ASSESSMENT OF ANIMAL DIVERSITY IN PULAU TINGGI, MERSING, JOHOR FOR CONSERVATION AND INDICATOR FOR POTENTIAL WILDLIFE TOURISM

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledge

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DEDICATION

Family and friends who inspired me throughout completing this work project.

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ABSTRACT

Pulau Tinggi is a marine park that is located in Mersing, Johor. This study aimed to document the checklist of wildlife in Pulau Tinggi and investigate suitable wildlife organisms to be emulated as wildlife tourism products, wildlife tourism hotspots and new wildlife tourism package. Wildlife sampling was conducted in three nature trails in Pulau Tinggi. Different methods were applied to different animal groups. Drift fence pitfall traps and visual encountered surveys were used in the herpetofauna survey. Mist nets were used in bats, while cage traps and camera traps were used for other mammals on the island. Pitfall traps, light traps, and hand catching methods were used for insects. Wildlife sampling were conducted from February 2019 to October 2019. This study successfully documented nine species of amphibians, of which six were newly recorded species in Pulau Tinggi. For the reptile checklist, seven among the fourteen species documented were a new record for Pulau Tinggi. For mammals, twelve species of bats and one species each for large and small mammals. Among all wildlife, insects were the most diverse group which amassed a total of two hundred twenty species. Wildlife tourism was assesed in three nature trails according to each developed tourism packages based on seven criterial of good nature tourism product. From the diversity data gathered, the potential hotspot were determined in three nature trails for each wildlife species. For herpetofauna tourism, *Draco melanopogon* and *Kaloula pulchra* were selected as potential tourism products; for bat-based tourism is *Pteropus hypomelanus;* in camera trap, targeted species for wildlife tourism is *Caloenas nicobarica* and for entomotourism, lepidoptera order was selected to be developed as a tourism product. The result demonstrated that Trail 3 has a high potential for wildlife tourism since all targeted species were frequently distributed in this trail.

ABSTRAK

Pulau Tinggi adalah Taman Laut yang berada di Mersing, pantai timur Johor. Kajian ini bertujuan untuk mendokumentasikan senarai hidupan liar di Pulau Tinggi, mengkaji spesis yang paling sesuai untuk dijadikan produk pelancongan dan menentukan tempat pelancongan hidupan liar berdasarkan data hidupan liar yang dikumpulkan di laluan yang berbeza. Pelbagai kaedah telah digunakan untuk kumpulan haiwan yang berlainan. Perangkap katak dan koleksi secara aktif telah dijalankan untuk mendapatkan spesimen amfibia dan reptilia. Jaring kabut telah digunakan untuk kelawar, manakala perangkap sangkar digunakan sebagai perangkap mamalia tidak terbang, kamera inframerah telah dipasang untuk mengkaji mamalia sederhana dan mamalia besar. Perangkap Pitfall serangga, tangkap secara manual dan perangkap lampu serangga telah digunakan untuk mendapatkan spesimen serangga. Pengumpulan data dibuat dari Febuari 2019 hingga Oktober 2019. Kajian ini telah mendapati sembilan spesies amfibia, enam spesies adalah rekod baru. Antara empat belas spesies reptilia, tujuh adalah rekod baru di Pulau Tinggi. Terdapat dua belas spesies kelawar. Dalam mamalia tidak terbang, mamalia besar dan mamalia kecil terdapat satu spesis di setiap kumpulan. Serangga terdiri daipada kumpulan yang paling banyak antara hidupan liar iaitu dua ratus dua puluh spesis. Pelancongan hidupan liar telah dibangunkan di tiga laluan utama berdasarkan pakej pelancongan yang telah dianalisis melalui tujuh kriteria produk pelancongan alam semula jadi. Spesies yang disasarkan dalam pelancongan *Herpetofauna* adalah *Draco melanopogon* dan *Kaloula pulchra*; bagi pelancongan kelawar adalah *Pteropus hypomelanus*. Pelancongan hidupan liar berdasarkan perangkap kamera inframerah adalah *Caloenas nicobarica*. Lepidoptera telah dijadikan produk entopelancongan. Kajian menunjukkan laluan 3 berpotensi untuk pelancongan hidupan liar kerana mempunyai semua spesis sasaran.

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LIST OF SYMBOLS AND ABBREVIATIONS

Σ	-	Total
%	-	Percentage
^{o}C	-	Degree Celsius
ASL	-	Above sea level
DD	-	Data Deficient
ECERDC	-	East Coast Economic Region Development Council
EJIA	-	East Johor Island Archipelagos
Ha	-	Hectar
ITBC	-	Tropical Biology and Conservation
IUCN	-	International Union for Conservation of Nature
KM	-	Kilometer
LC	-	Least Concern
M	-	Metre
NE	-	Not Evaluated
NT	-	Near Threathened
RA	-	Rapid Assessment
RM	-	Ringgit Malaysia
SVL	-	Snout-vent length
UMS	-	Universiti Malaysia Sabah
UNWTO	-	United Nations World Tourism Organisation
UTHM	-	Universiti Tun Hussein Onn Malaysia
VJR		Virgin Jungle Reserves
WTO	-	World Tourism Organization

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CHAPTER 1

INTRODUCTION

1.1 Research background

Wildlife is a range of different living organisms with various genetic, species, and ecosystem levels living in the wild (Amare, 2015). Globally, it is approximated there are 6,771 amphibian species, of which 5,966 species are frogs and toads, 242 species of caecilians, and 19 species of salamanders. According to the International Union for Conservation of Nature (IUCN), Brazil has the most diverse amphibians with at least 798 species. Malaysian amphibian includes more than 203 species comprising of the Anura order. From this, 107 species can be found in Peninsular Malaysia, 111 species in Sabah, of which 18 are endemic, while Sarawak has more than 130 species (Latiff, 2018). A total of 10,272 reptile species were recorded by August 2015 globally (Uetz, 2018). It has been documented that 397 reptiles species were reported around Malaysia, and among them, an estimated 256 species exist in Peninsular Malaysia (Das & Norsham, 2007).

More than 360 species of mammals have been recorded in Malaysia, and at least 30 species are endemic (Jaafa, 2017). In Peninsular Malaysia, 223 species of mammals could be found (Hashim, 2017). The IUCN Red List of Threatened Species 2017 has assessed 219 species of the 223 that were listed in Peninsular Malaysia. Of these, 4 were categorised as critically endangered, 13 were considered to be endangered, 28 were classified as vulnerable, and 26 were near-threatened, and 1 were classified as extinct (Tajuddin *et al*, 2010). 307 species belong to 108 genera and 32 families of non-marine mammals in Malaysia; this total includes 229 species in Peninsular Malaysia and 221 species in Sabah and Sarawak, of which 152 species are common (Tweedie & Harrison, 1956; Medway, 1983).

Insects are an important faunal group in terrestrial ecosystems where they play a vital role in stabilising the ecosystem. Based on an estimation of global species richness, 5.5 million species of insects are already recorded (Stork, 2018). There are more than 1,031 butterfly species globally, more than 300 species in Peninsular Malaysia; thus, the macromoths alone comprise more than 5,000 species. The dragonflies and damselflies (Odonata) are represented by 230 species in Peninsular Malaysia alone (Orr, 2003). Malaysia also has the greatest density of stingless bees, Trigona, with more than 35 species. The ant fauna is not well-known as only 15,000 species of ants were estimated globally (Bolton, 1994), while Malaysia Borneo has at least 1000 species described (Hashimoto & Homathevi, 2003). Similarly, of the 2,500 species of stick and leaf insects in the world, between 200 and 250 species have been recorded in Malaysia. The cicadas, Homoptera, are represented by more than 104 species in the Cicadidae and Tibicinidae families in Peninsular Malaysia (Cheng and Kirton, 2007).

'Tourism' is deriving from government and private sector activities that manage and fulfill the needs for trips, businesses, and travelling (Pearce, 1998). The tourism industry is reported to have significantly boosted the world economy (UNWTO, 2004). In Malaysia, the tourism sector is one of the economic generators that has grown drastically. Nature-based tourism includes all forms of tourism where relatively undisturbed natural environments form the primary attraction or setting (Newsome *et al.*, 2002, Buckley *et al*., 2009;). Nature tourism means people travel to a low-disturbance destination to involve themselves and enjoy nature (Christ, 2003). It is a significant component of the global tourism industry, with estimates of worldwide economic scale ranging from hundreds of billions to one trillion dollars annually (Buckley, 2009). Natural area tourism includes ecotourism, wildlife tourism, geotourism, and adventure tourism (Newsome *et al*., 2002).

Wildlife tourism can be defined as the intent of tourists to approach non-domesticated animals in their natural habitat or captive environment (Higginbottom, 2004). To get the best experience on wildlife tourism, one must need to get the accurate, relevant, interesting on-site experiences and off-site information through interpretation. Wildlife tourism depends heavily on interpretation to support its ecological and economic benefits. Ham & Weiler (2012) mentioned that to be able to support conservation of species through wildlife tourism, it must (1) satisfy customer demand, (2) create opportunities for local employment, (3) influence on-site visitor behaviour,

and (4) promote conservation ethics in tourists that may extend well beyond their on-site experience (Ham, 2012; Weiler, 2012).

Pulau Tinggi is a marine park in Johor that located on the east coast of Johor, and it is one of the largest and tallest islands in the East Johor Island Archipelagos (EJIA). Its nomenclature comes from the appearance of its elevation of 600 meters or 2000 feet above sea level, located 13km off the east coast of Johor with a total area of 16 km^2 . The island is perennial green by the evergreen tropical forest and the summit of the mount is known as Gunung Semudu (Azman *et al*., 2008). Pulau Tinggi is a dominant island located in the middle arc of Seribuat Archipelago. Pulau Tinggi marine park is surrounded by 13 islands including Pulau Harimau, Pulau Mensirip, Pulau Goal, Pulau Besar, Pulau Tengah, Pulau Hujung, Pulau Rawa, Pulau Tinggi, Pulau Mentinggi, Pulau Sibu, Pulau Sibu Hujung, Pulau Pemanggil, and Pulau Aur. The cluster of islands and the aquatic around was gazetted as a marine park in 1994 under the fishery act (Department of Marine Park Malaysia, 2012). This study is important to increase the awareness on biodiversity of the islander and to fill the knowledge gap of wildlife research and conservation in this island

1.2 Problem statement

The assessment of animal diversity in Pulau Tinggi provides information for conservation and assists in the development of wildlife tourism. However, there is limited research that has examined wildlife in Pulau Tinggi. There is a lack of awareness about wildlife and island tourism among the local community. The status of wildlife diversity in Pulau Tinggi still remains unknown due to the limited funding for accommodation, transport, and access to research. Previous research only focused on herpetofauna (Escobar *et al*., 2003; Grismer, 2006; Grismer, 2011), urothoe (Azman & Melvin, 2011), plant (Turner *et al*., 1997), dugong (Louisa *et al.,* 2015), and seagrass (Jillian, 2011). There is still a huge knowledge gap that needs to be filled by conducting further research in Pulau Tinggi, especially on herpetofauna, mammals, and insects. Meanwhile, there is a lack of awareness about the uniqueness of island tourism in Malaysia and also internationally. Tourism is an effective tool to create awareness on conservation; unfortunately, the wildlife tourism in Pulau Tinggi has never been promoted (Natalie & Nair, 2013).

The successful development of entomotourism and anuran tourism in the mainland of Endau-Rompin National Park is a good example. However, the promotion of island tourism is still inadequate. The understanding and interest of the public toward wildlife and nature is a significant factor in wildlife tourism. Additionally, the awareness about biodiversity and conservation among local people is still low. Therefore, community-based conservation through nature tourism can be conducted in Pulau Tinggi. Wildlife tourism would be sustainable only if it contributes to the conservation and survival of target species and their habitats, provides benefits for local communities and community development, offers good quality tourism in line with market expectations and is commercially viable (Tapper, 2006).

1.3 Research objectives

The aims of this study are:

1. To determine the checklist of wildlife in Pulau Tinggi, Mersing, Johor.
2. To evaluate the most suitable wildlife organisms to be emulated as potential wildlife tourism products in Pulau Tinggi, Mersing, Johor.
3. To determine wildlife tourism hotspots in Pulau Tinggi based on the wildlife diversity data gathered.
4. To develop new tourism package based on wildlife data gathered.

1.4 Significance of the study

Research on wildlife in the island ecosystem is important to understand the current status of wildlife diversity in the island. Pulau Tinggi was selected as the study site mainly because there are minimal studies about terrestrial animals on the island. This research will improve the species diversity survey conducted previously on herpetofauna (Escobar *et al*. 2003(b); Grismer 2006; Grismer 2011), Urothoe (Azman & Melvin 2011), plant (Turner *et al.* 1997), dugong (Louisa *et al.,* 2015), and seagrass (Jillian, 2011). Thus, the first study of volant mammals, non-volant large, medium, and small mammals, wildlife using camera trap, and insect was conducted. This study is significant as it contributes towards the species checklist. The current study is designed

to integrate animal diversity in Pulau Tinggi for conservation and management purposes.

The island in Johor is worth to be developed as a tourism destination. Studies related to wildlife tourism market is important for the development of a competitive and sustainable tourism industry. As mentioned by Moscardo and Saltzer (2004), the importance of understanding the market for wildlife tourism is for tourism managers to evaluate the type of tourists and localities in order to develop services and facilities for them. It is also for park managers to estimate the threshold level of use of the habitat and infrastructure needed for the programme to work (Moscardo & Saltzer, 2004). Wildlife tourism depends heavily on interpretation to support its ecological and economic benefits. To get the best experience of wildlife tourism, one must need to get accurate, relevant, interesting on-site experiences and off-site information through interpretation. Wildlife tourism aims for the sighting and seeing of wildlife.

Wildlife tourism in Malaysia is less active than Africa. The reason is that South-East Asia countries usually target wildlife in forest at terrestrial national parks and minimal studies were conducted in dense rainforest (Aihara *et. al.*,2016). This is because wildlife is not a popular attraction in this region and only a few studies have been conducted on Malaysian wildlife tourism such as 'Wildlife Tourism In Lower Kinabatangan, Sabah' (Natalie & Nair, 2013); 'Mammalian Wildlife Tourism In South-East Asian Tropical Rainforests: The Case Of Endau-Rompin National Park, Malaysia' (Aihara *et al.,* 2016); 'Man-Made Wildlife Tourism Destination: The Visitors Perspective on Lok Kawi Wildlife Park, Sabah, Malaysia.' (Sun, Johnny & Bakansing, 2014). In Malaysia, wildlife tourism is favourable in national parks that are home to diverse forest fauna. As new areas and species are becoming accessible, wildlife tourism has significant future potential in some countries (Higginbottom, 2004). However, it is challenging to find and observe wildlife in dense rainforests (Hill, Curtin & Gough, 2014; Knight, 2010; Hill & Gough, 2014). This study is important to contribute to the development of wildlife tourism in Malaysia, especially in this isolated island.

1.5 Scope of the study

The scope of study mainly involves the collection of data on animal diversity in Pulau Tinggi, which includes herpetofauna, volant mammals, non-volant mammals, wildlife in camera traps, and insects. Three nature trails were chosen to be developed as potential wildlife tourism hotspots during the preliminary survey. These nature trails were used by tourist, wildlife sampling were conducted in the potential hotspot. The total overall sampling period was from February until October 2019, specifically this study will follow the following scope:

1) Herpetofauna: Herpetofauna was carried out from February 2019 to October 2019. The purpose was to produce an updated checklist of herpetofauna in the island. Sample was collected using active catching method and drift fence pitfall trap.
2) Bats: Bats were caught by using mist nets from February to July 2019. 10 mist nets were set up each month. These traps were set up based on potential foraging trail of bats placed around well-established trails and moved at three to four-day intervals.
3) Wildlife in camera trap: Twenty-two cameras were employed between June 2019 and October 2019 throughout the waterfall of Gunung Semudu based on stratified randomised design, 22 individual sites were randomly chosen within a 500 x 500m grid square. Cameras were fixed on trees from a height of 0 to 0.5m using a bicycle cable lock and positioned at an optimum angle for sensor detection of multiple species. GPS was used to record the camera spots. The date, time, and location were automatically recorded in the camera traps. The targeted species for camera trap were medium and big mammals; however, all wildlife captured in camera trap was documented. Artificial salt lick was used to attract the animals. Additional research using camera trap was done in Kampung Sebirah in August.
4) Non-volant small mammals: Cage traps were used to collect non-volant small mammals. Pineapple, banana, salted fish, and peanut were used as baits to attract animals. The traps were placed randomly in the study area, mainly secondary forest and village area. Location and coordination of traps were marked, the cages were checked every morning and evening. Data on non-volants mammals were collect in February and August 2019.

5) Insect: Samples were collected from the forest area in Pulau Tinggi on three occasions (20-30 April, 1-10 May, and 20-30 June 2019). Various insect species were studied to document the first checklist of insect fauna in Pulau Tinggi. Research conducted using various scientific methods which included insect pitfall trap, light trap, sweep net, insect net, and active sampling. Specimens were dried and curated for identification.

The captured specimens were measured and the morphology of the live specimens was recorded and preserved for identification purposes (Joann *et al*., 2011). At the end of this study, the checklist for all species in the different animal groups was completed. The tourism products were tested using seven criteria of good new tourism product listed by Kueh (2006). The 7 criteria are (1) endemism, (2) rarity, (3) reliability of sightings, (4) morphological attractiveness, (5) behavioural enticement, (6) safety and (7) linkage to local cultures (Kueh, 2006). Wildlife tourism hotspots among the three nature trails were analysed based on the wildlife diversity data gathered. Locations that possess the most abundant and diverse wildlife were selected as hotspots.

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