Direct RESEARCH JOURNALS
Vol.4 (12), pp. 326-333, December 2016
ISSN 2354-4147
International Standard Journal Number (ISJN) e-ISJN: A4372-2604
Article Number: DRJA67840196

Direct Research Journal of Agriculture and Food Science
http://directresearchpublisher.org/aboutjournal/drjafs

Research Paper

Preliminary Observations on the Ichthyofauna and Ichthyobiomass of River Dinder Flood Plains in Sudan

Abdel Moneim Khalid[1], Ahmed Al Badawi Adam[2]* and El Saeir Hassan Mohamed Salih[3]

[1]General Administration of Fisheries and Aquatic Resources, Fisheries Research Center, Khartoum, Sudan
[2]General Administration of Fisheries, Fisheries Research Center, Jazan, Kingdom of Saudi Arabia.
[3]Department of Fisheries, College of Natural Resources, University of Juba, Southern Sudan.
*Corresponding author E-mail: aelbadawi72@gmail.com.

Received 4 October 2016; Accepted 26 October, 2016

The ichthyofauna of River Dinder flood plains consisted of (31) species belonging to 20 genera and 13 families representing about 14.4% of the total number of fish species occurring in the River Nile and its tributaries in Sudan. The catch was dominated by species belonging to the families Clariidae, Characidae, Cichlidae, Bagridae, Distichodontidae and Osteoglossidae respectively. Ras Amir 'mayah', the largest water body in the flood plains, contained the most diversified fish fauna among the six sampled stations with a total number of 21 species. Birkat El Orta pool ranked second (13 species), followed by Ain El Shamis 'mayah' (10 species), then Al Tabia pool (9 species), Greirisa 'mayah' (5 species) and finally Birkat El Timsah pool with only 4 species. The highest mean catch per unit effort (CPUE) was obtained for Birkat El Timsah pool with a mean value of 2233 kg/100m^2/ day. Mean CPUE values of 152, 62, 35, 26 and 24 kg/100m^2/day were recorded for El Tabia pool, Greirisa 'mayah', Ain El Shamis 'mayah', Ras Amir 'mayah' and Birkat El Orta pool respectively.

Key words: Catch per unit effort, Flood plains, Ichthyobiomass, ichthyofauna, index of evenness, Index of relative importance.

INTRODUCTION

The River Nile within Sudan is characterized by numerous flood plains which become inundated during the flood season and become disconnected from the main course of the river during the dry season. These flood plains are usually formed as a result of the fall of water level subsequent to the flood season, and are considered a valuable source of recruitment of various freshwater fish species and offer refuge and protection to Juvenile stages of fishes until the next flood.

One of the most intricate systems of flood plains occurs in River Dinder along its course through the Dinder National Park in Sudan. They are usually present in form of pools and lake depressions of various sizes, known locally as 'mayah' and 'birkat'. They become very productive when colonized by weeds and macrophytes and furnish important feeding, breeding and nursery grounds for the larval and juvenile stages of fish (Welcomme, 1979). The economy of the local population inhabiting the areas surrounding Dinder National Park is dependent upon these water bodies which host a good number of fish species which can be exploited during various stages of the hydrological cycle of the river. They constitute the main source of fresh and dry-salted fish for the local inhabitants in the area.

Most of the studies carried out in the Nile system and its tributaries within Sudan focused on studies of the Jebel Aulia Dam Reservoir on the White Nile, including investigations on the ichthyofauna, (Abu Gideiri, 1984; Bailey, 1994); productivity of Jebel Aulia Reservoir (Adam, 1977); distribution and abundance of fish (Adam, 1986); assessment of catch of some commercially important fishes (El Moghraby 1973; Ahmed 1978; Babiker, 1984; Asma, 1985; Belleman and Khalid, 1998; Bashir, 2003). More recently, Bashir, (2007) and Obeida *et al*. (2013) estimated the biomass of some commercially important fish species in Jebel Aulia Reservoir on the White Nile in Sudan. However, Mishrigi, (1970) gave an account of fishes of Lake Roseires on the Blue Nile and Mahmoud, (1984) carried out some investigations on the ichthyofauna of Dinder River National Park in Sudan. Despite its ecological significance, the flood plains of River Dinder received little attention. The present work was undertaken to investigate the fisheries of these flood plains with the aim to establish the species composition, fish diversity and estimate the ichthyobiomass and catch per unit of effort, as a preliminary step towards formulating a strategy for managing the fisheries resources of this valuable ecosystem in Sudan.

MATERIALS AND METHODS

Fishes were caught from six sampling stations located on the eastern and western flood plains of River Dinder. The sampling stations comprised small depression lakes and pools known locally Ras Amir 'mayah' (4.52 km^2), Greirisa 'mayah'(2.11 km^2), Ain El Shamis' mayah (0.72 km^2),), Birkat El Timsah pool (0.009 km^2), Birkat El Orta pool (0.009 km^2) and El Tabia pool (0.002 km^2). Experimental fishing was carried out by using canoes and gill nets during the period January- June, 2013 The sets gill nets ranged in length from 35.0- 13.0 m, 1.20- 3.5 m in width and of mesh size ranging from 60.0 –160.0 mm.

Samples of fish were identified down to the species level according to (Abu Gideiri, 1984; Bailey, 1994). Total length of individual fishes was measured to the nearest millimeter from the tip of the snout to the end of the upper lobe of the caudal fin by using a standard measuring board. Total weight was measured to the nearest gram using Sartorius weighing balance (model 1106, Texas, USA).

The overall catch per station was converted using a standard net of 100 m^2 and a standard fishing time of 24 h. In this way, catches in different stations were compared and expressed as mean standard catch per unit of effort, (kg/100 m^2/ day.

Biodiversity and distribution of fishes were calculated according to Begon *et al*. (1990); index of relative importance (IRI) for each species per net setting was calculated following Kolding *et al*. (1994). Occasional sampling was carried out in Birkat El Timsah pool using a beach seine net measuring 75.0 x 1.5 m and of mesh size of 0.5 centimeter in order to estimate the fish biomass by using De Lury method (1947), which is based on the assumption that the catch per unit effort (CPUE) decreases constantly with fishing relative to the number of individuals remaining from the population after successive applications of effort. The equation relating to CPUE to population number is:

CPUE = 359.53- 0.13 P.

The frequency of occurrence of fish in each sampling station indicates whether a fish species is present or not present in the catches of net sets. Water characteristics were recorded from Ras Amir 'mayah', which is the largest water body in the flood plains.

RESULTS

The overall catch composition of the ichthyofauna of Dinder River flood plains is shown in (Table 1). A total number of 31 species belonging to 21 genera and 13 families were recorded representing about 14.4 per cent of the total number of the 215 fish species occurring in the Nile system and its tributaries within Sudan. Family Characidae was represented by (6) species in the overall catch composition, followed by Clariidae (4 species), then Bagridae, Mochokidae and Cyprinidae, each represented by (3) species. Members of Cichlidae, Citharinidae, Distichodontidae and Schilbeidae were represented by (2) species, and each of the Centropomidae, Osteoglossidae, Mormyridae and Polypteridae were represented by only one species.

However, species belonging to family Clariidae were the most dominant and represented 37.01 % of the total index of relative importance (IRI), followed by members of Osteoglossidae (23.70%), Cichlidae (13.44%), Characidae (10.71%), Citharinidae (10.33%), Centropomidae (1.76%) and Distichodontidae (1.11 %). Each of the remaining six families contributed an IRI of less than 1.0% (Table 2).

Ras Amir 'mayah' contained the most diversified fish fauna among the sampled stations, with 21 fish species and Shannon's diversity index of 2.2 and an index of evenness of 0.72. Catfishes of the family Clariidae dominated over other species, followed by members of Characidae and Cichlidae. Species belonging to the remaining families were relatively limited in abundance (Table 3).

Birkat El Orta pool ranked second in fish diversity, with13 species and Shannon's diversity index value of 1.85, and an index of evenness of 0.75 (Table 4). The most dominant fish species in this station was *Citharinus citharus* which gave an IRI value of 62.4 %, followed by *Sarotherodon galilaeus* (8.50%), *Distichodus rostratus* (8.45%), *Heterotis niloticus* (6.93%), *Lates niloticus*(3.42%) and *Labeo niloticus* (3.38%).

Table 1. Overall catch composition of the ichthyofauna of River Dinder flood plains.

Family	No, of genera	Species
Clariidae	2	*Clarias gariepinus* *C. anguillaris* *C. engelseni* *Hetrobranchus bidorsalis*
Osteoglossidae	1	*Heterotis niloticus*
Cichlidae	2	*Sarotherodon galilaeus* *Oreochromis niloticus*
Characidae	3	*Hydrocynus brevis* *H. vittatus* *H. forskalii* *Alestes dentex* *Brycinus nurse* *B. macrolepidotus*
Citharinidae	1	Citharinus citharus C. latus
Centropomidae	1	*Lates niloticus*
Distichodontidae	1	*Distichodus rostratus* *D. niloticus*
Bagridae	3	*Bagrus Bayad* *Auchenoglanis occidentalis* *Clarotes laticeps*
Mormyridae	1	*Mormyrus kannume*
polypteridae	1	*Polypterus bichir*
Mochokidae	2	*Synodontis schall* *Synodontis batensoda* *Hemisynodontis membranaceus*
Cyprinidae	1	*Labeo niloticus* *L. coubie* *L. horie*
Schilbeidae	1	*Schilbe intermedius* *S. uranoscopus*

Table 2. Total number, weight, frequency of occurrence and index of relative importance (IRI) of most important fish species caught in Dinder River flood plains.

Species	Total no	%	Total Wt. (kg)	%	Freq.	%	IRI	%
Clarias gariepinus	148	18.50	316.81	38.03	16	50.0	2826	35.40
Heterotis niloticus	155	19.38	198.89	23.87	14	43.75	1892	23.7
Sarothrodon galilaeus	152	19.0	49.54	5.95	13	40.63	1013	12.69
Hydrocynus vitatus	65	8.13	79.88	9.59	15	46.88	830	10.40
Citharinus citharus	110	13.76	41.80	5.02	14	43.75	821	10.28
Lates niloticus	16	2.0	30.08	3.61	8	25.0	140	1.76
Clarias anguillaris	21	2.63	25.85	3.10	7	21.88	125	1.57
Bagrus bayad	12	1.50	16.23	1.95	6	18.75	65	0.81
Oreochromis niloticus	29	3.63	9.09	1.19	4	12.50	60	0.75
Distichodus rostratus	17	2.13	21.48	2.58	4	12.50	59	0.74
Hemisynodontis membranaceus	24	3.0	3.75	0.45	4	12.50	43	0.54
Distichodus niloticus	10	1.25	9.52	1.14	4	12.50	30	0.37
Hydrocynus brevis	9	1.13	6.70	0.80	4	12.50	24	0.30
Mormyrus kannume	6	0.75	0.05	0.73	4	12.50	18	0.23
Auchenoglanis occidentalis	6	0.75	2.18	0.26	3	9.38	9	0.12
Polypterus bichir	3	0.38	5.15	0.62	3	9.38	9	0.12
Citharinus latus	4	0.50	0.69	0.08	2	6.25	4	0.05
Labeo niloticus	2	0.25	2.45	0.29	2	6.25	3	0.04
Clarias engelseni	2	0.25	1.75	0.21	2	6.25	3	0.04
Labeo coubie	2	0.25	1.75	0.21	2	6.25	3	0.04
Synodontis schall	2	0.25	0.75	0.09	1	3.13	1	0.01
Labeo horie	1	0.13	1.50	0.18	1	3.13	1	0.01
Distichodus rostratus	2	0.25	0.25	0.03	1	3.13	1	0.01
Hydrocynus forskali	1	0.13	0.08	0.01	1	3.13	0.0	0.01
Schilbe intermedius	1	0.13	0.04	0.0	1	3.13	0.0	0.01
Total	800	100.0	833.08	100.0			7984	100.0

Table 3. Total number, weight, frequency of occurrence and index of relative importance (IRI) of fish species in Ras Amir 'mayah'.

Species	No.	%	Wt. (kg)	%	Freq.	%	IRI	%
Clarias gariepinus	127	37.03	273.81	62.76	10	62.37	6237	59.70
Hydrocynus vittatus	61	17.78	72.52	16.62	11	68.75	2366	22.64
Sarotherodon galilaeus	27	7.78	10.69	2.45	8	50.00	516	4.94
Lates niloticus	13	3.79	18.93	4.34	6	37.50	305	2.92
Clarias anguillaris	13	3.79	18.58	4.26	5	31.25	251	2.41
Citharinus citharus	31	9.04	4.41	1.01	3	18.75	188	1.80
Heterotis niloticus	15	4.37	7.10	1.63	4	25.00	150	1.44
Bagrus bayad	10	2.92	12.23	2.80	4	25.00	143	1.37
Hydrocynus brevis	9	2.62	6.70	1.54	4	25.00	104	1.00
Hemisynodontis membranaceus	14	4.08	3.75	0.86	3	18.75	93	0.89
Distichodus niloticus	6	1.75	1.32	0.30	3	18.75	38	0.37
Auchenoglanis occidentalis	4	1.17	1.63	0.37	2	12.50	19	0.18
Oreochromis niloticus	3	0.87	1.05	0.24	2	12.50	14	0.13
Citharinus latus	2	0.58	0.31	.07	1	6.25	4	0.04
Labeo niloticus	2	0.58	0.25	0.06	1	6.25	4	0.04
Mormyrus kannume	1	0.29	1.50	0.34	1	6.25	4	0.04
Polypterus bichir	1	0.29	0.75	0.17	1	6.25	3	0.03
Distichodus rostratus	1	0.29	0.33	0.07	1	6.25	2	0.02
Clarias engelseni	1	0.29	0.25	0.06	1	6.25	2	0.02
Labeo coubie	1	0.29	0.15	0.03	1	6.25	2	0.02
Schilbe intermedius	1	0.29	0.04	0.01	1	6.25	2	0.02
Total	343	100.0	436.28	100.0			10448	100.0

N = number of fishes; wt= of fish; frequency of occurrence of fish in catch; IRI = index of relative importance.
Shannon's diversity index = 2.2; index of evenness = 0.72.

Table 4. Total number, weight, frequency of occurrence, and index of relative importance (IRI) of fish species in Birkat El Orta pool.

Species	No.	%	Wt. (kg)	%	Freq.	%	IRI	%
Citharinus citharus	27	40.91	25.75	25.69	4	100.0	6860	62.40
Sarotherodon galilaeus	9	13.64	4.70	5.05	2	50.0	935	8.50
Distichodus rostratus	11	16.67	19.05	20.48	1	25.0	929	8.45
Heterotis niloticus	3	4.55	9.95	10.70	2	50.0	762	6.93
Lates niloticus	2	3.03	11.15	11.99	1	25.0	375	3.42
Labeo niloticus	4	6.06	8.20	8.82	1	25.0	372	3.38
Mormyrus kannume	3	4.55	3.35	3.60	1	25.0	204	1.85
Hydrocynus vittatus	1	1.52	2.80	3.01	1	25.0	113	1.03
Polypterus bichir	1	1.52	3.40	2.58	1	25.0	102	0.93
Synodontis schall	2	3.03	0.75	0.81	1	25.0	96	0.87
Bagrus bayad	1	0.52	1.80	1.94	1	25.0	86	0.78
Labeo coubie	1	0.52	1.60	1.72	1	25.0	81	0.74
Clarias engelseni	1	1.52	1.50	1.61	1	25.0	78	0.71
Total	66	100.0	93.0	100.0			10993	100.0

Shannon's diversity index = 1.85; index of evenness = 0.75.

The remaining fish species formed together an IRI of 6.91%.

The ichthyofauna of Ain El Shamis 'mayah consisted of 10 species and Shannon's diversity index of 1.65 and an index of evenness of 0.64, thus ranking third in species abundance. The catch was dominated by *Heterotis niloticus* giving an IRI value of (74.48%),followed by *Clarias gariepinus* (16.62%) and *Citharinus citharus* (5.17 %). The remaining species represented only (3.73%) of the total IRI value (Table 5).

El Tabia pool ranked fourth in terms of species abundance with nine fish species and Shannon diversity index of 1.60 and an index of evenness of 0.77 (Table 6). *Citharinus citharus* was the most dominant species with an IRI of 64.57 %, followed *by Labeo niloticus* (8.94%), *Mormyrus kannume* (6.47 %), *Heterotis niloticus* (4.68%)

Table 5. Total number, weight, frequency of occurrence and index of relative importance (IRI) of fish species in Ein El Shamis'mayah'.

Species	No.	%	Wt. (kg)	%	Freq.	%	IRI	%
Heterotis niloticus	90	55.90	147.34	76.43	4	66.67	8822	73.48
Clarias gariepinus	18	11.18	36.15	18.75	4	66.67	1996	16.62
Citharinus citharus	20	12.42	0.00	0.00	3	50.0	621	5.17
Clarias engelseni	8	4.97	7.28	3.77	2	33.33	291	2.29
Sarotherodon galilaeus	10	6.21	0.00	0.00	1	16.67	104	0.86
Hemisynodontis membranaceus	10	6.21	0.00	0.00	1	16.67	104	0.86
Auchenoglanis occidentalis	2	1.24	0.56	0.29	1	16.67	25	0.21
Hydrocynus vittatus	1	0.62	1.05	0.54	1	16.67	19	0.16
Distichodus rostratus	1	0.62	0.40	0.21	1	16.67	14	0.12
Lates niloticus	1	0.62	0.00	0.00	1	16.67	10	0.09
Total	161	100.0	192.76	100.0			12007	100.0

Shannon's diversity index = 1.65; index of evenness = 0.64.

Table 6. Total number, weight, frequency of occurrence and index of relative importance (IRI) of fish species in El Tabia pool.

Species	No.	%	Wt. (kg)	%	Freq.	%	IRI	%
Citharinus citharus	12	50.0	9.43	37.41	3	100.0	8741	64.57
Labeo niloticus	2	8.33	2.45	9.81	2	66.67	1210	8.94
Mormyrus kannume	2	8.33	1.20	4.81	2	66.67	876	6.47
Heterotis niloticus	1	4.17	3.70	14.82	1	33.33	633	4.68
Sarotherodon galialeus	3	12.50	1.30	5.21	1	33.33	590	4.36
Hydrocynus vittatus	1	4.17	2.70	10.82	1	33.33	499	3.69
Bagrus bayad	1	4.17	2.20	8.81	1	33.33	433	3.20
Polypterus bichir	1	4.17	2.00	8.01	1	33.33	406	3.00
Hydrocynus foskali	1	4.17	0.075	0.30	1	33.33	149	1.10
Total	24	100.0	24.97	100.0			13537	100.0

Shannon's diversity index = 1.60; index of evenness= 0.77.

Table 7. Total number, weight, frequency of occurrence and index of relative importance (IRI) of fish species in Girerisa 'mayah'.

Species	No.	%	Wt. (kg)	%	Freq.	%	IRI	%
Heterotis niloticus	13	59.05	13.20	58.21	1	100.0	11730	58.65
Clarias engelseni	2	9.09	6.60	29.11	1	100.0	3820	19.10
Distichodus rostratus	4	18.18	1.70	7.50	1	100.0	2568	12.84
Citharinus latus	2	9.09	0.38	1.65	1	100.0	1074	5.37
Hydrocynus vittatus	1	4.55	0.80	3.53	1	100.0	807	4.04
Total	22	100.0	22.68	100.0			20,000	100.0

Shannon's diversity index = 1.2; index of evenness= 0.74.

and *Sarotherodon galileus* (4.36%). The combined IRI value of the remaining four species accounted for 10.99 %.

The catch in Greirisa 'mayah' consisted of only five fish species and with diversity index of 1.2 and an index of evenness of 0.74 (Table 7).The catch was dominated by *Heterotis niloticus* with IRI value of 58.65%, followed by *Clarias engelseni* (19.10%), *Distichodus niloticus* (12.84 %), *Citharinus latus* (5.37%) and *Hydrocynus vittatus* (4.04%).

Only four species of fish were present in Birkat El Timsah pool with a diversity index of 0.86 and an index of evenness of 0.62 (Table 8). *Sarotherodon galilaeus* dominated the catch with an IRI value of 71.35 %, followed by *Oreochromis niloticus* (18.08%), *Citharinus citharus* (9.29% and finally *Heterotis niloticus* (1.29%).

The fish biomass was estimated only from Birkat El Timsah pool according to De Lury method which is based on the assumption that the catch per unit effort (CPUE) decreases constantly relative to the number of individuals

Table 8. Total number, weight, frequency of occurrence and index of relative importance (IRI) of fish species in Birtak El Tamasih pool.

Species	No.	%	Wt. (kg)	%	Freq.	%	IRI	%
Sarotherodon galilaeus	103	69.13	32.86	73.57	1	100.0	14270	71.35
Oreochromis niloticus	25	16.78	8.65	19.37	1	100.0	3615	18.08
Citharinus latus	20	13.42	2.30	5.15	1	100.0	1857	9.29
Hydrocynus vittatus	1	0.67	0.85	1.90	1	100.0	257	1.29
Total	149	100.0	44.66	100.0			20,000	100.0

Shannon's diversity index = 0.86; index of evenness = 0.62.

Table 9. Average values of water parameters of Ras Amir 'mayah' (surface area = 4.52 km^2).

Temp(°c)	pH	DO(mg/l)	Alk.(mg/l)	BOD(mg/l)	NH4-N (mg/l)	NO_2(mg/l)	NO^3 (mg/l)	P (mg/l)
31.2	7.92	4.65	1.22	4.8	0.22	1.83	0.007	0.078

remaining from the population after successive application of an effort. The equation relating the CPUE to the population number is:

CPUE = 359.53 – 0.13 P, where, P = the total number of harvested fish.

Thus, the total number of fish harvested up to the time when depletion occurs is:

P = - 359.53 / 0.13 = 2766

Therefore, the estimated number of fish in Birkat El Timsah pool (surface area of 0.9 hectare) was 2766 fishes and the density of fish was 0.3073 fish /m^2. Considering the mean weight of fish in this station at 300 gm (0.3 kg), then the estimated ichthyo-biomass in Birkat El Timsah was 830 kg, which is equivalent to a density of 0.0922 kg/ m^2 or 922 kg/ha.

Water characteristics were measured in Ras Amir 'mayah, the largest water body in the flood plains. All of the examined parameters were within the range favorable for the survival and growth of fishes in the flood plains (Table 9).

DISCUSSION

Considerable variations were observed in the species composition and abundance in the different sampling stations of the study area. Welcomme (1979) observed such variations in the species composition in fish populations of flood plains of similar ecosystems. However, expressing the catch in absolute numbers can be misleading when different units of gear are used at different fishing times when catches from different habitats are investigated. So, catch rates are better expressed in terms of standardizing the fishing effort by a suitable conversion factor.

Furthermore, the percentage by number and weight and frequency of occurrence of fish species do not provide satisfactory information for making comparisons among a given species in the community. It is, therefore, preferable to consider the whole composition of the fish community in view of the index of relative abundance (IRI) of each species in relation to the total number of species present, as fishes that have similar percentage by number may show different values of IRI, depending on their weights and frequency of occurrence. Thus, by combining the numeric abundance (N), average weight (W), and the prevalence of a species it is possible to compare more favourably between various components of the community. The results of the analysis showed that Ras Amir 'mayah' had the highest value of diversity index of 2.2, while Birkat el Timsah pool had the lowest value of diversity index of 0.86.

In this study, the overall catch per station was converted using a standard net of 100 m^2 and a standard fishing time of 24 h. Therefore, catches in different stations can be comparably expressed as mean catch per unit effort, CPUE (kg/100m^2/day) regardless the size of the fishing gear and the fishing time. Hence, Birkat El Timsah pool which previously ranked third now ranked first with a mean standard CPUE of 2233 kg/100m^2/day. Estimates of CPUE of other water bodies were 152, 62, 35, 26, and 24 kg/100m^2/ day for El Tabia pool, Greirisa 'mayah', Ain el Shamis 'mayah', Ras Amir 'mayah' and Birkat El Orta pool respectively.

Although, it is difficult to determine an accurate estimate of the present level of fish biomass in these flood plains due to the lack of adequate data on fishing gear, catch and effort and production patterns, yet, estimates of fish biomass of about 922 kg/ha were obtained for Birkat El Timsah pool. This value compares favorably with the values recorded from other river systems in tropical Africa , for example, 196- 1440 kg/ ha, recorded for Sokoto River in Nigeria (Lowe-Mc Connell,1975), and 64- 2682 kg/ ha for Kafu River flood plains in Zambia (Lagler *et al*., 1971).

Members of the Clariidae, which dominated the catches, are fishes well adapted to the environmental conditions of the flood plains because they are equipped with accessory breathing organs and can survive well in poorly oxygenated water of the flood plains (Kolding,

1989).They are indiscriminate omnivores, and such a feeding habit enables them to cope successfully with the changing food availability in the habitat (Babiker, 1984).

Heterotis niloticus, on the other hand, is a swamp fish and it frequently appeared in the catches of the flood plains. These habitats are frequently infested with aquatic plants and provide suitable conditions for this nest-making species to feed and breed. Cichlids are omnivore - planktivore fishes and flourish well in the lentic habitats of River Dinder flood plains where planktonic communities are abundant.

The occurrence of the members of Characidae in the catch may be highly underestimated as they were caught only by gill nets. They are fast swimming carnivorous fishes and their confinement to habitats such as pools and "mayahs' may not provide them with sufficient food supplies, and they rely mainly on feeding on other small fishes and insects.

Citharinids, being phytophagus fishes, were abundant in the study area due to the availability of algae, aquatic vegetation and other macrophytes which cover the surface of the depression lakes and pools during the flood season. Nutrients are also available in the area, and they are seasonally flushed in sufficient amounts into the flood plains from the neighbouring agricultural projects, wetlands and human and animal wastes (Table 9). Members of the families Centropomidae, Distichodontidae, Bagridae, Mormyridae, Mochokidae, Cyprinidae and Schilbeidae were present in small numbers; yet, they are expected to play a significant role in the fisheries of the flood plains. It is to be noticed that the biomass of the fish stocks in the flood plains is a dynamic quantity showing constant variations which are induced by fishing mortality, natural mortality and habitat expansion or shrinkage during and after the flood season. It is therefore not unusual to reach different estimates for a single body of water depending on the stage of the flood cycle during which the samples are collected. In fact these fisheries are totally mismanaged due to the use of destructive fishing gear like monofilament nets and other types of local fishing gear.

With more refined sampling techniques over a prolonged period of time, it will be possible to obtain more accurate estimates on fish biomass and productions rates of these flood plains and maintain them as an important and valuable fisheries resource for the local inhabitants of River Dinder Park area.

CONCLUSION

Thirty one species of fish belonging to 20 genera and 13 families were recorded in Dinder River flood plains, representing about 14.4% of the total number of fish species occurring in the River Nile and its tributaries within Sudan. Ras Amir 'mayah' contained the most diversified fish fauna among the six sampled stations (21 species), followed by Birkat El Orta pool (13 species), then Ain El Shamis 'mayah' (10 species), El Tabia pool (9 species), Greirisa 'mayah' (5 species) and finally Birkat El Timsah pool with only 4 species. *Clarias gariepinus* was the most dominant species in the study area with an IRI value of 35.40%, followed by *Heterotis niloticus* (23.70%), then *Sarotherodon galilaeus* (12.69%), *Hydrocynus vittatus* (10.40%) and *Citharinus citharus* (10.28*%), Lates niloticus* (1.76%) and *Clarias anguillaris* (1.57%). The combined IRI of the remaining species represented only 4.19% of the total value of the IRI of the study area.The estimated catch per unit effort (CPUE) revealed that Birkat El Timsah pool had the highest mean CPUE of 2233 kg/100m^2/ day, followed Birkat El Tabia pool, Greirisa 'mayah', Ain El Shamis 'mayah', Ras Amir 'mayah' and then Birkat El Orta pool with CPUE values of 152, 62, 35, 26 and 24 kg/100m^2/day, respectively. Although it is difficult to estimate the present level of production in these flood plains, yet, with more extensive spatial and temporal sampling programs involving more diversified fishing gear, it will be possible to obtain more accurate information on the potential yield, estimates of biomass and catch per unit effort of this valuable, but rather fragile ecosystem in order to formulate a reliable management policy for its exploitation.

AUTHORS' DECLARATION

We declare that this study is an original research by our research team and we agree to publish it in the journal.

REFERENCES

Abu Gideiri YB (1984). Fishes of the Sudan. Khartoum University Press. Khartoum, Sudan.

Adam AB. (1977). Some studies on the productivity of Jebel Aulia Reservoir. M. Sc. Thesis. Department of Zoology, Faculty of Science, University of Khartoum, Sudan.

Adam AB (1986). Distribution and abundance of fish in Jebel Aulia Reservoir on the White Nile. Sudan J. Sci. 2:161- 175.

Ahmed AA (1978). On the biology of Cyprinidae fish in northern part of White Nile. M. Sc. Thesis. Dept. of Zoology, Faculty of Science, University of Khartoum, Sudan.

Asma ERA (1985*).* Final report of the project on the assessment of Jebel Aulia Reservoir fisheries. Fisheries Research Center, Agriculture Research Corporation. Khartoum. Sudan. 1-23.

Babiker MM (1984). Aspects of the biology of the catfish Clarias lazera (Cuv. & Val.) related to its economic cultivation, Hydrobiologia, 110: 295- 314.

Bailey RG (1994). Guide to the fishes of the River Nile in the Republic of the Sudan. Journal of Natural History, 28 (4): 937-970.

Bashir MM (2003). A Study on Catch Assessment in the Northern Part of Jebel Aulia Reservoir. M.Sc. Thesis. Department of Zoology, Faculty of Science, University of Khartoum. Sudan.

Bashir FA (2007). Biological Aspect s and Ichthyobiomass of Commercially Important Fish Species in Jebel Aulia Reservoir. M. Sc. Thesis. College of Natural Resources and Environmental Studies. University of Juba, Sudan.

Begon M, Harper JL, Townsend CR (1990). Ecology: Individuals, Populations and Communities. 2nd ed. Blackwell Scientific Publications.

Belleman M, Khalid AM (1998). Assistance to Fisheries Management, Republic of Sudan. TC: TCP/ SUD/6611.
De Lury DB (1947). On the Estimation of Biological Populations. Biometrics. 3(4): 145-167.
El Moghraby AI (1973). Fishes of the White Nile. pp 16- 17, in: 19th annual report 1972- 1973, Hydrobiological Research Unit, University of Khartoum, Khartoum University Press, Sudan.
Kolding J (1989). The fish resources of Lake Turkana and their environment. Cand. Scient. Thesis and final report of KEN- 043 trial fishery 1986-1987. Department of fisheries Biology, university of Bergen. Norway.
Kolding J, Ticheler H, Chanda B (1994). Assessment of the Bangweulu swamps fisheries. Final Report prepared for WWF Bangweulu Wetlands Project, SNV/Netherlands Development Organisation, and Department of Fisheries, Zambia.
Lagler KF (1971). Freshwater Fishery Biology, 2nd ed. WM. C. Brown Company. Dubuque, Iowa.
Lowe-McConnell RH (1975). Fish communities in tropical freshwaters, their distribution , ecology and evolution. Longman Inc., New York.
Mahmoud ZM (1984). Ichthyofauna of Dinder National Park, Sudan, Afr. J. Ecol., 14: 27-29.
Mishrigi SY (1970). Fishes of Lake Rosaries on the Blue Nile. Rev. Zool, Bot. Afr. LXX11: 1-2.
Obeida MM, Ali MT, Yousif FM (2013). Estimation of biomass of commercial fish species in the White Nile River, Sudan. International Journal of Marine, Atmospheric & Earth Sciences, 1(1): 17-26.
Welcomme RL (1979). The fisheries ecology of flood plain rivers. Longman, London.