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LENGTH - WEIGHT RELATIONSHIP, RELATIVE CONDITION AND FOOD AND FEEDING HABITS OF THE GOATFISH *UPENEUS SULPHUREUS* IN SAFAGA BAY OF THE RED SEA

FAWZY A. BORAEY AND FAIZA M. SOLIMAN

Department of Zoology, Faculty of Science, Sohag, Egypt

ABSTRACT

Upeneus sulphureus is a seasonal migratory fish in Safaga Bay of the Red Sea and it has high economic value and considerable fishery importance in the area.

The fish has the logarithmic equation: Log W= – 4.385 + 2.890 log L which indicates closely the cubic law (n=2.89) for isometric growth of the fish in its natural habitat.

The mean relative condition (K_n) was 1.03 which indicates the well-being of the fish under investigation.

The fish is a carnivore feeding mainly on annelids, crustaceans, molluscs and miscellaneous organisms. The annelid worms were found to be the most preferred food item. Like the other goat fishes inhibiting the Red Sea, *Upeneus sulphureus* reveals bottom feeding habits and an active seasonal migrations for feeding and spawning in the studied area from the Red Sea.

INTRODUCTION

THE GOAT FISH *Upeneus sulphureus* Cuvier and Valenciennes of the family Mullidae is considered as one of the most economic summertime fish in Safaga Bay of the Red Sea. The fish make annual migrations from the deep water to the sandy and sandy-mud shore of the bay. These migrations are usually seen from April to August and coincide with the lunar periodicity. In that particular time, the fishermen direct their beam trawls and gill nets towards fishing that kind of fishes which are locally named *Enber*.

The knowledge about the biology and fishery of *U. sulphureus* in the Red Sea is meagre and being confined to the fish taxonomy and morphology given by Boraey (1969).

The present investigation was undertaken to elucidate length-weight relationship, relative condition factor and food and feeding habits of *U. sulphureus* to fullfil the essential needs of knowledges about the biology and fishery.

MATERIAL AND METHODS

The materials of the present study have been collected from Safaga Bay of the Sea during the four migrations (feeding and spawning) of *U. sulphureus* in 1984. A total of 750 specimens were brought from Safaga fish landing centre and directly examined. Standard lengths, weights and digestive tracts were taken for laboratory analyses.

The standard length of the collected fishes were grouped in class intervals and expressed in mm and their weights in grams. The equations used for the present estimations were followed according to Hile, 1936; Le Cren, 1951; Tyler, 1972; Weatherley, 1972; Boraey, 1980 and others.

The relative condition of each size group was estimated by using the equation $K_n = \frac{W}{w}$ used by Weatherley, 1972 and others.

The gut contents were preserved in 10% for malin saline water for food and feeding study-

The food contents were estimated according to the occurrence method used by Hynes, 1950; Pillay, 1953; Thomson, 1954; Chong, 1977 and others. Five points were used for empty and fullness categories of the stomachs. The food contents were sorted and identified by the binocular microscope upto families and genera according to the degree of digestion.

Results

Length-weight relationship

The length-weight relationship of *Upeneus sulphureus* was determined by using the equation $W = c\ L^n$ and its log–log transformation $\log W = \log c + n \log L$. Where W = weight, L = length, c is constant an n is an exponent. The mean size groups with their empirical and calculated weights were given in Table 1 and Fig. 1. The results in the Table were estimated by calculating the logarithmic regression equation using the method of least squares. The logarithmic regression equation obtained for *U. sulphureus* in Safaga Bay is: $\log W = -4.385 + 2.890 \log L$. The results indicate closely the cubic law (n = 2.89) for isometric growth of *U. sulphureus* in Safaga Bay of the Red Sea.

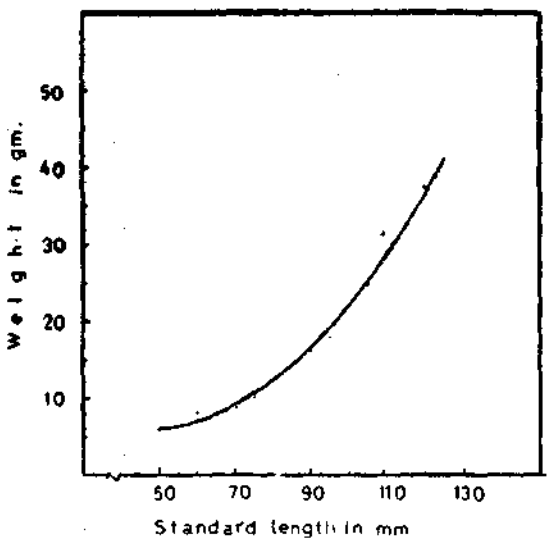

Fig. 1. Length-weight relationship of *U. sulphureus*.

Relative condition

The relative condition or ponderal index (Table 1) of *U. sulphureus* was estimated by using the equation : $K_n = \frac{W}{w'}$ where W = observed weight, w' = mean weight of each size group calculated from the length-weight relationship and K_n is the mean calculated K values. Weatherly (1972) noticed that this equation is suitable for the investigation of seasonal changes in condition and for maturation studies. The fish under investigation occur in their fishery ground seasonally, and by applying the previous equation on the collected data, good results were obtained and clearly show the well-being (K_n = 1.03) of *U. sulphureus* in its natural habitat.

Food and feeding habits

A. *Food contents* : 122, 306, 238 and 84 fishes of *U. sulphureus* were analysed for 1st, 2nd, 3rd and 4th migration respectively. As the gut analyses revealed, the food contents were as given below.

Annelid worms : The annelid worms represent the major food item constituting 75.09% 80.08%, 77.90% and 78.08% respectively in four migrations. Polychaete worms were the most constituents of the annelid and represented by the families: Nereidae and Syllidae. Other annelid worms from the families : Arenicolidae, Hermellidae and Terebellidae were met with through the stomach analyses.

Crustaceans : Benthic crustaceans formed the next main food item in the stomach contents constituting 13.37%, 14.30%, 12.66% and 10.88% respectively in the four migrations. The identifiable individuals were mainly from the families : Peneidae, Isoteidae, Calanoidae, Caprellidae, Cancridae, Leucosiidae, Portunidae and Pilumnidae (mud crabs).

Molluscs : Different small sized molluscan individuals particularly those of Gastropoda and Pelecypoda were found in the fish stomachs and constituted the third group of food items. The individuals were represented by 7.76%, 3.53%, 5.06% and 7.16% respectively in the four migrations. The identifiable families were : Arcidae (*Arca* spp.), Pectinidae (*Pecten* spp.), Mytilidae (*Mytilus* and *Modiolus* spp.) Veneridae (*Venus* spp.), Ostreidae (*Ostrea* spp.), Cardiidae (*Cardium* spp.) and Littorinidae (*Littorina* spp.).

Miscellaneous matter : This group of food items was found as benthic planktonic organisms, fish eggs and larvae, foraminifera, fragments of algae, fungi and bacteria. These organic matters constituting : 2.0%, 1.05%, 2.26% and 2.19% respectively in the four migrations.

Inorganic particles : This item was constituted of sand and mud particles and occurred in most analysed stomach contents. The presence of these particles may serve as triturating grit or additional nutritional factor and hence the fish engulf them with their food.

B. *Feeding intensity: Upeneus sulphureus* is known to migrate four times (15–20 days intervals) on and offshore to feed and spawn. The migrations usually occur from April to August and coincide with the lunar periodicity. The intensity of feeding (Table 3 and Fig. 2) were varied according to the time and kind of migration. In the first migration (feeding migration), all fishes were in start feeding and from 122 analysed stomachs, 2.45% were full, 16.39% were $\frac{3}{4}$ full, 36.89% were $\frac{1}{2}$ full and 44.26% were $\frac{1}{4}$ full. Empty stomachs were not observed in that period.

In the second migration (feeding migration), 306 stomachs were analysed and the results indicated the absence of $\frac{1}{4}$ full and empty stomachs. The other stomach categories were 50.00% full, 29.41% $\frac{3}{4}$ full and 20.59% $\frac{1}{2}$ full.

In the third migration (spawning migration), 238 stomachs were analysed and showed 3.36% $\frac{1}{2}$ full, 23.11% full and 73.53% empty stomachs. The presence of the high percentage of empty stomachs in that migration is due to the attainment of sexual maturity.

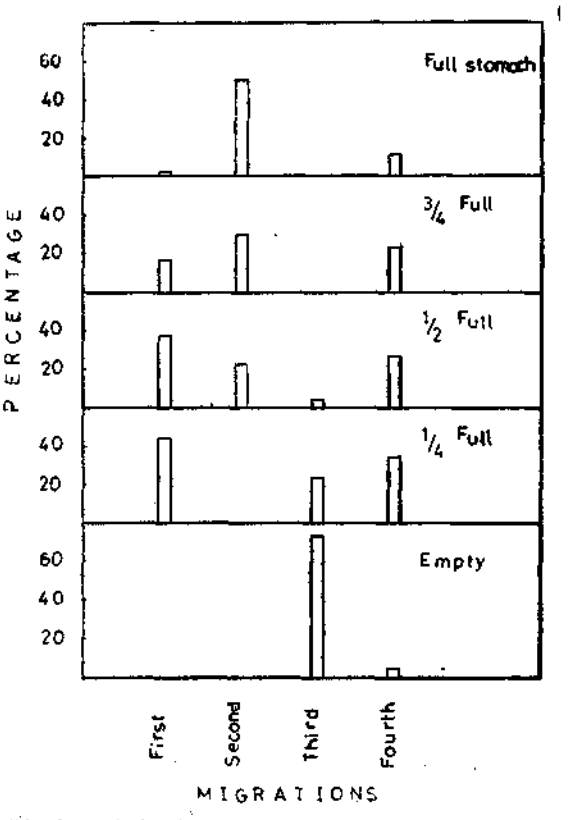

Fig. 2. Variation in feeding intensity of *U. sulphureus*.

In the fourth migration which considers as feeding and recovery migration, 84 stomachs were analysed, from these stomachs, 10.71% were full, 22.62% were $\frac{3}{4}$ full, 26.19% were $\frac{1}{2}$ full, 35.71% were $\frac{1}{4}$ full and 4.76% were empty stomachs.

It has to emphasise that *U. sulphureus* in Safaga Bay feeds intensively in the first and second migrations, then its ability to take food

TABLE 1. *Length-weight relationship and the relative condition factor (K_n) of U.* sulphureus

Std. L. (mm)	No. of fish	Empirical Wt. (g)	Calculated Wt. (g)	Relative condition (K_n)
50	20	6.0	3.35	1.79
55	31	7.5	4.42	1.69
60	26	7.8	5.68	1.37
65	22	8.0	7.16	1.12
70	29	8.2	8.87	0.92
75	38	10.0	10.82	0.92
80	50	12.4	13.04	0.95
85	46	14.0	15.54	0.90
90	54	16.2	18.32	0.88
95	62	17.9	21.42	0.82
100	70	22.1	24.85	0.89
105	75	24.6	28.62	0.86
110	68	28.0	32.73	0.86
115	50	29.3	37.22	0.79
120	67	37.7	42.10	0.90
125	42	41.1	47.36	0.87
			mean K_n	1.03

The logarthmic regression equation of *U. sulphureus* :

$$\log c = \frac{\Sigma \log W \times \Sigma (\log L)^2 - \Sigma \log L \times \Sigma (\log L . \log W)}{N \times \Sigma (\log L)^2 - (\Sigma \log L)^2}$$

$$= \frac{18.9037 \times 59.5382 - 30.8145 \times 36.9627}{16 \times 59.5382 - 949.5334}$$

$$= \frac{-13.494848}{3.0778} = -4.3846$$

$$n = \frac{\Sigma \log W - N \times \log c}{\Sigma \log L}$$

$$= \frac{18.9037 - 16 \times -4.3846}{30.8145}$$

$$n = 2.890$$

decreased and empty stomachs were found, this indicate the fish fasting during the third migration (spawning migration). The fish then feeds intensively in the fourth migration to face the recovery period.

C. *Selective feeding:* The annelid worms constitute more than 75% from all the analysed stomachs in the four migrations. In all cases of food analyses, polychaetes were the dominant annelid worms. The Table also shows that crustacean and molluscan organisms were the next food items.

Discussion

Upeneus sulphureus Cuv. & Val. has great importance among the economic fishes of Safaga Bay of the Red Sea. The fish are known to migrate in the summer time on and offshore to feed and spawn.

For the length–weight relationship of *U. sulphureus*, the equation $W = c\ L^n$ and its log–log transformation: $\log W = \log c + n \log L$ were used. The results obtained are given in Table 1 and Fig. 1 and its logarithmic equation is: $\log W = -4.385 + 2.89 \log L$. It can be seen from the equation that the value of the constant (n) equals 2.89 and this means that the weight increased at a role equals to the cube of its length.

The relative condition K_n could be used as an indicator to show the well–being of fish, its relative robustness and suitability of habitat. The estimated data given in Table 1 indicated that the value of K_n ranged between 0.79 and 1.79 with a mean value 1.03 and that means the well–being of the fish in its habitat.

Study of food and feeding habits is of practical importance in understanding the fishery biology of the fish and also the characters of its natural habitat.

As seen from the results, it could say that *Upeneus sulphureus* in Safaga Bay feeds mainly on Annelid worms (77.78%); Crustacea (12.8%); Mollusca (5.87%) and miscellaneous organisms (1.88%). The inorganic contents were found in all the analysed stomachs and represented by 1.67%. Wood (1964) noted that the fine particles within food have the ability to absorb materials containing nitrogen, carbon, phosphate, bacteria and protozoa. The study also indicated that the fish under investigation feeds Intensively in the first, second and fourth migrations (feeding migrations) and take little food in the third migration (spawning migration). The percentage occurrence of the diet contents show that the fish selects its food from the bottom living organisms and the first preferable food item was the annelid worms and in particular the polychaetes. Crustaceans and molluscs came respectively as second and third preferable food items.

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