



First report of mactrid (mollusca: bivalvia) *Macrinula dolabrata* (Reeve, 1854) from Indian waters

Bhagyashree Dash^{1,2}, Sonali Sanghamitra Rout^{1,2}, A. Bharati¹, N. V. Subba Rao³, K. V. Surya Rao³, Akkur V. Raman¹ and Dipti Raut^{2*}

¹Marine Biology Laboratory, Andhra University, Visakhapatnam-530003, Andhra Pradesh, India.

²Centre of Excellence in Environment and Public Health, Environmental Science Laboratory, Ravenshaw University, Cuttack-753003, Odisha, India.

³Zoological Survey of India, New Alipore, Kolkata-700 053, India.

*Correspondence e-mail: raut.dipti2@gmail.com

Received: 11 June 2020 Accepted: 17 Nov 2020 Published: 30 Nov 2020

Short communication

Abstract

Occurrence of bivalve *Macrinula dolabrata* (Reeve, 1854) from the coastal waters off Andhra Pradesh, is the third addition to the species list of the genus from India. The present finding, new to Indian waters, is indicative of an extended range distribution of the species from the Malay Peninsula towards the east coast of India.

Keywords: First report, east coast of India, benthos, Mollusca

Introduction

Documentation of bivalves from the coasts of India indicates a total of 760 species belonging to 71 families (Subba Rao, 2016, 2017) with possibly a few additions subsequently. Of importance are specific taxa based studies essential in building comprehensive database on molluscs (Biju Kumar and Ravinesh, 2016). Of interest for dietary regimes is the high protein content, low calorific values, low fat/cholesterol

profile, substantial amounts of omega 3-fatty acids, essential amino acids, vitamin B12, and minerals such as iron, zinc, and copper in clam meat (Laxmilatha, 2009; Schug *et al.*, 2009; EFSA, 2014). Remarkably, of the total marine bivalves known worldwide, Asia contributes 85% to global production, with clams and oysters each adding 38 and 33% respectively (Wijsman *et al.*, 2019). In this communication, a bivalve species of surf or trough clam of the family Mactridae, new to India is reported. A typical hinge with a markedly broad internal resilifer in each valve, located directly under the umbones naturally distinguishes mactrids from other bivalve families (Wong, 2009). Few mactrids are found to be nutritive and palatable, therefore relished by many communities and thus economically important (Li *et al.*, 2011 and Wang *et al.*, 2011).

Family Mactridae is classified into five subfamilies with a total of 68 genera (MolluscaBase, 2020) and 180 species (Huber 2010). Of these, 7 genera and 29 species from three subfamilies are known to India. Genus *Macrinula* has 6 valid species of 9 direct children (MolluscaBase, 2020). With two species *M. plicataria* (Linnaeus, 1767) and *M. reevesii* (Gray, 1837), reported previously from the Indian Coast (Table 1), *M. dolabrata* (Reeve, 1854) is a new benthic finding, demonstrating its extended distribution from the Malayan Peninsula towards the east coast of India.

Table 1. Species of genus *Mactrinula* recorded from India

Sl. No.	Species recorded from India	Distinguishing character	Distribution in India	References
1	<i>M. plicataria</i> (Linnaeus, 1767)	Transversely elongate concentric plications throughout surface of the shell and fragile valves.	Andaman and Nicobar Islands, Andhra Pradesh, Goa, Maharashtra, Odisha, Tamil Nadu, West Bengal.	Melvill and Standen, 1906; Comber, 1906; Gravelly, 1941; Subrahmanyam <i>et al.</i> , 1949; Purkait and Manna, 1988; Subba Rao <i>et al.</i> , 1991; Subba Rao <i>et al.</i> , 1992; Dey and Ramakrishna, 2007; Dey, 2008; Mahapatra, 2008; Ramakrishna and Dey, 2010; Subba Rao, 2017
2	<i>M. reevesii</i> (Gray, 1837)	External appearance of shell smooth, compressed and less inflated, deep pallial sinus.	Odisha, West Bengal	Subba Rao <i>et al.</i> , 1991; Ramakrishna and Dey, 2010; Subba Rao, 2017
3	<i>M. dolabrata</i> (Reeve, 1854)	Smooth whitish brown outer shell with periostracum towards the ventral margin of the valves, concave anterior dorsal margin.	Present species and first report from India	Present study

Material and methods

A reexamination of benthic samples collected at 500 locations (depth 1-50 m) using a Naturalist’s dredge (20x50 cm; mesh size ~0.6 cm²) during the last 30 years (1987-2017) revealed a bivalve amongst others collected from Pudimadaka (17°27’00.0” N, 83°1’18.85” E). The dredge was operated from a fishing trawler moving at 3 nautical miles. The samples were washed with seawater, sorted on board and live forms carefully preserved in 10% neutralized formaldehyde. Morphometric measurements were recorded using a dial Caliper. Identification was carried out based on key taxonomic features with appropriate literature (Abbott and Dance, 1990; Subba Rao, 2017). The specimens were photographed with a digital (Nikon D90, Japan) camera, vouchered

(MBLDZAU-277), and deposited in the collections of the Marine Biology Laboratory, Department of Zoology, Andhra University, Visakhapatnam, India. The samples for hydrography were analyzed according to standard analytical methods as described in Standard Methods 20th edition of American Public Health Association APHA (2009), and Grasshoff *et al.* (1999). Sediment texture was determined through wet sieving and pipette analysis (Krumbein and Pettijohn, 1938) and nomenclature assigned according to Shepard (1954). Organic matter was estimated by modified wet oxidation method (Gaudette *et al.*, 1974).

Results

A total of 98 species of bivalves belonging to 28 families were collected through extensive sampling at GPS fixed selected locations along the coastal corridor (960 km) of Andhra Pradesh. Of these, Mactridae was the second largest contributing family with ten species of three genera. A perusal of literature indicated a new mactrid bivalve *M. dolabrata* hitherto not reported from the Indian waters. Systematic classification and morphological descriptions of the species are presented with collection details.

Systematic account

Order : Venerida
 Superfamily : Mactroidea
 Family : Mactridae Lamarck, 1809
 Genus : *Mactrinula* Gray, 1853

Type species *Mactrinula dolabrata* (Reeve, 1854)

Synonyms

Maetra dolabrata Reeve, 1854
Mactrinula dolabrata (Reeve, 1854)

Material examined

One live specimen, Pudimadaka (17°27’00.0” N, 83°1’18.85” E), 01-06-2008, coll. A.V. Raman, (Reg.No. MBLDZAU-277) Andhra Pradesh, India, depth 30 m.

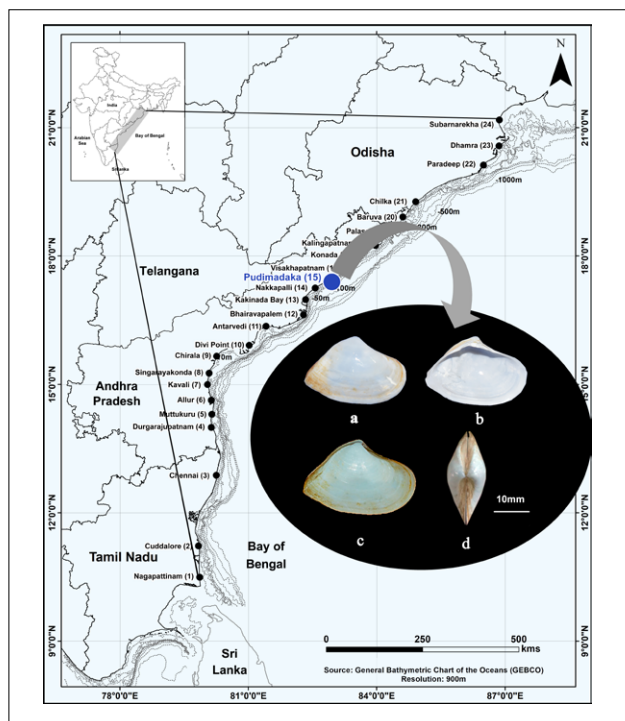


Fig. 1. Sampling locations of *M. dolabrata* from the coast off Andhra Pradesh, Right valve Dorsal (a), Left valve Ventral (b), Complete bivalve with both valves (c), Dorsal margin and Umbo (d), Scale 10 mm

Description

Shell small to medium sized (Length 23.34 mm, Height 15 mm and Thickness 9.5 mm), equi-valve and triangularly oblong, valves thin, fragile. Majorly white with brownish tinges of periostracum towards ventral margin of valves specifically in the direction of antero-posterior ventral sections of the shell. Shell surface even with delicate growth lines, somewhat deeper towards the ventral margin of valves. Anterior end of shell broader, bluntly pointed giving an elliptical shape to the shell, while posterior region additionally pointed with a triangular appearance. Umbo white in colour, smooth shiny, sharp, and to some extent curved inwardly. Shell interior white, incandescent and polished. Anterior dorsal margin of shell curved in whereas posterior end arched. Anterior adductor muscle scar indistinct in contrast to ovoid posterior adductor scar. Pallial sinus elongated, teardrop shaped, and deeper than pallial line. Lunule rough, not smooth like other parts of shell, narrow and light brownish in color. Lateral tooth one in each anterior and posterior side of left valve, however, two anterior lateral and two posterior lateral teeth on right valve present.

Ecology

The specimen was recorded from silty sand sediments (15.08% sand, silt 82.5% and clay 2.42%) sediment (organic matter 1.29%) from a depth of 30 m, salinity 34.31 PSU; dissolved oxygen 5.89 mg^l⁻¹.

Distribution

M. dolabrata was previously reported from Japan (Habe, 1968), Thailand (Tantanasiriwong, 1979; Vongpanich, 2000), Northern and Western coasts of Australia (Lamprell and Healy, 1998), Indonesia, Taiwan, (Bernard *et al.*, 1993), China (Qi, 2005), Korea (Kang *et al.*, 2019) and Singapore (Wong, 2009) waters.

Remarks

Of the two species of the genus reported from India, *M. plicataria* (Subba Rao, 2017) is characterized by transversely elongate concentric plications throughout the shell surface and fragile valves, a feature absent, in the present species *M. dolabrata*. The latter bears a similarity to *M. reevesii* (Subba Rao, 2017) associated with a reduced concave anterior dorsal margin and the absence of periostracum. Initially, the species was designated as *Mastra dolabrata* by Reeve, 1854 but later re-assigned to genus *Mastrinula*. In a review of the genera *Mactrella* and *Mastrinula* (Signorelli, 2012), *M. dolabrata* Reeve, 1854 is affirmed as *M. subplicata* Lamarck. Citing Signorelli, 2012 "The morphology of the type material described by Reeve (NHMUK 1996.444) coincides with the characters observed in

the Lamarck species". In the book "Compendium of Bivalves" Huber, 2010:446 illustrated *M. dolabrata* as *Mastrinula striatula* (currently accepted as *Mactrella striatula*) but later (Huber, 2015) it was renamed again as *M. dolabrata*.

Conclusion

The present finding a new report from India, adds the third mastrid species to the Molluscan database, indicating a westward range extension of the species distribution from Southeast Asian waters towards the coast of Andhra Pradesh, India. The geographical range of marine benthic invertebrates is structured by the ability of species to first arrive, inherent tolerance to physical factors besides the capacity to deal with competitors and predators in the environment (MacArthur, 1972). It is well known that many species of marine bivalves have planktotrophic larvae, which are capable of prolonged free-swimming stage (Jablonski and Lutz, 1983). Such species have a wide geographical range too. *M. dolabrata* could be one such form. In the Bay of Bengal, the reversing surface currents possibly aid westward distribution of benthic forms.

Acknowledgements

Over the years, several agencies helped in the collection of seabed samples through sponsored research. More recently, financial assistance in the form of a research grant (MoES/36/00SI/Extra/11/2012) on Benthic Communities of Coastal Andhra Pradesh from the Ministry of Earth Sciences, Government of India is gratefully acknowledged. Tune Usha and M. Iyyappan, NCCR, Chennai helped with the base map shown in Fig.1. We are thankful to A. Lova Raju and T. Pola Rao for their help in the collection of the samples. This work was carried out at the Marine Biology Laboratory, Department of Zoology, Andhra University.

References

- Abbott, R. T. and S. P. Dance. 1990. Compendium of Seashells. American Malacologists Inc., Florida, 411 pp.
- APHA, 2009. Standard Methods for the Examinations of Water and Wastewater. American Public Health Association, Washington DC, USA.
- Bernard, F. R., Y. Y. Cai and B. Morton. 1993. A Catalogue of the Living Marine Bivalve Molluscs of China. Hong Kong University Press, Hong Kong, 121 pp.
- Biju Kumar, A. and R. Ravinesh. 2016. Taxonomy of Marine Molluscs of India: Status and challenges ahead, In: S. Bijoy Nandan, P. Graham Oliver, P. R. Jayachandran, C. V. Asha (Eds.), Training manual 1st International training workshop on taxonomy of bivalve molluscs, chapter 5: 67-87.
- Comber, E. 1906. A list of marine Mollusca in the Bombay Natural History Society collection. *J. Bombay Nat. Hist. Soc.*, 17: 207-215.
- Dey, A. 2008. Commercial and Medicinal Important molluscs of Sunderbans. *Rec. Zool. Surv. India, Occ. Paper No.* 286: 1-54.
- Dey, A. and Ramakrishna. 2007. Marine molluscs of Andhra Pradesh: Bivalvia, Scaphopoda and Cephalopoda. Fauna of Andhra Pradesh, *Rec. Zool. Surv. India*, 5 (Part-7): 149-260.
- EFSA. 2014. Scientific opinion on health benefits of seafood (fish and shellfish) consumption in relation to health risks associated with exposure to methyl mercury. *EFSA J.*, 12 (7):80

- Gaudette, H. E., W. R. Flight, L. Toner and D. W. Folger. 1974. An inexpensive titration method for the determination of organic carbon in recent sediments. *J. Sediment. Res.*, 44 (1): 249-253.
- Grasshoff, K., K. Kremling and M. Ehrhardt. 1999. *Methods of Seawater analysis*. 3rd Ed., Weinheim: Verlag Chemie, 407 pp.
- Gravelly, F. H. 1941. Shells and other animal remains found in the Madras beach. *Bull. Madras Govt. Mus. New Serie (Nat. Hist)*, 5 (1): 69.
- Gray, J. E. 1837. A synoptical catalogue of the species of certain tribes of shells contained in the collection of the British Museum. *The Magazine of Natural History*, 1: 370-376.
- Habe, T. 1968. *Shells of the Western Pacific in Color*. Revised Edition, Hoikusha Publishing Company, Osaka, Japan, 2: 233 pp.
- Huber, M. 2010. Compendium of Bivalves. A Full-color guide to 3,300 of the world's marine bivalves. A status on Bivalvia after 250 years of research. Hackenheim, Conch Books, 446 pp.
- Huber, M. 2015. Compendium of Bivalves 2. A Full-color guide to the Remaining Seven Families. A Systematic Listing of 8'500 Bivalve Species and 10'500 Synonyms. Harxheim, Conch Books, 907 pp.
- Jablonski, D. and R. A. Lutz. 1983. Larval ecology of marine benthic invertebrates: Palaeobiological implications. *Biological Review*, Cambridge Philosophical Society, 58 (1): 21-89.
- Kang, S. M., O. H. Yu, and H. G. Lee. 2019. Impact of Environmental variables on the diversity and distribution of the Megabenthos in the south sea of Korea. *J. Korean Soc. Mar. Environ.*, 45: 354-365.
- Krumbein, W. C. and F. J. Pettijohn. 1938. *Manual of sedimentary petrography*. New York: Appleton Century Crafts Inc., 549 pp.
- Lamprell, K. and J. Healy. 1998. *Bivalves of Australia*. Backhuys Publishers, Leiden, 2: 288.
- Laxmilatha, P. 2009. Proximate composition of the surf clam *Mactra violacea* (Gmelin 1791). *Indian. J. Fish.*, 56(2):147-150.
- Li, Q., L. Yang, Q. Ke and L. Kong. 2011. Gametogenic cycle and biochemical composition of the clam *Mactra chinensis* (Mollusca: Bivalvia): Implications for aquaculture and wild stock management. *Mar. Biol. Res.*, 7: 407-415.
- Linnaeus, C. 1767. *Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Ed. 12. 1., Regnum Animale. 1 & 2. Holmiae, Laurentii Salvii. 1767: 533-1327.
- MacArthur, Robert H. 1972. *Geographical ecology*. New York: Harper & Row Ecology. 269 pp.
- Mahapatra, A. 2008. Molluscan fauna of Krishna Estuary. *Estuarine Ecosystem Series, Rec. Zool. Surv. India*, p. 105-173.
- Melvill, J. C. and R. Standen. 1906. The mollusca of the Persian Gulf, Gulf of Oman and Arabian sea, as evidence mainly through the collection of Mr. F.W. Townsend 1893-1906; with description of new species. *Proc. Zool. Soc. London*, p. 783-848.
- MolluscaBase. 2020. Mollusca Base. Mactridae Lamarck, 1809. Accessed through: World Register of Marine Species at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=230> on 2020-05-31
- Purkait, B. and B. Manna. 1988. Shell collected around Junput beach, West Bengal. *Environ. Ecology*, 6 (2): 441-443.
- Qi, Z. 2005. *Seashells of China*. China Ocean Press, Beijing. 520 pp.
- Ramakrishna and A. Dey. 2010. Annotated Checklist of Indian Marine Molluscs (Cephalopoda, Bivalvia and Scaphopoda): Part-I. *Rec. Zool. Surv. India, Occ. Paper No.* 320: 1-357.
- Reeve, L. A. 1854. Monograph of the genus *Mactra*. In: *Conchologia, or, Illustrations of the Shells of Molluscous Animals*, 8: 21 pp.
- Schug, D. M., K. Baxter and K. Wellman. 2009. Valuation of ecosystem services from shellfish restoration, enhancement and management: a review of the literature. Northern Economics Inc. Report, 58 pp.
- Shepard, F. P. 1954. Nomenclature based on sand-silt-clay ratios. *J. Sediment. Res.*, 24(3): 151-158.
- Signorelli, J. H. 2012. The molluscan genera *Mactrella* and *Mactrinula*: Taxonomic revision and re description of type species. *Malacologia*, 55(2): 191-202.
- Subba Rao, N. V. 2016. Annotated classification and diversity of marine bivalve molluscs of India, In: S. Bijoy Nandan, P. Graham Oliver, P. R. Jayachandran C. V. Asha (eds.), *Training manual 1st international training workshop on taxonomy of bivalve molluscs*, chapter 2: 25-46.
- Subba Rao, N. V. 2017. Indian Seashells (Part-2): Bivalvia. *Rec. Zool. Surv. India, Occ. Paper No.* 375: 1-568.
- Subba Rao, N. V., K. V. Surya Rao and S. Maitra. 1991. Marine Molluscs. Fauna of Orissa. State Fauna. *Rec. Zool. Surv. India, Series 1 (Part-3)*: 1-175.
- Subba Rao, N. V., A. Dey and S. Barua. 1992. Estuarine and marine molluscs of West Bengal. Fauna of West Bengal, State Fauna, *Rec. Zool. Surv. India, Series 3 (Part-9)*: 129-268.
- Subrahmanyam, T. V., K. R. Karandikar and N. N. Murti. 1949. The marine Pelecypoda of Bombay. *J. Univ. Bombay*, 17(5): 50-67.
- Tantanasiriwong, R. 1979. A checklist of marine bivalves from Phuket (area). *Res. Bull. Sun Chiwawitthaya thang Thale Phuket*, 27: 1-15.
- Vongpanich, V. 2000. Family Mactridae (Mollusca: Bivalvia) in Thai waters. *Res. Bull. Sun Chiwawitthaya thang Thale Phuket*, 21(2): 483-498.
- Wang, L. C., K. Zhang, L. Q. Di, R. Liu and H. Wu. 2011. Isolation and structural elucidation of novel homogenous polysaccharide from *Mactra veneriformis*. *Carbohydr. Polym.* 86: 982-987.
- Wijsman, J. W. M., K. Troost, J. Fang and A. Roncrati. 2019. Global Production of Marine Bivalves. Trends and Challenges. In: A. Smaal, J. Ferreira, J. Grant, J. Petersen and O. Strand, (Eds). *Goods and services of Marine bivalves*, Springer, p. 7-26.
- Wong, H. W. 2009. The Mactridae (Mollusca:Bivalvia) of East coast Park, Singapore. *Nat. Singapo.*, 2: 283-296.