SECTION - A

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SURVEY OF ICHTHYOFANA

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INTRODUCTION

The rapid increase in human population with the march of time, consequent with increasing need of food for their sustenance, has posed a serious problem before the present world. The world carrying a human population of 4022 million (in 1975) is increasing by about 80 million per year. Foresters and experts in world food situation predict an onset of serious food shortage by the turn of the present century, when the human population is likely to be between 6.0 and 7.1 billion (Agarwala, 1977). In order to meet this increasing demand, food (protein, carbohydrate and fat) production ought to be increased. Especially in a developing country like India where protein deficiency is a menace, protein production must considerably be enhanced. Fishes having 21.5% of protein content, 96% protein digestibility coefficient and 80% biological value of protein, constitute one of the major sources of animal protein (Swaminathan, 1977). So to meet the increasing need for protein food, fish production should substantially be accelerated along with the increased production of other protein item. Nature which has endowed man with fertile lands, again comes to his rescue by providing plentiful fishery potentialities in the ocean. It is man who will explore and exploit this treasure properly following a scientific basis for the benefit of one and all.

India has a coast line of 5,560 km and has been divided into 12 bio-geographical zones to facilitate the study of the distribution, biology of the fishes and the topography of the coastal regions. The coast line of West Bengal and Orissa constitute the Zone I (Anon, 1962). If the fishery resources of such a vast coast line of India is exploited properly, it will perhaps considerably help to mitigate the protein-food shortage of the country to a remarkable extent. However, a proper survey of the fishery resources of the coastal region is an essential prerequisite for better and needful exploitation. It has already been felt that exploration should precede judicious exploitation.
A survey of the available literature reveals that Day (1869) for the first time described the fishes of Orissa. Before Day the other valuable contributions in the study of Ichthyofauna are those of Bloch (1785-95), Bloch and Schneider (1801), Lacépède (1800, 1802, 1803), Russel (1807), Hamilton-Buchanan (1822), Cuvier and Valenciennes (1828-49), McClelland (1839), Cantor (1849) and Lyth (1860). Day (1878, 1889) in his magnum opus, 'The fishes of India' and 'Fauna of British India' described all the fresh water and marine fishes of India available then. Chauhan (1947) described fish and fisheries of the Patna state, Orissa. Devanesan and Chidambaram (1948) observed the food fishes both marine and island of the Madras presidency. Job et al. (1955) studied the fish and fisheries of Mahanadi river (Orissa) in relation to Hirakud dam. Menon (1961) and Jhingran (1963) studied the fishery resources of Chilka lake, Orissa. Jones and Kumaran (1965a,b) put forward some new records of fishes from seas round India. Dutt and Rao (1965) described a new bothid flatfish from Bay of Bengal.

One of the pioneer workers on the Orissa coast in the recent past was Nagabhushanam (1966) who studied the offshore demersal fisheries of Andhra and Orissa coast. However, he laid emphasis on fish catch statistics only without attempting to provide a systematic list of fishes available in that coast. Talwar and Chakrapany (1967) described a new flatfish of the genus Zebrion from the Orissa coast. Dharma Raja and Varughese (1975) and Muthu et al. (1975) observed the fisheries of east coast of India and of Kakinada respectively. Rama Rao et al. (1975) reported 75 species of fishes from the Andhra coast. Appa Rao (1976) investigated the relative abundance of Sciaenids along Andhra-Orissa coast. Das (1976) made a survey of the Ichthyofauna of the coast of West Bengal and provided a systematic list of 146 species of fishes available in that coast. Datta and Chatterjee (1977) recorded 62 species of fishes from the West Bengal coast off Bay of Bengal. An assessment of the small-scale fisheries such as fishing craft,
fishing gear, fish handling and utilization and coastal aquaculture of the Bay of Bengal was conducted by a consultant committee under the auspicious of Food and Agriculture Organization of the United Nations. In their report (1980) the committee recommended for a few acoustic surveys to obtain some knowledge of standing stocks of the east coast of India. The committee has also recommended for some aerial surveys in the Orissa-West Bengal areas to assess the effort deployed in that region.

Orissa, a maritime state of India, has a coast line of 720 km and thus obviously plays an important role in the marine fish production of Eastern India. But unfortunately very little effort has been made till now to investigate and develop the marine fishery of this coast. While literature is available regarding the fish fauna of the coast of West Bengal (a constituent of Bio-geographical Zone I) no such literature is available on Orissa coast. So the present investigator has made a sincere effort to make a survey of the ichthyofauna (teleosts) of Orissa coast and to provide a systematic list of fishes available in that coast so that a complete list of fishes available in the bio-geographical Zone-I can be prepared. Herein lies one of the justifications of the present undertaking. However, due to vastness of the coast line of Orissa and due to many other limitations the present investigator has restricted his survey to only the coastal region of two districts namely Balasore and Cuttack and the other two districts have been kept aside for future studies.

Indiscriminate fishing with the help of modern techniques can keep the fish population well below the natural level supported by the sea. For more than a century, fishery biologists have been pondering over the effect of uncontrolled fishing on future supplies of fish. Their concern has intensified as hunting techniques have improved unaccompanied by effective laws to conserve stocks. Governments are also not inclined to impose control over their fishermen as this will cause hardship to both the fishermen and the public. It is for
these reasons that ambitious programmes of mariculture were taken up in North America and some European countries towards the end of the last century (Shelbourne, 1964).

The present investigator likes to throw some light on the past ventures on mariculture in order to have a background knowledge in this branch of science as well as to explore the scope of such enterprise in the areas in question. The artificial propagation of sea fish on a commercial scale had its origin in the New World as a consequence of achievements in freshwater fish culture. In 1853, Dr. Theodatus Garlick of Cleveland made the first attempt to breed fish artificially on the North American continent by transplanting Canadian brook trout eggs from Ontario to Ohio. In the year 1873 as many as 35000 young shad, *Alosa sapidissima* (Wilson) from the east coast were transported across the continent and were released into the river Sacramento. By 1884 the shad had established itself as an important fish in the river of Pacific coast. In 1885, the Government of U.S.A. built its first commercial marine hatchery at Woods Hole, Massachusetts. The Norwegian government built a marine hatchery at Trondhjemsfjord in 1908 for mainly artificial propagation of *Pleuronectes platessa* L. However, as time passed on, more and more criticisms were levelled against the value and utility of marine hatchery movement of which Hjort and Dahl (1900) were the main architects. "Controversy arose; doubts hardened into prejudice; financial resources began to dry up; artificial propagation as a commercial proposition slowly lost its appeal and the movement virtually expired" in the 1950's (Shelbourne, 1964). However, to reaffirm public faith in the process of artificial propagation needed a scientific explanation to establish beyond doubt that this type of human intervention can improve the local yield of fish. Gunnar Dannnevig of Norway has been releasing 100-150 millions yolk-sac cod larvae into the Goloford every alternate year since 1950 to ascertain the advantage of artificial propagation. The preliminary observations have been encouraging. Hjort and Dahl (op. cit) in their criticism of the artificial propagation stressed
that "If the work of hatching could be perfected, so that, by its aid, the larvae of the plaice could be kept alive beyond the pelagic stage and reared until it settled on the bottom, a way might thus be found of increasing the stock of this species on our shores". Molander and Molander-Swedmark (1957) of Sweden successfully reared artificially fertilized eggs of plaice beyond metamorphosis and the survival was about 40% in some cases. Achievements of Great Britain in the field of mariculture is remarkable especially in the field of plaice rearing. The works of Shelbourne (1953, 1956, 1963, 1964) and Shelbourne et al. (1963) are worthmentioning here. Using ultraviolet radiation and antibiotics to make the water free from bacteria, circular tanks to minimize encounter with the solid obstacles, proper larval food, controlled salinity, temperature and pH, plaice were reared beyond the stage of metamorphosis and the survival was 66%. During 1962 at Port Erin Isle of Man a total of about 25000 metamorphosed plaice were produced and the plans were then to increase the production to 1 million within the next 5 years. Bardach (1968) discussed in length the problems of the aquaculture and suggested certain measures for its development.

Mariculture in its true sense means: 1. Mass release of young fishes in the coastal regions to neutralize the depletion due to fishing, 2. Establishment of new nursery grounds within the sea proper or in its inlets such as gulf and bays. According to Shelbourne (1964) "Man has learned to domesticate and farm most of his important food animals, with the notable exception of sea fishes. It is this fundamental anomaly, as well as the problem of stock depletion, which fosters scientific interest in prospects for marine fish farming". In spite of all the achievements made till recently by countries like U.K., U.S.A., France, Japan, Netherland and Canada, mariculture of marine farming is perhaps still in its early infancy.
India, endowed with a vast coast line of 5600 km is lagging much behind and has not achieved any remarkable progress in the pursuit of mariculture. The worth mentioning Indian work in this field is the experimental culture of Chanos in a saline lagoon on Palk Bay coast, conducted by Central Marine Fisheries Research Institute in the year 1958-59. The present survey is also aiming to take a note of the topography and ecological condition of the coast so as to provide a general idea regarding the coast. This knowledge will be of some use for future work for the development of mariculture in that coast. The present survey also suggests certain measures which may be undertaken for the development of marine fishery in this coast.
MATERIAL AND METHODS

For the survey of the ichthyofauna collection of fish samples were made from four selected spots, namely Chandipur, Chaumukh, Paradip and Talchua. During each collection tour, the investigator spent 3-4 days in each collection spot and collected samples both from day and night catches. The sampling was carried on during the pre-winter, winter, summer, early monsoon and postmonsoon seasons of 1978-1980. During the winter seasons when the sea was calm the investigator went for fishing in trawlers (bearing the names Glorea and Fortuna) at Paradip, in motor boats at Chandipur and in country boats at Chaumukh. Immediately after collection, the date and place of collection and the external colourations were recorded. Then the fishes were tagged and preserved in 10% solution of formalin. In larger specimen a ventral incision was made to facilitate the entry of the preservative. Finally the samples were brought to the laboratory where they were identified and a systematic list was prepared following Greenwood et al. (1966, 1967), Talwar and Kacker (in press).
Knowledge on the ecology and topography of a coast is not only quite relevant for the survey of the ichthyofauna but is an appropriate adjunct to any faunistic survey. But the study of ecology and topography of the coast of Balasore and Cuttack districts will form a separate chapter of research. However, a brief account of the topography and the ecological conditions of the collection spots based on the field observation made by the present investigator as well as from other available relevant literature (La Pond, 1957; Anon, 1961; Anon, 1962; Jayaraman, 1965; Panikar & Jayaraman, 1966; Jhingran, 1975; Das, 1976 and Anon, 1976 & 1977) has been provided so as to impart a clear understanding on the area of collection.

Balasore (Figs. 1, 2) is the north-eastern district of Orissa and lies between 20°-43'N and 21°-59'N latitude and between 86°-16'E and 87°-29'E longitudes. It is bounded by Bay of Bengal in the east. The district is a maritime one having a sea coast line of 137 kms. The district is traversed by 3 big rivers, namely, Subarnarekha in the north, Burabalang in the centre and Baitarani in the south which separates the district from Cuttack.

Cuttack (Figs. 1, 2) is also one of the coastal districts of Orissa having a coast line of 140 km and lies between 20°51'N and 21°10'N latitudes and between 84°58'E and 87°23'E longitudes. It is bounded on the north by Balasore and Keonjhar districts, on the south by Puri district, on the east by the Bay of Bengal. The district has three main rivers the Mahanadi flowing in the south, the Brahmani at the central part and the Baitarani in the north and they throw out many distributaries sometimes re-uniting and sometimes bifurcating as they pass across the level plains.
Due to the vastness of the coastline and to facilitate the survey, four collection centres were selected taking into account the following criteria.

1. River mouth area where more fish species are likely to occur.
2. Favourable ecological condition of the spot.
3. Availability of craft and gear used for fishing.
4. Suitable fish landing station.

Taking into account the above criteria, the following field stations were selected.

<table>
<thead>
<tr>
<th>District</th>
<th>Collection centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balasore</td>
<td>1. Chandipur</td>
</tr>
<tr>
<td></td>
<td>2. Chaumukh</td>
</tr>
<tr>
<td>Cuttack</td>
<td>3. Paradip</td>
</tr>
<tr>
<td></td>
<td>4. Talchua</td>
</tr>
</tbody>
</table>

A brief account of the topography, ecology, crafts and gears employed for fishing and the major fisheries of each centre has been given below. The investigator has also tried to highlight some of the major problems confronting the development of fishery of those areas, which the investigator has experienced during his course of survey. Certain remedial measures have also been suggested for the kind perusal of the authority concerned.

Chandipur (Fig. 2)

It is about 10 km away from Balasore town and is situated near the mouth of river Burabalang. The beach is wide, sandy and all along the beach casuarinas have been planted. About 30 motor boats are engaged here for fishing using gill nets. The major fishes of this spot are Pomfrets, mackerels, catfishes, sciaenids and clupeoids.
Occasionally trawling is done in this coast. The fishes which are caught by trawling are generally Sciaenids, *Cynoglossus arenarius*, *Cynoglossus linguus* and *Cynoglossus bilineatus*. Near the river mouth region fishes are also caught by Behundijal (a kind of local fish catching net). Behundijals are fixed in the tidal region of inshore water in the river with the mouth facing the tide. The high tide brings the fish in the net and when tide recedes the fishes are trapped. Using these nets a good amount of small prawns, ribbon fishes and Ponyfishes are caught.

Due to silting on the river mouth gradually it is becoming difficult for vessels to pass. The vessels can pass only during high tide period. So the river mouth requires periodic dredging.

Chaumukh (Fig. 2)

It is situated on the sea shore near the mouth of river Subarnarekha and is adjacent to Digha (a developing maritime township) of West Bengal. The sandy beach of this coast is about 500 yards wide and so firm that even military light air crafts land over it easily. The slope of the beach is long and gentle. Beneath the surface cover of sand there is occasional clay soil which in places form surface patches. Clay loams to the surface in lower portion of the beach is exposed only during low tides. A number of ball shaped lumps of clay are occasionally found in places lying scattered over the beach. Numerous pores were found to be present on the beach forming a sieve like appearance and house large number of crabs. When left undisturbed the crabs come out in thousands from the holes and move on the beach and thus forms a brown incrustation over the beach. All along the coastal region casuarinas have been planted and as a result dunes have been stabilized. Fishing takes place in this coast during the month of September to April when the sea usually remains calm. During the above period fishermen of the nearby places come here and settle in about 30-40 groups each group consisting of 20-25 personnel. They use to catch fish by shore seine. The major fishes
of this coast are anchovies, sciaenids, thread fins, whiting, and catfishes. Small size of C. arel, C. bilineatus are available in plenty. Paraplagusia blochii is available in abundance in this coast. During winter seasons a lot of jelly fishes are also caught along with the fishes.

Though a conspicuous amount of fish is procured from this coast, the latter does not play a significant role in the fishery of the state. The main problem inhibiting the development of fishery in this region is the lack of communication. One has to walk a distance of 14 km from this coast to reach the motorable road as a result quick transport of the fish is not possible. In addition to it, the lack of a freezing plant makes the problem more acute. Consequently fishes are sold here at an abnormal low price and thus the economy of the fishermen is greatly hampered. Besides this, a good amount of the total fish landings is also sun-dried and salted for future consumption but the curing process are by and large unscientific, highly unhygienic and the product is inferior for human consumption. Fortunately, very recently the Government of Orissa has turned its eye towards this spot and has started constructing a road to this place. A freezing plant should also be installed there to provide ice for the preservation of fish.

Paradip (Fig. 2)

It is about 100 km away from Cuttack town and is situated near the mouth of river Mahanadi. It is one of the deepest ports of India. The coast is very deep and the incursions of the sea towards the land has been checked by the embankment. There are about 200-250 trawlers engaged here in fishing. This coast is well known for its rich prawn resources. Besides this the other major fishes which are caught by the trawlers are sciaenids, lishes and flatfishes etc. The local fishermen also use to go to sea by catamarans and Dingi (a kind of indigenous fishing vessel) and catch fish by the gill nets. Their catches consist of mainly catfish, hilsa, carangids,
A good amount of mullets are also caught from the creeks like Atharabanki, Ganaghalia and Majidia which open to Mahanadi near Paradip. These creeks provide good nursery ground for brackish water fishes and if utilized properly may help to boost the fish production of the state.

Due to irregular supply of diesel the trawling is very often stopped. So a regular supply of fuel should be ensured to keep fishing uninterrupted. Steps should be taken to modernize the crafts and gears utilized by the local fishermen. A plant may also be installed in this coast to prepare poultry feeds utilizing the large amount of coarse fishes and crustaceans which are caught incidentally during trawling.

Talchua (Fig. 2)

It is situated near the mouth of river Baitarani. From ecological point of view this spot is very interesting due to the presence of mangroves on both the sides of the river. The mangrove swamps connected with the creeks and the marshy lands around the river provide very good ground for the development of coastal aquaculture. The local people of this area have started some type of a mariculture. They allow the sea water to enter into the low lands nearby the coast and culture prawns, catfishes, mullets and the perch like Lates calcarifer. Fishing in this coast is done with the help of motor boats using gill nets. The major fishes which are caught from this coast are sciaenids, carangids, pomfrets, mackerel and wolf-herrings etc.

A huge amount of hilsa fish is also caught generally during the month of November by a process called 'Sabard'. In the above mentioned process, a fish shoal is encircled by the fishermen using about 8-10 dingi. Then the fishermen keep on beating the surface of the water with the help of bamboo sticks to keep the fishes restricted in the middle. Finally, using a net (similar to mada valai of Coromandel Coast) the shoal is caught.
CLIMATIC AND HYDROLOGICAL CONDITIONS OF THE COAST

The climatic conditions of the coast bears a conspicuous influence over the marine forms. According to Jhingran (1975), "The dispersal of marine forms largely depends upon oceanic temperature, salinity and currents, besides other factors, such as availability of expanses of deep water, coast line configuration, submarine contours, etc."

The climatic conditions of the coastal areas are characterised by oppressive hot summer, high relative humidity and well distributed rainfall during the monsoon. The winter season begins from November and lasts upto end of February. The summer lasts from March to May. The south-west monsoon extends from June to September and from October to the first half of November makes the post monsoon season.

The relative humidity is high in the coastal region and was 85% (in August, 1978) in Balasore district and 82% (in August, 1978) in Cuttack district.

The temperature of the coastal region rises high during the month of May (36.4°C, 39.3°C in Balasore and Cuttack district respectively during 1978). During the winter season (January) the temperature comes down to 12.9°C and 15.4°C in Balasore and Cuttack district respectively (recorded during 1978).

The average rainfall in the coastal parts of Balasore district varied from 1082.3 mm to 1568.4 mm and in Cuttack from 951.9 mm to 1501.3 mm, as recorded during 1979.

Variation in salinity of sea water also affects the fish distribution. Surface salinity variation is generally caused by decrease of salinity by precipitation, increase of salinity by evaporation and change of salinity by process of mixing. However, in coastal
water apart from these factors, drift currents also influence salinity. There is a considerable influx of freshwater in the Bay of Bengal owing to a number of large rivers discharging into it, leading to the lowering of salinity. The average salinity values of Bay of Bengal is 30-35% approximately (Panikkar and Jayaraman, 1966). Salinity also shows a wide range of variation in Bay of Bengal recording 17-18% at the head of the Bay of Bengal or even less during the monsoon season and 0.31% in the southern part (Jhingran, 1975). The upper oxygen rich layer of the northern Bay of Bengal on an average value lies between 4.00 to 4.800 ppm approximately (Jhingran, 1975).

The transparency of sea water depends upon the suspensoids which may be of organic or biological such as plankton, or inorganic, such as fine particles of sand or clay. Generally in winter the water is beautifully clear and blue, but during rainy season the turbidity of the coastal water increases due to the accumulation of different organic and inorganic materials carried by the river system. According to a hydrological survey of the Mohanadi estuary conducted by INS Investigator (1952), the Zooplankton of the estuary were less numerous than phytoplankton and were mostly marine and brackish water form. The zooplankton consisted mainly of Pseudodiaptomus spp., Oithona spp., Paracalanus spp., Acrocalanus spp., Labidocera spp., Copepodid stages and nauplii. Rotifers, molluscs and polychaetes were also found in the collection. Amongst the phytoplankton diatoms and green algae were most common.

The magnitude of primary productivity of the sea as well as the estuaries is largely influenced by the availability of nutrients. La Pond (1957) indicated the presence of upwelling on the continental shelf off the central east coast, between the mouth of river Godavari and Krishna river in the south and the Mahanadi in the north during March to May. However, according to Jayaraman (1965) such upwelling is quite different in regards to the physicochemical and biological conditions, from the classical upwelling of the West Coast of India. In the West Coast of India during the late south-west
monsoon and early post-monsoon upwelling is intensive and thereby the water becomes very rich in nutrients. This may be ascribed to the high fishery productive capacity of the west coast in comparison to the east coast of India.

A list of the fishes (teleosts) collected from the above coast is given below.

**BONY FISHES COLLECTED FROM THE COAST OF ORISSA (BALASORE AND CUTTACK DISTRICTS)**

<table>
<thead>
<tr>
<th>Class</th>
<th>- Osteichthyes (Bony fishes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subclass</td>
<td>- Actinopterygii (Modern bony fishes)</td>
</tr>
<tr>
<td></td>
<td>DIVISION Taeniopaedia</td>
</tr>
<tr>
<td>Order</td>
<td>- Elopiformes</td>
</tr>
<tr>
<td>Family</td>
<td>- Megalopidae (Tarpons)</td>
</tr>
<tr>
<td></td>
<td>1. <em>Megalops cyprinoides</em> (Broussonet)</td>
</tr>
<tr>
<td>Order</td>
<td>- Anguilliformes</td>
</tr>
<tr>
<td>Family</td>
<td>- Muraenocidae (Pike Conger eels)</td>
</tr>
<tr>
<td></td>
<td>2. <em>Congresox talabonoides</em> (Bleeker)</td>
</tr>
<tr>
<td>Family</td>
<td>- Congridae (Conger eels)</td>
</tr>
<tr>
<td></td>
<td>3. <em>Muraenox bagio</em> (Hamilton - Buchanan)</td>
</tr>
<tr>
<td></td>
<td>4. <em>Uroconger lepturus</em> (Richardson)</td>
</tr>
<tr>
<td>Order</td>
<td>- Clupeiformes</td>
</tr>
<tr>
<td>Family</td>
<td>- Clupeidae (Sardines, ShAds)</td>
</tr>
<tr>
<td>Subfamily</td>
<td>- Alosinae</td>
</tr>
<tr>
<td></td>
<td>5. <em>Hilsa ilisha</em> (Hamilton - Buchanan)</td>
</tr>
<tr>
<td></td>
<td>6. <em>Hilsa kelee</em> (Cuvier)</td>
</tr>
<tr>
<td></td>
<td>7. <em>Hilsa toll</em> (Valenciennes)</td>
</tr>
<tr>
<td>Subfamily</td>
<td>- Clupeinae</td>
</tr>
</tbody>
</table>
8. Sardinella fimbriata (Valenciennes)

Subfamily - Dorosomatinae

9. Anodontostoma chacunda (Hamilton)

Subfamily - Dussumierinae

10. Dussumieria acuta Valenciennes

Subfamily - Pristigasterinae

11. Ilisha megaloptera (Swainson)

12. Opisthopterus tardoore (Cuvier)

13. Haconda russeliana Gray

Family - Engraulidae (Anchovies)

Subfamily - Coiliinae

14. Coilia dussumieri Valenciennes

15. Coilia neglecta Whitehead

16. Coilia ramcarati (Hamilton - Buchanan)

17. Coilia reynaldi Valenciennes

Subfamily - Engraulinae

18. Setipinna phase (Hamilton - Buchanan)

19. Setipinna taty (Valenciennes)

20. Stolephorus heterolobus (Ruppell)

21. Thryssa dussumieri (Valenciennes)

22. Thryssa hamiltonii (Gray)

23. Thryssa mystax (Schneider)

24. Thryssa purava (Hamilton - Buchanan)

Family - Chirocentridae (Wolf herrings)
25. Chirocentrus dorab (Forsskal).
26. Chirocentrus nudus Swainson

DIVISION • Euteleostei •

Order    Family
Myctophiformes
Synodidae (Lizard fish)

27. Saurida tumbil (Bloch)

Family    Order
Harpadontidae (Bombay - duck)

28. Harpadon nehereus (Hamilton - Buchanan)

Order    Family
Siluriformes
Bagridae (Catfishes)

29. Mystus (Mystus) gulio (Hamilton)

Family    Order
Ariidae (Sea catfishes)

30. Osteogeneiosus militaris (Linnaeus)
31. Tachysurus caelatus (Valenciennes)
32. Tachysurus jelle (Day)
33. Tachysurus platystomus (Day)
34. Tachysurus tenuispinis (Day)
35. Tachysurus thalassinus (Ruppell)

Family    Order
Plotosidae (Catfish - eels)

36. Plotosus canius (Hamilton - Buchanan)

Order    Family
Atheriniformes
Hemirhamphidae (Halfbeak fishes)

37. Hyporhamphus limbatus (Valenciennes)

Family    Order
Belonidae (Garfishes)
38. Strongylura strongylura (Van Hasselt)
   Order - Beryciformes
   Family - Holocentridae (Squirrelfishes, Soldierfishes)
   Subfamily - Holocentrinae

39. Adioryx ruber (Forsskal)
   Subfamily - Myripristinae

40. Myripristis murdjan (Forsskal)
   Order - Gasterosteiformes
   Family - Fistularidae (Hair-tailed flute mouths)

41. Fistularia villosa Klunzinger

42. Platynemus cantorii Bleeker
   Order - Scorpaeniformes
   Family - Platycephalidae (Flat heads)

43. Minus monodactylus (Bloch and Schneider)
   Family - Scorpaenidae (Scorpionfish)

44. Parascorpaena plica (Cuvier)
   Order - Perciformes
   Family - Centropomidae (Seaperches)

45. Lates calcarifer (Bloch)
   Family - Ambassidae (Glassfishes)

46. Ambassus commersonii Cuvier
   Order - Perciformes
   Family - Serranidae (Seabasses & Groupers)

47. Anperodon leucogrammicus (Valenciennes)
   Family - Theraponidae (Therapon perches)

48. Cephalopholis boenack (Bloch)

49. Epinephelus latifasciatus (Temminck & Schlegel)
50. Therapon jarbua (Forsskal)
51. Therapon theraps Cuvier

Family - Priacanthidae (Bigeyes, Bulleyes)
52. Priacanthus tavenus Richardson

Family - Apogonidae (Cardinal fishes)
53. Apogon (Nectamia) taeniatus (Cuvier)
54. Apogon (Nectamia) quadrifasciatus (Cuvier)

Family - Sillaginidae (Whiting)
55. Sillaginopsis panijus (Hamilton - Buchanan)
56. Sillago sihama (Forsskal)

Family - Lactariidae (False Trevallies)
57. Lactarius lactarius (Schneider)

Family - Rachycentridae (Sergeantfish)
58. Rachycentron canadus (Linnaeus)

Family - Echeneidae (Suckerfish)
59. Echeneis naucrates Linnaeus

Family - Carangidae (Jacks, Kingfishes)
60. Alectis indicus (Ruppell)
61. Alepes djedaha (Forsskal)
62. Alepes para (Cuvier)
63. Atropus atropus (Bloch)
64. Carangoides malabaricus (Bloch)
65. Decapterus russelli (Ruppell)
66. Megalaspis coriula (Linnaeus)
67. Scomberoides commersonianus Lacepede
68. Scomberoides tol (Cuvier)
Family - *Menidae (Moonfishes)*

69. *Mene maculata* (Bloch)

Family - *Leiognathidae (Ponyfishes, slipmouths)*

70. *Gazza minuta* (Bloch)

71. *Leiognathus hindus* (Valenciennes)

72. *Leiognathus blochii* (Valenciennes)

73. *Leiognathus equulus* (Forsskal)

74. *Secutor insidiator* (Bloch)

75. *Secutor ruconius* (Hamilton - Buchanan)

Family - *Lutjanidae (Snappers)*

76. *Lutjanus erythropterus* Bloch

77. *Lutjanus fulviflammus* (Forskal)

78. *Lutjanus johni* (Bloch)

79. *Lutjanus lunulatus* (Mungo park)

80. *Lutjanus rivulatus* (Cuvier)

Family - *Nemipteridae (Threadfin breems, Monocle breems)*

81. *Nemipterus japonicus* (Bloch)

Family - *Gerreidae (Mojarras)*

82. *Gerres poesi* Cuvier

83. *Gerres filamentosus* Cuvier

84. *Gerres setifer* (Hamilton - Buchanan)

85. *Pentaprion longimanus* (Cantor)

Family - *Pomadasyidae (Grunts)*

86. *Pomadasys hastas* (Bloch)

87. *Pomadasys maculatus* (Bloch)
<table>
<thead>
<tr>
<th>Family</th>
<th>Subfamily</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sparidae</td>
<td></td>
<td>Argyrops spinifer (Forsskal)</td>
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<td></td>
<td></td>
<td>Sciaenidae (Croakers)</td>
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<tr>
<td></td>
<td></td>
<td>Atrobucus nibe (Jordon &amp; Thompson)</td>
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<td></td>
<td></td>
<td>Chrysochir aureus (Richardson)</td>
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<td></td>
<td></td>
<td>Johnius amblycephalus (Bleeker)</td>
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<td></td>
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<td>Johnius carutta (Bloch)</td>
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<td></td>
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<td>Johnius coiter (Hamilton - Buchanan)</td>
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<td></td>
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<td>Johnius gula (Cuvier)</td>
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<td></td>
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<td>Johnius vogleri (Bleeker)</td>
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<td></td>
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<td>Nibea soldado (Lacepede)</td>
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<td></td>
<td></td>
<td>Otolithoides bigurita (Cantor)</td>
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<td></td>
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<td>Pama pama (Hamilton - Buchanan)</td>
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<td></td>
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<td>Panna microdon (Bleeker)</td>
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<td></td>
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<td>Pennahia macrophthalmus (Bleeker)</td>
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<td></td>
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<td>Protonibea diacanthus (Lacepede)</td>
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<tr>
<td>Mullidae</td>
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<td>Pterotolithus maculatus (Kuhl and van Hasselt)</td>
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<td>Upeneus (Pennon) bancasi (Temminck &amp; Schlegel)</td>
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<td>Upeneus (Upeneus) sulphureus (Cuvier)</td>
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<tr>
<td>Ephippidae</td>
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<td>Drepane punctata (Linnaeus)</td>
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<td>Ephippinae</td>
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<td>Epipus orbis (Bloch)</td>
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<tr>
<td></td>
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<td>Platex pinnatus (Linnaeus)</td>
</tr>
</tbody>
</table>
Family - Scatophagidae (Scats)
108. Scatophagus argus (Linnaeus)

Family - Mugilidae (Grey mullets)
109. Liza macrolepis (Smith)
110. Liza pargie (Hamilton – Buchanan)
111. Liza tade (Forskal)
112. Mugil cephalus (Linnaeus)
113. Rhinomugil corsula (Hamilton – Buchanan)
114. Valamugil cunnesius (Valenciennes)
115. Valamugil speigleri (Bleeker)

Family - Sphyraenidae (Barracudas)
116. Sphyraena forsteri Cuvier
117. Sphyraena obtusata Cuvier

Family - Polynemidae (Threadfins, Tasselfish)
118. Eleutheronema tetradactylum (Shaw)
119. Polynemus indicus Shaw
120. Polynemus paradiceus Linnaeus
121. Polynemus sexfilis Valenciennes
122. Polynemus sextarius Bloch

Family - Uranoscopidae (Star-gazers)
123. Uranoscopus guttatus

Family - Gobiidae (Gobies)
124. Glossogobius giurie (Hamilton)
125. Parachaeturichthys polynema (Bleeker)
126. Pseudapocryptes lanceolatus (Schneider)
Family Gobioididae (Bel like gobies)

127. Taenioides anguillaris (Linnaeus)

Suborder Kurtoidi
Family Kurtidae (Nurseryfishes, Hampheads)
128. Kurtus indicus Bloch

Family Trichiuridae (Ribbonfishes)
129. Ruppleurogrammus glossodon (Bleeker)
130. Lepturacanthus savala (Cuvier)
131. Trichiurus lepturus Linnaeus

Family Scombridae (Mackerel & Tunas)
132. Rastrelliger kanagurta (Cuvier)
133. Scomberomorus guttatus (Bloch & Schneider)

Family Stromateidae (Silver pomfrets)
134. Pampus argenteus (Buphrasen)
135. Pampus chinensis (Buphrasen)

Family Apolectidae (Black pomfrets)
136. Apolectus niger (Bloch)

Family Ariommmidae (Aromma)
137. Ariommm indica (Day)

Order Pleuronectiformes
Family Psettodidae (Toothed Flounders)
138. Psettodes erumei (Bloch & Schn)

Family Bothidae (Left-handed Flounders)
139. Pseudorhombus arsius (Hamilton - Buchanan)
140. Pseudorhombus elevatus Ogilby
141. Pseudorhombus malayanus Bleeker
Family  
- Soleidae (Soles)

142. *Brachirus commersoni* (Lacepede)

143. *Solea ovata*, Richardson

144. *Zebras altipinnis* (Alcock)

145. *Zebras synapturoideae* (Jenkins)

Family  
Subfamily  
- Cynoglossidae (Tongue soles)

146. *Cynoglossus arel* (Schneider)

147. *Cynoglossus bilineatus* (Lacepede)

148. *Cynoglossus cynoglossus* (Hamilton - Buchanan)

149. *Cynoglossus lingua* (Hamilton - Buchanan)

150. *Cynoglossus puncticeps* (Richardson)

151. *Paraplagusia blochii* (Bleeker)

Order  
- Tetraodontiformes

Family  
- Triacanthidae (Tripodfish)

152. *Triacanthus brevirostris* Schlegel

Family  
- Tetraodontidae (Puffers)

153. *Gastrophysus lunaris* (Bloch)

154. *Gastrophysus scleratus* (Gmelin)
SUGGESTIONS FOR FISHERY DEVELOPMENT

The present investigator makes the following suggestions for the consideration of the authority for the development of coastal water fishery of Balasore and Cuttack districts.

1. Modernization of crafts and gears

Majority of the fishermen of this coast use to catch using small country boats (Dingi and Catamaran) and nets which are scientifically not sound. As a result not only a lot of man power is wasted but also the catches are not economically profitable. So the fishermen should be educated about the modern fishing crafts and gears so that the catch will be boost off. The trawlers and motor boats engaged in fishing may be provided with Echo finder and fish finder equipments for safe and fruitful fishing.

2. Instalation of freezing plants

Except Paradip and Chandipur, the other fishing centres are lacking freezing plants. As a result a good amount of the catch becomes unfit for human consumption. So freezing plants should be installed at Chaumukh and Talchua.

3. Improvement of transport

Lack of transport facilities for the transport of the fishes from Chaumukh and Talchua to the market is the other major hindrance for the development of fishery in this region. Motorable road should be constructed from Chaumukh to Baliapal and motor boats may be employed for quick transport from Talchua to Chandbali.
4. Adoption of new nursery ground

The creeks like Atharabanki, Ganaghalia and Majidia which open to Mahanadi near Paradip provide good nursery grounds for the fishes. Mangrove swamps and creeks present on both the sides of the river Baitarani also provide good nursery grounds. So steps should be initiated for practising coastal water fish culture in these regions.

5. Installation of ancillary industry

Trawling by about 250 trawlers also bring a huge amount of coarse fishes, some crustaceans and molluscs which are unfit for human consumption. Presently these are just thrown away on the sea beach, thereby making the beach dirty and unhygienic. So a small industry may be installed in this region for the preparation of poultry feeds utilizing the above mentioned waste materials.

6. Dredging of the river mouth

The gradual silting on the river mouth of Burabalang has posed a problem for the smooth passage of the vessels into the sea. So a periodic dredging of the river mouth is required to keep the river mouth navigable.

7. Opening of co-operative societies for the fishermen

Though this suggestion seems to have gone beyond the perview of this present work, the investigator fails to check his temptation to highlight this issue, as the problems of the fishermen can hardly be kept alienated from the fishery development problems. With few exceptions, the majority of the fishermen of this coast are extremely poor and live much below the poverty line. So they use to borrow money from the local
money lenders at the cost of high interest. As a result their economic condition is not improving keeping pace with the economic development of the country. So the government and the local administrative authorities may show interest in opening co-operative societies for the fishermen for providing loan and equipments at reasonable price for the modernization of their crafts and gears.

It is needless to mention that the improvement of socio-economic condition of the fishermen will have positive impact on the fishery development.