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BIBLIOGRAPHY

Diseases, Parasites and Toxicology of *Perna viridis*, *Crassostrea madrasensis* and *Villorita cyprinoides* (Mollusca: Pelecypoda) of India



A P Cess Funded National Network Project on
National Risk Assessment Programme for
Fish and Fish Products for Domestic and
International Markets

D. Prema, N. K. Sanil & P. S. Sivaprasad



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

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FOREWORD



The study on the parasites, diseases and toxicology of bivalve molluscs was initiated in India with the establishment of various fisheries research institutions under central and state governments and universities. Naturally, a great volume of literature has accumulated over the years which was scattered in different regional, national and international journals, proceedings, bulletins, special publications and post graduate, doctoral and post doctoral theses. It was found extremely difficult for a researcher to access information from these sources. Even though, *on-line* access of the literature has minimized the difficulties, the unprecedented increase in the costs and financial constraints coupled with the incompleteness of the bibliographic citations of the literature, researchers still resort to manual search of bibliography.

Central Marine Fisheries Research Institute has always given prime consideration to documenting bibliographies. The Institute has published more than a dozen bibliographies on various aspects of finfishes and shellfishes. It is gratifying to note that for the first time, the parasites, diseases and toxicology of three commercially important bivalves form a theme for bibliography. The present bibliography has been an output from the AP Cess Funded National Network Project on National Risk Assessment Programme for Fish and Fish Products for Domestic and International Markets. I am hopeful that the Bibliography on Diseases, Parasites and Toxicology of *Perna viridis*, *Crassostrea madrasensis* and *Villorita cyprinoides* (Mollusca: Pelecypoda) of India, will serve as a ready source of reference for future investigators in this field. I congratulate the project personnel for the commendable effort in bringing out this publication.

Cochin - 18
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Prof. (Dr.) Mohan Joseph Modayil

Director

PREFACE

A proper understanding of the hazards associated with the fishery products on national basis has been the primary objective of the AP Cess Funded National Network Project on *National Risk Assessment Programme for Fish and Fish Products for Domestic and International Markets*. In this connection, the bibliography is prepared with the sole aim to compile all the available literature on this subject to produce a ready source of reference material for future investigators. In spite of the meticulous task and completeness, the authors express their regrets for any errors or omissions.

A host of well wishers have rendered wholehearted support, encouragement and valuable suggestions in bringing out this publication. The Principal Investigator wish to place on record our indebtedness to the authorities of ICAR- AP Cess Funded National Network Project for the financial assistance. The PI gratefully acknowledge the liberal help extended by Dr. S. Ayyappan, DDG (Fy), ICAR. I express my deep sense of gratitude to Prof. (Dr.) Mohan Joseph Modayil, Director, CMFRI, Kochi for the moral support, constructive criticism and encouragements for this endeavor. The advice and guidance of Dr. M. Rajagopalan, Head, FEM Division, CMFRI, Kochi are thankfully acknowledged. I am extremely obliged to Dr. P. K. Surendran, National Project Leader and Head, MFB Division, CIFT, Kochi, Dr. K. K. Appukuttan, Principal Scientist, MF Division and Shri. Edwin Joseph, Technical Officer-in-Charge, Library and Documentation Section, CMFRI, Kochi for critically going through the manuscript and offering suggestions for improvement. I place on record the highest level of appreciation to the co-authors, without their unfailing support this bibliography would not have been possible.

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Introduction

Peninsular India is endowed with extensive and valuable molluscan resources along the coasts, bays, backwaters, estuaries and the seas surrounding the sub continent. The shellfishes/molluscs belong to different taxonomic groups, namely, mussels, oysters, clams, whelks, chanks, squids and cuttle fishes. These groups are of immense economic importance and have been exploited since time immemorial for food, pearls and shells.

Studies on the commercially important marine molluscs of India date back to the turn of the nineteenth century (Nevill, 1877; Melvill, 1893; Melvill & Abercrombie, 1893). Nevill (*loc cit.*) presented a comprehensive list of molluscs available in the Indian waters. J. J. Hornell realised the scope of bivalve mariculture and carried out extensive investigations for more than four decades (1906- 1949) on the molluscan resources in the country. But it was only after the establishment of Central Marine Fisheries Research Institute in 1947, the study on the biology, fisheries and culture of different species of marine molluscs got momentum.

Among the different varieties of marine molluscs, species belonging to the family Pelecypoda, popularly known as bivalves, have unique significance in the capture and culture fisheries of the country. In India, three species of bivalves, namely, green mussel (*Perna viridis*), edible oyster (*Crassostrea madrasensis*) and black clam (*Villorita cyprinoides*) are abundant and enjoys greater acceptance. In addition to human consumption, all the three species are widely used as major ingredients in commercial shrimp feeds.

In the light of the recent setbacks in shrimp culture industry, farmers all over the country are looking for oyster and mussel culture as an alternative source of income. Eventhough bivalve culture in the country started during the middle of the last century, mariculture of bivalves in

its present form gained importance and public acceptance since 1990s.

Despite their economic significance, bivalves can act as potential reservoirs of parasites/commensals, pathogens and foulers and are known for their ability to accumulate a variety of toxicants/pollutants, since they are filter feeders. Though less investigated, occurrences of diseases/mortalities are also a regular phenomenon in the wild and culture stocks of bivalves in the country.

During the last 5 decades, considerable efforts have been made to study the different aspects of bivalves including taxonomy, biology and culture. But much attention has not been given to the parasitological, pathological and toxicological aspects of the commercially important bivalve molluscs.

In this context, it is necessary to create a greater awareness among the scientists and farmers about the possible havocs related to the culture of bivalves. Therefore it is imperative to intensify the studies on bivalve pathology and toxicology for which a sound literature database is highly essential. In view of this strongly felt need, it was thought worthwhile to compile the relevant literature pertinent to the studies done on associates, commensals/ symbionts, foulers, parasites/pathogens, diseases and toxicology of *P. viridis*, *C. madrasensis* and *V. cyprinoides* from the Indian subcontinent.

The present bibliography includes original research works which appeared in standard Indian and foreign journals, bulletins, special publications and proceedings. Unpublished literature in the form of M. Sc. and M. Phil. dissertations and Ph. D. thesis were also included. Maximum efforts have been taken to include all the information available till June 2005. But it is not claimed to be complete in itself. Some publications, which must have appeared in obscure journals, would have been left out. Nevertheless, it is hoped that this bibliography would serve the scientists and students working on pathological and toxicological aspects of bivalves in India and abroad as a useful guide.

For the convenience of the users, the information is presented here under three sections, followed by an index. Section I dealing with the literature on parasites/pathogens, diseases and toxicants related to *Perna viridis*, Section II on the above aspects of *Crassostrea madrasensis* and Section III on *Villorita cyprinoides*.

SECTION I

... (Linnæus, 1758)

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***Perna viridis* (Linnaeus, 1758)**

Mussels belonging to the genus *Perna* (= *Mytilus*) are exploited in considerable quantities from different parts of the Indian coastline. Kuriakose and Nair (1976) reported that the mussels of the genus *Mytilus* do not occur in India and the species *M. viridis* should be redesignated as *Perna viridis*. Two species of *Perna* have been recorded along the Indian coast so far, they are *P. viridis* (green mussel) and *P. indica* (brown mussel).

Taxonomic Position

Phylum : Mollusca

Class : Pelecypoda

Order : Filibranchia

Family : Mytilidae

Genus : *Perna*

Species : *P. viridis* (Linnaeus, 1758)

Synonyms

Myaperna Linnaeus (1758). *Sys. Naturae*, **10**: 671.

Mytilus viridis Lyngø (1909). *Mem. Acad. Res. Sci. Lett.*

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Perna viridis Kuriakose & Nair (1976). *Aqua. Biol.*, 1: 25-36.

Common Names

English - Green Mussel

Malayalam - Kadukka, Kallummalkai

Tamil - Pachai alli

Distinctive characters

Large (upto 230 mm in length and 72 mm in height), elongate, sub-triangular, arched, beak like shell with pointed anterior end. The dorsal margin of the shell is angularly convex in the middle. Posterior margin is broadly rounded and ventral margin is slightly concave. Valves are strongly flattened, particularly in the anterior part. The surface of the shell is strongly decussately striated.



Ligament is strong and elongated. The surface of the shell is covered by firm, horny, bright green periostracum. The mussel attaches to the substratum by means of a tough, thin, flexible byssus thread secreted by the byssus gland present in the byssus cavity and foot,

The soft body has visceral mass, with two pairs of gills covered by a pair of mantle lobes, which are united dorsally and free ventrally. The gonad extends into the lobes of mantle. The mantle is creamy but during sexual maturity it becomes deep reddish orange in female. The foot is much reduced, tongue shaped and has a groove on the posterior side.

Distribution

P. viridis is distributed in the Northern Indian Ocean around the mainland coast of South East Asia, Philippines, South Africa and New Zealand, China and Siam. In India the species occurs all along the East and West coasts. On the East coast, it occurs as small beds along the Chilka lake, Visakhapatnam, Kakinada, Chennai, Pondicherry, Cuddalore, Porto Novo and Port Blair. On the West coast, extensive beds are found along Kollam, Alapuzha, Kochi, Kozhikode to Kasargode, Mangalore, Karwar, Goa, Bhatia Creek, Malvan, Ratnagiri and Gulf of Kutch.

Habitat

P. viridis is found in open coasts, harbours, mouth of estuaries and rivers where the salinity is almost equal to seawater. They occur from intertidal zones to a depth of 15m, usually attached to rocks, pilings and other hard objects.

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(Prastun, 1956)

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 ... (1956), *Proc. Indian Acad.*
 ... 372-396-10;
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***Crassostrea madrasensis* (Preston, 1916)**

Bivalves belonging to the family Ostreidae are known as edible oysters. About 11 species of oysters occur on the Indian coast. However, 4 species of edible oysters of the genus *Crassostrea* contribute substantially to the fisheries.

Taxonomic position

Phylum : Mollusca

Class : Pelecypoda

Order : Eulamellibranchia

Family : Ostreidae

Genus : *Crassostrea*

Species : *C. madrasensis* (Preston, 1916)

Synonyms

Ostrea cucullata Hornell (1910). *Madras Fish. Bull.*, **4**: 25-31

Ostrea virginica Annandale & Kemp (1916). *Mem. Indian Mus.*, **5**:
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Ostrea(= *Crassostrea*) *madrasensis* Rao (1956). *Proc. Indian Acad. Sci.*, **44B**: 332-356-10.

Crassostrea madrasensis Rao (1958). *Fish. West Coast India*: 55-59.

Common Names

English - Edible oyster

Malayalam - Muringa, Muru

Tamil - Ali, Kalungu, Patti

Distinctive characters

The species is characterized by straight shells with irregular shape. The shell is provided with numerous foliaceous laminae. The left valve of the shell is deep and the right one is slightly concave. Hinge is narrow and elongated. The adductor scar located sub-centrally, is kidney shaped and dark purple in colour. The inner surface of the valve is white, glossy and smooth. The inner margin of the valve is purple black in colour.



The right and left mantle lobes of the oyster enclose a large mantle cavity, which is divisible into a lower inhalent chamber and an upper exhalent chamber. The two pairs of ctenidia, one on each side, extend forward up to the labial palps. The mouth is located between the two labial palps. In the middle of the body is the adductor muscle which runs across the two valves of the shell. In front of the posterior adductor muscle is the pericardium enclosing the heart. The digestive system consists of mouth, narrow oesophagus, spacious stomach, digestive gland situated on either side of the stomach, slightly twisted midgut, long intestine, rectum and anus. The gonad is creamy white, highly branched and tubular.

Distribution

The species is widely distributed in India and occurs along the east coast in Bahuda estuary near Sonapur, Vishakhapatanam, Sarada estuary, Kakkinada, deltas of Godavari and Krishna rivers, Gokulapalli, Pulicat Lake, Ennore (Madras), Cuddalore and Mandapam. On west coast the oyster is distributed in Kerala, Mangalore and Gujarat.

Habitat

C. madrasensis is essentially a euryhaline brackishwater oyster, occurs in estuaries, backwaters, ports and harbours in thick beds and occasionally in open sea. They are found in the intertidal zones to a depth of about 4m. The species generally colonise on rocks, concrete surfaces and wooden poles. They also thrive well on hard muddy bottom.

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SECTION III

***Villorita cyprinoides* (Gray, 1825)**

Black clam is a purely brackish water species belonging to the family Corbiculidae, which cannot tolerate high salinities. However, *Villorita cyprinoides* var. *cochinensis* (Hanley) is capable of tolerating a wide range of salinities, even upto 34 ppt.

Taxonomic position

Phylum : Mollusca

Class : Pelecypoda

Order : Eulamellibranchia

Family : Corbiculidae

Genus : *Villorita*

Species : *V. cyprinoides* (Gray, 1825)

Synonyms

Cyprena cyprinoides Gray, 1825. *Ann. Philosophy*, **IX**: 137.

Venus cyprinoides Wood, 1828. *Index Test. Supplment*, fig. 14, pl. ii.

Villorita cyprinoides Griff & Pudgeon, 1834. *An. Kingdom*, **XII**,
fig. 5, pl. xxxi.

Prashad, 1921. *Rec. Indian Mus.*, **XXII**: 111-119.

Velorita cyprinoides Deshayes, 1854. *Cat. British Mus. Conchifera*,
II: 240.

Prime, 1870. *American Foun. Conch.*, **V**: 141.

Preston, 1915. *Faun. British Indian Freshwat.*

Moll., p. 209.

Common names

English - Black clam

Malayalam - Karutha kakka

Distinctive characters

V. cyprinoides has a moderately large, thick, ovately triangular, inflated, oblique shell. The shell is swollen in the umbonal region and in the middle region. The short anterior margin of the shell is evenly curved above, almost straight in the middle, rapidly curving backwards below and



continued into a ventral border. The shell in the ventral border curves upwards posteriorly to meet the posterior margin in an angular corner.

The soft body of the animal is somewhat triangular, but the greater part of the umbonal region is occupied by a triangular structure formed by the union of the mantle flap of the two sides. The rest of the soft parts being somewhat elliptic in outline and lying below the hollow structure. The mantle is very thin and translucent upto the pallial junction, below which, owing to the large numbers of radiating muscle fibres. The two adductor muscles are of about the same size, but the posterior one is more internally situated. The abdominal mass is comparatively small, while the foot is of a fair size, not very thick, triangular and acutely pointed at the apex.

Distribution

The species is edemic to Penninsular India. On the coasts of Kerala, it occurs primarily in backwaters, can adapt and withstand the wide fluctuations in salinities from nearly 1ppt to about 34 ppt.

Habitat

V. cyprinoides is usually found in the upper reaches of the estuaries and back waters. The species prefer sandy bottom with coarse sand, silt and clay.

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