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RESEARCH ARTICLE

ICTHYOFAUNA OF ATHARBANKI WATERWAY, MAHANADI ESTUARY, EAST COAST OF INDIA

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ABSTRACT

Investigations of a one year study (December, 2012 to November, 2013) on the fisheries of a human impacted estuarine mangrove fringed waterway Atharbanki (lat $20^0$15'01.34"N, long $86^0$38'21.20"E; to lat $20^0$17'26.13"N, long $86^0$42'16.23"E) of Mahanadi estuary, East coast of India revealed thirty six species of fish belonging to ten orders, twenty four families and thirty three genera. Order Perciformes was the most dominant (25%) followed by Siluriformes (15%), Cypriniformes and Clupeiformes (12%), Mugiliformes (6% each) and the others like Gonorynchiformes, Anguilliformes, Plueronectiformes and Elopiformes constituting 3% each of the fish fauna. Crustaceans such as *Scylla serrata, Peneaus monodon, Parapenaeopsis sculptilis* and *Macrobrachium rosenbergii* and others constituted 18 % of the total fauna. Observations indicated the use of traditional crafts and gears such as simple wooden canoes, motorized boats, gill nets, bag nets, drag net, set barriers, cast nets and scoop nets for subsistence fishing. With steady fragmentation of mangroves coupled with the effects of industrial units in its' vicinity, the fishery of this stressed waterway could be affected.

INTRODUCTION

Most coastal and estuarine environments of tropical and subtropical latitudes are characterized by mangroves. These ecosystems provide habitat (Nagelkerken *et al*.2002; Cocheret de la Morinière *et al*. 2002; McLusky and Elliott 2004; Dorenbosch *et al*. 2004, 2005; Nakamura & Sano 2004 a, b; Verweij *et al*. 2006) and food to numerous organisms, including species that support fisheries (Saenger *et al*. 2012). Detritus rich waters out welling from mangroves to the adjacent interspersed waterways are a rich source of nutrients for fish, enhancing their biomass as well as yields (Manson *et al*. 2005; Aburto-Oropeza *et al*. 2008). In the state of Odisha (17^0 49'N-22^0 34' N Latitude and 81^0 24'-$87^0$29'E Longitude), the Mahanadi estuarine system at Paradip (Lat. $20^0$17'08"N; Long $86^0$42'24"E) with a commercially important and tidal influenced waterway Atharbanki ((lat $20^0$15'01.34"N, $86^0$38'21.20"E; to lat $20^0$17'26.13"N, long $86^0$42'16.23"E) is fringed with mangroves such as *Avicennia officinalis* , *A. marina, A. alba, Ceriops decandra, Exoecaria agallocha and Rhizophora mucronata* to name a few.

In contrast to numerous other waterways, Atharbanki supports artisanal fishery and is a source of livelihood for the local fisher communities of the region. Next to Paradip, it is an important fish landing centre. In recent times, it is being used as a conduit of waste water discharge from industrial units in its' vicinity and trawler traffic. While information on the fish catch of Mahanadi estuary has been reported (Shetty, 1965), there is no published information on the ichthyofaunal diversity of Atharbanki.

Hence the objective of the present study (in the context of steady anthropogenic interference), is to address this hitherto lack of knowledge on the ichthyofauna of the waterway by providing preliminary information on their composition, abundance and analyzing the artisanal aspect of this fishery with information on the gears and crafts used. A baseline study of this kind assumes significance as could be used as a reference for comparative studies of other grossly impacted creeks / channels of the region.

MATERIALS AND METHODS

Location and duration of study

The waterway under study is situated within the state of Odisha (17^0 49'N-22^0 34' N Latitude and 81^0 24'-$87^0$29'E Longitude) on the east coast of India (Figure 1a). It is shallow (≤2m), tidal and sheltered. At high tide, it is inundated by water from the Mahanadi estuarine system opening into the Bay of Bengal and partially exposes intertidal mudflats at low tide. The climatic setting is tropical, distinguished into four distinct seasons, namely the cool season (December to February), hot (March to May), monsoon (June to September) and post monsoon season (October to November).

Adjacent to the Bay of Bengal, near Kansaripatia (lat $20^0$15'01.34"N and long $86^0$38'21.20"E) Atharbanki creek meanders for about 13.5 km skirting Paradip phosphate Limited township, Paradip Phosphate Limited (PPL), Indian Farmers Fertilizer Co-operative Limited (IFFCO) opening adjacent to the Fishing harbour (lat $20^0$17'26.13"N and long $86^0$42'16.23"E), farther coursing into the Mahanadi which eventually enters into the Bay of Bengal.

Industrial units located in the vicinity of this region are Indian farmers and Fertilizers Co-operative Ltd. (IFFCO), Paradip Phosphates Limited, Cargil oil, Indian Oil Corporation Limited, POSCO, Essar Steel, Deepak Fertilizer, Sea Food Processing and Petroleum Coke. Mangroves existing as luxuriant vegetation a few years ago have been denuded at most of these places. The study area included eight stations designated as St. 1, 2, 3, 4, 5, 6, 7 and 8 **(**Figure 1b **)** for sampling water along both banks of the waterway.

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Hydrological Condition

Water quality estimations consisted of a series of environmental variables namely pH, Temperature, salinity and Dissolved oxygen. Water sample (surface) was collected with the help of a polythene bucket from selected locations. After collection the samples were transported to the laboratory in cold conditions. All the samples were filtered appropriately (e.g. Whatman G.F/C/F of 1µm prior to analysis. The samples were analyzed according to standard analytical methods as described in Standard methods for the estimation of water, 20th edition of American Public Health Association 2009. Hereafter referred to as Standard methods and Grasshoff *et al* 1983.

Figure1a. Google earth map showing study area

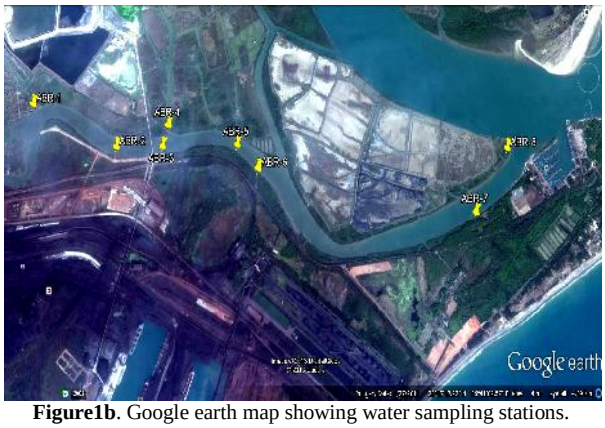


Figure1b. Google earth map showing water sampling stations.

Fish

Samples of fish were obtained with the help of fishermen using different types of nets namely gill nets, cast nets, dragnets and country boats. Photographs were taken immediately with help of a digital camera. Fish were brought to the laboratory and preserved in 10% formalin solution in separate specimen jars according to the size of species. Small fish were directly placed, while large fish were given an incision in their abdomen and preserved. Fishes were identified up to the species level, with the help of standard keys Nelson (2006), books (Jayaram 1999); Menon (1999); Ponniah & Sarkar (2000), Vishwanath *et al*., (2007), Talwar & Jhingran (1991), and the website Fish base. Expertise from Central Institute of Fresh water aquaculture, Bhubaneshwar was sought for confirmation.

RESULTS AND DISCUSSION

Hydrography

TEMPERATURE

Temperatures remained high (35^0C) in the hot months and low (26^0C) during the cooler times (Table 1).

Table 1 Hydrographical parameters, Atharbanki Creek, 2013

Stations	pH	DO(mg/l)	Salinity(PSU)	Temp(0C)
1	6.2	6.2	1.7	32.0
2	7.0	4.7	1.2	31.0
3	7.9	8.8	9.6	31.3
4	6.9	5.8	1.2	32.0
5	6.6	4.2	1.2	32.0
6	6.4	5.1	1.2	32.0
7	8.6	10.6	15.0	30.5
8	8.6	10.6	15.0	30.5
min	6.2	4.2	1.2	30.5
max	8.6	10.6	15.0	32.0
Average	7.2	7.0	5.8	31.4

pH

The pH of water across the channel fluctuated between 6.2 to 8.6 with an average of 7.2. Higher pH values were observed at stations fringed with mangroves. This could be due to mixing of seawater with estuarine waters and mangrove photosynthetic activity, which utilized CO_2, thereby shifting the equilibrium towards highly alkaline (Ruttner 1953). Similar findings were also reported from Pitchavaram mangrove regions (Ramanathan, 1999).

Salinity

Salinity varied from 1.2 PSU to 15 PSU with an average of 5.8 PSU. Towards the mouth of the estuary the salinity gradually increased due to the tidal incursion whereas in the rest of the waterway it remained relatively low.

Dissolved Oxygen

Across the waterway, dissolved oxygen varied from 4.2 mg/l to 10 .6 mg/l (Station 3, June, 2013) with a mean of 7 mg/l. Dissolved oxygen content values remained low at stations in the vicinity of fisher settlements probably attributable to anthropogenic influences.

Overall, Atharbanki exhibited appreciable temporal and spatial (environmental) gradients attributable to catchments inflow, local precipitation/evaporation, presence of mangroves and tidal incursion.

Fish Fauna

Investigations of from December, 2012 to November, 2013 on the fish fauna of Atharbanki (lat $20^0$15'01.34"N, long $86^0$38'21.20"E; to lat $20^0$17'26.13"N, long $86^0$42'16.23"E) revealed thirty six species of fish belonging to ten orders, twenty four families and thirty three genera. Order Perciformes was the most dominant (25%) followed by Siluriformes (15%), Cypriniformes and Clupeiformes (12%), Mugiliformes (6% each) and the others like Gonorynchiformes, Anguilliformes, Plueronectiformes and Elopiformes constituting 3% each of the fish fauna. Crustaceans such as *Scylla serrata, Peneaus monodon, Parapenaeopsis sculptilis, Macrobrachium*

rosenbergii and others constituted 18 % of the total fauna (Fig 2, Table 2).

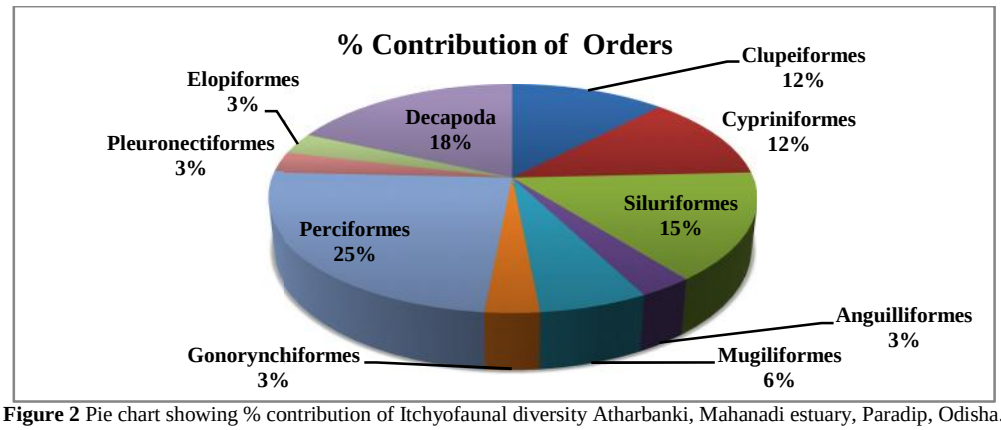


Figure 2 Pie chart showing % contribution of Itchyofaunal diversity Atharbanki, Mahanadi estuary, Paradip, Odisha.

Table 2 Ichthyofaunal diversity and abundance at Atharbanki Creek-Mahanadi estuary, Odisha, 2013. +++Very abundant, ++abundant, +present

S.N	Genus	Order	Family	Abundance
1.	*Tenualosa ilisha*	Clupeiformes	Clupeidae	++
2.	*Sardinella* sp.	Clupeiformes	Clupeidae	+++
3.	*Chirocentrus* sp.	Clupeiformes	Chirocentridae	++
4.	*Thryssa* sp.	Clupeiformes	Engraulidae	++
5.	*Salmophasia bacaila*	Cypriniformes	Cyprinidae	+
6.	*Amblypharyngodon mola*	Cypriniformes	Cyprinidae	+
7.	*Cirrhinus mrigala*	Cypriniformes	Cyprinidae	+++
8.	*Puntius* sp.	Cypriniformes	Cyprinidae	++
9.	*Netuma thalassina*	Siluriformes	Ariidae	+
10.	*Wallago attu*	Siluriformes	Siluridae	+
11.	*Ompok bimaculatus*	Siluriformes	Siluridae	+
12.	*Mystus seenghala*	Siluriformes	Bagridae	++
13.	*M. Vittatus*	Siluriformes	Bagridae	+++
14.	*Congresox talabonoides*	Anguilliformes	Muraenesocidae	+
15.	*Mugil cephalus*	Mugiliformes	Mugilidae	+++
16.	*Liza parsia*	Mugiliformes	Mugilidae	+++
17.	*Chanos chanos*	Gonorynchiformes	Channidae	++
18.	*Megalaspis cordyla*	Perciformes	Carangidae	+
19.	*Parastromateus niger*	Perciformes	Carangidae	+
20.	*Otolithodes pama*	Perciformes	Sciaenidae	+
21.	*Lepturacanthus savala*	Perciformes	Trichiuridae	+
22.	*Scomberomorus commerson*	Perciformes	Scombridae	++
23.	*S.gutatus*	Perciformes	Scombridae	+
24.	*S. lanceolatus*	Perciformes	Scombridae	+
25.	*Rastrelliger kanagurta*	Perciformes	Scombridae	+
26.	*Nemipterus* sp.	Perciformes	Nemipteridae	+
27.	*Lethrinus sp.*	Perciformes	Lethrinidae	+
28.	*Leignathus* sp.	Perciformes	Leignathidae	+
29.	*Pampus chinensis*	Perciformes	Stromateidae	+
30.	*Anabas testudineus*	Perciformes	Anabantidae	++
31.	*Glossogobius giuris*	Perciformes	Gobiidae	+
32.	*Polynemus indicus*	Perciformes	Polynemidae	+
33.	*Eleutheronema tetradactylum*	Perciformes	Polynemidae	+
34.	*Lates calcarifer*	Perciformes	Latidae	+
35.	Cyanoglossus sp.	Pleuronectiformes	Cyanoglossidae	+
36.	*Megalops cyprinoides*	Elopiformes	Megalopidae	+++
37.	*Scylla serrata*	Decapoda	Portunidae	++
38.	*Peneaus monodon*	Decapoda	Penaeidae	++
39.	*P. indicus*	Decapoda	Penaeidae	++
40.	*Parapenaeopsis sculptilis*	Decapoda	Penaeidae	++
41.	*Metapenaeus* sp.	Decapoda	Penaeidae	++
42.	*Macrobrachium rosenbergii*	Decapoda	Penaeidae	++

In terms of fish catch during 2012-13, Order Perciformes recorded the maximum of 1639.38 Metric tonnes with Scombrids such as *Scomberomorus commerson (262 MT), S.gutatus* (256.82 MT), *S.laneolatus* (35.57 MT) and *Rastrelliger kanagurta* (52.15 MT). Polynemids for example *Polynemus indicus, Eleutheronema tetradactylum* recorded 92.09 MT, Trichiurid *Lepturacanthus savala* 69.51 MT, of the last paragraph in the left column the widespace between 92.09 and MT and before Trichiurid should be reduced. 222. 21 MT, Nemipterid, *Nemipterus* 182.18 MT and Lethrinid, *Lethrinus* 17.24 MT. Clupeiformes notably *Tenualosa ilisha* constituted 178.25 MT, *Sardinella* sp. 285.60 MT, *Chirocentrus* sp. 44.57 MT and *Thryssa* sp. 59.33 MT. Mugiliformes was the third abundant group with *Mugil cephalus* and *Liza parsia* constituting 738.49 MT.

Siluriformes (417.85 MT), Penaed sp. (204.6MT), Non penaed sp. (37.71 MT) and Crabs (28.53 MT) were the other groups of

the catch (Figure.3).The total landings of fish and crustaceans from mangrove fringed Atharbanki waterway for a year is recorded as 5134.17 Metric tonnes (Directorate of Fisheries, Cuttack, Odisha). As mangroves have been reported to enhance fish biodiversity and fisheries of adjacent systems (Laegdsgaard, Johnson 1995; Mumby *et al*. 2004) the yield from the waterway could have been influenced by dense patches of this vegetation along its 'course.

CRAFTS AND GEARS

Fishing is carried out practically throughout the year. The fisher folk use crafts such as motorized boats, plank built boat and simple wooden canoes for fishing. Fisher families venture into the waterway for the day's catch in small indigenously built boats locally known as *Dongas*. Women and small children were seen wading close to the mangrove vegetation

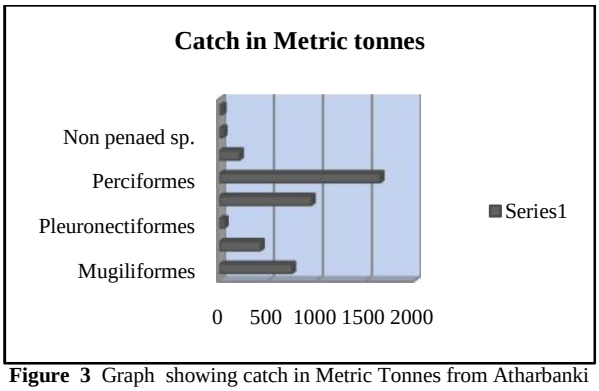


Figure 3 Graph showing catch in Metric Tonnes from Atharbanki waterway, Mahanadi estuary, Odisha

for netting fish juveniles and prawns. Mangrove areas connect the high intertidal zone where many fishes forage during high tides, while residing in the subtidal areas during low water period. Common artisanal fishing methods take advantage of the regular tidal migrations connecting different intertidal fish habitats and consequently target the fishes in their nursery environment (Giarrizzo and Uwe, 2009).

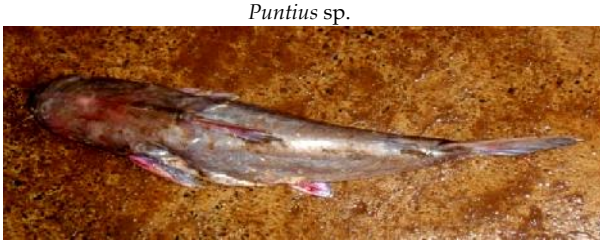
Tenualosa ilisha

Thryssa sp.

Amblypharyngodon mola

Salmophasia bacaila

Puntius sp.

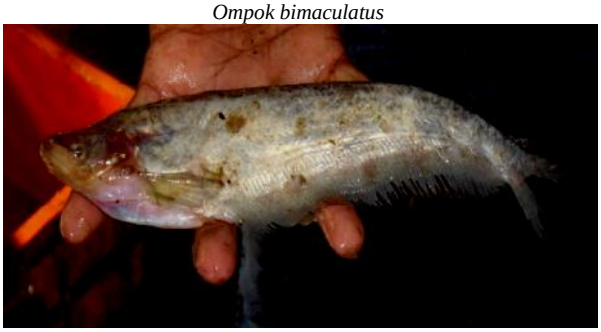


Netuma thalassina

Mystus. vittatus

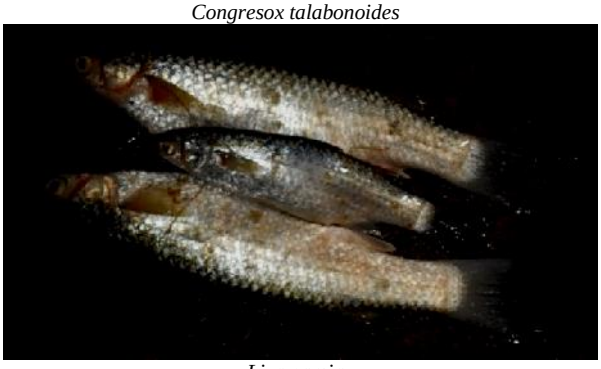
Mystus seenghala

Ompok bimaculatus

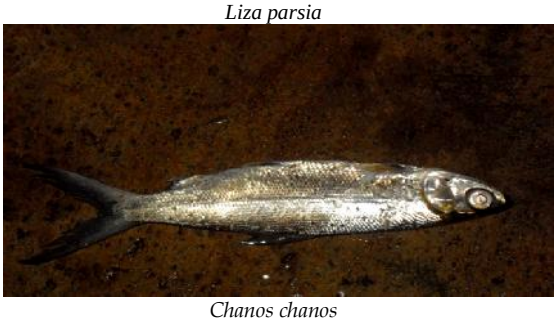


Wallago attu

Congresox talabonoides



Liza parsia

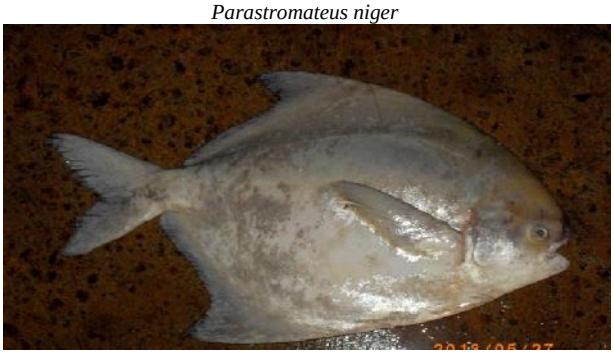


Chanos chanos

Mugil cephalus

Megalaspis cordyla

Parastromateus niger



Pampus chinensis

Rastrelliger kanagurta

Scomberomorus

Otolithoides pama

Lepturacanthus savala

Parapenaeopsis sculptilis

Scylla serrata

Plate 1 Photographs of different fish fauna

Gears such as Longline, Hook & Line, Shoreseine lines, traps of different types for example basket trap (poluha), ground basket traps (Khainchi), gill nets, bag nets, drag net, set barriers, cast nets and scoop nets are used. The number of gill nets in operation in Atharbanki is estimated to be 156 followed by 116 cast nets and others (Figure. 4). The gill nets commonly used are locally known as 'Nakuda Jalo' or 'Sanla Jalo', and are used for entangling / gilling of species such as *Polynemus indicus, Eleutheronema tetradactylum* and *Otolithodes pama*. 'Ilishi Jalo', mainly used to catch *Tenualosa ilisha* as well as *Parastromateus niger, Pampus chinensis* and *Leignathus* sp. is widely used. 'Behendi Jalo', is used to catch prawns and small fish, while 'Bhasani Jalo' for very small fish as reported from North Odisha (Cunningham *et al*., 1985). Shore seines have been successfully used to net about 9000 kilogram of fish while bag nets gave a catch of 840 Kg of fish. The cast nets have been used frequently with a yield of 366 Kg in the year of study.

Fishing is carried out practically throughout the year. The fisher folk use crafts such as motorized boats, plank built boat and simple wooden canoes for fishing. Fisher families venture into the waterway for the day's catch in small indigenously built boats locally known as *Dongas*. Women and small children were seen wading close to the mangrove vegetation for netting fish juveniles and prawns. Mangrove areas connect the high intertidal zone where many fishes forage during high tides, while residing in the subtidal areas during low water period. Common artisanal fishing methods take advantage of the regular tidal migrations connecting different intertidal fish habitats and consequently target the fishes in their nursery environment (Giarrizzo and Uwe, 2009). Gears such as Longline, Hook & Line, Shoreseine lines, traps of different types for example basket trap (poluha), ground basket traps (Khainchi), gill nets, bag nets, drag net, set barriers, cast nets and scoop nets are used. The number of gill nets in operation in Atharbanki is estimated to be 156 followed by 116 cast nets and others (Figure. 4). The gill nets commonly used are locally known as 'Nakuda Jalo' or 'Sanla Jalo', and are used for entangling / gilling of species such as *Polynemus indicus, Eleutheronema tetradactylum* and *Otolithodes pama*. 'Ilishi Jalo', mainly used to catch *Tenualosa ilisha* as well as *Parastromateus niger, Pampus chinensis* and *Leignathus* sp. is widely used. 'Behendi Jalo', is used to catch prawns and small fish, while 'Bhasani Jalo' for very small fish as reported from North Odisha (Cunningham *et al*., 1985). Shore seines have been successfully used to net about 9000 kilogram of fish while bag nets gave a catch of 840 Kg of fish. The cast nets have been used frequently with a yield of 366 Kg in the year of study.

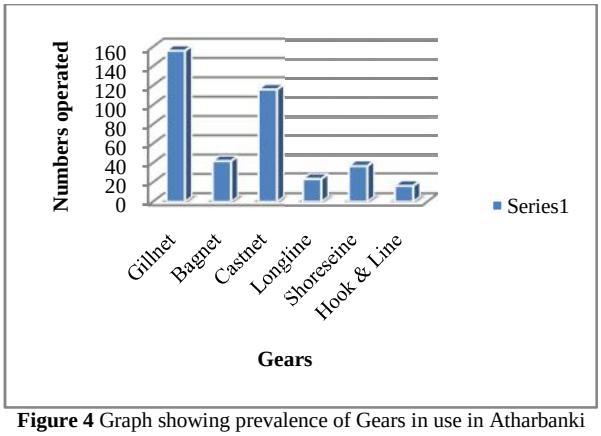


Figure 4 Graph showing prevalence of Gears in use in Atharbanki

CONCLUSION

The number of fish and crustacean species present in Atharbanki is recorded as 42 with a total catch of 5134.17 Metric tonnes during the year of study. These fish species account for the broad ichthyofaunal diversity in the region and are targeted by the subsistence and the artisanal fishers. Exploitation of mangrove resources beyond threshold has strong negative consequences on the *status quo* of fish biodiversity and may eventually result in a collapse in fisheries production (Abrogueña *et al*. 2012). In recent times the waterway is being increasingly used as a conduit for the discharge of effluents from industries as well as wastes from

fisher settlements along its' banks, all of which are likely to have significant impacts on a temporal scale. A conservationist approach would be most appropriate for a sustainable management of these valuable fisheries resources.

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