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Ontogenetic changes in feeding and food preferences of the dog conch *Laevistrombus canarium* Linnaeus 1758 (Mollusca: Gastropoda) from Merambong shoal, Malaysia*

HUSNA Wan Nurul Wan Hassan[1, 2], MAZLAN Abd Ghaffar[1, 2, 3], COB Zaidi Che[1, 2, **]

[1] *School of Environmental and Natural Resource Science, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

[2] *Marine Ecosystem Research Centre (EKOMAR), Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

[3] *School of Fisheries and Aquaculture Sciences, Universiti Malaysia Terengganu 21030 Kuala Terengganu, Terengganu, Malaysia*

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Abstract *Laevistrombus canarium* is one of the marine gastropod mollusks that have high commercial value, particularly in the aquaculture sector in Malaysia. This study was conducted to determine the feeding and food items of *L. canarium* at different ontogenetic stages (juveniles, sub-adults and adults) from Merambong shoals, Malaysia. Field observations on feeding activity were conducted, followed by detailed laboratory analysis on the stomach content. Five-minutes observations on randomly selected individuals were conducted at the field sampling site and their feeding activities were recorded with reference to age stage. Various shell sizes from each ontogenetic stage were randomly collected and quickly anaesthetized with ice and preserved in 10% formalin before being transported to the laboratory for stomach content analyses. Field observations showed that *L. canarium* mainly grazed on epiphytes occurring on seagrass (46.67%), followed by sediment surface (40%) and epiphytes occurring on macroalgae (13.33%). Stomach content analyses showed a significant difference ($P<0.05$) in gastro-somatic index (Gasi) between the juveniles (0.39±0.05), sub-adults (0.68±0.09) and adults (0.70±0.05) ($P<0.05$). Food items found in the conch stomach include diatoms, detritus, foraminifera, seagrass and macroalgae fragments, sand particles and shell fragments. The Index of Relative Importance (%IRI) indicates three main types of food dominated the three ontogenetic stages namely diatoms, sand particles and detritus. However, no significant difference ($P>0.05$) was detected between the three main food items (diatoms, sand particles and detritus) among the ontogenetic stages. Therefore, feeding activity revealed the role of the dog conch in the marine food network. While, classification of the types of food consumed by *L. canarium* through stomach content analysis determines the particular position of the gastropod in the food chain. Further studies are needed to provide a better insight between trophic relationships of *L. canarium* with marine ecosystem.

Keyword: *Laevistrombus canarium*; feeding activity; gut contents; Merambong shoal

1 INTRODUCTION

Laevistrombus canarium Linnaeus, 1758, or the dog conch, is a marine gastropod mollusc species of high economic value (Cob et al., 2008a, b) and great potential for aquaculture (Castell, 2003; Cob et al., 2011). This marine conch is originally from the coastal waters of Indo-Pacific region, and is widely distributed from southern India to Melanesia, extending north to the Ryukus in Japan and south to Queensland, Australia and New Caledonia (Abbott, 1960; Poutiers, 1998). *Laevistrombus canarium* in Peninsular Malaysia are mainly found in the Johor Straits area (Cob et al., 2008), in areas such as Pulau

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** Corresponding author: zaidicob@gmail.com

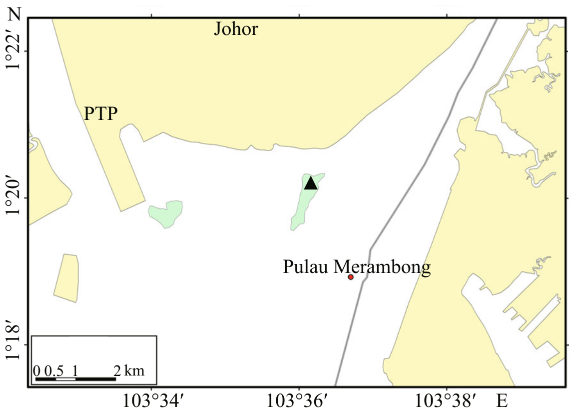

Fig.1 Study area at Merambong Shoal (black triangle) of Johor Straits, Malaysia

Tinggi and Pulau Besar, in eastern Johor, and in Port Dickson and Teluk Kemang in Negeri Sembilan. According to Poutiers (1998), dog conch lives on muddy sand bottoms among algae and seagrass beds on peninsular and continental shores. This gastropod species is important as food, especially for local communities (Poutiers, 1998; Arularasan et al., 2010), as well as for use as ornaments (Latiolais et al., 2006) and fishing equipment.

How the diet of an organism is determined integrates various critical ecological components comprising behavior, position in a habitat, energy intake and specific intra- and inter-actions (Zacharia and Abdurahiman, 2004). Steinarsdóttir et al. (2009) stated that the study of trophic relationships is very important to understand the roles and functions of organisms in an ecosystem. To date, there has been limited study on the trophic biology of *L. canarium*, (Cob et al., 2005, 2009c). This paper reports the feeding and food preferences of the dog conch *L. canarium*, in order to obtain a better perspective on their trophic biology in the marine ecosystem.

This study was conducted at the Merambong Shoal, located in the western part of the Straits of Johor, Malaysia. The Merambong Shoal seagrass bed is one of the most important and most extensive seagrass habitats in Malaysia. This dense seagrass meadow provides a place suitable for breeding, as a nursery, for protection and as a feeding ground, especially for aquatic plants and animals (Bujang, 1994). *Laevistrombus canarium* has high market value, it is in high demand in many parts of Southeast Asia and it is undergoing rapid economic development in the aquaculture sector (Cob et al., 2009a). The objectives of this study were to observe and investigate the in-situ feeding behavior of *L. canarium*, at the Merambong Shoal and the Johor Straits and to identify the changes in food consumption according to the different ontogenetic stages of *L. canarium*.

2 MATERIAL AND METHOD

2.1 Study area

The Merambong Shoal (01°19′N, 103°35′E) is located within the Sungai Pulai estuary, western Johor Straits, Malaysia (Fig.1). The shoal is characterized by muddy sand densely covered by seagrasses and is ~1–1.2 km long and 100–200 m wide, measured during extremely low tides.

2.2 Field observation and sampling

Observations on conch feeding were carried out during spring low tides (-1.5 to -2.7 MSL) when the shoal was exposed. Conch behavior and activity during feeding were monitored randomly along the >40 ha seagrass bed for five minutes for each sample (shell length between 43.13±1.33 mm to 65.16±0.91 mm and body weight between 8.71±1.43 g to 31.81±1.01 g) to determine the food preferences, locomotion, activeness (feeding intensity) and general behavior. This focal-animal sampling method (Lehner, 1992) records all the activities of one animal for a specified time period. Meanwhile, 5 minutes is considered enough for behavioral observation, as they are slow moving organisms. The characteristics of the microhabitat where the conch fed was also recorded, such as type of substrate, types of seagrass and macroalgae and their percent coverage. This field-observation study was performed on different ontogenetic stages of the conch i.e. juvenile, sub-adult and adult. The stages can be identified by several criteria, such as the thickness of the shells, shell flaring (outward growth of the outer columella lip) and the thickness of the flared lip (CFMC, 1999; Cob et al., 2009b).

For further observations, the conchs were also sampled for stomach content analysis. Conchs within the field observation area were randomly collected, anaesthetized with ice and then preserved in 10% formalin. According to Cob et al. (2008b), using this technique (ice-cooled and with formalin), the samples were in better condition and easier to handle compared to when using alcohol. The samples were then transported to the UKM's laboratory and kept frozen prior to analysis.

Table 1 In-situ feeding activities of *Laevistrombus canarium* at Merambong Shoal, Johor Straits (expressed in percentages)

	Juvenile (%) *n*=10	Sub-adult (%) *n*=10	Adult (%) *n*=10
Seagrass epiphytes	40	50	50
Macroalgae epiphytes	20	20	0
Sediment	40	30	50
Total	100	100	100

2.3 Laboratory analyses

The morphometric parameters (shell length, shell width and body whorl length) and weights (animal weight, stomach content weight and shell weight) for all samples were measured. Shell length was measured to the nearest 0.01 mm using a vernier calliper and the body weight to the nearest 0.01 g using a digital scale. After the morphometric measurements, the animals (soft tissue) were carefully separated from their shells. The weight of the animals and the shells were then recorded. The contents of the stomach were gently removed using a micropipette and weighed. The stomach contents of each individual were analyzed and identified under a compound microscope and then preserved in 70% ethanol for future reference. Feeding intensity, also known as gastro-somatic index (Gasi), was calculated using the equation below (Desai, 1970):

Gastro-somatic index (Gasi)=(gut contents weight/ samples weight without shell)×100.

2.4 Gut contents analyses

Diet analyses of the dog conch were calculated using both qualitative and quantitative methods. Qualitative methods were used to identify and categorize items found in the conch stomach. The items were then quantified and described using three quantitative measurements i.e. frequency occurrence of food (%O), the volumetric index based on the percentage by numbers (%N) and by weight (%W) and the relative importance of the food index (%IRI) (Lima-Junior and Goitein, 2001). The equations are as follows:

$\%O=(n/N)\times100$,

where, n=number of stomachs that have a food, N=total number of stomachs analyzed.

$\%N=(N_n/N_p)\times100$,

where, N_n=number of food items of food group and observed, N_p=total number of food items of all food groups.

$\%W=(P_p/P_t)\times100$,

where, P_p=weight of food items of food group and observed, P_t=total weight of food items of all food groups

$\mathrm{IRI}=(\%N+\%W)\times\%O$,

where, %N, %W and %O represent percentage by number, weight and frequency of food items.

$\%\mathrm{IRI}=(\mathrm{IRI}\times100)/\sum\mathrm{IRI}$,

where, IRI=represent each value of food items, ∑IRI=total value IRI.

2.5 Statistical analyses

Prior to any statistical analyses, data distributions were tested for normality and homogeneity of variances. Similarities in variances and covariances were tested using Bartlett's test for univariate and Box's M test for multivariate analyses. Differences in morphometric parameters and gastro-somatic index between the three ontogenetic stages were then further analyzed via the univariate method, i.e. one-way ANOVA or nonparametric Kruskal-Wallis tests, followed by the appropriate post-hoc analyses, at P=0.05 probability levels. Statistical analyses were conducted using MINITAB® 14.1 statistical software.

3 RESULT

3.1 Feeding behavior and activity

Observations on feeding activities of *L. canarium* are presented in Table 1. This species was observed grazing epiphytes on leaves of *Halophila* spp. and *Thalassia hemprichii*, and on the shells of other conchs (46.67%). In addition, they were also found grazing on the sediment (40%) and macroalgae epiphytes (13.33%). Field observations showed that 40% of the juveniles grazed on the seagrass epiphytes and sediment, while 20% grazed on macroalgae epiphytes. Meanwhile, 50% of the subadults were grazing on the seagrass epiphytes, followed by sediment (30%) then macroalgae epiphytes (20%). On the other hand, adult dog conch were grazing on seagrass epiphytes (50%) and sediment (50%), but none on macroalgae epiphytes.

3.2 Gastro-somatic index (Gasi)

Dog conch with shell length from 40.44 to 66.70 mm and body weight from 5.71 to 34.75 g were

Table 2 Morphometric parameters and Gastro-somatic index (Gasi) of *Laevistrombus canarium*

	Juvenile (mean±S.E.) *n*=10	Sub-adult (mean±S.E.) *n*=10	Adult (mean±S.E.) *n*=10
Shell length (mm)	44.64±1.44[c]	56.06±0.86[b]	64.62±0.76[a]
Shell width (mm)	24.75±2.01[c]	33.43±1.18[b]	39.83±0.61[a]
Body weight (g)	9.91±1.67[c]	18.90±1.51[b]	30.77±1.00[a]
Body whorl length (mm)	32.90±1.36[c]	44.34±1.08[b]	49.56±0.88[a]
Tissue body weight (g)	3.46±0.49[c]	6.37±0.36[b]	11.15±0.36[a]
Stomach weight (g)	0.01± 0.00[b]	0.04±0.01[a]	0.08±0.01[a]
Gastro-somatic index (Gasi)	0.41±0.05[b]	0.68±0.09[a]	0.70±0.05[a]

Different letters indicated significant differences.

analyzed according to their different ontogenetic stages (Table 2). The mean gastro-somatic index for the juveniles group was 0.41±0.05, sub-adult 0.68±0.09 and adult 0.70±0.05. The statistical analysis showed a significant difference in gastro-somatic index between the ontogenetic stages (one-way ANOVA, F=6.34, df=2, P<0.05).

3.3 Stomach content analyses

Eight types of food items were identified from the conch stomachs, which consisted of diatoms, detritus, seagrass and macroalgae fragments, foraminifera, zooplankton, plus sand particles and shell fragments. Various species of diatoms, including *Chaetoceros* sp., *Fragilaria* sp., *Navicula* sp. and *Nitzschia* sp. were identified. Detritus consisting of dead particulate organic material also were obtained in this analysis. Other types of food seen during this study were seagrass fragments, representing epiphytes on the leaves of *Thalassia* spp. and *Halophila* spp., which dominated the Merambong shoal. In addition, a few species of macroalgae were found that live attached to sandy or sandy-mud substrates at the shoal. On the other hand, *Trocommina* sp., a foraminiferan, was found in the stomach of *L. canarium*. Ostracods and other smaller crustaceans found in stomach samples are categorized as zooplankton.

The percentage composition of food items according to ontogenetic stage is presented in Fig.2. Six food items found in the stomach of juveniles, dominated by diatoms (29.03%), followed by sand particles (25.81%), detritus (19.35%), seagrass fragments (16.13%), foraminifera (6.45%) and lastly macroalgae fragments (3.23%). There were eight types of food found in the stomach of sub-adults and the percentage composition of the diet was diatoms

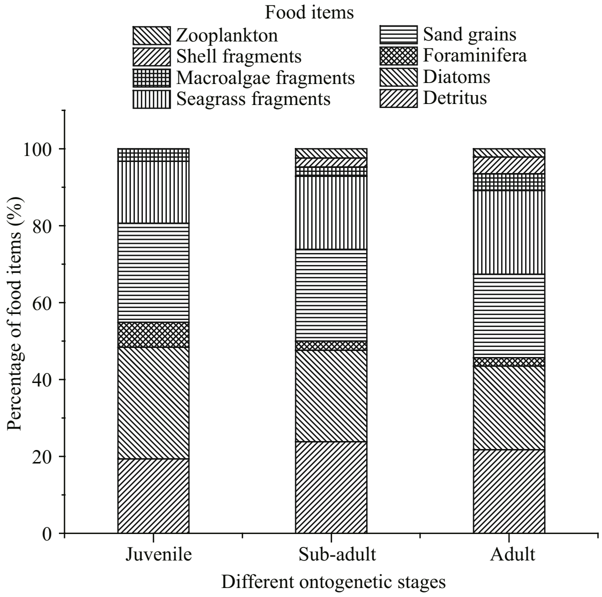

Fig.2 Percentage of food items in the gut contents analyses of dog conch *Laevistrombus canarium* according to the different ontogenetic stages (juvenile, sub-adults and adults) (*n*=10)

(23.81%), detritus (23.81%) and sand particles (23.81%), followed by seagrass fragments (19.05%), foraminifera (2.38%), macroalgae fragments (2.38%), shell fragments (2.38%) and zooplankton (2.38%). Adult dog conch also contained eight types of food items. The percentage of food composition is as follows: diatoms (21.74%), detritus (21.74%), fragments of seagrass (21.74%) and sand particles (21.74%), followed by shell fragments (4.35%), macroalgae (4.35%), foraminifera (2.17%) and zooplankton (2.17%).

3.4 Qualitative and quantitative analyses of food items

Table 3 shows the analysis of the food items according to the ontogenetic stages of *L. canarium*. They encompassed of the percentage of frequency (%O), the index of volumetric analysis (percentage by number %N, percentage by weight %W) and the index of relative importance (%IRI). Diatoms, detritus and sand grains dominated all three ontogenetic stages of *L. canarium*.

The index of relative importance (%IRI) for juvenile *L. canarium* showed the highest value for the diatoms (44.21%), followed by sand grains (30.08%), detritus (15.6%), seagrass fragments (8.55%), foraminifera (1.72%) and the lowest value was for macroalgae fragments (0.38%). Meanwhile, %IRI in sub-adults %IRI was dominated by diatoms (29.70%)

Table 3 Occurrence (%*O*), index of volumetric number (%*N*) and weight (%*W*) and Index of Relative Importance (%IRI) for each food items of dog conch *Laevistrombus canarium* according to ontogenetic stages

	Juvenile (*n*=10)				Sub-adult (*n*=10)				Adult (*n*=10)			
	%*O*	%*N*	%*W*	%IRI	%*O*	%*N*	%*W*	%IRI	%*O*	%*N*	%*W*	%IRI
Detritus	60	19.35	16.16	15.06	100	23.81	25.75	27.57	100	21.74	23.28	24.66
Diatoms	90	29.03	40.46	44.21	100	23.81	29.57	29.7	100	21.74	28.52	27.53
Foraminifera	20	6.45	5.74	1.72	10	2.38	1.44	0.21	10	2.17	1.6	0.21
Seagrass fragments	50	16.13	8.05	8.55	80	19.05	13.64	14.55	100	21.74	18.98	22.3
Macroalgae fragments	10	3.23	2.21	0.38	10	2.38	3.4	0.32	20	4.35	3.42	0.85
Zooplankton	0	0	0	0	10	2.38	0.32	0.15	10	2.17	1.53	0.2
Shell fragments	0	0	0	0	10	2.38	0.54	0.16	20	4.35	1.24	0.61
Sand grains	80	25.81	27.38	30.08	100	23.81	25.34	27.34	100	21.74	21.43	23.64

followed by detritus, (27.57%), and sand grains (27.57%), seagrass fragments (14.55%), macroalgae fragments (0.32%), foraminifera (0.21%), shells fragments (0.16%) and lastly zooplankton (0.15%). %IRI in adults showed that the main food items were diatoms, which accounted for 27.53%, followed by detritus (24.66%), sand grains (23.65%), seagrass fragments (22.30%), macroalgae fragments (0.85%), shell fragments (0.61%), foraminifera (0.21%) and zooplankton (0.20%).

4 DISCUSSION

4.1 Feeding behavior and activities

Laevistrombus canarium grazes on seagrass epiphytes found on the leaves of *Halophila* spp. and *Thalassia* spp., sediment and macroalgae epiphytes. This concords with findings by Heck Jr and Valentine (2006), who stated that small invertebrates associated with seagrass areas normally grazed on the epiphytes and periphyton growing on the leaves of seagrass or on blades of macroalgae. This study showed that none of adults of *L. canarium* grazed on macroalgae epiphytes. According to Cob et al. (2014), *L. canarium* never purposely consumes the macrophyte itself. Bujang et al. (2001) and Bujang and Zakaria (2003) defined the Merambong Shoal as sandy mud area filled with seagrass meadows. Consequently, *L. canarium* was also found to graze on the sediment found on substrates, rocks, and organic materials, especially during low tides.

According to Orth and van Montfrans (1984) and Valentine and Duffy (2006), grazing animals including gastropods, amphipods, isopods and decapods preferably graze only on the epiphytes and periphyton occurring on the leaves of seagrass rather than on the seagrass itself. Holzer et al. (2011) reported that epiphytes, referring to the colonies of algae that grow and adhere to plants or animals, while periphyton consists of a consortium of microscopic algae spores, diatoms, bacteria, and particles that stick to the leaves of seagrass. Previous findings indicated that gastropods within temperate, subtropical or tropical climates prefer to swallow and digest the leaf tissues (Rueda and Salas, 2007; Rueda et al., 2009; Holzer et al., 2011). However, numerous other studies have reported that epifaunal organisms (gastropods, bivalves, and crustaceans) have indirectly increased the growth and production of seagrass by grazing on the epiphytes and periphyton (Robertson and Mann, 1982; Nelson and Waaland, 1997; McGlathery et al., 2007).

Holzer et al. (2011) stated that seagrass beds around the world are mostly dominated by small gastropod mollusks. In temperate areas, invertebrate species (size<2.5 cm) represents the dominant users. In subtropical and tropical areas, however, invertebrates only play a small role compared to the larger herbivorous species such as the sirenians, turtles and fish (Thayer et al., 1984). *Laevistrombus canarium* is a tropical gastropod species closely linked to the seagrass ecosystem (Robertson, 1961; Cob et al., 2012). However, the more specific habitat for herbivorous strombid gastropods (Robertson, 1961; Cob et al., 2009b) remains unknown (Cob et al., 2012).

Laevistrombus canarium use their long proboscis in selecting and inspecting food items consuming them. According to Abbott (1960), *L. canarium* have a characteristic hopping movement. This species probes the substrate from side to side using their proboscis in searching for food. They were still actively feed even at low tide (0.0 to 0.4 m water level) when the tide receding. When the shoal becomes more exposed, *L. canarium* slowly seeks shelter under rocks and/or bury themselves in the substrates. Burrowing behaviour is common among the strombids, and they may partially or entirely burrow into sediment (Savazzi, 1989). Burrowing behaviour consists of three types of movement, probing, shoveling and extensible proboscis action. They also spray themselves with sedimentary materials using their long proboscis to blend in with the sediments in the surrounding area (camouflage technique) to avoid predation. This snail species is also found individually or in colonies during foraging activities.

Results from this study showed that the *L. canarium* formed groups rather than going individually during feeding. This observation confirms studies by Frankiel (1989) and Schotmann (1990) on one of the gastropod species often found in colonies. Based on the field observation in this study, *L. canarium* were seen active at night as compared to daytime. Similarly, Davis (2005) demonstrated that *Strombus gigas* are most active at night. During the daytime, conchs generally lie dormant with their apertures close to the substrates and tend to be partially or fully buried when not feeding. In contrast, when underfed, *L. canarium* are actively seeking food even during the daytime. The results of this study are similar those conducted by Raut and Goshe (1984), Rauth and Barker (2002) and Robertson (1961). They discovered a gastropod species that becomes active in the late afternoon until the early morning, and remains less active during the day. However, according to Numazawa et al. (1988), the activity rate of some species of gastropods might be influenced by abiotic factors such as sunlight and physical parameters such as salinity and water temperature.

4.2 Gastro-somatic index (Gasi)

This study found that the values of gastro-somatic index (Gasi) of sub-adults and adult *L. canarium* were higher than in juveniles. The juvenile stage undergoes the process of gonad growth and development that leads to a reduction in food intake. Rather similarly, Saikia et al. (2012) reported that feeding intensity was reduced during the development of gonads. However, John et al. (2012) described that sample size does not affect the gastro-somatic index. Instead, it is their gender that affects the intensity of their food intake in an ecosystem. According to the author, the gastro-somatic index for the female of the species is lower than in the male due to the activity of the digestive enzymes, especially during migration. However, the present research could not conduct a gender-difference study due to the much higher number of females in the samples compared to males (4:1).

4.3 Stomach contents analyses

The food items found in the stomach of the three *L. canarium* stages consist of diatoms, detritus, foraminifera, seagrass and macroalgae fragments, zooplankton, and include sand particles and shell fragments. Stoner and Waite (1991) and Houbrick (1980) made similar findings while conducting a study on *S. gigas* (Linnaeus, 1758) and button snail *Modulus modulus* (Linnaeus, 1758), respectively. According to the importance relative index (%IRI), three main food items dominate the three ontogenetic stages of *L. canarium*, namely diatoms, detritus and sand particles. Findings from this study are similar to studies conducted by Stoner and Waite (1991), Malaquias et al. (2004), and Sitnikova et al. (2012). The compositions of the diet found in the stomach of *L. canarium* depends strongly on ontogenetic stage, with juveniles showing six types, and both sub-adults and adults each showing eight kinds of food. This compares with the findings of Davis (2005), who reported that juveniles and adults of *S. gigas* consumed different varieties of foods.

According to Rudman (1971), the structure and function of the gastropod's oral cavity and the radula are to chew and digest very small food (Arularasan et al., 2011). Therefore, during the juvenile stage, the oral cavity is smaller than that of sub-adults and adults. Our finding indicate that juveniles do not consume zooplankton (>0.5 mm) or shell fragments (>0.3 mm) because their stomach (0.01±0.00 g) is smaller in size and weight than that of their food items. Thus, the food consumption rate of the juveniles was less than in sub-adults and adults. Davis (2005) showed that juvenile stages remain buried for most of their first year and take in less food than the subadult and the adult stages.

Based on the stomach-content analysis of the food types, *L. canarium* has been classified as herbivorous (Robertson, 1961; Cob et al., 2008b). Rudman (1971) stated that a gastropod can only accept small foods such as diatoms and filamentous algae. There were four species of diatoms identified and found in abundance during this study, namely *Chaetoceros* sp., *Fragilaria* sp., *Navicula* sp., and *Nitzschia* sp.

However, Malaquias et al. (2004) and Sitnikova et al. (2012) recorded 16 and 31 species of diatoms, respectively. The result from this study may have been lower than in the previous studies due to several factors, namely the study area, the season of the study, the sampling period and the number of samples used. Therefore, it can be concluded that the food choice of most of these gastropod species is diatoms.

Detritus also contributes to a higher percentage of food preferences of *L. canarium*. Similar findings were obtained by Jakubik (2009). According to Kolodziejczyk (1984), detritus (in the form of decaying tissue sections) is one of the selected foods because it is easy to chew and digest. However, detritus has a low relative nutritional value and must be taken in large amounts to meet energy requirements. In addition, a large number of sand particles and shell fragments found in the stomach of *L. canarium* may not be chosen actively. These materials may have been inadvertently consumed during foraging activities due to the high density of sand particles compared to that of the preferred food (Chester, 1993).

Some of the *L. canarium* food choices include seagrass epiphytes (*Halophila* spp. and *Thalassia* spp.) and macroalgae. Merambong Shoal is an area densely covered by seagrass and major habitat for the *L. canarium*, however *L. canarium* does not directly graze on aquatic plants, but rather on the epiphytes and periphyton occurring on the leaves of the plants (Orth and van Montfrans, 1984; Malaquias et al., 2004; Valentine and Duffy, 2006). In this study the epiphytic foraminiferan *Trocomina* sp. was recorded in the conch stomach, as Malaquias et al. (2004) found in another gastropod, *Haminoea orbygniana*. Nevertheless, the foraminifera accounted only for a small part of the *L. canarium* food choices. Apart from that, a few zooplankton species were also found in the stomach of sub-adults and adults of *L. canarium*, which comprised ostracods and other crustaceans. These findings are similar to that of Erlambang and Siregar (1995), who furthermore found some crustacean nauplii in the conch stomach.

5 CONCLUSION

The feeding behavior of the dog conch *L. canarium* includes grazing on the epiphytes on the leaves of *Halophila* spp. and *Thalassia* spp., sediment, rocks and substrates, as well as macroalgae epiphytes. In addition, the grazing of *L. canarium* on seagrass epiphytes indicates their trophic status as herbivores and as first users in the marine food chain. In addition, they are very active in searching and selecting food, especially at low tide, either in colonies or solitarily. Observations on their feeding activity show the importance role of the dog conch, especially in the food network, thus providing useful information particularly in the marine ecosystem.

Eight types of food were found, namely diatoms, detritus, foraminifera, seagrass and macroalgae fragments, zooplankton, sand particles and shell fragments. Meanwhile, three major food items dominate all three ontogenetic stages, namely diatoms, detritus and sand particles. However, the number of diet items varied among all stages. Identification of the types of food items determines the particular position of a gastropod in the food chain. Therefore, a more detailed study is needed in the future that can provide a better understanding of the relationship between trophic *L. canarium* with marine ecosystem.

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