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⁵**Comparison of sustainability level of Skipjack Tuna (*Katsuwonus pelamis*) purse seines operated inside and outside FADs areas in the Makassar Strait Waters, South Sulawesi Indonesia**

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Abstract. Skipjack tuna is an important fishery commodity in the Makassar Strait waters, exploited by fishermen using various types of fishing gear. The study was conducted in March 2017 to November 2018 with the aim of analyzing the level of sustainability of skipjack fishing technology in the Makassar Strait waters. Data on biological, technical, economic, social, and legal aspects are collected through direct observation and interviews. The sustained level of fishing technologies is analyzed using the scoring method. The results that there are differences between purse seine operated inside and outside FADs areas in terms of the size structure of fish, percentage of eligible size to catch, the impact of technologies on the habitat, diversity, and fishermen, and bycatch. It is not different in terms of the quality of fish caught, the impact on consumers, the value of the investment, the amount of labor, business profits, and the legality. The research concluded that purse seines operated outside the FADs areas have a moderate level of sustainability, and purse seines operated inside the FADs areas have a low level of sustainability.

1. Introduction

⁷The Makassar Strait waters are part of the Indonesia Fisheries Management Area (WPPRI) 713. The Makassar Strait waters are flanked by the Pacific Ocean in the north, and the Indian Ocean in the south and are thought to be feeding and nursery areas of various large pelagic fishes such as yellowfin tuna (*Thunnus albacares*), narrow barred Spanish mackerel (*Scomberomorus commerson*), Indo Pacific King Mackerel (*Scomberomorus guttatus*), skipjack tuna (*Katsuwonus pelamis*) and others [1]. Of the various types of large pelagic fish, skipjack fish occupies the first position in the production of large pelagic fisheries in WPPNRI 713 [2]. Fishermen in skipjack tuna fishing generally use traditional small-scale fishing technologies such as traditional lift net, hand line, vertical hand line, as well as medium-scale semi-modern technology such as long surface line, drift surface gill net and purse seine. In practice, fishermen in Makassar Strait waters use two types of purse seines, namely purse seines, which are operated in the FAD area and purse seine outside the FAD area [2,3]. The operation of purse seine in the FAD area can reduce the uncertainty of the fishing area, reduce the cost of finding a group of fish [4], can increase the productivity of fishing gear [5,6]. However, it can cause the dominant small-sized tuna fish or young fish in the catch of fishermen [7-11], and increasing the number of bycatch in fishermen catches [5,12-17]. The use of FADs can damage habits in narrow environments [11].

Research on the sustainability of the skipjack purse seine is still lacking. Several recorded studies are the level of technology, sustainability of skipjack fishing in Bone Bay waters [11] and in the Flores Sea waters [2]. The management concept of skipjack tuna fisheries within the Bone Bay zone in the perspective of sustainability [18], environmental friendliness of purse seine in Aceh waters [19].

Based on the description above, it is necessary to study the level of sustainability of the purse seines that are operated inside and outside the FADs areas. This study aims to compare the level of sustainability of purse seine inside and outside FAD areas. The results of the study can be preliminary information for decision-makers to determine policies in the development of purse seine fisheries in the waters of the Makassar Strait.

8 Research method

2.1. Time and place

This research was conducted for 24 months, namely from April 2017 - October 2018 in the waters of the Makassar Strait in South Sulawesi. The research location is presented in figure 1.

2.2. Materials and equipments

Materials used in this study include skipjack fish, some chemicals, and office stationery, while the research equipment includes two units of purse seiners, FADs, GPS, digital cameras, measuring boards, digital scales, computers, and software.

2.3. Data collection

The research data includes the size of skipjack fishermen's catches, bycatch, quality of catches, the impact of technology on biodiversity, impacts on the habitats, fuel use, investment costs, business profits, the legality of fishing gear according to national and international regulations as well as local customs and wisdom. Collected through direct observation during fishing operations take place and interviews with purse seine fishermen, owners of fishing units, and policymakers.

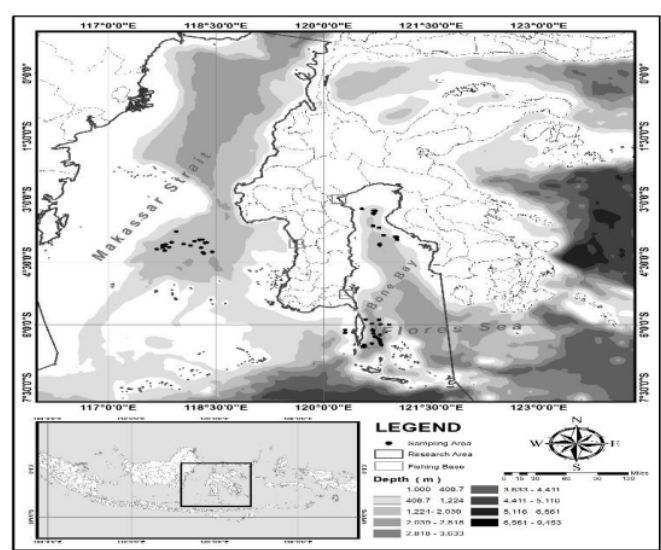


Figure 1. Location of the research (Makassar Strait (Source Mallawa, 2020).

2.4. *22*ta analysis

The analysis of the sustainability level of purse seine operated in the FAD area and outside the FAD was analyzed using the scoring method [1], as presented in Table 1.

Table 1. The sustainability analysis of purse seine inside FADs and outside FADs areas.

No	Sustainability variables	Weight	Value	Weight* value
1	Size structure of skipjack in catches ¹	1,00		
	1.1 catches dominated by young fish		1	
	1.2 catches dominated by young & preadult fish ²		2	....
	1.3 catches dominated by preadult & adult fish		3	
	1.4 catches dominated by adult fish		4	
2	Percentage of eligible size in catch	1,00		
	2.1 0 – <10 % eligible size in catch		1	
	2.2 10 – < 30 % eligible size in catch		2	....
	2.3 30 – <50 % eligible size in catch		3	
	2.4 ≥ 50 % eligible size in catch		4	
3	Impact of technology to habitat	0,75		
	3.1 damaged habitat in the wide area		1	
	3.2 damaged habitat in the narrow area		2	....
	3.3 damage a part of habitat in the narrow area		3	
	3.4 safety for habitat		4	
4	Quality of fish product	0,50		
	4.1 dead and rotten fishes		1	
	4.2 dead fishes and physical deformity		2	....
	4.3 dead and fresh fishes		3	
	4.4 live fishes		4	
5	The impact of using technology on fishermen	0,50		
	5.1 can cause death		1	....
	5.2 can result in defects		2	
	5.3 can interfere with the user's health		3	
	5.4 safe for fishermen users		4	
6	Impact of the fish product on consumers	0,50		
	6.1 likely to cause death		1	
	6.2 cause health problems		2	....
	6.3 relatively safe for consumers		3	
	6.4 safe for consumers		4	
7	By catches	0,75		
	7.1 bycatch consists of several unsold species		1	....
	7.2 bycatch consists of several species, and there can be sold		2	
	7.3 bycatch < 3 species and sold		3	
	7.4 bycatch <3 species and high value		4	
8	Impact on the diversity of aquatic organisms	0,75		
	8.1 often captures protected marine organisms		1	....
			2	

	8.2 several times capturing protected marine organisms,		3	
	8.3 have ever captured protected marine organisms		4	
	8.4 never catch protected marine organisms			
9	The use of fuel oil	0,75		
	9.1 fuel use > IDR 2 million / trip		1	
	9.2 fuel usage of IDR 1.0 - 2.0 million / trip		2	....
	9.3 fuel usage IDR. 0.5 – 1.0 million/trip		3	
	9.4 fuel use < IDR 0.5 million / trip		4	
10	Value of investment costs ²⁾	1,00		
	10.1 investment value > IDR 500 million		1	
	10.2 investment value of IDR > 400 - 500 million		2	....
	10.3 investment value of IDR 300 - 400 million		3	
	10.4 investment value < IDR 300 million		4	
11	Total labor use	0,50		
	11.1 using < 5 workers		1	
	11.2 using 5 - < 10 workers		2	....
	11.3 using 10 - < 15 workers		3	
	11.4 using >15 workers		4	
12	Value of business profits	0,50		
	12.1 business profit < IDR 100 million / year		1	....
	12/2 business profit IDR 100 - < 250 million/year		2	
	12.3 business profit IDR 250-500 million/year		3	
	12.4 business profit > IDR 500 million/year		4	
13	Legal according to national and international regulations	0,50		
	13.1 contrary to more two regulations		1	....
	13.2 contrary to two regulations		2	
	13.3 contrary to one regulation		3	
	13.4 not against any of the rules		4	
14	Relation to local customs and wisdom	0,50		
	14.1 very contrary to local customs and wisdom,		1	....
	14.2 contrary to local customs and wisdom,		2	
	14.3 slightly contrary to local customs and wisdom,		3	
	14.4 not contrary to local customs and wisdom,		4	
Total weight*value				...

Explanation: ¹⁾ young fish (< 40 cm of length), preadult fish (> 40 – 50 cm of length), adult fish (> 50 cm of length), ²⁾ the cost of procuring one unit of purse seine

The dominant size of skipjack in the catch can be known through descriptive analysis by plotted the middle-class length value and the relative frequency of each length class and presented in the column diagram [1]. The percentage of sizeable tuna fish in the catch is obtained by comparing the number of size fish that have been spawned and the number of fish in the catch. The size of skipjack tuna that has been spawned is ≥ 55 cmFL [1].

The level of sustainability is calculated using the Mallowa et al. method [20] equation as follow:

$$SL = (\sum Wi * Vi) / Vf \quad (1)$$

Where,

SL is sustainability level of technology

Wi is weighted of variable i,

Vi is value of variable i,

Vf is full value of all variable (40)

i = 1,2,3,.....n

The categories of the sustainability level of fishing technology are:

$\geq 80\%$, is high sustainable

$\geq 65 - < 80\%$, is moderate sustainable

$\geq 50 - < 65$, is low sustainable

$< 50\%$, is not sustainable

9 3. Results and discussion

3.1 Size structure

The observation results that skipjack tuna catches purse seines inside FADS areas are dominated by ¹³ small size fish or young fish, while skipjack tuna catches purse seines outside FADS areas are dominated by young fish and adult fish (Figure 2 and 3).

2 3.2 Eligible size to catch

Based on the size of skipjack tuna that has been spawned (55 cm FL), it can be seen that the ² percentage of eligible sizes to catch in catches of purse seines inside FADs areas is smaller (6.50%) compared to purse seines outside FADs areas (17.41%).

3.3 Impact of technology on the habitat

Field observations show that purse seine inside FADs areas causes habitat damage to a narrow extent and leaves remnants of unused FADs at sea, while purse seine outside is safe for the habitat.

3.4 Quality of fish products

Skipjack tuna produced in purse seines inside and outside FADs areas has died and fresh. The high freshness of skipjack tuna is due to handling through the provision of good ice.

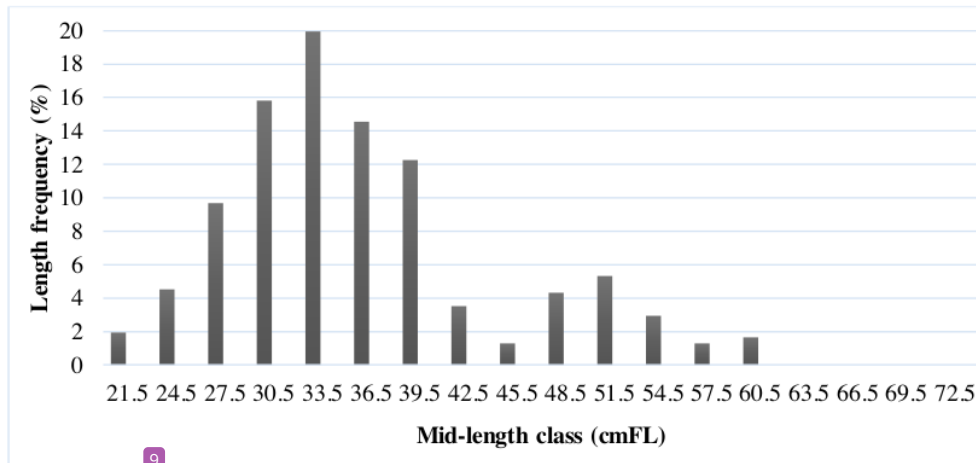


Figure 2. Size structures of skipjack in purse seines inside of the FADs areas.

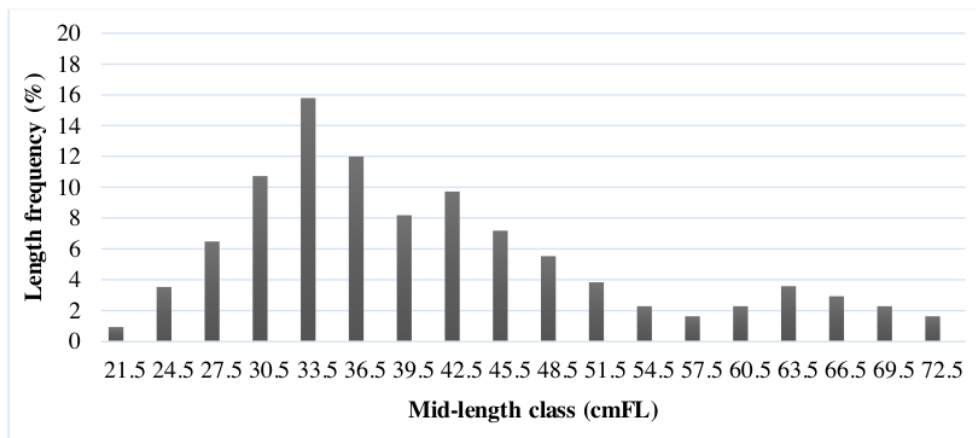


Figure 3. Size structures of skipjack in purse seines outside of the FADs areas.

3.5 Impact of technology on fishermen

The practice of detecting the presence of fish in FADs through diving without using standard equipment on the purse seines inside the FADs area can cause disruption to fishermen's health such as damage to the eardrum, while on purse seines outside the FADs the practice is not carried out so that it is safe for fishermen users.

3.6 Impact of fish products on consumers

Skipjack fish and other fish catch purse seines inside and outside FADs areas use post-capture handling properly and in a fresh condition, so it is safe for those who eat it.

3.7 Bycatch

Field observations show that in purse seine inside FAD areas, other than skipjack fish, frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rohei*), juvenile of yellowfin tuna (*Thunnus albacares*), Indian mackerel (*Rastrelliger spp*), sardine (*Sardinella spp*), sharks (*Charcahinus sp & Sphyrna sp*), the dolphins, sea turtles (*Chelonidia*) and others. While purse seines outside FADs areas bycatch include juvenile yellowfin tuna, frigate tuna, bullet tuna, Indian mackerel, sardine, and sometimes also caught dolphins, sharks.

3.8 Impact of technology on the diversity of aquatic organisms

Field observations show that the purse seines inside the FADs areas are always caught by one of the protected marine organisms, namely sharks or turtles or dolphins, while purse seines outside the FADs areas are frequently caught one of the protected marine organisms.

3.9 Fuel usages

The observation results that purse seines inside FADs spend less money than purse seine outside FADs to purchase fuel in one trip. The difference in the value of fuel use between the two technologies is because the purse seines inside the FADs area go directly to the FADs for fishing, while the purse seines outside the FADs area go around looking for fish hordes and this uses a lot of fuel.

3.10 Value of investment

The investment value of purse seine inside and outside FADs areas is not much different. Although the purse seines inside the FADs area have additional investment to purchase FADs, more investment also occurs in the purse seines outside the FADs areas in the purchase of fishing gear and vessels. The size of the purse seines outside the FADs area, and the ship is slightly larger than the purse seines inside the FADs area.

3.11 Labour usage

The amount of labor used in the operation of purse seines inside and outside the FADs area is almost the same.

3.12 Value of business profits

The value of business profits is influenced by differences in the amount of investment value that results in the amount of depreciation value, real operating costs, catches, size of fish caught, or the price of fish per fish and others. The value of profit between the two technologies is not much different.

3.13 Legality of technology

The results of the legality assessment of each technology refer to the national, international as well as local regulations showed that the purse seines inside the FADs area contradict the national regulations namely Regulation of Ministry of Maritime and Fishery of Republic of Indonesia number 18/2016 concerning fishing lanes and the placement of fishing gear [21]. It was also contradicted with the Code of Conduct for Responsible Fisheries concerning is not catching protected marine organisms [22]. At the same time, purse seines outside the FAD area are against the regulation of not catching protected marine organisms.

3.14 Local customs and wisdom

Interview results that purse seines inside and outside FADs areas do not conflict with local customs and wisdom. Comparison of purse seine inside and outside FADs area according to 14 variables of the level of sustainability of technology as presented in Table 2.

Table 2. The 14 sustainability level variables of purse seine inside and outside FADs areas.

Sustainability Variables	Purse Seine Inside FAD	Purse Seine Outside FAD
Size structure of fish in the catch	Smallest fish 20.5 cmFL Largest fish 62.5 cmFL Dominant size 27.5-39.5 cm FL (young fishes)	Smallest fish 21.5 cmFL Largest fish 72.5 cmFL Dominant size 27.5-48.5 cmFL (young and preadult fishes)
Eligible size to catch	6.50%	17.41%
Impact of technology to habitats	Damage a part of habitat in the narrow area	Safety for habitat
Quality of fish product	Dead and fresh fishes	Dead and fresh fishes
The impact of using technology on fishermen	Can interfere with the user's health	Safe for fishermen
Impact of fish product to consumers	Fish product is safe for consumers	Fish product is safe for consumers
By catches	Bycatch consists of several unsold species	Bycatch consists of several unsold species
Impact of technology on the diversity of marine organisms	Often captures protected marine organisms	Several times capturing protected marine organisms,
The use of fuel oil (IDR million)	0.30–0.40	0.50–0.75
Value of investment costs (IDR million)	450 – 500	400 – 500
Total labor use (person/unit)	10 – 13	10 – 12
Value of business profits (IDR million/year)	350 – 500	300 – 500
Legal according to national and international regulations	Contrary to two regulations	Contrary to one regulation
Relation to local customs and wisdom	Not contrary to local customs and wisdom	Not contrary to local customs and wisdom

Based on direct observations and interviews obtained in Table 2, and the values that should be given as shown in Table 1, an analysis of the sustainability of purse seines inside and outside the FADs areas are presented in Tables 3 and 4.

Table 3. Sustainability analysis of purse seine operated inside FADs areas.

Sustainability Variables	Weight	Value*	Weight*Value
The size structure of skipjack in catch	1,00	1	1.00
Percentage of eligible size to catch in catch	1,00	1	1.00
Impact of technology to habitat	0,75	3	2.25
Quality of fish product	0,50	3	1.50
Impact of using technology on fishermen	0,50	3	1.50
Impact of fish product to consumers	0,50	4	2.00
By Catch	0,75	2	1.50
Impact of technology on the diversity of marine	0,75	1	0.75

organisms			
The use of fuel oil	0,75	4	3.00
Value of investment costs	1,00	2	2.00
Total labor use	1,00	3	3.00
Value of business profits	0,50	3	1.50
Legal according to national and international regulations	0,50	2	1.00
Relation to local customs and wisdom	0,50	4	2.00
Total weight*value			24.00
Sustainability level (%)			60.00
Sustainability category			Low sustainable

Note: * Grading is based on Table 2 information and rating system in Table 1

Based on the results of the analysis in Table 3, purse seine fishing tuna in the FAD area is categorized as a low level of sustainability or quite sustainable. The low level of sustainability of purse seines inside the FADs area is due to the structure of catches dominated by young fish, the low percentage of eligible size to catch, bycatch of more than three species, always the capture of protected marine organisms, the high value of investment and technology against two regulations.

Based on the results of the analysis in Table 4, purse seines that make arrests of free-swimming school skipjack categorized as moderate sustainability. Several factors cause purse seines outside FAD areas not to be categorized as high sustainability, such as the catches is still dominated by young and adult fish, the percentage of eligible size to catch is not too high. In addition, bycatch more than three species, the impact of technology on the diversity of the marine organisms that are often the capture of protected organisms, and investment are high.

Table 4. Sustainability analysis of purse seine operated outside FADs areas.

Sustainability Variables	Weight	Value*	Weight*Value
The size structure of skipjack in catch	1,00	2	2.00
Percentage of eligible size to catch in catch	1,00	2	2.00
Impact of technology to habitat	0,75	4	3.00
Quality of fish product	0,50	3	1.50
Impact of using technology on fishermen	0,50	4	2.00
Impact of fish product to consumers	0,50	4	2.00
By Catch	0,75	3	2.25
Impact of technology on the diversity of marine organisms	0,75	2	1.50
The use of fuel oil	0,75	3	2.25
Value of investment costs	1,00	2	2.00
Total labor use	1,00	3	3.00
Value of business profits	0,50	3	1.50
Legal according to national and international regulations	0,50	3	1.50
Relation to local customs and wisdom	0,50	4	2.00
Total weight*value			28.50
Sustainability level (%)			71.25
Sustainability category			Moderate Sustainable

Note: * Grading based on Table 2 information and Table 1 values.

Based on the analysis results in Tables 3 and 4, it can be stated that the level of sustainability of purse seines inside and outside the FADs area is different. The difference in the level of sustainability of purse seine inside and outside FADs areas is due to differences in the size structure of the caught fish, percentage of eligible size to catch in catches, the impact of technology on the habitat, the impact of technology on fishermen, bycatch, the impact of technology on the diversity of protected marine organisms, and legality aspect. Of the several causes of differences in the two technologies, the five most prominent factors are size structure of catch, percentage of eligible size to catch, the impact of technology on diversity on the marine organisms, the impact of technology on the habitats, and bycatch. These five findings are related to the use of fish aggregation device (FAD).

The difference in the size structure of skipjack tuna catches inside and outside FADs areas is that the purse seines catches inside FADs area are dominated by young, few preadult and very few adult fish. While purse seine outside FADs areas dominated by young and preadult fish and the percentage of adult fish is higher. Skipjack tuna catches purse seine inside FADs areas are relatively smaller than skipjack tuna catches outside FADs area occurs in Flores Sea waters [10], in Makassar Strait waters [23], in Maldivian waters [24], in the Indian Ocean [25], central Pacific waters [26], western and central Pacific Ocean [27-28].

The difference in the size structure of skipjack fish inside FADs and outside FADs areas is that small-sized skipjack tuna feel more comfortable in a FAD area, and large skipjack tuna has a tendency to be in deeper waters or known as size-dependent migration [6,20].

The difference in eligible size to capture in catches purse seine inside and outside the FADs are mainly due to differences in the size structure of the caught fish. Skipjack tuna caught by purse seines outside the FAD area has a wider size distribution, and there are more adult fishes compared to purse seines inside FADs areas [1,6,10,23]. This also occurs in skipjack tuna and pole and line catch inside and outside the FAD area [29-30]. The use of FADs in tuna fishing in the waters of the Pacific Ocean causes an increase in young fish in catches [7]. The skipjack tuna caught by purse seines in the FAD area in the waters of the Bone Bay is dominated by small-sized fish, and most are not yet eligible to catch [31].

The difference in the influence of the two technologies on the diversity of marine organisms is not only due to the capture of protected marine organisms. The use of FADs can also cause disruption of adult skipjack fish to spawning areas. Catching tuna species, including skipjack tuna using FADs, can disrupt fish migration patterns, can change dietary patterns, growth and survival, and measure structures [8-32].

The difference in the impact of technology on the habitat in the two technologies is caused by the use of FADs. Installation of FADs standing at the bottom of the water can damage the habitat where the FADs placed. In addition, the rest of the FADs that are damaged, unused, and abandoned can pollute the sea [33].

The difference in bycatch purse seines inside and outside FADs areas is due to the many types of fish that gather in the FAD area. Tuna fishing in the FAD area can increase the type and number of bycatch [6,15,34,35].

4. Conclusion

The level of sustainability of purse seine inside and outside of FADs areas is different, where purse seine inside FADs area is categorized as low sustainable, while purse seine outside FADs area is moderately sustainable. The low level of sustainability of purse seine inside the FADs area is due to the use of FADs, whose implications are the predominance of young fish in catches, the low percentage of eligible size fish to catch, always catching protected marine organisms, damaging habitats and conflicting with some regulations.

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References

- [1] Mallawa A, Amir F and Sitepu F G 2016 Study of Indonesian Fisheries Management Region of 713 as the area of utilization and management of skipjack tuna (*Katsuwonus pelamis*) fisheries sustainable: 1st year, Biological aspect and population dynamic of skipjack. Research Report (unpublished). Hasanuddin University, Indonesia.
- [2] Mallawa A, Amir F and Safruddin 2017 Study of Indonesian Fisheries Management Region of 713 as the area of utilization and management of skipjack tuna (*Katsuwonus pelamis*) fisheries sustainable: 2nd year, Performance and level of sustainability of skipjack fishing technology. Research Report (unpublished). Hasanuddin University, Indonesia.
- [3] Mallawa A, Musbir, Sitepu F G, and Amir F 2016 Fishery aspect of skipjack tuna (*Katsuwonus pelamis*) in Barru waters Makassar Strait, South Sulawesi. *Journal of Science Technology of Fisheries Resources Utilization* **3** 392 – 404.
- [4] Yusfiandayani R, Baskoro M S, and Monintja D 2015 Impact of the fish aggregation device on sustainable capture fisheries. *Life Sciences* **1** 224 – 237
- [5] Menard F, Fonteneau A, Gaertner D, Nordstrom U, Stequert B and Marchal E 2000 Exploitation of small tuna by a purse seine fishery with fish aggregation device and their feeding ecology in an eastern tropical Atlantic ecosystem. *ICES Journal of Marine Sciences* **57** 525 – 530.
- [6] Mallawa A 2020 Comparison of catches of skipjack purse seine inside and the outside of the FADs areas. *Pertanika Journal Science and Technology* **28** 717-733.
- [7] Bromhead D, Foster J, Attard R, Findlay J, and Kalish J 2003 A review of the impact of fish aggregating devices (FADs) on tuna fisheries. *Final Report to the Fisheries Resources*.
- [8] Dempster T and Taquet M 2004 Fish aggregation devices (FAD) research; Gaps in current knowledge and future directions for ecological studies. *Reviews in Fish Biology and Fisheries* **14** 21 – 41.
- [9] Dempster T and Taquet M 2005 FAD base and future direction for ecological studies of FAD. *Fisheries Newsletter* **112** 18 – 19.
- [10] Susaniati W 2014 *Research on the biological population of skipjack (Katsuwonus pelamis) in Flores Sea waters, South Sulawesi*. (Unpublished Magister Thesis) Hasanuddin University, Indonesia.
- [11] Mallawa A, Amir F, Safruddin dan Mallawa E, 2018. The sustainability of fishing technology of skipjack tuna (*Katsuwonus pelamis*) in Bone bay waters. *Marine Fisheries Journal* **9** 93 – 106.
- [12] Romanov E V 2008 By-catch and discard catch in the Soviet purse seine tuna fisheries on FAD-associated school in the north equatorial area on the Western Indian Ocean. *Western Indian Ocean Journal of Marine Sciences* **7** 163 – 174.
- [13] Amande M J, Ariz J, Chassot E, Moline AD, Gaertner D, Murua H and Chavance P 2010 By-catch of the European purse seine tuna fishery in the Atlantic Ocean for the 2003 – 2007 period. *Aquatic Living Resources* **23** 353 – 362
- [14] Dagorn L, Filmater J D, Forget F, Amande M J, Hall M, Williams P and Bez N 2012 Targeting big schools can reduce ecosystem impact of fishery. *Canadian Journal of Fishery and Aquatic Sciences* **69** 1463 – 1467.
- [15] Dagorn L, Holland K N, Restrepo P and Moreno G 2013. Is it good or bad to fish with FADs? What are the real impact of the use of drifting FADs on pelagic marine ecosystems? *Fish and Fisheries* **14** 391-415
- [16] Hall M A and Roman M 2013 By-catch and non-tuna catch in the tropical tuna purse seine fisheries of the world. *FAO Fisheries and Aquaculture Technical Paper* 568.
- [17] Bourjea J, Clermont S, Delgado A, Murua H, Ruiz J, Ciccione S and Pierre C 2014 Marine turtle

- interaction with purse seine fishery in the Atlantic and Indian Ocean: lesson for management. *Biological Conservation* **178** 74 – 87
- [18] Jamal M, Sondita F A, Wiryawan B, Haluan J 2014 Management concept of skipjack tuna (*Katsuwonus pelamis*) fisheries within Bone Bay waters, in the perspective sustainability. *Journal of Sciences and Technology of Fisheries Resources Utilization* **1** 196 – 207.
- [19] Fadli E, Miswar E, Rahmah A, Irham M and Perdana A W 2020. The environmental friendliness of purse seine in Sawang Bau, South Aceh District. *Journal of Marine Sciences and Fishery* **5** 1 – 10.
- [20] Mallawa A, Amir F and Zainuddin M 2014 Biological performance aspect of Skipjack tuna (*Katsuwonus pelamis*) captured by purse seine in East season at Flores Sea. *Journal of Sciences and Technology of Fishery Resources Utilization* **1** 129 – 145
- [21] MMAF-RI 2016 Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia number 71 of 2016 concerning fishing lanes and placement of fishing gear in of the Republic of Indonesia Fisheries Management Areas. Jakarta
- [22] FAO 1995 Code of Conduct for Responsible Fisheries. FAO, Rome.
- [23] Wilantara W 2016 Comparison of catches of skipjack (*Katsuwonus pelamis*) with purse seines-FAD and non FAD-purse seines in the Makassar Strait waters (unpublished research report), Hasanuddin University, Indonesia.
- [24] Adam M S and Sibert J R 2002 Population dynamics and movement of skipjack tuna (*Katsuwonus pelamis*) in the Maldivian fishery: analysis of tagging data from an advection-diffusion-reaction model. *Journal Aquatic Living Resources Elsevier* **15** 13 – 23.
- [25] Nurdin E and Panjaitan A S 2017 Fishing seasons and size structure of skipjack tuna (*Katsuwonus pelamis*, Linnaeus 1758) around FADs in Palabuhanratu waters. *Indonesian Journal of Fishery Research* **23** 299 – 307
- [26] Hoyle S, Klieber P, Davies N, Lagley A and Hampton J 2011 Stock assessment of skipjack tuna in the western and central Pacific Ocean. WCPFC-SCT-2011/SA-MP-04.
- [27] Wang X, Xu L, Chen Y, Zhu G, Tian S and Zhu J 2012 Impact of fish aggregation devices on size structures of skipjack tuna (*Katsuwonus pelamis*). *Aquat. Ecol.*
- [28] Hare SR, Harley S J and Hampton W J 2015 Verifying FAD-association in purse seine catches on the base of catch sampling. *Fisheries Research* **172** 361 – 372.
- [29] Mallawa A 2016 Size structure of skipjack tuna (*Katsuwonus pelamis*) captured by pole and line fishermen inside and outside of fish aggregation devices in Bone Bay waters. *International Journal of Scientific and Technology Research* **5** 159 – 163.
- [30] Alamsjah R, Musbir and Amir F 2014 Size structure and feasible length for catch of skipjack (*Katsuwonus pelamis*) in Bone bay waters. *Journal of Science and Technology* **14** 95 – 100.
- [31] Mallawa A, Musbir, Amir F and Marimba A A 2012 Analysis of size structure of skipjack tuna (*Katsuwonus pelamis*) by season, fishing ground, and fishing technology in Bone Bay waters, South Sulawesi. *Journal of Science and Technology Fisheries Resources Utilization* **3** 29 - 38.
- [32] Hallier J P and Gartner D 2008 Drifting fish aggregation devices could act as ecological trap for tropical tuna species. *Marine Ecology Progress Series* **353** 255 – 264
- [33] Leroy B, Phillips J S, Nicole S, Pilling G M, Harley S, Bromhead D and Hampton J 2013 A critique of the ecosystem impact of drifting and anchored FADs use by purse-seine tuna fisheries in the Western and Central Pacific Ocean. *Aquatic Living Resources* **26** 49 – 61.
- [34] Morgan A C 2011 Fish Aggregation device and Tuna, Impact and Management Options, Ocean Science Division, Pew Environment Group.
- [35] Fonteneau A, Chassot E and Gaertner D 2015 Managing tropical tuna purse seines through limiting the number of fish aggregation devices in the Atlantic: Foods for thought. *Collection Volume Science Paper International Commission for the Conservation of Atlantic Tuna*, **71** 460 – 475.

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