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Length and weight relationship studies of alimentary canal compared to the total body weight of grass carp *Ctenopharyngodon idella* (Valenciennes, 1844) at Balkhu live fish Market of Kathmandu, Nepal

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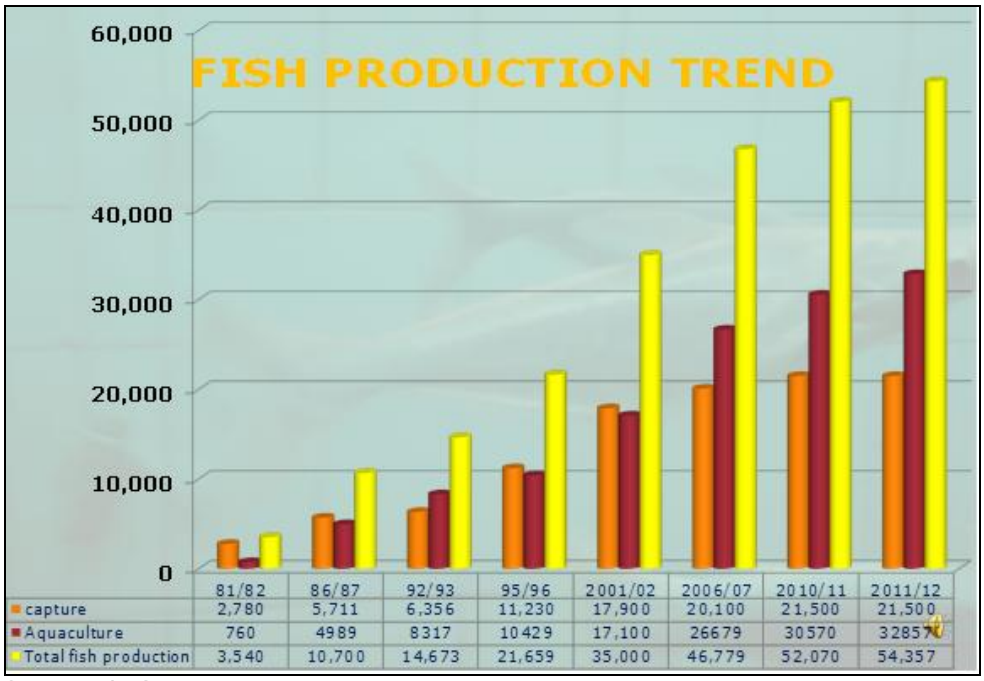
Abstract
Length weight relationship is an important tool for fishery management and which will able us to know about size, structure, age and also to assess the health of the host. It will provide various facts about seasonal cycle of the host, growth period of fishes and influential aspect of biotic and abiotic factor. The length-weight relationship of the same species may be different in the population because of feeding, reproduction activities and fishing. Likewise, relative gut length is the useful index used to know about the nature of food and feeding habit. It is therefore necessary to know the length and weight relationships of gutof fishes to understand depends on the nature of food they consume, the length increases with the increase in the vegetable matter in the diet. Most of the literatures show only the length and weight relationship of whole body but not the gut hence this study was conducted to establish the length and weight relationship of alimentary canal compared to the whole body weight of exotic grass carp *Ctenopharyngodon idella* from Balkhu live fish Market of Kathmandu, Nepal. Ninety fish samples in three phases i.e. first during winter (Magh/Falgun), second in spring (Chaitra/Baishakh) and final during summer (Jestha/Ashad) has been investigated. The weight of carp showed the increasing trend with the increase in length and weight of alimentary canal. The slope value of length was 0.875 and for weight was 0.0714.

Keywords: Length, Weight, *Ctenopharyngodon idella*, Alimentary canal, Nepal

1. Introduction
Aquaculture is the fastest growing food-producing sector in the world, contributing one-third of global food fish production. Aquaculture is small sub-sector of agriculture having high growth potential, but low organizational stature in Nepal. The modern aquaculture along with fisheries practices contributes nearly 2% of Gross Domestic Production (G.D.P). According to the Fisheries Association of Nepal (FAN) [1] around 80% of the domestic requirement of fish is fulfilled by local producers and rest is imported from outside of the country. In the context of Nepal Terai considered as the best place for the fish production because of its warm environment. Now about 70%of the fishes are supplied in Kathmandu from different region of Nepal. A study done by Nepal Rasta Bank in 47 districts and eight key urban centers across the country found that the fish production in this district amounted to 38-78 tons in the last fiscal year 2015 [2]. According to the directorate around 79,000 people are directly or indirectly involved in the fisheries for their livelihood. Chitwan, Bara, Parsa, Morang, Rautahat, Makwanpur, Rupendehi, Janakpur, Dhanusa, Bardia and Saptari, etc. are the main fish producing district in the country. Nepal's net fish Production was 64,900 tons in the last fiscal year 2013-14 against 57,500 tons in fiscal year 2012-13 (By directorate of Ministry of Agricultural Development) [3]. However annual demand comes around 80,000 tons, FAN said.



	81/82	86/87	92/93	95/96	2001/02	2006/07	2010/11	2011/12
capture	2,780	5,711	6,356	11,230	17,900	20,100	21,500	21,500
Aquaculture	760	4989	8317	10429	17,100	26679	30570	32857
Total fish production	3,540	10,700	14,673	21,659	35,000	46,779	52,070	54,357

***Source*:** NARC

Fig 1: General trend of fish production in Nepal

Kathmandu, the capital city with dense population has been offering good market place for the fish. Kalimati, Balkhu and Baneshowor are some famous and renowned market for table fish. About 13 varieties of the table fish have been found in Kathmandu for consumption. In the most of the shop of Kathmandu (70-75%) are brought from Terai region and (25-30%) are imported from India. "The Kathmandu valley now has more than 38 outlets selling live fish," said Giri, who is also the president of the Fishery Association Nepal [4]. According to the association, more than 800 to 1,000 kg of live fish are sold daily from the Balkhu Vegetable Market. Nepal has to encourage farmers to produce more vegetables and other agro Balkhu Agriculture and Vegetables Market was established by the private sector with Main reason behind this is it is centrally located and it has easy access of provides Chicken Mutton duck & live fish in competitive price.

The length-weight relationships (LWR) of fishes are important in fisheries biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between the two (Patiyal& Kumar, 2014) [5]. Besides providing a mathematical relationship between length and weight of fish it solves various problems concerned with the life history of fishes such as means of interconversion, yields information on the general wellbeing of the fish, variations in growth, size at first maturity, gonad development and breeding season(Thomas *et al*., 2003) [6]. LWR parameters (a and b) are useful in fisheries science in many ways: to estimate weight of individual fish from its length, to calculate condition indices, to compare life history and morphology of populations belonging to different regions (Petrakis &Stergiou, 1995) [7] and to study ontogenetic allometric changes (Teixeira de Mello *et al*., 2006) [8]. LWR parameters (a and b) are useful in fisheries science in many ways: to estimate weight of individual fish from its length, to calculate condition indices, to compare life history and morphology of populations belonging to different regions (Petrakis &Stergiou, 1995) [7] and to study ontogenetic allometric changes (Teixeira de Mello *et al*., 2006) [8]. Thus an experiment was conducted in the department of Zoology, Tri-Chandra Multiple Campus, Kathmandu, Nepal to fulfill the requirement of B. Sc. Dissertation which was equivalent to three credit hours in course.

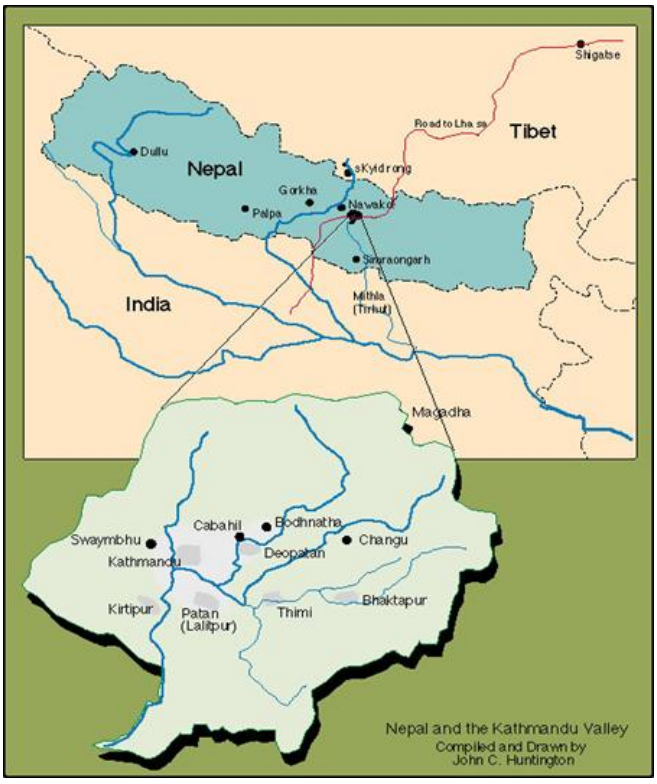


Fig 2: Showing the location of Balkhu Market.

2. Materials and Methods

The Balkhu fish market is hub for fish and it is one of the big and famous markets for the live table fish in the country. Thus, the present study was carried out in the "Rohan fresh fish shop", Balkhu, Kathmandu. An exotic grass carp *Ctenopharyngodon idella*was selected for this

experimentaltogether ninety fish samples of grass carps @ 30 fishes per sample and in three phases i.e. first during winter (Magh/Falgun), second in spring (Chaitra/Baishakh) and final during summer (Jestha/Ashad) was investigated. First of all the fish was identified with the help taxonomic identification key and with the standard procedure. After that some morphological characters such as colour, size, fin formula and the distribution of the scales on the body etc. the local name of the fishes were also noted down in the field. After the identification, the weight of individual species was taken with the help of digital balance and noted. And then the total length and total weight of the alimentary canal was also measured with help of measuring tape (inches) and thread and noted down and also digital balance. The data obtained after the experiment were analyzed with the help of SPSS v-20 (Statistical Packages for Social Sciences) computer software. Present data does not follow the normal distribution law so the descriptive statistical tools such as correlation coefficient and regression coefficient were used to analyze the length-weight relation.

The length-weight relationship (LWR) between total length (TL, cm) and body weight (WT, g) was determined from transformed pooled data. The parameters a and b were estimated by linear regression equation given by LeCren (1951) [9] and Jones (2002) [9]. This equation is sometimes also referred as the length-weight key (Biswas, 1993) [10]:

$W = a\ Lb$

$\log W = \log a + b \log L,$

Where:

a = coefficient related to body form,

b = exponent

The coefficient of correlation (r) was calculated following standard statistical procedure given by Snedecor and Cochran (1967) [11] Condition factor (K) and relative condition factor (Kn) were determined for different length groups using length and weight data following the equation given by Le Cren (1951) [9]:

$K = (W \times 100) / L3$

$Kn = W / w$

Where:

W = Weight (gm) of fish

L = Standard length (cm) of fish

w = Calculated weight (gm) of fish

For statistical analysis computer package MS Excel 10 was used.

Grass carp was classified as:

Order : Cypriniformes

Family : Cyprinidae

Subfamily : Cyprininae

Genus : *Ctenopharyngodon*

Species : *idella*(Valenciennes, 1844)

3. Results and Discussion

Ctenopharyngodon idella is commonly known as the grass carp and locally known as Ghase Macha was a well-built silvery elongated carp with dark grey back and dark fins. Fins were dark colored. It has low set eyes, very near to the mouth. It has upper jaw slightly longer than lower one. There was no barbel in this fish dorsal and ventral profile arched. Upper jaw was protectile. Dorsal fin was originated near to the snout pectoral fin smallish. Pelvic fin as rule was not reaching the ventral fin, anal fin was rounded and caudal fin was forked. Scales were small with brownish tinge at the base of each scale. Its elongated body, broad head, short snout and sub-terminal mouth was diagnostic; operculum was large almost square in shape. Adult was herbivore and juvenile fed on the zooplankton. It needs flowing water for spawning and does not breed in the stagnant water. It lives in still and slows flowing water and likes to live a lush environment full of aquatic plants. It need warm water 18 to 25°C. Eggs were free floating and develop white drifted by current. It attains the maximum size of about 1.5 meter in length and 30 kg in weight. Fin Formula: 3/7(10); a 3/8(11); P18; V9; L1 43-45; TL=90cm.

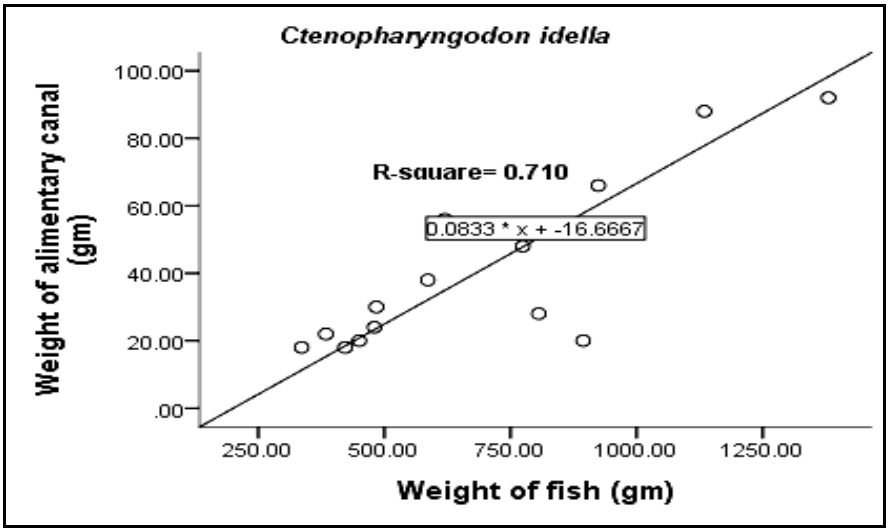


Fig 3(a): Regression analysis between length of gut (inch) and the body weight (g)

During the present investigation of grass carp in the Balkhu Market of Kathmandu the minimum body weight of grass carp was 334 g showed the weight of gut was 38g in relation to length of gut was 78 inches while among the 90 fishes of all three groups the highest body weight was 1173 g compared to the weight of gut was 87g in relation to length of gut was 167 inches. The average mean weight of carp was 786.72±0.54 g while the average mean weight of alimentary canal was 148. 23±4.62 g compared to the average mean length 118. 11±3.12 cm. Length weight relationships ((LWR) provide basic information on fish biology and thus is useful to estimate the weight from length of individual fish (Forese, 1998; Koutrakis and Tsikliras, 2003) [13]. This also helps to estimate fish crop biomass (Martin-Smith, 1996; Petrakis and

Stergiou, 1995) [15] and to convert growth -in- length equations to growth-inweightfor prediction of weight-at-age (Pauly, 1993) [16]. Similarly, it is also useful to calculatecondition indices (Safran, 1992; Petrakis and Stergiou, 1995) [17, 15] and to compare themorphology of populations from different regions (Petrakis and Stergiou, 1995) [15]. Number of fishery scientists around the world were inspired from the importance of lengthweight relationship and condition factor of fishes and this relationship was applied in marineand freshwater fishes. Such kind of study of Indian major carps in relation to growthparameters was earlier studied by (Patel *et al*., 2014; Behera *et al*., 2015; Gokhale *et al*., 2015;Barrich and Kaur, 2015 and Verma, 2015) [18, 19, 20, 21, 22].

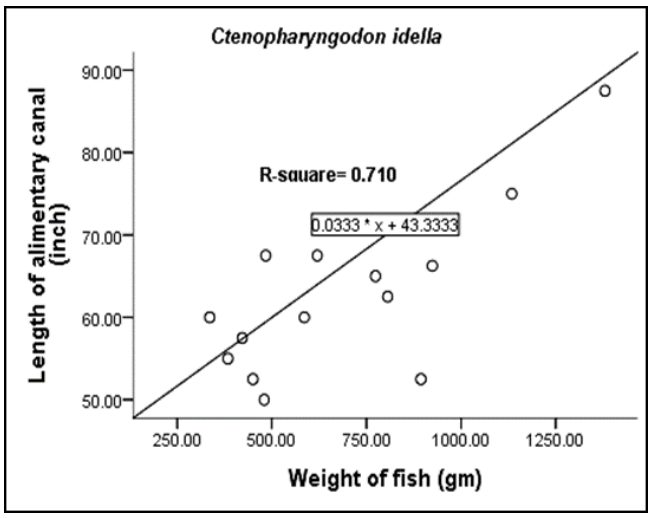


Fig 3(b): Regression analysis between length of gut (inch) and the body weight (g)

The correlation coefficient (r) was calculated from the logarithmic transformed data of total length and weight of alimentary canal and compared the the whole body weight of fish and found 0.71. These values are suggesting that the variables (total length and weight) are highly correlated (Fig. 1). Johal and Tandon (1983) [23] reported a strong linear relationship between total length and weight of C. catla from Govind Sagar. The strong relationship between total length and weight of Indian major carps were also reported by Ujjania (2012 & 2013) [24], Das el al. (2013) [7] and Phulwade *et al*. (2015) [25]. The value of b = 3 is considered suitable for an isometric growth and if it fluctuates from 3 then considered a sign of allometric growth. The findings of current study showed the negative allometric growth for *Ctenopharyngodon idella*. According to Hile (1936) [26] and Martin (1949) [27] exponent value 'b' could lie within the range of 2.5 to 4.0. Beverten and Holt (1957) [28] reported that the deviation of this value from '3.0' is rare in adult. Soni *et al*. (1979) [29] reported an exponent value of 3.75 for Cyprinus carpio which showed positive allometric growth from a tropical lake and 1.5-2.17 for catla which was negative allometric growth reported by Sachidanandmurthy *et al*. (2013) [30] in Mysure Lake. Negi and Negi (2009) [31] and Negi (2013) [32] reported that value of regression coefficient was 3.0 from lake of Nainital India. Ujjania *et al*. (2013) [33] also reported regression coefficient 2.97-3.13 in rohu of different types of water bodies in southern Rajasthan.

Bhosale S.V. and Bhilave M.P (2014) [34] investigate the length weight relationship of *Ctenopharyngodonidella*fed with formulated feed and found the regression intercept and regression slope -4.59 and 2.87 respectively and shows that high positive correlation of length and weight i.e. 0.97. However the present study found correlation coefficient 0.710 and the regression intercept and regression slope 0.842 and 0.0833 respectively in case of relationship of weight of alimentary canal with the body weight and 0.754 and 0.033 as the length as the parameter. Muhammad Neem and Abdual Salam (2005) [35] studied the length-weight relationship of immature *Labeo rohita* and found the slope value (b) 3.06. Later (Calcutta and Bhat, 2011) [36] found the slope value and correlation value were 2.97 and 0.98 respectively. In this experiment the value of the correlation coefficient is 0.754 and 0.842 and slope value is 0.033 and 0.0833 for the length and weight of alimentary canal with body weight respectively. The regression (b) value is found to be -16.667 and 43.33. The relationship equations for the length of alimentary canal as parameter: W=0.033L^43.33 Or, Logw = -3.141+43.33 Log L and for weight of alimentary canal as parameter W=0.083L^-16.667.

Condition factor (K) and relative condition factor (Kn) are the important biological parameters which indicate the suitability of a specific water body for growth of fish (LeCren, 1951) [37]. Condition factor has been used as an index of growth and feeding intensity (Fagade, 1979) [38]. The condition factor (K) and relative condition factor (Kn) of grass carps were studied in present study and the values of K (1.854±0.030, 1.248±0.016 and 1.186±0.014) and Kn (1.005±0.012, 1.010±0.013 and 1.008±0.012) were observed for grass carp in all three variable seasons mentioned above. The results of K and Kn were > 1.0 which indicated good condition of the fish in this water body.

Table 1: Condition factor (K) and relative condition factor of C. idella in three different seasons.

Seasons	n	Condition factor (K)			Relative Condition factor (Kn)		
		Min	Max	Mn±SE	Min	Max	Mn±SE
Winter (Magh/Falgun)	30	1.381	3.13	1.85±0.21	0.757	1.377	1.05±0.21
Spring (Chaitra Baisakh	30	0.897	1.671	1.27±0.22	0.763	1.389	1.01±0.22
Summer (Jestha/Ashadh	30	0.925	1.873	1.18±0.23	0.725	1.346	1.08±0.23

Condition factor decrease with increase in length (Bakare, 1970; Fagade 1979) [39] and also influences the reproductive cycle in fish (Welcome, 1979) [33]. Chakraborty and Singh (1963) [40] and Rajbanshi *et al*. (1984) [41] estimated the relative conditions of the *Cirrhinus mrigala* from Allahabad and from Southern Rajasthan respectively. These authors have opined that it is mainly dependent upon the growth, maturity of gonads and length of fish. Johal and Tandon (1983) [21] have described the condition factor of *C. mrigala* from Sukhna Lake (Chandigarh) and results were similar to the present study. Similar findings on K andKn were also reported by Ujjania *et al*. (2013) [34] for Indian major carp (rohu) in different water bodies of southern Rajasthan.

4. Conclusion

From the present study it can be concluded that the length and weight of alimentary canal of grass carp in comparison to their body weight could be highly correlated to each other. The regression coefficient shows the negative allometric growth of the exotic grass carp. The values of condition factor and relative condition factor being >1.0 which show the good condition and wellbeing of the fish in Balkhu Live fish Market of Kathmandu, Nepal. It is also concluded that the aquatic environment is quite conducive and suitable for the survival and growth of anycarp species. These results can be considered useful as baseline data for further monitoring the growth related data and also inspirited the researchers to do further research in this area. Normally weight and length of fish usually measured but this is first time studied the length and weight of alimentary canal of grass carp and it has compared to their body weight of fish.

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