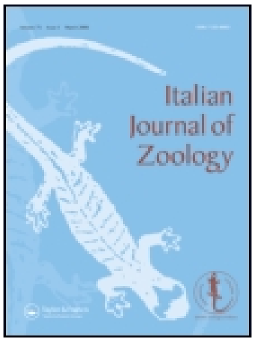

Italian Journal of Zoology

ISSN: 1125-0003 (Print) 1748-5851 (Online) Journal homepage: https://www.tandfonline.com/loi/tizo20

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To cite this article: Tiema Niare & Vincent Benech (1998) Between-year variation of lateral fish migrations in the Inner Delta of the River Niger (Mali, West Africa), Italian Journal of Zoology, 65:S1, 313-319, DOI: 10.1080/11250009809386839

To link to this article: https://doi.org/10.1080/11250009809386839

Published online: 28 Jan 2009.

Ital. J. Zool., *65, Suppl.*: 313-319 (1998)

Between-year variation of lateral fish migrations in the Inner Delta of the River Niger (Mali, West Africa)

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ABSTRACT

In the Inner Delta of the River Niger fish lateral migration from the river toward the plain was monitored at the beginning of the flood during 1991 and 1994, two hydrologically different years. Fish sampling was performed with a fyke-net (mesh-bar 8 mm) set in a small channel linking river to plain. This first step of the migration is generally less studied but yet very important for optimal colonization and natural fish farming of the food resources on the floodplain. The adults and/or the juveniles of more than thirty fish species representing thirteen families migrate yearly at the beginning of the flood from the river toward the plain. The species diversity (Shannon index) was similar for the two years (2.72 in 1991 and 2.44 in 1994). On the whole the migration into the plain was more important (+24% in number) in 1994, a high flood year. The relationships between the different migrating fish species and the water discharge, temperature and conductivity are evaluated. The between year variation of migratory behaviour was investigated. These results on the migratory behaviour could be used in the conservation and improvement of fisheries and in the development of fish farming in this area of Mali.

KEY WORDS: Niger delta -Fish migration - Floodplain - Flood discharge variation - Africa.

ACKNOWLEDGEMENTS

The authors thank Prof. P. G. Bianco and two unknown referees for critically reading and commenting manuscript, and for improving the English text.

(Received 24 September 1997 - Accepted 13 April 1998)

INTRODUCTION

The Inner Delta of the River Niger (also called Central Delta) is a large tropical floodplain in West Africa subject to between-year and seasonally contrasting variations linked to the hydrological regime of the River Niger and its main affluent, the Bani. Between-year variation in water volume is up to threefold, equivalent to an area of more than 20000 km^2. Seasonal variations, flood and fall, of this fluvial hydrosystem, induce fluctuations of the area of the ecotones that constitute the floodplain. Connections that are established between the fluvial system and the alluvial plain during the flood are behind various transfers (Amoros *et al.*, 1993) and notably lateral displacements of the ichthyofauna between the river and the floodplain. The ecological richness of this hydrosystem results from the diversity of the biotopes and ecotones which are connected during the flooding period. This results in a very important fishery. The annual fish yield (mean: 80000 tons) fluctuates in relation to the flooded area, i.e. the yearly variation in resources attainable by both spawners and juveniles migrating into the floodplain.

Lateral fish migrations have been studied at several tropical sites (see Welcomme, 1979; Bénech & Quensière, 1982, 1983a, b, for a review). They allow optimal exploitation of the trophic resources of floodplain for initial growth and thus favour the renewal of stocks. In the Central Delta of Niger biomass increases close to nine times during the flood (Bénech *et al.*, 1994). This migratory phenomenon is well known and exploited by local fishermen during falling waters. For similar ecological conditions, the importance of the colonization of the floodplain determines the size of catches; hence interest in the knowledge of the first steps of fish lateral migrations.

Studies of fish displacement into the floodplain at the beginning of the flood and especially of small sized individuals are few. A first study of lateral migration in the Central Delta of Niger was performed in 1991 during a period of weak floods at the field station of Batamani (Bénech *et al.*, 1994). In 1994, during the first phases of water rising in the plain, the colonization by the ichthyofauna has been again monitored at this same station. The flood of that year appeared 'exceptional' when compared to those of preceding years. We compare here the observations undertaken during these two different flood years (1991 and 1994). Our aim is to better perceive consequences of the hydrological variation on fish assemblages that colonize the plain during the initial phases of the flood. As stated by Lévêque (1997), factors underlying these variations in community structure are fundamental in the understanding of fish community dynamics but also for the development of management and conservation programs.

MATERIALS AND METHODS

Sampling

The colonization by fish of a portion of the floodplain of the Central Delta of Niger has been followed in August-September 1991 at Batamani. At this site, in period of high waters, a side-arm of the River Niger, the Mayo Ninga, is connected to a permanent pool of the floodplain (the Débaré pool), via a small channel. The sampling device is described in Bénech *et al.* (1994). A fyke-net was set at each lunar phase, and a fishing cycle was undertaken over 24 h to take into account of the rhythms of activity of fish. The fyke-net (meshbar: 8 mm) was used to close the entire width of the channel; its mouth was extended to both banks by two wings. For each sample the number of individuals and total weight was measured for each species. The standard length (mm) was measured for at least fifty individuals of each species.

The lateral fish migration from the river toward the Débaré pool was followed again from 1st to 28th August 1994, i.e. approximately a month from the beginning of the connection between the pool and the side-arm of Niger. Modes of sampling were the same for the two years except that sampling was undertaken for a continuous 24 h period of time in 1991, while in 1994 it constituted four fishing periods of 6 h on 4 days. However, two diel cycles were undertaken in the same manner (a single period of 24 h) on 25/ 08/ 91 and 14/ 08/ 94.

Besides the fish monitoring, the water surface temperature in the channel and the conductivity were measured at 07.00 h am. Daily discharges of the River Niger at Mopti were provided by the Regional Direction of the Hydraulic and Energy of Mopti.

Data analysis

Since the flood of 1994 was earlier, the comparison was undertaken not on the same calendar period but on the same hydrological period, i.e. a lag of 11 days. The comparison focuses on catches of similar fishing effort. We will compare first the catches of two diel fishing cycles in the middle of the filling period of the pool in each year. This comparison is based on a similar sampling both for the protocol (24 h of continuous fishing) and for the hydrological phase (rapid filling phase). There was a lunar phase lag: full moon on 25/08/ 91 and first quarter on 14/ 08/ 94. However, a comparison limited to a single diel cycle can be biased by the transient presence of a gregarious species, and this is why the global comparison of the two years is also based on the sum of catches of five diel cycles distributed along the whole filling period.

The Shannon-Wiener index (Frontier & Pichod-Viale, 1991) has been calculated for each selected sample. Linear correlations between specific abundance and physical parameters (temperature and conductivity of the water in the channel and discharge of Niger at Mopti) were performed. Correlations between species diversity and ecological factors were also calculated.

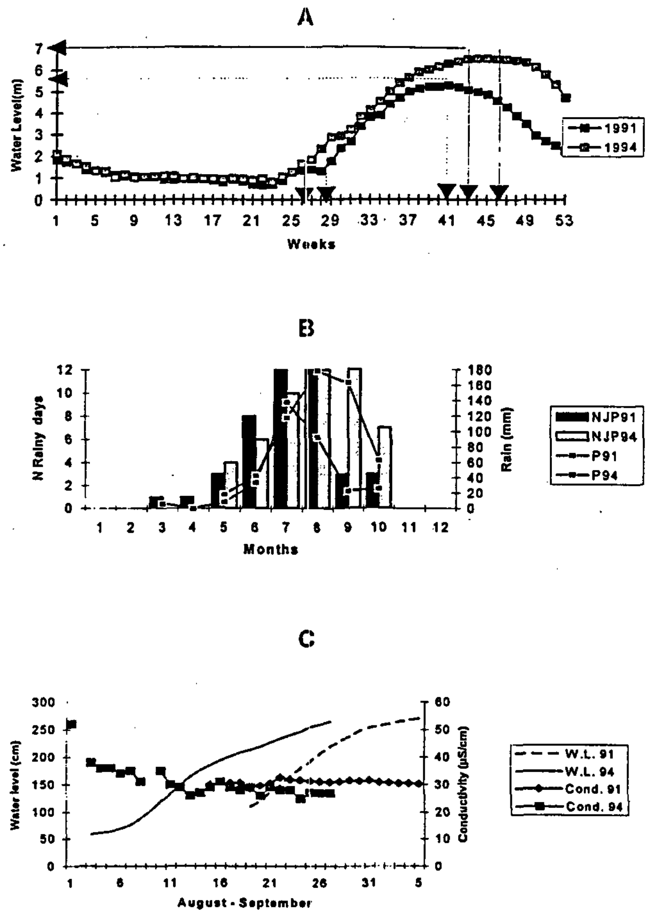

Fig. 1 - Seasonal variation of the water level of the River Niger (A), rainfall and number of rainy days (B) at Mopti in 1991 and 1994. Water conductivity (C) in the channel linking the river to the floodplain at Batamani during the filling phase in August-September 1991 and 1994.

RESULTS

Environment

The hydrological regime of Niger varied substantially between these two years (Fig. 1A). The flood of 1994 was characterised by an earlier rise in the water level, a higher maximum which was observed a month later than in 1991 and remained for approximately a month. The maximum water level of 1994 at the gauge of Mopti was 1.5 m higher than that of 1991, i.e. close to 25% more. It is therefore resulted in a larger flooded area and a longer period of flood. It began to rain earlier in 1991 that in 1994 (Fig. 1B), however, the total rain was higher (+78%) in 1994. The filling of the pool in August 1994 was characterized by a progressive decline in dissolved materials in the water of the channel connecting the pool to the river (Fig. 1C).

Migratory flows 1991 and 1994

Twenty-nine species or groups of species occurred in samples of 1994 against 24 in 1991 (Table I). *Hyperopisus bebe, Tetraodon lineatus, Hemichromis bimaculatus, H. fasciatus* and *Labeo senegalensis* were not caught in 1991.

This lower species richness was accompanied by a lower species diversity in 1991 (1.93 against 3.31). This difference resulted from the abundance of *Pellonula miri* in catches of 1991 (68%). When data for *P. miri*, whose huge and transient abundance can result from the gregarious behaviour of this species, were removed, catches of the two years were similar both numerically and for species diversity. However, among species whose number exceeded 30 individuals, large variations were noticed between years. In 1991, *Pellonula miri, Micralestes elongatus, Chelaethiops bibie* were far more abundant than in 1994; these were adults from very

TABLE I - *Fyke-net catches (individuals and %) of species entering the floodplain at Batamani during 1991 and 1994 flood seasons. Sampling for a single (date) or five (NT) diel fishing cycles. Species are ranked along the ratio '91/'94 for NT.*

Families	Species	MG	Flood '91				Flood '94				Ratio '91/'94	
			25/8/91	%	NT91	%	14/8/94	%	NT94	%	NT	Diel cycle
Amphiliidae	*Andersonia leptura*	-	0	0.00	2	0.02	0	0.00	0	0.00	-	-
Cichlidae	*Chromidotilapia guntheri*	-	0	0.00	2	0.02	0	0.00	0	0.00	-	-
Mormyridae	*Mormyrops deliciosus*	-	0	0.00	1	0.01	0	0.00	0	0.00	-	-
Cyprinidae	*Chelaethiops bibie*	2	37	0.78	50	0.57	2	0.12	7	0.06	7.14	18.50
Clupeidae	*Pellonula miri*	2	3235	68.03	4355	49.79	86	5.29	745	6.86	5.85	37.62
Characidae	*Micralestes elongatus*	2	367	7.72	420	4.80	8	0.49	73	0.67	5.75	45.88
Cyprinidae	*Labeo senegalensis*	1	0	0.00	30	0.34	1	0.06	7	0.06	4.29	0.00
Mormyridae	*Petrocephalus bovei*	1	84	1.77	132	1.51	30	1.85	36	0.33	3.67	2.80
Schilbeidae	*Physailia pellucida*	2	93	1.96	209	2.39	49	3.02	121	1.11	1.73	1.90
Distichodontidae	*Nannocharax sp.*	4	1	0.02	6	0.07	1	0.06	4	0.04	1.50	1.00
Mormyridae	*Pollimyrus petricolus*	4	3	0.06	34	0.39	12	0.74	25	0.23	1.36	0.25
Bagridae	*Clarotes sp.*	4	6	0.13	12	0.14	3	0.18	10	0.09	1.20	2.00
Cyprinidae	*Raiamas & Leptocypris*	4	32	0.67	94	1.07	12	0.74	79	0.73	1.19	2.67
Characidae	*Brycinus leuciscus*	1	80	1.68	512	5.85	174	10.71	447	4.11	1.15	0.46
Mochokidae	*Mochokus niloticus*	4	14	0.29	175	2.00	43	2.65	233	2.14	0.75	0.33
Centropomidae	*Lates niloticus*	1	30	0.63	58	0.66	35	2.15	88	0.81	0.66	0.86
Bagridae	*Bagrus sp.*	1	95	2.00	347	3.97	205	12.62	533	4.90	0.65	0.46
Bagridae	*Chrysichthys auratus*	1	37	0.78	176	2.01	139	8.55	277	2.55	0.64	0.27
Mormyridae	*Mormyrus rume*	3	3	0.06	7	0.08	8	0.49	12	0.11	0.58	0.38
Mormyridae	*Pollimyrus isidori*	1	91	1.91	291	3.33	130	8.00	505	4.65	0.58	0.70
Schilbeidae	*Schilbe mystus*	1	34	0.72	69	0.79	10	0.62	150	1.38	0.46	3.40
Schilbeidae	*Siluranodon auritus*	1	1	0.02	28	0.32	3	0.18	64	0.59	0.44	0.33
Bagridae	*Auchenoglanis sp.*	3	2	0.04	30	0.34	49	3.02	75	0.69	0.40	0.04
Clariidae	*Clarias sp.*	3	0	0.00	9	0.10	0	0.00	23	0.21	0.39	-
Cichlidae	*Tilapia sensu lato*	1	63	1.32	246	2.81	30	1.85	665	6.12	0.37	2.10
Characidae	*Hydrocynus sp.*	2	1	0.02	13	0.15	14	0.86	38	0.35	0.34	0.07
Characidae	*Brycinus nurse*	2	3	0.06	8	0.09	16	0.98	30	0.28	0.27	0.19
Tetraodontidae	*Tetraodon lineatus*	3	0	0.00	4	0.05	2	0.12	17	0.16	0.24	0.00
Cyprinidae	*Barbus sp.*	1	442	9.30	1423	16.27	556	34.22	6550	60.27	0.22	0.79
Characidae	*Alestes sp.*	2	0	0.00	1	0.01	0	0.00	8	0.07	0.13	-
Mochokidae	*Synodontis sp.*	3	1	0.02	1	0.01	1	0.06	8	0.07	0.13	1.00
Cichlidae	*Hemichromis fasciatus*	3	0	0.00	1	0.01	1	0.06	9	0.08	0.11	0.00
Distichodontidae	*Distichodus sp.*	3	0	0.00	0	0.00	0	0.00	8	0.07	0.00	-
Cichlidae	*Hemichromis bimaculatus*	3	0	0.00	0	0.00	1	0.06	1	0.01	0.00	0.00
Mormyridae	*Hyperopisus bebe*	3	0	0.00	0	0.00	4	0.25	17	0.16	0.00	0.00
Mormyridae	*Marcusenius senegalensis*	3	0	0.00	0	0.00	0	0.00	2	0.02	0.00	-

MG: Migratory Group (cf Bénech *et al.*, 1994).

	25/8/91	%	NT91	%	14/8/94	%	NT94	%
Total	4755	100	8746	100	1625	100	10867	100
Nb species	24		32		29		33	
Shannon Index	1,93		2,72		3,31		2,44	
Without Pellonula and Barbus:								
Total	1078	22,67	2968	33,94	983	60,49	3572	32,87
Nb species	22		30		27		31	
Shannon Index	3,28		3,74		3,50		3,68	

small sized species. The ratio between years was lower for *Physailia pellucida, Tilapia* s.l., *Petrocephalus bovei* and *Schilbe mystus,* with values between 1.9 and 3.4. In 1994, there were more adults of *Brycinus leuciscus* and young of large species of catfish of genera *Chrysichthys, Auchenoglanis, Bagrus,* and small sized species as *Mochokus niloticus. Lates* spp, *Barbus* spp and *Pollimyrus isidori* maintained comparable abundance for the two years.

Seasonal change in species diversity in the colonizing fish assemblage

The seasonal change in the species diversity of the colonizing fish assemblage was different for 1991 and 1994 (Fig. 2). In 1994, the diversity of the assemblage increased with the rise in the water level, then the Shannon index stabilized around 3 after the rapid filling phase. In 1991, the highest diversity was observed at

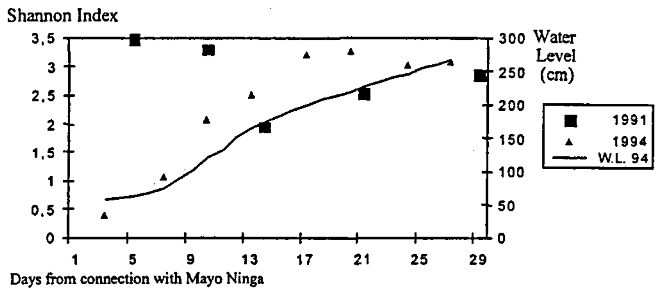

Fig. 2 - Seasonal change in the species diversity of the fish assemblage colonizing the floodplain during the filling period at Batamani in 1991 and 1994.

the beginning of flood, followed by a decline of the index at mid-filling, and a progressive increase up to a similar diversity to that of 1994 at the end of filling. These variations of the species diversity resulted from fluctuations of abundance in gregarious species such as *Barbus* sp. and *P. miri* that represent each more than 60% of catches in some samples.

Comparison of catches from five diel sampling cycles

This more important fishing effort displayed over the flooding period buffers risks resulting from gregarism. Fyke-netting used to monitor fish displacement to the pool caught 10900 fishes in August 1994, 25% more than in 1991. This number does not take into account entry of very small alevins.

A total of 33 taxa were caught (Table I) belonging to 13 families; 29 taxa were common to the two years. Among these families there were four including Clupeidae and Centropomidae which were represented by only one species. The *Barbus* genus is composed of several small sized species that have not been distinguished. Data for *Leptocypris* and *Raiamas* were combined because juveniles were sometimes confused.

Andersonia leptura, Chromidotilapia guntheri and *Mormyrops deliciosus* were not caught in 1994 while *Distichodus* sp., *Hemichromis bimaculatus, Hyperopisus bebe* and *Marcusenius senegalensis* were not caught in 1991.

Catches in 1991 were largely dominated by *Pellonula miri* (49%) and secondly by *Barbus* (16%). This latter group dominated in 1994 (60%) while *P. miri* occupied only the second rank (6.86%) before *Tilapia* s.l. (6.12%). The dominance of *Barbus* sp. and *P. miri* explained the relatively low species diversity in both two years (2.72 in 1991 and 2.44 in 1994). Without these two species the Shannon index values are respectively 3.74 and 3.68.

In 1991 abundance of *Chelaethiops bibie, Pellonula miri, Micralestes elongatus, Labeo senegalensis* and *Petrocephalus bovei*, were at least twice those in 1994. In 1994 there were three species groups with a converse pattern: *Hemichromis fasciatus, Alestes* sp., *Synodontis* sp. and *Tetraodon lineatus* were scarce, *Brycinus nurse, Hydrocynus* sp., *Clarias* sp., *Auchenoglanis* sp. and *Siluranodon auritus* were moderately abundant, and *Barbus* sp., *Tilapia* s.l. and *Schilbe mystus* were very abundant.

Lateral migrations and biological cycles

Apart from the fact that the floodplain serves as a refuge zone for some fish to escape predators, lateral migrations offer also the possibility to exploit variability in space and time for reproduction or initial growth of individuals. Among species which penetrate into floodplain, lateral migrations involves differents size classes. Distributions of standard length frequencies are illustrated for some typical examples (Fig. 3).

The colonization of the floodplain by the genus *Brycinus* differed between species. In *B. leuciscus* both juveniles (15-35 mm) and spawners (40-65 mm) migrated toward the plain. Similar colonization was shown by *Schilbe mystus* but it reproduces essentially in the plain. In *B. nurse*, spawners (90 to 120 mm) but not juveniles entered the plain to reproduce at the beginning of filling. This migration of the spawners was also observed in *Petrocephalus bovei* a small mormyrid.

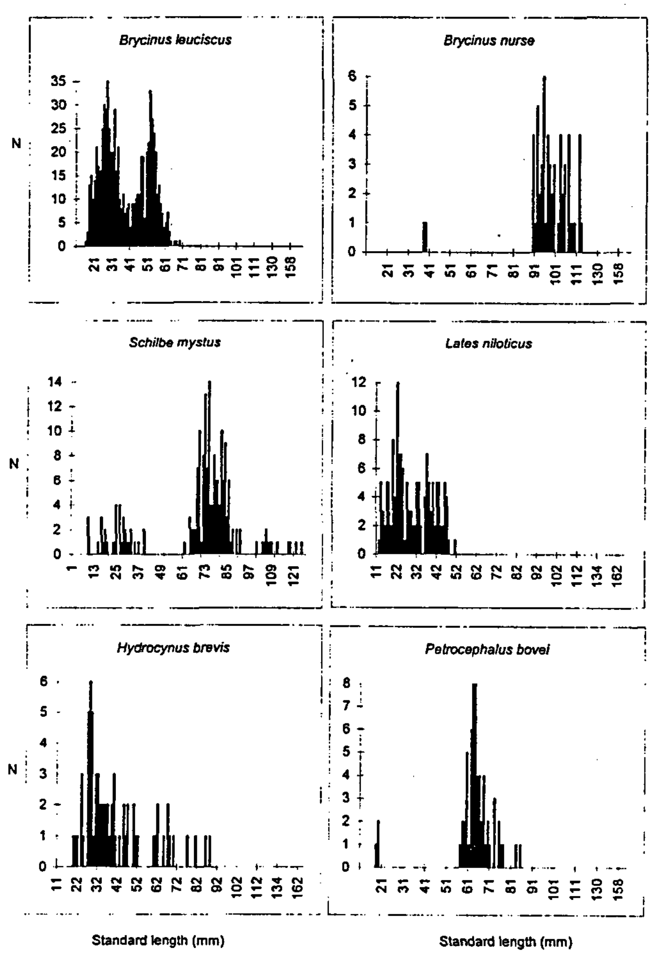

Fig. 3 - Distribution of standard length frequencies in six species of the fish assemblage colonizing the floodplain at Batamani in August 1994.

For the large predators such as *Lates* and *Hydrocynus*, only juvenile stages were caught entering the plain (Fig. 3). For *Lates*, individuals in 1994 had a greater range in size than in 1991. In *Hydrocynus* two ecophases of juveniles migrated into the floodplain: small individuals (20 to 52 mm) have a diet different from that of the larger ones (60 to 90 mm) which are strictly ichthyophagous

Lateral migrations and ecological factors

Coefficients of correlation between the abundance of a given species and physical parameters of the water in the channel (temperature, conductivity) and in the river (discharge) are recorded in table II. Water temperature was significantly correlated with water discharge.

In 1994, *Barbus* sp. was abundant from the connection of the pool with the Mayo Ninga at the moment when the conductivity increased. *Brycinus leuciscus* seemed to migrate when the water was warming, similar to *Chrysichthys auratus.* There was a positive and significant correlation between entries of *Synodontis* sp., *Pellonula miri, Lates niloticus, Labeo senegalensis* and *Distichodus* sp., and the discharge of the river. These relationships were not observed in 1991 for the same species. *Nannocharax sp.* a swift water species, seemed to be carried by the current; on the contrary *Auchenoglanis* sp. and *Siluranodon auritus* seemed to colonize the plain at the beginning of the flood. At the level of the fish assemblage, the species diversity of the sample in 1994 increased with the warming of the water. An opposite relationship was observed with conductivity. On the other hand, for the weak floodyear, the species diversity seems independent of variations in these parameters of the environment.

TABLE II - *Coefficients of correlation between species abundance and diversity index with water temperature, conductivity (cond) and discharge (disch) of the river in 1991 and 1994 and between abiotic factors (* P < 0.05).*

	1991			1994		
Species	T°C	Cond	Disch	T°C	Cond	Disch
Auchenoglanis sp.	-0.55	-0.30	-0.88*	-0.14	-0.16	-0.27
Barbus sp.	0.47	0.17	0.63	-0.96*	0.91*	-0.82
Brycinus leuciscus	0.68	-0.78	0.33	0.94*	-0.81	0.79
Chrysichthys sp.	-0.52	0.20	-0.22	0.90*	-0.83	0.70
Distichodus sp.				0.66	-0.46	0.88*
Labeo senegalensis	0.92*	- 0.72	0.75	0.75	-0.52	0.94*
Lates niloticus	-0.55	0.66	-0.26	0.76	-0.68	0.88*
Mormyrus rume	-0.75	0.51	-0.68	0.70	-0.89*	0.42
Nannocharax sp.	0.77	-0.05	0.96*	0.01	-0.41	-0.34
Pellonula miri	-0.11	0.70	0.09	0.75	-0.61	0.91*
Pollimyrus isidori	-0.44	0.14	-0.66	-0.83	0.88*	-0.73
Siluranodon auritus	-0.58	-0.27	-0.88*	-0.52	0.46	-0.51
Synodontis sp.	-0.13	0.69	0.03	0.66	-0.46	0.88*
Species diversity	-0.33	-0.67	-0.55	0.95*	-0.92*	0.78
Temperature		-0.46	0.88*		-0.86*	0.84*
Conductivity			-0.11			-0.78

DISCUSSION

Migrations of fishes into the floodplain could be considered as a major phenomenon in the concept of «ontogenic niche» defined as one of the four main suggested patterns of spatial and temporal models of habitat use (Lévêque, 1997). These lateral migrations were studied here by fyke-netting which is a passive method of fishing. Fish penetrate the fishing gear without being attracted by a bait, a lure, the light or without being frightened by a noise. So catches give information on the behavior of a given species (Bénech & Le Hong Chuong, 1993). However, this technique of sampling does not take into account the small juveniles that are not stopped by a mesh of 8 mm. Despite these reservations, the comparison of lateral migration from two dissimilar years provides an estimate of the annual variability of the fish colonization of the floodplain.

The flood of 1994 was more important than that of 1991. Colonization of the plain was influenced more quantitatively (increase of the global migratory flow) rather than qualitatively (species diversity).

The similarity of Shannon indexes for the two years indicated a relative stability in diversity which lies on an inherited adaptative strategy of the whole fish community to the deltaïc conditions. As stated by Lévêque (1997), diversity in community species composition is the result of both the frequency and intensity of disturbances compared to the life-cycle length of species. Besides in such a colonizing fish assemblage the principle of competitive exclusion does not operate as in the case of Cyprinodont fish assemblage studied by Brosset (1982) in Ivindo basin (Gabon).

The important migratory flow, that penetrates in the plain from the beginning of the flood, constitutes three forms of migrants: the spawners of small sized species such as *Brycinus nurse, Petrocephalus bovei, Chelaethiops bibie, Micralestes elongatus*; the juvenile of species of large size (*Lates niloticus* for example) that colonize the plain for the initial growth, and finally both phases (juvenile and adult) of species such as *Brycinus leuciscus, Schilbe mystus* or *Tilapia* sensu lato.

The first studies (Bénech *et al.*, 1994) have identified four migratory patterns corresponding to four groups of species. Schematically, group 1 and almost 3 penetrate deep into floodplain while group 2 and 4 colonize the flooded part close to the river bank. In Table I the ranking of species according to the value of the ratio of catches for the two years, shows an order in relation to the lateral migration characteristics in these species. At one end of Table I, especially species of the group 3 were more abundant in 1994 while, at the other end, species which were more abundant in 1991 belonged to groups two and four.

The year 1994 was therefore characterized by species of large size that entered early into the floodplain and moved out of it late in the course of the fall. The year 1991 was, on the other hand, characterized by small sized species that colonized the periphery of the plain and the channels. Group 4 consists of species of very small or small living in swift waters, essentially caught during the rise of water at the moment where the current was the most rapid in the channel.

This study on lateral migrations was carried out only over a limited period of time, but is very instructive on modes of colonization of the plain from its initial connection up to the end of the rapid rise of the water level in the plain. In support of hypotheses formulated on the colonization of the plain by fish of the group 3 (Bénech *et al.*, 1994), the early entry is confirmed for large sized species. Effects of interactions due to the lunar influence and the diel rhythm of fish behavior (Bénech & Quensière, 1983a) could also explain a part of variations of abundance.

It is almost always the juveniles of species of large size that penetrate the plain in greater abundance in periods of strong flood such as in 1994. These species have a fluvial mode of reproduction. The floodplain then plays a preponderant role of nursery (Bénech *et al.*, 1994). However, the migratory pattern of *Brycinus leuciscus*, a small sized species, could be a different strategy. Variations in abundance observed in this species could result from the influence of the lunar cycle that strongly determines its activities (Daget, 1952; Ghazaï *et al.*, 1991). Variability could also result from differences in reproduction over time (which did not seem to be finished in 94) or in space (reproduction both in river and in the plain).

During the period of study, colonization has been made by the entry of both cohorts of juveniles and spawners, particularly in small sized species. This strategy aims to increase the efficiency of the reproduction by a mechanism of adaptation to possible modifications of seasonal characteristics of the flood (Bénech *et al.*, 1994).

The entry into the plain by the ecophases of most of species does not seem to be determined by others environmental characteristics than the river discharge. The intra- and inter-specific variability of this relationship (between-year comparison) shows the linear independence between specific abundance during the colonization of the plain and variables of the environment. Nevertheless, for a strong flood, the recruitment of large size species that reproduce especially in the river appears important. The reproduction of these species could begin earlier (flexible reproduction strategy adaptable to the flood). Similarly, the gregarious behavior of *Pellonula miri* is amplified by the river discharge. These results would corroborate the hypothesis of colonization of the plain by the juveniles carried by the current, contrary to spawner migration. For rivers with a tropical hydrological regime Welcomme (1979) and Lowe-McConnel (1987) have noted that water level changes associated with seasonal flooding appear to be the keys factors in the biology of species and system functioning, rather than changes in water temperature or day length.

There were few significant results on relationships between the species diversity and environmental variables. Variations in species diversity with the water temperature or conductivity correspond to the progressive increase of the number of species colonizing the plain during the first days of filling. These variations confirm a passive transportation effect of colonizing species by the current, according to their rhythms of reproduction, rather than an actual species enrichment. The fry drift with the flood wave.

Some results on colonization of the plain in the Central Delta of Niger are comparable to those of others studies notably of the floodplain Yaere in the North Cameroon (Bénech *et al.*, 1983b, 1994). However, our comparative study, over a major period for the colonization of the plain in the Central Delta, depicts a between-year variation of the chronological organization of the first phases of migration toward the plain. This knowledge is essential to promote selective fish farming in some waters or for collecting alevins of appreciated species with the aim of increasing fish production.

In conclusion, despite the imperfections of the fishing gear and restricted sampling in time and space, these studies on two years with hydrological differences confirm main characteristics of an important step for lateral migrations. These results which could be valid in a large part of the Central Delta, highlight the characteristics of the between-year variability of the colonization of the plain. These characteristics which operate in the determination of the fish colonization of a water body, have to be taken into account for the conservation and the development of the fisheries potential in the Central Delta of River Niger.

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