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# Feeding patterns of the Mormyrid fish *Brienomyrus brachyistius* (Gill, 1862) in Kogon and Tinguilinta rivers (Guinea Republic).

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## ABSTRACT
Dietary patterns of *Brienomyrus brachyistius* (Gill, 1862) in Tinguilinta and Kogon rivers were described. Diets composition and feeding strategy were analyzed among hydrosystems based on the stomach content analysis. The diets compositions were similar in the two rivers and essentially composed of insects larvae (Diptera, Coleoptera, Ephemeroptera and Trichoptera) and insects debris. *Brienomyrus brachyistius* exhibited a generalist feeding strategy with a relatively narrow niche width in the two rivers as there was a trophic specialization by many individuals toward Trichoptera larvae. Apart from insects, seeds and sand were found in many stomach contents. The ontogenetic analysis of diet indicated that there were not size-related changes in the diet of the studied species.

## INTRODUCTION

*Brienomyrus brachyistius* is a common mormyrid with wide geographic distribution in freshwater coastal drainages from Gambia to Zaïre (Gosse, 1986). It occurs in most coastal basins in West Africa (Levèque *et al.*, 1990). Little information is available on the biology and ecology of this species apart from studies carried out by King (1989) in a Nigerian rainforest and Teugels *et al.* (1992) in Cross river basin. This species is met in Kogon and Tinguilinta rivers basins in Republic of Guinea (Edia *et al.*, 2014). According to previous authors, these rivers are less anthropized and characterized by a great diversity of flora and fauna species with the presence of some endemic fish species. However, mining activities were expanding in these watersheds (Edia *et al.*, 2014) threatening the life of aquatic and terrestrial organisms. The knowledge of the bioecology of organisms, including *Brienomyrus brachyistius*, in a relatively undisturbed environment, is necessary for their protection. Studies on organisms diet is important as it is a basic determinant of organism biology, being related with most of the ecological attributes (Hughes, 1993). Diet is sometimes associated with morphology (Winemiller, 1991), physiology (McNab, 2002), behaviour (Ward *et al.*, 2004), population abundances (Brown *et al.*, 2004) and dynamics (Berryman, 1999), community structure (Arim *et al.*, 2007) and even ecosystem processes (Thébault & Loreau, 2006). The master of species trophic behavior is a main step in order to advance in understanding its natural history.

*Brienomyrus brachyistius* is the most encountered mormyrid in Tinguilinta and Kogon basins. The present study aims at getting better knowledge on feeding habits of *Brienomyrus brachyistius* in a less anthropised environment for a proper management of this species.

## MATERIALS AND METHODS

### *Sampling Sites and fish collection*

Samplings were conducted in Kogon and Tinguilinta Rivers basins located in “Low Guinea” at the North-West of Guinea Republic (Fig. 1). These basins encompass areas of 7288 Km2 and 4850 Km2 respectively (Edia *et al*., 2014). Samplings were carried out between November 17th and December 07th of 2013. Fishes were caught through experimental fishing with gill nets which were usually set during the afternoon at about 16:00 and lifted the following morning at about 07:00. Fish traps and no baited hooks were also used. The fish specimens were then identified according to the determination keys of Paugy *et al*. (2003) and Eschmeyer *et al*. (2014), and preserved in formalin 10% for later laboratory observations.

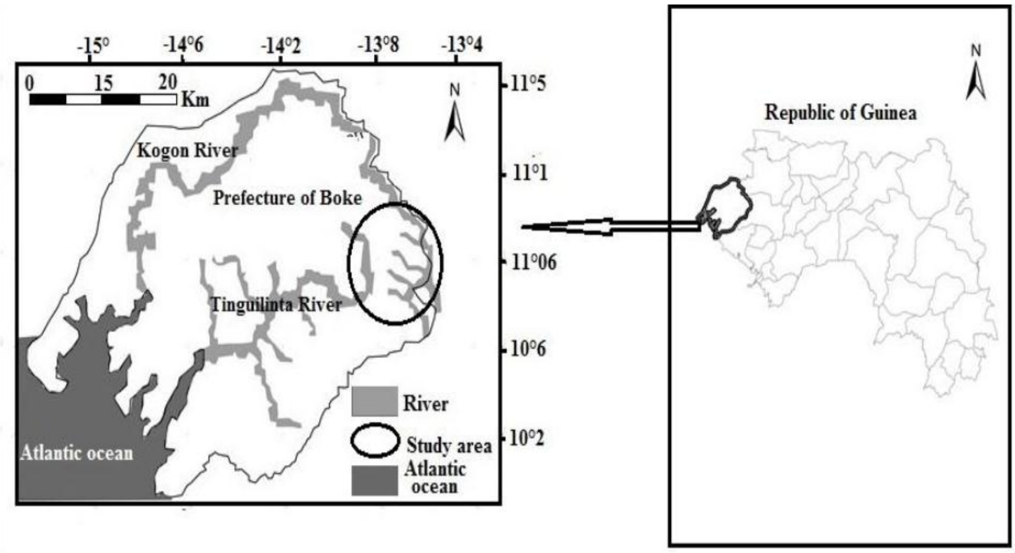


Fig. 1: Location of sampling stations in Kogon and Tinguilinta rivers

### *Laboratory observations*

After dissection, stomachs were removed and weighed to the nearest 0.01g using an Electronic scale, Denver type. Stomachs were conserved in 90° alcohol and later, their contents were analyzed after incision and recovery of the contents. Sixty-two (62) non empty stomachs were analyzed of which 35 were from Kogon and 27 from Tinguilinta. The different food items were then identified, sorted and enumerated under a 'LEICA EZ4' binocular loupe.

Prey identification was made using the insects’ identification keys established by Dejoux *et al.*, (1981), Cumberlidge and Huguet (2003), de Moor *et al*. (2002) and Tachet *et al*. (2003). In a petri dish which bottom was lined with a graph paper, contents of each stomach have been diluted, sorted as insect larvae, insect debris, sand or seeds.

For gut contents analysis, both qualitative and volumetric analysis methods were used (Doumbia, 2003). The qualitative method consisted in highlighting the different categories of prey consumed without showing their importance in the food bowl of fish. The volumetric analysis method consisted in calculating the area (mm2) occupied on the graph paper by each prey category that number and weight are very difficult to define, so that to approach relative abundance. According to Lima-junior *et al*. (2001), this area is proportional to the volume that the category of prey occupies in the stomach contents.

***Data Analysis***

***Prey occurrence***

The frequency of occurrence, the volumetric analysis index and food items importance index were assessed following the procedure of Lima-Junior & Goitein (2001).

The frequency of occurrence, expressed as a percentage, is the number of times that a food item occurs in the stomachs analyzed, divided by the total number of stomachs analyzed containing prey:

$$\text{Occurrence Frequency of prey } i\ (\%) = 100 \times \frac{\sum \text{Stomachs with prey } i}{\sum \text{Stomachs with prey}}$$

***Prey Preponderance index***

The Volumetric Analysis Index indicates the relative abundance of a particular item found in the stomach samples. Its calculation is based on points ascribed to distinct food items after a simple visual inspection of the stomach's food contents.

This procedure should be executed by a constant reference called Standard Weight (SW). The SW is the arithmetic mean of weights of stomach contents of specimens of a representative sample. Four (04) points have been ascribed to the SW. Then, points have been ascribed to each stomach content (using integers) according to its proportional weight in relation to the SW. For instance, if the weight of gut content is 0.5SW, 2 points will be ascribed to this stomach content. Points obtained for each gut content were then distributed among the items in this stomach, in proportion to the volume each item occupies in the stomach. The points ascribed to each food item found in the sample of stomachs were used to calculate the Volumetric Analysis Index according to the following formula:

$$Vi = 25 \times \frac{\sum i}{\text{n}}$$

where:

$V_i$: Volumetric Analysis Index of the food item *i* in the sample i; ∑i: Sum of the ascribed points for the food item; *n*: total number of stomachs with food in the sample.

The Items Importance or Preponderance Index indicates the relative importance a determined food category (item) plays in the fish's diet. It has been obtained separately for each food item by using the following formula:

$$\text{IPi} = Fi \times Vi$$

where:

IPi: Importance Index of the food item *i* in the sample; Fi: Occurrence Frequency of the item; Vi: Volumetric Analysis Index of the item.

The IP calculated for each item, has been expressed in percentage as for IRI (index of relative importance) in order to make comparisons among samples. Thus, IP has been calculated as follows:

$$\%\text{IPi} = 100 \times \frac{IPi}{\sum_{i=1}^{n} IPi}$$

## Feeding strategy

The Costello graphical method (Costello, 1990), modified by Amundsen *et al*. (1996) was employed to look for general trends in feeding behavior and feeding strategy of *Brienomyrus brachyistius* in the studied hydrosystems (Fig. 2).

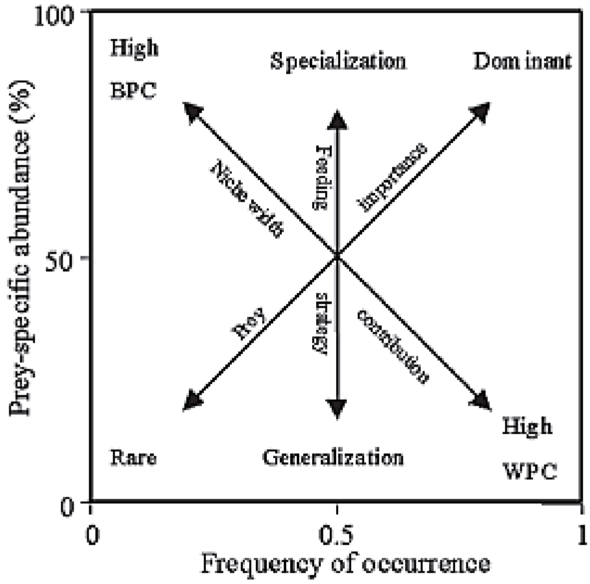


Fig. 2: Modified Costello graph showing explanatory axes (modified from Amundsen *et al*., 1996) and its interpretation to indicate feeding strategy. (BPC = between-phenotype component; WPC = within-phenotype component).

## RESULTS

### *Diet composition*

Diet composition of *Brienomyrus brachyistius* in Kogon and Tinguilinta rivers are indicated in Table 1. In both rivers, qualitative analysis of stomach contents enabled to distinguish 4 main prey types namely insect larvae, insect debris, seeds and sand.

Table1: Preponderance index (%PI) of prey found in stomach contents of *Brienomyrus brachyistius* from Kogon and Tinguilinta rivers in Guinea republic.

| Prey items | Kogon (%PI) | Tinguilinta (%PI) |
|---|---|---|
| **Insects** | | |
| Coleoptera larvae | 13.86 | 15.27 |
| Trichoptera larvae | 64.06 | 74.25 |
| Ephemeroptera larvae | 2.79 | 1.6 |
| Diptera larvae | 0.011 | 0.012 |
| Odonata larvae | 0 | 0.062 |
| Insects debris | 19.02 | 8.48 |
| **Seeds** | 0.23 | 0.052 |
| **Sand** | 0.02 | 0.27 |

Larvae items belonged to 5 orders namely Coleoptera, Trichoptera, Ephemeroptera, Diptera and Odonata. According to the preponderance index (PI), in both of the studied rivers the preys classified as main food were Trichoptera larvae (PI = 64.06% in Kogon and PI = 74.52% in Tinguilinta). Coleoptera larvae (PI = 13.86%)

and insect debris (PI = 19.02%) were secondary preys. The remaining preys namely Ephemeroptera larvae (PI = 2.79% at Kogon and PI = 1.6% at Tinguilinta), Diptera larvae (PI = 0.011% at Kogon and PI= 0.012% at Tinguilinta) and the seeds (PI = 0.23% at Kogon and PI = 0.052% at Tinguilinta) were accessory. Sand (PI = 0.02%) was only found in the stomachs of specimens from Kogon . Odonate larvae (PI = 0.062%) were only present in individuals caught in the Tinguilinta river.

***Feeding strategies***

The food strategy of *Brienomyrus brachyistius* in each surveyed habitat was determined through the Costello diagram modified by Amundsen (Fig. 3). In Kogon river (Fig. 3A), the most dominant items in the diet of this species, were Trichoptera larvae, followed by Coleoptera larvae, insect debris and Ephemeroptera larvae. In this river, the food strategy is generalist with a high intake of reduced amount of Trichoptera by a few individuals. Items such as seeds and sand are rare or occasionally consumed by some individuals. In Tinguilinta river (Fig. 3B), the most dominant prey in the diet of *Brienomyrus brachyistius* are Trichoptera larvae, followe d by Coleoptera larvae, insect debris and Ephemeroptera larvae.

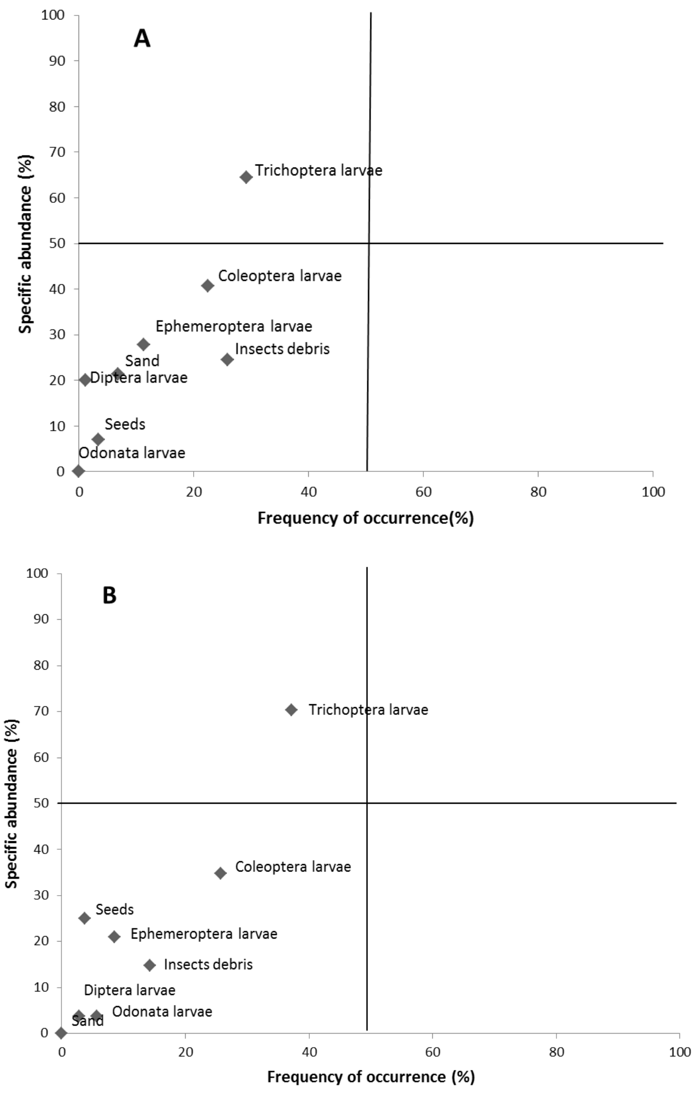


Fig. 3: Costello diagrams (Amundsen *et al.*, 1996) showing *Brienomyrus brachyistius* feeding strategies in Kogon (A) and Tinguilinta (B) rivers (Guinea republic).

The dietary strategy is generalist with a high intake of reduced amounts of Trichoptera by a few individuals. Seeds, larvae of Odonate and Diptera are occasionally consumed by a few individuals.

***Ontogenetic variation in diet***

Figure 4 shows the proportions of prey consumed by size class. In Kogon river (Fig. 4 A), the size of *Brienomyrus brachyistius* specimens analyzed varied between 35 mm and 115 mm SL. Trichoptera and Coleoptera larvae were widely consumed in all size classes. Insects debris were also met either in smaller fish or in bigger ones stomach contents. Seeds and sand were only observed in bigger specimens' stomachs with size greater than 85 mm SL. Ephemeroptera larvae were more abundant in younger fish stomach.

In Tinguilinta river (Fig. 4B), size of analyzed specimens ranged between 35 mm and 85 mm SL. In this river, Coleoptera and Trichoptera larvae and sand were eaten by fish of almost all size classes. Contrarily to Kogon specimens, odonata larvae were met in stomach contents of individuals from Tinguilinta with size evolving between 55 mm SL and 75 mm SL.

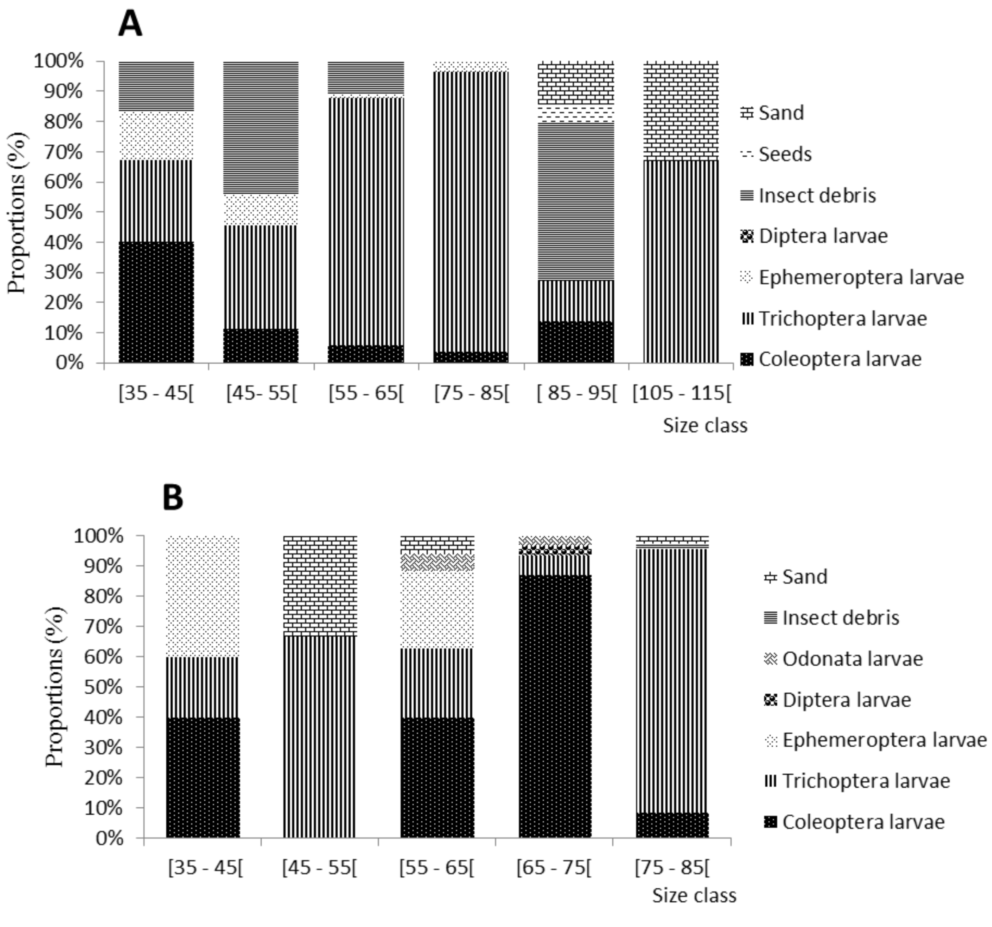


Fig. 4: Changes in diet components according to the size classes of *Brienomyrus brachyistius* from Kogon (A) and Tinguilinta (B) rivers in Guinea republic.

In both the studied rivers, there was not a clear shift in stomach contents components according to size classes of *Brienomyrus brachyistius.*

## DISCUSSION

The general profile of the diet of *Brienomyrus brachyistius* in the studied rivers showedthis species is mainly insectivorous. The qualitative examination of this diet revealed that 5 of the 8 feed inventoried in the stomach contents are insects larvae belonging to Odonata, Diptera, Ephemeroptera, Trichoptera and Coleoptera orders. Insects debris were also met in most of the stomach contents. The Trichoptera larvae were the most ingested by the specimens in both the rivers. These results are in accordance with those reported by Teugels *et al*. (1992) on mormyrid fish' diet. Indeed, he found high occurrence of benthic invertebrates and such common inclusions as zooplankton, terrestrial invertebrates, plant materials, mud and sand in the diet of *B. brachyistius*, *G. petersii*, *Isichthys henri* and *Petrocephalus ansorgi.*

This observation is also confirmed in the present study where apart from insects larvae, seeds and sand materials were found most of the time in *Brienomyrus brachyistius* individuals stomach contents. Nwani *et al*. (2006) reached similar results on *Campylomormyrus tamandua* in Anambra river where this mormyrid fish fed mostly on benthic and allochthonous invertebrates. Moreover, according to Irnevbore and Bakare (1970), the mormyrids are bottom feeding insectivores mainly on Chironomid larvae and they include the same groups of prey organisms in their diet. King (1989) also noticed the high preponderance of chironomid larvae in the diet of *Brienomyrus brachyistius* in a Nigerian rainforest stream. It is well known that the majority of predatory fish feed on the immature stages of prey stocks, especially the egg-laying periods where preys are more available (Popova, 1978).

The size related diet study of *Brienomyrus brachyistius* did not show a clear difference in feeding patterns among fish of different size. It seems that both immature and mature fish feed mainly on the larval stages of aquatic insects. This result is similar to that of Ikomi (1996) who found no distinct qualitative variations in the feeding habits in relation to size of *Brienomyrus longianalis* in the upper Warri River. Dietary variation in a given species may be related among other to the level of development or differentiation of the digestive system (Legendre, 1992) and the habitat exploited (Lowe-McConnell, 1975). The similarity noticed among diet of different size specimens and perhaps different maturity stage in the present study could be due to the fact that they are caught in the same habitats, the formation (or differentiation) of the digestive system of individuals from all size encountered is already completed, hence they have similar abilities to exploit the same resources (Koné, 2007).

Regarding the feeding strategy, results revealed that most individuals of *B. brachyistius* apply a generalist strategy on larvae of Diptera, Coleoptera and Ephemeroptera, insect debris and seeds. However, most of these specimens preferentially feed on Trichoptera larvae. The Trichoptera larvae are essentially aquatic and are present under stones or among the dead plants of streams (Faessel, 1985). The generalist strategy, adopted by the studied species in both the studied rivers, limits competition on available food resources between individuals of the same species (Lamesa *et al.,* 2008; Boussou, 2013).

In conclusion the present study has provided information on *B. brachyistius* 's dietary habits in a relatively well-preserved environment. These results could help to predict its capacity of resilience face to a drastic anthropization of its environment

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