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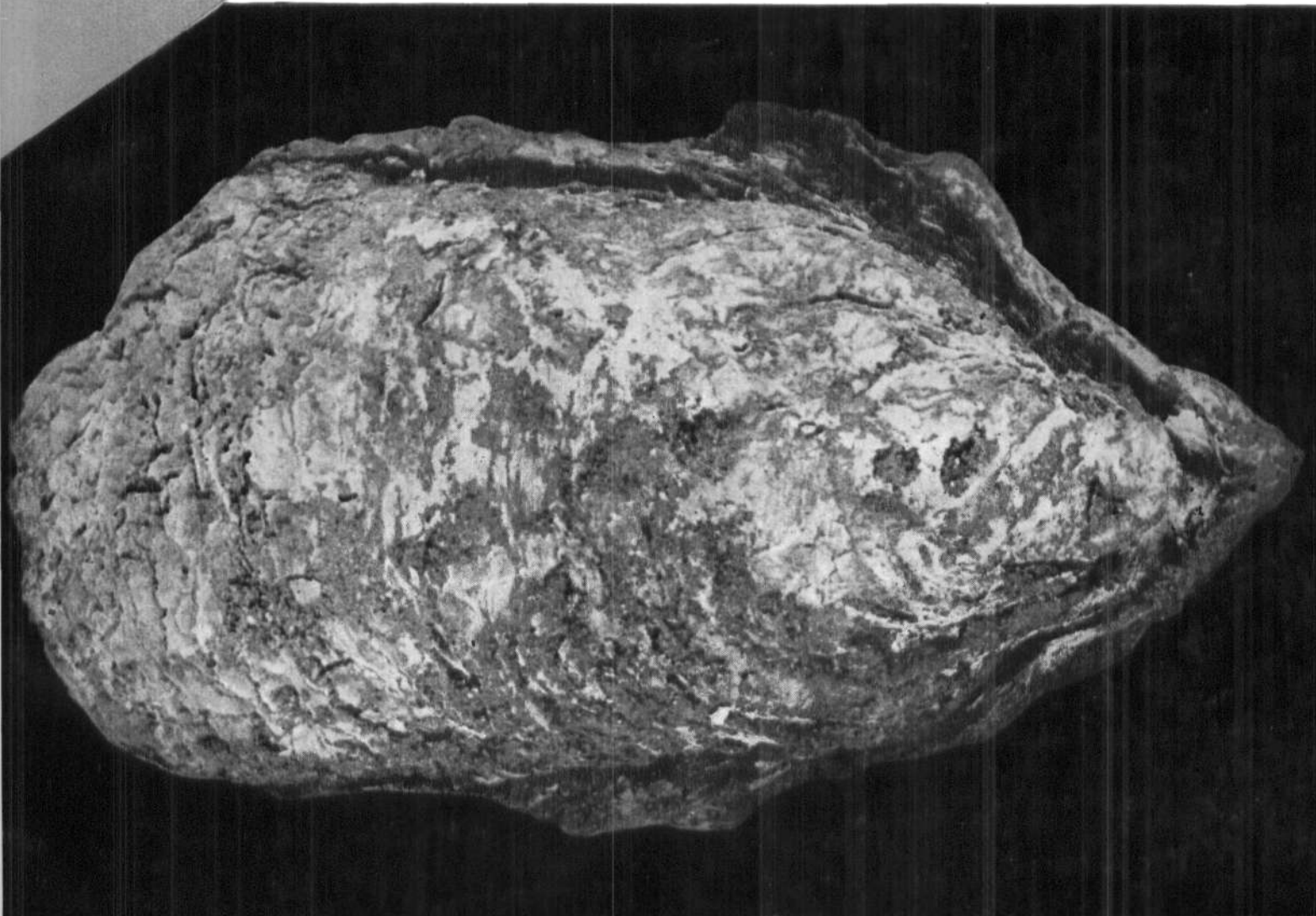
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### OYSTER CULTURE—STATUS AND PROSPECTS

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## TAXONOMY OF INDIAN OYSTERS

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There has been considerable disagreement on the identity of oysters due to the large variations in shape, size, texture and colour of shell which are very much influenced by the substratum and ecological conditions. As many as hundred species of living oysters and five hundred species of extinct ones were recognized initially (Korringa, 1952). Later it has been realized that most of the species were not valid. The palaeontologist Stenzel (1971) in his treatise on the systematics of oysters recognizes eight genera of living and fossilized ones, *Ostrea*, *Lopha*, *Alectryonella*, *Crassostrea*, *Saccostrea*, *Striostrea*, *Neopycnodonte* and *Hyothissa*. Oyster biologists distinguish four genera of living species of oysters *Ostrea*, *Crassostrea*, *Pycnodonta* and *Saccostrea* and this is accepted (Yonge 1960, Galtsoff 1964, Ahmed 1975).

Ranson (1948, 1950) included living species of oysters in three genera *Pycnodonta*, *Ostrea* and *Gryphaea* (which is synonymous with *Crassostrea*), based on the structural features of larval shell and adult. In the genus *Pycnodonta* the larval shell has equal sized valves with five teeth on the provinculum and the adult is oviparous, rectum traverses through the ventricle and promyal chamber is present. In the genus *Ostrea* the larval shell valves are of unequal size with two teeth on each side of the provinculum and the adult is larviparous, the rectum does not pass through the ventricle and promyal chamber is absent. The genus *Gryphaea* erected by Lamarck (1801) is not valid as *Gryphaea angulata* and some other species included in it were not diagnosed. The International Commission on Zoological Nomenclature (1955) in its opinion stated that the nominal species *G. angulata* was not type species of any nominal genus and the generic name *Crassostrea* 1897 was available for use for that species. Thus the species *angulata*, *virginica*, *gigas* and others are included under the genus *Crassostrea* which is characterized by the presence of two teeth on the right

valve and three teeth on the left valve in the larval shell and in the adult the shape of shell is irregular, the shell is generally attached to the substratum, the adult is oviparous, rectum does not pass through ventricle and promyal chamber is present. In the genus *Saccostrea* the umbonal cavity of the adult is deep and there are tubercles along the inner margin of the left shell valve.

### TAXONOMY OF INDIAN OYSTERS

The taxonomy of Indian oysters has been studied by Hornell (1910, 1922) Annandale and Kemp (1916), Preston (1916), Gravely (1941), Satyamurthi (1956), Durve (1968), Rao (1974) and Anonymous (1984). The Indian oysters were originally referred to the genus *Ostrea* (Awati and Rai, 1931) but later included under the genus *Crassostrea* (Rao 1956, 1958, Durve 1968), as the genus *Ostrea* comprises of larviparous oysters with the characteristics mentioned earlier. Awati and Rai (1931) have identified eight species of oysters including *Ostrea* (= *Saccostrea*) *cucullata*, *O* (= *Crassostrea*) *gryphoides* and *O. (C)* *madrasensis* but the identity of some of the oyster species has to be confirmed.

In this work oyster collections obtained from different places, Visakhapatnam, Kakinada, Madras, Athankarai, Mandapam, Tuticorin, Cochin, Mulki, Coondapur, Karwar, Ratnagiri, Bombay and Sikka (Gujarat) were examined and identified. Based on the structural features, six species of oysters including five of the genus *Crassostrea*, *C. madrasensis*, *C. gryphoides*, *C. rivularis*, *C. cristagalli* and *C. folium* and one of the genus *Saccostrea*, *S. cucullata* were identified. The diagnostic features of the two genera and six species are dealt with here together with their affinities and distribution.

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## GENUS *Crassostrea* Sacco

The shell valves are variable in shape and are usually elongated. The left valve situated on the lower side, is more or less cup-like and attached to the substratum while the right one is flat and functions like a cover for the former. The hinge does not have teeth and the ligament is partly external. The adductor scar is situated dorsolaterally. The gill ostia are small and rectum does not pass through ventricle. Sexes are separate but sex change takes place in some individuals and hermaphrodite oysters occur. Members of the genus are oviparous and gametes are discharged into water where fertilization takes place. Eggs are small in size. The species of the genus are euryhaline and thrive well in turbid brackish waters.

### *Crassostrea madrasensis* (Preston)

#### Synonyms

- Ostrea cucullata* Hornell, 1910, *Madras Fish. Bull.*, 4, 25-31.
- Ostrea virginica* Annandale and Kemp, 1916, *Mem. Ind. Mus.*, 5, 329-366.
- Ostrea virginiana* Hornell, 1922, *Madras Fish. Bull.*, 14, 97-215.
- Ostrea virginiana* var. *madrasensis* Moses, 1928, *J. Bombay nat. Hist. Soc.*, 32, 548-552.
- Ostrea arakanensis* Winckworth, 1931, *Proc. Malacol. Soc. London*, 19, 188-189
- Ostrea madrasensis* Preston, 1916, *Rec. Indian Mus.*, 12, 27-139.
- Ostrea madrasensis* Awati and Rai, 1931, *Ostrea cucullata* (The Bombay oyster). *Indian Zool. Memoir*, III, 107 pp.
- Ostrea madrasensis* Gravely, 1941, *Bull. Madras Govt. Mus.*, (New Ser.) *Nat. Hist. Sect.* 5 (1): 1-112.
- Ostrea madrasensis* Paul, 1942, *Proc. Indian Acad. Sci.*, 15B, 1-42.
- Ostrea* (*Crassostrea*) *madrasensis* Rao, 1956, *Ibid.*, 44B, 332-356.
- Ostrea madrasensis* Satyamurthi, 1956, *Bull. Madras Govt. Mus.* (New Ser.) *Nat. Hist. Sect.*, 1 (2) Part 7, 68.
- Crassostrea madrasensis* Rao, 1958, *Molluscan Fisheries. In Fisheries of West Coast of India*, S. Jones, (Ed.) 55-59.
- Crassostrea madrasensis* Rao, 1974, Chapt. II. *In The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25, 14.

#### Description

The shell valves are very irregular in shape; they are usually elongated. When spat set on flat surfaces and there is no crowding a flat shape is attained by the oysters. Those growing on uneven areas have shape of the niche where they are present and overcrowding leads to oysters with very much twisted shells.

Outer surface of shell valves has numerous foliaceous laminae with sharp edges. Width of shell 0.38 to 0.64 and thickness 0.14 to 0.36 in length. The left valve is deep and the right one slightly concave. Hinge is narrow and elongated; it is sometimes elevated and has a medial depression in some oysters. Adductor muscle is situated subcentrally, reniform and dark purple in colour. The colour of the outer surface is grey, green or light purple depending on the area in which the oysters occur due to the presence of detritus, algae etc. The inner surface of valves is smooth, glossy and white in colour with purplish black colouration along the margins of the valves (Pl. I A, B and C).

#### Remarks

Ahmed (1971, 1975) considers that this species occurring in India and Pakistan is a synonym of the American oyster *Crassostrea virginica* Gmelin. The shell of *C. madrasensis* resembles *C. virginica* in shape, presence of foliaceous laminae and reniform adductor scar. The shape, sculpture and pigmentation of inner side of shell and along the edges of the mantle and tentacles of *C. virginica* are known to vary very much (Galtsoff, 1964). The shell of *C. madrasensis* is heavier than that of *C. virginica* and there is dark purplish pigmentation along the inner margin of both valves in the former species. Until further malacological, karyological and physiological studies are made it is desirable to recognize *C. madrasensis* as a separate species.

This species grows to a size of 212 mm, the larger ones occurring in estuarine systems. It is a typical euryhaline species and flourishes especially well in turbid brackish waters like estuaries, creeks, bays and backwaters growing to a large size with heavy meat. It is also found in sheltered areas like ports and harbours where it occurs in large numbers attached to pillars, walls of wharves and buoys and along open coasts where hard substrata like rocks or stones are present for settlement. It is found from midlittoral zone to a depth of 15-16 metres.

The species is widely distributed in India and occurs along the east coast in Bahuda estuary near Sonapur, Vishakhapatnam, Sarada estuary, Kakinada, deltas of Godavari and Krishna Rivers, Gokulapalli, Pulicat

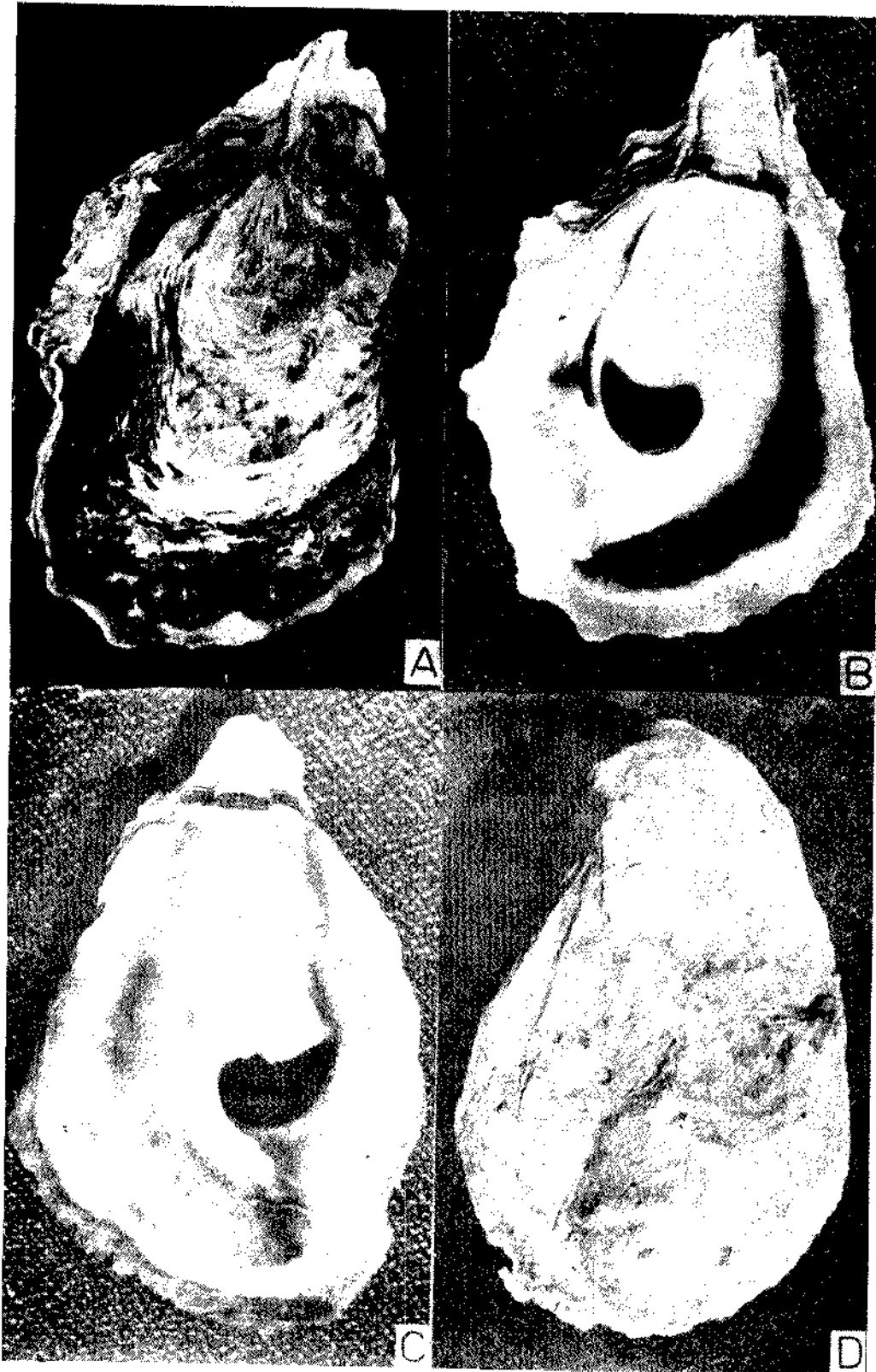


PLATE I. A. *Crassostrea madrasensis* (Preston). B. Inner view of left valve of *C. madrasensis*. C. Inner view of right valve of *C. madrasensis*. D. *Crassostrea gryphoides* (Schlotheim).

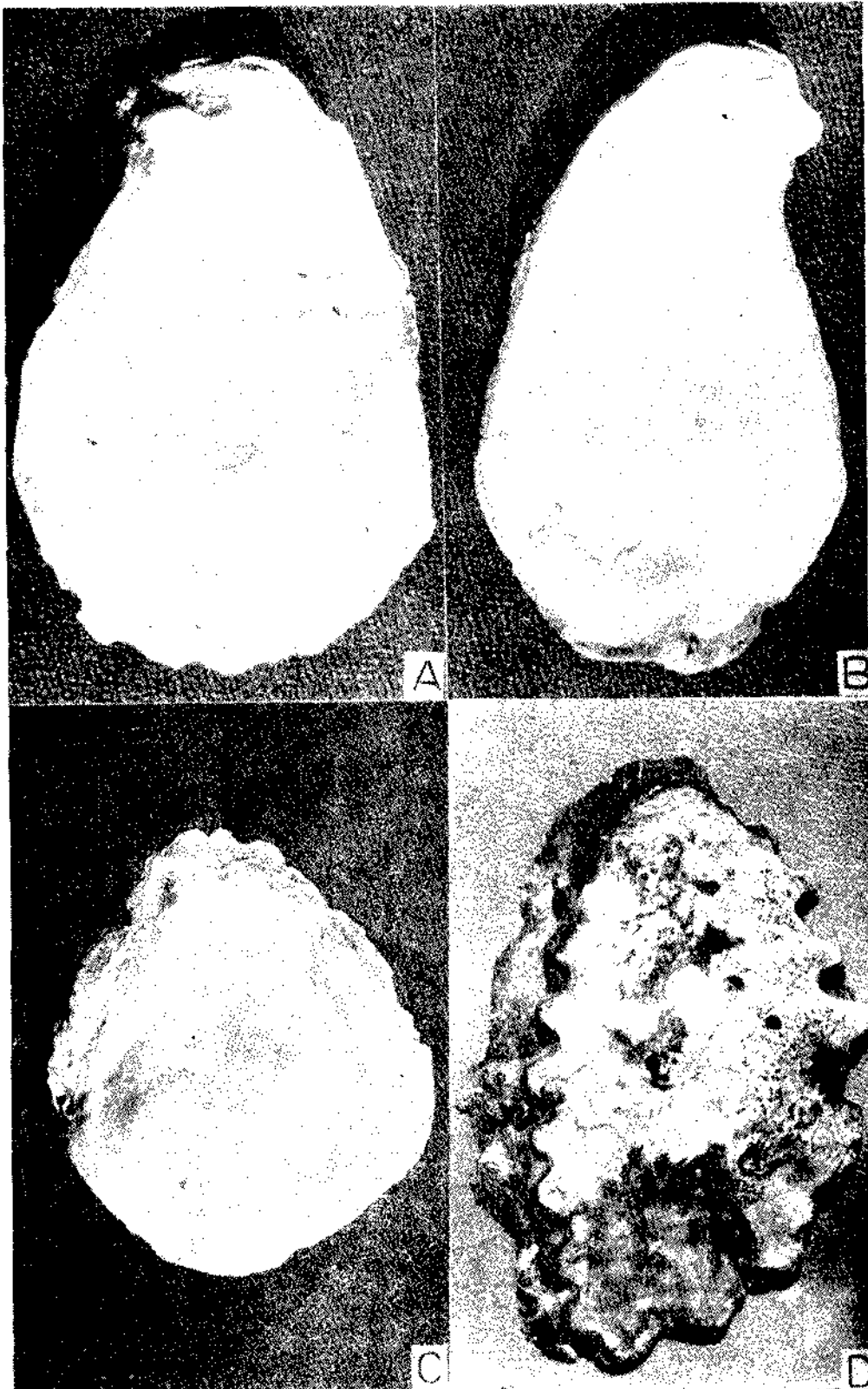


PLATE H. A. Inner view of left valve of *C. gryphoides*. B. Inner view of right valve of *C. gryphoides*. C. Inner view of left valve of *Crassostrea rivularis* (Gould). D. *Succostrea cucullata* (Born).

Lake, Ennur, Madras, Killai backwaters, Cuddalore, Muthupet, Sundarapandiappattinam, Karangad, Athankarai, Kancharangudi, Tuticorin, Pinnakayal and Palayakayal and on the west coast in Anchengo backwater, Ashtamudi and Vembanad Lakes, Cochin Harbour and backwaters, Azhikode, Beypore, Tellicherry, Elathur, Chaliyar Estuary, Pavanji, Sambhavi, Sitanadhi, Coondapur, Venkatapur, Sharavathi and Kalinadhi Estuaries and at Sikka and in Pirotan Island in Gujarat. This species occurs along Pakistan coast also (Ahmed 1971, 1975).

*Crassostrea gryphoides* (Schlotheim)

Synonyms

- Ostrea gryphoides* Vredenburg, 1904, *Rec. Geol. Surv. India*, 31, 174-176.
- Ostrea gryphoides* Awati and Rai, 1931, *Ostrea cucullata* (The Bombay oyster), *Indian Zool. Memoir*, III, 6-7.
- Crassostrea gryphoides* Durve and Bal, 1961, *J. Zool. Soc. India*, 13, 70.
- Crassostrea gryphoides* Rao 1974, Ch. II, In *The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25, 27-28.

Description

The shell valves are elongate and thick. Width of shell 0.60 to 0.72 and thickness 0.30-0.31 in length. Left valve cup like, hinge area is well developed and has a deep median groove with lateral elevations. Denticles are not present on the inner margins of valves. Adductor muscle scar is broad, more or less oblong and striations on the scar are obscure or absent. The inner surface of valves and adductor scar are pearly white in colour (Pl. I D, Pl. II A and B).

Remarks

The species grows to a size of 170 mm and occurs in the intertidal zone and down upto a depth of seven metres. Like *C. madrasensis* it is a euryhaline species, and inhabits coastal waters, estuaries and creeks of Goa, Maharashtra and Gujarat. Beds of the species are found in several places in Maharashtra such as Malad, Boiser and Satpuri Creeks, Palghar, Mahim, Kelwa, Navapur, Utsali, Dahisar, Alibag, Ratnagiri, Jaytapur and Malwan (Alagarwami and Narasimham, 1973). The species occurs at several places along the Bombay coast but does not grow more than about 40 mm in length due to heavy pollution of littoral waters. It is found at Dwarka, Aramda, Sikka,

Poshetra, Balapur, Nora Island, Baida Island and Azad Island in Gujarat (Sarvaiya and Chhaya, 1983).

*Crassostrea rivularis* (Gould)

Synonyms

- Ostrea discoidea* Awati and Rai, 1931, *Ostrea cucullata* (The Bombay Oyster), *Indian Zool. Memoir*, III, 7.
- Ostrea rivularis* Cahn, 1950, In *Oyster Culture in Japan*, 12.
- Crassostrea discoidea* Rao, 1958, In *Fisheries of West Coast of India*, S. Jones (Ed.) 55-59.
- Crassostrea discoidea* Alagarwami and Narasimham, 1973, *Proc. Symp. Living Resources around India*, 654.
- Crassostrea discoidea* Rao, 1974, Ch. II, In *The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25, 36.
- Crassostrea rivularis* Imai, 1977, In *Aquaculture in Shallow Seas: Progress in Shallow Sea Culture* 125-126.

Description

This species is characterized by large, roughly round, flat, thick shell valves with a shallow shell cavity. Width of shell 0.77 to 0.89 and thickness 0.27-0.29 in length. The left valve is thick and slightly concave and the right one is about the same size or slightly larger. Adductor muscle scar is oblong and white or smoky white in colour. Inner surface of valves is white and bright (Pl. II C).

Remarks

This species can be distinguished by the shape of the shell valves, shallow shell cavity and oblong white adductor scar. The species is synonymous with *O* (=C). *discoidea* recorded by Awati and Rai (1931) along Bombay coast as the structural features are similar. Imai (1977) has stated that the hinge part of the shell of *C. rivularis* is violet brown in colour. The colouration may be caused by ecological conditions such as luxuriant growth of sea weeds in the vicinity or some other such factor and therefore should not be considered a diagnostic character of taxonomic importance. The species grows to a size of 150 mm and inhabits the intertidal zone of coastal waters and creeks. It occurs in the creeks of Kutch, Aramda Creek, Poshetra Point, Port Okha, Dwarka and Porbandar in Gujarat and at Mahim, Ratnagiri and Jaytapur in Maharashtra. Outside India it is distributed along Pakistan coast (Ahmed, 1975), China and Japan (Cahn 1950, Imai 1977).

*Crassostrea cristagalli* (Linnaeus)

**Synonyms**

*Mytilus cristagalli* Linnaeus, 1758, *Systema Naturae*, 10th Ed.

*Ostrea cristagalli* Lamarck, 1819, *Histoire Naturelle des Animaux Sans Vertebres* 6 (1).

*Ostrea (Lopha) cristagalli* Standen and Leicester, 1906, *Report to the Govt. of Ceylon on the Pearl Oyster Fisheries of the Gulf of Mannar*, W. A. Herdman, Ed., V, 267-294.

*Ostrea crista-galli* Hornell, 1922, *Madras Fish. Bull.*, 14, 97-215.

*Ostrea cristagalli* Prashad, 1932, *Monogr. Siboga Exped.* 29, 1-353.

*Ostrea cristagalli* Satyamurthy, 1956, *Bull. Madras Govt. Mus. (New Ser.) Nat. Hist. Sect.* 1 (2) Part 7, 68-69.

*Crassostrea crista-galli* Rao 1974, Ch. II. In *The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25 : 36-37.

**Description**

The shell is broadly rounded or subquadrate in shape with the margins of valves thrown into deep, sharp, angular folds and interlocking with each other. The outer surface of the folded margins has diverging, closely set, granulated striae. The external shell colour varies from brownish to violet and the internal surface of the valves is greyish white.

**Remarks**

The species known as Cock's comb oyster due to the shape of the shell can be identified by the deeply angular folds of the shell margin and the brown or purplish colouration. It occurs attached to stones or dead corals and grows to a size of 60 mm. At Poshitra Point, Okha District, Gujarat, beds of the species are found and the oysters are collected and consumed by fisherfolk locally. Stray individuals of the species occur along the Thanjavur coast, Palk Bay and Gulf of Mannar.

*Crassostrea folium* (Gmelin)

**Synonyms**

*Ostrea folium* Chemnitz, 1781, *Conch. Cab.*, V, 8 pl. vii, Figs. 662 and 666.

*Ostrea folium* Gmelin 1791, *Syst. Nat.*, Ed. XIII, 33-34.

*Ostrea folium* Reeve, 1873. *Conch. Icon.*, XVIII, *Ostrea*, pl. xviii, Fig. 40.

*Ostrea folium* Satyamurthy, 1956, *Bull. Madras Govt. Mus. (New Ser.) Nat. Hist. Sec.*, 1 (2) Part 7, 69.

*Crassostrea folium* Rao, 1974, Ch. II. In *The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25 : 37.

**Description**

Shell broadly ovate in shape. The left valve is deeply concavely excavated along the middle to fit surface of attachment. Right valve is raised into a broad tube-like longitudinal rib in the middle corresponding to the excavation of left valve. Shell has a number of rounded folds diverging away from the rib-like elevation in the middle. The surface of valves is more or less smooth except for a few thin overlapping laminae towards the margin. Colour of valves pale grey or brownish purple externally and greyish internally.

**Remarks**

This species is found as solitary individuals attached to floating twigs in Pamban on the Southeast coast and in Gulf of Kutch and is not of economic value. It grows to a size of about 50 mm.

GENUS *Saccostrea* Dollfus AND Deutzenberg

Shell elongate and trigonal in shape. Shell cavity moderately deep. Umbonal cavity prominent. Tubercles present along the inner margin of the right valve with corresponding depressions in the left valve.

*Saccostrea cucullata* (Born)

**Synonyms**

*Ostrea forskali* Chemnitz, 1785, *Neues Systematisches Conchylien Cabinet*, 8.

*Ostrea cucullata* Born, 1780, *Testacea Mus. Caes. Vindobon.*, 114, pl. vi.

*Ostrea cucullata* Awati and Rai, 1931, *Ostrea cucullata* (The Bombay Oyster), *Indian Zool. Memoir*, III, 107 pp.

*Ostrea forskalii* Gravely, 1941, *Bull. Madras Govt. Mus. New Ser. Nat. Hist. Sect.*, 5 (1) : 41.

*Crassostrea cucullata*, Rao, 1969, *Indian Frmg.*, 29 (9) : 41.

*Crassostrea cucullata* Rao, 1974, Chapt. II. In *The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25 : 33.

### Description

The shell valves of this species are hard and stony, and the shape is trigonal or pear shaped. The left valve is deep or moderately so. The right valve is flat or slightly convex and covers the left one like a lid. The hinge is straight, of moderate size and devoid of teeth and the umbral cavity well developed. The margins of both valves have well developed angular folds sculptured with laminae. Small tubercles present along the inner margin of the right valve and there are corresponding pits in left valve. Adductor scar is kidney shaped, striated and white or greyish in colour. Colour of the outer surface of valves is variable being pale white, grey, light or dark brown, green or purplish. Inner surface of valves is white (Pl. II D).

### Remarks

This species known as rock oyster since it is usually found attached to rocks in the intertidal zone is included in the genus *Saccostrea* due to the genetic character, the presence of tubercles along the inner margin of the right shell valve. The diagnostic features of the species are the trigonal or pear shape, the marginal angular folds of the shell and oblong adductor scar. According to Stenzel (1971), the Sydney rock oyster *Crassostrea commercialis* is a subspecies of *Saccostrea cucullata*. Stenzel considers *Saccostrea cucullata* as a complex superspecies from which different stocks have evolved. This view cannot be accepted unless there are evidences of genetic differences and reproductive isolation.

In contrast to *Crassostrea madrasensis*, *Saccostrea cucullata* is distributed in the marine environment in shallow coastal waters and creeks. The species enjoys a wide distribution and is found in East Africa, India, Pakistan, northwestern Australia and Philippines (Ahmed, 1975). In India it occurs at various places along both the east and west coasts and around Andaman and Lakshadweep Islands. On the mainland it is found in Visakhapatnam, Madras, Killai backwaters, Mandapam, Krusadai Island, Pudumadam and Tuticorin on the east coast and Cochin, Pavanji Estuary, Coondapur Estuary, Kalinadhi, Goa, Coastal waters and Creeks of Maharashtra and Gujarat on the

west coast. Oysters of this species are found growing attached to rocks in some creeks of Bombay coast (Sundaram, personal communication) and at Aramda, Dwarka, Adatra and Hanuman-dandi in Gujarat (Sarvaiya and Chhya, 1983).

Three species of oysters *Ostrea cornucopia*, Chemnitz, *O. glomerata* Gould and *O. belcheri* Sowerby have been reported by Awati and Rai (1931) who also refer to the record of three more species *O. crenulifera* Sowerby, *O. bicolor* Hanley and *O. lacerata* Hanley by Standen and Leicester in the Proceeding of Manchester Library and Philosophical Society, Vol. 7, 4th Series. Due to the absence of material, the species mentioned by Awati and Rai (1931) are not dealt with here.

Oysters are distributed at several places along our coasts and we have knowledge of the common species found in a number of areas where studies have been carried out. But our knowledge of the identity of the oyster species of India is far from complete. Very little information is available on the oyster populations in the northeast and northwest coasts of India. Recent work indicates that consideration of shell characteristics alone will not be helpful in correctly distinguishing species of oysters as they are highly influenced by ecological conditions and study of morphometric characters, structure of chromosomes, protein bands and chemical composition may be useful in identifying oyster species.

From a study of oysters collected from some parts of Indian coasts carried out employing above techniques Anonymous (1984) has indicated that there are five species, *Crassostrea madrasensis*, *C. gryphoides*, *C. rivularis*, *C. (=S.) cucullata* and *C. (S) crenulifera* and the first three species showed similarities in biochemical characteristics and the other two formed a different group. It has also been observed that *C. gryphoides* and *C. rivularis* are closer to one another in biochemical make up compared to *C. madrasensis*. A thorough study of oysters collected from various parts of the Indian coasts using such techniques is needed for removing confusion which exists about some species and for better understanding of the identity of the various species as well as their affinities.



## REFERENCES

- AHMED, M. 1971. Oyster species of West Pakistan. *Pakist. J. zool.*, 3 : 229-236.
- AHMED, M. 1975. Speciation in Living oysters. *Adv. mar. Biol.*, 13 : 357-397.
- ALAGARSWAMI, K. AND K. A. NARASIMHAM. 1973. Clam, cockle and oyster resources of the Indian coasts. *Proc. Symp. Living Resources Seas around India*, C.M.F.R.I. Special Publication, 648-658.
- ANNANDALE, N., AND S. KEMP. 1916. Fauna of the Chilka Lake Mollusca Gastropoda and Lamellibranchiata. *Mem. Ind. Mus.*, 5 : 329-366.
- ANONYMOUS. 1984. *Final Report of the I.C.A.R. Project 'Taxonomy and Distribution of oysters along the west coast of India'*. Dept. of Fisheries and Limnology, Rajasthan Coll. of Agricult., Sukhadia University, Udaipur, 36 pp.
- AWATI, P. R. AND H. S. RAI 1931. *Ostrea cucullata* (The Bombay Oyster). *Indian Zool. Memoir*, III : 107 pp.
- CAHN, A. C. 1950. *Oyster Culture in Japan*. Publ. by Gen. H.Q. Supreme Commander for the Allied Forces Nat. Resour. Sect. Rept., 134, Tokyo, 80 pp.
- DURVE, V. S. 1968. On the nomenclature of two Indian backwater oysters. *J. mar. biol. Ass. India*, 9 : 173-178.
- DURVE, V. S. AND D. V. BAL 1961. Studies on the chemical composition of the oyster, *Crassostrea gryphoides* (Schlotheim). *J. mar. biol. Ass. India*, 13 : 70-77.
- GALTSOFF, P. S. 1964. The American oyster *Crassostrea virginica* (Gmelin). *U.S. Fish and Wildlife Serv., Fish. Bull.* 64 : 1-480.
- GRAVELY, F. H. 1941. Shells and other animal remains found on the Madras Beach. I. Groups other than snails etc. (Mollusca Gastropoda). *Bull. Madras Govt. Mus. N.S. Nat. Hist.*, 5 (1) : 1-112.
- HORNELL, J. 1910. Note on an attempt to ascertain the principal determining factor in oyster spawning in Madras backwaters (Madras Fish. Investigations, 1908), *Madras Fish. Bull.*, 4 : 25-31.
- HORNELL, J. 1922. The Common Molluscs of South India. *Madras Fish. Bull.*, 14 : 97-215.
- IMAI, T. 1977. Chapt. I. Biological Research on the oyster, In *Aquaculture in Shallow Seas : Progress in Shallow Sea Culture*. Transl. From Japanese, Oxford & IBH Publishing Co., New Delhi, 125-126.
- INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE, 1955. Opinion 338. Acceptance of the Mesozoic fossil species *Gryphaea arcuata* Lamarck, 1801, as the type species of the nominal genus *Gryphaea* Lamarck, 1801, and addition of the generic name *Gryphaea* Lamarck, 1801 (Class Pelecypoda) to the Official List of Generic Names in Zoology. *Opinions and Declarations rendered by the International Commission on Zoological Nomenclature*, 10 (5) : 125-180.
- KORRINGA, p. 1952. Recent advances in oyster biology. *Quart. Rev. Biol.*, 27 : 266-308.
- LAMARCK, J. 1801. *Système des animaux sans vertèbres*, Crapelet, Paris, 432 pp.
- PRESTON, H. B. 1916. Report on a collection of Mollusca from the Cochin backwaters. *Rec. Indian Mus.*, 12 : 27-39.
- RANSON, G. 1948. Prodissoconques et classification des ostreïdes vivantes. *Bull. Mus. Hist. nat. Belg.*, 24 : 1-12.
- RANSON, G. 1950. La chambre promyaire et la classification zoologique des ostreïdes. *J. Conchyliol.*, 90 : 195-200.
- RAO, K. VIRABHADRA. 1956. Seasonal changes in the adult backwater oyster *Ostrea (Crassostrea) madrasensis* (Preston) from Ennur near Madras. *Proc. Indian Acad. Sci.*, 44B : 332-356.
- RAO, K. VIRABHADRA. 1958. Molluscan Fisheries. In *Fisheries of West Coast of India*. S. Jones (Ed.), 55-59.
- RAO, K. SATYANARAYANA. 1974. Chap. II. Edible Bivalves Mussels and oysters. In: *The Commercial Molluscs of India*, *Bull. Cent. Mar. Fish. Res. Inst.*, 25 : 4-39.
- SARVAIYA, R. T. AND N. D. CHHAYA 1983. *Saurashtra Molluscs*. Prabhatba R. Sarvaiya, Ahmedabad, 46 pp.
- SATYAMURTHI, S. T. 1956. The Mollusca of Krusadai Island (in Gulf of Mannar) II. Scaphopoda, Pelecypoda and Cephalopoda. *Bull. Madras Govt. Mus. (New Ser). Nat. Hist. Sect.*, 1 (2) Pt. 7 : 202 pp.
- STENZEL, H. B. 1971. Oysters. In *Treatise on Invertebrate Paleontology* N 953-N 1224 pp. Part N, 3 (3), Mollusca 6. K. C. Moore, (Ed.) Geological Society of America Inc. and the University of Kansas, Boulder, Colorado.