**International Journal of Multidisciplinary Research and Development**
**Online ISSN: 2349-4182, Print ISSN: 2349-5979; Impact Factor: RJIF 5.72**
**Received: 08-07-2020; Accepted: 25-07-2020; Published: 07-08-2020**
**www.allsubjectjournal.com**
**Volume 7; Issue 8; 2020; Page No. 86-89**

# Composition and distribution of benthic foraminifera in spermonde and south makassar strait

**Sheila Zallesa[1*], Fittrie Meyllianawaty Pratiwy[2]**
[1, 2] Fisheries and Marine Sciences Faculty, Padjadjaran University, Jatinangor, West Java, Indonesia

**Abstract**
The purpose of this study was to look at the composition and distribution of benthic foraminifera in the waters of spermonde and southern Makassar Strait. In this study 20 sample stations were located in different and varied locations. In this study looked at the extent to which the distribution and composition are different with different ocean depths. There are several methods used in this study including survey methods for taking sediment samples using gravity corers, sediment grain size methods for sorting samples then foraminifera typing methods for benthic foraminifera species analysis. Data analysis in this research uses Shannon-Winner abundance, diversity and dominance analysis. Based on the research data, there are various results from 20 sampling stations. The highest abundance was obtained at Station 19 with an abundance value of 566.7 ind / m3. Station 19 is located in the coral reef area where species that live in the coral reef area are quite abundant due to the light factor. The highest diversity is found at station 4 with a diversity value of 2.96. The dominance value from station 1 to station 20 is smaller than 0.5 (D <0.5). This indicates that in the 20 sampling stations there were no dominant species, in other words the species found at these 20 stations are quite diverse although moderate diversity. The depth of the waters is one of the factors that greatly affects the diversity and abundance of bentonic foraminifera organisms in the waters of spermonde and southern Makassar strait.

**Keywords:** abundance, diversity, dominance, Foraminifera, benthic, depth

## 1. Introduction

Foraminifera belongs to the Phylum Protozoa which began to develop in the Cambrian to Resen. The majority of its members live in the marine environment and have sizes ranging from 3 µm to 3 mm (Natsir, 2011) [22]. According to their habitat, foraminifera are divided into planktonic foraminifera and benthic foraminifera. Foraminifera is a single-celled organism that has the ability to form shells from substances originating from itself or from foreign objects around it. The shell wall has various components and structures.

Foraminifera that live in the sendimen layer at the bottom of the waters are strongly influenced by the conditions of the micro and macro environment of the ocean. Therefore, foraminifera is used by researchers as a marker of the depositional environment. What is meant by the depositional environment by geologists is the type of water. For example shallow waters, brackish waters, deep sea, abisal, batial, and others. Until now geologists still use foraminifera as a reference to ancient environments. Foraminifera is used to determine the relative age of a layer or rock.

In general, benthic foraminifera are increased from areas near the coast and shallower areas, whereas in areas with deeper depths, benthic foraminifera will be less found (Douglas and Woodruff, 1981) [10]. The pattern of abundance of foraminifera both benthic and organic is influenced by many factors such as temperature, salinity, substrate, and circulation patterns also play a role, but in most cases food and nutrient sulpay most influences the distribution pattern of foraminifera (Pearson and Rosen, 1987) [23].

The general condition of the Makassar Strait waters is a deep sea area and a sedimentary basin and coral reef conservation (spermonde waters). Differences in seabed morphology also affect the characteristics of the sediment and the types of biota that live in the substrate or sediment. Bentonic foraminifera are biota that live on the bottom of the water or in the substrate. (Renema and Troelstra 2002 in Dewi, 2008) [8] explained that: large benthic foraminifera that spread in spermonde and southern Sulawesi ranged from 40-70% of seabed sediments. The type of substrate and depth of a water will determine the life, composition and variation of the genus of bentonic foraminifera. The spread and density of bentonic foraminifera is related to the average diameter of the sediment grains and the depth of their waters.

## 2. Materials and Methods

This research was conducted in the waters of the South Makassar Strait and Spermonde Waters which have a geographical location of 05 ° 00 '00 "- 07 ° 00 '00" LS and 117 ° 00 '00 "- 120 ° 00 '00" East. The range of water depths is 300-2100 meters which is part of the oil and gas basin and coral reef with 20 sampling stations.

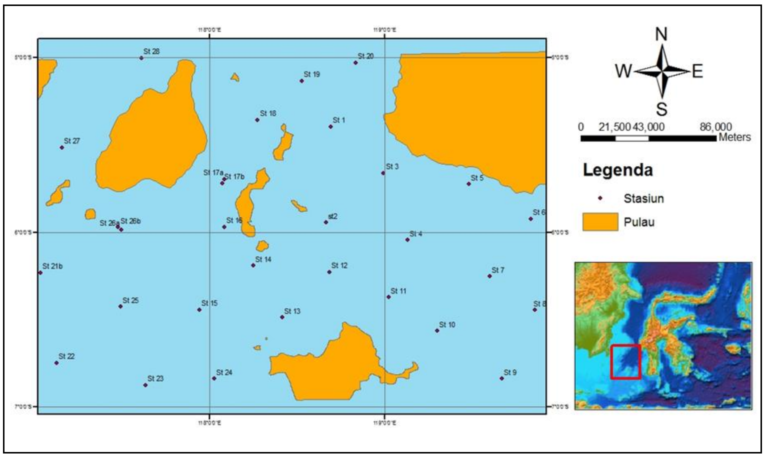


**Fig 1:** Map of research location

The method used in this study is a survey method, where the sediment retrieval technique uses a gravity corer. Then to do the other treatment methods in data processing, including:

- **Sieve method for grain size**

The basis of the sieve method is that the grains are divided into class intervals which are limited by the size of the sieve hole. The sifter method is needed to divide the granules into class hose based on the size of the sieve hole. The largest grain size will be caught in the largest sieve size. The scale of the sieve items is based on the scale of the Udden and Wenworth items.

- **Termination Methods and Identification of Foraminifera**

The stopping method is the method of taking foraminifera from the prepared sediment. Foraminifera will be flicked as many as 300 species at each station. Foraminifera will be collected in a chartman slide plate in which there are 60 boxes and, in each box, and each is filled with 5 specimens of foraminifera which will be identified foraminifera based on shell characteristics.

**Analysis of the data**

Analysis of the data in this method uses analysis, Shannon-Winner abundance, with the formula:

$$K = \frac{Ni}{A}$$

Note: K: The amount of abundance ( ind/m² )
Ni: Number of individuals
A: substrate volume ($m^3$)

Species diversity is a characteristic of community structure, its purpose is to measure the level of order in a system. Diversity is calculated using the Shannon-Winner Diversity Index formula (Fahrul, 2007):

$H' = - \Sigma pi. \log2\ pi$

And $pi = ni/N$

Note: H': Shannon-Winner diversity index
ni: number of individual species i
N: total of individuals

From the above calculation it can be seen the category of diversity level of the population in the waters, namely:
H '<1.0: Low diversity
1,0≤H'≤3,322: Medium diversity
H '> 3,322: High diversity

To determine the dominance of the community (type) is calculated using the index of dominance by the formula (Fahrul, 2007) with the formula, namely:

$D = \Sigma ( pi )^2$

$= \Sigma (ni/N)^2$

Note: D: domination
ni: number of individual species i
N: total number of individuals

From the above calculation, it can be seen the category of dominance index of the population in these waters, namely:
D <0.5: There is no dominant type
D> 0.5: there is a dominant type

Dominance index (D) has a range from 0 to 1. The index value is close to 1, so in the ecosystem tends to occur species dominance and species uniformity is low due to the instability of environmental factors and populations.

## 3. Results and Discussion

Foraminifera in the southern waters of the Makassar strait are quite diverse, the depth of the waters is also very influential on the diversity and abundance of bentonic foraminifera organisms. Based on the results of research on 20 sampling stations found 38 different species of species at 20 sampling stations, there are several stations that have the same species as the others.

**Table 1:** Rotalina sub order and depth

| Subordo Rotalina | Station | Depth (m) |
|---|---|---|
| *Nodosaria laevigata* | 3,4,6,16,17 | 400-1360 |
| *Laevidentalina sidebottomi* | 11,12,14,17 | 322-790 |
| *Laevidentalina bradyensis* | 5,6,7,11,13,15-20 | 222-1446 |
| *Pseudonodosaria discreta* | 1,2,4,5,9,11-16,19 | 332-1446 |
| *Lagena substriata* | 1,4,8,17-19 | 222-582 |
| *Bolivina spathulata* | 1-5,7,8,11,13,14,17-20 | 222-1446 |
| *Lenticulina suborbicularis* | 1,4,6-18,20 | 275-1446 |
| *Polymorphina oblonga* | 1,7,9 | 375 - 670 |
| *Amphicoryna separans* | 1,7,11,12,17-19 | 222-670 |
| *Polymorphina pulchella* | 1,4,9,11,13,14,18 | 320-790 |
| *Bulimina implata* | 11,14 | 300-790 |
| *Bulimina aculeata* | 2,4,11,16,17 | 300-1126 |
| *Siphogenerina raphana* | 10,11,19 | 200-350 |
| *Ehrenbergina carinata* | 7,8,11 | 300-700 |
| *Uvigerina mediterranea* | 4,9,10,11,15,16 | 375-600 |
| *Uvigerina aculeate* | 4,8 | 500-600 |
| *Neouvigerina ampullaceal* | 1,2,4,5,7,9,10,12,13,15,18 | 275-1126 |
| *Shiponina tubulosa* | 1,4,7-12,15,17,19 | 275-670 |
| *Planorbulina ungeriana* | 1,4,9,12,13,16,17,20 | 222-1446 |
| *Planorbulina wuellerstorfi* | 1,3,12-15,17,18,20 | 320-790 |
| *Rotalina beccarii* | 4,7,11,16,17 | 300-600 |
| *Protelphidium orbiculare* | 1,4,6,7,8,9,10,11-19 | 222-1360 |
| *Euvigerina flintii* | 4,6,12,13,18,20 | 320-1446 |

**Table 2:** Miliolina sub order and depth

| Sub ordo Miliolina | Station | Depth (m) |
|---|---|---|
| *Cornuspira planorbis* | 4,7,12,14,17-20 | 222-1446 |
| *Spiroculina manifesta* | 1,8,10,11,12,18,19 | 222-545 |
| *Pyrgo murrhina* | 10,12 | 275-550 |
| *Astacolus crepidulus* | 2,10,12,13,15,18 | 275-1126 |
| *Triloculina marshallana* | 1,4,7-9,11,13,14,18 | 320-790 |
| *Pulvinulina karsteni* | 2,9,12,16,18 | 320-1126 |
| *Inaequalina disparilis* | 7,19,20 | 222-1446 |
| *Hyalinonetrion sahulense* | 7,13,17 | 400-700 |
| *Gyroidina orbicularis* | 4 | 200-600 |
| *Truncatulina refulgens* | 3,4,6,8,9,11,16,17 | 350-1360 |

**Table 3:** Textularia sub order and depth

| Sub ordo Textularia | Station | Depth (m) |
|---|---|---|
| *Textularia agglutinans* | 2,5,6,7,16,17,18,20 | 320-1446 |
| *Siphotextularia fretensis* | 4,11,16,20 | 332-1446 |
| *Lagenosolenia bradyiformata* | 4,7,12-14,16-20 | 222-1446 |

### 3.1 Abundance

The abundance value of each station is different, this abundance value is calculated based on the volume of sediment sampling device, namely gravity core which has a diameter of 10 cm and a length of 200 cm. The highest abundance value is found in Station 19 with an abundance value of 566.7 ind / m3. Station 19 is in the coral reef area where species that live in the coral reef area are quite abundant due to the abundant light factor and can still penetrate into the waters so that there is enough a lot of food there, other than that the process of photosistesis is not inhibited by translucent light into the water for plankton species. Therefore the food chain is quite stable so that the species are quite abundant. While the lowest abundance based on the graph is at station 3 with an abundance value of 15.34 ind / m3, where at station 3 it is a sedimentary basin with deep waters so that the abundance is also low.

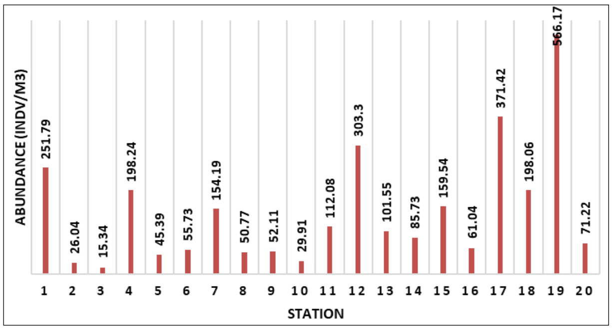


**Fig 2:** Species abundance at each station

### 3.2 Diversity

Diversity categories from station 1 to station 20 fall into the medium category where 1,0≤H'≤3,322. The lowest diversity value was found at station 3 with a diversity value of 1.09 while the highest diversity was found at station 4 with a diversity value of 2.96. The high value of species diversity in a place can indicate that the place has a good food chain so that many species are able to survive in these waters, besides the high diversity is also influenced by the physical conditions of the waters such as temperature, salinity which is the threshold of life of several species.

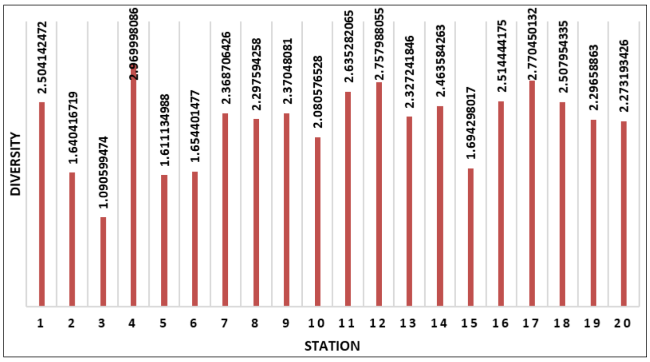


**Fig 3:** Diversity of species at each station

### 3.3 Dominance

The dominance value from station 1 to station 20 is smaller than 0.5 (D <0.5) the lowest dominance value is at station 4 with a dominance value of 0.06 while the highest dominance value is station 3 with a dominance value of 0.39. this indicates that at the 20 sampling stations there were no dominant species found in other words the species found at these 20 stations were quite diverse despite their moderate diversity.

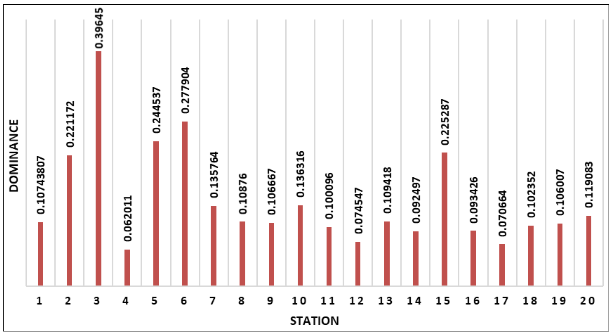


**Fig 4:** Species dominance at each station

Boltovsky and Wright (1976), in their research, provide a general description of foraminifera based on the batymetry zone, namely that the Intertidal Zone of the foraminifera shell is generally flat and attached to the substrate. Examples of Discorbis, Cibides. The shells are sometimes thick walls, for example Elpidium, Ammonia beccarii. Other species have a special shape, such as Buliminella. Deep Neritic Zone (0-30 m): composition and shape similar to litoral zones, such as Elphidium, Ammonia, Quinqueloculina, and other forms of milliloid, and poroeponides. Central Neritic Zone (30-100 m): more varied and emergent "agglutinant" species with simple morphology. Example: Textularia, Trochammina and Reophax. Other common genera include Ammonia, Elphidium, Quinqueloculina, Triloculina, Spiroloculina, Discorbis, Buliminella, and Buccella. Outer Neritic Zone (100-130 m): Variations are relatively increased to the shallower water. Composition is generally similar to shallow neritic zones, but Calcareous hyalin species increase between Porcellaneous forms.

The abundance and richness of species increases with a certain depth according to Buzas et al. (2007), foraminifera often shows improvement species richness and also influenced by depth. According to Mina Et.al. (2103) the structure of sediments and organic matter greatly influences the distribution and distribution of foraminifera. The abundance of foraminifera everywhere decreases gradually with increasing depth from the surface of the sediment regardless of the relief, depth, and nature of the sediment itself. So it can be said that the deeper the waters the less abundance of foraminifera

## 4. Conclusion

Based on research data shows that the deeper the water the lower the abundance indicates that certain species are able to live at depths above 1000 meters. And high abundance is found in shallow water areas where there is enough food available so that many species can survive.

From each station there are different types of species of foraminifera and there are also species of species that exist at each station. The diversity of species of species that live in these waters is also influenced by factors of depth, temperature, salinity as well as the substrate where the organism lives. Based on the above data above, it has been stated that there are several species that can live up to a depth range of 1400 meters, such as the bentonic foraminifera Protelphidium orbiculare species, from research data that have been obtained that this species lives at a depth of 200-1400 meters with a range temperature of 20-160 C and salinity of 30-32 ppt.

## 5. References


1. Abduljamiu OA, et al. A Baseline Investigation Of Benthic Foraminifera In Relation To Marine Sediments Parameters In Western Parts Of The Arabian Gulf. Marine Pollution Bulletin, 2019, 146.
2. Almogi-Labin A, Perelis-Grossovicz L, Raab M. Living Ammonia from a hypersaline inland pool, Dead Sea area, Israel. Journal of Foraminiferal Research, 1992; 22:257-266.
3. Boggs SJR. Prisiple of sedimentology and stratigraphy. Pearson Education. United States of America, 2006.
4. Boltovskoy E, Wright R. Recent Foraminifera. Dr. W. June, B. V. Publisher, The Haque, Netherland, 1976.
5. Bouchet VMP, Alve E, Rygg B, Richard J. Benthic foraminifera provide a promising tool for ecological quality assessment of marine waters. Telford Ecological Indicators, 2012; 23:66-75.
6. Buzasa MA, Hayeka LAC, Haywardb BW, Grenfellb HR, Sabaab AT. Biodiversity and community structure of deep-sea foraminifera around New Zealand. Deep-Sea Research. 2007; 1(54):1641-1654. doi:10.1016/j.dsr.2007.05.008.
7. Scott DB, Vilks G. Benthic Foraminifera In The Surface Sediment of The Deep-Sea Arctic Ocean. Journal of Foraminiferal Research. 1991; 21(1):20-38.
8. Dewi KT, dan Y Darlan. Partikel Mikroskopis Dasar Laut Nusantara. P3GL: Bandung, 2008.
9. Dewi KT, Suhartati MN, dan Y Siswantoro. Mikrofauna (Foraminifera) Terumbu Karang Sebagai Indikator Perairan Sekitar Pulau-Pulau Kecil. Ilmu Kelautan, Edisi khusus, 2010; 1:162-170.
10. Douglas RG, Woodruff F. Deep-sea benthic foraminifera. In: C. Emiliani (Editor), The Oceanic Lithosphere. (The Sea, 7). Wiley-Interseience, New York, 1981, pp.1233-1327.
11. Dolven J, Alve E, Rygg B, Magnusson J. Defining past ecological status and in situ reference conditions using benthic foraminifera: a case study from Oslofjord, Norway. Ecological Indicators, 2013; 29:219-223.
12. Armynot E, Viviane BR, Armelle R, Alain T. Sediment (grain size and clay mineralogy) and organic matter quality control on living benthic foraminifera: Elsevier, 2009, 52(1).
13. Fachrul MF. Metode Sampling Bioekologi. Bumi Aksara. Jakarta, 2007.
14. Jones BG, dan I Yassini. Recent Foraminifera and Ostracoda From Estuarine and Shelf Environments on the Southeastern Coast of Australia. University of Wollongong: Australia, 1995.
15. Fontanier C, Jorissen FJ, Licari L, Alexandre A, Carbonel P. Live benthic foraminiferal faunas from the Bay of Biscay: faunal density, composition, and microhabitats. Deep-Sea Research. 2002; 1(49):751-785.
16. Jorissen FJ. Benthic foraminifera from the Adriatic Sea; principles of phenotypic variation. Utrecht Micropaleontol. Bull, 1988, 31:179 pp.
17. Loeblich Jr, dan Tappan AR, H. Foraminiferal Genera and Their Classification. Van Nostrand Reinhold. New York, 1988.
18. Murgese DS, De Deckker P. The distribution of deep-sea benthic foraminifera in core tops from the eastern Indian Ocean. Marine Micropaleontology, 2005; 56:25-49. doi: 10.1016/j.marmicro.2005.03.005
19. Mina S, Fatemeh G, Hamed M, Babak M, Houri B. Identification and Abundance of Benthic Foraminifera in the Sediments from Fereidoonkenar to Babolsar of Southern Caspian Sea. Turkish Journal of Fisheries and Aquatic Sciences, 2013; 13:79-86. ISSN 1303-2712
20. Moghaddasi B, Nabavi SMB, Vosoughi G, Fatemi SMR, Jamili S. Abundance and Distribution of Benthic Foraminifera in the Northern Oman Sea (Iranian Side) Continental Shelf Sediments. Research Journal of Environmental Sciences, Academic Journals Inc, 2009a; 2:210-217.
21. Morten H, et al. Distribution Of Surface Benthic Foraminifera In The Southwestern Barents Sea. Journal Of Foraminifera Research, 1992, 22(4).
22. Natsir MS, Subkhan M. The Distribution Of Benthic Foraminifera In Coral Reefs Community And Seagrass Bad Of Belitung Islands Based On Foram Index. Journal of Coastal Development, 2011. ISSN: 1410-5217 Volume 15, Number 1.
23. Pearson TH, Rosenberg R. Feast and famine: structuring factors in marine benthic communities. In: J.H.R. Gee andP.S. Giller (Editors), Organization of Communities, Past and Present. Blackwell, Oxford, 1987, pp.373-395.
24. Phleger FB, Soutar A. Production of benthic foraminifera in three east Pacific oxygen minima. Micropaleontology, 1973; 19:110-115.
25. Pringgoprawiro H. Diktat Mikropaleontologi Umum. Laboratorium Mikropaleontologi, Jurusan Teknik Geologi, ITB: Bandung, 1987.
26. Pringgoprawiro H, dan Rubiyanto K. Pengenalan Mikrofosil dan Aplikasi Biostratigrafi. ITB: Bandung, 2000.
27. Romankevich EA. Geochemistry of Organic Matter in the Ocean. Springer, Heidelberg, 1984, 344 pp.