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EVALUATION OF ACOUSTIC TECHNOLOGY FOR QUANTIFYING AND MAPPING TROPICAL SEAGRASS HABITAT AT BINTAN SEAWATERS

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Approval Sheet

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ABSTRACT

Seagrass is an important component in coastal habitats such as in the waters of Bintan because it acts as a protective beach. Seagrasses have the ability to stabilize the bottom waters of sediments and are able to produce sediments that are able to fertilize the waters. Seagrass can be a reference in strategic management of coastal areas to improve the stability of the coastal environment. Seagrass beds are a protected area for small organisms, a place for spawning aquatic biota, and a place for juvenile and larval enlargement (Komatsu et al, 2003). Maps of distribution and abundance of seagrasses are important to know because they can describe coastal areas whether they are damaged or not.

So far, seagrass monitoring methods still use divers with limited survey area coverage. For this reason, through this research, an acoustic method was used to detect seagrass and the habitats that inhabited it.

From the results of the study it can be concluded that the acoustic method can measure sound intensity or acoustic backscatter from seagrass and the basic waters habitat that inhabits it. Seagrass height can be measured based on the acoustic reflection value of seagrass. In the study location there were 3 seagrass groups based on percent closure, which were small to none of seagrass groups, rare seagrass groups, and many seagrass groups. Seagrass is mostly in fine sedimentary habitats. The increase in the amount of seagrass biomass calculated manually is followed by an increase in the value of acoustic backscattering strength. Identification of seagrass species using the acoustic method has an overall accuracy of 87%.

1. Introduction

1.1. Background

Seagrass is an important component in coastal habitat because it acts as a protective beach. Seagrasses have the ability to stabilize the bottom waters of sediments and are able to produce sediments that are able to fertilize the waters. Seagrass can be a reference in strategic management of coastal areas to improve the stability of the coastal environment. Seagrass beds are a protected area for small organisms, a place for spawning aquatic biota, and a place for juvenile and larval enlargement (Komatsu et al, 2003). Maps of distribution and abundance of seagrasses are important to know because they can describe coastal areas whether they are damaged or not.

Seagrass is an important component of nearshore ecosystems that supports many estuarine species, including a number of commercial fisheries (Deegan, 2002). The distribution of seagrasses is controlled by light availability (Duarte, 1991), and also by several physical, geological, and geochemical factors in the environment near the coast (Koch, 2001). Many habitat requirements for seagrass beds can be disrupted by human activity, and loss of seagrass habitats is often associated with anthropogenic causes (Short and Wyllie-Echeverria, 1996). Damage to seagrass beds throughout the world has caused many government agencies and environmental groups to develop monitoring programs for this important coastal resource.

One technology that is widely used as a tool in detection, quantification and mapping of seagrasses is underwater acoustic technology. The application of underwater acoustic technology begins with its ability to detect fish, zooplankton, benthos and depth of water (Manik, 2018). With the development of information technology and material science, acoustic instruments can be used to detect oil and gas. Underwater acoustic methods for seabed mapping have been extensively developed over the past few decades. In particular, the development of bathymetry has enabled the creation of detailed maps of seafloor topography and acoustic backscatter data; this data has been used to predict the type of sediment and habitat (eg Medialdea et al., 2008; Sutherlandetal., 2007). Some studies have compared backscatter responses to water base types (examples of sampling, video images from the seabed) to assess the ability of different acoustic technologies to classify sea floor types (eg Ferrini and Banjir, 2006; Goffetal., 2004; Kostylevetal, 2001)

Backscatter intensity is carried out through sound measurement to detect sediment and energy from the sediment back to the transmitter with acoustic reflection and scattering. This has been shown to be related to the nature of sediments (eg Ferrini and Flood, 2006; Goffetal., 2004; Sutherland et al., 2007). The backscatter intensity of the muddy seabed has been shown to be inversely proportional to the sediment porosity, percent sludge content and clay content percent.

Seagrass beds in Bintan are important nursery habitat for commercial species of penaeid shrimp and fish. Seagrass is an important food for dugong, dugong dugong (Miller), and green turtles, Chelonia mydas (Linnaeus) (Lanyon et al 1989) and acts as a nutrient and sediment absorber (Short 1987). Seagrass in coastal areas plays an important role in maintaining sediment stability and water clarity. Padang Seagrass beach is an important source that is economically and ecologically. Information about composition, abundance and distribution of seagrasses is used by management for seagrass protection zones.

It is therefore important to know accurate information about seagrass habitats such as distribution, abundance and species composition, to determine the sampling design applied in surveys of seagrass habitats. Surveys that rely on diving-based operations are usually difficult to do in murky waters and over large areas. Dive based surveys also increase the safety risk of divers where there are attacks from dangerous marine animals. So that it needs a reliable remote sensing technique to observe seagrasses that will help reduce this risk and increase the intensity and resolution of the data collected.

Current remote sensing techniques (satellite imagery and aerial photography) are useful for mapping seagrass beds of dense pastures in clear waters in temperate climates, but in the tropics they are inadequate to detect seagrasses with low biomass or turbid water. Recent advances in acoustic techniques for surveying benthic habitats indicate new possibilities for application in surveys of seagrass beds in the tropics. In this research an initial evaluation of acoustic techniques for surveying Bintan's tropical grassland habitat and comparing this technique with diving-based survey methods will be used.

Management based on marine ecosystems

Compared to rocks and sediments, the acoustic scattering of seagrasses is poorly understood. Several studies have analyzed the acoustic response of different seagrass species to understand the mechanism of underlying physical scattering. Laboratory experiments have shown the speed of sound in resonators filled with plants to depend on plant biomass and tissue characteristics, which vary for different seagrass species (Wilson and Dunton, 2009). The acoustic response of seagrass is also influenced by photosynthetic activity, which produces free gas bubbles in plant sand in the water column (Hermand et al., 1998). Lyons and Abrahams (1999) also found that a description of backscatter variability statistics could be used to characterize the base colonized by P. oceanica dolphins because of the non-homogeneous distribution of seagrass beds and leaf movements due to swelling.

Dive-based surveys can be done to check the parameters of seagrass beds on a good or wide spatial scale. Although this method is labor intensive, it provides qualitative and quantitative data. Qualitative information can be in the presence / absence, percent cover and / or composition of species. Quantitative data can include measurements of density or biomass, composition of species, growth characteristics of seagrass beds and depth distribution in certain locations. This survey method requires extensive field resources (labor and time) and involves increasing the risk of safety of divers where dangerous marine animals occur. Coupled with intensive land-based seagrass data, acoustic remote sensing data can be used to map the distribution of seagrass communities with high densities over large areas.

1.2. Aim

The purpose of this study:

1. To determine the feasibility of an acoustic technique to map tropical seagrass beds.
2. To assess the effectiveness of acoustic techniques for determining seagrass biomass.
3. To find out the effectiveness of acoustic survey techniques to describe the types of seabed sediments.
4. Assess efficiency in mapping tropical seagrass habitats using acoustic techniques for current diving survey methods.

1.3. Expected results

The expected results from the study were identification and classification of seagrass genera based on acoustic backscattering values. Another result is looking at the correlation of the seabed type based on the reflection coefficient value with seagrass habitat.

2. Benefits and importance of conducting research

Application and evaluation of underwater acoustic technology to map seagrasses and their habitats quickly and in real time.

3. Methodology

The acoustic / sonar method is an important tool in fisheries studies; mapping the types of seabed, underwater vegetation, sediments and sub-lower sediment types (Hundley et al 1994; Collins and Gregory 1996). Acoustic instruments are also used under water to look for sinking ships, airplanes and falling pipelines. The advantage of using acoustic waves is being able to propagate through visual media or other media to extract information in the marine environment. Acoustic signals are less sensitive than light to turbidity or depth. Data collected at higher spatial resolutions and large areas can be surveyed quickly compared to diving based surveys. Data is digitally recorded on a PC in the field, and can be connected with GPS and processed into a GIS format.

The acoustic system installed on ships plus GPS will be used to map seagrass habitats. This system uses high frequency acoustic pulses to map the substrate and biota related to the area directly in the selected plot width.

This research will provide a preliminary evaluation of acoustic techniques to map tropical seagrass habitats in the waters of Bintan. Seagrasses will be surveyed using two methods: acoustic remote sensing techniques, and visual estimation techniques. The results of the two methods will then be compared. Logistics will be considered in a simple cost-benefit analysis and recommendations for applying this technique are made.

3.1 Research Sites

The survey area are conducted in Bintan waters (Figure 1). The survey area was expanded across seagrass beds and mapped depth profiles. This research was conducted to test the ability of acoustic techniques to distinguish habitat types and find boundaries of seagrass beds. The echo width of the plot is around 50 m used. Seagrass habitats and sediment types are expected to be heterogeneous within each survey area. Seagrass habitats with above-ground biomass of less than 5 g of dry wt-2 are specifically included for testing, because they can be an important food source for dugongs. Ranging sediments were examined from fine mud to coarse sand (grain size class <63μm to> 2000μm).

Figure 1. Research Location for Detection and Quantification of Seagrasses

3.2 Experimental Design

Surveys at sea are conducted in April-June 2018. Each area are surveyed with acoustic techniques, followed by diving. GPS differential are used to record the position of each acoustic data point that is accurate up to 15-20 m and each location for sampling seagrasses and sediments. Biomass and sediment data are connected spatially with acoustic data for statistical analysis.

3.3 Acoustic surveys

Seagrass and sediments are surveyed using two acoustic systems: a circular and rectangular transducer. The combination of recorded echo character and amplitude and transducer output geometry allows 3 interpretations of acoustic data.

1. Mapping habitat boundaries from acoustic transducer fan beams
2. Estimated seagrass biomass from the transducer with a detection angle of 10 °.
3. The type of sediment from the transducer with the detection angle at 45 ° or 90 °.

For this study the transducer was installed in a fixed position above the side of the ship (Figure 2a). The acoustic system uses high frequencies and if reflected or scattered from sediments or seagrass beds, it returns to the receiver to be digitally recorded. The geometry between acoustic and environmental instruments is used to calculate the position and strength of the correct acoustic signal received from the target environment. Instrument data Echosounder is recorded on two systems: a) as a real-time hardcopy print on EPC 9800 Chart Recorder and b) stored on a computer hard disk (Figure 2b). Thirty acoustic survey transects will be conducted to ensure adequate survey area coverage.

3.3.1 Mapping the edge of seagrass habitat

Seagrass habitats are mapped in all survey areas using an acoustic system. This technique uses a very narrow sound transducer (2 °) in the horizontal plane, and is wide (60 ° to 90 °) in the vertical plane. This geometry has a sonar .weep effect. The area of the sea floor is usually 1 m wide 70 m long in a direction perpendicular to the ship's track. Spatial acoustic data (recorded in decibels) is plotted using a color scale to represent the intensity of the acoustic signal. Interpretation of acoustic images involves monitoring the depth of sound that is on the survey vessel. Interpretation of raw data from sonar to identify seafloor features that can affect the interpretation of acoustic images.

Acoustic images will be produced by Matlab or Surfer software. The edges of seagrass beds will be interpreted on the acoustic map of the acoustic intensity distribution (decibels) above the survey area and from biomass information obtained from the diving survey.

3.3.2 Seagrass Biomass

Processing acoustic signals are used to survey the biomass of seagrasses in each of the three locations. Very narrow acoustic waves at small detection angles (10 °) are emitted from transducers and reflected from biota above the bottom of the water. Echo received by the transducer is influenced by the density of seagrass. High plant density results in higher echo amplitude and other seafloor factors. To calibrate acoustic data, the average echo will be plotted and tested against seagrass biomass data in the spatial scale range from a radius of 10 m to 100 m. Above ground seagrass biomass data in this case is obtained by visual estimation, calibrated with a measure of biomass above g gt wt m-2.

3.3.3 Types of sediment

The type of sediment are surveyed along the transect using a backscatter technique or acoustic reflection technique. Acoustic data will be collected at 1 m intervals throughout the transect survey and sediment sampling is taken close to this transect. Acoustic intensity will give a measure of the sediment granular parameters both in 1) the composition of coarse sand 2) the percentage composition.

3.4 Divers based surveys

All data from diver-based surveys are included in the database and will be validated based on the value of the acoustic backscatter.

3.4.1 Seagrass Habitat Mapping

Seagrass boundaries are determined based on GPS usage at each survey location. Errors in determining the edge of the seagrass are set at ± 10 m on both sides of the seagrass beds and are based on the distance between the locations of the survey. Other errors related to mapping, such as GPS and the position of divers under the ship, are assumed to be within this range.

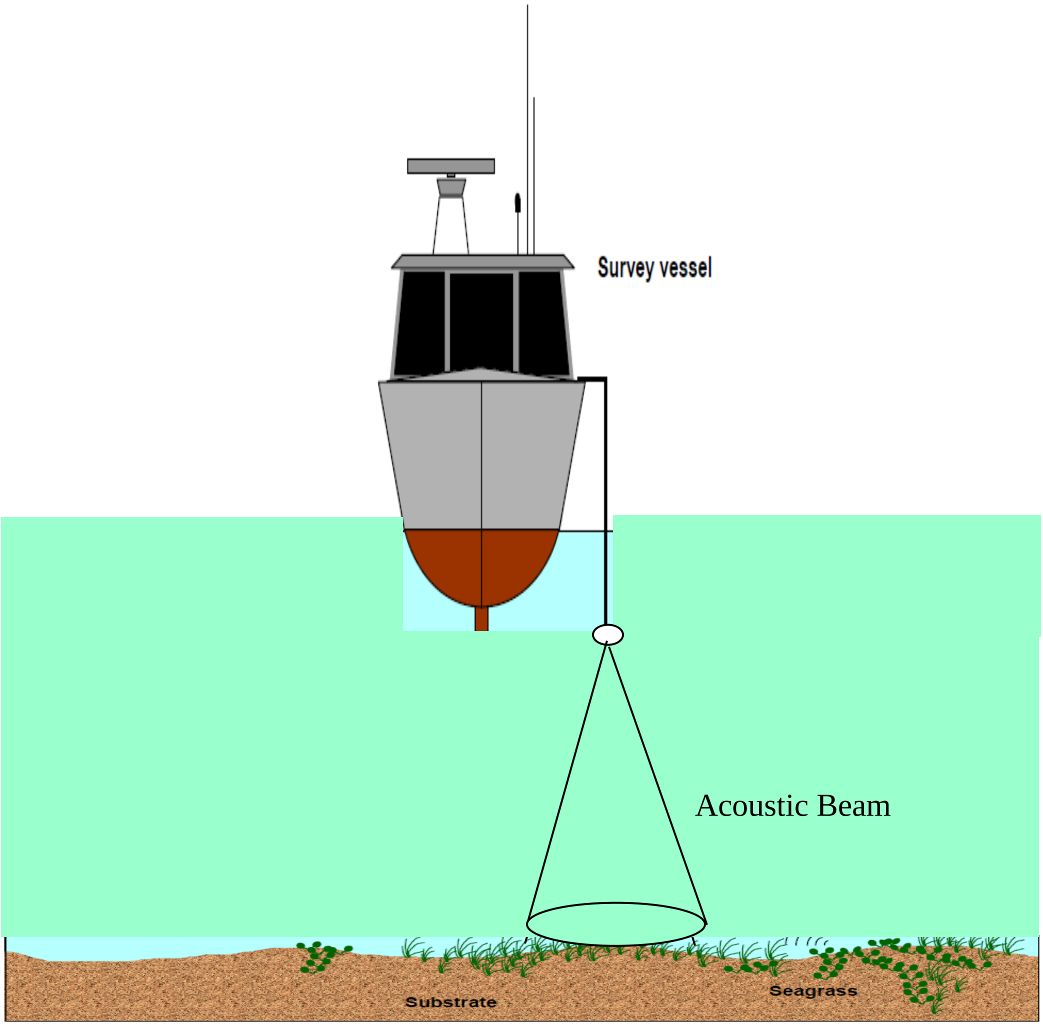


Figure 2. Equipment used in acoustic survey of seagrass.

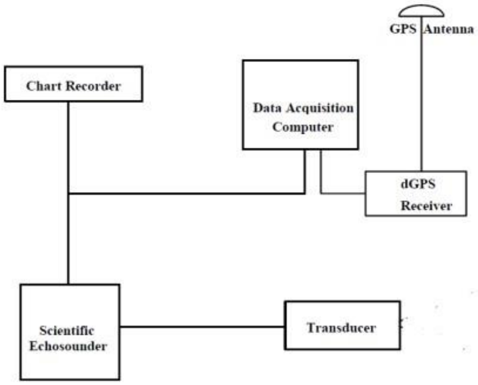


Figure 3. Hardware Equipment used in acoustic survey of benthic environments.

3.4.2 Seagrass Biomass

Estimates of seagrass biomass, composition of seagrass species, algal cover and sediment characteristics were calculated at each site surveyed. The relative proportions of the biomass of each seagrass species in each quadratic survey will also be calculated. In each location, divers recorded estimates of the amount of biomass of seagrasses. The high leaves of seagrass beds, leaf morphology and shoot density affect the ranking of biomass pastures on land predicted by divers. Each scale of seagrass biomass is calibrated against a set of harvested squares and the above dry biomass is measured (g DW m-2).

Seagrass species were identified according to Kuo and McComb (1989). The differential Global Positioning System (GPS) is used to determine the geographical location of all seagrasses, so that biomass of seagrasses anywhere can be linked to acoustic data at that location.

3.4.3 Sediment types

Sediment samples are obtained from the survey area using a standard V16 van. The grain size analysis will be determined by sieving each sample through a series of standard nets. Percentage composition (dry weight) was determined for each grain size category: shellfish, sand gravel (> 2000µm), coarse sand (> 500µm), sand (> 250µm), fine sand (> 63 pmm) and mud (<63 µm). The average size of the sediment grain for each sediment sample, calculated from the sediment composition data and each grain size class.

4. Results and Discussion

1. Calibrate underwater acoustic instrumentation

The calibration of the acoustic instrument was done to measure the standard Target Strength value using a ball sphere with a frequency of 200 kHz. The target strength calibration results will be verified by theoretical acoustic sphere ball measurements. Calibration value will determine the level of accuracy of the instruments used such as the factor transmitting and receiving transducer, the speed of sound propagating in the water column and the noise factor. The configuration system for underwater acoustic instruments used is given in Figure 4. Examples of recording calibration results are given in Figures 5 and 6.

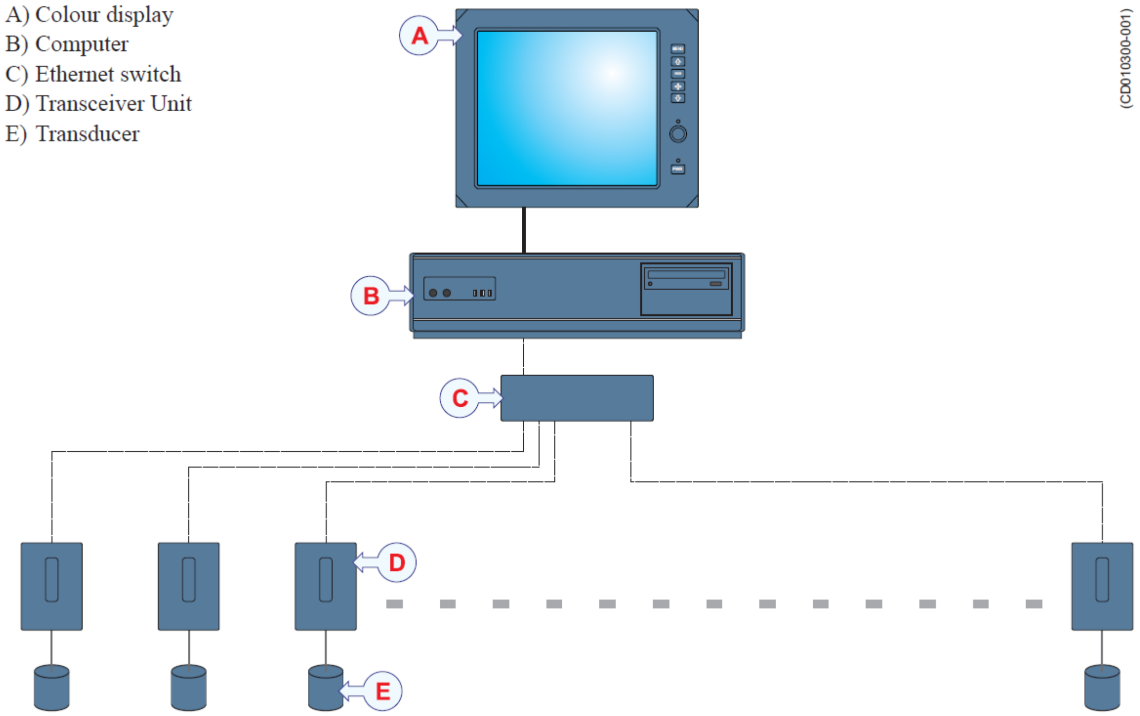


Figure 4. Configuration system of underwater acoustics instrument

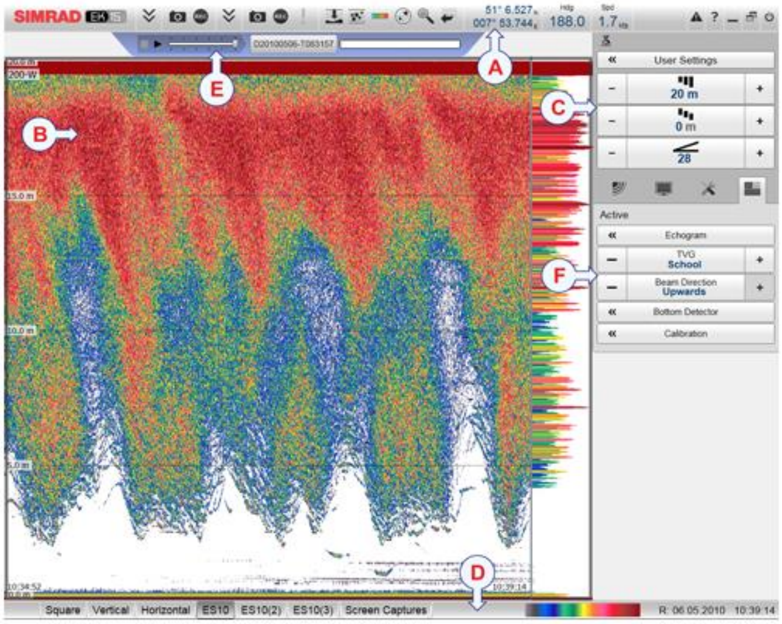
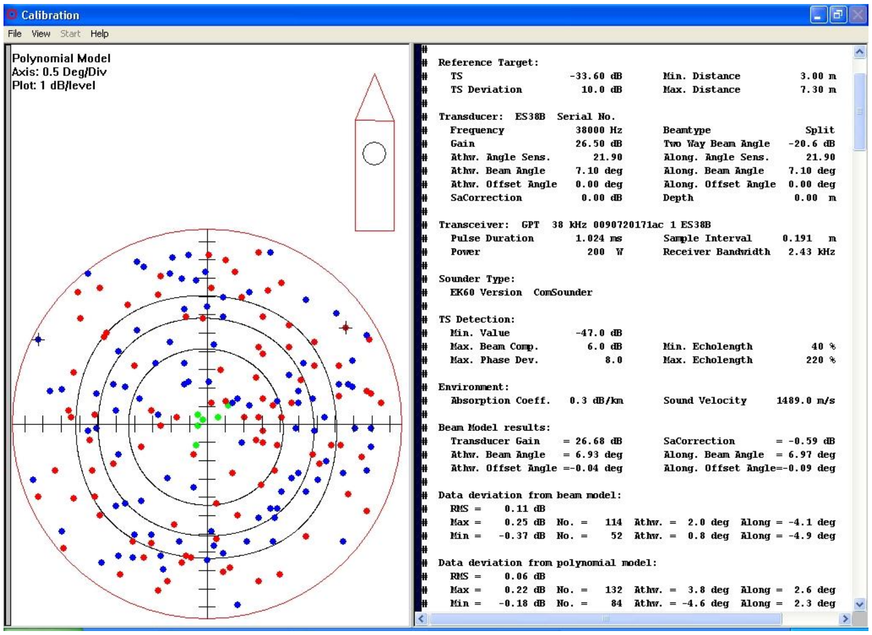


Figure 5. Example of acoustic data recording



```
#
# Reference Target:
#   TS                  -33.60 dB       Min. Distance          3.00 m
#   TS Deviation         10.0 dB        Max. Distance          7.30 m
#
# Transducer:  ES38B  Serial No.
#   Frequency            38000 Hz       Beamtype              Split
#   Gain                 26.50 dB       Two Way Beam Angle   -20.6 dB
#   Athw. Angle Sens.      21.90        Along. Angle Sens.     21.90
#   Athw. Beam Angle     7.10 deg       Along. Beam Angle    7.10 deg
#   Athw. Offset Angle   0.00 deg       Along. Offset Angle  0.00 deg
#   SaCorrection         0.00 dB        Depth                0.00  m
#
# Transceiver:  GPT  38 kHz 0090720171ac 1 ES38B
#   Pulse Duration       1.024 ms       Sample Interval     0.191   m
#   Power                  200  W       Receiver Bandwidth   2.43 kHz
#
# Sounder Type:
#   EK60 Version  ComSounder
#
# TS Detection:
#   Min. Value          -47.0 dB
#   Max. Beam Comp.        6.0 dB       Min. Echolength          40 %
#   Max. Phase Dev.          8.0        Max. Echolength         220 %
#
# Environment:
#   Absorption Coeff.   0.3 dB/km       Sound Velocity     1489.0 m/s
#
# Beam Model results:
#   Transducer Gain    = 26.68 dB       SaCorrection       = -0.59 dB
#   Athw. Beam Angle   = 6.93 deg       Along. Beam Angle  = 6.97 deg
#   Athw. Offset Angle =-0.04 deg       Along. Offset Angle=-0.09 deg
#
# Data deviation from beam model:
#   RMS =    0.11 dB
#   Max =    0.25 dB  No. =   114  Athw. =  2.0 deg  Along = -4.1 deg
#   Min =   -0.37 dB  No. =    52  Athw. =  0.8 deg  Along = -4.9 deg
#
# Data deviation from polynomial model:
#   RMS =    0.06 dB
#   Max =    0.22 dB  No. =   132  Athw. =  3.8 deg  Along =  2.6 deg
#   Min =   -0.18 dB  No. =    84  Athw. = -4.6 deg  Along =  2.3 deg
```

Figure 6. Example of the results of the underwater acoustic instrument calibration

2. Acoustic data collection and processing in Bintan waters

Research tools used include underwater acoustic instruments, sphere balls for calibration, underwater cameras, diving equipment, sediment samplers, global positioning systems (GPS), computer devices (Figure 7) and research vessels (Figure 8). Sea wave conditions when collecting data as shown in Figure 9.

Example 7. Acoustic and other instrument used during the survey

Figure 8. Research vessel used during acoustic survey

Figure 9. Sea conditions during an acoustic survey

The installation and set up of the acoustic sensor (transducer) is placed on the left side of the ship and is lowered 1 meter below sea level (Figure 10) with a water depth of about 20 m (Figure 11).

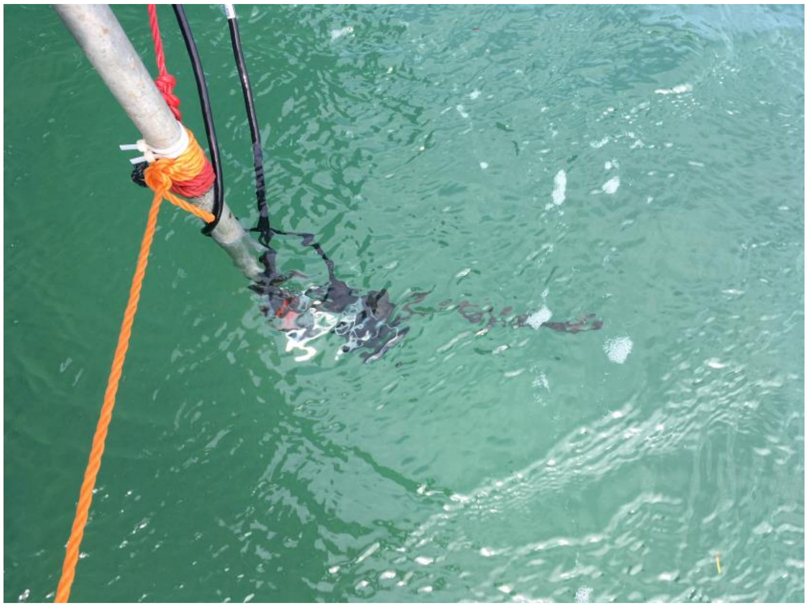


Figure 10. Instalation and Set-up of underwater transducer

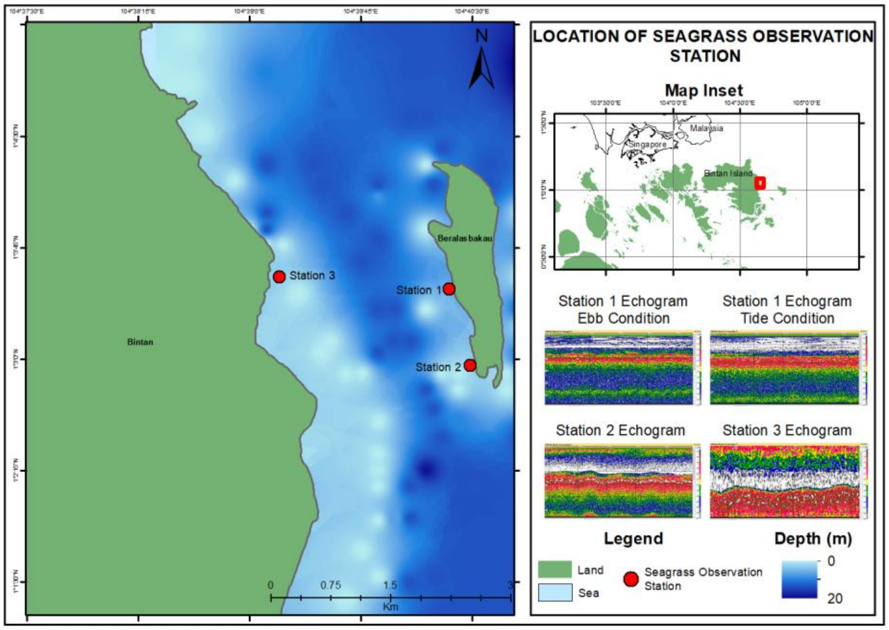


Figure 11. Location map for acoustic data collection

The detection results of the seagrass acoustic instrument are shown in Figure 12.d. 16. The value of the acoustic backscattering volume (SV) of seagrass at station 1 at low tide was -47.45 to -39.45 dB and the watershed SV was -25.26 to -12.74 dB. The average height of seagrass acoustically is 57 cm. At station 1 when the tide was obtained, the seagrass SV value was -47.45 to -39.45 dB while the watershed SV was -25.26 to -12.74 dB with an acoustic average seagrass height of 57 cm (Figure 13).

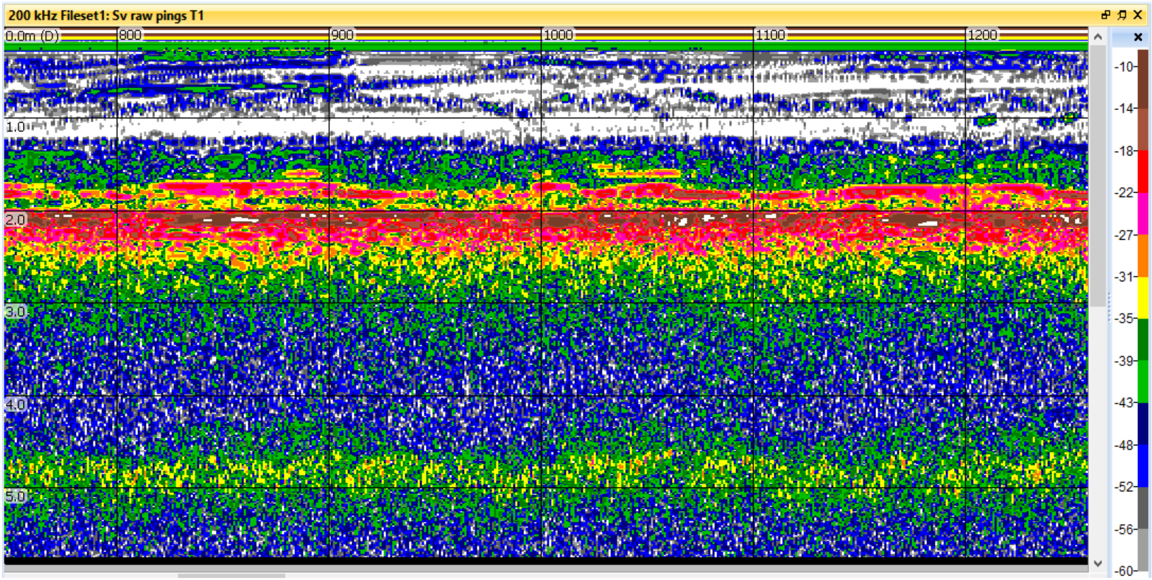


Figure 12. Seagrass detection during low tide using acoustics

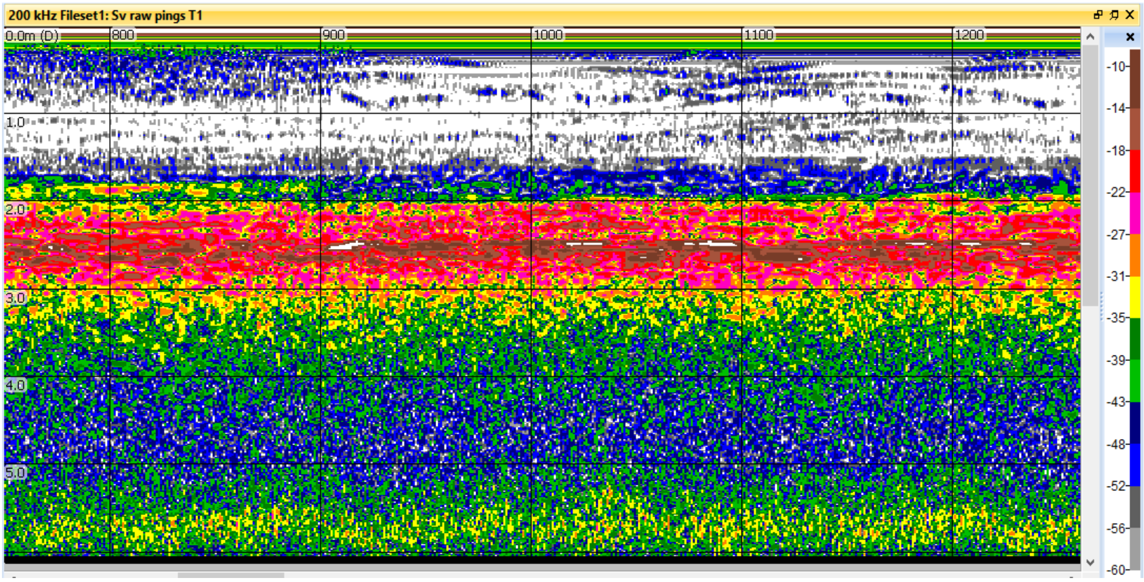


Figure 13. Detection of seagrass during high tide

At station 2 the seagrass SV values were -52.45 to -42.83 dB and the watershed SV values were -30.50 to -16.59 dB with an acoustic average seagrass height of 40.3 cm (Figure 14). At station 3 the seagrass SV value was -49.27 to -35.73 dB and the SV of the water base was -31.62 to -23.47 dB with the average height of seagrass acoustically was 27.7 cm (Figure 15).

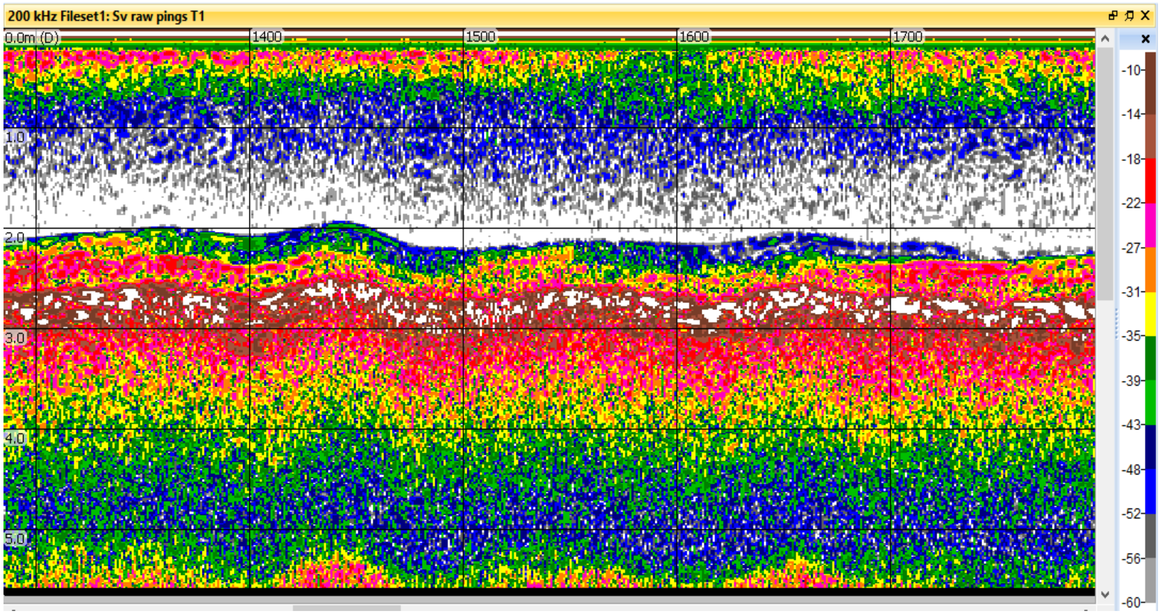


Figure 14. Seagrass detection in calm sea condition at station 2

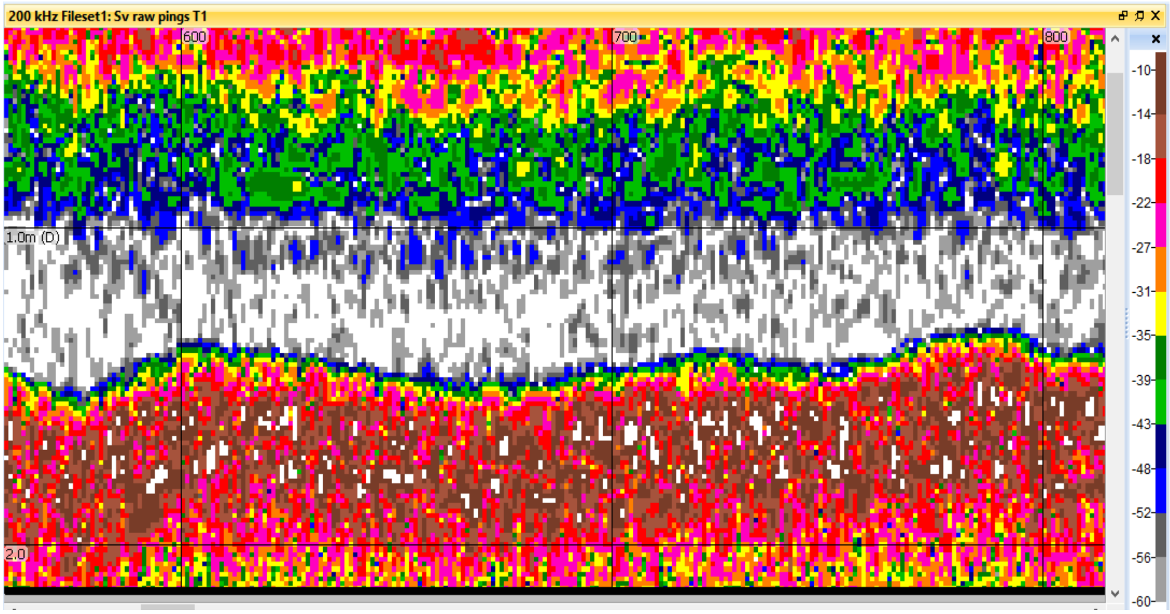


Figure 15. Seagrass detection in calm sea condition at station 3

3. Acquisition of Sediment sampler in Bintan seawaters

Figure 16. Sediments at Bintan seawaters

4. Seagrass data collection

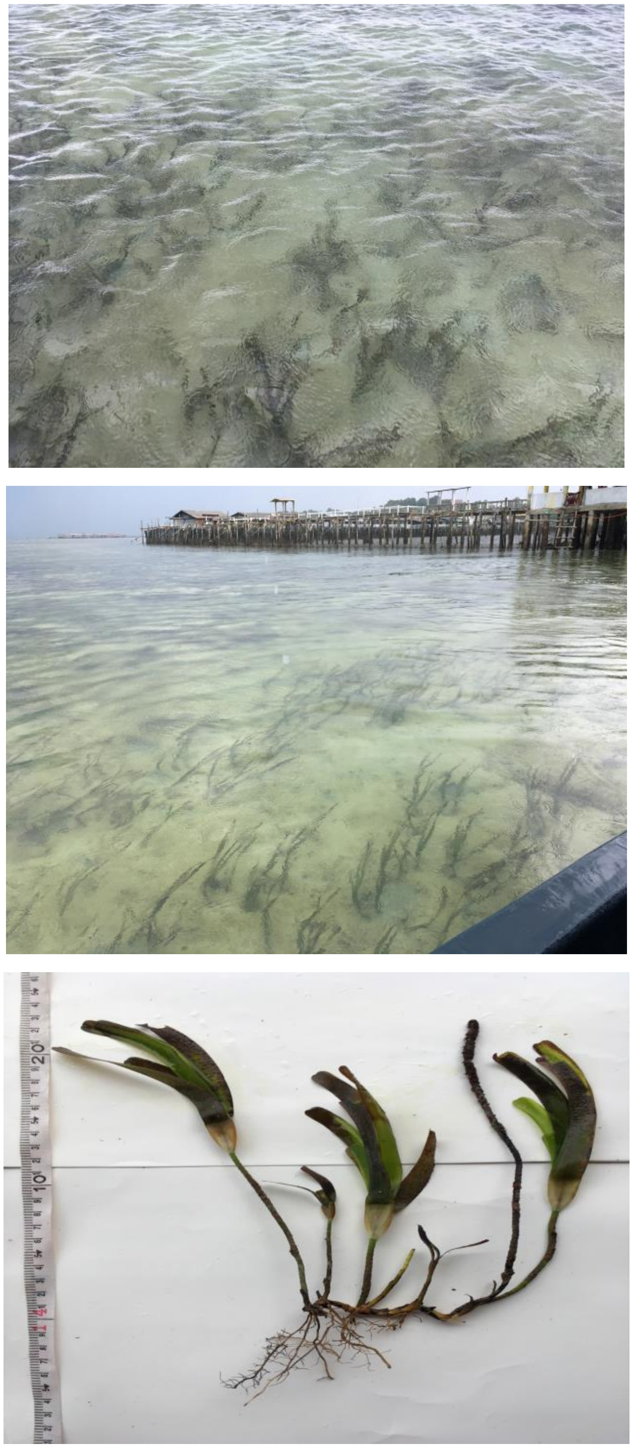


Figure 17. Seagrass data collection at station 1

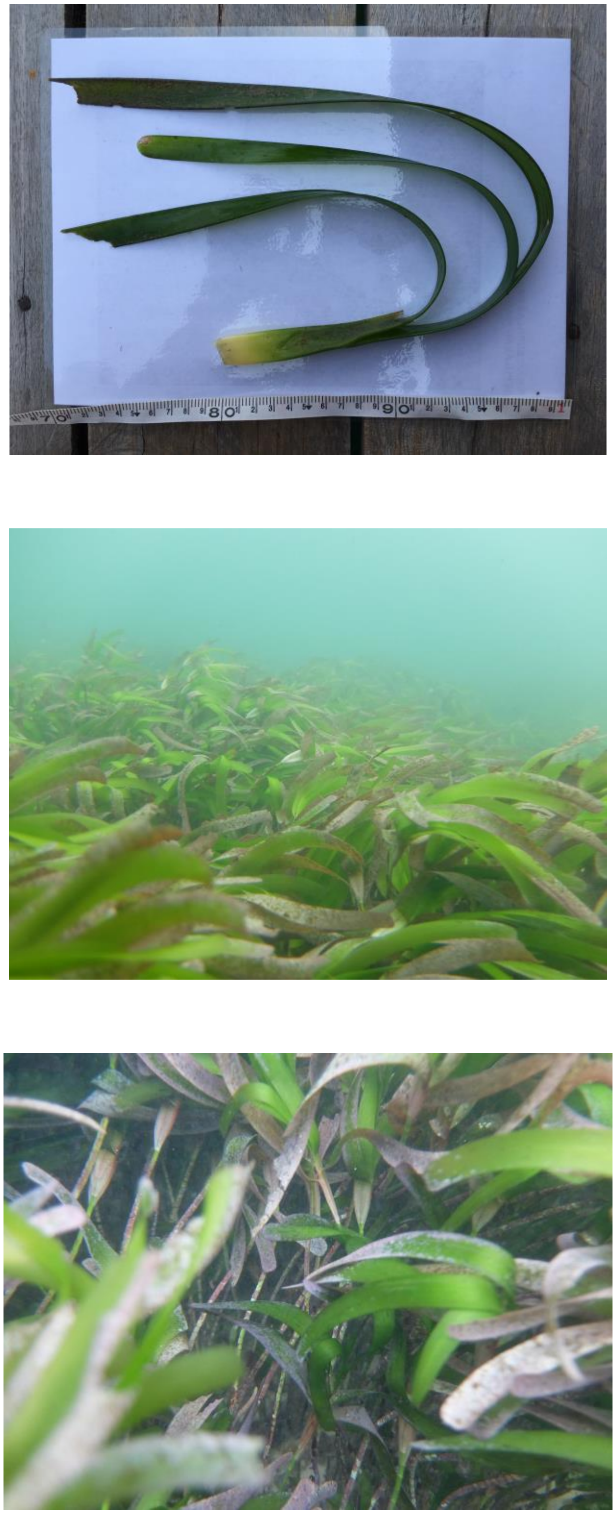


Figure 18. Seagrass data collection in station 2

Figure 19. Seagrass data collection at station 3

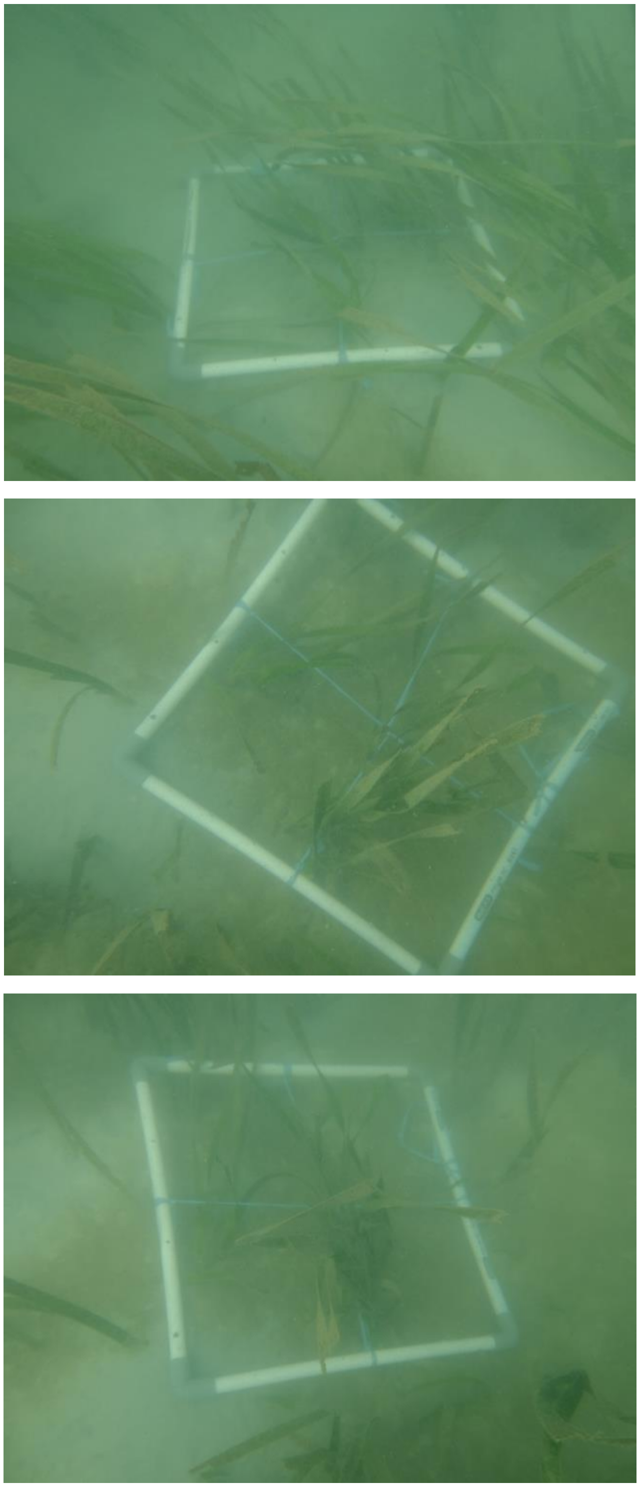


Figure 20. Measurement of seagrass biomass using the transect method.

Classification of stations based on the presence of seagrass can be divided into 3 categories including locations with dense seagrass numbers, scattered seagrasses, and little seagrasses until there are no seagrasses (Figure 21).

Figure 21. Examples of underwater images of video camera belonging to three categories of relative abundance of seagrass (A) dense seagrass, (B) sparse seagrass, and (C) little to no seagrass.

Table 1 represents 3 categories of relative abundance of seagrasses based on underwater and underwater acoustic videos. Table 2 is a sea floor map matrix error based on the criteria of 95% confidence level and depth range. Table 3 is a comparison of data obtained from biological samples and acoustic data.

Table 1. Three categories of relative abundance of seagrass

Underwater Photo			Acoustic Data (Beam Depth)		
Categories	95 % Confidence Level		Depth Range (m)		Mean Bottom Depth (m)
	Mean	S.D	Mean	S.D	
Dense seagrass	1.62	0.31	3.15	0.41	3.20
Sparse seagrass	0.57	0.16	2.28	0.18	2.90
Little to no seagrass	0.14	0.12	0.15	0.14	3.11

Table 2. Error matrix for seagrass map : (A) 95 % confidence level and (B) depth range

(A) 95 % Confidence Level		Reference Data			User Accuracy
		Dense	Sparse	No	
	Dense	8	1	0	0.89
Classified	Sparse	5	1	0	0.60
	Little to No	4	0	15	0.80
Producer accuracy		0.65	0.70	0.90	Overall accuracy 0.87
(B) Depth Range		Reference Data			User Accuracy
		Dense	Sparse	No	0.89
	Dense	6	1	1	0.60
Classified	Sparse	2	1	0	0.80
	Little to No	4	0	16	0.80
Producer accuracy		0.75	0.60	0.93	Overall accuracy 0.85

Table 3. Comparison of data derived from biological samples and acoustic

	Station 1	Station 2	Station 3
Sampling area (m^2)	0.25	0.25	0.25
Biomass (kg/0.25 m^2)	2.25	1.18	2.40
Mean SV (dB)	-33.5	-35.8	-31.5
Mean TS (dB)	-52.1	-54.2	-53.1
Mean Height, biological sample (m)	0.3	0.4-0.5	0.3-0.5
Mean Height, acoustical sample (m)	0.5	0.45	0.38

From Table 3, the relationship between data from biological sampling and the results of detection of acoustic instruments is obtained. These results indicate that the SV value is related to seagrass biomass. The higher the value of seagrass biomass will be followed by an increase in the value of acoustic volume backscattering strength (SV). The average height of seagrass done manually by divers shows that acoustic measurements are not much different from manual measurements.

Comparison of the classification of underwater videos and acoustic classifications for seagrass densities is given by criterion 1 a bit until there are no seagrasses, rare seagrasses, and abundant seagrasses (Figure 22).

Acoustic detection results to determine percent seagrass closure are given to all stations given in Figure 23. These results indicate different percent closures for all stations. Quantification of the results of recording seagrass detection to calculate seagrass backscattering acoustics using quantified fish finder is given in Figure 24. The results of sediment analysis based on the Bintan waters grain size are given in Figure 25.

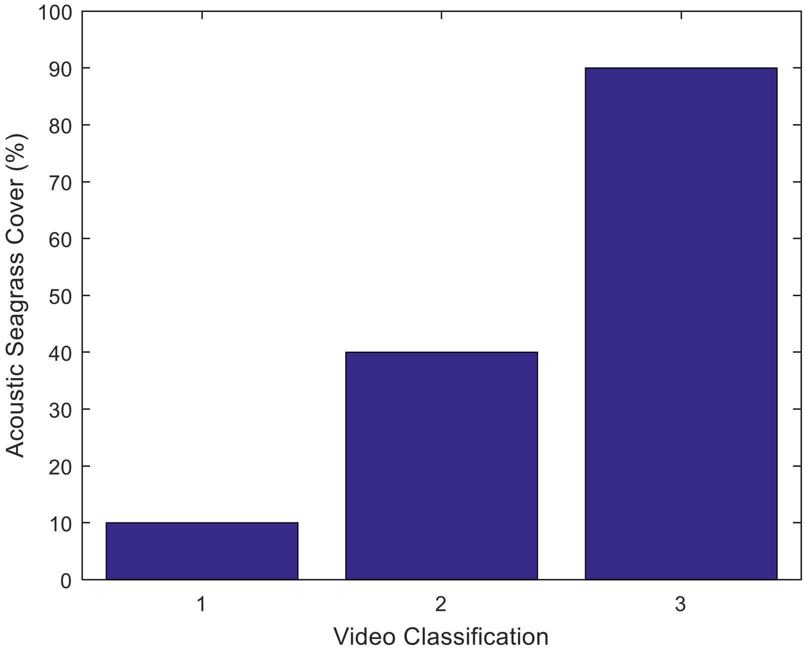
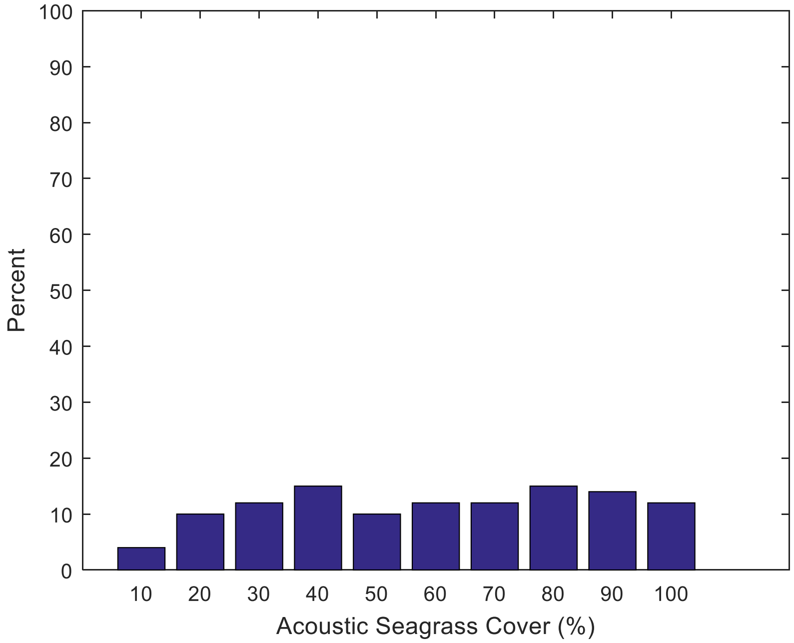
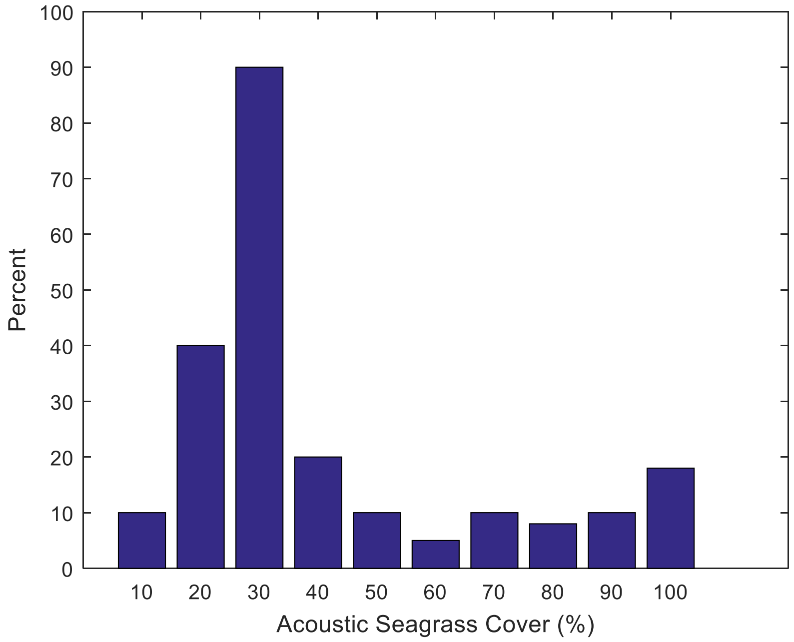


Fig. 22 Comparison of acoustic and video classification for different densities of seagrass (1, little to no seagrass; 2 sparse; 3 dense)


Percent
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
Acoustic Seagrass Cover (%)


Percent
100
90
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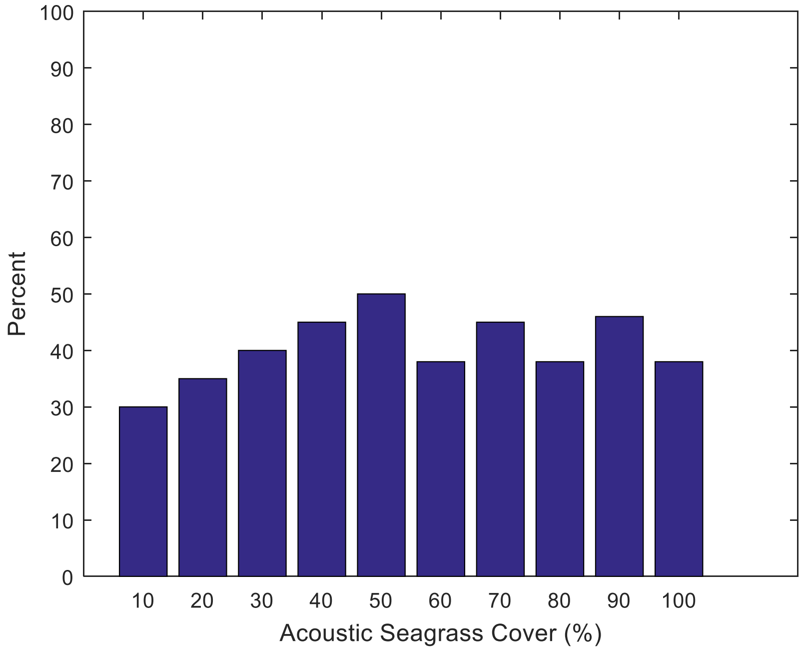
90
100
Acoustic Seagrass Cover (%)



Gambar 23. Seagrass percent cover using acoustic method.

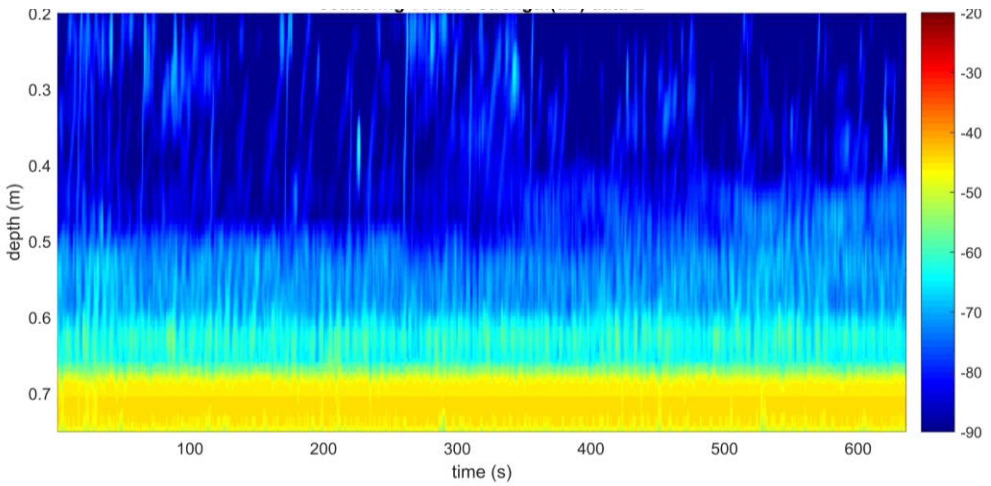


Figure 24. Acoustic backscattering (SV) of seagrass

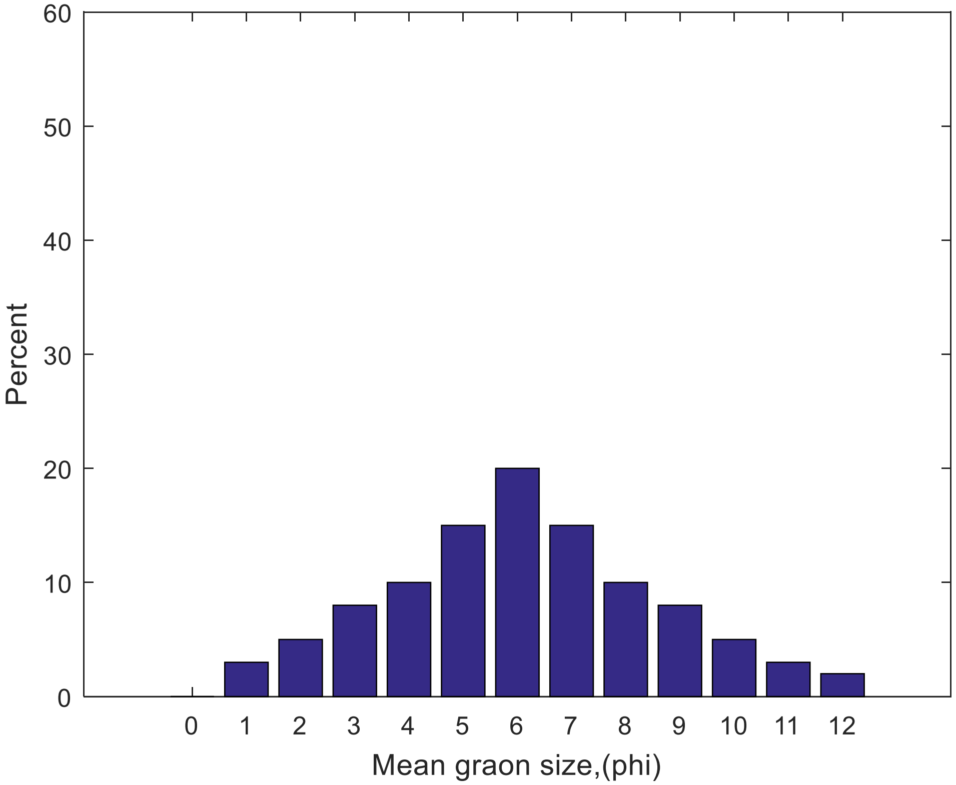


Figure 25. Sediment grain size distribution

Table 3 is the location and size of the grain size of sediments in Bintan waters and Figure 26 is the relationship of seagrass biomass with fine-sized sediments.

Table 3. Location and grain size parameters for samples collected at Bintan seawaters

Station	Gravel	Sand	Silt	Clay	Mean (phi)	Mean (mm)	Variance	Skewness	Kurtosis
1	0	95.8	2.8	1.4	2.7	0.15	1.37	3.25	18.75
2	0	92.5	5.2	1.3	2.65	0.16	1.28	3.35	16.60
3	0	96.5	2.3	1.2	2.33	0.2	1.07	3.53	23.5
4	0	99.0	1.0	0	2.04	0.24	0.58	0.24	3.93
5	0	100	0	0	0.86	0.55	1.95	-0.15	2.99
6	17.5	82.5	0	0	0.88	0.54	1.95	-1.25	3.34
7	13.3	86.7	0	0	1.12	0.46	1.64	-1.57	4.77
8	40	60	0	0	-0.34	1.27	2.35	-0.23	1.45
9	62.4	37.6	0	0	-1.35	2.58	2.18	0.44	1.53
10	62.3	37.3	0.7	0	-0.91	1.88	2.05	0.11	1.54

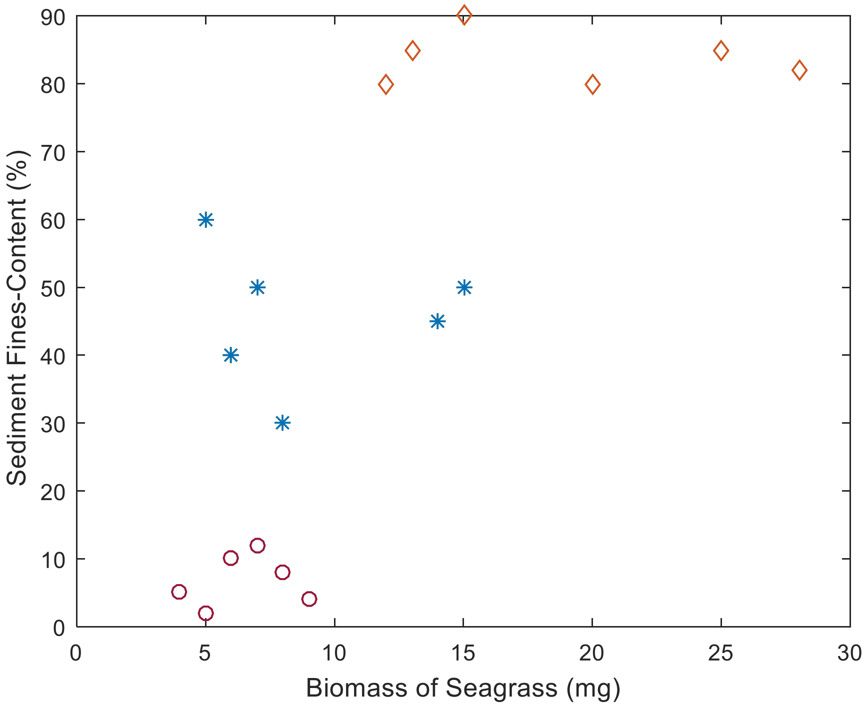


Figure 26. The relationship between sediment-fines content and seagrass biomass

Figure 27 is acoustic backscattering from the seabed where very fine sand has a small backscatter compared to coarse sand (course sand) or rough rock (rough rock). Reverberation level from mud has the smallest value compared to other sediments (Figure 28).

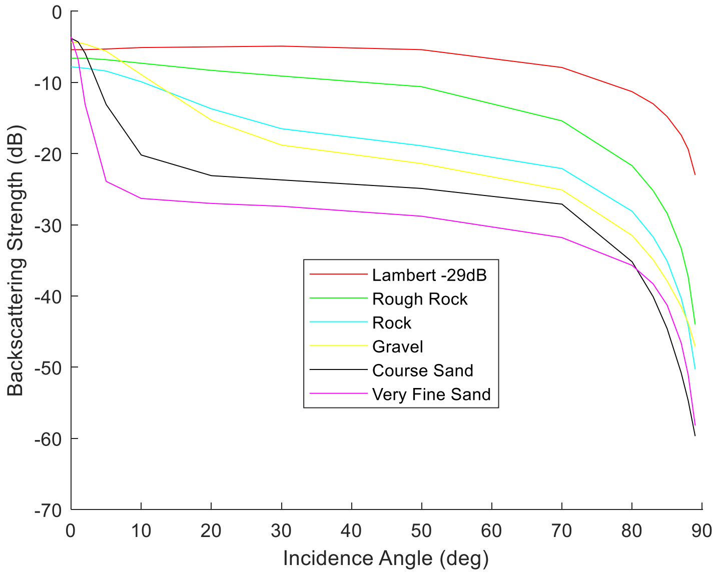


Fig.27. Acoustic backscattering strength of sea bottom

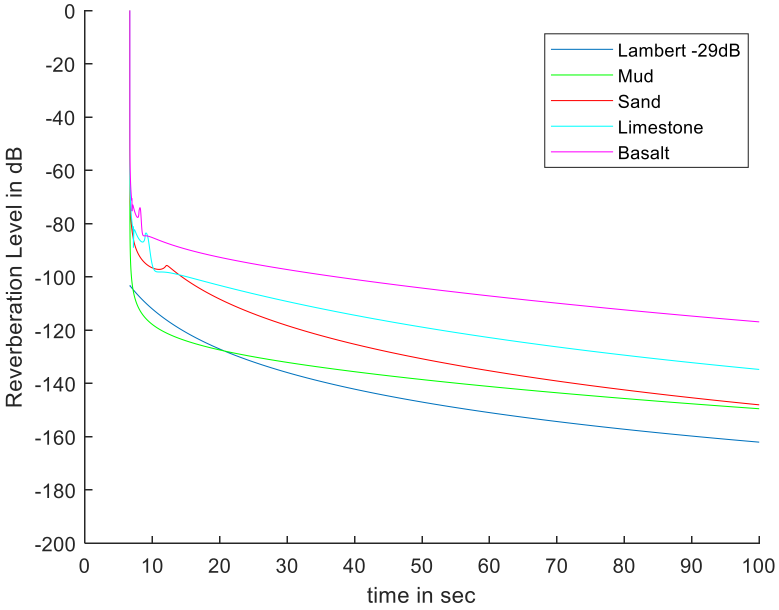


Fig. 28. Reverberation level of sea bottom

Figure 29 is the intensity value of the acoustic reflection of the water column and seagrass bottom. Basic seagrass waters range from -35.0 dB to -20.0 dB.

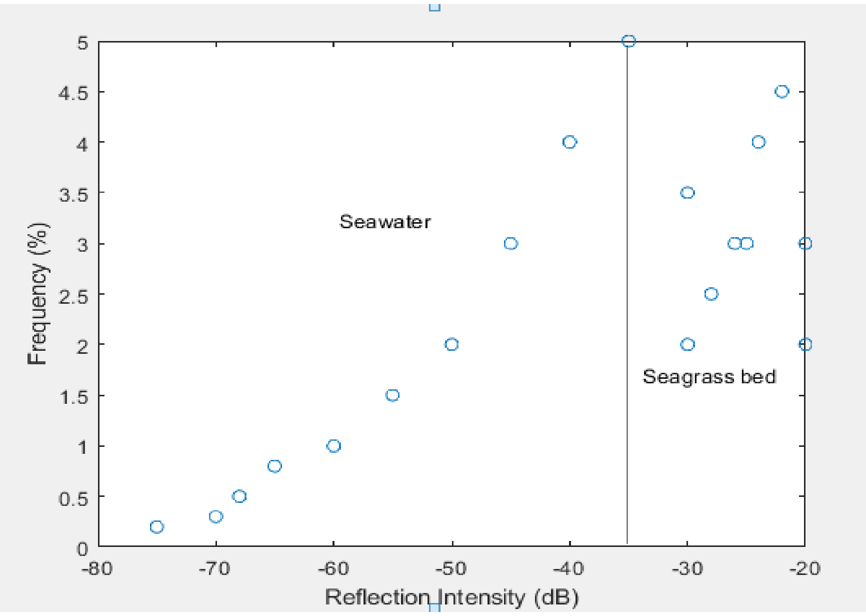


Fig. 29. Acoustic Reflection Intensity of Seagrass Bed

Figure 30. Sampling of fish in seagrass habitats.

Discussion

The coastal area of Bintan waters has high natural resource potential. Seagrass meadow is one of a chain of coastal ecosystems that greatly determines the sustainability of the marine ecosystem. Some functions of seagrass beds include protecting mangrove ecosystems and land from the influence of ocean waves. Another thing is that seagrass beds have a function of protecting coral reefs on the seabed and can inhibit pollution from the land so as to maintain the quality of sea water.

Seagrass beds on the east coast of Bintan Island have an area of> 2500 ha with high species diversity, where 10 species of seagrass are found in 12 species in Indonesian waters (Gillbert, A.J.and R. Jansenn, 1998). Seagrass beds in Bintan waters need to be protected because of the presence of rare animals such as dugong and turtles which can be a special income in the tourism sector.

From the results of the study found 6 types of seagrass such as Cymodocea rotundata (CR), C. serrulata (CS), Enhalus acoroides (EA), Thalassia hemprichii (TH), Thalassodendron ciliatum (TC), and Syringodium isoetifolium (SI).

Acoustic technology is capable of detecting seagrass and basic aquatic habitats that inhabit it. The ability of this method is obtained by measuring the value of acoustic backscattering from detected objects.

5. Conclusion

From the results of the study it can be concluded that the acoustic method can measure sound intensity or acoustic backscatter from seagrass and its surrounding habitat. Seagrass height can be measured based on the acoustic reflection value of seagrass. In the study location there were 3 seagrass groups based on percent closure, which were small to none of seagrass groups, rare seagrass groups, and many seagrass groups. Seagrass is mostly in fine sedimentary habitats. The increase in the amount of seagrass biomass calculated manually is followed by an increase in the value of acoustic backscattering strength. Identification of seagrass species using the acoustic method has an overall accuracy of 87%.

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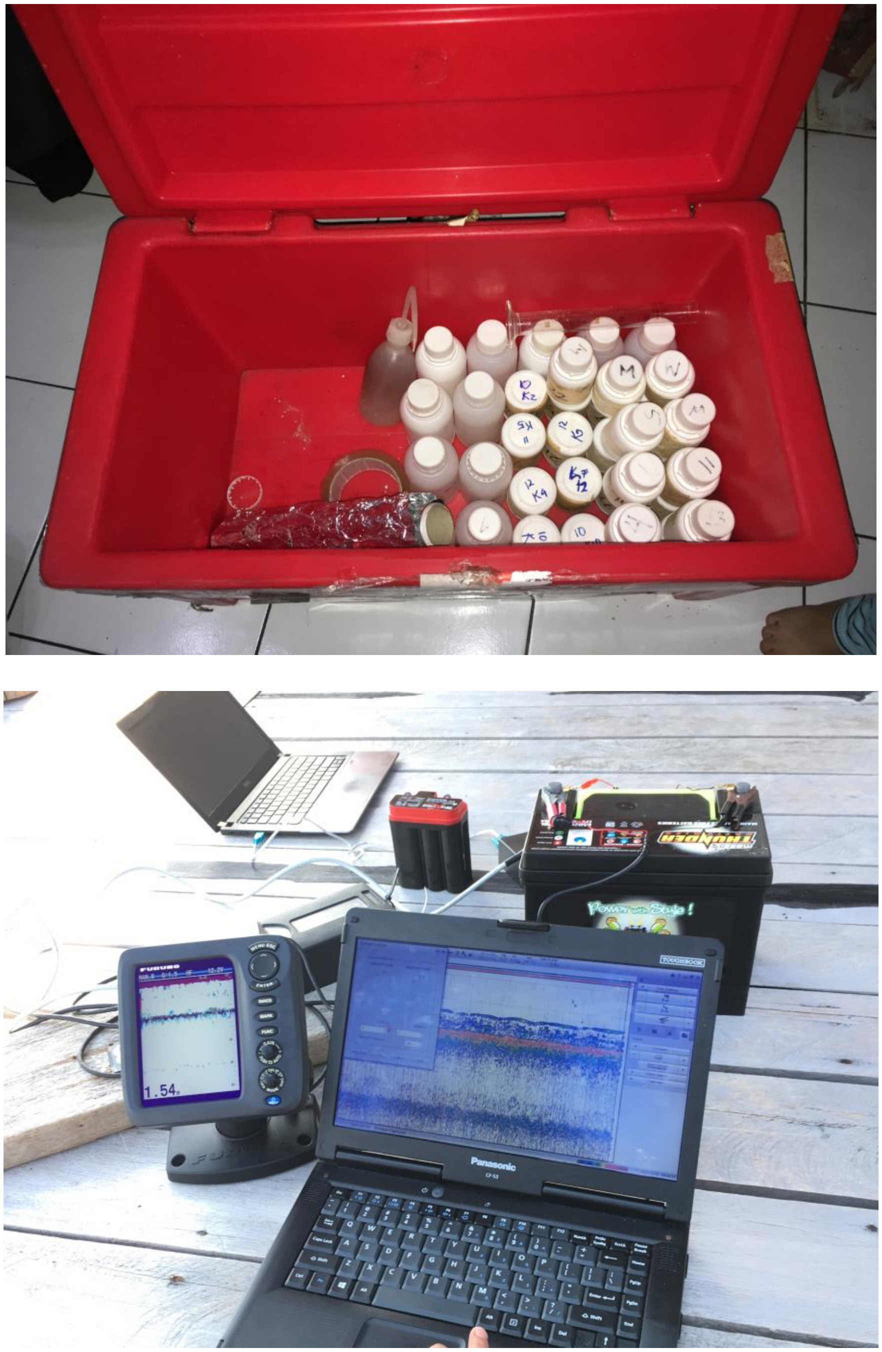
Appendixes

Underwater Transducer installation



Examples of acoustic data acquisition and sediment sampler

Underwater acoustic calibration system