

UPDATING THE DIURNAL RAPTORS ON BANDEALIT RESORT AT MERU BETIRI NATIONAL PARK, EAST JAVA, INDONESIA

Arif Mohammad Siddiq^{1*}, Hari Sulistiyowati¹, Rendy Setiawan¹,
Muhammad Kurniawan¹, and Puji Firmansyah²

¹Department of Biology, Faculty of Mathematics and Natural Sciences,
University of Jember, Jl. Kalimantan 37, Jember

²Meru Betiri National Park, Jl. Sriwijaya 53, Jember

*Corresponding author: arifsiddiq.fmipa@unej.ac.id

Received: 9 January 2023; Accepted: 4 December 2023; Published: 31 December 2023

ABSTRACT

Meru Betiri National Park (MBNP) is one of the conservation areas as a habitat for diurnal raptors in East Java. However, the updated information on diurnal raptors in MBNP is still limited, with the latest information recorded in 2014. Therefore, this study aims to inventory the species composition of diurnal raptors in Bandalit Resort at MBNP. This research was conducted in April-June 2022 using the point count method with an observation radius of 1 km. We sampled a total of three observation points in three forest cover types i.e dense vegetation (primary forest), semi-dense vegetation (secondary forest-plantation), and low vegetation (coastal forest). Data collection included diurnal raptors species, frequency of encounters for each species, time of encounter, coordinate points, and activity (flyover, soaring, and perched). The results showed the presence of 10 diurnal raptors at the Bandalit Resort MBNP which consisted of two families (Accipitridae and Falconidae). Based on the IUCN Red list of threatened species, there are eight species of least concern (LC), one species of near threatened (NT), and one species of endangered (EN). The frequency of encounters shows that Crested Serpent-eagle (*Spilornis cheela*) has the highest frequency value (20%), while the Spotted Kestrel (*Falco moluccensis*) and Changeable Hawk-Eagle (*Nisaetus cirrhatus*) have the lowest frequency value (4%). Furthermore, as a special record, the Javan Hawk-eagle (*N. bartelsi*) is found with a fairly high frequency of encounters (11%). Approximately 75.71% of observed diurnal raptors are in soaring activity. Moreover, based on their distribution area, the primary forest has the highest composition of diurnal raptor species encountered.

Key words: Bandalit Resort, diurnal raptor, Meru Betiri National Park, predatory birds

INTRODUCTION

Raptor is the terminology for predatory birds that ecologically have gripping behavior and carry their prey using claws or feet. Based on the activity pattern of time behavior, raptors are divided into two categories, that are diurnal and nocturnal raptors (McClure et al., 2019; Potier et al., 2020). In Indonesia, approximately 71-81 species of diurnal raptors belong to three families, i.e. Pandionidae, Accipitridae, and Falconidae (Ferguson-Lees & Christie, 2005; Sukmantoro et al., 2007; Eaton et al., 2016; Taufiqurrahman et al., 2022). According to Supriatna (2012) who referred to The International Union for Conservation of Nature's (IUCN) Red List of Threatened Species, there are 13 species of diurnal raptors in Indonesia with threatened status, including near threatened, vulnerable, endangered, and critically endangered. Indonesia is one of the countries that have the highest level of threatened raptors in the world (McClure et al., 2018). Three main factors cause the existence of diurnal raptors to become increasingly

threatened, i.e., poaching, illegal trade, and forest degradation as their habitat (Purwanto et al., 2015; Concepcion et al., 2018).

The existence of diurnal raptors in Indonesia has been threatened in the last 20 years (see van Balen, 1998). On a positive note, recently there has been an improvement in the frequency and distribution of diurnal raptors in conservation areas which tend to have suitable habitat characteristics and have a small risk of anthropogenic threat. One of the conservation areas in Indonesia which is the habitat for these diurnal raptors is Meru Betiri National Park (MBNP). In the last 30 years, there have been 214 bird species reported in TNMB, 14 of which are diurnal raptors (MacKinnon et al., 2010; Kurnianto et al., 2014). However, over the past eight years, information on the existence of diurnal raptors at the MBNP has been limited. Information about the occurrence of the top predator groups is needed, because its presence can be a keystone species in regulating the balance of the ecosystem (Donázar et al., 2016). In addition, these raptor groups also have a role as an umbrella species or a species that, if saved, will save other species because it requires the availability of habitat and a large area (Simberloff 1987; Rodríguez-Estrella et al., 2008).

Monitoring activities in the effort to conserve diurnal raptors have been carried out by MBNP staff. One of them is monitoring the Javanese Hawk-eagle from 2014 to 2019 at the Sukamade Resort. However, exploration or data updating is urgently needed regarding the presence of diurnal raptors in a wider area that is suspected to be a home range or specific habitat, such as in Bandalit Resort. The tropical forest in the Bandalit Resort has a complex vegetation structure (Syarif et al., 2018) which is thought to support diurnal raptor habitat. If these data are not periodically updated, it could lead to suboptimal conservation efforts for diurnal raptors and it is feared that it could affect their existence in the ecosystem. Therefore, this study is very important to be carried out with the specific aim of determining the species composition of diurnal raptors and their frequency in Bandalit Resort in TNMB. Furthermore, this scientific data will also provide up-to-date information about the existence of raptors in Indonesia, especially on Java Island.

MATERIALS AND METHODS

Study area

The research was conducted in April-June 2022 (for the total observation over 91 days). The data collection was carried out in three forest cover types i.e., low forest cover, medium forest cover, and high forest cover (Fig. 1). Determination of observation points was started with interviews with MBNP officers and the surrounding community who were active in the Bandalit Resort regarding potential locations for encounters with diurnal raptors. There are six potential locations for diurnal raptor encounters, including West Estuary, East Estuary, Lodadi Block, Cawang Block, Bun Ngetek Block, and Pringtali Block. Furthermore, to determine forest cover based on the Normalized Difference Vegetation Index (NDVI) with three categories, i.e., low forest cover, medium forest cover, and high forest cover. The NDVI map was made using the Landsat 8 imagery basemap obtained from the United State Geological Survey (USGS)

website (<https://www.usgs.gov/>) in ArcGIS 10.7.1. Based on the results of forest cover analysis at the previous six points, there are three potential observation points obtained which consisted of the East Estuary (Point 1: low forest cover), Cawang Block (Point 2: medium forest cover), and Blok Pringtali (Point 3: high forest cover) (Fig. 1). The determination of these three points also considered the accessibility for observers.

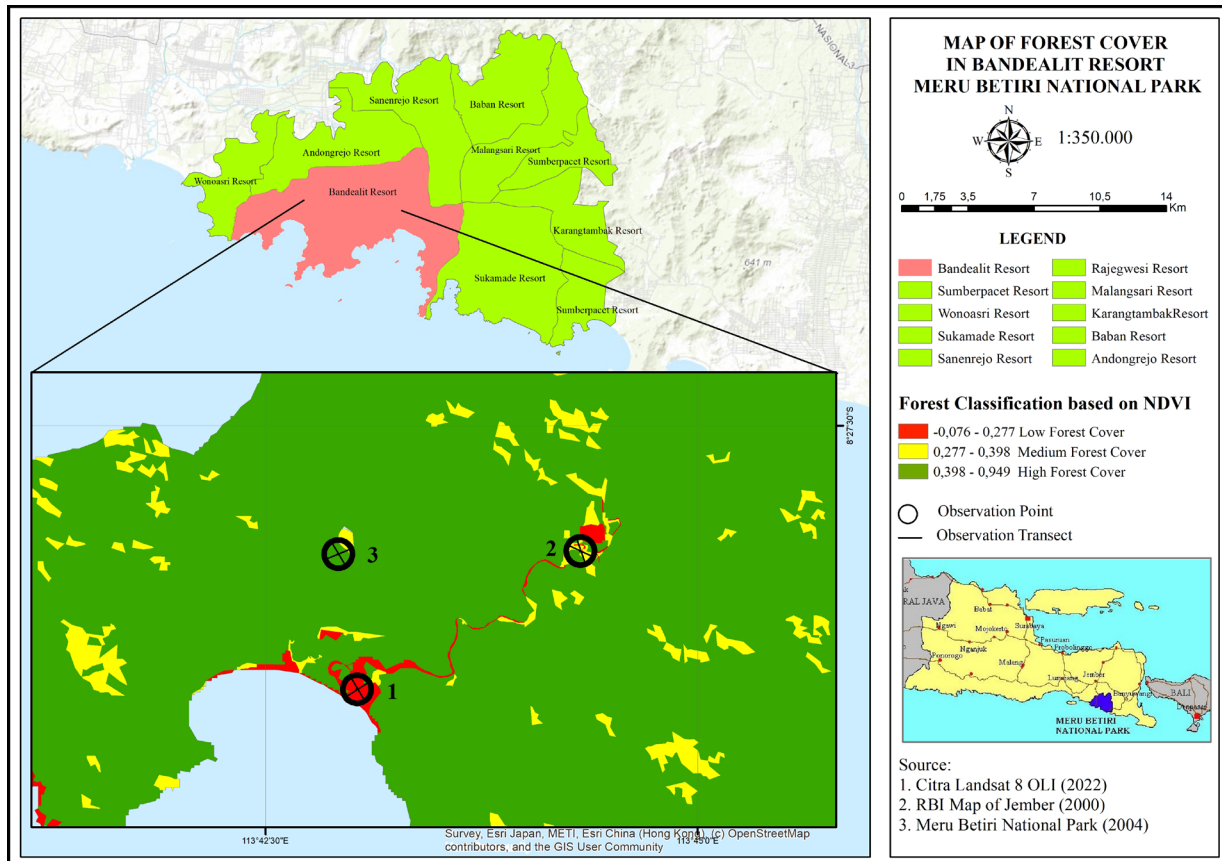


Figure 1. A map of the study area shows three observation points. Point 1 (low forest cover); Point 2 (medium forest cover); Point 3 (high forest cover).

Observation Point 1 ($8^{\circ}29'2.67''$ S and $113^{\circ}43'0.47''$ E) has characteristics of low forest cover with estuaries habitat combined with coastal forest, and it is located at an altitude of 1-4 m asl. Furthermore, Point 2 ($8^{\circ}28'13.23''$ S and $113^{\circ}44'15.60''$ E) has characteristics of medium forest cover with secondary forest-plantation habitat types (falcata tree, balsa tree, teak, and coffee plantations), and is located at an altitude of 6-8 m asl. Whereas Point 3 ($8^{\circ}28'15.04''$ S and $113^{\circ}42'54.87''$ E) has high forest cover characteristics with primary forest habitat types, and is located at an altitude of 20-26 m asl.

Diurnal raptors survey

Data collection was carried out using the point count method (Bibby et al., 2000) with a radius of 1 km (Thiollay 1989; Thiollay & Rahman, 2002). Field observations used Nikon Aculon Powerview 10x50 binoculars, Canon EOS 60D DSLR camera, telephoto lens 75-300 mm, Canon PowerShot SX540 HS DSLR camera, and field stationery. Observation of bird sounds using Sony ICD-PX240 recorder. At each point, observations were made for a duration

of 60-70 minutes. Data collection activities at each point were carried out by two observers in the morning (07.00-09.00), afternoon (11.00-13.00), and evening (15.00-17.00) considering daily activities of diurnal raptors (Purwanto et al., 2015). The data recorded includes species of diurnal raptors, frequency of encounters for each species, time of encounter, coordinate points, and activity (flyover, soaring, and perched) (Prawiradilaga et al., 2002). Identification and verification of diurnal raptors using the morphological characteristics (body size, color and shape of the head, color of the pattern of feathers, shape of the span of the wings) (MacKinnon et al., 2010; Taufiqurrahman et al., 2022) and sound recorded (<https://xeno-canto.org/>). Furthermore, each diurnal raptor species was determined of conservation status based on The IUCN Red List of Threatened Species (<https://www.iucnredlist.org/>).

RESULTS

Based on the observation over 91 days, there were 54 diurnal raptor encounters consisting of 18 encounters in April, seven encounters in May, and 29 encounters in June. Based on the species identification, there are 10 diurnal raptor species belonging to four genera and two families (Table 1). There are eight species of least concern status (*Spilornis cheela*, *Nisaetus cirrhatus*, *Ictinaetus malaiensis*, *Haliaeetus leucogaster*, *Accipiter trivirgatus*, *Pernis ptilorhynchus*, *Microhierax fringillarius*, *Falco moluccensis*), one species of near threatened status (*Lophotriorchis kienerii*), and one species of endangered status (*N. bartelsi*).

Table 1. Species composition of diurnal raptors in Bandalit Resort at MBNP

Family	Species	English Name	Conservation Status	Local Distribution
Accipitridae	<i>Spilornis cheela</i>	Crested Serpent-eagle	LC	PF, SF, PT, CF
	<i>Nisaetus cirrhatus</i>	Changeable Hawk-Eagle	LC	PF, SF
	<i>Nisaetus bartelsi</i>	Javan-Hawk Eagle	EN	PF, SF
	<i>Ictinaetus malaiensis</i>	Black Eagle	LC	PF, SF
	<i>Lophotriorchis kienerii</i>	Rufous-bellied Eagle	NT	PF, SF
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	LC	CF
	<i>Accipiter trivirgatus</i>	Crested Goshawk	LC	PF, SF, PT
	<i>Pernis ptilorhynchus</i>	Crested Honey-buzzard	LC	PF, SF, PT, CF
Falconidae	<i>Microhierax fringillarius</i>	Black-thighed Falconet	LC	SF, PT
	<i>Falco moluccensis</i>	Spotted Kestrel	LC	SF, PT

Notes: Least Concern (LC), Near Threatened (NT), Endangered (EN), Primary Forest (PF), Secondary Forest (SF), Plantation (PT), Coastal Forest (CF).

Based on local distribution, there were six species (*S. cheela*, *N. cirrhatus*, *N. bartelsi*, *I. malaiensis*, *L. kienerii*, *A. trivirgatus*) found in the primary forest, five species (*S. cheela*, *N. cirrhatus*, *N. bartelsi*, *I. malaiensis*, *L. kienerii*, *A. trivirgatus*, *P. ptilorhynchus*, *M. fringillarius*, *F. moluccensis*) in secondary forest, four species (*S. cheela*, *A. trivirgatus*, *P. ptilorhynchus*, *M. fringillarius*, *F. moluccensis*) in plantation, and one species (*H. leucogaster*) in coastal forest and estuary. Documentation of representative diurnal raptor species is presented (Fig. 2).

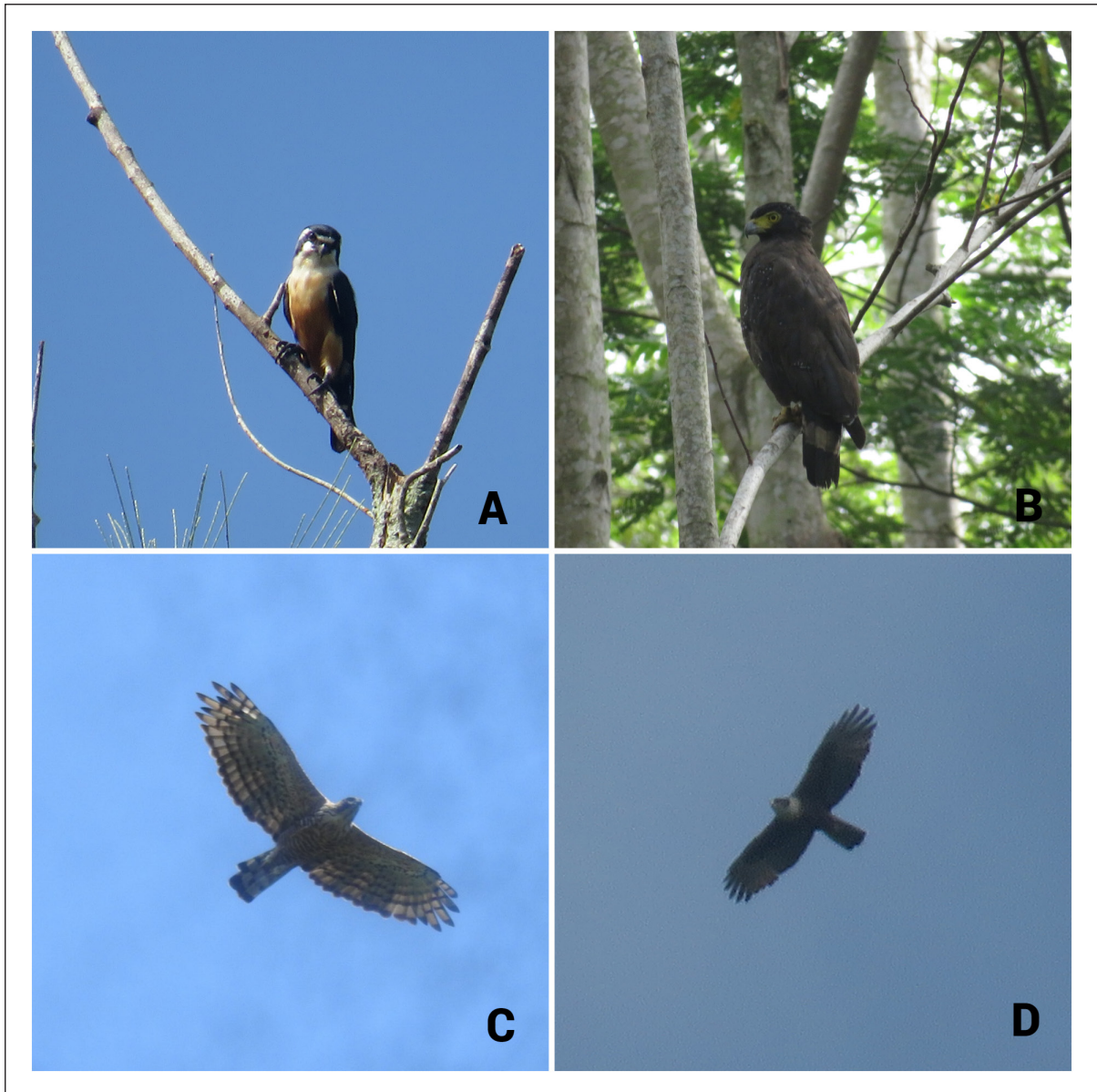


Figure 2. Diurnal raptors: *M. fringillarius* (A), *S. cheela* (B), *N. bartelsi* (C), *L. kienerii* (D). Photo A-B, D taken by MK, and photo C taken by PF.

Based on the frequency of diurnal raptor in Bandalit Resort, species *S. cheela* (20%) had the highest frequency, followed by *L. kienerii* (19%), *M. fringillarius* (11%), *N. bartelsi* (11%), *I. malaiensis* (9%), *P. ptilorhynchus* (9%), *H. leucogaster* (7%), *A. trivirgatus* (6%), *N. cirrhatus* (4%), and *F. moluccensis* (4%), respectively. In detail, the species *S. cheela* and *L. kienerii* were found during three months of observation (April, May, and June). Furthermore *F. moluccensis*, *M. fringillarius*, *A. trivirgatus*, *H. leucogaster*, *I. malaiensis*, *N. bartelsi*, and *N. cirrhatus*, were only found in two months of observation. Whereas *P. ptilorhynchus* was only found in one month (Fig. 3).

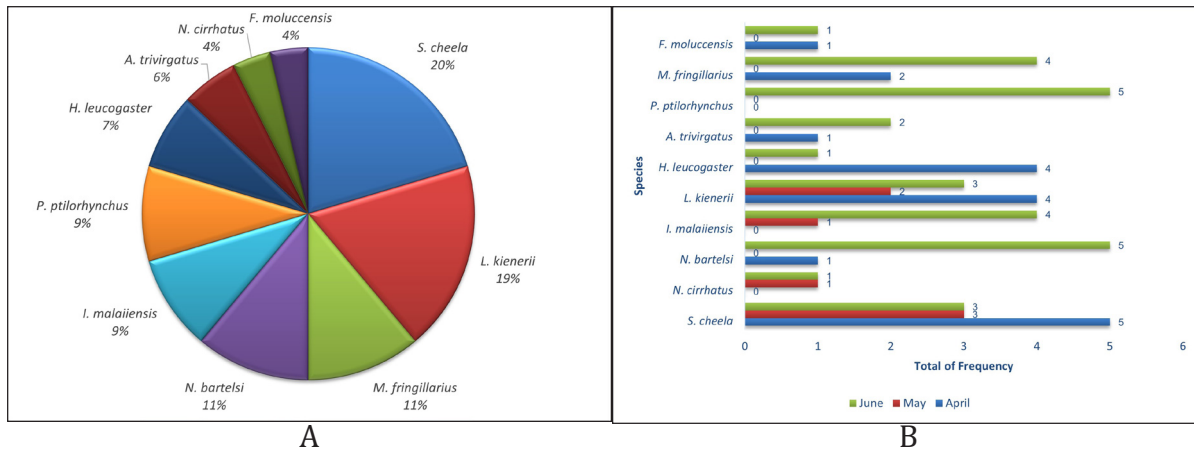


Figure 3. Total frequencies of diurnal raptors (A) and each in three months of observation (B).

Based on the forest cover category, the highest richness of diurnal raptor species was found in high forest cover (8 species), low forest cover (7 species), and medium forest cover (4 species) respectively. In the Pringtali Block (high forest cover) were found eight species of diurnal raptors with a total of 31 encounters. Three species have the highest encounter rate, i.e., *N. bartelsi* (19%), *L. kienerii* (19%) and *S. cheela* (19%). Furthermore, five species have varying encounters frequencies, i.e., *M. fringillarius* (13%), *P. ptilorhynchus* (13%), *I. malaiensis* (10%), *A. trivirgatus* (3%), and *H. leucogaster* (3%) (Fig. 4).

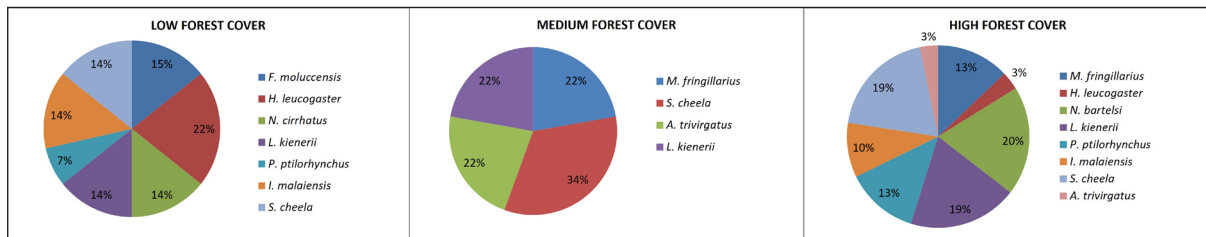


Figure 4. Frequencies of diurnal raptors in each cover category: Lower Forest Cover (Left), Medium Forest Cover (Middle), and High Forest Cover (Right).

In addition, in the East Estuary area (Low Forest Cover), seven species of diurnal raptors were found with a total of 14 encounters. Species *H. leucogaster* (22%) had the highest frequency, followed by *F. moluccensis* (14%), *N. cirrhatus* (14%), *L. kienerii* (14%), *I. malaiensis* (14%), *S. cheela* (14%), and *P. ptilorhynchus* (7%) (Fig. 4). Meanwhile, in the Cawang Block (Medium Forest Cover) four species of diurnal raptors were found with a total of nine encounters. Species *S. cheela* (34%) had the highest frequency, followed by *M. fringillarius* (22%), *A. trivirgatus* (22%), and *L. kienerii* (22%).

DISCUSSION

The results of this study provide up-to-date information about the existence of diurnal raptors in Bandalit Resort MBBP. Ten species were discovered to be distributed over three classifications of forest cover—low, medium, and high—with several types of habitats, i.e., primary forest, secondary forest, coastal forest, and plantation. There were eight species (*S. cheela*, *N. bartelsi*,

I. malaiensis, *L. kienerii*, *A. trivirgatus*, *P. ptilorhynchus*, *M. fringillarius*, *F. moluccensis*) that were also discovered by Kurnianto et al. in 2014 at Bandalit Resort. Furthermore, *N. cirrhatus* is a new record in Bandalit Resort, because Kurnianto et al. (2014) only found this species distributed in Sumberpacet, Rajekwesi, and Sukamade Resort. Meanwhile, this study did not find *F. peregrinus*, which was reported at Bandalit Resort in 2014, especially in the secondary forest (Kurnianto et al., 2014). Since this species is rarely recorded in MBNP (Kurnianto et al., 2014), we assumed that it is a migratory raptor that uses MBNP as a stopover location. However, this needs to be proven by further research over a relatively long period of observations.

Based on the frequency of diurnal raptors in Bandalit Resort at MBNP, the Crested Serpent-eagle (*S. cheela*) has the highest frequency (20%) (Fig. 2). This species occupied the low, medium, and high forest cover with four habitat types, i.e., primary forest, secondary forest, coastal forest, and plantation. Species *S. cheela* is quite common in several areas, such as in the Halimun-Salak corridor in West Java (Alya et al., 2015), the Conservation area at Semarang Raya in Central Java (Baskoro, 2018), and Ere-ere Geoforest Ijen Geopark in East Java (Siddiq et al., 2022). According to MacKinnon et al. (2010), *S. cheela* is a member of the Accipitridae which is commonly found in the Greater Sunda island. It is primarily found in open areas, although it can be found in nearly every kind of habitat, including coastal areas, mangrove forests, primary forests, secondary forests, forest edges, and plantations <2,000 m asl. Furthermore, *L. kienerii* also has a fairly high frequency, at 19%. This species was found in all categories of forest cover, including main forests, secondary forests, plantations, and the areas surrounding estuaries. During observation, this species was only seen soaring and gliding. Meanwhile, the presence of its nests has not been detected. However, Kurnianto et al. (2014), reported that adult of *L. kienerii* were found carrying nest material in the Bandalit forest area, and it was also observed that juvenile individuals were seen soaring in the Sukamade forest area. Therefore, there is a high possibility that *L. kienerii* occurs in Bandalit as well.

The existence of the endemic species Javanese Hawk-Eagle (*N. bartelsi*) in Bandalit Resort shows that this area is one of home ranges in MBNP. According to van Balen et al. (2001), *N. bartelsi* is estimated to have a home range that spans 300-12,000 ha in its natural habitat. Meanwhile, based on Kaneda et al. (2007), *N. bartelsi* in Telaga Warna Nature Reserve has a home range of approximately 930 ha. So far, the presence of *N. bartelsi* has also been reported in several conservation areas in Java (van Balen et al., 2001; Azmi et al., 2016). This is of course due to the increasing pressure from illegal poaching and forest degradation. *N. bartelsi* is a member of the diurnal raptor which is classified as endangered by the IUCN Red List (Birdlife International, 2017). At Bandalit Resort, the frequency value of this species is 11%, which is the third highest. The species *N. bartelsi* was observed in primary and secondary forests with soaring and perching activity. According to MacKinnon et al. (2010), *N. bartelsi* is generally inhabited in primary forests, but it is also occasionally found in secondary forests and plantations. This indicates that Bandalit Resort is one of the habitats selected by this endangered species, although more comprehensive research is still required on its characteristics and level of suitability.

Two species have a low frequency of encounters (4%), i.e., Changeable Hawk-Eagle (*N. cirrhatus*) and Spotted Kestrel (*F. moluccensis*). Changeable Hawk-Eagle has morphological

characteristics that are quite similar to Javan-Hawk Eagle. In this study, *N. cirrhatius* was only found soaring activity around the estuary. This species has a habitat in open forests, plantation areas, savannas, mountain forests, and areas close to settlements (MacKinnon et al., 2010; Rodrigues et al., 2020). In addition, the Crested Goshawk is smaller in stature than members of the genera *Nisaetus*, *Ictinaetus*, *Haliaeetus*, and *Pernis*, which fall into the medium category, and ranges from 30-36 cm. According to MacKinnon et al. (2010), this species is common in deciduous and evergreen forests, riverbank vegetation, near villages, gardens, and cultivated areas.

All of the diurnal raptors in Indonesia are protected by the government, including the ten species found at Bandalit Resort at MBNP. The findings can serve as a foundation for recommendation toward a framework for developing an animal conservation plan at MBNP. Furthermore, diurnal raptor species also require habitat management. In the future, several recommendations can be made, including home range studies, nest distribution, and habitat suitability, to preserve and protect the status of diurnal raptors as the top trophic level in the ecosystem.

ACKNOWLEDGMENTS

We are deeply thankful to Lembaga Penelitian dan Pengabdian Kepada Masyarakat (LP2M) Universitas Jember for financially supporting this research (contract no. 4259/UN25.3.1/LT/2022). We also thank Meru Betiri National Park for permission, information, and use of facilities during the research.

REFERENCES

- Alya, F.P., Jawardi, B.H. & Lilik, B.P. 2015. Kesesuaian Habitat Elang-ular bido (*Spilornis cheela*) di Koridor Halimun Salak. *Jurnal Penelitian Hutan dan Konservasi Alam*, 151–163.
- Azmi, N., Syartinilia & Mulyani, Y.A. 2016. The Spatial Distribution Model of Javan Hawk-Eagle's (*Nisaetus bartelsi*) Remnants Habitat in West Java. *Media Konservasi*, 21(1): 9–18.
- Baskoro, K. 2018. *Avifauna Semarang Raya*. Semarang: Universitas Diponegoro.
- Bibby, C., Burgess, N., Hill, D. & Mustoe, S. 2000. *Bird Census Techniques*. London: Academic Press.
- BirdLife International. (2017, Oktober 1). IUCN Redlist. Retrieved from IUCN Redlist: <https://www.iucnredlist.org/species/22696165/110050373>
- Concepcion, C.B., Bildstein, K.L., Collar, N.J. & Katzner, T.E. 2018. *Conservation Threats and Priorities for Raptors Across Asia*. In J. H. Sarasola, J. M. Grande & J. J. Negro, *Birds of Prey* (pp. 395-418). Seville: Springer International Publishing.
- Donazar, J.A., Cortés-Avizanda, A., Fargallo, J.A., Margalida, A., Moleón, M., Morales-Reyes M., Moreno-Opo, Pérez-García, J.M., Sánchez-Zapata, J.A., Zuberogoitia, I. & Serrano, D. 2016. Roles Of Raptors in A Changing World: From Flagships to Providers of Key Ecosystem Services. *Ardeola*, 63(1): 181–234.

- Eaton, J.A., van Balen, B., Brickle, N.W. & Rheindt, F.E. 2016. *Birds of the Indonesian Archipelago: Greater Sundas and Wallacea*. 1st ed. Barcelona: Lynx Edicions.
- Ferguson-Lees, J. & Christie, D.A. 2005. *Raptors of the World – a Field Guide*. Christopher Helm, London.
- Kaneda, H., Prawiradilaga, D.M. & Yamagishi, S. 2007. Home Range and Habitat Use of An Individual Javan Hawk-Eagle (*Spizaetus bartelsi*). *Journal of Raptor Research*, 41(1): 68–71.
- Kurnianto, A.S., Firmansyah, P., Ananda, A.A. & Narjianto, E. 2014. *Sayap-sayap Meru Betiri*. Jember: Taman Nasional Meru Betiri.
- MacKinnon, J., Phillips, K. & van Balen, B. 2010. *Seri Panduan Lapangan Pengenalan Burung-burung di Sumatera, Jawa, Bali, dan Kalimantan*. Bogor: LIPI-Burung Indonesia.
- McClure, C.J.W., Westrip, J.R.S., Sarah, S.J.J., Schulwitz, E., Virani, M.Z., Davies, R., Symes, A., Wheatley, H., Thorstrom, R., Amar, A., Buij, R., Jones, V.R., Williams, N.P., Buechleyh, E.R. & Butchart, S.H.M. 2018. State of the world’s raptors: Distributions, threats, and conservation recommendations. *Biological Conservation*, 227: 390–402.
- McClure, C.J.W., Schulwitz, S.E. & Anderson, L. 2019. Commentary: Defining Raptors and Birds of Prey. *Journal of Raptor Research*, 53(4): 419–430.
- Potier, S., Mitkus, M. & Kelber, A. 2020. Visual Adaptations of Diurnal and Nocturnal Raptors. *Seminars in Cell and Developmental Biology*, 106: 116–126.
- Prawiradilaga, D.M., Muratte, T., Muzakkir, A., Innoue, T., Kuswandono, Supriatna, A.A. & Sakaguchi, N. 2002. *Panduan Survey Lapangan dan Pemantauan Burung-burung Pemangsa*. Jakarta: PT. Bina Megawarna.
- Purwanto, A.A., Rakhman, Z., Supriatna, A.A., Sutito, A.S.B. & Srirejeki, I. 2015. Current Information on Migratory Raptors and Conservation Efforts in Indonesia. *Asian Raptors*, 1: 54–62.
- Rodríguez-Estrella, R., Donázar, J.A. & Hiraldo, F. 2008. Raptors as Indicators of Environmental Change in the Scrub Habitat of Baja California Sur, Mexico. *Conservation Biology*, 12(4): 921–925.
- Rodrigues, M., Sanuraj, T.K., Cherian, A. & D’souza, D. 2020. Status, distribution and breeding records of Crested Hawk Eagle *Nisaetus cirrhatus* in Kasaragod District, Kerala. *Piculet*, 3: 2020.
- Siddiq, A.M., Sulistiyowati, H., Kurnianto, A.S., Aninas, A. & Samsuri. 2022. The Diversity and Uniqueness of Avifauna in Erek-Erek Geoforest at Ijen Geopark, East Java, Indonesia. *Journal of Tropical Biodiversity and Biotechnology*, 8(1): 1–12.
- Simberloff, D. 1987. The Spotted Owl fracas: mixing academic, applied, and political ecology. *Ecology*, 68: 766–772.
- Sukmantoro, W., Irham, M., Novarino, W., Hasudungan, F., Kemp, N. & Muchtar, M. 2007. *Daftar Burung Indonesia no.2*. Bogor: Indonesian Ornithologists’ Union.
- Supriatna, A.A. 2012. Current Status of Diurnal Raptors in Indonesia and its Conservation Challenges. *Ornis Mongolica*, 1: 67–73.
- Syarief, N.R., Ananda, A.A., Sucipto, A., Firmandus, A.E. & Lindasari, I.T. 2018. *Jendela Meru Betiri*. Jember: KLHK Dirjen KSDAE Balai Taman Nasional Meru Betiri.

- Taufiqurrahman, I., Akbar, P.G., Purwanto, A.A., Untung, M., Assiddqi, Z., Wibowo, W.K., Iqbal, M., Tirtaningtyas, F.N. & Triana, D.A. 2022. *Panduan Lapangan Burung-burung di Indonesia Seri 1: Sunda Besar*. Batu: Birdpacker Indonesia.
- Thiollay, J.M. 1989. Censusing of diurnal raptors in a primary rain forest: comparative methods and species detectability. *Journal of Raptor Research*, 23: 72–84.
- Thiollay, J.M. & Rahman, Z. 2002. The raptor community of Central Sulawesi: habitat selection and conservation status. *Biological Conservation*, 107: 111–122.
- van Balen, S.B. 1998. Tropical Forest Raptors in Indonesia: Recent Information on Distribution, Status, and Conservation. *Journal of Raptor Research*, 32(1): 56–63.
- van Balen, S.B., Nijman, V. & Sozer, R. 2001. Conservation of the endemic Javan Hawk-Eagle *Spizaetus bartelsi* Strese-mann, 1924 (Aves: Falconiformes) density, age-structure and population numbers. *Contribution to Zoology*, 70: 161–173.