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OCCURRENCE STUDY OF BLACKTIP REEF SHARK (*Carcharhinus melanopterus*) IN THE WATERS OF GILI PETELU, EAST LOMBOK DISTRICT

STUDI KEMUNCULAN HIU KARANG SIRIP HITAM (*Carcharhinus melanopterus*) DI PERAIRAN GILI PETELU, KABUPATEN LOMBOK TIMUR

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ABSTRACT

Gili Petelu is one of the aggregation sites for marine species such as blacktip reef sharks. This study aims to determine the habitat characteristics of blacktip reef sharks in the waters of Gili Petelu, East Lombok Regency. This research was conducted from November to December 2023. Observations of blacktip reef sharks were carried out using two methods, namely UVC (underwater visual census) and accidental sampling. The UVC (underwater visual census) method was carried out by swimming on the east side of the island for approximately 170 m with a width of 10 m to the left and right. The use of the accidental sampling method is done to find out or observe the appearance of blacktip reef sharks that are outside the transect. Data collection of coral reef cover was carried out using the UPT (underwater photo transect) method, which was then analyzed using CPCe software. In addition, water conditions observed during the study were salinity, temperature, pH, and current speed. Based on the observation results, there were 87 encounters with the *Carcharhinus melanopterus* shark species in the water area. In the blacktip reef shark encounter area, it is known that there are locations dominated by soft coral, sand, coral breaks, and areas with hard coral. Based on water conditions, most shark individuals were found in water conditions with pH 8, current speed 0.27-0.35 m/s, salinity 30, and a temperature range of 28-29°C, with a total of 24 individuals found.

Keywords: blacktip reef shark, habitat, Petelu Island

ABSTRAK

Gili Petelu merupakan salah satu lokasi agregasi spesies laut seperti hiu karang sirip hitam. Penelitian ini bertujuan untuk mengetahui karakteristik habitat ikan hiu karang sirip hitam di perairan Gili Petelu, Kabupaten Lombok Timur. Penelitian ini dilaksanakan pada bulan November-Desember 2023. Pengamatan hiu karang sirip hitam dilakukan dengan dua metode yakni UVC (*underwater visual census*) dan *accidental sampling*. Metode UVC (*underwater visual census*) dilakukan dengan cara berenang pada sisi timur pulau sejauh kurang lebih 170 m dengan lebar pengamatn 10 m ke kiri dan ke kanan. Penggunaan metode *accidental sampling* dilakukan untuk mengetahui atau mengamati kemunculan hiu karang sirip hitam yang berada di luar transek. Pengambilan data tutupan terumbu karang dilakukan dengan metode UPT (*underwater photo transect*) yang kemudian dianalisis menggunakan *software* CPCe. Selain itu, kondisi perairan yang diamati selama penelitian yakni salinitas, suhu, pH, dan kecepatan arus. Berdasarkan hasil pengamatan menunjukkan bahwa sebanyak 87 kali perjumpaan dengan spesies hiu *Carcharhinus melanopterus* pada area perairan tersebut. Pada area perjumpaan hiu karang sirip hitam tersebut diketahui terdapat lokasi yang didominasi oleh *soft coral*, pasir, patahan karang, dan area yang terdapat karang keras. Berdasarkan kondisi perairan, paling banyak individu hiu tersebut ditemukan pada kondisi perairan dengan pH 8, kecepatan arus 0,27-0,35 m/s, salinitas 30 dan pada kisaran suhu 28-29°C dengan total individu yang ditemukan sebanyak 24.

Kata kunci: Gili Petelu, habitat, hiu karang sirip hitam

INTRODUCTION

Ecotourism is an activity or form of travel directed toward natural areas that remain undisturbed or unpolluted, intending to learn, admire, and enjoy the natural beauty of both flora and fauna. It also serves as a manifestation of local cultural heritage, encompassing both historical and contemporary elements (Ferdian *et al.* 2019). Marine ecotourism is a specific form of ecotourism that focuses on coastal and marine environments (Mulawanti *et al.* 2017). Marine ecotourism has the potential to become a sustainable tourism sector, particularly in marine areas, and is considered a profitable market as it emphasizes environmental conservation and promotes the interests of local communities (Faradilla 2022).

Gili Petelu is one of the uninhabited small islands located in East Lombok Regency. It has become a popular tourist destination frequently visited by both domestic and international travelers. The island's underwater beauty and natural charm serve as major attractions. Visitors can engage in snorkeling activities to observe the coral reefs and various species of reef fish. With some luck, tourists may even encounter blacktip reef sharks in the area. Additionally, a unique feature that can be experienced by visitors is the presence of a natural pathway connecting two small adjacent islands during low tide, which becomes submerged and inaccessible during high tide.

Intensive tourism activities in Gili Petelu, such as snorkeling and diving, can exert ecological pressure on coral reef ecosystems. Habitat degradation caused by environmentally unfriendly tourism practices may lead to a decline in habitat quality, which is crucial for the presence of blacktip reef sharks (*Carcharhinus melanopterus*). As apex predators, blacktip reef sharks play a vital role in maintaining the balance of coral reef ecosystems by regulating prey populations and preventing outbreaks that could damage marine habitats (Ferdiansyah and Hidayat 2016; Nicolas 2022). Numerous studies on blacktip reef sharks and other shark species have been conducted in various regions, including those by Arisandi *et al.* (2020), Amir *et al.* (2020), Hanifa *et al.* (2018), and Yudha *et al.* (2022). However, to date, no research has been carried out on this species in the waters of Gili Petelu. Therefore, research on the potential presence and habitat characteristics of blacktip reef sharks in Gili Petelu is essential, particularly to support conservation efforts and the sustainable management of marine ecotourism in the area.

METHODS

Time and location

This study was conducted from November to December 2023 in the waters of Gili Petelu, located in East Lombok Regency, as shown in Figure 1. Geographically, Gili Petelu is situated at -8.8550593 latitude and 116.5717666 longitude. Gili Petelu is one of the tourist destinations in East Lombok Regency. Visitors can access Gili Petelu by boat via Tanjung Luar. Tourist activities offered at this location include snorkeling, swimming, and feeding fish.

Tools and equipment

The tools and materials used in this study included basic diving equipment, a current meter, a camera, a quadrat, waterproof paper, a hand refractometer, a measuring tape, and a water quality tester. The research object in this study was the blacktip reef shark (*C. melanopterus*) observed in the waters of Gili Petelu.

This study employed a variety of instruments to support field data acquisition and analysis. Visual documentation of the aquatic ecosystem was conducted through underwater imaging using a Canon underwater camera. Water quality parameters were measured using a digital water quality tester, which provides an accuracy of ±0.01 for pH and ±0.5°C for temperature. Salinity measurements were carried out using an ATC-brand hand refractometer with an accuracy of up to 0.001 sg (1‰). Meanwhile, water current velocity was measured using a Flowatch FL-03 current meter, with an accuracy level of ±2%.

Shark observations

Observations of blacktip reef shark (*C. melanopterus*) occurrences were conducted using two methods: Underwater visual census (UVC) and accidental sampling. The UVC method was performed by surface snorkeling, as the waters of Gili Petelu are relatively shallow (average depth

of 1-4 meters) and have sufficient visibility to allow for direct visual observation (Yuneni *et al.* 2017; Hariharan *et al.* 2013). The UVC transect covered a distance of approximately 170 meters, with an observation width of 10 meters to the left and right of the swimming path (Figure 2).

The accidental sampling method was employed to detect the presence of blacktip reef sharks (*C. melanopterus*) observed outside the UVC transect lines. This method was selected due to the species' highly mobile nature and tendency to move frequently between locations (Postaire *et al.* 2020). Therefore, accidental sampling was useful for recording individuals that were incidentally sighted outside the designated transect areas (Hariharan *et al.* 2013).

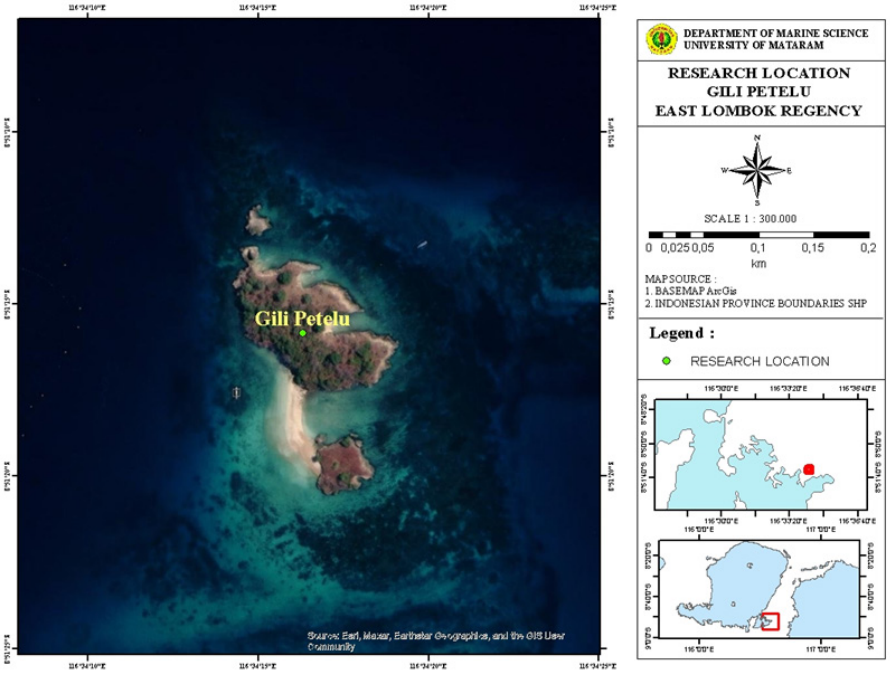

Figure 1. Research location in the waters of Gili Petelu, East Lombok Regency.

Figure 2. Observation of reef sharks in the waters of Gili Petelu was conducted using the UVC method (a modification of Yuneni *et al.* 2017).

Observations were conducted eight times at weekly intervals during November and December 2023, which represent the transitional period between the dry and rainy seasons. During this period, sea conditions were relatively calm and safe for snorkeling activities. The selection of this period was based on seasonal considerations and preliminary surveys conducted with local fishermen, who reported that blacktip reef sharks (*C. melanopterus*) are more frequently observed in the waters of Gili Petelu during these months. Observations were carried out between 08:00 and 11:00 Central Indonesia Time (WITA) at an average depth of 1-4 meters. Each observation was conducted at the same time each week to ensure consistency in the shark sighting data.

Coral reef condition observation

Observation of coral reef condition was conducted using the underwater photo transect (UPT) method by capturing photographs of the coral reef using a camera. The resulting images were then analyzed using the CPCe (coral point count with Excel extension) software (Giyanto *et al*. 2014). This method involved laying out a 50-meter transect line using a measuring tape. A 58×44 cm photo quadrat frame was placed along the 50-meter transect line at 1-meter intervals in a zigzag pattern (Cahyo 2017).

Observation of coral reef substrate conditions was conducted at three different points, as shown in Figure 3. These observations were based on the locations where individual blacktip reef sharks (*C. melanopterus*) were sighted. The assessment of coral reef conditions aimed to identify the habitat characteristics at the sites where blacktip reef sharks appeared in the waters of Gili Petelu, East Lombok Regency.

Water quality measurement

Measurement of water quality parameters was conducted in the waters of Gili Petelu and at the locations where individual blacktip reef sharks were sighted. The measured parameters included temperature, pH, salinity, and current velocity (Figure 3).

Data analysis

Data tabulation was carried out using Microsoft Excel to compile records of shark sightings and present them in the form of graphs or diagrams. ArcGIS 10.8 software was used to visualize the locations where individual sharks were observed and to illustrate the distribution of benthic habitats in the waters of Gili Petelu. CPCe software was used to identify the coral reef substrates found in the vicinity of the sharks to assess the habitat characteristics associated with blacktip reef shark (*C. melanopterus*) sightings. The results were then presented in chart form using Microsoft Excel.

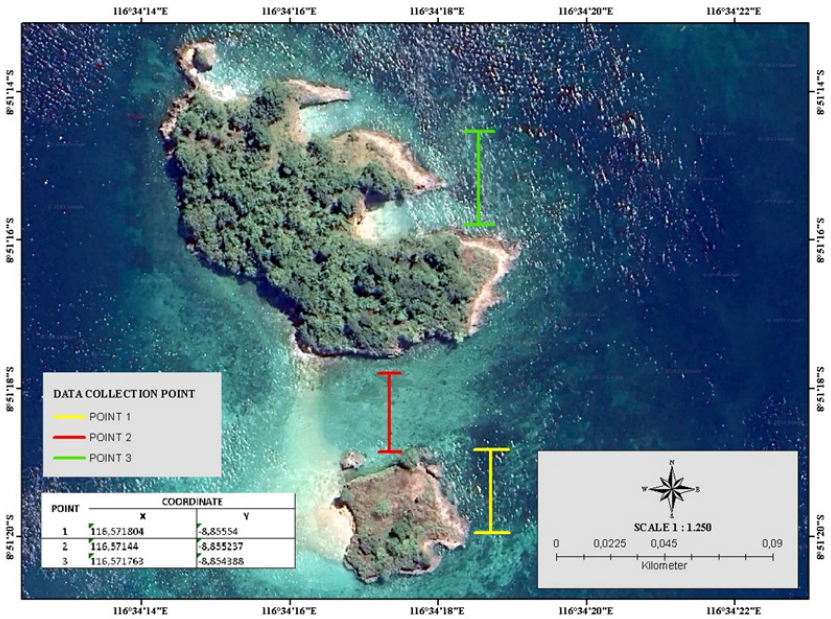

Figure 3. Observation transects of habitat characteristics at blacktip reef shark (*Carcharhinus melanopterus*) sighting locations during November–December 2023.

RESULTS AND DISCUSSION

An abundance of blacktip reef shark (*C. melanopterus*) sightings

Based on the observations conducted in the waters of Gili Petelu, the reef shark species recorded at the site was the blacktip reef shark (*C. melanopterus*). The presence of blacktip reef sharks in this area is likely due to its function as a habitat used for spawning, foraging, and possibly as a year-round residence (Heupel *et al.* 2019).

A total of 87 blacktip reef shark (*C. melanopterus*) sightings were recorded throughout the observation period. The highest number of sightings occurred during the sixth observation, with 24 individuals, while the lowest was recorded during the third observation, with only 2 individuals, as shown in Figure 4. The variation in the number of sightings is presumed to be influenced by tourism activities, primarily snorkeling and recreational swimming, that commonly take place in the shark sighting areas.

The blacktip reef shark (*C. melanopterus*) individuals observed exhibited avoidance behavior by swimming away when approached. This behavior is presumed to result from the sharks' feeling threatened or disturbed by tourist activities occurring in the area. This finding is consistent with Heupel *et al.* (2019), who stated that blacktip reef sharks are sensitive to environmental changes and disturbances. As a species that relies on coral reefs as its natural habitat, blacktip reef sharks are particularly vulnerable to disruption and exploitation (Heupel *et al.* 2019; Chin *et al.* 2012). The pattern of habitat use by blacktip reef sharks indicates a strong dependence on coral reef ecosystems. Excessive use of these habitats, such as by failing to regulate visitor numbers, may pose broader ecological risks, including coral reef degradation due to irresponsible tourist behavior.

Habitat characteristics of blacktip reef shark (*C. melanopterus*) sightings

The habitat of blacktip reef sharks is predominantly associated with reef environments, where nearly 85% of their life cycle takes place. These activities include reproduction, foraging, and spawning, all of which occur in areas with coral reef presence (Alaydrus *et al.* 2014). Consistent with the findings of Admaja *et al.* (2022), the presence of blacktip reef sharks can serve as an indicator that coral reefs are critical habitats for shark aggregation.

Based on observations conducted in the waters of Gili Petelu regarding the habitat of blacktip reef shark (*C. melanopterus*) sightings, Transect 1, shown in Figure 5, was characterized by a gently sloping environment with relatively low coral cover. The percentage of live coral cover in this transect was only 2.14%, and it was predominantly dominated by soft corals, which accounted for 40.95%.

Transect 2 is located in an environment that is relatively close to the shoreline and features a gently sloping substrate. During the observation period, blacktip reef sharks (*C. melanopterus*) in the waters of Gili Petelu were observed swimming near the coast or within the intertidal zone. Coral reef cover assessment was conducted at this transect; however, the area was found to be dominated by sand (50%) and coral rubble (33%). Transect 3 was characterized by a live coral cover of 26% and was dominated by sandy substrate at 27%. This transect was found to have better live coral conditions compared to Transects 1 and 2 (Figure 5).

Water quality during observation

In this study, water temperature ranged between 28°C and 33°C (Table 1). According to Table 1, the highest number of blacktip reef shark (*C. melanopterus*) sightings occurred during the sixth observation, with 24 individuals recorded at a temperature range of 28-29°C. This finding is consistent with the study conducted by Sentosa *et al.* (2020) in the waters of Makassar, which reported that members of the family Carcharhinidae are typically observed at depths of 0-22 meters within a temperature range of 24-30°C, with optimal occurrences between 28 and 29°C. This pattern may be attributed to the ectothermic nature of sharks, meaning they are unable to internally regulate their body temperature. Several studies have indicated that temperature is one of the key factors influencing shark distribution and movement (Sentosa *et al.* 2020).

The blacktip reef shark (*C. melanopterus*) is considered both a pelagic and demersal species, and is classified as euryhaline, meaning it has a high tolerance for varying salinity levels. This allows the species to inhabit not only marine

environments, which serve as its primary habitat, but also brackish waters (Sentosa *et al.* 2020). In the study conducted in Gili Petelu, salinity levels ranged between 30 and 35 ppt. The highest number of blacktip reef shark sightings occurred at a salinity level of 30 ppt, with 24, 19, and 9 individuals recorded, although only 2 individuals were observed during the third observation at the same salinity level (Table 1). Despite this, Harvianto *et al.* (2015) reported that seawater salinity generally ranges from 30 to 35 ppt, and that different marine species have varying levels of salinity tolerance. Therefore, specific salinity concentrations can influence the dominance of certain species in a given area. Additionally, it is suspected that during the third observation, the sharks may have already felt disturbed, as large numbers of tourists were previously seen swimming near the shark aggregation zone. Throughout the study, it was observed that blacktip reef sharks in Gili Petelu were still highly sensitive to tourist activity.

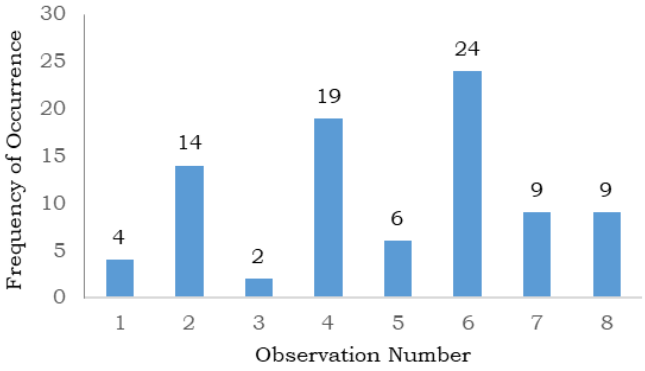

Figure 4. Number of blacktip reef shark (*Carcharhinus melanopterus*) sightings in November-December 2023.

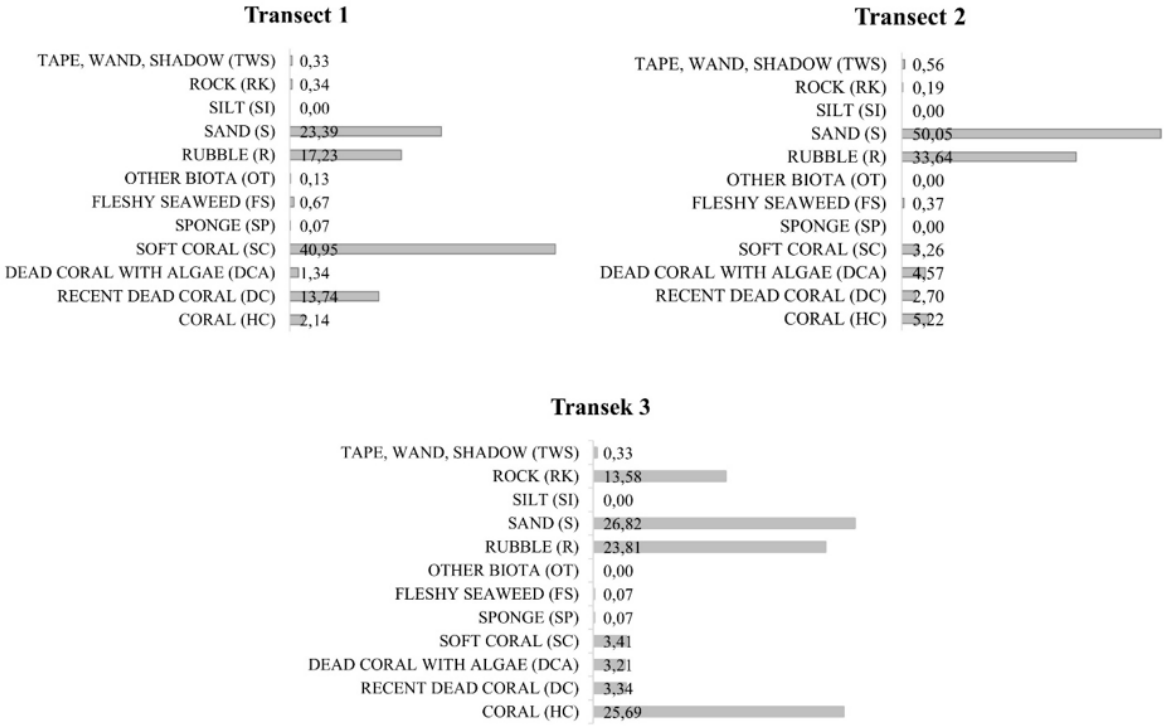

Figure 5. Coral reef cover at Transects 1, 2, and 3 during November-December 2023.

Table 1. Water quality in Gili Petelu during November–December 2023.

No	Number of Sightings	Water Quality			
		pH	Current Velocity (m/s)	Salinity (ppt)	Temperature (°C)
1	4	8.7	0.44	34	32
2	14	8.8	0.36	35	28
3	2	7.8	0.11	30	33
4	19	7.8	0.02-0.08	30	29-29.4
5	6	7.7-7.9	0.22-0.36	34-35	30-31
6	24	8	0.27-0.35	30	28-29
7	9	7.7-7.8	0.11-0.27	30-33	31-34
8	9	7.8	0.02	30	32

The occurrence of blacktip reef sharks (*C. melanopterus*) was also observed to be related to current conditions during the study period. Current velocity was classified into four categories according to Tambunan *et al.* (2013) in Chasanah *et al.* (2017): slow current (0-0.25 m/s), moderate current (0.25-0.50 m/s), fast current (0.50-1 m/s), and very fast current (>1 m/s). During the observations, only two current conditions were identified: slow and moderate. The highest number of shark sightings occurred under moderate current conditions, with velocities ranging from 0.27 to 0.35 m/s, totaling 46 individuals. Under slow current conditions (0.11 m/s), 41 individuals were observed (Table 1). These results align with findings by Sentosa *et al.* (2020), which reported that blacktip reef shark sightings were more likely to occur during moderate current conditions, with 62 individuals observed under such conditions and none during periods of no current. Similarly, Vianna *et al.* (2014) noted a positive correlation between current velocity and shark abundance in marine environments.

The next parameter observed was the water pH at the time of blacktip reef shark (*C. melanopterus*) sightings. pH represents the concentration of hydrogen ions in a solution and is commonly used to indicate the degree of acidity or alkalinity (Wibawa and Lutfi 2017). Seawater is generally alkaline, with a typical pH around 8.0; however, marine organisms are relatively capable of adapting to a wide pH range (Udi *et al.* 2011 in Patty and Akbar 2018). During the observation period, the pH values recorded in association with shark sightings ranged from 7.7 to 8.8, indicating alkaline conditions. The highest number of sightings (24 individuals) occurred at pH 8.0, while the lowest (2 individuals) was recorded at pH 7.8 (Table 1). According to Sentosa *et al.* (2020), shark sightings occurred at a pH range of 8.1-8.5, which differs slightly from the values recorded in this study. Nonetheless, the ideal pH range for aquatic organisms is generally considered to be between 7.0 and 8.5 (Sentosa *et al.* 2020). Notably, 14 individuals were also observed at a higher pH of 8.8, suggesting that blacktip reef sharks may still tolerate slightly elevated pH levels for survival in the waters of Gili Petelu.

Distribution of blacktip reef shark sightings in the waters of Gili Petelu

Observations of blacktip reef sharks (*C. melanopterus*) were conducted along the eastern side of the island, which directly faces open waters. No observations were carried out on the western side of the island due to the absence of reported shark sightings in that area. Furthermore, pearl farming activities (pearl net cages) were present on the western side. During the field observations, the blacktip reef sharks in Gili Petelu exhibited avoidance behavior toward humans. These sharks could not be observed for extended periods, as they would immediately swim away upon detecting human presence.

According to Mourier *et al.* (2013), habitat selection by an individual is one of the key processes influencing population distribution and abundance, and consequently affects the potential availability of a marine species for exploitation. The blacktip reef shark (*C. melanopterus*) is a species commonly found in Indo-Pacific coral reef areas (Mourier *et al.* 2013). This species typically inhabits shallow coral reefs and sandy flats in atoll environments.

However, some reef shark species have also been recorded in non-reef habitats. Blacktip reef sharks are often observed in small groups, particularly when foraging, although they are not considered to be a schooling species (Mourier *et al.* 2013). In the present study conducted in the waters of Gili Petelu, blacktip reef sharks were only observed swimming around coral reefs, soft corals, and sandy areas. They exhibited avoidance behavior whenever they became aware of nearby human activity.

The distribution of blacktip reef sharks (*C. melanopterus*) in the waters of Gili Petelu during November-December 2023 is presented in Figure 6. Shark sightings were observed in areas characterized by the presence of soft corals, sandy substrates, and coral reef coverage. These environmental conditions are consistent with the findings of Sentosa *et al.* (2020), where several sites were dominated by soft corals, sand, and coral reefs. However, at Galo-galo Point, an area dominated by soft corals, no blacktip reef sharks were observed in their study. In contrast, the present study in Gili Petelu recorded sightings of blacktip reef sharks swimming in areas dominated by soft corals. This suggests that the species may be able to adapt to environments with soft coral coverage, although observations indicated that the sharks were merely swimming through these areas without specific behavioral interactions. Additionally, blacktip reef shark individuals were also observed in areas dominated by sand and coral rubble, particularly near shallow coastal zones. This finding aligns with Sentosa *et al.* (2020), who reported the highest number of shark sightings at one of their stations that was dominated by sandy substrate. Therefore, it is suggested in this study that blacktip reef sharks are still likely to appear in sandy habitats.

Another sighting of blacktip reef sharks (*C. melanopterus*) was recorded in the northern area of the island. This area was found to have a coral reef cover of approximately 26%. This finding is consistent with the study by Sentosa *et al.* (2020), which reported that one of their observation stations had a coral cover of 29%, categorized as moderate, and was still dominated by soft corals (26%). Despite this, the station in their study exhibited a higher frequency of blacktip reef shark sightings compared to the other stations.

Throughout the observation period, the distribution of blacktip reef sharks (*C. melanopterus*) was also presumed to be influenced by environmental conditions. The highest number of sightings occurred at temperatures ranging from 28-29°C, with a salinity of 30 ppt, current velocities between 0.27-0.35 m/s, and a pH of 8. These findings are consistent with those of Sentosa *et al.* (2020), who reported that the optimal temperature for blacktip reef shark sightings ranged from 28-29°C, under moderate current conditions, and that the ideal pH range for aquatic organisms lies between 7-8.5.

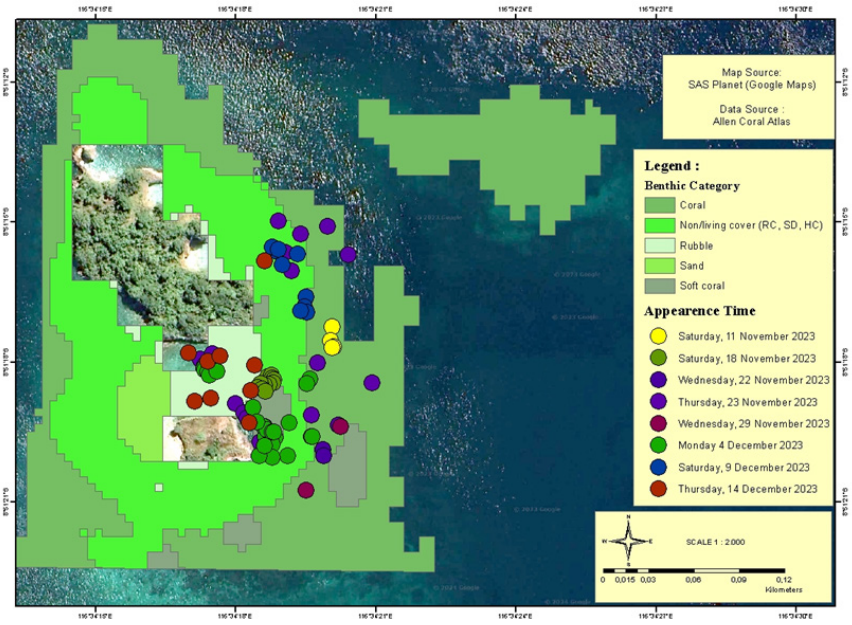

Figure 6. Distribution of blacktip reef sharks (*Carcharhinus melanopterus*) in the waters of Gili Petelu during November-December 2023.

CONCLUSION

Blacktip reef sharks (*C. melanopterus*) in the waters of Gili Petelu were found in locations characterized by coral reef areas, soft corals, and shallow coastal zones dominated by sandy substrates and coral rubble. The environmental conditions at the time of the sightings included a pH of 8, current velocity ranging from 0.27 to 0.35 m/s (classified as moderate), salinity of 30 ppt, and temperature between 28-29°C. Under these conditions, a total of 24 individuals were recorded. In addition to water quality parameters, it is also suspected that the presence of blacktip reef sharks is influenced by tourism activities occurring in the area.

REFERENCES

Admaja AK, Sumolong K, Yuneni RR, Iqbal M, Musrianton M, Muniawati M. 2022. Identifikasi Habitat Ideal Hiu Karang Sirip Hitam (*Carcharhinus melanopterus*) di Kabupaten Wakatobi. Simposium Hiu dan Pari di Indonesia ke-3. 193-203.

Alaydrus IS, Fitriana N, Jamu Y. 2014. Jenis dan Status Konservasi Ikan Hiu yang Tertangkap di Tempat Pelelangan Ikan (TPI) Labuan Bajo, Manggarai Barat, Flores. *Al-Kauniyah Jurnal Biologi*. 7(2): 83-88.

Amir F, Mallawa A, Tresnati J. 2020. Size, Structure, and Sex Ratio of Black Tip Reef Shark (*Carcharhinus melanopterus*) Landed in the TPI Paotere of Makassar City and TPI Beba of Takalar Regency, Province South Sulawesi. *Agrikan: Jurnal Agribisnis Perikanan*. 13(2): 232-237. DOI: https://doi.org/10.29239/j.agrikan.13.2.232-237.

Arisandi A, Arsana IN, Sudaryati NLG. 2020. Komposisi Ukuran dan Jenis Kelamin Ikan Hiu Karang Sirip Hitam (*Carcharhinus melanopterus*) Komoditas Ekspor Bali. *Jurnal Widya Biologi*. 11(1): 52-59. DOI: https://doi.org/10.32795/widyabiologi.v11i01.570.

Cahyo FD. 2017. Kondisi Terumbu Karang di Perairan Teluk Lada, Kabupaten Pandeglang, Provinsi Banten. *Prosiding Seminar Nasional Ekosistem Perairan Teluk Lada dan Pulau Tunda, LPSPL Serang*. 23-32.

Chasanah I, Purnomo PW, Haeruddin H. 2017. Analisis Kesesuaian Wisata Pantai Jodo Desa Sidorejo Kecamatan Gringsing Kabupaten Batang. *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan*. 7(3): 235-243. DOI: https://doi.org/10.29244/jpsl.7.3.235-243.

Chin A, Tobin A, Simpfendorfer C, Heupel M. 2012. Reef Sharks and Inshore Habitats: Patterns of Occurrence and Implications for Vulnerability. *Marine Ecology Progress Series*. 460: 115-125. DOI: https://doi.org/10.3354/meps09722.

Faradilla A. 2022. Pengembangan Ekowisata Bahari di Kepulauan Riau. *Jurnal Sains Sosial dan Humaniora (JSSH)*. 2(2): 12-15. DOI: https://doi.org/10.52046/jssh.v2i2.1322.

Ferdian KJ, DM IAI, Tondo S. 2019. Dampak Ekowisata Bahari dalam Perspektif Kesejahteraan Masyarakat dan Kelestarian Lingkungan Pesisir. *JIPAGS (Journal of Indonesian Public Administration and Governance Studies)*. 3(1): 481-499. DOI: http://dx.doi.org/10.31506/jipags.v3i1.5480.

Ferdiansyah D, Hidayat MT. 2016. Ancaman Perikanan Skala Kecil terhadap Hiu di Sumenep untuk Kebutuhan Pengelolaan yang Efektif dan Berkelanjutan. *Jurnal Agrosains: Karya Kreatif dan Inovatif*. 3(1): 224-233.

Giyanto, Manuputty AE, Abrar M, Siringoringo RM, Suharti SR, Wibowo K, Zulfianita D. 2014. *Panduan Monitoring Kesehatan Terumbu Karang*. Jakarta (ID): COREMAP CTI LIPI.

Hanifa I, Baskoro MS, Martasuganda S, Simbolon D. 2018. Tingkat Pemanfaatan dan Status Konservasi Perikanan Hiu di Pelabuhan Perikanan Samudera (PPS) Cilacap. *Jurnal Teknologi Perikanan dan Kelautan*. 9(1): 25-34. DOI: https://doi.org/10.24319/jtpk.9.25-34.

Hariharan A, Gallucci V, Heberer C. 2013. Estimation of Relative Efficiency of Adaptive Cluster vs Traditional Sampling Designs Applied to Arrival of Sharks. *arXiv:1304.2460*. 1-24. DOI: https://doi.org/10.48550/arXiv.1304.2460.

Harvianto L, Parenkuan M, Koropitan AF, Agustiadi T. 2015. Analisis

Diagram T-S Berdasarkan Parameter Oseanografi di Perairan Selat Lombok. *Surya Octagon Interdisciplinary Journal of Technology*. 1(1): 103-119.

Heupel MR, Papastamatiou YP, Espinoza M, Green ME, Simpfendorfer CA. 2019. Reef Shark Science – Key Questions and Future Directions. *Frontiers in Marine Science*. 6: 1-14. DOI: https://doi.org/10.3389/fmars.2019.00012.

Mourier J, Mills SC, Planes S. 2013. Population Structure, Spatial Distribution and Life-History Traits of Blacktip Reef Sharks (*Carcharhinus melanopterus*). *Journal of Fish Biology*. 82(3): 979-993. DOI: https://doi.org/10.1111/jfb.12039.

Mulawanti TS, Nasution S, Elizal E. 2017. The Development Strategy in Marine Eco-Tourism of Nongsa Beach Batam City in Riau Islands Province [Dissertation]. Pekanbaru (ID): Universitas Riau.

Nicolas A. 2022. Sharks are Key to The Health of Our Oceans and Climate. https://www.worldwildlife.org/stories/sharks-are-key-to-the-health-of-our-oceans-and-climate. [30 Juni 2025].

Patty SI, Akbar N. 2018. Kondisi Suhu, Salinitas, pH dan Oksigen Terlarut di Perairan Terumbu Karang Ternate, Tidore, dan Sekitarnya. *Jurnal Ilmu Kelautan Kepulauan*. 1(2): 1-10. DOI: https://doi.org/10.33387/jikk.v1i2.891.

Postaire BD, Bakker J, Gardiner J, Wiley TR, Chapman DD. 2020. Environmental DNA Detection Tracks Established Seasonal Occurrence of Blacktip Sharks (*Carcharhinus limbatus*) in a Semi-enclosed Subtropical Bay. *Scientific Reports*. 10(1): 11847. DOI: https://doi.org/10.1038/s41598-020-68843-0.

Sentosa WB, Nurruhwati I, Apriliani IM, Khan A. 2020. Distribution of Blacktip Reef Sharks (*Carcharhinus melanopterus*) Based on Habitat Characteristics by the Baited Remote Underwater Video (BRUV) Method in Morotai Waters of North Maluku. *Asian Journal of Fisheries and Aquatic Research*. 7(3): 34-50. DOI: https://doi.org/10.9734/ajfar/2020/v7i330121.

Vianna GM, Meekan MG, Bornovski TH, Meeuwig JJ. 2014. Acoustic Telemetry Validates A Citizen Science Approach for Monitoring Sharks on Coral Reefs. *PloS One*. 9(4): 1-12. DOI: https://doi.org/10.1371/journal.pone.0095565.

Wibawa IGNA, Luthfi OM. 2017. Kualitas Air pada Ekosistem Terumbu Karang di Selat Sempu, Sendang Biru, Malang. *Jurnal Segara*. 13(1): 25-35. DOI: http://dx.doi.org/10.15578/segara.v13i1.6420.

Yudha IG, Salsabilla FR, Sulistiono S, Caesario R. 2022. Status Konservasi dan Pertumbuhan Ikan Hiu dan Pari yang Didaratkan di Labuhan Maringgai, Lampung Timur. *Jurnal Teknologi Perikanan dan Kelautan*. 13(1): 25-35. DOI: https://doi.org/10.24319/jtpk.13.25-35.

Yuneni RR, Tania C, Ariyogagutama D, Estradivari A, Sumolang K. 2017. *Protokol Survei Pemantauan Spesies Hiu dan Pari Bawah Laut pada Konservasi Perairan (Dalam Mendukung Upaya Pengelolaan Hiu dan Pari yang Berkelanjutan)*. Jakarta (ID): WWF-Indonesia.