

**FIREFLIES' ECOTOURISM AND CONSERVATION
IN KLIAS AND WESTON**




SITI ROZZIANA BINTI JEPERI

UTMS
UNIVERSITI MALAYSIA SABAH

**INSTITUTE FOR TROPICAL BIOLOGY AND
CONSERVATION
UNIVERSITI MALAYSIA SABAH
2021**

**FIREFLIES' ECOTOURISM AND CONSERVATION
IN KLIAS AND WESTON,**

SITI ROZZIANA BINTI JEPERI



**THIS IS SUBMITTED IN FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF
SCIENCE**

**INSTITUTE FOR TROPICAL BIOLOGY AND
CONSERVATION
UNIVERSITI MALAYSIA SABAH
2021**

UNIVERSITI MALAYSIA SABAH
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JUDUL : **EKOPELANCONGAN DAN PEMELIHARAAN KELIP-KELIP DI
KLIAS DAN WESTON BEAUFORT**

IJAZAH : **SARJANA SAINS**

BIDANG : **PROSES EKOLOGI**

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Disahkan Oleh,

SITI ROZZIANA BINTI JEPERI
MX1611018T

(Tandatangan Pustakawan)

Tarikh : 30 November 2021

(Prof. Madya Dr. Mahadimenakbar
bin Mohamed Dawood)
Penyelia Utama

DECLARATION

I hereby declare that the material in this thesis is my own except for quotations, excerpts, equations, summaries and references, which have been duly acknowledged.

21st July 2021

.....

Siti Rozziana binti Jeperi

MX1611018T



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CERTIFICATION

NAME : **SITI ROZZIANA BINTI JEPERI**

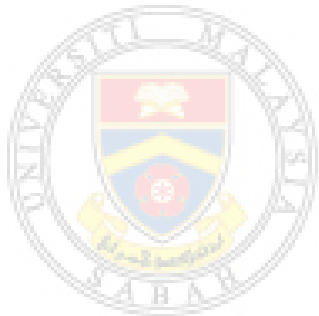
MATRIC NO. : **MX1611018T**

TITLE : **FIREFLIES' ECOTOURISM AND CONSERVATION IN
KLIAS AND WESTON**

DEGREE : **MASTER OF SCIENCE**

FIELD : **ECOLOGICAL PROCESSES**

VIVA DATE : **21st JULY 2020**



CERTIFIED BY;

Signature

1. MAIN SUPERVISOR

Assoc. Prof. Dr Mahadimenakbar bin
Mohamed Dawood

2. CO-SUPERVISOR

Dr. Fiffy Hanisdah binti Saikim

ACKNOWLEDGEMENT

Alhamdulillah, it was indeed a *fafirru ilallah* journey along the process of completion of this thesis.

I would like to express my gratitude to those who have rendered their valuable support, encouragement, guidance and necessary assistance to me. With due respect, I would like to extend to the following people, my most appreciative thanks and gratitude:

- Assoc. Prof. Dr Mahadimenakbar Bin Mohamed Dawood and Dr Fiffy Hanisdah Binti Saikim, who, as my supervisors, have been given me encouragement, patience and valuable guidance throughout the study. Also, to Dr Nurul Wahida Binti Othman and Dr Hamimah Talib as my examiners. Their astute criticisms and tolerance significantly improved the outcome of this thesis;
- Yayasan Sabah Group, for their staffs;
- The Malaysian Remote Sensing Agency (MRSA) and JUPEM, which supplied the satellite data of the study areas, Forestry Department, my GIS & drone team, Firefly Tour Operators (lodges), related JPKK's and local people;
- The staff of University Malaysia Sabah, especially the Institute for Tropical Biology and Conservation (ITBC) and the Post-Graduate team.
- My lovely parents, Jeperi Bin Khamis and Saadiah Binti Aliudin (both of you are always in my heart), my fiancé, my siblings and friends who gave me the never-end encouragement and support;
- My gratitude also to my fellow post-graduate members for their knowledge sharing's, assistance and tolerances throughout these years.

Finally, I would like to thank those who have been directly or indirectly involved or contributed themselves; throughout the whole process of completing my master's degree. I would not able to complete this thesis without all the given guidance's and supports. Thanks a lot, and may Allah bless each one of you.

Siti Rozziana Binti Jeperi
21st July 2020

ABSTRACT

Fireflies from the genus *Pteroptyx* had drawn a lot of attention from human beings due to their congregating behaviour, thus provides local communities with a lucrative business opportunity. The most commonly known firefly hotspot in East Malaysia is Klias and Weston, Beaufort Sabah. However, it is believed that the adjacent community might pose a threat of encroachment to the Klias and Weston, where mangrove forests are located. To restore this industry's sustainability in Klias and Weston, this research is separated into three parts; part one investigated the impact of land-use change on native firefly habitat by applying remote sensing technique. Part two determined the effect of some abiotic factors on the present firefly habitat. In contrast, part three involved assessing Klias and Weston stakeholders' exposure to the importance of fireflies and wetland ecosystems and the extent to which they are keen to conserve the firefly populations. Only two water quality tests, pH and dissolved oxygen from 12 parameters tested showed negative results indicate a low pH (acidic) and the low dissolved oxygen (hypoxic) of the river water. For land use changes, 30 years of aerial view shows a reduction and anthropological disturbance towards firefly habitat, consequently requiring constant monitoring and legal enforcement on appropriate land-use development. A total of 423 respondents comprised of the local community and tourist has been surveyed and analysed with Leximancer tools. Likewise, we could develop a more thorough understanding of the relations between the stakeholders and the firefly ecosystem. Based on the findings, 84.4% of them are willing to protect the future generation's fireflies. Meanwhile, 66.2% volunteered to participate in an education program on firefly conservation. Concerning the importance of village development instead of firefly conservation, 40.7% stated that both are important. Meanwhile, spider web analysis shows that locals lack knowledge of firefly ecology and biology. Most of the respondents were less likely to value the importance of fireflies in the ecosystem. Therefore, more public awareness, tourism and environmental education should be allocated. Lastly, the authority should develop a blueprint for firefly conservation to help a focus preservation at the location with the highest need to control the rate of firefly habitat loss due to development, a robust legal system, earlier exposure towards environmental education, well-planned development implementation and long-term monitoring program to strengthen efforts in conserving firefly in Sabah. The long-term security and enhancement in perpetuity biodiversity are essentials to ensure sustainable development and conserve the environment for future generations.

Keywords: *Pteroptyx* fireflies, firefly-watching, ecotourism, stakeholders, Leximancer, conservation.

ABSTRAK

EKOPELANCONGAN DAN PEMELIHARAAN KELIP-KELIP DI KLIAS DAN WESTON BEAUFORT

Kelip-kelip dari genus Pteroptyx telah menarik perhatian yang tinggi dari manusia kerana kelakuan secara berkumpulan mereka, sehingga menyediakan peluang perniagaan yang menguntungkan kepada masyarakat tempatan. Antara lokasi kelip-kelip yang terkenal di bahagian Timur Malaysia ialah Klias dan Weston, Beaufort Sabah. Walaubagaimanapun, komuniti berdekatan dipercayai mungkin telah mengakibatkan pencerobohan ke atas hutan bakau di Klias dan Weston. Bagi mengembalikan kelestarian industri ini di Klias dan Weston, kajian ini diasingkan kepada tiga bahagian; bahagian pertama untuk melihat kesan perubahan penggunaan tanah pada habitat asal kelip-kelip dengan menggunakan Teknik Penginderaan Jauh. Bahagian kedua menentukan kesan beberapa faktor abiotik pada habitat kelip-kelip kini. Sebaliknya, bahagian ketiga merangkumi penilaian terhadap pendedahan pihak berkepentingan di Klias dan Weston akan pentingnya ekosistem kelip-kelip dan melihat sejauh mana mereka berminat untuk memelihara populasi kelip-kelip. Hanya dua ujian kualiti air, iaitu pH dan oksigen terlarut, dari 12 parameter yang diuji yang menunjukkan hasil negatif; pH rendah (berasid) dan oksigen terlarut rendah (hipoksia) bagi air sungai. Untuk perubahan gunatanah, pandangan udara selama 30 tahun menunjukkan pengurangan dan gangguan antropologi terhadap habitat kelip-kelip, sehingga memerlukan pemantauan dan penguatkuasaan yang berterusan. Seramai 423 responden yang terdiri daripada komuniti setempat dan pelancong telah disoal-selidik dan dianalisis menggunakan alat Leximancer. Maka, pemahaman yang lebih mendalam mengenai hubungan antara pihak berkepentingan dan ekosistem kelip-kelip dapat diterapkan. Berdasarkan penemuan tersebut, 84.4% daripada responden bersedia melindungi kelip-kelip untuk generasi akan datang. Sementara itu, 66.2% menawarkan diri untuk menyertai program Pendidikan mengenai pemuliharaan kelip-kelip. Mengenai kepentingan pembangunan kampung atau pemuliharaan kelip-kelip, 40.7% menyatakan bahawa kedua-duanya adalah penting. Sementara itu, analisis jaring labah-labah menunjukkan bahawa penduduk tempatan kurang mengetahui ekologi kelip-kelip. Selanjutnya, pihak berwajib harus membuat pelan tindakan bagi membantu pemuliharaan kelip-kelip secara berfokus di lokasi yang berkeperluan tinggi untuk mengawal kadar kehilangan habitat kelip-kelip akibat pembangunan, sistem perundangan yang lebih kuat, pendedahan awal terhadap pendidikan alam sekitar, pelaksanaan pembangunan yang lebih terancang dan program pemantauan jangka panjang untuk menguatkan usaha memelihara kelip-kelip di Sabah. Keselamatan jangka panjang dan peningkatan dalam kepelbagaian biodiversiti adalah penting untuk memastikan pembangunan lestari dan memulihara alam sekitar untuk generasi akan datang.

Kata kunci: *Kelip-kelip Pteroptyx, aktiviti melihat kelip-kelip, eko-pelancongan, pihak berkepentingan, Leximancer, pemeliharaan.*

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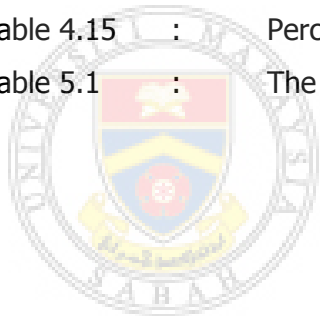
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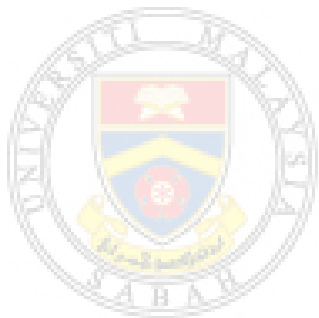
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LIST OF ABBREVIATIONS

GDP	-	Gross Domestic Product
UNWTO	-	The World <i>Tourism</i> Organization
WTTC	-	World Travel & Tourism Council
STB	-	Sabah Tourism Board
UNSECO	-	United Nations Educational, Scientific and Cultural Organization
EPD	-	Environmental Protection Department
EIA	-	Environmental Impact Assessment
SIA	-	Social Impact Assessment
ERDAS	-	Earth Resource Development Assessment System
DO	-	Dissolved Oxygen
COD	-	Chemical Oxygen Demand
BOD₅	-	Biological Oxygen Demand
TDS	-	Total Dissolved Solids
RH	-	Relative Humidity
LI	-	Light Intensity
DID	-	Department of Irrigation and Drainage
MRSA	-	Malaysian Remote Sensing Agency
JUEM	-	Jabatan Ukur dan Pemetaan Malaysia
GPS	-	Global Positioning System
APHA	-	American Public Health Association
ArcGIS / GIS	-	Geographic Information System
TM	-	Thematic Map
SPSS	-	Statistical Package for Social Sciences
ESRI	-	Environmental Systems Research Institute
WGS	-	World Geodetic System
JKR	-	Jabatan Kerja Raya
UGSG	-	United States Geological Survey
RBG	-	Red Blue Green
LULC	-	Land Use Land Cover
SAFODA	-	Sabah Forestry Development Authority
RS	-	Remote Sensing

USEPA	-	United State Environmental Protection Agency
ANOVA	-	Analysis of Variance
IUCN	-	International Union for Conservation of Nature
CITES	-	Convention on International Trade in Endangered Species
PFR	-	Permanent Forest Reserve
<i>Tapai</i>	-	A traditional fermented preparation of rice or other starchy foods
<i>Jempili</i>	-	Mollusc group
TIES	-	The International Ecotourism Society
FAO	-	Food and Agriculture Organization
PM	-	Prime Minister
M.Sc.	-	Master of Science
PhD	-	Doctor of Philosophy
USGS	-	United States Geological Survey
DMTs	-	Decision-Making Tools
LUPs	-	Land Use Plans
MYR	-	Malaysian Ringgit
USD	-	United State Dollar
Pers. comm.	-	Personal Communication
PSF	-	Peat Swamp Forest
pH	-	Potential of Hydrogen
WHO	-	World Organization of Health
MOH	-	Ministry of Health
Mph	-	Mile per hour
SE\bar{x}	-	Standard Error of the means
SE	-	Standard Error
WTC	-	Willingness to Conserve
WTP	-	Willingness to Pay
etc.	-	and the rest
NGO	-	Non-Governmental Organization
ICDP	-	Integrated Conservation and Development Project
B&B	-	Bed and Breakfast
MTCE	-	Ministry of Tourism, Culture and Environment

SOP	-	Standard Operating Procedure
PRC	-	Pilajau River Cruise
SWOT	-	Strength, Weaknesses, Opportunities, Threat
EIFAC	-	European Inland Fishery Advisory Commission



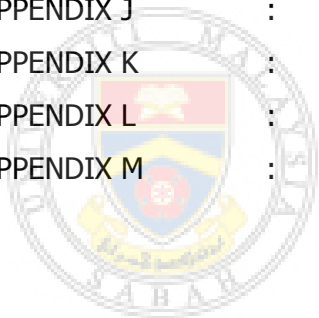
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LIST OF SYMBOLS

%	-	Percentage
&	-	And
/	-	Or
e.g.	-	For Example
i.e.	-	That is
sp.	-	Species
m	-	Metre
bn	-	Billion
sq.km	-	Square kilometre
km	-	Kilometre
µS/cm	-	Micro Siemens/centimetre
mg/L	-	Milligram per litre
°C	-	Degree Celsius
NH₃	-	Ammonia
ppt	-	Precipitation
et al.	-	And others
Σ	-	Sum of all/Total
Ha	-	Hectare
RM	-	Ringgit Malaysia
<	-	Greater than
>	-	Less than
n	-	Frequency
~	-	Approximately to
(-)	-	Decreasing value
Ppm	-	Part(s) per million

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The chapter describes the background information and statement of the research problem. It provides the research objectives and significance of the study. Briefly, it outlines the study's scope: tourism, firefly watching tourism, and the firefly's importance to the ecosystem.

1.2 Research Background

Tourism is the fastest growing industry globally and has become the world's most significant source of employment and GDP contributor to many developing countries (Jules, 2005; UNWTO, 2012). Malaysia has one of the most vibrant and developed economies in Southeast Asia, highlighting its potential contribution to the local, national, and global economy. The tourism industry is the third major contributor to Malaysia's revenue, contributing to MYR167.5 billion (USD40.4bn), 13.7% of Malaysia's GDP in 2016. It has also marked a 43.0% rise from MYR117.2 billion in 2001, a 6.5% jump from MYR157.3 billion in 2015 and is forecast to increase to MYR295.6 billion (USD71.3bn) or 15.9% in 2027, while the total contribution of travel and tourism to employment, including jobs indirectly supported by the industry, was 12.0% of full employment (1.7005 million jobs). This employment is expected to rise by 4.0% per annum to 2.564 million jobs in 2027 (14.5%) (WTTC, 2017).

This sector's resilience results from the active involvement of public and private sectors in the promotion and marketing, market diversification, and improving the competitiveness of tourism products that attract tourists to Malaysia (Rosniza Aznie *et al.*, 2012).

Sabah, which is located in the northern part of Malaysian Borneo, tourism has grown steadily from the infancy stage into an industry that has contributed to the state and national economies after agriculture and manufacturing. Total tourist arrivals in 2016 were 3,427.9 million (STB, 2017), with more than a million visitors from China alone. It shows a booming growth (209.00%) within 15 years, expanding from 1.107 million in 2002 (STB, 2004), contributing to Sabah's economy. Sabah is rich in biodiversity and heritage, making it ideal to become one of Asia's most successful ecotourism and adventure tourism destinations. Thus, Malaysia is one of the twelve mega-biodiversity hotspots worldwide (UNDP & FRIM, 2008), including wetlands. The unique characteristics of wetlands are their vegetation, which serves as habitats for wildlife of various species (Mitsch & Gosselink, 1993).

Wetlands in Malaysia are mostly mangrove forests found in coastal regions and along riverbanks near the sea. They account for about 11.7% of Southeast Asia mangroves' total area, which is approximately 564, 971 hectares (FAO, 2007). Two remaining sites support the largest peat soil areas in Sabah, which are on the Klias Peninsula and in the Kinabatangan – Segama Valleys. Klias is located within the Beaufort district. In 1978, 30 900 hectares of Klias were gazetted as a Class I protection forest reserve 1984, together with the nearby Binsulok Forest reserve, comprises an area of 12, 106 ha (Hutton *et al.*, 2010; Phua *et al.*, 2008). Today, the Klias Wetland Mangrove Forest Reserve consists of only 3 630 ha peat swamp forests (Klias Forest Reserve Conservation Plan, 2007). Despite providing significant value to humans, especially socio-economic sustainable development (Liu *et al.*, 2004), this pristine area is threatened