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Original research article

Changes in The Area and Condition of Seague on Lepar Island, South Bangka using Sentinel 2A Image

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ABSTRACT

Seagrass is a higher-level plant that has symbiosis, vessels and reproduces generatively and lives submerged in water. Seagrass has many functions in waters, namely as a breeding ground, primary producer, water stabilizer, and as a sediment trap. The large number of mining activities in the Bangka Belitung Islands Province, especially in South Bangka district, can cause sediment to enter the seagrass ecosystem which will indirectly damage the seagrass ecosystem. Not only mining, many other human activities around the seagrass ecosystem also pose a threat to this ecosystem, such as ship propellers, reclamation activities and dock construction. The method used to determine station points is purposive sampling, to assess the condition of seagrass using the quadratic transect method at 3 stations, namely Penutuk, Tanjung Sangkar and Tanjung Labu. The research results of the seagrass area on Lepar Island in 2020 was 1437.53 Ha, in 2021 it was 1428.14 Ha, in 2022 it was 1339.54, and in 2023 it was 1258.22. The changes in seagrass area that occurred were a reduction in area of 9.39 Ha from 2020-2021, in 2021-2022 it decreased by 88.6, in 2022-2023 it decreased by 81.22 Ha and the total change in seagrass area from 2020-2023 was reduced by 179.31 Ha. The condition of seagrass cover on Lepar Island is categorized as poor with a percentage of station 1 (Penutuk) 22.042%, station 2 (Tanjung Sangkar) 14.071%, and Station 3 (Tanjung Labu) 0.0868%.

Introduction

Indonesia is known as a maritime country, namely a country that has an ocean area larger than its land area and has rich potential in biodiversity and natural resources in coastal areas (Lasabuda, 2013). One of the coastal ecosystems that has important resources and roles is the seagrass ecosystem. The seagrass area in Indonesia is around 150,000 ha with a cover percentage of 42.23% (Sjafrieet al., 2018). Indonesia has 15 species of seagrass out of 60 species in the world (Swabraet al., 2022). One of the provinces in Indonesia that has

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a seagrass ecosystem is the Bangka Belitung Islands Province, precisely in South Bangka Regency (Rosalinaet al., 2018). There is a change in the status of seagrass meadows in Bangka Selatan Regency precisely in Pulau Lepar which was originally categorized as good in 1999-2011 with an area of 32,956.29 Ha to 56,096.46 Ha changed to a poor category in 2017 with an area of 4,066.7. This is influenced by the decrease in seagrass fertility as an impact of human activities around the seagrass habitat waters (Adi, 2015; Sari, 2019).

Seagrass is a higher-level plant that has symbiosis, vessels and reproduces generatively and lives submerged in water. Seagrass has many functions in waters, namely as a breeding ground, primary producer, water stabilizer, and as a sediment trap (Sari, 2019). The large number of mining activities in the Bangka Belitung Islands Province, especially in South Bangka district, can cause sediment to enter the seagrass ecosystem which will indirectly damage the seagrass ecosystem (Bidayani, Rosalina and Utami, 2017). Not just mining, lots of it other human activities around the ecosystem Seagrass beds also pose a threat to this ecosystem, such as ship propellers, reclamation activities and dock construction (Fahruddin et al., 2017). Damage to the seagrass ecosystem has an impact on reducing the area of seagrass beds which will then affect the very important functions of seagrass such as binding CO2, feeding ground, nursery ground, andspawning ground for biota associated in seagrass beds (Murzaniet al., 2020). Therefore, it is necessary to do itmonitoring by mapping changes in the extent of the seagrass ecosystem so that maximum management of the seagrass ecosystem can be carried out.

Mapping is one of the efficient and effective steps in mapping coastal ecosystems so that it can provide information that is easily accepted by the community and stakeholders (Adi, 2019). Mapping is the main tool in geographical studies which is one of the bases for management, especially in water areas (Juhadi, 2009). Mapping in the coastal sector has been carried out, such as mapping the distribution of coral reefs, maps of fishing potential, and maps of the suitability of coral reef marine tourism (Syah, 2010).

Research methods

Time and place

This research was conducted in June 2023 on Lepar Island, Bangka Selatan Regency, Indonesia (Figure 1).

Tools and materials

The tools and materials used are a camera, ArcGIS software, Microsoft Excel software, 2A sentinel imagery, seagrass identification sheet, timestamp application, ENVI software, QGIS software, Global Mapper software, 50x50 cm squares, and roll meter.

Data Collection

Data collection on seagrass conditions used the quadratic transect method (Rahmawatiet al., 2017) and ground check data collection refers to Kurniati & Sugara (2023) by taking 50 ground check points (Figure 2).

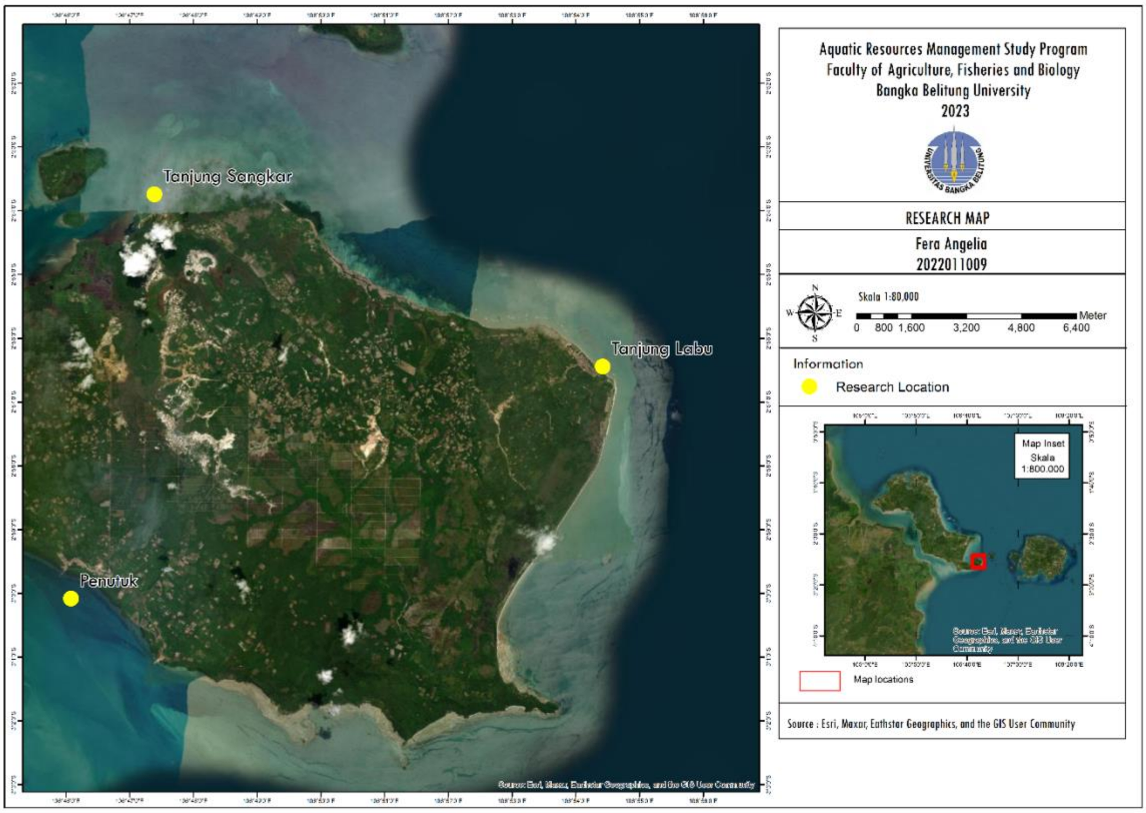

Figure 1. Map of research locations

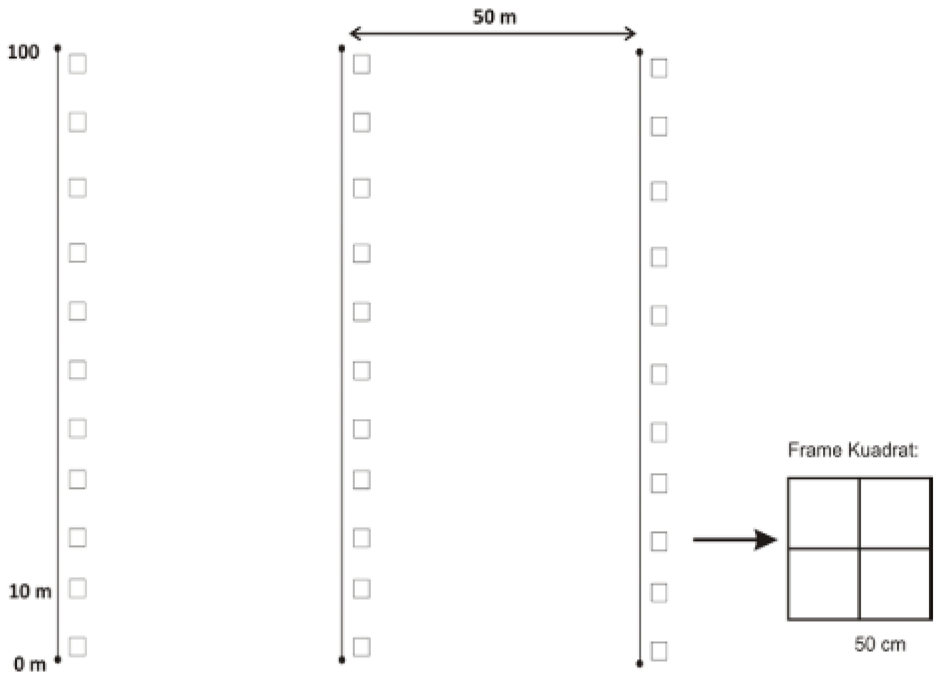

Figure 2. Scheme of quadrat transects in seagrass beds (Source: Rahmawati et al, 2017)

Data Analysis

Correctsun glint is the process of eliminating effectsglint which is generally done on high resolution images because in these images the effect of sunlight reflection (glint) looks very clear (Setiawanet al., 2015). The following is the formula used for sun glint correction (Hafiztet al., 2017).

$$Ri' = Ri - bi \times (RNIR - MinNIR)$$

Information:
Ri: reflectance value in each band (blue-sunglint band, green bandsun glint, and red-sunglint band)
Bi: regression slope value of statistical results (blue band vs infrared bands, green band vs infrared bands, red band vs infrared bands)
RNIR: reflectance value in the near infrared band
MinNIR: minimum value of near infrared band reflectance of all selected samples.

Water column correction aims to obtain information about objects below the water surface that are free from the influence of water depth, turbidity and water surface movements by creating a new image. This new image is known asDepth Invariant Index which is formed by a combination of visible light bands with the following equation (Arief, 2013):

$$\textit{Depth Invariant Index} = \ln(Li) - [(Ki/Kj).\ln(Lj)]$$

Information
Li = Digital value on band i
Lj = Digital value in band j
Ki/Kj = Attenuation coefficient ratio in band i and j views

Analysis of the rate of change in seagrass area is an analysis used to obtain the percent change value that occurs in seagrass area at the research location using the following formula Siregar and Purwanto in (Adi, 2015).

$$\Delta L = \frac{(Lt2 - Lt1)}{Lt1} \times 100\ \%$$

Information:
ΔL : Area change rate (%)
Lt1 : Area in the first observation year (Ha)
Lt2 : Area in the next observation year (Ha)

Result and Discussion

Result

Extent If

The result of research on the area of seagrass on Pulau Lepar is 1437.53 hectares (year 2020), 1428.14 hectares (year 2021), 1339.54 hectares (year 2022) and 1258.22 hectares (year 2023). The result of the seagrass area in Pulau Lepar can be found in Figure 3.

Rate of Change If

The rate of change at the research location is a reduction in seagrass area per year with changes in area from 2020-2021 decreasing by 9.39 hectares, in 2021-2022 seagrass area decreasing by 88.6 and in 2022-2023 decreasing by 81.32

hectares. The average annual rate of change from 2020-2023 is -4.31%. The following results obtained can be seen in Table 1.

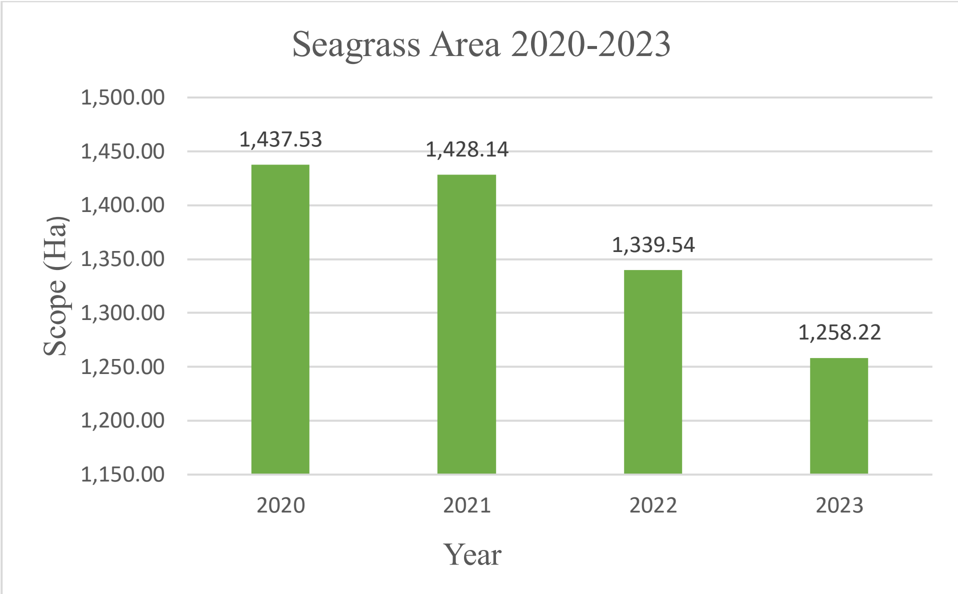

Figure 3. Graph of Seagrass Area for 2020-2023

Table 1. Rate of Change in Seagrass

Year	Area (Hectares)	Change	Rate of Change (%)	Information
2020	1437,53			
2021	1428,14	-9,39	-0,65	Reduce
2022	1339,54	-88,6	-6,20	Reduce
2023	1258,22	-81,32	-6,07	Reduce
Average rate of change per year (2020-2023)			-4,31	Reduce

Seagrass cover and condition in Pulau Lepar

Based on the results obtained at all research location stations, the condition of seagrass cover was categorized as poor, namely at station 1 (Penutuk) 22.042%, station 2 (Tanjung Sangkar) 14.071%, and Station 3 (Tanjung Labu) 0.0868%. The following are the results of the seagrass conditions which are presented in tabular form (Table 2).

Table 2. Cover If

Station	Location	Cover (%)	Condition
1	Penutuk	22,042	Poor
2	Tanjung Sangkar	14,071	Poor
3	Tanjung Labu	0,8680	Poor

Based on data collection on water physics parameters taken on the web data.marine.copernicus.eu, the results obtained were that the temperature at the research location was around 30-31 ºC, the salinity obtained was 32-33 ppt and the current speed at the research location was 0.03-0. .25. Below are presented the results of the physical parameters at the research location in Table 3.

Table 3. Water Physical Parameters

Parameter	Year				You Are Not Dead
	2020	2021	2022	2023	
Temperature	30	31	31	30	28-30 ºC
Salinity	33	32	32	33	33-34 ppt
Flow Speed	0,25	0,23	0,08	0,03	-
Flow Direction	North to south	North to south	South to North	South to North	

Source: Quality standards according to Republic of Indonesia Government Regulation Number 22 of 2021 (Attachment VIII). Flow Direction based on data*marine copernicus*

Discussion

Seagrass area in Pulau Lepar

Based on the results obtained at the research location, there was a decrease in seagrass area from 2020-2023, that is, in 2020, the area of seagrass around Lepar Island was 1,437.53 hectares (Picture 4), in 2021, the area of seagrass on Lepar Island decreased to 1,428.14 hectares, in 2022 it will decrease again to 1,339.54 and in 2023 the area of seagrass on Pulau Lepar will be 1,258.22 hectares (Picture 4). The difference in the change in the area of seagrass on Lepar Island from 2020-2021 is a decrease of 9.39 hectares, in 2021-2022 seagrass on Lepar Island decreased by 88.6 hectares and in 2022-2023 the area decreased by 81.31 hectares. The total difference in seagrass area change from 2020-2023 is 179.31 hectares in a period of 4 years. The change in the area of seagrass that continues to decrease from year to year if left unchecked is expected to result in the loss of the seagrass ecosystem on Pulau Lepar.

Changes in the area of seagrass on Lepar Island in 2020-2021 saw a reduction in area in the north and east of Lepar Island and an increase in the southeast part of Lepar Island (Pictures 5 and 6). In 2021-2022, the northern and northeastern parts of Pulau Lepar experienced an increase in area, while the western and southeastern parts experienced a reduction in area. In 2022-2023, the area of seagrass on Lepar Island experienced a decrease in seagrass in the west, north, and northeast, and there was an increase in area in the east and southeast. According to Wahyu Adi (2017), changes in the distribution of seagrass can occur due to the influence of currents in the waters around the seagrass ecosystem.

The change in seagrass area on Lepar Island is thought to be influenced by human activity. According to Muftiadiet al., (2019) in the area of South Bangka Regency there are many human activities such as residents' settlements, marine tourism activities, industrial activities, and also the development of sea farming. In particular, in the waters of Pulau Lepar there are boat transport activities from Sadai to Pulau Lepar, wharves, fishing activities. Ports or ship docks cause the entry of pollutants into the waters so that they can interfere with the growth of seagrass (Bidayaniet al., 2017). Apart from the pier, the factors suspected to be the cause of the disturbance of seagrass at the research location are the activities of local communities looking for snails, the use of fishing gear and mining activities (Ferdianet al., 2022). Searching for barking snails in seagrass areas is thought to cause many seagrasses to be trampled on, which is feared to cause damage to seagrasses in the waters (Sariet al., 2021).

Another cause of changes in the area of seagrass on Lepar Island is due to the influence of currents, namely in 2020 and 2021, on the same date the image was taken, the direction of the influence was from north to south, which is thought to have caused the seedlings to be carried away so that the dominant seagrass grows in the south. In 2022 and 2023 the current will move in the opposite direction, namely from south to north so that seagrass growth will grow in the eastern and northern areas of Lepar Island. This is supported by Larkum et al (2000) who stated that current movements will most likely influence the spread and capture of pollen. Most seagrasses reproduce in the summer, namely from June to August, the seagrasses that reproduce in this season are seagrasses.Halodule, Halopila, Thalassodendron, Thalassia. It is suspected that when the image data was collected for classification the seagrass was undergoing a reproductive process so it was very possible that the seeds would spread in other directions.

The Speed of Seagrass Change in Pulau Lepar

Based on the results obtained at the research location, it was found that the average rate of change per year was reduced by 4.31% per year with the actual annual results being -0.65% (2020-2021), -6.20% (2021- 2022), -6.07% (2022-2023). Factors that influence the rate of change in seagrass are internal factors and external factors. Internal factors that influence the rate of change of seagrass are the reproductive ability of the seagrass itself, and external factors that influence the rate of change of seagrass are biotic factors and abiotic factors, namely the speed of the current which causes the seagrass to be carried to new places and the biota associated with the seagrass which is thought to carry seeds. -seagrass seeds to other places (Adi, 2015).

The rate of change in seagrass which continues to decrease every year is thought to be due to increasing anthropogenic activities around the research location, according to the results of field surveys that have been carried out at the research location, there are sero fishing activities, fishing boat traffic, places to search for bark snails, tourism, construction of docks, and places boat parking and a place for fishermen to anchor. Damage to seagrass is mostly caused by fishing boats and dock construction activities (Fyfe & Davis, 2007). Previous research regarding the rate of change in seagrass area was carried out on Lepar Island, there was a change in seagrass area on Lepar Island, namely an increase in seagrass area by 70.2% for 12 years from 1999 to 2011 (Adi, 2015).

According to Sari (2019), one of the causes of the reduction in seagrass area on Lepar Island is due to mining activities in the waters which can cause turbidity and increase sediment in the waters due to the stirring process when digging for sand at the bottom of the waters. Apart from that, the large number of human activities around the seagrass ecosystem causes turbidity at the research location which reduces the ability of seagrass to photosynthesize.

Seagrass condition on Lepar Island

In this study, the results obtained for the condition of seagrass cover at the research station ranged from 0.86% – 22.042%. Based on these results, the seagrass cover at the research station is categorized as poor according to the Decree of the Minister of the Environment Number 200 of 2004

Appendix VIII. The seagrass species found during the field survey wereHalodule uninervis, Cymodocea rotundata, Oceana serrulata, Thalassia hemprichii, Enhalus acoroides, Oceana serrulata, dan Syringodium isoetifolium, Halophila ovalis. The results of different seagrass cover at each research station are thought to be due to differences in substrate between stations. Based on visual observations, the substrate for each station is different, namely at station 1 the substrate is mud, this is because station 1 is not far from the mangrove ecosystem, station 2 has a sand substrate, and at station 3 has a rubble substrate. Substrate characteristics are a reference for seagrass habitat and environmental conditions (Rahmawatiet al., 2017). The highest seagrass cover was found at station 1, this is thought to be because the species most commonly found isEnhalus acoroides (Table 8). Known speciesEnhalus acoroides is a species that has a larger size compared to other species.

Environmental Parameters

The research results show that environmental parameters from 2020-2023 are temperature, salinity and current speed. In the research results, the temperatures obtained ranged from 30-31 °C, namely 30 °C (2020), 31 °C (2021), 31 °C (2022), and 30 °C (2023). According to the Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning the Implementation of Environmental Protection and Management, the temperature quality standard for seagrass is around 28-30 °C, so based on this the temperature in 2021 and 2022 has exceeded quality standards for seagrass. Temperature is one of the environmental factors that influences seagrass growth because changes in temperature can affect metabolism, nutrient absorption and seagrass survival (Sariet al., 2021). Temperatures ranging between 25ºC-32º C will encourage photosynthesis to increase as the temperature increases (Hutomo, 1997). The average temperature required for seagrass growth ranges from 24ºC-27°C (Nontji, 1993).

The salinity obtained from this research ranges from 32-33 ppt, namely 33 ppt (2020), 32 ppt (2021), 32 ppt (2022), and 33 ppt (2023). The salinity results at this research location do not meet seagrass quality standards (Government Regulation of the Republic of Indonesia No.22, 2021). Salinity plays an important role in the photosynthesis process and will affect productivity, density, leaf width and speed of recovery (Atiet al., 2016). The results of the current speed at the research location are between 0.03-0.25, that is, from year to year the current speed in the seagrass area on Lepar Island decreases. The current speed at the location in 2020-2021 is categorized as moderate and in 2022-2023 is categorized as weak (Rosalinaet al., 2018).

Current speed greatly influences seagrass productivity, currents affect light penetration if they lift sediment, thereby reducing light penetration which will disrupt the photosynthesis process (Sariet al., 2021). Based on the results obtained from marine Copernicus data, the direction of the current in 2020 was to the south, in 2021 it was also south, then in 2022 it was south and in 2023 it was south. This can affect the distribution of seeds and the accumulation of sediment at the research location. Currents can help the pollination process in seagrass reproduction so that it can cause the reproduction process to occur and can help spread new seeds (Larkum, Orth and Duarte, 2000).

Conclusion

The seagrass area obtained from the data processing results was 1437.53 Ha in 2020, then in 2021 the seagrass area on Lepar Island was 1428.14 Ha, in 2022 the seagrass area on Lepar Island was 1339.54, and in 2023 the seagrass area seagrass is 1258.22 Ha. The change in seagrass at the research location decreased by 9.39 Ha from 2020-2021, then there was a change in seagrass area decreasing by 88.6 Ha from 2021-2022, and in 2022-2023 the seagrass area on Lepar Island decreased by 81.22 Ha with the total area from 2020-2023 decreasing by 179.31 Ha. The rate of change in this study showed changes with the average change per year being that seagrass area decreased by 4.31% per year. The condition of seagrass cover at the research location was poor with seagrass cover values, namely station 1 (Penutuk) 22.042%, station 2 (Tanjung Sangkar) 14.071 %, and Station 3 (Tanjung Labu) 0.0868 %.

References

Adi, W. (2015) 'Review of Seagrass Bed Cover Changes Using Remote Sensing At Lepar Island Bangka Belitung Islands Province', Maspari Journal, 7(1), pp. 71–78.

Adi, W. (2019) 'Mapping Gelasa Small Island, Central Bangka Regency', Journal of Tropical Marine Science, 2(1), pp. 11–14. doi:10.33019/jour.trop.mar.sci.v2i1.909.

Arief, M. (2013) 'Development of Lyzenga Method for Coral Reef Detection in Seribu Islands Using AVNIR-2 Satellite Data', Statistika, 13(2), pp. 55–64.

Ati, RNA et al. (2016) 'Characteristics and Potential of Waters as Supporters of Seagrass Growth in Buyat Bay and Ratatotok Bay, North Sulawesi', Journal of Man and Environment, 23(3), pp. 342–348.

Bidayani, E., Rosalina, D. and Utami, E. (2017) 'Heavy metal content of lead (Pb) in seagrass cymodocea serrulata in tin mining areas of South Bangka Regency', Maspari Journal, 9(2), pp. 169–176.

Fahruddin, M., Yulianda, F. and Setyobudiandi, I. (2017) 'Density and Coverage of Seagrass Ecosystems on the Coast of Bahoi Village, North Sulawesi', 9(1), pp. 375–384.

Ferdian, KJ et al. (2022) 'Agrarian Conflict (Case Study at the Mining Land Location of Tanjung Labu Village, Lepar Pongok District, South Bangka Regency)', Polinter Journal: Political Studies and International Relations, 8(1), pp. 69–77. doi:10.52447/polinter.v8i1.6005.

Fyfe, SK and Davis, AR (2007) 'Spatial scale and the detection of impacts on the seagrass Posidonia australis following pier construction in an embayment in southeastern Australia', Estuarine, Coastal and Shelf Science, 74(1–2), pp. 297–305. doi:10.1016/j.ecss.2007.04.022.

Hafizt, M., Iswari, MY and Prayudha, B. (2017) 'Assessment of Landsat-8 Image Classification Method for Benthic Habitat Mapping in Padaido Islands, Papua Abstract Introduction Methodology', Oceanology and Limnology in Indonesia, 2(1), pp. 1–13. Available at: https://jurnal-oldi.or.id/index.php/oldi/article/view/69/67.

Hutomo, M. (1997) 'Community Structure of Seagrass Meadows in Indonesian Waters', pp. 54–61.

Juhadi (2009) 'Functions and Applications of Topographic Maps for Learning in Schools', Journal of Geography Research and Development, 1(2).

Kurniati, RA and Sugara, A. (2023) 'Spatial Distribution Mapping of Seagrass Using Sentinel-2a Imagery on Kelapa Dua Island, Seribu Islands National Park, DKI Jakarta', Proceedings of the National Seminar on Marine and

Fisheries Research Results, 5587, pp. 177–186.

Larkum, AW., Orth, RJ and Duarte, C.M. (2000) 'Seagrasses: Biology, Ecology and Conservation', in Seagrass Ecology. Cambridge University Press, pp. 248–291. doi:10.1017/CBO9780511525551.008.

Lasabuda, R. (2013) 'Coastal and Marine Area Development in the Perspective of the Archipelagic State of the Republic of Indonesia', Platax Scientific Journal, 1(2), p. 92. doi:10.35800/jip.1.2.2013.1251.

Muftiadi, MR et al. (2019) 'Study Of Water Quality And Coastal Area Of South Bangka Regency', Jurnal Sumberdaya Perairan, 13(1), pp. 79–86.

Murzani et al. (2020) 'Benefits of Seagrass Meadows as a Balancer of Marine Ecosystems on Pramuka Island, Seribu Islands', JOURNAL OF GEOGRAPHY Geography and Its Teaching, 18(1), p. 1. doi:10.26740/jggp.v18n1.p1-14.

Natsir, NA et al. (2020) 'Analysis of Mercury (Hg) Content and Chlorophyll Levels of Seagrass Enhalus Acoroides in Marlosso and Nametek Waters, Buru Regency, Maluku Province', Biosel: Biology Science and Education, 9(1), p. 89. doi:10.33477/bs.v9i1.1321.

PPRI No.22. (2021) 'Implementation of Environmental Protection and Management', State Secretariat of the Republic of Indonesia, 8(22), p. 483. Available at: http://www.jdih.setjen.kemendagri.go.id/.

Nontji, A. (1993) 'The Archipelago Sea', p. 367.

Rahmawati, S. et al. (2017) Seagrass Monitoring Guide. Available at: www.coremap.or.id.

Rosalina, D. et al. (2018) 'Diversity of Seagrass Species in South Bangka Regency, Bangka Belitung Islands Province', EnviroScienteae, 14(1), p. 21. doi:10.20527/es.v14i1.4889.

Sari, RM, Kurniawan, D. and Sabriyati, D. (2021) 'Density and Distribution Pattern of Seagrass Based on Community Activities in Pengujan Waters, Bintan Regency', Journal of Marine Research, 10(4), pp. 527–534. doi:10.14710/jmr.v10i4.31679.

Sari, SP (2019) 'Mapping of Seagrass Condition in the Waters Around Lepar Island, South Bangka Regency', Journal of Tropical Marine Science, 2(2), pp. 83–88. Available at: https://journal.ubb.ac.id/index.php/jtms/article/view/1451.

Setiawan, KT, Marini, Y. and Winarso, G. (2015) 'Coral Reef Mapping in Tidung Island Waters, Seribu Islands, DKI Jakarta Using Worldvie-2 Imagery', Proceedings of the XX PIT MAPIN Annual Scientific Meeting, pp. 418–424.

Sjafrie, NDM et al. (2018) 'Status of Indonesian Seagrass Meadows', Jakarta: Oceanography Research Center – LIPI [Preprint].

Swabra, L. et al. (2022) 'Seagrass Community in the Reef Coastal Waters of Saubeba Bay, Manokwari Regency'.

Syah, AF (2010) 'Remote Sensing and Its Applications in Coastal and Ocean Areas', Marine, 3(1), pp. 18–28. Available at: https://journal.trunojoyo.ac.id/jurnalkelautan/article/view/838/737.