DETERMINATION OF FOREST TREES STRESS IN 1 ha PLOT DIPTEROCARP FOREST AT GUNUNG BASOR FOREST RESERVE

by

NUR SHUHADAH BINTI AZAHARI

A report submitted in fulfilment of the requirements for the degree of Bachelor of Applied Science (Natural Resources Science) with Honours

FACULTY OF EARTH SCIENCE

UNIVERSITI MALAYSIA KELANTAN

2019

FYP FSB

DECLARATION

I declare that this thesis entitled " Determination of forest trees stress in 1 ha plot of dipterocarp forest at Gunung Basor Forest Reserve" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name :

Date :

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

APPROVAL

I hereby declare that I have read this thesis and in our opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Applied Science (Natural Resources Sciences) with Honors"

Signature : ……..

Name of Supervisor :

Date : ……..

FYP FSB

UNIVERSITI MALAYSIA KELANTAN

FYP FSB

ACKNOWLEDGEMENT

I am very grateful to Allah S.W.T for His willing and blessing. Alhamdulillah, I have completed my final year project entitled "Determination of forest trees stress in 1 ha plot dipterocarp forest at Gunung Basor Forest Reseve successfully.

First of all, it was a great pleasure to address people who helped me throughout this project to enhance my knowledge and practical skill especially my supervisor, Dr. Norashikin Binti Mohd Fauzi for her directly contribution by always giving comments, suggestions and ideas in order to ensure that this project runs smoothly. With her time and unfailing support, it helped me a lots in process of researching and writing this thesis.

My gratitude was extended to Kelantan Forestry Department for granting the permit to conduct sampling in Gunung Basor Forest Reserve.

Besides that, thank you to Faculty of Earth Science as giving the permission and providing me with all the necessary facilities for the research. Next, thank you Miss Hasimah Binti Hassan and all laboratory assistants for helped me during conducted my project.

Furthermore to all lectures, my beloved teammates Syahmi Bin Hanafi, Rabaitul Athirah Binti Ahmad Azhar, Maizatul Afiqah Binti Mohd Zaki, Nur Syafira Binti Mohamad Pazol, Nik Norain Binti Nik Hassan for helping me a lot especially during my sampling and all final year students from Nature Resources Science Program for their support. This accomplishment would not have been possible without them.

I would like to express my appreciation to my parents, Azahari Bin Shariff and Ismawati Binti Ismail for their encouragement and moral support as well as financial support from the beginning until the end of my project.

UNIVERSITI MALAYSIA KELANTAN

Determination of forest trees stress in 1 ha plot dipterocarp forest at Gunung Basor Forest Reserve

FYP FSB

ABSTRACT

The information on forest trees at the east coast of Malaysia particularly in Kelantan is scanty. No prior studies have been carried out to determine vegetation stress in Kelantan. This study was conducted to determine the vegetation stress in 1 ha plot of dipterocarp forest at Gunung Basor Forest Reserve. Vegetation stress may be defined as any factor that reduces productivity below the optimum value. For the vegetation stress, the measured parameters were ambient temperature, soil pH and soil moisture content. The temperature of 137 individual trees found in 1 ha plot was using infrared thermometer. The highest temperature was 27°C which at the number of tree 67 with dbh value was 7.04 cm. The temperature for these trees was higher than others because of the location was exposed to the sun compared to others trees. The lowest temperature was 21.1 °C with dbh value 10.19 cm. The pH value at Gunung Basor was within the range of 6.0 to 7 but mostly 6.5. This finding indicated that the soil pH in Gunung Basor still in optimum range level of pH value. Eighteen sample of soil were taken randomly from study 1 ha plot dipterocarp to measure the soil moisture contents. The highest soil moisture content was 68.41% with tree temperature was 22°C while the lowest soil moisture content was 10.63 % which tree temperature was 23.7°C.This study is vital in providing data about plant stress that was affected by ambient temperature, soil pH and soil moisture content of trees. In addition, this study also acts as a guideline for forestry department and in agriculture sector when dealing with drought.

UNIVERSITI
MALAYSIA
KELANTAN

Penentuan tekanan pokok-pokok di hutan dalam 1 hektar hutan dipterokarp di Hutan Simpan Gunung Basor

ABSTRAK

Maklumat mengenai tekanan pokok-pokok di hutan pantai timur Malaysia terutamanya di Kelantan adalah kecil. Tiada kajian terdahulu yang dilakukan untuk menentukan tekanan tumbuhan di Kelantan. Kajian ini dijalankan untuk menentukan tekanan tumbuhan dalam 1 hektar hutan dipterokarp di Hutan Simpan Gunung Basor. Tekanan vegetasi boleh ditakrifkan sebagai faktor yang mengurangkan produktiviti di bawah nilai optimum. Untuk tekanan tumbuhan, parameter yang diukur adalah suhu ambien, pH tanah dan kandungan lembapan tanah. Suhu 137 pokok individu yang terdapat di 1 ha plot diukur menggunakan termometer inframerah. Suhu tertinggi adalah 27°C yang pada bilangan pokok 67 dengan nilai dbh adalah 7.04 cm. Suhu untuk pokok ini lebih tinggi daripada yang lain kerana lokasi terdedah kepada matahari berbanding dengan pokok lain. Suhu terendah ialah 21.1°C dengan nilai dbh 10.19 cm. Nilai pH di Gunung Basor berada dalam lingkungan 6.0 hingga 7 tetapi kebanyakannya 6.5. Dapatan ini menunjukkan bahawa pH tanah di Gunung Basor masih berada di tahap optimum nilai pH. Lapan belas sampel tanah diambil secara rawak dari plot dipterocarp plot 1 untuk mengukur kandungan lembapan tanah. Kadar kelembapan tanah tertinggi adalah 68.41% dengan suhu pokok 22°C manakala kandungan kelembapan tanah terendah adalah 10.63% yang suhu pokok adalah 23.7°C. Kajian ini adalah penting dalam memberikan data tentang tekanan pokok-pokok yang dipengaruhi oleh suhu ambien, tanah pH dan kandungan lembapan tanah pada pokok. Di samping itu, kajian ini juga bertindak sebagai garis panduan bagi jabatan perhutanan dan sektor pertanian ketika menghadapi kemarau.

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

TABLE OF CONTENTS

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

LIST OF TABLE

FYP FSB

UNIVERSITI MALAYSIA KELANTAN

LIST OF FIGURES

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

LIST OF SYMBOLS

°C	Degree Celsius
=	Equal to
×	Multiplication
%	Percentage
-	Subtraction

FYP FSB

UNIVERSITI MALAYSIA KELANTAN

LIST OF ABBREVIATIONS

Cm	Centimetre
dbh	Diameter Breast Height
ha	Hectare
GPS	Global Positioning System
m	Meter

FYP FSB

UNIVERSITI MALAYSIA KELANTAN

CHAPTER 1

INTRODUCTION

1.0 Background of study

Forest trees stress may be defined as any factor that reduces productivity below the optimum value. Forest trees stress can be caused by various biotic and abiotic factors the effects could be detrimental to the overall growth and development of plants as well as the environment. Stresses symptoms may include stunted growth, wilting, reduce shoot growth and chlorosis. However, stress may result from a change in the physic-chemical condition of the environment, pests, and pathogen. The environmental factors that can cause plant stress are divides into two factors which are biotic and abiotic. Biotic environmental factors are an infection or mechanical damage by herbivore or trampling, as well as effects of symbiosis or parasitism. Abiotic environmental factors include temperature, humidity, and light intensity, the supply of water and minerals, and carbon dioxide. These are the parameters and resources that determine the growth of a plant the primary factor that can affect the rate of plant development is temperature. When the temperature expected was hotter with climate change, the potential for temperature increases is high for plant development (Jerry L. & John H., 2015). Forest trees stress can be caused by various biotic and abiotic factors the effects could be detrimental to the overall growth and development of trees as well as the environment. Stresses symptoms may include stunted growth, wilting, reduce shoot growth and chlorosis. Dry matter production in trees are subject to a variety of environmental constraints,

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

the most frequent of which are related to shortages and excesses in the supply of solar energy, water, and a mineral nutrient.

Plants species and even different genotypes of the same species may different effect upon vegetation composition. Over the course of a year, several stresses may operate intermittently in the same habitat, analyses of the impact of stresses may become quite complex (J. Philip, 2016)

In general, Malaysia forest types are divided into lowland dipterocarp, hill dipterocarp, upper hill dipterocarp, oak laurel forest, montane ericaceous forest, peat swamp forest and mangrove forest. Mostly, forest in Malaysia is dominated by Dipterocarpaceae family which is known as dipterocarp forests. Lowland dipterocarp forest is forest located below 300 meters altitude and consists of a vast variety of tree species while hill dipterocarp forest elevation more than 600 meter. The main species found in this forest type are dipterocarpaceae such as Meranti, Balau, and Kapur. Dipterocarp grows tall and large to cover rainforest canopy.

In this study, the first attempt was to determine the forest trees stress in 1 ha plot at hill dipterocarp at Gunung Basor Forest Reserve.

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

1.1 Problem Statement

Forest trees stress is any unfavorable condition or substance that affects or blocks a plants metabolism, growth or development, is to be regarded as stress (Lichtenthaler, 1998). Forest trees stress can affect the various natural and anthropogenic stress factors. Meanwhile, In Kelantan the information relating to forest trees stress in the particular dipterocarp forest is rarely documented and there have no established data been executed on forest trees stress. As drought regimes change, the ability to quantify and predict the impacts on forests is critical to develop and implement management actions for drought resilience and adaptation. So, the study will be conducted to determine the forest trees stress at Gunung Basor Forest Reserve Jeli, Kelantan by using an infrared thermometer.

1.1 Objective

To determine the forest trees stress in 1 ha plot dipterocarp forest at Gunung Basor Forest Reserve.

1.3 Scope of study

In this study, the primary focus was to determine of forest trees stress since the temperature nowadays was interchangeable. The study was conducted mainly in hill dipterocarp forest and encompass of 1 ha plot of Gunung Basor. For the forest trees stress, the measured parameters were ambient temperature, soil pH and soil moisture content.

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

1.4 Significant of study

The finding of this study was provided information about the forest trees stress. This study also provided knowledge about plant stress that was affected by ambient temperature, soil pH and soil moisture content of plants species. Besides that, the data from this study could be used as a guideline for forestry department and in agriculture sector when dealing with drought.

Therefore, by using an infrared thermometer in this study, the advantage of using this method yielded the accuracy of the result with full coverage of all the forest trees in 1 ha plot dipterocarp forest. Furthermore, the result of this study may be used for further research. Hence, it was hoped that the future study will find an effective way to reduce the forest trees stress in dipterocarp forest at Gunung Basor Forest Reserve.

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

CHAPTER 2

LITERATURE REVIEW

2.1 Concept of plant stress

The stress usually defined as an external factor that exerts a disadvantageous influence on the plant. In most cases, stress is measured in relations to plant survival, crop yield, growth (biomass accumulation) or the primary assimilation process (carbon dioxide and mineral uptake) which related to overall growth.

According to (Souza & Cardoso, 2003) stress in plants is a singular phenomenon caused by external disturbances that disrupt the hierarchical organization of the system, affecting the stability homeostasis and decreasing the life span or decreasing the reproduction capacity of plants. Thus, an actual stress condition is a singularity in the plant development caused by strong oscillations in the environment disturbing plant survival. In this definition, stress is considered as a singular phenomenon since plants, and any living beings, can use environmental noise to improve their own survival. So the (Souza & Cardoso, 2003) was conducted study with objective to contribute to the definition of stress, using a hierarchical approach.

Plants can also adapt to different environmental conditions to mitigate the effects of stress, such as high or low light growth conditions at any particular point in time (Lichtenthaler, 1998)

The concept of stress is intimately associated with that of stress tolerance, which is the plant's fitness to cope with an unfavorable environment. An

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

environment that stressful for one plant may not stressful for another. According to (Lichtenthaler, 1998) In the past 10 years, an immense increase has occurred in the number of scientific publications found in journals of botany, plant physiology, ecophysiology, and plant biochemistry dealing with plant stress and plant stress detection. Indeed, a huge number of stressors with various methods of activity frequently beside, other than particular impacts, the same or at least similar as same as general reactions of and in the plant. Plants are adjusted and for the most part, react adaptably to such relentlessly re-happening changes of cell metabolism and physiological activity as a reaction to changing natural conditions. In botany, the expression "strain" is sometimes utilized and frequently not known. The strain is as a rule supplanted by pressure reactions. In light of this pressure idea, obviously a plant can develop under strain and long-term strain without intense harm. Indeed, with particular strain and constrained imperatives, the plant can also make due under persistent stress contrast. This is archived, be that as it may, by much decreased metabolic movement and development rate.

2.2 Drought stress in plants

Drought is the one the major restrains limiting crop production worldwide. According to (M Othman, et al., 2016), there is no direct definition of droughts and it is hard to measure as there are various ways and indices that can be used to define drought. Generally, drought can be classified into four groups that are meteorological drought, agriculture drought, hydrological drought and socioeconomic drought. Drought destroys normal growth, disturbs water relations and reduces water use efficiency in plants. However, plants have a variety of physiological and biochemical

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

response to cellular and whole organism levels, making it a more complex phenomenon.

Plants exhibit a range of mechanisms to prevent drought, such as reduced water loss by increased diffusive resistance, increased water uptake with prolific and deep roof systems and smaller and succulent leaves to reduce transpiration loss (Farooq, et al., 2009). Then, nutritional imbalance affecting under drought conditions depresses plant growth and therefore productivity by affecting nutrient uptake, transport, and distribution (Rouphael, et al.,2012). The scarcity of water is a severe environmental limit to plant productivity. The drought-induced loss in crop yield probably exceeds losses from all other causes, since both the severity and duration of the stress are critical.

2.3 Factors that contributing to forest trees stress

According to the (Haferkamp, 1987) plant productivity are affected by the environment during all phase of growth development and the factors were discussed with stress on water, temperature, light, atmosphere, nutrients, fire and grazers. Plants are bound to their living space, they can't escape from the numerous threatening natural or anthropogenic stressors, and in this way require uncommon systems of stress prevention and stress adaptation. Abiotic stress is known as environmental conditions that reduce growth and yield below optimum levels. Water required by all living organisms. Plants can be stressed by lack of moisture as well as an excess of moisture. The signage of plants that under water stress are reduced leaf size and internode length, stunned tops of plants, suppresses root growth in proportion to shoot growth, delayed time of flowering and fruit, reduced seed

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

number, size, and availability and halted growth and development with severe stress. Next, the optimum temperature for growth rate occurs between 20 degree Celsius and 25 degree Celsius for most temperate festucoid grasses (Cooper & Tainton, 1968). The ability of different plants to survive extreme temperature depend both on their innate physiology and on the degree to which they have been acclimated by process of hardening (Jones, 2013). Besides that, plants can also react to natural changes by exceptional long-term adjustments to high-light or low-light development conditions by changing different parameters, for example, size and thickness of leaves, number, and thickness of stomata, ultrastructure, and capacity of the chloroplasts by expanding the levels of photoprotecting enzyme and of stress metabolites. Such adjustments may take put inside 1 or 2 days or in one week at the most recent.

2.4 Plants nutrient

The mineral nutrients originate from the soil, are softened in water and retained through a plant's roots. There are not generally enough of these nutrient in the soil for a plant to grow healthy. The primary nutrients are nitrogen (N), phosphorus (P), and potassium (K).Nitrogen being a major food for plants is an essential constituent of protein build from amino acids that involves in catalyzation of chemical responses and transportation of electrons and chlorophyll enable the process of photosynthesis present in many major portions of the plant body. Nitrogen plays a most important role in various physiological processes. It imparts dark-green colour in plants, promotes leaves, stem and other vegetative part's growth and development. Moreover, it also stimulates root growth. Deficiency of nitrogen causes

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

reduced growth, appearances of chlorosis. Changing of the green colour into the yellow colour of leaves, and appearances of red and purple spots on the leaves, restrict lateral bud growth from which leaves, stem, and branches develop. Nitrogen is primarily absorbed from roots and leaves. Phosphorus (P) is fundamental to every single living life form. Plants must have phosphorus for ordinary development and development. Phosphorus assumes a part of photosynthesis, respiration, energy store and exchange, cell division, cell growth and a few different procedures in plants. A plant must have a phosphorus to entire its ordinary generation cycle. Phosphorous deficiency is not exceptionally self-evident, yet one can recount its quality if plants neglect to develop to their ordinary size or take too long to develop. Lastly, according to (Prajapati & Modi, 2012) many plant physiologists consider potassium second only to nitrogen in importance for plant growth. Potassium is second to nitrogen in plant tissue levels with ranges of 1 to 3% by weight. Potassium (K) increases crop yield and improves quality. It is required for numerous plant growth processes.

2.5 Dipterocarp forest

The physiological characteristics of the dominant tree species in the tropical rainforest mainly belonging to dipterocarps as well as the environmental conditions especially for the light in the forest were studied to establish the silvicultural system for the forest regeneration in tropical South Asia (Sasaki, 2008). Temperature, rainfall, and extreme weather have been indicated to affect the phenological patterns and forest productivity by shifting flowering and fruiting seasons and patterns, as well as crop production. Dipterocarpaceae are high-value trees for both timber and

non-timber forest products. This study aims to determine the response of phenological patterns of flowering and fruiting of Dipterocarps to climate variability. Temperature, rainfall, and extraordinary climate have been demonstrated to influence the phonological patterns and forest efficiency by moving blooming and fruiting seasons and as well, and also trim generation. Dipterocarpaceae is a high amount of trees for both timber and non-timber timberland items. The implication of this study is discussed with reference to climate change, and conservation of habitat with will show the activities will be affected the place which the vegetation stress. Most of the dipterocarp trees at Gunung Basor exposure to hazard from anthropogenic activity that happens at the Gunung Basor.

2.6 Forest Stratification

Based on the previous study by (Parker & Brown, 2000) Stratification is layering and that used by ecologists to define the simultaneous change and management they see when coming upon into the forest canopy. Besides that, it generally declares that there can be different things like structure, species or environment at a different elevation in the canopy to a degree that might define attribute zones and canopies can differ in the organization. The basic concept of the forest ecology is vertical stratification and animal communities. The layers of vegetation in a rainforest increases the number of spaces available for animals to live in. some. The layers of the rainforest are emergent, canopy, understory and forest floor. The top layer and consist of the tallest trees are called as the emergent. The trees that found at this layer are received full sunlight but exposed to strong wind and high temperature. Besides that, there are some spaces between the trees which allow

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

the sunlight to reach the next layer. The next layer of the rainforest is a canopy. Canopy layer consists of lower-growing trees and their leaves and branches interlock to form a crown or roof for the forest. After that, the other layer of the rainforest is understory. This layer is not as dense, as it receives sunlight under the canopy. It consists of smaller trees such as palm that struggle to grow to reach the light. Lastly, the layer that found in the rainforest is forest floor or known as shrub layer. In this layer, it consists of small trees like a shrub. The characteristic is short, woody plants that have more than one stem because the canopy and understory filter out so much light so the shrub layer can be quite sparse. Since the light is hardly any sun to reaches this area, the forest floor begins to decay quickly. This is the reason why it can be quite easy to walk through a rainforest.

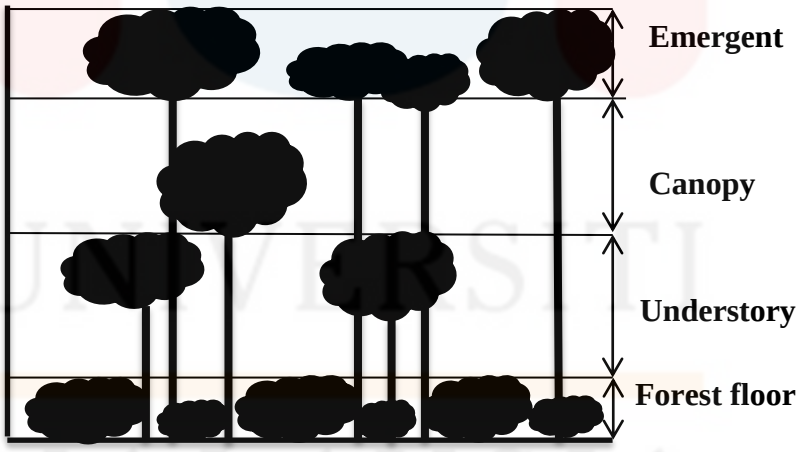


Figure 2.1: Layers of Rainforest

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

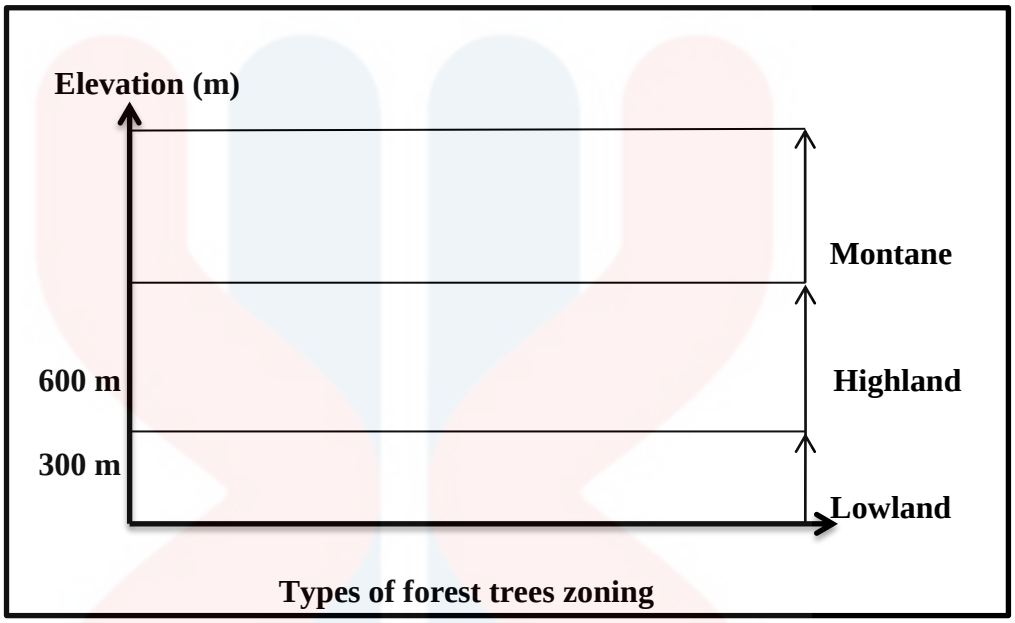


Figure 2.2: Elevation of different type of forest trees zoning at standard height

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

CHAPTER 3

MATERIALS AND METHOD

3.1 Study Area

The study area was carried out at Gunung Basor Reserved Forest Jeli Kelantan. It was located in Kelantan Malaysia. The latitude of Gunung Basor 50 35'57.12" and longitude 1010 48"31.32. About approximately 40,613 ha and 34,763 ha area of Gunung Basor was gazetted as permanent forest reserve. The soil type varies according to the terrain conditions. The average maximum and minimum temperature of Gunung Basor is 32°C and 25°C with mean annual rainfall of 2750-3000 mm. Generally, there were three type of zoning forest of Gunung Basor Forest Reserve which lowland dipterocarp, hill dipterocarp, and montane forests. In addition Gunung Basor was the forest reserve that still keeps most of their wilderness criteria and ecosystems.

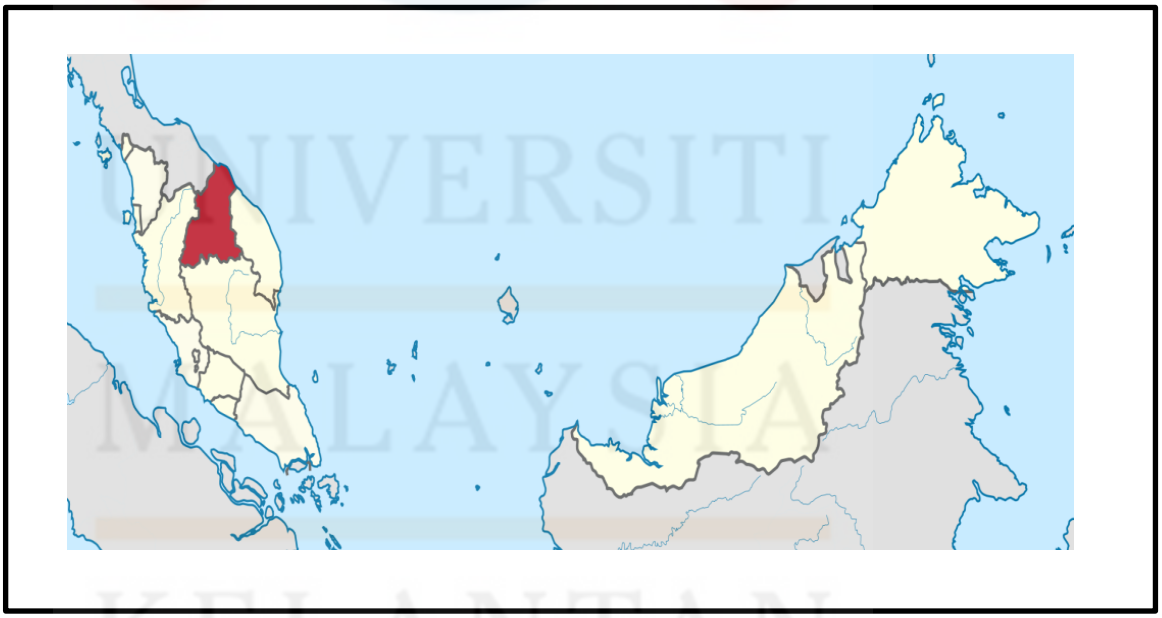
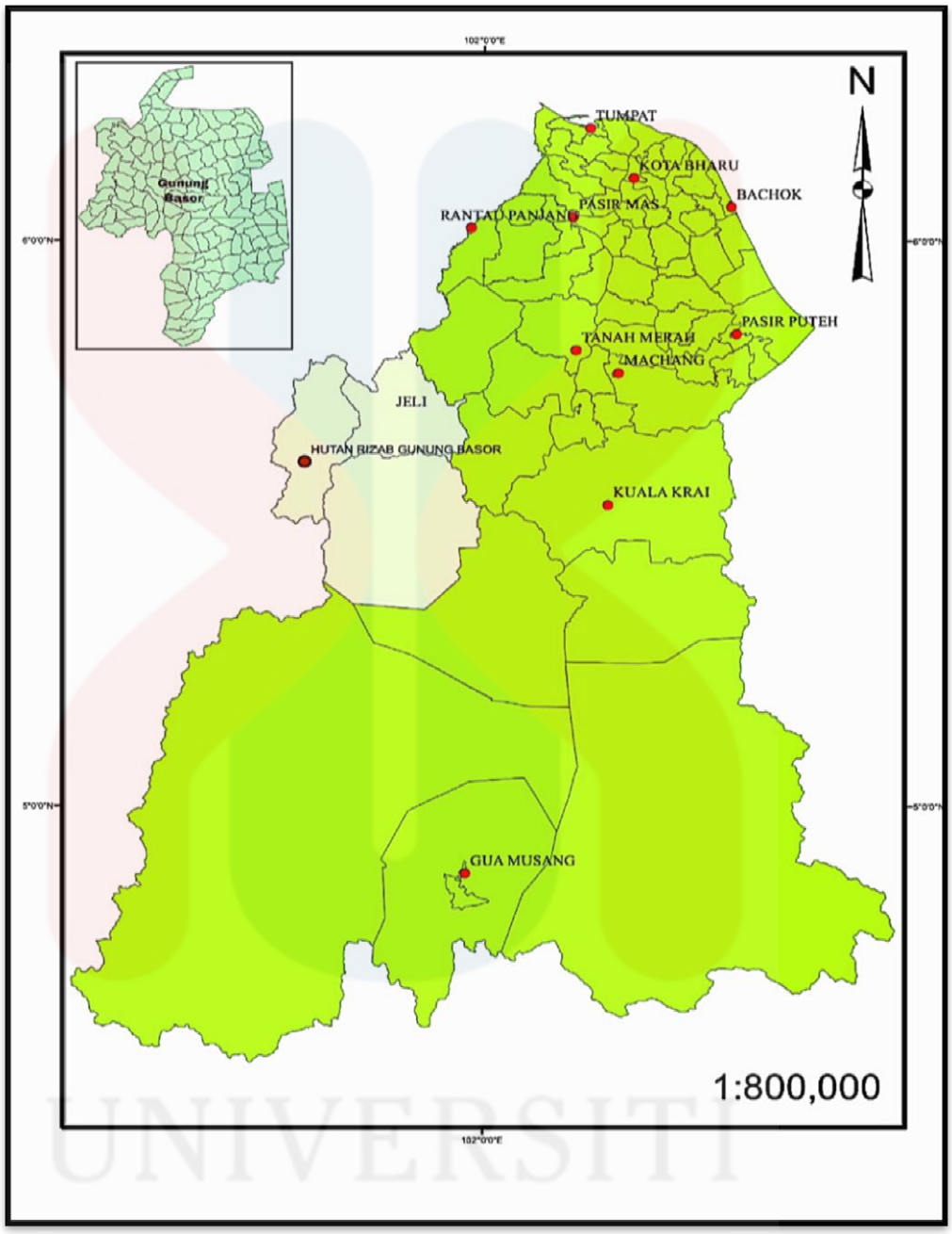


Figure 3.1: Location of Kelantan in Malaysia



Sources: Arcgis map software

Figure 3.2: Map of Gunung Basor

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

3.2 MATERIALS

When conducting this study, the materials were divided into 2 parts which were sampling materials and identification. Table 3.2 showed the list of the materials were used in this study.

Table 3.2: List of materials

	Material	Description
Sampling material	Infrared Thermometer 	The infrared thermometer was used to detect the temperature for each of the trees

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

	Red Tape 	To mark 1ha area that had received the research attention
	GPS garmin 	To record and resolve accurately the located quadrat altitudes of each plot

FYP FSB

	Ziplock Plastic bag 	To keep the soil specimen before brought to the laboratory
	Soil meter  Tape Meter 	To measure the temperature, soil moisture, and PH Tool used for site plotted and marked the 1ha plot of Gunung Basor

	Scales  	To weight the soil sample in the laboratory
	Knife 	To ensure the study area was cleared from bush

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

3.3 METHODOLOGY

Overall, there was significance work process involved to complete this study. Firstly, preliminary study was done as the indirect method from desk study. It was done by collecting data from literature review, study of vegetation stress and filed preparation for field activity later. This was followed with the preparation of list of materials and equipment needed for the filed work. Figure 3.2 shows the study flow chart

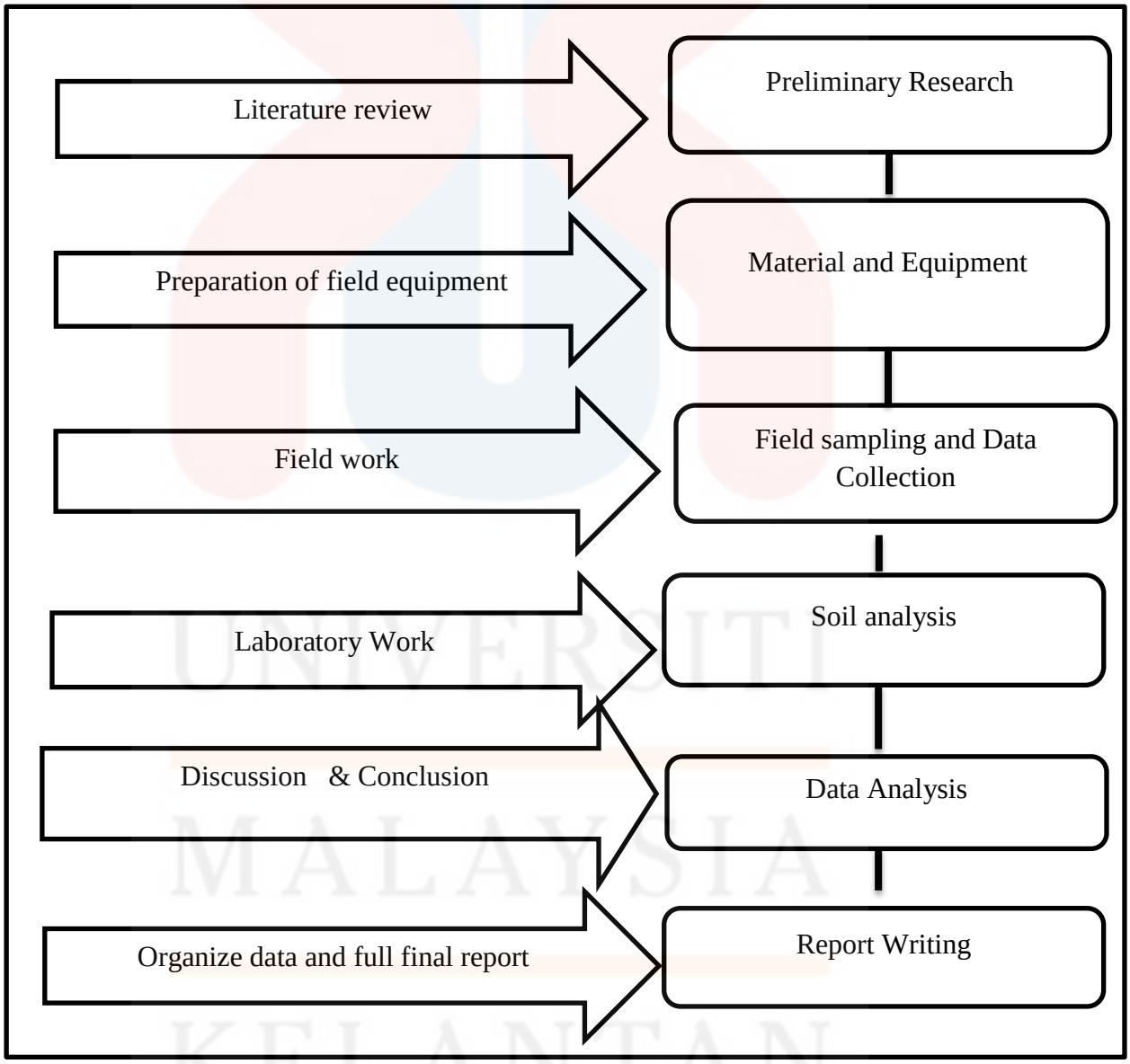


Figure 3.3: Research flow chart

3.3.1 Sampling technique

Figure 3.3: Plot of 1 ha dipterocarp forest

The sampling technique was aimed to generate a numerical description of the real system wish to analyze (Wildi, 2010).

This study was carried out during the dry season or also known as the hot season at Gunung Basor by referring to the data obtained from Methodology Department of Kelantan State. The selected area was about 1.0 ha plot of dipterocarp forest which a rectangular shape. A geographical positioning system (GPS) was used to record location and resolve the altitudes and position of each number of trees that were plotted. The infrared thermometer was used to detect the temperature for each of the trees.

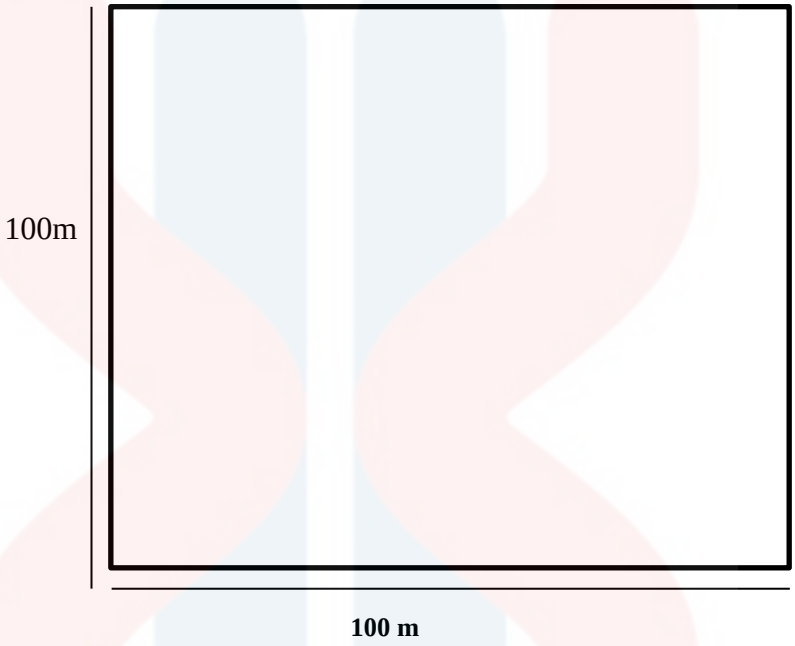


Figure 3.4: Plot of the1ha area

3.3.2 Infrared Thermometer

Figure 3.5 : Measured trees temperature using infrared thermometer

An infrared thermometer is rapid, reliable instruments for measuring foliage temperature. The infrared thermometer provides a technique for the remote detection of stress in all types of plants (Hatfield, 1990). By using this method, the accuracy to detect plant stress was measured. Infrared thermometers show the average temperature of all objects included in their field of view. (Fuchs, 1990) Besides that, the importance of plant temperature is to provide important information for crop management (Hadfield, 2015)

3.3.3 Soil analysis

Figure 3.6: Measured soil moisture content in the laboratory

The "vitality" of plants and vegetation represents a combination of different factors. When plant species and plant communities are not optimally adapted to the existing phenological environment and its hydrological and chemical features, then they might show various indications of stress. Typical stress factors are changes in soil properties such as nutrient and salinity stress and changes in moisture which is

conditions water stress (Lausch et al., 2013). A soil analysis was used to measure the soil fertility and level of nutrient found in a soil sample.

Firstly, the soil was randomly collected from any point in 1 ha area plot of dipterocarp forest. Next, the soil PH was measured by using PH meter. Soil PH referred the acidity and alkalinity of the soil. Then, measured the soil moisture contents by using the soil samples that was taken from field and brought to the laboratory for calculated the soil moisture content percentage. An equation that was used to calculate the soil moisture content was showed below.

Soil moisture content:

$$\boldsymbol{Moisture\ content} = \left(\frac{\boldsymbol{Wet\ weight - Dry\ weight}}{\boldsymbol{Dry\ weight}}\right) \times \mathbf{100\%}$$

3.3.4 Data Analysis

The data analysis was used Microsoft excel to interpret the data and graph obtained from this study. The forest trees temperature was determine and analysed properly.

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results

4.1.1 Vegetation temperature and dbh in 1 ha dipterocarp forest

At Gunung Basor forest reserve, Kelantan, the numbers of trees temperature that have been collected about one hundred thirty seven trees. The highest value of temperature in 1 ha area of dipterocarp forest of Gunung Basor was 27°C with coordinate N 05°30´43.3 E 101°47´41.3 and the lowest temperature was 21.1°C with coordinate N 05°30´44.3 E 101°47´43.4.From this study, Table 4.1 shows the value of vegetation temperature and dbh in 1 ha area of dipterocarp forest at Gunung Basor forest reserve

Table 4.1: Forest trees temperature and dbh of 1 ha area of dipterocarp forest

Number of trees	Trees temperature (°C)	Dbh (cm)
1	23.4	25.48
2	22.5	33.76
3	24.8	39.81
4	24	35.99
5	23.2	27.83
6	23	56.37
7	22	6.62

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

8	23.4	24.3
9	23.7	20.96
10	22.8	7.26
11	23.1	25.32
12	23.5	7.56
13	23.4	7.56
14	22.9	7.56
15	23.1	13.69
16	24.1	7.64
17	22.6	26.11
18	23	12.9
19	22.6	6.59
20	22.4	29.68
21	22.8	23.54
22	22.7	106.53
23	23	9.84
24	23.4	8.34
25	23.3	10.8
26	23	13.98
27	22.4	24.04
28	23.1	15.67
29	22	13.15
30	23.4	24.84
31	22.4	21.66
32	22.7	21.5

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

33	23.5	7.42
34	23.8	7.26
35	23.1	19.43
36	24	10.89
37	23.2	16.94
38	22.9	10.67
39	22.3	14.84
40	22.4	207.01
41	21.8	13.85
42	22.3	8.69
43	21.8	14.17
44	22.1	10.19
45	22	7.64
46	22	58.92
47	22.8	25
48	22	28.66
49	23.4	8.6
50	23	35.8
51	21.5	20.54
52	21.9	13.5
53	22.8	5.41
54	22.9	16.62
55	22.3	5.73
56	22.4	11.37
57	23.2	22.07

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

58	23.6	16.72
59	22.7	8.69
60	23.5	9.49
61	23.5	16.5
62	25.5	17.52
63	25.1	17.04
64	25.2	21.66
65	25.7	18.95
66	25.5	22.29
67	27	7.04
68	25	8.41
69	23	11.72
70	26.1	5.1
71	26.5	70.06
72	25	5.8
73	25.1	6.53
74	24.1	5.15
75	24.5	12.1
76	24.7	6.62
77	24.4	5.41
78	23.8	5.41
79	24	7.48
80	24.1	7.96
81	23.1	7.36
82	23	7.64

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

83	23.3	9.87
84	23.4	12.74
85	23.6	16.75
86	24	15.32
87	23.1	14.24
88	23.3	9.55
89	23.8	29.14
90	23.7	28.85
91	23.6	14.33
92	23.3	27.839
93	23	9.33
94	23	14.49
95	23.5	6.59
96	23.5	16.56
97	24.1	12.13
98	23.2	7.32
99	23.1	14.14
100	23.4	24.59
101	25.1	31.56
102	23.2	6.21
103	22.6	5.73
104	23.4	6.27
105	24.3	7.17
106	23.7	17.45
107	22.7	7.17

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

108	23.9	9.17
109	23.1	7.45
110	23.3	37.54
111	23.2	5.1
112	23	5.41
113	23.6	19.27
114	23.3	9.71
115	23.1	8.44
116	22.8	15.32
117	24.1	13.69
118	24.2	12.04
119	24.1	18.47
120	23.9	9.87
121	24	18.47
122	23.5	6.75
123	23.8	22.29
124	24	6.69
125	23.9	16.56
126	23.8	5.89
127	23.5	11.78
128	23.1	7.64
129	24.8	15.03
130	25	10.22
131	24.2	26.11
132	23.8	97.77

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

133	24.1	31.53
134	24.6	90.45
135	23.7	53.18
136	24.3	16.88
137	24.7	27.07

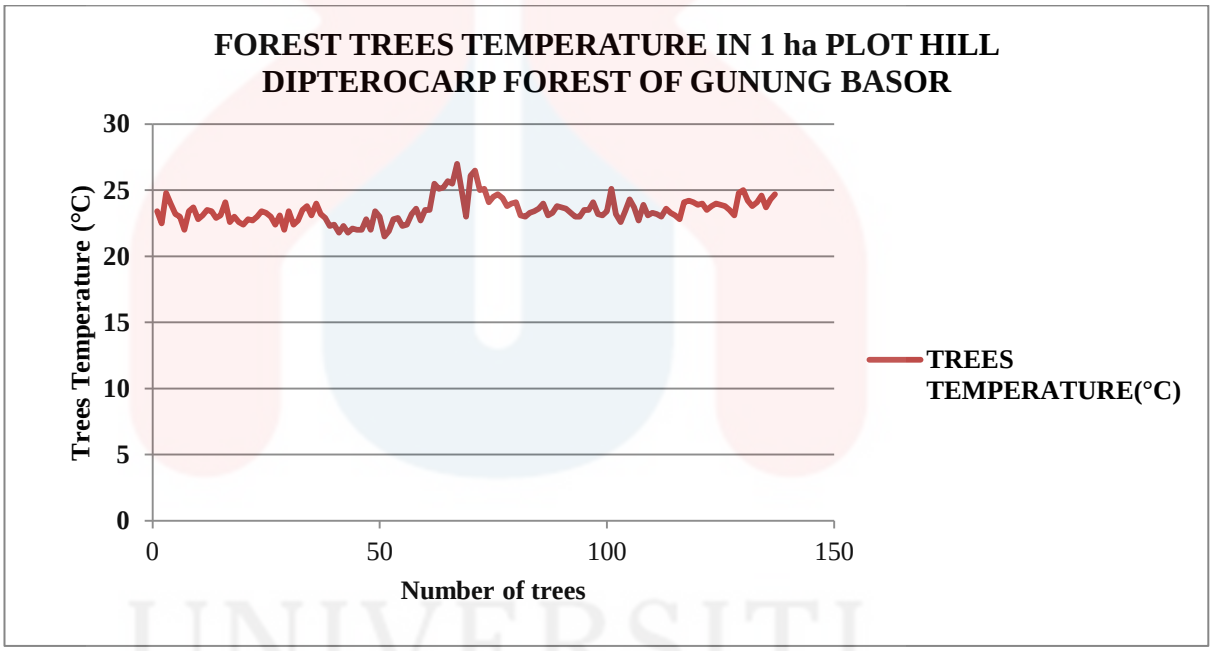


Figure 4.1: Graph of forest trees temperature in 1 ha plot dipterocarp forest

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

4.1.2 Soil Analysis of forest trees

The highest soil moisture content was 68.41% with soil pH 6.5 while the lowest soil moisture content was 10.63% with soil pH 7.

Number of trees	Soil Moisture (%)	Soil PH	Location
3	40.72	6.5	N 05°30´43.3 E 101°47´43.1
8	44.12	6.5	N 05°30´43.8 E 101°47´43.3
10	32.3	6.5	N 05°30´43.9 E 101°47´43.7
16	31.18	6.5	N 05°30´43.4 E 101°47´42.7
18	49.24	6.5	N 05°30´44.4 E 101°47´43.4
29	68.41	6.5	N 05°30´43.5 E 101°47´43.3
38	38.17	7	N 05°30´44.3 E 101°47´43.3
44	50	6	N 05°30´44.3 E 101°47´43.4
50	38.92	6.5	N 05°30´44.2 E 101°47´43.6

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

51	56.15	6	N 05°30´44.2 E 101°47´43.6
62	23.82	6.5	N 05°30´71.7 E 101°47´68.6
75	34.8	7	N 05°30´43.8 E101°47´41.0
83	57.28	6.5	N 05°30´44.0 E 101°47´40.7
90	50.01	7	N 05°30´43.8 E 101°47´40.7
98	30	6.5	N 05°30´43.8 E 101°47´40.9
106	10.63	7	N05°30´44.5 E101°47´41.8
133	42.92	6.5	N 05°30´44.3 E 101°47´44.2

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

4.2 Discussion

According to (Saw, 2010).The mean annual temperatures in the lowlands vary within 1.6°C of 26.7°C. Elsewhere ambient temperature limits the distribution of many trees and animals but in Malaysia, the only major influence on temperature is changes in temperature resulting from change in altitude, with a temperature drop of 6.5°C with every 1 km increase in altitude.

In this study, the temperature of 137 individual trees found in 1 ha plot was using infrared thermometer. The ambient temperature around 1 ha plot dipterocarp forest was 23°C. Temperature is a stress factor that is physical or chemical injury that the environment may impose on a plant. The forest trees stress was determined based on the temperature and soil moisture content obtained. For this study, the highest temperature was 27°C which at the number of tree 67 with dbh value was 7.04 cm. The temperature for these trees was higher than others because of the location was exposed to the sun compared to others trees. Based on the study, the forest gap with higher temperature had larger- sized gap and medium -sized gap. Besides that, the highest forest gap also affected by lowest soil moisture content.

The higher reading of infrared thermometer was depend when it face with the same direction of the sunlight. Most plants that with excess abundant of water able to maintain leaf temperature below 45°C by evaporated cooling or even at elevated ambient temperatures

There was no difference in phenology development and leaf area of the tree. Besides that, the lowest temperature was 21.1 °C with dbh value 10.19 cm. The temperature obtained was not exceed optimum range because the limitation of the study due to bypass of the dry season which July to August. The temperature fortrees

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

consider in stress condition was 35°C with change in physical of trees which was decreases number of leaves and colour. In addition, the area of lowest temperature had small-sized gap. So less amount of sunlight can penetrate.

Soils are another key determining factor in vegetation development. Soils in Peninsular Malaysia are generally acidic, predominantly weathered from igneous rocks (granite) into oxisols and ultisols. (Saw, 2010) .Other measurement in this study was soil pH. Soil pH function is to measure the acidity and alkalinity in soil. The range of pH level started from 0 -14, with below 7 acidic, 7 was neutral and above 7 alkaline. The optimum pH value for most plants was 5.5 to 7 but minimum PH recommended for plant production was 5.5. According to (Carver & Ownby, 1995) the soil test survey revealed critically acid conditions pH below than 5.0. So sensitive plants are disrupted.

Based on the study, the pH value at Gunung Basor was within the range of 6.0 to 7 but mostly 6.5. This finding indicated that the soil pH in Gunung Basor still in optimum range level of pH value.

Eighteen samples of soil were taken randomly from study1 ha area dipterocarp to measure the soil moisture contents. The highest soil moisture content was 68.41% with tree temperature was 22°C while the lowest soil moisture content was 10.63 % which tree temperature was 23.7°C. The important of soil moisture was to regulate the soil temperature and it was represented the quantity of water it contained.

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In the end of study, it showed the study was achieved successfully the objective that have been stated in the study which was to determine the forest trees stress in 1 ha plot of dipterocarp forest at Gunung Basor Forest Reserve.

An infrared thermometer was used to determine the temperature of 137 individual trees in hill dipterocarp forest. Overall, the highest temperature in 1 ha area was 27°C and the lowest temperature 21.1°C.Based on the observation, trees in Gunung Basor do not in stress condition because all the trees that taken in 1 ha plot that had enough sunlight and soil moisture in right soil conditions. Besides that, the highest soil moisture content was 68.41%with soil pH 6.5 while the lowest soil moisture content was 10.63% with soil pH 7. The pH value at Gunung Basor was determining which the range between 6.0 to 7 but mostly 6.5. This study provides useful baseline information about how temperature affected the trees in dipterocarp forest of Gunung Basor.

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

5.2 Recommendations

Along this, there were some study limitations such as period of time of fieldwork due to bypass the dry season. It was supposed to come out early and longer duration as well to get more temperature reading of the trees. The weather at the places also affects the reading of the infrared thermometer. During the period time of sampling at the Gunung Basor, the weather at the site was not stable and sometime raining. So the temperature reading showed trees that more exposed to sunlight had high temperature reading while trees that less exposed to sunlight had low temperature reading but still in optimum temperature range value and does not had stress condition.

FYP FSB

UNIVERSITI
MALAYSIA
KELANTAN

REFERENCES

Carver, B., & Ownby, J. (1995). Acid Soil Tolerance in Wheat. *Advances in Agronomy*, 117-173.

Cooper, J., & Tainton, N. (1968). Light and temperature requirements for the growth of tropical and temperate grasses. *Herbage Abtracts*, 167-177.

Deepesh, R., Scott A, H., & Dileepa M, J. (2018). Effect on Drought on Nutrient Uptake and the Levels of Nutrinet Uptake Proteins in Roots of Drought Sensitive and Tolerant Grasses. *Plant (Basel), Switzerland*, 28.

Fuchs, M. (1990). Infrared measurement of canopy temperature and detetion of plant water stress. *Theoretical and Applied Climatology*, 253-261.

Gotmark, F., Gotmark, E., & Jensen, A. M. (2016). Why Be a Shrub? A Basic Model and Hypotheses for the Adaptive Values of a Common Growth Form. *Front. Plant Sci.*, 1-14.

Grime, J. (2006). *Plant Strategies, Vegetation Process and Ecosystem Properties.* Sheffield, United Kingdom: John Wiley & Son.

Haferkamp, M. R. (1987). Environmental Factors Affecting Plant Productivity. *Fort Keogh Research Symposium*, 27-36.

Hassan, S. (1975). Effect of High Temperature and Soil Moisture on Survival of First- Instar Larvae of the Scarab Anoplognathus porosus. *The Journal of Applied Ecology*, 749.

Huntley , B., & Baxter, R. (2013). Vegetation Ecology and Global Change. *In Vegetation Ecology Second Edition*, 509-530.

J. Philip, G. (2016). *Plant Strategies, Vegetation Process and Ecosystem Properties.* Sheffield,United Kingdom: John Wiley & Sons.

Jerry L., H., & John H., P. (2015). Temperature extremes : Effect on plant growth and development. *Weather and Climate Extremes*, 4-10.

Lichtenthaler, H. (1998). The stress concept in plants : An introduction . *In Annals of the New York Academy of Sciences*, 187-198.

M Othman, Z H , A., F M, M., W N A, S., H Hamisan, N D, M., et al. (2016). Assessment of drought impact on vegetation health : a case study in Kedah. *IOP Publishing Conference Series Earth and Environment Science*, vol 37.

M, F., A, W., & N Kobasyashi, S. D. (2009). Plant drought stress : effects, mechanisms and management. *Agronomy for sustainable Development*, 185-212.

Ma , Y., & Berkowitz G.A. (2012). Biotic stress signalling: Calcium mediated pathogen defence programmes. *Plant Stress Physiology*, 291-309.

Parker , G., & Brown, M. (2000). Forest Canopy Stratification- Is It Useful. *The American Naturalist*, 473-484.

Rouphael , Y., Cardarelli, M., Schwarz , D., Franken, P., & Colla, G. (2012). Effect of drought on nutrinet uptake and assimilation in vegetable crop. *In Plant Responses and Drought Stress : Marphological to Molecular Features*, 171-195.

Sasaki, S. (2008). Physiological charateristics of tropical rain forest tree species: A basis for the development of silvicultural techonology. *Proceedings of the Japan Academy, Series B Physical and Biological Sciences*, 31-57.

Saw, L. G. (2010). Vegetation of Peninsular Malaysia. *Flora of Peninsular Malaysia*, 21-300.

Schulze, E., Beck, E., & Muller-Hohenstein , K. (2005). *Plant Ecology*. Berlin/Heidelberg: Springer.

Souza, G. M., & Cardoso, V. J. (2003). Toward a hierarchical concept of plant stress. *Israel Journal of Plant Sciences*, 29-37.

Wilkinson, S. (1999). PH as a stress signal. *Plant Growth Regulation*, 87-99.

Wildi, O. (2010). *Data Analysis in Vegetation Ecology*. *Data Analysis in Vegetation Ecology*. https://doi.org/10.1002/9780470664971

FYP FSB

UNIVERSITI
MALAYSIA
KELANTAN

APPENDIX A

Location of 1 ha plot dipterocarp forest

APPENDIX A: The 1 ha plot was marked by using red tape

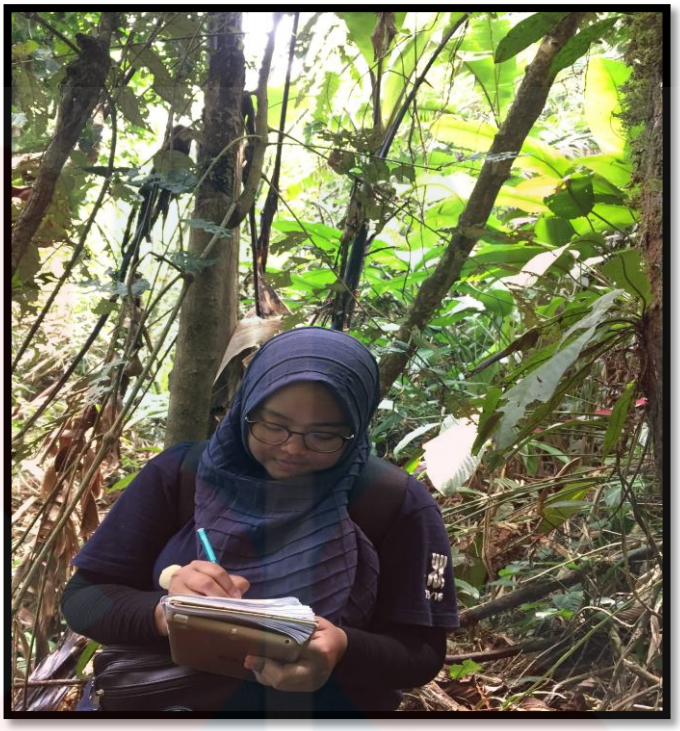
FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

APPENDIX B

Fieldwork at Gunung Basor Forest Reserved

Appendix B.1: List of materials used at the field

Appendix B.2 : Measured trees temperature by using infrared thermometer



Appendix B.2: Collected data at the field

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

APPENDIX C

The table shows the planning of Final Year Project I and Final Year Project II

Table C.1: Planning of final year project I and II

Research Activities	**Date**
Proposal Writing	February 2018
Submission and Proposal Writing	May 2018
Completion of FYP 1	July 2018
Field Sampling	July to September 2018
Data Analysis	September to December 2018
Completion of Chapter 4 and 5	December 2018
Submission Final Report	December 2018
Presentation of FYP II	December 2018
Hardbound Submission	January 2019

FYP FSB
UNIVERSITI MALAYSIA KELANTAN