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Length-weight relationship and variation in condition of *Chanos chanos* (Forsskål, 1775) from tide-fed brackishwater ponds of the Sunderbans - India

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Length-weight relationship (LWR) and monthly variation in the Fulton's condition factor (*K*) were investigated for 380 samples of Milkfish *Chanos chanos* cultured in tide-fed brackishwater ponds of the Sunderbans, West Bengal, India during July 2008 to June 2009. LWR ($W = 0.008 \times TL^{2.9859}$) indicated isometric growth of milkfish having constant body shape with proportionate increase in length and weight. There was monthly variation in *K* values with the highest mean value of 0.936 in January when the fishes were smaller and the lowest mean value of 0.670 in June when the fishes were larger. This infers that smaller individuals grew well with better plumpness than larger ones and provision of supplementary feeding is necessary after attainment of certain size to produce milkfish with good plumpness in tide-fed brackish water pond system.

[Keywords: Length-weight relationship, condition factor, milkfish, brackishwater ponds**]**

Introduction

Milkfish *Chanos chanos* (Forsskål, 1775) is a marine species and the sole candidate in the family Chanidae belonging to the order Gonorynchiformes[1]. It is an economically important and widely cultured food fish of south-east Asia and has distribution in the tropical and subtropical areas of the Indo-west Pacific Ocean within the 20°C winter-surface isotherm[2,3]. It matures sexually in sea and breeds there. Advanced larvae migrate onshore and enter coastal wetlands, estuaries during juvenile stage. Usually seeds are collected from these areas and grown in culture ponds. In India, extensive abundance of milkfish seeds is observed in the south-west and south-east coasts during April to June and October to December[4]. However, non-availability of natural seeds in West Bengal coast has been the main impediment for undertaking its culture. At present, culture potential of this species in brackish water of the Sunderbans region of West Bengal is being explored.

Length-weight relation parameters and condition factor provide basic information to the producer with an evaluation of the specific conditions under which organisms are growing[5]. Length-weight relationship (LWR) of fish also plays a significant role in studying the growth, rate of feeding, metamorphosis, fatness, onset of maturity, gonadal development and general well-being of the fish population[6,7]. Further, it helps in establishing the biomass and in converting one variable to another as is often required during regular samplings for culture operation. Whereas, condition factor (*K*) is a quantitative parameter estimated based on length-weight data, that indicates the state of well-being of the fish for determining the present and future population success by its influence on growth, reproduction and survival[8]. Though few reports on LWR and *K* of milkfish cultured in freshwater[9], brackishwater[10,11], inland saline ground water[12] and captured from coastal lagoon water[13] are available, no information exists in these aspects of the species cultured in tide-fed brackish water ponds of the Sunderbans, West Bengal.

Materials and methods

The present study was carried out during an experimental farming of milkfish in the Sunderbans region of West Bengal for the period of July 2008 to

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June 2009. Seeds (3.11±0.50cm/ 0.21±0.09 g) brought from the Tamil Nadu coast, were stocked at the rate of 4000 numbers/ha in two tide-fed brackishwater ponds of 0.09 ha each of the Kakdwip Research Centre of Central Institute of Brackishwater Aquaculture, Kakdwip (Lat. 21°51'15.01"- 21°51'30.77" N, Long. 88°10'58.44"- 88°11'12.09"E), South 24 Parganas, West Bengal, India. The fish were grown under natural productivity of fertilized ponds with provision of no supplementary feeding. Ponds were fertilized fortnightly with application of cattle dung, urea and single super phosphate at the rate of 500, 30 and 30 kg/ha, respectively for sustained production of fish food organisms. Water of the culture ponds was exchanged monthly at 40-50% rate during high tides with maintenance of 1 m depth throughout the culture period.

LWR was calculated from the data collected from fish samples of both the ponds at monthly intervals. For each individual fish, total length (*TL*) was measured to the nearest 0.1 cm and whole body weight (*W*) was recorded to the nearest 0.01 g. The mathematical relationship between length and weight was calculated using the conventional formula[14]:

$$W = a.TL^b \quad \ldots (1)$$

Where *a* is the proportionality constant and *b* is the isometric exponent.

Statistical significance of the isometric exponent (*b*) was analyzed with a function[15] based on the t-test:

$$t = \frac{s.d.(x)}{s.d.(y)} . \frac{|b-3|}{\sqrt{1-r^2}} . \sqrt{n-2} \quad \ldots (2)$$

Where *t* is the *t*-student statistic; *s.d.*(*x*) and (*y*) are the standard deviation of log *TL* and *W* values; r^2 is the potential fit determination coefficient; *n* is the number of specimens recorded.

The Fulton's condition equation was used to find out the condition factor of each individual fish[16]:

$$K = \left(W/TL^3\right) \times 100 \quad \ldots (3)$$

K values of individual fish were pooled to calculate monthly mean.

Water samples from both the ponds were collected between 09:00 and 10:00 hours at 15-day intervals to measure important parameters. Temperature, pH, dissolved oxygen, total alkalinity, inorganic nutrients (total ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen and phosphate-phosphorus) and gross primary productivity were measured following standard methods[17] and salinity was assessed using a refractometer (ATAGO, Japan). Plankton samples were also collected during each water sampling by filtering 50l of water from each pond with the help of a bolting silk plankton net (No.25, mesh size 64 μ). Plankton concentrates were immediately preserved in 5% formalin for quantitative analysis using a Sedgewick-Rafter counting cell following direct census method[18]. All data in the paper are expressed as mean±standard deviation (S.D.).

Results and Discussion

Water quality parameters

The water quality parameters of the two ponds are presented in Table 1. The recorded parameters were within the optimum ranges for brackishwater aquaculture[19,20]. However, salinity showed wide variation in both the ponds (3.4-18.0 and 3.5-17.0 ppt) throughout the culture duration and it was attributed mainly to the seasonal changes with the highest value

Table 1— Water quality parameters in the experimental ponds

*Water parameters**	*Pond 1 (n=25)*	*Pond 2 (n=25)*
Temperature (°C)	19.0–32.0 (27.1±3.3)	18.5–32.0 (27.2±3.3)
pH	7.80–8.54 (8.17±0.17)	7.75–8.50 (8.12±0.19)
Dissolved oxygen (mg/l)	7.00–8.80 (7.75±0.43)	6.00–9.20 (7.79±0.66)
Total alkalinity (mg $CaCO_3$/l)	136.0–192.0 (156.6±14.7)	108.0–184.0 (150.7±19.3)
Salinity (ppt)	3.4–18.0 (9.4±4.9)	3.5–17.0 (9.4±4.7)
Total ammonia-nitrogen (mg/l)	0.002–0.122 (0.037±0.042)	0.002–0.122 (0.030±0.039)
Nitrite-nitrogen (mg/l)	0.009–0.036 (0.019±0.008)	0.001–0.036 (0.018±0.009)
Nitrate-nitrogen (mg/l)	0.057–0.184 (0.135±0.030)	0.074–0.181 (0.134±0.029)
Phosphate-phosphorus (mg/l)	0.002–0.095 (0.051±0.031)	0.002–0.094 (0.052±0.029)
Gross primary productivity (mgC/m^3/hr)	112.50–656.20 (345.38±150.01)	156.24–598.71 (320.90±149.26)

*Values indicate range; figures in parentheses are expressed as mean±S.D. of parameters recorded at 15-day intervals for a period of 12 months.

during May and the lowest during November. This is the usual seasonal salinity variation of the tidal water in the Sunderbans region[21].

Monthly mean phytoplankton and zooplankton counts revealed uniform trends until January and then there were marked progressive decrease from February to the end of the experiment in both the ponds (Fig. 1).

Length-weight relationship

The LWR of 380 specimens of milkfish exhibited curvilinear growth pattern (Fig. 2). Monthly growth increment for length and weight showed gradual increase over the culture period (Fig. 3). When the parameter *b* is equal to 3, growth is called isometric and when it is lesser or greater than 3, it is allometric[22]. As the slope value (b = 2.9859) obtained was not different from 3 based on t (t = 0.8192; P>0.05), the growth of milkfish was isometric. The value of *b* was comparatively higher than the slope value (2.622) of fishes reared in inland saline ground water[12] and brackishwater pond[10]and lower than the fishes (3.2598) caught from the Negombo lagoon of Sri Lanka[13]. The isometric exponent value (2.9859) of the present study lies between the values of 2.887-3.145 and 2.854-3.411 recorded for the milkfish fingerlings collected from freshwater[9] and coastal seawater of the Philippines[11], respectively. The *b* value in the present study indicated that the fish maintained a constant body shape with proportionate increase in length and weight.

Condition factor

The Fulton's condition factor ranged between 0.427 to 1.429 with the highest mean value of 0.936 in January and the lowest mean value of 0.670 in June

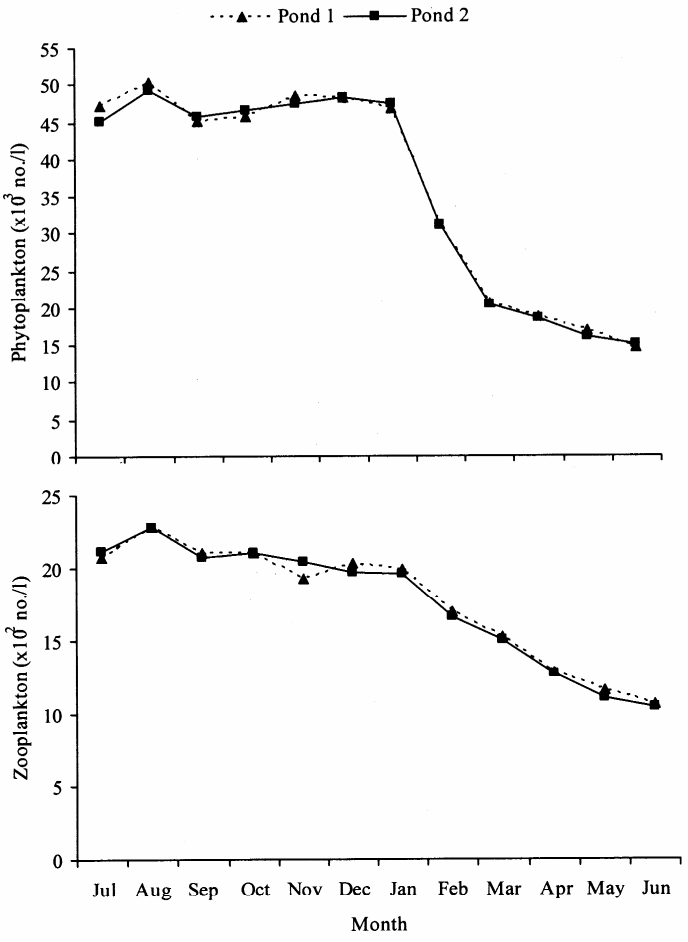

Fig 1—Monthly variation of mean plankton counts in the two experimental ponds.

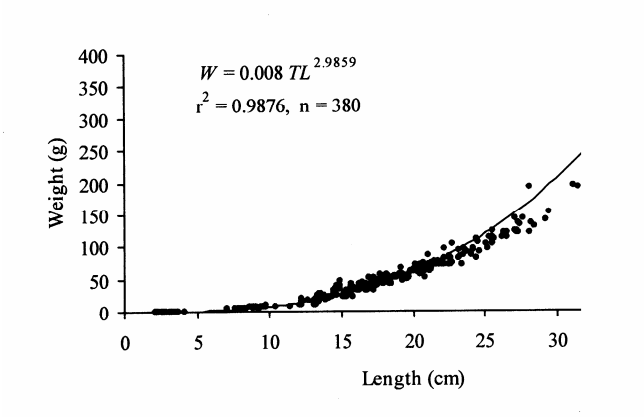

Fig 2—Length-weight relationship of milkfish grown in tide-fed brackishwater ponds of the Sunderbans, West Bengal.

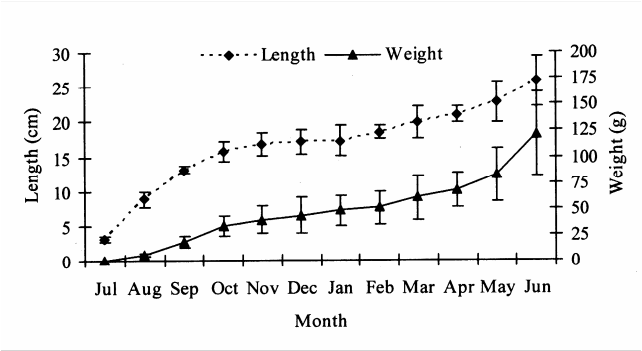

Fig 3—Monthly growth increment (mean±S.D.) of milkfish from tide-fed brackishwater ponds.

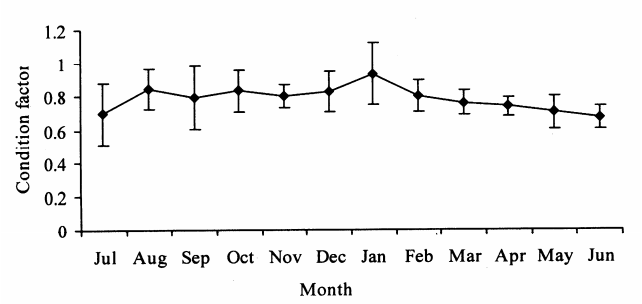

Fig 4—Monthly variation of mean values (±S.D.) of Fulton's condition factor of milkfish cltured in tide-fed brackishwater ponds of the Sunderbans, West Bengal.

(Fig. 4). The higher values were observed in the fishes of 14.4-20.8 cm size and the larger grown fishes of 21.0-37.3 cm size exhibited lower values. This observation was in consistence with the values in the range 0.79-0.91 of milkfish fingerlings (12.2-25.3 g) raised in brackishwater ponds of the Philippines[11]. *K* values in the present study suggest that smaller-sized fishes grew well with better plumpness than larger individuals. Examination of the *K* values indicated that smaller fishes exhibited healthy and robust condition showing good compatibility with the environment and larger individuals showed poorer growing condition. The possible reason is that with the increase of fish size and total biomass, the natural pond productivity maintained through periodical fertilization could not support adequate food availability to the growing fishes. This is well evident from the decreasing trends of the plankton counts after January with the lowest values in the last month of culture (Fig. 1). Hence, it is inferred that provision of supplementary feeding is necessary after attainment of certain size (17.24±0.40 cm/47.72±2.70 g) to produce milkfish with good plumpness in tide-fed brackishwater pond system.

Although, LWRs for this species from different locations of the globe are available in FishBase[23], the present finding will be the first report from the Sunderbans region of West Bengal, India.

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