

The Presence of Aquatic Resources in Biological Fish Aggregating Devices (Bio-FADs) Tree Technology in the Waters of the Makassar Strait

Muchlis Nawa^a, Wayan Kantun^{b*}, Indra Cahyono^c

^{a,b,c} Institut Teknologi dan Bisnis Maritim Balik Diwa

Correspondent Author* : aryakantun@gmail.com

Doi : (please leave blank)

Abstract

Fishing for bottom fish has been so intensive that it is thought to have had an impact on ecosystem damage and changes in bottom fish populations. Based on this, this research was conducted to analyze the presence and composition of fish species in the Biological Fish Aggregating Devices (Bio-FADs) Tree installation area. This research was conducted in the Tanakeke waters of the Makassar Strait from August to September 2024. This research used an experimental method by installing three Bio-FADs Trees at three stations. The first station has habitat conditions without seagrass, the second station has damaged seagrass conditions, and the third station has good seagrass habitat conditions. Observations were made using underwater cameras for each station. The results of the research showed that the number of fish present at station one was 17 species with a total of 455 individuals, station 2 with 14 species totaling 293 individuals and station three with 11 species with 351 individuals. The highest presence at station one was *Siganus guttatus* fish at 22.86%, while at stations two and three the *Pentapodus bifasciatus* species were 18.77 and 18.52% respectively. Station one with a habitat without seagrass provides a higher presence of aquatic resources than the other stations.

Keywords: aquatic resources, Bio-FADs, technology

Abstrak

Penangkapan ikan dasar sangat intensif sehingga diperkirakan berdampak pada kerusakan ekosistem dan perubahan populasi ikan dasar. Berdasarkan hal tersebut, penelitian ini dilakukan untuk menganalisis keberadaan dan komposisi spesies ikan di area pemasangan pohon Alat Pengagregat Ikan Biologis (Bio-FAD). Penelitian ini dilakukan di perairan Tanakeke Selat Makassar pada bulan Agustus hingga September 2024. Penelitian ini menggunakan metode eksperimental dengan memasang tiga Pohon Bio-FAD di tiga stasiun. Stasiun pertama memiliki kondisi habitat tanpa lamun yang tidak dimiliki, stasiun kedua memiliki kondisi lamun yang rusak, dan stasiun ketiga memiliki kondisi habitat lamun yang baik. Pengamatan dilakukan menggunakan kamera bawah air untuk setiap stasiun. Hasil penelitian menunjukkan bahwa jumlah ikan yang ada di stasiun satu adalah 17 spesies dengan total 455 individu, stasiun 2 dengan 14 spesies dengan total 293 individu dan stasiun tiga dengan 11 spesies dengan 351 individu. Keberadaan tertinggi di stasiun satu adalah ikan *Siganus guttatus* sebesar 22,86%, sedangkan di stasiun dua dan tiga spesies *Pentapodus bifasciatus* masing-masing sebesar 18,77 dan 18,52%. Stasiun satu dengan habitat tanpa lamun memberikan keberadaan sumber daya perairan yang lebih tinggi daripada stasiun lainnya.

Kata Kunci: Bio-FADs, sumber daya akuatik, teknologi

Manuscript received March; revised March; accepted April Date of publication 30 April 2025 BD-JoST is licensed under a [Creative Commons Attribution-Share Alike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/)



INTRODUCTION

Seagrass grassland ecosystems are shallow water ecosystems and are of great importance because they provide habitats, food sources and breeding grounds for different types of aquatic resources, (Duarte et al., 2013; Unsworth & Cullen, 2010). Padang lamun ecosystems have a very important ecological role in supporting aquatic resources, namely as habitat providers, carbon sinks, sediment stabilizers and sources of nutrients, (Fourqurean et al., 2012; Waycott et al., 2009). Seagrass ecosystem is one of the ecosystems found in coastal areas, (Gusriana et al., 2020). Seagrass beds consist of groups of seagrass species that interact with biotic and abiotic elements in their

environment, (Purnomo et al., 2017). In addition, seagrass has a function as a primary producer and acts as a stabilizer on the bottom of the water, nutrient source, food source and shelter, (Azkab, 1987).

Rumpon is a tool to concentrate fish, a shelter, a place for fish to gather, find food and make it easier for fishermen to find a place to operate their fishing gear. One type that is currently widely used by the public is live rumpon or Biological-Fish Aggregation Devices (Bio-FADs). Bio-FADs are grasses that use seaweed or other aquatic plants as an attraction. (Nevada et al., 2012) using seaweed as an attraction to catch a type of sand green lobster (*Panulirus homorus*). Suardi et al. (2016) Using live rumpon from seaweed to attract/collect various types of fish as fish gather on seaweed cultivated by fishermen. Research related to the use of Bio-FADs has been published, among others, on live rumpon and its relationship with the structure of fish communities spatially temporally on the coast of Luwu Regency (Suardi et al., 2016) and the dynamics of the catch of baronang (*Siganus sp.*) on the temporal spatially living rumpon on the coast of Uloulo, Luwu Regency, (Suardi et al., 2016).

The presence of aquatic resources in *Biological Fish Aggregating Devices* (Bio-FADs) Tree technology in the waters of the Makassar Strait is a strategic effort to support the sustainability of fisheries management based on coastal ecosystems. This study is motivated by previous findings in the waters of Tompotana, Takalar (Kantun et al., 2021), which suggests that the installation of Bio-FADs with attractants can influence the composition and presence of fish species. Previous research has installed attractants on three different types of habitats, namely seagrass beds, coral reefs, and river estuaries, while this study differentiates habitat variables at uniform depths but with three different ecological conditions: no seagrass meadows, damaged seagrasses, and seagrass that is still in good condition. Another significant difference lies in the physical structure of the Bio-FADs Tree used. This study uses paralon pipes as the main axis and steel wire as the attractant branch, in contrast to previous research that used rattan material. The sampling technique is carried out during the day to ensure the consistency of recording the presence of fish at times with maximum light intensity. This innovative approach shows that the Bio-FADs Tree not only functions as a fish aggregating tool, but also as an ecotechnological solution in the rehabilitation of ecosystems that have been degraded due to anthropogenic activities, especially environmentally unfriendly fishing.

Practically, this research has high urgency because Bio-FADs Tree has the potential to be an applied technology to increase fisheries productivity in coastal areas that have experienced a decline in catches. This technology allows fishermen to remain productive without having to damage natural ecosystems such as coral reefs or fragile seagrass meadows. In addition, the Bio-FADs Tree supports the implementation of community-based conservation areas by providing artificial structures that can accelerate the recovery of fish habitats, while strengthening the food network through increasing biodiversity. Meanwhile, from the theoretical and academic side, this research is important to expand the understanding of the interaction between artificial structures and the presence of fish resources in various habitat types. The results of this study can enrich the wealth of knowledge in the field of coastal aquatic ecology and marine biotechnology, as well as provide relevant empirical data for the development of new theories in habitat-based fisheries management. In addition, this research can be used as a reference for policy makers in formulating ecosystem conservation and restoration strategies based on green and environmentally friendly technology approaches. Thus, the presence of Bio-FADs Tree as a marine technology innovation not only has a positive impact on increasing fish catches, but also contributes to the preservation of aquatic ecosystems in a sustainable manner. This research not only answers practical problems in the field, but also strengthens the theoretical basis for the development of marine and fisheries science in Indonesia and other tropical regions.

METHOD

This study uses a quantitative-descriptive approach with a field experiment method (Moreno et al., 2016; Sziráki et al., 2021) to observe the effectiveness of Bio-FADs Tree's technology on the presence of aquatic resources. This approach allows for systematic measurement of changes in the composition and number of fish associated with the Bio-FADs device compared to the control area without FADs aiming to analyze the presence and composition of fish species based on stations with different habitat conditions, (Moreno et al., 2016). This research was carried out for three months from



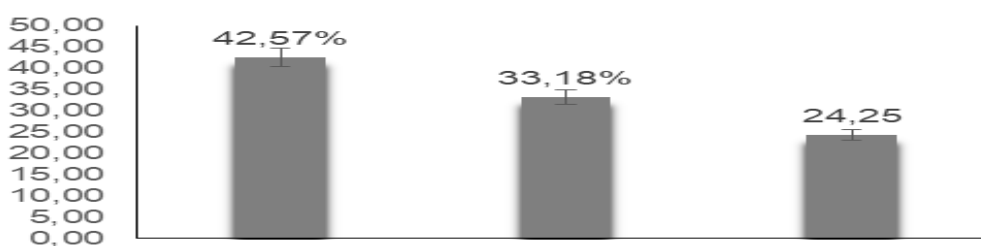
August to September 2024 at the installation location of Biological Fish Aggregating Devices (Bio-FADs) Tree in the waters of Tanakeke Makassar Strait. The procedure for this research, namely Biological Fish Aggregating Devices (Bio-FADs) Trees is installed at three stations, at the first station with habitat without seagrass meadows, the second station with damaged seagrass conditions and the third station with good seagrass habitat. The depth of installation of this technology is relatively the same, namely 5 m with 2000 m from the coastline. Observations were made using underwater cameras and were carried out three times a week every day for a whole month. Observations were made during the day when the tide was around 11.00 with a duration of 10 minutes. The selection of daylight time takes into consideration the calm water conditions and there is sunlight that helps provide natural lighting. The fish recorded by the camera were separated by type and station and then identified with reference to the identification guidelines of the www.fishbase.se and www.fishider.org website pages. Furthermore, the data obtained from the results of the recordings through underwater observations was analyzed based on the presence of fish, (Lopez et al., 2014; Sziráki et al., 2021). The fish that are present are observed the frequency of their presence by counting each species of fish present and then comparing it with the number of all species. To calculate the presence of fish types the formula is used, (Odum, 1993).

RESULT AND DISCUSSION

Based on the results of visual observations around the Bio-FADs Tree, the species present for station one with habitat conditions without seagrass as many as 21 species with a total of 639 individuals (42.57%), station two with damaged seagrass habitat as many as 16 species with a total of 498 individuals (33.18%) and station three with good seagrass habitat conditions as many as 12 species with a total of 364 individuals (24.25%) (Figure 1). The highest proportion of fish presence is at station one and the lowest at station three. Based on the results of fish identification at all Bio-FADs Tree installation stations during the study, 27 species, 18 families with a total of 1501 individuals were obtained. The Siganidae family from the genus *Siganus* is the most present in this study with 3 (three) species, namely *Siganus canaliculus*, *S. gutattus* and *S. virgatus*. The presence of this type of fish is an indicator that the technology installed is indeed suitable for attracting herbivorous fish.

Figure 1.

Number of fish presence in bio-FADs by station



Source: research results

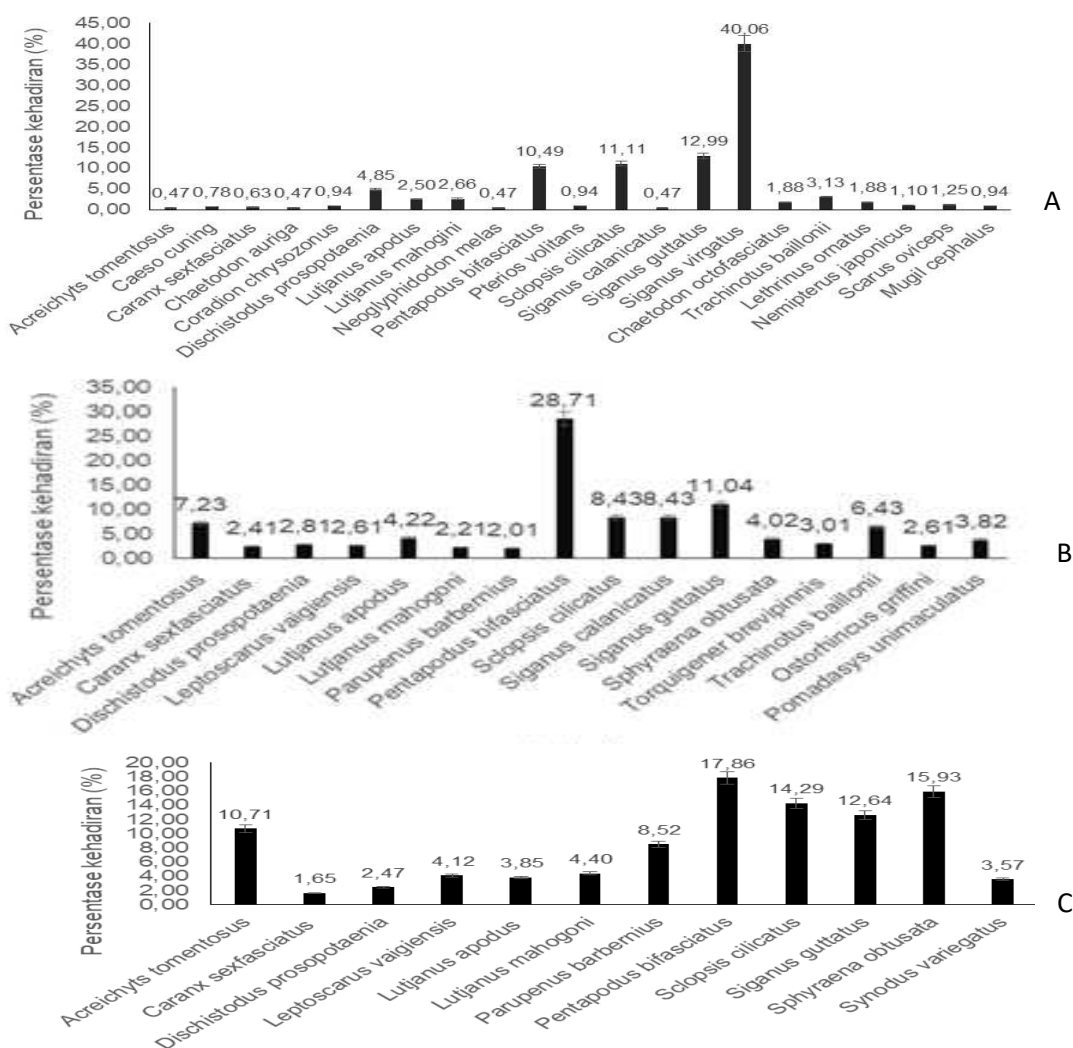
The presence of fish species is dominated at each station one, but nevertheless the fish at station one is also present at stations two and three with different frequencies of presence. Fish of the genus *Lutjanus* are always present in every station, as are the genus *Acreichyts* and *Sclopsis* as an indication that all three stations are suitable places to grow. The data obtained in Figure 1 after statistical testing based on stations was calculated using the analysis of the t-Test: *Two-Sample Assuming Equal Variances* statistical test showed that there was no difference in the value of the presence of fish observed ($T_{\text{count}} < T_{\text{table}}$) between stations.

Based on the types of fish present at each station, information was obtained that at one station there were many fish species of *Siganus virgatus* as much as 40.06% (Figure 2A), while at stations two and three the dominant types were *Pentafodus bifasciatus* at 28.71% (Figure 2B) and 17.86% (Figure 2C). The presence of fish at one station with a habitat without seagrass is more varied than at other stations in damaged seagrass habitats and good seagrass. The variation of fish at station one without seagrass is suspected because in that habitat the food source is only found in the Bio-FADs Tree. Bio-FADs



technology is the only structure available thus attracting more fish looking for shelter, food or gathering places. In conditions like this, Bio-FADs technology becomes the center of activity for fish that do not have an alternative place to live. Meanwhile, in damaged seagrass habitats and good seagrasses, there are many food sources so that there is a spread of fish when looking for food.

Picture 2.
The presence of fish species caught at the Bio-FADs Tree installation site



Source: research results

Meanwhile, at station three with good seagrass habitat conditions, the presence of a relatively small number of fish species compared to others. This is allegedly related to the availability of natural habitats, space competition, resources, habitat preferences, and the attraction of Bio-FADs Tree technology in less-than-ideal habitats. In habitats with good seagrass, fish have many options for shelter and forage naturally so that fish do not depend on installed technology to obtain food. In conditions like this, fish tend to spread in various available areas around them. In a good habitat, fish can take advantage of many natural structures in addition to Bio-FADs Tree technology to find food or shelter. This makes the fish not need to rely on one point so that the number of fish present and gathered on the Bio-FADs Tree technology is small. On the other hand, certain types of fish may prefer to take shelter and forage in seagrass meadows, coral reefs rather than in Bio-FADs Tree technology because the natural structure is more in line with its ecological behavior and needs.



In addition, the presence of Bio-FADs Tree technology also provides a comfortable place to shelter for fish from predator attacks, with a seaweed attractant structure that is able to create a habitat similar to the natural environment of fish so as to provide a sense of comfort. The seaweed attractants on each Bio-FADs Tree also serve as a food source so that it attracts various plankton and other small organisms that are food sources for fish. The presence of plankton can create a food chain that invites small fish and attracts larger consumers. It is likely that some species use Bio-FADs Tree technology as a spawning area because seaweed provides a surface structure as a place to attach eggs and is a safe area for fish larvae.

Waheda et al (2015) In his research, it is shown that in habitats with high seagrass density, it is more varied than in low seagrass density due to the provision of food and shelter from predators, while the lack of variation of fish in low seagrass habitats is due to seagrass density and food sources. Research results (Latuconsina et al., 2013) found that in the seagrass ecosystem in the coastal waters of Wael-Tekuk Kotonian, *Siganus canalicatus* species were found during the day and at night with an abundance of fish at night due to *Siganus canaliculatus* being nocturnal and active at night. Fishermen's activities near the area of installing Bio-FADs and passenger ship traffic can affect the presence of fish because fish tend to avoid threat disturbances that come from fishing activities. The abundance of reef fish in seagrass habitats is also determined by the bottom substrate of the waters. (Muchlisin et al., 2012) found an abundance of reef fish in the seagrass beds of Kapoposang Island, Pangkep Regency, South Sulawesi which consists of several families such as Haemulidae, Lutjanidae, Mullidae and Scaridae. (Pereira et al., 2010) reveals that the abundance of these fish maintains connectivity between coastal ecosystems and conducts ruaya between the three ecosystems (seagrasses, mangroves and coral reefs), which involves changes in diet and behavior.

The existence of Bio-FADs Tree in this study makes various types of fish come to meet their life needs. According to the purpose of making Bio-FADs Tree, which is to create fish-quiet waters into waters that are crowded with bottom and demersal fish. One of the functions of the Bio-FADs Tree is to be able to increase the abundance of fish due to the availability of food sources and shelter for fish from predators. (Waheda et al., 2015) stated that the seagrass ecosystem is used by coral fish as a place of care and protection, as a place to spawn and a place to find food. (Espadero et al., 2021; Lee et al., 2014) Revealing seagrass beds in shallow or intertidal sea waters are greatly influenced by the tides so that they are inhabited by demersal fish. Fish is one of the organisms associated with seagrass meadows. There are four main categories of association of fish with seagrass beds in waters (Kantun et al., 2021), namely, (1) as a permanent resident in spawning and spending most of his life in seagrass habitats such as fish of the *Apogon margaritophorus*, (2) seagrass beds as fish food of the species of cockatoos of the family Scaridae, such as the species *Siganus guttatus*, *Siganus virgatus* and *Siganus canalicatus*, family Hemimphridae Included in the group of reef fish that are diurnal are fish eaters who live in seagrass beds, (3) as a place to forage, (4) as an interaction between seagrass beds and places to forage in tropical waters. This information shows that not all types of fish associated with seagrass beds settle permanently.

Research results (Latuconsina et al., 2013) in the seagrass ecosystem in the coastal waters of Wael Kotonian Bay found the species *Siganus canalicatus* during the day and night with abundant fish conditions at night. This is because *Siganus canalicatus* is nocturnal and active at night. Kawaroe & Nugraha (2016) found reef-dwelling fish that are also found in seagrass ecosystems such as Chaetodonidae, Scaridae, Holocentridae, Ostraciidae, Hemiramphidae, Haemulidae, Synodontidae and Nemipteridae. The proximity of the seagrass ecosystem to coral reefs affects the number of coral reef fish in the pandang area, (Faiqoh et al., 2017). This is in accordance with the ecological condition of the seagrass meadow at the research site which is directly adjacent to the coral reef.

CONCLUSION

Based on the results of the study on the presence of fish in Bio-FADs Tree technology in the waters of the Makassar Strait, it was found that station one, which has habitat conditions without seagrass meadows, shows a higher level of fish presence compared to stations two and three, which each have damaged and good seagrass habitat conditions. This phenomenon suggests that the existence of seagrass meadows, which are generally associated with their function as spawning



habitats and fish shelters, is not always the main factor in determining fish aggregation against Bio-FADs. In contrast, the structure of the Bio-FADs themselves appears to have served as an artificial habitat that is quite effective in attracting and retaining the presence of fish, even in areas that are ecologically poor in basic vegetation such as station one. These differences can be influenced by various local oceanographic factors, such as the depth of the waters, the level of water clarity, ocean currents, and surface temperature, which also play an important role in fish habitat preferences. In addition, the possibility of higher spatial competition and natural predation in seagrass areas, especially those that are still classified as "good", may make pelagic fish prefer open areas with artificial aggregation structures such as Bio-FADs as an alternative protection and gathering place. These findings support the idea that the development of Bio-FADs technology can be an adaptive fisheries conservation and management strategy, especially in coastal areas that experience degradation of basic ecosystems such as seagrass beds. Thus, the success of Bio-FADs in attracting fish in non-seagrass habitats shows the potential of this technology in increasing aquatic productivity and supporting fisheries sustainability, especially in areas that experience natural habitat damage. However, further research considering other biotic and abiotic factors is needed to strengthen the understanding of the ecological mechanisms underlying fish's spatial preference to the Bio-FADs device.

REFERENCES

- Azkab, M. H. (1987). Percobaan transplantasi lamun, *Cyrtosira rotundata* Ehrenb. & Hemprich ex Aschers di rataan terumbu Pulau Pari, Kepulauan Seribu. *Kongres Nasional Biologi VIII, Purwokerto*, 8–10.
- Duarte, C. M., Losada, I. J., Hendriks, I. E., Mazarrasa, I., & Marbà, N. (2013). The role of coastal plant communities for climate change mitigation and adaptation. *Nature Climate Change*, 3(11), 961–968.
- Espadero, A. D. A., Nakamura, Y., Uy, W. H., & Horinouchi, M. (2021). Tropical intertidal seagrass beds as fish habitat: Similarities between fish assemblages of intertidal and subtidal seagrass beds in the Philippines. *Estuarine, Coastal and Shelf Science*, 251, 107245.
- Faiqoh, E., Wiyanto, D. B., & Astrawan, I. G. B. (2017). Peranan padang lamun selatan Bali sebagai pendukung kelimpahan ikan di Perairan Bali. *Journal of Marine and Aquatic Sciences*, 3(1), 10–18.
- Fourqurean, J. W., Duarte, C. M., Kennedy, H., Marbà, N., Holmer, M., Mateo, M. A., Apostolaki, E. T., Kendrick, G. A., Krause-Jensen, D., & McGlathery, K. J. (2012). Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience*, 5(7), 505–509.
- Gusrina, I., Lestari, F., & Kurniawan, D. (2020). Hubungan Kerapatan Lamun dengan Kepadatan Bivalvia di Perairan Pulau Karas Kecamatan Galang Kota Batam Provinsi Kepulauan Riau. *Student Online Journal (SOJ) UMRAH-Kelautan Dan Perikanan*, 1(1), 18–31.
- Kantun, W., Kabangnga, A., & Nurhikmah, N. (2021). Kehadiran Dan Komposisi Jenis Ikan Pada Habitat Biological Fish Aggregating Devices (BioFADs) di Perairan Tanekeke, Selat Makassar. *Prosiding Seminar Nasional Politeknik Pertanian Negeri Pangkajene Kepulauan*, 2, 47–56.
- Kawaroe, M., & Nugraha, A. H. (n.d.). *Juraj. 2016. Ekosistem padang lamun*. IPB press. Bogor.
- Latuconsina, H., Sangadji, M., & Sarfan, L. (2013). Struktur komunitas ikan padang lamun di perairan pantai wael teluk kotania kabupaten seram bagian barat. *Agrikan: Jurnal Agribisnis Perikanan*, 6(Supplement), 24–32.
- Lee, C.-L., Huang, Y.-H., Chung, C.-Y., & Lin, H.-J. (2014). Tidal variation in fish assemblages and trophic structures in tropical Indo-Pacific seagrass beds. *Zoological Studies*, 53, 1–13.
- Lopez, J., Moreno, G., Sancristobal, I., & Murua, J. (2014). Evolution and current state of the technology of echo-sounder buoys used by Spanish tropical tuna purse seiners in the Atlantic, Indian and



- Pacific Oceans. *Fisheries Research*, 155, 127–137. <https://doi.org/https://doi.org/10.1016/j.fishres.2014.02.033>
- Moreno, G., Dagorn, L., Capello, M., Lopez, J., Filmlalter, J., Forget, F., Sancristobal, I., & Holland, K. (2016). Fish aggregating devices (FADs) as scientific platforms. *Fisheries Research*, 178, 122–129.
- Muchlisin, Z. A., Fadli, N., Nasution, A. M., Astuti, R. A. R., & Marzuki, M. (2012). Analisis subsidi bahan bakar minyak (BBM) solar bagi nelayan di Kabupaten Aceh Besar, Provinsi Aceh. *Depik*, 1(2).
- Nevada, H. A. T., Martasuganda, S., Zulfainarni, N., & Dirwana, I. (2012). Pengaruh Perbedaan Atraktor Terhadap Hasil Tangkapan Juvenil Lobster Dengan Korang Di Desa Sangrawayan, Palabuhanratu (the Effect of Different Attractor Against Catch of Juvenile Lobster by Korang in Sangrawayan Village, Palabuhanratu). *Marine Fisheries: Journal of Marine Fisheries Technology and Management*, 3(2), 129–133.
- Odum, E. P. (1993). *Dasar-dasar ekologi (terjemahan)*. Gadjah Mada University Press. Yogyakarta. 574hlm.
- Pereira, P. H. C., Ferreira, B. P., & Rezende, S. M. (2010). Community structure of the ichthyofauna associated with seagrass beds (*Halodule wrightii*) in Formoso River estuary-Pernambuco, Brazil. *Anais Da Academia Brasileira de Ciencias*, 82, 617–628.
- Purnomo, H. K., Yusniawati, Y., Putrika, A., Handayani, W., & YASMAN, Y. (2017). Seagrass species diversity at various seagrass bed ecosystems in the West Bali National Park Area. *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia*, 3(2), 236–240.
- Suardi, S., Wiryawan, B., Santoso, J., & Riyanto, M. (2016). Rumpon Hidup Dan Hubungannya Dengan Struktur Komunitas Ikan Secara Spasial-temporal Di Pesisir Kabupaten Luwu (Bio-fads and Its Association with Spatio-temporal Fish Community Structure of Cach in Luwu District Coastal Water). *Marine Fisheries*, 7(1), 83–95.
- Sziráki, B., Staszny, Á., Juhász, V., Weiperth, A., Nagy, G., Fodor, F., Havranek, M., Koltai, T., Szári, Z., Urbányi, B., & Ferincz, Á. (2021). Testing the efficiency of artificial spawning nests for pikeperch (*Sander lucioperca* L.) under natural conditions (Lake Balaton, Hungary). *Fisheries Research*, 243, 106070. <https://doi.org/https://doi.org/10.1016/j.fishres.2021.106070>
- Unsworth, R. K. F., & Cullen, L. C. (2010). Recognising the necessity for Indo-Pacific seagrass conservation. *Conservation Letters*, 3(2), 63–73.
- Waheda, S., Lestari, F., & Zulfikar, A. (2015). Struktur komunitas ikan di ekosistem padang lamun di perairan desa teluk bakau kecamatan gunung kijang kabupaten Bintan. *Jurnal Manajemen Sumber Daya Perairan*, 2(3), 51–64.
- Waycott, M., Duarte, C. M., Carruthers, T. J. B., Orth, R. J., Dennison, W. C., Olyarnik, S., Calladine, A., Fourqurean, J. W., Heck Jr, K. L., & Hughes, A. R. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences*, 106(30), 12377–12381.

