LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF DISTICHODUS SPECIES OF ANAMBRA RIVER

NWANI Christopher Didigwu
Department of Applied Biology Ebonyi State University Abakaliki

Corresponding Author: Nwani, C. D. Department of Applied Biology Ebonyi State University, Abakaliki. Email: nwanicd@yahoo.com Phone: 234-8037509910

ABSTRACT

The length-weight relationships (LWRs) and condition factor of Distichodus 169 Distichodus rostratus, 167 D. brevipinnis and 163 D. engycephalus from Anambra river were investigated from November 2004 to October 2005. LWRs showed that the b-values for the combined sexes were 3.051, 3.114 and 3.040 for D. rostratus, D. brevipinnis and D. engycephalus respectively. Thus, all the Distichodus species exhibited isometric growth with high, positive and significant correlations. The mean condition factor for the combined sexes was 1.12 ± 0.48, 1.06 ± 0.22 and 0.94 ± 0.33 for D. Rostratus, D. brevipinnis and D. engycephalus respectively. Except for D. brevipinnis, there was no significant difference (P > 0.05) in the condition factor (K) between the males and females of other species. The condition factor also demonstrated interseasonal variability in all the species. The importance of condition factor in the breeding activities of Distichodus species is discussed.

Keywords: *Distichodus*, Length-weight relationships, Condition factor

INTRODUCTION

Distichodus species are among the major exploitable fish species and are widely distributed in Nigeria, Nilo-Sudan, Niger, Volta, Chad and Nile basins (Teugels *et al.* 1992). They are used extensively in aquaculture on account of the ready availability of their seeds in the wild for stocking, good adaptation to climate, ability to support high population densities and to feed on grasses and weeds in ponds (Satia, 1990). Although a sizeable amount of literature exists on their biology, especially their length-weight relationships and condition factor (Imevbore and Okpo 1972; Arawomo, 1982; Francisco, 1992; Entsua-Mensah *et al.,* 1995; King, 1996, 1998; Nwani, 1998; Ezenwaji, 2004 among others) in some inland water bodies there is still paucity of information on the biology of *Distichodus* species in Anambra river, their importance and potentials not withstanding. The present study thus examines the length-weight relationship and condition factor to fill a gap in the current knowledge of the species.

MATERIALS AND METHODS

Study Area: The Anambra river has its source in Ankpa highlands of Kogi State of Nigeria about 100 km North of Nsukka (Azugo, 1978). It lies between latitudes $6^{0}10^{-}$ and $7^{0}40^{-}$ East of the Niger (Awachie, 1975). Essentially the river has a southward course crossing the Kogi / Enugu State boundary, then meanders through Ogurugu to Otuocha from where it flows down to its confluence with the Niger at Onitsha. The main river channel, which has a total length of about 207.40 km (Azugo 1978), has its bank covered by such plants like *Echinoclae species, Salvinia nymnellula, Ludiwigia decurrens, Imperita cylindirica, Andropogon spp, Jussiaea spp, Pennisetum spp and Cynodon spp*. There is a rainy season (April – September / October) and a dry season (October / November - March). From December to January / February, the basin is influenced by the harmattan but their effect is not well marked. Agricultural activities are very high and crops such as yam, cassava, rice, millet, vegetables, groundnut, potatoes, banana, and plantain are produced in large quantities. Fishing methods in the river basin include bailing out of water or pumping out water from ponds with water pumps, construction of fish fences, the use of "atalla", hooks and line, set lines, lift nets, dragnets, beach seines, cast nets, among others (Awachie and Ezenwaji, 1981; Eyo and Akpati 1995). Species of fishes found in the river include *Distichodus, Alestes, Mormyrids, Clarias, Labeo* and *Heterobranchus* among others.

Fish Sampling: Fish samples were collected monthly around Otoucha and Ogurugu river ports along the Anambra river between November 2004 and October 2005, using gill nets of mesh sizes ranging from 38.1 mm to 177.8 mm. Baskets, traps and hook and lines were also used. Fish collected were preserved in ice and transported to the laboratory for measurements. Each fish was weighed to the nearest 0.1 g and total and standard lengths were determined to the nearest centimeter.

Biometrics: The length -weight relationships of the Distichodus species were determined employing the power curve: $W = aL^{b}$, where W = wet weight of fish in grams, L = standard length in centimeters, and a and b are regression constants. The logarithm-transformed data gave the straight line relationship thus: Log W = log a + bLog L. The condition factor for each specimen was calculated using the method of Bagenal and Tesch (1978) thus: $K= W/L^{3} X 100/1$;

where K = condition factor, W = weight of fish in grams and L = length of fish in centimeters. The coefficient of variation (CV) was determined as: CV = [S/X x 100/1] % (King and Udo, 1996); where S = standard deviation and x = population mean.

Data Analysis: T-test was used to verify if the 'b' values obtained were significantly different from 3. The sexual and seasonal variations in condition factor were also determined using t-test, while the coefficient of variation (CV) was tested by the F-test.

RESULT

Length-Weight Relationship: The length-weight relationship and related parameters of the male, female and combined sexes of *Distichodus* species in Anambra river are presented in Table 1. In all the *Distichodus* species studied, the b values were not significantly different from 3 ($P > 0.05$) thus indicating isometric growth patterns for all the species. The correlation coefficients were all positive and highly significant. The intercept 'a' showed high heterogeneity among the populations (CV = 1003.5 %) and varied from 5.6×10^{-3} in *D. brevipinnis* combined sex to 4.5×10^{-2} in *D engycephalus* combined sex. Conversely, the exponent 'b' showed low variation among the populations (CV = 8.937 %) and ranged from 2.845 in male *D. brevipinnis to* 3.051 in the combined sex of *D. rostratus*

Condition Factor (K): The monthly variations in the mean condition factors for the three species of *Distichodus* are presented in Table 2. The mean K-value of male *D. rostatus* varied from 0.36 ± 0.04 in April to 1.79 ± 0.11 in September with an annual mean of 1.08 ± 0.45. The mean K for the wet season (1.35 ± 0.51) was significantly higher than the dry season (0.82 ± 0.14) ($t = 2.40$, df_{10}, $P < 0.05$). The coefficient of variation (CV) (Table 3) for the wet season (CV = 58.48 %) was significantly different from the dry season (CV = 43.45 %) ($F = 2.30$, $P < 0.05$). The female K-value ranged from 0.57 ± 0.10 in February to 1.98 ± 0.17 in August with a mean of 1.17 ± 0.50. Mean K-value for the wet season (1.53 ± 0.49) was significantly differed from that of the dry season (0.82 ± 0.15) ($t = 3.38$, df_{10}, $P < 0.05$). The coefficient of variation (CV) for the wet season (51.13 %) was not significantly different from the dry season (48.43 %) ($F=1.08$, $P > 0.05$). There was -no significant difference in the average condition factor between male and female *D. rostratus* ($t = 0.464$, df_{22} $P > 0.05$). The K-value for the combined sex was 1.12 ± 0.48. The wet season value of 1.67 ± 0.28 was significantly different from the dry season value of 0.58 ± 0.18 ($t = 2.10$ df_{10} $P < 0.05$). However, the coefficient of variation for the wet (55.75 %) was not significantly different from the dry season (44.29 %) ($F = 1.94$, $P > 0.05$).

The mean K-value for male *D. brevipinnis* was 1.02 ± 0.20. The factor varied from 0.70 ± 0.35 in November during the onset of dry season to 1.32 ± 0.12 in September during the peak of the rains. The mean K-value for the dry season (0.91 ± 0.19) and wet season (1.14 ± 0.14) were not significantly different ($t = 0.30$, df_{10}, $P>0.05$). The coefficient of variation (CV) for the dry season (81.73 %) was significantly different from that of the wet season (40.98 %) ($F = 2.67$, $P < 0.05$). The average female condition was 1.12 ± 0.25 and varied from 0.79 ± 0.26 in November to 1.63 ± 0.35 in May. The K-value of 0.93 ± 0.11 for the dry season differed significantly from that of the wet season (1.30 ± 0.22), ($t= 3.90$, df_{10}, $P < 0.05$). In contrast, the coefficient of variation (CV) for the wet (37.52 %) was not significantly different from the dry season (37.06 %) value ($F = 1.07$, $P > 0.05$). The mean male K-value of *D. brevipinnis* was significantly different from that of the female ($t= 1.08$, df_{22}, $P < 0.05$). The mean K-value for the combined sex was 1.06 ± 0.22 and was not significantly different between the seasons, 1.20 ± 0.40 for the wet and 0.86 ± 0.14 for the dry seasons, ($t = 1.12$, df_{10}, $p > 0.05$). Similarly the coefficient of variation for the wet season (CV = 40.33 %) and dry season (41.51 %) were not significantly different ($F = 1.63$, $P > 0.05$).

Male condition factor for *D. engycephalus* ranged from 0.63 ± 0.07 in December to 1.35 ± 0.23 in August with a mean value of 0.90 ± 0.30. Average condition factor for the dry season (0.67 ± 0.03) and wet season (1.12 ± 0.27) were significantly different ($t = 4.10$, df_{10}, $P< 0.05$). Similarly the coefficient of variation (CV) for the dry (26.50 %) and wet (49.29 %) seasons were significantly different ($F = 2.64$, $P < 0.05$). The mean condition factor for the female *D. engycephalus* was 0.98 ± 0.37 and ranged between 0.67 ± 0.07 to 1.74 ± 0.90. The average condition factor for the dry (0.72 ± 0.06) and wet (1.23 ± 0.38) seasons were significantly different ($t = 3.27$, df_{10} $P<0.05$). Similarly, the coefficient of variation for the wet season (CV = 52.86 %) significantly differed from the dry season (CV = 31.11 %) ($F= 2.17$, $P< 0.05$). There was, however, no significant difference between the condition factors of males and females D. *engycephalus* ($t = 0.58$, df_{22}, $p>0.05$). Considering the combined sex, the average condition factor was 0.94 ± 0.33. The wet season value of 1.38 ± 0.45 was significantly different from the dry season value of 0.69 ± 0.08 ($t= 2.04$, df_{10}, $p < 0.05$). The coefficient of variation (CV) for the dry (50.58 %) was also significantly different from the dry season value of 27.63 % ($F = 2.04$, $p < 0.05$)

DISCUSSION

The isometric growth pattern exhibited by *Distichodus* species of Anambra river is consistent with the b-values reported for other African *Distichodus* species (Entsua-Mensah *et al,* 1995., Palomeres *et al*. 1996., Francisco, 1992). The result however differed from the allometric growth of some distichodontides in Nigeria (King 1996a, Ezenwaji, 2004) with b values ranging from 2.158 to 3.354. The variation especially in the case of Ezenwaji (2004) may be attributed to the number of specimens used (< 60).

Table 1: Length-weight relationship of *Distichodus* species of Anambra river basin

Species	Sex	a	b	r	Number N	Length Max	Range (cm) Min
D. rostratus	M	0.0071	2.993	0.854	84	32.06	11.00
D. rostratus	F	0.0082	3.012	0.6894	85	34.04	13.06
D. rostratus	M and F	0.0064	3.051	0.8809	169	35.08	13.60
D. brevipinnis	M	0.0066	2.845	0.7102	81	38.80	12.04
D. brevipinnis	F	0.0064	3.040	0.6640	86	38.80	13.60
D. brevipinnis	M and F	0.0056	3.014	0.7460	167	39.60	13.62
D. engycephalus	M	0.0074	3.011	0.6024	76	9.00	27.50
D. engycephalus	F	0.0088	2.996	0.5832	84	10.06	31.40
D. engycephalus	M and F	0.0455	3.040	0.6194	163	30.20	11.50

a = regression intercept, b = slope and r = correlation coefficient

Table 2: Monthly variations in the condition factor (cf = w. 1000/L^3) of *Distochodus* species in Anambra River Basin

Month	*D. Rostratus*			*D. brevipinnis*			*D. engycephalus*		
	Male	Female	Male and Female	Male	Female	Male and Female	Male	Female	Male and Female
Nov 2004	0.78±0.7	0.78±0.16	0.78±0.15	0.70±0.35	0.75±0.26	0.75±0.31	0.68±0.07	0.77±0.11	0.72±0.09
Dec 2004	0.08 ± 0.14	1.93±0.13	0.87±0.14	1.08±0.22	1.02±0.18	1.05±0.20	0.63±0.07	0.67±0.08	0.64±0.08
Jan 2005	1.05±0.23	0.97±0.24	1.01±0.24	0.03±0.22	0.89±0.30	0.89±0.26	0.64±0.09	0.66±0.08	0.66±0.99
Feb 05	0.90±0.10	0.89±0.12	0.90±0.11	1.12±0.08	1.06±0.30	0.09±0.19	0.07±0.18	0.74±0.12	0.72±0.15
March 05	0.36±0.04	0.59±0.28	0.48±0.1	0.90±0.26	1.43±0.43	1.18±0.35	1.34±0.18	1.42±0.19	1.43±0.19
April 05	1.63±0.47	1.74±0.56	1.69±0.52	1.18±0.20	1.63±0.35	1.41±0.28	0.74±0.05	0.73±0.16	0.74±0.11
May 05	1.44±0.17	1.43±0.23	1.44±0.20	1.23±0.15	1.09±0.21	1.16±0.18	16±0.15	1.74±0.90	1.45±0.53
June 05	1.28±0.46	1.65±0.20	1.47±0.30	1.04±0.21	1.11±0.16	1.08±0.19	1.17±0.09	1..20±0.15	1.19±0.12
JULY 05	1.58±0.21	1.98±0.17	1.78±0.19	1.14±0.18	1.23±0.10	1.19±0.19	1.35±0.23	1.45±0.17	1.40±0.20
AUG 05	1.79±0.11	1.76±0.14	1.77±0.13	1.32±0.12	1.32±0.12	1.32±0.12	0.90±0.9	0.81±0.54	0.76±0.54
SEPT 05	0.67±0.21	0.76±0.18	0.63±0.20	0.76±0.37	1.00±0.35	0.73±0.36	0.71±0.36	0.81±0.54	0.76±0.54
Mean	$\bar{x}$ =1.08±0.45	$\bar{x}$ =1.17±0.50	$\bar{x}$ =1.12±0.48	$\bar{x}$ =1.02±0.20	$\bar{x}$ =1.12±0.25	$\bar{x}$ =1.06±22	$\bar{x}$ =0.90±0.30	$\bar{x}$ =0.98±0.37	$\bar{x}$ =0.94±0.33

Table 3: seasonal variation in condition factor and coefficient of variation (CV) among three *Distichodus* species of Anambra river

Species	Condition factor			Coefficient of variation (%)		
	Dry season	Wet season	T-Value	Dry season	Wet season	T-Value
			D. rostratus			
M	0.82±0.14^a	1.35±0.51^b	2.40	43.45^a	58.48^b	2.30
F	0.82 ±0.15^a	1.53±0.49^b	3.38	48.43^b	51.13^a	1.08
M and F	0.58±0.18^a	1.67±0.28^b	2.01	44.29^a	55.75^a	1.94
			D. brevipinnis			
M	0.91±0.19^a	*1.14±0.14^a*	0.39	81.73^a	40.98^b	2.67
F	0.93±0.11^a	*1.30±0.22^b*	1.30	37.06^a	37.52^a	1.07
M and F	**0.86**±0.14^a	*1.20±0.40^a*	1.12	41.51^a	40.43^a	1.63
			D. engyphalus			
M	*0.67±0.03^a*	*1.12±0.27^b*	4.10	26.50^a	49.29^b	2.64
F	0.72±0.06^a	*1.23±0.38^b*	3.27	31.11^a	52.86^b	2.17
M and F	*0.69±0.08^a*	1.38±0.45^b	1.05	50.58^a	27.63^b	2.04

a and b indicate significant corresponding means at P=0.05

The non-significant difference in the average condition factor in male and female *Distichodus* species excluding *D. brevipinnis* is in line with the findings of Arawomo, 1982; Francisco 1992., Ahmed and Saha, 1996; King, 1996; Nwani, 1998., Ezenwaji 200 among others.

The present study also revealed that except for *D. brevipinnis* the mean condition factor for the combined sexes in the wet season were significantly higher than that of dry season. This agrees with the mean K of female *Periophthalmus barbarus* in Imo river (King and Udo, 1996) and *Heterobranchus bidorsalis* in Idodo river (Anibeze 1995). The high condition factor noted in the wet season could be attributed to increased food availability occasioned by flooding, favourable environmental condition and gonad development. Conversely, the low condition factor observed during the dry season may be attributed to physiological stress due to changes in physical and chemical conditions of the habitant. Earlier workers (Olatunde, 1983; Nwadiaro and Okorie, 1985; Mgbenka and Eyo, 1992; Ikomi, 1996; Ekanem, 2000) made similar observation.

REFERENCES

AHMED, K. K. and SAHA, S. B. (1996). Length-weight relationships of major carps in Kaptai Lake, Bangladesh, *Naga, ICLARM Quarterly,* 19(2): 28.

ANIBEZE, C. I. P. (1996). *Aspects of the Ecobiology of Heterobranchus longifilis* (Val 1840) *in Idodo river basin (Nigeria) and their application to Aquaculture.* Ph.D. Dissertation, University of Nigeria, Nsukka. 153 pp.

ARAWOMO, G. A. O. (1982). Food and feeding of three *Distichodus* species (Pisces: Characiformes) in lake Kainji Nigeria. *Hydrobiologia, 94:* 177 – 181.

AWACHIE, J. B. E and EZENWAJI, H. M. G. (1981). The importance of *Clarias* species in the fisheries development of the Anambra river basin Nigeria. *CIFA Technical Paper, 8:* 212 – 233.

AZUGO, W. I. (1978). *Ecological studies of the helminth parasites of the fish of Anambra river system.* M. Phil Thesis, University of Nigeria Nsukka, 178 pp.

BAGENAL, T. B. and TESCH, F. W. (1978). Age and growth. Pages 101 – 136. *In:* T. B. Bagend (ed). *Methods for the assessment of fish production in fresh waters.* Blackwell Scientific Publication, Oxford.

EKANEM, S. B. (2000). Some reproductive aspects of *Chrysichthys nigrodigitatus* (Lacepede) from Cross River, Nigeria *Naga ICLARM. Quarterly, 3(2):* 24 – 28

ENTSUA-MENSAH M., OSEI-ABUNYEWA, A and PALMERS, M. L. D. (1995). Length-weight relationship of fishes, Ghana: Part I. Analysis of pooled Data sets. *Naga ICLARM Quarterly, 18(1):* 36 – 38.

EYO, J. E and AKPATI, C. I. (1995). Fishing gears and fishing methods. Pages 143 – 167. *In:* EZENWAJI, H. M. G, INYANG, N. M and ORJI, E. C. (Eds). Proceeding of the UNDP assisted Agriculture and rural development programme (Ministry of Agriculture Awka, Anambra State). Training course on Artisanal Fisheries development, held at University of Nigeria Nsukka, October 29-November 12, 1995.

EZENWAJI, H. M. G. (2004). Length-weight relationships of fishes from Anambra river, South-Eastern Nigeria. *Animal Research International, 1(1):* 1 – 6.

FRANCISCO, S. B. (1992). Length -weight relationship of Lake Kariba fishes. *Naga ICLARM Quarterly, 15(4):* 42 – 43.

IKOMI, R. B (1996). Studies on the growth pattern, feeding habits and reproductive characteristics of the mormyrid *Brienomyrus longionalis* (Boulenger, 1901) in the Upper Warri River Nigeria. *Fisheries Research,* 26: 187 – 198.

IMEVBORE, A. M. A and OKPO, W. S. (1972), Aspects of the Biology of Kainji Lake Fishes. The ecology of lake Kainji. *Limnology, 1:* 163 – 178.

INYANG, N. M. (1995). On the fish fauna of Opi Lakes, South-Eastern Nigeria, with particular reference to the biology of *Tilapia z*illi (Gervais, 1948) Cichlidae. *Journal of Aquatic Sciences,* 10: 29 – 36.

KING, R. P. (1996). Length –weight relationship of Nigerian fresh water fishes. *Naga ICLARM Quarterly,* 19(3): 49 - 5 2.

KING, R. P. and UDO, M. T. (1996). Length weight relationship of the mud skipper P*eriophthalmus barbarus* in the Imo River estuary. *Naga ICLARM Quarterly,* 19(2): 27 – 28.

KING, R. P. (1998). Weight –Fecundity relationship of Nigeria Fish Populations *Naga ICLARM Quarterly 21(3): 33 – 38.*

MGBENKA, B. O. and EYO, J. E. (1992). Aspects of the biology of *Clarias gariepinus* in Anambra river basin. 2. Maturation and condition factor. *Journal of Agricultural Science and Technology,* 7: 52 – 55.

NWADIARO, C. S. and OKORIE, P. U. (1985). Biometric characteristics, Length-weight relationship and condition factors in *Chrysichthys filamentosus* (Pisces: Bagriidae) from Oguta Lake Nigeria, *Biologia Africa, 2(1):* 48 – 57.

NWANI C. D. (1998). *Aspects of the biology of Distichodus species in Anambra river, Nigeria.* Msc Project Report, University of Nigeria, Nsukka. 133 pp

NWANI C. D. (2004). *Aspects of the biology of Mormyrids (Osteichthyes: Mormyridae) in Anambra river, Nigeria. PhD Thesis* University of Nigeria Nsukka 194 pp.

OLATUNDE, A. A. (1983). Length – weight relationship and the diets of *Clarias lazera*

(Cuvier and Vallenciennes), Family Clariidae (Osteichthyes: Siluriformes) in Zaria, Nigeria. Pages 183 – 192. *In*: ITA, E. O. (ed). *Proceedings of the 3rd Annual Conference of the Fisheries Society of Nigeria* (FISON), Maiduguri.

PALOMERES, M. L. D., ENTSUQ-MENSAH, M. and OSEI-ABUNYENWA, A. (1996). Length - weight relationships of Fishes from tributaries of the Volta Rivers, Ghana: Part 11 and Conclusion. *Naga ICLARM Quarterly, 19(1):* 45 – 47.

SATIA, B. P. (1990). National Reviews for Aquaculture Development in Africa. 29, Nigeria. *FAO Fisheries Circular, Number 770:* 193 pp.

TEUGELS, G. G., MCGREID, G. and KING, R. P. (1992). Fishes of the Cross River Basin (Cameron Nigeria): Taxonomy, Zoogeography, Ecology centrale, Tervuren, Belgium.

.