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BIRD ASSEMBLAGES IN LOWLAND DIPTEROCARP FORESTS OF TASIK KENYIR AND SETIU, TERENGGANU

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Abstract: The landscape of Tasik Kenyir and Setiu are consists of lowland dipterocarp forests which bear to sustain various species of birds. A study was conducted to determine the bird assemblages in two lowland dipterocarp forests at Tasik Kenyir and Setiu from July to October 2016 by using two different methods; mist-netting and point count methods. A total of 82 species, 28 families and 343 individuals were recorded at both sites. Tasik Kenyir showed a higher number of species with 53 species compared to Setiu with account of only 48 species. However, Setiu recorded a higher number of individuals (184 individuals) compared to Tasik Kenyir (159 individuals) with the same number of families (23 families). The most commonly found species at Tasik Kenyir is Cream Vented Bulbul, *Pycnonotus simplex*, and Barn Swallow, *Hirundo rustica* at Setiu, with 15 and 28 individuals respectively. Point count method recorded a total of 57 species (51%), while mist-netting recorded 40 species (36%) and both methods shared 14 species (13%). As a conclusion, knowledge on the current population of birds and their habitat status may provide beneficial information towards effective conservation management in the studied areas.

Keywords: *Bird, mist netting, point count, Tasik Kenyir, Setiu.*

Introduction

Tropical rainforest in the Southeast Asian is considered to be among the most diverse forests in the world (Myers *et al.,* 2000). There are 10 000 species of birds worldwide and about 1270 species were recorded in countries of Southeast Asia such as; Peninsular Malaysia, Thailand and Singapore (Robson, 2000). Malaysia consists of a high number of bird species with 670 species were found in the Peninsular Malaysia (Zakaria *et al.,* 2014; MNS, 2015). It has been observed that the forest ecosystem in the Peninsular Malaysia has recorded most of the bird species in Malaysia. However, global expansion of agriculture land use has led to habitat loss, where 60% of bird species in the IUCN red list had tremendously declined (Johnson *et al.,* 2011). Besides, habitat loss due to the continuous deforestation and anthropogenic activities has also threatened the survival of tropical rainforest birds (Nor Hashim & Ramli, 2013).

Birds are indeed significant to the ecosystem, they act as pollinators and seed dispersers (Nason, 1992). Furthermore, birds are also a good indicator in describing the actual health condition of the forests (Zakaria *et al.,* 2005). They are the best indicator in determining a disturbance of tropical rainforest (Barlow *et al.,* 2006), floral composition and food availability as they are highly sensitive to any changes in the vegetation structure and composition (Barlow & Peres, 2004; Zakaria *et al.,* 2014). Moreover, they are also able to indicate a long-term environmental disturbance such as urbanization, air pollution and landscape alteration (Sidra *et al.,* 2013).

Despite their importance in ecosystems, there is still lack of published information on the bird assemblage in Malaysia, particularly in the eastern part of Peninsular Malaysia. Two studies were previously carried out at Kenyir i.e. Hulu Kenyir (Sah & Baharuddin, 2001) and Tanjong Mentong (Sulaiman *et al.,*

2015). Meanwhile, bird assemblages in Setiu have only been documented by Tamblyn *et al.* (2005) and a proceeding paper from Yee *et al.* i.e. Saok, Tasik Kenyir (N05º08'35.51", E102º45'39.09") and Kampung Guntong, Setiu (N05º35'34.10", E102º40'41.58"), Terengganu (2015). Thus, this study aims to determine the bird assemblages collected from two different lowland dipterocarp forests of Tasik Kenyir and Setiu as well as to compare bird species composition using mist netting and point count methods.

Materials and Methods

Study Sites

(Figure 1) which covers approximately 2000 m_2 for each study site. Tasik Kenyir is the biggest man-made lake in Southeast Asia. The forest area that surrounds the lake is mainly comprises of lowland and hill dipterocarp forest. It consists of 340 islands, numerous rapids and rivers with 14 waterfalls covered by canopy trees of the tropical rainforest (Bhuiyan *et al.,* 2015). Setiu is located in the northern Kuala Terengganu. The study site that was located in Setiu is a lowland dipterocarp forest which is surrounded by several habitat types such as oil palm plantation, forest patches and anthropogenic activity such as resorts. The resorts are frequently visited by visitors and the oil palm plantation is frequented by workers particularly during harvesting season.

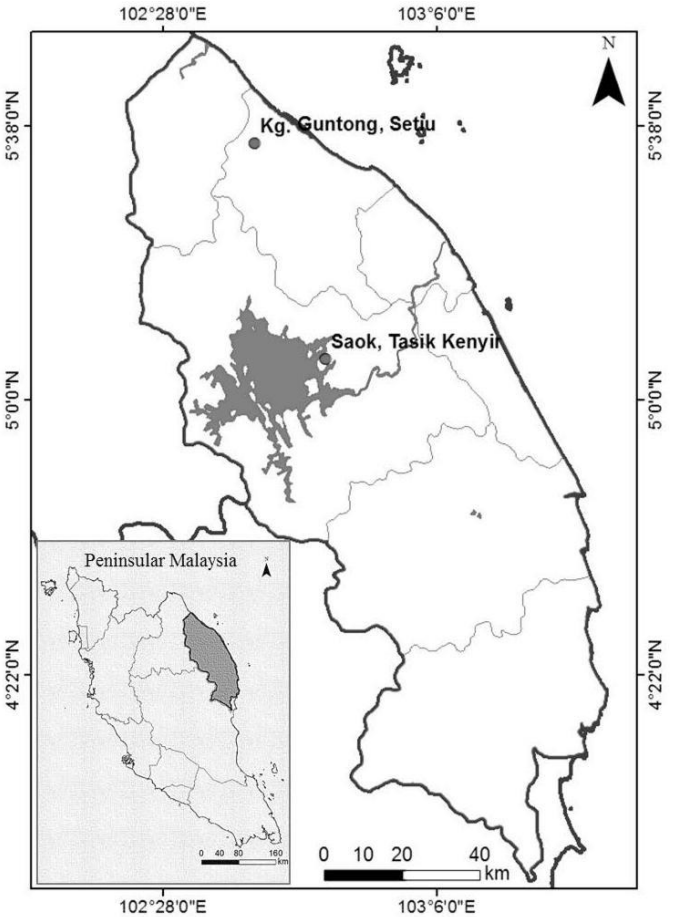

Figure 1: Schematic map showing the study sites at Saok, Tasik Kenyir and Kampung Guntong, Setiu, Terengganu.

Sampling Methods
Mist Netting

A total of ten mist nets (9 m x 2.5 m; 36 mm mesh size) were being used for each study site. They were deployed at 100m interval and set up 0.5m above the ground to avoid any captured birds from the ground-dwelling predators. Geographical Position System (GPS) reading was taken for each of the locations of mist nets. The mist nets were left opened from 0700 to 1800 and they were inspected frequently at every two hours to ensure the birds remained alive and in a good condition. The captured birds were placed in cloth bags and subsequently measured based on their morphological characters such as tarsus, bill length and wing length (Robson, 2008).

Point Count

A trail of 1000 m with an interval of 100m apart between point counts was set up by using measuring tape. A total of 10 observing stations were placed systematically throughout the trail (David *et al.,* 2016). Each station was between 100m interval to prevent from recounting the same individuals of birds at each station. An observation time of approximately 10 minutes at each station was conducted by using a Bushnell marine waterproof binocular (7x24 magnification). The point counts were conducted from 0700 to 1000 in the morning and 1500 h to 1800 h in the evening during the peak hours for bird activities (Azman *et al.,* 2011). The birds that were observed and heard from both sides of the point count trail were recorded in the data sheets. All birds observed, captured and bird calls were identified to the species level based on Robson (2000) and Davison and Chew (2003).

Data Analysis

We used PAST software (Hammer *et al.,* 2007) and EcoSim700 (Gotelli & Entsminger, 2001) to determine the rank abundance curve and species accumulation curve for both datasets of Tasik Kenyir and Setiu.

Results
Birds Species at Tasik Kenyir and Setiu

A total of 82 species, 28 families and 343 individuals were recorded from Tasik Kenyir and Setiu (Table 1). Species from Pycnonotidae was the highest and the most commonly found species, followed by Bucerotidae and Nectariniidae. Meanwhile, 11 families (Laniidae, Oriolidae, Hemiprocnidae, Aegithinidae, Irenidae, Monarchidae, Apodidae, Hirundinidae, Passeridae, Campephagidae and Trogonidae) were noted as the least families recorded with only one species each.

Table 1: List of bird species at Tasik Kenyir and Setiu recorded from July until October, 2016

Family	Scientific name	Common name	Tasik Kenyir	Setiu	Status	IUCN
Dicruridae	*Dicrurus remifer*	Lesser Racquet-tailed Drongo	2	0	R	LC
	Dicrurus paradiseus	Greater Racquet tailed Drongo	1	10	R	LC
	Dicrurus annectans	Crow-billed Drongo	1	0	M	LC
Pycnonotidae	*Pycnonotus simplex*	Cream-vented Bulbul	15	0	R	LC
	Alophoixus bres	Grey-cheeked Bulbul	0	7	R	LC
	Pycnonotus goiavier	Yellow-vented bulbul	0	8	R	LC
	Pycnonotus plumosus	Olive-winged Bulbul	0	2	R	LC
	Tricholestes criniger	Hairy-backed Bulbul	8	0	R	LC
	Pycnonotus finlaysoni	Stripe-throated Bulbul	2	0	R	LC
	Criniger phaeocephalus	Yellow-bellied Bulbul	8	5	R	LC
	Pycnonotus atriceps	Black-headed Bulbul	1	0	R	LC

Family	Scientific name	Common name	Tasik Kenyir	Setiu	Status	IUCN
	Alophoixus ochraceous	Ochraceous Bulbul	1	0	R	LC
	Pycnonotus erythropthalmos	Spectacled Bulbul	2	0	R	LC
	Pycnonotus cyaniventris	Grey-bellied Bulbul	2	0	R	NT
	Pycnonotus eutilotus	Puff-backed Bulbul	4	0	R	NT
	Pycnonotus brunneus	Red-eyed Bulbul	1	1	R	LC
Laniidae	*Lanius tigrinus*	Tiger Shrike	1	0	M	LC
Eurylaimidae	*Eurylaimus ochromalus*	Black and Yellow Broadbill	4	2	R	NT
	Calyptomena viridis	Green Broadbill	2	8	R	NT
Bucerotidae	*Anthracoceros albirostris*	Oriental Pied Hornbill	3	0	R	LC
	Buceros rhinoceros	Rhinoceros Hornbill	2	0	R	NT
	Buceros bicornis	Great Hornbill	3	4	R	NT
	Anorrhinus galeritus	Bushy-crested Hornbill	1	8	R	LC
	Berenicornis comatus	White-crowned Hornbill	0	3	R	NT
	Anthracoceros malayanus	Black Hornbill	2	0	R	NT
Picidae	*Picus puniceus*	Crimson-winged Woodpecker	0	3	R	LC
	Meiglyptes tukki	Buff-necked Woodpecker	0	5	R	NT
	Celeus brachyurus	Rufous Woodpecker	3	0	R	LC
Muscicapidae	*Copsychus saularis*	Oriental Magpie Robin	3	10	R	LC
Vangidae	*Philentoma pyrhoptera*	Rufous-winged Philentoma	2	5	R	LC
	Hemipus picatus	Bar-winged Flycatcher Shrike	1	0	R	LC
Megalaimidae	*Megalaima mystacophanos*	Red-throated Barbet	0	5	R	NT
	Megalaima oorti	Black-browed Barbet	0	1	R	LC
Cisticolidae	*Orthotomus sutorius*	Common Tailorbird	5	3	R	LC
	Orthotomus atrogularis	Dark-necked Tailorbird	1	0	R	LC
	Centropus bengalensis	Lesser Coucal	0	1	R	LC
	Eudynamys scolopaceus	Asian Koel	0	1	R,M	LC
	Rhinortha chlorophaea	Raffles's Malkoha	5	1	R	LC
	Phaenicophaeus diardi	Black-bellied Malkoha	1	1	R	NT
	Centropus sinensis	Greater Coucal	0	1	R	LC
	Surniculus lugubris	Drongo Cuckoo	0	1	R	LC
Dicaeidae	*Dicaeum concolour*	Plain Flowerpecker	0	1	R	LC
	Prionochilus percussus	Crimson-breasted Flowerpecker	3	3	R	LC
	Dicaeum trigonostigma	Orange-bellied Flowerpecker	3	0	R	LC
Nectariniidae	*Arachnothera robusta*	Long-billed Spiderhunter	0	1	R	LC
	Arachnothera crassirostris	Thick-billed Spiderhunter	0	1	R	LC
	Arachnothera longirosta	Little Spiderhunter	4	0	R	LC
	Aracnothera modesta	Grey-breasted Spiderhunter	0	1	R	LC
	Hypogramma hypogrammicum	Purple naped sunbird	1	2	R	LC
	Anthreptes singalensis	Ruby-Cheeked Sunbird	0	1	R	LC
Chloropseidae	*Chloropsis hardwickii*	Orange-bellied leafbird	0	1	R	LC
	Chloropsis cyanopogon	Lesser-green leafbird	1	2	R	NT

Family	Scientific name	Common name	Tasik Kenyir	Setiu	Status	IUCN
Columbidae	*Geopelia striata*	Zebra dove	7	8	R	LC
	Chalcophaps indica	Green-winged Pigeon	8	4	R	LC
Oriolidae	*Oriolus cruentus*	Black and Crimson oriole	1	0	R	LC
Hemiprocnidae	*Hemiprocne comate*	Whiskered Treeswift	8	0	R	LC
Aegithinidae	*Aegithina viridissima*	Green Iora	5	0	R	NT
Irenidae	*Irena puella*	Asian-fairy Bluebird	1	0	R	LC
Timaliidae	*Macronous ptilosus*	Fluffy backed tit babbler	1	0	R	NT
	Stachyris erythroptera	Chestnut-winged Babbler	2	0	R	LC
	Stachyris poliocephala	Grey-headed Babbler	1	0	R	LC
	Stachyris nigricollis	Black-throated babbler	0	1	R	NT
	Erpornis zantholeuca	White-bellied Yuhina	2	0	R	LC
	Malacocincla malaccensis	Short tailed babbler	3	0	R	NT
	Malacopteron magnum	Rufous-crowned Babbler	1	0	R	NT
	Pellorneum capistratum	Black-capped babbler	0	2	R	LC
	Alcippe brunneicauda	Brown Fulvetta	1	0	R	NT
Alcedinidae	*Alcedo euryzona*	Blue-banded-Kingfisher	1	0	R	CR
	Ceyx erithaca	Oriental-Dwarf Kingfisher	0	3	R,M	LC
	Actenoides concretus	Rufous-Collared Kingfisher	0	1	R	NT
Monarchidae	*Hypothymis azurea*	Black naped monarch	5	0	R	LC
Apodidae	*Rhaphidura leucopygialis*	Silver rumped needletail	3	0	R	LC
Hirundinidae	*Hirundo rustica*	Barn Swallow	0	28	M	LC
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	0	16	R	LC
Campephagidae	*Pericrocotus igneus*	Fiery Minivet	0	1	R	NT
Tytonidae	*Strix leptogrammica*	Brown Wood Owl	0	1	R	LC
	Phodilus badius	Oriental Bay Owl	0	3	R	LC
Trogonidae	*Harpactes diardii*	Diard's Trogon	0	2	R	NT
TOTAL			159	184		

Figure 2 shows that Tasik Kenyir recorded a higher number of species (53 species) but a lower number of individuals (159 individuals). Meanwhile, Setiu showed a lower number of species (48 species) but a higher number of individuals (184 individuals). Both sites, however, consist of similar number of families (23 families).

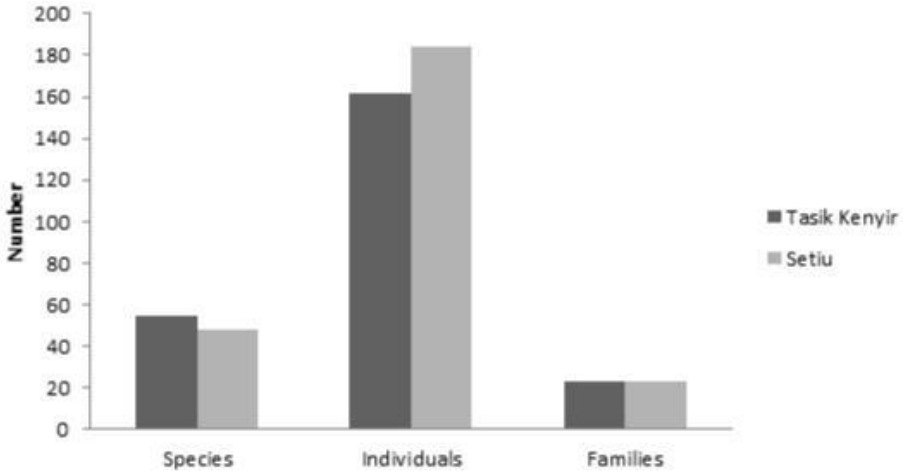

Figure 2: Total number of species, individuals and families recorded at Tasik Kenyir and Setiu.

Cream -Vented Bulbul, *Pycnonotus simplex* was the most prevalent species at Tasik Kenyir with 15 individuals, meanwhile, Barn Swallow, *Hirundo rustica* was the most prevalent species at Setiu with 28 individuals (Figure 3).

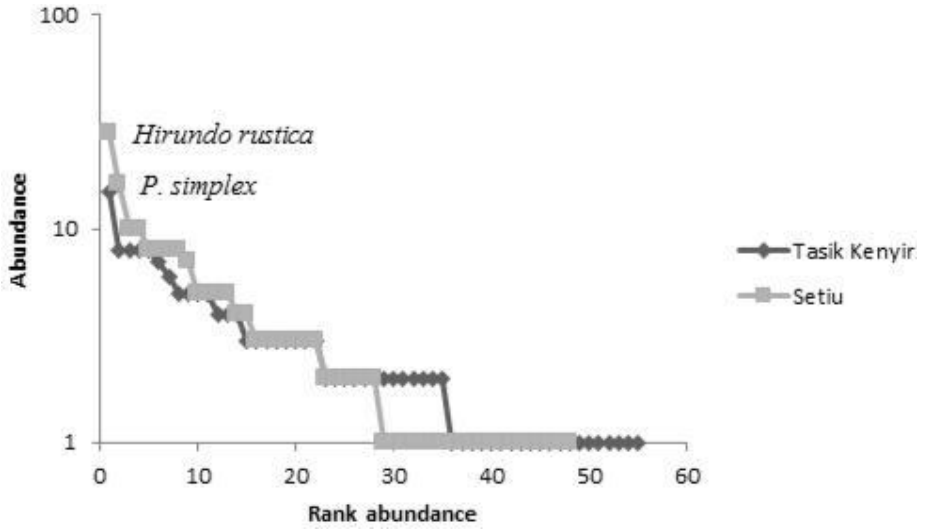

Figure 3: Rank abundance of bird species at Tasik Kenyir and Setiu

Thirty six species were only found at Tasik Kenyir, while 29 species were only found at Setiu (Figure 4). Meanwhile, 19 species were recorded at both Tasik Kenyir and Setiu.

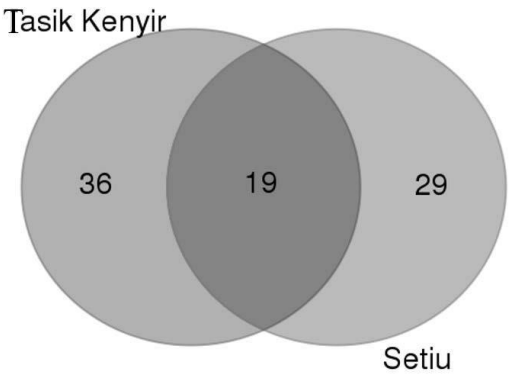

Figure 4: The Venn diagram shows the shared and unshared species between the two sites

Figure 5 shows that the species accumulation curve at both sites posed an increasing trend with a total of 82 species recorded. However, both sites did not reach the asymptote, indicating more unrecorded species present in both sites. Thus, additional samplings need to be conducted in order to record all the remaining species in both sites.

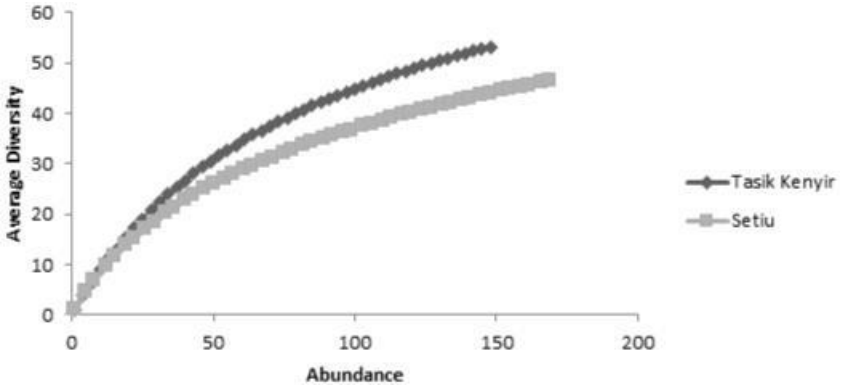

Figure 5: Species accumulation curve of bird species at Tasik Kenyir and Setiu

Bird Species Composition According to Sampling Methods

In general, the results shows that the number of bird species recorded was varied, of which the species was recorded higher when point count method was used, compared to mist-netting (Table 2). The point count method recorded a total of 57 species (51%), while mist-netting recorded 40 species (36%) and both methods shared 14 species (13%). Figure 6 shows that, at Tasik Kenyir, both mist-netting and point count methods recorded a total of nine species (12%). Thirty seven species (49%) were detected by using the point count method and 29 species (39%) were captured using mist-nets. At Setiu, the point count method detected 35 species (57%), 20 species (32%) were captured using mist nets and both methods recorded seven species (11%).

Table 2: List of bird species recorded using mist-netting, point count and both methods.

Family	Scientific name	Mist-netting	Point count	Both
Muscicapidae	*Copsychus malabaricus*	+		
	Copsychus saularis		+	
	Enicurus ruficapillus	+	+	+
	Enicurus leschenaulti	+		
	Ficedula hyperythra		+	
Pycnonotidae	*Pycnonotus simplex*	+	+	+
	Pycnonotus erythropthalmos	+		
	Pycnonotus cyaniventris	+		
	Pycnonotus eutilotus	+		
	Pycnonotus brunneus	+		
	Pycnonotus goiavier		+	
	Pycnonotus plumosus		+	
	Pycnonotus finlaysoni		+	
	Pycnonotus atriceps		+	
	Alophoixus bres	+	+	+
	Alophoixus ochraceous	+		
	Criniger phaeocephalus	+	+	+
	Iole olivacea	+		
	Tricholestes criniger	+		
Dicruridae	*Dicrurus remifer*	+	+	+
	Dicrurus paradiseus	+	+	+
	Dicrurus annectans		+	
Eurylaimidae	*Eurylaimus ochromalus*	+	+	+
	Calyptomena viridis	+	+	+
Vangidae	*Philentoma pyrhoptera*	+		
	Hemipus picatus	+		
Alcedinidae	*Alcedo euryzona*	+		
	Actenoides concretus	+		
	Ceyx erithaca	+		
Columbidae	*Chalcophaps indica*	+		
	Geopelia striata		+	
Timaliidae	*Erpornis zantoleuca*	+		
	Stachyris nigricollis	+		
	Stachyris poliocephala	+		
	Stachyris erythroptera		+	
	Macronous ptilosus		+	
	Alcippe brunneicauda	+		
	Malacopteron magnum	+		

Family	Scientific name	Mist-netting	Point count	Both
	Pellorneum capistratum	+		
	Malacocincla malaccensis	+	+	+
Nectariniidae	*Arachnothera longirosta*	+		
	Hypogramma hypogrammium	+	+	+
	Aracnothera modesta	+		
	Arachnothera robusta		+	
	Arachnothera crassirostris		+	
	Anthreptes singalensis		+	
Monarchidae	*Hypothymis azurea*	+	+	+
Dicaeidae	*Prionochilus percussus*	+	+	+
	Dicaeum trigonostigma	+	+	+
	Dicaeum concolour		+	
Tytonidae	*Strix leptogrammica*	+		
	Phodilus badius	+		
Trogonidae	*Harpactes diardii*	+		
Picidae	*Meiglyptes tukki*	+	+	+
	Picus puniceus		+	
	Celeus brachyurus		+	
Laniidae	*Lanius tigrinus*		+	
Cuculidae	*Surniculus lugubris*		+	
	Centropus bengalensis		+	
	Eudynamys scolopaceus		+	
	Rhinortha chlorophaea		+	
	Phaenicophaeus diardi		+	
	Centropus sinensis		+	
Bucerotidae	*Anthracoceros albirostris*		+	
	Buceros rhinoceros		+	
	Table 2: (Continued)			
	Buceros bicornis		+	
	Anorrhinus galeritus		+	
	Berenicornis comatus		+	
	Anthracoceros malayanus		+	
Megalaimidae	*Megalaima mystacophanos*		+	
	Megalaima oorti		+	
Cisticolidae	*Orthotomus sutorius*		+	
	Orthotomus atrogularis		+	
Chloropseidae	*Chloropsis hardwickii*		+	
	Chloropsis cyanopogon		+	
Oriolidae	*Oriolus cruentus*		+	

Family	Scientific name	Mist-netting	Point count	Both
Hemiprocnidae	*Hemiprocne comata*		+	
Aegithinidae	*Aegithina viridissima*		+	
Irenidae	*Irena puella*		+	
Apodidae	*Rhaphidura leucopygialis*		+	
Hirundinidae	*Hirundo rustica*		+	
Passeridae	*Passer montanus*		+	
Campephagidae	*Pericrocotus igneus*		+	
TOTAL		40	57	14

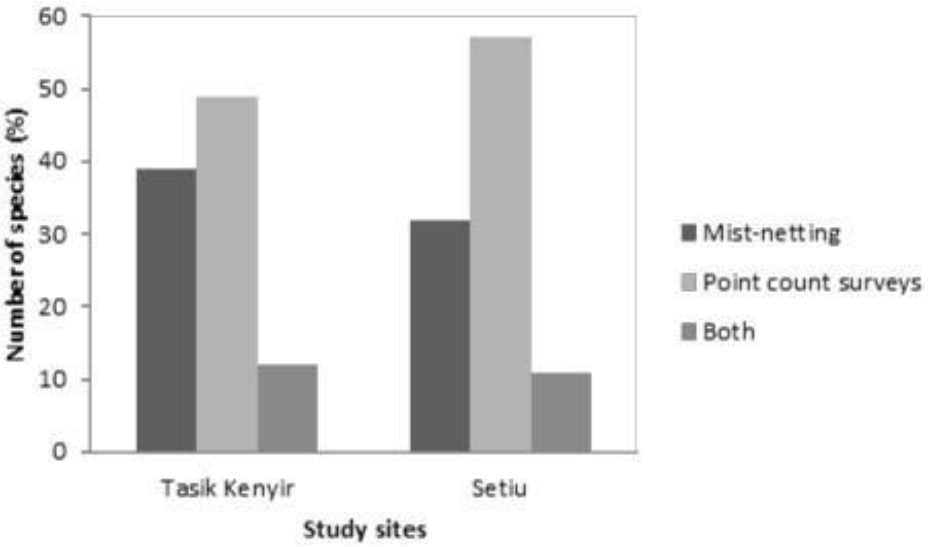

Figure 6: Bird species composition based on sampling methods

Discussion

Bird Assemblages at Tasik Kenyir and Setiu Lowland Dipterocarp Forest

Birds from family Pycnonotidae were the most commonly found species in lowland dipterocarp forest at Tasik Kenyir and Setiu. Most of previous studies had also found similar results in which this family was common in the secondary forests, oil palm plantation (Azman *et al.*, 2011) and in logged forests (Zakaria *et al.*, 2005). This family is able to survive in both disturbed and undisturbed areas due to its high tolerance to temperature and light intensity (David, 2014).

Lowland dipterocarp forest consists of high tree species diversity and the Dipterocarpaceae represents the major component of the canopy and emergent layer (Sakai *et al.*, 1999). According to Erwin (2001), vegetation with tall and large basal areas provide suitable habitat for various species of insects as a result of moist conditions and dense foliage. Thus, it increases the abundance of insects and food availability for insectivore-frugivore species including Pycnonotidae. This group of birds is also adaptable to the seasonal variation in fruit abundance and able to change their diet from insectivore to frugivore (Zakaria *et al.*, 2005). The Pycnonotidae, which consists of the bulbul species is also known as colonising species (Zakaria *et al.* 2005). Hence, it is not surprising that birds from this family dominates the bird population in most of the forests in Malaysia,

including Tasik Kenyir and Setiu.

Tasik Kenyir recorded a higher number of species compared to Setiu, showing less human disturbance to this area. Tropical birds are very responsive to any changes in the environment, especially the vegetation structure that faced habitat fragmentation (Bregman *et al.*, 2014). Lowland dipterocarp forest at Setiu which is near to the oil palm plantation contributes to the low number of bird species in this area. Similarly, other previous studies also recorded a low number of bird species in fragmented habitat due to the conversion of forested areas into agriculture areas such as oil palm plantation (Waltert *et al.*, 2004; Azman *et al.*, 2011). Furthermore, the forest in Setiu is also near to the resort, leading to the increase of human disturbance. Therefore, forest in Setiu was shown to be more disturbed compared to Tasik Kenyir, simultaneously contributing to the lower number of species in Setiu. Despite the higher number of bird species, the number of individuals of birds in Tasik Kenyir was lower than that of Setiu. This is probably due to the thick foliage and dense forest in Kenyir that make it more difficult to observe or capture many individuals of bird.

Bird Species Composition According to Sampling Methods

In this study, point count survey recorded more than 50% of the bird species compared to the mist-netting method. This result was consistent with other previous studies, of which point count method provided better results and displayed high efficiency in bird studies (Azman *et al.*, 2011; Zakaria & Rajpar, 2010). According to Wang and Finch (2002), mist netting and point count methods were mainly related to vegetation and forest structures to ensure the suitability and effectiveness of the method. By using point count method, the birds could be directly observed within 25 m radius at different levels or strata in surveyed habitat (Watson *et al.*, 2004). It is also possible to observe bird species inhabiting the upper storey of the forest such as hornbill, of which six species were recorded only by using point count survey. Mist-netting, on the other hand, could only capture the bird species inhabiting the understorey or ground layer such as babbler species, unless aided by canopy mist net.

Conclusion

Kenyir study site recorded higher number of species compared to Setiu due to the less disturbed habitat that promotes a more suitable area for forest-dependent species, while Setiu recorded lower number of species due to the disturbance from anthropogenic activity. Point count method recorded more number of species compared to mist net as more species are always detectable at any level, while mist-netting method detects small bird species that have secretive behaviours or rarely vocalise. Species accumulation curve showed that this study did not record all possible species of birds available at Tasik Kenyir and Setiu since the asymptote curve was not achievable. Thus, additional research efforts such as adding the number of mist nets, using canopy mist nets and increasing the point count trail distance might increase the number of species recorded in the future.

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Appendices

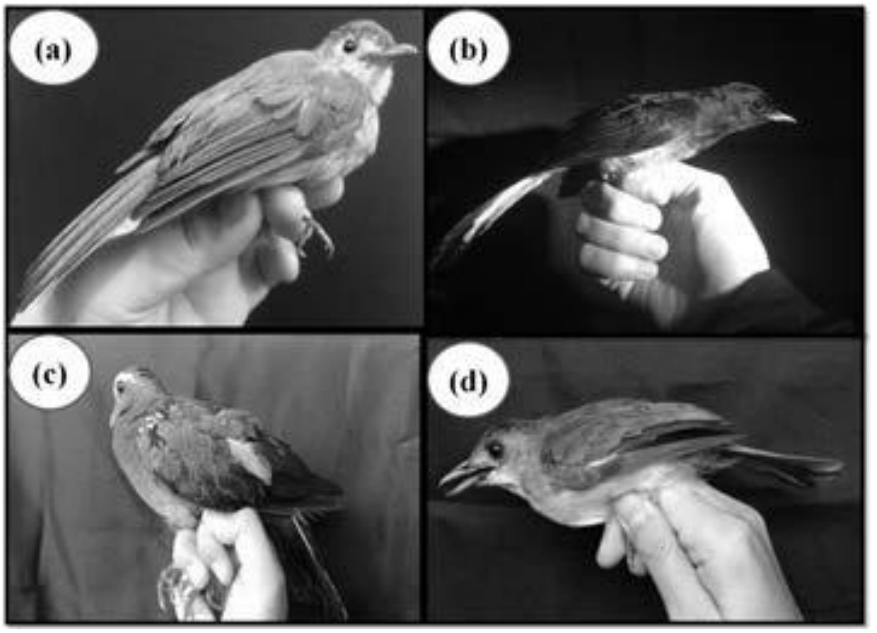

Figure A1: Some of the bird species that were recorded at Tasik Kenyir; (a) Hairy-backed Bulbul *(Tricholestes criniger),* (b) White-rumped shama *(Copsychus malabaricus),* (c) Green-winged Pigeon *(Chalcophaps indica)* and (d) Yellow-bellied Bulbul *(Criniger phaeocephalus).*

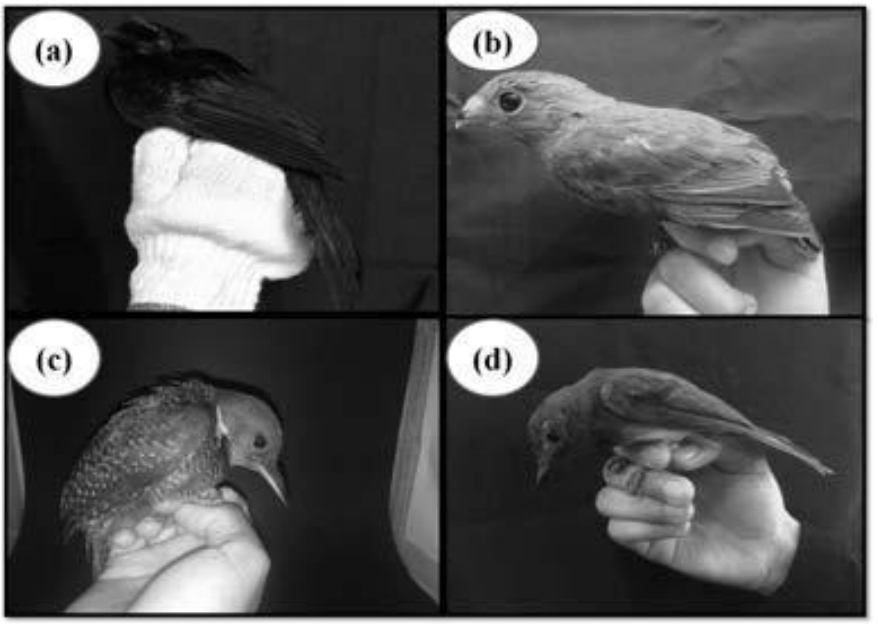

Figure A2: Some of the bird species that were recorded at Setiu; (a) Greater Racquet Tailed Drongo *(Dicrurus paradiseus),* (b) Green Broadbill *(Calyptomena viridis),* (c) Buff necked woodpecker *(Meiglyptes tukki),* (d) Rufous winged philentoma *(Philentoma pyrhoptera).*