Journal of Tropical Biology and Conservation 20: 173–191, 2023 ISSN 1823 3902
E-ISSN 2550-1909

Research Article

A Brief Description of Avian Communities in Sungai Tongod Forest Reserve, Tongod, Sabah, Malaysia

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Received 24 June 2023|Reviewed 26 July 2023|Accepted 09 September 2023|Published 15 October 2023
Doi: https://10.51200/jtbc.v20i. 4655

Abstract

A rapid assessment of the avifauna of Sungai Tongod Forest Reserve (STFR), a logged-over forest, was conducted in Tongod district in central Sabah, Malaysia. A modified MacKinnon List method was used to assess species diversity. The four-day survey recorded a total of 15 MacKinnon lists, with 342 individuals detected. A total of 85 species from 38 families were recorded, with H=4.07 and E_H=0.70. True species richness was estimated (using SuperDuplicates® online calculator) to be approximately 114 species, with about 30 species not detected. There were 10 Bornean endemics, half of which were listed as Least Concerned, two as Near Threatened, and one as Vulnerable, in the IUCN Red List of Threatened Species. The Pellorneidae, Pycnonotidae and Nectariniidae were represented by eight, seven and six species respectively. The family Pycnonotidae had the highest number of individuals at 40 followed by Pellorneidae with 35. The five most detected species comprised 42.4 % of all individuals. The most detected species were the Bold-striped Tit-babbler (17 individuals), Green Iora (15), Pink-necked Green Pigeon (15), Black-and-yellow Broadbill (12), and Black-headed Bulbul (12). Most of the species detected (77) were forest-dependent, of which 62 were strictly forest birds. Insectivores comprised the most dominant dietary guild, i.e., 25 species (from 22 families). Frugivores ranked second with 25 species from 10 families.

Keywords: avifaunal survey; MacKinnon List method; Sungai Tongod Forest Reserve; Tongod district; Sabah, Malaysia; feeding guilds; rapid assessment

Introduction

Since 1997 when the Sabah state government committed to implement sustainable forest management in all forest reserves, the Sabah Forestry Department (SFD) geared its management policies and practices towards multiple-use of forests. Much emphasis has been committed to timber certification and sustainability, forest conservation, rehabilitation and stakeholder participation. Over the past two decades, the Forest Research Centre (FRC) which serves as the R&D division of SFD, has contributed a

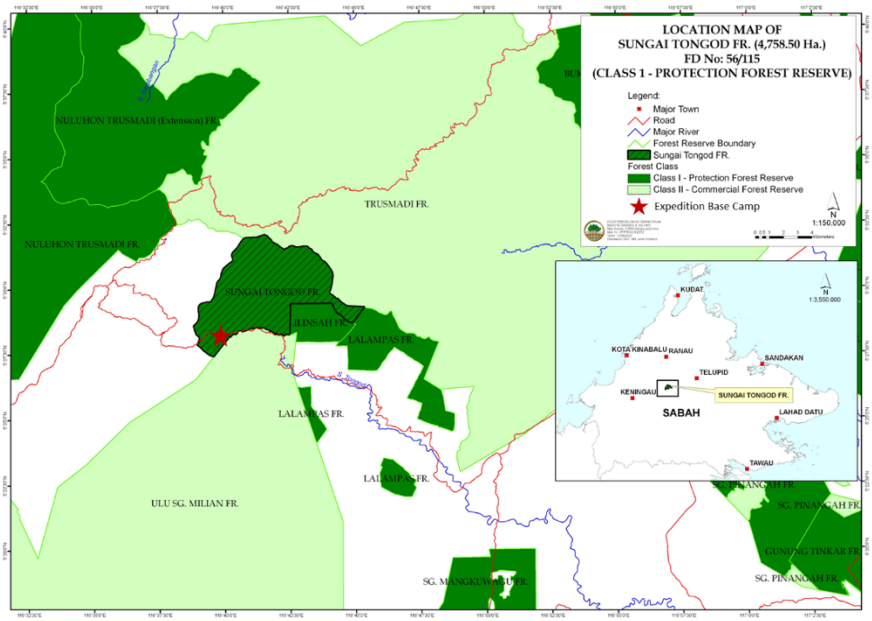
significant amount of research-generated information to support such efforts, either for the department or for the private sector. FRC has realigned its research programmes to be more oriented towards supporting conservation efforts. Understanding that birds play important functional roles in ecosystems as pollinators, seed dispersers, and predators, FRC established an avifaunal research team in 2017. The team aims to develop a rapid assessment methodology based on a modified MacKinnon List method (MacKinnon & Phillipps, 1993) to allow researchers and field staff to collect reliable avifaunal data within a span of a few days. The Sungai Tongod Forest Reserve (STFR) survey was part of these ongoing field trials.

This paper documents the outcome of the said avifaunal survey conducted during the STFR scientific expedition from 10th to 16th October 2022. FRC organised the expedition with funds from the Heart of Borneo Initiative project. The main objective of this survey was to describe the avian community and ecology within the forest reserve for future forest management initiatives. Surveys were conducted along the main road within the forest reserve.

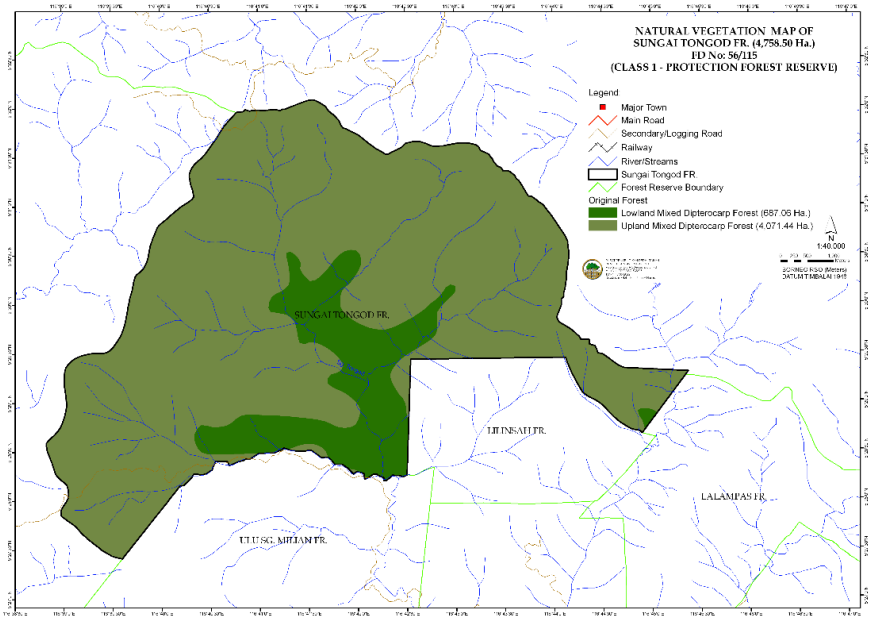
Site description

In 2010, STFR was gazetted as a Class I Protection Forest Reserve, approximately 4,758.5 ha in size, with elevation between 390 m (base camp) to 900 m (ridge close to western boundary). Prior to gazettement, it was state land and logged in most parts. It is located in central Sabah and is accessible by road from the Telupid-Pinangah main road. The expedition base camp was situated in the southwest portion of the reserve (5.472740 N, 116.684111 E), along a tributary of Sungai Tongod, where heavy road construction works were being carried out. The survey was conducted along this road which runs through STFR.

The documentation of historical forest logging has remained elusive. However, through the utilization of Google Earth's Historical Imagery feature, a conspicuous logging trail was discernible in the imagery from December 1984 (subsequent images were consistently captured each December). The expansion of a network of roads within the reserve became evident by 1990, serving as a clear indicator of pronounced logging activities that persisted until 1995–1996. Subsequent manifestations of logging road presence resurfaced between 2003 and 2007, suggestive of a potential resurgence in logging operations. Nevertheless, from 2008 to 2023, a gradual proliferation of vegetation obscured the visibility of these roadways.



Map 1. Location of STFR.



Map 2. Natural vegetation map of STFR.

The natural vegetation of STFR consisted of upland mixed dipterocarp forest over the Crocker soil association consisting of predominantly sandstone and mudstone-based soils. Its topography is typical of the Crocker association, with hills having amplitudes over 300 m and slopes typically greater than 25°. Ridge crests and valley bottoms are narrow, and landslips are common (Bower et al., 1975). As mentioned earlier, STFR was previously logged and much of its dipterocarp composition was lost. There were patches of relatively intact natural forest along the southwest and western boundaries, close to the expedition base camp. We suspect the hilly terrain and steep slopes prohibited logging in those areas.

Survey methods

The MacKinnon Lists (ML) method is a time-efficient, cost-effective sampling approach developed for studying avian tropical biodiversity, where lists of recorded species are collected from a single survey site (MacKinnon & Phillipps, 1993). The straightforward sampling method employed in this study proves to be well-suited for research endeavours characterized by constraints in time, resources, and personnel availability. It is particularly advantageous for entities like government agencies, non-governmental organizations, citizen scientists, and forest concessionaires, who often operate within limited capacities when conducting surveys. The simplicity of the approach facilitates its implementation in such contexts, enabling efficient data collection and analysis. This method thus emerges as a valuable tool for avifaunal research in Sabah, Malaysia, and holds the potential to contribute significantly to our understanding of the region's avian biodiversity. It also accounts for differences in effort, observer experience and knowledge, and weather (Poulsen et al., 1997). As the method relates species richness to the number of observations rather than to time, area, or walking speed, it allows the comparison of data obtained by different observers or under varying field conditions (Herzog et al., 2002). The ML method has gained popularity since the 1990s, in avian surveys and in biodiversity assessments of mammal and fish species (Bach et al., 2020).

To apply the ML method, we compiled lists of consecutive bird species recorded aurally and visually. Each list comprised 15 species. A species accumulation curve was generated by adding species not recorded on any of the previous lists to the total species number, which was then plotted as a function of the list number. However, in contrast to the traditional ML method, we also recorded the number of individuals for each species observed within each list. This provided more accurate species abundance ranks and decreased the chances of double-counting individuals.

Observation methods

Every observer had a pair of Nikon binoculars (8 x 42s). The reference field guide of choice was *Phillipps' Field Guide to the Birds of Borneo*', *3rd Ed*. (Phillipps and Phillipps, 2014). The latest taxonomic changes were determined from online sources (www.worldbirdnames.com and https://birdsoftheworld.org) and published papers. A Nikon P1000 mega-zoom camera (3000 mm equivalent) was used to photograph birds to confirm their identities.

Surveys were conducted over four days (11-14 October 2022), beginning at 7:30 am and ending after 4 hours. Two surveys were conducted along the road and another two along the temporary forest trails made by other expedition teams. Night surveys to detect nocturnal birds were conducted close to the base camp as rainy conditions during the evenings made the steep, bare-earth roads extremely slippery.

A designated person recorded all observations. Care was taken to prevent intra-list and inter-list double counts of individuals. As about half of the individuals were detected by their calls/vocalizations, individual birds were listed only if and when observers were confident that they were different, especially when inputting abundance data within the same 15-species list. Criteria for determining distinct individuals of the same species were: a) their calls originated from different directions; b) there were two or more calls heard subsequently from a similar direction of a previously recorded individual; c) the distance from a previously recorded individual was deemed sufficient for a call to be considered as from a separate individual. Photographs were taken and immediately viewed for species flying in flocks to estimate the number of individuals. Care was taken not to double-count the same flock. As the trails were not looped, only bird species not recorded earlier were recorded on the return leg.

Analyses

From survey observations, basic diversity information was extracted, including species richness, a diversity index (H), relative abundance (E_H), species family, endemicity, etc. A species accumulation curve was generated by adding species not recorded on any of the previous lists to the total species number, which was then plotted as a function of the list number. To estimate the area's species richness, we used the SuperDuplicates® online calculator developed by Chao et al. (2017), which requires only the total number of species observed and the number of species observed only once (uniques/singletons). The relative abundance indices of the species observed were calculated. The most common

families and species, and the number of Bornean endemics, were also determined.

Analyses of feeding guilds provided information on how communities of species use specific forest resources (fruits, insects, arthropods, seeds, etc.) and may indicate the condition or health of the forest ecosystem. Thus, the species were categorised according to 6 feeding guilds based on their preferred diet; carnivores (Car), frugivores (Fru), insectivores (Ins), nectarivores (Nec), granivores (Gra) and omnivores (Omn). Species were considered omnivores if they were known to consume roughly similar amounts of animal- and plant-based food resources. Guild information was determined mainly from Phillipps and Phillipps (2014) and Wells (1999 & 2007). Feeding guilds were then described according to habitat type (e.g., forest, forest edge and open areas) to examine the importance of various habitats to different guilds.

Results

Avifaunal Composition and Species Richness

The four survey days yielded 15 lists of 15 individuals and a total of 342 individuals, of which 142 (41.5%) were detected by their calls/vocalisations. **Table 1** shows a quick comparison of STFR with other forest reserves from previous surveys using the same methodology but in different forest types, conditions and elevations. The total species count of 85 in STFR was lower than the mean of 90.78 species.

Table 1. Comparison of STFR to other selected forest sites.

Forest site	Total species	Total families	Total individuals	Shannon Index, H'	Evenness, E_H
Sungai Tongod	85	38	342	4.07	0.70
Mt. Mandalom[1]	92	38	242	4.25	0.77
Sg. Tindikon & Sg. Tikolod[2]	79	36	328	3.67	0.63
Balingkadus[3]	86	37	388	3.89	0.65
Bukit Hampuan[4]	71	33	408	3.44	0.57
Sapagaya[5]	115	43	624	4.17	0.65
Mensalong[6]	101	37	566	4.18	0.75
Mengilan[7]	75	33	486	3.86	0.62
Sg. Rawog[8]	113	42	465	4.29	0.66
Average	**90.78**	**37.44**	**427.67**	**3.98**	**0.67**

Compiled from [1]Joeman *et al.* 2023, [2]Petol *et al.* 2022a, [3]Petol *et al.* 2022b, [4]Petol *et al.* 2021b, [5]Joeman *et al.*, 2020a, [6]Joeman *et al.*, 2020b, [7]Petol *et al.*, 2021a., [8]Petol & Rudolf 2019.

Although the STFR forest was relatively intact, its totals of species and families were similar to that of Balingkadus FR, a small, fragmented forest reserve with

high levels of forest disturbance. In terms of forest conditions, STFR is very similar to Mensalong FR and Sg. Rawog Conservation Area, but both of these sites had significantly more species.

The survey also yielded 10 Bornean endemics: Bornean Wren-Babbler listed as Vulnerable (VU); Bornean Crested Fireback and Black-throated Wren-Babbler, Near Threatened (NT); and the rest, Least Concern (LC) (IUCN 2023; see **Table 2**. Only the wren-babblers and the Bornean Crested Fireback are uncommon forest birds.

Table 2. Species endemic to Borneo and their respective categories in the IUCN Red List (2023) of threatened species.

No.	Species	Family	Category
1	Black-throated Wren-Babbler	Pellorneidae	NT
2	Bornean Black-capped Babbler	Pellorneidae	LC
3	Bornean Brown Barbet	Megalaimidae	LC
4	Bornean Wren-babbler	Pellorneidae	VU
5	Chestnut-crested Yuhina	Zosteropidae	LC
6	Cream-eyed Bulbul	Pycnonotidae	LC
7	Bornean Crested Fireback	Phasianidae	NT
8	Dusky Munia	Estrildidae	LC
9	Golden-naped Barbet	Megalaimidae	LC
10	White-crowned Shama	Muscicapidae	LC

Table 3 lists species according to IUCN (2023) Red List categories. All species categorised as NT are lowland mixed dipterocarp forest species. The five hornbill species were listed as VU, EN or CR.

Table 3. Species listed as Near Threatened (NT), Vulnerable (VU), Endangered (EN) dan Critically Endangered (CR) by the IUCN (2023).

Species	IUCN Red List Category
Black-and-yellow Broadbill	NT
Black-throated Babbler	NT
Black-throated Wren-Babbler	NT
Bornean Crested Fireback	NT
Brown Fulvetta	NT
Chestnut-rumped Babbler	NT
Dark-throated Oriole	NT
Diard's Trogon	NT
Great Argus	NT
Green Iora	NT
Lesser Green Leafbird	NT
Rufous-crowned Babbler	NT

Scaly-breasted Bulbul	NT
Short-tailed Babbler	NT
Sooty-capped Babbler	NT
White-chested Babbler	NT
Yellow-crowned Barbet	NT
Asian Black Hornbill	VU
Bornean Wren-Babbler	VU
Rhinoceros Hornbill	VU
Wallace's Hawk-eagle	VU
Wreathed Hornbill	VU
White-crowned Hornbill	EN
Helmeted Hornbill	CR

Table 4 shows that Pellorneidae and Pycnonotidae were the most speciose families, with eight and seven species respectively. The seven families in the table contributed 41 species or approximately 48.2% of the total number of species observed.

Table 4. Top four most speciose families (with shared rankings).

Rank	Family	No. of species
1	Pellorneidae	8
2	Pycnonotidae	7
3	Nectariniidae	6
4	Bucerotidae	5
4	Megalaimidae	5
4	Muscicapidae	5
4	Timaliidae	5

As shown in **Table 5**, the Pycnonotidae (bulbuls) was the most commonly detected family, with 40 individuals. Of the seven species of bulbuls, the Black-headed Bulbul (12 individuals), Red-eyed Bulbul (11 individuals) and Spectacled Bulbul (11 individuals) were the most commonly detected.

Among the Pellorneidae, the White-chested, Sooty-capped, and Puff-throated Babblers claimed second place in rank, exhibiting 11, 9, and 7 individuals respectively. Virtually all babblers were identified through their vocalizations. Notably, the Puff-throated Babbler, though unlisted in Borneo, was distinguished by its persistent vocalizations. Its proximity to dense roadside vegetation facilitated comparison of its call with online databases (xenocanto.org). Owing to post-survey identification (no mobile reception at expedition basecamp or survey sites), a subsequent visit to confirm its true identity is warranted. For present publication purposes, we classify it as 'Puff-

throated Babbler?' based on its call's closest resemblance to that of the Puff-throated Babbler.

The Timaliidae family featured the Bold-striped Tit-Babbler as the most frequently detected species, accounting for 17 individuals distinguished by their calls. Similarly, the Red-headed Tailorbird and Yellow-bellied Prinia of the Cisticolidae family, each with 9 individuals, were also discerned by their vocalizations. Among the Nectariniidae, the Purple-naped Sunbird was identified on 6 occasions, marking the highest count. In the fifth-ranking Columbidae family, the Pink-necked Green Pigeon prevailed as the most frequently detected species, numbering 15 individuals.

Table 5. The five families with the highest percentage of detected individuals (note shared rankings).

Rank	Family	No. of individuals	% of detected individuals
1	Pycnonotidae	40	11.7
2	Pellorneidae	35	10.2
3	Timaliidae	27	7.9
4	Cisticolidae	23	6.7
4	Nectariniidae	20	5.8
5	Columbidae	19	5.5

Table 6 shows the list of species detected 10 or more times (with shared rankings). These species made up approximately 33.3% of all individuals detected. Being aurally conspicuous, most individuals were first detected aurally. Some were later identified visually.

Table 6. List of species detected 10 or more times (note shared rankings)

Rank	Species	Family	No. of individuals detected	Relative abundance Index
1	Bold-striped Tit-Babbler	Timaliidae	17	0.050
2	Green Iora	Aegithinidae	15	0.044
2	Pink-necked Green Pigeon	Columbidae	15	0.044
3	Black-and-yellow Broadbill	Eurylaimidae	12	0.035
3	Black-headed Bulbul	Pycnonotidae	12	0.035
4	White-chested Babbler	Pellorneidae	11	0.032
4	Red-eyed Bulbul	Pycnonotidae	11	0.032
4	Spectacled Bulbul	Pycnonotidae	11	0.032
5	Chestnut-crested Yuhina	Zosteropidae	10	0.029

As expected for the ML rapid assessment method and only a 4-day survey, the species accumulation curve (**Figure 1**) did not achieve an asymptote. To estimate the species richness, the SuperDuplicates® online calculator was used (Chao et al., 2017). Only the total number of species detected and the number of singletons (species detected only once) were needed by the calculator (**Table 7**). It estimated Chao1 (species richness using abundance data) to be approximately 114 species, with an upper and lower threshold of approximately 138 and 101 species, respectively, in the 95% confidence interval. The number of doubletons (species detected only twice) was estimated to be 14, slightly more than the actual number (13) obtained from the survey. The calculator also estimated that approximately 30 species were undetected, i.e., the survey detected about 74.3% of the total species in the area. Based on the linear regression line in **Figure. 1**, it estimated that another nine lists, or an extra two-survey days, were needed to detect the estimated 144 species of birds in STFR.

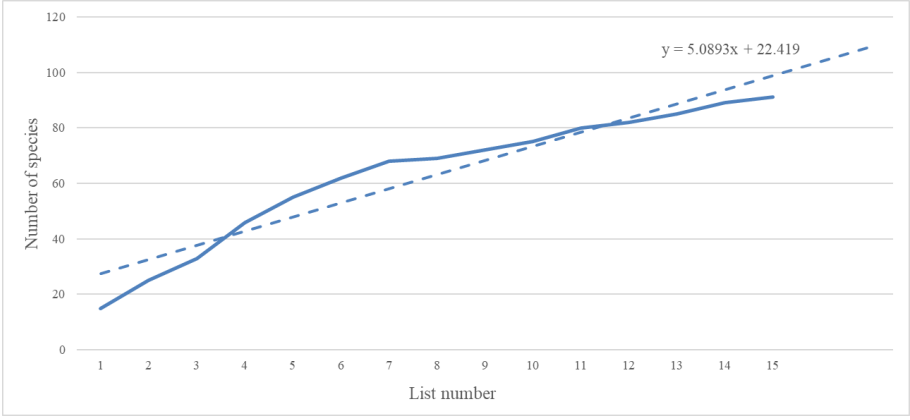


Figure 1. Species accumulation curve and linear regression line of birds in STFR.

Table 7. Results from SuperDuplicates®

Estimated number of doubletons	Estimated species richness	Standard error	95% C.I. lower	95% C.I. upper	Number of undetected species	Undetected percentage (%)
14.27	114.44	9.07	101.32	138.11	29.44	25.72

Habitat types and feeding guilds

Species were categorised according to their preferred habitats (e.g., forest, forest edge, open areas) and feeding guilds (**Figure 2**). Of the 77 forest-

dependent species, 62 were strictly forest birds. Most of the common families in Bornean lowland rain forests were present. These included raptors, hornbills, woodpeckers, pigeons/doves, cuckoos, trogons, barbets, broadbills, leafbirds, tailorbirds, and bulbuls. Ground birds, such as pheasants and wren-babblers, were also detected. Pittas were not detected but this may be because they are quiet when not breeding. The commonly heard Plaintive Cuckoo, Indian Cuckoo, Banded Bay Drongo-cuckoo and Square-tailed Drongo-cuckoo were also not detected in STFR.

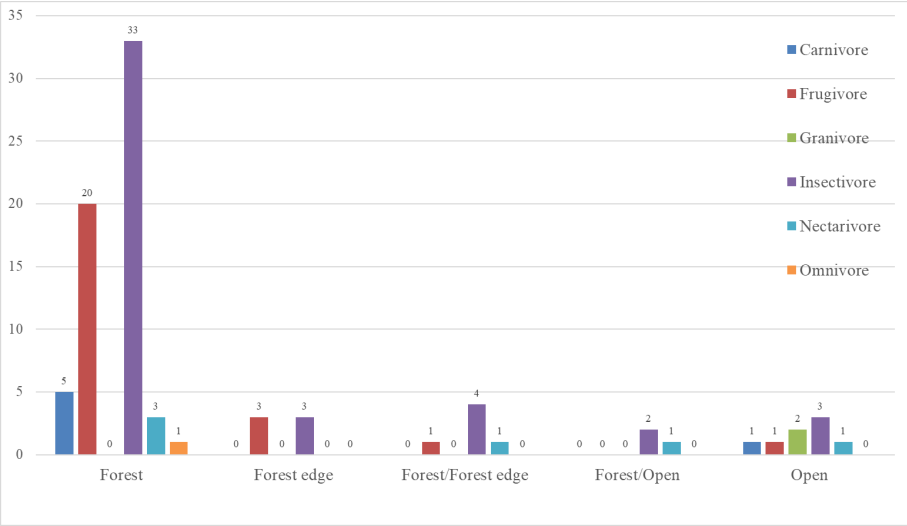


Figure 2: Number of species according to habitat types and feeding guilds in STFR.

In terms of feeding guilds, insectivores and frugivores comprised 89.5% of the total individuals detected, with the former being the most abundant at 188 individuals. Of the 45 species (representing 21 families) of insectivores, 33 were strictly forest species. The Black-and-yellow Broadbill, Green Iora, Bold-striped Tit-Babbler and White-chested Babbler were the most common insectivores.

The second most dominant guild was the frugivores, with 118 individuals detected (25 species, 10 families). With 40 individuals from seven species, the bulbuls (Pycnonotidae) were the most detected family amongst the frugivores. From their conspicuous calls, 15 individuals of barbets from five species were detected. As in our previous surveys, the total number of insectivorous and frugivorous species (33 & 20, respectively) were significantly higher in the 'Forest' habitat as compared to other habitats (Petol & Rudolf, 2019; Petol et

al., 2021a; Petol et al., 2021b; Joeman et al., 2020a, Petol et al., 2022 & Joeman et al., 2020b).

Table 8 compares insectivores and frugivores figures between STFR and other selected FRs that were surveyed using similar methods. At 82.3%, the percentage of insectivorous-frugivorous species was similar to that in other forest reserves. In STFR, insectivores made up 55.0% of the total individuals detected, slightly above the average of 53.1% for all sites. The number of insectivorous species was slightly above average while the number of insectivorous species was about average. For frugivores, the percentage of total individuals (34.5%) was higher than the other forest reserves except for Mensalong FR. The number of frugivorous species was slightly below the average of 27 species. The number of frugivorous species was about average.

Table 8. Comparison of insectivores/frugivores in STFR and in other selected forest reserves.

Forest reserve	% of insectivorous + frugivorous species	Insectivores			Frugivores		
		% of total individuals	Number of species	Number of families	% of total individuals	Number of species	Number of families
Sg. Tongod	82.3	55.0	45	21	34.5	25	10
Mt Mandalom[1]	71.9	43.0	38	21	28.9	27	10
Sg. Tindikon & Sg. Tikolod[2]	83.8	58.1	40	22	25.7	25	10
Balingkadus[3]	82.5	52.8	41	22	29.6	29	10
Bukit Hampuan[4]	77.2	52.9	35	19	24.2	22	9
Sapagaya[5]	82.4	61.4	62	27	25.8	32	11
Mensalong[6]	80.4	43.1	48	22	45.0	34	12
Menghilan[7]	84.0	59.0	41	19	25.1	22	9
Average	**80.1**	**53.1**	**43.8**	**21.6**	**29.9**	**27.0**	**10.1**

Compiled using survey data from [1]Joeman et al. 2023, [2]Petol et al. 2022a, [3]Petol et al. 2022b, [4]Petol et al. 2021b, [5]Joeman et al., 2020a, [6]Joeman et al., 2020b, [7]Petol et al., 2021a.

Discussion

The findings of this survey underscore the capacity of heavily logged forest ecosystems to maintain a noteworthy diversity of avian species. Regeneration processes post-logging have demonstrated the potential to enhance species richness over extended time periods, particularly when regrowth remains undisturbed for durations ranging from two to four decades (Dent & Wright, 2009). The proximity of STFR to neighboring areas, specifically Trus Madi FR and Ulu Sungai Milian FR, raises the prospect of recolonisation, contributing to the gradual restoration of species within the logged forest. These contiguous Class II Production Forest Reserves offer the potential to serve as repositories for

reinstating STFR's species composition. Moreover, observable indicators point to ongoing avian recolonisation within the surveyed habitat. Supported by diversity indices, H' and E_H, signifying robust species diversity and even distribution, the presence of diverse taxa, including five hornbill species and 62 forest specialists, accentuates conducive conditions for avian niche expansion. The identification of ground-dwelling species such as the Great Argus and the Bornean Crested Fireback, along with flourishing forest specialists, bolsters the notion of abundant food resources within STFR. This deduction finds support in data from Table 8, where both insectivore and frugivore ratios exceed those of other forest contexts.

Similar investigations have provided insights into post-logging avian dynamics. Research in West Malaysian rainforests by Husin and Rajpar (2015) delineated temporal patterns post-logging, with an initial phase of species susceptibility followed by heightened diversity approximately three decades after disturbance. Although the pre-logging species inventory of STFR was not available, the diversity observed within the 15–16 years following logging aligns with regenerative trends. Similarly in Kalimantan, where Cleary et al. (2007) showed shifts in avian dietary preferences and sizes due to logging. Likewise, Edmunds et al. (2013) examined avian responses to logging-induced changes, highlighting the vulnerability of dietary specialists to localised extirpation, with persisting species displaying no strict alignment with trophic positions. These insights illuminate the complexities of avian dynamics post-logging, underscoring the interactions between ecological succession, trophic adaptation, and taxonomic persistence. The concealed intricacies of trophic recalibration, stemming from forest degradation, highlights the need to shift from exclusive feeding guild associations to a more holistic understanding of functional intricacies within logged-over forest ecosystems.

Conversely, the plausibility of STFR retaining a substantial portion of its initial avian community arises from the survey site's relative ecological integrity, distinct from the extensively degraded forest in other parts of STFR. This specific forest area might have functioned as a refugium, offering specialised habitats that safeguard and support avian populations. The presence of two distinct Bornean gibbon groups within the surveyed area serves to corroborate the notion put forth by Davies and Tan (2019), suggesting a resurgence in gibbon densities to levels akin to the pre-logging era. This alignment with the post-logging 20-year recovery timeline emphasizes the restorative potential of the ecosystem after logging activities. However, it is important to exercise caution in interpreting these survey findings.

Conclusion

While the rest of STFR was mainly degraded forest, the survey provided a window to understanding the avian community within the reserve. Its relatively high H' and E_H values indicate a diverse bird assemblage. The presence of hornbills and ground-dwelling species also indicated a moderately healthy bird community. However, while still in its early phases, the road construction project through the southern border of the reserve already showed signs of having a destructive impact on the few remaining tracts of intact forests in STFR. The extent of preservation of STFR in the years ahead remains uncertain. It would be interesting to survey this area a few years after the completion of the road to access the avian community's response to (potentially) further disturbance.

Acknowledgements

This survey was part of the Heart of Borneo Initiative project, which is funded by the Ministry of Energy and Natural Resources, Malaysia. Our appreciation also goes to the research officers and staff of the Forest Research Centre, Sabah Forestry Department, who successfully organised the STFR Scientific Expedition.

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APPENDIX I

List of bird species detected at Sungai Tongod Forest Reserve (Class I), sorted by families. Common names in bold denote Bornean endemics. Bird names are according to the classification in Gill, Donsker and Rasmussen (2023).

Common name	Species	Family
Crested Serpent Eagle	*Spilornis cheela*	Accipitridae
Wallace's Hawk-eagle	*Spizaetus nanus*	Accipitridae
Common Iora	*Aegithina tiphia*	Aegithinidae
Green Iora	*Aegithina viridissima*	Aegithinidae
Rufous-backed Kingfisher	*Ceyx rufidorsa motleyi*	Alcedinidae
Brown Fulvetta	*Alcippe brunneicauda*	Alcippeidae
Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae
Little Egret	*Egretta garzetta*	Ardeidae
White-crowned Hornbill	*Aceros comatus*	Bucerotidae
Asian Black Hornbill	*Anthracoceros malayanus*	Bucerotidae
Rhinoceros Hornbill	*Buceros rhinoceros*	Bucerotidae
Helmeted Hornbill	*Rhinoplex vigil*	Bucerotidae
Wreathed Hornbill	*Rhyticeros undulatus*	Bucerotidae
Lesser Cuckoo-shrike	*Coracina fimbriata*	Campephagidae
Malaysian Eared Nightjar	*Lyncornis temminckii*	Caprimulgidae
Yellow-bellied warbler	*Abroscopus superciliaris*	Cettiidae
Lesser Green Leafbird	*Chloropsis cyanopogon*	Chloropseidae
Red-headed Tailorbird	*Orthotomus ruficeps*	Cisticolidae
Rufous-tailed Tailorbird	*Orthotomus sericeus*	Cisticolidae
Yellow-bellied Prinia	*Prinia flaviventris*	Cisticolidae
Emerald Dove	*Chalcophaps indica*	Columbidae
Pink-necked Green Pigeon	*Treron vernans*	Columbidae
Banded Bay Cuckoo	*Cacomantis sonneratii*	Cuculidae
Violet Cuckoo	*Chrysococcyx xanthorhynchus*	Cuculidae
Raffles's Malkoha	*Phaenicophaeus chlorophaeus*	Cuculidae
Scarlet-backed Flowerpecker	*Dicaeum cruentatum nigrimentum*	Dicaeidae
Orange-bellied Flowerpecker	*Dicaeum trigonostigma*	Dicaeidae

APPENDIX I (cont.**)**

Common name	Species	Family
Bronzed Drongo	*Dicrurus aeneus*	Dicruridae
Greater Racquet-tailed Drongo	*Dicrurus paradiseus*	Dicruridae
Chestnut Munia	*Lonchura atricapilla*	Estrildidae
Dusky Munia	*Lonchura fuscans*	Estrildidae
Black-and-yellow Broadbill	*Eurylaimus ochromalus*	Eurylaimidae
Whiskered Treeswift	*Hemiprocne comata*	Hemiprocnidae
Grey-rumped Treeswift	*Hemiprocne longipennis*	Hemiprocnidae
Barn Swallow	*Hirundo rustica*	Hirundinidae
Asian Fairy-bluebird	*Irena puella*	Irenidae
Bornean Brown Barbet	*Calorhamphus fuliginosus*	Megalaimidae
Gold-whiskered Barbet	*Psilopogon chrysopogon*	Megalaimidae
Blue-eared Barbet	*Psilopogon cyanotis*	Megalaimidae
Yellow-crowned Barbet	*Psilopogon henricii*	Megalaimidae
Golden-naped Barbet	Psilopogon pulcherrimus	Megalaimidae
Red-bearded Bee-eater	*Nyctyornis amictus*	Meropidae
Blyth's Paradise Flycatcher	*Terpsiphone affinis borneensis*	Monarchidae
Grey Wagtail	*Motacilla citreola*	Motaciliidae
Oriental Magpie Robin	*Copsychus saularis adamsi*	Muscicapidae
White-crowned Shama	*Copsychus stricklandi*	Muscicapidae
Hill Blue Flycatcher	*Cyornis whitei*	Muscicapidae
White-crowned Forktail	*Enicurus leshenaulti*	Muscicapidae
Dark-sided Flycatcher	Muscicapa sibirica	Muscicapidae
Eastern Crimson Sunbird	*Aethopyga siparaja*	Nectariniidae
Brown-throated Sunbird	*Anthreptes malacensis bornensis*	Nectariniidae
Plain Sunbird	*Anthreptes simplex*	Nectariniidae
Thick-billed Spiderhunter	*Arachnothera crassirostris*	Nectariniidae
Little Spiderhunter	*Arachnothera longirostra*	Nectariniidae
Purple-naped Sunbird	*Kurochkinegramma hypogrammicum*	Nectariniidae
Dark-throated Oriole	*Oriolus xanthonotus*	Oriolidae
Sooty-capped Babbler	*Malacopteron affine*	Pellorneidae
Rufous-crowned Babbler	*Malacopteron magnum*	Pellorneidae

APPENDIX I (cont.**)**

Common name	Species	Family
Black-throated Wren-Babbler	*Napothera atrigularis*	Pellorneidae
Bornean Black-capped Babbler	*Pellorneum capistratoides*	Pellorneidae
Short-tailed Babbler	*Pellorneum malaccense*	Pellorneidae
White-chested Babbler	*Pellorneum rostratum*	Pellorneidae
Puff-throated Babbler?	*Pellorneum ruficeps*	Pellorneidae
Bornean Wren-Babbler	Ptilocichla leucogrammica	Pellorneidae
Great Argus	*Argusianus argus*	Phasianidae
Bornean Crested Fireback	*Lophura ignita ignita*	Phasianidae
Crimson-winged Woodpecker	*Picus puniceus*	Picidae
Rufous Piculet	*Sasia abnormis*	Picidae
Blue-crowned Hanging Parrot	*Loriculus galgulus*	Psittaculidae
Black-headed Bulbul	*Brachypodius melanocephalos*	Pycnonotidae
Spectacled Bulbul	*Ixodia erythropthalmos*	Pycnonotidae
Scaly-breasted Bulbul	*Ixodia squamata*	Pycnonotidae
Red-eyed Bulbul	*Pycnonotus brunneus*	Pycnonotidae
Yellow-vented Bulbul	*Pycnonotus goiavier*	Pycnonotidae
Olive-winged Bulbul	*Pycnonotus plumosus*	Pycnonotidae
Cream-eyed Bulbul	*Pycnonotus pseudosimplex*	Pycnonotidae
Boobook	*Ninox scutulata borneensis*	Strigidae
Bold-striped Tit-babbler	*Mixornis bornensis*	Timaliidae
Chestnut-backed Scimitar Babbler	*Pomatorhinus mantanus*	Timaliidae
Chestnut-rumped Babbler	*Stachyris maculata*	Timaliidae
Black-throated Babbler	*Stachyris nigricollis*	Timaliidae
Grey-headed Babbler	Stachyris rufifrons	Timaliidae
Diard's Trogon	*Harpactes diardii*	Trogonidae
Rufous-winged Philentoma	*Philentoma pyrhopterum*	Vangidae
Chestnut-crested Yuhina	*Staphida everetti*	Zosteropidae