

Biodiversity and conservation status of flora and fauna in Magetan, East Java, Indonesia: A focus on rare and protected species of mammals, birds and plants

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Abstract. *Astirin OP, Pitoyo A, Hidayat A, Astuti AY, Rahmawati WM, Nurcahyo RW. 2025. Biodiversity and conservation status of flora and fauna in Magetan, East Java, Indonesia: A focus on rare and protected species of mammals, birds and plants. Biodiversitas 26: 1607-1618.* Indonesia is recognized for its high level of species endemism across its islands, but this biodiversity is under significant threat due to high loss rates. Magetan District, East Java Province, Indonesia comprises 8% of protected areas, located adjacent to Mount Lawu, which harbor substantial biodiversity. This study aims to assess the diversity, distribution and protection status of wildlife in Magetan, based on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Minister of Environment and Forestry Regulation of the Republic of Indonesia, especially for mammals, birds and plants. The research utilized a combination of methods, including the collection of biodiversity data from 2013 to 2022, interviews with relevant stakeholders, and field observations. The findings identified three mammalian species and one plant listed under CITES Appendix I. Additionally, 19 wild animal species and one plant species were found to be rare and protected under the government regulation. Among these, five species belong to the mammal group, while 14 species are avifauna group. The highest concentrations of these protected species were observed in the Panekan and Plaosan Sub-districts, highlighting the importance of these two areas for conservation. Conservation strategies are required to protect these animals and plants by avoiding deforestation and habitat restoration. Other conservation strategies are by enforcing laws, addressing human-wildlife conflicts, raising awareness, and conducting regular monitoring. The study provides critical insights for conservation policy development and biodiversity documentation, specifically for Magetan District.

Keywords: Biodiversity, conservation, endemics Indonesia, Magetan, wildlife

Abbreviations: CBD: Convention on Biological Diversity; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; MoEF: Minister of Environment and Forestry

INTRODUCTION

Indonesia has a very high level of species endemism (Rambe et al. 2021). This high endemism can be attributed to Indonesia's two major biodiversity hotspots, Sundaland and Wallacea, which are shaped by the country's isolated archipelago and complex geological history. These factors have given rise to a wide variety of habitats (von Rintelen et al. 2017). These diverse habitats and environmental conditions have positioned Indonesia as one of the world's seventeen megadiverse nations (Keong 2015). Indonesia's vertebrate diversity is remarkable with a significant proportion of endemic species. Of the 720 mammal species documented in Indonesia, 270 are endemic, while 386 of 1,605 bird species are unique to the region (Maskun et al. 2021).

Although Indonesia is renowned for its extraordinary biodiversity, it also faces one of the most cases of biodiversity depletion globally, underscoring the urgent

need for conservation efforts. Budiharta et al. (2011) found that habitat loss like deforestation caused 82-83% of threatening processes in 240 vulnerable plant species, unsustainable exploitation caused 64%, and natural causes like drought and floods caused 6%. Exploitation with poaching and unlawful trade imperil the population of wild animals (Sherman et al. 2022). Beside such threats, human behavior involving the utilization of fossil fuels has been identified as contributing to the observed increase in global temperatures, which is a primary driver in climate change (Shivanna 2022). Climate change has changed ecosystems, causing ocean acidification and increased carbon dioxide concentrations in the atmosphere (Malhi et al. 2020), heightening the risk of extinction for species that have limited adaptability and are endemic (Muluneh 2021). Losing an ecosystem element threatens other species by removing its functions and services (Cepic et al. 2022). For example, the loss and disturbance of forest trees resulted in

the decline of arboreal primates that feed on drupes and are responsible for seed dispersal (Munstermann et al. 2022). It conforms with the ecological function of species that maintains the ecosystem balance (Withaningsih et al. 2022).

Indonesia actively participates in international biodiversity conservation agreements like the Convention on Biological Diversity (CBD) and CITES. Both aim to protect endangered species, although the scope of CITES only prevents the threat originating from international trades. Indonesia has been a CITES member country since 1978. The ratification of these two conventions is the basis for Indonesia to strengthen conservation efforts and sustainably manage its biodiversity. Subsequently, the government enacted several national policies, including Law No. 32/2024 about the Conservation of Living Natural Resources and Ecosystems and Law No. 5/1994 regarding the Legalization of CBD. This policy is strengthened by technical regulations such as Indonesian Minister of Environment and Forestry (MoEF) Regulation No. P.106 of 2018 which lists protected species. This technique relies on provincial and district/municipality governments to identify, monitor, and conserve local species and habitats. Indonesia maintains biodiversity as part of its global commitment and assures long-term community welfare and environmental sustainability via synergistic central and regional policies.

Indonesia has a terrestrial conservation area of 27,140,384.05 ha, consisting of national parks, wildlife reserves, nature reserves, nature conservation areas, and others (Setiawan 2022). Mount Lawu is an area that stores biodiversity in Indonesia because of its natural ecosystem and serves as important habitat for various species, such as lawu starlings (Astirin et al. 2019). The mountain is located in the Magetan District, East Java Province which has an altitude up to 3,265 meters above sea level. Due to its intersection with Mount Lawu, 8% of the Magetan area is protected to maintain biodiversity within it. The protected forest in Magetan lies atop Mount Lawu, home to many plant and animal species. Apart from natural ecosystems, there are artificial ecosystems deliberately created by humans, such as rice fields, moorlands, and plantation (Clifford and Heffernan 2018). The area also has key and umbrella species that protect the entire ecosystem. However, threats to biodiversity occur due to deforestation, poaching, illegal trade, or other activities. This research aims to examine the distribution and protection status of

wild animals and plants in Magetan, East Java, Indonesia based on CITES and the MoEF Regulation No. P.106 of 2018. This research seeks to support the development of effective conservation policies and contribute valuable biodiversity data, with a specific focus on Magetan District.

MATERIALS AND METHODS

Study area

The research was performed in Magetan District, East Java, Indonesia, covering 18 sub-districts including six sub-districts on the slopes of Mount Lawu with a mountainous ecosystem type, while the rest have lowland ecosystem types. Administratively, this district borders Ngawi District to the north, Madiun District to the east, Ponorogo and Wonogiri Districts to the south, and Karanganyar District in Central Java Province to the west (Figure 1). This research area covered the eastern slopes of Mount Lawu.

Data collection

Data collection was performed through a combination of various methods. Biodiversity data collection was conducted in Magetan from 2013 to 2022. Field observations were conducted to collect primary data on diversity of mammals, birds and plants. Purposive random sampling with explorative method was used in field observations, which were carried out by selecting locations based on specific assessments and criteria aligned with the research goals.

Locations were selected based on ecosystem type, and areas chosen for this purpose were randomly selected to obtain data representative of the wider environment (Ahmed 2024). Sampling locations were located in 18 sub-districts, with several sampling points determined based on discriminating ecosystems (Table 1). This study considers ecosystem diversity and altitude as altitude plays an important role in ecosystem formation due to changes in soil composition and species distribution. Interviews to collect information on biodiversity in the study area were carried out in stages, starting from sub-district officials and villages, to residents. Direct observation was also carried out in the field to re-verify the results of the study obtained and analyze changes in land use in Magetan and their impact on the area's biodiversity.

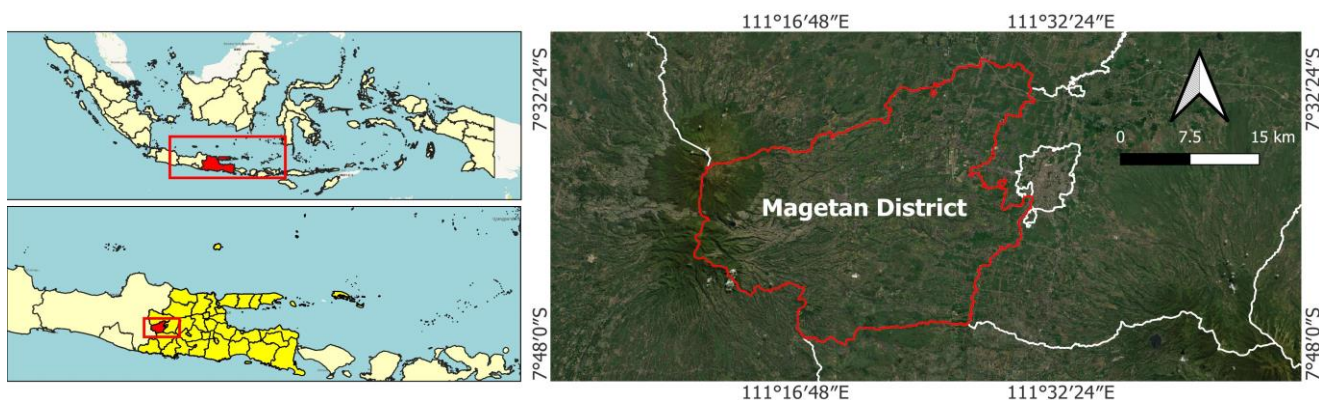


Figure 1. Map of study location of Magetan District, East Java Province, Indonesia

Table 1. Location of sampling stations and altitude in Magetan District, East Java, Indonesia

| Station | Altitude (m asl.) | Sub-district | | | |
|---------|-------------------|--------------|----|------|--------------|
| 1 | 61 | Barat | 11 | 52 | Nguntoronadi |
| | 68 | Barat | | 78 | Nguntoronadi |
| | 71 | Barat | | 85.6 | Nguntoronadi |
| | 78 | Barat | | 108 | Nguntoronadi |
| 2 | 89 | Barat | 12 | 114 | Nguntoronadi |
| | 129 | Bendo | | 146 | Nguntoronadi |
| | 149 | Bendo | | 545 | Panekan |
| | 150 | Bendo | | 675 | Panekan |
| | 160 | Bendo | | 735 | Panekan |
| 3 | 179 | Bendo | 13 | 851 | Panekan |
| | 87 | Karangrejo | | 902 | Panekan |
| | 88.7 | Karangrejo | | 1015 | Panekan |
| | 90 | Karangrejo | | 223 | Parang |
| | 90.8 | Karangrejo | | 332 | Parang |
| 4 | 94.5 | Karangrejo | 14 | 478 | Parang |
| | 130 | Karas | | 564 | Parang |
| | 143 | Karas | | 592 | Parang |
| | 146 | Karas | | 1028 | Parang |
| | 167 | Karas | | 543 | Plaosan |
| 5 | 174 | Karas | 15 | 711 | Plaosan |
| | 52 | Kartoharjo | | 841 | Plaosan |
| | 66 | Kartoharjo | | 1056 | Plaosan |
| | 77 | Kartoharjo | | 1278 | Plaosan |
| | 87 | Kartoharjo | | 1316 | Plaosan |
| 6 | 111 | Kartoharjo | 16 | 1638 | Plaosan |
| | 124 | Kawedanan | | 1871 | Plaosan |
| | 161 | Kawedanan | | 640 | Poncol |
| | 171 | Kawedanan | | 828 | Poncol |
| | 180 | Kawedanan | | 943 | Poncol |
| 7 | 210 | Kawedanan | 17 | 1212 | Poncol |
| | 231 | Kawedanan | | 1350 | Poncol |
| | 127 | Lembeyan | | 1460 | Poncol |
| | 150 | Lembeyan | | 1515 | Poncol |
| | 162 | Lembeyan | | 603 | Sidorejo |
| 8 | 174 | Lembeyan | 18 | 640 | Sidorejo |
| | 187 | Lembeyan | | 674 | Sidorejo |
| | 197 | Lembeyan | | 886 | Sidorejo |
| | 222 | Lembeyan | | 1126 | Sidorejo |
| | 355 | Magetan | | 127 | Sukomoro |
| 9 | 355 | Magetan | 19 | 153 | Sukomoro |
| | 397 | Magetan | | 165 | Sukomoro |
| | 406 | Magetan | | 187 | Sukomoro |
| | 49 | Maospati | | 194 | Sukomoro |
| | 56 | Maospati | | 214 | Sukomoro |
| 10 | 71 | Maospati | 20 | 222 | Sukomoro |
| | 91 | Maospati | | 79 | Takeran |
| | 100 | Maospati | | 84.7 | Takeran |
| | 149 | Ngariboyo | | 88 | Takeran |
| | 239 | Ngariboyo | | 91 | Takeran |
| | 301 | Ngariboyo | | 110 | Takeran |
| | 340 | Ngariboyo | | 131 | Takeran |
| | 404 | Ngariboyo | | | |

Primary and secondary data were organized by data tabulation and then analyzed descriptively. The outcomes of data management were assessed to formulate policies necessary for biological resource conservation strategies. Search for information regarding the status of biodiversity conservation is based on the CITES appendix categories

and the MoEF Regulation No. P.106/MENLHK/SETJEN/KUM.1/12/2018 concerning the second revision of MoEF Regulation No. P. 20/MENLHK/SETJEN/KUM.1/6/2018 on protected flora and fauna types.

RESULTS AND DISCUSSION

Animal (mammal and bird) diversity in Magetan

Observations using purposive random sampling identified a total of 27 mammal species and 118 avifauna species in the Magetan District (Tables 2 and 3). The mammal species belong to 17 families (Figure 2), with the family Bovidae comprising the largest number of species (4 species), followed by Felidae with three species. Similarly, the avifauna group consisted 51 families (Figure 3), with Pycnonotidae being the most diverse family (7 species), followed by Columbidae and Muscicapidae, each with six species.

Conservation status of animals (mammal and bird) in Magetan

This study documented 19 rare and protected animal species occurring in Magetan District, including five mammal species and 14 avian species under CITES and MoEF Regulation as detailed in Table 4. The protection status of these species aligns with the criteria prescribed in the Government Regulation of Indonesia No. 7/1999 on the Preservation of Plant and Animal Species. These criteria include a small population size, an extreme decrease in wild populations, and a restricted distribution range or endemism. The designation of protected species follows a formal process involving a ministerial decree based on recommendations from scientific authorities.

Based on the Indonesian Minister of Environment Regulation regarding protected plant and animal species, the mammal groups found in Magetan include those from Felidae, Manidae, Cercopithecidae, Cervidae, and Hystricidae. *Panthera pardus* (Linnaeus, 1758), and *Manis javanica* (Desmarest, 1822) were listed in Appendix I CITES, so trading these animals is strictly prohibited in international trade. Otherwise, the Cercopithecidae, Hystricidae, Falconidae, Accipitridae, and Psittacidae are classified under CITES Appendix II, where international trade is still permitted with strict regulations so that these species are not threatened with extinction.

The Felidae family includes the Javan leopard and Javan tiger, which serve as apex predators on Java and play a crucial role in the forest environment. Their population continues to decline due to forest destruction and reduced habitat quality (As'ary et al. 2023). The Javan tiger was declared extinct by CITES in 1996. The distribution of the Javan tiger in 1940 covered the areas of Balambangan, Meru Betiri, Gunungkidul, Boja, Banyumas, Leuweung Sancang, Garut, Mount Malabar, Tampomas, Subang, Cibadak, Halimun, South Banten and Ujung Kulon. It was last discovered in 1976 at Meru Betiri Wildlife Reserve. After reports of the extinction of this species, multiple records of Javan tiger footprints, scratches, and droppings, along with public encounters, were documented from 1997 to mid-2013 throughout different parts of Java, including Lawu in 1998 (Apriando 2014).

Table 2. Mammal diversity and distribution in Magetan District, East Java, Indonesia

| Family | Name | Sub-district | | | | | | | | | | | | | | | | |
|------------------|-----------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
| Bovidae | <i>Ovis aries</i> | | | • | • | • | • | • | | | | | | | | | | • |
| Bovidae | <i>Capra hircus</i> | | | • | • | • | • | • | | | | • | | • | | | | • |
| Bovidae | <i>Bos taurus</i> | | | • | • | • | • | • | | | | • | | • | | | | |
| Bovidae | <i>Bos indicus</i> | | | | | | | | | | | | | | | | | • |
| Camelidae | <i>Camelus dromedarius</i> | | | | | | | | | | | | | • | | | | |
| Cercopithecidae | <i>Macaca fascicularis</i> | • | • | | | | | • | | | | | | | | | | |
| Cercopithecidae | <i>Trachypithecus auratus</i> | • | • | | | | | | | | | | | | | | | |
| Cervidae | <i>Muntiacus muntjak</i> | • | • | | | | | | | | | | | | | | | |
| Equidae | <i>Equus caballus</i> | | | | | | | | | | | | | • | | | | |
| Equidae | <i>Equus asinus</i> | | | | | | | | | | | | | • | | | | |
| Felidae | <i>Panthera tigris sondaica</i> | • | • | | | | | | | | | | | | | | | |
| Felidae | <i>Panthera pardus melas</i> | • | • | | | | | | | | | | | | | | | |
| Felidae | <i>Felis catus</i> | | | • | • | • | • | • | | | | | | | | | | |
| Herpestidae | <i>Herpestes javanicus</i> | • | • | | • | | | | | • | | | | | | | | • |
| Hystricidae | <i>Hystrix sp.</i> | • | • | | | | | | | | | | | | | | | |
| Hystricidae | <i>Hystrix javanica</i> | | | | | | | | | | | | | | | | | • |
| Leporidae | <i>Lepus nigricollis</i> | | | | • | | • | | | | | • | | | | | | |
| Manidae | <i>Manis javanica</i> | • | • | | | | | | | | | | | | | | | |
| Muridae | <i>Rattus argentiventer</i> | | | | | | | | | | | | | | | | | • |
| Nycteridae | <i>Nycteris javanica</i> | | | | | | | | | | | | | | | | | • |
| Sciuridae | <i>Ratufa bicolor</i> | | • | | | | | | | | | | | | | | | |
| Sciuridae | <i>Callosciurus notatus</i> | | | | | | | | | | | • | | | | | | |
| Suidae | <i>Sus scrofa</i> | • | • | | | | | | | | | | | | | | | |
| Tupaiaidae | <i>Tupaia javanica</i> | | | | | | | | | | | | | | | | | |
| Vespertilionidae | <i>Pipistrellus javanicus</i> | | | | | | | | | | | | | | | | | • |
| Viverridae | <i>Paradoxurus hermaphroditus</i> | • | • | | | | | | | | | | | | | | | |
| Viverridae | <i>Viverricula indica</i> | • | • | | | | | | | | | | | | | | | |

Note: A. Panekan; B. Plaosan; C. Poncol; D. Parang; E. Sukomoro; F. Bendo; G. Kawedanan; H. Lembeyan; I. Maospati; J. Barat; K. Kartoharjo; L. Nguntoronadi; M. Takeran; N. Karas; O. Karangrejo; P. Magetan; Q. Ngariboyo; •: Present

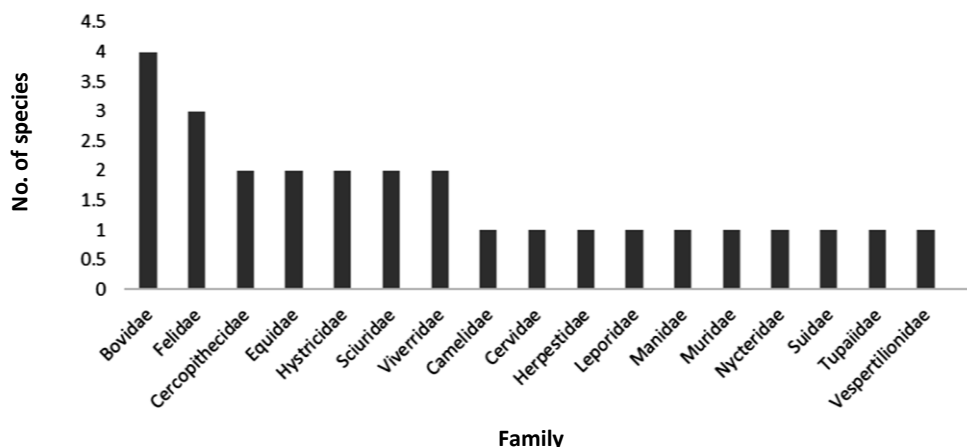


Figure 2. Mammal families and number of species in each family in Magetan District, East Java, Indonesia

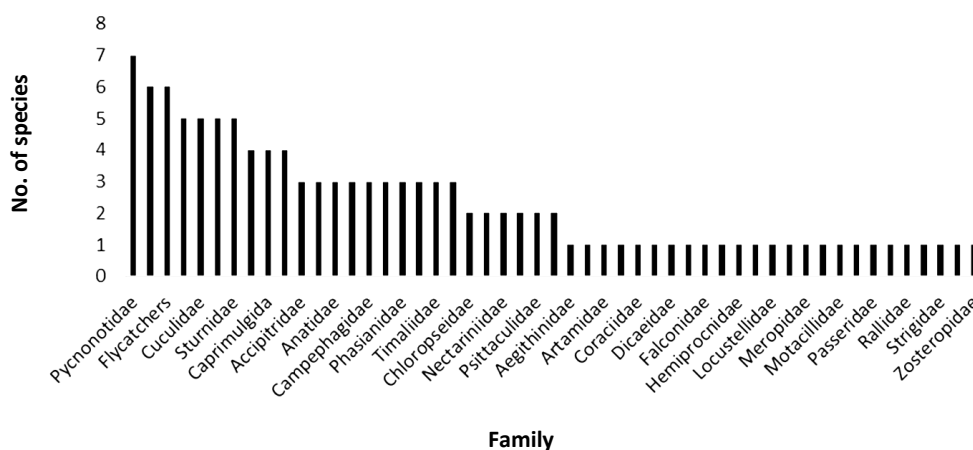


Figure 3. Avifauna families and number of species in each family in Magetan District, East Java, Indonesia

Table 4. List of rare and protected animals in Magetan District, East Java, Indonesia

| Family | Local name | Scientific name | CITES Ministerial decree | |
|-----------------|-----------------------------|--|--------------------------|---|
| Mammals | | | | |
| Felidae | Javan leopard | <i>Panthera pardus</i> (Linnaeus, 1758) | I | P |
| Manidae | Sunda pangolin | <i>Manis javanica</i> (Desmarest, 1822) | I | P |
| Cercopithecidae | Javan langur | <i>Trachypithecus auratus</i> (É.Geoffroy Saint-Hilaire, 1812) | II | P |
| Cervidae | Indian muntjac | <i>Muntiacus muntjak</i> (Zimmermann, 1780) | - | P |
| Hystricidae | Sunda porcupine | <i>Hystrix javanica</i> (F.Cuvier, 1823) | II | P |
| Birds | | | | |
| Chloropseidae | Greater green leafbird | <i>Chloropsis sonnerati</i> (Jardine & Selby, 1827) | - | P |
| Chloropseidae | Javan leafbird | <i>Chloropsis cochinchinensis</i> (Gmelin, 1789) | - | P |
| Falconidae | Spotted kestrel | <i>Falco moluccensis</i> (Bonaparte, 1850) | II | P |
| Psittacidae | Red-breasted parakeet | <i>Psittacula alexandri</i> (Linnaeus, 1758) | - | P |
| Accipitridae | Crested serpent-eagle | <i>Spilornis cheela</i> (Latham, 1790) | II | P |
| Accipitridae | Changeable hawk-eagle | <i>Nisaetus cirrhatus</i> (Gmelin, 1788) | - | P |
| Accipitridae | Black eagle | <i>Ictinaetus malayensis</i> (Temminck, 1822) | II | P |
| Sturnidae | Black-winged myna | <i>Acridotheres melanopterus</i> (Daudin, 1800) | - | P |
| Psittacidae | Black-capped lory | <i>Lorius lory</i> (Linnaeus, 1758) | II | P |
| Rhipiduridae | Malaysian pied fantail | <i>Rhipidura javanica</i> (Sparman, 1788) | - | P |
| Psittacidae | Moluccan eclectus | <i>Eclectus roratus</i> (Statius Muller, 1776) | II | P |
| Psittacidae | Coconut lorikeet | <i>Trichoglossus haematodus</i> (Linnaeus, 1771) | II | P |
| Psittacidae | Blue-crowned hanging parrot | <i>Loriculus galgulus</i> (Linnaeus, 1758) | II | P |
| Megalaimidae | Lineated barbet | <i>Psilopogon lineatus</i> (Vieillot, 1816) | - | P |

Note: P: Protected

Based on the interviews, several residents claimed to see this animal, including in 1984 in Bedagung Village, 2002 in Ngancar Village, 2008 in the Perhutani area, and most recently on Mount Lawu in mid-2013. On other area in Java, footprints were found in Bromo Tengger Semeru National Park in October 2013 that were strongly suspected of belonging to this animal. In 2019, this Javan tiger was also seen in Sukabumi, West Java, by Ripi Yanuar Fajar with four conservation activists with evidence left behind in the form of a strand of hair reinforced with footprints and claw marks, which were strongly suspected to belong to the tiger (Apriando 2014). The results of mtDNA analysis of the hair show that this specimen is identical to Javan tiger specimens stored in museums in Java, which can be differentiated from other tiger species and Javan leopards (Wiradateti et al. 2024). However, the accuracy and validity of the research by Wiradateti et al. (2024) is doubted by Sui et al. (2024) due to methodological limitations. The confusion between the status and existence of this animal is still a question and debate for several experts and groups. Consequently, field research must be reinitiated to evaluate the occurrence of these wild creatures.

In the Manidae family, the Sunda pangolin has a wide distribution covering Southeast Asia and South China. However, this species has become the most traded mammal in the world without sustainability, which has caused a sharp decline in its population (Sitam et al. 2023). The Sunda pangolin was listed in Appendix I of CITES in 2016. However, illegal trade of this animal is still reported through confiscations in Indonesia even though it has decreased in 2021 and 2022 to 400 and 600. These confiscations occur in 17 out of 22 provinces with East Java, Jakarta, and Medan being the city with the largest number of confiscated animals (Nijman 2023).

The Javan langur, an indigenous Indonesian primate, is threatened with extinction owing to unlawful hunting and forest land conversion (Wardhana et al. 2022). Indian muntjac from the Cervidae family lives in clusters and is unevenly distributed in forest habitats in the central mountains at an altitude of 1100-1300 m with dense canopy cover, good water sources, and less human disturbance (Rambe et al. 2021). Sunda porcupine from the Hystricidae family is an endemic species in Indonesia with a natural habitat in forests. This species is also one of the mammal species with increasing use, including trading, because of the unique shape of its spines as a decorative element, its nutritious meat and the belief as traditional medicine (Mustikasari et al. 2019; Gomez 2021).

Protected avifauna groups in Magetan include the families Chloropseidae (2 species), Accipitridae (3 species), Falconidae (1 species), Psittacidae (5 species), Megalaimidae (1 species), Sturnidae (1 species), and Rhipiduridae (1 species). Accipitridae is a raptor family with large body sizes, hooked beaks, and sharp claws with a diverse habitat ranging from forests to open areas (Sugiyarto et al. 2020). Accipitridae species found in Magetan include the crested serpent-eagle, changeable hawk-eagle, and black eagle. This bird is an indicator of

habitat quality because of its role as a predator that controls the food chain and maintains ecosystem balance (Husodo et al. 2020). Birds that eat fruit and seeds play a role in spreading seeds that can grow and become a food source for other birds (Da Silva 2022).

Distribution of rare and protected animals in Magetan

Protected mammals in Magetan are mainly distributed in the Panekan Sub-district and Plaosan Sub-district, except for the Sunda porcupine, which is only found in Karangrejo. Most of the protected mammal habitats are forest areas. The protected forest in Magetan had an area of 3982 Ha, covering the sub-districts of Poncol, Plaosan, Sidorejo, and Panekan in 2011 (Hanifah 2013). Protected birds are more widely distributed than protected mammals. There are no protected bird species in the sub-districts of Magetan, Takeran, Karas, and Karangrejo (Figure 4). The areas with the highest number of protected animals are Panekan and Plaosan, followed by Poncol, Parang, Lembeyan, and Bendo (Figure 5).

Plant diversity in Magetan

This study documented 560 plant species in Magetan with 24 species listed in the CITES appendix (Table 5). There is only one protected plant species under the MoEF Regulation No. P.106/2018, namely *Nepenthes gymnamphora* Reinw. ex Nees, even though it is listed in appendix II CITES. This is different from *Paphiopedilum javanicum* (Reinw. ex Lindl.) Pfitzer which is not protected according to the government regulation but is listed in Appendix I.

The Java *Paphiopedilum* (*P. javanicum*) was observed in Poncol Sub-district with population of approximately 104 individuals identified in Mount Lawu within its natural habitat, located at elevations ranging from 1,231 to 1,825 meters above sea level. The habitat of this endemic orchid is characterized by relative humidity levels of 61-78.5% and air temperatures between 21.8°C and 29.7°C (Romadlon et al. 2021). The species faces consequential threats to habitat loss because of deforestation, forest fires, habitat fragmentation, and poaching. These challenges underscore the vulnerability of *P. javanicum* and the need for immediate conservation efforts. Notably, all species within the genus *Paphiopedilum* were included under Appendix I of CITES, except for seeds or in vitro tissue cultures that comply with the "artificially propagated" criteria. These criteria are outlined in Resolution Conf. 11.11 (Rev. CoP18), considered at the Conference of the Parties, to support sustainable trade and conservation practices

Nepenthes gymnamphora were also found in the Poncol Sub-district. The existence of *N. gymnamphora* is threatened due to habitat loss, including land conversion, natural disasters and excessive exploitation. This plant's attractiveness as an ornamental plant stems from its carnivorous nature and unique pitcher shape, contributing to its high economic value (Pistanty 2023). The law strictly regulates international trade of this plant as it is a protected species to safeguard the plant from extinction.

Table 5. List of rare and protected plants and CITES appendix categories in Magetan District, East Java, Indonesia

| Family | Local name | Scientific name | CITES | Ministerial Decree |
|---------------|---------------------------|---|-------|--------------------|
| Bignoniaceae | <i>Tabebuaya</i> | <i>Tabebuia rosea</i> (Bertol.) Bertero ex A.DC. | II | - |
| Cactaceae | <i>Cochineal cactus</i> | <i>Opuntia cochenillifera</i> (L.) Mill. | II | - |
| Cactaceae | <i>Naga</i> | <i>Hylocereus undatus</i> (Haw.) Britton & Rose | II | - |
| Cycadaceae | <i>Pakis Haji</i> | <i>Cycas rumphii</i> Miq. | II | - |
| Ebenaceae | <i>Persimmon</i> | <i>Diospyros kaki</i> L.f. | II | - |
| Euphorbiaceae | <i>Euphorbia flower</i> | <i>Euphorbia neriifolia</i> L. | II | - |
| Euphorbiaceae | <i>Pencil tree</i> | <i>Euphorbia tirucalli</i> L. | II | - |
| Euphorbiaceae | <i>Poinsettia</i> | <i>Euphorbia pulcherrima</i> Willd. ex Klotzsch | II | - |
| Euphorbiaceae | <i>Crown of thorns</i> | <i>Euphorbia milii</i> Des Moul. | II | - |
| Leguminosae | <i>Angsana</i> | <i>Pterocarpus indicus</i> Willd. | II | - |
| Leguminosae | <i>Indian Rosewood</i> | <i>Dalbergia latifolia</i> Roxb. | II | - |
| Liliaceae | <i>Mangar flower</i> | <i>Dracaena marginata</i> Lem. | II | - |
| Meliaceae | <i>Mahogany</i> | <i>Swietenia mahagoni</i> (L.) Jacq. | II | - |
| Nepenthaceae | <i>Nepenthes</i> | <i>Nepenthes gymnamphora</i> Reinw. ex Nees | II | Protected |
| Orchidaceae | <i>Pocket orchid</i> | <i>Paphiopedilum javanicum</i> (Reinw. ex Lindl.) Pfitzer | I | - |
| Orchidaceae | <i>Coelogyne orchid</i> | <i>Coelogyne miniata</i> (Blume) Lindl. | II | - |
| Orchidaceae | <i>Deglung Orchid</i> | <i>Vanda tricolor</i> Lindl. | II | - |
| Orchidaceae | <i>Orchid dorotis</i> | <i>Phalaenopsis pulcherrima</i> (Lindl.) J.J.Sm. | II | - |
| Orchidaceae | <i>Moon orchid</i> | <i>Phalaenopsis amabilis</i> (L.) Blume | II | - |
| Orchidaceae | <i>Wax orchid</i> | <i>Aerides odoratum</i> Reinw. ex Blume | II | - |
| Orchidaceae | <i>Pigeon orchid</i> | <i>Dendrobium crumenatum</i> Sw. | II | - |
| Orchidaceae | <i>Puser earth orchid</i> | <i>Pecteilis susannae</i> (L.) Raf. | II | - |
| Orchidaceae | <i>Trumpet orchid</i> | <i>Dendrobium aphyllum</i> (Roxb.) C.E.C.Fisch. | II | - |
| Zamiaceae | <i>Zamia</i> | <i>Zamia furfuracea</i> L.f. | II | - |

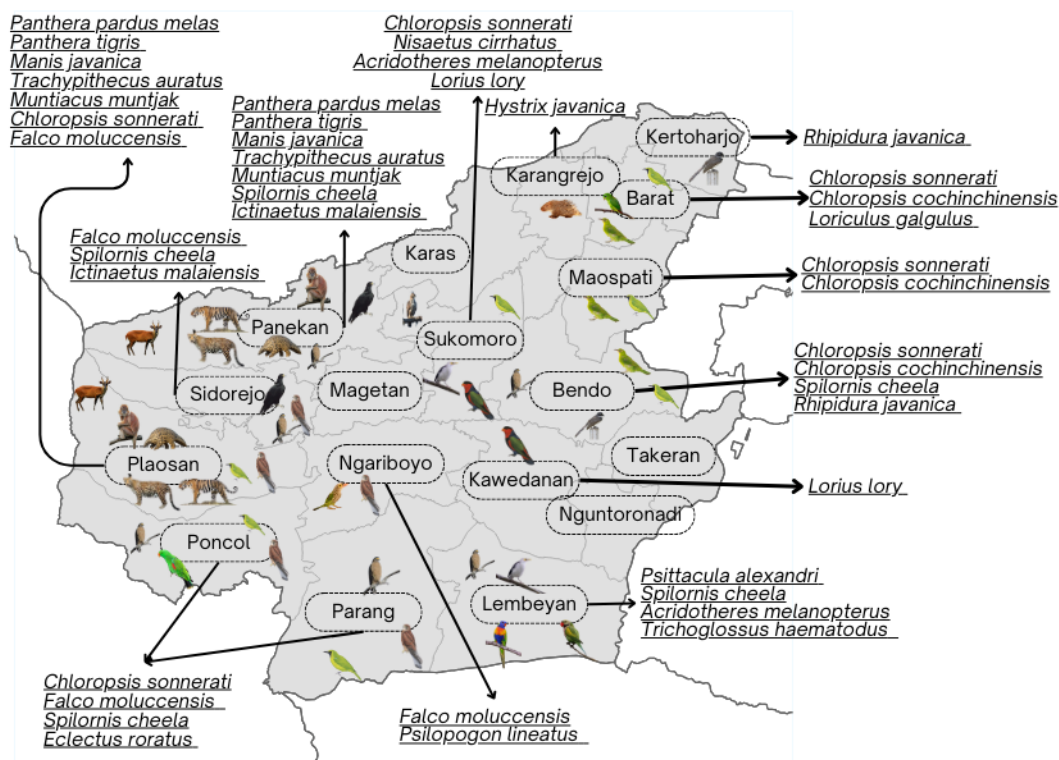


Figure 4. Map of the distribution of protected mammals and aves in Magetan District, East Java, Indonesia

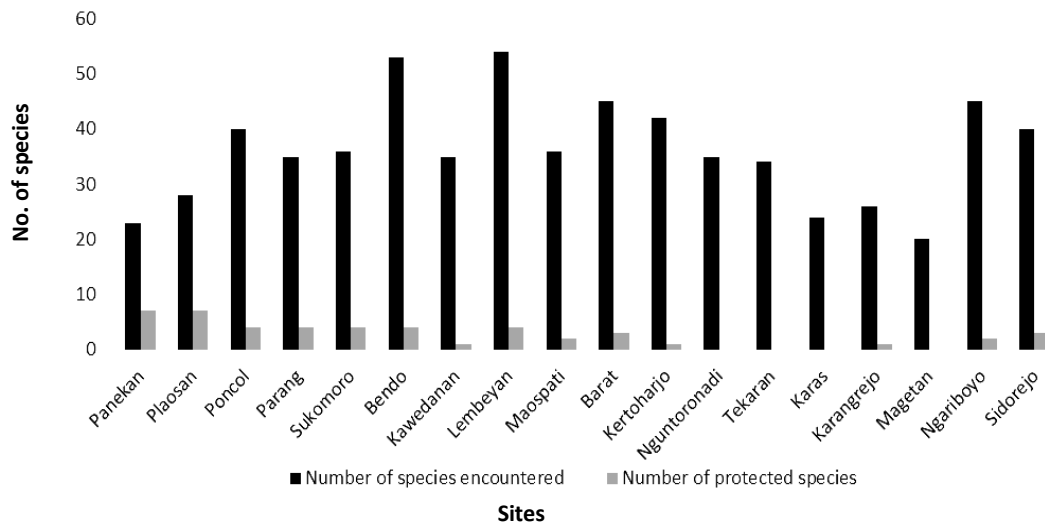


Figure 5. Distribution of all species (mammal, bird and plant) found and protected species in each sub-district in Magetan District, East Java, Indonesia

Conservation efforts for rare and protected plants and animals in Magetan

Biodiversity hotspot means that the place has rich diversity in the world because the presence of many endemic and threatened species (Ayeni et al. 2023). The Indonesian Ministry of Environment and Forestry conducted a national assessment, identifying key biodiversity areas in Sumatra, Kalimantan, Java, Sulawesi, and Papua as habitats for endemic and threatened species. An Indonesian Biodiversity Strategy and Action Plan has also been developed, which provides a comprehensive framework for biodiversity conservation in Indonesia and emphasizes the importance of protecting biodiversity hotspots. Biodiversity serves as a vital biological resource that supports human welfare by providing ecosystem services such as climate regulation, water purification, food security, and raw materials for medicine and industry. Jaureguiberry et al. (2022) state that changes in land use, exploitation of natural resources, and pollution are direct drivers of global anthropogenic degradation of biodiversity. These factors disrupt ecosystems, leading to habitat destruction, species extinction, and the degradation of essential ecosystem services. Land use changes such as deforestation or agricultural intensification are the main drivers of biodiversity decline (Jung et al. 2019; Cabernard et al. 2024). Indonesia was among the world's most deforested countries from 1950 to 2017, with an average rate of deforestation of 985,300 hectares per year (Santoro et al. 2023). The deforestation impacts ecosystem imbalance by reducing the quality of the forest, causing a decline in biological communities and changes in species composition (Faria et al. 2023). Land use changes that occur in Magetan include the creation of various facilities for human activities including accommodation in Sarangan, Plaosan Sub-district, ecotourism in Plaosan, and Panekan Sub-districts, industrialization practices, and agricultural intensification in various sub-districts. Human activities in

this area cause various negative impacts, such as pollution and household waste.

Various sources of pollution, such as solid waste, air, noise, water, and visual pollution, which increase with tourism activities, can also affect the mating cycle and natural behavior of wild animals (Belsoy et al. 2012; Sanderfoot et al. 2021; Grunst et al. 2023). As in the Brownsberg Nature Park, Suriname, ecotourism causes most species to avoid spots with many climbers or change to more nocturnal patterns (Ouboter et al. 2021). Therefore, the local government needs to design regional spatial planning wisely to maintain the biodiversity in Magetan. The Indonesian government has prepared instruments related to the utilization of land, which must adjust the Regional Spatial Plan by Government Regulation No. 16/2004 on Land Management and Law No. 26/2007 concerning Spatial Planning. Eco Bamboo Park or Botanical Bamboo Garden in Magetan is an example of solution to meet the target of green open space, producing oxygen that reduces emissions, and being an educational tourism destination under the management of the Ministry of Environment and Forestry.

Protecting biological resources can be done using various conservation methods. Conservation goals are to realize the preservation of biological natural resources and ecosystem balance to support and improve human welfare. Apart from that, conservation is also one way to preserve animals and maintain their natural habitat. The main conservation strategies include in-situ and ex-situ conservation. Ex-situ conservation is performed outside the natural habitat of the target species with a focus on captive breeding, such as in zoos and botanical gardens. In-situ conservation is conducted in natural habitats of target species that are protected, managed, and monitored, such as wildlife reserves. In-situ conservation is an ideal long-term solution, while ex-situ conservation is utilized for the short-term conservation of threatened species (Mestanza-Ramón et al. 2020). Some management bodies in Mount Lawu,

such as the KGPAA Mangkunegara I Grand Forest Park, have also collected data on biodiversity on Mount Lawu to support conservation efforts. The Grand Forest Park is a nature conservation area that integrates ex-situ and in-situ conservation.

Illegal hunting in Magetan District still occurs for both mammals and aves. This illicit hunting can drastically change the ecosystem (Mozer and Prost 2023). Hunting of large mammals results in reducing mammal populations due to competition for food and predators (Benítez-López et al. 2017). Mammals and birds also play a role in dispersing plant seeds in their habitat (Razafindratsima et al. 2021). Hunting for wild animals disrupts the balance of the ecosystem, thereby impacting other species. For example, illegal hunting of predatory leopard species has resulted in a surge in small mammals. Illegal hunting can also affect human activities, such as poaching *Falco moluccensis* (Bonaparte, 1850) until they become locally extinct, causing an increase in the rat population, a rice pest. Therefore, supervision, outreach, control, and prohibition of animal hunting must be implemented both in and outside conservation areas.

The role of government and society is necessary to protect protected animals and plants in Indonesia. The government has issued various regulations regarding the conservation of biological resources in Indonesia. Educating and increasing awareness of society about the significance of biodiversity and the consequences of species extinction is necessary in addition to enacting the regulations. This outreach is useful in increasing community understanding so they can be actively involved in conservation (Bennett et al. 2017; Dayer et al. 2020; Manfredo et al. 2021). Establishing wildlife conservation regulations and law enforcement patrols helps reduce and prevent wildlife crime (Kurland et al. 2017).

In conclusion, this study recorded has five mammals, 14 protected aves, and one protected plant in Magetan District. Habitat destruction, poaching, and illegal trade threaten the biodiversity in the district. CITES protects biodiversity from international trade, while MoEF No. P.106/MENLHK/SETJEN/KUM.1/12/2018 protects biodiversity from poaching and habitat destruction. Nevertheless, law enforcement efforts for violators of regulations, such as poaching or exploitation of animals and plants, need to be carried out to provide a deterrent effect for these individuals to reduce poaching and illegal trade.

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