THE STUDY ON OIL BODIES OF SOME LIVERWORTS IN KINABALU PARK

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THESIS SUBMITTED IN PARTIAL FULFILLMENT REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE

PROGRAM BIOLOGI PEMULIHARAAN
SEKOLAH SAINS DAN TEKNOLOGI
UNIVERSITI MALAYSIA SABAH

FEB 2005

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Ijazah: Sarjana Muda sains (Kep) Biologi Pemuliharaan

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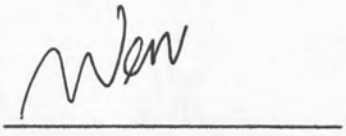

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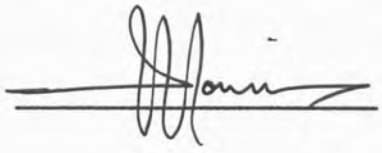

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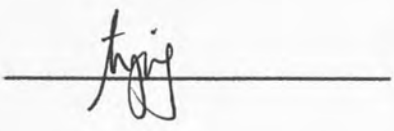

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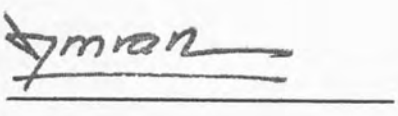

ACKNOWLEDGEMENT

This thesis would not have been successfully written if not for the help and kindness of many peoples, all of which is very much appreciated and valued.

My heartfelt thanks and gratitude goes to my supervisor, Dr. Monica Suleiman of the Institute for Tropical Biology and Conservation, for her invaluable supervision, guidance and support, which contributed much to this writing. I am very much happy with her guidance that gives me confidence in handling this investigation. I am very motivated by her dedication and commitment. Her qualities are much appreciated and I am glad to have such opportunity to express my thanks to her.

I am also indebted to Dr. Tatsuwo Furuki of Natural History Museum and Institute, Chiba of Japan for his kind identifications of my specimens. He has helped me in providing information of oil body, such as literatures and journals and also identification of my specimens.

Also, not forgetting Miss Chee Fong Tyng, Dr. Kartini Saibeh, and En. Hairul Hafiz Mahsul, lecturers of School of Science and Technology. They have helped me a lot in this study. Their invaluable favour of helped is very much appreciated and valued.

Appreciation also goes to Sikula Magupin, master student of the Institute for Tropical Biology and Conservation, who has helped in providing digital camera and information of map of Sabah.

I would also like to thank Mr. Johnny, laboratory assistant of the Institute for Tropical Biology and Conservation. He has helped me a lot in field work.

I would also wish to thank Sabah Park and Kinabalu Park, for providing the research permit and information of map of Sabah. Their invaluable favour of helped is much appreciated.

Finally, I would like to thank my parents, family members and friends who have given a lot of support to me.

Here, I would like to express my sincere thanks to all mentioned above. Thank you.

ABSTRACT

Oil bodies of liverworts are true membrane-bound organelles. Only the liverworts contain oil bodies among bryophytes. The purpose of this study is to classify the oil body types of some liverworts in Kinabalu Park. A total of 22 species in 13 families and 16 genera of liverworts were collected from Silau-silau Trail and Liwagu Trail at elevation of 1450m – 1750m in Kinabalu Park. Field works were carried out on 9 July 2004 and 10 July of 2004. Twenty-one species have been identified to species level and one to genera level. The oil bodies photographs were taken by a Camedia Olympus digital camera which was attached to a compound Olympus microscope. There were five oil body types distinguished, namely: Massula-type; Bazzania-type; Jungemannia-type; Calypogeia-type; and, Radula-type. A key to species of liverworts was constructed based on oil body and other characters. A dendrogram has been constructed by 'Nearest Neighbour Method' from the Multivariate Statistical Package (MVSP) program. In conclusion, the oil body characteristics play an important role in the taxonomy of liverworts

ABSTRAK

Oil body merupakan organel yang menakjubkan, di mana ia dibataskan oleh membran. Hanya lumut hati yang di antara bryophyte mengandungi *oil body*. Kajian ini bertujuan untuk menggolongkan jenis-jenis *oil body* di Taman Kinabalu. 22 spesies dalam 16 genera dan 13 famili dikumpul dari runut Silau-silau dan runut Liwagu pada ketinggian 1450m-1750m di Taman Kinabalu. Kerja lapangan dijalankan pada hari 9 Julai 2004 dan 10 Julai 2004. Sebanyak 21 spesies dikenalpasti ke tahap spesies dan satu hanya dapat dikenalpasti ke tahap genera. Gambar-gambar *oil body* diambil dengan Kamera digital yang berjenama Camedia Olympus, yang disambung kepada mikroskop kompaun Olympus. Lima jenis *oil body* dikenali, iaitu: jenis *Massula*; jenis *Bazzania*; jenis *Jungemannia*; jenis *Calypogeia*; dan, jenis *Radula*. Satu pengelasan kekunci dikotomi disediakan berdasarkan diskripsi ciri-ciri morfologi *oil body* dan ciri-ciri morfologi yang lain. Data morfologi lumut hati yang diperolehi, digunakan untuk analisis komputer dengan menggunakan kaedah 'Nearest Neighbour Method' dibawah program Multivariate Statistical Package (MVSP). Sebagai kesimpulan, ciri-ciri *oil body* memainkan peranan penting dalam taksonomi lumut hati.

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LIST OF ABBREVIATIONS

BORH	BORNEENSIS Herbarium
GGSc	Gower General Simmilarity Coefficient
MVSP	Multivariate Statistical Analysis
NSW	New South Wales
OTUs	Operational Taxonomic Units
SP	Sabah Park Herbarium

CHAPTER I

GENERAL

1.1 Introduction

Only the liverworts (Hepatics) contain oil bodies among bryophytes. Oil bodies synthesize large quantities of essential oils. Oil bodies are diagnostic of most liverworts (Fig. 1.1). The liverwort oil body is an intriguing organelle and is true membrane-bound organelles. They form either directly from the endoplasmic reticulum or by fusion of dictyosome vesicles. They also contain a diversity of ethereal terpenoid oils, suspended in a carbohydrate-and/or protein-rich matrix. The enclosing membrane of the oil body resembles the tonoplast in having an asymmetrical, tripartite organization. Oil bodies are absent from actively dividing cells, but are formed during early stages of cell maturation (Crandall-Stotler, 1981). Differentiated cells will contain dispersed lipid globules in addition to the terpene-filled oil bodies.

Variations that occur in oil body size, shape, color, number, distribution, and chemical composition are taxonomically informative characters of liverworts. Unfortunately, because of the volatility of the oils contained in them, they rapidly "disappear" in dried specimens. In fact, the morphology of oil body is often modified even

during short-term storage in the dark so observations of oil body morphology must be conducted only on freshly collected samples. Ultra structural evidence confirms that the oil body membrane and internal matrix remain intact for up to six weeks in dark-stored specimens, but the oil droplets within the matrix disappear within a few days.

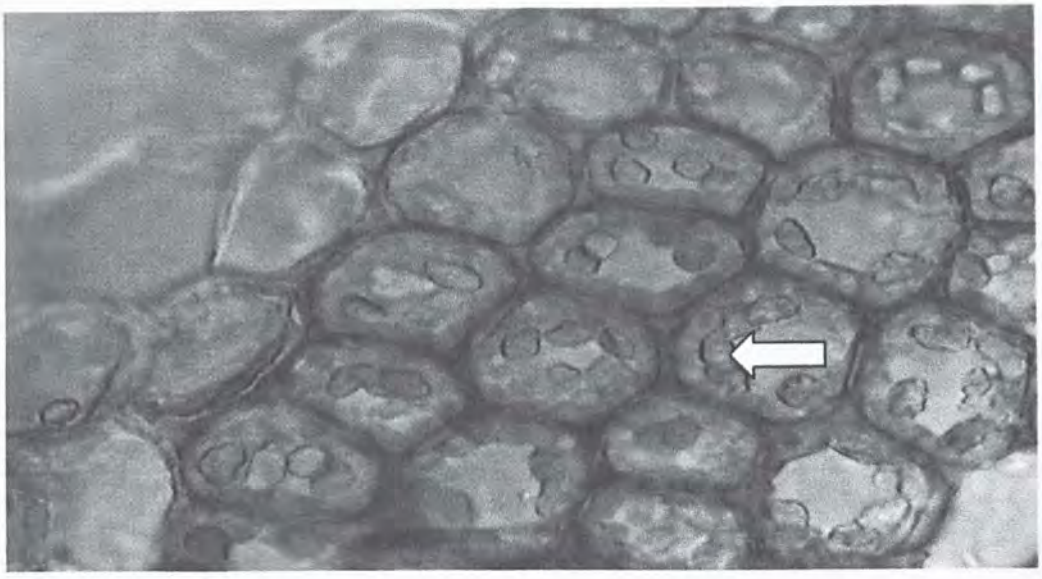

Figure 1.1 Oil bodies of a liverwort.

1.2 Justification

Kinabalu Park with its famous landmark, Mount Kinabalu at 4101 m, South-East Asia's highest peak, is two hours drive from Kota Kinabalu, the Sabah state capital. Covering an area of 754 km², slightly bigger than the island of Singapore, the park was gazetted in 1964 and covers areas which lie between the altitudes of 152 m – 4104 m above sea-level. Kinabalu Park has long been known as one of the world's richest centers of biodiversity and high levels of endemism, which mean the species, occur only on the mountain or within the Kinabalu Park and are found nowhere else in the world. Furthermore, park areas

have been protected from human activities by the State Government, thus forming well-preserved natural forests, especially above 1500 m. These conditions certainly serve the rich bryophyte flora found in the park (Phillipps, 2001).

As the first biological reserve established in the state of Sabah, Kinabalu Park has been extensively studied by scientists from all over the world. Each year, hundreds of scientists and students come to study the ecology, evolution and behavior of Kinabalu Parks flora and fauna. To date, more that 300 research projects have been completed and their finding published in scientific journals both locally and internationally (Beaman *et al.*, 2001).

Much of the recent scientific work in Kinabalu Park has been primarily devoted to documenting flora and fauna diversity. The species richness of plants of Mount Kinabalu has received much attention of botanists from all over the globe since Stapf's first ever scientific expedition to the area in 1894 internationally (Beaman *et al.*, 2001).

The importance of Kinabalu Park for international scientific community has been long recognized. The unique biological and geological features of the park which include the tropical lowland, montane and sub-alpine forests provide habitats that are not available elsewhere on the island of Borneo. The park protects these areas of virgin forest and home to many animals and plant species that could disappear within our lifetime if not protected from the many forces contributing to deforestation. Indeed, in a world where tropical forests are disappearing at an alarming rate, the Kinabalu Park stands as a nature

monument for scientific research and conservation; providing some hope for the future (Phillipps, 2001).

According to Shaw and Goffinet (2000), the significance of oil body type for taxonomy of Hepaticae has been demonstrated by Müller. The oil-body type of hepatics provides a very important criterion for the discrimination of species and genera. Short descriptions about the history of study of oil-body types were made by Schuster (1966), Inoue (1967) and Gradstein *et al.* (1977). Schuster (1966) made an attempt to classify the oil-body types of the hepatics, and Gradstein *et al.* (1977) recognized four types of oil-body in the Jungermanniales.

There is no data on the oil-body types of hepatics in Borneo. The present study of oil body is the first for Borneo. Moreover, Inoue (1979) have mentioned that the data on the oil-body types of the species in tropical regions are still very limited, and the observations on tropical species have often shown some differences from those on temperate regions even in the same species. Whether or not the observed difference may serve to delimit the different geographical races is not yet decided (Gradstein *et al.*, 1977).

Thus, the overall aim of the present research is to study the oil body of liverworts in Kinabalu Park and therefore to provide useful characteristics for the discrimination of species and genera.

1.3 Scope

The Kinabalu Park, comprising of Mount Kinabalu and the Poring hot springs, covers an approximate area of 75 370 hectares. It Park lies some 92 km from the Sabah capital, Kota Kinabalu. The scope of this study was along the Silau-silau Trail and Liwagu Trail at elevation of 1450 m – 1750 m in Kinabalu Park.

1.4 Objectives

The objectives of this study were directed to the followings:

1. To classify the oil body types of some liverworts in Kinabalu Park.

2. To construct a key to species of liverworts based on oil bodies and other characteristics in Kinabalu Park.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction to bryophytes

Bryophytes belong to the oldest land plants. Frahm (2003) studied that they already existed in the Palaeozoic 300 million years ago in forms which were hardly different from the extant species. The bryophytes often called a "conservative" plant group and remained relatively unchanged with relatively low evolution rates. They could successfully establish themselves in an always varying environment form Devonian swamps to Permian forests, Mesozoic deserts and as epiphytes in Tertiary rainforest.

Bryophytes have increased their diversity by occupying new ecological niches, such as epiphytic existence in forests (Frahm, 2003). The bryophytes are small plants with flat, prostrate, thallus-type bodies, or with an erect central stem that bears leaves of simple form (Cook, 1967). Bryophytes are the second largest group of green land plants, there are about 25,000 species of bryophytes distributed in the entire world (Greenaway, 1991).

Like the algae, the bryophyta are autotrophic plants which are able to photosynthesize their own carbohydrate from carbon dioxide and water. They differ from algae in being essentially land-plants, but they usually grow in fairly damp habitats since a film of water is essential for fertilization of the egg. Unlike the algae, they have a constant alternation of generations with the most prominent generation the haploid gametophyte on which the sporophyte generation is parasitic. They are always oogamous and have a typical archegonium which has a sterile layer of cells surrounding the egg. The antheridium also has a sterile layer. This possession of a sterile layer round the sex organs is characteristic of both bryophyte and pteridophyta but the algae have sex organs without such a layer (Johnson, 1965).

According to Frahm (2003), bryophytes are not at all "primitive" plants. Bryophytes are rendered possible by various morphological, anatomical and physiological adaptations. They grow in an astonishingly broad variety of substrates and habitats. They occur in the snow vegetation with a nine months 'snow cover', form masses in the tundra and in the boreal forests, cover tree trunks in tropical rain forests, grow 50m deep in lakes and at 5000m altitude on mountain peaks, in extremely acid peat bogs, and on heavy metal rich soil, in canopies and deserts, in dark caves and on exposed rocks.

2.1.1 Geography of bryophytes

Frahm *et al.* (1996) addressed that the South East-Asia shows the most diverse bryoflora of all the tropical rainforests in the world. Montane species can reach far north or south to humid subtropical to temperate regions, some as far north as NSW-Europe. For example,

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