

Indigenous knowledge in the management of Bivalve Fishery of South Konkan coast of Maharashtra, India

¹Gangan SS*, ²Metar SY, ³Nirmale VH, ⁴Chogale ND, ⁵Balange A K, ⁶Bhalekar MS & ⁷Pai R

¹ Khar Land Research Station, Bandar Road, Opp. Old Panvel Court, Panvel 410206; ^{2,3,5} & ⁶ College of Fisheries, Shirgaon, Ratnagiri 415629; ⁴ & ⁷ Marine Biological Research Station, Peth Killa, Ratnagiri 415612

E-mail: shardul76@rediffmail.com

Received 14.06.12; revised 22.10.12

Fishermen rely on their knowledge for their livelihood, so it has always been 'put to work' in the most practical sense. Study of the indigenous knowledge held by the fishermen will help in its recognition and preservation, besides generating important information base and pinpointing essential future research needs. The present study was conducted to gain access to the indigenous knowledge of the fishermen engaged in the bivalve fishery practiced in the region. A total of 100 fishermen constituted the sample size of the study. The data were gathered through a combination of personnel interview and non-participant observation methods. The study has documented rich, varied and potential indigenous knowledge associated with the management of the bivalve fishery. Indigenous knowledge on variety specific habitats, fishery season for bivalves, methods of their exploitation and preservation has been documented. Similarly indigenous knowledge related to preference timing and depth for bivalve exploitation, preparation of byproducts, and effect of different abiotic phenomenon on condition and availability of bivalves is noted.

Keywords: Indigenous knowledge, Bivalve fishery, Specific habitats, Exploitation and preservation, Preference timing for fishing

IPC Int. Cl.⁸: A01K 61/00- A01K 89/00, A01K 91/00, A01K 93/00, A01K 95/00, A01K 97/00

Indigenous knowledge is the knowledge gained by the people in a given community over a time period by experience, experimentation and handling on old people's knowledge. It is adapted to local culture and environment, and is dynamic in nature ¹. Use of indigenous knowledge allows fisherman living in discrete association with their environment to use the natural resources in a more sustainable way ²⁻³. It is fact that fishermen world over use the traditional knowledge to overcome specific localized problems based on their knowledge related to ecology and fish behavior ⁴, weather and oceanographic conditions, navigation ⁵, fishing methods ⁶, vessel design and propulsion and processing and trade, etc. Documentation, compilation and legitimization of indigenous knowledge assure that end users of specific development programmes are involved in developing technologies appropriate to their needs. Unfortunately, indigenous knowledge is either ignored or inadequately used by the fisheries scientists ⁷. Keeping this in view the present study

attempted to explore the indigenous knowledge possessed by fishers in managing the bivalve fishery off South Konkan coast. The bivalves comprising a variety of clams, oysters and mussels form part of molluscan landings in the state. The bivalve fishery is an important traditional fishery practiced in the South Konkan coast.

Methodology

The present study was conducted in purposively selected two coastal districts of Maharashtra namely, Ratnagiri and Sindhudurg representing the South Konkan. Geographically, the study area is located between 17° 02' 43" N latitude and 73° 16' 57" E longitudes to 15° 43' 46" N latitude and 73° 40' 37" E longitudes (Fig. 1). The two districts have a combined coastline of 281 km and continental shelf area of 52000 sq km. The active estuarine fishermen population of South Konkan is about 1625 ⁸. The bivalve fishery is concentrated in fishing villages situated adjacent to estuaries and creeks in the region and having rich bivalve beds. The study was carried out during the period from April 2009 to November

*Corresponding author

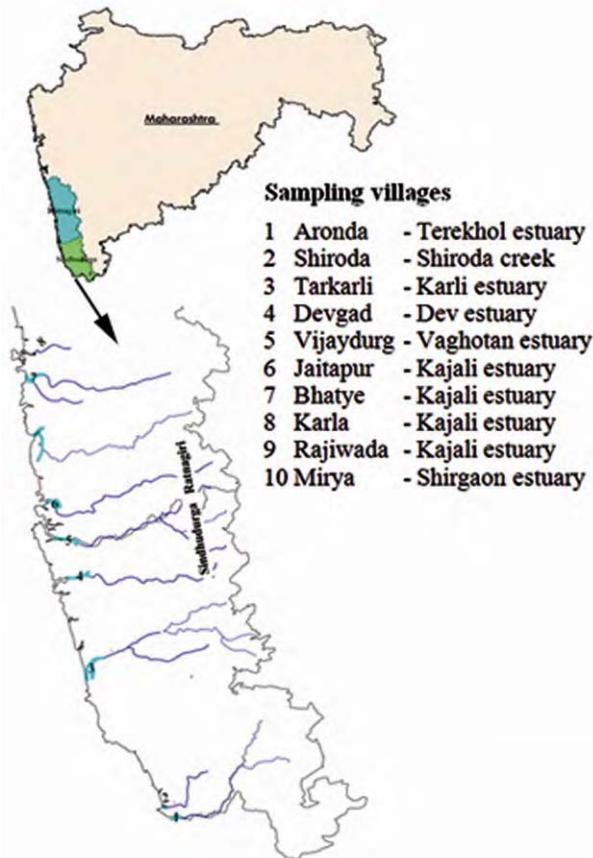


Fig.1 –Map of study area

2011 in ten randomly selected fishing villages where the bivalve fishery is concentrated. The selected villages were *Mirya*, *Karla*, *Bhatye*, *Rajiwada*, *Jaitapur*, *Aronda*, *Shiroda*, *Tarkarli*, *Devgad* and *Vijaydurg*. A total of about 100 fishermen including women were interviewed for the study. The data were collected with the help of semi-structured interview schedule designed by incorporating all the items on which the information was required. To support the findings of the study non-participant observation was carried out. All the questions were asked in the same way, in an understandable manner to the interviewed fishermen who were allowed plenty of time to answer. The respondents were selected using the ‘snow ball’ method in which people from the community and the interviewees themselves indicate the people to be interviewed⁹. Information gathered from the fishers was quantified as percentage of interviewees that mentioned a given answer to asked questions. The majority of often mentioned answers to a particular question were considered as reflecting aspects of indigenous knowledge. PIC (Prior Informed Consent)

was taken from the fishermen (about 100) with their names, village names and ages.

Results

1. Profile characteristics

The sum of percentages may differ from 100 %, because the interviewed fishers usually gave more than one answer to the same question. Age wise distribution of respondents shows that about 61% of the fishers are of above 40 yrs of age followed by 36% and 3% in the range of 25-40 yrs of age and upto 25 yrs of age, respectively. The majority 43% is having experience of bivalve capture of more than 20 yrs, followed by 38% fishers having experience between 11 to 20 yrs and 19% up to 10 yrs. Nearly 48% of the respondents were studied up to high school, 43% had primary schooling while 8% were illiterate. Most of the fishers were Hindu (70%) belonging to castes such as *Gaabit* (34%), *Bhandari* (23%) and *Kunbi* (20%). 24% of the respondents were Muslim followed by 6% fishers belonging to other categories. Out of total respondents 13% were women and 77% men.

2. Indigenous knowledge on availability of different bivalve species

A variety of bivalves comprising clams, mussels and oysters are fished along the estuaries dotting the South Konkan coast. Table 1 depicts the indigenous knowledge of fishers regarding popularly fished species of bivalves in the region comprising its local name, size range and different identifying characters. Fishers identify various clams, mussels and oysters based upon its external identifying characters particularly color, shape, size, thickness of valve (*shipe*) and markings on the shell.

3. Indigenous knowledge on availability of bivalves on particular habitat

Most of the fishermen opined that *tasare* (*P. malabarica*) are found on *retad/karap* substratum usually buried to a depth of 13 – 16 cm in inter to subtidal region. *Laali* (*Meretrix casta*) and *dhamni mule* (*M. meretrix*) are found on fine sandy surface to a depth of 5- 10 cm in intertidal estuarine areas. The Black Clam, *Karmale* (*Villorita cyprinoides*) are found on sandy substratum (*pulan*). *Todai* (*Soletellina diphos*) are found dispersed on sandy and muddy substratum, buried up to one & half feet depth. Fishermen also observed that there is a small circular mound of about one inch height on sand with a hole inside which *todai* is found. *Rangne* (*Anadora*

Table 1—Indigenous knowledge on availability of different bivalve species

Sr. No.	Species	Local name	Size range	Morphological characteristics as told by fishers
A. Clams				
1.	<i>Paphia malabarica</i>	<i>Tasre</i>	2 – 4 cm	Bivalve shell thin, horizontal markings
2.	<i>Meretrix casta</i>	<i>Lali mule</i>	2 1/2 – 5 cm	Varying colored, smooth surface, slimy meat secretion
3.	<i>M. meretrix</i>	<i>Dhamni mule</i>	5 – 7.5 cm	Bigger sized, varying colored, smooth surface,
4.	<i>Katylisia opima</i>	<i>Wati mule</i>	2 – 4 cm	Inflated, lead black colored, roundish
5.	<i>Polymedosa erosa</i>	<i>Mharai</i>	9 – 10 cm	Bigger & dark colored, bivalve shell thick
6.	<i>Anadora granosa</i>	<i>Rangane mule, Adare</i>	5 – 6 cm	Shell thick with vertical groove like markings
7.	<i>Tapus radiatus</i>	<i>Gubir</i>	2.5 – 5 cm	Whitish to brown in color, minute vertical & horizontal lines
8.	<i>Soletellina diphos</i>	<i>Todai</i>	8 – 12 cm	Elongated pale greenish to brown, shell thin & sharp edges
9.	<i>Villorita cyprinoides</i>	<i>Kale, Karmale</i>	3 – 5 cm	Black colored, shell thick.
B. Mussels				
1.	<i>Perna viridis</i>	<i>Kakai, Shinane, Shidane, Wakunda</i>	3 – 12 cm	Green colored, bivalve shell thin and longer
C. Oysters				
1.	<i>Crassostrea spp</i>	<i>Saad, Bud Kaalve</i>	12-16 cm	Irregular surface, oval shape, bigger sized
2.	<i>Saccostrea cuculata</i>	<i>Kaalve</i>	2.5 – 6 cm	Irregular surface, smaller size

granosa) and *wati* (*Katylisia opima*) are found on sandy plus muddy beds while *Mharai* (*Polymedosa erosa*) is found in muddy substratum in mangrove areas. As far as oysters are concerned, fishermen reported that *saad/bud kaalve* are found in subtidal areas with muddy to sandy bottom and the green mussel, *Shinane* are found on *khadap* in inter and subtidal areas.

4. Association of bivalve species with other species

Most of the fishers have reported the presence of tiny crabs locally known as *gadhav/khekade/jui* inside the cavity of some of the clams. They also stated the clams in which such crabs are present have relatively less meat. Fishermen stated that spotting of the Jelly fish locally known as *Jharm/jhar* in the estuary with high tide, presence of the *ghurap* (Gastropod) in intertidal areas as well as abundance of green algae in intertidal beds indicate good availability of clams in ensuing months.

5. Indigenous knowledge on fishery season for bivalves

Most of the fishermen opined that peak fishing season for clams such as *Laali* and *Karmale* and Green mussel, *Shinane* is during October to May. They reported the fishery season for *Laali* and *Karmale* to be throughout the year. The fishery season for *Tasare* is reported from November to February and January to May. The fishery season for *Wati* and *Dhamni* is reported to be during November to May and September to June. While fishermen opined that the fishery season for *Saad* and *Kaalve* is throughout

the year. Fishermen have also stated that most of the times the fishery for a particular species of clams is good and may last for 2-3 yrs continuously.

6. Indigenous knowledge on good harvest of bivalves based on rain during particular *nakshatra*

Fishermen opined that if there is rainfall during *Dev deepawali nakshatra* there will be good harvest of *laali* and if there is rainfall during *Hast nakshatra* there will be good harvest of *tasare*. Also there will be good catch of *mule* if it rains during *Rohini, Swati* and *Vishakha nakshatra* and good catch of *shinane* is obtained if there is rainfall during *saap nakshatra*.

7. Indigenous knowledge on effect of tides on availability of bivalves

Majority of the fishermen have indicated that more catch of clams is obtained during low tide. Also they viewed that less catch of clams is obtained during high tide. Most of the fishermen particularly women collect clams during low tide.

8. Indigenous knowledge on the effect of temperature on the condition of bivalves

Fishermen reported that the quantity of meat collectively in clams, oysters and mussels in that sequence is relatively more during summer and is less (a condition known as *niju/nijor* in oysters) during winter months.

9. Indigenous knowledge on the storage methods of bivalves

Fishermen use *Zole/Zaabli* a conical bag of varying capacity (1-20 kg) made up of nylon twine to store the

bivalves more preferably clams in fresh condition till they are sold. The bag is kept submerged in creek water with one end tied to buoy with rope. Clams can be stored for one to five days in this condition. The bag is agitated with hand daily or once in two days to facilitate creek water circulation.

10. Indigenous knowledge on preparation of byproducts from clams

Fishermen prepare *mulyacha kaat* a clam meat extract from *Tasare* (*Paphia malabarica*). They opined that the product has a shelf life of about six months to one year. Another product locally known as *Mulyache kaple* is also prepared from *Lali* (*Meretrix casta*) with a reported shelf life of about six months.

11. Indigenous knowledge on preservation methods of bivalves

Sun drying of the clams is the popular preservation method of the bivalves in the region. Most of the fishermen resort to sun drying if clams are collected in excess quantities. Fishermen stated that the dried clams can be preserved for a period of two-three months.

12. Indigenous knowledge on the effect of the lunar cycle/periodicity on the availability of the bivalves

One reflecting aspect of the indigenous knowledge regarding the effect of the lunar cycle on the availability of the bivalves is noted. Fishermen reported that more bivalves particularly oysters and mussels are available during spring tides.

13. Indigenous knowledge on preference timing and depth of operation for bivalve fishing.

Most of the fishermen including women prefer to collect the clams during low tide in exposed intertidal area and up to knee deep water depth. While rest collect the bivalves in a depth of about 2 - 7 m water when low tide is in progress and water has receded to half of its magnitude till when the high tide begins and water again rises to half of its magnitude.

14. Indigenous knowledge on methods of bivalve collection / exploitation

Fishermen resort to hand picking of the clams and fish them with the aid of either knife or *koyati* (knife like implement with sharp curved end) (Fig. 2). They make use of *aakli* (Fig. 3) to collect clams. *Aakli* is a gear made up of circular metal frame (dia 2- 4 ft) with a conical net attached to it (3-6 ft long). Similarly a gear locally known as *mhangare/aakya* (Fig. 4) is also used to collect clams. It is made up of triangular metal frame (1-2 ft x 1-2 ft x 1-2 ft) with a conical net

attached to it (5-6 ft long). Nails are fixed to the lower beam of frame. A bamboo pole is attached to the apex end of the frame. Collection of oysters is done with the aid of *hatodi* or hammer (Fig. 5) and *chhinni* (small iron bar with sharp end). While mussels are collected by skin diving with the help of *taasni* or *paarai*. Some fishermen collect clams by using *Indi* or *Konda* (Fig. 6). The gear comprises of a bag like conical net (5-6 ft), attached to a semicircular wooden frame (4-8 ft). The frame is made of out of *nirgundi* wood stick (*Sonnertia alba* J. Smith).

Discussion

1. Profile characteristics

Age wise distribution of respondents shows that about 61% of the fishermen are of above 40 yrs of age followed by 36% and 3% in the range of 25-40 yrs of age and up to 25 yrs of age, respectively. The majority 43% are having experience of bivalve capture of more than 20 yrs, followed by 38% fishers having experience between 11 to 20 yrs and 19% up to 10 yrs. Most of the fishermen are well experienced to be able to nurture indigenous knowledge related to the bivalve fishery. Information regarding educational status showed that about 48% of the respondents were studied up to high school and 43% had primary schooling while 8% were illiterate. Majority of fishermen had better access to education in respective villages. Most of the fishermen were Hindu (70%) belonging to castes such as *Gaabit* (34%), *Bhandari* (23%) and *Kunbi* (20%). While 24% of the respondents were Muslim followed by 6% belonging to other categories. Out of total respondents 13% were women and 77% men. Fishermen belonging to different communities and castes including women are actively engaged in bivalve collection. Indigenous knowledge is closely associated with local culture and customs.

2. Indigenous knowledge on availability of different bivalve species

A variety of bivalves comprising clams, mussels and oysters are fished along the estuaries dotting the South Konkan coast. Fishermen identify various clams, mussels and oysters based upon its external identifying characters particularly color, shape, size, thickness of valve (*shipe*) and markings on the shell. These characters help them to differentiate commercial varieties of bivalves easily. Scientific identification of the bivalves is also based upon the characteristics similar to those used by the fishermen



Fig. 2 to 6; 2. Fisher women with *Koyati*; 3. Fisherman with *Aakl*; 4. *Mhangare/ Aakya*; 5. *Hatodi* (Hammer) and 6. *Indi or Konda*

in identifying the bivalves. Most of the empirical data obtained from fishers regarding the identification of bivalves was corroborated with scientific identification of the species at the laboratory¹⁰⁻¹².

3. Indigenous knowledge on availability of bivalves on particular habitat

Reflecting aspects of indigenous knowledge from fishermen indicated that *tasare* (*P. malabarica*) are found on *retad/karap* substratum usually buried up to a depth of 5-6 inches in inter to subtidal region. *Retad/karap* relates to the substratum which is coarse sand with small broken particles of bivalve shells. *Laali* (*Meretrix casta*) and *dhamni mule* (*M. meretrix*) are found on fine sandy surface to a depth of 2-4 inches in intertidal estuarine areas. *Rangne* (*Anadora granosa*) and *wati* (*Katylisia opima*) are found on sandy plus muddy beds. The Black Clam, *Karmale* (*Villorita cyprinoides*) are found on sandy substratum (*pulan*). *Mharai* (*Polymedosa erosa*) is found in muddy substratum in mangrove areas. And *saad/bud kaalve* are found in subtidal areas with muddy to sandy bottom and the green mussels, *Shinane* are found on *khadap* (rocky substratum) in inter and subtidal areas. Scientific reports have stated that *P. malabarica* is found on sandy bottom^{13, 14} stated that for *Meretrix casta* 63-125 μm particle size is preferred habitat.^{15,13} have reported that *Meretrix meretrix* prefers predominantly sandy bottoms. While *Anadora granosa* and *Katylisia opima* thrives well in mud flats^{13, 12}. *Villorita cyprinoides* usually occurs in sandy bottom with coarse sand^{12, 16} have stated that the species belonging to the genus *Crassostrea* occur in intertidal areas upto a depth of 7- 16 m. Fishermen have intricate knowledge regarding the availability of different bivalves on particular habitat and most of the empirical data obtained from the fishermen is corroborated with scientific reporting. Fishermen know in which habitat a particular variety of clam, mussel and oyster is found and thus harvest them either by using suitable gear, hand picking or skin diving.

4. Association of bivalve species with other species

Most of the fishers have reported the presence of tiny crabs locally known as *gadhav/khekade/jui* inside the cavity of some of the clams. They also stated the clams in which such crabs are present have relatively less meat. The presence of the Pea crab in the mantle cavity of the clams has been reported by¹⁷. It is obvious that if the mantle cavity is

occupied by Pea crab there will be proportionately less meat in the cavity. Fishermen also opined that spotting of Jelly fish in the estuary with high tide locally known as *Jharm/jhar*, presence of *ghurap* (Gastropod) in intertidal areas as well as abundance of green algae in intertidal beds indicate good availability of clams in ensuing months. Former two observations need to be scientifically investigated. Clams are filter feeders and presence of green algae in respective substratum may reflect availability of natural feed for clams. Fishers are well aware of co - existence of bivalves with other species as well species that act as indicators of bivalve abundance. Such knowledge enables them to know the availability of bivalves in ensuing months and also understand the condition of bivalves.

5. Indigenous knowledge on fishery season for bivalves

The fishermen have intricate knowledge regarding availability of bivalves in various seasons and tend to intensify the bivalve fishing during peak fishery season. Most of the fishermen have stated that peak fishing season for clams such as *Laali* and *Karmale* and Green mussel, *Shinane* is during October to May. They reported the fishery season for *Laali* and *Karmale* to be throughout the year. The fishery season for *Tasare* is reported from November to February and January to May. The fishery season for *Wati* and *Dhamni* is reported to be during November to May and September to June by most of the fishers. While fishery season for *Saad* and *Kaalve* is throughout the year. The observations regarding fishery season for bivalves pertains to the local conditions and cannot be generalized. The fishing season for bivalves is usually during the post and pre-monsoon¹⁸. Fishermen have also reported that most of the times the fishery for a particular species of clams is good and may last for two to three years continuously.

6. Indigenous knowledge on good harvest of bivalves based on rain during particular *nakshatra*

Fishermen opined that if there is rainfall during *Dev deepawali nakshatra* there will be good harvest of *laali* and if there is rainfall during *Hast nakshatra* there will be good harvest of *tasare*. Also there will be good catch of *mule* if it rains during *Rohini*, *Swati* and *Vishakha nakshatra* and good catch of *shinane* is obtained if there is rainfall during *saap nakshatra*. These observations help fishermen to forecast the catch of bivalves. The recruitment and species dominance in bivalves is controlled by a combination

of different hydrographic parameters like salinity, availability of settlement substrates and current pattern¹⁸ in different regions. Rain would most probably have an effect on salinity regime of estuarine waters and rainfall on particular *nakshatra* coinciding with other favorable hydrographic conditions might be responsible for the above observed phenomenon but further scientific investigations on this regards are necessary.

7. Indigenous knowledge on effect of tides on availability of bivalves

Majority of the fishermen have stated that more catch of clams is obtained during low tide. They also reported that less catch of clams is obtained during high tide. The rationale behind this view may be attributed to difficulty in collection of clams due to rising water. Due to this reason most of the fishermen preferably women collect clams during low tide. Also more area in intertidal region gets exposed during low tide thereby making scouting and collection of clams much easier. Tides play an important role in deciding the preference timing for collection of mussels and oysters which is discussed separately elsewhere in this manuscript.

8. Indigenous knowledge on the effect of temperature on the condition of bivalves

Most of the respondents have expressed their view regarding the condition of the bivalves with respect to the temperature regime and reported that the quantity of meat in clams, oysters and mussels in that sequence is relatively more during summer and is less (a condition known as *niju/nijor* in oysters) during winter months. These observations most probably are related to the condition of the bivalves during spawning and post spawning periods rather than effect of the temperature. The former observation might be related to the onset of the spawning period of the bivalves during which there is full *gonadal* development. While the latter observation might be coinciding with post spawning condition of the bivalves wherein after spawning the condition of the bivalve is degraded due of deprivation of energy reserves and corresponding unfavorable conditions notably availability of food and salinity.¹⁸ has reported the spawning period of *Villorita cyprinoides*, *Meretrix meretrix* and *M. casta* to be during May-June along the West coast. Similarly he has reported the spawning period of *Perna viridis* and *Crassostrea madrasensis* to be during July to November and November to February respectively

which contradicts to the condition of fullness as opined by the fishers. Further biological works in this regards are necessary.

9. Indigenous knowledge on the storage methods of bivalves

To store the bivalves in fresh condition till they are sold fishers make use of *Zole/Zaabli* a conical bag of varying capacity (1-20 kg) made up of nylon twine. The bag is kept submerged in creek water with one end tied to buoy with rope. Care is taken that it remains exposed to the water all the time. Clams can be stored for one to five days in this condition. The bag is agitated with hand daily or once in two days to facilitate creek water circulation. This may help the clams to remain alive for longer duration as its original habitat is not disturbed.

10. Indigenous knowledge on preparation of byproducts from clams

Most of the fishermen resort to the preparation of clam meat extract locally known as *mulyacha kaat*. The extract is generally prepared from *Tasare* (*Paphia malabarica*). They opined that the product has shelf life of about six months to one year. Clams are steamed in a vessel on firewood with little quantity of water enough to facilitate steaming for about 15 - 30 minutes till they are entirely deshelled. The deshelled clams along with the meat inside it are then removed. The supernatant is filtered through the cloth. The extract thus obtained is concentrated further by boiling up to one - sixth of its original quantity and stored in air-tight container. *Tasare* (*Paphia malabarica*) is chosen to prepare the clam extract because it is the tastier variety of clam. Another product locally known as *Mulyache kaple* is also prepared from *Lali* (*Meretrix casta*) with a reported shelf life of about six months albeit less popularly. Clams are washed and steamed in a vessel for about 30 minutes. The meat is then removed and kept in salt water overnight. Afterwards the clam meat is mixed to make dough. This particular species is chosen as it has got somewhat slimy meat which makes dough making quite easy. The dough is pressed with hand till maximum water/moisture from the dough gets removed. Little amount of turmeric (one teaspoon to about one kg dough) is added. Small *polis* are made from dough and dried in sunlight for about two days. The product is stored in airtight container. By products are generally prepared when the particular variety of clam is fished in bulk quantity.

11. Indigenous knowledge on preservation methods of bivalves

Sun drying of the clams is the popular preservation method of the bivalves in the region. Most of the fishermen resort to sun drying if clams are collected in excess quantities. Clams are steamed in a vessel on firewood with little quantity of water enough to facilitate steaming for about 15 to 30 minutes till they are entirely de-shelled. The meat from the clams is removed and sundried for about two to three days. Sun drying is one of the cheapest and oldest methods of preservation of fishes in India and clams are no exception. Fishers opined that the clams can be preserved for a period of 2-3 months.

12. Indigenous knowledge on the effect of the lunar cycle/periodicity on the condition and availability of the bivalves

Fishermen reported that more bivalves particularly oysters and mussels are available during spring tides. Maximum difference between low tide and high tide is noted during spring tides. Due to this lot of space is available during low tide for collection of oysters and mussels which are available in deep inter-tidal to sub-tidal areas. Fishermen strategically make use of this knowledge and thus obtain more catch of the oysters and mussels during spring tides.

13. Indigenous knowledge on preference timing and depth of operation for bivalve fishing.

Most of the fishermen including women prefer to collect the clams during low tide in exposed intertidal area and up to knee deep water depth. It is easy to collect more clams during low tide as described elsewhere. Fishermen also collect the bivalves in a depth of about 2 - 7 m water when low tide is in progress and water has receded to half of its magnitude till when the high tide begins and water again rises to half of its magnitude. They get more time for bivalve collection during this particular duration. Thus fishermen go for bivalve fishing keeping in view the ease of bivalve collection and as per the availability of bivalves in varying depths in intertidal region.

14. Indigenous knowledge on methods of bivalve collection and exploitation

The methods of bivalve fishing are easy and suitable to collect the variety of clams, mussels and oysters from a particular habitat. Fishers resort to hand picking of the clams and fish them with the aid of either knife or *koyati* (knife like implement with sharp curved end). Knife and *koyati* are used to dig

the substratum where the clams are found buried. Few fishermen make use of *aakli* to collect clams. *Aakli* is a gear made up of circular metal frame (dia 2- 4 ft) with a conical net attached to it (3-6 ft long). *Aakli* is dragged along the sandy substratum with the help of hand. The gear is slightly buried in the sandy substratum while being dragged. A gear locally known as *mhangare/aakya* is also used to collect clams. It is made up of triangular metal frame (1-2 ft x 1-2 ft x 1-2 ft) with a conical net attached to it (5-6 ft long). Nails are fixed to the lower beam of frame. A bamboo pole is attached to the apex end of the frame. Collection of oysters in sub-tidal areas is carried out by skin diving with the aid of *hatodi* (hammer) and *chhinini* (small iron bar with sharp end). *Hatodi* and *chhinini* are used to detach oysters from substratum. While mussels are collected by skin diving with the help of *taasni* or *paarai*. Again *taasni* or *paarai* is used to detach the mussels from substratum. Some fishers collect the clams by using *Indi* or *Konda*. The gear comprises of a bag like conical net (5-6 ft), attached to a semicircular wooden frame (4-8 ft). The frame is made of out of *nirgundi* wood stick (*Sonnertia alba* J. Smith). Fishers opined that the particular wood exhibits flexibility and can be bended into a semicircular form. A pair of rope is attached to the wooden frame which acts as a sling and the ends of wooden frame are held in position by a 1-3 ft long foot rope. The net is dragged along the sandy substratum by holding the sling with hands and the foot rope between the toes.

Conclusion

Fishers engaged in bivalve fishery possess rich and varied indigenous knowledge which is evident from the data generated by this study. The documentation and validation of the indigenous knowledge systems in a fishing community should be the part of any developmental plan proposed for the upliftment of the community. The study of indigenous knowledge will play an important role in implementing co-management strategy although this strategy is far from being widely practiced in the country. By applying their knowledge traditional fishers make a living. It would be unwise on the part of scientific community to ignore this knowledge and maximum effort should be made to document the indigenous knowledge to get ideas on essential research needs.

Acknowledgement

The authors are grateful to the Associate Dean, College of Fisheries, Ratnagiri for providing necessary help for carrying out this study. The authors also are thankful to all the fishermen (about 100) engaged in bivalve fishery of South Konkan region of Ratnagiri and Sindhudurg who readily provided the knowledge they possessed and who are really knowledgeable as far as its practicability is concerned.

References

- Berkes F, Sacred Ecology, *Traditional Ecological Knowledge and Resource Management*, (Taylor & Francis, Philadelphia, PA), 1999.
- Gray F & Zann L, Traditional Knowledge of the Marine Environment in Northern Australia, Workshop series No. 8, (Great Barrier Reef, Marine Park Authority, Townsville), 1988.
- Gadgil M, Berkes F & Folke C, Indigenous knowledge for Biodiversity conservation, *Ambio*, 22 (2-3) (1993) 151 – 156.
- Johannes RE, *Words of the lagoon: Fishing and Marine Lore in the Palau District of Micronesia*, (University of California Press, Berkeley), 1981.
- Worsely P, *Knowledge: What different peoples make of the world*, (Profile Books, London), 1971, 61- 65.
- Brandt von A, *Fish catching methods of the world*, (Fishing News (books) Ltd. West Byfleet, UK) 1972, 280-285.
- Johannes RE, Traditional marine conservation methods in Oceania and their demise, *Ann Rev Ecol Syst*, 9 (1978)349 – 364.
- Anonymous, *Marine Fishermen Population Census*, (Maharashtra State, India), 2003, 30-32.
- Bailey KD, *Methods of Social Research*, (The Free Press, Macmillan Publishers, New York), 1982.
- Sathyamurthi T, The mollusca of Krusadai Island. *Bull.Madras Mus* (NH), I(2) (1956) 200-202.
- Sawant MS & Ranade AM, Edible oyster of the genus *Crassostrea* (Sacco,1897) along the Ratnagiri coast, Maharashtra, India, *J Bom Nat Hist Soc*, 99(1) (2002) 44-46.
- Narsimhan KA, *Molluscan Fisheries of India*, (BR Publishing Corporation, New Delhi), 2005.
- Apte DA, *The book of Indian Shell*, (Bombay Natural History Society, Oxford University Press), 1998.
- Sreenivasan PV, Distribution of seed of clam, *Meretrix casta* (Chemnitz) in Vellar estuary *Proc. Symp. Coastal Aquaculture*, Marine Biological Association of India, Cochin 2, 1983, 561-563.
- Nayar KN, Ramadoss K & Rajan CT, Molluscan resources of Kali River estuarine system in Karnataka, *Mar Fish Info Serv T E Ser*, 58 (1984) 1-8.
- Rao KS, Taxonomy of Indian oysters, *Bull Cen Mar Fish Res Inst*, 38 (1987) 1-6.
- Bal DV & Rao KV, *Marine Fisheries of India*, (The Tata McGraw Hill Publishing House, New Delhi), 1990, 470-471.
- Mohammed KS, Molluscan Fisheries of India. In: *(ICAR) Handbook on Fisheries and Aquaculture*, (ICAR, New Delhi), 2011.