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Biological and fisheries aspect of *Octopus* sp. (Cephalopoda) from the waters of buton regency, southeast Sulawesi, Indonesia

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Abstract
An octopus fishery in Buton waters is expected to continue to decrease its catch. To know the condition of octopus fishery need to do research to get information of biology and fishery aspect as management effort. The aim of this research is related to fishery in Buton regency waters. Case study method was used in this research, by choosing Buton regency waters as the research area. This research was carried out in January until May 2016. Observation had been done in order to get the biological data of *Octopus* sp. and fisheries aspect had been used by Purposive Sampling methods. The result of the research of 402 samples *Octopus* sp. shows the pattern of allometric negative growth that grow rapidly from heavy growth *Octopus* sp. the value of a (intercept) = equal to 1,979812, b (slope) = equal to 2,5722 and r (coefficient of correlation) = equal to 0.867888 then the equation of length and weight becomes W = 1,979812 L 2,5722. This shows that the b value obtained is smaller than 3 (three), which means that the octopus (*Octopus* sp.) has a negative allometric growth pattern, due to the increase in octopus length faster than growth weight. Judging from the above calculation, the correlation value (r) is 0.867888 which is almost close to 1 (one) indicates the presence of a close enough and positive relationship between weight gain and octopus length.

Keywords: Biological aspect, Buton regency, Fisheries, *Octopus* sp., Buton waters

Introduction
Cephalopoda is a group of soft animals that have no spine (invertebrates). Some species of Cephalopoda have high commercial value and are a biologically important species in marine ecosystems [1]. In the national trade in Indonesia, in the family Cephalopoda there are 3 species of squid (squid), cuttlefish (cuttlefish), and octopus (octopus) of high economic value [2]. Each group may consist of one tribe (family) or more that have important economic significance. Loliginidae, Onychoeteuthidae, and Ommastrephidae, are the tribes that support the squid group. Family members Sepiidae and Octopodidae are often caught in the waters of Buton is cuttleoctopus and octopus. The octopus fishery in the waters of Buton has an important role that almost all fishermen during the octopus season make the octopus as the main catch. The season of octopus in the waters of Buton occurs throughout the year, the decade of 1990 to 2000 is an octopus season in a good and safe situation. Observations made in this study aims to determine the characteristics of morphometry and long-term relationship to know the factual about fishery. gurita (*Octopus* sp.) around Buton regency waters which landed in Pasarwajo. The commonly used octopus capture tool softens the bell. Operation time with spear catching done in the morning for up to 4 hours. The management of octopus fishing attempts shows that proper octopus fisheries management is to monitor the techniques of capturing octopuses at low risk and the importance of improving the quality of human resources, thus obtaining sustainable and responsible fisheries. To know the effort of octopus fishery management need to do study about aspect of biology and fishery as effort and step in management of fishery octopus in the future.

Materials and Methods
This study was conducted from January to May 2016. The octopus catches were from the Buton regency waters theme and landed at the octopus auction, Bajo Fisherman Village,

Pasarwajo, Buton, Southeast Sulawesi. Primary data compensated by itself at landing octopus in Bajo Fishing village as well as interviews aimed at fisherman. Long frequency distributions were grouped by month and created classes. Data collection was done by taking samples using purposive sampling method, that was intentionally or not random sampling. This measurement was done by using a meter gauge that has a functional scale of 1 cm. Further weighing the weight of the octopus using a digital scale that has a scale of 1 gram. The weight of the octopus can be used as a function of its length, and this long heavy relationship almost follows the cubic law of a octopus of the rank of three of its length. But because the octopus is grown then the body shape, length and weight is always changing [4]. An analysis of the length and weight data according to the Effendie (1979) [3]. The estimation of the size of the octopus was first caught with the appearance of octopus containing with a cumulative percentage (Y axis). To obtain the Lc value (the length of the first catch) is to take the line of relationship on the X axis for the 50% value on the Y axis [5].

Results and Discussion

Based on the observation it was found that the octopus caught with the spear in the waters of Buton Regency, Pasarwajo has the overall characteristics of the head that blends with a coat that enveloped the whole body to form a rather loose collar on the neck or outer protective skin as a substitute for shells as in other cephalopoda types (Figure 1.), has two large eyes protruding and located around the periphery of the head, having legs divided into arms of 8 pieces of arm lengths several times the length of the body used as a swimming tool and feeding on food, having a very sucker or sucker much in the form of concave spheres on his arms, having webs on the interleaved arms, and ocellus or aqueduct located in the middle between his eight arms. The grayish-white body of octopus is very flexible and flexible to make it easier to move and hide among the rocks but not slimy or transparent.

(a) (b)

Fig 1: Morphological specs(a) octopus morphology (*Octopus* sp.) (b) the octagon arm having (1) sucker, (2) web and (3) ocellus,

Octopus sp. spread from Southeast Asia to the Western Pacific, found in the Lembeh Strait, Maumere Bay of Flores and Milne Bay of Papua New Guinea. In the Great Barrier Reef of Australia, six members of this subgenus are known, two of which are Octopus aceluatus d'Orbigny, 1834 and Octopus capricornicus which are new species in the cephalopod taxonomy [17]. Based on these characteristics it is suspected that the octopus caught with the spear is a family of Octopodidae that is from the type of octopus *Cystopus* indicus. The western waters of the coast of Sumatra, Java Sea, to the north of Arafura there are estimated 4 (four) types: *Octopus* vulgaris, *Octopus* aegina, *Octopus* macropus, and *Cystopus* indicus[8].

The features of the octopus are coat lengthwise, the neck contracting with the head narrowed [1]. Long sleeve shape, slender with flattened tip. Oktariza, *et al* 2015[16]. found the length of the sample measurements, it is known that most *L. chinensis* males were caught from 144-176 mm (20.11%) and female catches were from 144-176 mm (43.50%). The length of *L. chinensis* mantle in Andaman Bay, Thailand, is from 50 to 286 mm for male and from 46 to 235 mm for female. Furthermore, octopus samples were measured in body length (Fig. 2.) using a measuring instrument and calculating body weight using a digital scales.

Fig 2: *Octopus* sp. Measurements caught with spears around the waters of Buton Regency, Pasarwajo, Southeast Sulawesi.

Measurement of coat length starts from the base of the mantle to the center of the eye. As for the total length measured from the base of the mantle to the longest arm of the octopus.

Length and weight relationship of the *Octopus* sp.

The analysis of the length and weight relationship of the octopus (*Octopus* sp.) was done by mentranforsikan data of mantle length (cm) and weight (gram) into heavy length relation graph. The exponential line equation of the long-heavy relationship graph follows the Effendie (2002) [4]. with the equation W = a Lb. The results of the analysis of the length relationship of octopus weight (*Octopus* sp.) obtained values as in Table 1.

Table 1: Result of Calculation of Octopus sp. Long Weight Relation around Buton Regency waters, Pasarwajo.

Octopus samples	A	B	R	N	$W=a\ L^b$
Total	1,979812	2,572208	0,867888	402	$_{1,979812}L^{2,572208}$

Information:
a: intercept
b: slope
r: correlation coefficient
n: the number of octopus samples
W: linear equations

Total samples of the captured octopus totaled 402 heads, with a spear catch tool in the waters of Buton Regency. Based on table 1 and mempe figure 3 then we can get the value (intercept) = value 1.979812, b (slope) = 2, 5722 and r (correlation coefficient) = equal to 0.867888 then the equation of length and weight becomes W = 1, 979812 L 2,5722. This shows that the value of b obtained is smaller than 3 (three), which means that the octopus (*Octopus* sp.) Has a negative allometric growth pattern, because the increase in octopus length is faster than the growing weight. Judging from the above calculation, the correlation value (r) is 0.867888 which is close to 1 (one) indicating a close enough and positive relationship between weight gain and octopus length. The graph showing the relationship between the length and weight of octopus (*Octopus* sp.) in the waters of Buton regency, Pasarwajo, Southeast Sulawesi can be seen in Figure 3. as follows:

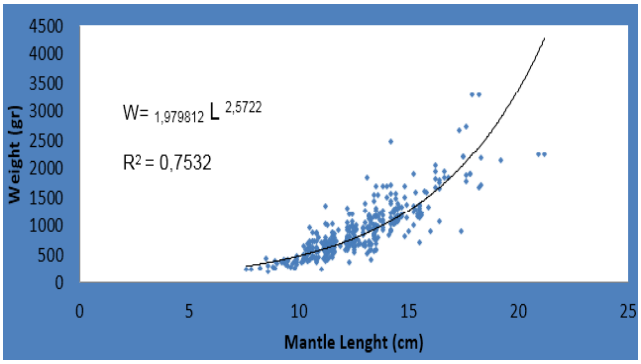

Fig 3: The graph of length and weight relationship (*Octopus* sp.) Landed in the waters of Buton Regency, Pasarwajo, Southeast Sulawesi

Based on the graph of the relationship length and weight of the calculation results obtained by the equation of weight weight of W = 1,979812 L 2,5722. As for the value of b from the calculation results obtained value of b <3, this indicates that octopus (*Octopus* sp.) that landed in the waters of Buton regency, Pasarwajo, Southeast Sulawesi has a negative allometric.

The value of r obtained from the calculation is 0.867, which means that the value of r is close to 1 (one), so it can be said that there is a close and positive relationship between growth weight and length. Then the value of b is tested to determine the probability obtained by using t test 0.05 (580, db). From the calculation result, the value of tcount is 5,84 and ttable is 1,966, then tcount> table to show that value of b is significantly different with 3 (three) meaning that octopus (*Octopus* sp.) landed in the waters of Buton Regency, Southeast Sulawesi has body length, this is thought to be due to the growth of octopus length faster than growth weight. This means that the observation of the biological aspects of Octopus (*Octopus* sp.) length and weight relationship is not different in general. This is in accordance with research conducted by Carolus *et al.* (2008) [7], which states in the waters of Sangihe, North Sulawesi that octopus (*Octopus* sp.) Caught around Sangihe waters by taking octopus samples (*Octopus* sp.) As many as 29 tail also experienced a negative allometric growth pattern, due to measurements of long octopus growth faster than growth weight so that the captured octopus tended to elongate. Long range octopus 7.46 cm - 14.86 cm with an average length of 11.16 cm. Allegedly one of the factors affecting allometric growth in octopus is the t-table value of the total sample of 402 animals after the comparative test of the table at a real level of 95% (n-2) is 1.9658. Based on the long measurement data on the octopus it can be seen that the mantle of the length (ML) which has a range of size of 7.6 cm - 21.2 cm which is allometric negative to the wet weight. The negative allometric properties of ML measurement and wet weight indicate that the general growth in the octopus lasts with elongated growth after which it widened. The length of the mantle greatly affects the growth of cephalopoda species, especially the addition of body weight, the coat length is also used as a comparative basis to facilitate the cephalopod growth grouping [8]. The allometric growth in octopus shows that the octopus body's overall proportion is not fixed. Avoidance of predators may explain differences in distribution between adolescent *O.vulgaris* and adults, *O. dofleini* and adult *O. tetricus* was discovered by [9, 10, 11]. Although the average depth of octopus, octopus was collected (2.9 m) shallower than large specimens (3.8 m) in this study, differences in depth distributions can not be verified because tidal fluctuations are not considered. The morphometric relationship to the *O. vulgaris* in False Bay, Africa is similar to that reported for species in the northwest coast of Africa[12], on the east coast of South Africa[23] and in Mediterranean coast of Spain[13].

Frequency distribution

This frequency distribution calculation is intended so that we can know how many and are in the range of the size and weight of the octopus in the sample used. From field observation to 402 octopuses landed in Buton regency waters, Pasarwajo, Southeast Sulawesi obtained the long data of octopus class, which is the smallest length of 7.6 cm and the largest length of 21.2 cm shows the average length size of 12, 73 cm, and average weight size of 911.05 grams (Figure 4).

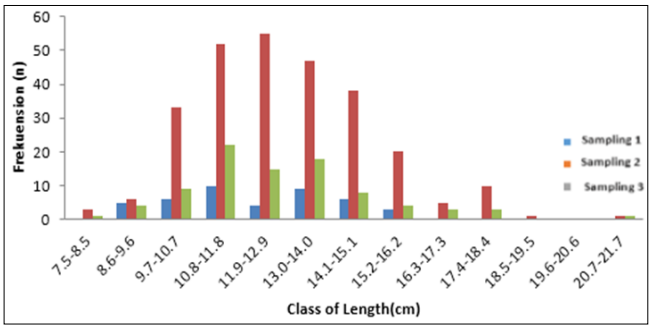

Fig 4: The octopus frequency distribution chart (*Octopus* sp.) That landed in the waters of Buton Regency, Pasarwajo, Southeast Sulawesi

Based on Figure 4., it is found that from the catch of the octopus landed in the waters of Buton Regency, Pasarwajo, Southeast Sulawesi shows the average length of fluctuating size in each size range of octopus length. During observation many male and female octopuses are caught with a long range between 11.9 cm - 12.9 cm. Study squids in Lamongan waters mantle length of the females ranged from 4.6 to 38 cm and their weight ranged from 5 to 410 g. Mantle length of the male ranged from 4.5 to 29 cm and 6 to 360 g weight [14].

Several squid studies and in some areas among those conducted in Beibu Bay - China show that the length of *L. chinensis* squid mantle is 49 to 438 mm and weighs from 7.3 to 723 g [15]. The result of *L. chinensis* research on Belitung Island waters, Indonesia is with the length of the male and female coat in the range of 7.8 to 37 cm and the weight ranges from 9 to 349 g [16].

First Size Captured (Lc)

One that is used as a reference in the effort to manage fishery resources to remain sustainable is through the estimation of the first size of octopus or captured octopus (Lc). Determination of the size of the first time caught is intended for controlling the arrest of octopus in order to avoid exploitation, so that the octopus resources can be maintained its sustainability. The results of the measurement analysis of the length of the octopus mantle (*Octopus* sp.), the total of octopuses caught as many as 402 tails. The first captured size distribution (Lc) can be seen in Figure 5.

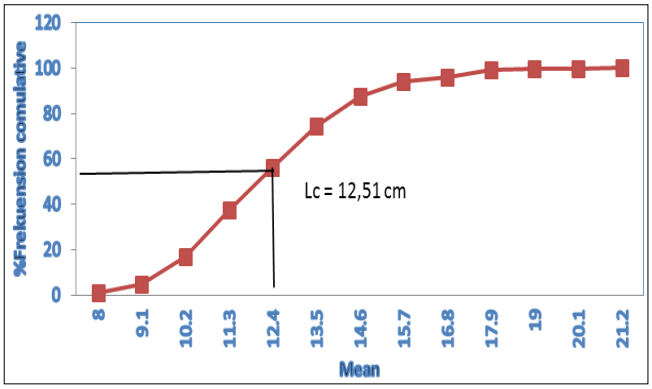

Fig 5: Graph of first size captured (Lc) octopus (*Octopus* sp.) Landed in the waters of Buton Regency, Pasarwajo, Southeast Sulawesi.

Based on the first size chart captured (Lc) the octopus from the observations made in the field shows that the maximum length of the captured octopus is 21.2 cm, and for the minimum length captured is 7.6 cm, and obtained the length of the octopus that is allowed to be captured by taking the line of relationship between the mean value to the value of 50% at the cumulative frequency percentage of more than 12.51 cm.

During the observation took place the catch obtained by fisherman in Pasarwajo showed the average size of octopus caught in the waters of Buton Regency, Pasarwajo of 12.4 cm in the long range of 11.9 - 12.9 cm. The length of the captured average mantle (L50%) is 12.51 cm with the length of the infiniti (LOO) obtained by the equation (LOO) = Lmax / 0.95 is 20.14 cm, ideally the size of the octopus first caught no less than LOO. It is suspected that the octopus caught in the waters of the Buton Regency, Pasarwajo relatively still small for the size of decent catch. Male *O. vulgaris* mature at smaller size than females, consistent with most other cephalopods [18, 20]. However, male maturation is largely determined by the size of the octopus, and all octopuses> 170 g mature. *O. vulgaris* may develop and reproduce throughout the year at False Bay, with possible peaks in spring and summer when the water is warmer [25]. The top spawning in *O. vulgaris* has been reported for other temperate regions, but varies seasonally, for example in the spring of South Carolina, in autumn in North-West Africa [12].

Fishing Area of *Octopus* sp.

Fisherman conducted the arrest of octopus from the edge to the breakwater area. The extent of the octopus catching area is different at each Fishing site, allegedly depending on the extent of the reefs.

The location of octopus Fishing in the waters of Buton regency is a rocky waters that starts from the waters around Banabungi Village, Holimoumbo Jaya to Kampung Bajo. The Fishing grounds around Banabungi Village are centered around the pier which is a deep sandy and rocky beach. The right side of the pier is a continuation of Fishing ground until the waters of Holimoumbo Jaya to enter the waters of Kampung Bajo. The condition of the seafloor in the waters of Holimoumbo Jaya is more steep compared to the waters of Banabungi Village, causing the waves crashing to the beach to become harder. The location of the octopus catching around the waters of Buton Regency, Pasarwajo is allegedly not representative of the octopus area where there is an octopus because based on information from local fisherman the operation of the octopus Fishing operation depends on the limitation of Fishing gear and human resources in the case of fisherman who do not go diving when conditions of waters and weather not possible to avoid the risk of diving.

Season of *Octopus* sp.

For the classification of seasons octopus fishing is based on the season that is already known by the Fisheries community, especially Bajo fishermen who are in the area of Buton Regency. The octopus catching season is divided into three seasons as follows: East Season, West Season and Transitional Season.

The capture of octopus in Buton waters takes place in the east season (February to April). Fishing activities of the octopus are done in the morning until late afternoon. *O.vulgaris* Adults in the False Bay, Africa may be more active at night [25], and in other waters for *O.vulgaris* species [19, 20, 21]. The higher proportion of *O. vulgaris* small octopus captures is exposed during the day rather than at night [9]. The difference in activity of small octopuses and adults is suspected to be a strategy to avoid predation and cannibalism [23, 24].

Conclusion

The long-octane (*Octopus* sp.) Association of 402 heads is negative allometric, i.e the length increase is faster than the weight gain (b = 2.57) with an average length of 12.73 cm and an average weight of 911.05 grams. The first measure of capture (Lc) from the observation results of octopus (*Octopus* sp.) as much as 402 heads obtained the long coat range between 11.9 cm - 12.9 cm and the average length of 12.4 cm then found the value of Lc 12,51 cm and LOO value of 20.14 cm. From the first captured size (Lc) and LOO with an average length of 12.73 cm and an average weight of 911.05 grams, it is suspected that the catch of fisherman in Pasarwajo is still relatively small for the arrest of an octopus during the observation.

The aspect of octopus fishery (*Octopus* sp.) is Fishing gear which used by Fisherman Pasarwajo is spear (hook) made of iron berukura 75 cm with diameter 0,5 cm. The Fishing area of octopus fisherman (*Octopus* sp.) around the waters of Buton Regency starts from Banabungi Village, Holimoumbo Jaya Village, to Kampung Bajo around the rocky waters with a depth of 5-6 meters. The octopus Fishing season (*Octopus* sp.) in the waters of Buton Regency takes place at 3 seasons, East Season, lasts for 5 months (December-April), West Season, runs for 4 months (May-August), and Transitional Season, lasts for 3 months (September-November).

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