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Distribution and biology off the deep-sea eel, *Gavialiceps taeniola* along the continental slope off Indian EEZ

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Abstract

The distribution, abundance and biological characteristics of the deep-sea eel *Gavialiceps taeniola* (Alcock,1889) caught by deep-sea trawling on board FORV *Sagar Sampada* along the continental slope in the depth zone 200 –1000m, off the west and east coast of India are reported. This species was found abundant at 10^{0}N and 80^{0}E in east coast and in west coast at Lat 9^{0}N and Long 75^{0}E. Females dominated the catch. Length range varied from 16 to 82 cm. The b value in length weight relationship was < 3, which showed that the fish becomes slender as length increases.

Keywords: Deep-sea eel, *Gavialiceps taeniola*, continental slope, EEZ India

Introduction

Nair and Joseph (1984), Sudarsan and Somavanshi (1988), James and Pillai (1990), Sivakami (1990), Panicker *et al.* (1993), Khan *et al.* (1996), Venu and Kurup (2002) and Jayaprakash *et al.* (2006) have reported the existence of fairly rich grounds of deep-sea fish resources in the Exclusive Economic Zone of India. The Fisheries and Oceanographic Research Vessel (FORV) *Sagar sampada* of Ministry of Earth Sciences (MoES) has been conducting pelagic/bottom trawling in the 200-500m depth zone in the Indian EEZ for the last two decades. The results of these surveys on the distribution and availability of various fishery resources are available in the Proceedings of the First and Second Workshops conducted at Cochin (Mathew, 1990; Pillai *et al.*, 1996). However, only limited information is available on the deep-sea demersal resources beyond 500-m depth zone. The need for exploitation of deep-sea fishes is gradually gaining importance in the recent years as the production from the present fishing grounds alone would not be able to meet the future nutritional demand of the country.

FORV *Sagar Sampada* has been carrying out deep-sea demersal resource survey in the 400-1000m depth zone of the continental shelf edge during 2002-2007. Most of the fin-fishes reported are non-conventional and at present not much is known about their edibility, nutritional quality or utility and other attributes (Venu and Kurup, 2002; Jayaprakash *et al.*, 2006). The present paper discusses the distribution and biology of the little known deep-sea eel, *Gavialiceps taeniola* (Family: Muraenesocidae), a non-conventional deep-sea resource based on the data collected from three fishing cruises undertaken by the vessel beyond the 400 m depth zone in the continental slope of the Indian EEZ. Generally, the eel is considered as a luxury food and consumed in delicacy by Greeks, Romans, Japanese and the people of several Asian and European countries. Even though it is considered as food fish in India their exploitation is limited (Balu, 2004). *G. taeniola* is most widely distributed among the deep-sea eels in the Indian Ocean, Arabian Sea, Oman and Bay of Bengal (Alcock, 1889).

Materials and methods

Samples for the present study were collected by deep-sea trawling (EXPO model trawl – an imported design and HSDT version – developed by CIFT for high speed demersal trawling in Indian EEZ) carried out by FORV *Sagar Sampada* during Cruises: 241, 247 and 250 in the pre-monsoon (January), monsoon (July) and post-monsoon seasons (November) of the year 2006.The transects between 9^{0}14'N to 15^{0}30'N and 72^{0}40'E to 75^{0}47'E were covered in the southwest region and between Lat 10^{0}57'N to 17^{0}27'N and Long 80^{0}21'E to 83^{0}24'E in the east coast. The depth of operation ranged from 150 to 1070m.

Catch by weight and number was recorded for each fishing station. Random samples were collected from each haul for biological investigations such as length frequency, sex, maturity, gut content analysis, etc. Total length was measured from tip of the snout to tip of the tail. Weights of both sexes were taken separately. Length weight relationship was determined following the formula W= aL^b where W = weight in gram, L= length in cm and 'a' and 'b' are constants. Analysis of covariance (Snedecor, 1968) also was employed. Gut contents were analyzed by visual examination after grading the stomach as full, 3/4, 1/2, 1/4, trace and empty. Chi square analysis (Biradar, 1989) was used to test the null hypothesis. Condition factor was calculated by using the formula K=W*100/L^n, where 'W' is the weight of the fish in gram, 'L' is the length in cm, 'n' is pooled b value (Hile, 1936).

Results

Distribution and abundance: The bottom trawling revealed that *G. taeniola* is one of the important deep-sea resources in the slope regions of the Indian EEZ (Fig.1). This resource is not commercially exploited, as there is no consumer demand of any type and therefore it is not economical also to do so. Bathymetric distribution showed that this resource is available at 400 –1000m depth. This deep-sea eel is seen in muddy regions. Fishing was conducted at 55 fishing stations and *G.taeniola* was found to occur in 19 stations and the total catch was 460 kg (Fig.2). The depth wise and latitude wise abundance of this species are listed in Table 1.Length range in different depth is given in Figure 3. The average catch rate in the east coast was 158 kg/h whereas on the west coast it was 8.5 kg/h. The highest catch of 298 kg was recorded at Lat 10^{0}57'and Long 80^{0}21'in the east coast. Gear wise, the maximum contribution was by EXPO.

Length composition: The length ranged from 37 to 82cm. The length measurements were classified into 2cm size groups. It may be observed that the male and female showed a different pattern in the length frequency distribution (Figs. 4 & 5). The mode was at 54 –56 cm and

Fig 1.*Gavialiceps taeniola,* the deep-sea eel

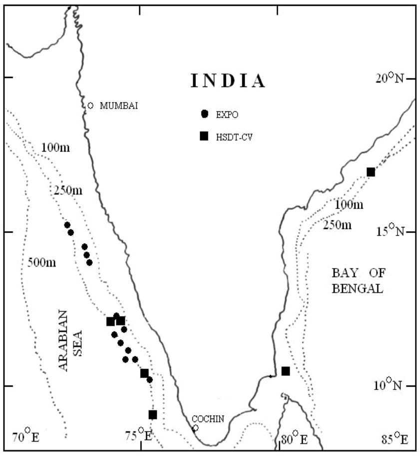

Fig 2.Area of deep-sea demersal trawl survey

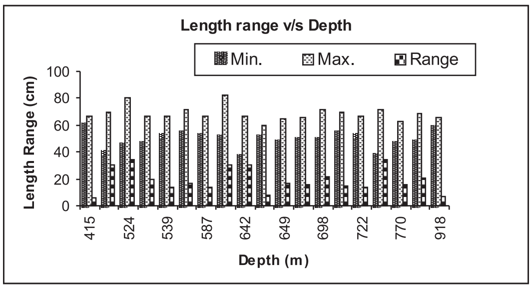

Fig 3. Difference in length range in each depth

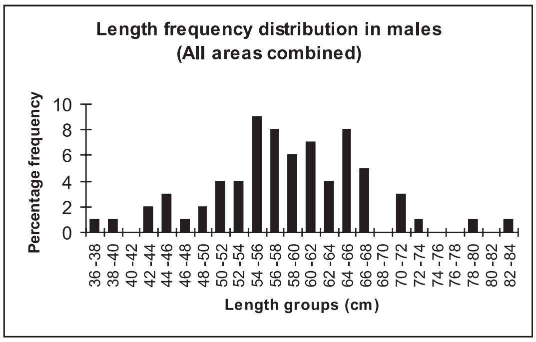

Fig 4.Length frequency distribution of males

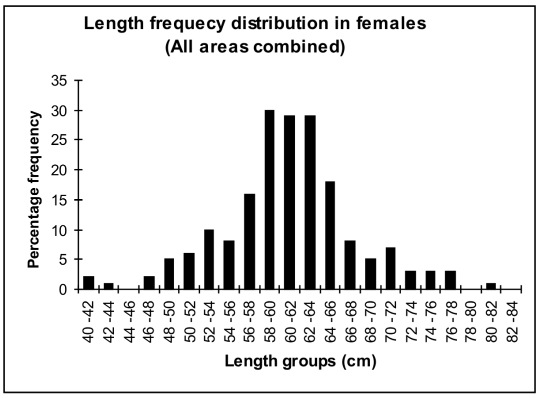

Fig. 5.Length frequency distribution of females

Table 1. *Catch rate and size (cm) of* G.taeniola *in the Indian EEZ*

Latitude	Longitude	Catch/hour (kg)	Depth (m)	Gear	Length range-cm
9^0 14' 30	75^0 38' 93	18	524	HSDT-CV	46 - 80
$10^0$33' 36	75^0 19' 39	0.9	649	EXPO	52 - 60
10^0 38' 52	75^0 16' 32	5	698	HSDT-CV	50 - 72
10^0 57' 40	80^0 21' 66	298	637	HSDT-CV	52 - 82
11^0 11' 35	74^0 54' 29	4	670	EXPO	50 - 66
11^0 16'02	74^0 52' 84	12	587	EXPO	53 - 67
11^0 17' 06	74^0 50' 04	0.3	666	EXPO	48 - 65
11^0 52' 56	74^0 24' 43	6	623	EXPO	53 - 67
12^0 14' 80	74^0 09' 48	0.2	916	EXPO	59 - 66
12^0 22' 19	74^0 10' 75	1	555	EXPO	55 - 72
12^0 22' 10	74^0 08' 84	14	740	HSDT-CV	55 - 70
12^0 24' 86	74^0 10' 25	61	415	HSDT-CV	61 - 67
12^0 26' 27	74^0 07' 47	0.4	708	EXPO	53 - 67
14^0 17' 59	73^0 09' 39	5	673	EXPO	37 - 67
14^0 34' 79	73^0 05' 65	3	546	EXPO	40 - 70
14^0 43' 90	73^0 00' 53	3	536	EXPO	47 - 67
15^0 14' 27	72^0 44' 26	7	828	EXPO	48 - 69
15^0 30' 54	72^0 40'79	3	743	EXPO	38 - 72
17^0 06' 82	83^0 25' 84	18.75	770	HSDT-CV	47 - 63

58 –60 cm for males and females respectively.

Length –weight relationship: A total of 187 females (40 to 80 cm) and 71 males (36 to 82 cm) were sampled to study the length-weight relationship (Table 2).

The results of the logarithmic regression showed that the 'b' was < 3, which denotes that fish becomes more slender as length increases (Grover and Juliano; 1976). The length-weight relationship showed that no significant difference existed between males and females.

Condition factor: The distribution of values of K is summarized in Table 3. Figures 6 and 7 show condition factor in male and female.

Sex ratio: Out of 258 specimens, 187 were females

Table 2. *Length-weight relationship in* G. taeniola

	a	b	R^2
Males	0.011	2.24	0.84
Females	0.08	2.32	0.79
Pooled	0.009	2.29	0.8

Table 3. *Distribution of values of condition factor 'K '*

	Female	Male
Number of fish	187	71
Range of 'K'	4.36-14.4	1.5-11.1
Mean K	8.16	5.5

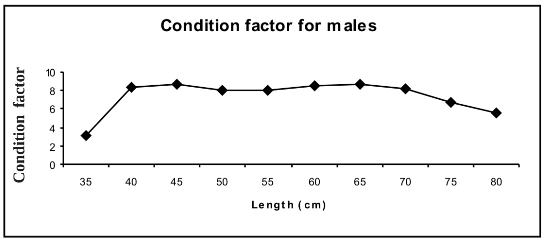

Fig. 6. Average condition factor in male

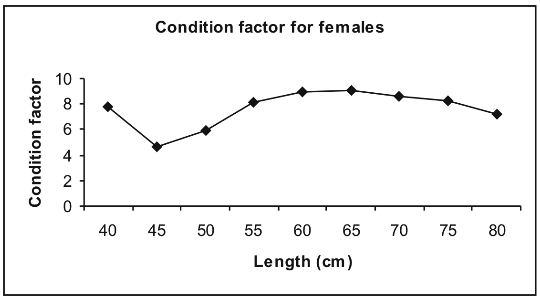

Fig 7. Average condition factor in female

and 71 were males. Females dominated in most of the length groups. Male: Female ratio was 1:2.6. Length related Chi –Square analysis showed that sex ratio was significantly different. The table value of X^2 with 1 df at 5% level of significance is 3.841. As X^2 computed is more than the table value of X^2, the null hypothesis is rejected.

Maturation and spawning: During pre–monsoon, stages IV and II showed higher representation. It was observed that the males start to sexually mature at about 30 cm (Tesch, 2003). Immature and ripe fishes were represented in lesser percentage. During monsoon season, most of the females were in advanced stage of maturity. Fishes in the maturing stage were mostly found during the post-monsoon.

Gut content analysis: Nearly 90 % of stomachs in male and in female, irrespective of depth and seasons, were empty. Those with trace and digested matter constituted 8%. Full stomach formed only 2%.The important food items were fishes such as *Nemichthys* and *Leptocephalus* and deep-sea shrimps like *Plesionika spinipes.*

Discussion

The demersal fin-fish and shellfish resources in 200 –1000 m are non-conventional. Since 1998, some of the deep-sea shrimps in the 200-400m depth zone in the shelf areas are exploited by private trawlers as they have great commercial value. Some of the species which were termed as bycatch are now being targeted due to consumer demand. The production from fishing ground up to 200m depth zone has reached optimum level and further increase is possible only by adopting responsible fishing. The future nutritional requirements can be met only through development of the deep-sea fishing. Though some of the oceanic resources such as tunas, sharks, and cephalopods are at least marginally exploited, the deep-sea demersal resources remain neglected. Though a number of species have been recorded, commercial exploitation would be possible with respect to a few species exploited from like the Orange roughy (*Hoplostethus atlanticus*) as exploited from Australian waters. Resource surveys to locate the fishing grounds, their commercial concentration, seasonal pattern of abundance, information on their biology, improvisation in gear technology for economic exploitation, utilization and extraction of bioactive compounds, etc assume importance in the context of increasing demand for sea food. *G. taeniola* is the most widely distributed deep-sea eel. Some of the eels like *Congresox talabanoides*, *C.talabon*, *Muraenesox cinereus*, *Muraenesox bagio*, etc are commercially exploited from the fishing grounds within the 200m depth zone. These eels and their bladder are in good demand in the domestic markets. Young ones of eel elvers were once eaten by fishermen as a cheap dish, but environmental changes have lead to increased rarity of the fish. They are now considered a delicacy and are highly priced in the UK. Apart from its food value, eels are also used for making icinglass, fish meal, etc. In our country, the average annual landing of eels increased to 10,232 t in 2004 but subsequently decreased to 7998 t in 2004 and 8548 t in 2005 and further increased to 10,201 t in 2006. Leptocephalid biomass on south-west coast of India is constituted mainly by leptocephali belonging to five families *viz.*, Congridae, Ophichthidae, Muraenidae, Nemichthyidae and Synaphobranchidae. Of the five families, Congridae, Ophichthidae and Muraenidae dominated the catch (Balu, 2004). It's right time to think about exploitation of the deep-sea demersal resources and evolve ways and methods to develop consumer demand by popularising them or the by-products that could be made out of them.

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