Scientific Research Publishing

Advances in Bioscience and Biotechnology, 2021, 12, 309-322
https://www.scirp.org/journal/abb
ISSN Online: 2156-8502
ISSN Print: 2156-8456

The Fish Fauna of the Future Large Size Reservoir of Ouessa, on the Mouhoun River, Burkina Faso

Raymond Ouedraogo[1,2*], Florent M. Y. Sawadogo[2], Nomwine Da[1,2], Komandan Mano[2,3]

[1]INERA-Institut de l'Environnement et de Recherches Agricoles, Ouagadougou, Burkina Faso
[2]Laboratoire de Biologie et d'Ecologie Animales, Université Joseph KI-ZERBO, Ouagadougou, Burkina Faso
[3]Université de Dédougou, Dédougou, Burkina Faso
Email: *ouedray@yahoo.com

How to cite this paper: Ouedraogo, R., Sawadogo, F.M.Y., Da, N. and Mano, K. (2021) The Fish Fauna of the Future Large Size Reservoir of Ouessa, on the Mouhoun River, Burkina Faso. *Advances in Bioscience and Biotechnology*, **12**, 309-322.
https://doi.org/10.4236/abb.2021.1210020

Received: August 28, 2021
Accepted: October 22, 2021
Published: October 25, 2021

Abstract

Reliable and basic information on fish are required for the sustainable management of a fishery. For this reason, the fish fauna of the future reservoir of Ouessa in the low section of the Mouhoun River, Burkina Faso is studied. In order to describe the fish community, the fish were sampled in March 2020 thanks to cast nets and gill nets. They were sorted into species and each fish was weighted at the nearest 0.1 g and its total length measured at the nearest mm. The landings of commercial fishermen were also observed. In total, 1059 fishes were collected and grouped into 42 species, 27 generas and 16 families. The dominant species were *Synodontis nigrita*, *Synodontis schall*, *Marcusenius senegalensis*, *Schilbe intermedius*, *Brycinus nurse* and *Alestes baremoze*. However, the compilation of diverse sources suggests the presence of nearly 70 species. The index of Shannon-Weaver (3.97), the values of the condition factor, the fish size and the presence of intolerant species indicate the relatively good conditions of the aquatic ecosystem. Among the 24 dominant species, 54% have a positive allometric growth, 42% a negative allometric growth and 0.04 an isometric growth. This study builds the basis of sustainable management of the future reservoir of Ouessa that is planned to be the largest one of the country (40,000 ha large).

Keywords

Ichthyofauna, Reservoir, Ouessa, Mouhoun River, Burkina Faso

1. Introduction

1.1. General Aspects

As Burkina Faso is arid and not provided with important natural waters, a policy

of water resources development led to the creation of 1500 reservoirs which size varies from 0 to 25,000 ha depending on the season. The development of water resources resulted in the development of commercial capture fisheries [1], which employs 32,000 fishermen, 3400 sellers of fresh fish, 2300 sellers of processed fish and 3000 women fish processors [2]. The archives of the General Directorate for Fish Resources reveal that in tonnes, the national production of fish was 28,365 (capture fisheries: 27,803, aquaculture: 562) in 2019 and 29,752 (capture fisheries 29,105, aquaculture 647) in 2020. This source adds that in 2020, the country imported 146,995 tonnes, that is five times more than the national production; in 2020, the consumption of fish per capita was 8 kg. Increasing the national production of fish is therefore a requirement mentioned in many national development policies, such as the national plan for social and economic development and national strategy for sustainable development of capture fisheries and aquaculture by 2025.

1.2. Problematic

The feasibility study of the large size reservoir of Ouessa on the most important river that is the Mouhoun is already done. Important roles are assigned to fishing and fish farming, but scientific knowledge lacks suddenly, which can compromise the management of the future reservoir fishery. Though a few works like [3] [4] [5] and [6] were recently done on the upper part of Mouhoun, they do not provide a comprehensive understanding of the state of the fish community of the upcoming reservoir. Moreover, in Burkina Faso, the fish communities are seldom studied before the creation of reservoirs, including the large size ones that are Toece (5000 ha large; created in 1995), Ziga (8000 ha; 2000), Sourou (10,000 ha; 1984), Kompienga (20,000 ha; 1988) and Bagré (25,000 ha; 1992). In Kompienga, such study was done by a foreign company, but the results were said to be for internal use only. However, we need reliable information on the fish community for conservation and sustainable management [7] [8] [9].

1.3. Objectives

Therefore, the general objective of this piece of work is to provide reliable information on the ichthyofauna of the area of Ouessa on the downstream part of River Mouhoun. The specific ones are to describe the fish assemblages, the length-weight relationship, some indices of diversity of species, the condition factor, the yield per fish effort and some physico-chemical factors.

2. Methodology

2.1. The Study Site

The future dam of Ouessa will be built on the Mouhoun River, formerly known as Black Volta, at a site that is close to the frontier with the Republic of Ghana. The site is located in the downstream section of the Burkinabe part of the most important river, an area that probably hosts a large number of fish species. Ac-

cording to [10], the reservoir will be 40000 ha large and will yearly produce 4500 t of fish and that currently the area hosts 1265 fishermen (of which 5% are women) who, together annually land 585.5 tonnes of fish.

2.2. Fish Sampling

The fish were sampled from 06 to 15 March 2020 with cast nets of 15 mm of mesh size and gill nests of 15 to 65 mm. Two professional fishermen were recruited for this purpose. In the water the fishermen were moving from downstream to upstream generally by canoe and exceptionally by foot. In total we covered about 35 km of reach that was divided into 7 sections (Bridge, Konkiri, Memère, Dianlé, Dike, Bon and Laro,) of about 5.8 km-long each (Table 1 and Figure 1). Each section was covered by a sampling session and the number of

Table 1. Names and GPS coordinates of the starting points of the sampling sessions, from downstream to upstream.

N°	Dates	Sites names	GPS coordinates	
			Latitude	Longitude
1	15 March	Bridge	0519067 N	1218324 W
2	06 & 07 March	Konkiri	0518354 N	1223770 W
3	08 March	Memère	0518882 N	1225337 W
4	09 March	Dianlé	0522174 N	1228543 W
5	10 March	Dike	0522455 N	1228454 W
6	12 March	Bon	0522903 N	1233994 W
7	13 March	Laro	0515838 N	1243123 W
8	14 March	Boura	0554712 N	1221093 W

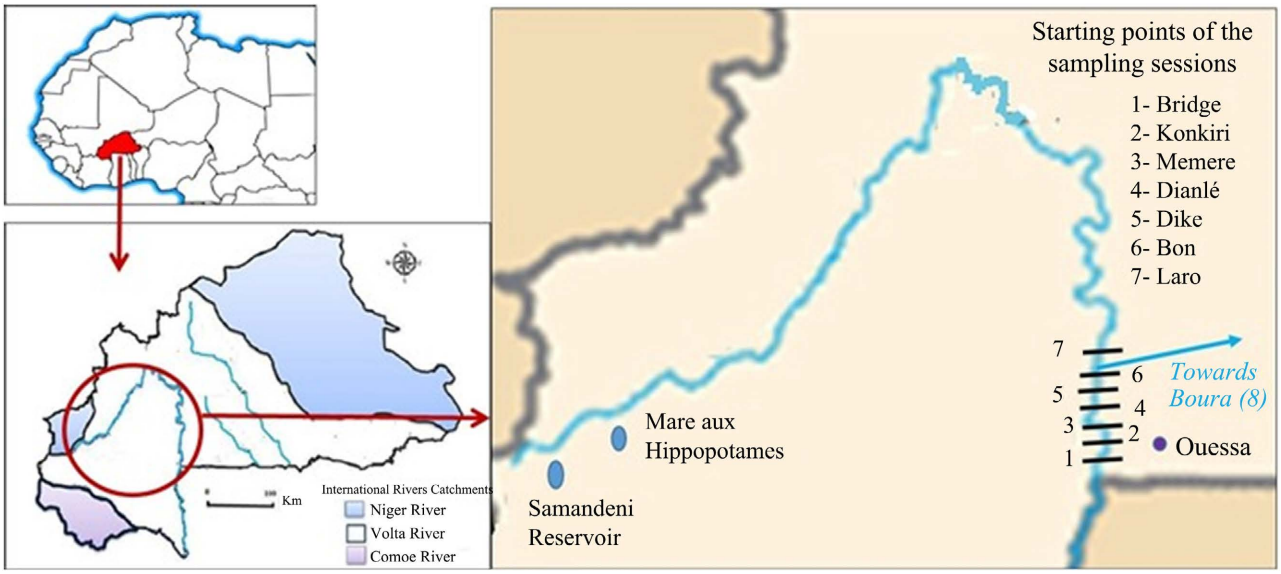

Figure 1. Location of study site, showing the Mouhoun sections (1 to 7) that were sampled (Important: Point 5 is the place where the dike of the future reservoir will be built).

throws of cast net were counted. Additionally, we sampled in the small size reservoir of Boura (32 km far from the Mouhoun) which water flows into the area that will be flooded by the future reservoir.

The fishes were sorted into species thanks to [11] and each fish was weighed at the nearest 0.1 g and its total length measured at the nearest 0.1 cm. Specimens of species difficult to identify were conserved in alcohol 90˚ for deeper examination in the Laboratory of Animal and Fish Biology and Ecology of the University Joseph KI-ZERBO of Ouagadougou. We also observed the landings of local commercial fishermen to look for species and size of specimen that we could not catch. We questioned local fishermen, about the names of species in *dagara* and *gourounsi* the two local languages in the area and their signification in *dagara* the most spoken language.

2.3. Measurement of Physico-Chemical Parameters

Between 07 h and 09 h that is the start of each sampling session, we measured the pH, the conductivity, the temperature and the dissolved oxygen thanks to a portable multimeter HANNA, Model COMBO and the transparency with a Secchi disc.

2.4. Data Analysis

We calculated the frequencies of families, genera and species, the index of diversity of Shannon-Weaver (H') and the index of eveness of Pielou (E).

$$H' = -\sum P_i * \ln P_i$$

where the quantity p_i is the proportion of individuals found in the i^{th} species [12]. The values of H' usually range between 1.5 and 3.5 and only rarely exceeds 4.5 [13].

We calculated the index of evenness of Pielou (E) $E = H' / \log_2(S)$ where H' is the value of Shannon index and S the taxonomic richness. This index denotes a balance relationship between species and its individual richness of a sample. It ranged between 0 and 1 which expresses the absolute distribution of relative abundance of species [14].

The length - weight relationship was appreciated thanks to [15]: $Pt = aLt^b$, where Pt and Lt are respectively the weight (g) and the total length (cm). The constants a et b are derived from the linearisation of the relationship by logarithmic transformation in the form of $\log_2(Pt) = \log_2(a) \times b * \log_2(Lt)$ [16]. The growth of the species is isomeric when $b = 3$, allometric positive when $b > 3$ and allometric negative when $b < 3$.

The condition factor K of the most common 24 species was calculated: $K = P * 100 / Lt^3$, [17] where Pt is the total weight in (g) and Lt the total length of the fish in (cm).

Finally, the yield per unit of fishing effort was also calculated, the unit of fishing effort being the throw of cast net.

3. Results

3.1. Fish Families, Generas and Species

In total we observed 1059 specimens sorted into 16 families, 27 generas and 42 species. At family level, the *Mochokidae* was dominant (44.3%), followed by the *Alestidae* (16.9%), the *Mormyridae* (12.90%) and the *Cichlidae* (6.7%). None of the remaining ones exceeded 5% (Figure 2).

The species were dominated by *Synodontis nigrita* (26.4%), followed by *Synodontis schall* (12.7%), *Marcusenius senegalensis* (9.7%), *Brycinus nurse* (7.8%) and *Alestes baremoze* (6.4%). None of the remaining ones exceeded 5% (Figure 3).

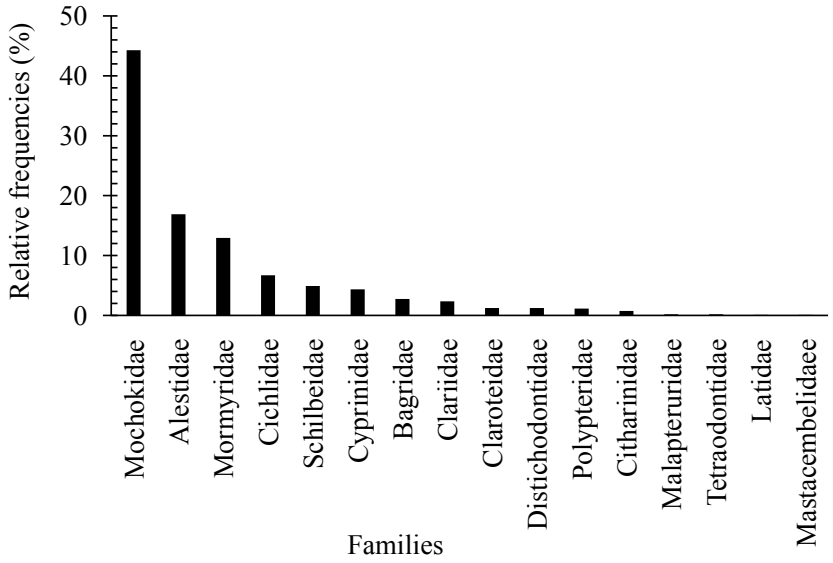

Figure 2. Fish family assemblage of the Mouhoun River at Ouessa in Mars 2020.

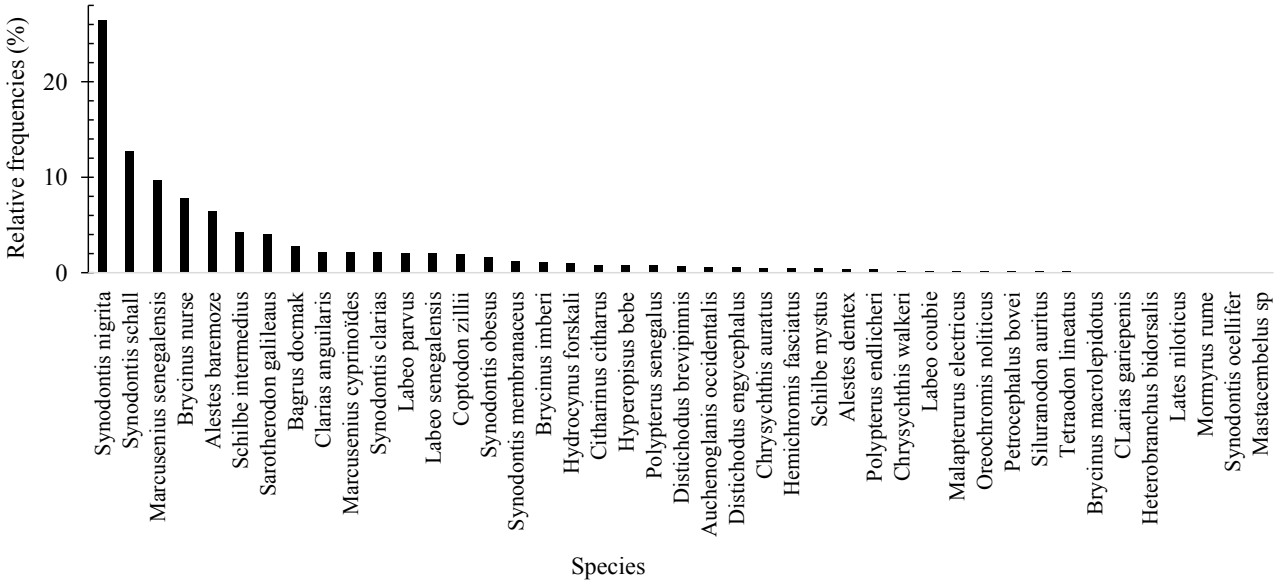

Figure 3. Fish species assemblage of the Mouhoun River at Ouessa in Mars 2020.

Many of the species did not have their names indicated by the local fishermen in the local languages (Table 2). The names are given with reference to the morphology, the colour or the ethology of the species. For instance, *B. nurse* is named *Zourzier* in *dagara* language, meaning that it has a red tail. Also *Zu saala*, the name of *C. anguillaris* in *dagara* means the fish slips easily through the fingers. For some species we were able to find the names, but not the meaning.

Table 2. The fish species: names and signification in local languages.

Species scientific names	Names and signification in langue dagara		Name in gourounsi
	Names	Signification	
Alestes baremoze *Alestes dentex*	Talankpol	Toothless	Barfilew
Brycinus imberi *Brycinus nurse* *Brycinus macrolepidotus*	Zourzièr	Red tail	Nanewsagè
Hydrocynus forskali	Ba-gnimin	Dog fish	Zingo
Bagrus docmak	Dekor-nasaolou	Comparable to valiant single	Sossia
Chrysichthys auratus *Chrysichthys walkeri*	Memboura	Prikes dangerously	
Auchenoglanis occidentalis			kokow
Citharinus citharus			Bedeneguiew
Clarias anguillaris *Heterobranchus bidorsalis* *Coptodon zillii* *Hemichromis fasciatus* *Oreochromis niloticus*	Zu saala	Slips easily	Nawbio
Sarotherodon galileaus	Pinpela	Large tilapia	
Distichodus engycephalus *Distichodus brevipinnis*	Kanka-vaar	Ficus leaves	
Labeo coubie *Labeo parvus* *Labeo senegalensis*	Bindol	Fast in the water Large and retractile mouth Eats much	Boundaré
Lates niloticus *Malapterurus electricus* *Marcusenius cyprinoïdes* *Marcusenius senegalensis* *Mormyrus rume* *Petrocephalus bovei* *Hyperopisus bebe*	Mao-nou	Makes hand shiver	

Continued

Schilbe intermedius			Guiguio
Schilbe mystus	Tintira	Easily and painful picks	Guiguio
Siluranodon auritus			
Polypterus endlicheri	Ba-wa	Aquatic snack	Dankassanè
Polypterus senegalus			Dankassanè
Synodontis clarias	Koko zourzier	Koko = Synodontis; Zourzier = red tail	
Synodontis membranaceus	Koko pla	White synodontis	Kokonayarow
Synodontis nigrita			
Synodontis obesus	Koko hihi	Hihi, onomatopoeia referring to the noise the fish makes out of water	
Synodontis ocellifer			
Synodontis schall			
Tetraodon lineatus	Vonon	Big stomach, blows like a ball	
Mastacembelus sp			

3.2. Index of Diversity of Fish Species

The values of index of Shannon-Wiener H' was 3.97 and the equitability E of Pielou 0.74.

3.3. Length-Weight (LW) Relationship

For the 24 most frequent species the mean length and weight and the parameters of their relationship are given in Table 3. We estimated that the number of specimens of the 18 remaining species is too low to allow a reliable calculation of the LW relationship. We found a positive allometric growth for 13 species ($b > 3$; $p < 0.05$), a negative allometric growth for 10 species ($b < 3$; $p < 0.05$) and an isometric growth ($b = 3$; $p > 0.05$) for 1 species.

The values of the condition factor for the 24 species vary from 0.140 to 4.320, the lowest value being for *H. forskali* and the highest one for *H. bebe* (Table 4).

3.4. Catches per Unit of Fish Effort (CPUE)

In terms of biomass, on average a cast net throw yielded 21.91 g, with the highest record at Konkiri (39.72 g) and the lowest one at Mémère (15.06 g). As for the number of fishes, the mean yield of throw was 0.45, with the maximum in Dianlé (0.76 fish) and the minimum at Boura and at the bridge (0.58 fish). The details are given in Table 5.

3.5. The Physico-Chemical Parameters

The mean content of dissolved oxygen was 6.70 mg/l with the minimum of 5.64 at Dianlé and the maximum of 7.9 at the dike, the mean value of pH 7.86 with the minimum of 7.45 at Boura and the maximum of 8.06 at Laro, the mean transparency 29.64 cm with the minimum of 17.1 at Laro and the maximum of 107 at Boura and the mean temperature in ˚C was 28 with the minimum of 27 at

Table 3. The 24 main species: mean weight, length and parameters of the LW relationship (Min = minimum; Max = maximum; *a* = growth coefficient; *b* = slope of the regression line; $^{+}$A = Positive allometry; $^{-}$A: Negative allometry; I = Isometry).

Species	Weight (g)			Total length (cm)			*a*	*b*	Growth type
	Min	Max	Mean	Min	Max	Mean			
A. baremoze	7.9	289.0	68.04	10.4	36.6	21.26	0.015	2.55	$^{-}$A
A. dentex	5.8	39.3	28.18	10.2	20.0	17.15	0.008	2.80	$^{-}$A
A. occidentalis	41.9	122.0	87.23	15.4	21.7	19.35	0.006	3.08	$^{+}$A
B. docmak	21.6	354.0	90.57	16.5	36.5	24.62	0.005	3.04	$^{+}$A
B. nurse	6.9	78.3	29.63	7.1	18.5	13.25	0.012	2.75	$^{-}$A
C. auratus	14.2	70.0	34.44	10.2	17.9	13.86	0.099	2.85	$^{-}$A
C. citharus	54.8	101.0	74.75	16.1	19.0	17.69	0.005	3.18	$^{+}$A
C. anguillaris	17.5	2004.0	196.29	14.8	60.0	25.44	0.001	3.55	$^{+}$A
C. zillii	9.3	114.0	41.50	7.8	18.9	12.09	0.009	3.00	I
D. brevipinnis	22.6	80.2	45.46	12.6	18.1	15.34	0.002	3.56	$^{+}$A
S. intermedius	6.8	107.7	23.91	2.0	21.0	13.97	0.002	3.58	$^{+}$A
H. forskali	38.9	266.0	92.11	18.3	32.5	22.56	0.002	3.56	$^{+}$A
H. bebe	16.0	45.2	29.05	14.3	20.2	16.96	0.025	2.30	$^{-}$A
L. parvus	14.5	925.0	120.48	11.6	44.8	19.89	0.005	3.16	$^{+}$A
L. senegalensis	20.9	236.0	90.62	13.2	29.2	19.79	0.005	3.13	$^{+}$A
M. cyprinoïdes	9.9	39.7	27.11	10.1	16.5	14.02	0.016	2.60	$^{-}$A
M. senegalensis	8.2	63.3	30.31	10.2	17.6	14.50	0.006	3.08	$^{+}$A
P. senegalus	54.9	460.0	172.94	21.7	42.2	29.46	0.003	3.21	$^{+}$A
S. galileaus	7.8	228.0	87.63	7.1	21.6	15.30	0.013	2.84	$^{-}$A
S. clarias	17.6	146.0	60.74	12.2	23.2	17.00	0.003	3.44	$^{+}$A
S. membranaceus	16.2	330.0	74.52	12.0	23.8	16.20	0.007	2.98	$^{-}$A
S. nigrita	8.5	42.4	21.65	8.7	17.9	11.35	0.016	2.66	$^{-}$A
S. obesus	14.3	48.3	25.96	11.0	15.4	13.14	0.004	3.23	$^{+}$A
S. schall	9.9	79.6	32.97	9.7	18.9	14.27	0.008	2.92	$^{-}$A

Table 4. Equation of the regression W-L and condition factor of the 24 main species (W = Weight; L: Total Length, R^2: Correlation coefficient).

Species	Regression equation	R^2	Factor of condition K	
			Mean	Ecart-Type
A. baremoze	$W = 0.015L^{2.55}$	0.79	2.802	0.157
A. dentex	$W = 0.008L^{2.80}$	0.99	0.986	0.105
A. occidentalis	$W = 0.006L^{3.08}$	0.98	0.950	0.192
B. docmak	$W = 0.005L^{3.04}$	0.92	0.534	0.160
B. nurse	$W = 0.012L^{2.75}$	0.82	2.430	0.146

Continued

C. auratus	$W = 0.099L^{2.85}$	0.98	1.919	0.262
C. citharus	$W = 0.005L^{3.18}$	0.94	0.805	0.341
C. anguilaris	$W = 0.001L^{3.55}$	0.97	0.201	0.089
C. zillii	$W = 0.009L^{3.00}$	0.98	2.348	0.071
D. brevipinnis	$W = 0.002L^{3.56}$	0.99	0.273	0.197
S. intermedius	$W = 0.002L^{3.58}$	0.94	0.190	0.140
H. forskali	$W = 0.002L^{3.56}$	0.97	0.140	0.186
H. bebe	$W = 0.025L^{2.30}$	0.74	4.320	0.522
L. parvus	$W = 0.005L^{3.16}$	0.97	0.949	0.062
L. senegalensis	$W = 0.005L^{3.13}$	0.99	0.793	0.041
M. cyprinoïdes	$W = 0.016L^{2.60}$	0.80	2.829	0.286
M. senegalensis	$W = 0.006L^{3.08}$	0.89	0.803	0.106
P. senegalus	$W = 0.003L^{3.21}$	0.98	0.332	0.115
S. galileaus	$W = 0.013L^{2.84}$	0.94	3.786	0.120
S. clarias	$W = 0.003L^{3.44}$	0.96	0.355	0.146
S. membranaceus	$W = 0.007L^{2.98}$	0.51	1.853	0.868
S. nigrita	$W = 0.016L^{2.66}$	0.74	3.382	0.093
S. obesus	$W = 0.004L^{3.23}$	0.83	0.633	0.367
S. schall	$W = 0.008L^{2.92}$	0.89	1.403	0.160

Table 5. Catches per unit of fish effort per sampling section (Nbr = Number).

Sampling sections	Total per section				Catches per throw		
	Nb of throws	Nb of species	Nb of fishes	Biomass (g)	Nb of species	Nb of fishes	Biomass (g)
Konkiri	230	14	99	9136.20	0.06	0.43	39.72
Bon	280	8	122	6506.20	0.03	0.44	23.24
Dike	280	23	137	5278.00	0.08	0.49	18.85
Dianlé	290	21	219	5340.80	0.07	0.76	18.42
Boura	105	3	24	1906.70	0.03	0.23	18.16
Laro	320	16	153	5391.10	0.05	0.48	16.85
Bridge	270	15	61	4256.10	0.06	0.23	15.76
Memère	265	14	101	3989.60	0.05	0.38	15.06
Mean	*253*	*14*	*117*	*5474.06*	*0.05*	*0.45*	*21.91*

Bon and the maximum 29.7 at Dianlé, the mean conductivity in µS/cm was 113.75 with the minimum of 110 at Bon, at the Dike, at Konkiri and at Memère and the maximum of 120 at Boura, Dianlé, Laro. The details are given in Table 6.

Table 6. Values of the physico-chemical parameters and time of measurement (Oxy: Oxgen; Temp: Temperature, Transp = Transparency; Cond: Conductivity).

Stations	Date	Hours	pH	Oxy (mg/l)	Temp in °C	Transp (cm)	Cond (µS/cm)
Bon	12/03	10h20	7.96	7.45	27.0	19.1	110
Boura	14/03	10h31	7.45	5.69	29.1	107.0	120
Dianlé	09/03	16h23	7.91	5.64	29.7	17.2	120
Dike	10/03	09h40	7.95	7.9	27.1	20.9	110
Konkiri	06/03	09h50	7.73	7.32	28.3	18.0	110
Laro	13/03	17h24	8.06	6.32	29.2	17.1	120
Memère	08/03	09h41	7.95	7.27	28.6	20.5	110
Bridge	15/03	10h40	7.87	6.04	28.2	17.3	110

4. Discussions

We listed 42 species of fish at Ouessa, which is appreciable but many other species could have been seen if the sampling was done during the rainy season as explained by many authors such as [18] and [19]. In exceptional cases the opposite is possible and the explanation could lie in the sampling strategy. One more reason to expect more many species is the lowest level of anthropic pressure in the area, compared to other parts of the country [18]. Furthermore, according to the river continuum concept [20], the downstream section of a river hosts more many species than the upstream one does. As Ouessa is in the downstream section of the Mouhoun in Burkina Faso one could expect more many species as revealed by the compilation of results from some other studies. Indeed, we synthesised recent works undertaken in the upstream area of the Mouhoun: [6] who sampled in March 2020 in the Mare aux Hippopotames [21], who worked from April 2018 to January 2019 in the recently created reservoir of Samandeni and [5] who targeted Samandeni reservoir, the Mare aux Hippopotames and the Mare de Bama. This compilation shows 25 more species that are *Bagrus bajad*, *Brienomyrus niger*, *Brycinus leuciscus*, *Chelaethiops bibie*, *Chromidotilapia guntheri*, *Coptodon dageti*, *Ctenopoma kingsleyae*, *Ctenopoma petherici*, *Enteromius macrops*, *Gymnarchus niloticus*, *Hemichromis bimaculatus*, *Heterotis niloticus*, *Hippopotamyrus pictus*, *Leptocypris niloticus*, *Mormyrops anguilloides*, *Parachanna obscura*, *Parailia pellucida*, *Polypterus ansorgii*, *Polypterus bichir*, *Protopterus annectens*, *Synodontis ansorgii*, *Synodontis batensoda*, *Synodontis filamentosus*, *Synodontis punctifer* and *Synodontis velifer*. In one word, currently Ouessa hosts probably more than 67 species. On a historical level, [21] compiled a list of species met from 1963 to 2020 in the Mouhoun. In that river, a total number of 115 species were listed and grouped into 57 genera and 26 families but an update is necessary to draw reliable conclusions.

The presence of intolerant species such as *Heterobranchus* sp., *L. niloticus*, *G. niloticus*, *H. niloticus* and *Tetraodon* sp. suggests that the aquatic ecosystem is somehow healthy [18], which is confirmed by the good values of Shannon index

which usually range from 1.5 to 3.5 in most ecological studies; but exceptionally from 0 to 5 [22].

We found a value of equitability of 0.74 that allows to appreciate the organisation of the fish community, the best organisation being shown by a value of equitability of 1 [23]. However, we may have found a higher value if the sampling was done in the rainy season. A low equitability means that a very few species (or even one species) are over dominant. In case of no suraboundance of a few species, the specific diversity is important because of the proliferation of many other species [9].

B But the values of coefficient of allometry in Ouessa are lower than those of [21] in Samandeni on the same river catchment. Samandeni is only 2-year-old and its conversion from lentic to lotic water generates important dynamics of the aquatic ecosystem, including the increase of food items. But our results are comparable to those of [24] [25] and [19] who studied in more or less impacted waters.

According to [17] the values of the condition factor K varying from 2.9 and 4.8 are acceptable in freshwaters. Our values are included from 0.140 et 4.320 but one should note that K varies with the season, the repletion of the stomach, the maturity of the gonads, and the sex [4] [26] and [27].

The CPUE also varies from one season to another as demonstrated by [18] in the area of Koubri in Burkina Faso. Furthermore [28] showed that in 18 small size reservoirs, a fisherman was landing 1.81 kg of fish per hour but up to 2.62 kg/hr in the mean size reservoir of Tapoa. Instead, in a laguna in Benin, a cast net could catch 292 to 416 g of fish per hour [29].

The physic-chemical parameters were measured punctually, which does not allow interpretation. Because the study took place at the end of the dry season, highest values of the transparency were expected. But we were told that the 25 - 50 km upstream Ouessa there were many artisanal gold mining sites that abstract water from the river and where it is released without treatment.

[30] found similar values of conductivity in the same river. But generally, in the Burkinabe reservoirs the conductivity tends to increase by the end of the dry season (March-May) as shown by [31] and [32]. Usually in tropical Africa the conductivity varies from 35 à 1200 µS/cm [33]. Unfortunately, as our measures did not last for long time, they cannot yield reliable conclusions.

5. Conclusions and Perspectives

This study listed 42 species in Ouessa but more than 67 species may exist in the area as shown by the compilation of many sources. The fish community is likely in good conditions as shown by the values of diversity indexes of Shannon-Wiener H' and the Pielou's evenness index E, the relatively large size of the fishes, the condition factor and the presence of intolerant species. This conforms with the moderately low state of impact of the area.

The results of this study could be used for the formulation and the implemen-

tation of a plan for the sustainable management and conservation of fishery of the future reservoir which creation will soon take place.

Acknowledgements

The data were collected within the research project titled Sustainable Management of Water and Fish Resources in Burkina Faso (http://www.susfish.boku.c.at/). The authors acknowledge the project funders (Austrian Partnership Programme in Higher Education and Research for Development, http://www.appear.at/) and the managers of the project that took end in November 2020.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Kabré, A.T., Diarra, D. and Traoré, A. (2003) Le fumage du poisson au Burkina Faso: Comparaison des caractéristiques et de la rentabilité de trois types de fumoirs améliorés. *Cahiers Agricultures*, **12**, 409-417.
https://revues.cirad.fr/index.php/cahiers-agricultures/article/view/30412

[2] Le President Du Faso, President Du Conseil Des Ministres (2014) Décret N˚2014-791/PRES/PM/MRAH/MEF du 16 septembre 2014 portant adoption de la Stratégie Nationale de Développement Durable de la Pêche et de l'Aquaculture au Burkina Faso (SN-DDPA). JO N˚47 de 2014.

[3] Mano, K., Oueda, A., Ouedraogo, R., Ouedraogo, I., Kaboré, I., Kabré, G.B. and Melcher, A.H. (2019) Fish Assemblages in the Upper Part of the Volta River, Burkina Faso: A Link Analysis towards Fisheries Management and Conservation. *International Journal of Biological and Chemical Sciences*, **13**, 2560-2572.
https://www.ajol.info/index.php/ijbcs/article/view/192330
https://doi.org/10.4314/ijbcs.v13i6.11

[4] Minoungou, M., Ouedraogo, R., Da, N. and Oueda, A. (2020). Relation longueur-poids et facteur de condition de sept espèces de poisson du réservoir de Samandeni avant son ouverture à la pêche (Burkina Faso). *Journal of Applied Biosciences*, **151**, 15559-15572.
http://www.m.elewa.org/Journals//wp-content/uploads/2020/07/5.-Minoungou-1.pdf
https://doi.org/10.35759/JABs.151.5

[5] Compaoré, I., Sanogo, S., Tankoano, B., Tama, K., Nacro, B.H. and Kabré, T.A. (2021) Specific Richness, Size Classes and Growth Parameters of the Main Fish Species in the Upper Mouhoun River Basin in Burkina Faso. *International Journal of Fisheries and Aquatic Studies*, **9**, 195-203.
https://www.fisheriesjournal.com/archives/?year=2021&vol=9&issue=1&part=C&ArticleId=2402
https://doi.org/10.22271/fish.2021.v9.i1c.2402

[6] Vogna, D. (2020) Caractérisation de la faune piscicole et de la pêche à la Mare aux Hippopotames au Burkina Faso. Mémoire de fin de cycle présenté comme exigence partielle en vue de l'obtention du diplôme d'Inspecteur des Eaux et Forêts, ENEF, Burkina Faso.

[7] Lalèyè, P., Chikou, A., Philippart, J.C., Teugels, G.G. and Vanderwalle, P. (2004)

Étude de la diversité ichtyologique du bassin du fleuve Ouémé au Benin (Afrique de l'Ouest). *Cybium*, **28**, 329-339.

[8] Wu, J., Wang, J., He, Y. and Cao, W. (2011) Fish Assemblage Structure in the Chishui River, a Protected Tributary of the Yangtze River. *Knowledge and Management of Aquatic Ecosystems*, **400**, 1-14.

[9] Kamelan, M.T., Berté, S., Zi, G.K.N., Bamba, M., Goore, G. and Essetchi, P. (2013) Peuplement ichtyologique du complexe Brimé-Méné-Nounoua, Côte d'Ivoire (Afrique de l'Ouest). *International Journal of Biological and Chemical Sciences*, **7**, 2248-2263. https://www.ajol.info/index.php/ijbcs/article/view/103469 https://doi.org/10.4314/ijbcs.v7i6.6

[10] Study International (2018) Etudes techniques du barrage hydroélectrique et Hydroagricole de Ouéssa, Avant-Projet Sommaire Développement de la pêche et de la pisciculture.

[11] Paugy, D., Lévêque, C. and Teugels, G.G. (2003) Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest.

[12] Magurran, A. (2004) Measuring Biological Diversity. Blackwell, Oxford.

[13] Gaines, W.L., Harrod, R.J. and Lehmkuhl, J.F. (1999) Monitoring Biodiversity: Quantification and Interpretation. https://www.fs.fed.us/pnw/pubs/gtr_443.pdf https://doi.org/10.2737/PNW-GTR-443

[14] Kumar, A., Sharma, R. and Vyas, V. (2017) Diversity of Macrozoobenthos in Dudhi River—A Tributary of River Narmada in the Central Zone, India. *International Journal of Pure & Applied Bioscience*, **5**, 1998-2007. http://www.ijpab.com/form/2017%20Volume%205,%20issue%204/IJPAB-2017-5-4-1998-2007.pdf https://doi.org/10.18782/2320-7051.5428

[15] Le Cren, E.D. (1951) The Length-Weight Relationship and Seasonal Cycle in Gonad Weight and Condition in the Perch (*Perca fluviatilis*). *Journal of Animal Ecology*, **20**, 201-219. https://doi.org/10.2307/1540

[16] Lévêque, C. and Paugy, D. (2006) Les poissons des eaux continentales africaines . Institut de Recherche pour le Développement. IRD Edition, Paris.

[17] Bagenal, T.B. and Tesch, A.T. (1978) Conditions and Growth Patterns in Fresh Water Habitats. Blackwell Scientific Publications, Oxford, 75-89.

[18] Ouedraogo, R. (2010) Fish and Fisheries Prospective in Arid Inland Waters of Burkina Faso, West Africa. Ph.D. Thesis, University of Natural Resources and Life Sciences, Vienna.

[19] Ouedraogo, R., Edith, A. and Zerbo, H. (2015) Caractérisation du peuplement piscicole du réservoir de Boalin, Ziniaré (Burkina Faso) deux décennies après l'introduction de Heterotis niloticus. *International Journal of Biological and Chemical Sciences*, **9**, 2488-2499. https://www.ajol.info/index.php/ijbcs/article/view/130068 https://doi.org/10.4314/ijbcs.v9i5.20

[20] Vannote, R.L., Wayne Minshallk, G., Cumminjs, K.W., Sedella, K.R. and Cushing, C.E. (1980) The River Continuum Concept. *Canadian Journal of Fisheries and Aquatic Sciences*, **37**, 130-137. https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1777.pdf https://doi.org/10.1139/f80-017

[21] Minoungou, M. (2020) Caractéristiques environnementales et piscicoles du lac de barrage de Samendeni avant la première ouverture de la pêche-Burkina Faso. Mémoire pour l'obtention du diplôme de Master II en Sciences Biologiques Appliquées Université Joseph KI-ZERBO, Burkina Faso.

[22] University of Idaho (2021) Principles of Vegetation Measurement & Assessment and Ecological Monitoring & Analysis: Estimating Biodiversity. University of Idaho, College of Natural Resources, Moscow. https://www.webpages.uidaho.edu/veg_measure/modules/lessons/module%209(composition&diversity)/9_3_Estimating%20Biodiversity.htm

[23] Pedel, L. and Fabri, M.C. (2012) Etat de l'art sur les indices existants concernant l'Etat Ecologique des habitats benthiques du domaine profound: Convention MEDDTL—Ifremer pour la DCSMM-BEE. https://archimer.ifremer.fr/doc/00118/22924/20744.pdf

[24] Coulibaly, N.D. (2008) Relation longueur-poids chez quatre espèces de poissons de la rivière Sourou au Burkina Faso. *International Journal of Biological and Chemical Sciences*, **2**, 331-338. https://doi.org/10.4314/ijbcs.v2i3.39744

[25] Sirima, O., Toguyeni, A. and Kabore-Zoungrana, C.Y. (2009) Faune piscicole du bassin de la Comoé et paramètres de croissance de quelques espèces d'intérêt économique. *International Journal of Biological and Chemical Sciences*, **3**, 95-106. https://doi.org/10.4314/ijbcs.v3i1.42740

[26] Hossain, M.Y., Ahmed, Z.F., Leunda, P.M., Jasmine, S., Oscoz, J., Miranda, R. and Ohtomi, J. (2006) Condition, Length-Weight and Length-Length Relationships of the Asian Striped Catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, Southwestern Bangladesh. *Journal of Applied Ichthyology*, **22**, 304-307. https://doi.org/10.1111/j.1439-0426.2006.00803.x

[27] Baby, F., Tharian, J., Abraham, K.M., Ramprasanth, M.R., Ali, A. and Raghavan, R. (2011) Length-Weight Relationship and Condition Factor of an Endemic Stone Sucker, Garra Gotyla Stenorhynchus (Jerdon, 1849) from Two Opposite Flowing Rivers in Southern Western Ghats. *Journal of Threatened Taxa*, **3**, 1851-1855. https://doi.org/10.11609/JoTT.o2535.1851-55

[28] Baijot, E., Moreau, J. and Bouda, S. (1994) Aspects hydrobiologiques et piscicoles des retenues d'eau en zone soudano-sahélienne, le cas du Burkina Faso.

[29] Gnidete, F., Houssou, C.S., Gibigaye, M., Vissin, E.W., Cledjo, P. and Lalèyè, P. (2017) Systèmes d'exploitation halieutiques dévastateurs des ressources naturelles dans le complexe fluvio-lacustre couffo-ahémé-ahô-lagune côtière, sud-ouest du Bénin. *Revue Ivoirienne des Sciences et Technologie*, **30**, 160-181.

[30] Guenda, W. (1996) Etude faunistique, écologique et de la distribution des insectes d'un réseau hydrographique de l'Ouest africain: Le Mouhoun (Burkina Faso); rapport avec *Similium damnosum* Theobald, vecteur de l'onchocercose. Thèse d'état, Université Aix-Marseille, Marseille.

[31] Kabré, A.T. and Illé, A. (2000) Rétrécissement saisonnier des superficies d'eau Variation physico chimique et production des pêcheries artisanales de Bagré. Centre-Est Burkina-Faso. *Tropicultura*, **18**, 130-135. http://www.tropicultura.org/text/v18n3/130.pdf

[32] Ilboudo, P. (2017) Contribution d'un poisson planctonophage (*Oreochromis niloticus*) dans la lutte Biologique contre la prolifération des algues: Cas du lac de barrage de Ziga au Burkina Faso. Mémoire pour l'obtention du Master II en ingenierie de l'eau et de l'environnement, option: Eau et assainissement. Institut International d'Ingénierie.

[33] Bénech, V. and Ouattara, S. (1990) Rôle des variations de conductivité de l'eau et d'autres facteurs externes dans la croissance ovarienne d'un poisson tropical, *Brycinus leuciscus* (Characidae). *Aquatic Living Resources*, **3**, 153-162.