

Environmentally Friendly Analysis on Fishing Gear of Trammel Net in Cilacap, Central Java

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Abstract

The purpose of this study was to analysis about the composition of the catch, the selectivity of fishing gear and fishing gear level of friendliness to the environment. The data collection is done by experimental fishing. Selectivity analysis applied by Shannon diversity index and Simpson dominance index. Analysis of scoring was used to rate the friendliness of fishing gear on the environment. The main target of the catch composition (33.93%) and the by catch (66.07%) of the catch species diversity index was 2,16 to 2,78 (high diversity index; the selectivity of fishing gear is low). Dominance index was 0,36 to 0,50 (did not happen dominance species catches). The total value of the scoring is based on the criteria of degree of friendliness of fishing gear on the environment is the 26 included in the category of less environmentally friendly fishing gear. The catch is dominated by small fish. If it lasts for a long time and continuously, it can adversely affect the conservation of fish resources. It should be a mechanism for management systems such as open and close an area to fishing operations or modifications to fishing gear mechanism which can reduce the yield of bycatch and small ones.

Keywords: composition, selectivity, diversity, dominance and environmentally friendly

INTRODUCTION

Modern fisheries declining resource quality and quantity of fish in different waters of the world for high exploitation [1]. The shrimp fishery in Cilacap also shows there has been a degradation of biological resources shrimp. Since 1980 trammel net is increasingly recognized and widely used by fishermen. Trammel net used as an alternative gear for catching shrimp as a side effect of the banned of trawl. Catching shrimps in Cilacap predominantly use trammel net. The decline occurred in the catch per unit of fishing effort (CPUE) with a trammel net or triple-walled net. This is indicated by the decreasing trend in shrimp production average of 7.2% in 2004-2008 [2].

Trammel net included in the category of gillnet. Trammel net has three layers of netting which is operated on the basis of the waters to catch shrimp. The problem is the use of gillnets on the low quality of the catch and the low selectivity for fish with the size indicated by the size distribution of fish caught [3]. Selectivity can be used as a quantitative measure of the ability of fishing gear on species and sizes. Selectivity depends on the mesh size. Selectivity is also influenced by the value of the hanging ratio. The diversity of the catch (fish size range) decreases with increasing hanging ratio [4].

Fishing method and mesh size net have a major influence on the selectivity [5]. Knowledge of selectivity fishing gear needs to be combined with knowledge of the biological development measures based on the fish species. The biological development such as the size of the first ripe gonads. Such knowledge will help fishermen in setting the appropriate mesh size to catch the target species at the desired size.

Trammel nets including fishing gear category which is less environmentally [6]. Less friendly trammel net fishing gear is mainly on the composition of the catch. Results of bycatch is more than 50% of the total catch. High species diversity index and catches of small fish dominated [7]. If the fishing activity takes place in a long period of time without any management mechanisms such as an open-close system management area or setting fishing gear, it can be feared will affect the sustainability of fish resources.

Development of fishing technologies emphasized in environmentally friendly fishing technology. Environmentally-friendly fishing is expected to make utilization of fishery resources in a sustainability [8]. The development of environmentally friendly fishing gear as directed by

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the Code of Conduct for Responsible Fisheries (CCRF). In principle, environmentally friendly technology has a little or no negative impact on the environment. The objective of this study was to analyze the composition of the catch, the selectivity of fishing gear level and friendliness to the environment.

RESEARCH METHODS

The study was conducted in February-March 2016 in Cilacap, Central Java. The study was conducted by attending fishing operations by fishing gear trammel net with 8 times the trip catching as much as 36 times the stocking and survey in the Fish Landing Base. Catches All catches trammel net in the form of shrimp / fish sampled when the total weight is less than 2 kg. Meanwhile, when the weight of the catch between 3-10 kg sample is taken about 2 kg and if it catches more than 10 kg then sampled as much as 20%.

Environmental friendliness obtained from respondents owner of vessel and gear with reference to the FAO (Food and Agriculture Organisation) CCRF that later developed by Monintja [9] and Sultan [10]. The data collected related to aspects of environmentally friendly, (1) the data selectivity of fishing gear, (2) data on habitat destruction by trammel net, (3) the data quality of the catch, (4) the data security of the use of fishing gear on the operator / fisherman (5) level data security / danger catches to consumers, (6) data by-catch of trammel net, (7) data relating to biodiversity of operation trammel net (8) the data relating to the hazard of fishing gear on the protected fish, (9) the data from fishing operations with a trammel net social acceptance in society.

DATA ANALYSIS

Catch Composition Data

Data are classified according to the catch of the total catch of each species. Data are grouped in order to obtain the composition of catches per species were caught. Side of the catch composition data is calculated based on the percentage weight of each type of individual to total catch. Prior to analysis done to determine the identification of common names and Latin names of fish caught.

Structure size

The calculation of the size structure includes a maximum length, minimum length, the average length of the long and often appears (mode).

Diversity and Dominance

To determine the diversity of fish relating to the selectivity of fishing gear used against targets catching Shannon-Wiener diversity index [11], with the following formula:

$$H' = \sum P_i \ln P_i$$

$$H' = \sum \left(\frac{n_i}{N} \right) \ln \left(\frac{n_i}{N} \right)$$

Information :

H' = Shannon-Wiener diversity diversity

n_i = number of individuals of species to -i

N = number of individuals of all species

The range of diversity index value of the catch

> 1 high diversity, low selectivity of fishing gear

≈ 0 low diversity, high selectivity of fishing gear

This analysis was conducted to determine the dominant species catches associated with fishing gear selectivity towards the target of arrests. Simpson dominance analysis [12] with the following formula:

$$C = \sum_{i=1}^s \left(\frac{n_i}{N} \right)^2$$

Information :

S = number of species

c = Simpson dominance index

n_i = number of individuals of species -i

N = number of individuals of all species

> 1 dominance of high, low selectivity of fishing gear

≈ 0 dominance low, the high selectivity of fishing gear

Environmental friendliness fishing gear

Data analysis was performed with a trammel net friendliness process data obtained from field observation and description of the respondent in accordance with the criteria and sub-criteria contained in the benchmark analysis of environmentally friendly aspects. From the results of respondents were weighted (value). Weight given ranges from 1 to 4. The weight of 9 criteria are then summed and categorized in this level of hospitality gear [13].

RESULTS AND DISCUSSION

Catch composition

The identification results trammel net caught fish obtained as many as 30 species, divided into two groups of organisms that target and by catch. The catch is composed of two types of fish and shrimp. The catches consist of shrimp / crab found 8 species and 22 fish species (Table 1).

Based on the weight of the fish for the main form of shrimp catches are dominated by banana shrimp (*Penaeus merguensis*) of 25.75% of the total catch. To fish is dominated by a croaker fish (*Johnius coruna*) by 11.56%. A number as a result of bycatch and discarded is mantis shrimp to 7.52%. A fish species dominate where trammel net operated, it can be suspected catches will continue to be dominated by these species.

Table 1. The fish composition caught trammel net in Cilacap

No.	Fish Catch		Amount	
	Target Catch		Weight (kg)	%
	Nama Umum	Nama Latin		
1	Tiger Shrimp	<i>Penaeus monodon</i>	2.4	0.97
2	Banana shrimp	<i>Penaeus merguensis</i>	63.7	25.75
3	Rainbow shrimp	<i>Parapenaeus scudipennis</i>	6.95	2.81
4	Endeavour shrimp	<i>Metapenaeus ensis</i>	8.3	3.35
5	Orange shrimp	<i>Atypopenaeus formosus</i>	1.75	0.71
6	small white shrimp	<i>Metapenaeus lysianassa</i>	0.85	0.34
	Sub total I		83.95	33.93
II	By-catch			
1	Carour Croacker	<i>Johnius coruna</i>	28.6	11.56
2	Bighead Pennah Croacker	<i>Pennahia macrocephalus</i>	20.2	8.16
3	Bluecheek Grunt	<i>Pamadasys argyreus</i>	6.5	2.63
4	Donkey Croacker	<i>Pennahia anea</i>	2.3	0.93
5	Splendid Threadfin	<i>Filimanus perplexa</i>	7.5	3.03
6	Yellowthread Threadfin	<i>Filimanus Xanthonema</i>	0.1	0.04
7	Common hairfin Anchovy	<i>Septipinna tenuifilis</i>	13.2	5.34
8	Tardoore	<i>Opisthopterus tardore</i>	9.5	3.84
9	Tigertooth Croacker	<i>Otolithes ruber</i>	10.7	4.32
10	Saddle Grunt	<i>Pamadasys maculatus</i>	1.8	0.73
11	Swimming crabs	<i>portunus pelagicus</i>	13.5	5.46
12	Light/blue green	<i>Panilurus versicolor</i>	0.3	0.12
13	Moustached Thryssa	<i>Thryssa mystax</i>	6.9	2.79
14	Tonguesole	<i>Cynoglossus sp.</i>	9.15	3.70
15	Indian halibut	<i>Psettodes erumei</i>	1.75	0.71
16	Cuttlefish	<i>Sepia spp.</i>	0.65	0.26
17	Giant Sea Catfish	<i>Netuma thalassina</i>	1.6	0.65
18	Rough Flathead	<i>Grammoplitis scaber</i>	1.6	0.65
19	Jones Ponyfish	<i>Eubleekeria jonesi</i>	3.3	1.33
20	Largescale Grunter	<i>Terapon theraps</i>	1.1	0.44
21	Ponyfish	<i>Equulites sp.</i>	0.5	0.20
22	White spotted whipray	<i>Hematuria gerrardi</i>	3.2	1.29
23	Bombay Duck	<i>Herpadon nehereus</i>	0.9	0.36
24	Mantis shrimp	<i>Squilla spp.</i>	18.6	7.52
	Sub Total II		163.45	66.07
	Total		247.4	

The composition of the catch is also influenced by the structure of the community and the fishing season in the fishing areas. Total catch during the trip is as much as 247.4 kg catching details catches target Catch 83.95 Kg (33.93%) and by-catch 163.65 kg (66.07%).

Based on the measurement of trammel net catches obtained very sufficient size. Species caught have a fairly large size variation. Shrimp as the main catches have a carapace length variations in size from 1.30 to 5.93 cm and for the length of the fish caught from 7 cm to 32 cm. The size of the body girth gained 3 cm to 17 cm. The body girth of the fish are caught, it is likely that the net has an opening that is low so shrimp / small fish can be caught in the net.

The data size carapace length on shrimp catches, tiger shrimp (*Penaeus monodon*) has length 3,22 to 5,93 cm with mode value of 3.54 cm, banana shrimp (*Penaeus merguensis*) obtained length 1,40 to 5,41 cm with mode value 3,17 cm, endeavor shrimp (*Metapenaeus ensis*) has length 2,0 to 4,95 cm with mode value of 3.16 cm, rainbow shrimp (*Parapenaeus scudipennis*) has length 1,3 to 2,8 cm with mode value of 2.19 cm, orange shrimp (*Atypopenaeus formosus*) has length 1,42 to 3,1 cm with mode value of 2,43 cm and small white shrimp (*Metapenaeus lysianassa*) has length 1,3 to 2,5 cm with mode value of 2,30 cm.

To catch the dominant fish are croacker fish (*Johnius coruna*, *Pennahia macrocephalus*). Total length for *Johnius coruna* gained 8.5 to 19 cm and body girth 5.5 to 12 cm by mode of length value 14.22 cm. *Pennahia macrocephalus* obtained length range from 10 to 16.5 cm and body girth 6.5 to 9.5 cm with a mode value of 12.31 cm (Figure 1). The maximum total length for croacker fish (*Johnius coruna*, *Pennahia macrocephalus*) is 30 cm and 29 cm [14]. This indicates that the fish were caught still in the category of small size.

Opisthopterus tardore which is one of the catch in large quantities, has the same flat shape with *Septipinna tenuifilis* is thin, elongated and tail forked. This type of fish caught trammel net on a fork lengths 6.5 to 21 cm, 7 - 16,5 cm with each mode value of 17.55 cm and 13.15 cm (Figure 2). *Opisthopterus tardore* caught up with the size of the body girth 3 to 12.6 cm, *Septipinna tenuifilis* 5-9 cm. Based on observation at fish landing sites, the larger size of these types of fish caught by other fishing gear such as Bottom gillnet (jaring sirang).

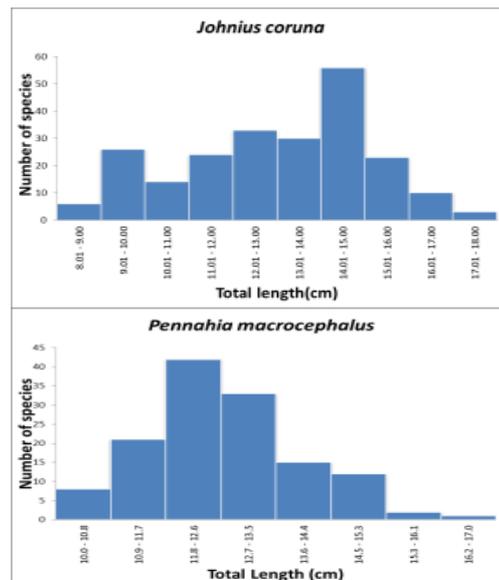


Figure 1. Composition of length croacker fish (*Johnius coruna* and *Pennahia macrocephalus*)

Other fish caught are tonguesole fish (*Cynoglossus sp.*) which has a thin wide body to the side. The tonguesole fish caught by trammel net in the size range of 11 to 19.9 cm in total length and the body girth 7-10 cm by 13.94 cm mode (Figure 3). The tonguesole fish with a large size between 25-35 cm was found in the results of other fishing gear such as sirang nets which has a larger mesh size. This shows that the tongue fish caught by trammel net is still small in size.

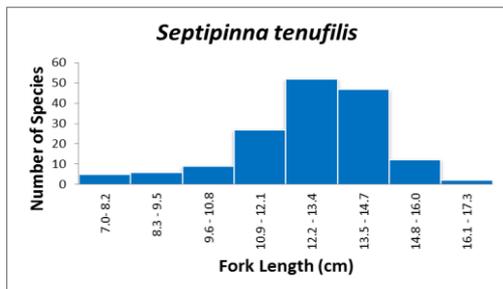
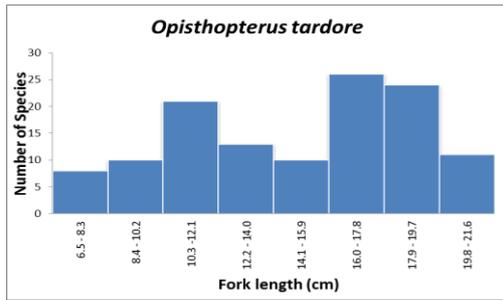


Figure 2. The composition of length *Opisthopterus tardore* and *Septipinna tenuifilis*

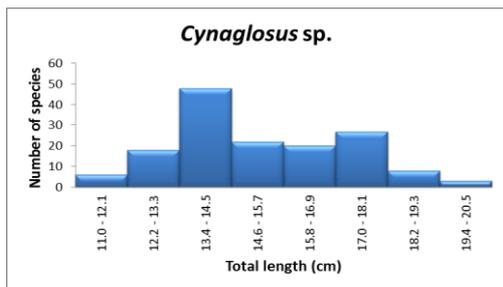


Figure 3. Composition of tonguesole fish (*Cynoglossus* sp.)

The swimming crab (*Portunus pelagicus*) caught by trammel net has a carapace length from 4.5 to 13 cm. At the observation on board when the withdrawal of nets that crabs caught a lot of which are still small in size which of dominated carapace length 4,5 - 5,5 cm and generally discarded. Mantis shrimp (*Squilla* spp.) have also captured still in small size the total length of between 10 -14.5 cm and discarded.

Diversity and Dominance

Diversity index of the catch when the research is in February and March 2016 are presented in Figures 4 and 5. The diversity index illustrates the diversity of fish during the study.

The figure 4 shows that the highest diversity index of 2.78 and a trip to the third lowest in the trip to 2 of 2.16, but when seen diversity index value of each catch is not too different. This diversity index values were high, namely more than 1. This shows that the diversity of species in the waters of Cilacap high. High value diversity index also showed that the low selectivity of trammel net.

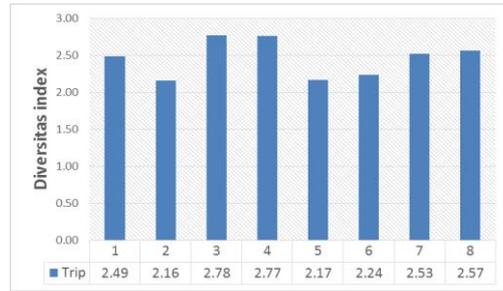


Figure 4. Diversity index trammel net catches in Cilacap

Lowest dominance index value on the trip to 2 of 0.36 and the highest on the trip to 6 of 0.50 (Figure 5). It is low dominance value close to 0. dominance value less than the value of 1 indicates that the trammel net fishing gear selectivity is low.

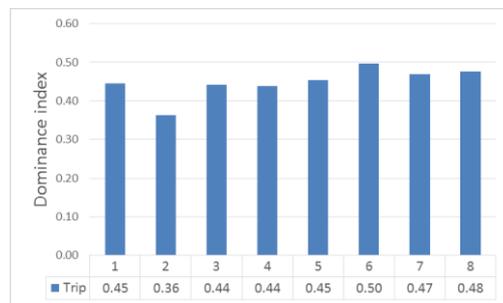


Figure 5. Dominance index trammel net catches in Cilacap

Environmental friendliness Trammel Net

Based on direct observation in the field and supported by the testimony of fishermen result of the level of friendliness criteria trammel net fishing gear as follows:

1. High selectivity

Trammel net catches are highly variable in terms of size and type. The catch on each trip more than three species of fish and shrimp. Trammel net total catch during the study caught 30 species of shrimp / fish. For shrimp caught carapace length ranging from 1.3 cm to 5.93 cm while the size of the fish caught with a length of size 7 cm to 19.9 cm. The body girth of fish for the results from 3 cm to 17 cm. The fish and shrimp are caught too much in a small category. So for this criterion trammel net fishing gear is given a value 1 which is a tool captures more of the three species with vastly different sizes.

2. Do not damage the habitat

Trammel net operated on the basis of nearshore to target caught shrimp. These gear has a length of 40 m per piece and 9 piece per unit of fishing gear can capture with a quite wide range. Coastal waters is an area of orphan fish so trammel net potentially capture still a small fish. Operating trammel net but this will only damage the habitat of

the area where the gear is operated. For this criterion trammel net fishing gear in Cilacap is valued 3 that cause habitat destruction on small areas.

3. Produce high-quality fish

The time between setting and hauling operation of the trammel net is relatively short. The fish was not long entangled in the nets so still in a fresh state. So to the criteria of the catch, trammel net in Cilacap assigned value 3 that fish caught in dead condition and fresh. Damage to the catch usually occurs because when taking the fish out of the shackles of the net a little difficult so it's kind of a little fish will be forced to speed up the release process.

4. No harm to fishermen

Trammel net can have an impact on the health of fishermen will be but temporary as injured, sprains and others. This is because the gear is operated manually in setting and hauling. But the danger level also depends on the skills of fishermen in operating gear. For security criteria trammel net for fishermen in Cilacap is assigned a value 3 that there are health problems are temporary.

5. Production Not harmful to consumers

In the operation of trammel net which is operational in territory waters Cilacap only one day (one day fishing), where to store the catch just use ice. So trammel net catches very little opportunity for the health of consumers. Based on the information fishermen and traders in Cilacap that never happens poisoning in people who eat fish from the fishermen trammel net. So for this friendliness criteria given value 4 that the catch is safe for consumers.

6. By-catch

The results obtained bycatch fishing trammel net average of more than 10 species. In total bycatch during the course of research for 66.07% of the total catch and 24 species. Not all types of catches economically valuable bycatch. There are species caught and thrown into the sea like a mantis shrimp (*Squilla* spp.) and swimming crab (*Portunus pelagicus*), which is quite a lot. Most of by catch of trammel net salable in the market but the price is very low. Trammel net caught fish if mixed only priced at Rp. 2,000 - Rp. 3,000 per Kg. Mantis shrimp and crab almost all discarded because small so that they do not sell in the market. The fish bycatch were purchased merchants usually sorted again, small size usually used as feed ducks or catfish and larger for consumption. So for this criterion is given a weight of 2 is the result of bycatch consists of several species and there is a market behavior.

7. Impact on biodiversity

Trammel net fishing gear based on field observation tool can lead to the death of some species and can damage the habitat. This is related to the degree of selectivity of fishing gear. Trammel net has a low selectivity so many species that can be caught with vastly different sizes. If this trend continues constantly with the intensity of catching big enough lead to resource pressure that can impact the diversity of biological resources in the waters. For it was on this criterion is given a weight of 2 which led to the death of some species and habitat damage.

8. Security on protected species

The impact on the protected fish, fishing gear trammel net is a fishing gear that never catches of protected species. This can be seen in the current study found no protected fish species caught in trammel net. Also based on the testimony of fishermen that during capture with a trammel net never existed participate protected fish species caught in fishing gear. Therefore, for this criterion given weight 4 is a fish that enter the category of protected no one ever caught.

9. Social acceptance

Based on the information that the fishermen for fishing unit trammel net investas quite expensive. Price per unit ships reached Rp. 300.000.000, - including engines, fishing gear and all accessories. However trammel net, including favorable for small fishermen. Fishing gear is never likely to cause conflicts with other gear. Trammel net is a fishing gear used as a substitute for government banned trawling to catch shrimp, so it is not an illegal fishing gear.

There are things to be aware of the trammel net fishing gear that catches must be recorded as a media control to maintain its sustainability. The catch is often not recorded and reported, the fish were recorded only in the form of catches of shrimp and sold through an auction process on the auction place. The catch is in the form of fish sold directly the basket without any data collection process. Most fishermen do not follow the auction process at the time of the sale of the catch. With such information may be given trammel net value of 3 that the criteria the fishing gear into the category of major investments, profitable, does not conflict with the local culture, and does not conflict with existing regulations.

The results of the scoring calculation trammel net fishing gear in Cilacap is 25. From the scoring of trammel net value included in the criteria for fishing gear that is less environmentally friendly. Therefore these types of gear are in high yield by catch small fish and many are considered young.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

- 1) Trammel net fishing gear operating in Cilacap is not selective for the catch. The fish were caught consists of 30 species of fish with a low dominance values of the catches from 0,36 to 0,50 and a high diversity between 2,16 to 2,78. This occurs because the fishing area near the beach.
- 2) Trammel net based on the assessment criteria included environmental friendliness less environmentally friendly category with a value 25. This value is lower primarily on the criterion of selectivity devices and the high number of catches (by catch).

Recommendation

Need to do the monitoring and control of mesh sizes and hanging ratio trammel net in Cilacap that the dimensions of fishing gear used fixed ideal (optimum) thus ensuring the sustainability of fishery resources is maintained. There should be regulations on trammel net to measure net permitted particularly in Cilacap.

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REFERENCES

- [1]. Fauzi, A. 2010. Ekonomi Perikanan : Teori kebijakan dan pengelolaan. Gramedia Pustaka Utama. Jakarta. 259 hal.
- [2]. Pangesti, T.P. 2011. Model pengelolaan udang *Penaideae spp.* di Kabupaten Cilacap Provinsi Jawa Tengah. Thesis. IPB. 73 pp [unpublished]
- [3]. Arami, H. 2006. Seleksi Teknologi Penangkapan Ikan Karang dalam Rangka Pengembangan Perikanan Tangkap Berwawasan Lingkungan di Kepulauan Wakatobi, Sulawesi Tenggara. (Tesis) IPB. Bogor. [unpublished]
- [4]. Rengi, P. 2002. Pengaruh *Hanging Ratio* terhadap selektivitas *drift gillnet : experimental fishing* di Perairan kab. Bengkalis Riau. Tesis. Pascasarjana IPB. Bogor. 123 pp [unpublished]
- [5]. Sparre, P. Dan C. Venema. 1998. *Introduksi Pengkajian Stok Ikan Tropis*. Jakarta. Terjemahan Puslitbangkan 1999. p. 438
- [6]. Sumardi, Z., A.A. Sarong dan M. Nasir. 2014. Alat Penangkapan ikan yang ramah lingkungan berbasis *Code of Conduct for Responsible Fisheries* di Kota Banda Aceh. Universitas Syiah Kuala. Banda Aceh. *Jurnal Agrisep* 15(2):10-18
- [7]. Kertawijaya, T., Ardani, E. Hamka, D.Komarudin, A.K.Jati, I.M.Thenu, S.P.Febri, dan K. Saleh. 2011. Analisis Keramahan Lingkungan Alat Tangkap Trammel Net di Teluk Pelabuhanratu. *Buletin PSP*. ISSN:0251-286X. Vol 19 No 3.
- [8]. FAO. 1995. *Code of Conduct for Responsible for Fisheries*. FAO Fisheries Departement. 24p.
- [9]. Monintja, D.R. 2001. Pemanfaatan Sumberdaya Pesisir dalam Bidang Perikanan Tangkap. Prosiding pelatihan untuk pengelolaan wilayah pesisir terpadu. Pusat Kajian Sumberdaya Pesisir dan Lautan, Institut Pertanian Bogor. 156 hal.
- [10]. Sultan, M. 2004. Pengembangan perikanan tangkap dikawasan taman nasional laut Taka Bonerate. Disertasi. Pascasarjana IPB. Bogor.pp.174 [unpublished]
- [11]. Brower, J. E and J.H. Zer. 1990. *Fields and laboratory for general Ecology*. 3rd. Dubuque, Iowa:wm, C. Brown Publisher.
- [12]. Simpson, E.H. 1949. *Measurement on diversity*. Nature. Lond.
- [13]. Mallawa, A., Najamuddin, M. Zainuddin, Musbir, Abustang, Safruddin dan Fakhrol. 2006. Studi pendugaan potensi perikanan dan kelautan di kabupaten selayar. Fakultas Ilmu Kelautan dan Perikanan. UNHAS
- [14]. White, W.T., P.R. Last, Dharmadi, R. Faizah, U. Chodrijah, B.I. Prisantoso, J.J. Pagonoski, M. Puckridge and S.J.M. Blabar. 2013. *Market fishes of Indonesia*. ACIAR Monograph No. 155.437.p