



**VOCAL BEHAVIOUR OF DIURNAL
RAPTORS IN UNIVERSITI
MALAYSIA KELANTAN (UMK)
JELI CAMPUS**

BY

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DECLARATION

I declare that thesis entitle “ Vocal Behaviour Of Diurnal Raptors In Universiti Malaysia Kelantan (Umk) Jeli Campus” 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.

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**VOCAL BEHAVIOUR OF DIURNAL RAPTORS IN
UNIVERSITI MALAYSIA KELANTAN (UMK) JELI
CAMPUS**

ABSTRACT

The objective of this study is to study the vocal behavior of diurnal raptors at the Universiti Malaysia Kelantan (Umk) Jeli Campus. In addition, land use involves the management and modification of natural environments or forests to built environments such as settlements and semi-natural habitats such as pineapple fields and goat pens. For methodology, Binoculars, Note to record bird species, the xeno canto website will be used in this research for binoculars are used to see raptors that are not reached by eye sight. xeno canto is used to analyze the data that has been taken throughout the study. The study was conducted at UMK Kampus Jeli, from February 28 to March 28. Observation time is 11:00 am to 2:00 pm because at that time is the active time of raptors vocalization. Xeno Canto was used to analyze each Raptors voice recording to identify the meaning of vocalization throughout the study in 2024 because xeno canto provides information about the meaning of vocalization of each type of voice produced.

Keywords: diurnal vocal raptors, Land use, Binocular, Xeno Canto.

**TINGKAH LAKU VOKAL RAPTOR DIURNAL DI UNIVERSITI
MALAYSIA KELANTAN (UMK) KAMPUS JELI**

Mohd Hafizi Bin Juhari, Dr. Aainaa Syazwani Binti Mohammad Amir
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ABSTRAK

Objektif kajian ini adalah untuk mengkaji tingkah laku vokal raptor diurnal di Universiti Malaysia Kelantan (Umk) Kampus Jeli. Selain itu, penggunaan tanah melibatkan pengurusan dan pengubahsuaian persekitaran semula jadi atau hutan kepada persekitaran binaan seperti penempatan dan habitat separuh semula jadi seperti sawah nanas dan kandang kambing. Untuk metodologi, Teropong, Nota untuk merekod spesies burung, laman web xeno canto akan digunakan dalam penyelidikan ini bagi binocular digunakan untuk melihat raptors yang tidak tercapai melalui pandangan mata. Xeno canto digunakan untuk menganalisis data yang telah diambil sepanjang kajian dijalankan. Kajian dijalankan di UMK Kampus Jeli, bermula 28 Februari hingga 28 Mac. Masa pemerhatian ialah 11:00 pagi hingga 2:00 petang kerana pada masa tersebut adalah masa aktif penyuaran raptors. Xeno Canto telah digunakan untuk Menganalisis setiap rakaman suara Raptors untuk mengenal pasti maksud penyuaran sepanjang kajian pada tahun 2024 kerana xeno canto memberikan informasi tentang maksud penyuaran setiap jenis suara yang dikeluarkan.

Kata kunci: Raptor Vocal Diurnal, penggunaan Tanah, Xeno Canto

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CHAPTER 1

INTRODUCTION

1.0 Background of Study

There are many different kinds of birds that belong to the order of raptors, which are sometimes referred to as birds of prey. For generations, people have been captivated by these creatures. My goal in this study proposal is to explore the vocal behaviour of diurnal raptors that are found on the Jeli Campus of the Universiti Malaysia Kelantan. Birds are another kind of animal that may be found all over the globe and come in a variety of sizes (Field, Daniel J.; and Benito, March (2020). There are around ten thousand different species still alive today. Wings are a characteristic feature of birds, and their development varies from species to species. The capacity to fly in birds comes from their wings, which are essentially modified forelegs. However, as a result of subsequent development, many kinds of birds, such as penguins and several unique island species, have lost their ability to fly. The digestive and respiratory systems of birds have also developed special adaptations that allow them to fly. (Yonezawa et al. 2017). Birds are vertebrate animals with wings and feathers that belong to the class Aves. They have a high metabolic rate, a four-chambered heart, and a strong yet light frame. Birds have wings that develop differently according to species, giving them ability to fly, although further evolution has led to the loss of flight in some birds, such as penguins and various endemic island species. Birds' digestive and respiratory systems are also uniquely adapted for flight. Birds are found in every country in the world and in almost every habitat, ranging from hummingbirds to ostriches, from penguins to eagles. There are about 10,000 living species of birds,

exhibiting an impressive diversity.

Derived from Latin, the word raptor means 'to seize and carry away by force'. Raptors, are a group of birds that belong to the order Accipitriformes, which includes most diurnal birds of prey such as hawks, eagles, vultures and many allies (Toru et. al., 2012). There are around 225 different species of raptors, however this number does not include falcons since that particular order of birds was just established in 2008. According to (Chaiyan and Nualsri 2008), raptors are distinguished by possessing long claws that are very sharp, hooked beaks, and acute eyesight. According to Ferguson-Lees and Christie (2007), these characteristics and adaptations make it possible for raptors to capture and devour their prey, which often comprises of small birds, mammals, reptiles, and insects, but may sometimes include carrion. Raptors have a diverse morphology that allows them to hunt in a variety of environments and take advantage of both nocturnal and diurnal lifestyles. Hunting style is considered the most important determinant of raptor morphology, habitat and behaviour (Park 2003). Some raptors, like the eagles observed in this study, are ambush predators and thus spend most of their time perched looking for prey, while others, like the bee-eater, tend to spend more time flying as they search for prey. Many species may even utilize a combination of hunting styles. As with any bird, maintenance tasks like preening (cleaning feathers) and bathing take longer. Excluding behaviours centred around migration and mating, most species are considered solitary. Raptors are generally considered to be intelligent, because they have to learn a huge amount throughout their lives to master the task that takes up most of their time: foraging. (Jones 2001).

Raptors, being at the top of the food chain, are highly sensitive to alterations in ecosystem structure and energy flow. As such, raptors can be used as indicators of the health of the environment. For example, clearing of forest may result in a loss of prey, which may affect the population and distribution of raptors (Toru et. al., 2012.). Vocal behaviour is an important aspect of raptor ecology, as it is used for communication, territorial defence, mate attraction, and parent-offspring interactions. However, little is known about the vocal behaviour of diurnal raptors in Malaysia, especially in the Jeli Campus of Universiti Malaysia Kelantan, which is home to several species of raptors, such as the white-bellied sea eagle, the crested serpent eagle, and the black eagle. Therefore, this research proposal aims to fill this gap in knowledge by studying the vocal behaviour of diurnal raptors in this area, using methods such as acoustic recording, playback experiments, and behavioural observations.

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1.1 Problem Statement

Diurnal raptors serve as crucial markers of environmental health due to their sensitivity to changes in ecosystem structure and energy dynamics. On the other hand, the Jeli Campus of the Universiti Malaysia Kelantan (UMK) has a limited amount of information on the diversity of diurnal raptors as well as their vocalisations. This site is home to a diverse population of raptor species, some of which include the black eagle, the crested serpent eagle, and the white-bellied sea eagle. The growth of infrastructure and services of UMK Jeli has adverse effects on the diurnal population of raptors. For example, cutting down trees and clearing hills in order to open up new agricultural regions in the Agro Park area, which would result in the destruction of habitat, the requirement of relocation, and the depletion of resources and resources. As a result, answering the following research questions is the purpose of this inquiry; they are as follows: 1) What kinds of diurnal raptors may be found on the UMK Jeli Campus, and how large a population do they make up? 2) What kind of vocal repertoire do diurnal raptors on the UMK Jeli Campus have, and what kind of conduct do they exhibit? 3) What influence do social and environmental factors have on the vocal behaviour of diurnal raptors on the UMK Jeli Campus? The findings of this study will contribute to a better knowledge of the ecology and conservation of raptors in Malaysia, as well as provide baseline data for the future monitoring and management of diurnal raptors at the UMK Jeli Campus. This study was carried out by conducting field observations, the method of recording diurnal raptors' vocals and performing the technique of following the diurnal movements of the raptors throughout their stay in the Jeli Campus area.

1.2 Scope of Study

The scope of this study is to investigate the vocal behaviour of diurnal raptors in UMK Jeli Campus, which is located in the state of Kelantan at longitude and latitude $101^{\circ} 51'15''$ to $101^{\circ} 53'15''$ E and $5^{\circ} 43'15''$ to $5^{\circ} 45'30''$ N. The study area covers an estimated area of 1.09265 km², including the Agro Park UMK Jeli Campus. The geographical boundary is determined to arrive at the coordinates specified in the estimate using point count with a distance of 200 meters for each point. The investigation will begin in January of 2024 and continue through June of that year. The selection of diurnal raptor species in the Jeli Campus area is because the area surrounded by tall forest areas shows the probability of diurnal raptors nesting areas and the lake area also encourages the presence of diurnal raptors in this area. The diurnal raptor species that are found in the region under investigation make up the research population. These include , the crested serpent eagle, and the black eagle. Throughout the observation of raptors, the methodology used is to record and observe the sounds often uttered by raptors. to avoid interference with their natural behavior is to observe from a long distance to prevent raptors from feeling threatened and running away from observation. The techniques of research include observing raptors via the use of binoculars, capturing audio and video of them, and taking photographs of them. Vocal repertoire, vocal frequency, vocal behavior, and environmental and social factors that affect diurnal raptor vocal behavior are the variables being studied for this specific research project. for Vocal Repertoire is the Number of call types by Counting the number of different vocal call types in the animal's repertoire. Spectrogram and frequency analysis is by using spectrogram to analyze the characteristics

of frequency, duration, and modulation of each call. The context of use is to record the context in which a particular vocal call is used to understand its function and importance in communication. Counting the number of times a certain type of call is produced in a certain period of time by analyzing the temporal pattern of calls to understand the daily cycle in vocalization to measuring the rate of calls per individual to understand individual variation in vocal use. Bird identification can be challenging especially due to the similarities between species. Additional steps or procedures to ensure accurate identification are use of field guides apart from the "Birds of Malaysia and Singapore" Book, use other field guides that are specific to a particular area or group of birds. Field guides often contain detailed illustrations or photographs, as well as descriptions of the main characteristics of each species. Also, photography and optical equipment by using binoculars or telescopes as these tools help in seeing birds from a distance clearly. Detailed observation is to observe the following characteristics that can help distinguish between similar species according to color and pattern of fur, size and shape, behavior, habitat and sound and song. In addition to referring to the community or experts is also a step to ensure accuracy in collecting data, join a birdwatching group or forum where you can share photos and observations. More experienced members can help with identification. This can facilitate accuracy in species identification or data or ensuring the accuracy and reliability of sound analysis using raven and audacity involves careful consideration of several factors, including recording quality, software settings, and specific analysis parameters. A general step to ensure accuracy and reliability is high-quality recording by using a high-quality microphone and sound card to capture clear

audio. Record in a quiet environment to minimize background noise and set the recording level properly to avoid clipping and distortion. The consistent recording setting is to keep the same distance from the microphone for all recordings to maintain a consistent volume level. Calibration is by using a known reference sound to calibrate the recording setup. Check and calibrate equipment regularly to ensure consistent performance over time.



1.3 Objective

- Identify and describe the diurnal vocal repertoire of raptors at Universiti Malaysia Kelantan, Jeli Campus.
- Analyzing the vocalization of the diurnal repertoire of raptors at UMK Jeli Campus.

1.4 Significant of Study

The significance of this study is to enhance the understanding of the vocal behaviour and communication of diurnal raptors in UMK Jeli Campus which is a relatively unexplored area for raptor research. The project will provide a wealth of information on the ecology, diversity, and conservation of bird species in the region. It is possible that these species are in danger because the expansion of this region is destroying their habitats and the resources they rely on. People in the community will become more aware of the significance of wild creatures as a result of the research, and it will also motivate people to cherish and preserve eagles and the environments in which they dwell. This research will also provide information on species by examining the frequency with which these birds produce noises. The frequency with which they make sounds may reveal how they act by revealing things like territorial defense, chatting to mates, or issuing warning cries. The research will also assist us in gaining a deeper understanding of the ways in which raptors interact with one another and make use of sound, both of which are vital to the functioning of ecosystems and the evolution of raptors. This

study will also provide researchers with a foundation for future work and will assist in keeping a watch on diurnal hawks on the UMK Jeli Campus as well as in other places in Malaysia.



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CHAPTER 2

LITERATURE REVIEW

2.1 The classification and diversity of diurnal raptors

Diurnal raptors, which are avian predators, exhibit diurnal activity patterns and are classified into three distinct orders: Falconiformes, Accipitriformes, and Cathartiformes. The taxonomic group Falconiformes includes falcons and caracaras, characterised by their distinctive anatomical and physiological adaptations that enable them to achieve high flight speeds and effectively capture airborne prey. There exists a total of around 60 distinct species of falcons and caracaras worldwide. Among these species, some may be seen in Malaysia, including the peregrine falcon, the black-thighed falconet, and the red-necked falcon (Mindell and Johnson 2018).

The taxonomic group Accipitriformes, which is the most extensive order of diurnal raptors, include the majority of diurnal avian predators, including hawks, eagles, vultures, and kites, with the exception of falcons. The taxonomic order Accipitriformes now has a total of 262 species and 75 genera, distributed across four extant families and maybe one extinct family. The avian orders Accipitriformes and Falconiformes are characterised by possessing relatively small bills that are highly hooked, as well as sharp and curved talons (often referred to as claws). Additionally, falcons are distinguished by the presence of a bone tubercle located inside the nose (Harshman and John 2008). Ongoing studies are focused on the taxonomy and phylogenetic linkages of diurnal wild animals, with the objective of integrating full information on current species diversity and their evolutionary relationships. In Malaysia itself, studies on wild animals are more focused on

aspects of ecology and conservation, such as habitat use, feeding ecology, and migration patterns, but there are some gaps in the period of studying certain vocalizations such as the context and function of vocalizations, Changes Due to Human Disturbance, and Record Technology and Analysis. There are few specific studies of vocal behavior, but existing ecological studies can provide an important foundation for vocal behavior research. The categorization of diurnal raptors into different orders, such as Accipitriformes and Falconiformes, was established by findings of recent DNA investigations . The categorization of Diurnal Raptors is based on a combination of physical characteristics such as beak shape, flight characteristics, and hunting behavior, as well as more importantly, genetic studies that have elucidated evolutionary relationships. Special Vocal Characteristics which are vocal patterns and genetics because genetically closer species tend to have more similar vocal patterns. These molecular discoveries have clarified traditional taxonomy, emphasizing evolutionary lineages rather than mere morphological similarities. the findings of recent DNA investigations (Barrowclough and Tsang 2014).

There are three families of daytime raptors, or diurnals, and these are the Falconiformes, Accipitriformes, and Cathartiformes. Falcons and caracaras, both members of the order Falconiformes, are able to fly quickly and grab prey in the air because to their specialised anatomy and physiology. Some of the about 60 species of falcons and caracaras in the world may be found in Malaysia (Chesser et. al., 2010). This includes the peregrine falcon, the black- thighed falconet, and the red-necked falcon. The Accipitriformes is the biggest order of diurnal raptors, with over 262 species and 75 genera in 4

living families. These include hawks, eagles, kites, harriers, and vultures. White-bellied sea eagles, crested serpent eagles, black eagles, and brahminy kites are just some of the raptor species that call Malaysia home (Barrowclough, and Tsang, 2014). The order Cathartiformes includes the New World vultures, which are often seen feeding on carrion. Cathartiformes are only found in the Americas, hence you won't find any of the seven species in Malaysia (Chesser. et. al., 2012). The Jeli Campus of Universiti Malaysia Kelantan (UMK) is home to several species of raptors (Amera Natasha Mah Muhammad Adam Mah, Chong Leong Puan, and Mohamed Zakaria 2023), but there have been few studies on the vocalisation of diurnal raptors in Malaysia.

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2.2 The vocal repertoire and behaviour of diurnal raptors

Diurnal raptors exhibit a wide range of vocalisations that are intricate and varied in nature. These vocalisations serve several functions, including communication, defence of territory, attracting mates, and interactions between parents and young. Various sorts of vocalisations are seen among animals, including whistles, screams, barks, chirps, and grunts. These calls serve distinct purposes and convey diverse messages, which are contingent upon both the specific situation and the species in question. Leonardi, Amato, and Brogna, et al. (2012). The majority of vocalization-related raptor behavior studies in Malaysia are mostly focused on nocturnal raptors, while research on diurnal raptors is still quite limited. The specialized diurnal vocal patterns of raptors are surveillance and territorial calls, and Warning Calls. this pattern reflects the role of ecology and the different periods of activity are adaptations to habitats, communication in the dark and hunting strategies. Research Focused on Nocturnal Raptors is because they are easy to hear at night because nocturnal raptors are more vocal at night when noise interference from other sources is minimal. This makes it easier to detect and study their calls. However, there are also Implications for understanding diurnal raptor vocal behavior which is the Lack of Comparative Data, and limited understanding. during vocalization there is also a difference in vocal behavior between diurnal and nocturnal raptors, namely the frequency and duration of the call and the function of the call. Nevertheless, a research investigation conducted on the Changeable Hawk-Eagle (*Nisaetus cirrhatus*) inside the Ayer Hitam Forest Reserve located in Selangor, Malaysia, revealed that this particular species of hawk-eagle emitted a minimum of seven distinct

vocalisation patterns. Notably, the study observed that the hawk-eagle exhibited heightened vocal activity at noon, characterised by prolonged and intensified vocalisations. The Changeable Hawk- Eagle mostly uses call type 1, which is the most often observed call type, at various periods of the day, including both in-flight and when perched (Mah Muhammad Adam Mah, Puan, & Zakaria, 2023)

The vocal behaviour of diurnal raptors in Malaysia, particularly in the Jeli Campus of Universiti Malaysia Kelantan (UMK), remains poorly documented. However, research conducted on the Yellow-breasted Barbet (*Trachyphonus margaritatus*) in Malaysia has shed light on their vocal repertoire and daily calling patterns. The Yellow-breasted Barbet produces four unique vocalizations, with unison calls and group vocal displays being common forms. Studies of vocalization patterns in the Variable Hawk-Eagle Barbet and Yellow-breasted Barbet provide interesting insights into the importance of vocalization in the behavioral and ecological context of these species. the importance of vocalization for the Variable Hawk-Eagle Barbet in terms of Territorial Defense helps in signaling presence and territorial boundaries to other competitors and for Mate Attraction with a consistent and strong Call that can indicate the health and strength of the bird, which is a good genetic indicator while for the Chestnut Barbet Yellow (Yellow-breasted Barbet) Importance of Vocalization for Territorial defense is Loud and repetitive calls assist in marking territories and warning other barbets not to enter the area. Additionally, Mate Attraction is a rhythmic, repetitive call that can attract a mate by indicating the bird's health and fitness. The zenith of collective vocal exhibitions transpired from 6 a.m. to 8 a.m., while the

pinnacle of cohesiveness calls transpired from 7 a.m. to 8 a.m. (Dahlin and, Benedict, 2013).

Diurnal raptors, also known as diurnally active birds of prey, use vocalisations for a range of functions including territorial defence, young interaction, and mating courtship. Both male and female diurnal raptors often engage in vocalisations as a means of defending their territory and during the process of courtship with potential mates. Vocalisations serve several functions in social interactions among individuals, including deterring rivals, challenging competitors, asserting dominance, claiming ownership, marking borders, advertising strength, intimidating opponents, and resolving problems. Moreover, diurnal raptors use vocalisations as a means of engaging with their progeny, including activities such as directing, feeding, safeguarding, and instructing them in the art of flight and hunting. According to Ferguson-Lees and Christie (2001),

Previous studies have included fundamental characterizations of vocalisations and vocal behaviour in raptors. Avian vocalisations serve several tasks within and across species, including intraspecific and interspecific communication. These functions include conveying alarm signals, indicating the presence of resources, maintaining pair bonds, defending territories, and attracting potential mates. The primary emphasis of research has been on vocalisations made during the daytime by birds that are active during daylight hours (Alerstam, 2009). In brief, diurnal raptors use vocalisations for a diverse range of significant functions, including the defence of their territory, communication with their progeny, and the attraction of potential mates.

According to Catchpole and Slater (2008), vocalisations are of utmost importance in the social interactions and survival strategies of these organisms. Diurnal Raptor Species in Malaysia that Need Further Investigation in Malaysia are Crested Serpent Eagle, Changeable Hawk-Eagle, Brahminy Kite, and Black Eagle. New technologies or methodologies that can advance our understanding of raptor vocal behavior are Bioacoustics and Automated Recorders, GPS and Radio Telemetry, Drones and Aerial Monitoring. Advances in Technology and Uses are due to Automatic Recorders that help in identifying each species found.

2.3 The factors that influence the vocal behaviour of diurnal raptors

Diurnal raptors exhibit adaptive vocal behaviour in response to many environmental and social stimuli, including factors such as seasonal variations, diurnal patterns, weather conditions, habitat characteristics, and social interactions. During the reproductive period, raptors may exhibit heightened vocalisation patterns in order to enhance their chances of attracting and forming social connections with potential mates, create and defend their territories, or engage in parental care for their offspring. According to Carlson et al. (2020), raptors may modify their vocal behaviour throughout the migratory period in order to synchronise their travels, prevent collisions, or locate appropriate resting places. The diurnal vocal behavior of raptors is influenced by diurnal variables, which are linked to their daily rhythms and activity patterns. For example, raptors exhibit potential variation in their vocalization patterns in response to diurnal fluctuations. Diurnal raptors that are active during the day, adjust their vocal behavior in response to various patterns, such as changes in lighting, temperature, and prey availability. This vocal adaptation helps them in communication, territory marking, as well as finding mates and prey. Vocal activity peaks in the morning because the morning is often used to mark territory and reinforce their presence in the area. These variations serve to align their vocal activity with their feeding and resting cycles, adapt to prevailing light and temperature conditions, and establish synchronisation with conspecifics and other species.

Weather factors influence the vocal behaviour of diurnal raptors, as they are related to their thermoregulation and energy expenditure. For example, raptors may modify their vocal activity depending on the weather, to cope with the heat and cold stress, to conserve or expend energy, or to adapt to the wind and

precipitation conditions. Habitat factors influence the diurnal vocal behavior of raptors, as they relate to habitat selection and resource availability. Habitat characteristics can significantly influence the diurnal vocal behavior of raptors. For example, a study on the Mountain Hawk-Eagle found that juveniles in forested habitats had a peak call rate at 7 am, which then gradually decreased throughout the day (Bellocq, and Go'mez-Insausti 2005). This suggests that dense vegetation in forested areas may limit the ability of raptors to vocalize effectively throughout the day, leading to more concentrated call periods. In summary, while diurnal predators show species-specific patterns in their vocal behavior, the habitat they occupy can influence the timing and frequency of their vocalizations. Wooded habitats may lead to more concentrated call periods, while open habitats may allow more flexibility in vocal activity throughout the day. The vocal behavior of diurnal raptors can vary depending on their geographic location and habitat type. These differences are often influenced by factors such as population density, prey availability, human disturbance, and habitat structure. The diurnal vocalizations of raptors in UMK jelly differ because they are located in areas with tropical rainforests, the call frequency of raptors living in tropical rainforests may use lower frequency calls to reduce sound reflections, agricultural areas with high frequencies in more open agricultural areas, raptors tend to use higher frequency calls that can span greater distances, and semi-urban environments Territorial Calls Raptors may use more frequent territorial calls to defend their territory from closer competitors. This habitat provides a wide variety of food, but there may be pressure from human activities. Human Disturbance at UMK Campus Jeli and other semi-urban areas, human disturbance tends to be higher compared to other forest habitats. Additionally, Prey Availability Different habitats have different

prey availability, which can affect hunting patterns and vocalization times. Social factors influence vocal behavior diurnal predators, as it relates to their social structure and interactions. For example, raptors can change their vocal activity depending on the social context, to reflect their social status and role, to control their social distance and relationships, or to respond to the signals and actions of others. Diurnal predators show significant variation in their vocal patterns depending on social contexts such as during mating and territorial disputes. Each of these social situations has a different type of vocalization that reflects the purpose and emotion involved. Although vocalization during territorial disputes with aggressive calls, In the context of territorial disputes, raptors use more aggressive and high-pitched calls to scare off competitors. These calls are often louder, shorter and more repetitive than mating calls.

The methods used to observe and measure the vocal behavior of raptors can involve various scientific and technological approaches including Field Observation, Automatic Microphone Installation, Vocal Detector, GPS tags and Radio Telemetry (Shonfield and Bayne 2018). However, there are challenges and limitations in data collection such as Habitat Accessibility, Human Disturbance, Recording Quality, and Lack of Data. In data collection include the secretive nature of some raptors, low call rates and low density in the landscape, making them difficult to detect (Clement et al. 2019). Furthermore, data quality concerns arise from variable observer expertise and diversity in collection data, which leads to observer bias. This can result in false positive or negative records, affecting the accuracy of the data collected (Weisshaup , Lehtiniemi. 2020). The interaction between various factors such as weather, habitat, and social interaction in influencing vocal behavior is complex and multifaceted. These

factors interact at different levels and can affect vocal behavior in significant ways. Weather Factors will cause Raptors to vocalize less during bad weather because of the sounds produced by wind or rain can interfere with vocal communication. While for the Habitat Type in thick forest areas, vocalization may be more complex and the frequency used may be higher to penetrate dense vegetation. On the other hand, in open areas such as grasslands, vocalizations may be louder and longer distances. Social Interaction is also a factor influencing the behavior of raptors due to Interaction with Other Species. The presence or threat of other species can cause changes in vocalization patterns. For example, raptors may vocalize more frequently to warn other species of their presence (Clement et al. 2019).

2.4 The methods and techniques for studying the vocal behaviour of diurnal raptors

A case study of diurnal raptors where this methodology has been used successfully is the rescue center study in the Czech Republic, which aimed to analyze the reasons for admission, outcomes, and length of stay of diurnal raptors at rescue centers from 2010 to 2019 (González Martín Moro and, Hernández Verdejo 2017). The investigation of vocal behavior in diurnal raptors requires the integration of field observations and sound analysis, using a variety of methodologies and techniques. This study was conducted to make it easier for us to understand the diurnal vocal repertoire of raptors. with the data collected will help in identifying the behavior performed by the raptors during the following vocalizations. This study also contributes to our understanding by identifying the vocalization patterns produced by the raptors. However, there are some challenges or obstacles when using this method, one of which is the change in weather, the rainy weather on that day will interfere with the field observations carried out because when it rains diurnal raptors will not appear throughout the day. the challenge is also the limit of the visibility area of this because when raptors fly too far from the study area it will cause limited visibility. this will also make it difficult for us to carry out the study. Next, the constraints of construction activities because when construction is carried out during the study it will disturb the behavior of raptors and prevent raptors from flying in the study area. A way or strategy to help a little in field observation is the use of binoculars to facilitate the sight of raptors that cannot be seen. This process requires the use of many

technologies, including binoculars, cameras and notebooks to facilitate accurate data collection. for - the use of binoculars is used to see diurnal raptors that are far from the eye's sight to make sure to identify the species accurately even at a distance that is difficult to reach. while the use of the camera is to take pictures of the raptors for reference. by taking pictures will make it easier to identify the species. for the notebook is to record all the data obtained during the field observation carried out throughout the day. this is done to avoid forgetfulness when not recorded in a notebook (Brennan, and. Block. 1986).

The procedure performed to analyze the sound of raptors is to collect relevant data from voice recordings taken during sampling. when the data has been collected, the data taken must also be recorded regarding the behavior of the raptors at that time because it can help in analyzing the vocalizations. In voice analysis, this study is also assisted by the Xeno canto website because the website stores a lot of data related to the diurnal vocalizations of the raptors, using the website will help ensure accuracy in the analysis of the raptors' vocalizations. This will avoid errors during the analysis. This is achieved by the use of various equipment, including microphones, recorders, and specialized software. The use of sound analysis techniques enables researchers to discern and elucidate the vocal repertoire, vocal frequency, vocal structure, and vocal function shown by diurnal raptors (Engesser et al., 2016).

CHAPTER 3

MATERIAL AND METHOD

3.1 Study Area

The study was conducted in the area of universiti malaysia kelantan (umk) jeli campus ($101^{\circ}51'15''$ to $101^{\circ}53'15''$ e and $5^{\circ}43'15''$ to $5^{\circ}45'30'$ n , 1.09265 km. The study area covers an area of 1.09265 km², and has a wide variety of spaces, including lakes, sports courts, faculty buildings and agricultural gardens. This study area is suitable for studying the vocal behavior of diurnal raptors, as it is home to the crested snake eagle raptor species. In this area only the crested serpent eagle species was found throughout the study. Based on the research i conducted, the location of the study was conducted close to agricultural and animal husbandry areas, this would lead to the presence of the raptors in that area. Make sure the observation point provides a clear and unobstructed view of the surrounding area. As for time, count behavior during the peak activity period for raptors, usually from 11:00 a.m. To 2:00 p.m. The observation equipment used is binoculars for remote observation. Make sure observers have a field notebook or data sheet to record sightings. While for data collection by record the number of individuals for each raptor species observed. Note the time of each bird observation and behavior and record the environmental conditions.

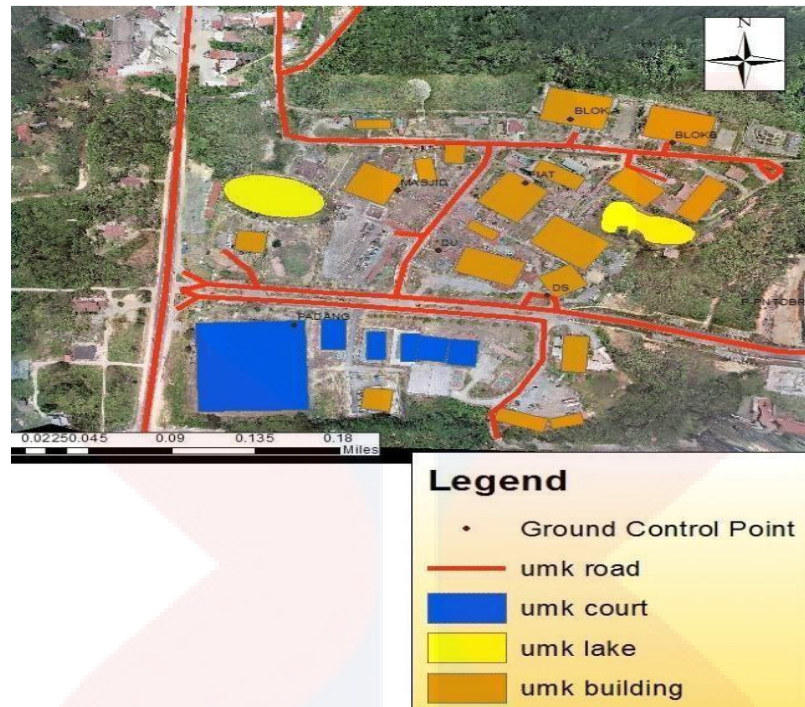


Figure 3.1: Maps of University Malaysia Kelantan, Jeli

3.2 Material

The materials and equipment that already used in this study are: 1) binoculars, which is an optical device that magnifies the image of distant objects, and allows the observation and identification of diurnal raptors up to the species level. The binoculars that used in this study are the Nikon Monarch 5 8x42, which has 8x magnification, objective lens diameter of 42 mm, field of view of 110 m at 1000 m, and weight of 590 g. These binoculars help a lot during the study of this vocal repertoire. I also conduct this study every day, during that time the use of binoculars is very important to identify the species being studied.. The audio recording equipment that used in this study is the poco x3 nfc phone, which has a built-in microphone, MP3 recording format, up to hours of recording time. using the phone recording audio will provide

quick information after the recording is complete. Audio recording equipment used to record the sounds of raptor species found in the study area, and to examine the vocal repertoire, frequency and diurnal behavior of raptors. recording equipment is used when glimpses of raptors appear, this is because the non-static movement of raptors will cause recordings to be taken when it is too late.

The period of data collection in a study can vary depending on the type of study, objectives, and methodology used. Data collection done after the field observations are completed each day. This is done to ensure that no forgetting occurs when entering the data that has been taken. In the study of raptor vocal behavior or any study that involves observing animals in their natural habitat, it is important to record environmental variables. This is because environmental variables can have a large impact on animal behavior. Environmental factors and measurement methods are air temperature, relative humidity, wind speed and direction, habitat type, human presence and activity and recording time.. Temperature weather conditions temperature can affect the level of activity and vocalization of raptors. Humidity can also affect vocal behavior and wind speed and direction can affect a raptor's ability to hear and produce vocalizations. Sky conditions indicate whether it is sunny, cloudy, or raining can affect the activity of raptors. For location and habitat is for habitat type for example, forests, grasslands, or urban areas can affect vocal behavior. Height above sea level is elevation because it can affect weather and vegetation, which in turn affects behavior.

Presence of predators or food sources the presence of predators or the availability of food can affect the frequency and type of vocalization. Human activity will also cause noise and disturbance from human activity to affect the vocal behavior of raptors in the study area. By recording these environmental variables, researchers can control or account for environmental effects in data analysis. Understand the context in which vocal behavior occurs and make more accurate comparisons between different situations.



Binocular



Audio Recording Equipment

Figure 3.2 Materials (source,google 2024)

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3.3 Data collection

3.3.1 Monitoring the raptors

Follow the raptors is the method used to track the species of raptors seen to find out the locations that are often visited by the raptors. During strip transects, raptor monitoring involves the use of motorized vehicles traveling at speeds between 10 and 30 kilometers per hour. Sightings of wild animals, whether seen or heard, within 1 kilometer on either side of the route were duly documented. In the study and monitoring of raptors, various tools and devices are used to document their sightings and calls. In addition, standardized forms and software are also used to ensure consistent data recording. Tools and Devices used are Telescopes and Binoculars. Telescope Used to see raptors from a distance clearly, especially species that are difficult to approach. While Binoculars are important for fast and portable observation. Camera with Telephoto Lens Used to capture detailed photos and videos of raptors, allowing accurate identification and documentation. Additionally, Voice Recorders are used to document raptor calls, which are important for species identification and behavioral studies. Occasionally, brief stops were made to confirm raptor identification during this interval, no additional raptor sightings were recorded.

During the brief stopover for raptor identification verification, several specific steps are taken to ensure accurate identification. The Confirmation Step is Detailed Observation by analyzing Physical Characteristics by observing characteristics such as plumage color, wing pattern, beak shape, body size, and tail shape. For Behavior by observing flight behavior, hunting methods, and interactions with the surrounding environment. Next, Written Description by making detailed notes about the physical characteristics and behavior of the observed raptors and recording the location and time of observation. Photography and Videography is also done by photographing raptors using a phone camera with a telephoto lens to capture important details that may not be visible with the naked eye Record Video to observe behavior and flight characteristics that can aid in identification. Audio Recording is to record the sound of a raptor call using a voice recorder or a recording application on a smartphone. Calls can be an important clue to identifying a particular species. EntitiesIn the context of raptor monitoring, a 'short period' to exclude a raptor from data collection usually refers to a period of time that is too short for the observer.

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To make an accurate assessment of the species or behavior of the raptor. Duration Time for short periods may refer to observations lasting less than a few seconds to several minutes, which are insufficient to make a confident identification. In many studies, observations lasting less than 5-10 seconds are considered too short to obtain accurate data. Observations of more than 1 minute provide more time to collect detailed data on physical and behavioral characteristics. Behavior Indicators are during Flight Behavior by observing flight patterns such as gliding, wing flapping, and flight style can provide important clues about the species. Interaction with the Environment is also by Seeing how the raptor interacts with its environment, such as hunting or perching, can provide additional context for identification. Next Listening and recording the calls or sounds of raptors during observation can help identify the species more accurately.

Transect surveys to monitor raptor activity are usually conducted frequently and on a strict schedule to capture diurnal (daily) variation in raptor activity. Daily activities transect surveys should be done during peak raptor activity times, which are early morning and late afternoon. This is the time when raptors are most active hunting and exhibiting vocal behavior. In addition, seasonal changes in breeding season, migration season, rainy season and drought. Transect surveys are usually conducted daily because to see the diurnal presence of raptors depends on the objectives of the study and available resources. During the breeding or migration season, survey frequency may be increased to capture important vocal repertoire changes in raptor activity. This is because the survey is conducted to ensure that the data

obtained is sufficient and accurate. Time of survey is survey conducted at different times of the day to capture diurnal variation in raptor activity. This includes morning, noon, and evening. Midday and late afternoon are often considered the most productive times to see raptors, as raptors are more active at this time in search of food. The survey schedule is usually planned to ensure sufficient data throughout the day. For example, a transect may be run at some fixed time such as 11:00 a.m., 2:00 p.m. Some studies may have more detailed schedules tailored to the specific activity patterns of the raptor species being studied. By following this strict and varied schedule, researchers can obtain a more complete picture of raptor activity patterns throughout the day and season, which is important for understanding raptor ecology and conservation.

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3.4 Data analysis

3.4.1 Descriptive statistics

Descriptive statistics are a method of summarizing and presenting the data using numerical or graphical methods, such as mean, standard deviation, frequency, table, or chart. This method is suitable for analysing the data collected from the methods of this research, as it allows the description and comparison of the main features and patterns of the data, such as the abundance, diversity, distribution, and density of raptors and their vocalizations in the study area. This method is also feasible and reliable because the accuracy in data collection is complete. However, there are some specific challenges when collecting or analyzing data, challenges in terms of similarities between vocalizations that are done but have different meanings. The way to deal with the problem is to carefully examine the vocalization patterns that are sounded. Additionally, the data will be tagged and categorised, and any outliers or abnormalities will be detected and dealt with accordingly. Data Visualization is Box Plot by Displaying data in the form of boxes and lines, where outliers usually appear as points that are far outside. While the Histogram is to check the distribution of data to identify values that are far from others to make a comparison. The data will be summarised using descriptive statistics to quantify the central tendency, variability, and frequency of the data. Data visualization plays an important role in understanding the abundance, diversity, distribution, and density of raptor species. Line Charts are for Monitoring Changes Over Time Line charts are used to show changes in raptor abundance over time. For example, the number of raptor species observed each day. while Histogram is used for Abundance

Distribution because Histogram helps in seeing the distribution of raptor abundance, such as how many locations have a certain number of raptors. in order to show the data in a manner that is both brief and visually appealing. In order to explain and compare the data, such as the abundance, variety, distribution, and density of raptors and their vocalisations, the data will be evaluated using descriptive statistics and graphical approaches.



CHAPTER 4

RESULT DISSCUSION

4.1 Raptors Family

This study was conducted at UMK only the Crested Serpent eagle species was found. the total number of individuals found throughout the study was 3, namely 2 adults and 1 baby eagle. the baby eagle was found in the eagle's nest which is near the hill of Agro Park. During the research I also found 3 crested serpent eagle nests but only one nest was active because there were baby eagles in the nest. while the other 2 were found abandoned. The most dominant sighting is from the accipitridae family consisting of the crested serpent eagle. Only one species of bird is found at UMK jeli, which is only represented by a single species. Crested serpent-eagle raptor records from the accipitridae family, which were detected throughout the sampling effort of all species recorded in this study are classified as least concern (lc) by the iucn red list of threatened species. The accipitridae family consists of the crested snake eagle found at UMK Jeli, the brahminy kite, the black eagle, the red-tailed eagle, the white-bellied sea eagle and the sea eagle but only the crested snake eagle is often found at UMK Jeli compared to other species and this data will be recorded in this research. This is because the study area is only suitable for the diurnal species of raptors crested serpent eagle. Crested serpent eagle *Spilornis cheela* is found throughout south-east, south and east asia and is categorized as least concern (birdlife international 2017). It is found in a wide variety of habitats, from mangroves at sea-level to hilly, disturbed and primary forests up to 1,900 m (wells 1999).



Figure 4.1: Crested Serpent Eagle from the Accipitridae family.(Source Mybis 2024)

In this study, members of the accipitridae family can only be found during the midday hours around 11 am to 2 pm. This is because at that time it is an active time for raptors. They have a wide foraging range and feathers adapted for long and fast flight (Manchi and Sankaran, 2010). Therefore, they constantly move from one place to another in search of food.

Of the 44 species found in Peninsular Malaysia, UMK jeli kampus has one species from the accipitridae family. The species recorded is the crested serpent eagle. The exposed skin of the face and legs is yellow. The lower part is spotted with white and yellowish brown when the tip of the wing does not reach the tip of the tail. This coloration is important for its adaptation in terrestrial ecosystems. Most of them are sociable because the crested serpent eagle is only friends with its own species and can only be found in groups of its own species. In this study, crested snake eagles can be found at the forest edge canopy level, usually in pairs or friends, rarely alone.

4.1.1 Raptors repertior

The crested serpent eagle (*Spilornis cheela*) is known for its diverse vocal repertoire, which includes a variety of calls and songs. Among them is that in terms of calls, the crested serpent eagle has several types of calls including perching calls. These are usually short and shrill, often described as "Kuk-kuk-kuk, fi-fifi-feefee" Or "Fee fee" (Ferguson-lees, and, Christie 2005). The flight call is usually longer and more melodious, often described as a series of whistling notes like "Fii-feefee". A begging call is a high-pitched, urgent call by young birds to beg for food from adults. Song: The crested serpent eagle has a distinctive song, often described as a series of whistling notes, which is used for territorial defense and mate attraction such as "Fee dues" (Ueta and Minton. 1996).

Types of domestication species have been recorded making different types of vocalizations which are referenced based on the website xeno canto, Ueta and Minton(1996) where the vocalization data of each crested snake raptor will be referenced on the website as an example of a flight call based on each assigned code. The use of the xeno canto website is to determine the behavior of the raptors and be able to compare the vocalizations for each behavior ie xc501303, xc549583, xc338049, xc730962, xc730880, xc730880, xc8269. While for calls to voice codes are xc501303, xc549583, xc338049, xc730962, xc730880, xc826945, xc809895. Next is beggar calls are xc213912, xc730962, xc730880, xc826945, xc809895, xc570921, xc530270, xc150851, xc88411, xc529891. Each given code is a vocalization of one crested snake eagle species but a different individual.

Vocalization duration is vocalization duration varies from 0.04 to 1:53 seconds, with most recordings between 0.1 to 1.0 seconds. Voicing quality the recording quality varies from clear and loud to distant and faint, depending on the location and recording conditions of the study site under study. The frequency of vocalization of raptors is for the frequency of vocalization varies depending on the location and time of day. In general, this species is loudest in the afternoon and evening. Vocalization context: Vocalization is often used in specific contexts, such as courtship where males sing to attract females and defend territories. While for territorial defense, males use vocalizations to defend their territory from other males who want to enter their territory. Communication is used when both males and females use vocalizations to communicate with each other, especially during courtship and territorial defense. Conservation status: The crested serpent eagle is listed as least concern on the iucn red list, indicating that it is not considered endangered. However, some subspecies are critically endangered due to habitat destruction.



Figure 4.2: crested serpent eagle fight call behaviour
(Source eBird 2024)

DAY	TIMES	TEMP	ID SPECIES	VOCAL REPERTOIR	MEAN VOICE
DAY 1	10:30-2.00	31`c	Crested Serpent Eagle	" fi-fifi-feefee"	CALL
DAY 2	10:50-1.00	28`c	Crested Serpent Eagle	" fii-feefee"	SONG, FLIGHT CALL
DAY 3	10.30-1.30	29`c	Crested Serpent Eagle	"fee fee"	Song
DAY 4	11.50-2.00	33`c	Crested Serpent Eagle	"Kuk-kuk-kuk, fi-fifi-feefee"	Call
DAY 5	11.50-2.00	31`c	Crested Serpent Eagle	"fi-fifi-feefee"	Call
DAY 6	10.33-1.00	28`c	Crested Serpent Eagle	"fee fee"	Song
DAY 7	10.16-12.00	29`c	Crested Serpent Eagle	"Kuk-kuk-kuk, fi-fifi-feefee"	call
DAY 8	10.29-1.00	31`c	Crested Serpent Eagle	"fee fee"	Song
DAY 9	10.30-1.30	31`c	Crested Serpent Eagle	"fi-fifi-feefee"	call
DAY 10	10.26-2.00	29`c	Crested Serpent Eagle	" fi-fifi-feefee"	call
DAY 11	10.16-1.00	30`c	Crested Serpent Eagle	"Kuk-kuk-kuk, fi-fifi-feefee"	call
DAY 12	10.34-1.00	31`c	Crested Serpent Eagle	" fii-feefee"	Flight call
DAY 13	10.30-1.30	30`c	Crested Serpent Eagle	Kuk-kuk-kuk, fi-fifi-feefee	call
DAY 14	11.00-2.00	31`c	Crested Serpent Eagle	" fii-feefee"	Flight Call
DAY 15	10.45-1.30	30`c	Crested Serpent Eagle	"fee fee"	Song

DAY 16	10.30-1.30	28`c	Crested Serpent Eagle	"Kuk-kuk-kuk - feefee"	call
DAY 17	11.00-2.00	29`c	Crested Serpent Eagle	"fee fee"	Song
DAY 18	11.00-2.00	31`c	Crested Serpent Eagle	"Kuk-kuk-kuk, fi-fifi-feefee"	call
DAY 19	10.30-1.30	30`c	Crested Serpent Eagle	"fee fee"	song
DAY 20	11.00-2.00	31`c	Crested Serpent Eagle	"fee fee"	song

Table 4.1: Vocalization behavior of crested snake eagle at UMK Jeli Campus

Based on a table of results from a field study conducted for 20 days, the table shows the diurnal behavior of raptors when producing different vocalizations or repertoires. based on the table, only one species was found throughout the study which was the crested snake eagle. In this study, I also found 3 crested snake eagle nests in the UMK Jeli agro park, which shows that raptors have been living in the agro park for a long time. The agro park area has an environment filled with tall trees and the environment that encourages the agro park to be used as a habitat encourages the crested snake eagle to inhabit tall trees as a place to live.

Throughout the study, vocalizations produced by diurnal raptors varied from day to day. Vocalizations frequently emitted throughout the study conducted by the diurnal crested serpent eagle raptor were voice calls, songs, and flight calls. The vocalizations emitted are to indicate behavior during

territory surveillance, foraging and mate-seeking. based on table 4.1 shows the time the study was conducted is at 11:00 in the morning at 2:00 in the afternoon because at that time are the active hours for the active crested snake eagle species. The temperature in the field observation also changes every day because the temperature change in the area is a factor in the cloud cover in the area. Time intervals and temperatures were chosen for observation because certain temperatures affect the behavior of raptors when the surrounding temperature changes. while at different times affect behavior because only at noon is the active time for each raptors.

For the crested serpent eagle's vocal repertoire, each meaning produced is different, such as for the repertoire "fii-feefee" means flight call while for "fee fee" it means song and the vocal repertoire for call is "Kuk-kuk-kuk, fi -fifi-feefee". During the study, one of the 3 crested serpent eagle nests found in Agro Park had raptors living in the nest.

4.1.2 Vocal behaviour

The crested serpent eagle (*Spilornis cheela*) is a diurnal raptor known for its vocal behavior. Crested eagles communicate with each other using vocal signals and aerial displays. Their courtship display involves leaping at each other with raised head and tail feathers. They can often be seen hovering above the forest making their distinctive call, which tends to be three high pitched "Fi-fifi-feefee". When anxious, the crested snake eagle will raise its crest. This visual display may work in conjunction with their vocalizations to communicate. The function of nocturnal vocalizations in diurnal raptors is not fully understood but may be used for purposes such as communication alarm, resource location, maintenance of pair bonds, territorial defense and mate attraction. For more specific studies, researchers can refer to Raptor Research and Management Techniques by David Bird and Keith Bildstein, which provides a comprehensive overview of raptor vocal behavior. Detailed field studies and direct observations of crested snake eagles in their natural habitat to better understand the context and function of their nocturnal vocalizations. In short, the crested serpent eagle uses a variety of vocal and visual displays, including a distinctive three-note call and raised crest, to communicate with conspecifics. Although primarily diurnal, nocturnal vocalizations have been observed in this species, indicating a more complex pattern of activity than traditionally believed.

Based on the search results provided the battle call behavior of the crested serpent eagle is that the crested serpent eagle has a diverse vocal repertoire that includes a variety of calls and songs used for communication, courtship and territorial defense. One of the crested snake eagle's primary vocalizations is its "flight call", which is described as longer and more melodious, often a series of whistling notes. This flight call is used by crested serpent eagles during air displays and territorial defense. the difference between each vocalization can be seen from the vocal repertoire of the vocalization such as short acoustic characteristics, loud vocalization and long vocalization. The birds are known to call often while hovering above the forest canopy with their wide wings and tails. Flight calls are an important part of the species' territorial behavior. Males use this call to defend their territory from other males, often engaging in vocal duets with neighboring birds. The frequency and timing of flight calls varies, with birds being loudest in the early morning and late afternoon. This suggests calling plays a role in activities such as courtship and territory maintenance. In addition to flight calls, the crested serpent eagle also makes other vocalizations, such as perching calls, begging calls, and dawn songs, which serve different communicative functions.

4.1.3 Vocalization

Fortunately, some species have strong calls that aid in detection and location. First of all, a very noisy group of crested snake eagles is easy to follow when making any vocalizations and will be quiet if someone walks back and forth for several hours through their home range. Crested serpent eagle will also become silent when there is disturbing human activity near their nest. The thing that triggers vocalization is when the raptors feel threatened or hunting prey. Around their nests, crested serpent eagles are aggressive and but may be quiet if no other species disturbs them several hundred meters away. Crested snake eagles rarely fail to perform display flights over the canopy with loud calls almost every day if the weather is good, but usually short (5-15 min) and only once a day in mid-afternoon to evening. Good weather is starting at 11:00 is a situation where the raptors will come out. While when the weather is not good such as rain or too high temperature will cause raptors not to come out or do less activity. Therefore, the territory pair can be located from within the forest.

The crested serpent eagle (*Spilornis cheela*) is known for its diverse vocal repertoire. Here is a comparison of its vocal behavior according to different temperatures, which is for the temperature range, the crested serpent eagle is found in tropical and subtropical areas, with a temperature range of 15°C to 35°C (59 °F to 95°F). The vocalization patterns of species vary with different temperatures. For example, warmer temperatures because in warmer temperatures, rattlesnake vocalizations tend to be louder, with a higher frequency of calls and songs (Ferguson- and Christie 2001). This is because at

high temperatures Temperature also affects the sound transmission medium. At higher temperatures, air density decreases, causing less resistance to sound waves, which can increase the amount of sound produced. Muscle Contraction Speed is At higher temperatures, the muscles involved in sound production contract faster. This increases the frequency of the vibrations that produce sound, which in turn increases the frequency of calls. Whereas for warmer temperatures in warmer temperatures, the frequency of species vocalization tends to decrease, with fewer calls and songs. The vocalization type of crested snake eagle makes a variety of vocalizations, including this territorial call which is usually longer and more melodious, often described as "Kuk-kuk-kuk, fi-fi-fi-feefee". This vocalization will be used when there is a threat from another species that disturbs its territory. Flight call This is shorter and louder, often used during aerial displays and territorial defense (wells 1999).

4.2 Data Analysis

4.2.1 Comparison of voice repertoire between frequencies

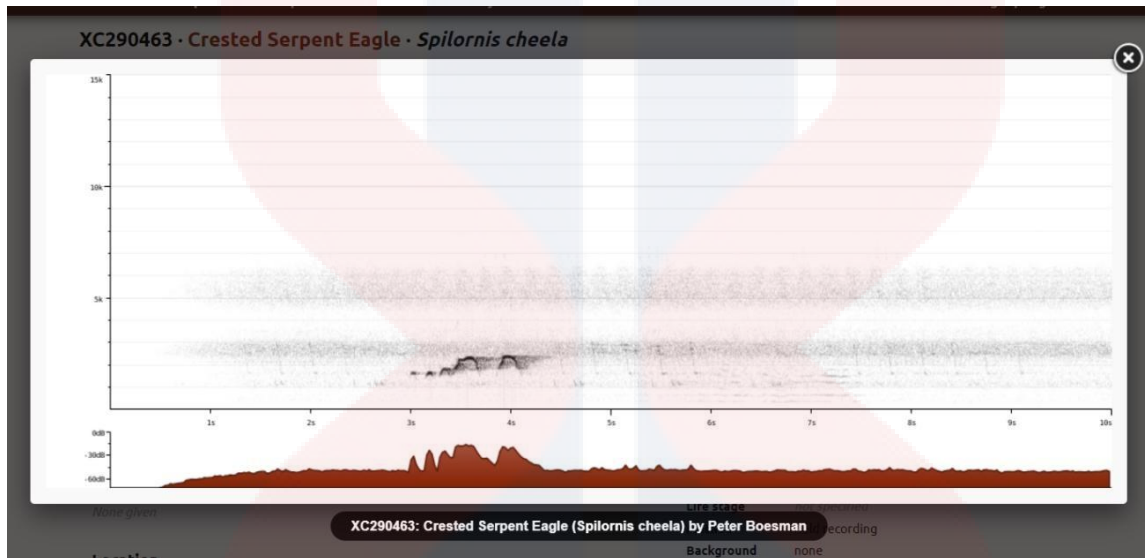


Figure 4.3: Crested Serpent Eagle call Frequency

Referring to figure 4.3 shows the frequency period of the eagle-crested snake's call, the raptor's diurnal call pattern produces only rare sounds. frequency duration is the vocalization that is chanted, how many seconds it takes to sound one vocalization. while for rare sounds, this vocalization is only done a few times throughout the duration of the vocalization recording at any given time. This is because the use of vocalization is only used for territorial defense. One of the main reasons crested snake eagles call is to establish and defend their territory. Communication with children is to call parents to communicate with their eaglets, especially when bringing food. While the warning to danger call can also serve as a warning to warn eagles or other birds of potential threats, such as predators or humans. After making a sound, the crested snake eagle will take time to make the same sound every few minutes.

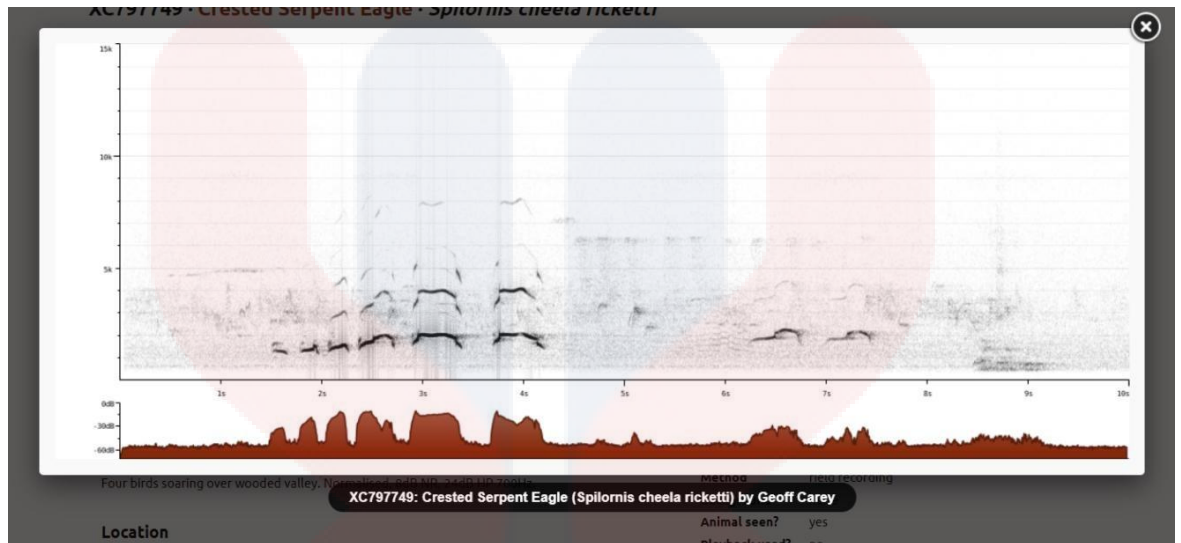


Figure 4.4: crested serpent eagle flight call frequency

Picture 4.4 shows the crests serpent eagle's flight call pattern which is often sounded by the species. The frequency in speaking is high because looking at the picture the frequency in speaking is frequent. this is because voicing is done will produce a higher voicing. This vocalization indicates territory announcement because while flying over its territory, an eagle may call to announce its presence to warn other eagles to stay away from its territory. Also for coordination because when flying with other eagles, such as family groups or during migration, flight calls can help maintain position among group members and also for alerts because flight calls can serve as a warning to other birds or eagles about the presence of predators or potential threats this type of call can convey a state of readiness to respond to danger.

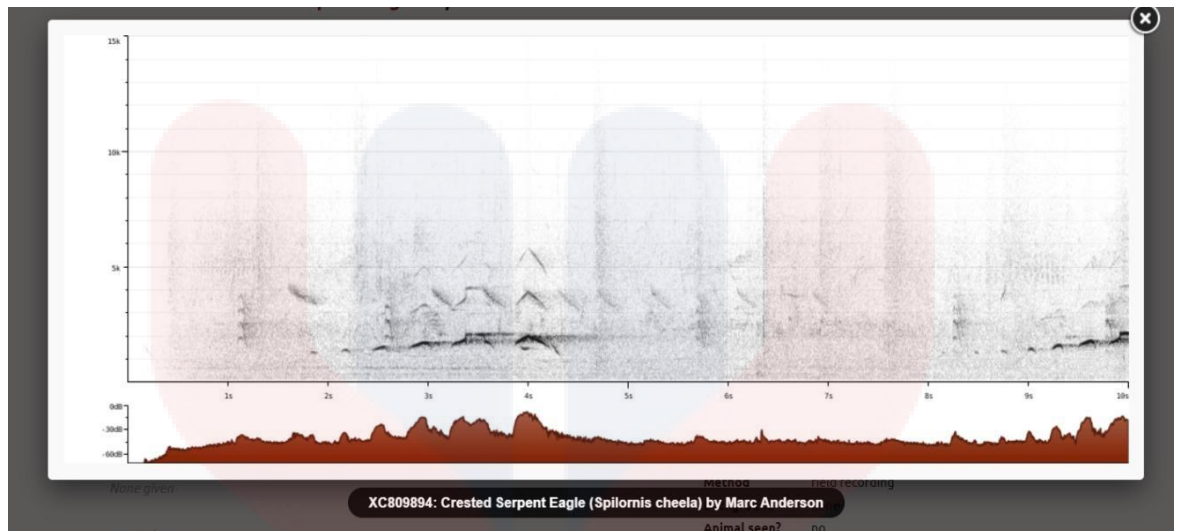


Figure 4.5: Crested Serpent Eagle Song Frequency

Figure 4.5 shows the frequency of the crested snake eagle's song on the umk jeli campus, this vocalization is one of those that are often sounded to perform a behavior. The frequency of the crested snake eagle's (*Spilornis cheela*) call is an important aspect of its communication, reflecting both its ecological adaptations and its behavioral needs. The call frequency feature is the range and pitch of this because crested eagle calls are usually in the high-pitched whistle range. This frequency is ideal for long-distance communication, which is important for territorial defense, mate attraction, and warning of danger. Behavioral functions during vocalization are to territorial calls as these are often high-pitched and loud to ensure they cover a large area, making it clear to other eagles that the territory is occupied. Additionally call songs are also for mate attraction and courtship because during the breeding season, call frequency may vary slightly to include a more varied tone pattern, which can be more attractive to potential mates.

	Song	Call	Flight Call
Total	6	10	3

Table 4.2 : Total vocal repertoire diurnal raptors

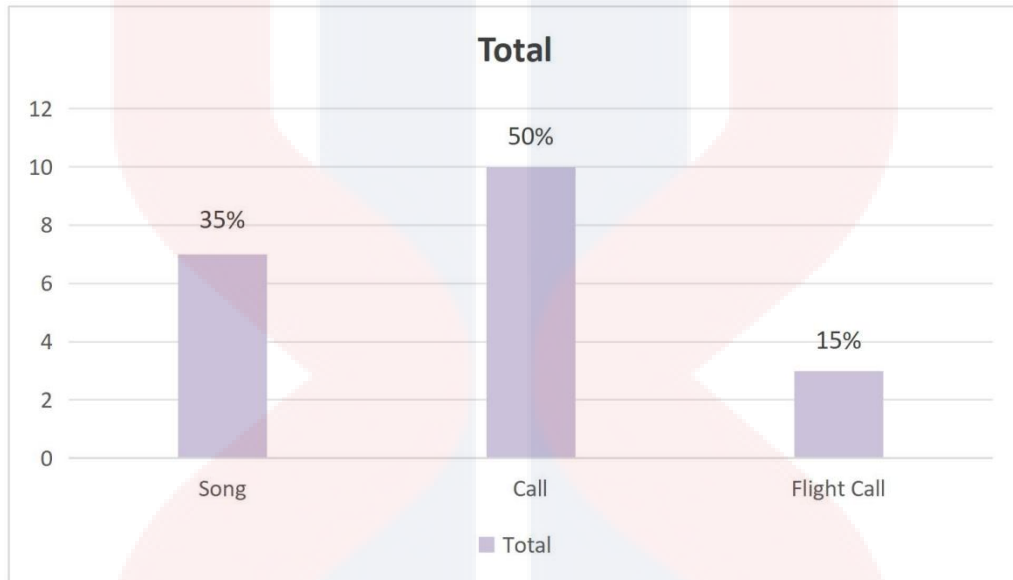


Figure 4.6: Total difference Sound Crested Serpent Eagle at UMK Kampus Jeli.

Another tool that helps in evaluating diurnal vocalization differences of raptors residing in Agro Park UMK Jeli uses daily data. It is a free software widely used by biologists and conservationists to calculate the various differences between each of the diurnal vocalizations of these raptors. In this study, excel was used to carry out total calculations such as calculations for accuracy, the resulting graphs are smooth and easy to understand and interpret. A histogram graph in an excel spreadsheet using the vocalization data of each different call.

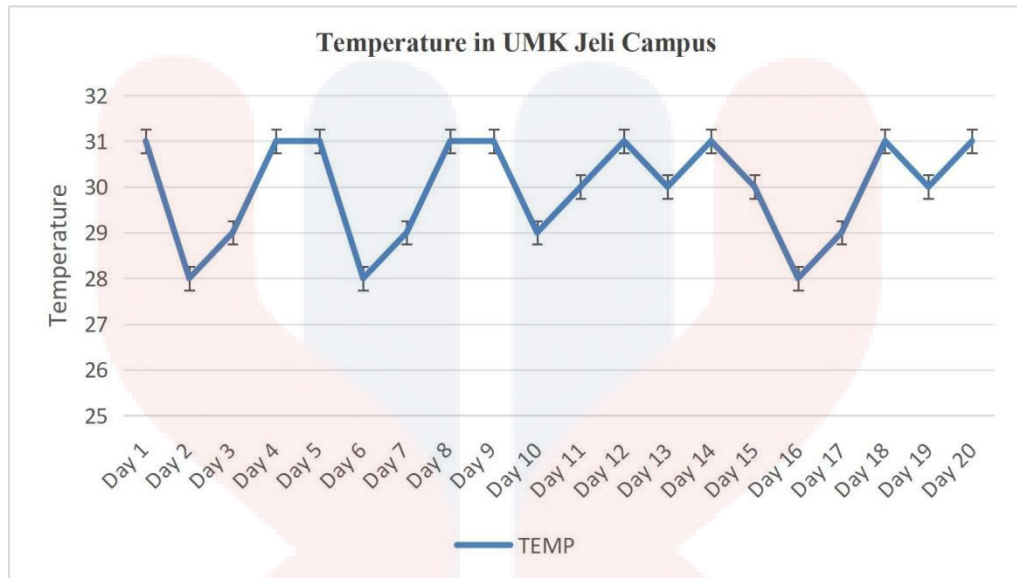


Figure 4.7: Line graph sampling temperature in UMK Jeli Campus

Based on table 4.3 is the temperature throughout the field observation carried out for 20 days. The temperature in an area is also a factor that affects the diurnal vocalization behavior of raptors in that area. This is because the highest temperature throughout the sampling was at a temperature of 31°C because at that temperature the behavior of the raptors will slow down or decrease because the raptors are more perched on tall trees or in their nests. While the lowest temperature during training is at a temperature of 28°C.

In addition, based on figure 4.7 is a line graph that shows the temperature changes on each day throughout the sampling. On the first day, the highest temperature was at 31°C and decreased on the second day to 28°C. This shift occurs on a daily basis because the erratic temperature in the area causes it to change. Look at the graph also shows that the temperature of 31°C is a temperature that is often experienced at umk jeli campus. However, the temperature experienced throughout the sampling will not interfere with the

observation being carried out unless it rains which will interfere with the sampling being carried out because diurnal raptors will not come out when it rains and they will sit in their nests until the rain stops.

Table 4.4: Total temperature sampling

Temp	28°c	29°c	30°c	31°c
Total	3	4	4	9

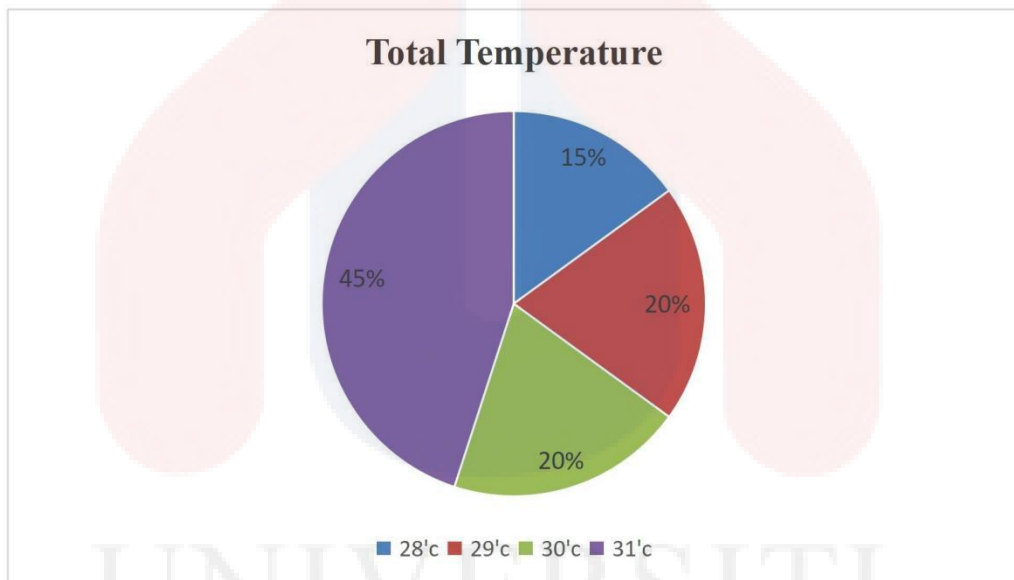


Figure 4.8: Pie chart temperature Crested Serpent Eagle according to temperature at UMK Campus Jeli.

Each pie represents the total number of temperatures throughout the 20 sampling days. At a temperature of 28°c the amount for sampling is as much as 4 days or equal to 15%, at this temperature there is also a lot of activity because the temperature of the area is normal, causing high vocalization. While at 29 and 30°c it is equal to 4 days or equal to 20%. A slight increase in activity as the temperature becomes higher. In addition to that, at a temperature of 31°c is the temperature that is often experienced when carrying

out the sampling. At this temperature is also where the crested serpent eagle will be active in their vocalization and behavior. It is because vocal activity will peak, the ideal temperature range for many diurnal wildlife. For the temperature of 31°C there is also a significant increase in vocal activity due to the high temperature. Referring to this pie graph the most experienced temperature throughout the study was at a temperature of 31°C. While the most common temperature throughout the 20 samplings is at a temperature of 29-30°C. This is because the area is on a hillside which causes high temperatures at that time. In cold temperatures, raptors can conserve energy, while in high temperatures, they avoid overheating by reducing activity.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Universiti Malaysia Kelantan Jeli campus can still be considered as a suitable habitat for the Crested Sserpent eagle community. Through this preliminary study, we observed a low diversity of Accipitridae species, with only one species of diurnal raptor identified in the area. This could be due to the specific habitat preferences of the Crested Serpent Eagle and the limited scope of our study. This is because the species of accipitridae crested serpent eagle has the same habitat as the study area which has a forest environment around it. This study demonstrates that human-modified habitats can still support diurnal wildlife species, but their ecological value may diminish without sustainable management practices. Anthropogenic activities, such as land conversion for agriculture or urban development, can lead to deforestation, habitat fragmentation, and increased stress on resident bird populations, thereby threatening their survival. The step that needs to be taken is to reduce the felling of trees because it can threaten the habitat of the raptors. Therefore, further studies are important to monitor their population in the future.

The methodology used in this study is to monitor raptors from 11:00 am to 2:00 pm. this is because only at that time the raptors will be active compared to other times. The study area is in agro park because it is suitable for carrying out observation procedures. which have environments that favor

more other diurnal raptor species from the accipitridae family. In addition, the number of individuals throughout the observation was low, ie 3 individuals were in the same area. There was 1 common species found during the 20 days of sampling, which shows that the agro park is still protected because the surrounding forest and land are not overused.

This study also emphasizes the importance of forests to resident birds and the effects of forest degradation or land conversion to agriculture or urbanization where the frequency of bird sightings is much lower than in forested areas. Changes in Call Frequency and Loudness occur Frequency Decline as Some species may decrease their call frequency in degraded forest areas. This may be due to changes in forest structure that affect sound transmission. For Specific Indicators and Observed Trends are Changes in Habitat and Structure because Habitat Fragmentation is Forest Fragmentation due to logging or agricultural development causing the habitat to become smaller and more isolated. The development of recreational areas has somehow disturbed the ecology of forest-dependent species because only 45% of all bird species can adapt in human-modified habitats (Birdlife International, 2013). Therefore, more bird species can be found if no recreation area is built there. This study also focuses on the diurnal vocal behavior of raptors to describe the state of the ecosystem where resident birds and resident birds live. It is because birds are one of the fauna that habitats. As they are responsive to change, their diversity and abundance reflect other ecological trends of biodiversity.

5.2 Recommendation

The following recommendations may be made based on the findings regular resurveying should be conducted, ideally on an annual basis, to monitor the presence of raptor species and ensure their habitats remain suitable, preventing them from escaping or migrating due to unfavorable conditions. Future development at UMK Jeli campus should adhere to stringent environmental guidelines that prioritize the conservation of raptor habitats. This includes limiting tree felling, preserving green spaces, and implementing eco-friendly construction practices. This is because to carry out excessive development and can threaten the species of raptors in the area. According to this study, since the recreation area is still in the early stages of development, it may support a variety of diurnal wildlife species. Other animals supported by the recreation area are birds of other species such as small birds. The early phase of development and support for wild animals is green design planning with native tree planting because the selection and planting of native trees that are suitable for the local ecosystem helps provide habitat and food sources for wild animals. In addition, the herb and flower garden is also an early phase of development by planting herbs and flowers that attract insects to help support bird populations that depend on insects as a source of food. With an increase in bird species, the region has the potential to develop eco-tourism activities such as bird watching and educational tours. Collaborating with forestry agencies to organize events like bird races can enhance community involvement and support the conservation of raptor habitats. This can be done by carrying out activities with any forestry agency such as bird race activities to identify bird species found in the umk jeli

campus area. This will also encourage the maintenance of species habitat rather than excessive development. However, due to variations in temperature, diversity and species richness naturally fluctuate frequently. Stable temperatures support diversity because areas with less variation in temperature throughout the year tend to have more species because stable conditions make it easier for species to adapt and reproduce. When temperatures change reduces diversity because in areas with high temperature variations only highly adaptive species can survive, reducing overall diversity.



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7.0 APPENDIX



Nest Crested Serpent Eagle



Sampling Site



Binocular Sampling

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