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The Value of Acoustic Backscattering in Determining the Integration Thickness of the Seabed in Yos Sudarso Bay Papua

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Abstract
A considerable amount of research has already been conducted into the nature of water on the ocean floor/seabed, ranging from mapping of the seabed, volume backscattering strength (SV) of acoustics on the seabed, classification of the seabed, besides the relationship between the ocean floor and the biota above it with which it interacts. The Yos Sudarso Bay, Jayapura Papua, is a bay with a seabed which faces the floor of the Pacific Ocean and also forms the estuary of the river Anafre which contributes particles that settle on the seabed. This research aimed to collect data in order to understand differences in the integration of water thickness at 0.2 m and 0.5 m besides differences in the types of substrate based on the results of SV. Data was collected using single beam echosounder. The acoustic data were collected at 11 stations. The result is interval of value of SV ranged from -37.81dB to -15.62 dB (at the integration of 0.2 m) up to -15.07dB (at the integration of 0.5 m). The value of SV from the gravel was higher compared to the values found in the coarse sand, fine sand, mud mixed with sand or the pure mud. The lowest value of SV was found in the mud substrate. Results showed that thickness integration yielded different results when tested at 0.2 m and 0.5 m on the seabed. Furthermore, it was found that different types of substrate.

Keywords: Humboldt Bay, Irian Jaya, Unsoiled sediment

1. Introduction

Study of the seabed using an acoustic backscattering technique makes for interesting, efficient and valuable research. This is because without the need for diving, we can come to know the types of substrate based on the values of SV detected through the acoustic equipment. The topics for acoustic research include mapping the seabed, backscattering of seabed, and the interaction seabed with the biota (Ehrhold *et al.*, (2006).

The Research location in Yos Sudarso Bay, Papua. This bay is of particular interest because it is overlooked by the city of Jayapura which is Papua's provincial capital and seat of government. The waters of the bay face the waters of the Pacific Ocean besides forming the estuary of the river Anafre (Sari and Dahlan, 2015) which contributes particles that settle on the seabed. Substrate on the seabed that are soft and fine usually give backscattering values that are small compared to seabed substrate that are hard and coarse (Penrose, 2005).

The use of acoustic equipment with various types of beams is becoming increasingly prolific. Using a single beam instrument is one of the ways by which we can find a target in the water column or on the seabed. Biffard *et al.,* (2007) use a single beam instrument to classify the seabed. Ferrini and Flood (2006); Lubis et al., 2019 use a multibeam instrument with a frequency of 300KHZ to gauge the intensity of backscattering in sandy seawater.

The aim of this research is to understand differences of integration in the processing of data, i.e. with regard to the integration of water thickness/density at 0.2 m and 0.5 m, besides differences in the types of substrate based on the values of SV.

2. Research Methods
2.1 Time and Location

This research was carried out in the Bay of Yos Sudarso (Figure 1), Papua on the 29th and 30th April 2017 at 11 strategic stasions which were chosen at random in the western and eastern areas of the bay. Acoustic data collection was conducted using a single beam EK-15 instrument which had a frequency of 200KHZ. This was supplemented with on-location substrate data which was collected using Ekman grab sampler equipment.

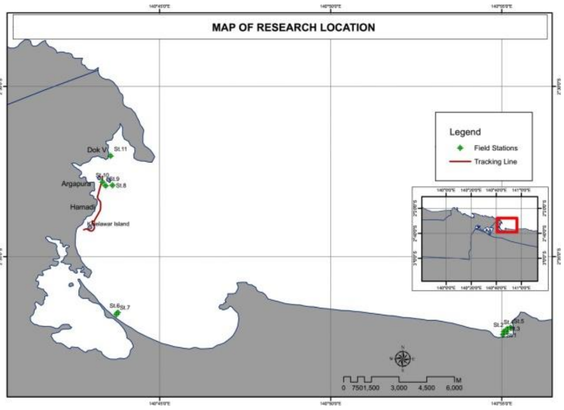

Figure 1. Research Location

2.2 Data Collection

Acoustic data was collected through sounding using a single beam EK-15 instrument for 15 minutes at each chosen stasion. Acoustic data was then recorded and stored in a data Row. The EK-15 instrument with its frequency of 200 KHZ was used because this frequency enables integration of the entire water column including deep and shallow waters.

The acoustic data was supported by data on the type of substrate. The substrate data was collected using the Ekman grab equipment with its mouth opening set at 20x20cm. Before the Ekman grab equipment could be lowered, it was necessary to know the depth of the water and this was gauged in advance using the EK-15 acoustic instrument. This information was vital in order to ensure that the lowering and operation of the EKman grab tool could be done most effectively.

Operations began with lowering the Ekman grab tool to within approximately 0.2 m above the seabed at which point it was opened to its maximum capacity. Having collected the sample, the Ekman grab tool was pulled up to the surface and the substrata sample was put into a plastic container for further analysis.

2.3 The Processing and Analysis of the Data

Post prosessing of the acoustic data was made using an echoview 3.5 (demo version). Processing was divided into 100 pings which comprised the Elementary Sampling Distant Unit (ESDU) that is commonly known as repetition. As for the variables, those which were used, formed the threshold for the backscattering i.e. 0-40 dB with a thickness integration of 0.2 and 0.5 meters. The thickness value was taken based on the value of cτ/2 or as big as 0.2 m, so the thickness integration, 0.2 m was approximately 1 times the value cτ/2 and 0.5 m was 2 times the value cτ/2.

The data on the type of substrate was then taken to the laboratory to perform data analysis on the size of substrate granules and also the type of substrate. Analysis was conducted using a stratified filter. The results of the analysis could therefore be classified into types of strata, ranging from mud to abused coral/broken coral.

Data collection results of backscattering on the seabed with an integration of 0.2 m and 0.5 m were then tabulated with the help of the echoviewprogramme and further verified with data on the types of substrate analysed at the laboratory.

After the backscattering data with an integration thickness of 0.2 and 0.5 m were subjected to a ‘Fully Randomized Design’ check to determine whether differences in these thicknesses were real differences or not, and also to observe the differences of backscattering in each type of substrate.

3. Result and Discussion

The waters of the Yos Sudarso Bay, located beside Jayapura Papua, contain various types of substrate, ranging from substrate that are soft to those which are rough, that is, from mud to gravel. Figure 2 shows an echogram of the bottom of the seabed acoustic sounding results.

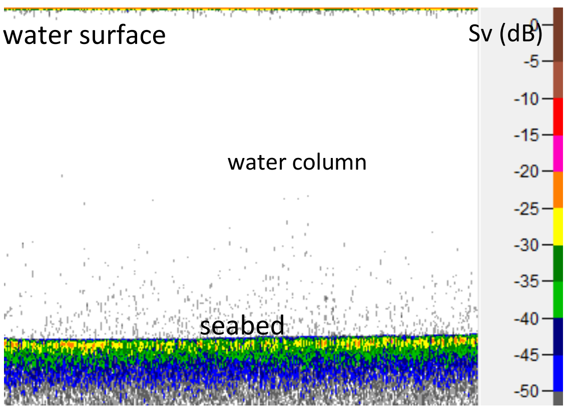

Figure 2. Echogram of the seabed

Results from the laboratory analysis which sought to classify substrata from 11 location stasions, showed that 4 stasions yielded a substrata of mud (St. 2,3,4 5); 1 stasion yielded a substrata of sand mixed with mud (stasion 1); 2 stasions yielded a substrata of fine sand (stasions 9,10); 3 stasions yielded a substrata of coarse sand (stasions 6,7 and 8) and 1 stasion yielded a substrata of gravel (stasion 11).

Based on the results of the acoustic data collected, each substrat had a different SV value (

Figure 3). The interval of value of SV was -37.81dB up to -15.62dB (at the integration of 0.2 m) and -34.61dB up to -15.07dB (at the integration of 0.5 m).

The value of SV from the gravel (K) had a higher backscattering value compared to coarse sand (PK), fine sand (PH), mud (L) and mud mixed with sand (LP). The lowest SV value was found in the substrate composed of mud. This is because a substrate that is fine and ssoft, such as mud, has a tendency to make the acoustic signal continue on, so that the acoustic energy is reduced, whereas hard and rough substrate tend to scatter the acoustic signal, as demonstrated by Biffard*et al* (2007), Ferrini and Flood (2006), Hamuna*et al* (2018) and Pujiyati (2008).

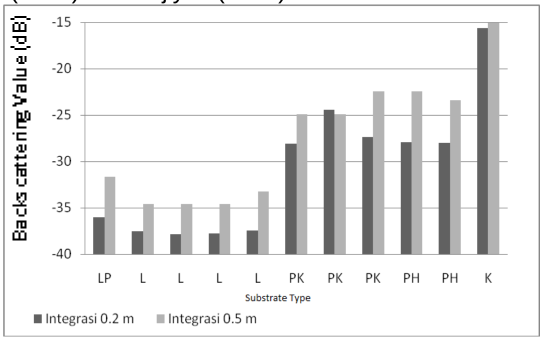

Figure 3 The value of backscattering on the seabed at an integration of 0.2 and 0.5 m

Results of the 0.2 m integration show that the SV value is smaller compared to the integration at 0.5 m. This demonstrates that at an integration of 0.5 m the substrate layer that was detected, had a more solid structure than the substrate with an integration of 0.2 m. This in turn shows that that the thickness of the substrate with an integration of 0.2 m was an upper layer compared to the substrate with an integration of 0.5 m.

An upper layer (integration 0.2 m) by nature, is more easily broken down/unsolided and is also a younger substrate in terms of its age (Pujiyati*et al*, 2008). The result of RAL statistical analysis with a confidence interval of 95% with regard to the SV at integrations of 0.2 and 0.5 m has different real values, where F (1.238) >0.279 then refutes Ho. This indicates that in the confidence interval of 95%, on average, the integration at 0.2 m differences with integration at 0.5 m; or, in other words, Ho's decision to decline can be taken, meaning that there can be many types of influences on what we observe.

To continue, the results of analysis on the different values of backscattering between integrations at o.2 and 0.5 m with a confidence interval of 95%, show that are three different groups, that is, the type A group, consisting of substrates of mud and mud mixed with sand (stations/stasions 1,2,3,4,5), the Type B group, consisting of substrates of fine sand and coarse sand (stations/stasions (6,7,8,9,10) and the Type C group, consisting of gravel substrate (station/stasion 11).

Table 1. Duncan Mean Range Test

SUBSTRATE	Integration Average		GROUP
Mud	-33.8400	± 3.04056	A
Sandy Mud	-35.9325	± 1.86012	A
Fine Sand	-25.3633	± 2.06338	B
Rough sands	-25.4450	± 2.96483	B
Gravel	-15.3450	± 0.38891	C

4. Conclusion

The outcome from this statistical experiment (Complete random Test) shows that SV with integration thicknesses of 0.2 and 0.5 m yielded results with real differences.

Furthermore with regard to types of substrate it was shown that there were t3 values oSV which differed as follows: Type A as represented by mud and mud mixed with sand, Type B as represented by coarse sand and fine sand and Type C as represented by gravel.

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