



Faculty of Resource Science and Technology

**Feeding Behaviour of an Obligate Arboreal Crab *Labuanium politum* at
Selected Nipa Forests in Sarawak, Malaysia**

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Feeding Behaviour of an Obligate Arboreal Crab *Labuanium politum* at
Selected Nipa Forests in Sarawak, Malaysia

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DECLARATION

I declare that this research entitle “Feeding Behaviour of an Obligate Arboreal Crab *Labuanium politum* at Selected Nipa Forests in Sarawak, Malaysia” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature for any other degree.

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ABSTRACT

Labuanium politum is an arboreal sesarmid crab and locally known as ‘geramak apong’ in Sarawak that inhabits the nipa palm (*Nypa fruticans*) forests. Its brief ecology reported by previous researchers does not cover on the feeding behaviour. Thus this pioneer study attempts to document the natural diet and feeding behaviour of *L. politum* in the western part of Sarawak, through stomach content analysis and feeding experiments. This study aimed to (i) determine the diet composition of *L. politum* according to different localities, seasons and nipa management level, (ii) investigate the feeding preferences of *L. politum* in captivity and (iii) determine the effect of different nipa leaf conditions on the survival and growth of *L. politum* in captivity. A total of 720 crabs (carapace width range: 8.03-33.02 mm) were collected from Tambirat and Tambak for stomach content analysis. of the Frequency of occurrence results showed that this crab consumed two main components, namely plant (97.92%) and sediment materials (98.06%), followed by diatom (21.11%), animal (12.5%) and unidentified materials (29.17%). In addition, the Weighted Resultant Index (Rw) gave similar findings whereby the two main components were significantly different from other food materials ($p < 0.001$). Based on the degree of stomach fullness, crabs with 100% full stomach were higher (11.53%) than those with empty stomach (2.36%) whereby more male crabs have full stomach than the females, but vice versa for empty stomach. Results of the corresponding analysis (CA) demonstrated that food preferences did not vary between (i) different sizes of crabs but (ii) small crabs feed more than larger crabs. Furthermore, no variation was observed in feeding preferences of *L. politum* at different localities, seasons and nipa management level. Based on overall findings, the natural feeding mode of *L. politum* is herbivorous. For the first feeding experiments, *L. politum* preferences on three nipa leaf conditions was evaluated within

three day period by placing one crab per glass aquarium together with green, yellow and brown leaves. This experiment involved eight crabs of both sexes. It was observed this crab significantly preferred green leaf over yellow and brown leaf ($p<0.001$). Similar results were obtained for male and female crabs ($p<0.001$). Next, the same setup and crabs were used for the multiple-choice feeding experiment but the foods given were mangrove slug, cricket, bee and green nipa leaf. Surprising outcome was obtained whereby *L. politum* strongly prefer the animal materials over green leaf, indicating a shift of feeding behaviour towards opportunistic omnivores although they are herbivores in their natural habitat. The last experiment measured the survival and growth performance of *L. politum* in captivity (60 days) under different nipa leaf conditions. Each leaf condition had triplicate of both crab sexes in which one crab was placed in each aquarium and the leaf was exchanged daily. The initial and final weights of the crabs were recorded on Day 1 and Day 60, while the leaves were weighed daily. It was found that green leaf gave the highest survival than the yellow and brown leaf. Even though the highest SGR was obtained in crabs that fed on green leaf, the difference in mean weight gain of the crabs was not significant. The best FCR was recorded by the green leaf (73.98%), but it is not an efficient feed for *L. politum*. Thus, green nipa leaf is substantial for *L. politum* survival but inadequate for their growth. Overall findings of this research had provided useful information on *L. politum* feeding behaviour that can be applied towards its future conservation and culture works.

Keywords: Natural diet, feeding habits, in captivity, survival, growth performance.

***Kelakuan Pemakanan Ketam Arboreal Obligat Labuanium politum di Hutan Nipah
Terpilih di Sarawak, Malaysia***

ABSTRAK

Labuanium politum adalah ketam sesarmid arboreal dan dikenali sebagai 'geramak apong' di Sarawak yang mendiami hutan nipah (*Nypa fruticans*). Ekologi ringkasnya yang dilaporkan oleh pengkaji terdahulu tidak menyentuh tentang kelakuan pemakanan. Maka, kajian perintis ini cuba mendokumentasi diet semula jadi dan kelakuan pemakanan *L. politum* di Sarawak melalui analisis kandungan perut dan eksperimen pemakanan. Kajian ini bertujuan untuk (i) menentukan komposisi diet *L. politum* mengikut lokasi, musim dan tahap pengurusan nipah yang berbeza, (ii) menyelidik keutamaan pemakanan *L. politum* dalam kurungan dan (iii) menentukan kesan keadaan daun nipa yang berbeza terhadap survival dan pertumbuhan *L. politum* dalam kurungan. Sebanyak 720 ekor ketam (julat lebar karapas: 8.03-33.02 mm) dikutip dari Tambirat dan Tambak bagi analisa kandungan perut. Keputusan kekerapan kewujudan makanan menunjukkan ketam ini memakan dua komponen utama iaitu tumbuhan (97.92%) dan sedimen (98.06%), diikuti oleh diatom (21.11%), haiwan (12.5%) dan bahan tidak dikenali (29.17%). Tambahan pula, indeks *Rw* menunjukkan penemuan yang serupa dimana dua komponen utama tersebut berbeza secara signifikan berbanding makanan lain ($p < 0.001$). Berdasarkan tahap kepenuhan perut, ketam berperut penuh 100% adalah lebih tinggi (11.53%) dari berperut kosong (2.36%) dimana lebih banyak ketam jantan berperut penuh berbanding betina tetapi sebaliknya bagi skala perut kosong. Keputusan CA menunjukkan tiada perbezaan keutamaan makanan antara (i) saiz ketam tetapi (ii) ketam kecil makan lebih banyak berbanding yang besar. Tiada variasi dilihat pada keutamaan pemakanan *L. politum* di lokasi, musim dan tahap pengurusan nipah yang berbeza. Berdasarkan penemuan keseluruhan, mod pemakanan semula jadi *L. politum* adalah herbivor. Untuk eksperimen

pemakanan yang pertama, keutamaan L. politum terhadap tiga jenis keadaan daun nipah dinilai selama tiga hari dengan meletakkan seekor ketam per akuarium kaca bersama daun hijau, kuning dan coklat. melibatkan lapan ekor ketam bagi setiap jantina. Secara keseluruhan, ketam ini menggemari daun hijau berbanding kuning dan coklat ($p < 0.001$) dan hasil serupa diperoleh bagi kedua jantina ($p < 0.001$). Seterusnya, persediaan dan ketam yang sama digunakan untuk eksperimen pemakanan pelbagai pilihan tetapi makanan diberikan berbeza (lintah bakau, cengkerik, lebah dan daun nipah hijau). Hasil yang mengejutkan diperoleh dimana L. politum sangat mengemari bahan haiwan berbanding daun hijau, menunjukkan anjakan kelakuan pemakanan kepada omnivor oportunistik walaupun mereka adalah herbivor di habitat semula jadi. Eksperimen terakhir mengukur survival dan prestasi pertumbuhan L. politum dalam kurungan (60 hari) di bawah keadaan daun nipah yang berbeza. Setiap keadaan daun mempunyai triplikat bagi kedua jantina ketam, dimana setiap akuarium mengandungi seekor ketam dan daunnya ditukar setiap hari. Berat awal dan akhir ketam direkod pada hari pertama dan ke-60, manakala daun ditimbang setiap hari. Hasilnya, daun hijau memberikan survival tertinggi berbanding kuning dan coklat. Walaupun SGR tertinggi diperoleh pada ketam yang memakan daun hijau, tiada perbezaan signifikan pada min peningkatan berat badan ketam. FCR terbaik direkodkan oleh daun hijau (73.98), tetapi ianya bukan makanan yang efisien bagi L. politum. Oleh itu, daun nipah hijau penting bagi survival L. politum tetapi tidak mencukupi untuk pertumbuhannya. Penemuan keseluruhan kajian ini memberi maklumat berguna mengenai kelakuan pemakanan L. politum yang boleh diaplikasikan terhadap kerja pemuliharaan dan kultur di masa hadapan.

Kata kunci: *Makanan semula jadi, tabiat pemakanan, dalam kurungan, kelangsungan hidup, prestasi pertumbuhan*

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LIST OF ABBREVIATIONS

CV	Vacuity Index
EtOH	Ethanol
FCR	Feed Conversion Ratio
R _w	Weighted Resultant Index
SD	Standard Deviation
SGR	Specific Growth Rate

CHAPTER 1

INTRODUCTION

1.1 Research Background

Mangroves are distributed almost throughout the coast of Malaysia with the largest part is in the northeast Sabah (Food and Agriculture Organizations of the United Nations, 2005). In Sarawak, it is mostly in Sarawak Deltas (located in Kuching and Bau district), Rajang and Trusan-Lawas rivers while in Peninsular Malaysia, the mangroves are concentrated more on the west coast (FAO, 2005; Badang et al., 2017). Typically, mangrove could be found in all areas with humid weather and has high rate of rainfall where several mangrove species inhabit particular areas or niches within the ecosystem. Commonly on the seaward area, there is an *Avicennia-Sonneratia* species inhabitant, followed by *Rhizophora* sp., *Bruguiera* sp. and inland species where it is predominant towards landward (Hamdan et al., 2012). While towards riverine areas, it is dominated by *Nypa* palms vegetation that has greater influence by freshwater (Hossain & Islam, 2015).

Mangrove forest is occupied by vast mangrove species indicating that it can support very large biomass of flora and fauna especially crabs because it is rich in organic matter and nutrients (Pawar, 2012). It is seem that crustaceans exhibit the highest range of morphological diversity (Martin & Davis, 2001). Two types of crab, namely sesarmid and fiddler crabs are commonly found in mangrove forests. Currently, the listed genera from Family Sesarmidae are 32 in total and this family shows various feeding habits such as a filter feeder, sand cleansers, mud, plant and carrion feeders, predators, commensals and parasites (Dall & Moriarty, 1983). In the highly diverse mangrove systems of Southeast Asia and Australia, sesarmids graze on large proportions of mangrove litter (Micheli,

1993). About fifty species of sesarmid crabs have been reported to be dominantly associated with mangrove ecosystems (Islam et al., 2002).

Among the mangroves vegetation, nipa palm trees are widely distributed in the South, Southeast Asia and Oceania (Tsuji et al., 2011). This nipa palm trees are habitat of an obligate arboreal, tree-climbing sesarmid crab *Labuanium politum* (Ng et al., 2015). Local people at Saribas area in Sarawak, including Betong, Spaoh, Pusa, and Maludam called it as 'geramak apong'. 'Geramak' stands for small crabs, while 'apong' stands for nipa palm tree. At present, this species has been considered as a widely distributed in Sarawak nipa forests (Masini, 2019). According to field observations of Ng et al. (2015), this species exhibits nocturnal behaviour where it can be seen clinging on the nipa leaf and feed on it during night time. Meanwhile during day time, this crab lives hiding deep between the narrow spaces of the nipa tree base fronds.

This crab is an edible species since it is being consumed by local people in certain part of Sarawak especially Saribas, in which the selling price range from RM 40.00 to RM 50.00 (USD 9.95 to USD 12.44) per kg. This crab is collected by local people using a traditional gear, called 'pengait'(see Appendix 2). It is made from a bamboo stick with a sharp hook end. To catch *L. politum*, the presence of crab is check first before inserting the gear in between the nipa base fronds in order to hook it to the carapace of the crab.

1.2 Problem Statement

The sesarmid fauna in Malaysian Borneo is not well studied especially *L. politum*. The only information regarding this crab is their taxonomy and ecology in the natural environment (Ng et al., 2015). Currently, information on its feeding behaviour are still scanty and inconclusive, without proper scientific research to support the details about the

species. Therefore, there is urgency to initiate and document the feeding ecology study of this species.

Although *L. politum* was not listed in the IUCN Red List and are still abundant in the wild, nipa forest areas in Sarawak are subjected to human disturbance such as nipa sap tapping activity, development of aquaculture and for urban development. Reduction in nipa areas might pose threat and bring negative impact to *L. politum* population. Thus, study on the feeding ecology of this species is important for conservation and sustainable management of this species.

1.3 Significance of the Study

The outcomes of this study will be useful in gaining a better understanding on *L. politum* feeding behaviour and their ecological role in nipa mangrove ecosystem. Furthermore, this study provides fundamental knowledge of *L. politum* for future conservation works. Lastly, since *L. politum* are edible, this crab might become a potential food source and income generator for local people in future with suitable and proper management.

1.4 Objectives of the Study

This study was conducted in order;

- i. to determine the natural diet composition of *L. politum* at different locality, seasonal variation and nipa management level,
- ii. to investigate feeding preferences of *L. politum* in captivity,
- iii. to determine the effect of different leaf conditions on the survival and growth of *L. politum* in captivity.

1.5 Hypotheses

At the beginning of this study, the hypotheses suggested were as follows:

- i. H₀: There is no difference in the diet composition of *L. politum* at different locality, seasonal variation and nipa management level.
H_a: There are differences in the diet composition of *L. politum* at different locality, seasonal variation and nipa management level.
- ii. H₀: There is no difference in the feeding preferences of *L. politum* in captivity.
H_a: There are differences in the feeding preferences of *L. politum* in captivity.
- iii. H₀: There is no difference in the effect of different leaf conditions on the survival and growth of *L. politum* in captivity.
H_a: There are differences in the effect of different leaf conditions on the survival and growth of *L. politum* in captivity..