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Potency and Spatial Distribution of *Trochus* sp. In Intertidal Zone of Rhun Island Waters, Banda Sub-District, Central Maluku Regency

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Abstract

Trochussp belongs to class gastropods in order Archaeo gastropoda. Most of this mollusks live in intertidal zone of coastal waters area. Utilization on fishery resource by inappropriate-based information toward this potential resource will cause population structure changes inflicting extinction. This study aims to know the size, density, potency, diversity index, homogeneity index, dominance index and distribution pattern of *Trochus sp.* Research site is located in intertidal zones which are divided into three zones (high, middle and low) in an area width of 111.000 m^2, while the observed area is 20.875 m^2 (18.81%). Applied method is transect quadrant in size of 5x5 m with 25 m of transect distance which is perpendicular to the shoreline and this quadrant is set based on the line transect with no distance. The findings show that dominant species in high and mid intertidal zones is *T. Pyramis*, while the dominant species in low zone is *T.niloticus.* Average size of *Trochus* sp. basal diameter increases in a deeper waters; this is in contrast to the density. *Trochus* sp. potency in high zone is 46 $ind.ha^{-1}$, 28 ind ha^{-1} in the mid zone and 25 $ind.ha^{-1}$ in the low zone. Diversity index value of *Trochus* sp.is moderate, low. Obtained distribution pattern of *Trochus* sp. in research sites from the three zones are clumped pattern based on habitat and food.

Keywords: *Trochus Sp*, Potency, Spatial Distribution, PulauRhun

1. Introduction

Trochus sp.belongs to class gastropods in order Archaeo gastropoda in habiting intertidal zone of coastal waters (Arifin and Pradina, 1993, Nurdin*et al*., 2010), coral reef and intertidal flat in depth of up to >10 m (Woodhams. 2009). It also lives in waters with a wide coral reef flat (Lalli and Parsons. 2001). Ease of extraction conducted by people allows excessive utilization toward this marine resource either for food, side dish alternatives, raw material of jewelry, souvenirs or paint compound and high protein content in its meat as well (Dolorosa,*et al.*, 2010).

Commonly utilized Trochus in coastal community of Maluku are *Trochusniloticus, T.piramys, T.Maculatus, and T.radiatus* (Purnomowati R. 2001). Continuous human activities disregarding bio-ecological aspect will decrease resource potency of *Trochussp* and habitat degradation. Therefore, it needs an effort to protect this marine resource sustainability.

Recently faced problem is lack of information on *Trochus* sp. potency, especially in Rhun Island, and knowledge related to this biota. This condition encourages local people to exploit more disregarding its potency and ecological condition. In order to solve the problem, there should be a study on *Trochus* sp.potency and spatial distribution.

This study aims to understand natural population condition of *Trochus* sp.covering: size, density, diversity index, homogeneity index, dominance index and distribution pattern. Expected benefit of the study is to be the basic information for resource management of *Trochus* sp. in Lokong coastal waters, PulauRhun village, Banda Sub-district, Central Maluku Regency.

2. Research Method

2.1 Research Time and Site

This study is conducted from May to July, 2013 in coastal waters of Rhun Island village, Banda Sub-district, Central Maluku Regency. Location of the study lies at southern latitude of 04°31′ 17.2′and longitude east of 129°40′24.6 (Figure 1).

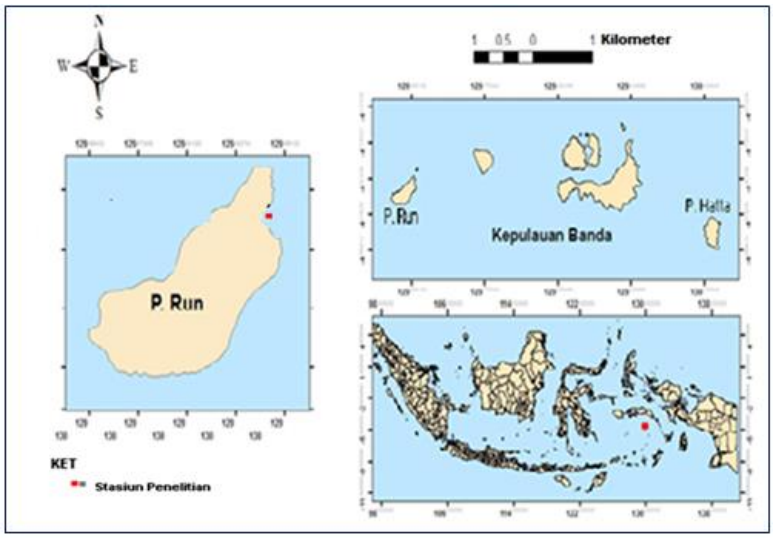

Figure 1. Map of Research Site

2.2 Sampling and Data Collection Method

Sampling is aimed to the three kinds of intertidal zones, i.e., high, middle and low. High zone is characterized by small coral pieces, seaweed and sand-dominated substrate, middle zone is characterized by reef block substrate and small number of living coral, while low zone is characterized by living coral, macroalgae and microalgae.

Applied method is transect quadrant, while transect distance is 25 m in quadrant size of 5x5 m which is set by following transect with no distance.

2.3 Data Analysis

a) Density

Species density refers to the number of individuals of species in a certain volume or area and it is calculated based on formula as proposed by Dahuri *et al.*, (1993) as follows:

$$K = \frac{\sum x_i}{n}$$

Description:
K= Sea cucumber density
x_i= Number of sea cucumber in *i*thsample unit
n = Number of *i*th sample unit

b) Potency

Potency is calculated by applying equation below:

$$P = \bar{X} . A$$

Description
P= Potency
X= Density (ind/m^2)
A= Width of research area

c) Diversity and Homogeneity Index

Diversity index is an overview that reflects community structure of organism which can make information analysis process on organism species and its number easier. The more biota species inhabiting waters, the higher of its diversity.Shannon – Wiener index calculator (Magguran, 1955 in Hartati and Awaluddin (2007) is presented as follows:

$$H' = -\sum_{i=1}^{s} Pi\, Ln\, Pi$$

Description:
H′= Diversity index
Pi=ni / N
N= Number of *i*th individual species
S= Number of *i*th biota species

Based on equation above, Shannon-Wiener diversity is categorized as follows:

H < 1.0 = Low
1.0 < H <3.0 = Average
H > 3.0 = High

Diversity index can be calculated by equation as follows:

$$e = \frac{H'}{H_{maks}}$$

Description:

H' = Diversity Index

$H_{maks} = \ln S$

Homogeneity index value is around 0−1. If the homogeneity index is close to 0, there is an inclination of species dominance caused by environmental factors instability in the ecosystem. If the homogeneity index is close to 1, it shows that the ecosystem is relatively stable, i.e., when the number of every species is relatively equal (Brower danZar 1977).

d) Dominance Index

Applied dominance index is Simpson's dominance index (Simpson, 1949 in Krebs. 1989), as follows:

$$D = \sum_{i=1}^{s}\left[\frac{n_i - (n_i - 1)}{N(N-1)}\right]$$

Description:

D= Simpson's dominance index
ni= Number of individuals of the *i*th species
N= Total number of individuals
s = Total of sample

The value of D is categorized as follows:

0 <D≤0.5 = Less dominant
0.5<D≤0.75 = Moderate dominant
0.75<D≤1.00 = High dominant

e) Distribution Pattern

Knowledge on distribution pattern is important to understand the clump level of individuals which can impact population. Distribution pattern of *Trochus* sp.is analyzed based on distribution pattern as developed by Morisita (1962) in Khouw (2009) by the following equation:

$$I_d = n\,\frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x} = n\,\frac{\sum[x(x-1)]}{\sum x(\sum x - 1))}$$

Description:

I_d= Morisita's distribution index
n= Number of samples
∑x= Total of individuals in every quadrant

$\sum x^2$ = Squared total of individuals in every quadrant

Below is criterion of each value:

Id = 1 indicates a random distribution
Id > 1 indicates a clumped distribution
Id < 1 indicates a uniform distribution

3. Findings and Discussion

3.1 Description on Research Site

Coastal waters of Rhun Island in intertidal zone has a slope coastal topography with substrate type of sand, seaweed, small coral pieces, reef block and living coral.

Habitat structure of high zone are sand, seaweed and small coral pieces as well as some types of macroalgae and microalgae under water depth of 0.1 to 2 m. Research site area is 41,000 m^2 in observed area of 8,125 m^2 or 18.82% of research site area and the total of observed quadrant (325 quadrants). Types of *Trochus* sp.found in this zone are *T. piramys, T. niloticus, T. makulatus* and *T. radiatus* attached to leaves of seaweed as their foraging habitat because the leaves has a great number of epiphytes as the food of various kinds of gastropods. The dominant types of gastropods is*T. pyramis*, then followed by *T. niloticus, T. maculatus*and *T. radiatus.*

Mid zone has habitat structure of coral fracture, dead reef block, small number of living coral, and some macroalgae and microalgae in depth of 2.0 to 3 m. Research area is 48,000 m^2 in observed area of 8,875 m^2 or 18.48% of the whole research site area. The number of observed quadrant is 355 quadrants. Types of *Trochus* sp.found in this zone are *T. piramys, T. niloticus, T. makulatus* and *T. radiatus*. The dominant species is *T. pyramis*, then followed by *T. niloticus, T. maculatus* and *T. radiatus*.

Habitat structure of low zone are dead reef block, soft coral with living coral dominating this zone. It also has much macro algae and microalgae in depth of 3.0 to 4 m. Research site area is 22,000 m^2 or 17.61% of research site area with 155 observed quadrants.Types of *Trochus* sp. found in this zone are *T. niloticus, T. piramys*, while *T. makulatus* and *T. radiates* cannot be found in this area. Types of dominant *Trochussp* isspesies *T. niloticus* and *T. pyramis*.

3.2 Size of Trochus sp.

Result of analysis on the size of *Trochus* sp. in intertidal zone is presented in Table 1.

Table 1. Size of *Trochus* sp. in Intertidal Zone

Intertidal zone	Depth (m)	Species	Diameter (mm)	Height of Apex (mm)	Diameter of basal (mm)
High	0.1-2 m	*T. niloticus*	21.62	8.51-16.87	12.21-32.15
		T. pyramis	15.93	8.15-23.54	8.10-23.40
		T. maculatus	13.09	7.12-14.56	10.83-16.03
		T. radiatus	12.72	10.21-15.12	10.35-15.71

Middle	2.0-3 m	*T. niloticus*	36.18	36.39-51.29	31.31-42.33
		T. pyramis	29.49	17.91-33.60	25.91-34.46
		T. maculatus	28.88	16.01-37.67	20.66-36.58
		T.radiatus	24.90	17.54-27.54	20.78-29.05
Low	3.0-4 m	*T. niloticus*	49.55	49.31-61.51	40.08-62.26
		T. pyramis	38.06	26.12-35.42	33.42-42.05
		T. maculatus	-	-	-
		T.radiatus	-	-	-

Table 1 shows that there are 4 types of *Trochus* sp. in intertidal zone, they are *T. niloticus*, *T. pyramis*, *T. maculatus* and *T. radiatus* which has various average size of basal diameter in high and mid zone, but *T. maculatus* and *T. radiates* could not be found in low zone. Due to its tiny size, both of *Trochus* sp. could not be found in low zone where the habitat is not suitable for them. According to Paonganan*et al.* (2001), if average diameter of *T. niloticus* is 40.2 mm, it will be found in zone depth of 0.1-3 m, 61.3 mm in >3-5 m deep, 100.4 mm in >5-8 m deep, and 117.8 mm in >8-11 m deep.

Average size of basal diameter in four of these *Trochus* sp. types from high to low zone are different, the deeper of the waters, the bigger of average size. The same notion is also proposed by Poutiers (1998) that the deeper zone, the smaller number of population with the bigger size of eggshell. Differences on eggshell size in each zone is caused by adaptation to habitat, food and physiology of the biota. Besides, adaptation also relates to shelter searchings from predators such as fish, octopus and starfish.

3.3 Density

Analysis result on density value of *Trochus* sp. in intertidal zone can be seen in table 2.

Table 2. Density of *Trochussp* in Intertidal Zone

Intertidal Zone	Area Observed(m^2)	Species	Number (ind)	Density (ind m^{-2})	Percentage (%)
High	8125	*T. niloticus*	42	0.00517	28.00
		T. pyramis	68	0.00837	45.33
		T. maculatus	21	0.00258	14.00
		T.radiatus	19	0.00234	12.67
		Average		0.00462	100.00
Middle	8875	*T. niloticus*	29	0.00357	31.87
		T. pyramis	42	0.00517	46.15
		T. maculatus	10	0.00123	10.99
		T.radiatus	10	0.00123	10.99
		average		0.00280	100.00
Low	3875	*T. niloticus*	10	0.00258	52.63
		T. pyramis	9	0.00232	47.37
		T. maculatus	–		
		T. radiatus	–		
		average		0.00245	100.00

Table 2 shows that *Trochus sp.* is distributed in intertidal zone based on changes of waters depth where the deeper of depth the bigger of its size; on the contrary, the density decreases. This change is caused by changes of physiology, morphology and behavior. It is found that during juvenile phase, a sample of species *T.niloticus* lives in high intertidal zone and attaches to seaweed, lives in coral reef flatness during its adolescence phase and migrates to the deeper waters in its maturity phase. Kubo (1991) also found that in intertidal zone, *Trochus sp.* also depends on its life cycle. During its juvenile and adolescence phase, it populates coral reef flatness area and migrates to the deeper waters for the upcoming phase.

3.4 Potency of Trochus sp.

Potential degree is important for the continuity of waters resource management. Knowledge and technology are needed to manage this natural resource and they will only effectively play its role if there is data basis to calculate its potency and opportunity to be developed (Erwin and Laimena, 2002).

Analysis result on the potential degree of *Trochus sp.* in intertidal zone can be seen in Table 3. It shows that *Trochus sp.* found in high zone has potency of 46 ind ha^{-1}, 28 ind ha^{-1} in the mid zone and 24 ind ha^{-1} in the low zone.

Table 3. Potency of *Trochus sp.* in Intertidal Zone

Intertidal Zone /Depth (m)	Research Area (M^2)	*Trochussp*	Density (types m^{-2})	Potency (Ind)	(Ind/ha)
High/0.1–2 m	41000	*T. niloticus*	0.00517	212	52
		T. pyramis	0.00837	343	84
		T. maculatus	0.00258	106	26
		T. radiatus	0.00234	96	23
Middle/2.0–3 m	48000	Total		757	
		T. niloticus	0.00357	171	36
		T. pyramis	0.00517	248	52
		T. maculatus	0.00123	59	12
		T. radiatus	0.00123	59	12
Low/ 3.0–4	22000	*Total*		538	
		T. niloticus	0.00258	57	26
		T. pyramis	0.00232	51	23
		T. maculatus		0	0
		T. radiatus		0	0

Potency of *Trochus sp.* decreases because habitat condition in high and mid zone is alleviating as the impact of people's activities in utilizing fishery potency, such as ornamental fish extraction, mollusks hunt at the ebb current and people's waste disposal. Indeed, it needs special handling method to protect the existing fishery resource sustainability in intertidal

zone that will deliver sustainable utilization. Ecosystem has an important role for juvenile growth, food and spawning (Indrawan*et al* . 2007).

3.5 Diversity and Homogeneity of Trochus sp.

Diversity and homogeneity value of *Trochus* sp.in intertidal zone can be seen in Table 4. Analysis result on diversity (H') of *Trochus sp.* shows that biota community in high and mid zone is steady moderate and unstable in the low zone. According Stirn (1981), if H'<1, biotic community is unstable, if H' ranges from 1-3, it is moderate and if H'>3, it means biotic community is sturdy (stable). The higher of H' value, the more diverse of the organisms in the waters. It means that this is a better habitat.

Odum (1971) states that a community has a high diversity rate if its Shannon's diversity index is 4.0. High diversity of species in a community indicates that the community is complex. High diversity occurs when environmental condition in the deep sea is stable for a long time, so it allows the species to live through during that time up to specialization phase in order to inhabit macrohabitat or utilize certain feed (Shanders, 1968 in Nyabaken, 1980).

Table 4. Diversity and Homogeneity Value of *Trochus* sp. in Intertidal Zone

Intertidal Zone	SPECIES	ni	Pi	ln Pi	PiLnPi	E
High	*T. niloticus*	42	0.28	-1.27	-0.3564	0.90
	T. pyramis	68	0.45	-0.79	-0.3586	
	T. maculatus	21	0.14	-1.97	-0.2753	
	T. radiates	19	0.13	-2.07	-0.2617	
	Number of individual (N)	150		H'	1.25205	
	Number of species (S)	4		H'max	1.38629	
Middle	*T. niloticus*	29	0.32	-1.14	-0.3644	0.87
	T. pyramis	42	0.46	-0.77	-0.3569	
	T. maculatus	10	0.11	-2.21	-0.2427	
	T. radiates	10	0.11	-2.21	-0.2427	
	Number of individual (N)	91		H'	1.20662	
	Number of species (S)	4		H'max	1.38629	
Low	*T. niloticus*	22	0.59	-0.52	-0.3091	0.97
	T. pyramis	15	0.41	-0.90	-0,366	
	T. maculatus	0				
	T. radiates	0				
	Number of individual (N)	37		H'	0.67514	
	Number of species (S)	2		H'max	0.69315	

Homogeneity value of *Trochus sp.* in PulauRhun waters in the three intertidal zones is high (e > 0.75), where the existence of biota is distributed, so there is no dominant species. If homogeneity value is close to zero, it means that homogeneity of inter-species in the community is low. On the contrary, if the homogeneity value is close to one, it can be said that homogeneity of inter-species is even or equal (Pirzan*et al.* 2005). Specifically for *Trochus sp.* in this ecosystem, there is no tendency of certain species domination which is

caused by the existence of environmental factors instability. According to Brower and Zar (1977), diversity will moderate and homogeneity will high if species abundance is equal or nearly equal, and if only some species is plenteous, species diversity will be low.

3.6 Dominance Index

Analysis result on dominance index of *Trochus sp.* in intertidal zone can be seen in the following Table 5:

Table 5. Domination Index Value of *Trochus* sp.in Intertidal Zone

Intertidal Zone	Species *Trochussp*	Dominance Index					
		S	N	ni	∑Di	D	Note
High	*T. niloticus*	150	42	66	0.00058	0.0061	less dominant
	T. pyramis	150	68	122	0.00022		
	T. maculatus	150	21	27	0.00238		
	T. radiatus	150	19	29	0.00292		
Middle	*T. niloticus*	91	29	65	0.00123	0.0240	less dominant
	T. pyramis	91	42	88	0.00058		
	T. maculatus	91	10	26	0.01111		
	T. radiatus	91	10	16	0.01111		
Low	*T. niloticus*	37	22	51	0.00216	0.0069	less dominant
	T. pyramis	37	15	31	0.00476		

Analysis result on dominance index value (D) of *Trochus* sp.shows low value meaning that there is no specific species domination in the waters. If dominance index value is close to 1, it refers to a condition where one species dominates the others in the community. On the contrary, if its value is close to zero, it means there is no extreme domination of one species toward the others in the community. In order to avoid certain species domination in Rhun Island waters, coral reef and seaweed bed preservation as well as exploitation prohibition to certain areas (nurture place) are need to be done.

3.7 Distribution Pattern

Analysis result on distribution pattern value of *Trochus sp.* in intertidal zone can be seen in the following table 6.

Table 6. Distribution Pattern of *Trochus sp.* in Intertidal Zone

INTERTIDAL ZONE	SPECIES *Trochussp*	Distribution Pattern				
		n	∑x	∑x²	Id	Note
High	*T. niloticus*	150	42	66	2.09	Clumped
	T. pyramis	150	68	122	1.78	Clumped
	T. maculatus	150	21	27	2.14	Clumped
	T. radiatus	150	19	29	4.39	Clumped
Middle	*T. niloticus*	91	29	65	4.03	Clumped
	T. pyramis	91	42	88	2.43	Clumped
	T. maculatus	91	10	26	16.18	Clumped
	T. radiatus	91	10	16	6.07	Clumped
Low	*T. niloticus*	37	22	51	2.32	Clumped
	T. pyramis	37	15	31	2.82	Clumped

Analysis result on distribution pattern (Id) of *Trochus* sp.show a clumped pattern. Odum (1971) states that clumped pattern is the most common pattern, while the random one is rarely found in nature because it exists in a very homogeneous nature. Distribution pattern of *Trochus*sp found in intertidal zone of Rhun Island waters is clumped. It relates to habitat structure especially for the distribution pattern of coral blocks as the settlement and shelter from predators as well as microalgae and macroalgae distribution. Nurdin *et al* (2009) states that substrate type and environment effects such as salinity and temperature affects gastropods distribution. The same finding stated by Tarumingkeng (1994) proposes that organism tends to form a clumped pattern as an effort to forage, breed and defend from the predators attack.

4. Conclusion and Suggestion

4.1 Conclusion

Based on the findings and discussion, it can be concluded as follows:

1. There are four types of *Trochus sp.* found in research site. The dominant species in high and mid zone is *T. Pyramis*, while the dominant species found in low zone is *T.niloticus.*

2. Average size of basal diameter from the four species *Trochus sp.* increases along with the increasing of waters depth, it occurs conversely to the density.

3. Potency of *Trochus* sp.in high zone is 46ind ha^{-1}, 28 ind ha^{-1} in mid zone and 25 ind ha^{-1} in the low zone.

4. Diversity index value of *Trochus* sp.in high and mid zone is moderate (medium) and unstable (low) in low zone.

5. Diversity index of *Trochus* sp.in the three intertidal zones of Rhun Island waters is high.

6. Dominance index of *Trochus* sp.in the three zones is low.

7. Distribution pattern of *Trochus sp.* found in intertidal zone is clumped based on habitat structure and food.

4.2 Suggestion

It is suggested that there is the needs to do habitat improvement in intertidal zone in order to improve population diversity by performing rehabilitation on coral condition and alleviating people's activities in intertidal zone.

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