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Assessment of Ichthyofaunal Diversity in Sasihithlu Estuary of Dakshina Kannada, Karnataka, India

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ABSTRACT

The ichthyofaunal diversity is an excellent bio indicator of the status and health of aquatic ecosystems. The present study elucidates the ichthyofaunal diversity of Sasihithlu estuary in the west coast of Karnataka, India. The study was conducted from January 2019 to January 2020. Field explorations in estuary were undertaken on a monthly basis. A detailed analysis of piscine diversity revealed a total of 63 species of fresh water, estuary and marine fish belonging to 13 orders and 37 families. Perciformes was found to be a predominant order with 20 families and 31 species. Of the recorded species, one is Vulnerable and two are Near Threatened species. The greater diversity of fish was recorded during monsoon and the lesser diversity was recorded during winter.

1. Introduction

Wetlands are some of the most productive ecosystems and an important natural resource^[1,2]. Among them, estuaries are the second most productive ecosystems in the world and a significant life support system^[3,4]. Estuaries are special transitional zones which connects true freshwater ecosystems with adjacent marine ecosystem. They also host mangroves^[5]. They provide various ecological, environmental, economical and scientific services to mankind^[6,7] and understanding the biodiversity of these ecosystems is important^[8,9,10]. Estuaries, being the special transitional aquatic habitat serve as excellent repositories of ichthyofauna and form a major component of fisheries^[11]. India has rich estuarine and brackish water systems along its east and

west coast. They provide conducive environment and conditions for breeding, spawning, feeding, nursing grounds and migration routes for several marine and freshwater fish species^[12,13]. Estuaries are also called as nurseries of oceans as they provide safe habitat and rich food resources for initial stages of development for fish larvae and juveniles^[14,15,16]. About 80% of the world's fisheries are dependent on mangrove^[17,18] and majority of marine organisms spend a part of their life in mangroves^[19,20]. Concomitantly, fish play an important role in managing the species diversity, its population and ecological balance of an area.

Contrary to this, wetlands and estuaries are severely modified, disturbed and destroyed by humans^[21] which has resulted in decreased biodiversity^[22,23]. Intense anthropogenic activities have drastically deteriorated and reduced

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estuaries of India [24]. This has led to the rapid decline in ichthyofaunal diversity and population which will in turn cause serious ecological imbalance. Keeping this in view, the study is aimed at cataloguing the ichthyofaunal diversity of Sasihithlu estuary as no comprehensive studies have been conducted so far with this regard. The present investigation, which is part of a larger integrated research, serves as a crucial prerequisite for sustainable management of ichthyofauna and formulation of conservation strategies.

2. Materials and Methods

2.1 Study Area

Sasihithlu is an estuary which is a confluence point of two rivers, Nandini and Shambhavi which originates in Western Ghats (Figure 1). It is located 25 km north of Mangaluru city (13.02° N & 74.47° E) and has an average elevation of 3 m above mean sea level. The region experiences climate and weather pattern which is typical to that of a coastal area. The temperature varies from 26° C to 42° C with an annual precipitation of about 3,500 mm. The depth ranges between 1 to 8 m. The mouth of the estuary is dominated by sand whereas the mid and the upper reaches of the estuary is dominated by silt and clay sediments. The estuary is greatly influenced by tidal inundations exhibiting semidiurnal tides and hence the water is brackish throughout the year. 5 sampling sites were selected (Table 1) with a minimum distance of 500 m from each other to ensure Quasi independence [25].



Figure 1. Map and google image of the study area

Periodic field exploration was conducted from January 2019 to January 2020. The study period was divided into 3 distinct phases, viz., the pre-monsoon (March to June), the monsoon (July to October) and the post-monsoon (November to February). Fish samples were collected from the estuary with the help of fishermen through random netting. Seine net, bag net, cast net, gill net, scoop net, drag net, stake net, trap net of varying mesh size and hook and line were used for fishing. Majority of the specimens were identified at the site of collection itself. Unidentified samples were preserved in 10% formalin and brought to the laboratory for identification and experts in the field were also consulted for the same. Standard literature was used for ichthyofaunal identification [26,27,28,29,30,31,32,33,34,35].

Canon EOS 70D and 600D DSLR cameras with 18 - 55 mm and 18 - 135 mm lens were used to photograph the fish and Garmin Etrex 30X GPS machine was used to take the waypoints (latitude and longitude) and altitude of the area.

Table 1. Details of the sampling sites

SI No.	Study Sites	Latitude	Longitude	Elevation (m)
1.	Site 1	13° 3'5.09"N	74°47'14.65"E	2
2.	Site 2	13° 3'37.23"N	74°46'59.56"E	0
3.	Site 3	13° 4'15.13"N	74°46'41.51"E	0
4.	Site 4	13° 4'46.41"N	74°46'41.38"E	2
5.	Site 5	13° 5'30.01"N	74°46'47.29"E	2

3. Results

The health and ecological status of an estuary can be evaluated by studying its biological assemblages and community. An ecosystem with relatively few species indicates that it is under strain [36]. Sasihithlu estuary harbours a rich ichthyofaunal diversity which reflects its overall health and wellbeing. Perennial supply of freshwater from the rivers and periodic supply of marine water from the tidal activity provides preferable conditions for ichthyofauna. The present study revealed the presence of 63 species belonging to 13 orders and 37 families of class Actinopterygii. The checklist of the documented species along with its conservation status is listed in Table 2. Perciformes was the dominant order with 20 families followed by Beloniformes and Clupeiformes with three families. Pleuronectiformes was represented by two families whereas Anguilliformes, Carangiformes, Cichliformes, Cyprinodontiformes, Gonorynchiformes, Mugiliformes, Scorpaeniformes, Siluriformes and Tetraodontiformes were represented by one family each. Red-tipped Halfbeak (*Hyporhamphus xanthopterus*), a Vulnerable species (Vu) was documented from the estu-

Table 2. Checklist of ichthyofauna recorded during the study

SI No.	Order	Family	Scientific Name	Common Name	Conservation Status
1	Anguilliformes	Anguillidae	<i>Anguilla bicolor</i>	Shortfin Eel	NT
			<i>Anguilla bengalensis</i>	Indian Mottled Eel	NT
2	Beloniformes	Belonidae	<i>Strongylura strongylura</i>	Spottail Needlefish	LC
			<i>Xenentodon cancila</i>	Freshwater Garfish	LC
		Hemiramphidae	<i>Hyporhamphus xanthopterus</i>	Red-tipped Halfbeak	VU
			<i>Hyporhamphus limbatus</i>	Congaturi Halfbeak	LC
		Zenarchopteridae	<i>Zenarchopterus buffonis</i>	Buffon's River Garfish	NE
			<i>Scomberoides lysan</i>	Doublespotted Queenfish	LC
3	Carangiformes	Carangidae	<i>Carangoides praeustus</i>	Brownback Trevally	LC
			<i>Caranx ignobilis</i>	Giant Trevally	LC
			<i>Caranx hippos</i>	Crevalle Jack	LC
			<i>Caranx tille</i>	Tille Trevally	LC
4	Cichliformes	Cichlidae	<i>Etroplus maculatus</i>	Orange Chromide	LC
			<i>Etroplus suratensis</i>	Green Chromide	LC
			<i>Tenualosa ilisha</i>	Hilsa Shad	LC
		Clupeidae	<i>Anodontostoma chacunda</i>	Chacunda Gizzard Shad	LC
			<i>Nematalosa nasus</i>	Bloch's Gizzard Shad	LC
5	Clupeiformes	Engraulidae	<i>Sardinella longiceps</i>	Indian Oil Sardine	LC
			<i>Stolephorus indicus</i>	Indian Anchovy	LC
			<i>Stolephorus commersonii</i>	Commerson's Anchovy	LC
			<i>Opisthopterus tardoore</i>	Long-finned Herring	LC
6	Cyprinodontiformes	Aplocheilidae	<i>Aplocheilus panchax</i>	Blue Panchax	LC
7	Gonorynchiformes	Chanidae	<i>Chanos chanos</i>	Milkfish	LC
8	Mugiliformes	Mugilidae	<i>Mugil cephalus</i>	Flathead Grey Mullet	LC
			<i>Crenimugil crenilabis</i>	Fringelip Mullet	LC
		Acanthuridae	<i>Planiliza macrolepis</i>	Largescale Mullet	LC
			<i>Acanthurus gahhm</i>	Black Surgeonfish	LC
		Ambassidae	<i>Ambassis natalensis</i>	Slender Glassy	LC
			<i>Ambassis ambassis</i>	Commerson's Glassy	LC
		Drepaneidae	<i>Drepane punctata</i>	Spotted Sickleafish	LC
			<i>Gerres erythrourus</i>	Short Silverbidy	LC
		Gerreidae	<i>Gerres limbatus</i>	Saddleback Silverbidy	LC
			<i>Gerres filamentosus</i>	Whipfin Silverbidy	LC
		Gobiidae	<i>Glossogobius giuris</i>	Bar-eyed Goby	LC
		Haemulidae	<i>Diagramma labiosum</i>	Painted Sweetlips	LC
		Lactariidae	<i>Lactarius lactarius</i>	False Trevally	NE
		Latidae	<i>Lates calcarifer</i>	Barramundi	LC
			<i>Secutor insidiator</i>	Pugnose Ponyfish	NE
		Leiognathidae	<i>Leiognathus equulus</i>	Common Ponyfish	LC
			<i>Lutjanus argentimaculatus</i>	Mangrove Red Snapper	LC
		9	Perciformes	Lutjanidae	<i>Lutjanus fulviflamma</i>
<i>Lutjanus johnii</i>	John's Snapper				LC
<i>Lutjanus ehrenbergii</i>	Blackspot Snapper				LC
Monodactylidae	<i>Lutjanus rivulatus</i>			Blubberlip Snapper	LC
	<i>Monodactylus argenteus</i>			Silver Moony	LC
Scatophagidae	<i>Scatophagus argus</i>			Spotted Scat	LC
	<i>Otolithes ruber</i>			Tigertooth Croaker	NE
Sciaenidae	<i>Johnius dussumieri</i>			Sin Croaker	NE
	<i>Rastrelliger kanagurta</i>			Indian Mackerel	DD
Serranidae	<i>Epinephelus malabaricus</i>			Malabar Grouper	LC
Siganidae	<i>Siganus vermiculatus</i>			Vermiculated Spinefoot	LC
Sillaginidae	<i>Sillago sihama</i>			Silver Sillago	LC
	<i>Acanthopagrus berda</i>			Gold silk Seabream	LC
Sparidae	<i>Crenidens crenidens</i>			Karanteen Seabream	LC
	<i>Sphyaena obtusata</i>			Obtuse Barracuda	NE
Sphyraenidae	<i>Sphyaena jello</i>			Pickhandle Barracuda	NE
	<i>Terapon jarbua</i>			Tiger Perch	LC

Sl No.	Order	Family	Scientific Name	Common Name	Conservation Status
10	Pleuronectiformes	Cynoglossidae	<i>Cynoglossus arel</i>	Largescale Tonguesole	NE
		Soleidae	<i>Brachirus orientalis</i>	Oriental Sole	NE
11	Scorpaeniformes	Platycephalidae	<i>Platycephalus indicus</i>	Bartail Flathead	DD
12	Siluriformes	Ariidae	<i>Arius arius</i>	Hamilton's Catfish	LC
			<i>Arius maculatus</i>	Spotted Sea Catfish	LC
13	Tetraodontiformes	Ostraciidae	<i>Lactoria cornuta</i>	Longhorn Cowfish	NE

Note: LC - Least Concern, NT - Near Threatened, VU - Vulnerable, NE - Not Evaluated.

ary. Shortfin Eel (*Anguilla bicolor*) and Indian Mottled Eel (*Anguilla bengalensis*) are the two Near Threatened species (NT) which were documented from the area. 48 species belonged to Least Concern (LC) category, two species belonged Data Deficient (DD) and 10 species belonged to Not Evaluated (NE) category.



Figure 2. Giant Trevally (*Caranx ignobilis*)



Figure 3. Mangrove Red Snapper (*Lutjanus argentimaculatus*)



Figure 4. Tigertooth Croaker (*Otolithes ruber*)



Figure 5. Vermiculated Spinefoot (*Siganus Vermiculatus*)

4. Discussion

Monsoon and post-monsoon were the most productive seasons in terms of abundance and species richness. The maximum ichthyofaunal activity was recorded during the rise and fall of tides. With the rising tides, many marine species would enter the estuary and return back to the marine system with the receding tides. The migration of marine fishes and the overall fish community in the estuary is governed by the suitable hydrobiological, physico-chemical conditions^[37,38,39] along with seasonal nutrient variation^[40] and other environmental conditions^[41]. The young ones and juveniles of Tiger Perch (*Terapon jarbua*), Bar-eyed Goby (*Glossogobius giuris*), Silver Sillago (*Sillago sihama*), Flathead Grey Mullet (*Mugil cephalus*), Giant Trevally (*Caranx ignobilis*) (Figure 2), Tille Trevally (*Caranx tille*), Crevalle Jack (*Caranx hippos*), Indian Mackerel (*Rastrelliger kanagartha*), Indian Anchovy (*Stolephorus indicus*) and Mangrove Red Snapper (*Lutjanus argentimaculatus*) (Figure 3) prove that the estuary is used as breeding and nursing ground by many commercially important species. Presence of catadromous migrants like Largescale Mullet (*Planiliza macrolepis*), Flathead Grey Mullet (*Mugil cephalus*), Tiger Perch (*Terapon jarbua*), Shortfin Eel (*Anguilla bicolor*) and Indian Mottled Eel (*Anguilla bengalensis*) and anadromous migrants like Oriental Sole (*Brachirus orientalis*), Commerson's Anchovy (*Stolephorus commersonii*), Hilsa Shad (*Tenualosa ilisha*), Chacunda Gizzard Shad (*Anodontostoma chacunda*) and Bloch's Gizzard Shad (*Nematalosa*

nasus) along with amphidromous migrants like Hamilton's Catfish (*Arius arius*), Milkfish (*Chanos chanos*), Saddleback Silverbiddy (*Gerres limbatus*), Whipfin Silverbiddy (*Gerres filamentosus*), Malabar Grouper (*Epinephelus malabaricus*), Freshwater Garfish (*Xenentodon cancila*), Spotted Sickfish (*Drepane punctata*), Pugnose Ponyfish (*Secutor insidiator*), Common Ponyfish (*Leiognathus equulus*), Spotted Scat (*Scatophagus argus*), Tigertooth Croaker (*Otolithes ruber*) (Figure 4), Bar-eyed Goby (*Glossogobius giuris*), Silver Sillago (*Sillago sihama*), Long-finned Herring (*Opisthopterus tardoore*) and Orange Chromide (*Etroplus maculatus*) validate the fact that estuary acts as an imperative corridor for migratory fish species. The present study has unveiled a relatively good ichthyofaunal diversity in Sasihithlu estuary. Contrary to this, the estuary is subjected to ecological degradation caused by intense anthropogenic activities like dredging, overfishing, extraction of shells and water pollution. Other problems like solid waste deposition by rivers and sea, destruction of mangrove patches by riverine and coastal erosion, conversion of mangroves and wetlands into aquaculture ponds for fish and shrimp farming along with siltation and sedimentation issues. This necessitates the systemic and continuous monitoring which is important to ensure the productivity and sustainability of the estuary for future generations. As there were no studies undertaken in this estuary with regards to ichthyofaunal conservation, the present study can be used as baseline data to assess the status of ichthyofauna and to formulate conservation strategies.

5. Conclusions

The present study has unveiled a relatively rich ichthyofaunal diversity in Sasihithlu estuary. On the contrary, the estuary is subjected to ecological degradation caused by intense anthropogenic activities like dredging, overfishing, extraction of shells and water pollution. Other problems like solid waste deposition by rivers and sea, destruction of mangrove patches by riverine and coastal erosion, conversion of mangroves and wetlands into aquaculture ponds for fish and shrimp farming along with siltation and sedimentation issues. This necessitates the systemic and continuous monitoring which is important to ensure the productivity and sustainability of the estuary for future generations. As there were no studies undertaken in this estuary with regards to ichthyofaunal conservation, the present study can be used as baseline data to assess the status of ichthyofauna and to formulate conservation strategies.

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