REPRODUCTIVE BEHAVIOUR OF CAPTIVE MALE MALAYAN TIGERS *(PANTHERA TIGRIS JACKSONI)*

By

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ABSTRACT

The Malayan tiger (*Panthera tigris jacksoni*), a critically endangered subspecies, faces a significant risk of extinction. Effective conservation strategies, particularly captive breeding programs, are crucial to ensuring the species' survival. However, successful reproduction in captivity is challenged by various factors, including stress, limited space, and social dynamics, which can affect the reproductive behaviour of male tigers. Understanding these behaviours is crucial for enhancing breeding success and supporting population growth. This study aims to bridge the gap, providing understanding of the reproductive behaviour of captive male Malayan tiger. The study was conducted at the National Wildlife Rescue Centre (NWRC) in Sungkai, Perak. Focal observation through closed-circuit video (CCTV) of the reproductive behaviours of captive male Malayan tigers (n=2) was conducted daily between 08:00 and 17:00hours for a period of 24 days. The key reproductive behaviours such as prustening, the Flehmen response, rolling, rubbing, and other mating-related activities were observed and recorded in a sampling ethogram sheet. Data obtained were analysed to categorize and evaluate the specific patterns of reproductive behaviour in captive male Malayan tiger. The research found that Yeop Kuang (T1M) exhibited a significant increase in the frequency of synchronized behaviours with Mek Santong (T1F), particularly prustening, rubbing, and rolling, which suggests a closer bond and active courtship. This increased synchronization highlights the potential for improving mating interactions in captive settings, as these behaviours may indicate higher reproductive readiness and compatibility. In contrast, the study also found that Apek Bihai (T2M), another male tiger, showed fewer and less frequent reproductive behaviours, possibly due to his younger age and lower acclimatization to captivity. The limited display of prustening and Flehmen response supports the idea that age and environmental factors may play a significant role in shaping reproductive behaviours. The findings from this research provide valuable insights into the reproductive dynamics of male Malayan tigers in captivity, emphasizing the importance of behavioural synchronization and environmental factors.

Keywords: *Captive breeding, Conservation, Focal observations, Male Malayan tigers, Reproductive behaviour,*

TINGKAH LAKU REPRODUKTIF HARIMAU MALAYA JANTAN (*PANTHERA TIGRIS JACKSONI*) DALAM KURUNGAN

ABSTRAK

Harimau Malaya (*Panthera tigris jacksoni)* ialah subspesies yang terancam secara kritikal dan menghadapi risiko kepupusan yang tinggi. Strategi pemuliharaan yang berkesan, terutamanya program pembiakan dalam kurungan, adalah penting untuk memastikan kelangsungan spesies ini. Namun, terdapat beberapa faktor yang mencabar pencapaian kadar pemuliharaan Harimau Malaya dalam kurungan iaitu tekanan, ruang terhad, dan dinamik sosial, Oleh itu, memahami tingkah laku ini adalah penting untuk meningkatkan kejayaan pembiakan dan menyokong pertumbuhan populasi**.** Kajian ini bertujuan untuk merapatkan jurang, memberikan pemahaman tentang tingkah laku pembiakan harimau Malaya jantan yang ditangkap. Kajian ini dijalankan di Pusat Penyelamat Hidupan Liar Kebangsaan (NWRC) di Sungkai, Perak. Pemerhatian fokus melalui video litar tertutup (CCTV) terhadap tingkah laku pembiakan harimau Malaya jantan yang ditangkap (n=2) dijalankan setiap hari antara 08:00 jam dan 17:00 jam selama 24 hari. Tingkah laku pembiakan utama seperti prustening, tindak balas Flehmen, berguling, menggosok, dan aktiviti berkaitan reproduktif yang lain telah diperhatikan dan direkodkan dalam helaian etogram pensampelan. Data yang diperoleh telah dianalisis untuk mengkategorikan dan menilai corak tingkah laku pembiakan tertentu dalam harimau Malaya jantan yang ditangkap. Penyelidikan mendapati bahawa Yeop Kuang (T1M) menunjukkan peningkatan ketara dalam kekerapan tingkah laku yang diselaraskan dengan Mek Santong (T1F), yang menunjukkan ikatan yang lebih rapat serta keserasian yang baik. Peningkatan penyelarasan ini menonjolkan potensi untuk meningkatkan interaksi pembiakan dalam persekitaran kurungan kerana tingkah laku ini menunjukkan ketersedian reproduktif dan keserasian yang lebih tinggi. Sebaliknya, kajian juga mendapati bahawa seekor lagi harimau jantan iaitu Apek Bihai (T2M), mencatatkan tingkah laku mengawan yang rendah berkemungkinan disebabkan oleh faktor usia yang lebih muda dan penyesuaian yang lebih rendah dalam kurungan. Pameran terhad prustening dan tindak balas Flehmen harimau ini menyokong idea bahawa faktor umur dan persekitaran mungkin memainkan peranan penting dalam membentuk tingkah laku pembiakan. Penemuan daripada penyelidikan ini memberikan pandangan berharga tentang dinamik pembiakan harimau jantan Malaya dalam kurungan, menekankan kepentingan penyelarasan tingkah laku dan faktor persekitaran. Dengan meningkatkan pemahaman tentang tingkah laku ini, kajian ini bertujuan untuk memaklumkan dan meningkatkan protokol pembiakan dalam kurungan, menyumbang kepada pemuliharaan jangka panjang harimau Malaya dan kelangsungannya dalam populasi dalam kurungan dan liar.

***Kata kunci**: Harimau Malaya jantan, Pembiakan dalam kurungan, Pemerhatian fokus, Pemuliharaan, Tingkah laku pembiakan*

CERTIFICATIONS

This is to certify that we have read this research paper entitled **'Reproductive Behaviour of Captive Male Malayan Tigers *(Panthera Tigris Jacksoni)'*** by **Batrisyia Bazla binti Husain**, and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirements for the course DVT 55204 – Research Project.

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LIST OF ABBREVIATIONS

NWRC - National Wildlife Rescue Center

DWNP - Department Wildlife National Parks

MYCAT - Malaysian Conservation Alliance for Tigers

CCTV - Closed-Circuit Television

LH - Luteinizing Hormone

ID – Identification

GnRH - Gonadotropin hormone-releasing hormone

CHAPTER 1

INTRODUCTION

1.1 Research Background

The global population of tigers (*Panthera tigris*) has experienced a significant decline, primarily due to habitat loss and fragmentation, human persecution, and the depletion of prey (Ten *et al.,* 2021). Conservation scientists have identified six existing subspecies of tigers: the Bengal tiger (*Panthera tigris tigris*), the Amur or Siberian tiger (*Panthera tigris altaica*), the Sumatran tiger (*Panthera tigris sumatrae*), the Indochinese tiger (*Panthera tigris corbetti*), the Malayan tiger (*Panthera tigris jacksoni*), and the South China tiger (*Panthera tigris amoyensis*) (Liu et al., 2018). All these subspecies are listed as endangered, critically endangered, or extinct in the wild.

The Malayan tiger, endemic to the forests of Malaysia is a distinctive and vitally important species for the region's biodiversity. Due to the continuing decrease in the wild, the Malayan tiger (*Panthera tigris jacksoni*) has become an urgent priority to conservation efforts. For optimally breeding success in captivity, understanding male reproductive behaviour is one of the strategies among many that are used to preserve genetic diversity and maintain such species' survival.

Despite its importance, there is only little understanding of male reproductive behaviours in tigers in particular relating to their mating strategies and social interactions. Such lack of knowledge represents breeding program challenges to raising Malayan tiger numbers. The purpose of this study is to examine and monitor the reproductive behaviour of male Malayan tigers in captivity systemically. This research will deepen our understanding of male mating dynamics in the documenting behaviours such as prustening, rubbing, tail lifting, and Flehmen response.

1. 2 Problem Statement

A critically endangered subspecies, the Malayan Tiger (*Panthera tigris jacksoni)* is at very high risk of extinction with less than 200 left in the wild (PERHILITAN, 2022). For the species survival, conservation efforts have been crucial, and captive breeding programs are one of the crucial. Despite its importance, captive breeding still confronts many challenges because little is known about how male tigers reproduce.

Natural mating behaviours like dominance signalling, territorial marking, and wooing displays can be disrupted by things like stress and unfavourable environmental conditions. Despite being crucial to effective reproduction, these behaviours are still not well understood. There is a significant knowledge gap about the role male tigers play in mating success because the majority of the current study focusses on the reproductive cycles of female tigers.

Significant progress has been made in habitat protection and anti-poaching measures thanks to conservation initiatives spearheaded by the Department of Wildlife and National Parks Peninsular Malaysia (DWNP) and partnerships with groups like the Malaysian Conservation Alliance for Tigers (MYCAT).However, reproducing successfully in captivity is also very difficult and this is so because of factors such as stress, lack of space and social dynamics that have a bearing on the reproductive behaviour of male's tigers. In order to support population growth, the reproductive behaviour of male Malayan Tigers in captivity is necessary to understand so that breeding success can be improved.

The role of male reproductive behaviour, consisting of courtship displays, territory marking, dominance, is underexplored and much of the existing research revolves around the reproductive cycles of Malayan tigers. Stress, environmental conditions in captivity, and specific behavioural patterns may significantly impact reproductive success (Kleiman et al., 2015). This gap in understanding represents a bottleneck is to optimizing breeding programs in captivity.

1.2 Research Questions

1. What are the reproductive behaviours of male Malayan tigers (*Panthera tigris jacksoni*) in captivity?

1.3 Research Hypothesis

1. Male Malayan tigers in captivity exhibit specific mating behaviours, such as prustening, rubbing, and rolling.

1. Research Objectives

1. To determine the reproductive behaviours of male Malayan tigers in captivity.

CHAPTER 2

LITERATURE REVIEW

2.1 Reproductive Mechanism

Generally, there are two reproductive mechanisms which are induced and spontaneous. Tigers (*Panthera tigris*) and other Felids undergo induced ovulation. Copulation triggers ovulation in these animals. In solitary animals with limited male-female interactions, this mechanism is crucial to reproductive success (Brown et al., 2001). Understanding this reproductive approach is essential for tiger conservation, especially in captivity where regulated mating is key to breeding programs. Tigers need copulatory stimulation to trigger the hormonal chain reaction that causes ovulation, unlike spontaneous ovulators. A female tiger's copulation stimulates sensory, which increase hypothalamic gonadotropin hormone-releasing hormone (GnRH) production. Following then, the anterior pituitary gland releases luteinizing hormone (LH) causing ovulation (Schmidt et al., 2014). This mechanism ensures that wild tigers release eggs only when a male is present, maximizing fertilization.

Tigers' induced ovulation improves reproductive efficiency, especially in solitary species with limited mating options. Tigers dwell in enormous territory and only mate briefly. This prevents unfertilized eggs from wasting without a partner (Brown, 2011). Thus, induced ovulation synchronizes the female reproductive cycle with male availability, increasing the likelihood of pregnancy during mating.

Unlike induced ovulators, spontaneous ovulators like people, dogs, and cows ovulate regularly due to hormonal changes unrelated to mating. Estrous or menstrual cycles in spontaneous ovulators predict ovulation regardless of mating (Bazer et al., 2008). The evolution strategy of forced ovulation is especially useful for solitary and territorial species like tigers, because intermittent male-female interactions make mating need ovulation. Captive breeding of rare animals like the Malayan tiger requires knowledge of induced ovulation. Ovulation and reproduction depend on proper mating timing and monitoring in captivity, where natural social cues may be reduced (Wildt et al., 1993). Monitoring hormone levels in captive females can help to identify estrous phases and introduce a male tiger at the right time.

In addition, behavioural observations during mating can serve as evidence that ovulation has been effectively induced. Tigers frequently exhibit repeated copulatory behaviour within a brief period, during which females become momentarily receptive if ovulation

does not result in fertilization (Brown et al., 2001). This means numerous mating sessions over several days may be needed to induce ovulation and boost fertility.

Induced ovulation is well studied in captivity, but remains a difficult procedure. Stress, limited space, and unnatural environmental conditions may cause tigers to fail to bring about ovulation or to maintain pregnancy (Schmidt et al., 2014). Environmental enrichment, hormone and behaviour monitoring are needed for successful breeding programs (Brown, 2011). It is important to understand the time and hormonal triggers of estrous in females also. Without sufficient physical and environmental stimuli, induced ovulation may not occur even if mating occurs, resulting in failure breeding (Wildt et al., 1993). Improved tiger facilities and close replication of natural stimuli are crucial for captive breeding program success. In order to maximize the success of mating, it is essential for conservation and captive breeding efforts to have a thorough understanding of the hormonal and behavioural indicators that are related with induced ovulation.

2.2 Reproductive behaviour

In contrast to certain other social animals, tigers exhibit a preference for solitude and do not establish enduring pair connections. Male and female tigers live separately and defend their own territories, which could overlap. The pair would only interact when the female enters estrous, the time she is ready to mate and capable of conception. Particularly the Malayan subspecies (*Panthera tigris jacksoni*), male tigers show reproductive behaviour vital for successful mating and species survival. Male tigers display a range of actions to indicate their readiness for reproduction, display of power, and attraction of appropriate partners. Environmental factors, the presence of other males, and the availability of receptive females routinely affect these behaviours (Sunquist et al., 2002).

Highly territorial, they depend on marking their territory to convey to other males and possible partners their authority and reproductive status. Common activities utilized to mark territory and signal their presence to females are scents marking through urine spraying, rubbing their cheeks on trees, and ground scraping (Smith et al., 1993). Being usually solitary animals and females choose to mate with the dominant male whose domain spans their own range, tigers depend on their territorial behaviour to attract mates (Goodrich et al., 2010).

Male tigers perform in ways meant to draw in and woo females during the breeding period. These activities may include vocalizations like roaring or prustening, which serve as auditory signals to females that the male is ready for mating (Goodrich et al., 2010).

Males may also accompany a female in estrous closely, participating in frequent scent marking and attempting to initiate physical contact. These behaviours are crucial in promoting receptivity from the female and establishing the male's presence.

In addition, aggressive tendencies can be observed, especially when competing with other males for access to females. Tactics of fights and other muscular profiles form the basic structures of dominance where the most superior male acquires the rights to mate (Sunquist et al., 2002). This competition ensures that all the male of the species can only reproduce when they are able to fend off other males for their territory and resources.

The ability to control land areas and repel other males often is what determines the success of a male at mating with a female. Large territory and wealth in resources are the indicators that these males and females would likely to have a higher reproductive success (Smith et al., 1993). However, it is necessary to comprehend these natural behaviours in order to maximize breeding operations especially in captive conditions where they may be masked.

Male tigers may show either abnormal or diminished reproductive behaviour under stressful conditions and a lack of appropriate space or natural bio sources that trigger this behaviour. Therefore, monitoring and assessing this behaviour in captivity is crucial to obtain higher breeding rates and to maintain the general health of species in conservation project (Kleiman et al., 2015).

2.3 Alterations in Male Behaviour in Response to Estrous Cycle

Male tigers *(Panthera tigris)* exhibit significant behavioural alterations in response to the estrous cycle of females, highlighting their essential function in reproduction. These behavioural changes are especially evident during the estrous phase, when male tigers modify their behaviours to enhance reproductive success.

During this stage, a notable characteristic is the increased incidence of scent-marking, including urine spraying and scraping, which conveys their presence and authority to receptive females. These marks are frequently heightened at territorial borders, as males seek to allure females and repel competing males from intruding on their territory (Smith et al., 1989).

The estrous phase in females stimulates competitive tendencies in males, frequently leading to violent altercations or heightened marking activities. These actions guarantee dominance and exclusivity in reproductive prospects. Moreover, males employ chemical

signals from female scent marks and physical behaviours, such as vocalizations, to identify estrous and modify their strategy accordingly (Smith et al., 1989). These adaptive behaviours highlight the complex interaction between male and female reproductive strategy, demonstrating how males exploit restricted mating opportunities through behavioural adjustments.

These findings underscore the significance of comprehending male behavioural reactions to female estrous in enhancing captive breeding initiatives. By identifying these indicators, conservationists can enhance breeding management, hence augmenting the probability of reproductive success for endangered animals such as the Malayan tiger.

2.4 Challenges in Captive Breeding

Together with conservation partners, the Department of Wildlife and National Parks (DWNP) discussed ways to prevent the extinction of the Malayan tiger (DWNP, 2008). The major objective of the breeding program is the maintenance of a healthy, genetically viable captive population of Malayan tigers. In the likely events of further decline in the wild population, this population can act as a safety net. These initiatives are concentrated at the centre of which are the Malayan Tiger Captive Breeding Program that is implemented by specialized establishments such as Zoo Negara (National Zoo) and National Wildlife Rescue Centre (NWRC) Sungkai, Perak. Despite these programs play an essential role in conservation efforts, they also face numerous challenges

Stress is a major component contributing to reproductive failure, which often leads to hormonal imbalances that can interfere with both estrous and ovulation (Kleiman et al., 2010). Confinement in artificial environments that offer no spatial complexity or stimulus of the range of natural activities in which tigers engage, is one of the most serious stresses imposed in captive breeding operations. Unusual housing arrangements and insufficient space, social isolation, create stressors that further worsens this, preventing tigers from being able to engage in necessary territorial and reproductive behaviours that promote successful mating (Schmidt et al., 2014).

Repeated movements, called stereotypic behaviours, are a common way confined stressed tigers express stress and indicate low welfare. These behaviours include pacing, head rolling and obsessive grooming. Appearing in large carnivores such as tigers, pacing is caused by the lack of the ability of the animal to carry out natural hunting, patrolling, and territorial aspects in restricted situations (Clubb and Mason, 2007).

The actions themselves are stereotyped, which means that they are a sign of ongoing stress, and interferes with reproduction by interfering with hormone balance and natural mating behaviours (Powell et al., 2012). Females may also not go into artificial ovulation when long term stress prevents the release of important reproductive chemicals like LH (Brown, 2011).

Male tigers in captive breeding programs encounter considerable behavioural difficulties. In the wild, male tigers assert dominance over females by territorial activities, including scent marking and vocalizations, which signify their expansive territory and inherent dominance (Smith et al., 1993). Conversely, captive male tigers are frequently restricted to smaller enclosures, so inhibiting their capacity to exhibit natural territorial and reproductive behaviours. This limitation may result in the manifestation of stereotypic behaviours and challenges in sustaining hormonal equilibrium, thereby affecting effective mating. The captive breeding of tigers has various obstacles, including the management of stereotypic tendencies, the preservation of hormonal balance, and the maintenance of genetic variety.

2.4 Ethology

Ethology is the science of understanding animal behaviour, particularly in its natural environment (Fericean *et al.,* 2015). The research and understanding of animal instincts and adaptations involves observing natural activities like communication, courtship, and nutrition. Hence, the observation method will be utilized in this study, instead of more invasive and laborious methods such as blood or faecal hormonal assays. The estrous behaviour observed in Malayan tiger would be further categorized to ease data analysis.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Ethical approval

This study was conducted with the necessary consent and permits from the Department of Wildlife and National Parks Peninsular Malaysia (DWNP). The permit was granted with registered number of D-01014-15-24 to ensure that the research adhered to ethical standards for the welfare of the captive Malayan tigers and to support the conservation efforts for this critically endangered subspecies.

3.2 Study area

The study was conducted at the National Wildlife Rescue Centre (NWRC) in Sungkai, Perak, Malaysia, with a particular focus on male Malayan tigers (*Panthera tigris jacksoni*). The NWRC plays a critical role in the ex-situ conservation of endangered wildlife, and it is recognized for its efforts in rehabilitating and preserving species such as the Malayan tiger. The centre is situated in a geographically strategic location within Perak, within the Sungkai Wildlife Reserve, offering both a controlled and naturalistic environment suitable for the observation of wildlife behaviour.

The NWRC is an important conservation hub that supports a variety of programs, including captive breeding, wildlife research, and educational outreach. As part of this study, behavioural observations of male Malayan tigers will be conducted in these enclosures. The tiger section comprises five blocks that are currently housing more than 10 tigers in captivity. The research focused on understanding their reproductive behaviours in captivity, such as courtship displays and social interactions with females. The NWRC's role in both in-situ and ex-situ conservation provides an ideal setting for this research, offering both controlled environments and opportunities to observe natural behaviours. By studying tigers in this setting, the findings may contribute valuable insights into how environmental factors and captivity affect their reproductive success and overall well-being.

3.3 Study design

The study implemented a cross-sectional design with field samples across a specific period during ethology in the field. This study was designed to observe and record reproductive behaviour of Malayan tigers between 8:00 hours to 17:00 hours. The behaviour will be recorded using an ethogram and the frequency will be computed using a tally numeration technique. The visual observation is made through the CCTV to ensure minimal human interactions that may disrupt the natural behaviour of tiger. Recording were made for the purpose of analysis of the primary behaviours include prustening, rubbing, rolling and Flehmen reaction. The table below shows ethogram table used during the study conducted.

Table 3.1 Ethogram chart of behavioral acts in the Malayan Tiger

Behavioral acts	Description	Duration
Prustening	Prustening, also known as "chuffing," is a soft, low-frequency vocalization produced by tigers as a friendly or non-threatening form of communication.	
Rubbing	Rubbing behavior in tigers involves the animal pressing its head or body against objects, trees, or other tigers. This action serves both as a form of scent marking, where tigers use scent glands located on their face and body to leave olfactory cues, and as a means of social bonding.	
Flehmen reaction	The Flehmen reaction is a specialized behavior where the tiger curls its upper lip, exposing the teeth and gums, while inhaling air through the mouth.	
Rolling	Rolling is a behavior in which tigers lie on their side or back and rub their body on the ground.	
Aggression	Aggressive behavior in tigers include growling, snarling, swiping with their paws, and biting.	

Table 3.2: Focal sampling worksheet of estrous behaviours in male Malayan tigers *(Panthera tigris jacksoni)*

Animal ID : Age : Sex : Date : Start time: End time :

Time	Prustening	Rubbing	Rolling	Urine spray/Scent marking	Flehmen respond	Other

3.4 Study population

The details and information regarding the animals such as the species, identification name, sex, age, weight and status of mating. The study population involved two male Malayan tigers that are placed in a stall. The details of the tigers are listed below (Table 3.3).

Daily routines of activity conducted in night stalls of Yeop Kuang and Apek Bihai were the same. The activity starts at 9.30 am with the tiger transferred to the next night stall temporarily to allow the keeper to cleaning the area. The feeding hour is at 3:30 p.m. every day of the week except Saturday. Observations were conducted intermittently, alternating between morning and late afternoon timings, to enable recording of each tiger during both periods.

Table 3.3 : Study population data

Tiger ID	Age	Status	Pairing	Date of acquisition	Origin	Unit of night stall
Yeop Kuang	7 years old	Wild caught	Not paired	10.2.2024	Ulu Luang, Sungai Siput Perak	C
Apek Bihai	4 years old	Wild caught	Not paired	1.10.2023	Pos Bihai, Gua Musang Kelantan	D

3.5 Sampling technique

In this study, a behaviour sampling technique employed to monitor the estrous cycle and reproductive behaviour. This method involved utilizing ethograms by conducting focal sampling from 8:00 hours to 17:00 hours to document the activities or behavioural states of the animals. The ethogram and focal sampling worksheet were created based on the behaviour and the frequency of behaviour was noted.

While the primary focus was on male behaviour, data on the reproductive behaviour of a female Malayan tiger were also included to provide contextual insights and examine potential behavioural interactions between the sexes. The information regarding the female tiger were collected from a separate study conducted at the same time by Nur Qamarina that focused on female reproductive behaviour. Taking into account the interconnected nature of male and female reproductive strategies, the inclusion of this information allowed for a more comprehensive evaluation of how male actions correlated with changes in female reproductive circumstances, particularly during crucial stages such as estrous. To ease referencing of the observed subjects, individual identifier label had been assigned to each of the individual tigers (Table 3.2).

Table 3.4 : Tiger Individual Identifier Label

Tiger Identifier	
T1F	Mek Santong
T1M	Yeop Kuang
T2F	Yong Tawai
T2M	Apek Bihai

CHAPTER 4

RESULT AND DISCUSSION

4.1 Results

Results are interpreted in line graph utilizing the tally numeration system and ethogram worksheet. The results emphasize various behaviours such as prustening, rubbing, and other affiliative or courtship-related activities. The results were presented in the form of line graphs as illustrated below.

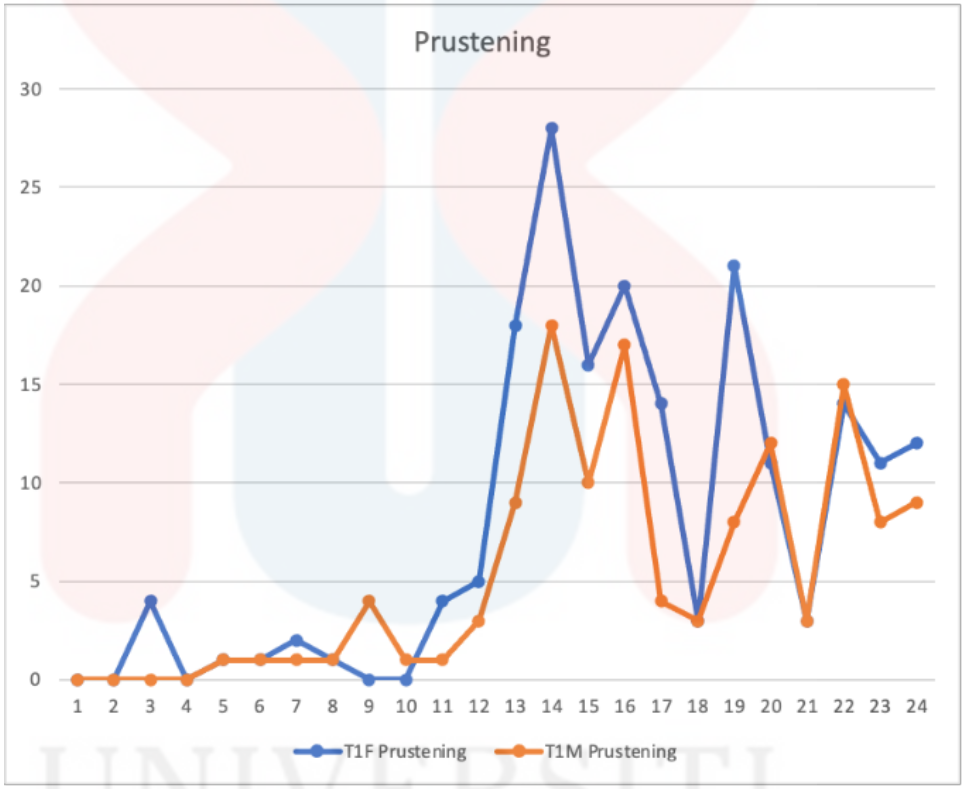


Figure 4.1 : Line graph of prustening behaviour in between Yeop Kuang (T1M) and Mek Santong (T1F)

The graph (Figure 4.1) illustrates the frequency of prustening behaviour in a female (T1F) and a male (T1M) Malayan tiger over 24 days. Female T1F referring to Mek Santong and male T1M referring to Yeop Kuang both show very low levels of prustening behaviour during the first 12 days, with occasional spikes for T1F as can be seen in Day 3 and Day 11 but almost no activity for T1M. Furthermore, there is sudden increase in prustening frequency for both T1F and T1M rises sharply on Day 13, peaking on Day 14, where T1F shows a notably higher frequency than T1M. The male responds to the female's behavioural cues, resulting in a mutual increase in prustening behaviour. T1M's increase in prustening suggests responsiveness to T1F's heightened communication. After Day 16,

the prustening behaviour declines for both tigers but continues to show periodic fluctuations. The male (T1M) maintains relatively consistent, though lower, prustening behaviour during this period, while T1F's frequency is more variable. This could be suggestive in a post-estrous phase where the female is no longer in her fertile window, but affiliative communication continues sporadically.

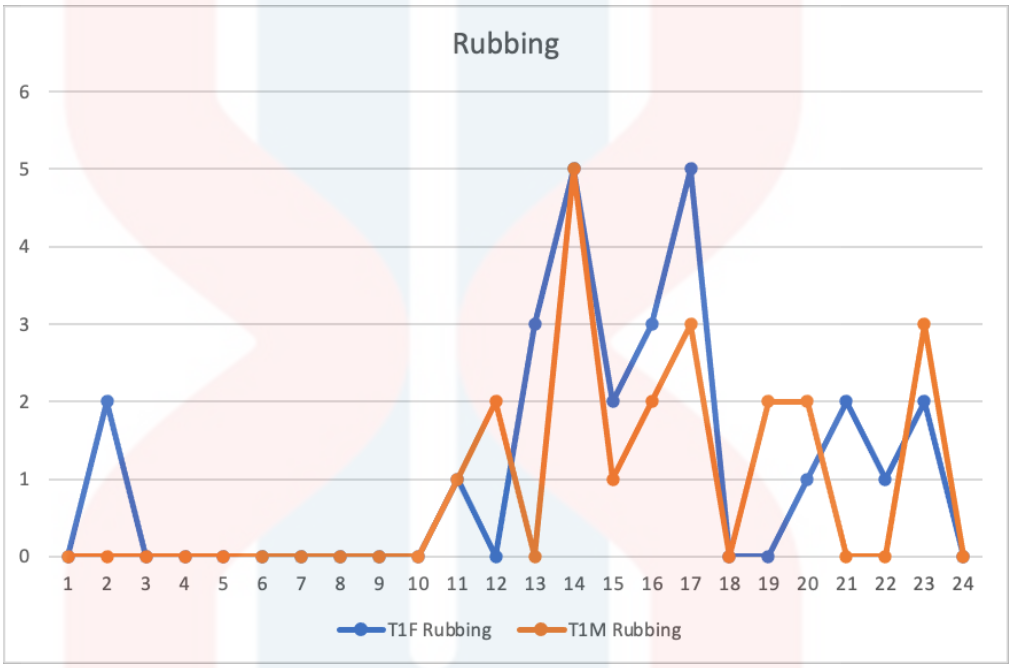


Figure 4.2: Line graph of rubbing behaviour in between Yeop Kuang (T1M) and Mek Santong (T1F)

This second graph (Figure 4.2) illustrates the frequency of rubbing behaviour observed in both the male (T1M) and female (T1F) Malayan tigers over a 24-day period. Both the male and female exhibit little to no rubbing behaviour during this period. The female shows isolated activity on Day 2, while the male begins displaying rubbing behaviour from Day 11. This could be a phase when reproductive signalling and the pair had not yet entirely begun to interact. After this, the rubbing behaviour for both tigers greatly increase between Days 12 and 17 with peaks on Days 13 through 16. During this period, the male and female show overlapping and increases in activity, with peak levels occurring on Day 14 for both. The strong synchronization places strong emphasis on the fact that female rubbing behaviour is closely linked to the female's estrous phase, when she actively signals her reproductive readiness. Increased rubbing of the male may be a response to the female's cues, perhaps to mark his presence, or to reinforce his interest. The rubbing behaviour fluctuates during days 18 to 24, alternately becoming inactive with intermittent spikes. The female rubs sporadically, whereas the male rubs more steadily but less often.

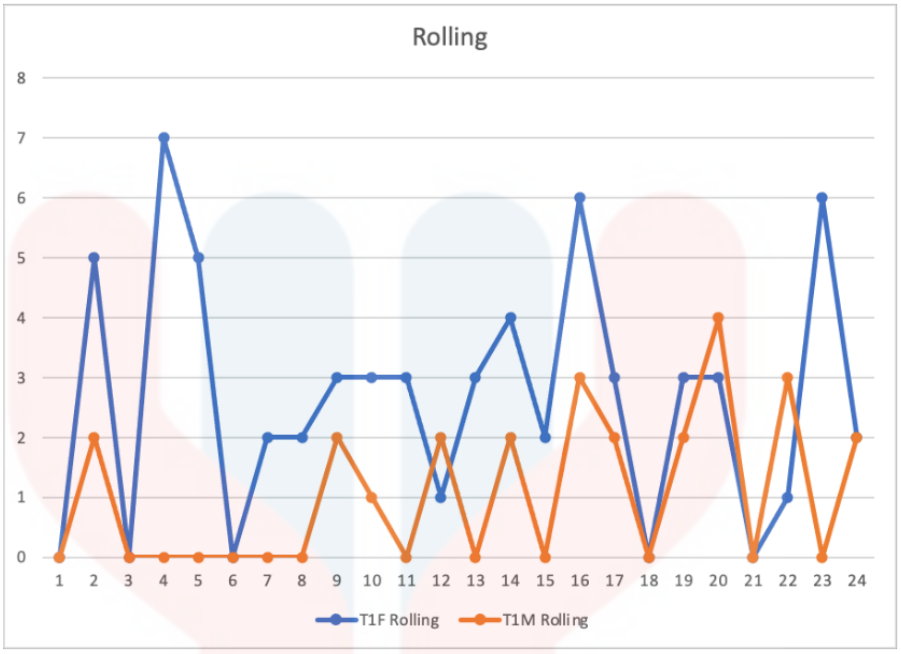


Figure 4.3: Line graph of rolling behaviour in between Yeop Kuang (T1M) and Mek Santong (T1F)

A male Malayan tiger (T1M) and a female Malayan tiger (T1F) rolling behaviour graph over 24 consecutive days of observation is displayed in the graph above (Figure 4.3). Tigers are usually thought to roll behaviourally when they are courting, relaxing or social bonding. As a form of tactile communication, the rolling activity can also occur during the mating periods, based on the first six days of full rolling activity, the rolling activity is dominated by the female (T1F) with peaks on Days 2 and 3. In this phase, the male (T1M) exhibits minimal rolling and isolated activity on Day 2. In addition to this, there is increase in the male and female display gradient. Then, these tigers become more synchronized following Day 10 and more active in both tigers that peak toward Days 14–15. For both the male and the female, after the peak on Day 15 rolling becomes fluctuated. On Days 18, 21 and 24 the female has spikes, while the male does not until days 21 and 18. The male has shorter rolling periods with peaks for days 18 and 21.

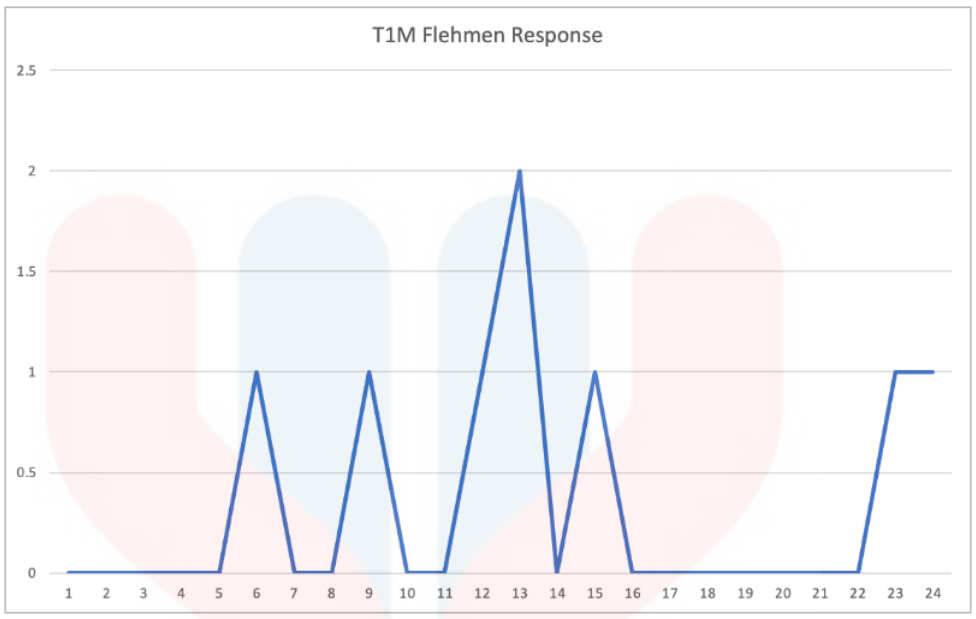


Figure 4.4 : Line graph of Flehmen response behaviour in Yeop Kuang (T1M)

The Flehmen response exhibited by the male Malayan tiger (T1M) during 24 days of observation is graphed (Figure 4.4). A characteristic behaviour of many mammals, including tigers, is the Flehmen response in which the animal curls its lips backwards and in breaths, making detection of pheromones through the vomeronasal organ possible. Absence of initial period of Flehmen responses from Day 1 to 5 signified that there were no significant chemical cues or stimuli which triggered the behaviour during this phase. Despite this, notable peaks in Flehmen responses were seen on Days 6, 9 and 13. This behaviour is particularly shows the prominent spike on Day 13 which appears to be due to a period of heightened chemical signalling (perhaps the female is in estrous). This is consistent with the function of the Flehmen response in female reproductive readiness detection. Flehmen responses were not recorded following day 14 until day 22. Reduction in chemical cues or redirection in the male's focus away from chemical cues to other behaviours is suggested. Behaviour appeared consistently from Day 22 to Day 24 at a low frequency. It is possible that residual interest or response to residual chemical cues in the environment. Unlike other behaviours, although female data was collected, the Flehmen response was not combined with the female data (as the Flehmen response occurred minimally in the female tiger). This distinction to the Flehmen response emphasises the role of this behaviour in being sex specific, where males are performing the Flehmen response in being able to assess reproductive cues.

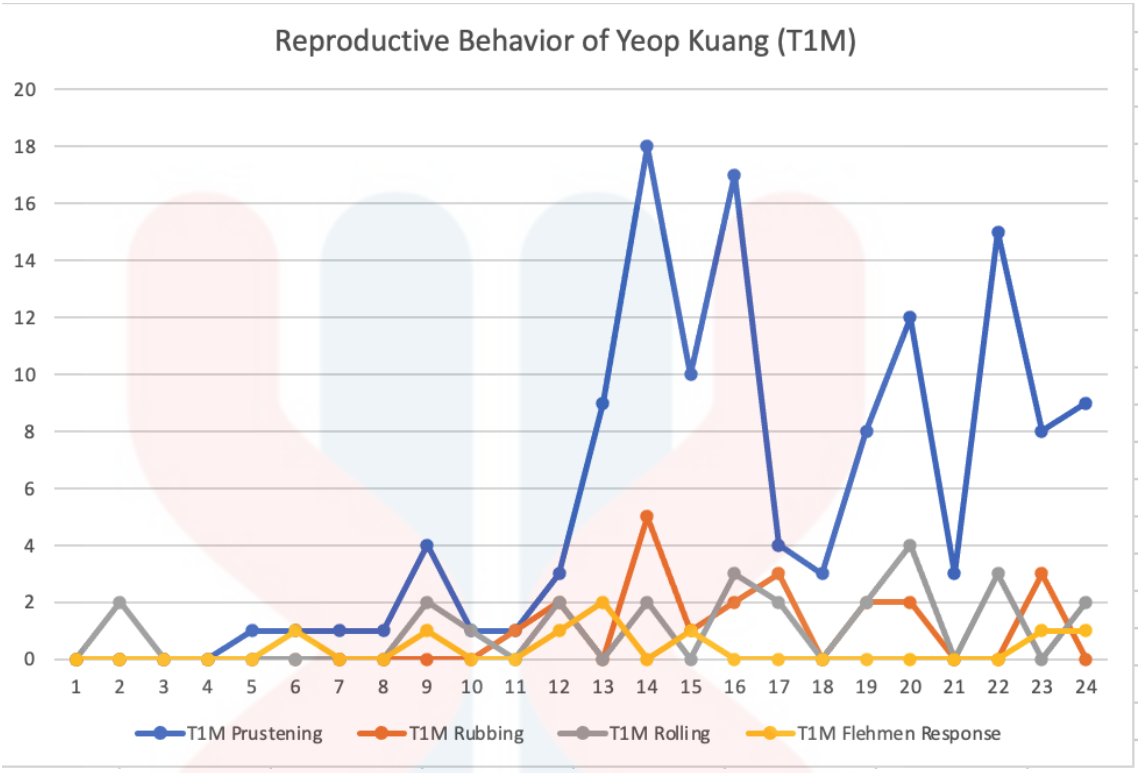


Figure 4.5: Line graph reproductive behaviour in Yeop Kuang (T1M) from day 1 to day 24

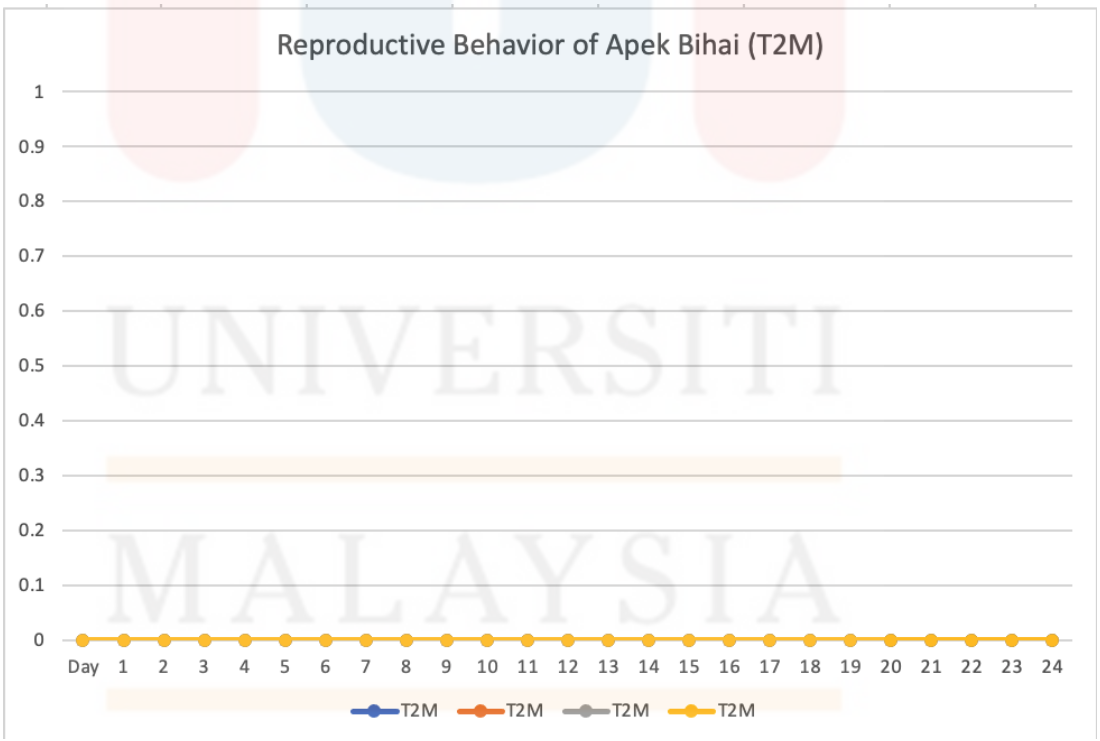


Figure 4.6: Line graph reproductive behaviour in Apek Bihai (T2M) from day 1 to day 24

T1M shows variation of behaviour ranging from prustening, rubbing, rolling and flehmen response (Figure 4.5). This aligned with T1F behaviours. T1F most frequent behaviour

throughout the 24 days was prustening, which she displayed when communicating with T1M beside her night stall. The next most common behaviours were rolling and rubbing, which were often seen together, particularly when she faced the male's night stall. She would roll in front of the connected doors of the male's stall, usually after becoming restless. Rubbing behaviours were less frequent and occurred towards the wall, enrichment items, and doors. Tail lifting and lordosis were not observed during the entire observation period, which could be due to various factors affecting T1F's behaviour and estrous cycle.

In contrast, T2M did not display any apparent reproductive behavioural other than resting (Figure 4.6). Prolonged periods of inactivity or lying down especially under the enrichment as a shade was defined as resting behaviour. Throughout the data collection period, there were no clear trends which would indicate reproductive behaviour in T2M. This behaviour is tally with T2F, who did not show significant behavioural patterns, suggesting the absence of an estrous cycle. Throughout the observation period, T2M displayed various behaviours, including restlessness, resting, and aggression. Restlessness involved frequent pacing within the night stall, while resting was marked by long periods of inactivity or lying down. Aggressive behaviours, such as vocalizations, posturing, and physical confrontations with the keeper and visitors, were also observed. However, these behaviours did not appear to be linked to any specific phase of the estrous cycle.

4.2 Discussion

This study of the reproductive behaviour of male and female Malayan tigers *(Panthera tigris jacksoni*) will provide invaluable information on the mating of these animals in captivity. The data presented evidence that could indicate unique breeding activities including prustening, rubbing and rolling, with variability in frequency and intensity that may represent reproductive dynamics.

Prustening was among the most observed behaviours in this investigation. T1M consistently demonstrated this behaviour, indicating that he was in active communication with. T2M did not show prustening, most likely because to his lower comfort level and poorer bond with T2F. Prustening has been discovered as an important component of mating rituals, indicating a male's interest or readiness for reproductive action with a female (Smith et al., 1991). In this study, T1F and T1M had a significant rise in prustening

behaviour that corresponded to the female's oestrus cycle. It elevated significantly on Day 13 and peaked on Day 14, indicating increased reproductive signalling from T1F and a similar response from T1M. This synchronization emphasizes the function of pruning as a crucial communication technique between mating partners, complementing findings from previous research that highlights the importance of behavioural cues in tiger mating dynamics (Zainuddin et al., 1992)

The Flehmen response is a unique behavioural reaction seen in a variety of species, including tigers (*Panthera tigris*), which includes curling back the upper lip, revealing the front teeth, and inhaling through the nostrils. This motion enables the animal to detect pheromones and other scents more effectively via the vomeronasal organ (VNO) located on the roof of the mouth (Siva, 2023). Male tigers frequently demonstrate this activity after detecting urine or scent imprints left by females, suggesting their desire and likely readiness to mate (Mowatt, 2016). This habit is frequently witnessed in the morning while cleaning the night stall. The keeper will transfer the male tiger to the female's night stall while the female tiger is transferred to the keeper's walk walkway. T1M will roam around the night stall, then sniff the pee and perform the Flehmen response. This aids in detecting pheromonal cues from females, which can affect their own reproductive schedule (Siva, 2023). This behaviour was less obvious in T2M and occurred less frequently than pruning. This is consistent with previous study, which has shown that male tigers engage in prustening during courtship (Smith et al., 1991; Sankhala, 1978).

In addition, rolling was one of the reproductive behaviour expressed by T1M particularly when facing near T1F, however none of this observed in T2M. Rolling is an activity that indicates comfort, territorial confidence, or a general sense of well-being. These factors can contribute to reproductive fitness and readiness to engage in mating activities (Smith et al., 1991; Schaller, 1967).

Similarly, rubbing behaviour displayed by both tigers during the observation period further supports this notion. The overlapping peaks in rubbing behaviour between Days 12 and 17 suggest a strong link to the female's estrous phase. While rubbing is not always related to reproduction, it does signal the male's readiness to mate by making contact with the female (Smith et al., 1991). Additionally, olfactory, and chemical signals are crucial for triggering reactions in conspecifics, especially females in which rubbing may enhance their flow. When a male tiger rubs against something or gets close to a female, he releases pheromones that tell her about his hormonal state, fitness level, and readiness to mate (Sunquist et al., 2002).

There are quite significant differences were noticed in the behaviours of T1M and T2M. A tiger's (*Panthera tigris)* reproductive behaviour and success in captivity are profoundly affected by its sexual maturity, a crucial developmental step. On average, female tigers reach sexual maturity at a younger age, between 3 and 4 years, whereas male tigers do so at a later age, typically around 4 to 5 years (Kitchener et al., 2017; Smith & McDougal, 1991). Due to longer period for males to reach sexual maturity, they are able to acquire secondary sexual traits like greater stature and dominant behaviours, which are crucial for protecting their territory and having healthy offspring. Factors like as temperament, age, and environmental circumstances greatly impact the reproductive behaviours of captive male Malayan tigers.

Since T1M is seven years old, he has passed the average age of sexual development for male tigers and is thus at the height of his reproductive maturity. Prustening, Flehmen reaction, and rubbing were among his many reproductive behaviours, which he performed more frequently and in a wider variety. T1M appears to be actively involved in reproductive activities and showing signs of hormonal and behavioural readiness for mating based on these behaviours. To the contrary, T2M, which stands at 4 years old, denotes a younger person on the cusp of sexual maturity. Compared to T1M, the frequency and intensity of reproductive behaviours, like prustening and Flehmen response, were reduced. This reduce behavioural expression could be a reflection of his developmental stage, when reproductive behaviours are still coming into their own as he gradually matures (Barlow et al. 2009).

In addition, it is observed throughout 24 days of observation T2M spend most of the time hiding under the enrichment in the night stall. During feeding hour, T1M would restlessly wait for his feed, whereas T2M would only rest and eat when there is no human in sight. The difference between T1M and T2M highlights the importance of considering age and environmental stressors in the context of reproductive behaviour studies. Glucocorticoids are hormones released in response to stress and have the potential to mobilize energy reserves. However, their prolonged elevation may have a detrimental effect on reproductive success (Young et al., 2006; Kumar et al., 2014). Elevated glucocorticoid concentrations have been associated with increased levels of perceived stress during tourism periods in a study investigating the physiological stress responses of tigers to anthropogenic disturbances (ok et al., 2019). This implies that chronic stress from frequent human interactions may disrupt hormone production and normal reproductive behaviours

Throughout this observational study, T1M consistently exhibited a unique behavioural pattern that underscores the importance of visual access in facilitating reproductive behaviours. T1M frequently positioned himself on the enrichment furniture facing the night stall where T1F was placed. This will then follow by prustening which is a well-documented affiliative and reproductive behaviour in tigers. The order and timing of these events point to the closeness and unimpeded visibility of T1F as a possible cue for the display of mating behaviours. However, owing to the constrained sightlines offered by the linked doors, T1M's visual access to T1F was limited when he was on the floor of the enclosure. Pruning and other reproductive behaviours were less common at these times. Body language and postures are visual cues that tigers use to communicate their reproductive readiness (Schaller, 1967). This disparity suggests that being at a higher position may be very important for being seen, which in turn makes communication and reproduction easier. As shown in T1M's actions on the floor of the enclosure, males may have trouble seeing and responding to these signals, which could cause them to postpone or even stop courtship behaviours altogether (Sundararaj et al., 2012).

Understanding these reproductive behaviours is crucial efforts in captive breeding. Additionally, each individual tiger has a unique personality that sets it apart from others, which can significantly influence their interactions. For instance, certain male tigers may consistently demonstrate incompatibility with females. On November 25, 1942, a tiger cub near Jaipur, which was two months old, was captured, providing a historical example of this. On two different occasions, his violent conduct killed two females despite repeated efforts to introduce him to other females as he grew older. This exemplifies the difficulties of bringing tiger cubs into captivity, both male and female. Tragically, a male may accidentally kill a female when her hostile behaviour is mistaken for a wooing display (Sankhala, 1967).

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, The findings of this study on the reproductive behaviours of captive male Malayan tigers successfully address the hypothesis that seeks to determine these tigers' reproductive behaviours in captivity. The observed behaviours, which include prustening, rubbing, rolling, and the Flehmen response, demonstrate that male Malayan tigers have distinct reproductive behaviours that are essential for mating success. Yeop Kuang (T1M) exhibited frequent and coordinated behaviours, such as prustening and rubbing, particularly in response to Mek Santong (T1F), indicating active courtship and reproductive readiness. The frequency and intensity of these actions were greater in older tigers, such as T1M indicating reproductive maturity. In contrast, T2M a younger tiger, displayed fewer and less prominent actions, indicating that his reproductive systems are still maturing. These studies emphasize the influence of age, maturity, and environment on reproductive behaviour. Hence, in the future repeat observations with other females to confirm the consistency and reliability of the reproductive behaviours can be considered. This would provide additional insight into whether the observed behavioural patterns are influenced by particular female traits, such as their reproductive condition or compatibility with the male, thus improving captive breeding strategies.

The study also highlighting the importance of environmental elements in promoting natural courtship behaviours, such as sight access between male and female tigers. This shows that upgrading captive settings to improve visual communication may increase mating success. Understanding male tiger behaviour in captivity can help manage and improve breeding operations for this critically endangered subspecies which contribute to Malayan tigers' long-term survival.

5.1 Recommendation

Based on the findings of this study, several recommendations for future research are proposed to further enhance the understanding of reproductive behaviour in Malayan tigers (*Panthera tigris jacksoni*) and improve captive breeding programs. Future studies

should extend the observation period to 24 hours to capture a more comprehensive range of reproductive behaviours. By observing behaviours throughout the day and night, researchers can obtain a more complete data set and reduce the influence of external factors that may affect behaviour during daylight hours. This will allow for more accurate assessments of mating readiness and courtship dynamics. Installation of closed-circuit television (CCTV) with the ability to record and store the memory could be really helpful.

Further research could explore the effects of specific environmental enrichment strategies designed to enhance the visibility and social interactions between male and female tigers. This would involve modifying enclosures to allow greater visual and olfactory communication between tigers, potentially increasing the frequency of reproductive behaviours. Identifying methods to reduce stress, such as minimizing human disturbances and providing more naturalistic enclosures, may enhance reproductive success and overall well-being in captive tigers.

By addressing these areas, future research could significantly contribute to improving captive breeding efforts for Malayan tigers and support the long-term conservation of this critically endangered subspecies.

REFERENCES

1. Barlow, A. C. D., et al. (2009). Linking monitoring and conservation management for tigers (Panthera tigris): The use of monitoring data for effective conservation. *Biological Conservation* 142(12), 2951–2960. https://doi.org/10.1016/j.biocon.2009.07.018

2. Bazer, F. W., Thatcher, W. W., & Hansen, P. J. (2008). Reproductive biology of mammals: Basic and applied research. *American Journal of Reproductive Immunology*, 60(3), 123-137.

3. Brown, J. L., Graham, L. H., Wu, J. M., Collins, D., & Swanson, W. F. (2001). Reproductive endocrine responses to exogenous gonadotropins in tigers (*Panthera tigris*). *Biology of Reproduction*, 64(3), 899-906. Brown, J. L. (2011). Comparative endocrinology of domestic and nondomestic felids. *Domestic Animal Endocrinology*, 41(3), 151-162.

4. Clubb, R., & Mason, G. (2007). Natural behavioural biology as a risk factor in carnivore welfare: How analysing species differences could help zoos improve enclosures. *Applied Animal Behaviour Science*, 102(3-4), 303-328.

5. Schmidt, M. J., Swanson, W. F., & Roth, T. L. (2014). Reproductive physiology and endocrinology of felids. *Zoo and Wildlife Medicine*, 8(1), 373-393.

6. Department of Wildlife and National Parks Peninsular Malaysia (2008) *National Tiger Action Plan for Malaysia.* Retrieved from https://www.wildlife.gov.my/images/stories/penerbitan/pelan/NTCAP.pdf

7. Goodrich, J. M., Kerley, L. L., Smirnov, E. N., Miquelle, D. G., McDonald, L., Quigley, H. B., & Hornocker, M. G. (2010). Reproductive behaviour of wild Amur tigers (*Panthera tigris altaica*). *Journal of Mammalogy*, 91(3), 737-746.

8. Johnson A. K. (2018). Assisted Reproduction in the Male Cat. *The Veterinary clinics of North America. Small animal practice*, *48*(4), 511–521. https://doi.org/10.1016/j.cvsm.2018.02.001

9. Kleiman, D. G., Thompson, K. V., & Baer, C. K. (Eds.). (2010). Wild mammals in captivity: Principles and techniques for zoo management (2nd ed.). *University of Chicago Press*

10. Kitchener, A. C., et al. (2017). A revised taxonomy of the Felidae: The final report of the Cat Classification Task Force of the IUCN Cat Specialist Group. *Cat News*, Special Issue 11

11. Kumar, A., Zafar, I., & Kumar, S. (2019). Physiological stress responses of tigers due to anthropogenic disturbances in central India. *Conservation Physiology*, 7(1), coz045.

12. Kumar, S., et al. (2020). Behaviour of captive tigers: Influence of enclosure enrichment on reproductive performance. *Zoo Biology*, 39(5), 344–351.

13. Liu YC, Sun X, Driscoll C, Miquelle DG, Xu X, Martelli P, Uphyrkina O, Smith JL, O'Brien SJ, Luo SJ (2018) Genome-wide evolutionary analysis of natural history and adaptation in the world's tigers. *Curr Biol* 28:3840–3849

14. Logington, L.K. (2022). Observational study of breeding behaviour in malayan tigers at the National Wildlife Rescue Center. Retrieved

15. Mellen, J. D. (1993). Environmental enrichment for small felids: A behavioural, welfare, and conservation approach. *Zoo Biology, 12*(1), 121-140. https://doi.org/10.1002/zoo.1430120110

16. PERHILITAN. (2022). *Tiger conservation: Centralized Malayan Tiger Conservation Program*. Department of Wildlife and National Parks Peninsular Malaysia. https://www.wildlife.gov.my/tiger-conservation

17. Powell, D. M., Carlstead, K., Tarou, L. R., Brown, J. L., & Monfort, S. L. (2012). Effects of social and environmental enrichment on reproductive success in captive carnivores. *Zoo Biology*, 31(5), 586-600

18. Sankhala, K. S. (1967). Breeding behaviour of the tiger (*Panthera tigris)* in Rajasthan. International Zoo Yearbook, 7(1), 133–147. doi:10.1111/j.1748-1090.1967.tb00354.x

19. Siva, S. (2023). Behavioural Indicators of Estrous in Felids: Implications for Reproductive Success. *Journal of Animal Behaviour Studies, 15(2), 123-134.

20. Schaller, G. B. (1967). *The deer and the tiger: A study of wildlife in India*. University of Chicago Press.

21. Schmidt, M. J., Swanson, W. F., & Roth, T. L. (2014). Reproductive physiology and endocrinology of felids. *Zoo and Wildlife Medicine*, 8(1), 373-393.

Smith, J. L. D., McDougal, C., & Sunquist, M. E. (1993). Female land tenure system in tigers. *Animal Behaviour*, 45(6), 981-991.

22. Smith, J. L. D., & McDougal, C. (1991). The contribution of variance in lifetime reproduction to effective population size in tigers. *Conservation Biology, 5*(4), 484–490.

23. Smith, J. L. D., McDougal, C., & Miquelle, D. (1989). Scent marking in free-ranging tigers, *Panthera tigris*. *Animal Behaviour*, 37(1), 1–10. https://doi.org/10.1016/0003-3472(89)90001-8

24. Sunquist, M., & Sunquist, F. (2002). *Wild cats of the world*. University of Chicago Press.

25. Sundararaj, V., Ramesh, T., & Sankar, K. (2012). Pre-copulatory and copulatory behaviours of free-ranging Bengal tigers (*Panthera tigris)* in the Bandipur Tiger Reserve, southern India. Current Science, 103(6), 633-635.

26. Ten DCY, Jani R, Hashim NH, Saaban S, Abu Hashim AK, Abdullah MT (2021) (*Panthera tigris Jacksoni*) population crash and impending extinction due to environmental perturbation and human-wildlife confict. Animals 11:1032

27. Wildt, D. E., Swanson, W. F., & Brown, J. L. (1993). Reproduction in non-domestic carnivores. *Theriogenology*, 39(1), 217-248.

28. Schaller, G. B. (1967). *The deer and the tiger: A study of wildlife in India*. University of Chicago Press.

29. Sundararaj, V., Ramesh, T., & Sankar, K. (2012). Pre-copulatory and copulatory behaviours of free-ranging Bengal tigers *Panthera tigris tigris* in the Bandipur Tiger Reserve, southern India. *Current Science, 103*(6), 633-635.

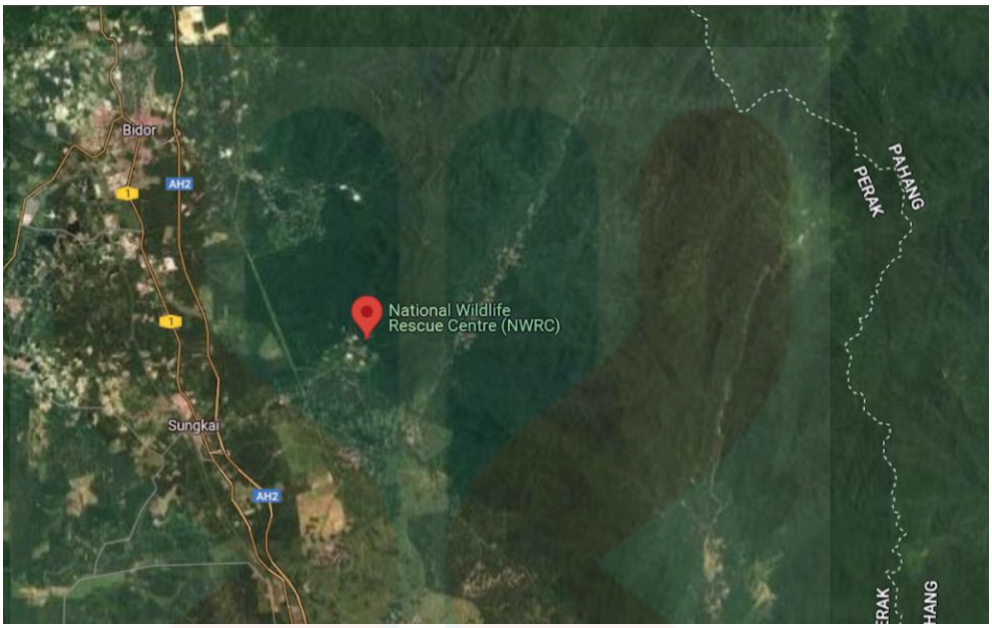
30. Logington, L.K. (2022). Observational study of breeding behaviour in malayan tigers at the National Wildlife Rescue Center.

31. Zainuddin, Z., Yasak, M.N., Daim, M.S., & Hassan, S. (1992). The breeding of Malayan tigers at Zoo Melaka.

32. Young, R.J., & Hadinger, M.C. (2006). Prolonged stress can directly affect behaviour and reproductive success in mammals: A review. *Animal Welfare*, *15*(4), 399-409.

33. Zainuddin, Z., Yasak, M.N., Daim, M.S., & Hassan, S. (1992). The breeding of Malayan tigers at Zoo Melaka. Malayan Wildlife Journal, 10(3), 45-58.

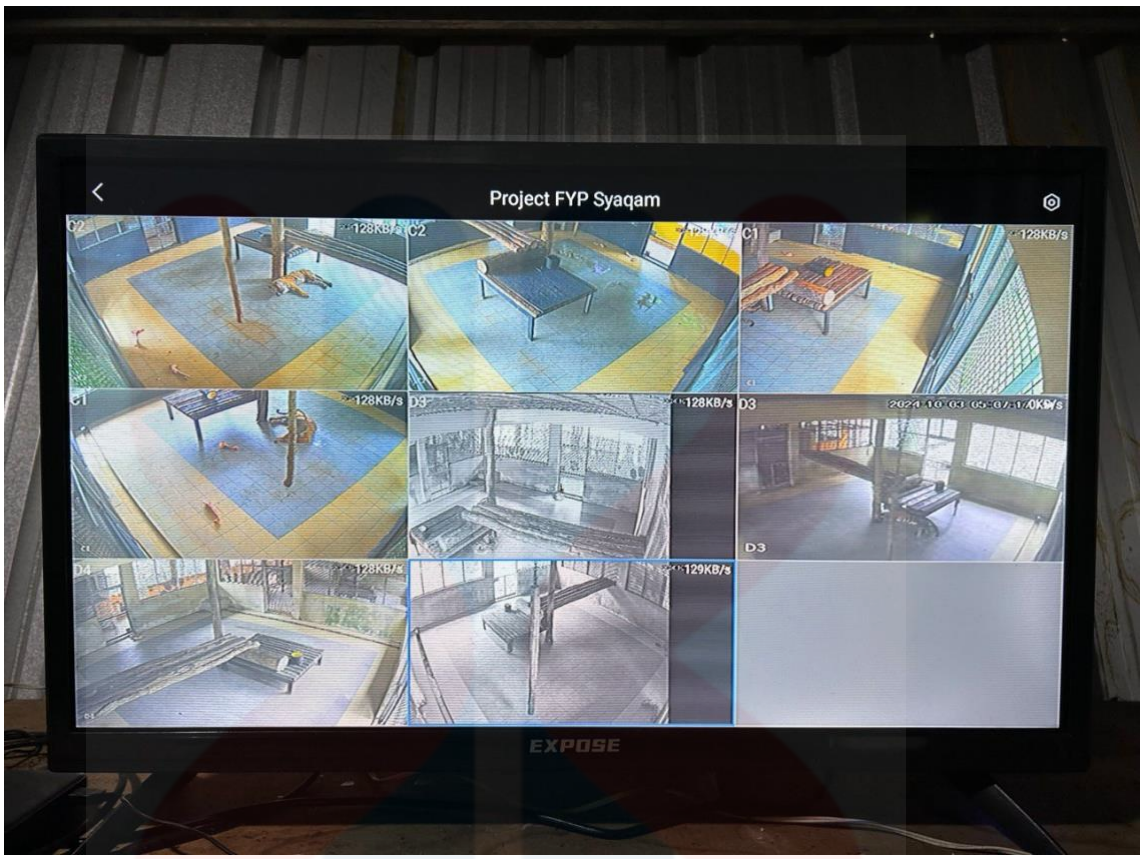
APPENDIX A



Appendix A1 : Satellite view of location National Wildlife Rescue Centre (NWRC)

Appendix A2 : View entering the tiger block

Appendix A3 : Surveillance room

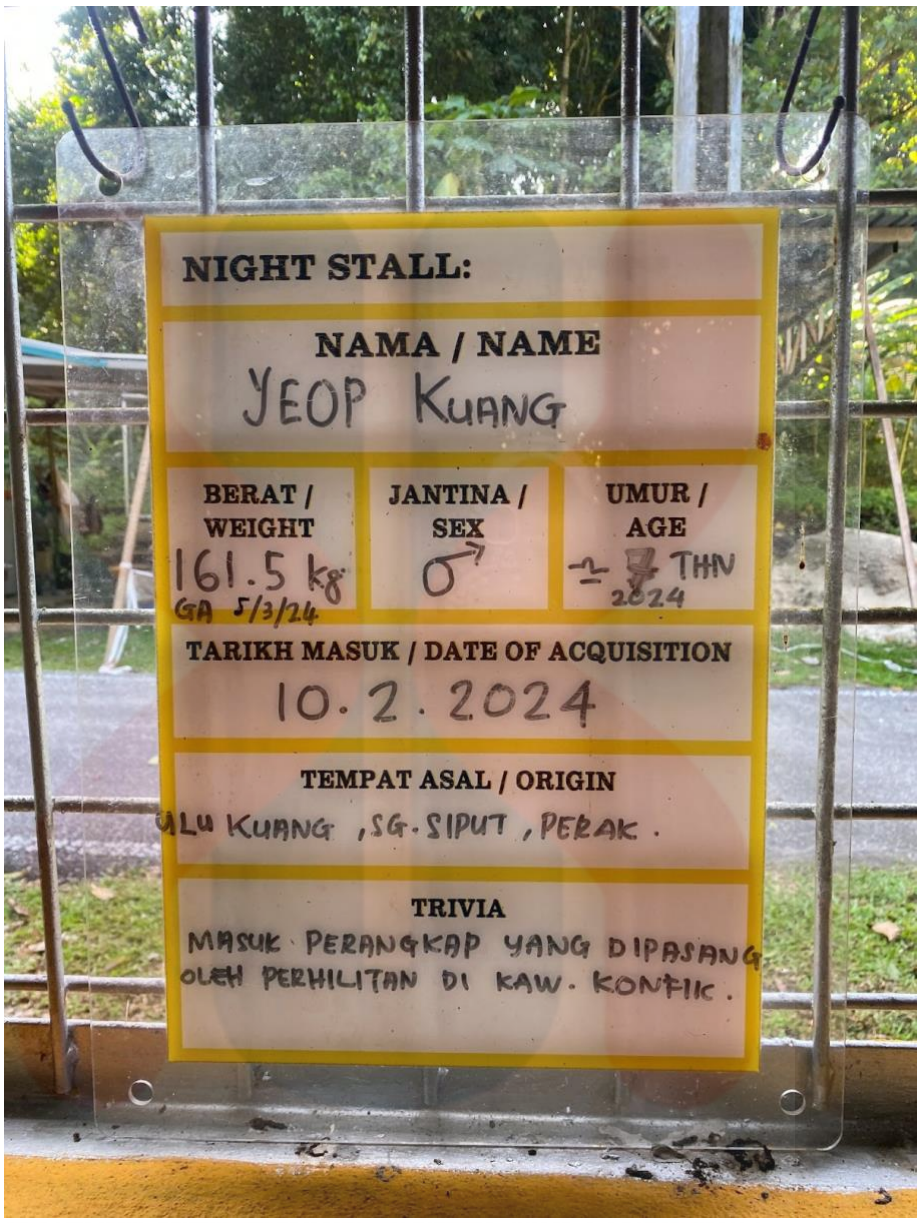


Appendix A4 : Surveillance observation

Appendix A5 : Apek Bihai shading under furniture in night stall

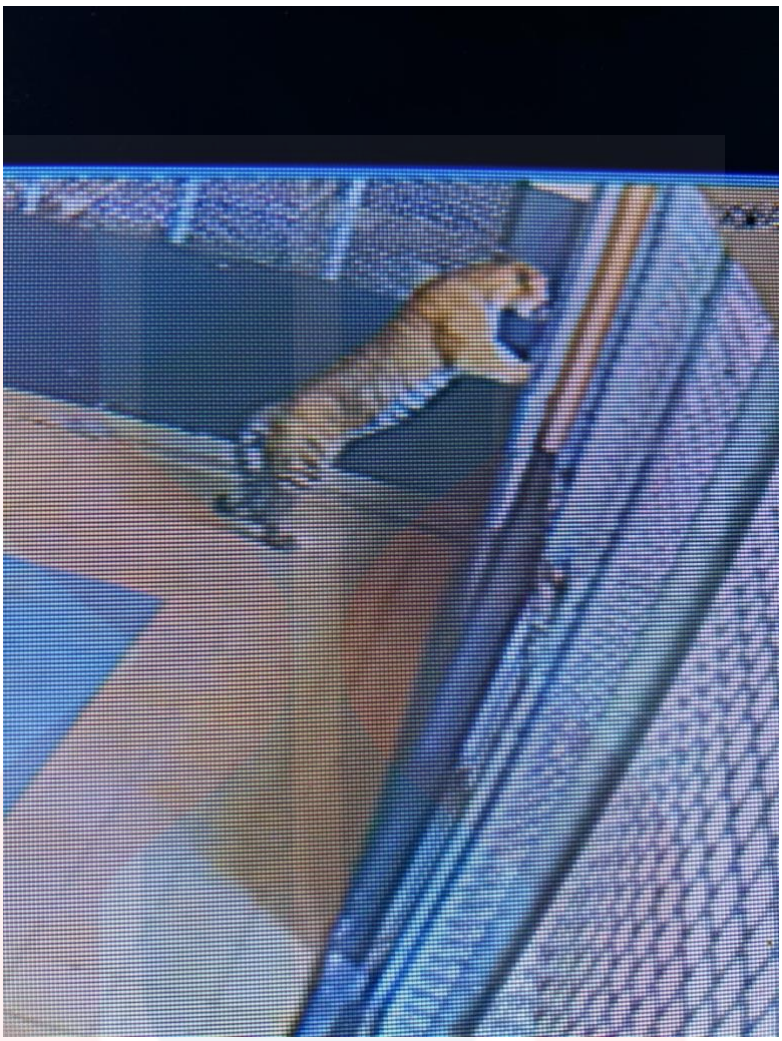
Appendix A6 : Yeop Kuang prustening towards Mek Santong through connecting door

Appendix A7 :Yeop Kuang rolling facing connecting door



Appendix A8 : General information of Yeop Kuang

Appendix A9 : Yeop Kuang resting facing connecting door



Appendix A10 : Yeop Kuang shows aggression towards keeper

Appendix A11 : Yeop Kuang shows aggressiveness when encounter with human

IBU PEJABAT
JABATAN PERLINDUNGAN HIDUPAN LIAR DAN
TAMAN NEGARA (PERHILITAN) SEMENANJUNG MALAYSIA
HEADQUARTERS
DEPARTMENT OF WILDLIFE AND NATIONAL PARKS (DWNP)
PENINSULAR MALAYSIA
KM.10, JALAN CHERAS
56100 KUALA LUMPUR
MALAYSIA

Tel. : 03-90866800
Faks : 03-90752873
E-mel : pakp@wildlife.gov.my
Laman Web : www.wildlife.gov.my

Rujukan : JPHLTN.600-6/1/4 JLD 5(80

Tarikh : 28 November 2024

Batrisyia Bazla Binti Husain
019 Block B
Jalan Ukay Perdana 2
68000 Ampang,
SELANGOR

d20b0089@siswa.umk.edu.my

Puan,

KEPUTUSAN PERMOHONAN PERUBAHAN/PINDAAN BUTIRAN PERMIT PENYELIDIKAN BERTAJUK REPRODUCTIVE BEHAVIOR MONITORING IN MALE MALAYAN TIGERS *(Panthera tigris)*

Dengan hormatnya saya merujuk kepada perkara di atas dan keputusan Mesyuarat Jawatankuasa Penyelidikan Bil 10/2024 adalah berkaitan.

2. Sukacita dimaklumkan bahawa Jabatan PERHILITAN **meluluskan** perubahan/pindaan butiran Penyelidikan **Batrisyia Bazla binti Husain (Universiti Malaysia Kelantan)** seperti butiran di **Lampiran** bermula September **2024 hingga Oktober 2025 (1 tahun).**

a. Menghubungi rakan saing dan *Co-author* yang dilantik iaitu **Dr Zubaidah binti Kamarudin, Pegawai Veterinar (NWRC)** bagi memantau dan membantu perjalanan penyelidikan ini di lapangan;

b. Berkongsi hasil penyelidikan seperti laporan/penerbitan kertas saintifik/tesis dengan Jabatan melalui rakan saing yang telah dilantik;

c. Mengemukakan satu laporan hasil penyelidikan yang lengkap kepada Jabatan dalam tempoh dua (2) bulan selepas tamat penyelidikan;dan

d. Penyelidikan hendaklah diselesaikan dalam tempoh yang dinyatakan dalam permit.

Appendix A12 : Permit approval letter DWNP

JABATAN PERLINDUNGAN HIDUPAN LIAR DAN TAMAN NEGARA
DEPARTMENT OF WILDLIFE AND NATIONAL PARKS

PERHILITAN

D-01014-15-24

PERMIT PENYELIDIKAN ATAU KAJIAN KE ATAS HIDUPAN LIAR-AKADEMIK(DILINDUNGI)

Seksyen 10(1)(a)

AKTA PEMULIHARAAN HIDUPAN LIAR 2010 [AKTA 716]

BUTIRAN PEMILIK

NAMA PEMILIK	: BATRISYIA BAZLA BINTI HUSAIN	**NAMA PREMIS**	: UNIVERSITI MALAYSIA KELANTAN
NO MYKAD / PASPORT	: 990512105742	**NO PENDAFTARAN PREMIS**	:
PEKERJAAN	: LAIN-LAIN	**ALAMAT PREMIS**	: KAMPUS KOTA 16100-KOTA BAHRU, KELANTAN

TEMPOH SAH

10/12/2024 - 31/10/2025

Syarat-syarat Permit Penyelidikan Atau Kajian Ke Atas Hidupan Liar-Akademik(Dilindungi)

1. Permit ini tidak boleh dipindah milik.
2. Permit ini sah untuk tempoh yang telah dinyatakan pada permit.
3. Permit ini hanya sah bagi kajian spesies yang dinyatakan sahaja.
4. Ketua Pengarah boleh menggantung atau membatalkan permit jika pemegang permit melanggar syarat-syarat yang telah dinyatakan.
5. Pemegang tertakluk kepada peruntukan Akta Pemuliharaan Hidupan Liar 2010 (Akta 716) dan apa-apa perintah yang pada masa itu berkuatkuasa.
6. Pemegang permit perlu membuat permohonan permit yang baharu dalam tempoh empat belas (14) hari dari tarikh tamat tempoh sah permit.

Syarat-syarat tambahan

1. Menghubungi rakan saing dan Co-author yang dilantik iaitu Dr Zubaidah binti Kamarudin, Pegawai Veterinar (NWRC) bagi memantau dan membantu perjalanan penyelidikan ini di lapangan;
2. Berkongsi hasil penyelidikan seperti laporan/penerbitan kertas saintifik/tesis dengan Jabatan melalui rakan saing yang telah dilantik
3. Mengemukakan satu laporan hasil penyelidikan yang lengkap kepada Jabatan dalam tempoh dua (2) bulan selepas tamat penyelidikan;dan
4. Penyelidikan bertajuk Reproductive Behavior Monitoring In Male Malayan Tigers (Panthera Tigris) hendaklah diselesaikan dalam tempoh yang dinyatakan dalam permit September 2024 hingga Oktober 2025 (1 tahun)..

Ini adalah cetakan komputer dan tidak perlu ditandatangani

Nama Pegawai : CHE MUHANDI BIN CHE ISMAIL
No Lesen: D-01014-15-24

Appendix A13 : Permit from DWNP