

First report on daily activity and feeding behavior of Javan hawk-eagle (*Nisaetus bartelsi*) in the protected forest of Kondang Merak Beach, Malang, Indonesia

ALIFANDI RAHMATUL ILMI¹, MUHAMMAD LUTHFI¹, DEWI ELFIDASARI¹✉,
YORIANTA SASAERILA HIDAYAT¹, DEWI M. PRAWIRADILAGA²

¹Department of Biology, Faculty of Science and Technology, Universitas Al Azhar Indonesia. Jl. Sisingamangaraja, Kebayoran Baru, South Jakarta 12110, Indonesia. Tel.: +6221-727-92753, Fax.: +6221-724-4767, ✉email: d_elfidasari@uai.ac.id

²Research Center for Biosystematics and Evolution, National Research and Innovation Agency. Jl. Raya Jakarta-Bogor Km 46, Cibinong 16911, West Java, Indonesia

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Abstract. *Ilmi AR, Luthfi M, Elfidasari D, Hidayat YS, Prawiradilaga DM. 2023. First report on daily activity and feeding behavior of Javan hawk-eagle (Nisaetus bartelsi) in the protected forest of Kondang Merak Beach, Malang, Indonesia. Biodiversitas 24: 6770-6779.* The Javan Hawk-Eagle (JHE) (*Nisaetus bartelsi*) is an endemic bird of prey (raptor) on Java Island that is increasingly threatened due to land conversion, habitat destruction, and illegal hunting. These factors have led to its classification as a critically endangered species. There is a need to monitor one of the natural conservation areas in the southern region of East Java, namely the protected forest of Kondang Merak Beach, which serves as a habitat for Javan hawk-eagle to preserve the existence of this species. Therefore, this research aimed to understand and identify the daily activity and feeding behavior of Javan hawk-eagle in the protected forest of Kondang Merak Beach, Malang, East Java. The implication of this research is to provide ecological data for further research and disseminate information to the community to support conservation efforts of Javan hawk-eagle species in the protected forest of Kondang Merak Beach area. The methods used included field surveys, observation of daily activity and feeding behavior, collection of daily temperature data, habitat assessment, disturbance assessment, and interviews. Based on the observation of daily activity, the percentage of perching behavior was 71%, while flying behavior was 29%. The peak flying activity occurred between 9:00 and 12:00. Environmental factors such as temperature, rainfall, and human activities influenced daily activity in the conversation area. The observation of feeding behavior showed that the highest frequency belonged to the category of 23 occurrences, where the peak occurred between 14:00 and 17:00. Furthermore, the activity was affected by nesting seasons and the presence of other raptor species besides Javan hawk-eagle.

Keywords: Activity budget, feeding ecology, Javan hawk-eagle, lowland forest, *Nisaetus bartelsi*, raptor

INTRODUCTION

Indonesia has 1,809 species of birds, some of which are birds of prey (Lepage 2023). One of Indonesia's birds of prey (raptor) is the Javan hawk-eagle (*Nisaetus bartelsi* (Stresemann, 1924)). The Javan hawk-eagle is classified as a bird of prey endemic to the island of Java, Indonesia (van Balen et al. 1999). It occupies the top of the food pyramid and is commonly known as an apex predator, essential in maintaining prey populations and creating balance in an ecosystem (Mariyappan et al. 2023). In addition, the Javan hawk-eagle is sensitive to environmental changes, and its presence can indicate ecological health (Poirazidis et al. 2007; Ardiansyah et al. 2015). When an environment is disturbed, the species is increasingly threatened, leading to a decline in population numbers. Based on its role and characteristics, the Javan hawk-eagle is a protected species in Indonesia by Government Regulation No. 7/1999 and Ministerial Decree No. 106/MenLHK/SETJEN/KUM.1/12/2018.

The majority of the Javan hawk-eagle habitat distribution is in the tropical rainforests of Java Island, characterized by steep slopes at an altitude range of 500-

2,000 meters above sea level (Prawiradilaga 2006; Syartinilia and Tsuyuki 2008). Due to rapid land use change, the Javan hawk-eagle distribution area has been fragmented. The Javan hawk-eagle distribution area in the forests of Java Island is estimated to be divided into three parts: western, central, and eastern. This fragmentation has resulted in a threatened and isolated population of Javan hawk-eagle. In addition, habitat destruction and poaching also threaten the Javan hawk-eagle population. Based on the findings of Nijman et al. (2022), 29 Javan hawk eagles were sold freely through social media, and the authorities confiscated seven of them. According to Gunawan et al. (2017), the illegal wildlife trade has led to a decline in the Javan hawk-eagle population. This declining population trend has prompted the International Union for Conservation of Nature (IUCN) to classify birds as endangered (IUCN 2017). According to the Convention on International Trade of Endangered Species of Wild Fauna & Flora (CITES), the Javan hawk-eagle is classified as an Appendix II species, which means that this species will be threatened with extinction in the future if its trade cycle is not closely monitored (Hombre et al. 2016).

Javan hawk-eagle populations are spread across several regions, including East Java, which has the highest proportion according to population estimation models (Syartinilia et al. 2009). One of the natural habitats in East Java is the protected forest of Kondang Merak Beach. The protected forest of Kondang Merak Beach is one of the nature conservation areas in the southern region of East Java with natural forest conditions and various vegetation types. This protected forest area is managed by Perum Perhutani and assisted by a conservation organization called *Sahabat Alam* (SALAM) (Luthfi and Setianingsih 2018). However, research on Javan hawk-eagle activity and behavior in the protected forest of Kondang Merak Beach has yet to be conducted. According to van Balen et al. (1999), this bird has been present in the southern region of East Java since 1997. Ardiansyah et al. (2015) also found this bird in three locations, while Iskandar et al. (2022) reported breeding success in the Kondang Merak Beach Protection Forest. Therefore, the presence of Javan hawk-eagle in Kondang Merak Protection Forest should be continuously monitored to support its sustainability. Due to their endangered population status, research and monitoring related to daily activities and feeding behaviors are considered essential for the conservation and protection of the Javan hawk-eagle.

This research aims to understand and identify the daily activities and feeding behavior of the Javan hawk-eagle in the protected forest of Kondang Merak Beach, Malang, East Java. The results of this study are expected to provide ecological data for further research and disseminate information to the public to support conservation efforts of Javan hawk-eagle species in the protected forest of Kondang Merak Beach area.

MATERIALS AND METHODS

Study area

This research was conducted in the protected forest of Kondang Merak Beach, Malang District, East Java Province, Indonesia. The protected forest of Kondang Merak Beach is located at coordinates $8^{\circ}24'15''$ - $8^{\circ}23'14''$ S and $112^{\circ}27'54''$ - $112^{\circ}33'13''$ E, which is located in Sumberbening Village, Bantur Sub-district. The observation location in the Kondang Merak area is between 2 different villages, namely Sumberbening Village and Srigrongo Village, Bantur Sub-district, Malang District. Daily activities and feeding behavior were observed at four observation points in the protected forest of Kondang Merak Beach, with the following coordinates TP1a: $8^{\circ}23'40''$ S, $112^{\circ}32'18''$ E, TP1b: $8^{\circ}23'41''$ S, $112^{\circ}32'5''$ E, TP2a: $8^{\circ}23'39''$ S, $112^{\circ}32'26''$ E, TP2b: $8^{\circ}23'28''$ S, $112^{\circ}31'55''$ E (Figure 1). The Quantum GIS (QGIS) software delineated these locations on a map.

Procedures

Observations were conducted over two phases. The first phase was from March to April and June 2021. The second phase was from July to August 2022. The total observation time was 49 days, with a cumulative duration of 362 hours. Prior to observation, Javan hawk-eagle individuals were searched for. The search for individuals is carried out in the morning by paying attention to trees that are habitual places for Javan hawk-eagles to perch. Furthermore, individuals were identified based on the characteristics of Javan hawk-eagle body parts, such as the crest on the head. Identifying differences between male and female individuals was done by paying attention to body size (females are larger than males).

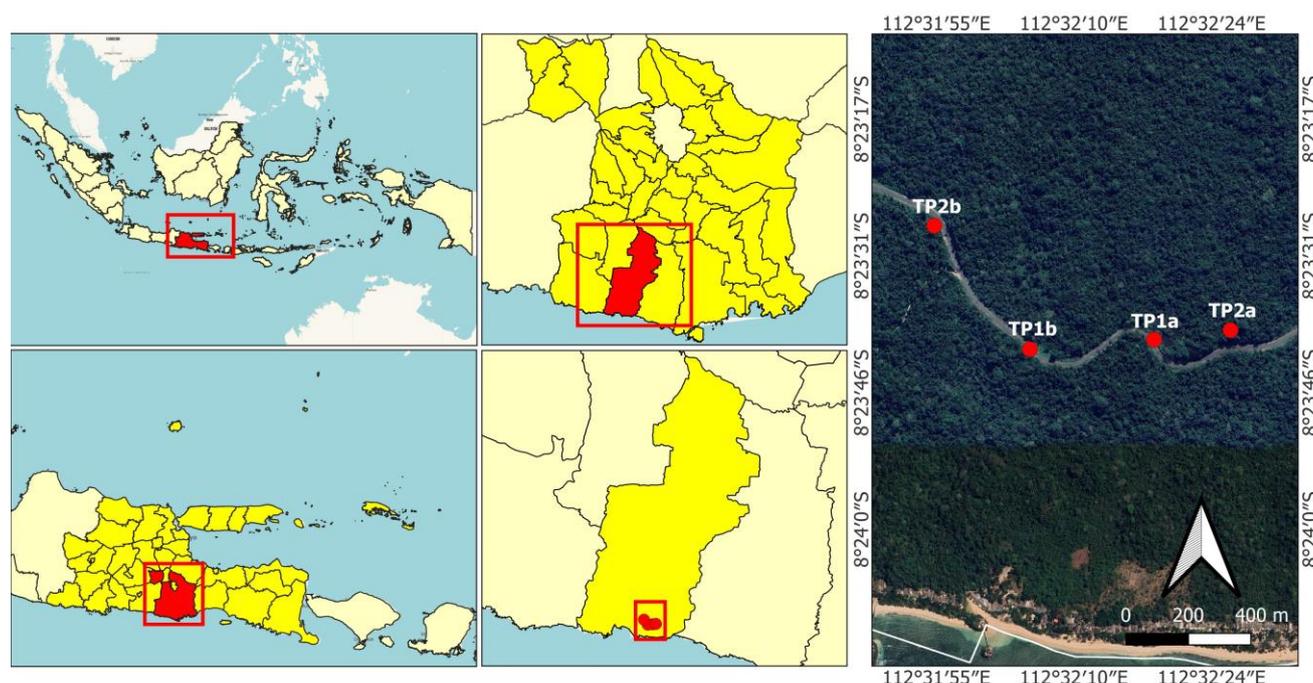


Figure 1. Observation map of daily activity and feeding behavior of Javan hawk-eagle in the protected forest of Kondang Merak Beach area, Bantur Sub-district, Malang District, East Java Province, Indonesia

Phase 1 daily activity

In the first phase, data collection focused on the daily activities of Javan hawk-eagles. The subjects observed were two adult males and females with one eaglet in the nest. Primary data collected were flight, perching and eating activities (ethogram). Other primary data were temperature data recorded during daily activity observations. Observations of the daily activities of Javan hawk-eagles began with a field survey conducted over two days to determine the habitat and location of observations. Observations were conducted using a combination of focal animal sampling and ad-libitum methods. The focal animal sampling method is to observe the behavior of one individual Javan hawk-eagle as the focus of observation and then record in detail the behavior that occurs in the specified time. The ad-libitum method records all activities of the Javan hawk-eagle during the observation period using the activity change limit (Altmann 1974). Observations were conducted from 7:00 to 17:00 for 30 days at the observation site. The observation period was adjusted to the activities of Javan hawk-eagles, which are classified as diurnal animals active from morning to evening (Syartinilia et al. 2023).

Phase 2 feeding behavior

In the second phase, data collection focused on the feeding behavior of Javan hawk-eagles. The subjects observed were three individuals: two adult males and females and one eaglet. Primary data collected included hunting flights, carrying prey, tearing the prey, feeding, beak cleaning, and defecating (ethogram). Observations of Javan hawk-eagle feeding behavior began with a field survey conducted over one day to determine the general description of the observation site, the presence of active nests and the observation location. Feeding behavior was observed using a combination of focal animal sampling and ad-libitum methods. The focal animal sampling method is to observe the behavior of one individual Javan hawk-eagle as the focus of observation and then record in detail the behavior that occurs in the specified time. The ad-libitum method records all activities of Javan hawk-eagles during the observation period using the activity change limit (Altmann 1974). Observations were divided into two periods, morning and afternoon. The morning period started at 07.00-12.00, while the afternoon period started at 14.00-18.00 for 19 days at the observation site. The observation period was adjusted to the activities of Javan hawk-eagles, which are classified as diurnal animals, and hunting time, which is active from morning to evening (Syartinilia et al. 2023).

Secondary data were obtained through direct interviews with forest rangers. Data collected included information on Javan hawk-eagle nesting habitat, breeding status, population size, nesting tree types and perching trees.

Data analysis

Data analysis was carried out descriptively by categorizing daily activities and feeding behavior from direct observations. Daily activity categories observed included flying, perching, and eating activities. The

observed feeding behavior categories included hunting flights, carrying prey, tearing prey, feeding, beak cleaning, and defecating. The data obtained were processed, and the frequency of each behavior category was statistically analyzed. Furthermore, graphs and diagrams were made to display data on the percentage of activity frequency, followed by descriptive interpretation. The formula used to calculate the percentage of activity frequency is as follows:

$$\text{Activity} = \frac{\text{Number of activity}}{\text{Total number of activity}} \times 100\%$$

The proportion of daily activity and feeding behavior data of the Javan hawk-eagle that has been described descriptively was then analyzed qualitatively regarding data from other habitats, such as Mount Halimun Salak National Park in West Java and around Malang Regency, East Java. This analysis compared Javan hawk-eagle daily activity and feeding behavior in different locations.

RESULTS AND DISCUSSION

The Javan hawk-eagle daily activity

Based on the observations, Javan hawk-eagle engaged in daily activity that was repetitive and dependent on environmental conditions. The results indicated that daily activity was categorized into perching and flying, with a percentage of 71% and 29%, respectively, as presented in Figure 2. The calculations of daily activity and behaviors, repeated in the observation period from morning to afternoon, showed relatively diverse frequencies of flying and perching activities between 07:00 and 17:00, as illustrated in Figure 3.

During the 30 days of observation from 07:00 to 17:00, Javan hawk-eagle was observed between 07:00 and 09:00. Perching and flying activities in the morning were performed periodically to obtain sunlight. From 09:00 to 12:00, the frequency of daily activity significantly increased, as shown in Figure 3. In the afternoon, between 14:00 and 17:00, there was a tendency for a decrease in activities due to environmental conditions in the observation area, such as the decline in temperature and sunlight intensity.

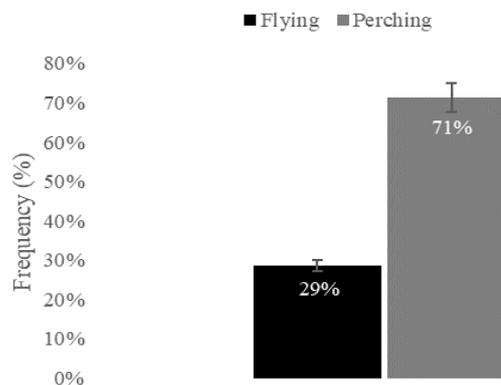


Figure 2. Comparison graph of daily activity of Javan hawk-eagle for 30 days of observation between 07.00-17.00

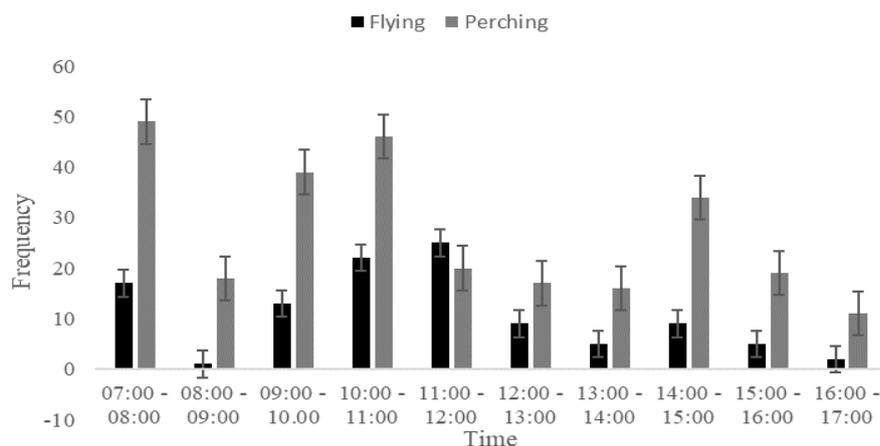


Figure 3. Daily activity frequency per total 30 days observation of Javan hawk-eagle based on the use of daily time

Daily activity and behavior of individual Javan hawk-eagle in the protected forest of Kondang Merak Beach were visible and influenced by weather conditions. Additionally, the activity under or within the forest canopy cannot be observed due to the obstructed view caused by the canopy cover. This made observing perching and flying activities difficult due to environmental factors in the forest.

The Javan hawk-eagle perching activity

The most frequently observed activity was perching, which exhibited a relatively high frequency and served various purposes, including monitoring the surrounding conditions. During perching, Javan hawk-eagles commonly groom themselves by cleaning their feathers and turning their head to the left and right (Sitorus and Hernowo 2016). The vigilance behavior was divided into two categories, as shown in Figure 4: monitoring the surrounding environment and observing any prey movements from the perching location. These behaviors are regularly performed when perching.

The observation results showed that perching was the most frequently Javan hawk-eagle performed by Javan hawk-eagle, accounting for 71% of the recorded daily activity. Similarly, Gjershaug et al. (2004) reported that the Javan hawk-eagle spent 57% or more of its daily time on perching. This was carried out in the day according to environmental conditions, while the remaining time was spent flying or feeding.

The perching activity also served as a mechanism to maintain body temperature regulation (thermoregulation). This was because, during flying and hunting, the eagle used flight muscles, thereby increasing muscle activity. This increased movement caused a temporary rise in body temperature, which required heat dissipation through evaporative cooling processes with the assistance of feathers and legs and behavioral mechanisms such as perching in shaded trees (Delfita 2019). Eagles also use perching activities to groom themselves; a behavior aims to maintain the condition of the feathers to keep them clean and neat, provide resistance to water, warm the body when it rains, and defend against parasites (Whittaker et al. 2016). Self-grooming behavior is carried out using a beak coated with oil from the uropygial glands at the base of the

tail (Mench and Blatchford 2014; Whittaker et al. 2014).

The Javan hawk-eagle flying activity

Flying is the behavior of changing bird positions accompanied by flapping their wings for foraging, migration, and breeding (Ruaux et al. 2020). Nijman and Sözer (1998) stated that a flying Javan hawk-eagle was identified by observing its tail's slightly V-shaped wingspan and tapering shape. Flying activity encompasses several behaviors, including soaring, which involves flying and circling without flapping the wings and taking advantage of the rising warm air currents. Gliding is a form of flight performed when transitioning between perching locations. During gliding, the tail feathers remain erect, followed by wing flapping. Another flying behavior is a periodic up-and-down flight with a horizontal trajectory, as shown in Figure 5, which occurs during the mating season to attract mates' attention and repel other individuals.

During the observation period, Javan hawk-eagle engaged in flying activity 29% of the time. Figure 3 showed that flying activity occurred from morning to midday between 09:00 and 12:00 but decreased in the afternoon, between 14:00 and 17:00. Similarly, Luthfi et al. (2020) in the Gunung Halimun Salak National Park reported that Javan hawk-eagle was frequently observed flying between 09:00 and 14:00.

The daily activity of the Javan hawk-eagle is also influenced by its habitat. According to Cunningham et al. (2015), habitat is an important factor in supporting the life of wildlife animals, such as foraging, breeding, and sheltering. This is further supported by McCabe et al. (2018) regarding the canopy's role in covering and vegetation structure in the habitat, which directly affects the availability of prey and their hunting strategy. Canopy cover in natural forests is associated with the structure and vegetation composition, both vertically and horizontally, and the canopy quality. This affects the diversity of wildlife within the habitat, including the prey of the Javan hawk-eagle. Additionally, vegetation diversity in an area is influenced by environmental conditions such as temperature, altitude, latitude, and rainfall (Li et al. 2019).



Figure 4. Javan hawk-eagle perching activity in the protected forest of Kondang Merak Beach, Malang, Indonesia



Figure 5. Javan hawk-eagle flying activity in the protected forest of Kondang Merak Beach, Malang, Indonesia

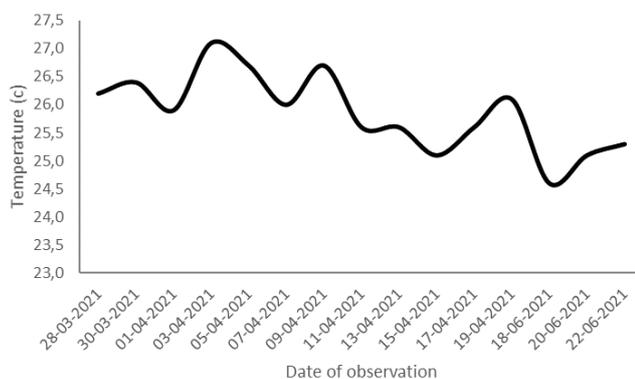


Figure 6. Graph of fluctuations of daily average air temperature in the protected forest of Kondang Merak Beach, Malang, Indonesia

The Meteorology, Climatology, and Geophysics Agency (BMKG 2021) obtained air temperature and rainfall data. As shown in Figure 6, the air temperature in protected forest of Kondang Merak Beach ranged from 23°C to 27°C, with a total rainfall of 327.5 mm during a 30-day observation period in March to April, and June 2021. Based on the data, the conservation area can be categorized as one with high rainfall and relatively moderate air temperature. Environmental factors such as rainfall and air temperature influenced the daily activities of the Javan hawk-eagle (Luthfi et al. 2020). This was related to the data obtained during the observations, as perching activity had a higher percentage than flying. Furthermore, previous investigations had established that eagles required warm air for daily activities such as flying and hunting.

Other factors, such as human activities, also influenced the daily activity of the Javan hawk-eagle. During the observation and data collection, the protected forest of Kondang Merak Beach was undergoing construction of the Southern Cross Road, resulting in high human activity and the mobility of heavy construction equipment. This project was located in the Javan hawk-eagle foraging area, approximately 200-300 meters from nest trees and perching locations. This condition affected the daily activity of this bird as the project construction fragmented the protected forest.

The Javan hawk-eagle feeding behavior

The observed feeding behavior was categorized into different categories. The successful observed feeding behavior consisted of hunting while flying, carrying prey, tearing prey, feeding, beak cleaning, and defecation. Furthermore, there were derivative variables such as feeding eaglet and self-feeding. Based on data recording and calculations in Figure 7, feeding behavior has the highest frequency with 23 occurrences.

Feeding behavior was the most frequent because it corresponded to the parental care provided by the Javan hawk-eagle pair for the eaglet. During this period, an increase in food provisioning to the nest by both parents was observed. According to Setiadi et al. (2000), food provisioning by parents to eaglet was frequent during the

growth period. After feeding the eaglet, the parents must consume the remaining food to survive (Prawiradilaga et al. 2001).

Feeding behavior tended to be highest in the afternoon, between 14:00 and 17:00, followed by the morning between 8:00 and 10:00, as shown in Figure 8. This made Javan hawk-eagle engage in less feeding behavior during the midday hours between 11:00 and 13:00. There was no observation of feeding behavior between 12:00 and 14:00 because their daily activity was not particularly high. However, Prawiradilaga (2006) stated that the peak hunting period for Javan hawk-eagle occurred in the morning between 7:00 and 11:00. Based on the observation, the peak feeding behavior in the afternoon was affected by the overlapping use of resources by another bird species, namely Crested Serpent-Eagle (*Spilornis cheela* (Latham, 1790)). The presence of the Crested Serpent-Eagle caused the Javan hawk-eagle to reduce its feeding behavior in the morning and tended to peak in the afternoon.

Javan hawk-eagle uses its sharp eyesight to hunt while flying (Prawiradilaga 2006). Based on observations, the

Javan hawk-eagle in the protected forest of Kondang Merak Beach watches and approaches its prey by briefly flying and perching on tree branches. Hunting while flying is performed twice a day, in the morning between 07:00 and 09:00 and between 14:00 and 17:00. The highest frequency of encounters occurred in the morning (2 occurrences). The timing selected for hunting while flying is related to the peak activity of the prey, which is also in the morning and afternoon.

Based on observations, the behavior of carrying prey to the nest began with the male eagle emitting a calling sound. After the calling sound was heard, within approximately 1-3 minutes, the male parent carried the prey to be handed over to the female parent in the nest, as presented in Figure 9. The field observations revealed that the male parent carries all prey brought to the nest. Similarly, Nijman et al. (2000) stated that the male eagle provided prey to the female with a frequency of 7 times during 28 days of observations. Once the prey was brought to the nest by the male parent, the female continued to feed the eaglet, and the male left the nesting tree, as shown in Figure 10.

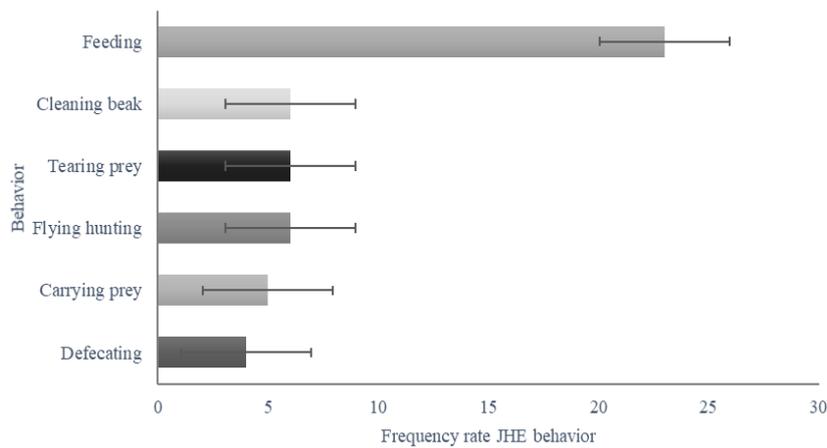


Figure 7. The total frequency rate of feeding behavior of Javan hawk-eagle for 19 days of observation between 07.00-12.00 and 14.00-18.00

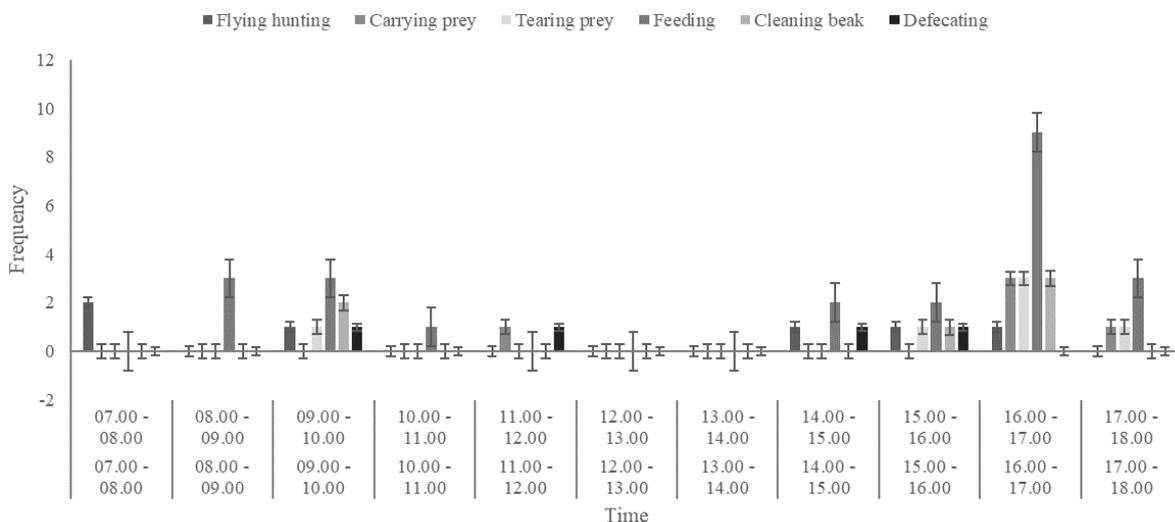


Figure 8. Feeding behavior frequency per total 19 days observation of Javan hawk-eagle based on the use of daily time



Figure 9. Behavior of a Javan hawk-eagle parent carrying prey to the nest

The frequency of the male parent carrying prey to the nest was observed only once a day. However, Prawiradilaga et al. (2001) stated that male and female parents provided prey to the nest twice daily, in the morning and afternoon. In this observation, feeding was only done once because the female parent and the eaglet could not consume the entire prey in a day. This occurred due to the presence of leftover food in the nest after feeding behavior was completed. The encounters of the male parent carrying prey also occurred during midday between 11:00-12:00 or in the late afternoon between 16:00-18:00. This was different from the statement by Prawiradilaga et al. (2001), where the male or female parent was observed to bring prey in the morning and afternoon. The difference in encounter time in this observation compared to previous research was because the male Javan hawk-eagle was actively hunting for prey in the morning. The male parent did not immediately bring the prey due to human disturbances around the nest site (Gunawan et al. 2016). When the conditions were calm, the male parent brought the prey to the nest during midday and the near evening.

After the male parent brought the prey to the nest, the female parent was observed to tear apart the prey's body. The role of the female parent in tearing the prey was crucial as it facilitated the eaglet in swallowing the prey. Tearing the prey was necessary because predatory birds only have a sharp beak as a tool to process their food. The female Javan hawk-eagle was observed tearing the prey in the morning between 9:00-10:00 and 15:00-16:00. The time used by the female parent for tearing was after the male parent brought the prey to the nest, specifically in the afternoon. The observation of the female tearing the prey in the morning did not align with the time the prey was brought to the nest. This occurred because any remaining prey would be stored and consumed for the next day. The behavior of tearing prey in the morning was also observed by Sitorus and Hernowo (2016) from 08:28 to 08:33. Therefore, the behavior of tearing prey can occur at any time, either in the morning or afternoon, depending on the prey availability.

Javan hawk-eagle consumes its prey, which has been torn into pieces. Moreover, feeding behavior is very important in maintaining survival because it involves taking energy and nutrients used to carry out daily activities (Petrovich 2019). Feeding the eaglet by the

female parent is necessary as the eaglet is still caring inside the nest. Feeding is also initiated from the egg's hatching until the eaglet can eat independently. As shown in Figure 11, the female parent on the left will feed her eaglet on the right inside the nest.

Feeding frequency was observed to be twice a day, in the morning at 08:15, 08:37, and 10:27. In the afternoon, at 15:14, 16:06, 16:43, 17:02, and 17:12. The average duration spent by the female Javan hawk-eagle in feeding its eaglet was 8 ± 9.12 minutes ($n=8$; n represents the number of observed feeding behavior), with the longest duration being 28 minutes for mammalian prey. However, Sözer and Nijman (1995) stated that the female parent spent 22 minutes feeding its eaglet with medium-sized mammalian prey and snakes. The difference in time was due to the variation in the weight of the prey given by the female parent and the eating preference of the eaglet. Feeding duration depends on the weight of the prey and increased eating preference, as heavier prey require more time, and vice versa. During feeding activity, the female parent assisted the eaglet in tearing the prey, as shown in Figure 12. The eaglets were observed taking the intestines from the torn prey provided by the female parent. After a few minutes, the female parent moved to another perch, and the process of consuming the prey continued independently by the eaglet.

The observational data showed that the eaglet used an average of approximately 16 ± 14.44 minutes ($n=9$, n represents the number of observed feeding behaviors) to consume the prey in the nest. However, the female parent only used approximately 5 ± 5.78 minutes ($n=6$, n represents the number of observed feeding behaviors). The eaglet used more time to consume the prey due to the inability to feed independently, requiring the necessary skill to carry out feeding behavior. Meanwhile, being mature and accustomed to self-feeding, the female parent required less time. The female and male parents used the morning and afternoon as feeding times, with the female tearing apart their prey.

The roles of male and female parents in caring for their eaglet were crucial in the reproductive process of the Javan hawk-eagle. The male and female parents have their respective tasks in nurturing their eaglet, which include bringing prey to the nest, tearing the prey, and feeding their eaglet. Based on observations and previous literature, the specific tasks of the male and female parents in caring for their eaglet in the nest were summarized in Table 1.

Cleaning the beak is part of self-care in eagles, including Javan hawk-eagle, which also cleans the feathers on its body. Based on observations, the behavior of cleaning the beak was only performed by the eaglet in the nest. The male and female parents were not observed performing this behavior, as they often stayed outside the nest tree. The behavior of cleaning the beak among eaglets was accomplished after consuming their prey. Figure 13 showed that the eaglet cleaned the beak using one of their feet (Figure 13). Based on the results, the average time spent by Javan hawk-eagle eaglets to clean their beak was 0.66 ± 1.63 minutes ($n=6$, n represents the number of observed behaviors) for mammalian prey.

Table 1. The role of male and female parents in caring for their eaglet

Data source	Carrying prey	Tearing prey	Feeding the eaglet
In this research	Male	Female	Female
Sozer and Nijman (1995)	Male	Female	Female
Prawiradilaga et al. (2001)	Female and Male	-	Male and Female



Figure 10. A) The female Javan hawk-eagle comes to the nest to feed the eaglet, B) Male Javan hawk-eagle leaves after carrying prey



Figure 11. The female Javan hawk-eagle feeding the eaglet



Figure 13. Javan hawk-eagle eaglet clean their beaks on a branch nest tree



Figure 12. The female Javan hawk-eagle assists the eaglet in taking out the prey

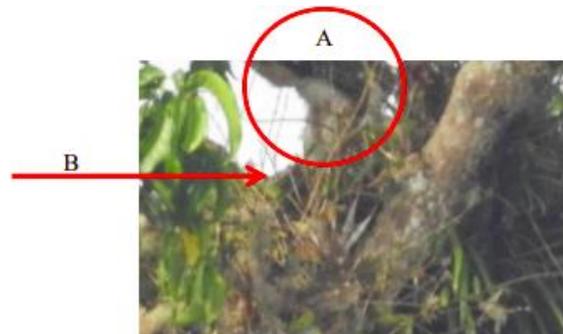


Figure 14. A) Javan hawk-eagle eaglet, B) defecate at the edge of the nest

Defecation eliminates waste material from the animal body (Quan et al. 2015; Dharmawan et al. 2020). This behavior is rarely observed, both in the male and female parents, during the observation period. In this research, the eaglets defecated in the nest tree, as shown in Figure 14.

Meanwhile, the defecation activity of both parents was rarely observed in the nest tree (Subagyo 2022, pers. comm.).

Javan hawk-eagle eaglets defecate by walking toward the edge of the nest, bending their bend with both wings

partially stretched to maintain balance. The back part of the body, the tail, opens, and the waste is expelled outside the nest. According to Sözer and Nijman (1995), Javan hawk-eagle eaglet flicks their tails after defecation and returns to the nest's original position. Based on the research results by Quan et al. (2015), almost all nesting birds defecate after feeding. Similarly, Changeable hawk-eagle defecates after feeding activity in the morning and afternoon (Safanah et al. 2018).

In conclusion, Javan hawk-eagle (*Nisaetus bartelsi*) daily activities consist of perching (71%) and flying (29%). The Javan hawk-eagle feeding behavior consisted of flying, hunting, carrying prey, tearing the prey, feeding, cleaning the beak, and defecation. Feeding was the most frequently observed behavior category, with a frequency of 23 occurrences. This is because the observations were made during the nesting season, which causes the need for food to increase for both Javan hawk-eagle parents and eaglet. The results of direct observations in the protected forest of Kondang Merak Beach show that the frequency of daily activities of Javan hawk-eagles consisting of perching and flying activities occurs at 09:00-12:00. These results are influenced by several environmental factors, such as temperature and rainfall, as well as disturbances from human activities and heavy equipment mobility in the Javan hawk-eagle home range in the Kondang Merak Beach protected forest. The frequency of Javan hawk-eagle feeding behavior encounters occurred at 14:00-17:00. This result was influenced by the activity of the crested serpent eagle in the morning in the Javan hawk-eagle home range in the protected forest of Kondang Merak Beach, causing Javan hawk-eagles to tend to start being active in the afternoon.

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