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AN ANNOTATED CHECKLIST OF MIGRATORY BIRDS IN KENYIR, SETIU AND PULAU PERHENTIAN BESAR, TERENGGANU, MALAYSIA

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Abstract: A field survey was done in Kenyir, Setiu and islands in Terengganu from March 2015 until February 2016. Mist nets were deployed at understorey level (>5 m) and canopy level (> 10 m for Setiu and > 15 m for Kenyir). Point Count was conducted at a 1 km distance and birds from the canopies and understorey were observed. A total of 106 individuals representing 26 species of migratory birds were recorded through mist netting and point count method throughout this period. The most abundant number of individuals came from the family Ardeidae with a total of 40 individuals (38%) from five species which are the *Ardeola bacchus* (Chinese Pond Heron), *Egretta garzetta* (Little Egret), *Ixobrychus cinnamomeus* (Cinnamon Bittern), *Ixobrychus sinensis* (Yellow Bittern) and *Ardea cinerea* (Grey Heron). While the second most abundant individuals came from the family Meropidae with only one species which is the *Merops viridis* (Blue-throated bee-eater) with a total of 20 (19%) individuals. According to Rajpar & Zakaria (2013), different habitat types will attract specific species of migratory birds based on vegetation structure and composition, food resources and microclimatic conditions that provide abundant resources for their survival. This paper presents a preliminary migratory avifauna list for Kenyir, Setiu and Pulau Perhentian Besar, Terengganu, Peninsular Malaysia and state the various habitat types that influence the migratory bird species that utilise it as stopover sites.

Keywords: *Birds, migratory, preliminary, point count, mist net.*

Introduction

According to Newton (2007), migration is known when individuals make regular return movements to specific destinations each year. Migrations routes and flyways are travel paths that a species normally make when travelling from breeding grounds to wintering grounds (Tamblyn *et al*., 2006). Flyways are considered to be the major highways to the branches of migratory routes. Most birds spent the annual non-breeding period at lower latitudes compared to their breeding period, but some may migrate to the opposite hemisphere with similar latitudes where the seasons are reversed. Migration caused bird distribution to be constantly changing (Newton, 2007). Birds are also well-equipped for long-distance migration compare to other animals.

The flight advantage is speed, which is faster than walking, running or swimming. Some birds benefit from migrating throughout the year because they are able to consume occurring rich food supplies. Breeding restrict birds to fixed localities for specific period of the year, because individuals need to remain or visit their nests frequently in order to feed their young. According to previous research, birds use at least two types of system to navigate which are the geomagnetic and celestial cues (the sun by day and the stars at night) (Wiltschko & Wiltschko, 2009). The migratory birds' order of arrival is greatly influenced by the condition of the birds (Kokko, 1999). Islands serve as habitats for endemic, endangered and migratory species (Turner *et al*., 2002).

Birds' lives are significant in the east coast area of Peninsular Malaysia and its offshore islands as they fall under the East Asian-Australasian Flyway migration route (Tamblyn *et al*., 2006). Previous studies on birds in Setiu have been conducted by Tamblyn *et al*. (2006) and also in Perhentian islands by Tamblyn *et* al. (2005). In Perhentian islands, Tamblyn *et al.* (2005) recorded 30 species of birds. Tamblyn *et al*. (2006) recorded 1862 individual birds representing 76 species from 30 families from point count and 84 individuals representing 26 species and 15 families for mist-netting method in the study site in Setiu Wetlands. In this study, Pacific Swallow (*Hirundo tahitica*) was the most recorded species with 242 observations. The only bird survey study done in Kenyir was conducted by Sulaiman *et al*. (2015) at Tanjung Mentong which recorded a total of 21 individuals representing 12 species belonging to 10 families.

Wetlands are known as the border of habitats between terrestrial and aquatic ecosystems (Beury *et al*., 2008). Wetlands are highly important due to its role as a habitat for various fauna such as mammals, birds, fishes, reptiles, amphibians and aquatic invertebrates (Nelson *et al*., 2000). Wetlands are considered among the most greatly impacted and degraded habitats of all the ecological systems and these threatens the wetland birds worldwide (Hunter *et al*., 2001; Keller *et al*., 2003; Ma *et al*., 2009).

A one-year bird survey in multiple study sites with various habitat types were conducted from March 2015 until February 2016. The objectives of this study are to document the migratory species encountered throughout this survey and to justify the relationship between the habitat types and the migratory species.

Materials and Methods

Tasik Kenyir is the geology park that has been identified to have a potential to be a Geosite in Malaysia. It is the largest man-made lake in Southeast Asia with the total of 340 islands (Shaharom-Harrison *et al*., 2015). A field survey has been conducted in Belukar Bukit (N 4° 53' 25.362" E 102° 59' 33.506") from 25th of September until 2nd October 2015 and Taman Pertanian Sekayu (N 4°58'177 E 102°57'467) from 17th to 24th of October and both sites are located at Kenyir.

The Setiu Wetlands are situated in the northeast of Peninsula Malaysia (Tamblyn *et al*., 2006) in the Terengganu state. The state has 670,000 ha still remaining under forest cover

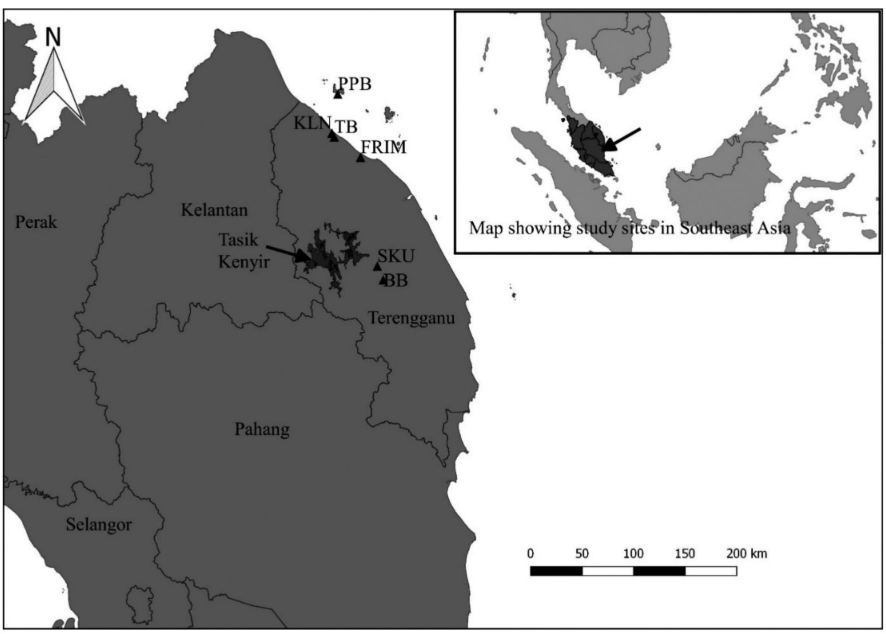

Figure 1: Map point of migratory birds in several localities in Terengganu. BB=Belukar Bukit, SKU=Sekayu, FRIM=Forest Research Institute Research Station, TB=Tasik Berombak, KLN=Kampung Limau Nipis, PPB=Pulau Perhentian Besar

while 5,168 ha are selected to be converted into plantation (Krishnapillay & Ong, 2003). The wetlands formed a portion of the Setiu river basin which consists of estuaries and delta, intertidal mudflats, sand flats and mangroves, coastal brackish and saline lagoons and marshes, *Melaleuca* swamp forest or freshwater swamp forests and vegetation compromising mostly of *Melaleuca cejeputi*, lowland dry forest with Dipterocarps and Nipah palm characteristics (Global Environment Facility, 1999). A field survey has been conducted at Kampung Limau Nipis (N05° 40' 680" E102° 42'662") from 5th to 15th of July 2015, Tasik Berombak (N05° 39'23.1" E102º 43'18.6") from 7 to 13th May 2015 and Forest Research Institute Malaysia (FRIM) (N 5° 32' 50.606" E 102° 51' 46.935") from 10th to 15th of January 2016 where three sites are located in Setiu.

The Perhentian Island Archipelago is located 21km off the mainland of Peninsular Malaysia, Terengganu. It is made up of 11 small islands with Pulau Perhentian Besar being the largest island with approximately 867 ha followed by Pulau Perhentian Kecil with 524 ha. Additional islands off Perhentian Kecil are Susu Dara Besar, Susu Dara Kecil, Rawa and Takong Laut. All these islands together with their surrounding waters have been recently recognised as Marine Parks (Tamblyn *et al*., 2005). A field survey has been conducted in Perhentian Besar (N 5° 54' 9.767" E 102° 45' 21.283") from 14th to 20th of September 2015.

Forest and Habitat Types of Study Sites with Migratory Species

Melaleuca Forest

A forest with a seasonal freshwater swamp also known as Gelam (*Melaleuca cajuputih*) that can be seen to exist as two intrinsically linked subhabitat types: large sand "dunes" with limited vegetation (primarily *melaleuca leucadendron*) intersped with waterlogged forest. The formation is mainly consisting of beach ridges/ sand plains covered by Aeolian sands, underlain by back and fore-shore depositions, originally from weathered granite. This area of Gelam consists of an area of monoculture with man-made irrigation and a small track network (Tamblyn *et al*., 2006). Wet gelam is intersped with a dryer mix of Gelam dominated by grasses with scattered juvenile and the soil is sandy.

Peatswamp Forest

This forest is made up ofa lasting remnant of inland peat swamp forest that has extended much further in the past (Tamblyn *et al*., 2006). Acidic soils were permanently water-logged in this habitat. Dead vegetation will form a spongy layer and can accumulate up to 20 m thick. Very dense understoreys (up to 10 – 15 m) and canopies formed (up to 20 m and above) due to the moist conditions. Dominant tree species in this area include *Dipterocarps sp., Gonystylus sp., Durio s.p* and *Shorea sp* which all species have great commercial value.

Lowland Dipterocarp Forest

Terengganu's most extensive forest type and also the most species-rich is the lowland dipterocarp forest. Named due to its most dominant family which is family Dipterocarps, various parts of this state is coated by this forest type from the sea level to about 300 m above sea level. The main canopy of this forest consists of trees dominated by Dipterocarps that can grow up to 20 – 35 m tall, while the emergent can reach a height up to 40 m tall. These upper storeys shade a modest understorey layer of sapligs and trees such as Euphorbiaceae and Annonaceae. The ground layer is often thin and consists of maily shrubs, climbers and herbs such as gingers, palms, aroids, gesneriads and grasses.

Coastal Dipterocarp Forest

Coastal dipterocarp forest is mainly consisting of exposed cliffs and species such as Bogak (*Cycas littoralis*) and various Pandan (*Pandanus*) species such as *P. odoratissimus*, *P. dubius* and *P. tectorius* (Forestry Department Peninsular Malaysia, 2007).

Table 1: Study sites where migratory species is captured or observed (shade region)

Study Sites		Forest Types
TM	Tanjung Mentong	Lowland Dipterocarp Forest
KF	Kampung Fikri	Melaleuca Forest
TB	Tasik Berombak	Peatswamp Forest
SBW	Sungai Buweh Waterfall	Lowland Dipterocarp Forest
BB	Belukar Bukit	Lowland Dipterocarp Forest
PB	Pulau Bidong	Coastal Dipterocarp Forest
SKU	Sekayu Waterfall	Lowland Dipterocarp Forest
PR	Pulau Redang	Coastal Dipterocarp Forest
FRIM	Forest Research Institute Malaysia	BRIS Forest
KRS	Kenyir Research Institute	Lowland Dipterocarp forest
PPB	Pulau Perhentian Besar	Coastal Dipterocarp Forest
PAR	Peladang Agro Resort	Lowland DIpterocarp Forest
TPS	Taman Pertanian Sekayu	Lowland Dipterocarp Forest
RELA	Pusat Latihan Rela Wilayah Timur	Domesticated Flora
LAG	Laguna Resort	Beach Vegetation
SW	Saok Waterfall	Lowland Dipterocarp Forest

Point Count and Mist-netting

According to Zakaria and Rajpar (2010), point count and mist net methods are standard techniques that are most commonly used to sample different bird species population in different habitats. The most effective methodological approach for monitoring tropical bird assemblages will be the combination of two techniques (Karr, 1971; Remsen & Parker 1983; Wallace *et al.,* 1996; Gram & Faaborg 1997; Zakaria & Rajpar, 2010).

Point Count

According to Ralph *et al*. (1995), one of the most commonly used method in studying abundance, distribution and ecology of forest birds is point count. Point count method has been broadly used to observe the density, diversity and relative abundance of bird species in different habitats (Blake, 1992; Thompson *et al*., 1999; Ralph *et al*., 1995; Rosenstock *et al*., 2002). This method involves visualization and vocalisation of birds within fixed or moveable radius plots to identify species abundance, diversity and density (Codesido & Bilenca 2000; Mills *et al*., 2000) and thus making this method the best way to study the relationship between efforts and precision together with accuracy of the estimates of population trends or population indexes.

According to Farnsworth *et al*. (2002), point count results can be used to justify the presence and abundance of birds. However, the probability of the birds' detection should be taken into consideration which is different according to species, habitat type and time of day or year (Blake, 1992; Ralph *et al*., 1995; Pacifici *et al*., 2008). Point sampling method is suitable to survey animals and birds in difficult terrain (Rosli & Zakaria, 2011). Distance survey using point sampling is widely used to study on avian communities (Buckland *et al*., 1993). Detection capability of birds will be different depending on foliage density, canopy cover, visibility and perception of sounds and the observer's skill (Schieck 1997; Whitman *et al*., 1997; Blake & Loiselle, 2001). Point count was chosen because it allowed observers to locate and observe rainforest birds through standing at a fixed location in a fixed time which aid in identifying birds that are difficult to spot. Point count also benefits in causing less disturbance to the area observed. To start a starting point for each point count, a random compass bearing was chosen and then marked. The intervals between point counts are 100m apart and the total distance for this point count is 1 km. The total numbers of point count stations are 10 stations. Point count is usually done in a radius of 25 m because it is not possible to observe species past this distance (Watson *et al*., 2004) while observation of soft-singing canopy species will have a high probability to be missed (Waide & Narins, 1988). Point count is usually done for a period of 10 minutes (Marsden *et al*., 2001) to detect most bird species with least efforts and disturbance to obtain reliable results and reduce bias. Only observed species within the point count area were recorded and calls were used to assist in identification (Moradi *et al*., 2009). Bird calls that were heard but could not be identified will be recorded and compared with local bird songs (Scharringa, 2001). We reconfirmed doubtful sightings by repeated observations involving note-taking and drawings which were later identified using various field guides. Point count was conducted twice a day which is from 0700 until 1000 hours in the morning because detection rates will decrease three hours after sunrise (Lynch, 1995) and it is the peak of birds activity (Azman *et al.,* 2011) while the evening session is from 1600 until 1900 hours in the evening because birds are normally active during this hours, permitting better sighting for more convenient identification and data collection (Ramli *et al*., 2009). No survey was made on rainy and windy days and birds belonging to the families Accipitrinae, Apodidae, Hemiprocnidae and Hirundinae were recorded during flight because these families are rarely observed perching on the trees (Azman *et* al., 2011). All observed birds were identified up to species level and extra information such as status of distribution, protection status and conservation status (according to IUCN Red List 2014) was referred from published materials. Birds identification was aided by Robson (2002), Strange and Jeyarajasingam (1993), Davison and Fook (2003) and Shi (2012) with additional information by Wells (2007). Each species were grouped according to their feeding guilds aided by Wells (1997, 2007). All censuses were conducted by a single observer to reduce observer bias and to avoid possible inter-observer variability (Voon *et al*., 2014).

The instrument used for point count is the Bushnell marine waterproof binoculars (7 x 42 magnifications). Point survey was done in days with no precipitation and strong winds (Peh *et al*., 2005). In extreme weather conditions, bird census will be avoided in order to reduce the possible adverse effects on the avian distribution and abundance (Rajpar & Zakaria, 2013).

Mist Netting

Mist netting is another method that leads to more specific identification that also includes cryptic species, sampling of genetic materials, parasite and morphological data collection on captured birds (Chmel *et al*., 2016). Mist-netting method has been used broadly in ornithology studies and proved to be more effective method for detecting small, highly cryptic bird species that have secretive behaviours or rarely vocalize (Ralph *et al*., 1993; Rappole *et al*., 1998). Mist-netting technique is the best standard technique in both temperate and tropical forest (Willson & Moriarty, 1976). Mist-netting is also important as it helps to reconfirm the species observed during point-count survey and it has the advantage of capturing individuals of several species (Azman *et al.*, 2011). However, the disadvantages of mist netting method are time consuming and requires large efforts (Humphrey *et al*., 1968; Meyers & Pardieck, 1993). In addition, this method focuses more on the results of species distribution rather than abundance (Remsen & Good 1996). Nets were checked every two hours interval to reduce mortality caused by predators which can easily detect the nets whereabouts (Wong, 1986). Birds were released at the location of their capture to reduce the disruption of their regular activities. According to Bibby *et al*. (1998), standard mist netting techniques can be practiced to survey the less noticeable species that is missed during point count. Nets were established by tying both ends on aluminium poles or trees. These nets can be operated at various heights. Five mist nets with four shelves (9 m x 2.5 m, 36 mm mesh size) were placed at canopy level by using a slingshot and shoot over tall trees and five mist nets (12 m x 2.5 m high, 36 mm mesh size) were placed understorey based on their accessibility, bird activities and the bird flyways. The methods of canopy mist-net installation were identical to that of Humprey *et al*. (1968). For setting up the canopy mist net, we selected a suitable site in the forest and tall trees with almost the same height that is parallel against each other. We cleared the area and smaller trees, branches and lianas (< 10 cm in diameter) were cleared and cut to give space for the mist nets. We chose a branch that is 10 m from the ground and shoot a line over the branches of tall canopy trees. After that, we fixed out mist net against the two trees and use the pulley system (?) to bring the mist upward or downward. According to Pardieck & Waide (1992), mist nets of 36 mm mesh size were most efficient in catching passerine birds which are the most abundant group of birds in tropical rainforest. However, our mist nets were not suitable for catching very large birds. The mist nets must be deployed under closed canopy to avoid direct sunlight and allowing the canopy to shadow the nets to prevent the birds from detecting it (Rahman & Abdullah, 2002). The colour of mist net is black because black is the least visible color when placed against any background (Bub, 1991).

Nets were opened from 0630 hours until 1830 hours depending on the weather conditions where the nets will be closed when there are heavy precipitations or strong winds (Ramli *et al*., 2009). These times depend on the weather conditions and mist nets will be closed in heavy rain conditions. According to Rahman *et al*. (1995), the highest captures were recorded during the mid-morning hours. Nets were checked every 2 hours intervals and closed before dusk. Mist nets were closed during strong winds and rain to prevent the captured birds from being injured and facing hypothermia. Nets data were recorded such as their height and GPS reading. Birds captured were placed in cloth bags before being measured and processed. Birds were identified until species level (Ramli *et al.,* 2009) and the external morphological data of captured birds were recorded including their brooding patch, moulting stage and the nets that they were captured. The birds were marked with nail polish before released at the captures sites. Captured birds were released nearby to the spot they were captured to avoid disturbance to their daily activities (Hashim & Ramli, 2013). Birds identification was aided by Robson (2002), Strange and Jeyarajasingam (1993), Davison and Fook (2003) and Shi (2012) with additional information by Wells (2007).

Results and Discussion

A. bacchus is the most recorded species with a total of 28 observations because it is a common non-breeding winter visitor from September to March and it is also easily spotted as its habitats are usually open areas. According to Zakaria and Rajpar (2014), the Chinese Pond Heron inhabits paddy fields, shallow marshes, swamps, riverbanks, mangroves, tidal pools, streams, fishing ponds and dry grasslands. Bitterns and herons preferred scattered emergent vegetation especially along the water body edges for foraging as emergent vegetation in shallow water provide suitable breeding and foraging habitat for a variety of aquatic animals such as fishes, amphibians and invertebrates which is easy to catch in the shallow water due to low water depth (Rajpar & Zakaria, 2014). This explains the abundance of the *A. bacchus* in Setiu.

The second most recorded species are *Lanius cristatus* (Brown Shrike) (Figure 2) and *Larvivora cyane* (Siberian Blue Robin) (Figure 3) with a total of two individuals respectively. This is because *L. cristatus* is a common migrant from Eastern Palaeartic and Oriental Australasia (Robson, 2002). It arrives in Peninsular Malaysia on September and will leave to breed in Eastern Palaeartic by May. It is a common and widespread passage migrant and winter visitor principally at low elevations (Jeyarajasingam & Pearson, 2012). *L. cyane* is

Table 2: Checklist of migratory species in kenyir, Setiu and islands according to different habitat types

Bil	Family Species	**Common Name**	**Founder**	**LDF**	**DF**	**BRIS**	**PS**	**BV**	**MF**	**CDF**	**TOTAL**	**Distribution**	**IUCN Red List**
	Muscicapidae												
1	*Cyornis rubeculoides*	Blue throated flycatcher	(Vigors, 1831)	1	0	0	0	0	0	0	1	M	LC
2	*Luscinia cyane*	Siberian blue robin	(Pallas, 1776)	6	0	0	0	0	0	0	6	M	LC
	Alcedinidae												
3	*Alcedo atthis*	Common Kingfisher	(Linnaeus, 1758)	1	0	0	0	0	0	0	1	M	LC
4	*Halcyon pileata*	Black-capped Kingfisher	(Boddaert, 1783)	0	0	1	0	0	0	0	1	M	LC
	Motacillidae												
5	*Motacilla cinerea*	Grey wagtail	(Tunstall, 1771)	1	0	0	0	0	0	0	1	M	LC
6	*Motacilla flava*	Yellow wagtail	(Linnaeus, 1758)	0	2	0	0	0	0	0	2	M	LC
7	*Anthus rufulus*	Paddyfield Pipit	(Vicillot, 1818)	0	0	1	0	0	0	0	1	M	LC
8	*Anthus cervinus*	Red throated pipit	(Pallas, 1811)	0	0	0	1	0	0	0	1	M	LC
	Aredeidae												
9	*Ardeola bacchus*	Chinese Pond Heron	(Bonaparte, 1855)	0	0	0	0	0	28	0	28	M	LC
10	*Egretta garzetta*	Little Egret	(Linaeus, 1766)	0	0	6	0	0	3	0	9	R,M	LC
11	*Ixobrychus cinnamomeus*	Cinnamon Bittern	(Gmelin, 1789)	1	0	0	0	0	0	0	1	R/M	LC
12	*Ixobrychus sinensis*	Yellow Bittern	(Gmelin, 1789)	0	0	0	0	0	1	0	1	R/M	LC
13	*Ardea cinerea*	Grey Heron	(Linnaeus, 1758)	0	0	0	0	0	1	0	1	R/M	LC

	Phylloscopidae												
10	*Phylloscopus borealis*	Arctic Wabler	(Blasius, 1858)	0	0	1	0	0	1	0	2	M	LC
	Accipitridae												
11	*Accipiter soloensis*	Chinese Sparrowhawk	(Horsefield, 1821)	1	0	0	0	0	0	0	1	M	LC
12	*Aviceda leuphotes*	Black Baza	(Dumont de Sainte-Croix, 1820)	0	0	1	0	0	0	0	1	M	LC
	Lnniidae												
13	*Lanius cristatus*	Brown Shrike	(Linnaeus, 1758)	0	0	0	0	0	0	3	3	M	LC
14	*Lanius tigrinus*	Tiger Shrike	(Drapiez, 1828)	0	0	0	0	0	0	1	1	M	LC
	Scolopacidae												
15	*Actitis hypoleucos*	Common Sandpiper	(Linnaeus, 1758)	0	0	0	0	0	0	1	1	M	LC
	Coraciidae												
16	*Eurystomus orientalis*	Dollarbird	(Linnaeus, 1766)	0	0	4	0	0	0	0	4	R, M	LC
	Meropidae												
18	*Merops viridis*	Blue throated bee-eater	(Linnaeus, 1758)	18	0	1	1	0	0	0	20	R,M	LC
	Laridae												
19	*Sterna albifrons*	Little Tern	(Pallas, 1764)	0	0	0	0	0	0	3	3	R,M	LC
	Oriolidae												
20	*Oriolus chinensis*	Black-naped Oriole	(Linnaeus, 1766)	1	0	0	0	3	1	4	9	R,M	LC
	Alcedinidae												
21	*Todiramphus chloris*	Collared kingfisher	(Boddaert, 1783)	0	0	1	0	2	1	0	4	R/M	LC

	Cuculidae												
22	*Eudynamys scolopaceus*	Asian Koel	(Linnaeus, 1758)	0	0	0	0	0	2	0	2	R/M	LC
	Rallidae												
26	*Amaurornis phoenicurus*	White-breasted waterhen	(Pennant, 1769)	0	0	0	0	0	1	0	1	R/M	LC
			Total number of individuals:	106									
			Total number of species:	26									

R= Resident; M= Migrant; LC= Least Concern; LDF=Lowland Dipterocarp Forest; DF= Domesticated Flora; PS= Peatswamp Forest; BV=Beach Vegetation; MF=Melaleuca Forest; CDF=Coastal Dipterocarp Forest.

also a non-breeding winter migrant from Eastern Palaeartic that will visit Malaysia during winter and come back to breed in Eastern Palaeartic (Robson, 2002). It is a locally common passage migrant and winter visitor principally from low elevations up to 800 m south to Singapore (Jeyarajasingam & Pearson, 2012). *Accipiter soloensis* (Chinese Sparowhawk) (Figure 4) is also one of the interesting migratory birds caught in the canopy in Belukar Bukit, Kenyir and it usually migrate to Southeast Asia together with the *Aviceda leuphotes* (Black Baza) and it feeds on frogs (Wells, 2010).

The most abundant number of individuals came from the family Ardeidae with a total of 40 individuals (38%) (Figure 1) from five species which are the *Ardeola bacchus* (Chinese Pond Heron), *Egretta garzetta* (Little Egret), *Ixobrychus cinnamomeus* (Cinnamon Bittern), *Ixobrychus sinensis* (Yellow Bittern) and *Ardea cinerea* (Grey Heron). While the second most abundant individuals came from the family Meropidae with only one species which is the *Merops viridis* Blue-throated bee-eater) with a total of 20 (19%) individuals. There are abundant migratory waterbirds species from the family Ardeidae especially from the wetlands because these species rely on wetlands for breeding, nesting and over wintering (Tamblyn *et al*., 2006). Wetland habitats represent important sanctuaries for a wide range of specialists in many fragmented areas such as Setiu (Sebastian, 2002).

Merops viridis (Blue-throated bee-eater) from the family Meropidae is a resident and migrant insectivore which is known to be sensitive towards habitat disturbance (Mansor & Sah, 2012). Previous studies have also stated that insectivorous are more sensitive to habitat disturbance compare to other feeding guilds due to having high habitat specificity (Mansor & Sah, 2012). The most recorded habitat for this species is from lowland dipterocarp forest in Kenyir because they are strongly restricted to the forest interior especially in tropical forest where habitat loss and its consequences are largely affected (Sekercioglu, 2002). This species is rarely seen in other habitat due to the limited

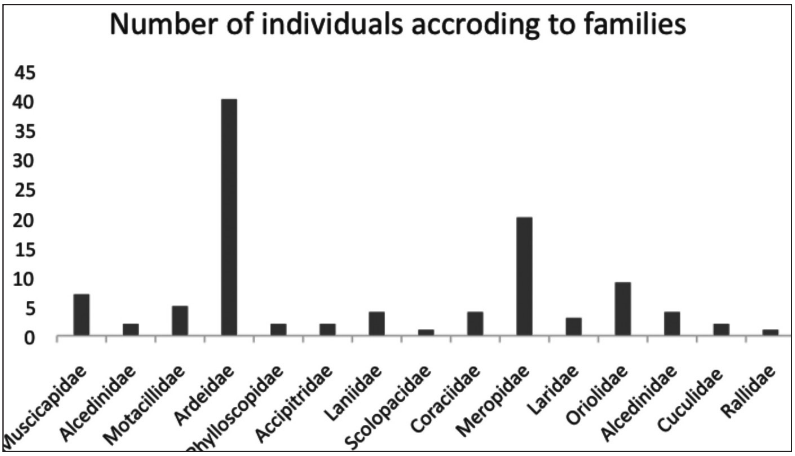

Figure 2: The total number of species according to families

food resources in disturbed habitat, changes in microclimate and in rate of predation, and interspecific competition (Mansor & Sah, 2012).

From Figure 2, Ardeidae is the most abundant family (40 individuals) and Rallidae and Scolopacidae both being the family with the least number of individuals (only one individual each). This is because most migratory species were recorded in wetlands as the wetland habitat provides variables such as aquatic vegetation composition, vegetation cover percentage and microclimate which affect on the distribution and richness of waterbird in particular wetland habitat such as Setiu (Rajpar & Zakaria, 2014). Waterbirds often entirely rely on wetlands for a variety of activities such as foraging, loafing and nesting (Rajpar & Zakaria, 2009).

Muscicapidae

Cyornis rubeculoides (Vigors) 1831- Blue-throated Flycatcher- *Sambar Tekak Biru*

This species is found breeding in the Himalayas through China, Myanmar, northern Thailand and Indo-China; northern populations will come to winter south to South and South-East Asia to Peninsular Malaysia (Jeyarajasingam & Pearson, 2012). The Blue-throated Flycatcher is a less common and local passage migrant and winter visitor in the low elevations up to 1100 m, south to Singapore where its population is rare. Also present above 1100 m during autumn and spring passage. Its habitat is the forests and patches of freshwater swamp-forest within the dry-land habitat, occasionally also found in secondary growth and it is often found solitarily in the middle and lower storey (Jeyarajasingam & Pearson, 2012).

Lusicinia cyane (Pallas) 1776 (Figure 3) – Siberian Blue Robin – *Murai Biru Siberia*

This species can be found breeding in eastern Russia, northern China, Korea and Japan; wintering south to North-East India and the southern China through South-East Asia to Sumatra, Borneo and the Phillipines (Jeyarajasingam & Pearson, 2012). It is a locally common passage migrant and winter visitor found from low elevations until 800 m south to Singapore. It only occurs above 900 m during autumn and spring passage. Its habitat includes forests, shrubs, reddbeds and it is mostly found in the on the ground or lower storey. Lurks in the thick undergrowth and will flicks its tailed when it is surprised.

Ardeidae

Ardeola bacchus (Bonaparte, 1855) – Chinese Pond Heron – *Pucung Danau Cina*

The most observed migratory species with a total of 28 observations. It is a common widespread non-breeding winter visitor at low elevations, south to Singapore where it is uncommon. Its habitat usually consists of mangroves, inland freshwater swamps, flooded rice fields, oil palm factory sludge ponds and sewage oxidation ponds (Jeyarajasingam & Pearson, 2012). Usually forage in small flocks but group in large numbers when traveling between feeding and roosting sites. A diurnal hunter that generally stays in thick covers, observing terrestrial prey at the water's edge and consumes largely on small vertebrates and insects (Wells, 1999; Jeyarajasingam & Pearson, 2012). Roosts in groups in small trees.

Meropidae

Merops viridis Linnaeus, 1758 – Blue-throated Bee-eater – *Beberek Leher Biru*

A fairly common breeding migrant and non-breeding visitor from low elevations up to 670 m and sometimes higher south to Singapore (Jeyarajasingam & Pearson, 2012). Breeding populations will disperse to Sumatra during the non-breeding season. Breeding migrants will often prefers the beach shrub, open lightly wooded country, river sand-banks, abandoned dredge–mine land, grazing-grounds, large lawns gardens and tin mines while non-breeding migrants will prefer the forest canopies of peatswamp forest, mature tree plantations, tall secondary growth, the forest edge and mangroves (Wells, 1999; Jeyarajasingam & Pearson, 2012. This species usually can be seen on open perches in open country and travels in noisy groups. Usually forms large groups in tall trees.

Birds possessed timing mechanisms to ensure that individuals arrive in their nesting sites at suitable and optimum condition for breeding and leave before conditions becomes worse and unsuitable (Newton, 2007). According to Newton (2007), seasonal migration is possible because birds are able to accumulate large body fats to fuel the flights. Small birds double their usual weight through fuel deposition while crossing large areas of sea or desert and some species also reduce their body mass and thus reduce the overall energy needs for the journey. Birds also have the ability to convert the fatty acids in fuel reserves to the energy needed to supply energy to the wings. Act of breeding requires that birds remain within restricted localities, that explains why breeding and migrating does not occur at the same time. Besides that, feather replacement can also reduce flight efficiency temporarily, so moulting and migration will not occur simultaneously. Large bird species such as raptors span a large area relative to body weight on the spread wings to provide good lifting in rising air currents. This applies for broad-winged raptors, pelicans, storks, anhingas and cranes. These species depend mostly on soaring-gliding flight than other birds (Kerlinger, 1989; Hedenström, 1993). They usually travel low enough to be seen with the naked eye and sometimes be determined by geography and topography to form migratory streams. Birds are able to navigate depending on their sensory abilities. The eyesight of normal diurnal birds at night is the same with humans but in addition, at least some bird species are able to distinguish ultraviolet light and the plane of polarised light. Moreover, birds also have a good sense of hearing which allows individual migrants to detect the calls of other birds at night. Birds from the west of Eurasia must cross the Mediterranean Sea and Sahara Desert during migration while those from further east must go through the deserts of Southwest Asia and Arabia. The natural vegetation of Southeast Asia is categorized as rainforest or dry deciduous woodland, with some savannah and grassland. Many Eurasian species will become a winter visitor in Africa and Asia simultaneously. When it comes to doing migratory birds survey, Malaysia has the potential because the Peninsular Malaysia, which is the southernmost extension of the continent of Asia, forms a natural flight pathway for migratory birds which come together here before spreading out further south to the Indonesian Archipelago and Australasia (Jeyarajasingam & Pearson, 2012). The large numbers of migratory birds of prey can also be seen in Peninsular Malaysia during breeding season.

Migratory birds usually start to arrive in both Peninsular Malaysia and Singapore as early as July and August, but large numbers will arrive from September until November. From March to late May, the migrant populations will return northward to spring. During winter, these migratory populations move south and the resident population will increase (Jeyarajasingam & Pearson, 2012). Terengganu is indeed a pathway for migratory birds because Titiwangsa Range and other parallel ranges along most of the central part of Peninsular Malaysia is a major route taken by nocturnal migrants (Jeyarajasingam & Pearson, 2012). Another route used by migrants that have crossed the South China Sea from Indo-China follows the east coast plain. Singapore, lying at the southern tip of Peninsular Malaysia is the point of meeting from these two streams on their way to wintering grounds in the south. Terengganu has been a potential state as a birding destination as migratory birds use this state as a pathway and 9 of the 10 hornbills found in Peninsular Malaysia can be found in Tasik Kenyir, Terengganu.

Most of the migratory species are recorded from the habitats in Setiu wetlands because the wetlands contains heterogenous vegetation which provides various food resources, suitable loafing, safe foraging and breeding sites for wide array of avian species. Wetlands is selected by birds based on vegetation structure and composition, food resources and microclimate conditions that provide optimal resources for their survival. The diversity of vegetation structure and composition gives physical arrangement features to the wetland habitats and attract diverse bird species (Soderstorm & Part, 1999; Canterbury *et al*., 2000; Rajpar & Zakaria, 2010). Vegetative structure and composition is the main factor that determines the way birds utilise their resources, select their habitats, determines the species abundance, distribution, diversity and density (Rottenberry, 1985; Block & Brennan, 1993).

Wetland habitats in many fragmented areas such as Setiu provide fundamental refuges for a wide range of specialists (Sebastian, 2002). Meanwhile, recent decrease in bird populations especially those inhabiting wetlands and migratory bird species can be associated with the drainage and conversion of wetland areas. This can affect the wetland birds that utilise these sites for breeding, nesting and over wintering. Coastal populations are also pressured by the large-scale of development, including aquaculture and the clearance of mangroves (BirdLife, 2005).

The presence of Brown Shrike (*Lanius cristatus*), Tiger Shrike (*Lanius tigrinus*) (Figure 4), Black-naped Oriole (*Oriolus chinensis*) and Common Sandpiper (*Actitis hypoleucos*) in Pulau Perhentian Besar has supported the fact that the Perhentian islands fall under the East Asian Flyway and provides a haven for endemic, endangered, coastal and migratory species (Tamblyn *et al*., 2005). Coastal areas are not only fundamental for feeding and roosting sites for resident species but also serve as stopovers, food and shelter for migratory birds (Tamblyn *et al*., 2005). Bird populations that are deteriorating in the region have been associated with deforestation of lowland dipterocarp forest habitats (Peh *et al*., 2005).

The presence of forest bird species such as the Blue-throated Flycatcher (*Cyornis rubeculoides*) and the Siberian Blue Robin (*Luscinia cyane*) indicate that the lowland dipterocarp forest and domesticated flora habitat in Kenyir and Setiu where these migratory birds are recorded contains the resources and shelter needed by these migrants.

Conclusion

Migratory shorebirds face two major threats which are coastal land reclamation as well as excessive hunting and trapping. Throughout South-East Asia, mudflats and connecting mangroves have been greatly reduced due to increasing human population and the consistent demand for land. This has reduced the number of ‘refuelling’ or staging points along migratory routes between breeding and wintering grounds. The illegal shooting and trapping of shorebirds for food in Thailand, Indonesia and to a some parts in Malaysia, took a heavy toll every year on migratory shorebirds both during spring and autumn passage (Jeyarajasingam & Pearson, 2012). Mitigation action and control must be taken to overcome this problem so that the migratory birds especially shorebirds status can be protected and conserved and Terengganu can continue being one the passageway for migratory birds.

As a conclusion, different habitat types will attract different species of migratory bird species based on vegetation structure and composition, food resources and microclimatic conditions that provide sufficient resources for their survival (Rajpar & Zakaria, 2013). Migrants are susceptible to threats in more habitats, sites or countries than sedentary species. Migration promotes collaboration among ornithologists and conservationists from different nations and there is much support from international legal instruments. The most countries in need for conservation of migratory species are developing countries such as Malaysia because these countries host many migratory species but their biodiversity significance is often dominated by endemic and threatened species. Conservation of migratory birds can be achieved if migration caught the attention of wealthier countries to the circumstances and needs elsewhere in the world (Bibby, 1998).

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Table 3: Overall checklist of species in Kenyir, Setiu ad islands in Terengganu, Malaysia

Family Species	Forest Types							Strata					
	LDF	DF	BRIS	PS	BV	MF	CDF	Canopy	Understorey	Strata	Distribution	IUCN Red List	Feeding Guilds
Pycnonotidae													
Criniger phaeocephalus (Hartlaub, 1844)	32	5	0	0	0	0	0	2	35	B	R	LC	Omnivore
Pycnonotus plumosus Blyth, 1845	11	5	19	25	0	71	0	22	109	B	R	LC	Frugivore
Pycnonotus erythropthalmos (Hume, 1878)	2	1	0	0	0	0	0	1	2	B	R	LC	Frugivore
Tricholestes criniger (Blyth, 1845)	5	1	0	0	0	0	0	0	6	U	R	LC	Omnivore
Pycnonotus simplex Lesson, 1839	4	4	0	0	0	0	0	2	6	B	R	LC	Omnivore
Pycnonotus goiavier (Scopoli, 1786)	16	17	2	1	0	27	0	7	56	B	R	LC	Omnivore
Ixos malaccensis (Blyth, 1845)	1	0	0	0	0	0	0	0	1	U	R	NT	Omnivore
Hemixos castanonotus Swinhoe, 1870	1	0	0	0	0	0	0	0	1	U	n/a	LC	Omnivore
Pycnonotus finlaysoni Strickland, 1844	3	2	0	0	0	0	0	0	5	U	R	LC	Omnivore
Criniger finschi (Salvadori, 1871)	2	0	0	0	0	0	0	2	0	C	R	NT	Omnivore
Alophoixus bres (Lesson, 1832)	1	0	0	0	0	0	0	1	0	C	R	LC	Omnivore
Pycnonotus cyaniventris Blyth, 1842	3	0	0	0	0	0	0	3	0	C	R	NT	Frugivore
Iole olivacea Blyth, 1844	1	0	0	0	0	0	0	1	0	C	R	NT	Omnivore
Pycnonotus melanoleucos Eyton,1839	1	0	0	0	0	0	0	1	0	C	R	NT	Frugivore
Pycnonotus atriceps (Scopoli, 1786)	1	0	0	0	0	0	0	0	1	U	R	LC	Omnivore
Pycnonotus brunneus Blyth, 1845	3	1	0	0	0	0	0	2	2	B	R	LC	Omnivore
Columbidae													
Chalcophaps indica (Linnaeus, 1758)	20	0	0	0	0	0	1	4	17	B	R	LC	Granivore
Streptopelia chinensis (Scopoli, 1786)	0	6	5	0	0	2	0	1	12	B	R	LC	Granivore
Geopelia striata (Linnaeus, 1766)	1	1	16	0	9	3	0	3	27	B	R	LC	Granivore

Caloenas nicobarica (Linnaeus, 1758)	0	0	0	0	0	0	3	0	3	U	R	NT	Granivore
Ducula bicolour (Scopoli, 1786)	0	0	0	0	0	0	17	14	3	B	R	LC	Omnivore
Trevon curvirostra (Gmelin, 1789)	1	0	0	0	0	0	0	1	0	C	R	LC	Omnivore
Muscicapidae													
Copsychus malabaricus (Scopoli, 1786)	19	0	1	1	0	2	18	5	36	B	R	LC	Insectivore
Copsychus saularis (Linnaeus, 1758)	33	19	7	0	1	1	2	0	63	U	R	LC	Insectivore
Myophonus robinson (Ogilvie-Grant, 1905)	1	0	0	0	0	0	0	0	1	U	R	NT	insectivore
Cyornis rubeculoides (Vigors, 1831)	2	0	0	0	0	0	0	1	1	B	M	LC	Insectivore
Cyornis tickelliae Blyth, 1843	0	0	0	0	0	3	0	0	3	U	R	LC	Insectivore
Cyornis rufigastra (Raffles, 1822)	0	0	0	3	0	0	0	0	3	U	R	LC	Insectivore
Culicicapa ceylonensis (Swainson),1820	1	0	0	0	0	0	0	0	1	U	R	LC	Insectivore
Ficedula zanthopygia (Hay, 1845)	0	0	0	0	0	1	0	1	0	C	R	LC	Insectivore
Cyornis banyumas (Horsefield, 1821)	0	0	0	0	0	2	0	0	2	U	R	LC	Insectivore
Enicurus ruficapillus Temminck, 1832	1	0	0	0	0	0	0	0	1	U	R	NT	Omnivore
Luscinia cyane (Pallas, 1776)	6	0	0	0	0	0	0	0	6	U	M	LC	Insectivore
Vangidae													
Philentoma pyrhoptera (Temminck, 1836)	7	0	1	0	0	0	0	1	7	B	R	LC	insectivore
Monarchidae													
Hypothymis azurea (Boddaert, 1783)	1	0	0	0	0	0	0	1	0	C	R	LC	insectivore
Timaliidae													
Mixornis gularis (Horsefield, 1822)	2	0	1	2	0	5	0	0	10	U	R	LC	Insectivore
Stachyris poliocephala (Temminck), 1836	1	0	0	0	0	0	0	0	1	U	R	LC	Insectivore
Stachyris erythroptera (Blyth, 1842)	5	0	0	0	0	0	0	0	5	U	R	LC	Insectivore
Trichastoma malaccense (Hartlaub, 1844)	1	1	0	0	0	0	0	0	2	U	R	NT	Insectivore
Malacocincla sepiaria (Horsefield, 1821)	0	0	0	1	0	1	0	0	2	U	R	LC	Insectivore

Pellorrneum capistratum (Temminck, 1823)	1	1	0	0	0	0	0	0	2	U	R	LC	Insectivore
Malacocincla malaccencis (Hartlaub, 1844)	0	2	0	0	0	0	0	0	2	U	R	LC	Insectivore
Dicaeidae													
Prionochilus percussus (Temminck & Laugier, 1826)	3	2	0	0	0	1	0	0	6	U	R	LC	Frugivore
Prionochilus maculatus (Temminck & Laugier, 1836)	6	0	0	0	0	0	0	0	6	U	R	LC	Frugivore
Dicaeum trigonostigma (Scopoli, 1786)	1	3	1	0	0	1	1	0	7	U	R	LC	Frugivore
Dicaeum cruentatum (Linnaeus, 1758)	2	0	1	1	0	2	0	1	5	B	R	LC	Frugivore
Dicaeum chrysorrheum Temminck & Laugier, 1829	2	0	0	0	0	0	0	0	2	U	R	LC	Frugivore
Prionochilus xanthopygius Salvadori, 1868	2	0	0	0	0	0	0	0	2	U	R	LC	Frugivore
Chloropseidae													
Chloropsis sonnerati Jardine and Selby, 1827	1	0	0	0	0	0	0	0	1	U	R	LC	Omnivore
Chloropsis cyanopogon (Temminck, 1829)	5	1	0	0	0	0	0	2	4	B	R	NT	Omnivore
Chloropsis cochinchinensis (Gmelin, 1789)	0	1	0	0	0	0	0	1	0	C	R	LC	Omnivore
Irenidae													
Irena puella (Latham, 1790)	5	2	0	0	0	0	0	6	1	B	R	LC	Omnivore
Nectariniidae													
Arachnothera longirostra (Latham, 1790)	19	1	0	0	0	0	0	1	19	B	R	LC	Nectarivore
Arachnothera crassirostris (Reichenbach, 1854)	1	0	0	0	0	0	0	1	0	C	R	LC	Omnivore
Arachnothera robusta Müller and Schlegel, 1845	4	0	0	0	0	0	0	4	0	U	R	LC	Omnivore
Arachnothera modesta (Eyton, 1839)	2	0	0	0	0	0	0	1	1	B	R	LC	Omnivore
Nectarinia sperata (Linnaeus, 1766)	0	0	8	2	0	3	5	0	18	U	R	LC	Nectarivore

Chalcoparia singalensis (Gmelin, 1789)	0	0	0	0	0	0	2	0	2	U	R	LC	Omnivore
Anthreptes simplex (Müller, 1843)	2	0	0	0	0	2	0	0	4	U	R	LC	Omnivore
Hypogramma hypogrammicum (Müller, 1843)	9	1	6	0	0	1	0	2	15	B	R	LC	Omnivore
Anthreptes malacensis (Scopoli, 1786)	3	2	4	7	0	2	9	4	23	B	R	LC	Omnivore
Anthreptes rhodolaemus Shelley, 1878	0	0	4	0	0	0	0	1	3	B	R	NT	Omnivore
Nectarinia jugularis (Linnaeus, 1766)	0	0	1	0	0	0	0	0	1	U	R	LC	Omnivore
Nectarinia calcostetha Jardine, 1843	0	0	1	0	0	0	0	0	1	U	R	LC	Nectarivore
Nectarinia zeylonica (Linnaues, 1766)	1	0	0	0	0	0	0	0	1	U	n/a	LC	Omnivore
Alcedinidae													
Alcedo meninting Horsefield, 1821	1	0	0	0	0	0	0	0	1	U	R	LC	Piscivore
Alcedo euryzona Temminck, 1830	2	0	0	0	0	2	0	2	2	B	R	VU	Piscivore
Alcedo atthis (Linnaeus, 1758)	1	0	0	0	0	0	0	0	1	U	M	LC	Omnivore
Lacedo pulchella (Horsefield, 1821)	1	0	0	0	0	0	0	1	0	C	R	LC	Omnivore
Todiramphus chloris (Boddaert, 1783)	0	0	1	0	2	1	0	2	2	B	R/M	LC	Omnivore
Halcyon pileata (Boddaert, 1783)	0	0	1	0	0	0	0	0	1	U	M	LC	Omnivore
Pelargopsis capensis (Linnaeus, 1766)	0	1	1	0	0	0	0	1	1	B	R	LC	Piscivore
Halcyon smyrnensis (Linnaeus, 1758)	6	10	9	1	0	9	0	13	22	B	R	LC	Omnivore
Picidae													
Meiglyptes tukki (Lesson, 1839)	4	0	0	0	0	1	0	3	2	B	R	NT	Insectivore
Meglyptes tristis (Horsefield, 1821)	2	0	1	0	0	1	0	3	1	B	R	LC	Insectivore
Sasia abnormis (Temminck, 1825)	2	0	0	0	0	0	0	1	1	B	R	LC	Insectivore
Reinwardtipicus validus (Temminck, 1825)	1	1	0	0	0	0	0	2	0	C	R	LC	Insectivore
Dinopium benghalense (Linnaeus, 1758)	0	0	1	0	0	0	0	1	0	C	n/a	LC	Insectivore
Dinopium javanense (Ljungh, 1797)	0	0	1	0	0	0	0	1	0	C	R	LC	Insectivore
Picus puniceus Horsefield, 1821	0	0	1	0	0	0	0	1	0	C	R	LC	Insectivore

Chrysophlegma humii Hargitt, 1889	1	0	0	0	0	0	0	1	0	C	R	LC	Insectivore
Picus chlorolophus Vieillot, 1818	1	0	0	0	0	0	0	0	1	U	R	LC	Insectivore
Picus miniaceus Pennant, 1769	5	0	0	0	0	0	0	2	3	B	R	LC	Insectivore
Calyptomenidae													
Calyptomena viridis Raffles, 1822	3	1	0	0	0	1	0	3	2	B	R	NT	Insectivore
Eurylamidae													
Cymbirhynchus macrorhynchos (Gmelin, 1788)	4	0	0	0	0	0	0	0	4	U	R	LC	Generalist
Motacillidae													
Motacilla cinerea Tunstall, 1771	1	0	0	0	0	0	0	0	1	U	M	LC	Insectivore
Motacilla flava Linnaeus, 1758	0	2	0	0	0	0	0	0	2	U	M	LC	Insectivore
Anthus rufulus Vieillot, 1818	0	0	1	0	0	0	0	0	1	U	M	LC	Insectivore
Anthus cervinus (Pallas, 1811)	0	0	0	1	0	0	0	0	1	U	M	LC	Insectivore
Estrildidae													
Erythrura prasina (Sparrmann, 1788)	3	0	0	0	0	0	0	0	3	U	R	LC	Granivore
Lonchura punctulata (Linnaeus, 1758)	0	0	1	0	0	1	0	0	2	U	R	LC	Granivore
Passerinae													
Passer montanus (Linnaeus, 1758)	4	4	1	0	0	0	0	0	9	U	R	LC	Granivore
Argithininae													
Aegithina tiphia (Linnaeus, 1758)	3	0	3	3	0	3	20	3	29	B	R	LC	Insectivore
Strigidae													
Otus bakkamoena Pennant, 1769	1	1	0	0	0	1	0	0	3	U	R	LC	Omnivore
Cuculidae													
Cacomantis merulinus (Scopoli, 1786)	2	1	0	0	0	0	0	0	3	U	R	LC	Insectivore
Surniculus lugubris (Horsefield, 1821)	1	0	0	0	0	0	0	1	0	C	R	LC	Insectivore
Centropus sinensis (Stephens, 1815)	7	1	0	0	0	3	0	0	11	U	R	LC	Insectivore
Phaenicophaeus tristis (Lesson, 1830)	0	0	0	0	0	1	0	0	1	U	R	LC	Insectivore

Phaenicophaeus diardi (Lesson, 1830)	0	1	2	0	0	2	0	0	5	U	R	NT	Insectivore
Phaenicophaeus curvirostris (Shaw, 1810)	0	1	7	0	0	0	0	7	1	B	R	NT	Insectivore
Rhinortha chlorophaea (Raffles, 1822)	4	1	1	0	0	0	0	3	3	B	R	LC	Insectivore
Eudynamys scolopaceus (Linnaeus, 1758)	0	0	0	0	0	2	0	2	0	C	R/M	LC	Frugivore
Ardeidae													
Ixobrychus cinnamomeus (Gmelin, 1789)	1	0	0	0	0	0	0	0	1	U	R/M	LC	Piscivore
Ixobrychus sinensis (Gmelin, 1789)	0	0	0	0	0	1	0	0	1	U	R/M	LC	Piscivore
Ardea cinerea Linnaeus, 1758	0	0	0	0	0	1	0	0	1	U	R?M	LC	Piscivore
Ardeola bacchus (Bonaparte, 1855)	0	0	0	0	0	28	0	28	0	C	M	LC	Piscivore
Egretta sacra (Gmelin, 1789)	0	0	0	0	0	0	3	0	3	U	R	LC	Piscivore
Egretta garzetta (Linaeus, 1766)	0	0	6	0	0	3	0	3	6	B	R,M	LC	Piscivore
Caprimulgidae													
Caprimulgus macrurus Horsefield, 1821	0	0	2	2	0	6	0	0	10	U	R	LC	Insectivore
Rhipiduridae													
Rhipidura javanica (Sparrman, 1788)	1	0	0	2	4	2	0	0	9	U	R	LC	Insectivore
Cisticolidae													
Orthotomus ruficeps (Lesson, 1830)	1	0	2	1	0	4	1	0	9	U	R	LC	Insectivore
Orthotomus sericeus Temminck, 1836	4	0	0	0	0	1	0	0	5	U	R	LC	Insectivore
Orthotomus sutorius (Pennant, 1769)	0	0	0	0	0	1	0	0	1	U	R	LC	Insectivore
Rallidae													
Amaurornis phoenicurus (Pennant, 1769)	0	0	0	0	0	1	0	0	1	U	R?M	LC	Piscivore
Phylloscopidae													
Phylloscopus borealis (Blasius, 1858)	0	0	1	0	0	1	0	1	1	B	M	LC	Insectivore
Meropidae													
Merops leschenaulti Vieillot, 1817	0	0	7	0	0	10	0	15	2	B	R	LC	Insectivore

Nyctyornis amictus (Temminck, 1824)	4	0	0	0	0	0	0	3	1	B	R	LC	Insectivore
Merops viridis Linnaeus, 1758	18	0	1	1	0	0	0	0	20	U	R,M	LC	Insectivore
Dicrurinidae													
Dicrurus paradiseus (Linnaeus, 1766)	15	5	10	0	0	8	0	16	22	B	R	LC	Insectvore
Dicrurus remifer (Temminck, 1823)	1	0	1	0	0	0	0	1	1	B	R	LC	Insectivore
Hirundinidae													
Hirundo tahitica Gmelin, 1789	8	28	0	1	0	0	5	6	36	B	R	LC	Insectivore
Megalaimidae													
Megalaima mystacophanos(Temminck, 1824)	3	0	0	0	0	0	0	0	3	U	R	NT	Frugivore
Megalaima lineata (Vieillot, 1816)	0	0	0	1	0	0	0	0	1	U	R	LC	Frugivore
Psilopogon australis (Horsefield, 1821)	1	0	0	0	0	1	0	1	1	B	R	LC	Frugivore
Megalaima rafflesii (Lesson, 1839)	2	0	0	0	0	0	0	0	2	U	R	NT	Frugivore
Psilopogon haemocephalus (Müller, 1776)	0	1	0	0	0	0	0	1	0	C	R	LC	Frugivore
Sturnidae													
Aplonis panayensis (Scopoli, 1783)	0	9	1	1	0	0	0	0	11	U	R	LC	Insectivore
Gracula religiosa Linnaeus, 1758	15	0	0	0	0	0	0	15	0	C	R	LC	Omnivore
Acridotheres tristis (Linnaeus, 1766)	0	4	0	0	0	0	0	0	4	U	R	LC	Omnivore
Phasianidae													
Argusianus argus (Linnaeus, 1766)	1	0	0	0	0	0	0	0	1	U	R	NT	Insectivore
Gallus gallus (Linnaeus, 1758)	1	0	0	0	0	0	0	0	1	U	R	LC	Insectivore
Corvidae													
Corvus macrorhynchos Wagler, 1827	12	0	0	0	0	0	0	3	9	B	R	LC	Scavenger
Corvus enca (Horsefield, 1822)	4	1	0	0	0	0	0	4	1	B	R	LC	Scavenger
Platysmurus leucopterus (Temminck, 1824)	2	4	0	0	0	0	0	6	0	C	R	NT	Omnivore
Hemiprocnidae													
Hemiprocne comata (Temminck, 1824)	17	0	0	0	0	0	0	1	16	B	R	LC	Insectivore

Bucerotidae												
Anthracoceros albirostris (Shaw & Nodder, 1807)	33	0	0	0	0	0	0	24	9	B	R	LC	Frugivore
Anthracoceros malayanus (Raffles, 1822)	9	0	0	0	0	0	0	9	0	C	R	NT	Frugivore
Aceros corrugatus (Temminck, 1832)	7	0	0	0	0	0	0	7	0	C	R	NT	Frugivore
Buceros rhinoceros Linnaeus, 1758	3	0	0	0	0	0	0	3	0	C	R	NT	Omnivore
Buceros bicornis Linnaeus, 1758	4	0	0	0	0	0	0	4	0	C	R	NT	Frugivore
Aceros comatus (Raffles, 1822)	5	0	0	0	0	0	0	5	0	C	R	NT	Omnivore
Accipitridae												
Haliaeetus leucogaster (Gmelin, 1788)	0	0	1	0	3	0	5	8	1	B	R	LC	Piscivore
Accipiter soloensis (Horsefield, 1821)	1	0	0	0	0	0	0	1	0	C	M	LC	Carnivore
Spilornis cheela (Latham, 1790)	18	2	0	0	0	4	0	24	0	C	R	LC	Carnivore
Haliastur indus (Boddaert, 1783)	0	0	0	0	1	1	0	2	0	C	R	LC	Carnivore
Aviceda leuphotes (Dumont, 1820)	0	0	1	0	0	0	0	1	0	C	M	LC	Omnivore
Nisaetus cirrhatus (Gmelin, 1788)	1	0	1	0	0	0	0	2	0	C	R	LC	Carnivore
Apodidae												
Aerodramus fuciphagus (Thunberg, 1812)	0	0	0	0	0	0	1	0	1	U		LC	Insectivore
Aerodramus maximus (Hume, 1878)	0	0	0	0	0	0	1	1	0	C	R	LC	Insectivore
Apus affinis (Gray, 1830)	0	0	3	0	0	19	0	19	3	C	R	LC	Insectivore
Laridae												
Sterna albifrons (Pallas, 1764)	0	0	0	0	0	0	3	0	3	U	R,M	LC	Piscivore
Sterna sumatrana Raffles, 1822	0	0	0	0	0	0	2	0	2	U	R	LC	Piscivore
Laniidae												
Lanius cristatus Linnaeus, 1758	0	0	0	0	0	0	3	0	3	U	M	LC	Insectivore
Lanius tigrinus Drapiez, 1828	0	0	0	0	0	0	1	0	1	U	M	LC	Insectivore
Scolopacidae												
Actitis hypoleucos Linnaeus, 1758	0	0	0	0	0	0	1	0	1	U	M	LC	Insectivore

Trogonidae												
Harpactes diardii (Temminck, 1832)	1	0	0	0	0	0	0	1	0	C	R	NT	Frugivore
Oriolidae												
Oriolus xanthonotus Horsefield, 1821	1	0	0	0	0	0	0	1	0	C	R	NT	Omnivore
Oriolus chinensis Linnaeus, 1766	1	0	0	0	3	1	4	9	0	C	R,M	LC	Omnivore
Anatidae												
Dendrocygna javanica (Horsefield, 1821)	0	0	0	0	0	5	0	5	0	C	R	LC	Frugivore
Coraciidae												
Eurystomus orientalis (Linnaeus, 1766)	0	0	4	0	0	0	0	4	0	C	R, M	LC	Insectivore
Number of families	35	21	24	15	6	26	14						
Number of species	104	42	45	19	7	50	22						
Number of individuals	513	158	151	57	23	256	108						

Figure 3: Brown Shrike, *Lanius cristatus*
Male
Photo courtesy to En. Mazrul Aswaddy

Figure 4: Siberian Blue Robin, *Larvivora cyane*
Female
Photo courtesy to Gertrude David

Figure 5: Chinese Sparrowhawk,
Accipiter soloensis Juvenile
Photo courtesy to Gertrude David