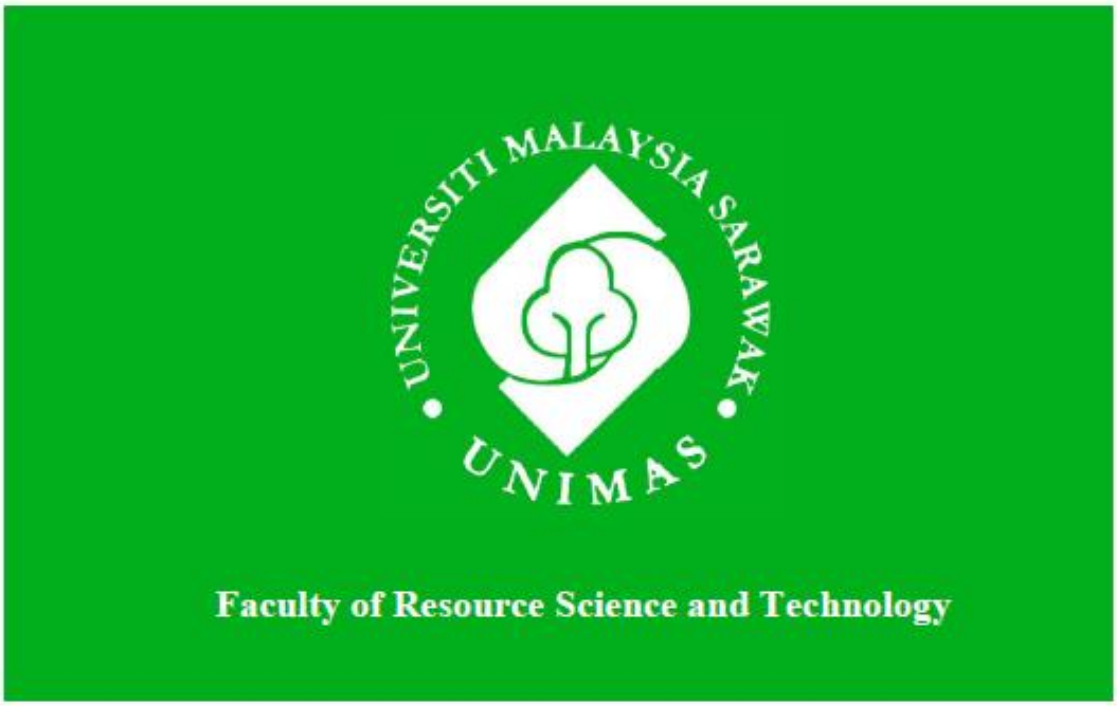

PRELIMINARY STUDY ON THE REPRODUCTIVE BIOLOGY OF PEANUT WORM IN LUNDU AND KUCHING DIVISION, SARAWAK

Nor Afilia Binti Muhammad Nor

(37589)

Bachelor of Science with Honours
(Aquatic Resource Science and Management)
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Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2015

ACKNOWLEDGEMENTS

First and foremost, I would like to congratulate myself for successfully giving the very best effort in finishing this writing. All praise and worship to Allah the Almighty, God of The Universe for giving me strength and guidance to ease my journey in finishing my studies. He is the one who provides me the path and as well as the strength.

I am thankful for the support and motivation from Dr Siti Akmar Khadijah Ab. Rahim, my supervisor. A special thanks to the Department of Aquatic Science and Resource Management of Universiti Malaysia Sarawak, for giving me the opportunity to learn and gain valuable experiences in pursuing my degree.

Not forgetting my friends and to whom I not mentioned, a big thanks for all of your concern, care, help and support while the writing is in progress.

Lastly, to my mum, Rohani Roslan, and my father, Muhammad Nor Bin Shakroni, and my siblings, who always there for me through thick and thin, care and support me mentally and financially. They are the one who never failed to support me. Nothing in this world can be compared to them. All my hard works are for them to repay their priceless love and this report is dedicated specially for them.

DECLARATION

I hereby declare that no portion of this dissertation has been submitted in support of an application for another degree of qualification of this or any other university or institution of higher learning.

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The project entitled “Preliminary Study on Reproductive Biology of Peanut Worm in Kuching and Lundu division, Sarawak” was prepared by Nor Afilia Binti Muhammad Nor and submitted to the Faculty of Resource Science and Technology in partial fulfillment of the requirements for the Degree of Bachelor of Science (Honours) in Aquatic Science and Resource Management.

Received for examination by:

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(DR SITI AKMAR KHADIJAH AB RAHIM)

Date: _____

Table of Contents

List of Abbreviations

List of Tables and Figures

List of Tables

List of Figures

Preliminary Study on Reproductive Biology of Peanut Worm in Lundu and Kuching Division, Sarawak

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ABSTRACT

Study was conducted at Lundu and Kuching districts. Samplings were done at Kampung Pugu, Kampung Lebak, Trombol and Pantai Puteri and covering both hard and soft substrates. From the sampling sites, two species that were recognised in these two locations are *Sipuncula nudus* and *Antillesoma antillarium.* Various methods have been used in this study, including observing the natural release of gametes, induced fertilization by two means that were by exerting the pressure and using the heat shock method. The anatomy of reproductive organs were illustrated for both species, the eggs morphology were observed and throughout the study, any fertilization was observed.

Key words: Peanut worm, sex, fertilization, reproductive biology

ABSTRAK

Kajian telah dijalankan di daerah Lundu dan Kuching. Kerja lapangan telah dijalankan di Kampung Pugu, Kampung Lebak, Pantai Trombol dan Pantai Puteri, meliputi dua jenis kawasan, substrat keras dan substrat lembut. Dari kawasan kajian, dapatan telah menunjukkan bahawa dua sepsis telah dikenal pasti sebagai sampel yang telah diperolehi iaitu Sipuncula nudus dan Antillesoma antillarium. Pelbagai kaedah telah digunakan dalam kajian ini termasuklah memerhati pelepasan gamet secara semula jadi, persenyewaan yang dirangsang menggunakan kaedah tekanan dan mengolah suhu air dalam habitat Cacing Wak-wak. Anatomi organ pembiakan telah dikaji untuk kedua-dua spesis, morfologi telur telah direkod dan pembiakan telah diperhatikan sepanjang kajian berlangsung.

Kata kunci: Cacing Wak-wak, jantina, pembiakan, biologi pembiakan

1.0 Introduction

Peanut worms are a type of unsegmented marine worm, under member of Phylum Sipuncula and their shape resembles a peanut. Most species occupy marine habitat, from intertidal zones up to certain depths, some species live just a few centimetres below the surface but larger species burrow down a metre (Cutler, 1994).

Peanut worms are very important because of their commercial value. According to Chen and Yen (1958) as cited in Cutler (1994), the people of China eat peanut worms that are locally known as star worm there. Although the human consumption of peanut worm is not widely spread, but it is commonly been eaten by the people in China and Indo-West Pacific. Peanut worms are being used by the local people and they are being exported and also available in international markets (Ying *et al.,* 2009).

Andrey *et al.* (2011) stated that the peanut worm is a group of trochophore animals that includes about 150 species within the Phylum Sipuncula. The study of peanut worm has been carried out a long time ago since the mid-sixteenth century and the first illustration of the peanut worm was produced in the mid-sixteenth century (Cutler, 1994).

In Sarawak, peanut worms are also known as Cacing Wak-wak and the local people use the peanut worm as fish bait. According to Taniuchi *et al.* (1983) as cited in Cutler (1994), certain species of fish feed on peanut worm. Despite of its known usage, the information of peanut worm in Sarawak is very limited. Therefore, this study was conducted to provide more information regarding peanut worm focusing more on the reproduction.

Reproductive biology is mainly about the reproductive system and sex organs of that species. To date, several aspects of peanut worm reproductive biology are still unknown, and its artificial breeding technology still needs much improvement (Ying *et al.,* 2009). In Sarawak, no comprehensive and systematic assessment has been carried out to document the reproductive biology of peanut worms.

Thus, a study was conducted to determine the reproductive biology of peanut worm in Lundu and Kuching with the aim to provide more information for future research. Kampung Pugu, Kampung Lebak, Trombol and Pantai Puteri are the chosen locations in this study. The objectives of this study are: (i) to document the sexes of peanut worm; (ii) to illustrate the reproductive biology of the peanut worm; (iii) to observe the eggs morphology of peanut worm and (iv) to monitor and document if any fertilization occur during the study period.

2.0 Literature Reviews

2.1 Background of Peanut Worm

Peanut worms or well-known as star worms, fall under the Phylum Sipuncula is a group of unsegmented cylindrical-shaped marine worm. This group of animals are closely related to the annelid and molluscs (Cutler, 1994). Approximately 150 species are found to inhabit the marine habitat, at various depths, within the soft or hard substrate or inside any shelters such as mollusc shells, corals or rock oysters (Schulze and Rice, 2004).

Peanut worms are known to feed on the small pecks of organic matter that drifted down through the water and settled at the bottom. This describes the peanut worms that they are classified as deposit feeders. Few of the peanut worms are known as the deposit feeders with more extended tentacular crown or known as themiste (Cutler, 1994). This group of animals are also known to consume detritus and fecal as well as bacteria, algae and small invertebrates.

2.2 Status of Peanut Worm in the World

The distribution of peanut worm covers throughout the world ocean, with the greater diversity and abundance in the tropical seas of the Indo-Pacific. According to Andiranov and Maiorova (2009), peanut worms are distributed widely in the world. Rice *et al.* (1995) had reported the presence of peanut worms in the Indian River Lagoon and has been recorded in several macrobenthos studies. Schulze and Rice (2004) stated that the peanut worm can be found in the Caribbean, specifically around the Pacific Coast of Panama, Ecuador, James and Hood Islands as well as Galapagos Islands. They were found inhabiting inside the rocks.

2.3 Status of Peanut Worm in Malaysia

Peanut worms were reported to inhabit the mangrove forests in Bachok, Kelantan (Sasekumar and Moh, 1970). The peanut worms were found to live with some species of crustaceans, bivalves and gastropods. According to them, there is still lack of study related to peanut worm in Malaysia, thus the baseline data regarding the peanut worm is not widely known.

2.4 Habitat of Peanut Worm

Peanut worms live in a wide range of depth and they are very well distributed from the intertidal waters to the abyssal plains (Andrianov and Maiorova, 2009). They can be found in the mud, burrowing the sand and gravel, inhabit below the rocks either rocks or even in crevices of rocks. Their boring activity in the coral has the correlation with the reef natural erosion. The boring activity by the peanut worm is significant with the reef natural erosion (Cutler, 1994).

Other than that, some species of peanut worm live in the empty shells of gastropods. In soft grounds, the peanut worm usually inhabit the uppermost layer with several centimeters from the uppermost substrate. The Sipunculus members are easily bury themselves vertically through the silt or sandy substrates down until a metre deep.

2.5 Taxonomy of Peanut Worm

The taxonomy of peanut worm for all the species were successfully reported by Cutler (1994). The taxonomy of *Sipuncula nudus* was described in Figure 1 whereas the taxonomy for *Antillesoma antillarium* was described in Figure 2.

Kingdom : Animalia

Phylum : Sipuncula

Class : Sipunculidea

Order : Sipunculiformes

Family : Sipunculidae

Genus : Sipunculus

Species : *Sipunculus nudus*

Figure 1 shows the taxonomy of *Sipuncula nudus* as described by Culter (1994).

Kingdom : Animalia

Phylum : Sipuncula

Class : Sipunculidea

Order : Sipunculiformes

Family : Sipunculidae

Genus : Antillesoma

Species : *Antillesoma antillarium*

Figure 2 shows the taxonomy of *Antillesoma antillarium* as described by Culter (1994).

2.6 General Morphology of Peanut Worm

Peanut worms have several characteristics that separate them easily from these other groups. The body consists of a cylindrical trunk and an introvert that invaginates completely inside the trunk (Cutler, 1994). The mouth is located at the tip of the introvert and may be surrounded by digitiform tentacles. The peculiar position of the anus in the antero-dorsal region of the trunk is an easily seen external character that distinguishes the sipunculans from other worm-like invertebrates. Peanut worms are dioecious but sexes are not distinguishable externally.

Peanut worms are large, with elongate body. Their longitudinal muscles in the body wall and coelomic canals is what makes it unique from other worms. Peanut worms have the tentacles around their mouth. The body morphology consists of two main parts, a cylindrical trunk and the introvert that can withdraw into the trunk. According to Ruppert and Rice (1995), the introvert begins with the cylindrical head and an elongated neck area. The head parts tangled with the terminal crown with ciliated tentacles. The latters are used for feeding and the gas exchange also takes place through their walls.

2.7 Reproduction of Peanut Worm

Reproduction is the production of new individuals more or less similar in new form to the parent organisms. This may be achieved by a number of means and serves to perpetuate or increase a species. One that is the least widely discussed is the reproductive biology of an organism and according to the United States Science Department of Natural Resources, the reproductive biology of a species is among the most important life-history parameters that researches must take into consideration when doing their research.

Majority of the peanut worms are dioecious and lack of sexual dimorphism (Cutler, 1994). Dioecious defines that the males and females releasing their gametes after the spawning activity. The gametes are released in the water and fertilization will take place then. This describes that the fertilization occurs externally. The male and female gonads rises from the coelomic epithelium cells. This thin cords are located along the bases of the central refractor muscles.

2.7.1 Sexual Reproduction

Sexual means reproduction of peanut worm indicated by their lack of dimorphism (Cutler, 1994). The gametes will produced internally, which will be then stored in the coelom lining. When the gametes are matured enough, they will then be released into the water column. The fertilization process occurs externally.

Peanut worms are very active at night, than that the breeding process may also occur at night. The mature gametes collected in nephridia, but somehow the sperm will be released first (Akesson, 1958). Sperm presence in the water column stimulates the female peanut worm to release their eggs and fertilization occurs in the water column.

2.7.2 Asexual Reproduction

Peanut worms carry the asexual reproduction by several means that are parthenogenesis, and budding. The parthenogenesis is usually known as the partial sexual process where meiosis occurred and oocytes are formed (Cutler, 1994). The term parthenogenesis falls into asexual reproduction because there is no syngamy occurs. This method spontaneously develop the unfertilized eggs into normal larvae (Pilger, 1987).

The budding process takes place and consequently gives a result of constriction that appears at the end of trunk, introvert, refractor muscles, anterior intestine and nephridia. These parts are replicated into smaller daughter part. According to Cutler (1994), this is just a smaller posterior part and this may form three to five buds. All the nervous system and other parts will be produced before the separation occurs.

2.7.3 Peanut Worm Reproductive Biology

Present-day, the development and reproductive biology of Sipuncula have been studied, for 22 Sipunculan species (Andrey *et al.*, 2011). Schulze (2005) had carried out the survey on peanut worm's diversity including larvae adults from Bocas del Toro, Panama. He claimed that this study was the first study done in Bocas del Toro.

According to Ying *et al.* (2009), some characteristics of Sipuncula reproductive biology are known for *Phascolopsis gouldi, Phascolosoma agassizii, Phascolosoma granulatum, Golongia vulgaris, Golongia ikedai, Golongia pugettensis, Golongia minuta and Golongia misakiana* (Rice, 1983) and *Sipunculus nudus* but there is no investigation on *Phascolosoma esculenta.*

According to Acik (2007), the present study provides information about the morphological and ecological characters of the alien species, *Aspidosiphon elegans.* He believed that the research has to be continued in determining the reproductive biology of Sipuncula especially when it comes to alien species. From here there is a need that much more study need to be done for peanut worm in providing more information especially on reproductive biology.

According to Andrey *et al.* (2011), the first and, so far, the only effort to combine and process the information on the time and conditions during the breeding season and the specific features of embryogenesis and larval development in the different species of peanut worm is a work of Rice (1967).

Rice (1967) was the first person to introduce data on the embryonic and larval development stages of *Phascolosma agassizii* cultured in the laboratory. These data displayed with light micrographs which make it possible to observe the main stages of development of this peanut worm. Despite the undisputed success of Rice work, again the illustrations using only the light microscope has limited the observation of total images. Hence, this condition does not allow complete representation of the morphogenesis of all developmental stages in this species.

Later, the findings were developed using the scanning electron microscope resulted in better information of Sipuncula where they combine the coherent information of the wild and the cultured Sipunculans' reproductive biology. Only then during the study, the study resulted with the failure to obtain meiobenthic stages from pelagospheras that settled after 1 month of development in the laboratory. The cultured pelagospheras had lived for several months after settlement on the bottom but subsequently died.

Ying *et al.* (2009), carried out the first year-round study on the reproductive cycle monitoring germ cells in the coelomic fluid and also, other aspects of the reproductive biology of *P. esculenta*. They successfully obtained their finding using dissecting method. They dissected the adult females of *P. esculenta*. In the paper, Ying et al. (2009) had provided the information on other aspects regarding the reproductive biology.

2.7.4 Gametes

Peanut worms produce their gametes in the coelomic lining. The gametes are being released to the coelom in order to let they mature by themselves. The metanephridia system pick up the gametes and then releases them into the aquatic environment. This is where the fertilization takes place as it occurs externally (Cutler, 1994).

Though some species grows directly into the adult form, majority of the species hold up to the stage called trochophore larvae, which then proceed with the metamorphosis process into the adult. In some cases, where few species develop into trochophore larvae, but the larvae does not develop directly into the adult, but into an intermediate pelagosphaera stage, that possesses a greatly enlarged metatroch (ciliated band).