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POPULATION PARAMETERS AND FEEDING BIOLOGY OF SERGESTID SHRIMP, LUCIFER HANSENI, FROM TEBRAU STRAITS, MALAYSIA

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POPULATION PARAMETERS AND FEEDING BIOLOGY OF SERGESTID SHRIMP, *Lucifer hanseni*, FROM TEBRAU STRAITS, MALAYSIA

By

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

POPULATION PARAMETERS AND FEEDING BIOLOGY OF SERGESTID SHRIMP, *Lucifer hanseni,* FROM TEBRAU STRAITS, MALAYSIA.

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July 2013

Chairman: Professor Aziz Arshad, PhD

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A study on *Lucifer* population was conducted to examine their population dynamics and feeding habit. Growth, mortality, recruitment, status of the stock and feeding habits of *Lucifer hanseni* were examined from five stations along the Tebrau Straits, Johor, Malaysia during November 2009 to October 2010. Two stations were located in Pendas River and its estuary, while three others were established Tebrau Straits with different habitat characteristics viz. fringing mangroves, sea grass bed and open water. Sampling station was approximately 1 km apart from each other. The specimens were collected during high tide by subsurface towing of a bongo net (mesh size of 500 µm) for 20 minutes. The samples were then preserved in 5% formalin and brought back to the laboratory for analysis.

The growth, mortality and recruitment of *L. hanseni* were investigated based on monthly length-frequency data, using FiSAT software. The results showed that average natural mortality (2.84 yr^{-1}) was higher than the average value of fishing mortality (1.20 yr^{-1}) indicating the imbalance position in the stock. The value for exploitation level (E) was 0.30. This indicates that the fishery of *L. hanseni* in the

Tebrau Straits is still under exploited. This is based on the assumption that a stock is optimally exploited when fishing mortality (F) equals natural mortality (M), or E = (F/Z) = 0.5. The annual recruitment of *L. hanseni* showed continuous recruitment with three major peaks observed in March, July and October. The peaks were possibly affected by environmental factors and the availability of food source.

Feeding habits and diet composition of *L. hanseni* were also investigated. A total of 600 guts were examined using standard method of gut content studies. Diet composition was categorized into five main groups which were phytoplankton, zooplankton, macroalgae, debris, and unidentified materials. According to simple resultant index (%SRI), the highest percentage of food components was debris (42.76%) followed by phytoplankton (34.96%), zooplankton (12.56%), unidentified materials (5.80%) and macroalgae (3.93%). Phytoplankton was mainly made up of *Nitzschia* sp., *Dactylococcopsis* sp., *Synedra* sp., *Gonylaux* sp., *Peridinium* sp., *Coscinodiscus* sp., *Navicula* sp. and *Rhizosolenia* sp. while the zooplankton was comprised of appendages of crustacean, appendages of copepod, nauplii and cladocerans. The various composition of food items proved that *L. hanseni* is an opportunistic omnivorous. *Lucifer hanseni* can possibly switch their food preference depends on the abundant types of food available at that particular time.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

PARAMETER POPULASI DAN BIOLOGI PEMAKANAN UDANG SERGESTID, *Lucifer hanseni,* DARI SELAT TEBRAU, MALAYSIA.

Oleh

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Satu kajian telah dijalankan ke atas populasi *Lucifer* untuk memeriksa populasi dinamik dan tabiat pemakanan mereka. Pertumbuhan, kadar kematian, pemulihan, status stok dan tabiat pemakanan *Lucifer hanseni* diperiksa daripada lima buah stesen di sepanjang Selat Tebrau, Johor, Malaysia di antara November 2009 hingga Oktober 2010. Dua stesen terletak di Sungai Pendas dan muaranya, manakala tiga yang lain adalah di Selat Tebrau dengan ciri habitat yang berbeza iaitu di pinggiran paya bakau, hamparan rumput laut dan laut terbuka. Jarak di antara setiap stesen adalah dianggarkan satu kilometer antara satu sama lain. Spesimen dikumpul pada waktu air pasang dengan menggunakan jaring bongo (saiz jaring 500 µm) yang ditunda di permukaan air selama 20 minit. Sampel kemudiannya disimpan di dalam lima peratus formalin dan kemudian dibawa balik ke makmal untuk analisis.

Pertumbuhan, kadar kematian dan pemulihan *L. hanseni* dikaji berdasarkan data frekuensi panjang bulanan menggunakan perisian FiSAT. Keputusan menunjukkan purata kematian semula jadi (2.84 setahun) adalah lebih tinggi berbanding nilai purata kekerapan tangkapan (1.20 setahun) dan ini menunjukkan ketidakseimbangan

pada stok. Aras eksploitasi (E) adalah 0.30. Ini menunjukan perikanan *L. hanseni* di perairan Selat Tebrau adalah di bawah kadar eksploitasi. Ini berdasarkan kepada andaian bahawa stok dieksploitasi secara optimum apabila kekerapan tangkapan (F) bersamaan dengan kadar kematian (M), atau E=(F/Z)=0.5. Kajian ini menunjukan corak pemulihan *L. hanseni* adalah berterusan dengan tiga kohot besar yang dapat dilihat pada bulan Mac, Julai dan Oktober. Hal ini adalah berkemungkinan dipengaruhi oleh faktor keadaan persekitaran dan kelimpahan sumber makanan yang tersedia.

Tabiat pemakanan dan komposisi diet *L. hanseni* juga dikaji. Sebanyak 600 perut diperiksa menggunakan kaedah yang biasa digunakan untuk mengkaji isi kandungan perut. Komposisi diet dikategorikan kepada lima kumpulan utama iaitu fitoplankton, zooplankton, makroalga, debris dan bahan yang tidak dapat dikenal pasti. Berdasarkan kepada hasil analisa 'Simple Resultant Index' (SRI%), peratusan tertinggi bagi komponen makanan ialah debris (42.76%), diikuti dengan fitoplankton (34.96%), zooplankton (34.96%), bahan tidak dapat dikenal pasti (5.80%) dan makroalga (3.93%). Fitoplankton terdiri daripada *Nitzschia* sp., *Dactylococcopsis* sp., *Synedra* sp., *Gonylaux* sp., *Peridinium* sp., *Coscinodiscus* sp., *Navicula* sp. dan *Rhizosolenia* sp. manakala zooplankton diwakili oleh of serpihan krustasea, serpihan kopepod, nauplius dan kladosera. Kepelbagaian komposisi dalam kandungan makanan membuktikan bahawa *L. hanseni* adalah omnivor oportunistik. *Lucifer hanseni* boleh menukar pemilihan makanan utama bergantung kepada kelimpahan jenis makanan yang terdapat di persekitarannya pada masa tersebut.

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I certify that a Thesis Examination Committee has met on 3 July 2013 to conduct the final examination of Norhafizah binti Osman on her thesis entitled "Population Parameters and Feeding Biology of Sergestid Shrimp, *Lucifer hanseni*, From Tebrau Straits, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

NORHAFIZAH OSMAN

Date: 3 July 2013

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LIST OF ABBREVIATIONS

E	Exploitation rate
ELEFAN	Electronic Length Frequency Analysis
FiSAT	FAO ICLARM Stock Assessment Tools
FAO	Food and Agriculture Organization
K	Growth co-efficient of VBGF
$L\infty$	Asymptotic length
M	Natural mortality
mm	Millimeter
N	Sample size
SL	Standard length
Sp.	Species
SRI	Simple resultant index
TL	Total length
t_{max}	Maximum life span
UPM	Universiti Putra Malaysia
Z	Mortality
φ'	Growth performance index
˚C	Degree celcius
%	Percentage
<	Less than
>	More than

CHAPTER 1

INTRODUCTION

1.1 Background of the study

An estuary is a partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with salt water from the ocean. Estuarine environments are among the most productive on earth, creating more organic matter each year. They serve important economic function including transport, industry and tourism but also drainage of waste from domestic, industrial and agriculture activities. One of the important organisms living in estuary is sergestid shrimp. Example of sergestid shimps are *Lucifer* and *Acetes*. Sergestid shrimps are an abundant component of oceanic micronekton and constitute an important link between zooplankton and higher trophic levels in pelagic ecosystems. In Malaysia, the fishery of sergestid shrimp is mainly focused on *Acetes*. Many have realized the food value of these tiny shrimps and are exploiting them commercially.

There are about 2000 species of shrimps (Macrura; Natantia) in the world. At least 200 of these species pass their entire life in the pelagic phase. Sergestoidea are represented by two families, Luciferidae and Sergestidae. The family Luciferidae is represented by a single genus, *Lucifer*. In some places, the common name of this shrimp is 'ghost shrimp' (Hiatt, 1947). In Malaysia, there is no common name reported for this shrimp and it is not commercially important to the locals.

Lucifer sp. is a little-known and degenerate of shrimp. It has a long body, but many fewer appendages than other shrimps, with only three pairs of pereiopods remaining, all without claws. It also bears no gills. The females, uniquely among prawns, carry the fertilized eggs on her pleopods until they are ready to hatch. This parallels the development of a similar system in pleocyemates, although the attachment is less strong in *Lucifer*. The length of the eye-stalks and the form of the petasma are used in distinguishing the seven species from each other.

Species of the *Lucifer* occur commonly in the surface layers of tropical and subtropical waters, and they sometimes become a major component of surface-dwelling plankters. The genus has been examined by several taxonomists (Hansen, 1919; Bowman, 1967; Kensley, 1971; and Petit, 1973) and it currently contains seven recognized species. *Lucifer typus* (Milne Edwards, 1837) is essentially oceanic, and the only species with circumglobal distribution in warm waters.

In general, all species of *Lucifer* are so distinctive that they can be recognized without difficulty by plankton biologists. However, records of *Lucifer* from the eastern Pacific are surprisingly scarce (Hendrickx and Estrada-Naverrete, 1989). Omori (1977) failed to indicate the occurrence of *Lucifer* sp. in the eastern Pacific, since he overlooked Burkenroad's (1937) single record of a collection of *L. typus* from the mouth of the Gulf of California.

The larval forms and adults of the epiplanktonic shrimps of the genus *Lucifer* constitute a sizable component of the zooplankton collections especially during the southwest monsoon and immediate post monsoon seasons along the coastal waters of

India (Rajagopalan *et al.*, 1992). According to Qassim *et al*., (1978), *Lucifers* constitute 27% of the total zooplankton and rank next to copepods in numerical abundance in the coastal waters of India.

It is important to understand the important population parameters of shrimp such as asymptotic length (L_∞), growth co-efficient (K), fishing mortality (F), natural mortality (M), recruitment pattern and exploitation rate. Without the knowledge of these parameters, it is not possible to undertake sound and effective management program on the stock. All these information help us to provide advice to the fishing industry, fishermen, fisheries managers and the planners and policy makers on the optimum level of exploitation of fisheries resources and to provide possible management options.

There are many tools for assessing exploitation level and status of stock. Of these, FiSAT (FAO-ICLARM Stock Assessment Tools) has been most frequently used for estimating population parameters of shrimps (Jayawardane *et al,*. 2003, Paraconstantinou and Kapiris, 2001; Etim and Sankare, 1998 and Enin *et al*., 1996), primarily it requires only length-frequency data. Knowledge of various population parameters are necessary for planning and management of *Lucifer* resources such as asymptotic length (L_∞) and growth coefficient (K), mortality (natural and fishing) rate and exploitation level (E). Length-frequency data are collected routinely for fisheries management and as part of exploitary surveys (Asila and Ogari, 1998; Pińero *et al*., 1997).

Different shrimps have different types of food and feeding habits. Up to the present time, there is no paper on the feeding of *Lucifer* sp. has been produced in Malaysia. One important aspect of the biology of any species which is relevant to the success of any aquaculture operation is the knowledge of its food and feeding habit. Shrimps have been described by many researchers as the omnivorous scavengers that feed on a variety of benthic organisms including large quantities of organic detritus, silt, and sand.

Study on feeding habits and diet composition have various importance in fishery biology. A detail data about the food and feeding habit is crucial for successful aquaculture. Gut content analyses are widely used for food and feeding habits of aquatic organisms. Realizing the importance of the genus *Lucifer* as an intermediary link in the coastal food web of the coastal waters and to assess the suitability of these shrimps as potential live feed for larvae of fishes and prawns, studies were conducted to study on different aspects of population dynamics, feeding habits and distribution of *Lucifer sp.* from the Tebrau Straits of Johor, Malaysia.

The specific objectives of this study were:

1) To identify the species of *Lucifer* in Tebrau Strait, Johor, Malaysia.
2) To determine the asymptotic length (L_∞), growth coefficient (K), total mortality (Z), fishing mortality (F), natural mortality (M) and exploitation rate (E) of *Lucifer* shrimp in Tebrau Strait, Johor, Malaysia.
3) To examine the feeding biology of *Lucifer* shrimp in Tebrau Strait, Johor, Malaysia.

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