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SOME FISHERY BIOLOGICAL ASPECTS OF THE DEEP WATER SHARK Iago omanensis IN AQABA GULF

By

M. ABDALLAH*

**National Institute of Oceanography and Fisheries, Alexandria, Egypt.*

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ABSTRACT

*The dwarf smooth hound **Iago omanensis** was captured from deep water 1000 m depth off Ras Abu-Galum (28° 35'. 5479 N, 034° 34'. 037 E) in Aqaba Gulf, Red Sea. Length-based estimates of growth parameters, mortality coefficients and the maximum exploitation ratio, which generates the maximum sustainable yield, were obtained using the compleate ELEFAN program. They were found to be; asymptotic length (L_∞) = 64.17 cm, growth constant (K) = 0.410 year^{-1}, total mortality (Z) = 0.741 year^{-1}, fishing mortality (F) = 0.035 year^{-1}, natural mortality (M) = 0.706 year^{-1} and maximum exploitation ratio (Emax) = 0.6409.*

Investigation of stomach contents revealed that, this species feeds on fish, cephalopods, shrimp and polychaetes. Cephalopods were the main food of the different sized sharks.

INTRODUCTION

Sharks in the Red Sea were the subjects of some researchers who studied its utilization. Moharram & Awadallah (1983) dealt with identification and financial evaluation of shark utilization in Djibouti. Sachithanathan (1983) studied the technical feasibility of processing sharks in the same previous area. El-Tanahy (1990) gave an account on canned products from shark meat. The shark ***Iago omanensis*** from the northern Red Sea was dealt by Waller and Baranes (1991 & 1994) who studied its morphology and feeding habits.

By increasing the tendency of sharks' utilization, the present study was dealt with the stock of ***Iago omanensis*** in Aqaba Gulf, off Ras Abu-Galum to obey our needs in resource management and more effective environmental protection.

MATERIALS AND METHODS

Experimental fishing were conducted seasonally during the period from January to December, 1994 in the studied area by means of bottom settled trammel nets to collect the shark samples. ***Iago omanensis*** represented 81.31±5.54% of the collected total catch. It ranged from 33 to 59 cm in total length.

Growth

Mean lengths at the end of each year of life were estimated by using the method of Bhattacharya (1967). The asymptotic length (L_∞) and growth constant (K) were obtained by applying Walford's method (1946) to the estimated lengths of different age groups.

The constant t_0 of the Von Bertalanffy model was estimated from the following formula:

$$t_0 = t + 1/K \; Ln \; ((L_\infty - L_t) / L_\infty)$$

This equation is a rearranged formula of the Von Bertalanffy's (1938 &1949) equation in which t is the age with the largest population frequency.

Mortality coefficients & current exploitation rate

Total mortality coefficient (Z) was estimated using the length converted catch curve technique (Pauly, 1987) incorporated in ELEFAN II program. Natural mortality coefficient (M) was calculated using the empirical relationship of Pauly (1980), i.e.

$$Log_{10} M = - 0.0066 - 0.279 \log_{10} L_\infty + 0.6543 \log_{10} K + 0.4634 \log_{10} T.$$

Where L_∞ & K are parameters of Von Bertalanffy's growth equation and T is the mean annual temperature (in °C) in which the stock lives. It is considered here as 21 °C (Morcos, 1970).

The estimates of fishing mortality coefficient (F) was calculated by subtraction of M from Z, and then the current exploitation ratio (E = F/Z) was computed.

Length at first capture (Lc)

It was estimated using ELEFAN II which was used to construct a plot of probability of capture by length (Pauly, 1984) by extrapolating the catch curve.

Relative yield per recruit

Estimation of relative yield per recruit (Y'/R) was carried out according to Pauly and Soriano (1986) by using the estimated growth parameters, probability of capture by length and estimates of natural mortality coefficient (M).

Feeding habits

Stomach contents were analyzed quantitatively according to Windell and Bowen (1978). The following different indices were used: Percentage frequency of occurrence (O%); numerical abundance percentage (N%); and gravimetric percentage (G/%). The index of relative importance (IRI%) was estimated according to Rosecchi & Nouaze (1987). To investigate the overlapping food items among the different size classes of ***Iago omanensis***, the following Schoener's formula (1970) was used:

$$T = 1 - 0.5\sum_{i=1}^{n}\left|Pxi - Pyi\right|$$

where T is the index of overlapping; Pxi and Pyi are the proportions by number of the food item i respectively in fish x and in fish y.

RESULTS

Growth

Three age groups (Table, 1 & Figure, 1) were separated possessing mean lengths of 39.045, 49.091 and 55.123 cm for the first, second and third age groups respectively. The results indicated that ***Iago omanensis*** attained its maximum increment (39.045 cm) in length by the first age group then decreased to reach 10.046 and 6.032 cm for the second and third group respectively.

Table (1): Separation of length-frequency distributions for *Iago omanensis* by using Bhattacharya's (1967) method.

Age group	*Mean length (cm)*	*Standard Deviation*	*Population number*	**Separation index*
I	39.045	2.758	10.120	---
II	49.091	2.156	218.660	4.089
III	55.123	1.650	17.220	3.170

*Should be > 2 for groups to be meaningfully separated.

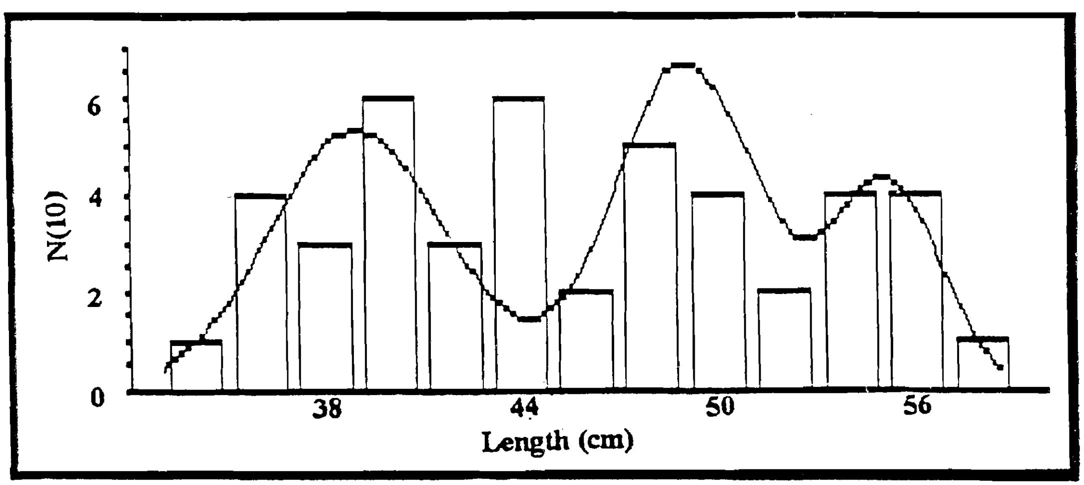

Fig. (1): Composite distribution of the length groups of *iago omanensis* using Bhattacharya's method.

According to Walford (1946), the constants (L_∞, K and t_0) of Von Bertalanffy theoretical growth model were calculated and the growth formula can be represented in the following form:

$$L_t = 64.170\ [1-e^{-0.410(t+1.531)}]$$

Where L_t is the total length at age t.

Mortality coefficients & current exploitation rate

Coefficients of total mortality (Z), fishing mortality (F) and natural mortality (M) were estimated as 0.741, 0.035 and 0.706 year^{-1} respectively. The catch curve used in the estimation of total mortality coefficient (Z) is given in Figure (2). The black dots in the figure represent the points used in calculating Z through least squares linear regression, while open dots represent the points either fully recruited or close to L_∞ and hence discarded from the calculations. A good fit for the descending right limb of the catch curve was obtained, with a correlation coefficient of r = 0.931. On the base of the estimated mortality coefficients, the current exploitation rate (Ecurr) was calculated as 0.047.

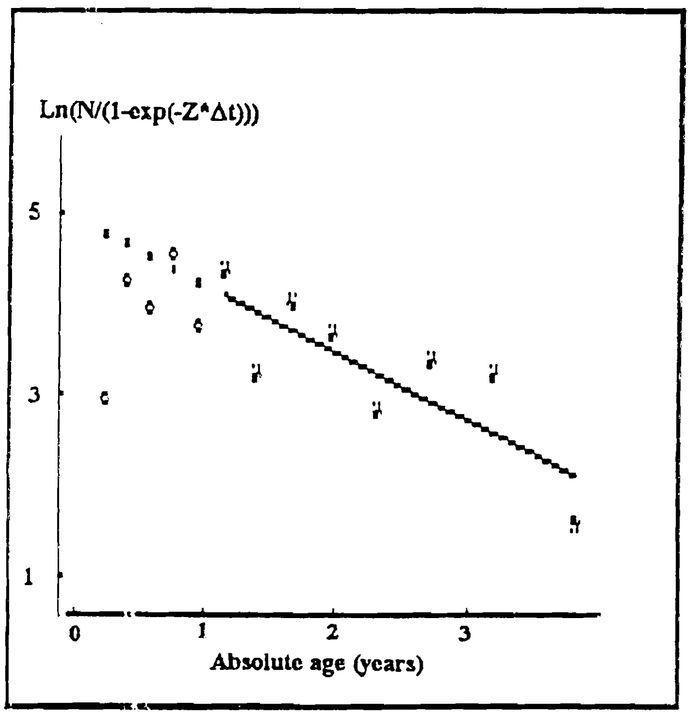

Fig. (2): Length-converted catch curve of *iago omanensis* collected from Aqaba Gulf, off Ras Abu-Galum.

Length at first capture

As indicated in Figure (3), which presents the probabilities of capture derived from length-converted catch curve, length at first capture was estimated as 34.997 cm.

Relative yield per recruit

Figure (4) shows the estimation of relative yield per recruit (Y'/R) as a function of Lc/L_{∞}. This figure indicates that the detected maximum exploitation rate (Emax = 0.6409) which generates the maximum sustainable yield was much higher than the current exploitation rate (Ecurr = 0.047).

Feeding pattern

Investigation of stomach contents (Table, 2 & Figure, 5) revealed that, cephalopods were recorded in most of the examined stomachs (97.22%). They constituted 55.56% (by number) and 71.67% (by weight) of the food bulk with an importance index of 89.43%.

Fish and shrimp possessed the same percentage of occurrence (O%=22.22) in the diet of the detected stomachs. Indices of their numerical abundance were 12.70% for fish and 25.40% for shrimps. Fish items had a higher gravimetric presentation (14.17%) than that of the shrimps (10.56%). Shrimp attained importance index (IRI%) of 5.78%, which was slightly higher than that of fish (4.32%). Unidentified digested food was recorded in 8.33% of the detected stomachs possessing N% = 4.76, G% = 2.22 and IRI% = 0.42.

Polychaetes constituted the food item of the least importance in the detected diet. They were detected only in 2.77% of the total number of the examined stomachs possessing negligible values of N% (1.59), G% (1.39) and IRI% (0.06).

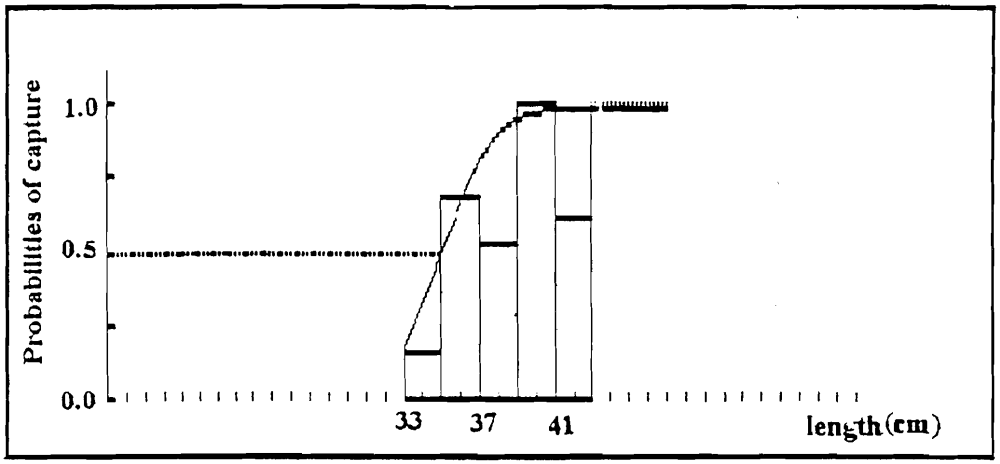

Fig. (3): Probabilities of capture by length of *iago amanensis* collected from Aqaba Gulf, off Ras Abu-Galum.

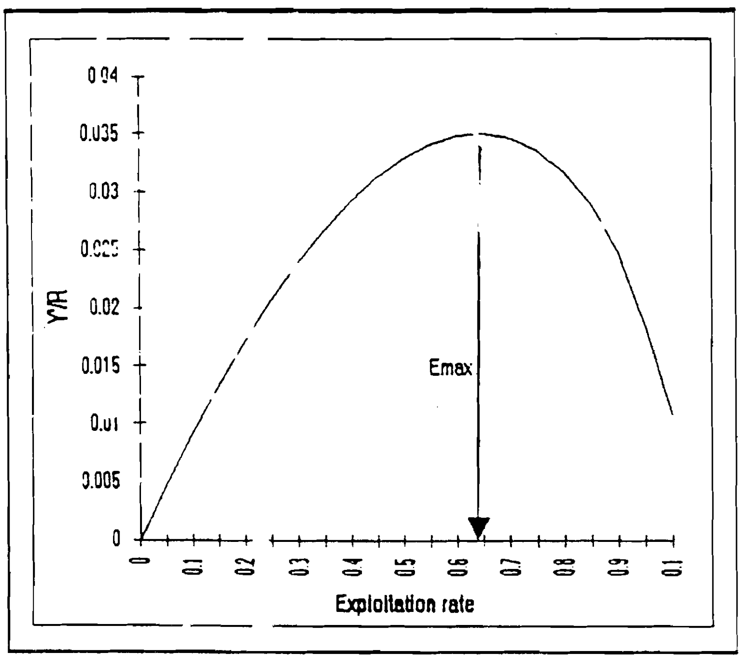

Fig. (4): Relative yield per recruit (Y'/R) of *iago omanensis* collected from Aqaba Gulf, off Ras Abu-Galum.

Table (2): Occurrence percentage (O%). Numerical percentage (N%), Gravimetric percentage (G%) and Relative importance index (IRI%) of food items in the diet of ***Iago omanensis*** collected from Aqaba Gulf off Ras Abu-Galum.

Food items	*O%*	*N%*	*G%*	*IRI%*
Cephalopods	97.22	55.56	71.67	89.43
Fish	22.22	12.70	14.17	4.32
Shrimp	22.22	25.40	10.56	5.78
Polychaetes	2.77	1.59	1.39	0.06
Digested food	8.33	4.76	2.22	0.42

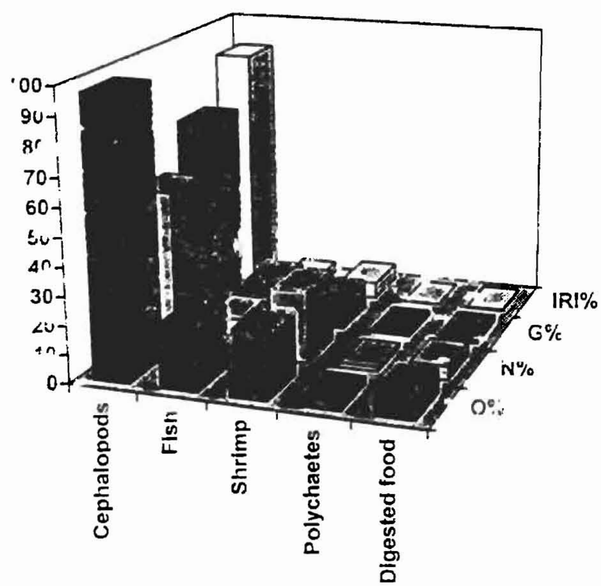

Fig. (5): Food items consituting the diet of *Iago omanensis* collected from Aqaba Gulf, off Ras Abu-Galum.

Variation of food items with shark length

Table (3) and Figure (6) show the variation of food patterns with shark size. Shark individuals were divided into three length classes, small (<40 cm), medium (40-50 cm) and large ones (>50 cm). The results show that small sized sharks fed mainly on cephalopods, which possessed an importance index (IRI%) of 98.28. Shrimp and unidentified digested food were detected in their stomachs possessing a negligible value of importance index (0.86%).

Medium sized sharks fed mainly on cephalopods (IR= 93.21%) and to less extent on shrimp (IRI = 4.74%), followed by fish (IRI = 1.52%). Polychaetes and unidentified digested food were recorded possessing negligible importance indices (IRI%) of 0.30 and 0.22 respectively.

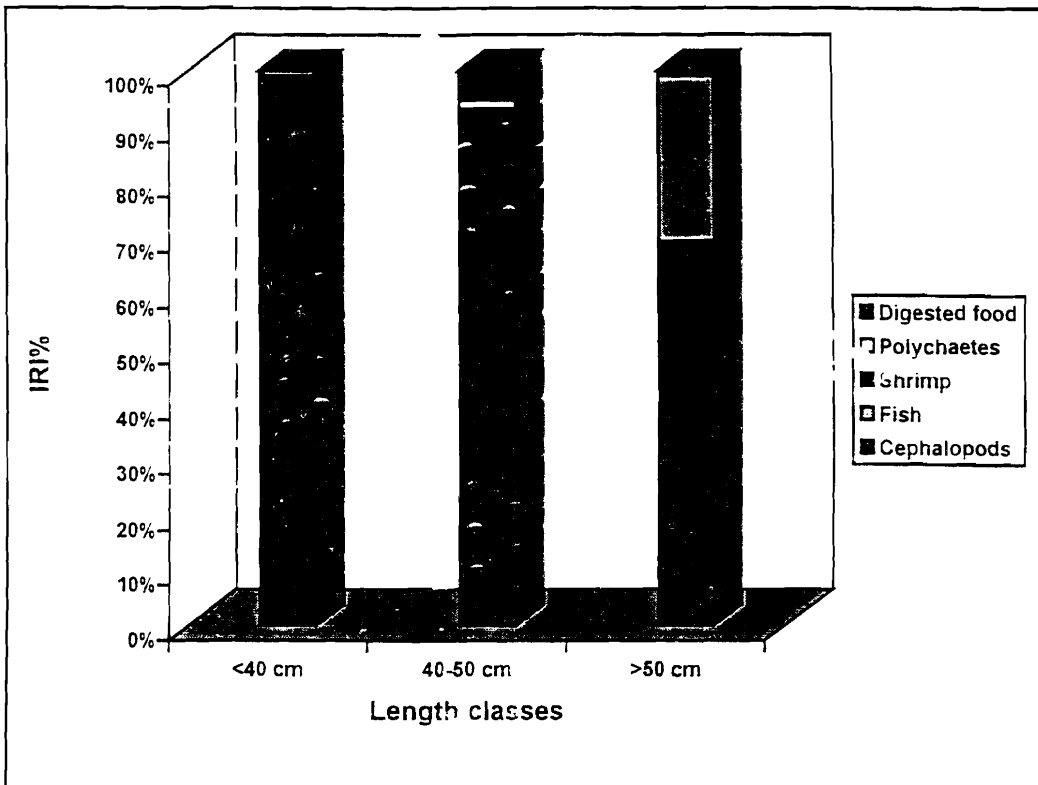

Fig. (6): Variation of the food items in the diet *Iago amanensis* with its length.

Table (3): Variation of food items in the diet of *Iago omanensis* with its length

Food item	Length class											
	<40 cm				40-50 cm				>50 cm			
	O%	N%	G%	IRI	O%	N%	G%	IRI	O%	N%	G%	IRI
Cephalopods	100	81.8	91.1	98.1	100	66.6	73.7	93.2	90.0	50.0	56.0	69.3
Fish	---	---	---	---	12.5	8.33	10.0	1.52	60.0	33.3	35.0	29.8
Shrimp	11.1	9.09	5.56	0.92	25.0	16.6	11.8	4.74	20.0	11.1	6.00	0.25
Polychaetes	---	---	---	---	6.25	4.17	3.13	0.30	---	---	---	---
Digested food	11.1	9.09	5.56	0.92	6.25	4.17	1.25	0.22	10.0	5.56	3.00	0.62

Large sized sharks fed widely on cephalopods (IRI % = 69.33) and fish (IRI%=29.80). Both shrimp and unidentified digested food possessed importance indices of 0.25% and 0.62% respectively.

Values of overlapping index indicated the presence of significant overlap in the diet resources between small & medium (T=0.7995), small & large (T=0.647) and between medium & large sized (T=0.7355) sharks.

DISCUSSION

According to Baranes and Golani (1992), ***Iago omanensis*** is considered as one of the smaller members of the family Triakidae. As indicated in the present study, its catch is composed of individuals ranging from 34 to 59 cm. in total lengths. The present study shows that the current exploitation rate (Ecurr = 0.047) is much lower compared with the maximum ones (Emax = 0.6409) which generates the maximum sustainable yield. This reveals that the stock of the studied ***Iago omanensis*** can be considered as unexploited ones. More fishing efforts by means of suitable commercial fishing gears should be conducted together with continuous scientific investigations to evaluate the catch, fishing effort and the exploited stock. As ***Iago omanensis*** constituted 81.31% of the total catch taken by the trammel net during the sampling processes, the same fishing gear can be recommended to be used but on a commercial scale to exploit that stock.

Stomach contents of ***Iago omanensis*** are composed of cephalopods, fish, shrimp and polychaetes. Waller & Baranes (1994) reported that ***Iago omanensis*** captured from the northern Red Sea (off the marine laboratory of Eilat) feeds on benthoplagic fishes, deep water cephalopods, crustaceans, benthic mollusks and polychaetes. They recorded also terrigenous plant matter, animal remains and large quantities of mud in the detected stomachs. According to Nikolsky (1963), such differences in food patterns recorded in the present study with that of Waller & Baranes (1994) can be attributed to the different abundance of food items in various habitats. In agreement with the findings of Nikolsky (1963), the present study recorded changes in food pattern among individuals having different size ranges.

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