Aceh Journal of Animal Science (2024) 9 (3): 81 - 88

Aceh Journal of Animal Science

Journal homepage: www.jurnal.unsyiah.ac.id/AJAS

# Inventory and ecology of avifauna in Universitas Andalas campus complex, Indonesia

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ARTICLE INFO

*Keywords:*
Bird diversity
Campus boulevard
Main-campus
Point-count survey
Typical species

*Received: 24 February 2024*
*Accepted: 27 September 2024*

*DOI: 10.13170/ajas.9.3.37539*

ABSTRACT

Universitas Andalas campus is located at Payakumbuh region, West Sumatra, Indonesia. This campus is surrounded by forest and settlement. This study aimed to determine species inventory and its ecological condition in Andalas University campus complex (UACC), Limau Manis, Padang, West Sumatra. It had been conducted between October 2022 and January 2023, where the survey was carried out at three zonation in UACC based on its level of anthropogenic interference; campus entrance with the heaviest disruption (campus boulevard), main campus, and forest-edge that bordered with the eastern side of campus. Point count method was applied along ten observing points which approximately 100 m distance from one to another; the forest-edge were surveyed with only five points. Species and individual numbers were recorded within maximum 100 m radius from center of each point for ten minutes. The data was then analyzed for its diversity, similarity across sites and typical species per survey site. The study recorded 38 bird species with total 418 individuals; they belong to 20 families and 7 orders. The overall bird diversity in UACC was moderate (H' = 2.9), with the lowest was observed at the campus boulevard (H' = 2.1) followed by forest-edge (H' = 2.2) and the highest was at lecturing complex (H' = 2.6). The similarity among sites was low to moderate (21.7% > J > 52%) which suggested some species are typical to their respective habitat site. The forest-edge site has the most typical species (n = 14) among other habitats. This study also hinted the possibility of the occurrence of mixed-flock bird species event at the main campus habitat between yellow-vented bulbul *Pycnonotus goiavier* and Coppersmith barbet *Psilopogon haemacephala* along with some other participants.

## Introduction

Birds as part of natural biodiversity play various functions and advantages for human, directly or indirectly, which include the ecological, economical, aesthetical, knowledge or cultural aspects (Bibby *et al.*, 2000). Furthermore, birds are also important for educational, recreational and tourism purposes (Alikodra, 2002). Birds are good indicator for ecological condition, as they inhabit many types of habitats, occupy almost all levels in ecological food network, sensitivity toward environmental changes, and well-studied organisms with established observation methods (Widodo, 2010).

Avian diversity is also used for recreational purpose that initiated the birth of birdwatching activity. Birdwatching is currently one of favorable outdoor activities with rampant number of enthusiasts, which in turn provides potential baseline data for avian research and conservation. Birdwatching has become a fascinating trend in West Sumatra, where the birdwatchers observe its avifauna while admiring the beauty of natural sceneries (Andira, 2014). Furthermore, some facilities are also needed to establish a birdwatching destination, such as birding station, birding pathways as well as experienced manpower as birding guide (Highst-Zaher, 2021)

Universitas Andalas campus complex (UACC), which located in approximately 500 hectares hilly terrain of Limau Manis Village, meets the requirements for being a birdwatching spot. More than 30% of its area (160 ha) is categorized as old secondary or primary hilly rainforest and harbors more than 160 bird species (Janra, 2019). While the

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Printed ISSN 2502-9568; Electronic ISSN 2622-8734

eastern part of UACC directly bordered with dense vegetation, the western part is purposed for academic and research activities hence more building and other campus infrastructures established. This situation has let the formation of different habitat and in turn impact bird diversity dwelling in it as the resources will vary (Sihotang *et al.*, 2015). Therefore, this study intended to do the inventory on bird species dwelling prominent habitats in UACC as well as its ecological aspects, in which being the future birding destination is a possibility.

## Materials and Methods

### Study site and field time

This study had been conducted from October 2022 until January 2023 at Universitas Andalas campus complex or UACC (GPS coordinates 0.9152° S, 100.4582° E, 250-400 m altitude) by dividing observation sites into two anthropogenic area i.e. heavy-traffic campus boulevard and main campus complex; and forest edge where anthropogenic activity is the least (Figure 1). The first site, hereinafter campus boulevard, spanned along campus 1.2 km main boulevard that connects campus main gate up to the rectorate building, characterized with frequent and heavy traffics as well as scarce vegetation of *Pterospermum* sp. and *Swietenia mahogani*. The main campus comprises of buildings and other structures used mainly for academic and administrative affairs, with more vegetation aesthetically grown as part of its landscape which dominated by *Pterospermum* sp., *Swietenia mahogani* and *Syzygium myrtifolium*. The forest-edge site is the border between campus and forested area in the most eastern part of campus complex where dense tree stand was easily found, mixed between the dominant tree plants found in main campus with *Macaranga* spp and some Dipterocarps. All sites possess aquatic bodies (e.g. tributaries, streams or ponds), as result of being in the area with hilly tropical rainforest.

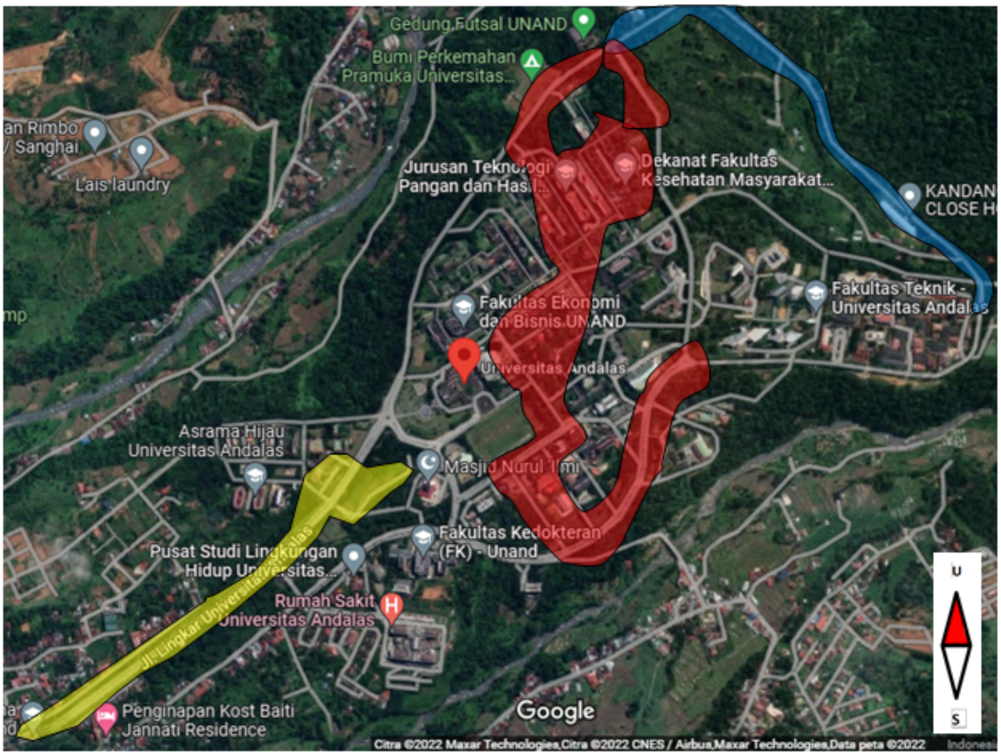


**Figure 1.** Study site in Universitas Andalas campus complex (UACC). Area shaded with yellow represent campus boulevard, red shade for main campus and blue shade for forest-edge (source: Google Maps, 2023).

### Data collection

The study used point-count survey technique by establishing observation points along imaginary transect and with distance 100 m from one to another. Anthropogenic site and main campus site were with ten points, while forest-edge was only with five; ten to twenty minutes were spent in each point. All birds seen or heard within the maximum 100 m radius from the central point was recorded. Sighting was enhanced using 10 x 42 binocular, while photography documentation was with Nikon P900. Morphological characters were noted and recorded, before identified using proper guides (MacKinnon *et al.*, 2010; Eaton *et al.*, 2016). Sound recognition referred to online database for wildlife sound (www.xeno-canto.org). Individual per species was also counted in each observation point.

### Data analysis

All species identified then tabulated accordingly, with taxonomy following Eaton *et al.* (2016) and taxonomical sequence refers to Sukmantoro *et al.*

(2007). Ecological analysis used Shannon-Wiener diversity index (H') (Odum, 1993; Rahayuningsih *et al.*, 2010), with formula as follow.

$$H' = -\sum Pi \ln Pi$$

Note: Pi = $n_i$/N, in which $n_i$ is total individuals of i-species and N is total of all individuals observed. Diversity is determined as low if H' < 1, intermediate if it lays between 1 to 3, and high if H' >3.

The similarity among surveyed habitats is calculated using Jaccard index (Odum, 1993; Rahayuningsih *et al.*, 2010), with formula as follow.

$$J = C/(a+b+c) \times 100\%$$

Note: letter a represents the species observed only in location a, letter b is for the species observed only in location b, while letter c is the species observed in both locations. The closer the index to one hundred percent, the more similar among compared habitats. Jaccard index was also use to determine common species in all habitats as well as the typical ones in each of them. The result then outlined descriptively using tables, figures and graphics.

## Results

### Species composition

The study recorded 38 bird species which classified into 20 families and 7 orders (Table 1). Order Accipitriformes and Gruiformes were represented by only single species. Meanwhile, Passeriformes became the order with the most family (n = 13) and species (n = 23) members recorded. According to the habitats where the observation conducted, main campus possessed more species (n = 22), slightly exceeded the forest-edge (n = 21) but overwhelmed what recorded at campus boulevard (n =15). On the contrary, campus boulevard was more abundance with bird individuals (n = 158) than what recorded at the main campus (n = 137) or forest-edge (n = 117). Each habitat was dominated by species from Passeriformes, which seemed to be a common denomination in many bird studies.

Despite having poorer vegetation and some other biotic aspects in its environment, birds found at campus boulevard may have been well-adapted to its condition. Glossy Swiftlet *Collocalia esculenta* (n = 23) and Scaly-breasted Munia *Lonchura punctulata* (n = 56) were observed more abundance than other species in this area, contributing their sheer number to the total individual count in this area ($\bar{x}$ individual = 10.5). Meanwhile, at main campus, Glossy Swiftlet (n = 26), Grey-rumped Treeswift *Hemiprocne longipennis* (n = 23), Yellow-vented Bulbul *Pycnonotus goiavier* (n = 18) and Eurasian Tree Sparrow *Passer montanus* (n = 17) showed as prominent species. Meanwhile in forest-edge, only Yellow-vented Bulbul (n = 22) and Asian Glossy Starling *Aplonis panayensis* (n = 44) that counted as the most prominence. These two sites had lower average individual number compare to the campus boulevard. In all habitats, there were only five generalist species which included Glossy Swiftlet *Collocalia esculenta*, Coppersmith Barbet *Psilopogon haemacephala*, Green Iora *Aegithina viridissima*, Yellow-vented Bulbul *Pycnonotus goiavier*, dan Eurasian Tree Sparrow *Passer montanus* (Figure 2).

**Table 1.** Detail on bird species observed at three habitats in Universitas Andalas Campus Complex

| Taxonomy | Vernacular Name | Observation | | | All |
|---|---|---|---|---|---|
| | | CB | MC | FE | |
| **Accipitriformes** | | | | | |
| Accipitridae | | | | | |
| *Spilornis cheela* | Crested Serpent-eagle | - | - | 2 | 2 |
| **Gruiformes** | | | | | |
| Rallidae | | | | | |
| *Amaurornis phoenicurus* | White-breasted Waterhen | - | 2 | - | 2 |
| **Columbiformes** | | | | | |
| Columbidae | | | | | |
| *Treron vernans* | Pink-necked Green-pigeon | - | 8 | 1 | 9 |
| *Columba livia* | Rock dove | - | 2 | - | 2 |
| *Streptopelia chinensis* | Spotted Dove | 7 | - | - | 7 |
| *Geopelia striata* | Zebra Dove | 9 | 2 | - | 11 |
| **Apodiformes** | | | | | |
| Apodidae | | | | | |
| *Aerodramus fuchiphagus* | Edible-nest Swiftlet | - | - | 8 | 8 |
| *Collocalia esculenta* | Glossy Swiftlet | 23 | 26 | 9 | 58 |
| Hemiprocnidae | | | | | |
| *Hemiprocne longipennis* | Grey-rumped Treeswift | 3 | 23 | - | 26 |

| Taxonomy | Vernacular Name | Observation | | | All |
|---|---|---|---|---|---|
| | | CB | MC | FE | |
| **Coraciiformes** | | | | | |
| Alcedinidae | | | | | |
| *Alcedo meninting.* | Blue-eared Kingfisher | 1 | 1 | - | 2 |
| *Halcyon smyrnensis* | White-throated Kingfisher | 3 | 2 | 1 | 6 |
| *Todiramphus chloris* | White-Collared Kingfisher | - | 2 | - | 2 |
| **Piciformes** | | | | | |
| Capitonidae | | | | | |
| *Psilopogon mystacophanos* | Red-throated Barbet | - | - | 1 | 1 |
| *Psilopogon australis* | Yellow-eared Barbet | - | 2 | - | 2 |
| *Psilopogon haemacephala* | Coppersmith Barbet | 2 | 2 | 2 | 6 |
| **Passeriformes** | | | | | |
| Eurylaimidae | | | | | |
| *Eurylaimus javanicus* | Banded Broadbill | - | - | 2 | 2 |
| Hirundinidae | | | | | |
| *Hirundo rustica* | Barn Swallow | - | - | 5 | 5 |
| Motacillidae | | | | | |
| *Motacilla cinerea* | Grey Wagtail | 2 | - | - | 2 |
| *Anthus novaeseelandiae* | Australasian Pipit | 1 | 3 | - | 4 |
| Aegithinidae | | | | | |
| *Aegithina viridissima* | Green Iora | 12 | 3 | 4 | 19 |
| Pycnonotidae | | | | | |
| *Pycnonotus aurigaster* | Sooty-headed Bulbul | - | 2 | - | 2 |
| *Pycnonotus goiavier* | Yellow-vented Bulbul | 14 | 18 | 21 | 53 |
| *Pycnonotus brunneus* | Asian red-eyed Bulbul | - | - | 1 | 2 |
| Timaliidae | | | | | |
| *Macronous ptilosus* | Fluffy-backed Tit-babbler | - | - | 1 | 2 |
| Sylviidae | | | | | |
| *Prinia familiaris* | Bar-winged Prinia | - | - | 1 | 2 |
| *Orthotomus ruficeps* | Ashy tailorbird | - | - | 2 | 3 |
| Muscicapidae | | | | | |
| *Muscicapa dauurica* | Asian Brown Flycatcher | - | - | 2 | 3 |
| Dicaeidae | | | | | |
| *Prionochilus maculatus* | Yellow-breasted Flowerpecker | - | - | 3 | 3 |
| *Dicaeum trigonostigma* | Orange-bellied Flowerpecker | - | 4 | 2 | 4 |
| Nectariniidae | | | | | |
| *Anthreptes malacensis* | Brown-throated Sunbird | - | 5 | - | 5 |
| *Cinnyris jugularis* | Olive-backed Sunbird | - | 2 | - | 2 |
| *Arachnothera longirostra* | Little Spiderhunter | - | - | 1 | 3 |
| Estrildidae | | | | | |
| *Lonchura striata* | White-rumped Munia | 10 | 6 | - | 16 |
| *Lonchura punctulata* | Scaly-breasted Munia | 56 | 3 | - | 59 |
| *Lonchura maja* | White-headed Munia | 7 | 2 | - | 9 |
| Ploceidae | | | | | |
| *Passer montanus* | Eurasian Tree Sparrow | 8 | 17 | 2 | 27 |
| Sturnidae | | | | | |
| *Aplonis panayensis* | Asian Glossy Starling | - | - | 44 | 44 |
| *Sturnus sturninus* | Daurian Starling | - | - | 2 | 3 |
| **Total species/family/order** | | 15/10/5 | 22/13/6 | 21/17/6 | 38/20/7 |
| **Total individual/average ind. per species** | | 158/10.5 | 137/6.2 | 117/5.6 | 418/11 |

Remarks: CB = campus boulevard, MC = main campus, F-E = forest-edge. In taxonomy column, bolded names represent order level, regular names represent family level and italic names for species.

Aceh Journal of Animal Science (2024) 9 (3): 81 - 88

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Despite having poorer condition on vegetation and some other biotic aspects, birds found at campus boulevard may have been well-adapted to its condition. Glossy Swiftlet *Collocalia esculenta* (n = 23) and scaly-breasted Munia *Lonchura punctulata* (n = 56) were more abundance than other species in this area, contributing their sheer number to the total individual count in this area ($\bar{x}$individual = 10.5); it was also the highest among observed habitats in this study. Meanwhile, at main campus, glossy swiftlet (n = 26), Grey-rumped Treeswift *Hemiprocne longipennis* (n = 23), Yellow-vented Bulbul *Pycnonotus goiavier* (n = 18) and Eurasian Tree Sparrow *Passer montanus* (n = 17) showed as prominent species. While at forest-edge, only Yellow-vented Bulbul (n = 22) and Asian Glossy Starling *Aplonis panayensis* (n = 44) that counted as the most prominence in abundancy. These two sites had lower average individual number compare to the campus boulevard, i.e. respectively 6.2 and 5.6 individuals per species. In all habitats, there were only five generalist species which included Glossy Swiftlet *Collocalia esculenta*, Coppersmith Barbet *Psilopogon haemacephala*, Green Iora *Aegithina viridissima*, Yellow-vented Bulbul *Pycnonotus goiavier*, dan Eurasian Tree Sparrow *Passer montanus* (Figure 2).

**Figure 2.** Representatives of generalist species; green iora *Aegithina viridissima* (A), yellow-vented bulbul *Pycnonotus goiavier* (B), Eurasian tree sparrow *Passer montaus* (C). Representatives of typical species; grey wagtail *Motacilla cinerea* at campus boulevard (D), rock pigeon *Columba livia* at main campus (E), Banded Broadbill *Eurylaimus ochromalus* at forest-edge (F).

**Some ecological aspects**

Based on the data regarding species and individual number gained in this study (Table 2), UACC in overall possessed moderate diversity of avifauna (H' = 2.9). The main campus site had the highest diversity (H' = 2.6) compared than the forest-

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Printed ISSN 2502-9568; Electronic ISSN 2622-8734

edge (H' = 2.2) or campus boulevard (H' = 2.1). It is not necessarily meant that the forest, which was the most natural site observed in this study, had the least diversity nor species inventory therein. The less surveyed points in this area, in addition to the dense canopy layers, low intensity of light or other obscurity aspects had contributed to the lower diversity at forest-edge. Yet, albeit surveyed with half number of points than the other two habitats, the forest-edge habitat still booked 21 species of 17 families and six orders (Table 1). This was close to, or even exceeded, the statistics recorded for main campus (22 species, 13 families, 6 orders) or campus boulevard (15 species, 10 families, 5 orders). Birds were observed to use vegetation canopy provided by *Pterospermum* sp., *Swietenia mahogani* and other tall trees for perching, finding foods, doing calls and other activity. The vegetation not only harbors insects for insectivorous birds, but fruit as well, such as found in fruit as well, such as found in *Syzygium myrtifolium*, *Macaranga* spp., or even the shrub of *Rhodomyrtus tomentosa*.

**Table 2.** Diversity of avifauna at three habitats in the Universitas Andalas Campus Complex.

| Parameter | Site | | | |
|---|---|---|---|---|
| | CB | MC | FE | All |
| Total Species | 15 | 22 | 21 | 38 |
| Total Individual | 158 | 137 | 117 | 418 |
| H' | 2.1 | 2.6 | 2.2 | 2.9 |
| Total Typical Species | 1 | 7 | 14 | |

Remarks: CB = campus boulevard, MC = main campus, F-E = forest-edge

Furthermore, the forest-edge had the highest number of typical species, which specifically recorded from one habitat only (Table 2). Of fourteen typical species in forest-edge, eleven were from Passeriformes which mostly categorized as forest-interior species (MacKinnon *et al.*, 2010). It included Banded Broadbill *Eurylaimus javanicus*, Asian Red-eyed Bulbul *Pycnonotus brunneus*, Fluffy-backed Tit-babbler *Macronous ptilosus*, Asian Brown Flycatcher *Muscicapa dauurica*, Yellow-breasted Flowerpecker *Prionochilus maculatus*, and Little Spiderhunter *Arachnothera longirostra* (Table 1). Meanwhile, the main campus had seven typical species which included White-breated Waterhen *Amarournis phoenicurus*, rock dove *Columba livia*, Coppersmith Barbet *Psilopogon australis*, Brown-throated Sunbird *Anthreptes malacensis* and Olive-backed Sunbird *Cinnyris jugularis*. White-collared Kingfisher *Todiramphus chloris* which was also typical in this site was slightly peculiar because this species usually inhabits coastal area and seldomly had overlapped range with other kingfisher especially the White-throated Kingfisher *Halcyon smyrnensis* which also recorded in this study. The last site, the campus boulevard, only had one typical species, a migratory Grey Wagtail *Motacilla cinerea*.

**Table 3.** Jaccard similarity index among habitats in Universitas Andalas campus complex.

| | Campus boulevard | Main Campus | Forest-edge |
|---|---|---|---|
| Campus boulevard | | 52% | 21.7% |
| Main Campus | | - | 28% |

The existence of both typical and general bird species across habitats proportionally influences the similarity among them (Table 3). Two anthropogenic habitats in this study, campus boulevard and main campus shared the highest similarity (J = 52%), which means that more than half species inventory in both habitats were the same. On the other hand, between campus boulevard and forest-edge shared the lowest similarity (J = 21.7%). Table 3 showed that the pair of adjacent habitats (e.g. campus boulevard with main campus and main campus with forest-edge) might have higher species similarity rather than those separated (e.g. campus boulevard with forest-edge).

**An important note on possible mixed-flock species event**

In one survey done at main campus habitat, both authors observed individuals of yellow-vented bulbul making alarm calls attended by two Coppersmith Barbets (Figure 3) and possibly also by Sooty-headed Bulbuls *Pycnonotus aurigaster* and Bengali Finches *Lonchura striata*; all of this happened for couple of minutes on the canopy of ferntree *Filicium decipiens* which planted massively within the campus complex.

Both authors, however, failed to identify on which threat this mutual alarm calls made. Despite unidentifiable, the possible threats mostly came from above since the mixed-flock participants frequently looked upward while sounding the alarming noise. This case is probably the first one reported from the anthropogenic area in UACC, hence require more observation to determine the frequency, participants, types of threats, function and other aspects of mixed-flock bird species that happened.

**Figure 3**. Mixed-flock bird species event that occurred between Yellow-vented Bulbul (left) and Coppersmith Barbet (right)

**Discussion**

The domination from Passerines (Passeriformes) was a common result from many bird surveys as it is apparent observed at each type of habitat in this study. The Passeriformes is known as the bird order with the most taxa members either in national or global scale (del Hoyo *et al*., 2003; Rahayuningsih and Priyono, 2006: Sukmantoro *et al*., 2007). Members of passerines have adapted to and inhabit vast array of niches and various types of habitats, which explains the existence any of its members at any place in the world (Ericson *et al*., 2014).

It was confirmed that there is specificity in species and community of birds that adapt to anthropogenic-impacted environment (Sheta *et al*., 2011). In many cases, the loss of forest habitats which then replaced with artificial or human-interfered habitats has urged some bird species, especially non forest specialist and generalist species to use these new habitats (Morante-Filho *et al*., 2015). In contrary, forest specialist birds along with frugivorous and insectivorous species are negatively impacted and tend to relocate elsewhere with intact vegetation. Furthermore, the distance between two location (or surveyed habitats in this study) gives impact to the abundance and similarity as many species will have chance to commute between locations (Tu *et al*., 2020).

Natural habitats or enriched anthropogenic habitats have been known to have richer bird diversity than those heavily impacted by anthropogenic-related activities (Tu *et al*., 2020). Bird species which have adapted to anthropogenic environment tend to be dominant ones due to their ability to use available resources therein as well as lack of the competitors (Jokimäki *et al*., 1996; Al-agouri *et al*., 2021). The anthropogenic-impacted area which in this study represented by campus entrance and main campus complex are suitable for species categorized as generalist which typically prefer urbanized landscapes (Kurnia *et al*., 2021). It may explain that some species such as Glossy Swiftlet, Yellow-vented Bulbul, Eurasian Tree Sparrow or Asian Glossy-starling appeared blooming in their related habitats in the UACC.

The existence of typical species in each observation site is possibly caused by their biological requirements which can be supplied only in certain habitat such as food sources, nesting site or protection factor (Rahayuningsih *et al*., 2010). On the other hand, despite being generalist species, their counted individuals were different across habitats. This difference in individual numbers could hind the degree of adaptability from generalist species to the respective habitat, how much local resource can be used to support their live or how extensive their adaptability (dos Anjos *et al*., 2019; Withaningsih *et al*., 2020). While Yellow-vented Bulbul was observed abundance in each habitat, the Glossy Swiftlet, Grey-rumped Treeswift *Hemiprocne longipennis*, Green Iora *Aegithinia viridissima*, Bengali finch *Lonchura striata*, or Scaly-breasted Munia *L. punctulata* seemed to inhabit campus boulevard better than forested habitat in UACC. The abundancy of these species can directly or indirectly affect the ecological aspects of bird community in each area. The dominant population of certain species in one area can impact the overall diversity of that taxa in the said area (Odum, 1996).

Mixed-species flock is an interspecific group of birds that forage in close association by maintaining bond over time through contact calls and moving together while looking for food (Greenberg, 2000: Thiollay, 2003; Harrison and Whitehouse, 2011). Birds do the mixed-species flocking for some reasons, i.e., predation avoidance and foraging effectivity as the flocking participants can spend more time feeding and less time watching over the predators (Dean, 1990; Mangini and Areta, 2018). Mixed-species flock may be occurring at disturbed, fragmented or altered habitats (such as campus boulevard or main campus in this study) which require the participants to become more aware during flocking (Brandt *et al*., 2009). The observation on rare mixed-species flocking in UACC's main campus showed that the participants were alerted by threat from something unidentified. Threats might come from above as most participants frequently looked upward while making alarm calls. It might be the presence of predatory Crested Serpent-eagle *Spilornis cheela*, Black Eagle *Ictinaetus malaiensis*, Black-thighed Falconet *Microhierax fringillarius*, Tiger Shrike *Lanius tigrinus* and Brown Shrike *L. cristatus* that are known to exist in this area that trigger the response of small frugivorous and/or insectivorous birds to flock together (Janra, 2019). As mixed-species flock is believed to be more frequent in disturbed habitat (Thiollay, 1999), it is impending to have more observation of this occasion at campus boulevard, main campus or other disturbed habitats in UACC to reveal how local bird species perceive the alteration of their habitat.

## Conclusions

This study recorded a total 418 bird individuals that identified into 38 species, 20 families and 7 orders from three types of habitats surveyed in Universitas Andalas Campus Complex. The main campus habitat harbored more species than forest-edge or campus boulevard. The bird diversity in UACC in overall was moderate (H' = 2.9), which also reflected in the diversity calculated from each habitat where H' range between 2.1 at campus boulevard to 2.6 at main campus. Forest-edge became the habitat with most typical bird species (n = 14) and the pair between campus boulevard and main campus were with the highest similarity (J = 52%) This study also recorded a possible mixed-flock bird species event at the main campus habitat, the first to be reported from the locality of UACC, which then demand for further observation therein.

## Acknowledgments

The authors would like to thank to Biology Department, Faculty of Mathematics and Natural Sciences in Universitas Andalas for accommodating this study.

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