Global Scientific JOURNALS

GSJ: Volume 8, Issue 7, July 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

CATCH COMPOSITION OF DRIFT GILLNET IN TANJUNGPANDAN WATERS, BELITUNG REGENCY

Miqdad Fathul Ilmi*,[1], Emma Rochima[2], DediSupriadi[2], Alexander M.A. Khan[2]

[1]*Student inFaculty of Fisheries and Marine Science, Fisheries Department,UniversitasPadjadjaran*
[2]*Lecturer inDepartment of Fisheries, Faculty of Fisheries and Marine Science, UniversitasPadjadjaran*
JalanRaya Bandung - Sumedang, KM 21, Jatinangor,KabupatenSumedang 40600, Indonesia.
**E-mail: miqdadfathuli@gmail.com*

KeyWords
Narrow-bared Spanish mackerel, Catch composition, Drift gillnet, Influence of operating time, Tanjungpandan

ABSTRACT

This study aims to determine differences in the catch composition of drift gillnet with the operating time in the evening and night and oceanographic parameters at the study site. The research method used was experimental fishing with data processing using t-test which was then analyzed descriptively. Catching activity were carried out in August - September 2019 in the waters of Tanjungpandan, Belitung Regency. The total catch of fish during the study was 1027.8 kg or 880 fish. The types of fish caught and the amount of each fish based on weight during the study were narrow-bared Spanish mackerel (Scomberomoruscommerson) 36.96%, kawakawa (Euthynusaffinis) 34.97%, dorab wolf-herring (Chirocentrusdorab) 2.30%, Indo-Pasific sailfish (layIstiophorusPlatypterus) 2.29%, mackerel (Rastrelligersp) 4.07%, whitecheek shark (Charcarhinusdussumieri) 15.80%, and mahi-mahi (Coryphaenahippurus) 3.62%. The results of oceanographic parameter measurements at the study site are sea surface temperature (SST) ranging from 28 - 30°C in the evening and 30 - 32°C at night, salinity ranges between 28 - 32ppt in the evening and 30 - 31ppt at at night, the brightness ranges from 6 - 8 m in the evening and 5 - 7.5 m at night, and the depth of the waters ranges from 32 - 34 m. T-test results with $\alpha = 0.05$, dk = 26 and T_{table}= 1.70 get the value of T_{count}= 4.65 based on the total weight and T_{count}= 2.77 based on the number of fish so $T_{count} > T_{table}$ so $H_{0\ is}$ rejected and $H_{1\ is}$ accepted, which means that there is a significant difference in the catch of the drift gillnet in the evening and at nigh based on the total of the weight and individuals.

1. INTRODUCTION

Tanjungpandan waters in Belitung Regency are rich in pelagic fish species such as Narrow-bared Spanish Mackerel (*Scomberomorus) commerson*), anchovy (*Stolephorus* sp), kawakawa (*Euthynnusaffinis*) mackerel (*Rastrelliger* sp), sardinella (*Sardinella gibbosa*), yellowtail scad (*Atule mate*), and bream (*Nemiptarusnemathoporus*) [1]. Fishermen in these waters generally use drift gillnet to catch various types of pelagic fish such as narrow-bared Spanish mackerel, kawakawa, scad, and mackerel [2]. The main fish caught by fishermen who use drift gillnet in the waters of Tanjungpandan, Belitung Regency are narrow-bared Spanish mackerel and kawakawa.

The success factor of a fishing effort depends on knowledge of the fish's behavior in order to find the whereabouts of the fish [3]. The existence of fish in water depends on the distribution of these fish. The distribution of fish in the water is influenced by various environmental factors, including internal and external factors of the fish [4]. Internal factors are related to population dynamics (age and genetics) while external factors include water temperature, water salinity, water depth, and availability of food sources [5].

Fishermen who operate using drift gillnet in the waters of Tanjungpandan Belitung Regency generally conduct fishing operations at night, but some fishing groups do fishing operations at 2-time intervals, namely in the evening and at night. The difference in operating time is one of the factors that result in differences in catch both in the number of fish and the types of fish caught. The different catch times will result in differences in the catch [6].

The volume of capture fisheries production in Belitung Regency always exceeds the target, but based on the performance report of the Indonesian Ministry of Maritime Affairs and Fisheries in 2018, the volume of capture fisheries production has not been able to reach the targets planned in the Ministry of Maritime and Fisheries Strategic Plan (Renstra) in 2014 - 2019. It can be seen from the achievement of national capture fisheries production in 2017 amounting to 6.93 million tons or 78.57% of the target of 8.82 million tons and the achievements of national capture fisheries production in 2018 only reached 7.25 million tons or equal to 76.64% with a target of 9.46 tons. The number of captured fisheries production in 2018 only reached 69.23% of the 2019 target of 10.47 million tons [7].

Increasing the volume of capture fisheries production in Belitung Regency is inseparable from efforts to increase capture fisheries facilities and infrastructure [8]. The results of this study aim to determine the best time in the operation of drift gillnets and it is expected that information related to the best operating time of drift gillnets can provide other solutions to be able to continue to increase the volume of capture fisheries production in Belitung Regency and even be able to help increase the volume of national capture fisheries production.

2. METHODS

2.1 Research Location

This research was conducted in August - September 2019, the research location is ± 60 miles from the Tanjungpandan Archipelago Fisheries Port (PPN), Belitung Regency, Bangka Belitung Province. The study consisted of 2 treatments based on the time of catching activity that is in the evening with a time interval of 5 – 9 pm and at night with a time interval of 12.00 – 04.00 am.

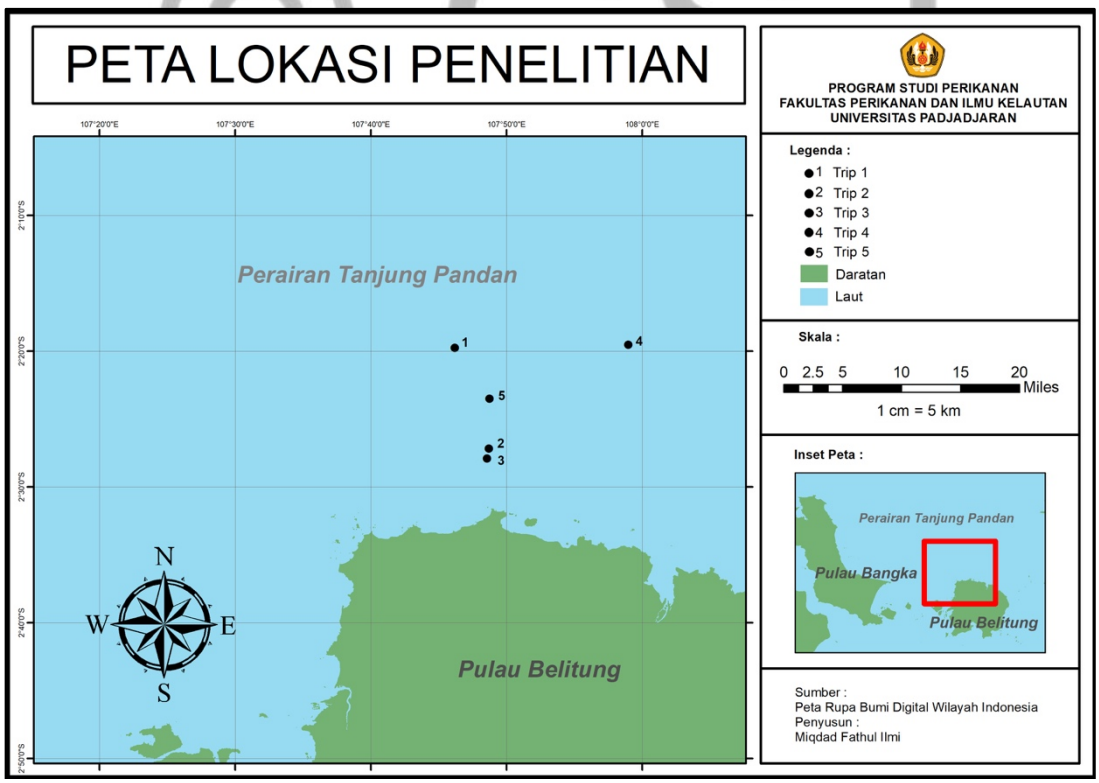

Figure 1. Map of Research Location

2.2 Research Method

The research method used in this study is experimental fishing method. The experimental method is a way to find a causal relationship (causal relationship) between two factors that are intentionally caused by researchers by eliminating or reducing or setting aside other factors that interfere [9]. The analytical method used in this research is descriptive analysis method. The descriptive research method is a method in examining the status of a group of people, an object, a set of conditions, a system of thought, or a class of events in the present. The purpose of this descriptive method is to make a systematic, factual, and accurate description, picture, or painting of the facts, properties, and relationships between the phenomena investigated [10].

2.3 Parameters and Data Analyst

Parameters and data analyzed in this study include the composition of the catch in the evening and evening, the effect of differences operating time for the number of individuals and total weight each species of fish caught, and oceanographic parameters include temperature, salinity, brightness and depth of water. The study was conducted as many as 5 fishing trips with a total of 14 fishing activities. The catch composition data is taken from each capture activity.

The composition of the catch is counting the number of each species of fish caught both the main catch and bycatch. The composition of the catch taken is divided into two, namely the composition of the catch in the evening and the composition of the catch at night. The proportions of the main catch and the bycatch at both operating times are presented in graphical form. The calculation of the proportion of the main target catches and the bycatch is carried out as follows:

$$\text{Main Catch Proportion} = \frac{\text{Main Catch Composition}}{\text{Total of Catch Composition}} \times 100\%$$

$$\text{Bycatch Proportion} = \frac{\text{Bycatch Composition}}{\text{Total of Catch Composition}} \times 100\%$$

The effect of differences in operating time of catches is carried out by t-test with a level of confidence (α) = 0.05. The T-test is used to conduct a comparative test between two conditions or problems [11]. Weight data (kg) of total catches and individual (tail) catches of each species were analyzed using a t-test. If t_{count} is greater than t_{table}, there is a difference in the catch between the operating time in the evening and the evening. The hypothesis used is as follows [12]:

H_0 : If the value of $t_{table} < t_{count}$ then H_0 is accepted, which means there is no significant difference between the composition of the catch with the operating time.
H_1 : If the value of $t_{table} > t_{count}$ then H_1 is accepted, which means there is a significant difference between the composition of the catch with the operating time.

The t test formula used is as follows [12]:

$$t_h = \frac{(\overline{\chi_1} - \overline{\chi_2} - \delta)\sqrt{n_1 n_2 (n_1 + n_2 - 2)}}{\sqrt{(n_1 + n_2)\{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2\}}} \approx t_{(n_1+n_2-2)}$$

Information :

$\overline{\chi_1}$: The average catch in the evening
$\overline{\chi_2}$: The average catch in the night
δ : 0
n_1 : Number of samples 1
n_2 : Number of samples 2
s_1^2 : Sample variance 1
s_2^2 : Sample variance 2

3. RESULT AND DISCUSSION

3.1 Proportion of Catches

There were 7 species of fish caught by the gill drift net during the study. This research was conducted with *hauling* different times, namely in the evening and evening. The main catches of drift gillnets obtained during the study were narrow-bared Spanish mackerel (*Scomberomoruscommerson*) and kawakawa (*Euthynusaffinis*) while the bycatch of drift gillnets during the study were dorab wolf-herring (*Chirocentrusdorab*), Indo-Pacific sailfish (*Istiophorusplatypterus*), mackerel (*Rastrelliger* sp), whitecheek-shark (*Carcharhinusdussumieri*) and mahi-mahi (*Coryphaenaequiselis*).

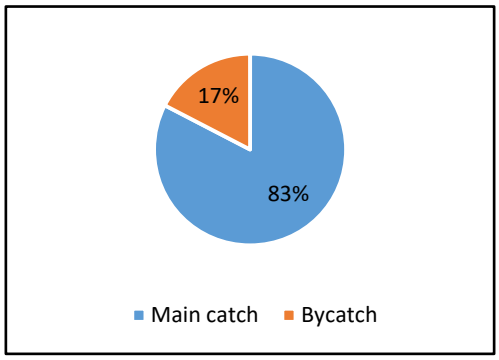

Figure 3. Proportion of Catches in The Evening Based on The Total Weight (kg)

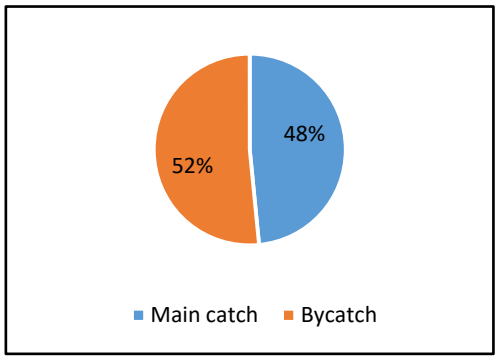

Figure 2. Proportion of Catches in The Night Based on The Total Weight (kg)

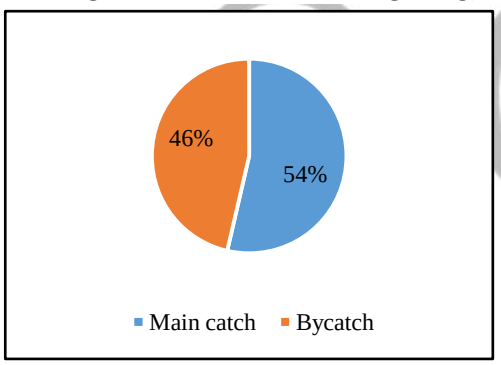

Figure 4. Proportion of Catches in The Evening Based on The Total Amount of The Fish

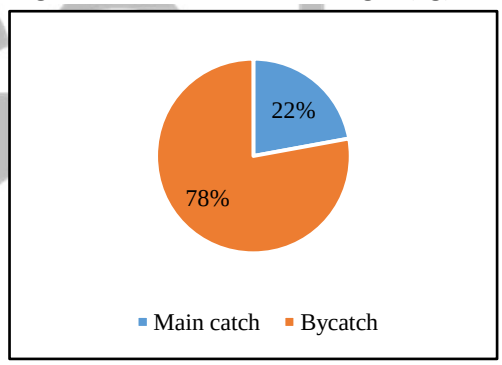

Figure 5. Proportion of Catches in The Night Based on The Total Amount of The Fish

The proportion of the main catch in the evening based on the total weight (kg) of 83% (Figure 2) and based on the number of individuals (tail) of 54% (Figure 4). This shows that the proportion of the number of main catches has a greater amount than the bycatch in the evening both in the amount of weight (kg) and the number of individuals (tail). While at night the proportion of bycatch has a greater amount than the main catch which is 52% in weight (kg) (Figure 3) and 78% in the number of individuals (tails) (Figure 5).

3.2Catch Result Based on Weight (Kg) and the Number of Individuals (Tails)

Based on each fishing activity during the study, the number of catches in the evening (x1) in the amount of weight (kg) was 706.5 kg with an average value of 50.46 kg. The number of catches in the evening has a high value on the 13th day which is 76.5 kg and has a low value on the first day which is 0.5 kg. The number of catches at night (x2) in weight (kg) is 321.3 kg with an average value of 22.95. The number of catches at night has a high value on the 10th day that is equal to 35.9 and has a low value on the first day that there are no fish caught at all.

Table 1. Catches in The Evening (x1) and Night (x2) Based on The Amount of Weight (kg)

Number	Date	Catch Result (Kg)	
		Evening (x_1)	Night (x_2)
1	19 August 2019	0.5	0
2	20 August 2019	49.3	7.5
3	22 August 2019	63.8	29.5
4	23 August 2019	53.5	22.2
5	24 August 2019	61.4	30.3
6	26 August 2019	34.6	17.5
7	27 August 2019	86	41.8
8	28 August 2019	28	20.3
9	30 August 2019	56.6	20.3
10	31 August 2019	67.6	35.9
11	1 September 2019	48.7	19.3
12	3 September 2019	28.8	33.3
13	4 September 2019	76.5	17.2
14	5 September 2019	51.2	26.2
Total		706.5	321.3
Average		50.4	22.9

T-test was conducted to determine the differences in the composition of the catch during the study in Tanjungpandan waters of Belitung Regency at the time of the evening and evening operations with a total weight value. The test results obtained value t-test T_{count}= 4.65 with α = 0.05 and df = 26, then obtained the T_{table}= 1.70, thus the value of T_{count}= 4.65>T_{table}= 1.70 so that H_0 rejected and H_1 accepted which means that there is a significant difference between the composition of the catch with the operating time in the evening and evening based on the amount of weight (kg).

Based on each fishing activity during the study, the number of catches in the evening (x1) in the number of individuals (tails) was 550 tails with an average value of 39 tails. The number of catches in the evening has a high value on the 10th day that is equal to 67 tails and has a low value on the first day that is equal to 3 tails. The number of catches at night (x2) in the number of individuals (tails) is 330 heads with an average value of 23. The number of catches at night has a high value on the seventh day of 42 and has a low value on the first day that there are no fish caught at all. This is similar to the catch in the amount of weight (kg) where the number of catches with the lowest value is on the first day both in the evening and evening.

Table 2. Catches in The Evening (x1) and Night (x2) Based on The Individuals (Tails)

Number	Date	Catch Result (Tails)	
		Evening (x_1)	Night (x_2)
1	19 August 2019	3	0
2	20 August 2019	20	13
3	22 August 2019	49	23
4	23 August 2019	39	26
5	24 August 2019	41	37
6	26 August 2019	28	22
7	27 August 2019	66	42
8	28 August 2019	24	19
9	30 August 2019	54	25
10	31 August 2019	67	34
11	1 September 2019	41	20
12	3 September 2019	30	41
13	4 September 2019	48	13
14	5 September 2019	40	15
Total		550	330
Average		39	23

T-test was conducted to determine the differences in the composition of the catch during the study in Tanjungpandan waters of Belitung Regency at the time of the evening and evening operations with the number of individuals. The test results obtained value t-test T_{count}= 2.77 with α = 0.05 and df = 26, then obtained the T_{table}= 1.70, thus the value of Tcount= 2.77>Ttable= 1.70 so that H_0 rejected and H_1 accepted which means that there are significant differences between the composition of the catch with the operating time in the evening and evening based on the number of individuals (tails).

The number of catches of the gill drift net during the study in the evening has a higher value than at night which is 706.5 kg with an average value of 50.46 kg while at night the number of catches of the drift gillnet is only 321.3 kg with an average value of 22.95 kg. Based on the number and average values, it can be seen that there are differences in the number of fish catches with differences in operating time in the evening and at night based on the weight. Based on the number of individuals the higher value was also in the evening compared to at night, namely with a total of 550 tails with an average value of 39 tails while at night the total catch of the gill drift net was only 330 tails with an average value of averaging 23 tails. Based on the number and average values, it can be seen that there are differences in the number of fish catches with differences in operating time in the evening and at night, both by weight and by the individuals.

The results showed that the operating time in the evening is better than at night. The results in this study are supported by research conducted by Sarma et al*.* (2014) [13]; Oka et al. (2014) [14]; and Lumbantoruan (2018) [15] regarding the effect of time differences on gillnet catches, all three get different results with varying time intervals and the best time yields are different with different water areas and fish species caught. Unlike the case with research conducted by Oka et al*.* (2014) [14], the results of research on differences in the catch of gillnet before midnight with time intervals of 18.00 - 23.00 and after midnight with time intervals of 00.00 - 05.00 show that catches of gillnet after midnight is better than before midnight. The difference in results occurs because of differences in the types of fish caught and the location of the waters studied including bilis(*Mystacoleucuspadangensi*), barb (*Osteochilushasselti*) and hampala (*Hampalamarolepidota*) carried out in freshwaters so that the fish caught have different habits as well.

3.2Catch Result Based on Species of the Fish

The types of fish caught are quite diverse, even the types of fish caught by the side are more than the main types of fish caught. The bycatch is very difficult to avoid in fishing activities in Indonesian waters because of its biodiversity. The diversity of fish caught by gillnet is because Indonesia is a tropical country with high biodiversity, so it is very difficult to determine and catch fish with certain species without the presence of bycatch [16].

Table 3. Species and Amount of The Fish Catches in The Evening (x_1) and Night (x_2) During The Research

Species	Catch Result (Kg)		Catch Result (Tails)	
	Evening (x_1)	Night(x_2)	Evening (x_1)	Night (x_2)
Narrow-bared Spanish Mackerel (*Scomberomoruscommerson*)	291.6	88.3	162	43
Kawakawa (*Euthynusaffinis)*	292	67.4	133	30
Dorab wolf-herring (*Chirocentrusdorab*)	0	23.6	0	46
Indo-Pacific Sailfish (*Istiophorusplatypterus*)	23.5	0	1	0
Mackerel (*Rastrelliger*sp.)	35.8	6	201	36
Whitecheek-shark (*Carcharhinusdussumieri*)	28.7	133.7	37	174
Mahi-mahi (*Coryphaenaequiselis*)	34.9	2.3	16	1
Total	706.5	321.3	550	330

Narrow-bared Spanish mackerel and kawakawa are more common at the time of capture in the evening compared to the evening. The number of catches is also more obtained in the evening with a weight of 706.5 kg (550 heads) while at night the number of catches is only 321.3 kg (330 heads). Based on this it can be concluded that the time of catching in the evening is the best time to catch fish compared to at night.

Narrow-bared Spanish mackerel in general often eat small fish, especially the types of anchovy *Stolephorus* and *Anchoviella,* various types of cupleids such as *Sardinella* also squid (*Lolligo*) and several types of penaeid shrimp [17]. The research of Hidayat et al.(2018) shows that kawakawa fish food is squid, anchovy, sardinella, Indian scad, mackerel, ponyfishes, and flying fish [18]. The results of Johnson and Tamatamah's (2013) research on the biological aspects and eating habits of Narrow-bared Spanish mackerel and kawakawa show the results that the composition of the types of food of narrow-bared Spanish mackerel and kawakawaare almost the same and have the same main food types [19]. Research on the study of the contents of the hull of the anchovy in several time intervals at night conducted by Sudirman (2003) states that the anchovy actively forages before midnight [20]. This shows that at the time of capture in the evening with a time interval at 17:00 to 21:00 there is a possibility anchovy as food for narrow-bared Spanish mackerel and kawakawaare active in the study waters so that narrow-bared Spanish mackerel and kawakawaare mostly actively foraging on anchovies and caught by drift gillnet wereaway at that time. In addition, the results of the study showed that mackerel fish as food for narrow-bared Spanish mackerel and kawakawawere also caught in large numbers when caught in the evening (Table 3). Food availability is one of the internal factors that influence the distribution of fish in the water [4];[5].

In addition, the number of Narrow-bared Spanish mackerel and kawakawathat are caught in the evening is related to the distribution of fish that is influenced by the habits of the group of fish. Adult Narrow-bared Spanish mackerel lives solitary while small and juvenile of Narrow-bared Spanish mackerel live in small groups [21]. Chiou and Lee (2004) mention that small-sized kawakawa live in groups with small numbers [22]. Based on research conducted by Johnson and Tamatamah (2013), the size of narrow-bared Spanish mackerel and kawakawa caught during the day and at night is different from the results of kawakawa caught at night having a larger size with a total length of between 45 - 82 cm compared to the day with a total length of 32 - 63 cm and narrow-bared Spanish mackerel caught at night have a size between 66 - 119 cm. [19] This indicates that during the study of narrow-bared Spanish mackerel and kawakawa caught in groups at the time of the operation in the evening while at the time of the

operation at night caught individually so that the time of operation in the evening showed a greater amount than when operating at night.

Narrow-bared Spanish mackerel and kawakawatuna are caught on the both time of catching activity during the study, although at the night, the number of white cheek-shark is the most dominant but the number of narrow-bared Spanish mackerel and kawakawa is also quite dominant. This happens because narrow-bared Spanish mackerel and kawakawa occupy high trophic levels in aquatic ecology. As Brill (1987) statement, narrow-bared Spanish mackerel and kawakawa play a key ecological role as high-level predators in oceanic pelagic ecosystems because they occupy high trophic levels and consume large amounts of prey to meet their high energy needs [23]. Other fish species prefer to avoid these water areas during the study so that they are only caught in small amounts, according to the statement of Magnhagen and Magurran (2008), food competition in fish can affect the distribution of fish in the water [24].

Predation activity occurred on the first trip on the 19th and 20th of August 2019. The fish caught on both days were only a few but there was an Indo-Pasific sailfish with a weight of 23.5 kg (1 tail) caught. When there is a meeting between predators and prey, the prey will take action to avoid predators [25]. These various forms of action can be grouped into three general categories. A fish can escape to a shelter, take action to escape individually or in groups, or show aggressive defenses to trick predators into stopping their attacks [25]. According to Collette and Nauen (1983), narrow-bared Spanish mackerel are eaten by Indo-Pasificsailfish [26]. So that when the Indo-Pacific sailfishare in the waters during the catching activity, other fish are making efforts to avoid the predation of the Indo-Pasific sailfish. This is also supported by the statement of Schultz (2004), Indo-Pasific sailfish foraging on the surface or in the middle column of sea waters and they prey on scombrids, kawakawa, flying fish, and other small fish species [27].

Nighttime fishing gets a greater proportion of bycatch than the main catch both in weight and in individuals. The most caught bycatch at night catching during the study were dorab wolf-herring and whitecheek-shark. The types of fish most caught at night catching fish are whitecheek-shark of 133.7 kg (174 individuals). The dorab wolf-herring is only caught during the night catch, while the whitecheek-shark is caught in both catches but more are caught at night both in weight and in individuals (Figure 6 and Figure 7).

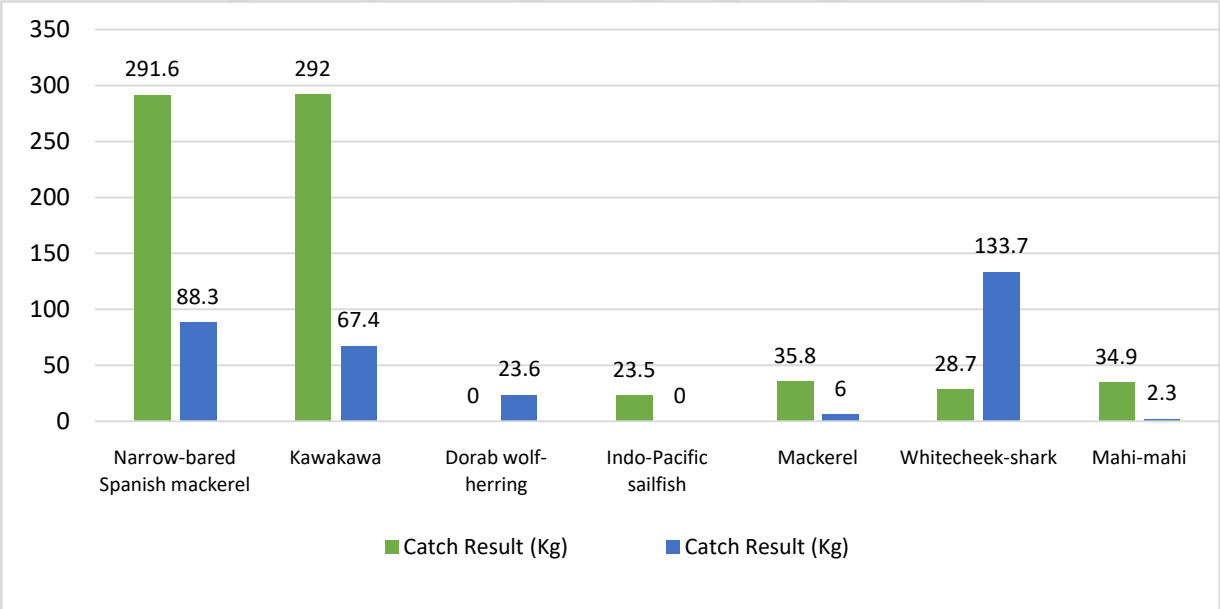

Figure 6. Total Weight (Kg) of Catches in the Evening and Night During the Research

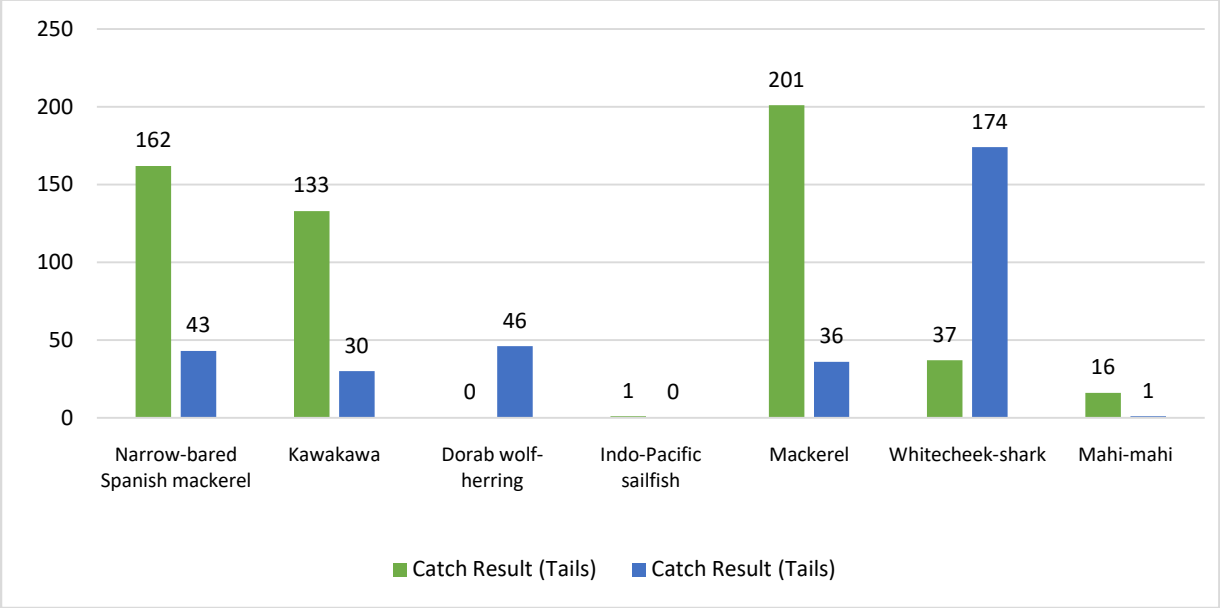

Figure 7. Total Individuals of Fish (Tails) Catches in the Evening and Night During the Research

Whitecheek-shark is included in the family Carcharhinidae (ground sharks). This fish is caught at the both time of catching activity but more caught at the night. According to Heupel (2019), sharks have a habit of swimming closer to the surface at night and swimming deeper during the day [28]. This explains why many of the whitecheek-shark were caught at night by drift gillnet during the study. Catching time at night can cause over-exploitation of whitecheek shark with a large amount caught. Whitecheek-shark is included in the red list IUCN (*International Union for Conservation of Nature and Natural Resources*) with conservation status VU (*Vulnerable*) which means it is feared to have a high risk of extinction in the future [29].

The condition of SST during the study in the evening ranged from 28-30 ° C while at night it ranged from 30-32 ° C. The SST at night tends to be warm because during the day the water receives heat from sunlight so that at night the water temperature rises [15]. According to Romimohtarto and Juwana (2001), the temperature of the waters with a range of 27-32 ° C is a good temperature for fishing areas, it shows that the temperature conditions in the waters of Tanjungpandan Belitung Regency have good temperature conditions for fishing areas[30].The salinity of the waters in the waters during the study ranged from 28-32 ppt in the evening and 30-32 ppt at night. The waters area during the study was still classified in good condition following the statement of Romimohtarto and Juwana (2001) that waters with salinity between 18 - 32 ppt were classified as good waters [30].

Brightness in the water area during the study ranged from 6-8 m in the evening and 5-7.5 m at night. These conditions indicate that the waters during the study were classified as good for organism growth. In general, the level of brightness of the study area during the study was classified as good following the standard quality of seawater for marine biota (KEPMEN-LH / No.51 / 2004) [31]. While the depth of the waters in the study area ranged from 32-34 meters.

4. CONCLUSIONS

Main catch composition of drift gillnets in Tanjungpandan Waters Belitung Regencyare narrow-bared Spanishmackerel*(Scomberomoruscommerson*)andkawakawa *(Euthynnusaffinis)* while the composition of the bycatcharedorab wolf-herring *(ChirocentrusDorab),* Indo-Pacific sailfish *(Istiophorusplatypterus),* mackerel *(Rastreliger* sp.), whitecheek-shark (*Carcharhinusdussumieri*) and mahi-mahi (*Coryphaenaequiselis*). T-test results showed that the time of arrest in the evening and night wassignificantly different both based on the amount of weight and individual. Main catch is caught mostly in the evening while bycatch is caught mostlyat night. Catching time in the evening is the best time to catch fish based on the amount of fish caught and the types of fish caught.Efforts to increase the volume of fisheries production of drift gillnet in the waters of Tanjungpandan, Belitung Regency can be doneby choosing the right time to catch. Besides, the right catch time can also preserve fish, especially the whitecheerk-shark that has the status ofconservation of VU from the threat of extinction in the future.Tanjungpandan waters Belitung Regency have a good condition for fishing areas and organism growth.

5. ACKNOWLEDGEMENTS

The authors would like to thank the Head ofKesyahbandaran PPNTanjungpandan, Belitung Regency, DarmonoS.St.Pi who has provided many kind of assistance to the authors during conducting the research activities.

6. REFERENCES

[1] Dinas Kelautan dan Perikanan Kabupaten Belitung. (2007). *Indikator Kriteria Teknis (Sektor Kelautan dan Perikanan)*. Kabupaten Belitung.

[2] Pratiwi, M. (2010). Komposisi Hasil Tangkapan Ikan Pelagis Pada Jaring Insang Hanyut Dengan Ukuran Mata Jaring 3,5 Dan 4 Inci Di Perairan Belitung Provinsi Bangka Belitung. *Skripsi*. Institut Pertanian Bogor, Bogor.

[3] Ayodhyoa. (1981). *Metode Penangkapan Ikan*. Bogor: Yayasan Dewi Sri.

[4] Simbolon, D. (2008). Pendugaan Daerah Penangkapan Ikan Tongkol Berdasarkan Pendekatan Suhu Permukaan Laut Deteksi Satelit dan Hasil Tangkapan di Perairan Teluk Pelabuhanratu. *Jurnal Litbangda NTT*, *4*, 23–30.

[5] Jumsurizal, Nelwan, A., & Kurnia, M. (2014). Produktivitas Penangkapan Pancing Ulur Ikan Tenggiri (*Scomberomorus commerson*) Berdasarkan Waktu di Perairan Kecamatan Tambelan. *Fakultas Perikanan Dan Ilmu Kelautan*, *Universitas Hassanudin*.

[6] Rosyid, A., Jayanto, B. B., & Amaludin, A. (2005). Pengaruh Perbedaan Waktu Penangkapan dan Jenis Umpan Terhadap Hasil Tangkapan Kepiting Bakau Dengan Alat Tangkap Wadong. *Prosidding Seminar Perikanan Tangkap*, *15*, 1–7.

[7] Kementerian Kelautan dan Perikanan. (2018). *Laporan Kinerja Kementerian Kelautan dan Perikanan Tahun 2018*. Jakarta.

[8] Pemerintah Kabupaten Belitung. (2019). Laporan Kinerja Pemerintah Kabupaten Belitung Tahun 2018. In *Journal of Chemical Information and Modeling* (Vol. 53).

[9] Arikunto, S. (2006). Prosedur Penelitian Suatu Tindakan Praktik. *Jakarta: Rineka Cipta*.

[10] Nazir, M. (2011). *Metode Penelitian*. Bogor: Penerbit Ghalia Indonesia.

[11] Hanief, Y. N., & Himawanto, W. (2017). *Statistik Pendidikan*. Yogyakarta: Deepublish.

[12] Miller, I., & Freund, J. (1987). *Probability and Statistics for Engineers* (Third Edit). New Jersey: Prentice-Hall Inc.

[13]Sarma, U. I., Brown, A., & Rengi, P. (2014). Composition Of Fish Catch Using Gilnet Opereted In The Evening And Night In Paluh Sibaji Village, Pantai Labu District, Deli Serdang Regency, Sumatera Utara Province. *Jurnal Online Mahasiswa Fakultas Perikanan Dan Ilmu Kelautan Universitas Riau*, *1*(2), 248–249.

[14] Oka, M., Bustari, & Arthur, B. (2014). The Difference of Fish Catches bu Using “Jaring Insang” (Gillnet) Before and After Midnight in Nagari Tikalak (Tikalak Village), X Koto Singkarak, Solok Regency, West Sumatera. *Jurnal Online Mahasiswa Fakultas Perikanan Dan Ilmu Kelautan Universitas Riau,* Vol 2(1).

[15] Lumbantoruan, Y. (2018). Komposisi Hasil Tangkapan Gillnet di PPI Kelurahan Nipah Panjang 1 Kabupaten Tanjung Jabung Timur Provinsi Jambi. *International Reviews of Immunology*, *66*(1), 1–15.

[16] Apriliani, I. M., Khan, A. M. A., Dewanti, L. P., Rizal, A., Hamdani, H., & Oktavera, C. (2019). Hanging Ratio Gillnets on Different Mesh Sizes for Mackerel (*Scomberomorus commerson*): A Case of Pangandaran Regency, Indonesia. *Asian Journal of Fisheries and Aquatic Research*, (August), 1–7.

[17] Widodo, J. (1989). Sistematika, Biologi dan Perikanan Tenggiri (*Scomberomorus, Scombridae*) di Indonesia. *Oseana*, *XIV*(4), 145–150.

[18] Hidayat, T., Noegroho, T., & Chodrijah, U. (2018). Biologi Ikan Tongkol Komo (*Euthynnus affinis*) di Laut Jawa. *Jurnal Pengelolaan Perikanan Tropis*, *2*(1), 30–36.

[19] Johnson, M. G., & Tamatamah, A. R. (2013). Fishery and Feeding Habits of Kawakawa (*Euthynnus affinis* -Cantor 1849) and Narrow barred Spanish mackerel (*Scomberomorus commerson* - Lacepède 1800) in the Coastal Waters of Dar es Salaam Tanzania. *Indian Ocean Tuna Comission*, *WPNT03*(21), 1–24.

[20] Sudirman. (2003). Analisis Tingkah Laku Ikan untuk Mewujudkan teknologi Ramah Lingkungan dalam Proses Penangkapan pada Bagan Rambo. *Disertasi*. Institut Pertanian Bogor.

[21] Collette, B. B. (2001). Tunas (Also, Albacore, Bonitos, Mackerels, Seerfishes, and Wahoo). *FAO Species Identification Guide for Fishery Purposes The Living Marine Resources of the Western Central Pacific*.

[22] Chiou, W., & Lee, L. (2004). Migration of Kawakawa *Euthynnus affinis* in the Waters Near Taiwan. *Fisheries Science*, *70*, 746–757.

[23] Brill, R. W. (1987). On the standard metabolic rates of tropical tunas, including the effect of body size and acute temperature change. *Fishery Bulletin*, *86*(1), 25–35.

[24] Magnhagen, C., & Magurran, A. (2008). Decision-making and Trade-offs in Fish Behaviour. In C. Magnhagen, V. Braithwaite, E. Forsgren, & B. G. Kapoor (Eds.), *Fish Behaviour* (pp. 499–523). Enfield: CRC Press.

[25] Helfman, G. S., & Keenleyside, M. H. A. (1979). *Diversity and Adaptation in Fish Behaviour*. New York: Springer-Verlay Berlin Heidelberg

[26] Collette, B. B., & Nauen, C. E. (1983). FAO Species Catalogue Vol . 2 Scombrids of the World an Annotated and Illustrated Catalogue of Tunas, Mackerels, Bonitos and Related Species Know to Date. In *FAO Fisheries Synopsis* (Vol. 2). Synop. 125(2)

[27] Schultz, K. (2004). *Ken Schultz's Field Guide to Saltwater Fish*. New Jersey: John Wiley & Sons, Inc.

[28] Heupel, M. R. (2019). Sharks. *Encyclopedia of Animal Behavior*, 181–189.

[29] Fahmi, & Dharmadi. (2005). Status Perikanan Hiu dan Aspek Pengelolaannya. *Oseana*, *XXX*(1), 1–8.

[30] Romimohtarto, K., & Juwana, S. (2001). *Biologi Laut : Ilmu Pengetahuan Tentang Biota Laut*. Jakarta: Djambatan.

[31] Keputusan Menteri Lingkungan Hidup. *Keputusan Menteri Lingkungan Hidup Nomor 51 Tahun 2004 Tentang Baku Mutu Air Laut*. (2004)