Scholar Publishing Group
Academic Journal of Agricultural Sciences
https://doi.org/ 10.38007/AJAS.2021.020304
ISSN 2789-8415 Vol. 2, Issue 3: 42-54

Ecotourism of Small Benthic Animals in Anchovy Spawning Grounds in the South Yellow Sea

Yucheng Li

Guangxi Normal University, Guilin, China

lyc0658@gxnu.edu.cn

Keywords: Small Benthic Animals, Marine Nematodes, Anchovy Spawning Ground, South Yellow Sea

Abstract: In order to study the ecotourism of small benthic animals in the southern Yellow Sea anchovy spawning grounds, this article uses sediment samples obtained from 10 sites in the southern yellow sea anchovy spawning grounds in June 2018 to determine the abundance and abundance of small benthic animals. Related researches on biomass and environmental factors have provided environmental evaluation indicators for the study of microbenthic ecotourism in anchovy spawning grounds in the South Yellow Sea. The survey results show that the average abundance of small and medium-sized benthic organisms at different depths in the South Yellow Sea sediments, such as the surface (0-2cm), the deeper layer (2-5cm) and the deepest layer (5-8cm), is 890.8ind.10cm- 2. The average biomass is 1220μg.10cm-2; 10 environmental factors in the sediments, such as the depth of water, the temperature of the bottom water of the sediment, the amount of organic matter, the amount of chlorophyll, the amount of pheophorbide, and the water content, Ch-a, the amount of sand, clay (%) and the median particle size and other parameters show a correlation, among them, the abundance is negatively correlated with water depth ($r=-0.579$, $P<0.05$), and Ch- a is positively correlated ($r=0.497$, $P<0.05$), abundance and biomass are negatively correlated with bottom surface water temperature and clay content ($r=-0.357$, $P<0.05$); a total of 17 species of small benthic animals at different depths have been identified Among them, marine nematodes (74%), copepods (14%), and polychaetes (7%) are the most important populations in terms of numbers; in comparison with other sea areas, the South Yellow Sea anchovy spawning ground The groups and numbers of meiobenthos are very close to those of other sea areas; in terms of vertical distribution, meiobenthos gradually decrease at the surface, sub-surface, and deep layers of sediments, and different species are distributed in depth. There is a significant difference on the above. This paper studies and analyzes the biocommunity composition and biodiversity characteristics of the microbenthos in the anchovy spawning grounds in the South Yellow Sea, which can be used to protect the microbenthos in the anchovy spawning grounds for ecotourism and real-time detection of the marine environment in the South Yellow Sea. Contributed to the theoretical foundation.

1. Introduction

In recent years, with the promotion of international organizations, research on marine ecotourism has become active. The starting point of early marine research was that humans blindly demand marine energy and food, but did not pay too much attention to the interaction between the dynamic process of marine ecological environment, regional environment and global climate change, leading to prominent problems of marine ecological crisis, and global climate change in recent years. Gradually deteriorate. Therefore, an indicator is needed for real-time monitoring of marine ecology and ecological health assessment. There are many small benthic animals [1-2], numerous and widely distributed, existing in land, fresh water and deep oceans, and high or no oxygen on the surface of the earth. In the North and South Pole. Therefore, the study of meiobenthos is conducive to the study of the biological diversity of the region, the dynamic process of the interaction of surrounding environmental factors, and the coupling mechanism of various parameters. Therefore, it is widely used in the research of real-time monitoring of the marine environment, providing a direction for the research of marine ecotourism. Anchovy spawning point [3] and juvenile anchovy breeding point are located in the southwest of the South Yellow Sea [4]. The distribution of water flow system, benthic organisms and sedimentary environment formed in the South Yellow Sea presents a clear gradient with the change of water depth, which can reflect the response position of the benthic ecosystem to climate change. In addition, it is also an area where various human activities are concentrated. In recent years, with the rapid population growth and various frequent construction activities, marine biodiversity is facing a huge survival crisis, leading to the gradual disappearance of many organisms. Therefore, it is urgent to strengthen the research of biodiversity and protect the marine ecosystem.

Small benthic organisms are the main members of the marine detrital food chain, mainly distributed in coastal areas. In coastal waters, economic organisms cannot directly absorb surface runoff and organic waste into the ocean, so bacteria and benthic organisms must be used to complete the energy cycle. In addition, most of the spawning areas of anchovy and juvenile fish are located in the southern part of the Yellow Sea. In marine life monitoring, microbial communities are the most economical and ideal food for fish, shrimp, and shellfish larvae. They are also major members of the benthic food chain and play an important role in the marine ecological cycle. The microbial community mainly feeds on organic debris and microalgae in the sediment. The amount of feed and microbial output is basically balanced, which is conducive to the regulation of microbial production processes. In addition, the abundance of macrobenthos and macrobenthos is limited to some extent by macrobenthos and macrobenthos. The biomass of meiobenthos generally does not exceed 21% of that of macrobenthos. However, the production of small benthic animals is not lower than that of macrobenthos. There is evidence that the breeding of microbenthos and the regulation of other microorganisms have a global and large-scale impact. In recent years, with the establishment of the marine ecosystem health and ecological environment monitoring and evaluation system, the abundance of small benthic species has become a monitoring indicator for marine environmental surveys.

Anchovy spawning sites in the South Yellow Sea are for the analysis of small benthic animal ecotourism. This article selects the spawning sites 9162, 8394, 8451, 7794, 7483, 8062, 7994, 8594 of the South Yellow Sea in June 2018, 9394, 8794, etc. [5-7], and then collect samples from the sediment [8-9]. The diameter of the plastic tube is 2.9cm. In order to study the spatial distribution of small benthic animals, the sediment samples from the spawning grounds of anchovy are deeply stratified, and the samples are sequentially stored in flasks. In order to analyze the small benthic animals in the sediments, the samples in the jars were soaked in a certain concentration of formaldehyde solution. At the same time, in order to analyze the content of organic matter and chlorophyll a in the sediment, some samples need to be stored in the freezer. For the statistics of the abundance of small benthic animals and the biomass of benthic organisms, it is necessary to drop 3.0ml tiger red solution into the storage sample bottle. After vibrating for 24 hours, the sieve with a diameter of 0.5 mm was filtered through a sieve with a diameter of 0.031 mm. In this way, we can filter out a large number of mature small benthic animals. Finally, the small benthic animals are filtered in a petri dish and transferred to a dissecting microscope for quantitative statistics. Then fix the statistics of free-living marine nematodes, copepods, polychaetes, ostracods, bivalves and many other species in plastic bottles of each species, and add a certain concentration of formaldehyde solution [10-12].

Based on the above background, in order to study the ecotourism analysis of small benthic anchovy spawning grounds in the South Yellow Sea, this article conducted a sampling survey on the spawning grounds of anchovy in the South Yellow Sea and analyzed the small size of anchovy spawning grounds in the South Yellow Sea. Benthic animals. Full reading of a large number of literature studies shows that in the study of abundance and biomass, meiobenthos are very beneficial to biodiversity in the South Yellow Sea and its surrounding waters, the dynamic process of the interaction between environmental factors and various parameters the coupling mechanism can be applied to the South Yellow Sea and its surrounding waters. The research of real-time monitoring technology provides a direction for the research of marine ecotourism. The average abundance of benthic organisms in the surface layer (0-2cm), subsurface layer (2-5cm) and deep layer (5-8cm) is 890.8 ind.10cm-2, and the average biomass [13-14] is 1220μg.10cm-2. 10 environmental factors in sediments [15] such as depth of water, bottom temperature of sediments, amount of organic matter, amount of chlorophyll, amount of pheophorbide, water content, Ch-a, sand content, clay content (%) and the median particle size, etc. There is a correlation between the abundance and biomass and the negative correlation with the bottom water in marine nematodes [16] (88.1%), schilopods [17] (16.3%), Hairy [18] (4.1%). The results show that the spawning grounds of anchovy in the South Yellow Sea are similar to those in other sea areas. In terms of spatial distribution, small benthic animals are mainly distributed in the surface layer, rarely in the deep layer. Different types of benthic animals have different distributions on the surface, subsurface and deep layers. This study analyzed the community structure and diversity of small benthic animals in anchovy spawning grounds in the South Yellow Sea, which can be used for real-time monitoring of the marine environment.

2. Sedimentary Environment of Meiobenthos

This article uses sediments sampled at 10 locations in the southern Yellow Sea anchovy spawning site in June 2018 for research. The geographical location of the South Yellow Sea is 35^0-37^0 north latitude and 120^0-124^0 east longitude. It refers to the foothills of the Korean Peninsula in the north of the Shandong Peninsula, and the oval semi-enclosed sea area north of the Yangtze River estuary to Jeju. The biological communities of the South Yellow Sea are closely related to the environment. Therefore, before analyzing the ecological characteristics of benthic organisms, it is necessary to analyze the sedimentary environment where small benthic animals live.

2.1. Characteristics and Types of Sediments

Research and analysis of sediments show that sediments are mainly composed of six types of sediments: coarse silt, clayey silt, silty clay, sand-silt-clay, silty sand and sandy silt. It contains organic matter, chlorophyll a, pheophorbide a, sand, clay content (%) and median particle size, etc.

The types of sediments at each site are shown in Table 1.

Table 1. Sediment types at the research site

Station	Type of sediment	Station	Type of sediment
9162	Sand-silt-clay	7994	Clay silt
8394	Sandy silt	8594	Silty clay
8451	Sand-silt-clay	9394	Silty sand
7794	Silty clay	8794	Silty clay
8062	Clay silt	7483	Coarse Silt

The main environmental parameters of the distribution of meiobenthos in sediments are as follows:

(1) The particle size of the sediment. The sediments are mainly composed of coarse silty soil, clayey silty soil, silty clay, sandy silty clay and sandy silty soil. They are sandy silty clay (9162, 8451), silty clay (7794, 8594, 8794), clay silty clay (8062, 7994), silty sand (9394), coarse silty clay (7483) and sand Quality silty clay (8394). The sediments in the South Yellow Sea are dominated by silty clay, gradually decreasing from the coast station to the central station.

(2) Chlorophyll a in sediments. To a certain extent, the content of chlorophyll a can become a benchmark for measuring the food sources of small benthic animals and the environment of seabed sediments. The chlorophyll a content of the surface layer (0-2cm) is 0.0743mg/kg, the subsurface layer (2-5cm) is 0.0437mg/kg, and the deep layer (5-8cm) is 0.0362mg/kg.

(3) Folate green a. According to the spatial distribution of sediments, the content of the outermost part of the sediment is 0.386mg/kg, the content of (2-5cm) is 0.287mg/kg, and the content of pheophorbide a in the deep layer (5-8cm) It is 0.341mg/kg. The results showed that the content of pheophorbide a was the highest (8451 station and the lowest 9394 station).

(4) Organic matter content. The organic matter content of the surface layer (0-2cm) is 0.278mg/kg, the organic matter content of the subsurface layer (2-5cm) is 0.359mg/kg, and the organic matter content of the deep layer (5-8cm) is 0.491mg/kg. The organic content is 3.2% on average, and the highest is 5.8%.

2.2. Composition Analysis in Sediments

This paper uses the 7 environmental factors obtained from the sediment samples obtained by sampling to do a principal component analysis. The analysis results show that the largest content of PC1 is the depth of water (-0.389), followed by the content of organic matter (-0.380), with the smallest contribution is the sand content (0.023); the highest content of PC2 is pheophorbide a (-0.587), followed by water content (-0.543), and the lowest is clay content (-0.125). The specific results are shown in the Table 2.

Table 2. PCA analysis results

Variable	PC1	PC2
Water Depth	-0.389	-0.587
Gravel	-0.380	-0.543
Sand	0.023	0.299
Clay	-0.363	-0.125
Water Content	-0.299	-0.128
Chl–a	0.081	0.261
Silt	-0.051	-0.318

2.3. Sampling Method

This article collected sediment samples using plastic sampling tubes with an inner diameter of 2.9 cm in 10 locations of the Southern Yellow Sea eel spawning site in June 2018. The sediment samples were sampled according to the depth of the sediment, such as surface layer, subsurface layer and deep layer. In order to detect small benthic animals in the sediment for analysis, the samples are stored in plastic jars and immersed in a certain concentration of formaldehyde solution. In addition, in order to analyze the organic matter and chlorophyll a content in the sediment, some samples need to be stored in the freezer. When calculating the abundance and biomass of small benthic animals, 3.0ml of solution was added dropwise to the jar where the sample was stored, shaken slowly, and left for 24 hours. Pour the sample into a 0.5mm mesh screen and a 0.031mm in the sieve, then rinse the screened 0.031mm sieve. Therefore, many mature individuals of small benthic animals can be screened. The steps are as follows:

(1) Sampling sediments at various sites with a mud picker;

(2) Using a prepared plastic sampling tube with an inner diameter of 2.9cm, sample the undisturbed sediment samples according to the surface, subsurface and deep layers and put them into the prepared plastic bottles;

(3) Use a certain concentration of formaldehyde solution to soak the sample in the bottle;

(4) Store some samples in the freezer;

(5) Add 3.0 mL of Tiger Red solution dropwise to the jar where the sample is stored, and count the abundance and biomass of meiobenthos;

(6) Introduce the sample into the aperture mesh sieve and screen the sample;

(7) Finally, put the selected small benthic animals in a petri dish and transfer them to a dissecting microscope for counting;

(8) Record the types and numbers of small benthic animals.

2.4. Data Processing

Principal component analysis (PCA) was used to analyze the main environmental factors in the study area, and analytic hierarchy process (AHP) was used to study the differences in meiotic components in different seasons and at different sites. At the same time, the Spearman correlation analysis method was used to analyze the relationship between environmental factors, abundance and biomass. The bioenergy spectrum is used to analyze the influence of environmental factors on the composition of meiobenthos. SPSS software was used to analyze the spatial and seasonal differences of meiotic abundance. The yield was converted to P/B=9, and the sediment was analyzed with a laser particle size analyzer. According to the national marine standards, chlorophyll a and pheophytin a are determined by fluorescence spectrophotometry. In the "Marine Monitoring Specification", the potassium dichromate redox volume method is used to determine the organic matter in the sediment. Biomass is determined by the volume exchange algorithm in international standards. The average weight of different species is calculated according to international standards. The conversion of biomass into yield is calculated as P/B=9, and the yield of macrobenthos is calculated as IGP=-0.4+1.007 lGB-0.27 LGW.

3. Abundance and Biomass of Meiobenthos

Small benthic animals are defined as organisms that can pass through a 0.5mm mesh screen in the sediment, but are retained by a 0.031mm mesh screen. Microbenthos are one of the inseparable members of the benthic ecosystem and part of the food chain of the benthic ecosystem. They are ideal food for most fish, shrimp and shellfish. On the other hand, there are a variety of small and medium-sized benthic animals in the benthic ecosystem, and their survival time is very short. Their metabolic activities are closely related to the material circulation and energy flow in all benthic ecosystems. Therefore, it is necessary to study the ecological process of the benthic ecosystem in the southern part of the Yellow River, and study the abundance and biomass of benthic organisms. The analysis results of the abundance and biomass of meiobenthos in this paper are shown in Table 3.

Table 3. Average abundance and average biomass of meiobenthos

Class	Mean abundance(ind.10cm^{-2})	Average biomass (μg.10cm^{-2})	Average production (μg.10cm^{-2}a^{-1})
Marine nematode	478.9	344.69	3189.94
Copepods	127.5	280.75	4783.98
Hairy	32.4	374.23	2994.79
Kissing	11.3	48.39	389.01
Ostracod	4.35	12.93	5732.14
Bivalve	2.81	283.87	27.93
Planaria	0.97	6.83	784.03
Heteropod	0.31	4.32	4.29
Abdominal hair	0.10	0.78	2.23
Ripples	0.69	5.15	19.64
Newworm	1.34	197.34	37.20
Hydra	0.02	0.95	209.36
Beauty shrimp	0.13	114.30	1.45
Snaketail	0.59	4.58	29.47
Amphipod	0.04	0.13	111.48
Insects	3.27	18.85	264.99
others	0.01	27.08	3.94

3.1. Abundance of Meiobenthos

The calculated average of benthic abundance in the study area is 1584±686ind.10cm^{-2}. It can be seen from the table that the station with the highest abundance is 8062 (478.9ind.10cm^{-2}), and the station with the lowest abundance is 7794 (0.01ind)..10cm^{-2}). High-content points are mainly distributed in coastal areas, such as 7483, 8062, and 8594. The abundance is the lowest (0.18ind.10cm^{-2}) and the highest (1.1ind.10cm^{-2}). There is a certain correlation between the abundance of meiobenthos and water depth, that is, as the water depth deepens, the abundance of meiobenthos gradually increases from high to low. Only 9162 (80 meters deep) monitoring station did not show the correlation between abundance and water depth, and the abundance value was higher than the average.

There are 17 mature species of small benthic animals selected in this experiment. After analysis, it is found that nematodes are the dominant species, accounting for 88.65% of the abundance of small organisms. Nematodes and copepods are the two main types of organisms. The significant group is significantly related to the total number of bacteria ($P < 0.01$), and there is also a strong correlation between the changes in their numbers.

In this study, the average ratio of nematodes to copepods was 16.2:1. The average abundance is $(0.6\times10\pm0.36\times10)$ind.10cm^{-2}, which accounts for 73.8% of the total abundance. The second largest group is the snouts and polychaetes (10.1×1.5) ind.10cm^{-2}, and the second largest group is insects (10.1×10.1) ind.10cm^{-2}. In this study, the abundance of underwater small creatures is similar to that of the Yellow River underwater delta and its adjacent waters [(0.79×10×10.29)mm], and the distribution of underwater creatures is less. According to the available data, underwater organisms in the Bohai Sea are relatively sparsely distributed on the water surface (0-5 cm). Only in winter do small benthic animals move down, so this area is less than 5cm high. Taking into account the distribution of fish, the core sample of this study is only 5cm, and the microbenthos can be divided into two layers. The content of microbenthos was (89.7±9.1), of which the nematodes were 88.6 and the pods were 95.5, respectively, which was much higher than the marine nematodes 59, very similar to the Bohai Sea. The difference of nematodes in the two habitats may be related to the food source of cuttings. Jiaozhou Bay is a semi-enclosed bay. The bottom of the bay is rich in organic matter and sediments are in a state of declining. However, the study area is an open area, and many marine systems currently coexist. In June, as the temperature increased, organic fragments of phytoplankton sediment accumulated on the seabed. The main population abundance of microbenthos is shown in Table 4.

Table 4. The abundance of the main populations of meiobenthos

Station	small benthic animal	marine nematode	copepod
9162	2180	1918	327
8394	1276	1122	208
8451	1874	1611	262
7794	894	786	143
7483	2651	2332	426
8062	660	580	79
7994	1176	1034	211
8594	1782	1425	299
9394	1893	1552	318
8794	2817	2394	309
Average	1720	1475	258

3.2. Comparison of the Abundance of Meiobenthos in Different Sea Areas

Small benthic animals, especially marine nematodes, can be found in any type of marine sediments in the world. Although there are large differences in number, species composition, and biodiversity, by comparing the size of the grid with similar ones in the ocean Living environment, you can get the overall trend. In recent years, a large number of relevant scientific researchers have conducted a large number of sampling experiments on small benthic animals in the sediments of the Yellow River underwater delta and shrimp pond intertidal beaches, and the methods used are roughly the same. In June 2018, the average abundance of meiobenthos in the South Yellow Sea was sampled at 900.8 ind.10 cm-2, which is higher than the East China Sea and the Yellow Sea, but lower than the Yellow River Delta, Bohai Sea, Jiaozhou Bay, Yangtze River Estuary and Its nearby waters. Compared with Zhang Zhinan's related research in June 2002, we have obtained a comparative result of higher abundance of meiobenthos. However, the abundance of meiobenthos is relatively lower than that of other sea areas, and the result is lower than that of western seaports. The Kiel Bay and the North Sea, however, are very similar in depth, sediments, water salinity and screen aperture. The marine nematodes isolated in this study accounted for 88.5% and 88.5% of the total respectively. The distribution of marine nematodes is similar to that of Jiaozhou Bay, East China Sea, Yellow Sea and Yellow River Delta, but different from Bohai Sea. The distribution of marine nematodes is related to the presence of fine-grained sediments (silty clay) and large amounts of organic matter. At present, a large number of studies have found that most of the small benthic animals are located in the uppermost layer of sediments. The sampling efficiency of sediment samples (0-2 cm) can reach 92.5%, which is higher than the East China Sea, the Yellow Sea (91%) and the Changjiang Estuary (86.2%), and lower than the Yellow River Delta (95%). This experiment found that most of the small benthic animals exist on the surface of the sediment. The same results also show that among nematodes and copepods, copepods are mainly distributed in surface sediments of 0-2 cm, and copepods account for a higher proportion. In general, the spatial layout of microbenthos in sediments will be affected by the content of chlorophyll a and organic matter in the food supply.

3.3. Biomass of Meiobenthos

The average biomass and production of meiobenthos in the South Yellow Sea region are 1186 μg.10cm^{-2} and 8374 μg.10cm^{-2}a^{-1}. The maximum biomass and yield were 1853.45 μg.10cm-2 and 1667.9 μg.10cm^{-2}a^{-1}, and the lowest biomass and yield of 34.9 μg.10cm^{-2} and 3428.2 μg.10cm^{-2}a^{-1} appeared at the 7794 station. The biomass of free marine nematodes, polychaetes, copepods, anastasis, bivalves, and osteoblasts were 55.61%, 21.85%, 15.62%, 3.96%, 0.85%, 0.76% and 0.84%, respectively. The distribution pattern and abundance pattern of small biomass in the South Yellow Sea are similar. The high biomass is distributed at 50 m in the South Yellow Sea, and the low biomass is distributed near the parallel coastline stations such as 7494, 8594 and 9394. There are 8594 high biomass sites, reaching 2.994 g.10cm^{-2}. The number of meiobenthos at this site is not high (115in.10cm^{-2}), but its biomass is twice that of the 7994 sites, which may be caused by the difference in the composition of the small biological community. Nematodes are the most abundant species, accounting for 20% of the total biomass and the third most abundant. The polychaete biomass is 0.352μg.10cm^{-2}. In the northern part of Jiaozhou Bay, the distribution patterns and biological characteristics of benthic organisms were discussed, similar to soft bottoms, and the research results are consistent with most areas in the world. In the northern hemisphere, such as the North Sea, northern Germany in the Gulf of Mexico, and similar habitats (mainly sand) on the west coast of Scotland, using the same sampling and sorting process, the study found that similar communities formed sediments mainly due to these small benthic Biological similarities.

4. Results Analysis

This article uses 10 sites in the southern Yellow Sea eel spawning grounds in June 2018, such as 9162, 8394, 8451, 7794, 7483, 8062, 7994, 8594, 9394, and 8794, and then uses a mud picker to sample the sediment at the sites. The analysis results of the sediments obtained in this paper show that in the sediment samples, a total of 17 species of small benthic organisms have been identified. Among them, marine nematodes (74%), copepods (14%), and polychaetes (7%) are the most important groups in terms of numbers. In terms of spatial distribution, most of the small benthic organisms are distributed in the surface layer, followed by the sub-deep layer, and the biological groups distributed in the deep layer are the least; moreover, the distribution of different biological groups on the surface, subsurface, and deep layers is very large. difference. The spatial layout of small benthic organisms is shown in Figure 1.

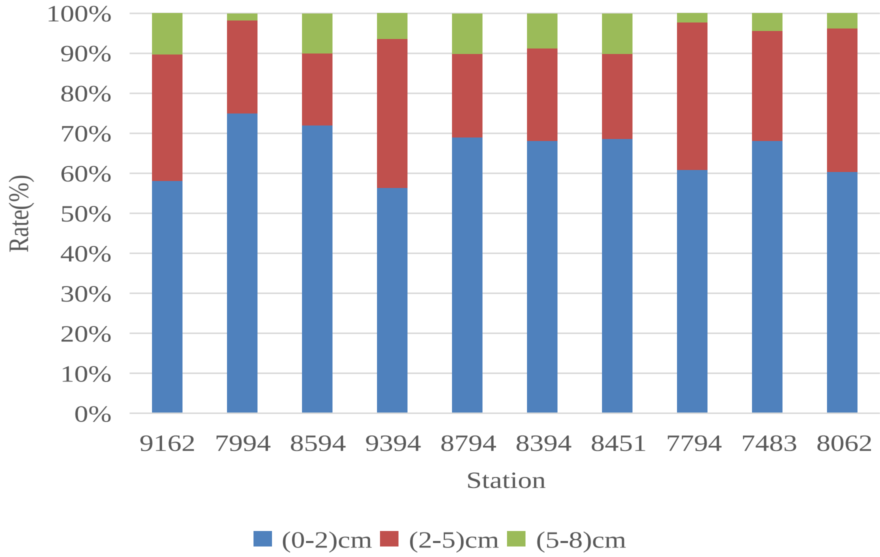

Figure 1. Vertical distribution of meiobenthos

The experimental results of the spatial layout of small benthic animals show that most of the biological groups exist in the outermost layer, even the large logarithm is at (0-2cm), and the average abundance is 1102.2ind.10cm^{-2}, accounting for the total abundance of 63.24%. The abundance of meiobenthos distributed (2-5 cm) in the sediment is 478.3 ind.10 cm-2, accounting for 26.36% of the total abundance. The abundance of meiobenthos at the depth of the sediment sampling (5-8cm) is 10.2ind.10cm^{-2}, which is only 6.75%. This indicates that the sampling efficiency of (0-5cm) sediment samples can reach 93.5% in the deposition type of this study. The vertical distribution of different groups is slightly different. The surface (0-2cm) distribution of nematodes is 859.1ind.10cm-2, accounting for 61.4%; the surface distribution of copepods is 72.61ind.10cm-2, accounting for 83.8%.

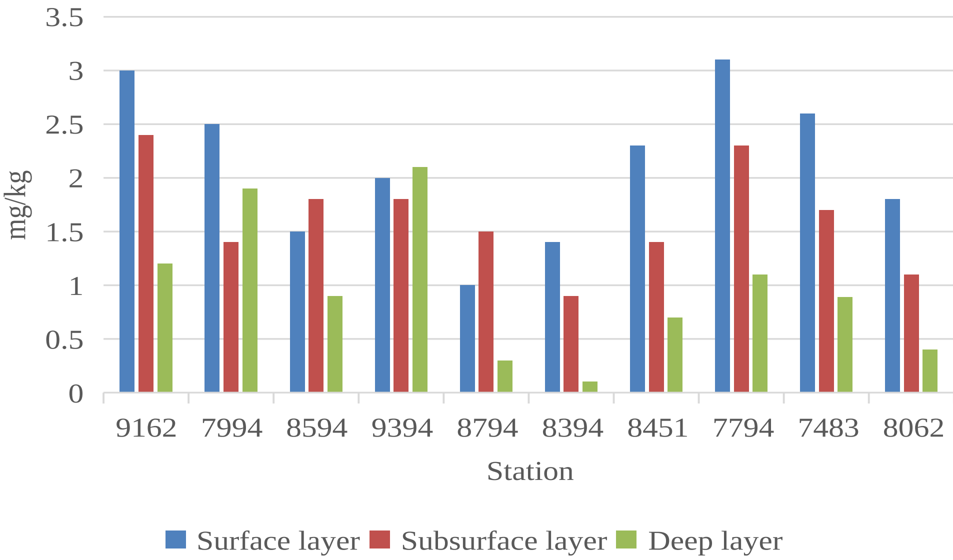

Figure 2. Distribution of chlorophyll a in sediments

The content of chlorophyll a can be used to measure the food sources of small organisms and the seabed environment. The content of chlorophyll a on the surface (0-2cm) is 7.43mg/kg and the content on the subsurface (2-5cm) is 4.37mg/kg. The content in the deep layer (5-8cm) is 0.362mg/kg. It can be seen from Figure 2 that the content of chlorophyll a in the surface layer of the sediment is relatively high. For example, the content of chlorophyll a at stations 9162 and 7794 is relatively large, while the content of chlorophyll a at stations 8794 and 8394 is very low. The content of chlorophyll a in the surface layer, subsurface layer, and deep layer decreased sequentially. A large number of studies have shown that studying the content of chlorophyll a in the sediments of small benthic animals is helpful to study the source of small benthic animals' food, and helps to study and infer the population diversity of organisms in the South Yellow Sea and the interaction of environmental factors. The coupling mechanism of dynamic processes and various parameters, and the application of real-time monitoring to the research of marine environment, provides a direction for the development of marine ecotourism research.

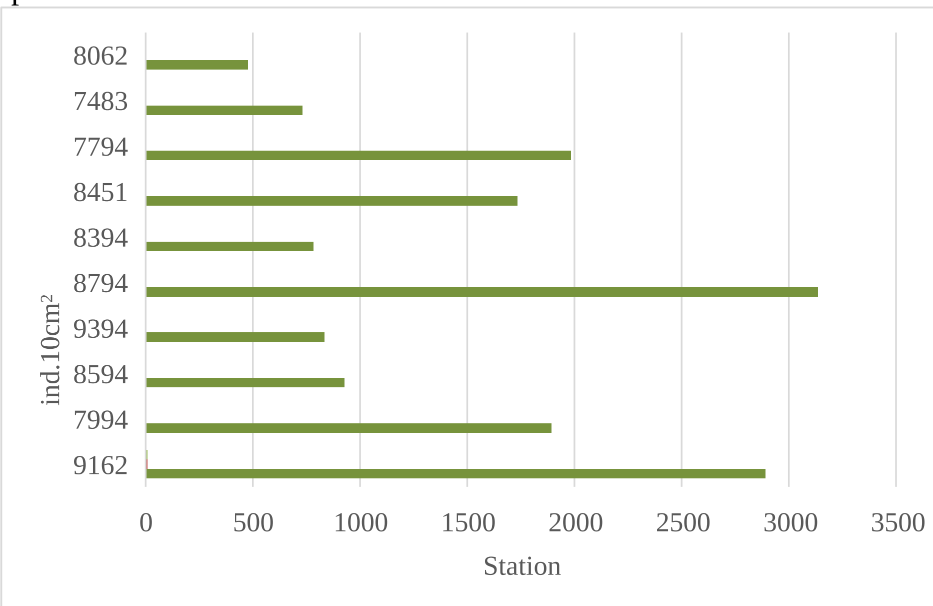

Figure 3. Abundance of meiobenthos

It can be seen from Figure 3 that the abundance of small benthic fauna in the sediments sampled at 10 stations is different. The calculated average abundance of benthic fauna in the South Yellow Sea region is 1584±686ind.10cm-2, Among them, the abundance of meiobenthos at station 8794 was greater, and the abundance of mezobenthos at station 8064 was the lowest. The locations with higher content are mainly distributed in coastal areas, such as 7794, 7994 and 8451. This experiment screened a total of 17 small classes, covering marine nematodes, benthic animals (copepods), polychaetes (polychaetes, etc.), bivalves (classes), gastropods, epigastrics, and amphibians, Miscellaneous (Anura), insects (insects), worms (worms) and many other groups. The experimental results show that marine nematodes are the dominant group, accounting for 88.65% of all biomass and abundance. Nematodes and copepods are the main two animals, and there is also a strong correlation between changes in their numbers.

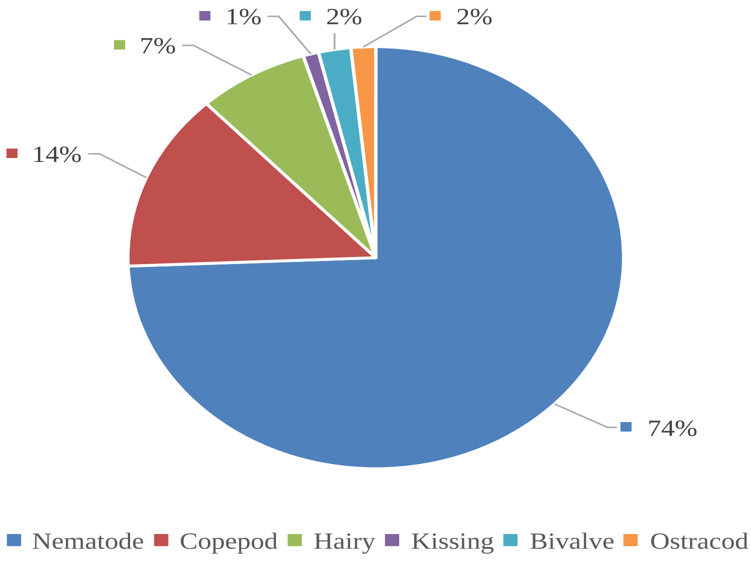

Figure 4. Percentage of major groups in sediments

It can be seen from Figure 4 that the 17 species of small benthic fauna identified in the experiment, of which marine nematodes (74%), copepods (14%), and polychaetes (7%) are the most important groups in terms of numbers. Small benthic organisms are one of the inseparable members of multiple systems of ocean bottom sediments and a trophic level in the food chain of ocean bottom systems. They are ideal foods for most fish, shrimp and shellfish. There are many types of small benthic animals in the benthic ecosystem, and their survival life is very short. Their metabolic activity closely connects them with the material circulation and energy flow in all benthic ecosystems.

5. Conclusion

In order to carry out marine eco-tourism research, study the dynamic process of the interaction between the marine ecological environment, the local marine environment, and local weather changes, and avoid the marine ecological crisis caused by the process of obtaining food and energy from the ocean. Therefore, the use of microbenthos, such as the numerous and widely distributed microbes at the bottom of the ocean, to monitor marine ecology and assess ecological health in real time provides a direction for the development of marine ecotourism research. Eel spawning grounds and elvers are found in the southwestern part of the South Yellow Sea. The distribution of ocean current ecosystems, benthic organisms and sedimentary environment in the South Yellow Sea showed obvious gradient changes with changes in water depth, reflecting the response of the benthic organisms to climate change. The experimental data used in this article comes from sediment sample data obtained from 10 stations near the spawning grounds of anchovy in the Southern Yellow Sea in June 2018. The abundance, biomass, and environmental factors of small benthic animals were correlated. In-depth analysis, the relevant investigation of sediments in the South Yellow Sea provides environmental evaluation indicators for ecotourism research. The results show that the average abundance of surface (0-2cm), secondary (2-5cm) and deep (5-8cm) microbenthos is 890.8ind.10cm^{-2}, and the average biomass is 1220μg.10cm^{-2}; sediments There is a correlation between the various parameters of the 10 environmental factors in, and a total of 17 small microorganisms have been identified, of which marine nematodes (74%), copepods (14%)

and polychaetes (7%) are the main groups. This study analyzed the community structure and diversity of small benthic animals, and provided a scientific basis for the protection of anchovy spawning grounds and real-time monitoring of the marine environment.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Yuhara, T., Takagi, S., & Furota, T. (2016). Distribution and habitat condition of the endangered benthic animals associated with salt marsh in tokyo bay, japan., 70(2), 50-64. https://doi.org/10.5179/benthos.70.50

[2] Erauskin-Extramiana, M., Alvarez, P., Arrizabalaga, H., Ibaibarriaga, L., Uriarte, A., & Cotano, U., et al. (2019). Historical trends and future distribution of anchovy spawning in the bay of biscay., 159(JAN.), 169-182. https://doi.org/10.1016/j.dsr2.2018.07.007

[3] Xun-Hua, Z., Jin-Yu, Y., Gang, L., & Yan-Qiu, Y. (2015). Basement structure and distribution of mesozoic-paleozoic marine strata in the south yellow sea basin. Chinese Journal of Geophysics, 58(1), 96-107. https://doi.org/10.1002/cjg2.20158

[4] Zheng, W., Zou, L., & Han, Z. (2015). Genetic analysis of the populations of japanese anchovy engraulis japonicus from the yellow sea and east china sea based on mitochondrial cytochrome b sequence. Biochemical Systematics & Ecology, 58, 169-177. https://doi.org/10.1016/j.bse.2014.12.007

[5] Xianye, Z., Kejian, W. U., & Lunyu, W. U. (2017). Influence of the physical environment on the migration and distribution of nibea albiflora in the yellow sea. Journal of Ocean University of China, 16(001), 87-92. https://doi.org/10.1007/s11802-017-3036-y

[6] Liang, Jie, Zhang, Penghui, Chen, Jianwen, Gong, Jianming, & Yuan, Yong. (2017). Hydrocarbon preservation conditions in mesozoic–paleozoic marine strata in the south yellow sea basin. Natural Gas Industry, 4(6), 432-441. https://doi.org/10.1016/j.ngib.2017.05.013

[7] Marco Octávio de Oliveira Pellegrini, & Horn, C. N. (2017). Two peculiar new species of heteranthera ruiz & pavón (pontederiaceae) from brazil, with notes on inflorescence architecture in the family. Phytokeys, 82(1), 35-56. https://doi.org/10.3897/phytokeys.82.13752

[8] Wood, P. J., & Armitage, P. D. (2015). Sediment deposition in a small lowland stream—management implications. River Research & Applications, 15, 199-210.

[9] Yu, L., & Oldfield, F. (2017). A multivariate mixing model for identifying sediment source from magnetic measurements. Quaternary Research, 32(2), 168-181. https://doi.org/10.1016/0033-5894(89)90073-2

[10] Shah, P. A., Brooks, D. R., Ashby, J. E., Perry, J. N., & Woiwod, I. P. (2015). Diversity and abundance of the coleopteran fauna from organic and conventional management systems in southern england. Agricultural & Forest Entomology, 5(1), 51-60.

https://doi.org/10.1046/j.1461-9563.2003.00162.x

[11] Jiang, W., Wang, H., & Huang, Y. (2015). Two new free-living marine nematode species of enchelidiidae from china sea. Cahiers De Biologie Marine, 56(1), 31-37.

[12] Erauskin-Extramiana, M., Alvarez, P., Arrizabalaga, H., Ibaibarriaga, L., Uriarte, A., & Cotano, U., et al. (2019). Historical trends and future distribution of anchovy spawning in the bay of biscay., 159(JAN.), 169-182. https://doi.org/10.1016/j.dsr2.2018.07.007

[13] Huang, D., Licuanan, W. Y., Hoeksema, B. W., Chen, C. A., Ang, P. O., & Huang, H., et al. (2015). Extraordinary diversity of reef corals in the south china sea. Marine Biodiversity, 45(2), 157-168. https://doi.org/10.1007/s12526-014-0236-1

[14] Burgin, S., & Hardiman, N. (2015). Effects of non-consumptive wildlife-oriented tourism on marine species and prospects for their sustainable management. Journal of Environmental Management, 151(mar.15), 210-220. https://doi.org/10.1016/j.jenvman.2014.12.018

[15] George-Nascimento, M., & Oliva, M. (2015). Fish population studies using parasites from the southeastern pacific ocean: considering host population changes and species body size as sources of variability of parasite communities. Parasitology, 142(01), 25-35. https://doi.org/10.1017/S0031182014001127

[16] Ying, C., Ying, W., Li, X. Z., & Jing, Z. (2015). Potential dietary influence on the stable isotopes and fatty acid composition of migratory anchovy (coilia mystus) around the changjiang estuary. Journal of the Marine Biological Association of the United Kingdom, 95(1), 193-205. https://doi.org/10.1017/S0025315414000873

[17] Yiqian, J., Chi, Z., Zhenjiang, Y. E., & Yongjun, T. (2019). Analyses of egg size, otolith shape, and growth revealed two components of small yellow croaker in haizhou bay spawning stock. Journal of Oceanology and Limnology, 37(4), 1423-1429. https://doi.org/10.1007/s00343-019-8105-1

[18] Ghigliotti, L., Ferrando, S., Carlig, E., Blasi, D. D., & Vacchi, M. (2016). Reproductive features of the antarctic silverfish (pleuragramma antarctica) from the western ross sea. Polar Biology, 40(1), 1-13. https://doi.org/10.1007/s00300-016-1945-7