

USING DIVERSE DATA SOURCES TO DETECT ELEVATIONAL RANGE CHANGES OF BIRDS ON MOUNT KINABALU, MALAYSIAN BORNEO

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ABSTRACT. — Few empirical studies have measured the effects of climate change on tropical biodiversity, and this paucity has contributed to uncertainty in predicting the severity of climate change on tropical organisms. With regards to elevational changes, most studies have either re-sampled historical systematic survey sites or analyzed time series of occurrence data at long-term study sites. Such data sources are unavailable for most tropical mountains, so other methods of detecting elevational changes must be sought. Here we combine data from published checklists, recent field work, peer-reviewed literature, unpublished reports, birdwatchers' trip reports, databases of birdwatchers' observations, audio recordings, and photographs to compare historical (pre-1998) and current (post-2006) bird distributions on Mt. Kinabalu in Sabah, Malaysian Borneo. Records were carefully checked by experts on Bornean birds. More species are now known from Mt. Kinabalu, but historical data provided elevational range estimates for more species than current data because of extensive mountain-wide collections and surveys. Most elevational comparisons for this study had to be limited to the 1450–1900 m elevational band, where most of the recent work has been done. Information was compiled

into an annotated list of 342 species from 200–4095 m. We present this list to encourage refinement of the dataset and future work on elevational distributions on the mountain. Of 58 species with sufficient data from 1450 m to the summit, 38 appear to have shifted their ranges (24 species upslope and 14 downslope). A total of 22 resident species have recently been observed above their published maximum elevation for Borneo. Some species that have shifted upwards, such as *Chalcophaps indica* and *Pellorneum pyrrogenys*, are now common or breeding at elevations above their published maximum. Fifteen species appear to have declined on the mountain, probably as a result of habitat loss outside the protected area. Several of the upslope shifts are probably attributable to climate change, but many downslope shifts may be artifacts of incomplete recent sampling. The upward shifts agree with the few other tropical range comparisons that have been published. Our approach demonstrates the viability of combining diverse data sources (of varying accuracy and bias) to detect distributional shifts from climate change.

KEY WORDS. — checklist, citizen science, climate change, habitat loss, range limit

INTRODUCTION

Approximately 1,000 bird species are restricted to tropical mountains (Harris et al., 2011). Most of these species are considered of ‘least concern’ because their upland ranges are typically forested (BirdLife International, 2011), yet they may be particularly vulnerable to climate change because their montane and often narrow ranges put them at risk of mountaintop extinctions and range shift gaps (Colwell et al., 2008; Sekercioglu et al., 2008). New modelling approaches have made progress in predicting which tropical species may be most vulnerable to climate change (e.g., La Sorte & Jetz, 2010), but so few studies have measured the effects of climate change on tropical birds that our understanding is still rudimentary (Harris et al., 2011). In addition, weather station coverage is extremely sparse in many tropical uplands in both space and time, which makes climate monitoring and associated biodiversity studies difficult (Raxworthy et al., 2008).

The few published distributional comparisons from tropical mountains—studies of moths on Gunung [=Mount] Kinabalu in Malaysian Borneo (Chen et al., 2009, 2011), birds in Peru (Forero-Medina et al., 2011), reptiles and amphibians in Madagascar (Raxworthy et al., 2008), and multiple taxa in Costa Rica (Pounds et al., 1999, 2005)—have found upward shifts in species distributions, which will likely cause changes in the ecology of montane communities. Chen et al. (2009) analysed climate data and compared moth (Lepidoptera) distributions from 1965–2008 on Mt. Kinabalu. They found that temperatures have increased by c. 0.7°C on the mountain since 1965, and distributions of the 102 moth species have shifted upwards by 67 m on average (which is less than the adiabatic lapse rate prediction of 127 m of elevation change with temperature change). Peh (2007) took a broader approach and compared elevational ranges of 300 generalist bird species (to control for the effects of habitat loss) from Southeast Asian field guides between 1975 and 2000. He found that 84 species shifted their upper range margin upslope while maintaining a stable lower margin, seven shifted their lower margin upslope with a stable upper margin, and three shifted both margins. His results suggest that birds are shifting their ranges upslope in the region (especially the upper margins),

but his analysis was restricted to generalist species at a regional scale.

To develop a database and compare elevational distributions of birds from prior to 1998 to after 2006 on Mt. Kinabalu, we surveyed birds on the mountain and compiled information from checklists, citizen science observations, the literature, and unpublished reports. We also checked for changes in species abundance when comparing historical and current patterns, as has been done with other checklist comparisons and re-surveys of historically-sampled sites in the tropics (Sodhi et al., 2006; Pearson et al., 2010).

At 4095 m, Mt. Kinabalu is the tallest mountain between New Guinea and the Himalayas. It is the “most important biogeographic feature of Borneo” (Sheldon et al., 2001: 49) and potentially an essential refuge of endemism from climate change-induced range shifts (Chen et al., 2011). Kinabalu Park, which covers c. 753 km², was declared protected in 1963. Most of the park is above 1200 m, but elevations descend to 200 m at Serinsim (Fig. 1). In 1978, 289 bird species were known from Mt. Kinabalu (Jenkins & de Silva, 1978). In 1996, this number had increased to 306 species (Jenkins et al., 1996). Weather station coverage is poor in the Mt. Kinabalu region, but gridded data in the 5° × 5° cell that encompasses Mt. Kinabalu show an increase in mean annual temperature of +0.48°C from 1998–2007 (Chen et al., 2009). The lapse rate on Mt. Kinabalu was estimated as c. 0.55°C per 100 m of elevation gain (Kitayama, 1992), so the observed temperature change could have theoretically driven an 87 m upward shift during our study period, assuming a linear relationship between climate and species distributions (Ghalambor et al., 2006).

Most of Kinabalu Park has remained largely undisturbed since 1963, which makes it ideal for studying range shifts from climate change independent of the effects of habitat loss. But areas outside the park have become increasingly disturbed (Beaman & Beaman, 1990; McMorro & Talip, 2001), and the extensive submontane forest on the Pinosuk plateau near Kundasang was degazetted from the park and deforested in the early 1980s to develop a copper mine and other land uses (Fig. 1; Sheldon, 1986). Therefore, some submontane species

that were once recorded on the plateau (e.g., by Smythies, 1964; Gore, 1968) are no longer found there, and populations of submontane forest birds below park headquarters are much reduced (Sheldon et al., 2001). This situation makes it difficult to compare past and current lower range margins for some species, and the limited submontane forest bird community below the headquarters may affect climate-related community changes at higher elevations. Nonetheless, much of the historical data we analysed comes from after 1980, and upward range shifts above the headquarters should be little affected by these habitat changes.

The citizen science data we collected from Mt. Kinabalu varied in spatial coverage, methods, effort, and observer bias (Harris & Haskell, 2007; Boakes et al., 2010; Dickinson et al., 2010) that made it difficult to conduct standardised historical to current comparisons. We attempted to address these problems by: (1) restricting range estimates to areas that have received more research and birdwatching compared to the rest of the park; (2) consulting experts on Bornean birds to remove suspect records; and (3) contacting birdwatchers, scientists, and bird tour companies to verify time, place, and identification details for many records.

Given the usually strong relationships between climate and species distributions (e.g., Bush et al., 2004), and the results of similar studies (for examples, see Pearson et al., 2010; Chen et al., 2011), we hypothesized that: (1) warming temperatures have caused elevational increases in some resident birds on Mt. Kinabalu, and (2) declines in forest bird species would be apparent, likely as a result of habitat loss outside the park. We examined these possibilities with diverse data sources and report the results here.

METHODS

Data sources. — We compared “historical” distribution data collected prior to 1998 (a few records came from as far back as the late 1800s) to “current” data from 2007–2011. We also reviewed intermediate information from 1998–2006, and present these data in Appendix 2 to promote further study, but we did not use these years in the elevational comparisons to allow a 10-year gap. Elevational range shifts from climate change were found after 10 years in a previous study on reptiles and amphibians (Raxworthy et al., 2008), and the marked temperature increase shown during this interval (0.48°C; Chen et al., 2009) indicated that shifts would likely be observed. Tropical birds have also been shown to shift their ranges in response to small temperature changes (Pounds et al., 2005; Forero-Medina et al., 2011). Data came from published checklists, recent field work, peer-reviewed literature, unpublished reports, birdwatchers’ trip reports, audio recording databases (Xeno Canto, www.xeno-canto.org; AVoCet, <http://avocet.zoology.msu.edu>), Oriental Bird Images (OBI; a photographic database, <http://orientalbirdimages.org>), Global Biodiversity Information Facility specimen records (GBIF; <http://data.gbif.org>), and two online databases of georeferenced occurrence data, mostly from birdwatchers’ observations: eBird/Avian Knowledge Network (AKN;

<http://www.avianknowledge.net>) and Bird I Witness (BIW; www.worldbirds.org/malaysia). Mt. Kinabalu is one of Asia’s most frequently visited birdwatching sites, and there are many trip reports available from the region. We collected trip reports from independent birdwatchers (on Surfbirds [<http://www.surfbirds.com>], Birdtours [<http://www.birdtours.co.uk>], and World Twitch [<http://www.worldtwitch.com>]), and professionally-led bird tours (from Victor Emanuel Nature Tours, Birdtour Asia, Tropical Birding, Bird Quest, and Rockjumper Birding Tours). We contacted the aforementioned tour companies as well as WINGS, Field Guides, and King Bird tours to ask for historical trip reports but none were available. In all, we obtained 52 reports covering the historical and current time frames from these bird-watching sources.

Historical (pre-1998) data. — The main historical data sources are two published checklists of the birds of the Kinabalu region (Jenkins & de Silva, 1978; Jenkins et al., 1996). The checklists combined data from specimens, the literature, unpublished scientific reports, and sight records to produce species accounts and elevational ranges (see Sheldon et al. [2001] for details on areas covered by historical expeditions including a figure showing collecting localities). Jenkins and de Silva (1978) and Jenkins et al. (1996) focused on bird records from (1) Kinabalu Park headquarters (c. 1575 m) up to the summit (4095 m) along the power station road and the summit trail, and (2) Poring Hot Springs (c. 500 m, but many historical Poring records did not have elevations specified) (Fig. 1). The checklists also include records from other areas on the mountain, particularly from older specimens. Overall, Jenkins et al. (1996) made minor edits to the 1978 checklist, making it difficult to find range changes between the two lists. We therefore included the additions by Jenkins et al. (1996) and treated the checklists as a single data source.

Data from the study of elevational distributions of birds on Mt. Kinabalu by Biun (1999) provided a substantial supplement to the checklists. Biun (1999) surveyed birds in 1996 and 1997 at five sites (primary forest at Poring, 700 m; park headquarters, 1600 m; Kemburongoh, 2100 m; Layang-Layang, 2600 m; and Paka cave, 3100 m) during six sampling periods (Jun, Sep, and Dec in 1996; Apr, Jun, and Oct in 1997). He spent four days at each site during each sampling period, amounting to 120 days of sampling effort. He sampled birds with 30 12-m mist nets that were open day and night, and one hour of aural and visual observations along a 500 m transect at each site. This research would have served as an adequate benchmark for future comparisons, but the abundance data are no longer available.

Additional historical data came from the literature (Gore, 1968; Smythies, 1981, 1999; Sheldon & Francis, 1985; Sheldon et al., 2001; Mann, 2008), unpublished scientific reports (Sheldon, 1977; Phillips, 1986; Batchelor, 1991; Rahman et al., 1998), Xeno Canto ($n = 1$), AVoCet ($n = 25$), Oriental Bird Images ($n = 3$), Global Biodiversity Information Facility specimens ($n = 88$), Avian Knowledge Network observations (298 records total; P. Bono, 1997, Kinabalu Park; W. Nezadal, 1991, Poring c. 975 m; D.

Roberson, 1988, Kinabalu Park and summit trail), Bird I Witness observations from park headquarters (n = 16), and birdwatchers' trip reports (Wall & Yong, 1985; Johnstone, 1989; Vermuelen, 1996). In the Methods we use "n" to refer to the number of records coming from each data source; this differs from the sample sizes (number of range margins) used in the range comparisons.

Intermediate data (1998–2006). — Intermediate data came from the literature (Moyle, 2003), unpublished reports (Moyle & Sheldon, 2000; Sheldon et al., 2004), Xeno Canto (n = 52), AVoCet (n = 10), Oriental Bird Images (n = 189), Global Biodiversity Information Facility specimens (n = 208), Bird I Witness (53 total records from Mt. Kinabalu trails (Liwagu and Silau Silau), power station road, Kinabalu headquarters area, Poring (Langanan trail), and Mesilau headquarters and trail), Avian Knowledge Network observations (690 records total; C. Artuso, 2000, Poring c. 560 m; E. Barnes, 2005, Silau Silau trail c. 1570 m, and Poring c. 560 m; R. Carratello, 2003, Kinabalu Park; A. Lazere, 2005, Kinabalu Park; D. Roberson, 2003, Kinabalu Park) and trip reports (Benstead & Benstead, 2001; Addison, 2002; Clayton & Thomas, 2002; Rheindt, 2003; White & Clarke, 2003; Benstead,

2004; Gandy, 2004; Hall & Kroll, 2004; Ericsson, 2005; Hornbuckle, 2005; Babic & Babic, 2006).

Current (post-2006) data. — Substantial current data came from recent field work by JBCH, AJB, and JAE. From Mar–Apr.2010 JBCH conducted systematic point count and transect surveys on Mt. Kinabalu along the Liwagu and summit trails from 1450–4095 m, and at Poring along the waterfall trail from the headquarters car park up to Langanan waterfall (500–1000 m). The point counts were conducted for 10 minutes and covered a 50 m radius. They were separated by 250 horizontal meters along continuous elevational gradients on mountain trails (Ralph et al., 1995; Fig. 2; see Appendix 1 for coordinates of points, to enable re-sampling). Occurrence data were also collected along 'transects' in between the points to 50 m on either side of the trail. Systematic surveys were done in the morning from 0600–1030 hours, and sites were opportunistically re-surveyed in the afternoon. JBCH also revisited the points and transects at night to sample nocturnal birds, however, only every other point was surveyed because low bird abundance made point count detections uncommon. Transects were found to be more effective for sampling nocturnal birds on the mountain. As suggested by Ralph et al. (1995), estimates of the distance of singing birds from the point were made more accurate by conducting trials with audio playback and a measuring tape. A Nikon Forestry 550 laser range finder was used to verify visual distance estimates.

AJB documented elevational distributions of birds on Mt. Kinabalu as part of TEM's long-term nest-searching and mist-netting project at the site. The data presented here are a combination of AJB's observations, GPS points taken at nests located by TEM and his field crew, and mist-net captures by his team. Mist-netting was conducted every day from 0700–1300 hours with 12 9-m mist-nets set up in consistent locations within banding plots, which were distributed evenly across the study area. Nests were found using both parental behaviour and systematic search techniques (Martin & Geupel, 1993). AJB spent a total of 12 months over three years (from Feb–Jun, in 2009–2011) at the site. The majority of AJB's records come from forest between the junction of the Liwagu and Silau-Silau rivers up to Timpohon gate, on both sides of the power station road (1450–1900 m). Additional AJB observations come from Poring (10 field days), the Mt. Tambuyukon summit trail above Kampung Monggis (3 field days), and Kundasang (Fig. 1).

JAE has visited Mt. Kinabalu on 18 occasions, totaling c. 90 days from 2002–2010, specifically for birdwatching, both privately and leading birdwatchers for Birdtour Asia, covering all months except Dec–Mar and Sep. On each visit JAE spent at least one day at Poring (each time walking on the Langanan trail to at least km 3.1 (c. 975 m), and all the way to Langanan Waterfall on five occasions), one morning or afternoon at Mesilau (c. 1940 m), and two days walking from Timpohon gate to the summit and back. The majority of the time spent within Kinabalu Park was between the headquarters and Timpohon Gate, birdwatching along trails, particularly Bukit Ular and Mempening, with occasional visits to Silau-Silau and along the road.

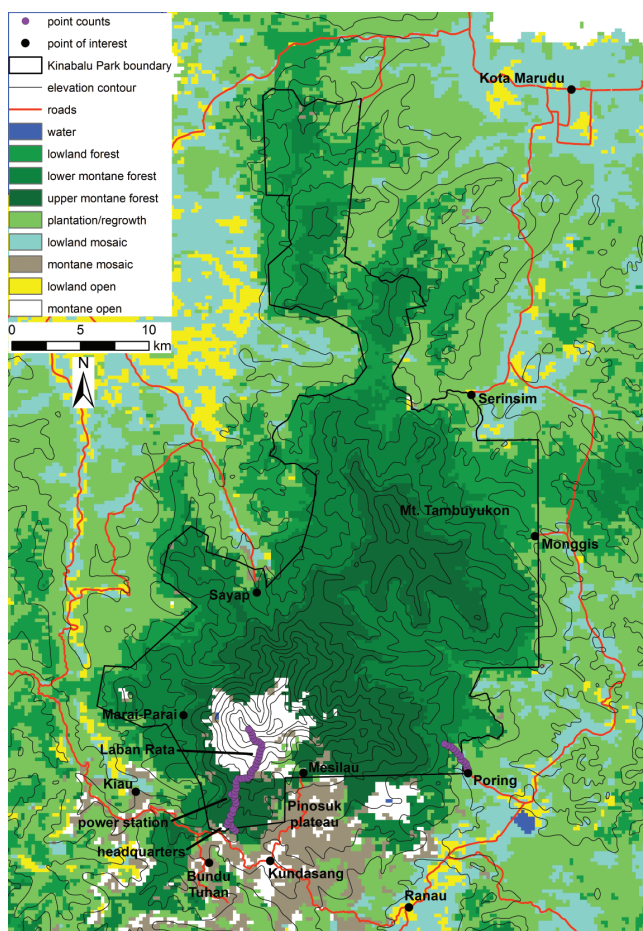


Fig.1. Map of Kinabalu Park, Sabah (solid black line). Land cover from 2010 (Miettinen et al., 2011), JBCH's point count locations, elevation contours (303 m intervals), roads, and points of interest including towns and collecting localities are shown. Timpohon gate is c. 50 m from the power station; the summit trail extends from the power station to the summit (shown by JBCH's points).

Additional current data came from the literature (Mann, 2008; Sheldon et al., 2009), unpublished reports (Sheldon & Moyle, 2008), Xeno Canto ($n = 152$), AVoCet ($n = 120$), Oriental Bird Images ($n = 307$), Global Biodiversity Information Facility specimens ($n = 32$), Avian Knowledge Network (860 total records; J. Sevenair, 2010, Kinabalu Park; J. Watson, 2010, Poring c. 500 m and Kinabalu Park; S. Brown, 2011, Kinabalu Park, Poring c. 560 m, and Mesilau c. 2000 m; L. Harding, 2011, Poring c. 560 m, summit trail, and Mesilau c. 1930 m; J. Harrison, 2011, Kinabalu Park; R. Merrill, 2011, Kinabalu Park), Bird I Witness (1081 total records from Mt. Kinabalu trails [Bukit Ular, Liwagu, Mempening, Silau Silau, Kiau View], power station road, Kinabalu headquarters area, Poring [Langanan trail, canopy walkway], and Mesilau headquarters), and trip reports (Banwell, 2007; Low, 2007; Newnham, 2007; Shackelford, 2007; Woods, 2007, 2008; Dobbs, 2008; Harrap, 2008, 2010, 2011; Matheve, 2008; Valentine, 2008; Valentine & Thurmilangan, 2008a, 2008b; Barnes, 2009; Chafer, 2009; Eaton, 2009, 2010a, 2010b; Gear, 2009; Hutchinson, 2009, 2011; Roadhouse, 2009; Gurney, 2010; Lambert & Yong, 2010; Myers, 2011). Lastly, AB has worked at Kinabalu Park for the last 34 years and has collected supplemental data on the park's avifauna.

Data accuracy and comparing ranges. — Records from the different data sources varied in certainty in identifications and spatial accuracy. They were carefully reviewed by two experts on Bornean birds (FHS and JAE) and questionable identifications were removed or considered hypothetical. To maximise spatial accuracy, we took the conservative approach of assigning approximate elevations only if a location could be sufficiently narrowed to a small elevational range. For example, we did not assign elevations to records from “Poring” because most observers cover elevations from 500–1000 m in a single visit. We considered Avian Knowledge Network records from “Kinabalu Park, 1845 m” to be located somewhere between park headquarters and Timpohon gate, and we did not assign an elevation. We conservatively considered Avian Knowledge Network records from “greater than 2000 m on the summit trail” to be from 2050 m (in many cases we contacted the observer

to verify the locality). In total, we contacted 25 observers to clarify identifications and details on the place and time where sightings were made. We consider mist net records to be the most reliable, followed by published observations, and finally birdwatchers' trip reports.

We attempted to standardise datasets by compiling elevational range information only from records in the two focal regions of the checklists (Jenkins & de Silva, 1978; Jenkins et al., 1996) and JBCH's sample sites (see above). We decided a priori that it would not be appropriate to compare means of the lower and upper margins because of differences in sampling effort over time. Several lines of evidence indicate that historical sampling was more complete than recent sampling: (1) the historical dataset incorporated a much longer time period with a legacy of much ornithological research (Sheldon et al., 2001); (2) the historical data produced range margin information for more species than the current data, even though more species are now known from the mountain; and (3) the distance between the mean range margins across all comparable species is larger in the historical data (see Results). Historical sampling was most comprehensive from near park headquarters (c. 1450 m) to the summit, and recent sampling was most complete from park headquarters to Timpohon gate (1900 m). Given the overlap in sampling effort, we looked for upward and downward shifts from park headquarters to Timpohon gate. We also checked for range expansions above Timpohon gate (upward shifts) because these elevations were well surveyed historically and any expansions would likely reflect a genuine shift. Possible downslope shifts above Timpohon gate were marked in Appendix 2, but we found these changes much less reliable because apparent range contractions above Timpohon gate could easily result from incomplete recent sampling at high elevations. Range changes of ≥ 100 m were considered to be outside the range of measurement error and marked as upward or downward shifts in Appendix 2. We also compared historical and current elevational ranges for each species to Borneo-wide ranges from Mann (2008) to weigh the evidence for a substantial shift. In some cases, maximum elevations of the study by Mann (2008) disagreed with those of Sheldon et al. (2001), and we checked the original specimen data to find the Bornean maximum.

We also considered making range comparisons based on individual components of the dataset (e.g., JBCH data vs. Biun [1999]), but found such secondary comparisons to be poorly justified, given that our dataset is collated from multiple contributing sources with varying spatial and temporal coverage, and any one data source produces incomplete ranges for species. Instead, we plotted contributions of records from each data source to check for disproportionate effects from single data sources.

To organise species, we followed the classification of the International Ornithologists' Union (Gill & Donsker, 2011), except when published phylogenies indicated otherwise, e.g., for Bornean fork-tail *Enicurus borneensis* (Moyle et al., 2005) and Bornean spiderhunter *Arachnothera everetti* (Moyle et al., 2011).

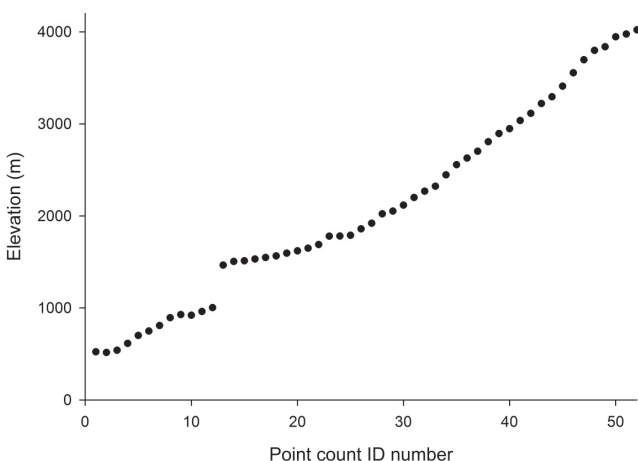


Fig. 2. Plot of elevational coverage of point counts done by JBCH in 2010 at Poring (lower 12 points) and from near park headquarters to the summit (upper points).

RESULTS

The historical data produced a list of 317 species for Mt. Kinabalu from the period prior to 1998. The current list comprises 342 species (51% of Borneo's total; Phillips & Phillips, 2011), including 42 endemics (82% of the total for Borneo; Phillips & Phillips, 2011), 39 non-breeding species, and seven hypothetical species (Appendix 2). Despite the increase in species, the current data provided less comprehensive overall coverage of species' ranges than the historical data: we were able to compile 229 lower and 239 upper margins from the historical data, compared to 218 lower and 200 upper margins from the current data. 170 species had historical and current data for the lower range margin, while 161 had historical and current data for the upper margin. The mean elevational ranges of comparable species (those with both historical and current data) were $601.2 \text{ m} \pm 19.9 \text{ SE}$ to $1565.7 \text{ m} \pm 66.5$ (historical lower and upper margins) versus $742.2 \text{ m} \pm 29.2$ to $1314.9 \text{ m} \pm 56.4$ (current lower and upper margins). The broader elevational band in the range means indicates historical sampling was more extensive than current sampling.

The checklists and Biun (1999) were the most important historical data sources, collectively contributing information on 75% of the species in the historical list, whereas birdwatchers' trip reports, JBCH's data, and unpublished reports were the most important intermediate and current data sources, contributing information on 63% of the species in the current list. Species that shifted their ranges (Table 1) generally were recorded in proportion to all species, except that AJB's data were especially important for detecting upward shifts, and JAE's data detected many downward shifts (Fig. 3). The trip reports contributed information on nearly 25% of the species but were less important for identifying shifts in elevations in our study because many records had inadequate spatial resolution.

Fifty-eight species had sufficient data from park headquarters to the summit (or from headquarters to Timpohon gate, for prospective downward shifting species; see Methods) to enable current-historical comparisons. Of these, 38 appear to have shifted their ranges; 23 may have shifted their upper margin upslope, 14 their upper margin downslope, and one its lower margin upslope (Table 1). An additional 35 species appeared to have moved downwards (Appendix 2), but these changes occurred above Timpohon gate, where many apparent downshifts likely resulted from incomplete current sampling. Birds showing possible upward shifts included six species that appeared to expand their ranges above Timpohon gate, three of which moved $\geq 100 \text{ m}$ above their published Bornean maximum elevation (Mann, 2008). The period between sightings was at least 12 years for all species that shifted their ranges (Table 1). There were no clear taxonomic patterns in species that appeared to shift elevations, although two woodpeckers (checker-throated woodpecker *Chrysophlegma mentale* and orange-backed woodpecker *Reinwardtipicus validus*), two cisticolids (yellow-bellied prinia *Prinia flaviventris* and ashy tailorbird *Orthotomus ruficeps*) and three spiderhunters (*Arachnothera*) shifted

upwards, and two bulbuls (ochraceous bulbul *Alophoixus ochraceus*, and yellow-vented bulbul *Pycnonotus goiavier*) shifted downwards.

Eight species in Table 1 and 25 other species, including seven migratory birds, have been observed above their published Bornean ranges since 1995 (Table 2). No species showed

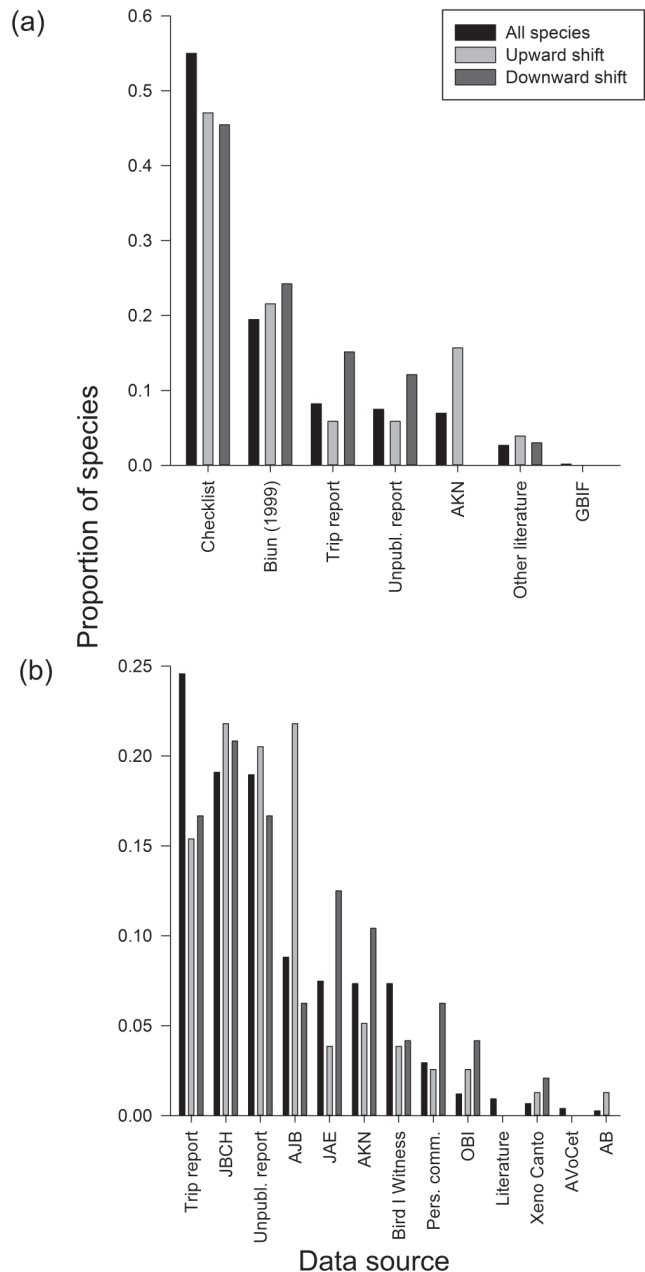


Fig. 3. Contribution of various data sources to (a) historic and (b) current + intermediate species accounts (Appendix 2) for bird species in the Mt. Kinabalu region. Data source contributions are shown for all species and species exhibiting possible upward or downward range shifts. For example, in the historical data, checklists contributed information to ranges of 55% percent of the species known from Mt. Kinabalu, while checklists contributed data to ranges for 47 and 45% of the species that showed upward or downward shifts, respectively. See Table 1 for a list of species that apparently shifted their ranges. Trip report refers to birdwatchers' trip reports; AKN to Avian Knowledge Network; GBIF to the Global Biodiversity Information Facility; JBCH, AJB, JAE, and AB to data from the authors; OBI to Oriental Bird Images.

Table 1. Birds that appear to have shifted their ranges on Mt. Kinabalu (from park headquarters, c. 1575 m, to the summit, 4095 m) by at least 100 m. * indicates a shift upward; ** indicates a shift downward. Bold numbers indicate margins at least 100 m higher than the maximum previously recorded in Borneo (Mann, 2008). Underlined numbers are marginally higher than in Mann (2008). Ambiguities in the upper margin reported in Mann (2008) were checked against the literature and specimens to estimate the maximum. See Appendix 2 for data sources for each margin.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Time period between sightings (for shifting margin)	Upper margin from Mann (2008)	Notes
Crested Honey Buzzard ¹	<i>Pernis ptilorhynchus</i>	818	848	500	1500*	unspecified	to over 1000 m	three recent records from Kinabalu Park (at least 1500 m)
Crested Goshawk	<i>Accipiter trivirgatus</i>	303	909	560	1500*	1913 to 2009	to 2015 m	recently bred at 1500 m
Common Emerald Dove	<i>Chalcophaps indica</i>	600	1600	1450	1900*	before 1978 to 2009	up to at least 1590 m	multiple recent mist-net captures from 1450–1850 m; recent sighting at 1900 m
Chestnut-breasted Malkoha	<i>Phaenicophaeus curvirostris</i>	303	1061	539	1600*	1962 to 2010	to 1220 m	two recent sightings from c. 1500 m, one sighting at 1600 m
Dark Hawk Cuckoo	<i>Hierococcyx bocki</i>	909	1835	1509	<u>2023*</u>	1957 to 2010	to 1985 m	recently heard up to 2023 m
Collared Owlet	<i>Glaucidium brodiei</i>	1515	1600	1450	1900*	1996/1997 to 2009/2010	to 1530 m on Mt. Kinabalu, to 2100 m on Mt. Trus Madi	recent sightings up to 1900 m
Bornean Frogmouth	<i>Batrachostomus mixtus</i>	700	2540	1575	1850**	before 1998 to 2011	to 2540 m	inconspicuous; no recent sightings above c. 1850 m
Rufous-collared Kingfisher	<i>Actenoides concretus</i>	500	1667	530	750**	before 1968 to 2011	to 1680 m	no recent sightings above 750 m
Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	1061	1758	645	950**	before 1978 to 2008	to 1750 m in Sabah (Sheldon et al., 2001)	no recent sightings above 950 m
Bornean Barbet	<i>Megalaima eximia</i>	560	2121	600	1800**	before 1978 to 2011	to 2140 m	no recent sightings above 1800 m
Checker-throated Woodpecker	<i>Chrysophlegma mentale</i>	545	1667	600	1900*	before 1940 to 2009/2010	to at least 1835 m, perhaps to 2160 m on Mt. Trus Madi	recent sightings up to 1900 m
Orange-backed Woodpecker	<i>Reinwardtipicus validus</i>		1561	818	1900*	1986 to 2009/2010	to 1985 m on Mt. Murud, Sarawak	recent sightings up to 1900 m
Rufous Woodpecker	<i>Micropternus brachyurus</i>	700	1600	500	600**	1996/1997 to 2010	to 1818 m (Gore, 1968)	no recent sightings above 600 m
Whitehead's Broadbill	<i>Calyptomena whiteheadi</i>	700	1667	700	<u>1900*</u>	before 1978 to 2009/2010	to 1850 m on Mt. Trus Madi, to 1700 m on Mt. Kinabalu	recent sightings up to 1900 m
Black-and-Yellow Broadbill	<i>Eurylaimus ochromalus</i>	303	700	530	1547*	1996/1997 to 2010	to at least 1800 m	recently heard at 1547 m
White-bellied Erpornis	<i>Erpornis zantholeuca</i>	700	1515	516	<u>1800*</u>	before 1978 to 2009/2010	to over 1750 m	recent sightings up to at least 1800 m
Black-and-crimson Oriole	<i>Oriolus cruentus</i>	700	1600	900	1900*	1996/1997 to 2009/2010	to 2300 m on Mt. Trus Madi	recent sightings up to at least 1900 m
White-throated Fantail	<i>Rhipidura albicollis</i>	800	3100	975	3290*	1996/1997 to 2010	to 2750 m	recent sightings up to 3290 m

Table 1. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Time period between sightings (for shifting margin)	Upper margin from Mann (2008)	Notes
Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	909	1667	700	1533**	before 1978 to 2010	to 1700	no recent sightings above 1533 m
Fluorescent Bulbul	<i>Pycnonotus flavescens</i>	1575	3485	1900*	3294	before 1978 to 2009/2010	to 3970 m	no recent records below 1900 m
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	500	1575	500	560**	1970 to 2010	to 1590 m	open country species; no recent sightings above 560 m
Ochraceous Bulbul	<i>Alophoixus ochraceus</i>	700	2636	1452	1780**	1970 to 2010	to 2650 m	no recent records above 1780 m below Timpohon gate, but recent records at Mesilau (c. 1940–2000 m)
Grey-cheeked Bulbul	<i>Alophoixus bres</i>	500	1485	500	927**	before 1927 to 2010	to 1500 m	no recent records above 927 m
Yellow-bellied Warbler	<i>Abrosopus superciliosus</i>	909	1818	530	1575**	before 1996 to 2008	to 1530 m	no recent records above c. 1575 m
Mountain Leaf Warbler	<i>Phylloscopus trivirgatus</i>	1515	3100	1450	3221*	1929 to 2010	to 3100 m (Smythies, 1960; Sheldon et al., 2001)	recent sightings up to 3221 m
Yellow-bellied Prinia	<i>Prinia flaviventris</i>		1091		1500*	before 1968 to 2010	to 1530 m	open country species; recent sightings up to 1500 m
Ashy Tailorbird	<i>Orthotomus ruficeps</i>	303	975	500	1500*	1991 to 2007	to over 1500 m	recent sightings up to 1500 m
Chestnut-backed Scimitar Babbler	<i>Pomatorhinus montanus</i>	455	1667	530	1850*	before 1960 to 2011	to 1700 m (Kinabalu), to 2200 m (Trus Madi)	recent record at 1850 m
Brown Fulvetta	<i>Alcippe bruneicauda</i>	500	1500	500	950**	1985 to 2009	to 1432 m	no recent records above 950 m
Temminck's Babbler	<i>Pellorneum pyrogenys</i>	500	1575	975	1900*	before 1996 to 2009/2010	to 1550 m	several recent sightings up to 1650 m, one breeding pair at 1860–1900 m
Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	909	1970	1500	1762**	before 1996 to 2010	to about 2100 m	no recent records above 1762 m in headquarters area, but seen at Mesilau (c. 1900 m) in 2008
Orange-headed Thrush	<i>Geokichla citrina</i>	909	1800	1500	1900*	1998 to 2009/2010	to 1800 m	recent breeding records up to 1900 m
Oriental Magpie-Robin	<i>Copsychus saularis</i>	500	939	523	1575*	before 1940 to 2005	1530 m	open country species; recent sightings up to 1575 m
White-tailed Flycatcher	<i>Cyornis coneretus</i>	700	1667	630	975**	before 1978 to 2009	to 1680 m, usually to 1200 m	no recent records above 975 m, except for a record with no details from “Kinabalu” (Hornbuckle, 2005)
Bornean Leafbird	<i>Chloropsis kinabaluensis</i>	600	2121	850	1800**	before 1968 to 2009/2010	to 2200 m on Mt. Trus Madi, to 2140 m on Mt. Kinabalu	no recent records above 1800 m
Little Spiderhunter	<i>Arachnothera longirostra</i>	500	975	530	1500*	1991 to 2010	to at least 1500 m	mist-netted in forest at 1500 m in 2010 and 2011
Bornean Spiderhunter	<i>Arachnothera everetti</i>	700	1515	530	2100*	unspecified	to 1530 m	recently mist-netted at 2100 m
Whitehead's Spiderhunter	<i>Arachnothera juliae</i>	1212	1667	1450	2000*	unspecified	to 2100 m on Mt. Trus Madi	recent sightings up to 2000 m

¹ *Pernis ptilorhynchus* has resident and migratory populations

Table 2. Birds recorded in the Mt. Kinabalu region above their Bornean elevational range (Mann, 2008). English names of migratory species are underlined. Number is in bold if the margin is at least 100 m higher than the maximum in Borneo (Mann, 2008) or underlined if marginally higher. See Appendix 2 for data source for each margin.

English name	Scientific name	Past upper margin	Current upper margin	Upper margin from Mann (2008)	Notes
Red-breasted Partridge	<i>Arborophila hyperythra</i>	3100	3068	to 1890 m on Mt. Kinabalu, to 2200 m on Mt. Trus Madi	seen at 3100 m in 1996 (Biun, 1999) and recent records up to 3068 m
Grey-faced Buzzard	<i>Butastur indicus</i>	1600	1650	to 1500 m	sighting from 1600 m in 1996 (Biun, 1999) and at c. 1650 m below Mesilau in 2010
Crested Hawk-Eagle	<i>Nisaetus cirrhatus</i>		1575	to 1400 m	recent records up to 1575 m
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	1515		to 1530 m	two recent records near Mesilau, at least 1900 m
Little Bronze Cuckoo	<i>Chrysococcyx minutillus</i>		1575	<i>C. minutillus</i> is scarce, possibly into montane areas; <i>C. m. russatus</i> is scarce, up to 945 m	recent sighting at c. 1575m
Mountain Scops Owl	<i>Otus spilocephalus</i>	3100	3036	to 2705 m	Recent records up to at least 3036 m. This species may have been overlooked. It was considered “rare” and “rarely seen” (Jenkins & de Silva, 1978; Jenkins et al., 1996, respectively) but was commonly heard on night surveys from 1800–2800 m in 2010 (JBCH).
Brown Wood Owl	<i>Strix leptogrammica</i>		1900	to 1500 m	recent sightings from 1550–1650 m near park headquarters and at c. 1900 m at Mesilau (Phillips & Phillips, 2011)
Giant Swiftlet	<i>Hydrochous gigas</i>		1900	to about 1800 m	recent sightings from 500–1900 m
Maroon Woodpecker	<i>Blythipicus rubiginosus</i>	2100	1921	to 1800 m	sight records at 2100 m in 1996/1997 (Biun, 1999); recently seen up to 1921 m
Grey-chinned Minivet	<i>Pericrocotus solaris</i>	2600	2456	to 2440 m	many observed at 2600 m in 1996/1997 (Biun, 1999)
Ashy Drongo	<i>Dicrurus leucophaeus</i>	2600	2052	to 2200 m or possibly 2400 m	sight records up to 2600 m in 1996/1997 (Biun, 1999)
<u>Crow-billed Drongo</u>	<i>Dicrurus annectans</i>	1600	1575	up to c. 600 m	seen at 700 m, netted at 1600 m 1996/1997 (Biun, 1999); seen at park headquarters in 2008
Hair-crested Drongo	<i>Dicrurus hottentotus</i>	2050	2050	to 1700 m	historical and recent sightings up to 2050 m
Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	975	800	to 650 m	historical sightings up to 975 m, recent sightings to at least 800 m
<u>Yellow-browed Warbler</u>	<i>Phylloscopus inornatus</i>		1900	The only previous record was from sea level in Sarawak	vocal individual photographed at 1900 m, 24 Oct. 2008
Sooty-capped Babbler	<i>Malacopteron affine</i>	700	750	to 550 m	sight records from 700 m in 1996/1997 (Biun, 1999) and to 750 m in 2011
<u>Siberian Blue Robin</u>	<i>Luscinia cyane</i>	700	1850	to 1680 m	recent sightings up to 1850 m
<u>Ferruginous Flycatcher</u>	<i>Muscicapa ferruginea</i>	1500	1850	to 1530 m	recent sightings up to 1850 m
<u>Narcissus Flycatcher</u>	<i>Ficedula narsissina</i>		1900	to 1530 m	recent sightings up to 1900 m
<u>Mugimaki Flycatcher</u>	<i>Ficedula mugimaki</i>	3100	3270	to 2325 m	recorded at 3100 m in 1996, netted at 3270 m in 2005, seen at 3255 m in 2010

Table 2. Cont'd.

English name	Scientific name	Past upper margin	Current upper margin	Upper margin from Mann (2008)	Notes
Thick-billed Flowerpecker	<i>Dicaeum agile</i>		560	below 200 m	recent records from 500 and 560 m
Plain Sunbird	<i>Anthreptes simplex</i>		560	to 1220 m	netted at c. 1500 m in 1999 (Moyle, 2003)
Temminck's Sunbird	<i>Aethopyga temminckii</i>	2100	<u>2050</u>	to 1985 m	sight record from 2100 m in 1996/1997 (Biun, 1999); recent sight record from summit trail, at least 2050 m
Eurasian Tree Sparrow	<i>Passer montanus</i>		1940	to at least 1400 m	recent records up to 1550 m near park headquarters and c. 1940 m at Mesilau
<u>Grey Wagtail</u>	<i>Motacilla cinerea</i>	3100	1900	to about 1800 m	sight records at 3100 m in 1996/1997 (Biun, 1999)

Table 3. Birds showing apparent changes in abundance from prior to 1998 to after 2006 in the Mt. Kinabalu region. See Appendix 2 for more information on each species.

English name	Scientific name	Observations
Little Green Pigeon	<i>Treron olax</i>	recorded at Poring, 500 m in 1985 (Phillips, 1986); no recent records
Thick-billed Green Pigeon	<i>Treron curvirostra</i>	considered the “commonest green pigeon at Poring hot springs” (Jenkins & de Silva, 1978); a dead bird collected at park headquarters in 1988 (Jenkins et al., 1996); no recent records
Barred Eagle-Owl	<i>Bubo sumatranus</i>	historical records include an old specimen with no locality data, being heard at Poring, c. 600 m (Wall & Yong, 1985), and recorded at 909 m; no recent records
Black Hornbill	<i>Anthraceroceros malayanus</i>	seen at lower elevations of Poring (Wall & Yong, 1985); no recent records
Black-and-Red Broadbill	<i>Cymbirhynchus macrorhynchos</i>	was considered common at Poring (Jenkins et al., 1996); Wall & Yong (1985) and Batchelor (1991) also recorded the species at Poring; the only recent record is from Dobbs (2008) at the Poring hot pools; seems to no longer be common
Long-tailed Broadbill	<i>Psarisomus dalhousiae</i>	may have declined; before 1978, 14 specimens were obtained from 3000–4500 ft (909–1364 m), and the species was recorded up to 1667 m; the only recent record from the headquarters area is of an active nest at 1500 m
Rufous-winged Philentoma	<i>Philentoma pyroptera</i>	netted at Poring in 1971; no recent records
Bar-bellied Cuckoo-shrike	<i>Coracina striata</i>	sight record from Poring and recorded up to 1212 m on Kinabalu (Jenkins & de Silva, 1978); seen at canopy walkway, Poring (Vermeulen, 1996); no recent records
Straw-headed Bulbul	<i>Pycnonotus zeylanicus</i>	several historical records from Poring, including nine birds seen by Vermuelen (1996); no records after 1996, except a recent sighting from park headquarters that may have been an escapee (AB)
Bornean Bulbul	<i>Pycnonotus montis</i>	was “fairly common around 3000 ft (909 m)” (Jenkins & de Silva, 1978) and recorded at Bundu Tuhan (Batchelor, 1991) and Poring, 700 m (Biun, 1999); also Sayap, c. 1000 m (Moyle & Sheldon, 2000); no recent records
Cinereous Bulbul	<i>Hemixos cinereus</i>	was common from 3000–6000 ft (909–1818 m) on Kinabalu” (Jenkins et al., 1996) and recorded up to 2727 m (Batchelor, 1991); now considered rare from 1450–1950 m (AJB)
Black-throated Babbler	<i>Stachyris nigricollis</i>	seen at Poring, c. 500 m in 1989 (Batchelor, 1991); no records since
Black-throated Wren Babbler	<i>Napothera atrigularis</i>	netted at Poring, 700 m in 1996/1997 (Biun, 1999); no records since
Malaysian Blue Flycatcher	<i>Cyornis turcosus</i>	netted at Poring, c. 545 m (Sheldon, 1977); also recorded from Ranau (Jenkins & de Silva, 1978); no records since
Van Hasselt's Sunbird	<i>Leptocoma brasiliana</i>	collected at Poring in 1977 (Jenkins & de Silva, 1978); no recent records

downward shifts ≥ 100 m below their published minimum, but mountain barbet *Megalaima monticola* was recorded at 700 m in 1996, which is marginally lower than its 750 m minimum (Mann, 2008). Fifteen species showed apparent decreases in abundance (Table 3).

DISCUSSION

In comparing species occurrence before 1998 and after 2006 on Mt. Kinabalu, we found evidence for upward shifts in 24 species and downward shifts in 14 species. Eight of the upward-shifting species were observed at least 100 m above their published maximum Bornean elevation (Mann, 2008), which suggests the observed shifts correspond to genuine range changes. Some species appear to be colonising higher elevations. Common emerald dove *Chalcophaps indica* was known previously to reach only 1590 m in Borneo, but AJB observed this species near the power station (1900 m) on numerous occasions from 2009–2011, and it was commonly recorded in 2011 from 1450–1850 m. Temminck's babbler *Pellorneum pyrrogenys* was formerly known only to range from 500–1575 m in Borneo, but now, on Mt. Kinabalu, it ranges from 975–1900 m, is fairly common from 1450–1650 m, rare to c. 1900 m, and has nested at 1860–1900 m (AJB; Appendix 2). Other species have evidently increased in elevation above their previous maxima, including chestnut-breasted malkoha *Phaenicophaeus curvirostris* (seen three times at 1500–1600 m), white-throated fantail *Rhipidura albicollis* (recent sightings up to 3300 m), mountain leaf warbler *Phylloscopus trivirgatus* (recent sightings up to 3221 m), and Bornean spiderhunter *Arachnothera everetti* (one mist-netted at 2100 m). Of the 25 additional species that were recorded above their Bornean maximum (Table 2), clear candidates for upward shifts include crested hawk-eagle *Nisaetus cirrhatus* and little bronze cuckoo *Chrysococcyx minutillus*.

Previous studies from tropical mountains have documented smaller shifts than predicted by the adiabatic lapse rate for most species (Raxworthy et al., 2008; Chen et al., 2009; Forero-Medina et al., 2011). All apparent shifts we documented occurred over at least a 12 year span. Thus it is unsurprising that changes may have exceeded the 1997–2007 lapse rate prediction of 87 m upwards from +0.48°C. Given the spatial and temporal uncertainties from our various data sources, it is difficult to compare observed changes to predicted shifts based on the lapse rate. The widespread upward shifts, showing no clear signal of taxonomic or dietary bias, agree with results of other climate change studies from Southeast Asia (Peh, 2007; Chen et al., 2009, 2011), and other regions (Pounds et al., 1999, 2005; Seimon et al., 2007; Raxworthy et al., 2008; Forero-Medina et al., 2011).

While some species may have moved upward as a consequence of climate change, other range changes can probably be explained by other factors. Three species, Oriental magpie robin *Copsychus saularis*, yellow-bellied prinia *Prinia flaviventris*, and Eurasian tree sparrow *Passer montanus*, are open country birds that likely expanded their

ranges along roads as a result of habitat clearance in the region. Six species were migrants which may be less sensitive to warming, and yellow-browed warbler *Phylloscopus inornatus* is a vagrant with only two records for Borneo. Others, including brown wood owl *Strix leptogrammica*, Bornean frogmouth *Batrachostomus poliophus*, giant swiftlet *Hydrochous gigas*, and orange-headed thrush *Geokichla citrina* are inconspicuous, rare, or difficult to identify, all of which make an accurate assessment of their ranges difficult or unreliable.

Our results also indicate that some species may have moved downslope since the 1990s. Perhaps the most convincing downslope shifts were shown in the upper range margins of two species, Bornean leafbird *Chloropsis kinabaluensis* (formerly seen up to 2650 m, but no recent records above 1800 m) and yellow-bellied warbler *Abroscopus superciliaris* (formerly up to 1818 m, no recent records above 1575 m). We find these apparent changes convincing because these species are conspicuous and they have not been recorded recently in well sampled areas between park headquarters and Timpohon gate or at Mesilau. The influence of biotic and abiotic factors on lower and upper range margins are a subject of active debate (Lenoir et al., 2010; Gifford & Kozak, 2011), and detailed studies of downward shifting species are urgently needed. It would be interesting to investigate the incidence of downward range shifts as a function of species traits such as elevational range, presence of competitors, and tolerance to habitat disturbance. For example, range changes in *Chloropsis kinabaluensis* could be compared in Kalimantan where a lowland competitor (*C. cochinchinensis*) is present, and in Sabah where the competitor is absent, but *C. kinabaluensis* appears to be shifting its upper range margin downwards. It is unclear if changes in competitive interactions were related to downward shifts shown in the present study, but upward shifts in generalist species such as little spiderhunter *Arachnothera longirostra* (Table 1) could drive changes.

We suspect that many of the other possible downward shifts are due to past records of post-breeding dispersing birds (e.g., brown fulvetta *Alcippe brunneicauda*) or localised changes in abundance below Timpohon gate and incomplete sampling above the gate (e.g., ochraceous bulbul *Alophoixus ochraceus* and velvet-fronted nuthatch *Sitta frontalis*, both of which have been recently observed above 1900 m at Mesilau). In addition, it is possible that human disturbance (from increased numbers of hikers on the summit trail) could have contributed to reduced bird detection. Nevertheless, we think it is unlikely that disturbance from hikers could explain the lack of records for conspicuous species such as Bornean leafbird, and many months of current observations (from AJB and TEM) come from lightly used trails in between park headquarters and Timpohon gate.

Our historical-current data comparison also uncovered an apparent reduction in abundance of 15 species. This reduction may be explained by habitat loss, hunting, the pet trade, climate change, or incomplete sampling. Most of the observed declines are probably related to habitat loss at lower

elevations in Kinabalu Park near Poring, and deforestation on the Pinosuk Plateau. All lowland species in Table 3 except straw-headed bulbul *Pycnonotus zeylanicus* and Van Hasselt's sunbird *Leptocoma brasiliensis* are either known to be or thought to be negatively-affected by forest fragmentation or logging (Lambert & Collar, 2002; Edwards et al., 2011). The apparent declines of these species could have been caused by relatively recent disturbances, or delayed extinction debt from earlier habitat loss (Kuussaari et al., 2009). Hunting, especially of large bodied species such as black hornbill *Anthracoceros malayanus* and *Treron* pigeons could have also contributed to declines. The cage bird trade is likely to blame for the dramatic decline in straw-headed bulbul *Pycnonotus zeylanicus* at Poring and elsewhere in Borneo (Sheldon et al., 2009). Incomplete sampling at Poring may also be a factor, but all species in Table 3 are reasonably conspicuous, with the possible exceptions of barred eagle-owl *Bubo sumatranus* and black-throated wren babbler *Napothera atrigularis*. At higher elevations, observations of long-tailed broadbill *Psarisomus dalhousiae* and cinereous bulbul *Hemixos cinereus* from park headquarters upwards may have become less frequent because of population reductions caused by deforestation on the Pinosuk plateau in the early 1980s (Sheldon, 1986).

Our results indicate that citizen science data (including birdwatchers' trip reports and databases of audio, photographic, and birdwatchers' records) are invaluable resources for comparing bird distributions, but these data tend to lack adequate spatial or temporal details. We reiterate the call by Boakes et al. (2010) for birdwatchers "who intend their observations to be of practical use to others to carry a GPS".

The apparent range shifts documented here could help guide future research investigating changes in distribution and abundance of lowland colonists and highland endemics driven by climate change (reviewed in Harris et al., 2011). For example, it would be interesting to use playback experiments to study interactions among the three *Arachnothera* spiderhunters that now all occur at middle elevations on Mt. Kinabalu, and evaluate how interactions change with increasing elevation. In a similar situation, Jankowski et al. (2010) used playback experiments to discover that the higher elevation thrush *Catharus fuscater* was subordinate to the lower elevation *C. mexicanus*, which could have implications for the persistence of *C. fuscater* under climate change. dark hawk cuckoo *Hierococcyx bocki* is a nest parasite of chestnut-capped laughingthrush *Garrulax mitratus* in Peninsular Malaysia and a probable nest parasite of mountain leaf warblers on Mt. Kinabalu (Smythies, 1999). The apparent upward expansion of dark hawk cuckoo and its possible effects on Mt. Kinabalu's high elevation avifauna (assuming flexible host preferences) would make for an interesting research topic. Lastly, our results, when used in future studies, should help validate and improve models that forecast avian distributional changes and extinction risk from climate change (Shoo et al., 2005; Gasner et al., 2010).

In conclusion, we demonstrate a novel method for compiling avian occurrence data from diverse sources and attempting to account for varying temporal and spatial coverage and accuracy. Twenty-four species, eight of which were recorded above their published Bornean ranges, appear to have shifted their distributions upward. In addition, 14 species may have moved their ranges downslope and 15 species may have declined in abundance. The ecological consequences of these shifts are still largely unknown and we hope our findings will be continually refined and stimulate further research on the mountain's avifauna.

ACKNOWLEDGEMENTS

We are grateful to the many birdwatchers who posted their observations on the internet. B. Brook, D. Fordham, and N. Sodhi provided valuable advice. D. Bakewell, G. Dobbs, D. Edwards, P. Ericsson, M. Gurney, J. Harding, L. Harding, R. Johnstone, C. Lee, A. Pierce, P. Rasmussen, F. Rheindt, U. Treesucon, S. Woods, F. Verbelen, and BIW and OBI staff generously provided details on observations or provided unpublished data. Victor Emanuel Nature Tours, Birdtour Asia, Tropical Birding, Bird Quest, Rockjumper Birding Tours, WINGS, Field Guides, and King Bird Tours all responded to requests for historical data. JBCH thanks B. Butit for valuable assistance in the field, the Loke Wan Tho Memorial Foundation and University of Adelaide EIPRS for funding, J. George, M. Lakim, A. Lo, D. Simon, and F. Tuh for logistical support, and the Economic Planning Unit (UPE: 40/200/19/2436) and Sabah Parks for graciously issuing permits. Three anonymous reviewers gave valuable comments for the manuscript.

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Appendix 1. Location and elevation of JBCH's point counts. Note that the point ID numbers shown in Fig. 2 were for display purposes only.

Point ID	Elevation (m)	Coordinates
K 42	516	6.04826°N, 116.70244°E
K 41	523	6.0462°N, 116.70332°E
K 43	540	6.0504°N, 116.70179°E
K 44	614	6.05208°N, 116.70027°E
K 45	700	6.05322°N, 116.69832°E
K 46	748	6.05553°N, 116.69812°E
K 47	808	6.05687°N, 116.69636°E
K 48	893	6.05883°N, 116.69525°E
K 50	920	6.06189°N, 116.69195°E
K 49	927	6.06031°N, 116.69357°E
K 51	961	6.0625°N, 116.68982°E
K 52	1003	6.06355°N, 116.68782°E
K 1	1465	6.00705°N, 116.5495°E
K 2	1504	6.00859°N, 116.54781°E
K 3	1509	6.01056°N, 116.54663°E
K 4	1531	6.01096°N, 116.54433°E
K 5	1547	6.01318°N, 116.54479°E
K 6	1564	6.01489°N, 116.54639°E
K 7	1594	6.01711°N, 116.54631°E
K 8	1620	6.01879°N, 116.54779°E
K 9	1648	6.02109°N, 116.54813°E
K 10	1688	6.02301°N, 116.54936°E
K 12	1779	6.02742°N, 116.54959°E
K 11	1780	6.02519°N, 116.54997°E
K 13	1789	6.0294°N, 116.5486°E
K 14	1859	6.03108°N, 116.54717°E
K 15	1921	6.03065°N, 116.54941°E
K 16	2023	6.03297°N, 116.5495°E
K 17	2052	6.03504°N, 116.5503°E
K 18	2117	6.03731°N, 116.55009°E
K 19	2200	6.03958°N, 116.55034°E
K 20	2268	6.04147°N, 116.55157°E
K 21	2322	6.0413°N, 116.55377°E
K 22	2446	6.04164°N, 116.556°E
K 23	2556	6.04191°N, 116.55824°E
K 24	2629	6.04334°N, 116.55996°E
K 25	2703	6.04558°N, 116.56007°E
K 26	2806	6.04738°N, 116.56137°E
K 27	2895	6.04898°N, 116.56301°E
K 28	2948	6.05113°N, 116.5636°E
K 29	3036	6.0532°N, 116.56442°E
K 30	3115	6.05527°N, 116.56525°E
K 31	3221	6.05745°N, 116.56579°E
K 32	3294	6.05967°N, 116.56623°E
K 33	3410	6.06181°N, 116.56715°E
K 34	3555	6.06403°N, 116.56703°E
K 35	3697	6.06557°N, 116.56529°E
K 36	3799	6.06604°N, 116.56302°E
K 37	3859	6.06781°N, 116.56165°E
K 38	3946	6.07°N, 116.56101°E
K 39	3976	6.07214°N, 116.56021°E
K 40	4022	6.07389°N, 116.55877°E

Appendix 2. Bird species recorded in or near Kinabalu Park up until Oct.2011. Records from before 1998 are considered historical, and after 2006 current. Historical elevational ranges come from Jenkins & de Silva (1978) and Jenkins et al. (1996) unless specified otherwise. Intermediate records from 1998–2006 are listed in the current notes but were not included in the range comparison. Bold indicates species observed by Biun (1999) that were not included in the 1996 list, bold italic indicates species observed since Biun (1999). Species ranges are bold if margin is at least 100 m higher than the maximum in Borneo (Mann, 2008), or underlined if marginally higher (25–99 m) than in Mann (2008). Only one species, *Megalaima monticola*, was recorded below the minimum elevation in Mann (2008). * indicates an upward shift of >100 m compared to the historic margin; ** indicates a downward shift of >100 m compared to the historic margin. Only apparent shifts from park headquarters to the summit are highlighted because of uncertainty in ranges at Poring from low historical and current sampling effort. Underlined species are migratory; [] indicate hypothetical (usually a single sighting without sufficient details or photographs); † indicates a downward shift within the headquarters to summit band (included in Table 1); AKN=Avian Knowledge Network; GBIF=Global Biodiversity Information Facility; JBCH, AJB, JAE, and AB = data from the authors; OBI=Oriental Bird Images; BIW=Bird I Witness, “accepted” records were verified by authorities at BIW (we do not necessarily endorse these records as valid).

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
GALLIFORMES: Phasianidae								
King Quail	<i>Excalfactoria chinensis</i>	303	<u>1575</u>			1550	“lalang covered slopes”; also Ranau; several run over at Park Headquarters (taken to be 1575 m); somewhere between park headquarters and Timpohon gate (Roberson, 1988; AKN)	
Red-breasted Partridge	<i>Arborophila hyperythra</i>	606	3100	1555	3068	610–1890	1600–3100 m (Biun, 1999)	range from JBCH data
Crimson-headed Partridge	<i>Haematoryx sanguineiceps</i>	1667	3030	1450	2322**	185–3050		1507–2322 m (JBCH); down to 1450 m (AJB); Mesilau, Dec.2008 (C. Lee, BIW, accepted)
Crested Partridge	<i>Rollulus rouloul</i>		1061			1300	also Bundu Tuhan	seen at Poring c. 560 m (Artuso, 2000; AKN); female seen at park headquarters (Rheinhardt, 2003); female seen on Mt. Tambuyukon, 1100 m, above substation Monggis, Jun.2011 (AJB)
<i>Bulwer's Pheasant</i>	<i>Lophura bulweri</i>					1475		750 m (JBCH); dancing grounds near Langanan waterfall collected at Ranau; 700 m (AJB, c. 1000 m)
Great Argus	<i>Argusianus argus</i>	700	909	750	1000	1800	recorded “near Poring”; (Biun, 1999)	one at Poring (Newnham, 2007)
PELECANIFORMES: Ardeidae								
<i>Black-crowned Night-Heron</i>	<i>Nycticorax nycticorax</i>					none given	“rocky stream at the foot of Kinabalu” (Whitehead)	in river near Serinsim headquarters, c. 200 m (Sheldon et al., 2004)
Striated Heron	<i>Butorides striata</i>					none given		Poring (Hornbuckle, 2005); Kundasang (Gurney, 2010)
<i>Eastern Cattle Egret</i>	<i>Bubulcus coromandus</i>					none given		[near] Poring (Benstead & Benstead, 2001)
<i>Purple Heron</i>	<i>Ardea purpurea</i>					1100		in river near Serinsim headquarters, c. 200 m (Sheldon et al., 2004); Poring, c. 560 m (Harding, 2011; AKN)
<i>Little Egret</i>	<i>Egretta garzetta</i>				560	none given		
ACCIPITRIFORMES: Pandionidae								
<i>Western Osprey</i>	<i>Pandion haliaetus</i>					resident and migratory populations in Borneo; no upper margin given		two seen at Poring Hot Springs in Feb (Shackelford, 2007)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
ACCIPITRIFORMES: Accipitridae								
<u>Crested Honey Buzzard</u>	<i>Pernis ptilorhynchus</i>	818	848	500	1500*	resident and migratory populations in Borneo; to over 1000	altitudes given are for resident race	one seen at Kinabalu Park (Dobbs, 2008; Lambert & Yong, 2010; Harapp, 2011; taken to be at least 1500 m); at Poring c. 500 m (Watson, 2010; AKN)
Bat Hawk	<i>Macheiramphus alcinus</i>		1545			possibly up to 1550	seen at headquarters (5100 ft) at dusk	
Brahminy Kite	<i>Haliastur indus</i>	303				probably over 1100	also at Ranau (1800 ft)	Poring (Hornbuckle, 2005)
[Lesser Fish Eagle]	<i>Ichthyophaga humilis</i>		1600			1000	sight record at 1600 m (Biun, 1999)	
Mountain Serpent Eagle	<i>Spilornis kinabaluensis</i>	909	3100	1450	2023**	750–2900	collected “above 3000 ft by Whitehead”; 1600–3100 m (Biun, 1999)	1450–1500 m (AJB); 1688–2023 m (JBCH); Harapp, 2010 at lower slopes of Poring (taken to be less than 600 m; we take this to be unconfirmed unless the bird was vocal); seen above Bukit Ular, c. 1900 m (JAE); at least three individuals resident. Regularly seen circling around Bukit Ular (the hill), 1900 m, Feb–Jun in 2010 and 2011 (AJB)
Crested Serpent Eagle	<i>Spilornis cheela</i>	700		560	1000	up to about 1200, possibly higher	700 m (Biun, 1999); Jenkins & de Silva (1978) is vague about <i>Spilornis</i> ranges; Jenkins et al. (1996) said: collected at Tenompok 5000 ft; “seen several times above park headquarters” (no details); Poring (Vermeulen, 1996)	731–843 (JBCH); 250–450 m at Serinsim (Sheldon et al., 2004); Poring canopy walkway (Addison, 2002; taken to be 560 m); up to Langanan waterfall, particularly at km 1.5–1.8, in recent years (JAE); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted)
Crested Goshawk	<i>Accipiter trivirgatus</i>	303	909	560	1500*	up to 2015 throughout Borneo (Smythies, 1957, 1999)		Poring c. 560 m (Barnes, 2005, AKN); bred at 1500 m, 2009–2011 (AJB); Poring (Matheve et al., 2008)
Chinese Sparrowhawk	<i>Accipiter soloensis</i>	303				500	one collected by Whitehead in 1887	
Japanese Sparrowhawk	<i>Accipiter gularis</i>	303	500		1200		sight record Poring (no locality data); Jenkins et al. (1996) say “Poring hot springs” (taken to be c. 500 m)	
Besra	<i>Accipiter virgatus</i>	303	1575	1500	1660	1900	nesting on Silau Silau trail 1982, taken to be 1575 m; between Park headquarters and Timpohon gate (Bono, 1997, AKN)	seen at Kiau View (Dobbs, 2008; taken to be 1660 m); seen “lower down on the mountain” (Woods, 2008); nest along road near Silau Silau, 2006 (JAE); bred at 1500 m in 2011 (nest active May–Jun) (AJB); Poring (Matheve et al., 2008)
Grey-faced Buzzard	<i>Buteo indicus</i>	303	1600		1500		at Park Headquarters in 1981; also Bundu Tuhan (4200 ft); 700, 1600, 3100 m (no photos) (Biun, 1999)	Mesilau golf course, Nov.2010 (JAE; c. 1650 m)
Black Eagle	<i>Ictinaetus malayensis</i>	939	<u>1575</u>		reaching 1525 and above		pair presumed to be this species seen at Kinabalu Park headquarters (taken to be 1575 m)	one on Mount Kinabalu [trails] (Newnham, 2007; Gurney, 2010; Harapp, 2010; Lambert & Yong, 2010); uncommon above Kundasang, c. 1300 m (AJB); c. 200 m at Serinsim (Sheldon et al., 2004); seen on Mt. Kinabalu (Benstead & Benstead, 2001)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Rufous-bellied Hawk-Eagle	<i>Lophotriorchis kieneri</i>	303	600			1530	Poring lower elevations (Wall & Yong, 1985; taken to be 600 m)	seen in Kinabalu Park, somewhere from headquarters to Timpohon gate (Lazere, 2005, AKN; Sevenair, 2010, AKN); seen at Mt. Kinabalu (Harrap, 2010)
Crested Hawk-Eagle	<i>Nisaetus cirrhatus</i>			500	1575	1400	one collected on the Tempassuk plain	dark phase at Poring headquarters area (Harrap, 2011; taken to be 500 m); seen above Mesilau (Bishop, 2010; Kinabalu (Myers, 2009); regular at park headquarters, 2006–2008, c. 1575 m (JAE)
Blyth's Hawk Eagle	<i>Nisaetus alboniger</i>			560	2000	2000	Poring (no locality data)	Poring c. 560 m (Brown, 2011, AKN); Poring (Harrap, 2010); upper elevations of Poring (Addison, 2002; taken to be at least 800 m); seen at Kinabalu Park (Valentine & Thumilang, 2008a; Lambert & Yong, 2010); seen at Kiau View (Dobbs, 2008; taken to be c. 1660 m); c. 2000 m soaring over Bukit Ular (AJB)
FALCONIFORMES: Falconidae								
White-fronted Falconet	<i>Microhierax latifrons</i>		975			to about 1200	sight records at Ranau and Poring; Poring, c. 975 m (Nezadal, 1991, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); hike to waterfall, Poring, in telescope (Shackelford, 2007); waterfall hike (Harrap, 2011); Poring (Hutchinson, 2008, Jun); pair regular at Poring entrance pre-2006 until dead tree chopped down (JAE)
Peregrine Falcon	<i>Falco peregrinus</i>		2424	1570	1575**	2440		race <i>ernesti</i> in Kinabalu Park (Newnham, 2007; taken to be 1575 m); Silau Silau trail, 1570 m (Barnes, 2005, AKN)
Oriental Hobby	<i>Falco severus</i>					none given	Kinabalu specimen with no locality data; Poring sighting with no locality data	
Common Kestrel	<i>Falco tinnunculus</i>					none given	sight record from Ranau	
GRUIFORMES: Rallidae								
Red-legged Crane	<i>Rallina fasciata</i>	909	1575	650		1550	dead bird collected at Park Headquarters, 1987	650 m at Poring, May 2011 (AJB)
[<i>Slaty-breasted Rail</i>]	<i>Gallirallus striatus</i>					to at least 1000		Ch'ien Lee observed one at close range at Mesilau golf course, c. 1600 m (C. Lee, BIW Sep.2009)
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>		1515			1530	also Pinosuk Plateau and Ranau	near Mesilau (Myers, 2010, Aug; Brown, 2011, AKN; the latter at c. 2000 m)
CHARADRIIFORMES: Scolopacidae								
Pin-tailed Snipe	<i>Gallinago stenura</i>					none given	common in hill rice at Poring Hot Springs (before 1978)	
Common Sandpiper	<i>Actitis hypoleucos</i>	758				up to 1300 in Kelabit uplands		c. 200 m elevation in river near Serinsim headquarters (Sheldon et al., 2004)
COLUMBIFORMES: Columbidae								
Spotted Dove	<i>Spilopelia chinensis</i>					1000	specimens from Kinabalu with no locality data; also Ranau; sight record from Kundasang	Poring (Wallace & Wallace, 2001); c. 200 m at Serinsim (Sheldon et al., 2004); Poring and Kundasang (Gurney, 2010; Poring taken to be 500 m); c. 1900 m. at Mesilau (Harding, 2011, AKN)

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Ruddy Cuckoo Dove	<i>Macropygia emiliana</i>	500	1575	975		1835	at Kundasang up to 4500 ft; netted in Poring by FHS, c. 500 m; sight records at 700 and 1600 m (Biun, 1999). We consider records above park headquarters to be hypothetical until details become available.	Seen "on all three days" at Poring (Wallace & Wallace, 2001); Poring (Benstead & Benstead, 2001); 3100 m mark on Langanan trail, c. 975 m elevation, May 2009 (JAE). We consider records above park headquarters to be hypothetical until details become available.
Little Cuckoo Dove	<i>Macropygia ruficeps</i>	303	3100	521	2000**	to at least 2945	eggs at Kiau; 3100 m (Biun, 1999)	521–1789 (JBCH); common to 2000 m (AJB); regular at Mesilau headquarters (JAE)
Common Emerald Dove	<i>Chalcophaps indica</i>	600	1600	1450	1900*	1590	window kill at night at park headquarters before 1978, presumed to be a disperser; 600 m is approximate for "lower elevations of Poring" (Wall & Yong, 1985); 1600 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); seen 2009–2011 near power station (1900 m), common in 2011 where birds were seen and banded regularly from 1450–1850 m (AJB); Poring (Rheindt, 2010, pers. comm.; Matheve et al., 2008)
Little Green Pigeon	<i>Treron olax</i>	500				1220	500 m at Poring in 1985 (Phillips, 1986)	interesting that there are no recent records
Pink-necked Green Pigeon	<i>Treron vernans</i>	303	700			none given	700 m (Biun, 1999)	250–450 m at Serinsim (Sheldon et al., 2004)
Thick-billed Green Pigeon	<i>Treron curvirostra</i>	500				1300	commonest green pigeon at hot springs (Jenkins & de Silva, 1978; taken to be c. 500 m); also Ranau; dead bird collected at park headquarters, 1988 (Jenkins et al., 1996); this species has been collected on night dispersal at 700 m in Crocker Range (Jenkins et al., 1996) so dead bird at headquarters could have been a disperser	interesting that there are no recent records
Jambu Fruit Dove	<i>Ptilinopus jambu</i>	700	1575	1575		to at least 1600	nest at 5100 ft in 1985; two window kills at park headquarters at night (taken to be 1575 m); 700 m (Biun, 1999) also several collected at Kiau 4200 ft	Poring (Benstead, 2004); female in flight at park headquarters (Bishop, 2007; taken to be 1575 m)
Green Imperial Pigeon	<i>Ducula aenea</i>		939			1050		Poring (Hornbuckle, 2005)
Mountain Imperial Pigeon	<i>Ducula badia</i>	700	2455	774	1997**	to 2500 (Sheldon et al., 2001)	700 m (Biun, 1999); Kiau (eggs)	range from JBCH data; Poring (Woods, 2007; Matheve et al., 2008)
PSITTACIFORMES: Psittacidae								
Blue-crowned Hanging Parrot	<i>Loriculus galgulus</i>	500	1606	516		1620	sightings near park headquarters in 1971 and 1973; near Poring headquarters (Vermeulen, 1996; taken to be 500 m)	516 m (JBCH); several trip report records from Poring (no elevations given); canopy walkway (Rheindt, 2003; taken to be 560 m)
CUCULIFORMES: Cuculidae								
Greater Coucal	<i>Centropus sinensis</i>	500		500		at 750 on Mt. Trus Madi	Poring at edge of compound, taken to be 500 m; Kiau (eggs)	c. 200 m at Serinsim (Sheldon et al., 2004); heard in town of Poring, 500 m (JBCH)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Lesser Coucal	<i>Centropus bengalensis</i>		1552			2000	specimen from park headquarters in 1971 (1552 m); sight record from Poring (no locality data); two seen at Poring (Vermeulen, 1996)	heard in Kundasang 1300 m (JBCH, AJB); seen at Poring (Hornbuckle, 2005)
Raffles's Malkoha	<i>Rhinorhina chlorophaea</i>	303	1061	513	964	to 1100	also Kuang (c. 2200 ft); Ranau (no locality data)	range from JBCH data; c. 200 m at Serinsim (Sheldon et al., 2004)
Red-billed Malkoha	<i>Zanclostomus javanicus</i>	303			700	to at least 1750	also Kuang, Poring (no locality data)	seen at Poring (Dobbs, 2008; Hutchinson, 2011); Poring, 700 m Nov.2010 (JAE)
Chestnut-breasted Malkoha	<i>Phaenicophaea curvirostris</i>	303	1061	539	1600*	1220	also Ranau	539 m (JBCH); two sightings near park headquarters since 2009 (AJB, at least 1500 m); 1600 m above park headquarters (AB, Jul.2010); c. 200 m at Serinsim (Sheldon et al., 2004)
[Chestnut-bellied Malkoha]	<i>Phaenicophaea sumatranus</i>	700				to at least 1300	"rising to foothills above Ranau" (Gore, 1968)—Jenkins et al. (1996) said "An unusual and possibly doubtful record; normally a mangrove/coast resident". We consider the few records since to be hypothetical pending documentation.	
Black-bellied Malkoha	<i>Phaenicophaea diardi</i>	303	975	560		to 915, once at 1700	c. 975 m above Poring (Nezadal, 1991, AKN); 700 m (Bium, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); on Langanan trail at Poring (Addison, 2002); c. 560 m at Poring (Brown, 2011, AKN); Poring (Matheve et al., 2008); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted)
<u>Chestnut-winged Cuckoo</u> <u>Asian Koel</u>	<i>Clamator coromandus</i> <i>Eudynamis scolopacea</i>			500		to 975 in Kelabit uplands none given	seen in hill rice field at Poring (no locality data)	Poring entrance, Nov.2010 (JAE, c. 500 m)
Violet Cuckoo	<i>Chrysococcyx xanthorhynchus</i>	500		521		1300	winter visitor, recorded crossing the track between Ranau and Kundasang	510 m (JBCH); female or young male at Poring (Lambert & Yong, 2010); female, Poring (Matheve et al., 2008); Langanan trail, May 2011 (S. T. Yeo & L. Harding, BIW)
Little Bronze Cuckoo	<i>Chrysococcyx minutillus</i>	939			1575	scarce, possibly into montane areas. For <i>C. m. rissatus</i> , Mann (2008) says: scarce, up to 945	specimen of " <i>C. r. altheus</i> " collected at 3100 ft	Poring (Kiong, 2008, OBI); seen at Poring with telescope (Valentine & Thurmilangan, 2008a); seen in telescope near Kinabalu Park headquarters (Harapp, 2011; taken to be 1575 m)
Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>			560		perhaps up to 1530	netted at Poring (no locality data); unconfirmed sighting from 5000 ft	seen at Poring with telescope (Valentine & Thurmilangan, 2008a); heard at Poring (Harapp, 2008, 2010; F. Rheindt pers. comm.); seen at Poring c. 560 m (Harding, 2011, AKN)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Plaintive Cuckoo	<i>Cacomantis merulinus</i>	700	939	500	560	none given	netted at 700 m (Biun, 1999)	seen and heard near Poring hostel (Dobbs, 2008; taken to be c. 500 m); heard canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Rusty-breasted Cuckoo	<i>Cacomantis sepulchralis</i>			516	530	about 1715	sight record from Poring	range from JBCH data: Poring (Hutchinson, 2008; Woods, 2008, Xeno Canto)
Square-tailed Drongo- Cuckoo	<i>Surniculus lugubris</i>	303	700	782	824	up to 1220 or 1310	Nalumad (2500 ft); Tenompok; 700 m (Biun, 1999)	range from JBCH data; c. 200 m at Serinsim (Sheldon et al., 2004)
Moustached Hawk-Cuckoo	<i>Hierococcyx vagans</i>	600	700			to about 610	Poring “on trail to the bamboo grove”, taken to be at least 600 m (Phillips, 1986); 700 m (Biun, 1999)	
Dark Hawk Cuckoo	<i>Hierococcyx bocki</i>	909	1835	1509	2023*	1985	“to 1835 m on Mt. Kinabalu (Smythies, 1957, Natural History Museum)” in (Mann, 2008); seen somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN; Bono, 1997, AKN)	JBCH data; Mesilau, Dec.2008 (C. Lee and S. T. Yeo, BIW, accepted); regularly 50 m above Mesilau on trail to summit (JAE)
Malaysian Hawk-Cuckoo	<i>Hierococcyx fugax</i>	700	1600	510	1600	to 1620	nominate race collected at 3000 ft while laying in a <i>Culicicapa</i> nest; <i>H. fugax niscolor</i> collected at 3100 ft; young dead bird collected at headquarters (taken to be 1575 m); netted at 700 m, seen at 1600 and 2100 m (Biun, 1999)—no photos so we treat upper record as unconfirmed	Poring (Gabrielsen, 2005, OBI); 510 m Poring Botanical Garden, Nov.2010 (JAE); at Poring waterfall trail (Harap, 2011); heard at Poring (only hiked to “above bat cave”; taken as 600 m) and elsewhere in Kinabalu Park (Bishop, 2010); banded (in breeding condition) at 1600 m in 2011 (AJB)
Indian Cuckoo	<i>Cuculus micropterus</i>		1212	645	904	1220		range from JBCH data: two questionable records from somewhere between park headquarters and Timpohon gate (Hornbuckle, 2005; Merrill, 2011, AKN); c. 200 m at Serinsim (Sheldon et al., 2004)
Sunda Cuckoo	<i>Cuculus lepidus</i>	900	2750	1507	2700	750 to above 2750	1600–2600 m (Biun, 1999); species/races involved unclear in all records; to 2750 m (Whitehead in Smythies, 1999)	range (resident <i>Cuculus lepidus</i>) is from JBCH data; heard at Poring, 26–27 Mar (Hornbuckle, 2005); seen at Poring, 6–9 Apr (Wallace & Wallace, 2001); taxonomy unclear; Mesilau, Dec.2008 (C. Lee and S. T. Yeo, BIW, accepted)
STRIGIFORMES: Tytonidae Oriental Bay Owl	<i>Phodilus badius</i>		700			to about 750	netted at 700 m (Biun, 1999)	
STRIGIFORMES: Strigidae Reddish Scops Owl	<i>Otus rufescens</i>		1515	600		1985	netted at 5000 ft in 1964. Jenkins et al. (1996) said: ID doubtful, confusion with Mountain Scops Owl has occurred on other Malayan mountains	seen at Poring (Hornbuckle, 2005; Eaton, 2008); most visits to Poring at least heard at 600 m (JAE)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Mountain Scops Owl	<i>Otus spilocephalus</i>	1600	3100	1509	3036	750 to 2705	1600–3100 (Bium, 1999); Jenkins et al. (1996) said this species was “rarely seen”	range from JBCH data; the species may have been overlooked. It was common on night surveys from 1800–2800 m in 2010 (JBCH); likely occurs above 3036 m, windy survey conditions made sampling difficult; Mesilau, Dec.2008 (C. Lee and S. T. Yeo, BIW, accepted)
Rajah Scops Owl	<i>Otus brookii</i>		1880			to 2000 on Mt. Dulit	dead bird found on summit trail in 1986 at c. 1880 m.	sight record by Daniel Munoz during the day at 1500 m near park headquarters, May 2011 (no photograph, but details match description of this species; AJB)
Collared Scops Owl	<i>Otus lempiji</i>	303	600	500		at least 1000	Poring lower elevations (Wall & Yong, 1985; taken to be 600 m); netted at Kiau	heard at Poring (Harrap, 2010); Poring entrance, most visits heard (JAE)
Barred Eagle-Owl	<i>Bubo sumatranus</i>	600	909			to about 1000	heard at Poring lower elevations (Wall & Yong, 1985; taken to be 600 m)	
Brown Wood Owl	<i>Strix leptogrammica</i>			650	1650	1500		Seen at bat cave, Poring, Nov.2011 (c. 650 m; JAE); seen from 1550–1650 m from Mar–Jun in 2009–2011 (AJB); also seen or heard somewhere between headquarters and Timpohon gate in 2007 (Bishop, 2007), and 2008 (Eaton, 2008; Harrap, 2008; Hutchinson, 2008, Jun, Jul); also Mesilau (Phillips, 2011)
Collared Owlet	<i>Glaucidium brodiei</i>	1515	1600	1450	1900*	to 1530 on Mt. Kinabalu, to 2100 on Mt. Trus Madi	also c. 3300 ft specimen from Kinokok; dead bird at park headquarters in 1989; 1600 m (Bium, 1999)	range from AJB data
Brown Hawk-Owl	<i>Ninox scutulata</i>		1515		1530		eggs at Kaung; collected at Ranau	heard at Poring (Benstead & Benstead, 2001)
CAPRIMULGIFORMES: Podargidae								
Gould's Frogmouth	<i>Batrachostomus stellatus</i>				650	to 915		day roosting at canopy walkway (taken to be 560 m) by Uthai Treeson in 2002; in Apr.2011 A. Pearce (audio recording) and AJB made audio recordings of one just above bat cave (c. 650 m)
Bornean Frogmouth†	<i>Batrachostomus mixtus</i>	700	2540	1575	1850**	610–2540	calls heard at Park Headquarters in 1984, 1985 thought to be this species; nesting on Silau Silau trail in 1982 (Phillips, 1986; taken to be 1575 m); netted at 700 m, no photograph (Bium, 1999); to 2540 on Kinabalu before 1998 (Mann, 2008)	audio recordings from Oct.2011 of birds near hill lodge (c. 1575 m) and on road opposite Bukit Ular (c. 1850 m) (S. Woods pers. comm.; JAE)
Blyth's Frogmouth	<i>Batrachostomus affinis</i>					to about 800	seen and heard at Poring by Dennis Yong, between 1978 and 1996	

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
CAPRIMULGIFORMES: Caprimulgidae								
Malaysian Eared Nightjar	<i>Lyncornis temminckii</i>		1061		500	at least 1065	also Tenompok	heard at Poring headquarters (Woods, 2007; taken to be 500 m); 3 birds at Monggis substation, Mt. Tambuyukon (350 m, Jun 2011, AJB)
Grey Nightjar	<i>Caprimulgus jotaka</i>		1575			2000	migrants at Kinabalu Park headquarters since 1982 (taken to be 1575 m); Dec.1984, Mar.1985 (Phillips, 1986)	flushed about 2 km up power station road from headquarters (Addison, 2002); seen somewhere in between park headquarters and Timpohon gate (Merrill, 2011, AKN)
Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	394	606			1190	also Bundu Tuhan 3900 ft	
APODIFORMES: Hemiprocidae								
Grey-rumped Treeswift	<i>Hemiprocne longipennis</i>	500	975	500		at least 1050	specimen from Kinabalu (no locality data); Poring headquarters (Vermeulen, 1996; taken to be 500 m); c. 975 m above Poring (Nezadal, 1991, AKN)	small numbers at Poring (Valentine & Thurmlangan, 2008ab); Poring headquarters (Harrap, 2010; taken to be 500 m); fairly common at Poring (Wallace & Wallace, 2001)
Whiskered Treeswift	<i>Hemiprocne comata</i>					850	Poring (no locality data)	Poring (Newnham, 2007); c. 200 m at Serinsim (Sheldon et al., 2004)
APODIFORMES: Apodidae								
Giant Swiftlet	<i>Hydrochous gigas</i>			500	1900	about 1800		between park headquarters and Timpohon gate (Caratello, 2003; Roberson, 2003, AKN); four on Mt. Kinabalu (Hornbuckle, 2005); four from Kiau View (Dobbs, 2008; taken to be 1665 m); inspecting Langanan waterfall for possible nesting (Eaton, 2009, May; 1000 m); summit trail (Hutchinson, 2009, Jul; taken to be c. 1900 m); records of vocal flocks when weather is bad and cloud ceiling low; between park headquarters and Timpohon gate (1700–2000 m) in 2009–2011 (AJB); Mesilau, May 2009 (JAE, c. 1900 m); on entrance road from Ranau, c. 500 m at edge of Poring town (F. Rheindt, Jul.2010, pers. comm.)
Glossy Swiftlet	<i>Collocalia esculenta</i>		1500	645		probably up to 4120	specimen from 1500 m (Moyle et al., 2008); Mann (2008) states that the swiftlets at park headquarters are <i>C. esculenta</i>	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Gurney, 2010); audio recording from Aug.2010 at bat cave, c. 645 m (P. C. Rasmussen, AVoCet)
Bornean Swiftlet	<i>Collocalia dodgei</i>			1800	2730	none specified	confusion with previous species makes it difficult to compare; Jenkins et al. (1996) said <i>C. esculenta</i> was found “from the coast to the highest point on Kinabalu” but this probably refers to <i>C. dodgei</i>	specimens collected from 1500 m in 1937, also up to 2730 m (Moyle et al., 2008); 1800–1900 m (AJB); 1861 m (JBCH)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
[Edible-nest Swiftlet]	<i>Aerodramus fuciphagus</i>		939			none specified but record from 1130 in Sarawak	Griswold specimen; lowland cave resident, possibly a doubtful record	
Silver-rumped Spinetail	<i>Rhiphidura leucopygialis</i>			530		none given	sight records from Poring (no locality data); also a possibly doubtful record from somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN)	530 m (JBCH); many trip report records from Poring
Brown Needletail	<i>Hirundapus giganteus</i>		1575			1700	Kinabalu Park headquarters taken to be 1575 m; sight record from Poring (no data)	c. 1930 m at Mesilau (Harding, 2011, AKN)
Asian Palm Swift	<i>Cypsiurus balasensis</i>			500		750	specimens from Kinabalu (no locality data)	seen near Poring headquarters, 500 m (JBCH); c. 200 m at Serinsim (Sheldon et al., 2004); also "lower slopes of Kinabalu Park" (Dobbs, 2008)
<u>[Fork-tailed Swift]</u>	<i>Apus pacificus</i>					none given	small numbers at Poring (Vermeulen, 1996)	seen at Poring (Benstead & Benstead, 2001)
<u>[House Swift]</u>	<i>Apus nipalensis</i>	975				1450	c. 975 m above Poring (Nezadal, 1991, AKN)	Poring (Harrap, 2010); and "near Kinabalu [park]" (Harrap, 2008, 2010); at site "near Mt. Kinabalu" where Pygmy Ibon was observed (Harrap, 2011); also somewhere between park headquarters and Timpohon gate (Brown, 2011, AKN)
TROGONIFORMES: Trogonidae								
Red-naped Trogon	<i>Harpactes kasumba</i>	700	800			1220	sight records from Poring; 1982 and 1985 in bamboo grove (Phillips, 1986; taken to be c. 800 m); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); heard at Poring (Harrap, 2011); 600–800 m at Poring (F. Rheindt, Jul.2010, pers. comm.)
Diard's Trogon	<i>Harpactes diardii</i>		700	560	905	1220	Poring (no locality data); Ranau; 700 m (Biun, 1999)	905 m (JBCH); c. 200 m at Serinsim (Sheldon et al., 2004); heard at Poring (Bishop, 2010; only hiked to "above bat cave"; taken to be c. 600 m); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted)
Whitehead's Trogon	<i>Harpactes whiteheadi</i>	909	1970	1450	1900	900–2500, up to 1780 at least on Kinabalu [unclear where 2500 record comes from] (Mann, 2008); 900–2000 in Sabah (Sheldon et al., 2001)	many specimens from 3000–6000 ft; 6500 ft record (1970 m) "presumed to be of this species (Smythies)"; breeding behaviour seen near park headquarters (Phillips, 1986)	1450–1900 m (AJB); 1557–1760 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Cinnamon-rumped Trogon	<i>Harpactes orrphaeus</i>	700	<u>1550</u>			1530	netted at 700 m (Biun, 1999); higher elevations of Poring, taken to be c. 800 m (Wall & Yong, 1985)	heard at Poring (Newnham, 2007); 900–1000 m at Sayap (Moyle & Sheldon, 2000)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Scarlet-rumped Trogon	<i>Harpactes duvaucelii</i>		1575	650		to 1005, occasionally to 1500	Poring in 1982, Park Headquarters in 1986, 1988 (taken to be 1575 m)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Harrap, 2011); near bat cave, c. 650 m, Poring (F. Rheindt, Jul.2010, pers. comm.)
Orange-breasted Trogon	<i>Harpactes oreskios</i>	303	1061	750	900	200–1500		below 3 km mark on waterfall trail, Poring (taken to be c. 900 m) (Addison, 2002); regularly seen/heard at Poring, 2002–2011, usually 1.5–2 km on Langanan trail (750–900 m; JAE)
CORACIIFORMES: Coraciidae								
<u>Oriental Dollarbird</u>	<i>Eurystomus orientalis</i>					resident and migratory populations in Borneo; no upper margin given	specimens with no locality data; sight records from Poring “where it is common” (Phillips & Phillips cited in Jenkins et al., 1996)	seen somewhere between Kinabalu Park headquarters and Timpohon gate (Wallace & Wallace, 2001); 250–450 m at Serinsim (Sheldon et al., 2004)
CORACIIFORMES: Alcedinidae								
Rufous-collared Kingfisher†	<i>Actenoides concretus</i>	500	1667	530	750**	1680		530 m (JBCH); up to 750 m at Poring (JAE); female at bat cave (Benstead, 2004; taken to be 645 m); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Banded Kingfisher	<i>Lacedo pulchella</i>	606	1030	500	975	1680		894 m (JBCH); c. 200 m at Serinsim (Sheldon et al., 2004); range from JAE
<u>Black-capped Kingfisher</u>	<i>Halcyon pileata</i>					none given	Jenkins & de Silva (1978) cited Smythies (1968), saying this species occurs on “Kinabalu foothills”	
Collared Kingfisher	<i>Todiramphus chloris</i>					occasionally up to 1500	specimen obtained by Treacher on Kinabalu (no locality data); somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN)	Poring (Wallace & Wallace, 2001); c. 200 m at Serinsim (Sheldon et al., 2004); “at Mt. Kinabalu at an unusually high altitude” (Myers, 2011)
Blue-banded Kingfisher	<i>Alcedo euryzona</i>		1212	560		1400		stream crossing on trail to Langanan waterfall (Wallace & Wallace, 2001); c. 200 m at Serinsim, netted in small stream (Sheldon et al., 2004); second stream crossing on Langanan trail (Benstead, 2004; taken to be c. 600 m), Poring at c. 560 m (Brown, 2011, AKN)
Blue-eared Kingfisher	<i>Alcedo meninting</i>					1375		around the river at Poring (Addison 2002); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Oriental Dwarf Kingfisher	<i>Ceyx rufidorsa</i>		909	560		1200	also netted at Poring (no locality data)	c. 200 m at Serinsim (Sheldon et al., 2004); hike to waterfall, Poring (Shaekelford, 2007); Poring (Matheve et al., 2008); Poring, c. 560 m (Harding, 2011, AKN); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
CORACIIFORMES: Meropidae								
Red-bearded Bee-eater	<i>Nyctornis amictus</i>	303	800	560	833	1200	Ranau; higher elevations of Poring (Wall & Yong, 1985 taken to be c. 800 m)	250–450 m at Serinsim (Sheldon et al., 2004); Poring, c. 560 m (Harding, 2011, AKN); 671–833 (JBCH)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Blue-throated Bee-eater	<i>Merops viridis</i>					800	sight records from Poring in 1976	
BUCEROTIFORMES: Bucerotidae								
Bushy-crested Hornbill	<i>Anorrhinus galeritus</i>	303	1061	500		to 1065 in Sabah		2–3 seen on 24 Jun.2010 at hot pools, Poring (F. Rheindt, pers. comm.; c. 500 m)
Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>		1575			500	seen by Jenkins at park headquarters in 1970 (taken to be 1575 m); Jenkins et al. (1996) said: thought by some authorities to be a doubtful record	
Black Hornbill	<i>Anthracoceros malayanus</i>	303	600			about 1000	eggs at Kaung; lower elevations of Poring (Wall & Yong, 1985; taken to be 600 m)	interesting that there are no recent records
Rhinoceros Hornbill†	<i>Buceros rhinoceros</i>	1061	1758	645	950**	to 2000 or 2500 (Mann, 2008); to 1750 in Sabah (Sheldon et al., 2001)		645–824 m (JBCH); seen at 2.7 km up waterfall trail (Dobbs, 2008; taken to be c. 950 m)
Helmeted Hornbill	<i>Rhinoplax vigil</i>	700	909		800	to 915, perhaps to 1800	700 m (Biun, 1999)	heard at Poring (Hornbuckle, 2005); regularly heard Poring at km 1.8 on Langanan trail at least (JAE)
Wreathed Hornbill	<i>Rhyticeros undulatus</i>	700	2848	750	2400**	3050	700 m (Biun, 1999); flyover records up to 3030 m (Jenkins et al., 1996) and 3100 m (Biun, 1999)	1700 m on Mt. Kinabalu (Ericsson, 2005); a pair at Poring (Newnham, 2007); Poring in flight (Valentine & Thurmilangan, 2008a); seen at 1900 m (AJB); seen at 2400 m on summit trail, Jun.2011 (Harding, 2011, AKN; pers. comm.); regular, 1.5 km a pair at c. 750 m, along Langanan trail and above (JAE)
PICIFORMES: Capitonidae								
Gold-whiskered Barbet	<i>Megalaima chrysopogon</i>	303	1061	530	866	to at least 1525		range from JBCH data; c. 200 m at Serinsim (Sheldon et al., 2004)
Red-crowned Barbet	<i>Megalaima rafflesii</i>					1300	specimen from Kinabalu without locality data	
Red-throated Barbet	<i>Megalaima mystacophanos</i>	500	1061	513	1002	1380		c. 200 m at Serinsim (Sheldon et al., 2004); also a doubtful record from the Kinabalu Park headquarters area (Hornbuckle, 2005); range from JBCH data
Mountain Barbet	<i>Megalaima monicola</i>	<u>700</u>	2182	1002	2085	750–2200	sight record at 700 m (Biun, 1999)	1002–1620 m (JBCH); recent records (no photographs) from 2085 and 2600 m on summit trail, Jun.2011 (S. T. Yeo, pers. comm.; L. Harding, BIW; J. Harding, AKN); We consider the 2600 m record to be unconfirmed until details become available.
Yellow-crowned Barbet	<i>Megalaima henrici</i>		1061	500	894	1220		645–894 m (JBCH); record from behind football pitch near Poring headquarters (Dobbs, 2008; taken as 500 m)
Golden-naped Barbet	<i>Megalaima pulcherrima</i>	909	3182	1465	2613**	600–3200		range from JBCH data, Mesilau headquarters (JBCH)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Blue-eared Barbet	<i>Megalaima australis</i>	303	1061	516	927	1065		250–450 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Bornean Barbet†	<i>Megalaima eximia</i>	560	2121	600	1800**	425–2140	“appears to be rare” (Jenkins et al., 1996); canopy walkway, Poring (Verneulen, 1996; taken to be 560 m)	Poring, 600 m (Edwards, 2008, Xeno Canto); seen at Poring (Dobbs, 2008; Hutchinson, 2011); heard in Kinabalu Park (Bishop, 2010); “high on the [waterfall] trail at Poring” (Harrap, 2010); 900–1000 m at Sayap (Moyle & Sheldon, 2000); km 1.8 and above on waterfall trail (JAE; c. 800–1000 m); photographed at c. 1800 m, Jun.2011 (S. T. Yeo and L. Harding, AKN, 2011; pers. comm.)
Brown Barbet	<i>Calorhamphus fuliginosus</i>	303	1061	500	1000	1450		250–450 m at Serinsim (Sheldon et al., 2004); Poring headquarters (Addison, 2002; taken to be 500 m); Poring (Newnham, 2007; Gurney, 2010); common at Poring up to waterfall (JAE; 500–1000 m)
PICIFORMES: Indicatoridae								
Malaysian Honeyguide	<i>Indicator archipelagicus</i>	700	800	500		1300	sight record at 700 m (Biun, 1999); higher elevations of Poring (Wall & Yong, 1985; taken to be c. 800 m)	several sightings before 2008 near Poring canopy walkway (fide JAE), juvenile seen c. 2007 at Brown Barbet colony near Poring resort, c. 500 m (K. Barnes pers. comm.)
PICIFORMES: Picidae								
<i>[Speckled Piculet]</i>	<i>Picumnus innominatus</i>				1000	up to 1220 on Mt. Magdalena, usually in hilly country		near Langanan waterfall, Poring (Harrap, 2010; taken to be c. 1000 m)
Rufous Piculet	<i>Sasia abnormis</i>	303	700	560	900	1590	700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); seen at 2 km mark on Langanan waterfall trail (Low, 2007; taken to be c. 900 m); 826 m (JBCH); bat cave, 645 m, male making a hole for 1 h with female nearby in 2009 (JAE); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Grey-and-Buff Woodpecker	<i>Hemicircus concolor</i>	500	550			1530	Poring, 1981, 1985; 1981 record at hot pools clearing (Phillips, 1986) and 1985 in forest “just above the pools” (taken to be 500–550 m)	250–450 m at Serinsim (Sheldon et al., 2004); seen at Poring (Hornbuckle, 2005)
Grey-capped Woodpecker	<i>Dendrocopos canicapillus</i>	606	909	500	600	1700		heard at Poring (Bishop, 2010, hiked to above bat cave; taken to be c. 600 m); Poring, c. 500 m (Watson, 2010, AKN); Poring (Myers, 2011)
Banded Woodpecker	<i>Chrysophlegma miniaceum</i>	303	939	500	800	1675		near Kipungit waterfall (Wallace & Wallace, 2001; taken to be 565 m); near Poring headquarters (Low, 2007; taken to be 500 m); Poring (Valentine & Thurmilang, 2008b); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW); Poring, 800 m (JAE)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Checker-throated Woodpecker	<i>Chrysophlegma mentale</i>	545	1667	600	1900*	to at least 1835, perhaps to 2160 on Mt. Trus Madi	also Ranau; somewhere between Kinabalu Park headquarters and Timpohon gate (Roberson, 1988, AKN)	250–450 m at Serinsim (Sheldon et al., 2004); past Kipungit waterfall (Low, 2007; taken to be c. 600 m); Poring (Shackelford, 2007); 1450–1900 m (AJB); Mesilau, Sep 2009 (C. Lee, BIW, accepted)
Crimson-winged Woodpecker	<i>Picus puniceus</i>	606	1667	500	1575	1700	also Ranau; somewhere between Kinabalu Park headquarters and Timpohon gate (Bono, 1997, AKN)	250–450 m at Serinsim (Sheldon et al., 2004); Kiau view trail (Hall & Kroll, 2004); Poring (Shackelford, 2007); Mt. Kinabalu (Harrap, 2010); somewhere between Kinabalu Park headquarters and Timpohon gate (Harding, 2011, AKN); 900–1000 m at Sayap (Moyle & Sheldon, 2000); recent records from Poring headquarters (JAE; 500 m); Mempening trail, taken to be c. 1575 (S. T. Yeo, BIW, May 2011)
Olive-backed Woodpecker	<i>Dinopium rafflesii</i>	606		560		1590	also at Ranau	seen at Poring (Hornbuckle, 2005; Matheve et al., 2008; Eaton, 2010 Oct); canopy walkway, taken to be 560 m, Sep 2009 (C. Lee, BIW, accepted)
Maroon Woodpecker	<i>Blythipicus rubiginosus</i>	700	2100	530	1921**	1800	range from Biun (1999)	250–450 m at Serinsim (Sheldon et al., 2004); range from JBCH data; 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Orange-backed Woodpecker	<i>Reinwardtipicus validus</i>		1561	818	1900*	to 1985 on Mt. Murud, Sarawak, at 1530 on Mt. Kinabalu	breeding near Mt. Kinabalu headquarters (nestling observed)(Phillips, 1986)	250–450 m at Serinsim (Sheldon et al., 2004); Mesilau (Kiong, 2007, OBI; taken to be c. 1900 m); uncommon 1450–1900 m (AJB); 818 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000); regularly seen at Mesilau car park, 2009–2010 (JAE; 1900 m)
Rufous Woodpecker†	<i>Micropternus brachyurus</i>	700	1600	500	600**	to 1818 in Sabah (Gore 1968)	1600 m (Biun, 1999); higher elevations at Poring (Wall & Yong, 1985; taken to be c. 800 m)	near Kipungit waterfall (Wallace & Wallace, 2001; taken to be 565 m); Poring (Valentine & Thurmilangan, 2008a); Poring (Bishop, 2010, only hiked to above bat cave; taken to be c. 600 m); c. 500 m at Poring (Watson, 2010, AKN)
Buff-rumped Woodpecker	<i>Meiglyptes tristis</i>			500	563	to 765, possibly to 1100	2500 ft, Nalumad on the east side of Kinabalu; also collected at Ranau; Poring (Vermeulen, 1996)	250–450 m at Serinsim (Sheldon et al., 2004); near waterfall at Poring (Addison, 2002; taken to be c. 950 m); Poring (Valentine & Thurmilangan, 2008a, 2008b); Poring car park (Eaton, 2009, May; taken to be 500 m); canopy walkway, taken to be 560 m, Oct 2010 (L. S. Ni, J. Ong, BIW); 563 m (JBCH)
Buff-necked Woodpecker	<i>Meiglyptes tukki</i>	303	700		630	1225	700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring, <1.5 km up Langanan waterfall trail (Addison, 2002; taken to be c. 600 m); seen at Poring (Valentine & Thurmilangan, 2008a); below bat cave, c. 630 m, Poring (F. Rheindt, Jul 2010, pers. comm.)
PASSERIFORMES: Eurylaimidae								
Green Broadbill	<i>Calptomena viridis</i>	700	1212	560	900	generally below 700 but occasionally as high as 1300	at Poring 1986, 1989, 1990 (Batchelor, 1991); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); close views at Poring (Shackelford, 2007); 2 km up waterfall trail (Low, 2007; taken to be c. 900 m); canopy walkway at Poring (Dobbs, 2008; taken to be 560 m)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Hose's Broadbill	<i>Calypptomena hosii</i>	700	795	550	975	1680	700 m (Biun, 1999); 795 m at Poring (Smythies, 1981 in Mann, 2008)	seen at Poring (Hombuckle, 2005; Eaton, 2008, Oct and several other trip reports); 2.7 km up waterfall trail (Dobbs, 2008; taken to be c. 950 m); range from JAE 1450–1900 m (AJB); 1516–1550 m (JBCH); 2.7 km up waterfall trail (Dobbs, 2008; taken to be c. 950 m); 900–1000 m at Sayap (Moyle & Sheldon, 2000); 700 m, Jun.2002, Oct.2008 (JAE)
Whitehead's Broadbill	<i>Calypptomena whiteheadi</i>	700	1667	700	1900*	to 1850 on Mt. Trus Madi, to 1700 on Mt. Kinabalu	700 m (Biun, 1999); somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN); also eggs at Kiau	
Black-and-Red Broadbill	<i>Cymbirhynchus macrorhynchus</i>	500	972	530		to at least 900	common at Poring (Jenkins et al., 1996); also collected at Kaung; lower elevations at Poring (Wall & Yong, 1985); at least up to Kipungit waterfall in 1990 (Batchelor, 1991)	c. 200 m at Serinsim (Sheldon et al., 2004); seen at Poring bathing area (Dobbs, 2008; taken to be 530 m); seems to no longer be common at Poring
Long-tailed Broadbill†	<i>Psarisomus dalhousiae</i>	909	1667		1500**	900–1700	14 specimens collected from 3000–4500 ft before 1978	nesting at 1500 m in 2010 (AJB); 900–1000 m at Sayap (Moyle & Sheldon, 2000); Langanan waterfall (Rheindt, 2003; taken to be c. 1000 m)
Banded Broadbill	<i>Eurylaimus javanicus</i>	303	600	500	843	1220	heard lower elevations of Poring (Wal & Yong, 1985; taken to be 600 m)	250–450 m at Serinsim (Sheldon et al., 2004); 572–843 m (JBCH); 500–750 m (JAE)
Black-and-Yellow Broadbill	<i>Eurylaimus ochromelas</i>	303	700	530	1547*	at least 1800	also Kundasang 4300 ft; Ranau; Poring (Jenkins et al., 1996); lower elevations of Poring (Wall & Yong, 1985); 700 m (Biun, 1999)	250–450 m at Serinsim (Sheldon et al., 2004); Poring (Valentine & Thumilangan, 2008a and others); around baths at Poring (Dobbs, 2008; taken to be 530 m); 832–1547 m (JBCH; heard at 1547 m); c. 1000 m above Monggis, Tambuyukon Jun.2011 (AJB)
Dusky Broadbill	<i>Corydon sumatranus</i>	600	1818			to at least 1220, once at 1600, possibly to 1835	lower elevations of Poring (Wall & Yong, 1985; taken to be 600 m); two at Poring (Vermeulen, 1996)	seen on waterfall trail at Poring (White & Clarke, 2003); past Kipungit waterfall (Rheindt, 2003; taken to be c. 600 m)
PASSERIFORMES: Pittidae Giant Pitta	<i>Hydroornis caeruleus</i>			700	750	1525		female seen very well by Matheve et al. (2008) and F. Verbeelen (also 2008) at 1.4 km marker, c. 700 m; heard singing at 750 m at Poring, May 2011 (99% probability) (AJB)
Blue-headed Pitta	<i>Hydroornis baudii</i>					to 610, possibly to 1200	sight record from Poring by “Peters” (Jenkins et al., 1996)	
Bornean Banded Pitta	<i>Hydroornis schwaneri</i>	600	1515	600	750	1680	heard at lower and upper elevations of Poring (Wall & Yong, 1985; taken to be 600 and 800 m)	heard from canopy walkway (Poring), seen 1.8 km along waterfall trail and near waterfall (Addison, 2002; taken to be 560, c. 800 and c. 950 m, respectively); 1–2 males along Langanan trail (Benstead, 2004); Poring, 600 m (Edwards, 2008, Xeno Canto); waterfall trail (Eaton, 2008); Poring (Hutchinson, 2008 Jun, Jul); male seen, 750 m (JAE)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Blue-banded Pitta	<i>Erythropitta arquata</i>	606	1212	560	960	150–1520		km 2.9 on Langanan trail (Dobbs, 2008; taken to be c. 960 m); Poring, c. 560 m (Brown, 2011, AKN); 782 m (JBCH)
Black-crowned Pitta	<i>Erythropitta ussheri</i>					none given		250–450 m at Serinsim (Sheldon et al., 2004); two seen at Poring, c. 560 m (Barnes, 2005, AKN)
<u>Blue-winged Pitta</u>	<i>Pitta moluccensis</i>		1575			1800	seen at Tenompok pass 4800 ft (migrant); dead birds collected at park headquarters in Apr and Oct	
PASSERIFORMES: Acanthizidae								
Golden-bellied Gerygone	<i>Gerygone sulphurea</i>			500	560	1700	rare. Specimen from “lower slopes of Kinabalu” (Jenkins & de Silva, 1978)	seen on Kinabalu (Bishop, 2007); heard and seen fairly frequently in Kinabalu Park (Bishop, 2010); Poring, c. 500 m (Watson, 2011, AKN); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted)
PASSERIFORMES: Tephrodornithidae								
Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	700	1515	530	1547	Mostly 750 to 1835; occasionally below 150	Silau Silau trail, c. 5000 ft (1515 m) in 1989 (Batchelor, 1991); 700 m (Biun, 1999)	250–450 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Black-winged Flycatcher-shrike	<i>Hemipus hirundinaceus</i>	600	700	500	560	1200	collected at Ranau; lower elevations of Poring (Wall & Yong, 1985; taken to be 600 m); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Barnes, 2009); near Poring headquarters (Harrap, 2011; taken to be 500 m); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted)
Large Woodshrike	<i>Tephrodornis virgatus</i>		909	800	900	1150	Poring, 1986, 1988 (Batchelor, 1991); Poring (Vermeulen, 1996)	c. 200 m at Serinsim (Sheldon et al., 2004); 2 km along waterfall trail (Low, 2007; taken to be 900 m); Poring (Newnham, 2007); 800 m, Poring (JAE)
Rufous-winged Philentoma	<i>Philentoma pyroptera</i>	500				1530	netted at Poring, c. 1600 ft in 1971	interesting that there are no recent records
Maroon-breasted Philentoma	<i>Philentoma velata</i>	545	1500		800	1530	somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN); 700 m (Biun, 1999)	canopy walkway, Poring (Gabrielsen, 2005, OBI; taken to be 560 m); Poring (Matheve et al., 2008); 800 m (JAE)
PASSERIFORMES: Artamidae								
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	333		1575	1900	2000	along roadsides in Poring and Ranau (Batchelor, 1991)	seen at 1900 m on Mt. Kinabalu (Sheldon & Moyle, 2008); seen from Kiau View (taking thermals up from open country) and over park headquarters (Dobbs, 2008; taken to be 1575 m); Mesilau vegetable garden near Bukit Babi, Apr.2011 (AB)
PASSERIFORMES: Aegithinidae								
Common Iora	<i>Aegithina tiphia</i>	500		560		610	collected at Ranau	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Barnes, 2009); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
<i>Green Iora</i>	<i>Aegithina viridissima</i>			500	850	1220		upper boundary with an audio recording (JBCH); 250–450 m at Serinsim (Sheldon et al., 2004); Poring (Benstead & Benstead, 2001; Rheindt, 2003; Valentine & Thurmilangan, 2008a; Barnes, 2009; Lambert & Yong, 2010); near Poring HQ (Harrap, 2011; taken to be 500 m)
PASSERIFORMES: Campephagidae								
Sunda Cuckoo-shrike	<i>Coracina larvata</i>	909	1970	1450	2040	700–2550	up to at least 6500 ft (1970 m) and “along power station road” in 1989 (Batchelor, 1991)	1450–1900 (AJB); 2040 m on Mt. Kinabalu (N. Athanas, 2008, Xeno Canto); “greater than 2000 m on summit trail” (taken to be c. 2050 m but Xeno Canto record more accurate) and c. 1900 m at Mesilau (Harding, 2011, AKN)
Bar-bellied Cuckoo-shrike	<i>Coracina striata</i>	560	1212		1250		seen at Poring by “Berwick & Lathbury” (Jenkins & de Silva, 1978); to 4000 ft on Kinabalu (Smythies, 1959 in Jenkins & de Silva, 1978); canopy walkway, Poring (Vermeulen, 1996; taken to be 560 m)	interesting that there are no recent records
Lesser Cuckoo-shrike	<i>Coracina fimbriata</i>	909			1036			canopy walkway (Rheindt, 2003; taken to be 560 m); at Poring (one bird on two days)(Newnham, 2007)
Fiery Minivet	<i>Pericrocotus igneus</i>			550		to 600 (Sheldon et al., 2001)	status uncertain-no locality data for two specimens	near Poring headquarters (Addison, 2002); female seen well at fruiting tree at 550 m, Poring (Dobbs, 2008)
Grey-chinned Minivet	<i>Pericrocotus solaris</i>	909	2600	1504	2456**	650–2440	1600–2600 m (Biun, 1999)	range from JBCH data; 900–1000 m at Sayap (Moyle & Sheldon, 2000); Mesilau, Dec.2008 (C. Lee and S. T. Yeo, BIW, accepted)
Scarlet Minivet	<i>Pericrocotus speciosus</i>	700	1212	560		to at least 1300	700 m (Biun, 1999); at Poring in 1986 and 1989 (Batchelor, 1991)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring, “along upper trail” (Addison, 2002; taken to be at least 800 m); a group at Poring (Woods, 2008); 900–1000 m at Sayap (Moyle & Sheldon, 2000); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
PASSERIFORMES: Pachycephalidae								
Bornean Whistler	<i>Pachycephala hypoxantha</i>	909	3100	1450	2597**	2920	more common at higher elevations; netted 1600–3100 m (Biun, 1999)	breeds down to 1450 m (AJB); 1506–2597 m (JBCH); Mesilau, Dec.2008 (C. Lee, BIW, accepted)
PASSERIFORMES: Laniidae								
Tiger Shrike	<i>Lanius tigrinus</i>					1300	sight records from Ranau	
Brown Shrike	<i>Lanius cristatus</i>					1700	collected on Kinabalu at low altitudes	Poring (Hornbuckle, 2005)
<i>Long-tailed Shrike</i>	<i>Lanius schach</i>					none given		on hillside just below the Kinabalu Heritage Resort (Kampung Simisian), 1320 m, 2009–2011 (AJB); on powerlines “near Mesilau” (Myers, 2010, Jul; taken to be at least 1700 m); between Kundasang and Mesilau, pair, calling, May 2009, again Nov.2010, seems to refer to race <i>nasutus</i> (JAE)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
PASSERIFORMES: Vireonidae								
White-bellied Erpornis	<i>Erpornis zantholeuca</i>	700	1515	516	1800*	sea level to over 1750	700 m (Biun, 1999)	516–1500 m (JBCH); uncommon to at least 1800 m (AJB)
Blyth's Shrike Babbler	<i>Pteruthius aeralatus</i>	1212	3030	1510	3003	750–3100		two possibly doubtful records from low elevations at Poring: c. 500 m (Watson, 2010, AKN), "seen very nicely from the canopy walkway" (Bishop, 2010; taken to be 560 m); range from JBCH data: Mesilau headquarters (JBCH)
PASSERIFORMES: Oriolidae								
Dark-throated Oriole	<i>Oriolus xanthonotus</i>	300	800	516	563	to at least 1315	Ranau; not found above 300 m by Whitehead; lower and higher elevations of Poring (Wall & Yong, 1985; taken to be 600 and 800 m)	250–450 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Black-naped Oriole	<i>Oriolus chinensis</i>	606				either a rare resident or an escapee; no maximum given	collected in 1893 at Kampung Melangkap at 2000 ft. Kinabalu; status unknown	
Black-and-crimson Oriole	<i>Oriolus cruentus</i>	700	1600	900	1900*	erroneously cites Jenkins and de Silva (1978) as saying "to 1835 on Kinabalu"; to 2300 on Trus Madi; down to 600	788–1575 m, common around park headquarters (Jenkins & de Silva, 1978); 700–1600 m (Biun, 1999); somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN; Bono, 1997, AKN)	250–450 m at Serinsim (Sheldon et al., 2004); km 2.1 on Langanan trail (Dobbs, 2008; c. 900 m); 1451–1779 m (JBCH); rare to 1900 m (AJB); Mesilau Jul–Aug.2005 (S. Wong, BIW, accepted)
PASSERIFORMES: Dicteriidae								
Ashy Drongo	<i>Dicrurus leucophaeus</i>	500	2600	1575	2052**	150–2200 or possibly 2400	also recorded at Kiau (eggs); Poring c. 975 m (Nezadal, 1991, AKN); 700–2600 m (Biun 1999)	Poring (Newnham, 2007; Harrap, 2011); greater than 2000 m on summit trail (Harding, 2011, AKN); 1762–2052 m (JBCH); bred at headquarters, c. 1575 m (AJB); many times at Mesilau headquarters (JAE); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Crow-billed Drongo	<i>Dicrurus annectans</i>	700	1600		1575	up to c. 600	collected at Poring; Kinabalu "low altitude"; 700 m, netted at 1600 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); clearing c. 500 m along Langanan waterfall trail (Addison, 2002; taken to be c. 600 m elevation); park headquarters May 2008 (N. Abghani, BIW, accepted; taken to be c. 1575 m)
Bronzed Drongo	<i>Dicrurus aeneus</i>	500	800		950		netted at Poring; higher elevations of Poring (Wall & Yong, 1985; taken to be 800 m); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Wallace & Wallace, 2001)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Hair-crested Drongo	<i>Dicrurus hottentottus</i>	700	2050	500	2050	1700	758–1575 m overall, eggs at Kaung, recorded from Pinosuk Plateau (Jenkins & de Silva, 1978); somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN; Bono, 1997, AKN); greater than 2000 m on the summit trail (Roberson, 1988, AKN; taken to be 2050 m); 700, 1600 m (Biun, 1999)	250–450 m at Serinsim (Sheldon et al., 2004); Poring (Roadhouse, 2009); Poring c. 500 m (Watson, 2010, AKN); Poring c. 560 m (Brown, 2011, AKN); seen 300 m up summit trail from Timpohon gate, c. 2050 m (Harding, 2011, AKN; L. Harding, pers. comm.); bred at 1900 m (AJB) (AJB) 927–1568 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	500	975	530	800	650	Kampung Nalumad; upper elevations of Poring (Wall & Yong, 1985; taken to be 800 m); Poring c. 975 m (Nezadal, 1991, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); 530–563 m (JBCH); regularly to c. 800 m on Langanan trail (JAE)
PASSERIFORMES: Rhipiduridae								
White-throated Fantail	<i>Rhipidura albicollis</i>	800	3100	975	3290*	700–2750	909–2727 m (Jenkins & de Silva, 1978); 1600–3100 m (Biun, 1999); common around park headquarters; also seen at higher elevations of Poring (Wall & Yong, 1985; taken to be c. 800 m)	1508–3290 m (JBCH); Mesilau headquarters (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000); c. 200 m below Langanan waterfall (Dobbs, 2008; taken to be c. 975 m)
Pied Fantail	<i>Rhipidura javanica</i>	300				1530	also Poring and at 5000 ft on Pinosuk plateau	c. 200 m at Serinsim (Sheldon et al., 2004)
Spotted Fantail	<i>Rhipidura perlata</i>	500	1606			1680		Poring (Hornbuckle, 2005); above Monggis, Tambuyukon, c. 800 m, Jun.2011 (AJB)
PASSERIFORMES: Monarchidae								
Black-naped Monarch	<i>Hypothymis azurea</i>	303	1212	560	984	1220	also Nalumad	250–450 m at Serinsim (Sheldon et al., 2004); canopy walkway at Poring (Dobbs, 2008; taken to be 560 m); 624–984 m (JBCH)
Asian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	500	700	640	984	1432	also at 4000 ft on road to Kinabalu Park from Kota Kinabalu; Ranau; 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); just below bat cave (Dobbs, 2008; taken to be c. 640 m); 984 m (JBCH)
PASSERIFORMES: Corvidae								
Crested Jay	<i>Platylophus galericulatus</i>	500	1303	510	984	1680	commonly seen at Poring	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data; many trip report records from Poring; 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Black Magpie	<i>Platysmurus leucopterus</i>	303	800			1065	“specimen at nearly 1000 ft”; lower and higher elevations of Poring (Wall & Yong, 1985; taken to be 600 and 800 m)	past Kipungit waterfall (Rheindt, 2003; taken to be c. 600 m); Poring (Hornbuckle, 2005; Matheve et al., 2008)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Common Green Magpie	<i>Cissa chinensis</i>	303	1515			to 1530 or 2150	303–1515 m, also at Kiau (eggs) (Jenkins & de Silva, 1978); 700 m, netted at 2100 m (no photograph) (Biun, 1999)	at Mt. Kinabalu (in between HQ and T gate): “longer tail with black and white edgings clearly differentiated it from the previous species [<i>C. thalassina</i>]” (Wallace & Wallace, 2001); Mt. Kinabalu (Hall & Kroll, 2004); between headquarters and Timpohon gate (Brown, 2011, AKN; taken to possibly be doubtful); near Rajah Lodge, park headquarters area, Aug.2008 (A. H. Peng, BIW, accepted; possibly doubtful, apparently no photograph); doubtful records from Mesilau, Apr.2006 (R. Teo, BIW, accepted)
Short-tailed Green Magpie	<i>Cissa thalassina</i>	909	2600	1508	2016**	305–2735	2600 m (Biun, 1999)	range from JBCH data, probably heard down to 961 m (JBCH); 300 m from Mesilau headquarters along Mesilau trail May 2009 (JAE)
Bornean Treepie	<i>Dendrocitta cinerascens</i>	303	2900	700	2300**	305–2900, occasionally much lower (Smythies, 1957, 1981 in Mann, 2008)	common from 2700–7000 ft	894–2284 m (JBCH); c. 200 m at Serinsim (Sheldon et al., 2004); 900–1000 m at Sayap (Moyle & Sheldon, 2000); audio recording from c. 2300 m, Aug.2010 (P. C. Rasmussen, AVoCet); Mesilau, Sep.2009 (C. Lee, BIW, accepted); regular down to 700 m at Poring (JAE)
Slender-billed Crow	<i>Corvus enca</i>	303				1065	Whitehead specimen from 1000 ft; also Poring (Jenkins & de Silva, 1978)	
Large-billed Crow	<i>Corvus macrorhynchos</i>					status unknown	status unknown, collected on Kinabalu by Everett	
PASSERIFORMES: Eupetidae								
Rail-babbler	<i>Eupetes macrocerus</i>		909			2135	above Poring at 3000 ft (909 m; Wall & Yong, 1985)	
PASSERIFORMES: Stenostiridae								
Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i> †	909	1667	700	1533**	to 1700		at Poring (“only hiked to above bat cave”, so taken to be < 700 m; Bishop 2010); c. 500 m at Poring (Watson, 2010, AKN); 782–1533 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
PASSERIFORMES: Pycnonotidae								
Straw-headed Bulbul	<i>Pycnonotus zeylanicus</i>	500	975			1500	eggs at Kiau; 9 at Poring (Vermeulen, 1996); c. 975 m at Poring (Nezadal, 1991, AKN)	seen near park headquarters, 1600 m, Apr.2011 (AB; possibly an escapee); appears to have been extirpated from most of its range in Sabah, presumably from pet traders (Sheldon et al., 2009) seen at c. 1500 m and c. 1650 m on 31 May (Harding, 2011, AKN; L. Harding and S. T. Yeo, pers. comm.)
Black-and-White Bulbul	<i>Pycnonotus melanoleucus</i>			1500	1650	1750+ at Mt. Mulu, 1280 at Mt. Luaku, once at 3050	10,000 ft (3030 m) record from a dead bird, probably a disperser	
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	700	1600	523	1575	at least 1700, once 2580	recorded at Poring; collected at Kaung; 700–1600 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); 523 m (JBCH); occasionally reaches park headquarters from Apr–Jun each year (AB)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Bornean Bulbul	<i>Pycnonotus montis</i>	700	1061			610–1550	also Bundu Tuhan (Batchelor, 1991); 700 m (Biun, 1999)	900–1000 m at Sayap (Moyle & Sheldon, 2000); interesting that there are no recent Poring records
Scaly-breasted Bulbul	<i>Pycnonotus squamatus</i>		700	516	675	1200	recorded in Ranau and Poring (no locality data); 700 m (Biun, 1999)	in clearing on way to Kipungit waterfall (Wallace & Wallace, 2001; taken to be 550 m); past bat cave (Low, 2007; taken to be c. 675 m); canopy walkway at Poring (Bishop, 2010; taken to be 560 m); 516–535 m (JBCH); past bat cave (Rheindt, 2003; taken to be c. 750 m)
Grey-bellied Bulbul	<i>Pycnonotus cyaniventris</i>					1300		c. 200 m at Serinsim (Sheldon et al. 2004)
Puff-backed Bulbul	<i>Pycnonotus euliotus</i>	550		520	645	1300	at Poring in Jun. 1989 somewhere between 500–600 m (Johnstone, 1989)	Poring (Benstead & Benstead, 2001; Matheve et al., 2008); on trail to bat cave (Wallace & Wallace, 2001); Poring near football pitch (Addison, 2002; taken to be 500 m); c. 200 m at Serinsim (Sheldon et al., 2004); bat cave (Low, 2007; taken to be 645); two at Poring (Dobbs, 2008); past bat cave (Rheindt, 2003; taken to be c. 750 m); c. 520 m, Poring (F. Rheindt, Jul. 2010, pers. comm.)
Flavescent Bulbul	<i>Pycnonotus flavescens</i>	1575	<u>3485</u>	1900*	3294**	to 3400 on Kinabalu (Sheldon et al. 2001)	Smythies (1968) said it was a montane resident from 3000–11500 ft (909–3485 m) from Kinabalu to Mt. Murud but it is not clear if these lower elevations include Mt. Kinabalu. Many collected from 5200–10200 ft (1575–3091 m) Jenkins & de Silva (1978); 1600–3100 m (Biun, 1999)	Mesilau (Bishop, 2010 and other trip reports; taken to be c. 1940 m); 2184–3294 m (JBCH); regular down to 1900 m (AJB)
Yellow-vented Bulbul†	<i>Pycnonotus goiavier</i>	500	1575	500	560**	1590	also Kundasan[g] (Batchelor, 1991); seen near park headquarters (Jenkins, 1970)	c. 200 m at Serinsim (Sheldon et al., 2004); Kundasang (Gurney, 2010); Poring headquarters (Dobbs, 2008; taken to be c. 500 m); canopy walkway, taken to be 560 m, Oct. 2010 (L. S. Ni, J. Ong, BIW)
Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	500		516	540	up to 490 at Poring, 1700 at Bangau, Kaliaantan Timur		c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Cream-vented Bulbul	<i>Pycnonotus simplex</i>	303	700	523	624	1300	700 m, netted at 3100 m (Biun, 1999; we consider the latter to be a vagrant or an error)	c. 200 m at Serinsim (Sheldon et al., 2004); Langanan trail (Addison, 2002); range from JBCH data
Asian Red-eyed Bulbul	<i>Pycnonotus brunneus</i>	500		516	560	1005		c. 200 m at Serinsim (Sheldon et al., 2004); 516 m (JBCH); canopy walkway, taken to be 560 m, Sep. 2009 (C. Lee, BIW, accepted)
Spectacled Bulbul	<i>Pycnonotus erythrophthalmos</i>	500	975	516	961	up to about 1300	collected at Ranau; c. 975 m at Poring (Nezadal, 1991, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data (upper margin with audio recording)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Ochraceous Bulbul†	<i>Alophoixus ochraceus</i>	700	2636	1452	1780**	305–2650	700 m (Biun, 1999)	range from JBCH data; Poring (Wallace & Wallace, 2001; Matheve et al., 2008; Harrop, 2011); Mesilau (Kiong, 2007; OBI; JAE; taken to be c. 1940 m); somewhere between park headquarters and Timpohon gate (Merrill, 2011, AKN; Harding, 2011, AKN); Mesilau c. 2000 m (Brown, 2011, AKN); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Grey-cheeked Bulbul†	<i>Alophoixus bres</i>	500	1485	500	927**	1500		Poring c. 500 m (Watson, 2010, AKN); 624–927 m (JBCH)
Yellow-bellied Bulbul	<i>Alophoixus phaeocephalus</i>	500	700	550	905	1650	Poring Hot Springs, 1982, 1985 (Phillips, 1986; taken to be c. 500 m); 700 m (Biun, 1999)	Poring, c. 550 m (Brown, 2011, AKN; Harding, 2011, AKN); 894–905 m (JBCH)
Hairy-backed Bulbul	<i>Tricholestes criniger</i>	500	700	530	902	to at least 900	700 m (Biun, 1999)	range from JBCH data
Buff-vented Bulbul	<i>Iole olivacea</i>			500	600	to at least 950		Poring (Benstead & Benstead, 2001; Gurney, 2010, Lambert & Yong, 2010); Poring, 600 m (JBCH); Poring (Mann, 2008, no observer or date specified); common, Poring entrance, 500 m (JAE)
Streaked Bulbul	<i>Ixos malaccensis</i>		700	523	916	1200	recorded at Poring (no locality data); 700 m, netted at 3100 m (Biun, 1999; we consider the latter record to be a vagrant or an error)	250–450 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Cinereous Bulbul	<i>Hemixos cinereus</i>	500	2727	550	1950**	up to about 2800	common from 3000–6000 ft on Kinabalu; seen above Carson's camp (at least 9000 ft [2727 m]) 1989, on summit trail, and at power station 1986, 1988 (Batchelor, 1991); netted at Poring (Phillips & Phillips in Jenkins & de Silva, 1978)	forest interior Poring (Addison, 2002); Poring (Reindt, 2003; Harrop, 2011); Poring above headquarters, 550 m (Dobbs, 2008); rare from 1450–1950 m (AJB data); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
PASSERIFORMES: Hirundinidae								
Barn Swallow	<i>Hirundo rustica</i>	1575	2424	560		to at least 2400	park headquarters (taken to be 1575 m); c. 8000 ft on Kinabalu, 4 Apr. 1989 (Batchelor, 1991)	c. 200 m at Serinsim (Sheldon et al., 2004); somewhere between park headquarters and Timpohon gate (Merrill, 2011, AKN); canopy walkway, taken to be 560 m, Oct. 2010 (L. S. Ni, J. Ong, BIW)
Pacific Swallow	<i>Hirundo tahitica</i>		1575	500	1575	1680	park headquarters (taken to be 1575 m)	c. 200 m at Serinsim (Sheldon et al., 2004); common at Poring (Dobbs, 2008; taken to be 500 m); seen at park headquarters (c. 1575 m), probably also at overlook at Timpohon gate (Harding, 2011, AKN; pers. comm.)
Asian House Martin	<i>Delichon dasypus</i>					accidental visitor	recorded at 3200 ft in Liwagu valley above Ranau; Kundasan[g] Hotel in 1984 (Batchelor, 1991; taken to be c. 1300 m)	

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
PASSERIFORMES: Cettiidae								
Bornean Stubtail	<i>Urosphena whiteheadi</i>	1212	3100	1564	2271**	to 3100 (Sheldon et al., 2001)	nesting at park headquarters in 1982 (Phillips, 1986); specimen in Sarawak Museum collected by T. Harrison on 6 Feb. 1952 at Paka Cave (taken to be c. 3100 m)	Mesilau, c. 1900 m (Harding, 2011, AKN); 1564–2271 m (JBCH); seen at 2100 m, Mesilau, Nov.2010 (JAE)
Sunda Bush Warbler	<i>Cettia vulcania</i>	1364	3636	1500	3653	1380–3700	specimens down to 5500 ft; also at Marai Parai plateau, 1970–2121 m (Phillips, 1986)	1607–3653 m (JBCH); breeding at 1500 m, Feb.–Jun in 2010, 2011 (AJB); Mesilau headquarters (JBCH)
Yellow-bellied Warbler†	<i>Abracosopus superciliosus</i>	909	1818	530	<u>1575</u> **	1530	eggs at Kiau; 3000–5000 ft (Jenkins & de Silva, 1978); up to 6000 ft (Jenkins et al., 1996); two at Poring (Vermeulen, 1996)	netted at park headquarters (Sheldon & Moyle, 2008; taken to be 1575 m); park headquarters (AJB, Sheldon et al., 2009); 530–1003 m (JBCH)
Mountain Tailorbird	<i>Phyllogates cucullatus</i>	1212	2636	1504	2008**	1000–2650	common from 4000–6000 ft; also at Marai Parai plateau, 1970–2121 m (Phillips, 1986)	c. 2100 m above Mesilau in Jun (Harding, 2011, AKN; pers. comm.); 1504–2008 m (JBCH); Mesilau, Sep.2009 (C. Lee, BIW, accepted)
PASSERIFORMES: Phylloscopidae								
<u>Yellow-browed Warbler</u>	<i>Phylloscopus inornatus</i>				1900	only previous record was from sea level in Sarawak		vocal individual photographed (and detailed notes taken) by David Bakewell, who has ample experience with the species, near power station, 1900 m, 24 Oct.2008 (BIW)
<u>Arctic Warbler</u>	<i>Phylloscopus borealis</i>	303	1970	560	1575**	to at least 2000		seen at Mt. Kinabalu (Benstead & Benstead, 2001); seen somewhere between park headquarters and Timpohon gate (Brown, 2011, AKN); seen at park headquarters, Nov.2010 (JAE); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Mountain Leaf Warbler	<i>Phylloscopus trivirgatus</i>	1515	3100	1450	3221*	to 3100 (Smythies, 1957; Sheldon et al., 2001)	common higher montane resident, many collected from 5000–10000 ft (Jenkins et al., 1996); Smythies (1957) says “to 10000 ft” on Kinabalu. This is likely based on specimens collected at Paka Cave by the Raffles Museum group in 1929 (taken to be c. 3100 m). Also at Marai Parai plateau, 1970–2121 m (Phillips, 1986)	1511–3221 m (JBCH); down to 1450 m or lower (AJB); Mesilau headquarters (JBCH)
Yellow-breasted Warbler	<i>Seicercus montis</i>	1212	2424	1455	2166**	1036–2450	common above 4000 ft, several collected from 3500–5000 ft	greater than 2000 m on the summit trail (Harding, 2011, AKN); range from JBCH data; Mesilau headquarters (JBCH)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
PASSERIFORMES: Locustellidae								
Friendly Bush Warbler	<i>Bradypterus accentor</i>	2121	3800	2246	3665**	1800–3800 (Sheldon et al., 2001; Mann, 2008)	common from 10000–12000 ft; all collections above 7200 ft; somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN)	Mesilau (JAE many times); range from JBCH data; above 2200 m to above Laban Rata, Jun.2002 (JAE)
<u>Middendorff's Grasshopper Warbler</u>								
	<i>Locustella ochotensis</i>	303				to 1000 in Kelabit uplands	status uncertain, one record by Whitehead at 1000 ft	
PASSERIFORMES: Cisticolidae								
Yellow-bellied Prinia	<i>Prinia flaviventris</i>		1091		1500*	1530		c. 200 m at Serinsim (Sheldon et al., 2004); heard 1500 m, below park headquarters (across Kota Kinabalu-Ranau road; JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>				700	1000		Poring (Wallace and Wallace 2001; Matheve et al. 2008); female on Langanan trail (Addison 2002); Poring c. 560 m (Barnes 2005); "close to Poring hot springs" (Woods 2007); in an area where there was a view over some more open ground with tall gingers and similar vegetation, probably less than half way along the [Langanan] trail (Gurney 2010; taken to be c. 700 m)
Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>		700	513	560	to over 1200	recorded at Poring; 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); lower margin from JBCH data; 550 m Poring (Dobbs, 2008); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Ashy Tailorbird	<i>Orthotomus ruficeps</i>	303	975	500	1500*	to over 1500	700 m (Biun, 1999); Poring, c. 975 m (Nezadal, 1991, AKN)	250–450 m at Serinsim (Sheldon et al., 2004); "Mt. Kinabalu National Park" May 2007 (Klabdee, 2007, OBI); Poring (Newnham, 2007; Barnes, 2009; Roadhouse, 2009; Harrap 2011); near Poring headquarters (Harrap, 2008; taken to be 500 m); 1450–1500 m (AJB)
PASSERIFORMES: Timaliidae								
Chestnut-backed Scimitar Babbler	<i>Pomatorhinus montanus</i>	455	1667	530	1900*	to 1700 on Kinabalu, to 2200 on Trus Madi (Sheldon et al., 2001)	commonly heard 3500–5500 ft; eggs at Kiau	250–450 m at Serinsim (Sheldon et al., 2004); at bat cave, Poring (Low, 2007; taken to be 645 m); 530 m (JBCH); rare to 1500 m, territory on Kiau View trail (AJB); one seen well at Timpohon gate, 1900 m (Nov.2011; JAE).
Grey-throated Babbler	<i>Stachyris nigriceps</i>	303	3273	1451	2399**	305–3290		Poring (Woods, 2007); range from JBCH data; 900–1000 m at Sayap (Moyle & Sheldon, 2000); Mesilau, Dec.2008 (C. Lee and S. T. Yeo, BIW, accepted)
Grey-headed Babbler	<i>Stachyris poliocephala</i>	500	1212	572	905	1220		250–450 m at Serinsim (Sheldon et al. 2004); range from JBCH data
Chestnut-rumped Babbler	<i>Stachyris maculata</i>	545		560		950	collected at Poring at 1800 ft (545 m)	two at Poring (Hornbuckle, 2005); heard canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
White-necked Babbler	<i>Stachyris leucotis</i>	700		700	818	1070	netted at 700 m (Biun, 1999)	down to 700 m (JAE); 818 m (JBCH); bat cave (Rheindt, 2003; taken to be 645 m)
Black-throated Babbler	<i>Stachyris nigricollis</i>	500				490	Poring, 1989 (Batchelor, 1991)	interesting that there are no recent records
Chestnut-winged Babbler	<i>Stachyris erythroptera</i>	500	800	540	930	1220	upper elevations of Poring (Wall & Yong, 1985; taken to be 800 m)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Rufous-fronted Babbler	<i>Stachyridopsis rufifrons</i>	500				1530	appears to be rare (FHS in Jenkins et al., 1996)	Poring (Hutchinson, 2008, Jul)
Bold-striped Tit-Babbler	<i>Macronous bornensis</i>	303	500	560		to at least 1300	Kiau (eggs)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Newnham, 2007; Woods, 2007; Barnes, 2009; Lambert & Yong, 2010); Kudasang, 1300 m (JBCH); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Fluffy-backed Tit-Babbler	<i>Macronous pitulosus</i>	500	700	560		1070	also "a few hundred feet up the spurs of Kinabalu" (Whitehead in Jenkins & de Silva, 1978); 700 m (Biun, 1999)	250–450 m at Serinsim (Sheldon et al., 2004); halfway up waterfall trail (Wallace & Wallace, 2001; taken to be c. 700 m); Kipungit waterfall (Low, 2007; taken to be 565 m); Poring (Harap, 2011); bat cave (Rheindt, 2003; taken to be 645 m); canopy walkway (Dobbs, 2008; taken to be 560 m)
PASSERIFORMES: Pellorneidae								
Brown Fulvetta†	<i>Alcippe brunneicauda</i>	500	<u>1500</u>	500	950**	1432	seen on Kiau view trail (Wall & Yong, 1985; taken to be at least 1500 m); 500–606 m (Jenkins & de Silva, 1978; Jenkins et al., 1996); 700 m (Biun, 1999)	250–450 m at Serinsim (Sheldon et al., 2004); 530–927 m (JBCH); 500–950 m (JAE)
Black-throated Wren Babbler	<i>Napothera atrigularis</i>		700			1530	netted at 700 m (Biun, 1999)	interesting that there are no recent records
Mountain Wren Babbler	<i>Napothera crassa</i>	939	2848	1461	2740**	915 to at least 2900	commonly seen from 6500–9400 ft, many collected 3100–7750 ft; nest on Silau Silau trail, Jul.1982 (Phillips, 1986); also at Marai Parai plateau, 1970–2121 m (Phillips, 1986)	nest at 2740 m, Apr.2011 (AJB); 1461–1805 m (JBCH); Mesilau, Sep.2009 (C. Lee, BIW, accepted)
Eyebrowed Wren Babbler	<i>Napothera epileptoides</i>	700	1575		1500	370–1750	939–1515 m (Jenkins & de Silva, 1978); seen on Silau Silau or Kiau View trail (Vermeulen, 1996; taken to be at least 1575 m); netted at 700 m (Biun, 1999)	Silau Silau trail (Hall & Kroll, 2004); Poring (Hutchinson, 2008, Jun); banded at 1500 m in 2009 (AJB); Poring bamboo (Rheindt, 2003; taken to be c. 800 m)
Abbott's Babbler	<i>Malacocincla abbotti</i>			500		1100		recent records at Poring headquarters by R. Hutchinson (pers. comm.)
Horsfield's Babbler	<i>Malacocincla sepium</i>			510	530	1700	netted at Poring (no locality data)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Short-tailed Babbler	<i>Malacocincla malaccensis</i>	500	700			950	700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Wallace & Wallace, 2001; Newnham, 2007; Eaton, 2010b; Harrap, 2011)
Moustached Babbler	<i>Malacopteron magnirostre</i>	500	1061	500	866	1220		784–866 m (JBCH); headquarters area at Poring (Dobbs, 2008; taken to be c. 500 m)
Sooty-capped Babbler	<i>Malacopteron affine</i>	500	700	500	750	550	entrance to Poring hot springs, 1988 (Batchelor, 1991; taken to be c. 500 m); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring, near 1.5 km mark on Langanan trail (Addison, 2002; taken to be c. 750 m); Poring, to 750 m in Nov.2011 (JAE)
Scaly-crowned Babbler	<i>Malacopteron cinereum</i>	500	700	530	645	950	700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Rufous-crowned Babbler	<i>Malacopteron magnum</i>	700	800	530	894	1000	recorded at Poring (no locality data); upper elevations of Poring (Wall & Yong, 1985; taken to be c. 800 m); “Poring” and “Poring waterfall” [unclear if this refers to Kipungit or Langanan waterfall] (Batchelor, 1991; 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
White-chested Babbler	<i>Trichastoma rostratum</i>		700			to at least 1100	seen at Poring (no locality data); needs corroboration (FHS); netted at Poring 700 m (Biun, 1999)	seen at Poring “on 2 out of the 3 days we were there” (Wallace & Wallace, 2001)
Ferruginous Babbler	<i>Trichastoma bicolor</i>	500				to over 1300	netted at Poring 1600 ft (Phillips & Phillips); two specimens collected by J. J. Menden (Yale University Peabody Museum) at “Mt. Kinabalu” in Mar.1977 (GBIF)	c. 200 m at Serinsim (Sheldon et al., 2004); on 24 Jun.2010 at Poring (F. Rheindt, pers. comm.)
Striped Wren Babbler	<i>Kenopia striata</i>					to at least 1200	recorded at Poring by “Berwick and Lathbury”; no locality data; record needs corroboration (Fred Sheldon)	
Temminck's Babbler	<i>Pellorneum pyrogenys</i>	500	<u>1575</u>	975	1900*	490–1550 but lower in some places	Kiau (eggs); fairly common 3000–4000 ft; seen at park headquarters (taken to be 1575 m); seen somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN)	fairly common 1450–1650 m, rare to c. 1900, one nest in 2010 and 2011 at 1860–1900 m (AJB; TEM); 1451 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000); c. 975 m, Poring (F. Rheindt, Jul.2010, pers. comm.)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Black-capped Babbler	<i>Pellorneum capistratum</i>	303	975	560	750	1410	Poring, c. 975 m (Nezadal, 1991, AKN); upper elevations of Poring (Wall & Yong, 1985; taken to be c. 800 m)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Benstead & Benstead, 2001); at the bat cave, Poring (Low, 2007; taken to be 645 m); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted); 750 m in bamboo, Poring (JAE)
PASSERIFORMES: Leiothrichidae								
Sunda Laughingthrush	<i>Garrulax palliatus</i>	909	2100	1550	1921**	to 2424 in Sabah (Gore, 1968); 1000–1900 (Sheldon et al., 2001)	common at park headquarters; 1600–2100 (Biun, 1999)	range from JBCH data; 200 m above Mesilau headquarters, May 2009 (JAE)
Chestnut-hooded Laughingthrush	<i>Garrulax treacheri</i>	212	3333	1506	3176**	200–3350	particularly common from 3000–10500 ft; eggs at Kiau	range from JBCH data; 900–1000 m at Sayap (Moyle & Sheldon, 2000); Mesilau, Sep.2009 (C. Lee, BIW, accepted)
Bare-headed Laughingthrush	<i>Garrulax cabus</i>	500	1818	1500	1900	490–1835	fairly common from 4000–6000 ft; somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN; Bono, 1997, AKN)	one at Poring (Newham, 2007); several in mixed laughingthrush flock at Timpohon gate (Barnes, 2009; taken to be 1900 m); seemingly a thin elevational band in the headquarters area, from 1500–1700 m (AJB data); 1550 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000); perhaps becoming more scarce (JAE)
PASSERIFORMES: Zosteropidae								
Chestnut-crested Yuhina	<i>Yuhina everetti</i>	500	2576	560	2100**	near sea level to 2800	common from 1600–8500 ft; many specimens from 3000–8500 ft; eggs at Kiau	down to 300 m at Serinsim (Sheldon et al., 2004); 916–1867 m (JBCH); to 2100 m (AJB); 900–1000 m at Sayap (Moyle & Sheldon, 2000); canopy walkway, taken to be 560 m, Sep.2009 (C. Lee, BIW, accepted), Oct.2010 (L. S. Ni, J. Ong, BIW); Mesilau, Dec.2008 (C. Lee, BIW, accepted)
Pygmy Ibon	<i>Oculocincta squamifrons</i>	182	2121		50–2150		end of Liwagu trail (Vermeulen, 1996; taken to be 1890 m)	Poring (Shackelford, 2007); summit trail (Dobbs, 2008); Mt. Kinabalu (Harrap, 2011); Kundasang, 2010, 2011, at c. 1300 m (AJB, JBCH); Kundasang, pair feeding 2 recently fledged chicks, Nov.2011 (JAE)
Mountain Blackeye	<i>Chlorocharis emiliae</i>	1364	3900	1575	3838	1265–4000 but can occur lower during drought (Smythies, 1957; Mann, 2008); to 4000 (Sheldon et al., 2001)	commonest bird from 5500–9400 ft (1667–848 m) on Kinabalu's East Ridge (Smythies, 1962 [1964]) and above 10000 ft (Jenkins & de Silva, 1978); recorded at headquarters during 1983 drought; specimens from 4500–12000 ft; also at Marai Parai plateau, 1970–2121 m (Phillips, 1986); 1600–3100 m (Biun, 1999); There is very little vegetation above 3840 m so we consider the earlier 4000 m margin to be somewhat doubtful.	1890–3838 m (JBCH); JBCH found that this species was often the most common bird only above 2850 m (in contrast to Smythies' (1962 [1964]) observations); reported down to 1660 m, "elevation approximate" (Lambert & Yong, 2010); somewhere between park headquarters and Timpohon gate (Harding, 2011, AKN; Harrison, 2011, AKN; Merrill, 2011, AKN); Mempening trail, taken to be c. 1575 m (C. T. Yeo, BIW, May 2011); Mesilau, Dec.2008 (C. Lee and S. T. Yeo, BIW, accepted); audio recording, 1820 m, Aug.2010 (P. C. Rasmussen, AVoCet); down to 1575 in dry or windy weather (AB)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Black-capped White-eye	<i>Zosterops atricapilla</i>	909	2121	1450	2000**	885–2150	common at park headquarters; 909–2121 m (Jenkins & de Silva, 1978); greater than 2000 m on the summit trail (Roberson, 1988, AKN); sight record at 700 m (no photo), 1600–2100 m (Biun, 1999)	common from 1450–2000 m (AJB); 1506–1871 m (JBCH); greater than 2000 m on summit trail (Harding, 2011, AKN; taken to be c. 2050 m); up to 2150 m on Mesilau trail Oct. 2009 (JAE); Mesilau headquarters (JBCH)
Everett's White-eye	<i>Zosterops everetti</i>	305	1667	510	1575	close to sea level to above 1700	305 m (Natural History Museum Tring); Poring (Smythies, 1999); somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN)	park headquarters (Hall & Kroll, 2004); one in bamboo on waterfall trail (Newnham, 2007); Kundasang, 2011 at c. 1300 m (AJB); 510 m (JBCH); canopy walkway, Jul. 2010 (F. Rheindt, pers. comm.; taken to be 560 m); park headquarters near telecommunications tower, Apr. 2006 (R. Teo, BIW, accepted); park headquarters May 2008 (N. Abghani, BIW, accepted); taken to be c. 1575 m; possibly doubtful record from, St. John's Lodge Mesilau, Apr. 2006 (R. Teo, BIW, accepted)
PASSERIFORMES: Irenidae								
Asian Fairy-bluebird	<i>Irena puella</i>	303	975	561	920	1900	also at Kundasang (4300 ft); Poring, c. 975 m (Nezadal, 1991, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
PASSERIFORMES: Sittidae								
Velvet-fronted Nuthatch†	<i>Sitta frontalis</i>	909	1970	1500	1762**	to about 2100	often seen at park headquarters; two at Poring (Vermeulen, 1996)	1762 m (JBCH); 1500–1750 m (AJB); Mesilau, Dec. 2008 (C. Lee and S. T. Yeo, BIW, accepted; taken to be c. 1940 m)
PASSERIFORMES: Sturnidae								
Asian Glossy Starling	<i>Aplonis panayensis</i>					none given	recorded at Ranau and Mt. Kinabalu (unknown altitude) (Jenkins & de Silva, 1978); doubtful record from somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN)	Poring (Shackelford, 2007; Harrap, 2011)
Common Hill Myna	<i>Gracula religiosa</i>	600		560	731	1200	heard on two days at lower elevations of Poring (Wall & Yong, 1985; taken to be c. 600 m)	Poring (Sheldon et al., 2001); c. 200 m at Serinsim (Sheldon et al., 2004); heard above Poring, 731 m, Apr. 2010 (JBCH); heard canopy walkway, taken to be 560 m, Oct. 2010 (L. S. Ni, J. Ong, BIW)
PASSERIFORMES: Turdidae								
Bornean Whistling Thrush	<i>Myophonus borneensis</i>	606	2750	808	2565	to 2750 (Sheldon et al., 2001; Mann 2008)	netted 700–2100, seen 2600 and 3100 (Biun, 1999, no photos)	808–2565 m (JBCH); bat cave, taken to be 645 m, Mar. 2006 (N. Cheung, BIW); Mesilau, Sep. 2009 (C. Lee, BIW, accepted)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Chestnut-capped Thrush	<i>Geokichla interpres</i>			523	750	1300	specimen on Kinabalu and nesting record at Poring in 1969 with no locality data; 1300 m as a night migrant; dead bird on Kota Kinabalu–Ranau road; netted at 700 and 2600 m (Biun, 1999; we consider the latter to be a vagrant or an error)	c. 200 m at Serinsim (Sheldon et al., 2004); nesting at Serinsim River (250–400 m), Aug. 1998 (AB); Mike Grenfelder saw one near the canopy walkway (Benstead, 2004; taken to be 560 m); lower boundary from JBCH data; “almost back [to Poring headquarters from waterfall hike]” (Harrap, 2011; taken to be c. 600 m); 750 m (JAE)
Orange-headed Thrush	<i>Geokichla citrina</i>	909	1800	1500	1900*	to 1800	rare, 3000 ft to park headquarters (taken to be 1575 m) (Jenkins et al., 1996); 1800 m (Robson, 1998 in Mann, 2008)	rare, 1500–1900 m (breeding) (AJB); 900–1000 m at Sayap (Moyle & Sheldon, 2000); Bukit Ular roadside, 2000–2010 (JAE c. 1850 m)
Everett's Thrush	<i>Zoothera everetti</i>	1575		1500	1900	2140	rare (Jenkins et al., 1996); Silau Silau trail and dead individual at park headquarters (taken to be 1575 m)	rare, 1500–1900 m (breeding) (AJB); 1850 m (JBCH)
<u>[White's Thrush]</u>	<i>Zoothera aurea</i>					none given		one sighting near park headquarters, c. 20 Apr. 2005 (Ericsson, 2005; taken to be 1575 m)
Island Thrush	<i>Turdus poliocephalus</i>	1575	<u>3700</u>	1665	3640	1475–3650	to “limit of vegetation” and found breeding near the summit (taken to be c. 3700 m but this can only be approximate); park headquarters and Tenompok in 1983 drought (taken to be c. 1575 m); “down to 6000 ft on the summit trail” (1818 m) in 1990 (Batchelor, 1991; taken to be 1900 m because this is where summit trail starts)	recently up to 3800 m (Benedict Butit pers. comm.); 3036–3640 m, probably heard down to 2624 m (JBCH); at Kiau View (photographed) Dobbs, 2008; taken to be 1655 m; from Mesilau [taken to be at HQ] up to 2200 m (Bishop, 2010); Mesilau headquarters Nov. 2010 (JAE)
<u>Eyebrowed Thrush</u>	<i>Turdus obscurus</i>	700	3100	523	2597	3290	plentiful up to 8000 ft; Kudasang (Batchelor, 1991); range form Biun (1999)	common at Layang Layang (Hall & Kroll, 2004); Mesilau, Apr. 2006 (R. Teo, BIW, accepted); range from JBCH data
Fruithunter	<i>Chlamydochaera jefferyi</i>	700	3200	1450	2700**	700–3200	700–2600 m (Biun, 1999); to 3200 m (Sheldon et al., 2001)	nest on Silau Silau (Wallace & Wallace, 2001); rare from 1450–2300 m (AJB); top of Langanan trail in 2002 (R. Hutchinson pers. comm.; c. 900 m); c. 200 m before trail junction above Layang Layang (Dobbs, 2008; taken to be c. 2700 m)
White-browed Shortwing	<i>Brachypteryx montana</i>	1061	3600	1465	2806**	885–3600	to 3600 m on Kinabalu (Sheldon et al., 2001)	range from JBCH data; Mesilau headquarters (JBCH)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
PASSERIFORMES: Muscicapidae								
<u>Siberian Blue Robin</u>	<i>Luscinia cyane</i>	303	700	650	1850	1680	Ranau; Kundasang (4800 ft); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); below 1.8 km on Langanan trail (Addison, 2002; taken to be c. 750 m); Bukit Ular c. 1850 m, Oct.2008, Nov.2009 (JAE); Bukit Ular, taken to be c. 1850 m (D. Bakewell, Oct.2008, BIW); 650 m, Poring (JAE)
Oriental Magpie-Robin	<i>Copsychus saularis</i>	500	939	523	1575*	1530	4800 ft at Bundu Tuhan	c. 200 m at Serinsim (Sheldon et al., 2004); park headquarters (Hornbuckle, 2005; Newnham, 2007; Harrop 2011; taken to be 1575 m); lower margin from JBCH data
White-crowned Shama	<i>Copsychus stricklandi</i>	500	975	510	843	to above 1220 on Kinabalu	specimen with no locality data; c. 975 m at Poring (Nezadal, 1991, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Rufous-tailed Shama	<i>Trichixos pyrropygus</i>		700				netted at 700 m (Biun, 1999)	Poring, unclear but taken to be at least 900 m (Addison, 2002); past Kipungit waterfall (Rheinhardt, 2003; taken to be c. 600 m); Poring, year unspecified (Clive Mann, 2008); heard, Poring (Matheve et al., 2008)
Chestnut-naped Forktail	<i>Enicurus ruficapillus</i>				975	1250	netted at Poring (no locality data)	Poring, on stream below/before Langanan waterfall (Dobbs 2008; taken to be c. 975 m)
Bornean Forktail	<i>Enicurus borneensis</i>	303	1939	900'	1850	305–1955	range from Smythies (1962 [1964]), 1939 m "above Poring"; courtship behaviour near park headquarters in 1985 (Phillips, 1986); somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN);	range from JBCH and AJB data (birds identified as this species seen from 600–975 m at Poring, Jun.2011, but mist-netting needed to eliminate possibility of <i>E. leschenaulti</i>); 1504–1609 m (JBCH); common 1450–1850 m (AJB); Poring 900 m after 2007 (JAE); three specimens (AMNH) from Serinsim of <i>E. leschenaulti</i> (Moyle et al., 2005); specimen from 900–1000 m at Sayap (Moyle & Sheldon, 2000), unclear if this is <i>E. borneensis</i> or <i>E. leschenaulti</i> ; Mesilau, Sep.2009 (C. Lee, BIW, accepted)
<u>Blue Rock Thrush</u>	<i>Monticola solitarius</i>		1550			2100	Recorded at Kundasang in 1983; also 10–11 Dec.1984 (Batchelor, 1991)	
Fulvous-chested Jungle Flycatcher	<i>Rhinomyias olivaceus</i>		700	510	560	to about 900	specimen from unknown locality on Kinabalu; 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); 510–530 m (JBCH); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Grey-chested Jungle Flycatcher	<i>Rhinomyias umbratilis</i>	303	700	500	899	to 500, occasionally to 1220	700 m (Biun, 1999)	common, Poring, from entrance to 800 m (JAE); 880–899 m (JBCH)
Rufous-tailed Jungle Flycatcher	<i>Rhinomyias ruficauda</i>		909			1530	possibly doubtful record from canopy walkway at Poring (Vermeulen, 1996)	900–1000 m at Sayap (Moyle & Sheldon, 2000)
Eyebrowed Jungle Flycatcher	<i>Rhinomyias gularis</i>	909	3273	1450	1950**	915–3290	more common at higher elevations (towards 7000 ft, Whitehead); also at 5000 ft on Pinosuk plateau	range from AJB data (breeding); Mesilau headquarters, Jun.2006, Jul.2007 (JAE)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
<u>Dark-sided Flycatcher</u>	<i>Muscicapa sibirica</i>		1606			1620	records at 5300 ft in Sep, Oct, and Jan (Jenkins & de Silva, 1978)	Mt. Kinabalu (Addison, 2002); c. 200 m at Serinsim (Sheldon et al., 2004); at park headquarters (Ericsson, 2005; taken to be 1575 m); one at Poring (Newnham, 2007); somewhere between park headquarters and Timpohon gate (Brown, 2011, AKN); <i>M. d. williamsoni</i> seen at Poring (Benstead & Benstead, 2001); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
<u>Asian Brown Flycatcher</u>	<i>Muscicapa dauurica</i>	909	1606	560		1620		near Langanan waterfall (Addison, 2002; taken to be c. 1000 m); on Mempoing trail (Myers, 2010, Aug; taken to be c. 1575 m); 1500 m on Liwagu River (JBCH); seen at c. 1850 m (100 m down from Timpohon gate) in Nov.2011 (JAE)
<u>Ferruginous Flycatcher</u>	<i>Muscicapa ferruginea</i>		1515	1500	1850	1530	also "lower slopes of Kinabalu"	Liwagu restaurant (c. 1575 m) and Timpohon gate, 1900 m (Eaton 2010a); 521–530 m (JBCH)
<u>Narcissus Flycatcher</u>	<i>Ficedula narcissina</i>	303		521	1900	1530		Kiau View and Poring (Wallace & Wallace, 2001); park headquarters (Hall & Kroll, 2004); netted at 3270 m in 2005 (Sheldon et al., 2009); Mount Kinabalu at 1563 m (Singh, 2009, OBI); c. 2000 m at Mesilau (Brown, 2011, AKN); Mt. Kinabalu (Valentine & Thurmilangan, 2008a; Gear, 2009); 2629–3255 m (JBCH)
<u>Mugimaki Flycatcher</u>	<i>Ficedula mugimaki</i>	1575	3100	1563	3255	2325	park headquarters taken to be 1575 m; somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN); 3100 m (Biun, 1999)	900–1000 m at Sayap (Moyle & Sheldon, 2000)
<u>Rufous-chested Flycatcher</u>	<i>Ficedula dumetoria</i>	700	1606				to 1200 or 1620 but upper records may have been confused with <i>F. mugimaki</i>	
<u>Snowy-browed Flycatcher</u>	<i>Ficedula hyperythra</i>	1212	3700	1451	2508**	1000–3700	plentiful 4000–8000 ft; common above Poring 6000–9500 ft; to 3700 m on Kinabalu (Sheldon et al., 2001)	range from JBCH data, Mesilau, Sep.2009 (C. Lee, BIW, accepted)
<u>Little Pied Flycatcher</u>	<i>Ficedula westermanni</i>	1515	3100	1453	2613	850–3100	common from 5000–8000 ft; regularly seen at park headquarters; 1600–2600 m (Biun, 1999); to 3100 m on Kinabalu (Sheldon et al., 2001)	range from JBCH data, Mesilau headquarters (JBCH)
<u>Blue-and-white Flycatcher</u>	<i>Cyanoptila cyanomelana</i>	303	1575			1835	park headquarters taken to be 1575 m	near Poring headquarters (Addison, 2002; taken to be 500 m); Poring (Kiong, 2008, OBI; Gurney, 2010; Lambert & Yong, 2010); Mount Kinabalu (Samaraweera, 2011, OBI); Kinabalu Park (Valentine & Thurmilangan, 2008a; Lambert & Yong, 2010); Kundasang 1300 m (JBCH); Mesilau, Apr.2006 (R. Teo, BIW, accepted)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Verditer Flycatcher	<i>Eumyias thalassinus</i>	303		516	560	to 1200 or 1300	heard on summit trail (Wall & Yong, 1985)	canopy walkway at Poring (Dobbs, 2008; taken to be 560 m); possibly doubtful records from Mesilau, c. 1940 m (Harding, 2011, AKN; R. Teo, Apr. 2006, BIW, accepted); seen "near Kinabalu" (Harrap, 2011); lower boundary from JBCH data; 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Indigo Flycatcher	<i>Eumyias indigo</i>	818	2636	1452	2414**	825–2650	many collected from 2700–8000 ft; 8700 ft record from one sighting (Jenkins & de Silva, 1978); 1600–2600 m (Biun, 1999); netted at 700 m (Biun, 1999)	Mesilau (Myers, 2009); range from JBCH data; Mesilau headquarters (JBCH)
Pale Blue-Flycatcher	<i>Cyornis unicolor</i>	700			780	1400		seen by other observers at Poring (Hornbuckle, 2005); JBCH audio recording at 780 m; canopy walkway (Rheindt, 2003; taken to be 560 m)
Hill Blue Flycatcher	<i>Cyornis banyumas</i>	700		500	1000	to over 1200	specimen from Kinabalu (no locality data); Kiau (eggs); netted at 700 m (Biun, 1999)	recent specimens indicate this species is fairly common in submontane forest in Sabah [at least] from 900–1000 m (Sheldon et al., 2009); 900–1000 m at Sayap (Moyle & Sheldon, 2000); Poring, three times, from Poring entrance up to 900 m, Oct. 2008 and May 2009 (JAE); near Langanan waterfall on 24 Jun. 2010 at Poring (F. Rheindt, pers. comm.; c. 1000 m); 816–984 m (JBCH, with audio recordings)
Bornean Blue Flycatcher	<i>Cyornis superbus</i>	606	1515	560	640	1530	also Ranau and Poring; records from 600–1500 m unusually high, it is possible that there has been confusion with <i>C. banyumas</i> (Jenkins et al., 1996); netted at 700 m (Biun, 1999)	just before bat cave, responding to playback, no audio recording made (Dobbs, 2008; taken to be c. 640 m); seen and heard, responding to playback of D. Edwards's recordings from Danum Valley (identical song) at canopy walkway, c. 560 m, on 4 Jun. 2009 (AJB); heard and seen above Monggis, Tambuyukon c. 1000 m, responding to same playback, in Jun. 2011; female had rufous tail (AJB)
Malaysian Blue Flycatcher	<i>Cyornis turcosus</i>	545				1000	netted at Poring c. 545 m (Sheldon, 1977); also Ranau	c. 200 m at Serinsim (Sheldon et al., 2004); interesting that there are no recent records from Poring
White-tailed Flycatcher†	<i>Cyornis concretus</i>	700	1667	630	975**	sea level to 1680, usually 600–1200	700 m (Biun, 1999)	one at Kinabalu (Hornbuckle, 2005); waterfall trail (Newnham, 2007); Poring (Hutchinson, 2008, Jun, Jul; Shortell, 2008, OBI); range from JAE data; Poring bamboo (Rheindt, 2003; taken to be c. 800 m); bat cave (Matheve et al., 2008)
Pygmy Flycatcher	<i>Muscicapella hodgsoni</i>	1212	1890	1450	1850	850–2200	end of Liwagu trail (Vermeulen, 1996; taken to be c. 1890 m)	c. 1900 m at Mesilau (Harding, 2011, AKN); range from AJB data; 1546 m (JBCH)
PASSERIFORMES: Chloropseidae								
Greater Green Leafbird	<i>Chloropsis sonnerati</i>	500	975	560	645	to at least 1300	Poring, c. 975 m (Nezadal, 1991, AKN); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring canopy walkway (Clayton & Thomas, 2002; Rheindt, 2003; taken to be 560 m); bat cave, Poring (Low, 2007; taken to be 645 m); Poring (Harrap, 2008); canopy walkway, taken to be 560 m, Oct. 2010 (L. S. Ni, J. Ong, BIW)

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Lesser Green Leafbird	<i>Chloropsis cyanopogon</i>	700		516	600	to at least 950	recorded at Poring; collected at Kaung; 700 m (Biun, 2009)	lower boundary from JBCH data; c. 200 m at Serinsim (Sheldon et al., 2004); Poring, c. 560 m (Brown, 2011, AKN); on Langanan trail (Harapp, 2008; taken to be at least 600 m)
Bornean Leafbird†	<i>Chloropsis kinabaluensis</i>	600	2121	850	1800**	to 2200 (Trus Madi), 550–2140 (Kinabalu); generally above 500	lower elevations of Poring (Wall & Yong, 1985; taken to be 600 m); also Kundasan[g] (Batchelor, 1991; taken to be c. 1300 m); one at Poring (Vermeulen, 1996); one netted at 3100 m (Biun, 1999; taken to be a vagrant)	927 m (JBCH); rare to 1800 m (AJB); somewhere between park headquarters and Timpohon gate (Merrill, 2011, AKN); c. 1800 m, with photograph (L. Harding, 2011, AKN; pers. comm.); 900–1000 m at Sayap (Moyle & Sheldon, 2000); regular at Poring c. 850–975 m (JAE); c. 975 m, Poring (F. Rheindt, Jul.2010, pers. comm.)
PASSERIFORMES: Dicaeidae								
Yellow-breasted Flowerpecker	<i>Prionochilus maculatus</i>	500	700			to at least 1250	700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Poring on waterfall trail (Eaton, 2009, May)
Crimson-breasted Flowerpecker	<i>Prionochilus percussus</i>					to at least 1200		“two near the waterfall” at Poring (Addison, 2002; taken to be c. 1000 m); Poring (Hutchinson, 2008, Jun.2008, Jul.2011)
Yellow-rumped Flowerpecker	<i>Prionochilus xanthopygius</i>	500	975	500	984	1700	Poring c. 975 m (Nezadal, 1991, AKN); 700 m and netted at 2600 m (Biun, 1999; taken to be a vagrant)	250–450 m at Serinsim (Sheldon et al., 2004); near Poring headquarters (Dobbs, 2008; Harapp, 2008; taken to be c. 500 m); 624–984 m (JBCH)
Thick-billed Flowerpecker	<i>Dicaeum agile</i>			500	560	200		two viewed through a telescope near Poring headquarters (Harapp, 2011; taken to be c. 500 m); Poring (Hutchinson, 2008, Jul); canopy walkway 10–13 Jul.2010 (F. Rheindt, pers. comm.; taken to be 560 m)
Yellow-vented Flowerpecker	<i>Dicaeum chrysorrheum</i>		970	500	700	1700		c. 200 m at Serinsim (Sheldon et al., 2004); Poring (Newnham, 2007; Dobbs, 2008; Lambert & Yong, 2010); past bat cave on ridge (Low, 2007; taken to be c. 700 m); “Poring, around lodge area and lowest slopes” (Harapp, 2010; taken to be c. 500–550 m)
Orange-bellied Flowerpecker	<i>Dicaeum trigonostigma</i>	303	975	515	1003	1700	also Kundasang, 4300 ft; Poring c. 975 m (Nezadal, 1991, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Plain Flowerpecker	<i>Dicaeum concolor</i>					1200	recorded at Poring: Kiau (eggs); two at Poring (Vermeulen, 1996)	Poring football pitch (Addison, 2002; taken to be c. 500 m)
Black-sided Flowerpecker	<i>Dicaeum monticolum</i>	606	2182	1511	2016**	to 2182 on Kinabalu (Sheldon et al., 2001, Sarawak Museum); to 2540 on Trus Madi (Sheldon & Francis, 1985; FHS pers. obs.)	common above 3000 ft; somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN; Roberson, 1988, AKN); Sarawak Museum specimen from “Kamboragoh 7200 ft” (2182 m) from before 1978 (Sheldon et al., 2001)	range from JBCH data; Mesilau, Sep.2009 (C. Lee, BIW, accepted)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	303	700			to above 1750	700 m (Biun, 1999)	seen daily at Poring (Wallace & Wallace, 2001)
PASSERIFORMES: Nectariniidae								
Ruby-cheeked Sunbird	<i>Chalcoparia singalensis</i>	303		500	972	to at least 1200	one at Poring (Vermeulen, 1996)	c. 200 m at Serinsim (Sheldon et al., 2004); near Poring headquarters (Harrap, 2008; taken to be c. 500 m); upper margin from JBCH data
Plain Sunbird	<i>Antheptes simplex</i>			521	560	1220	Poring: feeding a fledgling in 1982, seen 1985 (Phillips, 1986)	canopy walkway (Rheindt, 2003; Jul.2010, pers. comm.; taken to be 560 m); netted at c. 1500 m in 1999 (Moyle, 2003); c. 200 m at Serinsim (Sheldon et al., 2004); 521 m and possibly at 916 m (JBCH)
Brown-throated Sunbird	<i>Antheptes malacensis</i>		939	516	560	to at least 1220		250–450 m at Serinsim (Sheldon et al., 2004); 516–535 m (JBCH); canopy walkway, taken to be 560 m, Oct.2010 (L. S. Ni, J. Ong, BIW)
Red-throated Sunbird	<i>Antheptes rhodolaema</i>			510		none given	Poring 1982, 1986 (Phillips, 1986)	250–450 m at Serinsim (Sheldon et al., 2004); good views of a male at Poring (Valentine & Thurmilangan, 2008a); waterfall trail (Harrap, 2008); Poring (Barnes, 2009); hot pools, 510 m (JAE)
Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	500	975	510	984	to at least 1000	Poring, c. 975 m (Nezadal, 1991); 700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); range from JBCH data
Van Hasselt's Sunbird	<i>Leptocoma brasiliana</i>	500				to at least 1000	collected at Poring in 1977	interesting that there are no recent records
Olive-backed Sunbird	<i>Cinnyris jugularis</i>	700	1552	500	1550	1565 (erroneously cites Jenkins & de Silva, 1978 as giving this elevation)	5120 ft at park headquarters; somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN); 700 m (Biun, 1999)	Poring (Wallace & Wallace, 2001; Newnham, 2007; Barnes, 2009); upper boundary from AIB data (breeding); 1 km towards Kundasang from Poring, c. 500 m (JAE)
Crimson Sunbird	<i>Aethopyga siparaja</i>		606	500	510	1190	also Ranau	c. 200 m at Serinsim (Sheldon et al., 2004); near chalet at Poring (Harrap, 2008; taken to be c. 500 m); Poring (Gurney, 2010); at hot pools (Harrap, 2011; taken to be 510 m)
Temminck's Sunbird	<i>Aethopyga temminckii</i>	606	2100	894	2050	sea level to 1985	plentiful around 4000 ft; netted at 1600 m, seen at 2100 m (Biun, 1999)	down to 300 m at Serinsim (Sheldon et al., 2004); Poring (Dobbs, 2008); greater than 2000 m on summit trail (Harding, 2011, AKN; taken to be 2050 m); breeding at 1900 m, Mar.2011 (AIB); many records at Mesilau headquarters c. 1950 m (L. Harding; JAE); 894–1859 (JBCH)
Little Spiderhunter	<i>Arachnothera longirostra</i>	500	975	530	1500*	1500	cited Gore that goes up to 4500 ft in Borneo; collected at c. 500 m (Sheldon, 1977); three specimens below 909 m (Jenkins & de Silva, 1978); Poring, c. 975 m (Nezadal, 1991, AKN); somewhere between park headquarters and Timpohon gate (Bono, 1997, AKN)	c. 200 m at Serinsim (Sheldon et al., 2004); banded at 1500 m, Jun.2010, May 2011 (AIB); 530–961 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000)

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Thick-billed Spiderhunter	<i>Arachnothera crassirostris</i>		700	500		to at least 1200	netted at 700 m (Biun, 1999)	Poring (Benstead & Benstead, 2001; Wallace & Wallace, 2001; Rheindt, 2003; Barnes, 2009); briefly seen by the cabins at Poring (Harrap, 2008; taken to be c. 500 m)
Long-billed Spiderhunter	<i>Arachnothera robusta</i>	500	700	500		to at least 1500	Poring window kill; 700 m (Biun, 1999)	Poring, unclear but at least 600 m (Addison, 2002); Poring, c. 500 m (Watson, 2010, AKN); canopy walkway (Rheindt, 2003; taken to be 560 m); Poring (Matheve et al., 2008)
Spectacled Spiderhunter	<i>Arachnothera flavigaster</i>		700	560		to at least 1680	recorded eastern side of Kinabalu, unknown altitude; 700 m (Biun, 1999)	near Poring headquarters (Benstead & Benstead, 2001; Addison, 2002); Poring, c. 560 m (Harding, 2011, AKN); canopy walkway (Rheindt, 2003; taken to be 560 m); Poring (Matheve et al., 2008)
Yellow-eared Spiderhunter	<i>Arachnothera chrysogenys</i>		975	510		1220	recorded at Poring (BL); record needs to be corroborated (Jenkins et al., 1996); c. 975 m at Poring (Nezadal, 1991, AKN)	250–450 m at Serinsim (Sheldon et al., 2004); Poring (Benstead & Benstead, 2001; Matheve et al., 2008); seen “occasionally in the forest at Poring” (Addison, 2002); seen at 510 m (JBCH); canopy walkway (Rheindt, 2003; taken to be 560 m)
Bornean Spiderhunter	<i>Arachnothera everetti</i>	700	1515	530	2100*	1530	700 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); <i>A. affinis everetti</i> netted at 2100 m, confirmed by DNA sequencing (Sheldon & Moyle, 2008); Poring 550 m (Eckert, 2009, Xeno Canto); 530–1531 m and possibly to 1756 m (JBCH); 900–1000 m at Sayap (Moyle & Sheldon, 2000)
Whitehead's Spiderhunter	<i>Arachnothera juliae</i>	1212	1667	1450	2000*	945–2100 (2100 is from Mt. Trus Madi)	frequently observed at headquarters; somewhere between park headquarters and Timpohon gate (Roberson, 1988, AKN; Bono, 1997, AKN)	range from AJB data (rare and nomadic); 1516–1688 m (JBCH)
PASSERIFORMES: Passeridae								
Eurasian Tree Sparrow	<i>Passer montanus</i>			516	1550	to at least 1400		Poring (Wallace & Wallace, 2001); c. 200 m at Serinsim (Sheldon et al., 2004); flock at Mesilau (Newnham, 2007; taken to be at least 1900 m); between park headquarters and Timpohon gate (Watson, 2010, AKN; Harding, 2011, AKN); 516–523 m (JBCH); 1550 m at headquarters (AJB)
PASSERIFORMES: Estrildidae								
Tawny-breasted Parrotfinch	<i>Erythrura hyperythra</i>	1200	3273	1500	1900**	400–3300	1818–3273 m (Jenkins et al., 1996); 2600–3100 m (Biun, 1999); probably 1200–3300 m (Sheldon et al., 2001)	seen at 1505 m, possibly heard up to 2788 m (JBCH); breeding from c. 1500–1900 m, Feb–Apr. 2010 (AJB); three at Mesilau (Gurney, 2010); probably heard in bamboo 300 m above Mesilau headquarters (JBCH); 1–2 km above Timpohon gate, summit trail (Rheindt, 2003)
Pin-tailed Parrotfinch	<i>Erythrura prasina</i>		1575			none given	Dusun rice fields on Kinabalu; record from park headquarters in 1988	

Appendix 2. Cont'd.

English name	Scientific name	Past lower margin (m)	Past upper margin (m)	Current lower margin (m)	Current upper margin (m)	Maximum elevation in Borneo (Mann, 2008) (m)	Historical notes	Current notes
Dusky Munia	<i>Lonchura fuscans</i>	500	1600	508	1550	to at least 1600	"seen at park headquarters more frequently in recent years" (Jenkins et al., 1996); 700, 1600 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); breeding at 550 in Poring (JBCH); 508–530 (JBCH); breeding up to 1550 m near headquarters (AJB)
Chestnut Munia	<i>Lonchura atricapilla</i>	500	1667	510		1680	collected up to 5500 ft before 1978 by Peters; somewhere between headquarters and Timpohon gate (Roberson, 1988, AKN)	seen at Poring (Valentine and Thurmilangan 2008b; Gurney 2010); range from JBCH data
PASSERIFORMES: Motacillidae								
<u>Forest Wagtail</u>	<i>Dendronanthus indicus</i>		909			up to about 1000	"Harrison" saw one at 909 m on Kinabalu in Feb. 1952	
<u>Grey Wagtail</u>	<i>Motacilla cinerea</i>	700	3100	560	1900**	to about 1800	Poring, 28 Feb. 1989 (Batchelor, 1991); 700–3100 m (Biun, 1999)	c. 200 m at Serinsim (Sheldon et al., 2004); Mesilau (Bishop, 2010); Poring, c. 560 m (Brown, 2011, AKN); 1900 m (JBCH)