ISSN: 2339-0883

PUSAT UNGGULAN IPTEK PERGURUAN TINGGI INDONESIA

RISTEKDIKTI

KEMENTERIAN KELAUTAN DAN PERIKANAN

PERTAMINA EP
ASSET 3 TAMBUN FIELD

SEMINAR TAHUNAN HASIL PENELITIAN PERIKANAN DAN KELAUTAN VI
ANNUAL SEMINAR OF FISHERIES AND MARINE SCIENCE VI

PROSIDING

APLIKASI IPTEK PERIKANAN DAN KELAUTAN DALAM PENGELOLAAN, MITIGASI BENCANA DAN DEGRADASI WILAYAH PESISIR, LAUT DAN PULAU-PULAU KECIL

APPLICATION OF FISHERIES AND MARINE SCIENCE AND TECHNOLOGY ON MANAGEMENT, MITIGATION OF DISASTER AND ENVIRONMENTAL DEGRADATION IN COASTAL AREAS, SEAS AND SMALL ISLANDS

SEMARANG, 12 NOVEMBER 2016

FAKULTAS PERIKANAN DAN ILMU KELAUTAN
UNIVERSITAS DIPONEGORO
JULI, 2017

KATA PENGANTAR

Tahun 2016 merupakan seminar tahunan ke VI yang diselenggarakan oleh FPIK UNDIP. Kegiatan seminar ini telah dimulai sejak tahun 2007 dan dilaksanakan secara berkala. Tema kegiatan seminar dari tahun ketahun bervariatif mengikuti perkembangan isu terkini di sektor perikanan dan kelautan.

Kegiatan seminar ini merupakan salah satu bentuk kontribusi perguruan tinggi khususnya FPIK UNDIP dalam upaya mendukung pembangunan di sektor perikanan dan kelautan. IPTEK sangat diperlukan untuk mendukung pembangunan sehingga tujuan pembangunan dapat tercapai dan bermanfaat bagi kemakmuran rakyat.

Dalam implementasi pembangunan selalu ada dampak yang ditimbulkan. Untuk itu, diperlukan suatu upaya agar dampak negatif dapat diminimalisir atau bahkan tidak terjadi. Oleh karena itu, Seminar ini bertemakan tentang **Aplikasi IPTEK Perikanan dan Kelautan dalam Mitigasi Bencana dan Degradasi Wilayah Pesisir, Laut dan Pulau-Pulau Kecil.** Pada kesempatan kali ini, diharapkan IPTEK hasil penelitian mengenai pengelolaan, mitigasi bencana dan degradasi wilayah pesisir, laut dan pulau-pulau kecil dapat terpublikasikan sehingga dapat dimanfaatkan untuk pembangunan yang berkelanjutan dan dapat menjaga kelestarian lingkungan. Seminar Tahunan Hasil Penelitian Perikanan dan Kelautan ke-VI merupakan kolaborasi FPIK UNDIP dan Pusat Kajian Mitigasi Bencana dan Rehabilitasi Pesisir (PKMBRP) UNDIP.

Pada kesempatan ini kami selaku panitia penyelenggara mengucapkan terimakasih kepada pemakalah, reviewer, peserta serta Pertamina EP Asset 3 Tambun Field yang telah mendukung kegiatan Seminar Tahunan Penelitian Hasil Penelitian Perikanan dan Kelautan VI sehingga dapat terlaksana dengan baik. Harapan kami semoga hasil seminar ini dapat memberikan kontribusi dalam upaya mitigasi bencana dan rehabilitasi pesisir, laut dan pulau-pulau kecil.

Semarang, Juli 2017

Panitia

SUSUNAN PANITIA SEMINAR

Pembina	: Dekan FPIK Undip
	Prof. Dr. Ir. Agus Sabdono, M.Sc
Penanggung jawab	: Wakil Dekan Bidang IV
	Tita Elvita Sari, S.Pi., M.Sc., Ph.D
Ketua	: Dr.Sc. Anindya Wirasatriya, ST, M.Si., M.Sc
Wakil Ketua	: Dr.Ir. Suryanti, M.Pi
Sekretaris I	: Faik Kurohman, S.Pi, M.Si
Sekretaris II	: Wiwiet Teguh T, SPi, MSi
Bendahara I	: Ir. Nirwani, MSi
Bendahara II	: Retno Ayu K, S.Pi., M.Sc
Kesekretariatan	: 1. Dr. Agus Trianto, ST., M.Sc
	2. Dr. Denny Nugroho, ST, M.Si
	3. Kukuh Eko Prihantoko, S.Pi., M.Si
	4. Sigit Febrianto, S.Kel., M.Si
	5. Lukita P., STP, M.Sc
	6. Lilik Maslukah, ST., M.Si
	7. Ir. Ria Azizah, M.Si
Acara dan Sidang	: 1. Dr. Aristi Dian P.F., S.Pi., M.Si
	2. Dr. Ir. Diah Permata W., M.Sc
	3. Ir. Retno Hartati, M.Sc
	4. Dr. Muhammad Helmi, S.Si., M.Si
Konsumsi	: 1. Ir. Siti Rudiyanti, M.Si
	2. Ir. Sri Redjeki, M.Si
	3. Ir. Ken Suwartimah, M.Si
Perlengkapan	: 1. Bogi Budi J., S.Pi., M.Si
	2. A. Harjuno Condro, S.Pi, M.Si

DEWAN REDAKSI
PROSIDING
SEMINAR NASIONAL TAHUNAN KE-VI
HASIL-HASIL PENELITIAN PERIKANAN DAN KELAUTAN

Diterbitkan oleh : Fakultas Perikanan dan Ilmu Kelautan, Universitas Diponegoro bekerjasama dengan Pusat Kajian Mitigasi Bencana dan Rehabilitasi Pesisir serta Pertamina EP Asset 3 Tambun Field

Alamat redaksi : Fakultas Perikanan dan Ilmu Kelautan
Jl. Prof. Soedarto, SH, Tembalang, Semarang 50275
Telpn/ Fax: 024 7474698

DAFTAR ISI

halaman

Rehabilitasi Ekosistem: Mangrove, Terumbu Karang dan Padang Lamun

Bencana Wilayah Pesisir, Laut dan Pulau-pulau Kecil: Ilmu Bencana dan Dampak Bencana

Aplikasi IPTEK Perikanan dan Kelautan dalam Pengelolaan dan Pemanfaatan Sumberdaya Wilayah Pesisir, Laut dan Pulau-pulau Kecil (Budidaya Perairan)

Aplikasi IPTEK Perikanan dan Kelautan dalam Pengelolaan dan Pemanfaatan Sumberdaya Wilayah Pesisir, Laut dan Pulau-pulau Kecil (Pemanfaatan Sumberdaya Perairan)

PUSAT UNGGULAN IPTEK PERGURUAN TINGGI INDONESIA
RISTEKDIKTI
KEMENTERIAN KELAUTAN DAN PERIKANAN
PERTAMINA EP
ASSET 3 TAMBUN FIELD

RESEARCH ABOUT STOCK CONDITION OF SKIPJACK TUNA *(Katsuwonus pelamis)* IN GULF OF BONE, SOUTH SULAWESI, INDONESIA

Achmar Mallawa, Amir Faisal, Farida Sitepu, and Elsa Mallawa
Fishery Department Faculty of Marine and Fishery Sciences University Hasanuddin
Email: achmar_mallawa@yahoo.co.id

ABSTRACT

Research on stock of skipjack tuna in the Gulf of Bone has been done from January until October, 2016. The objective of the research was to analyze condition of skipjack tuna according to fishing season and fishing area. The condition of the stock be analyzed using some indicators such as size structure, number of cohort, exploitation rate, population growth rate, fishing mortality rate. Stock condition was determined by Mallawa method. The result of the research showed that population of skipjack tuna captured in the Gulf of Bone dominated by small size fishes, population consist three cohorts, fishing mortality was high (more than 1.0), exploitation rate was high (more than 0.5), growth rate was low (less than 0.5) and percentage of suitable length for catch was low (less than 50%) for all fishing season. The research conclusion that stock conditionof skipjack tuna either in East monsoon season or West monsoon season were less good or under pressure.
Key word: skipjack tuna, stock condition, Gulf of Bone

1.INTRODUCTION

1.1 BACKGROUND

Skipjack tuna*(Katsuwonus pelamis)* is one of large pelagic fish species economically important in the waters of the Gulf of Bone are exploited by fishermen from several districts in and outside the province of South Sulawesi. Skipjack tuna has been exploited by fishermen through the year using various types of fishing technology such as pole and line, purse seine drift surface gill nets, traditional seine nethand line, and boat lift net (Mallawa, 2012) [24]. The use of various types of fishing technology, especially combined with fish aggregation device, less selective fishing gear and fishing activities that take place throughout the year as well as absence management policies can lead to pressure on skipjack tuna stocks in these waters. Bromhead et.al. (2003)[7] that the use of fish aggregation devicegave impacts on the biology and ecology of theskipjacktuna fishery.

Dempters and Taquet (2004 and 2005)[9,10] that the use of a means of fish aggregation device in purse seine fisheries result in disruption of skipjack tuna populations in the Pacific Ocean.Baso (2013)[5] that the use of pole and line technology combined with fish aggregation devicegave negative impacts to populations of skipjack tuna in the waters of the Gulf of Bone. Mallawa et al (2012)[27,28] found that in the waters of the Gulf of Boneskipjack tuna caught by pole and lineinside of fish aggregation device has a smaller size than the skipjack caught by hunting. They also explained that the use of

traditional seine net gavean impact on fish stocks, characterized by the presence remarkably of small size of the fish in the catch. Mallawa et.al (2013)[29] explained that the use of fish aggregation device in purse seine provides higher pressure on fish populations of skipjack tuna in the waters of the Flores sea. Mallawa et.al. (2015)[32], reported that the use of purse seine combined with fish aggregation device gave a negative impact on skipjack tuna fishery in Flores sea which characterized by decreasing of skipjack tuna stock condition. Mallawa (2016)[33] described that size structure of skipjack tuna caught by pole line combined with fish aggregation device dominated by small fishes. To prevent the depletion of skipjack tuna populations, there should be an assessment of the condition of the stock of skipjack tuna especially in the waters of the Gulf of Bone South Sulawesi, Indonesia.

1.2 RESEARCH OBJECTIVE

This research aims to assess the condition of the stock of skipjack tuna according to season in the waters of the Gulf of Bone South Sulawesi.

2.METHODS

2.1 TIME AND PLACE

This research was conducted over teen months ie from January to October 2016 in the waters of the Gulf of Bone South Sulawesi (Figure 1).

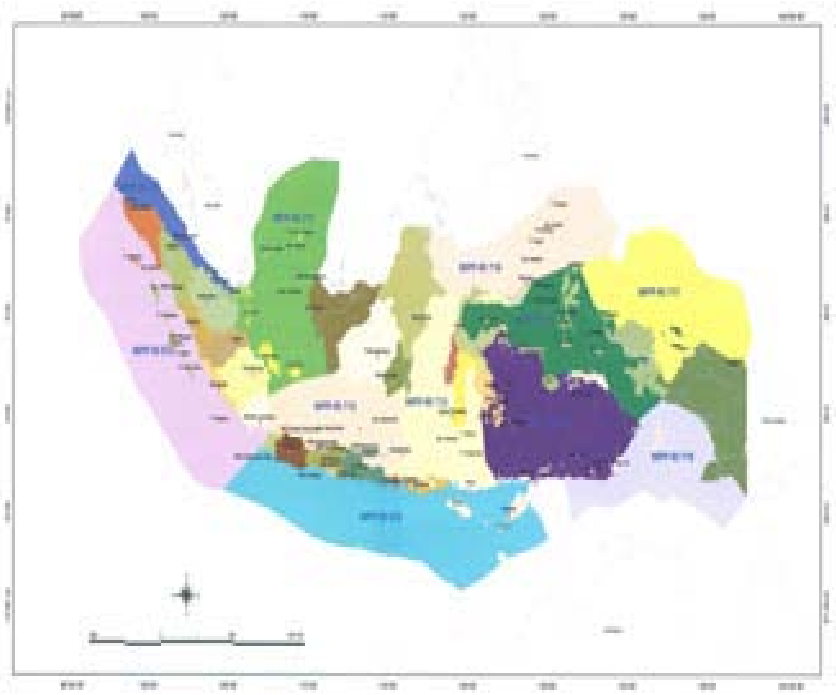

Figure 1. Research area [20],

2.2 EQUIPMENT AND MATERIALS RESEARCH

The materials used in this research are skipjack tuna, some chemical substances, fishing boats, fish aggregation device (FADs), globepositioning systems,current meter, fish finder,digital camera, digital thermometer, board measure, computers and software. Materials and equipmentused as well as its usefulness is presented in Table 1.

2.3 Data Collecting

This research is a case study in which a case was skipjack tuna fisheries in the waters of the Gulf of Bone. The main primary data in this study was the length of skipjack tuna*(*Fork Length, FL) collected from the commercial fishery by following the fishing activities of fishermenusing purse seine, drift surface gill nets, pole and line, traditional seine net, boat lift net, hand line and trolling line.Supporting data or oceanographic conditions of fishing areas include the speed and direction of currents, water depth, latitudes and longitudes location of capture, water temperature were also insitu collected during fishing operations currently performed. To increase the number of fish observed then fish also be measured fish in Fish Landing Sites.

Table 1. Materials and equipment research and its usefulness

Material / Equipment	Usefulness
Skipjack tuna	Determiningthe structureof the size and age groups, and histology
Bottle samples	Storage of fish gonads
Globe positioning system	Positioning of fishing area
Fishing vessel	Operational research
Fish finder	Measuring of the depth of the fishing area
Measuring board	Measuring the length of the fish
FADs	Operasinal fishing
Current meter	To know direction and speed of current
GPS	To know position of the fishing ground
Digital thermometer	To measure sea surface temperature
Chemical substances	Histology observation

2.4 DATA ANALYSIS

The indicators used in assessing the condition of the stock of skipjack tuna in the waters of the Gulf of Bone, namely the structure of the fish size, the number of age groups or cohorts, the mortality rate of fishing (F), the rate of exploitation (E), the growth rate (K), yield per recruitment (Y/R) and a percentage of the suitable length to catch.Stock condition indicators valueswere calculated by various means and methods as shown in Table 2. Each indicator is weighted differently according their urgently. Each indicator is divided into sub-indicators with different values. Furthermore, the multiplication of the weight indicator and the acquisition value of the indicator. Analysis of the determination of the stock using the worksheet assessment as presented in Table 3.

Table 2. Methods for estimating indicators of Skipjack tuna stock condition

Stock Condition Indicators	The calculation methods
Size structure of fish	Mallawa et al.,(2011)[23]
Number of cohort	Bhattacharya (Mallawa,1987)
Fishing mortality rate	Beverton and Holt (1957) [6]
Exploitation rate	Beverton and Holt (1957)[6]
Growth rate	Von Bertalanffy (Mallawa, 1987)[22], Ford and Walford (Sparre et. al., (1989)[41]
Yield per Recruitment	Beverton and Holt (1957)[6]
The percentage of catch suitable length	Mallawa (2012)[24]
Gonad maturity stage	Histology (Itano, 2011)[19], Takashima et al., (1995) [43]

Table 3 Indicators and weighted of each used in stockCondition determination

Indicators and sub indicators	Weight	Value	Weighted x value
The size structure of fish			
Dominated by small size	1.00	1	
Dominated by medium size		3	
Dominated by large fish		5	
Number of age groups			
Less than three cohort	1.00	1	
Three to five cohort		3	
Morew than five cohort		5	
The fishing mortality			
F value more than 2.0	2.00	1	
F value was 1.0 to 2.0		3	
F value less than 1.0		5	
Exploitation rate value			
E more than 1.0	1.00	1	
E equal 0.5 - 1.0		3	
E less than 0.5		5	

Table 3. Continue

Indicators and sub indicators	Weight	Value	Weighted x value
Population growth rate K low than 0.4 per year K 0.4until 0.5 per year K high than 0.5 per year	1:00	 1 3 5	
Yield per Recruitment Y/R actual < Y/R optimal Y/R actual = Y/R optimal Y/R actual > Y/R optimal	2.0	 1 3 5	
% Catch suitable length CSL less than 20% CSL 30 until 50% CSL more than 50%	2.00	 1 3 5	
	10		Σ value

The percentage of the value of the condition of the stock was calculated using the equation raised by Mallawa at.al (2015)[32], namely:

Stock condition = $\{\Sigma(B \times N)/F_v)\}x100\%$,

where :

B weighted of each indicator,N value of each indicator,$F_v$full value (equal50).

The stock condition using the reference as follows:

If the value of the stock condition is ≥ 85-100%, the stock is very good condition,

If the value of the stock condition is <85-65%, the stock is good condition,

If the value of the stock condition is <65%, the stock is less good or under pressure.

3. RESULT AND DISCUSSION

3.1 The size structure of skipjack tuna

Observation of the fish caught by fishermen commercially either on East seasonor onWest season showedthat the size of the fish varied from small to large, but is dominated by small fish or young fish. In the East season the size of skipjack caught ranging 26.0 – 69.2 cm, dominant size was 32.0 – 42.0 cm, while in the West season the skipjacks tuna caught ranging 26.0 – 57.0 cm and dominant size was 31.5 – 38.5 cm(Table 4) The dominance of young fish in the catch of fishermen suspected to be caused by two things: first that the fishermen in catching skipjack was generally done in the area of FADs which are located in shallow waters Indahyani (2010)[18] reported that there were relationship between distribution of skipjack and oceanographic factors such as temperature, water depth etc. Tunas including skipjacks tuna are known to migrate away from the shore with

the increasing size (sizedependents migration), second, that the waters of the Gulf of Bone is an area of enlargement (nurseryground) so that any fish small size fish. Mallawa et.al (2015)[32,33] explained that skipjack tuna used Flores sea. Gulf of Bone and Makassar Strait waters as nursery ground or feeding ground, stayed there for three until four years and then go to somewhere for spawning. Syamsuddin and Mallawa (2009)[42] explained that the size composition of the skipjack tuna caught in waters of Kupang ranging 29.0 cm - 58.9 cm, catches the most was the size of 47.0 cm - 49.9 cm (17.90%), and followed by size from 44.0 to 46.9 cm (16.64%), and the size of 38.0 to 40.9 cm (16.36%).Mallawa et al., (2012)[25] explains that the skipjack tuna caught in the waters of the Gulf of Bone ranging between 29-65 cm FL with an average length of 41.06 cm FL and Baso (2013)[5] explains that catches huhate (pole and line) in the waters of the Gulf of Bone has a long range of 17, 2 cm FL - 72.5 cm FL, dominant size in the range of length from 24.5 to 32.5 cm FL.Bromhead et al (2003)[7]reported that the use of FADs in purse seine to catch skipjack tuna resulted in the dominance of small size in the catch in some Asian countries.Dempster and Taquet (2004 and 2005)[9;10] described that the use of FADs in fishing of tunas in the Atlantic led to many small size fish caught.

3.2 NUMBER OF COHORTS OF SKIPJACK IN CATCH

The results of the analysis of the size structure using difference of length frequency logarithm method with the help of software ELEFAN (Gayanilo et al., 1989)[13] and tools FISAT (Gayanilo et al., 1996)[14] found that the number of cohort in the catch very few, varying from two to three Any age group according to fishing season shown in Table 4. The small number of age groups or cohort in the catch associated with variaations in the size of the fish that is dominated by the small size of the fish. Another possibility, that fishing activities have been very intense so that the population does not grow well. Rezkika (2012)[38] explains that the skipjack tuna caught in Gulf of Bone waters consists of three age groups. Mallawa et al., (2012)[25] that the skipjack tuna caught by pole and line without FADs consists of three age groups whileskipjack tuna caught by pole and line inside FADs area only consisted of two age groups. Baso (2013)[5]reported that the skipjack tuna caught by pole and line inside and outside FADs area in the waters of the Gulf of Bone consists of three age groups, but from a different age group. Alamsyah (2013)[3] that the skipjack tuna caught by pole and line in the Gulf Bone waters consists of three age groups for each fishing season. Samad (2002)[39]described that the skipjack tuna caught by purse seine in the waters of the Strait of Makassar consists of three age groups. Andriani (2012)[4]and Agus (2012)[2] reported that the skipjack tuna caught in the

waters of the Strait of Makassar consists of three age groups. Fidyatul (2013)[11] found that skipjack tuna caught by fishermen using purse seine in the Flores sea waters consists of three age groups. Qorimah (2013)[37] that skipjack tuna catches of fishermen in the waters of the Strait of Makassar consist of three age groups. Mallawa (2016)[34,35] reported that skipjack tuna caught in Makassar Strait waters consist of two until three age groups and varied according to fishing technologies used. Adams and Siebert (2002)[1] that the tuna caught fishermen using purse seine Maldive waters consist of two age groups. Hoyle at al (2011) [17] that the tuna caught by purse seine fishermen in the waters of the Central Pacific consists of three age groups. Koya et al., (2012)[21] explains that the tuna caught from the waters of India consists of three age groups. Mallawa at al. (2013)[28] explains that the number of age groups of skipjack in the catches of fishermen in the waters of the Sea of Flores varied according to the fishing season, fishing areas and fishing technology

3.3 MORTALITY OF FISHING

The results of the analysis of predicting values of fishing mortality rate (F) found that mortality due to fishing of skipjack tuna in the waters of the Gulf of Bone according to fishing season was very high (F> 1.0) both in West season (F = 1.1) and East season (F = 1.15) as shown Table 4. The high value of fishing mortality (F > 1.0) of skipjack tuna in the Gulf of Bone waters also found by Rezkika (2011)[38], Mallawa at.al (2012)[25], and Alamsyah (2013)[3]. Fidyatul (2013)[11] reported that the rate of death due to fishing in the waters of the Flores seaalso high (F = 1.23).Qorimah (2013)[37] reported that the rate of fishing mortality of skipjack in the waters of the Strait of Makassar in West season was low(F = 0.42), while Mallawa (2016)[35] reported that the rate of fishing mortality of skipjack tuna in the Makassar Strait water for all the seasons was high (F > 1.0). Adams and Siebert (2003)[1] explains that tuna is an economically important fish so that the rate of fishing mortality on lately in various waters in the world is very high.

3.4 RATE OF EXPLOITATION

Results of analysis using Beverton and Holt method described that the rate of exploitation either in West season or East season were 0.57 and 0.65 respectively as shown inTable 4. Rezkika (2011)[38] and Baso (2013)[5] also reported the same phenomenon. Samad (2002)[39] and Fidyatul (2013)[11] in the waters of the Sea of Flores,South Sulawesi shows the value of the exploitation rate of skipjack was high (E> 0.5).The high value of exploitation rate of skipjack in the Makassar Strait waters also found by Qorimah (2013)[37]and Mallawa (2016)[34].The high value of rate of exploitationwas associated

with high mortality due to fishermen fishing in all fishing season and fishing activities through the year. Coan (2003)[8] that the populations of tuna in the waters of the Western Pacific experienced a high rate of exploitation in lately because many fishermen from various countries who make fishing in those waters. University of Hawaii (2008)[44] and the WCPFC (2009)[45] that the rate of exploitation of tuna in the waters of Hawaii and Vanuatu was quite high.

3.5 THE RATE OF GROWTH

The estimated result of the growth rate of skipjack in the waters of the Gulf of Bone either in West season or in East seasonwas low (K <0.5) as shown in Table 4. Studyon the rate of growth of skipjack tuna have been done in various waters provide results that differ from each other. Rezkika (2011)[38], Mallawa et al. (2012)[25], Baso (2013)[5] and Alamsjah (2013)[3] reported that the growth of skipjack tuna in the waters of the Gulf of Bone quite low (K < 0.50 per year). Samad (2002)[42], Fidyatusl (2013)[11] and Mallawa et al., (2013)[28] that the growth rate (K) of skipjack tuna in the waters of the Flores also low (K<0.50 per year). Mallawa et al.,(2014)[30,31], Mallawa (2016)[34] and Mallawa etal., (2016)[35] reported that the growth rate of skipjack tuna in thr waters of Makassar Strait less than 0.50 per year. Garnert at al(2008)[12] that growth rate of skipjack tuna occurred variability by fishing area in the Atlantic and was low (K <0.5 per year). Hallier and Garnert (2006)[15] that the growth rate of skipjack in the waters of Senegal varies according to the fishing areas.

3.6. YIELD PER RECRUITMENT

Analysis results showed that value of Y/R of skipjack tuna in the waters of Gulf of Bone was not optimal either in East season or in West season. The values of Y/R actual and Y/R optimal in East season were 0.1342 gram and 0.2346 gram respectively, and then the values of Y/R actual and Y/R optimal in West seasonwere 0.1798 gram and 0.2478 gram respectively. Rezkika (2012)[38] and Baso (2013)[5] also reported that recruitment process of skipjack tuna in the waters of Gulf of Bone was not optimal. Qorimah (2013) and Mallawa (2016) that in the waters of Makassar Strait the process of recruitment of skipjacks was not optimal where the Y/R actual value was small than optimal value. Mallawa et.al (2016) described that these phenomenon caused mainly by intensive fishing.

3.7 PERCENTAGE OF CATCH SUITABLE LENGTH.

Mallawa et al. (2012), Baso (2013) and Alamsyah (2013) found that catch suitable length of fish caught in the waters of the Bay of Bone was more than 55 cm FL in females and more than 60 cm FL in males. Observation of skipjack tuna catches of fishermen in the

waters of the Gulf of Bone can be seen that a percentage of the catch suitable length of fish caught is very low at less than 50% of the catch (Table 4). Some researchers explained that the use of fish aggregation device combined with the pole and line multiply the number of small size of fish in fishermen catch. Mallawa et al. (2013)[26] found that percentage of catch suitable length of skipjack caught by fishermen using purse seine combined with Garnert fish aggregation device in Flores sea waters was also low or less than 20 %. Mallawa et al., (2014)[31] and Mallawa (2016)[35] reported that percentage of catch suitable length of skipjack tuna caught by fishermen using several fishing gears in Makassar Strait waters was also low. Mallawa et al., (2014)[30] and Mallawa (2016)[33] described that using kinds of fishing gears especially which combined with fish aggregation device raising the small size of skipjack in the catch of fishermen. Hallier and Garnert (2008)[16] explained that drifting fish aggregation devices could act as an ecological trap for the tropical tuna speciesThe value of some parameter that is used as an indicator of stock condition in this study are presented in Table 4.

Table 4 Values of several parameters indicators of stock condition

Indicators	East season	West Season
Structure Size		
Range	26.0 to 69.2 cm	26.0 to 57.0 cm
Dominant	32.0 to 42.0 cm	31.5 - 38.5 cm
Average	35.2 ± 12.6 cm	34.5 ± 11.7 cm
Number of cohorts	3 cohorts	3 cohorts
Fishing mortality	1.1 yearly	1.15 yearly
Rate of exploitation	0.57	0.65
Growth rate	0.41 yearly	0.42 yearly
Y/R actual	0.1342 gram	0.1798 gram
Y/R optimal	0.2376 gram	0.2478 gram
% catch suitable length	26 – 32%	25 – 34 %

Data in Table 4 above showed that the indicators of stock condition value was not too diffence according to the season.

3.8 STOCK CONDITION OF SKIPJACK IN WEST SEASON

Based on data from Table 4 and do grading according to the guidelines listed in Table 3 gave results of the assessment of stock condition of skipjack tuna in the waters of the Gulf of Bone in West seasonas shown in Table 5.

Table 5 Conditions stocks of skipjack West season

Indicators	Weight	Value	Thickness x value
Skipjack caught dominated by medium size of fish	1.00	3	3.00
Population consist of three cohort	1.00	3	3.00
Fishing mortality rate 1.15	2.00	3	6.00
Rate of exploitation (E) 0.57	1.00	3	3.00
Population growth (K)0.42	1:00	3	6.00
Y/R value 0.1798	2.00	1	2.00
Percentage of catch suitable length	2.00	3	6.00
Total value			29.00
Percentage (%)			58.00%

Result of assessment (Table 5) showed that the stock of skipjack tuna in the waters of the Gulf of Bone in West season acquired 58.0 % of ideal condition of stock. If we use criteria proposed by Mallawa et al., (2015)[32] condition of skipjack tuna in the waters of Gulf on Bone categorized was less good or under pressure stock.

3.9 STOCK CONDITION OF SKIPJACKS IN EAST SEASON

Based on data from Table 4 and do grading according to the guidelines listed in Table 3 gave the results of the assessment of each indicator stock condition in East season as shown in Table 6.

Table 6. Stock Condition of skipjack in Rast seaon

Indicator	Weight	Value	weight x value
Skipjack caught dominated by medium size of fish	1.00	3	3.00
Population consist of three cohort	1.00	3	3.00
Fishing mortality rate 1.15	2.00	3	6.00
Rate of exploitation (E) 0.57	1.00	3	3.00
Population growth (K)0.42	1.00	3	3.00
Y/R value 0.1342	2.00	1	2.00
Percentage of catch suitable length	2.00	3	6.00
Total Value			26.00
Percentage (%)			52.00%

Result of assessment (Table 6) showed that the stock of skipjack tuna in the waters of the Gulf of Bone in West season acquired 58.0 % of ideal condition of stock. If we use criteria proposed by Mallawa et al., (2015)[32] condition of skipjack tuna in the waters of Gulf on Bone categorized was also less good or under pressure stock. Mallawa et al., (2015)[32] explained that the condition of skipjack tuna stock in the waters of the Flores sea in all seasons categorized was less good or under pressure stock. Mallawa (2016)[35]

reported that in the waters of the Makassar Strait condition of stock of skipjack was quite good in the West season while in the East season condition of stock of skipjack tuna was less good or under pressure stock.Mallawa (2016)[36] described that the mainly cause of stock of skipjack decreased in several waters in Indonesia was the highly percentage of skipjack which was not suitable length to catch in fishermen yield. Mallawa (2016)[33] reported that using fish aggregation device in skipjack tuna fishing either by pole and line or by purse seine raised number of small size of skipjack in catch.

4. CONCLUSION

Based on the result of analysis can be concluded that the condition of the stock of skipjack tuna in the waters of the Gulf of Bone either in West monsoon season or East monsoon season are categorized less good or under pressure.

ACKNOWLEGMENT

Authors wish to thanks Ministry of Research Technology and High Education for finance support this research.

REFERENCES

Adam, M.S and J.R. Sibert, 2002. Population dynamics and movement of skipjack tuna *(Katsuwonus pelamis)* in the Maldivian fishery: analysis of tagging the data from an advection-diffusion-reaction models. J. Aquat. Living resour. Elsevier 15: 13-23.

Agus, N.A., 2012. Study some aspects of population dynamic of skipjack (Katsuwonus pelamis) in South part of Makassar Strait waters, South Sulawesi. Research report, Marine Sciences and Fishery Faculty, University of Hasanuddin, Makassar. 83 p.

Alamsjah, R., 2013. Study on temporally of biological population of skipjack tuna (*Katsuwonus pelamis*) in the waters of the Gulf of Bone, South Sulawesi. Research report of PPs, University of Hasanuddin, Makassar. 199 p.

Andriani,A.N., 2012. Study on some parameters of population dynamic and exploitation level of skipjack tuna (*Katsuwonus pelamis*) in the waters of Makassar straits. Research report. 83 p.

Baso, H.S., 2013. Study on biological population of Skipjack tuna (*Katsuwonus pelamis*) captured in FADs area and non FADs area in Gulf of Bone waters. Research report. 101 p.

Beverton, R.J.H and S.J. Holt, 1957. Population dynamic of exploited fish. Books, Her Majesty, London. 533 p.

Bromhead D, J.R. Foster, Attard, J. Findlay and J.Kalish, 2003. A review of the impact of fish aggregating devices (FADs) on tuna fisheries. Final Report to the Fisheries Resources. 13 p

Coan, A.L.Jr., 2000. California's living marine resources and their utilization eastern Pacific skipjack tuna. NOAA / NMFS Southwest Fisheries Science Center, California, USA. 10 p.

Dempster T and M. Taquet, 2004. Fish aggregation devices (FADs) research; Gaps in current knowledge and future Reviews directions for ecological studies. Reviews in Fish Biology and Fisheries; 14: 21-41.

Dempster T and M.Taquet, 2005. FAD base and Future Direction for Ecological Studies of FAD. Fisheries Newsletter, 112: 18-19.

Fidyatul, MT, 2013. Study on some parameters of population dynamics Study of Skipjack tuna*(Katsuwonus pelamis)* in the waters of the Flores Sea, Bulukumba, South Sulawesi, Makassar 53 p.

Gartner, D., A.D De Molina, J. Ariz, R. Pianet, and R. Hallier, 2008. Variability of the growth parameters of skipjack tuna *(Katsuwonus pelamis)* Among areas in the eastern Atlantic. : Analyzing the data from tagging within a meta-analysis approach. Aquatic Living Resources, 21: 349-356.

Gayanilo, F., Pauly D., and M. Soriano. 1989. *A Draft Guide to the Compleat ELEFAN Software Package Version **1.0.** ICLARM*. Manila.

Gayanilo, F.C, P. Sparre and D. Pauly, 1996. FAO-ICLARM Stock Assessment Tools (FiSAT) user's Guide. FAO Computerised Information Series (Fisheries), No. 8, Rome, FAO, 266 p.

Hallier, J.P and D. Gartner, 2006. Estimated growth rate of the skipjack tuna *(Katsuwonus pelamis)* by tangging survey conducted in the Senegalese Area (1996-1999) within a meta-analysis framework. Col.vol.Sci Pap.ICCAT, 59 (2): 411-420.

Hallier J,P and D. Gartner, 2008. Drifting fish aggregation devices could act as an ecological trap for the tropical tuna species. Marine Ecology Progress Series 353: 255-264.

Hoyle, S, P. Klieber, N. Davies, A. Lagley and J. Hampton, 2011. Stock assessment of skipjack tuna in the western and central Pacific Ocean.WCPFC-SCT-2011 / SA-MP-04.

Indahyani, F., 2010. The Relationship Between Parameters Oceanography and Catch of Pole and Line in the waters of the Gulf of Bone, Luwu, Research Reports, Makassar.57 p.

Itano, DG, 2011. The reproductive biology of yellowfin tuna *(Thunnus albacore)* in Hawaiian waters and the western tropical Pacific ocean: Project Summary. Joint Institute for Marine and Atmospheric Research and NOAA. 75 p.

The Ministry of Marine Affairs and Fisheries, Fisheries Indonesian 2011. Book. CTF and JICA, Jakarta.165 p

Koya, K.P.S, K.K. Joshi, E.M. Abdussamad, P. Rohit and M. Sebastine, 2012. Fishery, biology and stock structure of skipjack tuna, *Katsuwonus pelamis*, exploited from Indian Waters. Indian J.Fish, 59 (2): 39-47.

Mallawa, A., 1987. Population dynamics and fishery aspects of European Eel *(Anguilla anguilla*) in Bages-Sigean and Canet St Nazaires lagoons, France. Doctor Research Report , University of Perpignan, South France. 424 p.

Mallawa, A., Budimawan, Musbir, A. Faisal., 2011. The models of population dynamics and prediction of the stock. Module Master Program of Fisheries , Hasanuddin University, 365 p.

Mallawa, A., 2012. Aspects of fishing and Catch Per Unit Effort of Skipjack in Luwu waters, Bone Bay. Proceedings of the National Seminar on Fisheries and Marine Research UGM 2012. Yogyakarta :325-377

Mallawa, A., Musbir, A.Fasisal and A.A, Marimba, 2012. Sustainable Use of Resources of Skipjack in the waters of the Gulf Bone,Luwu Research Report, Hasanuddin University, Makassar. 196 p.

Mallawa, A., Musbir, A. Faisal and A.A.Marimba. 2012 Size Structure Analysis of Skipjack *(Katsuwonus pelamis)* According to the fishing season, the fishing area and Fishing Technology in Luwu waters, Bone Bay, South Sulawesi . Journal of Science and Technology vol 3 no 2 : 29-38.

Mallawa, A., Musbir, A. Faisal and A.A.Marimba, 2013. The analysis of technology pressure to populations of skipjack tuna in the waters of Luwu, Bone Bay, South Sulawesi , Paper presented at the 5thNational Seminar on Fishing , Bogor Agriculture Institute, Bogor. 21 p.

Mallawa, A., Musbir, A. Faisal and M. Zainuddin, 2013. The population biology and fisheries aspects of skipjack tuna *(Katsuwonus pelamis)* in the waters of the Flores Sea. Laboratory-Based Research Report,The Marine Sciences and Fishery Faculty, University of Hasanuddin, Makassar. 199 p.

Mallawa, A., Musbir, A. Faisal and M.Zainuddin, 2013. Performance of the population biology of skipjack tuna (*Katsuwonus pelamis*) caught by purse seine in East season in the waters of the Flores sea, South Sulawesi. Papers on 4thNational Seminar on Restoration and Management of Fishery Resources Forum, Padjadjaran University Bandung, 25 p.

Mallawa, A., A. Faisal., and W. Susanti. 2014. Analysis of Pressure of Technology on Skipjack *(Katsuwonus pelamis)*populations in the waters of the Flores Sea, South Sulawesi. Prosiding 1stNational Symposium on Marine and Fisheries, Marine Sciences and Fishery Faculty, Hasanuddin University, Makassar : 323 - 345

Mallawa, A., A, Faisal and W.Susanti, 2014. The structure of the size and growth of skipjack *(Katsuwonus pelamis)*in waters of the Flores Sea, South Sulawesi,Papers of 7ththe National Seminar on Fish and 4th Congress of Ichthyology Society, Bogor Agriculture Institute. 24 p.

Mallawa,A., A. Faisal and W.Susianti, 2015. Stock condition of skipjack tuna (*Katsuwonus pelamis*) in the waters of Flores South Sulawesi. Proceed of 2nd National Symposium on Maritime and Fishery, Marine Sciences and Fishery Faculty, University of Hasanuddin : 323 – 343.

Mallawa, A., 2016. Size structure of skipjack tuna (*Katsuwonus pelamis*) captured by pole and line fishermen inside and outside of fish aggregation device. International Journal Scientific and Technology research, volume 5 issue 09 September 2016 : 150 – 163

Mallawa, E., A. Mallawa, and A.Faisal, 2016. Population dynamic of skipjack tuna (*Katsuwonus pelamis*) in the waters of Makassar Strait. International Journal of Scientific and Tecgnology Research, volume 4 issue 4 April 2016 : 42 – 46.

Mallawa, E., 2016. Assessment of stock condition and environmental friendliness of technology catching skipjack tuna (*Katsuwonus pelamis*) in the waters of Makassar strait, South Sulawesi. Research report of Post Graduate School, University of Hasanuddin, Makassar. 218 p.

Mallawa, A., 2016. Percentage of Catch Suitable Length of Skipjack tuna (*Katsuwonus pelamis*) of fishermen using kinds of fishing technology in Indonesia Fishery Management Area of 713. Papers on 3rd National Symposium on Maritime and Fishery, Marine Sciences and Fishery Faculty, University of Hasanuddin, Makassar, South Sulwesi. 26 p.

Qorimah, A., 2013. Population dynamics of Skipjack tuna (*Katsuwonus pelamis*) in the waters of the Strait of Makassar Pare-Pare. The research report, University of Hasanuddin. Makassar 79 p.

Rezkika, F.S., 2011. Estimation of somepopulation dynamics parameters of Skipjack tuna*(Katsuwonus pelamis)* in the waters of the Gulf of Bone, Luwu. Research Report, Makassar. 47 p,

Samad, D., 2002. Study of some parameters of population dynamics of Skipjack tuns*(Katsuwonus pelamis)* were caught in the waters of the Strait of Makassar. Research Report, Makassar. 79 p.

Sibert J, and J. Hampton, 2003. Mobility of tropical tuna and the implication for fisheries management. J.Mar.Pol 27: 87-95.

Sparre, P, E.Urchin and S.C.Vernema, 1989. Introduction to tropical fish stock assessment. Part I, Manual. FAO, Rome. 337 p.

Syamsuddin and A. Mallawa,, 2009. Assessment of skipjack fisheries development (*Katsuwonus pelamis)* in NTT Kupang waters. Journal of Science and Technology vol II (3), Post Graduate Prog. Univ. of Hasanuddin, Makassar: 45-58.

Takashima, F and T. Hihiya, 1995. An atlas of fish histology, normal and pathology features. Second Edition, University of Tokyo. 245 p.

University of Hawaii, 2008. The Associative Dynamics of Tropical Tuna to a Large Scale Array Anchored FAD. The Pelagic Fisheries Research Program. Hawaii. 15 p.

WCPFC, 2009. Summary Report-Scientific Committee Fifth Regular Session. Port Vila Vanuatu. 5 p.


UNIVERSITAS DIPONEGORO
SEMARANG
PUSAT UNGGULAN IPTEK
PERGURUAN TINGGI INDONESIA
RISTEKDIKTI
KEMENTERIAN KELAUTAN DAN PERIKANAN
PERTAMINA EP
ASSET 3 TAMBUN FIELD