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RESEARCH ARTICLE

RAPJELLYFISH METHOD TO EVALUATE THE SUSTAINABILITY STATUS OF EDIBLE JELLYFISH RESOURCES MANAGEMENT IN THE SALEH BAY, INDONESIA

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ABSTRACT

Saleh Bay (Sumbawa Island, Indonesia) waters suitable for edible jellyfish (scyphozoan) *Crambione mastigophora* Maas 1903. Fishermen in Saleh Bay exploited the scyphozoan since 2006. The problem in scyphozoan resources is not yet known of stock and exploitation status. This research was conducted during 01st September 2014 - 15th December 2014. Research method is survey and simple random sampling. Total scyphozoan samples were 104 individuals are catched on October-December. The aims of this study were to know: growth pattern and body shape, potential stock and exploitation status and sustainability status of scyphozoan fisheries resources management. Method of data analysis used assessment of growth patterns with simple regression method, stock assessment using surplus production model of Gordon-Schaefer (1959) and standing stock using method of Walter and Hilborn (1992). Analysis of the sustainability status of scyphozoan fisheries management using RAPJELLYFISH method is modified from RAPFISH. The first study that apply the RAPJELLYFISH method is this study. The growth pattern of scyphozoan is allometric negative and body shape is slim. MSY of scyphozoan resource is 33,261.18 tons/year, the yield in 2013 amounted to 32.115.26 tons and the exploitation status is "fully exploited". Meanwhile, RAP analysis results indicate the present sustainability status is "quite sustainable" and results of Leverage analysis indicate there are 19 attributes classified as "sensitive attributes". As for resources security and improving of the sustainability status, needed a model of sustainable management of edible jellyfish fisheries resources to develop strategies and actions plan.

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INTRODUCTION

BACKGROUND

Resource of Indonesia jellyfish that has been exploited and contributes to tes to foreign exchange reserves and the money supply in Indonesia is a group of edible jellyfish. The edible jellyfish resource is one of the many fisheries resources of coastal waters that have high and important economic value. Important in this case for the income of small scale fishermen and their households. This is due to edible jellyfish resources has evolved into a jellyfish fishery activities that provide economic benefits for local fishermen, This is due to edible of resources jellyfish has evolved into a jellyfish fishery activities that provide economic benefits for fishermen, businesses and coastal communities, as well as the government and people of Indonesia.

Indonesia is one of the leading suppliers of jellyfish to China during 2012 from 18 exporter countries. Export volume of jellyfish products from Indonesia same with Vietnam is 3,000 mt (11.35%). Bahrain country is the biggest exporter (7,000 mt), followed by Mexico (5,640 mt). The volume of international trade transactions edible jellyfish products to China during 2012 amounted to 26.440 mt (López-Martínez and Álvarez-Tello, 2013) (Table 1). CBSI (2011) reported that the edible jellyfish product of Indonesia accounted for 1.51% of the total export value of fishery products in 2010.

Edible jellyfish exported in the salted jellyfish type is one of the fishery products which have demand and prices continue to increase every year. All product types of edible jellyfish are only intended to meet the demands and needs of the export market, and not traded/marketed in the Indonesia domestic market. According to Omori (1981) and Omori & Nakano (2001), Indonesia has long edible jellyfish exporting to Japan, and most famous abroad is a product processed jellyfish namely Flower Type and Prigi Type. Product of Indonesian edible jellyfish has been exported to several countries including China, Japan, Hong Kong, Taiwan, and Korea (Mujiono,

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2010). One of the jellyfish processed centers of Prigi Type in Indonesia encountered in coastal areas of Saleh Bay, West Nusa Tenggara (FMA WNT, 2009).

Saleh bay area of 2,123 km^2 is located in Sumbawa Island which is one of the two main islands in West Nusa Tenggara Province, in addition to the Lombok Island. The western part of Saleh Bay region located in the Sumbawa Regency administration area. While the eastern part of the bay region is the administrative area of Dompu Regency.

Table 1 Leading jellyfish suppliers to China, 2012

No.	Country	Yield (mt)	Ratio (%)
1	Mexico	5,640	21.33
2	Malysia	200	0.76
3	Thailand	1,000	3.78
4	Myanmar	200	0.76
5	India	300	1.13
6	Indonesia	3,000	11.35
7	Sri Langka	800	3.03
8	Pakistan	1,600	6.05
9	Iran	300	1.13
10	Bahrein	7,000	26.48
11	Vietnam	3,000	11.35
12	Korea	600	2.27
13	EUA	1,000	3.78
14	Japan	1,800	6.81
	Total	**26,440.00**	**100.00**

Source: López-Martínez and Álvarez-Tello (2013)

Biologically, the edible jellyfish (scyphozoan) in the Saleh Bay waters is species *Crambione mastigophora* MAAS 1903 (Asrial *et al.*, 2015), that also called "red jellyfish" or "ubur-ubur merah" (Indonesia name). While ecologically, Saleh Bay waters suitable for *C. mastigophora* based on the parameters of water temperature, pH, and salinity (Asrial *et al.*, 2015).

Scyphozoan was first exploited in 2006 by Saleh Bay fishermen who live in the District of Sumbawa through fishing activities. While the fishermen from Dompu District who settled around the coastal of Saleh Bay first catch jellyfish in 2009. The fishermen conduct fishing operations of jellyfish began afternoon to early morning using scoop-net, lights, and wooden boats since 2006 until now. Fishermen sold the entire jellyfish to buyers who have the jellyfish processing units scattered in mainland coast around the area of Saleh Bay. In the Saleh Bay coast, scyphozoan is processed only mouth-arm part (mouth-feet).

This fishery resource becomes important because if the population of scyphozoan increased (blooming) then all fishermen in the Saleh Bay switch catch jellyfish. In addition, the Saleh Bay coastal communities (especially the women) are also involved in scyphozoan fishing activities as jellyfish mouth-arm part release and work on the jellyfish processing units.

The problem is not yet known potential and stock of population of the edible jellyfish resource in the waters of Saleh Bay. To that end research is needed to estimate the resource reserves of edible jellyfish populations, exploitation status and sustainability status of management.

Management of edible jellyfish resources in the waters of Saleh Bay is closely linked with systems that live and thrive in the region. So that exploitation of edible jellyfish resources as a fishing activity can be beneficial to coastal communities of Saleh Bay region, especially fishermen household it is necessary to obtain information about the dimensions of the management that contribute to utilization of edible jellyfish resources. All of those dimensions are bio-ecological, economic, technological, social and legal & institutional, who live and thrive in coastal communities of the Saleh Bay region. This is in accordance with the opinion of many experts that the management of fishery resources should be done with a holistic and multidimensional approach and planning with the precautionary principle (Fauzi, 2004; Fauzi, 2006; Nuitja 2010; Tuwo, 2011; Sulaiman, 2011). The multidimensional or holistical approach is the main theoretical basis of this study.
Research on the utilitazion of edible jellyfish ever conducted in the waters of Bali on 2012. Mulyadi *et al.* (2012) suggested that the management of edible jellyfish resource in the waters of Bali through a holistic approach that bio-ecological aspects, technological aspects and economic aspects. The study on the management of edible jellyfish in the waters of Saleh Bay in 2014 discuss about five dimensions of management namely bio-ecological, economic, technological, social and legal & institutional.

The aim of this study was to: (1) Assessing the biological aspects of the edible jellyfish resources in the waters of Saleh Bay, (2) Describe the potential and the exploitation status of edible jellyfish resource in the waters of Saleh Bay, and (3) Describe the status of sustainable management of edible jellyfish resource in the waters Saleh Bay.

MATERIALS AND METHODS

Research concerning in resources and fisheries of edible jellyfish in the Saleh Bay waters has been carried out in 01st September 2014 - 15th December 2014. The authors visited four times to the research location in order to get data and information of the edible jellyfish, and to interview the local fishermen.

The data is the main materials in this study were divided into time series data and cross section data. Time series data (jellyfish production, fishing gear) sourced from the Fisheries and Marine Affairs (Sumbawa District, Dompu District). While the cross section data (biological jellyfish) obtained from the sampling, measurement and direct observation research on the samples of edible jellyfish totaling 104 individuals of adult jellyfish. As for the main equipment is used in this research divided into two functions: (a) to catch edible jellyfish namely scoop-net, lights, and boats, baskets (@ 40 kg) and (b) to measure edible jellyfish namely rulers, scales, and stationery.

This research was conducted in the Saleh Bay waters, Indonesia. Research method is survey method namely the activities of in-depth observation and data collection to obtain the correct, good and represented information and data to a problem, events or phenomena that occur in a specific region. Sampling is done randomly by simple random sampling

method for collecting primary data. Meanwhile, secondary data are collected by the method of documentation especially with the reports that have been published in the form of annual data production quantities of edible jellyfish and number of scoop-nets in Saleh Bay. A total of 104 individuals jellyfish example be identified to determine the size range of jellyfish are caught by fishermen during the research period.

Analysis of the growth pattern and body shape of edible jellyfish

This analysis uses primary data from measurements of length (diameter umbrella) and body weight of edible jellyfish is to determine the Weight-Diamaeter Relationship (WDR). WDR is obtained by using simple regression method ($Y = \alpha + \beta X$) between variables of weight (W) and diameter (D) of umbrella. Results of this analysis are also used to determine the pattern of growth and body shape edible jellyfish through the coefficient of independent variable (b) refers to the growth scale that comes from Effendie (1997). The stages of analysis are as follows:

1. Compiling the data in the matrices form of weight (W) and diameter (D)
2. Transform data into value system of logarithms (log D and log W)
3. Calculating the values of correlation (r), determination (R^2), the ability of the sample (Adjusted R^2), the pattern of growth (b) and body shape (b)

$\log W = a + b \log D$ …… (1)

The pattern of growth and body shape refers to a scale developed by Effendie (1997), sticking to the value of the independent variable coefficient (diameter) that is b <3: allometric negative or thin / slim, b = 3: Isometric or proportional, and b> 3: allometric positive or plump/ obese.

Analysis of the exploitation status of edible jellyfish resources

Analysis of the exploitation status of edible jellyfish resource in the waters of Saleh Bay by applying the method of surplus production model of Gordon-Schaefer (1959) to estimate the catch per unit effort (CpUE), the maximum sustainable yield (MSY), the exploitation status and potential stock of edible jellyfish. It is necessary for measures for the analysis of exploitation status as below:

1. Compiling data on production in units of weight (tons) and fishing effort in units of time-series based on the type of fishing gear.
2. Calculating Catch per Unit Effort (CpUE or U)

$U = \text{Yield/Effort}$ ……..… (2)

3. Estimate the Maximum Sustainable Yield / MSY (Y_{MSY}, f_{MSY}, U_{MSY}), the exploitation status and potential stock of scyphozoan as follow the equations:

$Y = a*f + b*f^2$ ……... (3)
$Y/f = U = f + b*f$ ……..(4)
$Y_{MSY} = a^2/4b$ …….. (5)
$f_{MSY} = a/2b$ ....……...(6)
$U_{MSY} = a/2$ ……(7)
$ES = Y_t/Y_{MSY} \times 100\%$ ...…….(8)

Note:
U = Catch per unit effort/CpUE (tons/unit)
Y = Yield of edible jellyfish (tons)
a = Intercept Coefficients
b = Effort Coefficients (Scoop-net)
f = Number of Scoop-net (units)
MSY = Maximum Sustainable Yield (ton/year)
ES = Exploitation Status (%)
t = Year (2013)

Analysis of the sustainability status of edible jellyfish resource management

RAPFISH is a rapid appraisal technique to evaluate the sustainability status of fisheries (Pitcher and Preikshot, 2001). Sustainability status of scyphozoan resource management analyzed by the method of Rapid Appraisal for Fisheries (RAPFISH) which is the latest technique, developed by the Univesity of British Columbia Vancouver (Canada) in 1999. This analysis aimed to evaluate the sustainability status of fisheries resources management in fishing activities in multi-disciplinary. RAPFISH based on the ordination technique that puts something on the order of attributes measured by using Multi-Dimensional Scaling / MDS. Dimensions in RAPFISH concerning the attributes of sustainability which consists of ecological, economic, technological, social, and ethical, with 51 attributes (Pauly and Pitcher, 2000; Pitcher and Preikshot, 2001; Fauzi and Anna, 2002; Kavanagh and Pitcher, 2004). Hartono *et al*. (2005) develops or modifies the dimensions in RAPFISH be ecological, economic, technological, social, and governance, with 48 attributes. According to Hartono *et al*. (2005), RAPFISH method is rapid and accurate assessment method that explain of the utilization and management of fishery resources. RAPFISH application of this analysis following the procedure described by Alder *et al*. (2000) (Figure 1).

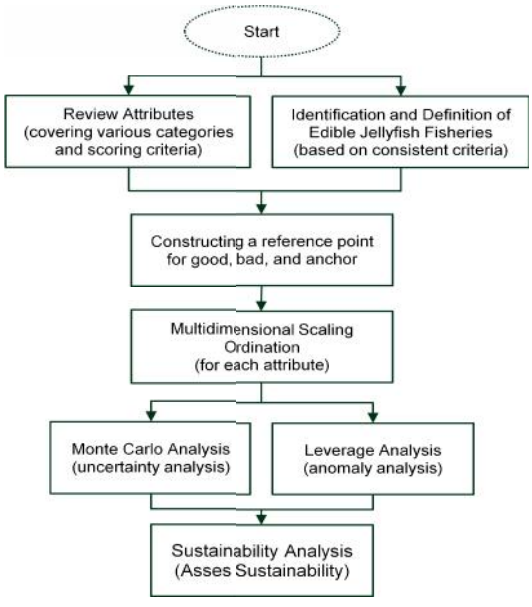

Figure 1 Elements of the RAPJELLYFISH application process

According to Fauzi and Anna (2005), MDS method has the following stages:

1. Standardization (normalization): variables that have different units and magnitude should be standardized beforehand in order to be analyzed.
2. Multidimensional distance measurement: that in this study the distance between the fishing gear (scoop-net) to center point of coordinates can be seen.
3. Dimension reduction analysis: this analysis was also performed ALSCAL algorithms with excel template. The position of objects in multidimensional space above the plotted back to the two-dimensional space.
4. Measurement of the stress value: Stress is a 'value standard deviation' of the MDS method. The smaller of the stress value is better. The biggest stress value is still acceptable dalah 25%.

To asses the sustainability status of edible jellyfish resource management in Saleh Bay is used the RAPJELLYFISH method that is adopted and modified from RAPFISH method. This method consists of five dimensions, namely bio-ecological, economic, technological, social, and the last is legal and institutional with 47 attributes. Anlysis in RAPJELLYFISH consist of RAP analysis, Monte Carlo analysis, and Leverage analysis. RAP analysis aims to determine the status value of sustainability, Monte Carlo analysis to assess significant differences of each attribute (Pauly and Pitcher, 2000), and analysis of Leverage to determine the sensitivity level of each attribute. On the whole dimension of RAPFISH and RAPJELLYFISH are shown in Table 2.

Table 1 Leading jellyfish suppliers to China, 2012

No.	Country	Yield (mt)	Ratio (%)
1	Mexico	5,640	21.33
2	Malysia	200	0.76
3	Thailand	1,000	3.78
4	Myanmar	200	0.76
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12	Korea	600	2.27
13	EUA	1,000	3.78
14	Japan	1,800	6.81
	Total	**26,440.00**	**100.00**

Source: López-Martínez and Álvarez-Tello (2013)

Table 2 Difference between rapfish and rapjellyfish

No.	Rapfish*	Rapjellyfish
1	Ecology	Bio-ecology
2	Economy	Economy
3	Technology	Technology
4	Social	Social
5	Ethic	Legal and Institutional

Sustainability analysis begins with the RAP analysis that aims to determine the value / index sustainability. The value shows the status of sustainability namely sustainable (>75-100), quite sustainable (>50-75), less sustainable (>25-50), and not sustainable (0-25) (Susilo, 2003; Suyitman, *et al.*, 2009).

RESULTS AND DISCUSSION

Body Weight-Diameter of Umbrella Relationship

Sampling results of body weight (B_W) and umbrella diameter (D_U) of edible jellyfish (Table 3) are used to estimate the Body Weight-Diameter of Umbrella Relationship (BWeDoUR), Growth Pattern (GP) and Body Shape (BS) of edible jellyfish Analysis of relationship of the body weight and the diameter of umbrella of *C. mastigophora* conducted between data of the umbrella diameter and the body weight data. Analysis results of the relationship between umbrella diameter and body weight (BWeDoUR) with a simple regression using the equation log W = log a + b log D (Pauly, 1984; Efendie, 1997) against 104 individuals jellyfish sample. The equation is $W = -2.399 \times D^{2,672}$ (Figure 2), r = 94.852%, R^2 = 89.970%, Adjusted R^2 = 89.872%, SEb = 0.088 (8.832%), and b = 2.672.

r value (94.852%) were close to 1.00 (100%) showed between variable of body weight and variable of umbrella diameter has a "very strong correlation" (80% -100%). Whereas value of R^2 meaningful 89.970% of equation is determined by the variable of umbrella diameter or "very dominant" affect to variation of body weight variable (10.030% equation is determined by other variables that are not included in this study), most of the data (89.970%) were able to explain the similarities, and these equations can be used to perform a "forecasting" because the value of R^2> 60%. Meanwhile, the value of SEb means the regression coefficient of diameter umbrella variable occur "very small deviation" (<10.0%) and has contributed "significantly" to variable of jellyfish body weight.

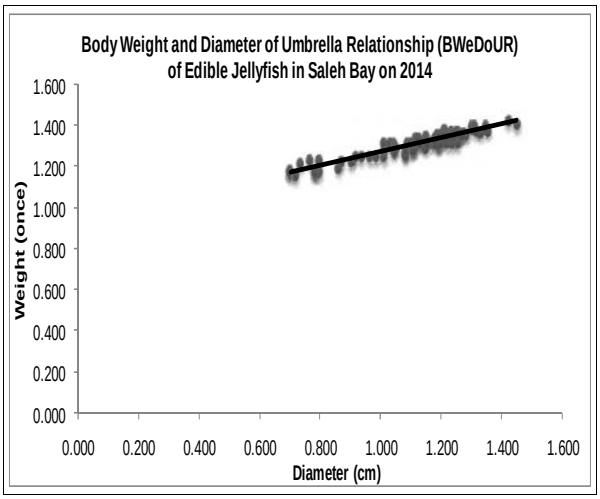

Figure 2 Weight and Diameter Relationship (BWeDoUR) of Edible Jellyfish from Saleh Bay, Indonesia, on 2014

Growth Pattern and Body Shape

The value of b = 2.672 on the analysis result of simple regression above, indicated the growth patterns according Efendie (1997) is "negative allometric" (b <3) that occurred long growth is more dominant than the growth of the weight, and body shape is slim. The situation is reinforced by the equation of relationship between body weight and umbrella diameter which this equation ($W = -2.399 \times D^{2,672}$) indicates if the diameter of the umbrella increasing the width so the body

weight decreases. This means jellyfish body shape will be thinner with increasing width umbrella.

Proof can also be done through other approaches, can be proved by using a monthly sampling data. If the monthly data of body weight and umbrella diameter were analyzed with simple regression method, the shape of the jellyfish body is getting thinner until the end of the fishing season jellyfish.

Maximum Sustainable Yield/MSY (Y_{MSY}, f_{MSY}, U_{MSY})

Analysis of the sustainable potential of scyphozoan *C. Mastigophora* using surplus production model of Gordon-Schaefer (1959), shows this model is very realistic used to estimate the maximum sustainable yields (Y_{MSY}) of scyphozoan *C. Mastigophora*, maximum sustainable fishing effort (f_{MSY}) and the value of maximum sustainable CpUE (U_{MSY}). The type of data being analyzed is time series data consisting of the volume of edible jellyfish catches (tons) and the number of fishing gear scoop-net (units) which operate in the waters of Saleh Bay. (Table 4, Figure 3)

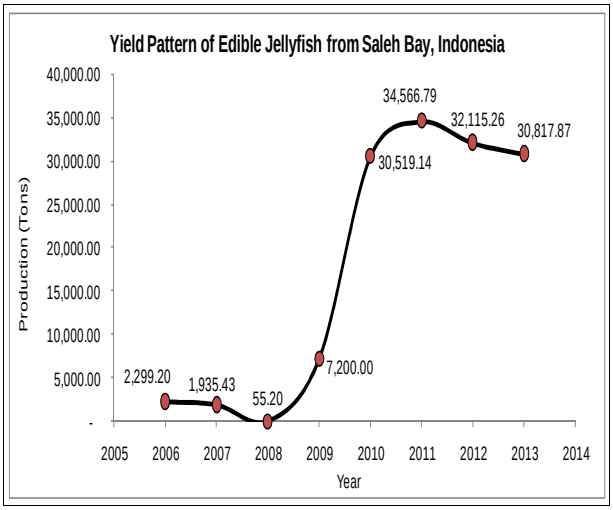

Figure 3 Yield pattern of edible jellyfish from Saleh Bay, Indonesia

Table 3 Sampling result of edible jellyfish on October-December 2014 in the Saleh Bay, Indonesia

No. of Specimen	Sampling Data W_B (once)	Sampling Data D_U (cm)	Logarithmic Data W_B (once)	Logarithmic Data D_U (cm)	No. of Specimen	Sampling Data W_B (once)	Sampling Data D_U (cm)	Logarithmic Data W_B (once)	Logarithmic Data D_U (cm)
1	14.0	22.5	1.146	1.352	53	17.0	22.5	1.230	1.352
2	16.1	24.5	1.207	1.389	54	12.8	19.5	1.107	1.290
3	9.2	18.0	0.964	1.255	55	11.0	19.0	1.041	1.279
4	14.0	21.5	1.146	1.332	56	12.0	18.5	1.079	1.267
5	13.8	21.0	1.140	1.322	57	12.6	19.5	1.100	1.290
6	18.6	23.5	1.270	1.371	58	14.6	21.5	1.164	1.332
7	15.8	21.5	1.199	1.332	59	12.0	19.5	1.079	1.290
8	13.0	21.0	1.114	1.322	60	15.4	20.5	1.188	1.312
9	13.6	21.5	1.134	1.332	61	15.6	21.5	1.193	1.332
10	11.2	20.0	1.049	1.301	62	22.0	25.0	1.342	1.398
11	16.0	22.5	1.204	1.352	63	15.4	20.5	1.188	1.312
12	12.2	20.0	1.086	1.301	64	17.2	22.0	1.236	1.342
13	13.2	22.0	1.121	1.342	65	21.2	23.5	1.326	1.371
14	13.0	22.0	1.114	1.342	66	15.8	21.5	1.199	1.332
15	8.6	18.0	0.934	1.255	67	15.2	21.0	1.182	1.322
16	6.2	15.0	0.792	1.176	68	14.0	20.0	1.146	1.301
17	6.2	17.0	0.792	1.230	69	17.0	23.0	1.230	1.362
18	6.0	15.0	0.778	1.176	70	17.6	23.0	1.246	1.362
19	6.0	15.0	0.778	1.176	71	17.8	24.0	1.250	1.380
20	5.0	15.5	0.699	1.190	72	28.0	26.0	1.447	1.415
21	5.0	15.0	0.699	1.176	73	18.2	23.0	1.260	1.362
22	5.8	17.0	0.763	1.230	74	18.0	22.5	1.255	1.352
23	7.2	16.0	0.857	1.204	75	17.0	21.0	1.230	1.322
24	5.0	15.0	0.699	1.176	76	15.8	22.0	1.199	1.342
25	5.2	14.5	0.716	1.161	77	16.4	21.0	1.215	1.322
26	5.4	16.5	0.732	1.217	78	17.8	22.0	1.250	1.342
27	12.3	21.0	1.090	1.322	79	15.0	21.0	1.176	1.322
28	14.5	21.0	1.161	1.322	80	20.0	24.5	1.301	1.389
29	10.2	21.0	1.009	1.322	81	16.4	22.0	1.215	1.342
30	7.4	17.0	0.869	1.230	82	26.2	27.0	1.418	1.431
31	13.6	21.0	1.134	1.322	83	17.8	24.0	1.250	1.380
32	8.0	17.0	0.903	1.230	84	19.8	25.0	1.297	1.398
33	8.2	18.0	0.914	1.255	85	15.8	21.5	1.199	1.332
34	10.2	19.0	1.009	1.279	86	15.0	22.0	1.176	1.342
35	17.0	24.0	1.230	1.380	87	16.0	22.0	1.204	1.342
36	13.4	21.0	1.127	1.322	88	20.2	25.0	1.305	1.398
37	22.4	24.0	1.350	1.380	89	16.8	22.5	1.225	1.352
38	10.2	18.0	1.009	1.255	90	14.2	21.0	1.152	1.322
39	12.6	20.0	1.100	1.301	91	16.0	23.5	1.204	1.371
40	12.8	20.0	1.107	1.301	92	17.8	21.0	1.250	1.322
41	12.0	19.0	1.079	1.279	93	15.6	21.0	1.193	1.322
42	10.9	21.0	1.037	1.322	94	13.2	22.0	1.121	1.342
43	12.6	21.0	1.100	1.322	95	17.2	23.0	1.236	1.362
44	12.3	21.0	1.090	1.322	96	18.2	23.0	1.260	1.362
45	12.2	21.0	1.086	1.322	97	15.4	23.0	1.188	1.362
46	12.2	20.0	1.086	1.301	98	19.0	23.0	1.279	1.362
47	12.9	20.0	1.111	1.301	99	16.4	23.0	1.215	1.362
48	12.2	20.0	1.086	1.301	100	20.4	24.0	1.310	1.380
49	9.6	18.0	0.982	1.255	101	17.6	24.0	1.246	1.380
50	12.5	21.0	1.097	1.322	102	15.0	22.0	1.176	1.342
51	10.7	21.0	1.029	1.322	103	18.5	23.0	1.267	1.362
52	11.0	20.0	1.041	1.301	104	15.2	23.0	1.182	1.362

Note: W_B = Wieght of Body D_U = Diameter of Umbrella

Table 4 Yield of edible jellyfish in the Saleh Bay, Indonesia

No.	Year	Yield of Scyphozoan (tons)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Agu	Sep	Oct	Nov	Dec	Total
1	2006	0	0	0	0	0	0	0	0	0	692,26	827,51	779,42	2.299,20
2	2007	0	0	0	0	0	0	0	0	0	535,82	672,77	726,84	1.935,43
3	2008	0	0	0	0	0	0	0	0	0	10,57	18,91	25,72	55,20
4	2009	0	0	0	0	0	0	0	0	0	934,12	2,521,01	3.744,87	7.200,00
5	2010	0	0	0	0	0	0	0	0	0	6.137,77	10.183,75	14.197,61	30.519,14
6	2011	0	0	0	0	0	0	0	0	0	7.008,83	12.539,70	15.018,26	34.566,79
7	2012	0	0	0	0	0	0	0	0	0	6.474,16	11.095,53	14.545,57	32.115,26

Analysis result of the variables fishing effort (f) and variable catch per unit effort (CpUE) scyphozoan using simple regression analysis of surplus production model of Gordon-Schaefer (1959) obtained values are as follows r = 86.69%, R^2 = 75.15%, *Adjusted* R^2 = 68.86%, Standard error = 0.00072, a = 16.982, and b = -0.002

The resulting equation/model between the yield of edible jellyfish (Y) with edible jellyfish fishing effort (f) *C. Mastigophora* is Y = 16.982 f - 0.002 f^2. While the regression equation obtained between yield per edible jellyfish fishing effort with edible jellyfish fishing effort is Y/f = U = 16.9815 - 0.002 f. The equation is meaningful, the more effort catching edible jellyfish attempted/made by the fishermen then CpUE tends to decline. Realisticity of models can be tested based on the value of the effort (f).

The model is said to be realistic if f-value is smaller than the -a/b value (f < -a/b). The highest level of effort occurred in 2009 namely 6,498 units/year, while the value -a/b for the year amounted to 7,835 units. The level of effort (f) in 2009 is still not exceeds the value of -a/b (6,498 < 7,835).

Thus, it becomes realistic model is used to estimate the magnitude of the yield (Y) and the catch per unit effort (CpUE), so that the results of these estimates also be realistic. This equation obtained from the analysis of the model of surplus production Gordon-Schaefer (1959) become realistic to use the results to estimate the maximum sustainable yields (Y_{MSY}), maximum sustainable fishing effort (f_{MSY}) and the value of maximum sustainable CpUE (U_{MSY}) edible jellyfish *C. Mastigophora* at the research location.

The analysis results of the relationship between fishing effort with CpUE has a correlation/relationship is very strong (75%<R<100%) due to the value of correlation coefficient (r) of 86.69%. Meanwhile, the value of R^2 (75.15%) means that as many as 75.145% of data fishing effort is able to explain/influence variation CpUE. For the value of Adjusted R^2 (68.86%) means as much as 68.86% of the sample were able to find answers required from the population, which means the sample has a "high degree of accuracy".

The value of standard deviation of 0.00072 explained that small deviations regression coefficient of fishing effort variable, and has contributed significantly to the variable CpUE. Independent variable (fishing effort) simultaneously able to explain the change in the dependent variable (CpUE), this is indicated with F significance value of 0.05 (if calculated F value is 0.057).

Based on the analysis of the sustainable potential of jellyfish C. Mastigophora Gordon-Schaefer model (1959), obtained the following results:

- the value of maximum sustainable catches (Y_{MSY}) = 33,261.18 tons/year
- the value of maximum sustainable fishing effort (f_{MSY}) = 3,917 units/year
- the value of maximum sustainable CpUE (U_{MSY}) = 8.49 tons/unit/year

Exploitation Status

Based on the results of the analysis using a model of Gordon-Schaefer (1959) which compared with the criteria for the status of utilization of edible jellyfish resources that follows the provisions of Dwiponggo (1987), the status of jellyfish fisheries in the Saleh Bay region in 2013 classified as "Fully Exploited" namely the stock of jellyfish resources have exploited close to the value of Y_{MSY}. This is due to catch of jellyfish resources in 2013 as much as 32,115.26 tons, means already being exploited by 92.65% of the total value Y_{MSY} that is 33,261.18 tons. While the fishing effort in 2013 a number of 6,404 units of fishing gear has exceeded maximum sustainable fishing effort (f_{MSY}) amounted to 3,917 units of fishing gear, or have more as much as 63.48%.

The exploitation status of edible jellyfish (92.65%) has threatened of existence, viability and conservation of edible jellyfish resource because it exceeds the allowable catch (<80% from MSY). So that edible jellyfish fisheries activities do not threaten the sustainability of edible jellyfish resource in the Saleh Bay it is necessary to adjust the amount of fishing effort (fishing gear).

Potential Stock

The analysis used to estimate the potential of the stock reserves (standing stock) and catches jellyfish *C. mastigophora* that is using a model developed by Walter and Hilborn (1992). Results of linear regression analysis based on the model obtained values of a = 0.00, b = -0.8079, c = -0.0004, r = 80.79%, R^2 = 65.28% (CpUE variation can be explained by variations in fishing effort of 65.28%). Furthermore, the value of r obtained as a natural growth rate of the stock biomass (constant) of 7.3300, the value of q (coefficient cacthability) of -0.0004 and a value k as the maximum carrying capacity of the natural aquatic environment of 24,544.65 tons/year. By using the coefficient r, q, and k are obtained alleged potential stock or reserve sustainable (Be) edible jellyfish *C. Mastigophora* for

the current state (standing stock) in the Saleh Bay waters of 12272.32 tons/year.

For the purposes of the precautionary principle and sustainability of jellyfish *C. mastigophora* resource management in the region Saleh Bay hence the need for sustainable resource management efforts of edible jellyfish. Allan and Castillo (2007) explain that the activities related to the effort to manage fisheries resources should be based on a holistic science. Neala *et al.* (2009) suggest that the utilization of fish resources necessary precautionary principle in order not to over-fishing conditions occur.

The precautionary principle in general is a mandate based on the UN resolution No. 4/95 1995, the Food and Agricaltural Organisation (FAO) on Code of Conduct for Responsible Fisheries (CCRF) is setting aspects aims to fishing activities can take place in a sustainable the CCRF in article 7, paragraph 5. This is also a mandate for the entire nation of Indonesia (SS-RI, 2004; SS-RI, 2009; FMA-RI, 2007).

Analysis of Sustainability Status

Analysis of the sustainability of edible jellyfish fisheries resources in the waters of Saleh Bay is based on fishing gear that used to catch edible jellyfish. In this sustainability analysis used RAPJELLYFISH technique is a method of analysis with Multi Dimensional Scaling (MDS) with five dimensions, namely (1) dimension of bio-ecology, (2) dimension of economic, (3) dimension of social, (4) dimension of technology, and (5) dimension of legal and institutional.

Dimension of Bio-ecology

The dimension of bio-ecology had 10 (ten) attributes consist of (1) Exploitation Status, (2) Migratory Range, (3) Trend Biomass (CpUE), (4) Size of Jellyfish, (5) Discard by-catch, (6) By-catch Species, (7) Environmental Understanding, (8) Weight-Diameter Relationship (BeWeDoUR), (9) Status of Growth Pattern and (10) Status of Jellyfish Processable. Based on the RAP analysis of all attributes obtained the sustainability index value of 73.21. The value of meaning is sustainability index of edible jellyfish management in the Saleh Bay at category of "quite sustainable".

While the results of the Leverage analysis each attribute is as follows: (1) Exploitation Status: 0.45 , (2) Migratory Range: 2.70, (3) Trend Biomass (CpUE): 4.27, (4) Size of Jellyfish: 4.67, (5) Discard by-catch: 5.13, (6) By-catch Species: 4.72, (7) Environmental Understanding: 8.33, (8) Weight-Diameter Relationship: 3.12, (9) Status of Growth Pattern: 3.16 and (10) Status of Jellyfish Processable: 0.65. From the Leverage analysis is known that the most sensitive attributes affect the sustainability of bio-ecological dimensions of edible jellyfish management activities in the Saleh Bay are attributes "Trend Biomass (CpUE)" "Environmental Understanding" (by fishermen) and "Status of Growth Pattern" as indicator of the main levers.

Dimension of Economic

The economic dimension is composed of 10 attributes, namely (1) Price, (2) Fisheries in GRDP, (3) Limited Entry (Quota Distribution), (4) Profit, (5) Ownership Transfer, (6) Other Income, (7) Market, (8) Income Relative to RMW (Regional Minimum Wages), (9) Sector Employment, and (10) Subsidy. RAP analysis results of all these attributes, the value of sustainability index is 70.45 or the category of "quite sustainable". This means that the performance of the economy and economic actors of edible jellyfish management is high enough to bring great benefits to the economy of Saleh Bay coastal communities. Edible jellyfish resources management activities are likely to be a source of the new economic growth and the driving of economic development in the Saleh Bay coastal region. In addition, edible jellyfish fisheries will remain without disrupting ongoing business scale and sustainability of the stock of edible jellyfish resources.

The detailed of Leverage analysis result is (1) Price: 6.41, (2) Fisheries in GRDP: 7.49, (3) Limited Entry (Quota Distribution): 8.95, (4) Profit: 4.26, (5) Ownership Transfer: 4.94, (6) Other Income: 4.80, (7) Market: 4.46, (8) Income Relative to RMW: 4.87, (9) Sector Employment: 5.45, and (10) Subsidy: 5.47. There are three attributes have a value of Leverage which adversely affect the performance of sustainability. These attributes are Price, Fisheries in GRDP and Limited Entry (Quota Distribution).

Dimension of Social

The attributes are attached to the social dimension is related to fishing , the involvement of fishermen, fishing conflicts, and fishing capacity is (1) Conflict Status, (2) Fishing Community Growth, (3) Education Level, (4) Fisherman Influence, (5) Fisherman Experience, and (6) Tipology of Fisherman. The value of the social dimension sustainability index is 53.79 , or category of "quite sustainable"

The sustainability index value of the social dimension is 53.79, or category "quite sustainable". This means, if there is no horizontal conflict in the future, the activities of edible jellyfish fishery will sustainable.

Meanwhile, the results of the Leverage analysis on the social dimension obtaining the value of each attribute is as follows:: (1) Conflict Status: 1.24, (2) Fishing Community Growth: 1.84, (3) Education Level: 13.92, (4) Fisherman Influence: 4.35, (5) Fisherman Experience: 9.27, and (6) Tipology of Fisherman: 3.50. Attributes of Education Level, Influence Fisherman and Fisherman Experience correlates to the low value of the sustainability indexes of social dimension.

Dimension of Technology

Dimension that related and in direct contact with the extraction of edible jellyfish resources is dimension of technology. In this dimension, there are 9 (nine) attributes consist of: (1) Trip Length, (2) Landing Site, (3) Pre-sale Processing, (4) Handling on board, (5) Fishing Gear, (6) Selective Gear, (7) Vessel Size, (8) Catchability of Fishing Gear, and (9) Side Effects of Fishing Gear. The value of sustainability status of dimension of

technology obtained from the RAP analysis is 39.25 or "less sustainable" category. The sustainability index value that means the technology chosen and applied by fishermen namely the scoop-net (fishing gear), the light (attractant), and the wooden vessel, very aptly applied to retain productivity. The low value index of the technological dimension means that the technology applied by fishermen for extracting edible jellyfish resources basically does not interfere with the stock of edible jellyfish resources that live and breed in the waters of Saleh Bay

The Leverage analysis results of of the technological dimension attributes is (1) Trip Length: 3.82, (2) Landing Site: 0.47, (3) Pre-sale Processing: 6.47, (4) Handling on board: 8.79, (5) Fishing Gear: 9.27, (6) Selective Gear: 10.73, (7) Vessel Size: 0.06, (8) Catchability of Fishing Gear: 6.60, and (9) Side Effects of Fishing Gear: 3.36. The attributes of Pre-sale Processing, Handling on Board and Catchability of Fishing Gear contribute to increasing the value of sustainability status of the technological dimension.

Dimension of Legal and Institutional

Law (regulation) and institutional (organizations) are vital elements in a management, including the macro-scale management such as management of edible jellyfish resources in an coastal waters area.

Attributes contained in the dimension of legal and institutional, chosen and allegedly give effect to the sustainability of the legal and institutional dimensions are: (1) Public Agency (District, Province), (2) Personal Investor, (3) Coopertion Institution, (4) Banking Insitution, (5) Buyer/ Processing Unit, (6) Core Enterprise, (7) Fishing Port Institution, (8) Marine Security Institution, (9) Fishermen Group, (10) Illegal Fishing, and (11) Regulation about Management of Edible Jellyfish Resources. The sustainability index value of the legal and institutional dimension use RAP analysis, the result is 33.04 with the category "less sustainable". It shows the level of insecurity and uncertainty are a bit high on the sustainability of edible jellyfish management in the Saleh Bay.

Leverage analysis earn value of that each attribute as follows: (1) Public Agency: 0.64, (2) Personal Investor: 3.94, (3) Coopertion Institution: 5.61, (4) Banking Insitution: 7.16, (5) Buyer/Processing Unit: 9.78, (6) Core Enterprise: 6.68, (7) Fishing Port Institution: 9.27, (8) Marine Security Institution: 5.56, (9) Fishermen Group: 3.29, (10) Illegal Fishing: 3.41, and (11) Regulation about Management of Edible Jellyfish Resources: 1.63. Leverage analysis result is showed that the Buyer/Processing Unit, the Fishing Port Institution and the Banking Insitution are sensitive attributes influence for dimension of legal and institutional.

CONCLUSION

RAPJELLYFISH method is modified and developed from RAPFISH method, used to evaluate and analyze the sustainability status of edible jellyfish fisheries resources management. in Saleh Bay, Indonesia. Evaluate result of the sustainability status of edible jellyfish resources management in the Saleh Bay using RAPJELLYFISH method is “Quite Sustainable”. To achieve the status of "Sustainable", then proceed with preparing a model of sustainable management of fishery resources of edible jellyfish in the Saleh Bay waters.

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