



## Relation analyse of TSS with abundance of gastropods using Landsat Sattelite imagery in nongsa beach batam

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### Abstract

Nongsa beach, residing in Nongsa Regency, Batam City is a territory whose economy's began developing by marine tourism. These activities will certainly have a negative impact to the condition of waters in Nongsa beach. One of the consequences is the decreasing of Gastropods population which has the most important role in aquatic ecosystem and is the bio-indicator of the waters. The purpose of this research is to know the composition and density of gastropods and to know the relation among TSS, sedimen fractions and organic matter with density of gastropods in Nongsa beach Batam. TSS and sedimen fractions contained in the bottom substrate are closely related to gastropods, because a kind of sedimen is a habitat preference for gastropods. Nutrients used by gastropods for feeding is needed to survive. TSS analysis can be used by satellite imagery procession. Landsat data was used to determine the concentration of TSS up to 25 meters deep. Using satellite imagery can simplify and accelerate of data analysis process. The statistics result of the validation test shows the coefficient of determination ( $R^2=0.6662$ ), which indicates the TSS concentration extracted from satellite images data of Landsat determined 66.6% the conditions in field. This research used the descriptive method and purposive sampling method to determine the object which was suitable with the purpose. TSS concentration are between 0,092 – 0,11mg/l. Various kinds of gastropods were found from Famili Strombidae, Muricidae, Neritidae, Ceritidae, Potamididae, Terrebridaedan Phasianellidae.

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## Introduction

Nongsa Beach is a marine tourism area which has marine diversity such as coral reefs and seagrass ecosystems. The ecosystem is very threatened by the pressure changes in the environment such as chemical and physical parameters of the surrounding waters, especially due to the development and activities that occur around the coast. Such changes can determine the abundance of life in the waters, including gastropods. Gastropods is a group of animals of the phylum of mollusks that live on the type of substrate from rough to smooth (Suwignyo, 2005). Furthermore Effendi (2003) states that the abundance of gastropods are influenced by physical factors in waters and one of them is the TSS (Total Suspended Solid)

TSS is a suspended solids consisting of silt and fine sand as well as microorganisms, which is mainly caused by scraping of soil or soil erosion which has been dragged to the water bodies in the water. The cause of TSS in the waters of the main ones are piling up or erosion of soil-borne to water bodies. Too high TSS concentration will inhibit the penetration of light into the water and lead to disruption of the process of photosynthesis.

Along with the development of technology and informatics, any changes that occur in the Earth's surface can be monitored using satellite images, one of which is with the Landsat image. Barret and Curtis (1982) state that remote sensing technology has been widely applied to study water quality, one of which is to calculate the value of TSS in the waters and water transparency. The quality of water has a different light penetration in certain areas and it can be seen with multispectral technique. Management efforts can be done by knowing the locations that degrades or damage quickly and accurately.

The purpose of this study was to determine the TSS at the beach Nongsa Batam and the relationship between the abundance of gastropods with TSS and TSS knowing equation models which were analyzed using Landsat TM satellite imagery 8.

## Methods of Study

### *Study site*

Nongsa beach is one of the beaches located in the district of Nongsa, Batam, Riau Islands. Nongsa is located in the north of the island of Batam, Bintan Island bordering the Straits of Malacca and Singapore Straits. Batam Island has 415 km<sup>2</sup> area which is geographically located on 0°55'–1°55' Latitude dan 103°45'–104°10' Longitude. The beach including a gently sloping beach with white sand bottom substrate and the waves in the medium category. However, when the sea breeze seasons between December and February, waves and ocean currents are categorized with high wind speeds.

### *TSS processing method*

Analysis of samples TSS (Total Suspended Solid) used Gravimetry method (ISO 2004). 1 liter of sea water is filtered using Whatman filter paper AH / 934 1.5 µm. Filter paper firstly heated in an oven at a temperature of 80°C for 24 hours, then cooled in a desiccator and weighed to constant weight. Then the calculation results of the analysis carried out by the formula according to ISO (2004):  $TSS = \frac{(A-B) \times 1000}{V}$

### *In which*

TSS = Total Suspended Solid (mg/l)

A = weight of filter paper + weigh of dry residue (mg)

B = weight of filter paper (mg)

V = volume samples (l)

### *Satellite imagery data analysis for TSS*

Regression be used to development of the model to predict the concentration of TSS waters. Regression formula was get from combination of the values of the digital number on satellite imagery and value of TSS in situ. The model used in the form of regression equations that have the highest of coefficient of determination (R<sup>2</sup>), where y is the value of a parameter in the field (data in situ concentration TSS) and x is a combination of digital number of bands in imagery. Form of regression used in the study are polynomial regression, with formula:  $Y = b_0 + b_1X + b_2X^2 + \dots + b_kX^k$

*In which*

- Y = response variable
- $b_0$  = intersep
- $b_1, b_2, \dots, b_k$  = regression coefficient
- X = predictor variable

*Satellite image data processing method*

Image data processing performed to generate information of TSS in waters based on digital number by the satellite imagery. Then the digital number regressed to determine the validity of the model used. Image processing method used is as follows:

- a. Image composite.
- b. Atmospheric correction, Cropping and Enhancement
- c. Band (Red Green Blue)
- d. Image Cropping.
- e. Gridding Wizard
- f. Edit formula
- g. Overlay and Layout

*Individual abundance*

Definition of individual abundance is the number of individuals or species of each station in a cubic unit. Formula to calculate individual abundance using Odum's formula (1993):  $KR = \frac{ni}{N} \times 100\%$

*In which*

- KR = Relative density
- $N_i$  = Number of individu
- N = Number of individu each station

*Species diversity*

Species diversity is the heterogeneity of species and quantitative measure that reflects how many different types (such as species) in an ecosystem. This research using Shannon-Wiener (Krebs, 1989) formula:

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

*In which*

- $H'$  = Diversity index
- $P_i$  =  $n_i / N$

- $N_i$  = Number of individuals in species i
- N = Total number of individuals in the community
- Criteria of diversity index result ( $H'$ ) are as follows:
- $H' \leq 1$  : Low diversity
- $1 < H' < 3$  : Medium diversity
- $H' \geq 3$  : High diversity

*Uniformity index*

Uniformity index is composed of individuals of each species contained in the community. Uniformity index (Krebs, 1989) taking the following form:

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

*In which*

- E = Uniformity index
- $H'$  = Diversity index
- $H_{maks} = \log s$

*Dominance index*

Simpson's Dominance is a very flexible measurement that takes the entire community into account (Krebs 1989). Here is the equation of Simpson's dominance:

$$C = \sum_{i=1}^s (P_i)^2$$

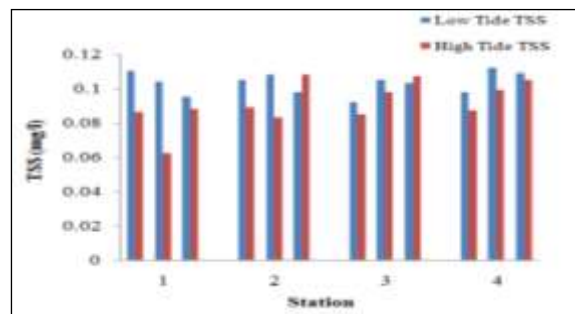
*In which*

- C = Dominance index
- $P_i = n_i / N$
- s = Number of species

**Result and discussion**

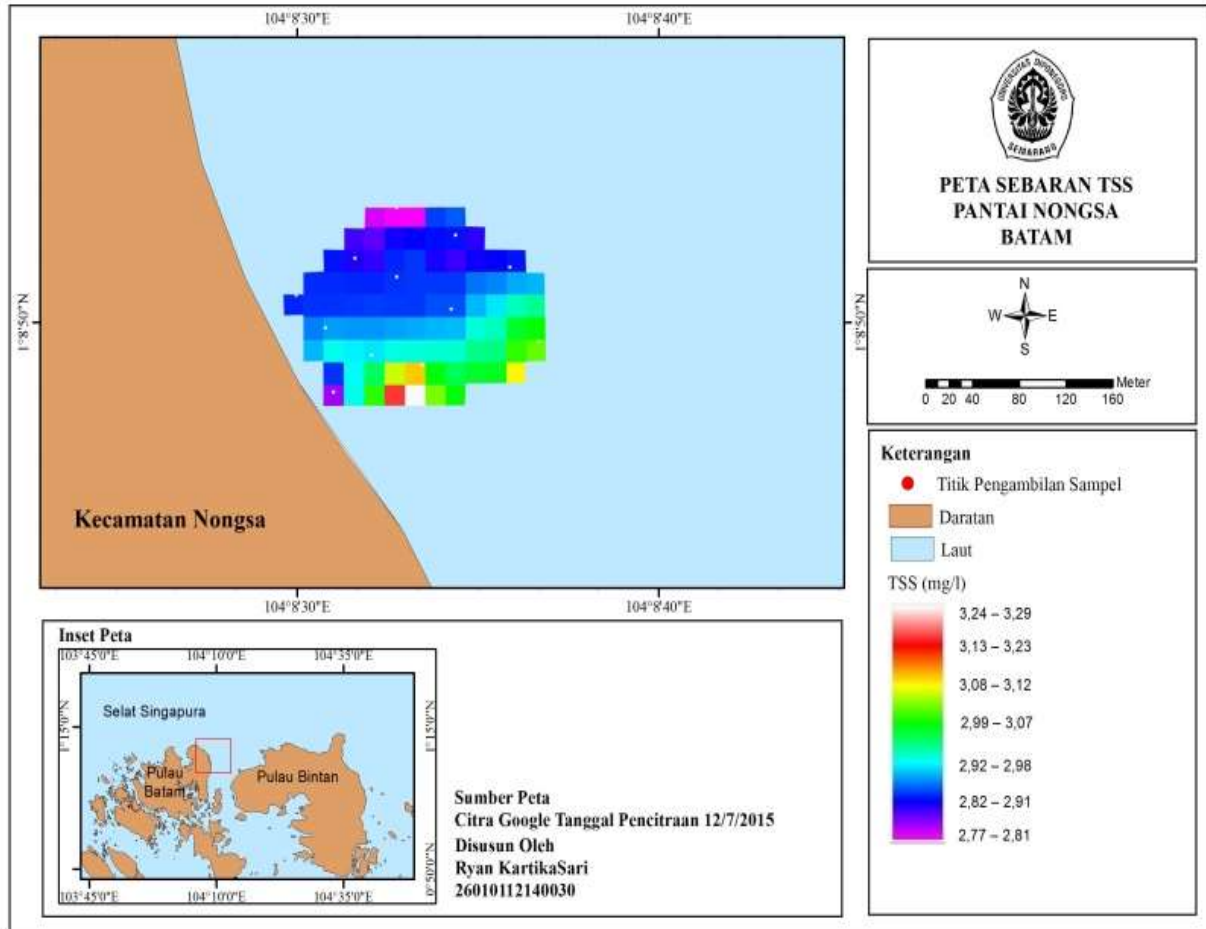
*Result*

The following histogram contains of TSS values at high tide and low tide in coastal waters Nongsa,



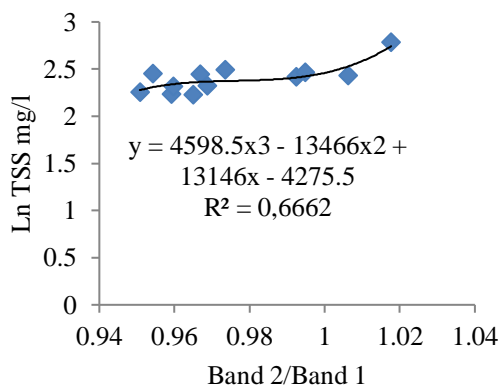
**Fig. 1.** Histogram of TSS in Nongsa Beach Batam.

Here is a map of the distribution of TSS around the sampling point on the coast of Nongsa processed by using Landsat 8 TM.



**Fig. 2.** TSS's distribution map in Nongsa Beach Batam.

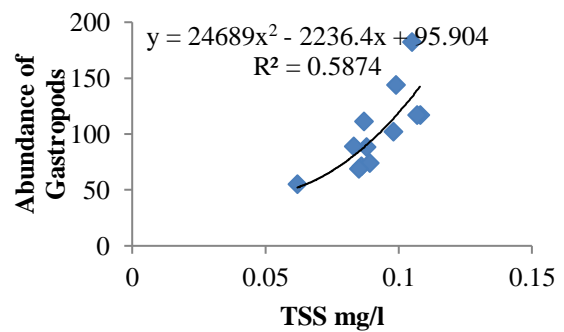
Here is the regression equations used as a model equation for TSS process using TM Landsat 8 satellite imagery.



**Fig. 3.** The Result of Regression Between Digital Number and Number of TSS in situ.

Here are the results of the regression relationship between levels of TSS.

With an abundance of gastropods on the Nongsa beach



**Fig. 4.** Result of Regression Between TSS Concentrate and Abundance of Gastropods.

The following table contains of abundance and community structure data of gastropods at four stations on the Nongsa Beach.

**Table 1.** Abundance, Diversity Index, Uniformity Index and Dominance Index of Gastropods in Nongsa Beach Batam.

No	Species	Station 1				Station 2				Station 3				Station 4			
		A	b	c	KI	a	b	C	KI	a	B	c	KI	a	B	c	KI
1	<i>Strombusurceus</i>	1	0	1	2	1	1	3	5	2	1	3	6	0	1	1	2
2	<i>Strombusturturella</i>	0	2	1	3	0	2	1	3	2	0	1	3	1	0	1	2
3	<i>Parpura panama</i>	1	0	0	1	0	2	0	2	0	1	0	1	1	2	0	3
4	<i>Neritasquamata</i>	5	2	1	8	6	8	8	22	8	5	6	19	6	5	10	21
5	<i>Rhinoclavissinensis</i>	2	3	2	7	5	2	2	9	2	2	3	7	5	2	3	10
6	<i>Cerithidea cingulate</i>	62	47	81	190	62	73	102	237	55	92	102	249	97	134	167	398
7	<i>Hastulahectica</i>	0	0	2	2	0	1	1	2	0	1	2	3	0	0	0	0
8	<i>Phasianellidae</i>	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1
	total	71	55	88	214	74	89	117	280	69	102	117	288	111	144	182	437
	Abundance	214				280				288				437			
	H'	0.53				0.64				0.60				0.41			
	E	0.26				0.31				0.28				0.20			
	C	0.79				0.72				0.78				0.83			

Source: Research Data 2016.

**Discussion**

Based on the research results at low tide on the TSS values ranging between 0.092mg/l up to 0.11mg/l while the TSS value at the time of high tide ranges between 0.062mg/l up to 0.108mg/l. TSS value at the time of low tide and high tide on the beach included in the category of low levels, i.e. no more than 50mg/l. This is because the condition of coastal waters there has not been a major pollution done directly by human activity, so that the condition of coastal waters based on TSS safe for the existence of Gastropods. This was confirmed by Setiawan (2008) state the value of TSS 25mg/L has no effect, 25-80mg/L has little effect, 81-400mg/L is less good, and > 400mg/L is not good.

TSS value at each station at high tide to rise between point A, point B and point c. TSS value at station 1 point a of 0.086mg/l, point b of 0.062mg/l and a point c of 0.088mg/l. A point located close to the shoreline while the point c was located about 15 meters from the shoreline or in the area breaking waves (surf zone).

It can be said that the value of suspended solids increasingly leading to higher sea levels value. It is thought to be caused by the movement of water occurs at low tide and the tide heading towards downs caused sediment transport at the base, causing a shift in the sediment at high tide and low tide. This can be explained at high tide, the tide would spread to the waterfront area,

which is accompanied by a mass transport sea water in a very large number, so did the opposite at low tide. This was confirmed by Triatmodjo (1999), stating that the ebb be the most important parameter in the circulation flow in the coastal areas. Salinity and suspended sediment will be affected in pergeseranya along the coast, which will move at high tide upstream and downstream at the time of low tide.

Species of gastropods were found on the beach Nongsa Batam consists of six families that Strombidae family consists of *Strombusurceus* and *Strombusturturella*, family Muricidae consists of species *Parpura panama*, family Neritidae consists of *Neritasquamata*, family Ceritidae consists of species *Rhinoclavissinensis*, family Potaminidae consists of species *Cerithideacingulata*, Terrebridae family consists of *Hastulahectica* and family Phasianellidae. Dominance Index in this study was obtained by 0.79 at station 1, station 2 obtained a value of 0.72, the third station obtained a value of 0.78, and at station 4 obtained a value of 0.83. Species of gastropods dominate on the beach.

Nongsa is *Cerithideacingulata*. *Cerithideacingulata* is a gastropod that lives on argillaceous sand substrate. *Cerithideacingulata* generally live in the intertidal zone, especially muddy, sandy beaches, and mangroves (Hinton 1972: 4; Roberts *et al.* 1982: 28; Sriaroon *et al.* 2006: 108 in Laksmana, 2011).

Diversity index were spread about 0.41 to 0.64. The index value of diversity included in the low category because it is smaller than 1. This is reinforced by the Shannon-Wiener (1963) in Fachrul (2007), which states that  $H' < 1$  is a low biodiversity value by the number of individual was not uniform and had one of the dominant species. Low value diversity index is suspected that these ecosystems under pressure. The pressure that occur in an ecosystem is usually influenced by many factors such as the changing patterns of currents and waves on the beach due to changes in the earth's temperature (global warming). Changes in currents and waves become firmer can lead to coastal erosion and loss of balance in the sediment transport along the coast.

The current velocity was quite high, ranging from 0.2 to 0.5m/s. Based on data from BMKG Batam, Nongsa coast wind speed in February was quite high. The wind was blowing in the Riau Islands were primarily from the north to northeast with blowing speed were 5-15m/sec (about 10-40 km/h) (BMKG Batam, 2016).

Results of regression analysis of the relationship between TSS value at high tide with abundance of Gastropods, by following equation polynomial regression  $y = 24689x^2 - 2236.4x + 95904$  with a value of  $R^2 = 0.5874$ . The linear equation indicates that the positive relationship between TSS and with an abundance of gastropods with the coefficient of determination ( $R^2$ ) 0.5874. This means that the effect of TSS in the waters to abundance of gastropods around the station by 59% while 41% were influenced by other factors. Value of correlation ( $r$ ) in the regression 0.766. This shows that there is a strong relationship between the abundance of gastropods with TSS value ( $> 0.5$ ).

### Conclusion

This study attempts to identify the TSS in Nongsa beach using satellite- remote sensing data based on regression model from digital number and TSS concentration in the waters. We found that this regression algorithm can be successfully used for identify the TSS concentration over Nongsa beach. The regression algorithm for estimating the concentration of TSS is  $y = 4598.5x^3 - 13466x^2 + 13146x - 4275.5$ .

Abundance of gastropods at station 1 were 214 ind/m<sup>2</sup>, at station 2 were 280 ind/m<sup>2</sup>, the third station spread were 288 ind m<sup>2</sup> and at station 4 were 437 ind/m<sup>2</sup>. The concentration of TSS in Nongsa Beach Batam has a relationship with abundance of gastropods with a high correlation coefficient is equal to 0.766.

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