THE LENGTH-WEIGHT RELATIONSHIP, CONDITION FACTOR AND IMPACT OF FLUORIDE CONCENTRATION IN *Tor tor* (MAHASHEER) OF LAKE BHIMTAL, INDIA

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Summary

Present research has been designed to study the length-weight relationship of *Tor tor* of Lake Bhimtal in relation with fluoride concentration. Present study concentrated on the purpose 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 samples. Least square regression of $\log_{10} W$ x $\log_{10} TL$ produced the over all equation $\log W = -1.2714 + 2.5113\ TL$ with the value of $R^2 = 0.4781$.

Key words: *Tor tor*, fluoride concentration, condition factor

INTRODUCTION

Tor tor is a commercially important freshwater fish, locally known as Mahasheer in Uttrakhand, India. *Tor tor* is carnivorous in nature (J o h a l and T a n d o n,1981).

The condition factor (L e C r e n, 1951) is an organism-level response, with factors such as nutritional status, pathogen effects and organo-somatic indices are used as indicator of the well being of individual organism. Because it integrates many levels of the organismal processes. The indices also integrate, at the organ system and organism level, the combined effects of multiple contaminates and other stressors. A decrease in the condition factor, is considered a reflection of depletion in energy reserves because these indices are positively related to muscle and liver energy content (M o r e y et al., 2003).

N e u h o l d and S i g l e r (1960) reported that the accumulation of drinking water fluoride currently is being suspected as a cause for the decline of trout fishery in the China. He also reports that trout's critical habitat has been found to have measurable levels of fluoride, involve in delay migration. (A n g e l o v i c et al., 1961) observed the effect of

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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 with in the species. A decrease in weight due to a loss of energy reserves can be compensated for increased body water. 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) (D a m k a e r and D e y, 1989) 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-bearing 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 (G r o t h, 1975). The fluoride analysis indicated the concentration of fluoride in fish muscles ranged between 1.731 to 4.310 µg g^{-1} collected from Mediterranean sea (M o r e y et al., 2003) 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 (M i l l a r, 2005). The object of the present research was to investigate the length-weight relationship and variation in the condition factor in *Tor tor* as a result of adverse effect of fluoride pollution in the Lake Bhimtal.

MATERIALS AND METHODS

A total of hundred specimens *Tor tor* of variable sizes ranging from 19.21-33 cm total length and 98 to 250 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 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 (L e C r e n, 1951). 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 *Tor tor* by digesting muscles of fish in nitric acid and sulphuric acid.

RESULTS AND DISCUSSION

The length and weight relationship of fish *Tor tor* was determined by W=aL^b (Fig. 1). This equation corresponds to the logarithimized form, Log W = -1.2728+2.5387 TL (R^2 = 0.5219) (Fig. 2). The parameter b represents growth allometric rate and depends on genetically determined effects (L e C r e n, 1951). 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 isometrically in relation to length where $R^2 = 0.5219$ also support the value of b=2.7. The regression coefficient and constant regression present a remarkable relation with F^- content (Fig. 3-5).
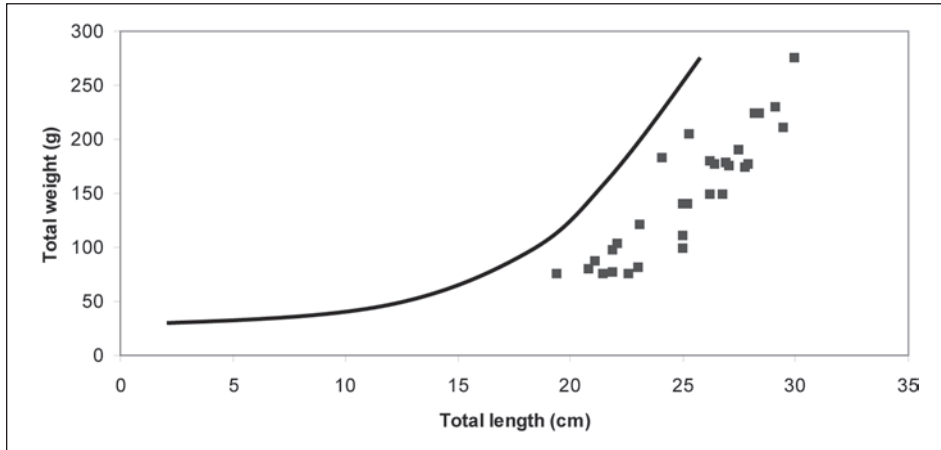

Fig.1. Relationship between total length and wet body weight in Tor tor

Slika 1. Odnos totalne dužine i mase kod vrste Tor tor *(nedehidriran uzorak)*
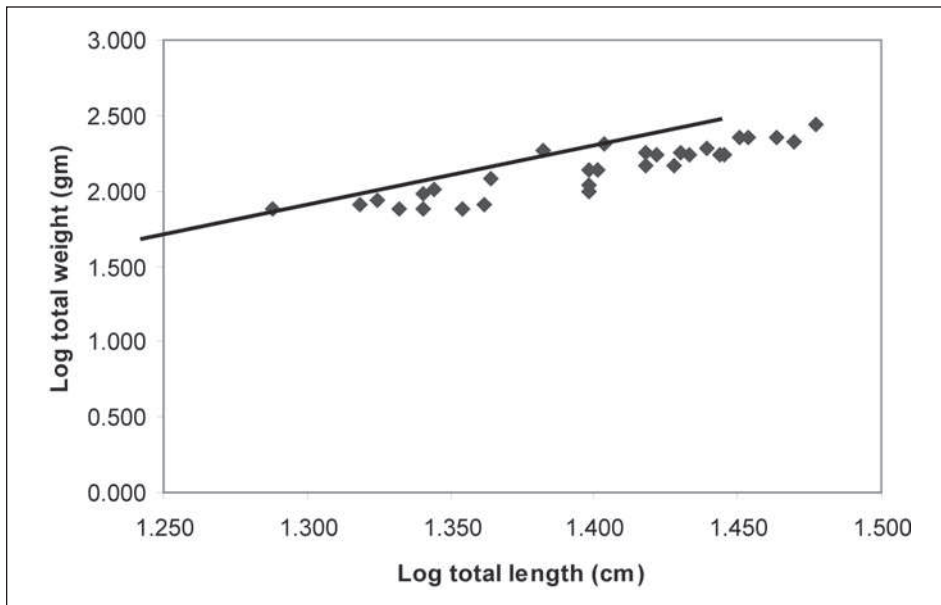

Fig. 2. Relationship between log total length and log wet body weight in Tor tor

Slika 2. Odnos između logaritma totalne dužine i mase kod vrste Tor tor *(nedehidriran uzorak)*
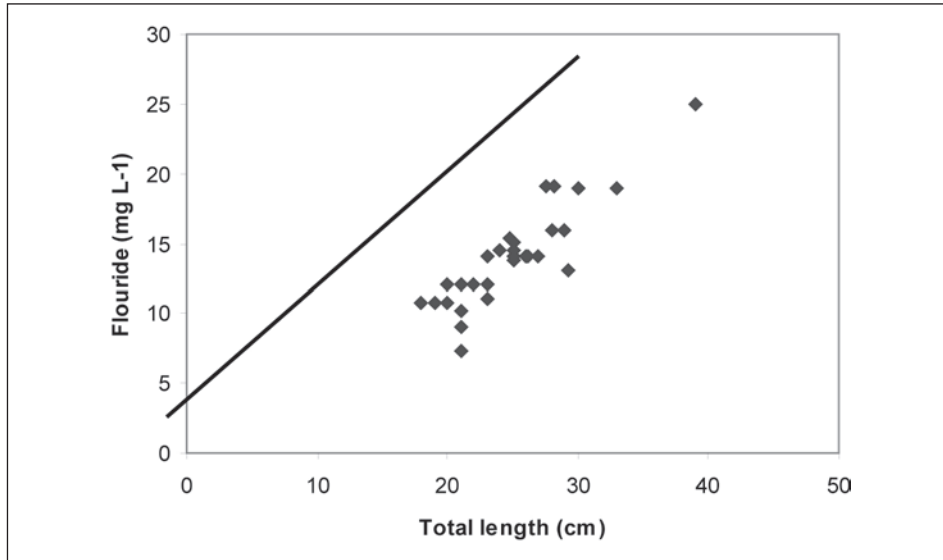
Fig. 3. Correlationship between total length and fluoride in Tor tor
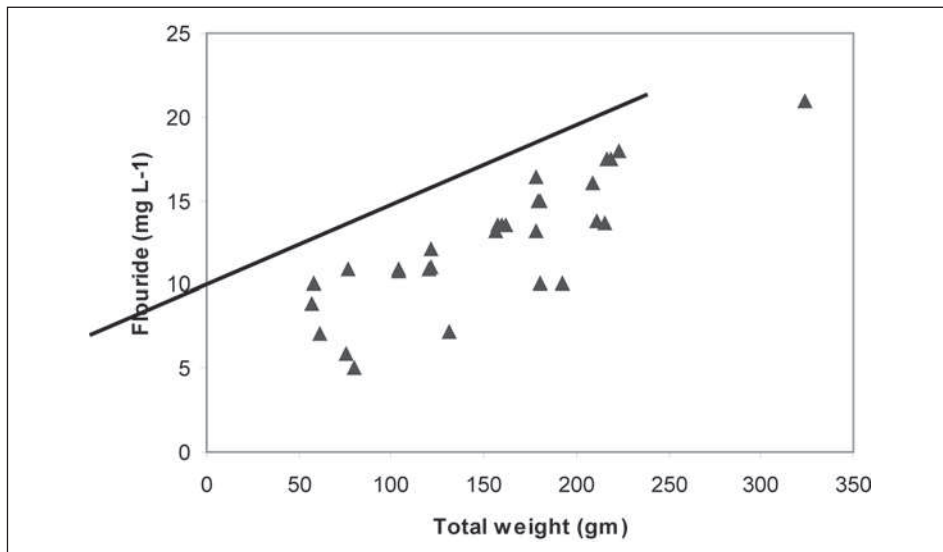*Slika 3. Korelacija između totalne dužine i koncentracije fluora kod vrste* Tor tor

Fig. 4. Correlationship between total weight and fluoride weight in Tor tor
Slika 4. Korelacija između totalne mase i koncentracije fluora kod vrste Tor tor
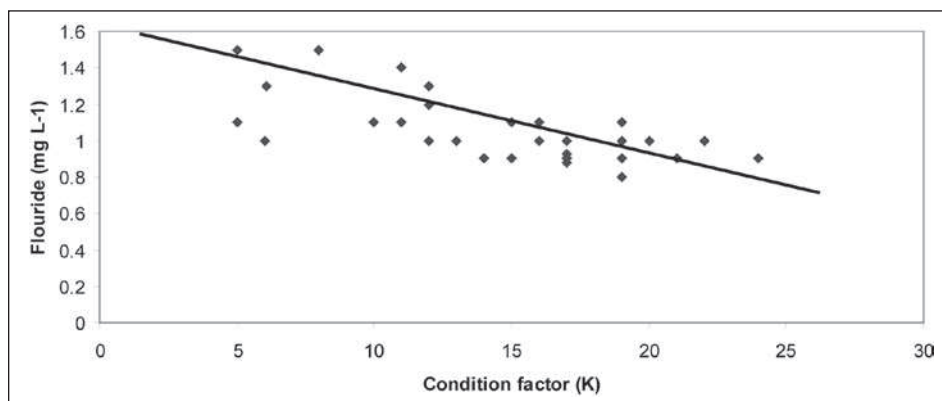
Fig. 5. Correlationship between condition factor and fluoride in Tor tor

Slika 5. Korelacija između kondicijskog faktora i koncentracije fluora kod vrste Tor tor

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 (R i c h t e r et al., 2000). The condition factor investigated shows largest input of pollutants like F⁻, favoring enrichment of these pollutants into the shallow water, which ultimately deposited into the fish body (D a v e, 1984). Highest condition factor were found TL< 25 cm individuals. Adults presenting TL=41, show 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 on information for a weight of evidence determination of impairment or health of fish (A r s l a n et al., 2004). Change in the condition factor (K) with increasing Weight and length in this investigation showed 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.

$K = 0.7821 + 2 \times 10^{-4}\ TL\ (R^2 = 0.5219)$

$K = 0.9638 + 7 \times 10^{-6}\ TW\ (R^2 = 4 \times 10^{-6}$

Concentration of fluoride is found to be 17-28 mg L^{-1} highest to that of 2 mg L^{-1} set by Environmental Protection Agency. Fluoride concentration greater than 4 mg L^{-1} can cause bone disease in adults and tooth 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 (W a r r i n g t o n, 1990). A highly significant correlation was found in between fluoride concentration and total length and weight of fish.

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. J o h a l et al. (2005) reported the toxicity of fluoride in fish, results in inhibiting the enzyme activity, interrupting metabolic process such as glycolysis and protein synthesis of protein while effect of fluoride concentration. 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 special concern because high retention of toxic substance in fish tissue may be hamper to human health.

CONCLUSION

The present investigation shows the allometric growth of *Tor tor* in relation to high fluoride concentration in the Lake Bhimtal, Uttarakhand state, India. A highly significant correlation was found in between fluoride concentration and total length and weight of fish.

Sažetak

DUŽINSKO-MASENI ODNOS, FAKTOR KONDICIJE I UTJECAJ KONCENTRACIJE FLUORA KOD VRSTE TOR MAHSEER *Tor tor* (HAMILTON, 1822) JEZERA BHIMTAL, INDIJA

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Dosadašnja istraživanja bazirala su se na proučavanju dužinsko-masenih odnosa vrste *Tor tor* jezera Bhimtal u odnosu na koncentraciju fluora. Naše istraživanje usmjereno je na mjerenje odstupanja u kondiciji riba od očekivanog dužinsko-masenog odnosa kao pokazatelj onečišćenja. Totalna dužina (TL) i ukupna masa (TW) mjereni su za uzorak od stotinu riba. Regresija najmanjeg kvadrata log$_{10}$ W x log$_{10}$ TL daje nam ukupnu jednadžbu log W = -1.2714 + 2.5113 TL s vrijednosti R^2 = 0.4781.

Ključne riječi: *Tor tor*, koncentracija fluora, faktor kondicije

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