Fisheries Journal, 14(3), 1282-1294 (2024)
http://doi.org/10.29303/jp.v14i3.1013

MEGA GASTROPODA ASSOCIATION IN THE MONOSPECIFIC SEAGRASS MEADOWS OF BADAK BADAK ISLAND, BONTANG CITY

Asosiasi Mega Gastropoda Pada Padang Lamun Monospesifik Pulau Badak Badak, Kota Bontang

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(Received June 5th 2024; Accepted August 4th 2024)

ABSTRACT

Mega Gastropods play an important role in the food chain in bottom waters. Mega Gastropods are associated with seagrass beds which have sand and sandy mud bottom substrates. The aim of the research is to determine the association of Mega Gastropods in monospecific seagrass beds as their habitat. This research was carried out from October 2023 - February 2024 in the seagrass beds of Badak Badak Island. The station is divided into 3 stations and each station is divided into 3 zones. Seagrass and Mega Gastropod samples were taken using a 50x50cm quadrant frame. The relationship between seagrass density and Mega Gastropod density was used by the Pearson's Product Moment correlation test and the distribution of basic substrate fractions and the distribution of Mega Gastropod species was used by Principal Component Analysis (PCA) and Corespondence Analysis (CA). The Mega Gastropods found consisted of L. turturella, C. tigris, P aluco, and T. telescopium. The relationship between Mega Gastropod density and E. acoroides density was not positively correlated and the presence of Mega Gastropod species was associated with the characteristics of the basic substrate fraction.

Key words: Association, Mega Gastropod, Monospecific, Seagrass

ABSTRAK

Mega Gastropoda berperan penting dalam rantai makan di perairan dasar. Mega Gastropoda berasosisasi dengan padang lamun yang bersubstrat dasar pasir dan lumpur berpasir. Tujuan penelitian untuk mengetahui asosiasi Mega Gastropoda di padang lamun monospesifik sebagai habitatnya. Penelitian ini dilaksanakan mulai Oktober 2023 - Febuari 2024 di padang lamun P. Badak Badak. Stasiun terbagi dalam 3 stasiun dan setiap stasiun terbagi dalam 3 mintakat. Pengambilan sampel lamun dan Mega Gastropoda menggunakan bingkai kuadran berukuran 50x50cm. Hubungan kerapatan lamun dan kepadatan Mega Gastropoda digunakan uji korelasi *Pearson's Product Moment* dan sebaran fraksi substrat dasar dan sebaran spesies Mega Gastropoda digunakan *Principal Component Analysis* (PCA) dan *Coresspondence Analysis* (CA). Mega Gastropoda yang ditemukan terdiri dari *L. turturella*, *C. tigris*, *P aluco*, dan *T. telescopium.* Hubungan kepadatan Mega Gastropoda dengan kerapatan *E. acoroides* tidak berkorelasi postitif dan kehadiran spesies Mega Gastropoda berasosiasi dengan karakteristik fraksi substrat dasar.

Kata Kunci : Asosisasi, Lamun, Mega Gastropoda, Monospesifik

INTRODUCTION

Mega Gastropods are generally epifauna on the sandy and sandy mud substrates in seagrass ecosystems (Dinata *et al.,* 2022; Raiba *et al.,* 2022) which have an important role in the bottom food chain of waters as herbivores, detritus eaters and as biofilters of suspended particles and environmental bioindicators (Susintowati *et al.,* 2019; Nopiansyah, *et al.,* 2021). Mega-sized individuals are generally hunted for their meat for consumption and their shells are traded (Safrillah *et al.,* 2023).

Seagrass beds are habitats for various aquatic biota from both the nekton (Irawan *et al*., 2018) and zoobenthic (Ardhiani *et al*., 2020; Jalaluddin *et al*., 2020) groups. Seagrass beds composed of multispecies form the characteristics of sand, fine sand and very fine sand substrates (Ramili *et al.,* 2018) which are the habitats of individual mega gastropods (Riniatsih *et al.,* 2021).

The importance of seagrass beds as a habitat for gastropods is illustrated by the report of Safrilla *et al.* (2023) namely that seagrass beds on Mandalika Beach support the lives of 15 families divided into 25 species of gastropods with a moderate diversity category with a basic substrate of sand and coral rubble. Likewise, the report of Afrizal *et al*. (2023) reported that there were 25 species of gastropods associated with multi-species seagrass beds in Poton Bako Hamlet, East Lombok with the characteristics of sandy mud and muddy sand substrates, while Nopiansyah *et al*. (2021) reported that the multi-species seagrass beds on Puding Beach, South Bangka Regency, found 5 species of gastropods, this was caused by anthropogenic activities.

Seagrass beds on Badak Badak Island, Bontang City tend to be monospecific, namely predominantly composed of Enhalus acoroides stands (Ananda et al., 2024) and such conditions create habitat characteristics that are typical for mega gastropod species. The purpose of this study was to determine the association of mega gastropods with the characteristics of monospecific seagrass beds as their habitat.

RESEARCH METHODS

Time and Place

The research was conducted from October 2023 to February 2024 and was conducted in the seagrass ecosystem on Badak Badak Island , Bontang City (Figure 1)

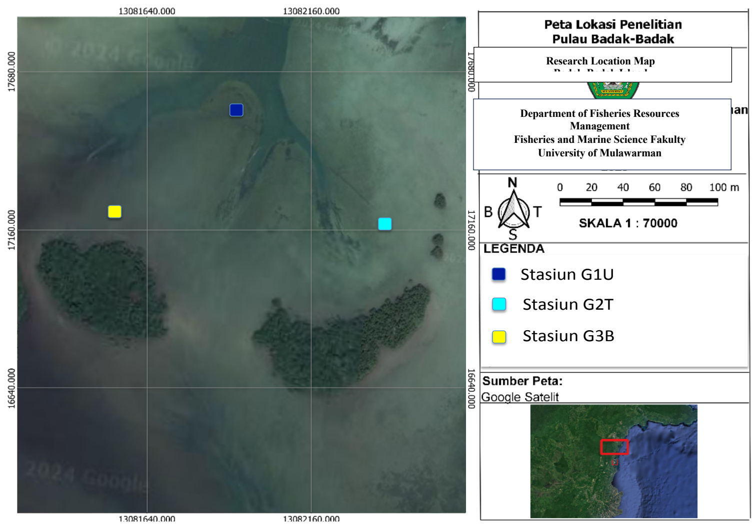

Figure 1. Research Location Map

Tools and materials

The tools used in this study were 50×50 cm seagrass quadrant transects, meter rolls, sample bags, cameras, GPS, stationery, thermometers, pH meters, DO, handfractometers, small shovels, sieve nets, coolboxes, and turbidimeters. The materials used in the study were distilled water, mega gastropods, substrates, 70% alcohol, and water samples.

Determination of Research Stations

In the direction of the research station is divided into 3, namely G1U, G2T, and G3B. Each station is divided into 3 quadrant transects, namely High Surface Water (HSW), Middle Surface Water (MSW), and Low Surface Water (LSW).

Research Parameters

The physical parameters of water consist of temperature, brightness, turbidity, and salinity. The chemical parameters of water consist of DO, pH, nitrate, and phosphate. The substrate parameters consist of fine sand, medium sand, coarse sand, clay, dust, total sand, and texture.

Sampling

Water Quality Parameters and Basic Substrate

Water measurements and sampling were carried out at high tide based on the station and basic substrate sampling was carried out at low tide using a modified corer following the station distribution pattern.

Seagrass

Seagrass sampling was carried out at low tide divided into 3 stations with 3 quadrant transects measuring 50x50 cm, at the High Surface Water (HSW), Middle Surface Water (MSW), and Low Surface Water (LSW) levels. Each quadrant frame was calculated for seagrass species stands.

Mega Gastropods

Mega gastropod sampling was carried out at low tide divided into 3 stations with 3 quadrant transects measuring 50x50 cm, at the High Surface Water (HSW), Middle Surface Water (MSW), and Low Surface Water (LSW) levels. Each quadrant frame was counted for individual mega gastropod species.

Data analysis

Mega Gastropods

Species Composition and Population Density (K)

Species composition can be calculated using the species composition formula (Fachrul, 2007):

$$Ks = \frac{ni}{N} \times 100$$

Description: Ks = species composition (%); n_i = number of individuals of mega gastropod species; N = number of individuals of all species

Population density is the number of individuals of a species contained in a unit volume or area. Krebs (1989) stated that population density calculations can be done using the following formula:

$$K = \frac{The\ number\ of\ individuals\ of\ a\ species}{Area}$$

Diversity Index (H')

This calculation uses the Shannon-Wiener diversity index according to Sudarso and Yusli (2015), namely:

$$H' = \sum_{t=1}^{n} pi \; In \; pi$$

Description: H' = diversity index; pi = number of individuals of each species (i= 1,2,3…n); S = number of species; ln = natural logarithm; pi = $\sum ni/N$(calculation of the number of individuals of a species with all species)

H' value criteria: H' > 3 = high uniformity ; 1 < H' > 3 = moderate uniformity; H' < 1 = low uniformity.

Uniformity Index (E)

To find out the balance of the community using the uniformity index, namely the number of individuals between species in a community. According to Sudarso and Yusli (2015) the uniformity index uses the following formula:

$$E = \frac{H'}{H\,maks} = \frac{H'}{LnS}$$

Description: E = uniformity index; H' = diversity index; ln S = natural logarithm of species

The uniformity index criteria are as follows: e > 0.4 = small population uniformity; 0.4 > e > 0.6 = medium population uniformity; e < 0.6 = if the value reaches 0 then the population uniformity will be smaller.

Dominance Index (C)

The dominance index in a community can use the Simpson Odum (1994) formula as follows:

$$C = \sum_{i=1}^{n} \left(\frac{ni}{N}\right) 2$$

Description: C = Simpson's dominance index; ni = number of individuals for each index; N = total number of individuals (1,2… and so on).

Categories in the dominance index: C approaching 0 (C < 0.5) = no species dominates; C approaching 1 (C > 0.5) = there is a species that dominates

Seagrass

Seagrass Density

Seagrass density is the number of individual seagrass stands per unit area. Seagrass density can be calculated using the formula (Fachrul, 2007) as follows:

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

Description: Ki = species density (stands/m ^{2}); Ni = number of stands of species i (stands); A = quadrant transect area (m ^{2})

Relationship between Mega Gastropoda, Seagrass Density and Habitat Characteristics

Determination of the relationship between mega gastropod density and seagrass density used the *Pearson's Product Moment correlation test approach* (Riduwan, 2003), namely:

$$r_{XY} = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

Description: r = correlation coefficient; X = density of mega gastropods; Y = density of seagrass.

Value r = -1: the relationship between X and Y is perfect and negative; r = 0: the relationship between X and Y is very weak; r = 1: the relationship between X and Y is perfect and positive (Riduwan, 2003).

The approach to determine the distribution of the bottom substrate fraction based on the station used *Principal Component Analysis* (PCA) (Setiawan *et al* ., 2024) and to determine the distribution of Mega gastropoda species based on the station used Corespondence Analysis (CA) (Ondina *et al*., 2003).

RESULTS

Characteristics of Mega Gastropod Habitat

Water Quality Parameters and Basic Substrate

The water quality parameters measured include temperature, salinity, pH, DO, brightness, nitrate and phosphate content in the waters (Figure 2). Based on PP No. 22 of 2021, it shows that the turbidity value has exceeded the quality standard. The basic substrate parameters show that the sand fraction tends to dominate (Figure 3).

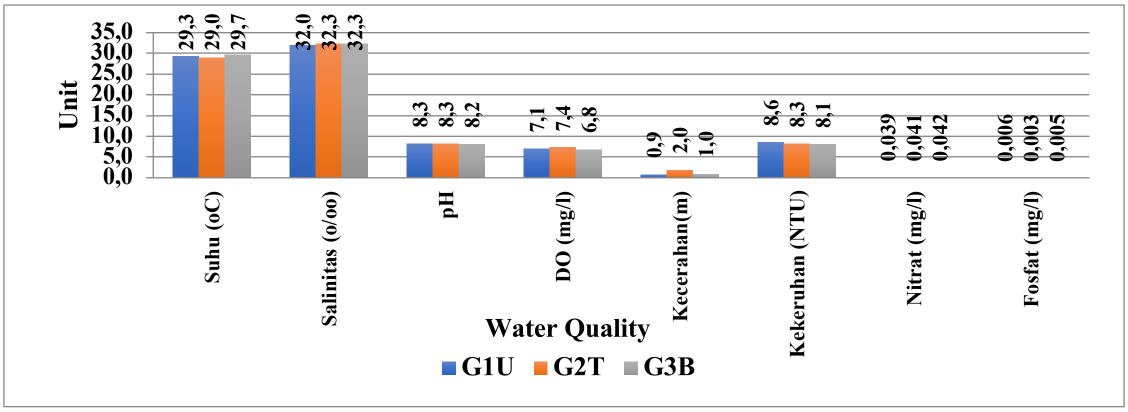

Figure 2. Water quality parameters

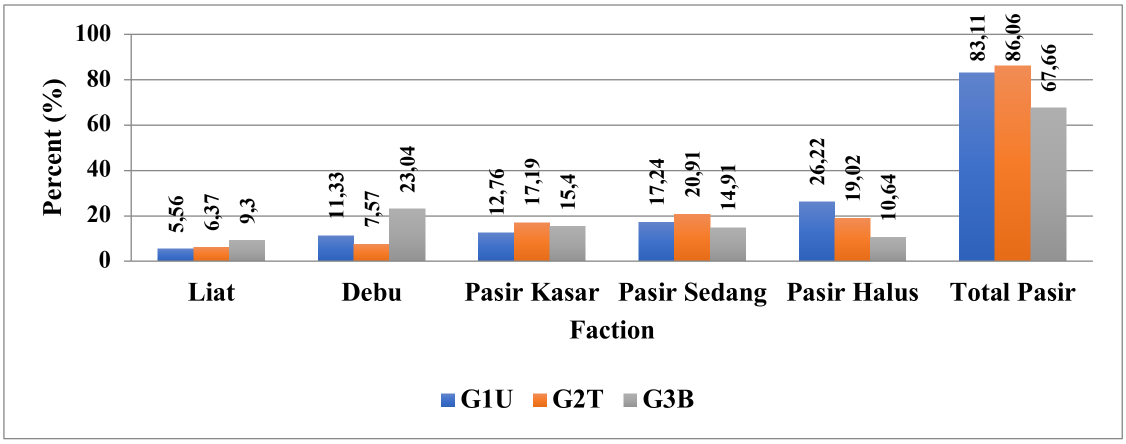

Figure 3. Basic Substrate Parameters

Seagrass

The seagrass species found in Badak Badak Island consist of 2 species, namely *Enhalus acoroides* which tends to dominate and *Cymodocea rotundata* which is only found at Station G2T (Figure 4).

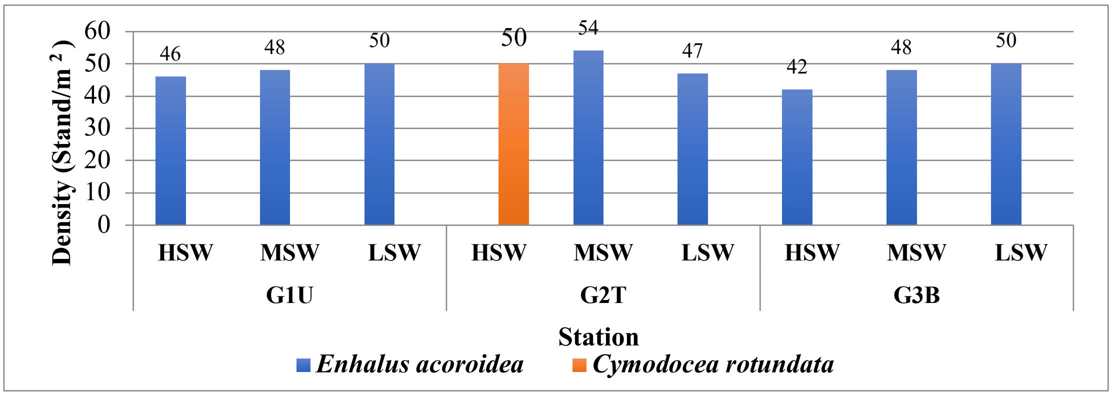

Figure 4. Density of seagrass species

Mega Gastropods
Species Composition

The Mega Gastropoda found consisted of 3 families, namely Strombidae (Laevistrombus), Cypraeidae (Cypraea), and Cerithiidae (Pseudovertagus and Telescopium) which were divided into 4 species, namely *Laevistrombus turturella, Cypraea tigris, Pseudovertagus aluco, and Telescopium telescopium* (Figure 5).

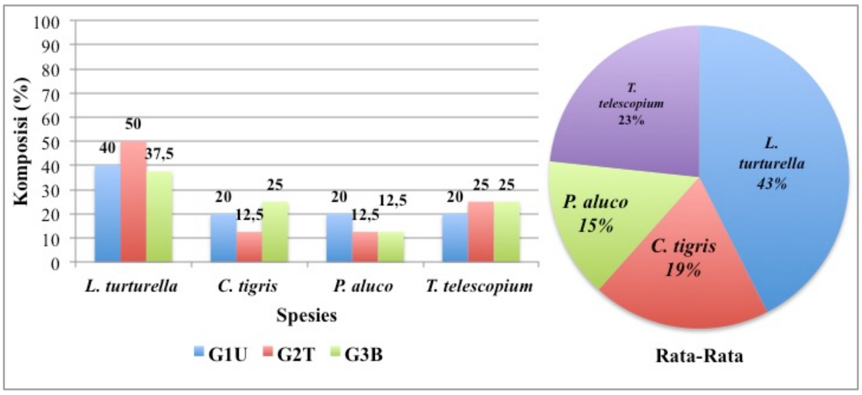

Figure 5. Composition of Mega Gastropoda species

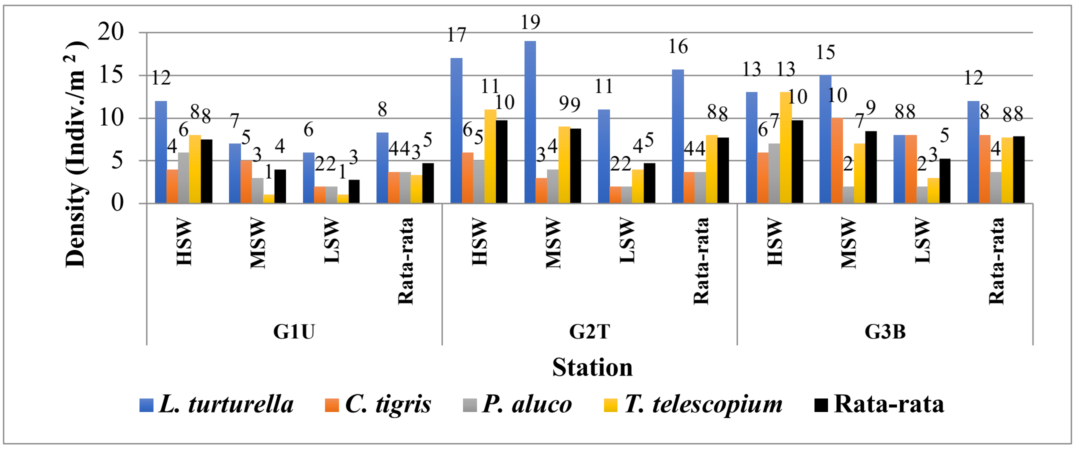

Figure 6. Density of Mega Gastropoda species

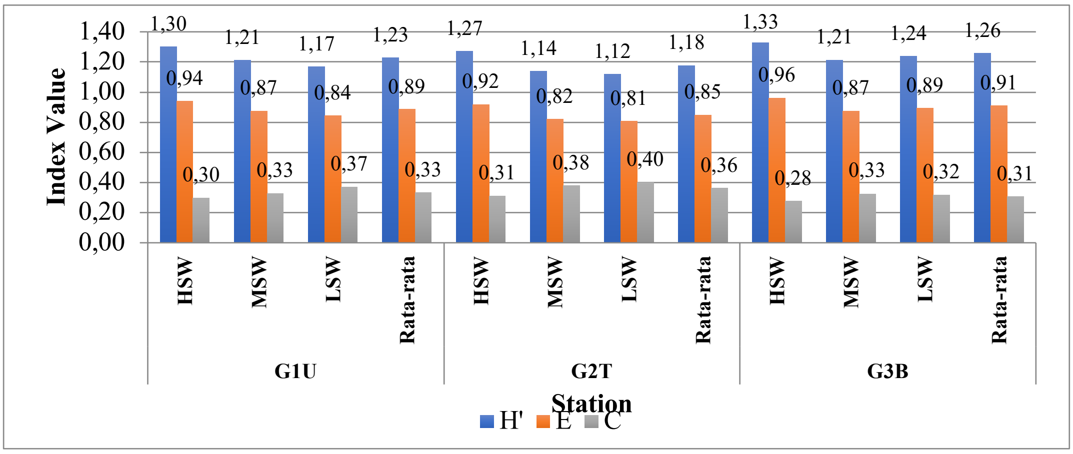

Figure 7. Value of diversity, evenness, and dominance index of Mega Gastropoda.

Relationship between Mega Gastropoda Density and Seagrass Species and Basic Substrate Habitat Characteristics

The relationship between the density of mega gastropod individuals with the total density of seagrass and the density of *E. acoroides* tends to be negatively correlated, while the relationship between the density of mega gastropods and the stands of *C. rotundata* is positively correlated (Table 1).

Table 1. Relationship between Mega Gastropoda density and seagrass species density

Density	Density (plants/m ^{2})		
(Individuals/m ^{2})	Daydream	*E. acoroides*	*C. rotundata*
Mega Gathropods	r=(-)0.544;	r=(-)0.460	r=(+)0.421

Based on the results of the basic substrate PCA, the contribution of information reached 100% (F1: 28.02% and F2 : 71.98 %) with the characteristics of Station G1U which is not characterized by the basic substrate fraction analyzed, Station G2T is characterized by medium sand and coarse sand fractions, while Station G3B is characterized by dust and clay fractions (Figure 8).

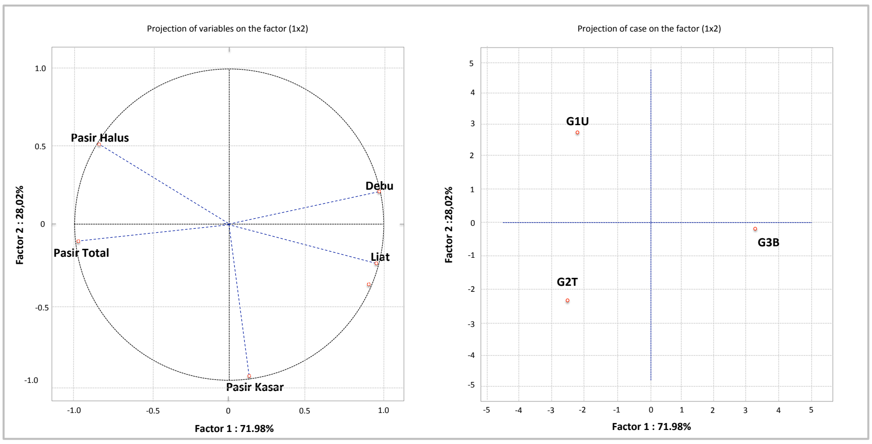

Figure 8. Results of PCA of the basic substrate based on station distribution.

Based on the results of CA distribution of Mega Gastropoda species based on stations with information contributions reaching 100% (D1 : 31.19 % and D2: 68.81%), *P. aluco* is associated with Station G1U, *L. turturella* is associated with Station G2T, and *C. tigris* is associated with Station G3B (Figure 9).

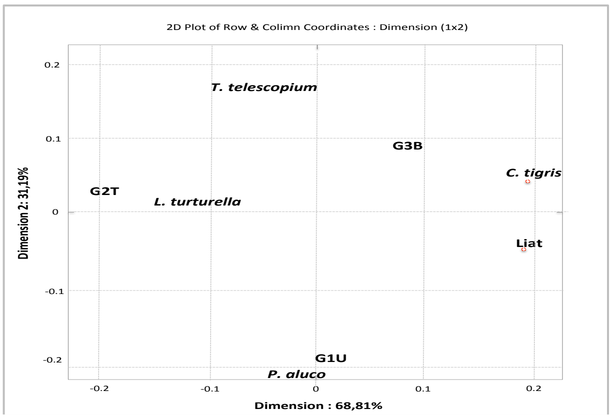

Figure 9. CA results of distribution of Mega Gastropoda species based on stations

DISCUSSION

Characteristics of Mega Gastropod Habitat

Basic Substrate Water Parameters

Based on Figure 2, the average temperature reaches 29.3^{O}C, the average temperature is relatively the same as the temperature range in the seagrass beds of Hiri Island, Ternate, Maitara and Tidore, which is 27.3-29.7^{O}C (Ramili *et al.,* 2018). Likewise, the temperature of the gastropod habitat in the Puding Beach seagrass beds ranges from 29.0-30^{O}C with an average of 29.6^{O}C (Nopiansyah *et al*., 2021) and in the waters of Lampanairi Village it ranges from 29.3-30.3^{O}C with an average of 29.8^{O}C (Raiba *et al*., 2022). This shows that the mega gastropod habitat is in the average range of 27.3 - 30.3^{O}C and this range is still within the standard quality range of 28-30^{O}C (PP No. 22 of 2021).

Salinity ranges from 32-32.3 ‰ with an average of 32.2 ‰ (Figure 2), the range and average tend to be lower than the quality standard which ranges from 33-34 ‰ (PP No. 22 of 2021), but the salinity in the habitat of *L. turturella* in the Tukak seagrass meadow and Anak Air Island ranges from 3.2-31.2 ‰ (Supratman *et al*., 2018) and in the Tanjung Ru and Kubu waters ranges from 14-29 ‰ (Yunita *et al* ., 2021) tends to be lower than the salinity in the habitat of the mega gastropod Badak Badak Island. This condition also shows that *L. turturella* can be found in the salinity range of 3.2-32.3 ‰.

The acidity level (pH) of the waters ranges from 8.2-8.3 (Figure 2) with an average of 8.3, the pH of the mega gastropod habitat is relatively the same as the pH range in the seagrass beds on the East Coast of Bintan Island, namely 7.8-8 with an average of 7.9 (Hati *et al*., 2022), as is the pH range in Lembar Bay for the families Cerithiidae, Strombidae and Cypraeidae reached 7.80-8.14 (Hafish *et al* ., 2022), while in Kelabat Bay, *L. turturella* was found at a pH of 7 (Abdullah *et al*., 2021). The pH range indicates that the Cerithiidae, Strombidae and Cypraeidae families tend to be found in the range of 7-8.3.

The dissolved oxygen (DO) content ranges from 6.8-7.4 mg/l (Figure 2) with an average of 7.1 mg/l. This average range is relatively higher in dissolved oxygen content than in Kelabat Bay which ranges from 4.5-7.8 mg/l with an average of 5.7 mg/l (Abdullah *et al*., 2021). Dinata *et al*. (2022), reported the habitat of the Cerithiidae and Strombidae families with a DO range of 7.23-7.80 mg/l with an average of 7.53 mg/l, likewise the DO range in the East Coast seagrass beds of Bintan Island reached 7.6-7.9 mg/l (Hati *et al* ., 2022) while the DO range in the Pasir Putih Manokwari seagrass beds was 6.5-6.7 mg/l with an average of 6.6 mg/l (Gultom *et al ., 2023) The DO range shows that species from the* Cerithiidae, Strombidae and Cypraeidae families tend to be found in the DO range of 4.5-7.9 mg/l.

The water clarity of mega gastropod habitat in Badak-Badak Island ranges from 0.9 to 2.0 m with an average of 1.3 m (Figure 2). Likewise, the brightness of *S. turturella habitat* in the seagrass beds of Tukak Coast and Anak Air Island ranges from 0.48 to 2.8 m with an average of 1.3 m (Supratman & Syamsudin, 2018), while in the seagrass beds of Puding Beach it tends to be lower with a range of 0.31 to 0.78 m with an average of 0.47 m (Nopiansyah *et al* ., 2021) and *L. turturella habitat* in Tanjung Ru and Kubu waters which ranges from 0.73 to 0.87 m (Yunita *et al* ., 2021). The range of water clarity for the habitat of species from the families Cerithiidae, Strombidae and Cypraeidae is in the range of 0.31 to 2.0 m.

The turbidity of the waters ranges from 8.1-8.6 NTU with an average of 8.3 NTU (Figure 2), while the turbidity in the P. Serangan seagrass beds ranges from 0.66-5.53 NTU with an average of 3.8 NTU (Martha *et al*., 2018). This shows that the turbidity in the P. Badak Badak seagrass beds tends to be higher than the turbidity in other seagrass beds and has exceeded the turbidity quality standard which only reaches 5 NTU (PP No. 22 of 2021). The tendency for high turbidity in the Badak Badak Island seagrass beds is related to the location of the seagrass beds in the Tanjung Limau River Estuary.

The nitrate content in the seagrass beds of Badak Badak Island ranges from 0.039-0.042 mg/l with an average of 0.041 mg/l (Figure 2). The nitrate content is sufficient for the growth of organisms (nitrate content of 0.3-0.9 mg/l for the growth of organisms in sufficient criteria) (Wardoyo, 1982). Patty (2015), reported that the nitrate content in the waters of the Lembeh Strait, North Sulawesi ranges from 0.015 - 0.026 mg/l with an average of 0.003 mg/l, different from the nitrate content in the seagrass beds of Sintok Island, Menjangan Besar and Kemujan, Karimunjawa which ranges from 0.23-0.33 mg/l (Noor *et al*., 2023). Such conditions indicate that the nitrate content in seagrass beds ranges from 0.015-0.33 mg/l.

The phosphate content in waters ranges from 0.003 – 0.006 mg/l with an average of 0.005 mg/l (Figure 2), the phosphate content is within a fairly fertile fertility level (0.0021-0.050 mg/l: a fairly fertile fertility level) (Joshimura *in* Wardoyo, 1982). Noor *et al*. (2023), reported that the phosphate content in the waters of the Lembeh Strait ranged from 0.005 – 0.011 mg/l with an average of 0.008 mg/l (Patty, 2015) and the phosphate content in the seagrass beds of P. Sintok, Menjangan Besar and Kemujan ranged from 0.01- 0.11 mg/l (Noor *et al*., 2023). These conditions show that the phosphate content in seagrass beds ranges from 0.003 – 0.11 mg/l.

The basic substrate in Badak Badak Island is composed of an average clay fraction composition reaching 4.67%, dust: 9.23%, coarse sand: 9.98%, medium sand: 11.68%, fine sand 12.30% and the total sand average reaches 52.13% and the texture tends to be *sand clay* (Figure 3).

Seagrass Composition and Density

The composition of seagrass species that make up the seagrass meadows on Badak Badak Island, namely *Enhalus acoroides* reaches 88.51% and *Cymodocea rotundata* reaches 88.51%. 11.49%. The distribution of *E. acoroides* tends to be found in all areas except in the *HSW area* of G2T Station (Figure 4). Based on this composition, it shows that the field tends to be monospecific which is dominated by *E. acoroides*.

The density of seagrass stands ranges from 46-50 stands/m^2 with an average of 48 stands/m^2. Based on the station, the density at Station G1U ranges from 46-50 stands/m^2 with an average of 48 stands/m^2, Station G2T ranges from 47-54 stands/m^2 with an average of 50 stands/m^2, and G3B ranges from 42-50 stands/m^2 with an average of 47 stands/m^2. Based on the level, the density at *the HSW level* ranges from 42-50 stands/m^2 with an average of 46 stands/m^2, the *MSW level* ranges from 48-54 stands/m^2 with an average of 50 stands/m^2 , and at *the LSW* level ranges from 47-50 stands/m2 with an average of 49 stands/m^2 . Based on the range and average, it shows that the density of seagrass in the criteria is rare (Gosari & Haris, 2012).

Composition and Density of Mega Gastropod Species

Based on the number of species, it shows that the Cerithiidae family has the largest number of species with 2 genera and 2 species, then the Strombidae family with 1 species, as well as the Cypraeidae family with 1 species (Figure 4). The presence of species of the Cerithiidae family is related to its ability to adapt in seagrass beds, according to Arbi (2012) who reported that there were 9 species associated in the Wori Beach seagrass beds, North Sulawesi and Sanjaya *et al*. (2020), reported that there were 5 species of the Cerithiidae family associated in the Penyengat Island seagrass beds, namely *Cerithium zonatum*, *Clypeomarus batillariaeformis*, *Cerithium crassilabrum*, *Bittium glaresum*, and *Clypeomorus concise*. Likewise, the association of species from the Strombidae family tend to be predominantly found in association with seagrass beds (Gultom *et al*., 2023) and species from the Cypraeidae family with 13 species (Arbi, 2012).

Based on the composition of Mega Gastropoda species, it consists of *L. turturella* with a range of 37.5-50% with an average of 43%, *C. tigrisi* with a range of 12.5-25% with an average of 19%, *P. aluco* with a range of 12.5-20% with an average of 15%, *and T. telescopium* with a range of 20-25% with an average of 23% (Figure 2). The range and average show that *L. turturella* has the highest composition then *T. telescopium*, *P. aluco* and *C. tigrisi.* Likewise, based on the station, it shows that the highest density of mega gastropod individuals was found at Stations G2T and G3B with an average of 8 individuals/m^2 or contributing to the density of mega gastropods in seagrass beds of 38.1% each and G1U with an average of 5 individuals/m^2 which contributed 23.8% (Figure 5). Based on Figure 3, it shows that the highest average density was found at the *HSW level* reaching 7 individuals/ ^{m2} which contributed to the density of mega gastropods in seagrass beds reaching 55.6%, then *MSW* reached 3 individuals/ ^{m2} which contributed 26.8% and *LSW* reached 2 individuals/ ^{m2} which contributed 17.6%.

Based on the average species density at the station and based on the level, it shows that the highest density is by *L. turturella* with a density ranging from 8-16 individuals/m^2 with an average of 8 individuals/m^2. This density is relatively higher than the density of *L. turturella* in multi-species seagrass beds (*H. ovalis, H. uninervis, H. pinifolia, C. serrulata, C. rotundata, T. hemprichii, S. isoetifolium* and *E. acoroides*) Tukak Village and Anak Air Island ranging from 1 - 4 individuals/m^2 with an average of 2 individuals/m^2 (Supratman *et al*., 2018) and Dinata *et al*. (2022), reported the density of *Laevistrombus canarium* in multispecies seagrass beds (*E. acoroides, C. serrulata, H. ovalis,* and *T. hemprichii*) Semujur Island, Bangka Belitung ranged from 0.02-0.03 ind/m^2 with an average of 0.02 ind/m^2. Similarly, Hati *et al.* (2022), reported that the density of *Strombus canarium* and *Strombus turturella* in seagrass beds composed of *E. acoroides, T. hemprichii, C. rotundata, C. serrulata, H. uninervis, H. ovalis* and *S. isoetifolium* ranged from 0.4-0.8 ind/m^2 with an average of 0.6 indv./m^2 and 0-0.4 indv./m^2 with an average of 0.03 indv./m^2. This condition indicates that the density of mega gatropoda in seagrass beds dominated by *E. acoroides* (monospecific) tends to be higher than the density found in multispecies seagrass beds.

Diversity Index (H'), Uniformity (E), and Dominance (C)

The diversity index ranges from 1.12-1.33 with an average of 1.22 (Figure 7). Based on the station, it shows that Station G1U ranges from 1.17-1.30 with an average of 1.23, Station G2T ranges from 1.12-1.27 with an average of 1.18, and Station G3B ranges from 1.21-1.33 with an average of 1.26 (Figure 7). Based on the request, it shows that the *HSW level* ranges from 1.27-1.33 with an average of 1.30, the *MSW level* ranges from 1.14-1.21 with an average of 1.19, and *the LSW level* ranges from 1.12-1.24 with an average of 1.18 (Figure 7). Based on the range and average of the diversity index values, it is in the moderate diversity criteria (Odum, 1994).

The uniformity index ranges from 0.81 to 0.96 with an average of 0.88 (Figure 7). Based on the station, it shows that Station G1U ranges from 0.84 to 0.94 with an average of 0.88, Station G2T ranges from 0.81 to 0.92 with an average of 0.85, and Station G3B ranges from 0.87 to 0.96 with an average of 0.91 (Figure 7). Based on the request, it shows that the *HSW level* ranges from 0.92 to 0.96 with an average of 0.94, *the MSW level* ranges from 0.82 to 0.87 with an average of 0.85, and the *LSW level* ranges from 0.81 to 0.89 with an average of 0.85 (Figure 7). Based on the range and average value of the uniformity index in the moderate uniformity criteria (Brower *et al*., 1990)

The dominance index ranged from 0.28 to 0.40 with an average of 0.33 (Figure 7). Based on The stations show that Station G1U ranges from 0.30 to 0.37 with an average of 0.33, Station G2T ranges from 0.31 to 0.40 with an average of 0.36, and Station G3B ranges from 0.28 to 0.33 with an average of 0.31 (Figure 7). Based on the request, it shows that the *HSW level* ranges from 0.28 to 0.31 with an average of 0.30, *the MSW level* ranges from 0.33 to 0.38 with an average of 0.35, and the *LSW level* ranges from 0.32 to 0.40 with an average of 0.36 (Figure 7). Based on the range and average value of the dominance index, the criteria tend to be low dominance or there is no dominant species (Odum, 1994).

Relationship between Mega Gastropoda Density and Seagrass Species Density

The relationship between Mega Gastropoda density and total seagrass and *E. acoroides density* is not positively correlated (Table 1) and the relationship level is sufficient (Riduwan, 2003), while the relationship between Mega Gastropoda density and *C. rotundata density* is positively correlated (Table 1) and the relationship level is sufficient (Riduwan, 2003). These results indicate that the density of seagrass and *E. acoroides* does not encourage an increase in the density of Mega Gastropoda species, it is possible that the seagrass meadow tends to be monospecific, especially dominated by *E. acoroides* which has leaf morphology, large rhizomes and dense roots (Sarinawaty *et al*., 2020) thus narrowing the habitat space of Mega Gastropoda.

The distribution of substrate fractions based on stations and the distribution of Mega Gastropoda species (Figures 8 and 9) show that *P. aluco* is associated with Station G1U which is not characterized by the analyzed basic substrate fractions, while *L. turturella* is associated with Station G2T which is characterized by medium and coarse sand fractions and *C. tigris* is associated with Station G3B which is characterized by dust and clay fractions.

CONCLUSION

The conclusions are:

1. The Mega Gastropoda found consisted of *L. turturella*, *C. tigris*, *P aluco*, and *T. telescopium* and the highest species composition was the *L. turturella species.*
2. The value of the mega gastropod diversity index is in the medium category, the uniformity value is in the high category and the dominance value is in the low category or there are no dominant species.
3. The relationship between the density of Mega Gastropoda and the density of *E. acoroides* was not positively correlated and the presence of Mega Gastropoda species was associated with the characteristics of the bottom substrate fraction.

ACKNOWLEDGEMENT

Thanks to the Dean of Fisheries and Marine Science Mulawarman University and the Coordinator of the Fisheries Resources Management Study Program who have facilitated the implementation of this research.

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