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STATUS OF CORAL FISH STOCK IN THE MARINE CONSERVATION AREA OF GILI SULAT AND GILI LAWANG, EAST LOMBOK REGENCY

Kondisi Stok Ikan Karang di Kawasan Konservasi Perairan Gili Sulat dan Gili Lawang, Kabupaten Lombok Timur

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ABSTRACT

The Gili Sulat and Gili Lawang Marine Recreation Park (TWP) has a significant diversity of reef fish, but fishing activities threaten its stock. This research aims to estimate the stock condition of reef fish using a length-based stock assessment approach and Spawning Potential Ratio (SPR) analysis. Data were collected from two fish landing sites throughout 2023, covering fish species, catch results, and fish length data. A CPUE (Catch Per Unit Effort) analysis was conducted to assess fishing efforts and catches, while SPR was used to evaluate the stock condition of the fish. The research results show that 151 species of reef fish were caught, with three dominant species: Naso thynnoides (35%), Acanthurus mata (33%), and Caesio caerulaurea (32%). The SPR values of these three species were above 30%, indicating relatively healthy stocks (Naso thynnoides 58%, Acanthurus mata 43%, Caesio caerulaurea 34%). However, the exploitation rate of Acanthurus mata indicates that this species is fully exploited (E=0.578), requiring strict management to prevent overfishing. In conclusion, most reef fish stocks are in good condition, but Acanthurus mata requires special attention. Fishing control and regular monitoring are recommended to maintain the sustainability of reef fish stocks in TWP Gili Sulat and Gili Lawang.

Keywords: CPUE; Fish stock condition; SPR; TWP Gili Sulat Gili Lawang

ABSTRAK

Taman Wisata Perairan (TWP) Gili Sulat dan Gili Lawang memiliki keanekaragaman hayati ikan karang yang signifikan, namun aktivitas penangkapan ikan mengancam stoknya. Penelitian ini bertujuan untuk mengestimasi kondisi stok ikan karang dengan pendekatan *length-based stock assessment* dan analisis *Spawning Potential Ratio* (SPR). Data

dikumpulkan dari dua lokasi pendaratan ikan sepanjang tahun 2023, meliputi jenis ikan, hasil tangkapan, dan data panjang ikan. Analisis CPUE dilakukan untuk menilai upaya penangkapan dan hasil tangkapan, serta SPR digunakan untuk menilai kondisi stok ikan. Hasil penelitian menunjukkan bahwa 151 spesies ikan karang tertangkap, dengan tiga spesies dominan: *Naso thynnoides* (35%), *Acanthurus mata* (33%), dan *Caesio caerulaurea* (32%). Nilai SPR ketiga spesies tersebut berada di atas 30%, menandakan stok yang relatif sehat (*Naso thynnoides* 58%, *Acanthurus mata* 43%, *Caesio caerulaurea* 34%). Namun, tingkat eksploitasi *Acanthurus mata* menunjukkan bahwa spesies ini sudah pada tingkat *fully exploited* (E=0,578), memerlukan pengelolaan ketat untuk mencegah overfishing. Kesimpulannya, sebagian besar stok ikan karang berada dalam kondisi baik, namun *Acanthurus mata* membutuhkan perhatian khusus. Pengendalian penangkapan dan pemantauan rutin disarankan untuk menjaga kelestarian stok ikan karang di TWP Gili Sulat dan Gili Lawang.

Kata Kunci: CPUE; Kondisi stok ikan; SPR; TWP Gili Sulat Gili Lawang

INTRODUCTION

The existence of coral reef potential in the Gili Sulat and Gili Lawang Marine Tourism Parks is one of the factors that influences the potential of fish resources in the area. TWP Gili Sulat and Gili Lawang have the potential for coral fish resources with a diversity of 419 species, an average abundance of coral fish of 20,577 individuals/Ha, and a coral fish biomass of 182.53 Kg/Ha (FIP2B-NTB, 2021). The potential for coral fish resources in TWP Gili Sulat and Gili Lawang is widely utilized by fishermen around the area, especially in the sustainable fisheries utilization zone. However, this activity is indicated to have caused a decrease in the abundance and biomass of coral fish in TWP Gili Sulat and Gili Lawang, moreover, there are still fishermen who carry out fishing in an environmentally unfriendly manner. Based on monitoring of coral fish resources in the Gili Sulat and Gili Lawang TWP areas in 2013, 2018, and 2021, it is known that there has been a decline in the abundance and biomass of coral fish in the area (FIP2B-NTB, 2021). This is worrying for the availability of coral fish resources. Therefore, to ensure the current availability of coral fish resources in the Gili Sulat and Gili Lawang TWP areas, it is necessary to conduct research on the condition of coral fish stocks in the area.

The problem-solving approach in this study is to determine the condition of coral fish stocks in the Gili Sulat and Gili Lawang. Fish stock estimation is carried out using a length-based stock assessment approach, because it is very possible to do it in the Gili Sulat and Gili Lawang with existing limitations. Through this approach, the number of coral fish stocks in the Gili Sulat and Gili Lawang will be known, which can be used as an indicator to determine the effectiveness of regional water conservation area management and can be used to determine coral fish resource management strategies. Optimally managed regional marine conservation areas can answer their role as a source of food security.

Research on estimating fish stocks in the Gili Sulat and Gili Lawang has never been conducted before. Until now, research that has been conducted in the Gili Sulat and Gili Lawang has only studied the potential of coral reef ecosystems (Adiyoga *et al*., 2020), the suitability of conservation zones (Akhyar & Prasetyo, 2022), general capture fisheries activities (Damayanti *et al*., 2022), and fluctuations in coral fish using the census method (Hilyana *et al*., 2020). These previous studies generally focused on studying the ecosystems in the Gili Sulat and Gili Lawang, such as mangrove, seagrass, and coral reef ecosystems along with a few coastal biota in them. Studies on the influence of capture fisheries activities on marine

environmental pressures have never been conducted, while to determine the effectiveness of conservation area management, it is necessary to look at both aspects so that they can be used as a reference in policy making by the area management agency. Therefore, it is necessary to conduct research on the condition of coral fish stocks in the Gili Sulat and Gili Lawang.

METHODS

Data collection in this study was conducted at 2 fish landing locations around the Gili Sulat and Gili Lawang. The data collected were primary and secondary data. Primary data were collected directly at the research location using sampling techniques. The data collected were data on fishing units, fishing operations, fishing areas, fish catches, fish species, and fish length data. Secondary data were obtained from the West Nusa Tenggara Province Sustainable Fisheries Management Scientific Forum (FIP2B-NTB). The data collected were time series data for 2023 consisting of data on fish species, fishing units, and data on the length of reef fish landed around the Gili Sulat and Gili Lawang.

The method for estimating fish stock conditions used a length-based stock assessment approach. This approach was chosen because the length-based data approach is more effective in fisheries management efforts with limited data (Miethe *et al*., 2016; Trenkel *et al*., 2007). In addition, this study also conducted an analysis of catch per unit effort (CPUE). This analysis is used to determine the condition of fishing activities by fishermen, so that it can be used as a reference for the direction of fisheries management based on current fish stocks (Kantoussan *et al.*, 2014). This is possible because of the relationship between fishing effort and catch probability, as well as observations of catch trends. After that, a spawning potential ratio (SPR) analysis was carried out, this SPR value is used as an important biological reference point for fisheries management with limited data or poor fisheries data (Hordyk *et al.*, 2015; Yonvitner *et al.*, 2021). The data needed for the SPR analysis are the composition of length data, natural mortality ratio data and growth coefficient (M/k) (Hordyki *et al*., 2015). The data was then analyzed using Microsoft Excel and Rstudio software (Mildenberger *et al*., 2017). SPR estimation is carried out online with the Length-based Spawning Potential Ratio concept on the website http://barefootecologist.com.au/lbspr. The threshold used in this SPR analysis is 30%, if the SPR is more than 30% then the stock condition is healthy and if the SPR is less than or equal to 30% then the stock condition is unhealthy (AULT *et al.*, 2008).

RESULT

Reef Fishing Activities

Fishermen around the Gili Sulat and Gili Lawang are small-scale fishermen with simple fishing gear with an average boat size of 5-8 GT. The fishing gear used by these fishermen is arrows (speargun), handline, bottom longline. The most dominant fishing gear used by these fishermen is the arrow fishing gear. These fishermen carry out fishing operations using one day fishing with an average fishing time of 8-12 hours. The types of target fish caught by fishermen around the Gili Sulat and Gili Lawang TWP are reef fish.

The number of fish species caught and landed by fishermen in the Gili Sulat and Gili Lawang TWP during January - December 2023 was 151 species of reef fish from 23 families. The types of reef fish most commonly landed by fishermen are Naso thynnoides, Acanthurus mata, and Caesio caerulaurea. The composition of the three dominant fish species is 35% for the Naso thynnoides species, 33% for the Acanthurus mata species, and 32% for the Caesio caerulaurea species.

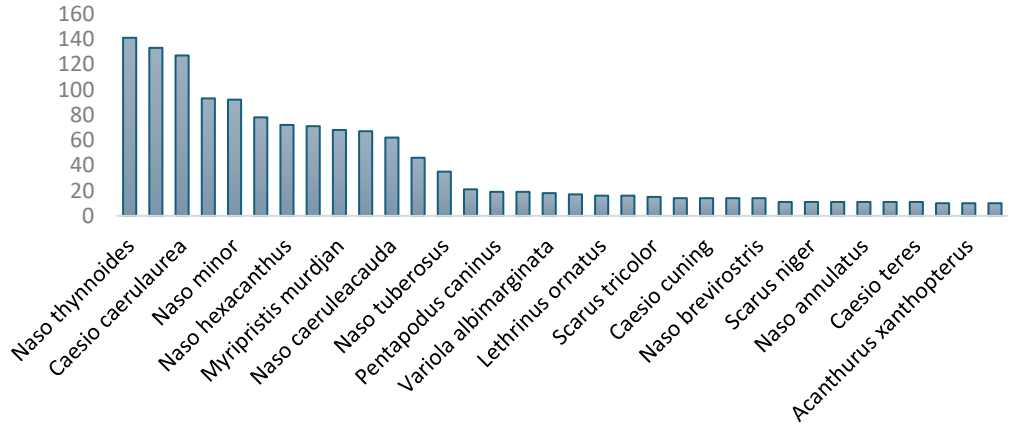

Figure 1. Number of reef fish landed around TWP Gili Sulat and Gili Lawang

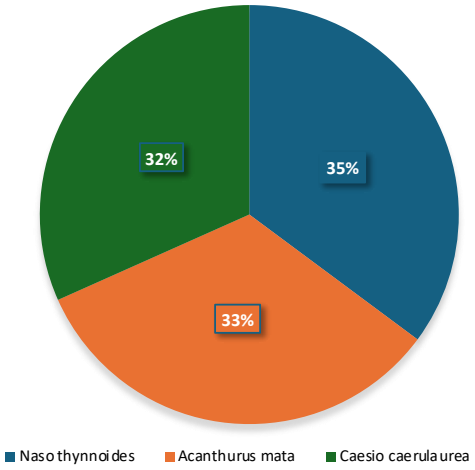

Figure 2. Composition of dominant reef fish species caught in TWP Gili Sulat and Gili Lawang

Catch Per Unit Effort (Cpue)

The arrow fishing gear is the most widely used fishing gear by fishermen around TWP Gili Sulat and Gili Lawang, therefore the standard fishing gear is the arrow. The results of the standard CPUE calculation in 2023 showed that there was a fluctuation every month.

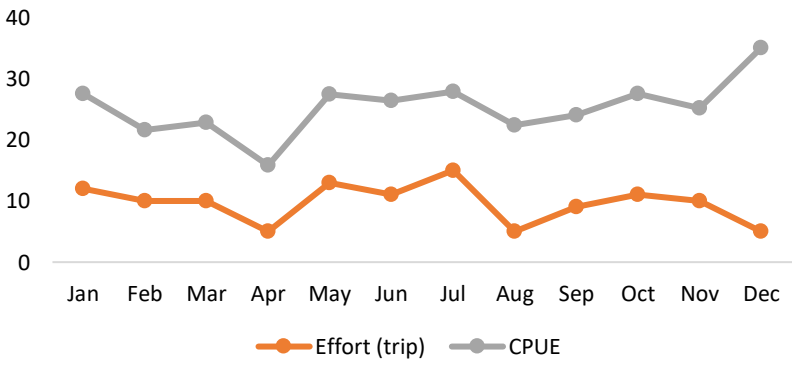

Figure 3. Standard CPUE values and number of trips (effort) for reef fishing units in TWP Gili Sulat and Gili Lawang in 2023

Based on the data above, CPUE from January to March was relatively stable between 11.6 ind/trip to 15.5 ind/trip with small fluctuations. In April, CPUE decreased to 10.8 ind/trip, which was one of the lowest points. From May to July, CPUE increased again with a range of numbers between 12.86 ind/trip to 15.36 ind/trip, indicating an increase in fluctuations after April. In August, CPUE increased sharply to 17.4 ind/trip, while from September to November, CPUE was stable at around 15 ind/trip to 16 ind/trip. In December, CPUE jumped drastically to 30.03 ind/trip, which was much higher than the previous months. Overall, CPUE fluctuations occurred throughout the month. However, there was no consistent upward trend from month to month. There was a significant decrease in April, then an increase in the following months, with a peak in August and especially in December.

Coral Fish Length Composition

Analysis of the length of coral fish in the Gili Sulat and Gili Lawang TWP was carried out on 3 types of coral fish that were landed, namely Naso thynnoides, Acanthurus mata, and Caesio caerulaurea. These types of fish were chosen because they met the criteria for the minimum number of samples to continue further analysis to estimate coral fish stocks. The number of fish samples that can be tested further is a minimum of 100 data (Anas *et al.*, 2023).

Table 1. Length of fish caught around the Gili Sulat and Gili Lawang TWP

No	Fish Species	Lmin (cm)	Lc (cm)	Lm (cm)	L Average (cm)
1.	*Naso thynnoides*	18,06	19,27	17,47	22,96
2.	*Acanthurus mata*	23,46	27,74	21,41	30,02
3.	*Caesio caerulaurea*	21,26	25,60	18,95	26,83

Note: Lmin = minimum length of fish caught; Lc = length of fish first caught; Lm = length of fish first mature; Laverage = average length of fish caught.

Based on table 1, the average length of fish (L Average) caught around Gili Sulat and Gili Lawang is greater than the length of the first adult fish (Lm). In fact, the minimum length of fish caught (Lmin) in this study was also greater than Lm. This indicates that all fish caught by fishermen have had time to reproduce or mature gonads, so it can be said that the reef fish stock is still in a relatively healthy condition. To maintain the sustainability of fish stocks and minimize the impact on the ecosystem, it is necessary to control the catch so that it remains close to the size of adult fish.

Coral Fish Exploitation Rate

The results of the coral fish exploitation rate in TWP Gili Sulat and Gili Lawang are as follows:

Table 2. Coral Fish Exploitation Rate

Parameter	Fish Species		
	Naso thynnoides	***Acanthurus mata***	***Caesio caerulaurea***
M	0,488	0,368	4,220
Z	0,706	0,873	6,651
F	0,219	0,505	2,431
E	0,309	0,578	0,366

Keterangan: M = Kematian alami; Z = Kematian total; F = Kematian karena penangkapan; E = Laju eksploitasi.

Identification of the exploitation rate of coral fish is used to estimate the utilization level (Rochet & Trenkel, 2011) of coral fish species *Naso thynnoides*, *Acanthurus mata*, *Caesio caerulaurea* around Gili Sulat and Gili Lawang. The results of the analysis show that the utilization level of *Naso thynnoides* and *Caesio caerulaurea* species is below its optimal utilization or under exploited with E values of 0.309 and 0.366 respectively. Meanwhile, a different thing happened at the utilization level of Acanthurus mata fish species, this type of fish has an E value of 0.578. This indicates that this type of fish is at a fully exploited level or has exceeded its optimum utilization level.

Coral Fish Stock Condition

The results of the coral fish stock condition estimation in TWP Gili Sulat and Gili Lawang are as follows:

Table 3. Coral fish stock condition for 3 types of fish in TWP Gili Sulat and Gili Lawang

Parameter	**Fish Species**		
	Naso thynnoides	***Acanthurus mata***	***Caesio caerulaurea***
Linf	29,56	37,61	32,36
K	0,35	0,27	2,01
t_0	-0,48	-0,59	-0,05
A max	9	12	1
SPR	0,58	0,43	0,34

Note: Linf = Asymptotic length/average length of very old fish (cm); K = Growth coefficient (year-1); t0 = Length of fish when age 0 (cm); A max = Maximum age of fish (years); SPR = Spawning Potential Ratio.

Table 3 shows the results of the calculation of fish stock estimation using the fish length approach. Based on the calculation results, it is known that all types of reef fish are in a safe condition (under exploited). The three types of fish have SPR values above 0.3 or 30%. The SPR values are as follows, Naso thynnoides with an SPR value of 0.58 or 58%, Achanturus mata with an SPR value of 0.43 or 43%, and Caesio caerulaurea with an SPR value of 0.34 or 34%.

DISCUSSION

Gili Sulat and Gili Lawang are regional marine conservation areas managed by the NTB Provincial Government. The existence of this area not only functions to preserve the ecosystem and its natural resources, but also plays a role in improving the welfare of the local community. One form of utilization of the Gili Sulat and Gili Lawang areas by the surrounding community is through coral fishing activities. Fishermen in the Gili Sulat and Gili Lawang areas generally use simple fishing gear such as arrows (spearguns), handlines, and bottom longlines. The most dominant fishing gear used is arrows. The duration of fishing operations carried out by these fishermen is an average of 8-12 hours/day. The main target of fishermen is coral fish, with the catch landed in 2023 totaling 151 species from 23 families of coral fish. The three most dominant species caught were *Naso thynnoides*, *Acanthurus mata*, and *Caesio caerulaurea*, with compositions of 35%, 33%, and 32%, respectively.

The arrow fishing gear is used as the standard in calculating CPUE. Monthly CPUE data in 2023 showed fluctuations throughout the year. At the beginning of the year, such as January to March, CPUE was relatively stable, but decreased drastically in April with a value of 10.8 ind/trip. In the following months, such as May to July, CPUE increased again, with a peak in

December reaching 30.03 ind/trip. This CPUE fluctuation can be caused by environmental changes or pressure from fishing activities on fish abundance.

Table 1 presents the length data of the three dominant species. Interestingly, the average length of fish caught is greater than the length when the fish first matured (Lm). This indicates that the fish caught have had time to produce, so that the reef fish population is still relatively healthy. However, to maintain the sustainability of reef fish stocks, environmentally friendly fishing practices must continue to be monitored and adjusted if there is an increase in catches of immature or gonad-mature fish.

The exploitation rate (E) for the three dominant species showed varying results. *Naso thynnoides* has an E value of 0.309 and *Caesio caerulaurea* has an E value of 0.366. Both types of fish are categorized as under exploited or the utilization of these fish has not reached an optimal level. Meanwhile, *Acanthurus mata* has an E value of 0.578 which indicates that the tanad is fully exploited or has reached a full utilization level, which means that this species faces the risk of overfishing if not managed properly. This suggests that special conservation efforts are needed, especially for the *Acanthurus mata* species, to prevent significant stock declines. Further regulatory measures may be needed to balance fishing efforts on this species.

The stock conditions of the three dominant species in the Gili Sulat and Gili Lawang appear relatively healthy with Spawning Potential Ratio (SPR) above 0.30 or 30%. The SPR values for each species, namely *Naso thynnoides*, are 0.58 or 58%, *Acanthurus mata* is 0.43 or 43%, *Caesio caerulaurea* is 0.34 or 34%. These values indicate that the fish population still has sufficient reproductive potential to maintain itself under current fishing conditions. However, it is necessary to continue to maintain the SPR above the critical limit to avoid stock declines.

CONCLUSION

The conclusion of this study is that most of the reef fish species in Gili Sulat and Gili Lawang are in healthy condition. However, there are indications of full utilization of the *Acanthurus mata* species, which requires stricter management to prevent overfishing. Some suggestions from this study are that it is necessary to control the catch of the *Acanthurus mata* fish species to prevent excessive exploitation, ensure that the size of the fish caught remains above the adult size to maintain stock sustainability, continue routine monitoring of CPUE to track fish stock abundance and adjust management plans as needed.

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