DISTRIBUTION AND MORPHOMETRICS OF
Kalophrynus palmatissimus (KIEW, 1984) FROM AYER HITAM FOREST
RESERVE, SELANGOR AND PASOH FOREST RESERVE,
NEGERI SEMBILAN, MALAYSIA

MUHAMMAD FARIS BIN ABDUL AZIZ

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By

MUHAMMAD FARIS BIN ABDUL AZIZ

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfilment of the Requirements for the Degree of
Master of Science

August 2019
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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

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Kalophrynus palmatissimus (Kiew, 1984) FROM AYER HITAM FOREST RESERVE, SELANGOR AND PASOH FOREST RESERVE, NEGERI SEMBILAN, MALAYSIA

By

MUHAMMAD FARIS BIN ABDUL AZIZ

August 2019

Chairman : Dr. Marina binti Mohd. Top @ Mohd. Tah, PhD
Faculty : Science

A research study on an endemic frog species of Peninsular Malaysia, Kalophrynus palmatissimus (Kiew, 1984) (commonly known as Lowland Grainy Frog) at Ayer Hitam Forest Reserve (AHFR), Selangor and Pasoh Forest Reserve (PFR), Negeri Sembilan was carried out from November 2016 until September 2017. This leaf-litter frog species can be found in the lowland forests of Peninsular Malaysia including Pasoh Forest Reserve, Gombak Forest Reserve, Forest Research Institute Malaysia (FRIM), and Ayer Hitam Forest Reserve. The distribution of this species has severely declined and the quality of its habitat in Peninsular Malaysia also continues to decrease as suitable areas are being converted to non-timber plantations and undergo rapid development of infrastructure. This study was conducted to determine the distribution, population density, and morphometric and microhabitat structures of K. palmatissimus at AHFR and PFR. Fifteen and eighteen nocturnal 400 m transect lines with an interval distance of 20 m were used for frog surveys at AHFR and PFR, respectively. In addition, temperature, humidity, soil pH, wind, and light of different microhabitats were also recorded. A total of 34 and 31 individuals of K. palmatissimus were recorded at AHFR and PFR, respectively. The population density of K. palmatissimus recorded at AHFR was 5.31 individuals/km², whereas 6.02 individuals/km² was recorded at PFR. Fifteen morphometric traits of K. palmatissimus were measured. Most of the 15 morphometric traits of K. palmatissimus at AHFR and PFR positively correlated with each other. The AHFR’s mean snout-vent length (SVL) (37.00 mm) was larger than PFR’s mean SVL (30.29 mm). The AHFR’s mean SVL for male and female K. palmatissimus were 35.30 mm and 39.40 mm, respectively, whereas the PFR’s mean SVL for male and female K. palmatissimus were 28.60 mm and 33.50 mm, respectively. This species was abundantly found on the surface of forest litter (96.9 %), compared to sandy surface (1.5 %) and on the dead log (1.5 %). It was found that K. palmatissimus at AHFR and PFR highly preferred leaf litter with non-hairy/smooth type morphology as their habitats. The data collections from AHFR and PFR have significantly contributed to a better understanding of ecological distributions, morphometrics, and habitats of this species. This information could help future conservation programmes and management to protect this endemic species from extinction.

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TABURAN DAN MORFOMETRIK
Kalophrynus palmatissimus (Kiew, 1984) DARI HUTAN SIMPAN
AYER HITAM, SELANGOR DAN HUTAN SIMPAN PASOH, NEGERI
SEMBILAN, MALAYSIA

Oleh

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Ogos 2019

Pengerusi : Dr. Marina binti Mohd. Top @ Mohd. Tah, PhD
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Satu kajian penyelidikan mengenai satu spesies katak endemik di Semenanjung Malaysia, Kalophrynus palmatissimus (Kiew, 1984) (dikenali sebagai Katak Berbintik Tanah Pamah) telah dijalankan di Hutan Simpan Ayer Hitam (AHFR), Selangor dan Hutan Simpan Pasoh (PFR), Negeri Sembilan bermula November 2016 hingga September 2017. Spesies katak sesampah hutan ini boleh ditemui di hutan tanah pamah Semenanjung Malaysia termasuk Hutan Simpan Pasoh, Hutan Simpan Gombak, Institut Penyelidikan Perhutanan Malaysia (FRIM), dan Hutan Simpan Ayer Hitam. Taburan spesies ini telah berkurangan dan kualiti habitatnya di Semenanjung Malaysia juga terus merosot disebabkan habitat yang sesuai telah ditukar menjadi kawasan penanaman bukan kayu dan infrastruktur yang pesat. Kajian ini dijalankan untuk menentukan taburan dan kepadatan populasi, dan morfometrik dan struktur mikrohabitat K. palmatissimus di AHFR dan PFR. Lima belas dan lapan belas garisan transek sepanjang 400 m berselang dengan jarak 20 m digunakan untuk tinjauan katak, masing-masing di AHFR dan PFR. Selain itu, suhu, kelembapan, pH tanah, angin dan cahaya dari setiap habitat yang berbeza juga telah direkodkan. Sebanyak 34 dan 31 individu K. palmatissimus telah direkodkan, masing-masing di AHFR dan PFR. Kepadatan populasi K. palmatissimus yang direkodkan di AHFR adalah 5.31 individu/km², manakala 6.02 individu/km² di PFR. Lima belas ukuran morfometrik K. palmatissimus telah diambil. Kebanyakan daripada 15 ciri-ciri morfometrik K. palmatissimus di AHFR dan PFR berkorelasi positif antara satu sama lain. Nilai purata ‘snout-vent length’ (SVL) K. palmatissimus di AHFR (37.00 mm) lebih besar berbanding PFR (30.29 mm). Nilai purata SVL bagi individu jantan dan betina K. palmatissimus di AHFR masing-masing, adalah 35.30 mm dan 39.40 mm, manakala nilai purata SVL bagi individu jantan dan betina K. palmatissimus di PFR adalah 28.60 mm dan 33.50 mm. Spesies ini banyak ditemui di atas permukaan sesampah hutan (96.9 %), berbanding di atas permukaan pasir (1.5 %) dan di atas kayu mati (1.5 %). Didapati K. palmatissimus di AHFR dan PFR lebih suka mendiami sesampah hutan dengan struktur morfologi yang tidak berbulu/licin sebagai habitatnya. Data yang dikumpulkan di AHFR dan PFR telah menyumbang kepada pemahaman yang lebih baik mengenai ekologi taburan, morfometrik dan habitat spesies ini. Maklumat ini dapat membantu program pemuliharaan dan pengurusan masa depan untuk melindungi spesies endemik ini daripada kepupusan.
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I certify that a Thesis Examination Committee has met on 20 August 2019 to conduct the final examination of Muhammad Faris bin Abdul Aziz on his thesis entitled "Distribution and Morphometrics of Kalophrynum palmatissimus (Kiew, 1984) from Ayer Hitam Forest Reserve, Selangor and Pasoh Forest Reserve, Negeri Sembilan, 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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<tr>
<td>%</td>
<td>Percentage</td>
</tr>
<tr>
<td>°C</td>
<td>Degree Celcius</td>
</tr>
<tr>
<td>a.s.l</td>
<td>Above sea level</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of variance</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeters</td>
</tr>
<tr>
<td>ED</td>
<td>Eye diameter</td>
</tr>
<tr>
<td>EN</td>
<td>Eye-nostril distance</td>
</tr>
<tr>
<td>FL</td>
<td>Foot length</td>
</tr>
<tr>
<td>FLL</td>
<td>Forelimb length</td>
</tr>
<tr>
<td>ha</td>
<td>Hectares</td>
</tr>
<tr>
<td>HAL</td>
<td>Hand length</td>
</tr>
<tr>
<td>HL</td>
<td>Head length</td>
</tr>
<tr>
<td>HW</td>
<td>Head width</td>
</tr>
<tr>
<td>IND</td>
<td>Internarial distance</td>
</tr>
<tr>
<td>IOD</td>
<td>Interorbital distance</td>
</tr>
<tr>
<td>km</td>
<td>Kilometers</td>
</tr>
<tr>
<td>lx</td>
<td>Lux</td>
</tr>
<tr>
<td>m/s</td>
<td>Meter per second</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeters</td>
</tr>
<tr>
<td>N</td>
<td>Total abundance</td>
</tr>
<tr>
<td>p</td>
<td>Probability</td>
</tr>
<tr>
<td>Q</td>
<td>Probability</td>
</tr>
<tr>
<td>r</td>
<td>Correlation coefficient</td>
</tr>
<tr>
<td>RH</td>
<td>Relative humidity</td>
</tr>
<tr>
<td>SL</td>
<td>Snout length</td>
</tr>
<tr>
<td>SVL</td>
<td>Snout-vent length</td>
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<td>TD</td>
<td>Tympanum diameter</td>
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<td>THL</td>
<td>Thigh length</td>
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<tr>
<td>TL</td>
<td>Tibia length</td>
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<td>UEW</td>
<td>Upper eyelid width</td>
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<td>$X^2$</td>
<td>Chi square</td>
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CHAPTER 1

INTRODUCTION

1.1 General Background

The word ‘anuran’ originates from the Greek word: a- + oura tail. The order Anura (also called Salientia) consists of frogs and toads as all of them lack tails at the adult stage. Frogs and toads are ancient animals that have been around since 200 million years (Norhayati, 2017). The body of an adult anuran is commonly described by a stout body, bulging eyes, cloven tongue, and limbs folded beneath (Stuart et al., 2004). Frogs generally have moist and smooth skin, whereas toads have warty and dry skin (Norhayati, 2017). Anurans are members of the zoological class called Amphibia that have jumping abilities and croaking sounds. They can be found around the world and are among the most diverse wild animals in the world.

The habitat of amphibians including anurans is the tropical rainforest, where it is numerous and diverse. Most of them are dependent on water sources such as ponds, rivers, streams, rain pools, water holes, ditches, and water puddles (Norhayati, 2017). Anurans prey on a wide range of vertebrates, ranging from medium- to large-sized, and act as predators of various insects and other small vertebrates (Yong, Ahmad & Helpsi, 2013).

Malaysia is rich in amphibian diversity with about 267 species including the caecilians with eight families, namely Bufonidae, Ceratobatrachidae, Dicroglossidae, Megophryidae, Microhylidae, Ranidae, Rhacophoridae, and Ichthyophiidae (Norhayati, 2017). Anurans are among the most specious group of vertebrates and can provide valuable data to monitor biological diversity in Malaysia (Chan, Daicus & Norhayati, 2010). In Borneo, more than 180 species of frogs have now been found on the island and the number continues to grow (Inger, Stuebing, Grafe & Dehling, 2017). The majority of anurans are adapted to primary and secondary forests. Most of the species take advantage of human-influenced ecosystems and appear to tolerate disturbed habitats (Inger, Voris & Voris, 1992).

The genus *Kalophrynus* is reported to contain 25 nominal species with the greatest diversity in Borneo (Zug, 2015). Members of this genus are distributed from Northeast India, Northern Bangladesh, North Central Myanmar, Peninsular Myanmar, Southeast Asia (Laos, Thailand, Vietnam, and Cambodia), Southern China, Sumatra, Borneo, Peninsular Malaysia, and the Philippines (Zug, 2015). Six species have been reported in Peninsular Malaysia, namely *Kalophrynus limbooliati*, *K. palmatissimus*, *K. pleurostigma*, *K. robinsoni*, *K. tiomanensis*, and *K. yongi* (Zug, 2015). The known localities for these species in Peninsular Malaysia are usually at relatively low elevations, and the known highest record was 1,006 m a.s.l. for *K. robinsoni* (Dring, 1979).
This study focused on *K. palmatissimus* (Lowland Grainty Frog), which is a leaf-litter frog species that can be found in lowland forests. This species is from the family Microhylidae and can be found in forest litter on the forest floor (Sukumaran, 2004). It is usually dark brown in colour with dark blotches on the dorsal skin, and brown in colour at the throat and chest (Sukumaran, 2004).

The Ayer Hitam Forest Reserve (AHFR), Selangor and Pasoh Forest Reserve (PFR), Negeri Sembilan are lowland dipterocarp forest and secondary forest. Ayer Hitam Forest Reserve (AHFR), Selangor is situated about 20 km from Universiti Putra Malaysia and 45 km from Kuala Lumpur. It is near the Federal Territory of Putrajaya, Bandar Kinrara towards the north, Bandar Puteri to the west, and Taman Desaminium at the east. Ayer Hitam Forest Reserve is made up of Compartment 1, 2, 12, 13, 14 and 15 of the forest reserve, which covers 1,248 ha. The AHFR has undergone some disturbances over the last few decades, which led to a change in the forest’s landscape undergrowth and affected the habitat and population of fauna (Paiman & Amat Ramsa, 2007; Shamsudin, Mohd Farhan & Kamarulizwan, 2015).

The Pasoh Forest Reserve (PFR), situated in Simpang Pertang, Negeri Sembilan, is an internationally recognised site for tropical forestry research. A well-equipped field research centre known as the Pasoh FRIM Research Station (PFRS) within the reserve is managed by the Forest Research Institute Malaysia (FRIM). The forest is connected to a various range of hills (the highest point is Bukit Palong at 645 m). Pasoh Forest Reserve is a dipterocarp forest that is surrounded by palm oil plantations and has been subjected to logging since the 1970s, sparing 600 ha of virgin forest. Loggings over the years have caused degradation of habitats and population of animals in this forest. The distribution of *K. palmatissimus* has severely declined, in which its available habitat is small and limited, as most suitable areas are being converted to non-timber plantations and undergoing rapid development of infrastructure (Norsham, Sukumaran & Tzi Ming, 2004). It is imperative that these areas receive strong protection and management.

### 1.2 Problem Statement

*Kalophrynus palmatissimus* is listed as an endangered species because the extent of its occurrence is less than 5,000 km² (IUCN, 2017). The distribution of this species has severely declined and the quality of its habitat in Peninsular Malaysia also continues to decrease (Norsham et al., 2004). It is threatened by the development of human settlements, commercialisation and industrial areas, annual and perennial non-timber crops, and road construction. Meanwhile, mining and quarrying for granite could be a potential future challenge faced by *K. palmatissimus* for the subpopulation occurring in the Panti Forest Reserve (IUCN, 2018).

A similar challenge is also faced by *Kalophrynus pleurostigma* as the main threat to this species is deforestation (logging and wood harvesting) (IUCN, 2018). *Kalophrynus interlineatus* is threatened by destruction and degradation of breeding
habitats caused by logging and fire suppression in China (IUCN, 2018). *Kalophrynus palmatissimus* is known to be present only at PFR, the Gombak Forest Reserve, FRIM, and Templer's Park (Templer FR) in Selangor (IUCN, 2017), and AHFR, Puchong, Selangor (Muhammad Faris, Mohammad Nur Firdaus, Shamarina & Marina, 2016). According to the Wildlife Conservation Act 2010, it is a protected species. However, there is still a lack of information about the habitat structure and distribution of this species in Malaysia, especially for AHFR and PFR. Therefore, this research was conducted in order to study the ecology and biology of *K. palmatissimus* at AHFR and PFR to assist in better management decisions.

1.3 Objectives

The objectives of this study were:

1. To determine the distribution and population density of *Kalophrynus palmatissimus* at two forest reserves; AHFR and PFR.
2. To examine the morphometrics of *Kalophrynus palmatissimus* at AHFR and PFR.
3. To determine the relationship between habitat types and distribution of *Kalophrynus palmatissimus* at AHFR and PFR.
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