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International Journal of Current Research in Life Sciences
Vol. 09, No. 10, pp.3342-3348, October, 2020

ISSN: 2319-9490

RESEARCH ARTICLE

A BRIEF REPORT ON MARINE FAUNAL DIVERSITY OF VISHAKAPATTANAM – REPRESENTING THE EAST COAST OF INDIA

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Received 07th August, 2020; Accepted 20th September, 2020; Published 30th October, 2020

ABSTRACT

Studying Biodiversity is an important tool to understand the intrinsic functions of all species on the earth. The present work was carried out to collect data regarding faunal diversity of Bay of Bengal emphasizing to the coastal stretch of Vizag. The city lies between 17º44'N latitude, and 83º23'E. According to IUCN a considerable number of available fish species of the coastal Bay of Bengal are in a state of danger in near future due to indiscriminate fishing, habitat degradation, pollution etc. Fishes constitute almost half of the total number of vertebrates in the world and important marine resource and considering its contribution to the overall economy of India, immediate intervention is required. Therefore conservation, aimed towards preserving existing biodiversity to maintain ecological balance is required, although the pressure on natural habitats associated with increasing population and economic growth will continue to lead to the loss of biological diversity.

Key words: Biodiversity, Bay of Bengal, Chondrychthyes, Osteichthyes, IUCN, Icthyofauna, Molluscs, Arthropods

Citation: Tapasi Roy and Kausiki Chakrabarti. 2020. "A brief report on marine faunal diversity of Vishakapattanam – representing the east coast of India" *International Journal of Current Research in Life Sciences*, 09, (10), 3342-3348

INTRODUCTION

Biodiversity is an essential area of study for stabilization of ecosystems, protection of overall environment and understanding the intrinsic functions of all species on the earth (Ehrlich and Wilson 1991). Whereas the species diversity of an ecosystem is often related to the amount of living and nonliving organic matter present in it and depends mainly on the interactions between ecosystems. India is one of the mega biodiversity countries in the world (Mittermeier and Mittermeier 1997) where 2,500 species of fishes were found; among them 930 are freshwater and 1570 are marine (Kar 2003a). It is reported that 2,019 km long coastline along the east coast of India bordered the western bank of Bay of Bengal (Vivekanandan and Krishnakumar 2010) and are comprising of four maritime states, i.e., West Bengal, Orissa, Andhra Pradesh and Tamil Nadu among them Andhra Pradesh ranks second in marine fish production, with a coastline of 974 km, which is about 12.5% of India's coastal length (Sudharani P 2015). Again Visakhapatnam is one of the main harbours of Andhra Pradesh for the mechanized boats, where adequate shelter, shore facilities exist and is the only deep-sea trawler base on the east coast of India. Moreover, this place is the reservoirs of the most important large number of living aquatic animals including crustaceans and molluscs, which are economically important. A very limited work has been done on Ichthyo-faunal study (Sujatha K 1995; 1996; Kandra P *et al*. 2010; Das M *et al*. 2013; Rao Y P *et al*. 2013). Fishes constitutes almost half of the total number of vertebrates in the world and constitutes important marine resource and considering its contribution to the overall economy of the country, the present field study was carried out to collect data relating to icthyofaunal diversity along with other faunal varieties in this area.

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MATERIALS AND METHODS

In order to continue and complete the survey work we used some simple materials like nets, hooks, traps, measuring tapes and high quality camera.

Study Area: A coastal stretch of Vizag was chosen for this study due to vast diversity in faunal composition and at the same time less report from this area. The city lies between 17º44'N latitude, and 83º23'E. It is one of the most important and sensitive areas of the country extending 5 km from the north-western arm to the outer harbour and is connecting to the open sea through the entrance channel. The important beaches include Ramakrishna beach and Rishikonda beach.

The survey: During the entire study period, field survey was conducted and the faunal diversity observed was photographed

and characters were noted for identification. The catch details from individual boats were also noted after landing from the crew. The trade details were collected from traders of the "seafood trading centre" located at the harbour. Moreover from each landing of individual boats, its utilization and discards were observed and recorded.

Crude density calculation: Crude density of the sand crab population was calculated as number of crab holes present per Sq. Meter.

RESULTS AND DISCUSSION

Results

Percentage of marine faunal diversity: Along the coast line of Visakhapatnam (17º44'N, 83º23'E), in the east coast of India different species of chondrichthyes, osteichthyes, arthropods and molluscs are recorded. The percentage of species composition is given in Fig. 1.

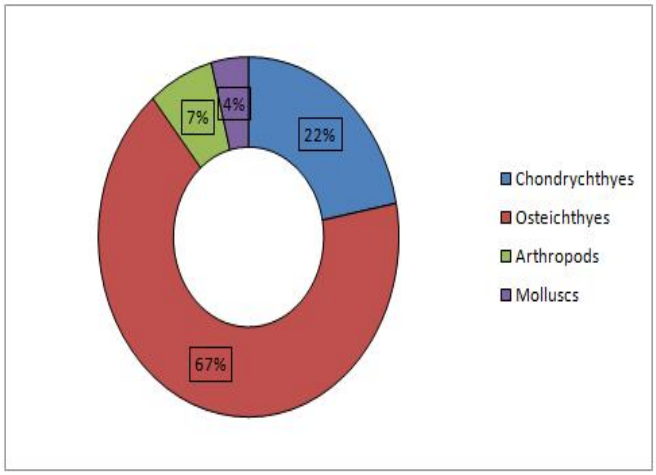

Fig: 1. Showing percentage of marine faunal diversity

Ichthyofaunal composition

Chondrychthyes

Carcharhius dussumieri is a rare species of requiem shark. IUCN has listed them as "Near Threatened" (Bennett and Kyne 2003). It is a small and stocky gray shark, with long head, rounded snout and oval eyes. Both jaws of the shark have multiple rows of backward-pointing, serrated teeth. The pectoral fins are long, narrow, and curved and have narrow, pointed tips. The first dorsal fin is triangular, uncurved, moderate-sized, and the second dorsal fin is much smaller than the first bearing a large black patch at its apex. It feeds on small bony fishes, cephalopods, and crustaceans.

Rhizoprionodon acutus or the milk shark is also a species of requiem shark. The IUCN has assessed them as "Least Concern" (Simpfendorfer CA 2003). The milk sharks typically found in coastal tropical waters. The milk shark has a slender body with a long, pointed snout, large eyes and a long furrow at the corners of its mouth with 7 - 15 enlarged pores just above them. The number of tooth rows is 24–25 in both jaws. The broad, triangular pectoral fins originate below the third or fourth gill slits. The anal fin is about twice as long as the second dorsal fin and preceded by long ridges. The first dorsal fin originates over the pectoral fin and the much smaller second dorsal fin originates over the last third of the anal fin base. The lower lobe of the caudal fin is well-developed and the upper lobe has a ventral notch near the tip. The milk shark feeds primarily on small bony fishes, but also takes cephalopods and crustaceans.

Chiloscyllium griseum The Slender bamboo shark, is a small, sluggish, in-shore, bottom dwelling shark found on sandy and muddy bottoms of coastal water (Compagno *et al*. 2005; Froese *et al*. 2006). It is accessed as "Near Threatened" on the IUCN Red list of Threatened species globally (Barratt *et al*. 2003). *Chiloscyllium sp.* serves as one of the favourite hosts for a wide range of trypanorhynchid and tetraphyllid cestodes. Cestode parasites are implicated as major causative agents for diseases in fishes as they affect the health status, growth, survival and reproduction of the hosts by reducing their food intake and provoking nutritional stress (Anderson and May 1978; Petekevicius 2007; Wenchaun 2007).

Electric rays represent a complex group of restricted endemics, which are generally discarded as by catch. These are assessed as "Data Deficient" by IUCN (ICUN 2013; Pheeha 2004; Carvalho and McCord 2006; Smale 2006; Notarbartolo *et al*. 2009). Larger specimens are capable of producing strong electric shocks reported to reach a discharge of 220 volts (Coates and Cox 1942; Bigelow and Schroeder 1953). Species of the electric rays occur in tropical and temperate waters, circum-globally from the shoreline down to about 600 m on the continental slope (Carvalho 2002). The family is identified by transversely elliptical disc, monocuspid teeth; moderately reduced tail, well developed and moderate sized dorsal fins and large caudal fin.

Gymnura poecilura has a widespread distribution but due to high level of exploitation it becomes "Near Threatened" globally. It is restricted to the inner continental and coastal shelves with a narrow depth range, typically on sand or mud substrate (James 1966). Although no specific information is available, habitat loss and degradation may be the reason of its inshore coastal occurrence. The diet includes fishes, molluscs and crustaceans (James 1966).

Sphyrna lewini or hammer head is, semi-pelagic, living in both coastal and offshore waters in tropical and sub-tropical regions. It is cosmopolitan in distribution and listed as "Endangered" (Baum J *et al*. 2007) in the IUCN Red List of Endangered Species. Spiracles and inter dorsal ridge were absent; first dorsal fin was situated very high and patented; second dorsal and anal fins small and far behind; caudal fin was asymmetrical with well defined sub-terminal notch and small lobe; pre-caudal pits were present. Front margin of head with a distinct median indentation; anal fin base longer than second dorsal fin base. Body elongated and laterally compressed; lateral extensions of head narrow and blade like; anterior margin of head broadly convex, with a distinct median indentation and another prominent notch is present laterally near the end. Body was brownish-grey, shading to white ventrally; ventral side of pectoral fin tips was black. Hammer head sharks feed mainly on teleost fishes and cephalopods, lobsters, shrimps, crabs, as well as smaller elasmobranchs (Clarke 1971). After more than three decades, *Sphyrna lewini* has reappeared on the Indian coast demonstrating its continued existence in Indian waters.

Osteichthyes

Rastrelliger kanagurta i.e. the Indian Mackerel is a seasonal fish, the spawning concentrations have been observed in large quantities on the Middling fishing ground (West 1973). These are assessed as "Data Deficient" by IUCN. Adults occur in coastal bays, harbors and deep lagoons, usually in some turbid plankton-rich waters. The head of this species is longer than body depth, maxilla partly concealed, but extending to about hind margin of eye. Bristles present on longest gill raker. A black spot present on the body near lower margin of pectoral fin. Inter pelvic process is small and single. Anal spine is rudimentary. The species feed on phytoplankton (diatoms) and small zooplankton (cladocerans, ostracods, larval polychaetes, etc.).

Istiophorus platypterus i.e. the sailfish are the apex predators in the oceanic food chain, feeding primarily on sardines, crustaceans and cephalopods. They are considerably under-valued and are "vulnerable" to over-exploitation. They are highly sought by sport fishermen and certain countries in the western Indian Ocean have used areas of congregation of sailfishes to develop a recreational fishery/tourism earning valuable foreign exchange (Hoolihan 2004). However, in most other countries in the Indian Ocean region, they are by-catch in drift gillnets and long lines operated for large pelagics such as oceanic tunas and sharks.

Nemipterus japonicas is perch-like, marine, non-migratory fish found on sand or mud bottoms of Indian Ocean, Arabian Sea and Bay of Bengal (Ning P *et al*. 2015). These are "Not Evaluated" by IUCN. In this species suborbital spines are absent, pectoral fins moderately long, reaching to or just behind anus, Pelvic fins long, reaching to or just beyond level of origin of anal fin. Scale rows on body below lateral line are upward and anteriorly curved. Axillary scales present. Dorsal part of the body is pinkish whereas ventral part is silvery. Snout has 2 indistinct stripes. The species feeds mainly on crustaceans, cephalopods (Loligo), small fishes and polychaetes.

Priacanthus hamrur are assessed as "Least Concern" by IUCN (Carpenter KE *et al*. 2016). Body of this fish is deep, ovate, and laterally compressed. Anterior profile is slightly asymmetrical, tip of protruding lower jaw located usually above midline of body. Small teeth present on dentaries, vomer, palatines, and premaxillaries (Sivakami S *et al*. 2001).Total gill rakers on first gill arch are 24 - 26 in number. Scales modified, the posterior field elevated as a separate flange with spinules. Swim bladder of this fish is with a pair of anterior and posterior protrusions.

Scatophagus argus, or the spotted scat occurs in two basic colour morphs (Allen 1984) which are called green scat and ruby or red scat and are assessed as "Least Concern" by IUCN. They live in coastal muddy areas, including estuaries, mangroves, harbours, and the lower courses of rivers. They are the popular aquarium fish. The body is strongly compressed. The dorsal head profile is steep, with a rounded snout. The body is greenish-brown to silvery with many brown to red-brown spots. Spines and rays of the dorsal fin are separated by a deep notch. Small ctenoid scales cover their body. They can adapt to varying salinities. The common scat is omnivorous.

Acanthocybium solandri is also assessed as "Least Concern" by IUCN and an oceanic, epipelagic species. It feeds on fishes and on cephalopods. This is a fast growing species with high mortality. This species exhibits early sexual maturity, usually within the first year (Collette *et al*. 2015). The species lives on average for 5–6 years (Oxenford *et al*. 2003). This species is caught in commercial, artisanal, or recreational fisheries throughout its range. This species is typically a by-catch in purse-seine and long line fisheries (Collette *et al*. 2015).

Chirocentrus dorab or Blackfin wolf-herring is a coastal fish and are "Not Evaluated" by IUCN. It is found in both marine and brackish water (Whitehead PJP 1985). This species, however, is most commonly found in turbulent waters. Blackfin wolf-herrings are narrow elongated fish, so named for the black markings on the upper part of the dorsal fin and the wolf-like canines protruding from their mandible and premaxilla. Blackfin wolf-herring is a carnivorous fish and feeds on other members of the order clupeiformes as well as members of the class cephalopoda mainly octopus and squid. Sardines are another preferred prey of this species. Juvenile of the species feeds on small shrimp, post-larvae, and early juvenile fish.

Leiognathus equulus is a widespread and common species of fish and is listed as "Least concerned" by IUCN. This species occurs in inshore muddy-bottomed coastal waters, river mouths and estuaries (Allen 1991). The fish feeds on polychaetes, small fishes and crustaceans (Woodland *et al* 2001). In Indian waters, this species are found near the surface during April-May, when it can be caught with drifting gill nets. Local fisheries may pose a localised threat to this species.

Lutjanus argentimaculatus is a marine; demersal fish and assessed as "Least Concern" by IUCN (Allen GR 1985). It is red or reddish-orange coloured fish. The species is well distributed in Indian Ocean and the Bay of Bengal, but probably widespread in the tropical regions. Total numbers of dorsal spines are 10 – 11and anal spines are 3. Dorsal profile of their head is steeply sloped. The preorbital bone is relatively broad and its width greater than the eye diameter. Preopercular notch and knob poorly developed. Scale rows on back rising obliquely above lateral line. Median fins are reddish, sometimes with a yellow or narrow brown or black border; pelvic fins are red; pectoral fins yellow. Adults occur over rocky bottoms. They feed on fishes and crustaceans.

Lutjanus johnii is widespread in the Indo-West Pacific (Anderson and Allen 2001). It is found in a variety of habitats including but not limited to coral reefs (Allen 1985; Kiso and Mahyam 2003). It is listed as "Least Concern". This species feeds on fishes and benthic invertebrates including shrimps, crabs and cephalopods. Spawning has been reported during September in the Andaman Sea (Anderson and Allen 2001). This species is caught mainly with handlines, bottom longlines, traps, and bottom trawls.

Lutjanus rivulatus is found on reefs and shallow inshore reef flats. This species is managed to varying degrees throughout its range and is found in marine protected areas. This is a widespread species and is listed as "Least Concern". Adults are found on deep coastal slopes, juveniles on shallow algae-reef flats, often near freshwater run-offs (Kuiter and Tonozuka 2001). It feeds on fishes, cephalopods and benthic crustaceans (Sommer *et al*. 1996). Populations of

Megalaspis cordyla (horse mackerel) from four areas, two each from the east (Digha and Mandapam regions in the Bay

of Bengal) and west (Cochin and Mumbai regions of the Arabian Sea) coasts of the Indian peninsula were studied based on conventional morphometry and meristics.

The torpedo scad is a moderately large fish. The body is elongated and sub-cylindrical, with a marked median keel on the caudal peduncle. There are two separate dorsal fins; the first consisting of 8 moderately high spines and the second of a single spine followed by 18 to 20 soft rays. The anal fin consists of two anteriorally detached spines followed by a single spine attached to 16 or 17 soft rays. The breast is devoid of scales. The eye has a well-developed adipose eyelid which nearly completely covers the eye. The upper jaw contains small villiform teeth (Randall 1995), while the lower jaw has a single row of small teeth. There are 26 to 32 gill rakers. The torpedo scad has bluish-grey to green above the body while the colour changes to a silvery white on its sides and belly. The dorsal and anal fins are pale to yellow, becoming dusky at the outer edges. The pectoral and pelvic fins are also pale with dusky upper halves, while the caudal fin is dark, particularly on the leading and trailing edges. A large black spot is present on the operculum. The species is a predatory fish which consumes larger prey and filter feeds to consume planktonic organisms (Jaiswar 1991). Larger prey items include a variety of fishes and cephalopods including squid and cuttlefish. Smaller foods are mostly crustaceans such as shrimps, prawns, stomatopods, cladocerans and crabs. Molluscs and gastropods are also reported to be minor constituents of the diet of the species (Sivakami S 1995).

Muraenesox bagio has a slender body with a hair-like tail that is extremely thin and tender. Anus is before mid-body. Gill opening slit is large. Snout is elongated, anterior nostril is tubular and located middle from the upper jaw tip to the posterior nostril. Posterior nostril is located in front of the eye at the mid-eye level. Pectoral fin is absent. Dorsal fin is confluent with caudal fin and anal fin. Scale is absent (van der Elst R 1981).

Pomadasys maculatus is a marine, brackish, reef-associated, amphidromous, small-sized fish of moderately deep body. The species is listed as “Least Concern” by IUCN (Smith MM and McKay RJ 1986). The species found throughout the Indian Ocean and the western Pacific, north to China, south to Australia. Total numbers of dorsal spines of this species are 12; the dorsal soft rays are13-14 in number; anal spines are 3; anal soft rays are 7 in number. The chin has 2 pairs or small pores. This species is characterized by several dark large elongate blotches on the upper back. The species is oviparous and feeds on crustaceans and fishes.

Parastromateus niger or the black pomfret is a fish with flattened body and a lot of colours. It is marine, reef-associated, amphidromous, deep-bodied and strongly compressed fish (Riede K 2004). The species is “Not Evaluated” by IUCN (IUCN SSC Antelope Specialist Group. 2016). The dorsal spines of the species are 2 – 6 in number; dorsal soft rays are 41-46, anal spines are 2 in number. Lateral line ends in weakly-developed scutes on the caudal peduncle. Pelvic fins are lost in individuals over 9 cm. The colour of their body is brown above, silvery-white below. The anterior parts of the dorsal and anal fins are bluish-gray. The species feed on zooplankton.

Trichiurus lepturus or the Ribbon fishes having long body resembling to that of a snake are highly compressed and has a ribbon like body with silvery in colour and occurring abundantly in the Indian Ocean. Now the fishery is confined to the depth zone shallower than 70 m (Nakamura I and Parin NV 1993).

Arthropods Composition

Portunus pelagicus or the flower crab, blue crab, blue swimmer crab, blue manna crab or sand crab and has rough to granulose carapace; front with 4 acutely triangular teeth; 9 teeth on each antero-lateral margin. The most external tooth is 2 to 4 times larger than the precedent. Chelae elongated with conical tooth at the base of fingers; legs laterally flattened, last 2 segments of last pair is paddle-like. Males coloured with blue markings whereas females are dull green (Joelle CYL *et al*. 2010). *Portunus pelagicus* feeds on a wide variety of sessile and slow moving benthic invertebrates including hermit crabs, gastropods, bivalves, ophiuroids, and gammarid amphiods. They stay buried under sand or mud most of the time, particularly during the daytime and winter. *Portunus sanguinolentus*, the three-spot swimming crab or the blood-spotted swimming crab is a large crab. It is a marine form. In India it is distributed through the East and West Coast, Gulf of Mannar, Andaman and Nicobar islands. The carapace of this species is very broad, convexed, with 3 red spots in posterior half, in the young carapace is finely granular everywhere. Supra-orbital borders cut by 2 fissures into 3 lobes, the angles of the middle lobe not conspicuous. The antero-lateral borders very long and oblique cut into 9 teeth, the last of which is about four times as long as any of the others. Chelipeds in the adult male is about 2 - 2/3 times the length of the carapace, but rather less in the female and in young male. The arms of this species are with 3 or 4 large spines on the anterior border, but without any on the posterior border. Its hands and outer surface of wrist is costate. A spinule present near the far end of the posterior border of the carpus of the first two pairs (Ng PKL and Davie P 2015). Primarily the crab is a carnivore. It is generally a harmless crab and commercially harvested as an edible crab species in many countries.

Molluscs Composition

Sepia or Cuttlefish are marine cephalopodahttps. Cuttlefish have a unique internal shell, the cuttlebone which is porous and is made of aragonite. Cuttlefish feeds on small molluscs, crabs, shrimp, fish, octopus, worms, and other cuttlefish. They have an unusual biogeographic pattern. They are found in sub littoral depths (Hewitt and Pedley 1978). The cuttlefish is listed under the Red List category of "Least Concern" by the IUCN. Cuttlefish have sophisticated eyes (Hewitt and Pedley 1978). The suckers of cuttlefish extend upto the length of their arms and along the distal portion of their tentacles. Cuttlefish have ink, which they use to help evade predators.

Density of sand crab population in sea-beach: The density of sand crab population was studied at Ramkrishna beach. The total area for that study was 36 Sq. Ft. distant between two dominant crab holes was found 100 cm. Diameter of 1st dominant crab hole was 2.4 cm and the diameter of the 2nd dominant crab hole was 2.8 cm. The sub-quadrat number with respective number of crab holes are given in Table 1.

Table 1. Showing the sub-quadrat number with respective number of crab holes

Subquadrat number	Number of holes
1	118
2	19
3	18
4	45
5	82
6	50

Density of Rock Barnacles (*Balanus sp.*): The density of rock barnacles was studied at Rushikonda beach. The total volume of rock surface was 69.834 Sq. M in which total 150 individuals were counted. The crude density was calculated as 150/69.834 = 2.15 per Sq.M. Again the crude density was found to be greater in the land-ward direction (100/34.917 = 2.86 per Sq.M) than the sea-ward direction (50/34.917 = 1.43 per Sq. M).

DISCUSSION

In India the studies of marine fauna has drawn greater attention since eighteenth century by surveys and expeditions conducted by the British. In the marine ecosystems of the world 32 are reported out of 34 phyla (Venkataraman K 2005). In India major studies have been conducted only on the commercially important organisms such as crustaceans, molluscs, holothurians and higher vertebrates whereas studies on commercially non important minor phyla were neglected. For example species of different minor phyla living as the interstitial fauna are not reported till today and there is lack of expertise in the field too. Although taxonomy is being taught in the curricula of school and college levels moreover taxonomic studies in the universities are discouraged for various reasons. At the same time there is no committed institution for taxonomic studies except survey departments of Government of India. Till date surveys and inventions of fauna and flora have been conducted only in selected areas especially around the mainland coasts where some of the research institutions are located such as NIO, Goa, Andhra University, Visakapattinam; Gulf of Mannar, CMFRI, Chennai Coast and Zoological Survey of India.

To culminate the present scenario in the taxonomic studies in India, capacity building on taxonomy at national, regional and sub-regional level with the preparation and publication of faunal guides for identification is essential. Regular survey and information on faunal composition are also required to adopt proper management strategies with regard to maintain sustainability. It would be preferable to assay assumption on standing stock, replacement yield, allowable catch, etc. A considerable number of fish species which are available in the coastal Bay of Bengal are in a state of danger in near future (Shanmugaasokan L *et al*. 2013). These calls for immediate intervention to prevent the undesired decline of the potentially marketable fishes and this can only be achieved by the active participation of the local populations and thereby solving two problems, unemployment and ecological restorations of the water bodies. This will also lead to the prevention of emigration. Government of India has established many marine protected areas for conservation of fauna and flora, whereas, for better conservation of marine ecosystems the involvement of community is highly essential. Again the establishment of government museums (Natural History Museum, Zoological Survey of India, Forest Departments, Navy, CMFRI and in State Government and Union territories) and aquaria alone are not enough to create awareness about the importance of the conservation and management of marine biodiversity for the future generation of this country. The coastal fisheries faces several threats such as indiscriminate fishing, habitat degradation, pollution, social conflicts, introduction of highly sophisticated fishing gadgets, need management measures and conservation of marine biodiversity to maintain sustainable use of marine biodiversity (Barua S *et al*. 2014). Some of the measures such as control of excess fleet size, control of some of the gears like purse seines, ring seines, disco-nets, regulation of mesh size, avoid habitat degradation of nursery areas of the some of the species, reduces the discards of the low value fish, protection of spawners, implementation of reference points and notification of marine reserves for protection and conservation.

The pressure on natural habitats associated with increasing population and economic growth will continue to lead to the loss of biological diversity. Some of the harmful human impacts of aquatic biodiversity are due to ignorance, lack of understanding of the importance of aquatic biodiversity etc. Recognition of the scale of problem, the nature of the underlying causes, and the limited resources available to counteract powerful destructive trends will definitely lead to a best way of conserving the Biological Diversity of the aquatic ecosystems of India (Madhavi K *et al*. 2012). It could be a little difficult for detailed study of each group. There could be uncertainties with all scientific endeavours to monitor abundance and productivity of stocks and the underlying causes.

Further, there are uncertainties with regard to climate, aquatic ecosystem productivity, predation and fishing pressure. Managing for ichthyodiversity provides a useful clue against these uncertainties because it represents the epitome of water stewardship, quite distinct from simply maintaining reliable stocks of individual species.

Fishermen and ichthyologists have a critical role to play in understanding and protecting diverse fish resources. Concomitant to the above, the ongoing process of ecosystem change, as is evident in Lake Sone today, directly or indirectly affects the abundance and composition of the fish species; and, is, to a large and increasing degree, due to human activities which are sometimes unconnected to fisheries. The state of the fish community may be seen as a valid integrative indicator of aquatic ecosystem quality and health; and, little more distantly, may be viewed as a regional quality of life for the human beings. Conservation of fish diversity assumes topmost priority under the changing circumstances of gradual habitat degradation.

Conclusion

Bay of Bengal harbours a large number of potentially marketable fish species, which are in a state of great danger in near future. To maintain sustainable development and use of marine biodiversity, participation of the local populations is highly required to prevent the undesired decline of fish biodiversity at the same time indiscriminate fishing, habitat degradation, pollution, social conflicts, introduction of highly sophisticated fishing gadgets should be checked which in turn will help to achieve ecological restorations of the water bodies and at the same time conservation of fish diversity.

Acknowledgements

Authors acknowledge Zoological Survey of India, Kolkata for identification of the specimens and Mr. Chirandeep Dey for his assistance during this field study work.

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