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Bird Diversity in Ayer Hitam Utara Forest Reserve, Johor and Implications on Peat Swamp Forest Management Strategies

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Abstract: Ayer Hitam Utara Forest Reserve (AHUFR) is the largest and last existing peat swamp forest in Johor. Peat swamp forest are known to be very important as it serve as a home to variety of flora and fauna, especially the bird species. Other than that, peat swamp forest also prone to forest fire as it become the major threat in Ayer Hitam Utara Forest Reserve during a hot weather or drought (El Nino events). This problem will cause biodiversity loss and threaten bird's habitat and behaviour since some birds are extremely susceptible to sudden environmental changes. Therefore, effective management need to be implemented on the peat swamp ecosystem in order to conserve the forest as well as the bird species that inhabit the area. Hence, this study was conducted to provide a preliminary checklist of the bird, while identify the threats faced by AHUFR in order to came out with the best management of peat swamp forest to protect the bird and the wildlife in it. The method used in this study are mist-netting, direct observation with the aid of DSLR camera, video camera, binocular, and spotter scope, sound recording and interview with forest ranger for four days. About 15 species was recorded, five species from direct observation and interview method, three species from sound recording, and two species from mist-netting method. From the data, one vulnerable (VU) and near threatened (NT) species was recorded which are Black Hornbill (*Anthracoceros malayanus*) (VU) and Fluffy-backed Tit-babbler (*Macronus ptilosus*) (NT) respectively. Both are native to peat swamp forest. In terms of threat, forest fire was identified as a common problem occurring in AHUFR. The bird diversity in AHUFR can be threatened by the forest fire if there are no action or management taken to by various parties as well as spreading the awareness among the communities according to this issue. Therefore, this study suggested few recommendations of best practices to manage peat swamp forest of AHUFR.

Keywords: Peat swamp forest, bird diversity, forest fire, ecosystem management

1. Introduction

Peat swamp forest worldwide covers about 350,00 km^2 [1] where it can be found in several places including Africa, some parts of Central and South America, but the majority of them are in Southeast Asia (60%) [2]. Malaysia was known as the second-largest peat swamp forest in Southeast Asia following Indonesia with 2,588,900 hectares [3]. Malaysia's

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peat swamp forests account for over 75 % of the country's total wetlands [4]. There are predicted to be around 1.54 million hectares left, with 80 % in east Malaysia (Sarawak 73 %; Sabah 8 %) and 20 % in Peninsular Malaysia. Ayer Hitam Utara Forest Reserve is known to be the largest and last existing peat swamp forest that can only be found in Johor that covers about 3,797 acres, where the conservation and protection of this area are crucial [5].

Peat swamp forest is very important to conserve biodiversity because there are at least 1,524 plants, 123 mammals, 286 birds, 219 fresh-water fish species, a very large number of invertebrates, as well as a diverse range of bryophytes, ferns, and fungi [6]. Several tree species have been stated by [7] that are native to peat swamp forest including *jongkong (Dactylocladus stenostachys), ramin (Gonystylus bancanus), terentang (Campnosperma* spp.*),* and *kapur paya (Dryobalanops rappa)*, while there are also several rare, endangered and endemic animals that inhabit the peat swamp forest such as the Bornean orangutan, Southern Bornean gibbon, Sumatran tiger, Sumatran elephant [6][8], and freshwater crocodile, the false gharial [3]. As for the birds, peat swamp forest consists of a large number of rare and threatened species as well as a stopover of migratory birds such as Rufous-tailed Shama (*Copsychus pyrropygus*), Grey-chested Jungle Flycatcher (*Cyornis umbratilis*), Grey-breasted Babbler (*Malacopteron albogulare*), Scarlet-breasted Flowerpecker (*Prionochilus thoracicus*) [7] and many more. Furthermore, it serves as an essential ecosystem service, such as flood mitigation, river flow regulation, tidal flood protection near the coastline, and carbon sink that actively accumulate carbon in the long term [5].

However, the peat swamp forest is prone to a range of threats, including logging for a valuable timber species, land conversion for agriculture and plantation, hydrological problems of water resources affected by the canals system [5] and, forest fire existing from uncontrolled land use or during extreme drought (strong El Nino events). This can bring a negative impact to the birds as some birds are extremely susceptible to sudden environmental changes [10]. So, the need for effective management is vital to mitigate this disturbance.

This study will provide a preliminary checklist of birds since there is a lack of publishable scientific records or data of bird species in Ayer Hitam Utara Forest Reserve. Other than that, the threats faced by the Ayer Hitam Utara Forest reserve will be identified through an interview and possible suggestions will be recommended for proper management of birds in AHUFR.

2. Methodology

2.1 Study Area

Ayer Hitam Utara Forest Reserve is located in the Muar district, Johor (1° 52' North, 103° 11' East) of Peninsular Malaysia. This area is known to be the largest and last peat swamp forest that covers around 3,797 hectares (ha) (Fig. 1). Besides that, the forest has been surrounded by oil palm plantations, cash crops, and also settlement areas [5] where it is threatened by forest fire and intrusion of local people activities associated with minor agriculture activities near the forest reserve's boundary.

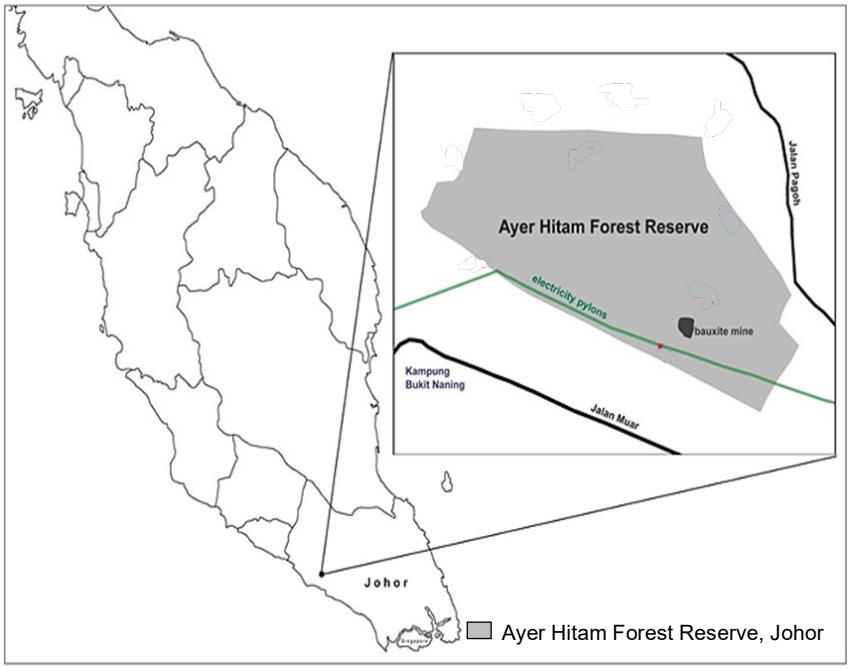

Fig. 1 - Map of Ayer Hitam Utara Forest Reserve, Johor

2.2 Direct Observation Technique and Sound Recording Method

Direct observation technique was used to observe the birds near the secondary forest area and around the outside of the peat swamp forest with the aid of the DSLR camera (Nikon P1 500), binocular [11], video camera and spotter scope throughout the four days of sampling. The distance of 100 m away was set while observing the birds so that it does not affect the bird's activity. Moreover, the sound recording method also was used using a smartphone to record the sound of the unseen canopy birds.

2.3 Mist-netting Method and Bird Identification

The mist-netting method was used to sample birds. About 8 mist net (2.5 m x 3 m x 3m) was set up at the right and left side of each trail (estimates at 500 m and below) and an open area at the secondary forest from 0830 till 1630 for four days sampling. For every two hours interval, the net was routinely checked [11]. All the bird captured was identified using a field guide to the birds of Peninsular Malaysia and Singapore [12] and the birds will be released back to the wild.

2.4 Interview Session

The interview session was conducted on the last day of bird sampling that involves three forest rangers. Three types of question have been asked regarding the bird species that can be found in Ayer Hitam Utara Forest Reserve, the threats or disturbances that mostly occurred in Ayer Hitam Utara Forest Reserve, and lastly about the management that has been taken by forestry department to protect and conserve the Ayer Hitam Utara Forest Reserve.

3. Results and Discussion

3.1 Species Composition of Birds

A total of 15 species belonging to 12 families were recorded throughout the four days sampling period (Table 1). There were about 5 (33.3%) species was recorded by the observation technique and interview session, while for mist-netting method and sound recording methods, only 2 (13.3%) species for mist-netting method and 3 (20%) species for sound recording was documented during the bird sampling. Next, 2 out of 15 species were listed as vulnerable species which is Black Hornbill (*Anthracoceros malayanus)* and near threatened species which is Fluffy-backed Tit-babbler (*Macronus ptilosus*). Through the research, 10 species were recorded as totally protected and 5 species were recorded as protected under the Wildlife Conservation Act, 2010 (Act 176).

Table 1 - List of distribution status of birds in Ayer Hitam Utara Forest Reserve, Johor

No.	Family	Scientific Name	Common Name	Local Name	Residential Status [13]	Act 716 [14]	Conservation Status [15]	Method
1	Muscicapidae	*Copsychus malabaricus*	White-rumped Shama	*Murai Batu*	N	P	LC	Mist-netting
2	Pycnonotidae	*Rubigula erythropthalmos*	Spectacled Bulbul	*Merbah Kecil*	N	TP	LC	Mist-netting
3		*Pycnonotus plumosus*	Olive-winged Bulbul	*Merbah Belukar*	N	TP	LC	Observation
4	Phylloscopidae	*Phylloscopus inornatus*	Yellow-browed Warbler	*Cekup Rimba*	M	P	LC	Observation
5	Accipitridae	*Spilornis cheela*	Crested Serpent Eagle	*Helang Berjambul*	N	TP	LC	Observation
6		*Nisaetus ciirrhatus*	Changeable Hawk-eagle (dark morph)	*Helang Hindek*	NN	TP	LC	Observation
7	Apodidae	*Aerodramus fuciphagus*	White-nest Swiftlets	*Layang-layang Gua*	N	P	LC	Observation
8		*Cypsiurus balasiensis*	Asian Palm Swift	*Layang-layang Asia*	N	TP	LC	Interview

9	Bucerotidae	*Anthracoceros malayanus*	Black Hornbill	*Enggang Hitam*	N	TP	VU	Interview
10	Columbidae	*Chalcophaps indica*	Emerald Dove	*Punai Tanah*	N	P	LC	Interview
11	Caprimulgidae	*Caprimulgus macrurus*	Large-tailed Nightjar	*Burung Tukang*	N	TP	LC	Interview
12	Aegithinidae	*Aegithina tiphia*	Common Iora	*Kelicap Kunyit*	N	P	LC	Interview
13	Timaliidae	*Macronus ptilosus*	Fluffy-backed Tit-babbler	*Rimba Pong-pong*	N	TP	NT	Sound recording
14	Ramphastidae	*Psilopogon duvaucelii*	Blue-eared Barbet	*Takur Pipi Biru*	N	TP	LC	Sound recording
15	Alcedinidae	*Halcyon smyrnensis*	White-breasted Kingfisher	*Pekaka Belukar*	N	TP	LC	Sound recording
Total number of species = 15 species **Total number of families = 12 families**								

*Note: Act 716 = Wildlife Conservation Act, 2010
(Legend: Act 716; TP = Totally Protected, P = Protected. Residential Status; N = Native, M = Migrant, NN = Non-native. Conservation Status; LC = Least Concern, VU = Vulnerable, NT = Near Threatened)

Based on the unpublish bird record by [16] that has been surveyed on February 2021 in Ayer Hitam Utara Forest Reserve, 18 species from 13 families was recorded. From the 18 species, two birds were listed as near threatened species (NT), and one bird as vulnerable (VU) and endangered (EN) species respectively. The birds are Lesser Green Leafbird (*Chloropsis cyanopogon*) (NT), Black-and-yellow Broadbill (*Eurylaimus ochromalus*) (NT), Javan Myna (*Acridotheres javanicus*) (VU) and Buff-rumped Woodpecker (*Meiglyptes tristis*) (EN).

During the sampling, mostly bird data collection was come from direct observation and interview with the forest ranger. Hence, it shows that direct observation techniques and interviews are most effective in sampling the birds in a limited time of sampling for this study in which four days sampling. For the mist-netting method and sound recording, it was not effective due to several obstacles that occurred during the sampling such as unpredictable weather like heavy rain during the sampling and ambient noise disturbance such as human voice, water generator and, sound from car, motorcycle, and lorry. This causes not many birds to fly out and emerge outside the secondary forest and peat swamp forest. As a result, it led to the low capture rate of birds, specifically during heavy rain. Generally, when the heavy rain comes, most birds preferred to sit and take shelter as well as store energy under the canopy of the tree since they are waterproof [17].

From Table 1, ten species that are recorded as totally protected, and five species were recorded as protected under the Wild Conservation Act, 2010. According to [14], a totally protected species means the species cannot be hunted, taken, or kept without a special license as this legislation appears to be an attempt to reduce indiscriminate wildlife collection and hunting, to tighten control of illicit wildlife trafficking, and to safeguard threatened species in Peninsula Malaysia. The high occurrence of totally protected bird species in Ayer Hitam Utara Forest Reserve shows that the conservation value of peat swamp forest is at its best condition where it means that the forest is still protected from poachers or the forest was less explored thus providing habitat with good sources of food to these birds.

3.2 Threats to Peat Swamp Forest and Impact on the Bird

The common threat that always occurred in the peat swamp ecosystems is forest fire due to the drying of peat during the hot weather or drought (such as in March and April), and also from human activity. In 2020 and 2021, a forest fired was occurred in Ayer Hitam Utara Forest Reserve where it happened near the forest reserve border caused by the open burning by man and also hot weather at that time. However, this fire did not severely damage the peat swamp habitat as it was successfully controlled by Johore Malaysian Fire and Rescue Department (JBPM), volunteer firefighters, Malaysian Civil Defence Department (JPAM), and many more before it spread widely to other parts. Despite that, the authorities should closely monitor the forest fire as well as new and latest management need to establish in order to control the fire. This is to ensure that it will not threaten the animals, especially birds that occupy the peat swamp forest. Rereferring to the forest fire that occurred in the Kalimantan peat swamp forest, the forest fire event in 1997 - 1998 and 2015 - 2016 is the worst fire ever [18] as it had a significant detrimental influence on biodiversity [19]. One of the species that are affected by this even is Bornean orangutan (*Pongo pygmaeus*) since this species is abundant in the Kalimantan. In addition, the impact of forest fires in Kalimantan has also resulted in a 40.1 % drop in forestland, from 106,554 hectares in August 2008 to 63,848 hectares in October/November 2015 [19].

Forest fire also give a huge impact on the birds. It plays an important role in structuring habitat conditions such as it alters vegetation heterogeneity and resource availability where it affects the behaviour of the wild species including birds [20]. There are several effects of forest fire on the birds based on the previous study. A forest fire can cause indirect impact on birds through habitat disturbance [21] by decreasing the bird nests on trees or bushes [22][23][24]. Other than that, the loss of structural density of vegetation will reduce the presence and abundance of forest bird species, encouraging the growth of habitat generalists and open area species, which are likely ecologically suited to disruptions induced by fire [25]. Moreover, forest fire restricted the availability of food for the birds, with insectivorous species being among the most impacted, especially those that feed on the leaves and stems of trees or shrubs [25]. Forest fire also can cause changes in the number of rivals or predators [21] due to the loss in understory vegetation cover by enhanced the potential threat of nest predation and parasitism in ground-nesting birds [27][28][29].

3.3 Suggestion for Management of Peat Swamp Forest

3.3.1 Water Table Management and Monitoring

Water table management and monitoring are one of the managements to halt the forest fire due to the excessive drying of peatlands caused by inadequate water management and over-drainage. It was done by strategically placing and numbering water level gauges at the openings of collecting drains behind each stop-off while the water management officer monitors it for efficient and timely water control at the optimum level [30]. Furthermore, coordination should also be established between the water management team and the fire control units to identify dry and fire-prone regions inside the plantation systematically.

3.3.2 Fire Kit Detector

Fire kit detector used the technology to detect the early fire that occurred in a peat swamp and enhance fire monitoring management in terms of speed, accuracy, and systematic approach to coordinating fire warnings. The sensor node network has been chosen as the most effective fire kit detector to detect the fire [31] in Ayer Hitam Utara Forest Reserve as the authorities will get fire alerts if smoke is detected via smartphones, laptops, or computers. The sensor node network was designed with the help of Internet of Things (IoT) technology and the aid of solar panels as a source of electricity supply. Then the remote server will collect and store all the data delivered from node-gateway sensors, while fire notifications will be provided through Telegram [31].

3.3.3 An Ecotourism Hotpsot

By making the Ayer Hitam Utara Forest Reserve an ecotourism hotspot, it can help in conserving the peat swamp forest as the local community tend to protect the area if the area can generate income. This statement can be supported by study by [32] and [33] where ecotourism is a way to maximize social and economic advantages while simultaneously acting as a development tool that helps to conserve the environment by limiting adverse effects and promoting the use of local resources. Moreover, ecotourism encourages communities to protect and conserve the forest and wildlife by providing the local peoples with opportunities to improve their well-being and help to receive direct and indirect benefits such as jobs, earning income, sources of food, water supply for agriculture and many more.

3.3.4 Awareness and Rehabilitation Program/Campaign

Awareness and rehabilitation program/campaign involve many stakeholders and parties in which it was the most effective management as it required to increase the awareness and deliver the knowledge among the stakeholders and parties. Several program or campaign has been done in Ayer Hitam Utara Forest Reserve organized by various authorities since there is concern to protect and conserve the last remaining peat swamp forest in Johor. Among the programs that have been run in Ayer Hitam Utara Forest Reserve include the “Go Green” program organized by North Johor District Forest Office on 17 November 2018. This program involves the activity such as planting tree and exhibitions about the flora and fauna found in the peat swamp forest. Next is a “Forest Fire and Forest Offense Awareness campaign with the Forest Local Community” in the year 2020 where the team of *'Semut Merah'* has been formed to serve as the first party to prevent forest fires from spreading while waiting for Fire and Rescue to arrive at the site to put out the fire. The last one is the "Water For Life" program conducted by Coca-Cola in collaboration with Yayasan Kemanusiaan Muslim Aid Malaysia (Muslim Aid), the Forest Research Institute Malaysia (FRIM), and the Johor State Forestry Department in 2017. The program aims to provide technical advice, restoration, and rehabilitation work by FRIM and the Forestry Department, while Muslim Aid organizes and manages the project and community engagement. At the same time, the officers from the Forestry Department also trained the community about fire prevention and mitigation.

The awareness and rehabilitation program/campaign are effective in protecting the peat swamp forest. This can be proved by the conservation program that has been carried out in Raja Musa Peat Swamp Forest Reserve, Selangor. According to [34], the awareness and rehabilitation program participated by local community were successful as it decreased the occurrences of peat swamp forest fire events, detected no more new cases of intrusion along the forest

reserve border, observed natural regeneration in areas where hydrological restoration was carried out, and lastly, increased above-ground carbon content as a result of a productive tree planting program and the elimination of peat fires.

4. Conclusion

To conclude, this study is to provide an updated preliminary checklist of bird species where there are about 15 species of birds from 12 families were recorded at the secondary forest and peat swamp forest during the four days sampling. However, due to the short period of conducting the bird sampling in Ayer Hitam Utara Forest Reserve, the preliminary checklist of birds was documented only a few species, but it still can help in updating the current bird species that inhibit the peat swamp forest since it is vulnerable and near threatened bird species was recorded during the sampling. The threat faced by Ayer Hitam Utara Forest Reserve must be taken seriously since a severe damage done by forest fire can bring a big impact to the peat swamp ecosystem such as the fire that broke out in Kalimantan. Hence, appropriate management will help in controlling the forest fire and also the cooperation from various parties are crucial for the management to be successful.

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