Implications of climate change for Malaysian tropical montane bird communities discernible over a 14-years interval.

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Abstract: Tropical montane ecosystems are vulnerable to multiple threats, and severe ecological impact on such systems has been documented. However, trends for local montane biodiversity are often varied. Such discrepancy underscores the need to parse the spatial and temporal dynamic of each habitat type within a montane landscape in terms of their species richness, species turnover rate, and relative abundance. We studied species richness and composition of two tropical montane bird communities at two localities in Peninsular Malaysia in 2002-03 and 2016-17. The habitat types sampled at each locality represent a disturbance gradient within a montane landscape. While the number of species generally increased along the disturbance gradient, all study sites (bar tea plantation) had the same or fewer species observed in 2016-17. At the community level observed from the two time periods, Fraser's Hill – where development has been absent since 1920s – had a decrease in species richness; and a higher proportion of species with a decline in their relative abundance, compared to the more disturbed landscape in Cameron Highlands. Both the number of species lost and the number of species gained also varied considerably between the two communities. Our results suggest that climate change is a likely factor in negatively impacting the montane bird communities in Peninsular Malaysia, and highlight the need to monitor the temporal dynamic in the composition of local communities.

Keywords: climate change, community structure, conservation, habitat degradation, Southeast Asia, tropical cloud forests

INTRODUCTION

The nature conservation of montane habitats in Malaysia was a recurrent theme in the 21st anniversary Special Issue of MNJ (Molesworth Allen, 1961; Watson, 1961; Wyatt-Smith, 1961). Subsequently, habitat degradation and climate change have been identified as two major threats to tropical birds (Sekercioglu *et al.*, 2012; Sodhi *et al*. 2004a), with those of montane habitats particularly impacted. For example, the ranges, and population sizes, of montane birds are projected to decrease by 19–42% and 19–62%, respectively, when both habitat loss and climate change are considered together (Harris *et al*., 2014). These threats could also cause changes in tropical montane bird communities at species level. Lawler *et al.* (2009) reported that hundreds of tropical montane species of restricted range are already threatened by habitat degradation, and are therefore particularly vulnerable to extinction from climate change. Conversely, those that are habitat generalists and have access to suitable habitats spanning a wide elevation range are expected to be less affected (Anciaes & Peterson, 2009).

While global biodiversity monitoring of tropical montane birds showed consistent decline (e.g., Sekercioglu *et al*., 2008), this effect may not translate into responses at community level. Soh *et al.* (2019) reported that there are variable trends in local montane communities, which could be due to species' equivocal or inverse responses to habitats with intermediate level of degradation; citing higher resource availability (e.g., food resources or breeding habitats) typically associated with those lightly disturbed habitats as the main cause of higher species richness. The discrepancy could also be due to the occurrence of more resilient species that are generalists, not threatened, have broad elevational distribution, are introduced, or adaptable to climate change (Soh *et al.*, 2019; Dornelas *et al.*, 2014; Supp and Ernest, 2014; Thomas, 2013). The contradictory findings at global and local community levels underscore the need for better understanding of the effects of habitat degradation on diversity of local communities, and for identifying actual local diversity consequences of the observed climate changes. Despite the conservation importance of tropical montane bird communities, there has been no previous study at this level on the extent and magnitude of current changes in their diversity and distributions – and their differences in temporal trends – in response to the synergistic effects of habitat degradation and climatic change.

We studied changes in species richness and composition of two tropical montane bird communities at the landscape level in Peninsular Malaysia, between two time periods, 2002-3 and 2016-17. Combining observations from the two surveys, we produce a comprehensive checklist of birds for two montane localities – namely Fraser's Hill and Cameron Highlands. This allowed us to document the persistence of birds across a range of disturbed habitats within these localities; identify species that are vulnerable to habitat degradation (i.e., species that are confined to forests only). We also highlight the conservation value of degraded habitats if they also harbour forest dependent species.

Our main questions are: (1) How has species richness of the montane bird community at each locality (alpha diversity) changed over a period of 14 years? (2) Has species turnover (beta diversity, i.e., change in community composition over time) differed between the two localities? (3) Did the relative abundance change between the two time periods?

Based on the findings that Southeast Asian bird populations have shifted their elevational distribution upwards, due to climate change (Peh, 2007), and the assumption that community level change would mirror the population level responses to changing climate, we hypothesise that (1) species richness has increased in both localities as some lowland species expanded their upper elevational boundaries; (2) species turnover has been higher in Cameron Highlands, as its landscape is more disturbed; and (3) forest dependent species have become less common, relative to other species in the landscape.

MATERIALS AND METHODS

Study region

The montane localities of Fraser's Hill and Cameron Highlands provide a range of habitat types that reflect historical and current land-use in the tropical montane forest areas of Peninsular Malaysia (Figure 1, Table 1). Fraser's Hill is gazetted as a wildlife sanctuary and permanent forest reserve. and has remained relatively free from further development since it was last developed as a holiday respite in the 1920s (Er *et al*., 2013). In contrast, the protected status of Cameron Highlands was lifted in 1960 to allow timber extraction, agricultural and urban development (Chan, 2006). Since the 1960s, cultivation of temperate fruit and vegetables, and tea, in Cameron Highlands has intensified (Chan, 2006; Peh *et al*., 2011). GIS analyses revealed 2% loss of the forest cover in Cameron Highlands over one decade (Ismail *et al*., 2014), and an increase in mean annual temperature of 0.9 °C from 1970 to 2006 (Ismail *et al.*, 2011, 2014).

Bird surveys

We first surveyed our study sites in 2002 to 2003 (Soh *et al.*, 2006) and then resurveyed the same sites 14 years later (Table 1). Bird occurrence and abundance surveys were conducted over six periods within each sampling year in 2002-3 and 2016-17 (Table 2). During each sampling period, six 10-minute point counts were conducted at each site (i.e., 36 point-counts per habitat type: primary forest, secondary forest, edge forest, small fragment, tea plantation, rural and urban areas), except for the fragment in Fraser's Hill where only three point counts were conducted due to the small area (totaling 18 points). All points were spaced at least 300 m apart to ensure that observations were independent (Ralph *et al.*, 1993). All birds seen or heard within a 25 m radius from the centre of each point over a 10-minute period were recorded, but birds flying overhead were excluded (*sensu* Soh *et al.*, 2006). To maximize detections, point counts were conducted between 0700 and 1100 hours on fair weather days (i.e., no heavy rain). All point counts were conducted by M.C.K. Soh along forest trails and along roads in rural and urban areas. Random sampling in the forested sites away from the forest trails was deemed unsafe due to the steep terrain. Unfamiliar calls were recorded with digital audio recorders (Olympus models DW-90 in 2002-3 and LS-14 in 2016-7) and later identified to species by consulting expert ornithologists.

Data analysis

All statistical analyses were performed using R 3.2.2 (R Core Team, 2017). We determined if species richness of each habitat type, as well as total species richness at each locality (i.e.. landscape-scale), differ over time by comparing the numbers of species observed between the two time periods (2002-3 and 2016-17).

To estimate the total species turnover of each habitat type and landscape, we divided their sum of species gained and species lost by total species observed in both time periods, to derive the proportion of species that differed between the two time periods (Diamond, 1969). Since total species turnover incorporates both species that appeared (i.e.,, species gained) and disappeared (i.e., species lost), we also report the proportion of species that appeared in 2016-17 and that of species that disappeared in 2016-17, relative to the total number of species observed in both time periods, in order to determine their relative contribution.

To determine if the relative abundance of each species differed between the two time periods, we conducted Bayesian analysis using the “Bbinom” (Bayesian binomial simulation) function from the “wiqid” package (Meredith, 2017) to compare two sets of binomial data (focal species or not). Our approach involved a sample of 50,000 Markov Chain Monte Carlo [MCMC] simulations from the posterior for a binomial likelihood (i.e., probability of an individual being the focal species being lower or higher in 2016-17 compared to 2002-3); and we used a uniform prior in our analyses, instead of an informative prior, because we did not have any prior information about the species’ relative abundance at landscape level. For each species, we compared binomial likelihood of its identification between the two time periods to deduce if it had increased or decreased (probability cut-off at 90%) in terms of relative abundance.

RESULTS AND DISCUSSION

We observed 68 species at Fraser's Hill (60 in 2002-3; 57 in 2016-17) and 76 species at Cameron Highlands (64 in 2002-3; 66 in 2016-17). In total, we recorded 80 species from both localities in both time points (see checklist in Supporting Information Appendix 1). In Fraser's Hill, the total number of species observed in both time points in primary forest, forest fragment and forest edge were 39, 43 and 54, respectively. The total number of species observed in both primary forest (48) and secondary forest (48) in Cameron Highlands fell within that range. Both rural habitat in Fraser's Hill and Cameron Highlands had 52 and 47 species culminated from both time points, respectively. In comparison, we observed fewer total species number in tea plantation (38) and urban habitat (20) in Cameron Highlands.

Changes in species richness along disturbance gradient and between two time periods

In general, the number of species increased along disturbance gradient in Fraser's Hill. However, the most disturbed sites in Cameron Highlands (tea and urban) had the least number of species (Fig. 2a). All sites had either the same number or fewer species observed in 2016-17, with the exception of tea plantation (Fig. 2a). At landscape-scale, fewer species were observed in Fraser's Hill as compared to Cameron Highlands/ This, was mainly due to an increase in the number of species in tea plantation at the latter location (Fig. 2a).

Our results generally do not support our hypothesis that species richness increased in Fraser's Hill and Cameron Highlands from first to second survey. While we reasoned that global warming would have encouraged species with lowland affinities to expand their vertical distribution, this increase was apparently negated by a greater loss in montane specialists due to contractions in their attitudinal ranges. Upwards shifts and narrowing vertical distributions are well documented for Neotropical montane birds and are a consequence of a reduction in their climatic niches (e.g.. Bender *et al.*, 2019; Forero-Medina *et al.*, 2011; Neate-Clegg *et al*., 2018). More worryingly, higher altitudinal specialists are also at risk of local extirpations in some mountain tops (Freeman *et al.*, 2018). In Peninsular Malaysia uplands, such vulnerable species include upper-montane specialists such as Rufous-bellied niltava (*Niltava sundara*) and Chestnut-tailed minla (*Actinodura strigula*) which probably deserve closer conservation attention.

Since we were careful to repeat the sampling protocol in the same localities and the same observer (M.C.K. Soh) conducted the surveys in both periods, we doubt that the observed phenomenon was an artefact of sampling error. Further, the decline in species richness was a consistent trend across all habitat types, except for the tea plantation. Any climatic changes are expected to be slight, since the lapse between our sampling periods was only 14 years. Thus, it is not surprising that declines in species richness in each habitat type were incremental. Nonetheless, if the current climatic trends remain, species declines are likely to progress over a protracted period. Further, our sampled sites remained relatively unchanged in terms of level of disturbance since the survey in 2002-3 was conducted.

On a more positive note, the increase in species richness at the tea plantation is encouraging and demonstrates the potential conservation value of such estates -- assuming certain landscape features such as remnant pockets of forest, native riparian vegetation along streams for irrigation, and natural hedges along roads remain prominent. Aside from these features, the closeness to forest habitats may also encourage more edge species to venture into the tea plantation to forage (Barlow *et al.*, 2007; Lucey & Hill, 2012). Some species may also use small forest remnants as ‘stepping stones’ to move between forest patches (Baum *et* *al.*, 2004; Uezu *et al.*, 2008; Saura *et al.*, 2014). Thus, by maintaining natural corridors to facilitate movement and remnant forest patches, well-managed plantations that are biodiversity friendly can still contribute towards the conservation of the montane ecosystem.

Species turnover rates between two time periods

The primary forests of Fraser's Hill and urban areas of Cameron Highlands had the lowest proportion of species that appeared in 2016-17 relative to the total number of species observed in both time points (Fig. 2b)**.** All disturbed sites in Cameron Highlands (bar urban areas) had the lowest proportion of species that disappeared in 2016-17 relative to the total number of species observed in both time points (Fig. 2b). The edge forests in Fraser's Hill and tea plantation in Cameron Highlands had the highest total turnover (Fig. 2b). There was no difference in total species turnover at both Fraser's Hill and Cameron Highlands, but Fraser's Hill had a higher proportion of species lost and Cameron Highlands had a higher proportion of species gained (Fig. 2b).

Our hypothesis that species turnover would be higher in Cameron Highlands since it was more disturbed was not supported; rather the species turnovers in both Fraser's Hill and Cameron Highlands were similar. However, the gains did exceed losses in Cameron Highlands, primarily due to a greater number of new species detected in the more recent survey at the tea plantation for reasons explained earlier. Conversely, the losses were higher than gains in Fraser's Hill, which we postulate is a likely consequence of progressively warmer climate. The higher turnover losses were unlikely to be caused by increased habitat degradation in Fraser's Hill, since the landscape cover remained largely unchanged during the interval of 14 years (Er *et al.*, 2013). Fraser's Hill is still protected and, unlike Cameron Highlands, its steep terrain is generally unsuitable for extensive agriculture (Chan, 2006; Ismail *et al*., 2011, 2014). Thus, the absence of previously detected species in Fraser's Hill was probably due to more species retreating to higher elevations. That said, the higher species turnover losses seen in most habitat types in Cameron Highlands could also be attributed to a warmer climate, compounded by continual deforestation and habitat degradation.

Changes in relative abundance between two time periods

The rural areas at Fraser's Hill, and tea plantation and urban areas at Cameron Highlands had the highest proportion of species with an increase in relative abundance (21-25%; Fig. 2c)**.** The secondary forest and rural areas at Cameron Highlands had the highest proportion of species with a decrease in relative abundance (19-21%; Fig. 2c)**.** Generally, there was a decline along the disturbance gradient in the proportion of species that had no change in their relative abundance, though the trend is less pronounced at Cameron Highlands (Fig. 2c)**.** There was no difference between Fraser's Hill and Cameron Highlands at landscape-scale in terms of the proportion of species that had no change in their relative abundance. However, Fraser's Hill had a higher proportion of species with a decrease in relative abundance, and Cameron Highlands had a higher proportion of species with an increase in relative abundance (Fig. 2c).

The increased bird abundances in the tea plantation and urban areas at Cameron Highlands indicate that some species probably thrive in human modified habitats. Many such species are affiliated to lowland habitats: marked increases in abundance were observed for Black-naped oriole (*Oriolus chinensis*), Common myna (*Acridotheres tristis*), Eurasian tree sparrow (*Passer montanus*), Large-billed crow (*Corvus macrohynchos*), Oriental magpie-robin (*Copsychus saularis)*, and Spotted dove (*Spilopelia chinensis*). The results suggest that the species composition in highly developed areas in montane environments are not unlike those at lower altitudes, demonstrating the effects of biotic homogenisation, whereby a few highly adaptable species dominate the community (Lever, 1987; Marzluff, 2001; Soh *et al.*, 2006). Yet, the abundance of some montane species also increased in the tea plantation, including Blue-winged minla (*Actinodura cyanouroptera*), Fire-breasted flowerpecker (*Dicaeum ignipectus*), Long-tailed sibia (*Heterophasia picaoides*), Mountain bulbul (*Ixos mcclellandii*) and Silver-eared mesia (*Leiothrix argentauris*). This result implies that the tea plantation not only attracted new bird species but also more individuals; thus, providing further evidence of its increased conservation value since the 2002-3 surveys. However, the preservation of large tracts of contiguous montane forests is still a priority as the montane birds that are utilising in the tea plantation are all more adaptable edge species (Robson, 2008).

Apart from the observed decline in species richness and greater species turnover losses, the larger number of bird species with a reduction in abundance at Fraser's Hill may additionally signal an effect of global warming. This result reiterates the need to monitor to the population dynamics of montane specialists over the long-term, in order to better comprehend their responses to climate change.

Limitations and future research

Our results provide a preliminary analysis of the changes in the montane bird community in Peninsular Malaysia which include alpha and beta diversities, and relative abundance. We did not correct for imperfect detection, which can arise from imperfect sampling design and environment constraints (e.g., not detecting a species behind an observer, or dense vegetation obstructing a clear line of sight) (MacKenzie *et al.*, 2002). Estimating detection probabilities to correct for species occupancy probabilities and abundance estimates can be done, using multispecies occupancy modelling or N-mixture models respectively if their assumptions such as sampling closure are met (Kéry & Royle, 2014).

We may also have missed cryptic and/or rare species during our surveys. Such sampling deficiencies can be supplemented by deploying autonomous sound recorders. These may be more successful than traditional sampling by point counts and line transects in detecting species that tend to avoid human observers, and can be scheduled to record for much longer periods (Tegeler *et al*., 2012; Zwart *et al*., 2015).

Our results are also indicative of the responses of birds, a group relatively more mobile than other taxa that may be more vulnerable to disturbances such as amphibians and reptiles (Hopkins, 2007; Bishop *et al.*, 2012). Apart from deforestation and land-use conversion, the montane landscape at Cameron Highlands is increasingly fragmented; this may compromise gene flow in some isolated populations (Habel *et al.* 2014; Husemann *et al.*, 2015). Studies for certain species vulnerable to such impacts can help inform future land-use planners if the preservation of natural corridors to encourage greater gene flow may be needed.

CONCLUSION

Our results suggest that climate change was a likely factor in negatively impacting two montane bird communities in Peninsular Malaysia. This was more clearly demonstrated at our Fraser's Hill sampling sites, where community-specific changes were observed without further habitat degradation since 2002-3. An increase in species richness, in the tea plantation suggest that agricultural landscapes can increase in conservation value if interspersed with remnants and/or corridors of native vegetation. The relatively high species turnover in local montane bird communities in our study suggests the need to monitor the temporal dynamics in the composition of local communities. While our study indicates the effect of climate change and habitat degradation on montane bird communities, more research to investigate the impacts on other taxa, and population genomics of vulnerable species is crucial to better comprehend such responses to environmental change.

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Table 1: Description and elevation of habitat types across two montane localities in Peninsular Malaysia surveyed in 2002 and 2017.

Habitat type and locality/localities	Elevation (m) of each locality as listed in previous column	Description
Primary forest CH, FH	1621, 1280	Primary montane forest
Secondary forest CH	1506	Exotic softwood plantation ~2 ha surrounded by roads and native forests left to regenerate more than 50 years ago
Tea CH	1591	Mature tea plantation
Rural CH, FH	1477, 1243	Roadsides beyond the perimeter of town centres and flanked by vegetation
Urban CH	1475	Roads within the town centres which are mostly devoid of vegetation
Edge forest FH	1236	Part of continuous montane forest 100–150 m away from edge of road
Small fragment FH	1260	Small forest patch <5 ha isolated by narrow roads and golf course

CH = Cameron Highlands, FH = Fraser's Hill

Table 2: Dates that point counts were conducted

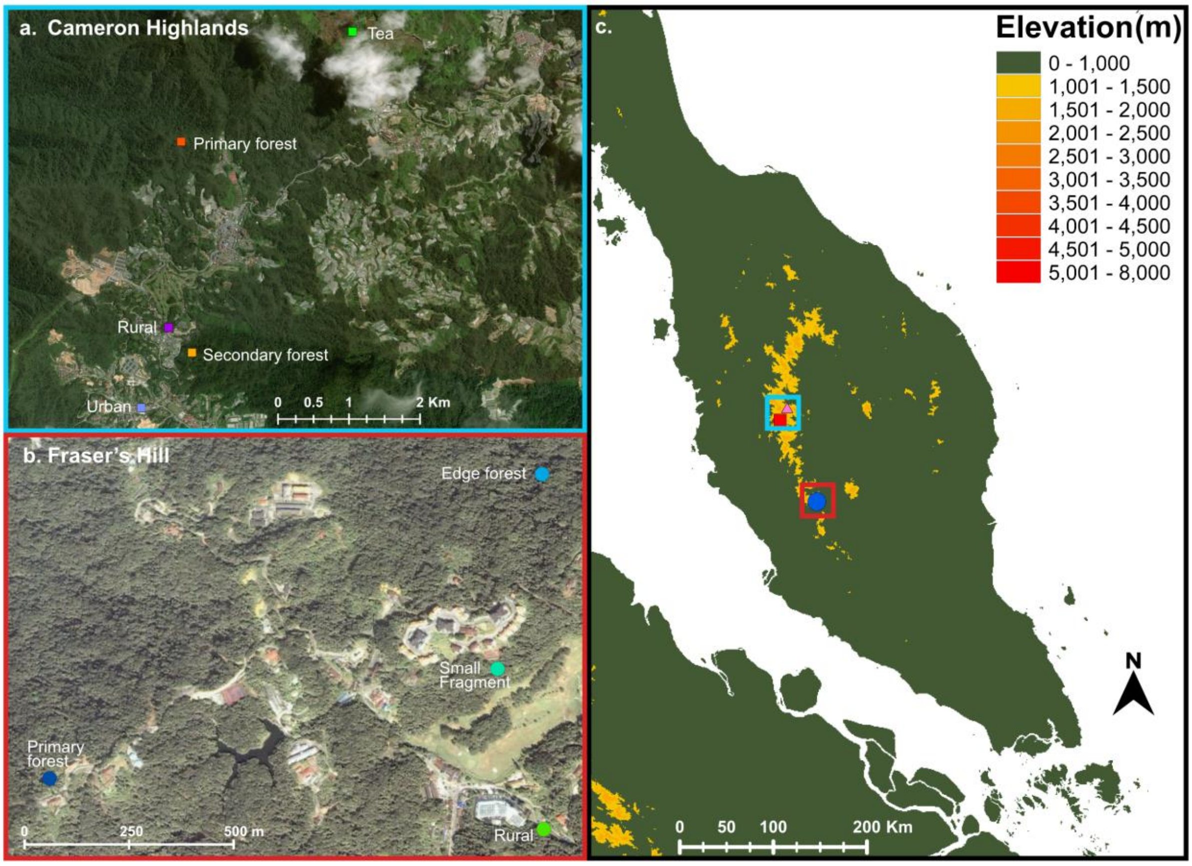
2002-3	2016-7
26th July to 29th September 2002	21st May to 15th June 2016
12th October to 8th November 2002	30th July to 23rd August 2016
23rd November to 9th December 2002	30th October to 25th November 2016
17th February 2003 to 23rd March 2003	27th December 2016 to 22nd January 2017
5th May 2003 to 24th June 2003	14th March to 7th April 2017
1st July 2003 to 13th August 2003	9th May to 2nd June 2017

Figure legends

Figure 1: Map of Peninsular Malaysia showing two study localities and sites along the Main Range.

Figure 2: (a) Species richness; (b) species turnover; and (c) relative abundance of all habitat types and landscapes at Fraser’s Hill and Cameron Highlands.

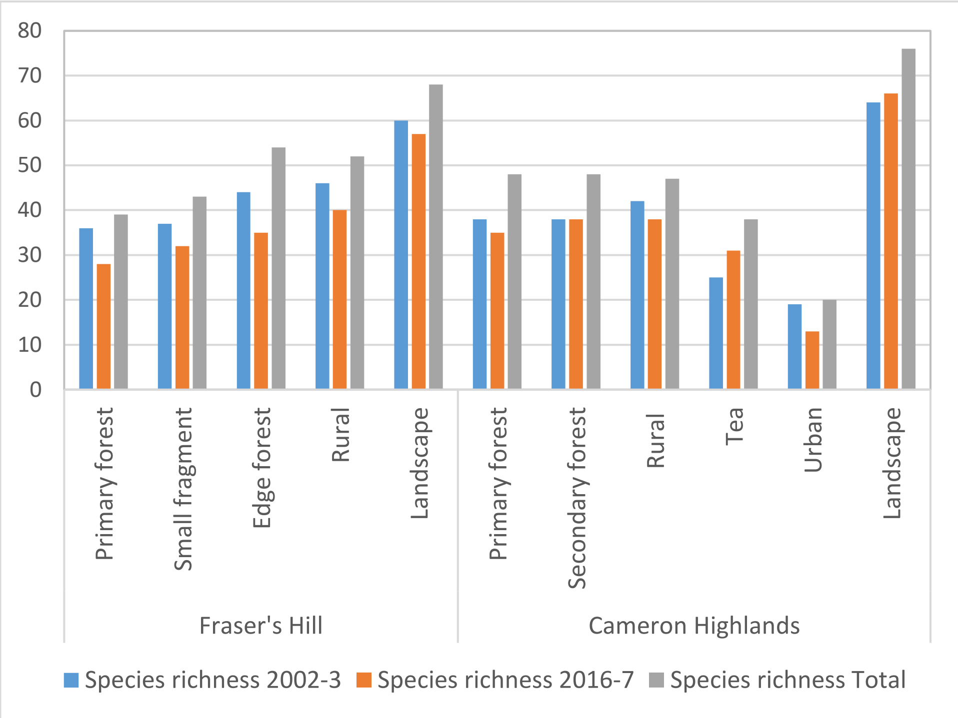
Figure 1



a. Cameron Highlands
Tea
Primary forest
Rural
Secondary forest
Urban
0 0.5 1 2 Km
b. Fraser's Hill
Edge forest
Small Fragment
Primary forest
Rural
0 250 500 m
c.
Elevation(m)
0 - 1,000
1,001 - 1,500
1,501 - 2,000
2,001 - 2,500
2,501 - 3,000
3,001 - 3,500
3,501 - 4,000
4,001 - 4,500
4,501 - 5,000
5,001 - 8,000
N
0 50 100 200 Km

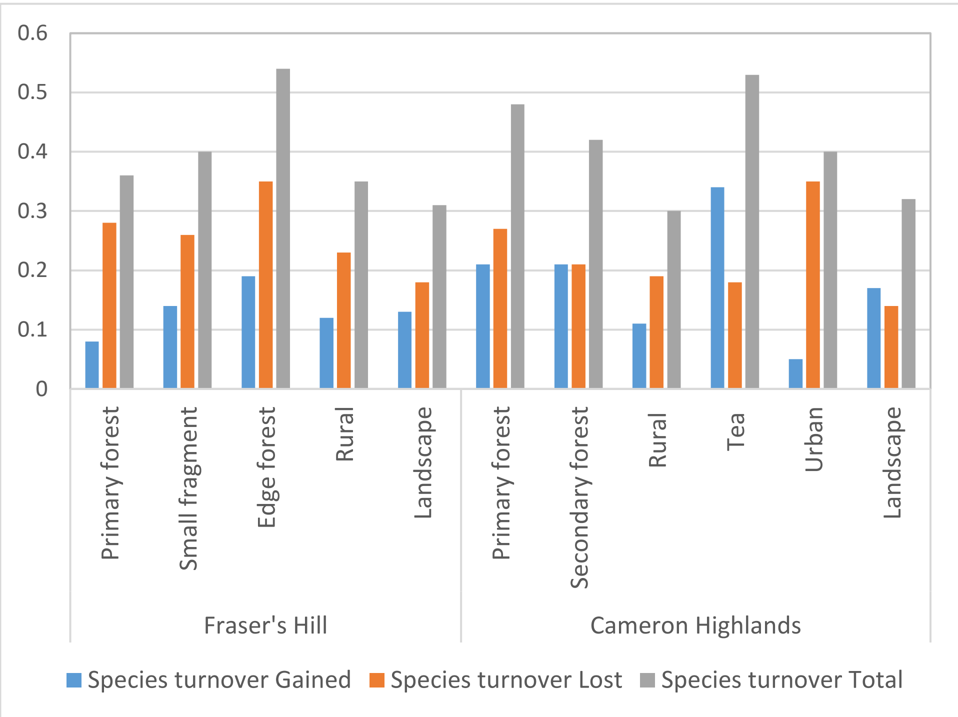
Figure 2

(a)



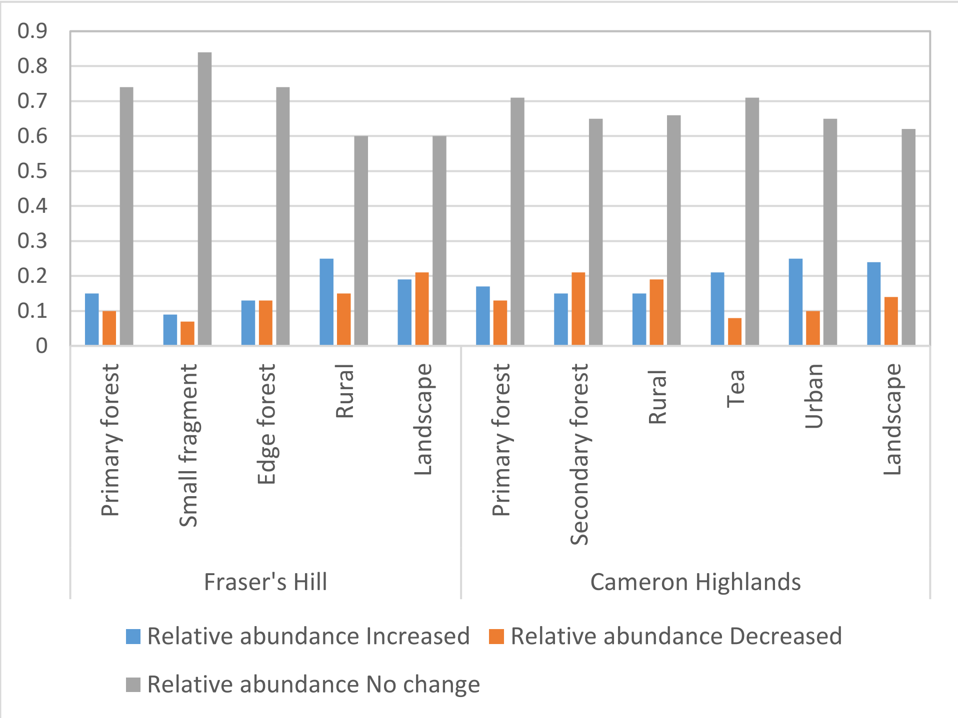
80
70
60
50
40
30
20
10
0
Primary forest
Small fragment
Edge forest
Rural
Landscape
Primary forest
Secondary forest
Rural
Tea
Urban
Landscape
Fraser's Hill
Cameron Highlands
Species richness 2002-3
Species richness 2016-7
Species richness Total

(b)



0.6
0.5
0.4
0.3
0.2
0.1
0
Primary forest
Small fragment
Edge forest
Rural
Landscape
Primary forest
Secondary forest
Rural
Tea
Urban
Landscape
Fraser's Hill
Cameron Highlands
Species turnover Gained
Species turnover Lost
Species turnover Total

(c)


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Primary forest
Small fragment
Edge forest
Rural
Landscape
Primary forest
Secondary forest
Rural
Tea
Urban
Landscape
Fraser's Hill
Cameron Highlands
Relative abundance Increased
Relative abundance Decreased
Relative abundance No change

APPENDIX

Appendix 1: Species checklist of resident birds detected in 2002-3 and 2016-7. Acronyms indicate the study region and habitat type, followed by the year of survey, i.e., 02 refers to 2002-3 and 16 refers to 2016-7. FP – Fraser's Hill primary forest, FE – Fraser's Hill edge forest, FF – Fraser's hill small fragment forest, FR – Fraser's Hill rural areas, CP – Cameron Highlands primary forest, CS – Cameron Highlands secondary forest, CT – Cameron Highlands tea plantation, CR – Cameron Highlands rural areas, and CU – Cameron Highlands urban areas. Common and scientific names follow IOC world bird list (Gill *et al.*, 2020).

1. Ashy Bulbul; *Hemixos flavala*; FR16; CS02

2. Black Laughingthrush; *Melanocichla lugubris*; FE02

3. Blue Nuthatch; *Sitta azurea*; FF02; FR02; CP02 & CP16; CS02

4. Bay Woodpecker; *Blythipicus pyrrhotis*; CP16

5. Buff-breasted Babbler; *Pellorneum tickelli*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16

6. Black-browed Barbet; *Psilopogon oorti*; FP02 & FP16; FE02 & FE16; FR16

7. Black-crested Bulbul; *Rubigula flaviventris*; CR16

8. Black-and-Crimson Oriole; *Oriolus cruentus*; FP02; FE02 & FE16; FF02 & FF16; FR02 & FR16; CS02 & CS16; CR02

9. Black-eared Shrike-babbler; *Pteruthius melanotis*; FP02; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02; CS02 & CS16; CR02 & CR16

10. Blyth's Hawk-Eagle; *Nisaetus alboniger*; CS16

11. Black-naped Oriole; *Oriolus chinensis*; CT16; CR02

12. Blyth's Shrike-Babbler; *Pteruthius aeralatus*; FP02 & FP16; FE02 & FE16; FF02; FR02; CP02; CS02 & CS16; CR02

13. Bar-throated Minla; *Actinodura strigula*; CP02

14. Black-throated Sunbird; *Aethopyga saturata*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16; CU02 & CU16

15. Blue-winged Minla; *Actinodura cyanouroptera*; FP02 & FP16; FE02; FF02; CP02; CS16; CT16; CR02

16. Bar-wing Flycatcher-shrike; *Hemipus picatus*; FE16; FR02 & FR16; CU16

17. Common Myna; *Acridotheres tristis;* CR02 & CR16; CU02 & CU16

18. Collared Owlet; *Glaucidium brodiei*; FP02 & FP16; FE16; FF02; FR16; CP02 & CP16

19. Common Tailorbird; *Orthotomus sutorius*; FR02 & FR16; CT02 & CT16; CR02 & CR16; CU02 & CU16

20. Chestnut-capped Laughingthrush; *Pterorhinus mitratus*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CR02 & CR16; CU02

21. Chestnut-crowned Warbler; *Phylloscopus castaniceps*; FE02; FF02; FR02; CP02

22. Common Green Magpie; *Cissa chinensis*; FE02; FF16; FR02 & FR16; CP16; CS02

23. Crested Serpent Eagle; *Spilornis cheela*; CP02; CS02; CT02

24. Diard's Trogon; *Harpactes diardii*; CP16

25. Dark-necked Tailorbird; *Orthotomus atrogularis*; FE02; FR02 & FR16; CT02; CR02

26. Everett's White-eye; *Zosterops everetti*; FP16; CS02; CR02 & CR16; CU02 & CU16

27. Eurasian Tree Sparrow; *Passer montanus*; CT16; CR02 & CR16; CU02

28. Fire-breasted Flowerpecker; *Dicaeum ignipectus*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16; CU02

29. Fire-tufted Barbet; *Psilopogon pyrolophus*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16

30. Golden Babbler; *Cyanoderma chrysaeum*; FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CR02 & CR16

31. Greater Yellownape; *Chrysophlegma flavinucha*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16

32. Green-billed Malkoha; *Phaenicophaeus tristis*; FR02 & FR16; CT16; CR02 & CR16; CU02

33. Grey-chinned Minivet; *Pericrocotus solaris*; FP02; FE02 & FE16; FF02 & FF16; CP02

34. Grey-headed Canary-flycatcher; *Culicicapa ceylonensis*; FP02; CT02 & CT16

35. Grey-throated Babbler; *Stachyris nigriceps*; FP02; FE02 & FE16; FF02; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02

36. Golden-throated Barbet; *Psilopogon franklinii*; FP02; CP16; CS16; CR02

37. Javan Myna; *Acridotheres javanicus*; CU02

38. Large Cuckooshrike; *Coracina macei*; FE16; FR16; CP16; CS16; CR16

39. Large Niltava; *Niltava grandis*; FP02; FE02; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CR02 & CR16

40. Lesser Shortwing; *Brachypteryx leucophrys*; FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS16; CT02 & CT16; CR02 & CR16

41. Little Spiderhunter; *Arachnothera longirostra*; FP02 & FP16; FE02; FR02 & FR16

42. Lesser Yellownape; *Picus chlorolophus*; FE02 & FE16; FF02

43. Large-billed Crow; *Corvus macrorhynchos*; FF02 & FF16; FR02; CP02; CS02 & CS16; CT02 & CT16; CR02 & CR16; CU02 & CU16

44. Long-billed Spiderhunter; *Arachnothera robusta*; CP02

45. Little Cuckoo-dove; *Macropygia ruficeps*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16

46. Large Cuckooshrike; *Coracina macei*; FP02; FE02; FF02; FR02; CP02; CS02

47. Large Hawk-Cuckoo; *Hierococcyx sparverioides*; FP02; FE02; FR02; CP16

48. Little Pied Flycatcher; *Ficedula westermanni*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02; CR02 & CR16

49. Lesser Racket-tailed Drongo; *Dicrurus remifer*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CR02 & CR16

50. Large Scimitar Babbler; *Erythrogenys hypoleucos*; FE02; FF16; FR02; CP16

51. Long-tailed Broadbill; *Psarisomus dalhousiae*; FE02 & FE16; FR02 & FR16

52. Long-tailed Shrike; *Lanius schach*; CT16

53. Long-tailed Sibia; *Heterophasia picaoides*; FP02 & FP16; FE02; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT16; CR02 & CR16

54. Mountain Bulbul; *Ixos mcclellandii*; FP02 & FP16; FE16; FF02 & FF16; FR02 & FR16; CP02; CS02 & CS16; CT16; CR02 & CR16; CU02 & CU16

55. Mountain Fulvetta; *Alcippe peracensis*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16

56. Malayan Laughingthrush; *Trochalopteron peninsulae*; FP02 & FP16; FE16; FR02; CP02 & CP16; CS02 & CS16; CT02

57. Malaysian Patridge; *Arborophila campbelli*; CP16; CS16

58. Mountain Tailorbird; *Phyllergates cucullatus*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16

59. Maroon Woodpecker; *Blythipicus rubiginosus*; FE02

60. Mountain Imperial Pigeon; *Ducula badia*; FP02 & FP16; FE02; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02; CR02 & CR16

61. Mountain Leaf-warbler; *Phylloscopus trivirgatus*; FP02; FE02 & FE16; FF02 & FF16; CP02 & CP16; CS02 & CS16; CT02; CR02 & CR16

62. Ochraceous Bulbul; *Alophoixus ochraceus*; FE16

63. Oriental Cuckoo; *Cuculus optatus*; FR02

64. Indian White-eye; *Zosterops palpebrosus*; CT16

65. Orange-bellied Leafbird; *Chloropsis hardwickii*; FP02; FE02; FR02 & FR16; CP02; CS16; CR02 & CR16

66. Oriental Magpie-Robin; *Copsychus saularis*; FF02; FR02 & FR16; CS16; CT02 & CT16; CR02 & CR16; CU02 & CU16

67. Pacific Swallow; *Hirundo tahitica*; CT16; CR02 & CR16; CU02 & CU16

68. Pale Blue Flycatcher; *Cyornis unicolor*; CR02 & CR16

69. Pygmy Flycatcher; *Ficedula hodgsoni*; FE02; CP02; CS02 & CS16; CT16; CR02 & CR16

70. Rock Dove; *Columba livia*; CR02 & CR16; CU02 & CU16

71. Rhinoceros Hornbill; *Buceros rhinoceros*; FE16

72. Rufous-browed Flycatcher; *Anthipes solitaris*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP16; CS02 & CS16; CR02 & CR16

73. Red-headed Trogon; *Harpactes erythrocephalus*; FE16; CS02

74. Rusty-naped Pitta; *Pitta oatesi*; FE16

75. Red-whiskered Bulbul; *Pycnonotus jocosus*; CR02 & CR16

76. Spotted Dove; *Spilopelia chinensis*; FF16; CT02; CR02 & CR16; CU02 & CU16

77. Streaked Spiderhunter; *Arachnothera magna*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16; CU02 & CU16

78. Snowy-browed Flycatcher; *Ficedula hyperythra*; FE16; FR02; CS16

79. Slaty-backed Forktail; *Enicurus schistaceus*; FF16; FR02; CS02 & CS16; CT16

80. Scaly-breasted Munia; *Lonchura punctulata*; FR02 & FR16; CT16; CR02 & CR16; CU02

81. Silver-eared Mesia; *Leiothrix argentauris*; FP02 & FP16; FE02; FF02 & FF16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16

82. Stripe-throated Bulbul; *Pycnonotus finlaysoni*; FF16; FR02 & FR16; CT02 & CT16

83. Streaked Wren-babbler; *Gypsophila brevicaudata*; FP02 & FP16; FE02 & FE16; FF16; FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16

84. Verditer Flycatcher; *Eumyias thalassinus*; FF02; FR16

85. White-rumped Munia; *Lonchura striata*; FR02

86. White-throated Fantail; *Rhipidura albicollis*; FP02 & FP16; FE02 & FE16; FF02 & FF16; FR02 & FR16; CP02 & CP16; CS02 & CS16; CT02 & CT16; CR02 & CR16; CU02

87. White-tailed Robin; *Myiomela leucura*; FE02; FF16; CP16; CS16; CT02; CR02 & CR16

88. Yellow-bellied Prinia; *Prinia flaviventris*; CT16

89. Yellow-breasted Warbler; *Phylloscopus montis*; FE02; FF02; CP02 & CP16; CS02

90. Yellow-vented Bulbul; *Pycnonotus goiavier*; FR02 & FR16; CS02; CT02 & CT16; CR02 & CR16; CU02 & CU16