

Diversity, distribution and abundance of oceanic resources around Andaman and Nicobar Islands

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ABSTRACT

Andaman and Nicobar Archipelago is bestowed with rich oceanic resources. Information on its dynamics is essential to evolve an exploitation strategy and therefore an attempt has been made to understand the diversity, distribution and abundance of oceanic resources around Andaman and Nicobar Islands by utilising exploratory tuna long-line survey data. A total of 29 species of fishes including 15 species of pelagic sharks were recorded during the study. Dominance of pelagic sharks over the target species, *i.e.*, tuna was a major characteristic of the fishery. Drastic reduction in the composition of tuna and sharks towards total catch in recent years was noticed. Hooking rates recorded during different months and at different latitudes are presented. Sharks were dominant between lat. 08° N and 12° N, while no significant pattern was observed in the case of yellowfin tuna. Diminishing trend of hooking rates of tuna and sharks since nineties and replacement of a major share of these resources by uneconomical fishes indicates need for stringent management measures for the conservation of oceanic resources.

Keywords: Andaman and Nicobar Islands, Oceanic resources, Pelagic sharks, Tuna long-line fishery

Introduction

Andaman and Nicobar archipelago of Indian EEZ is well known for its oceanic resources (BOBP, 1987). The Fishery Survey of India (FSI) has carried out exploratory resource surveys around Andaman and Nicobar Islands (A&N Islands) employing tuna long-liners since 1989 to understand the dynamics of these resources. Pioneering studies based on the exploratory survey data provided information on occurrence, spatial distribution and abundance of oceanic resources around A&N Islands (John and Somvanshi, 2000; John *et al.*, 2005; Somvanshi *et al.*, 2008). A detailed account on the diversity of oceanic resources available in the area is still lacking as the above studies mainly concentrated on abundance and distribution of the resources. Moreover, information on the stock structure of oceanic resources since 2006 is not available as far as A&N Islands is concerned. Hence an attempt has been made here to understand the diversity, distribution and abundance of oceanic resources around A&N Islands.

Changes in the environment, oceanographic parameters and anthropogenic interference may lead to changes in the stocks of oceanic resources (Rothschild, 1996). Currently no such information is available on the alteration in the species composition and abundance pattern of oceanic resources around A&N Islands. Though, FSI has carried out exploratory resource surveys since 1989, no attempt has so far been made to evaluate the changes to

the stocks, which may have been taking place since then. Present study made an attempt to understand such changes by comparing the results of the present study with the historical data. The above information is vital for the conception of management strategies aimed at sustainable exploitation of the resources.

Materials and methods

The survey vessel M.V. Blue Marlin of FSI, attached to Port Blair, was employed to carry out exploratory tuna long line surveys around A&N Islands since 1989. Survey data collected during the period January 2006 to December 2008 by M.V. Blue Marlin around A&N Islands between the Latitudes (lat.) 06° N and 14° N was the data source of the present study. A total of 302 sets of multifilament tuna long-line gears with five 3.6 sun hooks per basket were operated during the study period. A set of tuna long line gear operated normally consists of 125 baskets and 625 hooks; accordingly the total number of hooks immersed during the study period was 1,82,235 hooks (total effort). Frozen sardines and mackerels were used as bait fish. Gear was normally shot in the morning before sunrise and hauled in after providing 5 to 6 h of immersion time.

Fishes caught by the gear were identified as per Nelson (1994) and categorised into six species/group following John and Somvanshi (2000), namely yellowfin tuna (YFT), other tunas (OTN), billfishes (BLF), other fishes (OFS), pelagic sharks (PLS) and pelagic stingray (PSR). The

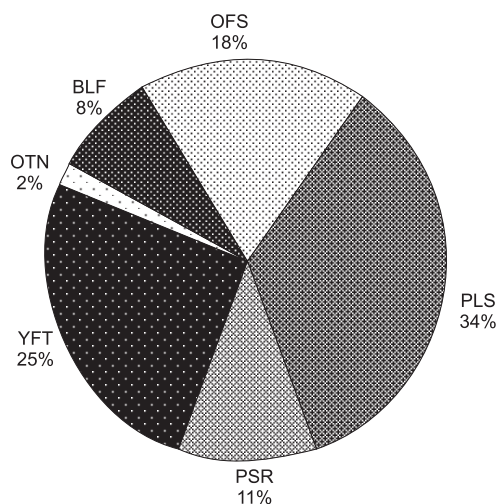
number of specimens per species/group caught were recorded separately for further calculations. Catch per unit effort (CPUE) was estimated in hooking rate as number of fishes caught (successful hooks) per 100 hooks (John and Somvanshi, 2000). Distribution and abundance of species/group were estimated by determining aggregate hooking rates of fishes caught from each 1° lat. (Somvanshi *et al.*, 2008).

Seasonal abundance of resources was estimated by analysing the hooking rate recorded during different months of the study period. Aggregate hooking rate was estimated for all fishes and species/group by aggregating the hooking rates of species/group in each month. Results of the present study were compared with historical data collected by M.V. Blue Marlin (John and Somvanshi, 2000; John *et al.*, 2005; Somvanshi *et al.*, 2008) to understand the alteration to the dynamics of oceanic fishery resources around A&N Islands, that might have taken place over the years. Oceanic fish landing data of A&N Islands during the period 2000-2008 (ANA, 2011) were used to understand the anthropogenic effect on the fishery.

Results and discussion

Diversity of oceanic resources

Altogether 29 species of fishes were hooked during the study period. A checklist of species of fishes caught is furnished in Table 1. Oceanic fish resources of A&N islands were represented by 2 Classes, 5 Orders and 9 Families which comprised 15 species of sharks, 5 species of billfishes, 4 species of tunas, 4 species of other fishes and 1 species of pelagic stingray. Pelagic sharks dominated both in species richness and in abundance by number (Fig. 1). contributing 34% of total fishes caught during the



(YFT - yellowfin tuna; OTN- other tunas; BLF- billfishes; OFS- other fishes; PLS - pelagic sharks; PSR- pelagic stingray)

Fig.1. Species composition of oceanic fishes inhabiting waters around Andaman & Nicobar Islands

period. Yellowfin tuna, *Thunnus albacares* Bonnaterre, 1788 comprised 25% of the catch and was the largest single species contributor. Other fishes (18%), pelagic stingray, *Pteroplatytrygon violacea* (Bonaparte, 1832) (11%) billfishes (8%) and other tunas (2%) were the other components of the total catch.

Table 1. Checklist of species of fishes caught in long-line around Andaman and Nicobar Islands during January 2006 to December 2008

Name of Class / Subclass /Order/Famiy/ Species
Class Chondrichthyes; Subclass Elasmobranchii; Order Carcharhiniformes;
Family Carcharhinidae
Oceanic whitetip shark, <i>Carcharhinus longimanus</i> (Poey, 1861)
Silvertip shark, <i>Carcharhinus albimarginatus</i> (Ruppel, 1837)
Whitecheek shark, <i>Carcharhinus dussumieri</i> (Valenciennes in Muller and Henle, 1839)
Spottail shark, <i>Carcharhinus sorrah</i> (Valenciennes in Muller and Henle, 1839)
Blacktip reef shark, <i>Carcharhinus melanopterus</i> (Quay and Gaimard, 1824)
Hardnose shark, <i>Carcharhinus macloti</i> (Muller and Henle, 1839)
Blacktip shark, <i>Carcharhinus limbatus</i> (Valenciennes in Muller and Henle, 1839)
Tiger shark, <i>Galeocerdo cuvieri</i> (Peron and Le Sueur 1822)
Scalloped hammerhead shark, <i>Sphyrna lewini</i> (Griffith and Smith, 1834)
Great hammerhead shark, <i>Sphyrna mokarran</i> (Ruppel, 1837)
Smooth hammerhead shark, <i>Sphyrna zygaena</i> (Linnaeus, 1758)
Order Lamniformes; Family Alopiidae
Thresher shark, <i>Alopias vulpinus</i> (Bonnaterre, 1788)
Pelagic thresher shark, <i>Alopias pelagicus</i> Nakamura, 1936
Bigeye thresher shark, <i>Alopias superciliosus</i> (Lowe, 1840)
Family Lamnidae
Shortfin mako shark, <i>Isurus oxyrinchus</i> Rafinesque, 1810
Order Rajiformes; Family Dasyatidae
Pelagic stingray, <i>Pteroplatytrygon violacea</i> (Bonaparte, 1832)
Class Actinopterygii; Subclass Neopterygii; Order Aulopiformes;
Family Alepisauridae
Long snouted lancetfish, <i>Alepisaurus ferox</i> Lowe, 1833
Order Perciformes; Family Coryphaenidae
Dolphin fish, <i>Coryphaena hippurus</i> Linnaeus, 1758
Family Sphyraenidae
Giant barracuda, <i>Sphyraena barracuda</i> Walbum, 1792
Family Scombridae
Wahoo, <i>Acanthocybium solandri</i> (Cuvier, 1831)
Dogtooth tuna, <i>Gymnosarda unicolor</i> (Ruppel, 1836)
Skipjack tuna, <i>Katsuwonus pelamis</i> Linnaeus, 1758
Yellowfin tuna, <i>Thunnus albacares</i> Bonnaterre, 1788
Bigeye tuna, <i>Thunnus obesus</i> (Lowe, 1839)
Family Xiphiidae
Sword fish, <i>Xiphias gladius</i> Linnaeus, 1758
Indian sailfish, <i>Istiophorus platypterus</i> (Shaw and Nodder, 1792)
Striped marlin, <i>Tetrapturus audax</i> Philippi, 1887
Black marlin, <i>Makaira indica</i> Cuvier, 1832
Blue marlin, <i>Makaira mazara</i> (Jordan and Snyder, 1901)

The dominance of sharks over the other fishes in species richness and abundance is a significant feature of oceanic resources of A& N Islands. John and Somvanshi (2000), John *et al.* (2005) and Somvanshi *et al.* (2008) reported this phenomenon of dominance of sharks in the long-line catches around A& N Islands and is in agreement with the results of the present study. Earlier studies were also based on the survey results of M.V. Blue Marlin and the methodology followed for data collection were similar to the present study and hence the results are comparable.

Species composition of tuna long-line catches recorded around A& N Islands since 1989 is presented in Table 2. Yellowfin tuna which contributed 36.33% of total catch during the eighties was reduced to 25% of total catch during 2006-08. Decline in percentage contribution was more significant in the case of pelagic sharks as their contribution was reduced by nearly 12%. The contribution of billfishes remained at 8% throughout the period. The decreased share of yellowfin tuna and pelagic sharks in the recent catches indicates the decline of their stocks in the area. Meanwhile, the share of lancet fishes and pelagic stingrays increased significantly. These fishes were very rare or caught in less numbers during the eighties (John and Somvanshi, 2000).

Ward and Myers (2005) reported increased abundance of formerly rare and smaller fishes in the recent catches from the tropical Pacific Ocean. The authors opined that replacement of major share of economically important fishes with formerly rare uneconomical fishes is an indication of overexploitation of the targeted resources.

Results of the present study indicate overexploitation of economically important oceanic fishes from A&N Islands and hence warrants stringent management measures to conserve the resources.

Distribution and abundance

Aggregate hooking rates recorded at different latitudes during the study are furnished in Table 3. Highest aggregate hooking rate for all fishes was recorded from lat. 11° N. But in the case of yellowfin tuna highest aggregate hooking rate was obtained from lat. 12° N. In contrast, the billfishes dominated in Andaman waters (lat. 10°- 15° N) and hooking rate of other tunas was more in Nicobar waters (lat. 06°- 10° N). Higher hooking rate for other tunas was recorded from lat. 07° N to lat. 09° N.

Pelagic sharks were abundant between lat. 08° N and lat. 12° N with maximum hooking rates from lat. 09° N and lat. 11° N. Pelagic stingray showed a decreasing trend towards upper latitudes with maximum hooking rate from lat. 06° N. Though variations in the hooking rates from different latitudes were recorded, no significant distribution pattern was observed in the case of yellowfin tuna, hence results of the present study rules out any set pattern of aggregation of yellowfin tuna in any specific geographical location around A&N Islands. The migratory nature of the species may be the reason for this irregular distribution. In general, except pelagic stingray, no other species/ group showed any specific trend of decrease/increase of hooking rates with changing latitudes.

Table 2. Species composition of tuna long-line catches around Andaman and Nicobar Islands recorded since 1989

Period of study	Percentage contribution towards total catch			Author/s
	YFT	BLF	PLS	
1989-1998	36.33	7.93	46.36	John and Somvanshi (2000)
1989-2002	33.22	8.22	44.95	John <i>et al.</i> (2005)
2006-2008	25.00	8.00	34.00	Present study

(YFT- yellowfin tuna; BLF- billfishes; PLS- pelagic sharks)

Table 3. Latitude-wise aggregate hooking rate in percentage

Latitude	Total	YFT	OTN	BLF	OFS	PLS	PSR
06° N	0.64	0.05	0.00	0.00	0.09	0.23	0.27
07° N	0.78	0.21	0.04	0.64	0.12	0.17	0.20
08° N	0.84	0.12	0.07	1.28	0.13	0.30	0.18
09° N	0.86	0.12	0.04	2.72	0.09	0.39	0.12
10° N	0.67	0.15	0.00	3.04	0.16	0.20	0.08
11° N	0.86	0.20	0.01	5.12	0.16	0.35	0.05
12° N	0.75	0.32	0.01	2.56	0.14	0.18	0.05
13° N	0.53	0.18	0.00	2.40	0.12	0.15	0.02
14° N	0.41	0.05	0.00	0.48	0.07	0.18	0.05

(YFT- yellowfin tuna; OTN- other tunas; BLF- billfishes; OFS- other fishes; PLS- pelagic sharks; PSR- pelagic stingray)

A comparative statement of aggregate hooking rates for all fishes, yellowfin tuna and pelagic sharks recorded by earlier studies since 1989 (Table 4) showed a declining trend in hooking rates. Steep fall in hooking rate in the case of all fishes indicated that billfishes and other fishes also may follow a similar trend of declining catches. Fall in hooking rate since 1989 may be an indication of overexploitation of these resources.

Oceanic fish landings of A&N Islands during 2000-2008, furnished in Table 5 revealed a drastic decline in the landing of yellowfin tuna, other tunas, billfishes and pelagic sharks as compared to their landings during 2000. Landing data is in agreement with the resource survey results as both followed a decreasing trend. The decreasing trend demands for an in-depth study on the status of the stock.

Seasonal abundance

Aggregate monthly hooking rates recorded during the study period (Table 6) did not show a specific trend for any species/group. However, best hooking rates for yellowfin tuna, billfishes and pelagic sharks was during January. John and Somvanshi (2000), John *et al.* (2005) and Somvanshi *et al.* (2008) have reported better hooking rates of yellowfin tuna during January (Table 7) which is in agreement with the results of the present study. Hence it can be inferred that best fishing season for yellowfin tuna is during the first quarter of the year. Hooking rates

of pelagic sharks were more during November - January (Table 7). Better hooking rates of pelagic sharks have been reported during September - February (John and Somvanshi, 2000; John *et al.*, 2005; Somvanshi *et al.*, 2008). Hence, the best fishing season for pelagic sharks around Andaman and Nicobar Islands can be considered as November - January.

Pelagic stingray catches were more during the period from December to April. Other tunas, billfishes and other fishes did not show any significant dominance during any of the seasons except with some minor variations in the hooking rates. Results of an exploratory survey carried out by the FSI fleet since 1989 indicated an abundance of tuna and tuna like fishes around A&N Islands. Comparative study of the hooking rates recorded since 1989 with the results of present study points out to the changes occurred in the stock of oceanic fishes inhabiting A&N archipelago. Diminution of hooking rates and landings of yellowfin tuna and pelagic sharks as well as increased hooking rates of pelagic stingray and lancet fishes are major changes observed in the present study. Results of the present study provided information on the current status of oceanic resources and call for the conservation approach to ensure sustainable exploitation of these economically important resources. Moreover, an in depth study to understand the major factors that lead to the present status of the oceanic resources of A&N Islands is highly essential to enlighten the dynamics of the population.

Table 4. Aggregate hooking rate (%) recorded around Andaman and Nicobar Islands since 1989

Period of study	ALF	YFT	PLS	Author/s
1989-1998	2.29	0.83	1.06	John and Somvanshi (2000)
1989-2002	1.85	0.62	0.83	John <i>et al.</i> (2005);
2005-2007	0.79	0.22	0.34	Somvanshi <i>et al.</i> (2008).
2006-2008	0.74	0.19	0.25	Present study

(ALF- all fishes; YFT- yellowfin tuna; PLS- pelagic sharks)

Table 5. Oceanic fish landings (t) of Andaman and Nicobar Islands during 2000-2008

Year	YFT	OTN	BLF	PLS
2000	54	49	1307	Not available
2001	92	84	316	„
2002	25	23	82	„
2003	61	56	253	„
2004	7	6	169	„
2005	20	18	69	„
2006	2	1	1	7
2007	1	1	2	95
2008	2	1	4	96

(YFT - yellowfin tuna; OTN - other tunas; BLF - bill fishes; PLS - pelagic sharks)

Source: Directorate of fisheries, Andaman and Nicobar Administration. (ANA, 2011)

Tables 6. Month-wise aggregate hooking rate (%)

Latitude	Total	YFT	OTN	BLF	OFS	PLS	PSR
January	1.44	0.49	0.01	0.16	0.16	0.48	0.13
February	0.67	0.23	0.00	0.04	0.22	0.17	0.01
March	0.80	0.11	0.07	0.05	0.16	0.27	0.13
April	0.74	0.20	0.03	0.00	0.15	0.11	0.25
May	0.58	0.11	0.00	0.07	0.15	0.19	0.06
June	0.45	0.05	0.01	0.16	0.06	0.16	0.00
July	0.19	0.08	0.00	0.02	0.06	0.03	0.00
August	0.98	0.33	0.01	0.06	0.40	0.19	0.00
September	0.49	0.08	0.00	0.08	0.02	0.24	0.07
October	0.61	0.21	0.02	0.04	0.09	0.20	0.06
November	0.62	0.05	0.02	0.02	0.14	0.33	0.06
December	0.64	0.05	0.00	0.02	0.01	0.42	0.14

(YFT- yellowfin tuna; OTN- other tunas; BLF- billfishes; OFS- other fishes; PLS- pelagic sharks; PSR- pelagic stingray)

Table 7. Seasonal abundance of oceanic fishes around Andaman and Nicobar islands since 1989

Period of study	Months corresponding to better hooking rates			Authors
	ALF	YFT	PLS	
1989-1998	Not recorded	January, July and June	November, February and October	John and Somvanshi (2000)
1989-2002	January, February and December	January, June and July	November, February and October	John <i>et al.</i> (2005);
2005-2007	December, January and November	January, November and October	January, September and November	Somvanshi <i>et al.</i> (2008).
2006-2008	January, August and March	January, August and February	January, December and November	Present study

(ALF- all fishes; YFT- yellowfin tuna; PLS- pelagic sharks)

Acknowledgements

The authors are grateful to Dr. K. Vijayakumaran, Director General, Fishery Survey of India, Mumbai for providing facilities and support during the study. We acknowledge the efforts of the Zonal Director and Scientists of Fishery Survey of India, Port Blair for effectively carrying out the survey programme. Sincere thanks are due to the Skipper and crew of the vessel M.V. Blue Marlin for their effort during the data collection.

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Date of Receipt : 17.01.2012

Date of Acceptance : 29.02.2012