

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

Authors: Suarez-Rubio, Marcela, Aung, Thein, Lin Oo, Sai Sein, Shwe, Nay Myo, Hlaing, Nay Myo, et al.

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### Nonbreeding Bird Communities Along an Urban-Rural Gradient of a Tropical **City in Central Myanmar**

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Marcela Suarez-Rubio<sup>1</sup>, Thein Aung<sup>2</sup>, Sai Sein Lin Oo<sup>3</sup>, Nay Myo Shwe<sup>4</sup>, Nay Myo Hlaing<sup>3</sup>, Kyaw Myo Naing<sup>3</sup>, Tun Oo<sup>5</sup>, Mie Mie Sein<sup>3</sup>, and Swen C. Renner<sup>1,6</sup>

#### 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

#### **Corresponding Author:**

Swen C. Renner, Institute of Zoology, University of Natural Resources and Life Sciences, Vienna, Austria. Email: swen.renner@boku.ac.at



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<sup>&</sup>lt;sup>1</sup>Institute of Zoology, University of Natural Resources and Life Sciences, Vienna, Austria

<sup>&</sup>lt;sup>2</sup>Wild Wings, Yangon, Myanmar

<sup>&</sup>lt;sup>3</sup>Department of Zoology, University of Mandalay, Myanmar

<sup>&</sup>lt;sup>4</sup>Fauna & Flora International, Yangon, Myanmar

<sup>&</sup>lt;sup>5</sup>Indo-Myanmar Conservation, Yangon, Myanmar

<sup>&</sup>lt;sup>6</sup>Smithsonian Conservation Biology Institute, Smithsonian Institution, Front Royal, USA

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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 urbanrural 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<sup>-2</sup>. 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 15m 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.

![](_page_4_Figure_3.jpeg)

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.

![](_page_5_Figure_4.jpeg)

**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

![](_page_5_Figure_9.jpeg)

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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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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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			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	I	15	43
Streptopelia chinensis	Spotted Dove	Open	2	17	8	5	32
Acridotheres tristis	Common Myna	Open	10	I	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	I	13	12		26
Cypsiurus balas	Asian Palm Swift	Aerial	12	2	10		24

(continued)

#### Appendix A. Continued

Megolaima haemaccephala   Coppersmith Barbet   Forest   16   1   4   21     Ardeala sp.   Pond Heron   Water   2   19   21     Ardeala sp.   Common Tailorbird   Open   3   4   1   3   111     Delkhon doxplus   Asian House Martin   Aerial   10   10   10     Delkhon doxplus   Asian House Martin   Aerial   10   10   10     CopperShot soularis   Oriental Magpie Robin   Edge   2   6   18     Placous macrocercus   Black Drongo   Edge   2   6   8     Phylacopit fusctus   Dusky Warbler   Forest   3   1   4   8     Passer montanus   Eurasian Tere Sparrow   Aerial   1   6   7   7     Acridotheres burnannicus   Vinous breasted Myna   Open   2   6   8   8     Acridotheres sp.   Acridotheres sp.   Open   6   1   7   7     Acridotheres sp.   Acridotheres sp.   Open   6   6   6   6	Scientific name	English name	Affinity	Downtown Mandalay	Mandalay Hill	University Campus	Paddy Fields	Total
Ardeols sp.Pond HeronWater21921Sociols maunsEastern StonechtOpen1212Sociols maunsCommon TialofbirdOpen341311Delchon dospusAsian House MartinAerial1010Streptoplin decoactoEurasian Claired DoveOpen2619Dicruts macrocercusBlack DrongoEdge2619Dicruts macrocercusBlack DrongoEdge268Phylloscopti fixotatusDusky WarblerForest3148Egretta garzettaLitule EgretWater888Aridoberes burnonicusVinous breasted MynaOpen267Lanius cristatusBrown ShrikeOpen777Aridotheres sp.Aridotheres sp.Open666Phylloscopti fixotatusSaly breasted MuniaEdge55Denhura JunculutaSaly breasted MuniaEdge55Phylloscopti fixotatusYellow browed WarblerForest1416Phylloscopti fixotatusYellow browed WarblerForest1416Phylloscopti fixotatusSaly breasted MuniaEdge555Phylloscopti fixotatusAsht Wood swallowAerial555Phylloscopti fixotatusRed rumped SwallowAerial111 <t< td=""><td>Megalaima haemaccephala</td><td>Coppersmith Barbet</td><td>Forest</td><td>16</td><td>I</td><td>4</td><td></td><td>21</td></t<>	Megalaima haemaccephala	Coppersmith Barbet	Forest	16	I	4		21
Saxicolo maurus     Eastern Stonechat     Open     3     4     1     3     11       Dathom dasybas     Asian House Martin     Aerial     10     10     9       Sarptoplefa decoacta     Eurasian Collared Dove     Open     2     6     1     9       Capychus saularis     Oriental Magpie Robin     Edge     2     6     1     8       Phyloscopta fuscatus     Dusky Warbler     Forest     3     1     4     8       Egretta garcetta     Little Egret     Water     8     8     8       Acridatheres burmonnicus     Winous breasted Myna     Open     2     6     1     7       Acridatheres burmonnicus     Bran Nanlow     Aerial     1     6     7     7       Acridatheres burmonnicus     Bran Nanlow     Forest     4     1     1     6       Arriant fuscas     Ashy Wood Warbler     Forest     4     1     1     6       Arrianta fuscas     Ashy Wood Warbler     Forest     1     4     1 <td< td=""><td>Ardeola sp.</td><td>Pond Heron</td><td>Water</td><td></td><td></td><td>2</td><td>19</td><td>21</td></td<>	Ardeola sp.	Pond Heron	Water			2	19	21
Orthotomus sutoriusCommon TailorbirdOpen34I3IIDelichon daspusAxian House MartinAerial1010Screptupleid accotaEursian Collared DoveOpen2619Copsychus saularisOriental Magpie RobinEdge2619Dierum macrocercusBlack DrongoEdge2688Phyloscopis fixotavsDusky WarblerForest31488Egreta garzettaLittle EgretWater88 </td <td>Saxicola maurus</td> <td>Eastern Stonechat</td> <td>Open</td> <td></td> <td></td> <td></td> <td>12</td> <td>12</td>	Saxicola maurus	Eastern Stonechat	Open				12	12
Delichan dasypusAsian House MartinAerialI0I0Streptopla decoctoEurasian Collared DoveOpen9Opspchus saudurisOrinetal Maggie RobinEdge268Phylloscopus fixcatusDusky WarblerForest3148Paser montanusEurasian Tree SparrowAerial88Acridatheres burmonicusVinous breasted MynaOpen268Acridatheres burmonicusNonus breasted MynaOpen77Agrithina tiphiaCommon IoraForest617Acridatheres sp.Acridatheres sp.Open666Lankac ristatusBrown ShrikeOpen666Lankac ristatusBrown ShrikeOpen666Acridatheres sp.Acridatheres sp.Open655Acridatheres sp.Acridatheres sp.Open655Phylloscopus insmatusYellow browed WarblerForest1411Fylloscopus insmatusYellow browed WarblerForest144Aridatheres sp.Aridatheres sp.S555Phylloscopus insmatusYellow browed WarblerForest144Aridatheres sp.Aridathere555Phylloscopus insmatusRed rumped SwallowAerial113Alda karbardRed rumped SwallowAerial1 </td <td>Orthotomus sutorius</td> <td>Common Tailorbird</td> <td>Open</td> <td>3</td> <td>4</td> <td>I</td> <td>3</td> <td>11</td>	Orthotomus sutorius	Common Tailorbird	Open	3	4	I	3	11
Streptopela decaactoEurasian Collared DoveOpen9Copschus soularisOriental Magne RobinEdge2619Copschus soularisBlack DrongoEdge268Phyllascopus fuscatusDusky WarblerForest3148Passer montonusEurasian Tree SparrowAerial888Acridatheres burmannicusVinous breasted MynaOpen268Aridatheres burmannicusVinous breasted MynaOpen268Aridatheres burmannicusSonomo IoraForest617Acridatheres sp.Open677Acridatheres sp.Open666Phyllascopus sionatusYellow browed WarblerForest4116Aramus fuscusAsthy Vood swallowAerial555Pied BuschatEdge5555Cecrapis dauricaRed rumped SwallowAerial555Pied BuschatEdge4444Amandava amandavaRed collared DoveEdge444Amandava amandavaRed collared DoveEdge222Piedols fokinellusGlosy IbisWater3333Dicaeum cruentatumScarlet backed FlowerpackerOpen3333333Piedols fokinellusGlosy Ibis <td>Delichon dasypus</td> <td>Asian House Martin</td> <td>Aerial</td> <td></td> <td></td> <td>10</td> <td></td> <td>10</td>	Delichon dasypus	Asian House Martin	Aerial			10		10
Copsychus saularis     Oriental Magpie Robin     Edge     2     6     1     9       Dirrums macrocercus     Black Drongo     Edge     2     6     8       Passer montanus     Eurasian Tree Sparrow     Aerial     8     8       Passer montanus     Eurasian Tree Sparrow     Aerial     8     8       Acridohers burmanicus     Vinous breasted Myna     Open     2     6     8       Hirundo rustica     Barn Swallow     Aerial     1     6     7       Acridohers burmanicus     Brown Shrike     Open     6     6     6       Acridohers sp.     Acridohers sp.     Open 6     6     6       Antarus facaus     Ashy Wood svallow     Aerial     5     5       Phylloscopus inoratus     Yellow browed Warbler     Forest     1     4     5       Phylloscopus sp.     Phylloscopus sp.     Forest     1     4     6     5     5       Phylloscopus sp.     Phylloscopus sp.     Forest     1     4     4     4	Streptopelia decaocto	Eurasian Collared Dove	Open				9	9
Dicrurus macrocercusBlack DrongoEdge268Phyloscopus fuscatusDusky WarblerForest3148Egretta garzettaLittale EgretWater88Egretta garzettaLittale EgretWater88Acridatheres burnannicusVinous breasted MynaOpen268Aridatheres burnannicusBarn SvallowAerial167Lanius cristatusBrown ShrikeOpen77Aegithin diphiaCommon IoraForest4116Lonchura punctulataScaly breasted MuniaEdge666Phylloscopus sionatusYellow browed WarblerForest4116Aridatheres sp.Aridatheres sp.Sorest1455Phylloscopus sp.Phylloscopus sp.Forest1455Phylloscopus sp.Phylloscopus sp.Forest144Pied Bush chatForest5555Pitacula krameriRose ringed ParakeetForest555Pieddus krameriaGlossy IbisWater444Aridander addowa amandowRed AvadavatEdge44Ariamus fixerQ2222Pigedia facinaquebaricaRed AvadavatEdge222Pigedia facinaquebaricaBacel BuvebreberOpen3 <t< td=""><td>Copsychus saularis</td><td>Oriental Magpie Robin</td><td>Edge</td><td></td><td>2</td><td>6</td><td>I</td><td>9</td></t<>	Copsychus saularis	Oriental Magpie Robin	Edge		2	6	I	9
Phylloscopus fuscatusDusky WarblerForest3148Passer montanusEurasian Tree SparrowAerial88Egretta garzettaLitel EgretWater88Acridathers burnannicusVinous breasted MynaOpen268Hirundo nusticaBarn SwallowAerial167Lanius cristatusBrown ShrikeOpen677Acridatheres sp.Acridatheres sp.Open666Lonchura punctulataScaly breasted MuniaEdge666Lonchura punctulataScaly breasted MuniaEdge55Phylloscopus sp.Phylloscopus sp.Forest1455Phylloscopus sp.Phylloscopus sp.Forest1455Ped Bush chatEdge55555Peddus krameriRose ringed ParakeetForest555Plegadis falcinellusGlossy IbisWater444Ariandara Plain PriniaEdge444Streptopelia tranquebaricaRed collared DoveEdge222Accipter sp.Accipter sp.Accipter sp.Acrial1113Lonchura sp.Lonchura sp.Open33333333333333333333	Dicrurus macrocercus	Black Drongo	Edge			2	6	8
Passer montanusEurasian Tree SparrowAerial8Egretta gorzettaLittle EgretWater88Acridotheres burmannicusVinous breasted MynaOpen268Arridotheres burmannicusBarn SwallowAerialI67Lanius cristatusBrown ShrikeOpen777Aegithina tiphiaCommon IoraForest617Acridotheres sp.Acridotheres sp.Open666Lanchura punctulataScaly breasted MuniaEdge666Phylloscopus sp.Phylloscopus sp.Forest1416Artamus fuscusAshy Wood SwallowAerial555Pied Bush chatEdge5555Pied Bush chatPied BushchatEdge444Artamus fuscusGlossy IbisWater555Pistacula krameriRose ringed ParakeetForest555Helyon smyrnensisWhite throated KingfisherWater444Accipiter sp.Accipiter sp.Aerial1113Lonchura sp.Lonchura sp.Open22222Pina imornatisPinia imornatisSariet backed FlowerpeckerOpen3333333333333333333 <td< td=""><td>Phylloscopus fuscatus</td><td>Dusky Warbler</td><td>Forest</td><td></td><td>3</td><td>I</td><td>4</td><td>8</td></td<>	Phylloscopus fuscatus	Dusky Warbler	Forest		3	I	4	8
Egretta garzettaLittle EgretWater88Acridatheres burnannicasVinous breasted MynaOpen268Hirundo rusticaBarn SwallowAerial167Lanius cristatusBorow ShrikeOpen77Aegithina tiphiaCommon IoraForest617Acridatheres sp.Acridatheres sp.Open666Phylloscopus inornatusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial555Phylloscopus sp.Phylloscopus sp.Forest145Pied Bush chatEdge555Fattaculuk KameriRose ringed ParakeetForest55Haloyon smyrnensisWhite throated KingfisherWater44Prinia inornataPlain PriniaEdge44Armadya amendavaRed collared DoveEdge222Accipiter sp.Accipiter sp.Aerial1113Joneau annodavaRed collared DoveEdge2222Armadya fuel abaked FlowerpeckerOpen22222Amodava amendavaRed NatavatEdge2222222222222222222222222 <t< td=""><td>Passer montanus</td><td>Eurasian Tree Sparrow</td><td>Aerial</td><td>8</td><td></td><td></td><td></td><td>8</td></t<>	Passer montanus	Eurasian Tree Sparrow	Aerial	8				8
Acridotheres burmannicusVinous breasted MynaOpen268Hirundo rusticaBarn SvallowAerialI67Lanius cristatusBrown ShrikeOpen77Actidatheres sp.Common IoraForest617Acridatheres sp.Acridatheres sp.Open666Lonchura punctulataScaly breasted MuniaEdge41166Artidatheres sp.Open6666Phylloscopus sp.Forest41166ArtidutareYellow browed WarblerForest1455Pield Bush chatEdge55555Pield Bush chatPied BushchatEdge555Piedatical krameriRose ringed ParakeetForest555Piedatical krameriRose ringed ParakeetForest444Arnadava amandavaRed collared DoveEdge444Arnadava amandavaRed collared DoveEdge222Cripties p.Accipter sp.Accipter sp.Acrial1113Lonchura sp.Lonchura sp.Open22222Charphis guelarisOhren2222222222222222222222	Egretta garzetta	Little Egret	Water				8	8
Hinundo rusticaBarn SwallowAerialI67Lanius cristatusBrown ShrikeOpen77Aegithina tiphiaCommon IoraForest617Acridatheres sp.Acridatheres sp.Open66Lanchura punctulataScaly breasted MuniaEdge66Phylloscopus inamatusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial555 <td>Acridotheres burmannicus</td> <td>Vinous breasted Myna</td> <td>Open</td> <td>2</td> <td></td> <td>6</td> <td></td> <td>8</td>	Acridotheres burmannicus	Vinous breasted Myna	Open	2		6		8
Lankus cristatusBrown ShrikeOpen77Aegithina tiphiaCommon IoraForest617Acridotheres sp.Acridotheres sp.Open66Inchura punctulataScaly breasted MuniaEdge66Phylloscopus sinornatusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial55Phylloscopus sp.Phylloscopus sp.Forest1455Phylascopus sp.Phylloscopus sp.Forest555Peid Bush chatEdge5555Peidaush chatGose ringed ParakeetForest555Plegadis falcinellusGlossy IbisWater444ArmandavaRed collared DoveEdge444Amandava amandavaRed collared DoveEdge444Accipiter sp.Accipiter sp.Aerial111333Jocaeum cruentatumScarlet backed FlowerpeckerOpen222	Hirundo rustica	Barn Swallow	Aerial		I		6	7
Aegithina tiphiaCommon IoraForest617Aridatheres sp.Aridatheres sp.Open666Lanchura punctulataScaly breasted MuniaEdge66Phylloscopus innantusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial555Phylloscopus sp.Phylloscopus sp.Forest1455Pied Bush chatPied BushchatEdge555Statacula krameriRose ringed ParakeetForest555Hakyon smymensisWhite throated KingfisherWater444Amandava amandavaRed AvadavatEdge444Arcipiter sp.Accipiter sp.Aerial1133Dicaeum cuentutumScarlet backed FlowerpeckerOpen2222Phylloscopus sp.Dive backed SunbirdEdge22222Phylloscopus sp.Open2222222Dicaeum cuentutumScarlet backed FlowerpeckerOpen222 <td>Lanius cristatus</td> <td>Brown Shrike</td> <td>Open</td> <td></td> <td></td> <td></td> <td>7</td> <td>7</td>	Lanius cristatus	Brown Shrike	Open				7	7
Acridatheres sp.Acridatheres sp.Open6Lanchura punctulataScaly breasted MuniaEdge66Phylloscopus inornatusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial55Phylloscopus sp.Phylloscopus sp.Forest145Pied Bush chatPied BushchatEdge55Cecropis dauricaRed rumped SwallowAerial55Pitacula krameriRose ringed ParakeetForest55Hakyon smyrnensisWhite throated KingfisherWater44Prinia inornataPlain PriniaEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.Aerial113Lonchura sp.Lonchura sp.Open333Joiceum cruentatumScarlet backed FlowerpeckerOpen333Aqual fasciataBonelli's EagleOpen222Inmyris jugularisOive backed SunbridEdge222Amauromis phoenicurusWhite breasted WaterhenWater111Upupa epopsCommon HioopoeOpen1111Upupa epopsCommon HioopoeOpen1111Upupa epopsCommon KingfisherWater1111Upupa e	Aegithina tiphia	Common Iora	Forest			6	I.	7
Lonchura punctulataScaly breasted MuniaEdge66Phylloscopus sinornatusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial55Phylloscopus sp.Phylloscopus sp.Forest145Phylloscopus sp.Phylloscopus sp.Forest145Pied Bush chatFedge555Cecropis dauricaRed rumped SwallowAerial55Plegadis ficinellusGlossy IbisWater44Prinia inomataPlain PriniaEdge44Aranava amandavaRed AvadavatEdge44Aranava amandavaRed AvadavatEdge44Arcipiter sp.Accipiter sp.Aerial113Lonchura sp.Open21333Joicaeum cruentatumScarlet backed FlowerpeckerOpen3333Aquila fasciataBonelli's EagleOpen2222Phylloscopus sp.Lonchura sp.Edge1111111113Lonchura sp.Lonchura sp.Open222222222222222222222222222222222 <td< td=""><td>Acridotheres sp.</td><td>Acridotheres sp.</td><td>Open</td><td>6</td><td></td><td></td><td></td><td>6</td></td<>	Acridotheres sp.	Acridotheres sp.	Open	6				6
Phylloscopus inornatusYellow browed WarblerForest4116Artamus fuscusAshy Wood swallowAerial55Phylloscopus sp.Priet I455Pied Bush chatPied BushchatEdge55Secropis dauricaRed rumped SwallowAerial55Psittacula krameriRose ringed ParakeetForest55Halcyon smyrnensisWhite throated KingfisherWater55Plegadis falcinellusGlossy IbisWater44Prinia inornataPlain PriniaEdge44Armandava amandavaRed AvadavatEdge44Atcipiter sp.Accipiter sp.Aerial1113Lonchuro sp.Lonchuro sp.Open2222Auila fasciataBonelli's EagleOpen3333Aquila fasciataBonelli's EagleOpen2222Cinnyris jugularisOlive backed SunbirdEdge22222Amauronis phoenicurusWhite brasted WaterhenWater11111Ludynamys scolopaceusAsian KoelForest111111Ludynamys scolopaceusAsian KoelForest1111111111111111111	Lonchura punctulata	Scaly breasted Munia	Edge				6	6
Artamus fuscusAshy Wood swallowAerial55Phylloscopus sp.PorestI45Pied Bush chatPied BushchatEdge55Cecropis dauricaRed rumped SwallowAerial55Statacula krameriRose ringed ParakeetForest55Halcyon smyrnensisWhite throated KingfisherWater44Prina inornataPlain PriniaEdge44Amandava amandavaRed AvadavatEdge44Accipiter sp.AcrialII13Lonchura sp.Open213Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge111Aduila fasciataBonelli's EagleOpen222Cinnyris jugularisOlive backed SunbirdEdge111Autoliga sturata?Aetinopyg sp.Edge222Amanys scolopaceusAsian KoelForest1111Ihus migransBlack KiteOpen1111Iuhyus migransBlack KiteOpen1111Iuhyus migransBlack KiteOpen1111Iuhyus migransGrey backed ShrikeOpen1111 <tr< td=""><td>Phylloscopus inornatus</td><td>Yellow browed Warbler</td><td>Forest</td><td></td><td>4</td><td>I</td><td>I.</td><td>6</td></tr<>	Phylloscopus inornatus	Yellow browed Warbler	Forest		4	I	I.	6
Phylloscopus sp.ProrestI45Pied Bush chatPied BushchatEdge55Cecropis dauricaRed rumped SwallowAerial55Psittacula krameriRose ringed ParakeetForest55Halcyon smyrnensisWhite throated KingfisherWater55Plegadis ficinellusGlossy IbisWater44Amandava amandavaRed AvadavatEdge44Amandava amandavaRed collared DoveEdge44Accipiter sp.Accipiter sp.AerialII3Lonchura sp.Lonchura sp.Open222Ciacaun cruentatumScarlet backed FlowerpeckerOpen333Aquila fasciataBonelli's EagleOpen222Phylloscopus plumbeitarusTwo barred WarblerEdge1IIILudynamys scolopaceusAsian KoelForestIIIIIUpupa epopsCommon HoopoeOpenIIIIIIILainus tephronatusGreater Racket tailed DrongoForestIII </td <td>Artamus fuscus</td> <td>Ashy Wood swallow</td> <td>Aerial</td> <td></td> <td>5</td> <td></td> <td></td> <td>5</td>	Artamus fuscus	Ashy Wood swallow	Aerial		5			5
Pied Bush chatPied Bush chatEdge55Gecropis dauricaRed rumped SwallowAerial55Pisttacula krameriRose ringed ParakeetForest55Halcyon smyrnensisWhite throated KingfisherWater55Plegadis falcinellusGlossy lbisWater44Armandova armandavaRed AvadavatEdge44Armandova armandavaRed AvadavatEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.Aerial1113Lonchura sp.Lonchura sp.Open222Motacilla albaWhite WagtailOpen333Motacilla albaWhite WagtailOpen222Innyris jugularisOlive backed SunbirdEdge222Phylloscopus plumbeitarsusTwo barred WarblerEdge111IIIIII1Muranys scolopaceusAsian KoelForest1I1Ihvanyn sgrandiseusGreater Racket tailed DrongoForest1I1Invirus paradiseusGrey HaronWaterII1Invirus paradiseusGrey HeronWaterIIIInvirus paradiseusGreater Racket tailed DrongoForestIIIInvirus hottenetotusGrey	Phylloscopus sp.	Phylloscopus sp.	Forest	I	4			5
Cecropis dauricaRed rumped SwallowAerial55Psittacula krameriRose ringed ParakeetForest55Halcyon smyrnensisWhite throated KingfisherWater44Prina inornataPlain PriniaEdge44Amandava amandavaRed AvadavatEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.Aerial1113Lonchura sp.Lonchura sp.Open213Dicaeum cruentatumScarlet backed FlowerpeckerOpen333Aquila fasciataBonelli's EagleOpen222Phylloscopus plumbeitarsusTwo barred WarblerEdge222Andaroms phoenicurusWhite breasted WaterhenWater222Apula fasciataBonelli's EagleOpen1111Lonchura sp.Open11111Aquila fasciataBonelli's EagleOpen222Aduatornis phoenicurusWhite breasted WaterhenWater222Atchopyga saturata?Acthopyga sp.Edge1111Milvus migransBlack KiteOpen1111Milvus migransCommon KingfisherWater1111Lanius tephronatusGrey backed ShrikeOpen <td>Pied Bush chat</td> <td>Pied Bushchat</td> <td>Edge</td> <td></td> <td></td> <td></td> <td>5</td> <td>5</td>	Pied Bush chat	Pied Bushchat	Edge				5	5
Psitacula krameriRose ringed ParakeetForest55Halcyon smyrnensisWhite throated KingfisherWater55Plegadis falcinellusGlossy IbisWater44Prinia inornataPlain PriniaEdge44Amandava amandavaRed AvadavatEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.AerialII3Lonchura sp.Lonchura sp.Open2I3Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Aquila fasciataBonelli's EagleOpen222Cinnyris jugularisOlive backed SunbirdEdge222Phylloscopus plumbeitarsusTwo barred WarblerEdge1IILudynamys scolopaceusAsian KoelForestIIIUpupa epopsCommon HoopoeOpenIIIILarius tephronatusGres backed ShrikeOpenIIILarius tephronatusGrest tailed DrongoForestIIILarius tephronatusGrest backed ShrikeOpenIIILinus tephronatusGrey backed ShrikeOpenIIILinus tephronatusGrey backed ShrikeOpenIIILinus tephronatusGrey backed ShrikeOpenIII<	Cecropis daurica	Red rumped Swallow	Aerial				5	5
Hakçon smyrnensisWhite throated KingfisherWater55Plegadis fakinellusGlossy IbisWater44Prinia inornataPlain PriniaEdge44Amandava amandavaRed AvadavatEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.AcrialII13Lonchura sp.Lonchura sp.Open213Dicaeum cruentatumScarlet backed FlowerpeckerOpen333Aquila fasciataBonelli's EagleOpen222Cinnyris jugularisOlive backed SunbirdEdge222Phylloscopus plumbeitarsusTwo barred WarblerEdge111Ludynamys scolopaccusAsian KoelForestII1Upupa epopsCommon KingfisherWaterII1Lares billed DrongoForestIII1Larius tephronotusGrey backed ShrikeOpenIIIActopitya sculopaceusAsian KoelForestIIIIlpupa epopsCommon KingfisherWaterIIILanius tephronotusGrey backed ShrikeOpenIIIInius tephronotusGrey backed ShrikeOpenIIIIlpupa epopsCommon KingfisherWaterIIIInius tephronotus	, Psittacula krameri	Rose ringed Parakeet	Forest			5		5
Plegadis faicinellusGlossy lbisWater44Prinia inornataPlain PriniaEdge44Amandava amandavaRed AvadavatEdge44Amandava amandavaRed collared DoveEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.AerialIII3Lonchura sp.Lonchura sp.Open2I33Dicaeum cruentatumScarlet backed FlowerpeckerOpen333Aquila fasciataBonelli's EagleOpen222Cinnyris jugularisOlive backed SunbirdEdge222Phylloscopus plumbeitarsusTwo barred WarblerEdge1IIIMitvus migransBlack KiteOpenIIIIIUpupa epopsCommon HoopoeOpenIIIIILacdo atthisCommon KingfisherWaterIIIIILareb blinde Led DrongoForestIIIIIILareb blinde Led DrongoForestIIIIIILareb blinde Led DrongoForestIIIIIILareb blinde Led DrongoForestIIIIIIILareb blinde Led DrongoForestIIII<	Halcyon smyrnensis	White throated Kingfisher	Water				5	5
Prinia inornataPlain PriniaEdge44Amandava amandavaRed AvadavatEdge44Arandava amandavaRed collared DoveEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.AerialIII3Lonchura sp.Open2I33Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Matacilla albaWhite WagtailOpen22Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WaterhenWater22Aethopyga sturata?Aethopyga sp.EdgeIIILudynamys scolopaceusAsian KoelForestIIIVilvus migransBlack KiteOpenIIIILorurus paradiseusGreater Racket tailed DrongoForestIIILarde cinereaGrey backed ShrikeOpenIIIILorurus hottenetotusHair crested DrongoForestIIIILarde cinereaGrey HeronWaterIIIIILorurus hottenetotusHair crested DrongoForestIIIILarde cinereaGrey HeronWaterIIII<	Plegadis falcinellus	Glossy Ibis	Water				4	4
Amandava amandavaRed AvadavatEdge44Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.AerialII13Lonchura sp.Lonchura sp.Open2I3Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Motacilla albaWhite WagtailOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Aethopyga sp.EdgeIIILudynamys scolopaceusAsian KoelForestIIIl Upupa epopsCommon KingfisherWaterIIIIl Carius paradiseusGreater Racket tailed DrongoForestIIIIl Carius phonotusGrey backed ShrikeOpenIIIIIl Carius paradiseusGrey backed ShrikeOpenIIIIIl Carius paradiseusGrey backed ShrikeOpenIIIIIl Carius paradiseusGrey backed ShrikeOpenIIIIIl Carius hottenetotusHair crested DrongoForestIIIIIl Carius hottenetotusHair crested DrongoForestIIIIIl Carius hottenetotusHair crested Dro	Prinia inornata	, Plain Prinia	Edge				4	4
Streptopelia tranquebaricaRed collared DoveEdge44Accipiter sp.Accipiter sp.AerialIII3Lonchura sp.Lonchura sp.Open2I3Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Motacilla albaWhite WagtailOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Aethopyga sturata?Aethopyga sp.EdgeIIILudynamys scolopaceusAsian KoelForestIIINikvus migransBlack KiteOpenIIIIUpupa epopsCommon HoopoeOpenIIIIDicrurus paradiseusGreater Racket tailed DrongoForestIIILanius tephronotusGrey backed ShrikeOpenIIIAltedo atthisGrey HeronWaterIIIDicrurus hottenetotusHair crested DrongoForestIIIPhylloscobus magnirostrisLare billed Leaf WarblerForestIIIIIIIIIIIDicrurus hottenetotusHair crested DrongoForestIIIDicrurus hottenetotusHair crested DrongoForestI </td <td>Amandava amandava</td> <td>Red Avadavat</td> <td>Edge</td> <td></td> <td></td> <td></td> <td>4</td> <td>4</td>	Amandava amandava	Red Avadavat	Edge				4	4
Accipiter sp.AcrialIIII3Lonchura sp.Lonchura sp.Open2I3Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Motacilla albaWhite WagtailOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Anaurornis phoenicurusWhite breasted WaterhenWater22Aethopyga saturata?Aethopyga sp.EdgeIILudynamys scolopaceusAsian KoelForestIIIMilvus migransBlack KiteOpenIIIDicrurus paradiseusGreater Racket tailed DrongoForestIIIArdea cinereaGrey backed ShrikeOpenIIIDicrurus hottenetotusHair crested DrongoForestIIIArdea cinereaGrey HeronWaterIIIPhylloscopus magnirostrisLare billed Leaf WarblerForestIII	Streptopelia tranguebarica	Red collared Dove	Edge				4	4
Lonchura sp.Open213Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Motacilla albaWhite WagtailOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Armaurornis phoenicurusWhite breasted WaterhenWater22Aethopyga saturata?Aethopyga sp.Edge11Eudynamys scolopaceusAsian KoelForest11Milvus migransBlack KiteOpen11Upupa epopsCommon HoopoeOpen11Dicrurus paradiseusGreater Racket tailed DrongoForest11Ardea cinereaGrey backed ShrikeOpen11Dicrurus hottenetotusHair crested DrongoForest11Phylloscobus magnirostrisLarge billed Leaf WarblerForest11	Accipiter sp.	Accipiter sp.	Aerial	I		I	I	3
Dicaeum cruentatumScarlet backed FlowerpeckerOpen33Motacilla albaWhite WagtailOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Amaurornis phoenicurusWhite breasted WaterhenWater22Aethopyga saturata?Aethopyga sp.Edge11Eudynamys scolopaceusAsian KoelForest11Milvus migransBlack KiteOpen11Upupa epopsCommon HoopoeOpen11Dicrurus paradiseusGreater Racket tailed DrongoForest11Ardea cinereaGrey backed ShrikeOpen11Dicrurus hottenetotusHair crested DrongoForest11Phylloscobus magnirostrisLaree billed Leaf WarblerForest11	Lonchura sp.	Lonchura sp.	Open	2			I	3
Motacilla albaWhite WagtailOpen33Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Amaurornis phoenicurusWhite breasted WaterhenWater22Aethopyga saturata?Aethopyga sp.EdgeIIEudynamys scolopaceusAsian KoelForestIIMilvus migransBlack KiteOpenIIIUpupa epopsCommon HoopoeOpenIIIActedo atthisCommon KingfisherWaterIIIDicrurus paradiseusGreater Racket tailed DrongoForestIIIArdea cinereaGrey HeronWaterIIIDicrurus hottenetotusHair crested DrongoForestIIIPhylloscobus magnirostrisLarge billed Leaf WarblerForestIII	, Dicaeum cruentatum	Scarlet backed Flowerpecker	Open			3		3
Aquila fasciataBonelli's EagleOpen22Cinnyris jugularisOlive backed SunbirdEdge22Phylloscopus plumbeitarsusTwo barred WarblerEdge22Amaurornis phoenicurusWhite breasted WaterhenWater22Aethopyga saturata?Aethopyga sp.EdgeIIEudynamys scolopaceusAsian KoelForestIIMilvus migransBlack KiteOpenIIUpupa epopsCommon HoopoeOpenIIAlcedo atthisCommon KingfisherWaterIIDicrurus paradiseusGreater Racket tailed DrongoForestIIArdea cinereaGrey backed ShrikeOpenIIDicrurus hottenetotusHair crested DrongoForestIIPhylloscopus magnirostrisLarge billed Leaf WarblerForestII <td>Motacilla alba</td> <td>White Wagtail</td> <td>Open</td> <td></td> <td></td> <td>3</td> <td></td> <td>3</td>	Motacilla alba	White Wagtail	Open			3		3
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Alcedo atthis   Common Kingfisher   Water   I   I     Dicrurus paradiseus   Greater Racket tailed Drongo   Forest   I   I     Lanius tephronotus   Grey backed Shrike   Open   I   I     Ardea cinerea   Grey Heron   Water   I   I     Dicrurus hottenetotus   Hair crested Drongo   Forest   I   I     Phylloscobus magnirostris   Large billed Leaf Warbler   Forest   I   I	Ububa ebobs	Common Hoopoe	Open			1		Ì
Dicrurus paradiseusGreater Racket tailed DrongoForestIILanius tephronotusGrey backed ShrikeOpenIIArdea cinereaGrey HeronWaterIIDicrurus hottenetotusHair crested DrongoForestIIPhylloscobus magnirostrisLarge billed Leaf WarblerForestII	Alcedo atthis	Common Kingfisher	Water				1	Ì
Lanius tephronotus Grey backed Shrike Open I I   Ardea cinerea Grey Heron Water I I   Dicrurus hottenetotus Hair crested Drongo Forest I I   Phylloscobus magnirostris Large billed Leaf Warbler Forest I I	Dicrurus baradiseus	Greater Racket tailed Drongo	Forest		1		-	1
Ardea cinerea Grey Heron Water I   Dicrurus hottenetotus Hair crested Drongo Forest I   Phylloscobus magnirostris Large billed Leaf Warbler Forest I	Lanius tebhronotus	Grey backed Shrike	Open		•		I	I
Dicrurus hottenetotus Hair crested Drongo Forest I I   Phylloscobus magnirostris Large billed Leaf Warbler Forest I I	Ardea cinerea	Grev Heron	Water	I			•	I
Phylloscobus magnirostris Large billed Leaf Warbler Forest I	Dicrurus hottenetotus	Hair crested Drongo	Forest	•		I		
	Phylloscopus magnirostris	Large billed Leaf Warbler	Forest		I	•		·

(continued)

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

#### **Appendix A. Continued**

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

Comparison	t	Þ
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

မြိုပြေပြာင်းလဲရြင်းသည် ငှက်များ၏ မိျံးစိတ်အရေအတွက်နှင့် အကောင်ရေပေါ ကြွယ်ဂမု အပေါ် အဓိက အကြောင်းရင်းတစ်ရပ်အဖြစ် လူသိများပါသည်။ သို့ သော့် အပူပိုင်းဒေသနိုင်ငံ မြို့ပြများ တွင် ငှက်များ အရေအတွက်နှင့် မိျံးစိတ်မည်ကဲ့သို ့တုံ ပြန်ဆက်နွယ်သည်ကို လေ့လာဆဲသာ ဖြစ်ပြီး မြန်မာနိုင်ငံတွင် လေ့လာမှ လုံးဝမရှိသေးပေ။ မြန်မာနိုင်ငံအလယ်ပိုင်း၏ မြို့ကြီးတစ်မြို့ဖြစ်သော မွန္တလေးမြို့နှင့် အနီးတဝိုက်တွင် မြို့ပြ ပြောင်းလဲခြင်းနှင့် ငှက်များ ဆက်နွယ်မှအကြောင်းကို စတင် လေ့လာခဲ့ပါသည်။ လေ့လာမှကို ၂၀၁၅ ခုနှစ် အောက်တိုဘာလတွင် နေရာဒေသလေးခု၌ ပွိုင့် အမှတ် (၁၀) ခု စီဖြင့် လေ့လာခဲ့ပြီး တည်နေရာအလိုက် မျိုးစိတ်ကွဲပြားမှု နိုင်းယှဉ်နိုင်ရန်အတွက် Shannon မိျူးစိတ် ပေါ်ကြွယ်မှု အည့်နင်္ဂကိုအသုံးပြုပြီး generalized linear model (GLM) ဖြင့် သုံးသပ်ခဲ့ပါသည်။ လေ့လာမှုကာလအတွင်း မိျုံးစိတ် (၆၉) မိျုံးနှင့် အရေအတွက် (၁၅၃၆) ကောင်ကို မှတ်တမ်းတင်နိုင်ခဲ့ပါသည်။ လေ့လာခဲ့သည်ဒေသ လေးခုအတွင်း မိျူးစိတ် ပေါ်ကြွယ်ပ မှနှင့် အကောင်အရေအတွက် သိသာစွာကွဲပြားသည်။ မွေ့လေးတောင်နှင့် မွန္တလေးမြို့လယ် ဒေသသည် မိျုံးစိတ်နည်းပါပြီး မွန္တလေးတွောင်အရေအတွက် သိသာစွာကွဲပြားသည်။ မွေ့လေးတောင်နှင့် မွန္တလေးမြို့လယ် ဒေသသည် မိျုံးစိတ်နည်းပါပြီး မွန္တလေးတွောင်အရေ အနည်းဆုံး (၁၀၃)ကောင်းများတွင် မိျုံးစိတ် အရေ အတွက် ပိုမိုပေါများသည်ကို တွေ့ရှိရသည်။ လေ့လာမှကာလအတွင်း မွန္တလေးမြို့လယ်တွင် အရေအတွက် ကောင်ရေ အများဆုံး (၁၀၀၃ ကောင်) တွေ့ ရှိရသည်။ လေ့လာမှအေသာင်ဖွေ အနည်းဆုံး (၁၀၃)ကောင်သာတွေ ့ရှိရသည်။ ထို ့ကြောင့် မြို့ပြေငပြာင်းလဲခြင်းသည် မိျုံးစိတ် ပေကြွယ်ပမုံနှင့် အကောင်အရေအတွက်အပေါ် လုံးပဆက်နွယ် သက်ရောက်နေပါသည်။

**အဓိကစကားလုံးများ**။ ငှက်အုပ် အစုအဂေး၊ငှက် ပေါ်ကြွယ်ဂမူ၊ မျိုးစိတ်ပေါ်ကြွယ်ဂမူ၊ မန္တလေး၊ ဝွိုင့်အမှတ်ဖြင့် စာရင်းကောက်၊ အရှေ့တောင် အာရှ၊ မြို့ပြ ပြောင်းလဲခြင်း။

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