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Study of Types and Production of Trap Net Fishery Fish based on Moon Phase in the Waters of Segeri District, Pangkep Regency, South Sulawesi Indonesian

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Abstract: The research was carried out in October-November 2020 in the waters of the Pangkep Regency. The data collected consisted of primary and secondary data, using direct observation in the field. Tidal observations were carried out in every moon phase for 2 x 24 hours. I collected data on the type and number of catches in each month's phase. Tidal analysis using the criminal method and descriptive analysis of the types and quantities of trap net fish production (kg) and (Rp). The full moon phase is the highest tide at 185 cm and the lowest at 42 cm. The average sea level (mean sea level) is 113.5 cm. Types of trap net catch based on the moon phase in the waters of Sergei District, Pangkep Regency, identified 13 types of catches. The highest amount of fish production was obtained by the full moon phase of 100 kg, followed by the 80 kg dead moon phase, 95 kg early quarter moon, and 65 kg final quarter moon phase.

Keyword: Study; Fish production. net traps; Moon phase; Pangkep South Sulawesi Indonesia

1. Introduction

The waters of the Pangkep Regency have the abundant potential for fishery resources due to the fertile water environment. Biologically some fish migrate to coastal waters at high tide, even some types of fish that enter the river to look for food (feeding migration), do care (nursery migration) and do spawning (spawning migration). To take advantage of the abundant fish resources in coastal waters, fishermen use trap net fishing gear that traps and blocks fish by taking advantage of tidal conditions. Trap net fishing gear, passive in nature, is installed horizontally parallel to the shoreline, and fish entering the coastal area will be blocked in the trap net at low tide [1].

Tides are a phenomenon of the movement of up and down sea levels caused by a combination of gravity and the attractive force of astronomical objects. Tides are nothing, but ocean currents, where the tides move towards the coast and the tides move away from the land. The movement of ocean currents causes several types of fish to roam every day near the coast, even entering the river and living semi-permanently in the river, including titan fish and others [2].

The coastal waters of the Pangkep Regency are important habitats for several types of fish, both for foraging, spawning, and breeding habitats for various types of fish that are "sedentary/resident" and migratory fish. Estuary waters are a fertile coastal ecosystem and function as a place for spawning, nurturing, and foraging for several types of fish outside of mangroves, seagrass, and coral reefs. The water movement is utilized by fishermen using trap nets and several other fishing gears with a fairly large catch production. Production of fish and fish species from the sea that make roaming to the beach at low tide, for each moon phase caught with a trap net

("net-like" local name), which is a 3-sided trap/barrier net that is classified into the group of traps by the Decree of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia No. 06 of 2010 concerning Fishing Equipment in the Fisheries Management Area of the Republic of Indonesia [3]. This study aims to examine tidal conditions and the production of trap net fishing gear based on the moon phase in the waters of the Segeri District, Pangkep Regency, South Sulawesi Province, Indonesia.

2. Materials and Methods

This research was conducted from October to November 2020 in the coastal waters of the Segeri District, Pangkep Regency, South Sulawesi, Indonesia. The materials and tools used in the study consisted of a Trap net, Global Positioning System, Meter, Digital Camera, Writing Instruments, Scales, Boat, and Identification Book. For the measurement of tidal data related to the moon phase and its relation to trap net catches, namely by measuring the tides using a tidal estimator (TPP) carried out for 1 x 24 hours each moon phase by recording observations every 60 minutes and still equipped with data secondary data sourced from Dishidros data for data accuracy. Tidal observations of the catch were carried out directly by observing and measuring at the installation location of the trap net fishing gear by noting the conditions around the installation location of 2 trap net fishing gear placed in different areas to make an optimal area comparison by looking at the catch in the form of the number of tails and the number of fish caught. The weight of the catch of each type of fish (kg) for each trip of the two trap net fishing gear. This observation was carried out in each phase: the dead moon phase, the early quarter moon phase, the full moon phase, and the final quarter moon phase.

The data analysis consisted of analyzing the tides' height according to the moon's phase. Indicator of the value of the moon phase, namely the high and low tides of each moon phase. The catch data and tidal height for each of the moon phases were analyzed using the Admiralty method [4]. The Admiralty method is a tidal analysis used to calculate two harmonic constants: amplitude and phase delay. After obtaining the tidal components, namely the amplitude and the price of the phase delay, then it is calculated:

- Mean Sea Level
  $MSL = A(S0)$
- Lowest Low Water Level
  $LLWL = A(So) - (M2 + S2 + K1 + O1 + P1 + K2)$
- Highest High Water Level
  $HHWL = A(So) + (M2 + S2 + K1 + O1 + P1 + K2)$
- Tidal type $(F) = A(K1) + A(O1) / A(M2) + A(S2)$

Where:
F = Formzahl Number.
K1 = Amplitude of the average daily tidal wave affected by the declination of the sun and moon.
O1 = Amplitude of the single daily tidal wave affected by the sun's declination.
M2 = Amplitude of the average double daily tidal wave influenced by the moon.
S2 = Amplitude of the average double daily tidal wave influenced by the sun.

According to Triatmodjo (1999) [4] there are four classifications of tidal types based on tidal constants:

$0 < F < 0.25$ = Pure Double daily tidal type

0.25 < F < 1.50 = Mixed Tidal Type Double Inclined Daily
1.50< F < 3.0 = Single Daily Inclined Mixed Tidal Type
F > 3.0 = Pure Single Daily Tidal Type

Analysis of the production of trap net catches identification of fish species, using book identification keys [5] and visually matching fish images using books of economically important marine fish in Indonesia. [6]. Meanwhile, the amount of production and the production value of the trap net (kg) trap net for each moon phase were analyzed descriptively for each trap net catching trip by analyzing the composition of the type of catch.

3. Results and Discussion

3.1 Tidal Height by Moon Phase

Tides are fluctuations in sea level caused by the attraction of celestial bodies, especially the sun and moon, to the mass of seawater on earth. In planning coastal buildings, it is necessary to know the highest (tidal) and lowest (low tide) water level elevations; for example, the peak elevation of the breakwater building and the peak elevation of the pier is determined by the elevation of the tidal water level. In contrast, the low tide level determines the depth of making shipping lanes or ports [7].

The results of tidal analysis obtained the type of tidal type is a single daily tide because, in a day, it experiences one tide at night and one low tide during the day. Based on the Admiralty method, there are four moon phases; in the dead moon phase, the highest tide is 162 cm, and the lowest tide is 59 cm, with an average sea level of 110.5 cm. The early quarter moon phase experienced the highest tide with a value of 115 cm and the lowest ebb with a value of 23 cm, so the mean sea level was 69 cm. The full moon phase experienced the highest tide with a value of 185 cm and the lowest low tide of 42 cm, with an average sea level (mean sea level) of 113.5 cm. The final quarter moon phase experienced the highest tide of 149 cm and the lowest ebb with a value of 40 cm, so the mean sea level was 94.5 cm. [8], The results of the MSL calculation (using the MSL formula) obtained the MSL value of the tidal in the waters of the Dungan Island of 183.52 cm, while the highest tide was 242 cm and the lowest tide was 141.5 cm. From the results of tidal observations, it can be seen that the type or types of tides found on Dutungan Island are mixed tides prevailing diurnal; in one day, there is one high tide and one low tide, but sometimes temporarily. Two high tides and two low tides have very different heights and periods. [4] said that the tidal data obtained from the Soekarno Port of Makassar, that the tidal range in the waters of the Makassar Strait during the last 5 (five) years, namely 2010-2015, was not more than 1 meter, the length of time the water inundated the coastal area is around 8-16 hours. There are many tides in the waters of Eastern Indonesia.

The high and low sea levels around the coast of Segeri District, Pangkajenne Islands Regency, have a relationship with the phases of the moon, both the dead moon phase, the quarter moon phase, the full moon phase, and the three-quarter moon phase. Looking at the study's results, the full moon phase is the best in catching fish using a trap net by getting the most catches from other moon phases. This is because at high tide, there is a strong current and the addition of the depth of the waters makes the fish food source carried by the current towards the coast so that fish that are looking for food are caught when the sea water conditions are receding which is where the depth of the water is shallow during the full moon phase. [8] said that knowledge of tides is very necessary for sea transportation, activities in ports, development in coastal areas, and others. Due to the periodic nature of the tides, it can be predicted. Tides also greatly affect the life of marine

organisms, especially in intertidal and littoral areas. Furthermore, [8] said that with the tides, organisms have their ecological strategies to survive. In addition, the tides greatly affect the mangrove ecosystem, which is the main pillar of natural defense in coastal areas from the threat of storms, erosion, and others. Tides also greatly affect the life of marine organisms, especially in intertidal and littoral areas. With the tides, organisms have their ecological strategies to survive. In addition, the tides greatly affect the mangrove ecosystem, which is the main pillar of natural defense in coastal areas from the threat of storms, erosion, and others.

3.2. Description of Trap Net

The waring net has a length of 500 m and a width of 1.2 m with a mesh size of 4 mm, which along the waring are provided with several wooden pegs with a diameter of 5 cm and a height of 3 m with a distance between the pegs of approximately 1.5 m and is equipped with a rope. No. 4 which is attached to the top and bottom of the net to tie the wooden pegs. The description of the Trap net tool is presented in Figure 1.

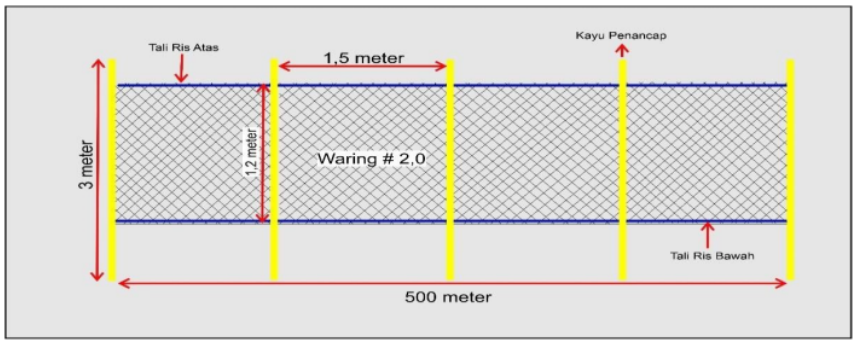

Figure 1. Description of the trap net

3.3. Production, Trap Net catches in the Dead Moon Phase

Production and fish prices at the level of fishermen caught by trap net fishing gear in the dead moon phase found seven types of fish with a total catch (Kg) obtained during the study can be seen in Table 1.

Table 1. Production, production value, and price of catch in the dead moon phase

No	Types of Fish Catch	Production (Kg)	Percentage (%)
1	White Snapper (*Lates calcarifer*)	35	43,75
2	Milkfish (*Chanos-chanos*)	15	18,75
3	Goalkeeper Fish (*Scatophagus argus*)	9	11,25
4	Gulamah Fish (*Johnius trachycephalus*)	12	15,00
5	Nine Fish (*Plotosus canius*)	2	2,50
6	Rejung Fish (*Sillago sihama*)	2	2,50
7	Cotton Fish (*Gerres punctatus)*	5	6,25
	Amount	80	100

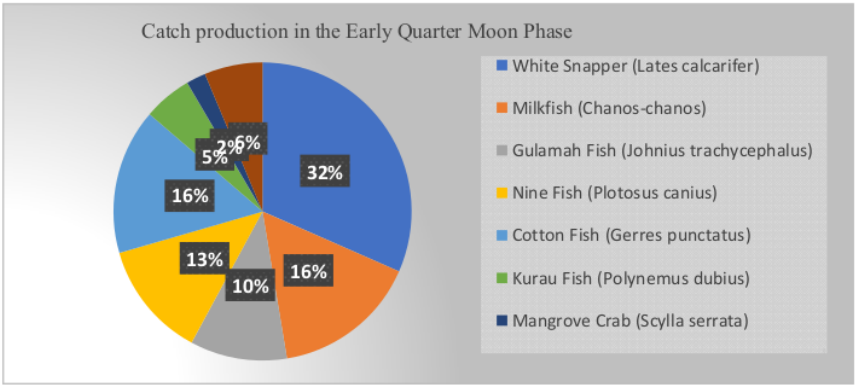

Figure 2. Production, production value, and price of catch in the dead moon phase

In (Table 1 and Figure 2) the types of fish caught and sold during the dead moon phase and the total types of fish sold in the dead moon phase were 80 kg with different types, namely snapper 43.75 %), milkfish (18.75 %), dominated the catch in the dead moon phase, while the fish caught the least was nine fish (2.50%). In order to maximize the catch of this, then more catching is done.

3.4. Production, Trap Net catches in the Early Quarter Moon Phase

The production and price of fish caught by trap net fishing gear in the early quarter moon phase found eight fish species with the total catch obtained during the study. The description of catch production in the early quarter moon phase can be seen in Table 2.

Table 2. Catch production in the Early Quarter Moon Phase

No	Types of Fish Catch	Production (Kg)	Percentage (%)
1	White Snapper (*Lates calcarifer*)	30	31,58
2	Milkfish (*Chanos-chanos*)	15	15,79
3	Gulamah Fish (*Johnius trachycephalus*)	10	10,53
4	Nine Fish (*Plotosus canius*)	12	12,63
5	Cotton Fish (*Gerres punctatus)*	15	15,79
6	Kurau Fish (*Polynemus dubius*)	5	5,26
7	Mangrove Crab (*Scylla serrata*)	2	2,11
8	Udang Putih (*Penaeus merguiensis de man*)	6	6,32
	Amount	95	100

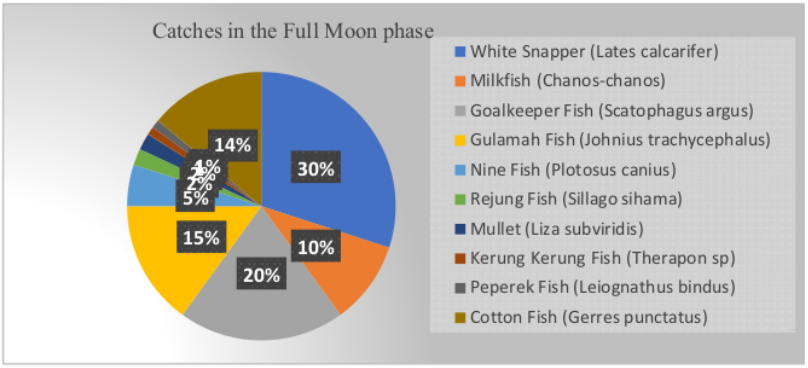

Figure 3. Catch production in the Early Quarter Moon Phase

We can see in Table 2 and Figure 3 that there are 8 types of fish caught in the early quarter moon phase and the total types of fish sold in the early quarter moon phase are 95 kg with the dominant catch species being snapper (31.58%), milkfish (15.79%), ulama fish (10.53%), nine fish (12.63%), cotton fish (15.79%. At the same time, the least types of catch are kurau fish, mangrove crabs, and white shrimp. The catch is still Low compared to fish production in general. In the future, it is hoped that fishermen as producers will increase their catches.

3.5. Production, Trap Net catches in the Full Moon Phase

The trap net fishing gear production in the full moon phase found ten species of fish with a total catch (Kg), which was obtained during the study. The description of catch production in the full moon phase can be seen in Table 3.

Table 3. Production, production value, and prices of catches in the Full Moon phase

No	Types of Fish Catch	Production (Kg)	Percentage (%)
1	White Snapper (*Lates calcarifer*)	30	30
2	Milkfish (*Chanos-chanos*)	10	10
3	Goalkeeper Fish (*Scatophagus argus*)	20	20
4	Gulamah Fish (*Johnius trachycephalus*)	15	15
5	Nine Fish *(Plotosus canius)*	5	5
6	Rejung Fish (*Sillago sihama*)	2	2
7	Mullet (*Liza subviridis*)	2	2
8	Kerung Kerung Fish (*Therapon sp*)	1	1
9	Peperek Fish *(Leiognathus bindus)*	1	1
10	Cotton Fish (*Gerres punctatus)*	14	14
	Amount	100	100

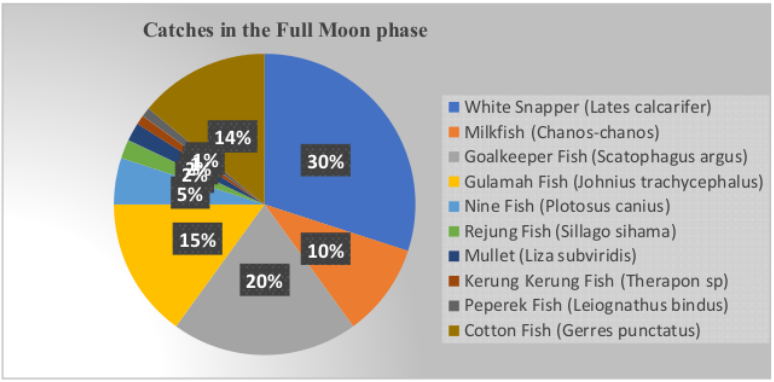

Figure 4. Production, production value, and prices of catches in the Full Moon phase

In Table 3 and Figure 4, there are ten types of fish caught and sold during the full moon phase, and the total types of fish caught in the full moon phase are 100 kg, with the dominant fish species being snapper (30%), milkfish (10.0%), goalkeeper fish (20%), gulamah fish (15.0%). Fish such as nine, cotton, turtle, and white shrimp are not caught much in this phase of the moon. In the future, of course, fishermen are expected to obtain catches to increase their income and standard of living of fishermen.

3.6. Production, trap net catch in the Late Quarter Moon Phase

The production of trap net fishing gear in the final quarter moon phase found ten species of fish with a total catch (Kg) obtained during the study. The description of catch production in the final quarter moon phase can be seen in Table 4. Below

Table 4. Production, production value and prices of catches in the Late Quarter Moon Phase

No	Types of Fish Catch	Production (Kg)	Percentage (%)
1	White Snapper (*Lates calcarifer*)	25	38,46
2	Milkfish (*Chanos-chanos*)	10	15,38
3	Goalkeeper Fish (*Scatophagus argus*)	20	30,77
4	Gulamah Fish (*Johnius trachycephalus*)	15	23,08
5	Nine Fish (*Plotosus canius*)	10	15,38
6	Rejung Fish (*Sillago sihama*)	2	3,08
7	Mullet (*Liza subviridis*)	1	1,54
8	Kerung Kerung Fish (*Therapon sp*)	1	1,54
9	Peperek Fish *(Leiognathus bindus)*	1	1,54
10	Cotton Fish (*Gerres punctatus)*	5	7,69
	Amount	90	100

The types of fish caught and sold in the final quarter moon phase and the total types of fish sold in the final quarter moon phase were 90 kg, with the dominant fish species being White Snapper (38,46 %), milkfish (15.38 %), goalkeeper fish (30.77 %), gulama fish (23.08 %), nine

fish) 15.38 %). Other types of fish such as mullet, kerung kerung, peppered, and cotton-cotton fish are not caught much in this phase of the moon. To describe the percentage value production, production value and prices of catches in the Late Quarter Moon Phase, presented in figure 5:

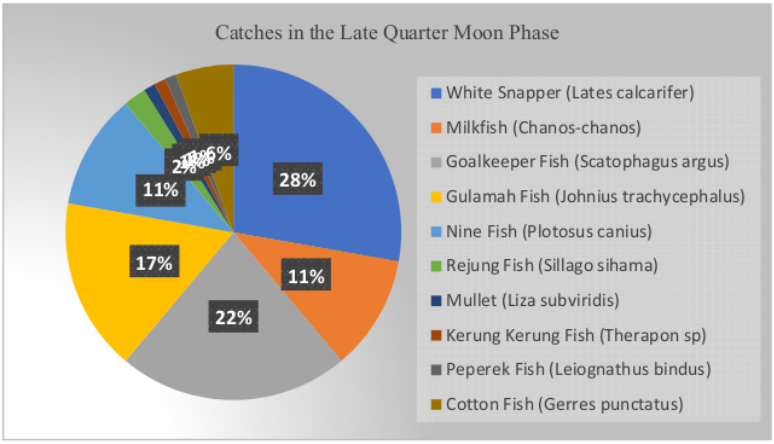

Figure 5. Production, production value and prices of catches in the Late Quarter Moon Phase

The results of the descriptive analysis showed that several types of fish, such as milkfish, gulamah, Sembilang, and cotton fish, were caught in all phases of the moon, so it can be said that fish species migrate daily at low tide and make the beach a place for foraging and nurturing.

The effect of the moon phase, which is directly related to the tides, is one of the factors that is closely related to the behavior of fish both as permanent residents in coastal waters and other fish on the coast whose nature is not permanent, only foraging data and after receding back to their habitat. Original. The results of the study [9] explained that the tidal pattern that occurs in the estuary waters greatly determines the distribution and abundance of fish larvae in these waters. Where the tidal pattern is closely related to the phase of the moon. The spring tide pattern occurs in the new and full moon phases, while the neap tide pattern occurs in the quarter and three-quarter moon phases. The tidal strength that occurs in the Spring Tide is greater than the tidal strength that occurs in the Neap Tide so that it is able to bring larger fish larvae into the estuary waters.

Several trap net catches are caught because they are influenced by tides, one of which is cotton-cotton fish (Gerres punctatus). This is confirmed by the research [9] results that the catches caught were eight genera, namely Stolephorus, Ambassis, Periopthalmus, Gerres, Leiognathus, Terapon, Atherinomorus, and Chanos. Fish larvae caught at high and low tide based on the moon phase; both the New Moon phase, Quarter Moon phase, Full Moon phase, and three quarter Moon phase were dominated by Stolephorus and Ambassies.

According to [10], the fishing gear cager net (set net), which is operated around the mangrove forest in Jabon District, Sidoarjo Regency, is a type of fishing gear in the form of a combination of a series of net sheets, measuring 200 m long and 1 m wide each series. Fishermen use 3-5 sets of net sheets. The total length of the cager nets is 600-1000 m, with a total of 17 types of fish caught, namely milkfish, balance, Peloso, eel, tender feathers, gulamah, kerong-kerong, kurau, crab, rejum, serwall, anchovies, dogol shrimp, giant prawns, white prawns, and prawns.

Furthermore, it was explained that there were two types of fish resources which were the main catches of cager nets, namely rebon shrimp at 1729.1 kg (30.1%) and anchovies at 774.5 kg (13.5%). Furthermore, there are 15 types of fish resources caught in cager nets that can be categorized as by-catch, namely white shrimp of 554.3 kg (9.4%), dogol shrimp of 418.2 kg (7.1%), giant prawns of 346.1 kg (6.1%), as much as 272.4 kg (4.7%), kurau by 233.9 kg (4.6%), chicken feathers by 231.7 kg (4.4%), mullet by 215 kg (3.7%), gulamah by 207.6 kg (3.6%), cendro by 194.2 kg (3.4%), rejum by 127.2 kg (2.4%). , beloso by 121.6 kg (2.1%), kerong-kerong by 113.1 kg (1.9%), milkfish by 76.6 kg (1.3%), crab by 67.5 kg (1 .2%), and the last eel was 49 kg (0.8%).

According to [11] that these environmental parameters will affect the distribution of fish, migration, aggregation (grouping), spawning and food supplies, as well as fish behavior. Furthermore, [12] said that the pattern of fish life could not be separated from various environmental conditions. Fluctuations in environmental conditions have a great influence on the seasonal migration period, as well as the presence of fish in a place. [13] said that current local oceanographic conditions strongly influence the stage of migration/distribution of pelagic fish.

For the overall catch of each phase of the month, the price received by fishermen is relatively low. The thing that should be the government's attention is how to shorten the marketing system of fishery products. [10] The highest average catch occurred during dark moon conditions, 356.14 kg. Then, in a row, the semi-bright moon phase 1 was 306.38 kg, the semi-bright moon phase 2 was 290.54 kg, and the bright moon phase was 210.8 kg. Furthermore, based on the results of the t-test and Anova test above, the results of both are rejected H0. Therefore, to find out which treatments give different values to the number of fish caught, further tests are needed. The further test used was the BNT test (Least Significant Difference) or LSD (Least Significant Difference) test. The catch during the dark moon phase differed significantly from the light and semi-bright moon phases (1 and 2). This can be seen from the significance value (0.000) <0.05. During the bright moon phase, the catch showed a difference from the catch during the dark moon phase and semi-bright one and semi-bright 2 (sig. 0.000 < 0.05). While the catch during the semi-bright phase 1 and the semi-bright phase 2 showed a difference from the catch during the dark moon phase and bright moon phase (sig. 0.000 < 0.05). However, the catches during this lunar phase were not significantly different. This can be seen from the significance value (0.116) > 0.05.

[14] The lowest average catch occurred in the bright/full moon phase, 210.8 kg. During the bright/full moon phase, the tides tend to be stronger than usual, and the strong currents make the plankton as fish food move quickly, even erratically. This causes the fish to fast for food. As a result, the catch of cager net fishermen during the bright/full moon phase is reduced/decreased. Meanwhile, the highest average catch occurred during the dark moon phase, which was 356.14 kg. Furthermore, it is explained that the sea currents due to tides tend to be calm during the dark moon phase. The availability of food in the form of plankton is also abundant. So many fish are looking for food around the mangrove forest trapped in cager nets. This affects the maximum catch of fishermen during the dark moon phase.

The results of the study [15], at the time of the semi-bright moon phase 1 and semi-bright 2, the average catches of fishermen in this phase did not differ much, namely 306.38 kg and 290.54 kg. This may be due to water conditions, where the waters before and after the bright/full moon phase (semi-bright) are still influenced by high tidal phenomena. The sea currents due to the tides

in the transitional phase from and to the bright moon phase are still faster than the seawater currents due to the tides in the dark moon phase so that the spread of fish is more on the surface[16][17].

4. Conclusion

The tidal conditions are of the single daily tidal type because, in a day, it experiences one high tide at night and one low tide during the day. The highest lunar phase occurs at the full moon, with a value of 185 cm, and the lowest low tide of 42 cm, with an average sea level (mean sea level) of 113.5 cm. The results of the production of trap net fishing gear based on the moon phase in the waters of the Segeri District, Pangkep Regency, South Sulawesi, identified 13 types of catches. The highest number of catches was obtained during the full moon phase, which was 100 kg, followed by the dead moon at 95 kg, the first quarter moon at 95 kg, the last quarter moon at 90 kg, and the dead moon phase at 80 kg.

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