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Condition factor and health inference of garua bachcha C*lupisoma garua* in the river Old Brahmaputra, north-eastern Bangladesh

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Abstract. A twelve-month study over a year was conducted from Januaryto December 2016 to determine condition factor and health condition of garua bachcha, *Clupisoma garua* (Hamilton, 1822) in the river Old Brahmaputra, Bangladesh.Condition factor of an individual fish was estimated as the ratio of the parameter, a in length-weight relationship (LWR), ($W=aL^b$), and a' in $a'=W/L^b$, where, L and W are length and weight of the individual fish respectively. The study calculated condition factors in four ways. Firstly,it was determined according to length classes of each month with corresponding monthly LWR, secondly, according to length classes of each month with LWR of pooled data over the study period. The third and final ways wereemployed according to length classes with LWR of pooled data over the study period, and according to monthly mean length and mean weight data with LWR of pooled data over the study period respectively. Garua bachcha were not in ideal health condition irrespective of length classes and months under any of above mentioned methods of calculation, rather they were either lean or plump during study period. Monthly health conditions did not reveal any definite trend.Monthly sample-wise a'/a values explained that fish individuals were lean in January, while they attained plump health in other months from February to December.

Keywords: *Clupisoma garua*, Condition factor, Health inference, River Old Brahmaputra

Introduction

Condition factor is a measure of leanness or plumpness of a fish calculated as the relationship between length and weight which is also entitled as coefficient ofcondition. It is an important fishery tool and an indicator of the general fish condition which is based on the hypothesis that heavier fish of a given length is in fatty condition (Bagenal and Tesch 1978). Bakare (1970) and Fagade (1979) reported that with increase in length of fish, condition factor decreases and it also influences the reproductive cycle in fish (Welcome 1979). This factor is a measurement of several different biological and ecological aspects such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Mac Gregoer 1959). It also acts as an index of growth and feeding intensity (Fagade 1979) i.e., when the fish has attained a better condition the value of condition factor is higher. Effective spatial management of wild fisheriesrelies on a sound knowledge of a species' biology and ecology (Dewhurst-Richman *et al.* 2016).The length-weight relationships and length-length relationships of threatened fishes are the most important biological parameters to provide information on the growth and condition of fish species and the entire fish community, and are highly significant for management and conservation of natural populations (Sarkar *et al.* 2009, Muchlisin *et al.* 2010).

The inland waters of Bangladesh are inhabited by about 260 indigenous species and 12 exotic species of fish, and 24 species of prawn (DoF 2015). The garua bachcha *Clupisoma garua* (Hamiltion 1822), locally known as ghaura is a siluriformes riverine catfish belong to the family Ailiidae, and the species forms commercially important fishery. The fish occur in freshwater and

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brackish water environment and are distributed in parts of Asia, including Pakistan, Bangladesh, Myanmar, Nepal and India. It is mainly found in the rivers Padma, Meghna, Jamuna, and Old Brahmaputra in Bangladesh, especially in the rainy season the fish migrate abundantly to the marginal area of the jute and paddy fields (Bhuiyan 1964, Rahman 2005) creating additional interest to the fishers. Previous works on various biological aspects of *C.garua* are limited, consequently the present research aimed to calculate condition factors and describe health condition of the important fish species listed as least concern by the IUCN.

Materials and Methods

Study area and fish sample collection: Fish samples of *Clupisoma garua* were collected once a month over an entire calendar year from January to December 2016 from the traditional fishers catching in the stretch of theriver Old Brahmaputra passing through Bangladesh Agricultural University. The study dealt with the relevant data of a total of 150 fish individuals over the study period. Fishers usedgill nets to catch the fish. All specimens were preserved with small ice crystals in an insulated fish box to avoid decomposition.

Recording of length and weight: Standard length (SL) was measured from the tip of the snout (mouth closed) to the last vertebrae. Whole fish weight was taken as the body weight (BW). SLwas measured to the nearest cm using a wooden device marked with standard units, and BW was taken using a digital balance (Shimadzu ATY 224 Analytical Balance). Size data were input on the spreadsheet of the computer software, Microsoft Excel.

Length-weight relationship (LWR) and condition factor (CF): The relationship between standard length and body weight was established using the cubic equation, $BW = aSL^b$, where, a and b are parameters. The parameters were obtained converting the power equation to its double logarithmic linear equivalent as lnBW=lna+blnSL. Condition factor of an individual fish was calculated as the ratio between the parameter, a in LWR equation and a' in $a'=W/L^b$, where, L and W are length and weight of the individual fish respectively. Four different algorithms to determine condition factors were followed in the study. Firstly, condition factors were calculated based on SL classes of a monthly sample with corresponding monthly LWR equation. Secondly, it was according to SL classes of each monthly sample with LWR equation of pooled data over the study period. Thirdly, condition factors were determined based on SL classes with LWR equation of pooled data over the study period, and finally, according to monthly mean length and mean weight data with LWR equation fitted with pooled data over the study period. Health condition was inferred as Ideal, lean and plump.

Results

The standard length ranged from 6.0 to 26.2 cm and body weight varied from 8.0 to 272.2 gfor fish individuals of *Clupisoma garua* available in all monthly samples collected over the study period in the river Old Brahmaputra.The ranges of parameters a and b values in length-weight relationships calculated separately for individual monthwere 0.0040-0.0737 and 2.375-3.434 respectively. Based on condition factor, fishes at each month were not having ideal health irrespective of SL classes and months over the study period, while they showed health either in lean or plump. Individuals appeared lean at 17-20 cm SL class in January and February,5-8,11-14, 14-17 and 20-23 cm SL classes in April, 23-26 cm SL class in May, 20-23 cm SL class in July,8-11 and 26-30 cm SL classes in September, and 14-17 cm SL class in November. Fishes at

remaining SL classes were plump in all months. Table I presents monthly health conditions of *garua bachcha* individuals with regard to various SL classes.

Table I. Health inference based on SL classes and LWR of each month, NF denotes no fish

	SL Class (cm)							
Month	5-8	8-11	11-14	14-17	17-20	20-23	23-26	26-29
Jan	nf	nf	Plump	Plump	Lean	Plump	nf	nf
Feb	nf	nf	Plump	Plump	Lean	nf	Plump	nf
Mar	nf	nf	Plump	nf	nf	nf	nf	nf
Apr	Lean	Plump	Lean	Lean	Plump	Lean	Plump	nf
May	nf	nf	plump	plump	plump	nf	Lean	nf
Jun	nf	Plump	Plump	Plump	Plump	nf	nf	nf
Jul	nf	Lean	Plump	Plump	Plump	Lean	nf	nf
Aug	nf	nf	nf	Plump	Plump	Plump	Plump	nf
Sep	nf	Lean	Plump	Plump	Plump	Plump	Plump	Lean
Oct	nf	Plump	Plump	nf	Plump	nf	nf	nf
Nov	nf	nf	Plump	Lean	Plump	nf	nf	nf
Dec	nf	nf	Plump	Plump	Plump	nf	nf	nf

The values of the parametersa and b in the length-weight equation employing pooled data of SL and BW over the study periodwere 0.0104 and 3.091 respectively. Based on condition factor, fish health at all SL classesbelong to each month were similar with those of monthly calculations with respect to SL classes except a few cases. Individuals were lean at 14-17 and 20-23 cm SL classes in January, 14-17 and 23-26 SL classes in February, 20-23 SL classes in May, 8-11 and 11-14 SL classes in June, 23-26 SL class in August, and 11-14 cm SL cm class in December. Fishes at 20-23 and 23-26 cm SL classes in April, and 8-11 cm SL class in July, September and October were plump. Fishes showed no ideal health condition irrespective of SL classes and months (Table II).

Table II. Health inference based on monthly SL classes and LWR of pooled data over the study period, NF denotes no fish

	SL Class (cm)							
Month	5-8	8-11	11-14	14-17	17-20	20-23	23-26	26-29
Jan	nf	nf	Plump	Lean	Lean	Lean	nf	nf
Feb	nf	nf	Plump	Lean	Lean	nf	Lean	nf
Mar	nf	nf	Plump	nf	nf	nf	nf	nf
Apr	Lean	Plump	Lean	Lean	Plump	Plump	Plump	nf
May	nf	nf	Plump	Plump	Plump	Lean	nf	nf
Jun	nf	Lean	Lean	Plump	Plump	nf	nf	nf
Jul	nf	Plump	Plump	Plump	Plump	Lean	nf	nf
Aug	nf	nf	nf	Plump	Plump	Plump	Lean	nf
Sep	nf	Plump	Plump	Plump	Plump	Plump	Plump	Lean
Oct	nf	Plump	Plump	nf	Plump	nf	nf	nf
Nov	nf	nf	Plump	Lean	Plump	nf	nf	nf
Dec	nf	nf	Lean	Plump	Plump	nf	nf	nf

Condition factor and health condition of the species based on mean SL and corresponding mean BW of each SL classes and length-weight relationships of pooled data over the study period

are given in Table III. Individuals were lean at 5-8, 20-23 and 26-29 cm while they were plump at other SL classes. Ideal health condition was not found in individuals belong to any SL class. Sample wise condition factor did not reveal any discernible trend over months (Fig. 1). Fish individuals were lean in January, while they showed plump health in other months from February to December. Condition factor was low during November, December, January, February, and June (0.996-1.082), while it was high in other months (1.102-1.545).

Table III. Health inference based on SL classes and LWR of pooled data over the study period

SL class (cm)	Mean SL (cm)	Mean BW (g)	CF (a'/a)	Health inference
5-8	6.00	1.56	0.585	Lean
8-11	10.14	14.05	1.040	Plump
11-14	13.05	30.75	1.044	Plump
14-17	15.81	53.36	1.001	Plump
17-20	18.83	93.64	1.024	Plump
20-23	21.96	145.40	0.988	Lean
23-26	24.50	223.22	1.081	Plump
26-29	27.80	166.64	0.546	Lean

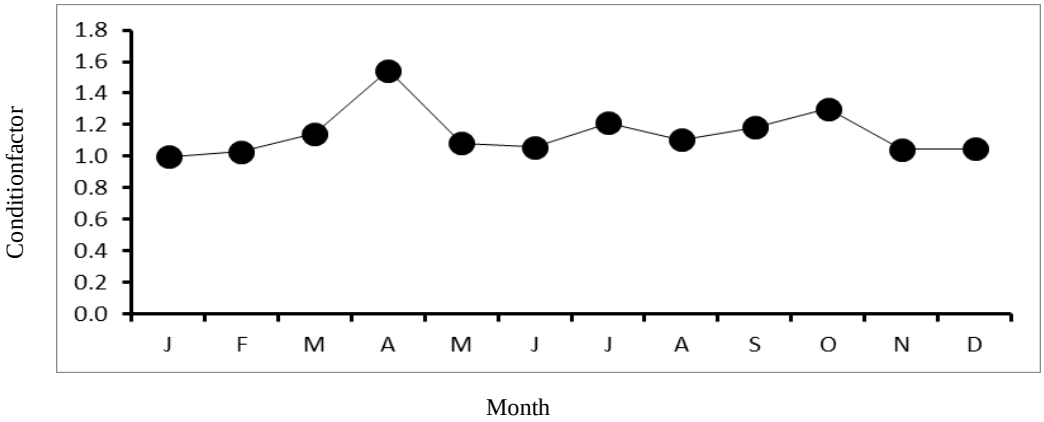

Fig. 1. Monthly variations of condition factors based on mean SL and BW with pooled LWR over the study period.

Discussion

Though IUCN recognizes garua bachcha as least concern species, but local fishermen raise concerns about its gradual disappearance from the river Old Brahmaputra and its contiguous inland ecosystems spanning the catchment areas. Fish species that become less available in local inland water bodies are very prone to be listed at threatened IUCN category shortly (Hossain et al., 2015). Literature on biology of *C. garua* are few, though length-weight relationships, maximum length and weight, several reproductive parameters including mode of fertilization, and chromosome number are meagerly available (Breder and Rosen1966, Shrestha 1994, Arkhipchuk 1999, Sani *et al.* 2016, Akter *et al.* 2019, Hasan *et al.* 2020). No previous work on the calculation of condition factors to understand health status of *C. garua* exists with which the present findings could be correlated. Sani *et al.* (2016) measured the size range of the species 5.4-36.6 cm TL with

LWR parameters of 0.0056 and 3.1 respectively in the river Gomti of India. Hossain et al. (2006) undertakes a similar work on condition of an allied species, *Mystus vittatus* belong to Order Siluriformes with which insights obtained inthe present findings might be realized to a minimum scope. The above-mentioned paper calculated Fulton's condition factor of *M. vittatus* and recorded that condition factor varied with regard to both size and months. The present study revealed monthly variations in condition factor like Asian striped catfish in which the fact is attributed to monthly fluctuations of gonadosomatic index and maturity (Ahamed *et al.* 2014).

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