Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

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Length weight relationship and condition factor of *Anabas testudineus* (Bloch, 1792) from Rudrasagar Lake (A Ramsar site), Tripura

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Abstract
The aim of this study was to assess the length-weight relationship as well as condition factor of a medium sized freshwater fish species i.e. *Anabas testudineus* from Rudrasagar Lake, a Ramsar site, Tripura. For the aforesaid purpose, a total of 312 fish specimens were collected from June 2015 to December 2015 following random sampling approach using different types of fishing gears as gill net, cast net and drag net of various mesh sizes. The results revealed intercept 'a' and slope 'b' value as -1.868 and 3.044, respectively with $R^2 = 0.99$ at 95% confidence limit. This indicates growth in the species is isometric and statistically significant correlation found between length and weight of sampled fish. Isometric growth indicates that the shape of fish does change as it grows. The computed value of Fulton's condition factor ranged from 1.25 to 1.84 indicating good health condition of the fish. The average K value was obtained as 1.51 which is a sign of good health status of fish as well as its habitat. This study is useful in providing relevant information in understanding the biology of the fish, estimation of fish condition in its environment and in the assessment of population dynamic parameters.

Keywords: *Anabas testudineus*, Length weight relationship, Condition factor, Rudrasagar Lake, Ramsar site

Introduction
The length-weight relationship study is an approach to assess basic biological parameters fish population, widely considered in fisheries management as it provides information on stock's condition [1]. This relationship is used by fishery researchers and managers for two main purposes: one is to predict the weight from the length of a fish and second to compare the average associated parameters between fish groups spatially or temporally [2]. The morphometric relationships between length and weight can be used to assess the well-being of individuals and to determine possible differences between separate unit stocks of the same species [3]. Length-weight relationships analysis is done to predict weight from length measurements made in the yield assessment [4]. The fishes can have either isometric or allometric (negative or positive) growth. The isometric growth is associated with constant change of body shape in proportion to the size or length of an organism. The negative allometric growth means that the fish becomes more slender as it increases in length while positive allometric growth indicates relatively deeper-bodied as it increases in length [5]. It is an important tool for getting facts on the increment in weight as a function of length in that way monitoring the healthiness of the fish species under study [6, 7, 8]. In addition, length-length relationships are also important in fisheries management for comparative growth studies [9]. The condition factor is a measure of various ecological and biological factors such as degree of fitness, gonadal development and the suitability of the environment with regard to the feeding condition [10]. When condition factor value is higher it means that the fish is in a better condition. The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds, and other water quality physico-chemical parameters [11]. The different values of condition factor 'K' is indicative of the state of degree of food source availability in its habitat [12]. To the best of knowledge no information is available on the length weight relationship and condition factor of *Anabas testudineus* from Rudrasagar Lake. The current study was planned to study the length-weight relationship as well as the condition factor of *Anabas testudineus* occurring in Rudrasagar Lake, a Ramsar site in Tripura.

Materials and Methods
Study area
Rudrasagar Lake is located in Melaghar district of Tripura State between latitude 23°29' N and longitude 90°01' E.

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The Ministry of Environment and Forest (Govt. of India) has identified Rudrasagar as one of the wetlands of National Importance of conservation and sustainable use based on its bio-diversity and socio economic importance. The lake was identified as Ramsar site (Wetlands of International Importance) in the year 2005. Wetland ecosystems are fragile but vital ecosystems, recognized for their role in conservation of fish biodiversity and are designated as Ramsar sites (Internationally recognized wetlands) on the basis of the number of threatened fish species they support [13]. The role of wetlands in conserving fish diversity has been widely acknowledged as these ecosystems are used by fishes as a refuge for breeding, feeding and nesting purposes at one or the other stage of their life cycle [14]. About 53 fish species are so far been reported from this lake [15].

Collection of specimen
The samples of *A. testudineus* were collected during day time from June 2015 to December 2015.Different types of fishing gears such as cast net, gill net and drag net having mesh size of about 1.5- 2.0 cm were used for collecting fish specimens. After collection, specimens were preserved in 10% formalin solution and were correctly labeled. The fish specimens were identified according to [16]. The total length (TL) of each fish was taken from the tip of the snout to the extended tip of the caudal fin by vernier calipers and weighed to the nearest 0.01 g body weight by a digital electronic balance. Simple random sampling method has been used for the collection of the specimen.

Length weight relationship
The length-weight relationship of fish under study was calculated using the expression: $W= aL^b$ [6] where W = body weight (g), L= total length (cm); and 'a' and 'b' are the intercept and regression coefficients respectively. The statistical analysis, linear regression was done using MS Excel software to estimate the value of the coefficients 'a' and 'b', and coefficient of determination i.e. R^2. In computing linear regression between length and weight of the collected fish samples the confidence limit was set to be 95 %.

Condition factor (K)
The condition factor shows relative fatness and well being of fish was determined by Fulton's formulae [17] $K = 100* W/L^3$, where W = weight (g), L = length (cm) and 100 is a factor to bring the value of K near unity.

Result and Discussion
A total of 312 specimens ranging from 5.3-19.2 cm in TL (total length) and 2.5-121.37 g in BW (body weight) were used for the study of length weight relationship and condition factor. The length weight relationship was calculated as Log W = -1.868 + 3.044 Log L with R^2 = 0.99. The weight of the fish increases logarithmically with an increase in length and with the value of 'b' lying between 2.5 and 3.5 but usually close to 3.0 [18]. The value of 'b' usually remains constant at '3' in an ideal fish [19], but under natural conditions the value of 'b' usually ranges between 2.5 and 4 [20, 21]. The b value was calculated to find out whether the fish is growing allometrically or isometrically. If the 'b' value is 3.0 the growth is considered to be isometric and the increase in weight is proportional to the cube of length. Moreover, when b is far less or greater than 3, growth in the fish is allometric which means the fish becomes much thinner or thicker with increase in length [22, 23, 24]. The b value decides growth pattern

of the fish species. In the present study the 'b' value obtained for *A. testudineus* is 3.044, so we can conclude that an isometric growth has been observed in the present study. Regarding growth type, a value close to 3.0 follows the cube law indicating that the fish grows isometrically and values other than 3.0 indicate allometric growth [1]. A positive allometric growth for *A. testudineus* reported by [25] as the 'b' value obtained was more than 3 from Deepar beel of Asom, India. [26] Reported negative allometric growth for *A. testudineus* from Kuttanad, Kerala. Using the same methodology, [27] found positive allomteric growth for *Pethia ticto* from Gomti River, Uttar Pradesh. Difference in b values can be attributed to the combination of one or more factors such as: number of specimens examined; area; seasonal effect; habitat; degree of stomach fullness; gonadal maturity; sex; health and general fish condition; preservation technique; and differences in the observed length ranges of the specimens caught [28]. The coefficient of determination was found to be the 0.99 indicating highly significant value of the result. The length weight relationship plot is presented in Fig.2.
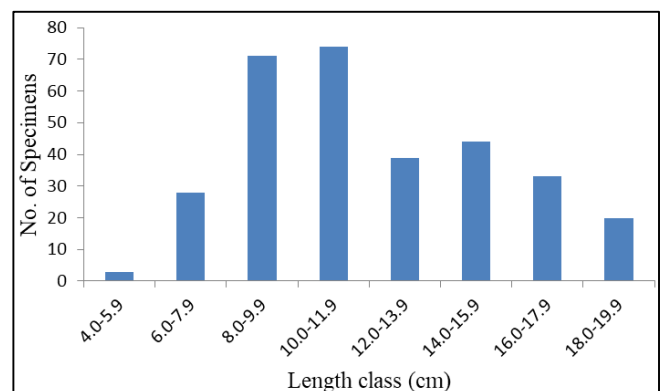

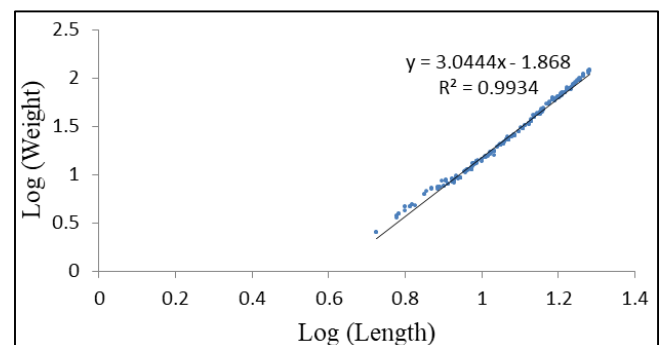**Fig 1:** Number of fish specimens in each length group

Fig 2: Length weight relationship of *A. testudineus*

Condition factor basically represents health status of fish which is actually the result of the interactions between biotic and abiotic factors and their effect on the physiological condition of the fish. However, variations in condition factor of fish primarily reflect its nourishment status and state of sexual maturity. In the present study the Fulton's condition factor ranged from 1.25-1.84 with an average value of 1.51. The K value for length groups 4.0-5.9 cm, 6.0-7.9 cm, 8.0-9.9 cm and 10.0-11.9 cm was found to be as 1.67, 1.69, 1.44 and 1.42 respectively. The same for length groups 12.0-13.9 cm, 14.0-15.9 cm, 16.0-17.9 cm and 18.0-19.9 cm was calculated as 1.44, 1.57, 1.6 and 1.68 respectively. The K value for each length group is shown in Fig. 3. Since the calculated K value is more than 1 for each length group, it can be concluded that

the fitness of the candidate species is good in the ecosystem. This also indicates a sign of good health status of fish as well as its habitat. The results shows that the K values are more for extreme length groups (4.0-5.9 cm, 6.0-7.9 cm, 16.0-17.9 cm and 18.0-19.9 cm) but less for middle length groups (8.0-9.9 cm, 10.0-11.9 cm, 12.0-13.9 cm and 14.0-15.9 cm). [26] reported that the K value ranged from 1.45 to 3.08 with a mean value of 2.06 for *A. testudineus* from Kuttanad, Kerala. The factors affecting the K value includes sex, size, season and degree of gonadal development in fish [29]. Ecological factors, food supply, disease outbreak and parasitism have great influence on the well being of the fish [6]. Fluctuations in K of many fishes were observed in relation to their reproductive cycle, feeding rhythms, physico-chemical factors of the environment, age, physiological state or some other environmental factors [30, 31, 32]. This study indicates that *A. testudineus* is naturally recruited in the study area. The samples observed are also healthy as indicated by the length and its weight relationship. Further studies are needed to assess the abundance of other fish stock available in relation to their environment to maintain the preferred habitat.
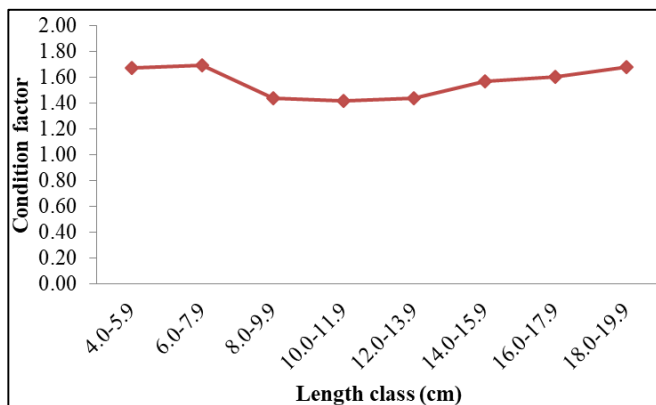

Fig 3: Condition factor of each length group

Conclusion
Based on our length weight relationship and condition factor results, it can be concluded that *A. testudineus* is in good condition in Rudrasagar Lake. The present study for *A. testudineus* will therefore provide useful information for fishery biologists and conservation agencies for sustainable fishery management.

Acknowledgement

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