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Preliminary Data on Dietary Strategies of The Small Pelagic Fish *Pellonula Leonensis* Boulenger, 1916 (Pisces; Clupeidae) in Taabo Manmade Lake (Bandama; Côte D'ivoire)

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ABSTRACT

This study concerns the analysis of physico-chemical parameters (Temperature, pH, dissolved oxygen, TDS, turbidity, transparency) and seasonal variation in the dietary strategies of *Pellonulaleonensis* in Taabo manmade Lake. Water samples were taken in three stations during wet and dry seasons. A principal Component Analysis of physico-chemical data was made. For the study of the diet strategy, 119 specimens of *P. leonensis* were sampled, including 53 in rainy season and 66 in the dry season. The index of relative importance (IRI) calculated by combining the occurrence, digital and weight percentages was used. *P. leonensis* is insectivorous and consumes mostly larvae of Chironomidae (62.2% of the IRI in rainy season and 56.4% of IRI in the dry season). It also feeds on Crustaceans, Arachnids and Macrophytis. The Spearman correlation coefficient shows no difference of diet composition between the two seasons (R = 0.722; P = 0.003) in spite of the variation in environmental conditions between the rainy season and the dry season.

KEYWORDS: *Pellonulaleonensis*, diet, seasonal variation, Taabo Lake, Côte d'Ivoire.

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INTRODUCTION

The Clupeidae family is economically very important[1] and has several species of freshwater and brackish waters [2]. African freshwater species all belong to the sub-family Pellonulinae[3, 4].

Among these fish species, *Pellonulaleonensis* represents the most widespread freshwater Clupeid in West Africa. Although, it is often present in large numbers in the waters pelagic zones in Côte d'Ivoire, its biology and ecology are poorly known[2]. Yet, this small pelagic fish, locally called "Mimie la go", is subject to significant commercial exploitation inTaabo manmade Lake.

With regard to diet, if there is some works on some species of the genus *Pellonula*[5, 2], very few studies have been devoted, in particular, to *P. leonensis*. With the exception of the study on the diet of this species in Buyo manmade Lake during the rainy season[6], no other study has been yet conducted in Côte d'Ivoire.

In the tropical zone, most biological organizations and annual variations in production are strongly influenced by rain, and thus, the dry and wet seasons[7, 8, 9, 10, 11].

In order to remediate to this situation, we undertook this study on *Pellonulaleonensis* dietary strategies related to the seasonal variation in environmental conditions in Taabo manmade Lake.

MATERIAL AND METHODS

Taabo Lake is located on the Bandama River between 06 ° 20' and 06 ° 40' North latitude and 05° and 05 ° 30' longitude West (Fig.1). According to [12],Taabo Lake covers 7000 hectares.

Physico-chemical parameters

Three stations were selected for this study according to their accessibility and *P. leonensis* fishing activity. These are, respectively, Courandjourou, Taabo city and Taabo village. The physic - chemical parameters were measured at the surface (40 cm) between eight and ten in the morning to the different sampling stations. Measurements of the dissolved oxygen, temperature, conductivity, dissolved solids content, pH and water transparency were conducted in situ in each station, for each sampling campaign at different climatic season.

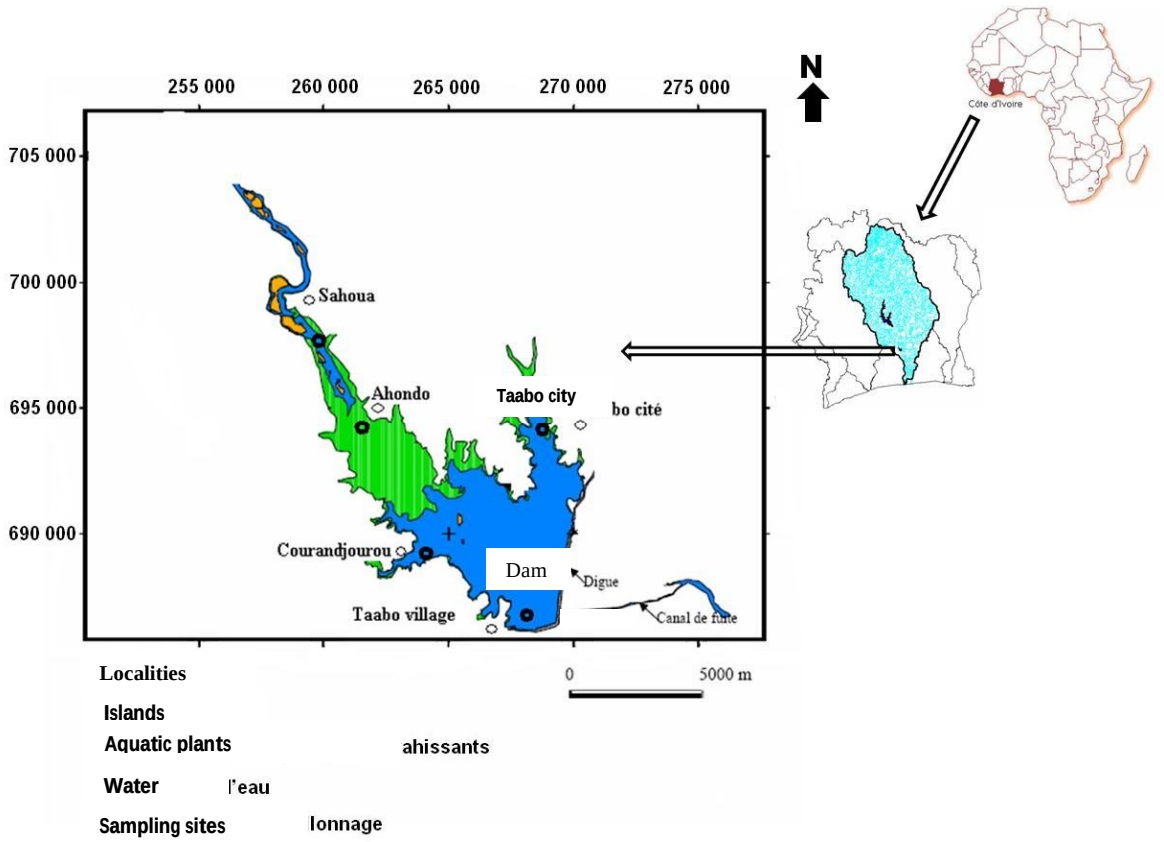

Fig. 1: Lake of the Taabo hydroelectric dam and location of sampling sites[12]

Fish sampling and stomach contents analysis

Pellonulaleonensis specimens are all from March 2005 experimental fishing (dry season) and September 2007 (rainy season) in Taabo Lake. Fish species sampling were performed using the shore seines of meshes 10 and 12 mm, about 30 m long with 2 m of fall. In the laboratory, specimens of this Fish species were measured to the closely millimeter (LS = standard length) and, then, weighed to the nearest gram before be dissected. Extracted stomachs are preserved in vials containing 70% alcohol. Then, food categories are extracted, counted, and weighed after their identification under the stereomicroscope using identification keys established by [13,14].

The contribution of each type of food to the diet was expressed as percentage frequency of occurrence (F), numerical percentage (N) and weight percentage (P).

F = (Nie/Net) x 100, where Nie = number of stomachs containing food i and Net = total number of examined full stomachs. This method is simple, easy and quick[15], but provides none information on the quantitative importance of the food[16]. For this need, the numeric percentage, N = (Ni / Nt) x 100, where Ni = total number of the food i and NT = total number of all foods, is determined. We attribute, for the computation, the number 1 to the presence in the stomach of a food as animal debris, plant debris and indeterminate [17]. This method is, also, easy and quick[15], but it has the disadvantage to minimize the heavy food[16]. Furthermore, the weight percentage, P = (FT/Pt) x 100, where Pi = weight of food i and Pt = total weight of all food, was determined. It allows knowing the weight of each type of prey[15]. On the other hand, it gives little information on food preferences[17].

To remedy this constraint, index of relative importance, IRI = F x (N + P) [18], which is a combination of the different percentages indicated above, was determined to better characterizing the diet of a fish species by eliminating the bias caused by these different percentages [17].

Finally, the classification of food was made using the method proposed by[17] . The value of the index of each food is expressed as a percentage of the sum of all indices. Foodstuffs were, then, ordered by descending order according to the scale percentage, and by adding the index percentages of different food to get 50% or more of the total index. These foods are classified as preferential. By continuing stacking up to 75% or more; foods are called secondary. All others food are accessories.

Seasonal variations in *Pellonulaleonensis*dietary strategies were analysed using Costello[19] graph.Statistical analyses were performed using Statistica 4.5 program. The Spearman correlation coefficient was used to compare the different diets. This test allows appreciating the similarities and differences between the samples by comparison of the ranks.

RESULTS

Physico-chemical characteristics

The results of the ACP analysis of physicochemical parameters (Fig. 2) measured during the long rainy and long dry seasons show, that both axes F1 and F2 have, respectively, 85.8% of inertia whose 54.2% for F1 and 31.6% for F2. The F1 axis discriminates transparency and towards positive values and temperature and conductivity and TDS in negative side. F2 axis isolates pH and oxygen (O2) in its positive part (Figure 3). With respect to the seasons (Figure 4), rainy season occurs in negative side and

dry seasons in the positive side of F1axis. F2 axis, isolates the station 2 (Taabo City), Taabo village (Station 3), and Courandjourou (Station 1).

General profile of the diet during the two seasons

A total of 119 *Pellonulaleonensis* stomachs collected in dry and rainy seasons was examined. Table 1 gives the general composition of *P. leonensis* diet in percentage of occurrence (F), numeric (N) and weight (P). Qualitative analysis of various stomachs containing prey allows to distinguish 14 types of foo, grouped into 4 categories. These are insects, crustaceans, Arachnids, and macrophytes. The diet is composed, mainly, of insects (60.6%) including 8 preys divided into 6 orders: diptera, ephemeroptera, odonata, hymenoptera, trichoptera and plecoptera.

In the rainy season, the classification of the food from their percentages of relative importance index (IRI) allows to consider Chironomidae (62.2%) as a preferred food. The Baetidae (16.6%) and cladocera (7.3%) may be considered as secondary food.

Fourteen (14) food types grouped into 4 categories (insects, crustaceans, arachnids, and macrophytes) were also observed in the dry season. The classification of foods according to their index IRI percentages shows, that *Pellonulaleonensis*diet, in dry season, consists mainly of insects (82.3% of IRI). All other taxonomic groups contribute to 17.7%. Chironomidae with 56.4% represents preferential foods. The Baetidae (15.0% of IRI) are secondary food. The Spearman correlation coefficient shows no difference in diet composition between the two seasons (R = 0.722; P = 0.003).

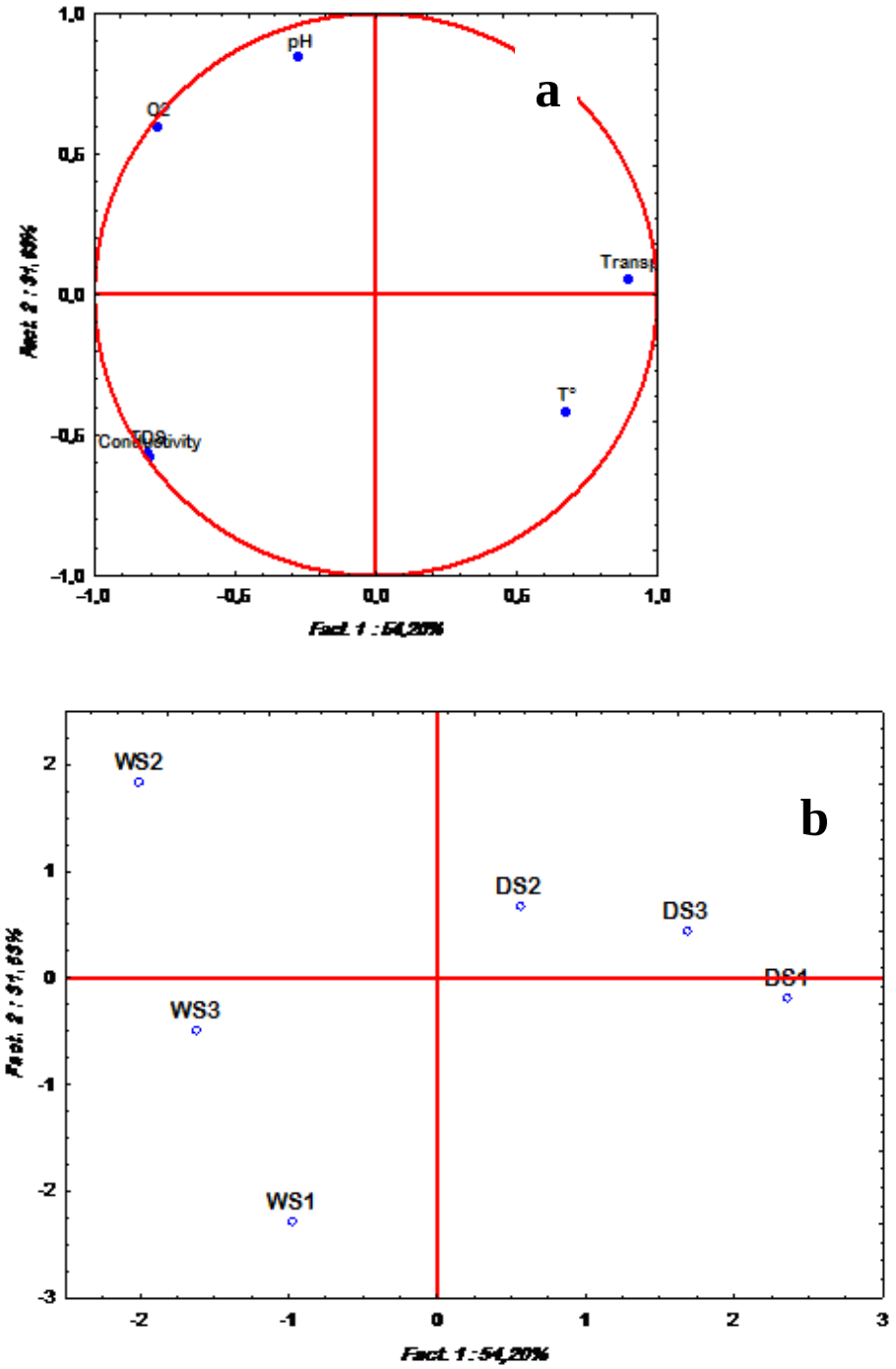

Fig. 2: Principal components analysis (PCA) of the physico-chemical parameters in study stations. (a): factorial map of physicochemical variables; (b): map factorial of the seasons SP1: rainy season station 1; SP2: rainy season station 2. SP3: rainy season station 3; SS1: dry season station 1; SS2: Dry season station 2; SS3: Dry season station 3.

Table 1: **Diet and index of relative importance (IRI in percentage) of different categories of foods of *Pellonulaleonensis*Taabo Dam Lake; F: percentage of occurrence, N: numeric percentage, P: weight percentage**

Food items	Wetseasson				Dry season			
	F	N	P	%IRI	F	N	P	%IRI
Insects								
Ephemeroptera								
Baetidae	14.0	15.8	15.4	16.6	12.8	12.1	15.4	15.0
Others Ephemeroptera	2.3	5.3	2.6	0.7	6.4	6.1	2.6	3.3
Odonata								
Libellulidae	2.3	3.9	8.6	1.1	4.3	4.5	9.1	2.4
Others Odonata	4.7	3.9	5.1	1.6	4.3	4.5	5.1	1.8
Diptera								
Chironomidae	23.3	34.2	36.2	62.2	21.3	27.3	36.2	56.4
Trichoptera	4.7	2.6	1.5	0.5	6.4	3.0	2.3	2.2
Hymenoptera								
Formicidae	7.0	5.3	2.9	1.9	6.4	3.0	2.3	0.9
Plecoptera								
Neoperlaspio	2.3	1.3	1.7	0.3	2.1	1.5	1.7	0.3
Crustaceans								
Cladocerans	9.3	5.3	1.2	7.3	8.5	7.6	0.9	9.3
Ostracods	4.7	6.6	2.9	1.7	4.3	4.5	2.9	1.4
Arachnids	7.0	3.9	4.8	1.2	6.4	4.5	5.7	1.4
Macrophytis								
Fruits	7.0	2.6	11.8	1.7	6.4	4.5	9.6	2.2
Plant debris	4.7	3.9	3.4	1.3	4.3	4.5	3.4	3.0
Animals debris	6.7	5.4	1.9	1.9	6.4	9.1	1.9	3.0

Seasonal variation of P.leonensis diet

Food consumed by *Pellonulaleonensis* in rainy season (Fig.3) are divided into three (3) groups according to the graph of Costello. Group 1 is represented by the Chironomidae with a frequency of occurrence and a high specific abundance. Group 2 is composed of Formicidae which have a

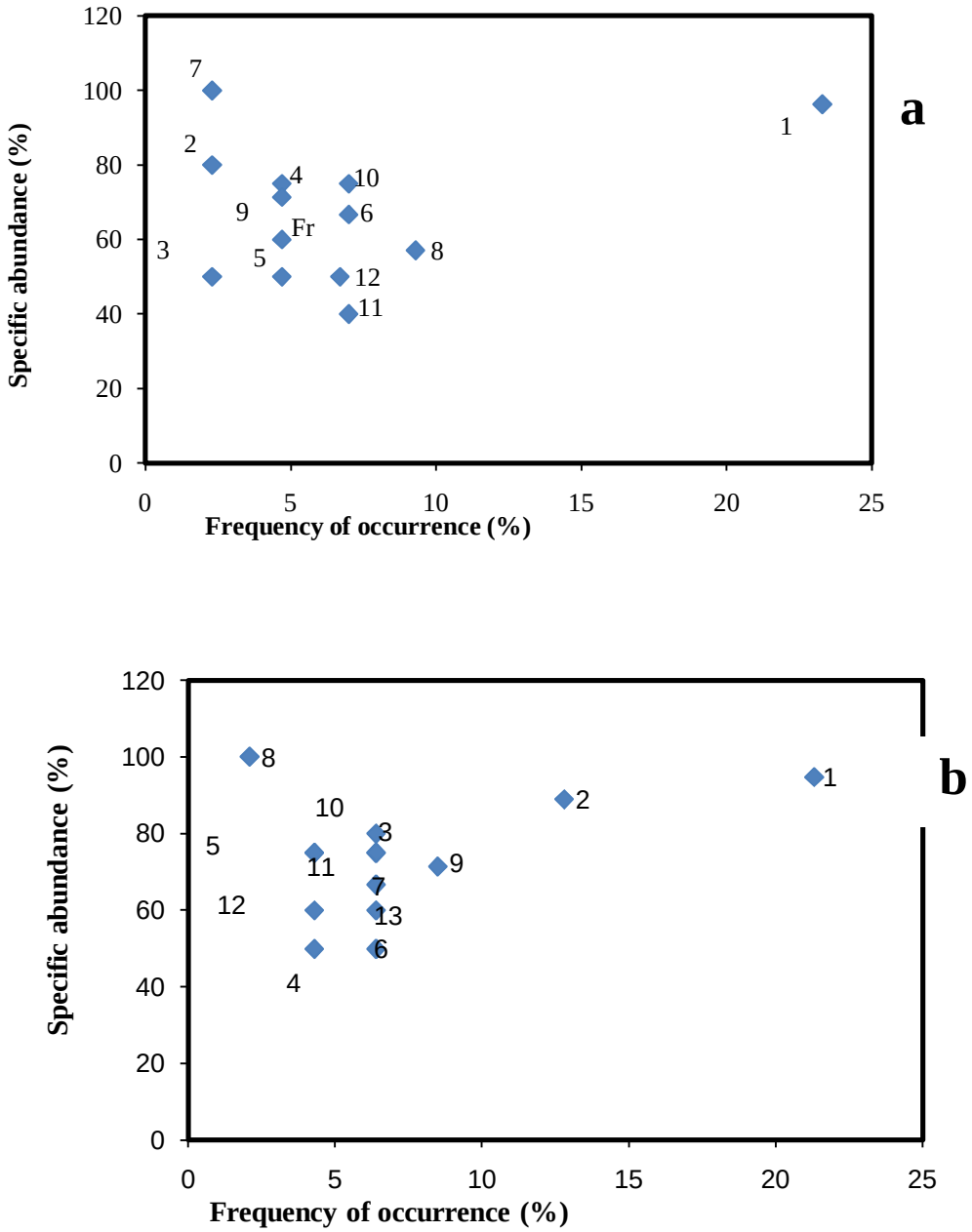

Fig. 3: Feeding strategy diagram for individuals of *P. leonensis* in rainy season (a) and in dry season (b). Prey-specific abundance (%) plotted against frequency of occurrence (%) of food items in the diet. Food item: 1. Chironomidae, 2. Baetidae, 3. other mayflies, 4. Libellulidae, 5. other Odonata, 6. Trichoptera; 7. Formicidae, 8. *Neoperla*, 9. Cladocera, 10. Ostracods, 11. Arachnids; 12. Plant debris, 13. Fruits.

low occurrence rate and a high specific abundance. In Group 3, prey have a low frequency of occurrence and specific abundance.

In the dry season (figure 5) we distinguish, also, three (3) groups of food, but Group 1 is represented by two types of prey Chironomidae and the Baetidae. Group 2 is represented by the *Neoperlaspio* while other preys compose group 3.

DISCUSSION

The principal component analysis of the physicochemical parameters allows us to distinguish two essential factors in this study. These are, notably, the water current and the season.

Indeed, concerning water currents, three zones are observed. Courandjourou bay and Taabo village areas are characterized by low water currents, while in Taabo city, strong currents, notably near the chenal zone is noticed.

With regard to seasonal aspect, we observed in rainy season, a drop of temperature and consequently, the transport of nutrients to the Lake resulting in a decrease of the water transparency. In the dry season, there is a decrease in the volume of water in Taabo Lake, and consequently the increase of the concentration of dissolved substances. This results to the increase of conductivity and TDS.

In rainy season, the lake water is enriched in matter and suspended particles, plant debris and sludge brought by the phenomenon of leaching observed. Runoff tear off various invertebrates, including Chironomidae, different materials and make them available in the water column. The Formicidae of the terrestrial environment are, also, drained into the Lake, as well as those that fall from vegetables. For this reason, Formicidae become the most important prey of *Pellonulaleonensis* in rainy season. In dry season, with the absence of exogenous prey, the Baetidae is added to Chironomidae for being the basis of the diet of *P. leonensis*.

Thus, environmental conditions seem to have an impact on the availability of prey of *Pellonulaleonensis*. Indeed, *P. leonensis*is a pelagic Fish species that feed in the water column. It mainly consumes insects and planktonic crustaceans [6]. This diversity of the food categories indicates a food opportunism linked to prey availability. This result corroborates that of[5], which notes that the diet of the genus *Pellonula* was linked to trophic opportunities offered by each habitat. The general profile of this scheme shows that *P. leonensis* consumes, mostly, Chironomidae whatever the season. Our results corroborate those of [20]who indicates that the *Pellonula* diet consists, mainly, of aquatic and terrestrial insects.

This predominance of Chironomidae in the diet of *Pellonulaleonensis* would be related to their small size and their abundance in lacustrine environments. Also, [14]reports that Chironomidae are the most abundant and diverse benthic macro fauna. The Chironomidae prey in *P. leonensis* diet comes from submerged dead trees trunks. Indeed, [21] showed that this family feeds in Lake Volta (Ghana) of phytobenthos living on dead submerged trees trunks. This explains the presence of plant debris in the stomachs. Furthermore, planktonic Crustaceans (Cladocerans and Ostracods), although, quantitatively little in the diet of *P. leonensis*, constitute a significant nutritional supplement. A similar diet of insects and planktonic crustaceans was described by[5] in the lagoon from Lagos in Nigeria.

So, therefore the high number of prey registered in the rainy season in comparison with the dry season indicates the difference in availability of food between the two seasons. With regard to the diet strategy of this Fish species, this one does not vary significantly according to the both seasons. Chironomidae remains the dominant prey in all seasons.

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