

Biodiversity and habitats of zoobenthos in the coastal zone of Thanh Hoa province, Vietnam

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ABSTRACT: The zoobenthos samples were collected in 30 collecting points in October, November 2017 and May 2018. There are 74 species zoobenthos belonging to 44 genera of 31 families, 14 orders, 3 phyla (Arthropoda, Mollusca, Annelida) were identified. Zoobenthos density varied between 5 - 72 ind. m⁻². The average Shannon-Weiner (H') diversity index varied between 0.97 to 2.87 at 30 collecting points and was 1.90 in whole study area. Highest biodiversity was found in the estuarine habitats, with 55 species, followed by the mudflat habitats (27 species each), the mangrove habitats (23 species), the river habitats (16 species), the small water canals (8 species) and the aquacultural areas (5 species).

KEYWORDS - Zoobenthos, biodiversity, coastal zone, Thanh Hoa province

I. Introduction

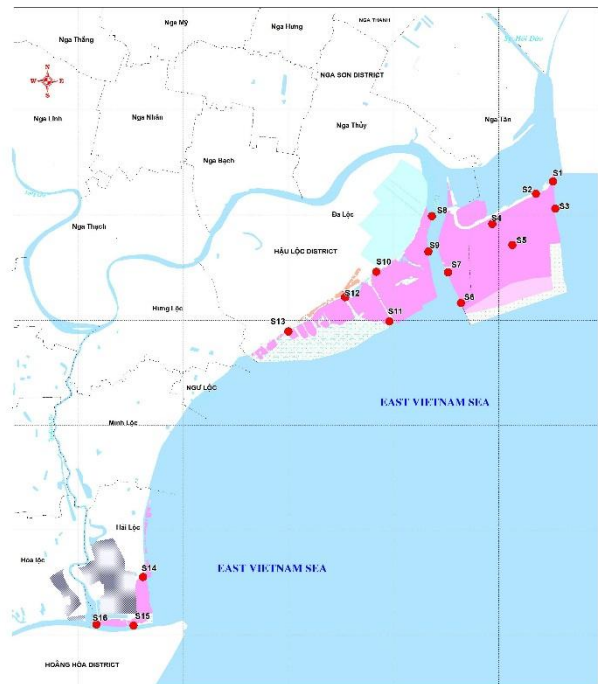
Thanh Hoa province located in the North Central Vietnam, with a coastline of 102 km, including 6 districts and cities: Nga Son, Hau Loc, Hoang Hoa and Quang Xuong, Nghi Son and Sam Son. The coastal area of Thanh Hoa is characterized by a low, flat, strongly divided by estuaries. There are five large estuaries. The estuaries have an average depth of 4-6m, sometimes up to 10m. The coastal area has a shallow seabed with a depth of 10m, last from 15 to 20km from the shore. This area has favorable conditions for fishing and aquaculture, especially crustaceans and molluscs.

In Thanh Hoa, there is recorded a total of 179 species belonging to 132 genera, 76 families of 3 phyla: Annelida, Arthropoda and Mollusca, mainly concentrated in special-use forests, protection forests, rivers and large estuaries [1]. In the Ma river, from Muong Lat to three estuaries, namely Cua Hoi, Lach Truong, and Lach Sung, there are 40 species of molluscs belonging to 31 genera, 21 families of 9 orders; 47 species of crustaceans belonging to 21 genera, 10 families [2]. However, there is no published on zoobenthos composition for the coastal area of Thanh Hoa province. From that, we have investigated and studied zoobenthos fauna in Thanh Hoa province, contributing to the diversity of species composition in the study area.

II. Studied site and Methods

2.1. Studied site and time survey

Samples were collected at 30 points in 5 estuaries, rivers (brackish water), aquaculture areas, mangroves, mudflats in coastal communes in 4 districts and cities namely Nga Son, Hau Loc, Hoang Hoa and Nghi Son districts in 2 times in October, November 2017 and May 2018 (Fig 1).



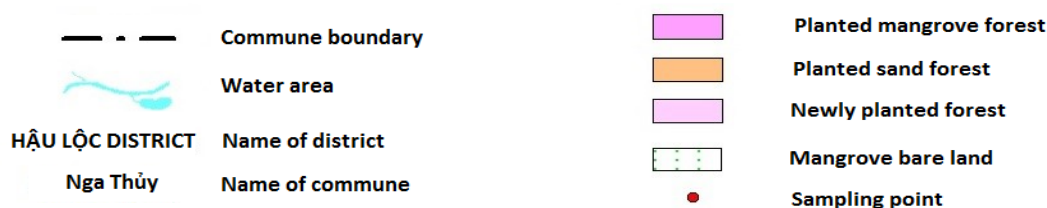


Figure 1. Diagram of sampling points

2.2. Method of collecting specimens in the wild

Collecting samples according to the research methods used in the studies of Nguyen Quang Hung (2010), Hoang Ngoc Khac (2010), Snedaker S. C & Snedaker J. S (1984), Scott & Blake (1996) [3, 4, 5, 6] specifically as follows:

Qualitative sampling: Collecting by hand, racquet, bottom net. In deep water areas, samples are also collected with Petersen buckets. Samples were also collected by fishermen's fishing equipment such as nets, bottoms, etc.

Quantitative sampling: Collecting by a Petersen bucket with an area of 0.025m², each collection point is 4 buckets. In intertidal areas and mangroves, use a 50x50cm quantification frame, placing 4 frames on 1 sampling point.

Samples were fixed with 90° alcohol.

2.3. Sample analysis in the laboratory

The classification of specimens is based on the taxonomy documents of the authors Scott & Blake (1996), Apel & Spiridonow (1998), Carpenter & Niem (1998), Paterson et al. (2004), Perry & Larsen (2004), Shih et al (2016), Tweedie (1949) [6, 7,8, 9, 10, 11, 12].

Quantitative samples of zoobenthos are counted directly with the naked eye, then the density is calculated in units: individual/m².

2.4. Data processing

The data is calculated, processed and presented through tables, diagrams, graphs representing quantities and proportions. Using Microsoft Office Excel® v.2019 software of Microsoft® Corporation and Primer® v.6 of Primer - ETM Ltd, UK to process the data.

III. Result and Discussion

3.1. Composition of zoobenthos in the coastal area of Thanh Hoa province

The results of laboratory classification of samples at 30 survey sites are showed in Table 1.

Table 1. Composition of zoobenthos in the coastal area

No	Science name	Family		Genus		Species	
		Amount	Ratio (%)	Amount	Ratio (%)	Amount	Ratio (%)
1	Arthropoda	10	32.3	18	40.9	38	51.3
2	Mollusca	20	64.5	25	56.8	35	47.3
3	Annelida	1	3.2	1	2.3	1	1.4
Total		31	100	44	100	74	100

This study has provided a list of zoobenthos composition for the coastal area of Thanh Hoa province, contributing to the database of Thanh Hoa province.

3.2. Variation of species composition and density in the study area

The results of the zoobenthos classification in the laboratory by season are showed in Table 2.

Table 2. Number of taxa of zoobenthos phyla by season

No	Science name	Family		Genus		Species	
		Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
1	Arthropoda	10	10	17	17	25	32
2	Mollusca	16	19	20	21	27	30
3	Annelida	1		1		1	
Total		27	29	38	38	53	62

Quantitative analysis showed that: the average density reached 16 individuals/m² in the dry season, ranging from 5 to 58 individuals/m²; the average reached 21 individuals/m², ranging from 6 to 72 individuals/m².

The average number and density of zoobenthos in the rainy season is higher than in the dry season because phytoplankton and zooplankton grow fast in rainy season, which is a rich source of food for zoobenthos. The rainy season is also a breeding time for many zoobenthos. The results of this study coincide with the research results of Hoang Ngoc Khac (2010) [4] in estuary of the Red River.

3.3. Zoobenthos biodiversity index in the study area

The average H' index of zoobenthos according to the sampling points ranges from 0.97 to 2.87, corresponds to the degree of low to medium rare diversity. For the whole study area, the average H' index is 1.90; corresponds to the low diversity of zoobenthos animals in the study area.

The average H' index of zoobenthos was highest at Lach Hoi estuary (point S18) and lowest at the aquaculture area in the dike, Nga Tan commune, Nga Son district (point S2). Lach Hoi estuary has a wide river bed and mangroves grow; the terrain is not flat; the substrate is mainly sand, alluvium, flexible and sticky soil. It still forms very deep creeks for boats to travel when the tide is low. These features make Lach Hoi estuary has high biodiversity. The group with H' ≥ 2 index are also points in brackish water rivers affected by tides (Yen river) and estuaries (Lach Can, Lach Sung, Lach Truong and Lach Hoi estuary). These are areas that often have high diversity due to environmental characteristics such as salinity, substrate, mangrove tree growth. In contrast, the aquaculture area in the dike, Nga Tan commune, Nga Son district only has *Litopenaeus vannamei* or *Penaeus monodon* as the main species. In the ponds, there are few zoobenthos species that do not belong to the target group and are often disturbed before and after each culture. Similarly, the point in the aquaculture water canal outside the dike (S23) also has many environmental disturbances when conducting and discharging aquaculture water; The newly planted mangrove forest (S6) has not yet stabilized the environment for many zoobenthos species to develop.

In terms of seasons, the average H' index of zoobenthos in the rainy season is higher than that in the dry season (dry season: 1.88, rainy season: 1.93), both seasons have low average biodiversity.

3.4. Distribution of zoobenthos according to habitat in the study area

The distribution of zoobenthos according to 6 different habitat types in the coastal area of Thanh Hoa province is presented in Table 3.

Table 3. Number of species by habitat

No	Science name	Number of species by habitat					
		Estuary	River	Aquaculture	Water canal	Mangrove	Mudflat
1	Arthropoda	30	9	4	5	12	10
2	Mollusca	25	6	1	3	11	17

3	Annelida		1				
Total		55	16	5	8	23	27

Mangrove and mudflat habitat recorded 23 and 27 species, respectively. These habitat are adjacent to each other, many mudflat areas have scattered mangrove trees, so many species living in mudflats can move into mangrove areas and vice versa, especially at high tide. This is reflected in the index of similarity zoobenthos composition between mangroves and mudflats also reaching the highest value (48%). However, there are differences when comparing the species composition between these two habitats. Mangrove areas are more suitable for crabs and gastropods than for bivalves. While the alluvial area is more suitable for bivalves and gastropods than crabs. This is consistent with the ecology of the studied benthic groups and species. This is consistent with the ecology of the studied zoobenthos. For example, crabs prefer habitats rich in humus, mud, and mangrove roots, while bivalves prefer habitats with sandy substrates. The results of this study coincide with the study of Kottè-Mapoko et al. (2017) [13] when studying in mangroves, the number of bivalve species (4 species) is very small compared to the gastropod species (30 species).

Estuary habitat recorded 55 species because this habitat has mangroves and the adjacent mudflat. The boundary between the estuary, mangrove and mudflat area is difficult to define specifically, especially in the transition zone. Due to this feature, many species in this study recorded in the estuary can migrate to mangrove areas, mudflats and vice versa, especially during high tide. This represents a continuum of zoobenthos habitats. For example, windcuffs of the genus *Uca* are common from tidal flats all the way along the edge of the forest and outside of mangroves, where mangroves are sparse. *Scylla serrata* is commonly found in or near mangroves, especially in mangrove estuaries. However, they can also be found offshore during the breeding season. Shrimp species (like *Penaeus*) are commonly found in mangrove estuaries, or mangrove areas during high tide.

Others habitat: River, Aquaculture, Water cannel recorded from 5 to 16 species, lower than these habitat above because of many environmental disturbances or breeding certain dominant species.

Thus, the recognition of zoobenthos species by habitat does not mean that the species is confined to the habitat sampled. In fact, they can be distributed in adjacent habitats, continuous exchange with the habitat found.

IV. Conclusion

- The study provided additional data on zoobenthos species composition in the coastal area of Thanh Hoa province.

- The results of identification of zoobenthos samples have identified 74 species belonging to 44 genera, 31 families, 14 orders of 3 phylums: Arthropoda, Mollusca, and Annelida.

- In the dry season, 53 zoobenthos species belonging to 38 genera, 27 families, 13 orders of 3 phylums were identified, namely Arthropoda, Mollusca, Arthropods and Annelida; The average density of zoobenthos is 16 individuals/m², ranging from 5 to 58 individuals/m². In the rainy season, 62 zoobenthos species belonging to 38 genera, 29 families, 13 orders of 2 phyla are Arthropoda, Mollusca; The average density reached 21 individuals/m², ranging from 6 to 72 individuals/m².

- The average H' index of zoobenthos ranges from 0.97 to 2.87, corresponding to the degree of low diversity to medium diversity; for the whole study area, the average H' index is 1.90; corresponds to a low average level of biodiversity. The average H' index of zoobenthos in the rainy season is higher than in the rainy season (dry season: 1.88, rainy season: 1.93).

- Distribution of zoobenthos according to 6 different habitat types in the coastal area of Thanh Hoa province. Estuary habitats recorded the most zoobenthos species with 55 species. The habitat of the aquaculture area recorded the least number of zoobenthos species with 5 species.

V. Acknowledgments

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