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Research Article

The Diversity of Birds in Kota Belud Bird Sanctuary, Sabah

Nur Syamimi Makbul, Anna Wong*

Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia
*Corresponding author: anna888@ums.edu.my

Abstract

This research was conducted in the Kota Belud Bird Sanctuary (KBBS), with the objectives to determine the diversity and species richness of birds in KBBS and to identify habitats of birds that occur there. The overall purpose was to provide information for managing and conserving birds in the Sanctuary. The methods applied in this study were point counts, line transects and mist-netting. Shannon and Margalef indices indicated the bird diversity was quite high (3.4664) for Shannon index, as was species richness (9.232) for Margalef index. *Lonchura atricapilla* was the most abundant resident species whereas *Himantopus himantopus* was the most dominant migratory species. In addition, there were four general habitats of birds that were identified within the study area: i) grassland, scrub, bush, and open and suburban areas, ii) paddy fields and flooded paddy, iii) coastal strand and mudflats, and iv) swamp, mangrove, lakes and pools. This study added six species into the list of birds in KBBS, which was previously compiled in 1985. Among species recorded were the critically endangered (CR) *Fregata andrewsi* and near threatened (NT) *Anhinga melanogaster*.

Keywords: Kota Belud Bird Sanctuary, bird diversity, species richness, Shannon-Wiener index, Margalef index, IUCN red list status

Introduction

The island of Borneo, which is divided among three countries; Malaysia, Indonesia and Brunei, has about 620 bird species, of which 52 species are endemic (Phillipps & Phillipps, 2011). Apart from high endemism, the island is also a hot spot for migrating birds to stop-over. This is especially true for birds requiring wetland and coastal areas. An important site that provides a wintering habitat for such migrants is the Kota Belud Bird Sanctuary (KBBS) which was gazetted in 1960 on the west coast of Sabah, Malaysia. KBBS is one of the most important bird sanctuaries in Sabah as indicated by significant records of migratory birds, such as Garganey (*Anas querquedula*), Tufted duck (*Aythya fuligula*) and Mallard (*Anas platyrhynchos*). Black coot (*Fulica atra*)

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was a particularly unusual migrant recorded in this sanctuary by Burgess in February 1964 (de Silva, 1968). During a survey that was conducted in KBBS in 1984 – 1985 by Payne & Parish (1985), about half a million individual birds were recorded, representing 127 resident and migrant species. The majority were birds that migrated from the northern hemisphere (although some austral migrants also occur). Swallows were the most common bird species during the survey, with 300,000 individuals. Other migrants included Christmas island frigatebird (*Fregata andrewsi*), Grey heron (*Ardea cineria*) and Great egret (*Ardea alba*).

Four types of habitats were identified as foraging and breeding sites for birds in KBBS. These habitats were: i) grassland, scrub, bush, open land and suburban areas, ii) paddy fields and flooded paddy, iii) coastal strand and mudflats, and iv) swamp, mangrove, lakes and pools. KBBS is unique as it is associated with people, settlements and development. It also affords a beautiful view of Mount Kinabalu from the west side. The local people are of various ethnic groups, such as Bajau, Dusun and Iranun and they still practice agricultural activities such as farming and cattle raising.

The objectives of our study were to determine the diversity and species richness of birds in KBBS and to identify habitats of the birds that occur there. The overall purpose was to provide information for managing and conserving birds in the Sanctuary. We censused birds and incorporated information gathered by other researchers in the last 25 years.

Methods

Study area

The study was carried out in KBBS, which is located on the west coast of Sabah at N 6°27'52" E 116°29'15" (Figure 2). The total area of the sanctuary is approximately 12,200 ha, starting from the northern part of Kota Belud town and continuing along the coast of Sabah until Rampayan village (Payne & Parish, 1985).

Field surveys

A total of 19 days of sampling were conducted from October 2011 until March 2012. There were seven (7) villages that had been selected as sampling stations namely Pantai Emas (PE), Kg. Taun Gusi (TG), Kg. Tempasuk-Sangkir (TS), Kg. Kesapang (KG), Kg. Kawang-Kawang-Rosok (KKR), Kg. Nanamun (NN)

Figure 1. Diagram of line transect of 1 km that was applied during the survey

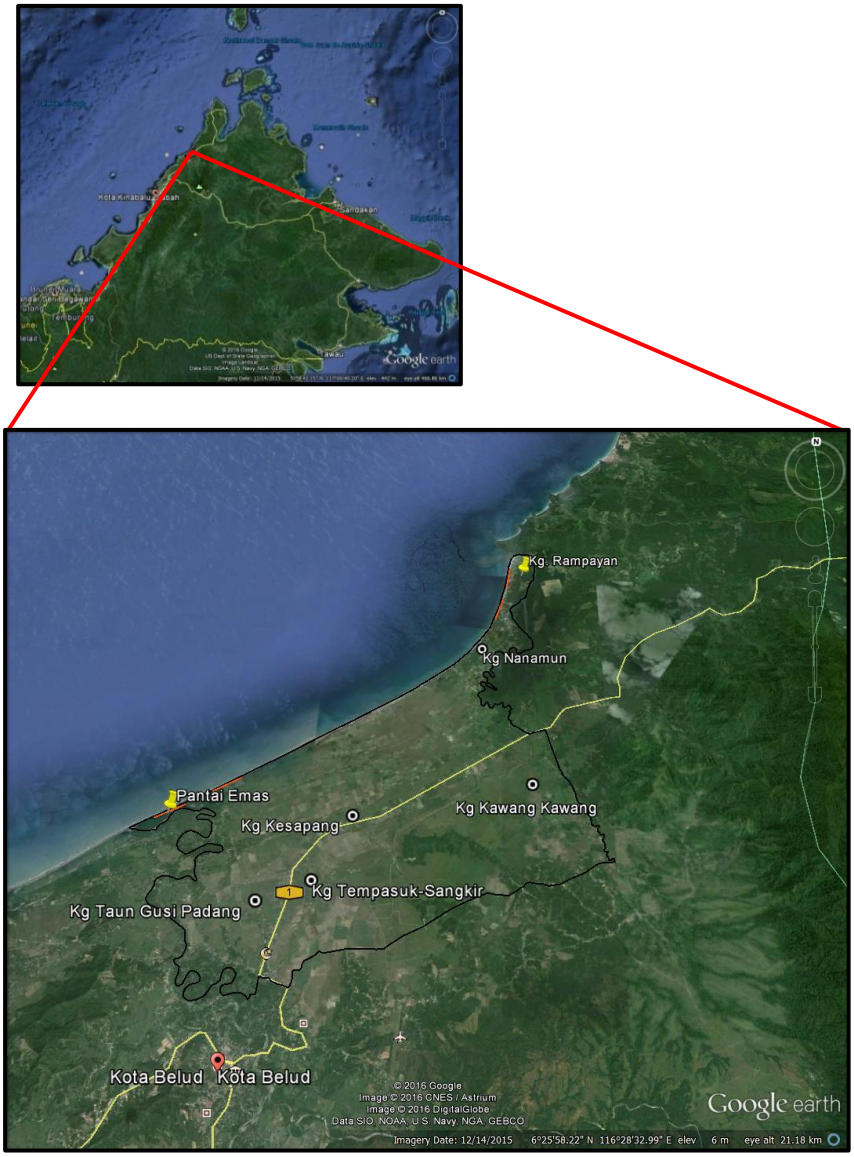

Figure 2. Map of Kota Belud Bird Sanctuary indicating locations of point (•) and line transect (red line) sampling (Source: Google Earth)

and Kg. Rampayan (RN). Censusing methods consisted of direct observation on line transect and point counts (Figure 1 & 2), and also mist-netting.

Four transects of one kilometre (km) each were established, two in the coastal area of Pantai Emas and two at Rampayan, respectively as these areas are open habitat and large, thus this method was effective and practical (Bibby et al., 1992). Transects were divided into five stop points 200 metres (m) apart. Each point was surveyed for 10 to 15 minutes. In addition, five point counts were established within the study area, and 30 minutes or more were spent at each site based on the occurrence of birds. Each point covered mainly habitats that are associated with humans such as settlements and agricultural sites. TG and KG stations mostly covered the habitat of suburban area and paddy field. TS and KKR stations covered the habitat of paddy field and flooded paddy and the habitat of grassland and bushes, respectively. Meanwhile, NN station covered the habitat of swamp and mangrove.

Sampling was conducted in the early morning from 0600 hours to 1000 hours and at dusk, from 1600 hours to 1800 hours. For mist-netting, there were only two types of habitats that could be accessed in order to set up the nets namely paddy fields and flooded paddy, and the habitat of grassland, scrub, bush and open and suburban area. Four mist-nets of 12 - 13 m were set up based on bird flight direction in each habitat for four days of sampling and they had been opened at 0700 hours and closed at 1800 hours. The nets were checked for any captured birds every two hours. The captured individuals or birds were identified and released after measurements of standard methods were taken such as beak length, wingspan, body length and tail length as well as tarsus length.

Analysis

Shannon and Margalef indices were calculated to determine bird diversity and species richness, respectively using Species Diversity and Richness version 2 software (Seaby & Henderson, 1998).

Results

Richness and bird composition

Overall, a total of 2,717 birds were recorded during the study, of which 74 species from 31 families were identified. October 2011 had recorded the highest number of birds in which a total of 689 birds were recorded in the sanctuary. A total of 27 out of 74 species were migrants; 12 species were

classified as both migrants and residents; and the remaining 35 species were residents. Four types of habitats were identified as foraging sites and breeding sites for birds (see Table 1). These habitats were: i) grassland, scrub, bush, and open and suburban areas which was found in TG, KN and KKR, ii) paddy fields and flooded paddy which was found in TG, KN and TS, iii) coastal strand and mudflats in PE, NN and RN and iv) swamp, mangrove, lakes and pools mostly found in PE, NN, RN and KKR (Table 1).

The abundance of individual bird species of all types (resident and migrant species) and in all habitats is shown in Figure 3-6. In grassland, scrub, bush, and open and suburban areas, the most dominant species was *Lonchura atricapilla* (21.47 %) followed *by Aplonis panayensis* (15.3 %) and *Hirundo tahitica* (9.71 %). Paddy fields and flooded paddy were dominated by *Egretta intermedia* (13.3 %) and *Himantopus himantopus* (10.7 %). Coastal strand and its surrounding area were dominated by *Artamus leucorhynchus* (29.96 %), followed by *Hirundo tahitica* and *Bubulcus ibis* with 14.76 % and 10.5 %, respectively. In swamp, mangrove, lakes and pools, *Dendrocygna arcuata* was the most recorded species, with 53 individuals (73.6 %). Overall, *Lonchura atricapilla* was the most recorded species (359 individuals), followed by *Hirundo tahitica* (197 individuals) and *Aplonis panayensis* (194 individuals).

Species Richness and Diversity of Birds

KBBS possessed a high species diversity and richness in which Shannon index was H'=3.4664 and Margalef index was D_{mg} = 9.232.

Table 1: The presence and absence of bird species based on habitat

Habitat 1: Grassland, open areas, bush and suburban areas (TG, KN & KKR),**Habitat 2:** Paddy fields and flooded paddy (TG, KN & TS)
Habitat 3: Coastal strand and associated areas (PE, NN & RN),**Habitat 4:** Swamp, mangroves, lakes and pools (PE, NN, RN & KKR)

No	Common Name	Species Name	Habitat 1	Habitat 2	Habitat 3	Habitat 4
1	Eastern Marsh Harrier	*Circus spilonotus*	-	/	-	-
2	Brahminy Kite	*Haliastur indus*	-	/	/	-
3	Black-shouldered Kite	*Elanus caeruleus*	/	/	-	-
4	Peregrine Falcon	*Falco peregrinus peregrinator*	-	/	-	-
5	Great Egret	*Ardea alba*		/	/	
6	Intermediate Egret	*Egretta intermedia*	/	/		
7	Little Egret	*Egretta garzetta*	/	/		
8	Little Egret	*Egretta nigripes*		/		
9	Grey Heron	*Ardea cineria*	/			
10	Purple Heron	*Ardea purpurea*		/		/
11	Chinese Pond Heron	*Ardeola bacchus*		/		
12	Javan Pond Heron	*Ardeola speciosa*		/		
13	Cattle Egret	*Bubulcus ibis*	/		/	
14	Yellow Bittern	*Ixobrychus sinensis*		/		
15	Cinnamon Bittern	*Ixobrychus cinnamomeus*		/		
16	Wandering Whistling Duck	*Dendrocygna arcuata*		/		/
17	Darter	*Anhinga melanogaster*				/
18	Slaty-breasted Rail	*Gallirallus striatus*		/		
19	Watercock	*Gallicrex cineria*		/		
20	Common Moorhen	*Gallinula chloropus*		/		
21	Purple Swamphen	*Porphyrio porphyrio*		/		
22	White-breasted Waterhen	*Amaurornis phoenicurus*	/	/	/	
23	Black-winged Stilt	*Himantopus himantopus*		/		
24	Little Ringed Plover	*Charadrius dubius curonicus*		/		
25	Kentish Plover	*Charadrius alexandrinus*			/	
26	Lesser Sand Plover	*Charadrinus mongolus*			/	
27	Pacific Golden Plover	*Pluvialis fulva*		/	/	
28	Whimbrel	*Numenius phaeopus*		/		
29	Common Redshank	*Tringa totanus*		/		
30	Common Greenshank	*Tringa nebularia*		/		

(Continued on next page)

Table 1. (Continued)

No	Common Name	Species Name	Habitat 1	Habitat 2	Habitat 3	Habitat 4
31	Wood Sandpiper	*Tringa glareola*		/		
32	Marsh Sandpiper	*Tringa stagnatilis*		/		
33	Common Sandpiper	*Actitis hypoleucos*		/		
34	Red-necked Stint	*Calidris ruficollis*		/		
35	Whiskered Tern	*Chlidonias hybridus*		/		
36	Black-naped Tern	*Sterna sumatrana*		/		
37	Little Tern	*Sterna albifrons*	/	/		
38	White-winged Black Tern	*Chlidonias leucopterus*		/		
39	Zebra Dove	*Geopelia striata*	/	/	/	
40	Spotted Dove	*Streptopelia chinensis*	/		/	
41	Feral Pigeon	*Columba livia*	/			
42	Greater Coucal	*Centropus sinensis*	/			
43	Lesser Coucal	*Centropus bengalensis*	/			
44	Large-tailed Nightjar	*Caprimulgus macrurus*	/			
45	Collared Kingfisher	*Todiramphus chloris*	/	/	/	/
46	Stork-billed Kingfisher	*Pelargopsis capensis*				/
47	Common Kingfisher	*Alcedo atthis*				/
48	Blue-throated Bee-eater	*Merops viridis*			/	
49	Dollarbird	*Eurystomus orientalis*	/		/	
50	Pied Triller	*Lalage nigra*	/			
51	Brown Shrike	*Lanius cristatus lucionensis*	/			
52	White-breasted Woodswallow	*Artamus leucorhynchus*	/	/	/	
53	Sand Martin	*Riparia riparia*	/			
54	Barn Swallow	*Hirundo rustica*	/	/	/	
55	Pacific Swallow	*Hirundo tahitica*	/	/	/	
56	Red-headed Tailorbird	*Orthotomus ruficeps*	/			/
57	Oriental Reed Warbler	*Acrocephalus orientalis*	/			
58	Striated Grassbird	*Megalurus palustris*		/		
59	Yellow-bellied Prinia	*Prinia flaviventris*	/			
60	Olive-winged Bulbul	*Pycnonotus plumosus*	/			

(Continued on next page)

Table 1. (Continued)

No	Common Name	Species Name	Habitat 1	Habitat 2	Habitat 3	Habitat 4
61	Yellow-vented Bulbul	*Pycnonotus goiavier*	/	/		/
62	Oriental Magpie Robin	*Copsychus saularis adamsi*	/			
63	Pied Fantail	*Rhipidura javanica*	/	/		/
64	Olive-backed Sunbird	*Nectarinia jugularis*	/		/	/
65	Brown-throated Sunbird	*Anthreptes malacensis*	/			/
66	Scaly-breasted Munia	*Lonchura punctulata*	/	/		
67	Chestnut Munia	*Lonchura atricapilla*	/	/		
68	Dusky Munia	*Lonchura fuscans*		/		
69	Yellow Wagtails	*Motacilla flava*	/	/	/	
70	Paddyfield Pipit	*Anthus rufulus*	/	/		
71	Eurasian Tree Sparrow	*Passer montanus*	/			
72	Asian Glossy Starling	*Aplonis panayensis*	/			
73	Common Iora	*Aegithina tipia*	/			
74	Christmas Island Frigatebird	*Fregata andrewsi*			/	
	Total Number of Species		**37**	**46**	**18**	**11**

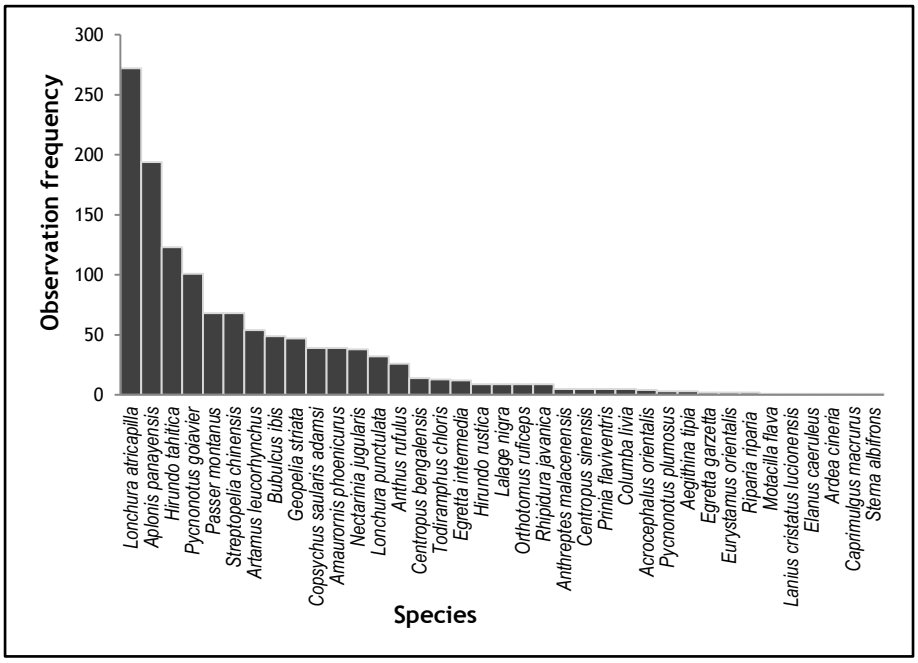

Figure 3. Bird species abundance in habitat of grassland, scrub, bush, and open and suburban areas.

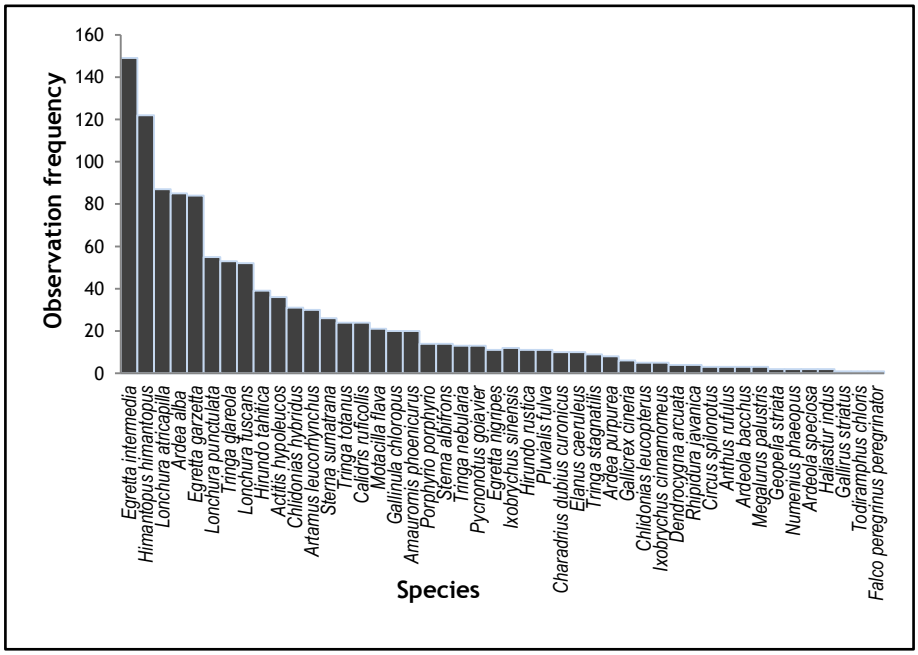

Figure 4. Bird species abundance in habitat of paddy fields and flooded paddy.

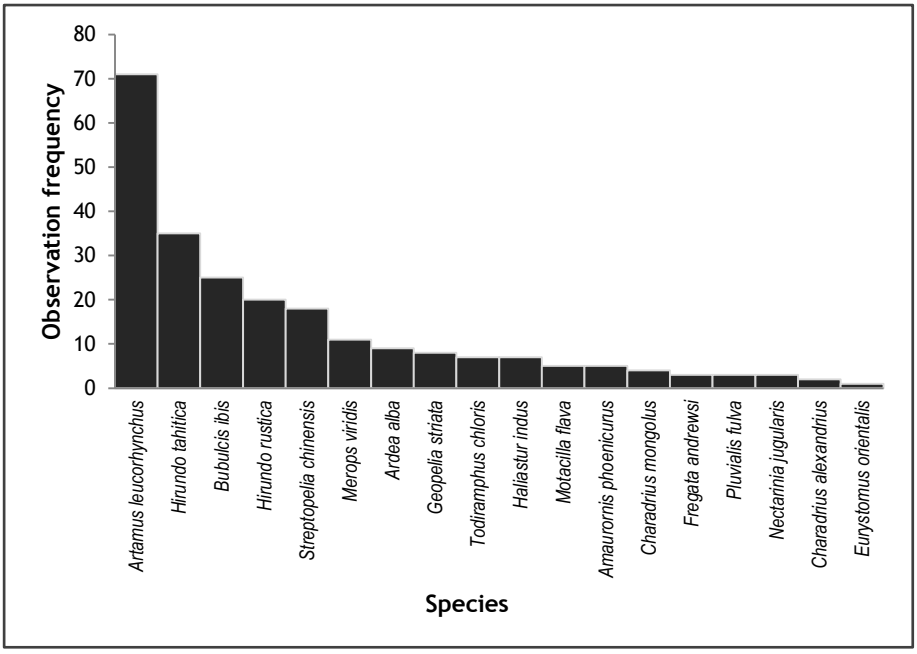

Figure 5. Bird species abundance in habitat of coastal strand and mudflats.

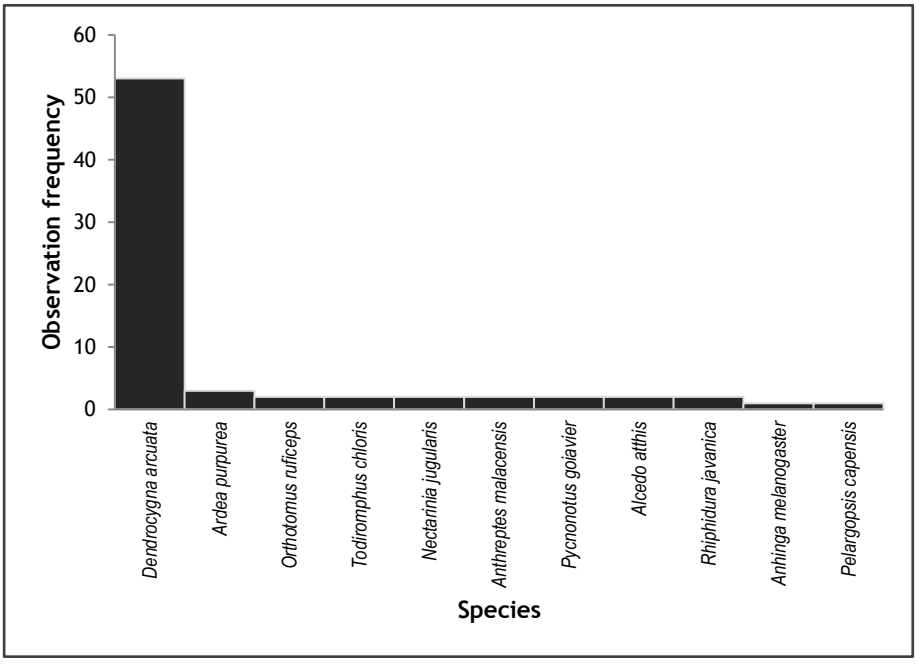

Figure 6. Bird species abundance in habitat of swamp, mangrove, lakes and pools.

Discussion

The timing of bird migration is expected to have a strong influence on the number of birds using KBBS. According to Phillipps & Phillipps (2011), October is the peak migration period for northern migrants to reach the north-western coast of Borneo. In addition to that, Payne & Parish's (1985) survey reported that October to March recorded the highest number of migrant birds in KBBS. *Himantopus himantopus* was one migrant species that was recorded in a big group during these months.

Overall, the total bird individuals that were recorded in this study was lower compared to the previous survey by Payne and Parish in a one year period from 1984 until 1985. This could be due to the short term sampling effort as 19 days of surveys in five months is fairly limited for better results. Since most part of the sanctuary is associated with settlements and communities (private land), it was quite difficult to access the entire sanctuary therefore the sampling stations were chosen because of accessibility and this may have influenced the sampling effort. In terms of diversity, 74 bird species were identified, but we were able to classify numerous others in specific taxonomic groups. Of these Charadriidae (shorebird) was particularly abundant (about one hundred) in flooded paddy. Although this study documented only 74 species compared to 127 species from the 1985 survey, we still managed to add a few bird species to the KBBS list that were not recorded during the past study, namely *Ardeola bacchus*, *A. speciosa*, *Columba livia*, *Dendrocygna arcuata*, *Lonchura punctulata* and *Passer montanus*.

Four main habitats were identified in the sanctuary as important locations for foraging and breeding. Grassland, open areas, shrub and suburban areas had similar vegetative structure made up mainly of grasses and secondary plants. Thus, these areas were considered as one habitat. In this habitat we recorded 37 species, of which *Pycnonotus goiavier* and *Passer montanus* were among the common species. The urban species, *Columba livia* was found in this habitat group, indicating that some parts of the sanctuary are experiencing urbanization with the increase in human population and development. As in the forested areas of Borneo (Davison, 2001), parts of KBBS have faced land use changes and associated problems. However, land use changes in an agricultural area such as KBBS has had a different impact on the bird community.

According to Lansdown (1986), 16 species of ardeid had been recorded in KBBS including both herons and bitterns. These birds were found in six different

habitats, namely grazing areas, mangroves, swamp, paddy fields and in a large agricultural area consisting of paddy, plantation, and river, Little Egret (*Egretta garzetta*) was the most common among all species found in those habitats. Paddy fields and flooded paddy are outstanding locations to watch birds in KBBS, as a lot of migrant birds can be seen here, mainly waders of water birds. This habitat serves a good foraging site for birds as it attracts other organisms, such as insects and several vertebrate species. In fact, vertebrate diversity is higher in cereal crops compared to oil palm (Neave & Neave, 1998; Lee et al., 2006). However, gramnivorous or seed-eating species, especially birds of family Estrildidae, were found in this habitat in large numbers. A few raptors were also recorded during the survey in this habitat, namely *Circus spilonotus*, *Elanus caeruleus* and *Haliastur indus*.

Coastal strand and associate areas also held *Haliastur indus*, as it is a raptor that occurs widely in coastal habitats. The vegetation structures of coastal strand are mainly short grasses and open woodland consisting of beach-edge trees. A few wader species were recorded in this area as well, and interestingly, a few individuals of critically endangered *Fregata andrewsi* were recorded flying above the sea at Rampayan in March 2012. March until July is the breeding period of sea birds and the seas are calmest during that time, thus facilitating the foraging activity of those birds (Phillipps & Phillipps, 2011).

The final habitat (swamp, mangroves, lakes and pools), held 11 recorded species of birds, including a large group of *Dendrocygna arcuata* in the lakes. It was the only resident duck species that was found, and unfortunately, there was no record of migrant ducks within the 19 days of sampling in the KBBS. *Ardea purpurea* and *Alcedo atthis* were found in the swamp and mangroves areas.

KBBS has significant values as a resting and wintering site for migratory birds, and it complements other wetland areas such as Padang Teratak Wildlife Sanctuary on Klias Peninsula and the urban Kota Kinabalu Wetland Centre (KKWC). KBBS has different types of habitats compared to the other sites. It provides ideal foraging for both resident and migrant birds, and breeding sites for residents. Its paddy fields and flooded paddy, as well as the coastal strand, are attractive spots for migrants such as shorebirds and waders, as evidenced by their commonality in these habitats from October to March.

An important issue is that it lacks wildlife patrolling and signage that indicates its purpose. It also does not have an information centre that would be useful for eco-tourists. Thus, the local communities of KBBS do not have much information and knowledge of the sanctuary. In this respect it is different from other sanctuaries. Therefore, the importance of the sanctuary should be looked into as well as to inculcate public awareness about bird conservation and the value of this bird sanctuary.

Conclusion

In conclusion, KBBS is one of the favourite hotspots or locations for migratory birds to stop-by or stay in Borneo during the northern migration season. This is especially true for migratory waders. The sanctuary has at least four different types of habitats. Its coastal strand even featured the critically endangered species *Fregata andrewsi*. Although the total recorded species in this study is lower than the previous survey, KBBS still possesses a high diversity of birds. Our study can act as reference for future studies and can be useful in assisting conservation efforts to preserve this important site.

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