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The Length-weight Relationship, Condition Factor and Impact of Fluoride Concentration in *Johnius belangerii* of Arabian Sea*

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Abstract: This research has been designed to study the length-weight relationship of *Johnius belangerii* of Arabian Sea in relation with fluoride concentration. The purpose of study to measure the variation in condition from expected weight for length as an indicator of pollution. The Total Length (TL) and Total Weight (TW) were measured for hundred fish specimen collected by net with fisherman. Least-square regression of $\log_{10} W$ x $\log_{10} TL$ produced the over all equation log W = -1.2681 +2.4486TL with the value of $R^2 = 0.4701$. Using the exponential form of the slope and y- intercept, relative condition factor for the fish can be calculated as $K_n = 0.7928 + 2\times10^{-3}$ TL ($R^2 = 0.0408$) and $K_n = 0.9824\ 7\times10^{-6}$ TW ($R^2 = 4\times10^{-6}$). Over all body condition of fish compared with condition ranges and growth in literature, showed the effect of concentration of fluoride on weight and length of fish. A statistically significant relation is observed in between fluoride concentration and condition.

Key words: *Johnius belangerii*, condition factor, fluoride

INTRODUCTION

Johnius belangerii a commercially important marine fish, locally known as Mushka and Goli in Pakistan, inhibits coastal waters above soft bottoms. The young ones are common in mangroves and form large schools in shallow waters. *Johnius belangerii* is carnivorous in nature (Ahmed and Niazi, 1988).

The condition factor (Dulcic and Kraljevic, 1996; Andu and Kangur, 1996) is an organism-level response, with factors such as nutritional status, pathogen effects and toxic chemical exposure causing greater- than-normal and less-than-normal weights. Both the condition factors and organo-somatic indices are used as indicator of the well being of individual organism. Because it integrates many levels of the organismal processes (e.g., molecular, cellular, organ system). The indices also integrate, at the organ system and organism level, the combined effects of multiple contaminates and other stressors. A decrease in condition factor, is considered a reflection of depletion in energy reserves because these indices are positively related to muscle and liver energy content (da Costa and Araujo, 2003; Anderson and Neumann, 1996; Atkinson, 1989; Hasan and Secer, 2003).

Gray (2001) reported that the accumulation of drinking water fluoride currently is being suspected as a cause for the decline of salmon fishery in the Northwest and British Columbia. He also reports that salmon's critical habitat has been found to have measurable levels of fluoride, involve in delay migration. Bhatnagara and Bhatnagara (2000) observed the effect of fluoride on cynobacterium, which is capable of interacting with cellular components and thus plethora of effects on cell metabolism and condition indices can also vary from location to location within a species. A decrease in weight due to a loss of energy reserves can be compensated for increased body water. Condition factor and organ

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somatic indices can reflect adverse effects of chemical exposure that are not monitored routinely by water quality program. Fluoride compounds are contained in minerals, particularly fluorspar (also called fluorite) and apatite (mixture containing calcium fluoride) (Veressinina, 2001; Piñskwar, 2001) and are found in most parts of the world. Research of several investigators during the last 5-6 years has proved that life-long impact and accumulation of fluoride causes not only human skeletal and teeth damage, but also change the DNA-structure, Paralysis of volition, cancer, etc. The fluoride-bearing mineral or fluoride-rich minerals in the rocks and soils and their dumping into the sea are the main cause of high fluoride content in fishes (Thomas, 1986). The fluoride analysis indicated the concentration of fluoride in fish muscle ranged between 1.875 to 3.79 μg g^{-1} collected from Mediterranean Sea Egypt (Masoud *et al*., 2006) causes no health risk. The highest fluoride concentration caused 25-30% growth rate retardation. The highest concentration of fluoride (805.8 and 969.3 mg kg^{-1} in dry bone tissue) was reported in the carnivorous fish taken from the reservoir of Lubon, Poland (Piñskwar *et al*., 2003).

The objective of the present research was to investigate the length-weight relationship and variation in the condition factor in *Johnius belangerii* as a result of adverse effect of fluoride pollution in the Arabian Sea.

MATERIALS AND METHODS

A total of hundred specimen *Johnius belangerii* of marine water fish of variable sizes ranging from 18.75-34 cm total length and 95 to 250 g were captured from two sampling stations near Karachi coast with the help of local fisherman in bimonthly sampling program during September 2005 to November 2006. Fishes were transported (20 km) live to the laboratory (Department of Zoology) in plastic shopper begs containing seawater. Some of them were died during transportation. Each specimen was washed with tap water and then deionizesd water, dried by wrapping filter paper. Body length was measured to nearest 0.1 cm and weights were recorded to nearest 0.1 g on analytical digital top loading balance. Condition factor was calculated by $W = aL^b$, where W is the derived weight (g), L is the length (cm), a is the intercept of the regression curve and b the regression coefficient (Salam *et al*., 2005). The parameters a and b are most easily estimated by linear regression based on logarithms Log W = log a + b log (L). Atomic Absorption Spectrophotometry detected the fluoride ion concentration in *Johnius belangerii* by digesting muscles of fish in nitric acid and sulphuric acid.

RESULTS AND DISCUSSION

The length weight relationship of fish *Johnius belangerii* was determined by $W = aL^b$ (Fig. 1). This equation corresponds to the logarithimized form, Log W = -1.2681 + 2.4486 TL ($R^2 = 0.4701$) (Fig. 2). The parameter b represents growth allometric rate and depends on genetically determined effects (Craig *et al*., 2005; Jones *et al*., 1999). If it stays constant and tending to assure values close to 3.0, indicate the isometric growth without change its form along the ontogenetic growth whereas in present investigation b = 2.4 shows that fish is not growing isometrically in relation to length where $R^2 = 0.4701$ also support the value of b = 2.4. The regression coefficient and constant regression present a remarkable relation with F^- content (Fig. 3-5). Young of the year tend to allocate a large amount of energy in growth, while adults put a considerable part of their energy in reproduction process or increasing weight or survival in environmental stress. It was observed that smaller sized individual in first collection present high growth rate and inversely related to condition factor. As the variation in the regression constant correspond to condition factor, which is subjected to seasonal oscillation and pollution (Fig. 5). Regression coefficient is not a good support indicator for characteristics of different population, because it can vary seasonally in the same population (Sukumaran and Neelakantan, 1997; Bhatnagara and Bhatnagara, 2000). The condition factor

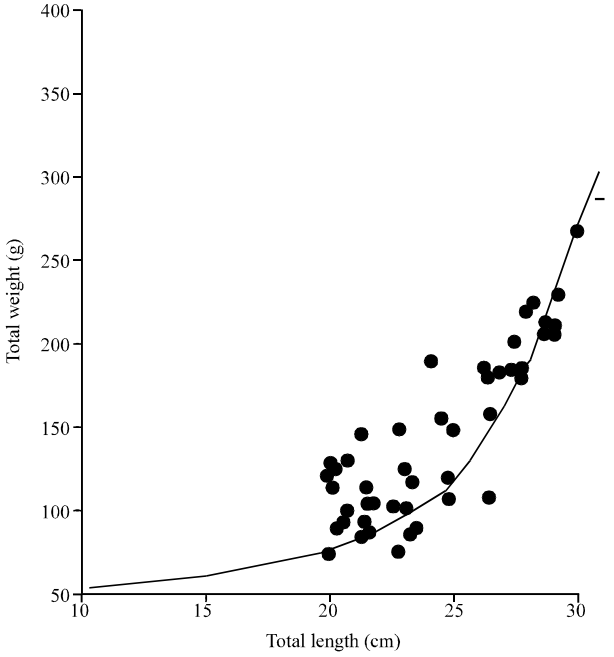

Fig. 1: Relationship between total length (cm) and wet body weight (g) in *Johnius belangerii*

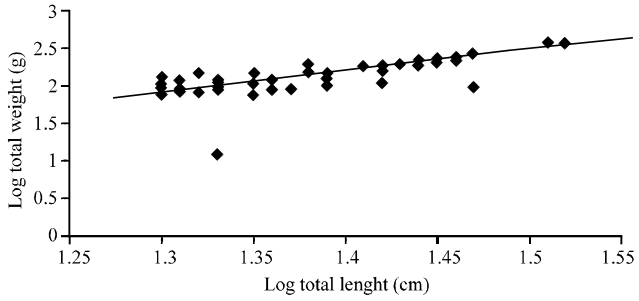

Fig. 2: Relationship between log total length (cm) and log wet body weight (g) in *Johnius belangerii*

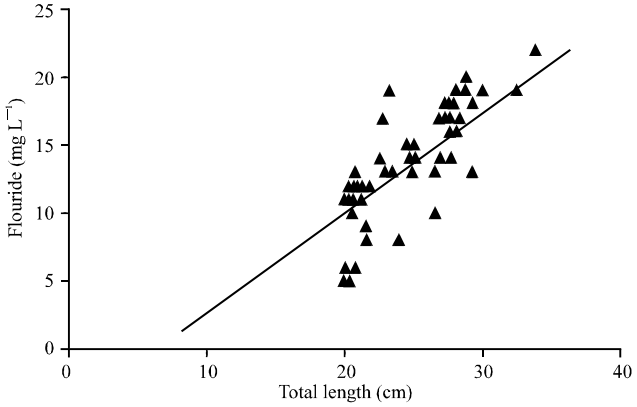

Fig. 3: Correlation between total F^- and total length of *Johnius belangerii*

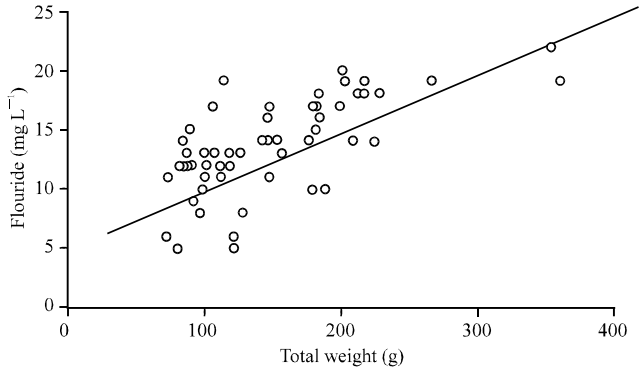

Fig. 4: Correlation between total F^- and total weight of *Johnius belangerii*

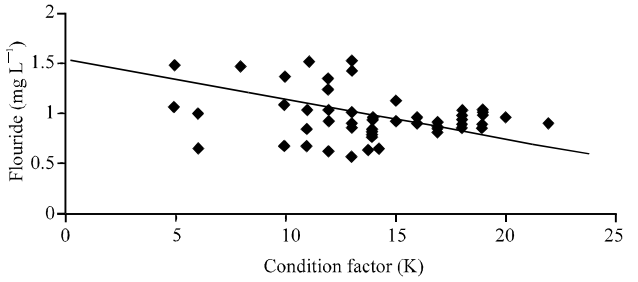

Fig. 5: Correlation between total F^- and condition factor of *Johnius belangerii*

investigated shows largest input of pollutants like F^-, favoring enrichment of these pollutants into the shallow water, which ultimately deposited into the fish body (Weatherley and Gill, 1987). Highest condition factor were found for TL<21 cm individuals, mostly captured in the month of October 2006. Adults presenting TL = 34, which were mostly captured from inner zone of shallow water should less value of condition factor indicating the effects of pollution on growth of fish.

A negative correlation in between body condition and fluoride concentration (Fig. 3 and 4) was observed. However competition of base line weight-length equation and condition factor for many fishes support use of condition factor in monitoring research studies and it may used as another source of information for a weight of evidence determination of impairment or health of fish (Jones *et al*., 1999). Change in the condition factor (K) with increasing weight and length in this investigation showed that average weight of fish doesn't increase in direct proportion to the cube of its length. Decrease in condition factor due to very high metabolic condition factor K was determined by the plot of values of K against Total Length (TL) and Total Weight (TW), corresponds to the following equation.

$$K = 0.7928 + 2\times10^{-4}\ TL\ (R^2 = 0.0408)$$
$$K = 0.9824 + 7\times10^{-6}\ TW\ (R^2 = 4\times10^{-6})$$

Concentration of fluoride is found to be 17-28 mg L^{-1} highest to that of 2 mg L^{-1} set by EPA (Environmental Protection Agency). Fluoride concentration greater than 4 mg L^{-1} can causes bone disease in adults and tooth mottling (discoloring) in children. How ever moderate level (0.7 to 12 mg L^{-1}) is beneficial to children during the time they are developing permanent teeth (Veressinina *et al*., 2001). A highly significant correlation was found in between fluoride concentration and total length and weight of fish.

Table 1: Comparison of relationship of body condition of *Johnius belangerii* with available data of other fish species

	TW/TL relationship				
Species	N	a	b	R^2	Ref
Astyanax Altiparaane	1832	0.02348	3.13	0.94	(Lizama, 2003)
Astyanax schubarti	662	0.0179	3.11	0.94	(Lizama, 2003)
Aphyocharax nasutus	1393	0.0162	2.89	0.94	(Lizama, 2003)
Cheirodon motomelas	755	0.0199	3.09	0.92	(Lizama, 2003)
Hyphessobrycom callistus	108060	0.0183	3.10	0.90	(Lizama, 2003)
Hemigramus marginatus	1712	0.0145	3.14	0.91	(Lizama, 2003)
Moenkhausia intermedia	1641	0.0176	3.02	0.96	(Lizama, 2003)
Moenkhausia samctae-filomenae	295	0.0204	3.21	0.91	(Lizama, 2003)
Roehoides paramensis	2287	0.0104	3.21	0.94	(Lizama, 2003)
Puntis chola	52	1.6170	2.88	0.9820	(Salam,2005)
Callinectes sapidus	317	0.0091	2.5625	0.857	(Hasan, 2003)
Johnius belangerii	100	-1.2681	2.44	0.4701	Present

N = No. of fish, a = Intercept of equation, b = Slope and R^2 = coefficient of determination

$$F = 0.868TL - 7.713 \ (R^2 = 0.6036)$$
$$F = 0.0423TW + 7.3858 \ (R^2 = 0.4508)$$

The above equation showed the adverse effects of fluoride concentration length and weight of fish with $R^2 = 0.6036$ and $R^2 = 0.4508$, respectively.

A comparison of values of a and b of present study with international data (Table 1) showed the allometric growth of fish due to higher chemical pollution (like F^-) in water body. Fluoride compound readily accumulated in fish with a particular affinity of F^- in bone tissue and thus shed light on contamination of the entire fish which may be attributed with retardation of growth rate of fish. (Masoud *et al*., 2006; Piñskwar *et al*., 2003). Camargo (2003) reported the toxicity of fluoride in fish, results in inhibiting the enzyme activity, interrupting metabolic process such as glycolysis and synthesis of proteins while effect of fluoride concentration with other aquatic organism like *Daphina magna* shows disorder in reproductive system whereas in crustacean species like *Euphausia crystallorphoias* can accumulate considerably higher levels of fluoride with out such effects (Sands *et al*., 1998; Dave, 1984) but in current research the impact of high concentration of fluoride alter the growth rate by impairing the weight and length of fish, such type of chemicals accumulation in aquatic organism, particularly in fish consumed by humans in large quantities are of special concern because high retention of toxic substances in fish tissue may be determined to human health.

CONCLUSION

The present investigation shows the allometric growth of *Johnius belangerii* in relation to high fluoride concentration in the Arabian Sea near Karachi coast in Pakistan. Further studies on fluoride pollution and their effects on other fish species are encouraged.

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