Research Article

Nonbreeding Bird Communities Along an Urban–Rural Gradient of a Tropical City in Central Myanmar

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Abstract

Urbanization is known to be a major driver in abundance and species richness of birds. However, how birds respond to urbanization in tropical cities is understudied in general and entirely absent from Myanmar. We conducted a study in and around Mandalay, a large city in central Myanmar to gather first data on birds and their response to urbanization. We selected four habitats with 10 sampling points each in November 2015. We made 1,536 observations of 68 bird species. The number of species and diversity significantly differed between the four localities. Mandalay Hill and Downtown Mandalay had the lowest number of species and diversity, whereas the University Campus and Paddy Fields had the highest. The highest number of observations was in Downtown Mandalay (1,003 counts) and the lowest on Mandalay Hill (103). Nonmetric multidimensional scaling ordination techniques showed that the four habitat types had significantly different bird species composition. Our results indicate a large effect of urbanization on species diversity, species richness, and species composition of birds.

Keywords

bird diversity, Mandalay, point counts, urbanization, Myanmar

Introduction

Urban development has rapidly increased worldwide and an estimated 70% of the world's human population will be living in cities by 2050 (UN-HABITAT, 2013). Urbanization alters natural habitats and is considered as a major cause of the extinction of native species (Czech, Krausman, & Devers, 2000; Marzluff, 2001). Birds are highly affected by urbanization (e.g., Beissinger & Osborne, 1982; Biamonte, Sandoval, Chacón, & Barrantes, 2011; Crooks, Suarez, & Bolger, 2004; Reale & Blair, 2005; Sorace & Gustin, 2010; Suarez-Rubio, Renner, & Leimgruber, 2011). In general, bird species diversity and richness decrease in urban areas compared with native habitats, whereas biomass and density increase (Chace & Walsh, 2006; McKinney, 2008; Suarez-Rubio et al., 2011). However, this pattern may not hold for all geographic regions (Saari et al., 2016). Species composition also changes with urban development. Urban assemblages are similar in species composition compared with nonurban assemblages, indicating that urbanization is a major cause of biotic homogenization (Clergeau, Croci, Jokimaki, Kaisanlahti-Jokimaki, & Dinetti, 2006; Filloy, Grosso, & Bellocq, 2015; McKinney, 2006). Bird communities are usually dominated by a few, often introduced

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species, and granivores, omnivores, and cavity-nesting species are favored (Beissinger & Osborne, 1982; Blair, 1996; Fernández-Juricic, 2001; Ortega-Alvarez & Mac Gregor-Fors, 2009). These patterns have been confirmed throughout the world for forest, desert scrub, and grassland habitats (Chace & Walsh, 2006). Nonetheless, diversity patterns and composition of urban bird communities depend on abiotic factors and ecological and evolutionary forces at play (e.g., species interactions, immigration, and natural selection) (Faeth, Bang, & Saari, 2011).

Although Southeast Asia has a rapid human population growth, the level of urbanization is fairly low compared with other regions (Jones, 2013). Nonetheless, urban areas have been rapidly increasing in the last decades (Jones, 2013). In 2010, around 2% of Southeast Asia's population lived in urban areas, twice the proportion in 1970 (Jones, 2013). However, there is a paucity of information on the impacts of urbanization on avian communities in Southeast Asia (Chace & Walsh, 2006; Magle, Hunt, Vernon, & Crooks, 2012) and Myanmar in particular. Myanmar harbors some of the world's most biodiversity-rich ecosystems (Mittermeier, Turner, Larsen, Brooks, & Gascon, 2011; Sodhi, Koh, Brook, & Ng, 2004) and has been recognized as a biodiversity hotspot given the high concentration of endemic species in this area (Mittermeier et al., 2011; Myers, Mittermeier, Mittermeier, da Fonseca, & Kent, 2000; Sodhi et al., 2004). However, little is known about the effects of urbanization on Myanmar's avifauna despite the rich diversity that might be under pressure from human population growth.

The aim of this study was to examine bird species richness, diversity, and relative abundance along an urban–rural gradient in and around Mandalay city in central Myanmar and to assess bird community composition in areas with different housing density. We expected that areas with high housing density had low number of bird species, low diversity, and high relative abundance, whereas areas with low housing density and higher proportion of trees had high number of species, high diversity, and low relative abundance, as well as a shift in species composition.

Methods

Study area

The study was conducted in and around Mandalay (21°59′N, 96°5′E), Mandalay Region, in central Myanmar (Figure 1). Mandalay is the second largest city of Myanmar with around 1.5 million inhabitants and a population density of 7,000 people km^{-2}. Population of Mandalay increased from 960,000 to 1,200,000 between 1993 and 2003 and the city is projected to increase 10% by 2025 (United Nations, 2008). The city is located in the central dry zone of Myanmar, in which total annual precipitation is 915 mm on average. Mean annual temperature is 27.3°C and ranges between 13°C and 38°C. Elevation is 74 m a.s.l., except for Mandalay Hill, which is located at the outskirts of the city, where elevation reaches 223 m. The typical vegetation in Mandalay is dry deciduous tropical forests.

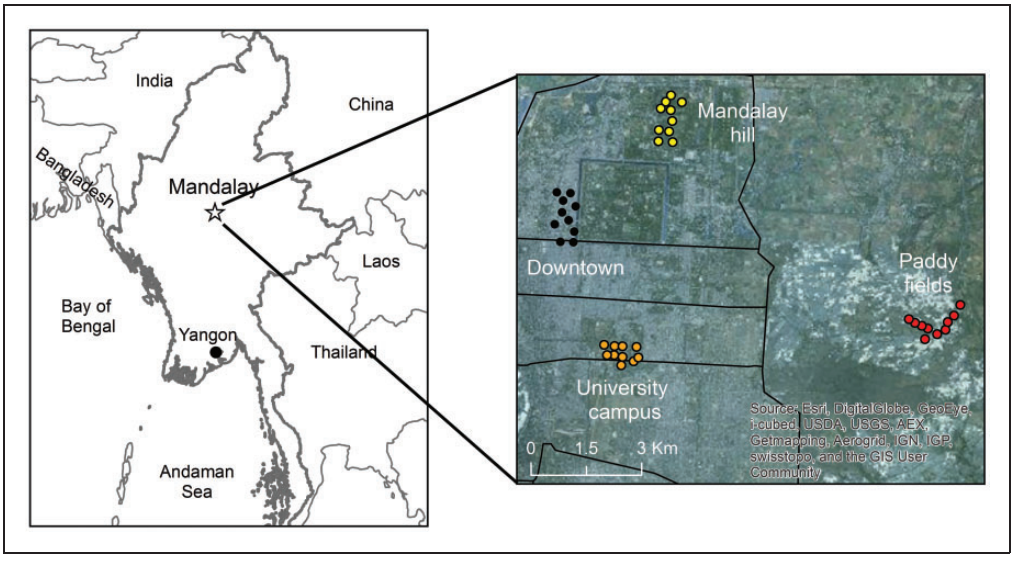

Figure 1. Study area (*star*) in Myanmar (*bold gray line*) and locations of point counts in Mandalay (*colored dots/circles*). Each *dots/circle* is a point count locality in one of the four land use classes (names refer to the classes and major sites we use in this study); *black lines* are township borders in Mandalay.

We selected four habitat types based on differences in housing density (Figure 1). Downtown Mandalay (DM) is mainly located at the western part of the Royal Palace, is highly developed (> 70% impervious surface), and has a very high housing and human population density. Trees, mostly native species, are limited to few rather small patches and along streets. Mandalay University Campus (UC) is located south of downtown. It is moderately developed (30–40%), has many large trees, and partially dense understory. Some parts are covered with grass or bare soils. Mandalay Hill (MH) is located northeast of the city, is sparsely developed (< 30%), and is covered with forests that consist mainly of scrubs and thorn bushes of up to 15 m height. Buildings consist of few pagodas/stupas and the stairways. In addition, there are few houses, and inhabitants living on the Hill are restricted to the monks. Paddy Fields (PF) at the eastern fringes of Mandalay near the village of Yay Kyi (around 300 m distance northeast) are rural agricultural areas with no houses and some larger trees. The agricultural area is characterized by a patchwork of rice Paddy Fields and *Eugenia* plantations, although rice is the dominant crop in the area.

At each habitat type, we selected 10 sampling points (i.e., 40 points in total) and kept a minimum distance of 250 m in-between point counts to ensure independence and considerably decrease the likelihood of counting the same bird twice. In Mandalay Hill, we placed the points along the main road to the pagoda and stairways to minimize interference with religious activities. In the other three places, we kept on roads or walking paths to have similar observational conditions and reduce bias by diversification of microhabitats. The characteristics of habitat, housing density, and general structure within each of the four areas are homogenous as to reduce any other potential effects on the bird species composition and relative abundance during analysis.

Bird surveys

We surveyed birds at the four habitat types from 20 to 24 November 2015. We used fixed-radius point counts with a 50-m radius. At each sampling point, we surveyed all birds heard or seen during 10 min from 6.30 a.m. to 10.00 a.m. We covered the same time span in each of the four habitat types to guarantee the same effort and procedure in all four areas. We recorded all birds and number of observations and noted weather, time, distance to observer, sex, and age as precise as possible. Each audiovisually recorded bird was likely an individual, but we used the term *observation* instead because we cannot certainty exclude double counts of one individual, because in few instances records may be impossible to tell apart. By using 10-min intervals, we decreased the probability of double counting and increased the probability of recording all species at any given sampling point during the 10-min intervals (Bibby, 2000). We also recorded all birds in-between point counts but did not use these for statistical analysis.

Data analysis

To evaluate differences between habitat types and number of species, we performed a generalized linear model (GLM) with a Poisson error distribution and checked for overdispersion. When overdispersion was detected, we corrected the standard errors using a quasi-GLM model (Zuur, Ieno, Walker, Saveliev, & Smith, 2009). Differences between habitat types and Shannon diversity index were assessed using analysis of variance (ANOVA) after verifying for homogeneity of variances (Fligner test) and normality (Bartlett test). We did a Tukey test for a posteriori comparison of diversity of the four habitats. We also assessed differences between habitats and observations (i.e., relative abundance) using a GLM with a Poisson error distribution. We performed this latter analysis both including and excluding the Rock Pigeon, because Rock Pigeons accounted for 78.9% of all observations in Downtown Mandalay. All analyses were done in R version 3.1.1 (R Core Team, 2014) and an alpha level of 0.05. We also assessed the abundance-based sampling coverage (C.hat, S.hat), calculated with Hsieh, Ma, & Chao (2013) with 500 bootstraps, per habitat type.

We assessed differences in bird community composition among habitat types using nonmetric multidimensional scaling (NMS; McCune & Grace, 2002). Relative abundance were log-transformed and then we searched for outliers among habitat types and bird species, using Sørensen (Bray–Curtis) distance with a cutoff of two standard deviations (McCune & Grace, 2002). We ran NMS using Sørensen distance, with a first approximation run of 6D stepping down to 1D solution, starting 20 runs from a random configuration and 250 iterations. We selected 2D as the final solution, using the starting configuration that worked best, and one real-run as suggested by McCune and Grace (2002). To evaluate significant differences among habitat types and bird species composition, we performed a distance-based permutational multivariate ANOVA (PerMANOVA) (Anderson, 2001) using 4,999 number of randomizations and using Sørensen distance. The outlier analysis, NMS, and PerMANOVA were performed using PC-ORD 6 for Windows (McCune & Mefford, 2011).

Results

During our survey, we recorded 1,536 in 68 bird species, with Rock Pigeon, House Sparrow, Streak-eared Bulbul, and House Crow the species with the overall most encounters (Appendix A). Our sampling coverage per

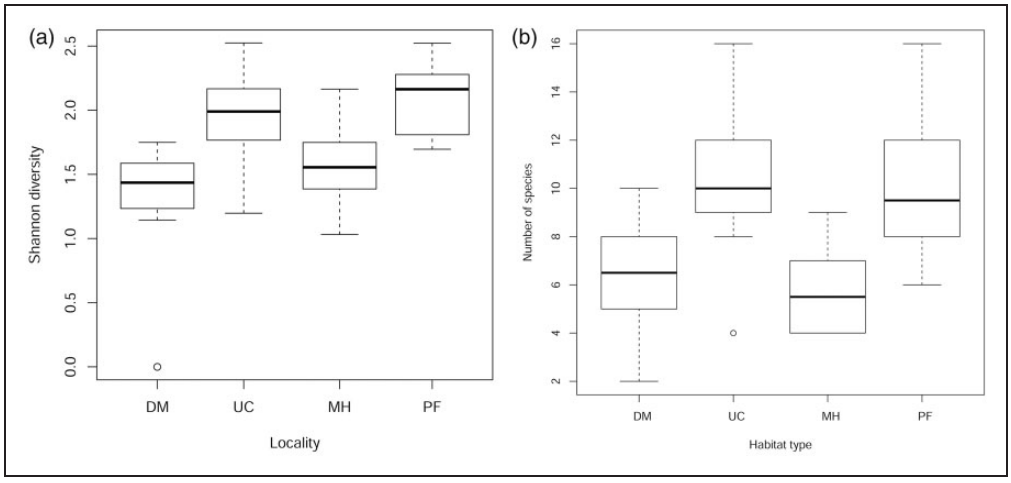

Figure 2. (a) Number of species among four habitat types in Mandalay, Myanmar, and (b) bird species diversity among four habitat types in Mandalay, Myanmar: Downtown Mandalay, University Campus, Mandalay Hill, and Paddy Fields.

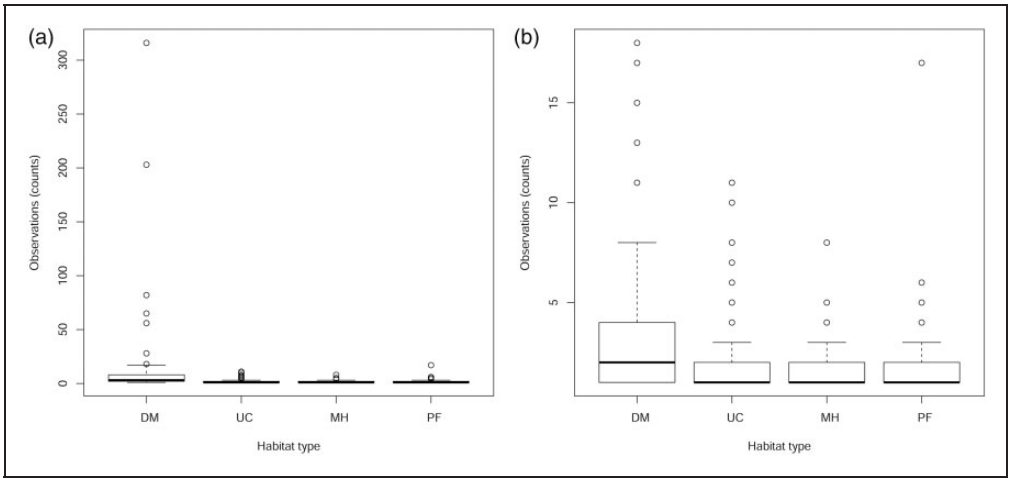

Figure 3. Variability in number of observations per locality (a) including and (b) excluding the Rock Pigeon in Mandalay, Myanmar.

habitat type (C.hat) varied from 0.923 in Mandalay Hill to 0.994 in Downtown Mandalay and is overall very high approaching 1.000. Number of species significantly differed between the four habitat types (GLM: Residual deviance = 32.480, $df = 36$, $p < .001$), also for estimated species richness per habitat type (Chao1: DM = 25.6, UC = 48.6, MH = 34.6, PF = 67.1). Mandalay Hill and Downtown Mandalay had the lowest number of species, whereas the University Campus and Paddy Fields had the highest (Figure 2). Bird diversity was also significantly different among habitats (ANOVA: $F_3 = 11.7$, $p < .001$; Figure 2). Downtown Mandalay had the lowest bird diversity and was significantly different from University Campus ($p = .002$) and Paddy Fields ($p < .001$), which both had the highest diversity. Also Paddy Fields had high bird diversity compared with Mandalay Hill ($p = .018$). Observations were different among the four habitat types (including Rock Pigeon: GLM Residual deviance = 3,450, $df = 328$, $p < .001$; excluding Rock Pigeon: GLM Residual deviance = 469.02, $df = 308$, $p < .001$). The highest number of observations was in Downtown Mandalay (1,003 counts; Figure 3) and the lowest on Mandalay Hill (103).

Neither habitat types nor bird species were identified as outliers. NMS analysis produced a final optimum 2D ordination space, which represented 75% of the variance in the original species data (R^2 NMS1 = 0.43, NMS2 = 0.32, stress = 0.15). The NMS ordination showed that habitat types had different bird species composition (Figure 4). This was supported by the PerMANOVA,

which showed a significant difference among habitat types ($p < .001$). Pairwise comparisons also indicated significant differences on species composition for the different habitats (Appendix B). An examination of the relative abundance of some species showed that some birds such as Eastern Stonechat tend to prefer Paddy Fields, others such as Yellow-browed Warbler may favor Mandalay Hill, and others such as Common Myna occurred more often in University Campus and Downtown Mandalay (Figure 5).

Discussion

Our results indicate distinct responses by the bird communities towards housing densities and development.

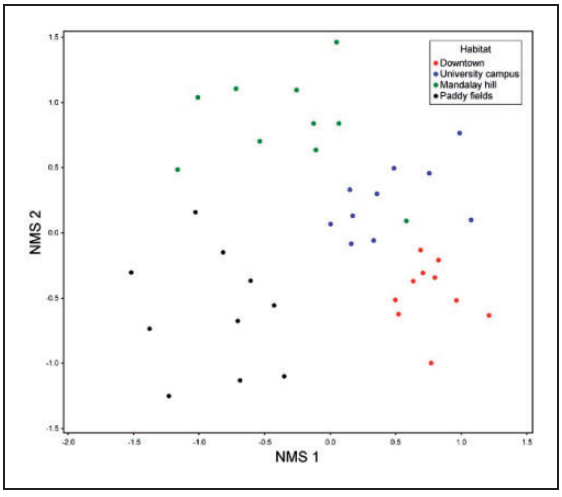

Figure 4. NMS ordination of sampling locations color-coded by habitat types. The first and second NMS axes represent 43% and 32% of the variance.

We found that urbanization has significant effects on bird species richness (observed and estimated), diversity, and abundance. With the data we collected, we can confirm our expectations that areas with high developed areas (particularly Downtown Mandalay) have low number of bird species, low diversity, but high relative abundance, whereas low developed areas and areas with higher portion of trees (particularly University Campus) had high number of species, high diversity, and low relative abundance. Our results contradict at least partially other studies; for example, others have found that bird richness is highest in residential areas with yards composed by trees, shrubs, and lawn (Blair, 1996; Leveau & Leveau, 2005; Marzluff, 2008). Our results support previous studies in which higher abundance of few species such as sparrows are found in areas with high housing density, while at the same time generalist species that feed on anything available and breed mainly in cavities occur (Suarez-Rubio et al., 2011; Suarez-Rubio & Thomlinson, 2009).

We were surprised by the relatively large number of bird species in the paddy fields, because agriculture usually has lower numbers of birds than, for example, forested sites (O'Connell, Jackson, & Brooks, 2000). But in our case, the close proximity of many bushes and hedge rows diversified the otherwise monotonous landscape, which could explain the high diversity. In contrast, we found very low numbers of individuals and relatively few species on Mandalay Hill, an area with diverse habitat structure with interspersed pagodas. Perhaps, the daily high activity of humans might drive the bird individuals into areas with less activity and therefore have not been recorded in our surveys.

Besides the change in species numbers and diversity, we found a significant shift in species composition. In high developed areas (Downtown Mandalay), we found more species that are commonly associated with human

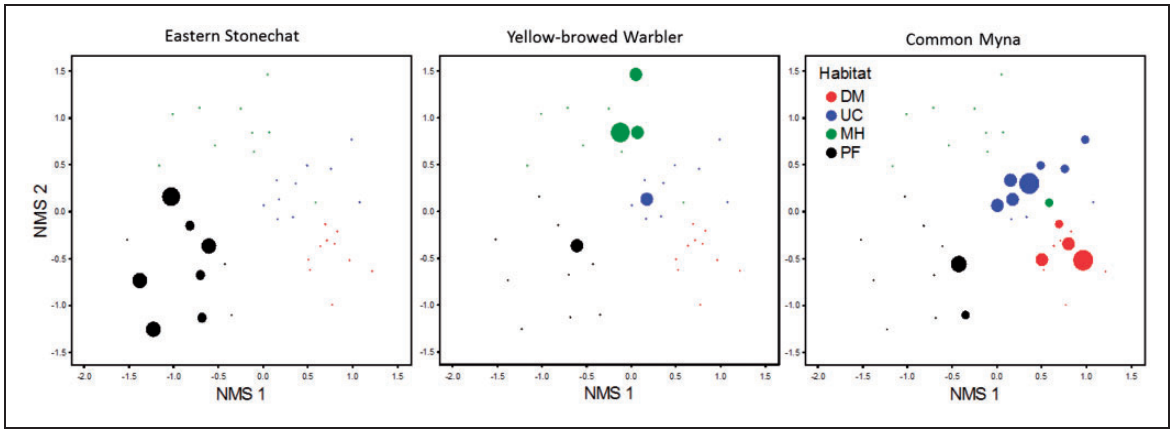

Figure 5. NMS ordination of sampling locations sized by relative abundance of Eastern Stonechat, Yellow-browed Warbler, and Common Myna and color-coded by habitat type. DM = Downtown Mandalay; US = University Campus; MH = Mandalay Hill; PF = Paddy Fields.

development such as Rock Pigeon or Sparrows. Similar trends have been found for urban areas where few generalist species increase in numbers and are present while absent in forested areas for example (Blair, 1996). In addition, significant species composition changes have been found along other trends of human development such as exurban development (Suarez-Rubio et al., 2011).

As in other cities of the world, the Rock Pigeon and the House Sparrow were very frequent in Downtown Mandalay, but interestingly other sensitive species such as Streak-eared Bulbul can still be found in the city, probably due to remaining forest fragments or parks within the city. Nonetheless, our results indicate that urbanization has an effect on the bird community although the level of urbanization in Mandalay is fairly low compared with other Southeast Asian cities.

Implications for conservation

We provided preliminary information on the bird community of Mandalay, Myanmar and showed the effects of development (housing) on the species composition, diversity, and abundance. Although we have a small sample size (but very high estimated sampling coverage with over 92%) and have considered only a short time period, several species tend to avoid downtown areas such as Mandalay. To our knowledge, this is the first time that the effects of urbanization are being documented for Myanmar—a notoriously understudied country—and indicates its congruence with studies in other tropical and temperate regions (Sorace & Gustin, 2010; Suarez-Rubio et al., 2011; Suarez-Rubio & Thomlinson, 2009). Thus, continued monitoring of the bird community in cities of Myanmar, particularly Mandalay, would provide further insights on the effects of urbanization on birds, especially given the projected population growth in the city. In addition, remnant habitat and diverse vegetation structure within the city such as Mandalay University Campus should be preserved to aid the conservation of birds in the city.

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Declaration of Conflicting Interests

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Appendix A. Species observations per habitat type, sorted by total observations

Scientific name	English name	Affinity	Downtown Mandalay	Mandalay Hill	University Campus	Paddy Fields	Total
Columba livia	Rock Pigeon	Open	792	5	11		808
Passer domesticus	House Sparrow	Open	72	3	35		110
Pycnonotus blanfordi	Streak eared Bulbul	Edge	12	15	31	7	65
Corvus splendens	House Crow	Open	32		16	11	59
Acridotheres grandis	White vented Myna	Open	24	3	1	15	43
Streptopelia chinensis	Spotted Dove	Open	2	17	8	5	32
Acridotheres tristis	Common Myna	Open	10	1	14	4	29
Merops orientalis	Little Green Beeeater	Aerial		6	20	2	28
Bubulcus coromandus	Cattle Egret	Water	2			25	27
Pycnonotus cafer	Red vented Bulbul	Edge	2	7	10	8	27
Turdoides gularis	White throated Babbler	Edge	1	13	12		26
Cypsiurus balas	Asian Palm Swift	Aerial	12	2	10		24

(continued)

Appendix A. Continued

Scientific name	English name	Affinity	Downtown Mandalay	Mandalay Hill	University Campus	Paddy Fields	Total
Megalaima haemaccephala	Coppersmith Barbet	Forest	16	1	4		21
Ardeola sp.	Pond Heron	Water			2	19	21
Saxicola maurus	Eastern Stonechat	Open				12	12
Orthotomus sutorius	Common Tailorbird	Open	3	4	1	3	11
Delichon dasypus	Asian House Martin	Aerial			10		10
Streptopelia decaocto	Eurasian Collared Dove	Open				9	9
Copsychus saularis	Oriental Magpie Robin	Edge		2	6	1	9
Dicrurus macrocercus	Black Drongo	Edge			2	6	8
Phylloscopus fuscatus	Dusky Warbler	Forest		3	1	4	8
Passer montanus	Eurasian Tree Sparrow	Aerial	8				8
Egretta garzetta	Little Egret	Water				8	8
Acridotheres burmannicus	Vinous breasted Myna	Open	2		6		8
Hirundo rustica	Barn Swallow	Aerial		1		6	7
Lanius cristatus	Brown Shrike	Open				7	7
Aegithina tiphia	Common Iora	Forest			6	1	7
Acridotheres sp.	*Acridotheres sp.*	Open	6				6
Lonchura punctulata	Scaly breasted Munia	Edge				6	6
Phylloscopus inornatus	Yellow browed Warbler	Forest		4	1	1	6
Artamus fuscus	Ashy Wood swallow	Aerial		5			5
Phylloscopus sp.	*Phylloscopus sp.*	Forest	1	4			5
Pied Bush chat	Pied Bushchat	Edge				5	5
Cecropis daurica	Red rumped Swallow	Aerial				5	5
Psittacula krameri	Rose ringed Parakeet	Forest			5		5
Halcyon smyrnensis	White throated Kingfisher	Water				5	5
Plegadis falcinellus	Glossy Ibis	Water				4	4
Prinia inornata	Plain Prinia	Edge				4	4
Amandava amandava	Red Avadavat	Edge				4	4
Streptopelia tranquebarica	Red collared Dove	Edge				4	4
Accipiter sp.	*Accipiter sp.*	Aerial	1		1	1	3
Lonchura sp.	*Lonchura sp.*	Open	2			1	3
Dicaeum cruentatum	Scarlet backed Flowerpecker	Open			3		3
Motacilla alba	White Wagtail	Open			3		3
Aquila fasciata	Bonelli's Eagle	Open				2	2
Cinnyris jugularis	Olive backed Sunbird	Edge			2		2
Phylloscopus plumbeitarsus	Two barred Warbler	Edge		2			2
Amaurornis phoenicurus	White breasted Waterhen	Water			2		2
Aethopyga saturata?	*Aethopyga sp.*	Edge	1				1
Eudynamys scolopaceus	Asian Koel	Forest			1		1
Milvus migrans	Black Kite	Open		1			1
Upupa epops	Common Hoopoe	Open			1		1
Alcedo atthis	Common Kingfisher	Water				1	1
Dicrurus paradiseus	Greater Racket tailed Drongo	Forest		1			1
Lanius tephronotus	Grey backed Shrike	Open				1	1
Ardea cinerea	Grey Heron	Water	1				1
Dicrurus hottenetotus	Hair crested Drongo	Forest			1		1
Phylloscopus magnirostris	Large billed Leaf Warbler	Forest		1			1

(continued)

Appendix A. Continued

Scientific name	English name	Affinity	Downtown Mandalay	Mandalay Hill	University Campus	Paddy Fields	Total
Centropus bengalensis	Lesser Coucal	Edge				1	1
Phalacrorax niger	Little Cormorant	Water				1	1
Plain-backed Sparrow	Plain backed Sparrow	Edge		1			1
Cinnyris asiaticus	Purple Sunbird	Edge			1		1
Pycnonotus sp.	*Pycnonotus sp.*	Edge	1				1
Accipiter badius	Shikra	Open		1			1
Athene brama	Spotted Owlet	Forest			1		1
Ficedula albicilla	Taiga Flycatcher	Edge			1		1
Gallicrex cinerea	Watercock	Water				1	1
Cisticola juncidis	Zitting Cisticola	Edge				1	1

Appendix B. Pairwise comparisons of bird species composition between four habitat types in and around Mandalay, Myanmar

Comparison	*t*	*p*
Downtown Mandalay vs. University Campus	3.505	<.001
Downtown Mandalay vs. Mandalay Hill	2.684	<.001
Downtown Mandalay vs. Paddy Fields	3.677	<.001
University Campus vs. Mandalay Hill	2.065	<.001
University Campus vs. Paddy Fields	2.567	<.001
Mandalay Hill vs. Paddy Fields	2.780	<.001

Appendix C. Abstract in Myanmar

အနှစ်ချုပ်

မြို့ပြပြောင်းလဲခြင်းသည် ငှက်များ၏ မျိုးစိတ်အရေအတွက်နှင့် အကောင်ရေပေါ် ကြွယ်ဝမှု အပေါ် အဓိက အကြောင်းရင်းတစ်ရပ်အဖြစ် လူသိများပါသည်။ သို့သော့် အပူပိုင်းဒေသနိုင်ငံ မြို့ပြများ တွင် ငှက်များ အရေအတွက်နှင့် မျိုးစိတ်မည်ကဲ့သို့ တုံ့ပြန်ဆက်နွယ်သည်ကို လေ့လာဆဲသာ ဖြစ်ပြီး မြန်မာနိုင်ငံတွင် လေ့လာမှု လုံးဝမရှိသေးပေ။ မြန်မာနိုင်ငံအလယ်ပိုင်း၏ မြို့ကြီးတစ်မြို့ဖြစ်သော မန္တလေးမြို့နှင့် အနီးတဝိုက်တွင် မြို့ပြ ပြောင်းလဲခြင်းနှင့် ငှက်များ ဆက်နွယ်မှုအကြောင်းကို စတင် လေ့လာခဲ့ပါသည်။ လေ့လာမှုကို ၂၀၁၅ ခုနှစ် အောက်တိုဘာလတွင် နေရာဒေသလေးခု၌ ပွိုင့် အမှတ် (၁၀) ခု စီဖြင့် လေ့လာခဲ့ပြီး တည်နေရာအလိုက် မျိုးစိတ်ကွဲပြားမှု နိုင်းယှဉ်နိုင်ရန်အတွက် Shannon မျိုးစိတ် ပေါကြွယ်မှု အညွှန်းကိုအသုံးပြုပြီး generalized linear model (GLM) ဖြင့် သုံးသပ်ခဲ့ပါသည်။ လေ့လာမှုကာလအတွင်း မျိုးစိတ် (၆၉) မျိုးနှင့် အရေအတွက် (၁၅၃၆) ကောင်ကို မှတ်တမ်းတင်နိုင်ခဲ့ပါသည်။ လေ့လာခဲ့သည်ဒေသ လေးခုအတွင်း မျိုးစိတ် ပေါကြွယ်ဝ မှုနှင့် အကောင်အရေအတွက် သိသာစွာကွဲပြားသည်။ မန္တလေးတောင်နှင့် မန္တလေးမြို့လယ် ဒေသသည် မျိုးစိတ်နည်းပါးပြီး မန္တလေးတက္ကသိုလ်နှင့် မြို့အပြင် စပါးကွင်းများတွင် မျိုးစိတ် အရေ အတွက် ပိုမိုပေါများသည်ကို တွေ့ရှိရသည်။ လေ့လာမှုကာလအတွင်း မန္တလေးမြို့လယ်တွင် အရေအတွက် ကောင်ရေ အများဆုံး (၁၀၁၃ ကောင်) တွေ့ရှိပြီး မန္တလေးတောင်တွင် ကောင်ရေ အနည်းဆုံး (၁၀၃)ကောင်သာတွေ့ရှိရသည်။ ထို့ကြောင့် မြို့ပြပြောင်းလဲခြင်းသည် မျိုးစိတ် ပေါကြွယ်ဝမှုနှင့် အကောင်အရေအတွက်အပေါ် လုံးဝဆက်နွယ် သက်ရောက်နေပါသည်။

အဓိကစကားလုံးများ။ ငှက်အုပ် အစုအဝေးငှက် ပေါကြွယ်ဝမှု၊ မျိုးစိတ်ပေါကြွယ်ဝမှု၊ မန္တလေး၊ ပွိုင့်အမှတ်ဖြင့် စာရင်းကောက်၊ အရှေ့တောင် အာရှ၊ မြို့ပြ ပြောင်းလဲခြင်း။

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