Distribution and Abundance of Family Orchidaceae in Gunung Stong State Park (GSSP), Kelantan

by

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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

2024

DECLARATION

I declare that this thesis entitled "Abundance and Abundance of Family Orchidaceae at Gunung Stong State Park (GSSP), Kelantan" is the result of my 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 : Ahmad Adham bin Abdul Aziz

Date : 5/8/2024

ACKNOWLEDGMENT

First and foremost, I want to thank Allah S. W. T., my creator, for giving me the health and strength I needed to complete my final year project. Even the challenges that I face, thankfully I manage to handle them with the help of others. I learned a lot about who I am as a person and as a student during this process. I sincerely appreciate the holy Prophet Muhammad's (Peace be upon him) example of living, which has served as an inspiration to me.

I would like to express my deep and sincere gratitude to my FYP supervisor, Gs. Dr. Nazahatul Anis Binti Amaludin for allowing me to do research and providing guidance throughout this research. Her kindness, determination and motivation have inspired me. She has taught me how to collect data during the fieldwork. It was a great honour to work and study under her guidance. I feel very grateful that my supervisor manages to help me even though she has a very tight schedule. I also would like to express my gratitude towards my beloved parents En. Abdul Sahmad Bin Lehbak and Khairunnisa Binti Mohd Yunus for supporting me in moral and financial. Without them, I cannot procced my studies.

I want to say thanks to my friends and group members, Muhammad Hafizzudin Bin Roslam, Sow Bao Jun, Nur Izati Binti Baharom, Norerliana Syafika Binti Abdullah, Muhammad Al-Hafiz Bin Mat Razii and Nur Husna Syasya Binti Shamsul Amri for their constant encouragement. Without them, I cannot complete my research and I owe them a lot.

Distribution and Abundance of Family Orchidaceae in Gunung Stong State Park, Dabong, Kelantan

ABSTRACT

The purpose of this study was to determine the distribution and abundance of Orchidaceae in Gunung Stong State Park (GSSP), Kelantan. The data was analysed using the Simpson and Shannon-Wiener indices, and GIS was used for additional geographical analysis. According to the research, the study region contained 34 Orchidaceae species, of which 12 were found to belong to 6 genera collected at this area along the trails from the elevation 100m until 600m. Simpson's Diversity Index (D) was 0.906, while the Shannon-Wiener Diversity Index (H') was 2.262. These data show the abundance and distribution of Orchidaceae in GSSP. The study's findings confirm the necessity of Orchidcaeae conservation at the GSSP site.

Taburan dan Kelimpahan Famili Orchidaceae di Taman Negeri Gunung Stong, Dabong, Kelantan

ABSTRAK

Tujuan kajian ini adalah untuk mengetahui taburan dan kelimpahan Famili Orchidaceae di Taman Negeri Gunung Stong (GSSP), Kelantan. Data analisis yang digunakan adalah indeks Simpson dan Shannon-Wiener, dan GIS digunakan untuk analisis geografi tambahan. Menurut penyelidikan, kawasan kajian mengandungi 34 spesies Orchidaceae, di mana 12 daripadanya didapati tergolong dalam 6 genera yang dikumpulkan di kawasan ini di sepanjang laluan dari ketinggian 100 m hingga 600 m. Indeks Kepelbagaian (D) Simpson ialah 0.906, manakala Indeks Kepelbagaian Shannon-Wiener (H') ialah 2.262. Data ini menunjukkan kelimpahan dan taburan Orchidaceae dalam GSSP. Penemuan kajian mengesahkan keperluan pemuliharaan Orchidcaeae di tapak GSSP.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GSSP	Gunung Stong State Park

LIST OF SYMBOLS

%	Percentage

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Orchids are plants in the Orchidaceae family, which have a large and extensive group of flowering plants with vivid and fragrant blossoms. Orchidaceae, along with Asteraceae, is one of the two largest flowering plant families. It has over 28,000 presently recognized species spread across 763 genera (Christenhusz & BYNG, 2016). This is because new members of both of these gigantic families are constantly discovered, it is unknown which of the two families is greater. Regardless, the number of orchid species is about equivalent to that of bony fishes, more than double that of bird species, and roughly four times that of mammal species. In Malaysia, there are about 3,000 species of the most beautiful and mysterious plant species, with more than 1,000 found in Peninsular Malaysia such as *Coelogyne foerstermannii*, *Dendrobium hymenanthum* (Go, 2021).

1.2 Problem Statement

Gunung Stong State Park (GSSP) consider as high conservation value forest which Gunung Stong is rich with biodiversity of species including Orchidaceae but there is no prior research about distribution and abundance of Orchidaceae in Gunung Stong State Park (GSSP). Hence, this study aims to identify the distribution and abundance of Orchidaceae located at Gunung Stong State Park (GSSP), Kelantan. There is also a lack of data about Orchidaceae in Kelantan which there are not many data can be refer to. Thus, this study will provide the base data about the distribution and abundance of Orchidaceae in Gunung Stong State Park (GSSP).

1.3 Objective

The objectives of this study are:

1. To determine distribution of Orchidaceae in Gunung Stong State Park (GSSP), Kelantan.
2. To estimate the abundance of Orchidaceae in study area.

1.4 Scope of Study

This study will be focus on the family of Orchidaceae that located at Gunung State Park (GSSP), Kelantan. This study will be also focus on sampling the species diversity from the study area and using the camera to record the species of Orchidaceae. General observation is used to locate the species of Orchidaceae. Hence, this study will be done in terms of identification of Orchidaceae species which follow by determine their distribution and abundance within in study area.

1.5 Significant of Study

This study will be acting as base data for researcher that want to study further about Orchidaceae that area available at Gunung Stong State Park (GSSP). This study will give an insightt to locate the orchid and the distribution of the orchid. Research on orchids helps determine the effects of environmental changes because they are frequently used as indicators of the health of ecosystems. The variety of Orchidaceae needs to be studied because habitat destruction and climate change are major threats to conservation efforts. In addition to helping to protect biodiversity, researchers that identify and conserve different orchid species may potentially find new genetic resources and chemicals that have industrial and medical uses. This is because researching the distribution of Orchidaceae offers a wealth of information that is crucial for maintaining ecological harmony, advancing scientific understanding, and fostering sustainable cohabitation with the natural world.

CHAPTER 2

LITERATURE REVIEW

2.1 Orchidaceae

Orchidaceae are one of two largest families of flowering plant and are second only to Asteraceae (The Plant List, 2013). It contains about 28 000 species distributed 763 genera in the world and more unknown species of Orchidaceae have not yet discover (Christenhusz & BYNG 2016). In Malaysia, Orchidaceae is one of the most abundance flowering plant which approximately 978 species recorded in Peninsular Malaysia and 3000 species that have been recorded in Sabah and Sarawak (Go, 2021). According to MYBIS website, there are approximately 30 species that are available in Kelantan. Orchidaceae can be consider as epiphytic plant because most of orchid species grow anchored to trees or shrub in the tropic and subtropic (Rasmussen & Rasmussen, 2018). In order to search the Orchidaceae, the Orchidaceae are locate around the tree or shrub.

2.2 Morphological Characteristics of Orchidaceae

According to the International Journal of Botany Studies (2020), stems in orchid can be divided into two groups according to their growth habits: sympodial and monopodial orchids. The stem of a monopodial orchid grows from a single bud, lengthens, and generates leaves annually from the apex. The blossom stalk appears from the base of the leaves that are highest. For example, Phalaenopsis Vanilla and Vanda. In orchids that are sympodial, the plant creates a group of nearby shoots that reach a specific size, blossom, stop growing, and then be replaced. The origin of sympodial epiphyte stems, or in certain species. It is possible to thicken practically the whole stem to create what is known as a pseudobulb that holds water and minerals for drier times.

For roots, the roots of epiphytic orchids serve as anchors, while the aerial roots, which dangle freely in the atmosphere and aid in moisture absorption, absorb roots that pierce the humus on bark. The chlorophylls found in epiphytic roots often allow them to carry out photosynthesis. While the roots of Aerides and Vanda help the plant to trail, those of genera like Phalaenopsis become flat and aid in the plant's creeping across the surface. Orchids have strong, white roots. The spongy layer covering the roots of epiphytic orchids aids in the orchid's ability to cling to trees or rocks and collect nitrogen and water from the atmosphere. Aerial roots of epiphytic orchids can occasionally reach a length of several metres. The velamen, a modified spongy epidermis, is responsible for absorbing humidity in the older portions of the roots. It might seem white, brown, or silvery-grey and is composed of dead cells. In order to gain a solid grip on their support, the root epidermis cells grow at a right

angle to the root's axis. Yet velamen is found in relatively few terrestrial orchids. Apart from the basic absorbing roots with root hairs, terrestrial orchids can also have huge root tubers, like in Habenaria, or root tubercles, like in Nervilia.

Like most monocots, orchids generally have simple leaves with parallel veins, although some Vanilloideae have reticulate venation. Depending on the particular plant, leaves might be ovate, lanceolate, or orbiculate, and their sizes can vary greatly. Their traits are frequently indicative of a disease. They usually have no stipules and are alternate on the stem. They are also frequently folded lengthwise in the middle. The fibrous siliceous structures in the vascular bundle sheaths of orchid leaves are known as stegmata. The peculiar environment of the plant is reflected in the structure of its leaves. Species with thick, leathery leaves and laminae wrapped in a waxy cuticle to retain their essential water supply are those that usually grow in sunny spots or on occasionally very dry areas. Conversely, species that thrive in shade have long, thin leaves.Most orchids have perennial leaves, meaning they survive for a number of years.

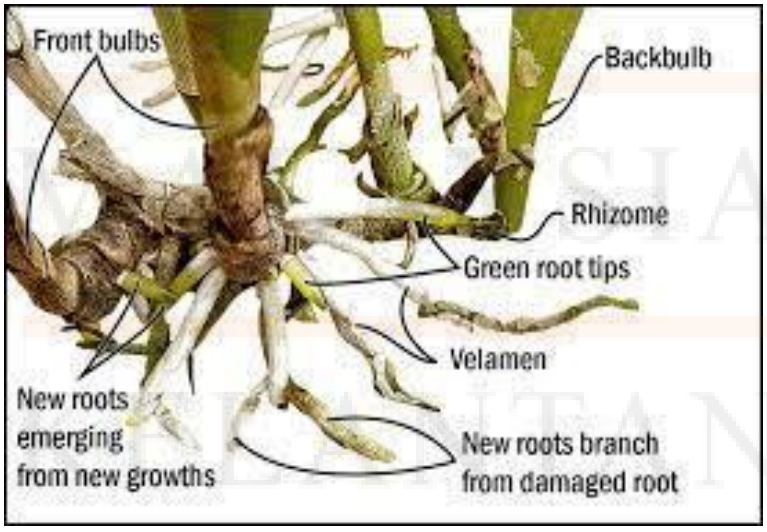

Figure 2.1: Roots of Orchidaceae

Orchid flowers contain three sepals, three petals, and a three-chambered ovary are features of orchid blooms. One petal is typically greatly modified, forming a "lip" or labellum, but the three sepals and two petals are frequently similar to one another. Resupination is the 180° twisting that most orchid genera' flowers go through as they grow, causing the labellum to fall below the column. In addition to drawing insects, the labellum of resupinate flowers serves as a landing platform and occasionally a trap. The stamens and style of an orchid flower are united to form a single structure called the column, which makes the reproductive organs of the flower distinctive. Thousands of pollen grains are held in one or two bundles called pollinia, which are affixed to a sticky disc towards the top of the column, rather than being discharged individually. The stigma is a second, bigger sticky plate located just beneath the pollinia.

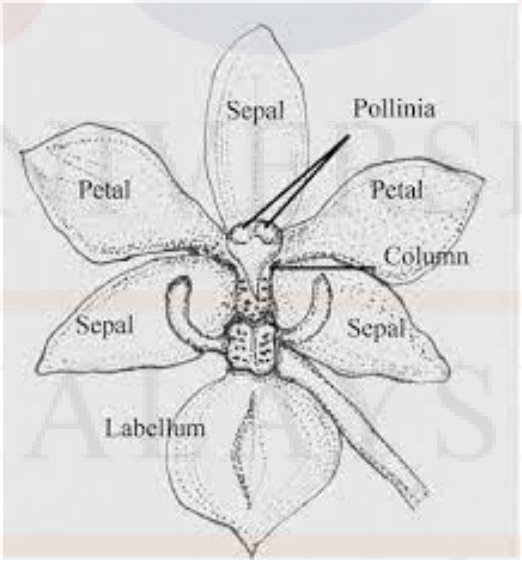

Figure 2.2: Flower of Orchidaceae

2.3 Habitat of Orchidaceae

Since most of orchids are epiphytic, the orchid grows on another tree. It is known that epiphytic plant species diversify in habitat within tree crowns, some species being confined to the twig zone, others to larger branches or to trunks (Johansson, 1974; Zotz, 2007) and a subset of species preferentially grow in trees of small stature. Orchid species seldom have a one-to-one association with phorophyte species, but bias towards or against specific tree species is well-documented in several orchid species.

2.4 Importance of Orchidaceae

The family Orchidaceae has a huge therapeutic range. Since ancient times, orchid plants have been used as medicinal plants. Orchidaceae plants have a wide range of applications, including wound healing, anti-platelet, antidiabetic, immunomodulatory, anti-aging, pain relief, antiviral, antimicrobial, anti-inflammatory, antioxidant, anticancer, antipyretic, antimutagenic, anticonvulsive, antihelmintic, and antihepatotoxic. This is caused by a variety of substances found in these plants, including flavonoids, triterpenoids, steroids, glycosides, xanthones, coumarins, and alkaloids, which are mostly generated from aromatic amino acids. Stilbenoids, on the other hand, primarily consist of bibenzyl and pheanthrenes. Important genera with promising medicinal use include Dendrobium, Eria, Coelogyne, Bletilla, Bulbophyllum, Cremastra, and Pholidota (Arora et al., 2017).

CHAPTER 3

MATERIALS AND METHOD

3.1 Study Area

Kelantan's Gunung Strong State Park (GSSP) is a destination for ecotourism. It was established at 31 March 2006. The location of Gunung Stong State Park is near Dabong, Kelantan. Standing at 1,442 metres, Gunung Stong is one of Kelantan's tallest peaks (Kamaruzaman & Skidmore, 2006). The investigation was carried out in Gunung Stong State Park (GSSP) at latitude 5.3364° N and logitude 101.9378° E (Kamaruzaman & Skidmore, 2006). It is located in the Kuala Krai area, which forms Kelantan's boundary. Universiti Malaysia Kelantan Campus Jeli is 46 km away from Gunung Stong in Kuala Krai, Kelantan. On the other hand, Kota Bharu, the capital of Kelantan, is 149 kilometres away from the place, and Gua Musang is 64 km away (Gunung Stong State Forest Park, 2016). Gunung Stong can be considered as high conservation value forest which Gunung Stong is rich with biodiversity of species. With this, this place is suitable for studying the distribution of species that available within the area.

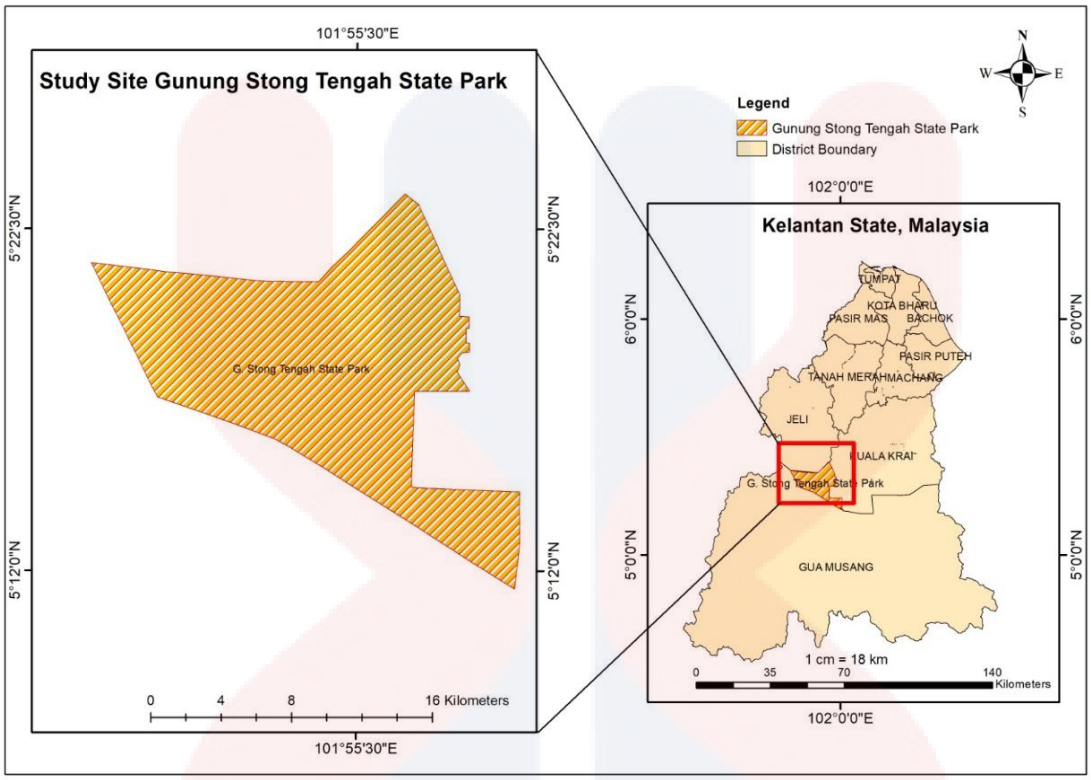

Figure 3.1: Map of Gunung Stong State Park, Dabong, Kelantan

3.2 Materials

The material that will be used in this study as presented in the Table 3.1.

Name	Function
Global Positioning System (GPS) receiver	A radio wave receiver that provides coordinates indicating an object's precise location inside a given space (Gunung Stong State Park)
Flagging Tape	To designate measured limits and markers. furthermore, served as a location to identify and mark different orchid species.
Measuring Tape	In surveying, tape is used to measure distances that are slope-related, vertical, or horizontal.
Camera Phone	To capture and record the species for further identification
Noted book and pen	To write and record the species found using the pen
Reference book	To identify the species that have been recorded.

Binocular	To search the species of orchid easier
Orienteering Compass	To keep the trail forward

Table 3.1: The tools use in study area

3.3 Method

3.3.1 Sampling Design

The process involves one trails that span various habitat types and altitudes inside Gunung Stong State Park (GSSP). This sampling was indicated by markers on the path. By doing this, the sampling is guaranteed to accurately reflect the park's natural diversity. Over the course of the trail, sampling was conducted between 100 and 600 meters above sea level. By avoiding over- or under-represented areas, random sampling contributes to the accuracy of the distribution of species.

3.3.2 Sample Collection

In order to locate the orchid, binocular will be used to observe the orchid species that located on the tree. Then, camera will be used to capture pictures of the orchid species. The picture will be used as data and each orchid species that found will be recorded in the book to count the distribution of Orchidaceae. All of the orchid species that are recorded will be identified using the book called Flora of Peninsular Malaysia.

3.4 Data Analysis

3.4.1 Shannon-Wiener Index

According to Spellerberg (1991), species variety is a manifestation or measure of a relationship between a small number of species and their individuality. The standard indicator utilised in ecological studies is the Shannon Diversity indicator (Spellerberg & Fedor, 2003). This index is used to measure species of Orchidaceae within area.

$$H = -\sum_{i=1}^{s} (Pi)In(Pi) \qquad \text{Equation 3.1}$$

Where:

H'= Shannon Diversity Index

Pi = The number of individuals of a species over the total number of individuals overall

S = Total number of species

ln = Natural logarithm

3.4.2 Simpson Index

The diversity index was developed by Simpson (1949) as a probability measure. A lower diversity denotes a higher chance that two randomly selected individuals are members of the same species. There is a one in a thousand chance that two randomly selected individuals will be identical when there is only one species of variety. This index are used to measure species of Orchidaceae within area. This index is used to measure the distribution of Orchidaceae within area. The Simpson Index formula is displayed below:

$$D = \sum_{i-1}^{s} \left(\frac{n_i}{N}\right)^2 \qquad \text{Equation 3.2}$$

Where:

n_i = the number of individuals in species i,

N = total number of individuals of all species

n_i/N = p_i(proportion of individuals of species i)

S = species richness

3.4.3 Evenness Index

The evenness index, represented in Equation (3.3), gives information about the composition of the area. This computation displays the frequency (number) of each species in a given area. The Shannon Evenness Index has a value between 0 and 1.

$$H = \frac{H'}{In(S)} \qquad \text{Equation 3.3}$$

Where:

E = Evenness

H'= Shannon's Diversity Index

S = Total number of species

ln = Natural logarithm

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Diversity of Family Orchidaceae in Gunung State Park

Based on the sample methods used, 12 species of Orchidaceae were identified in Gunung Stong State Park, according to in Table 4.1 below. As indicated in Table 4.1 below, there are 6 genus and each of the species which has more than 10 localities and coordinates. Among the 12 species in the family Orchidaceae, 34 individuals were found overall. *Bulbophyllum longiflorum* has the highest total number of individuals with coordinated marked of 7 while *Bulbophyllum lobbii, Coelogyne cobbiana*, *Coelogyne viscosa* and *Spathoglottis plicata* have the least total number of with coordinated marked which are 1 only.

No.	Species (family Arecaceae)	Total number of species with coodinates
1.	*Bulbophyllum longiflorum*	7
2.	*Bulbophyllum gracilimum*	4
3.	*Bulbophyllum lobbii*	1
4.	*Coelogyne cobbiana*	1
5.	*Coelogyne magna*	1
6.	*Coelogyne viscosa*	1
7.	*Dendrobium aloifolium*	2
8.	*Dendrobium crumenatum*	3
9.	*Polystachya concreta*	5
10.	*Spathoglottis plicata*	1
11.	*Spathoglottis pubescens*	4
12.	*Vanilla planifolia*	4

Table 4.1: List of the family Orchidaceae in Gunung Stong State Park

4.2 Species Diversity of Orchidaceae

Indices	Values
Shannon – Wiener Diversity Index (H')	2.26
Simpson's Diversity Index (D)	0.906

Table 4.2 shows the values of diversity indices used for Orchidaceae in GSSP, Kelantan

The Shannon-Wiener diversity index (H') for a community of 12 species is displayed in Table 4.2 to explain its richness. This index takes into consideration the distribution of these species (species evenness) as well as their number (species richness). Each species' proportion (Pi) is calculated by dividing the total number of individuals 34 from 12 species by the total number of individuals in all species. Pi * ln(Pi), which represents the proportionate contribution of each species to the overall diversity, is obtained by multiplying the natural logarithm of Pi (ln(Pi)) by Pi. Adding these values for all species yields a total of approximately -2.26. The negative of this sum gives the Shannon-Wiener diversity index (H'), which in this case is approximately equal to 2.26.

The Simpson's Diversity Index (D) is also displayed in Table 4.2. Also, the data was used to compute the Simpson's Diversity Index (D) and its corresponding measure, the Simpson's Index of Diversity (1 - D), which measures a community's biodiversity by taking into consideration both species richness and evenness of distribution. The estimated values are roughly D = 0.906 for this data set.

4.3 Distribution of Orchidaceae in Gunung State Park, Kelantan

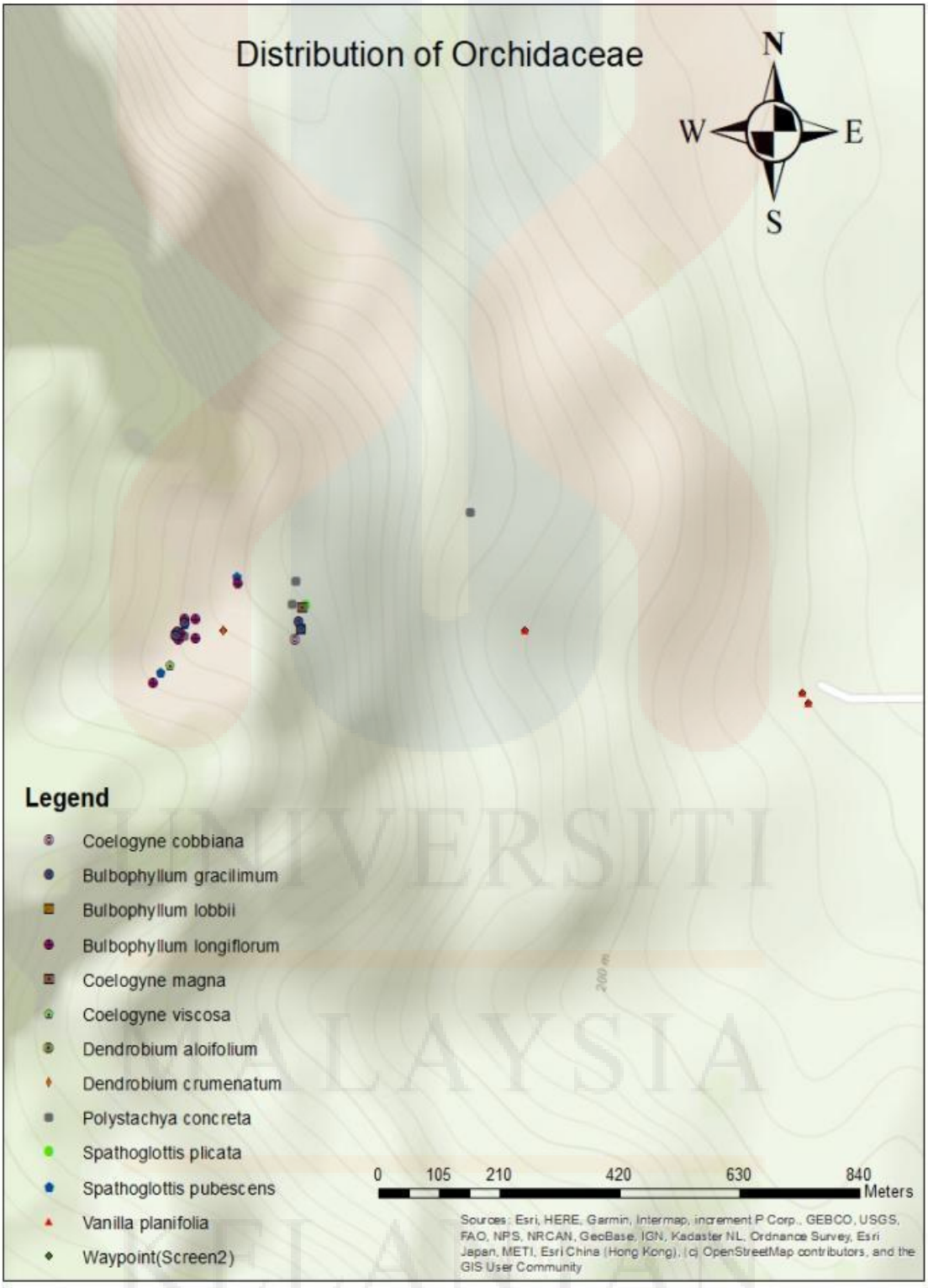

Figure 4.3: Map of Orchidaceae distribution at GSSP, Kelantan

The Figure 4.3 shows the map of Family Orchidaceae distribution which representing 12 species and 34 individuals. Each of the species had been tagged with coordinated. Based on the Figure 4.3, *Bulbophyllum longiflorum* had the most individual which was 7. *Bulbophyllum longiflorum* was marked with circle with cross and with colour of catlleya orchid. The second highest was *Polystachya concreta* which was 5. The *Polystachya concreta* was marked with rounded circle with colour of gray. Next individual species with 4 each were *Bulbophyllum gracilimum*, *Spathoglottis pubescens* and *Vanilla planifolia*. The *Bulbophyllum gracilimum* was marked with circle with x with colour of glacier blue, the *Spathoglottis pubescens* was marked with pentagon with colour of ultra-blue and *Vanilla planifolia* was marked with triangle with colour of mars red. Then, the *Dendrobium crumenatum* had 3 individual species which was marked with diamond shape with colour of fire red. For *Dendrobium aloifolium* had 2 individual species which was marked with circle with small dot with colour of lichen green. The lowest individual species were *Bulbophyllum lobbii*, *Coelogyne cobbiana, Coelogyne magna*, *Coelogyne viscosa* and *Spathoglottis plicata* which were 1 each of the species. *Bulbophyllum lobbii* was marked with square with x mark with colour of raw umber, for *Coelogyne cobbiana* was marked with circle with small circle with colour of tudor rose dust, for *Coelogyne magna* was marked with square with small dot with colour of cocoa brown, for *Coelogyne viscosa* was marked with pentagon with small with colour of fern green and *Spathoglottis plicata* was marked with circle with colour of quetzel green.

4.3.1 *Bulbophyllum longiflorum*

Bulbophyllum longiflorum was the most found in the study area. The flowers of *Bulbophyllum longiflorum*, which come in an amazing variety of shapes and colours, were the main attraction of the plant. The usually small to medium-sized flowers exhibit a range of colours, from pale yellow to deep crimson or purple, which is indicative of the genetic variability within the species. Each bloom is made up of long, slender petals and sepals that are frequently grouped in a spiderweb pattern to give the impression that the flower was foreign. The labellum, or moveable lip, was a prominent characteristic that was frequently hinged. This lip that moves was essential to the plant's pollination process because it contacts pollinators easier and increases the plant's chances of successful reproduction. The leaves of the orchid are usually glossy, bright green, and thick. They are normally lanceolate or oblong in shape. In order to survive in their native environments, these leaves must maximise photosynthesis while minimising water loss.

Figure 4.3.1: *Bulbophyllum longiflorum*

4.3.2 *Bulbophyllum gracilimum*

Bulbophyllum gracilimum is distinguished by its beautiful floral structures, which were pivotal in its identification and appreciation. Beautiful floral structures are what set *Bulbophyllum gracilimum* apart and were essential to its recognition and praise. The petals and sepals of the very small but intricately designed flowers were typically airy and almost ethereal in appearance. Usually white to light pink in colour, these floral components have subtle veining or speckling that enhances their aesthetic appeal. Umbels of flowers rest on slender, arching inflorescences to form a dramatic display that appears to float above the plant.The labellum, or lip, of *Bulbophyllum gracilimum* was one of its defining characteristics. It serves a functional as well as aesthetic purpose. In the Bulbophyllum genus, the labellum is frequently movable, which aids in pollination by interacting with visiting insects. This movement helps ensure that pollen is delivered between flowers in an efficient manner, increasing the likelihood of successful pollination. The leaves are slender, lanceolate, and have a leathery texture, optimizing them for photosynthesis while minimizing water loss. The plant also has pseudobulbs, which were swollen, bulb-like stems that stored water and nutrients, providing resilience against environmental fluctuations. These pseudobulbs were typically small and clustered, contributing to the compact growth habit of the plant.

Figure 4.3.2: *Bulbophyllum gracilimum*

4.3.3 *Bulbophyllum lobbii*

The flowers of *Bulbophyllum lobbii* were very attractive since they were comparatively huge in comparison to many other species of Bulbophyllum. Every flower has thick, broad petals, and the sepals, which were sometimes bright yellow with complex red or brown markings, contrast sharply and add to the flowers' visual appeal. The bloom appears more exotic because to the elongated, sometimes wavy or fringed sepals. *Bulbophyllum lobbii* was distinguished by its labellum, or lip, which was frequently movable and vividly coloured, usually in reddish or orange tones. In addition to being visually appealing, this moveable lip was essential to the plant's pollination strategy since it moves to contact passing pollinators easier. The leaves of *Bulbophyllum lobbii* were leathery, lanceolate, and dark green, growing from the apex of the pseudobulbs. These leaves were designed to optimize photosynthesis while minimizing water loss, making them well-suited to the orchid's natural habitats. In order to provide resistance against environmental stress, the plant creates pseudobulbs, which are inflated, bulb-like structures that store water and nutrients. They can be placed tightly apart along the rhizome and are usually ovoid in shape.

Figure 4.3.3: *Bulbophyllum lobbii*

4.3.4 *Coelogyne cobbiana*

The main characteristic that distinguishes *Coelogyne cobbiana* from other species is its beautiful and delicate flowers, which are highly prized. The flower of *Coelogyne cobbiana* appears delicate and immaculate due to the colour of its sepals and petals, which generally range from white to cream in colour. The petals were wider and frequently have a mild curve, whilst the sepals are slightly longer and bigger. The overall beauty of the flower is enhanced by the form and size contrast between the sepals and petals. The labellum, with its remarkable colours and beautiful design, was the most distinguishing feature of the flower. It was often white with yellow or orange markings in the centre, and its margins are frequently lobed or fringed. The labellum contains three lobes, the most noticeable of which was the central lobe, which was covered in tiny, hair-like projections called cilia. In addition to adding to the flower's visual appeal, its intricate structure was essential for drawing pollinators. Pseudobulbs were produced by the plant which they were lengthy and somewhat spindle-shaped. These pseudobulbs, which were normally grouped along the rhizome, act as water and nutrient storage organs, helping the plant to survive adverse environmental conditions. Two dark green, leathery lanceolate leaves adorn each pseudobulb. These leaves were well adapted to the orchid's natural environment since they were made to maximise photosynthesis while minimising water loss.

Figure 4.3.4: *Coelogyne cobbiana*

4.3.5 *Coelogyne magna*

The main characteristic that distinguishes *Coelogyne magna* from other species was its exquisite and ornate blossoms.The flower of *Coelogyne magna* appears delicate and immaculate due to the colour of its sepals and petals, which are typically white to cream in colour. The petals were wider and frequently have a mild curve, whilst the sepals are slightly longer and bigger. The overall beauty of the flower was enhanced by the form and size contrast between the sepals and petals. The labellum, with its remarkable colours and exquisite design, is the most distinguishing feature of the flower. It was often white with yellow or orange markings in the centre, and its margins were frequently lobed or fringed. The labellum has three lobes, the most noticeable of which is the central lobe, which was covered in tiny, hair-like projections called cilia. In addition to adding to the flower's visual appeal, its intricate structure is essential for drawing pollinators. This plant also had pseudobulbs which were typically clustered along the rhizome and serve as storage organs for water and nutrients, aiding the plant's survival during periods of environmental stress and each pseudobulb contains two lanceolate leaves that were leathery and dark green.

Figure 4.3.5: *Coelogyne magna*

4.3.6 *Coelogyne viscosa*

One characteristic that sets *Coelogyne viscosa* distinct from many other species in the Coelogyne genus is its subtle floral architecture. The flowers have a distinct appeal and elaborate design, even though they aren't as big or beautiful as some of their relatives. The petals and sepals of *Coelogyne viscosa* were frequently slightly translucent and are typically a pale green or yellowish-green colour. The petals were somewhat larger and shorter than the sepals, which were elongated and narrow. The blooms have a soft, delicate grace because to their colour and structure. The labellum, which is the most distinguishing feature of the flower. Its borders are frequently lobed or fringed, and its colour was usually white or cream with yellow or orange streaks in the centre. The labellum contained three lobes, the central lobe being the most noticeable and frequently covered in tiny, hair-like projections called cilia. This flower's elaborate pattern was essential for drawing pollinators in addition to enhancing its visual attractiveness. This plant also contained pseudobulb and each pseudobulb bears two lanceolate leaves that are leathery and dark green.

Figure 4.3.6: *Coelogyne viscosa*

4.3.7 *Dendrobium aloifolium*

Dendrobium aloifolium stands out in the orchid family due to its unique morphological features, particularly its foliage which resembles that of Aloe plants, hence the name "aloifolium." *Dendrobium aloifolium* has small, attractive blooms that were frequently placed in brief racemes that develop at the nodes along the stem. Narrow petals and sepals with occasional light stripes or patterns can be white, yellow, or greenish in colour. The labellum, or lip, was typically more vividly coloured, frequently displaying orange or yellow tones with detailed patterns that draw pollinators. Thick, meaty leaves that resemble succulent plants are *D. aloifolium*'s most characteristic trait. Usually lanceolate, the leaves had dark green colour and a leathery texture. Because of their ability to store water, these alternating leaves are distributed sporadically along the stem, providing the plant with resistance to dry spells. This species does not have the noticeable pseudobulbs that many other orchid species do. Rather, the thick leaves were supported by elongated stems. These cylindrical, somewhat inflated stems help to store water as well.

Figure 4.3.7: *Dendrobium aloifolium*

4.3.8 *Dendrobium crumenatum*

Dendrobium crumenatum, also referred to as the "Pigeon Orchid," was a fascinating species in the Dendrobium genus. *Dendrobium crumenatum* flowers were small, yet they have a subtle charm. These loosely clustered blossoms have white petals and sepals that frequently have a tinge of green or yellow. The main feature was the lip, or labellum, which is decorated with bright yellow patterns that direct pollinators to the flower's reproductive organs. Another noteworthy characteristic of the blooms was their fragrance, which draws in nocturnal pollinators like moths with their sweet, citrusy aroma. Specific pseudobulbs lack in *Dendrobium crumenatum*, in contrast to many other Dendrobium species. Rather, it consists of thin, cane-like stalks with lanceolate leaves that alternate. It receives support from these stems, which also help to maintain its upright growth pattern.

Figure 4.3.8: *Dendrobium cremanatum*

4.3.9 *Polystachya concreta*

Within the Polystachya genus, *Polystachya concreta*, sometimes known as the "Concrete Orchid," that is well-known for both its sturdy nature and unusual appearance. The most remarkable feature of *P. concreta* was its inflorescence, which is a dense cluster of tiny flowers grouped along a central axis. These flowers were usually tiny, with creamy white to pale yellow sepals and petals that are frequently decorated with complex designs and markings. Specialised petals like the lip or labellum are especially remarkable since they frequently have complex structures and vivid colours to draw pollinators. *Polystachya concreta* had narrow, elongated leaves that are placed along the stem in a fan-like pattern. The dainty blooms stand in stark contrast to these leathery, dark green leaves. As photosynthetic organs, the leaves convert sunlight into energy needed for the growth and development of the plant.

Figure 4.3.9: Polystachya *concreta*

4.3.10 *Spathoglottis plicata*

Ground orchids, or *Spathoglottis plicata,* are a species in the Orchidaceae family that are valued for their hardiness, vivid flowers, and adaptability. The most alluring aspect of *Spathoglottis plicata,* was its breathtaking flowers, which bloom in a variety of colour, including white, yellow, and pink, purple, and magenta. Six tepals were arranged in a star-like pattern on each flower, with the bottom tepal frequently acting as a landing platform for pollinators. The lip, also known as the labellum, was a highly specialised organ that frequently displays complex patterns and markings that direct pollinators towards the flower's reproductive components. The leaves of *Spathoglottis plicata,* were long and strap-like, growing from a central pseudobulb or rhizome. These leaves, which were usually glossy and dark green, give the vivid blossoms a striking backdrop. To produce energy for the growth and development of the plant, photosynthesis depends on the leaves.

Figure 4.3.10: Spathoglottis *plicata*

4.3.11 *Spathoglottis pubescens*

The plant *Spathoglottis pubescens*, commonly known as the "Buttercup Ground Orchid," *Spathoglottis pubescens* is mostly known for its vibrantly coloured flowers, which come in a variety of colours including pink, purple, yellow, and white. Six tepals are placed symmetrically in the shape of a star in each flower. Particularly remarkable are the labellum's, or lip's, elaborate patterns, and markings, which frequently feature contrasting hues and textures. It helps to draw pollinators with this specialisation. Another characteristic that sets *Spathoglottis pubescens* apart are its leaves. Found at the base of the plant, they emerge from pseudobulbs and are lanceolate, long, and narrow. As a defence mechanism against herbivores and to lessen water loss, the leaves' pubescent or fuzzy texture is caused by fine hairs covering them. Usually glossy and dark green, their leaves create a dramatic contrast with the vibrantly coloured blossoms. *Spathoglottis pubescens* produces tiny, spherical pseudobulbs that act as fertiliser and water storage devices.

Figure 4.3.11: *Spathoglottis pubescens*

4.3.12 *Vanilla planifolia*

Vanilla planifolia, also known as the "Vanilla Orchid," *Vanilla planifolia* is a vining orchid, in comparison with many other orchid species that grow compactly. With its long, green, cylindrical stems that can grow to a maximum length of 15 metres, the plant is able to climb nearby trees and other buildings. The large, thick, ovate to lanceolate leaves of *Vanilla planifolia* have this form. Usually, they are lustrous and dark green. Two different kinds of roots are produced by *Vanilla planifolia* terrestrial roots that take up water and nutrients from the soil, and aerial roots that aid in anchoring the plant to trees and other supports. Because of their thick and porous nature, the aerial roots may take up moisture from the humid air. *Vanilla planifolia* has incredibly attractive flowers that are usually yellow-green in colour. Every flower contains three petals and three sepals, with the third petal producing the labellum, a unique structure.

Figure 4.3.12 *Vanilla planifolia*

4.4 Abundance of Orchidaceae at Gunung Stong State Park

No	Genus	Total Number of individuals	Abundance (%)
1	Vanilla	4	11.76
2	Spathoglottis	5	14.71
3	Polystachya	5	14.71
4	Dendrobrium	5	14.71
5	Coelogyne	3	8.82
6	Bulbophyllum	12	35.29

Table 4.3: Abundance of Orchidaceae at Gunung State Park

Species abundance is the number of individuals per species and relative abundance refers to the evenness of individual distribution within group between species. Two populations may be similarly species-rich but relative abundance.

Table 4.3 shows that genus Bulbophyllum is the most abundant with total percentage of abundance of 35.29%. Spathoglottis, Polystachya and Dendrobrium have the same percentage of abundance which are 14.71% where the second highest. Then follow with Vanilla which is 11.76%. The lowest abundance is Coelogyne with 8.82%.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

In conclusion, all of the 12 species of Orchidaceae family have been identified on the map by using Geographic Information System (GIS) software. These maps show the potential the distribution and abundance of Orchidaceae family in Gunung Stong State Park (GSSP), Dabong, Kelantan. From the results, the species of Orchidaceae family have a total of 34 individuals from 12 species were collected at GSSP, Kelantan. *Bulbophyllum longiflorum* is the highest individuals which is 7 while the *Bulbophyllum lobbii*, *Coelogyne cobbiana, Coelogyne magna*, *Coelogyne viscosa* and *Spathoglottis plicata* is the lowest individual which are 1. The most abundant in genus are Spathoglottis, Polystachya and Dendrobium which are 14.71% while the lowest abundant is Coelogyne which is 8.82%. Distribution the pattern of 12 Orchidaceae species was identified randomly. The distribution of Orchidaceae species is low in diversity. However, the Orchidaceae family can be beneficial for tourist attractions due to the beautiful pattern of the flower and attract tourist to visit Gunung Stong State Park, Dabong, Kelantan.

5.2 Recommendations

Based on the study that has been conducted, recommendations for this study is to bring reference book during the fieldwork in order to identify the Orchidaceae

species easily. It can avoid collecting wrong sample. Next is to avoid pluck the flower because the flower is one the main attraction of this species and we have to conserve this family for future reference.

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