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# Seagrass community at tawang coast pacitan in rainy and dry season

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**Abstract.** Ecologically, the presence of seagrass contributes to an ecosystem offering for human need. This research was conducted to study the seagrass appearance at Tawang Coast Pacitan, East Java, Indonesia during rainy and dry season using a percentage of the covered area and physico chemical factors. The method used was transect-plot. The physical and chemical factors measured included temperature, light penetration, rapidity flow, high water rate, salinity, wave level, sediment texture, pH, dissolved oxygen, and nutrients such as ammonium, nitrate, C-organic and phosphorus pentoxide. The result showed that seagrass bed in Tawang Coast was formed by three seagrass: *Cymodocea rotundata, Thalassia hemprichii,* and *Halophila ovalis*. The average percentage of seagrass cover was 37.66 % in rainy season and 32.49% in dry season. According to decree of the Minister of Environment No. 200 in 2004, the seagrass bed conditions in Tawang Coast in the rainy season and dry season were categorized into less rich/less healthy. The decline in the seagrass covering percentage in the dry season was caused by light and temperature factors. Seagrasses in Tawang Coast were associated with different types of organisms.

## 1. Introduction

Seagrass meadow is one of the most productive communities, living in submerged underwater, covering the shallow coastal area, forming seagrass ecosystems, taking the crucial elements of tropical coastal ecosystems, other than coral reefs and mangroves [1], and has wide worldwide distribution [2]. In comparison with the both, the seagrass ecosystem received less attention from academic researchers, while this seagrass ecosystem contributed significantly to the utilization of its potential. [3].

The presence of seagrass contributes to an ecosystem offering [4]–[6] as natural processes and cosmponents that immediately or incidental meet the human needs [7]. Seagrass meadows offer a number of ecosystem products which include food, natural place, refreshment, and others [8]. For marine life forms, these habitats are utilized for spawning, foraging, rearing place and as natural shelter [9].

Based on anthropogenic influences, seagrass is not only found at the underwater but also situated near the mainland [10].

The components such as nutrients, sediment, light, salinity and temperature control the distribution and balance of seagrass communities [9], [11]–[13]. In a coastal environment, fluctuation frequently occurs due to seasonal variation and daily tidal cycle. It regulates the character and zonation of intertidal and shallow water organisms [14]. Sea tidal events cause the quality and intensity of light attaining the seabed to assist seagrass photosynthesis vary widely. It also regulates the growth and production of marine plants [9]. Such environmental elements have been presented to steer substantially growth and recruitment rate of the large seagrass species *Enhalus acoroides.* [15]. Heavy sediment load can affect the percentage of biomass, cover, and species composition of seagrass, which reduce the intensity of subsurface light [16].

Indonesia has two seasons throughout the year, namely dry and rainy seasons. The two seasons did not take place simultaneously in the Indonesian archipelago. Generally, the dry season occurs in April continuing until about September-October, and the wet season occurring in October-November continues March-May. The islands of Java and Nusa Tenggara experienced a dry season in April-October and a rainy season in November-March. We characterized the seagrass at Tawang Coast, which is located in Pacitan, East Java. Information about seagrass in Pacitan is limited.

## 2. Methodology

This research was conducted to study the condition of seagrass at Tawang Coast Pacitan, East Java, Indonesia during rainy and dry season using a percentage of the covered area and physico chemical factors. The method used was transect-plot. We used four transect (each transect 50 m) perpendicular to the shoreline. The distance between transect is 25 m. Data was collected at each transect using the quadrate plot, 0.5 m x 0.5 m, the distance between plot 5 m. The total number of plots is 44. Species identification is carried out on each plot by noting the organism found and measuring the percentage of the covered area. The determination of a percentage of the covered area follows percent cover standards from seagrasswatch.org. The physical and chemical factors measured included temperature, light penetration, rapidity flow, high water rate, salinity, wave level, sediment texture, pH, dissolved oxygen, and nutrients such as ammonium, nitrate, C-organic and phosphorus pentoxide. Identification of seagrass based on [17], a guide to tropical seagrasses of the Indo-West Pacific. There is no statistical analysis was used in this study.

## 3. Result and Discussion

The results showed that there were three of seagrass species in Tawang Coast, with species composition in Table 1. Based on the seagrass species that were more than one species, the seagrass community in Tawang Coast was mixed vegetation.

**Table 1**. Seagrass species in Tawang Coast

| No. | Familia | Sub Familia | Genus | Species |
|---|---|---|---|---|
| **1.** | Potamogetonaceae | Cymodoceoideae | *Cymodocea* | 1. *C. rotundata* |
| **2.** | Hydrocharitaceae | Thalassiodae | *Thalassia* | 2. *T. hemprichii* |
| | | Halophiloideae | *Halophila* | 3. *H. ovalis* |

The types of seagrass found were classified into two families, namely Potamogetonaceae and Hydrocharitaceae. Cymodocea and Halophila are genera commonly found in Indonesian coastal waters [18], while *Thalassia hemprichii* is a type that is almost always found in Indonesian waters.

Seagrass beds at a certain location within a certain time can be assessed by using a percentage area of cover. Based on the measurement results at the research location, the following data is obtained:

**Table 2.** The average percentage of seagrass cover

| Transect | C (percentage of the covered area) in rainy season | C (percentage of the covered area) in dry season |
|---|---|---|
| **I** | 15 % | 14.33 % |
| **II** | 28.33 % | 20 % |
| **III** | 50.63 % | 45 % |
| **IV** | 56.67 % | 50.63 % |
| **Average** | **37.66 %** | **32.49 %** |

The average percentage of seagrass cover varies between transects (Table 2). This is because dispersion and condition of chemical physico factors also differ between transects. The average percentage of seagrass cover in the rainy season is higher than in the dry season. According to decree of the Minister of Environment No. 200 in 2004, the seagrass bed conditions in Tawang Coast in the rainy season and dry season were categorized into less rich/less healthy.

Comparisons performed at the Flores Sea and South Lombok (East Indonesia) show a small seagrass closure. However, when compared to several locations in Java (for example, Sowan Coast, Tuban) the value is ideal. The percentage of seagrass closure in Tawang Coast is the factor causing less wealth. In addition to natural factors, also due to the expanding human activity and the excessive of fishing boat activity, thus turbidity is difficult to avoid. The fishermen sell their sea catches to Tawang TPI.

The frequent activities of fishing boats stimulate the turbulence above sea which causes turbidity. Photosynthesis process becomes less optimal because the penetration of sunlight inhibited due to high turbidity. This has a direct impact on decreasing the amount of seagrass growth. The osmoregulation system also experiences interference due to high turbidity [19]. Physico chemical factors at Tawang Coast as follows:

**Table 3**. Physico chemical factors at Tawang Coast

| No. | Parameter | Unit | Rainy | Dry |
|---|---|---|---|---|
| **1** | Light penetration | m | 1.5 | 2 |
| **2** | Air temperature | $^0C$ | 24 | 34 |
| **3** | Water temperature | $^0C$ | 28 | 36 |
| **4** | Salinity | $^0/_{00}$ | 35 | 39.05 |
| **5** | DO | | 7.9 | 7.5 |
| **6** | pH | - | 11.8 | 10.2 |
| **7** | Current velocity | m/s | 0.06 | 0.1 |
| **8** | $NH_4$ | me/l | 0.130 | 0.135 |
| **9** | $NO_3$ | me/l | 0.109 | 0.101 |
| **10** | $P_2O_5$ | ppm | 4.11 | 4.25 |
| **11** | Organic C | % | 0.167 | 0.155 |
| **12** | Organic matter | % | 0.288 | 0.350 |

Chemical physics factors in the rainy and dry seasons show no significant difference, except the temperature as shown in Table 3. All the chemical physics and nutrient factors measured are still within the tolerance range of the seagrass. The need for certain light intensity of seagrass is necessary for photosynthesis [11]. Reduced light penetration into seagrass is caused by eutrophication and the sediment load [11], [20] which increase by fishing boat activities in Tawang Coast. Without human activities, seagrasses can develop in the deeper spot since they obtain the high light intensity.

The decline of seagrass coverage percentage in the dry season (Table 3) was implied by light and temperature factors which causes dieback of seagrass. The high photosynthesis rate and seagrass growth range from thermal optima 15 to 33°C and generally representing the geographic distribution in specific temperature [21]. In shallow water habitat, the thermal optima are probably exceeded during the low tide and have been linked to seagrass disappearance [22]–[23]. Despite the fact that coastal water temperatures are nonetheless inside the range of seagrass tolerance, seagrass has been shown to replace in morphological character and the covered area percentage.

Stress conditions can affect seagrass metabolism in several ways, including an unbalanced water temperature that impress photosynthesis and respiration processes. The photosynthetic apparatus is terribly sensitive to temperature. Cyclic change in temperature effect fixation and reduction process, also transport and distribution of electron and photosynthetic products during the photosynthetic pathways [24]. Afterward, the temperature exceeds the threshold then photosynthetic efficiency will decrease [13]. Each species has a different level of sensitivity to elevated temperatures. Tropical species have a proportion at high temperatures compared to subtopic species and temperate species [13], [21]. Extreme temperature stress implies seagrasses mortality. Unfortunately, in situ observation of seagrass mortality is commonly applied after a thermal stress process, making it difficult to straightly connect the physiological changes with mortality [22]–[23], [25].

Numerous grazers and other fauna inhabits seagrass meadows at Tawang Coast. Macroinvertebrates were found in the plots are eight species namely *Archaster typicus*, *Echinometra mathaei*, *Holothuria atra*, *Nerita chamaeleon*, *Trochus maculates*, *Conus textile*, *Cypraea eglantina*, and *Turbo argyrostomus.* There are also three species of macroalgae were found in the plots namely: Padina sp., *Ulva* sp., and *Halimeda* sp.

## 4. Conclusion

Seagrass meadow in Tawang Coast was formed by three of seagrass species: *Cymodocea rotundata*, *Thalassia hemprichii*, and *Halophila ovalis*. The average percentage of seagrass cover was 37.66 % in the rainy season and 32.49% in the dry season. According to decree of the Minister of Environment No. 200 in 2004, the seagrass bed conditions in Tawang Coast in the rainy season and dry season were categorized into less rich/less healthy. The decline in the seagrass covering percentage in the dry season was caused by light and temperature factors. Seagrasses in Tawang Coast were associated with different types of organisms.

## References

[1] Torre-Castro M D La, 2006, Humans and Seagrasses in East Africa: A Social-Ecological Systems Approach, Stockholm: Department of Systems Ecology, Stockholm University.

[2] Gessner F, 1971 C. den Hartog: The sea-grasses of the world. Amsterdam, London: North-Holland Publishing Company 1970. 275 pp. Hfl. 55.— *Int. Rev. der gesamten Hydrobiol. und Hydrogr.* **55**, 1 p. 159–160.

[3] De la Torre-Castro M Di Carlo G and Jiddawi N S, 2014 Seagrass importance for a small-scale fishery in the tropics: The need for seascape management *Mar. Pollut. Bull.* **83**, 2 p. 398–407.

[4] Campagne C S Salles J M Boissery P and Deter J, 2014 The seagrass Posidonia oceanica: Ecosystem services identification and economic evaluation of goods and benefits *Mar. Pollut. Bull.* **97**, 1–2 p. 391–400.

[5] Cullen-Unsworth L C Nordlund L M Paddock J Baker S McKenzie L J and Unsworth R K F, 2014 Seagrass meadows globally as a coupled social-ecological system: Implications for human wellbeing *Mar. Pollut. Bull.* **83**, 2 p. 387–397.

[6] Mtwana Nordlund L Koch E W Barbier E B and Creed J C, 2016 Seagrass ecosystem services and their variability across genera and geographical regions *PLoS One* **12**, 1 p. 1–23.

[7] de Groot R S Wilson M A and Boumans R M J, 2002 A typology for the classification, description and valuation of ecosystem functions, goods and services *Ecol. Econ.* **41**, 3 p. 398–408.

[8] Tuya F Haroun R and Espino F, 2014 Economic assessment of ecosystem services: Monetary value of seagrass meadows for coastal fisheries *Ocean Coast. Manag.* **96** p. 181–187.

[9] Hemminga M A and Duarte C M, 2000, Preface, in *Seagrass Ecology*, (Cambridge: Cambridge University Press).

[10] Ambo-Rappe R, 2014 Developing a methodology of bioindication of human-induced effects using seagrass morphological variation in Spermonde Archipelago, South Sulawesi, Indonesia *Mar. Pollut. Bull.* **86**, 1–2

p. 298–303.
[11] Ralph P J Gademann R and Dennison W C, 1998 In situ seagrass photosynthesis measured using a submersible, pulse-amplitude modulated fluorometer *Mar. Biol.* **132**, 3 p. 367–373.
[12] Kahn A E and Durako M J, 2006 Thalassia testudinum seedling responses to changes in salinity and nitrogen levels *J. Exp. Mar. Bio. Ecol.* **335**, 1 p. 1–12.
[13] Campbell S J McKenzie L J and Kerville S P, 2006 Photosynthetic responses of seven tropical seagrasses to elevated seawater temperature *J. Exp. Mar. Bio. Ecol.* **330**, 2 p. 455–468.
[14] Chappuis E Terradas M Cefalì M E Mariani S and Ballesteros E, 2014 Vertical zonation is the main distribution pattern of littoral assemblages on rocky shores at a regional scale *Estuar. Coast. Shelf Sci.* **147** p. 113–122.
[15] Kaewsrikhaw R and Prathep A, 2014 The effect of habitats, densities and seasons on morphology, anatomy and pigment content of the seagrass Halophila ovalis (R.Br.) Hook.f. at Haad Chao Mai National Park, Southern Thailand *Aquat. Bot.* **116** p. 69–75.
[16] Bentley S J Freeman A M Wilson C S Cable J E and Giosan L, 2014, Using what we have: Optimizing sediment management in Mississippi River Delta restoration to improve the economic viability of the nation, in *Perspectives on the Restoration of the Mississippi River Delta: The Once and Future Delta*, (Dordrecht: Springer), p. 85–97.
[17] Waycott M *et al.*, 2009 Accelerating loss of seagrasses across the globe threatens coastal ecosystems *Proc. Natl. Acad. Sci.* **106**, 30 p. 12377–12381.
[18] Juwana S and Romimohtarto K, 1987 A comparative study of some larval stages of Penaeus monodon and Penaeus merguiensis (Crustacea: Decapoda) from Indonesia *Publ. Seto Mar. Biol. Lab.* **32**, 1–3 p. 109–122.
[19] Walker T S, 2003 Root Exudation and Rhizosphere Biology *Plant Physiol.* **132**, 1 p. 44–51.
[20] Christianen M J A *et al.*, 2012 Marine megaherbivore grazing may increase seagrass tolerance to high nutrient loads *J. Ecol.* **100** p. 546–560.
[21] Collier C J Uthicke S and Waycott M, 2011 Thermal tolerance of two seagrass species at contrasting light levels: Implications for future distribution in the Great Barrier Reef *Limnol. Oceanogr.* **56**, 6 p. 2200–2210.
[22] Massa S I Arnaud-Haond S Pearson G A and Serrão E A, 2009 Temperature tolerance and survival of intertidal populations of the seagrass Zostera noltii (Hornemann) in Southern Europe (Ria Formosa, Portugal) *Hydrobiologia* **619**, 1 p. 195–201.
[23] Rasheed M A and Unsworth R K F, 2011 Long-term climate-associated dynamics of a tropical seagrass meadow: Implications for the future *Mar. Ecol. Prog. Ser.* **422**, 93 p. 93–103.
[24] Buxton L Takahashi S Hill R and Ralph P J, 2012 Variability in the primary site of photosynthetic damage in symbiodinium sp. (dinophyceae) exposed to thermal stress *J. Phycol.* **48**, 1 p. 117–126.
[25] Marbà N and Duarte C M, 2010 Mediterranean warming triggers seagrass (Posidonia oceanica) shoot mortality *Glob. Chang. Biol.* **16**, 8 p. 2366–2375.