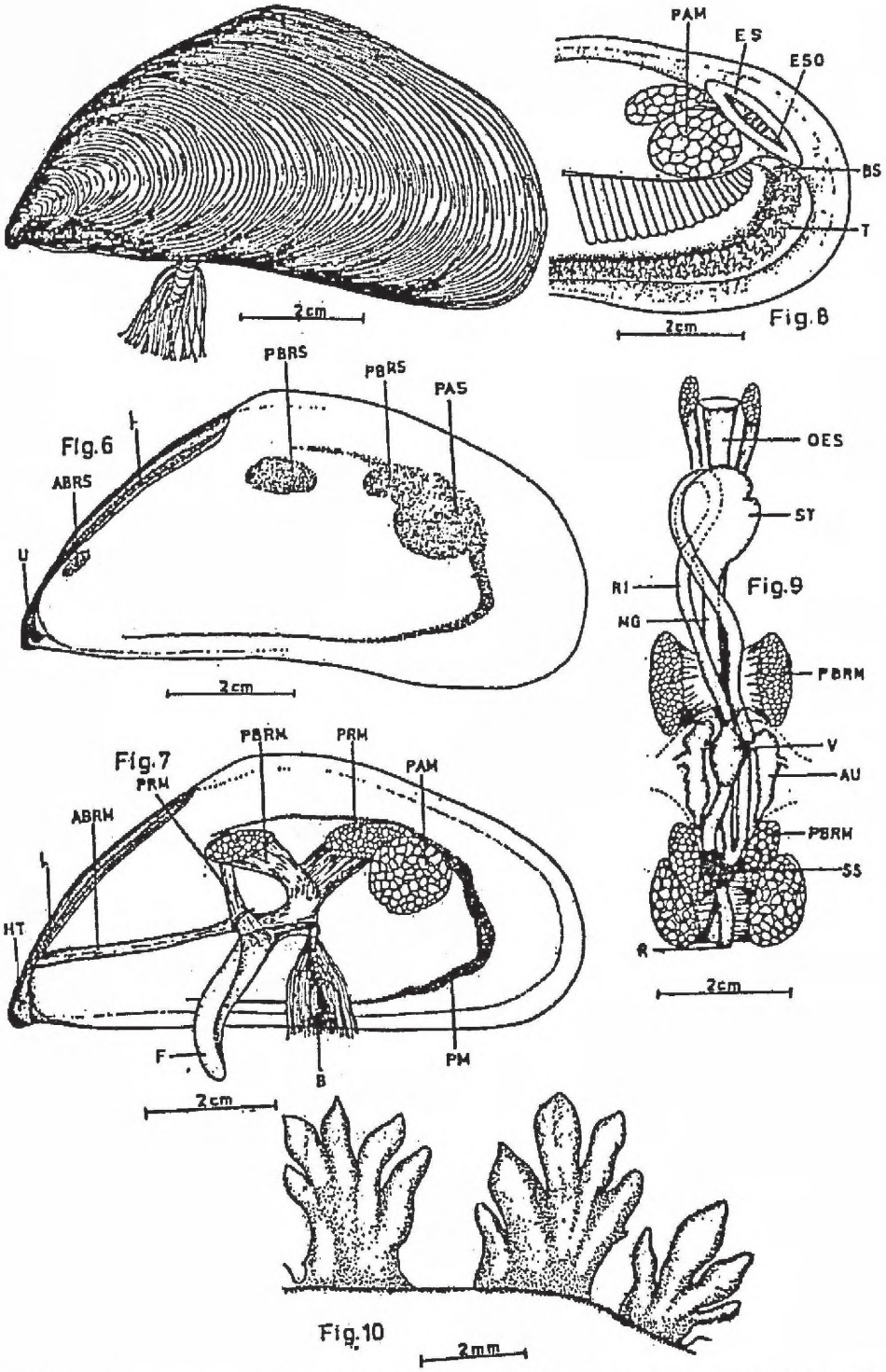
Material examined

East coast:— Pondicherry, 16 specimens 23–52 mm; Cauddalore, 13 specimens 42–75 mm; Pamban, 36 specimens 16–48 mm; Tuticorin, 20 specimens 13–56 mm; Thiruchendur, 53 specimens 28–79 mm, Vijapati, 189 specimens 8–106 mm; and Cape Comorin 24 specimens 14–62 mm in length.

West coast:— Muttom, 92 specimens 16–110 mm; Kolachel, 52 specimens 23–69 mm; Trivandrum, 1690 specimens 3–113 mm; Quilon, 185 specimens 11–107 mm; Alleppey, 13 specimens 36–48 mm; and Cochin, 38 specimens 22–76 mm in length.

Distribution in India

Pondicherry, Cauddalore, Pamban, Tuticorin, Thiruchendur, Vijapati, Cape Comorin, Kolachel, Muttom, Vizhinjam, Kovalam, Trivandrum, Varkeley, Quilon, Alleppey and Cochin (Fig. 11).



Figs. 5–10 : *Perna indica* n.sp. 5. lateral view of the animal ; 6. inner view of the right valve showing the muscle impressions, and ligament; 7. internal view showing the arrangement of muscles, foot and byssus apparatus; 8. internal view of the posterior part of the animal showing the branched tentacles on the ventral mantle margin and the opening of the excurrent aperture into the mantle cavity 9. dissection showing the disposition (dorsal view) of musculature, pericardium, alimentary tract and crystalline style-sac ; 10. enlarged view of the tentacles of the ventral mantle margin.

Fig.11

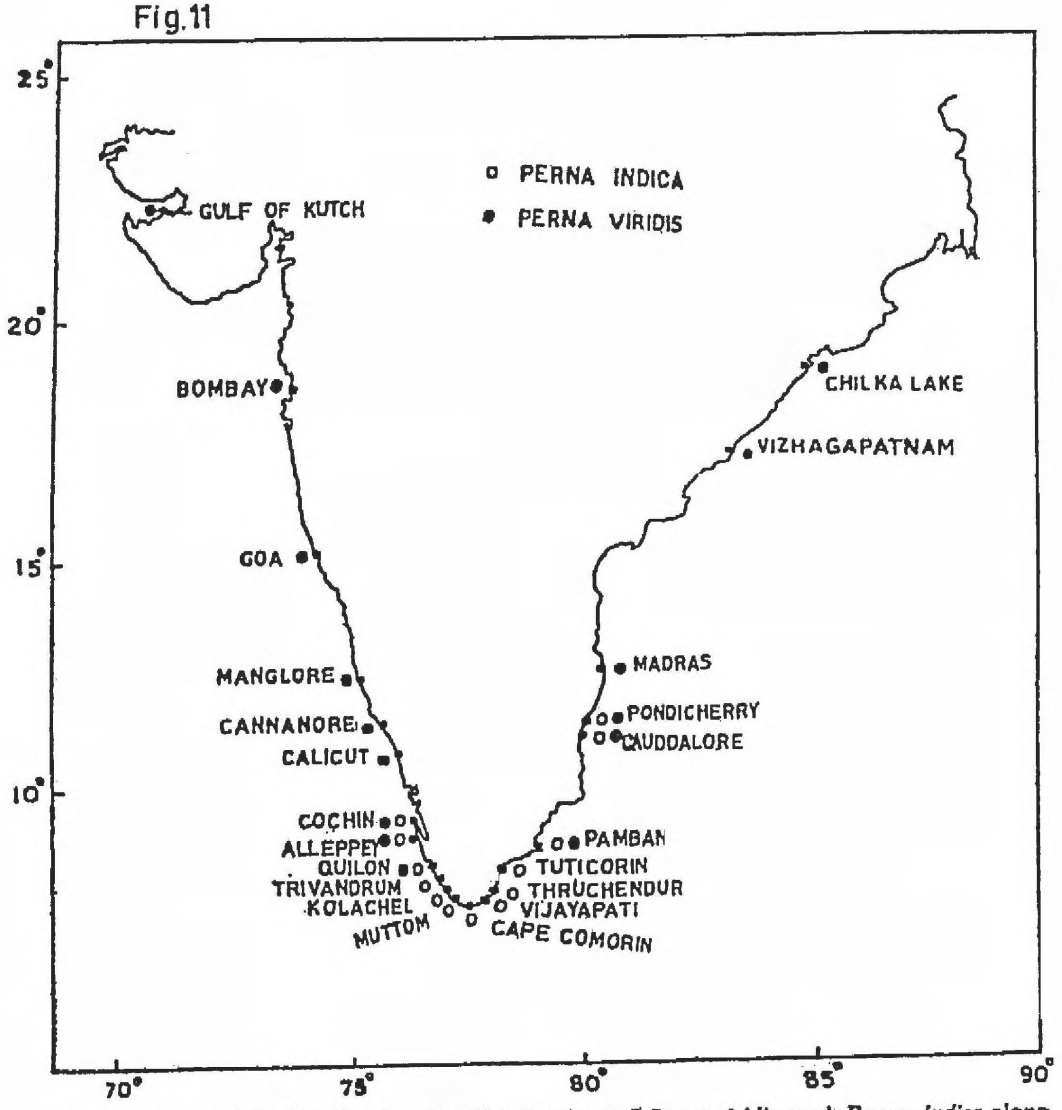


Fig. 11. Map of India showing the distribution of *Perna viridis* and *Perna indica* along the east and west coasts.

Habitat

This species is found along rocky coasts, from intertidal region to a depth of about 10 fathoms. Large sized specimens were collected from 0.5 to 1 metre depth. The mussels attach firmly to the substratum with the help of strong byssus threads.

P. indica n. sp., the common brown mussel of the Indian waters has appearently a restricted distribution. It has been noticed as extensive, thick beds from Tuticorin to Cape Comorin along the east coast and from Cape Comorin to Alleppey along the West coast. This species is readily distinguished from *P. viridis*, the common green mussel, by its dark brown colour; pointed, almost straight and terminal umbos; very small, narrow and terminal hinge plate; straight dorsal ligamental margin; well developed hump or dorsal angle in the mid-dorsal shell margin; presence of a single large tooth on the right valve; straight ventral shell margin, thick ventral mantle margins bordering the incurrent aperture and provided with 18–22 long, branching, stout tentacles. The opening of the excurrent aperture into the mantle cavity is oval and very wide. The rectum and posterior adductor

muscle are distinctly visible through the opening from outside The ratio of mean length / mean height of *P. indica* and *P. viridis* is 1.8:1.91 respectively. *P. viridis* reaches a maximum length of 173 mm while *P. indica* attains only about 121 mm (maximum recorded length). The mean weight and ratio of mean length by mean height of *P. indica* and *P. viridis* collected from the same locality and same habitat are given in Table III. In external colouration and shape *P. indica* is closely related to *P. perna* of Valvis Bay, South Africa. But the former species differs from the latter in many morphological and anatomical characters, details of which are given in Table II.

REFERENCES

Annandale, N. 1916. Fauna of Chilka Lake. *Mem. Ind. Mus.* 5 : 350–360

Blanford, W. T. 1867. Contributions to Indian Malacology; No. VIII List of estuary shells collected in the delta of Iravady in Pegu, with descriptions of the new species. *J. Asiat. Soc. Bengal.* 33 : 51–72.

Gravely, F. H. 1941. Shells and other animal remains found on the Madras beach. Part I. Groups other than snails, etc. Mollusca Gastropoda. *Bull. Madras Govt. Mus.* 5 : 35–37.

Hornell, J. 1917. The edible molluscs of the Madras Presidency. *Madras Fish. Bull.* 11 : 1–51.

Hornell, J. 1921. Indian molluscs, Lamellibranchia. *J. Bombay Nat. Hist. Soc.* 19 : 50–52.

Jones, S. 1951. Observations on the bionomics and fishery of the brown mussel (*Mytilus* sp.) of the Cape region of Peninsular India. *J. Bombay Nat. Hist. Soc.* 49 : 519–528.

Kundu, H. L. 1965. On the marine fauna of Gulf of Kutch. Part III. Pelecypods. *J. Bombay Nat. His. Soc.* 62 : 84–103.

Lamy, E. 1937. Revision des Mytilidae Vivantes du Museum National d Histoire Naturelle de Paris. *Journ. de Conchyl.* 80 : 5–71, 99–132, 169–197.

Linnaeus, C. 1758. *Systema Naturae* ed. 10 : 671.

Lynge, H. 1909. Danish Expedition to Siam 1899–1900 IV. Marine Lamellibranchiata. *Mem. Acad R. Sc. Lett. Denemark.* 5 : 23.

Menon, Sareen and Tandon. 1966. On the marine fauna of Goa. A preliminary survey Part I. Mollusca–Pelecypoda. *Research Bull. (N. S.) Punjab Univ.* 18 : 317.

Paul, M. D. 1942. Studies on the growth and breeding of certain sedentary organisms in the Madras Harbour. *Proc. Ind. Acad. Sci.* 15 : 1–10.

Preston H. B. 1916b. Report of a small collection of marine Mollusca dredged in shallow water in the Andaman Islands. *Rec. Indian Mus.* 12 : 93.

Rao H. S. 1941. Indian shell fish and their fisheries. *Sci. Cult.* 7 : 69–78.

Satyamurti, S. T. 1956. The mollusca of Krusadi Island (in Gulf of Mannar) II. Scaphopoda, Pelecypoda and Cephalopoda. *Bull. Madras Govt. Mus., New Ser.* 1 : 1–202.

Soot-Ryen, T. 1955. A report on the family Mytilidae. *Allan Hancock Pacific Expeditions.* 20 : 1–154, Pls. 1–10; Figs. 1–78.

Wilson, B .R. 1967. A new generic name for three recent and one fossil species of Mytilidae (Mollusca : Bivalvia) in Southern Australia, with redescriptions of the species. *Proc. malac. Soc. Lond.* 37 : 279–295.