

**DISTRIBUTION, ABUNDANCE INDICES AND SOME BIOLOGICAL CHARACTERISTICS OF THE INDO-PACIFIC SAILFISH, *ISTIOPHORUS PLATYPTERUS* (SHAW AND NODDER, 1792) IN THE NORTH WESTERN INDIAN EEZ**

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**ABSTRACT**

*Although sailfishes, predominantly represented by the Indo-Pacific sailfish *Istiophorus platypterus* constitute a prominent by-catch component of the tuna fishery of the Indian Ocean, very little effort is expended to estimate status of the stock, their biological characteristics and the impact of this by-catch fishery on the target species, if any. In India the sailfishes are exclusively the by-catches of tuna fishery as there is no exploitation of the species on commercial line. The tuna long line survey results in the Indian EEZ shows that tunas, billfishes and sharks are the three major groups of fishes caught on the longline gears. Among billfishes, the sailfish, *I. platypterus* form the major constituent. The information on the abundance indices indicates that the average catch rate obtained from the North West sector of the EEZ is 39.42 kg/1000 hooks representing 15.58% of the total longline catches. From the seasonal variation of the catch rates it is observed that the second quarter (April-June) recorded the highest catch rate of 91.97 kg/1000 hooks from this sector. The spawning season of the species is estimated to be protractive one from March-September in the Arabian Sea with peaks in March - April and August - September. The size of the specimens caught ranged from 100 cm to 260 cm (FL) majority being in the length group of 145-240 cm. The average weight of individual specimen was 27 kg. The sailfishes are found to feed on cephalopods, bony fishes and crustaceans. The paper portends usefulness of such study extending over greater areas of the ecosystem.*

**INTRODUCTION:**

The Indo-Pacific Sailfish, *Istiophorus platypterus* constitute a major component of the tuna longline fishery in the Indian waters. The tuna fishery in Indian waters is mainly supported by coastal fishery and the oceanic components. In the coastal fishery the catches of sailfish are taken by pole and line, troll line and gill net whereas in the oceanic fishery they are exclusively caught by longline gear. Though the longline gear is aimed at catching the tunas, more than fifty percent of the catches is often comprised of bill fishes and sharks. Since these 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 elsewhere. Such information are therefore vital in understanding the impact of the by-catches on targeted tuna fishery. Though there is no major commercial fishery for sail fish in the Indian Ocean, significant quantities of the catches are taken by long lines, gillnets and also through a variety of artisanal fishing methods like trolling and handlining. There is an increasing trend in developing a game fishing industry targeting sailfish and marlins in the coastal waters and around the island groups.

The annual production of sail fish in the Indian Ocean is estimated to be 2153t (IPTP, 1994) of which 460t tonnes is reported from the longline fishery in the Indian waters. Other major producers of sail fish from the Indian Ocean are Pakistan, Oman and Sri Lanka and the catches are mostly taken by drift gill nets. The sailfish has a strong tendency to approach continental coasts, islands and reefs. In India also occurrence of sail fish in the coastal fishery is

reported. Unusual landings of sailfish, *I. gladius* (Broussonet) was reported from the Calicut coast of India by drift net units (Balan, 1978). Silas and Rajagopalan (1967) has reported occurrence of sailfish in the gill net fishery off Tuticorin on the south east coast of India. No separate statistics are available on the sailfish catch from coastal waters.

In this paper an attempt is made to provide a brief account of the sailfish, *I. platypterus* caught as by-catch of the tuna long line gear operated by the Fishery Survey India from the north west sector of Indian EEZ during the period from 1989-2000. Parameters dealt with in this study include the relative abundance and seasonal variability of the species in the north west coast of India, some aspects of the reproductive biology and the forage items of the species.

**MATERIAL AND METHODOLOGY**

The data in respect of sailfishes, *I. platypterus* caught as by-catches of the tuna longline gears operated by the survey vessel, *Yellow Fin* of Fishery Survey of India (FSI) along the north west coast of India during the period from 1989-2000 is analysed in this paper. A total of 501 specimens collected over a period of four years from 1997-2000 are considered for biological studies. The spawning season of the species is estimated based on the occurrence of mature female gonads during different months. The forage items of the species are identified from the stomach contents examined during different months.

## GEOGRAPHICAL DISTRIBUTION AND THE STUDY AREA

The Indo-Pacific sailfish, *I. platypterus* is widely distributed in the tropical and temperate waters of the Pacific, Atlantic and Indian Oceans, the latitudinal range of distribution of the species based on the tuna longline catches is between 45° – 50° N and 40° - 35° S in the Western Pacific; 45° S in the Western Indian Ocean; and 35° S in the Eastern Indian Ocean.

In Indian waters organized effort to explore the tuna resources by longlining was carried out in two phases. During the first phase surveys were conducted in the seas north of the equator upto latitude 16° N and between

longitude 67° E and 96° E during the period 1983-88. The results of this preliminary surveys indicated abundance of billfishes including sailfish caught as by-catch to the tuna fishery and presented in the Atlas of tunas, billfish and sharks in the Indian EEZ (Sudarsan *et al.*, 1988). The second phase of survey undertaken from 1989 to 2000 in the north western sector of the EEZ between lat. 16° N to 22° N and the waters around Andaman & Nicobar islands between lat. 6° to 13°N. The results of survey conducted in the Andaman and Nicobar islands is given by John *et al.* (1995). Fig.1 shows the geographical limits of study area on the north west sector of the EEZ where longline survey was conducted targeting the tunas.

## RELATIVE ABUNDANCE

Table 1. Fishing effort and catch/CPUE of sail fish, *I. platypterus* caught during the long line survey in the north western Indian EEZ.

Year	Hooks	Total catch			Sailfish catch		
		No.	Wt(kg)	Kg/1000H	No.	Wt(kg)	Kg/1000H
1989	37010	646	20349	549.82	67	1720	46.47
1990	41775	537	14436	345.57	51	1212	29.01
1991	6520	109	3135	480.83	1	30	4.60
1992	74330	591	12419	167.08	32	771	10.37
1993	37215	480	9352	251.30	20	390	10.48
1994	44740	241	5192	116.05	46	890	19.89
1995	64450	443	6403	99.35	44	495	7.68
1996	65045	576	11811	181.58	21	509	7.83
1997	84375	1341	24518	290.58	217	4774	56.58
1998	59900	969	28697	479.08	172	4996	83.41
1999	90450	797	20765	229.57	197	5432	60.06
2000	87600	753	18978	216.64	229	6113	69.78
<b>Total</b>	693410	7483	176055	253.90	1097	27332	39.42

Table 1 shows the year-wise sampling effort (hooks operated), catch of sailfish (both by number and weight) and the corresponding total catch of all fishes (including sailfish) during the period from 1989 to 2000 from the north western Indian EEZ. In this sector, the sailfishes represented constituted to the extent of about 15.58% of the total tuna longline catches. The maximum percentage of sailfish was observed in the year 2000 (32.2%). The

CPUE index (kg/1000 hooks) was highest, 83.41 kg during 1998 followed by 69.78 kg during 2000, 60.06 kg during 1999; 56.58 kg during 1997 and 46.47 kg during 1989. The average catch rate was 39.42 kg per 1000 hooks. In general the period 1997-2000 registered the highest catch rate ranging between 56.58 kg/1000 hooks and 83.41 kg/1000 hooks and the percentage contribution to the total catch ranging from 17.4% to 32.2%.

## SEASONAL ABUNDANCE

Table 2 Seasonal variation in the CPUE(Kg/1000 hooks) of Sail fish, *I.platypterus* caught from north western Indian EEZ

Month/ quarter	Hooks	Total catch			Sailfish catch		
		No.	Wt(kg)	Kg/1000H	No.	Wt(kg)	Kg/1000H
Jan	72957.00	989.00	21055.00	288.59	48.00	1174.00	16.09
Feb	55093.00	995.00	19729.00	358.10	36.00	869.00	15.77
Mar	79205.00	1152.00	24476.00	309.02	83.00	1649.00	20.82
Jan-Mar	207255.00	3136.00	65260.00	314.88	167.00	3692.00	17.81
Apr	65670.00	763.00	20844.00	317.41	199.00	5216.00	79.43
May	54210.00	662.00	17993.00	331.91	247.00	6730.00	124.15
Jun	29050.00	258.00	6880.00	236.83	77.00	1717.00	59.10
Apr-Jun	148930.00	1683.00	45717.00	306.97	523.00	13663.00	91.74
Jul	28590.00	312.00	7904.00	276.46	53.00	1169.00	40.89
Aug	50155.00	287.00	8832.00	176.09	47.00	978.00	19.50
Sep	69420.00	579.00	11702.00	168.57	111.00	2701.00	38.91
Jul-Sep	148165.00	1178.00	28438.00	191.93	211.00	4848.00	32.72
Oct	60225.00	304.00	7599.00	126.18	63.00	1745.00	28.97
Nov	56065.00	373.00	10510.00	187.46	77.00	2002.00	35.71
Dec	72770.00	809.00	18531.00	254.65	56.00	1382.00	18.99
Oct-Dec	189060.00	1486.00	36640.00	193.80	196.00	5129.00	27.13
<b>Total</b>	<b>693410.00</b>	<b>7483.00</b>	<b>176055.00</b>	<b>253.90</b>	<b>1097.00</b>	<b>27332.00</b>	<b>39.42</b>

Table 2 shows the quarterwise total catch, and catch rate of sail fish caught during the period from 1989 to 2000 from the north west coast. The second quarter (April-June) recorded the highest catch rate of 91.97 kg/1000 hooks followed by the third quarter registering 32.72 kg, fourth quarter recording 27.13 kg and the lowest catch rate was observed during the first quarter (17.50 kg). The monthwise catch details indicate a steady increase in the catch rate of sail fish from February to May coinciding with the observed spawning season. The period April-June appears to be the best fishing season for the species. However, since this period coincides with the estimated spawning season of the species, abundance of the species could be related to the spawning aggregation. Further, investigation on the spawning migration of the fish could throw more light on the relative abundance of the species in this sector.

### MATURATION CYCLE

A total of 501 specimens consisting 344 males and 157 females collected over a period of 4 years from 1997 to 2000 are analysed to estimate the spawning season. The male to female ratio worked out is 2.2:1. The spawning season of the species is thus estimated based on the occurrence of female gonads (157 specimens) in different maturity stages. Maximum percentage occurrence of females gonads in the penultimate stage of maturity was observed during March-May and in August-September. As no specimens with spent ovaries were encountered it is not

clear whether a spawning migration is involved. The presence of female individuals with mature ovaries in high percentage indicates that the spawning occurs during March – September. The species appears to have a protracted spawning period extending from March – September with two peaks one in March – April and the second in August – September.

Nakamura (1985) observed that the species spawn throughout the year in tropical and sub-tropical water of the Pacific with peak spawning occurring in the respective local summer seasons. Spawning occurs with males and females swimming in pairs or with two or three males chasing one female. The sex ratio in the present investigation indicate that the male species were dominant during all the months. There exists practically no information on the reproductive biology of sailfish from Indian waters and therefore the present account could be of immense importance to carryout future investigations on the spawning periodicity, fecundity indices etc. The abundance of large number of male and female specimens during the observed spawning season possibly suggest that north west Arabian Sea could be a spawning ground of the species.

### FOOD

Bill fishes are active and voracious predators using their long rostrum for attacking the prey. It appears that there are no regular predators for billfishes. The stomach contents of 501 individuals of sail fish were analysed on

visual estimation to understand the major food items consumed by this fish. As revealed from this observation, they are found to feed mainly on teleost fishes, cephalopods and crustaceans. The two main food items found to be dominating during all the months in the stomach contents of individuals belonging to both the sexes were bony fishes and squids. The bony fishes which are identified are eel, pufferfish, flying fish, file fish, horse mackerel and juvenile of a number of fish species. Among cephalopods, squids (*Loligo* spp) were dominant food item while *Octopus* spp. and cuttle bones were found occasionally. Crabs were found on few instances. Very large individuals of sailfish with "full" stomach condition were found to devour upto 20 small squids (250 gms) as exclusive food. As evidenced from the stomach contents it appears that they are not selective feeders but opportunistic feeders as there is no difference in the food items consumed by both the sexes during different months. The food items consumed by tunas and the sail fish appear to have a similarity as they are found to feed on the common food items.

Nakamura (1985) observed that major forage items of Indo-Pacific sailfish are fishes and squids, but adults are fairly opportunistic feeders and take almost any food they come across. During several longline cruises of Japanese research vessels in the eastern North Pacific Ocean, adult *I. Platyterus* have been found to feed mainly on cephalopods and fishes (Bramidae, Stromaticidae, Carangidae, *Ostracion* spp., Gempylidae, *Auxis* spp., *Trachipterus* spp, Belomidae, Balistidae, *Coryphaena* spp, *Lagocephalus* spp. etc.)

#### SIZE DISTRIBUTION

The length frequency studies conducted from 1997 – 2000 shows that the size of the specimens ranged in length (FL: lower jaw to fork) from 100 - 260 cm; majority of the specimens were found to be in the length group of 145 cm to 240 cm. The prominent model classes represented were 145-150, 175-180, 195-200, 215-220 and 235-240 cm (Fig.2). The FL (cm) of the sailfish caught from the Andaman & Nicobar waters were in the length group of 135 cm to 245 cm.

The individual weight of the fish caught during the survey ranged from 4 kg to 55 kg with an average weight of 27 kgs. The female individuals were found to be heavier with an average weight of 30 kgs. while the average weight of males were 26 kgs. The overall mean weight of the fish caught from the Andaman island was 32 kg. The sailfish caught from Andaman & Nicobar waters seems to be larger than those caught from the mainland while the size of the fish in terms of length (FL) is more with respect to the stock occurring in the north west sector of the EEZ. Individuals below 100 cm length were seldom encountered during the present survey, which probably indicates that mature specimens above certain lengths are vulnerable to the longline gears.

The size range of sailfish caught in the pelagic fisheries of Sri Lanka varies from 60 to 300 cm FL (tip of lower jaw to fork) (Maldeniya et al., 1995).

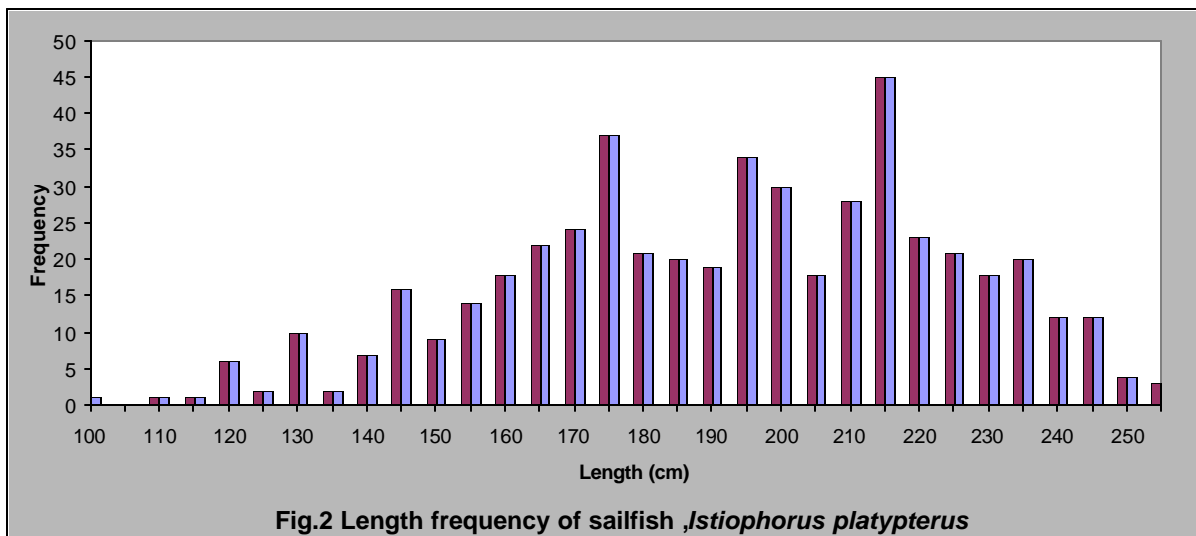
#### DISCUSSION

The production of bill fishes in India has been increased considerably from 1151 (t) in 1991 to 4448 (t) in 1997. The major species contributing to the bill fish catches are *I.platyterus*, *Makaria indica* and *Xiphias gladius* (Somvanshi et al., 1998). Though there is no commercial fishery targeted for the sailfish, significant quantities of this species are taken by the longlines, gillnets and a variety of artisanal methods like trolling and hand lining. The two important sources of information on the sailfish catch in the Indian waters are the data collected through the operation of chartered foreign fishing vessels (1988-94) and the survey operation by FSI. The operation of chartered vessels in the Indian waters ceased from 1994. The results of both the operations have indicated the abundance of sailfish, *I.platyterus* in the Indian EEZ. The surveys indicate appreciable catch rate of 39.42 kg/1000 hooks from the mainland and 45.76 kg/1000 hooks from the Andaman and Nicobar waters. The Indian EEZ area in the mainland and island waters are found to be productive for sailfish. The length frequency analysis from 1997-2000 shows that the specimens were found to be in the length range of 100-260 cm (FL – lower jaw to fork) and the average weight of the individual fish being 30 kg. In the Andaman & Nicobar waters, the size of the specimens ranged from 135 cm to 245 cm and the average weight of the fish was found to be 32 kg (John et al., 1995). The size range of sailfish caught in the pelagic fishery of Sri Lanka as reported by Maldeniya et al., (1995) varied from 60 cm to 300 cm (FL). The males were found to dominate with aggregate ratio 2.2:1. Analysis of maturity stages of female specimens indicated two peak spawning period, March-April and August-September.

Since the longline fishery targeting the tunas in the high seas catch large numbers of bill fishes, there should be collaborative effort to assess the stock of the by-catch fishery spread over larger area of ecosystem. The tunas and bill fishes have unique physiological adaptations enabling them to perform horizontal migration in wide expanse of area while thermo-regulation enable them to perform quick movements in the vertical expanse of the water column between surface and deeper waters. Information on the distribution and biological characteristics of the associated species of the targeted fishery which constitute the by-catch fishery are important to know the vulnerability of both categories of the species sharing the common ecosystem. The forage items of the sailfish as evidenced from the stomach contents reveal that these fishes share the common food items (squids and bony fishes) with tunas resulting in a weaker or stronger competition. However, the sailfishes appear to be non-selective feeders. The present study on gut contents of *I. platyterus* exhibits dependence of the species on larger number of forage items in its feeding. Therefore, priority should be given for estimating the basic biological characteristics of the species like age, growth, food and breeding pattern of the species in the Indian Ocean to assess the status of these species.

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**Fig.2 Length frequency of sailfish, *Istiophorus platypterus***