Introduction

Mormyridae are one of the largest fish groups of the Masendula stream. Although many publications and other works have been focused on their systematics [1,2], there are few works on their reproduction and diet [3,4]. The study of the diet by stomach content analysis allows to solve primarily the issue of food resources in a qualitative and quantitative way, understand if in natural environments, the diverse species of the same group have an individualized diet or not and compare food relations existing between the species studied. This involves the concept of ecological niche as well as food specialization of Stomathorinus cf polli (Figure 1).

Figure 1: Stomathorinus cf polli.
Analysis methods of stomach contents and sexual maturity

The occurrence method was used in order to count the number of stomachs in which a prey or a prey category is present. If \( n \) is the number of stomachs containing a prey category and \( N \) is the total number of examined stomachs. The results are expressed as a percentage of total number of inventoried stomachs. \( \% \text{Occ} = \frac{n \times 100}{N} \) [7-11].

This method gives a good idea of food preferences for the fish, but does not provide the indication on the quantitative importance of ingested prey.

To determine the food preferences for this abundant species, the classification of Chikou et al. [12] and Lausane [7], have been adopted:
- Preferred prey: \( \% \text{Occurrence} > 50\% \).
- Secondary prey: \( 10 \leq \% \text{Occurrence} \leq 50\% \).
- Accidental prey: \( \% \text{Occurrence} \leq 10\% \).

Relative length of intestine, relative weight of stomach and condition factor K were determined according to the methods described by Biswas [13].

Maturity stages and fecundity were estimated according to Philipart [14].

Data analysis

Statistical analyses were performed using Microsoft Excel 2010. The correlation coefficients between weight of fish (g) and fish size (cm), and gonad weight (g), weight of fish and absolute fecundity and finally absolute fecundity and size of fish were calculated.

The similarity index was used in order to compare the diet depending on the size classes on the basis presence / absence of prey [15]. The similarities of diet between the size classes within this species were identified through the hierarchical ascending classification analysis “cluster analysis”. Biodiv. MVSP (Multi Variate Statistical Package) software was used to calculate this similarity.

Results

A total of 260 specimens of Mormyridae were sampled belonging to three species including Stomatorhinus cf polli with 151 individuals (or 58%), Pollumirus cf fasciolatus with 79 specimens (or 30%) and Gnathonemus petersii with 30 individuals (or 12%).

Relative abundance of mormyridae according to seasonal periods

Legend: PRP1 = rainy season 1 (March to May), PRS1 = relatively dry season 1(June to August), PRP2 = rainy season 2 (September to November), PRS2 = relatively dry season 2 ((December to February).

Figure 3 shows that the relative abundance of Mormyridae was highest during the rainy season 1 with 60% of individuals.

Abundance distribution of species by seasonal periods

Figure 4 shows that the capture was important during rainy
season 1 for *Pollumyrus cf fasciolatus* with 74 individuals followed by *Stomathorinus cf polli* with 62 individuals. Other seasonal periods (PRS1, PRP2 and PRS2), the catches have been important to *Stomathorinus cf polli* with 53, 15 and 21 specimens respectively.

Size structure of *Stomathorinus cf polli*

151 specimens of *Stomathorinus cf polli* with standard length that varies from 0.5 to 6.1 cm were included into 8 classes with the interval of 0.7 cm.

Figure 5 shows that the class 3 is the most abundant with 41.05% followed by class 4 with 21.19% while the lowest is the class 8 with 1.32%.

Weight structure

151 individuals of *Stomathorinus cf polli* with the weight of body varies from 0.1 to 4.9 g were included into 8 classes with the interval 0.6 g.

Figure 6 shows that class 1 is the highest with 70.19% followed by class 2 with 17.88%.

Relationship between the size and weight of *Stomathorinus cf polli*

Figure 7 summarizes the relationship between the size and weight of specimens of *Stomathorinus cf polli*. The growth is allometric ($b = 0.3747$) with predominance by weight which the correlation with size is significant ($r^2 = 0.7626$).
There exists significant linear functional relationship between length of intestine and standard length of *Stomatorhinus cf polli* as shown in the Figure 8. The correlation between length of intestine and standard length is slightly significant ($r^2 = 0.2693$ and $r = 0.5189$). The growth of intestine is depending on length of fish.

Overall quality diet of *Stomatorhinus cf polli*

Table 1 shows the categories of prey consumed by *Stomatorhinus cf polli*, their coefficient of occurrence and their coefficient of emptiness for the set of analysed stomachs.

By analysing the overall composition of food and calculated occurrences, we find that the food preference of *Stomatorhinus cf polli* is mainly from animal origin. The animal detritus was highest consumed with 79.09% followed by vegetable detritus with 50% and Chironomidae with 34.54%.

Figure 9 shows that the individuals of different classes of size feed on the same prey but in different proportions. Note that the occurrence of plant detritus seems to increase with fish size.

**Euclidean similarity index and morista distance of diet according to size classes**

Figure 10 and Table 2 indicate the information on the degree of similarity of diet between the size classes of *Stomatorhinus cf polli*.

**Table 1:** Prey categories, frequency (n), percentage of occurrence (% Occ) and rate of vacancy (CV) of *Stomatorhinus cf polli* caught in the Masendula River.

| Prey category       | Frequency (n) | % occ. |
|---------------------|--------------|--------|
| Animal detritus     | 87           | 79.09  |
| Chironomidae        | 38           | 34.54  |
| NI                  | 1            | 0.9    |
| Plant detritus      | 55           | 50     |
| Other               |              |        |
| Pebbles             | 7            | 6.36   |
| Sand                | 9            | 8.18   |
| Rate of vacuity     |              |        |
| NES = 41, RV = 37.27 % |  |

Occ = occurrence, NI= unidentified, NES = number of empty stomachs, RV = rate of vacuity.

**Table 2:** Percentage of similarity index.

| Node | Group 1 | Group 2 | Simil. | Group |
|------|---------|---------|--------|-------|
| 1    | C16     | C17     | 93.75  | 2     |
| 2    | C12     | Node 1  | 81.579 | 3     |
| 3    | C14     | C15     | 76.404 | 2     |
| 4    | C13     | Node 3  | 65.142 | 3     |
| 5    | C11     | Node 2  | 50.649 | 4     |
| 6    | Node 5  | Node 4  | 43.063 | 7     |
| 7    | Node 6  | C18     | 19.376 | 8     |

Figure 11: Change in the main food according to seasonal periods.

Figure 12: Distribution of prey categories depending on size classes during rainy season.

Figure 13: Distribution of prey categories depending on size classes during relatively dry season.
diet of *Stomatorhinus cf polli* allowed to note similarities among the different size classes;
- Class 6 shows more similarity with class 7 (or 93.75%). However the class 2 indicates more affinity with classes 6 and 7 (Node 1) of 81.58%;
- Class 4 shows more similarity with class 5 (or 76.4%) while class 3 reports more affinity with the classes 4 and 5 (Node 3) of 65.14%.

**Diet quality according to the seasonal periods**

Figure 11 contains the values of occurrence index of food ingested by *Stomatorhinus cf polli* during seasonal periods.

Figure 11 shows that the animal detritus is essential prey in the diet of *Stomatorhinus cf polli* with higher percentage of occurrence. The highest rate of vacuity is observed in the rainy season 1 followed by seasonal periods relatively dry 1 and 2.

**Diet quality according to size classes for the rainy season**

The values of intraspecific change in the diet of *Stomatorhinus cf polli* are reflected in the Figure 12.

Figure 12 shows that the animal detritus is abundant prey for all sizes, followed by the plant detritus and chironomidae.

**Diet quality according to the size for relatively dry season**

The values of intraspecific change in the diet of *Stomatorhinus cf polli* are reflected in the Figure 13.

Figure 13 shows clearly that animal detritus is abundant prey for all sizes, followed by pant detrituse and chironomid.

**Influence of seasons on the relative weight of stomachs and condition coefficient**

Table 3 shows that the average relative weights of stomachs (0.1157g) and condition factor K (0.3564) during the relatively dry season 1 are higher than those of other periods (PRP1, PRP2 and PRS2).

**Reproduction**

The results on mean absolute fecundity of *Stomatorhinus cf polli* are shown in the Table 4.

Table 4 shows that the high estimated relative fecundity is reported during the rainy season 2 with a minimum and maximum varying from 11,250 to 39,000 oocytes per kg with an average of 25,125 oocytes per kg, followed by the rainy season 1 with a minimum and maximum oscillating from 26,090 to 33,530 oocytes per kg with an average of 30,220 oocytes.

**Ecology of *Stomatorhinus cf polli***

According to the field observations relating to the micro-habitat of this species, we report that:
- It lives on benthic.
- It is more caught near bank in hollow place.
- It prefers water relatively quiet, heavily shaded dominated by aquatic vegetation (*Bambusa vulgaris*) and its relatively slow.

**Discussion**

**Systematic inventory of mormyridae**

At total of 260 specimens of Mormyridae were collected belonging to three genera and three species which *Stomatorhinus cf polli* is the most abundant with 58%. The method used for fishing is complementary but nevertheless insufficient in the assessment of diversity.

Teugels & Guégan [16], mentioned that the family of Mormyridae is abundant in specific diversity. Indeed, we found that fishing net combined with the amplifier seems more appropriate to give very good results for fishing in stream. It would be complemented by other methods such as fishing to gillnets, creels, etc.

The findings show that the capture was highest during the rainy season 1 (Figure 2). That could be due to this seasonal period coincides with the reproduction of the most species of central basin. The dominance of *Stomatorhinus cf polli* on other species could be explained by the fact that this species finds optimal conditions of life.
in this stream including low change of physicochemical factors such as dissolved oxygen and temperature [17]. Matthes [18], indicated that this species operates the forest streams such as middle and small rivers and streams.

**Size and weight of Stomatorhinus cf polli**

Note that a difference to left of size and weight classes most represented while we thought to normal distribution. This could be explained by the low abundance of individuals [19], probably due to the collecting method low adapted for this species or the high exerted anthropogenic pressure on individuals with high size. White and Edwards [19], confirm that small sample will difficulty enable to the collecting method low adapted for this species or the high

The value of coefficient b between weight and size of individuals is 0.37 with a slightly significant regression coefficient ($r^2 = 0.2669$). This value shows that this species has an allometric growth against weight. Our results are similar to these found by Mahamba [19], in Yoko and Biaro forest streams (DRC) for Stomatorhinus corneti.

**Relationship intestine length-standard length of Stomatorhinus cf polli**

The findings show that the correlation value found between intestine length and standard length is significant ($r^2 = 0.76$).

Several authors established a positive relationship between intestine and nature of food that consumed by fish. It is a useful index which gives an idea of nature of food [13].

From our study, the average intestine coefficient calculated is 0.58.

Mahamba [20], reported an average intestine coefficient of 0.56 for Stomatorhinus cornet in Yoko and Biaro forest streams. Pigneur [21], worked on Marcusenius macrolepidotus angleonius, found an intestinal coefficient of 0.63 in Malebo stream (DRC). Mbimbi [22], indicated an average intestine coefficient of 0.54 for Marcusenius greshoffi in Kinshasa streams (DRC). Kouamélén [4] found at the Lake Ayamé Dam (Ivory Coast) for Marcusenius ussher and M. furcident an intestine coefficient of 0.62and 0.64 respectively.

**Diet**

Our results show that Stomatorhinus cf polli consume more animal detritus. The findings of Mahamba [20], on Stomatorhinus corneti collected in Yoko and Biaro forest streams showed this species consumed more insects and crustaceans. Pingeur [21] and Mbimbi [22], found that genus Marcusenius consumed more animal and plant detritus in Malebo stream.

Our findings reported that there is no significant change depending on size and prey not consumed in similar proportions in all size classes. That would explain the influence of size on diet could be caused by size of prey to ingest proportionally to the size and the age of fish and could also be due to the seasonal periods. Animal detritus are preferred prey of this species during all seasonal periods and plant detritus remain secondary prey during all periods.

In the study of Traoré et al. [23], on feeding behavior depending on the size of fish, revealed that larvae of chironomidae are preferential prey of fish populations regardless of their size.

**Reproduction**

Fecundity can be defined as the most common measure of reproductive potential in fishes, because it is relatively easy to measure [24].

The minimum and maximum estimated fecundity of Stomatorhinus cf polli varied 11,250 to 39,000 oocytes per kg with an average of 25,125 oocytes per kg. Kirschbaum [25], mentioned that several species of Mormyridae breed according to the raising of water level with lower conductivity.

**Conclusion**

This investigation was conducted at Masendula stream during one year. It was mainly focused on the ecology and biology of Stomatorhinus cf polli. 260 specimens of Mormyridae were collected by using a circular dip scoop net. The findings showed that Stomatorhinus cf polli was the highest captured during the sampling with 58%. The mean intestinal coefficient calculated is 0.58. It was observed Stomatorhinus cf polli preferred more the animal detritus during all seasonal periods although other prey categories were identified into its stomach contents such as plant detritus, chironomidae, pebbles and sand. The results also show that Stomatorhinus cf polli breeds throughout the year. The results indicated that the estimated fecundity of Stomatorhinus cf polli varied 11,250 to 39,000 oocytes per kg with an average of 25,125 oocytes per kg. Stomatorhinus cf polli prefers water relatively quiet, heavily shaded dominated by Bambusa vulgaris.

The size of first maturity as well as diameter of oocytes should be also studied in order to complete the biological characteristics of this species.

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