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Fish biology

**FISH COMMUNITIES OF THE OVWERE STREAM IN THE NIGER
DELTA AREA, NIGERIA**

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Studies on the composition and distribution of fish species of the Owere Stream in the Niger Delta area of Southern Nigeria were conducted between March 1992 and February 1993. A total of 42 species was recorded, of which 29 occurred upstream while 35 and 37 species were represented in the mid- and downstream respectively. The mormyrids, characids, cyprinodontids, and cichlids were the most common fish families. The climatic regimes and the flood from the river Ethiope affected the distribution of fishes of some families in the stream. More species were recorded during the rainy season than in the dry one. The different sections showed ichthyofaunal similarity with nearby sections showing higher indices of similarity than the distal ones.

INTRODUCTION

The Owere Stream is a tributary of the river Ethiope in the Niger Delta area of Southern Nigeria. This stream serves as a spawning and nursery ground for a number of fish species. Detailed studies are therefore, required to understand some aspects of the ecology of fish families and species that exist therein.

A lot of studies have been conducted on the fisheries ecology of most West African rivers. Majority of the studies were conducted to assess the effect of damming (Motwani and Kanwai 1970; Lelek and El-Zarka 1971; Lelek 1973, 1975; Petr 1974; Ita 1978; Victor and Tetteh 1988). Other were to ascertain the fish community structure in natural running rivers (Boulenger 1901–1916; Maclaren 1950; Daget 1954; Daget and Iltis 1965; Scott 1966; Reed et al. 1967; Reid and Sydenham 1977;

Sydenham 1977; Adebisi 1978; Merona 1981; Lowe-McConnel 1987). Despite the abundant data on the fish communities in West Africa, only the works of Boulenger (1901–1916) and Scott (1966) provide published information on the fish communities in the river and streams in the Niger Delta area of Southern Nigeria. Accordingly, the results of this recent study on the fish communities in the Owwere Stream are presented here.

STUDY AREA

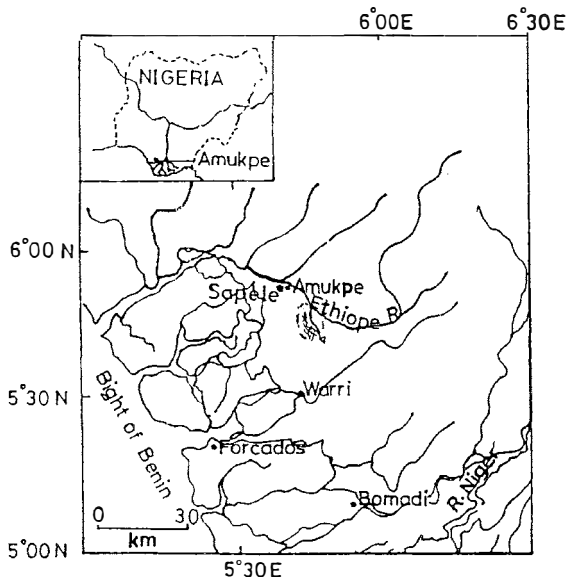


Fig. 1. Map of a part of the Lower Niger Delta showing study area

The Owwere Stream (5°30' N; 5°53' E) (Fig. 1) is a black fresh-water stream with its source at Asoro. It flows North–West for about 14 km through Aghalokpe and discharges into the Ethiope River. In this area, two climatic seasons prevail: “wet” and “dry”. The wet season (May–October) has high average monthly rainfall values (25.6–45.3 cm). The dry season extends from November to April with average precipitation value of 0–17.1 cm.

For the purpose of this study, the stream stretch was demarcated into three sections: upstream, midstream and downstream. The

upstream section is narrow, with an average width and depth of 18 and 2.6 m respectively. The stream in this section dries up during the dry season with water collecting only in natural and dug out pools. In the rainy season, the stream is swift flowing (average 18 cm·sec⁻¹). The substratum here is sandy and occasionally mixed with pebbles. The midstream is on the average 29-m wide, 3.6-m deep, water flowing at an average rate of 8.6 cm·sec⁻¹. The stream here is lotic in both dry and rainy season. The substratum is muddy-sand. The downstream section is relatively wider. On average, the width, depth, and flow velocity measures 40 m, 3.4 m, and 8.0 cm·sec⁻¹ respectively. The substratum is mainly sandy mud.

The stream area is highly vegetated. It flows through farm lands and the deltaic swamp forest with vegetations such as *Grewia coriacea* Mast., *Oxystigma manni* Harms., *Mitragyna aubryanum* Baill., *Elaeis guinensis* Jacq., *Raphia hokeri* P. Beauv., *Bambusa* sp. etc. fringing the stream. The dominant aquatic ma-

crophytes are *Nymphaea* sp. and *Pistia stratiotes* (L.). Other common macrophytes are *Azolla africana* Desv., and *Utricularia* sp.

The level of pollution in the stream appears low as dumping of industrial and domestic waste into it has not been observed. Human activities in the stream include subsistence fishing, sand dredging, clothes washing, and bathing.

METHODS

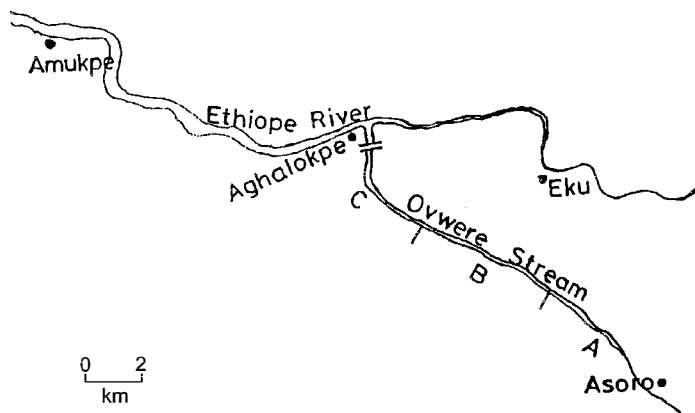


Fig. 2. Map of Owere Stream showing sampling portions A, B, and C

Monthly sampling of the fish fauna was conducted between March 1992 and February 1993 from three sections in the stream (Fig. 2). Fishing was routinely done with the assistance of the local fisherman for 24 hours using a drag net (20–40 mm mesh size), a fleet of gill nets (30–177 mm mesh size), and traditional basket traps with no-return valve.

The small dry-season pools were raked with mosquito net seine while the large pools were drained and the fishes contained in the ponds were collected. A total of 37 samples was collected from all sections including the pools. The fishing efforts in all the sections were approximately the same. All fishes obtained from the different sections were preserved in 10% formaldehyde labelled and transported to the laboratory for enumeration and identification. In the laboratory, fishes were identified using keys and descriptions of Boulenger (1901–1916), Daget and Itis (1965), Reed et al. (1967), Lowe-McConnell (1972), Lindberg (1974) and Anthony (1982).

The diversity of the fish fauna was analysed using Margalef's index (d) for species richness, the Shannon-Weiner index (H) for general diversity and Evenness index (E) which is the ratio of H and H_{\max} , the maximum expected diversity. In assessing similarities in faunal composition of the three sections of the stream, the data obtained were analysed using the Sorenson's index of similarity (Krebs 1978; Zar 1984).

RESULTS

Species composition and distribution

The fish species composition and their relative distribution in each of the three study section are presented in Tab. 1. A total of 3857 fishes, made up of 42 species in 21 families and 36 genera was recorded, while 242 fishes were found i isolated dry season pools in the stream. All the fishes were freshwater species. 69.1% of the species occurred upstream while 83.3% and 88.1% were found in the mid- and downstream respectively. Overall, 25 species were ubiquitous, 10 were common to the mid- and downstream respectively. No species was restricted to the midstream section (Tab. 1). Evidently, the number of species increased along the longitudinal gradient from the upstream to the downstream.

Some of the families rich in terms of species composition and number are abundant upon here. For example, the family Mormyridae, represented by the highest number of species occurred principally in the mid- and downstream sections with muddy-sandy substratum. Species such as *Brienomyrus longinalis*, *Hippopotamyrus psittacus*, *Gnathonemus petersii* were ubiquitous. The characids were represented by three species and dominated by *Brycinus longipinnis*. *B. longipinnis* though ubiquitous, was mainly found in the swift flowing upstream section. The species was singularly the most abundant fish in the stream. *Brycinus nurse* and *Arnoldichthys spilopterus* were distributed variably (Tab. 1).

The cichlids were a co-dominant group along with the mormyrids in terms of species composition and abundance. They are made up of 5 species which occurred mainly in the mid- and downstream sections. However, they were all ubiquitous.

The dry season pools in the upstream section was dominated by the small fishes, namely the cyprinodontids and cyprinids and the juveniles of *Clarias gariepinus*, *Brienomyrus longianalis*, *Thysia ansorgii* and *Malapterurus electricus*.

Table 2 presents the values of Sorenson's index analysed to evaluate similarity of the fish fauna from the three sections of the stream. All the sections had significant similarity values with each other. However, nearby sections had higher values than the more distant ones. Accordingly, the indices of diversity showed marginal higher values from the upstream to the downstream section (Tab. 3).

Table 1

A checklist of species recorded in the Owwere Stream, their percentage composition and distribution; also shown is the percentage composition of species in the dry season pools in the upstream

Family and species	n	%	Distribution (%)			Isolated dry season pools of upstream (%)
			upstream	midstream	downstream	
POLYTERIDAE						
<i>Calamoichthys calabaricus</i> (J.A. Smith)	23	0.6	30.4	43.5	26.1	2.5
PANTODONTIDAE						
<i>Pantodon buchholzi</i> Peters	51	1.3	29.4	31.3	39.2	3.7
OSTEOGLOSSIDAE						
<i>Papyrocranus afer</i> Günther	5	0.1	100.0	—	—	0.8
<i>Xenomystus nigri</i> Günther	24	0.6	29.2	37.5	33.3	—
MORMYRIDAE						
<i>Brienomyrus longianalis</i> (Boulenger)	466	12.1	31.3	26.0	42.7	9.5
<i>Petrocephalus bane</i> (Lacepede)	128	3.3	—	24.2	75.8	—
<i>Hippopotamyrus psittacus</i> Boulenger	45	1.2	31.1	40.0	28.9	—
<i>Mormyrops deliciosus</i> Leach	20	0.5	—	60.0	40.0	—
<i>Gnathonemus petersii</i> (Günther)	21	0.6	33.0	47.6	19.4	—
<i>Isichthys henryi</i> Gill	7	0.2	100.0	—	—	1.7
PHRACTOLAEMIDAE						
<i>Phractolaemus ansorgii</i> Boulenger	3	0.1	100.0	—	—	1.2
CHARACIDAE						
<i>Brycinus longipinnis</i> Günther	637	16.5	56.7	24.7	18.6	—
<i>Brycinus nurse</i> (Ruppel)	374	9.7	—	5.6	94.4	—
<i>Arnoldichthys spilopterus</i> Boulenger	25	0.7	32.0	68.0	—	2.1
HEPSETIDAE			—			
<i>Hepsetus odoe</i> Bloch	10	0.3		27.8	72.2	—
ICHTHYOBORIDAE						
<i>Phago loricatus</i> Günther	13	0.3	—	46.2	53.8	—
CYPRINIDAE						
<i>Barbus leonensis</i>	191	5.0	—	22.5	77.5	—
<i>Barbus callipterus</i> Boulenger	63	1.6	33.3	25.0	41.7	—
BAGRIDAE						
<i>Chrysichthys auratus</i> (Geoffrey St. Hilaire)	21	0.6	—	38.1	61.9	—
<i>Achenoglanis occidentalis</i> Valenciennes	29	0.8	—	41.4	58.6	—
<i>Achenoglanis biscutatus</i> (Geoffrey St. Hilaire)	13	0.3	—	30.8	69.2	—

Table 1 (cont.)

Family and species	n	%	Distribution (%)			Isolated dry season pools of upstream (%)
			upstream	midstream	downstream	
SCHILBEIDAE						
<i>Eutropius niloticus</i> Ruppel	23	0.6	39.1	43.5	17.4	—
<i>Schilbe mystus</i> Linne	23	0.6	43.5	34.8	21.7	—
<i>Physalia pellucida</i> (Boulenger)	11	0.3	—	63.6	36.4	—
CLARIIDAE						
<i>Clarias gariepinus</i> (Burchell)	169	4.4	18.9	37.3	43.8	11.4
<i>Gymnallabes typus</i> Günther	6	0.2	100.0	—	—	1.2
MALAPTERURIDAE						
<i>Malapterurus electricus</i> Gmelin	36	0.9	16.7	50.0	33.3	5.0
MOCHOKIDAE						
<i>Synodontis nigrita</i> Valenciennes	8	0.2	—	—	100.0	—
<i>Synodontis schall</i> Boulenger	3	0.1	—	—	100.0	—
CYPRINODONTIDAE						
<i>Epiplatys sexfaciatus</i> Gill	296	7.7	55.1	30.4	14.5	35.1
<i>Epiplatys</i> sp.	88	2.3	10.0	61.6	28.4	10.7
<i>Aphyosemion bivittatus</i> Lonnberg	350	9.1	40.6	37.8	21.5	—
CHANNIDAE						
<i>Channa obscura</i> (Günther)	29	0.8	17.2	27.6	55.2	1.7
<i>Channa africana</i> Steindachner	12	0.3	8.3	33.3	58.3	—
NANDIDAE						
<i>Polycentropsis abbreviata</i>	49	1.3	14.3	32.6	53.1	2.1
CICHLIDAE						
<i>Tilapia mariae</i> (Boulenger)	348	9.0	21.8	35.7	42.5	—
<i>Thysia ansorgii</i> Boulenger	71	1.8	23.9	29.6	46.5	5.0
<i>Hemichromis bimaculatus</i> (Gill)	55	1.4	21.8	30.9	47.3	2.5
<i>Hemichromis fasiatus</i> Peters	14	0.4	12.5	32.5	50.0	—
<i>Pelvicachromis pulcher</i> Boulenger	48	1.3	14.6	31.3	54.1	—
ANABANTIDAE						
<i>Ctenopoma kingsleyae</i> Günther	13	0.3	15.4	15.4	69.2	2.1
MASTACEMBELIDAE						
<i>Mastacembelus loennbergii</i> Boulenger	24	0.6	50.0	41.7	8.3	1.7
Number of species			8	12	12	5
Total number of species caught			29	35	37	17
Total number of fish caught			969	1162	1726	242
GRAND TOTAL	3857					

Table 2

Sorenson's index of similarity values of the fish fauna in the different sections of Owwere Stream, March 1992–February 1993

	Upstream	Midstream	Downstream
Midstream	78.13*	—	—
Downstream	75.76*	94.60*	—

* Significant relationship at CL of 50%

Table 3

Diversity of the fish fauna in the different sections of Owwere Stream, March 1992–February 1993

	Upstream	Midstream	Downstream
Number of samples	8	12	12
Number of species	29	35	37
Number of individuals	969	1162	1726
Species richness (d)	0.9316	1.0268	1.1165
General diversity (H)	1.0404	1.1228	1.2436
Evenness (E)	0.7114	0.7272	0.7930

Temporal changes

The distribution of the ichthyofauna in the stream is more revealing when the temporal pattern of distribution is viewed. Of the 42 species recorded in this study, 6 species: *Gnathonemus petersii*, *Mormyrops deliciosus*, *Barbus leonensis*, *Synodontis nigrita*, *Brycinus nurse* and *Chrysichthys auratus* were absent in all the sections during the dry season. *Petrocephalus bane*, and *Brycinus longipinnis*, *Hippopotamyrus psittatus*, *Achenoglanis occidentalis* and *Achenoglanis biscutatus* were obtained only in the mid- and downstream sections in the dry season (Tab. 4). Other species recorded in Table 4 occurred variably in the perennial sections in both the dry and rainy season.

During the months of June–October, when the water level continues to rise as a result of the incoming flood, species such as *Petrocephalus bane*, *Clarias gariepinus*, *Barbus leonensis*, and *Gnathonemus petersii* move towards the headwaters. These species were mainly composed of mature spawning individuals. In the headwaters, the fishes penetrate into the surrounding vegetation, which has been inundated by the flood which overflows the bank. There they probably spawn. Other species found in the inundated vegetation with ripe spawning or spent gonads were *Brienomyrus longianalis*, *Barbus callipterus*, and *Ctenopoma kingsleyae*.

Table 4

Temporal variations in the spatial distribution of some species in Owwere Stream

Family and species	Wet season (May–October)			Dry season (November–April)		
	Up-stream	Mid-stream	Down-stream	Up-stream (Pools)	Mid-stream	Down-stream
MORMYRIDAE						
<i>Brienomyrus longianalis</i>	+	+	+	+	+	+
<i>Petrocephalus bane</i>	–	+	+	–	+	+
<i>Hippopotamyrus psittacus</i>	+	+	+	–	+	+
<i>Mormyrops deliciosus</i>	–	+	+	–	–	–
<i>Gnathonemus petersii</i>	+	+	+	–	–	–
<i>Isichthys henryi</i>	+	–	–	+	–	–
CHARACIDAE						
<i>Brycinus longipinnis</i>	+	+	+	–	+	+
<i>Brycinus nurse</i>	–	+	+	–	–	–
CYPRINIDAE						
<i>Barbus leonensis</i>	–	+	+	–	–	–
<i>Barbus callipterus</i>	+	+	+	–	–	–
BAGRIDAE						
<i>Chrysichthys auratus</i>	+	+	+	–	–	–
<i>Achenoglanis occidentalis</i>	–	+	+	–	+	+
<i>Achenoglanis biscutatus</i>	–	+	+	–	+	+
MOCHOKIDAE						
<i>Synodontis nigrita</i>	–	–	+	–	–	–
<i>Synodontis schall</i>	–	–	+	–	–	+
CLARIIDAE						
<i>Clarias gariepinus</i>	+	+	+	+	+	+
CYPRINODONTIDAE						
<i>Epiplatys sexfaciatus</i>	+	+	+	+	+	+
<i>Epiplatys sp.</i>	+	+	+	+	+	+
<i>Aphyosemion bivittatus</i>	+	+	+	–	+	+
CICHLIDAE						
<i>Tilapia mariae</i>	+	+	+	+	+	+
<i>Thysia ansorgii</i>	+	+	+	–	+	+
<i>Hemichromis bimaculatus</i>	+	+	+	+	+	+
<i>Hemichromis fasiatus</i>	+	+	+	+	+	+
<i>Pelvicachromis pulcher</i>	+	+	+	+	+	+
Other species	+	+	+	–	+	+

DISCUSSION

The primary objective of a sampling survey of this nature is to attempt to find out what fish species exist in the stream and perhaps look at the factors governing their distribution. However, according to Benech et al. (1983), fish communities studies are not generally equivalent to ichthyocoenoses because the description of any fish community is a biased image arising from the sampling of a group of fi-

shes in a particular environment at a given time. Gear selectivity and sampling strategies are usual sources of these biases. Despite these shortcomings, attempts will be made here to compare data obtained in this study with that from related studies.

In this study, 42 species belonging to 36 genera and 21 families were recorded. This is a fairly rich ichthyofaunal composition and compares favourably with results obtained for some other small Nigerian rivers such as the upper Ogun River with 36 species (Adebisi 1978), the upper Benin River with 42 species (Fufenyin 1987) but a lot lower than figures obtained for larger rivers, such as the entire Ogun River with 85 species (Sydenham 1977), the upper Niger with 107 species (Daget 1954), lower Benue River with 128 species (Reid and Sydenham 1979). Apart from *Brienomyrus longianalis* and *Gymnallabes typus*, all other species recorded in this study have been recorded previously for some other rivers in Nigeria by the authors already cited above.

The data charted in Table 1 show clearly that the species number and abundance increased toward downstream. Fish community composition is commonly influenced by habitat characteristics (water depth, current velocity, substrate) (Gorman and Karr 1978; Schlosser 1982) while zonation or downstream change in fish community composition within a river system has been associated with gradient of habitat change (Hynes 1970; Hawks 1975; Barila et al. 1981). In the case of the Owere Stream, the climatic regimes, mainly the wet season and flooding from the main river appear to play a major role in the distribution of fish species. During the dry season, the water level was generally low and even part of the upstream section dried and only stranded species of *Clarias gariepinus*, *Malapterurus electricus*, *Channa obscura*, *Xenomystus nigri*, *Arnoldichthys spilopterus*, *Polycentropsis abbreviata* among others were found in the dry season pools. In the mid- and downstream sections which are perennial, a greater variety of fishes were found.

In the months of May and June during the rainy season, the runoff of rain water together with the rising flood water from the Ethiope River flows into the stream and along with this come in a number of fish species, some to spawn and others to utilise such areas as feeding or nursery grounds. In this stream, the mormyrids were important food species. During their upstream and downstream breeding movements they are collected in large quantities in woven traditional baskets by the riparian communities at night and utilised as food. Their distribution may be related to their food habits. They are bottom dwelling fishes that feed mostly on aquatic insect larvae and detrital materials in the substratum (Okedi 1971; Lewis 1974; Olatunde and Moneke 1985; Ikomi 1996). The mid- and downstream sections provided such suitable habitats which perhaps explains why most of the mormyrids were nearly always found in these sections. *Clarias* is widely credited

with amphibious habits and ability to survive in wet muds of drying pools. However, they dependent upon the temporary wetland for reproduction. Bruton (1979) reported that in Southern Africa, *Clarias* sometimes forego migration and spawn in the surrounding lakes or river edges.

Among the characids, *Brycinus nurse*, utilise the stream mainly as feeding ground. They consist mainly of juveniles which come into the stream from the Benin River, via the Ethiope River around October and November at the peak of the flood. At the end of the receding flood in March when the water level is low, they move back into the Ethiope River. *B. longipinnis* occurred in all sections of the stream during the rainy season. In the headwaters, where they flourish, the flow velocity was swift and the substratum consisted principally of fine sand mixed with pebbles. According to Lowe-McConnell (1987), such areas provide suitable habitats for characids because of their high dissolved oxygen level. Also, such areas have abundant insect that form food for most of the characids. Around January–March when the headstream water is drying up, *B. longipinnis* leaves this section for the mid- and downstream, perhaps in response to the low level of oxygen normally associated with low levels of water as observed by Benech et al. (1983). Among the characids, only *Arnoldichthys spilopterus* was found in the dry season pools. Observation on this species in most rivers in the Niger Delta shows that it occurs mainly in the backwaters with abundant food supply but low in dissolved oxygen, it rarely occurs in the main channel of the rivers.

All the cichlids were ubiquitous in all the stretches of the stream. The cichlids according to Lowe-McConnell (1987) thrive in lacustrine water bodies. They however, occur in most parts of the stream in a large variety. Their appreciable occurrence here may be related to the substratum which is endowed with detrital materials and the associated algal inclusions on which cichlids feed. As for cichlids trapped in the dry season pools, they might face problems such as oxygen shortage. Morgan (1972), however observed that *Tilapia* species are able to survive levels of oxygen as low as $0.6 \text{ mg}\cdot\text{l}^{-1}$ but become distressed below this figure.

The fish diversity in the different sections of the river varied slightly. Relatively, marginal high diversity values were recorded from the upstream to the downstream section. The Ethiope River is probably the main recruitment source of fishes of Owere Stream. The fishes therefore are more likely to readily colonise the wide proximal lower section of the stream than the narrow distal one. In addition, the narrow upstream section may not be able to accommodate a large number biomass of the different species particularly during period of depressed resource abundance and reduced water volume (dry season).

It is of interest in this study to observe that only a restricted variety of fishes moved from the perennial to the seasonally flooded upstream section of the stre-

am to spawn or feed. Notable too, is that only the migrating visiting species, found only during the rainy season utilise the upstream section as feeding and spawning grounds. The stream population probably make lateral movement into the inundated vegetation or channels to spawn and grow following the flood, as earlier reviewed by Welcomme (1979) and Lowe-McConnell (1987).

CONCLUSION

The study shows that the ichthyofaunal composition of Owwere Stream in the Niger Delta area of Nigeria is rich and that the dominant families were: Mormyridae, Characidae, Cichlidae, and Cyprinodontidae. The distribution of these fishes was governed principally by the rainfall regime of the study area and the associated flooding from the connecting River Ethiope. These factors affected the fish diversity which marginally increased along the longitudinal gradient from the upstream to the downstream.

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REFERENCES

- Adebisi A. A.**, 1978: Studies on the ecology, growth and reproduction of the fishes of Upper Ogun River, Nigeria. PhD thesis, University of Ibadan, Nigeria.
- Anthony A. D.**, 1982: Identification of Nigeria freshwater fishes. Poothokaren, India.
- Barila T. Y., R. D. Williams, J. R. Stauffer jr**, 1981: The influence of stream order and selected stream bed parameters on fish diversity in Ryaston Branch, Susquehanna River drainage, Pennsylvania. *J. Appl. Ecol.*, **49**: 193–198.
- Benech V., J. R. Durand, J. Quensiere**, 1983: Fish communities of lake Chad and associated rivers and flood plains. In: Lake Chad, ecology and productivity of a shallow tropical system [Garmuze J. P., J. R. Durand, C. Leveque (eds)]. Dr. W. Junk, The Hague: 293–356.
- Bruton M. N.** 1979: The breeding biology and early development of *Clarias gariepinus* (Pisces: Clariidae) in Lake Sibaya, South Africa, with a review of breeding in species of subgenus *Clarias* (*Clarias*). *Trans. Zool. Soc. London*, **35**: 1–45.
- Boulenger G. A.**, 1901–1916: A Catalogue of the Freshwater Fishes of Africa in the British Museum (Nat. Hist.). vol. 1–4.
- Daget J.** Les poissons du Niger superior. *Memoires of Institute of French Africa North*, **14**: 191–225.
- Daget J., A. Iltis**, 1965: Poisson de Cote d'Ivoire denses at Saumatre. *Memoires of Institute Men. Inst. of French Africa North*, **74**: 1–385.
- Fufenyin P.**, 1987: Studies on the fish community of Benin River to evaluate the effect of the warm water effluent discharge by NEPA station at Sapele, Bendel State, Nigeria. MSc thesis, University of Benin, Benin City, Nigeria.

- Gorman T., J. R. Karr**, Habitat structure and stream fish communities. *Ecology*, **59**: 507–515.
- Hawks H.A.**, 1975: River zonation and classification. In: *River Ecology* [Witton B.A. (ed)]. University of California Press, Los Angeles: 312–374.
- Hynes H. B. N.**, 1970: *The ecology of running waters*. University of Toronto Press. Toronto.
- Ikomi R. B.**, 1996: Studies on the growth pattern, feeding habit and reproductive characteristics of the Mormyrid *Brienomyrus longianalis* (Boulenger 1901) in the upper Warri River, Nigeria. *Fish. Res.*, **26**: 187–198.
- Ita E. O.**, 1978: *Ecology, the experimental analysis of distribution and abundance*. (2nd ed.) Harper & Row, New York.
- Krebs C. J.**, 1978: *Ecology, the experimental analysis of distribution and abundance*. (2nd ed.) Harper & Row, New York.
- Lelek A.**, 1973: Sequences of changes in fish populations of a new tropical man-made lake, Nigeria, West Africa. *Arch. Hydrobiol.*, **78**: 381–420.
- Lelek A.**, 1975: Possible trends in the development of fish fauna in lake. In: *Ecology of lake Kainji, the transition from river to lake* [Imevbore A.M.A., Adegoke O.S. (eds)]. University of Ife Press, Ile-Ife: 157–162.
- Lelek A., S. El-Zarka**, Ecological comparison of pre-impounded fish fauna of river Niger and Kainji Lake, Nigeria. *Geophysical Monograph*, **17**: 655–660.
- Lewis D. S. C.**, 1974: The effect of formation of lake Kainji (Nigeria), upon the indigenous fish population. *Hydrobiol.*, **45**: 281–301.
- Lindberg G. U.**, 1974: *Fishes of the World*. John Wiley & Sons, New York.
- Lowe-McConnell R. H.**, 1972: *Freshwater fishes of the Volta and Kainji Lakes*. Ghana University Press, Accra.
- Lowe-McConnell R. H.**, 1987: *Ecological studies in tropical fish communities*. Cambridge University Press, Cambridge.
- Maclaren P. J. R.**, 1950: Fish and fisheries of the lower Ogun. *The Nigerian Field*, **15**: 177–181.
- Merona B. de**, 1981: Zonation ichthyologique in bassin du Randama (Cote d'Ivoire). *Revue Hydrobiologie Tropicale*, **14**: 63–75.
- Morgan P. R.**, 1972: Causes of mortality in the endemic Tilapia of lake Chilwa (Malawi). *Hydrobiol.*, **40**: 101–110.
- Motwani M. P., Y. Kanwai**, 1970: Fish and fisheries of the coffer-dammed right channel of River Niger and Kainji. In: *Kainji Lake Studies* [Visser S.A. (ed)] I. Ecology. Ibadan University Press, Ibadan: 27–48.
- Olatunde A. A., C. C. Moneke**, 1985: The food habits of four mormyrid species in Zaria, Nigeria. *Arch. Hydrobiol.*, **102**: 503–517.
- Okedi J.**, 1971: The food and feeding of the small mormyrid fishes of lake Victoria, East-Africa. *African Journal of Tropical Hydrobiology and Fisheries*, **1**: 1–120.
- Petr T.**, 1974: Distribution, abundance and food of commercial fish in the Black Volta and the Volta man-made lake in Ghana during the filling period (1964–1968). 11. Characidae. *Hydrobiol.*, **45**: 303–337.
- Reed W., J. Burchard, A. J. Hopson, J. Jenness, Y. Yar●**, 1967: *Fish and fisheries of Northern Nigeria*. Ministry of Agriculture, Northern Nigeria, Zaria.
- Reid G. M., H. Sydenham**, 1979: A checklist of lower Benue River fishes and an ichthyogeographical review of the Benue River (West Africa). *Journal of National History*, **17**: 41–67.
- Schlosser I. J.**, 1982: Fish community structure and function along the habitat gradient in a headwater stream. *Ecological Monographs*, **52**: 395–414.
- Scott J. B.**, 1966: Report on fisheries of Niger delta Special Area. Niger Delta Development Board Publication.
- Sydenham D. H. J.**, 1977: The qualitative composition and the longitudinal zonation of the fish fauna of the River Ogun, Western Nigeria. *Rev. Zool. Afr.*, **91**: 974–996.
- Victor R., J. O. Tetteh**, 1988: Fish communities of a perturbed stream in South Nigeria. *J. Trop. Ecol.*, **4**: 49–59.
- Welcomme R. L.**, 1979: *Fisheries ecology of floodplain rivers*. Longman, London.
- Zar J. H.**, 1984: *Biostatistical analysis*. (2nd ed.). Englewood Cliff, Pritence–Hall.

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RYBY STRUMIENIA OVWERE W REJONIE DELTY RZEKI NIGER

STRESZCZENIE

Przeprowadzono badania nad strukturą gatunkową i rozmieszczeniem ryb w strumieniu Owwere w rejonie delty rzeki Niger w południowej Nigerii w okresie od marca 1992 r. do lutego 1993 r. Odnotowano występowanie 42 gatunków, z których 29 zasiedlało górny bieg strumienia, 35 – środkowy bieg, zaś 37 – dolny bieg tego cieku. Najbardziej powszechnie spotykanymi gatunkami byli przedstawiciele rodzin Mormyridae, Characidae, Cyprinodontidae i Cichlidae. Warunki klimatyczne, jak też wody powodziowe z rzeki Ethiope zakłóciły rozmieszczenie ryb z niektórych rodzin w strumieniu. Więcej gatunków odnotowano w trakcie pory deszczowej niż pory suchej. Ichtyofauna poszczególnych sekcji strumienia wykazywała większe podobieństwo do ichtyofauny sąsiednich sekcji niż do kompozycji gatunkowej sekcji bardziej oddalonych.

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