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Diversity of Decapod Crustaceans in Lasongko Bay, Southeast Sulawesi, Indonesia

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ABSTRACT The aim of this study was to reveal the species diversity of Decapod Crustaceans in Lasongko Bay, Southeast Sulawesi, Indonesia. The study was conducted from April 2013 to March 2014. The sample collections were conducted on a monthly basis using gillnets at six stations. The abundance, diversity, and similarity indices of decapod species are presented spatially and temporally. Nineteen families and thirty-eight species were found in the bay, and they were dominated by the brachyuran group. The Shannon-Weiner diversity index, the evenness index, and the Simpson dominance index of the decapods spatially ranged 0.812–0.893, 0.592–0.683, and 0.215–0.313, respectively. The species similarity index ranged 0.560–0.831 spatially and 0.363–0.902 temporally. Decapods with high economic value were also discussed.

KEY WORDS Abundance; Brachyura; Muna Island; Crustacea; similarity.

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INTRODUCTION

The decapod crustaceans, consisting of crabs (Brachyura) and shrimps (Macrura), play important ecological roles (Aswandy, 2008) and have a high economic value in some species. Some species of decapods are high-value resources and become protein sources for human, such as penaeid shrimp, lobsters (*Panurilus* spp.), mud crabs (*Scylla* spp.), and blue swimming crabs (*Portunus pelagicus* Linnaeus, 1758). There are 14,756 different species of decapods in the world (De Grave et al., 2009), and brachyuran groups range from 5,000 to 10,000 species (Chakravarty et al., 2016), of which about 6793 species inhabit marine ecosystems (Ng et al., 2008; Kumaralingam et al., 2013).

Indonesian waters have a high diversity of decapod crustaceans, but are still poorly documented (Hutomo & Moosa, 2005). The decapod crustaceans found in Indonesian marine waters are about 1502 species, comprising 1,400 species of the brachyura group and 102 species of the Stomatopod group (Hutomo & Moosa, 2005). Researches on decapod crustaceans diversity in Indonesian marine waters have been carried out by Moosa (1980), Moosa & Aswandy (1994), Widyastuti (2007), Aswandy (2008), Pratiwi (2010, 2012), Pratiwi & Astuti (2012), Pratiwi & Widyastuti (2013), Pratiwi & Wijaya (2013), Anggorowati (2014), Anggraeni et al.

(2015), Mashar et al. (2014, 2015), Ardika et al. (2015), Wardiatno et al. (2015a, b), and Wardiatno et al. (2016a, b). The results of several studies have shown that the diversity of decapod species varied across locations and many of the studies still emphasized on the spatial aspect, whereas the diversity of decapod crustaceans was associated with season variability (Andrade et al., 2015). In terms of location, most of research on the biodiversity in Indonesia has been concentrated in the western region.

Lasongko Bay is a small bay located in Central Buton, Southeast Sulawesi, in the eastern part of Indonesia. The bay has been the fishing ground of the blue swimming crab fishery, and many biological aspects of the blue swimming crab in the bay have been reported, i.e., reproductive aspects (Hamid et al., 2015a, b; Hamid et al., 2016a), population dynamic and stock (Hamid & Wardiatno, 2015; Hamid et al., 2016a, c, d), and fishery management (Hamid et al., 2017). In the blue swimming crab fishery, many of the other Decapod Crustacean species are also caught as bycatch. This study aimed to reveal the diversity of decapod crustacean species spatially and temporally in Lasongko Bay, Southeast Sulawesi, Indonesia.

MATERIAL AND METHODS

Study area

The study was conducted in Lasongko Bay, Central Buton, Southeast Sulawesi - Indonesia. The bay is located at the latitude 05°15' to 05°27'S and longitude 122°27' to 122°33'E (Figure 1). Decapods have been collected on six stations situated from the inner to the middle part of the bay. Stations 1 to 5 are situated in the area between lower intertidal and subtidal zone. The seagrass was present in the area between lower intertidal and upper subtidal zone with sandy sediments, while the subtidal zone was a bare sandy area (Hamid et al., 2016a). Stations 1 and 2, situated near the coastline, are influenced by mangrove ecosystems. Station 6 is in the middle of the bay with a sandy clay substrate in the sea bed (Hamid et al., 2016a).

Sampling

Decapods samplings at each station were done monthly, from April 2013 to March 2014. Sample collections were conducted by gillnets with mesh

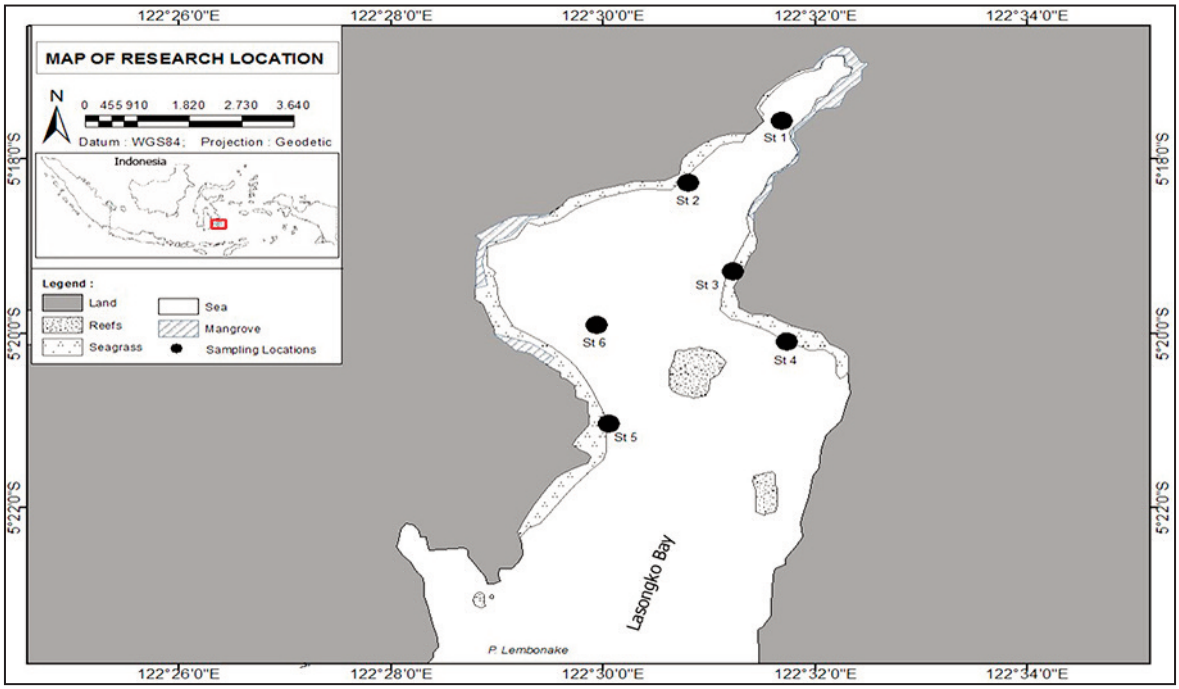

Figure 1. Map showing the location of the study site in Lasongko Bay, Southeast Sulawesi, Indonesia. Sampling sites are indicated by the black dots (adapted from Hamid, 2015).

sizes of 3.81, 6.35, and 8.89 cm. The gillnet was deployed in the afternoon and hauled in the morning of the next day. The decapods caught on each sampling were identified following Ng (1998), Chan (1998), Ng et al. (2008), and Khvorov (2012), and counted. Habitat characteristics such as temperature, salinity, dissolved oxygen, pH, turbidity, and total suspended solids were taken from Hamid (2015).

Data analysis

The data were grouped spatially (station) and temporally (sampling period) for analysis. To evaluate the diversity, three biological indices were used (e.g. Shannon-Wiener index, evenness index, and the Simpson dominance index). The species similarity index between stations was calculated by the Sorensen index (Brower et al., 1990).

RESULTS

Habitat Conditions

Habitat characteristics in Lasongko Bay during the study showed variation, but were still within the optimum limit for decapods life. The range of some environmental parameters are as follow: temperature, 23.6–35.6 °C; turbidity, 0.20–6.78 NTU; total suspended solid, 19.0–293.0 mg. l–1; dissolved oxygen, 3.05–7.77 mg. l–1; salinity, 16.0–35.0 psu; pH, 7.45–8.74 (Hamid, 2015).

Species Composition of Decapods

The collected decapods found during the study were 2508 individuls, consisting of two groups, the Brachyura group (16 families and 34 species) and the Macrura group (3 families and 4 species). All collected decapod crustaceans can be seen in Table 1. Some familes and species have always been found in each station and at each sampling time. These families are Portunidae, Dorippidae, Calappidae, Xanthidae, and Majidae (Figure 2). The species are *Portunus pelagicus*, *Dorippe sinica*, *Callapa hepatica*, *Schizophrys aspera*, *Podothalmus vigil*, *Charybdis anisodon*, *Thalamita crenata*, *T. spinimana*, *T. sima*, and *Lophozozymus pictor*.

Spatial Diversity

Decapods abundance at each station ranged from 243 to 730 individuals and the number of species ranged from 16 to 26 species. The highest abundance and species were found at station 1, while the lowest abundance at station 6 and the lowest number of species at station 3 (Table 1). The Shannon-Weiner diversity index ranged from 0.812 to 0.893. In addition, the evenness and Simpson dominance indices ranged from 0.592 to 0.683 and from 0.215 to 0.313, respectively. The similarity index of the decapod species between stations ranged from 0.560 to 0.831. The highest was found between stations 2 and 3, and the lowest between stations 1 and 4 (Table 2).

Temporal Diversity

According to the sampling period, the number of decapod species found ranged from 10 to 25 species with abundance ranging from 125 to 312 individuals. The highest number of species and abundance were found in March and May, while the lowest in December (Table 3). The Shannon-Wiener diversity ranged from 0.339 to 1.075, and the evenness and Simpson dominance indices ranged from 0.362 to 0.847 and from 0.113 to 0.710, respectively.

Decapoda Species of Economic Value

The number of decapod species with economic value found in this study were 20 species from the families Penaeidae, Portunidae, Calappidae, Dromiidae, Palinuridae, and Scyllaridae. Among the twenty species, six are categorized as decapods with high economic value: *P. pelagicus*, *P. versicolor*, *P. monodon*, *P. merguensis*, *S. serrata*, and *Thenus orientalis*.

DISCUSSION AND CONCLUSIONS

Portunidae was the dominant family found in Lasongko Bay (Table 1 and Figure 2), and this finding is identical to previous researches (Pratiwi & Wijaya, 2013; Varadharajan et al., 2013; Kumaralingan et al., 2013; Sruthi et al., 2014; Anggraeni et al., 2015; Fazrul et al., 2015; Pawar et al., 2017).

No.	Family	Species	Station					
			1	2	3	4	5	6
1.	Calappidae	*Callapa callapa*	1	17	1	9		1
		C. philargius					1	1
		C. hepatica	8	42	8	18	4	6
2.	Dorippidae	*Dorippe sinica*	13	34	29	14	31	33
3.	Dromiidae	*Dromia dormia*		3	4	6	11	2
4.	Epialtidae	*Phalangipus sp.*				1	1	
5.	Grapsidae	*Metopograpsus sp.*	1	3				
6.	Inachidae	*Compascia retusa*				1		
7.	Leucosiidae	*Randalia sp.*	1				2	1
8.	Majidae	*Schizophrys aspera*	19	16	8	3	5	5
9.	Matutidae	*Ashtoret lunaris*	3	2	4	4		3
10.	Menippidae	*Myomenippe hardwickii*	7	15			3	1
11.	Palinuridae	*Panulirus versicolor*	2					
12.	Parthenopidae	*Rhinolambrus pelagicus*	1	7		1	1	5
13.	Penaeidae	*Penaus. monodon*	9					
		P. merguensis	16					
14.	Pilumnidae	*Pilumnus sp.*		10		2		1
		Heteropanope indica				1		3
		Nano pilumnus		3		2		
15.	Portunidae	*Portunus pelagicus*	265	346	132	148	136	115
		P. granulatus				1	2	4
		Podothalmus vigil	40	25	7	9	16	16
		Charybdis affinis	88	7	2	7		6
		C. anisodon	180	39	4	10	10	7
		C. natator	31	6	21	2	4	
		Charybdis sp.	1					
		Thalamita crenata	26	37	3	2	4	2
		T. sima	4	35	17	3	1	5
		T. spinimana	4	33	47	6	12	8
		Thallamita sp.		2	1	1	1	2
		Scylla serrata	2					
16.	Sesarmidae	Neopisesarma sp.	2					
17.	Scyllaridae	*Thenus orientalis*				4	1	
18.	Varunidae	*Hemigrapsus* sp.		7				
19.	Xanthidae	*Lophozozymus pictor*	4	11	9	9	22	9
		Atergatis integerrimus	1					7
		Leptodius sanguineus	1					
		Etisus sp.		2			4	
Number of species			26	23	16	24	21	23
Abundance			730	702	297	264	272	243
Shannon-Wiener index			0.868	0.898	0.822	0.817	0.812	0.893
Evenness index			0.613	0.651	0.683	0.592	0.614	0.656
Simpson Dominance index			0.215	0.260	0.235	0.313	0.254	0.246

Table 1. Decapod family and species found in Lasongko Bay, Southeast Sulawesi, Indonesia.

Station	Similarity index at each station					
	1	2	3	4	5	6
1	-	0.653	0.619	0.56	0.596	0.694
2		-	0.831	0.723	0.727	0.783
3			-	0.800	0.703	0.769
4				-	0.756	0.809
5					-	0.773
6						-

Table 2. Matrix of Sorensen similarity index of Decapods among stations in Lasongko Bay, SE Sulawesi, Indonesia.

Sampling Time	No. of species	Abundance (individual)	Index		
			Shannon -Wiener	Evenness	Simpson Dominance
April 13	11	138	0.339	0.362	0.710
May 13	20	312	0.736	0.568	0.372
June 13	21	233	0.892	0.707	0.238
July13	18	178	0.830	0.693	0.263
Augustus 13	20	160	0.932	0.743	0.210
September	19	129	0.944	0.771	0.178
October 13	19	151	0.994	0.785	0.137
November 13	19	217	1.058	0.847	0.113
December 13	10	125	0.541	0.558	0.435
January 14	24	307	0.946	0.699	0.198
February 14	22	254	1.075	0.806	0.143
March 14	25	218	1.071	0.807	0.129

Table 3. The number of species, abundance, and biological indices of Decapod Crustaceans based on sampling time in Lasongko Bay, Southeast Sulawesi, Indonesia.

Location	No. of species	Diversity index (H')	Sources
Kawhia, New Zealand	29	-	Morley et al., 1997
Minden and Roe Reefs, West Australia	46	-	Richards et al., 2016
Malindi-Ungwana Bay, Kenya	22	< 0.5	Ndoro et al., 2014
Hong Kong waters	22	-	Lui et al., 2007
Mudasal Odai coast, India	34[a]		Sakthivel & Fernando, 2012
North Andaman sea, India	47	2.94-3.38	Kumaralingam et al., 2013
Puducherry coast, India	47	-	Varadharajan et al., 2013
Kanyakumari coast, India	40[a]	-	Sruthi et al., 2014
Tamil Nadu coast, India	55	3.13-5.53	Pillai et al., 2014
Uran coast, India	31[a]	-	Pawar. 2017
Odisha coast, India	29[a]	-	Dev Roy et al., 2017
Shantou Bay, China	41[a]	-	Huang et al., 2011
Pattani coast, Thailand	28	-	Fazrul et al., 2015
Kung Krabaen Bay, Thailand	17	-	Kunsook & Dumrongrojwatthana, 2017
Indonesia :			
South Lombok, seagrass bed	50	-	Moosa & Aswandy, 1994
Anambas Islands	39	0.65 -0.98	Widyastuti, 2007
Lampung Bay, seagrass bed	57	0.66-3.00*	Pratiwi, 2010
Kendari Waters, open waters	15	1.121-3.744*	Pratiwi & Astuti, 2012
Lampung Bay, mangroves	31	0.39-2.10*	Pratiwi & Widyastuti 2013
Matasiri Islands	59	0.97-3.74*	Pratiwi & Wijaya, 2013
West Lombok	85	-	Anggorowati, 2014
Tikus Island, Seribu Islands	31[a]	-	Anggraeni et al., 2015
Lingga, Riau Islands, mangroves	19[a]	0.673-1.954*	Widyastuti, 2016
Lasongko Bay	38	0.377-1.129	This study

Note: * = $\log_2$ a: brachyura only -: no data

Table 4. Number of species and Shannon-Wiener (H') index of Decapods community in some waters of the world.

The number of species and abundance of decapods in this study showed variations both spatially and temporally. It might be due to the spatial-temporal variation in habitat conditions. In terms of abundance, decapods found in this study were more than the ones found in other Indonesia waters (Pratiwi, 2010; Pratiwi & Wijaya, 2013; Anggorowari, 2014; Anggraeni et al., 2015). The number of decapod species found in the waters of Lasongko Bay was still within the range of decapod species found in other waters of the world and Indonesia, ranging from 15 to 85 species (Table 4).

The species number of Brachyura group found in this study were higher than that found by Fahzul et al. (2015), Dev Roy et al. (2017), Kunsook & Dumrongrojwatthana (2017), Pawar et al. (2017), and were lower than that found by Huang et al. (2011), Sruthi et al. (2014), as well as those found by Sakthivel & Fernando (2012). The number of species and abundance of decapods were influenced by the substrate type and seagrass density (Aswandy, 2008; Huang et al., 2011; Anggorowati, 2014; Andrade et al., 2015; Hamid, 2015), as well as temperature, salinity, oxygen, turbidity, and water depth (Lui et al., 2007; Ndoro et al., 2014; Andrade et al., 2015; Hamid, 2015; Kunsook & Dumrongrojwatthana, 2017).

Based on the sampling time, decapods diversity in Lasongko bay was generally low, except in November, February, and March, indicating ecological stress, probably due to fishing intensity. The diversity value of decapods in this study was lower compared to previous studies (Widyastuti, 2007, 2016; Pratiwi, 2010; Pratiwi & Astuti, 2012; Kumaralingam et al., 2013; Pratiwi & Wijaya, 2013; Pratiwi & Widyastuti, 2013a; Pillai et al., 2014; see Table 4). The evenness index of decapods in Lasongko Bay was moderate, indicating that the spatially-temporally distribution of the species tends to spread evenly. It is also supported by the low spatially-temporally dominance index values (Tables 1 and 2). The values of the evenness index and Simpson dominance indicess were still comparable with previous studies (Pratiwi, 2010; Pratiwi & Astuti, 2012; Pratiwi & Wijaya, 2013; Anggorowati, 2014), which ranged from 0.360 to 0.970 and from 0.070 to 0.620, respectively.

The species similarities found in this study tended to vary. Anggorowati (2015) suggests that a species similarity more than 0.61 is high. The species similarity of decapods in this study was higher than the one reported by Kumaralingam et al. (2013), Anggorowati (2014), and Pillai et al. (2014). At stations 2 and 3, 23 species and 16 species were found. These two stations have the highest species similarity of decapods, because all the decapod species found in station 3 are also found in station 2. The two stations are relatively similar to the seagrass bed conditions, i.e. *Thalassia hemprichii* dominated, but the substrate type on the subtidal were different, i.e., on the stations 2, substrate type was sand, while stations 3 has a different substrate type (clay sand) (Hamid 2015; Hamid et al., 2016a).

The species similarity of the decapods between stations 1 and 4 was the lowest. In the two stations, the decapods found belonged to 26 and 24 species, respectively. Of these, only 14 species were found on both stations (Table 2). This may be caused by differences in environmental conditions in both stations. Station 1 is located in the inner part of the bay, influenced by a dense mangrove ecosystem and a low density seagrass bed. The substrate was muddy, its salinity was lower and the water was more turbid compared to other stations (Hamid, 2015; Hamid et al., 2016a). In contrast, station 4 is relatively open, the seagrass bed was large and dense with a sandy substrate (Hamid et al., 2016a). However, there is an interesting thing about station 1. The species of *Panulirus versicolor*, *Penaeus monodon*, *Penaeus merguensis*, *Charybdis* sp., *Scylla serrata*, *Neopisesarma* sp., *Atergatis integerrimus*, and *Leptodius sanguineus* were found only in station 1 and not in any other stations.

The number of the species of economic valuable in this study is the same as found by Lui et al. (2007), and more than the one reported by Kunsook & Dumrongrojwatthana (2017), while the number of species with high economic value were less than Huang et al. (2011), Pratiwi & Astuti (2012), and Pratiwi & Wijaya (2013). *Portunus pelagicus* is one of the most valuable species, and has been a target for fishing in Lasongko Bay since the 1970s until now (Hamid et al., 2016d). The other 37 decapod species are bycatch of the blue swimming crab fishery in Lasongko Bay using gillnets. The gillnet was considered to be a selective fishing gear compared to trap for blue swimming crab fisheries (Fazrul et al., 2015; Kunsook & Dumrongrojwatthana, 2017), this finding however showed that there were still some other decapod species caught as bycatch. The

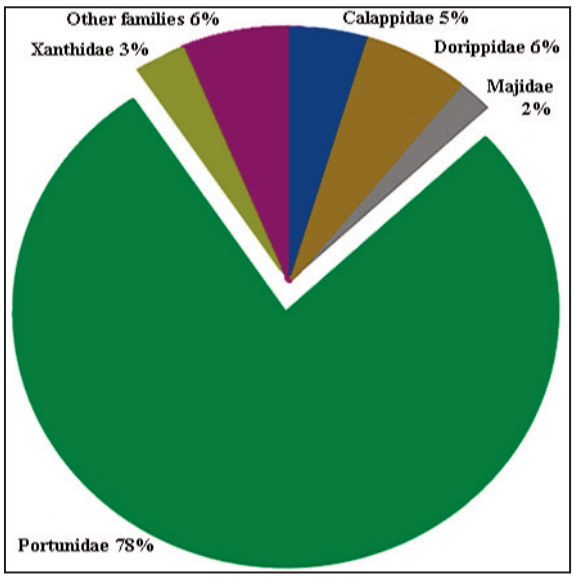

Figure 2. Family composition of the dominant Decapods based on abundance in Lasongko Bay, SE Sulawesi, Indonesia.

list of bycatches would be longer if fishes and molluscs were to be included.

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