A rapid assessment of logging effects on bird species in Kelantan Forests Areas, Malaysia

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Abstract

Kelantan Forest Areas (KFA) are known as the major of portion of Taman Negara National Park, and it has been identified as an Environmentally Sensitive Area (ESA) rank 1 under Malaysia's National Physical Plan (NPP). Since, access to the forest areas are often lacking and vital forest information are often inadequate, this study define to finding a baseline data for macro EIA of KFA. This study consists of rapid assessment of logging effects on bird species. Based on the study, Kelantan Forests are divided to (1) Lowland evergreen rain forest, (2) Lower mountain rain forest and (3) Upper mountain rain forest, using general vegetation forms. A total of 321 species of birds were recorded in KFA using data collection from related agencies, Mist-netting Method, Transect survey Method (Distance Sampling Method; Point Count Method) and Secondary data. Out of this number, 220, 49, 7 and 1 species were falls under totally protected, nearly threatened, vulnerable and Critically Endangered categories, respectively. Out of the total recorded species, a total of 155, 292 and 128 species were recorded in Lowland evergreen rain forest reserves, Lower Montain Rain Forest Reserve and Upper Kelantan Montain Rain Forest respectively. The Blue-banded Kingfisher *Alcedo euryzonia* in the list of Kelantan birds was fall under Critically Endangered status. A total of 83 species were observed commonly in 3 kind of habitats, 20 species were recorded only in Kelantan Lowland Forest Reserve, which species Jambu Fruit-Dove was fall under nearly threatened. Furthermore, a total of 5 species were recorded just in Upper Montain Kelantan Rain Forest. This study considered that Kelantan forests could be one of the `megadiversity' places in Malaysia, and effects of logging on wildlife species as well as birds were cleared.

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Introduction

Bird diversity has become a topic of increasing scientific and popular interest during the recent decade (Yarwood *et al.*, 2014). This growing interest is a result of increased scientific information (Adams, 2014), public recognition of and concern about the problem of species loss (Kim *et al.*, 2014) and an overall shift in societal values regarding the way in which natural resources, ecosystems, landscapes and species are viewed (Kessler, 1992).

Sustainable forest management is a balance between the forest services, health and diversity (Sayer *et al.*, 2007). Bird species represent a living library of options for assessing the effect of forest logging (Wong, 2006). Also, they are highly sensitive to many changes due to certain ecological process display wide range of sensitive to habitat modification and disturbance of natural process (Ghasemi *et al.*, 2012). They are especially useful in showing change in the over all condition of forest ecosystem (Kampichler *et al.*, 2014), which is expensive to measure directly (Kumar & Kumar, 2008) . Thus, regarding to high deforestation rates in Southeast Asia (Grogan *et al.*, 2015), bird species are good bio-indicator in the light of growing pressure on forest resouces due to logging, deforestation and ecxessive exploitation (Sodhi *et al.*, 2005)

However, the KFA has world-class wilderness and aesthetic value, and has been identified as an Environmentally Sensitive Area (ESA) Rank 1 under Malaysia's National Physical Plan (NPP), due to a lack of baseline data (Zain *et al.*, 2013), it is difficult to the assessment, development and management of Kelantan forest area as important habitats for certain wildlife species (Jusoff & Majid, 1995).

The study emphasize on the bird communities of Kelantan tropical rain forest in which determining a new guide for conservation initiatives of this ecosystem. Particularly, the following objective was: Are there any distinct bird communities associated with certain habitat types? This study findings would support state and regional programs to evaluate wildlife restoration

potential, actions, and success. This study also will allow managers, planners and policy makers to better mitigate the effects of human settlement on the Kelantan avian community.

Material and methods

Study area

KFA is located in the state of Kelantan, Peninsular Malaysia, shares a common border with Perak in the north-west, Pahang in the extreme west and Terengganu in the south-east (Fig. 1). According to the Auditor General's report for the year 2014, this state has land area of 1.49 million hectares. Out of the total land area, 886,767 hectares is forested and the remaining 606,414 hectares is not forested. Out of the total forested area, 629,687 hectares is Permanent Forest Reserve (HSK), 148,297 hectares is government forest land and the remaining area of 108,783 hectares is wildlife forest reserve.

KFA lie near the Equator and they are subject to maritime influence and the interplay of wind systems which originate in the Indian Ocean and the South China Sea. The topography of the area is hill land at the east, west and south while lowland at the north. KFA have a tropical climate, with temperatures ranging from 21 to 32 °C. The annual rainfalls in this area fluctuate from the lowest of 2.993 ml to the highest of 4.002 ml per year. Humidity is high.

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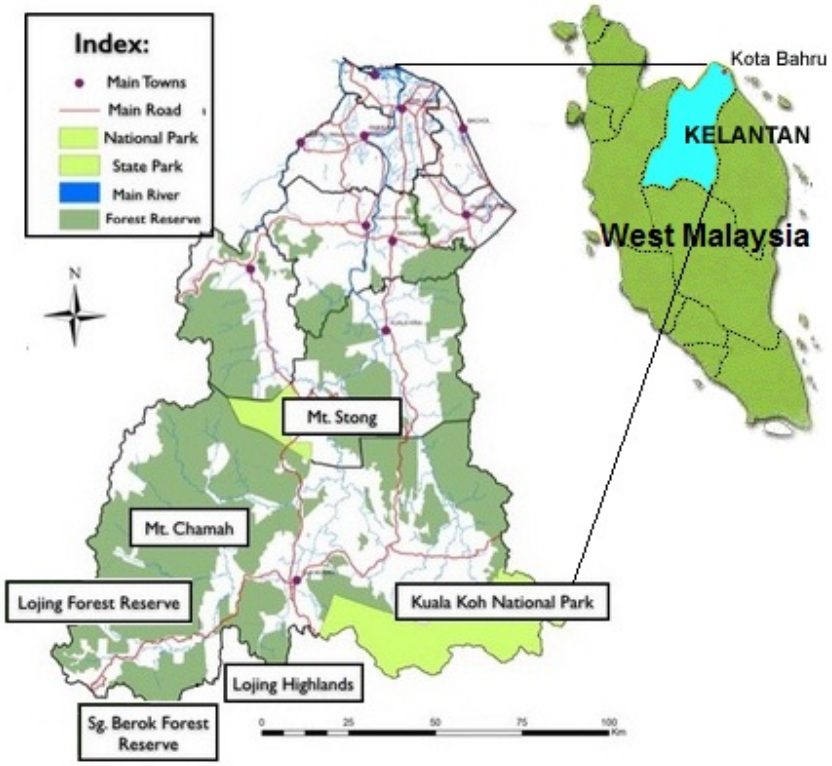

Fig. 1 Distribution of KFA in the State of Kelantan

Methods

KFA were divided to lowland evergreen rain forest, lower montain rain forest, and upper montain rain forest using the general vegetation formation and based on the information assembled from a number of departments and agencies, such as the Forestry Departments of Peninsular Malaysia, the Malaysian Timber Industry Board (MTIB), the Malaysian Timber Council (MTC), Unit Perancang Ekonomi Negeri Kelantan (UPEN), the Kelantan Forestry Department (*Perhutanan*) and the Lojing District and Land Office *(Pejabat Tanah Jajahan Kecil Lojing*).

Lowland evergreen rain forest (LERF) occurs in the lowlands and hills up to about 750–1200 m elevation, has the tallest trees (30–50 m high), and includes the most species-rich assemblages, structurally dominated by big, straight, tall trees of the Dipterocarpaceae and other families.

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Lower montain rain forest (LMRF) occurs between about 750–1200 m and 1500–2000 m elevation, mostly has an intermediate height (15–33 m), and includes abundant mosses and epiphytes, with the trees significantly from the *mempening* (Fagaceae), *medang* (Lauraceae), *kelat* (Myrtaceae) and *ekor kuda* (Coniferae) families.

Upper montain rain forest (UMRF) occurs from about 1500–2000 m up to the highest peaks, has a dwarfed structure from just 2 m to 20 m high, and has an abundance of mosses, lichens and orchids, and many crooked and twisted trees from the *rhododendron* (Ericaceae), *kelat* (Myrtaceae) and *myrsine* (Myrsinaceae) families.

However, macro EIA for the KFA has to cover the whole permanent forest reserves in Kelantan which is not possible to be done in a few months. Therefore, certain highly specialized techniques for bird inventory will be employed in order to obtain information on the composition and distribution. The techniques involve here is what we refer to as Rapid Assessment Technique. This means that the assessment is basically to confirm the existence of the wildlife species in a particular area and will be reconfirmed with the secondary data (if available). The methods that will be used to obtain information on birds are:

- Data from related agencies
- Mist-netting Method
- Transect survey Method (Distance Sampling Method; Point Count Method)
- Secondary data

Results

The study shows that Bachok district had quite a number of bird species that have adapted well as indicated by the presence of at least 70 species of 128 Malaysian Journal of Science 29 (Special Issue): 121-130 (2010) birds in human dominated habitat. The presence of three introduced species in the study area leads to mixed conclusions. It is well known that Whitevented Myna and

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House Crow have managed to successfully disperse throughout the country especially in human dominated habitat. Therefore, it is expected that these species will be recorded in the area. However, the presence of Javan Munia is unexpected. This is because the species is not in Peninsular Malaysia bird checklist and do not have widely distributied compared to the two former species. However, there is a possibility that the bird had been released into the wild or escaped from captivity. This is because its population is small, been observed in one study site only. With consideration of time and cost involved to survey the whole area, a total of 321 species of birds were recorded in KFA. Out of this number, 220, 49, 7 and 1 species were falls under totally protected, nearly threatened, vulnerable and Critically Endangered categories, respectively.

Out of the total recorded species, a total of 155 species were recorded in Lowland evergreen rain forest reserves. Which, only one species Blue-banded Kingfisher *Alcedo euryzonia* (about 0.65%) was fall under Critically Endangered status, 19 species (about 12.26%) were falls under nearly threatened status and 107 species (about 69.3%) considered as totally protected.

A total of 292 species were recorded in Lower Montain Rain Forest Reserve. Out of this number, 199 species (about 68.15%) were falls under totally protected category, 50 species (about 17.12%) were falls under nearly threatened whereas 7 species (about 2.39%) considered as vulnerable and only one species Blue-banded Kingfisher *Alcedo euryzonia* (about 0.34%) was fall under Critically Endangered status. A total of 128 species of birds were recorded at Upper Kelantan Montain Rain Forest, 22 species (about 17.19%) fall under nearly threatened and 91 species (about 71.09%) fall under totally protected category (Table1).

Based on Table1, 83 species were observed commonly in 3 kind of habitats, 20 species included Puff-throated Babbler, Lineated Barbet, Red-throated Barbet, Chestnut-headed Bee-eater, Grey-cheeked Bulbul, Zebra Dove, Common Flameback, Plain-backed Flowerpecker, Narcissus Flycatcher, Jambu Fruit-Dove, Hodgson's Hawk-Cuckoo, Malaysian Hawk-Cuckoo, Black-naped

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Monarch, Jungle Myna, Large-tailed Nightjar, Buffy Fish Owl, Tiger Shrike, Oriental White-eye, Rufous Woodpecker, and Banded Yellownape were recorded only in Kelantan Lowland Forest Reserve, which species Jambu Fruit-Dove was fall under nearly threatened. Furthermore, a total of 5 species included Scarlet-backed Flowerpecker, Bat Hawk, Pink-necked Pigeon, Red-rumped Swallow, and Red-throated Sunbird were recorded just in Upper Montain Kelantan Rain Forest. A total of 126 species also were recorded just in Lower Montain Rain Forest Reserve (**Table1**).

Table 1: List of bird species recorded in Kelantan Forest Reserves

NO.	COMMON NAME	SCIENTIFIC NAME	Status	LERF	LMRF	UMRF
1	Argus, Great	*Argusianus argus*	**NT**	*	*	*
2	Babbler, Abbott's	*Malacocincla abbotti*	TP	*	*	
3	Babbler, Black-capped	*Pellorneum capistratum*	TP		*	
4	Babbler, Buff-breasted	*Pellorneum tickelli*	TP		*	
5	Babbler, Chestnut-rumped	*Stachyris maculate*	**NT**		*	*
6	Babbler, Chestnut-winged	*Stachyris erythroptera*	TP	*		*
7	Babbler, Ferruginous	*Trichastoma bicolor*	TP	*	*	
8	Babbler, Fluffy-backed Tit	*Macronous ptilosus*	**NT**		*	
9	Babbler, Golden	*Stachyris chrysaea*	TP		*	
10	Babbler, Grey-headed	*Stachyris poliocephala*	TP		*	
11	Babbler, Horsfield's	*Malacocincla sepiarium*	TP		*	
12	Babbler, Large Scimitar	*Pomatorhinus hypoleucos*	TP		*	
13	Babbler, Moustached	*Malacopteron magniroste*	TP	*	*	
14	Babbler, Puff-throated	*Pellorneum ruficeps*	TP		*	*
15	Babbler, Puff-throated	*Pellorneum ruficeps*	TP	*		
16	Babbler, Rufous-crowned	*Malacopteron magnum*	TP		*	
17	Babbler, Rufous-fronted	*Stachyris rufifrons*	TP		*	
18	Babbler, Scaly-crowned	*Malacopteron cinereum*	TP	*	*	
19	Babbler, Short-tailed	*Malacocincla malaceensis*	TP	*	*	
20	Babbler, Sooty-capped	*Malacopteron affine*	**NT**	*	*	*
21	Babbler, Striped Tit	*Macronus gularis*	TP	*		*
22	Babbler, White-browed Shrike	*Pteruthius flaviscapis*	TP		*	
23	Babbler, White-hooded	*Gampsorhynchus rufulus*	TP		*	
24	Babbler, White-necked	*Stachyris leucotis*	**NT**		*	
25	Barbet, Blue-eared	*Megalaima australis*	TP	*	*	*
26	Barbet, Brown	*Calorhamphus fuliginosus*	TP	*	*	*
27	Barbet, Fire-tufted	*Psilopogon pyrolophus*	TP		*	
28	Barbet, Gold-whiskered	*Megalaima chrysopogon*	TP	*	*	*
29	Barbet, Lineated	*Megalaima lineata*	TP	*		
30	Barbet, Red-crowned	*Megalaima raffesii*	**NT**	*	*	*
31	Barbet, Red-throated	*Megalaima chrysopogon*	TP	*		
32	Barbet, Yellow-crowned	*Megalaima benricii*	**NT**	*	*	*
33	Baza, Black	*Aviceda leuphotes*	TP	*	*	
34	Bee-eater, Blue-tailed	*Merops superciliosus*	-		*	
35	Bee-eater, Blue-throated	*Merops viridis*	TP	*	*	*
36	Bee-eater, Chestnut-headed	*Merops leschenaulti*	TP	*		
37	Bee-eater, Red-bearded	*Nyctyornis amictus*	TP	*	*	*
38	Bluebird, Asian Fairy	*Irena puella*	TP	*	*	*
39	Broadbill, Banded	*Eurylaimus javanicus*	TP	*	*	*
40	Broadbill, Black-and-red	*Cymbirhynchus macrorhynchus*	TP		*	
41	Broadbill, Black-and-yellow	*Eurylaimus ochromalus*	**NT**	*	*	*

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42	Broadbill, Dusky	*Corydon sumatranus*	TP	*	*	
43	Broadbill, Green	*Calyptomena viridis*	**NT**	*	*	
44	Broadbill, Long-tailed	*Psarisomus dalhousiae*	TP		*	
45	Broadbill, Silver-breasted	*Seriophus lunatus*	TP		*	
46	Bulbul, Ashy	*Hemixos flavala*	TP	*	*	*
47	Bulbul, Black-crested	*Pycnonotus melanicertus*	TP	*	*	*
48	Bulbul, Black-headed	*Pycnonotus atriceps*	TP	*	*	*
49	Bulbul, Buff-vented	*Iole olivacea*	**NT**	*	*	*
50	Bulbul, Cream-vented	*Pycnonotus simplex*	TP	*	*	*
51	Bulbul, Finsch's	*Alophoixus finchii*	**NT**		*	
52	Bulbul, Grey-bellied	*Pycnonotus squamantus*	**NT**	*	*	*
53	Bulbul, Grey-cheeked	*Alophoixus bres*	TP	*		
54	Bulbul, Hairy-backed	*Tricholestes criniger*	TP	*	*	*
55	Bulbul, Ochraceous	*Alophoixus ochraceus*	TP		*	
56	Bulbul, Olive-winged	*Pycnonotus plumosus*	TP	*	*	
57	Bulbul, Puff-backed	*Pycnonotus eutilotus*	**NT**		*	
58	Bulbul, Red-eyed	*Pycnonotus brunneus*	TP	*	*	*
59	Bulbul, Scaly-breasted	*Pycnonotus melanoleucos*	**NT**	*	*	*
60	Bulbul, Spectacled	*Pycnonotus erythrophthalmus*	TP	*	*	*
61	Bulbul, Straw-headed	*Pycnonotus zeylanicus*	**VU**		*	
62	Bulbul, Streaked	*Ixos malaccensis*	TP	*	*	*
63	Bulbul, Stripe-throated	*Pycnonotus finlaysoni*	TP	*	*	*
64	Bulbul, Yellow-bellied	*Criniger phaeocephalus*	TP	*	*	*
65	Bulbul, Yellow-vented	*Pycnonotus goiavier*	-	*	*	*
66	Buzzard, Grey-faced	*Butastur indicus*	TP		*	
67	Coucal, Greater	*Centropus sinensis*	TP	*	*	
68	Coucal, Lesser	*Centropus bengalensis*	TP	*	*	
69	Coucal, Short-toed	*Centropus rectunguis*	**VU**		*	
70	Crake, Red-legged	*Rallina fasciata*	-		*	
71	Crake, White-browed	*Porzana cinerea*	-		*	
72	Crow, Large-billed	*Corvus macrorhynchos*	-		*	*
73	Crow, Slender-billed	*Corvus splendens*	-		*	*
74	Cuckoo, Banded Bay	*Cacomantis sonnerti*	TP	*	*	*
75	Cuckoo, Drongo	*Surniculus lugubris*	TP		*	*
76	Cuckoo, Indian	*Cuculus micropterus*	TP	*	*	*
77	Cuckoo, Plaintive	*Cacomantis merulinus*	TP		*	*
78	Cuckoo, Rusty-breasted	*Cacomantis sepulcralis*	TP		*	*
79	Cuckoo, Violet	*Chrysococcyx xanthorhynchus*	TP	*	*	*
80	Cuckoo-Shrike, Bar-bellied	*Coracina striata*	TP	*	*	
81	Cuckoo-Shrike, Lesser	*Cocacina fimbrata*	TP	*	*	*
82	Dollarbird	*Eurystomus orientalis*	-		*	*
83	Dove, Little Cuckoo	*Macropygia ruficeps*	-		*	*
84	Dove, Spotted	*Streptopelia chinensis*	-	*		*
85	Dove, Zebra	*Geopelia striata*	TP	*		
86	Drongo, Black	*Dicrurus macrocercus*	TP		*	
87	Drongo, Bronzed	*Dicrurus aeneus*	TP		*	
88	Drongo, Crow-billed	*Dicrurus annectans*	TP		*	
89	Drongo, Greater Racquet-tailed	*Dicrurus paradiseus*	TP	*	*	*
90	Drongo, Lesser Racquet-tailed	*Dicrurus remifer*	TP		*	
91	Eagle, Black	*Milvus migrans*	TP		*	*
92	Eagle, Blyth's Hawk	*Spizaetus alboniger*	TP	*	*	*
93	Eagle, Changeable Hawk	*Spizaetus cirrhatus*	TP	*		*
94	Eagle, Changeable Hawk	*Spizaetus cirrhatus*	TP		*	
95	Eagle, Rufous-bellied	*Hieraatus kienerii*	TP	*	*	
96	Eagle, Wallace's Hawk	*Spizaetus nanus*	**VU**		*	
97	Egret, Cattle	*Bubulcus ibis*	TP	*	*	
98	Egret, Little	*Egretta garzetta*	TP		*	
99	Falcon, Amur	*Falco amurensis*	-		*	

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100	Falcon, Peregrine	*Falco peregrinus*	TP	*	*	
101	Falconet, Black-thighed	*Hieraatus kienerii*	TP	*	*	*
102	Fantail, Spotted	*Rhipidura perlata*	TP	*	*	
103	Finfoot, Masked	*Heliopais personata*	**VU**		*	
104	Fish-Eagle, Grey-headed	*Ichthyophaga ichthyaetus*	**NT**		*	
105	Fish-Eagle, Lesser	*Ichthyophaga humilis*	**NT**		*	
106	Flameback, Common	*Dinopium javanense*	TP	*		
107	Flowerpecker, Crimson-breasted	*Prionochilus percussus*	TP	*	*	*
108	Flowerpecker, Orange-bellied	*Dicaeum trigonostigma*	TP		*	*
109	Flowerpecker, Plain-backed	*Dicaeum concolor*	TP	*		
110	Flowerpecker, Scarlet-backed	*Dicaeum cruentatum*	TP			*
111	Flowerpecker, Thick-billed	*Dicaeum agile*	TP		*	
112	Flowerpecker, Yellow-breasted	*Prionichiilus maculatus*	TP	*	*	
113	Flowerpecker, Yellow-vented	*Prionichiilus maculatus*	TP	*	*	*
114	Flycatcher, Asian Brown	*Muscicapa daurica*	-	*	*	*
115	Flycatcher, Dark-sided	*Muscicapa sibircia*	TP	*	*	
116	Flycatcher, Ferruginous	*Muscicapa ferruginea*	TP	*	*	
117	Flycatcher, Grey-chested Jungle	*Rhinomyias umbritalis*	**NT**		*	
118	Flycatcher, Grey-headed	*Culicicapa ceylonensis*	TP		*	*
119	Flycatcher, Hill Blue	*Cyornis banyumas*	TP	*	*	
120	Flycatcher, Mugimaki	*Ficedula mugimaki*	TP		*	
121	Flycatcher, Narcissus	*Ficedula narcissina*	TP	*		
122	Flycatcher, Pale Blue	*Cyornis unicolor*	TP	*	*	*
123	Flycatcher, Rufous-chested	*Fecidula dumetoria*	**NT**		*	
124	Flycatcher, Tickell's Blue	*Cyornis tickelliae*	TP		*	
125	Flycatcher, Verditer	*Eumyias thalassina*	TP	*	*	*
126	Flycatcher, White-tailed	*Cyornis concreta*	TP		*	
127	Flycatcher, Yellow-rumped	*Ficedula zanthopygia*	TP	*	*	
128	Flycatcher-Shrike, Bar-winged	*Hemipus picatus*	TP		*	
129	Flycatcher-Shrike, Black-winged	*Hemipus hirundinaceus*	TP	*	*	*
130	Forktail, Chestnut-naped	*Enicrurus ruficafilus*	**NT**	*	*	*
131	Forktail, Slaty-backed	*Enicurus schistaceus*	TP		*	
132	Forktail, White-crowned	*Enicurus leschenaultia*	TP		*	
133	Frogmouth, Javan	*Batrachostomus javensis*	-		*	
134	Fruit-Dove, Jambu	*Ptilinopus jambu*	**NT**	*		
135	Fulvetta, Brown	*Alcippe brunneicauda*	**NT**		*	
136	Gerygone, Golden-bellied	*Greygone sulphurea*	TP	*	*	*
137	Goshawk, Chinese	*Accipiter soloensis*	TP	*	*	*
138	Hawk, Bat	*Macheiramphus alcinus*	TP			*
139	Hawk-Cuckoo, Hodgson's	*Hierococcyx nisicolor*	-	*		
140	Hawk-Cuckoo, Malaysian	*Hierococcyx fugax*	TP	*		
141	Heron, Little	*Butorides striatus*	TP		*	
142	Honey-buzzard, Oriental	*Pernis ptiorhyncus*	TP	*	*	*
143	Honeyguide, Malaysian	*Indicator archipelagicus*	**NT**		*	
144	Hornbill, Black	*Anthracoceros malayanus*	**NT**		*	
145	Hornbill, Bushy-crested	*Anorrhinus galetitus*	TP	*	*	
146	Hornbill, Great	*Buceros bicornis*	**NT**		*	*
147	Hornbill, Helmeted	*Buceros vigil*	**NT**	*	*	*
148	Hornbill, Oriental Pied	*Anthracoceros albirostris*	TP		*	
149	Hornbill, Plain-pouched	*Aceros subruficollis*	**VU**		*	
150	Hornbill, Rhinoceros	*Buceros rhinoceros*	**NT**		*	*
151	Hornbill, White-crowned	*Berenicornis comatus*	**NT**	*	*	*
152	Hornbill, Wreathed	*Aceros undulates*	TP	*	*	*
153	Hornbill, Wrinkled	*Rhyticeros corrugatus*	**NT**		*	
154	House-Martin, Asian	*Delichon dasypus*	-		*	
155	Iora, Common	*Aegithina tiphia*	TP	*	*	
156	Iora, Great	*Aegithina lafresnayei*	TP	*	*	*
157	Iora, Green	*Aegithina viridissima*	**NT**	*	*	*
158	Jaeger, Long-tailed	*Stercorarius longicaudus*	-		*	

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159	Jay, Crested	*Platylophus galericulatus*	**NT**		*	
160	Junglefowl, Red	*Galus galus*	-		*	*
161	Kenopia	*Kenopia striata*	**NT**		*	
162	Kingfisher, Banded	*Lacedo pulchella*	TP	*	*	*
163	Kingfisher, Black-capped	*Halcyon pileata*	TP		*	
164	Kingfisher, Blue-banded	*Alcedo euryzonia*	**CE**	*	*	
165	Kingfisher, Blue-eared	*Alcedo meninting*	TP		*	
166	Kingfisher, Common	*Alcedo atthis*	TP		*	
167	Kingfisher, Oriental Dwarf	*Ceyx erithachus*	TP	*	*	
168	Kingfisher, Rufous-collared	*Actenoides concretus*	TP	*	*	
169	Kingfisher, Stork-billed	*Pelargopsis capensis*	TP		*	
170	Kingfisher, White-throated	*Halcyon smyrnensis*	TP		*	*
171	Kite, Black-shouldered	*Elanus caeruleus*	TP	*	*	
172	Kite, Brahminy	*Haliastur Indus*	TP	*	*	
173	Laughingthrush, Chestnut-capped	*Garrulax mitratus*	TP		*	
174	Leafbird, Blue-winged	*Chloropsis cochinchinensis*	TP	*	*	*
175	Leafbird, Greater Green	*Chloropsis sonnerati*	TP	*	*	
176	Leafbird, Lesser Green	*Chloropsis cyanopogon*	**NT**	*	*	*
177	Magpie, Black	*Platysmurus leucopterus*	**NT**	*	*	
178	Magpie, Common Green	*Cissa chinensis*	TP		*	
179	Malkoha, Black-bellied	*Phaenicophaeus diardi*	**NT**	*	*	*
180	Malkoha, Chestnut-bellied	*Phaenicophaeus sumatranus*	**NT**		*	
181	Malkoha, Chestnut-breasted	*Phaenicophaeus curvirostris*	TP	*	*	*
182	Malkoha, Green-billed	*Phaenicophaeus tristis*	TP		*	*
183	Malkoha, Raffles's	*Phaenicophaeus chlorophaeus*	TP	*	*	*
184	Malkoha, Red-billed	*Phaenicophaeus javanicus*	TP	*	*	
185	Mesia, Silver-eared	*Leiothrix argentauris*	TP		*	
186	Minivet, Ashy	*Pericrocotus divaricatus*	TP	*	*	*
187	Minivet, Fiery	*Pericrocotus igneus*	**NT**		*	
188	Minivet, Grey-chinned	*Pericrocotus solaris*	TP		*	
189	Minivet, Scarlet	*Pericrocotus flammeus*	TP	*	*	*
190	Monarch, Black-naped	*Hypothymis azurea*	TP	*		
191	Monarch, Maroon-breasted	*Philentoma velatum*	TP		*	
192	Munia, Scaly-breasted	*Lonchura punctulata*	TP		*	
193	Munia, White-bellied	*Lonchura leucogastra*	-		*	
194	Munia, White-headed	*Lonchura maja*	-	*	*	
195	Munia, White-rumped	*Lonchura striata*	-	*	*	
196	Myna, Common	*Acridotheres tristis*	-	*	*	
197	Myna, Hill	*Gracula religiosa*	-		*	
198	Myna, Jungle	*Gracula religiosa*	-	*		
199	Needletail, Brown-Backed	*Hirundapus giganteus*	TP		*	
200	Needletail, Silver-rumped	*Rhaphidura leucopygialis*	TP	*	*	*
201	Needletail, White-throated	*Hirundapus caudacutus*	TP		*	
202	Needletail, White-vented	*Hirundapus cochinchinensis*	-		*	
203	Nightjar, Large-tailed	*Caprimulgus macrurus*	TP	*		
204	Nightjar, Malaysian Eared	*Eurostopodus temminckii*	TP		*	
205	Nuthatch, Velvet-fronted	*Sitta frontalis*	-	*	*	*
206	Oriole, Black-hooded	*Orialus xanthornus*	TP		*	
207	Oriole, Black-naped	*Oriolus chinensis*	TP	*	*	*
208	Oriole, Dark-throated	*Oriolus zanthonotus*	**NT**	*	*	*
209	Osprey	*Pandion haliaetus*	TP		*	
210	Owl, Barn	*Tyto alba*	TP		*	
211	Owl, Barred Eagle	*Bubo sumatranus*	TP		*	
212	Owl, Brown Wood	*Strix leptogrammica*	TP		*	
213	Owl, Buffy Fish	*Ketups ketupu*	TP	*		
214	Owl, Collared Scops	*Otus bakameona*	TP		*	
215	Owl, Mountain Scops	*Otus spilocephalus*	TP		*	
216	Owl, Oriental Bay	*Phodilus badius*	TP		*	

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217	Owlet, Collared	*Glaucidium brodiei*	TP		*	
218	Paradise-Flycatcher, Asian	*Terpsipone paradise*	TP	*	*	*
219	Parrot, Blue-crowned Hanging	*Loriculus galgulus*	-	*	*	*
220	Parrot, Blue-rumped	*Psittinus cyanurus*	**NT**		*	
221	Parrotfinch, Pin-tailed	*Erythura prasina*	TP	*	*	
222	Partridge, Crested	*Rollulus rouloul*	**NT**		*	
223	Partridge, Ferruginous	*Caloperdix oculea*	**NT**		*	
224	Partridge, Long-billed	*Rhizothera longirostris*	**NT**		*	
225	Pheasant, Mountain Peacock	*Polyplectron inopinatum*	**VU**		*	
226	Philentoma, Rufous-winged	*Philentoma phyropterum*	TP		*	
227	Piculet, Rufous	*Sasia abnormis*	TP	*	*	*
228	Pigeon, Green Imperial	*Ducula aena*	TP		*	
229	Pigeon, Green-winged	*Chalcophas indica*	-	*	*	*
230	Pigeon, Large Green	*Treron capelli*	**VU**		*	
231	Pigeon, Little Green	*Treron olax*	TP		*	
232	Pigeon, Mountain Imperial	*Ducula badia*	TP		*	*
233	Pigeon, Pink-necked Green	*Treron vernans*	-			*
234	Pigeon, Thick-billed Green	*Treron curvirosa*	-		*	*
235	Pigeon, Yellow-vented Green	*Treron seimundi*	-		*	
236	Pipit, Paddyfield	*Anthus rufulus*	-		*	
237	Pitta, Banded	*Pitta guajana*	TP		*	
238	Pitta, Blue-winged	*Pitta moluccensis*	TP	*	*	
239	Pitta, Garnet	*Pitta granatina*	**NT**		*	
240	Pitta, Hooded	*Pitta sordida*	TP		*	
241	Pond-Heron, Chinese	*Ardeola bacchus*	TP		*	
242	Prinia, Rufescent	*Prinia rufescens*	TP		*	*
243	Prinia, Yellow-bellied	*Prinia flaviventris*	TP		*	*
244	Rail-babbler	*Eupetes macrocerus*	**NT**		*	
245	Reed-Warbler, Oriental	*Acrocephalus orientalis*	-		*	
246	Robin, Oriental Magpie	*Copsychus saularis*	-		*	*
247	Robin, Siberian Blue	*Lusciana cyane*	TP	*	*	
248	Sandpiper, Common	*Actitis hypoleucos*	-		*	
249	Sea-Eagle, White-bellied	*Haliaeetus leucogaster*	TP		*	
250	Serpent-Eagle, Crested	*Spilornis cheela*	TP	*	*	*
251	Shama, Rufous-tailed	*Trichixos pyrropyga*	**NT**		*	
252	Shama, White-rumped	*Copsychuc malabaricus*	-	*	*	*
253	Shrike, Brown	*Lanius cristatus*	TP	*	*	*
254	Shrike, Tiger	*Lanius tigrinus*	TP		*	*
255	Shrike, Tiger	*Lanius tigrinus*	TP	*		
256	Sparrow, Eurasian Tree	*Passer montanus*	-	*	*	
257	Sparrowhawk, Japanese	*Accipiter gularis*	-		*	*
258	Spiderhunter, Grey-breasted	*Arachnothera affinis*	-	*	*	*
259	Spiderhunter, Little	*Arachnothera longirostra*	TP	*	*	*
260	Spiderhunter, Long-billed	*Arachnothera robusta*	TP	*	*	*
261	Spiderhunter, Spectacled	*Arachnothrta flavigaster*	TP		*	*
262	Spiderhunter, Streaked	*Arachnothera magna*	TP		*	
263	Spiderhunter, Thick-billed	*Arachnothera crassirostris*	TP		*	
264	Spiderhunter, Yellow-eared	*Arachnothera chrysogenys*	TP	*	*	*
265	Sunbird, Brown-throated	*Anthreptes malacensis*	TP	*	*	
266	Sunbird, Crimson	*Aethopyga siparaja*	TP	*	*	*
267	Sunbird, Olive-backed	*Nectarinia jugularis*	TP		*	
268	Sunbird, Plain	*Anthreptes simplex*	TP	*	*	*
269	Sunbird, Purple-naped	*Hypogramma hypogrammicum*	TP	*	*	*
270	Sunbird, Ruby-cheeked	*Anthreptes singalensis*	TP	*	*	*
271	Sunbird, Scarlet	*Aethopyga mystacalis*	TP	*	*	
272	Swallow, Barn	*Hirundo concolor*	TP		*	*
273	Swallow, Pacific	*Hirundo tahitica*	TP	*	*	*
274	Swallow, Red-rumped	*Hirundo daurica*	-			*
275	Swallow, Red-rumped	*Hirundo daurica*	-	*	*	

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276	Swift, Asian Palm	*Cypsiurus balasensis*	-		*	
277	Swift, Fork-tailed	*Apus pacificus*	TP	*	*	
278	Swift, House	*Apus affinis*	TP		*	*
279	Swiftlet, Glossy	*Collocalia esculenta*	TP		*	
280	Swiftlet, White-nest	*Collocalia fuchiphaga*	TP		*	
281	Tailorbird, Common	*Orthotomus sutorius*	TP	*	*	*
282	Tailorbird, Dark-necked	*Orthotomus atrogularis*	TP	*	*	*
283	Tailorbird, Rufous-tailed	*Orthotomus sericeus*	TP		*	
284	Tern, Whiskered	*Chlidonias hybridus*	-		*	
285	Tern, White-winged	*Chlidonias leucopterus*	TP		*	
286	Thrush, Eye-browed	*Turdus feae*	TP		*	
287	Thrush, Orange-headed	*Zoothera citrina*	TP		*	
288	Tit, Sultan	*Melanochlora sultanea*	TP		*	*
289	Treeswift, Grey-rumped	*Hemiprocne longipennis*	TP	*	*	*
290	Treeswift, Whiskered	*Hemiprone comata*	TP			*
291	Treeswift, Whiskered	*Hemiprone comata*	TP	*	*	
292	Trogon, Diard's	*Harpectes diardii*	**NT**		*	
293	Trogon, Orange-breasted	*Harpectes oreskios*	TP		*	
294	Trogon, Red-headed	*Harpectes erythrocephalus*	TP		*	
295	Trogon, Red-naped	*Harpectes kasumba*	TP		*	*
296	Trogon, Scarlet-rumped	*Harpactes duvaucelli*	**NT**		*	*
297	Wagtail, Forest	*Dendronanthus indicus*	TP	*	*	*
298	Wagtail, Grey	*Motacillia cinerea*	TP	*	*	*
299	Warbler, Arctic	*Phylloscopus borealis*	TP	*	*	*
300	Warbler, Eastern Crowned	*Phylloscopus coronotus*	-		*	
301	Warbler, Inornate	*Phylloscopus inornatus*	TP		*	
302	White-eye, Everett's	*Zosterops japonicus*	TP		*	*
303	White-eye, Oriental	*Zosterops palpebrosa*	-	*		
304	Woodpecker, Bamboo	*Gecinulus viridis*	TP		*	
305	Woodpecker, Buff-necked	*Meiglyptes tukki*	**NT**	*	*	*
306	Woodpecker, Buff-rumped	*Meiglyptes tristis*	TP	*	*	
307	Woodpecker, Checker-throated	*Picus mentalis*	TP		*	
308	Woodpecker, Crimson-winged	*Picuc puniceus*	TP		*	*
309	Woodpecker, Great Slaty	*Muelleripicus pulverulentus*	TP		*	
310	Woodpecker, Grey-and-buff	*Hemicircus concretus*	TP	*	*	*
311	Woodpecker, Grey-capped	*Picoides mahrattensis*	TP		*	
312	Woodpecker, Maroon	*Blythipicus rubiginosus*	TP	*	*	
313	Woodpecker, Olive-backed	*Dinopium rafflesii*	**NT**	*	*	
314	Woodpecker, Orange-backed	*Reinwardtipicus validus*	TP		*	*
315	Woodpecker, Rufous	*Celeus brachyurus*	TP	*		
316	Woodpecker, White-bellied	*Dryocopus javensis*	TP		*	
317	Wood-shrike, Large	*Tephrodornis virgatus*	-		*	*
318	Wren-Babbler, Eye-browed	*Napothera epilepidota*	**NT**		*	
319	Wren-Babbler, Large	*Napothera macrodactyla*	TP		*	
320	Yellownape, Banded	*Picus miniaceus*	TP	*		
321	Yuhina, White-bellied	*Yuhina zanthaleuca*	TP	*	*	*
Total			-	**155**	**292**	**128**

Status Sources: http://www.birdinginmalaysia.com/lists.php

Note: CE= Critically Endangered, TP= Tottaly Protected, NT=Nearly Threatened, VER= Vulnerable, LERF= Lowland evergreen rain forest, LMRF= Lower montain rain forest, UMRF= Upper montain rain forest.

Discussion

As mentioned in the literature review, Malaysia is blessed with diverse rainforests such as hill dipterocarp, lowland dipterocarp, upper hill dipterocarp, oak–laurel, montane ericaceous, peatswamp and mangrove forest (WWF, 2015). Furthermore, it is well known that tropical

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rainforests, play a vital role in maintaining many species of wildlife due to their habitat diversity (Thinh *et al.*, 2012). Unfortunetly, Malaysia currently has one of the highest rates of deforestation (Butler, 2013) and over the past few decades, Peninsula Malaysia forests have been severely impacted by deforestation and the cultivation of exotic crops and urban sprawl (Jusoff & Majid, 1995; Soh *et al.*, 2006).

Deforestation may cause habitat loss and degradation (Shaw *et al.*, 2013) that ultimately affects the forest-dependent wildlife species community, richness and diversity (Muhamad *et al.*, 2013). According to Thiollay (1992), an overall 27–33% decrease of species richness, frequency, and abundance will be occurred after logging, with a less marked decline of diversity and evenness indices (Grandpré *et al.*, 1993). Moreover, Chew (2009) suggested that logging could affect the forest microclimate by exposing the mid-canopy of the forest and thus increase the temperature and decrease the humidity of the sites. The process of evaporation also increases and water vapour levels are usually higher when the forest is destroyed (Li *et al.*, 2007).

Bird species are highly sensitive to many changes due to certain ecological processes and display a wide range of sensitivities to habitat modification and disturbances of the natural process (Chapman *et al.*, 2010). One of the important impacts of primary forest destruction on bird population is a decrease in bird community (Nordin & Zakaria, 1997). Johns (1988) has reported decrease of hornbill's population in logged forest. This was probably due to the decrease in their preferred big trees that supply them with food and nesting sites. Study by Zamri and Mohamed (2002) at Ulu Muda Forest Reserve (which the forest environments are almost similar in most of forest reserve in Kelantan) found that a total of 75 species of understorey birds were recorded before logging and only 61 species were recorded immediately after logging (about three months). Silang (2001) recorded about 66 species of birds in primary forest, compared to only 55 species in 10-year-old logged forest in Sungai Lalang Forest Reserve. This revealed that primary forest recorded higher species composition than logged forest.

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According to Bell (1982), birds in tropical forests are able to choose suitable environmental conditions by moving between many vertical strata of the forest. However, certain groups of birds are able to tolerate their habitat disturbances such as those caused by logging activities. For example, bulbul and spiderhunter species are able to tolerate changes in microclimatic conditions (Nordin & Zakaria, 1997). The bulbuls, noted as generalist species, are capable of exploiting both insects and fruits. Species such as those from the babblers group are intolerant to the changes in microclimate due to logging operations (Hussin, 1994; Johns, 1988).

The avifauna of KFA recorded in this study include a total of 321 species, of which one is Critically Endangered, seven have been categorized in vulnerable and 49 are nearly threatened. It is about 40.27% of Malaysian birds. Out of the total recorded species, a total of 155, 292 and 128 species were recorded in Lowland evergreen rain forest reserves, Lower Montain Rain Forest Reserve and Upper Kelantan Montain Rain Forest respectively. The Blue-banded Kingfisher *Alcedo euryzonia* as critically endangered species, has been recorded in both Lowland evergreen and Lower Montain rain forests. This study considered that Kelantan forests area (without consideration of mangrove forest) with less than 50% of Malaysian birds, could be one of the `megadiversity' places in Malaysia.

There is however an urgent need to increase Malaysia's TPA system coverage in relation to IUCN/international standards, According to sources from the state Forestry Department, in 2014 alone, a total of 41 logging concession licences were approved in the Permanent Reserved Forests (PRF) in the South Kelantan Forest District (covering Jajahan Gua Musang and Jajahan Kecil Lojing). Maybe the main reason is that the state governments are afforded a very limited revenue base, and income from logging activity is the second largest income to the State ranking after land tax. Data extracted from National Audit Department (2014) showed that total revenue collected from logging activities in 2012, 2013 and 2014 were respectively RM50.91 million, RM59.03 million and RM64.94 million.

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Most of the approved logging concession licenses in the PRF in the South Kelantan Forest District are for the purpose of large-scale conversion to monoculture crops or what is called tree (forest) plantations. Most of the area involved in logging activities here considered as hill forest and the potential impacts of logging towards wildlife populations in most of logging areas here are almost similar. About impact of logging in density, habitat requirements and breeding of birds specialy in Kelantan, there is a danger with a study such as this that conclusions are made about the complete habitat requirements of different species or guilds of species.

According this study, KFA is rich in avian genetic resources. Importation of this has enriched the gene pool of the different species considerably. From the site survey and the information provided by Forestry Department of Kelantan, about 50 Species of birds under nearly threatened in Malaysia were recorded in KFA, such as Rhinoceros Hornbill, Great Argus, Crested Partridge, Ferruginous Partridge, Eye-browed Wren-Babbler (that they are falls under endangered category by IUCN), White-crowned Hornbill and Black Hornbill (that they are Falls under vulnerable category by IUCN and listed on CITES II). There are also 7 Species of birds vulnerable included Large Green Pigeon, Mountain peacock Pheasant, Masked Finfoot, Plain-pouched Hornbill, Short-toed Coucal, Wallace's Hawk Eagle, Straw-headed bulbul, that these birds are considered rare and vulnerable in Kelantan and globally vulnerable to extinction due to poaching and habitat destruction. They are listed on CITES II and listed as vulnerable by the IUCN (Table 2).

Table 2: List of Vulnerable species recorded in Kelantan Forest Reserves

Common name	Scientific name	Family	Pop. size (MT)	Pop. trend	Category
Bulbul, Straw-headed	*Pycnonotus zeylanicus* Gmelin, 1789	Pycnonotidae	10000-19999	Decreasing	VU
Coucal, Short-toed	*Centropus rectunguis* Strickland, 1847	Cuculidae	10000-19999	Decreasing	VU
Eagle, Wallace's Hawk	*Spizaetus nanus* Wallace, 1868	Accipitridae	2500-9999	Decreasing	VU
Finfoot, Masked	*Heliopais personata* Gray, 1849	Heliornithidae	600-1700	Decreasing	VU
Hornbill, Plain-pouched	*Aceros subruficollis* Blyth, 1843	Bucerotidae	1500-7000	Decreasing	VU
Kingfisher, Blue-banded	*Alcedo euryzonia*	Alcedinidae	50-249	Decreasing	CE

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	Temminck, 1830				
Pheasant, Mountain Peacock	*Polyplectron inopinatum* Rothschild,1903	Phasianidae	2500-9999	Decreasing	VU
Pigeon, Large Green	*Treron capelli* Temminck, 1823	Columbidae	10000-19999	Decreasing	VU

Note: MT=Mature Individuals, CE= Critically Endangered, VU= Vulnerable

A strong relationship between forest logging and bird community composition has been reported recently in the literature (Burivalova *et al.*, 2015; Muhamad *et al.*, 2013; Shaw *et al.*, 2013). Only few studies have been conducted to investigate the effects of forest logging on avian species in hill dipterocarp tropical rainforests not only in Kelantan, but also in Malaysia, and detailed information is still lacking.(Bing *et al.*, 2015; Nor Hashim & Ramli, 2013; Peh *et al.*, 2011). Refer to the impacts of forest destruction on bird population and decrease in species richness and diversity, logging practices in KFA should be revised and designed to minimize effects on wildlife population and their natural habitat, as well as avifuna. This could be done through a proper revised on logging practices (where applicable) with the end results may benefits to wildlife habitat as well as logging practices. In addition, it is necessary to monitor species or community trends, particularly understorey species that have been suggested to be affected mostly when the forest structure is altered. Moreover, the most urgent need for further research on avian and other order population in logging area is in-depth studies of the microhabitat requirement for each of wildlife species especially those that appear to be most adversely affected by logging. Finally, in any logging practices logging concessionaires must set aside patches of forest unlogged.

At the end of conclusion, the main objective of this study, was establishing a baseline data abut avifuna in forest areas of Kelantan for the assessment of habitat. This study consists of rapid assessment of logging and other environmental effects on the wildlife species and evaluates the need for restoration efforts at different localities of the forest to understand the success of restoration actions. From these assessment activities, findings can be used (1) to support state and

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regional programs to evaluate wildlife restoration potential, actions, and success, and (2) to predict the impacts of forest harvesting on wildlife species and habitats.

References

Adams, W. (2014). The value of valuing nature. *Science, 346*(6209), 549-551.

Bell, H. (1982). A bird community of New Guinean lowland rainforest. 3. Vertical distribution of the avifauna. *Emu, 82*(3), 143-162.

Bing, D. Y., Rajpar, M. N., & Zakaria, M. (2015). Avian Richness and Habitat Characteristics In Primary and Logged Hill Dipterocarp Tropical Rainforest Of Peninsular Malaysia. *The Malayan Nature Journal, 65*(4), 300-316.

Burivalova, Z., Lee, T. M., Giam, X., Şekercioğlu, Ç. H., Wilcove, D. S., & Koh, L. P. (2015). Avian responses to selective logging shaped by species traits and logging practices. *Proceedings of the Royal Society of London B: Biological Sciences, 282*(1808), 20150164.

Butler, R. (2013). Malaysia has the world's highest deforestation rate, reveals Google forest map. *mongabay. com, http://news. mongabay. com/2013/1115-worlds-highest-deforestationrate. html*.

Chapman, C. A., Struhsaker, T. T., Skorupa, J. P., Snaith, T. V., & Rothman, J. M. (2010). Understanding long-term primate community dynamics: implications of forest change. *Ecological Applications, 20*(1), 179-191.

Chiew, T. H. (2009). Malaysia Forestry Outlook Study: Working Paper Series, Asia-Pacific Forestry Sector Outlook Study II, Food and Agriculture Organization of the United Nations, Bangkok. Working Paper No. APFSOS II/WP/2009/02.

Ghasemi, S., Mola-Hoveizeh, N., Zakaria, M., Ismail, A., & Tayefeh, F. H. (2012). Relative abundance and diversity of waterbirds in a Persian Gulf mangrove forest, Iran. *Tropical Zoology, 25*(1), 39-53.

Grandpré, L., Gagnon, D., & Bergeron, Y. (1993). Changes in the understory of Canadian southern boreal forest after fire. *Journal of Vegetation Science, 4*(6), 803-810.

Grogan, K., Pflugmacher, D., Hostert, P., Kennedy, R., & Fensholt, R. (2015). Cross-border forest disturbance and the role of natural rubber in mainland Southeast Asia using annual Landsat time series. *Remote Sensing of Environment*.

Hussin, M. Z. (1994). Ecological effects of selective logging in a lowland dipterocarp forest on avifauna, with special reference to frugivorous birds.

Johns, A. D. (1988). Effects of" selective" timber extraction on rain forest structure and composition and some consequences for frugivores and folivores. *Biotropica*, 31-37.

Jusoff, K., & Majid, N. M. (1995). Integrating needs of the local community to conserve forest biodiversity in the State of Kelantan *Biodiversity & Conservation* (Vol. 4, pp. 108-114).

Kampichler, C., Angeler, D. G., Holmes, R. T., Leito, A., Svensson, S., van der Jeugd, H. P., & Wesołowski, T. (2014). Temporal dynamics of bird community composition: an analysis of baseline conditions from long-term data. *Oecologia, 175*(4), 1301-1313.

Kessler, W. B. (1992). A parable of paradigms. *Journal of forestry (USA)*.

Kim, J. Y., Do, Y., Im, R.-Y., Kim, G.-Y., & Joo, G.-J. (2014). Use of large web-based data to identify public interest and trends related to endangered species. *Biodiversity and Conservation, 23*(12), 2961-2984.

Kumar, M., & Kumar, P. (2008). Valuation of the ecosystem services: a psycho-cultural perspective. *Ecological economics, 64*(4), 808-819.

Li, K., Coe, M., Ramankutty, N., & De Jong, R. (2007). Modeling the hydrological impact of land-use change in West Africa. *Journal of hydrology, 337*(3), 258-268.

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Muhamad, D., Okubo, S., Miyashita, T., & Takeuchi, K. (2013). Effects of habitat type, vegetation structure, and proximity to forests on bird species richness in a forest–agricultural landscape of West Java, Indonesia. *Agroforestry systems, 87*(6), 1247-1260.

National Audit Department. (2014). AUDITOR GENERAL'S REPORT FOR THE YEAR 2014 *The Activities Of The Departments/Agencies And Management Of Kelantan State Government Companies, 1st Series, National Audit Office Malaysia, Putrajaya*

Nor Hashim, E., & Ramli, R. (2013). Comparative Study of Understorey Birds Diversity Inhabiting Lowland Rainforest Virgin Jungle Reserve and Regenerated Forest. *The Scientific World Journal, 2013*, Article ID 676507, 676507 pages, 672013. doi:676510.671155/672013/676507.

Nordin, M., & Zakaria, M. (1997). Some effects of logging in mixed lowland dipterocarp forests on birds. *State of the Malaysian environment*, 161-166.

Peh, K. S.-H., Soh, M. C., Sodhi, N. S., Laurance, W. F., Ong, D. J., & Clements, R. (2011). Up in the clouds: is sustainable use of tropical montane cloud forests possible in Malaysia? *Bioscience, 61*(1), 27-38.

Sayer, J., Campbell, B., Petheram, L., Aldrich, M., Perez, M. R., Endamana, D., . . . Doggart, N. (2007). Assessing environment and development outcomes in conservation landscapes. *Biodiversity and Conservation, 16*(9), 2677-2694.

Shaw, D. W., Escalante, P., Rappole, J. H., Ramos, M. A., Oehlenschlager, R. J., Warner, D. W., & Winker, K. (2013). Decadal changes and delayed avian species losses due to deforestation in the northern Neotropics. *PeerJ, 1*, e179.

Silang, S. (2001). *Primate Populations in Logged and Primary Forests of Sungai Lalang Forest Reserve, Selangor.* Universiti Putra Malaysia.

Sodhi, N. S., Koh, L. P., Prawiradilaga, D. M., Tinulele, I., Putra, D. D., & Tan, T. H. T. (2005). Land use and conservation value for forest birds in Central Sulawesi (Indonesia). *Biological Conservation, 122*(4), 547-558.

Soh, M. C., Sodhi, N. S., & Lim, S. L. (2006). High sensitivity of montane bird communities to habitat disturbance in Peninsular Malaysia. *Biological Conservation, 129*(2), 149-166.

Thinh, V., Doherty, P., & Huyvaert, K. (2012). Effects of different logging schemes on bird communities in tropical forests: A simulation study. *Ecological Modelling, 243*, 95-100.

Thiollay, J. (1992). Influence of selective logging on bird species diversity in a Guianan rain forest. *Conservation biology, 6*(1), 47-63.

Wong, A. (2006). *The impact of forestry practices on frog communities in Sabah, Malaysia.* MSc Thesis, Universiti Putra Malaysia, Kuala Lumpur, Malaysia.

WWF. (2015). The Malaysian Rainforest. *Web Accessed on 2th June, 2015 at URL:http://www.wwf.org.my/about_wwf/what_we_do/forests_main/*

Yarwood, M. R., Weston, M. A., & Garnett, S. T. (2014). From little things, big things grow; trends and fads in 110 years of Australian ornithology. *Scientometrics, 98*(3), 2235-2254.

Zain, R. M., Ismail, M. H., & Zaki, P. H. (2013). Classifying Forest Species Using Hyperspectral Data in Balah Forest Reserve, Kelantan, Peninsular Malaysia. *Journal of Forest Science, 29*(2), 131-137.

Zamri, R., & Mohamed, Z. (2002). *Immediate effects of selective logging on the feeding guild of the understorey insectivorous birds in Ulu Muda Forest Reserve, Kedah, Malaysia*. Paper presented at the Proceedings of the Regional Symposium on Environment and Natural Resources.

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