e-ISSN 2549-7529 | p-ISSN 1412-0313
https://ejournal.upi.edu/index.php/gea

JURNAL GEOGRAFI Gea

THE EFFECT OF TEMPERATURE ON THE DEVELOPMENT OF SEAGRASS IN THE WATERS OF PRAMUKA ISLAND, KEPULAUAN SERIBU REGENCY, JAKARTA, INDONESIA

Hizkia Tuejeh [1], Elva Susanti Meylani [2], Muzani Jalaludin[3]
[123] Geography Education, Faculty of Social Science, Universitas Negeri Jakarta, Indonesia
[1]hizkiatuejeh@gmail.com, [2]meylani.elva@gmail.com, [3]muzani@unj.ac.id

Received 16 August 2021; Revised 25 March 2023; Accepted 23 April 2023; Available online 30 April 2023

ABSTRACT

This research aims to analyze the correlation between sea surface temperature with seagrass bed in Pramuka Island, Kepulauan Seribu Regency. The observation to obtain the primary data which held on December 7th, 2019, was done through direct surveillance of existing seagrasses, and by doing some interviews with locals. Information from books, journals, reports, and satellite images are used as secondary data. Both data were processed with analytics description method to conclude the result. The finding shows that Pramuka Island has the optimal temperature for seagrass development. While temperature plays a crucial role in seagrass physiology and biomass production, there are other numerous environment and anthropogenic factors that affect seagrass distribution and quality. Furthermore, the local community activities are also affecting the seagrass ecosystem, especially those activities in the economic sector such as tourism and construction. Therefore, education on the importance of maintaining seagrass ecosystems will be needed by both local residents as well travelling tourists.
Keywords: *seagrass, sea surface temperature, Pramuka Island*

INTRODUCTION

As the largest archipelago in the world, it is a given that Indonesia has an abundance of maritime resources. This results from Indonesia's geographically strategic position between two major continents (Asia and Australia) and two oceans (Indian and Pacific). With the size of its sea that triples the land (6,159,032 km^2 to 1,904,569 km^2) the nation is a powerhouse of maritime resources. Located in the Capital Special Region Jakarta, Kepulauan Seribu Regency is home to various maritime resources the community attempts to reserve.

Kepulauan Seribu (5°10'00''- 5°57'00'' S and 106°19'30''- 106°44'50'' E) is the only regency among five administrative cities in Jakarta. Ocean National Park Kepulauan Seribu (Taman Nasional Kepulauan Seribu/TNKpS) is in this archipelago regency. The national park is found to protect ocean biodiversity and its ecosystem. One of the ecological resources richly is seagrass. In Pramuka Island, the seagrass ecosystem is among the flora specifically conserved by the national park.

Seagrass is an angiospermae that grows and adapts to live in a shallow sea to retain a supply of sunlight (Wood et al., 1969). Even so, seagrass may still grow in murky waters. In general, seagrass thrives in intertidal areas so in the low tide, its leaves would be subject to solar insolation.

Seagrass shares some similarities with vascular plants on the land: they are classified as monocots with roots, rhizomes, leaves, flowers, and fruits. Seagrass ecosystems can be found under the water in coastal areas dominated by seagrass vegetation (Sheppared et al., 1996). Indonesia has a large seagrass

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.

e-ISSN 2549-7529 | p-ISSN 1412-0313
https://ejournal.upi.edu/index.php/gea

ecosystem at around 30,000 km2 that functions as the habitat for fishes and other marine life in shallow water (Nontji, 2005).

The Ecosystem in Pramuka Island consists of many small islands with four main components: Mangrove, seagrass, coral reefs, and coastal ecosystem. There are seven species of seagrass present in Pramuka Island: *Enhalus acoroides, Thalassia hemprichii, Cymodocea serrulata, Cymodocea rotundata, Halophila ovalis, Syringodium isoetifolium*, and *Halodule uninervis*.

The parameters that control seagrass distribution are divided into physical parameters and anthropogenic inputs. The physical parameters are temperature, salinity, sea current, and the type of base substrate. While anthropogenic inputs cover variables such as nutrient and sediment supply as limiting factors in the availability of plant resources (Kawaroe, 2019: 22).

Although the seagrass ecosystem plays a crucial role in the shallow sea, the general population also needs to become more familiar with its importance than the other coastal ecosystems such as mangroves and coral reefs. According to Azkab (1988), seagrass has a significantly productive ecosystem compared to others commonly found in shallow seas. This is due to its role as a pivotal player in preserving the balance of productivity in the estuary and coastal environments, which is the Pramuka Island coastal area. Table 1 below compares biomass output and seagrass productivity among other ecosystems.

Table 1. Average biomass and primary production in different vegetation ecosystems

Ecosystems	Biomass (g BK m-2)	Production (g BK m -2/day)
Forest		
Tropical	45.000	5,2
Temperate	35.000	3,4
Steppe		
Savana	4.000	2,4
Temperate	1.600	1,6
Phytoplankton	9,2	0,35
Coral reefs	2.000	0,8
Macroalga	40,7	1,0
Mangrove	-	2,7
Seagrass	461	2,7

Source: Duarte & Chiscano (1999) in Kawaroe (2019)

Ecological functions of seagrass in coastal areas include primary producer, nutrient recycler, sea floor stabilizer, trapping sediments, protecting biota from erosion, food source, and living space for various organisms (Tomascik et al., 1997). Concerning the atmosphere, seagrass can absorb carbon which is an important function in supporting humans living on the planet (Nontji, 2010). From an economic perspective, seagrass is often used as material for many products. They range from compost fertilizer, plaited craft, product packaging, food, and medicine, to additional material in the paper industry (Kawaroe, 2019: 50-51).

RESEARCH METHOD

This research utilizes descriptive-analytical methods with observation techniques. The descriptive-analytical method as defined by Sugiono (2009:29) is the method that describes the research object using samples empirically collected by researchers. This method does not generate analysis or draw general conclusions. On the other hand, Supardi (2006: 88) describes observation as registering or observing certain cases or phenomena orderly and thorough. The focus of observation would be restricted on research, to produce cohesiveness of information.

The research occurred on Pramuka Island, Kepulauan Seribu Regency, Jakarta,

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.

e-ISSN 2549-7529 | p-ISSN 1412-0313
https://ejournal.upi.edu/index.php/gea

Indonesia, on December 6-8, 2019 (Figure 1). Observation of the species and profile of seagrass in Pramuka Island is the source of primary data. The sea temperature is the related data that is also collected. Secondary data is derived from reports, journals, books, and satellite images relevant to the research topic. The descriptive analytics method is used to explain the species and characteristics of the seagrass population in Pramuka Island.

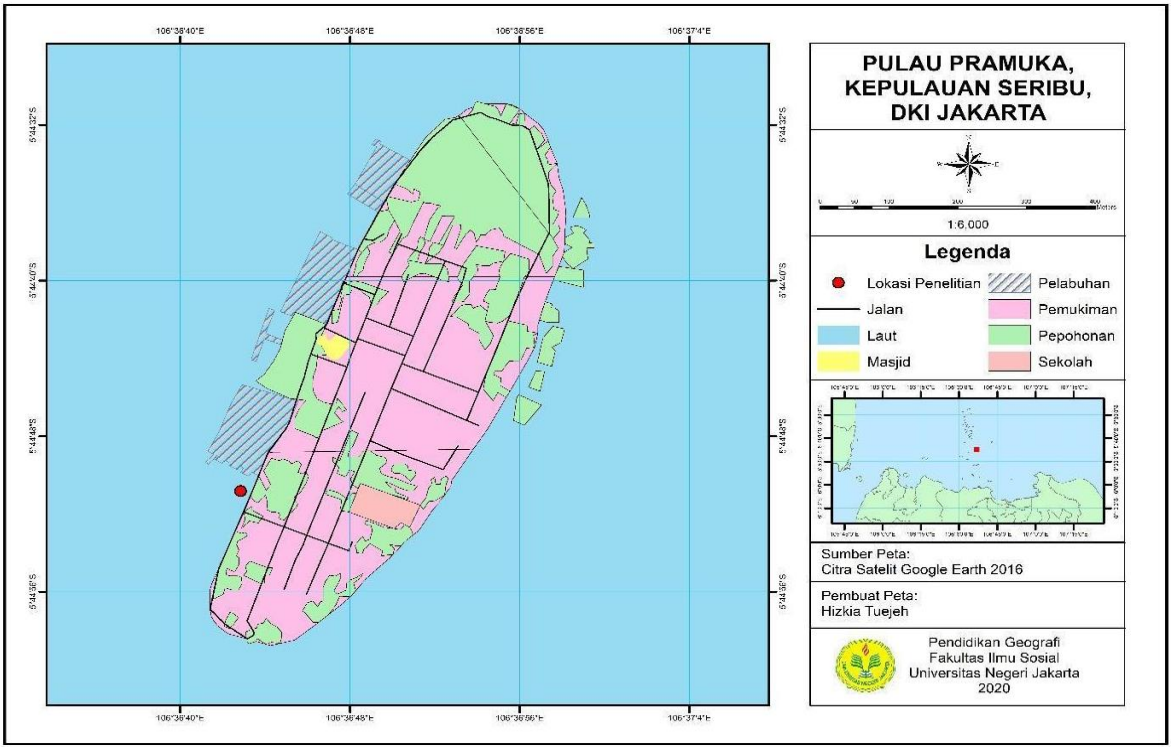

Figure 1. Research Location Map

RESULTS AND DISCUSSION

Temperature is a dominant factor in the living of organisms on Earth. Nowadays, temperature change is also affected by human activities such as deforestation, unsustainable industry, excessive fossil fuel burning, et cetera (Hilmy A, et al., 2021). A small temperature difference may not affect humans as much as other organisms with higher sensitivity to temperature. For seagrass, a thin increase in temperature will result in the diminishing productivity and living of its ecosystem.

Temperature affects the process of seagrass physiology as respiration, synthesis, and growth. Seagrass in the tropical climate may grow between the range 28—35o C, but the optimal temperature for best development is 28—30o C. Metabolism, nutrient absorption, and Metabolism, and life sustainability of seagrass can be disturbed by the change of temperature (Bulthuis (1987) in Kawaroe ((2019:27). Finding by Barber et al. (1985, in Kawaroe (2019: 27)) states that among many environmental factors in the growth of seagrass, the temperature is the only to contribute direct consequence to biomass production. Seagrass productivity keeps increasing between the temperature 10-35^{o} C. Above that range, seagrass quality would diminish and die.

The observation was held on Pramuka Island, in the west side of the island around the dock and Children Friendly Public Space (Ruang Publik Terpadu Ramah Anak/RPTRA) Tanjung Elang Berseri. The researchers took three observation spots with 5 meters of distance to the north between them. The result shows that there was no difference in temperature among the three observation spots. The weather was clear in the afternoon with a water temperature 30^{o} C. Weather is one of the factors determining sea temperature, especially in the shallow waters. On these spots, we found two species of seagrass that are *Cymodocea rotundata* and *Thalassia hemprichii*. The density is quite high but layers of small debris made it difficult for seagrass to

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.

e-ISSN 2549-7529 | p-ISSN 1412-0313
https://ejournal.upi.edu/index.php/gea

be seen from the surface. In the sea bed among the seagrass, we encountered many biota such as coral reefs, crabs, seastar, and small fishes.

On the species of *Enhalus acoroides*, the fine debris is more visible and the browning seagrass leaves can be observed in the image taken below (Figure 2). The sea on Pramuka Island has low to little waves. Sand substrate supports the development of seagrass.

Figure 2. Enhalus acoroides in Pramuka Island

Sea surface temperature data obtained from NOAA satellite (see Figure 3) from the year 1999 to 2019 in Pramuka Island (06°00'40"—05°54'40" S and 106°40'45"—109°01'19" E) is showing temperature fluctuation between 28-29^{o} C. Lowest temperature is found in 2000 at 28,9^{o} C while the highest annual temperature occurred in 2016 at 29,8^{o} C.

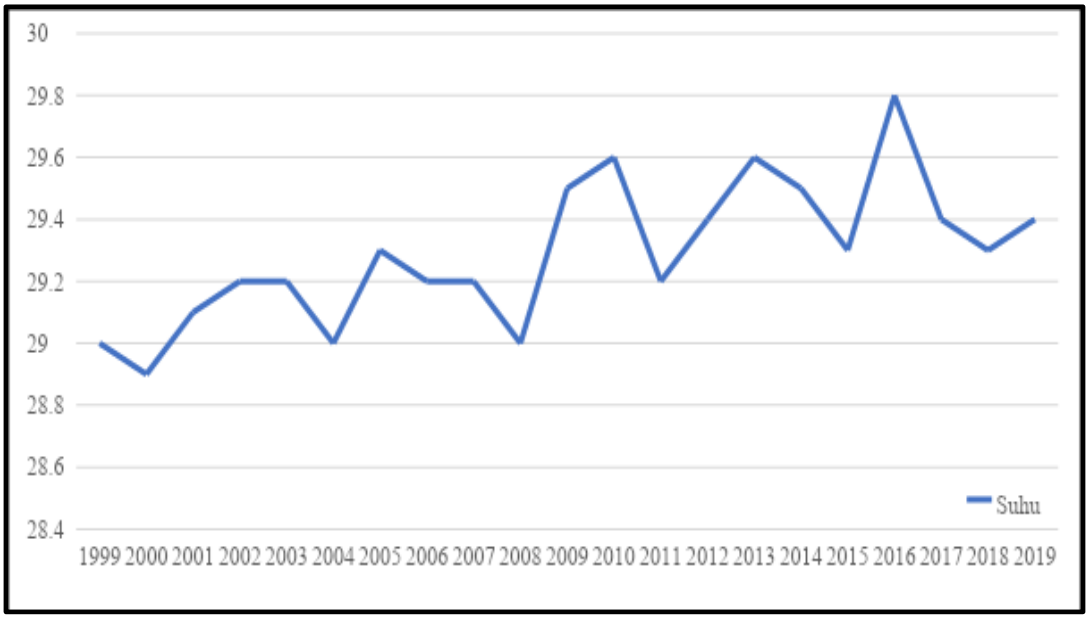

Figure 3. Graph of Sea Surface Temperature in Pramuka Island between 1999-2019

SOURCE: NOAA

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.

Hence, the sea surface temperature in Pramuka Island has the optimal value for seagrass development. Temperature is very crucial for marine organisms, including seagrass. Seagrass will be stressed if the temperature rises above the optimum point, 30º C, and may end in the seagrass dying out (Zieman & Wood, 1975 in Short et al, 2001). Climate temperature that peaked in the last decade has resulted in unpredictable weather. More effort will be needed to sustain and improve the quality of seagrass on Pramuka Island.

Other than temperature, there are some lesser contributing factors in seagrass distribution and development. The biggest factor that threatens seagrass conservation is human activity and the variability of nature. Direct human activities in this case physical modification of the natural environment (boating, fishing, and construction). Released waste can shift the quality of coastal sediment that is related to the seagrass food chain due to eutrophication and sedimentation. Indirectly, anthropogenic activities have resulted in global warming and sea level rising that threaten marine biodiversity all over the world.

In 2018, in the east of Pramuka Island began construction of a new dock. The design of the dock tends to spoil the surrounding ecosystems, including seagrass. Its crucial role in filtering sediment may diminish due to the construction resulting in excessive coastal sediment that reduces sunlight penetration into shallow waters.

As the center of administration in Kepulauan Seribu Regency, Pramuka Island has a high-density of population. This island is also a main tourist destination in the area. In supporting the flow of tourists, Pramuka Island is packed with numerous homestays. This sector provides notable income for the island's community with the more intense tourism activity coming on the way. Aside from its economic benefit, the activity of residents as well as tourists should observe to preserve the island's biodiversity. Natural phenomena such as hurricanes, cyclones, tidal waves, submarine volcano activities, and interaction between biota also contribute to the distribution and development of the seagrass ecosystem.

CONCLUSIONS

The optimal sea surface temperature for seagrass falls between 28-30º C. Temperature crucially determines physiology, metabolism, nutrient absorption, and biomass productivity in seagrass. Satellite images of the last 20 years record a steadily suitable sea surface temperature for seagrass development. However, many other contributing factors such as human activities and construction will influence the distribution and living of biota on Pramuka Island, particularly seagrass.

RECOMMENDATIONS

The seagrass ecosystem in Pramuka Island, Kepulauan Seribu Regency needs to be conserved. Human activities around the island should go hand-in-hand with the natural environment. Education holds an important post to raise the awareness of residents and tourists visiting Kepulauan Seribu Regency.

REFERENCES

Ansal, M. H. (2017). *Struktur Komunitas Padang Lamun di Perairan Kepulauan Waisai Kabupaten Raja Ampat Papua Barat*. Jurnal Ilmu Alam dan Lingkungan, Vol (8) 15; 29-37 (2017). P ISSN: 2086 – 4604.

Azkab, M. H. (1988). *Pertumbuhan dan produksi lamun Enhalus acoroides (L.f) Royle di rataan terumbu Pulau Pari, Kepulauan Seribu.* p. 55-59. In: Moosa MK & Praseno DP.

Azkab M.H. (1993). *Pertumbuhan dan Produksi Lamun di Teluk Kuta Lombok Selatan*. Puslitbang Oceanografi. LIPI. Jakarta.

Azkab, M.H. (1999). *Pedoman Inventarisasi Lamun*. Jurnal Oseana, Vol. 24 (1); 1. ISSN 0216-1877.

Azkab, M. H. (2000). *Produktivitas Lamun*. Jurnal Oseana, Vol. 25 (1); 1. ISSN 0216- 1877.

Balai Taman Nasional Kepulauan Seribu. (2011). *Laporan Penilaian Potensi Terumbu Karang 2011*. Jakarta: Balai Taman Nasional Kepulauan Seribu.

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.

Bulthuis, D. A. (1987). Effects of temperatureon photosynthesis and growth of seagrasses. Aquatic Botany 27 (1), 27 – 40.

Darsono, P. (1999). PemanfaatanSumber Daya Laut dan Implikasinya bagi Masyarakat Nelayan. Jurnal Oseana, Vol (24) 4;1-9. ISSN 0216- 1877.

Fajarwati, S. D. et al. (2015). Analisis Kondisi Lamun (Seagrass) di Perairan Pulau Pramuka, Kepulauan Seribu. Jurnal Spatial, Vol. 13 (1); 22-32. DOI:https://doi.org/10.21009/spatial. 131.03.

Haviarini, C. P. et al. (2019). Konservasi Jenis Lamun di Kawasan Perairan Pulau Pramuka, Kepulauan Seribu, Provinsi DKI Jakarta. Jurnal Geografi Gea, Vol. 19 (1); 42-47. DOI: https://doi.org/10.17509/gea.v19i1.14 780.

Hilmy, A., Susandi, A., Damanik, B. M., Widdyusuf, L., Ridwana, R., and Himayah, S. (2021). Analisis Perubahan Land Surface Temperature Akibat Kebakaran Hutan dan Lahan di Kota Pekanbaru Riau Tahun 2000 dan 2020. JPIG (Jurnal Pendidikan dan Ilmu Geografi), 6(1), 74-80.

Jalaluddin, M. et al. (2020). Padang Lamun Sebagai Ekosistem Penunjang Kehidupan Biota Laut di Pulau Pramuka, Kepulauan Seribu, Indonesia. Jurnal Geografi Gea, Vol. 20 (1); 44-53. e-ISSN 2549-7529 p-ISSN 1412-0313.

Kamaruddin, Z. S. et al. (2016). Keragaman Lamun (Seagrass) di Pesisir Desa Lihunu Pulau Bangka Kecamatan Likupang Kabupaten Minahasa Utara, Sulawesi Utara. Jurnal Mipa Unsrat Online. Vol (5), 1; 20-24. DOI:https://doi.org/10.35799/jm.5.1.201 6. 11194

Kawaroe. (2019). Ekosistem Padang Lamun. Versi Elektronik. Bogor: Penerbit IPB Press Mem. Simp. Intern. U.N.A.M. - UNESCO, Mexico,D.F., Nov., 1967. pp 495-502.

Khotib, A. W. M. (2010). Status Temporal Komunitas Lamun (Seagrass) dan Pertumbuhan dengan Berbagai Teknik Transplantasi dalam Kawasan Rehabilitasi di Pulau Harapan, Kepulauan Seribu, Jakarta. Bogor: Institut Pertanian Bogor.

Lasabuda, R. (2013). Pembangunan Wilayah Pesisir dan Lautan dalam Perspektif Negara Kepulauan Republik Indonesia. Jurnal Ilmiah Platax, Vol (1-2) 92-101. ISSN: 2302- 3589.

Muzani, et al. (2020). Manfaat Padang Lamun Sebagai Penyeimbang Ekosistem Laut di Pulau Pramuka, Kepulauan Seribu. Jurnal Geografi, Vol (18) 1; 1-14 (2020). ISSN 1412 – 6982, e-ISSN: 2443-3977.

Nontji. (2010). Bomassa dan Produktivitas Fitoplankton di Perairan Teluk Jakarta serta Kaitannya dengan Faktor-faktor Lingkungan. Bogor: Institut Pertanian Bogor

Nontji. (2005). Laut Nusantara. Djambatan: Jakarta

Rahman, Arwan Arif, Andi Irwan Nur, and Muhammad Ramli. (2016). Studi Laju Pertumbuhan Lamun (Enhalus acoroides) di Perairan Pantai Desa Tanjung Tiram Kabupaten Konawe Selatan. Jurnal Sapa Laut, Vol. 1 (1); 13. E- ISSN 2503-0396.

Sheppard, et al. (1996). Theory Of Reasoned Action: A Meta Analysis Of Past Research With Recommendations For Modification And Future Research. Journal Of Consumer Research. Vol 15 (3), 325-343.

Sugiyono. (2009). Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: Alfabeta.

Supardi. (2006). Metodologi Penelitian. Mataram: Yayasan Cerdas Press. Tangke, Umar. (2010). Ekosistem Padang Lamun (Manfaat, Fungsi, dan Rehabilitasi). Jurnal Ilmiah agribisnis dan Perikanan, Vol (3) 1; 9-29. DOI: 10.29239/j.agrikan.3.1.9-29.

Thomlinson. (1974). Vegetative morphology and meristem dependence – The Foundation of Productivity in Seagrass. Aquaculture 4: 107-130. DOI:https://doi.org/10.1016/0044-8486(74)90027-1.

Tomascik et al. (1997). The Ecology of the Indonesian Seas. Periplus Editions.

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.

Singapore. In TERANGI. 2007. Terumbu Karang Jakarta: Laporan Pengamatan Terumbu Karang Kepulauan Seribu (2004- 2005). Yayasan Terangi dan The David and Lucile Packard Foundation. Jakarta.

Wood, E.J.F., W.E. Odum and J.C. Zieman. (1969). Influence of seagrass on the productivity of coastal lagoons. In: Memoirs Symposium International Costeras (UNAM-UNESCO). Nov 28-30-1967: 495-502.

Zachawerus, T. et al. (2019). Morfometrik Lamun Thalassia hemprichii, di Pantai Pasir Panjang Desa Paputungan Likupang Barat Minahasa Utara. Jurnal Ilmiah Platax, Vol (7)1; 178-185. ISSN: 2302-3589.

© 2023, FPIPS UPI. Open access article under the CC BY-SA license.