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SHORT COMMUNICATION

Morphology and Stomach Content Analysis of Green Rough-backed Puffer Fish, *Lagocephalus lunaris* from Kuching, Sarawak

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ABSTRACT

A total of 101 individuals of green rough-backed pufferfish, *Lagocephalus lunaris* were collected at two sampling sites and were assessed for their morphological characteristics and diet by stomach content analysis. The physical characteristics were observed and body weight (BW), total length (TL), standard length (SL) and number of fin rays were recorded. The results showed that the physical body measurement in all individuals were almost similar in their range of size (TL: 8.6 ± 0.3 cm; SL: 7.0 ± 0.2 cm; BW: 14.3 ± 1.5 g) and most individual had same distribution of spines at the dorsal part which extended to dorsal fin. The numbers of caudal, dorsal, pectoral and anal fin rays ranged from 5 to 12, 7 to 11, 9 to 12 and 7 to 17, respectively. Analysis of the diet composition showed that fish is carnivorous which prey on crabs, prawns, small fish and squids. Based on index of relative importance, crabs were identified as most important prey in Site 1 and Site 2, with value of (47.5, 55.6%), and followed by prawns (36.3, 38.2%), fish (5.6, 11.2%), squids (0.7, 2.9%) and bivalves (0.1, 1.7%). Our results suggest that *L. lunaris* had unique spines distribution shape which important for species identification and it consumed mainly on crustacean as diet composition. To our knowledge, this is the first attempt to describe morphological characteristics and stomach content of *L. lunaris* which inhabit in Sarawak waters.

Keywords**:** *Lagocephalus lunaris*, green rough-backed pufferfish, stomach content analysis, index of relative importance, Sarawak

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Green rough-backed puffer, *Lagocephalus lunaris* is in the Tetraodontidae family which specifically have large four teeth. This marine pufferfish is commonly distributed in tropical and subtropical seas including the South and East China Seas (Hwang *et al.* 1992) and easily can be found in Malaysian waters. To date, only three species, *L. lunaris*, *L. spadiceus* and *L. sceleratus* which belong in *Lagocephalus* group have been recorded in Asia region which associated with pufferfish poisoning and their toxicities. Among them, *L. lunaris* is notorious species, because it contains potent neurotoxin or known as tetrodotoxin in their muscle (Man *et al.* 2010) and has caused severe food poisoning in Malaysian waters (National Poison Centre Report 2009). The first case was reported in 2009, when four fishermen consumed a dish of *L. lunaris* roes in Terengganu and experienced various degrees of pufferfish poisoning symptoms which caused one of them died before taken to the hospital. Pufferfish poisoning caused by *L. lunaris* also happened in Japan; even it rarely appears in temperate waters due to misidentified with non-toxic puffer, *L. wheeleri*, as both are closely similar to each other in external morphology (Taguchi 1982).

In Malaysia, knowledge about toxic and non-toxic pufferfish species are still limited. For *Lagocephalus* species, based on toxicity analysis, *L. lunaris* and *L. sceleratus* were reported as toxic puffer (Monaliza & Mohamad 2011), whereas, *L. spadiceus* is considered as a non-toxic species which safe for human consumption (Man *et al*. 2010). However, it is difficult to differentiate between all this three species due to their similarity in external morphology. This factor could be a possible reason of puffer fish poisoning in human, especially in Asian region, as it has been considered as a delicacy due to unique and tasty flesh (Lin *et al*. 2002).

Recently, the habit of eating puffer fish in Sarawak is slowly catching on and some

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Lagocephalus species can easily been found in the local market. Due to this reason, we collected *L. lunaris* from coastal area of Kuching, Sarawak, and described their morphological characteristics including their diet composition by mean of relative importance index. These findings are important to provide some basic knowledge for public in order to distinguish a toxic, *L. lunaris* from non-toxic puffer fish. Despite of that, we also can elucidate the possible toxin sources in puffer fish through diet composition study.

The puffer specimens caught in this study were collected from local fishing vessels along the inshore Muara Tebas, Kuching coastal waters. Two sampling sites (Site 1: N 01^0 39.194’, E 110^0 31.941’; Site 2N 01^0 39.846’, E 110^0 33.142’) were selected and distance between each location was approximately 1.5 km. The specimens caught were kept in cooler box until further analysis in laboratory.

Pufferfish specimens were identified according to Atan *et al*. (2010); Ngy *et al*. (2008) and Monaliza & Mohamad (2011), and the morphology (i.e. body plates, spines, and fin rays) and colour were described macroscopically. The following data were also recorded and analysed: total length (TL) and standard length (SL) to nearest cm, and body weight of the fish (BW to nearest 0.01 g).

Stomach contents was analysed following method describe by Hyslop (1980). Each prey item was sorted, weighted (g), and identified to the lowest taxonomic level possible and subsequently counted and maintained in 70% ethanol. Diet composition was evaluated and the index of relative importance (IRI) is calculated using the following formula: % IRI = [(%N + %W) x %O]; % N – percentage of number; % W – percentage of weight and % O – frequency of occurrence of prey items.

Pufferfish specimens (n= 101) collected in this study were analysed for morphological analysis and identified as *L. lunaris* based on their physical appearances described by Atan *et al*. (2010), Ngy *et al*. (2008) and Monaliza & Mohamad (2011). The characteristics of this species were described as follows; caudal, dorsal, pectoral and anal fin rays were ranged within 5 to 12, 7 to 11, 9 to 12 and 7 to 17, respectively, with all individuals have four large teeth like-incisor. The body shape and colour of *L. lunaris* were almost similar as been reported by Monaliza & Mohamad (2011), with elongated body shape and metallic gold colour. The broad silvery band is also appeared in all specimens at the longitudinal line of mid lateral body from mouth until edge of caudal fin (Figure 1). In addition, the distribution of spines at the dorsal part is in elliptical shape was observed in most samples. This unique characteristic was commonly used to distinguish *L. lunaris* with other member of *Lagocephalus* group (Masuda *et al*. 1984).

Physical body measurement of *L. lunaris* according to size classes and sampling sites are shown in Table 1. Most individuals caught in this study had sizes ranged from 8.2-8.6 cm in total length, 6.6-7.0 cm in standard length and 12.0-13.8 g in body weight, respectively, at both sampling sites. The samples caught could be considered small size as compared with

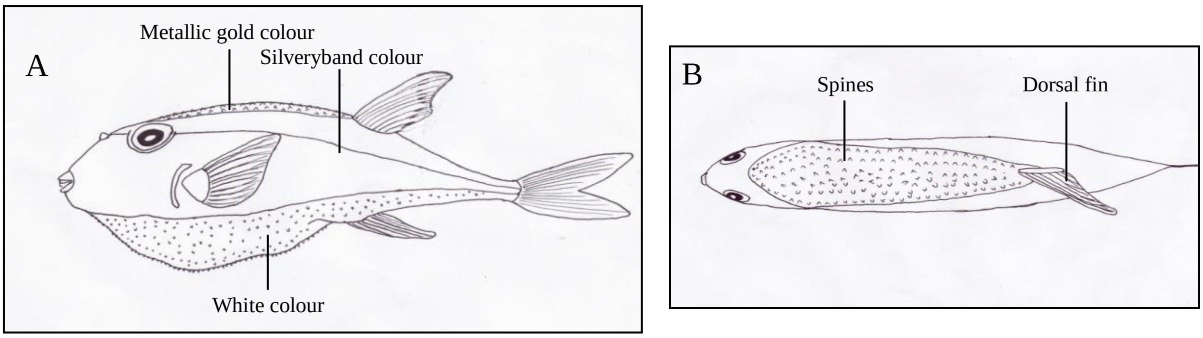

Figure 1. Sketch diagram of *L. lunaris:* Lateral view – elongated body shape, (A); Dorsal view - distribution patterns of spines, elliptical shape that extends to the base of the dorsal fin (B).

specimens from Sabah (Monaliza & Mohamad 2011). Indeed, Masuda *et al.* (1984) also reported that *L. lunaris* can reach maximum size of 45.0 cm in total length.

Analysis of the diet composition of the pufferfish, *L. lunaris* showed that the fish is carnivorous where the diet was composed mainly of 84% crustaceans (crabs and prawns), 10% fishes, 4% cephalopods (squids) and 1% mollusks (particularly bivalves) as shown in Table 2. The same diet composition were also reported in others *Lagochepalus* group, *L. sceleratus* (Sabrah *et al*. 2006; Aydin 2011) and the presence of bivalves make only difference in diet composition of *L. lunaris*. Based on the percentage of index relative importance (% IRI), crabs were indicated as dominant prey (47.5, 55.6), followed by prawns (36.3, 38.2) and fish (5.6, 11.2). Squids and bivalves had minor importance for this species, with % IRI values of 0.7, 2.9 and 0.1, 1.7, respectively. From these results, it can be postulated that TTX in *L. lunaris* could be come via food chain as mentioned by Noguchi *et al.* (2006), crabs and skeleton of shrimps are among the possible items contained TTX which accumulated into puffer fish. However, details studies on species of crustaceans involved are vitally needed to support this finding.

Table 1. Physical body measurement of *L. lunaris* according to size classes and sampling sites in Muara Tebas, Kuching, Sarawak.

Site	Size classes (TL in cm)	Sample number	Body size (mean ± SD)		
			Total Length (cm)	Standard Length (cm)	Body Weight (g)
1	5.0 – 6.9	5	6.4 ± 0.3	5.2 ± 0.3	5.8 ± 0.6
	7.0 – 9.9	27	8.2 ± 0.9	6.6 ± 0.8	12.0 ± 3.7
	10.0 – 12.9	6	11.0 ± 1.1	8.9 ± 0.8	27.1 ± 7.1
2	5.0 – 6.9	8	6.6 ± 0.5	5.3 ± 0.4	6.3 ± 1.3
	7.0 – 9.9	44	8.6 ± 0.9	7.0 ± 0.8	13.8 ± 4.3
	10.0 – 12.9	11	10.6 ± 0.4	8.7 ± 0.4	25.9 ± 4.6

Table 2. Diet compositions of *L. lunaris* collected from two different sites of Muara Tebas, Kuching in August and October, expressed as total number of prey items (N), percents by number (%N), frequency of occurrence (% O) and weight (% W), and the percent index of relative importance (%IRI) – sample size = 80 stomach with contents.

Site	Prey items	N	N%	O%	W%	IRI%
1	Crabs	86	45.03	26.92	47.42	47.55
	Prawns	75	39.27	26.92	35.05	38.22
	Fish	20	10.47	26.92	11.34	11.22
	Squids	8	4.19	15.38	5.67	2.90
	Bivalves	2	1.05	3.85	0.52	0.11
2	Crabs	88	54.32	25.92	53.40	55.59
	Prawns	59	36.42	25.92	33.98	36.33
	Fish	8	4.94	22.22	7.77	5.62
	Squids	3	1.85	11.11	1.46	0.73
	Bivalves	4	2.47	14.81	3.40	1.73

In general, both sampling sites gave almost similar data in diet composition and IRI values which mean the samples were most likely from the same area or same population. *L. lunaris* is pelagic marine fish which can move faster and covered wide area compared with others puffer fish, such as *T. nigroviridis* which dominant in mangrove area (Monaliza & Mohamad 2011).

This is the first attempts to record the morphology structures and to assess diet composition of marine puffer fish, *L. lunaris* from Sarawak waters. Macroscopically, this species can easily been identified based on their spines distribution which are in elliptical shape at the dorsal site of the body. This characteristic is commonly used to distinguish toxic, *L. lunaris* with other non-toxic puffer, for example *L. spadiceus.* From diet analysis, crustaceans were suggested to be main composition in *L. lunaris*, and could be possible associated with toxin origin in puffer fish. However, this exogenous postulation could be solved with further details toxin study to support this finding.

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