ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research

Vol. 17, Issue, 01, pp.31199-31207, January, 2025
DOI: https://doi.org/10.24941/ijcr.48325.01.2025

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

CONTRIBUTION TO THE STUDY OF THE ICHTHYOPLANKTON POPULATION OF THE ESTUARY AND MANGROVE AREAS OF SANGARÉAH BAY

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ARTICLE INFO

Article History:
Received 20th October, 2024
Received in revised form
17th November, 2024
Accepted 24th December, 2024
Published online 24th January, 2025

Key Words:
Estuary Areas, Mangroves, Sangaréah Bay, Ichthyoplankon,

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ABSTRACT

This study concerns the fish population of the estuary and mangrove areas of the bay of Sangaréah carried out from January 2015 to December 2016, at the rate of a monthly sample, carried out in the first week of each month. The methodology used by (7) has been used for qualitative and quantitative studies of ichthyoplankton. Thus, the study made it possible to inventory 5938 individuals divided between 20 families and 30 species, dominated by the Clupeidae (26%). The high concentration of ichthyoplanktonic organisms is observed in the areas of Sonfonia, Samatran, Soumba and Arabanty. In short, the constant presence of eggs and larvae of ontogenetic stages make these areas of estuaries and mangroves environments for migration advection, ontogenetic development and food. Ichthyoplankton is one of the modern tools used in bio-indication and bio-monitoring of aquatic ecosystems. Has diverse population, dominated by eggs and larvs

Citation: GUISSE Ahmed, KONATE Daouda and SOW Djoulde. 2025. "Contribution to the study of the ichthyoplankton population of the estuary and mangrove areas of sangaréah bay*". International Journal of Current Research*, 17, (01), 31199-31207.

INTRODUCTION

Coastal environments consisting of mangroves and estuaries are places with significant natural and economic potential, which have long played and continue to play an important role for humanity (1). From a socio-economic point of view, these ecosystems constitute privileged spaces for the development of numerous activities, sources of employment such as port and industrial activities; rapid urbanization and tourism which provide a wide range of goods and services (2). In addition, fishing, fish smoking, wood cutting, salt production and rice cultivation are also the main activities that exist in mangroves. Today the trend is reversed in some coastal areas, especially in mangrove and estuarine areas because of the decline that this ecosystem is taking (3). Therefore, it is necessary to strengthen coastal management that aims to find a balance in order to protect the quality of the environment while meeting social and economic needs. It is in this regard that (4). through its Intergovernmental Oceanographic Commission (IOC), sets itself the objectives of promoting and facilitating international maritime and coastal research, in order to improve knowledge on critical global, regional and national issues on the oceans, seas and coastal areas (4). Sustainable management of resources with a view to their exploitation therefore requires knowledge and techniques to analyse and model the spatial and temporal distribution of natural resources. It must be based on in-depth research methods leading to the sustainability of the environment and its surroundings. Many authorsalso consider that theThe ichthyoplankton consisting of fish eggs, larvae and post-larvae is also strongly constrained by hydrodynamics. Not to mention the lack of knowledge about the origin, destination of the ichthyoplankton phases and the mechanisms governing larval drift in these two zones (5). Furthermore, although many authors have worked on ichthyoplanktonic organisms in the Republic of Guinea (((6); (7); (8); (9); (10); (11); (12), very little information exists in Sangaréah Bay. This insufficiency could not only irreversibly cause upheavals in the long term in the renewal processes of exploited stocks, but also and above all weigh on fish production in the long term. It is in this perspective that the present study proposes to make its modest contribution to the knowledge of the distribution of ichthyoplanktonic organisms. In general, it was aboutto assess the main characteristics of the ichthyoplankton fauna of the estuary and mangrove areas of Sangaréah Bay, with the aim of preserving this ecosystem.

MATERIALS AND METHODS

Study environment: Sangaréah Bay is one of the coastal ecosystems closest to the capital. Located northwest of the city

of Conakry between 9° 11 and 10° 5 north latitude and between 13° 29 mn and 13° 45 mn west longitude, it covers an area of 38,000 ha and was home to 49,318 inhabitants, from 51 villages including 6 in mangroves in 1999 (13). It is bordered to the east by Mount Kakoulima and part of the coastal range, to the west by the Konkouré River, to the north by the classified forest of Kabitaye, the sub-prefectures of Wassou and Tanènè, to the south by the Atlantic Ocean and the Kaloum peninsula. It is fed to the north by the Konkouré River, to the east by the Soumba River and to the south by the Sonfonia River. Sangaréah Bay is characterized by hydromorphic alluvial soils of marine or continental origin (14). Sangaréah Bay presents the characteristics of a typical estuarine area that fish use as a breeding, nursery, refuge or feeding area. This ecosystem also represents a transit point for juveniles before their migration into deep waters (15).

Material

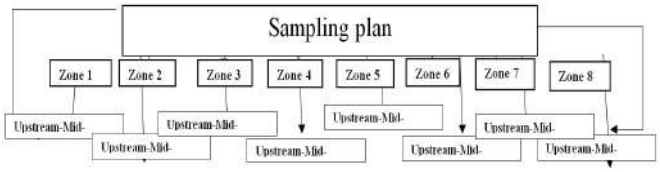
The following material was used to carry out this study

- Sampling and identification equipment for ichthyoplanktonic organisms: ichthyoplanktonic net, laboratory equipment and determination keys

Working methods

Documentary research: This research consisted of consulting documents (scientific articles, reports, dissertations, etc.) in libraries and on the website relating to the research theme.

Sampling plan: The description of the study areas was made according to the information collected in the literature, the response given by the perchers of this locality and the activities of the riverside populations of Sangaréah. All the information was important descriptive elements. At each campaign, sampling was carried out at three stations per watercourse (downstream, median and a have).



Study areas: To carry out this work and taking into account the various activities recorded in the area (wood cutting, salt farming, fish smoking, fisheries, domestic and agricultural wastewater), eight zones, distributed along the estuaries and mangroves were selected according to a downstream - upstream gradient and are defined as follows:

Eight areas of estuaries and mangroves prospected are dismayed by the physicochemical and ichthyoplanktonic analysis, the aim of which is to assess the quality of the waters. The areas explored are Sonfonia, Samatran, Soumba, Bonèya, Bouramaya, Touguissouri, Arabanty and Kandian Figure 1.

Sampling and processing of ichthyoplankton population: The measurement of the physical and chemical parameters of the water in the estuary and mangrove areas of Sangaréah Bay and the collection of samples of the ichthyoplanktonic population were carried out from January 2015 to December 2016., at the rate of a monthly withdrawal, made in the first week of each month.

The methodology used by (7) was used for qualitative and quantitative studies of ichthyoplankton. All fish larvae were sorted, identified and counted,identificationtaxonomicwas based on the guide of(16);(17);(18);(19);(20);(21) ;(7);(22). Larvae per sample were measured (standard length) using a micrometer eyepiece (± 0.1 mm) and the microscopic USB stick. Meristic characteristics concern measurements of total length, standard length and weight. Note that all these characteristics (morphological and meristic) were taken to the point of identifying the species.

RESULTS

Characterization of the ichthyoplankton population

The main characteristics of the ichthyoplankton population concerned by this study are:

- The qualitative study (consists of studying the taxonomic composition) and quantitative (estimating the biomass and density)
- Diversity (diversity index).

Qualitative study: It follows from the table above that the ichthyoplankton population composed of: 5938 individuals distributed between 20 families and 30 species identified across all the study areas. is dominated by the following families:

Albulidae (4%); Ariidae (3%); Clupeidae (26%); Carangidae (7%); Cichlidae (1%); Cynoglossidae (6%); Drepanidae (5%); Elopidae (1%); Exocoetidae (%); Gobidae (3%); Mugilidae (9%); Polynemidae (%); Pristigastridae (%); Sciaenidae (%); Tetraodontdae (%); Trichiuridae (%); Sphyraenidae (3%); Sparidae (1%); Syngnathidae (1%); Hemiramphidae (1%) (Figure 2). The dominant species were: Ethmalosa fimbriata 9%, Sardinella aurita 8%, Sardinella maderensis 8% and the weakest were represented by Sparus auratus 1%, etc. (figure 3). The qualitative analysis shows that the study areas are rich in ichthyoplanktonic organisms. Species of the Clupeidae family are widely represented in the estuary and mangrove areas of Sangaréah Bay, representing 26%, followed by 6% and Trichiurus lepturus with 2%. This study provides the results of the first inventory, which would currently be the most exhaustive of the areas surveyed, all the species recorded have already been described by (8). Among these 27 ichthyoplanktonic families reported 5 families, 5 species and 514 individuals appear in our samples and the other 7 are absent in the captures of (8). The presence or absence of a species in our fisheries is probably due to the tolerance or not of the species to the abiotic factors of the area (salinity, turbidity, temperature, tidal cycle, etc.), to the choice of stations, and to the difference in sampling gear and techniques.

Quantitative study: For the quantitative study of the ichthyoplankton population, density, biomass and egg counts were determined over time and space. The assessment of the variation in density (Figure 3) and the average biomass (Figure 4) of the ichthyoplankton population shows peaks during the months of June to September corresponding to the rainy season in the study area. In June, which totals 8.01 ind/m3 of which 1.57% are represented by the Clupeidae family which are the most diverse and abundant according to the downstream-upstream gradient.

Table 1. Geographic coordinates of the study areas

No. of zones	Name of the areas	Latitude (N)	Longitude (W)	Depth (m)
1	Sonfonia	9°43'59.73"	13°35'56.53"	3.5 - 7
2	Samatran	9°44'41.03"	13°32'30.99"	5.5 -9
3	Soumba	9°47'54.00"	13°32'38.04"	6.5 –9.9
4	Bonèya	9°48'59.83"	13°37'37.61"	8.6 – 9.89
5	Bouramaya	9°53'24.51"	13°39'35.85"	6.89 – 11.54
6	Touguissourie	9°55'37.32"	13°39'47.77"	5.7 – 12.54
7	Arabanty	9°47'46.38"	13°44'48.46"	4.7 – 6.82
8	Kandian	9°55'37.32"	13°41'37.53"	4.3 – 9.52

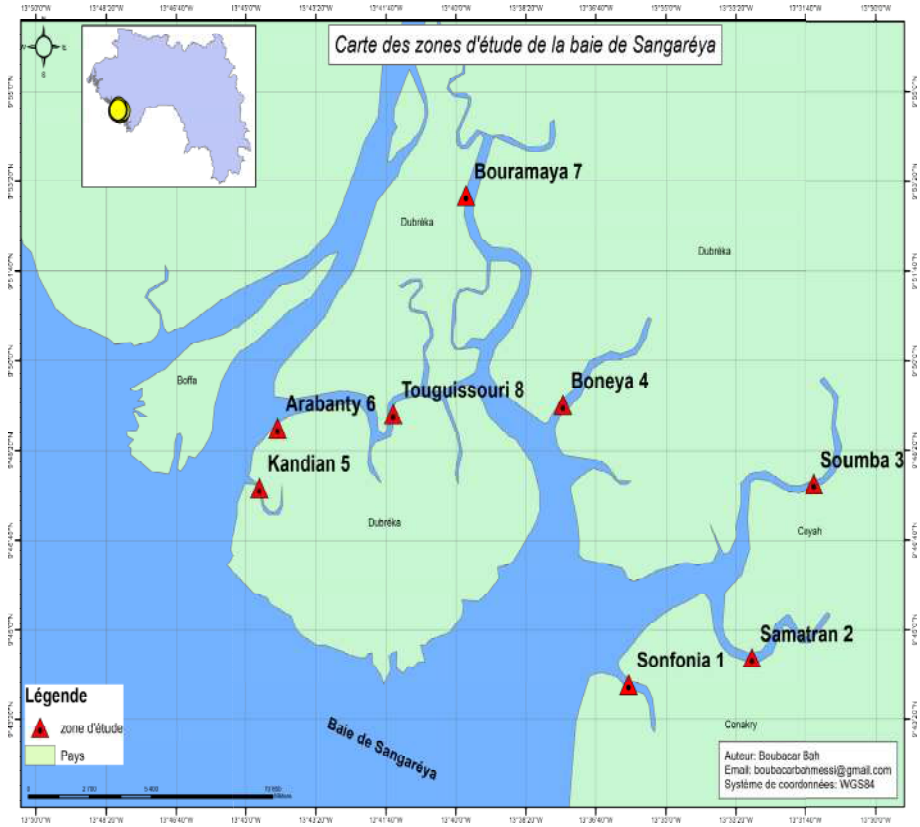


Figure 1. Map of the study area

Table 2. Inventory of ichthyoplankton population

Reign	Branch	Classes	Orders	Families	Abundance(%)	*Genres*	*Species*
Animalia	Chordata	Actinopterygii	Albuliformes	Albulidae	3.76	*Albula*	*Albula vulpes*
		Actinopterygii	Siluriformes	Ariidae	3.33	*carlarius*	*Arius latiscutatus*
						carlarius	*carlarius heudelotii*
		Actinopterygii	Clupeiformes	Clupeidae	26.12	*Ethmalosa*	*Ethmalosa fimbriata*
						Sardinella	*Sardinella aurita*
							Sardinella maderensis
		Actinopterygii	Perciformes	Carangidae	6.53	*Caranx*	*Caranx hippos*
							Chloroscombrus chrysurus
						Trachurus	*Trachurus*
		Actinopterygii	Pleuronectiformes	Cichlid	1.20	*Sarotherodon*	*Sarotherodon melanotheron*
		Actinopterygii	Perciformes	Cynoglossidae	5.84	*Cynoglossus*	*Cynoglossus senegalensis*
							Cynoglossus monodi
		Actinopterygii	Elopiformes	Drepanidae	4.72	*Drepane*	*Drepane africana*
		Actinopterygii	Beloniformes	Elopidae	1.21	*Elops*	*Elops senegalensis*
			Beloniformes	Exocoetidae	2.31	*Cheilopogon*	*Cheilopogon cyanopterus*
		Actinopterygii	Perciformes	Gobidea	2.76	*Periophthalmus*	*Periophtalmus barbarus*
			Mugiliforms	Mugilidae	9.40	*Lisa*	*Liza falcipinnis*
							Liza Grandisquamis
		Actinopterygii	Perciformes	Polynemidae	9.55	*Galeoides*	*Galeoides decadactylus*
						Pentanemu	*Pentanemus quinquarius*
				Pristigasteridae	4.45	*Ilisha*	*Ilisha africana*
			Perciformes	Sciaenidae	9.75	*Pseudotolithus*	*Pseudotolithus elongatus*
							Pseudotolithus epipercus
							Pseudotolithus typus
			Tetraodontiformes	Tetradontidae	3.35	*Ephippion*	*Ephippion guttifererum*
			Perciformes	Trichiuridae	0.64	*Trichiurus*	*Trichiurus lepturus*
			Perciformes	Sphyraenidae	2.75	*Sphyraena*	*Sphyraena barracuda*
				Sparidae	0.62	*Sparus*	*Sparus auratus*
			Syngnathiformes	Syngnathidae	0.96	*Hippocampus*	*Hippocampus punctulatus*
			Beloniformes	Hemiramphidae	0.51	*Hemiramphus*	*Hemiramphus brasiliensis*

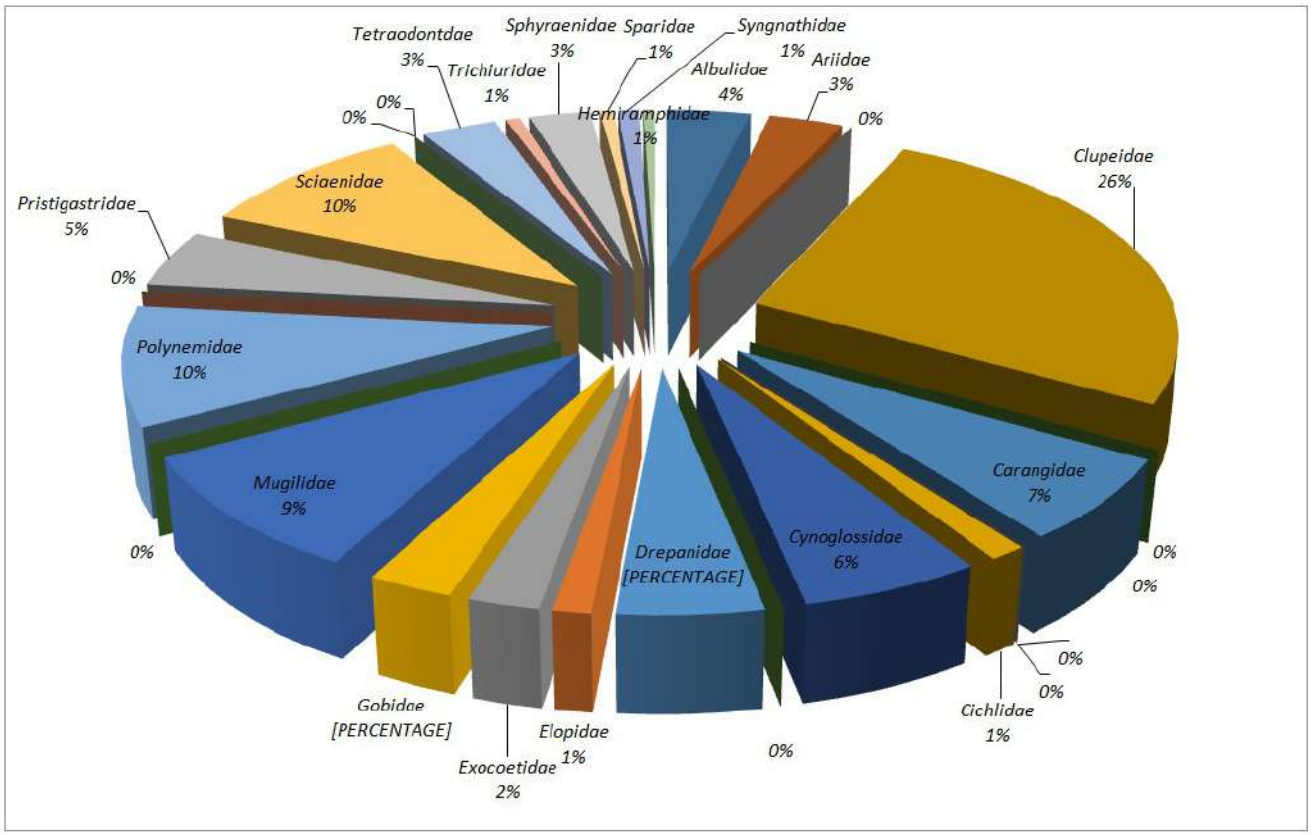


Figure 2. Proportion of fish larval families in the estuary and mangrove areas of Sangaréah Bay

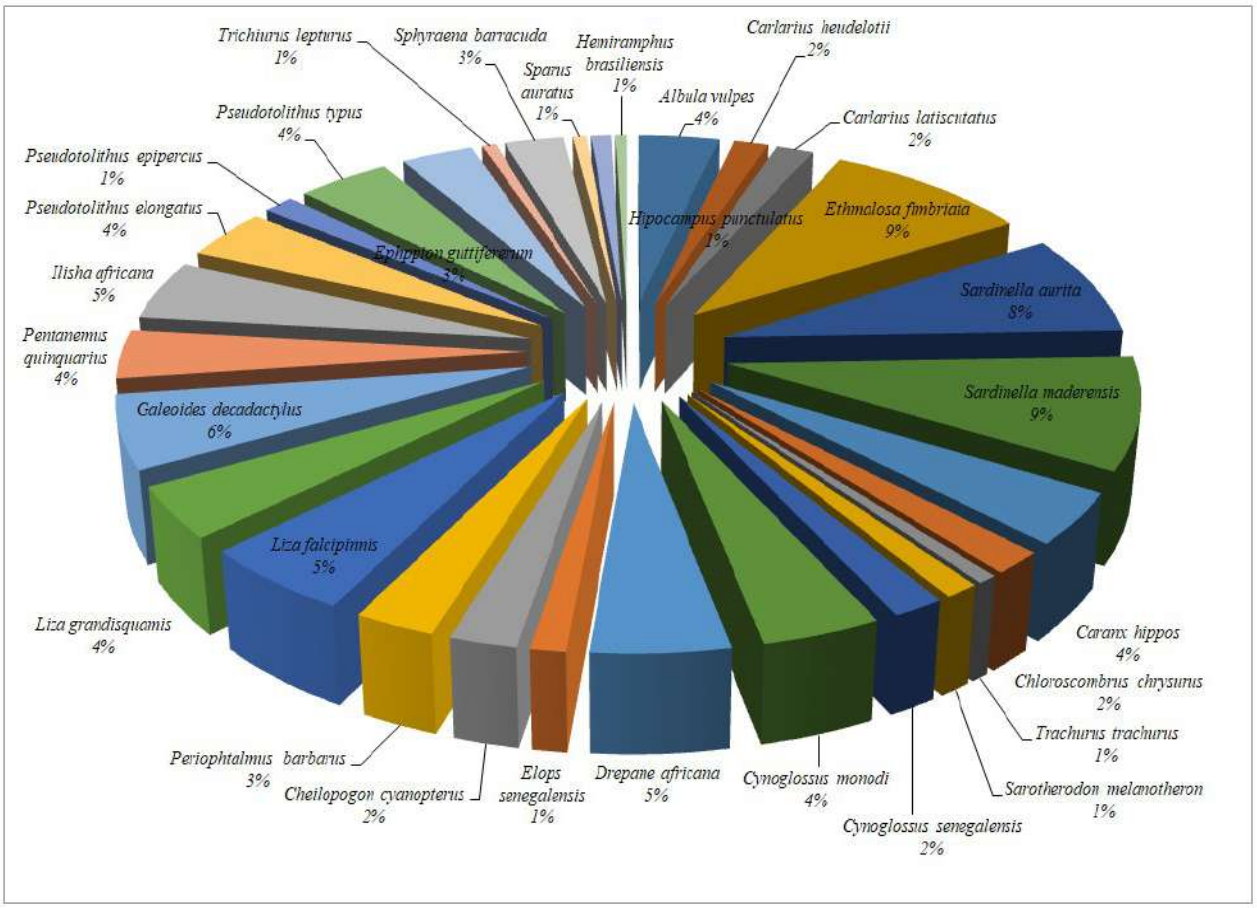


Figure 3. Proportion of larvae of fish species in the estuary and mangrove areas of Sangaréah Bay

Density of ichthyoplankton species

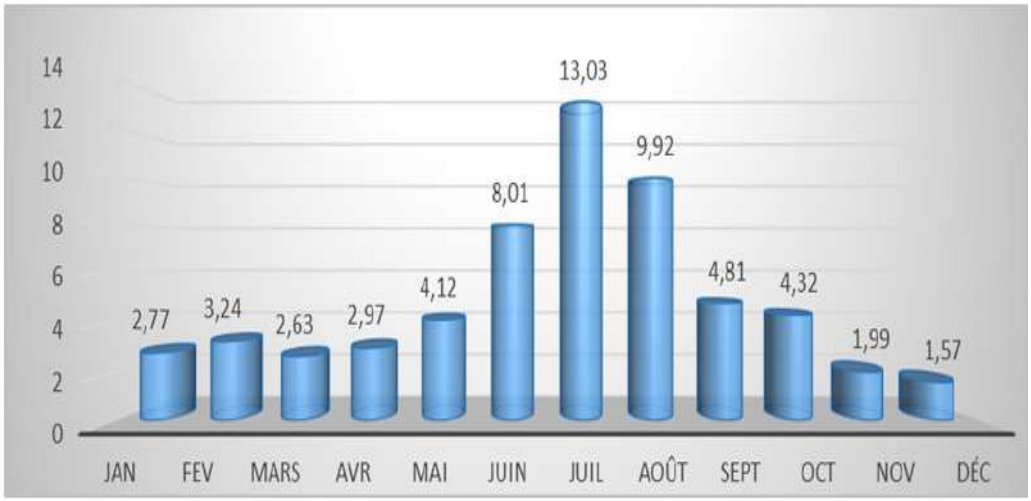


Figure 4. Monthly variation in the density of the ichthyoplanktonic population

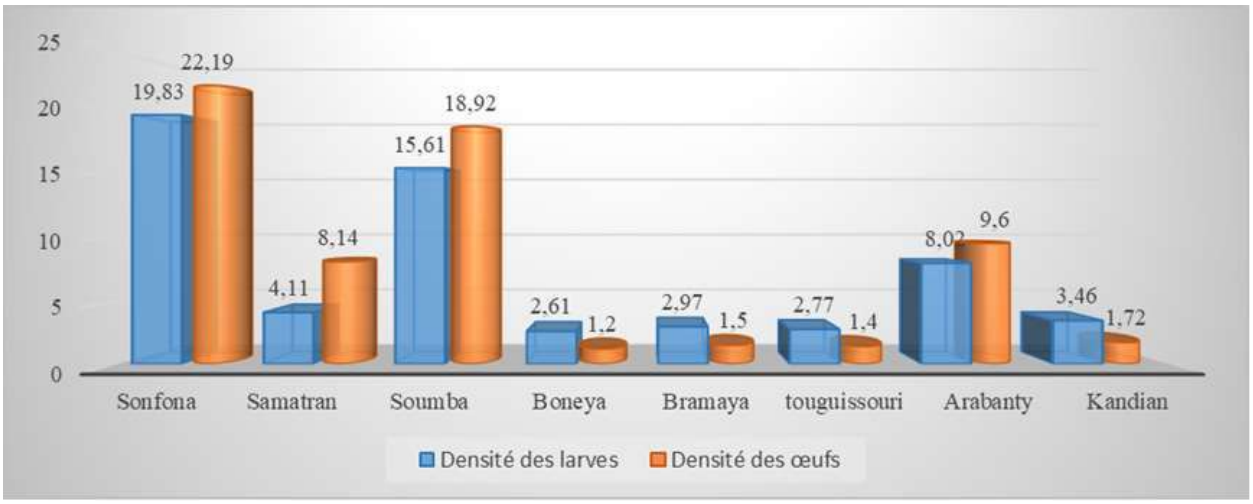
Biomass of ichthyoplankton species

Figure 5. Monthly variation in the biomass of the ichthyoplankton population

Counting ichthyoplankton eggs

Figure 6. Monthly variation in the number of eggs

Ichthyoplankton density by zones



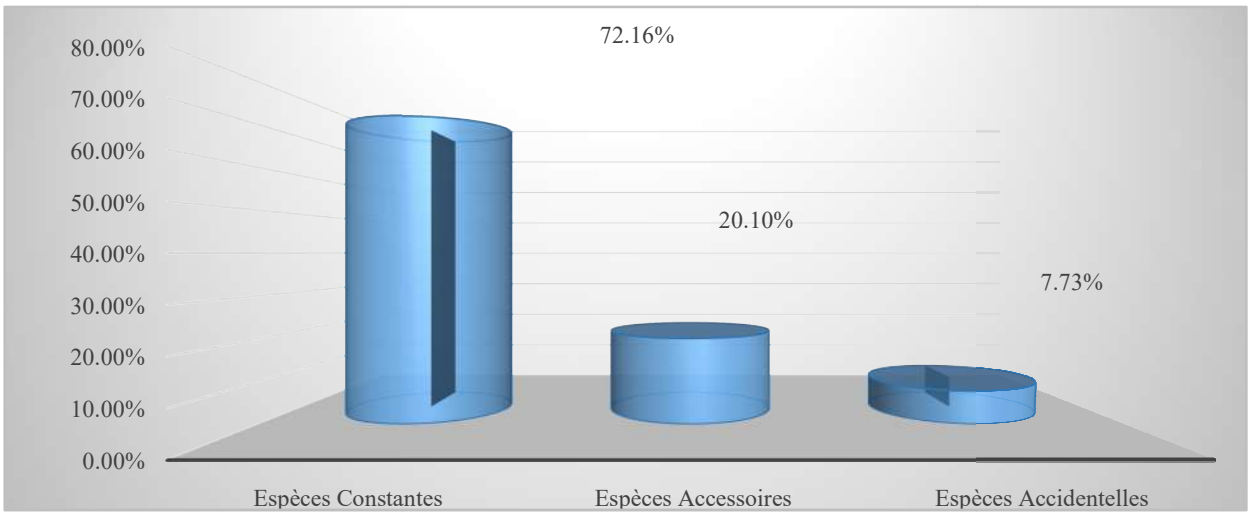


Figure 8. Frequency of occurrence (C in %) of the different ichthyoplankton families

Table 3. Sorensen similarity index of the 8 sampled areas

Areas	Sonfonia	Samatran	Soumba	Bouramaya	Touguissouri	Arabanty	Kandian	Bonèya
Sonfonia	70.79	55	62.65	51.06	62.65	58.62	58.25	100
Samatran	56.45	54	61.53	52.06	51.21	52.65	100	
Soumba	55.04	49.98	62.5	53.06	57.65	100		
Bouramaya	42.55	51.54	62.65	54,66	100			
Touguissouri	50.25	66.25	55.54	100				
Arabanty	55.05	58.56	100					
Kandian	58.45	100						
Bonèya	100							

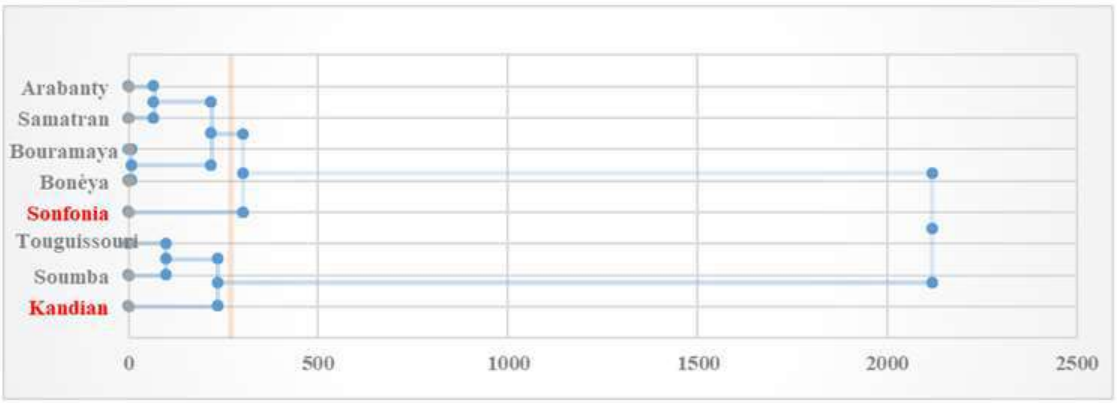


Figure 9. Dendrogram of the clustering in the 8 sampled areas

In this family, the Sardinella and Ethmalosa genus predominate with respective biomasses of 58.29 to 65.56 g/m3. In July, which represents a density close to 13.63 ind/m3 of which 26% of the individuals belong to the Clupeiformes class; the Sardinella and Ethmalosa genera also predominate by totaling a biomass of 12.72 g/m3 and a density of 13.63 ind/m3 respectively. The month of August, which records an average biomass of 10.9 g/m3 and a density close to 9.72 indu/m3 of which 8.5% are clupeiformes; it is also the genus Sardinella which records the highest density. Although less pronounced, the month of September, which records 4.81 ind/m3 of which 5% are represented by the Clupeidae family, it is the genera Sardinella and Ethmalosa which predominate with respectively 5.8 and 2.9 ind/m3 of density and a biomass of 65.26 g/m3. The monthly variation in the number of eggs (Figure 5) demonstrates the abundance during the months of June to August with a total average of 1134 eggs for 156 eggs on an annual average. In the middle of the rainy season (July – August), this average increases to 1501 eggs.

By observing the different values obtained (figures 3, 4 and 5), we see that it is in July that there is the highest concentration of the ichthyoplankton population in terms of density, biomass and number of eggs. Followed respectively by the months of August, June and September. These first two months justify the choice of the period for establishing biological rest in Guinea. The observed decrease in species density (Figure 4) from November to April, practically the dry season in the study areas, corroborates with the hypothesis of a seasonal succession, under the influence of predation on fish fry, deteriorating water quality and competition between species (24). It should be remembered that the dry season is characterized by low values of pH, dissolved oxygen, turbidity, conductivity and nutrients. On the other hand, the rainy seasons are distinguished by high values of nutrients (orthophosphates, nitrates and nitrites). This allows us to affirm with (25) that only the "season" factor influences the abundance and distribution of ichthyoplanktonic species. Also, the presence of eggs, larvae and juveniles of some coastal and marine species in the study areas sufficiently shows that estuaries and mangroves are places of reproduction, migration, fry and nursery. This information is consistent with the results obtained by (10). who states that in estuary and mangrove areas, the peak of biomass and density of larvae is pronounced in July and August.

In summary, the studied areas are characterized by a high concentration of planktonic organisms. The maximum values of density and biomass were obtained during the rainy season. While the minimum values were observed during the dry season. This could be explained by the contribution of continental waters rich in nutrients. According to some specialists such as (26)., this period corresponds to the decrease in the contribution of coastal waters coming from the continent due to the weakening of the inter-trade wind current. At this time, the influence of the Canary Current does not reach the Guinean sector, which causes the subsidence of upwellings and consequently the decrease in the quantity of plankton in the coastal zone Figure 7. The high concentration of ichthyoplanktonic organisms is observed in the areas of Sonfonia, Soumba, Arabanty and Samatran which total a density whose value varies between 156.1 and 198.3 ind/100m3. These areas are characterized by a massive presence of poison eggs, which suggests the hypothesis of ontogenetic development. In short, the constant presence of eggs and larvae of ontogenetic stages make these estuarine and mangrove areas advection environments for migration, ontogenetic development and food. Furthermore, the quantitative study of ichthyoplankton shows significant variations depending on the location of estuary and mangrove areas in relation to communication with the sea. Remote areas, receiving a low marine input, present very low and unstable abundances or specific richness. It should be noted the presence of various larval stages of meroplankton: Molluscs, Cephalopods (Cuttlefish, Squid), Crustaceans, Decapods (Shrimps, Lobsters, Crabs, Mantis shrimp, etc.) and phytoplankton, which demonstrates the diversity of the ichthyoplanktonic net in the sampling of hydrobionts.

Evaluation of frequency of occurrence: In order to have an idea of the organization and structure of the different ichthyo-planktonic populations inventoried, we calculated the frequencies of occurrence of the different families inventoried and the Similarity between the structure of the ichthyoplanktonic populations. The frequency of occurrence or the constancy C in % provides information on the species characteristic of the areas. A total of 10 families (72.16%), are considered constant having a cosmopolitan distribution with a broad ecological spectrum that are found in all the study areas. Also, 3 families (20.10%) are considered accidental and 7 families are accessory. Regarding the frequency of occurrence, we note a relative numerical resemblance between the groups of constant and accidental genera (Figure 8). The majority of the species reported as constant tolerate the various abiotic parameters characterizing their habitat. The presence of 72% of ichthyoplanktonic families with a frequency of occurrence of the "constant" type (C > 50%) indicates that these species have a high ecological valence and can withstand the conditions of different habitats. Accessory species can, on the other hand, develop in a particular type of biotope or at fairly limited periods of the year.

Similarities between the structure of ichthyoplankton populations (Sorenson similarity index): Based on the presence or absence of species in the studied areas, we compared the composition of ichthyoplankton populations taken two by two using the calculation of the Sorensen similarity index. This index is obtained from common genera, taken two by two. The calculated similarity index is greater than 50% in most cases of comparisons between the areas taken two by two. The highest rate of resemblance is noted between the areas; of Sonfonia of Samatran, of Bouramaya, of Bonèya and of Arabanty where the coefficient of similarity is 63.79%. The similarity between the areas taken two by two could be explained by the fact that they generally offer the same ecological conditions to the ichthyoplanktonic population. It is surely not accidental, because it reflects the action of the situational ecological conditions, in particular those of the action of the physico-chemical properties of the water on the development of these ichthyoplanktonic populations. The structure of the ichthyoplankton population shows a similarity between the different areas studied, thus demonstrating the resemblance of environmental conditions, in particular the physicochemistry of the water. The ichthyoplankton population of the Sonfonia area is closest in composition to that of Soumba and Samatran where the recorded values are 63.79% and 62.65% respectively. This similarity represents the greatest resemblance between the estuary and mangrove areas studied and the physicochemical parameters of the environment that characterize them.

The grouping of the sampling areas by means of a dendrogram using the simple link and for a minimum similarity level, makes it possible to distinguish 2 distinct homogeneous groups which are:

- The first group: includes the areas of Sonfonia, Bonèya, Samatran, Arabanty and Bouramaya.
- The second group: contains the areas of Kandian, Touguissouri and Soumba.

Furthermore, the grouping of variables using the simple link gives a similarity rate of (63.79%) which is greater than 50%. Figure 45 represents the dendrogram of the grouping of the sampled areas studied. In light of our results it was found that there are significant differences between the 8 studied areas, this difference can be related to the difference of seasons. In addition, the differences depend on the diet of the ichthyoplankton population in each sampled area, the physiological state of the individuals at the time of sampling and even the sampling period.

CONCLUSION

The study made it possible to inventory 5938 individuals divided between 20 families and 30 species, dominated by Clupeidae (26%). The high concentration of ichthyoplanktonic organisms is observed in the areas of Sonfonia, Samatran, Soumba and Arabanty. A particularity of the areas (Sonfonia, Samatran, Soumba and Arabanty) is that the peak of eggs is higher than the larvae which suggests the hypothesis of an ontogenetic development of reproduction and nursery. Ichthyoplankton is one of the modern tools used in bioindication and biomonitoring of aquatic ecosystems. A diverse population, dominated by fish eggs and larvae, is an indicator of the proper functioning of the prospected ecosystems. Depending on the classification of these areas, the data would correspond to the characteristics of a eutrophic zone.

The areas of high biomass and high concentration of larvae identified in this study could be essential reference indicators for (i) the creation of Marine Protected Areas (MPAs) or Protected Fishing Zones (PFZs)(ii) and the application of biological rest for the benefit of sustainable management and rational exploitation of fishery resources. With the extent of the anthropogenic pressures that threaten these ecosystems, it is absolutely necessary to establish these environments as protected areas with a ban on certain economic activities (fishing, cutting of mangrove wood, etc.). Further research into other links in the food chain and extend these studies to the entire coastal zone.

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