Fisheries Journal, 15 (1), 398-409 (2025)
http://doi.org/10.29303/jp.v15i1.1416

FEEDING HABITS AND GONAD MATURITY LEVELS OF MACKEREL (*Scomberomorus commerson*) LANDED AT THE RENGAS RIVER COASTAL FISHING PORT

Kebiasaan Makan Dan Tingkat Kematangan Gonad Ikan Tenggiri (Scomberomorus commerson) yang Didaratkan di Pelabuhan Perikanan Pantai Sungai Rengas

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(Received February 3rd 2025; Accepted February 28th 2025)

ABSTRACT

Coastal Fishing Port (PPP) is a landing place for fish caught by fishermen, including pelagic fish. The production of mackerel catches in the Rengas River PPP has decreased from 2012 to 2021. Due to the decline in mackerel fish catch production, research related to the reproduction of mackerel is needed. The aim of this research is to analyze eating habits, TKG, IKG, and IHS. The fish sampling method was carried out using the purposive sampling method. Sampling of 20 mackerel fish is carried out once a month. Mackerel fish are carnivorous fish, which can be seen from the type of mackerel mouth, namely terminal, the shape of the mackerel fish's teeth, which are canine-like, and the fish's gill filter, which is large and has few filaments. The average length of a mackerel fish's intestines is 0.59 cm of its body length, so it is classified as a carnivorous fish. The level of maturity of male gonads was highest in TKG IV and female gonads in TKG II, the average IKG of male gonads was 0.96%, and female gonads 1.13%. The liver of female mackerel fish (*Scomberomorus commerson*) experiences changes in weight as measured by the Hepatosomatic Index along with increasing egg growth based on TKG.

Key words: Feeding Habits, Gonad Maturity, Mackerel

ABSTRAK

Pelabuhan Perikanan Pantai (PPP) adalah tempat pendaratan ikan yang ditangkap nelayan diantaranya kelompok ikan pelagis. Produksi tangkapan ikan tenggiri di PPP Sungai Rengas mengalami penurunan dari tahun 2012 hingga 2021. Oleh karena adanya penurunan produksi tangkapan ikan tenggiri diperlukan penelitian terkait reproduksi ikan tenggiri. Tujuan penelitian ini menganalisis kebiasaan makan, TKG, IKG, dan IHS. Metode pengambilan sampel ikan di lakukan dengan metode purposive sampling. Pengambilan sampel ikan tenggiri dilakukan 1 kali dalam sebulan sebanyak 20 ekor ikan tenggiri. Ikan tenggiri termasuk ikan karnivora dapat dilihat dari tipe mulut ikan tenggiri yaitu terminal, bentuk gigi ikan tenggiri yaitu canine-like, dan tapis insang ikan yang berukuran besar dan filamennya yang sedikit. Panjang rata-rata usus ikan tenggiri adalah 0,59 cm dari panjang tubuhnya sehingga tergolong

sebagai ikan karnivora. Tingkat kematangan gonad jantan terbanyak pada TKG IV dan gonad betina pada TKG II, rata-rata IKG gonad jantan adalah 0,96%, dan gonad betina 1,13%. Hati ikan tenggiri betina (*Scomberomorus commerson*) mengalami perubahan peningkatan bobotnya yang diukur melalui Indeks Hepatosomatik seiring dengan meningkatnya pertumbuhan telur berdasarkan TKGnya.

Kata Kunci: Kebiasaan Makan, Kematangan Gonad, Tenggiri

INTRODUCTION

Coastal Fishing Port (PPP) is a facility built to support various aspects of fisheries activities, such as fish landing, processing, storage, distribution, and shipping. PPP Sungai Rengas is a landing place for fish caught by fishermen, including pelagic fish groups. Pelagic fish are groups of fish that live in the surface layer to the water column and have the main characteristic of always living in groups (schooling) and migrating for various life needs. The types of fish found in the PPP Sungai Rengas include: mackerel (*Rastrelliger* sp.), mackerel (*Scomberomorus commerson*), tuna (*Euthynnus affinis*), and anchovies (*Stolephorus* sp). Mackerel is a large pelagic fish and is one of the fish with high economic value in Indonesia and even the world because of its high fat content and is good for growth. Mackerel is a carnivorous and predatory fish and is a fast swimming fish.

The production of mackerel catches in the Rengas River PPP decreased from 2012 to 2015. Total production in 2012 was 204,688 tons, production in 2013 was 202,717 tons, production in 2014 was 151,368 tons, and production in 2015 was 128,303 tons. In 2012-2015 there was a decrease of 76,385 tons (Danielta *et al.,* 2016). In addition, according to Suwardi *et al.,* (2023), the total production of mackerel also decreased from 2018 - 2021 by 47,508 tons.

Due to the decline in mackerel catches at the Sungai Rengas Coastal Fishing Port, good supervision and management are needed from fishermen and local governments so that fish catch resources are maintained. Utilization of mackerel resources without considering the catch will result in a continuous decline in fish stocks. Research is needed on mackerel reproduction. This is the basis for the need for this research at the Sungai Rengas Coastal Fishing Port. The purpose of this study was to analyze the eating habits, TKG, IKG, and IHS of mackerel landed at the Sungai Rengas Coastal Fishing Port.

RESEARCH METHODS

The study was conducted for 3 months from February to April 2024. Sampling was carried out at the Sungai Rengas Coastal Fishing Port. Observing fish samples was carried out at the Aquatic Resources Management Laboratory, Faculty of Agriculture, Tanjungpura University, Pontianak.

Tools and Materials

The tools and materials used in the study were surgical instruments. Stationery, trays, scales, meters, and mackerel.

Research implementation

Fish sampling and ship selection were carried out using the purposive sampling method. According to Sugiyono (2019), purposive sampling is a sampling technique with certain considerations. The selection of ships is based on the availability of ships operating using gillnet fishing gear. Sampling of mackerel fish is carried out once a month as many as 20 fish.

Data Analysis

Sex Ratio Data Analysis

According to Effendie (2002), the analysis of the sex ratio of female and male fish uses the following formula:

$$\text{Sex Ratio} = \frac{M}{F}$$

The sex ratio is calculated based on the comparison between the number of males and females of the sample fish, so that the ratio of both can be known. Analysis to determine the balance of the sex ratio of male and female fish. This analysis is carried out with the help of the Chi-square test in Ms. Excel software, so that the population balance can be known.

Data Analysis of Relative Intestinal Length

According to Zuliani *et al.* (2016), the relative length of the intestine (Relative length of gut/RLG) can be calculated using the following formula:

$$RLG = \frac{GL}{TL}$$

Description:
RLG = Relative Length of Gut
GL = Gut Length
TL = Total Lenght

Gonad Maturity Index Data Analysis

The Gonad Maturity Index (GMI) is based on the gonad weight and overall body weight of the sample fish calculated using the formula (Effendie, 1979):

$$GMI = \frac{Bg}{Bt}\ x\ 100\%$$

Keterangan:
Bg = Gonad weight
Bt = Body weight

Hepatosomatic Index data analysis

The Hepatosomatic Index (IHS) of fish is calculated using the formula (Deniel, 1981) as follows:

$$IHS = \frac{Bh}{Bt} \text{ x } 100\%$$

Keterangan:
Bh = Heart weight (gr)
Bt = Fish weight (gr)

RESULT

The mackerel fish obtained were 57 consisting of 27 males and 30 females. The total number of male individuals found was less than the female individuals. In February and March, more female individuals were found. While in April, more male individuals were found. The total data on the number of mackerel fish is as shown in Table 1.

Table 1. Total Number of Mackerel Fish

Month	Male (tail)	Female (tail)	Total
February	7	11	18
March	8	12	20
April	12	7	19
Total	**27**	**30**	**57**

Fish eating habits can be seen from the shape of the mouth, teeth, and gills to determine the type of fish food including in the group of carnivorous, herbivorous or omnivorous fish. The type of mackerel mouth can be seen in Figure 1A, the shape of the mackerel teeth can be seen in Figure 1B, and the mackerel gill rakers can be seen in Figure 1C.

A B C

Figure 1. A. Terminal mouth type; B. Canine-like tooth shape; C. Gill raker of mackerel
Source: Personal documentation

Measurement of relative intestinal pang can be known from the comparison between the length of the fish intestine and the total length of the fish body. The results of the relative intestinal length of mackerel fish in February and April are listed in Table 2.

Table 2. Class interval of intestinal length of mackerel fish in February - April.

Month	Total Length	Intestine Length	Relative Intestine Length
February	44,89	28,06	0,63
March	49,45	28,65	0,58
April	52,53	30,68	0,58
Average			**0,59**

Gonad maturity level is a certain stage of gonad development before and after fish spawn. GMI can be observed morphologically. TKG of male and female mackerel fish can be seen in Table 3.

Table 3. GMI of male and female mackerel fish

Gender	GMI				
	1	**2**	**3**	**4**	**5**
Male	8	3	6	5	5
Female	4	6	12	2	6
Total	**12**	**9**	**18**	**7**	**11**

The relative frequency of GMI of male mackerel fish can be seen in Figure 2. based on class interval and Figure 3. Based on the month of research. The relative frequency of GMI of female mackerel fish can be seen in Figure 4. based on class interval and Figure 5. Based on the month of research.

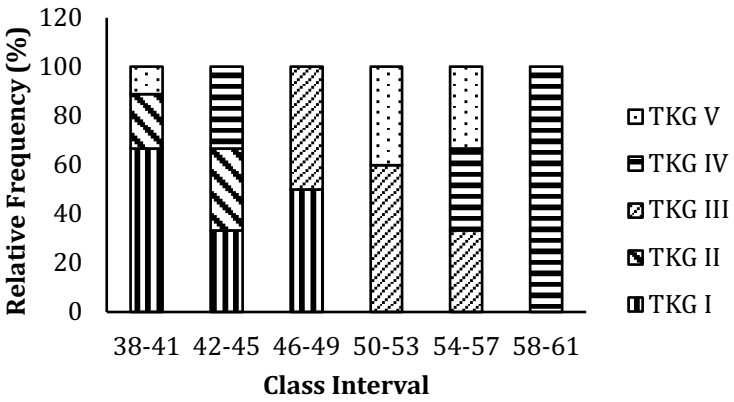


Figure 2. Histogram of GMI of male mackerel fish based on class intervals.

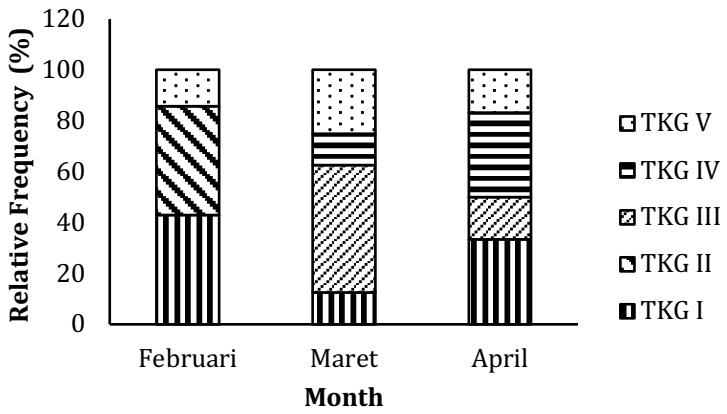


Figure 3. Histogram of GMI of male mackerel fish based on month

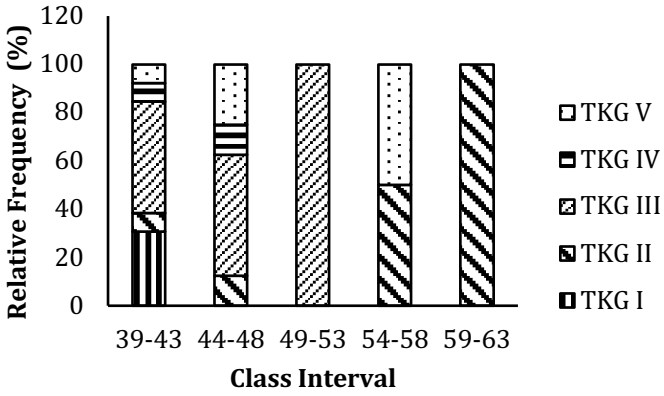


Figure 4. Histogram of GMI of female mackerel fish based on class intervals.

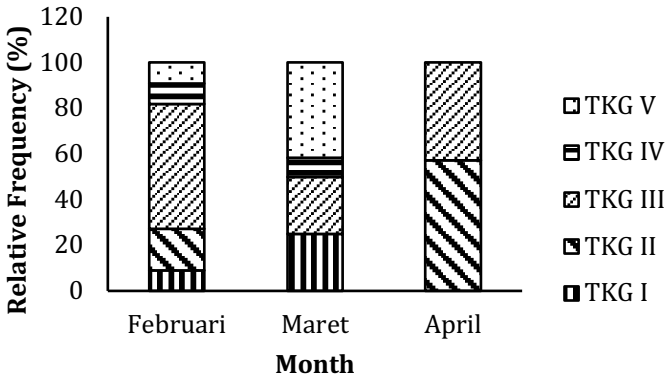
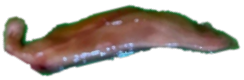


Figure 5. Histogram of GMI of female mackerel fish based on month

Visual depiction of the condition of mackerel gonads obtained at each level of maturity. The differences in size, color and shape of male and female mackerel gonads can be seen in Table 4.

Table 4. Characteristics of the maturity level of male and female mackerel gonads

GMI	Male	Female
I	 The testicles are clear in color and appear hollow at the tips.	 Ovaries are small, clear and red in color.
II	 The testicles are larger and starting to turn white.	 The ovaries are enlarged but the egg granules are not yet visible
III	 Testicles are white, getting bigger, and easily broken off	 The ovaries are yellow to orange and egg granules begin to appear.
IV		

	Testicles are large and appear more obvious	The ovaries are very large and bloated. red.
V	 The tip of the testicle looks flat	 The ovaries are slightly deflated and the egg pellets are less visible from the outside

The gonad maturity index of mackerel during the study is presented in Figure 6 for the GMI of male mackerel and in Figure 7 for the GMI of female mackerel.

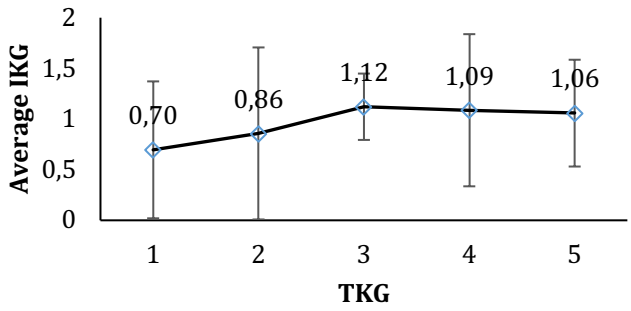


Figure 6. Average GMI graph of male mackerel based on TKG

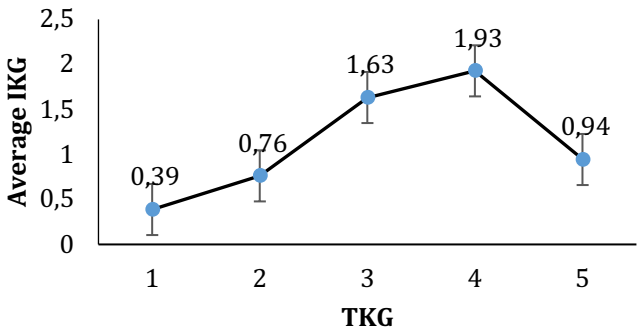


Figure 7. Average GMI graph of female mackerel based on TKG

Hepatosomatic Index is the ratio of liver weight to weight. The value of this index indicates the status of energy reserves in fish. The HIS of female mackerel during the study can be seen in Figure 8.

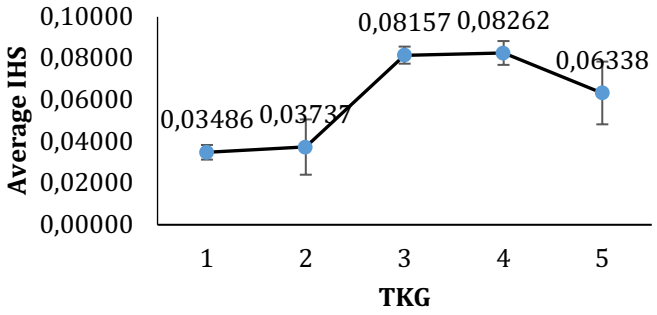


Figure 8. IHS of female mackerel

DISCUSSION

According to Thanh (2011), in general, the difference in the number of female and male fish caught by fishermen is related to the pattern of fish migration behavior, both for spawning and foraging. This is thought to be related to the natural process of fish reproductive strategies, namely that more male fish are needed to meet the quantity of sperm to support successful reproduction, although the composition of males and females in spawning is not yet known for certain. This is related to external fertilization of fish which have many inhibiting factors for fertilization, such as environmental factors and predators, so that the amount of sperm needed to fertilize eggs must be in large quantities. The results of research conducted in February found that the number of mackerel was fewer and the length of the fish forks was smaller than in other months. This is thought to be because February is the west season and fishermen do not catch mackerel during that season. Based on research by Situmorang and Agustriani (2018) in Suwardi *et al.* (2023), the west season occurs in December, January and February. In addition, variations in the length of mackerel are influenced by the length of time at sea and the fishing area. The length of time gill net fishermen go to sea is 2 weeks and some are less than 2 weeks. Likewise with the fishing areas of mackerel fishermen, namely in the waters of Datuk Island, Karimata Island and Tanjung Pinang so that the mackerel caught is more varied. This is also supported by research by Zamroni *et al.* (2020) in *Suwardi et al.* (2023), the varying length of fishing operation days will affect the variation in the size of the fish caught.

Mackerel fish are known as fast, agile swimmers, and have sharp eyesight to help detect their prey from a distance. Mackerel fish can see the movement of prey in the water and immediately chase it. After seeing prey, mackerel fish will usually make a quick and sudden attack. According to Susanto *et al.,* (2015) mackerel (*Scomberomorus commerson*) is a fish that actively searches for food at night has a better sense of smell compared to the sense of sight Mackerel fish have a terminal type mouth, the mouth of the fish with the same jaw and lower length allows the fish to push the jaw forward to catch food. Canine-like teeth resemble the shape of canine teeth, are long, and straight. Having sharp teeth that allow mackerel fish to bite and tear their prey easily. These teeth are very useful for catching and cutting prey into small pieces that are easier to swallow (Akhdan 2021). Gill rakers play an important role in finding fish food, especially in filtering, preventing damage, optimizing consumption, classification, and identification of fish species and in food-trapping mechanisms. Mackerel with dense, elongated, and comb-like gill rakers has the ability to filter small foods. Mackerel has a shorter intestine length than its body length with an average relative intestine length of

0.59 cm. Based on the characteristics of the type of mouth, shape of teeth, and gill rakers, mackerel is included in carnivorous fish.

It is known that male fish that mature gonads are only found in March and April. During the research period, female mackerel matured gonads faster, namely from February to April. Based on Noegroho *et al.,* (2018), the spawning season for mackerel occurs from February to April. In addition, mackerel that matures gonads can be influenced by the weight and length of the fish's body. Thus, the conditions of each water and the biological conditions of the fish are thought to be the cause of differences in the size of the first mature gonad in fish. Arifin *et al.,* (2015) stated that water conditions and geographical location can affect the size of the first mature gonad between one species and another. This can also happen in the same species.

Gonads that have reached a perfect level of gonad maturity are the ones that become new individuals through external changes. Maturity in fish begins with the development of gonads. Gonad development is influenced by several factors, including environmental factors and hormones. The dominant environmental factors that influence gonad development are temperature, food, in addition to light periods and seasons. The frequency distribution of the length of mackerel fish shows that the size of immature gonads dominates almost every month compared to mature gonads. If this is allowed to continue, it will endanger the mackerel population. One thing that can be done is to enlarge the mesh or hook, so that the fish caught are larger (Noegroho *et al.,* 2018).

The male and female gonad maturity index found in the Rengas River PPP is not linear, meaning that the heavier the body weight, the higher the gonad maturity index. The average GMI of male mackerel gonads is 0.96%, and female gonads 1.13%. The GMI values of male and female gonads have quite low values. Based on research by Bagenal (1966) in Arifin Dahlan *et al.,* (2015), fish that have an GMI value <20% are a group of fish that can spawn more than once a year. Generally, fish that live in tropical waters have low GMI values and can spawn all year round. If we refer to the IKG values obtained, then mackerel is included in the category of fish that can spawn more than once a year.

The GMI values of male and female mackerel have fluctuating GMI values. This can be seen that the peak of IKG is when the GMI value of male mackerel is at TKG III and in female mackerel is at TKG IV while the lowest IKG value of male mackerel is at TKG I and female mackerel is at TKG I. The IKG value of males is generally lower than that of females at the same level of gonad maturity, this is because the weight of the female fish gonad is greater than the weight of the male fish gonad Sulistiono *et al.,* (2011). Changes in GMI values are closely related to the stage of egg development. By observing changes in IKG based on time, the size of the fish can be determined during spawning. In line with gonad development, the gonad will reach a maximum when the fish spawn and then decrease rapidly during spawning until it is finished (Effendi, 1997).

The increase in the average IHS value at each TKG shows that the greater the TKG, the greater the IHS value. The increase in IHS value is interrelated with the increase in TKG. According to Olapade & Tarawallie (2014), the IHS value is closely related to TKG, where an increase in TKG is followed by an increase in IHS which will then decrease at the highest TKG because the energy is used for spawning. This is supported by Tresnati *et al.,* (2018) who reported that in flatfish, the greater the TKG, the greater the IHS value and Yunianti *et al.,* (2023) in skipjack tuna, the greater the TKG, the greater the HIS value.

Mackerel is a flat-bodied fish. The energy reserves in the liver of flat-bodied fish are mostly used for the vitellogenesis process (Déniel, 1983). From the results of the study, it is known that when TKG III towards TKG IV, the increase in IHS is no longer too high because the energy stored in the liver has been directed to the spawning preparation process. IHS will decrease during spawning, and reach its lowest point in the post-spawning period; which then increases again in the resting phase where the fish start to eat as much as possible which causes an increase in fat reserves in the liver. In addition to being closely related to the reproductive phase, the IHS value also indicates the environmental conditions of the waters where the fish are located. The environmental conditions in question are the abundance of food. Abundant food causes the fish to eat a lot and increase the fat reserves in their livers. The increase in fat reserves in the liver is then used for reproduction, where fat provides energy for spawning.

CONCLUSION

Based on the results of the research and what has been done, it can be concluded that the proportion of the number of male and female mackerel fish landed at the Sungai Rengas Coastal Fisheries Port is not ideal (1:1.1). Mackerel fish are carnivorous fish which can be seen from the type of mouth which is terminal, the shape of the teeth which is canine-like, and the gill rakers which are large and the filaments are dense and elongated. In addition, the RLG is 0.59 cm. TKG III and IV of male mackerel fish mature gonads in the class interval of 46-49 cm and 42-45 cm and both TKGs were found in March and April. While TKG II and IV of female mackerel fish mature gonads in the class interval of 39-43 and both TKGs were found in February to April. The IKG value of male fish ranges from 0.70-1.12% and the IKG of female fish ranges from 0.39-1.13%. The IHS value of female mackerel ranges from 0.03486-0.08262. The liver of female mackerel (Scomberomorus commerson) experienced changes in weight increase as measured by the Hepatosomatic Index along with the increase in egg growth based on its TKG.

ACKNOWLEDGEMENTS

I would like to express my gratitude to all parties who have provided support and contribution in writing this article.

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