



**Museum of  
Natural Science**

**OCCASIONAL PAPERS OF THE MUSEUM OF NATURAL SCIENCE**

LOUISIANA STATE UNIVERSITY

BATON ROUGE, LA

**ORNITHOLOGICAL EXPEDITIONS TO SARAWAK,  
MALAYSIAN BORNEO, 2007-2017**

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## ABSTRACT

Louisiana State University, the University of Kansas, and the Universiti Malaysia Sarawak undertook collaborative research on the evolution and ecology of Bornean birds starting in 2005. This collaboration included a series of expeditions from 2007–2017 to collect and study birds at >30 sites in Sarawak, Malaysian Borneo. Here we provide information on the study-sites and summarize the main discoveries resulting from the collaboration.

**KEY WORDS:** Biogeography, Birds, Ecology, Evolution, Gazetteer, Phylogeny, Phylogeography

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## INTRODUCTION

The Malaysian state of Sarawak in northwestern Borneo (Fig. 1) has a rich history in ornithological research. Scientific study of its birds began in the mid-19th century with the collections of A.R. Wallace and other naturalists (e.g., Wallace 1869; Everett 1889; Hose 1893) and was placed on firm footing with the founding of the Sarawak Museum in 1888 and the *Sarawak Museum Journal* in 1911. It reached a particularly productive period under the leadership of Sarawak Museum curator Tom Harrisson in the 1950s, culminating with the publication of *The Birds of Borneo* by B.E. Smythies (Smythies 1960). This 100-year period established Sarawak as a major force in Southeast Asian natural history. However, following the outstanding ecological work of Michael Fogden in the 1960s (e.g., Fogden 1972), ornithological research in Sarawak lagged for 25 years, and featured only a few highlights (e.g., Wells et al. 1978; McCormick 1979). It did not rebound substantially until the mid-1990s, when it was reinvigorated by research at the Universiti Malaysia Sarawak, UNIMAS (e.g., Ghazally 1998; Tuen and Darub 1999; Tuen et al. 2000; Rahman et al. 2010) and by the Sarawak Forest Department's ITTO-sponsored biodiversity surveys of the Lanjak-Entimau Wildlife Sanctuary (Grubh 1994). This resurgence was subsequently enhanced by research at such enterprises as the Sarawak Planted Forest project (e.g., Stuebing 2007; Styring et al. 2011) and the RIMBA project of the Sarawak Forestry Corporation (Stuebing 2015; Takeuchi et al. 2017), as well as by growth in Borneo's ecotourism industry (Myers 2009; Orenstein et al. 2010; Phillipps and Phillipps 2014).

In 2005, Louisiana State University Museum of Natural Science (LSU) and the University of Kansas Museum of Natural History (KU) began collaborating with UNIMAS on studies of bird evolution and ecology (Moyle et al. 2005). The collaboration featured expeditions to various parts of the state from 2007–2017 to collect specimens and data for studies of Bornean bird evolution and ecology. In this paper, we summarize those expeditions and their output. This compilation is analogous to one we published on similar work in Sabah from 1998–2008 (Sheldon et al. 2009a). It is intended as a gazetteer and guide for researchers who plan fieldwork in Sarawak or are compiling information on the birds of Sarawak.

## METHODS

Fieldwork consisted of three kinds of expeditions: long-term

visits to individual sites, such as the Kelabit Highlands, Mt. Mulu, Mt. Penrissen, Mt. Pueh, and Samarakan, which were intended to provide relatively thorough sampling of the avifauna; short visits to a variety of sites, which were designed to provide specimens for studies of geographic variation and hybridization in common species across the state; and ecological surveys of community structure along elevational gradients conducted by RCB on Mts. Mulu and Pueh.

Birds were mist-netted and prepared as museum specimens, either study skins or skeletons, and these specimens were divided between LSU, KU, and UNIMAS. Tissues and stomach contents were preserved in ethanol (U.S. Department of Agriculture regulations require the treatment of all avian tissues from Malaysia for H5N1 virus). Ectoparasites were deposited at the Field Museum of Natural History. Birds were also identified, audio-recorded, and photographed opportunistically. Vocal recordings were deposited in Macaulay Library, Cornell Laboratory of Ornithology ([macaulaylibrary.org](http://macaulaylibrary.org)), or on [xeno-canto.org](http://xeno-canto.org). Survey methods used to study elevational community ecology on Mts. Pueh and Mulu by RCB are described in Burner et al. (2016; 2018).

## FIELD SITES: LISTED WEST TO EAST

Here, we describe research-sites visited from 2007–2017, providing dates, latitude and longitude, habitat descriptions, and lists of personnel. For some sites we include additional information on locality or methods. When available, we also list publications that refer to a site or its birds. We avoid terms in Bahasa Malaysia, except when their use is simpler than translating them into English. Thus, we retain such words as *kampung* (village), *bukit* (hill), and *sungai* (river).

### **Kampung Pueh and Kampung Siru, Lundu District, Kuching Division**

*22 January–2 February 2010:* Camped in a roofed outdoor meeting hall located just above the Digi Telephone Towers behind the villages of Pueh and Siru on the lowest N slopes of Mt. Pueh (1.801N 109.706E, sea level to 60 m). *Habitat:* Secondary forest in various stages of recovery from shifting cultivation, and forest dominated by 15–20 year-old rubber and fruit trees. We also netted in village scrub in Pueh and Siru. *Participants:* FHS and Mohd Hasri (UNIMAS staff).

### **Mt. Pueh (=Mt. Poi, Mt. Berumput, Mt. Kanyi), Lundu District, Kuching Division**

*References:* Moulton (1913), Banks (1952), Ramji et al. (2012),

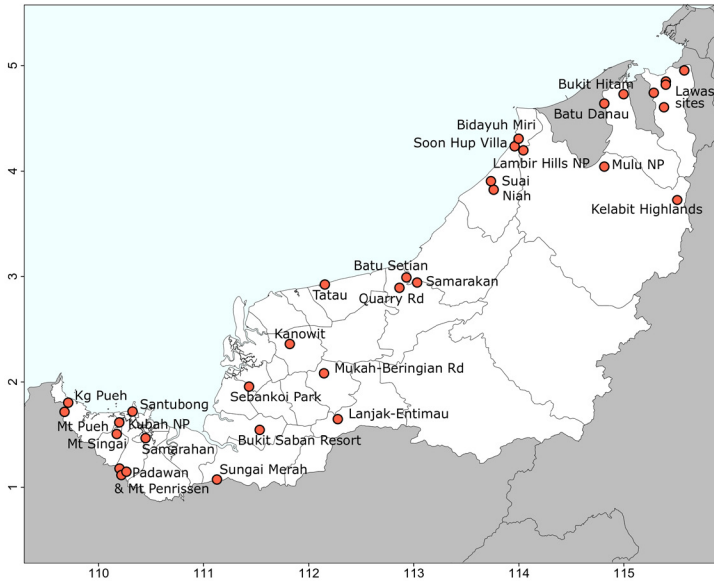


Fig. 1: Map showing location of field sites.

Gawin et al. (2014), Manthey et al. (2017), Burner et al. (2018).

**11–18 January 2010:** Camped c. 1 km beyond the defunct silkworm farm at the base of Mt. Pueh (1.801N 109.712E, 150 m). *Habitat:* The forest in this area was selectively logged perhaps 40 years earlier. It sloped steeply into a medium-sized river valley. In general, the forest was similar to primary forest, although in some areas near the silkworm plantation the habitat was regenerating scrub. *Participants:* JCM, RGM, MAR, FHS, ZAR; UNIMAS staff (Isa Sait, Rahah Mohd Yakup) and students (Nurul Ashikeen Abd Razak, Nur Aida Md Tamrin, Madinah Adrus, Mohd Ridwan Abd Rahman).

**9 June 2012:** Camped adjacent to Sebako village along the Sebako River (1.720N 109.707E, 40 m). *Habitat:* Secondary forest and river edge scrub. *Participants:* CEB, VLC, FHS.

**12–16 June 2012:** Camped above the village of Sebako along the Sipatung River, a tributary of the Sebako River (1.7244N 109.6947E, 614 m). *Habitat:* The forest up to c. 300 m was heavily disturbed from shifting cultivation. From 300–700 m and in the vicinity of our camp, the forest had been logged years earlier, as evidenced by skid trails or bulldozer tracks. Above that (up to 1500 m), the forest apparently had been logged using low impact methods. Near and above our camp, the forest was in good shape, with trees of 100 cm diameter at breast height fairly common (some to 120 DBH) and comparatively little landscape damage. *Participants:* LDS, FHS, Mohd Hasri (UNIMAS staff), and Cecilia Emang Ajeng (UNIMAS student).

**11–26 June and 3 July–14 August 2013:** Camped at three sites on the mountain: 1.721N 109.679E, 1200 m; 1.711N 109.691E, 620 m; and 1.710N 109.677E, 1200 m. *Habitat:* At 600 m, the forest was selectively logged perhaps 40 years earlier. At higher sites the sub-montane forest appeared to be unlogged. *Participants:* RCB and guides from Sebako. *Notes:*

This visit was devoted primarily to conducting point counts.

**18–21 June 2016:** Camped above Kampung Sebako (1.714N 109.677E, 1140 m). *Habitat:* Primary submontane forest. *Participants:* RCB, SBS, and guides from Sebako.

### **Mt. Singai and Kampung Tanjung Bowang, Bau District, Kuching Division**

**4–10 April 2013:** Work was conducted in the forest on Mt. Singai (1.504N, 110.173E, 70–190 m) and in more open areas of Kampung Tanjung Bowang (1.505N 110.178E, 40 m). To approach the mountain, we used the wooden stairway that starts at Kampung Tanjung Bowang and leads to the “Christ the King” church at 200 m. *Habitat:* Mature secondary forest containing unusually large, emergent fruit trees on the mountain. At low elevation around the village were scrub, gardens, and fruit-tree groves. *Participants:* VLC, JCM, FHS.

### **Kubah National Park Area, Kuching District, Kuching Division**

**21–23 June 2008:** 1.614N 110.197E, 100 m. *Habitat:* Young secondary forest. *Participants:* PMB, HCL.

### **Padawan Area, Kuching District, Kuching Division**

**18–19 June 2008:** Kampung Sapit (1.177N 110.199, 400 m). *Habitat:* Secondary forest and scrub. *Participants:* PMB, HCL.

**21–26 August 2014:** Kampung Annah Rais (1.147N 110.265E, 65 m). *Habitat:* Secondary forest. *Participants:* MLB.

### **Mt. Penrissen, Kuching District, Kuching Division**

*References:* Shelford (1900).

**24 May–4 June 2012:** Worked from a cabin at the Borneo Highlands Resort (1.133N 110.224E, 780 m). *Habitat:* Old secondary forest from extensive shifting cultivation and logging, also gardens. *Participants:* CEB, VLC, FHS.

**25 July–7 August 2014:** Worked at Borneo Highlands Resort (1.115N 110.217E, mainly from 1000–1200 m, also at 760 m). *Habitat:* Mature submontane forest and forest edge; and gardens. *Participants:* VLC and FHS.

### **Kampung Santubong, Kuching District, Kuching Division**

**12–14 April 2013:** Worked from the village, where the Takoyong River flows into the Santubong River (1.717N 110.323E, sea level). *Habitat:* Heavily disturbed mangrove and scrub. *Participants:* VLC, JCM, FHS. *References:* Tuen et al. (2000).

### **Kota Samarahan, Samarahan District, Serian Division**

**27, 29 July 2008:** UNIMAS campus (1.465N 110.447E, 20 m). *Habitat:* Kerangas (heath) forest. *Participants:* PMB, HCL. *References:* Tuen and Darub (1999).

### **Kampung Sungai Merah, Sri Aman District, Sri Aman Division**

**27 June 2008:** 1.073N 111.128E, 75 m. *Habitat:* Disturbed

kerangas (heath) forest. *Participants*: PMB, HCL.

**Sebankoi Recreational Park, Seratok District, Betong Division**

1–2 July 2008: c. 21 km SW of Sarikei (1.956N 111.433E, 100 m). *Habitat*: Secondary forest. *Participants*: PMB, HCL.

**Bukit Saban Resort, Betong District, Betong Division**

29–30 June 2008: c. 35 km NE of Sri Aman (1.543N 111.534E, 50 m). *Habitat*: Secondary forest with sparse undergrowth, and stream-edge secondary forest. *Participants*: PMB, HCL.

**Kanowit, Kanowit District, Sibiu Division**

5 July 2008: 2.082N 112.145E, 15 m. *Habitat*: Old rubber plantation. *Participants*: PMB, HCL.

**Mukah-Beringian Road, Mukah District, Sibiu Division**

8 July 2008: c. 7 km E of Mukah (2.923N 112.153E, 10 m). *Habitat*: Young secondary growth. *Participants*: PMB, HCL.

**Lanjak Entimau Wildlife Sanctuary, Song District, Kapit Division**

22–30 June 2017. *References*: Grubh (1994). *Participants*: VLC, LDS, FHS; Jody Kennard (volunteer); and staff of the Sarawak Forestry Corporation (Racheal anak Rosedy, Ruzy anak Marin, Lawrence Insol, Frazier anak Parose). Worked two sites each day.

Nanga Bloh: The research station at the junction of the Katibas and Bloh rivers (1.645N 112.276E, 100 m). *Habitat*: Secondary forest, river-edge scrub, and gardens.

Nanga Joh: The junction of the Bloh and Joh rivers (1.628N 112.303E, 100 m). *Habitat*: Lightly logged old growth forest.

**Tatau Area, Tatau District, Bintulu Division**

11–12 and 22–23 July 2008: c. 2 km NE of Tatau (2.892N 112.865E, 25 m). *Habitat*: Secondary forest. *Participants*: PMB, HCL.

**Off Quarry Road, Sibiu District, Sibiu Division**

25 July 2008: 2.360N 111.82E, 15 m. *Habitat*: Young secondary growth. *Participants*: PMB, HCL.

**Bukit Setian, Sibiu-Bintulu Road, Bintulu District, Bintulu Division**

10 July 2008: c. 15 km NE of Tatau (2.990N 112.931E, 100 m). *Habitat*: Secondary forest along a stream. *Participants*: PMB, HCL.

**Samarakan, Tatau District, Bintulu Division**

*References*: Stuebing (2007), Sheldon and Styring (2011), Styring et al. (2011), Styring et al. (2016), and Styring et al. (2018).

22 January–3 February 2007: Camped adjacent to the Sarawak Planted Forest Project's (PFP) *Acacia mangium*

plantation, c. 25 km S of Bintulu (2.942N 113.033E, 150 m). *Habitat*: Recently, heavily logged forest and some *Acacia mangium*. *Participants*: RGM, FHS; Sabah Museum staff (Freddie Julup and Patrick Francis); and PFP conservation unit staff (Azizan Juhin, Diana James, Eddie Abau, and Li Joseph).

30 January 2007: The PFP nursery (2.939N 113.121E, at 100 m). *Habitat*: Gardens, 8-year old *Acacia mangium* groves, and secondary forest edge.

**Kampung Suai, Miri District, Miri Division**

9–11 July 2012: 3.905N 113.734E, sea level. *Habitat*: Secondary forest and oil palm. *Participants*: DFG.

**Kampung Pangkalan Lobang, Niah National Park, Miri District, Miri Division**

14–16 July 2008: c. 65 km SSW of Miri (3.824N 113.760E, 20 m). *Habitat*: Young secondary growth along a river. *Participants*: PMB, HCL.

**Niah National Park Area, Miri District, Miri Division**

20 July 2008: 8 km SSE of Batu Niah (3.739N 113.789E, 20 m). *Habitat*: Young secondary forest. *Participants*: PMB, HCL.

21 July 2008: 5.5 km S of Batu Niah (3.755N 113.769E, 40 m). *Habitat*: Young secondary growth with river-edge bamboo. *Participants*: PMB, HCL.

**Soon Hup Villa, Miri, Jalan Sungai Rait, Miri District, Miri Division**

14–21 July 2011 and 11 July 2012: 4.235N 113.959E, 10 m. *Habitat*: Rubber plantation. *Participants*: DFG.

**Kampung Bidayuh Miri, Miri District, Miri Division**

14–15 June and 15, 24 July 2011: 4.307N 113.997E, 25 m. *Habitat*: Gardens, orchard, and hilly open areas. *Participants*: DFG.

**Lambir Hills National Park, Miri District, Miri Division**

16–26 April 2013: Work was conducted in the forest and open areas near Park headquarters (4.197N 114.042E, 50–300 m). *Habitat*: Mature dipterocarp and kerangas forest on the hillside above the headquarters; garden and scrub around park headquarters. *Participants*: VLC, JCM, FHS.

**Lambir Hills National Park Area, Miri District, Miri Division**

18 July 2008: North end of the Lambir Hills highway pass, 23 km W of Miri on the Miri-Bintulu Road, (4.236N 114.06E, 100 m). *Habitat*: Mature forest near a stream. *Participants*: PMB, HCL.

19 July 2008: 3 km S of Lambir Hills Park (4.159N 114.034E, 25 m). *Habitat*: Young secondary forest. *Participants*: PMB, HCL.

**Mt. Mulu National Park, Marudi District, Miri Division**

*References*: Banks (1935), Wells (1978), McCormick (1979), Hanbury-Tenison and Jermy (1979), Anderson et al. (1982),

Gawin et al. (2014), Brady and Burner (2015), Burner et al. (2016), van Els et al. (2016), Manthey et al. (2017), Burner et al. (2018), Burner et al. (2019).

*11–18 July 2010:* Worked at Park headquarters (4.043N 114.814E, 30 m) and Deer Cave (4.023N 114.821, 60 m). *Habitat:* Gardens at Park headquarters and secondary forest at Deer Cave. *Participants:* RGM, MAR, FHS, ZAR, and Isa Sait (UNIMAS staff).

*23 June–12 September 2014:* This was a major expedition covering large areas of the mountain (4.025N 114.8E, 25–1815 m) for a study of community ecology as well as to obtain specimens. Burner et al. (2016) describes it thoroughly. *Habitat:* Primary and disturbed lowland forest, and primary submontane and montane forest. *Participants:* MLB, RCB, VLC, PVE, David Bernasconi (LSU student volunteer), and Philip O. M. Steinhoff (University of Greifswald student volunteer).

*31 May–12 June 2016:* Worked along the summit trail at Camp 1 (4.051N 114.857E, 250 m), Camp 2 (4.0431N 114.871E, 550 m), Camp 3 (4.038N 114.888E, 1250–1450 m), and Camp 4 (4.044N 114.914E, 1850 m). *Habitat:* Primary upland, submontane, and montane forest. *Participants:* RCB, SBS, FHS, and Jody Kennard (volunteer).

#### **Batu Danau Area, Limbang District, Limbang Division**

*12–15 July 2011:* Kampung Pangkalan Madang, along the Limbang River (4.640N 114.814E, 20 m). *Habitat:* Orchards, river edge, and secondary forest. *Participants:* DFG.

*14–15, 19, 30 June, 4 July 2012:* Kampung Pangkalan Madang (04.646N 114.842E, 40 m). *Habitat:* Gardens, farmland, and secondary forest. *Participants:* CEB, VLC, DFG.

*17 June 2012:* Kampung Rangu, 3 km SSW of Batu Danau along the Limbang River (4.629N 114.849E, 40 m). *Participants:* CEB, VLC, DFG.

*2–4 July 2014:* Kampung Rangu (4.626N 114.85 E, 15 m). *Habitat:* Highly disturbed early-successional forest and scrubby vegetation. *Participants:* DFG, HCL.

*6–7 July 2014:* Kampung Bukit Impas (4.675N 114.926E, 25 m). *Habitat:* Work was conducted at several habitats surrounding the village: secondary forest with streamside marsh along the main dirt road into the village, and plantation and scrub near the village. *Participants:* DFG, HCL, PVE.

#### **Bukit Hitam, Limbang District, Limbang Division**

*8 July 2011:* 4.729N 114.997E, 25 m. *Habitat:* Secondary forest. *Participants:* DFG.

#### **Kelabit Highlands, Marudi District, Miri Division**

*References:* Mjöberg (1925), Harrisson (1949; 1959), Gregory-Smith (1998), Wang (2004), Sheldon et al. (2013).

*13–18 July 2011:* Worked from Gem's Lodge in Pa Umor, c. 3 km E of Bario along the Sungai Dappur (3.725N 115.507E, 1060 m). *Habitat:* Gem's lodge was in kerangas forest, with very sandy soil and extensive understory damage from cattle grazing and wood gathering. All of the Pa Umor landscape was heavily degraded—either deforested or with severely damaged forest—and the nearest relatively undisturbed forest (i.e., logged but structurally complex) was at least 1–2 km to the north or east. *Participants:* CEB, RGM, MAR, FHS, Trevor Allen (UNIMAS staff), and Tay Guan Khoo (UNIMAS student).

*19 July–1 August 2011:* Worked from a small rice farm NW of Pa Ukat village, c. 5 km NE of Bario (3.777N 115.476E, 1100 m). *Habitat:* The farm lay along a small stream that fed the Pa Ukat (Ukat River) c. 500 m to the south. North of the farm, forest was continuous into the mountains; thus, we were on the northern border of the Bario intermontane plateau. The farm consisted of wet and dry paddy fields immediately surrounded by steep, lower montane forest growing on good quality soil (as opposed to kerangas). The montane forest upstream (north) of the farm and on some of the surrounding ridges was in good condition compared to the forest immediately adjacent to the farm, which was degraded by wood-gathering and grazing. This forest had substantial understory growth and many small to medium-sized trees. The larger trees apparently had been removed for timber, although we did not see any stumps or recent damage to the forest in the areas where we netted. *Participants:* CEB, RGM, FHS, Trevor Allen (UNIMAS staff), Tay Guan Khoo (UNIMAS student).

#### **Long Kachu, Lawas District, Limbang Division**

*2 July 2011:* 4.742N 115.284E, 20 m. *Habitat:* Secondary forest and orchards. *Participants:* DFG.

#### **Lawas Area, Lawas District, Limbang Division**

*24 June 2011:* Gaya Lama (4.816N 115.374E, 20 m). *Habitat:* Secondary riverine forest. *Participants:* DFG.

*26–28 June 2011:* Long Tuma (4.801N 115.403E, 10 m). *Habitat:* Scrub adjacent to ponds and gardens. *Participants:* DFG.

*20 June–2 July 2012:* Ahmad Takong (4.819N 115.398E, 60 m). *Habitat:* Secondary forest and gardens. *Participants:* CEB, VLC, DFG.

*22–23 June 2012:* Kampung Peruan (4.781N 115.409E, 50 m). *Habitat:* Secondary riverine forest and gardens. *Participants:* DFG.

*28 June 2012:* Kampung Pengalih (4.827N 115.454E, 5 m). *Habitat:* Secondary forest and gardens. *Participants:* DFG.

*8–12 July 2014:* Ahmad Takong (4.819N 115.399E, 35 m). *Habitat:* Secondary forest, plantation and agricultural fields. *Participants:* MLB, HCL, PVE.

11 July 2014: Kampung Batu Tiga (4.849N 115.399E, 39 m). *Habitat*: Secondary scrub and plantation. *Participants*: MLB, HCL, PVE. *Notes*: Road-kill site.

#### Long Tengoa, Lawas District, Limbang Division

12–16 July 2014: Camped 1.25 km S of Long Tengoa on the bank of the Trusan River and a tributary (4.605N 115.381E, 70 m). *Habitat*: Hilly, old growth dipterocarp forest with substantial undergrowth; riparian forest; recently logged and secondary forest; river island scrub; and plantation. *Participants*: MLB, HCL, PVE.

#### Merapok Area, c. 20 km NE of Lawas, Lawas District, Limbang Division

30 June 2012: Kampung Sasa (4.950N 115.562E, 5 m). *Habitat*: Secondary forest and plantation. *Participants*: DFG. *Notes*: On labels and in catalogs it is called Kampung Sungai Sesak.

20–24 June 2011: Kampung Manchu (4.979N 115.584E, 20 m). *Habitat*: Rubber plantation. *Participants*: DFG. *Notes*: On labels and in catalogs it is called “Mujuh-Jelatong.” Jelatong refers to the streams in the area.

28 June, 1 July 2012: Kampung Undop, 20 km NE of Lawas (4.959N 115.572E, 15 m). *Habitat*: Secondary forest, farmland, and oil palm edge. *Participants*: DFG.

17–27 July 2014: Kampung Undop (4.954N 115.574E, 60 m). Work was conducted in the village and the surrounding hillside forest to the south and in rubber plantation to the east. *Habitat*: Hilly secondary forest interspersed with plantation, parts possibly primary forest; recent logging was evident; and teak plantation, riparian scrub and rice paddy. *Participants*: MLB, HCL, PVE.

## RESULTS AND DISCUSSION

Specimens and information collected during these expeditions have been used in 25 publications on the biogeography and phylogeography of Bornean birds by the LSU/KU/UNIMAS team (Nyári et al. 2009; Sheldon et al. 2009b; Hosner et al. 2010; Lim et al. 2010; Lohman et al. 2010; Lim et al. 2011; Lim and Sheldon 2011; Moyle et al. 2011; Sheldon et al. 2012; Gawin et al. 2014; Lim et al. 2014; Chua et al. 2015; Lim et al. 2015; Sheldon et al. 2015; Chua et al. 2017; Lim et al. 2017; Manthey et al. 2017; Moyle et al. 2017; Shakya et al. 2017; Shakya and Sheldon 2017; Campillo et al. 2018; Shakya et al. 2018; Boyce et al. 2019; Oliveros et al. 2019; Shakya et al. 2019). They have also been used in similar publications by other Southeast Asian researchers (e.g., Mahood et al. 2013; Fuchs et al. 2015; Dejtardol et al. 2016; Manawatthana et al. 2017). Data on the distribution and ecology of Sarawak birds are included in six publications (Sheldon et al. 2013; Brady and Burner 2015; Burner et al. 2016; van Els et al. 2016; Burner et al. 2018; Burner et al. 2019). The collaboration has also produced three Ph.D. dissertations on Bornean bird phyloge-

ography (Lim 2010; Gawin 2014; Burner 2019).

With respect to biogeography, the collaboration’s main contribution has been to provide genetic material to clarify the population structure of lowland passerines across Borneo (Sheldon et al. 2009b; Lim et al. 2011; Lim and Sheldon 2011; Sheldon et al. 2015; Lim et al. 2017; Shakya et al. 2018). The reason much of the fieldwork was concentrated in Lawas and Limbang districts in NE Sarawak is because this area lies in the transition (or contact) zone between distinct populations in Sarawak and Sabah. Bird populations in Sarawak and Sabah are thought to have evolved in isolation from one another and only recently (in geologic time) have come together. The collaboration has also clarified our knowledge of population structure in some montane species. We have shown that montane populations (unsurprisingly) have a different genetic structure than lowland populations, with isolation-by-distance and lowland barriers accounting mainly for genetic variation across the island (Chua et al. 2017; Manthey et al. 2017). We have also shown that in three cases in which lowland taxa are replaced by similar montane endemics—i.e., forktails (*Enicurus leschenaulti/borneensis*), leafbirds (*Chloropsis cochinchinensis/kinabaluensis*), and spiderhunters (*Arachnothera modesta/everetti*)—the taxa are not exchanging genes. Thus, they are distinct species, probably formed in allopatry on different islands rather than by ecological speciation in parapatry on montane slopes in Borneo (Moyle et al. 2017). Despite these advances, our understanding of montane population structure remains much poorer than for lowland populations because of a lack of sampling from key areas (see below).

With respect to bird ecology, RCB studied the dynamics of lowland versus montane communities along elevational gradients. Burner et al. (2018) identified the elevation of species-richness peaks and maximum lowland-montane species turnover on three mountains, Mulu and Pueh in Sarawak and Topap Oso in Kalimantan. On Mulu, the only mountain in Borneo with continuous undisturbed forest from 50 to > 2000 m, the richness peak occurs at c. 600 m and is caused by the overlap of distinct lowland and montane faunas. Burner et al. (2019) examined the abundant center and rare periphery hypotheses (Brown 1984; Gaston 2009) on Mt. Mulu and found that lowland bird species are most abundant near sea level and decline gradually with elevation, supporting the rare periphery hypothesis. This finding also implies that with global warming species may not be driven from the lowlands to mountains by temperature increases alone, although indirect effects of changes in temperature and precipitation could influence the distribution of lowland species.

One final discovery of our collaboration has little impact on the understanding of Bornean biogeography or ecology but highlights the nexus between hard work and serendipity. In the course of routine molecular comparisons of bulbul DNA, we uncovered a new species: the Cream-eyed Bulbul

*Pycnonotus pseudosimplex* (Shakya et al. 2019; Sheldon and Shakya 2019). This species looks almost exactly like the Cream-vented Bulbul *P. simplex*, except for its eye color, which is white instead of red. One ramification of this discovery—and another recent study (Garg et al. 2016)—is that eye-color is more important to species recognition in plain colored bulbuls than previously realized by systematists.

With respect to future projects, although we sampled numerous sites in Sarawak, much work remains to be done. Specimen material of montane populations is extremely limited, and this dearth has hampered investigations of montane bird phylogeography and evolution (Chua et al. 2017). Sampling is especially needed from the Dulit and Hose ranges and mountains along the Kalimantan border in the Kapit Division, an area for which no specimens exist at all (see Fig. 1). There is also a lack of sampling in certain species groups. Most of our lowland field work was focused on mist-netting in secondary forest and scrub, thus sampling of key taxa that inhabit older forest (e.g., pittas and endemic babblers) or the high canopy (e.g., leafbirds and some flowerpeckers, sunbirds, and babblers) is poor. In terms of ecological studies, a huge amount remains to be done, too much to enumerate here. Suffice to say that manpower and enthusiasm are rife in Sarawak, ensuring that such work will happen as long as forest remains intact and funding can be found.

## ACKNOWLEDGMENTS

For permission to undertake research in Sarawak, we thank the Malaysian Prime Minister's Department, the Chief Ministers' Department of Sarawak, Sarawak Forest Department, Sarawak Forestry Corporation, and Sarawak Biodiversity Institute. We also thank UNIMAS, Mulu National Park, Lambir Hills National Park, Grand Perfect Sdn. Bhd. Conservation Unit, Sarawak Planted Forest project, and dozens of Sarawak students and colleagues for their help in the field. Oscar Johnson and Rob Stuebing reviewed and improved the manuscript. Field techniques were approved by LSU's IACUC. Financial support was also provided by the National Geographic Society (8753-10), NSF DEB-0228688 and DEB-1241059 to FHS, NSF DEB-1241181 and DEB-1146345 to RGM, RGS/06(03)/647/2007(12) to MAR, the Coypu Foundation, Louisiana State University, and the Universiti Malaysia Sarawak.

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