PRELIMINARY BIRD SURVEY IN HUMAN SETTLEMENTS NEAR TAMAN NEGARA KUALA TAHAN, JERANTUT, PAHANG

Nur Thabitah Shaikh Nasir[1]*, Nor Lailatul Wahidah Musa[1], Liliwirianis Nawi[1], Nurun Nadhirah Md Isa[1], Sarah Laila Mohd Jan[1]

[1]*Faculty of Applied Sciences*
Universiti Teknologi MARA Cawangan Pahang, 26400 Bandar Tun Abdul Razak Jengka, Pahang Malaysia

[*]*Corresponding author: thabitah@uitm.edu.my*

Abstract

Birds respond actively to changes in environmental conditions. Deforestation and habitat fragmentation due to land use cause the loss of bird species diversity and changes in bird community, thus altering the feeding guilds that are important for many ecosystem services. The objectives of this study were to determine the avian species found in human settlements near Taman Negara Kuala Tahan and to categorise the observed bird species into feeding guilds. Bird surveys were conducted via binoculars using point count (PC) and opportunistic count (OC) methods for three days in early September 2022. A total of 179 individuals across 30 species from 13 families were recorded in the observed areas with Pycnonotidae having the highest number of species (7 species), followed by Columbidae (5 species) and Nectariniidae (4 species). Bird species with the highest number of individuals was *Passer montanus* (36 individuals) and the most found species was *Copsychus saularis* (20 out of 23 PC points). Six feeding guilds were also determined with insectivores and frugivores being the two most common feeding guilds found with 19 and 17 species, respectively. Out of the 30 species found, one is listed as Near Threatened, three as Vulnerable, and one as Endangered. Bird biodiversity must be considered when developing areas adjacent to rainforests to sustain local bird populations.

Keyword: Bird diversity, feeding guilds, Taman Negara Kuala Tahan

Introduction

Birds are one of the most populous life forms on the planet. They are important in the food webs of an ecosystem as they feed on other organisms like plants, insects, and other small animals and in turn become prey for other animals. Birds act as pollinating and seed-dispersing agents, biological control agents, and keystone species in many ecosystems. They also respond to vegetation characteristics, such as vertical structure, floristic composition, and topography. For example, most bird species prefer woodland with dense tree stands and river corridors compared to treeless or sparsely-covered-trees areas (Stagoll et al., 2010).

Malaysia has recorded 723 bird species, of which 583 are land birds (BirdLife International, 2023a) that are attractive in colour and appearance. Bird community and diversity are affected by a number of external factors, such as habitat fragmentation, vegetation composition and structure, seasonal changes, and human activities (Wang et al., 2014). Conversion of natural habitats to human-dominated landscapes has significant impacts on bird communities. Deforestation and habitat fragmentation due to the growth of rural and suburban areas are considered causes to extinction and losses of bird

diversity in many regions as land use changes the vegetation structure and landscape of an area. The changes of ecological conditions in an area can be indicated by the changes in bird species composition (Fraixedas et al., 2020). Loss of bird biodiversity may result in changes in functional feeding guilds responsible for various ecosystem services which may threaten the ecosystem. However, some birds are highly adaptable to the changing environmental conditions as rural and suburban areas create habitat for highly tolerant species (Morelli et al., 2021). Concerning changes in landscape due to land use, the occurrence of birds will be affected by their responses to tree cover and human infrastructure (Adams & Roots, 2022).

Kampung Kuala Tahan and Kampung Pagi in Jerantut, Pahang are two villages located near Taman Negara Kuala Tahan and separated by the Tembeling River. The proximity of human settlements to the national park, which is rich in bird diversity, may provide a new habitat or feeding area for birds that are readily adapted to the changing environment. Therefore, the objectives of this study are to determine the avian species found in villages near Taman Negara Kuala Tahan and to categorise the bird species found into feeding guilds.

Materials and Methods

Point count (PC) and opportunistic count (OC) are widely used methods for bird sampling as they are effective, easy to implement, and favourable in a habitat with dense tree stands (Bibby et al., 2000). The PC method requires the observer to stay still and record all bird sigh tings in one location at a fixed period. Meanwhile, the OC method involves the observations of birds done outside the PC location and the selected time range.

In this study, bird surveys were conducted for three days (2 to 4 September 2022) after dawn (0700 to 1000) and before dusk (1600 to 1900) at two locations, namely Kampung Kuala Tahan (approximately 4°22'48.5"N 102°24'08.0"E) and Kampung Pagi (approximately 4°26'51.1"N 102°28'57.7"E) located 21.8 km by the road route. The study area is shown in **Figure 1**. Several PC points of 150 m apart were randomly selected in each village and each observation was done for approximately 20 minutes. A total of 23 PC points were selected, with 15 and 8 PC points in Kampung Kuala Tahan and Kampung Pagi, respectively. Binoculars were used to assist in the observation and cameras and sketches were utilised to record any birds observed. All species found were compared to the illustrations in Robson (2015) and Lim et al. (2020). Some bird sounds were also recorded or compared in situ with t he data in Xeno-Canto: Sharing Wildlife Sounds from Around the World (https://xeno-canto.o rg/), and these sound data were used to corroborate with the observation data.

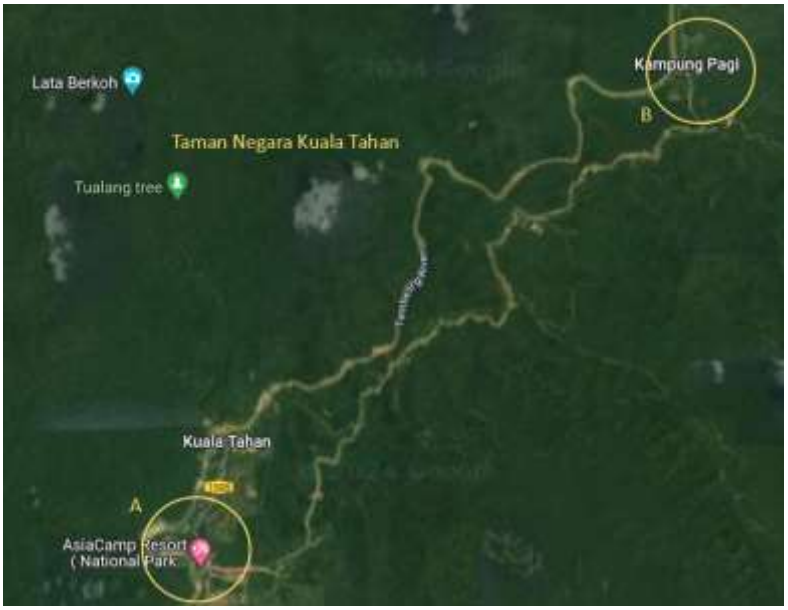

Figure 1 Map of the study areas indicated in circles. (A) Kampung Kuala Tahan. (B) Kampung Pagi. Retrieved from Google Map

Results and Discussion

All 23 PC points selected were located near human settlements. During the three days of observation, a total of 179 individuals of 30 bird species from 13 families were recorded. The family with the highest number of species was Pycnonotidae (bulbuls) with seven species, followed by Columbidae (5 species), Nectariniidae (4 species), Sturnidae (3 species), and two species each in the Bucerotidae and Cuculidae families. Meanwhile, the Alcedinidae, Chloropseidae, Corvidae, Irenidae, Muscicapidae, Passeridae, and Psittaculidae families recorded one species each. **Table 1** shows the list of avian species found in the studied areas. Moreover, 19 out of 30 species were protected under the Wildlife Conservation Act 2010, Laws of Malaysia Act 716. According to Saad et al. (2012), Pycnonotidae is the second most found family in the disturbed riparian forest along the Tembeling River in Taman Negara Kuala Tahan after Timaliidae.

In this study, bird species with the highest number of individuals observed are *Passer montanus* (Eurasian Tree-sparrow) with 36 individuals, followed by *Copsychus saularis* (Oriental Magpie-robin) (22 individuals) and *Acridotheres javanicus* (Javan Myna) (17 individuals). Eurasian Tree-sparrows are common resident in Peninsular Malaysia. This species relies heavily on buildings for nest-sites and inhabits settlements of all kinds, from the smallest rural villages through suburban areas to urban centres (Wells, 2010). They often live and forage in flocks on the ground and trees and can become accustomed to humans easily (Mohamed Zakaria & Rajpar, 2014). In this study, Eurasian Tree-sparrows were found in only two PC points where man-made structures were abundant and trees were scarce. However, they are usually in flocks of no less than 10 individuals when feeding on seeds and insects on the ground, contributing to their large numbers.

Table 1 List of bird species recorded in human settlements near Taman Negara Kuala Tahan, Jerantut, Pahang

No.	Species	Vernacular names	Family	Number of individuals	*Feeding guild	**Conservation status
1.	*Halcyon smyrnensis*	White-throated Kingfisher / Pekaka Belukar	Alcedinidae	5	I, C	LC
2.	*Anthracoceros albirostris*	Oriental Pied Hornbill / Enggang Kelingking	Bucerotidae	5	I, F	LC
3.	*Anthracoceros malayanus*	Black Hornbill / Kekek	Bucerotidae	3	F, C	VU
4.	*Chloropsis sonnerati*	Greater Green Leafbird / Burung Daun Besar	Chloropseidae	2	I, F	EN
5.	*Columba livia*	Rock pigeon / Merpati	Columbidae	1	G	LC
6.	*Columba punicea*	Pale-capped Pigeon / Pergam Haji	Columbidae	1	G, F	VU
7.	*Geopelia striata*	Zebra Dove / Merbuk	Columbidae	1	I, G	LC
8.	*Spilopelia chinensis*	Spotted Dove / Tekukur	Columbidae	4	G	LC
9.	*Treron vernans*	Pink-necked Green-pigeon / Punai Kericau	Columbidae	2	F	LC
10.	*Corvus macrorhynchos*	Large-billed Crow / Gagak Paruh Besar	Corvidae	2	S, C	LC
11.	*Centropus sinensis*	Greater Coucal / Bubut Besar	Cuculidae	4	C, F	LC
12.	*Rhinortha chlorophaea*	Raffles' Malkoha / Selayak	Cuculidae	1	I	LC
13.	*Irena puella*	Asian Fairy-bluebird / Murai Gajah	Irenidae	7	I, F	LC
14.	*Copsychus saularis*	Oriental Magpie-Robin / Murai Kampung	Muscicapidae	22	I	LC
15.	*Anthreptes simplex*	Plain Sunbird / Kelicap Kelabu	Nectariniidae	2	I, N, F	LC
16.	*Arachnothera crassirostris*	Thick-billed Spiderhunter / Kelicap Jantung Paruh Tebal	Nectariniidae	4	I, N	LC
17.	*Arachnothera longirostra*	Little Spidehunter / Kelicap Jantung	Nectariniidae	6	I, N	LC
18.	*Arachnothera affinis*	Grey-breasted Spiderhunter / Kelicap Jantung Bukit	Nectariniidae	1	I, N	LC
19.	*Passer montanus*	Eurasian Tree-sparrow / Ciak Eurasia	Passeridae	36	G, I	LC
20.	*Loriculus galgulus*	Blue-crowned Hanging-parrot / Bayan Serindit	Psittaculidae	7	F	LC
21.	*Brachypodius atriceps*	Black-headed Bulbul / Merbah Siam	Pycnonotidae	1	I, F	LC

22.	*Pycnonotus brunneus*	Red-eyed Bulbul / Merbah Mata Merah	Pycnonotidae	4	I, F	LC
23.	*Pycnonotus conradi*	Streak-eared Bulbul / Merbah Telinga Lorek In dochina	Pycnonotidae	2	I, F	LC
24.	*Rubigula cyaniventris,*	Grey-bellied Bulbul / Merbah Dada Kelabu	Pycnonotidae	2	I, F	NT
25.	*Pycnonotus finlaysoni*	Stripe-throated Bulbul / Merbah Kunyit	Pycnonotidae	4	I, F	LC
26.	*Pycnonotus goiavier*	Yellow-vented Bulbul / Merbah Kapur	Pycnonotidae	8	I, F, G, N	LC
27.	*Pycnonotus simplex*	Cream-vented Bulbul / Merbah Mata Putih	Pycnonotidae	10	I, F	LC
28.	*Acridotheres javanicus*	Javan Myna / Tiong Jambul Jawa	Sturnidae	17	I	VU
29.	*Acridotheres tristis*	Common Myna / Tiong Gembala Kerbau	Sturnidae	7	I, F, S	LC
30.	*Aplonis panayensis*	Asian Glossy Starling / Perling Mata Merah	Sturnidae	8	I, F	LC
			TOTAL	179		

*C=Carnivore; F=Frugivore; G=Granivore; I=Insectivore; N=Nectarivore; S=Scavenger
**LC=Least Concern; NT=Near Threatened; VU=Vulnerable; EN=Endangered

Oriental Magpie-robins are considered active dispersers and colonisers where they are among the first non-forest pioneers of new agriculture and other settled clearings (Wells, 2010). According to Wells (2010), Javan Mynas regularly occupy a wide range of rural and suburban habitats and forages in urban centres. On the other hand, Saad et al. (2012) discovered *Arachnothera longirosta* (Little Spiderhunter) as the most abundant species in riparian forest in Taman Negara Pahang. Eurasian Tree-sparrows are the most abundant species in this study due to the landscape of rural human settlements that are suitable as its nesting and feeding sites. Additionaly, *Columba livia* (Rock Pigeon), *Columba punicea* (Pale-capped Pigeon), *Geopelia striata* (Zebra Dove), *Rhinortha chlorophaea* (Raffles' Malkoha), *Arachnothera modesta* (Grey-breasted Spiderhunter), and *Brachypodius atriceps* (Black-headed Bulbul) were the species with one individual each.

Birds have a high rate of metabolism and generally active lifestyles. To cope with these, most birds need to feed on lots of high-energy food to sustain them. Based on **Table 1**, six bird feeding guilds were determined: carnivore, frugivore, granivore, insectivore, nectarivore, and scavenger. Insectivore is the most common guild in the studied areas with 20 species, followed by nectarivores with 18 species. This finding corresponds with the study by Saad et al. (2012), which discovered insectivores as the highest number of bird feeding guild in the riparian forest of Taman Negara Pahang (9 out of 28 families). Insectivores feed on insects and small invertebrates, granivores feed on grains and seeds, nectarivores feed on flower nectars, frugivores feed on fruits, carnivores feed on other animals such as small mammals and fishes, omnivores feed on animals and plants, and scavengers feed on dead decaying matter (Elphick, 2014). Furthermore, 21 out of the 30 species have more than one type of feeding guild. *Pycnonotus goiavier* (Yellow-vented Bulbul) has the most feeding types (4 types), namely as an insectivore, frugivore, granivore, and nectarivore. Flowering trees are abundant in cultivated, rural, and forest edge areas in villages near Kuala Tahan and they provide nectars, seeds, and fruits for the bird species. Insects are attracted to flowering trees, which attract the bulbul to feed on the insects. Other than Yellow-vented Bulbus, *Anthreptes simplex* (Plain Sunbird) and *Acridotheres tristis* (Common Myna) also have a varied diet with three feeding guilds each. Plain Sunbird is an insectivore, frugivore, and nectarivore often found among the foliage of flowering trees and trees with small fruits at the studied areas. Finally, Common Myna is an insectivore, frugivore, and scavenger. This myna species can be found in mangrove forests, agricultural lands, roads, gardens, and parks that feed on insects, small invertebrates, small fruits, food wastes, and carcasses (Wells, 2010).

Bird feeding guild is influenced by the changing of natural habitat. Within a habitat, different bird species will inhabit different niches based on the types of feeding guild. Vegetation structure as well as food availability and accessibility affect feeding activities. In this study, most insectivores, frugivores, and nectarivores were found in areas associated with forest edge and shrubs/secondary forests. Villagers often plant ornamental plants and fruit trees around their houses, which provide a source of food to insectivores, frugivores, and nectarivores. Insectivores prefer high closed canopy, dense vegetation (Mariyappan et al., 2023), and humid shaded plantations (Alvarez-Alvarez et al., 2022). Frugivores prefer below open canopy as fruits are more visible (Mariyappan et al., 2023) while nectarivores prefer complex vegetation structures (Alvarez-Alvarez et al., 2022) as well as open habitats that receive moderate disturbance with flowering plants (Chettri et al., 2005). A study by Wang et al. (2022) found that most bird species associated with forests feed on invertebrates whereas species associated with farmlands and villages feed on fruits and seeds. Granivores observed in this study, such as Zebra Dove and Eurasian Tree-sparrow, were found feeding on the ground in open areas such as car parks, abandoned football fields, and land clearings. The species prefers open and disturbed habitats due to large seed availability (Chettri et al., 2005). All the carnivores observed in this study (except Black Hornbill) were found near human settlements with tall trees or tall man-made structures such as lamp posts where they perched on branches to hunt for prey. The presence of carnivores is dependent on their prey (Chettri et al., 2005); as demonstrated in this study, *Halcyon smyrnensis* (White-throated Kingfisher) were always found near water bodies while *Centropus sinensis* (Greater Coucal) were seen hunting among bushes and tall grasses. Scavengers such as *Corvus macrorhynchos* (Large-billed Crow) and Common Myna were sometimes seen eating off carcasses on roads. Omnivores are generalists that can survive in various vegetation conditions (Mariyappan et al., 2023) and positively correlated with disturbed areas (Alvarez-Alvarez et al., 2022).

In densely populated tropical countries, land use change is the major cause of biodiversity loss. Shahabudin et al. (2021) studied the effects of land use change on forest bird species and guilds within a human-dominated landscape in the Western Himalaya, India

and found that forest specialists were replaced by commensals and open country species whereas forest generalists were least affected and constant across land use gradient. Forest-associated species found in this study, such as *Irena puella* (Asian Fairy-bluebird), Raffle's Malkoha, *Anthracoceros albirostris* (Oriental Pied Hornbill), *Loriculus galgulus* (Blue-crowned Hanging-parrot), and the endangered *Chloropsis sonnerati* (Greater Green Leafbird), might not survive urbanisation and open cultivation. Loss of bird biodiversity could result in changes in functional feeding guilds that are responsible for various ecosystem services. However, some birds are highly adapted to the changing environmental conditions as rural and suburban areas create the habitat for highly tolerant species (Morelli et al., 2021). Generalist species found in this study, such as Yellow-vented Bulbul, Plain Sunbird, and Common Myna, could survive environmental changes due to their varied diets as it means more food availability all year long in many locations (Elphick, 2014) and therefore contributes to the stable populations (IUCN Red List, 2021) of many LC species. Fragmenting natural habitats makes the interactions between humans and wildlife to be more common. Adams and Root (2022) found that in an oak-dominated forest, many bird species including forest-habitat, forest edge-habitat, residents, and migrants, displayed positive responses to tree cover, local building density, agriculture, and other rural land uses areas as tree cover becomes the primary source of habitat and the presence of bird feeders and attractions to cleared spaces diversify foraging opportunities.

According to the IUCN Red List, 25 of the observed species are listed as Least Concern (LC) (IUCN Red List, 2021) with one species (i.e., Rock Pigeon) was introduced in Malaysia through domestication as pets (Jeyarajasingam & Pearson, 2012). This species prefers open habitats and avoids areas with dense vegetation. In this study, this pigeon species was mostly found in the same open area near a resort in groups of less than 20 individuals with various plumage colours, from pure white, grey with glossy green chest, black, and a combination of black, brown, and white. One species observed in this study is listed as Near Threatened (NT), namely *Rubigula cyaniventris* (Grey-bellied Bulbul). This species has grey coloured head, neck, chest, and belly with olive-green wings and tail. A pair of the species was found once at the edge of a forest in Kampung Pagi. The main threat to this species is deforestation due to timber trade and agriculture (IUCN Red List, 2021).

Furthermore, three species observed in this study are listed as Vulnerable (VU) in the IUCN Red List (2021), namely *Anthracoceros malayanus* (Black Hornbill), Pale-capped Pigeon, and Javan Myna. All three species are native to this region except Javan Myna, which was introduced to Peninsular Malaysia from the Java Island in the 1900s and has since become widespread (Jeyarajasingam & Pearson, 2012). Javan Myna is considered VU in its native range (Java and Bali) only as the species is common and flourishing in the introduced regions. According to BirdLife International (2024), less than 10,000 individuals of this species have been found in Java and Bali, which is significantly fewer than the 20,000 to 168,000 individuals reported in Taiwan and Singapore in the year 2000. The major threat for Javan Myna within its native range is cage bird trade (IUCN Red List, 2021). During this study, this species was only seen once but in a large number of 17 individuals on the roof of a school. Both Black Hornbill and Pale-capped Pigeon are lowland forest inhabitants, but the pigeon can also be found in cultivated areas. Both species are threatened by deforestation for conversion of forests to agriculture and logging for timber trade (Kemp et al., 2020; BirdLife International, 2023b). In this study, Black Hornbills were observed four times, flying at low elevation in a pair of male and female. The males have whitish beak and white tail tip with black body and wings, whereas the females are all-black except for the underside of tail. Pale-capped Pigeon was seen once, perching on a tree by the roadside with dense vegetation in Kampung Kuala Tahan. This pigeon species is white-crowned with maroon wings and paler brownish maroon underside body parts. Additionally, one species is listed as

Endangered (EN), which is the Greater Green Leafbird. This vivid green-coloured species was observed twice in pairs of male and female at a forest edge near Kampung Pagi and on a tree by the roadside with dense vegetation at Kampung Kuala Tahan. In Malaysia, the major threat for this species is deforestation but in Indonesia, the major threat is bird trade as this species is used in bird singing events (Chng et al., 2017).

One species worth highlighting is the *Copsychus saularis* (Oriental Magpie-Robin), which is the most observed species based on the number of PC points (20 out of 23 PC points). This species can be found in most observation areas except areas adjacent to rainforests near Kampung Pagi. With its distinctive, varied, and melodious sounds, this species is not shy to human habitation (Ali & Mountfort, 2014) as it can be found in villages, shop lots, schools, and gardens in the study areas. A study done in 80 urban parks in Klang Valley, Selangor revealed that Oriental Magpie-Robin is the third most common species found out of 63 species identified, especially in parks with lots of green space areas and large trees (Nurul Aida et al., 2016) that harbour many types of insects for this species to feed on. The males have white belly with glossy black head, breast, wings, and white-sided tail whereas the females are dark grey in colour. They can mostly be found solitary or in pairs, perching on trees, various man-made structures like lamp posts and fences, as well as on the ground. In Malaysia, Oriental Magpie-Robin can be found in various type of habitats, such as shrubs, woodlands, forest edges, mangrove forests, and cultivated lands. They are insectivores foraging on various insects and worms (Mohamed Zakaria & Rajpar, 2014).

Conclusion

A total of 179 individuals across 30 species from 13 bird families were found in 23 PC locations inside the study areas with the Pycnonotidae family being the highest number of species observed (7 species). Six feeding guilds were determined with insectivore as the most common guild. The bird species found locally within an area must be considered in development policies, especially for developing areas adjacent to rainforests to sustain local bird populations, which eventually contribute to various local ecosystem services. Binoculars are a useful approach for observing birds; however, the binoculars used in this study were unsuitable in low light conditions, such as inside dense tree stands or during rainy days due to incompatibility (not waterproof) and visibility (small objective lens diameter hence less light entering the binoculars). During these conditions, observations were halted, thus cutting short the duration of observation. Also, the population size of birds could not be estimated due to the very short duration (three days) of observation. This limits the opportunity to observe rarer birds. Future research is recommended to observe birds in longer periods, including breeding and non-breeding seasons, to measure multi-species biodiversity indices for more scientifically robust information. With permission from PERHILITAN, the animals may be captured using camera traps or caught using nets and tagged for population monitoring, including population size, activity patterns, and behaviours. Future observations may include large agricultural areas such as oil palm and rubber tree plantations or any large clearings that are adjacent to rainforests. It is recommended for the local authorities and communities to work together in conserving local bird diversity by implementing sustainable development such as planting, restoring, or maintaining native or woody trees to support the avian community.

Ethics Statement

The research does not require research ethics approval.

Authors Contribution

Nur Thabitah Shaikh Nasir and Nor Lailatul Wahidah Musa conducted the observation and documentation. Nur Thabitah Shaikh Nasir wrote the article. All authors conceptualised the central research idea, sought relevant information regarding the research, designed the research, and revised the article.

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Conflict of interests

The author declares that there is no conflict of interest with this paper.

References

Adams, B. T. & Root, K. V. (2022). Multi-scale responses of bird species to tree cover and de velopment in an urbanizing landscape. *Urban Forestry & Urban Greening, 73,* 127601.

Ali, S. & Mountfort, G. R. (2014). Southern Asia: The Oriental Realm. In P. Scott, R. T. Peter son, C. H. Fry, J. J. M. Flegg, G. Vevers & O. S. Pettingill Jr. (Eds.), *The World Atlas of Birds* (pp. 160-179). Chartwell Books.

Alvarez-Alvarez, E. A., Almazán-Nuñéz, Corcuera, P., González-Garcia, F., Brito-Millán, M. & Alvarado-Castro, V. M. (2022). Land use cover changes the bird distribution and functional groups at the local and landscape level in a Mexican shaded-coffee agro forestry system. *Agriculture, Ecosystems & Environment, 330*, 107882.

Bibby, C., Jones, M. & Marsden, S. *Expedition Field Techniques: Bird Surveys.* BirdLife International.

BirdLife International (2023a). *Data Zone - Country profile: Malaysia*. http://www.datazone.birdlife.org/country/malaysia

BirdLife International (2023b). *Data Zone – Pale-capped Pigeon* Columba punicea. http://datazone.birdlife.org/species/factsheet/pale-capped-pigeon-columba-punicea

BirdLife International (2024). *Species factsheet:* Acridotheres javanicus. https://datazone.bird life.org/species/factsheet/javan-myna-acridotheres-javanicus

Chng, S.C.L., Eaton, J.A. & Miller, A.E. (2017). Greater Green Leafbirds: the trade in South-east Asia with a focus on Indonesia. *Traffic Bulletin*, *29*(1): 4-8.

Chettri, N., Deb, D. C., Sharma, E. & Jackson, R. (2005). The Relationship Between Bird Communities and Habitat. *Mountain Research and Development, 25(3)*, 235-243.

Elphick, J. (2014). *The World of Birds.* National History Museum.

Fraixedas, S., Lindén, A., Piha, M., Cabeza, M., Gregory, R. & Lehikoinen, A. (2020). A state-of-the-art review on birds as indicators of biodiversity: Advances, challenges, and future directions. *Ecological Indicators, 118,* 106728.

Google Maps (26 Mar. 2024). *Taman Negara Kuala Tahan*. Retrieved from https://www.google.com/maps/@4.4103914,102.4422369,14030m/data=!3m1!1e3?entry=ttu

IUCN Red List (2021). *The IUCN Red List of Threatened Species*. https://www.iucnredlist.org/

Jeyarajasingam, A. & Pearson, A. (2012). *The Birds of Peninsular Malaysia and Singapore* (2nd ed.). Oxford University Press.

Kemp, A.C., Boesman, P. & Sharpe, C.J. (2020). *Black Hornbill* (*Anthracoceros malayanus)*. https://www.hbw.com/node/55906

Lim. K. S., Yong, D. L. & Lim, K. C. (2020). *Birds of Malaysia & Singapore*. Princeton University Press.

Mariyappan, M., Rajendran, M., Velu, S., Johnson, A. D., Dinesh, G. K., Solaimuthu, K., Kaliyappan, M. & Sankar, M. (2023). Ecological Role and Ecosystem Services of Birds: A Review. *International Journal of Environment and Climate Change, 13(6),* 76–87.

Mohamed Zakaria, H. & Rajpar, M. N. (2014). *Birds of Wetlands in Peninsular Malaysia*. Universiti Putra Malaysia Press.

Morelli, F., Reif, J., Díaz, M., Tryjanowski, P., DiegoIbáñez-Álamo, J., Jokimäki, J., Kaisanlahti-Jokimäki, M. L., Møller, A. P., Bussière, R., Mägi, M., Kominos, T., Galanaki, A., Bukas, N., Markó, G., Pruscini, F., Jerzak, L., Ciebiera, O., & Benedetti, Y. (2021). Top ten birds indicators of high environmental quality in European cities. *Ecological Indicators, 133,* 108397.

Nurul Aida, Selvadurai Sasidhran, Norizah Kamarudin, Najjib Aziz, Chong, L. P. & Badrul Azhar. (2016). Woody trees, green space and park size improve avian biodiversity in urban landscapes of Peninsular Malaysia. *Ecological Indicators, 69,* 176-183.

Robson, C. (2015). *Birds of South-East Asia* (2nd ed.). Bloomsbury Publishing Plc.

Saad, M. N., Singh, H. R., Daim, M. S. & Mamat, I. (2012). Avian Communities from Differentially Disturbed Riparian Forest Along the Tembeling River, Taman Negara Pahang, Malaysia. *2012 IEEE Symposium on Business, Engineering & Industrial Applications,* 169-174.

Shahabudin, G., Goswani, R., Krishnadas, M. & Menon, T. (2021). Decline in forest bird species and guilds due to land use change in Western Himalaya. *Global Ecology and Conservation, 25,* e01447.

Stagoll, K., Manning, A. D., Knight, E., Fischer, J. & Lindenmayer, D. B. (2010). Using bird-

habitat relationships to inform urban planning. *Landscape and Urban Planning*, *98(1),* 13-25.

Wang, X., Zhu, G., Ma, H., Wu, Y., Zhang, W., Zhang, Y., Li, C. & de Boer, W. F. (2022). Bird communities' responses to human-modified landscapes in the southern Anhui Mo untainous Area. *Avian Research, 13,* 100006.

Wang, Y., Xu, J., Chen, J., Wu, B. & Lu, Q. (2014). Influence of the habitat change for birds on community structure. *Acta Ecologica Sinica, 34(1),* 1-6.

Wells, D. R. (2010). *The Birds of Thai-Malay Peninsula: Passerines* (Vol. 2). Christopher Helm.