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Availability and utilization of molluscs at Digha coast, East coast of India

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Abstract
Molluscs species are available at Digha coast more or less throughout the year. Highest population density is in post monsoon period. Availability goes down lowest in monsoon period and density is optimum in Pre-monsoon season. Both molluscs meat and shell are used abundantly in India especially Southern provinces of India like Odisha, Andhra Pradesh, Tamil Nadu, Kerala and Karnataka but very little in West Bengal. In the Southern States, the poor people including fishermen directly consume edible molluscs meat which are available. In West Bengal, the people show negligence to take edible molluscs meat as their everyday food. Only few tribal people consume molluscs meat adequately. There is a good prosperity of edible molluscs meat as food items in very near future in West Bengal because rapid depletion of marine fishery resources. In case of molluscs shell, it is used properly across the country. Shell is used to produce lime and lime is utilized to bring pH from acidic to basic side of a media in agricultural and fishery field. Molluscs shells are pulverized and used in poultry feed for the birds (hen and ducks) to lay eggs with thick and perfect shells. It can be used as feed of carnivorous fishes and shrimps for rapid growth as it contains high nutritional (Protein) values. The versatile use of molluscs shell has also gained momentum in the recent years.

Keywords: Articles, conservation, masonry construction, medicinal values, nutritional values

Introduction
The word 'Mollusca' is a Latin word which means 'soft'. Aristotle, the Greek scientist and philosopher, is the father of the word 'Mollusca'. Molluscs are benthic organisms that live on or in, the bottom of the water body with greater than 1.0 mm in size. Its body is made up of head, visceral mass and locomotory or digging foot, epidermis is forming mantle, secrets calcareous spicules or produces one or more shells. Chitinous is ribbon like or radial having small size teeth in the mouth but absent in bivalves. They are soft bodied animals, a large and most important group of invertebrates which occupies all the possible habitats except aerial. Molluscs are the largest phylum among the marine water invertebrates and it occupies 23% of total marine living animals. Molluscs species are second only to arthopods in numbers of all living animal species far behind the arthropods which are 11,13,000. Molluscs are found 10190 meter deep in the ocean to 5000 meter of elevation. It is a highly diversified group, differs in size, shape, number as well as its habit and habitat. Winckworth (1940) estimates 31643 (marine), 8765 (fresh water) and 24503 land forms making a total of 64,911 (approx. 65,000) [1]. Abbott (1954) estimates a total of 100000 of extant species comprising 80000 snails and 10000 bivalves and 10,000 for the other groups like monoplacophors, polyplacophors, cephalopods and scaphopods. Subba Rao (1995) made a conservative estimate 66535 species of which the Indian share is 5070 species (3400 marine, 183 freshwater and 1487 land) [2]. Chapman (2009). estimates of accepted described living species of molluscs vary from 50,000 to a maximum of 120,000 species [3]. In 1969 David Nicol estimated the probable total numbers of living molluscs at 107,000 of which were about 12,000 fresh water 35,000 terrestrial and 60000 marine molluscs. Haszprunar in 2001 estimated about 93,000 molluscs species which include 23% of all named marine living organisms. Continuous growth in human population over the decades has lead to greater pressure on the existing animal protein sources. Poultry, pork, beef, lamb and fish are considered the major sources of meat protein for humans.

In recent years, research into the nutritional value of molluscs has attracted much attention. The main reason for this interest is the large amount of molluscs available globally. A great varieties and huge amount of fishes, crustaceans and molluscs are landed every day at Digha landing centre. There are 93 varieties of molluscs species found during the study period at Digha coast.The present study is designed to assess the abundance of edible marine molluscs, their nutritional values and utilization of both meat and shell found at Digha coast.

Molluscs species have been and still are an important human food source for anatomically modern humans, but with a risk of food poisoning from toxins that accumulate in molluscs species under certain conditions, and many countries have regulations to reduce this risk. Molluscs species have, for centuries, also been the source of important luxury goods, notably pearls, mother of pearl, sea silk and Tyrian purple dye. Their shells have also been used as money in some preindustrial societies. Molluscs species can also represent hazards or pests for human activities. The bite of the blue-ringed octopus is often very fatal and that of *Octopus apollyon* causes inflammation that can last for over a month. Stings from a few species of large tropical cone shells can also kill, but their sophisticated, though easily produced, venoms have

become important tools in neurological research. Schistosomiasis (also known as bilharzia, bilharziosis or snail fever) is transmitted to humans via water snail hosts, and affects about 200 million people. Snails and slugs can also be made serious agricultural pests and accidental or deliberate introduction of some snail species into new environments has seriously damaged some ecosystems.

Beside these harmful effects, molluscs have other several beneficial effects. Molluscs are aquatic or terrestrial, not aerial. Most of the aquatic molluscs live in fresh water are edible, suitable for human consumption whereas marine water molluscs are maximum non-edible except few ones. At Digha, from Mohana of Dubda Water Basin to Paschim Gadadharpur, the beach is about 10 km long and I collected 54 bivalve species under 8 orders, 18 families and 34 genera, 35 gastropod species under 4 orders, 18 families and 27 genera & 4 cephalopod species under 3 orders, 3 families and 4 genera during my present study. Out of them 12 bivalves under 5 orders, 6 families and 8 genera, 2 gastropods species under 2 orders, 2 families and 2 genera and 4 cephalopods species under 3 orders, 3 families and 4 genera are edible. The meat of edible marine molluscs species does not eaten by local people at Digha except some seasonal migratory tribal people. The shell of edible marine molluscs species and both meat and shell of non-edible marine molluscs species are used versatile properly.

Materials and methods

Study site was selected based on initial pilot survey to collect the molluscs species from different spots at Digha coastal belt. Study points were so located as to produce a significant and accurate understanding of the existing hydro- biological characteristics as the molluscs specimen is benthic in nature. Inter tidal belts at Digha coast were selected for the detailed study of molluscs availability and utilization. The coastal belt of Midnapore (East) district of West Bengal, India extends longitudinally 87^0 5′ E to 88^0 5′ E and latitudinally 20^0 30′ N to 22^0 2′ N. In the present work, three contrasting study sites viz. Digha mohana, New Digha and Udaypur located along the intertidal belts of an ecotone at the confluence of Dubda water basin estuary with Bay of Bengal, West Bengal - Odisha coast, India have been selected.

Geographically, Digha is situated on the lap of the Bay of Bengal. It is located very close to the Gangetic mouth on the East coast of India facing the Bay of Bengal at latitude 21^0 36´30´´N and longitude 87^0 30´E. It is a very important fishing activities and fish landing centre as well as tourist centre in West Bengal. Tropical humid climatic conditions observe during most of the seasons of a year. Annual rainfall ranges from 1000 mm to 1300 mm where as temperature varies from 16^0 C to 35.5^0 C and relative humidity differs from 50% in the month of December to 78% in the month of July. The average wind flow is 30 km/hr. Tidal amplitude is about 2 m on an average in a total lunar cycle. The Hoogly river divides the total West Bengal coast into two separate coastal zones: i) Digha – Rasulpur Coast of Purba Medinipur district and ii) The deltaic region of South 24 Parganas district. Total coast of West Bengal is 158.2 km long. Out of which Digha – Rasulpur Coast is about 55.2 km long and the deltaic region of South 24 Parganas district occupies about 103 km coastal line. Fishing is done only from 64 km long area and rest portion (94.2 km) is prohibited for fishing activities due to Sunderban reserve forest.

Molluscs species are collected by hand picking from dry sea shore during low tide and some time by hand net during moderately high tide. (See figure – 1 & 2)

Fig 1: A woman collects molluscs along the sea beach during low tide.

Fig 2: A Molluscs collector with collection net.

The inter-tidal part of study spots are saturated with luxuriant estuarine flora and fauna. Several molluscs species apparently have distinct preferences for microhabitats such as mussel clamps or sea grass patches on inter-tidal soft bottoms. All the benthic molluscs under study were collected by three ways like - the gastropods are collected by hand picking from reef areas and from burrow under soft mud using a spade. The bivalves are collected by hand picking from reef areas and from Inter tidal zone scattered here and there on the sandy beach. The cephalopods are collected from inshore water by drag net operation.

Result and discussion

We conducted our study on total number of 54 species of bivalves belonging to 8 orders, 18 families, 35 species of gastropods belonging to 4 orders, 18 families and 4 species of cephalopods belonging to 3 orders, 3 families have been identified at Digha coast of West Bengal. All of these except cephalopods habitat (Sandy bottom) can be found in the different ghats (spots) at Digha coast.

Molluscs species are available at Digha coast more or less throughout the year. Highest population density is in post monsoon period from the months of September to February due to optimum water salinity and temperature. Availability

goes down lowest in monsoon period mainly from the months of June to August due to lowest water salinity. Population density is optimum in summer season from March to May in a year.

Table 1: Seasonal availability of molluscs (bivalvia) species at Digha coast [4-5].

Sl. No	Specimen (Bivalvia)	J	F	M	A	M	J	J	A	S	O	N	D
1.	*Anadara granosa* (Linnaeus, 1758).	+	+	+	-	-	-	-	+	+	+	+	+
2.	*Anadara inequivalvis* (Bruquiere, 1789).	+	+	+	-	-	-	-	-	-	+	+	+
3.	*Anadara antiquata (*Linnaeus, 1758).	+	+	+	-	-	-	-	-	+	+	+	+
4.	*Apolymetis edentula* (Spengler, 1782).	+	+	+	+	-	-	-	-	-	+	+	+
5.	*Astropecten indicus* (Doederlein, 1872).	+	+	+	+	-	-	-	-	-	+	+	+
6.	*Barnea candida* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	+	+	+
7.	*Crassostrea gryphoides* (Scholthein, 1813).	+	+	+	+	+	+	+	+	+	+	+	+
8.	*Diplodonta bullata* (Dunker, 1865).	+	+	+	+	-	-	-	-	-	+	+	+
9.	*Donax incarnates* (Gmelin, 1791).	+	+	+	+	+	+	-	-	-	+	+	+
10.	*Dosinia prostata* (Linnaeus, 1758).	+	+	+	-	-	-	-	-	-	+	+	+
11.	*Donax scortum* (Linnaeus, 1758).	+	+	+	+	+	+	-	-	-	+	+	+
12.	*Glauconome sculpta* (Sowerby, 1844).	+	+	+	-	-	-	-	-	-	+	+	+
13.	*Glauconome virens* (Linnaeus, 1767).	+	+	+	+	-	-	-	-	-	+	+	+
14.	*Katelysia opima* (Gmelin, 1791).	+	+	+	+	-	-	-	-	+	+	+	+
15.	*Katelesiya japonica* (Gmelin, 1791).	+	+	+	+	-	-	-	-	-	+	+	+
16.	*Laternula truncate* (Lamark, 1818).	+	+	+	+	-	-	-	-	-	+	+	+
17.	*Mactra mera* (Reeve, 1854).	+	+	+	+	+	+	+	+	+	+	+	+
18.	*Mactra violacea* (Gmelin, 1791).	+	+	+	+	+	+	+	+	+	+	+	+
19.	*Mactra plicataria* (Linnaeus, 1758).	+	+	+	+	+	+	+	+	+	+	+	+
20.	*Mactra luzonica* (Reeve, 1854).	+	+	+	+	+	+	+	+	+	+	+	+
21	*Mactra dissimilis* (Reeve, 1854).	+	+	+	+	+	+	+	+	+	+	+	+
22	*Mactra cuneata* (Gmelin, 1791).	+	+	+	+	+	+	+	+	+	+	+	+
23	*Mactra stultrum* (Linnaeus, 1758).	+	+	+	+	+	+	+	+	+	+	+	+
24	*Macoma blairensis* (Smith, 1906).	+	+	+	+	-	-	-	-	-	+	+	+
25	*Macoma truncata* (Jonas, 1843).	+	+	+	+	-	-	-	-	-	+	+	+
26	*Macoma birmanica* (Phillipi, 1849).	+	+	+	+	-	-	-	-	-	+	+	+
27	*Meretrix meretrix* (Linnaeus, 1758).	+	+	+	-	-	-	-	-	-	+	+	+
28	*Meretrix casta* (Gmelin, 1791).	+	+	+	-	-	-	-	-	-	+	+	+
29	*Modiolus striatulus* (Hanley, 1844).	+	+	+	-	-	-	-	-	-	+	+	+
30	*Modiolus undulates* (Dunker, 1856).	+	+	+	-	-	-	-	-	-	+	+	+
31	*Polymesoda bengalensis* (Lamarck, 1818).	+	+	+	-	-	-	-	-	-	+	+	+
32	*Perna viridis* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	-	+	+
33	*Pharella javanica* (Lamark, 1818).	+	+	+	+	-	-	-	-	-	+	+	+
34	*Pinna bicolor* (Gmelin, 1791).	+	+	+	+	-	-	-	-	-	+	+	+
35	*Pelecyrora trigona* (Reeve, 1850).	+	+	+	-	-	-	-	-	-	+	+	+
36	*Paphia textile* (Gmelin, 1791).	+	+	+	+	-	-	-	-	+	+	+	+
37	*Paphia semirugata* (Philippi, 1847).	+	+	+	+	-	-	-	-	+	+	+	+
38	*Pholas orientalis* (Gmelin, 1791).	+	+	+	+	-	-	-	-	-	+	+	+
39	*Roeta peliculla* (Reeve, 1850).	+	+	+	-	-	-	-	-	-	+	+	+
40	*Roeta pulchella* (Reeve, 1854).	+	+	+	-	-	-	-	-	-	+	+	+
41	*Saccostrea cucullata* (Born, 1778).	+	+	+	+	+	+	+	+	+	+	+	+
42	*Siliqua albida* (Dunker, 1865).	+	+	+	+	-	-	-	-	-	+	+	+
43	*Siliqua radiata* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	+	+	+
44	*Siliqua winteriana* (Dunker, 1852)	+	+	+	+	-	-	-	-	-	+	+	+
45	*Solen brevis* (Gray, 1842).	+	+	+	+	-	-	-	-	-	+	+	+
46	*Strigilla splendida* (Anton, 1838).	+	+	+	+	-	-	-	-	-	+	+	+
47	*Scapharca cornea* (Reeve, 1844).	+	+	+	-	-	-	-	-	-	+	+	+
48	*Sunetta meroi* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	+	+	+
49	*Sunettac scripta* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	+	+	+
50	*Sanguinolaria acuminata* (Reeve, 1857).	+	+	+	+	-	-	-	-	-	+	+	+
51	*Timoclea imbricata* (Sowerby, 1844).	+	+	+	-	-	-	-	-	-	+	+	+
52	*Tellina sinuata* (Spengler, 1782).	+	+	+	+	-	-	-	-	-	+	+	+
53	*Tellina opalina* (Chemitz, 1788).	+	+	+	+	-	-	-	-	-	+	+	+
54	*Trachycardium asiaticum* (Brugierra, 1794).	+	+	+	+	-	-	-	-	-	+	+	+

Table 2: Seasonal availability of molluscs (gastropoda) species at Digha coast [4-5].

Sl. No	Specimen (Gastropoda)	J	F	M	A	M	J	J	A	S	O	N	D
1	*Architectonica perspectiva* (Linnaeus, 1758).	+	+	+	-	-	-	-	-	-	+	+	+
2	*Architectonica laevigata* (Lamarck, 1816).	+	+	+	-	-	-	-	-	-	+	+	+
3	*Agaronia nebulosa* (Lamark, 1811).	+	+	+	-	-	-	-	-	-	+	+	+
4	*Amalda ampla* (Gmelin, 1791).	+	+	+	+	-	-	-	-	+	+	+	+
5	*Acrilla gracilis* (Sowerby, 1844).	+	+	+	+	+	+	+	+	+	+	+	+
6	*Bufonaria rana* (Linnaeus, 1758).	+	+	+	-	-	-	-	-	-	+	+	+
7	*Cerithidea cingulate* (Gmelin, 1791).	+	+	+	-	-	-	-	-	-	+	+	+
8	*Cerithidea obtusa* (Lamarck, 1758).	+	+	+	+	+	+	+	+	+	+	+	+
9	*Gyrinum natator* (Roding, 1798).	+	+	+	-	-	-	-	-	-	+	+	+
10	*Melo melo* (Solander, 1786).	+	+	+	-	-	-	-	-	-	+	+	+
11	*Murex tribulus* (Linnaeus, 1758).	+	+	+	+	+	+	+	+	+	+	+	+
12	*Natica tigrina* (Roding, 1798).	+	+	+	+	+	+	+	+	+	+	+	+
13	*Natica lineata* (Roding, 1798).	+	+	+	+	+	+	+	+	+	+	+	+
14	*Nassarius stolatus* (Gmelin, 1791).	+	+	+	+	-	-	-	-	-	+	+	+
15	*Nassarius faveolatus* (Reeve, 1849).	+	+	+	+	-	-	-	-	-	+	+	+
16	*Natica gualteriana* (Recluz, 1843).	+	+	+	+	+	+	+	+	+	+	+	+
17	*Nassaria nassaria* (Roeding P F, 1798).	+	+	+	+	-	-	-	-	-	+	+	+
18	*Nerita grayana* (Recluz, 1843)	+	+	+	+	+	+	+	+	+	+	+	+
19	*Olivancillaria gibbosa* (Born, 1778).	+	+	+	-	-	-	-	-	-	+	+	+
20	*Oliva oliva* (Linnaeus, 1758).	+	+	+	-	-	-	-	-	+	+	+	+
21	*Polinices didyma* (Roeding, 1798).	+	+	+	+	+	+	+	+	+	+	+	+
22	*Polinices tumidus* (Swainson, 1840).	+	+	+	+	+	+	+	+	+	+	+	+
23	*Phalium bisulcatum* (Schubert & Wagner, 1829).	+	+	+	+	-	-	-	-	-	+	+	+
24	*Pythia plicata* (Fe'russac, 1848).	+	+	+	-	-	-	-	-	-	+	+	+
25	*Pugilina cochlidium* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	+	+	+
26	*Seminricinula konkanensis* (Melvill, 1893).	+	+	+	+	-	-	-	-	-	+	+	+
27	*Sinum neritoiderum* (Linnaeus, 1758).	+	+	+	+	-	-	-	-	-	+	+	+
28	*Telescopium telescopium* (Linnaeus, 1758).	+	+	+	-	-	-	-	-	-	+	+	+
29	*Tonna dolium* (Linnaeus, 1758).	+	+	+	+	+	+	+	+	+	+	+	+
30	*Tonna sulcosa* (Swainson, 1840).	+	+	+	+	+	+	+	+	+	+	+	+
31	*Turritella attenuata* (Reeve, 1849).	+	+	+	-	-	-	-	-	-	+	+	+
32	*Terebra tenera* (Hinds, 1844).	+	+	+	-	-	-	-	-	-	+	+	+
33	*Thais blanfordi* (Melvill, 1893).	+	+	+	+	-	-	-	-	-	+	+	+
34	*Thais lacera* (Born, 1778).	+	+	+	+	-	-	-	-	-	+	+	+
35	*Umbonium vestiarium* (Linnaeus, 1758).	+	+	+	+	+	+	+	+	+	+	+	+

Table 3: Seasonal availability of molluscs (cephalopoda) species at Digha coast [4-5].

Sl. No	Specimen (Cephalopodas)	J	F	M	A	M	J	J	A	S	O	N	D
1	*Loligo duvauceli* (d'Orbigny, 1848).	+	+	+	+	+	-	-	-	+	+	+	+
2	*Octopus macropus* (Risso, 1826).	+	+	+	-	-	-	-	-	-	-	-	+
3	*Sepia aculeata* (Ferussac and d'Orbigny, 1848).	+	+	+	+	+	-	-	-	+	+	+	+
4	*Sepiella inermis* (Ferussac and d'Orbigny, 1848).	+	+	+	+	+	-	-	-	+	+	+	+

(J = January, F = February, M = March, A = April, M – May, J = June, J = July, A = August, S = September, O = October, N = November, D = December. '+' means available and '–' means unavailable)

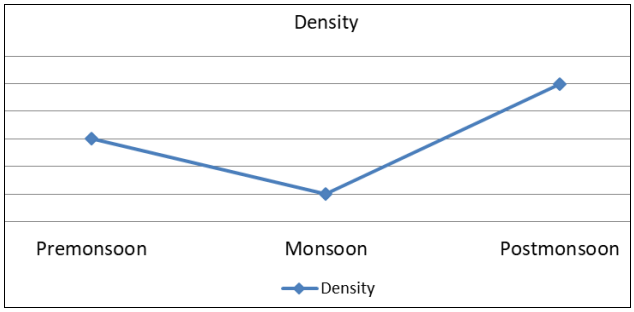

Fig 3: Seasonal abundance of molluscs species at Digha coast

There are multipurpose uses of both edible and non-edible molluscs meat and shell found at Digha coast. The uses are described in details below There are 12 edible bivalve species available at Digha coast. Out of 12 edible bivalve species, 9 species are clams, 2 species are oyster and 1 species is mussel. From the foregoing account it is cleared that clams are sought after by considerable section of poorer classes of fisher folk as a source of nutritious food. The meat of all available three species of *Anadara* is red in colour, believed to be highly nutritious. But in India the meat taste of these clams are not appreciated by people due to bad odour. The species of *Anadara* are not caught for human consumption, used industrially for lime production. The meat of available two species of *Donax* is caught in India for human consumption. Meat is highly delicious and nutritious. Flesh contains high protein value. It is served as steamed, rosted, boiled or

traditionally raw in Southern parts of India but the local people of Digha do not consume it due to availability of fishes and lack of awareness. In India *Meretrix casta* popularly known as matti in South India, yellow clam *Meretrix meretrix* and the baby clam, *Katelysia opima* are consumed by people as considered these as fish flesh. At Digha coast it is not considered as food at present. The two edible species of oyster available at Digha coast are *Crassostrea gryphoides* and *Saccostrea cucullata*. These two species of edible oyster are used as food of human beings. Meat is highly delicious and nutritious. Southern parts of India consume the meat but the local people at Digha do not consume it due to availability of fishes and lack of awareness. Oysters are being utilized only to a limited extent in India. In our country the oysters are cooked in ghee or vegetable oil after mixing salt and condiments. Only in some places on the West coast people know about the nutritious shell fish and eat them. But for this, only poor people usually fishermen consume them [4].

In Western countries where the oysters are greatly relished, oysters are eaten raw and in a variety of forms like oyster stew, smoked oyster, oyster meat canned in salad oil, oyster meat boiled in wine, breaded oysters etc.

The only available edible mussel at Digha coast is *Perna viridis.* In India the value of mussels as nutritious food is not realized to a large extent. Mussels are usually consumed after cooking in the form of curry. People of poorer classes boil the mussels with pieces of roots of tapioca or cassava with a little quantity of water and when they are cooked, drain and eat them. Some people eat raw mussels but this is very rare[4]. But at Digha coast it is not considered as food at present.

Table 4: List of Edible Marine Bivalvia Available at Digha Coast [4-5].

Sl. No.	Family Name (6)	Genera (8)	Specimen (12)
1.	Arcidae	*Anadara*	*Anadara granosa* (Linnaeus, 1758)
			Anadara inequivalvis (Bruquiere, 1789)
			*Anadara antiquata (*Linnaeus, 1758)
2.	Donacidae	*Donax*	*Donax incarnates* (Gmelin, 1791)
			Donax scortum (Linnaeus, 1758)
3.	Mytilidae	*Perna.*	*Perna viridis* (Linnaeus, 1758)
4.	Ostreidae	*Saccostrea*	*Saccostrea cucullata* (Born, 1778)
		Crassostrea	*Crassostrea gryphoides* (Scholthein, 1813)
5.	Solenidae	*Solen*	*Solen brevis* (Gray, 1842)
6.	Veneridae	*Katelysia*	*Katelysia opima* (Gmelin, 1791)
		Meretrix	*Meretrix meretrix* (Linnaeus, 1758)
			Meretrix casta (Gmelin, 1791)

There are 2 edible gastropods species available at Digha coast which are suitable for consumption and not being utilized properly as food of human in the country. They are fished by fishermen and poor coastal people for food usually when fish are not available. Meat of gastropods is seldom sold in the markets for being used as human food [4]. *Umbonium vestiarium* is the only species that finds a place in fish stall in foreign but not in India. The edible gastropods are boiled in fresh water and meat is extracted with the help of a needle and used in curry or soup. The flesh of *Olivancillaria gibbosa* is extracted after boiling the animal in fresh water. The meat is consumed by making curry or frying in oil [4].

Table 5: List of Edible Marine Gastropoda Available at Digha Coast [4-5].

Sl. No.	Family Name (2)	Genera (2)	Specimen (2)
1.	Olividae	*Olivancillaria*	*Olivancillaria gibbosa* (Born, 1778)
2.	Trochidae	*Umbonium*	*Umbonium vestiarium* (Linnaeus,1758)

There are 4 edible cephalopods species available at Digha coast which are all suitable for human consumption. Most of the squid, cuttlefish and octopus are valued as food of people in the world. In India only squids are relished to a large extent among the edible cephalopods. Mostly squid and cuttlefish are sold in the markets in fresh condition and only limited quantities in dried condition. After capture the large species of edible squid and cuttlefish are split open on the midventral plane to remove the ink sacs as otherwise the whole lot become undesirably stained with the dark ink. Generally the ink sac of smaller species like *Loligo duvauceli* is not removed before sent to the markets. During the peak of the season when the catch of cephalopods is enormous, a small quantity of them is cured. The meat of cephalopods is clean, attractive and has good flavor. It is also highly nutritive. The basic organic constituents of the squid meat and utility of the meat as human food from the point of view of digestibility and nutrition have been extensively studied by foreign workers. The meat of cephalopods is prepared in many ways for food. Fresh meat is cut into slices and treated with spices and fried or cooked into curries, cutlets or soup. In most of the preparation the white meat is sliced to frying size and well pounded before being cooked to render the flesh soft. In Philippines the meat of squids and octopus is boiled first in vinegar with crushed garlic and then fried with oil and spices [4].

Table 6: List of Edible Marine Cephalopoda Available at Digha Coast [4-5].

Sl. No.	Family Name (3)	Genera (4)	Specimen (4)
1.	Loliginidae	*Loligo*	*Loligo duvauceli* (d'Orbigny, 1848)
2.	Octopodidae	*Octopus*	*Octopus macropus* (Risso, 1826)

3.	Sepiidae	*Sepia*	*Sepia aculeate* (Ferussac and d'Orbigny, 1848)
		Sepiella	*Sepiella inermis* (Ferussac and d'Orbigny, 1848)

The meat of almost all molluscs both edible and non-edible is used as feed of poultry birds, ducks etc. Molluscs shells are pulverized and used in poultry feed for the birds to lay eggs with thick and perfect shells. But it can be used as feed of all carnivorous fishes and also prawn and shrimps. It is observed that carnivorous aquatic cultivable species show faster growth rate to take molluscs meat because molluscs meat contains maximum protein values.

Immensely great is the utilization of molluscs shell lime in all masonry construction and for white washing the buildings. Their use as fertilizers in plantations has also gained momentum in the recent years. From sandy shores washed shell are gathered in quantities. After the removal of meats for food, hells of all edible forms are collected. Dead shells in considerable quantities are annually gathered from oyster and clam beds, shells of even pearl oysters and window – pan oysters are much used for lime.

All molluscs shells, big or small, dull ones or beautifully tined ones go into the making of toys, boxes, lamp bases of shades, garlands, rings, ash-trays, knife handles etc. Most of the polished shells are sold as cunios, cameos (a gem with figure carved in relief) are carved on large shells by removal of the surface layers and exposing the deeper layers of varied colour pattern. The corridors of the temples are flooded with soaps selling such articles. Almost obsolete now are much used as the whelks for purple dye, cuttlebone for polishing furniture, sepia for drawing ink. The available marine molluscs shells are used for home decoration. *Paphia textile* is used in garment industry, presence of dye in it. *Donax incarnates* has medicinal value, is used as anticoagulant because it contains heparin in its body. The chank shell (Sankha) is used to produce sound to make people aware at the time of Earthquake and also other natural/manmade calamities. The chank shell producing sound used to kill disease causing organisms. (See figure – 4 to 15)

Fig 4: A toy of molluscs shells

Fig 5: Cradle decorated by molluscs shells

Fig 6: Home decoration works made of molluscs shell

Fig 7: Sankha in a shop of molluscs shells

Fig 8: Sankha (Conch/Chank) in a shop

Fig 9: Molluscs shell dust as poultry feed

Fig 10: Doll made of molluscs shells

Fig 11: Molluscs shells garland

Fig 12: Garland made of pearls

Fig 13: Mirrors decorated by molluscs shells

Fig 14: Key holder ring.

Fig 15: Idol decorated by molluscs shells

Availability of molluscs species at Digha coast depends upon the water salinity and temperature mainly. Availability is maximum in post-monsoon period from September to February due to lowest water temperature and comfortable limit of water salinity. Optomum availability is found in pre monsoon period when water temperature and salinity is maximum. Availability is lowest in monsoon due to lowest salinity and optimum temperature. From our observation among the available 54 bivalves at Digha coast it is known that *Crassostrea gryphoides*, all available species of genus *Mactra* and *Saccostrea cucullata* are found in every season of a year whereas other bivalves are seasonal.

Among the available 35 gastropods at Digha coast, *Acrilla gracilis, Cerithidea obtuse, Murex tribulus, Natica tigrina, Natica lineate, Natica gualteriana, Nerita grayana, Polinices didyma, Polinices tumidus, Tonna dolium, Tonna sulcosa and Umbonium vestiarium* are found throughout the year and other available gastropods are seasonal.

All available 4 species of cephalopods at Digha are seasonal, maximum amount founds during winter season. During the study period from August, 2012 to July - 2017, eight (8) areas are considered as study areas according to the local name of those areas *viz.*, Paschim Gadadharpur, Udaypur, Ongaria Ghat, Jatranala Ghat, New Digha (Bat tala ghat), Hospital Ghat (Marine aquarium ghat), Sea Hawk Ghat and Digha Mohana. During study period we observe the total number of 54 species of bivalves belonging to 8 orders,18 families, 35 species of gastropoda belonging to 4 orders, 18 families and 4 species of cephalopoda belonging to 3 orders, 3 families have been identified at Digha coast of West Bengal. All of these except cephalopoda habitat (Sandy bottom) can be found in the different ghats (spots) at Digha coast. Cephalopods are caught by drag net operation.

All molluscs species show abundant distribution in Mohana due to flow of fresh water of Dubda water basin but in very near future none of the molluscs species will show ample distribution in Digha mohana because of increasing fishing activities throughout the year and also for pollution in the area.

In old Digha i.e. Sea hawk ghat and Hospital ghat, there was low molluscs species diversity in beginning period of our research work due to very high anthropogenic activities in this area.

Old Digha shows till now very little molluscs species with moderate distribution which was due to construction of wall and cement boulder around coast. It is expected that the availability of molluscs species will be higher in coming future at all ghats of old Digha due to presence of boulders as substratum. In Jatranala ghat, Ongaria ghat, and Paschim gadadharpur ghat, the availability of molluscs is very poor due to lack of shelter and unsuitable physico-chemical parameters of soil and water but in Udaypur ghat, molluscs species richness is very high due to presence of substratum as shelter, suitable physico-chemical parameters of soil and water and peaceful environment.

huge amount of eroded sediments, fly ash along with several other industrial discharges mixed with the water of Bay of Bengal and have made every year this coast unsuitable for living fishes, prawns, shrimps, molluscs and other biodiversity which are economically important or not but play important role in existence of human life directly or indirectly [6].

The water pollution is directly reflected by the steady decline of the abundance of finfish and shellfish seeds, smaller fin fishes and other nektonic forms. The data collected during last 10 years from the Department of Fishery, Government of West Bengal, relating to fish and shellfish landings at Digha and surrounding coast, reveals a rapid reduction of total landings of different fishery resources [6].

Operation of huge number of fishing trawlers with nylon thread gears may be considered a major factor for such down going condition. It is well known that oil and other related organic products after being discharged from different fishing trawlers, ships and other marine vessels pollute considerably both pelagic and benthic environment. Domestic sewage in small quantities is known to fertile the sea water which leads to an increase in marine productivity because of eutrophication. Waste disposal from the tourist centers of Digha and nearby fishing harbours of Sankarpur contributes pollutants into the nearby estuaries and small marshes. We should be sincere immediately to protect the biodiversity of Digha coast in West Bengal. It is hopeful that government has taken some primary initiatives to save Digha. Beach side is concreted and very clean. There is restricted and carefully watched any untoward incident that hamper the natural and social environment of Digha [6].

Molluscs collectors, traders, exporters and also Govt. should focus their eyes on this fishery in all coasts of West Bengal. There are 4 numbers of molluscs shell processing industry on the way from Digha boarder to Talsari of Odisha. They process the shell in traditional way. Modern technology, advanced machinery system is not seen in such industries. A hut with straw shed is used as industry building. Government should implement a financial scheme that the small marginal industrialist can get financial support to extend their such

industry & arrange a training program on molluscs meat and shell processing technology that workers can know the modern meat and shell processing technology followed in the world and set up molluscs meat processing plant to process meat.

Exporters should go there at Digha, purchase the edible molluscs meat with giving suitable market value and export the meat to foreign countries. The future development of such industry will generate employment opportunity among the un - employed young people in the society.

An industry is needed to develop for the export trade of frozen or canned meat of oyster, mussel and clam, edible gastropods and cephalopods for which the demand in abroad countries is good. This requires only a little initiative and enterprise on the part of the business circles, as the processing facilities are already available in most parts of the country. More than this, a greater demand for the shellfish food within our own country could be created by educating the people on the nutritive merits of the molluscs. By developing cultured practices of useful shellfishes substantial increase in yield could be expected.

The shell of all available molluscs is used there at Digha properly. The shells, which are available at Digha coast are used for production of lime, home decoration, preparation of garlands and conch etc. All molluscs shells, big or small, dull ones or beautifully tined ones go into the making of toys, boxes, lamp bases of shades, rings, ash-trays, knife handles etc. most of the polished shells are sold as cunios, cameos (a gem with figure carved in relief) are carved on large shells by removal of the surface layers and exposing the deeper layers of varied colour pattern. The corridors of the temples are flooded with soaps selling such articles. Almost obsolete now are much used as the whelks for purple dye, cuttlebone for polishing furniture, sepia for drawing ink, molluscs shells are pulverized and used in poultry feed for the birds to lay eggs with thick and perfect shells.

Marine water molluscs have ability to filter water, take part in food chain as consumer and provide habitat to invertebrates is necessary to survive in water. Meat of few edible molluscs species are nutritious, delicious used as food of human beings in various parts of the world.

Conclusion

An awareness program for the fishermen, tourists, collectors of zoological samples has to be undertaken, as the fishermen and also the over-enthusiastic tourists destroy the living molluscs and other marine aquatic organisms (with or without their knowledge). Restrictions period (May and June) may be imposed on fishing activities except permissible seasons, and also on the mesh size regulation (> 90 mm) of fishing nets. General tourists as well as excursion team often collect a lot of specimen in the first flush of enthusiasm but it is observed that most of those are finally dumped on the beach where the animals are allowed to die and rot. This habit has also to be banned immediately. Over exploitation by repeatedly collecting the same organisms (especially the various species of live bivalve, gastropods, cephalopods and others) year after year from beach by the study team from various educational institutions for display in their museum should be restricted. Drag net operation on intertidal areas is to be banned or restricted and selective sorting and releasing of by catch organisms in the sea before their death should be made compulsory. In this context an alternative way might be taken as taking a number of photographs of the organisms from various angles without disturbing them and to collect only very few examples of each species, particularly of rare and poorly populated species. Comprehensive assessment (chemical, biological and environmental) of by catch organisms in the light of fishery exploitation and bio-medical studies may be invited.

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