The Diversity, Distribution and Feeding Guild of Mammals and Birds in Institut Teknologi Sumatera (ITERA) Landscape

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Abstract. ITERA was established in 2014 and caused a landscape conversion from a rubber plantation into a construction area. Changes in a landscape usually affect wildlife biodiversity such as mammals and birds. The objective of this research is to identify and to determine the diversity, distribution, and feeding guilds of mammal and bird species. A survey of mammals and birds in the ITERA landscape has conducted between April and September 2019. This research used line transect and trapping method for mammals. The combination of point count and transect method used for birds observation. ITERA Landscape divided into six transects. This research found three species mammals belonging to three families. C. notatus only found in rubber stands. 67% of terrestrial mammals and all feeding guilds are omnivorous. This research found 814 encounters of birds consisting of 28 species belonging to 18 families. Species with the highest dominance are Lonchura punctulata, and the dominant family is Ardeidae. Elanus caeruleus and Ardea alba are a protected species which stated in Indonesia regulation. The transect that has the highest species richness is transect 6 with 22 species, and transect 1 with 21 species. The highest stratification used for foraging of birds community is terrestrial, and the highest feeding guild is insectivorous.

1. Introduction

Biodiversity is a term that encompasses all forms of life and has an important role. Biodiversity is an attribute of landscape and specifically refers to the variety of living organisms, assemblages of living organisms, and biotic communities, whether naturally occurring or modified by humans [1]. Mammal and Bird are a part of living organisms that has an essential role in ecological dynamics, ecosystem stabilization, food chain stabilization, pollination, seed dispersal agent, ectomycorrhizae, and predator of pest [2]. Moreover, they have a benefit for human life, such as for research object, education, tourism, environment indicator, protein source, aesthetic value, and economic [3].

Ecological studies learned about the interaction between organisms to survive by considering the environmental condition [4]. In the ecosystem, there is a relationship of interdependence between biotic and abiotic factors that affect species composition [5]. The landscape of Institut Teknologi Sumatera (ITERA) South Lampung, Indonesia originated from rubber plantations, which were converted and functioned into a 285 ha of education area in 2012. Land-use change has resulted in significant impacts on biodiversity, such as changes in plant species composition and the richness of birds [6, 7]. Land-use change will have an impact on biodiversity conditions, including mammals and birds.
"Smart, Friendly, and Forest Campus" is the tagline and concept development of ITERA. Assessment of biodiversity, including mammals and birds, will be closely linked to forest tagline campus because it can be used as a data control and a tool to analyze biodiversity trends on the ecology of the ITERA landscape. In addition, the ecological database is necessary to realize the concept of development in line with greenways, green networks, green infrastructure, and ecological networks to bridge the simultaneous development with conservation activities. However, scientific reports on the formation of new ecosystems in ITERA have not been reported. Therefore, the objective of this study was to analyze diversity, distribution, and feeding guilds of mammals and birds in ITERA.

2. Methods

2.1. Study Area
The study was conducted from April to September 2019 in Institut Teknologi Sumatera (ITERA) Landscape (Figure 1). The size of ITERA’s study area is 285 ha. Data were collected along ±1,3km transect, in total six transects. In each transect, the observation repeated three times.

![Figure 1 Study area in Institut Teknologi Sumatera, Lampung](image)

2.2. Data Collection
The observation started at 06.00-08.00 a.m and 04.00-06.00 p.m. Mammals observation was carried out using the transect method. Inventory of small mammals (rodents) was carried out by the trapping method. Trapping method used ten traps in each transect with a total of 60 traps in all areas and repeated two times. Inventory of birds implemented using a combination of point count and transect method. The observation time is 10 minutes at each point.

2.3. Data Analysis
a) Shannon-Wiener Species Diversity Index: \[ H' = - \sum pi \ln pi. \]
Note: \( H' \) = Species diversity index
\( pi \) = Species richness \((ni/Ni)\)
b) Species Dominance Index: \( Di (%) = \frac{N_i}{N} \times 100\% \).

Note: 
\( Di \) = Species domination index  
\( N_i \) = Total individual per each species  
\( N \) = Total individual species

c) Index of Similarity, Distribution, and Feeding Guilds

The index of similarity between transects examined to analyze the interrelationships between transects based on species composition. Index of similarity between transect calculated using Bray-Curtis formula. The distributions map of mammals and birds obtained using ArcGIS online, license organizational account of Lea_Itera and organization name of Esri Indonesia Smart Community. Feeding Guild Analysis is based on the literature of feed bioecology and strengthened by field observations.

3. Result and Discussion

3.1. Diversity of Mammals and Birds

Three species of mammals from 3 families found within the study area. *Callosciurus notatus* and *Rattus tiomanicus* found in the transect, and *Suncus murinus* catch with trapping method. *C. notatus* from the Sciuridae family found two times and only found in the rubber plantations area. *C. notatus* is an arboreal species that can live in tree plantations such as palm oil, rubber, and albizzia [8]. *R. tiomanicus* found in the area of cultivation which has short vegetation, whereas *S. murinus* found in shrubs and cultivation areas.

ITERA has 28 bird species from 17 families (Table 1) with a diversity index (H') 1.84 which has a higher bird diversity compared to the UIN Raden Intan Lampung (UIN-RIL). UIN-RIL has 24 species of birds from 16 families [9]. Species with the highest dominance were *Lonchura punctulata* (54%), *Passer montanus* (10.5%) and *Hirundo tahitica* (7.5%). *L. punctulata* has the highest dominance because it is often found and has the highest number of individuals. Based on [10], *L. punctulata* is a bird that has a high abundance and belongs to the general bird which is often found in open areas. *P. montanus* and *H. tahitica* are cosmopolitan species which has a wide distribution and high adaptability in various habitats. These types of species usually live in association with humans and living in groups around the residential areas [11].

| No | Scientific Name       | Family         | No | Scientific Name       | Family         |
|----|-----------------------|----------------|----|-----------------------|----------------|
| 1  | *Elanus caeruleus*    | Accipitridae   | 15 | *Hirundo tahitica*   | Hirundinidae   |
| 2  | *Halcyon smyrnensis*  | Alcedinidae    | 16 | *Lanius schach*      | Laniidae       |
| 3  | *Todiramphus chloris* | Alcedinidae    | 17 | *Anthus novaeseelandiae* | Motacillidae  |
| 4  | *Collocalia linchi*   | Apodidae       | 18 | *Lonchura leucogastroides* | Ploceidae     |
| 5  | *Ixobrychus cinnamomeus* | Ardeidae  | 19 | *Lonchura punctulata* | Ploceidae      |
| 6  | *Ardeola speciosa*    | Ardeidae       | 20 | *Passer montanus*     | Ploceidae      |
| 7  | *Ardea alba*          | Ardeidae       | 21 | *Pycnonotus aurigaster* | Pycnonotidae   |
| 8  | *Ardea purpurea*      | Ardeidae       | 22 | *Pycnonotus goiavier* | Pycnonotidae   |
| 9  | *Artamus leucorynchus* | Artamidae     | 23 | *Amaurornis phoenicurus* | Rallidae     |
| 10 | *Caprimulgus affinis* | Caprimulgidae  | 24 | *Gallirallus striatus* | Rallidae      |
| 11 | *Geopelia striata*    | Columbidae     | 25 | *Cisticola juncidis*  | Silviidae      |
| 12 | *Streptopelia chinensis* | Columbidae  | 26 | *Orthotomus ruficeps* | Silviidae      |
| 13 | *Centropus bengalensis* | Cuculidae    | 27 | *Acridotheres tristis* | Sturniidae    |
| 14 | *Cacomantis sonneratii* | Cuculidae  | 28 | *Turnix suscitator*   | Turnicidae     |
Ardeidae and Ploceidae are the dominant families. Ardeidae family consists of *I. cinnamomeus*, *A. speciosa*, *A. alba*, and *A. purpurea*. These species found to inhabit the habitat of shrubs and lakeside in the observation area for rest and look for food in the sea. Ploceidae family consists of *Lonchura leucogasteroides*, *Lonchura punctulata*, and *Passer montanus*. This family is widespread in Asia, Africa, and Europe and classified as a pest for agricultural land [14].

All mammals not protected by Indonesia regulation, not listed as Appendix in CITES, and has IUCN Status “LC” (Least Concern). All birds have IUCN status Least Concern. *Elanus caeruleus* protected by Indonesian protection law P.106/2019 and listed in CITES as Appendix II. This species threatened by the use of rodenticides and pesticides within its range, and in some areas, housing and commercial development threaten the wetland habitats of this species [12]. *Ardea alba* Protected by Indonesia regulation P.106/2019. The species is threatened by wetland habitat degradation [13].

### 3.2. Distribution of Mammals and Birds

*Callosciurus notatus*, *Rattus tiomanicus*, and *Suncus murinus* only spread in several locations (Figure 2). *C. notatus* only found in transect 1 and 2 because both of these transect have rubber plantation area. *C. notatus* is an arboreal mammal that requires trees as feed and cover [14]. *R. tiomanicus* only found in transect 6 in the watermelon and cassava fields. This species found only in a variety of habitats in the lowland areas: from the secondary forest and agricultural areas [15]. *S. murinus* found in transect 1 and 5 in the scrub area.

**Figure 2. Distribution of Mammals in Institut Teknologi Sumatera**

In general, the species of birds found distributed in each observation transect (Figure 3). The transect that has the highest species richness is transect 6 with 22 species, and transect 1 with 21 species. Both of these transects are edge areas, which are the border areas between ITERA development areas and community plantations. According to [16], diversity is higher in edges than in interior patches. Moreover, [17] research shows that the diversity of birds in the periphery is higher than in the forest and settlement areas.
Figure 3. Distribution of Birds in Institut Teknologi Sumatera

Lanius schach, Lonchura punctulata, Centropus bengalensis, Ardea purpurea, Halcyon chloris, Halcyon smyrnensis, Pycnonotus aurigaster, Elanus caeruleus, Turnix suscitator, Amaurornis phoenicurus, Hirundo tahitica, Geopelia striata, and Streptopelia chinensis are species that can be found in all transect (Figure 4). Species that can be found in all transect show that these species have a wide range of distribution and high adaptability. Five species of birds only found in one transect Lonchura leucogastroides, Orthotomus ruficeps, Acridotheres tristis, Gallirallus striatus, and cacomantis sonneratii. These species have specific habitat preferences and low adaptability.

Figure 4. Species distribution in each transect
The index of similarity between transects results showed that the ITERA landscape is divided into two groups similarities. Group A consists of transects 1, 2, 3, and 6, while group B consists of transects 4 and 5 (Figure 5). There is a difference between these two groups because group A has some of the areas with tree vegetation, while group B dominated by shrubs without tree vegetation. Transect 1 and transect 2 have the highest similarity, which is 0.78. Transect 1 and 2 have the highest group similarity because these two locations have rubber plantation that supports the life of species with the same niche.

3.3. Stratification and Feeding Guild of Mammals and Birds

67% of the mammals found in ITERA are terrestrial because they are predominantly rat, while 33% is an arboreal mammal (Figure 6a). The use of vegetation stratification shows the condition of vegetation in ITERA, which has a low tree stand level with a proven number of terrestrial mammals. All mammals found are omnivorous because they can eat plants and other animals such as insects (Figure 6b). The stratification used for foraging in bird communities has a percentage of 57% terrestrial, 32% arboreal, and 11% aerial, and the highest feeding guild is Insectivorous 43%, followed by piscivorous 21% (Figure 6c, 6d). Stratification and feeding of guilds in birds are very closely related. The most feeding guild is insectivore because there are so many insects availability. According to [18], the highest abundance of insects found in grass and shrub ecosystems. Development and human activities in ITERA do not have a significant influence on the insects abundance. According to [19], insects on small branches or trees are not affected by urban development.

4. Conclusions

The data availability of mammals and birds diversity within the ITERA landscape is crucial due to their essential role in ecological dynamics. The construction activity within the ITERA will cause landscape conversion. This research found three species of mammals which are Callosciurus notatus, Rattus tiomanicus, and Suncus murinus. C. notatus only found in rubber stands. 67% of terrestrial mammals and all feeding guilds are omnivorous. 28 species of birds from 17 families found in this study. Species with the highest dominance are Lonchura punctulata and the dominant family is Ardeidae. Elanus caeruleus and Ardea alba protected by Indonesia regulation. The transect which has the highest species
richness is transect 6 with 22 species and transect 1 with 21 species. The highest stratification used for foraging of birds community is terrestrial and the highest feeding guild is insectivorous.

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