Received: 30 June, 2011

DISTRIBUTION, ABUNDANCE AND BIOLOGY OF INDO PACIFIC SAILFISH, *ISTIOPHORUS PLATYPTERUS* (SHAW AND NODDER, 1792) IN THE INDIAN EEZ AROUND ANDAMAN AND NICOBAR.

L. Ramalingam and A.B.Kar
Fishery Survey of India
Port Blair

ABSTRACT

The tuna long line survey results in the Indian EEZ around Andaman and Nicobar waters shows that tunas, billfishes and sharks are the three major groups of fishes caught in the longline gears. Among them the average annual landings of bill fish is 232 tonnes. Among the bill fishes the Indo pacific sail fish, *Istiophorus platypterus* has appreciable importance in Andaman waters. The sailfishes are exclusively the by-catches of tuna fishery as there is no aimed commercial fishery exists for the species in the Island groups. Although a by catch sailfishes are of considerable economic value. Very limited work has been done on the distribution and biological aspects of the species. Hence an attempt has been made in the present paper to study the distribution pattern, abundance and some biological aspects such as lengthy frequency, length weight, sex ratio, maturity and spawning and food and feeding habits of the species by analyzing the longline data collected onboard MFV Blue Marlin during the period 2000-2010. The study indicates that the dominant length group for male and female were 161-180cm and 181-200 cm(fork length) respectively. The male to female sex ratio was 1:0.89. The length weight relationship computed for males was $W = 0.00008\ L^{2.40}$, r = 0.96 and for females, $W = 0.0002\ L^{2.23}$, r= 0.97. The pooled data shows the relationship as $W = 0.00011\ L^{2.34}$, r= 0.96 . Four stages of maturity were recorded for the species viz. immature, maturing, mature and spent. The spawning occurs between December to June with a peak in February and June. The food and feeding study indicated the dominance of two major groups i.e cephalopods and teleost fishes in the gut. For male the cephalopods constituted 49% followed by teleost fishes 43% where as for female the teleost fishes constituted 44% followed by cephalopods(39%).

(Key words: Sailfish, distribution, morphometry, length-weight relationship, sex ratio, gonad index, food and feeding)

INTRODUCTION

The bill fishes are represented in Andaman waters by the species *Xiphias gladius, Istiophorus platypterus, Makaira mazara, Makaira indica* and *Tetrapturus audax.* In Andaman waters the major fishes caught in the longline gears in the tuna longline survey are tunas, bill fishes and pelagic sharks. The average annual Landing of bill fish is 232 tonnes in Andaman waters (Anon, 2011). Among the bill fishes the Indo pacific sailfish, *Istiophorus platypterus* (Shaw & Nodder, 1792) has appreciable importance. Although a by catch in the tuna longline, sailfishes are of considerable economic value. They are oceanic and epipelagic species and usually found above the thermocline. Sailfishes are reported to migrate towards coastal waters for feeding and spawning and have an affinity for the shelf area, thereby forming part of the coastal fisheries of many countries in the Indian Ocean including India (Campbell and Tuck, 1998). Hence an understanding of its fishery is of importance to assess the stock as well as the biological parameters. At present there is no commercial fishery for the species in the Island groups.

The extent of distribution and the magnitude of abundance of this species in the waters of Andaman and Nicobar Islands are known only since the initiation of extensive exploratory Surveys by Fishery Survey of India by deploying the survey vessel M.F.V. Blue Marlin in Andaman and Nicobar waters. A few reports on the abundance, distribution and biology are available from the Andaman waters (John et al., 1995, Somavanshi et al., 1998, Bhargava et al., 2005., Prabhakar Raj et al., 2005., Sivaraj et al., 2005 Varghese et al., 2005). Since sailfishes are not targeted species, little effort is expended in understanding the distribution and biological characteristics and estimate stock of these by-catch fishery in India and else where. The species is being harvested in coastal waters by pole & line, troll line and gillnet where as in the oceanic waters they are exclusively caught by longline gear. At present the bill fishes particularly Marlin & Sailfish are also caught by angling for game fishing in Andaman waters. Studies on the distribution and biology of sailfish are limited when compared to other oceanic species such as tunas. Therefore in the present paper, an attempt is made to study some aspects of biology such as length frequency, length weight, sex ratio, maturity and spawning and feeding patterns of Indo pacific sailfish from the Island waters of Andaman and Nicobar based on the survey data collected by M.F.V Blue Marlin during the period 2000-2010.

MATERIAL & METHODS.

The data of sailfish caught during the tuna longline survey conducted in the EEZ of Andaman and Nicobar waters (**Fig.1**) by the vessel M.F.V. Blue Marlin belongs to Fishery Survey of India during the period 2000-2010 was analyzed. The size distribution of the species during the period with the mean length and weight was analyzed. For morphometric analysis, the linear equation ($Y = a + b X$) was fitted for males and females separately among various parameters such as TL-FL, TL-HL, (S-1D)- (S-2D), (1D-A)-(2D-A). Where TL is total length, FL is fork length, HL is head length, (S-1D) is snout to first dorsal length, (S-2D) is snout to second dorsal length, (1D-A) is 1^{st} dorsal to anal length, (2D-A) is 2^{nd} dorsal to anal length. Regression analysis was performed to determine the constants 'a' and 'b'. The size distribution of the species during this period with their mean length was also analyzed. The length and weight relationship $W= al^{b}$ (Le Cren, 1951) was used for the analysis where W is the weight of the fish in Kg and L is the fork length in cm. Sexes are identified by the gonad observation and accordingly

maturity stages are also assessed. Spawning period is obtained by calculating the gonad index. Food and feeding pattern of the above species are carried out by examining the stomach and gut contents by occurrence method (Pillay, 1952).

RESULTS

Distribution of Sailfish

The landings of sailfish was 5071 tonnes to 13310 tonnes during the years 2002-2008 from the eastern Indian Ocean which includes Andaman sea (FAO, 2010) (**Table 1**). Among the bill fishes, sailfish is one of the most common species landed in the fish catch of Andaman and Nicobar. There is no separate data for sailfish landings available with the A&N administration. The combined data on billfish i.e. sailfish, swordfish and marlin during 2000-09 are given in **Table 2**. It can be seen that the landings of these groups fluctuated from 1tonnes to 1307tonnes with an annual average of 232 tonnes.

During the study period a total of 695560 no. of hooks were immersed in the Indian EEZ around Andaman and Nicobar and a total of 4513 fishes were caught, of which, 241 nos of sailfishes weighing about 6214 kg were recorded**(Table 3)**. The average aggregate hooking rate recorded for all fishes was 0.65% and the sailfish alone registered the average hooking rate of 0.03%. The average weight of sailfish was found to be 25.8 kg. in Andaman waters. The abundance indices (hooking rate in %) in 1°Lat× 1°Long of all fishes and sailfish is shown in **Figure 2**. In the above squares the hooking rate for all fishes ranged from 0.30% to 2.70%. The average hooking rate of sailfish recorded was in between 0.08% to 0.80%. The abundance of sailfish found to be more in the square 13°/95°(0.80%) followed by 0.48% in 13°/92° and 10°/89° and 0.40% in 07°/90° and 08°/95°. The seasonal variation of sailfish in the Andaman waters is shown in the **Table 4**. The aggregate hooking rate for all fishes varied from 0.44% to 1.05% with a maximum of 1.05% during the month of January followed by 0.80% during the month of December. The hooking rate of sailfish varied from 0.01% to 0.06% with a maximum of 0.06% during the month of June and November followed by 0.05% during the month of August.

Morphometric Characteristics.

Various morphometric characteristics such as total length, fork length, snout to 1st dorsal fin length, snout to 2nd dorsal fin length, 1st dorsal fin to 2nd dorsal fin length, 1st dorsal fin to anal fin length, snout to anal fin length of sailfish and correlation between

them in Indian waters have not been studied yet. The minimum value, maximum value, mean value, standard deviation value of various morphometric parameters and the 'a', 'b' and regression coefficient 'r' values for both the sexes are given in **Table 5, 6 and 7**.In the present study various morphometric characters were taken for both the male and female species and it was tested with linear relationship Y=a+bX. The parameters were regressed with each other and the relationship is given below.

Male

FL = 3.0+0.85 TL(r= 0.99)

HL=1.3+0.19TL(r= 0.98)

(S-2D)=18.7+3.3(S-1D)(r=0.92)

(2D-A)=6+0.45(1D-A) (r=0.90)

Female

FL= 0.29+0.87 TL(r= 0.98)

HL=1.69+0.19 HL(r= 0.97)T

(S-2D)=13.3+3.3(S-1D)(r=0.94)

(2D-A)=5.5+0.51(1D-A)(r=0.87)

Size Frequencies.

The length frequency distribution of different size range of sailfish recorded during the study period is given in **Fig. 3**. It could be observed that the male specimens are in the size range of 113-230 cm in fork length with the mean length of 177.8cm and mean weight of 22.2 kg. The dominant length range of male species was 161- 180cm followed by 181-200cm. The females recorded were on the size range of 133-250cm fork length with the mean length of 192.1cm and mean weight of 27.5 kg. The dominant length range for females was 181-200cm followed by 201-220cm.

Length-weight relationship.

The relationship was obtained by taking the fork length (cm) and weight (kg). The relationship obtained for males and females and both sexes (pooled data) **(Fig. 4(a,b,c)** are detailed below.

Male: $W= 0.00008 L^{2.401}$ (r=0.96)

Female: $W=0.00020 L^{2.23}$ (r = 0.97)

Pooled: $W=0.00011 L^{2.34}$ (r = 0.96)

Sex ratio.

A total of 142 specimens (75 males & 67 females) of sailfish were taken for sex ratio analysis. The male to female ratio was found to be 1:0.89.The sex ratios with respect to different size group are presented in **Table 8**. It could be observed that the percentage of male was more on the size range 161-180cm (19%) followed by 181-200 cm (18%) whereas in case of females it could be seen that the fishes of the higher size groups dominated the population than the male. The females were dominated in the size range 181-200cm (25%) followed by 201-220 cm (21%). The Male specimens were recorded more during the month of November (21 %) followed by October (13 %) where as the females were dominant during the month of January (25%) followed by June (18 %). It could be seen that both the sexes contribute equally during the month of December (**Table 9)**.

Maturity and spawning.

Based on the visual appearance of the gonads, four maternity stages could be observed in Andaman waters viz. Immature, Maturing, Mature, & Spent. 33% of the species were immature followed by 44% maturing, 21% fully mature and 2 % spent(**Fig.5.**) Observation on spawning season was made by analyzing the gonad index (GI). The mean Gonad Index evaluated is presented in **Fig. 6**. It is seen that the spawning occurs between December to June with a peak in February and June.

Food and feeding habits.

The gut contents and its fullness were analyzed for 110 specimens of *Istiophorus platypterus* (62 male &48 female) to understand the percentage of fullness of stomach of both the sexes as well the dietary composition. 8% of the male stomach was found to be empty whereas in the case of female, the empty stomach recorded was 16%. The percentage of fullness of $3/4^{th}$ full and full stomach in case of female were more (20% and 10%) when compared to male (20% and 7%) **(Fig.7 & 8).** The dietary composition of sailfish can be broadly divided into two categories i.e. cephalopods and teleost fishes. Throughout the study period only these two groups were recorded in the gut of *Istiophorus platypterus* in Andaman waters. Among the cephalopods, squids (*Loligo*

spp.) found to be most preferred item when compared to cuttle fish and octopus. However the teleost fishes found in the gut of *Istiophorus platypterus* were more diverse in case of both male and female. The composition of the teleost fishes in the gut of male specimens were snake mackerel, horse mackerel, puffer fish, anchovies, pony fish, flying fish , skipjack tuna, and sardines etc, whereas in the case of female species, little tunny, skipjack tuna, lantern fish, hatchet fish, file fish, anchovies, snake mackerel, horse mackerel, puffer fish, pony fish etc. were recorded.

Besides these two major groups detritus material was also recorded respectively at the rate of 8% and 17% in male and female guts. The food and feeding of both male & female *Istiophorus platypterus* are shown in **Figure 9 & 10**. From the figure it can be seen that the cephalopod constituted maximum of 49% followed by the teleost fishes(43%) in males where as in case of females, the teleost fishes constituted the maximum of 44% followed by cephalopods(39%) which shows its sex wise desirable feeding habits. Cephalopods considered to be the most preferred food item for males, where as for females, the most preferred food item was teleost fishes.

DISCUSSION

Though there is no aimed fishery for the *Istiophorus platypterus,* this species are also being landed significantly by longlines, gill nets and other gears like troll line, hand lines etc. As per the available data (Anon 2011) the bill fish landings during 2000-2009 fluctuates from 1 to 1307 tonnes with an average of 232 tonnes. The sailfish catch in the Indian waters was made available only with the data collected from the chartered foreign fishing vessel (1988-1994) as well as the tuna longline data collected by the survey vessel M.F.V Blue Marlin attached with Fishery Survey of India. The results indicated an appreciable catch rate of 39.42 kg/1000 hooks from the Indian peninsula and 45.76 kg/1000 hooks from the Andaman and Nicobar waters (John et al., 1995).

Sivaraj et al (2005) studied the abundance pattern of sailfish in the Andaman waters and the study revealed that the hooking rate for sailfish was more in Nicobar waters (0.07%) than in Andaman waters (0.041%). In Andaman and Nicobar waters the size of the specimens caught was ranging from 135-245 cm fork length and the average weight of the fish was found to be 32 kg (John et al., 1995). Sivaraj et al (2005) studied the length frequency of the species and found that the males caught were in the length range of 121-230 cm fork length with dominance in the 191-200 cm range where as the

females were ranging from 151-250 cm fork length with dominance in 181-190 cm range.

In the present study it could be seen that the average aggregate hooking rate (%) for all fishes in Andaman and Nicobar waters recorded was 0.65% and the average aggregate hooking rate of sailfishes recorded was 0.03%. The seasonal variation showed that the aggregate hooking rate for all fishes varied from 0.44% to 1.05% with a maximum during January(1.05%) and the average hooking rate of sailfish varied from 0.01% to 0.06% with a maximum during the month of June and November(0.06%). The male specimens were recorded in the length range of 113-230cm fork length with dominance at 161-180 cm range and the female specimens were recorded in the length range of 133-250 cm fork length with dominance at 180-200 cm range. In the present study the size distribution is unimodal. This study is in conformity with the earlier studies that the size of the female species is more than the male in the population.

The male to female ratio of the species reported by Sivaraj et al(2005) in the Andaman waters is 1:1.2. In the present study it was 1:0.89. Torres (1991) reported the 'b' value of sailfish from South Africa as 1.89. Merrett(1968) found no sexual distinction in the length – weight relationship of 120 Indian Ocean sailfish from the equatorial western Indian Ocean. Williams(1970) reported that a sexual difference in the length-weight relationship may exist for sailfish as is the case in marlins in Kenya. Jolley(1974) reported a significant difference between the length- weight relationship by sex. As per the studies, females smaller than 137 cm trunk length were notably heavier than males of similar length groups in the east coast of Atlantic. The length weight relationship obtained for male and female and pooled data was attempted by Varghese et al. (2005) in the North West EEZ of India. It was reported that the 'b' values vary significantly from the cube law and it was 1.4065 for male and 2.0701 for female and for the pooled data it was 1.5596. In the present observation much difference between the 'b' values of both the sexes was not noticed. The 'b' value of male and female was 2.4 and 2.23 respectively and for the pooled data it was 2.34. In the present study the 'b' value is not coming close to 3 and is deviating from the cube law hence the growth of the species is allomatric. Nakamura (1985) reported that the sailfish spawn throughout the year in tropical and subtropical waters of Pacific with peak spawning in local summer. Sivaraj et al(2005) reported the spawning season between October and April with a peak in

February in Andaman waters. Varghese et al(2005) reported the spawning period in the north west coast of India in between March- September. In the present study it was found that the spawning season was from December to June with a peak in February.

The feeding pattern reported by various researchers revealed that the sailfishes are opportunistic feeders and take almost any food they come across. The major forage items of the species are fishes and squids. Sivaraj et al (2005) reported the dominance of squids (44%) and teleost fish (41%) in the gut of sailfish. Nakamura (1985) observed that major food items of Indo Pacific sailfish are teleost fishes and squids. Varghese et al (2005) reported 50.72 % finfish, 44.93% squid and 4.35% crustaceans in the gut of sailfish in the North West coast of Indian EEZ. In the present work the percentage of empty stomach in female species (27%). The gut contents of the male specimens showed the dominance of cephalopod (49%) followed by teleost fish (43%) where as the gut contents of female specimens showed the dominance of teleost fish (44%) followed by cephalopods (39%). Hence the preference of food intake in case of females was towards teleost fishes and in case of males it was cephalopods.

CONCLUSION

The Sailfish is mainly a by catch of tuna long line fishing. At present the A&N administration is encouraging for the exploitation of tuna and allied resources in the EEZ of India around Andaman by upgrading the existing deep sea fishing fleets, acquiring new vessels under subsidized schemes, and also providing necessary infrastructure facilities like fish landing centers, fish processing unit, ice factory and cold storages etc. which will definitely strengthen the database on bill fish in near future. Therefore, at this juncture, priority should be given for more elaborate studies on the biological characteristics of the species like age, growth, food and feeding, spawning, and stock position of this group to harvest in a sustainable manner in the Andaman and Nicobar waters in future.

Acknowledgement: The authors are grateful to Dr. K.Vijayakumaran, Director General, Fishery Survey of India for his support and encouragement for the preparation of this paper. The authors are also grateful to Dr. M.E.John for his valuable suggestions during the preparation of this paper. The authors also express their heartfelt gratitude to all the scientist participants onboard MFV Blue Marlin and the Skippers, other officers and crew members for the help in data collection.

REFERENCES

Anon. 2011. Andaman and Nicobar Fisheries at a Glance, Directorate of Fisheries, A&N Administration.

Bhargava,A.K., D.E.Uikey, C.Babu and Sijo P. Varghese, 2005. Distribution, Abundance and Size of Marlins(*MAKAIRA* AND *TETRAPTURUS* SPP.) *in Indian waters.Proc.Tuna Meet-2003*: 181-190.

Campbell, R.A and G.N.Tuck,1998. Preliminary analysis of Billfish catch rates in the Indian Ocean. *Proceedings of the Seventh Expert consultation on Indian Ocean Tunas,* IOTC Proceedings: 192-210.

FAO 2010. Year Book- Fisheries and aquaculture statistics.

Francisco Torres Jr. 1991. Tabular data on marine fishes from Southern Africa. Part I: length- Weight Relationship. ICLARM Contribution,772. *Fishbyte* 9 (1). ISSN 0116-0079.

John, M.E., A.K.Bhargava, Vaijayanti Rane and A.S.Kadam, 1995. Some aspects of the distribution and biology of the Indi- Pacific sailfish, *Istiophorus platypterus* (Shaw and Nodder, 1792) in Indian waters. In : *Proceedings of the sixth expert consultation on Indian Ocean Tunas,* 25-29 September, Colombo-Srilanka, IPTP Collection Volume, 9: 286-292.

Jolley, Jr., John W.1974: On the biology of Florida east coast Atlantic sailfish,(*Istiophorus platypterus)*. Shomura, R.S., and F.Williams (eds.), Proceedings of the International Billfish symposium, Kailua- Kona, Hawaii, 9-12 August, 1972.

Le Cren, E.D.(1951). The length weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*) *J. Anim. Ecol.,* 20 : 21-219.

Merrett,N.R.1968. Weight- length relationships for certain scombroid fishes from the equatorial western Indian Ocean. East Afr. Agric.For.J.34:165-169.

Nakamura,I., 1985. FAO Species Catalogue Vol.5 Billfishes of the world. An Annotated and Illustarted Catalogue of Marlins, Sailfishes, Spearfishes and Swordfishes known to date. *FAO Fish.Synop., (125) Vol.5:* 65 p.

Pillay, T.V.R.,1952, A critique of the methods of study of food of fishes. *J.Zool.Soc.India.,* 4:185-200.

Prabhakar Raj, J.E., M.E.John and D.M.Ali.2005. Catch indices of bill fishes(Family – Istiophoridae and Xiphidae) from industrial longline fishery of Bay of Bengal. *In :* V.S.Somvanshi,S.Varghe and A.K.Bhargava(Eds.) *Proc.Tuna Meet- 2003:* 216-225

Sivaraj,P., S.A.Rajakumar, M.K.Sinha, A.B.Kar and S.K.Pattnayak.2005. Distribution , abundance and biology of Indo-Pacific sailfish in Andaman sea. *In: V.S.Somvanshi,S.Varghese and A.K.Bhargava(Eds.) Proc. Tuna Meet- 2003*: p. 216-225.

Somvanshi, V.S., N.G.K. Pillai and M.E.John, 1998. Current status of tunas and tuna like fishes in India. *Proceedings of the Seventh Expert consultation on Indian Ocean Tunas,* Seychelles 9-14 November, 1998. IOTC Proceedings. 1: 31-38.

Varghese,S., V.S.Somvanshi, D.K.Gulati, S.P.Varghese and B.J.Parakkal.2005. Distribution, abundance and biology of Indo-Pacific sailfish, *Istiophorus platypterus*(Shaw and Nodder, 1792) in the north western Indian EEZ. *In :* V.S.Somvanshi,S.Varghe and A.K.Bhargava(Eds.) *Proc.Tuna Meet-2003* : p. 191-208.

Williams, F. 1970. The sport fishery for sailfish at Malindi, Kenya, 1958-1968, with some biological notes. *Bull.Mar.Sci*. 20: 850-852.

Table.1. Landing of sailfish from eastern Indian Ocean (in tonnes)

Year	Total catch of bill fish	Sailfish catch	% of sailfish
2002	26911	7930	29.5
2003	34120	8831	25.9
2004	37182	13301	35.8
2005	25506	7063	27.7
2006	30496	11103	36.4
2007	20512	6441	31.4
2008	17978	5071	28.2

*** Data Source: Fishery and aquaculture statistics, FAO, 2010**

Table.2. Landing of billfish from Andaman Sea during 2000-2009 (in tonnes)

Year	Total landings	Billfish landings
2000	30339	1307
2001	27173	316
2002	25561	82
2003	30636	253
2004	26920	169
2005	8635	69
2006	24096	1
2007	28005	2
2008	32785	4
2009	32050	118

(* Data source: Andaman and Nicobar Fisheries at a Glance 2011, A & N Administration.)

Table.3. CPUE of *Istiophorus platypterus* caught from Andaman waters during 2000-2010.

Year	Total effort	Total Catch		Sailfish Catch	
		No.	Hooking Rate	No.	Hooking Rate
2000	48105	293	0.61	15	0.03
2001	47700	286	0.60	13	0.03
2002	71875	733	1.02	56	0.08
2003	51600	358	0.69	31	0.06
2004	56164	428	0.76	22	0.04
2005	60679	567	0.95	32	0.05
2006	57860	384	0.66	26	0.04
2007	75697	590	0.78	16	0.02
2008	83080	395	0.48	7	0.01
2009	55220	212	0.38	6	0.01
2010	87580	258	0.29	17	0.02
TOTAL	**695560**	**4504**	**0.65**	**241**	**0.03**

Table.4. Seasonal variation of *Istiophorus platypterus* in Andaman waters.

Month	Total Effort	Total Catch		Sailfish Catch	
		No.	Hooking Rate	No.	Hooking Rate
January	71780	757	1.05	34	0.04
February	54116	351	0.65	18	0.03
March	64339	416	0.65	8	0.01
April	54900	261	0.48	8	0.02
May	38310	168	0.44	9	0.02
June	43320	291	0.67	30	0.06
July	53710	242	0.45	20	0.04
August	31560	210	0.67	16	0.05
September	70466	317	0.45	21	0.04
October	79038	485	0.61	32	0.02
November	68775	484	0.70	40	0.06
December	65246	522	0.80	20	0.03
TOTAL	**695560**	**4504**	**0.65**	**241**	**0.03**

Table .5. Various morphometric measurements of *Istiophorus platypterus* (Male)

Parameters	Minimum	Maximum	Mean	SD
TOTAL LENGTH	154	259	218.2	9.9
HEAD LENGTH	29	49	43.4	1.4
S-1 D	27	52	41.4	2.8
1 D- 2D	86	128	115.4	12.0
S-2D	106	177	157.1	9.9
1 D-A	39	132	96.3	14.8
2 D-A	30	65	43.2	0.7
S-A	75	170	136.8	7.1
WEIGHT	9	40	26.8	4.9

Table .6. Various morphometric measurements of *Istiophorus platypterus* (Female)

Parameters	Minimum	Maximum	Mean	SD
TOTAL LENGTH	177	259	223.7	21.2
HEAD LENGTH	34	48	44.1	3.5
S-1 D	32	50	42.7	4.9
1 D- 2D	78	136	114.6	12.7
S-2D	125	173	155.7	12.0
1 D-A	70	102	84.3	4.9
2 D-A	35	58	48.3	2.1
S-A	89	136	116.8	7.1
WEIGHT	12	42	26.5	8.5

Table.7. Value of a,b and regression coefficient r of *Istiophorus platypterus* (Male and Female)

	Male			Female		
	a	b	r	a	b	r
TL-FL	3.0	0.85	0.99	0.29	0.87	0.98
TL-HL	1.3	0.19	0.98	1.69	0.19	0.97
(S-1D) – (S-2D)	18.7	3.3	0.92	13.3	3.3	0.94
(1D-A) – (2D-A)	6	0.45	0.90	5.5	0.51	0.87

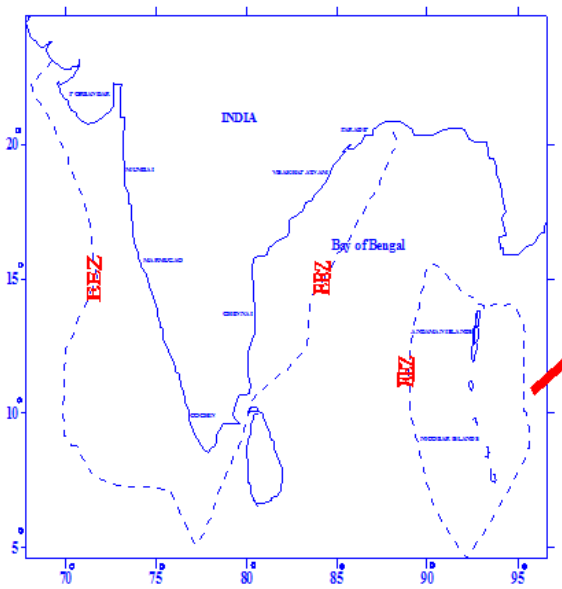
Table. 8. Size wise sex ratio of *Istiophorus platypterus* in A&N waters

Fork length range (cm)	Male	Female	Sex ratio (M:F)	Chi square
101-120	1	1	1:1.0	0
121-140	7	4	1:0.6	0.4
141-160	11	5	1:0.5	1.1
161-180	19	10	1:0.5	1.4
181-200	18	25	1:1.4	0.6
201-220	14	18	1:1.3	0.3
221-240	4	2	1:0.5	0.3
241-260	1	2	1:2.0	0.2
Total	**75**	**67**	**1:0.89**	**0.2**

Table .9. Month wise sex ratio and Chi square value of *Istiophorus platypterus* in A& N waters

Months	Male	Female	Sex ratio (M:F)	Chi square
January	5	17	1:3.4	3.3
February	8	4	1:0.5	0.7
March	3	2	1:0.7	0.1
April	2	3	1:1.5	0.1
May	3	2	1:0.7	0.1
June	8	12	1:1.5	0.4
July	4	2	1:0.5	0.3
August	2	3	1:1.5	0.1
September	6	7	1:1.2	0.1
October	10	4	1:0.4	1.3
November	16	3	1:0.2	4.4
December	8	8	1:1	0.0
Total	**75**	**67**	**1:0.89**	**0.2**

Fig.1. Exclusive Economic Zone of India.



EEZ of Andaman & Nicobar.

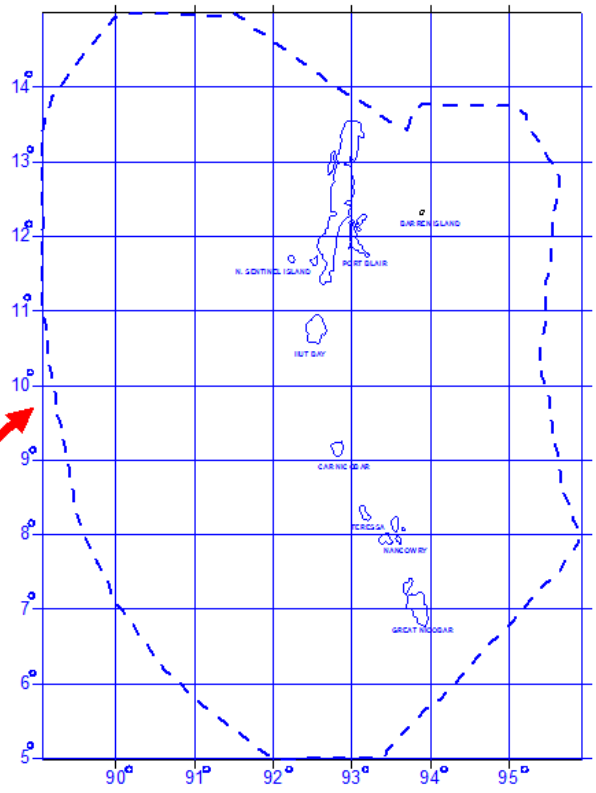
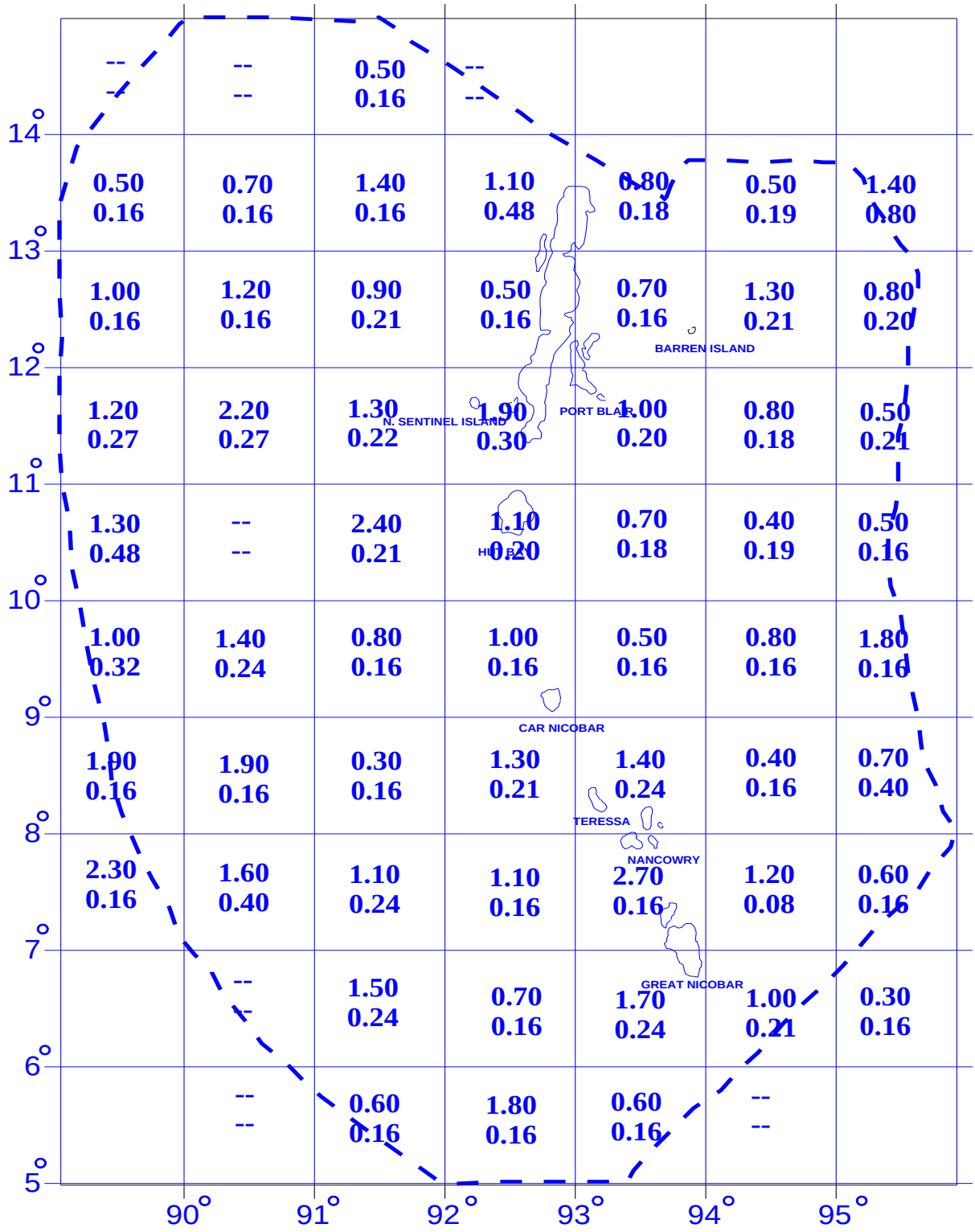


Fig.2. Abundance Indices(Hooking rate in %) in 1° Lat×1° Long. of all fishes and sail fish during 2000-2010.



Hooking rate of all fish.
Hooking rate of sailfish.

Fig. 3. Length frequency of I. platypterus(male and female) in A&N waters.

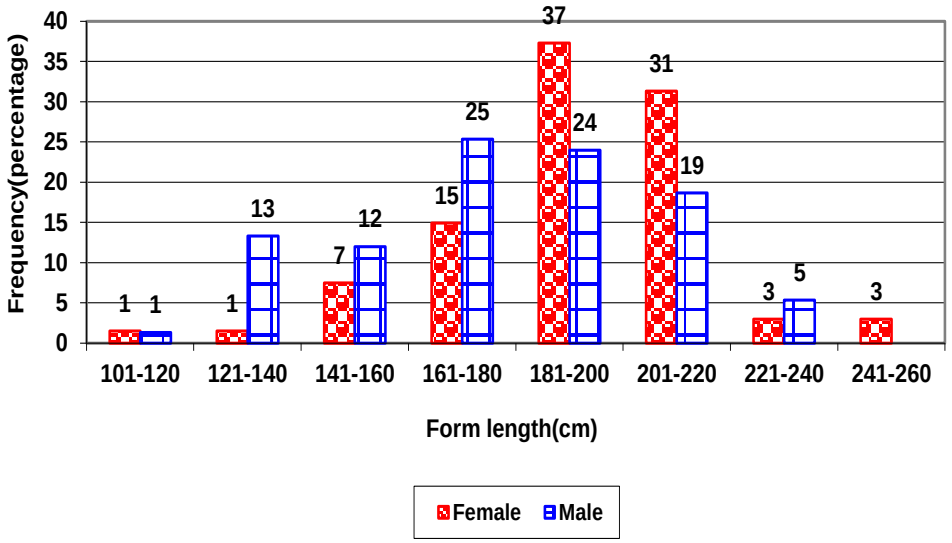


Fig.4.a. Length - weight relationship of *I. platypterus*(male) in A&N waters.

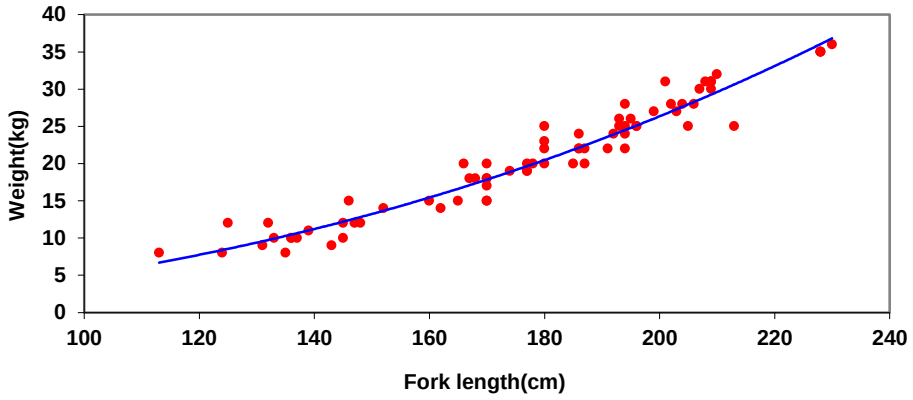


Fig.4.b. Length-weight relationship of *I. platypterus*(female) in A&N waters.

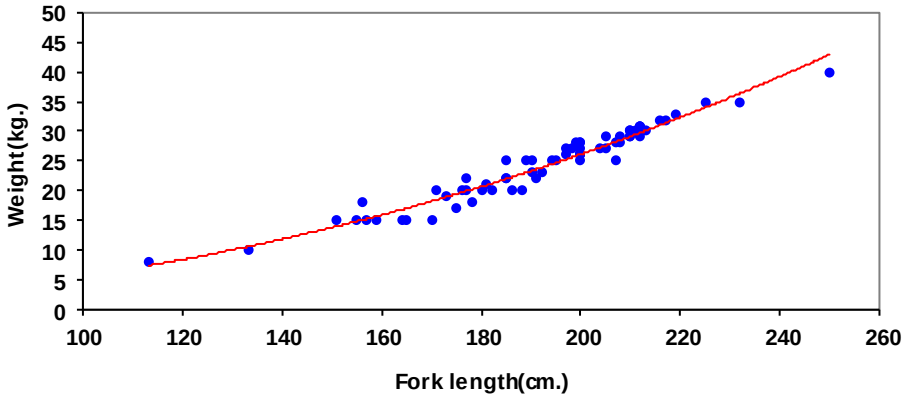


Fig.4.c. Length-weight relationship of *I. platypterus*(pooled) inA&N waters.

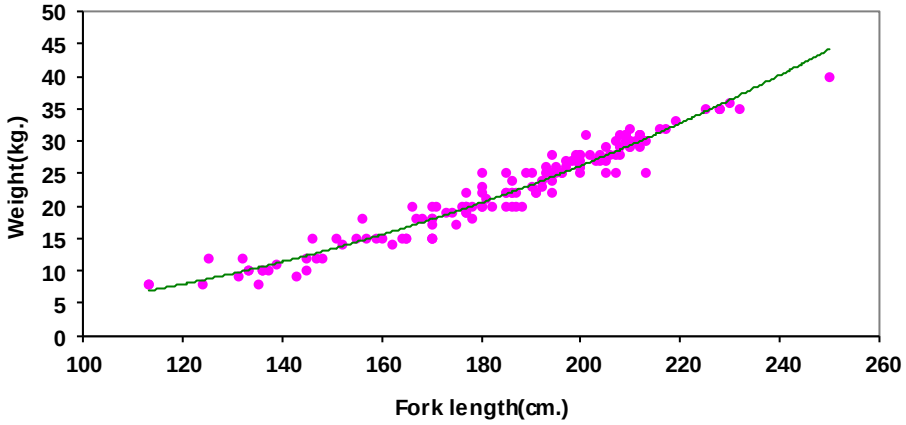


Fig. 5. Gonad maturity stages of *I. platypterus* in A&N waters.

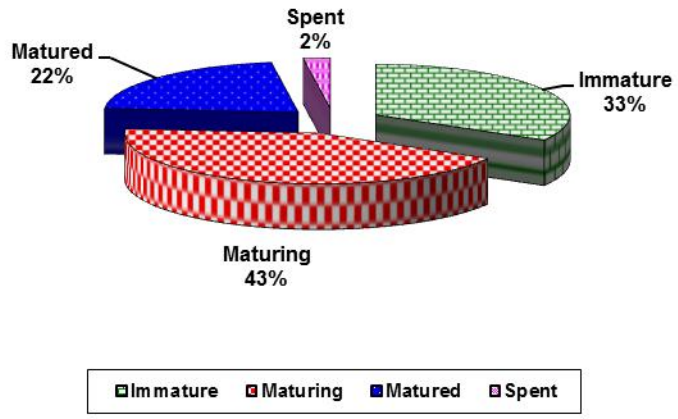


Fig.6.Gonad Index of I platypterus in A&N waters

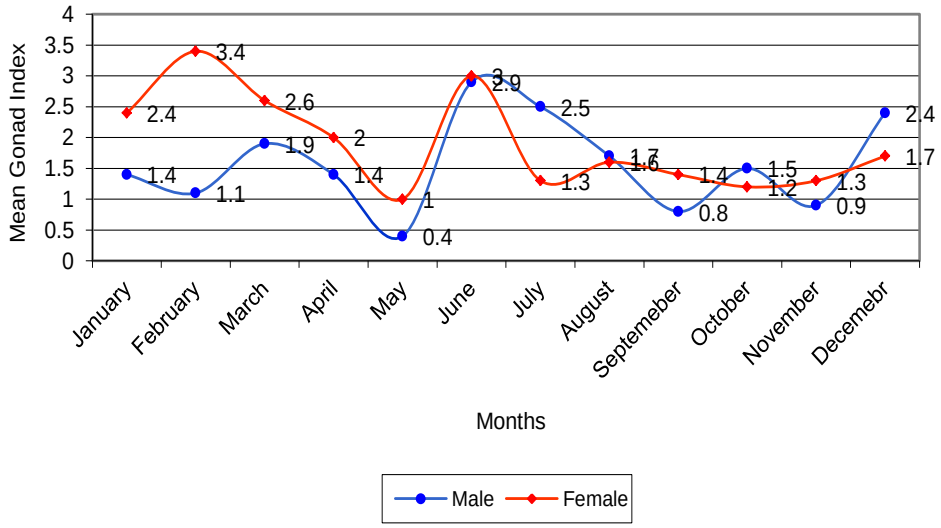


Fig.7. Food and feeding habbits of *I. platypterus*(male) in the A&N waters.

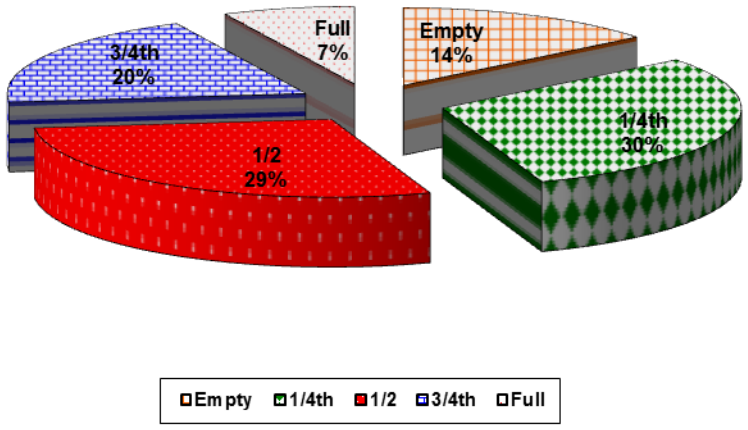


Fig.8. Food and feeding habbit of *I. platypterus*(female) in A&N waters.

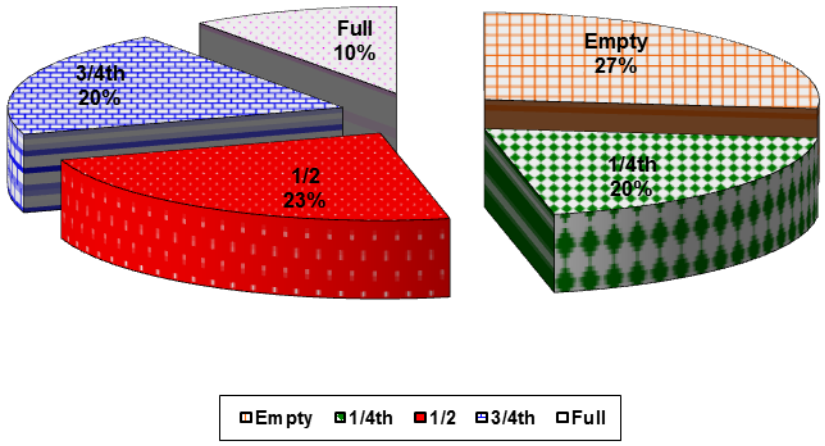


Fig.9. Food composition of *I. platypterus*(male) in A & N waters.

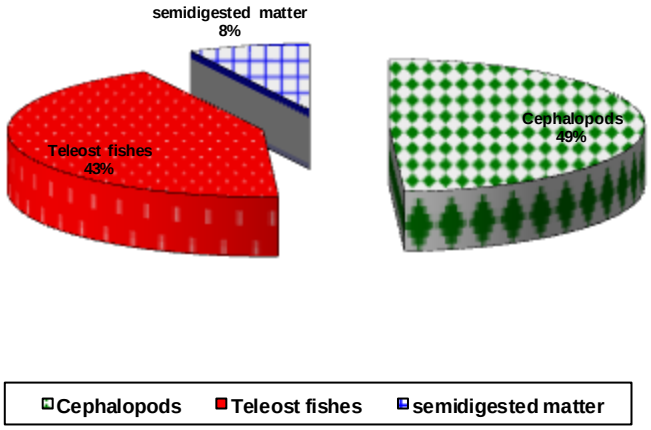


Fig.10.Food compositiopn of *I. platypterus*(female) in A&N waters.