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Temporal change in the composition of the bird community in isolated forests in Kuala Lumpur, Malaysia

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ABSTRACT The effects of forest disturbance on birds inhabiting three urban forest islands around Kuala Lumpur, Malaysia, were studied. This study was done on forest islands located in city areas, i.e., Bukit Gasing Forest Reserve (BGF), Taman Seputih Forest (TSF) and the patch of green area in University of Malaya campus (UMF). The forest fragments have different sizes; BGF is the largest (45 ha) followed by TSF (7 ha) and UMF (0.5 ha). Study was carried out in 1991 and 1997 to examine the effects of forest disturbance on the composition of bird community inhabiting each study area. Direct observation method had recorded more birds compared to mist-netting. Results has shown that there is no changes in species composition of birds inhabiting TSF, contrary to bird community in UMF and BGF, that shows major changes. Four species had totally vanished from BGF and 10 species of UMF had suffered local extinction. The main factor for this reduction is habitat degradation and/or habitat loss around and within the study areas due to rapid urbanization. In addition to this, direct human disturbance such as poaching also plays as a contributing factor.

ABSTRAK Kajian mengenai kesan gangguan hutan ke atas burung-burung yang mendiami tiga kepulauan hutan di sekitar Kuala Lumpur, Malaysia telah dilakukan. Kajian telah dijalankan di tiga kepulauan hutan yang terletak di kawasan perbandaran iaitu Hutan Simpan Bukit Gasing (BGF), Hutan Taman Seputih (TSF) dan sebahagian kawasan hijau di kampus Universiti Malaya (UMF). Pulau-pulau hutan ini mempunyai saiz yang berbeza-beza; BGF merupakan yang terbesar (45 ha), diikuti oleh TSF (7 ha) dan UMF (0.5 ha). Kajian yang dilakukan pada 1991 dan 1997 ini adalah untuk menyelidik kesan gangguan hutan ke atas komuniti burung yang mendiami kawasan-kawasan kajian. Kebanyakan burung telah direkodkan melalui kaedah pemerhatian langsung dan sebilangan kecil ditangkap menggunakan jaring kabus. Hasil kaijan menunjukkan komposisi spesies di TSF kekal tidak berubah tetapi komuniti burung di UMF dan BGF menunjukkan sedikit perubahan. Empat spesies yang mendiami BGF telah lenyap manakala 10 spesies dari tapak kajian UMF mengalami kepupusan tempatan. Faktor utama yang menyebabkan pengurangan ini adalah kerosakan atau kehilangan habitat di sekitar atau di sekeliling kawasan kajian ekoran proses pembangunan yang berkembang pesat. Selain daripada itu, gangguan lansung daripada manusia seperti pemburuan haram juga merupakan faktor penyumbang.

(Urban birds, forest island, biodiversity, urbanization, bird diversity, habitat degradation, man-made habitat)

INTRODUCTION

Urban birds are birds that spend all or part of their life in an urban environment [1]. Although some of these birds have modified their habitat requirement and successfully flourish in urban area, others still need natural forest for survival. Therefore, establishing parks or preserving patches of natural forests (commonly known as forest island or fragmented forest) is important in ensuring survival of more species of birds. These green areas are not only essential for wildlife but are also beneficial to human for recreational and social purposes.

Urbanization had changed original forest into human habitat to better suit their needs [1]. This converting process had affected wildlife due to re-arrangement of resources (such as food, water and shelter) provided by natural habitat [1]. Some animals such as birds are more affected than others since different species have their preferences in utilizing resources available in a particular habitat. Moreover, birds recognize the

environment by signals or cues in the characteristics of the vegetation in the habitat [2].

The effect of forest disturbance on birds varies according to species. Habitat specialist species such as flycatchers, babblers, kingfisher and warblers are more susceptible and tend to decrease in number as a response to urbanization, whereas habitat generalists such as crows, doves, starlings and sparrows are easily adapted species and will have better chances for survival [1, 3]. Species that fail to utilize new environment have to move away, searching for suitable habitat. Unfortunately not every species has the opportunity to migrate or successfully find available habitat. These species have to face the consequence of urbanization. Living in unfavorable environment will eventually lead them to extinction.

Growing human populations in urban area escalate direct disturbance on nesting and roosting sites [4]. Human disturbance can be a serious problem for birds because it can cause displacement, prevent access to resources, and reduce reproduction and survival [5, 6]. Ecotourists and recreationists are two major groups of people that cause this [7]. Recreational activities such as jogging and walking, especially near urban forest could disperse certain birds to the more remote parts of the forest [5].

Extensive study on urban ecosystems has only been carried out since 1970s [8, 9]. These studies have revealed that in spite of extreme urbanization urban forest still has the capability to support wildlife if its important ecological features are retained [10, 11]. On top of providing nesting habitat for many avian species, urban parks or green areas can also act as a stopover point for migratory birds [12]. Furthermore, the presence of birds in urban area will increase esthetical and social values for urban community. Urban birds population also have recreational, conservational, and scientific values that have not been fully appreciated [12]. This study was carried out to examine the effects of forest disturbance (such as fragmentation and shrinkage) on the structure of bird community inhabiting various urban forests/parks.

METHOD

Studies on three urban forests around Kuala Lumpur, Malaysia were carried out in 1991 and 1997. The study areas were Bukit Gasing Forest Reserve (BGF), Taman Seputih Forest (TSF), and patch of green areas in University of Malaya campus (near to First and Second Residential College; UMF). These areas have different sizes (0.5 ha for UMF; 7 ha for TSF; and 45 ha for BGF) and are located at longitude $101^{\circ}40'$T and latitude $3^{\circ}05'$U. Although these forest islands are situated closely (less than 2 km apart) in valley area and surrounded by low hills (40-160 m high), they are completely isolated from each other by highways and concrete building. Field surveys were conducted once a week in all study areas starting from June to October each year. Sampling time was recorded during every survey. Two standard methods (direct observation and mist-netting) were used to determine bird species. In observing birds, the author was walking within the study areas and recorded everything seen or heard within 50 meter of each side of trail. Observations were carried out in morning and afternoon sessions. The morning session started at 0700 and ended at 1000, while the afternoon session started at 1600 until 1830.

Mist netting was carried out once a week during study period in various parts of the forest. Ten mist-nets were set up at various sites for twelve hours from 0700 to 1900. These nets measured 39 m long and 2.5 m wide. All nets were set up 0.5 m above the ground to avoid predation from ground animals. Regular checking (every 30 minutes) of mist-nets was done. Trapped birds were identified and several standard parameters such as total length, body length, wing length, tarsal length, etc. were recorded. Identification was done according to Smythies [13], King *et al.*, [14], Medway and Wells [15], Strange and Jeyarajasingam [16], and Davison and Chew [17].

RESULTS

This study has revealed that 72 species of birds inhabiting three urban forests around Kuala Lumpur (Appendix 1). The distribution pattern of these birds varied among study areas. The majority of species were found in BGF (86% in 1991, 90% in 1997), followed by TSF (57% in 1991, 59% in 1997) and the green patch of UMF (42% in 1991, 30% in 1997) (Table 1). The UMF area suffered heavy loss with ten species vanishing from its compound (Appendix 1). Although they were missing from UMF during

second survey, some of these species appeared in BGF, suggesting that they had migrated to the latter area. Five new species were added into the 1997 BGF list - Ashy Drongo (*Dicrurus leucophaeus*), Asian Paradise Flycacther (*Tersiphone paradisi*), Crested Serpent-Eagle (*Spilornis cheela*), Japanese Sparrowhawk (*Accipiter gularis*) and Pied Triller (*Lalale nigra*). While accepting new species into its habitat, BGF also suffered local extinctions. The census in 1997 discovered that four species - Chested Munia (*Lonchura malacca*), White-Breasted Waterhen (*Amaurornis phoenicurus*), White-headed Munia (*Lonchura maja*), and White-rumped munia (*Lonchura striata*) - had disappeared from BGF (Appendix 1). Although there was a great change in species composition of BGF and UMF areas, TSF bird list remained unchanged either in species number or composition (Table 1).

Table 1. Status of bird species found in three urban forests around Kuala Lumpur, Malaysia (Note: BGF, Bukit Gasing Forest Reserve; TSF, Taman Seputih Forest; UMF, patch of green area in University of Malaya campus)

	1991				1997			
	BGF	**TSF**	**UMF**	**Total**	**BGF**	**TSF**	**UMF**	**Total**
Number of Species	63	42	31	73	64	42	21	71
Species Percentage	86	57	42	100	90	57	30	100
Migrant Species	7	3	2	8	8	3	0	8
Resident Species	50	34	25	57	49	34	19	55
Introduced Species	3	3	1	3	3	3	1	3
Uncertain Species	3	2	3	5	4	2	1	5

Table 2. Observation efficiency by different methods (number of birds/hour)

	Direct observation		**Mist-netting**	
	1991	**1997**	**1991**	**1997**
Bukit Gasing Forest Reserve	24	3	0.40	0.53
Taman Seputih Forest	11	2	0.40	0.42
University of Malaya Forest	5	1	0.10	0.50
Total	**40**	**6**	**0.90**	**1.45**

Most of the species found in this study were resident birds (78%); eight species (11%) were migratory birds and five species (7%) with uncertain status. In addition, three introduced species - House Crow (*Corvus splendens*), Hwamei (*Garrulax canorus*) and Rock Pigeon (*Columba livia*) – survived successfully in all study areas. More resident birds were present in all study areas during both surveys ($\chi^2 2 = 0.044$, $P < 0.97$ in 1991 and $\chi^2 2 = 1.949$, $P < 0.25$ in 1997). In second census, BGF and UMF showed changes in their bird species composition. UMF lost its migrant species (from two to none), six resident species and two uncertain species. Although four species (three resident and one with uncertain status) have disappeared from BGF, three new species (2 resident and a migrant) were added into the list (Table 1, Appendix 1).

Appendix 1. List of bird species found in three urban forests around Kuala Lumpur, Malaysia. (resident species (R) = breed locally throughout the year; migrant (M) = migrate to other areas (not locally) for some period of time during specific years; Introduce (I) = species that has been introduced into this country; common (C) = easy to find; abundant (A) = widely distributed; Rare (U) = only been observed less than ten times). For site name abbreviations see Table 1.

SPECIES	STATUS	1991			1997		
		BGF	TSF	UMF	BGF	TSF	UMF
Abbott's Babbler *Trichostoma abbotti*	C; R	√		√	√		√
Arctic Warbler *Phylloscopus borealis*	C; M	√			√		
Ashy Drongo *Dicrurus leucophaeus*	C; R/M			√	√		
Ashy Minivet *Pericrocotus divaricatus*	C; M	√			√		
Asian Paradise-Flycactcher *Tersiphone paradisi*	C; R/M			√	√		
Banded Woodpecker *Picus miniaceus*	C; R	√			√		
Barn Swallow *Hirundo rustica*	A; M	√			√		
Black-naped Oriole *Oriolus chinensis*	A; R/M	√	√	√	√	√	√
Blue-tailed Bee-eater *Merops philippinus*	U; R	√	√		√	√	
Blue-throated Bee-eater *Merops viridis*	C; R	√	√		√	√	√
Brahminy Kite *Haliastur indus*	C; R		√			√	
Brown Shrike *Lanius cristatus*	C; M	√	√		√	√	
Brown-throated Sunbird *Anthreptes malacensis*	C; R		√			√	
Buff-necked Woodpecker *Meiglyptes tukki*	U; R	√			√		
Chested Munia *Lonchura Malacca*	C; R	√					
Common Iora *Aegithina tiphia*	C; R	√			√		
Common Koel *Eudynomys scolopacea*	C; R/M	√			√		
Common Myna *Acridotheres tristis*	A; R	√	√	√	√	√	√
Crested Serpent Eagle, *Spilornis cheela*	C; R		√	√	√	√	
Crimson Sunbird *Aethopyga siparaja*	U; R	√			√		
Crimson-winged Woodpecker *Picus puniceus*	C; R	√			√		
Dark Necked Tailorbird *Orthotomus atrogularis*	C; R	√	√		√	√	
Eurasian Tree-Sparrow *Passer montanus*	A; R	√	√	√	√	√	√
Fluffy-backed Tit-Babbler *M. ptilosus*	C; R	√			√		
Flyeater *Gerygone sulphurea*	U; R	√			√		
Greater Coucal *Centropus sinensis*	C; R	√		√	√		
Greater Racket-tailed Drongo *Dicrurus paradiseus*	C; R	√	√	√	√	√	√
Green-winged Pigeon *Chalcophaps indica*	C; R	√	√	√	√	√	√
Grey-headed Flycatcher *Culicicapa ceylonensis*	C; R	√			√		
Horsfield's Babbler *Trichostoma sepiarium*	U; R	√	√	√	√	√	√
House Crow *Corvus splendens*	A; I	√	√	√	√	√	√
House Swift *Apus affinis*	C; R	√		√	√		√
Hwamei *Garrulax canorus*	U; I	√	√		√	√	
Jambu Fruit-Dove *Ptilinopus jambu*	U; R	√	√		√	√	
Japanese Sparrowhawk *Accipiter gularis*	C; M			√	√		
Jungle Myna, *Acridotheres fuscus*	C; R	√	√	√	√	√	√
Large-tailed Nightjar *Caprimulgus macrurus*	C; R	√			√		
Lesser Coucal *Centropus bengalensis*	C; R	√			√		
Little Green Pigeon *Treron olax*	C; R	√	√		√	√	
Little Spiderhunter *Arachnothera longirostra*	C; R	√	√	√	√	√	√
Common Tailorbird *Orthotomus sutorius*	C; R	√	√	√	√	√	√
Magpie Robin *Copsychus saularis*	C; R	√	√	√	√	√	√
Olive-backed Sunbird *Nectarinia jugularis*	U; R			√			√
Olive-backed Woodpecker *Dinopium rafflesii*	C; R	√	√	√	√	√	√
Olive-winged Bulbul *Pycnonotus plumosus*	U; R	√			√		
Orange-backed Woodpecker *Chrysocolaptes validus*	C; R		√			√	
Orange-bellied Flowerpecker *Dicaeum trigonostigma*	U; M	√	√		√	√	
Oriental Reed-Warbler *Acrocephalus orientalis*	C; R	√			√		
Oriental White-eye *Zosterops palpebrosa*	C; R	√			√		
Pacific Swallow *Hirundo tahitica*	C; R	√	√		√	√	
Peaceful Dove *Geopelia striata*	A; R	√	√		√	√	
Philipine Glossy Starling *Aplonis panayensis*	C; R		√	√	√	√	
Pied Triller *Lalage nigra*	C; R	√	√		√	√	
Pink-necked Pigeon *Treron vernans*							

Red Junglefowl *Gallus gallus*	C; R	√		√	√		
Red-eyed Bulbul *Pycnonotus brunnues*	C; R	√	√	√	√	√	√
Richard's Pipit *Anthus novaescenlandiae*	C; R	√			√		
Rock Pigeon *Columba livia*	C; I	√	√		√	√	
Scaly-breasted or Spotted Munia *Lonchura punctulata*	C; R	√	√		√	√	
Scarlet-backed Flowerpecker *Dicaeum cruentatum*	C; R	√			√		
Spotted Dove *Streptopelia chinensis*	C; R	√		√	√		√
Straw-headed Bulbul *Pycnonotus zeylanicus*	C; R	√	√	√	√	√	
Thick-billed Pigeon, *Treron curvirostra*	C; R	√	√		√	√	
Tiger Shrike *Lanius tigrinus*	C; M	√	√	√	√	√	
White-bellied Swiftlet *Collocalia esculenta*	C; R		√	√		√	√
White-breasted Waterhen *Amaurornis phoenicurus*	A; R/M	√	√			√	
White-headed Munia *Lonchura maja*	C; R	√					
White-rumped or Sharp-tailed Munia *Lonchura striata*	U; R	√	√			√	
White-rumped Shama *Copsychus malabaricus*	C; R	√	√	√	√	√	√
White-throated Kingfisher *Halcyon smyrnensis*	C; R	√	√	√	√	√	
Yellow Bellied Prinia *Prinia flaviventris*	C; R	√	√		√	√	
Yellow Wagtail *Motacilla flava*	C; M	√			√		
Yellow-vented Bulbul *Pycnonotus goiavier*	A; R	√	√	√	√	√	√

The species that were abundant in all study areas included Yellow-vented bulbul (*Pycnonotus goiavier*), Red-eyed Bulbul (*Pycnonotus brunnues*), Little Spiderhunter (*Arachnothera longirostra*), Common Myna (*Acridotheres tristis*) and House Sparrow (*Passer montanus*). They occurred in high numbers (more than 50 birds) in each study area and could be spotted easily. Most species occurred in moderate number (between 10 to 49 birds) and were quite easy to observe or capture. Species such as Magpie Robin (*Copsychus saularis*), Black-naped Oriole (*Oriolus chinensis*), Swallows (*Hirundo tahitica* and *H. rustica*), Spotted Dove (*Streptopelia chinensis*), Peaceful Dove (*Geopelia striata*) and Swifts (*Apus affinis* and *A. pacificus*) belonged to this group. Other species such as Horsfield's Babbler (*Trichastoma sepiarum*), Asian Paradise Flycacther (*Tersiphone paradisi*), Large-tailed Nightjar (*Caprimulgus macrurus*) and Yellow Wagtail (*Motacilla flava*) occurred in small number (less than ten birds) and were not frequently seen.

Most birds were recorded either through direct observation or by both methods (direct observation and mist-net) except four species that were captured without observation record. White-rumped Shama (*Copsychus malabaricus*) and Oriental white-eye (*Zosterops palpebrosa*) were netted in 1991 but only the former species was recaptured in 1997. The other two species - Hwamei (*Garrulax canorus*) and Olive-backed Woodpecker (*Dinopium rafflesi*) - were captured in 1997.

More birds have been observed than netted in both surveys (Mann-Whitney U test, z = -1.549). During the 1991 census, 1417 birds (95%) were recorded through direct observation compared to only 76 birds (5%) being captured. In 1997, 206 birds (21%) were captured and 758 birds were observed (79%). There was a great reduction in observation rate (number of birds observed per hour) in 1997 compared to 1991. Of the total birds, only six birds were observed per hour in 1997 compared to 40 birds for 1991 (Table 2). BGF had higher value (24 birds in 1991, 3 birds in 1997), followed by TSF (11 birds in 1991, 2 birds in 1997), and UMF (five birds in 1991, one bird in 1997). Contrary to observation rate, the capture rate (number of birds caught in mist net per hour) increased in 1997 (1.45 birds compared to 0.90 bird in 1991). In UMF and BGF, the capture rate increased drastically from 0.10 and 0.40 bird per hour to 0.50 and 0.53 bird per hour respectively. There was a slight increase in TSF's capture rate, from 0.40 bird per hour to 0.42 bird per hour.

DISCUSSION

This study reveals that many species of local birds (10% of total Malaysian birds) are able to survive in urban areas. Their existence in such highly developed area is probably assisted by the presence of urban forest and parks. Trees and shrubs in these green areas provide numerous resources for the bird's survival [18]. Therefore, various factors related to urban forest such as size and edge, the availability of food and water, type of vegetation and its structure, abundance of

perching and nesting sites and interspecific competition are influencing bird distribution [19]. Some species might require habitat patches whose size and configuration are precluded by even a small amount of development [6, 20]. Presence of preferred prey and suitable foraging habitat also apparently influences the existence of birds [21, 22].

The study areas (except TSF) have gone tremendous changes from 1991 to 1997. During this period the size of these green areas had been greatly modified. Although they still remain intact, their peripheries have been developed for human needs. Increasing demand for residential area has forced the local authority to sacrifice BGF periphery for more houses and condominiums, and allowing people to enter the forest to solve public request for recreational area. At UMF, the area has been developed for more basic infrastructures such as bus station, administration buildings and highway. In addition to size reduction, the small stream in this area has also been replaced with a concrete drainage. The development process has destroyed natural habitat in both areas and many birds thus probably had a reduction in habitat quality and/or quantity. Four species (three munias and waterhen) that disappeared from BGF are birds that live in open or swampy areas located at the forest periphery, which have been cleared for development. Species that vanished from UMF are either large birds (Ashy Drongo, Crested Serpent-Eagle, Greater Coucal and Red Junglefowl) that need large foraging area and less tolerant to modification and disturbance [20], or smaller birds (White-throated Kingfisher and Olive-Backed Sunbird) with specific resources requirement. Specialist birds are more susceptible to disturbance than generalist birds since they lack of adaptation mechanism and fail to switch their needs [1]. Other species (Asian Paradise-Flycacther, Japanese Sparrowhawk, Tiger Shrike and Pied Triller) are forest species that require large forest for survival [23].

Any development on urban forest will cause habitat loss or degradation. Although both events are important determinants of bird population [24], sometime habitat degradation is more influential in causing bird population declines such as in farmland birds [25]. In Taiwan, Hsu and Lin [26] show that habitat degradation threatens the survival of Styan Bulbul (*Pycnonotus taivanus*) and Chinese Bulbul (*Pycnonotus sinensis*). Whatever circumstances, it is important to realize that the degree of human disturbance on birds varies according to species [27]. In this study, both migrant and resident species are affected by forest disturbance but introduced species are well adapted with urban environment and their survival remain uninterrupted. Among forest bird species, understorey birds are less tolerant than overstorey birds but understorey insectivores have been identified as highly sensitive to forest disturbance [27, 28, 29] and conspicuous birds are less tolerant than inconspicuous species to an approaching human [28]. Study by Berry *et al.*, [22] shows that large predatory birds such as Red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*) and American kestrel (*Falco sparverius*) are able to survive at low-level urbanization (up to 30%). In addition to habitat destruction, sources of pollution also can affect urban bird diversity. Noise pollution produced by road use for example poses a problem to songbirds such as willow warbler (*Phylloscopus trochilus*) in defending their territories and lead to decreasing population density [30].

This study shows that urban forest plays a major role in providing resources for wildlife, especially birds. The increasing rate of urbanization without proper planning will destroy natural habitat, the ideal place for birds, and leave only man-made habitat for their survival. Therefore, it is necessary to conduct ecological study in any wildlife's sensitive areas before any development can be introduced. This study will provide insights into mechanism(s) regulating species richness due to the differences between urban biotopes and natural biotopes [31]. As suggested by Gilbert [8] and Adams [9], forest islands or urban parks can be used as a live laboratory to investigate the interaction between wildlife and their environment, to integrate wildlife conservation plans into urban landscape, and to provide pertinent information for regional land-planning exercises.

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