A PRELIMINARY GROWTH STUDY OF THE NILE PERCH (*Lates niloticus*, L.) COLLECTED FROM THE WHITE NILE RIVER, SUDAN

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ABSTRACT: This study was conducted in Jabel Awlia Dam Reservoir (JADR) in the White Nile River for studying the Nile perch's growth. Results showed that ctenoid scales cover the Nile Perch's body and they differ in their sizes according to their positions in the body. Age classes were fallen into age I^+ and age II^+; whereas, age 0^+ was not recorded. Lengths of age I^+ of male ranged between 15-17cm; whereas, those for female ranged between 14-16cm. The calculated standard lengths (SL) didn't harmonize with empirical lengths (EL) and therefore, growth was not isometric. The study concluded that stunting stages of the Nile perch were dominant may be due to change in the environment of JADR and over-fishing that the White Nile has been subjected to during recent years.

Keywords: Fresh water fishes, the White Nile fishes, Nile perch growth.

INTRODUCTION

The Nile Perch (*Lates niloticus,* Linnaeus 1758) is considered as one of the most famous carnivorous freshwater fish in Africa. The Nile Perch is widespread throughout the Ethiopian Region of Africa, occurring commonly in all major river basins including Nile, Chad, Niger, Senegal and Volta. The most common place to find the Nile perch is Lake Victoria, where the species was introduced in 1962. The Sudanese local names of this species are several and various. They differ from a region to another due to ethnic variety in the Sudan. The most common name used in the Sudan is Ijl "as discussed by Bailey [4]".

From the large variety of coloration that fishes exhibit, certain generalizations may be drawn as to basic pattern in relation to habit and concealing concept "as discussed by Lagler *et al*. [12]. Therefore, the Nile perch appears with different colors such as silver, gray, greenish and black color "as discussed elsewhere [4, 7]".

The Nile Perch is considered as the most important commercial fish in Sudan, which spreads along the Nile fisheries with different ratios "as discussed by Mohammed and Ali [19]" such as: in Lake Nubia where it showed increasing rates since 1972 from 8.1% up to 13.7% in 1980 and weighted 136kg with a maximum length was up to 180cm; while, in Lake Nassir, it weighted 175kg and measured up to 2m length "as discussed by Ali [3]; Latif [13]". Moreover, the Nile perch in Lake Nubia usually occurs the highest level during the periods of February to May and July to September that correlates with summer and flood seasons respectively "as discussed elsewhere [3]"; in the White Nile fishery, its ratios fluctuated during three decades ago "as discussed elsewhere [19]"; where, it was recorded in the White Nile in Al-Kalakla fishery in 1981 at 4.42% and in Um-Shabasha fishery with 1.86% "as discussed by Hamza [9]", but in Al-Kalakal fishery in 2006, its ratio was 3.22% "as discussed by Mohammed [18]"; in Al-Giteina fishery in 2003, its ratio was higher twice (3.0%) than that in JADR (1.5%) "as discussed by Abdel Rahman[1], but JADR in 2006, its ratio was 6.52% "as discussed elsewhere [18]". In addition, the average weights of the Nile perch in JADR were ranged between 200g to 300g with lengths of 19-72cm, were higher than those of 150g-400g with 8-21cm in Al-Kalakla fishery; in Al-Gireif fishery in the Blue Nile, its weight ranged between 250-1600g with 16-46cm lengths "as discussed by FD [6]". In general, the Nile perch has an average size around 85-100cm, but can grow up to 193cm. Moreover, it is usually seen around 2-4kg, but have been seen at larger than uncommon sizes, which reached up to 200kg. Generally, females are larger than males "as discussed elsewhere [7]".

The Nile perch is sexually dimorphic. Males and females of the Nile perch from Lake Nubia possessed mature gonads, though the running state was occasionally encountered in males during April to November; whereas, in females the running state was during March to July. Pooling of the data from this lake clearly showed that males outnumber females' pronouncedly in the Nile perch (males nearly 2-4 times females). During all months, this pattern did not change in all years, except in exceptionally large specimens from commercial catches, where females were often dominant "as discussed elsewhere [3]". Ovulation of the Nile perch takes place in spring with rising water temperature. Spawning is usually done in sheltered areas, but can also occur in open waters "as discussed by Hopson [10]".

Attainment of maturity in males in lake Nubia occurred at a length of about 32cm (age I^+), and for females was at 44cm (age III^+), varied from that found in other waters "as discussed elsewhere [3]"; where in lake Chad, it was found that sizes at first maturity was 46.0 cm of age III^+ and 49.6cm of age IV^+ for males and females, respectively "as discussed by Hopson [11]". In Lake Albert, a length of 47cm was found for first maturity of the Nile perch "as discussed by Gee [8]". Thus it is clear that attainment of sexual maturity is faster in Lake Nubia and in males compared to females "as discussed elsewhere [3]".

In Lake Victoria, smaller sizes of the Nile perch, males greatly were out-number the females with sex ratio (M:F) ranging from almost 10:1 to 7:1; but in the larger samples over 80 cm (TL) the proportion of males rapidly fell (1:1 at 90cm; 1:10 at 100cm TL). Specimens beyond 120cm generally were found to be females. In Lake Kyoga a similar pattern has been found "as discussed by Ligtvoet and Mkumbo [16]". The numerical superiority of large females is the result of high mortality in the males "as discussed elsewhere [11]".

Slow growth and small size of individuals enables several populations of fishes to exist on comparatively restricted food supplies. Fast growth and large size of fish indicates limited numbers with presence of abundant food supply for growth and surely some protection against predators "as discussed by Nikolsky [20]".

It was clear that the Nile perch grew better in Lake Nubia as compared to Lake Chad for example and even better than Lake Nassir (the northern part of the same reservoir), that may be due to more favorable conditions for growth "as discussed elsewhere [3]". In Lake Victoria, the growth of the Nile perch was found to be very fast attaining a mean total length of 52cm during the first year, and showing four growth stanzas at 26cm, 36cm, 46cm and 52cm TL. Growth rate decreased during the 2nd, 3rd, 4th and 5th year with annual increments of 24.3cm, 23.0cm, 17.2cm, 18.7cm and 9.8cm TL and then remained almost constant (9cm TL) for the rest of the cohort's life. Generally, females grow up to much larger sizes than males "as discussed by Acere [2]". The longevity of the Nile perch in Lake Chad may be up to age of 20 years "as discussed by Loubens [17]".

This study aimed to give a reasonable indication explaining why the Nile perch inhabiting the White Nile River has been fishing in small sizes and few numbers.

MATERIALS AND METHODS
Study area
This study was conducted in JADR in the White Nile River, south to Khartoum city (Plate 1), which locates at 32˚29′07.1″ E and 15˚14′18.1″ N with elevation 383m. The construction of dam started in 1933 and completed in 1937. Its total length is 5km; masonry length is 1693km; high greatest masonry is 22m; embankment length is 3307m; approximate total cube structure is $1,000,000m^3$; high reservoir level is 377.20 m^3 and low summer level is 370.35m^3 "as discussed elsewhere [18]".

Reservoir of the dam is a seasonal lake, which is located at 32˚27′ E and 15˚12′ N and it was formed as a result of Jabel Awlia Dam construction. The water of the lake is stored from early July to the end of January of the next year, which extends for over 600km up to Rank. The stored water releases gradually from early February until the end of June during, which the lake is emptied "as discussed elsewhere [1]".

The east bank of the dam is constructed manly of rock and some limited sandy and grassy areas. There are also three main harbors of fishing boats in the east bank and also one in the west bank of the downstream fishery. These harbors usually shift during flood season to concentrate around two inlets near the dam barrier "as discussed elsewhere [18]".

SOURCE: MOHAMMED 2006

Plate 1. Jabel Awlia Dam Reservoir Fishery (JADR) in the White Nile River, Sudan.

Sample collection
Forty samples of the Nile perch were bought from the station during March 2009 and May 2009 and transferred to the laboratory for preserving in a refrigerator until the study was carried out. Each sample was measured by using a wooden measuring board (accurate to ± 1 mm) and then weighted by a digital FEJ-2000B balance (Max= 2000g d= 1g).

Age determination
Scales were used for age determination in this study. They were taken from the left side of each specimen above the lateral line and then, they were cleaned and dried with tissue papers. Scales were studied by using a binocular microscope at a magnification of 10x after they were dried and fixed between two glass slides.
Age was computed by counting scales' rings that were known as year marks or annulus. Alternate translucent zones and opaque bands (Plates 2;3) were used for identifying age of each fish "as described by El-Zarka [5] and Olatunde [21]".

Growth rate
There were two equations used for studying growth of the Nile Perch such as:

Standard length-scale radius relationship
The log-log relationship between the standard lengths of fish and radius of scales was performed by using the following equation "as described by Le Cren [14]":-

Log L = log a + b Log S

Where   L = standard length (cm) of fish at the time of capture.

   S = total scale radius (converted to centimeter) at time of capture.

   a. = constant.

   b.   = an exponent.

Length-weight relationship
The relationship of length-weight was calculated using the following formula "as discribedby Le Crean [15]":-

$$W = aL^b (1)$$

Equation (1) can be represented as:-

$$Log W = log a + b log L \qquad (2)$$

Where,   W = weight of fish in grams.

   L = standard length in centimeters.

   a.= constant,

   and   b = an exponent.

Statistical analysis
PAST software package (version 1.99) was used for analyzing raw data of this study.

RESULTS

Age groups

Examined scales showed that ctenoid scales were noticed covering skin. They had different sizes according to a particular part of the body. Alternate translucent zones presented a period of fast growth (wide size) and opaque bands, which represented a period of no growth (very narrow) or slow growth. A complete season's growth was identified by comprising a wide translucent zone and a narrow opaque band. Age classes of the examined fishes were fallen into age I$^+$ and age II$^+$; whereas, age 0$^+$was not recorded (Plates 2 and 3).
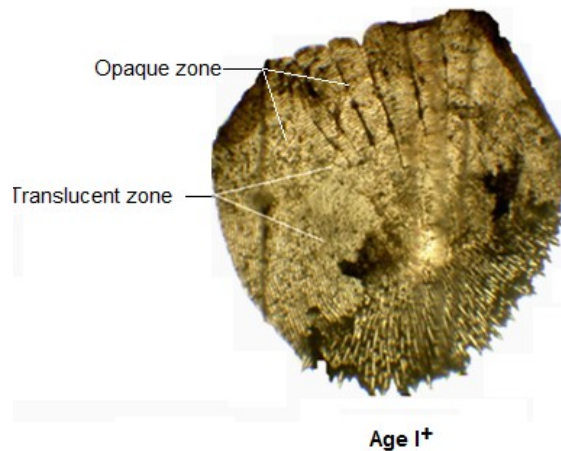

Plate 2. Depicts age I$^+$ of the Nile perch from the White Nile River in Sudan.
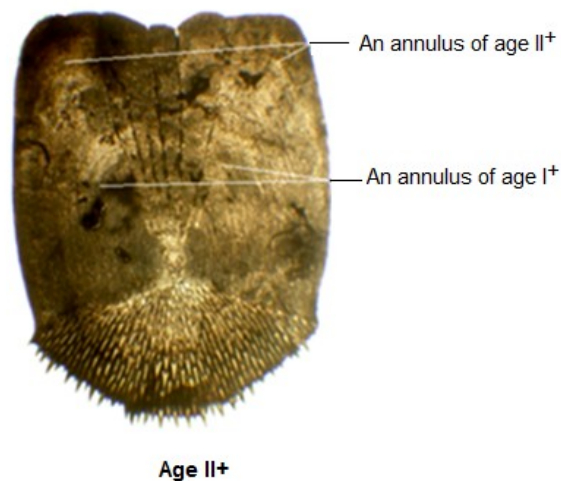

Plate 3. Depicts age II$^+$ of the Nile Perch from the White Nile River in Sudan.

Empirical and calculated lengths relationship

Empirical lengths for age I$^+$ ranged between 15cm and 19cm for male; whereas, those for female were 13-20cm. Empirical lengths for age II$^+$ ranged between 14-19cm for male; whereas, those for female were 15-20cm.

Calculated standard lengths showed not isometric growth among examined fished compared with empirical standard lengths. Generally, calculated standard lengths of all examined fishes were slight higher than empirical ones and highly correlated (Table 1).

Table 1.Comparison between empirical and calculated standard lengths of the Nile perch collected from the White Nile River in Sudan.

| ♂		Empirical standard length (cm)				Calculated standard length (cm)					
Age	No.	Range	Mean	SD	SE	Age	Range	Mean	SD	SE	r.
I$^+$	5	15-19	16.66	1.56	.70	I	15-19	16.62	1.57	1.57	.9082
II$^+$	13	14-19	16.7	1.27	.35	II	15-19	16.29	2.17	.60	.7984
♀											
I$^+$	10	13-20	15.94	2.00	.63	I	13-19	15.95	1.92	.61	.9282
II$^+$	14	14-20	16.86	1.51	.40	II	15-19	16.86	1.51	.40	.8033

Standard length-scale relationship

Log-log relationship between standard lengths of the Nile perch body and sections of scales were calculated for both male and female as below:

1. For male of age I$^+$: Log L = -.06694 + .77732 Log S (r = -.096545 & t = -.16801).
2. For male of age II$^+$: Log L = .77784 + 1.7368 Log S (r = .28245 & t = .97654).
3. For female of age I$^+$: Log L = .58876 + 1.6121 Log S (r = .64755 & t = 2.4035).
4. For female of age II$^+$: Log L = .54352 + 1.5765 Log S (r = .30643 & t = 1.1152).

Length-weight relationship

Result showed that growth rate of weight in the studied Nile perch was not isometric (Figures 1;2). Male showed weight values increasing with standard lengths, but not in gradual manner. However, most of weight readings concentrated between 16cm and 17cm (Figure 1). On the other hand, females confirmed that growth increased with standard length, but was not in systemic formula. Due to many readings recorded as higher as and lower than linear regression of the rest of weight readings (Figure 2).
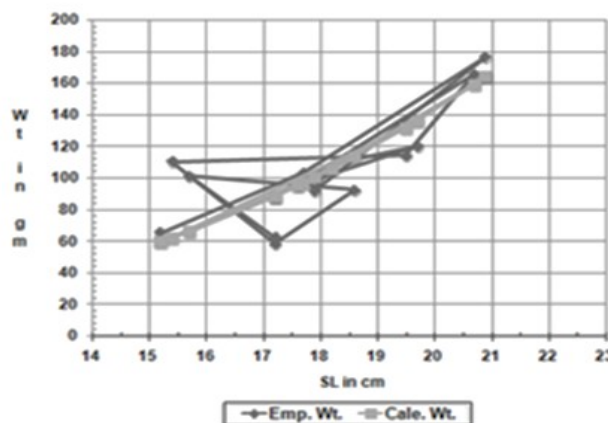
Figure 1. Length-weight relationship of male of the Nile perch from the White Nile River in Sudan.
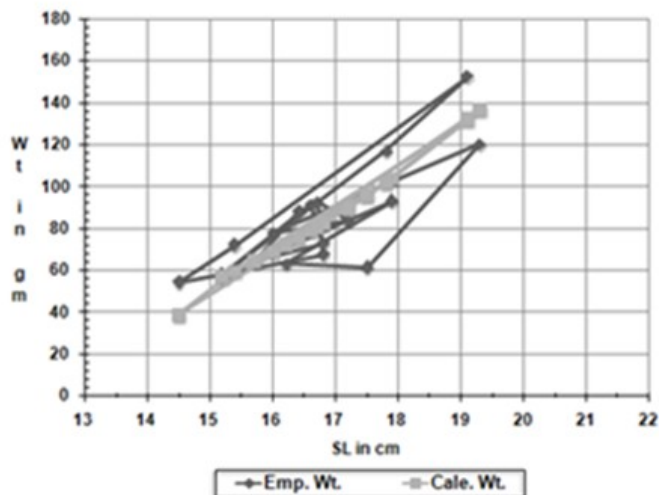
Figure 2. Length-weight relationship of female of the Nile perch from the White Nile River in Sudan.

Color
Results showed that the Nile Perch inhabiting White Nile River appeared with silver, gay or grayish and black colors.

DISCUSSION
The records of the previous studies showed that the Nile perch occurs during summer and flood seasons in Lake Nubia. Therefore, the Nile perch samples of this study were collected from JADR in seasons, where it was available in abundance. This is in harmonize with that result "as discussed elsewhere [3]".

The present study showed that the empirical lengths (Table 1) of the Nile perch of age I[+] for male ranged between 15cm and 19cm; whereas, those for female of the same age were 13-20cm. Empirical lengths for age II[+] were 14-19cm (male) and 15-20cm (female). The calculated standard for both sexes were higher than the empirical length, which may explain a difference between them to a few sample number that taken to carry out this study and may indicate that to defectiveness that has been happed in the growth of the Nile perch due to over-fishing and changing in the environment of Nile River. All these condition may cause in stunt the Nile perch, which leaded in difference between reading of empirical lengths and calculated standard lengths of the studied Nile perch.

On the other hand, both empirical lengths and calculated lengths confirm that decline in sizes of the Nile perch not only in the White Nile, but in whole the Nile River when a comparison is held with the previous studies "as discussed elsewhere [1, 3,6, 9, 13, 18, 19]". A comparison showed that the recorded weights of the Nile perch were being increased during 1972 and 1980 in Lake Nubia, where were 8.1% to 13.7% of total catch and the maximum weight recorded was 136kg, but in Lake Nassir the maximum weight recorded was 175kg. The decline of the ratio of the Nile perch was also recorded in the fisheries of the White Nile River, which were Al-Kalakla, Um-Shabasha and JADR. A decline was apparently when comparing the findings from downstream of JADR represented in Al-Kalakla fishery was 4.42% in 1981 and declined to be 3.22% in 2006 with degradation of 1.2%; whereas, a decline in the upstream of JADR, which was taken from Um-Shabasha fishery in 1981 was 1.86% and 3.0% in Al-Giteina fishery in 2003 with a degradation of 0.86%. In JADR, there was a clear increase of 5.02% in the catch of the Nile perch when a comparison is held between the findings of the study done in 2003 and findings of the study done in 2006. Furthermore, JADR showed having Nile perch were more weigh (200g-300g) with 19cm – 72cm than those in Al-Kalakla fishery (150g-400g) with 8cm – 21 cm as recorded in 2003.

A relation between length and weight of the studies Nile fishes showed that both male and female their weights increased with their lengths, but not in gradual manner (not isometric) as in normal case (Figures 1; 2). However, most of weight readings concentrated between 16cm and 17cm. This may be due to stunt sizes of the Nile perch, which being prevailed in the catch due to change in condition of JADR as mentioned above. These results confirmed decline of the Nile perch in the Nile River as whole and in JADR particularly "as discussed elsewhere [1, 3, 6, 9, 13, 18, 19]".

Results showed that the Nile Perch inhabiting, White Nile River appeared with silver, gay or grayish and black colors. This data is in agreement with those findings "as discussed elsewhere of [7, 4]". The recorded colors of the Nile perch may explain the concept of concealing behavior that the fishes belong in their lives. Moreover, the Nile perch occurred with varied color may also due to a particular places of JADR, where has many different niches scattered around its reservoir and downstream according to its environment that the dam has been built in. In its reservoir, there are grassy area extends along 600kg southwards the dam barrier, which constitutes the prevailing nich and with other limited niched laying on its east back such as rocky and sandy areas. Hence, adaptaion of the Nile perch with a particular surrounding habitat allows it to gain a designated color of the four ones mentioned above, to be survive for longer time as carnivorous. This explanation is also in agreement with that results "as discussed elsewhere [12, 18]".

Conclusion and recommend

The present study confirmed that the Nile perch inhabiting in JADR is in decline in both size and weight and its growth was not isometric due to stunting phenomenon and over-fishing. Therefore, it recommends to carry out a long growth study on the Nile perch in JADR and has to cover a wider range with larger number of samples.

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