

MANGROVE ECOSYSTEMS

**A MANUAL FOR THE ASSESSMENT
OF BIODIVERSITY**

**A follow up of the
National Agricultural Technology Project
(NATP.), ICAR.**

*Mangrove Ecosystem Biodiversity :
Its Influence on the Natural Recruitment of
Selected Commercially Important Finfish and Shellfish
Species in Fisheries*

Edited by :
Dr. George J. Parayannilam



Central Marine Fisheries Research Institute
(Indian Council of Agricultural Research)
P.B. No. 1603, Ernakulam North P.O; Cochin – 682 018, Kerala, India







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A Manual for the Assessment of Biodiversity

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Molluscs

Gurudas Chakravarty, Sunirmal Giri, S. K. Chakraborty, S. Dam Roy and Ansy Mathew

Molluscs constitute a major group in the animal kingdom. In number of species, the mollusca is the second largest phylum after arthropoda. About 1,00,000 living species of molluscs are reported to be occurring in the world. They occupy almost all possible habitats - marine, brackish water, freshwater, land and also arboreal in some groups. India harbours an approximate total of 3,271 species of molluscs spread over nearly 591 genera and 220 families (Mitra and Dey, 1992). On the other hand, a checklist of molluscs of Indian estuaries includes a total of 245 species (120 gastropods and 125 bivalvs) [Subba Rao and Surya Rao, 1985]. They play a significant role in maintaining the steady state of the mangrove ecosystem and enhance its biological potentiality. Molluscs constitute an important faunal component in the food web of any estuarine-marine coastal environment. Previously several taxonomic and ecological survey of estuarine-marine molluscs of India was conducted by several workers (Banford, 1867; Annandale and Kemp, 1916; Annandale and Prasad, 1919; Subba Rao *et al.*, 1983; Subba Rao *et al.*, 1992, Khalua *et al.*, 2003). The present study deals with the taxonomic survey (34 species, 24 genera, 22 families and 9 orders) of intertidal macrobenthic molluscs.

Phylum - Mollusca

Soft and unsegmented body in the adult stage; the visceral mass is enclosed by a thick muscular fold of the body wall, called *mantle*; a special structure named *radula* is present in most forms to assist in feeding; presence of ventral *muscular foot*.

Class - Gastropoda

Foot large and flat; well developed head with eyes and tentacles; radula present; torsion (coiling) of body mass at some time in development; shell present or absent, univalve and usually coiled.

Class - Bivalvia

Body enclosed in a bivalve shell and laterally compressed; head is indistinct; foot is tongue shaped; mouth is provided with two pairs of labial palps.

Class - Cephalopoda

Dorsoventrally elongated body; shell external or internal or absent; head distinct and large with well developed eyes, foot is modified as tentacles and siphon; Radula present.

Order - Archaeogastropoda

Presence of two bipectinate gills; two osphradia and single kidney; nervous system lacks pedal nerve cords.

Order - Mesogastropoda

Siphon, operculum and penis are present; single auricle, single monopectinate gill, single osphradium and single kidney are present; nervous system lacks pedal nerve cords.

Order - Neogastropoda

Siphonal canal is much elongated; Radula is usually *rachiglossate* type [i.e. the teeth on the radular rows are bilaterally arranged with a median (*rachidian*) tooth and lateral and marginal teeth on two sides].

Order - Basomatophora

The eyes are located at the base of the non-retractile tentacles.

Order - Soleolifera

Slug-like shell-less bodies; single pulmonary sac; anus and female gonopore are situated at the posterior side while the male genital aperture is located at the anterior end.

Order - Arcoida

Well developed shell; straight hinge; adductor muscle scar small and sometime without myophoric ridge.

Order - Pterioida

Gills are splited; Interfilamentar and inter lamellar junctions are present and are nonvascular; a single large adducter muscle is present.

Order - Veneroida

Gill filaments fused; adductor muscles two and of equal size; gills serve to capture food.

Order - Sepioida

Internal shell present; ten oral arms with stalked suckers.

Diagnostic characters of different families**1. Class - Gastropoda:****Family - Naticidae**

Animal covered with spirally coiled univalve shell; shell globose, body whorle large, aperture moderate; spine reduced ; umbilicus present, completely filled by a callous, some times exposed as concentric depression; collumella not flattened.

Family - Neritidae

Univalve globose shell spirally coiled; umbilicus absent; columellar margins richly callous and flattened.

Family - Trochidae

Shell cone shaped, brightly coloured, internally nacreous; not attached with foreign bodies; umbilicus small or absent.

Family - Littorinidae

Shell not turreted but terminate, solid with horny epidermis; aperture subcircular; anterior canal absent; operculum present.

Family - Assimnidae

Shell not turreted, ovately conical, sub-globose with horny epidermis; aperture ovate.

Family - Architectonidae

Shell globose or elongated, cone shaped with flattened base whorls; aperture small oblique; umbilicus large, margin dentate.

Family - Potamididae

Shell elongate, without a distinct notch towards the posterior end; spire less than twice of the body whorl; columella twisted; Anterior canal present.

Family -Epitoniidae

Shell less elongate, turreted; body with definite, prominent sculpture; anterior canal absent.

Family - Melongenidae

Shell pear shaped, without continuous varices; upper part of body whorl smooth; anterior canal wide.

Family - Nassariidae

Shell pyriform; suture not deep; columella not twisted; sculpture with axial ribs; aperture wide.

Family - Olividae

Shell glossy and brightly coloured; aperture narrow elongated; operculum absent; spire elongate.

Family - Ellobidae

Shell less elongate, without operculum; anterior canal absent; columella with teeth.

Family - Lymnaeidae

Shell elongate, with a distinct spire and without operculum; columellar axis typically twisted.

Family - Onchididae

Shell absent; dorsal integument of the body very hard, surface beset with numerous hard protuberances giving tufted appearance; mantle with small eyes scattered on its surface.

2. Class - Bivalvia**Family - Arcidae**

Shell well developed and encloses the entire animal; radiately striated or ribbed; hinge straight, scarcely arched; teeth arranged in straight line; ligamental pit absent; muscle scar without myophoric ridge or shelf.

Family- Mytilidae

Shell comparatively small (upto 60mm), mytiliform; ventral margin without any gap; ligament without nodules; anterior adductor muscle scar reduced or absent.

Family - Ostreidae

Shell strong, very thick; right valve without any foramen; ligament with modules; shell attached to

substratum with one valve; anterior adductor muscle scar reduced or absent.

Family - Solenidae

Shell with one hinge teeth, straight, margins parallel; anterior adductor muscle scar well developed; hinge teeth also well developed and differentiated.

Family - Donacidae

Shell without posterior flexure; cardinal teeth two in either valve, tending to bifid; pallial line connected to adductor muscle; scar by distinct pallial sinus; radial striae present at least as marginal crenulations.

Family - Gluconomidae

Shell elongate, thin with periostracum; lateral teeth absent.

3. Class - Cephalopoda

Family - Sepiidae

Cephalopoda with eight arms; suckers sessile, no horny rings; tentacles retractile to pockets; internal shell calcified, body wide.

Diagnostic characters of different species:

1. *Nerita articulata* Gould, 1847

Shell semiglobular with numerous growth striae, semicircles and crossed by finer spiral lines; whorls one to one and half; spire represented by elevated portion of the body whorls, obliquely turned in words; aperture crescent shaped; columellar callous well developed.

2. *Neritina smithi* Wood, 1828.

Shell oval, longer than broad, solid, white or dull brown with strong black, longitudinal, undulating and interrupted lines and bands, rarely with very fine, wavy and close set black lines, aperture broad, semilunar, columellar callous small and smooth; operculum semicircular; shell with distinct elevated spire.

3. *Neritina (Dostia) violacea* (Gmelin, 1791).

Shell ovate with the spire quite hidden by the body whorl; dorsoventrally flattened; spire minute, periostracum yellowish-brown.

4. *Umbonium vestiarium* (Linnaeus, 1758).

Shell button-shaped, spire depressed, umbilicus closed, highly polished and brightly coloured with smooth shell.

4. *Littorina (Littorinopsis) melanostoma* Gray, 1839.

Shell attenuated and conical, imperforate, yellowish white, punctate to elongate - rhomidal brown markings located between the spiral striae, sculptured with shallow incised spiral striae and fine oblique axial lines of growth.

5. *L. (Littorinopsis) scabra scabra* (Linnaeus, 1758).

Shell upto 43 mm in length, solid, with variable colour patterns, generally dark, violet grey to reddish brown, nodules white, columella reddish brown; sculptured with spiral cords and a row of small nodules on the penultimate whorl; presence of spiral cords and axial growth lines; aperture with many fine lines and spotted with brown spots inside and outside.

6. *Littorina (Littoraria) undulata* Gray, 1839.

Shell ornamented like marbled with brown spot; yellowish or cream in colour; sculptured thickened.

7. *Assiminea brevicula* (Pfeiffer, 1854)

Shell globose, with bright brick red or yellowish tan and with 6-7 whorls, sutures sharp, operculum conous, thin and elongated.

8. *Assiminea francessiae* (Wood, 1828)

Shell thin, elongately ovate, spire elongate, body whorls with number of ridges and reddish bands running across and with 6-8 whorls, aperture sub-circular.

9. *Architectonica perspectiva* (Linnaeus, 1755)

Shell thick, broad with flattened base and depressed conical spire; whorls inflated and perfectly straight; each whorl with distinct rib at the lower edge; bodywhorl sharply angular.

10. *Telescopium (Telescopium) telescopium* (Linnaeus, 1758)

Shell broadly elongate; whorls sculptured with spiral ribs; body whorls without varix; columella twisted, trochoid shaped, elevated and conical; labial lip actually curved.

11. *Cerithidea (Cerithideopsis) cingulata* (Gmelin, 1791)

Shell narrowly elongate, spire on many whorles, whorles sculptured with both spiral and axial ribs. Body whorl with varix, collumella not twisted,

- aperture oblique and outer lip expanded broadly with distinct anterior canal.
12. *Cerithidea obtusa* (Lamarck,1822)
Robust shell, aperture broadly rounded with thick and flattened outer lip; sculpture with spiral threads crossed by prominent transpiral ridges
 13. *Acrilla acuminata* (Sowerby,1844)
Shell elongate, torted, spire with ten whorls; body whorl with prominent keel at base; sculptured with numerous spine vertical; aperture obliquely ovate.
 14. *Natica tigrina* (Roeding,1798)
Shell globose, umbilicated, spire conically exerted, whorls rounded; columellar callous very thick especially at its base; aperture lunar-ovate ; colour white to cream, dotted all over with close - set purple-brown spots, dots generally arranged in a regular spiral line and occasionally they coalesce with these of adjacent lines.
 15. *Natica vitellus* (Linnaeus,1758)
Globose, thick, excavated umbilicated with inflated body whorls; whorls rounded , spire low ; body whorl with pale broad light band in middle and whitish on the base and sutures.
 16. *Pugilina cochlidium* (Linnaeus,1758)
Shell large and pear shaped; spire high and acute; whorls large and angulated; shoulder with tubercles; aperture ovately elongate; smooth columella, light brown in colour; shell covered with dark brown periostracum.
 17. *Nassarius foveolatus* (Reeve , 1853)
Surface of the shells smooth, sculptured restricted to spiral whorls only, suture channeled, shell ovate, spire sharp, elongated and outerly varicose; colour of shell dull white with steel bluish tinge.
 18. *N. stolatus* (Gmelin, 1790)
Shell ovately conical, acuminate, rather smooth, with chocolate or brown bands on the body; whorls convex, spire sharp, sculptured with slender axial ribs which become obsolete on the central area on the back of last whorl, interstices obscurely fine and cancellate; columella calloused, not expanded; outer lip thick and slightly varicose.
 19. *Amalda ampla* (Gmelin,1791)
Shell elongate, slender, smooth and polished, shells whitish or rusty brown, spire elevated.
 20. *Anadara granosa* (Linnaeus,1758)
Equivalve shell, orbicularly ovate, sculptured radiately ribbed, tuberculately crenulated.
 21. *Ellobium (Auricula) gangeticum* Pfeiffer, 1855
Shell fusiformly ovate, curved with straw coloured epidermis; spire short; whorls tumid; aperture slightly expanded below; columella with two plates, peristome straight.
 22. *Lymnaea (Pseudosuccinea) luteola f. typica* (Lamarck,1822)
Shell less inflated, thin and glossy, relatively smaller and laterally compressed; spire gradually tapering and aperture narrow.
 23. *Onchidium tenerum* Stoliczka, 1869
Body oval, more or less elongated at the time of movement, soft, pulpy; mantle greenish-grey and with dark granular spots; eyes black and centrally situated in transverse fold; eye pedicles stout at the base with distinct swollen, granular tips; pulmonary orifice is situated at the posterior end of the mantle.
 24. *O. tigrinum* Stoliczka, 1869.
Body large, ovate with strong coriaceous, hard mantle; upper surface with small granules enclosed between large tubercles; each with a jet black dot at the tip; pale greenish with blackish irregular spots; foot broad and extended upto the mantle; head and pedicles dark green; the pedicle thick at the base, thin in the middle, and slightly thickened tip which bear black eyes at upper surface.
 25. *Modiolus striatulus* (Hanley,1844)
Shell deep colour; ventral margin more depressed in the middle, sculptured with radiating ridges prominent and present on half of the body.
 26. *Modiolus undulatus* (Dunker, 1856)
Shell gibbous, oblong, thin, rather inequivalve; umbo not so prominent, anteriorly situated; Yellowish brown.
 27. *Crassostrea gryphoides* (Schlotheim, 1813)
Shell stout, bulky, elongated and irregular shape;

Inner margin pearly white; cavity beneath the hinge well marked; muscle scar broad and more or less oblong striations on the muscle scar.

28. *Crassostrea madra sensis* (preston 1916)

Shell straight, shape irregular, covered by numerous foliaceous laminae, left valve deep, right slightly concave, hinge narrow and elongated, adductor scar sub-central, reniform and dark purple in colour. A brackish water oyster. Shape varies with nature of substratum, flat rocky surface - shape round, soft mud - long and narrow uneven surfaces - shapes conform to that of the substratum.

29. *Saccostrea cucullata* (Born, 1778)

Shell with unequal valves, trigonal, some times oblong, extremely hard left valve thicker and larger than the right valve, outer margin with a number of folds which interlock with each other. Shell usually gray-white in colour with purple tinge towards the margin.

30. *Solen brevis* Gray, 1842

Shell almost straight with flattened tapering posterior end; posterior margin narrow; anterior margin broad abruptly truncated; sculpture with prominent growth lines.

31. *Donax (Latona) incarnatus* Gmelin, 1791.

Shell compressed, triangular, variously coloured, posterior margin short and serrated, anterior margin rounded, ventral margin convex.

32. *Meretrix meretrix* (Linnaeus, 1758)

Shell ventricose, highly variable in shape and colour, hinge narrow, posterior lateral tooth finely striated, anterior cardinal on left valve.

33. *Gluconome sculpta* (Sowerby, 1828)

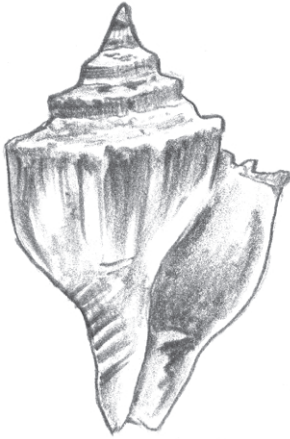
Shell elongately-oblong, anterior end short and angularly attenuated posterior end; sculptured with fine concentric striae and growth lines but eroded at the umbonal region; colour of the shell ranges from light greenish straw to white.

34. *Sepia aculeata* d'Orbigny, 1848

Tentacular suckers small, subequal and arranged in 12 longitudinal rows; proximal end of left ventral arm is hectocotylised with 3 rows of normal suckers and 5-6 rows of minute suckers.

Suggested References

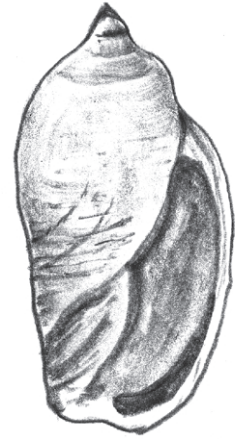
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Pugilina cochlidium



Nassarius foveolatus



Amalda ampla



Dorsal view



Ventral view

Onchidium tenerum



Dorsal view

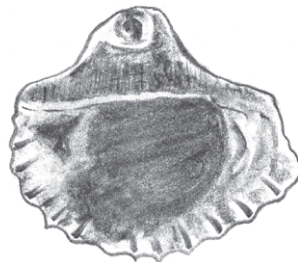


Ventral view

Onchidium tigrinum



Dorsal view



Ventral view

Anadara granosa



Dorsal view

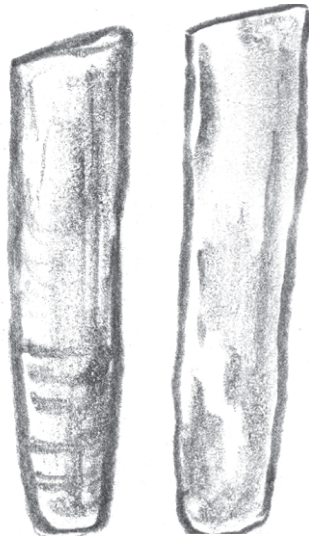


Ventral view

Meretrix meretrix



Crassostrea gryphoides

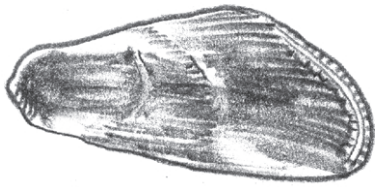


Solen brevis



Saccostrea cucullata

Pencil drawing

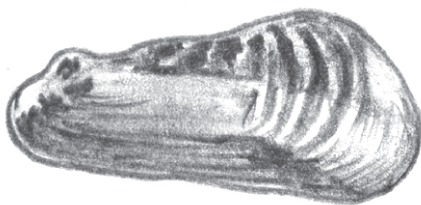


Dorsal view

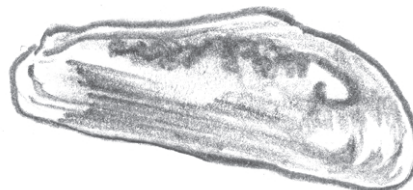


Ventral view

Modilus striatulus



Dorsal view

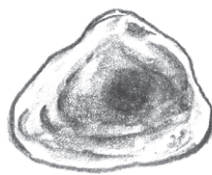


Ventral view

Modilus undulatus



Dorsal view



Ventral view

Donax incernatus



Sepia sp

Pencil drawing



Littorina scabra scabra



Assiminea brevicula



Assiminea francesiae



Architectonica perspectiva



Ellobium gangeticum

Pencil drawing

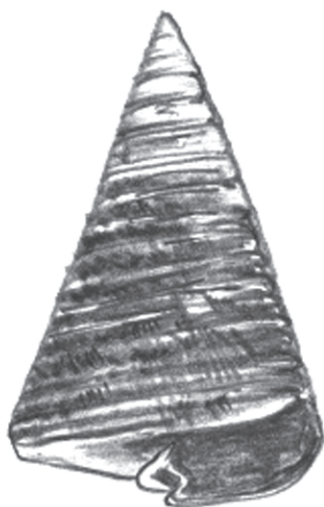


Dorsal view

Natica tigrina



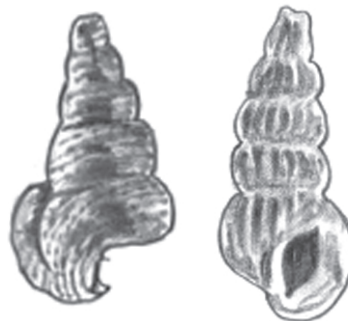
Ventral view



Telescopium telescopium



Cerithidia cingulata



Dorsal view Ventral view
Cerithidia obtusa



Natica vitellus



Acrilla acuminata



Dorsal view Ventral view
Nerita articulata

Pencil drawing



Dorsal view



Lateral view

Umbonium vestiarium



Ventral view



Neritina smithi



Neritina violacea



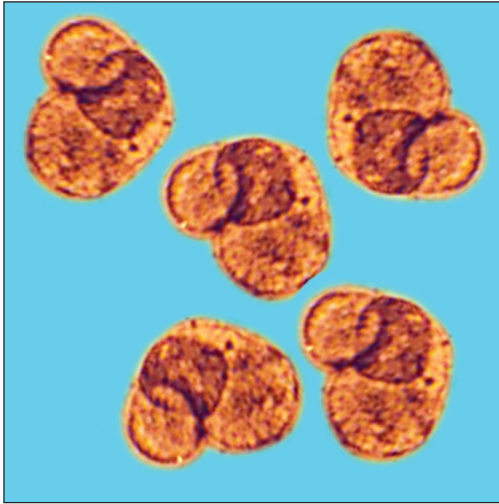
Littorina melanostoma



Littorina undulata

Larvae of Mollusca

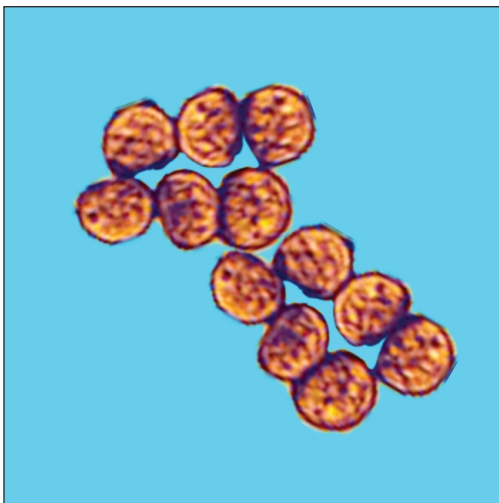
(Progressive stages of development)



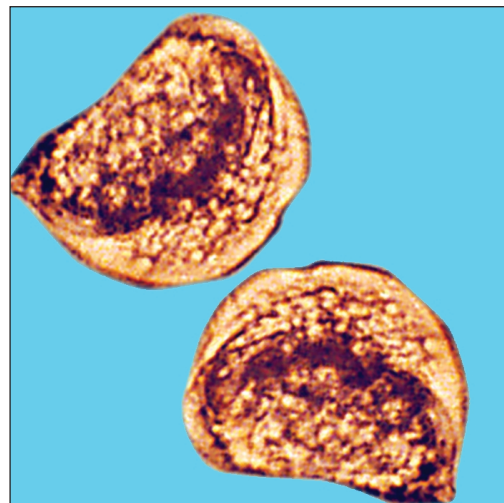
Trefoil (4 celled) stage



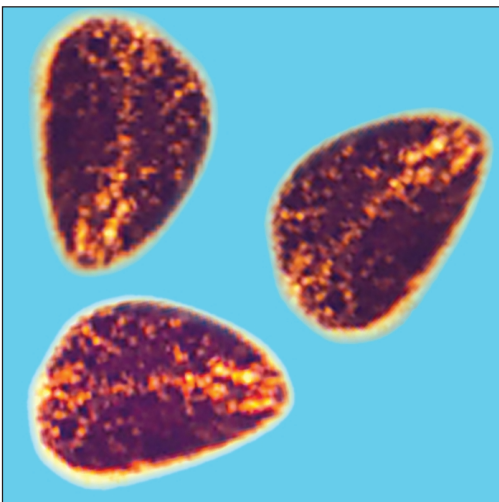
Morula stage



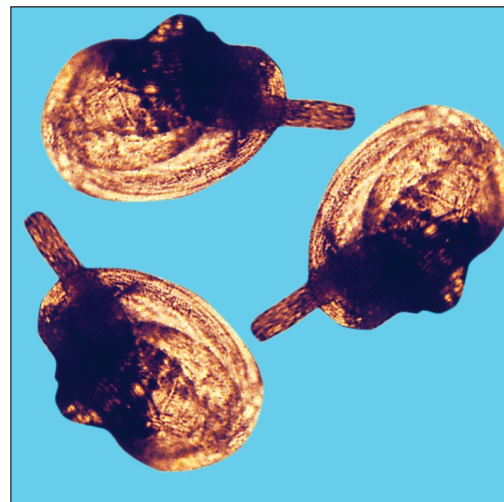
Early D-shaped larvae



D-shaped advanced larvae



Early pediveliger stage



Pediveliger stage



Crassostrea madrasensis (Indian Backwater Oyster)



Saccostrea cucullata (Indian Rock Oyster)