Journal of Research in Ecology

ISSN No: Print: 2319 –1546; Online: 2319– 1554

An International Scientific Research Journal

Original Research

Study of the diet of *Crassostrea gasar* in the lagoon Ebrie Ivory Coast

Authors:
Kouakou KF,
Aman JB,
Karamoko M and
Otchoumou A

Institution:
Université Nangui Abrogoua, Côte d'Ivoire

Corresponding author:
Kouakou KF

ABSTRACT:

The diet of *Crassostrea gasar* was studied in the sectors II, III and IV of the lagoon Ebrié precisely on the sites of Moossou, Bimbresso and Lokodjro of Ivory Coast. A monthly sampling of oysters was conducted and their prey were determined by microscopic observation of the stomach contents. No empty stomach was observed. The phytoplactoniques and zooplankton prey were counted through malassez cell and tank dollfuss respectively. The stomach contents consisted mainly of phytoplankton, zooplankton, debris and indeterminate elements. However, phytoplankton, regardless of the site, the time of year, the size of individuals, sex and sexual maturity remained dominant in all the observed stomachs. The results showed 98.91%, 97.23% and of phytoplankton 98.86%, Moossou in Bimbresso and Lokodjro respectively. Males had 97.64 phytoplankton and those of females had, 98.22% in their stomach. The percentage of phytoplankton ranged between 91.13% and 99.2% taking into account the seasons and sites. Phytoplankton dominated the stomachs in an amount of 97.07% for individuals at stage whereas it was 0, 96.2%, 96.37% and 94.19% for the stage 1, 2 and 3 respectivley.

Keywords:

Crassostrea gasar, diet, Lagoon Ebrié

Article Citation:
Kouakou KF, Aman JB, Karamoko M and Otchoumou A
Study of the diet of *Crassostrea gasar* in the lagoon Ebrie Ivory Coast
Journal of Research in Ecology (2019) 7(1): 2403-2416

Dates:
Received: 14 Dec 2018 **Accepted:** 06 Jan 2019 **Published:** 10 Feb 2019

Web Address:
http://ecologyresearch.info/documents/EC0678.pdf

INTRODUCTION

Bivalves are aquatic molluscs bilaterally symmetrical, characterized by a shell composed of two calcified valves which cover the right and left sides of the body. Under the action of the ligament, the shell tends to open along its anterior margin and posterior, especially belly. The body of the bivalves is soft, non-segmented, compressed laterally, without differentiated head (*Acephala*) or masticatory apparatus.

The outer edges of the mantle are sometimes more or less welded, forming rearwardly two siphon allowing the entry of water in the mantle cavity (inhalant siphon or ventral) or rejection outwardly (exhaling siphon or dorsal). Many bivalves have a pair of lamellar respiratory gills (Pelecypods) which are also involved in the collection of food through creation of water currents in the mantle cavity. Most species are macrophages. They feed either plankton or organic particles suspended in water (suspension feeders) or collected food on the bottom (deposit feeders) (Poutiers, 2001).

Like many other mollusks, *Crassostrea gasar* filter is a bivalve. It feeds on living organisms (plankton), detrital organic matter (tripton) and inorganic particles (seston: vase, fine sand and shell debris). This sessile animal, occurs in mangrove areas, or found clinging to the roots of the trees is fixed with plant debris or other supports (Furnestin *et al.,* 1966).

Knowledge of the animals in the wild diet is a necessary step to know their biology and ecology. Indeed, the feeding of a species may help to explain variations in growth, some aspects of reproduction, migration and behavior research and food intake (Berg, 1979).

Therefore, in order to know the oyster supply, we studied the diet of *C. gasar* on three sites in the lagoon Ebrié macrophages *viz*: Moossou, Bimbresso and Lokodjro.

MATERIALS AND METHODS

Study sites

Animals of this study were collected in the Ébrié lagoon which is coastal open complex and elongated. It is situated between longitude 03° 47' and 05° 29' and latitude 05° 02' and 05° 42' in Figure 1. It has an area of 566 km² and an average depth of about 4.8 m. The Ebrié lagoon since 1950 is in constant contact with the sea through the artificial channel Vridi (2700 m long, 300 m wide and 20 m deep) and sometimes by the temporary river mouth Comoé at Grand-Bassam. It is supplied with fresh water by three major rivers of unequal importance such as Comoé rivers and Mé Agnéby. It is characterized by a temperature varying between 27.4 and 31.2°C. Dissolved oxygen is between 4 and 7 mg/L.

Biological material

The animals included in this study are bivalve molluscs of order *Ostreoida,* the family of *Osteoidae,* of the genus *Crassostrea* and the species *Crassostrea gasar.*

Technical equipment

A foot to mark slides and vernier caliper of 0.1 cm accuracy was used to measure the total length, width and thickness of oysters. A Optika model microscope was used to observe the prey in the stomach. A Malassez cell was used for counting the phytoplankton and Dofus vessel for the zooplankton. A mechanical counter helped to count the different items and a Digital camera (Fine Pix S5500 Camera) with a resolution of 14 megapixel was used to capture the images.

Sampling

A sample of thirty *C. gasar* of different sizes were collected randomly by hand on each site. Sampling was conducted every month during the period from November 2015 to October 2017. The bivalves are transported from the sampling place to the laboratory in coolers.

Table 1. Proportions of planktons found in Moossou site

S. No	Prey	NOT(%)	Fc (%)	S (%)
1	Phytoplanktons	98.91	93.68	149.51
	Blue algae	34.06	23.74	43.28
2	Diatoms	64.85	69.94	106.33
	Centric	39.19	30.61	52.89
	Pinnate	25.66	39.33	53.44
3	Zooplankton	1.38	3.74	3.96
4	Debris	0	6.25	0
5	Undetermined	0.59	1.25	2.32

Study of the diet of *C. gasar*

Sampling of the visceral mass

In the laboratory, the samples were dissected and visceral mass of each animal is collected, weighed and then stored in a pill of 50 mL capacity. The volume of prey is reduced to 30 mL by addition of distilled water. Then, 10 mL of 5% formalin was also added. The samples thus obtained are labeled.

Observation and counting of prey

One mL of the solution containing the prey was kept on the slide and was used for the identification of phytoplankton and zooplankton. A coverslip is placed on the drop and spread to adhere to the blade. The assembly is placed on a microscope for observation of the contents. Counting of phytoplankton was done under an optical microscope using a Malassez cell. The sample solution was homogenized and the parts outside the coverslip was humidified. Then depositing the lamina on Malassez cell and then, adhering the strip to the blade by sliding the slide several times in the blade. Depositing the sample on the edge of the blade using a pasteur pipette. The liquid fills the cell by capillarity. Finally put mounting microscope.

Enumeration

At the first focusing lens x50, x100 magnification was set right and then moved to do the development. The grid was made visible, counting the number of cell for the sample. Counting the zooplankton is also microscopically using the vessel Dolfus. Then, by extrapolation, the number of individuals (phytoplankton and zooplankton) in the samples were estimated.

Identification of the prey

Phytoplankton genus were identified using keys and the other identification manuals (Desikachary 1959; Compere, 1986; Van and Huls, 1976; Rumeau and Coste, 1988; Krammer and Lange-Bertalot, 1991; Komarek and Anagnostidis 1998; Krammer and Lange-Bertalot 2000 and Komarek and Anagnostidis, 2005 and Lambert *et al,* 2008).

As for zooplankton, they were identified using the keys given by Pontin (1978); Pourriot (1980); Dussart (1980); Pourriot et *al.* (1982) and Sandacz and Ku-

Table 2. Proportions of planktons found in Bimbresso site

S. No	Prey	NOT(%)	Fc (%)	S (%)
1	Phytoplanktons	97.23	97.86	207.08
	Blue algae	4.36	3.34	27.17
2	Diatoms	92.87	94.52	179.31
	Centric	24.97	29.62	41.13
	Pinnate	67.9	64.9	138.78
3	Zooplankton	2.12	1.34	10.07
4	Undetermined	0.46	0.8	3.40

Table 3. Proportions of planktons found in Lokodjro site

S. No	Prey	NOT(%)	Fc (%)	S (%)
	Blue algae	98.86	94.01	193.2
1	Phytoplankton	3.23	2.38	17.04
	Blue-green algae	14.44	20.23	14.43
2	Diatoms	81.19	71.4	161.74
	Centric	18.27	14.28	64.84
	Pinnate	62.92	57.12	96.9
3	Zooplankton	-	-	-

bo (1982). The results of stomach contents of the analysis were expressed as a percentage of occurrence (Lauzanne, 1975; Hyslop, 1980; Paugy and Leveque, 1999; Gray *et al.,* 1997), Digital percentage (Hureau, 1970) and specific abundance (Amundsen *et al.,* 1996).

RESULTS

Vacuity coefficient

The emptiness coefficient represents the percentage of empty stomachs relative to the total number of stomachs examined. Its value can be appreciated the feeding activity of the species and their feeding behaviour (N'Da, 1992). The emptiness coefficient is determined by the following equation:

$$Cv = \frac{Nv}{Nt} \times 100 \quad \text{(N'da, 1992)}$$

where Cv = emptiness coefficient; Nv = Number of empty stomachs; Nt = Total number of stomachs examined.

Percentage of occurrence

The percentage of occurrence provides information on the food preferences of a given species. It provides information on prey consumed frequently by the species without indicating the quantitative importance of the ingested prey (Lauzanne, 1975 and Hyslop, 1980). This index is used to determine the percent of stomachs containing prey category (Ne) based on the total number (Nt) of stomachs containing at least a prey (Paugy and Leveque, 1999 and Gray *et al.,* 1997). It is calculated from the formula:

$$\%Fc = \frac{Fi}{\sum Fi} \times 100 \quad \text{(Paugy and Leveque, 1999)}$$

$$\text{with} \quad Fi = \frac{Ne}{Nt} \quad \text{(Paugy and Leveque, 1999)}$$

where, Fc = Percentage of occurrence corrected; Fi = Frequency of occurrence.

Numeric percent age

The numeric percentage is the proportion of a prey category 'i' throughout the stomach contents (Hureau, 1970). It is the ratio of the total number of prey category (i) of food to the total number of all prey reduced percentage. It is obtained from the following equation:

$$N = \frac{Ni}{Ne} \times 100 \quad \text{(Paugy and Leveque, 1999)}$$

where, N = Percentage Digital; Ni = Total prey category i; Do = Total of all prey.

Index of species abundance

This index is calculated on the basis of knowledge of the number, volume or weight of the prey. It expresses the proportion of each prey category, only in the stomach where it is encountered (Amundsen *et al.,* 1996). It was done by the formulae

$$Si = \frac{ai}{ati} \times 100 \quad \text{(Amundsen et al., 1996)}$$

where, S_i = index specific abundance of prey 'i'; ai = total abundance of the prey 'i'; at_i = total abundance of all prey only in all stomachs containing prey 'i'.

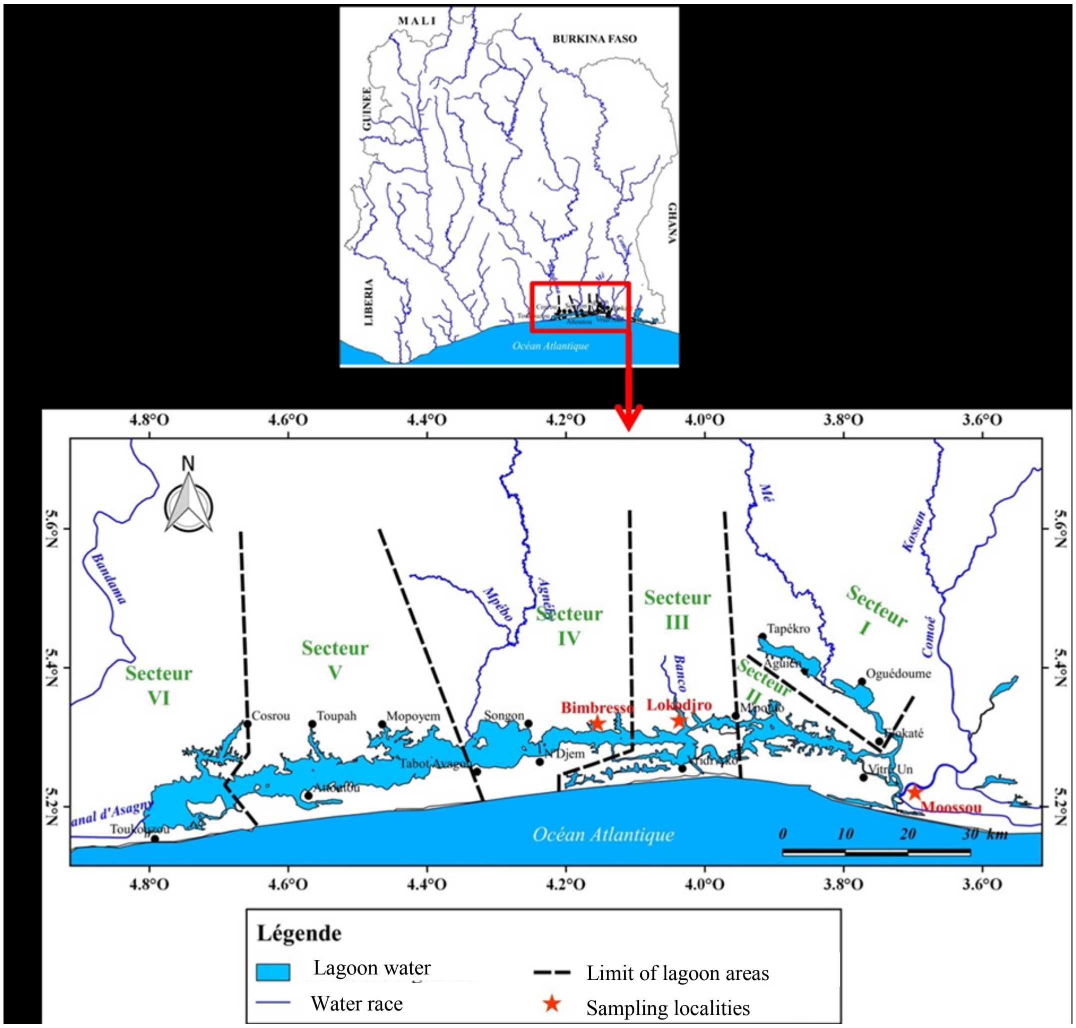

Figure 1. Map of the lagoon Ebrié with different sectors and sampling sites

RESULTS AND DISCUSSION

Results

General study of the diet

None of the stomachs examined were found empty. The emptiness coefficient for all sites is 0%. Stomach contents were observed consisting mainly of phytoplankton, zooplankton, debris and indeterminate elements (Tables 1, 2 and 3). The Phytoplankton consists mainly of blue algae, blue-green algae and diatoms (centric and pinnate), while, zooplankton consists of rotifers and foraminifera.

Study of the diet of *Crassostrea gasar* per site

Moossou site

Ats Moossou, phytoplankton represents 98.91% of total prey. It consists of 34.06% of algae and diatoms 64.85% of which 39.19% are centric and 25.66% are pinnate. Zooplankton represents 1.38% of the prey and is mainly composed of rotifers (0.59%) and foraminifers (0.79%). Some prey have not been well determined. They represent 0.59% of all preys consumed. Prey classified from the corrected percentage of occurrence indicated that diatoms are most recurrent (69.94%) followed by algae (23.74%), debris (6.25%), zooplankton (3.74) and indeterminate (1.25%) Table 1.

Bimbresso site

The diet of *Crassostrea gasar* at Bimbressso site is dominated numerically by phytoplankton (97.23%). This percentage is shared between algae (4.36%) and diatoms (92.87%) of which 24.97% are centric and pinnate are 67.9%. Zooplankton represents

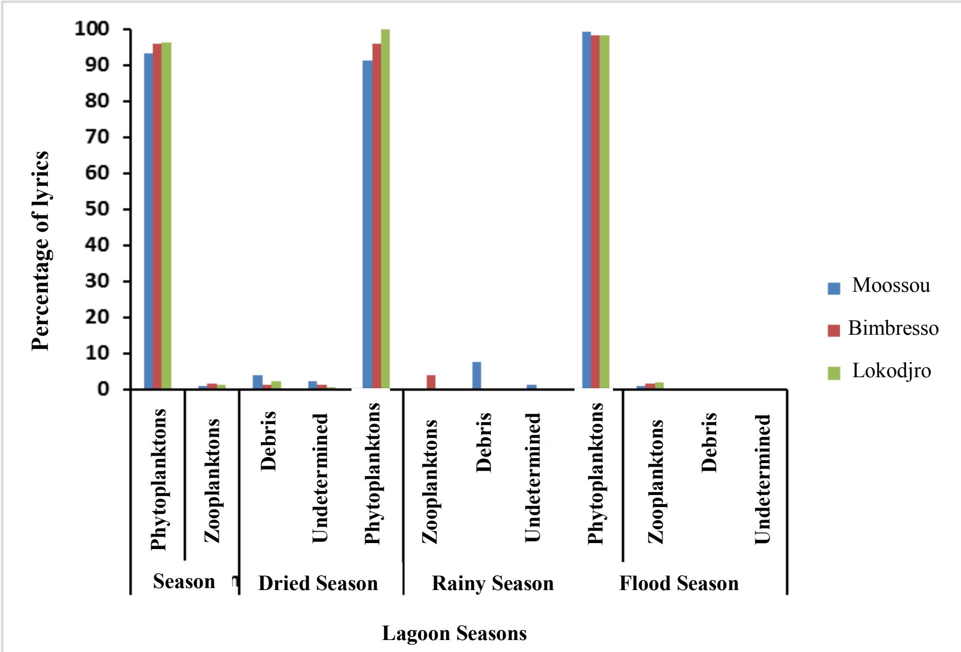

Figure 2. Distribution of prey per season depending on the site

2.12% of total prey on this site and 0.46% indeterminate prey.

The percentage of occurrence corrected is the highest among phytoplankton (97.86%). Diatoms are prey that appear most often in the stomach with a percentage of 94.52% occurrence (29.62% of centric and 64.9% of pinnate). Followed by zooplankton (1.34%) and indeterminate prey (0.8%). Phytoplankton species are most abundant in the stomachs examined (97.23%). Among them, there is a dominance of diatoms (92.87%) composed largely of pinnate (67.9%). Zooplankton abundance specifically (2.12%) is the least abundant entity in the stomach contents discussed on this website. Indeterminate prey accounted for 0.46% Table 2.

Lokodjro site

Crassostrea gasar, on the site of Lokodjro, phytoplankton diet (98.86%) dominated in number. The latter is composed mainly of diatoms (81.19%) with

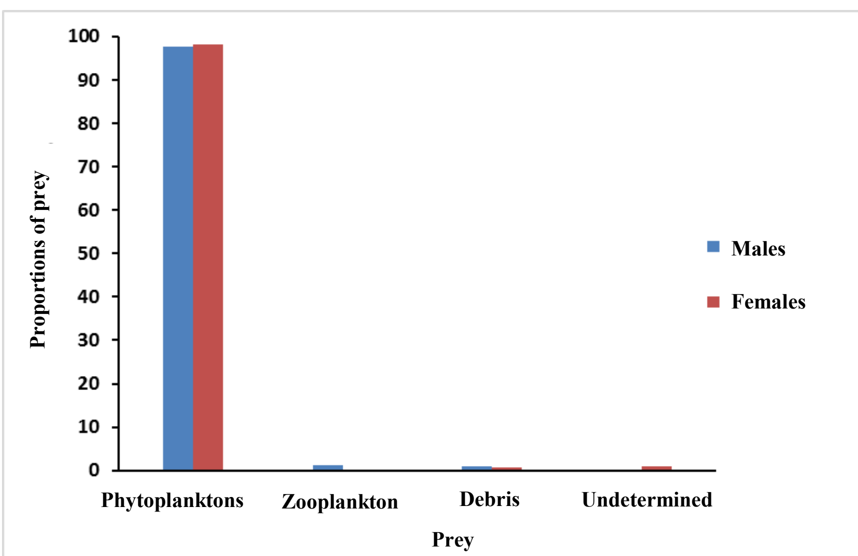

Figure 3. Distribution of prey by gender

18.27% centric and 62.92% pinnate. Algae represent 17.67% of the workforce of phytoplankton. The numerical percentage of zooplankton in relation to the total of all observed prey is 0.43% and the indeterminate individuals is 0.43%. The percentage of corrected occurrence of phytoplankton was 94.0% and the zooplankton is 3.57%. The most common phytoplankton are diatoms (71.4%) with 14.18% of centric diatoms and 57.12% of pinnate diatoms. The corrected frequency of the indeterminate pery is 1.19%. The specific abundance of phytoplankton for this site is 98.86%, which makes phytoplankton the most abundant prey with a dominance of diatoms (81.19%), including 62.92% for pinnate and 18.27% for centric. Zooplankton and indeterminate are the least abundant with each of the proportions of 0.43% Table 3.

Study of the diet of *C. gasar* per season

The diet of *C. gasar* was analyzed at each site according to the three lagoon seasons namely dry season, the rainy season and flood season. This diet takes into account the relationship between the prey consumed by these animals during different months of the year.

Moossou site

Table IV shows the seasonal diet composition *C. gasar* to Moossou. The most consumed prey in all seasons are phytoplankton (93.4% in the dry season, 91.13% in the rainy season and 99, 22% in the flood season). Diatoms were mainly observed in the stomachs analyzed on this site in the dry season and rainy season with respective percentages of 73.25% and 67.57%. Indeed, pinnate diatoms (51.51%) abound in the dry season while in the rainy season, it is rather the centric diatoms that are the most abundant (44.75%). By cons, during flood season it is more the blue-green algae that were more observed (75.53%).

Phytoplankton is very strongly represented in the dry season and rainy season with 3 species of algae and 30 diatom species including 22 species of pinnate diatoms and 8 species of centric diatoms. During flood season, only six species of diatoms were found in the stomachs. Zooplankton are poorly represented in the stomachs throughout the year (0.80% in the dry season, 0.33% in the rainy season and 0.71% during flood season). The numerical percentages of debris and indeterminate prey are also very low in all seasons.

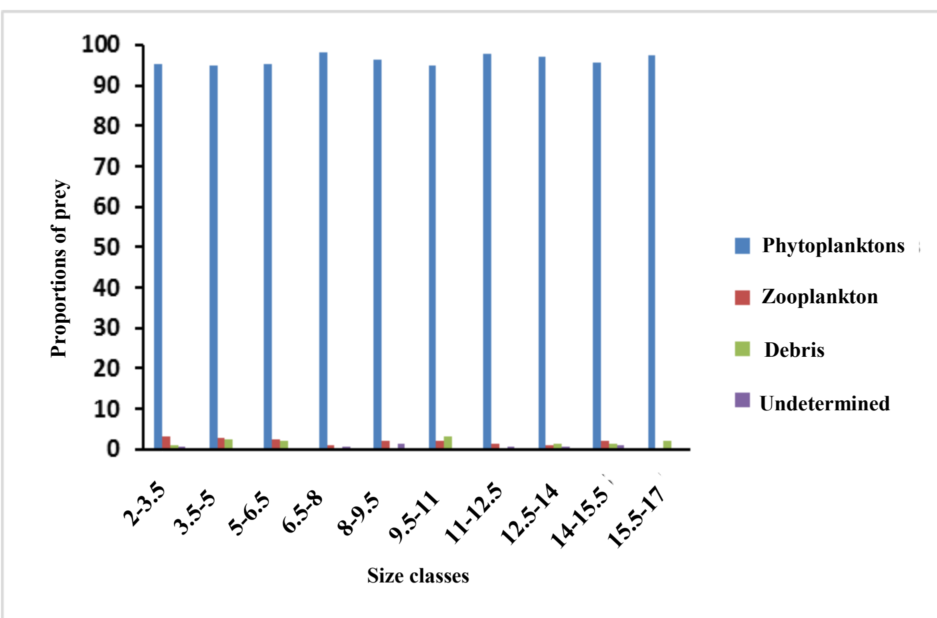

Figure 4. Distribution of prey based on size classes

Bimbresso site

Table 5 represents the diet of *C. gasar* during different lagoon seasons on the site of Bimbresso. The stomachs examined on this site are dominated in all seasons by phytoplanktons (96.06% in the dry season, 96.01% in the rainy season and 98.25% during flood season). Centric diatoms are the most abundant in the rainy season (50.49%). By cons, in the dry season and flood season, it is rather the pinnate diatoms that are the most abundant (67.97% in the dry season and 79.95% during flood season).

Thirty-five diatomaceous genera were identified here (8 kinds of centric diatoms and 27 kinds of pinnate). Zooplankton are the least abundant, whatever the season considered (dry season 1.45%, 3.88% rainy season and flood season, 1.58%). Debris and indeterminate prey are the less abundant.

Lokodjro site

At Lokodjro, phytoplankton are the most abundant in all seasons of the year with 96.15% in the dry season, 99.92% in the rainy season and 98.16% during flood season Table 6. Diatoms are the most abundant regardless of the season (55.39% in the dry season, 94.49% in the rainy season and 75.55% during flood season). The pinnate diatoms are more abundant in samples of rainy seasons and floods, while centric are in the dry season samples. Zooplankton are less abundant in the dry season (1.08%) and flood season (1.78%). In rainy season, no zooplankton were found in the stomachs examined.

Research *C. gasar* food diet by gender

Figure 3 shows the *C. gasar* food diet based on gender. The analysis there of shows that both males and females have almost exclusively phytoplankton diet (97.64% and 98.22%). Zooplankton occupy a significant proportion in the diet of these animals (1.33% for males and 0.31% for females). There is no apparent difference between the diets of males and the females.

Research *C. gasar* food diet based on size classes

The *C. gasar* food diet based on size classes, as presented in Figure 4 shows that it is largely dominated by phytoplankton to over 94% for all size classes. There are no statistical differences between the diets of oysters different size classes. Zooplankton have negligible proportions (less than 4%) in diet oysters different size classes.

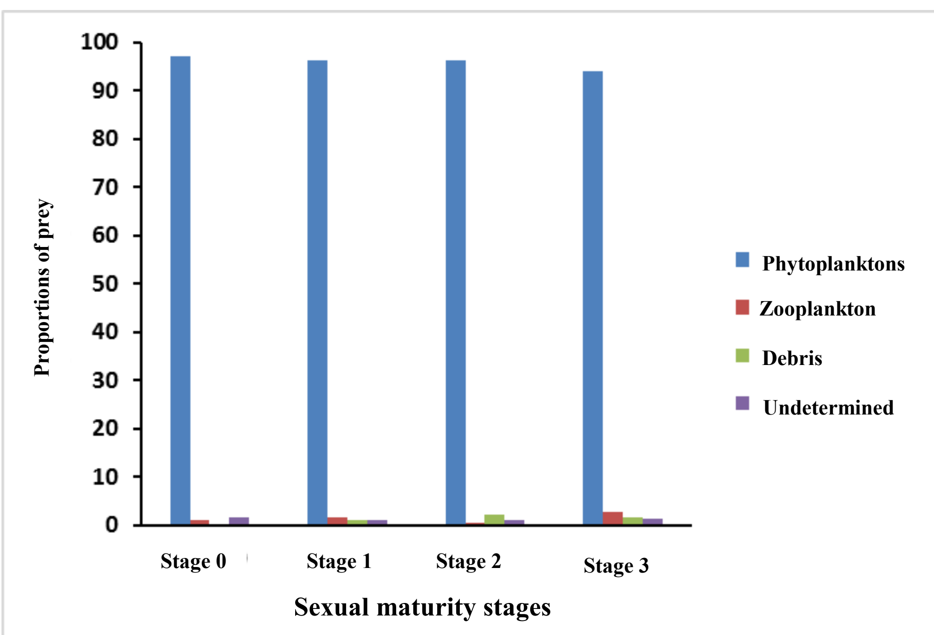

Figure 5. Distribution of prey depending on the stage of maturity

Table 4. Proportions of plankton according to the seasons in Moossou

S. No	Seasons / Prey	Dry Season		Rainy season		Flood season	
		N(%)	F(%)	N(%)	F(%)	N(%)	F(%)
1	Phytoplanktons	93.4	89.88	91.13	77.86	99.22	84.59
2	Blue-green algae	19.35	7.84	23.56	1.66	75.53	30.76
3	Diatoms	73.25	80.08	67.57	76.2	23.69	53.83
4	Centric	21.74	30.61	44.75	32.97	17.96	30.76
5	Pinnate	51.51	49.47	22.82	43.23	5.73	23.07
6	Zooplanktons	0.80	3.33	0.33	1.66	0.71	7.69

Study *C. gasar* diet based on sexual maturity stages

The *C. gasar* food system based on stages of sexual maturity is shown in Figure 5. The analysis of this figure shows that it is dominated by phytoplankton for all stages (97.07% for stage 0, 96.2% for stage 1, 96.37% for stage 2 and 94.19% for stage 3). There are no significant differences between the diets of oysters from stage 0, 1, 2 and 3. Mature individuals as immature feed on the same prey categories (phytoplankton and zooplankton). Zooplankton represents a negligible proportion of the diets of oysters at different stages of sexual maturity (1.08% for stage 0, 1.65% for stage 1, 0.5% for stage 2 and 2.81% for step 3).

DISCUSSION

The emptiness coefficient calculated at all sites is 0%, a repletion factor of 100%. Indeed, *C. gasar* is a mollusc filter. That is to say that the food particles suspended in the water are filtered and constituted the bolus. The value of emptiness coefficient (0%) showed that the oyster continuously consumes water to collect food. Barillé *et al.* (1993) have shown that the oyster filter 2.2 L of water per hour. According to Ishmael (2015), the oyster eats while she breathes. It filters 5-16 L of water per hour under normal conditions and the time full the path taken to food in the digestive tract of a hard oyster is from 80 to 150 min. This indicates that the stomach is always full.

Analysis of the stomach contents of specimens studied showed that *C. gasar* feeds on phytoplankton, zooplankton, suspended organic material (debris and litter), bacteria and other prey that have been dentifiées. It's results are consistent with those of Sylvio (2008) who worked on Ostreidae, Sara (2007) and of Dabouineau Ponsero (2004) and Pernet *et al.* (2012) who worked on other bivalve species. According to them, Ostreidae generally have diets led to suspended particles in the water. In fact, phytoplankton are the preferred prey to the detriment of others such as zooplankton and bacteria. These results confirm those of Mohlenberg (1981), Newel and Jordan (1983) and Briclej and Malouf (1984). These authors have shown that bivalve reject a portion of the compound feed offered to them under experimental farms, as pseudo feces. They

Table 5. Proportions de plancton en fonction des saisons à Bimbresso

S. No	Seasons / Prey	Dry Season		Rainy season		Flood season	
		N(%)	F(%)	N(%)	F(%)	N(%)	F(%)
1	Phytoplanktons	96.06	96.9	96.01	96.22	98.25	96.93
2	Blue-green algae	2.9	1.51	4.59	2.70	5.58	4.34
3	Diatoms	93.16	-	91.42	92.15	92.67	92.54
4	Centric	25.39	27.26	50.49	39.15	12.72	24.57
5	Pinnate	67.97	68.13	40.93	53.00	79.95	67.97
6	Zooplanktons	145	-	3.88	4.05	1.58	2.88

Table 6. Proportions of plankton according to the seasons Lokodjro

S. No	Seasons	Dry Season		Rainy season		Flood season	
	Prey	N(%)	F(%)	N(%)	F(%	N(%)	F(%)
1	Phytoplanktons	96.15	93.96	99.92	98.28	98.16	95.78
2	Blue-green algae	40.76	13.33	5.18	8.33	22.61	16.66
3	*Microcystis sp*	40.76	13.33	5.18	8.33	22.61	16.66
4	Diatoms	55.39	80.63	94.49	79.95	75.55	79.12
5	Centric	22.81	26.65	20.59	13.32	3.56	8.32
6	Pinnate	32.58	53.98	73.9	66.64	71.99	70.8
7	Zooplanktons	1.08	3.33	0	0	1.78	4.16

highlight the sorting of food category at the expense of another. Among the phytoplankton, diatoms are the most consumed prey with a preference for pinnate diatoms. This preference for pinnate diatoms could be explained by the fact that diatoms are benthic organisms, are growing in the shallow areas of the lagoon. Oysters that have them, are sessile and binds to the media at shallow depths. This feature would require them to be content with the food available in their living environment. It is easier for these animals to consume diatoms that are also benthic. This assertion is confirmed by Hennebelle (1975), which says that except for *Pectinidae* are likely to move, most bivalves (shells, oysters) are sessile organisms. Robert (1975) attributed this preference for pinnate diatoms to the size of these structures. He demonstrated as a part of work on the diet of oysters that this regime is dependent on the size of particles ingested. According to him, the particles of smaller sizes are more likely to be retained as the large particle sizes that are eliminated in the pseudofeces. The pinnate diatoms are generally smaller than centric, which will be more abundant in the food bowl. Jumars and Penry (1989) that bind to them the difference between the two entities of phytoplankton unlike middle particle concentration. The pinnate would therefore be more abundant in the environment than the centric.

The diet according to the site shows that some sites of *C. gasar* retains its preference for phytoplankton. Even though there are differences between some types of phytoplankton from one site to another, the overall trend remains the same at all sites. This consistency could be due to the fact that on its sites, plankto-

Table 7. Summary of prey categories by season and by site

S. No	Seasons	Prey	Sites				
			Moossou	Bimbresso	Lokodjro	p-value	X^2
1	Dry season	Phytoplanktons	93.4	96.06	96.15	0.0523	5.7924
		Zooplankton	0.80	1.45	1.08	0.2586	0.8787
		Débris	3.7	1.34	2.16	1.3309	0.5141
		Undetermined	2.1	1.15	0.61	0.9663	0.6168
2	Rainy season	Phytoplanktons	91.13	96.01	99.92	0.04559*	6.17
		Zooplankton	0.33	3.88	0	7.0211	0.02988
		Débris	7.5	0.11	0.08	15.0111	0.00055
		Undetermined	1.04	0	0	2.306	0.3157
3	Flood season	Phytoplanktons	99.22	98.25	98.16	0.05106	6.0517
		Zooplankton	0.71	1.58	1.78	0.6107	0.7369
		Débris	0.07	0.17	0.06	0.0752	0.963

nic communities suffer slight variations that do not have a big impact on them. These results corroborate those of Dufour (1994), which shows that, apart from sectors IV and V of the lagoon Ebrié that benthic communities are constant throughout the year, because confined, sectors II, III and IV are experiencing maximum diversity by dry season. This diversity fall rainy season and flood season, but still dominated by phytoplankton.

The diets of male and female *C. gasar* present no particular differences. Whether it is for females or males, diet is dominated by phytoplankton. Most of the work done on the diet of oysters in captivity made no difference between food consumed by males and those consumed by females (Egretaud, 1992; Baud, 1995; Bernard, 2012 and Ismail, 2015). These authors make no difference between food offered to males and the females as a part of their studies, probably because sexual dimorphism oysters is not an obvious observation. Indeed, the determination of this sexual dimorphism requires the sacrifice of animals and histological examination of the gonads.

The diet of *C. gasar* do not differ in terms of size classes. Phytoplankton are the preferred prey of oysters regardless of the size classes. These results are consistent with those of Bernard (2010). Indeed, in his study on the influence of food availability on the capture of oysters *(Crassostrea gigas),* the latter showed that the oyster larval (grub véligière) after 24 h approx (60 microns) are still living in their energy reserves. Eventually, they become strictly planktotrophic after five days around. Rico-Villa *et al.* (2010), made the same observation. It's very early that the oyster adopts planktonophagous diet . The animals of our study subjects are with a higher size to 2 cm, so are all plankton and in the environment we are concerned, planktonophagous. Oysters therefore keep the same diet growing up. This is not the case for all shellfish species. Unlike oysters, young cuttlefish have a different diet from that of mature and specialize their diet to one type of food growing (Castro and Guerra, 1990; Alves *et al.,* 2006; Evans, 2012 and Akesse *et al.,* 2016). The diet of *C. gasar* does not differ according to the stage of sexual maturity. Individuals stages 0, 1, 2, 3 all have the same diets that are dominated by phytoplankton. Zooplankton is negligible in the diet of these animals at all stages of sexual maturity. Our results agree with those of Kouato (2017), indeed, the work was carried on *Cardium costatum* (a marine bivalve) that mature individuals and immature have a similar diet. This author attributed the similarity of diets of individuals of different stage of maturity to food competition between individuals.

CONCLUSION

It appears from this study that a species is *C. gasar* planktonophagous, even that rare zooplankton appear in some stomachs. Its diet is dominated by phytoplankton on the three sites (Moossou, Bimbresso, Lokodjro) of the lagoon Ebrié some of the season, size, sex and sexual maturity. Diatoms are mainly represented in the food bowl. These diatoms, pinnate have numerical significance and a higher abundance to those centric, because of their smaller size than the latter.

REFERENCES

Akesse EV, Coffi FDA, Mamadou K, Jean DM and Otchoumou A. 2018. Study of the diet of the common cuttlefish *Sepia officinalis* of the exclusive economic zone (EEZ) of Côte d'Ivoire. *International Journal of Agronomy and Agricultural* Research, 9(1): 192-200.

Alves DM, Cristo M, Sendao J and Borges TC. 2006. Diet of the cuttlefish *Sepia officinalis* (Cephalopoda: Sepiidae) of the south coast of Portugal (eastern Algarve). *Journal of the Marine Biological Association of the United Kingdom* 86(02): 429-436.

Amundsen PA, Gabler HM and Staldvik FJ. 1996. A new approach to graphical analysis of feeding strategy from stomach contents data-modification of the Costello

(1990) method. *Journal of Fish Biology,* 48(4): 607-614.

Barillé L, Prou J, Héral M and Bougrier S. 1993. No influence of food quality, but ration dependent retention efficiencies in the Japanese oyster *Crassostrea gigas. Journal of Experimental Marine Biology and Ecology* 171(1): 91-106.

Baud. 1995. Rapport d'activité 1995 du Laboratoire. Génétique, aquaculture et pathologie DRV/RA/GAP. 275 p.

Berg J. 1979. Discussion of methods of investigating the food of fishes, with reference to a preliminary study of the prey of *Gobiusculus flauescens* (Gobiidae). *Marine Biology*, 50(3): 263-273.

Bernard I. 2012. Ecologie de la reproduction de l'huître creuse *Crassostrea gigas* sur les côtes atlantiques françaises : vers une explication de la variabilité du captage. Thèse de doctorat de l'Université de la Rochette (océanologie biologique et environnement marin) 199 p.

Bricelj VM and Malouf RE. 1984. Influence of algal and suspended sediment concentrations on the feeding physiology of the hard clam *Mercenaria mercenaria*. *Marine Biology,* 84(2): 155-165.

Castro B and Guerra A. 1990. The diet of *Sepia officinalis* (Linnaeus, 1758) and *Sepia elegans* (D'Orbigny, 1835) (Cephalopoda, Sepioidea) from the ria de vigo (NW Spain). *Scientia Marina,* 54(4): 375–388.

Compère P. 1986. Algues récoltées par J. Léonard dans le désert de Libye. *Bulletin du Jardin Botanique National de Belgique*, 56(1-2): 9-50.

Dabouineau L and Ponsero A. 2004. Synthèse sur la biologie des coques *Cerastoderma edule*. Réserve Naturelle Baie de St-Brieuc, 16 p.

Desikachary TV. 1959. Cyanophyta. ICAR. Monograph on Algae. New Delhi. 686 p.

Dufour P. 1994. Les microphytes *In* J.-R. Durand *et al.* (Eds.), *Environnement et ressources Aquatiques de Côte d'Ivoire. Tome II – Les milieux lagunaires*. 109 –136.

Dussart BH. 1980. Les copépodes. Flores et faunes aquatiques de l'afrique sahelo-soudanaise. Tome I; Durant JR and Lévêque C, (Eds.), ORSTOM, Paris. 1: 333-356.

Egretaud C. 1992. Etude de la biologie générale, et plus particulièrement du régime alimentaire de Lethrinus nebulosus du lagon d'Ouvéa (Nouvelle-Calédonie) Rapp. Sci. Mer Biol. ORSTOM Nouméa 45 p.

Evans HJ. 2012. The diet of the juvenile cuttlefish *Sepia officinalis* (Cephalopoda: Sepiidae) in the English channel. *Journal of the Marine Biological Association of the United Kingdom*, 15 p.

Furnestin ML, Maurin C, Lee JY and Raimbault R. 1966. Eléments de planctonologie appliquée. Revue des Travaux de l'institut des pêches maritimes. 30(2-3): 117 -283.

Gray AE, Mulligan TJ and Hannah RW. 1997. Food habits, occurrence and population structure of the bat ray, *Myliobatis californica*, in Humboldt Bay, California. *Environmental Biology of Fishes*, 49(2): 227-238.

Hennebelle JM. 1975. La coque. Thèse doctorat vétérinaire, Université de médecine de Créteil, 100 p.

Hureau JC. 1970. Biologie comparée de quelques poissons antarctiques (Nototheniidae). *Bulletin Institut Oceanographique Monaco*, 68(1391): 1-50.

Hyslop EJ. 1980. Stomach contents analysis, a review of methods and their application. *Journal of Fish Biology,* 17(4): 411-429.

Ismaël. 2015. Présentation de la fonction de nutrition de l'huître et du parcours des nutriments dans le tube digestif. *La nutrition de l'huître*.

Jumars PA and Penry DL. 1989. Digestion theory applied to deposit feeding, in: ecology of marine deposit feeders, G. Lopez, G. Taghon and J. Levinton, éditeurs. Lecture Notes on Coastal and Estuarine Studies, Springer-Verlag, 114-128 p.

Komàrek J and Anagnostidis K. 1998. Cyanoprokaryota teil: Oscillatoriales. In: Gärtner EG, Heying H and Mollenhawer D. (Eds.): süsswasserflora von mitteleuropa 19/1, Gustav Fisher, Jena, Stuttgart, Lübeck. 548 p.

Komàrek J and Anagnostidis K. 2005. Cyanoprokaryota 2nd part: Oscillatoriales. In : Büdel B, Gärtner G and Schagerl M. Eds.: Süsswasserflora von Mitteleuropa 19/2, Elsevier/ Spektrum, Heidelberg. 759 p.

Kouato F. 2017. Biodiversité des mollusques bivalves de la zone économique exclusive de la côte d'ivoire : croissance, reproduction et régime alimentaire de *cardium costatum* linné, 1758. Thèse unique de Doctorat de l'Université Nangui Abrogoua, Côte d'Ivoire, 174 p.

Krammer K and Lange-Bertalot H. 1991. Bacillariophyceae – 4. teil: achanthaceae, kritische ergänzungen Zu navicula (Lineolatae) und Gomphonema. 437 p.

Krammer K and Lange-Bertalot H. 2000. Bacillariophyceae – 1 teil. Naviculaceae. 331 p.

Lambert D, Cattaneo A and Carignan R. 2008. Periphyton as an early indicator of perturbation in recreational lakes. *Canadian Journal of Fisheries and Aquatic Sciences*, 65(2): 258-265.

Lauzanne L. 1975. Régimes alimentaire d'*Hydrocyon forskalii* (Pisces. Characidae) dans le lac tchad et ses tributaires. *Cahier ORSTOM. Série Hydrobiologie,* 9(2): 105-121.

Mohlenberg F and Kiorboe T. 1981. Partic1e selection in suspension feeding bivalves. *Marine Ecology Progress Series*, 5: 291-296.

N'Da K. 1992. Régime alimentaire du rouget de roche *Mullus surmuletus* (Mullidae) dans le nord de Golfe de Gascogne. *Cybium*, 16(2): 159-167.

Newell RIE and Jordan SJ. 1983. Preferential ingestion of organic matter by the American oyster *Crassostrea virginica. Marine Ecologie Progress Series,* 13(1): 47-53.

Paugy D and Lévêque C., 1999. Régimes alimentaires et réseaux trophiques. In : les poissons des eaux continentales africaines : Diversité, écologie et utilisation par l'homme. (Levêque, C., et Paugy, D., Eds.) Editions IRD, Paris. 167-190.

Pernet F, Malet N, Pastoureaud A, Vaquer A, Quéré C and Dubroca L. 2012. Les Diatomées marines à l'origine de la croissance des Bivalves dans une lagune méditerranéenne, *Journal of Sea Research*, 68: 20-32.

Pontin RM. 1978. A key to the fresh water planktonic and semi-planktonic *Rotifera* of the British Isles. *Scientific Publication: Fresh Water Biological Association*, 174 p.

Pourriot R, Capblancp J, Champ P and Meyer JA. 1982. Ecologie du plancton des eaux continentales. *Masson, Paris*, New York, Barcelone, 198 p.

Pourriot R. 1980. Les rotifères : Flore et faune aquatiques de l'Afrique Sahélo-Soudanienne: Durant JR. Et Levêque C, ORSTOM, Paris, 219-244 p.

Poutiers JM. 1998. Bivalves (Acephala, Lamellibranchia, Pelecypoda). In: Carpenter KE, Niem VH, eds. FAO species identification guide for fishery purposes: The living marine resources of the Western Central Pacific. Volume 1. Seaweeds, corals, bivalves and gastropods. FAO, Rome, 123–362 p.

Rico-Villa B, Bernard I, Robert R and Pouvreau S. 2010. A Dynamic Energy Budget (DEB) growth model for pacific oyster larvae, *Crassostrea gigas*. *Aquaculture*, 305(1-4): 84–94.

Robert JM. 1975. Le verdissement des huîtres dans les claires de la baie de Bourganeuf. *Bulletin de la société des naturalistes Ouest Fr,* 73: 123-129.

Rumeau A and Coste M. 1988. Initiation à la systématique des diatomées d'eau douce. *Bulletin Français de la Pêche et de la Pisciculture*, 309: 1–69.

Sandacz S and Kubo E. 1982. Copepoda (Calanoïda e Cyclopoïda) de reservatorios do estado de Sao Paulo. *Boletim do Instituto de Pesca*. 9(ùnico): 51-89.

Sarà G. 2007. Sedimentary and particulate organic matter: mixed sources for cockle *Cerastoderma glaucum* in a shallow pond, western Mediterranean. *Aquatic Living Resources,* 20(3): 271-277.

Sylvio D. 2008. Manuel de référence de l'ostréiculture: Agriculture et Aquaculture. New Nouveau Brunswich. 82 p.

Van DWA and Huls H. 1976. Diatomeeën flora van Nederland (diatom flora of the Netherlands) Otto Koeltz Science Publishers, 142 p.