Journal of Global Biosciences
ISSN 2320-1355
Volume 4, Number 1, 2015, pp. 1180-1185
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Research Paper

IMPACT OF HIGH SODIUM FLUORIDE CONCENTRATION ON LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR IN *Puntius ticto* OF LAKE NAINITAL, INDIA

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Abstract

This research has been designed to study the length-weight relationship of *Puntius ticto* of Lake Nainital 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 and fifty 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 = -1.4182 +2.9218 TL with the value of R^2 = 0.5282. Using the exponential form of the slope and y- intercept, relative condition factor for the fish was calculated as K_n = 0.8127 +2x10^{-3} TL (R^2 = 0.0561) and K_n = 0.9761 7x10^{-6} TW (R^2= 4x10^{-6}). Over all body condition of fish compared with standard ranges and growth and reported the modulations in the length and weight relationship of fish in response to fluoride concentration.

Key words: *Puntius*, fluoride, Pollution, Condition factor, length-weight.

INTRODUCTION

Puntius ticto is a freshwater fish, locally known as Sikka in Uttrakhand, India and is carnivorous in nature [8]. The condition factor [9] is an organism-level response with factors such as nutritional status, effects of pathogens and organo-somatic indices were used as indicator of the well being of individual organism because it integrates many levels of the organism processes. The indices also integrate at the level of organ system of organism and the interactive effects of multiple contaminates and other stressors. A decrease in the condition factor is considered as a reflection of depletion in energy reserves because these indices are positively related to muscle and liver energy content, previously [12].

It has been [13] reported that the accumulation of drinking water fluoride currently is being suspected as a cause for the decline of trout fishery in the China. It was also found that trout's critical habitat has been found to have measurable levels of fluoride that was involved with delayed migration. Investigators observed [1] the effect of fluoride on cynobacterial cellular components and thus plethora of effects on cell metabolism and condition indices might vary with locations within the species. A decrease in weight due to a loss of energy reserves can be compensated for increased body water content. Condition factor and organ 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 (fluorite) and apatite (mixture containing calcium fluoride) [3] [10]and are found in most of the parts of the world. Research of several investigators during the last 4-5 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 minerals or fluoride-rich minerals in the rocks and soils and their dumping into the sea, are the main cause of high fluoride contents in fishes [5]. The fluoride analysis indicated the concentration of fluoride in fish muscles ranged between 1.731 to 4.310 µg/l collected from Mediterranean sea [12] cause no health risk. The highest 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 [11].
Since the fluoride content in water bodies is increasing day by day due to enhance uses of domestics and industrial products, it has become a serious threat to aquatic organisms. Thus, the authors set forth the objective to investigate the length-weight relationship and variation in the condition factor in *Puntius ticto* exposed to variable concentrations of fluoride in the Lake Nainital.

MATERIALS AND METHODS

A total of hundred and fifty specimen of variable sizes ranging from 4.80-9.1 cm, 1.6 to 13.3 g were captured from sampling sites. Fishes were transported live in the laboratory in plastic shopper begs containing lake water. Each specimen was washed with tap water and then deionized water, dried by wrapping filter paper. Body length was measured to nearest 0.1 cm and weights were recorded to nearst 0.1 g on analytical digital top loading balance. Condition factor was calculated by following formula [9]:

$$W=aL^b$$

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 [9].
The parameters a and b are most easily estimated by linear regression based on logarithms Log W = log a + b log (L). Atomic absorption spectrophotometer detected the fluoride ion concentration in *Puntius ticto* by digesting muscles of fish in nitric acid and sulphuric acid.

RESULTS AND DISCUSSION

The length and weight relationship of fish *Puntius ticto* showed interesting results (Fig. 1 & 2). The above equation corresponds to the logarithmic form, Log W = -1.4182+2.9218 TL (R^2 = 0.5282). The parameter b represents growth allometric rate and depends on genetically determined effects [9] [15]. 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=2.7 shows that fish is not growing isometric in relation to length where R^2 = 0.5282 also support the value of b=2.7 [6]. 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 presented high growth rate and inversely related to condition factor. As the variation in the regression constant correspond to condition factor 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 [14]. The condition factor investigated shows largest input of pollutants like fluoride, favoring enrichment of the pollutant into the shallow water. It ultimately deposited into the fish body previously reported by other authors [4]. Highest condition factor were found TL< 25 cm individuals. Adults presenting TL=41, showed less value of condition factor indicating the effects of pollution on growth of fish.

Table.1 Comparison of relationship of body condition of *Puntis ticto* 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	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	0.98	Salam, 2005
Callinectes sapidus	317	0.0091	2.56	0.85	Hasan, 2003
Puntis ticto	150	-1.4182	2.9218	0.52	Present

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

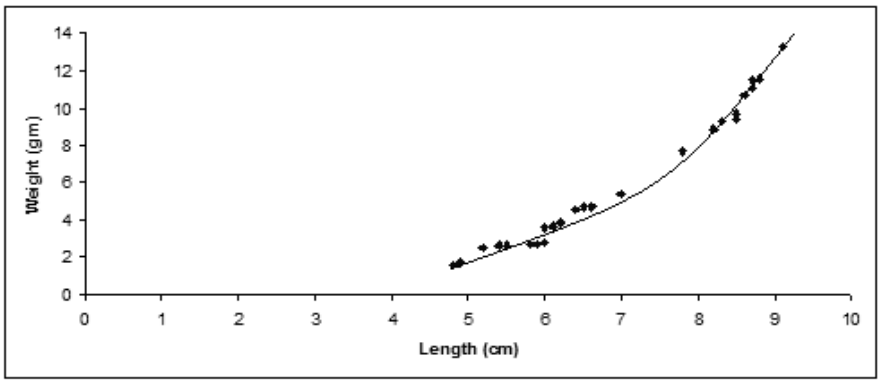

Fig.1. Relationship between total length and wet body weight in *Puntius ticto*

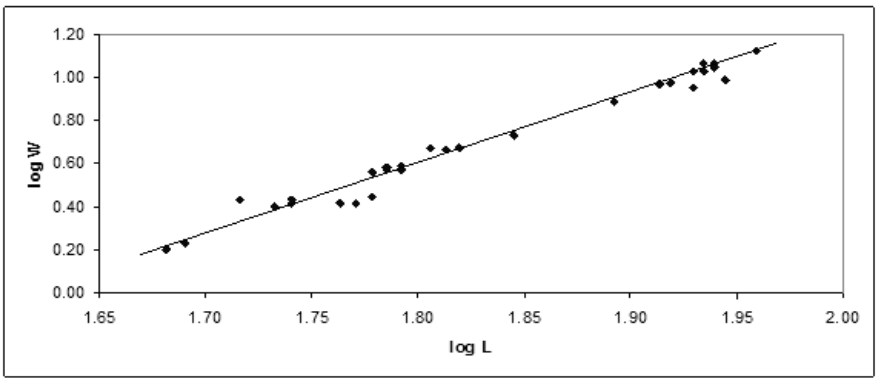

Fig.2. Relationship between log total length and log wet body weight in *Puntius ticto*

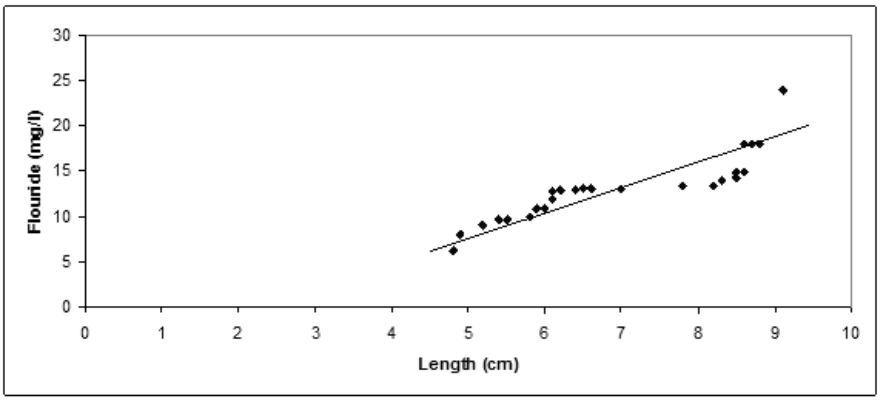

Fig.3. Correlationship between total length and fluoride in *Puntius ticto*

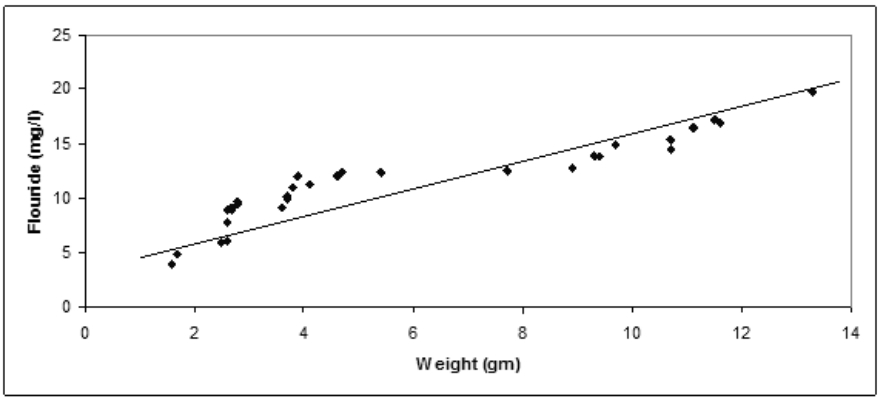

Fig.4. Correlationship between total weight and fluoride weight in *Puntius ticto*

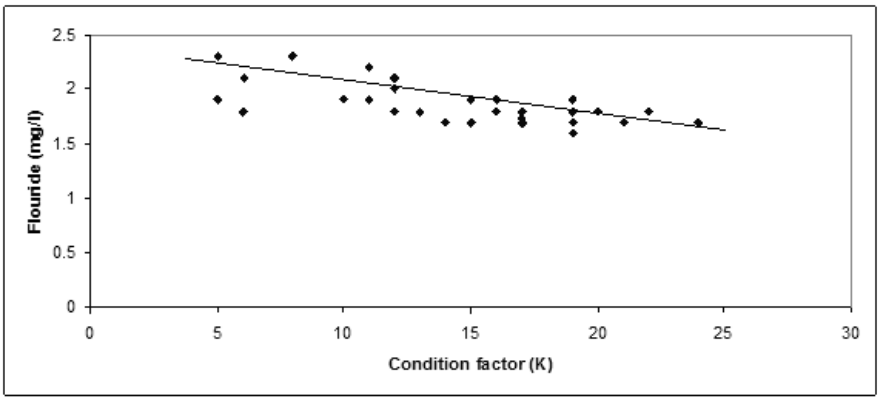

Fig.5. Correlationship between condition factor and fluoride in *Puntius ticto*

A negative correlation in between body condition and fluoride concentration (fig. 3 and 4) was also observed. However competition of base line weight-length equation and condition factor for many fishes, support the use of condition factor in monitoring research studies. It may be used as another source of information for a weight of evidence determination of impairment or health of fish [2]. Change in the condition factor (K) with increasing weight and length in this investigation proved that average weight of fish does not 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.

$$K = 0.8127 + 2 \times 10^{-4} TL \ (R^2 = 0.0561)$$
$$K = 0.9761 + 7 \times 10^{-6} TW \ (R^2 = 4 \times 10^{-6})$$

Concentration of fluoride was found to be 17-28 mg/l highest to that of 2 mg/l standard, recommended by Environmental Protection Agency. Fluoride concentration greater than 4 mg/l can cause bone disease in adults and tooth discoloring in children. However, the moderate level (0.7 to 12 mg/L) is beneficial to children during the time permanent teeth growth [16]. A highly significant correlation was found in between fluoride concentration and total length and weight of fish.

A comparison of values of a and b of present study with previous 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. Investigation revealed that [7] the toxicity of fluoride in fish, results in inhibiting the enzyme activity and interrupting metabolic process such as glycolysis and protein synthesis.

For the conclusion it has been reported during the present investigation that the allometric growth of *Punius ticto* was significantly modulated in relation to high fluoride content in the Lake Nainital, Uttarakhand state, India. The impact of high concentration of fluoride altered the growth rate by impairing the weight and length of fishes. Such chemical accumulations in aquatic organism, particularly in fish consumed by humans in large quantities, are of special concern because high retention of toxic substance in fish tissue may hamper the human health.

ACKNOWLEDGMENT

Authors are thankful to the Sardar Bhagwan Singh (PG) Institute of Biomedical Sciences and Reaserch, Balawala, Dehradun for providing laboratory and instrumentation facilities.

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