SMALL MAMMAL AND UNDERSTOREY BIRD SPECIES DIVERSITY ALONG ELEVATIONAL GRADIENTS IN MOUNT MAKILING, PHILIPPINES

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ABSTRACT

Under-storey bird and small mammal species diversity of mid-montane forest (760-899 masl), mossy forest (900-1100 masl), secondary lowland evergreen forest (442-665 masl), mixed grassland and agro-forest areas (261-442 masl) and secondary growth with built-up areas (148 - 261masl) of Mt. Makiling were investigated from May 2009 – May 2010. A combination of netting and transect line method was done to record bird species. For the small mammals, a combination of cage traps and snap traps were used. A total of 63 understorey bird species was recorded for all sampling sites. Majority of birds recorded were common but endemic species. There was no particular pattern for the computed species diversity indices (H') along the various elevational gradients. However, bird species richness from ~200 masl decreased with

elevation. Seven species of small non-volant mammals consisting of four endemic species and three introduced commensal species were recorded. Two of the endemic species are new records for Mt. Makiling with one possible new species (*Apomys sp*.). Species richness for small non-volant mammals from ~200 masl also decreased with elevation. Therefore, the species richness of understorey birds and small non-volant mammals decreases with elevation in these five elevational gradients of Mt. Makiling.

Key words: species richness, mossy forest, montane forest, low mountain, Luzon Island, endemic, commensal, Muridae

INTRODUCTION

Mount Makiling is one of the first protected areas established in the Philippines, recognized for its exceptional diversity of fauna and flora (Sajise et al. 1997). One of its unique features is the occurrence of mossy forests at its comparatively low peak of 1100 masl, thus forming different forest types along altitudinal gradients. It serves as a model study area for ecological research on lowland and montane forest plants and animals. Lowland evergreen forests have multi-strata structures, while montane and mossy forests comprise a single stratum. Despite numerous studies (Taylor 1922; Custodio 1986; Mendoza 1985; Miranda 1987; Ingle 1992; Dans et al. 1995; Gonzalez and Dans 1994 & 1997; Alcala et al. 1997; Sedlock 2001, 2002; Gonzalez et al.

2004) done on terrestrial vertebrates of Mount Makiling for more than a century, a comprehensive and comparative study of its montane and lowland fauna was not completed. Limitations of methodology, time, budget and expertise left gaps amongst various field researches. Status and records of rare and poorly known small mammals such as rodents and shrews on Mount Makiling particularly endemic forest rats: *Abditomys latidens* Sanborn, *Phloeomys cumingi* Waterhouse and *Chrotomys mindorensis* Kellogg needs to be determined. Conditions for loss of rare forest endemic understorey birds such as: *Ceyx melanurus* Kaup and *Centropus unirufus* Cabanis and Hein, and the persistence of other species such as: *Cyornis herioti* Rand and Rabor and *Zoothera cinerea* Bourns and Worcester requires evaluation.

Little is still known about the small mammal fauna and diversity of under-storey forest birds on Mount Makiling. The complexities of their distributional limits and specialization to various elevational forest types are not fully understood (Gonzalez and Dans 1997; Gonzalez 2006). The forest floor and undergrowth are easily affected by forest degradation due to the opening of canopy cover and consequent change in temperature and humidity from exposure. Small mammals and under-storey birds are specialized to the lower forest strata, and both serve as important bio-indicators of forest health and extent of fragmentation. A more practical survey of small mammals and

under-storey forest birds inhabiting the lower forest strata on Mount Makiling at different elevations is necessary to cite the invaluable implications of avian and mammal diversity to the conservation of remaining old growth forests on the mountain - a globally important conservation area (IBA) and national protected area (Mallari et al. 2001; DENR 1993; Fernando et al. 2004).

METHODS

Survey for small mammals and under-storey birds was conducted from 11-20 May 2009 covering the mossy forest (900 – 1100 masl) (Figure 1) and mid-montane (700 – 899 masl) (Figure 2). The secondary lowland forest (500-700 masl) (Figure 3) was covered from 21-24 January 2010. The mixed grassland and agroforest (261-442 masl) (Figure 4) was covered from 16-19 May 2010 while the secondary growth forest with built-up area (148 - 261masl) was covered from 25-28 May 2010.

General weather conditions during the sampling period in May 2009 was generally rainy due to La Niña while the January and May 2010 sampling periods were characteristically dry and warmer than normal due to the El Niño phenomenon.

Figure 1. Sampling site at the mossy forest

Figure 2. Sampling site at the mid-montane forest

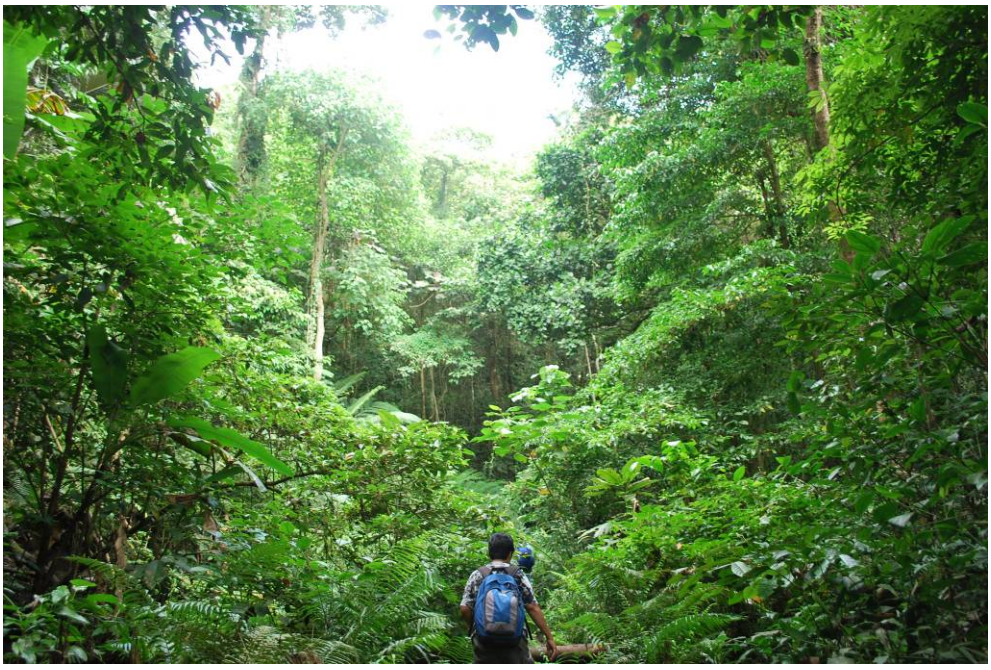

Figure 3. Sampling site at the secondary lowland evergreen forest

Figure 4. Sampling site at the mixed grassland and agro-forest area

A. Birds

1. Transect

Census was carried out by walking through established 2-km transect routes along each elevational gradient: 871-1094 masl (N 14° 08' 8.5" E 121° 11' 37" to N 14° 8' 15.9" 121° 11 50"), 760-870 masl (N 14° 8' 15.9" 121° 11 50" to N 14° 08' 13.5" E 121° 12' 21"), 500-700 masl (N 14° 08' 13.5" E 121° 12' 21" to N 14° 08' 44.3" E 121° 13' 49.2"), 261-442 masl (N 14° 08' 44.3" E 121° 13' 49.2" to N 14° 07' 50.9" E 121° 12' 59.6") and 148 - 261masl (N 14° 09' 32.7" E 121 14' 05.8" to N 14° 08' 44.3" E 121° 13' 49.2"). The observer walked along these routes at a pace of about 250-m/15 minutes thereby completing the whole stretch in at least 1 to 1.5 hours. More observation time which was about 5 to 10 minutes was given to mixed feeding flocks to ascertain identities of individuals. All individuals observed and/or heard were noted using the following information: species name and number of individuals. Each transect line was passed through twice (i.e. morning and afternoon), thereby gathering at least 16 observation hours at each elevational gradient.

Bird community diversity indices were calculated from a mathematical formula that takes into account both species richness and the relative abundance of each species in the community. Relative abundance refers to the number of individuals of a given species divided by the total number of all

species encountered. The community diversity was mathematically calculated using the Shannon-Weiner Index. The value of the Shannon-Weiner index (H') was calculated using the formula:

$H' = -\sum [ni/N \, l_n \, ni/N]$,

where: ni = number of individuals; N = total number of individuals

The following diversity indices (parameters) were also used to determine the degree of species diversity in the sampling site:

- Species Richness Index (*S*) – refers to the number of species for a given site
- Simpson's Dominance Index (D) was mathematically computed using the formula:

  $D = \sum(ni/N)^2$
- Shannon's Evenness Index (e) = H' / Hmax,

where: Hmax = ln (*S*)

2. Netting

Twelve-meter mist nets (standard length followed for this survey) were used to capture nocturnal and cryptic bird species. Nets were tended for 24 hours and checked for possible netted individuals every hour from 0530 to

2200 h. All captured individuals were identified based on Kennedy et al. (2000) and processed by taking standard biometric measurements: total length (TL), tail-vent length (TV), weight (WT), wing cord (WC), bill or culmen (B), gape (G), and tarsus (T). All birds captured were photographed and then released.

B. Small Non-volant Mammals

For small non-volant mammals (murid rodents and shrews), a combination of cage traps Victor snap traps and museum specials (snap traps for arboreal species) were used. There was a total of 3,631 trap nights for all sampling sites. Traps baited with roasted coconut meat coated with peanut butter and worms were positioned 5 to 10 meters apart along possible runways, near burrow entrances, under root tangles, on top of fallen logs, along tree branches, etc. Important information such as weight, sex, approximate age (adult, sub-adult or adult) and when applicable, reproductive condition, were noted. Standard biometric measurements such as total length (TL), tail-vent length (TV), ear length (E), and hindfoot length (HF) were taken for individuals caught. All caught individuals were collected and preserved in 70% ethanol. Tissue samples were collected for future DNA analysis.

RESULTS AND DISCUSSION

A total of 63 species of birds (Appendix A - Table 1) and seven species of small non-volant mammals (Appendix B - Table 2) were recorded for all sites.

Bird species were predominated by common (70%) but endemic (55%) species (see Figures 5 and 6). This total represents only 26% of the known 241 species (Gonzalez 1997) of birds found in Mt. Makiling. The variable weather conditions at the time of sampling, from a very wet summer (May 2009) to very dry and warm condition than normal (January and May 2010) may have affected transect and netting efforts. More species could have been recorded were if not for the La Niña and El Niño Phenomena occurring alternately during the sampling periods. There were five uncommon bird species (*Ducula poliocephala* Gray, *Cuculus fugax* Horsfield, *Cyornis herioti* Ramsay, *Batrachostomous septimus* Tweeddale and *Anthus gustavi* Swinhoe) and one threatened species recorded, the Ashy Ground Thrush (*Zoothera cinerea* Bourns and Worcester), listed as Vulnerable under the IUCN Red List of Threatened Species (Birdlife International, 2008). A total of 241 net days and net nights (Table 1) were recorded for all sampling sites with a variable netting success of 15.5%

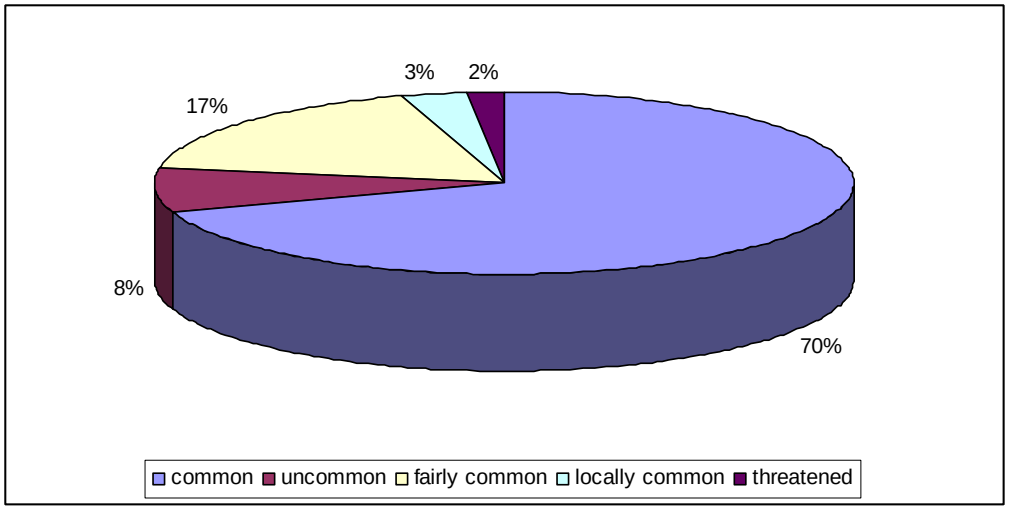

Figure 5. General population status of birds recorded at all sampling sites

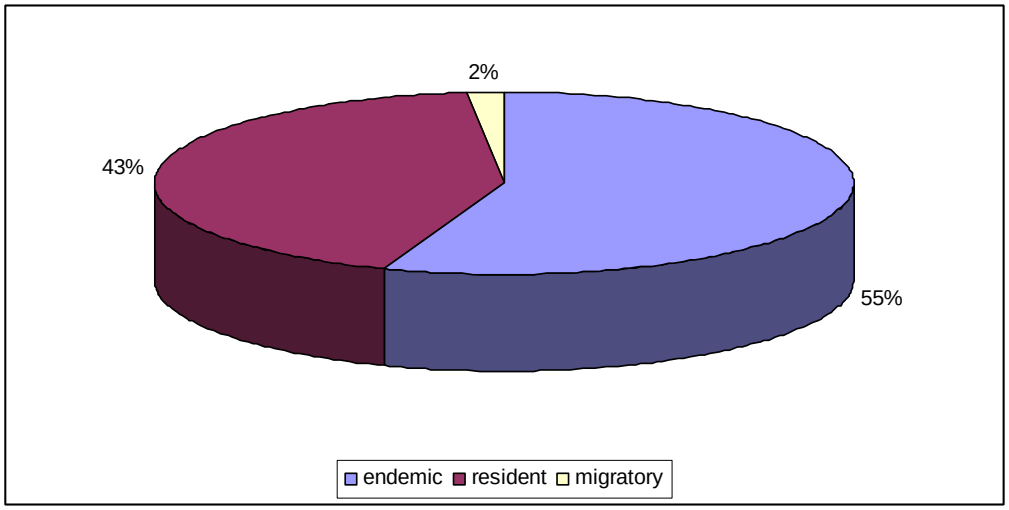

Figure 6. Distribution range of birds recorded at all sampling sites

Table 1. Summary of netting efforts and netting success for all sampling sites

Site	Elevational Range	Total # of nets set	Total # of individuals captured	Netting Success
1	900-1100	8	7	87.5%
2	760-899	170	75	44%
3	442-665	45	7	15.5%
4	261-441	18	10	55.5%
5	148-260	-	-	-
TOTAL		241	99	

(Lowland Forest) to 87.5% (Mossy Forest). This does not necessarily reflect abundance due to the variable number of nets set per site and varying temporal conditions during each sampling period.

Seven species of small non-volant mammals consisting of four endemic species and three introduced commensal species were recorded. Two of the endemic species are new records for Mt. Makiling with one possible new species (*Apomys sp.*). Commonly recorded in an elevation of up to ~200 masl are the common Philippine forest rat (*Rattus everetti* Gunther) and Luzon shrew (*Crocidura grayi* Dobson). One of the highlights of this study is the new record for Mt. Makiling of small Luzon forest mouse (*Apomys microdon* Hollister). Interestingly, this was recorded at lower elevations (from about 200 to 441 masl). A total of 3,631 trap nights (Table 2) was recorded for all sampling sites with a variable trapping success of 0.85% (mossy forest) to 2.48% (mixed grassland and agroforest).

Table 2. Summary of trapping efforts and trapping success

Site	Elevational Range	Total # of traps set	Total # of individuals captured	Trapping Success
1	900-1100	585	5	0.85%
2	760-899	1252	11	0.88%
3	442-665	494	7	1.42%
4	261-441	443	11	2.48%
5	148-260	857	9	1.05%
TOTAL		3,631	43	

A. Understorey birds

1. Mossy Forest (900-1100 masl)

A total of 15 bird species were recorded for this elevation. Distribution range of birds at this elevation was dominated (67%) by endemic species. The remaining birds recorded were non-endemic resident breeders (33%). Figure 7 shows the distribution range of birds recorded at this elevation. Majority of the birds recorded (87%) were common while the remaining were fairly common species. Figure 8 shows the population status of birds recorded at this elevation.

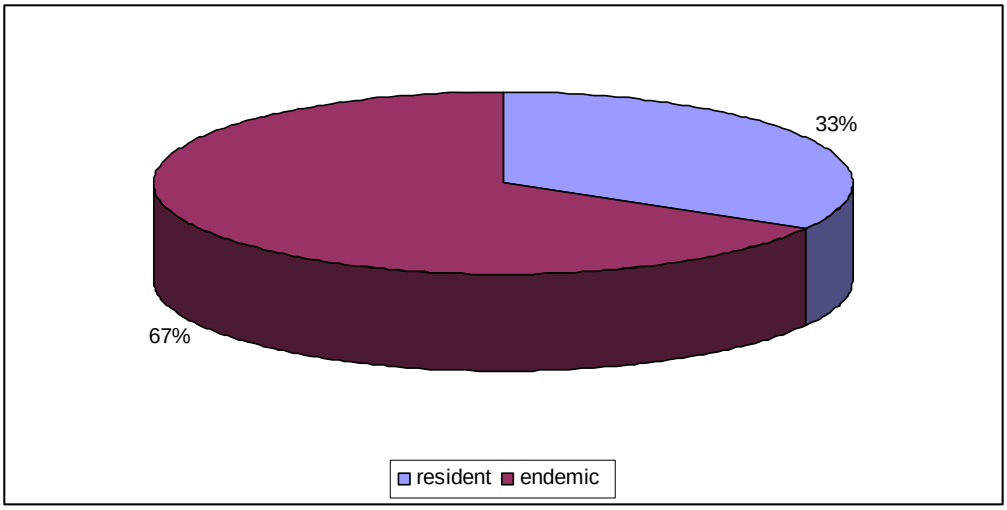

Figure 7. Distribution range of recorded bird species at the mossy forest

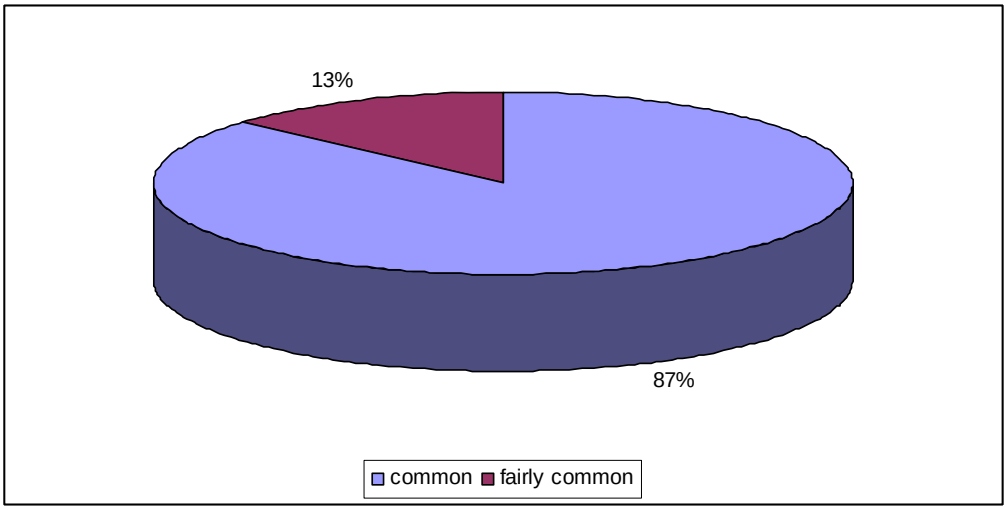

Figure 8. Population status of recorded bird species at the mossy forest

2. Mid-montane Forest (760-899 masl)

A total of 35 bird species were recorded at this elevation. In terms of distribution range, most species recorded (57%) were endemic species

while 40% were non-endemic resident breeders. One species recorded (3%), the Arctic warbler (*Phylloscopus borealis* Blasius) is a migrant species. This has been recorded from August 31 to May 22 in Luzon. Migratory birds come to the Philippines to escape the winter season in their country of origin (Kennedy et al. 2000). They usually arrive in October until March, although some species may overwinter. Figure 9 shows a chart representation of the range distribution of the recorded bird species at mid-montane forest. Overall population status at this elevation showed that majority (80%) are common, 11% are fairly common and there are three uncommon species (9%). Three uncommon species recorded were the Hodgson's hawk-cuckoo (*Cuculus fugax* Horsfield), the endemic blue-breasted flycatcher (*Cyornis herioti* Ramsay) and slaty-legged crake (*Rallina eurinozoides* Lafresnaye). Figure 10 shows the population status of birds recorded at mid-montane forest.

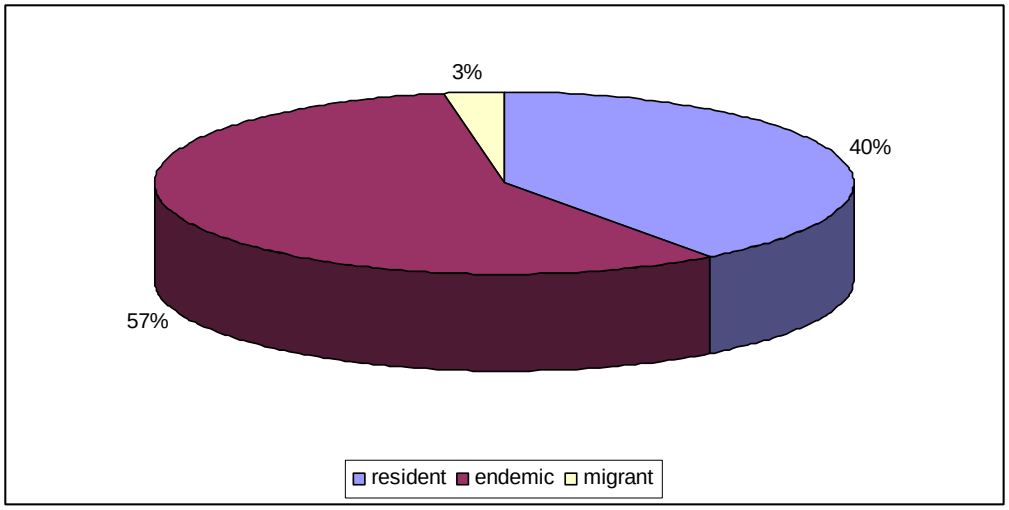

Figure 9. Distribution range of recorded bird species at the mid-montane forest

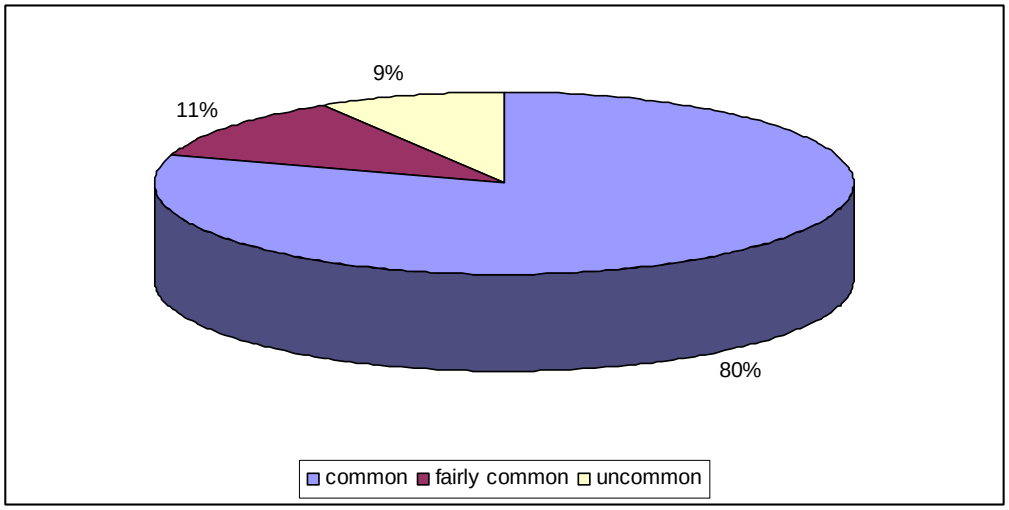

Figure 10. Population status of recorded bird species at the mid-montane forest

3. Secondary Lowland Evergreen Forest

A total of 36 bird species representing 19 families were recorded at this elevation. In terms of distribution range, most species recorded (69%) are endemic species while 31% are non-endemic resident breeders. No migratory species was recorded even when the sampling period covered the migratory season. Figure 11 shows a chart representation of the distribution status of the recorded bird species at the secondary growth forest. Overall population status at this elevation showed that majority (80%) are common, 17% are fairly common and one threatened species (3%). This uncommon species, *Zoothera cinerea* Bourns and Worcester is endemic to the Philippines and is listed as Vulnerable under the 2010 IUCN Red List of Threatened Species. It is generally considered uncommon and was found to be scarce in the Sierra Madre mountains during surveys in the early 1990s. It inhabits the floor, particularly open patches, of primary, selectively logged and secondary forests, mainly in the lowlands The continuing rapid reduction in the area of lowland forest throughout this species' range, coupled with more localised trapping pressure, is thought to be causing a rapid population decline. However, this species is known to be tolerant of secondary habitats, and may be more widespread than is currently thought. It is therefore listed as Vulnerable, pending better information on

population size and distribution. Figure 12 shows the population status of birds recorded.

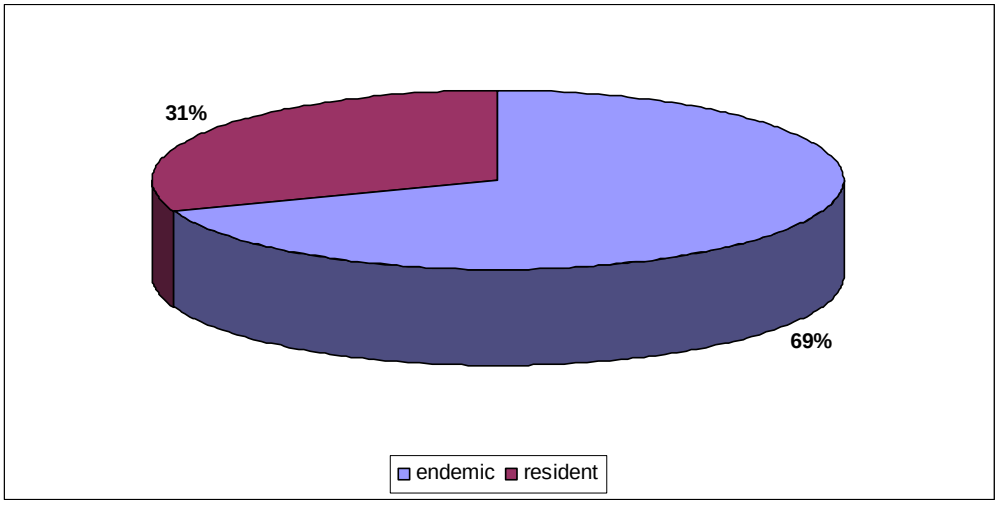

Figure 11. Distribution range of recorded bird species at the secondary lowland evergreen forest

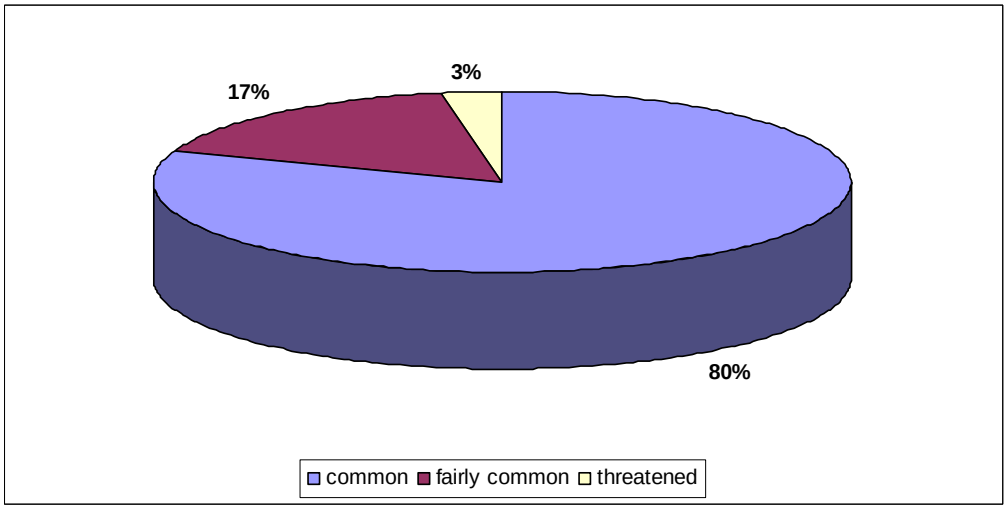

Figure 12. Population status of recorded bird species at the secondary lowland evergreen forest

4. Mixed grassland and agro-forest areas (261-442 masl)

A total of 40 bird species representing 27 families were recorded. In terms of distribution range, most species recorded (57%) were endemic species while 40% were non-endemic resident breeders and 3% were migratory species. One migratory species, Pechora pipit (*Anthus gustavi* Swinhoe) was recorded even when the sampling period was outside the migratory season. Figure 13 shows a chart representation of the distribution status of the recorded bird species. Overall population status at this elevation showed that majority (67%) was common species, 20% were fairly common, 10% were locally common and 3% were uncommon. Figure 14 shows the population status of birds recorded.

2. Secondary Growth with built-up areas (148 - 261masl)

A total of 37 bird species representing 24 families were recorded for the line transect method and mist netting at this elevation (Table 2). In terms of distribution range, most species recorded (51%) were endemic species and 49% were non-endemic resident breeders. Figure 15 shows a chart representation of the distribution status of the recorded bird species at this elevation. Overall population status at this elevation showed that majority (64%) of species recorded was common, 30% were fairly

common and 3% each of locally common and uncommon species. Figure 16 shows the population status of birds recorded.

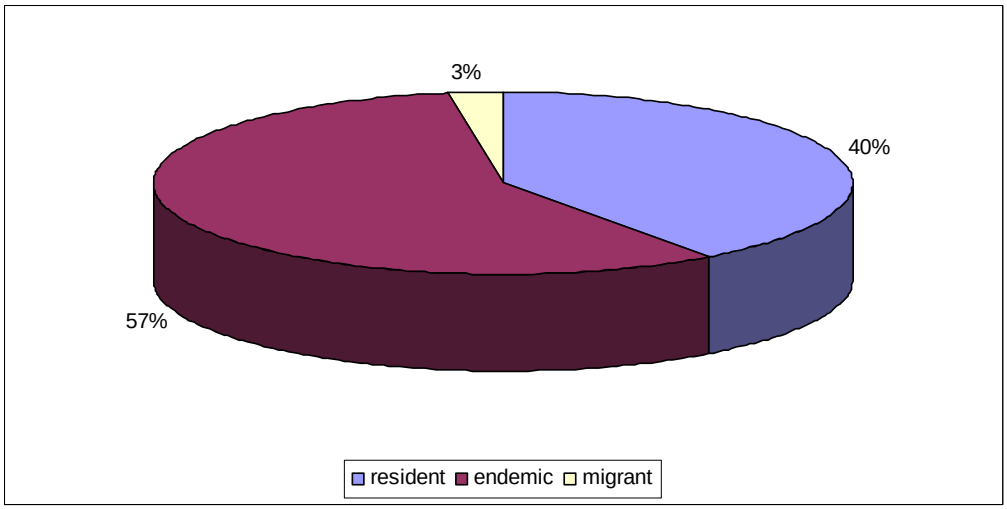

Figure 13. Distribution range of recorded bird species at the mixed grassland and agro-forest

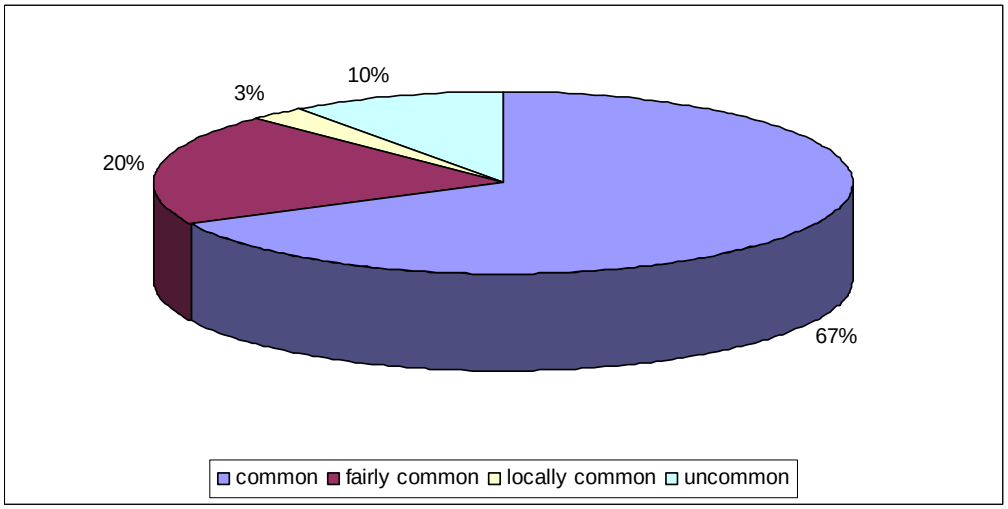

Figure 14. Population status of recorded bird species at the mixed grassland and agro-forest

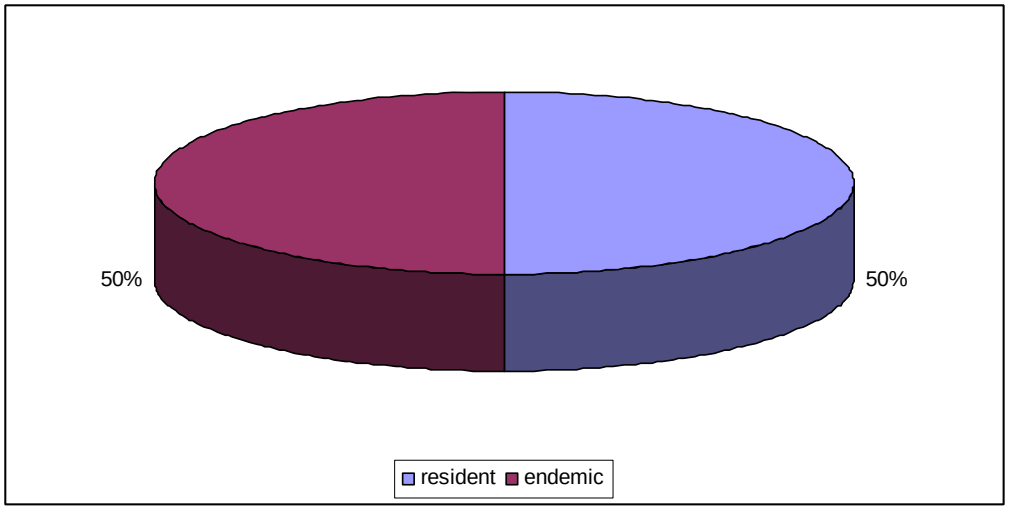

Figure 15. Distribution range of recorded bird species at the secondary growth forest with built-up area

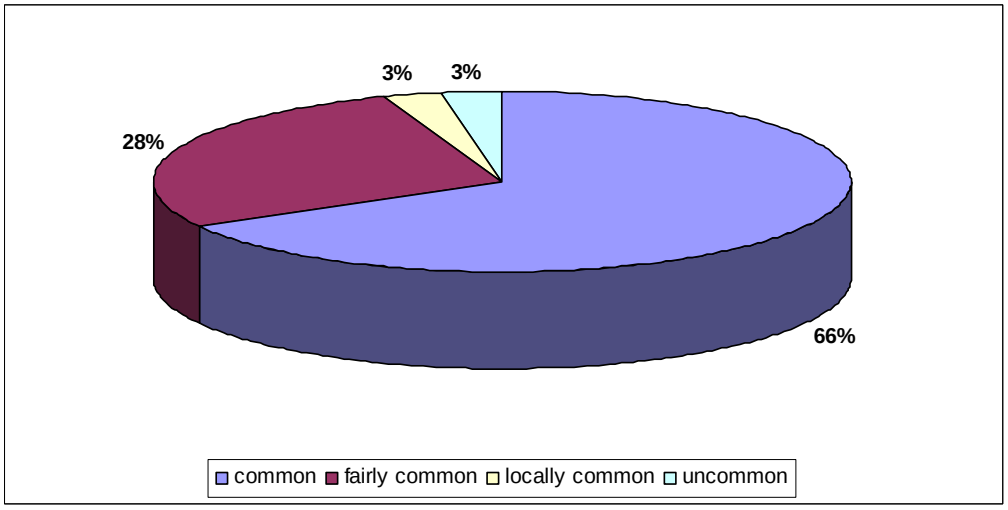

Figure 16. Population status of recorded bird species at the secondary growth forest with built-up area

Biodiversity Parameters: Species Richness, Diversity, Evenness and Dominance Indices

Species diversity indices (H') for the various elevational gradient ranged from low (2.41) in the Mossy Forest to high at the other lower elevations (Mid-montane, Secondary Lowland, Agro-forest and Semi-forest) where there were only slight variations in their respective values (Table 3). The same pattern was observed with the evenness (E) and dominance (D) indices among Sites 2-4 were values slightly varied. The high H' values for these sites are due to the relatively high evenness and low dominance. In these sites, not only are species richness relatively high but the number of individuals was also equally represented. In the mossy forest, a slight increase in the number of individuals easily affected the dominance, evenness and consequently H'.

Table 3. Summary of biodiversity parameters for all sampling sites

Site	Habitat Type	Elevational Range	(*S*)	(H')	(E)	(D)	Endemicity
1	Mossy Forest	900-1100	15	2.41	0.86	0.104	67%
2	Mid-montane Forest	760-899	35	3.29	0.89	0.042	57%
3	Secondary Lowland Forest	442-665	36	3.2	0.91	0.052	69%
4	Mixed Grassland and Agro-forest	261-442	40	3.17	0.88	0.054	57%
5	Secondary Growth Forest with Built-up Areas	141-261	36	3.2	0.89	0.048	50%

Among the 577 species of birds in the Philippines, 49% or 196 species are endemic to the Philippines (Catibog-Sinha and Heaney 2006), and mostly forest dwellers. Studies on patterns of bird species diversity along elevational gradients have documented a general pattern of inverse correlation between species richness and endemism (Mallari and Jensen 1993; Goodman et al. 1995). Species richness decreases with elevation but endemism increases at higher altitudes. However, recent studies have also shown that as lowlands are being degraded, this no longer holds true. Recent studies, for example in Mt. Kitanglad, Mindanao Island, showed that species richness was high in lowland and foothill forests (1100-1300) and middle elevations (1700-1800) but low at lowest and highest points (Townsend Peterson et al. 2008). The same pattern was observed in Mt. Banahaw de Tayabas, Luzon Island, where species diversity was highest at the mid-montane forest and low at lowest and highest elevations (Dans and Gonzalez 2010). Results do not show a straightforward pattern, but suggest that for understorey birds, mid-elevations show highest species richness in the mixed grassland and agro-forest (Figure 17) and highest species diversity index (H') at the mid-montane forest. Species endemism is also high (above 50%) at higher elevations (Table 3). Aside from elevation, habitat gradients also suggest that vegetation composition, degree of disturbance edge effect and niche availability are driving forces for species

diversity (Gonzalez 1993). Globally, bird display four distinct diversity patterns on mountains: decreasing diversity, low-elevation plateaus, low-elevation plateaus with mid-peaks, and unimodal mid-elevational peaks (McCain 2009). Based on these categories, understorey bird species diversity in Mt. Makiling best fit the low-elevational plateaus (Figure 18). Bird elevational diversity, generally, strongly supports current climate as the primary driver of diversity, particularly combined trends in temperature and water availability rather than the species–area and mid-domain effects (McCain 2009). Additionally, long-term studies can best establish species diversity patterns and changes thereof. Birds are highly mobile species and their movement and recruitment in an area are affected by changes in the temporal (time of the day, season of the year, El Niño Phenomenon) and spatial (availability of cover, degree of disturbance, perching areas, etc) characteristics of the environment. Figures 18-24 show some of the endemic birds recorded in Mt. Makiling.

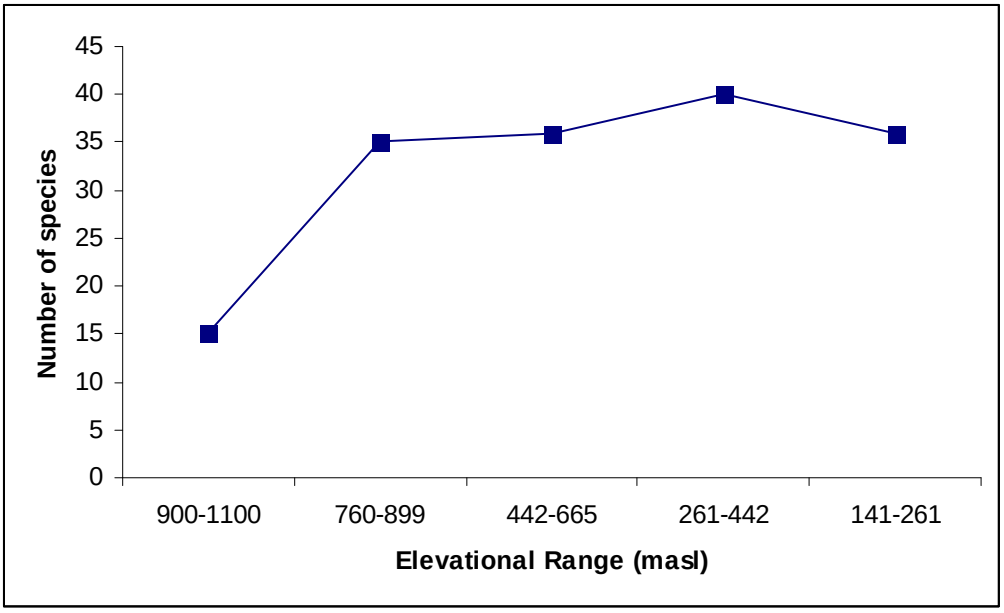

Figure 17. Bird species richness along the elevational gradients


Figure 18. White-browed Shama (*Copsychus luzoniensis* Kittlitz)

Figure 19. Blue-breasted Flycatcher (*Cyornis herioti* Ramsay)

Figure 20. Spotted Wood-kingfisher (*Actenoides lindsayi* Vigors)

Figure 21. Gray-backed Tailorbird (*Orthotomous derbianus* Moore)

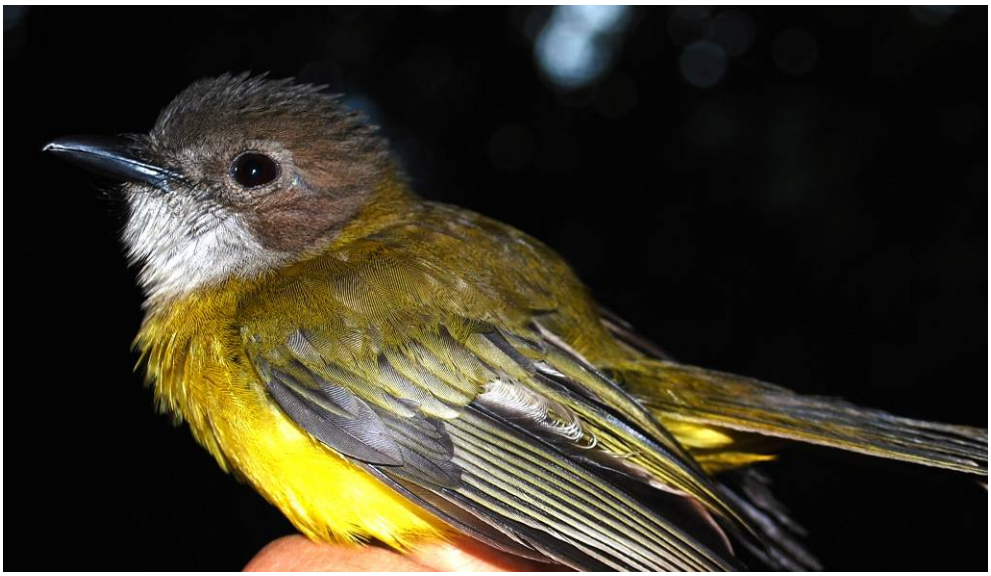

Figure 22. Yellow-bellied Whistler (*Pachycephala philippinensis* Walden)

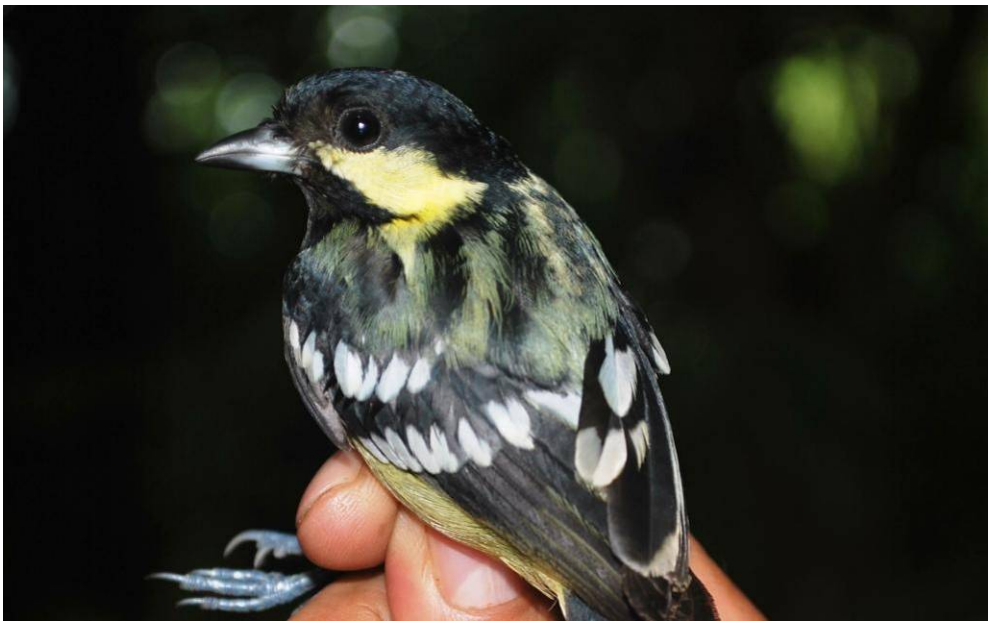

Figure 23. Elegant Tit (*Parus elegans* Lesson)

Figure 24. Amethyst Brown-dove (*Phapitreron amethystine* Bonaparte)

B. Small Mammals

1. Mossy forest and Mid-montane Forest

Two species were recorded at this elevation, the Philippine forest rat (*Rattus everettti* Gunther*;* Figure 25) which was recorded through trapping and the Luzon shrew (*Crocidura grayi* Dobson) which was sighted. Both are endemic to the Philippines. The Philippine forest rat is an endemic species found throughout the Philippines except the Palawan and Sulu faunal regions and the Batanes/Babuyan group of islands. It is found in primary and disturbed lowland, montane and mossy forest, a characteristic of the study sites, from sea level to 2200 meters above sea level (Heaney et al. 2010). The Luzon shrew occurs in lowland, montane, and mossy forest from near sea level to 2800 m. It is common in primary and secondary forest and beside trails cleared through forest, occasionally in shrubby grassland; most abundant in montane and mossy forest. Five individuals were caught for a trapping success in the mossy forest of 0.85%. In the mid-montane forest, 11 individuals were caught for a trapping success of 0.88%.

2. Secondary Lowland Evergreen Forest

Three species of small non-volant mammals were recorded, four (4) Philippine forest rat (*Rattus everetti* Gunther), one (1) Luzon shrew (*Crocidura grayi*) and two (2) individuals of forest mouse assigned as *Apomys sp.* (Figure

26). This is a new record for *Apomys* in Mt. Makiling, which is probably a new species or form due to its larger size that does not correspond with *A. microdon*. All three species are endemic to the Philippines.

Figure 25. Philippine Forest Rat (*Rattus everetti* Gunther)

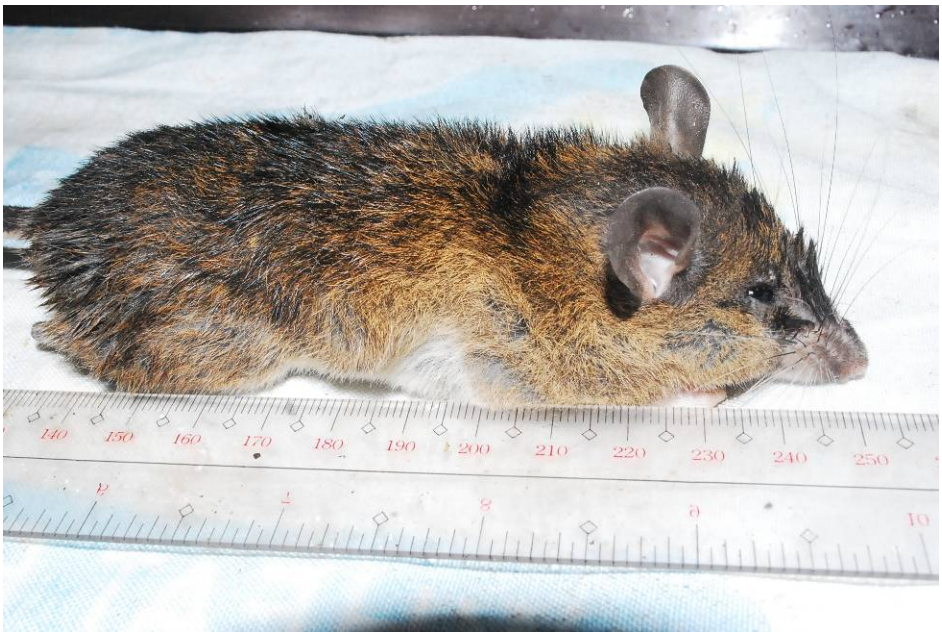

Figure 26. Probable new form or species (*Apomys sp*.)

3. Mixed Grassland and Agro-forest

This elevation had the highest number of species recorded. Five recorded species consist of three endemic species, *R. everetti*, *C. grayi and* a new record for Mt. Makiling of the small Luzon forest mouse *Apomys microdon* Hollister (Figure 27). *A. microdon* is a small mouse with large eyes and ears, soft fur, and tail longer than the length of its head and body. The pelage is brown with a slight orange tint dorsally, and bright orange-brown ventrally with some areas of white hair. This species has been documented from sea level to 2025 m occuring in secondary and primary lowland montane forest, and occasionally in mossy forest (Heaney et al. 2010). Thus, it is

worthwhile to further investigate why this species was recorded at lower elevations. It is also at this elevation that two commensal species, the Polynesian rat (*Rattus exulans* Peale) and the Oriental rat (*Rattus tanezumi* Temminck) were recorded.

Figure 27. Small Luzon Forest Mouse (*Apomys microdon* Hollister)

4. Secondary Growth Forest with Built-up Areas

Two species of small non-volant mammals were recorded near the flat rocks area. We again recorded here *A. microdon* and another commmensal species, the common house mouse, *Mus musculus* Linnaeus.

Species richness of small non-volant mammals

Elevation may be one of the major generators of species diversity in the Philippines (Catibogh-Sinha and Heaney 2006). Patterns of species richness for small non-volant mammals is generally low at low elevations and increases to about the area of montane to mossy forest and then decreases (Heaney and Rickart 1990; Heaney 2001; Catibog-Sinha and Heaney 2006; Heaney 2006, Balete et al. 2009, Rickart et al. 2010). On the other hand, diversity is also correlated with annual rainfall, total abundance of individuals in the community, food resource diversity and reduced competition (Heaney 2010). Alien small mammals are also generally restricted to highly disturbed areas although not necessarily at low elevations only. Moreover, a diverse community of native Philippine small mammals in either old-growth or disturbed forest habitats prevent invasive alien species to penetrate and maintain significant populations in forests (Balete et al. 2009).

The results of this study do not conform to the general pattern of species richness observed elsewhere in Philippine mountain ecosystems. From secondary lowland forest and higher, only endemic species were recorded while commensal species were recorded from Agro-forest to lower elevations. However, the mixed grassland and Agro-forest areas seem to be the lower limit

for most endemic species since only *Apomys microdon* Hollister was recorded at lower elevations. The presence of both endemic and commensal species at this elevation resulted to the highest species richness among all sampling sites. It is worthwhile to investigate why *A. microdon* was recorded at lower elevations rather than at the higher ones. The presence of a probable new form or species of *Apomys* could be further investigated by doing additional sampling in that elevation and examination of the collected specimens. The Lowland striped shrew rat (*Chrotomys mindorensis*) was not recorded although there was a reported sighting at the UPLB Forestry Housing area and an alleged capture in 2009 of two individuals at the International Rice Research Institute research fields (Singleton, pers comm.).

SUMMARY AND CONCLUSION

Species richness for both understorey birds and small non-volant mammals peaks at the mixed grassland and agro-forest areas (261-441 masl) for the five elevational gradients of Mt. Makiling. The area is possibly the lower limit for most endemic birds and mammals tolerant to disturbed habitats. This is also where resident birds and commensal mammals mix with the endemics. However, these findings need further evaluation for the small non-volant mammals. There have been indications of other endemic species found at lower elevational ranges and could be more tolerant to disturbances than expected.

The area supports a variety of birds and is habitat to endemic and threatened bird species. New records for *Apomys microdon* Hollister and a new form or possible new species of *Apomys* at the lower elevations are indications that some more previously unrecorded species may still be present in Mt. Makiling, especially in the less accessible portions of the mountain.

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Appendix – Table 1. General list of birds recorded at all sampling sites

No.	Species	Common name	Distribution status	Population status	Sites recorded (masl)				
					900-1100	760-899	442-665	261-441	148-260
	Family Falconidae								
1	*Microhierax erthrogenys*	Philippine Falconet	endemic	common					1
	Family Capitonidae								
2	*Megalaima haemacephala*	Coppersmith Barbet	resident	common		1	1	1	2
	Family Columbidae								
3	*Phapitreron leucotis*	White-eared Brown-dove	endemic	common	1	2	2	2	3
4	*Phapitreron amethystina*	Amethyst Brown-dove	endemic	locally common	2	3			
5	*Macropygia phasianella*	Reddish Cuckoo-dove	resident	common	3	4	3	3	4
6	*Chalcophaps indica*	Common Emerald-dove	resident	common			4	4	5
7	*Ducula poliocephala*	Pink-bellied Imperial-pigeon	endemic	uncommon				5	
8	*Ptilinopus occipitalis*	Yellow-breasted Fruit-dove	endemic	common		5			
	Family Alcedinidae								
9	*Halcyon smyrnensis*	White-throated Kingfisher	resident	fairly common					6
10	*Actenoides lindsayi*	Spotted Wood-kingfisher	endemic	fairly common	4	6	5	6	7
	Family Cuculidae								
11	*Centropus viridis*	Philippine Coucal	endemic	common	5	7	6	7	

Continuation…. Appendix – Table 1. General list of birds recorded at all sampling sites

12	*Phaenicophaeus cumingi*	Scale-feathered Malkoha	endemic	fairly common		8	7	8	8
13	*Phaenicophaeus superciliosus*	Red-crested Malkoha	endemic	fairly common			8	9	9
14	*Eudynamys scolopacea*	Common Koel	resident	locally common				10	10
15	*Cuculus fugax*	Hodgson's Hawk-cuckoo	resident	uncommon		9		11	11
16	*Cacomantis variolosus*	Brush cuckoo	resident	common	6	10	9		12
	Family Pycnonotidae								
17	*Hypsipetes philippinus*	Philippine Bulbul	endemic	common	7	11	10	12	13
18	*Pycnonotus urostictus*	Yellow-wattled Bulbul	endemic	fairly common	8	12	11	13	14
19	*Pycnonotus goiavier*	Yellow-vented Bulbul	resident	common	9	13	12		15
	Family Psittacidae								
20	*Loriculus philippensis*	Colasisi	endemic	common			13		
21	*Bolbopsittacus lunulatus*	Guaiabero	endemic	common			14	14	16
	Family Dicaeidae								
22	*Dicaeum pygmaeum*	Pygmy Flowerpecker	endemic	common		14	15	15	17
23	*Dicaeum australe*	Red-keeled Flowerpecker	endemic	common			16	16	18
24	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker	resident	common			17		
	Family Muscicapidae								
25	*Hypothymis azurea*	Black-naped Monarch	resident	common		15	18	17	19

Continuation… Appendix – Table 1. General list of birds recorded at all sampling sites

26	*Cyornis herioti*	Blue-breasted Flycatcher	endemic	uncommon		16			
27	*Rhipidura cyaniceps*	Blue-headed Fantail	endemic	common		17	19		
	Family Sylviidae								
28	*Orthotomous castaneiceps*	Philippine Tailorbird	endemic	common		18	20	18	20
29	*Orthotomus derbianus*	Grey-backed Tailorbird	endemic	common	10	19			
30	*Phylloscopus borealis*	Arctic Warbler	migrant	common		20			
31	*Phylloscopus cebuensis*	Lemon-throated Leaf-warbler	endemic	common		21	21		
	Family Dicruridae								
32	*Dicrurus balicassius*	Balicassiao	endemic	common		22	22	19	21
	Family Turdidae								
33	*Copsychus luzoniensis*	White-browed Shama	endemic	common		23	23	20	22
34	*Brachypteryx montana*	White-browed Shortwing	resident	common	11	24	24		
35	*Zoothera cinerea*	Ashy Ground-thrush	endemic	uncommon			25		
	Family Pachycephalidae								
36	*Pachycephala philippinensis*	Yellow-bellied Whistler	endemic	common	12	25	26	21	23
	Family Picidae								
37	*Dendrocopos maculatus*	Philippine pygmy Woodpecker	endemic	common			27	22	24
38	*Chrysocolaptes lucidus*	Greater Flameback	resident	fairly common		26	28	23	25
	Family Paridae								

Continuation… Appendix – Table 1. General list of birds recorded at all sampling sites

39	*Parus elegans*	Elegant Tit	endemic	common	13	27	29	24	
	Family Nectariniidae								
40	*Aethopyga pulcherrima*	Metallic-winged Sunbird	endemic	common			30		
41	*Nectarinia sperata*	Purple-throated Sunbird	resident	common				25	
42	*Nectarinia jugularis*	Olive-backed Sunbird	resident	common			31	26	26
	Family Strigidae								
43	*Otus megalotis*	Philippine Scops-Owl	endemic	common		28	32	27	
44	*Ninox philippensis*	Philippine Hawk-Owl	endemic	common			33	28	
	Family Bucerotidae								
45	*Penelopides manillae*	Luzon Tarictic Hornbill	endemic	fairly common			34	29	27
	Family Zosteropidae								
46	*Zosterops nigrorum*	Yellowish White-eye	endemic	common	14	29		30	
	Family Phasianidae								
47	*Gallus gallus*	Red Junglefowl	resident	common		30		31	28
	Family Meropidae								
48	*Merops viridis*	Blue-throated Bee-eater	resident	fairly common				32	
49	*Merops philippinus*	Blue-tailed bee-eater	resident	fairly common					29
	Family Trogonidae								
50	*Harpactes ardens*	Philippine Trogon	endemic	common				33	30
	Family Motacillidae								
51	*Anthus gustavi*	Pechora Pipit	migrant	uncommon				34	
	Family Pittidae								

Continuation… Appendix – Table 1. General list of birds recorded at all sampling sites

52	*Pitta erythrogaster*	Red-bellied Pitta	resident	fairly common				35	31
53	*Pitta sordida*	Hooded Pitta	resident	common		31		36	
	Family Oriolidae								
54	*Irena cyanogaster*	Philippine Fairy-bluebird	endemic	common				37	
55	*Irena puella*	Asian Fairy-bluebird	resident	common		32			
	Family Campephagidae								
56	*Coracina striata*	Bar-bellied Cuckoo-shrike	resident	common		33		38	32
57	*Lalage melanoleuca*	Black-and-white triller	endemic	fairly common					33
	Family Rallidae								
58	*Rallina eurizonoides*	Slaty-legged Crake	resident	common		34		39	
	Family Podargidae								
59	*Batrachostomus septimus*	Javan Frogmouth	resident	uncommon				40	
	Family Sittidae								
60	*Sitta frontalis*	Velvet-fronted Nuthatch	resident	common	15	35	35		
	Family Rhabdornithidae								
61	*Rhabdornis mystacalis*	Stripe-headed Rhabdornis	endemic	common			36		34
	Family Artamidae								
62	*Artamus leucorynchus*	White-breasted wood-swallow	resident	common					35
	Family Corvidae								
63	*Corvus macrorhynchos*	Large-billed Crow	resident	common					36
				TOTAL	**15**	**35**	**36**	**40**	**36**

Appendix – Table 2. General list of small mammals recorded at all sampling sites

No.	Species	Common name	Distribution status	Population status	Sites recorded (masl)				
					900-1100	760-899	442-665	261-441	148-260
Order Rodentia									
	Family Muridae								
1	*Apomys microdon*	small Luzon forest mouse	Luzon endemic	widespread and stable				X	X
2	*Apomys sp.*	forest mouse	TBD	TBD			X		
3	*Rattus everetti*	common Philippine forest rat	Philippine endemic	abundant and widespread	X	X	X	X	
4	*Rattus tanezumi*	Oriental house rat	Throughout the Philippines	non-native and abundant				X	
5	*Rattus exulans*	Polynesian rat	Throughout the Philippines	non-native and abundant				X	
6	*Mus musculus*	house mouse	Throughout the Philippines	non-native and abundant					X
Order Soricomorpha									
	Family Soricidae								
7	*Crocidura grayi*	Luzon shrew	Luzon, Mindoro, Babuyan islands	widespread and stable	X	X	X	X	
				TOTAL	2	2	3	5	2

*TBD – To be determined, possible new species

X – indicates presence