RAFFLES BULLETIN OF ZOOLOGY **66**: 110–131
Date of publication: 23 February 2018
http://zoobank.org/urn:lsid:zoobank.org:pub:FD788156-45E5-49D8-9B40-9BB624848858

An assessment of avifauna in a recovering lowland forest at Kinabalu National Park, Malaysian Borneo

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Abstract. Well-known for its high elevation areas, Kinabalu National Park in Sabah, Malaysia, also protects lowland areas that have received little ornithological attention. Here we describe the avian community at Serinsim Substation, an area of mixed lowland rainforest habitats within the park. We present observations from Serinsim, including an annotated list of the 202 species recorded, and measurements of mist-netted individuals. These observations derive from two expeditions: one in 2004 and one in 2014. Although parts of Serinsim's forests are recovering from forest fires and historic, low-intensity logging, they are a valuable habitat for many lowland rainforest bird species, including uncommon species such as chestnut-necklaced partridge, fulvous-chested jungle-flycatcher, and chestnut-capped thrush. The diversity of birds at Serinsim highlights the importance of preserving degraded tropical forest for conservation. Our observations serve as a valuable baseline assessment of the avifauna in this region, which is particularly important in this era of rapid environmental destruction and land-use change.

Key words. birds, conservation, disturbed forest, Serinsim

INTRODUCTION

Logging and land-use change have affected the lowland rainforests in Southeast Asia at unprecedented rates in recent decades (Sodhi et al., 2004; Curran et al., 2004; Koh & Wilcove, 2008). Particular threats to these forests include conversion to oil palm plantations or other agricultural uses and damage by forest fires, which are increasingly common as a result of human-caused environmental changes (Beaman et al., 1985; Woods, 1989; Sodhi et al., 2004). Forests on the island of Borneo are now heavily fragmented, with parks and preserves protecting virtually all that remains of undisturbed forest. Even within parks, large areas of remaining forest have been degraded by selective logging or forest fires (Sheldon, 1985). This is especially true of lowland tropical rainforest. Therefore, there is a need to document the response of biodiversity to human-induced perturbations to help guide conservation efforts (e.g., Tingley et al., 2009). For this to be possible, we must have a baseline assessment and data with which future surveys can be compared.

The lowland rainforests of Sabah, Malaysian Borneo, are a high priority for conservation. These forests are recognised by BirdLife International as a secondary area of endemism, with eight Important Bird Areas (i.e., areas of significant importance to the international conservation of bird populations; BirdLife International, 2018). Sabah's lowland forests also include significant ecotourism destinations, and are thus valuable to the local economy (WWFNM, 1996).

Among lowland areas that have received remarkably little ornithological attention are those in northernmost Sabah (Sheldon, 2015). This region includes Kinabalu National Park, a UNESCO World Heritage site surrounding the 4,095 m Mount Kinabalu. Although there have been many natural history studies in the park, including those of its avifauna, virtually all such studies have focused on high-elevation areas between Kinabalu's peak and the lower montane forest at Poring Hot Springs (e.g., Kitayama, 1992; Biun, 1999; Nor, 2001). North of Mt. Kinabalu, the park protects a large segment of lower elevation forest within its borders, but most of this forest is secondary or degraded by logging (Meijer, 1996) and, thus, of less interest to natural historians. As a result, the lowland forest located in the northern section of the park is relatively unexplored by ornithologists (Meijer, 1996; Wells & Phillipps, 1996; Sheldon, 2015).

Here, we provide an observational assessment of the avian community in a mixed-habitat lowland forest in the north section of Kinabalu National Park, an area called Serinsim

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ISSN 2345-7600 (electronic) | ISSN 0217-2445 (print)

Substation. Our data were collected by two expeditions: one undertaken by Louisiana State University (LSU) and the American Museum of Natural History (AMNH; FHS, RGM, and others) in January and February 2004, and one undertaken by Cornell University (TMP, ERGC, JIB, EMW, DWW, and K. S. Lauck) from June to August 2014. We highlight similarities, and some broad differences, between the observations gathered by the two expeditions.

MATERIALS AND METHODS

Study area. The headquarters of Serinsim (sometimes spelled Sorinsim) Substation lie at the confluence of the Serinsim and Kinarom rivers, at the foot of the 1,600 m Mount Nomboyukong (with spelling variants including Namboyukong, Fig. 1). The forest adjacent to and south of the substation headquarters was severely burned in 1997 during the exceptionally dry conditions associated with El Niño. Both expeditions surveyed along two main trails extending from Serinsim Substation into the forest (Fig. 1). One trail runs through lowland forest at the base of Nomboyukong, leading to a large cave with a bat colony. The other climbs to the top of Nomboyukong. The majority of our efforts took place within 2 km of Serinsim Substation on these trails. Surveys were conducted in the following habitats: (1) "primary" forest (elevation 200 m); this forest was not burned in 1997 and apparently has not been disturbed in recent times, but it lacks the large trees of typical primary lowland forest, probably because of subsistence logging over a long period of time by local people; (2) secondary forest (elevation 250–450 m in the main survey area); this forest was burned in 1997, but apparently to a lesser extent than the lower-lying areas; (3) forest adjacent to and south of the headquarters (elevation 200 m) recovering from the 1997 forest fires, which we refer to as "recovering forest;" and (4) clearings and river edge at the headquarters (elevation 185 m), including a mowed football field, overgrown fields, and open woodland (Fig. 1).

Sampling methods – Louisiana State University (LSU) and American Natural History Museum (AMNH) (Expedition 1). The LSU/AMNH expedition took place from 17 January 2004 to 1 February 2004. Field work consisted of netting with 12 m mist nets and opportunistic viewing along trails, audio recording, and photographing birds (Table 1). Most effort was focused on collecting museum specimens, tissues for biochemical analysis, and parasites. Field work was severely hampered by intense and continuous rain from 23–30 January 2004. Effort during this expedition was divided between habitats in the following (approximate) way: primary forest (habitat 1), 22%; secondary forest (habitat 2), 33%; recovering forest (habitat 3), 22%; clearings (habitat 4), 22%.

Sampling Methods – Cornell University (Expedition 2). The Cornell expedition took place from 28 June 2014 to 13 August 2014. We used a modified area search protocol (Ralph et al., 1993), in which we counted all birds along survey trails each day. Bird records are summarised in Appendix 1. Field work also included targeted netting with

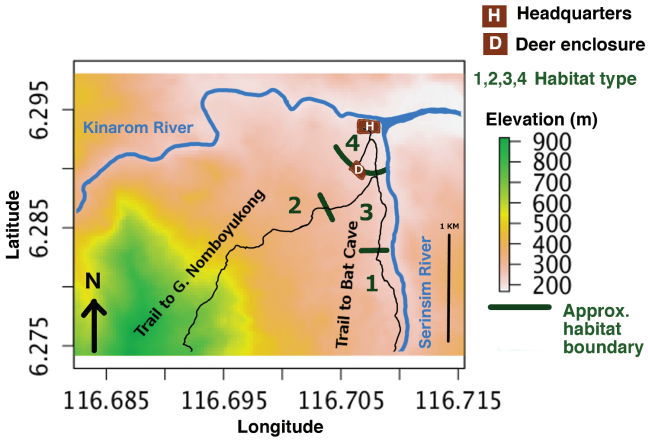

Fig. 1. A map of the area around the Serinsim Substation headquarters showing trails, rivers, and approximate habitat boundaries. 1 = "Primary" forest: unburned forest starting about one km from headquarters; 2 = "Secondary" forest: taller hillside secondary forest from 200–450 m; 3 = forest recovering from 1997 fires, adjacent to the headquarters compound at 200 m; 4 = Open area and river edge at the substation headquarters at 200 m.

12 m mist nets and audio and video recording birds. Netting effort was targeted toward certain species (see Appendix 3), and captures thus do not represent an unbiased sample comparable to results of passive netting. We used typical mist net sets to target mid-story and understory birds. For canopy species, we used "aerial" nets in which two 12 m mist nets were stacked and raised vertically like a curtain to a height of 4–10 m. Table 1 summarises net locations and effort. Target species were attracted using audio playback from a speaker placed near the nets. We measured and banded target and most non-target birds captured (Appendices 2, 3). We also noted all birds heard or seen and compiled a daily checklist at the end of each day. For some species, we include observations on behavior or natural history in Appendix 1. Using our observations from the lowlands, we calculated species richness, Shannon-Wiener Index and species evenness, and created a species accumulation curve. We excluded barbets from calculations of Shannon-Wiener Index and species evenness because their tendency to call constantly from the canopy made it difficult to tell how many individuals we detected each day.

Effort during this expedition was divided between habitats in the following (approximate) way: primary forest (habitat 1), 27%; secondary forest (habitat 2), 41%; recovering forest (habitat 3), 12%; clearings (habitat 4), 20%.

Some individual birds were collected and preserved as whole, fluid-preserved specimens. These specimens are being used in a forthcoming study on the morphological adaptations of rainforest birds, and will be available indefinitely for various museum-based studies. These specimens are at the Cornell University Museum of Vertebrates and Sabah Parks Vertebrates Collection at Kinabalu Park (Appendix 3). Specimens were collected under the approved Cornell IACUC protocol # 2001-0051 to DWW and under an access license from the Sabah Biodiversity Council and a research permit issued by Sabah Parks.

Table 1: Locations of netting efforts by both expeditions. Habitat numbers are defined in the "survey area" paragraph of the methods section, and elevation (in metres) is included where possible. In the "net setup" column, all ground nets are 12 m long and all aerial setups consist of two 12 m nets stacked vertically and raised. The number of metres (m) indicated in the "net setup" column for aerial nets indicates approximately how high the nets were at their vertical midpoint. The "date range" column indicates the period of time over which netting occurred and the "active netting days" column indicates how many days during that period were spent netting. The "captures" column lists how many birds we captured at each net (including banded individuals, collected individuals, and re-captures; see Appendices 2, 3.)

Habitat (elevation)	Approximate Lat/Long	Net setup	Date range	Active netting days	Year	Captures
3, 4	NA	ca. 15 ground nets	18 Jan to 20 Jan	3	2004	NA
2	NA	ca. 25 ground nets	21 Jan to 26 Jan	6	2004	NA
1	NA	ca. 25 ground nets	27 Jan to 30 Jan	4	2004	NA
4	NA	ca. 5 ground nets	31 Jan	1	2004	NA
2 (350 m)	6.28442°N, 116.69875°E	ca. 5 ground nets	7 July to 11 July	4	2014	29
2 (440 m)	6.28297°N, 116.69562°E	ca. 7 m aerial	10 July to 1 August	10	2014	14
2 (320 m)	6.28418°N, 116.7083°E	ca. 9 m aerial	14 July to 26 July	5	2014	2
2 (250 m)	6.28740°N, 116.70643°E	ca. 10 ground nets	13 July to 16 July	2	2014	8
4 (185 m)	6.29463°N, 116.70720°E	ca. 4 m aerial	15 July to 22 July	3	2014	2
1 (240 m)	6.27849°N, 116.70996°E	ca. 10 ground nets	21 July to 28 July	6	2014	2
1 (240 m)	6.27849°N, 116.70996°E	ca. 10 m aerial	1 Aug to 8 Aug	8	2014	8
4 (185 m)	6.29332°N, 116.70673°E	ca. 4 m aerial	24 July to 9 Aug	7	2014	1
3 (240 m)	6.28464°N, 116.70834°E	ca. 8 ground nets	4 Aug to 7 Aug	4	2014	26
3 (245 m)	6.2836133°N, 116.707589°E	ca. 6 m aerial	7 Aug to 8 Aug	2	2014	1

Bird vocalisations and behavior were audio and video recorded so that they will be available for future use by researchers. We collected audio recordings following standardised protocols published by the Macaulay Library (https://www.macaulaylibrary.org/contribute/recording-techniques/). These recordings are archived at the Macaulay Library (Appendix 1).

We surveyed two areas away from the main study area: the entire trail to the bat cave 6 km from the headquarters on 20 July 2014; and the 6.5 km trail to the summit of Mt. Nomboyukong (1,600 m) on 10–11 August 2014, where we encountered primary montane forest and a small area of stunted forest at the highest points on the mountain. Species recorded during these extralimital surveys are noted in Appendix 1.

RESULTS

The two expeditions each offer a snapshot of Serinsim's forest avifauna as the area recovers from the 1997 forest fire. The LSU/AMNH expedition took place seven years after fires damaged the forest at Serinsim, and the Cornell expedition took place 17 years after those fires. However, caution must be used when interpreting differences between the bird communities detected by the two expeditions, because of differences in duration, methods, season, and weather.

The 2004 LSU/AMNH expedition recorded 122 species at Serinsim (classified according to Clements, 2016), collected 186 specimens representing 60 species, banded a small number of common birds, and instructed two junior members of the park staff in modern techniques of specimen preparation and museum data collection. The 2014 Cornell expedition recorded 184 species at Serinsim, sound-recorded 121 audio tracks, generated 105 videos, collected 20 specimens of 13 species, and banded 60 individuals. Excluding barbets and

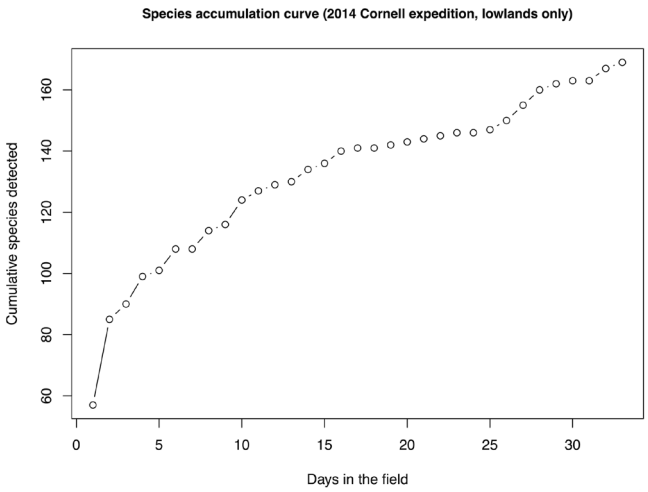

Fig. 2. A species accumulation curve (from the 2014 Cornell expedition, lowland species only). This curve demonstrates that we continued to accumulate new species throughout the entire time spent in the field.

species seen only at higher elevations, species richness in 2014 was 162 species, Shannon-Wiener Index was 4.16, and species evenness was 0.82. We continued to document new species throughout the expedition, highlighting the high avian diversity throughout the study area (Fig. 2).

Differences between 2004 and 2014

State of the recovering burned forest.

Expedition 1 – LSU/AMNH

The area marked as habitat 3 in Fig. 1 was "scrub forest" and consisted entirely of thick banana and ginger-dominated sapling forest of about 3–5 m in height.

Expedition 2 – Cornell University

The forest had grown to be about 10–20 m tall and was more similar in appearance to mature rainforest, but with thicker undergrowth. Bananas, bamboo, and gingers were still prevalent in some areas. Many trees were fruiting in the recovering burned forest and in high concentrations in a patch of secondary forest on Mt. Nomboyukong's lower slope (note that fruiting patterns fluctuate with seasonal and climatic factors, and the abundance of fruit in 2014 compared to 2004 is not necessarily a result of succession). Bulbuls, barbets, and white-eyes were abundant in this area.

Breeding activity.

Expedition 1 – LSU/AMNH

Few species of birds were in breeding condition, as judged by gonadal development: only 15 of 60 collected species (25%) showed signs of breeding (Appendix 1). Nevertheless, most species of sunbirds (Nectariniidae) were in breeding condition, suggesting that this family breeds earlier than some other groups in the area. The large proportion of non-breeding species at Serinsim contrasted markedly with the proportion of breeding birds (ca. 50%) found at Klias Forest Reserve during a subsequent survey conducted by the LSU/AMNH team from 5–12 February 2004 (Sheldon et al., 2014). The surveys at Serinsim were conducted in lowland forest whereas the Klias Forest Reserve surveys were in coastal scrub peatswamp. Therefore, differences in breeding activity could be due to different biotic and abiotic forces at play.

Expedition 2 – Cornell University

We observed nests of five species and fledglings or juveniles of 15 species (see Appendix 1), which were generally different species than those observed to be in breeding condition by the LSU/AMNH expedition. Only fulvous-chested jungle-flycatcher and chestnut-capped thrush showed signs of reproductive activity in both expeditions. We did not assess gonadal development.

Elevational observations.

Expedition 1 – LSU/AMNH

We observed some species in the lowlands that are more typically found at high elevations. Bornean Treepie occurred occasionally at 200 m and commonly at 300 m; this species is generally found at higher elevations (Myers, 2016), but has previously been recorded at 300 m (Eaton et al., 2016). Chestnut-crested yuhina was common at 300 m at Serinsim; its previous lowest record was 550 m (Sheldon et al., 2001, Myers, 2016).

Expedition 2 – Cornell University

During one month in the lowlands, we did not observe any chestnut-crested yuhinas. We had only one possible sighting of Bornean treepies at 300 m. In our two-day survey of Nomboyukong, we did commonly detect both of these species starting at around 1,000 m.

DISCUSSION

Although primary forest is of highest value for biodiversity, disturbed forest both within and outside of protected areas can provide important habitat for less sensitive species and can connect populations between undisturbed areas (Barlow et al., 2007; Edwards et al., 2011). Much of the forest at Serinsim is disturbed, but we found that the substation area hosts at least 202 species. Of those species, 20 are new records for the checklist of birds of Kinabalu National Park (Jenkins & de Silva, 1996), which reflects the fact that the lowlands in the park have not previously been systematically surveyed. Some commonly-detected species at Serinsim are considered uncommon elsewhere in Borneo, such as chestnut-necklaced partridge, fulvous-chested jungle-flycatcher, and chestnut-capped thrush (Phillipps & Phillipps, 2014; Eaton et al., 2016; Myers, 2016). Many frugivorous species were using the disturbed areas for feeding and breeding activities. We detected a comparable number of species in the lowlands of Serinsim as on a previous expedition to Tawau Hills Park during July of 2012 (160 species; Pegan et al., unpublished data), which is noteworthy because the forest surveyed at Tawau Hills is relatively undisturbed and includes un-logged primary forest. We calculated a Shannon-Wiener Index (H), which is a measure of species diversity that takes into account both abundance and evenness of species' assemblages, of 4.16 for Serinsim, which is slightly lower than that calculated from our data at Tawau Hills (H = 4.40). Both of these values are higher than other values of H reported for both undisturbed

and logged native forest in Borneo (H = 3.5–3.6; Slik & Van Balen, 2006; Sheldon et al., 2010). Our higher values are likely affected by the less-restrictive survey methods we used: Slik & Van Balen (2006) and Sheldon et al. (2010) used point counts on transects, while we used area search methods. The differences could also be related to differences in timing of surveys, survey effort, and area surveyed. It is important to note that although the avifauna of degraded forests may be as diverse as that of primary forest, there are differences in species composition between these two habitats, and some species present in degraded forest may require nearby patches of primary forest to persist (Lambert, 1992). Nonetheless, other studies have documented high diversity in fragmented, secondary growth forests (Pfeifer et al., 2017), which we suggest our data captured.

Because the two expeditions reported here took place 10 years apart, we observed patterns that may reflect changes in avifauna at Serinsim in the decade between 2004 and 2014. However, our ability to use these data to test hypotheses about differential patterns is limited by the fact that the expeditions took place in different seasons, for different durations, and using different methods. In our results section, we outline some major differences between the avifauna observed by each expedition. Differences in the prevalence of breeding birds and in the presence of higher-elevation species in the lowlands may be primarily related to the differing seasons during which the expeditions took place (January–February in 2004 and July–August in 2014). There were noticeable differences in the prevalence of hornbills and barbets between the two expeditions: during the LSU/AMNH expedition, no hornbills were sighted and gold-faced barbet was the only commonly calling barbet species. By contrast, the Cornell expedition observed hornbills of five species on 66% of days in the field; and red-throated and blue-eared barbets were at least as common as gold-faced. Although the complete absence of hornbills at Serinsim in 2004 may have been related to seasonal movements (and the presence of hornbills in 2014 related to high fruit abundance), it seems likely that hornbills have truly increased in abundance at Serinsim and the surrounding forest since 2004. This relative increase may be associated with habitat recovery following the 1997 fires, or with changing hunting practices. Hornbills (and monkeys) were nonetheless far less abundant at Serinsim than at Tawau Hills Park (Pegan et al., unpublished data).

In addition to the value of our assessment of the avifauna at Serinsim, our work there has contributed substantially to natural history collections of physical and digital specimens. The specimens collected by the 2004 LSU/AMNH expedition to Serinsim have significantly added to the understanding of Bornean bird evolution, with more than 17 publications using them so far (including but not limited to Moyle & Marks, 2006; Pasquet et al., 2007; Sheldon et al., 2009a; Sheldon et al., 2009b; Lim, 2010; Lim et al., 2010a, b, 2011, 2014, 2017; Lohman et al., 2010; Sangster et al., 2010; Lim & Sheldon, 2011; Moyle et al., 2011; Gawin, 2014; Chua et al., 2015; Sheldon et al., 2015). The specimens collected in 2014 are being used for forthcoming publications on morphology and will be available indefinitely for comparative studies. The Cornell expedition collected recordings (audio and video) that preserve vocalisations and behaviours for posterity and are available to the public at http://macaulaylibrary.org.

Historical data describing bird distributions play a critical role in our current ability to understand such patterns, especially in light of the rapid, large-scale environmental changes facing our planet (e.g., Tingley et al., 2009). Thus, it is also helpful to disseminate the results of recent surveys of previously un-surveyed areas, including Serinsim, in the hope that these might one day form historical baselines for future researchers.

ACKNOWLEDGEMENTS

The members of the 2004 LSU/AMNH expedition are particularly grateful to Benedict Butit, Ben Marks, and Johnny Lapidin for help in the field. For permission to conduct research in Sabah, we also thank the Malaysian Prime Minister's Department and Sabah Chief Minister's Department, Sabah Wildlife Department (Mahedi Andau, Laurentius Ambu, Augustine Tuuga, and Peter Malim), and Sabah Parks (Maklarin bin Lakim, Jamili Nais, Datuk Lamri Ali). Financial support was provided by the Coypu Foundation, American Museum of Natural History, and LSU Museum of Natural Science.

The members of the 2014 Cornell expedition would like to thank Rimi Repin, Justinus Guntabid, Jool, and Jaipin Mas. C. Y. Chung of the Sabah Biodiversity Council was extremely helpful as we completed our permits and Abdul Fatah Bin Amir was consistently supportive as we interacted with changing procedures at the Council. We thank Charles Dardia and the Cornell University Museum of Vertebrates for training and logistical support for specimen collecting, and the Macaulay Library for use of audio and video recording equipment. Ryan Shipley provided training and equipment for the experimental portion of the Cornell expedition. We would also like to acknowledge our fellow expedition member Katherine S. Lauck. Her expertise in climbing and ropes facilitated our ability to catch our target canopy birds. The 2014 expedition was funded by the following sources: the Ivy Expeditions Fund; National Geographic Young Explorer's Grant number 9505-14 to ERGC; Rawlings Presidential Research Scholars grant to TMP; Cornell University program support to DWW; Explorer's Club Youth Activity Fund grant to TMP; Morely Student Research Grant to ERGC; and a gift from Thomas Wickenden. This manuscript was improved by comments from Frank Rheindt and two reviewers.

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Appendix 1. A summary of all birds detected at Serinsim Substation by both expeditions.

In the species name (English) column, species endemic to Borneo are marked with " ° " and new additions to the checklist for Kinabalu Park (Wells & Phillipps, 1996) are marked with " * ".

Abundance 2014: Indicates what percentage of days a species was recorded in 2014 daily checklists. Birds appearing in <10% of lists were rarely reported (R), those in 10–50% of them uncommonly reported (U), those in 50–85% commonly reported (C), and those in > 85% abundantly reported (A). Species detected but with no abundance estimate, such as those observed only >2 km down the trail to the bat cave or the peak of G. Nomboyukong, are not included in abundance calculations and are marked "NA" in this column. Species not reported in 2014 are marked "NR."

A/V 2014: Indicates whether audio (A) and/or video (V) files were recorded at Serinsim and archived at the Macaulay Library.
Habitat reported 2004: Where the species was observed in 2004. See Fig. 1 for habitat number definitions. R = Recorded (either observed or heard); numbers in cells refer to specimens collected.
Notes 2004: ♂ = males in reproductive condition; ♀ = females in reproductive condition
Notes 2014: Nest = active or recently-active nest observed; Juv = fledglings or juveniles observed

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Crested partridge	Rollulus rouloul	NA							Present 2014; heard calls regularly but did not include them on daily lists because of uncertainty about identity (confirmed later)
Red-breasted partridge°	Arborophila hyperythra	NA							Two heard near the peak of Nomboyukong at ca. 1,600 m, calling from down slope
Chestnut-necklaced Partridge*	Arborophila charltonii	A	A						Abundant even in the recovering forest, where multiple individuals called throughout the day (up to 12 estimated on one day, average five detected per day). Seemed less cautious than other phasianids, allowing relatively close approach.
Great argus	Argusianus argus	C							Heard calling from a distance in primary forest and on higher slopes of Nomboyukong. Occasionally calling at night.
Crimson-headed partridge°	Haematortyx sanguiniceps	NA							Two heard near the peak of Nomboyukong at ca. 1,600 m, calling from down slope
Crested fireback*	Lophura ignita	R							One female crossing a path on 18 July at ca. 300 m
Oriental darter*	Anhinga melanogaster	R							Soaring on thermals near the Kinarom River and station headquarters on 18 July
Little egret*	Egretta garzetta	NR					R	One in river	
Striated heron	Butorides striata	NR					R	One along river	
Oriental honey-buzzard	Pernis ptilorhynchus	U	A						
Crested serpent-eagle	Spilornis cheela	R			R				

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Changeable hawk-eagle	Nisaetus limnaeetus	R							
Rufous-bellied eagle	Lophotriorchis kienerii	R							
Black eagle	Ictinaetus malaiensis	R		R					
Crested goshawk	Accipiter trivirgatus	R							
Red-legged crake	Rallina fasciata	R							One quietly walking near fallen logs in a swampy area in the recovering forest. Never heard calling.
Common sandpiper	Actitis hypoleucos	NR					R	In river	
Spotted dove	Streptopelia chinensis	R					R		Occasionally in headquarters compound especially near the entrance
Little cuckoo-dove	Macropygia ruficeps	U							
Asian emerald dove	Chalcophaps indica	A	AV	R	R	4		♂♀, many netted and seen	In all forest types and foraging in headquarters compound. One bird dropped all retrices except the two central ones when it was released after being caught in a mist net
Zebra dove*	Geopelia striata	R							Occasionally in headquarters compound especially near the entrance
Little green-pigeon	Treron olax	U							Feeding at fruiting trees, one caught passively in an aerial net
Pink-necked pigeon	Treron vernans	NR			R			Many in hill forest	
Jambu fruit-dove	Ptilinopus jambu	R							One immature male in a group of frugivorus birds at a fruiting tree
Moustached hawk-cuckoo	Hierococcyx vagans	R							
Malaysian hawk-cuckoo	Hierococcyx fugax	R							
Indian cuckoo	Cuculus micropterus	NR			R	R	R		
Banded bay cuckoo	Cacomantis sonneratii	U							
Plaintive cuckoo	Cacomantis merulinus	U			2	R	R	Many calling	One to two individuals living in the headquarters compound called frequently
Violet cuckoo	Chrysococcyx xanthorhynchus	U							Infrequently flying over

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Square-tailed drongo-cuckoo	Surniculus lugubris	R	A	R				Infrequently calling	Juv
Black-bellied malkoha	Phaenicophaeus diardi	U			R				Caught a female which seemed to have an egg in its oviduct
Chestnut-bellied malkoha	Phaenicophaeus sumatranus	U							
Raffles's malkoha	Phaenicophaeus chlorophaeus	C		R	R				
Red-billed malkoha	Phaenicophaeus javanicus	R							
Chestnut-breasted malkoha	Phaenicophaeus curvirostris	U	A	1	R	R		Common	
Greater coucal	Centropus sinensis	U			R	R	R		
Mountain scops-owl	Otus spilocephalus	NA	A						Three individuals calling at night at ca. 1,400 m on the slopes of Nomboyukong
Sunda scops-owl	Otus lempiji	NA							Heard calling in headquarters compound at night
Brown boobook	Ninox scutulata	NA							In the primary forest trail to bat cave several km from the station
Silver-rumped needletail	Rhaphidura leucopygialis	R							
Glossy swiftlet	Collocalia esculenta	U					R		Large flocks, probably underestimated abundance. Nesting under bridge just outside the park.
Asian palm-swift	Cypsiurus balasiensis	R					R		Along Kinarom river on 9 August
Gray-rumped treeswift	Hemiprocne longipennis	R							
Whiskered treeswift	Hemiprocne comata	R		R					
Red-naped trogon	Harpactes kasumba	U	A	1	R			Calling & river-edge net	
Diard's trogon	Harpactes diardii	U		R	R				
Scarlet-rumped trogon	Harpactes duvaucelii	C		R					
White-crowned hornbill*	Berenicornis comatus	R							At ca. 300 m in secondary hill forest on 29 July
Helmeted hornbill	Buceros vigil	NA							Due to the current conservation crisis involving this species (Collar, 2015), we report no details about its presence.

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Rhinoceros hornbill	Buceros rhinoceros	U							
Bushy-crested hornbill	Anorrhinus galeritus	U							
Wreathed hornbill	Rhyticeros undulatus	C							Often seen and heard flying over primary forest and secondary hill forest
Blue-eared kingfisher*	Alcedo meninting	R							Along Kinarom River on 15 July
Blue-banded kingfisher	Alcedo euryzona	NR		1				Netted in a small stream	
Black-backed dwarf-kingfisher	Ceyx erithaca	U		2	1				Only observed dark-winged individuals, no rufous-winged individuals
Banded kingfisher	Lacedo pulchella	U		1					
Stork-billed kingfisher*	Pelargopsis capensis	R							Along Kinarom River
Collared kingfisher	Todiramphus chloris	NR					R		Not seen within the park, but common in the nearby villages and along roads
Red-bearded bee-eater	Nyctyornis amictus	C			1				Heard frequently from the disturbed forest near headquarters compound into the 2º slopes and at ca. 950 m on Nomboyukong. (Juv)
Blue-throated bee-eater	Merops viridis	R							Three individuals sallying over Kinarom River 1 km from headquarters compound
Dollarbird	Eurystomus orientalis	NR			R			Numerous, conspicuous in 2º canopy	Not present in 2014
Brown barbet°	Calorhamphus fuliginosus	U	A		2			Common in 2º forest	
Blue-eared barbet	Psilopogon duvaucelii	A	A		R				
Bornean barbet°	Psilopogon eximius	NA							On slopes of Nomboyukong above 1,000 m
Red-throated barbet	Psilopogon mystacophanos	A	AV						Nest
Golden-naped barbet°	Psilopogon pulcherrimus	NA							On slopes of Nomboyukong above 1,400 m
Yellow-crowned barbet	Psilopogon henricii	U							
Mountain barbet°	Psilopogon monticola	NA							On slopes of Nomboyukong above 1,000 m

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Gold-faced barbet°	Psilopogon chrysopsis	A		R	R	R	R	Vastly outnumbering other barbets in terms of vocalisations	
Malaysian honeyguide	Indicator archipelagicus	R							Heard calling once, caught one passively in an aerial mist net
Speckled piculet	Picumnus innominatus	NA							One seen in a mixed-species flock on the lower slopes of Nomboyukong
Rufous piculet	Sasia abnormis	U		R	6				
Crimson-winged woodpecker	Picus puniceus	U			R				
Checker-throated woodpecker	Picus mentalis	R	A		R				
Olive-backed woodpecker	Dinopium rafflesii	R							Only in primary forest
Rufous woodpecker	Micropternus brachyurus	R	V						
Buff-rumped woodpecker	Meiglyptes tristis	U			R				
Buff-necked woodpecker	Meiglyptes tukki	U	V	R	3				
Maroon woodpecker	Blythipicus rubiginosus	C			1				
Orange-backed woodpecker	Reinwardtipicus validus	U			R				
Gray-and-buff woodpecker	Hemicircus concretus	R			R				
White-fronted falconet°	Microhierax latifrons	NR		R			R		
Blue-crowned hanging-parrot	Loriculus galgulus	A							Calling while flying over many times per day. Once seen eating fruit with flowerpeckers. A bird catcher in the nearby village had ca. 20 in a cage.
Green broadbill	Calyptomena viridis	A	A	2		1			Nest: one being built, another recently destroyed by a predator
Black-and-red broadbill	Cymbirhynchus macrorhynchos	C	A				R		Found 3 inactive nests and saw one juvenile
Banded broadbill	Eurylaimus javanicus	A							Juv
Black-and-yellow broadbill	Eurylaimus ochromalus	A	AV		R				Nest (one under construction), Juv
Black-headed pitta*°	Erythropitta ussheri	C	A		R			Calling incessantly	Common in the recovering forest and primary forest

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Bornean banded-pitta°	Hydrornis schwaneri	U			R				One pair at ca. 400 m, another on the lower slopes of Nomboyukong
Hooded pitta*	Pitta sordida	U	A						Molting juveniles present
Golden-bellied gerygone	Gerygone sulphurea	NA							One individual seen at the very top of Nomboyukong at ca. 1,600 m at dawn. The bird appeared, perched at the peak for a moment, and then flew downhill.
Large woodshrike	Tephrodornis virgatus	U	A	R	R				
Bar-winged flycatcher-shrike	Hemipus picatus	R			R				
Black-winged flycatcher-shrike	Hemipus hirundinaceus	A	AV	R	2			Common in 2º forest	
Rufous-winged philentoma	Philentoma pyrhoptera	R							
Maroon-breasted philentoma	Philentoma velata	U	A						
Common iora	Aegithina tiphia	U	V			R	R		Juv
Green iora*	Aegithina viridissima	R	AV		R				
Fiery minivet	Pericrocotus igneus	R							
Scarlet minivet	Pericrocotus speciosus	R			R		R	One attacked by Hill Mynas in compound	
Lesser cuckooshrike	Lalage fimbriata	U							Seen occasionally in the 2º forest and also with a mixed flock on the lower slopes of Nomboyukong
Mangrove whistler*	Pachycephala cinerea	R							In highly degraded habitat by Kinarom River and station headquarters
White-bellied erpornis	Erpornis zantholeuca	U							Seen plunge-bathing in a stream
Dark-throated oriole	Oriolus xanthonotus	A	A		R			Common	Juv
Ashy drongo	Dicrurus leucophaeus	R							
Crow-billed drongo	Dicrurus annectans	NR		1					
Bronzed drongo	Dicrurus aeneus	U		R					
Hair-crested drongo	Dicrurus hottentottus	NR			R				

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Greater racket-tailed drongo	Dicrurus paradiseus	C	A	R	R			Common	Common. Seen associating with a tree shrew.
Spotted fantail	Rhipidura perlata	U							
Malaysian pied-fantail	Rhipidura javanica	A	AV			4			
Black-naped monarch	Hypothymis azurea	C	A		5				
Blyth's paradise-flycatcher	Terpsiphone affinis	U		2	1				
Crested jay	Platylophus galericulatus	C	A			R			
Black magpie	Platysmurus leucopterus	C	A						
Bornean treepie	Dendrocitta cinerascens	NA	A		R	R		2°, low elevation	
Barn swallow	Hirundo rustica	R					R		Two seen flying high over the very top of Nomboyukong (ca. 1,600 m) at dawn, heading south
Pacific swallow	Hirundo tahitica	U					R		
Velvet-fronted nuthatch	Sitta frontalis	R							
Puff-backed bulbul*	Pycnonotus eutilotus	C			1				Common in the recovering forest and secondary slope forest
Black-headed bulbul	Pycnonotus atriceps	A	AV		R	R	R	Abundant in 2°, 3°	Singing commonly, found 3 nests, all of which were taken by predators.
Gray-bellied bulbul	Pycnonotus cyaniventris	NR		R					
Yellow-vented bulbul	Pycnonotus goiavier	R	V			R	R		
Olive-winged bulbul	Pycnonotus plumosus	A	AV		1	3	2		
Cream-vented bulbul	Pycnonotus simplex	U			6			Common	Perhaps undercounted due to similarity with red-eyed bulbul; many bulbuls left unidentified
Red-eyed bulbul	Pycnonotus brunneus	U	A		5	1			Perhaps undercounted due to similarity with cream-vented bulbul; many bulbuls left unidentified. Seemed more common than cream-vented
Spectacled bulbul	Pycnonotus erythropthalmos	A	A	3					
Hairy-backed bulbul	Tricholestes criniger	U		1				♂	

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Ochraceous bulbul	Alophoixus ochraceus	NA							On the sloped of Nomboyukong starting at ca. 1,000 m
Gray-cheeked bulbul	Alophoixus bres	A	A	1	5				
Buff-vented bulbul*	Iole olivacea	U	AV						Usually in secondary slope forest
Streaked bulbul	Ixos malaccensis	U	A		R				
Yellow-bellied warbler	Abroscopus superciliaris	R	A						Seen once at ca. 300 m in 2º forest, recorded near the peak of Nomboyukong at 1,200 m (ML audio 518590)
Ashy tailorbird	Orthotomus ruficeps	C	A		R				
Rufous-tailed tailorbird	Orthotomus sericeus	A	A		3	3	R		Juv
Yellow-bellied prinia*	Prinia flaviventris	NR				1		♂	
Chestnut-crested yuhina°	Yuhina everetti	NA				R		Low elevation	Common near the peak of Nomboyukong starting at ca. 1,400 m
Pygmy white-eye°	Oculocincta squamifrons	U	A						Juv; Observed and recorded adults and fledgling at 300 m (ML audio 198763-4)
Black-capped white-eye	Zosterops atricapilla	NA							Common near the peak of Nomboyukong starting at ca. 1,400 m
Everett's white-eye	Zosterops everetti	U	A						
Bold-striped tit-babbler	Mixornis bornensis	C			1	5		♂♀	
Fluffy-backed tit-babbler	Macronus ptilosus	U			3				
Chestnut-winged babbler	Cyanoderma erythropterum	C		3	2				
Rufous-fronted babbler	Cyanoderma rufifrons	U	A						
Chestnut-backed scimitar-babbler	Pomatorhinus montanus	C	A		1				
Black-throated babbler	Stachyris nigricollis	R							
Chestnut-rumped babbler	Stachyris maculata	U	A						
Gray-throated babbler	Stachyris nigriceps	NA							Seen feeding a young Asian drongo cuckoo at ca. 1,080 m
Gray-headed babbler	Stachyris poliocephala	U			2				

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Moustached babbler	Malacopteron magnirostre	U							
Sooty-capped babbler	Malacopteron affine	R	A	1					
Scaly-crowned babbler	Malacopteron cinereum	R		2					
Rufous-crowned babbler	Malacopteron magnum	C	A	3					
Black-capped babbler	Pellorneum capistratum	C	A	R	2	4		Extremely common in 2° forest, ♀	
Short-tailed babbler	Pellorneum malaccense	C		2	3				
White-chested babbler	Pellorneum rostratum	R							
Ferruginous babbler	Pellorneum bicolor	U		1					
Horsfield's babbler	Turdinus sepiarius	U	A	1				♂	
Brown fulvetta	Alcippe brunneicauda	C			R				
Chestnut-hooded laughingthrush°	Ianthocincla treacheri	NA							Recorded near the peak of Nomboyukong at 1,200 m (ML audio 518589)
Asian fairy-bluebird	Irena puella	A	A	R	1			Common	
Asian brown flycatcher	Muscicapa latirostris	NR					1		
Oriental magpie-robin	Copsychus saularis	C	V				3		The birds at Serinsim had plumage with a dark belly and white on the tail typical of the C. s. pluto subspecies (ML video 523722). Serinsim is near a zone of extensive hybridisation between magpie-robin plumage morphs (Sheldon et al., 2009b)
White-rumped shama°	Copsychus malabaricus	A	AV		2	3		♂, common	Common within the park. Also kept by a local bird catcher.
Pale blue-flycatcher	Cyornis unicolor	NA							Seen at 700 m on the slopes of Nomboyukong
Malaysian blue-flycatcher	Cyornis turcosus	U				3			Seen occasionally by the river. Observed inspecting an inactive Black-and-Red Broadbill nest.
Fulvous-chested jungle-flycatcher	Cyornis olivaceus	A	AV	3		3		♂, notably present in lieu of C. umbratilis	Juv

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Verditer flycatcher	Eumyias thalassinus	R							
Siberian blue robin*	Larvivora cyane	NR		R	3	3		Common migrant	
White-crowned forktail	Enicurus leschenaulti	U		3					
Chestnut-naped forktail	Enicurus ruficapillus	U	A						
Chestnut-capped thrush	Geokichla interpres	U	A	2	2			♂♀	Juv; AB reports that this species was nesting commonly in August of 1998
Asian glossy starling	Aplonis panayensis	R							
Common hill myna*	Gracula religiosa	C			2		2		
Greater green leafbird	Chloropsis sonnerati	U	V		R	R		Abundant	Probably underestimated due to difficulty separating Greater from Lesser; many leafbirds left unidentified. Found and filmed nestlings that had apparently fallen from a nest (ML 475249-50)
Lesser green leafbird	Chloropsis cyanopogon	U	V		1	R		Abundant	Probably underestimated due to difficulty separating Greater from Lesser; many leafbirds left unidentified
Yellow-breasted flowerpecker	Prionochilus maculatus	R		R					
Yellow-rumped flowerpecker°	Prionochilus xanthopygius	U			1				
Thick-billed flowerpecker*	Dicaeum agile	R							Caught one passively in aerial mist net. Wags tail constantly in the canopy.
Yellow-vented flowerpecker	Dicaeum chrysorrheum	NR					R	1 sighting	
Orange-bellied flowerpecker	Dicaeum trigonostigma	C	AV		R	R	R		
Plain flowerpecker	Dicaeum minullum	R							
Scarlet-backed flowerpecker	Dicaeum cruentatum	R							
Ruby-cheeked sunbird	Chalcoparia singalensis	U		1	R				
Plain sunbird	Anthreptes simplex	U	A		2	1			
Plain-throated sunbird	Anthreptes malacensis	U	A		4			♂	
Red-throated sunbird	Anthreptes rhodolaemus	NR			3			♂	

Species (English)	Species (Latin)	Abundance 2014	A/V 2014	Habitat reported 2004				Notes 2004	Notes 2014
				1	2	3	4		
Van Hasselt's sunbird*	Leptocoma brasiliana	R							
Olive-backed sunbird	Cinnyris jugularis	R							
Temminck's sunbird	Aethopyga temminckii	NA			1			♂	Common on Nomboyukong starting at ca. 1000 m
Crimson sunbird	Aethopyga siparaja	U	A		2	2		♂	
Long-billed spiderhunter	Arachnothera robusta	R							
Little spiderhunter	Arachnothera longirostra	A	A	R	2	4		♂	Juv
Purple-naped spiderhunter	Arachnothera hypogrammicum	U		R	5	1		♂, ♀	
Yellow-eared spiderhunter	Arachnothera chrysogenys	U			2			Common in 2°	
Spectacled spiderhunter	Arachnothera flavigaster	R							
Bornean spiderhunter°	Arachnothera everetti	U		1	3				
Gray wagtail	Motacilla cinerea	NR					R		
Eurasian tree sparrow*	Passer montanus	C					R		
Dusky munia°	Lonchura fuscans	R				1	1	♂	
Scaly-breasted munia*	Lonchura punctulata	R							One seen near headquarters

Appendix 2. A summary of measurements from birds captured at Serinsim Substation between 28 June 2014 to 13 August 2014. Measurements are reported with unit of measurement in the column header. Measurements are averages with standard deviation reported when possible. Bill depth and bill width measurements were taken at the distal end of the nares. See Appendix 3 for sample sizes.

Species (English)	Species (Latin)	Mean mass (g)	Mean flat wing (mm)	Mean tarsus (mm)	Mean tail length (mm)	Mean culmen (mm)	Mean bill depth (mm)	Mean bill width (mm)	Mean head+bill (mm)
Asian emerald dove	Chalcophaps indica	113	135	25.3	72	9.65	4.5	3.6	44.3
Black-bellied malkoha	Phaenicophaeus diardi	57	129	36.6	170	24.15	11.15	10.45	53.55
Black-backed dwarf-kingfisher	Ceyx erithaca	18 ± 2.12	60.67 ± 0.58	9.7 ± 0.46	21 ± 3.46	28.78 ± 1.3	8.53 ± 0.32	7.5 ± 0.2	56.93 ± 1.65
Red-bearded bee-eater	Nyctyornis amictus	74.5	126	15.01	111	48.34	12.53	9.6	80.51
Gold-faced barbet	Psilopogon chrysopsis	134.5 ± 4.95	119.5 ± 6.36	30.02 ± 1.24	70.25 ± 0.35	31.59 ± 0.83	15.96 ± 0.3	15.22 ± 0.75	75.26 ± 2.46
Malaysian honeyguide	Indicator archipelagicus	33.5	93	13.85	57	8.1	5.4	4.1	33.95
Rufous piculet	Sasia abnormis	10.5 ± 0.71	53.33 ± 1.15	14.85 ± 1.84	20.33 ± 0.58	9.97 ± 1.33	5.12 ± 0.7	4.2 ± 0.89	30.9 ± 3.56
Buff-rumped woodpecker	Meiglyptes tristis	Na	Na	Na	Na	Na	Na	Na	Na
Green broadbill	Calyptomena viridis	56.88 ± 2.39	102.1 ± 2.79	20.96 ± 1.15	42.8 ± 6.38	9.3 ± 0.96	6.07 ± 0.47	7.06 ± 0.91	42.47 ± 1.45
Black-and-red broadbill	Cymbirhynchus macrorhynchos	55.25 ± 2.47	81.5 ± 36.06	24.58 ± 0.74	81.75 ± 2.47	14.9 ± 2.11	12.27 ± 0.19	13.75 ± 0.5	50.8 ± 2.68
Banded broadbill	Eurylaimus javanicus	77	118	24.6	63.5	19.25	10.75	18	57.7
Black-and-yellow broadbill	Eurylaimus ochromalus	36 ± 2	77.67 ± 4.93	21.17 ± 0.5	48 ± 1.73	14.15 ± 1.12	8.28 ± 0.33	12.97 ± 0.51	44.62 ± 0.28
Black-headed pitta	Erythropitta ussheri	60.5	92.5	40.21	35.5	14.82	8.25	6.55	50.7
Hooded pitta	Pitta sordida	64.5	108	39.8	31	13.1	7.75	6.7	49.2
Large woodshrike	Tephrodornis virgatus	32	101	17.7	62	15.1	7.25	7.1	47.8
Malaysian pied-fantail	Rhipidura javanica	12.12 ± 0.18	72.25 ± 0.35	19.23 ± 1.24	79 ± 1.41	7.8 ± 0.57	3.45 ± 0.07	4.7 ± 0.14	31.77 ± 0.81
Black naped monarch	Hypothymis azurea	11.9 ± 0.79	71.33 ± 1.53	11.9 ± 5.5	70.67 ± 0.58	8.28 ± 0.73	3.72 ± 0.12	4.83 ± 0.25	33.03 ± 0.25
Black-headed bulbul	Pycnonotus atriceps	21.5 ± 1.32	75.67 ± 2.08	13.83 ± 0.45	60 ± 3.46	8.34 ± 0.67	4.01 ± 0.19	3.89 ± 0.55	34.42 ± 1.63
Olive-winged bulbul	Pycnonotus plumosus	30.38 ± 2.3	81.5 ± 3.54	20.95 ± 1.48	69.5 ± 4.95	10.93 ± 0.25	4.6 ± 0.64	4.28 ± 0.39	37.4 ± 0.42
Red-eyed bulbul	Pycnonotus brunneus	Na	87	17	69	9	5.1	6.4	36.85 ± 3.32
Gray-cheeked bulbul	Alophoixus bres	43.67 ± 3.33	105.33 ± 5.69	22.43 ± 0.79	83.67 ± 8.39	15.15 ± 0.68	7.4 ± 0.46	5.7 ± 0.53	46.85 ± 1.86
Ashy tailorbird	Orthotomus ruficeps	8.5	48	20.15	42	11.8	2.5	2.15	32.8

Species (English)	Species (Latin)	Mean mass (g)	Mean flat wing (mm)	Mean tarsus (mm)	Mean tail length (mm)	Mean culmen (mm)	Mean bill depth (mm)	Mean bill width (mm)	Mean head+bill (mm)
Rufous-tailed tailorbird	Orthotomus sericeus	10.99 ± 0.75	51.6 ± 2.41	21.51 ± 1.03	41.9 ± 5.05	10.07 ± 0.26	2.76 ± 0.19	2.74 ± 0.33	34.77 ± 1
Gray-headed babbler	Stachyris poliocephala	23.82 ± 0.11	67 ± 2.83	23.17 ± 1.03	50 ± 1.41	10.62 ± 0.88	5.28 ± 0.18	3.88 ± 0.18	36.58 ± 0.6
Rufous-crowned babbler	Malacopteron magnum	32	94	24.95	74	13.45	6.6	5.15	45.1
Black-capped babbler	Pellorneum capistratum	68 ± 4.24	31.4 ± 1.56	47 ± 4.24	10.7 ± 3.11	4.4 ± 0.28	4.8 ± 1.13	40.5 ± 0.42	40.2
Short-tailed babbler	Pellorneum malaccense	Na	73	29.5	39	10.7	4.55	3.65	39
White-rumped shama	Copsychus malabaricus	42.67 ± 3.01	101 ± 1.73	28.52 ± 1.04	111.07 ± 6.81	11.78 ± 0.97	5.35 ± 0.05	4.05 ± 0.69	45.67 ± 1.99
Fulvous-chested jungle-flycatcher	Cyornis olivaceus	16.11 ± 1.13	72.25 ± 1.32	17.79 ± 0.66	49 ± 4.74	9.38 ± 0.98	3.88 ± 0.22	5.08 ± 0.12	35.6 ± 2.46
Chestnut-naped forktail	Enicurus ruficapillus	29	89	Na	68	12.35	4.5	4.7	41.35
Chestnut-capped thrush	Geokichla interpres	35.5 ± 5.66	101.75 ± 1.77	27.85 ± 0.21	53.25 ± 1.77	6.23 ± 7.13	5.52 ± 0.26	5.18 ± 0.04	44.14 ± 0.93
Yellow-rumped flowerpecker	Prionochilus xanthopygius	Na	Na	Na	Na	Na	Na	Na	Na
Plain sunbird	Anthreptes simplex	8.63 ± 0.56	59.67 ± 4.62	15.12 ± 0.33	43 ± 4	10.38 ± 0.78	2.9 ± 0.12	3.14 ± 0.51	29.76 ± 1.08
Little spiderhunter	Arachnothera longirostra	14.06 ± 1.74	67.28 ± 4.08	16.38 ± 1.1	40.89 ± 2.87	32.56 ± 2.82	3.75 ± 0.3	3.84 ± 0.2	56.67 ± 2.91
Purple-naped spiderhunter	Arachnothera hypogrammicum	12.5	68	16.5	48	15.1	3.3	4.1	38.75

Appendix 3. A summary of other data taken from birds captured at Serinsim Substation between 28 June 2014 to 13 August 2014. Species targeted for capture are marked with a "T" next to their common name; all other species were caught passively.

= number of individuals caught
M:F ratio = number of each sex caught; unknown (unk) for monomorphic species.
Fat(n) = a fat score followed by the number of individuals showing this score in parentheses. Scores are as follows: 0 = no fat; 1 = trace fat in the furcula; 2 = easily visible fat in the furcula; 3 = fat filling the furcula
Mean wing parasites = number of parasites (small, mite-like spots) counted on the flight feathers of one wing (average for all individuals of that species). Numbers above 50 are estimates.
Molt measurements are reported as the fraction of individuals caught showing each type of molt.
Specimens = number of whole specimens taken
Location indicates whether these specimens are stored at the Cornell Museum of Vertebrates (CUMV) or the Sabah Parks Vertebrates Collection (SPVC).

Species (English)	Species (Latin)	#	Habitats captured	M : F ratio	Fat(n)	Mean wing parasites	Fraction with rectrix or remex molt	Fraction with head/ body molt	Specimens	Specimen location
Asian emerald dove	Chalcophaps indica	1	2	1 : 0	1(1)	0	0/1	0/1	0	NA
Black-bellied malkoha	Phaenicophaeus diardi	1	3	unk	1(1)	19	0/1	1/1	0	NA
Black-backed dwarf-kingfisher	Ceyx erithaca	3	2,3	unk	0(1), 1(2)	7 ± 6	2/3	2/3	0	NA
Red-bearded bee-eater[T]	Nyctyornis amictus	1	2	1 : 0	0(1)	2	0/1	1/1	1	SPVC
Gold-faced barbet[T]	Psilopogon chrysopsis	2	1	1 : 1	0(1), 1(1)	14 ± 6	2/2	1/2	2	SPVC
Malaysian honeyguide	Indicator archipelagicus	1	1	unk	NA	NA	NA	NA	1	SPVC
Rufous piculet	Sasia abnormis	3	3	1 : 1	1(3)	9 ± 12	1/3	1/3	0	NA
Buff-rumped woodpecker	Meiglyptes tristis	1	2	1 : 0	NA	NA	NA	NA	0	NA
Green broadbill[T]	Calyptomena viridis	5	1,2,3	4 : 0	0(2), 1(2)	7 ± 9	1/5	4/5	4	CUMV
Black-and-red broadbill[T]	Cymbirhynchus macrorhynchos	2	4	unk	0(1), 1(1)	117 ± 47	2/2	2/2	1	CUMV
Banded broadbill[T]	Eurylaimus javanicus	1	2	1 : 0	1(1)	7	1/1	1/1	1	CUMV
Black-and-yellow broadbill[T]	Eurylaimus ochromalus	3	1,2	2 : 1	0(2), 1(1)	40 ± 35	3/3	3/3	2	CUMV
Black-headed pitta[T]	Erythropitta ussheri	1	1	unk	0(1)	0	1/1	1/1	1	CUMV
Hooded pitta[T]	Pitta sordida	1	2	unk	1(1)	3	1/1	1/1	1	CUMV
Large woodshrike[T]	Tephrodornis virgatus	1	1	1 : 0	1(1)	5	1/1	1/1	1	CUMV
Malaysian pied-fantail	Rhipidura javanica	2	3	unk	0(2)	35 ± 36	1/2	2/2	0	NA

Species (English)	Species (Latin)	#	Habitats captured	M : F ratio	Fat(n)	Mean wing parasites	Fraction with rectrix or remex molt	Fraction with head/ body molt	Specimens	Specimen location
Black naped monarch	Hypothymis azurea	3	2,3	3 : 0	0(2), 1(1)	35 ± 59	2/3	3/3	0	NA
Black-headed bulbul	Pycnonotus atriceps	3	1,3	1 : 1	0(1), 1(2)	2 ± 2	2/3	1/2	2	SPVC
Olive-winged bulbul	Pycnonotus plumosus	2	2	unk	0(1), 2(1)	1 ± 1	2/2	2/2	0	NA
Red-eyed bulbul	Pycnonotus brunneus	2	2,3	unk	0(1)	0	1/1	0/1	0	NA
Gray-cheeked bulbul[T]	Alophoixus bres	3	2,3	unk	0(2), 1(1)	9 ± 8	3/3	3/3	2	SPVC
Ashy tailorbird	Orthotomus ruficeps	1	2	unk	0(1)	0	1/1	1/1	0	NA
Rufous-tailed tailorbird	Orthotomus sericeus	5	2,3	unk	0(5)	6 ± 6	1/4	1/5	0	NA
Gray-headed babbler	Stachyris poliocephala	2	2	unk	0(1), 1(1)	4 ± 6	0/2	2/2	0	NA
Rufous-crowned babbler	Malacopteron magnum	1	2	unk	1(1)	0	0/1	1/1	0	NA
Black-capped babbler	Pellorneum capistratum	2	1,3	unk	0(1), 1(1)	0	2/2	2/2	0	NA
Short-tailed babbler	Pellorneum malaccense	2	2	unk	0(1)	4	1/1	1/1	0	NA
White-rumped shama	Copsychus malabaricus	3	2,3	unk	0(1)	80 ± 52	2/3	1/3	0	NA
Fulvous-chested jungle-flycatcher	Cyornis olivaceus	4	2,3	unk	0(3), 1(1)	50 ± 13	4/5	5/5	0	NA
Chestnut-naped forktail	Enicurus ruficapillus	1	2	unk	0(1)	0	0/1	0/1	0	NA
Chestnut-capped thrush[T]	Geokichla interpres	2	3	unk	0(1), 1(1)	228 ± 271	1/2	1/2	2	SPVC
Yellow-rumped flowerpecker	Prionochilus xanthopygius	1	4	unk	NA	NA	0/1	0/1	0	NA
Plain sunbird	Anthreptes simplex	4	2	1 : 2	1(2), 2(1)	7 ± 11	1/3	1/3	0	NA
Little spiderhunter	Arachnothera longirostra	18	2,3	unk	0(3), 1(6), 2(7), 3(1)	<1	16/17	12/17	0	NA
Purple-naped spiderhunter	Arachnothera hypogrammicum	1	3	1 : 0	0(1)	22	1/1	1/1	0	NA