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Diet changes in fish species from a large reservoir in South America and their impact on the trophic structure of fish assemblages (Petit-Saut Dam, French Guiana)**

B. de Mérona[1]*, R. Vigouroux[2]

[1] IRD - LEHF, Université Cl. Bernard Lyon 1, 69622 - Villeurbanne cedex, France
[2] HYDRECO - Laboratoire de Petit-Saut, B.P. 823 - 97388 - Cayenne cedex, France

The prediction of the composition and structure of fish communities in reservoirs is essential in the management of the fisheries, an activity fundamental in emerging countries where human riverine populations depend on freshwater fish for their animal protein supply. The transformation of the river in a reservoir constitutes an environmental filter for the riverine fish species which, before anything else, must find food resources in the reservoir for their individual maintenance. After the closure of Petit-Saut Dam in 1994, fish were sampled by gillnets in the Sinnamary River in the period 1994-2000 and in the Petit-Saut Reservoir between 1998 and 2000. The stomach contents of the main species were analysed for 6 main food items. Analyses of similarity were conducted in order to compare river and reservoir diets of individual species on one hand and the trophic structure of fish assemblages on the other. Twelve species out of 23 analysed showed significant modifications in their feeding habits. The changes affected species from every feeding guild as established from the river stomach contents data. As a consequence the trophic structure was deeply modified in the reservoir. The abundance of piscivores and herbivores decreased while the relative importance of omnivores and invertivores increased. There was a general tendency for species to increase their food niche breath. The ability of species to modify their feeding habits is shown to be of fundamental importance for the trophic organization of the fish community in the Petit-Saut Reservoir.

Keywords : tropical fish community, stomach contents, diet plasticity, dam impact, trophic structure.

Introduction

In emerging countries freshwater fish constitute an important supply of animal proteins for riverine populations (Shrimpton & Giubliano 1979). As a consequence inland waters fisheries are generally well developed (Welcomme 1979). Dams' construction and the subsequent formation of large reservoirs disrupt the organization of the fisheries (Mérona 1990, Santos & Mérona 1996). Exploitation of the reservoir involves different methods of capture related to the change in fish communities' structure. In these situations, in order to avoid a shortage in markets' supply, some kind of anticipation of the structure and composition of fish communities in the reservoir is essential for its management. The formation of a reservoir, or the transformation of a river into a lake, forms an environmental filter through which only the species exhibiting strategies adapted to the new environment will pass (Tonn et al. 1990, Poff 1997). The first species to be excluded are species morphologically and physiologically adapted to strong currents and oxygen saturation (Welcomme & Mérona 1988). Pool species will be first selected based on their feeding strategies being that feeding exercises a primary influence on further activity, growth, reproduction and correlated aspects of fitness (Hugues 1993).

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* Corresponding author :
E-mail: bernard.de-merona@univ-lyon1.fr

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Published data on the trophic structure of fish communities in reservoirs show a great variability of the results. The only general tendency is a reduction in the proportion of detritivores. Piscivores, invertivores or omnivores can become dominant depending on the studied situation (Agostinho et al. 1999, Mérona et al. 2001, 2003, Densen & Morris 1999, Kubečka 1993). Observed trophic structures depend on various factors : 1) the period of the observations in relation with the succession in the reservoir formation (Kubečka 1993, Agostinho et al. 1994, Hahn et al. 1998, Mérona et al. 2003), 2) the main characteristics of the reservoir such as its position in the basin, mean depth, extension of the littoral zone, drawdown (Bernacksek 1984), and 3) above all, the composition of the fish fauna in the dammed river (Agostinho et al. 1999). Although this last factor has been pointed out by these authors as the main determinant of the composition of fish fauna in reservoirs, it has never been systematically investigated. There are two aspects related to this factor. In order to pass through the environmental filter fishes must either find in the new environment the food they are adapted to, or they must be able to change their diet according to the nature of the food present. In a previous work we have shown that species pertaining to the omnivore feeding guild in the river were dominant in the first stage of Petit-Saut reservoir formation (Mérona et al. 2003). However this dominance diminished afterward suggesting later recovery by fishes from other more specialized guilds. In this work we investigate the way these species adapt to the new resources.

We had three main objectives: 1) identify the main species which change their feeding habits, 2) integrate these changes in the construction of the trophic structure and demonstrate the changes in that structure from the pool habitats in the river to the reservoir, and 3) estimate the relative impact of these changes on the establishment of the trophic organisation of the reservoir fish community.

Material and Methods

Site description

Detailed description of the study site can be found in Mérona et al. (2003). In short, Petit-Saut Dam is located in French Guiana on the Sinnamary River (Fig. 1), a medium sized river with a drainage area of 6565 km^2 and a mean annual discharge of 230m^3 s^{-1} (Tito de Morais & Lauzanne 1994). The climate in the region is tropical humid with a mean annual precipitation of about 3000 mm. The mean water temperature in the river before the damming varied between 25 and 26 °C (Richard et al. 1997). The dam, planned for electricity production, was constructed at about 60 km from the estuary and closed in January 1994. It led to the inundation of more than 350 km^2 of pristine tropical forest. The surface water temperature in the reservoir can reach 32 °C in the dry season but most of the time it varied between 28 and 30 °C (Richard et al. 1997). Thermal stratification was rapidly established but was less marked at the beginning of the rains (January- February - Richard et al. 1997). In the first 2 years after the closure, large supplies of plant material and terrestrial invertebrates were observed falling in the aquatic compartment. This quantity of exogenous biomass progressively diminished during the subsequent years.

Fish sampling

Fish sampling has been described in a previous study (Mérona et al. 2003). We used two sets of 10 surface gillnets 25m long by 2 m height of different mesh sizes. The nets were set at about 05:00 p.m. and removed between 07:00 and 10:00 a.m. the next day. In the river, the nets were positioned along the banks in areas of low water current (pools) whereas in the reservoir the former canal of the river and the marginal areas were sampled. Two zones of the reservoir were sampled: one in the lower part, at about 5 km from the dam, and the other in the middle part at about 50 km from the dam. In the river, sampling took place in an area immediately above the upper limit of the reservoir until December 1996 and after that in three stations located at increasing distances upstream from the lake (Fig. 1). In the reservoir sampling was done twice a year from June 1998 to November 2000 whereas in the river sampling covers the period 1994 to 2000, on a nearly monthly basis from 1994 to 1996 and twice a year from 1997 on. Based on the results of a previous work showing no difference in trophic structure in the three stations upstream from the reservoir (Mérona et al. 2003) we pooled these samples for the analysis. There are a total of 35 samples in the river and 12 in the reservoir. Gillnet sampling to study fish communities has some shortcomings because of the highly selective nature of this fishing method (Hamley 1975). First of all it is unsuitable to sample fast running water habitats. However, in this work we were interested in species able *a priori* to adapt to a lacustrine habitat which are those inhabiting the pools in the river. Furthermore the use of a large range of meshes, the multiplicity of samples, and the care taken through the investigation to sample every habitat in a zone can reduce the bias associated with gillnet sampling (Tejerina-Garro & Mérona 2000) and were adopted in this study.

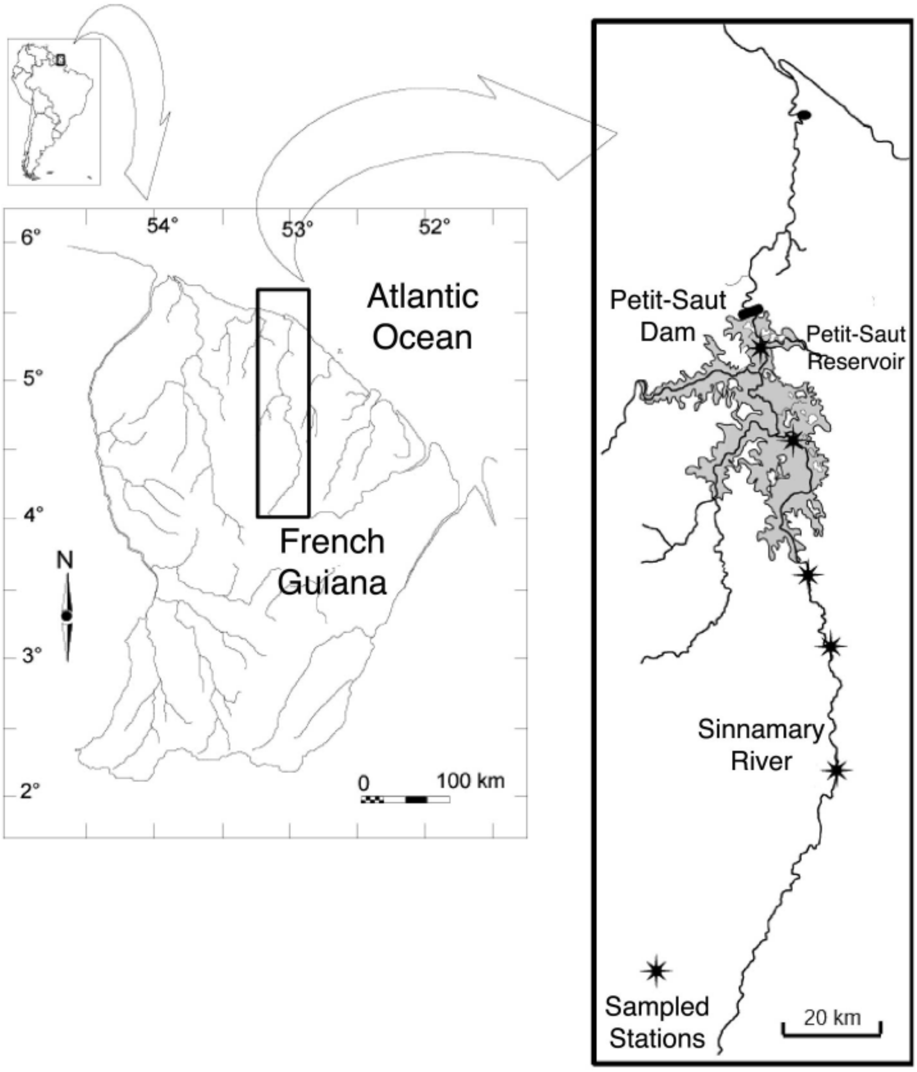

Fig. 1. Location of study site with indication of sampling stations.

In wide tropical rivers, where other sampling methods are difficult or impossible to utilize, gillnet sampling has been shown to be efficient in detecting changes in fish community structure (Tejerina-Garro et al. 1998, Mérona et al. 2001).

Stomach content analysis

In the field, after identification of the species (Planquette et al. 1996, Keith et al. 2000, Le Bail et al. 2000) individual fishes were measured and weighed and a maximum of 10 specimens of adult size of each species were taken at random, their stomachs removed from the visceral cavity and preserved in 70% alcohol. In the laboratory, the contents (if any) were spread in a Petri dish and the different items separated under a stereomicroscope. All analyses were supervised by the first author. Scores were attributed to each item based on their volumetric percentage in the stomach estimated visually (Point method - Wootton 1999). Items recognized in the stomachs were organic layer (periphyton, sediment and detritus), superior plants (leaves, fruits and seeds and plant remains), plankton, fish, decapod, terrestrial invertebrates and aquatic invertebrates.

Data treatments

Feeding guilds were determined from the matrix of stomach contents by an adapted stepwise procedure (Mérona et al. 2001), that is:

- Step 1: more than 70% of organic layer, detritus or sediment in the stomachs: detritivores.
- Step 2: more than 70% of plankton in the stomachs: planktivores.
- Step 3: more than 70% of fish and decapods in the stomachs: piscivores.
- Step 4: more than 70% of invertebrates in the stomachs: invertivores.
- Step 5: more than 70% of plant material in the stomachs: herbivores.
- Step 6: none of the above statements: omnivores.

The overall trophic structures of the two fish species assemblages were then defined by the proportion in biomass of each feeding guild identified. Global differences between trophic structures as well as between individual species' diets in the two habitats were tested by non-parametric analyses of similarity (Anosim - Clarke 1993). This analysis compares groups of samples from a distance matrix transformed to ranks. It gives a global index called global R, which is tested by permutations of the objects. The method also allows pair wise comparisons of the samples. Feeding niche breadths were computed as the inverse sum of squared proportions of each food item in the stomachs. Overlaps between each pair of species' diets in the assemblages were computed using the formula of Morisita (1959). Generally, values equal or greater than 0.60 are assumed to represent high dietary overlap (Zaret & Rand 1971). Difference in overlaps distribution between sites was tested by a chi square test.

Results

We were able to examine the stomach contents of 42 of the 72 species in the river, representing more than 99.4 % of the total biomass captured, and 27 of the 42 species in the reservoir representing 98.9 % of the total biomass captured.

Twenty three species, common to the two habitats and with enough stomach contents data to conduct valid similitude analyses, were used to compare individual diets between the river and the reservoir (Table 1). These species, which include members of the different feeding guilds as established from diet analyses in the river, represented 86.4% and 98.6% of the total capture in the river and the reservoir respectively.

The general tendencies were a large decrease in the relative contribution of terrestrial plant material and a parallel increase in aquatic invertebrates. Twelve, out of 23, showed a significant difference between the river and the reservoir. Among the piscivores, one small sized species *(Charax pauciradiatus)* substituted fish for aquatic invertebrates whereas the two other remained exclusive fish predators. Most invertivores consumed aquatic invertebrates instead of terrestrial invertebrates. This tendency to feed upon aquatic invertebrates was also observed for omnivores like *Moenkhausia georgiae, Poptella brevispina* and *Triportheus rotundatus* which thus substituted part of their food of terrestrial origin. The stomachs contents of benthic feeders like *Hemiodus unimaculatus, Hemiodopsis quadrimaculatus* and *Hypostomus gymnorhynchus* which were mainly composed of algae and detritus in the river were found to contain large quantities of aquatic invertebrates or plankton. Three herbivores *(Leporinus friderici, L. granti* and *Myleus rhomboidalis)* changed their diet to preying upon fish and aquatic invertebrates while two *(L. fasciatus* and *M. ternetzi)* maintained a diet based on terrestrial plants.

The trophic structure of the reservoir was significantly different from that of the river (Global R = 0.271 ; p = 0.002 - Fig. 2). The difference is mainly due to a large reduction in abundance of the piscivore and herbivore guilds and an increase in the omnivore guild (Table 2).

The comparison of the distributions of overlaps between species diets also showed a significant difference (chi square= 306.22; p < 0.001 - Fig. 3). The relative contributions of highest and lowest values of overlaps were reduced.

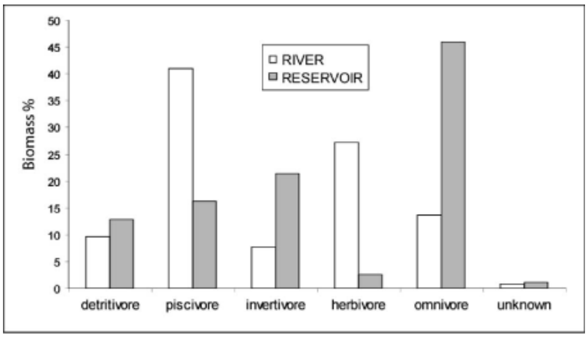

Fig. 2. Comparison of the relative contributions of feeding guilds in the trophic structures of fish communities in the Sinnamary River (1994-2000) and the Petit-Saut Reservoir (1998-2000).

Table 1. Results of stomach content analysis on the main fish species in the Sinnamary River and the Petit-Saut Reservoir, corresponding niche breath and probabilities associated with the analysis of similarity between site.

Species authority Feeding guild in the river/in the reservoir	Habitat	NB	Higher plants	Terrestrial Invertebrates	Plankton & Chaoborus larvae	Aquatic invertebrates	fish & Decapods	Algae & organic layer	Probability	Niche breath
Astyanax bimaculatus (Linné, 1758)	River	5	30	70	0	0	0	0	**0.048**	1.724
Invertivore/piscivore	Reservoir	5	8	20	0	4	68	0		1.959
Acestrorhynchus guyanensis Menezes, 1969	River	22	0	0	0	0	100	0	1.000	1.000
Piscivore/piscivore	Reservoir	27	0	0	0	0	100	0		1.000
Auchenipterus nuchalis (Spix, 1829)	River	147	10.54	81.61	3.17	4.12	0.54	0	**0.001**	1.471
Invertivore/invertivore	Reservoir	30	5	19.67	0	72.33	0	3		1.769
Bryconops affinis (Günther, 1864)	River	60	5.17	90.61	0	4.22	0	0	**0.001**	1.211
Invertivore/invertivore	Reservoir	17	0	65.29	0	26.47	0	8.24		1.987
Bryconops caudomaculatus (Günther, 1869)	River	118	21.8	76.26	0	0.75	0.85	0.34	0.725	1.589
Invertivore/invertivore	Reservoir	58	4.31	85	1.72	7.24	0	1.72		1.369
Curimata cyprinoides (Linné, 1758)	River	16	0	0	0	0	0	100	0.288	1.000
Detritivore/detritivore	Reservoir	7	5.71	8.57	0	0	0	85.71		1.342
Charax pauciradiatus Günther, 1864	River	13	0	7.69	0	0	92.31	0	**0.001**	1.166
Piscivore/invertivore	Reservoir	36	5.56	15.28	0	78.61	0	0.56		1.552
Cyphocharax spp.	River	35	11.90	0	0	2.14	2.38	72.86	0.119	1.831
Detritivore/detritivore	Reservoir	5	4.44	6.67	0	8.89	0	80		1.528
Doras carinatus (Linné, 1766)	River	11	9.09	9.09	0	32.12	0	46.06	0.191	3.013
Omnivore/invertivore	Reservoir	5	0	8	0	92	0	0		1.173
Hoplias aimara (Valenciennes, 1840)	River	10	0	0	0	0	100	0	1.000	1.000
Piscivore/piscivore	Reservoir	7	0	0	0	0	100	0		1.000
Hemiodus unimaculatus (Bloch, 1794)	River	12	1.67	0	0	0	0	98.33	**0.010**	1.034
Detritivore/omnivore	Reservoir	7	0	14.29	0	42.86	0	42.86		2.579
Hypostomus gymnorhynchus (Norman, 1926)	River	3	0	0	0	0	0	100	0.133	1.000
Detritivore/omnivore	Reservoir	7	14.29	14.29	57.14	0	0	14.29		2.579
Hemiodopsis quadrimaculatus (Pellegrin, 1908)	River	35	28.57	0	0	1.14	0	67.43	**0.001**	1.864
Herbivore/omnivore	Reservoir	22	9.09	6.36	22.73	35.91	0	25.91		3.846
Leporinus fasciatus (Bloch, 1794)	River	4	50	25	0	0	0	25	1.000	2.667
Herbivore/omnivore	Reservoir	4	35	40	0	15	0	10		3.175
Leporinus friderici (Bloch, 1794)	River	139	75.18	8.59	0	1.37	8.67	5.76	**0.001**	1.713
Herbivore/omnivore	Reservoir	21	29.52	32.38	0	0.95	29.52	7.62		3.508
Leporinus granti Eigenmann, 1912	River	14	60.71	21.43	0	0	7.14	10.71	**0.040**	2.320
Herbivore/omnivore	Reservoir	4	0	0	0	20	65	15		2.062
Moenkhausia chrysargyrea (Günther, 1864)	River	4	50	50	0	0	0	0	0.657	2.000
Omnivore/omnivore	Reservoir	4	0	50	0	10	20	20		2.941
Moenkhausia georgiae Géry, 1966	River	32	46.56	47.6	0	1.46	0.63	3.75	**0.001**	2.247
Omnivore/omnivore	Reservoir	5	0	20	0	60	0	20		2.273
Myleus rhomboidalis (Cuvier, 1818)	River	6	96.67	0	0	3.33	0	0	**0.012**	1.069
Herbivore/omnivore	Reservoir	3	0	0	0	40	33.33	26.67		2.922
Myleus ternetzi (Norman, 1929)	River	145	97.4	1.45	0	0.19	0	0.97	0.248	1.054
Herbivore/herbivore	Reservoir	8	95	5	0	0	0	0		1.105
Poptella brevispina Reis, 1989	River	112	35.25	60.8	0	0.89	1.60	1.46	**0.002**	2.022
Omnivore/invertivore	Reservoir	48	3.13	63.33	0	27.71	0.42	5.42		2.075
Parauchenipterus galeatus (Linné, 1766)	River	5	5	65	0	0	30	0	0.483	1.942
Omnivore/omnivore	Reservoir	18	21.11	65.56	0	0	11.11	2.22		2.053
Triportheus rotundatus (Schomburk, 1841)	River	201	63.81	30.34	0	1.08	3.71	1.06	**0.001**	1.996
Omnivore/omnivore	Reservoir	147	33.88	31.77	7.82	25.31	0	0.544		3.498
Mean	River		30.41	28.06	0.14	2.30	15.12	23.21		
	Reservoir		11.92	24.85	3.89	24.66	18.58	16.08		

Table 2. Results of the Analysis of similarity between the trophic structures of the Sinnamary River and the Petit-Saut Reservoir. Feeding guilds contributions to the dissimilarity. Biomass are expressed in grams captured by the 2 sets of nets (1000 m^2).

	RIVER	**RESERVOIR**				
Guild	**Av. biomass**	**Av. biomass**	**Av. Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Piscivore	22627.65	5591.10	17.61	1.36	28.27	28.27
herbivore	17267.13	898.22	13.89	1.41	22.29	50.56
omnivore	10332.35	15771.56	12.15	1.14	19.51	70.07
détritivore	8221.80	9130.89	11.39	0.75	18.29	88.36
invertivore	6250.59	7321.27	6.53	1.08	10.49	98.85
Total	65136.68	39097.31				

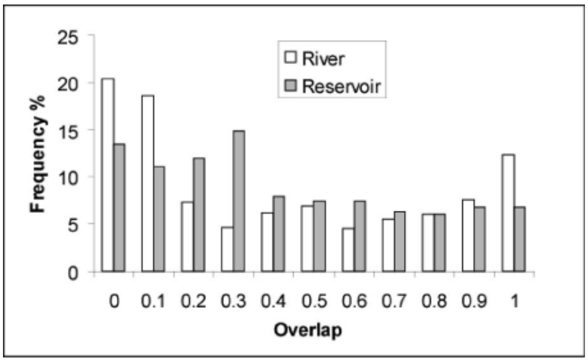

Fig. 3. Distribution of the frequency of overlaps values between species stomach contents in the Sinnamary River and the Petit-Saut Reservoir.

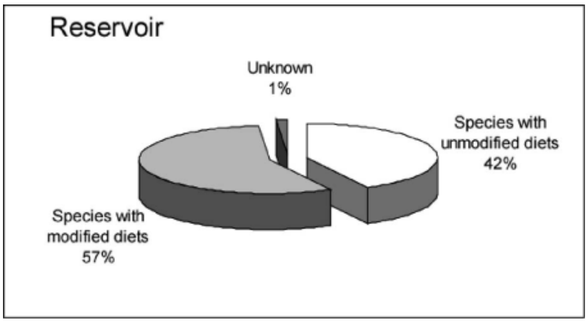

Fig. 4. Relative biomass contribution in the capture of fish species based on their ability to change their feeding habits in the Petit-Saut Reservoir.

The weight contribution to the reservoir community of species having changed their diet in the reservoir was high. These species represented 59.28% of the total capture (Fig. 4).

Discussion

It is generally accepted that fish species are mainly opportunistic in their feeding habits (LoweMcConnell 1987, Araujo-Lima et al. 1995, Matthews 1998). This observation led many authors to consider the guild concept as highly relative (Gerking 1994). However in a study of a rich fish assemblage from the Amazon floodplain, Mérona & Rankin-de Mérona (2004) showed that many species could be considered as feeding specialists. A specialist or stenophagous species cannot survive in an environment lacking the food resource it is adapted to. That means it is limited in its distribution and will consume the same food in the different environments where it occurs. In this study we showed different responses from species pertaining to the same feeding guilds to the drastic changes in the environment induced by the formation of the reservoir. Some species radically changed the quality of their food while other did not. The changes affecting the diets of invertivores, piscivores and omnivores are not fundamental in the sense that they probably do not involve strong modification of their feeding behavior. Conversely some herbivores and detritivores seemed to deeply modify the way they feed. The availability of terrestrial plant material is much reduced in the reservoir but some herbivores maintained populations by preying upon fish. *Leporinus friderici* and *Myleus rhomboidalis* have been already known to show a propensity for omnivorous habits (Boujard et al. 1990, Albrecht & Caramaschi 2003). Conversely, *Myleus ternetzi* is strictly folivorous and eats exclusively allochtonous food (Boujard et al. 1990). Because of the difficulty to separate partially digested algal material from true detritus in the gut, we included in the detritivore guild two different kinds of species. Some, like *Curimata cyprinoides* and *Cyphocharax* sp. feed preferentially upon periphytic algae, other, like *H. gymnorhynchus* and *H. unimaculatus* are more mud eaters. In the reservoir the former species found their preferred food in large supply because of the presence of tree trunks on which attached algae develop. Conversely the access for fish to the sediment deposited on the bottom of the reservoir is limited by the anoxic character of the lake hypolimnion (Richard et al. 1997). Only the marginal areas, where there was a great development of chironomids and other benthic invertebrates (Horeau et al. 1997), are accessible to benthic fishes. This fact explains the presence of large amounts of aquatic invertebrates in the stomachs of *H. gymnorhynchus* and *H. unimaculatus.* Given the specialized morphology and the scraping behavior of the first species, it is likely that the ingestion of aquatic invertebrates is accidental and cannot be interpreted as a change in feeding behavior for this species. Conversely *H. unimaculatus* which has been often described as an opportunistic feeder picking selected items on the bottom (Ferreira 1984, Leite 1987, Mérona et al. 2001), probably actively search for invertebrates.

These modifications in individual species' diets led to changes in the position of these species in the feeding guilds. In the reservoir as compared with the river, we observed a large decrease of herbivores and piscivores and a parallel increase of the relative importance of omnivores and invertivores. Observations on large reservoirs in the tropics reveal a great development of piscivores (Ita 1984, Marshall 1984, Siaw-Yang 1988, Hahn et al. 1998, Novoa et al. 1991,Mérona et al. 2001). According to Agostinho et al. (1999) this fact can be related to the presence in the river of piscivore species pre-adapted to lacustrine conditions, such as *Cichla* sp. and *Plagioscion* sp. (e.g., Tucurui reservoir: Petrere 1996, Mérona et al. 2001). In the Sinnamary River the high contribution of the piscivore guild is the consequence of the relative abundance of a large predator species: *Hoplias aimara,* a species which becomes rare in the reservoir where the piscivores are medium sized. As expected, herbivores, which in the Sinnamary River feed mainly upon the terrestrial marginal vegetation, diminished in abundance in the reservoir. Omnivores are generally dominant in relatively small reservoirs (Viera 1982, Ferreira 1984, Arcifa et al. 1988, Zarate et al. 1991, Agostinho et al. 1997, Hahn et al. 1997) but have not been reported to be abundant in Tucurui and Itaipu reservoirs. These observations support the hypothesis of a strong dependence of the fish community in reservoirs on the fish fauna in the river prior to impoundment. In very large rivers like the Tocantins River (Tucurui reservoir) and the Parana River (Itaipu reservoir) there are much more specialist species than in medium or small-sized rivers. According to Angermeier & Karr (1983) the relation between diversity of feeding guilds and river size could be related to an increase of feeding niches along the upstream-downstream gradient. The increase of invertivores went with a switch from terrestrial to aquatic invertebrates, a fact which has also been shown in Itaipu Reservoir (Hahn et al. 1998). In the Petit-Saut Reservoir terrestrial invertebrates were still an abundant resource for fish because of the presence of great number of dead trees which house large termite's colonies. However aquatic invertebrates, as generally observed in reservoirs, develop rapidly in the littoral and pelagic zone and constitute the main resource available for invertivores.

Most of the studied species enlarged their food niche breadth in the newly formed lake, which means they diversified their diet. The consequence was a reduction in the number of specialist species as shown by a decrease of highest overlaps at the community level (those between members of the same specialist guild) and a parallel decrease of lowest overlaps (those between members of two different specialist guilds - Fig. 3). In order to coexist in the long-term, species must partition the resource in such a way as to avoid competition which could lead to the elimination of the less competitive species (Schoener 1974). However, as pointed out by Matthews (1998), high overlaps cannot be interpreted as indicating that competition is or is not occurring. Indeed, if the common resources are superabundant, at least in some periods of time, competition does not occur. An upsurge of production has been always observed in the first years of reservoir formation (Ackermann et al. 1973, Petr 1975, Bernacsek 1984) and can extend many years after the reservoir filling in situations where nutrients from the inundated land are abundant. This is obviously the case of Petit-Saut dam, situated in a forested area, and it is likely that, at the time of our observations, food resources were not limiting for fish. With the passage of time, the level of production in reservoirs eventually decreases and the food resource available to fish diminishes. In that situation biotic interactions between species outweigh the influence of abiotic conditions of the environmental filter in constraining fish community structure (Poff 1997). This observation emphasizes the importance of considering the state of a reservoir in analyzing the trophic structure of its fish community.

In the Petit-Saut Reservoir the phenomenon of diet plasticity appears to be extremely important in the formation of the trophic structure of the fish community as fish species changing their feeding habits represent more than half of the total biomass captured (Fig. 4). However this does not seem to be a general feature. In the Tucurui Reservoir the contribution of such species has been shown to be of marginal importance (Mérona et al. 2001). Again, the fact that Tucurui Dam was implanted on a very large river with many specialist feeders can explain this difference. Also, it must be pointed out that observations on Tucurui Reservoir were carried out in the very first years after impoundment when trophic organization of the fish community was still very unstable.

Conclusion

This work demonstrates the great impact of the plasticity of fish species diets on the trophic structuration of fish communities in the Petit-Saut Reservoir. Many species, even those which were considered as specialist feeders in the river, were able to change their diet in order to adapt to the new availability of food resources. The results suggest that, in the process of equilibration of a reservoir, a first selection of species is achieved through an environmental filter induced by the transformation of the river in a lake. This process may last a long time depending of the quantity of organic material decomposing after the filling. It is probably much longer in reservoirs situated in pristine forest where the vegetal biomass flooded is considerable.

Substantial losses to downstream fishery production as a result of dam construction have been reported from around the world (WCD, 2000). On another hand, productive reservoirs fisheries often follow from dam construction, although they are rarely anticipated (Kapetsky & Petr 1984). As these authors have pointed out, planning must take place at the early pre-impoundment stages of reservoir development as one of the means for increasing benefits from African reservoir fisheries. The results presented here will contribute to forecast the type of species likely to develop in tropical reservoirs, as a function of the riverine fauna.

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