



Impact of Helminth Parasites on Length-weight Ratio and Condition Factor of Fishes in Ajiwa and Jibia Reservoirs, Katsina State, Nigeria

Abba AM*, Abdulhamid Y, Omenesa RL and Mudassir I

Department of Biological Sciences, Nigerian Defence Academy, P. M. B 2109, Kaduna, Nigeria

*Corresponding author: Abba AM, Department of Biological Sciences, Nigerian Defence Academy, PMB 2109, Kaduna, Nigeria, Tel: +2348036155551; E-mail: amabba89@yahoo.com

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Abstract

Helminth parasites, length-weight relationship (LWR) and condition factor (K) of fishes in Ajiwa and Jibia reservoirs, Katsina State, Nigeria were investigated. From August 2016 to January 2017, 269 (136 *O. niloticus* and 133 *C. gariepinus*) and 242 (117 *O. niloticus* and 125 *C. gariepinus*) fish samples from Ajiwa and Jibia reservoirs respectively were randomly selected from the catches of the local fishermen and were observed for helminth parasites. The parasites were identified using relevant literatures. *C. gariepinus* recorded the highest prevalence of 34.59 and 43.2% in Ajiwa and Jibia reservoirs respectively compared to 21.3 and 29.91% in *O. niloticus* in Ajiwa and Jibia reservoirs respectively. Chi-square test revealed significant difference ($p < 0.05$) between the Reservoirs and species examined. Length-weight relationship (LWR) and K factor of all individual fishes were determined. The regression coefficient "b" obtained was < 3 , thus indicating negative allometric pattern of growth in both species. There was strong positive correlation between the length and weight of the fish species ($r > 0.8$). Condition factor (K) of infected and uninfected fishes indicated that the K factor of infected *O. niloticus* was slightly higher than the uninfected *O. niloticus* in Jibia reservoir. However, in other groups of fishes, the K factor of uninfected fishes was slightly higher than that of the infected fishes. The result also indicated that the K factor of *O. niloticus* in the two reservoirs was higher ($K > 3$) than that of *C. gariepinus* ($K < 2$). This however, indicated that *O. niloticus* performed better than *C. gariepinus* in the study areas.

Keywords: Condition factor; Ajiwa, Jibia; *Oreochromis niloticus*; *Clarias gariepinus*

Introduction

Fish has continued to be the cheapest source of animal protein among the urban and rural populace [1] and economically as a source of subsistence income [2]. In most part of the world, fish production is mainly from the wild. As the world population grows, fish production can no longer meet the demand of the growing population because fish resources are being depleted at an increasing rate as a result of environmental degradation, over harvesting, overcrowding, poor

environmental conditions and pollution. Like humans and other animals, fishes suffer from various disease including parasitic infections [3].

Knowledge of some quantitative aspects such as length-weight relationship is important in studying fish biology. Length-weight relationships can be used to predict weight from length measurements made in the yield assessment. Condition factor which show the degree of well-being of the fish in their habitat is also a useful index for monitoring of various ecological and biological factors such as degree of fitness, gonad development, feeding intensity, age, and growth rate in fish [4,5].

Diseases as well affect fish production through direct fish mortality, nutrient devaluation, alteration of biology and behavior, lowering of immune capability, induction of blindness, growth and fecundity reduction and mechanical injuries which depends on the parasite species and load [6]. Helminthes are among the most important parasites and include nematodes, trematodes, cestodes and acanthocephalans affecting both wild and cultured fishes [7]. Parasitic helminthes can cause swollen abdomen in fishes thereby contributing to either pseudo weight or length of fishes and can also lead to stunted growth thereby reducing the length and weight of the fish [8].

Information on the length-weight characteristics and condition factor of fishes from the study areas are very dispersed and negligible. Therefore the present research was carried out to reveal the possible effect of helminth parasites on length-weight relationship and condition factor of *Oreochromis niloticus* and *Clarias gariepinus* in Ajiwa and Jibia Reservoirs of Katsina State, Nigeria [9].

Material and Methods

Study areas

Ajiwa Reservoir: The Reservoir is found in Ajiwa district of Batagarawa Local Government Area of Katsina State. Batagarawa lies between latitude $12^{\circ} 98' N$ and $12^{\circ} 58' E$ and longitude $7^{\circ} 75' N$ and $7^{\circ} 45'$. It has an area of 433 km² and a population of 184,575 at the 2006 census.

Jibia Reservoir: The Reservoir is located in Jibia Local Government Area of Katsina State. Jibia lies between latitude $13^{\circ} 05' N$ and $7^{\circ} 13' E$ and longitude $13^{\circ} 09' N$ and $7^{\circ} 23' E$. It has a total human population of 169,748 and total land mass of about 1,037 km². The Reservoir lies on the coordinates $13^{\circ} 04' 18' N$ and $07^{\circ} 15' 06' E$. It has a height of 23.5 m, a length of 3,660 m and a total capacity of 142 mm³.

Samples collection

A total of 511 fish samples comprising of *Oreochromis niloticus* (136 and 117 from Ajiwa and Jibia Reservoir respectively) and *Clarias gariepinus* (133 and 125 from Ajiwa and Jibia Reservoir respectively) were randomly selected from the catches of the local fishermen and purchased over a period of six months from August 2016-January 2017. Sample collections were done in the morning between 06:00 AM to 08:00 AM. Water from the reservoir was added to the samples before being transported in aerated plastic containers to the Department of Biological Science Laboratory of Umaru Musa Yar'adua University Katsina for examination.

Morphometric study

Fish morphometric measurements (measuring of weight and length) prior to observation of external fish condition and dissection was done. The standard length were measured and recorded to nearest 0.5 centimeter (cm) using a transparent ruler on a measuring board [10]. The standard length of each fish was taken from the tip of the snout to the end of the caudal peduncle [9]. Weight of each fish was taken using a sensitive weighing balance (Scout Pro SPU202) and recorded appropriately [7].

Examination of fishes for parasites

The external surface of the fish was grossly examined using a hand lens for ectoparasites. Scrapings from the skin, fins and gills were smeared on a microscopic slide and examined using dissecting microscope for ectoparasites [11]. The body cavity was opened with the aid of scissors and the mesentery and connective tissues, connecting loops of the gut and the liver were cut and the organs separated. The gut was then placed in a large Petri dish, stretched out and cut into four regions (oesophagus, stomach, intestine and duodenum). Each section was then placed in a separate labeled dish. The separated gut sections were opened by longitudinal incision to expose the inner surface which was washed with very little quantity of distilled water into labelled test tubes. A drop of the residue was placed on the slide, and observed under x10 and x40 objectives of dissecting and light microscope for the various parasites. This was repeated until the entire residue was examined [12]. Fish specimens found with parasite were given separate serial numbers to differentiate them from those without parasites. Parasites obtained were counted, labeled with the serial number of the fish and placed in physiological saline overnight to allow them stretch and relax; they were then fixed and stained using acetocarmine and lactophenol for identification to generic and species level where possible. Identification was carried out using keys provided with the assistance of a parasitologist [13-16].

Length-weight relationship and condition factor

Using the methods described by Dan-Kishiya [17], the relationship between the length (L) and weight (W) of fishes were calculated. Calculations for infected and uninfected fish species was done separately and also combined using the conventional formula as follows:

$$W = aL^b$$

The above equation and data was transformed in to logarithms before the calculation was made in order to obtained 'a' and 'b'. The equation becomes:

3

Statistical analysis

The relationships between species and reservoirs and parasitic infection were obtained using Analysis of Variance (ANOVA). Values equal to or less than 0.05 ($p \leq 0.05$) were regarded as significant. Linear regression table was used to ascertain the significance of the relationship derived from the length weight analysis of infected and uninfected fish species. All statistical analysis was done using Graph Pad InStat Software, 2016 InStat3 Software and Microsoft Excel 2010.

Result

The result indicated that 29 (21.32%) and 46 (34.59%) of *O. niloticus* and *C. gariepinus* from Ajiwa Reservoir were infected as against 35 (29.91%) and 58 (46.4%) from Jibia Reservoir Analysis of Variance (ANOVA) showed a significant difference ($p < 0.05$) between the species of fish examined in the Reservoirs (Figure 1) (Table 1).

Reservoirs	Fish Species	N.E	Trematodes N.I (%)	Cestodes N.I (%)	Nematodes N.I (%)	Acanthocephalans N.I (%)
Ajiwa	<i>O. niloticus</i>	136	06 (4.41)	04 (2.92)	27 (19.85)	02 (1.47)
	<i>C. gariepinus</i>	133	11 (8.27)	13 (9.77)	36 (27.07)	-
Jibia	<i>O. niloticus</i>	117	09 (7.69)	-	32 (27.35)	07 (5.98)
	<i>C. gariepinus</i>	125	09 (7.2)	24 (19.2)	38 (30.4)	06 (2.33)

Table 1: Prevalence of different Taxa of Helminth Parasites in the Study Areas. Note: N.E: Number Examined; N.I: Number Infected; %: Prevalence.

A total of eight species of helminth parasites belonging to two species of trematodes (*Dactylogyrus sp* and *Neascus sp*), three species of cestodes (*Polyonchobothrium clarias*, *Bothriocephalus aegypticus* and *Proteocephalus glanduliger*) two species of nematodes (*Procamallanus laevisconchus* and *Contraecum sp*) and one species of acanthocephalan (*Neoechinorhynchus rutili*) were found during the study. In this study, nematodes were more prevalent followed by cestodes, trematode and acanthocephalan. Among the species of *O. niloticus* examined, the prevalences for nematodes were 19.85% and 27.35% in Ajiwa and Jibia Reservoirs respectively. For the cestodes, the

percentage infection was 2.94% in Ajiwa Reservoir and for trematodes 4.41% in Ajiwa Reservoir and 7.69% in Jibia Reservoir while acanthocephalan showed a percentage of infection of 1.47 and 5.98% in Ajiwa and Jibia Reservoirs respectively. In *C. gariepinus*, nematode showed a percentage of infection of 27.07% and 30.4% in Ajiwa and Jibia Reservoirs respectively. Percentage of infection for cestodes was 9.77% in Ajiwa and 19.2% in Jibia Reservoir. Trematodes showed a percentage of infection of 8.27% and 7.2% in Ajiwa and Jibia Reservoirs respectively. Acanthocephalan showed a percentage of infection of 4.8% in Jibia Reservoir (Table 2).

Parasite Species	<i>O. niloticus</i>			<i>C. gariepinus</i>		
	A	B	C	A	B	C
<i>Dactylogyrus sp</i>	1	01	1	-	-	-
<i>Neasus sp</i>	05	11	2.2	11	19	1.7
<i>B. aegyptiacus</i>	4	06	105	04	11	2.8
<i>P. clarias</i>	-	-	-	09	19	2.1
<i>P. laevionchus</i>	09	18	2.0	19	36	1.9
<i>Contracaecum sp</i>	18	37	2.1	17	31	1.8
<i>N. rutuli</i>	02	04	2	-	-	-

Table 2: Parasites Species Recovered and their Mean Intensity in Ajiwa Reservoir. Note: A: Number Infected; B: Number of parasites recovered; C: Mean Intensity.

The intensity of infection by the various helminthes is presented on Tables 2 and 3. Among the trematodes, *Dactylogyrus sp* infected *O. niloticus* from Ajiwa Reservoir whereas nematodes, *P. laevionchus* and *Contracaecum sp* were more abundant in both fish species. *O. niloticus* had the least number of isolated parasites in both Ajiwa and Jibia Reservoirs. The mean intensity among *C. gariepinus* examined

revealed that *B. aegyptiacus* had the highest mean intensity of 2.8 in Ajiwa Reservoir while least intensity of infection was recorded in *Dactylogyrus sp* in the same Reservoir. Parasites that were recovered in Ajiwa Reservoir had highest intensity than those isolated in Jibia Reservoir.

Parasite Species	<i>O. niloticus</i>			<i>C. gariepinus</i>		
	A	B	C	A	B	C
<i>Neasus sp</i>	06	17	1.9	09	21	2.3
<i>B. aegyptiacus</i>	-	-	-	08	14	1.8
<i>P. clarias</i>	-	-	-	11	26	2.4
<i>P. glanduliger</i>	-	-	-	05	08	1.6
<i>P. laevionchus</i>	17	29	1.7	24	43	1.8
<i>Contracaecum sp</i>	15	32	2.1	04	25	1.8
<i>N. rutuli</i>	07	12	1.7	06	13	2.2

Table 3: Parasites Species Recovered and their Mean Intensity in Jibia Reservoir. Note: A: Number Infected; B: Number of parasites recovered; C: Mean Intensity.

Reservoirs	Fish Host	N	Status	a	b	r	Type of Growth
Ajiwa	<i>O. niloticus</i>	29	I	0.261	2.225	0.9017	Negative allometric
		107	U	0.301	2.334	0.9181	Negative allometric
		136	I+U	0.289	2.301	0.9161	Negative allometric
	<i>C. gariepinus</i>	46	I	0.468	2.270	0.8778	Negative allometric
		87	U	0.608	2.737	0.9337	Negative allometric
		133	I+U	0.548	2.514	0.9102	Negative allometric
Jibia	<i>O. niloticus</i>	36	I	0.384	2.615	0.9495	Negative allometric
		81	U	0.356	2.511	0.9338	Negative allometric

		117	I+U	0.366	2.545	0.9390	Negative allometric
	<i>C.gariepinus</i>	58	I	0.657	2.934	0.9556	Negative allometric
		67	U	0.628	2.802	0.9553	Negative allometric
		125	I+U	0.641	2.859	0.9561	Negative allometric

Table 4: Mean length-weight regression analysis of infected and uninfected fish species in the study areas. Note- N: Number of sample; a: Intercept; b: Regression Coefficient; r: Correlation Coefficient; I: Infected; U: Uninfected.

The Length-weight relationship and its association with helminth infection of the fish species, *O. niloticus* and *C. gariepinus* in Ajiwa and Jibia Reservoirs are presented in Table 4. The b values obtained in this study varied between the Reservoirs and the species examined. *O. niloticus* had b values between 2.301 and 2.747 while *C. gariepinus* had values range between 2.270 and 2.934. Analysis of both the infected and uninfected separately and combined showed that 'b' values were less than 3, thus indicating that all the species exhibited negative allometric growth pattern irrespective of their infection status. There was strong and highly significant correlation between the length and the weight of all the species ($r>0.8$).

The variations in the mean standard length, body weight and condition factor for the infected and uninfected fishes are shown in Table 5. The mean standard length range from 13.44-13.71 and 19.30-20.36 were recorded for *O. niloticus* and *C. gariepinus*

respectively from Ajiwa Reservoir while 13.02-13.05 and 19.61-20.52 were recorded for *O. niloticus* and *C. gariepinus* respectively from Jibia Reservoir. *O. niloticus* and *C. gariepinus* recorded a mean body weight range from 86.70-90.83 and 88.40-94.00 respectively in Jibia Reservoir whereas, a range from 82.30-83.70 and 86.43-94.27 were recorded in *O. niloticus* and *C. gariepinus* respectively in Ajiwa Reservoir. The condition factor comparison of infected and uninfected fishes indicated that the condition factor of infected *O. niloticus* was slightly higher than the uninfected *O. niloticus* in Jibia Reservoir. However, in other groups of fishes, the condition factor of uninfected fishes was slightly higher than that of the infected fishes. The result of the condition factor also indicated that the condition factor of *O. niloticus* in the two Reservoirs surveyed was higher ($K>3$) than that of *C. gariepinus* ($K<2$). This however indicated that *O. niloticus* performed better than *C. gariepinus* in the study areas.

Reservoirs	Fish Host	N	Status	Mean SL (cm)	Mean W (g)	Mean K
Ajiwa	<i>O.niloticus</i>	29	I	13.71	90.83	3.52
		107	U	13.14	85.33	3.59
		136	I+U	13.44	86.70	3.57
	<i>C.gariepinus</i>	46	I	20.36	94.00	1.11
		87	U	19.30	85.50	1.19
		133	I+U	19.67	88.44	1.16
Jibia	<i>O.niloticus</i>	36	I	13.02	83.70	3.79
		81	U	13.06	82.37	3.70
		117	I+U	13.05	82.77	3.72
	<i>C.gariepinus</i>	58	I	20.52	94.69	1.10
		67	U	19.61	86.43	1.15
		125	I+U	19.86	90.27	1.15

Table 5: Mean condition factor of infected and uninfected fish species in the study areas. Note- N: Number of sample; K: Condition factor; SL: Standard length; W: weight.

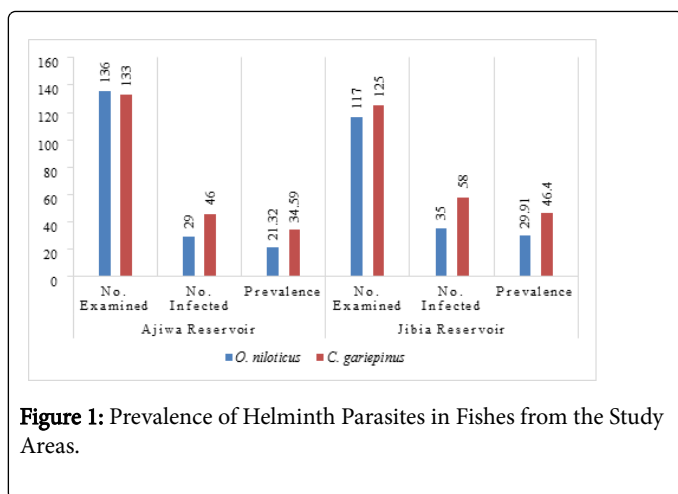


Figure 1: Prevalence of Helminth Parasites in Fishes from the Study Areas.

Discussion

The prevalence of infection by fish species and localities recorded in this study were 34.59% and 43.2% for *C. gariepinus* in Ajiwa and Jibia Reservoir respectively and 21.3% and 29.91% for *Oreochromis niloticus* in Ajiwa and Jibia Reservoir respectively. Variations in the prevalence rate recorded in the Reservoirs may be due to ecological differences between the two habitats [18]. Williams and Jones [19] opined that parasitism varies from one aquatic ecosystem to the other and that it influences by the interplay of mixed biotic and abiotic factors. It is also worthy to note that infection rates vary from one region to another and that a number of factors like availability of intermediate host, susceptibility of a definitive host, amongst others, determine to a large extent the rate of infection [10]. The highest prevalence of parasites in *C. gariepinus* may attributed to several factors which include habitat occupied, immuno-competence of the fish, behavioral pattern of the fish as well as high nutritional content of their intestine and suitability of the fish host in provision of appropriate ecological requirements of the parasite [6,20,21]

Helminth parasites recovered in this study include trematodes (*Dactylogyrus sp* and *Neascus sp*), cestodes (*Polyonchobothrium clarias*, *Bothriocephalus aegyptiacus* and *Proteocephalus glanduliger*) nematodes (*Procamallanus laevionchus* and *Contracaecum sp*) and acanthocephalan (*Neoechinorhynchus rutili*). The recovery of these helminth parasites in this study was not surprising as they have been reported previously from the same species or related species elsewhere [22]. Among helminth parasites community namely, nematode, trematode, cestode and acanthocephalan recorded from fishes in the study areas, nematode parasites dominated the helminth fauna of the fishes followed by cestode, trematode and very rare infection caused by acanthocephalan. These variations in relative prevalence of the different parasitic classes may be attributed to prevailing physico-chemical and ecological factors for the development of parasites, as well as the probable relative abundance of their intermediate hosts [23].

In order to ascertain the type of growth exhibited and wellbeing of the fishes in the study areas, the length-weight relationship and condition factor of infected and uninfected fishes were determined. The b values obtained in this work was not equal to 3, thus indicating allometric pattern of growth, which could either be positive if >3 or negative if <3. This was similar with documented works from Inland water bodies in Nigeria. Notable among them includes the findings of

Dan-kishiya [17] who determined length-weight relationship and condition factor of five fish species from a tropical water supply Reservoir in Abuja, Nigeria, Abowei and Hart [24] in an investigation of some morphometric parameters of 10 fin fish species of Lower Nun River in Niger Delta, Ibrahim et al. [25] observed allometric growth pattern in Kontagora Reservoir and Ude et al. [26] in an evaluation of length- weight relationship of fish species of Ebonyi River. The b values range obtained in this work were comparatively below the b values recorded from the works of Haruna, Nyaku et al. [27,28] and that of Bala et al. [29] but were greater than the values obtained by Fafioye and Oluajo, Imam et al [30,31]. *C.gariepinus* showed b values range of 2.270 and 2.934 which were relatively higher than what was recorded in *O. niloticus* in this study. This could probably be due to the nature of its feeding habit [31]. The relationship of length-weight can be used in the estimation of condition factor (K) of fish species. Condition factor which is a useful index for monitoring of feeding intensity, age and growth rates in fish is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live [32,33]. The condition factors (K) of the species in the present study were above what was obtained by Olurin and Aderigbe, Nyaku et al. and Bala et al. [28,29,34] in other tropical water bodies. However, the range of K values obtained in this study was within the range obtained by Kumolu-Johnson and Ndimele [35] from Ologe Lagoon in Lagos. *O. niloticus* had the highest mean K factor in this study thus indicating that the environment of the Reservoirs is more suitable for this species. The effect of helminth parasites on length-weight ratio and condition factor of the studied fishes was not clearly seen in this study and this could be attributed to the low level of infection and mean intensities of these parasites observed in the study areas [36].

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