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AVIFAUNA DIVERSITY IN THE MINING AREA OF PT ADARO INDONESIA

Gunawan*
Department of Biology, Faculty of Mathematics and Natural Sciences,
University of Lambung Mangkurat, Banjarbaru, South Kalimantan, Indonesia

Khoerul Anwar
Department of Pharmacy, Faculty of Mathematics and Natural Sciences,
University of Lambung Mangkurat, Banjarbaru, South Kalimantan, Indonesia

Didik Triwibowo
PT Adaro Indonesia, Tabalong, Indonesia

*E-mail: gunawan@ulm.ac.id

ABSTRACT
The initial environmental condition or initial environmental hue is very important to know before land clearing activities for mining begin. The objective of the research was to record Avifauna diversity in the PT Adaro Indonesia project site area, Tabalong Regency. Avifauna data were collected from nine locations. The animals recorded are birds, butterflies, and dragonflies. Bird monitoring in the observation point area used the point count method combined with the transect method. Observations of butterflies and dragonflies also used the transect method. A total of 32 bird species were found with 308 encounters. Based on observations, 18 species of butterflies were found, with a total number of 367 butterflies. Observations on the dragonfly conducted in the survey area have encountered 18 species of dragonflies with 278 encounters. Each observation location has different avifauna diversity due to different types of vegetation. This initial hue is given as a consideration in the development of the area, especially in the aspects of biodiversity and environmental services. By using the initial environmental hue, land clearing activities can be measured properly.

KEY WORDS
Avifauna, biodiversity, mining area.

Mining clearance activities can have negative impacts on the environment and biodiversity. These activities can damage habitats, flora and fauna, germplasm, water systems, reduce land productivity, and threaten the survival of species in these habitats. Mining activities are usually carried out by clearing forests, eroding soil layers, dredging and stockpiling (Abubakar, 2009; Delvian, 2004, Muhdi et al., 2012).

Reclamation (revegetation) has been done to overcome the problem of damage or land changes due to mining activity (Mukhtar and Heriyanto, 2012). The goal is not only to improve unstable and unproductive land and reduce surface erosion, but also in the long term is expected to improve the microclimate, restore biodiversity and improve land conditions to a more productive direction. Post-mining critical land rehabilitation activities must, in principle, be conservative, namely activities to help accelerate the natural succession process towards increasing the diversity of local flora, as well as saving and utilizing potential flora species that have become rare. The success of reclamation can be seen from the green space, hydrological function and diversity of flora and fauna in the former mining area.

The initial environmental condition or initial environmental hue is very important to know before land clearing activities for mining begin. The identification of the initial environmental hue aims to determine the environmental conditions before mining activities and to estimate the condition of the environmental hue after the activity. In addition, the

purpose of identifying the initial environmental hue is intended to assess the quality of the existing environment and the environmental impact of the activity plan, identify important environmental factors or certain geographic areas so as to prevent bad environmental risks, provide information to decision makers who are not familiar with the location of the activity plan, and provide information as a basis for determining the fulfillment of activity needs.

PT Adaro Indonesia is one of the coal mining companies in Indonesia located in Tabalong Regency, South Kalimantan. In this study, an initial environmental overview was conducted, especially avifauna diversity in the PT Adaro Indonesia project site area, Tabalong Regency. This initial hue is given as a consideration in the development of the area, especially in the aspects of biodiversity and environmental services. By using the initial environmental hue, land clearing activities can be measured properly.

MATERIALS AND METHODS OF RESEARCH

Avifauna data were collected from nine locations (Table 1, Figure 1) on June 2-9, 2023. The animals recorded are birds, butterflies, and dragonflies. Bird monitoring in the observation point area used the point count method combined with the transect method. At each observation point, 15 points were made along transect with an observation radius of 50 meters and a distance of 150 meters between points. The time required for observation at each point is 15 minutes. Every bird species found at each point in the observation path according to a certain radius was recorded with all forms of activity. The duration of observation at each point was 15 minutes. Data recorded at each observation point included time of encounter, Indonesian name of species observed, type of encounter, number of individuals observed, and activity observed. Observations were conducted by 2 people: 1 person as an observer, and 1 person as a recorder. The birds found were then identified using Akbar *et al.*, 2020 and MacKinnon *et al.*, 2010.

Observations of butterflies and dragonflies in the PT Adaro Indonesia mine area also used the transect method. Transects were placed at each predetermined observation point with a length of 1 km. The parameters observed were species and number of individuals. Each species was documented and then identified directly in the field. Unidentified species were collected using insect nets and then identified in more detail at the Animal Biosystematics Laboratory, Basic Laboratory, FMIPA ULM by matching the patterns of the abdomen, thorax, and wing venation using an identification guidebook. Identification of butterflies using butterflies using Baskoro *et al.*, 2018; Schize, 1999; and Kirton, 2021; and dragonflies identification using Rahadi, 2013; Irawan & Rahadi, 2016; and Baskoro *et al.*, 2018a.

Table 1 – Avifauna monitoring locations

No.	Location	Land Size (ha)	Types of Vegetation
1	L1 (SP 6C LW)	40,43	Original forest
2	L2 (SP 4 Wara)	86,53	Oil palm fields
3	L3 (SP 2B Wara)	55,17	Original forest
4	L4 (North Perimeter)	155,84	Original forest
5	L5 (PAAP)	55,93	Original forest
6	L6 (SP 10B HW)	114,52	Original forest
7	L7 (SP 6C HW)	22,06	Original forest
8	L8 (SP 2D HW)	53,21	Oil palm fields
9	L9 (SP 13 C HW)	151,13	Original forest

The species list of each taxa is equipped with a national protection description referring to the regulation of the Minister of Environment and Forestry of the Republic of Indonesia number P.106/MENLHK/SETJEN/KUM.1/6/2018 (Kementerian Lingkungan Hidup, 2018), rarity criteria, and population status internationally refers to the IUCN Redlist (IUCN, 2021).

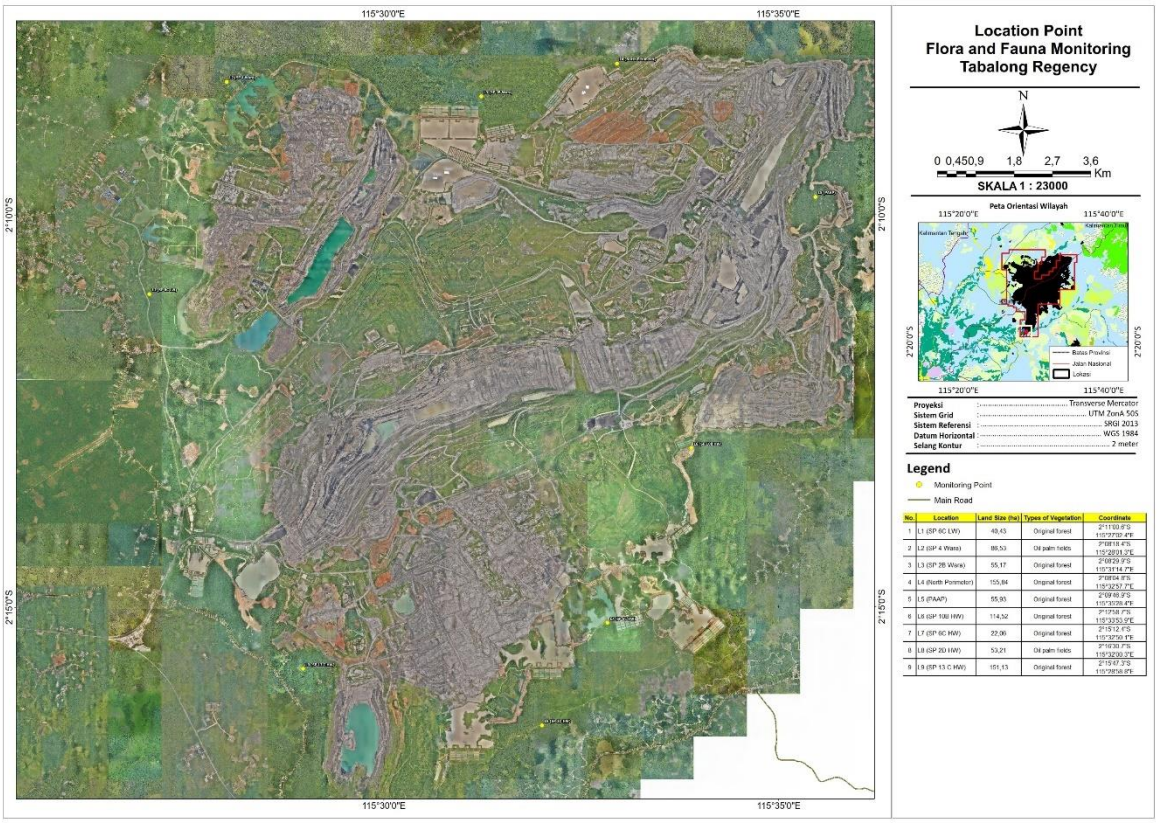

Figure 1 – Location point flora and fauna monitoring, Tabalong regency, Indonesia

RESULTS AND DISCUSSION

Based on bird observations at the survey sites, a total of 32 bird species were found with 308 encounters. Birdwatching and recording were done by listening to bird sounds and watching birds directly. Bird sounds were the first clue to the presence of birds, and to confirm the species, observations were made using binoculars. Most birds were encountered by sight after hearing the birds voice (Table 2). The birds encountered were engaged in various activities at the time of observation. Most birds were in flight when observed, then roosting, or resting, while birds that were only encountered by hearing sounds and not being seen, their activities were unknown.

Table 2 – Comparison of data of birds in each observation area

Category	Location								
	L1	L2	L3	L4	L5	L6	L7	L8	L9
Total species type	11	11	11	11	12	11	10	11	8
The Shannon-Wiener diversity index (H')	2.33	2.27	2.31	2.31	2.32	2.64	2.06	2.25	1.76
Total species recorded	33	31	36	35	39	46	27	33	28
Voice encounter (%)	81.82	80.65	77.14	80.43	81.48	80.43	81.48	78.79	78.57
Direct encounter (%)	18.18	19.35	22.86	19.57	18.52	19.57	18.52	21.21	21.43

The highest number of bird encounters was found in area L6 with 46 encounters. The location with the fewest bird encounters was in area L7 with 27 encounters. The L6 area has a large number of plant species compared to other observation areas. There is a link between plant species abundance and bird species variation and abundance. When forest structure is established and provides food abundance, microclimate changes, it will have a direct impact on community structure and bird species variation (Hashim & Ramli, 2013; Yap *et al*., 2007). Davidar et al. (2001) further interpreted that the more diverse the habitat, the more birds will live in that habitat (keystone habitat).

Table 3 – List of birds encountered at the observation site

No.	Species	Total Encounter	Conservation Status		
			P. 106/ 2018	IUCN	Population Trend
1	*Apus affinis*	5	Not protected	Least concern	Increasing
2	*Arachnothera longirostra*	1	Not protected	Least concern	Stable
3	*Cacomantis merulinus*	8	Not protected	Least concern	Stable
4	*Caprimulgus indicus*	12	Not protected	Least concern	Stable
5	*Centropus sinensis*	11	Not protected	Least concern	Stable
6	*Collocalia vestita*	18	Not protected	Not available	Unknown
7	*Dicaeum trochileum*	4	Not protected	Least concern	Stable
8	*Gallinago megala*	9	Not protected	Least concern	Unknown
9	*Geopelia striata*	9	Not protected	Least concern	Stable
10	*Gerygone sulphurea*	8	Not protected	Least concern	Decreasing
11	*Halcyon smyrnensis*	27	Not protected	Least concern	Increasing
12	*Hemipus hirundinaceus*	7	Not protected	Least concern	Decreasing
13	*Hirundo tahitica*	11	Not protected	Least concern	Unknown
14	*Lacedo pulchella*	11	Not protected	Least concern	Decreasing
15	*Lalage nigra*	16	Not protected	Least concern	Decreasing
16	*Lanius schach*	16	Not protected	Least concern	Unknown
17	*Leptocoma spirata*	2	Not protected	Not evaluated	Unknown
18	*Merops viridis*	5	Not protected	Least concern	Stable
19	*Mixornis gularis*	6	Not protected	Least concern	Stable
20	*Oculocincta squamifrons*	3	Not protected	Least concern	Decreasing
21	*Orthotomus ruficeps*	6	Not protected	Least concern	Stable
22	*Orthotomus sericeus*	4	Not protected	Least concern	Stable
23	*Passer domesticus*	5	Not protected	Least concern	Decreasing
24	*Prinia flaviventris*	26	Not protected	Least concern	Decreasing
25	*Prinia inornata*	28	Not protected	Least concern	Stable
26	*Pycnonotus aurigaster*	8	Not protected	Least concern	Decreasing
27	*Pycnonotus bimaculatus*	4	Not protected	Least concern	Decreasing
28	*Pycnonotus goiavier*	2	Not protected	Least concern	Increasing
29	*Sturnus contra*	7	Not protected	Not evaluated	Unknown
30	*Todiramphus cholris*	9	Not protected	Not available	Unknown
31	*Treron vernans*	8	Not protected	Least concern	Stable
32	*Zosterops palpebrosus*	12	Not protected	Least concern	Decreasing
Total		308			

The number of understory species found in each habitat type basically illustrates the level of complexity of the ecological function of the habitat type, especially as a bird habitat. In this case, it is related to the availability of habitat components that are important for the sustainability of bird life such as food, nest sites, shelter for resting places and cover to avoid predator attacks. This implies that the greater the diversity of plant species that make up an ecosystem will have an impact on the stability of the ecosystem (Srivastava & Vellend 2005), thus the diversity of the number of lower vegetation species found in each habitat type can represent a general description of the stability of the ecosystem or habitat type. In other words, a high diversity of understory and understory species will result in more availability of habitat functions.

Area L9 has the lowest diversity index value with an H' value of 1.76 which means it has a medium level of diversity. The L6 area has a high diversity value with a value of 2.64 which is included in the high diversity category. This can also be seen from the number of bird species in the L5 area which is the highest among other areas with 12 bird species and 46 records. This indicates that this area is suitable for bird habitat.

Based on their protection status, which refers to the regulation of the Minister of Environment and Forestry of the Republic of Indonesia number P.106/MENLHK/SETJEN/KUM.1/6/2018, all bird species found are not protected. Likewise, all bird species found are included in the IUCN red list with 28 species included in the least concern criteria (low risk), 2 species included in the not evaluated criteria, and 2 species has no available data (Table 3).

Based on observations at the designated locations, 18 species of butterflies were found, with a total number of 367 butterflies. The L7 area is the area where the most butterflies are found, namely 86 butterflies. Meanwhile, the area with the least number of butterflies was the L8 area, where only 14 butterflies were found (Table 4).

The composition of butterfly species found in each plot type is different. Differences in species composition and richness are thought to be related to the different characteristics of each plot type. The characteristics in question are the size of the plot area and the availability of butterfly food plants.

The existence of butterflies in nature is strongly influenced by the presence of host plants. Some butterfly species have specific types of host plants to lay their eggs. The existence of host plants is strongly influenced by habitat conditions (Peggie & Harmonis 2014). Butterfly habitats are primary forests, secondary forests, and heterogeneous plantation areas. Changes in habitat structure will affect butterfly species diversity (Nidup et al. 2014). Therefore, butterflies can be used as bioindicators of environmental damage (Brown & Freitas 2000).

The distribution of butterflies in an area is influenced by geography, the ability of species to spread and different habitat preferences. Generally, butterflies prefer open areas or habitat types with less dense canopy cover. Butterflies require sunlight to aid wing movement. The movement (migration) of butterfly populations from one place to another can be caused by climatic factors that are less suitable in the old habitat or the amount of food that is reduced in certain seasons (Parsons, 1999).

Table 4 – Comparison of data of butterflies in each observation area

Category	Location								
	L1	L2	L3	L4	L5	L6	L7	L8	L9
Total species type	8	10	7	6	10	11	9	4	6
The Shannon-Wiener diversity index (H')	1.88	2.16	1.73	1.75	2.10	2.23	2.13	1.17	1.60
Total species recorded	27	60	58	16	38	46	86	14	22

Based on the analysis of the Shanonn Wienner index, the level of butterfly diversity in some observation areas is low (H'<2). This is likely due to the low diversity of flowering plants contained in the observation plot. However, some locations have high butterfly diversity such as L2, L5, L6, and L7 area.

Some plant species visited by butterflies in the observation location are *Chromolaena odorata*, *Mikania micrantha*, *Macaranga* Sp., *Centrosema pubescens*, *Melastoma malabathricum*, *Imperata cylindrica*, *Paspalum conjugatum*, *Lantana camara*, *Calliandra calothyrsus*, *Costus* Sp., and *Mimosa pudica*. The presence of butterflies in an ecosystem is strongly influenced by the availability of food in the ecosystem. Food for butterfly larvae and imago varies depending on the butterfly species. Imago butterflies need nectar as their main food to fulfill their energy needs. One of the activities of butterflies to find their food is by searching for flowers, finding and sucking nectar using the proboscis (Schoonhoven et al. 2005).

Based on its protection status which refers to the regulation of the Minister of Environment and Forestry of the Republic of Indonesia number P.106 / MENLHK / SETJEN / KUM.1 / 6/2018 all butterfly species found are not protected. Likewise, all butterfly species found are included in the IUCN red list. Three species were categorized as Least Concern (low risk) and fifteen species were not available (Table 5).

Observations on the dragonfly fauna conducted in the survey area have encountered 18 species of dragonflies. The L3 area was the most common area with 58 dragonfly encounters. The survey area that had the lowest number was the location of L9 area with 18 dragonfly encounters (Table 6).

Dragonflies are one of the insects that have an important role for the sustainability of the ecosystem, namely acting as predators and indicators of environmental pollution. The presence of dragonflies in an environment can be used as an indication of environmental conditions. Dragonflies are also closely related to the availability of vegetation, so both richness and abundance are strongly influenced by the presence of vegetation. The presence of good vegetation allows dragonflies to carry out various daily activities such as eating, basking, and reproducing (Janra, 2018; Julaika et al., 2018). The presence of this vegetation affects the intensity of light entering an area. The more light intensity that penetrates the canopy, the more types of brightly colored dragonflies will be.

Table 5 – List of butterflies encountered at the observation site

No.	Species	Total Encounter	Conservation Status		
			P. 106/ 2018	IUCN	Population Trend
1	*Appias libythea*	13	Not protected	Not available	Unknown
2	*Appias nero*	18	Not protected	Not available	Unknown
3	*Athima pravara*	7	Not protected	Not available	Unknown
4	*Catopsilia pyranthe*	8	Not protected	Not available	Unknown
5	*Euploea core*	11	Not protected	Least concern	Unknown
6	*Eurema alitha*	22	Not protected	Least concern	Stable
7	*Eurema blanda*	91	Not protected	Not available	Unknown
8	*Heliconius charithonia*	11	Not protected	Not available	Unknown
9	*Hypolimas bolina*	3	Not protected	Not available	Unknown
10	*Jamides alecto*	16	Not protected	Not available	Unknown
11	*Lethe confusa*	16	Not protected	Not available	Unknown
12	*Morpho peledes*	5	Not protected	Not available	Unknown
13	*Mycalesis janardana*	4	Not protected	Least concern	Unknown
14	*Neptis columella*	2	Not protected	Not available	Unknown
15	*Papilio polytes*	22	Not protected	Not available	Unknown
16	*Syproeta stelenes*	56	Not protected	Not available	Unknown
17	*Vanessa atlanta*	1	Not protected	Not available	Unknown
18	*Ypthima pandocus*	61	Not protected	Not available	Unknown
Total		367			

Table 6 – Comparison of data of dragonflies in each observation area

Category	Location								
	L1	L2	L3	L4	L5	L6	L7	L8	L9
Total species type	8	8	8	8	8	7	11	8	6
The Shannon-Wiener diversity index (H')	1.99	2.02	2.25	1.86	2.05	2.43	2.33	1.97	1.75
Total species recorded	27	30	58	26	25	31	38	25	18

The index value of dragonfly diversity in each observation area is presented in Table 21. The L6 area has the highest diversity index with a value of 2.43. This is positively correlated with the diversity of plants in the area. Other locations with high H' > 2 are the areas of L2, L5, and L7, while other locations have low diversity values (H'<2).

There are several factors that influence the presence and distribution of dragonflies. The main factors are influenced by food resources and habitat. According to McPeek (2008), several factors that limit the presence and distribution of dragonflies in a habitat are habitat type, food availability, and interactions related to the dragonfly life cycle. All of these factors are interconnected and influence each other.

Table 7 – List of butterflies encountered at the observation site

No.	Species	Total Encounter	Conservation Status		
			P. 106/ 2018	IUCN	Population Trend
1	*Anotogaster sieboldii*	13	Not protected	Least concern	Stable
2	*Diplacodes trivialis*	22	Not protected	Least concern	Stable
3	*Neurothemis ramburii*	30	Not protected	Least concern	Stable
4	*Neurothemis terminate*	65	Not protected	Not available	Unknown
5	*Orthetrum chrysis*	31	Not protected	Least concern	Unknown
6	*Orthetrum glaucum*	20	Not protected	Least concern	Unknown
7	*Orthetrum Sabina*	20	Not protected	Least concern	Stable
8	*Pantala Flavescens*	28	Not protected	Least concern	Stable
9	*Potamarcha congener*	25	Not protected	Least concern	Unknown
10	*Rhyothemis phyllis*	17	Not protected	Least concern	Stable
11	*Vestalis luctuosa*	2	Not protected	Least concern	Deceasing
12	*Zygoptera*	5	Not protected	Least concern	Unknown
Total		278			

Based on their protection status, which refers to the regulation of the Minister of Environment and Forestry of the Republic of Indonesia number P.106/MENLHK/SETJEN/KUM.1/6/2018, all dragonfly species found are not protected. Likewise, all dragonfly species found are included in the IUCN red list. All dragonfly species are categorized as Least Concern (low risk) (Table 7).

Factors that influence the presence of animals are natural factors (season, natural conditions, drought, strong winds, vegetation conditions, and the presence of flowers and fruits) and human activities (mining activities, plantations, agriculture, and traffic). The presence of animals cannot be separated from the presence of plants and also people's behavior. In addition to the environmental atmosphere created by plants, the source of biological food is the reason why animals are present in a place. Hunting and poisoning are factors that can determine the presence and death of animals. Dynamics in the environment inevitably have an impact on changes in animals, both in terms of the number of individuals and the number of species.

CONCLUSION

A total of 32 bird species were found with 308 encounters. Based on observations, 18 species of butterflies were found, with a total number of 367 butterflies. Observations on the dragonfly conducted in the survey area have encountered 18 species of dragonflies with 278 encounters. Each observation location has different avifauna diversity due to different types of vegetation. This initial hue is given as a consideration in the development of the area, especially in the aspects of biodiversity and environmental services.

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