

# CMFRI bulletin 42

Part One

AUGUST 1988



## **NATIONAL SEMINAR ON SHELLFISH RESOURCES AND FARMING**

**TUTICORIN**

19-21 January, 1987

---

**Session - I**

---

**CENTRAL MARINE FISHERIES RESEARCH INSTITUTE  
(Indian Council of Agricultural Research)  
P. B. No. 2704, E. R. G. Road, Cochin-682 031, India**

## 7. ROCK OYSTER RESOURCES. OF BOMBAY COAST

K. S. Sundaram  
Central Marine Fisheries Research Institute, Cochin 682 031

### ABSTRACT

The results of a preliminary investigation conducted on the resource of the rock oyster *Saccosifea cucullata* from two selected centres viz. Baridra and Worli Sea Face are presented and discussed. Information on the population density, size, predators, pests and other associated organisms of the oyster and the general features of the oyster beds is given. The total area of the oyster beds at both the centres is 87,500 m<sup>2</sup>. The estimated standing stock of *S. cucullata* is 80.66 million in number and 3,35,125 kg in total weight. The estimated shell weight and meat weight are 2,80,825 kg and 33,075 kg respectively. Oysters of size range 7.00 mm to 55.00 mm with a mean length of 28.44 mm are represented in population. Adult oysters of 13-41 mm size groups formed 81.04%. The littoral concrete found along the coast is an ideal habitat for the settlement of the rock oysters.

### INTRODUCTION

Among the edible bivalves, oysters have a prime place due to the nutritive value and palatability of the meat. *Crassostrea madrasensis*, *C. gryphoides*, *C. rivularis* and *Saccostrea cucullata* are the commercially important oysters of India. The contributions of Rai (1928, 1932), Awaiti and Rai (1931), Subrahmanyam et al (1949), Durve and Bal (1962), Jones (1968), Alagarwami and Narasimham (1973), Rao

(1987) and Mahadevan (1987) give information on the oysters of Maharashtra. Rao (1987) stated that *S. cucullata* inhabits shallow coastal waters and creeks along both the coasts of India including Andamans and Lakshadweep. Mahadevan (1987) reported that the population of this oyster found along Maharashtra and Gujarat coasts is exploited for food on a small scale. He further stated that our information on the extent of beds, population density and

magnitude of the recruitment of *Ostrea* of India is still fragmentary. James (1987) emphasized the need to assess the oyster resource potential and collect information on the suitable areas for the culture of edible oysters for the benefit of enthusiastic entrepreneurs and agencies in states like Kerala, Goa and Maharashtra where there is no data base for the same at present. *Saccostrea cucullata* occur along the rocky littoral zone of Bombay and form beds. A preliminary study on the population of this little known resource was conducted during January-March 1986 in order to enhance our knowledge in the management and development of this food species for the benefit of the coastal fisher folk.

### MATERIAL AND METHODS

The extent of the oyster bed, standing stock, population density and size and ecology of the oyster have been investigated from two centres viz., Bandra and Worli Sea Face along the Bombay coast. The area of the oyster bed was determined by measuring the length and breadth during extreme low water spring tides and with the help of a map of the region. As oysters are found distributed continuously all along the rocky littoral zone the average breadth of the oyster belt was taken for the estimation of the total area of the oyster bed at both centres of the study. The oysters were sampled at every 100 m length of the oyster belt with a 25 cm<sup>2</sup> quadrat. One to 4 samples were taken from each station depending on the width of the oyster belt. The number, total weight (shell on), shell weight and meat weight of all live oysters in the sample were recorded and from this the average density/m<sup>2</sup> was derived. The meat was weighed after draining all the water. Based on this data the standing stock, density and meat weight of oysters in the bed were estimated. Data on length, predators, pests and other associated organisms of oysters were collected. The length was taken as the

greatest measure in an antero-posterior direction of the shell of the oysters. A representative sample of 100 oysters from both the centres was analysed for sex and condition of the gonad in order to know the breeding of the oyster. A chisel, hammer, and sharp knife were used to remove the oysters attached on rocks. Gonads

were examined under microscope. The survey was carried out at both the centres and the data collected for the period January to March 1986 were pooled for the estimation of different parameters. The general features of the littoral region were noted,

### General feature of the oyster beds

The oyster resources have been collected are situated on either side of the Mahim Bay along the coast (Fig 1) The tides are semidiurnal and the amplitude of spring and neap tides at Bombay is 3.66 m and 1.44 m.

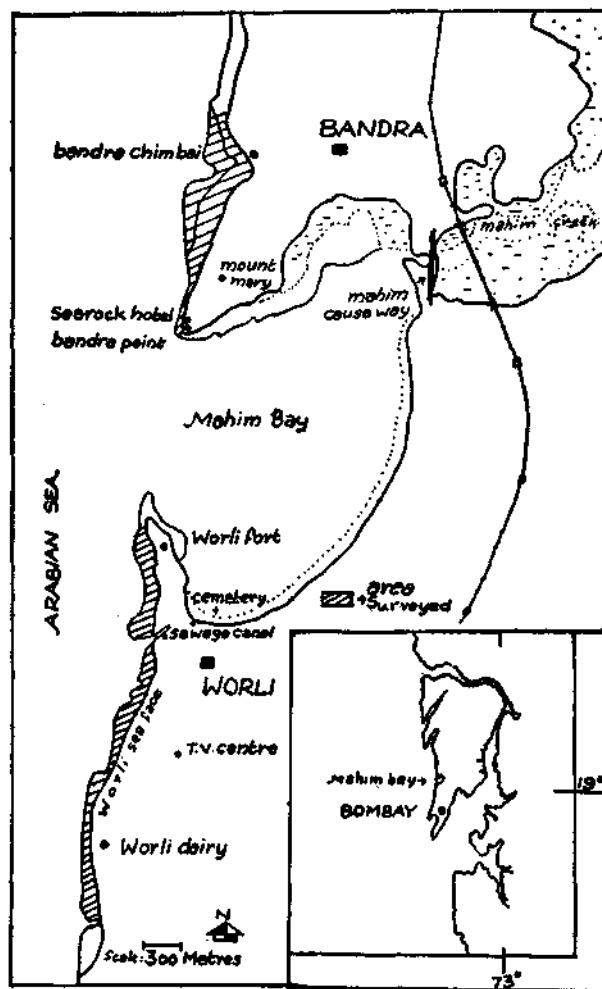


Fig. 1. Map showing the location of Bandra and Worli Sea Face, inset show\* the position of Bombay and Mahim bay.

### (<sup>o</sup>) Bandra Centre

This centre extends from the Sea Rock Hotel at Bandra point on the seaward side to

fish landing centre opposite Bandra chimbai village (Fig 1). The length of the beach surveyed is 2.0 km. Beach rock of littoral concrete s found in the entire zone. The area is shallow and 25 to 400 m (Breadth) of beach is exposed during extreme low water spring tides. The wide area of the littoral zone is towards the Bandra-chimbai village. Embankments constructed by placing small to moderate sized granite stones serve as fish traps in the area. Rock pools mounds occur in the zone. Small rock mounds are seen near the boat channel. Rock platforms or terraces are common. It has been observed that the waste materials from an indigenous cloth dying work on the beach is let into the littoral zone near the Sea Rock Hotel and the sand and silt brought along with the high waves get accumulated in the littoral zone and in some areas oysters are partially covered with coarse sand. The silt over the area makes the oyster bed very slippery when exposed and the sharp shell edges of the closely settled oysters give cut injury while walking on the horizontal beds with barefoot. The average effective width of the oyster belt is 30 m. The rock oysters occupy an area of 6 h.

(b) Worli Sea Face

The area lies between Worli Milk Dairy on the beach and Worli fort on the southern bank of the Mahim Bay (Fig 1) The total distance is 2.75 k.m. The dark granite type beach rocks found all along the shore are like those noticed at Bandra Centre. A sea wall is constructed along the road and large granite boulders are noticed scattered over the area below it on the shore. The shore is steep and rock platforms or terraces are very few in the exposed littoral zone. A sewage canal opens into the beach opposite the cementry. An area of 20 to 200 m (width) of the shore is emersed during low tide. The average width of the oyster belt is 10 m. The total area of the oyster bed is 2.75 ha.

Saccostrea Cucullata Population

(a) Bandra centre

A single species of oyster *Saccostrea cucullata* forms bed at this centre. The density of *S. cucullata* varied from 576 to 1792/m<sup>2</sup> with an average of 1062/m<sup>2</sup>. The number of oysters in the bed is 63,72,0000. The total biomass of oysters ranged from 1.57 to 5.89 kg/m<sup>2</sup> with an

average of 4.38 kg/m<sup>2</sup>. The total biomass of oysters in the bed is 2,62,800 kg. The shell weight ranged from 1.25 to 5.12 kg/m<sup>2</sup> with an average of 3.75 kg/m<sup>2</sup>. The weight of the-shell in the entire bed is 2,25,000 kg. The meat weight ranged from 0.22 to 0.64 kg/m<sup>2</sup> with an average of 0.40 kg/m<sup>2</sup>. In the bed 24,000 kg of meat is present,

Length of *S. cucullata* ranged from 7 to 50 mm with a mean length of 25.86 mm. The percentage frequency of oysters of different size groups is given in Figure 2. The 18-20 mm and 30-32 mm modal groups were prominent in the Population. The percentage of spats and young oysters of size range 6-17 mm was 38.55%. Oysters of size range 21-41 mm constituted 54.94%. The large sized adult oysters of 42-57 mm size group formed the rest.

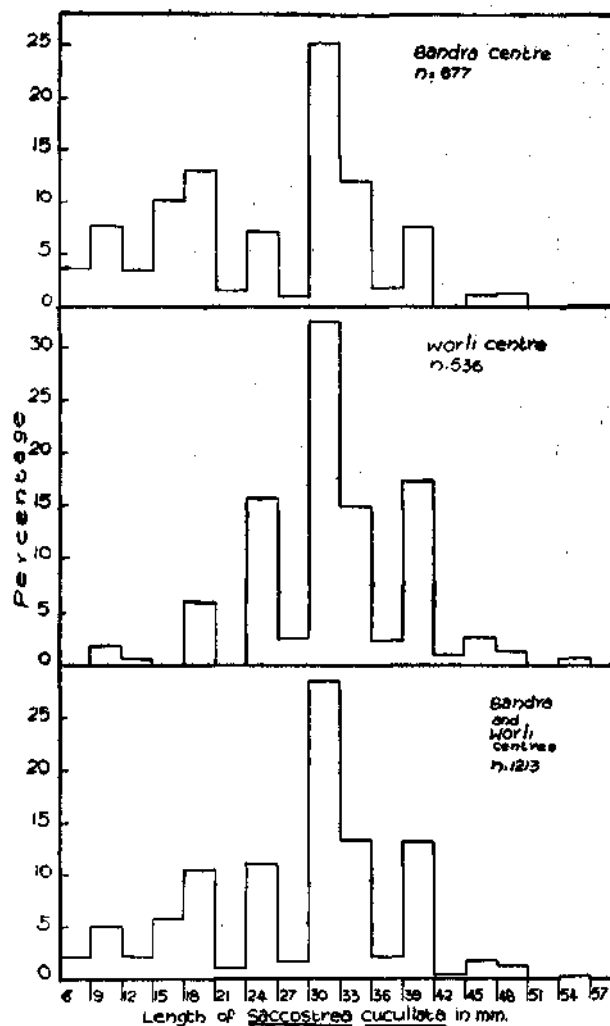


fig. 2. Percentage frequency of *S. cucullata* in the oyster beds at Bandra and Worli seaface.

Oysters are not exploited from the bed. Sometimes the fisherfolk scoop out the meat of large oysters from the cupped valve of the oyster by breaking the flat upper valve with the help of a sharp knife and use it as food. Immature, mature and partially spawned individuals of both sexes are met with in the population. The meat of the partially spawned oyster is thin, loose and watery. Ripe gonads are cream coloured and thick,

#### 'yúQñi' CQñttG

At this centre also *Saccostrea cucullata* is the only species found in the beds. The density of this oyster ranged from 256 to 1536/m<sup>2</sup> with an average of 616/m<sup>2</sup>. A total of 1,69,40,000 oysters are found in the bed. The total biomass of oysters in the entire bed is 72,325 kg. The shell weight ranged from 0.79 to 4.99kg/m<sup>2</sup> with an average of 2.03 kg/m<sup>2</sup>. The weight of the shell in the bed is 55,825 kg. The meat weight ranged from 0.14 to 0.66 kg/m<sup>2</sup> with an average of 0.33 kg/m<sup>2</sup>. The meat weight of the oysters in the bed is 9.075 kg.

The length of *S. cucullata* at Worli Centre ranged from 9 to 55 mm with a mean length of 31.70 mm. The percentage frequency of each size group is given in Figure 2; 24-26, 30-32 and 39-41 mm are the prominent modal groups. Spats in the population was very insignificant. The adult oysters of size range 24 to 41 mm form 85.26% of the population. The condition and nature of gonads are the same as observed at Bandra centre. Oysters are not fished from this area.

### ECOLOGY

a) *Settlement of oysters:* The rock oysters *Saccostrea cucullata* firmly adhere to the littoral concrete and colonize the mid littoral zone and in some places invade the supralittoral fringe. The oyster belt is distinctly noticed at both the centres and their zonation pattern is the same at both centres. The oyster spat cement their left valve to the substratum and its shell assumes various sizes and shapes. The right valve closes the animal like a lid and the valves of the oyster are tightly closed when it is exposed during low tide. The shell valves are hard and stony but not heavy. The colour of the outer

side of the shell is light brown or dirty white and almost blends with the colour of the substratum on which it gets attached. High density of oysters occur on exposed rocks and littoral platforms or terraces, especially at Bandra. The magnitude of settlement on protected or semi-exposed rocks of shoreward side and on polluted surfaces, as noticed near the sewage canal outlet at Worli, is very much less,

b) *Predators:* *Thais tiszoti*, *Bursa granularis* and *Drupa tuberculata* are the predatory gastropods recorded, *Littoridin* is found wedged on rocks at the centres at a density of 0.5/m<sup>2</sup> at Worli. This snail is very inactive when exposed. The other two species are present at Bandra. Oyster drills are not found.

#### *Pests and other associates*

The acorn barnacle *Balanus amphitrite* is the chief pest of the oysters. These animals are found attached on the beach rocks and shells of oysters in the midlittoral zone at both the centres. The average density of this barnacle is 855/m<sup>2</sup> at Bandra and 3413/m<sup>2</sup> at Worli. The shell of the oysters occurring on the rock platforms in the littoral zone at Worli is fully covered by the barnacles and it is very difficult to find oysters settled there. The conical barnacle *Cathamalus steffatus* forms a belt in the mid-littoral zone and sometimes invades the oyster belt on the littoral concrete platforms at the littoral zone. Saniils like *Panaxis sulcatus*, *Nerita* sp., *Cerithium* spp and *Cellana radiata* occur on oyster bed. *Panaxis sulcatus* is found in groups amidst oysters and on rocks. The littorinids like *Nuditiorina* sp occupy the supralittoral zone. *Chaetomotpha* sp grows in the pools of the mid-littoral zone at Bandra. The skipper (*Boleophthalmus* sp) and *Therapon* sp are occasionally observed swimming in the pools in the oyster bed at Bandra centre. Polychaetes, small crabs, anemones and sponges have been seen from the littoral zone,

### DISCUSSION

Rai (1928, 1932), Awati and Rai (1931), Subrahmanyam et al (1949), Alagaraswami and Narasimham (1973), Rao (1974) reported about the exploitation and traditional farming of

*S. cucullata* and *Crassostrea gryphoides* in the shallow coastal areas and creeks of Bombay. The fishery for clams and oysters of Mahim Bay ceased due to water pollution. However, the ecological conditions and water quality are relatively better in the coastal waters outside the Bay. (Govindan and Desai 1980-81). The existence of rich rock oyster beds at Bandra and Worli confirms that the quality of the coastal waters have not deteriorated so as to inhibit settlement and growth of the oyster in the littoral zone.

The total area of the oyster bed at both the centres is 8.75 ha. The *S. cucullata* population present at Bandra and Worli shows variation in density and size. The standing stock of *S. cucullata* at Bandra and Worli in a hectare is 1,06,20,000 and 61,60,000 in number and 43,800 kg and 28,300 kg in total weight (shell on) respectively. This shows that the oyster population at Bandra is 41.10% more in number and 39.95% more in total weight than at Worli. The meat weight is 4000 kg/ha at Bandra and 3300 kg/ha at Worli. Thus the meat weight at Bandra is 21.21% more than that of Worli. At Worli the percentage of small size groups (0-20 mm) oysters constituted 9.33% in the population while at Bandra they formed 38.55%. So the mean length of oyster population at Bandra (25.86 mm) is less than that of Worli (31.70 mm). The percentage of meat in total weight of oyster at Bandra oyster bed is 9.13. The percentage of meat in total weight is higher (12.55) at Worli when compared to Bandra because of the higher percentage of larger size groups in the oyster population of Worli. The probable reasons attributed to the high density of settlement of oysters at Bandra may be due to the availability of suitable substratum in the form of littoral rock mounds and platforms or terraces, the shallowness of the area, less intensive competitors for food and space and limited number of predators. At Worli the population of barnacle, *Balanus amphitrite*, the chief competitor for food and space is 396% more than that of Bandra centre. The conical barnacle *Chthamalus* sp is also found in abundance at Worli. As larvae of oysters form food of barnacles (Rajapandian and Rajan 1987), there might be high degree of oyster larval pre-

dition. A sewage canal directly pollutes the oyster bed at Worli. However at Bandra centre direct pollution source is less.

The density of *S. cucullata* recorded from Bombay appears to be very high when compared to their occurrence in some other locations along east and west coasts of India observed by Rao and Sundaram (1972).

It is known that rock oyster is well adapted to the littoral mode of life. The oyster spat settled on the substratum in the littoral zone has no escape from its dwelling place and are subjected to all types of environmental stress of the zone viz. exposure to air, high temperature during summer months, rains, humidity and water pollution. The oyster has to respond to these variables and adjust for its survival and growth. The oysters have to depend on the incoming tide for suspended nutrients and planktonic food. This filter feeder has also got the ability to filter the maximum quantity of food within a short time when the high waters cover the oyster bed. Awati and Rai (1931) concluded that spawning in *S. cucullata* is continuous except during monsoon period (June to September) and spawning during summer months is very intense. These authors have suggested that salinity and temperature may be responsible for the spawning of the species. The fluctuations in the salinity and temperature of the coastal waters of Bandra and Worli is less (Govindan and Desai 1980-81). The spawning of *S. cucullata* inhabiting the Shirgaon creek at Ratnagiri occurred from October to January (Nagabhushanam 1983). The maximum size of *S. cucullata* recorded during present study is 355 mm. There is no work known to the author on the growth of this species from India. Rai (1928) stated that *S. cucullata* of Bombay grow to 3-4 inches in the natural beds and within a span of 4 to years reach a size of 4 to 6 inches in the transplanted beds. Saraiya and Chhaya (1983) recorded a length range of 32 to 117 mm for the *S. cucullata* inhabiting the littoral zone of Gujarat. *S. cucullata* found in the natural beds at Bombay show retarded growth. This condition may be due to the exposure during low tides, crowding of large number of spat in a small area and presence of foulers on the shells.

The prospects of developing a commercial fishery for *S. cucullata* appear very dim, The difficulty in harvesting these oysters from wild prevents the exploitation of this resource present in high concentrations along the coast. It is of interest to note that this species is cultured in some countries. Aquapop (1982) reports that in French Polynesia the spat of *S. cucullata*, collected on *Tridacna* shells, are grown on some structures and reach a size of 60-80 mm in two years. Unar et al (1932) have observed 50 mm growth of *S. cucullata* within a year in the grow out grounds of Banten Bay in Indonesia. The same species attains an average size of 45 mm in one year from 5 mm spat stage in an experimental farm at Sarawak, Malaysia (Oon et al 1982). The spat of rock oyster also could be collected from coastal areas of our country by using suitable cultches and grown on same material in unpolluted creeks.

#### ACKNOWLEDGEMENTS

The author is grateful to Dr. P. S. B. R. James, Director, Central Marine Fisheries Research Institute, Cochin for encouragement, to Shri S. Mahadevan, Scientist S-3 and Head of Molluscan Fisheries Division of CMFR Institute for guidance and to Dr (Mrs) Kagwade, Scientist S-3 and Officer in Charge, Bombay Research Centre of CMFRI, Bombay for her unflinching interest in the work, critically going through the manuscript and facilities.

#### REFERENCES

- ALAGARSWAMI, K. AND K. A. NARASIMHAM. 1973. Clam, cockle and oyster resources of the Indian coasts. *Proc- Symp. Living Resources in the Seas around India*. Cochin, India, CMFRI Special publications: 648-658.
- AQUAPOP. 1982. Bivalve culture in Asia and Pacific-French Polynesia. *Proc. workshop held in Singapore* (Eds: F.B. Davy and M. Graham), 16-19 February, 1982 pp. 31-33. IDRC, Ottawa, Canada.
- AWATI, P. R. AND H. S. RAI. 1931. *Qstrea cucullata* (The Bombay oyster) *Indian Zool. Memoir*, III: pp 107.

- DURVE, V. S. AND D. V. BAL. 1972. Preliminary observations on the growth of spat of the oyster *Crassostrea gryphoides* (Schlotheim) *J, Mar. biol. ass. India*, 4(2) : 206-213
- GOVINDAN- K. AND B. N. DESAI. 1980-81. Mahim Bay-A polluted environment of Bombay. *J India Fish. Ass.*, 10 & 11: 5-10.
- JONES, S, 1968. The Molluscan fishery resources of India. *Proc. Symp Molluscs Part. III: Marine Biological Association of India*, 906-918.
- JAMES, P. S. B. R. 1937. Overview of oyster culture: Present status and prospects *In: Oyster culture-Status and prospects*. (Eds: K. N. Nayar and S. Mahadevan). *Bull. Cent Mar. Fish. Res. Inst.* 38: 59-62.
- MAHADEVAN, S. 1987. Oyster resource of India, *In: Oyster culture-Status and prospects: (Eds: K. N. Nayar and S. Mahadevan)*. *Bull. Cent. Mar. Fish. Res. Inst.* 38. 14-16.
- NAGABHUSHANAM, R. 1983. Neuro Secretory control of reproduction in the oyster *Crassostrea cucullata*. *Proc. Symp. coastal Aquaculture*. Mar. Biol. Ass. India, Pt. 2: 495.
- OON NG FONG, JOSEPHING PONG AND TANGTWENPOH. 1982. Bivalve culture in Asia and Pacific Malaysia *Proc. Workshop held in Singapore* (Eds : Davy and M. Graham), 16-19 February, 1982, pp. 47-52, IDRC, Ottawa, Canada.
- RAI, H. S. 1928. A short account of the oyster Industry in the islands of Bombay and Salsette. *J. Bomb, Nat. Hist. Soci.* 33 (4) : 893-898.
- RAI, H.S. 1932. The shell fisheries of Bombay Presidency *J. Bomb. Nat. Hist. Soc.* 35 (4) : 826-847.
- RAJAPANDIAN, M. E. AND C. T. RAJAN. 1987. Biological aspects of oysters *In: Oyster culture-Status and prospects*. (Eds-

- K.N. Nayar and S. Mahadevan)" flo//.  
*Cent. Mar. Fish. Res. Inst.*, 38: 30-39.
- RAO. K. SATYANARAYANA. 1974. Edible Bivalves, Mussels and Oysters, *fn: The Commercial Molluscs of India.* (Eds: Nair R. V. and K. S.Rao) *Bull. Cent. Mar. Fish. Res. Inst.*, 25. 4-39
- RAO, K, SATYANARAYANA, 1987. Taxonomy of Indian oysters. *In: Oyster culture-Status and prospects. Bull. Cent. Mar Fish. Res. Inst.*. 38: 1-6.
- RAO, K. SATYANARAYANA AND K. S. SUNDARAM. 1972. Ecology of Intertidal Molluscs of Gulf of Mannar and Palk Bay. *Prac. inc/i Nat: S.ci.AciacI.*, 38 Part-B (5 & 6) :462-474.
- SARAIYA. R. T. AND JM. D. CHHAYA, 1983 *Saura^htra Molluscs.* ?. R. Saraiya, Ahmedabad, pp 46.
- SUBRAHMANYAM, T. V., K. R. KARANDIKAR AND N. M: MURTI. 1949. The marine Pelecypods of Bombay. *J. univ. Bofnbay.* 27 (5)-1-33.
- UNAR, M., M. FATUCHRI AND RETNO AND-AMARI. 1982. Bivalve culture in Asia and Pacific-Indonesia. *Proc. Workshop held in Singapore* (Es: F. B. Davy and M.Graham), 16-19 February 1982, pp 44 46,1DRC, Ottawa, Canada