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A Study of Morphometric Relationships and Age and Growth of *Upeneus sulphureus* Cuvier of the Bombay Coast

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Relationships between 18 morphometric characters, variations in 6 meristic characters and age and growth of *U. sulphureus* of Bombay coast have been studied. Compared morphometric characters showed positive allometric growth and high degree of correlation between each other. A comparison of three variable meristic characters of the specimens of Bombay coast with those of specimens from Mandapam coast and Indo-Pacific region showed significant variations in the number of gillrakers and lateral line scales whereas no significant variation could be observed in the number of pectoral fin rays. Length frequency study of specimens of Bombay coast indicated a growth of 11.0, 14.0, and 15.5cm at the end of 12, 18 and 24 months respectively. It also indicated that the fishery of *U. sulphureus* of Bombay coast is constituted by the specimens ranging in size from 95 to 205mm in which 135mm size was dominant. 3%, 78% and 19% of the fishery were constituted by 0, 2 and 2+year groups of fishes respectively.

Key Words: *Upeneus sulphureus*, **Morphometric characters, Age and growth, Bombay**

Introduction

A study of the morphometric and meristic characters is necessary for identification of the populations of a particular species in different regions. The population in a place may be migrating to different places and appear at different times. Study of age and growth through any convenient method is absolutely necessary to know the fishery potentiality of that species. Knowledge on these biological aspects give an insight of the fishery and helps in judicial management and rational exploitation.

Upeneus sulphureus is landed in bulk, in association with Nemipterids, during the months January to October in Sassoon Dock, Bombay. At Bombay this fish is sold at a moderate price to be consumed fresh, otherwise it is sundried alongwith miscellaneous smaller varieties of fishes. Total landing of *upeneus* spp. from Indian Ocean region 51 and 57 during the period of 1973-76 ranged from 2637 to 6249 mt on an average of 4,550 mt/yr. (FAO 1976).

A few scientists (Al Hussaini 1946,

Gottlieb 1953, Herre & Montalban 1928, Marr (1955) and Wirszubski (1953), have worked on some of the aspects of the fishes of this genus. Recently Sithamparam and Dwivedi (1983) has contributed on the morphometry of *U. molucensis* of Bombay coast. Thomas (1969) has studied the morphometric characteristics of 50 specimens of this species from Mandapam region. Reference of any work on the biology of this species except on length weight relationship and Ponderal Index (Acharya & Bhattacharya 1983), from Bombay region, is wanting. Keeping these in view, work on the biology of this fish has been undertaken. Present paper deals with the morphometry and length frequency studies of this species.

Materials and Methods

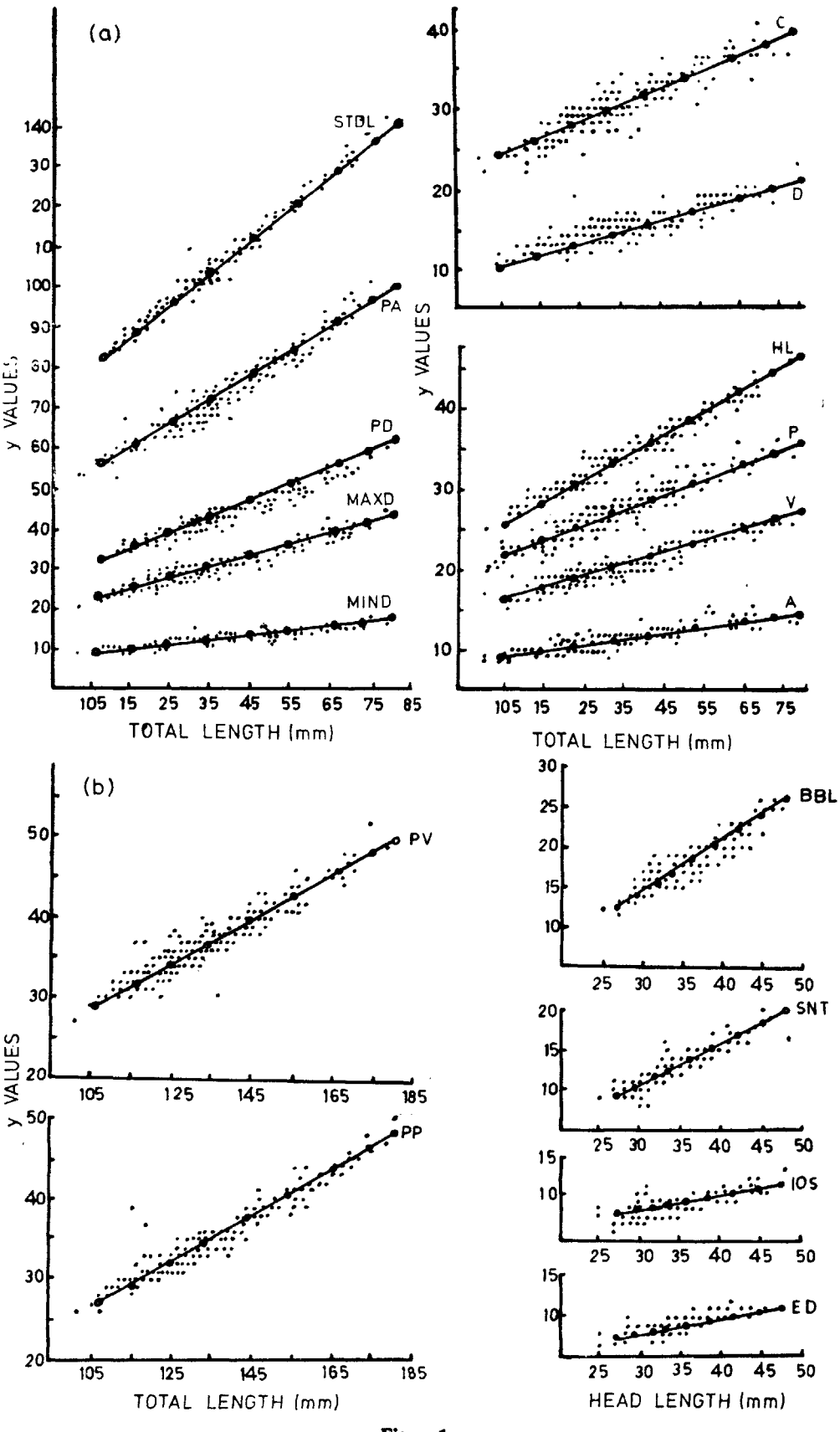
Specimens numbering 180 ranging in size from 101 to 180mm and in weight from 11.6 to 83.5g collected from Sassoon Dock, Bombay, were utilised for the study of 18 metric and 6 meristic characters. Standard methods, described by Snedecor (1946), La evestu (1965), and adopted by Dwivedi and Menezes (1974), were followed in the present studies.

To determine age and growth, attempts were made to read annuli on the scales collected from the region above the bases of the pectoral fins and on the left sagitta of the specimens but the scales were not found convenient. Consequently, Peterson's method of length frequency study as described by Ricker (1968) was followed. Total length data of 2,741 fishes in total, collected thrice in a month from Sassoon Dock, Bombay, during the same period (April 1977 to May 1978) were converted into monthwise length frequency polygons for study.

Results and Discussions

Morphometric characters, compared against total length, are standard length (STDL), Pre Anal length (PA), Pre Dorsal length (PD), Pre Ventral length (PV), Pre Pectoral length (PP), Maximum depth (MAXD), Minimum body depth (MIND), Head length (HL), Caudal fin length (C), Pectoral fin length (P), Ventral fin length (V), Dorsal fin length (DL) and Anal fin length (A); whereas Barbel length (BBL), Snout length (SNTL), Inter Orbital space (IOS) and Eye diameter (ED) were compared against the Head length. Figure 1a, b represents the regressions of these characters obtained by least square method against total length and Head length respectively, indicating that all the morphometric characters examined has proportionate positive allometric growth. The rate of growth of individual character in length in respect of total length is highest in case of STDL followed by PA, PD, PV, PP, HL, MAXD, C, P, V, DL, MIND and A respectively. In respect of Head length, BBL has the highest rate of growth followed by SNTL, IOS and ED. The figure indicates that the fish continues to retain its specific body shape throughout its life. This is in conformity with the *b* value obtained for length-weight relationship of the species (*b* value for males 3.0454 and that for females 2,9322, Acharya & Bhattacharya 1983) High *r* values (table 1) ranging 0.9734—0.9996 obtained against each of these characteristics indicate that high degree of correlation exists in between each of the compared characters.

Meristic characters examined are number of spines and rays in two dorsals, pectoral, ventral and anal fins; number of Gillrakers on the first gill arch of the left side and number of lateral line scales. Maximum variation was observed in the case of number of gill rakers, ranging 21–31 nos, number of lateral line scales ranging 34–40 nos, and number of rays in pectoral fin ranging 13–17 nos. 100% of the Anal fins were composed of one spine and six rays (i6) and the ventral fins of one spine and 5 soft rays (i5) respectively. Out


(a)
STDL
PA
PD
MAXD
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y VALUES
TOTAL LENGTH (mm)
C
D
HL
P
V
A
TOTAL LENGTH (mm)
(b)
PV
PP
y VALUES
TOTAL LENGTH (mm)
BBL
SNT
IOS
ED
HEAD LENGTH (mm)

Figure 1

of 180 specimens observed, 2 dorsal fins of 97.77% (176 nos) were composed of one small, 7 big spines and 8 rays (1/7/8); 1.66% (3 nos) had one small, 7 big spines and 7 rays (1/7/7); 0.55% (1 no.) had one small, 6 big spines and 8 soft rays (1/6/8). These variations being very negligible and may be inflicted by accidental deformity, have not been taken into consideration. Table 2 shows range, mode, mean, mean ± standard error, standard deviation and coefficient of variation in gill rakers, lateral line scales and pectoral fin rays. The study indicates that apart from the specific colouration mentioned earlier, the maximum number of specimens of *U. sulphures* of Bombay region bear the following meristic characters. D 1/7/8, P 3–17, V 1/5, A 1/5, LL 34-40 and Gill rakers 21–30. A comparative study of these variable characters made by analysis of variance technique indicated no significant variation in the number of pectoral fin rays, as obtained from the specimens of Indo-Pacific region (Lachner 1954, 1960), Mandapam region (Thomas

Table 1 *a, b, and r values of various morphometric characters compared with total length and head length*

Sr.	Characters	*a* value	*b* value	Coefficient of correlation (*r*)
1.	COMPARED WITH TOTAL LENGTH			
	Standard length	(—) 3.1098	0.8014	0.9996
	Pre Anal length	(—) 6.7536	0.5896	0.9948
	Pre Dorsal length	(—) 7.08	0.3746	0.9918
	Pre ventral length	(—) 0.8378	0.2832	0.9986
	Pre Pectoral length	(—) 3.7093	0.2890	0.9929
	Maximum Depth	(—) 5.5485	0.2698	0.9991
	Minimum Depth	(—) 2.5265	0.1095	0.9898
	Head length	(—) 3.0698	0.2765	0.9959
	Caudal length	3.0163	0.1974	0.9910
	Pectoral length	2.6687	0.1828	0.9889
	Ventral length	0.4509	0.1483	0.9980
	Dorsal length	(—) 3.9348	0.1393	0.9734
	Anal length	1.9927	0.0700	0.9831
2.	COMPARED WITH HEAD LENGTH			
	Barbel length	(—) 4.7200	0.6419	0.9889
	Snout length	(—) 4.0840	0.4921	0.9921
	Inter orbital space	(—) 0.9604	0.2980	0.9966
	Eye diameter	2.4600	0.1880	0.9729

Table 2 *Details of variable meristic characters*

Character	Range	Mode	Variance	Variance (mean)	Standard error	Mean	Mean	Standard Division	Coefficient of variance
Gill raker N = 180	21+31	27	7.1437	0.0396	0.1992	26.7611	0.3904	2.6727	9.9875
Lateral line Scale N = 178	34—40	37	1.1915	0.0066	0.0812	36.9213	0.1591	1.0915	2.9562
Pectoral fin rays N = 180	13—17	16	0.3775	0.0020	0.0458	15.889	0.0458	0.6144	3.866

1969) and Bombay region (present study); (table 3). Whereas the number of gill rakers and the number of lateral line scales of the specimens of these three regions varied significantly.

A preliminary study of the cumulative totals of percentage frequencies of the 12 length classes on probability paper indicated probable growth of fish at the end of 12, 18 and 24 months as 107, 135 and 148mm respectively at the 50% level. Further studies for more accurate results by ploting modal values of the length frequency polygons (figures 2 & 3) against the months of observations and drawing a curve through the mid points of the modal values extended up to 0 point revealed (approximately the same results) growth rates 110, 140 and 155mm at the end of 12, 18 and 24 months respectively. Figure 4 indicates that the month of April 1977, corresponds to 11.0cm and counting from '0' month, April 1977 corresponds to 12th month, i.e. the fish has a growth of 11.0cm in one year. In the same way the month of April, 1978 corresponds with 15.5cm i.e. the fish grows to 15.5cm in two year At the end of $1\frac{1}{2}$ year, in the month of October, 1977 it attains a length of 14.0cm. Thus it shows that the fish grows at a very fast rate (11.0cm) at the first year of its life time and the growth drastically reduces in the next year to 4.5cm only. Such type of disproportionate growth in fishes are not uncommon. Thomas (1969) has reported growth of *U. tragula* Richardson from Palk Bay and Gulf of Mannar region as 12cm in the first year and 14cm at the end of the 2nd year. The largest specimen encountered at Sassoon Dock, Bombay during the entire period of study was a 180mm female. It appears that specimens beyond this size and above +2 years either faces normal mortality or migrate to deeper areas beyond the reach of fishing gears. However due to continuous appearance of new recruits because of

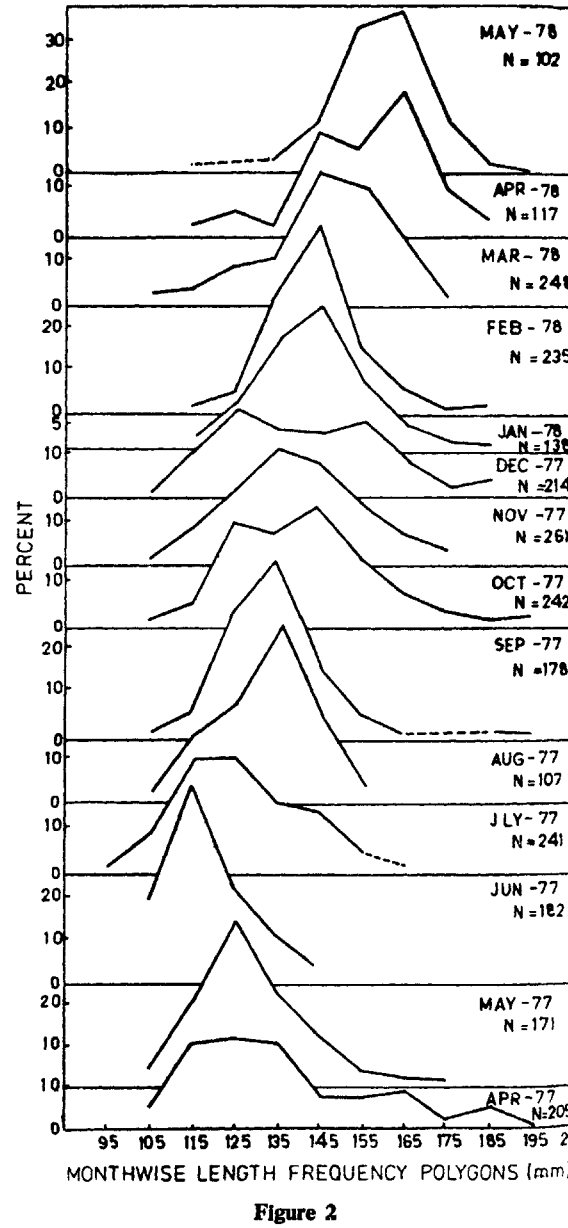

Figure 2

Table 3 *Variable meristic characters of* U. sulphureus *from three different regions*

Characters and region	No. of speci-mens	Range	Mean	SD	Std. error	M+2 SE of Mean	M—2 SE of Mean	F test
1. GILL RAKERS								
Indo-Pacific	43	26-32	29.35	1.38	0.21	29.77	29.83	Differ significantly
Mandapam	50	25-31	27.98	1.48	0.21	28.40	27.56	
Bombay coast	180	21-31	26.76	2.67	0.19	26.95	26.57	
2. PECTORAL RAYS								
Indo-Pacific	58	15-17	15.74	0.54	0.07	15.88	15.60	No significant difference
Mandapam	50	15-17	15.88	0.52	0.12	16.12	15.64	
Bombay coast	180	13-17	15.88	0.61	0.04	15.96	15.80	
3. LATERAL LINE SCALES								
Indo-Pacific	44	34-37	35.41	0.83	0.13	35.67	35.15	Differ significantly
Mandapam	75	35-37	36.13	0.60	0.07	36.27	35.99	
Bombay coast	178	34-39	36.92	1.09	0.08	37.08	36.77	

repeated spawning or protracted spawning season of the fish there is frequent overlaping of the modes in the length frequency polygon. It is therefore suggested that there is a necessity of studying age and growth of this species over a longer period of time for more accurate result.

Percentage frequency polygon of the pooled data of each length class (figure 4) for the entire period of investigation indicates that *U. sulphureus* fishery of the Bombay coast is supported by the fish ranging 95–205mm in length, in which fish of 135mm length group dominates. Length of the fish being 11.0cm in 0 year and 15.5cm the 2nd year, (figure 4) indicates that 3% of the fishery belongs to '0' year, 78% to 2 year and 19% to 2+ year age groups.

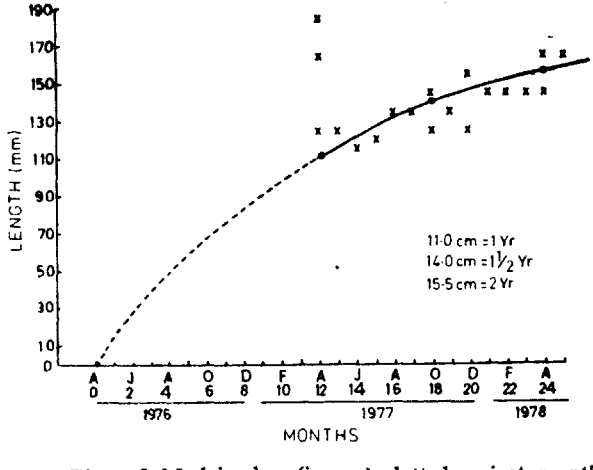

Figure 3 Modal values (in mm) plotted against month of observation

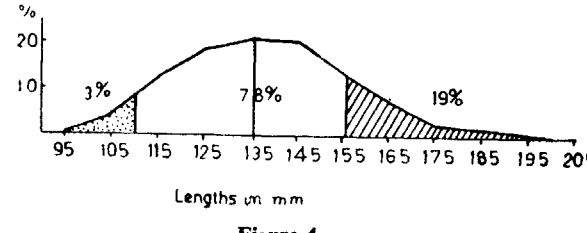

Figure 4

References

Al-Hussaini A H 1946 The anatomy and histology of the alimentary tract of the bottom feeder *Mulloides auriflamma* (Forskal); *J. Morph.* **78** 123–153

Acharya P and Bhattacharya D 1983 A note on the length weight relationship and Ponderal Index of *Upeneus sulphureus* cuvier of the Bombay coast; *Geobios New Reports* **2** 101–105

Dwivedi S N and Menezes M R 1974 A note on the morphometry and ecology of *Brachionous orientalis* (Bloch and Schenider) in the estuary of Goa; *Geobios* **8** 80–83

Gottlieb E 1953 On the biology of *Mulloides auriflamma*; *Information Bull Fishermens Union Haifa* **15** 5 pp

—— 1956 The age and growth of the red mullet *Mullus barbatus* L. in Israeli waters; *Sea Fish. Res. St. Bull.* **12** 20 pp

—— 1957 Age and growth studies of the yellow striped mullet *Upeneus molucensis*; *Fishermen's Bull. Haifa* 2 13–20

Herre A W C T and Montalban H R The goat fishes or Mullidae, of the Phillippines, *Phillippine*; *J. Sci.* **36** 1–6

La evestu T 1965 *Manual of Methods in Fisheries Biology fascicules* (Rome: FAO) pp 1, 2, 9 & 10

Marr J C 1955 The use of morphometric data in systems racial and relative growth studies in fish; *Copeia.*, **1** 23–31

Ricker W E 1968 *I.B.P. Handbook No.* 3 pp 106–108 and 162–163 (Oxford, Edinburg: Blackwell Scientific Publication)

Snedecore C K 1946 Statistical method applied to experiments in agriculture and biology; *Ames Iowa*

Sithamparam S and Dwivedi S N 1982 Morphometry of *Upeneus moluccensis* (Bleeker) found along the Bombay coast; *Proc. Indian natn. Sci. Acad.* **B48** 623–627

Thomas P A 1969 The goat fishes (family mullidae) of the Indian seas; *CMFRI Memio.* **3**

Wirszubski A 1953 On the biology and biotope of the red mullet *Mullus barbatus* L.; *Sea Fish Res. St. Bull.*, **7** 1–20