# COMPARATIVE COMPOSITION, ABUNDANCE AND DOMINANCE OF MEIOFAUNA BETWEEN A MUDDY AND A SANDY SUBSTRATE IN SILUT BAY, CENTRAL PHILIPPINES

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## ABSTRACT

**The tropical meiofauna communities of a muddy and a sandy portion in Silut Bay, Liloan, Central Philippines were compared. The sandy substrate supports a more varied meiofauna community than the muddy substrate although faunal composition between the two substrate types differs only slightly. Ten meiofauna groups (Copepoda, Bivalvia, Nematoda, Gastrotricha, Ostracoda, Tardigrada, Polychaeta, Amphipoda, Kinorhyncha and Turbellaria) were observed in the sandy substrate. However of the 10 groups, polychaetes and tardigrades were not found in the muddy station at the time of sampling. The muddy substrate showed an abundance (2024/10 cm$^2$) which is about 9 times higher than that in the sandy substrate (216/10 cm$^2$). Nematoda and Copepoda were the most dominant taxonomic groups in the muddy and sandy substrates, respectively.**

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**KEY WORDS:** Sandy substrate. Muddy substrate. Meiofauna. Composition. Abundance. Dominance. Silut Bay.

## INTRODUCTION

The term meiofauna was coined by Mare in 1942. Meiofauna refers to interstitial organisms living between sediment grains. It includes benthic metazoans which are smaller than the macrobenthos but larger than the microbenthos, i.e. with a size range of 50-500 μm (Eltringham, 1971).

In the marine ecosystem, meiofauna occupies a vital position. Many organisms belonging to the

meiofauna serve as important sources of food for the youngest bottom stages of macrofauna (Thorson, 1957 as cited by Natividad, 1977). Meiofauna also plays a significant role in the recirculation of nutrients in the marine environment (McIntyre, 1969). Recent studies done by Hulings and Gray (1971) showed that certain members of the meiofauna could serve as water pollution indicators. They also pointed out that because of the abundance, ease of collection and short life span of meiofauna, they are just appropriate test animals for pollution studies. For these reasons and for aquaculture purposes, a comparative knowledge on the different meiofaunal aspects of a muddy and sandy substrate could help in assessing the suitability of an area as a pond site.

Several aspects of meiofauna such as its ecology, distribution and population fluctuation have become subjects for research in many countries since the time meiofauna study was first initiated by Adolf Remane in Kiel Bay (McIntyre, 1964). Studies on sampling methodologies were conducted by Uhlig et al. (1973) and McIntyre (1964, 1973).

In tropical countries, only very few studies concerning meiofauna have been undertaken. In the Philippines, meiofauna studies on sandy substrates were conducted by Natividad (1977) and Sia (1978) and on muddy substrate by Vicente (1978). A comparative study between a muddy and a sandy substrate has not been conducted yet.

It is therefore evident that studies on the role of meiofauna in the marine ecosystem and comparisons of some of its aspects in muddy and sandy substrates are insufficient. Hence, this study was conducted generally to understand the basic differences between meiofauna communities of tropical muddy and sandy substrates and specifically to compare the composition, abundance, and dominance of meiofauna in the two substrates at the time of sampling.

## MATERIALS AND METHODS

### *Study Area and Sampling Stations*

For both muddy and sandy substrates, the study area is Silut Bay. The bay is situated southeast of the town of Liloan which is approximately 18 km from Cebu City (Fig. 1a), Central Philippines. It has an area of about 120 hectares and lies at about 24°N and 123°E. Its southern entrance is lined with mangrove stump patches. The inner shore has more developed mangrove vegetation than the eastern open ocean area (Fig. 1b). The substratum consists of muddy, rocky and sandy stretches although the muddy type predominates because the habitat is sheltered and wave action is minimal. The muddy station was established in the southern portion of the bay while the sandy station was established in the northern part.

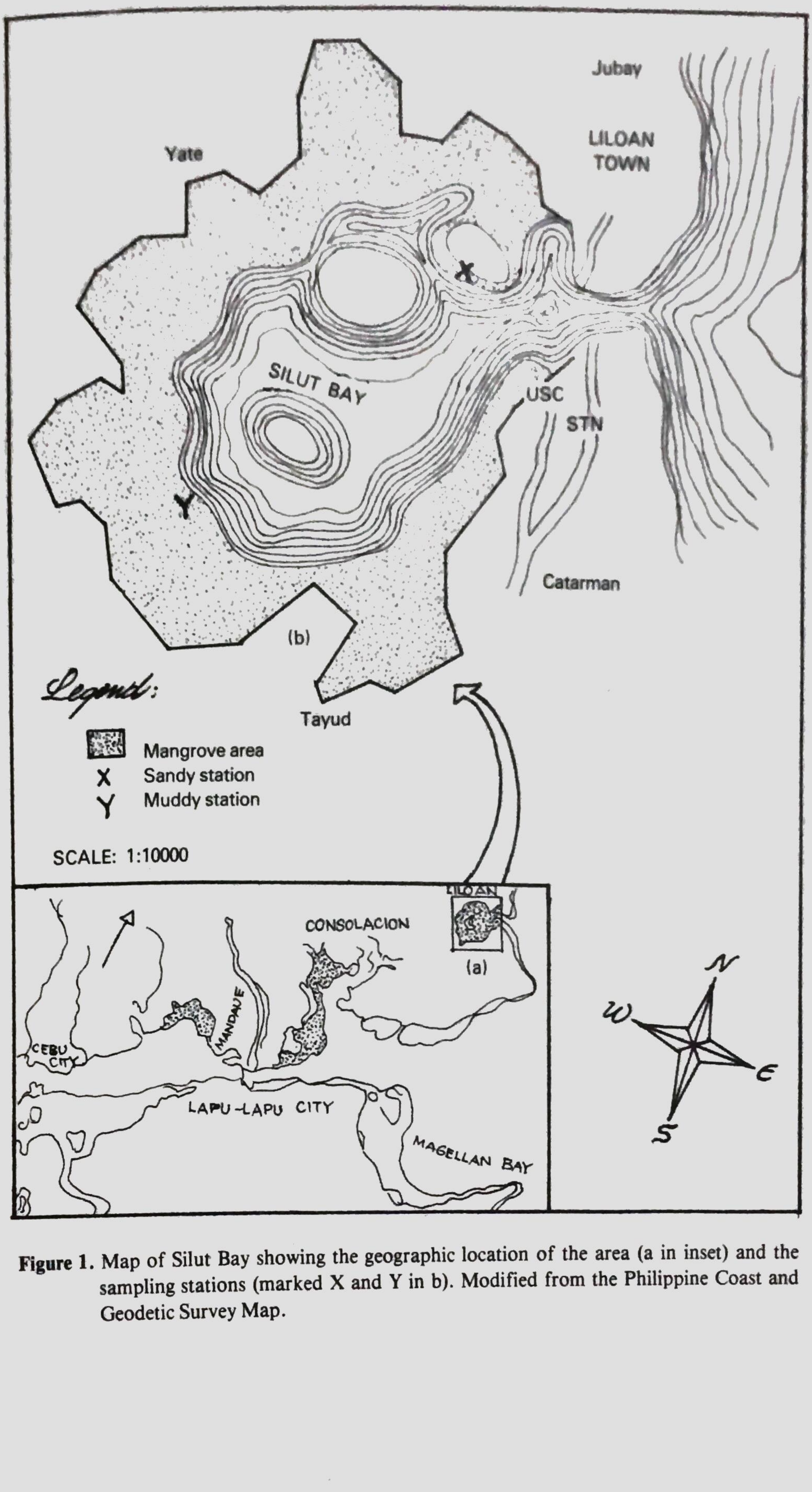


**Figure 1.** Map of Silut Bay showing the geographic location of the area (a in inset) and the sampling stations (marked X and Y in b). Modified from the Philippine Coast and Geodetic Survey Map.

*Sampling Method*

A 50 x 50 cm station was established at 10 meters from dry land on an area free of rocks and other obstructing objects. Four replicate samples were collected from the four corners of the station by coring vertically into the substratum to about 6 cm depth with a calibrated PVC corer. The corer is a tubing which is open at both ends with an inner diameter of 3 cm, an outer diameter of 3.6 cm and a height of 19.8 cm. To prevent the samples from sliding off during sampling, a cork stopper was inserted into the upper end of the corer. The sediment samples containing the meiofauna were then taken by removing the cork stopper. Each replicate sample was cut into two 3-cm portions which were placed in separate plexiglass bottles. Each bottle was added with 0.45 mL of 1% Rose Bengal in 70% alcohol. To facilitate sorting, the subsamples were left overnight for the meiofauna to absorb the stain.

*Separation of Meiofauna from Sediments*

The procedure of Uhlig et al. (1973) was followed to separate the meiofauna from the sediments. This involved two steps, namely: concentration, and sorting and counting.

*Concentration*. Concentration is the enrichment of meiofauna with respect to sediment particles in the sample. The method of decantation practised by Elmgren and Thiel (Natividad, 1977) was employed.

Each subsample previously stained with Rose Bengal solution was transferred into a 1000 mL calibrated plastic cylinder. Tap water was poured into the cylinder up to the 1000 mL mark such that the sediment particles were greatly agitated. The heavier particles were then allowed to settle for 30 seconds and the supernatant liquid was poured slowly into a 20 μm sieve held in an inclined position. This position permits more effective retention of meiofauna on the sieve because a stream of water meeting the sieve at a steeper angle would tend to force the meiofauna especially the nematodes through the mesh openings (Vicente, 1978). Decantation was repeated 8 times for each subsample to ensure that all the meiofauna were extracted.

*Sorting and Counting*. Each subsample was poured into a petri dish in small portions. Each small portion was examined under a stereoscope and the meiofauna were sorted, isolated by means of an improvised Irwin loop and counted using the mechanical hand-tally method. The isolated meiofauna were then transferred to small glass vials containing either 5% glycerin in 70% alcohol for the nematodes or 5% buffered formalin for the other meiofauna groups.

*Systematics*

Meiofauna were identified only by major taxa because there is no comprehensive compilation of literature on the taxonomy of the different meiofauna groups except those concerning fresh water, brackish water and free-living nematodes. Identification of meiofauna groups was based on the invertebrate literatures of Barnes (1974), Hyman (1969), Meglitsch (1972), Juario (1975) and Sia (1978). The identities of the meiofauna were verified under a microscope using higher magnification.

*Extrapolation*

For standardization purposes, the recommendations of the International Bureau of Standards were followed. Density of meiofauna at 3-cm level cores was extrapolated to N/10 $cm^2$ by using the formula cited by Natividad (1977) as follows:

$$N/10\,cm^2 = N/cm^2 \times 10$$

where: $N/10\,cm^2$ = number of individuals per 10 $cm^2$

$N/cm^2$ = number of individuals per $cm^2$ = A/B

where:

A = total number of individuals in sample

B = cross-sectional area of corer = D X H

where:

D = inner diameter of the corer

H = height of the cored sample

*Dominance Determination*

Dominance as percentage of individuals was calculated as follows:

$$\text{Dominance (\%)} = \frac{\text{Total no. of individuals of a group}}{\text{Total no. of meiofauna in collection}} \times 100$$

Computations were based on the means of three extrapolated replicate samples.

## RESULTS AND DISCUSSION

*Faunal Composition*

In the muddy station, meiofauna identified belong to phyla Nematoda, Arthropoda, Mollusca, Platyhelminthes, Gastrotricha and Kinorhyncha and include the groups Nematoda, Ostracoda, Copepoda, Bivalvia, Turbellaria, Amphipoda, Gastrotricha and Kinorhyncha. In the sandy station, isolated meiofauna were classified under the same phyla as in the muddy station and two other phyla, namely Annelida and Tardigrada. The groups Copepoda, Bivalvia, Nematoda, Gastrotricha, Ostracoda, Tardigrada, Polychaeta, Amphipoda, Kinorhyncha and Turbellaria are included in these phyla.

Results reveal that the sandy substratum supports a more varied fauna than the muddy substratum.

All the groups found in the sandy substrate except Polychaeta and Tardigrada were also observed in the muddy station. This could partly be attributed to the fact that coarser sand has greater interstitial space for organisms to occupy. Rao (1969 as cited by Natividad, 1977) pointed out that in areas with very fine sediments, fauna is very poor due to compactness of sediment grains which block interstices with organic detritus and inhibit development of interstitial population.

The absence of Polychaeta in the muddy substrate was rather unusual because polychaetes ranked second in dominance to nematodes in the study of Vicente (1978) in the same area. It is possible that the portion of the bay where the station was established is polluted to a certain degree and that the polychaete species existing in the area are very sensitive hence, their absence. This deduction is based on information that a certain piggery disposes its wastes in an area near the sampling station.

*Abundance*

Total numerical abundance of meiofauna in the muddy and the sandy stations at the time of sampling is presented in Table 1. In the muddy station, the total number of meiofauna per 10 $cm^2$ is 2024 in

**Table 1.** Number of meiofauna at 0-6 cm depth in muddy and sandy stations of Silut Bay.[1]

| Meiofauna Group | Number of Meiofauna/10 $cm^2$ | |
|---|---|---|
| | Muddy | Sandy |
| Nematoda | 2000 | 40 |
| Polychaeta | 0 | 18 |
| Copepoda | 9 | 58 |
| Ostracoda | 10 | 16 |
| Bivalvia | 3 | 45 |
| Turbellaria | 1 | 1 |
| Amphipoda | 1 | 11 |
| Gastrotricha | 0 | 11 |
| Kinorhyncha | 0 | 3 |
| Tardigrada | 0 | 13 |
| Total | 2024 | 216 |

[1] Values are means of three replicate samples.

contrast to only 216 in the sandy station.

Differences in meiofauna abundance between the muddy and sandy stations are probably due to variations in the prevailing biophysico-chemical factors at the time of sampling. Generally, the combined effect of several biophysico-chemical factors could limit the population density of meiofauna (McIntyre, 1964). McIntyre (1969) claimed that meiofauna decrease in abundance from coarse intertidal sediments where diversity of taxa is maximal to finer sand sediments. This is contrary to the result obtained in this study. However, it should be noted that only Nematoda which comprised about 99% of the total meiofauna was more abundant in the finer muddy sediment than in the sandy station. The rest of the meiofauna groups showed greater abundance in the sandy than in the muddy substrate. It is generally difficult to explain differences in the density of meiofauna since the distribution of species in particular substrates appears to be limited by the combined effects of several environmental factors (Rao, 1969 as cited by Natividad, 1977).

*Dominance and Rank*

The dominance (as percentage composition) and the respective ranks of meiofauna groups from the muddy and the sandy stations are shown in Table 2. Nematoda ranks first in the muddy station with a dominance of 98.81%. This is followed by Ostracoda (0.49%) and Copepoda (0.44%). This result concurs well with that of Vicente (1978) in the same study area. In the sandy station, Copepoda ranked first (26.85%) followed by Bivalvia (20.83%) and Nematoda (18.52%).

Differences in the dominance and ranking among the different meiofauna groups in the muddy and sandy substrates could be explained by competitive interactions between meiofauna groups or to possible prey-predator relationships. Vicente (1978) in her monthly population fluctuation study in the same area suggested that the Gaussian principle of competitive exclusion could be occurring between Kinorhyncha and Turbellaria, and between Kinorhyncha and Ostracoda. Furthermore, possible competition could exist among meiofauna groups, and between meiofauna and microfauna in the study area. However, it would be difficult to conclude as to the degree of competition and predation in the two stations without first conducting a survey of the different meiofauna species comprising each station and studying their feeding habits. This would require further study.

Moreover, the meiofauna taxa identified still need further taxonomic investigation. Studies on their mass and energy content, and methods of their possible manipulation should also be done before specific recommendations relevant to pond culture could be made.

**Table 2.** Dominance and rank of the different meiofauna groups in the sandy and muddy stations.

| | Muddy | | Sandy | |
|---|---|---|---|---|
| **Rank** | **Meiofauna Group** | **Dominance (%)** | **Meiofauna Group** | **Dominance (%)** |
| 1 | Nematoda | 98.81 | Copepoda | 26.85 |
| 2 | Ostracoda | 0.49 | Bivalvia | 20.83 |
| 3 | Copepoda | 0.44 | Nematoda | 18.52 |
| 4 | Bivalvia | 0.15 | Polychaeta | 8.33 |
| 5 | Turbellaria | 0.05 | Ostracoda | 7.41 |
| | Amphipoda | 0.05 | | |
| 6 | Gastrotricha | 0.02 | Tardigrada | 6.02 |
| | Kinorhyncha | 0.02 | | |
| 7 | | | Gastrotricha | 5.07 |
| | | | Amphipoda | 5.07 |
| 8 | | | Kinorhyncha | 1.39 |
| 9 | | | Turbellaria | 0.46 |

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