*Fisheries Journal*, 14(3), 1428-1436 (2024)
http://doi.org/10.29303/jp.v14i3.976

# ANALYSING THE POTENTIAL OF CORAL REEF ECOSYSTEMS FOLLOWING THE COVID-19 PANDEMIC IN BONDALEM, BULELENG, BALI

## Analisis Potensi Ekosistem Terumbu Karang Pasca Pandemi Covid-19 di Bondalem, Buleleng, Bali

Made Dwipa Kusuma Maharani[1*], Muhammad Sumsanto[2], I Nyoman Dodik Prasetia[1], Dewi Wulandari[1]

[1]Fisheries Biotechnology, Faculty of Mathematics and Natural Sciences, Ganesha University of Education
[2]Aquaculture, Faculty of Agriculture, University of Mataram

*Udayana Street No 11, Singaraja, Bali*

*Coresponding author: kusuma.maharani@undiksha.ac.id

(Received June 19th 2024; Accepted September 24th 2024)

**ABSTRACT**

Coastal and marine areas have considerable biological resource potential, because they are supported by three main ecosystems, namely mangrove ecosystems, seagrass beds and coral reefs. Coral reefs are one of the coastal ecosystems that contribute greatly to coastal areas. But behind the great potential, it is also very vulnerable to damage, both caused by nature and human activities on land and in sea waters. As an effort to maintain the existence of these ecosystems, ecosystem monitoring is needed to find out how much potential is still available in the coastal area. The purpose of this study was to determine and provide information related to the potential and condition of coral reefs in Bondalem Village. This research used descriptive quantitative method with purposive sampling technique. The data taken is primary data that includes observations of coral reefs based on the form of growth (lifeform). Coral reef data collection was carried out using the UPT (Underwater Photo Transect, Underwater Photo Transect) method. The results obtained, coral reefs at the observation station have a total of 18 lifeforms. The percentage of coral cover obtained at a depth of 3 meters has a coral cover ranging from 35.34%, while at a depth of 10 meters the result of coral cover is 26.30% (medium category). The coral reef ecosystem uniformity index ranges from 0.96 - 0.97 (high). The diversity index of coral reef ecosystems in Bondalem Village ranged from 1.25 which is included in the relatively medium category (1<H'<3). The dominance index of coral reef ecosystem in Bondalem Village ranged from 0.064 - 0.066 (low).

Keywords: Bondalem, Coral Reef, Coral Watch, Ecosystem

**ABSTRAK**

Wilayah pesisir dan laut memiliki potensi sumberdaya hayati yang cukup besar, karena



e-ISSN : 2622-1934, p-ISSN : 2302-6049

didukung oleh tiga ekosistem utama yaitu ekosistem mangrove, padang lamun dan terumbu karang. Terumbu karang merupakan salah satu ekosistem pesisir yang sangat besar kontribusinya terhadap wilayah pesisir. Namun dibalik potensi yang besar tersebut, sangat rentan juga terhadap kerusakan, baik yang disebabkan oleh alam maupun aktivitas manusia didaratan dan diperairan laut. Sebagai upaya mempertahankan keberadaan ekosistem tersebut, perlunya dilakukan monitoring ekosistem guna mengetahui seberapa besar potensi yang masih tersedia dikawasan pesisir. Tujuan dari penelitian ini adalah untuk mengetahui dan memberikan informasi terkait potensi serta kondisi terumbu karang di Desa Bondalem. Penelitian ini menggunakan metode deskriptif kuantitatif dengan teknik pengambilan data secara *purposive sampling*. Data yang diambil merupakan data primer yang meliputi pengamatan terumbu karang berdasarkan bentuk pertumbuhan (*lifeform*). Pengambilan data terumbu karang dilakukan dengan metode UPT (*Underwater Photo Transect*, Transek Foto Bawah Air). Hasil penelitian diperoleh terumbu karang pada stasiun pengamatan memiliki jumlah 18 lifeform. Presentase Tutupan Karang didapat pada kedalaman 3 meter memiliki tutupan karang berkisar antara 35,34%, sedangkan pada kedalaman 10 meter hasil tutupan karang ialah 26,30% (kategori sedang). Indeks keseragaman ekosistem terumbu karang berkisar 0,96 – 0,97 (tinggi). Indeks keanekaragaman ekosistem terumbu karang di Desa Bondalem berkisar 1,25 yang termasuk dalam kategori relatif sedang (1<H'<3). Indeks dominansi ekosistem terumbu karang di Desa Bondalem berkisar 0,064 – 0,066 (rendah).

Kata Kunci: *Coral Watch*, Ekosistem, Terumbu Karang, Bondalem

## INTRODUCTION

Coastal and marine areas have considerable biological resource potential, as they are supported by three main ecosystems: mangroves, seagrass beds, and coral reefs. These ecosystems not only provide habitat for various marine species, but also play an important role in protecting the coastline from erosion and storms. However, despite this great potential, coastal ecosystems are highly vulnerable to damage, whether caused by nature or human activities in land and marine waters. The existence of coral reefs and other coastal ecosystems is closely related to natural factors and human activities. Human activities such as unsustainable fishing, pollution, and development in coastal areas can put great pressure on these ecosystems. Natural factors such as storms, rising sea temperatures, and changes in ocean current patterns also affect the health of coral reefs (Mosriula *et al.*, 2018).

Bondalem Village has beautiful beaches with clear sea water and unspoiled coral reefs. This potential can be used to build the tourism sector such as resorts, homestays, and marine tourism activities such as snorkeling and diving (Sumerata *et al.*, 2017). However, little is known about the condition of coral reefs in Bondalem Village. The decline in the quality of coral reef ecosystems is a problem that often occurs, one of which is triggered by global climate change (Arjasakusuma *et al.*, 2020). An increase in water temperature will have an impact on coral bleaching, increase reef mortality, change community structure, reduce resistance, and reduce reef reproduction (Mutaqin *et al.*, 2018).

While threats to coral reefs can be minimized, conservation and sustainable management efforts are essential. In several coastal areas of Indonesia, including Bondalem Village, coral reef rehabilitation programs have begun to be implemented by involving local community participation. These efforts not only aim to restore the condition of damaged coral reefs, but also to increase community awareness of the importance of maintaining marine ecosystems. Education and training on the importance of maintaining water quality and reducing the negative impacts of human activities in coastal areas also need to be improved to ensure the sustainability of the coral reef ecosystem in Bondalem Village.

Previous research was conducted (Sinaga *et al.*, 2020), during the covid-19 pandemic



e-ISSN : 2622-1934, p-ISSN : 2302-6049

where the condition of coral reef health was still categorized as good because human activities such as tourism were not running. As an effort to maintain the existence of these ecosystems, it is necessary to monitor the ecosystem to find out how much potential is still available in the coastal area after the covid-19 pandemic. The purpose of this study is to determine and provide information related to the potential and condition of coral reefs in Bondalem Village after the co-19 pandemic. Based on the above background, the authors are interested in conducting research on the inventory of the potential and health of coral reef ecosystems after the covid-19 pandemic in Bondalem Village to find out how the condition of coral reefs after the pandemic with tourism activities that are starting to normalize.

## METHODS

### Place and Time

This research was conducted in July-August 2023 in the waters of Bondalem Village, Tejakula District, Buleleng, Bali with depths ranging from 3 meters to more than 10 meters.

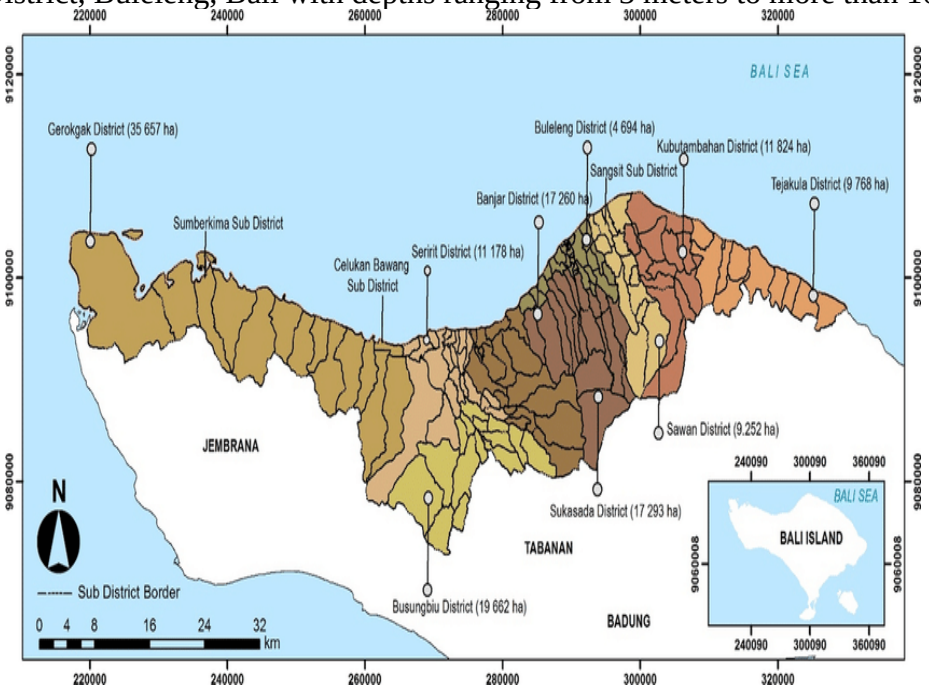


Figure 1. Research Location Map

### Tools and Materials

SCUBA diving equipment, GPS (Global Positioning System), Underwater Camera, Roll Meter, Frame size 50x50 cm, Speed Boat, Sabak, external Harddisk, coral reef.

### Research Design

This research uses quantitative and descriptive explorative methods. Quantitative research is a systematic scientific study of parts and phenomena and their relationships. Descriptive research studies problems in society, as well as procedures that apply in society and certain situations, including relationships, activities, attitudes, views and ongoing processes and the influence of a phenomenon (Hardani *et al.*, 2020; Purwanza *et al.*, 2022). The method used in this research is an exploratory survey method, with purposive sampling technique.

### Research Procedures

The initial determination of coral reef observation stations used a wide-scale observation method, such as manta tow or timed swim with the aim of seeing the diversity of coral reefs



e-ISSN : 2622-1934, p-ISSN : 2302-6049

that are still in the good or damaged category and represent the entire observation location at each survey location. Three observation stations were selected to ensure a more accurate representation of coral reef ecosystem conditions. Data collection of coral reef ecosystems in the field was carried out by diving using SCUBA diving equipment with the UPT (Underwater Photo Transect, Underwater Photo Transect) method (Giyanto *et al.*, 2017; Mosriula *et al.*, 2018). The technical implementation of the UPT method in the field is as follows:

- Draw and lay transect lines using a roll meter (scaled tape) along 50 meters at a depth where corals generally grow, namely at a depth of between 3-7 m and parallel to the coastline, starting from the starting point as the 0th meter.
- After the transect line was installed, data collection began by photographing underwater starting from the 1st meter, 2nd meter, and so on until the 50th meter on the transect line.

**Data Analysis**

The data taken is primary data that includes observations of coral reefs based on the form of growth (lifeform). Coral reef data were collected using the Line Transect method. This method is used to estimate the closure of live or dead corals. At each site a line transect (rollmeter) was stretched along 50 meters.

## RESULT

**General Condition of Coral Reef Ecosystem**

Coral reefs at the observation station have a total of 18 lifeforms. The results of coral growth forms obtained in this study show the value of massive corals and sand beds that are dominant in Bondalem waters. Dead coral can be found at a depth of 3 and 10 meters at the observation location of Bondalem Waters, but the percentage is very small.

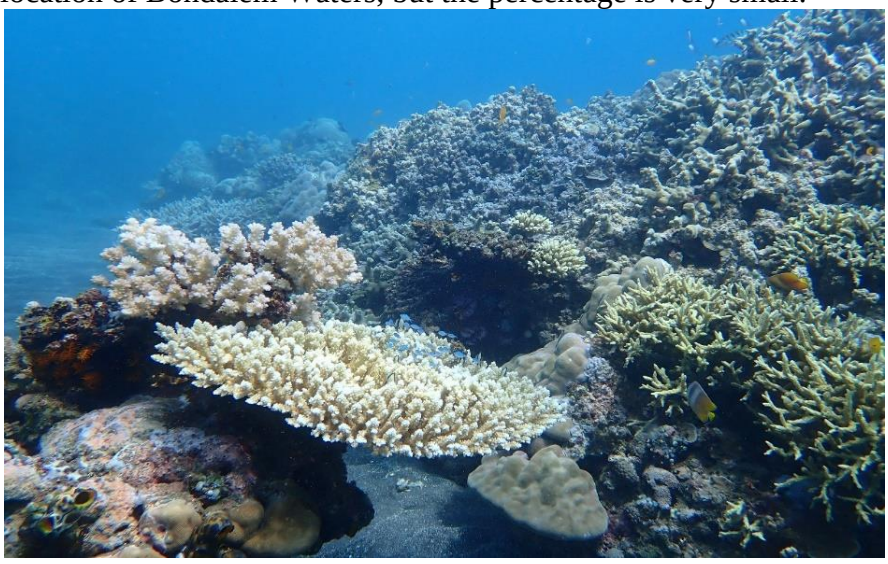

Figure 2. Coral Reef Ecosystem Condition in Bondalem Village

**Percentage Coral Cover**

The results obtained at a depth of 3 meters had coral cover ranging from 35.34%, while at a depth of 10 meters the result of coral cover was 26.30%. This shows that at shallower depths, coral cover tends to be better than at deeper depths. The average coral cover at the time of the study was still in the medium category. This indicates a greater potential threat to coral reefs at deeper depths, which may be caused by environmental factors or human activities. These data provide a serious warning of the pressures and challenges to the sustainability of coral reef ecosystems in the area.



e-ISSN : 2622-1934, p-ISSN : 2302-6049

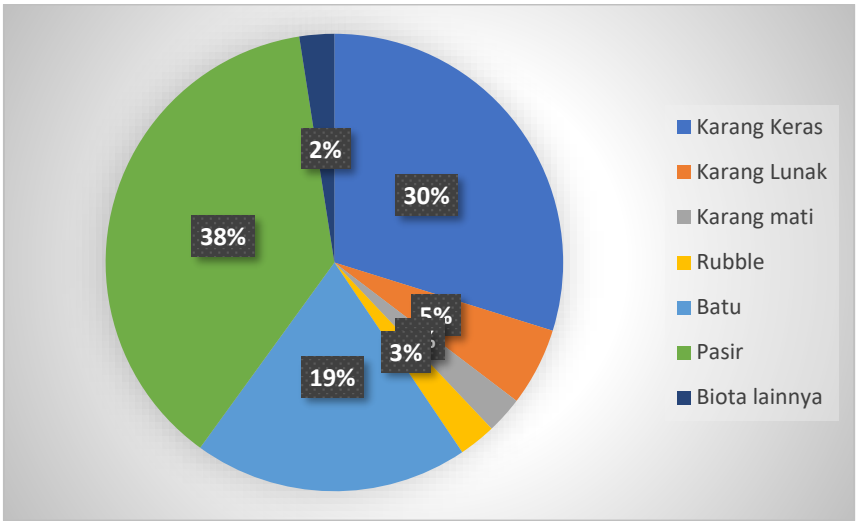


Figure 3. Percentage of Coral Reef Cover at 3 Meter Depth

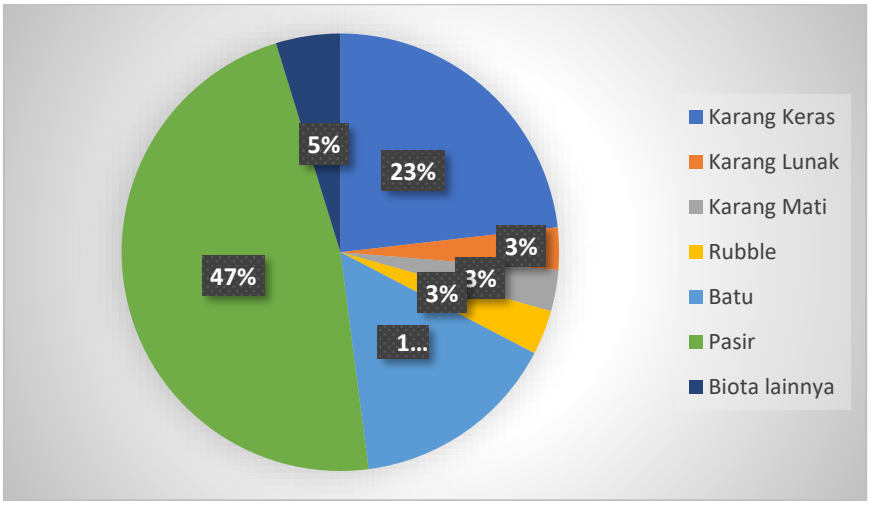


Figure 4. Percentage of Coral Reef Cover at 10 Meter Depth

**Uniformity Index**

The coral reef ecosystem uniformity index in Bondalem Village is an important indicator in measuring the health and sustainability of marine ecosystems in the region. The results showed that Bondalem Village has a coral reef ecosystem uniformity index ranging from 0.96 - 0.97. This figure indicates that not only are the coral reef species diverse, but also the distribution of each species within the community is quite even. These uniformity index results are relatively high, indicating good biodiversity in the coral reef community in the area. This diversity is key in maintaining ecosystem stability, given that high biodiversity is often associated with resilience to environmental change. The high uniformity index reflects the success of coral reef conservation and management efforts undertaken by the local government and community.



e-ISSN : 2622-1934, p-ISSN : 2302-6049

Figure 5. Research Implementation

**Diversity Index**

The results of research on the diversity index of coral reef ecosystems in Bondalem Village ranged from 1.25 which is included in the relatively moderate category (1<H'<3), illustrating a serious concern for the health of marine ecosystems in the area. Low coral reef ecosystem diversity can be caused by various factors such as climate change, destructive human activities, and other environmental pressures. The possible dominance of certain species in coral reef communities can lower the diversity index, meaning that some species may dominate while others may be present in lower numbers.

**Dominance Index**

The dominance index results of the coral reef ecosystem in Bondalem Village ranged from 0.064 - 0.066 which reflects a relatively low level of dominance in the coral reef community. Low numbers on the dominance index indicate that there are no species that dominate significantly above other species in the coral reef community.

## DISCUSSION

According to Nontji (2009), intact coral reefs have an aesthetic value that can rarely be matched by other ecosystems. Massive corals are a conservative group of corals that mostly live for tens to hundreds of years. English *et al.* (1997) classified coral growth into six categories, namely acropora, non-acropora, dead coral, abiotic, soft coral, and others. Dead coral can be found at a depth of 3 and 10 meters in the observation location of Bondalem Waters, but the percentage is very small. Coral damage is indicated due to fishing activities using fishing gear that is not environmentally friendly. This is evidenced by the discovery of coral fractures. Research by Smith *et al.* (2016) also showed that destructive fishing methods such as the use of dynamite and poisons can cause structural damage to coral reefs, which is often difficult to restore. Coral growth and distribution are heavily influenced by the characteristics of the marine environment, causing a linkage relationship between the marine environment reflected by oceanographic characteristics (Taofiqurohman *et al.*, 2021). In addition, changes in seawater temperature and acidity caused by global climate change also impact coral survival, which can accelerate the process of coral bleaching and death.

The percentage value of hard coral species (hardcoral) can add interest for divers in diving ecotourism activities (Darmansyah, 2010). The results of coral cover that is not too good



e-ISSN : 2622-1934, p-ISSN : 2302-6049

in the research location can open opportunities for coral reef rehabilitation activities to maintain the sustainability of the coral reef ecosystem in Bondalem Village and support marine tourism activities. This rehabilitation is very important considering the role of coral reefs as a habitat for various marine species which are the main attraction for divers. The existence of a less than optimal coral reef ecosystem in Bondalem Village is thought to be caused by the observation location which is often passed by fishing boats and the density of community activities. In addition, recent research by Suryanti *et al.* (2020) showed that increased sedimentation due to human activities in coastal areas is also one of the factors contributing to the decline in the quality of coral cover. According to the Decree of the Minister of Environment No. 4 of 2001, the condition of the percentage of coral cover at the observation station in Bondalem is included in the medium category. Rehabilitation efforts using coral transplantation methods such as those that have been successfully carried out in various other locations in Indonesia can be one solution to increase coral cover in this region (Widianingsih *et al.*, 2022).

Factors such as climate change, pollution, and uncontrolled human activities can be major causes of declining coral reef ecosystem cover, which in turn can negatively impact marine biodiversity and community livelihoods. The effect of sedimentation on coral reefs is that if the sedimentation rate is high, the coral reef cover will be lower (Faizal & Yuanita, 2017; Prasetyo *et al.*, 2018). Poor conditions in the percentage of coral reef ecosystem cover can trigger ecological imbalances and harm the local tourism and fisheries sectors. A lack of healthy habitat for marine life can reduce the attractiveness of underwater tourism destinations, which may impact the income and jobs generated by the tourism sector. In addition, declining coral reef ecosystem cover can also reduce the abundance of marine resources, affecting fishers' catches and local food security.

This good uniformity index has a positive impact on the tourism sector, as one of the main livelihoods in Bondalem Village. Healthy and diverse coral reefs attract tourists for snorkeling and diving activities, generating additional income for the local community. Coral reef-based ecotourism not only increases local economic income, but also encourages communities to be more active in conservation efforts (Wahyudi *et al.*, 2021). Thus, the results of research on the diversity index of coral reef ecosystems in Bondalem Village show that conservation efforts and sustainable management contribute positively to community welfare through key economic sectors in coastal areas. However, low diversity can reduce ecosystem resilience to environmental change and can result in significant losses in marine biodiversity. This decline in diversity is also associated with increasing human pressures, such as overfishing and pollution, which can exacerbate damage to marine ecosystems if not addressed (Sari *et al.*, 2023). Effective management strategies and active community participation are necessary to maintain the balance between utilization and conservation of coral reefs.

## CONCLUSION

The condition of coral reefs in Bondalem Village shows that although coral cover is not ideal, the range shows a relatively maintained condition, supporting biodiversity and the sustainability of marine ecosystems. However, coral reef conditions indicate that the ecosystem is still stable and balanced.

## ACKNOWLEDGEMENT

Thanks are due to Ganesha University of Education, especially the Faculty of Mathematics and Natural Sciences, as well as all those who have helped in the process of this research. This research has been funded by DIPA BLU UNDIKSHA.



e-ISSN : 2622-1934, p-ISSN : 2302-6049

## REFERENCES

Arjasakusuma S., Mutaqin B.W., Sekaranom A.B., Marfai M.A. (2020). Sensitivity of Remote Sensing-based Vegetation Proxies to Climate and Sea Surface Temperature Variabilities in Australia and Parts of Southeast Asia. *International Journal of Remote Sensing*. https://doi.org/10.1080/01431161.2020.1782509.

English, S., C. Wilkinson and V. Baker. (1997). Survey Manual For Tropical Marine Resources. – *Australia Marine Science Project Living Coastal Resources*. Australia, 390 pp.

Hardani., Helmina A., Jumari U., Evu F.U., Ria R.I., Roushandy A.F., Dhika J. S., Nur Himatul A. (2020). Metode Penelitian Kualitatif & Kuantitatif. *Pustaka Ilmu Group. Yogyakarta*. ISBN: 978-623-7066-33-0 (235-249).

Keputusan Menteri Negara Lingkungan Hidup. Nomor: 04 Tahun 2001 Tentang Kriteria Baku Kerusakan Terumbu Karang.

Mosriula, J., Muhammad, H. (2018). Inventarisasi Kerusakan Ekosistem Terumbu Karang Di Perairan Pulau Bungkutoko Kota Kendari Dan Pulau Barrang Lompo Kota Makassar. *Jurnal Akuakultur, Pesisir dan Pulau-Pulau Kecil*. 2(2): 67-75.

Mutaqin B.W., Lavigne F., Landa A., Ahyadi H., Hadmoko D.S., Hananto N., Handayani L., (2018). The Impact of AD 1257 Samalas Eruption to Coral Reef Ecosystems on the East of Lombok, Indonesia, *Asia Oceania Geosciences Society (AOGS) 15th Annual Meeting*, 3 – 8 June 2018, Honolulu, Hawaii

Mutaqin, B.W., Emy P.Y., Bagas. A., Isfi N.R., M Ilham., Shinta I.D., Sufia N.A, Novanda N.A. (2020). Kelimpahan Megabentos Sebagai Indikator Kesehatan Karang di Perairan Bilik, Taaman Nasional Baluran. *Jurnal Enggano*. September; 5(2): 181-194.

Nontji, A. (2006). Laut Nusantara. *Penerbit Djambatan*. Jakarta.

Prasetyo, A.B.T., Yuliadi, L.P.S., Astuty, S., & Prihadi, D.J. (2018). Keterkaitan Tipe Substrat Dan Laju Sedimentasi Dengan Kondisi Tutupan Terumbu Karang Di Perairan Pulau Panggang, Taman Nasional Kepulauan Seribu. *Perikanan Dan Kelautan*, 9(2): 1–7.

Purwanza S.W., Aditya W. Ainul M. dkk. (2022). Metodologi Penelitian Kuantitatif, Kualitatis dan Kombinasi. *Media Sains Indonesia*. Bandung.

Sari, D. A., Nugraha, R., & Yusuf, M. (2023). Human Pressures And Coral Reef Diversity: A Case Study Of The Impact On Marine Ecosystems In Indonesia. *Marine Biodiversity Records*, 16(1), 45-58.

Sinaga, E. C., I Wayan. R. dan Rani E. (2020). Kajian Kualitas Air, Potensi Karang dan Ikan Karang untuk Pengembangan Wisata Selam di Desa Bondalem, Buleleng, Bali. *Jurnal Current Trends in Aquatic Science*. 3(1): 39-46.

Smith, J. E., Shaw, M., Edwards, R. A., Obura, D., Pantos, O., Sala, E., Sandin, S. A. (2016). Indirect Effects Of Algae On Coral: Algae-Mediated, Microbe-Induced Coral Mortality. *Ecology Letters*, 9(8), 835–845.

Suharsono. (2008). Jenis –Jenis Karang Di Indonesia. Jakarta: Pusat Penelitian Oseanografi – LIPI.

Sumerata, W., Gendro K. Ati R.H. (2017). Potensi Sumberdaya Arkeologi Maritim di Pesisir Pantai Tejakula, Buleleng Bali. *Berkala Arkeologi Sangkhakala*. 20(1): 66-78.

Supriharyono. (2007). Pengelolaan Ekosisitem Terumbu Karang. *Penerbit Djambatan. Jakarta*.

Suryanti, A., Santoso, A., & Sukarno, S. (2020). Pengaruh Sedimentasi Terhadap Kondisi Tutupan Karang Di Kawasan Pesisir. *Jurnal Ilmu Kelautan dan Perikanan Indonesia*, 12(2), 127-135.

Taofiqurohman, A., Ibnu F., Kholid, A.R. (2021). Identifikasi Kondisi Kesehatan Ekosistem Terumbu Karang di Pulau Sepa, Kepulauan Seribu. *Buletin Oseanografi Marina, 10*(1): 23–32.



e-ISSN : 2622-1934, p-ISSN : 2302-6049

Wahyudi, M., Prasetyo, L. B., & Soewardi, K. (2021). The Impact Of Coral Reef-Based Ecotourism On Local Economy And Conservation Efforts: A Case Study In Eastern Indonesia. *Journal of Coastal Zone Management*, 24(1), 12-23.

Widianingsih, N. N., Suwarno, & Hermanto, B. (2022). Evaluasi Keberhasilan Transplantasi Karang Di Kawasan Pesisir Indonesia: Studi Kasus Di Bali Dan Lombok. *Jurnal Pengelolaan Sumber Daya Pesisir dan Laut*, 14(1), 45-58.



e-ISSN : 2622-1934, p-ISSN : 2302-6049