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Length-Weight Relationship and Relative Condition of Hatchery- and Bundh-Bred *Catla catla* (Ham) Spawn During Developmment

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Abstract

The length-weight relationship and relative condition (Kn) of hatchery- and bundh-bred Indian major carp, *Catla catla* (Ham) during the early developmental period were studied. The correlation coefficient (r^2) was found to be 0.9799 (bundh) and 0.9430 (hatchery). The source-wise difference in the exponent values 'b' were significant at the 1% level. From length-weight regression, the exponent 'b' was 3.284734 for the bundh- and 2.767123 for the hatchery-bred species. The regression coefficient of log weight on log length of *C. catla* of both sources was found to depart significantly at 1% level from the conventional cubic law. Low Kn of the species at 5.5 mm increased gradually up to 8.0 mm size. In the 8.0-18.5 mm size range, the value of Kn stabilized above 1 indicating a good supply of food in the pond.

Introduction

Le Cren (1957) asserted the utility of the mathematical relationship between weight and length as a practical index of growth, maturity and general condition of fish. It is also informative about the general wellbeing of fish, including fatness, gonadal development and life history (Le Cren 1957; Petrakis and Stergion 1995). A number of studies have focused on the length-weight relationship of Indian freshwater fish after the fingerling stage (Chakraborty and Singh 1963; Jhingran 1952; Natarajan and Jhingran 1963; Pathak 1975; Chatterjee et al. 1977; Agarwal and Saxena 1979; Soni and Kathal 1979; Raijada and Raijada 1982). However, information on length-weight relationship and relative condition, particularly in the Indian major carp, *Catla catla* (Ham), in its early developmental period, is scarce. Therefore, an attempt was made to study the length-weight relationship and relative condition (Kn) during post-embryonic development of bundh- and hatchery-spawned *C. catla*.

Materials and Methods

A *bundh* is a shallow depression enclosed on three sides by an earthen embankment impounding rain water from the catchment area during the monsoon period to simulate riverine condition. Male and female broodfish (average weight 2-2.5 kg) from two sources - hatchery (Fish Farm, Hooghly) and dry bundh (Fish Farm, Ramsagar, Bankura) were hormonally induced (Chaudhuri and Alikunhi 1957) and their released eggs fertilized. Two-day post hatch spawn of *C. catla* were collected and reared separately under identical conditions for two months. The rearing pond was well prepared with different fertilizer treatments to enhance zooplankton production, as it is the preferred food of the carp (Chakraborty and Kowtal 1973). The physical and chemical nature of the ambient medium of the bundh and hatchery were recorded during the collection period of hatched spawns (maximum diurnal temperature was 30-34°C, pH 6.8-7.1 and dissolved oxygen 8.6-10.2 ppm). The differences with respect to these parameters between the two rearing systems were observed to be negligible during the period of rearing. A comparable number of spawns (about 5,000) were kept in each hoopnet (150 x 140 x 90 cm). Nylon mosquito nets with a dense mesh (mesh size 1/12") to contain 3-4 d old spawn were used. Pond water was monitored daily for temperature (30-32°C), pH (6.9-7.1) and dissolved oxygen (5.8-10.8 ppm). Zooplankton was collected from the pond with a plankton net (154-μm mesh size), then filtered through a larger mesh (mosquito net) and the number estimated (110-127 individuals·l^{-1}) every other day using a Sedgewick Rafter counting chamber. The experimental protocol involved the random collection of 10 spawns of *C. catla* separately every fifth day from each hoopnet leveled as bundh and hatchery and installed in the same pond. Surface water from the individual spawns was absorbed with Whatman filter paper no. 1. Total length (from tip of snout to end of caudal fin) was measured in millimeters, and each fish was weighed with a precision balance in milligrams (Bagenal 1978). The length-weight relationship and Kn values of *C. catla* from two sources (hatchery and bundh) were calculated based on 120 specimens of each in the 5.5-21.5 mm range, and 1.0-69.0 mg weight range.

The formula used was a conventional equation $W = aL^b$, where W = total weight of the fish, L = total length of the fish, a = constant, b = regression coefficient. Kn was calculated for each individual with the formula, Kn = W/w (Le Cren 1957), where W = observed individual weight, w = estimated individual weight for the observed length.

Results

The sample size; the maximum, minimum and mean lengths (± SE); the parameters 'a' and 'b' of the length-weight relationships; and the standard error of 'b' are shown in Table 1. The coefficient of correlation between log length and log weight of *C. catla* was 0.9799 and 0.9430 for the bundh and hatchery sources, respectively, and it was highly significant.

The relationships were
Log W = -5.832728 + 3.284734 Log L, for bundh
Log W = -4.397959 + 2.767123 Log L, for hatchery.

The 't' test revealed that the regression coefficient values for *C. catla* from bundh (3.284734) and hatchery (2.767123) departed significantly from the cubic value (3) at 1% level with 9 d.f. Variation of Kn for *C. catla* from both bundh and hatchery were identical starting with a low value in the 5.5-mm size, increasing gradually and stablizing above 1 in the 5.5-18.5 mm size group. Finally, Kn declined slightly below 1 but remained close to 1 (Fig. 1). The only difference is that the Kn values in the bundh-bred species started with a negative value.

Analysis of variance (two sources x 10 replications) revealed significant variation (1% level) among the sources (hatchery and bundh) as far as regression value was concerned (Table 2).

Table 1. Length characteristics (total length, minimum length, maximum length, mean length, standard error) and parameters of the relationship ($W = aL^b$) between gross weight (mg) and total length (mm) of the spawns of *Catla catla* from two sources, bundh and hatchery.

Source	[N]	Length characteristics			L-W parameters		
		Mean ±SE	Minimum	Maximum	a	b ±SE	r^{2a}
Bundh	120	12 50 ±1.3874	5.5	21.5	-5.832728	3.284734 ±0.1597	0.9799
Hatchery	120	13.80 ±1.5612	6.0	21.0	-4.397959	2.767123 ±0.2179	0.9430

N : Number of fish; SE : Standard error; $^aP<0.01$

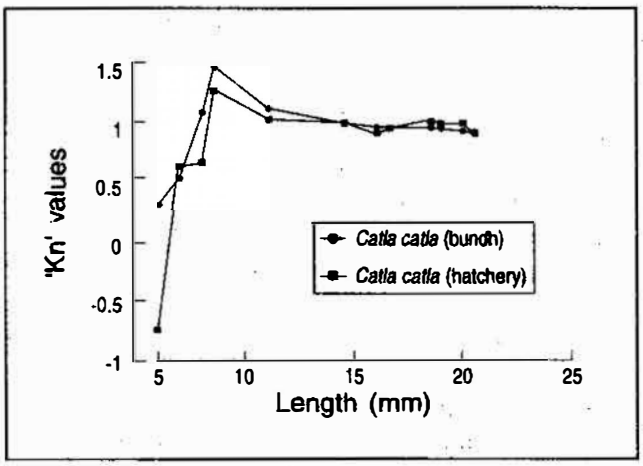

Fig. 1. Kn values at different lengths of bundh- and hatchery-bred *Catla catla* (post-embryonic developmental stages). *Catla catla* (bundh); *Catla catla* (hatchery).

Table 2. Two-way analysis of variance test to determine significance of variation within sources (bundh and hatchery) and in the replications of their regression values.

Source	ss	df	ms	F-value
Deviation from individual regression between sources	1.3433	1	1.3433	1,791.07[a]
Deviation between regression	0.0198	9	0.0022	2.93
Error	0.0068	9	0.00075	
Total	1.3699	19		

[a]$P<0.01$

Discussion

The exponent value 'b' was higher in bundh-bred young than hatchery. Controversy exists as regards the deviation of the numerical value of 'b' from 3 (Beverton and Holt 1957; Ricker 1958). We observed this deviation of the exponent value from the cubic law in the early developmental period of *C. catla*. Similar higher 'b' values have been reported in *C. catla* (80-120 mm size range), in adult fish from riverine sources (Jhingran 1952; Natarajan and Jhingran 1963; Agarwal and Saxena 1979) and in other freshwater fish (Chakraborty and Singh 1963; Ramamohona Rao and Hanumantha Rao 1972; Sinha 1972; Rangaswamy 1976; Chatterjee et al. 1977). So it may be interpreted that bundh-bred species behave in an identical way with 'natural' riverine species during the early developmental period. The mean values of Kn for different lengths of hatchery- and bundh-bred spawns during development of *C. catla* are plotted in Fig. 1. Low Kn was observed at 5.5 mm increasing gradually up to the 8 mm where it stabilized above 1 (8.0-18.5 mm). After that, the value declined slightly but remained close to 1. The Kn values reveai that up to 8 mm, the increase in length of *C. catla* spawns is more comparable to the increase in weight. Earlier Basu et al. (1991) found that the lag phase of growth in Indian major carp species is 2-15 d. In the present case we observed that the estimated weight of fish was higher than the observed weight during this period. An interesting relationship has been reported (Jhingran 1952) in *C. catla* in the 80-120 mm size group, and also in different carps (Chatterjee et al. 1977): that the estimated weight of smaller fish is greater than the observed weight. But opposite results were observed in larger fish. A similar result has been observed in the present case where the estimated weight of *C. catla* in the 5.5-8.0 mm size group was much higher than the observed weight. But the reverse results were noted in the 8.0-18.5 mm size group. Kn values in the 8.0-18.5 mm size group were above 1, indicating that the fertility and food supply of the pond was good.

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