



Exploitation Ratio of Characid Fish in Jebel Aulia Dam

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Abstract – This study was conducted from November 2007 to October 2008 at main fishing site in Jebel Aulia dam Reservoir, which were Jebel Aulia site 45 km south Khartoum city. This study concentrated on two genera family Characidae, which were *Hydrocynus forskalii*, *Hydrocynus lineatus*, *Hydrocynus brevis*, *Alestes baremoze*, *Alestes dentex* and *Alestes nurse*. The results were analyzing using standard approaches and advanced computer programmes (PAST). The estimated productivities were 77.02 kg/km² at Jebel Aulia site by using one type of fishing-net during period for fishing. For genus *Alestes* in Jebel Aulia site, exploitation ratio for genus *Alestes* between 0.52 and 0.90, while that for genus *Hydrocynus* was between 0.60 and 0.70, the recommended exploitation ratio level was 0.5.

Keywords – Exploitation Ratio, Characid, Jebel Aulia, Dam, Fish.

I. INTRODUCTION

Sudan is rich in water resource of surface area of more than two million hectares. Nile and its tributaries constitute the main water resources. There are five man-made lakes within the Nile and its tributaries. These collectively harbour an estimated fish potential of 17,000 tons/year and current production 13,000 tons/year (Ministry of Animal Resource and Fisheries report, 2006). The basic Local inhabitants exploit the fish resources in these inland reservoirs. Local companies for capture and marketing fish and fish products are involved in exploiting these potential, particularly in the White Nile, Blue Nile and Lake Nubia.

The fishing a practice is at small scale using craft consists mainly of traditional fishing boats. There were two local types: dugout canoes "Sharoug" and wooden boats "Sunt" both were made of planked wood and local timber respectively, with oars and few are motorized boats (Plate, 1).



Plate (1) Shows dugout canoes "Sharoug" using for fishing in shallow water, Jebel Aulia Dam reservoir

However, commercial firms use large collecting boats propelled by outboard and inboard engines. The dominant fishing method and fishing gear in use, according to Fisheries Department of Khartoum State (2003), are the fixed gillnets followed by long-lines, cast nets and drifting nets. At Jebel Aulia fisheries, the most fishing methods used were fixed nets and cast nets followed by long-lines and drifting nets. At sites north of the dam, the most fishing ways were drifting nets followed by fixed nets (plate 2).



Plate (2) Shows fishing by drifting nets in Jebel Aulia Dam reservoir

According to Kawai (1994), fishing nets used in the northern parts of Jebel Aulia dam were monofilament nets and hook-lines. These include passive and drifting gillnets beach seine nets, trammel nets, baited and unbaited long lines, as well as cast nets and fish traps. Companies and fish brokers transport fish to the marketing areas in insulated trucks or chilled in iceboxes transported with ordinary transportation means such as Lorries and pickups. Abdel-Rahman (2003) recorded the fishing methods used at both Jebel Aulia dam and El-Geteina station were beach seine nets, fixed nets, and long-lines while cast nets were confined to Jebel Aulia dam.

Four years ago (2005), Jebel Aulia dam started to generating electric power of around 30.4 MW (Plate 4). A hydroelectric power station composed of 40 turbines was fitted along 40 doors of the total fifty of the Jebel Aulia dam (Bihlmayer, 2005 and Schmid, 2005).

Ahmed (1985) reported that the family Characidae was the most dominant fish constituting almost 22% of the total catch in Jebel Aulia reservoir during 1983 -1985.



This family includes fishes of relatively high economic value that are processed mostly for wet salting. The genera were *Hydrocynus* and *Alestes*. Family Characidae members are found over the greater part of tropical Africa and tropical South America. Their fossils had first appeared in the upper territory of Brazil and Peru, whilst bones of tiger fish (*Hydrocynus*) were found in the Miocene and the early Pleistocene of Kenya. Two genera, viz. *Hydrocynus* and *Alestes* of this family are represented in White Nile (Latif, 1973).

II. MATERIALS AND METHODS

2.1. Sites of the Study

The lake of Jebel Aulia dam is located 32°27' E and 15°12' N. It was formed as result of Jebel Aulia Dam construction 45 km south the Khartoum capital of state. It is the largest reservoir in the Sudan. It is a large and shallow man-made lake covering an estimated area of about 1246 km² (Bellman, 1998).

Construction of dam was started in 1933 and completed in 1937 to impound water of the White Nile for irrigation purposes. Thus the dam is playing an important role of food security within Khartoum state providing agricultural products and fresh fishes to fish markets. Total length of dam is 5 km; length of monary dam is 1693km; greatest high monary is 22 m long approximately. The highest level of the reservoir is 337. 20 m above sea level; the lowest level is 327. 35 m at summer season with a maximum depth of 12 m and mean depth of 2.3 to 3.58 m. The capacity of water volume at filling stage is 3.5 million cubic meter. The dam has total length of 5 km compared to 1.7 km of rock filament embankment on the western side. The water of the lake is stored from early July to end of June of the next year. There is navigator lock at the dam site and fish ladder along the eastern side of the dam resembling a fish pool each of which is 7.25 m long, 5.0 m wide and deep. The study conducted at landing site, Jebel Aulia dam, (plate 3).

2.2. Study Procedure



Plate (3) Map show Site of the Study, Jebel Aulia Dam reservoir.

Source of the map: is design unit from the World Bank
The study started in November 2007 and terminated in October 2008 Sampling took place three times every month. During each time the sample were the randomly selected from the collect catch.

2.3. Fish Collection

Fish Samples were done randomly collection from fishermen's to cover night and day catches at the landing sites. This was aided by experimental fishing using a fleet of multi- filaments nets of the following range of mesh size and twine as in (Table 1).

Table (1) Gillnets used to collect fish sample used in the study site

Twine No 6	Length	50 m
	Depth	1.5 m
	Mesh size	4cm
Twine No 6	Length	50 m
	Depth	1.5
	Mesh size	6 cm

Fish collected of Characids were identified up to the species level using identification keys published by Boluenger (1907), Sandon (1950), Bailey (1994) and Abu Gieder (1984). Fish were collected from Jebel Aulia site 1931 specimens and 557 specimens from Kosti. Catch composition was analyzed by number and weight of family Characidae expressed as percentages of the other all families in the same catch.

Rate of Exploitation (E R)

$$E R = F/F+M$$

$$F = Z-M$$

Where F is Fishing Mortality, M is the natural mortality and Z is the total mortality. Total mortality (z) is estimated from Beverton and Holt Modal (1966) for Total mortality from the mean length due to the following empirical formula using (FIASTII.1.2.2) assessment program.

$$Z = K (L_{\infty} - L_{\text{mean}}) / (L_{\text{mean}} - L_{\text{min}})$$

Z= Total mortality

K= is the VBGF growth constant

L_∞= maximum attainable length in (cm).

L_{mean} =Mean length.

L_{min} =the lower limit of the smallest length

Thus fish mortality (F) is obtained as follow:-

$$F = Z - M$$

Where:-

F= fish mortality

Z=total mortality

M= natural mortality

Natural mortality (M)

Is calculated by adapting (Pauly, 1984, 1980, 1978), empirical formula:

$$\ln (M) = - 0.0152 - 0.279 \ln (L_{\infty}) + 0.6543 \ln (K) + 0.463 \ln (T)$$

Where:

M =natural mortality based on Pauly's empirical equation.

T=mean environmental temperature of habitat (° c).

L_∞=maximum attainable length in (cm).

K=is the VBGF growth constant.



III. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Estimation of exploitation ratio of family Characidae

In Site One, exploitation ratio of family Characidae was estimated for six species that were selected according to their availability for whole year and economic importance (Table 2 and Table 3). Lowest total mortality (Z) was

0.34/yr for *H. lineatus* and *H. brevis*, while the highest value of Z was 0.53/yr *Alestes baremose*.

Table (2): Natural mortality (M) and total mortality (Z) of characid fish in Jebel Aulia

Characid sp	Parameter	TL (cm)	(k)	Temp.(c°)	Lmean	L ⁻	M	Z
<i>Alestes baremose</i>		26.3	0.0776	25.9	18.98	5.1	0.1514	0.53/yr
<i>Alestes dentex</i>		29.2	0.04989	25.9	17.34	5.5	0.24380	0.50 /yr
<i>Alestes nurse</i>		19.1	0.13736	25.9	11.89	4.8	0.13736	0.140/yr
<i>Hydrocynus forskalii</i>		46.2	0.030616	25.9	22.69	8.6	0.15584	0.519/yr
<i>Hydrocynus lineatus</i>		40.8	0.023555	25.9	21.83	8.7	0.13591	0.34/yr
<i>Hydrocynus brevis</i>		52.1	0.02093	25.9	24.31	7.0	0.11750	0.336/yr

Table (3): Natural mortality (M) and total mortality (Z) of Characids fish in Jebel Aulia

Characidae sp	Parameter	L(cm)	(K)	Temp.	L mean	L ⁻	M	Z
<i>Alestes baremose</i>		8.6	0.8029	26.3	19.03	14.6	0.1510	0.258/yr
<i>Alestes dentex</i>		3.2	0.084096	26.3	13.88	8.9	0.150	0.326/yr
<i>Alestes nurse</i>		0.2	0.223	26.3	12.99	6.7	0.16067	0.256/yr
<i>Hydrocynus forskalii</i>		1.3	0.11554	26.3	24.65	48.	0.3210	0.547/yr
<i>Hydrocynus lineatus</i>		1.9	0.47841	26.3	24.50	0.8	0.52464	0.957yr
<i>Hydrocynus brevis</i>		2.8	0.91793	26.3	25.04	16.5	0.35422	0.834/yr

3.2. Discussion

Stress of fishing is expressed through the exploitation ratio (ER) of family Characidae species in Jebel Aulia site that is above the recommended level (0.5) special for the genus *Alestes* which ranging between 0.52 – 0.90. That of genus *Hydrocynus* ranges between 0.58 – 0.68 .

The study conducted by Hamaza (1981) stated that overfishing is the one of the major problem in the white Nile because continuous fishing is being carried out during most of the year. The study conducted by Ahmed (1985) in the vicinity of dam (up to 10 km) indicated that no direct overfishing can be proved, through the exploitation reached the maximum allowable level.

IV. CONCLUSION

It is apparent that a serious attention needed to be given to revise fish stock assessment, Loss in species diversity and reduction of family Characidae abundance is noticed in the study area. Beside, the majority of the catch in the two sites was composed of under sized fishes. Reduction in fish production came more likely as the result of the use of illegal gears. Gill nets are highly selective and their selectivity may passively affect the fish stock through: (a) decrease in yield due to intensive fishing; (b) direction of catching effort towards specific species and (c) over-fishing due to long-term practice.

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