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Flora and fauna in the areas around artisanal gold mining in Selogiri Sub-district, Wonogiri, Indonesia

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Abstract. *Isworo S, Oetari PS. 2022. Flora and fauna in the areas around artisanal gold mining in Selogiri Sub-district, Wonogiri, Indonesia. Biodiversitas 23: 6600-6618.* Artisanal or small-scale gold mining has devastating impacts on the environment due to negligence of the principles of good environmental management. In particular, the mining activities often involve vegetation clearing and topsoil removal, which affect the biotic elements of the mined landscape. Selogiri Sub-district, Wonogiri District, Central Java Province, has a gold mineral resource that drives many traditional mining activities that have an indirect impact on the ecosystem's species diversity and community structure. This research aimed to investigate the diversity of flora and fauna in Selogiri Sub-district by comparing the area where the artisanal gold mining occurred (the inside area) and the areas surrounding the mining (the outside area). Six groups of taxa were observed in this study, including the plant group using the plot method, avifauna (birds) using Indices Ponctuels d'Abondance method, Odonata (dragonflies) and Lepidoptera (butterflies) both using visual encountering survey (VES) method, micromammals (Rodentia) using traps, VES, and camera traps and herpetofauna (amphibians and reptiles) using VES method. The diversity values of each taxa group in the inside and outside area were calculated and Sorensen's Coefficient Similarity Index formula was analyzed to see the community similarity between the two areas. A total of 243 species were found, consisting of Lepidoptera (35%), flora taxa (29%), avifauna (16%), herpetofauna (9%), Odonata (7%), and mammals (3%). The avifauna and Odonata had higher diversity values in the outside area than in the inside area. Similarly, the outside area had a higher diversity value for mammalian taxa documented using the VES method. Meanwhile, using the trap method, the taxa of Lepidoptera, herpetofauna, and mammals had higher diversity value in the inside area than in the outside. Nonetheless, the two areas had moderate similarity in the composition of flora and fauna species, with a community similarity value of less than 60% for all taxa studied. Conservation activities and off-site tree planting are solutions for restoring ecosystem structure and function to support ecological stability and biodiversity.

Keywords: Avifauna, flora, herpetofauna, Lepidoptera (butterfly), micromammals, Odonata (dragonfly)

INTRODUCTION

Artisanal or small-scale gold mining has devastating impacts on the environment because these activities usually do not adhere to the principles of good environmental management (Htun et al. 2006). This is due to the direct disposal of various types of waste generated from the extraction process or preparation of mineral deposits into soils and water bodies, such as a river. The main pollutants from this activity include suspended solids, dissolved salts, and sulfide mineral oxidation (Al-Rawahy 2001). Mercury and cyanide are also released into the environment as a result of the extraction process, contributing to the degradation of soils and water bodies and possibly causing bioaccumulation and biomagnification, both of which are critical environmental issues (Odumo et al. 2014).

Like other mineral extraction activities, artisanal gold mining often uses the open pit method to extract the gold grains deposited below the ground. This method inevitably causes environmental problems, such as landscape change, vegetation loss and topsoil removal, which damages soil structure (Isdianti et al. 2022). The change in landscape and loss of vegetation will impact the diversity of species and community structures in the ecosystem indirectly (Antwi et al. 2017; Obeng et al. 2019). Eventually, the loss of flora and fauna will reduce the ecological functions of the landscape and is expected to have secondary effects that will change the ecological system in the area, mainly caused by microbe community alteration (Dong et al. 2019; Mulyadi et al. 2022).

The composition and structure of flora and fauna affect the stability of the community of an ecosystem (Matveyeva and Chernov 2019; Guimaraes Jr. 2020). Flora is critical to the survival of fauna because it provides food and shelter and plays an important role in the food chain of the ecosystem (Ecormier-Nocca et al. 2021). At a community level, flora forms vegetation with varying structures known as canopy in which, where there are several trees in the community, it will form the forest. The canopy can also be defined as a level of growth stage that includes undergrowth, saplings, young trees, and mature trees. Canopy can shape the microclimate of an ecosystem (Hidayat 2020) which is closely related to the shape and types of plants in it (Byers et al. 2021). At the species level, flora and fauna require special attention to avoid population reduction and extinction, especially those included in the International Union for Conservation of Nature Red List of Threatened Species (IUCN Red List) (Lee et al. 2019).

When a vegetation community is disturbed, for example, because of open pit mining, it changes the overall ecological system. Environmental disturbance also reduces flora and fauna diversity to catastrophic levels (Ahmed and Fakhruddin 2018). The reduction of flora and fauna can be used as bioindicators of environmental disturbance and the presence of threats to biodiversity (Stoll et al. 2022). Faunistic monitoring is useful to see the quality of an environment by observing some animal groups, such as avifauna or birds (Werema 2021), Odonata or dragonflies (Smith et al. 2008), butterflies (Kyerematen et al. 2018), herpetofauna or amphibian and reptile groups. In particular, herpetofauna has been extensively used as bioindicators of habitat damage since they play an important role in ecosystems as part of the food chain (Fabian et al. 2013)

Selogiri Sub-district, Wonogiri District, Central Java Province, Indonesia, is an area with a high potential for gold deposits. As a consequence, some villages in this subdistrict attract many people to extract the gold resource contained in the village (Nurcholis et al. 2017). The artisanal mining activities have an impact on the ecosystem environment in the Selogiri Sub-district, including flora and fauna. This research aimed to investigate the diversity of flora and fauna in Selogiri Sub-district by comparing the area where the artisanal gold mining occurred (the inside area) and the surrounding areas outside the mining (the outside area). We expect the result of this study can be used to generate potential conservation strategies for endemic and threatened species in the area pressured by artisanal gold mining.

MATERIALS AND METHODS

Study period and area

The survey was conducted between 12 November 2021 and 12 January 2022. The observation covered some villages in the Selogiri Sub-district, Wonogiri District, Central Java Province, Indonesia, including Jendi Village, Keloran Village, Kepatihan Village and Pule Village (Figure 1). The survey area within the yellow dotted line is referred to as the inside area of the site, while the survey area outside is referred to as the off-site area.

Sampling design

According to the preliminary survey, the area within the site was made up of the following ecosystems: shrubs, rivers, open land, mixed plantations, and homogeneous plantations. Outside the site, there were gardens, rice fields, rivers, and settlements. We chose the regular sampling method for determining survey points, combined with the path and random point methods, to be able to describe the condition of the area. This method is better for describing an area as a whole because the points are placed evenly throughout the area with the same distance between them (Hirzel and Guisan 2002).

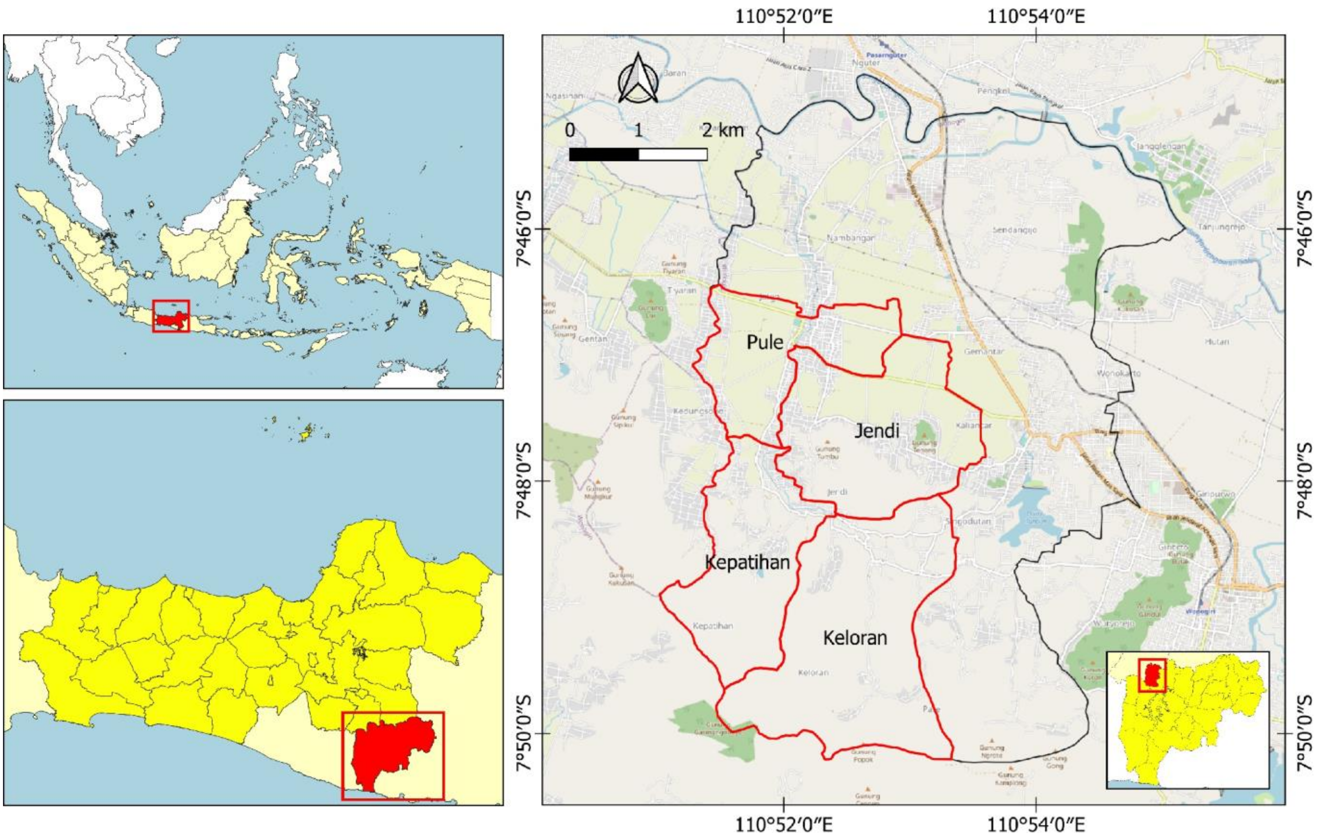

Figure 1. Map of the study area in several villages in Selogiri Sub-district, Wonogiri District, Central Java Province, Indonesia

The flora survey covered an area of 2.4 ha, or 1.23% of the total project site area. This decision was made based on preliminary survey findings, which revealed that the vegetation types found tended to be homogeneous with the main stands, namely *Tectona grandis* (teak) and *Swietenia mahogany* (mahagoni), so that species were not significantly different. Flora data was gathered using the quadratic method, with observation points placed on a regular basis or with a minimum distance of 500 m between them. The fauna survey in this activity employed four lines, two within the site and two outside the site. Each path had three points that were 500 m apart for each point.

Data collection procedure

Flora

Flora observations included perennials at saplings, poles, saplings, and tree strata, as well as understorey plants found in the sampled site. Perennials are a type of woody stemmed plant that has a chronic age and can grow large. While understorey refers to all vegetation that is not a tree and cannot grow to the tree level (Kramer 2012). Epiphytic plant species and orchids were also collected both inside and outside the sampled site.

Three plots measuring 20x20 m^2 were randomly placed at each point, with a total number of established plots was 60. Within each plot, nested subplots were created: 20x20 m to count tree stage (diameter at breast height/dbh > 20 m), 10x10 m to count poles (dbh 10-20 cm), 5x5 m to count saplings (dbh < 10 cm and height > 1.5 m) and 2x2 m to count seedlings (height < 1.5m). Each species found in the observation plot was directly identified. A subplot measuring 2x2 m^3 was also created to analyze the undergrowth, and the percentage of canopy cover was calculated. As additional data, the connecting path between the observation points was used to search for plant species that were not found in the plot. The explorative method was carried out in order to complete the list of plant species discovered in the survey area. The following references were used for identification, such as Soerjani (1987), Keenelyside et al. (2012), van Steenis et al. (2006), and Wood and Comber (1986).

Avifauna

The Indices Ponctuels d'Abondence (IPA) or Point Count method was used to collect bird data in the field. The observer stopped at a point in the observed habitat and counted all detected birds (both direct and sound encounters) over a 20-minute period. On each of the predetermined paths, observations were made both outside and inside the site. Each point was observed twice, with each data collection being repeated (a total of 4 data sets per point). Morning observations were made between 06.00 and 09.00 West Indonesian Time, and afternoon observations were made between 15.00 and 18.00 West Indonesian Time. Species, number of individuals, and time of encounter were all recorded for each bird observed during the survey period. Each type was documented in order to facilitate identification both in the field and at base camp. Bird identification guidebooks were used, including for Sumatra, Java, Bali, and Kalimantan (Robson 2020).

Odonata (Dragonfly) and Lepidoptera (Butterfly)

Odonata is a class of flying insects with medium to large size with characteristics such as short hair-shaped antennae, two pairs of wings with mesh vessels, large compound eyes, and a long and slender stomach (stomach) with two habitats, namely water and air. The true dragonfly group (suborder Anisoptera) and the needle dragonfly group are the two major groups of Odonata (suborder Zygoptera). The Anisoptera group has a pair of fused compound eyes, a larger body size than Zygoptera, front wings that are larger than hind wings, and wings that are supine when perched. While Zygoptera (needle dragonflies) have two separate compound eyes, the body is small and slender, the front and back wings are the same size, and the wings are folded on the body when perched (Hendriks and Jhonkain 2020).

Butterflies (Papilionoidea; Order Lepidoptera) can be identified by the scales that cover their wings and bodies. Butterflies have antennae that bulge at the ends, as well as wings that can move independently, and they are active during the day. Butterflies (Papilionoidea) are classified into six families: Pieridae, Papilionidae, Nymphalidae, Riodinidae, Lycaenidae, and Hesperiidae.

Observations of dragonflies and butterflies were carried out along four predetermined transect lines using the Visual Encountering Survey (VES) method. Data collection was carried out twice, with one replication for each observation path (4 sets of path data). Tracing the transect line and recording all types of dragonflies and butterflies, number of individuals of each species, and their activities during the observation period were used to make observations (08.00 West Indonesian Time - 13.00 West Indonesian Time). Feeding, egg laying (laying), perching and/or sunbathing, flying, and mating activities were all observed. Species whose scientific names are unknown are captured using an insect net, then placed in papilot paper and given a temporary label/naming for further identification at basecamp according to the guidelines. The following references were used for species identification, namely the dragonfly identification book Odonata Semarang Raya (Rachman and Rohman 2016), Lepidoptera butterfly identification book Semarang Raya (Freitas et al. 2021) dan *A Naturalist's Butterflies: identification and life history* (Field 2013).

Mammals (micromammals: Rodentia)

The mammals observed in this survey were small terrestrial mammals from the order Rodentia, or rodents, with the ability to gnaw with a pair of large incisors and no canines or front molars (Verde and D'Elía 2021). Mammals were observed using three methods: trap, VES, and Camera Trap. The trap method is effective for catching small mammals such as mice. The traps were placed along four predetermined routes (inside and outside areas of the site). Each track was observed twice, with a total of 28 traps placed at random with a minimum distance of 2 m between each trap. The traps were installed perpendicular to the cage's front door and baited with roasted coconut. The trap was set at 16.00 West Indonesian Time (because the rats are active at night) and collected at 06.00 West

Indonesian Time the next day. The rats that were caught were placed in a calico cloth to be identified later. When a caught specimen arrives at basecamp, it is anesthetized with chloroform for identification.

Observations using the VES method were conducted on four predetermined paths with two observations per path to record all types of arboreal mammals. Observations were made by slowly walking down each path between 09:00 and 12:00 West Indonesian Time. The observed animals were directly identified and documented, as well as the coordinates, time of encounter, and the number of individuals. The Rodent Guide in Java was used for identification (Phillipps 2016). The unknown species were identified based on documentation results according to the identification guidebook.

The camera trap method is useful for photographing or videotaping mammals that are difficult to locate in person. Camera traps, which can record the presence of animals automatically, are specially designed and used to inventory and study wildlife behavior (Apps and McNutt 2018). In this study, one camera trap was installed. Installation considered the strategic location and security reasons. The installation took place on 13 November 2021 and the collection took place on 30 November 2021 with a total number of 18 observations days. The *Phillips' Field Guide to The Mammal of Borneo* (Francis 2019) was used for identification.

Herpetofauna

In this study, herpetofauna referred to all groups of reptiles and amphibians. The VES method was used to collect data on herpetofauna in each transect, which was based on direct encounters in both terrestrial and aquatic areas. Paths with a length of 200 meters were built in aquatic habitats (waterways) or semi-aquatic habitats with the width determined by the width of the river or adjusted to the terrain of the path. While in terrestrial habitat, the distance between the paths was 200 meters (adjusted to the conditions of the place), with a width of 5 meters left and 5 meters right following the path. Furthermore, if the data found was becoming saturated, wide patrolling (random) was used to collect it. Because of the large coverage area and the scarcity of data collection personnel, random searches were conducted by 2-6 people. This search was aimed at places that herpetofauna commonly use for activities. We used *Amphibi Jawa dan Bali* (Tyler 2000), *Reptiles of South-East Asia* (Robinson 2017), *Amphibian and Reptiles of Mount Kinabalu* (North Borneo) (Malkmus and Brühl 2002) for species identification.

Environmental factor

The following environmental factors were measured: ambient temperature, environmental humidity, light intensity, soil pH, soil moisture, canopy cover, and canopy openings. Environmental factors were collected in two areas based on the flora and fauna survey line. In the off-site area, 10 points of environmental factor data were collected, which were divided into two lines and collected 4-5 times on different days. While the area within site was taken up to 10 points, the collection was done at random based on the day of the flora survey data collection.

Data analysis

Identification and naming of species

Plant taxa were identified by comparing the morphological characteristics of the flora encountered with identification books, both generative (flowers and fruit) and vegetative (stature, stems, leaves, and leaf arrangement). The identification of avifauna taxa was accomplished by comparing the results of documentation or observations in the form of general characteristics and coat colors of each species encountered with an identification guidebook. Odonata taxa were identified by comparing morphological features of the abdomen (stomach), eyes, thorax (chest), and wing venation to Odonata guidelines (Lepidoptera butterfly identification book Semarang Raya). Body size, color, venation, and pattern on the wings, as well as general wing shape, were used to identify Lepidoptera taxa, which were then compared to the Lepidoptera identification guide (Freitas et al. 2021). The morphometric results were used to identify the mammalian taxa caught in the trap. Morphometry was performed by measuring the following body parts: body length from the tip of the nose to the tip of the tail, tail length, ear length from base to tip, and length from the base of the back foot to the tip of the finger without nails. The Mammary formula was created by calculating the number of nipples on the chest (pectoral) and in the abdomen (inguinal) expressed in pairs, in addition to being used as supporting data. All measurements and observations were compared to the Phillips' Field Guide to Borneo Mammals. (Francis 2019). Naming was done based on scientific identity and English identity (international naming). The Global Biodiversity Information Facility/GBIF (https://www.gbif.org/) online data was used to standardize the scientific names. Scientific naming for flora taxa is based on online data from the World Checklist of Selected Plant Families/WCSP (https://wcsp.science.kew.org), whereas international naming was based on GBIF data. For bird taxa, the Indonesian name refers to the Indonesian Bird List 2 (Sukmantoro et al. 2007) while the English and scientific names refer to the Handbook of the Birds of the World and the BirdLife International digital checklist of the Birds of the World (International, 2020)

Status of protection

The protection status of each species encountered was determined based on Law No. 106 yrs. 2018 by the Ministry of Environment and Forestry (Kementrian Lingkungan Hidup dan Kehutanan, 2018). The International Union for Conservation of Nature and Natural Resources/IUCN page (https://www.iucnredlist.org/) was also used to determine international protected status by entering scientific names online. International trade protection refers to the CITES online data (https://checklist.cites.org/#/en).

Community stability

The diversity of each taxon was calculated using the Shannon-Wiener (H') formula to determine community stability:

$$H' = -\Sigma Pi.\ln Pi$$

$$Pi = \frac{ni}{N}$$

Where: H' is the Shannon-Wiener diversity index, and Pi is the proportion of the importance of species I (ni) to all species in each taxon (N).

The importance of species at the tree, poles and sapling levels was determined by the Important Value Index (IVI) as the sum of dominance, density, and frequency, while the IVI for seedlings only accounted for dominance and frequency. In general, IVI calculations can be written using the following formula:

$$NPi = DoRi + DeRi + FRi$$

The significance value of type I is NPi, the relative dominance of type I is DoRi, the relative density of type I is DeRi, and the relative frequency of type I is FRi.

In contrast to the flora taxa, the importance of the studied fauna (taxa Avifauna, Odonata, Lepidoptera, Mammals, and Herpetofauna) was expressed as the number of individuals in each fauna group. While Pi was calculated by dividing the number of individuals of species I by the total number of individuals found.

Community similarity

The community similarity was calculated to determine the extent of the similarity or difference between the area within the site and the area outside the site. Calculations to determine the value of community similarity were performed using Sorensen's Coefficient Similarity Index (SCSI), where the difference between two communities is seen through the presence/absence of a species in the two areas being compared (Hammond and Pokorný 2020). The following formula was used to calculate SCSI value.:

$$Cs = \frac{2C}{A + B + C}$$

Where: Cs is the Sorensen coefficient value, A is the number of species found in area 1, B is the number of species found in area 2, and C is the number of species found in both areas.

The Sorensen index value of >50% indicates that the two areas are similar, while a value less than this indicates a significant difference between the two areas investigated.

RESULTS AND DISCUSSION

During the survey, 243 species of animals and plants were recorded. Lepidoptera had the most species (35%), followed by flora taxa with 71 species (29%), avifauna with 40 species (16%), herpetofauna with 21 species (9%), Odonata with 16 species (7%), and mammals with only 8 species (4%) (Figure 2).

Flora

Plants were the second largest taxa group, consisting of 30 families and 71 species out of the 243 species of biotic constituents identified. Fabaceae (12 species) was the most common family found in the survey area. Plants in the Fabaceae family are very easy to propagate and spread, so the species is fairly common. Most of the tree species from Fabaceae were cultivated by local communities for timber production, such as Sonokeling (*Dalbergia latifolia*) and Sengon (*Falcataria falcata*); food crops like petai (*Parkia speciosa*); and shade plants like trembesi (*Samanea saman*) and Johar (*Senna siamea*). The remainder were weeds that appeared as bushes or undergrowth (Figure 3). The list of flora species found at the study site can be seen in Table S1.

Fabaceae, also known as Leguminosae, is a legume family with a distinctive fruit that splits in two when ripe. Because of their ability to absorb carbon, plants in this family can be used as shade in the environment. For example, a six-year-old stand *S. saman* can store carbon up to 314.28 tons/ha, while *S. siamea* can store 113.65 tons/ha in a nine-year-old stand (Fajariani et al. 2020)

Plant composition and abundance influence the stability of vegetation communities (Isbell et al. 2009). The results of the diversity index calculation showed that the vegetation community in the studied area was in a stable state. The herbaceous strata had the highest diversity index, followed by the seedling, tree, pole and sapling strata (Figure 4).

The higher the value of the diversity index, the more stable the community, and vice versa. The value of H'>3 indicates that a plant community is stable, while the value of H'=2-3 indicates a moderately stable community, and the value of H' < 2 indicates that it is unstable. In the studied area, the diversity index for the tree, pole, and sapling categories was less than 2, indicating that the plant community in that category was unstable. Meanwhile, the herb and seedling categories had a value between 2 and 3, indicating that these strata had moderate stability levels.

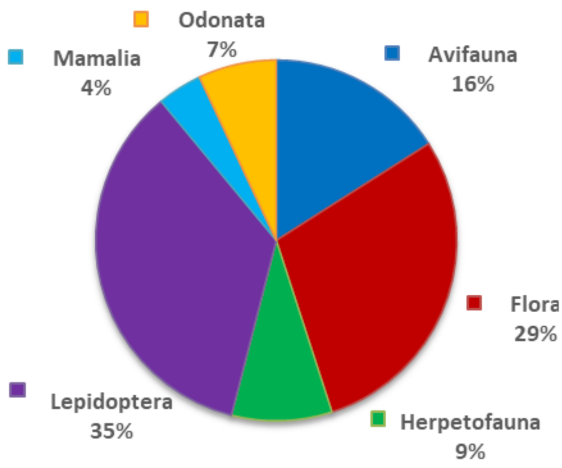

Figure 2. The composition of species in each taxa group in the surveyed area

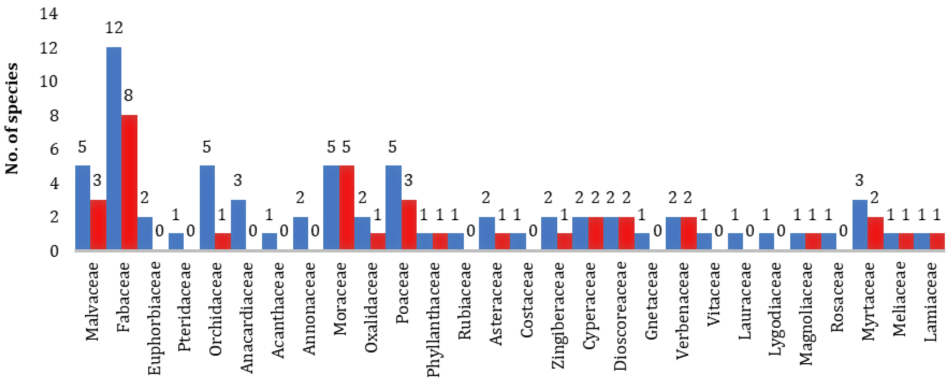

Figure 3. Plant species composition in each family in the studied area

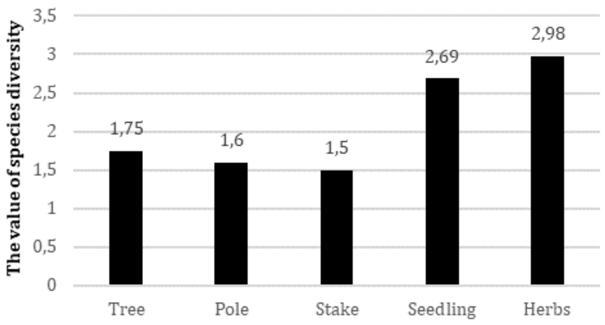

Figure 4. Shannon-Wiener diversity index for each plant strata

The high diversity index of herbaceous and seedling strata in comparison to other flora strata could be attributed to a lack of species dominance within the strata. This is demonstrated by the important value index of each plant species within the community (Table 1).

The importance of each species indicates the level of contribution of a plant species to natural conditions. The vegetation in the studied area was not in natural growth, with the exception of the herbaceous strata. As a result, the IVI of the tree, pole, sapling, and sapling strata of perennials only indicated the level of abundance in the studied area, particularly the area within the project site. Sonokeling (*D. latifolia*) was the species with the highest importance at the seedling, sapling, and pole strata, while at the tree strata, the highest important value was Teak (*Tectona grandis*). The study area was a community forest dominated by *T. grandis* and *D. latifolia*. Sonokeling and teak trees are agroforestry plants that are mostly found in dry, rocky and less fertile soil and tend to grow in groups. These plants are famous for their good and durable wood quality, so they were widely planted by the local people because of their high economic value.

The highest important value index at the herb strata were *Chromolaena odorata* and *Brachiaria reptans* grass. *C. odorata* is an invasive weed that grows quickly and forms a dense community. Similarly, because its stems are stolon, *B. reptans* grass can grow quickly and densely. Despite its invasive nature, *C. odorata* can be beneficial to the environment because it can act as a landslide barrier in slope areas, as a soil cover that can hold rainwater, and as a home for small animals or other soil insects.

Fauna

In terms of the diversity value of fauna groups, the location inside and outside the site had balanced stability. The group of Lepidoptera, herpetofauna, and mammalia (trap method) had higher values within the site, whereas avifauna, Odonata, and mammalia (VES method) had higher values outside the site (Figure 5). In comparison to other fauna groups studied, the Lepidoptera had the highest diversity value. While mammalian group (both using VES and trap) had the lowest diversity values. The list of fauna species found at the study site can be seen in Table S2.

Avifauna

As many as 554 records of avifauna data were obtained during the observation, with a total of 1354 individuals. There were 40 avifauna species from 26 families. The families with the most species were Cisticolidae and Cuculidae, each with four species (Figure 6). The state of bird diversity in Wonogiri, in terms of species richness and abundance, is similar to that of rural areas in Central Java, which have habitat types for rice fields, gardens, and settlements. The observation area is classified as a sub-urban bird community based on its species composition, with the species that comprise the community being resistant to human activities.

Based on the number of records, Swallow linchi (*Collocalia linchi*) was the most common bird with 85 records, followed by Cucak kutilang (*Pycnonotus aurigaster)* (51 times) and Cekakak river *(Todiramphus chloris)* (47 times). Based on the number of individuals of each species, Swallow linchi (*Collocalia linchi*) had the highest number of species, with 364 individuals recorded, followed by Peking Bondol (*Lonchura punctulate*) (167 individuals) and small sepah (*Pericrocotus cinnamomeus*) (161 individuals). Margareta (2010) found that diverse habitat types such as forests, rice fields, settlements, rivers, and vacant land are ideal for swallow habitats, which are suitable for rural landscape conditions. Some of these habitat types also had an impact on the diversity value of the two compared sites. Table 2 shows that the outside area had a greater avifauna richness and abundance than the inside area.

Table 1. The Important Value Index (IVI) of each plant species in each stratum

Stratum	Scientific name	IVI (%)
Sapling	*Acacia auriculiformis*	1.04
	Samanea saman	1.04
	Breynia officinalis	1.36
	Bridelia micrantha	3.35
	Catunaregam spinosa	1.36
	*Dalbergia latifolia***	43.84
	Falcataria falcata	9.09
	Ficus hispida	1.04
	Ficus montana	2.62
	Gliricida sepium	1.36
	Gmelina sp	1.67
	Gnetum gnemon	1.36
	Leea indica	5.43
	Leucaena leucocephala	6.38
	Litsea sp	7.32
	Magnolia sp	11.27
	Manihot utilissima	2.31
	Mangifera sp	1.36
	Melicope latifolia	4.39
	Murraya koenigii	3.12
	Parkia speciosa	1.04
	Polyalthia longifolia	3.12
	Psidium guajava	1.04
	*Senna siamea**	33.53
	Prunus sp	1.04
	Swietenia mahagoni	5.52
	Syzygium cumini	7,92
	Syzygium sp	1.04
	Tectona grandis	33.35
	Abelmoschus sp	1.67
Sapling	*Acacia auriculiformis*	3.35
	Annona muricata	1.46
	*Dalbergia latifolia***	94.00
	Falcataria falcata	21.07
	Ficus hispida	1.50
	Ficus septica	8.94
	Gnetum gnemon	6.82
	Leucaena leucocephala	2.12
	Mangifera indica	3.14
	Melicope latifolia	2.80
	Senna siamea	18.59
	Swietenia mahagoni	5.12
	Syzygium cumini	1.75
	*Tectona grandis**	129.33
Pole	*Acacia auriculiformis*	2.29
	Anacardium occidentale	3.17
	Averrhoa carambola	3.04
	*Dalbergia latifolia***	44.63
	Falcataria falcata	11.88
	Ficus hispida	5.21
	Ficus septica	1.57
	Leucaena leucocephala	2.54
	Melicope latifolia	2.25
	Parkia speciosa	1.57
	Samanea saman	3.06
	Senna siamea	27.25
	Swietenia mahagoni	11.98
	Syzygium cumini	1.64
	*Tectona grandis**	177.91
Tree	*Acacia auriculiformis*	12.16
	Anacardium occidentale	9.05
	Artocarpus heterophyllus	1.25
	Ceiba pentandra	1.56
	*Dalbergia latifolia***	26.50
	Falcataria falcata	12.59
	Ficus hispida	1.27
	Mangifera indica	5.23
	Melicope latifolia	2.58
	Parkia speciosa	2.77
	Samanea saman	14.60
	Senna siamea	23.95
	Swietenia mahagoni	20.14
	Syzygium cumini	5.32
	*Tectona grandis**	161.02
Herbs	*Abelmoschus moschatus*	0.81
	Acalypha rhomboidea	1.07
	Adiantum philippense	0.85
	Andrographis paniculata	2.88
	Axonopus compressus	3.95
	Brachiaria reptans	26.19
	Calopogonium mucunoides	8.56
	Centrosema pubescens	2.62
	Chromolaena odorata	48.83
	Curcuma zedoaria	5.28
	Cyperus kylingia	1.59
	Desmodium sp	0.74
	Dioscorea alata	2.03
	Geodorum densiflorum	0.96
	Hellenia speciosa	3.58
	Imperata cylindrica	10.54
	Isachne globosa	9.17
	Lantana camara	8.75
	Leea indica	0.68
	Lygodium flexuosum	3.43
	Melastoma malabathricum	0.85
	Mimosa pudica	0.70
	Oxalis barrelieri	1.48
	Pennisetum purpureum	1.94
	Scleria microcarpa	3.01
	Stachytarpeta jamaicensis	26.17
	Synedrella nodiflora	4.67
	Urena lobata	3.53
	Tacca palmata	2.25
	Zingiber montanum	1.40
	Zingiber zerumbet	11.46

Note : (*) The most significant value; (**) The second most significant value

Dragonfly (Odonata)

The survey recorded 58 dragonfly encounters, consisting of 16 dragonfly species from three different families (Figure 7). The family Libellulidae had the most species richness with 12 species recorded in both studied areas. Based on the number of records, the most common species was *Ortethrum sabina* (19 records), followed by *Brachytemis contaminata* (7 records), both are members of the Libellulidae family. *Orthetrum sabina* is a dragonfly that can withstand drastic environmental changes. This species' nymphs are known to be resistant to environmental and water salinity changes (Meidyna et al. 2019).

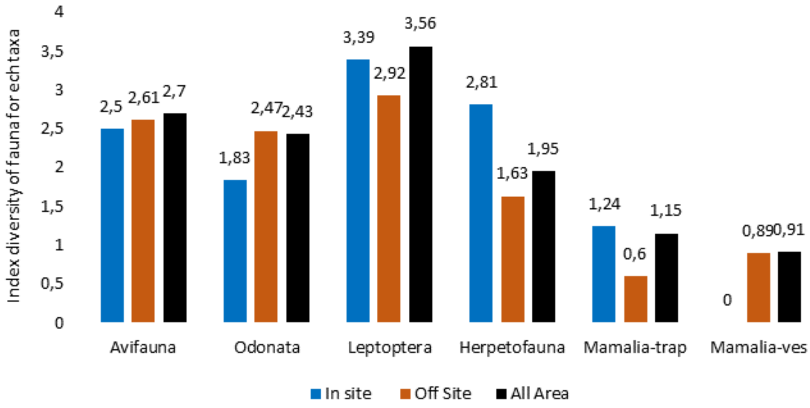

Figure 5. Value of faunal diversity for each fauna group in each studied area

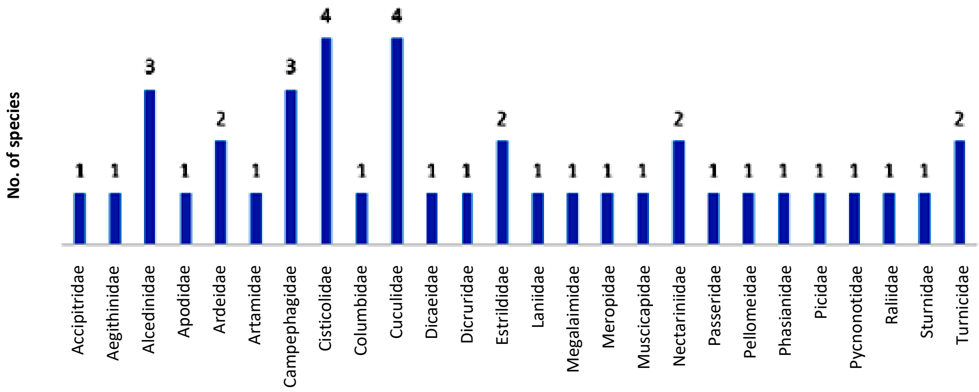

Figure 6. Number of avifauna species in each family in the studied area

Table 2. Comparison of avifauna community inside and outside area based on several parameters

Parameters measured	Inside	Outside
Number of records	205	349
Number of families	20	21
Number of species	31	37
Number of individuals	376	978
Diversity value	2.497	2.606
Community similarity value	0.47	
Community dissimilarity value	0.53	

Table 3. Comparison of dragonfly community inside and outside area based on several parameters

Parameters measured	Inside	Outside
Number of records	22	58
Number of families	3	3
Number of species	9	15
Number of individuals	22	58
Diversity value	1.83	2.47
Community similarity value	0.50	
Community dissimilarity value	0.50	

According to Table 3, the outside area had a higher species number and abundance of dragonflies, similar to the result of avifauna. This indicates that the outside area had a higher level of community stability than the inside area. This can also be seen in the value of the diversity index (H'), where the outside area had a higher value. The high level of dragonfly diversity in the off-site area was due to the type of habitat that is suitable for dragonfly life. The various life cycles of dragonflies are supported by habitat types in off-site areas such as rice fields with irrigation canals. Rice fields also provide a diverse range of food for dragonflies, such as small insects. (Hasanah et al. 2021). Dragonflies are an excellent indicator of environmental health, particularly aspects of water cleanliness of an area. On the other hand, some dragonflies, such as *Brachytemis contaminata*, are known to have requirements for polluted environments (Vorster et al. 2020).

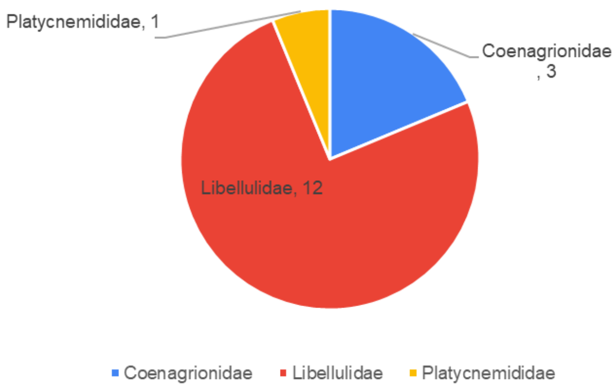

Figure 7. The composition of dragonfly species in each family in the studied area

Butterflies (Lepidoptera)

A total of 263 encounters of butterflies were recorded consisting of 86 species from 5 families, namely Pieridae (14 species), Papilionidae (8 species), Nymphalidae (39 species), Lycaenidae (16 species), and Hesperiidae (9 species) (Figure 8). Compared to other butterfly families, the Nymphalidae family had the most species and species abundance. This is due to the abundance of forage and host plants in the studied area. Nymphalidae is polyphagous, and their host plants are diverse (Subedi et al. 2021). Meanwhile, three species of butterflies with the most records were *Catopsilia pomona* (Pieridae) with 135 records, *Junonia almana* (Nymphalidae) with 42 records, and *Prosotas dubiosa* (Lycaenidae) with 40 records. The *C. pomona* was very common because many plants in the Fabaceae family are known to be hosts for this butterfly species (Nitin et al. 2018). Based on Table 4, the in-site area was more diverse than the off-site area. This is because of the presence of *Lantana camara* plant, which was commonly found around the site. *Lantana camara* is one of the most popular species, with its flower being visited by butterflies (Santhosh and Basavarajappa 2016). In addition, there were plants *Stachytarpheta* sp. in the surveyed area. Both plants are members of the Verbenaceae family, which is the most popular food plant for butterflies.

The in-site area had more diverse vegetation, including trees, shrubs, and herbs. Meanwhile, off-site areas in the form of rice fields and located near settlements experienced more disturbances from human activities. Butterflies are very dependent on the availability of plants as hosts for larvae and especially flowers as a source of nectar for adult butterflies (Santhosh and Basavarajappa 2016; Han et al. 2021).

Butterflies are bioindicators of a healthy environment because they have strong associations with several habitat variables, such as the abundance and diversity of plant species (Ghazanfar et al. 2016; Parikh et al. 2021). Butterflies are also an indicator of pollution and heavy metal contamination in the environment (Parikh et al. 2021). As a result, butterflies are frequently found in good-quality environments with little pollution (Rohman et al. 2019). Butterflies have several important roles in the ecosystem, including as pollinators, can reduce air pollution and as predators in the larval stage (Ghazanfar et al. 2016; Rohman et al. 2019).

Herpetofauna

There were 83 encounters of herpetofauna consisting of 21 species belonging to 12 families from a total of 235 individuals. With four species, the family Colubridae had the highest species richness (Figure 9). According to Table 5, the frog community was more stable in the inside area than in the outside, indicated by the higher diversity value. Although there were more off-site records, the number of species was lower, indicating that some species had a disproportionate influence in the area. This species was the wood lizard *Hemidactylus frenatus*, which had 12 individuals, whereas the other species had only 1-5 individuals (Table 5). According to the number of records, the wood gecko *H. frenatus* (17 times recorded), rice field frog *Fejervarya cancrivora* (14 times recorded), and dry field frog *F. cancrivora* were the three most frequently recorded species with 13 times.

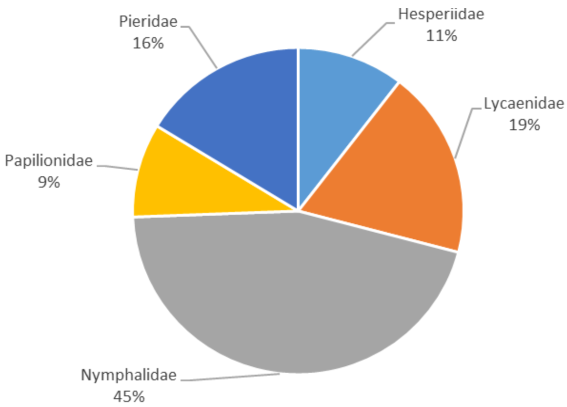

Figure 8. The composition of butterfly species in each family in the studied area

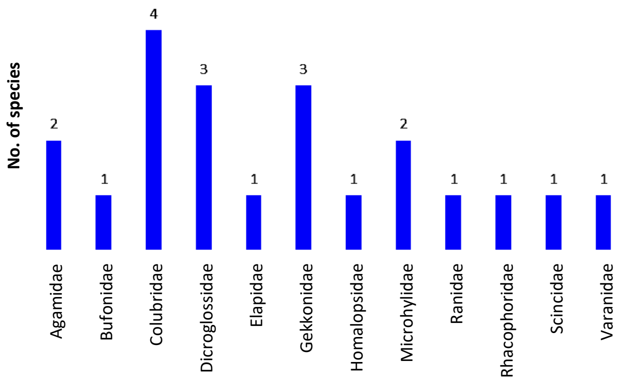

Figure 9. The composition of herpetofauna species in each family in the studied area

Table 4. Comparison of butterflies community inside and outside area based on several parameters

Parameters measured	Inside	Outside
Number of records	144	119
Number of families	6	6
Number of species	66	40
Number of individuals	423	280
Diversity value	3.39	2.92
Community similarity value	0.37	
Community dissimilarity value	0.63	

Table 5. Comparison of herpetofauna community inside and outside area based on several parameters

Parameters measured	Inside	Outside
Number of records	28	55
Number of families	11	9
Number of species	18	14
Number of individuals	39	134
Diversity value	2.18	1.63
Community similarity value	0.41	
Community dissimilarity value	0.59	

Table 6. Comparison of mammal community inside and outside area based on several parameters

Parameters measured	Inside	Outside
Number of records	8	5
Number of families	3	4
Number of species	6	4
Number of individuals	13	13
Diversity value	0.46	
Community similarity value	0.54	

Mammals

There were 13 encounters of mammals using both the VES and Trap methods consisting of 9 species belonging to 6 families both inside and outside areas (Figure 10). The Muridae family had the most species, with four, while the other families each had only one. Based on Table 6 and Figure 10, the inside area had better conditions than the outside area. This is in line with the diversity value obtained through the VES method, where the inside area had a higher H' value (H'=1.24) than the outside area. Even the VES observations installed outside the area did not get a single individual (H'=0). On the other hand, observations using traps showed that the outside area had a higher diversity value (H'=0.89) than the inside area (H'=0.60). The VES observations were intended to observe diurnal mammals, or mammals that are more active during the day. While trap observations were intended to collect data on nocturnal mammals that are more active at night. Based on these findings, it is possible that there had been a division of mammalian niches at the surveyed site, with the inside area serving as a niche for nocturnal mammals and the outside area as a niche for diurnal mammals. The division of these niches is the strategy to reduce competition between species (Kunz 2013). Furthermore, the availability of habitat and human activities in each area is very likely to influence the division of these niches (Hut et al. 2012). Terrestrial nocturnal mammals were strongly influenced by dense vegetation and sufficient humidity in the outside area. Terrestrial mammals discovered in the survey were also resistant to human activity. Despite the fact that the site had a high level of human activity, the mammals that occurred there were not adversely affected. The diurnal mammals discovered, on the other hand, were more sensitive to human activity and could only be found in the outside area. These diurnal mammals prefer areas with abundant food sources and little human activity (Bennie et al. 2014).

Conservation status

The conservation status of flora and fauna species found in the studied area was assessed according to three references: IUCN Red List (Figure 11A), CITES (Figure 11B), and Minister Regulation Number 106 Year 2018 of the Ministry of Environment and Forestry (Figure 11C). According to IUCN, three species were listed Vulnerable (VU), namely Sonokeling (*D. latifolia*), Buffalo crust (*Acridotheres javanicus*) and long-tailed macaque (*Macaca fascicularis*). Most species were classified as Least Concern (LC), while three species were listed as Data Deficiency (DD), namely Temu Putih (*Curcuma zedoaria*), Mango (*Mangifera indica*), and Lempuyang (*Zingiber zerumbet*).

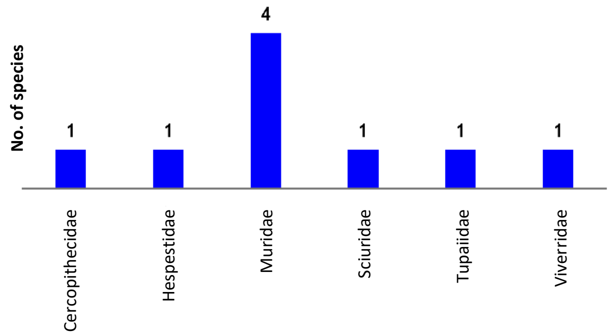

Figure 10. The composition of mammal species in each family in the studied area

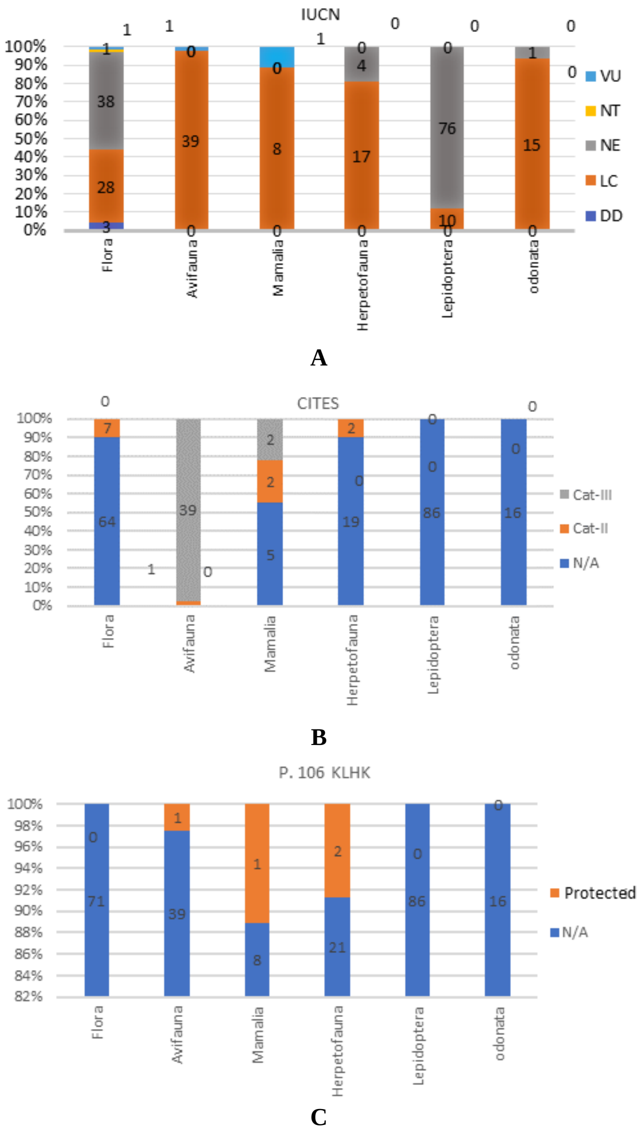

Figure 11. Species composition of each protected taxa according to: A. IUCN, B. CITES, C. P. 106 of the Ministry of Environment and Forestry in 2018

Dalbergia latifolia had Vulnerable status since its natural population had almost vanished due to high market demand for furniture material. As a result, in addition, to being listed in the IUCN criteria, this species was also included in the CITES international trade law under the category Appendix II, where international trade is restricted to cultivated species only. Mahoni (*Swietenia mahagoni*) is listed as Near Threatened (NT) and included in Appendix II CITES, in which the wood is also in high demand in the furniture market. Apart from these species, several species of orchids found are also included in Appendix II, with orchid hunting and overexploitation being the main reasons for their inclusion.

Within the avifauna, the buffalo crust (*A. javanicus*) is listed as Vulnerable (VU) due to habitat loss and pet trade (Aditya et al. 2020). In addition, the Bido eagle (*Spilornis cheela*) is listed under government regulation. This is due to the critical role of top predators that regulate ecosystem stability. Furthermore, eagle reproduction is quite slow, with only one egg laid per breeding period.

Similarity value

The differences in vegetation cover between the inside and the outside areas might affect flora and fauna composition, which can be analyzed using the Sorensen similarity index (SCSI). A high SCSI value indicates the similarity of community attributes that affect the composition or species richness between the two areas being compared and vice versa (Dinesh et al. 2018).

Flora group had the highest community similarity score of 54 % among all taxa studied (Figure 12). This is because the plant composition in both areas is affected by human activities and the presence of various understorey plants that can live in a variety of ecosystems and conditions. The condition of the habitat in the inside area had been damaged due to mining activities, resulting in fewer encounters with fauna taxa, particularly those with high mobility, such as mammals and avifauna. The high level of human activity had an impact on the behavior of the animals that live there. These community differences could also be attributed to a lack of natural corridors connecting the interior and exterior areas. The mini-style corridor acts as a connecting bridge between areas, allowing animals to move between them.

Environmental factor

The environmental factors measured in the two locations were ambient temperature, environmental humidity, light intensity, soil pH, and soil moisture. The measured data were then tabulated for the statistical test. The data used consisted of 35 values from each of the variables tested. Because the data were not mutually exclusive, the analysis of the various tests was performed using the SPSS program and the independent t-test method. Before running the t-test, the data normality of each variable was determined. If the normality was greater than 0.05, the data was normally distributed. Following testing, the analysis results were interpreted into a table that presents significant values, average values, and standard deviation values.

According to Table 7, the average environmental factor values of the five parameters were almost similar between the inside and the outside areas. Similarly, the standard deviation demonstrates that the distribution of the values of each parameter is nearly the same. The result of the independent sample t-test showed that the difference in the five environmental variables between the inside and the outside areas was not significant (P value > 0.05). This is reasonable since the two areas being compared are not far apart, so they have the same environmental conditions, especially climate. There was only one environmental parameter that showed a significant difference, namely soil moisture with, a P value of 0.008 (< 0.05), indicating that soil moisture differed between the outside and inside areas. This difference is likely caused by the difference in vegetation cover type (i.e. tree cover vs rice field) that composed the two areas which affected soil moisture. The rate of transpiration water loss and plant stomata opening are both directly controlled by humidity levels. Thus, humidity regulates photosynthesis and tissue temperature (Oksanen et al. 2018).

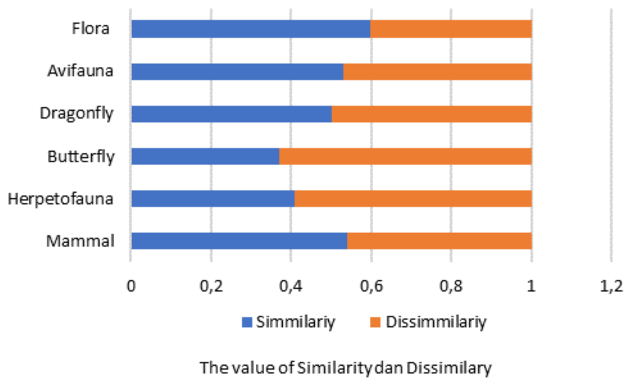

Figure 12. The Sorensen community similarity index and dissimilarity between the inside and the outside area for each taxon studied

Table 7. Comparison of environmental parameters between the inside and outside area

Parameter	Location	Ambient temperature	Air humidity	Light intensity	Soil Ph	Soil moisture
Average value	Inside	28.93	68.48	9801	6.26	77
	Outside	28.95	67.37	17222.13	6.35	66.31
Standard Deviation	Inside	5.26	10.37	10820.43	0.591	16
	Outside	3.36	11.17	46792.86	0.657	16.77
Value Significance	-	0.980	0.667	0.364	0.53	0.008

In conclusion, there were 243 different species of biotic components observed around artisanal mining areas in Selogiri Sub-district, with plant taxa (71 species), avifauna (40 species), herpetofauna (21 species), and dragonflies (16 species) the most abundant, while mammals being the least abundant (9 species). According to the IUCN Red List, three species are listed as Vulnerable and three species as Near Threatened. According to the CITES, 41 species are included in Appendix II criteria and 12 species are included in Appendix III. Only one avifauna species, Elang ular Bido (*S. cheela*), is included in the list of nationally protected species under the government regulation P. 106 of 2018. *Dalbergia latifolia* and *S. mahagoni* dominated the plant community with the greatest importance value index since both species were cultivated by the community. The avifauna and Odonata had a higher diversity value in the outside area than in the inside area. Similarly, the outside area had a higher diversity value for mammalian taxa documented using the VES method. Meanwhile, using the trap method, the taxa of Lepidoptera, herpetofauna, and mammals had a higher diversity value in the inside area than in the outside. Nonetheless, the two areas had moderate similarity in the composition of flora and fauna species, with a community similarity value of less than 60% for all taxa studied. Based on environmental parameters, the inside and outside areas had similar climate conditions. The results of this study imply that

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Table S1. List of flora in the artisanal gold mining in Selogiri Sub-district, Wonogiri, Indonesia

Family	Scientific name	Indonesia name	English name	IUCN	CITES	P.106	Inside	Outside
Malvaceae	*Abelmoschus moschatus*	Kapasan	Musk mallow	N/A	N/A	N/A	√	
Malvaceae	*Abelmoschus* sp.	Kapasan	-	N/A	N/A	N/A	√	
Fabaceae	*Acacia auriculiformis*	Akasia	Acacias	LC	N/A	N/A	√	√
Euphorbiaceae	*Acalypha rhomboidea*	Kucing galak	Copperleaf	N/A	N/A	N/A	√	√
Pteridaceae	*Adiantum philippense*	Suplir	Wild tea leaf	N/A	N/A	N/A	√	√
Orchidaceae	*Aerides odorata*	Anggrek kuku macan	Cat's tail orchid	N/A	II	N/A	√	√
Anacardiaceae	*Anacardium occidentale*	Jambu mete	Cashew nut	N/A	N/A	N/A	√	
Acanthaceae	*Andrographis paniculata*	Sambiloto	Bitterweed	N/A	N/A	N/A	√	
Annonaceae	*Annona muricata*	Sirsak	Soursop	LC	N/A	N/A	√	√
Moraceae	*Artocarpus heterophyllus*	Nangka	Jackfruit	N/A	N/A	N/A	√	√
Oxalidaceae	*Averrhoa carambola*	Belimbing	Star fruit	N/A	N/A	N/A	√	√
Poaceae	*Axonopus compressus*	Rumput jukut pait	Carpet grass	N/A	N/A	N/A	√	√
Malvaceae	*Bombax ceiba*	Randu alas	Red silk cotton tree	LC	N/A	N/A	√	
Poaceae	*Brachiaria reptans*	-	Creeping panic grass	LC	N/A	N/A	√	√
Phyllanthaceae	*Breynia vitis-idaea*	-	Mountain coffee bush	LC	N/A	N/A	√	
Anacardiaceae	*Buchanania arborescens*	Pohpohan	Sparrow's mango	LC	N/A	N/A	√	
Fabaceae	*Calopogonium mucunoides*	-	Calopo	N/A	N/A	N/A	√	√
Rubiaceae	*Catunaregam spinosa*	Delima gunung	Montain pomegranate	N/A	N/A	N/A	√	
Malvaceae	*Ceiba pentandra*	Kapuk randu	Kapok tree	LC	N/A	N/A	√	√
Fabaceae	*Centrosema pubescens*	Kacang kupu-kupu	Butterfly pea	N/A	N/A	N/A	√	√
Asteraceae	*Chromolaena odorata*	Kirinyu	Siamweed	N/A	N/A	N/A	√	√
Costaceae	*Hellenia speciosa*	Pacing	Crepe ginger	LC	N/A	N/A	√	
Zingiberaceae	*Curcuma zedoaria*	Temu putih	White turmeric	DD	N/A	N/A	√	√
Cyperaceae	*Cyperus kyllingia*	Jukut pendul	-	LC	N/A	N/A	√	√
Fabaceae	*Dalbergia latifolia*	Sonokeling	Indian rosewood	VU	II	N/A	√	
Orchidaceae	*Dendrobium aphyllum*	Anggrek tirai	The hooded orchid	LC	II	N/A		√
Fabaceae	*Desmodium* sp.	-	-	N/A	N/A	N/A	√	
Orchidaceae	*Didymoplexis pallens*	-	Crystal bells	N/A	II	N/A	√	
Dioscoreaceae	*Dioscorea alata*	Uwi	Water yam	N/A	N/A	N/A	√	√
Fabaceae	*Falcataria falcata*	Sengon	Batai	LC	N/A	N/A	√	√
Moraceae	*Ficus hispida*	Bisoro	Hairy fig	LC	N/A	N/A	√	√
Moraceae	*Ficus microcarpa*	Beringin	Indian laurel tree	LC	N/A	N/A	√	√
Moraceae	*Ficus montana*	Uyah-uyahan	Oakleaf fig	N/A	N/A	N/A	√	√
Moraceae	*Ficus septica*	Awar-awar	-	LC	N/A	N/A	√	√
Orchidaceae	*Geodorum densiflorum*	-	Nodding swamp orchid	N/A	II	N/A	√	
Fabaceae	*Gliricidia sepium*	Gamal	Gliricida	LC	N/A	N/A	√	√
Gnetaceae	*Gnetum gnemon*	Mlinjo	Joint fir	LC	N/A	N/A	√	
Poaceae	*Imperata cylindrica*	Alang-alang	Cogongrass	N/A	N/A	N/A	√	√
Poaceae	*Isachne globosa*	-	Swamp millet	LC	N/A	N/A	√	√
Verbenaceae	*Lantana camara*	Tembelekan	-	N/A	N/A	N/A	√	√

Vitaceae	*Leea indica*	Girang	Bandicoot berry	LC	N/A	N/A	√	
Fabaceae	*Leucaena leucocephala*	Mlanding	White lead tree	N/A	N/A	N/A	√	√
Lauraceae	*Litsea* sp.	-	-	N/A	N/A	N/A	√	
Lygodiaceae	*Lygodium flexuosum*	Paku kembang	Maidenhair creeper	N/A	N/A	N/A	√	√
Magnoliaceae	*Magnolia* sp.	-	-	N/A	N/A	N/A	√	√
Anacardiaceae	*Mangifera indica*	Mangga	Mango tree	DD	N/A	N/A	√	√
Anacardiaceae	*Mangifera* sp.	-	-	N/A	N/A	N/A	√	
Euphorbiaceae	*Manihot utilissima*	Singkong	Cassava	N/A	N/A	N/A	√	√
Melastomataceae	*Melastoma malabathricum*	Senggani	Malabar gooseberry	N/A	N/A	N/A	√	
Rutaceae	*Melicope latifolia*	Sampang	Broad leaved	N/A	N/A	N/A	√	
Fabaceae	*Mimosa pudica*	Putri malu	Sensitive plant	LC	N/A	N/A	√	√
Rutaceae	*Murraya koenigii*	Daun kari	Curry tree	LC	N/A	N/A	√	√
Orchidaceae	*Nervilia punctata*	-	-	N/A	II	N/A	√	
Oxalidaceae	*Oxalis barrelieri*	Belimbing tanah	Lavender sorrel	N/A	N/A	N/A	√	√
Fabaceae	*Parkia speciosa*	Petai	Stink bean	LC	N/A	N/A	√	√
Poaceae	*Cenchrus purpureus*	Rumput gajah	Elephants grass	LC	N/A	N/A	√	√
Annonaceae	*Polyalthia longifolia*	Glodokan	Mast tree	N/A	N/A	N/A	√	√
Rosaceae	*Prunus* sp.	-	Plum	N/A	N/A	N/A	√	
Myrtaceae	*Psidium guajava*	Jambu biji	Guava	LC	N/A	N/A	√	√
Fabaceae	*Samanea saman*	Trembesi	Rain tree	LC	N/A	N/A	√	√
Cyperaceae	*Scleria microcarpa*	-	Tropical nutrush	LC	N/A	N/A	√	
Fabaceae	*Senna siamea*	Johar	Kassoed tree	LC	N/A	N/A	√	√
Verbenaceae	*Stachytarpheta jamaicensis*	Pecut kuda	Blue porter weed	N/A	N/A	N/A	√	√
Meliaceae	*Swietenia mahagoni*	Mahoni	American mahagony	NT	II	N/A	√	√
Asteraceae	*Synedrella nodiflora*	Jotang kuda	Cinderella weed	N/A	N/A	N/A	√	√
Myrtaceae	*Syzygium cumini*	Duwet	Java plum	LC	N/A	N/A	√	√
Myrtaceae	*Syzygium* sp.	-	-	N/A	N/A	N/A	√	
Dioscoreaceae	*Tacca palmata*	Gadung tikus	-	N/A	N/A	N/A	√	
Lamiaceae	*Tectona grandis*	Jati	Teak	N/A	N/A	N/A	√	√
Malvaceae	*Urena lobata*	Pulutan	Caesarweed	LC	N/A	N/A	√	√
Zingiberaceae	*Zingiber zerumbet*	Lempuyang	Shampo ginger	DD	N/A	N/A	√	√

Table S2. List of fauna in the artisanal gold mining in Selogiri Sub-district, Wonogiri, Indonesia

Taxa	**Family**	**Scientific name**	**Indonesia name**	**English name**	**IUCN**	**CITES**	**P.106**	**Inside**	**Outside**
Avifauna	Phasianidae	*Gallus varius*	Ayam-hutan hijau	Green Junglefowl	LC	III	N/A	√	
Avifauna	Laniidae	*Lanius schach*	Bentet kelabu	Long-tailed Shrike	LC	III	N/A		√
Avifauna	Estrildidae	*Lonchura leucogastroides*	Bondol jawa	Javan Munia	LC	III	N/A	√	√
Avifauna	Estrildidae	*Lonchura punctulata*	Bondol peking	Scaly-breasted Munia	LC	III	N/A		√
Avifauna	Cuculidae	*Centropus bengalensis*	Bubut alang-alang	Lesser Coucal	LC	III	N/A	√	√
Avifauna	Passeridae	*Passer montanus*	Burung gereja	Eurasian Tree Sparrow	LC	III	N/A		√
Avifauna	Dicaeidae	*Dicaeum trochileum*	Cabai jawa	Scarlet-headed Flowerpecker	LC	III	N/A	√	√
Avifauna	Picidae	*Dendrocopos analis*	Caladi ulam	Fulvous-breasted Woodpecker	LC	III	N/A		√
Avifauna	Alcedinidae	*Halcyon cyanoventris*	Cekakak jawa	Javan Kingfisher	LC	III	N/A	√	√
Avifauna	Alcedinidae	*Todiramphus chloris*	Cekakak sungai	Collared Kingfisher	LC	III	N/A	√	√
Avifauna	Cisticolidae	*Orthotomus sepium*	Cinenen jawa	Olive-backed Tailorbird	LC	III	N/A		√
Avifauna	Cisticolidae	*Orthotomus sutorius*	Cinenen pisang	Common Tailorbird	LC	III	N/A	√	√
Avifauna	Aegithinidae	*Aegithina tiphia*	Cipoh kacat	Common Iora	LC	III	N/A	√	√
Avifauna	Pycnonotidae	*Pycnonotus aurigaster*	Cucak kutilang	Sooty-headed Bulbul	LC	III	N/A	√	√
Avifauna	Accipitridae	*Spilornis cheela*	Elang-ular bido	Crested Serpent-eagle	LC	II	Dilindungi	√	√
Avifauna	Turnicidae	*Turnix suscitator*	Gemak loreng	Barred Buttonquail	LC	III	N/A	√	√
Avifauna	Turnicidae	*Turnix sylvaticus*	Gemak tegalan	Common Buttonquail	LC	III	N/A		√
Avifauna	Cuculidae	*Phaenicophaeus curvirostris*	Kadalan birah	Chestnut-breasted Malkoha	LC	III	N/A	√	
Avifauna	Campephagidae	*Lalage nigra*	Kapasan kemiri	Pied Triller	LC	III	N/A		√
Avifauna	Rallidae	*Amaurornis phoenicurus*	Kareo padi	White-breasted Waterhen	LC	III	N/A		√
Avifauna	Artamidae	*Artamus leucoryn*	Kekep babi	White-breasted Woodswallow	LC	III	N/A		√
Avifauna	Campephagidae	*Coracina javensis*	Kepudang-sungu jawa	Large Cuckooshrike	LC	III	N/A	√	
Avifauna	Sturnidae	*Acridotheres javanicus*	Kerak kerbau	Javan Myna	VU	III	N/A	√	√
Avifauna	Meropidae	*Merops leschenaulti*	Kirik-kirik senja	Chestnut-headed Bee-eater	LC	III	N/A	√	
Avifauna	Ardeidae	*Egretta garzetta*	Kuntul kecil	Little Egret	LC	III	N/A		√
Avifauna	Ardeidae	*Bubulcus ibis*	Kuntul kerbau	Cattle Egret	LC	III	N/A		√
Avifauna	Nectariniidae	*Anthreptes malacensis*	Madu kelapa	Brown-throated Sunbird	LC	III	N/A		√
Avifauna	Nectariniidae	*Cinnyris jugularis*	Madu sriganti	Olive-backed Sunbird	LC	III	N/A	√	√
Avifauna	Pellorneidae	*Malacocincla sepiaria*	Pelanduk semak	Horsfield's Babbler	LC	III	N/A	√	
Avifauna	Cisticolidae	*Prinia inornata*	Perenjak padi	Plain Prinia	LC	III	N/A	√	√
Avifauna	Cisticolidae	*Geopelia striata*	Perkutut jawa	Bar-winged Prinia	LC	III	N/A	√	√
Avifauna	Alcedinidae	*Alcedo meninting*	Raja udang meninting	Blue-eared Kingfisher	LC	III	N/A		√
Avifauna	Campephagidae	*Pericrocotus cinnamomeus*	Sepah kecil	Small Minivet	LC	III	N/A	√	√
Avifauna	Muscicapidae	*Ficedula westermanni*	Sikatan belang	Little Pied Flycatcher	LC	III	N/A	√	
Avifauna	Dicruridae	*Dicrurus leucophaeus*	Srigunting kelabu	Ashy Drongo	LC	III	N/A	√	√
Avifauna	Megalaimidae	*Megalaima haemacephala*	Takur ungkut-ungkut	Coppersmith Barbet	LC	III	N/A	√	
Avifauna	Columbidae	*Spilopelia chinensis*	Tekukur biasa	Eastern Spotted Dove	LC	III	N/A	√	√
Avifauna	Apodidae	*Collocalia linchi*	Walet linchi	Cave Swiftlet	LC	III	N/A	√	√
Avifauna	Cuculidae	*Cacomantis merulinus*	Wiwik kelabu	Plaintive Cuckoo	LC	III	N/A	√	√
Avifauna	Cuculidae	*Cacomantis sepulcralis*	Wiwik uncuing	Brush Cuckoo	LC	III	N/A	√	
Odonata	Libellulidae	*Brachythemis contaminata*	Capung-Jemur Oranye	Ditch Jewel	LC	N/A	N/A	√	√

Odonata	Libellulidae	*Diplacodes trivialis*	Capung-Tengger Biru	Ground Skimmer	LC	N/A	N/A	√	√
Odonata	Libellulidae	*Lathrecista asiatica*	Capung-Tengger Merah Darah	Asiatic Blood Tail	LC	N/A	N/A		√
Odonata	Libellulidae	*Neurothemis terminata*	Capung-Jala Lurus	Straight Edge Red Parasol	LC	N/A	N/A	√	√
Odonata	Libellulidae	*Orthetrum chrysis*	Capung-Sambar Perut Kait	Spine Tufted Skimmer	LC	N/A	N/A		√
Odonata	Libellulidae	*Orthetrum pruinosum*	Capung-Sambar Merah	Crimson Tailed Marsh Hawk	LC	N/A	N/A	√	
Odonata	Libellulidae	*Orthetrum sabina*	Capung-Sambar Hijau	Green Marsh Hawk	LC	N/A	N/A	√	√
Odonata	Libellulidae	*Orthetrum testaceum*	Capung-Air Tawar Asia	Orange Skimmer	LC	N/A	N/A		√
Odonata	Libellulidae	*Pantala flavescens*	Capung-Kembara	Globe Skimmer	LC	N/A	N/A	√	√
Odonata	Libellulidae	*Potamarcha congener*	Capung-Sambar Perut Pipih	Yellow-Tailed Ashy Skimmer	LC	N/A	N/A	√	√
Odonata	Libellulidae	*Trithemis aurora*	Capung-Glider Rawa Merah	Crimson Marsh Glider	LC	N/A	N/A		√
Odonata	Libellulidae	*Trithemis festiva*	Capung-Glider Hitam	The Black Stream Glider	LC	N/A	N/A		√
Odonata	Coenagrionidae	*Agriocnemis femina*	Capung-Jarum Centil	Variable Wisp	LC	N/A	N/A	√	√
Odonata	Coenagrionidae	*Ischnura senegalensis*	Capung-Jarum Sawah	Marsh Bluetail, Senegal Golden Dartlet	LC	N/A	N/A	√	√
Odonata	Coenagrionidae	*Pseudagrion rubiceps*	Capung-Jarum Muka Jingga	Orange Faced Sprite	N/A	N/A	N/A		√
Odonata	Platycnemididae	*Copera marginipes*	Capung-Hantu Kaki Kuning	Yellow Featherlegs	LC	N/A	N/A	√	√
Lepidoptera	Pieridae	*Appias olferna*	-	Striped albatross	N/A	N/A	N/A	√	√
Lepidoptera	Pieridae	*Catopsilia pomona*	-	Lemon emigrant	N/A	N/A	N/A	√	√
Lepidoptera	Pieridae	*Catopsilia pyranthe*	-	Mottled emigrant	N/A	N/A	N/A	√	√
Lepidoptera	Pieridae	*Catopsilia scyla*	-	Orange emigrant	N/A	N/A	N/A	√	√
Lepidoptera	Pieridae	*Cepora iudith*	-	Orange gull	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Delias hyparete*	-	Painted jezebel	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Delias parasithoe*	-	Red-base jezebel	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Eurema blanda*	-	Three-spot grass yellow	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Eurema hecabe*	-	Common grass yellow	N/A	N/A	N/A	√	√
Lepidoptera	Pieridae	*Eurema laeta*	-	Spotless grass yellow	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Eurema brigitta*	-	Small grass yellow	N/A	N/A	N/A	√	√
Lepidoptera	Pieridae	*Gandaca harina*	-	Tree yellow	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Hebomoia glaucippe*	-	Great orange tip	N/A	N/A	N/A	√	
Lepidoptera	Pieridae	*Leptosia nina*	-	Psyche	N/A	N/A	N/A	√	√
Lepidoptera	Papilionidae	*Graphium agamemnon*	-	Tailed jay	N/A	N/A	N/A	√	√
Lepidoptera	Papilionidae	*Graphium sarpedon*	-	Common bluebottle	LC	N/A	N/A	√	
Lepidoptera	Papilionidae	*Graphium doson*	-	Common jay	N/A	N/A	N/A	√	
Lepidoptera	Papilionidae	*Pachliopta aristolochiae*	-	Common rose	LC	N/A	N/A	√	
Lepidoptera	Papilionidae	*Papilio demoleus*	-	Lime butterfly	N/A	N/A	N/A		√
Lepidoptera	Papilionidae	*Papilio demolion*	-	Banded swallowtail	N/A	N/A	N/A	√	
Lepidoptera	Papilionidae	*Papilio memnon*	-	Great mormon	N/A	N/A	N/A	√	
Lepidoptera	Papilionidae	*Papilio polytes*	-	Common mormon	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Acraea terpsicore*	-	Tawny coster	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Chersonersia rahria*	-	Great wavy maplet	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Cupha erymanthis*	-	Rustic	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Danaus chrysippus*	-	Plain tiger	LC	N/A	N/A		√
Lepidoptera	Nymphalidae	*Danaus genutia*	-	Common tiger	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Discophora sondaica*	-	Common duffer	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Elymnias hypermnestra*	-	Common palmfly	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Euploea climena*	-	Crow	N/A	N/A	N/A	√	

Lepidoptera	Nymphalidae	*Euploea eunice*	-	Blue-banded king crow	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Euploea mulciber*	-	Striped blue crow	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Euploea camaralzeman*	-	Malayan crow	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Euthalia aconthea*	-	Common baron	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Hypolimnas bolina*	-	Common eggfly	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Hypolimnas misippus*	-	Danaid eggfly	LC	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Ideopsis juventa*	-	Grey glassy tiger	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Junonia almana*	-	Peacock pansy	LC	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Junonia atlites*	-	Grey pansy	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Junonia erigone*	-	Northern argus	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Junonia hedonia*	-	Brown soldier	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Junonia iphita*	-	Chocolate pansy	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Junonia orithya*	-	Blue pansy	LC	N/A	N/A		√
Lepidoptera	Nymphalidae	*Melanitis leda*	-	Common evening brown	LC	N/A	N/A		√
Lepidoptera	Nymphalidae	*Melanitis phedima*	-	Dark evening brown	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Melanitis zitenius*	-	Great evening brown	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Mycalesis horsfieldii*	-	Horsfield's bushbrown	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Mycalesis perseus*	-	Dingy bushbrown	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Mycalesis sudra*	-	Bushbrown	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Neptis hylas*	-	Common sailor	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Orsotriaena medus*	-	Niger	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Pantoporia hordonia*	-	Common lascar	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Parantica aspasia*	-	Yellow grassy tiger	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Phaedyma columella*	-	Short-banded sailor	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Polyura athamas*	-	Common nawab	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Symbrenthia lilaea*	-	Common jester	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Tanaecia palguna*	-	Baron	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Tirumala limniace*	-	Blue tiger	N/A	N/A	N/A	√	
Lepidoptera	Nymphalidae	*Tirumala septentionis*	-	Dark blue tiger	N/A	N/A	N/A		√
Lepidoptera	Nymphalidae	*Yoma sabina*	-	Australian lurcher	N/A	N/A	N/A	√	√
Lepidoptera	Nymphalidae	*Ypthima pandocus*	-	Common three-ring	N/A	N/A	N/A	√	√
Lepidoptera	Lycaenidae	*Anthene emolus*	-	Ciliate blue	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Castalius rosimon*	-	Common pierrot	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Catochrysop panormus*	-	Silver forget-me-not	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Chilades pandava*	-	Plains cupid	N/A	N/A	N/A		√
Lepidoptera	Lycaenidae	*Cupido lacturnus*	-	Tailed cupid	N/A	N/A	N/A		√
Lepidoptera	Lycaenidae	*Heliophorus epicles*	-	Purple sapphire	N/A	N/A	N/A	√	√
Lepidoptera	Lycaenidae	*Ionolyce helicon*	-	Pointed linblue	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Lampides boeticus*	-	Pea blue	LC	N/A	N/A		√
Lepidoptera	Lycaenidae	*Loxura atymnus*	-	Yamfly	N/A	N/A	N/A	√	√
Lepidoptera	Lycaenidae	*Pithecops corvus*	-	Forest quaker	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Prosotas dubiosa*	-	Tailess lineblue	N/A	N/A	N/A	√	√
Lepidoptera	Lycaenidae	*Surendra vivarna*	-	Acacia blue	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Zizeeria karsandra*	-	Dark grass blue	N/A	N/A	N/A	√	√
Lepidoptera	Lycaenidae	*Zizina otis*	-	Common grass blue	LC	N/A	N/A	√	

Lepidoptera	Lycaenidae	*Zizula hylax*	-	Tiny grass blue	LC	N/A	N/A		√
Lepidoptera	Hesperiidae	*Ampittia dioscorides*	-	Common bush hopper	N/A	N/A	N/A		√
Lepidoptera	Hesperiidae	*Borbo cinnara*	-	Rice swift	N/A	N/A	N/A		√
Lepidoptera	Hesperiidae	*Caprona agama*	-	Spotted angel	N/A	N/A	N/A		√
Lepidoptera	Hesperiidae	*Pelopidas mathias*	-	Small banded swift	LC	N/A	N/A	√	
Lepidoptera	Hesperiidae	*Potantus omaha*	-	Lesser dart	N/A	N/A	N/A	√	√
Lepidoptera	Hesperiidae	*Tagiades japetus*	-	Common snow flat	N/A	N/A	N/A	√	√
Lepidoptera	Hesperiidae	*Taractrocera nigrolimbata*	-	Grass dart	N/A	N/A	N/A		√
Lepidoptera	Hesperiidae	*Telicota colon*	-	Common palm dart	N/A	N/A	N/A	√	
Lepidoptera	Hesperiidae	*Udaspes folus*	-	Grass demon	N/A	N/A	N/A	√	
Lepidoptera	Lycaenidae	*Yasoda pita*	-	Branded yamfly	N/A	N/A	N/A	√	
Mamalia	Muridae	*Rattus tanezumi*	Tikus Rumah	Oriental House Rat	LC	N/A	N/A		√
Mamalia	Muridae	*Rattus tiomanicus*	Tikus Pohon	Malaysian Field Rat	LC	N/A	N/A		
Mamalia	Muridae	*Mus musculus*	Mencit	Eastern house mouse	LC	N/A	N/A		√
Mamalia	Muridae	*Bandicota bengalensis*	Tikus Wirok	Lesser bandicot rat	LC	N/A	N/A		√
Mamalia	Sciuridae	*Callosciurus notatus*	Bajing	Plantain squirrel	LC	N/A	N/A	√	√
Mamalia	Cercopithecidae	*Macaca fascicularis*	Monyet Ekor Panjang	Crab-eating Macaque	VU	II	N/A	√	
Mamalia	Herpestidae	*Herpestes javanicus*	Garangan Jawa	Indian Mongoose	LC	III	N/A		√
Mamalia	Tupaiidae	*Tupaia javanica*	Tupai Jawa	Horsfield s Treeshrew	LC	II	N/A	√	√
Mamalia	Viverridae	*Paradoxurus hermaphroditus*	Musang	Asian Palm Civet	LC	III	N/A		√
Herpetofauna	Agamidae	*Bronchocela jubata*	Bunglon Surai	Maned forest lizard	LC	N/A	N/A	√	√
Herpetofauna	Elapidae	*Bungarus candidus*	Ular Weling	Malayan krait	LC	N/A	N/A	√	
Herpetofauna	Colubridae	*Dendrelaphis pictus*	Ular Tambang	Painted bronzeback	N/A	N/A	N/A	√	√
Herpetofauna	Agamidae	*Draco volans*	Cekibar	Common flying dragon	LC	N/A	N/A	√	
Herpetofauna	Bufonidae	*Duttaphrynus melanostictus*	Bangkong kolong	Asian common toad	LC	N/A	N/A	√	√
Herpetofauna	Homalopsidae	*Enhydris plumbea*	Ular air kelabu	Rice paddy snake	LC	N/A	N/A	√	
Herpetofauna	Scincidae	*Eutropis multifasciata*	Bengkarung/Kadal Kebun	Many-striped Skink	LC	N/A	N/A	√	√
Herpetofauna	Dicroglossidae	*Fejervarya cancrivora*	Katak sawah	Crab-eating frog	LC	N/A	N/A	√	√
Herpetofauna	Dicroglossidae	*Fejervarya limnocharis*	Katak Tegalan	Asian grass frog	LC	N/A	N/A	√	√
Herpetofauna	Gekkonidae	*Gecko gecko*	Tokek Rumah	Tokay gecko	LC	N/A	N/A	√	√
Herpetofauna	Gekkonidae	*Hemidactylus frenatus*	Cecak Kayu	Common house gecko	LC	N/A	N/A	√	√
Herpetofauna	Gekkonidae	*Hemidactylus platyurus*	Cecak Tembok	Flat-tailed house gecko	N/A	N/A	N/A	√	√
Herpetofauna	Ranidae	*Hylarana chalconota*	Kongkang Kolam jawa	Southest Asian White-lipped Frog	LC	N/A	N/A	√	
Herpetofauna	Microhylidae	*Kaloula baleata*	Belentung	Javanese Bullfrog complex	LC	N/A	N/A	√	
Herpetofauna	Microhylidae	*Microhyla achatina*	Percil Jawa	Java rice frog	LC	N/A	N/A	√	√
Herpetofauna	Dicroglossidae	*Occidozyga sumatrana*	Bancet Rawa	Sumatran puddle frog	N/A	N/A	N/A	√	
Herpetofauna	Rhacophoridae	*Polypedates leucomystax*	Katak Pohon Bergaris	Common tree frog	LC	N/A	N/A	√	√
Herpetofauna	Colubridae	*Ptyas mucosa*	Bandotan macan	Oriental ratsnake	N/A	II	N/A		√
Herpetofauna	Colubridae	*Rhabdophis subminiatus*	Ular Picung	Red-necked keelback snake	LC	N/A	N/A	√	
Herpetofauna	Varanidae	*Varanus salvator*	Biawak air	Asian water monitor	LC	II	N/A		√
Herpetofauna	Colubridae	*Xenochrophis vittatus*	Ular Lare Angon/Ular Kisik	Striped keelback	LC	N/A	N/A		√