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Trophic regime of the giant freshwater shrimp *Macrobrachium vollenhoveni* (Herklots, 1857) in the lower Oueme valley in Southern Benin

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Abstract
The diets of *Macrobrachium vollenhoveni* are not well known in Benin. This study aims to inventory these diets based on stomach contents. Indeed, measurements of physico-chemical parameters of the habitats, the measurement of morpho-metric lengths and the observation of the stomach contents of shrimps were carried out. Results revealed that pH varied between 6.7- 7.86, oxygen between 4-7 mg/l, temperature between 27.5°-29.1 °C, salinity between 2-5‰, depth between 0.83-3.82 cm, transparency between18-30 cm, conductivity between 64-69 µS/cm and total dissolved solubles between 33-36 mg/l. From the 27 feed regimes counted, animal (51%) and plant (36%) debris were majority. Clustering of individuals according to station and size class did not influence the variation in diets. The $\chi 2$ and Spearman correlation test showed that the proportions of preferred feeds varied significantly ($p < 0.05$). This study showed that *M. vollenhoveni* is an omnivorous detritivore whose diet in captivity would be less demanding.

Keywords: Diet, *Macrobrachium vollenhoveni*, valley, south-Benin

1. Introduction
Fishery resources, in their great diversity, contribute significantly to food security in Africa, in particular for populations with critical poverty levels (FAO, 2018) [9]. It Is essential to diversify the production of these resources to meet consumé expectations. In Benin, agricultural diversification remains a priority according to the Strategic Plan for Agricultural Sector Development (PSDSA, 2016) [29]. Among the exploited fishery resources in Benin, freshwater shrimp were very important due to their great diversity and abundance in the catches (Kouton, 2004; Agadjihouède *et al*. 2009) [20, 1]. Within this diversity, *Macrobrachium vollenhoveni* is the most exploited with a relative abundance of 44.75% in the catches (Agadjihouèdé *et al*. 2009) [1]. It is heavily exploited in the valleys of the Ouémé and Mono rivers by local populations for its commercial value (Gangbé, 2011) [10] and its large size (Goore-Bi, 1998) [15].
The high exploitation of shrimps wtith acceleration of the degradation process of aquatic ecosystems constitute a risk of disappearance of this biological resource (Gangbé *et al*. 2016) [11]. In Benin, all shrimp production comes exclusively from harvesting, whereas *Macrobrachium vollenhoveni* is an excellent candidate for aquaculture in Benin due to its size and high fecundity potential (Gangbé *et al*. 2019) [12]. Consequently, to meet the recommendations of the Strategic Plan for the Recovery of the Agricultural Sector in Benin, it is necessary to undertake in captivity the breeding of freshwater *Macrobrachium vollenhoveni* in order to contribute not only to a strengthening of the diversification of aquaculture protein resources but also and in particular to ensure the protection of these resources sufficiently exploited by fisheries. To achieve this goal, it is necessary to understand the trophic regime of shrimp species in its living environment.

2. Materials and Methods
2.1 Study Environment : The study area was the lower Ouémé valley located between 8°15' and 6°33' North latitude and between 2°00' and 1°50' East longitude. Three stations were selected for sampling (AgonlinLowé; Lowé and Gogbo) based on criteria such as: accessibility, the importance of.

fishing activities for freshwater shrimp of the genus Macrobrachium and the cooperation capacity of fishermen (Gangbé, 2011; Chikou, 2006) [10, 5]. The hydrological regime was directly influenced by the climate of the Central and Northern region. It was characterized by a single low water period that generally lasts seven months (December to June), and by a single flood period of five months, three of which were full flood (August to October) (Akélé, 2002) [2]. According to Lalèyè *et al*, (2004) [21], flooding in the delta occurs from late August to October, but could occur as early as July and ended in early November. Water levels and flows varried considerably in any given year.

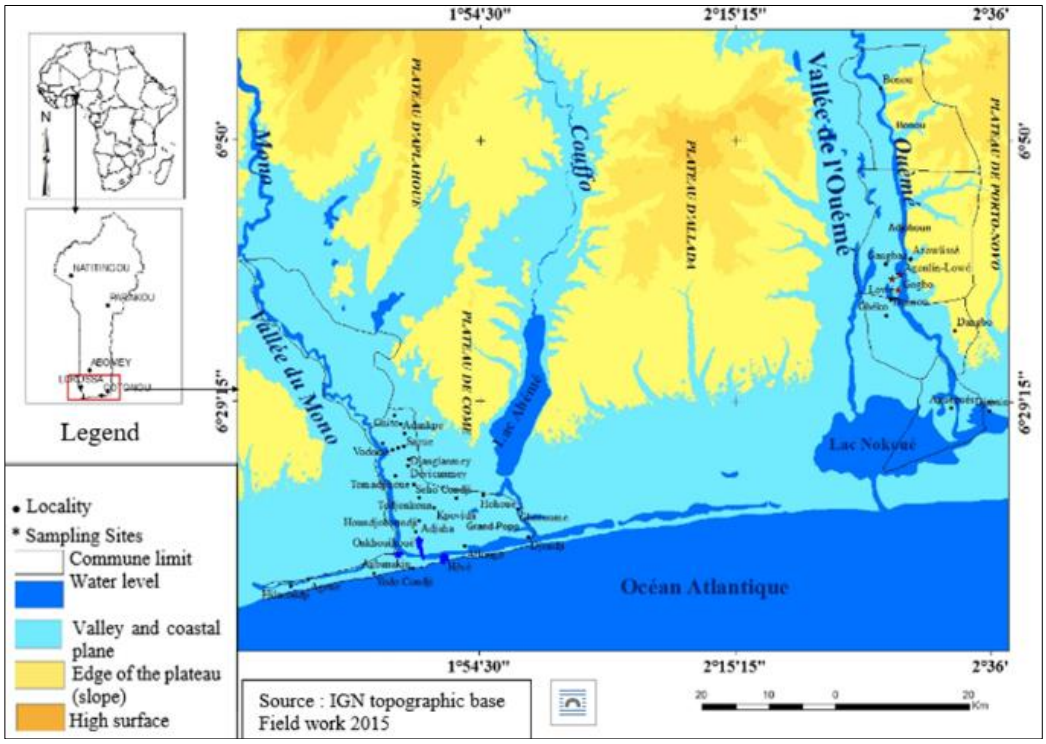

Fig 1: Map of the Ouémé Valley showing the sampling stations

2.2 Sampling

In each station, a sample of forty (40) specimens of M. *vollenhoveni* of all sizes was collected each month and for six (06) months (from June 2016 to November 2016) by means of creels, local fishing gears most commonly used at the different stations (Gnonleba *et al*., 2011) [13]. Concomitantly with the field sampling, the physico-chemical parameters of the water (pH, dissolved oxygen, temperature, salinity, transparency, depth, conductivity, TDS) were measured. The sampled shrimp were immediately kept cool at 4°C to stop the digestion process and then transported to the laboratory for various measurements and analysis.

2.3 Data collection in the laboratory

In the laboratory, the shrimp were re-examined to ensure their identification using the identification key of Monod (1966) [25]. The individuals on which doubt remains were eliminated. This exercise was followed by sorting of males and females according to the characteristics highlighted by Bilé *et al*. (2011) [4]. The total length and standard length were measured with a caliper. Shrimp were also weighed using an electronic scale with a 500 g capacity and 0.01 accuracy (Lutron GM-300P). Gonads were collected, weighed, and maturity stage was determined according to the scale used by Revathi (2012) [30] and Olele (2012) [27]. Shrimp were dissected and stomachs were collected. After sampling, a total of points (0; 2; 5; 10; 15; 20) was assigned to each stomach according to its filling level (empty, almost empty, 1/4, 1/2, 2/3, completely filled) and according to the individual size. Then the stomach contents were weighed, collected and diluted en 5% formalin and kept in a pillbox under a volume of 10 ml. After incision and collection of stomach contents, the empty stomach was weighed. The stomach contents of each specimen were also observed under a light microscope (NIKON ECLIPSE E 100) in small volumes (1 ml). When the density of the items was too high, a new dilution was made (x10, x20 etc.) in order to facilitate the identification and the enumeration of the prey. The different feed taxa were identified and counted when their state of digestion using the identification keys of Durand & Levêque (1981) [6]; Gominan & Hecq (2000) [14]; Ouattara (2000) [28]; Dussard (1967) [7]; Dussart (1980) [8]. The data obtained on the different taxon-feeds as well as those obtained on the different measurements carried out were used to perform various analyses.

2.4 Diet Determination and Data Analysis

The method used to determine diet was based on the search of stomach contents. With this method, identification of the contents was more satisfactory when digestion was less advanced. The method of determination was based on so-called point methods of Swynnerton & Worthington (1940) cited by Hynes (1950) [17]. Thus, in order to determine the specific composition of the diet, the prey was grouped into large taxonomic units and indices were calculated, namely:

- Vacuity Coefficient
- Occurrence Index
- Volumetric Index based on score (Hynes, 1950) [17];
- Index of Preponderance (Nataranjan & Jhingran, 1961) [26] to determine the contribution of each feed in the diet;

- Categorization (Rosecchi & Nouaze, 1987) [31] of prey into preferred, secondary, and accessory feeds. Statistical analysis of the data was performed with Statistica Version 6 and Staview 1990 softwares.
From the recorded data on overall diet and data on body length and sex, classes of individuals were formed.
- Hierarchical ascending classification (PCA) was used to highlight trophic similarities between classes according to size and sex;
- Spearman's rank correlation coefficient statistical test was performed to compare diets by size and sex classes;
- The $\chi 2$ test on the proportions of the Index of Preponderance of major feeds in each size and gender class group was performed to detect significant differences (p-value = 0.05).

3. Results

3.1 Physical and chemical characteristics of the sampling stations

The first information that best informs the influence of the shrimp environment are pH, oxygen, temperature, salinity, depth, transparency, conductivity and TDS (Table 1)

Table 1: Physical and chemical parameters of the sampling stations

	Lowe		Agonlin-lowe		Gogo	
	Menas	**min- max**	**Means**	**min- max**	**Menas**	**min- max**
pH	7.16±0.36	6.7-7.5	7.6±0.08	7.5-7.7	7.62±0.2	7.38-7.86
Oxygène (mg/l)	5.61±1	4.7-7.0	5.88±2.25	4 - 9.1	4.44±0.05	4.4-4.5
Temperature (°C)	28.2±0.41	27.9-28.8	28.01±0.73	27.6-29.1	26.64±0.13	27.5-27.8
Salinité(%)	4.33±1.16	3.0-5.0	3.33±1.16	2.0 - 4.0	3±0	3.0-3.0
Depth (cm)	2.04±1.19	1.4-3.82	1.16±0.12	1-1.27	1.56±0.60	0.83 - 2.3
Transparency (cm)	21.88±3.88	18-27	20.75±1.5	20-23	24.38±4.5	19 - 30
Conductivity (µS/cm)	66.66±0.58	66 - 67	65.75±0.60	64 - 66	66.34±0.59	66 - 69
TDS (mg/l)	33.67±0.58	33 - 34	34.65±0.48	33 - 35	33.87±0.5	33 - 36
State of Bank	vegetation		vegetation		vegetation	

TDS = total dissolved soluble, min = minimum, max = maximum

Overall, the pH varies between 6 and 7 with 7.86 as maximum value. Dissolved oxygen had an average value varying between 4.44±0.05 mg/l and 5.88±2.25 mg/l, it remains superior or equal to 4 mg/l during the study period. At all stations, the temperature varied between 26 and 28°C without crossing the maximum of 29°C. Salinity remained in the range of 3-4‰ while the minimum depth was 1 m with 3.82 m as maximum value. Transparency varied between 20 and 24 cm on average. Conductivity was between 65 and 66 µS/cm and TDS varied between 33-34 mg/l. The analysis of variance performed two by two for the stations showed that there was no significant difference between the average values obtained at the stations ($p>0.05$).

3.2 General diet profile of *Macrobrachium vollenhoveni*

The diet presented 37 feed resources (Table 2, Figure 2) essentially made up of animal debris (51%), plant debris (36%), Cyanophytes (8%), Diatoms (3%) and Chlorophytes (2%), the remainder being made up of Bryopsidophytes, Euglenophytes, Copepods and insect larvae which had a very negligible proportion. A distribution of feed types (Figure 3) according to the sampling months showed that whatever the type of feed considered, the months of June and September correspond to the high rates of feed ingestion. Similarly, when considering the feed categories, the feed intake rate for animal debris, plant debris, cyanophytes and diatoms were relatively higher than that for the other feed types.

Table 2: Types and species of feed found in stomach contents

Feed types		Feed species
Phytoplankton	Cyanophytes	*Microcoleuss lacustris*
		Microchaete tenera
		Oscillatoria sp
		Chrococcus turgidus
		Nostoc spa
		Synechocystis aquatilis
		Spirulina sp
		Microcystis robusta
		Lyngbya martensiana
	Diatoms	Diploneis sp
		Gyrosigma sp
		Gomphonema parvularum
		Melosira granulata
		Eunotia bilunaris
		Fragilaria sp
		Cyclotella sp
		Surirelle robusta
		Coscinodiscus rudolfii
		Navicula cuspidata
		Navicula criptocephala
		Niztchia sp
		Amphora sp

	Bryopsidophytes	*Cladophora holsatica*
	Chlorophytes	*Volvox aureus*
		Closterium aciculare
		Cosmarium granatum
		Staurastrum setegerum
		Closterium pavularum
		Stigeoclonium aestivale
		Pleodorina sphaera
		Audouinella violacea
	Euglenophytes	*Phacus longicauda*
		Euglena viridis
Zooplanktons	Copepods	Copepods
	Insect larvae	Insect larvae
Other feed	Animals debris	Undetermined
	Plants debris	Undetermined

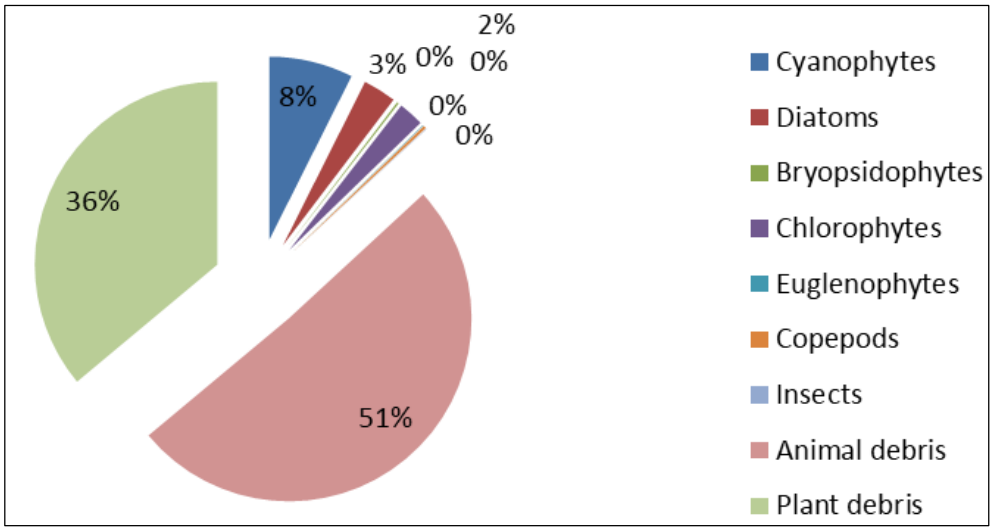

Fig 2: Proportion of feed types encountered in the stomach

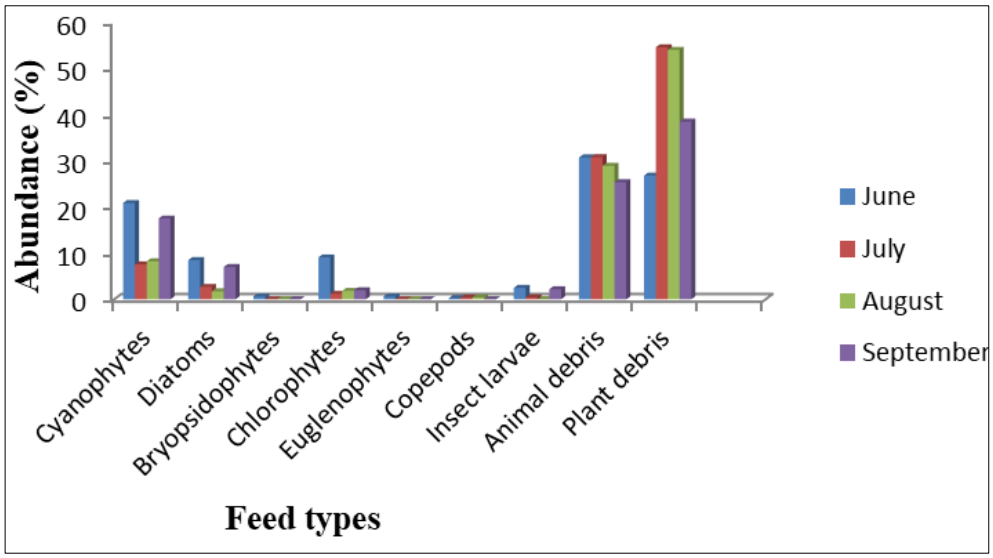

Fig 3: Monthly distribution of feed types encountered in the stomach

3.3 Categorization of the diet

For all three stations, a total of 320 *M. vollenhoveni* stomachs were examined of which 280 stomachs had content and 40 stomachs were empty (Table 3). The percentage of emptiness was 12.5%. According to the Preponderance Index (PI) percentages and cumulative frequencies (CF), animal and plant debris (54.75% and 32.42%, respectively) were classified as preferential foods, followed by *Microcoleus lacustris* (11.18%) and Stigeoclonium aestivale (0.46%) which were classified as secondary foods and the remainder among accessory foods.

Table 3: Global dite profile of shimpa

Feed	Global (n = 280) % PI	CF	Feed categories
ANIMALS DEBRIS	54.75	54.75	Preferred
PLANTS DEBRIS	32.42	87.17	preferred
Microcoleus lacustris	11.18	98.35	Secondary
Stigeoclonium aestivale	0.46	98.81	Secondary
Lyngbya martensiana	0.20	99.01	Accessory
Eunotia bilunaris	0.15	99.16	Accessory
Insects larvae	0.14	99.30	Accessory
Pleodorina sphaera	0.13	99.43	Accessory
Oscillatoria sp	0.13	99.56	Accessory
Coscinodiscus rudolfii	0.10	99.66	Accessory
Surirelle robusta	0.06	99.73	Accessory
Navicula criptocephala	0.03	99.76	Accessory
Melosira granulata	0.03	99.78	Accessory
Synechocystis aquatilis	0.02	99.80	Accessory
Microcystis robusta	0.02	99.82	Accessory
Cyclotella sp	0.02	99.84	Accessory
Niztchia sp	0.02	99.86	Accessory
Diploneis sp	0.02	99.88	Accessory
Copepodes	0.01	99.89	Accessory
Gomphonema parvularum	0.01	99.90	Accessory
Gyrosigma sp	0.01	99.91	Accessory
Fragilaria sp	0.01	99.92	Accessory
Cladophora holsatica	0.01	99.93	Accessory
Volvox aureus	0.01	99.94	Accessory
Cosmarium granatum	0.01	99.94	Accessory
Navicula cuspidata	0.01	99.95	Accessory

PI = Preponderance Index; CF = Cumulative Frequency

3.4 Diet variation according to the shrimps size

The standard lengths of shrimp varied from 3.5 cm to 13 cm. According to Sturge's rule, they falled into eight (08) size classes (Table 4). The Hierarchical Ascending Classification (HAC) analysis based on Ward's Euclidean distance carried out from the standard lengths showed three groups (Figure 4). The group 1 was composed by individuals of wich the length was less than 7.5 cm. The group 2 gathered individuals that the length was between [7.5; 10.5[and the group 3 that individuals size was between 10.5 cm and 13 cm. The quantitative analysis of the diet according to the three (03) groups were respectively in tables 5, 6 and 7.

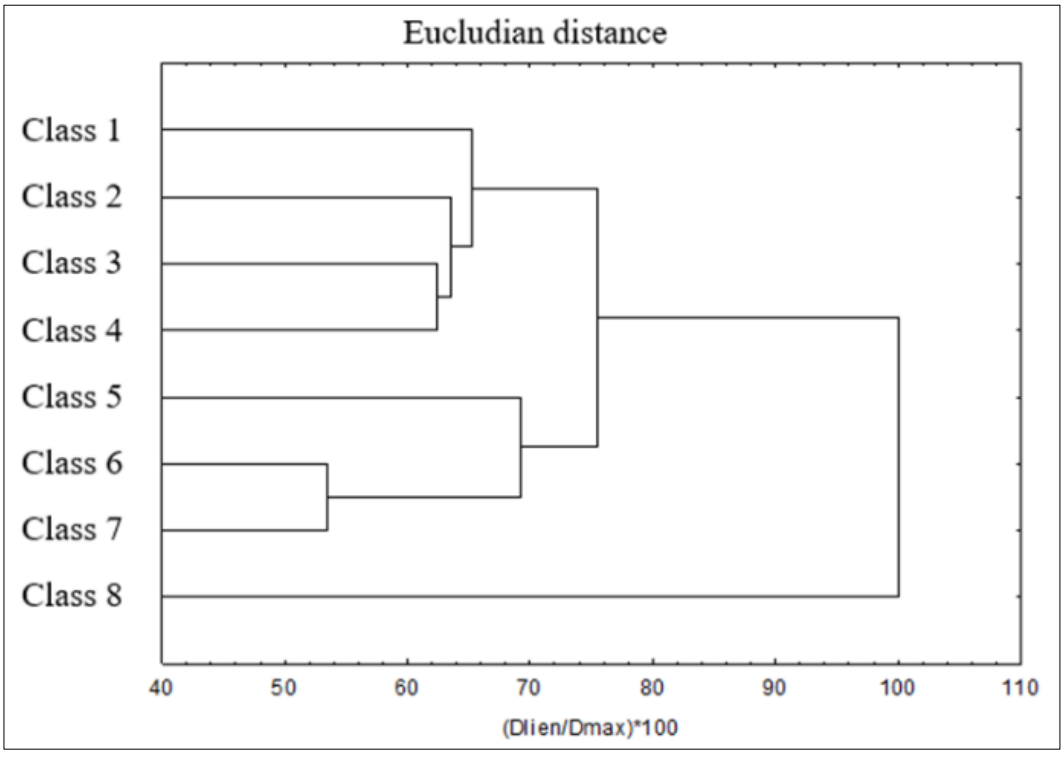

Fig 4: Hierarchical bottom-up clustering analysis

Table 4: Diffèrent classes of shimpa size

Group	Class	Size scope	Number
1	1	[3.5; 4.5]	30
	2	[4.5; 5.5]	80
	3	[5.5; 6.5]	70
	4	[6.5; 7.5]	56
2	5	[7.5; 8.5]	30
	6	[8.5; 9.5]	23
	7	[9.5; 10.5]	17
3	8	[10.5; 13]	17

Table 5: Diet profile of shrimp Group 1 (G1)

Feed	G1 (n=235)%PI	CF	Feed categories
PLANTS DEBRIS	52.49	52.49	Preferred
ANIMALS DEBRIS	32.98	85.47	Preferred
Microcoleus lacustris	12.10	97.57	Secondary
Stigeoclonium aestivale	0.82	98.39	Secondary
Lyngbya martensiana	0.31	98.69	Secondary
Eunotia bilunaris	0.25	98.95	Secondary
INSECTS LARVAE	0.18	99.13	Accessory
Oscillatoria sp	0.16	99.29	Accessory
Pleodorina sphaera	0.15	99.44	Accessory
Coscinodiscus rudolfii	0.13	99.57	Accessory
Surirelle robusta	0.08	99.65	Accessory
Melosira granulata	0.05	99.70	Accessory
Navicula criptocephala	0.04	99.74	Accessory
Synechocystis aquatilis	0.03	99.77	Accessory
Niztchia sp	0.03	99.80	Accessory
Microcystis robusta	0.02	99.82	Accessory
Gomphonema parvularum	0.02	99.84	Accessory
Gyrosigma sp	0.02	99.86	Accessory
Fragilaria sp	0.02	99.88	Accessory
Diploneis sp	0.02	99.90	Accessory
Cladophora holsatica	0.01	99.91	Accessory
Cyclotella sp	0.01	99.93	Accessory
Navicula cuspidata	0.01	99.94	Accessory
COPEPODS	0.01	99.95	Accessory
Euglena viridis	0.01	99.95	Accessory
Phacus longicauda	0.01	99.96	Accessory

PI = Preponderance Index; CF = Cumulative Frequency

Table 6: Diet profile of Group 2 shrimp (G2)

Feed	G2 (n = 68)% PI	CF (%)	Feed categories
PLANTS DEBRIS	61.91	61.91	Preferred
ANIMALS DEBRIS	30.31	92.22	Secondary
Microcoleus lacustris	7.18	99.41	Accessory
Coscinodiscus rudolfii	0.09	99.49	Accessory
Cyclotella sp	0.08	99.57	Accessory
Volvox aureus	0.08	99.66	Accessory
Pleodorina sphaera	0.08	99.74	Accessory
Oscillatoria sp	0.07	99.81	Accessory
COPEPODS	0.03	99.84	Accessory
Lyngbya martensiana	0.03	99.87	Accessory
Surirelle robusta	0.02	99.89	Accessory
Navicula criptocephala	0.02	99.91	Accessory
Stigeoclonium aestivale	0.02	99.93	Accessory
Microcystis robusta	0.02	99.95	Accessory
INSECTS LARVAE	0.01	99.96	Accessory
Synechocystis aquatilis	0.01	99.97	Accessory

PI = Preponderance Index; CF = Cumulative Frequency

Table 7: Diet profile of shrimp Group 3 (G3)

Feed	G3 (n = 17) % PI	CF (%)	Feed Categories
PLANTS DEBRIS	57, 7	57, 7	Preferred
ANIMALS DEBRIS	31, 1	88, 9	Secondary
Microcoleus lacustris	10, 7	99, 5	Accessory
INSECTS LARVAE	0, 2	99, 7	Accessory
Diploneis sp	0, 1	99, 8	Accessory
Cyclotella sp	0, 1	99, 8	Accessory
Surirelle robusta	0, 1	99, 9	Accessory
Pleodorina sphaera	0, 1	99, 9	Accessory

PI = Preponderance Index; CF = Cumulative Frequency

About the group 1 (G1) (size < 7.5 cm), 26 feed were identified. Groups 2 (G2) and 3 (G3) represented by medium (7.5 cm to 10.5 cm) and large (> 10.5 cm) individuals had 16 and 8 foods, respectively. The group 1 used animal and plant debris as preferred prey followed by *Microcoleus lacustris*, *Stigeoclonium aestivale*, *Lyngbya martensiana* and *Eunotia bilunaris* as secondary prey. About the groups 2 and 3, the preferential and secondary prey were animal and plant debris only. The Spearman rank correlation coefficient calculated from the preponderance index percentages of these three groups was significant (N = 40; rs = 0.99; p < 0.000). About all the three (03) groups, the χ 2 test indicated a significant difference between the proportions of preferred foods corresponding to groups 1 and 2 (χ2 = 104.11; p = 0.000), group 1 and 3 (χ2 = 75.11; p = 0.000), and groups 2 and 3 (χ2 = 79.71; p = 0.000).

3.5 Dietary variation by sex of individuals

Tables 8 and 9 showed the different types of feed corresponding to each category of individuals by sex. A total of 24 food types were identified for both males and females. For both sexes, the preferred food items were animal and plant debris followed by secondary food items consisting mainly of *Microcoleus lacustris* and *Stigeoclonium aestivale*. The Spearman rank correlation coefficient calculated from the percentages of preponderance index related to both sexes was significant (N = 36; rs = 0.47; p < 0.003). The χ2 test indicated a significant difference among the proportions of preferred foods corresponding to male and female sexes (χ2 = 396.04; p = 0.000).

Table 8: Dite profile of male shimpa

Feed	Male (n = 130) % PI	CF (%)	Feed categories
PLANTS DEBRIS	54.74	54.74	Preferred
ANIMALS DEBRIS	30.98	85.72	Preferred
Microcoleus lacustris	12.75	98.47	Secondary
Stigeoclonium aestivale	0.38	98.85	Secondary
INSECTS LARVAE	0.31	99.15	Accessory
Pleodorina sphaera	0.18	99.34	Accessory
Lyngbya martensiana	0.13	99.47	Accessory
Surirelle robusta	0.13	99.6	Accessory
Eunotia bilunaris	0.08	99.68	Accessory
Microcystis robusta	0.05	99.73	Accessory
Oscillatoria sp	0.04	99.78	Accessory
Navicula criptocephala	0.04	99.81	Accessory
COPEPODS	0.03	99.85	Accessory
Coscinodiscus rudolfii	0.03	99.87	Accessory
Melosira granulata	0.03	99.9	Accessory
Synechocystis aquatilis	0.02	99.92	Accessory
Diploneis sp	0.02	99.94	Accessory
Niztchia sp	0.01	99.95	Accessory
Volvox aureus	0.01	99.96	Accessory
Cyclotella sp	0.01	99.97	Accessory
Nostoc sp	0.01	99.98	Accessory
Cosmarium granatum	0.01	99.98	Accessory
Staurastrum setegerum	0.01	99.99	Accessory
Phacus longicauda	0.01	100	Accessory

PI = Preponderance Index; CF = Cumulative Frequency

Table 9: Diet profile of female shrimp

Feed	Female (n = 130) % PI	CF (%)	Feed categories
PLANT DEBRIS	54.59	54.59	Preferred
ANIMALS DEBRIS	33.72	88.31	Preferred
Microcoleus lacustris	9.81	98.11	Secondary
Stigeoclonium aestivale	0.54	98.65	Secondary
Lyngbya martensiana	0.27	98.93	Secondary
Oscillatoria sp	0.24	99.17	Accessory
Eunotia bilunaris	0.22	99.39	Accessory

Coscinodiscus rudolfii	0.21	99.6	Accessory
Pleodorina sphaera	0.09	99.69	Accessory
INSECTS LARVAE	0.03	99.72	Accessory
Cyclotella sp	0.03	99.75	Accessory
Melosira granulata	0.03	99.78	Accessory
Gyrosigma sp	0.02	99.8	Accessory
Synechocystis aquatilis	0.02	99.82	Accessory
Niztchia sp	0.02	99.85	Accessory
Navicula criptocephala	0.02	99.87	Accessory
Surirelle robusta	0.02	99.89	Accessory
Fragilaria sp	0.02	99.91	Accessory
Gomphonema parvularum	0.02	99.93	Accessory
Diploneis sp	0.01	99.95	Accessory
Cladophora holsatica	0.01	99.96	Accessory
Euglena viridis	0.01	99.97	Accessory
Navicula cuspidata	0.01	99.98	Accessory
Audouinella violacea	0.01	99.98	Accessory

PI = Preponderance Index; CF = Cumulative Frequency

4. Discussions

The diet profile of *M. vollenhoveni* showed that this species of shrimp is an omnivorous detritus feeder like *Macrobrachium rosenbergii* (Klimley, 1994) [19] which ate essentially on decomposing organic matter such as animal and plant debris. These are followed by secondary and accessory foods that are phytoplankton composed essentially by cyanophytes, chlorophytes and diatoms, and zooplankton composed essentially by copepods and insect larvae. These results are agreement with those obtained by Lima *et al.* (2011) with similar species *Macrobrachium carcinus*. About this species, detritus (animal and plant debris) followed by small crustaceans and aquatic plants form the diet in the wild. Previsiouly, in the Ape Lagoon River in Nigeria (Jimoh *et al*., 2011) [18] and in the Lake Asejire in Nigeria (Anetekhai, 1986) [3], the bioecology of *M. vollenhoveni* has been studied. In the Parana River Valley in Argentina, the feeding ecology of *M. borelli* (Collins & Paggi, 1998) was explored. The biology and distribution of *M. vollenhoveni* and *M. macrobrachion* has been studied in the Lagoon River in Nigeria (Marioghae, 1982) [24]. These studies showed also a strong presence of phytoplankton in the shrimp diet. The slightly high emptiness coefficient (12.5%) and the relative abundance of animal (51%) and plant (36%) debris indicated an advanced state of digestion at the time of capture. This is understandable since *M. vollenhoveni i*, like other Macrobrachium shrimp species, is nocturnal (Griessinger *et al*., 1998) [16]. However, in the prensent study, sampling was carried out during the day. The shrimp captured would therefore have fed during their nocturnal activity. The study of the diet according to the individuals size did not reveal other diet aside those globaly identified. However, there is a variation in the categorization (preferential, secondary, accessory species) of diet species. The small individuals (group 1) consume, in addition to debris (animal, plant), phytoplanktonic organisms (*Microcoleus lacustris*, *Stigeoclonium aestivale*, *Lyngbya martensiana*, *Eunotia bilunaris*) as secondary food. In contrast, larger shrimp (group 2 and 3) used animal and plant debris as preferential and secondary foods. Lima *et al.* (2011) justified this more diverse diet of small-sized shrimp by their relatively higher feeding frequency contrary to large-sized shrimp. This shows that small shrimp have relatively more diverse preferential and secondary diets. The preferential and secondary prey of shrimp are essentially animal debris, plant debris and organisms such as *Microcoleus lacustris*, *Stigeoclonium aestivale*, whatever the sex considered. The similar diet for males and females is related to the exploitation of the same feed resource and cohabitation in the same ecological niche. These results are agreement with those of Lima *et al.* (2011) who noted with *Macrobrachium carcinus* that the male and female have an identical diet. This feeding behavior is in support of reproduction and recruitment of young spawners that occur during the flood season which is June to October (Marioghae, 1982) [24]. The composition of the diet in phytoplankton including mainly cyanophytes, chlorophytes and diatoms was also noticed by Jimoh *et al.* (2011) [18] who showed that these organisms form more than 63% of the food resources encountered.

5. Conclusion

The present study show that *M. vollenhoveni* has an omnivorous detritivorous diet, feeding on any food item it finds in its environment with a preference for animal and plant debris. This feeding habit will be easily imitated in the rearing environment from available local ingredients. It is essential to consider this diet to succeed in captive feeding of this shrimp species in order to ensure effectively the diversification of aquaculture production in Benin, guaranteeing the preservation of shrimp biodiversity and food security.

6. References

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