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MORPHOMETRIC STUDIES ON SUBADULT *LIZA SUBVIRIDIS* AND *SILLAGO SIHAMA* FROM SONMIANI BAY (MIANI HOR), BALOCHISTAN, PAKISTAN

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ABSTRACT

Length-weight relationship of *Liza subviridis* and *Sillago sihama* (Family: Mugilidae; Class: Pisces and Family: Sillaginidae; Class: Pisces) in subadults sampled from Somiani Bay Balochistan, Pakistan during 2002, 2003 and 2006 was analyzed. *Liza subviridis* showed positive allometry (3.23) in 2002, and negative allometry during 2003 (2.95) and 2006 (1.95). Sub adults of *Sillago sihama* showed positive allometry during 2002 (3.10) and 2003 (3.13). An isometric condition (3.02) was observed in the samples of *Sillago sihama* collected from Bhaira in 2006.

Keywords: Length-weight relationship, *Liza subviridis*, *Sillago sihama*, Sonmiani Bay

INTRODUCTION

The relationship between the length and weight of a fish is used by fisheries researchers and managers for two main purposes. First, the relationship is used to predict the weight from the length of a fish. This is particularly useful for computing the biomass of a sample of fish from the length-frequency of that sample. Second, the parameter estimates of the relationship for population of fish can be compared to average parameters for the region, parameter estimates from previous years, or parameter estimates among groups of fish to identify the relative condition or robustness of the population (Hussain, 2010). Moutopolous and Stergiou (2002) referred that length weight relationships have much importance while comparative studies of growth are taken up.

Nelson (1994) identified the mullets as most common species from tropical and temperate marine coastal waters that form a fundamental protein resource of coastal living human communities. There are many morphometric relationships through which growth and state of well-being of a particular individual or popula-

tion can be measured. Length-weight and length-length relationships are commonly used in various organisms. Many investigators have used length-weight relationships in fish stock assessment (Garcia *et al.*, 1989; Binohlan and Pauly, 1998; Haimovici and Velasco, 2000; Koutrakis and Tsikliras, 2003; Valle *et al.*, 2003; Ecoutin *et al.*, 2005; Fafioye and Olouja, 2005; Chu *et al.*, 2011). The management and exploitation of fish resources can be predicted by using length-weight relationships (Pervin and Mortuza, 2008).

The morphometric analysis is also useful for comparing life histories and morphological characteristics of populations' inhabiting different eco-regions (Goncalves *et al.*, 1997; Stergiou and Moutopoulos, 2001). Length-weight relationships are also useful in estimations of weight from length, conversions of growth-in-length to growth-in weight for predictions of weight at particular age and further use in stock assessment models (Anderson and Gutreuter, 1993; Pauly, 1993). Hussain and Ahmed (1992) used length weight and structural indices to determine the condition factor and length frequency of *Pomadasys kaakan* collected from Ko-

rangi Fish Harbour, Karachi (Pakistan). Mahmood *et al.* (2012) worked out trends in *Ilisha melastoma* of Pakistan coast. The coastal waters of Pakistan were studied for *Hilsa kelee* (both males and females) growth patterns (Panhwar *et al.*, 2012).

The members of family Mugilidae (Mulletts) are considered as one of the most economically important species of marine fishes. Different species of mullets are found in tropical to subtropical and temperate regions, where in-shore fishermen depends on the fishing of available species. Thin lipped mullet is considered as valuable species in eastern Adriatic Sea and mostly caught as artisanal fish (Glamuzina *et al.*, 2007). The marketable size pays back a good reward to fishermen.

The Miani Hor is a home of fish biodiversity comprising a number of commercial and non-commercial fishes. The present study reports the analysis of length-weight relationship in two commercially important fish species (*Liza subviridis* and *Sillago sihama*) of Somiani Hor (Balochistan coast, Pakistan) with the hypothesis that these relationships vary with the species and the environmental conditions. For the purpose samples of small-sized fish of two species were collected during different calendar months (2002) and seasons (2003, 2005) used for morphometric analysis.

MATERIALS AND METHODS

Sonmiani Bay (commonly known as Miani Hor) is a lagoon, situated some 90 km. west of Karachi on the eastern most part of Balochistan coast, comprises of 60 km long and 7 km wide tortuous body of water connected with the Arabian Sea on southeastern end by a 4 km wide mouth. The total area of the bay is 125.5 km² and the adjacent shelf is about 80 km. wide. The Hor is characterized by sandy beaches, intertidal mudflats and the muddy beaches adjacent to mangrove forests (Figure.1).

Figure 1: Coastline map showing Sonmiani bay (Miani Hor/lagoon).

Small sized fishes and other pelagic nektons were collected by beach seine (10 m x 2.5 m) having polyester+ cotton (knotless) net (mesh 0.5 cm), a triangular iron frame equipped with net collection bag of the same mesh, and a rigid beam in front to maintain a fixed opening. The mouth was 1.25 m x 0.25 m wide and a collection bag of 3.0 m. The net was provided with the strong ropes to pull manually in the shallow intertidal zone.

Sampling was undertaken during 2002 once in a month on low tide, and during four seasons (north east monsoon, pre monsoon, south west monsoon and post monsoon) during 2003. When samples were collected on spring and neap tide using flooding and ebbing states. In 2006, flooding and ebbing states were used in spring and neap tides in north east monsoon and south west moon seasons. The individuals of both species *Liza subviridis* and *Sillago sihama* were measured for total length up to near 0.1 m using a fish measuring board, and weighed (to nearest 0.01 g) by using digital balance. Length-weight relationship was calculated following Rickett (1973) using equation:

$$W = a L^b$$

Where: W = weight of the individual

L = Length of the individual,

a = y-intercept or the initial growth coefficient

b = Slope or the growth coefficient

RESULTS

Liza subviridis

Sub-adults of *Liza subviridis* collected during 2002 (n 361) had mean length of 21.00 mm and mean wet weight of 1.13 g (Table 1). A positive allometry ($b = 3.23$) was seen when the logarithmic values were adjusted in the formula (Table 2, Figure.2A). The mean length and wet weight (n 1272) were recorded as 53.77 mm and 2.03 g, respectively (Table 1), in 2003. with altered allometric condition ($b=2.95$) (Table 2, Figure 2B). Estimated mean length (51.61 mm.) and wet weight (1.68 g.) during 200 (Table 1) also showed an increased negative allometric condition ($b=1.93$) (Figure 2C).

Sillago sihama

Sample of 120 *Sillago sihama* juveniles collected during 2002 exhibited mean length 52.93 mm and mean wet weight 1.80 g (Table 1) with a positive allometric condition ($b= 3.10$; Figure. 3A). Fish sampled during 2003 (n 641) ranged between 27.0 mm - 165.0 mm in length (Table 1) with a positive allometric value of slope 'b' (3.13) between length and weight. (Table 2, Figure. 3B). The length of juveniles ranged between 32.0 mm and 95.0 mm and wet weight between 0.21 g and 5.59 g in 2006 (Table 1). The value of $b=3.02$ indicated an isometric growth (Table 2, Figure. 3C).

Table 1. Descriptive statistics of total length (mm) and wet weight (G) of *Liza subviridis* and *Sillago sihama* sampled from Miani Hor during different years.

Species	Year	N	Length (mean±SD) (min-max)	Weight (mean±SD) (min-max)
<i>Liza subviridis</i>	2002	361	(47.80±9.80 - 21.0-95.0)	(1.13 ± 0.95 - 0.04±8.65)
	2003	1272	(53.77±14.60 - 16.0±168.0)	(2.03 ±2.83 - 0.10±46.3)
	2006	1197	(53.61±8.84 - 26.0-107.0)	(1.68 ±1.15 - 0.34±12.0)
<i>Sillago sihama</i>	2002	120	(52.93±23.90 - 22.0±133.0)	(1.80 ±2.66 - 0.03±16.6)
	2003	638	(61.50±23.46 - 27.0-165.0)	(2.61 ±4.32- 0.05±165.0)
	2006	23	(68.74±19.44 - 32.0±95.0)	(2.35±1.67- 0.21±5.59)

Table 2. Statistics on isometry in growth of stocks of *Liza subviridis* and *Sillago sihama* sampled from Miani Hor during different years, based on the total length as an independent variable and wet weight as dependent variable. (+ve = positive allometry, -ve = negative allometry and 0 = isometry).

Species	Year	No.	a	b	R ²	Al- lo- me- y
<i>Liza subviri- dis</i>	2002	361	4e ⁻⁰⁶	3.23	0.81	+ve
	2003	1272	1e ⁻⁰⁵	2.95	0.94	-ve
	2006	1197	0.000 7	1.92	0.52	-ve
<i>Sillago siha- ma</i>	2002	120	5e ⁻⁰⁶	3.10	0.97	+ve
	2003	638	4e ⁻⁰⁶	3.13	0.94	+ve
	2006	23	5e ⁻⁰⁶	3.02	0.98	0

Figure 2. Length-weight relationship in *Liza subviridis* collected from Miani Hor (Sonmiani Bay) in different phases of the study (A=2002; B=2003; C=2006).

Figure 3. Length-Weight relationship in *Sil-lago sihama* collected from Miani Hor (Sonmiani Bay) in different phases of the study (A=2002; B=2003; C=2006).

DISCUSSION

Studies on 3442 *L. subviridis* subadults sampled from Miani Hor during 2002 showed positive allometric condition during 2002 ($b=3.22$) and negative allometry during 2003 ($b= 2.94$) and 2006 ($b = 1.92$). Hussain *et al.* (2010) studied length-weight relationships of 46 fish species from Korangi-Phitti creek area (Indus delta, northern Arabian Sea). They reported that 16 species showed isometric growth, while 8 showed positive and 17 negative allometric growth. Their studies included 6 species of Family Mugilidae, of which only adult female *L. subviridis* showed positive allometric growth ($b= 3.15$). Several factors influence the growth, e.g., season, habitat, genetic makeup, sex, maturation, feeding, stomach fullness and health of the animal (Richter *et al.*, 2000; Moutopoulos and Stergiou, 2002).

An important study was done by Chu *et al.* (2012) on *Liza macrolepis* that determined length-weight and length-length relationships in which b value reached its maximum value of 3.00 (isometric) in fall and minimum value of 2.93 (negative allometry) during winter. Jaiswar *et al.* (2004) stated that mathematical interpretation of length-weight help in the study of biology, physiology, ecology, population dynamics, fisheries assessment, and general environmental conditions of the studied populations. In length-weight relationships, the use of standardized measures for all populations is essential to establish the more reliable results, when making comparisons between populations. Moutopolous and Stergiou (2002) proposed that length-weight relationships have importance in comparative studies on growth performance. The length-weight relationships play an important role in the fish stock assessment and to analyze fish growth variations during different seasons (Binohlan and Pauly, 1998; Garcia *et al.*, 1989; Haimovici and Velasco, 2000; Koutrakis and Tsikliras, 2003; Valle *et al.*, 2003; Ecoutin *et al.*, 2005; Fafioye and Olouja, 2005; Chu *et al.*, 2011). The length-weight relationships are also helping in the degrees of stabilization of tax-

onomic characters in fish species. In addition, the management and exploitation of fish populations are well documented through use of length-weight relationships (Goncalves *et al.*, 1997; Pervin and Mortuza, 2008; Stergiou and Moutopoulos, 2011). Among economically important fishes along the coast of Pakistan, Indian sand whitening (*Sillago sihama*) serves as a main catch of inshore fisheries. In Miani Hor, length-weight relationship showed positive allometric growth in 2002 and 2006 ($b = 3.10$ and $b = 3.13$, respectively).

The results agree with findings from Pulicat lake (India) that showed isometric growth ($b = 3.08$) for juveniles sized between 4 mm -10 mm. Shamsan and Ansari (2010) reported the isometric growth in both male and female individuals of *S. sihama* and reported that aging adult females gain more weight compared with the increase in length than adult male. The increased weight in females may be due to the weights of female gonads than male gonads (Gowda *et al.*, 1988).

In 2003, a total of 638 juveniles of *S. sihama* were caught and a positive allometric growth relationship was observed ($b = 3.13$). The maximum size (165 mm) was found in the same year and probably a matured individual size in Miani Hor. This is confirmed with the studies that showed the first maturity size groups ranges 155-164mm (Shamsan and Ansari, 2010). The isometric growth of *S. sihama* is influenced by the other factors e.g. habitat, diet, temperature and related hydrographic factors in Miani Hor. Krishnamurthy and Kaliyamurthy (1978), demonstrated a comparative analysis of length weight relationship for juveniles and adults from Pulicat lake and did not find any significant difference in the 'b' (slope) except 5% difference in elevations. The changing values of b in the length-weight relationship of fish are an indicator of feed and growth pattern. The biotic and abiotic factors as water temperature, food availability and habitat type affecting the growth pattern. The present study is a first report from Maini Hor (Sonmiani bay) on length weight relationships of small sized and sub adult

Liza subviridis and *Sillago sihama*. Moreover, the report is an addition in the fisheries science along the coast of Pakistan especially Balochistan coast.

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