EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 9/ December 2014

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Studies on the Relative Growth of *Mugil cephalus (Linnaeus, 1758)* from Interu Swamp at Krishna Estuarine Region of Andhra Pradesh, India

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Abstract:

The current study was focused on the relative growth of body parts in relation to body size in Mugil cephalus at Krishna estuarine region, east coast of Andhra Pradesh, India, for this study 110 specimens with length range 36 to 370mm were collected from the fish market at Bantumilli. The growth partition constant 'k' values were tabulated for the identification of Bradyauxesis, Tachyauxesis and Isoauxesis in 9 different parameters. The partition constant 'k' value was calculate by using the formula $Y = bx^k$ for 9 different parameters. The investigation of the study revealed that the observed the 'k' values for different parameters were recorded as Bradyauxesis (k <1), Tachyauxesis (k>1) and Isoauxesis (k=1) respectively.

Key words: *Mugil cephalus*, Bradyauxesis, Tachyauxesis and Isoauxesis

Introduction

Study of the rate of growth of different body parts in relation to the body size forms an interesting component of the individual

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growth [1]. Each body part, during the ontogeny of the fish, grows at a particular rate. Biological changes affecting the individuals during different growth stanzas bring about changes in the relative growth rates of the body parts. Within each growth stanza of a fish, the different body parts may grow at different rate. In the present study, the relative growth of different body parts in the stocks of *M. cephalus* from Enteru swamp is calculated.

Huxley [2] proposed the exponential formula to describe the relative growth rate of the different body parts in relation to the body size.

$$Y = bx^k$$

Where, Y = the body part measured
x = standard length
k = growth partition constant
b = intercept

Martin [3] applied this formula in his studies on fish. Later Graham [4], have successfully used the formula to describe the relative growth rates of the body parts in fish.

Length-weight relationships (LWRs) and length-length relationships (LLRs) are still scarce for most tropical and sub-tropical fish species [5, 6, 7, 8, 9].

In the present work the terminology introduced by Huxley et al.,[10] was adopted to describe the ontogenic growth. The term "Bradyauxesis" is used when a body part grows relatively slower ($k < 1$), than that of the body and the term. "Tachyaxesis" is used when the body part grows relatively faster ($k > 1$) than the body. These two cases are referred to as "allometric growth" by different workers [11]. When the growth rates of the body part and that of the body are equal ($k = 1$) the term "Isoauxesis" is used to describe the relative growth. This is a case of isometric growth.

Materials and Methods

For the study of the relative growth rate of different body parts 110 specimens of *Mugil cephalus* in the length range 36 to 370 mm TL. Collected during the present study from the fish market at Bantumilli were utilized. Each specimen was measured for its total length, standard length and the length of the different body parts are measured accurately using a fish measuring board and with the help of calipers. Data collected from individuals is grouped in to 1 cm size groups. Length of the each individual is represented on a graph paper along with the body part.

Relative growth of each body part is estimated by using the formula.

$$Y = bx^k$$

The Geometrical Mean (GM) functional regression was estimated as suggested by Ricker [6] [table- 1).

In the present study relative growth of the following body parts in relation to standard length was calculated.

1. Head length
2. Body depth
3. Pectoral fin length
4. Ventral fin length
5. Pre first dorsal distance
6. Pre second dorsal distance
7. Pre pectoral distance
8. Pre ventral distance
9. Pre anal distance

The relative growth of the following body parts in relation to head length was calculated.

1. Snout length
2. Eye diameter
3. Interorbital distance

The growth partition constant 'k' for each body part, value of the intercept 'b' and the correlation coefficient ' r ' are presented in (table.1)

Table 1. The regression and intercept values, correlation coefficient and 'k' value for the different body parts *M. cephalus*

Sl. No.	Body Parts	Intercept 'a'	Regression 'b'	Correlation Coefficient 'r'	Growth partition constant 'k'
1.	Head length	2.259526	0.237444	0.932	0.245
a.	Snout length	0.877433	0.263857	0.907	0.276
b.	Eye diameter	2.784036	0.183105	0.829	0.201
c.	Interorbital distance	-0.18176	0.429516	0.973	0.448
2.	Body depth	6.953601	0.910925	0.769	1.03
3.	Pre - first dorsal fin distance	7.616178	1.877026	0.926	1.951
4.	Pre - second dorsal fin distance	6.225769	2.884735	0.914	3.016
5.	Pre-pectoral fin distance	3.578442	1.013068	0.916	1.058
6.	Pre-ventral fin distance	3.60238	1.478273	0.838	1.615
7.	Pre-anal fin distance	4.622708	2.783863	0.84	3.025
8.	Pectoral fin length	3.249836	0.630764	0.902	0.663
9.	Ventral fin length	4.732859	0.557899	0.880	0.593
10.	Base of anal fin	1.52145	0.427211	0.877	0.456
11.	Height of anal fin	3.736092	0.441112	0.787	0.497

Results

Head length

Head length expressed as percentage of standard length ranges between 20.8 and 36.4 ($\bar{x}$: 27.6). The growth partition constant (k = 0.243) suggests that the rate of growth of head

length is slower in comparison with that of the standard length indicating 'Bradyauxesis' (Fig.1).

Snout length

Snout length expressed as percentage of standard length ranges between 10.8 and 41.6 ($\bar{x}$: 28.9). The growth partition constant (k = 0.276) indicated 'Bradyauxesis' indicating that the rate of growth of snout length slightly slower, in comparison with that of head length (Fig.2).

Eye diameter

Diameter of the eye expressed as percentage of standard length ranges between 10.8 and 33.8 ($\bar{x}$: 25.7). The growth partition constant (k = 0.201) showed 'Bradyauxesis' indicating that the rate of growth of eye diameter slightly slower in comparison with that of head length (Fig.3).

Interorbital distance

Inter-orbital distance as percentage of standard length ranges between 11.8 and 51 ($\bar{x}$: 25.7). The growth partition constant (k = 0.448) indicates showed 'Bradyauxesis' indicating that the rate of growth of interorbital distance slower in comparison with that of head length (Fig.4).

Body depth

Body depth expressed as percentage of standard length ranges between 23 and 36.4 ($\bar{x}$: 27.6). The growth partition constant (k = 1.03) showed 'Tachyauxesis' indicating its faster rate of growth in comparison with that of the body growth (Fig.5).

Pectoral fin length

Pectoral fin length expressed as percentage of standard length ranges between 16.6 and 56.1 ($\bar{x}$: 24.7). The growth partition constant (k = 0.663) indicated "Bradyauxesis' the rate of growth

of pectoral fin is slower in comparison with that of body growth (Fig.6).

Ventral fin length

Ventral fin length expressed as percentage of standard length ranges between 15.5 and 54.3 ($\bar{x}$: 21.1). The growth partition constant (k = 0.593) showed 'Bradyauxesis' indicated that the rate of growth is slightly shower in comparison with that of the standard length (Fig.7).

Pre first dorsal distance

Pre first dorsal distance expressed as percentage of standard length ranges between 49.6 and 62.1 ($\bar{x}$: 53.8). The growth partition constant (k = 1.951) showed 'Tachyauxesis' indicating that the rate of growth of distance before the pre first dorsal distance in faster in comparison with that of standard length (Fig.8).

Pre second dorsal distance

Pre second dorsal distance as percentage of standard length ranges between 73.5 and 89.9 ($\bar{x}$: 29.3). The growth partition constant (k =3.016) showed 'Tachyauxesis' indicating that the rate of growth is faster in comparison with that the standard length (Fig.9).

Pre pectoral distance

Pre pectoral distance expressed as percentage of standard length ranges between 26 and 39.5 ($\bar{x}$: 29.3). The growth partition constant (k = 1.058), showed 'Tachauxesis' indicating that the rate of growth is faster in comparison with that of the standard length (Fig.10).

Pre ventral distance

Pre ventral distance expressed as percentage of standard length ranges between 28.2 and 49.6 ($\bar{x}$: 39.7). The growth partition

constant (k = 1.615), showed 'Tachyauxesis' indicating that the rate of growth distance before the origin of II dorsal is faster in comparison with that the standard length (Fig.11).

Pre anal distance

Pre anal distance expressed as parentage of standard length ranges between 72.1 and 83.4 ($\bar{x}$: 75.8). The growth partition constant (k = 3.025). Showed 'Tacyauxesis' that the rate of growth of pre anal distance is faster in comparison with that of standard length (Fig.12).

Base of anal fin

It is expressed as percentage of standard length ranges between 10.6 and 16.2 ($\bar{x}$: 12.2). The growth partition constant (k = 0.456) showed 'Bradyauxesis' indicating that the rate of growth of base of anal fin distance is slower in comparison with that of body growth (Fig.13).

Height of anal fin

It is expressed as percentage of standard length ranges between 11.6 and 18.6 ($\bar{x}$: 14.5). The growth partition constant (k = 0.497) showed 'Bradyauxesis' indicating that the rate of growth of height of anal fin distance is slower in comparison with that of body growth (Fig.14).

The above analysis indicates that of the fourteen body parts studied for relative growth, the following : head length, eye diameter, snout length, interorbital distance, length of pectoral fin, length of ventral fin, base of anal fin, height of anal fin, showed ' Bradyauxesis'. While body depth, pre first dorsal distance, pre second dorsal distance pre pectoral fin, pre ventral fin exhibited 'Tachyauxesis'.

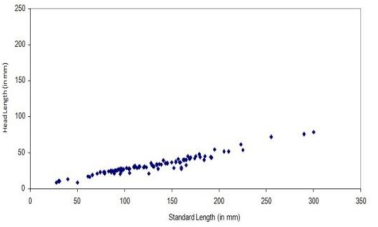

Fig .1. Scatter diagram showing the relationship between standard length and head length of *M. cephalus*

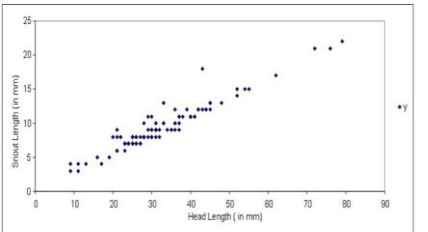

Fig. 2. Scatter diagram showing the relationship between head length and snout length of *M. cephalus*

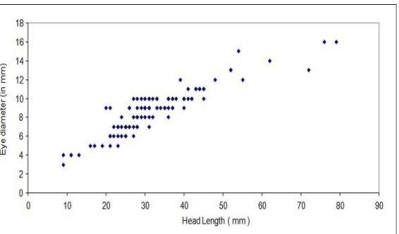

Fig.3. Scatter diagram showing the relationship between head length and eye diameter of *M.cephalus*

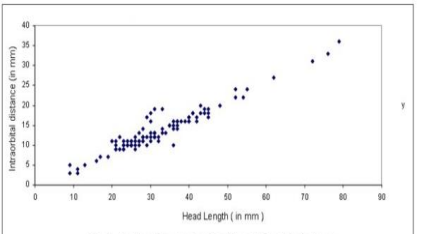

Fig. 4. Scatter diagram showing the relationship between head length and interorbital distance of *M. cephalus*

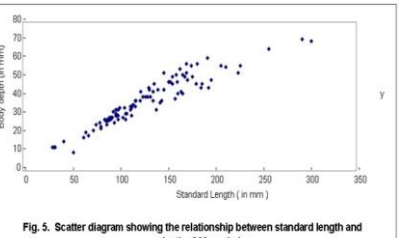

Fig. 5. Scatter diagram showing the relationship between standard length and depth of *M. cephalus*

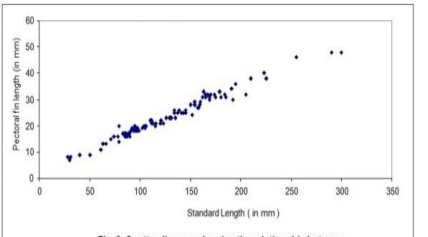

Fig. 6. Scatter diagram showing the relationship between standard length and pectoral fin length of *M. cephalus*

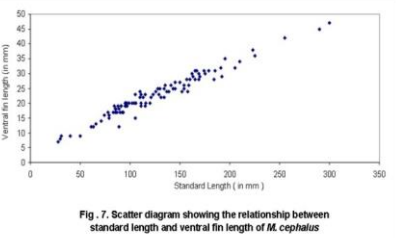

Fig . 7. Scatter diagram showing the relationship between standard length and ventral fin length of *M. cephalus*

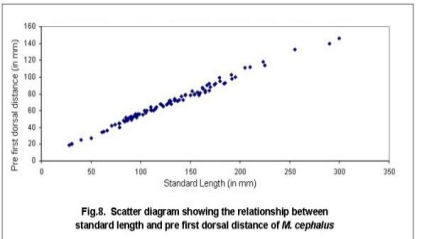

Fig.8. Scatter diagram showing the relationship between standard length and pre first dorsal distance of *M. cephalus*

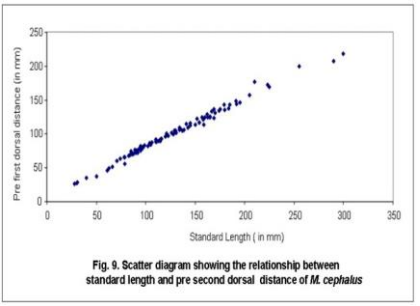

Fig. 9. Scatter diagram showing the relationship between standard length and pre second dorsal distance of *M. cephalus*

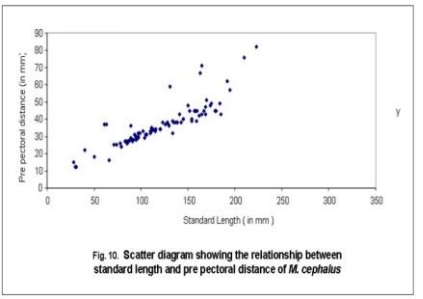

Fig. 10. Scatter diagram showing the relationship between standard length and pre pectoral distance of *M. cephalus*

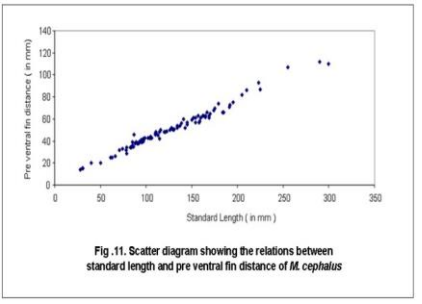

Fig .11. Scatter diagram showing the relations between standard length and pre ventral fin distance of *M. cephalus*

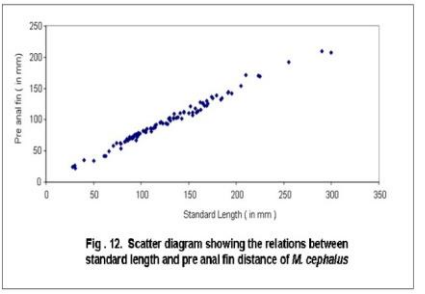

Fig . 12. Scatter diagram showing the relations between standard length and pre anal fin distance of *M. cephalus*

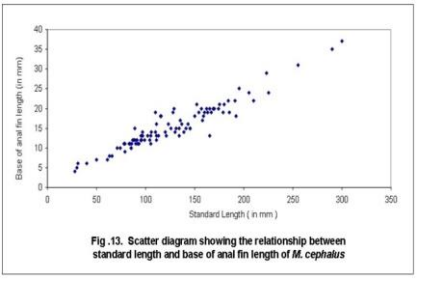

Fig .13. Scatter diagram showing the relationship between standard length and base of anal fin length of *M. cephalus*

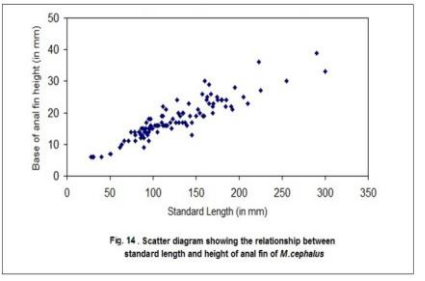

Fig. 14 . Scatter diagram showing the relationship between standard length and height of anal fin of *M.cephalus*

Discussion

The present study was conducted in the Krishna estuary, East coast of Andhra Pradesh, India. According to [12] the small indigenous fish species (SIS), which are defined as species attaining a maximum length of 5-25 cm contribute considerably to total fish intake. The morphometric relationships between length and weight can be used to assess the well-being of

individuals and to determine possible differences between separate unit stocks of the same species [13].

Information regarding on the relative growth of body parts in Mugil cephalus from the krishana estuary was the first attempt from India. Our study interested to focused on Growth partition constant "r" in Mugil cephalus, the r values were mentioned (Table No:1) to evaluate in terms of Bradyauxesis (k <1) , Tachyauxesis (k>1) and Isoauxesis (k=1). 9 different body parts taken into consideration for evaluate the k values. Head length (0.245) (Snout length (0.276), Eye diameter (0.201), inter orbital distance (0.448)), Length of Pectoral fin (0.663), length of ventral fin (0.593), Base of anal fin (0.456), Height of anal fin (0.497) were comes under Bradyauxesis.

Body depth (1.03, r>1), Free first dorsal distance (1.951, r>1), pre pectoral fin distance (1.058, r>1) were comes under Tachyauxesis and Pre second dorsal distance (k= 3.016) and pre anal fin distance (k= 3.025) were comes under Isoaxesis.

The calculated allometric coefficient b varied among the species from a minimum of 3.004 for A. morar, to a maximum of 3.758. These values are within the limits (2 and 4) reported by Tesch [14] for most fishes. In general and despite the many variations in fish forms between species, b is close to 3, indicating that fish grow isometrically; values significantly different from 3.0 indicate allometric growth [14]. Based on his observation we started to find out the relative length of Body parts in Mugilc ephalus, our results suggest that there was a similarity in 'r' values with previous studies on Fish by Tesch [14].

Conclusion

The current study revealed that the relative growth of body parts in Mugil ephalus at Krishan Esturian egion and we find out the 'k' values for Bradyauxesis (k <1), Tachyauxesis (k>1) and Isoauxesis (k=1). This was the first

report from Krishna Esturian region as per Mugil cephalus is concerned.

Acknowledgements
The authors are grateful to the Head, Department of Marine Living Resources, Andhra University, Visakhapatnam for providing laboratory facilities to carry out this research work.

REFERENCES

1. Weatherly A.H., 1972. Growth and ecology of fish populations Academic press, London and New York: 75 – 80.
2. Huxley, Julian S., 1932. Problems of relative growth. London: Methuen. pp. i – xix; 1 – 276.
3. Martin W.R., 1949. The mechanics of environmental control of body form in fishes. Univ. Toronto studies, Biol.Ser.no. 58: 1 – 91; Pub. Ont. Fish.Res. Lab.no.70.
4. Graham J.J., 1956. Observation on the Alewife, pomolobus pseudoharenqus (Wilson) in fresh water. Univ. of Toronto. Biol.Sec.No. 62: 42 p.
5. Harrison, T.D., 2001. Length–weight relationships of fishes from South African estuaries. Journal of Applied Ichthyology, 17: 46-48.
6. Ecoutin, J.M., J.J. Albaret, and S. Trape, 2005. Lengthweight relationships for fish populations of a relatively undistributed tropical estuary: the Gambia. Fisheries Research, 72: 347-351.
7. Hossain, M.Y., Z.F., Ahmed, P.M., Leunda, A.K.M.R., Islam, S., Jasmine, J., Oscoz, R., Miranda, and J. Ohtomi, 2006. Length-weight and length-length relationships of some small indigenous fish species from the Mathabhanga River, southwestern Bangladesh. Journal of Applied Ichthyology, 22: 301-303.

8. Hossain, M.Y. and Z.F. Ahmed, 2008. Some biological aspects of the river sprat Corica soborna (Pisces: Clupeidae) in the Mathabhanga River (SW Bangladesh). Fish Biology Congress Abstract, Portland, Oregon, USA: 1-114.
9. Hossain, M.Y., J. Ohtomi, Z.F., Ahmed, A.H.M. Ibrahim, and S. Jasmine, 2009. Length-weight and morphometric relationships of the tank goby Glossogobius giuris (Hamilton, 1822) (Perciformes: Gobiidae) in the Ganges of the northwestern Bangladesh. Asian Fisheries Science, 22(3): 961-969.
10. Huxley, Julian S., J. Needham and I.M. Lerner, 1941. Terminology of relative growth rates. Nature, 148 : 225.
11. Ricker W.E., 1979. Growth rate and models In Fish Physiology, eds. S. Hoar, D.J. Randal and J.R. Brett, New York, Academic press, VIII: 786p.
12. Ross, N., M. Islam, and S.H. Thilsted, 2003. Small indigenous fish species in Bangladesh: contribution to vitamin A, calcium and iron intakes. Journal of Nutrition, 133: 4021-4026.
13. King, M. 2007. Fisheries biology, assessment and management. Second Edition. Blackwell Scientific Publications, Oxford: 1-381.
14. Tesch, F.W., 1971. Age and growth. In: W.E. Ricker (Ed.), Methods for Assessment of Fish production in Fresh Waters. Blackwell Scientific Publications, Oxford: 99-130.