Univerzita Karlova v Praze
Přírodovědecká fakulta

Studijní program: Biologie
Studijní obor: Ekologie

Bc. Miroslav Petruf

Bird Communities Along the Altitudinal Gradient on Mt. Cameroon: Perspectives from Mist Nets

Vtáčie spoločenstvá pozdĺž výškového gradientu
na Kamerunskej hore z pohľadu odchytových dát

DIPLOMOVÁ PRÁCE

Školitel: RNDr. Ondřej Sedláček, Ph.D.

Praha 2019

Acknowledgment

I am thankful to my supervisor, RNDr. Ondřej Sedláček, PhD., for his time, support and valuable advices that helped me shape this work in every aspect. I would further like to thank Tomáš Albrecht, Oldřich Tomášek, Michal Ferenc, David Hořák, Pavel Munclinger, Jiří Mlíkovský, Tereza Králová, Jana Vokurková, Eric Djomo Nana, David Storch, Jaroslav Cepák, Štěpán Janeček and Ondřej Kauzál. I would not have been able to create this work without their precise data collection on Mt. Cameroon. Last but not least, I would like to thank my family for their endless support throughout my studies.

Čestné prehlásenie

Čestne prehlasujem, že som túto prácu vypracoval samostatne a všetky informačné zdroje a literatúru som riadne uviedol. Taktiež prehlasujem, že som túto diplomovú prácu, ani žiadnu jej časť, nepredložil na získanie iného alebo rovnakého akademického titulu.

V Prahe, 9. augusta 2019 Podpis

Abstract in English

Mt. Cameroon is a hotspot of diversity and endemism in Africa. Recent research of avian bird communities along the elevational gradient on Mt. Cameroon based on point counts has shown low-elevation plateau of species richness. At the same time, range-restricted montane populations of birds on Mt. Cameroon are unusually abundant if compared to lowland species. I analysed data on community composition, species richness and abundance of birds using an alternative quantitative method - 200 m of understory mist nets erected for three consecutive days across seven elevational plots along the forested gradient of the Mt. Cameroon. First, I looked at the technical limits of this method and confirmed the general opinion that they are better at detecting small birds below 33 g, and that they mostly detected fewer individuals after the first day and always detected fewer new species after the first day of mist-netting. Mist nets detected high proportions of ground-feeding and understory birds and low proportions of birds foraging in higher strata in the lowland forest, which has a scarce understory and a dense canopy. Mist nets recorded similar proportions of birds foraging in all forest strata in the vastly open mid-elevation forest, which has a dense herbaceous understory. They detected higher proportions of canopy-foragers in the montane forest, which has a dense understory and an open canopy. Second, I looked at the efficiency of mist-netting in detecting elevational patterns in the ecology of birds on Mt. Cameroon. Mist nets recorded higher species abundances in the montane forest, and very low abundances or a complete lack of understory and ground-feeding foragers at the foothill of the mountain. Mist-netting data also revealed that the species richness along the elevational gradient follows a hump-shaped pattern with a mid-elevational peak. Finally, I compared data that were collected by mist nets and point counts and found that point counts are better than mist nets at assessing species richness and abundance, especially in the lowland forest where mist-nets missed a great part of the community. The two methods were equally good at detecting some ecological patterns: mist nets and point counts recorded similar patterns of species turnover along the forested gradient as well as a similar increase of individuals per species with growing elevation. The two methods also uncovered similar elevational patterns of community composition in terms of the birds' feeding guilds. Mist-netting recorded 9 species that were completely missed by point counts. I confirm that the efficiency of both methods is habitat-dependent, and that they should be used simultaneously for the sake of reaching the most accurate results possible, as each method is a valuable complement to the other.

Keywords: tropical Africa; rainforest; bird community; elevation; mist-nets; point counts; seasonality; methods

Abstrakt v slovenčine

Kamerunská hora je centrom diverzity a endemizmu v Afrike. Nedávny výskum vtáčích spoločenstiev založený na bodových meraniach na tejto hore zistil, že druhová bohatosť je podobne vysoká pozdĺž celého nížinného gradientu, a že vysokohorské populácie vtákov sú na rozdiel od nížinných populácií veľmi početné. Zanalyzoval som dáta o zložení vtáčích spoločenstiev, ich druhovej bohatosti a ich početnosti, namerané alternatívnou kvantitatívnou metódou – dvesto metrov dlhými sieťami postavenými v podraste lesa po dobu troch dní v siedmych nadmorských výškach pozdĺž južného svahu Kamerunskej hory. Najprv som sa zameral na technické limity tejto metódy a potvrdil som všeobecne prijaté domnienky, že siete efektívne zachytávajú malé vtáky s hmotnosťou pod 33 g, a že počet jedincov po prvom dni väčšinou klesne, pričom počet novo zaznamenaných druhov klesne vždy. V nížinnom pralese s husto zarastenými, vysokými korunami stromov a riedkym podrastom zachytili siete najmä vtáky aktívne zháňajúce potravu na zemi a v podraste. V oblasti na hranici nížinného a vysokohorského pralesa, ktorá je charakteristická rozľahlými otvorenými plochami a hustým podrastom, sa do sietí chytali podobné proporcie vtákov zo všetkých lesných poschodí, a vo vysokohorskom pralese s relatívne riedkymi korunami stromov a hustým podrastom sa chytali najmä druhy zháňajúce potravu v korunách stromov a v podraste. Ďalej som sa venoval trendom v zložení vtáčieho spoločenstva, jeho druhovej bohatosti a početnosti pozdĺž výškového gradientu Kamerunskej hory, ktoré siete odhalili. Siete zaznamenali vysoké abundancie vysokohorských populácií a naopak veľmi nízke abundancie či úplnú neprítomnosť vtákov zháňajúcich potravu na zemi či v podraste v sekundárnom lese na predhorí Kamerunskej hory. Podľa sieťových dát rastie druhová bohatosť vtákov pozdĺž výškového gradientu až po stredné nadmorské výšky a potom zas klesá až po hranicu lesa. Na záver som porovnával dáta zo sieťových odchytov a bodových meraní, ktoré sa zbierali v rovnakom termíne v danej nadmorskej výške. Zistil som, že bodové merania sú vhodnejšie na meranie druhovej bohatosti a početností, najmä v nížine, kde siete nezaznamenali veľkú časť spoločenstva. Obe metódy však odhalili podobné ekologické javy: namerali podobný rozsah druhového obratu pozdĺž výškového gradientu, ako aj podobný nárast v počte jedincov na druh s rastúcou nadmorskou výškou a podobné zmeny v zložení vtáčích spoločenstiev pozdĺž výškového gradientu z pohľadu ich potravných guild. Siete odhalili deväť druhov, ktoré bodové meranie nezaznamenalo. Potvrdzujem, že efektívnosť oboch metód závisí na type prostredia a podporujem ich simultánne využívanie pre dosiahnutie čo najpresnejších výsledkov.

Kľúčové slová: tropická Afrika; dažďový prales; vtáčie spoločenstvá; výškové gradienty; sieťové odchyty; bodové merania; sezonalita; metódy

Table of Contents

1 Introduction

1.1 The Altitudinal Gradient of Diversity

The tropics hold the greatest part of the world's diversity (Klopfer & MacArthur 1960, Willig *et al.* 2003), and the factors that influence diversity are both extrinsic – such as temperature, rainfall or productivity (Hawkins *et al.* 2003) – and intrinsic, driven by biotic interactions and evolutionary processes (Mittelbach *et al.* 2007). It is, however, challenging to explain what the underlying factors are, and the complexity of tropical environments perplexes ecologists to this day.

Just as the world's species richness declines with growing latitude, it is widely accepted that it declines with growing altitude as well (Rahbek 1997). Mirroring the latitudinal decline, the altitudinal decline of species richness has generally been described to occur monotonically, and unsurprisingly so, as physiological stress is expected to grow with declining temperatures and soil moisture at higher elevations, resulting in low productivity, which curtails the carrying capacity of the environment (MacArthur 1972, Terborgh 1977, Stevens 1992). The ubiquity of such monotonic decline has since been challenged (e.g. Rahbek 1995, 2005, McCain 2005, 2007, 2009A), as the distribution of species richness along elevational gradients on tropical mountains has been found to be rather complex, following a number of possible patterns:

1. a continuous decrease of richness with growing elevation;
2. high richness across a range of lowland elevations followed by a monotonic decrease at higher elevations;
3. a similar low-elevational high-species-richness plateau pattern but with a mid-elevational peak, or a unimodal pattern with a continuous increase in diversity toward the mid-elevation followed by a monotonic decrease (McCain 2009A).

Tropical mountains are hotspots of diversity (Lomolino 2001) and birds have been the focus group of countless studies aiming to describe patterns in their distributions along tropical elevational gradients and pinpoint the drivers that shape that distribution (McArthur 1972, Terborgh & Weske 1975, Terborgh 1977, Rahbek 1995, Robinson & Terborgh 1995, Blake & Loiselle 2001, McCain 2009A, Hořák *et al.* 2019).

Several environmental factors have been outlined that could shape species distribution along gradients. Temperature variables, for instance, may be its key drivers (Root 1988, Reif *et al.* 2006, Zuckerberg *et al.* 2011, Halbritter *et al.* 2013). Daniel Janzen (1967) observed that temperature variation at single sites along elevational belts on tropical mountains is minute compared to temperate mountains. Therefore, tropical species would evolve narrower tolerances for variances in temperature and weaker acclimation capacities than temperate species, who are more likely to experience substantial changes in temperatures across their range throughout the year (Janzen 1967). This led Janzen (1967) to hypothesise, that species living on tropical mountains should have narrower elevational range sizes, because temperature along the gradient is not uniform, whereas elevational belts in the tropics have stable temperature throughout the year. On the other hand, temperature fluctuates at higher elevations in the tropics as well (Adams *et al.* 1920), thus tropical montane species should have a broader tolerance, and, as a consequence, a larger range (Stevens 1992). That is Rapoport's elevational rule (Stevens 1992), which describes a positive relationship of species range sizes with increasing altitude. Neither of these hypotheses was thoroughly tested before becoming widely accepted (McCain 2009B, McCain & Knight 2013), but recent global analyses have challenged both assumptions: ranges of tropical birds are not necessarily narrower than the ranges of those birds that inhabit similar elevations on temperate mountains (McCain 2009B) and montane birds in the tropics do not necessarily inhabit wider ranges than their lowland counterparts (McCain & Knight 2013).

Further factors influencing the shape of such altitudinal patterns may include evolutionary history (Kozak & Wiens 2010), space (Ferenc *et al.* 2016; see below), habitat structure (Hořák *et al.* 2019; see below) or forest age (Santamaría-Rivero *et al.* 2016) and many biotic processes (McCain 2009A).

Another generally accepted trend in ecology has been found to be violated in avian assembles of tropical montane forests: the positive inter-specific relationship between range sizes and abundance (Fjeldså 1999, Ryan *et al.* 1999, Sekercioğlu & Riley 2005, Reif *et al.* 2006, Hořák *et al*. 2010, Fjeldså *et al.* 2010, 2012, Djomo Nana *et al.* 2014, Ferenc *et al.* 2016). The positive abundance-range size relationship is pervasive in the temperate zone (Brown 1984, Gaston *et al*. 2000, Blackburn & Gaston 2006), and it may be shaped by resource use and availability (Brown 1984), by the species' vital rates (Holt *et al.* 1997) or by their dispersal (Brown *et al.* 1996). On the contrary, the negative abundance-range size relationship has been proposed to be shaped by three factors which may act synergistically on tropical mountains:

1. Density compensation facilitated by a competitive release due to a decrease in species richness at higher altitudes (MacArthur 1972). As species richness declines at higher elevation, the free ecological space may be filled by more individuals of montane populations.
2. A long-term eco climatic stability enabling narrow ecological specialization which mediates high local abundances (Reif *et al.* 2006, Fjeldså *et al.* 2012). This hypothesis assumes that montane species are more specialized than their lowland congeners.
3. The presence of an extinction filter that targets unabundant species selects for a high abundance of species with locally and geographically small ranges (Williams *et al.* 2009), since such species with low population densities are more likely to go extinct (Schaffer 1981, Ferenc *et al.* 2016).

The majority of studies that aim to disentangle the processes that drive the diversity and abundance of birds along altitudinal gradients on tropical mountains have been conducted in South America, which is not surprising considering that the neotropical avifauna is the world's richest (Latta *et al.* 2011). There is, on the other hand, a great gap in knowledge about these processes taking place in the similarly diverse Afromontane avifaunal assemblages (but see e.g. Ryan *et al.* 1999, Sekercioğlu & Riley 2005). Understanding the underlining mechanisms that drive macroecological processes on a global scale, in order to get closer to a unifying theory of biodiversity, requires thorough surveying across a range of various environments.

A series of recent studies about the above-mentioned patterns in avian species richness and abundance have been conducted in the forests Cameroon mountains (Reif *et al.* 2006, Ferenc *et al.* 2016, Hořák *et al.* 2019). Reif *et al.* (2006) recorded an unusually high abundance of montane species in Bamenda Highlands, a part of Cameroon mountains, whereas Ferenc *et al.* (2016) studied avian communities along the elevational gradient of the entire primary forest on the southern slope of Mt. Cameroon and found a negative (albeit non-significant) abundance-range size relationship along the entire surveyed gradient. Furthermore, Hořák *et al.* (2019) explored the relationship between vegetation and avian species richness along the elevational gradient of the primary forest on Mt. Cameroon. They found that species richness peaked below the mid-elevation and decreased thereafter (Hořák *et al.* (2019). All these studies used one surveying method, point counts (Bibby *et al.* 2000).

1.2 Methods of Bird Assessment: Point Counts and Mist Nets

The point-counting method (Bibbi *et al.* 2000) is currently the most common bird-surveying method and is suggested for surveys in areas with dense vegetation and high species richness (Martin *et al.* 2017). During point counts, ornithologists follow a transect of points, where they document the heard and observed birds within a fixed distance radius (see Materials and methods for details). Point counts are generally considered the best method do assess bird species richness, abundance and population trends (Gram & Faaborg 1997, Whitman *et al.* 1997, Blake & Loiselle 2000, 2001, Wang & Finch 2002, Derlindati & Caziani 2005). As all surveying methods, the point counting method has its disadvantages. Perhaps its most pronounced drawback is its absolute reliance upon the observer's (i.e. ornithologist's) skill and upon the detectability of the assessed birds. Unskilled ornithologists may miss a lot of species which are unknown to them or misidentify them. The ability to detect species may vary substantially between observers (Rappole *et al.* 1998, Nichols *et al.* 2000). Sedentary, quiet or otherwise secretive birds are often missed by point counts. New acoustic sampling methods are under development (Sedláček *et al.* 2015).

A method that has been suggested as a vital complement to point counts is the mist-netting method (Terborgh *et al.* 1990, Ralph & Dunn 2004). The combination of both methods is believed to provide the best results during bird community assessment (Whitman *et al.* 1997, Blake & Loiselle 2001). Mist-netting avoids observer bias (Wang & Finch 2002) and is more efficient at detecting secretive species than point counts (Wallace *et al.* 1996, Gram & Faaborg 1997, Rappole *et al.* 1998, Blake & Loiselle 2001, Wang & Finch 2002), especially in areas with dense understory (Martin *et al.* 2017). In species-poor areas, mist-netting has even been dubbed equally good in estimating species abundances as point counts (Wang & Finch 2002, Estades *et al.* 2006). But Mt. Cameroon is not species-poor, and interpreting relative abundances from mist-netting data is affected by a number of factors (MacArthur and MacArthur 1974), leading some authors to believe that this method is unfit for studying relative abundances and that mist-netting data solely represent bird activity (Remsen & Good 1996). Clearly, mist-netting overestimates highly active understory birds, and misses large, sedentary or canopy birds in forests with tall and structured vegetation (Blake & Loiselle 2001, Martin *et al.* 2017). But several authors argued that mist-netting is very efficient in sampling bird communities in forests with lower canopy and dense vegetation cover near the ground (Terborgh 1977, Martin *et al.* 2017). Therefore, tropical mountains with structurally complex forests along their elevational gradient invite a combination of these methods to be used during avian community assessments. Mt. Cameroon certainly is such a mountain, with its highly structured vertical stratification and tall canopy in the lowland forest, vast open areas with dense vegetation cover near the ground in the middle elevation forest, and a montane forest with fairly tall canopy but denser understory than the lowland forest (Proctor *et al.* 2007. Djomo Nana *et al.* 2015).

1.3 Aims of Study

In my thesis, I aim to assess bird community data collected along the elevational gradient of the rainforest on Mt. Cameroon between the years 2011 and 2017 using mist nets. I aim to pinpoint the strengths and weaknesses of mist-netting during the dry season on Mt. Cameroon, including the extent in which mist-netting successfully recorded the avifaunal community known to occur along the forested gradient of Mt. Cameroon. Further, I aim to assess how the results of mist-netting differed between various elevations and forest types, and, where possible, identify the differences in the outcome of mist-netting during the dry and rainy season. Moreover, I aim to identify the morphological and behavioural characteristics of bird species that may boost or hinder their detectability by mist-netting and compare the results with the few similar studies that have been conducted in various parts of the world’s tropics.

Most importantly, however, the aim of this work is to describe the general ecological patterns observed by mist-netting along the forested altitudinal gradient of Mt. Cameroon during the dry season. I intend to do so with particular focus on bird activity, species diversity and abundance of the avian assemblages along the gradient. This also includes a description of the community composition of avian assemblages in respect to their trophic guilds.

Finally, I include a comparison analysis of the outcomes of mist-netting with the results of point-counting.

2 Materials & Methods

2.1 Study site

The study was conducted along the south-west slope of Mt. Cameroon (South-West Province, Cameroon, West Africa). The mountain (4°10’2” N, 9°05‘3“ E) is an active volcano with a peak at 4095 m above sea level (a.s.l.), located on the Atlantic coast of the Gulf of Guinea, representing the highest peak of the Cameroon Volcanic Line, and the highest mountain of the central-west Africa (Fig. 1). It has a persistent cloud cover and perhumid climate (Fonge *et al.* 2005). The highlands of the Cameroon Volcanic Line are an important hotspot of diversity (Graham *et al.* 2005), and Mt. Cameroon is recognized as part of the most unique areas of bird endemism in Africa (Fishpool & Evans 2001). With its height and position, the thermally very stable and wet mountain is a clearly defined and isolated geographical unit with specific avifauna (Graham *et al.* 2005), including two strictly endemic species, *Francolinus camerunensis* and *Speirops melanocephalus*, and ten endemic subspecies (Gill & Donsker 2014).

The south-west slope is distinctive in comparison to the surrounding lowlands in that it is largely covered by tropical forest (Ferenc *et al.* 2016). Its foothill is covered by plantations or secondary-growth forests. The structurally heterogenous Bimbia-Bonadikombo Community Forest, with its area of 3,735 ha, covers about 15-20 km of coastal forests, mangroves and a freshwater swamp forest (Ferenc *et al.* 2018). This is where our lowest study plot is located, at ca. 30 m a.s.l., standing a little bit apart from the main massif of Mt. Cameroon (Fig. 2).

The secondary forest further transforms into a pristine primary old-growth forest above 300 m a.s.l., which is protected by the Mount Cameroon National Park (MCNP). The primary lowland forest consists of tall vegetation (up to 48 m), with sparse understory and closed canopy. Gaps in the canopy are, however, frequent above 600 m a.s.l. (Proctor *et al.* 2007). Two sampling plots were established in the primary lowland forest at 350 and 650 m a.s.l.

The mid-elevation forest spans between ca 900 to 1600 m a.s.l. This forest type is patchy and degraded due to disturbance caused by the African forest elephant (*Loxodonta cyclotis*), in contrast with the closed-canopy lowland forest, the mid-elevation forest has characteristic vast, open areas rich in shrubs and herbs which are dense due to high solar radiation (Fonge *et al.* 2005, Djomo Nana *et al.* 2015). Trees in this forest type are still tall (up to 43 m). Two sampling plots were established in the mid-elevation forest, one at 1100 m a.s.l. and one at 1500 m a.s.l.

near Crater Lake, which is an essential source of water for Mt. Cameroon's fauna during the driest season.

The montane forest spans from about 1600 m a.s.l. to about 2300 m a.s.l., and exhibits frequent mists. Tree ferns and strangling *Schefflera* are typical for this forest, as well as the lack of lianas and buttressing, which are typical for the lowland areas (Proctor *et al.* 2007). Trees in the montane forest are tall (up to 45 m) and the canopy is relatively open. The ongoing volcanic activity causes an abrupt timberline between 2200 and 2300 m a.s.l. Two sampling plots were established in the montane forest, one at 1800 m a.s.l. and one at 2200 m a.s.l.

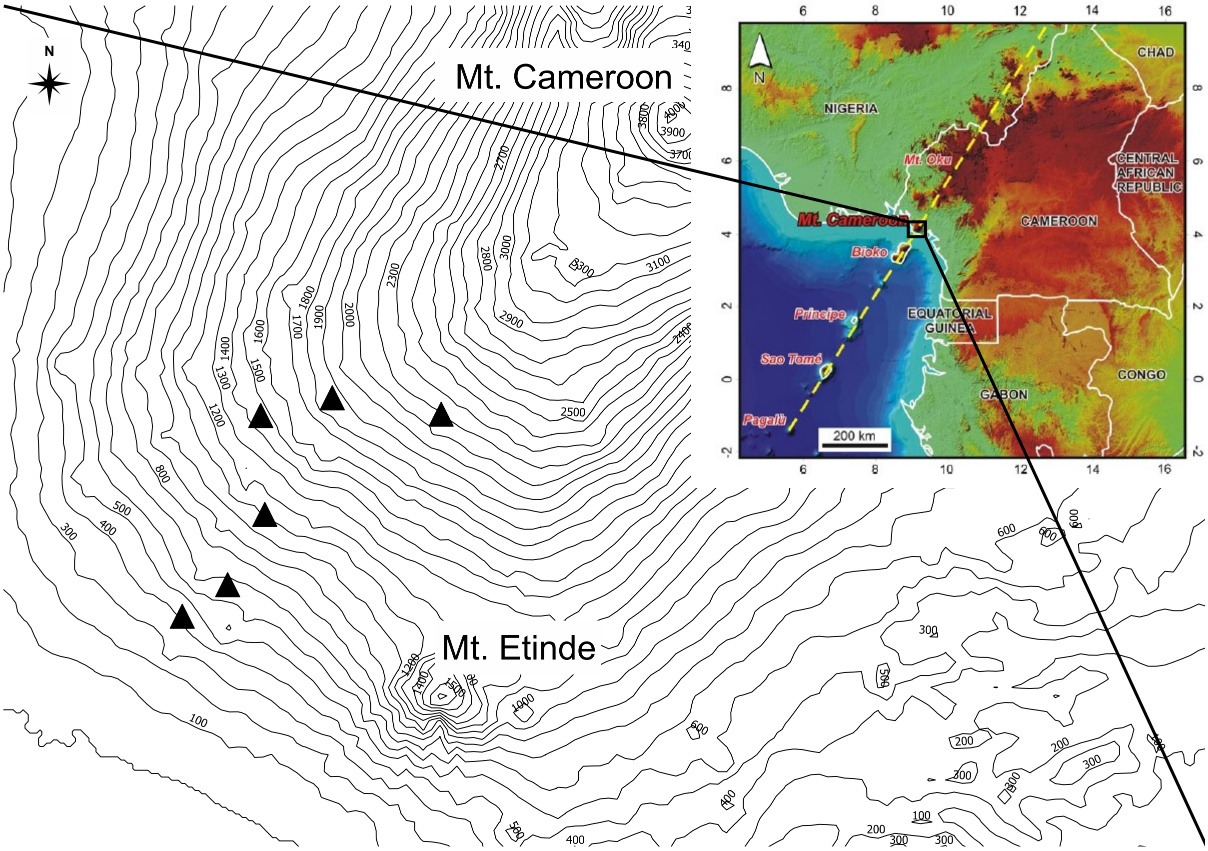


Fig. 1 Map of the study area with the position of our six elevational study plots within the Mount Cameroon National Park, marked by black triangles. The inset depicts the position of our study area within the Cameroon volcanic line indicated by the dashed line. Taken from Ferenc *et al.* (2016).

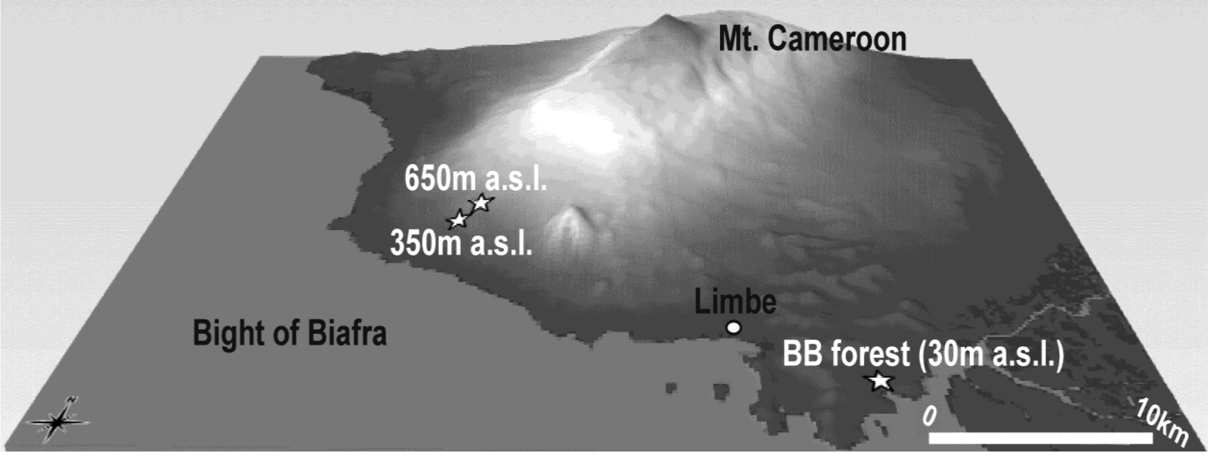


Fig. 2 Map of the study area with the position of our three elevational study plots in the lowland of Mt. Cameroon. Courtesy of Michal Ferenc (unpublished).

2.2 Sampling Methods

Mist-Netting

Bird communities were sampled between 2011 and 2017 mainly during the dry season (mid-November-March) but some plots were sampled during the peak rainy season (August-September) as well. Sampling was conducted in seven plots spanning seven forested elevations (30, 350, 650, 1100, 1500, 1800, 2200 m a.s.l., Table 1) using standard mist nets (Ecotone Poland) with 5 shelves. The nets were 2.5 m tall and 12 m (15 nets) or 10 m (2 nets) long, with a 16x16 mm mesh size. The nets were placed in the forest undergrowth in one 200 m long row – straight, if possible – and were continuously open between 6 a.m. and 6 p.m. for three consecutive days (referred to as "one mist-netting term") during the dry season (November-December and February-March). This, however, proved impossible during the rainy season (August-September) due to frequent interruptions by rain causing the team to immediately close the nets. For this reason, only data collected during the dry season were included in my main analyses, and data collected during the rainy season were only used for comparisons in activity, species richness and abundance measurements. The mist nets were checked every 60 minutes under suitable weather conditions. All captured individuals were identified, sexed, measured, weighted and banded with SAFRING aluminium bands. Birds recaptured during the same term of mist-netting were not included in the analyses. In order to minimize the effect of a greater sampling effort at 350, 650 and 2200 m a.s.l. (i.e. more than one mist-netting term), the elevational abundances of the recorded species were averaged by the number of surveying terms per plot. Relative abundance of a given species was calculated by averaging the sum of its elevational abundances by the number of plots in which the species was recorded (following Ferenc *et al.* 2016). The number of species recorded per plot is referred to as the "total abundance". The sum of elevational abundances is referred to as "the number of all mist-netted individuals".

Point Counts

Bird communities were sampled between 2011 and 2013 during the dry season (November-December) in the same plots as mist-netting, with the exception of 30 m a.s.l. (see Table 1), using a standardized point-count method (Bibby *et al.* 2000). Birds were recorded between 6 and 10 a.m. along a ca. 2.4 km transect over the course of three days. The transect comprised of 16 points with a 50 m radius, located at least 150 m apart to minimize the risk of counting the same individuals multiple times. To avoid daytime bias, the order of points was changed during each visit. During each visit, the birds were recorded in 5-minute intervals. The maximum number of individuals per species recorded during any of these 5-minute intervals was recorded as the species' abundance at the given plot, and the sum across all 16 plots as its elevational abundance. Seen and heard individuals were equally included in the dataset. Relative abundance of a given species was calculated by averaging the sum its of elevational abundances by the number of plots in which the species was detected.

Random Walks

Species spotted or heard during random walks on Mt. Cameroon were recorded for each elevation and are further referred to as "check-listed" species.

Table 1 Summary of study sites with plot elevation (in m a.s.l.), common plot name, forest type, number of netting terms per season per plot, month and year of surveying, and no. of point-count terms conducted per plot on Mt. Cameroon

Elevation	Plot name	Forest type	No. of mist-netting terms per season (dry / rainy)	Month and year	No. of point-counting terms
30 m	Bimbia-Bonadikombo	Lowland (Secondary)	1/0	Dec. 2015	1
350 m	Bamboo Camp	Lowland (Primary)	3/1	Nov. 2011 Feb. 2012 Sep. 2013 Nov. 2013	1
650 m	Drinking Garri	Lowland (Primary)	4/0	Mar. 2012 Nov. 2013 Dec. 2014 Nov. 2015	1
1100 m	Planti Camp	Middle	1/1	Nov. 2012 Sep. 2014	1
1500 m	Crater Lake	Middle	1/0	Nov. 2011	1
1800 m	Elephant Camp	Montane	1/0	Nov. 2012	1
2200 m	Mann's Spring	Montane	2/2	Nov. 2011 Aug. 2017	1

2.3 Taxonomy, Trophic Guilds and Stratum Preferences

The taxonomy in this study follows the Birds of West Africa (Borrow & Demey 2014). Species were further divided into trophic guilds based on their dietary preferences: insectivores, frugivores, nectarivores, granivores, carnivores. Kingfishers (Alcediniidae) are listed as a separate guild. Waterbirds were excluded from our dataset. Given the great diversity of insectivores on Mt. Cameroon, they were further divided into groups of specialists based on the substrate they acquire their food from:

1. foliage-gleaning insectivores (FGIs), who forage by gleaning leaves and twigs
2. ground-searching insectivores (GSIs), who search for and collect insects on the ground
3. aerial/flycatching insectivores (AFIs), who forage for flying insects
4. bark-probing insectivores (BPIs), who search for insects in tree trunks

All birds were divided into groups based on their preferred foraging stratum: forest floor, understory, sub-canopy and canopy (Fig. 3). The data on species ecology were taken from The Birds of Africa (Fry *et al.* 1982-2004).

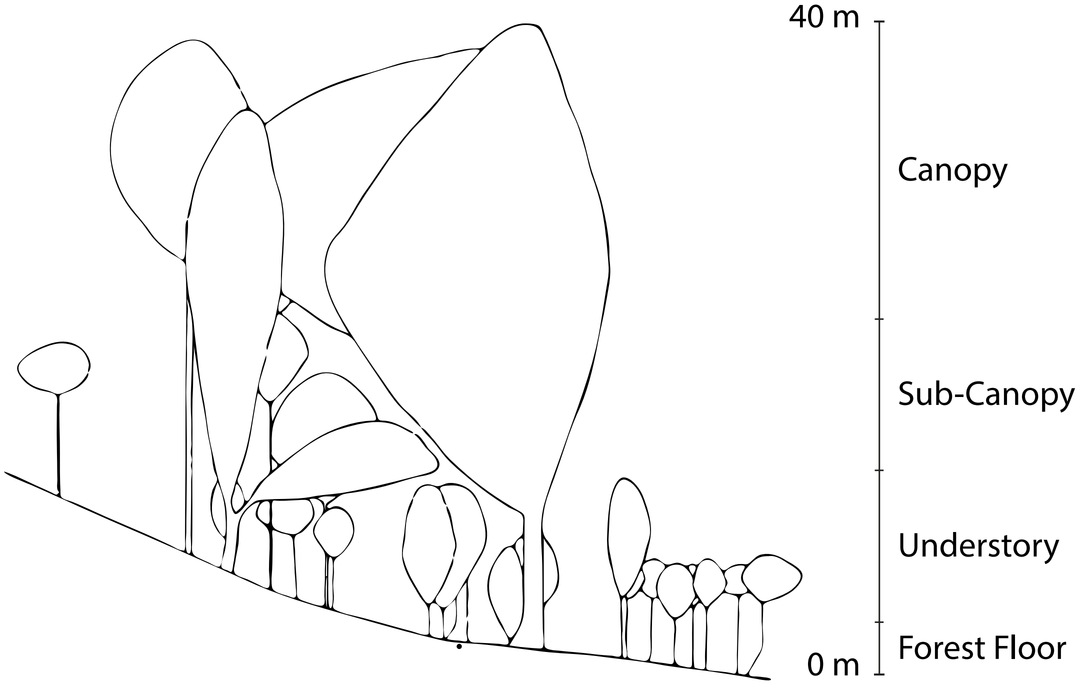


Fig. 3 In illustration of the lowland forest at ca. 600 m a.s.l. on Mt. Cameroon, taken from Proctor *et al.* (2007) and edited. The axis on the right marks the approximate foraging strata of Mt. Cameroon's avifauna: forest floor, understory, sub-canopy and canopy.

2.4 Statistical Analyses

All statistical analyses were performed in RStudio (R Core Team 2019). Shapiro normality tests were used to test for normality and Fligner tests to test for homoscedasticity. I used non-parametric Kruskal-Wallis and Wilcoxon tests to test for differences in the outcomes and shortfallings of mist-netting and/or point counts. Post-hoc Dunn tests with Bonferroni corrections were used where necessary using the package ‘FSA’ (Ogle *et al.* 2019). Diversity, including rarefaction curves, beta-diversity estimates using Jaccard’s index of dissimilarity and diversity estimates using Simpson’s index of diversity was analysed using the package ‘vegan’ (Oksanen *et al.* 2019). Rank-abundance curves were drawn using the package ‘goeveg’ (Goral & Schallenberg 2018).

To draw rarefaction curves from the overall mist-netting data (i.e. my main analysis) I used data with the largest sample size for elevational plots with more than one mist-netting term, as they can only be drawn using whole numbers, a condition that cannot be met when using averaged data from a number of mist-netting terms.

For the comparisons of mist-netting and point counts, I only used data collected during surveying terms conducted at the same time in each elevational plot. To compare the results on bird detection by either of the method, I calculated the capture rate (CR) of each bird recorded by mist-netting, expressed as 1 mist-netted bird per 1000 meter-hours (mh), and point-count density (PCD) of each counted bird, expressed as 1 point-counted bird per 10 ha (Table 2). The resulting graphs were created using the package ‘ggplot’ (Wickham 2016). Finally, I used Spearman’s correlation coefficient to measure the correlation between CR and PCD.

3 Results

3.1 The Practical Limits of Mist-Netting

3.1.1Variability in Bird Detection Across Space and Time

The number of individuals captured during one mist-netting term varied between 47 (Bimbia Bonadikombo site, 30 m a.s.l.) and 182 individuals (Crater Lake site, 1500 m a.s.l.; Fig. 4A). The maximum catch – 243 individuals – was reached at Mann's Spring (2200 m a.s.l.), but due to a higher sampling effort at this site (more mist-netting terms), the total number of individuals captured at this elevation was averaged by the number of mist-netting terms and is, therefore, lower (Fig. 4A). Total abundances generally grew toward the higher elevations (Fig. 4A). Significantly fewer individuals were mist-netted each day in the lowland forest (up to 650 m a.s.l.) than in the mid-elevation (1100 and 1500 m a.s.l.; post-hoc Dunn test, $Z = -2.711$, P unadjusted = 0.0067, P adjusted = 0.013) and montane forest (1800 and 2200 m a.s.l.; post-hoc Dunn test, $Z= -3.119$, P unadjusted = 0.0018, P adjusted = 0.0054).

The number of species detected during one mist-netting term varied between 15 (Bimbia-Bonadikombo site, 30 m a.s.l.) and 34 species (Planti Camp site, 1100 m a.s.l.). The general trend was hump-shaped with a mid-elevation peak (Fig. 4B). The number of species recorded each day was higher in the mid-elevation forest than in the lowland and montane forest, but the difference was not significant (Kruskal-Wallis, $\chi^2 = 5.36$, d.f. = 2, $P = 0.068$).

Overall, more birds were caught during the first day than during the second or third day (Fig. 5A), but patterns differed between forest types (see below). The number of new species recorded per day was significantly higher during the first day of mist-netting than on any other day in all plots (Kruskal-Wallis, $\chi^2 = 24.48$, d.f. = 2, $P < 0.001$; Fig. 5, but the difference in the number of species detected in the first day did not differ significantly among forest types (Kruskal-Wallis, $\chi^2 = 5.36$, d.f. = 2, $P = 0.069$). The second and third mist-netting day added significantly less new species to the dataset than the first day (Kruskal-Wallis, $\chi^2 = 24.48$, d.f. = 2, $P < 0.001$; Fig. 5B).

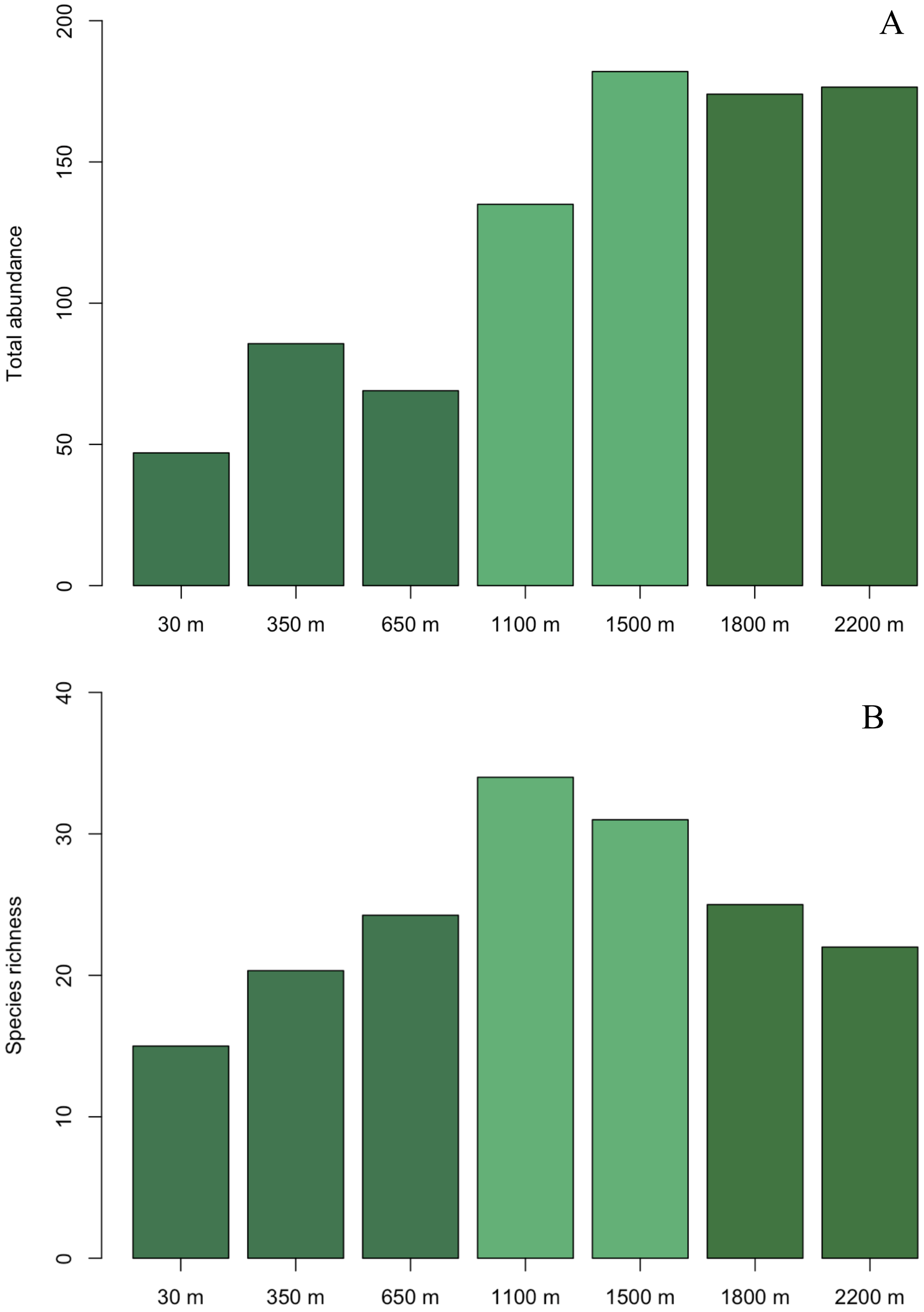


Fig. 4 Total abundance (A) and elevational species richness (B) of avifauna recorded in each elevational plot (listed in m a.s.l.). The three shades of green mark three distinct forest types: lowland, mid-elevation and montane.

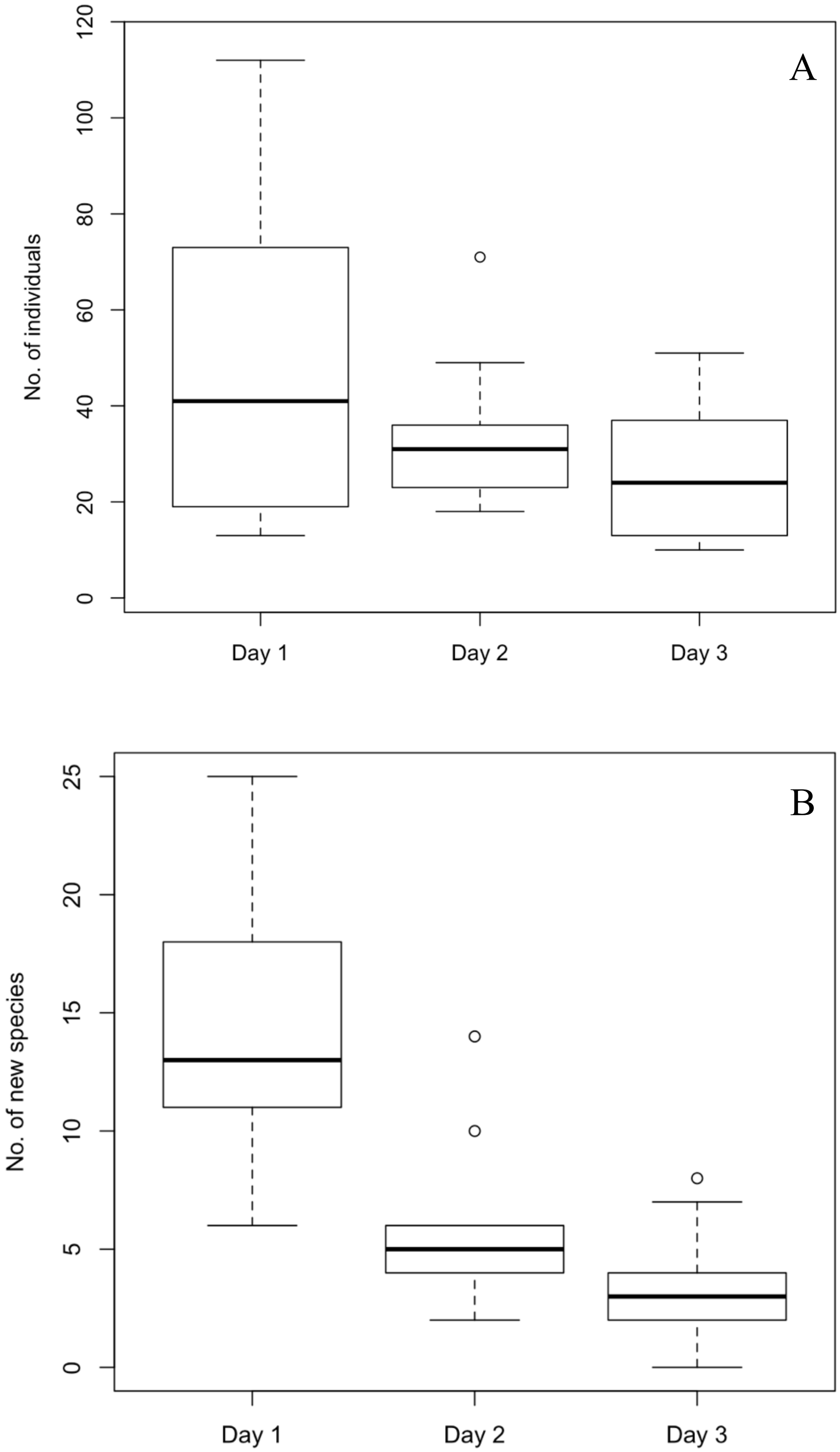


Fig. 5 No. of individuals (A) and new species (B) detected per mist-netting day. The picture shows all elevational plots on Mt. Cameroon summed together. The amount of previously undetected species decreased with each passing day. The thick line marks the median.

The Lowland Forest

Together, we recorded 148 bird species (checklist) in the lowland forest. Out of these species, 52 were mist-netted, 37 of them were exclusively in this forest type. The mean number of mist-netted individuals in the lowland forest reached its peak during the second day of mist-netting (Fig. 6A), but between-day differences in catch numbers were not significant (Kruskal-Wallis, $\chi^2 = 2.42$, d.f. = 2, $P > 0.2$). The number of previously unrecorded species declined with each passing day, but new, previously unrecorded species kept being recorded (Kruskal-Wallis, $\chi^2 = 13.52$, d.f. = 2, $P = 0.001$; Fig. 6B).

Bimbia-Bondikombo site, 30 m a.s.l.

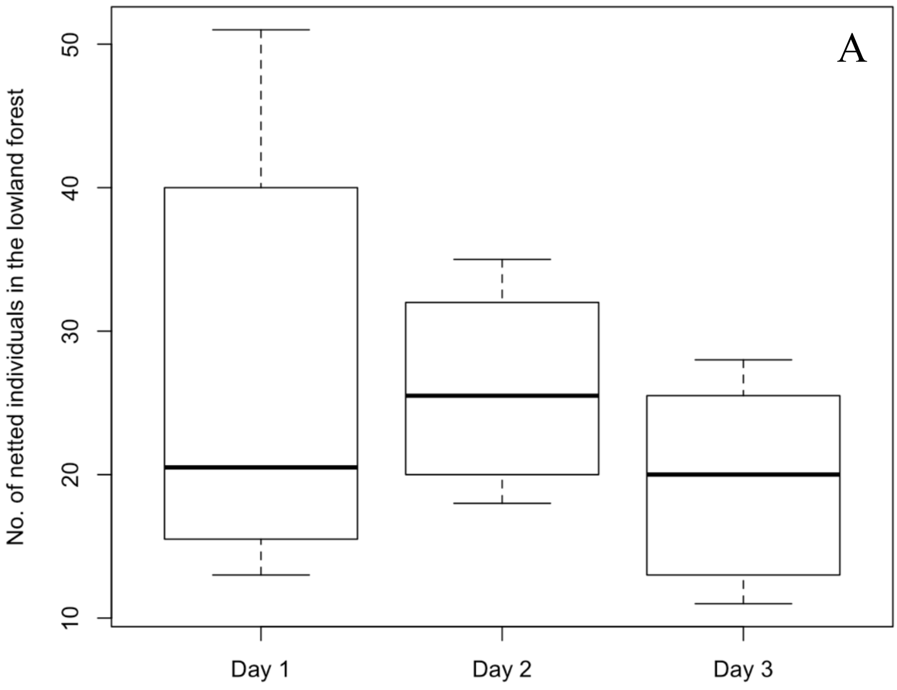
Over the course of three days, 47 individuals of a total of 15 species were recorded at 30 m a.s.l. (12.93% of the 116 check-listed species for this elevation). This site was far the poorest in the number of mist-netted individuals of all elevational plots. More individuals were caught during the second day of mist-netting than the previous or following day (Fig. 7A), while the number of previously unrecorded species detected declined with each passing day (Fig. 7B).

Bamboo Camp site, 350 m a.s.l.

A total of three terms of mist-netting were conducted at 350 m a.s.l. On average, 85.65 individuals of 20.33 species (16.80% of the 121 check-listed species for this elevation) were recorded there over the course of three days (Fig. 4A, B). Overall, the number of recorded individuals and previously unrecorded species at this plot declined with each passing day (Fig. 7A, B).

Drinking Garri site, 650 m a.s.l.

A total of four terms of mist-netting were conducted at 650 m a.s.l. On average, 69 individuals of 24.25 species (19.25% of the 126 check-listed species for this elevation) were recorded there over the course of three days (Fig. 4A, B). More individuals were mist-netted during the second day than during the first or the third day (Fig. 7A). With the exception of one term, the number of previously unrecorded species declined with each day (Fig. 7B).



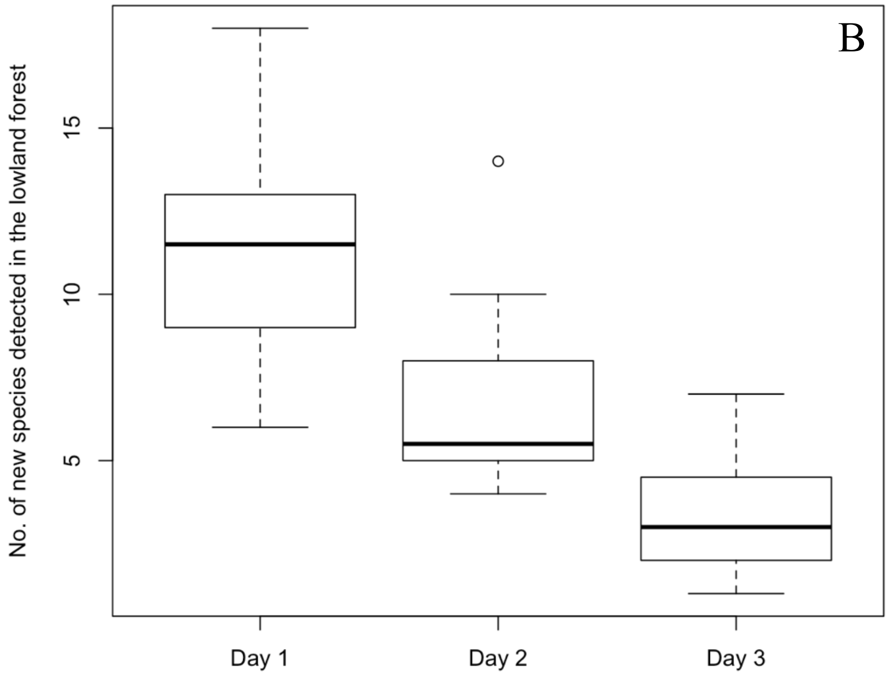


Fig. 6 No. of new individuals (A) and species (B) detected per mist-netting day in the lowland forest of Mt. Cameroon. The thick line marks the median.

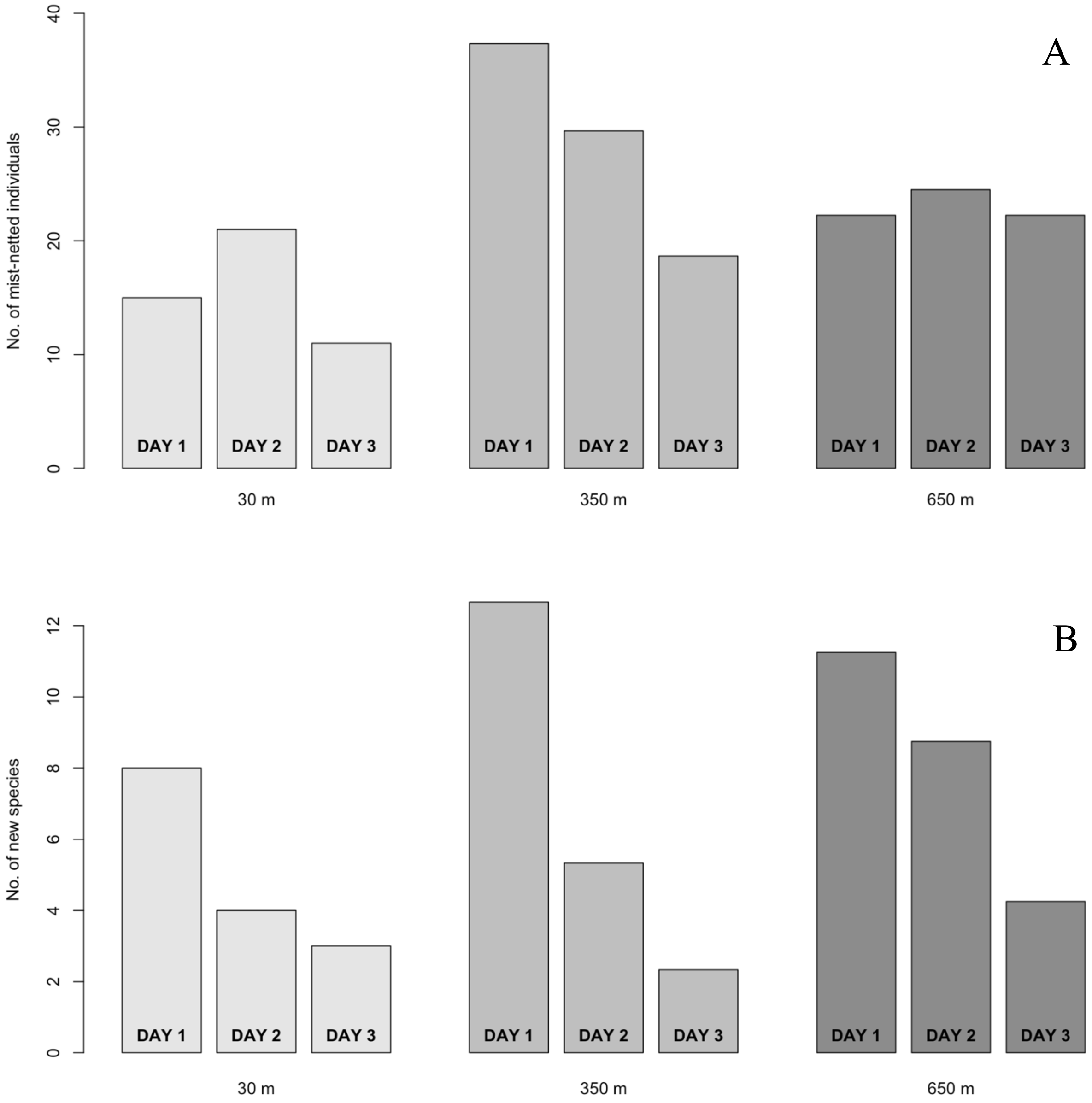


Fig. 7 No. of mist-netted individuals (A) and new species (B) detected per mist-netting day in the lowland forest of Mt. Cameroon divided into elevations (listed in m a.s.l.)

The Mid-Elevation Forest

Together, we recorded 127 bird species (checklist) in the mid-elevation forest. Out of these species, 47 were mist-netted, 21 exclusively in this forest type. More individuals were recorded during the first day of each mist-netting term than during the second or third day (Fig. 8A), albeit not significantly so, probably due to a low sample size (Kruskal-Wallis, $\chi^2 = 3.43$, d.f. = 2, P = 0.18; Fig. 8A), and the second and third day added significantly less species into our dataset than the first day, again without statistical significance due to a low sample size ($\chi^2 = 3.53$, d.f. = 2, P = 0.17; Fig. 8B).

Planti Camp site, 1100 m a.s.l.

A total of 133 individuals and 34 species (30.09% of the 113 check-listed species for this elevation) were recorded at 1100 m a.s.l. over the course of three days (Fig. 4A, B). Most birds were mist-netted on the first day, but more were captured during the third than during the second day, and the same holds true for new species per day at this elevation (Fig. 9A, B).

Crater Lake site, 1500 m a.s.l.

A total of 182 individuals and 31 species (42.47% of the 73 check-listed species for this elevation) were recorded at 1500 m a.s.l. over the course of three days (Fig. 4A, B). The number of mist-netted individuals and new species declined with each passing day (Fig. 9A, B).

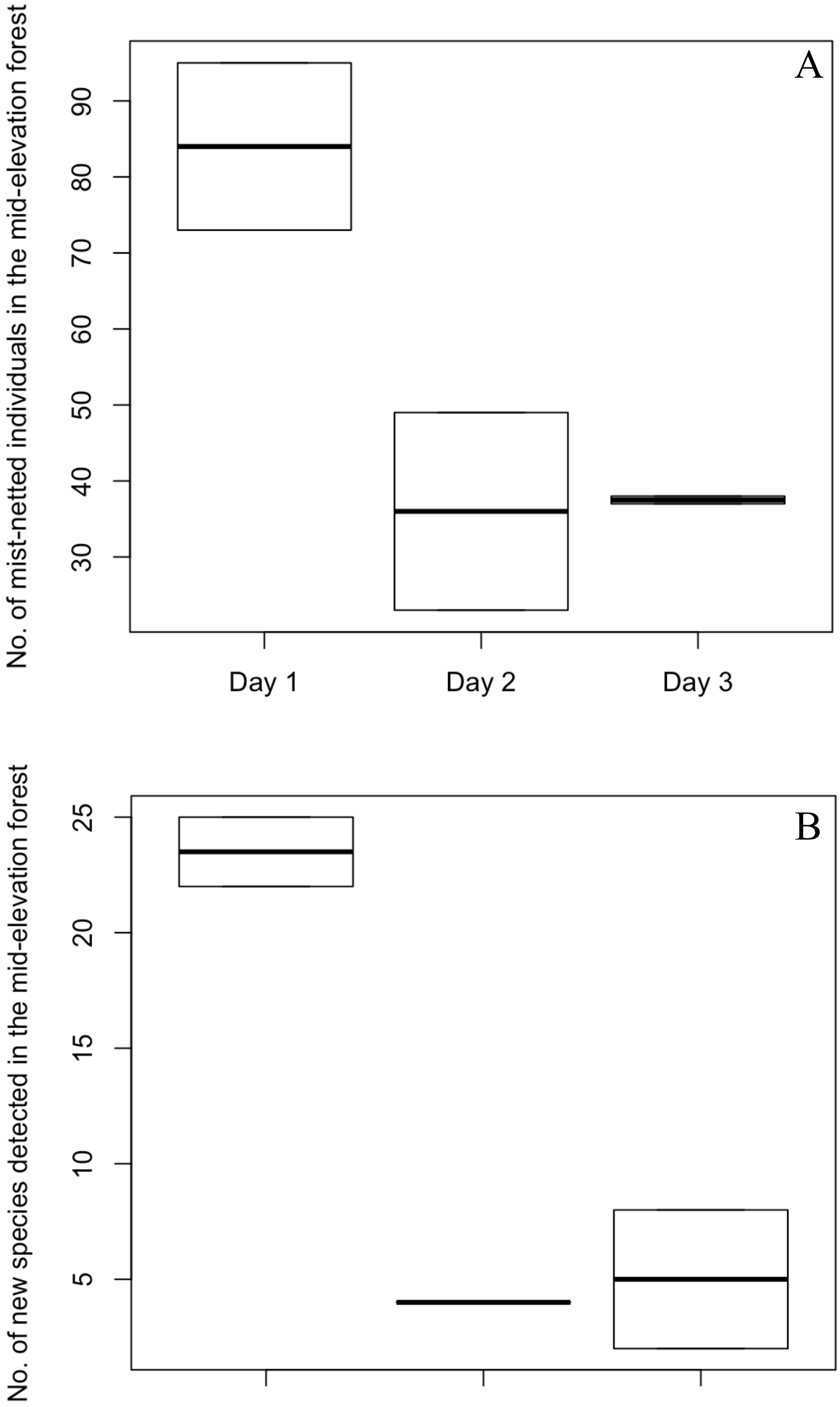


Fig. 8 No. of mist-netted individuals (A) and new species (B) detected per mist-netting day in the mid-elevation forest of Mt. Cameroon. The thick line marks the median.

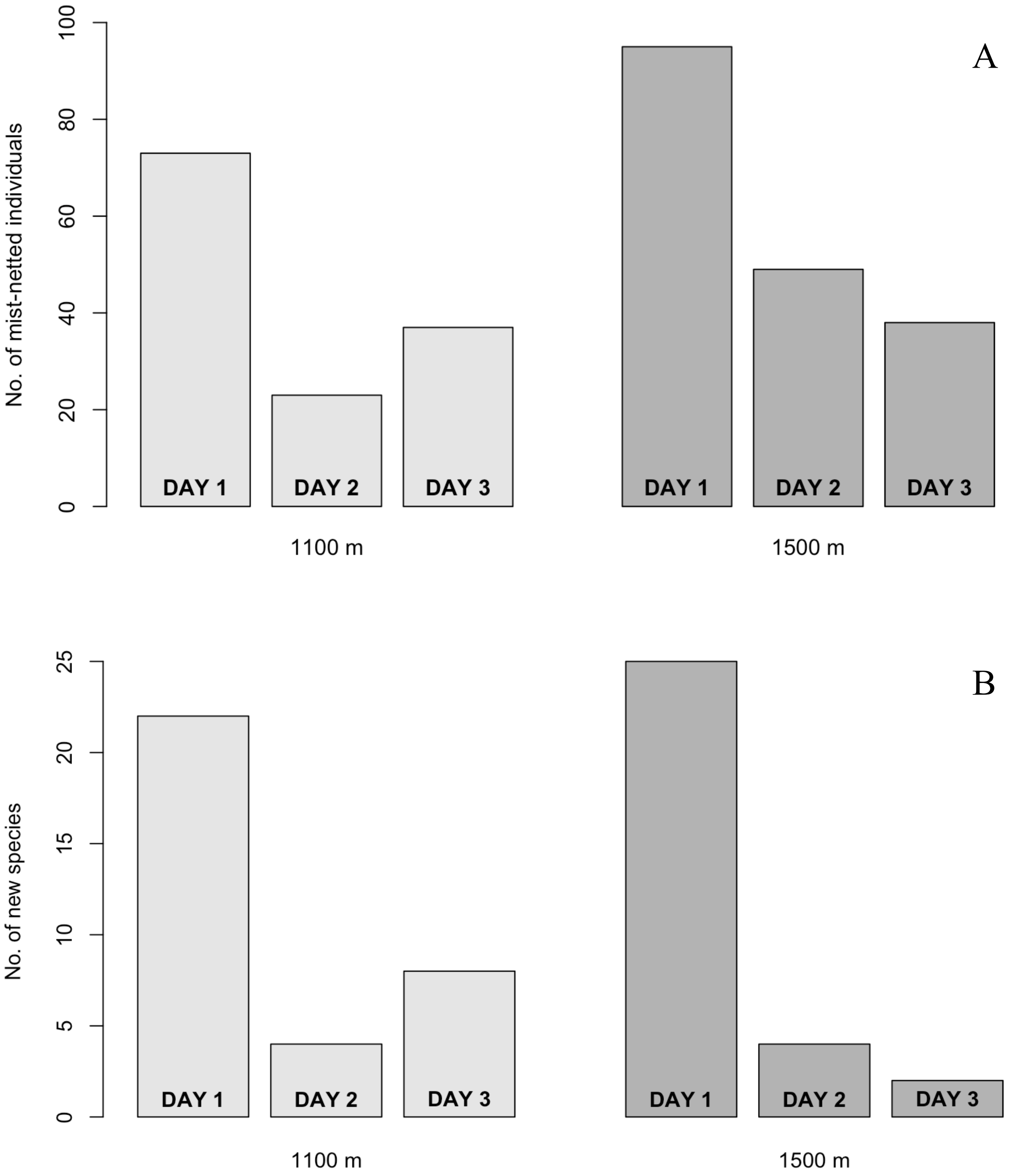


Fig. 9 No. of individuals (A) and new species (B) detected per mist-netting day in the mid-elevation forest of Mt. Cameroon divided into elevations (listed in m a.s.l.)

The Montane Forest

Together, we observed 72 bird species (checklist) in the montane forest. Out of these species, 33 were detected by mist nets, 12 exclusively in this forest type. Mist-netting detected more individuals during the first day than during the second or third day, although the difference is not statistically significant (Kruskal-Wallis, $\chi^2 = 5.42$, d.f. = 2, P = 0.066; Fig. 10A), probably due to a low sample size. Numbers of new species per day declined with each passing day (Kruskal-Wallis, $\chi^2 = 6.60$, d.f. = 2, P = 0.0369; Fig. 10B).

Elephant Camp site, 1800 m a.s.l.

A total of 174 individuals of 25 species (41.67% of the 60 check-listed species for this elevation) were recorded at this elevation over the course of three days. The most individuals were netted on day one and the least on day two (Fig. 11A), while species numbers declined with each day (Fig. 11B).

Mann's Spring site, 2200 m a.s.l.

An average of 176.5 individuals of 22 species (45.83% of the 48 species check-listed for this elevation) were recorded at this elevation over two terms, three days each. The numbers of individuals and new species declined with each passing day (Fig. 11A, B).

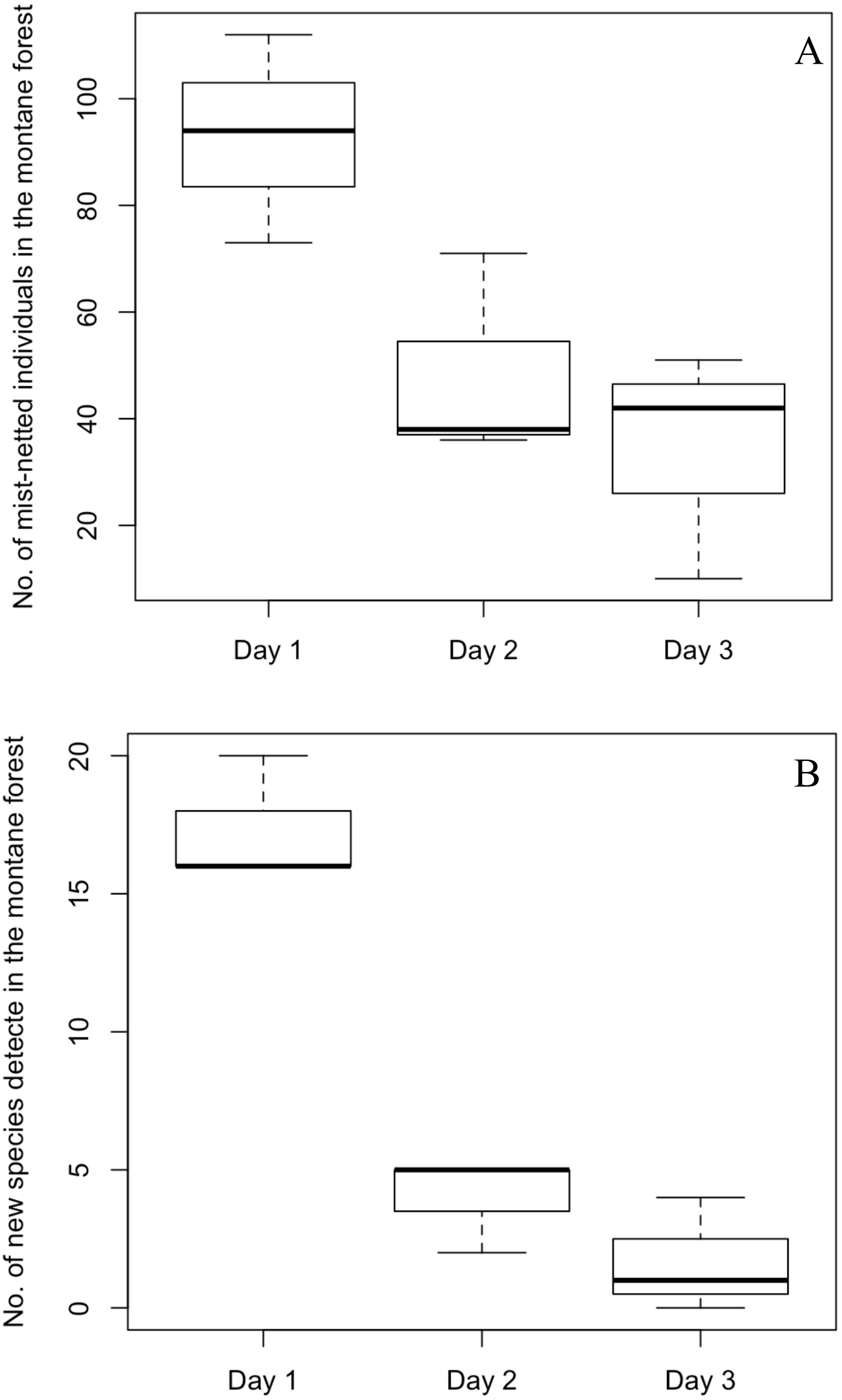


Fig. 10 No. of individuals (A) new species (B) detected per mist-netting day in the montane forest of Mt. Cameroon. The thick line marks the median.

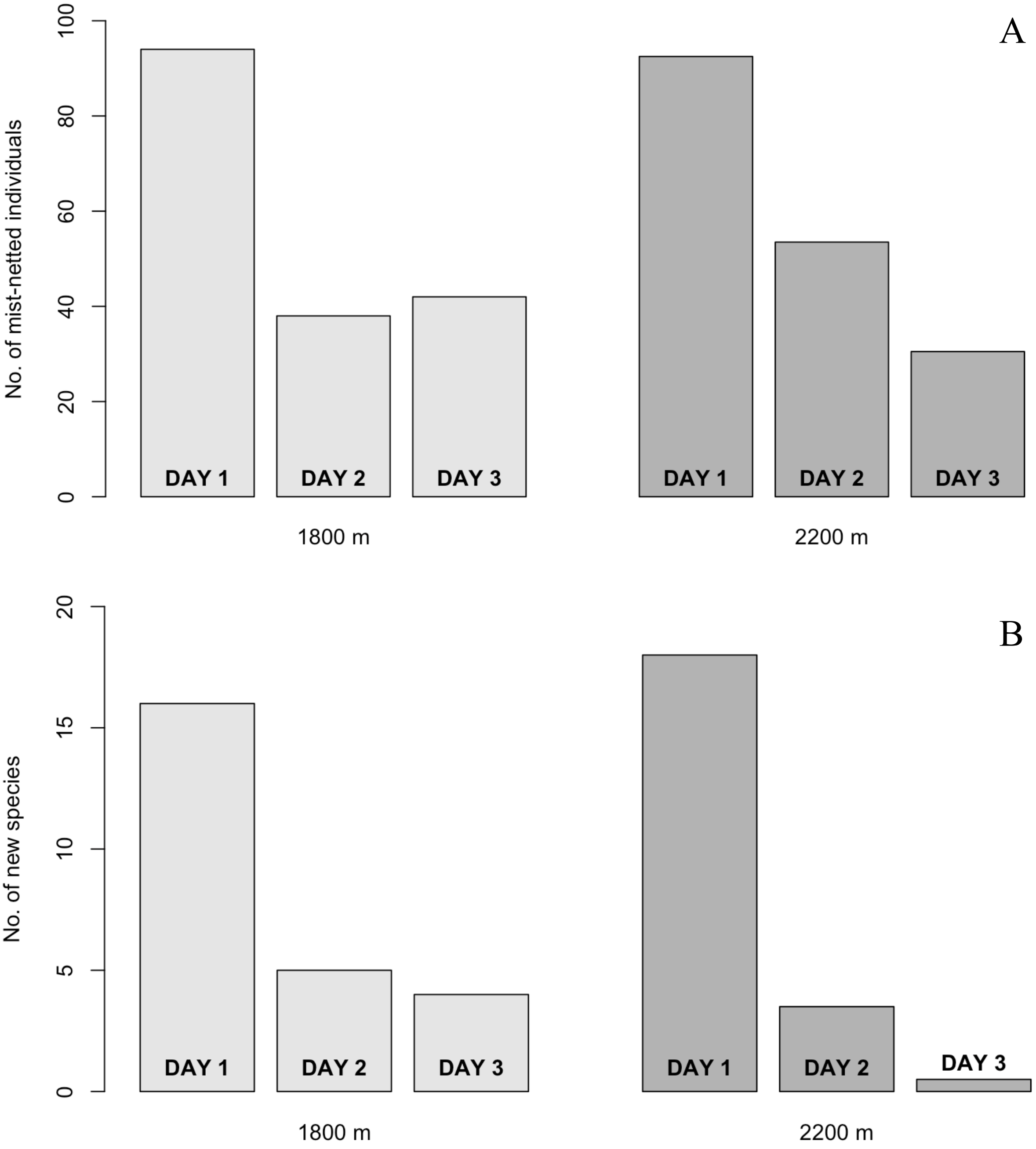


Fig. 11 No. of individuals (A) and new species (B) detected per mist-netting day in the mid-elevation forest of Mt. Cameroon divided into elevations (listed in m.a.s.l.)

3.1.2 The Effect of Season on Mist-Netting Success

Altogether, fewer individuals were detected by mist nets during the rainy season (mean catch per term = 77) than during the dry season (mean catch per term = 109.54; Fig. 12A), but the difference was not statistically significant, possibly due to the small sample (Kruskal-Wallis, $\chi^2 = 0.82$, d.f. = 1, $P > 0.2$). The number of species detected during the dry season in each plot (mean = 23.66) was similar to the number of species detected during the rainy season (mean = 22.25; Fig 12B). Three species were only mist-netted during the rainy season: *Cinnyris chloropygius* (at the Bamboo Camp site, 350 m a.s.l.)*, Saxicola torquata* (at Mann's Spring site, 2200 m a.s.l.)*, Serinus burtoni* (at the Mann's Spring site, 2200 m a.s.l.).

The Lowland Forest

Mist-netting during the rainy season was conducted in one term in the lowland forest, at the Bamboo Camp site (350 m a.s.l.). Fewer individuals (n = 47) and species (n = 17) were detected here during the rainy season than during the dry season (n of individuals = 64, n of species = 24; Fig 12A, B).

The Mid-Elevation Forest

Mist-netting during the rainy season was conducted in one term in the mid-elevation forest, at the Planti Camp site (1100 m a.s.l.). Fewer individuals were mist-netted in this plot during the rainy season (a total of 106) than were during the dry season (a total of 133; Fig. 12A), yet the number of species detected was equal in both seasons at this elevation (a total of 34; Fig. 12B).

The Montane Forest

Mist-netting during the rainy season was conducted in two terms in the montane forest, at the Mann's Spring site (2200 m a.s.l.). On average, mist-netting in this plot detected fewer individuals (mean = 77) and species (mean = 19) during the rainy season than during the dry season (mean of individuals = 176.5, mean of species = 22; Fig. 12A, B).

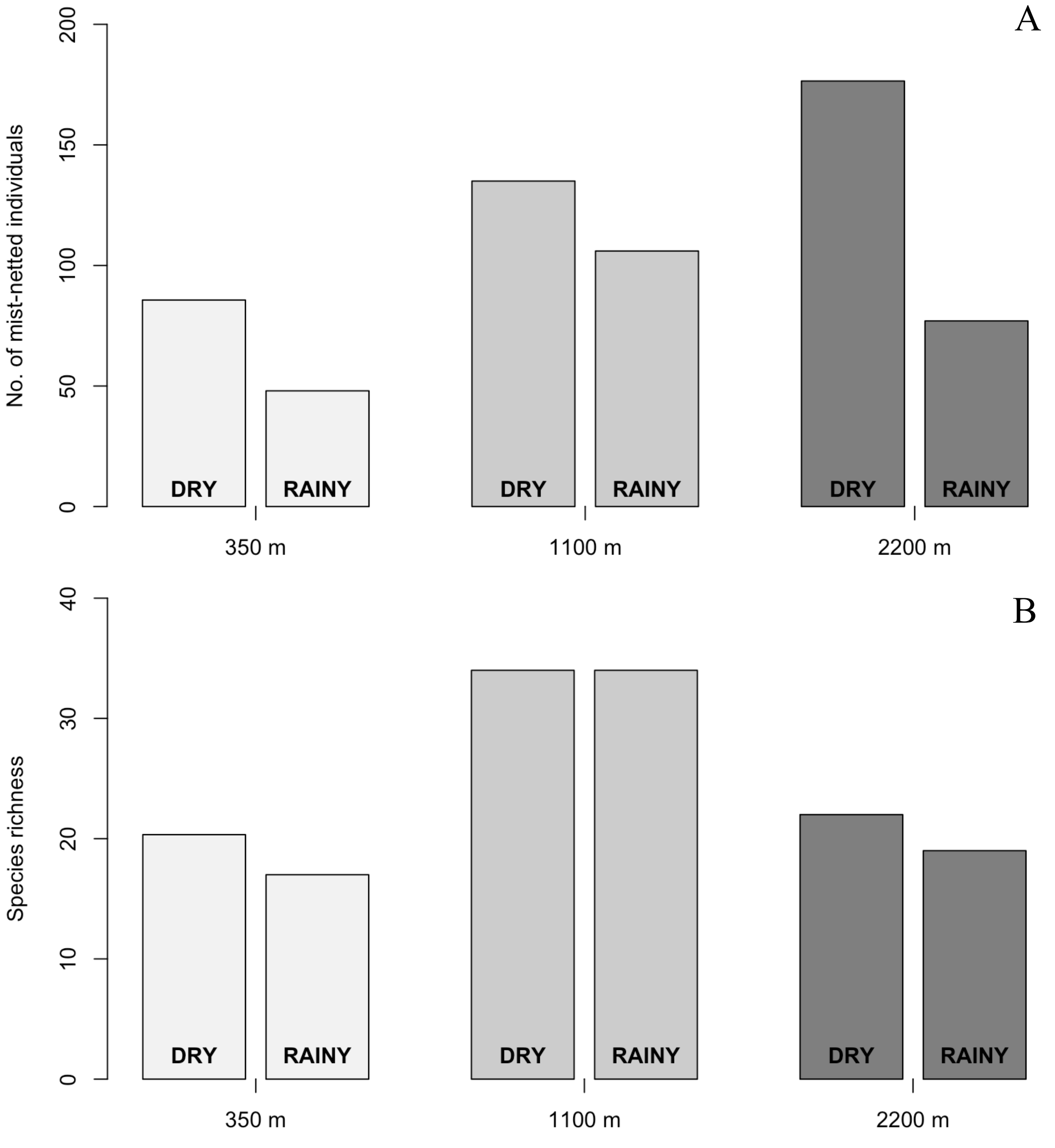


Fig. 12 Comparisons of the no. of mist-netted individuals (A) and recorded species (B) per mist-netting term between the dry and rainy season in one plot per forest type. Plot elevations are listed in in m a.s.l. The three shades of grey mark three distinct forest types: lowland, mid-elevation and montane.

3.1.3 The Weight of Mist-Netted Birds

Of the 242 species recorded in our checklist, 113 species are small birds (<30 g), 70 species are medium-sized birds (30-70 g) and 59 species are large birds (>70 g, see Appendix). In total, we recorded 92 species using the mist-netting method throughout all mist-netting terms and across all plots on Mt. Cameroon. Sixty of them were small, which represents 65.2% of all mist-netted species, 53.1% of check-listed small species and 75.5% of all mist-netted individuals. Twenty-six species were medium-sized, which represents 28.3% of all mist-netted species, 37.1% of check-listed medium-sized species and 24.72% of all mist-netted individuals. Only 6 mist-netted species belonged to large birds, representing 6.52% of all mist-netted species, 10.17% of check-listed large species and 0.78% of all mist-netted individuals.

The mean weight of mist-netted species was ca. 33 g. This weight is significantly lower if compared to the mean weight of the species missed by mist-netting, ca. 205 g (Kruskal-Wallis, $\chi^2 = 27.27$, d.f. = 1, $P < 0.001$; Fig. 13). Only four species with mean size over 80 g were mist-netted: *Accipiter tachiro* (347.1 g), *Aplopelia larvata* (139.35 g), *Picathartes oreas* (225 g) and *Turtur brehmeri* (122.5 g). Removing these species from the measurement resulted in a reduction of the mean weight of mist-netted species to ca. 25 g.

The mean relative abundance of all small mist-netted birds (10.79 individuals per species) was higher than the mean relative abundance of all medium-sized mist-netted birds (8.26 individuals per species) or large mist-netted birds (1.14 individuals per species) birds. The difference was only significant between the relative abundance of small and large mist-netted species (Dunn test, $Z = -2.736$, P. unadjusted = 0.006, P. adjusted = 0.018).

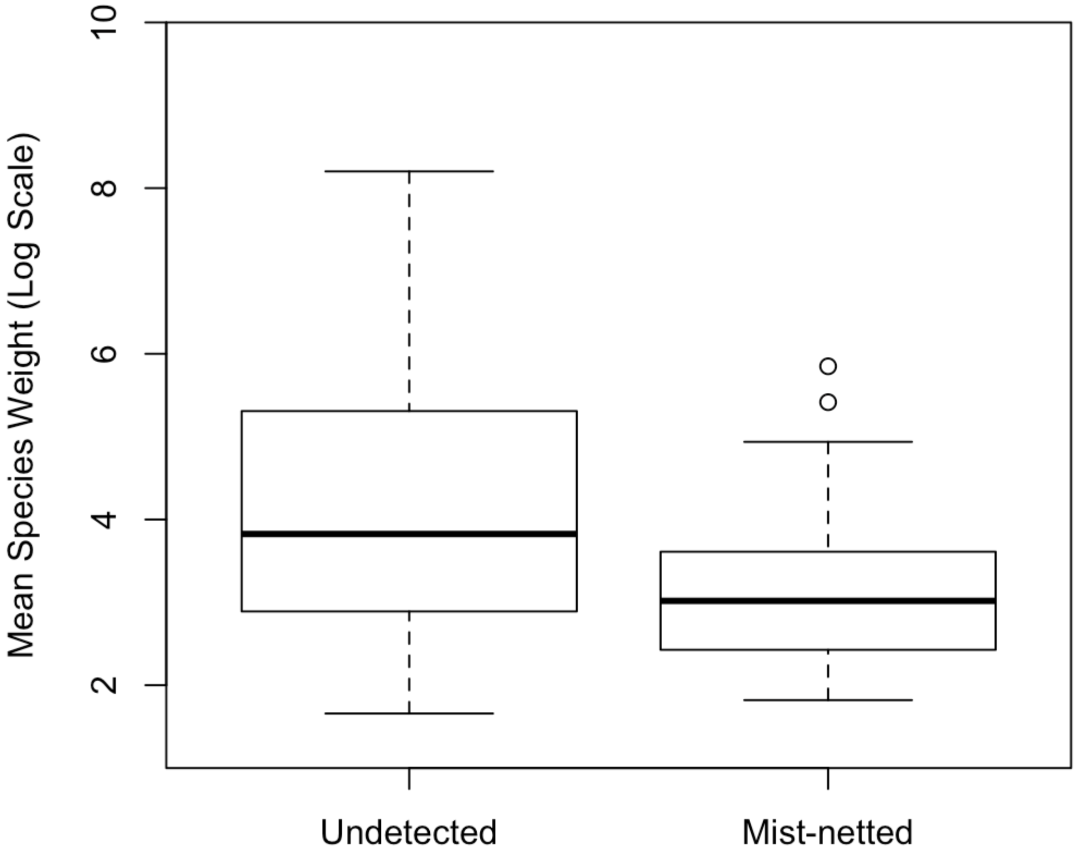


Fig. 13 Mean weight (presented in log scale to minimize skewness) of the check-listed species divided into bird that remained undetected (left) or were detected by mist-nets (right). The thick line marks the median.

3.1.4 Flocking Behaviour of Mist-Netted Birds

The species composition of the whole bird community on Mt. Cameroon does not differ considerably from the communities recorded by mist netting in respect to flocking behaviour. The majority (n = 160) of check-listed species are solitary birds (66.1%), 47 species form flocks facultatively (19.4%), and 35 species form flocks often and regularly (14.5%). Out of the 92 mist-netted species, 64 species are solitary (69.6%), 21 species form flocks facultatively (22.8%) and 7 species (7.6%) do so often.

This pattern holds true also for the overall proportions of mist-netted individuals (Fig. 14). The majority of mist-netted individuals belonged to solitary species (63.4%), followed by facultatively flocking species (18.8%) and only a small proportion of mist-netted individuals belonged to flocking species (17.7%). However, the mean abundance of species which often form flocks was the highest (5.99 individuals per species) if compared to the abundances of mist-netted solitary species and facultatively flocking species (2.80 and 2.96 individuals per species respectively).

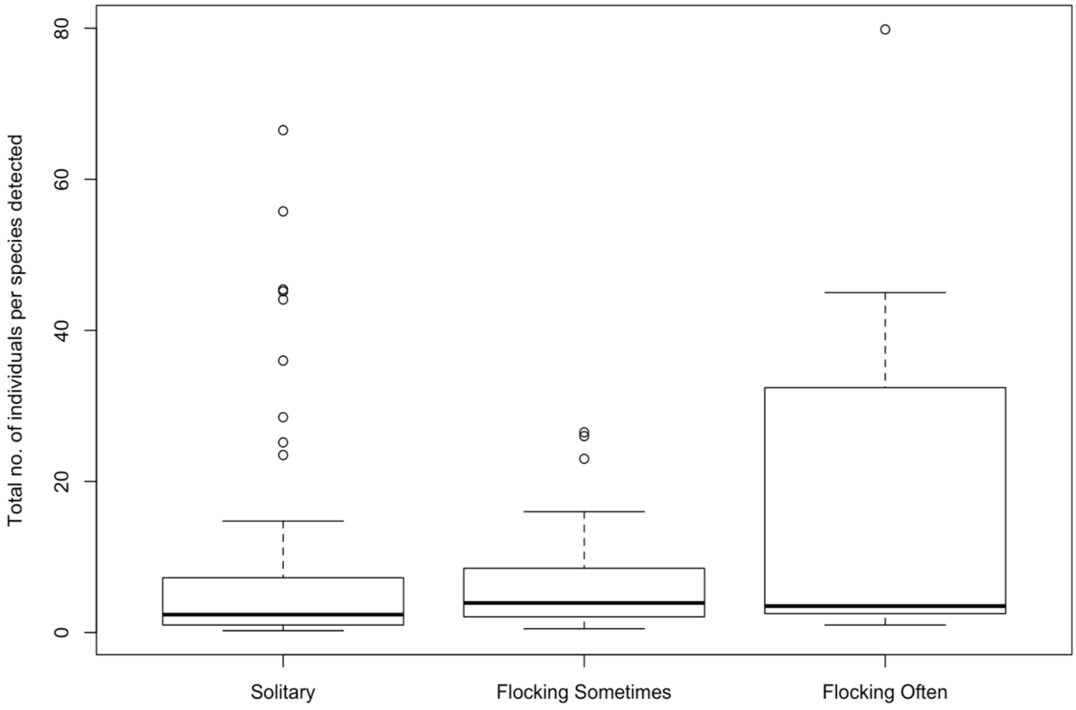


Fig. 14 The relative abundance all mist-netted individuals per species divided into three groups based on their probability of forming flocks: solitary (never form flocks), flocking sometimes and flocking often. The thick line marks the median.

3.1.5 Foraging Stratum Preferences of Mist-Netted Birds

Overall, mist nets detected 24 species of forest floor foragers, 32 understory foragers, 23 sub-canopy foragers, 12 species that prefer foraging in the canopy, and 1 species with no stratum preferences.

The species composition of birds in respect to the preferred foraging strata changed along the elevation (Fig. 15). In the lowland rainforest, we caught mainly birds belonging to forest-floor and understory foragers (Fig. 15), with occasional captures of birds with preferences for foraging in higher strata. In the mid-elevation forest, bird species from all four foraging strata were similarly represented in our mist-netting samples (Fig. 15). Interestingly, canopy foragers were the most frequent group of birds caught in the montane forest, if compared to the remaining three groups. In summary, the bird species preferring lower strata of the rainforest prevailed in the mist-nets at lower elevations, whereas the proportion of canopy foragers increased in our mist-nets with elevation.

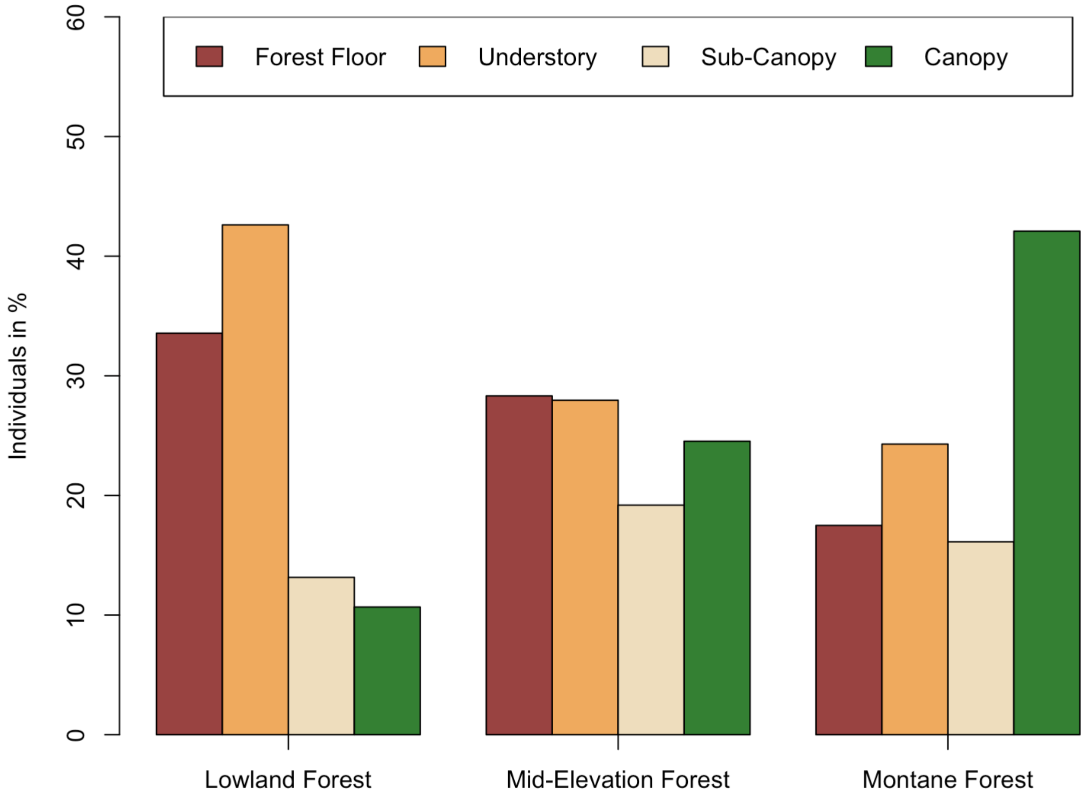


Fig. 15 Proportions of mist-netted individuals based on their foraging stratum preferences in each forest type.

3.2 Ecological Patterns Detected by Mist-Netting

3.2.1 Daily Activity Across the Elevational Gradient

Overall, the daily activity of birds on Mt. Cameroon was higher in the morning than it was in the afternoon. More birds were mist-netted in the morning than in the afternoon at each elevational plot (Kruskal-Wallis, $\chi^2 = 6.81$, d.f. = 1, P = 0.009, Fig. 16). There are, however, substantial differences in the activity patterns between the three forest types, between elevations and between seasons.

The Lowland Forest

Surprisingly, the activity of birds evaluated by the number of catches was not the highest in the early morning (6-8 a.m.) in this forest type, but peaked between 8-10 a.m.

Bimbia-Bonadikombo site, 30 m a.s.l.

Mean activity of birds in this plot was low in the early morning, peaked between 8-10 a.m. and decreased rapidly for the rest of the day. Almost no birds were captured late in the afternoon during 4-6 p.m (Fig. 17A).

Bamboo Camp site, 350 m a.s.l.

Mean activity of birds at this elevation was low in the early morning, peaked between 8-10 a.m., dropped slightly between 10 a.m. - 12 p.m., and then reached the all-day minimum between 12-2 p.m. Activity slightly increased between 2-4 p.m., but then dropped again during the last two hours of mist-netting (Fig. 17B).

Drinking Garri site, 650 m a.s.l.

Mean activity of birds at this elevation was again low in the early morning, peaked between 8-10 a.m., then continually decreased in the following hours. It dropped to the all-day minimum between 2-4 p.m. but slightly increased again between 4-6 p.m. (Fig. 17C).

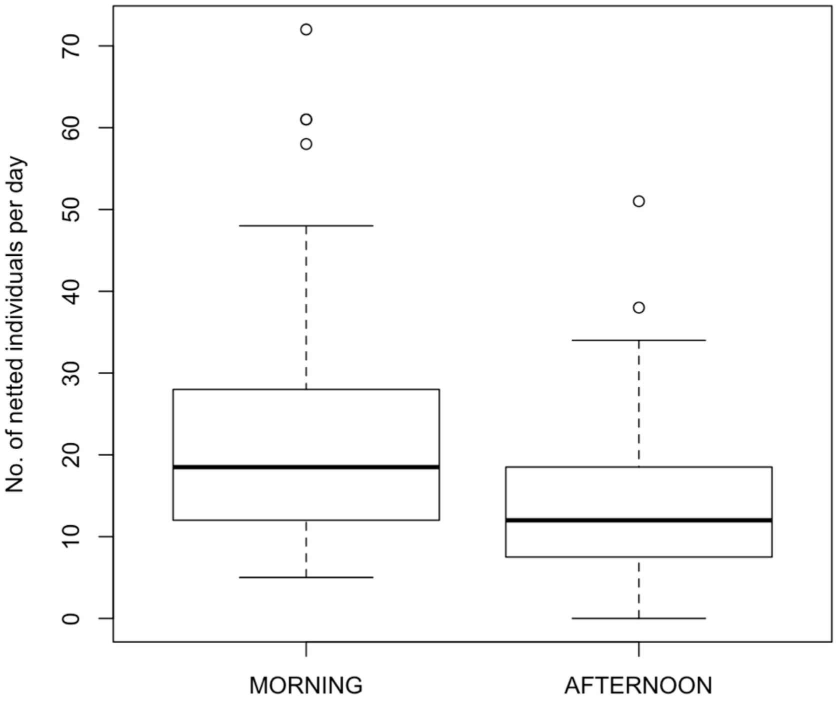


Fig. 16 The total number of mist-netted birds per day divided into morning and afternoon catches. The graph shows record from all elevational mist-netting plots. The thick line marks the median.

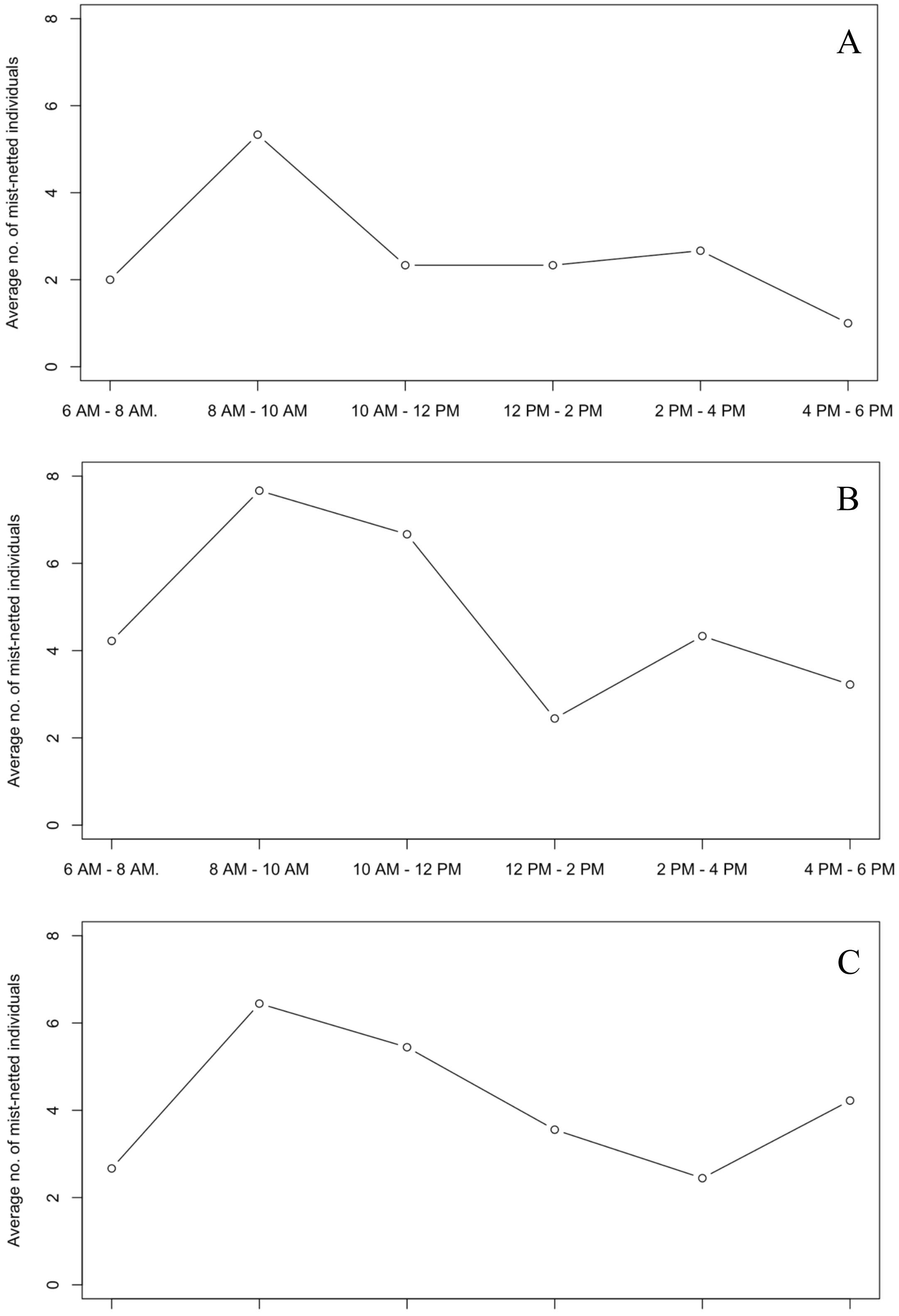


Fig. 17 Patterns of daily activity of birds estimated by the number of catches in mist nets during the dry season between 6 am and 6 pm in the lowland forest of Mt. Cameroon at 30 m a.s.l. (A), 350 m a.s.l. (B) and 650 m a.s.l.(C). Each dot represents the average daily catch during a two-hour interval.

The Mid-Elevation Forest

Birds in the mid-elevation forest were active from the early morning hours. Mean activity was higher in the morning than in the afternoon, but it peaked between 2-4 p.m. The birds were the least-active between 12-2 p.m. and 4-6 p.m.

Planti Camp site, 1100 m a.s.l.

Peak activity was reached in the early morning and continuously declined until it reached the all-day minimum between 12-2 p.m. Activity in the afternoon was slightly higher between 2-4 p.m. (Fig. 18A).

Crater Lake site, 1500 m a.s.l.

Mean activity was the highest in the morning, with the morning peak between 8-10 a.m., and kept declining until it reached the minimum between 12-2 p.m. The overall peak, however, was reached between 2-4 p.m., followed by a steep decline in the last two hours of mist-netting (Fig. 18B).

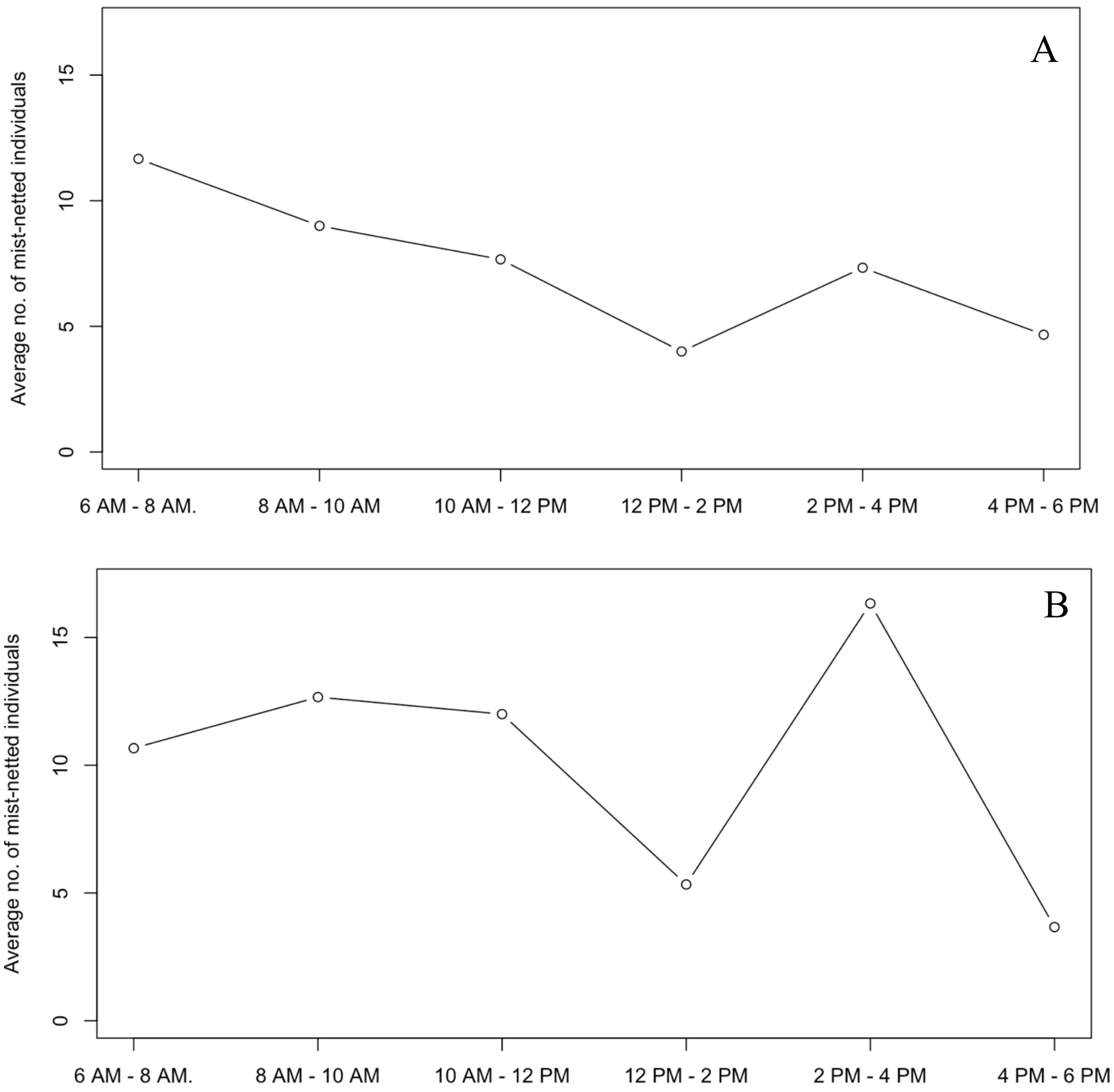


Fig. 18 Patterns of daily activity of birds estimated by the number of catches in mist nets during the dry season between 6 am and 6 pm in the mid-elevation forest of Mt. Cameroon at 1100 m a.s.l. (A) and 1500 m a.s.l. (B). Each dot represents the average daily catch during a two-hour interval.

The Montane Forest

The overall activity in the montane forest was higher in the morning, but no clear pattern has been found for the two montane elevational plots (Fig. 19). The increase and decline in activity were continuous prior to and past reaching the peak.

Elephant Camp site, 1800 m a.s.l.

Mean activity at 1800 m a.s.l. peaked between 8-10 a.m., then declined, increased again in the early afternoon, then reached the all-day minimum between 2-4 p.m. and remained low until 6 p.m. (Fig. 19A).

Mann’s Spring site, 2200 m a.s.l.

Mean activity at 2200 m a.s.l. was continuously increasing from the early morning. A steep increase in activity formed the peak between 10 a.m. - 12 p.m. Activity then declined continuously until the end of the day (Fig. 19B).

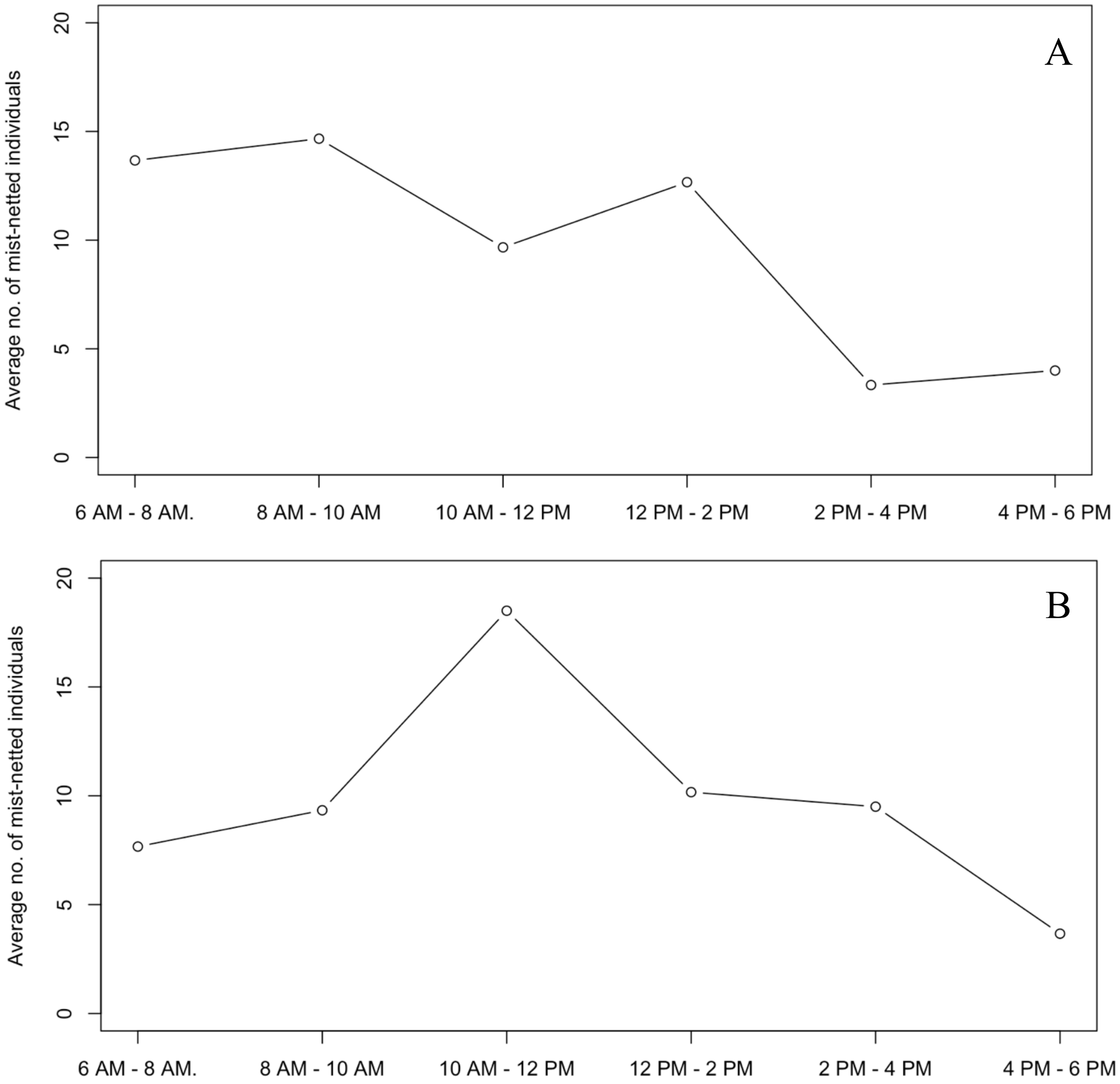


Fig. 19 Patterns of daily activity of birds estimated by the number of catches in mist nets during the dry season between 6 a.m. and 6 p.m. in the montane forest of Mt. Cameroon at 1800 m a.s.l. (A) and 2200 m a.s.l. (B). Each dot represents the average daily catch during a two-hour interval.

3.2.2 Inter-Seasonal Differences in Daily Activity

The Lowland Forest

We have collected data from the dry and rainy season at the Bamboo Camp site, 350 m a.s.l. The number of bird catches per two hours at 350 m a.s.l. was higher during the dry season (min. = 2.44, max. = 7.67, mean = 4.76 birds per two hours) than during the rainy season (min. = 0.67, max. = 4.67, mean = 2.67 birds per two hours; Wilcoxon rank-sum test, W = 658, P = 0.024, Fig. 20A). The activity of birds during the day followed a similar pattern during both seasons, with a shift in peak activity toward later hours during the rainy season (Fig. 20A)

The Mid-Elevation Forest

The minimum number of birds caught per two hours at 1100 m a.s.l. was equal between the seasons (4 birds per two hours), while the maximum and mean catch were higher during the dry season (max. = 11.67, mean = 7.39 birds per two hours) than during the rainy season (max. = 7.33 and mean = 5.89 bird per two hours), although the difference is not statistically significant (Wilcoxon rank-sum test, W = 179, P > 0.2, Fig. 20B). Bird activity was slightly higher in the afternoon during the rainy season (Fig. 20B)

The Montane Forest

The number of birds caught at 2200 m a.s.l. was higher during the dry season (min. = 3.67, max. = 18.50, mean = 9.81 birds per two hours) than during the rainy season (min. = 0, max. = 7.67, mean = 4.28 birds per two hours; Wilcoxon rank-sum test, W = 884, P = 0.007, Fig. 20C). The activity of birds peaked during the later morning hours during both dry and rainy season in the montane forest (Fig. 20C).

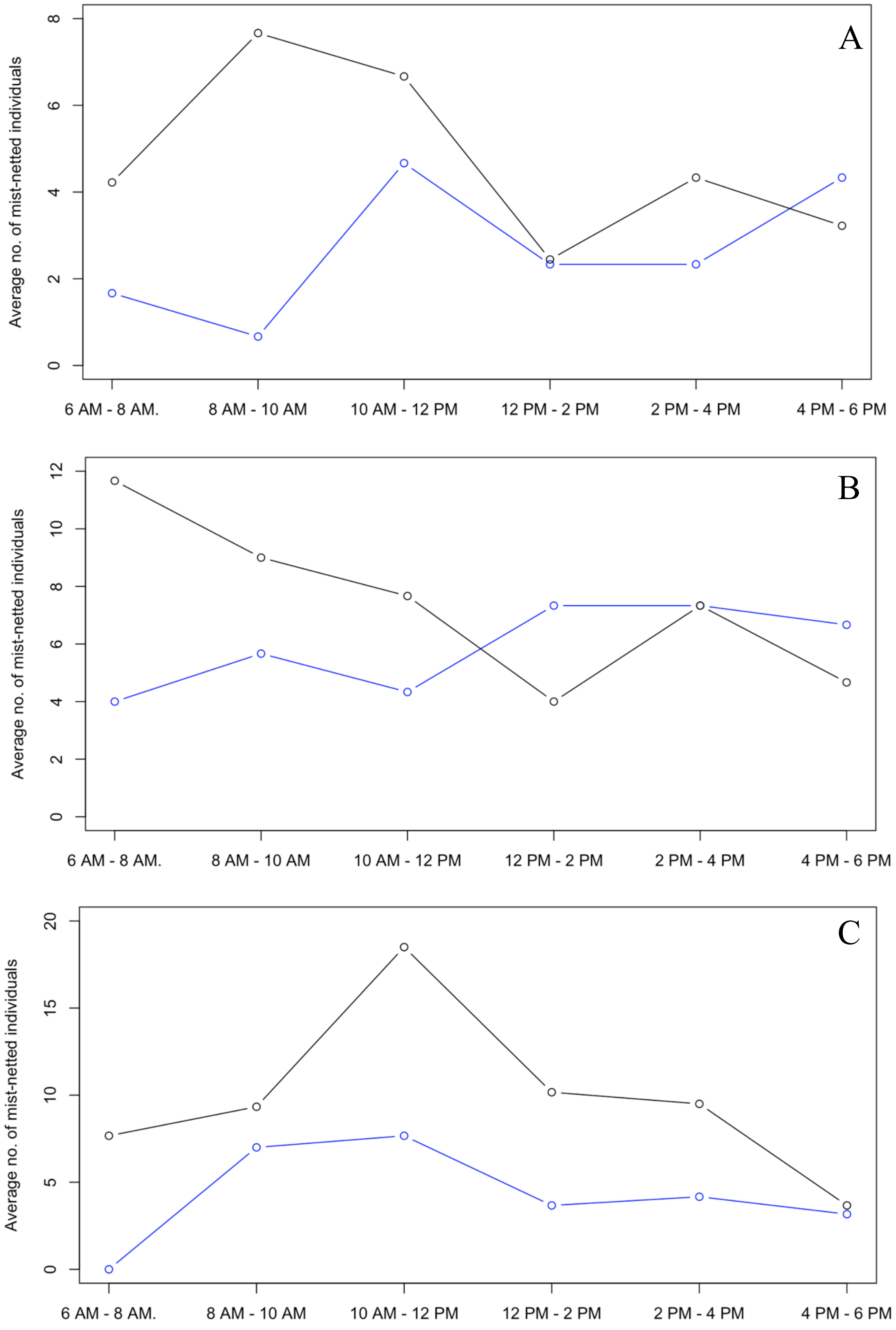


Fig. 20 Comparison of the daily patterns of avian activity during the dry season (black line) and rainy season (blue line) in the lowland forest at 350 m a.s.l. (A), the mid-elevation forest at 1100 m a.s.l. (B) and in the montane forest at 2200 m a.s.l. (C). Each dot represents the average number of birds captured during a two-hour interval.

3.2.3 Diversity and Abundance of Birds Across the Elevations

Species richness of birds along the rainforest gradient on Mt. Cameroon recorded by mist-netting revealed a hump-shaped pattern with the highest values recorded in the mid-elevation forest (Fig. 4B). The total number of individuals recorded per mist-netting session grew with elevation (Fig. 4A). The number of individuals recorded per species also grew with elevation (Fig. 21, 22). Rank-abundance curves show that the evenness of the bird community was the highest in the mid-elevation forest, whereas there were few very abundant bird species caught both in the lowland and montane forest (Fig. 23). The bird diversity measured by Simpson´s index shows a hump-shaped pattern – it grew with elevation, reached its maximum at 1500 m a.s.l. and declined for the two highest elevations in montane forest (Fig. 25).

The rarefaction curves show that three days of mist-netting sampled only a part of the bird community and additional catches were likely to add new species in each elevation (Fig. 24). The highest probability of adding new species was at the mid-elevation forest, as the rarefaction curves at 1100 and 1500 m a.s.l. are the steepest. A similar pattern was observed in the higher altitude of the lowland forest, but the total number of captured individuals was much lower here (Fig. 24). Rarefaction curves are much flatter in the montane forest, showing that more catches do not add many new species and that a higher proportion of the avian community has been sampled (Fig. 24). On the other hand, the plots in the lowest elevations (30 and 350 m a.s.l.) display relatively steep and short rarefaction curves, showing that only a very small proportion of the bird community has been sampled (Fig. 24).

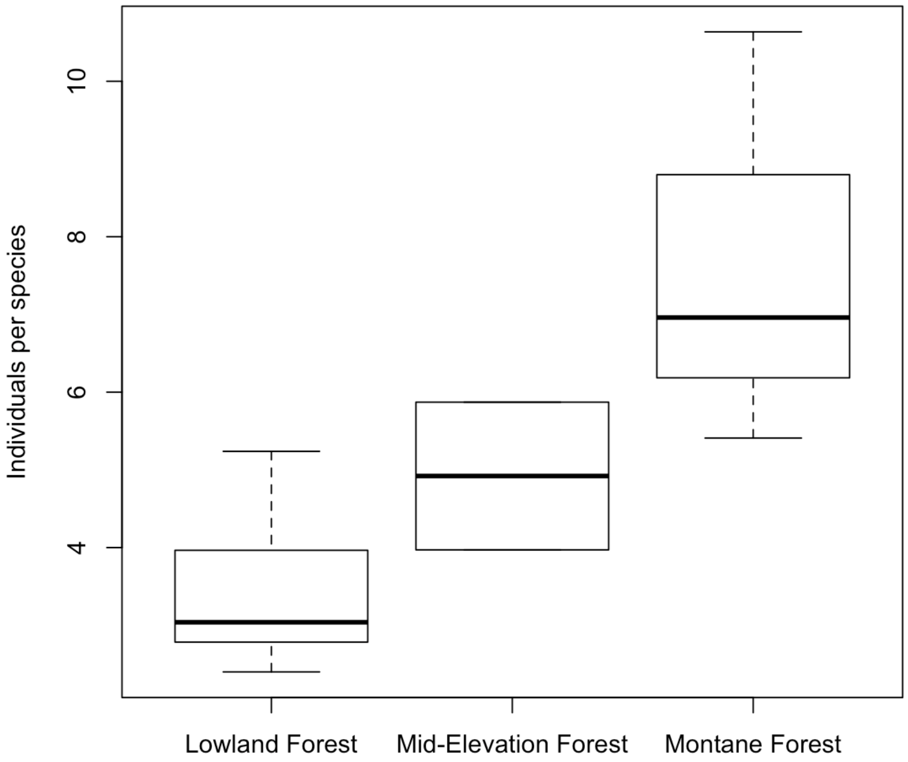


Fig. 21 Number of individuals per species recorded per plot in each forest type: lowland, mid-elevation and montane forest. Thick lines mark the median.

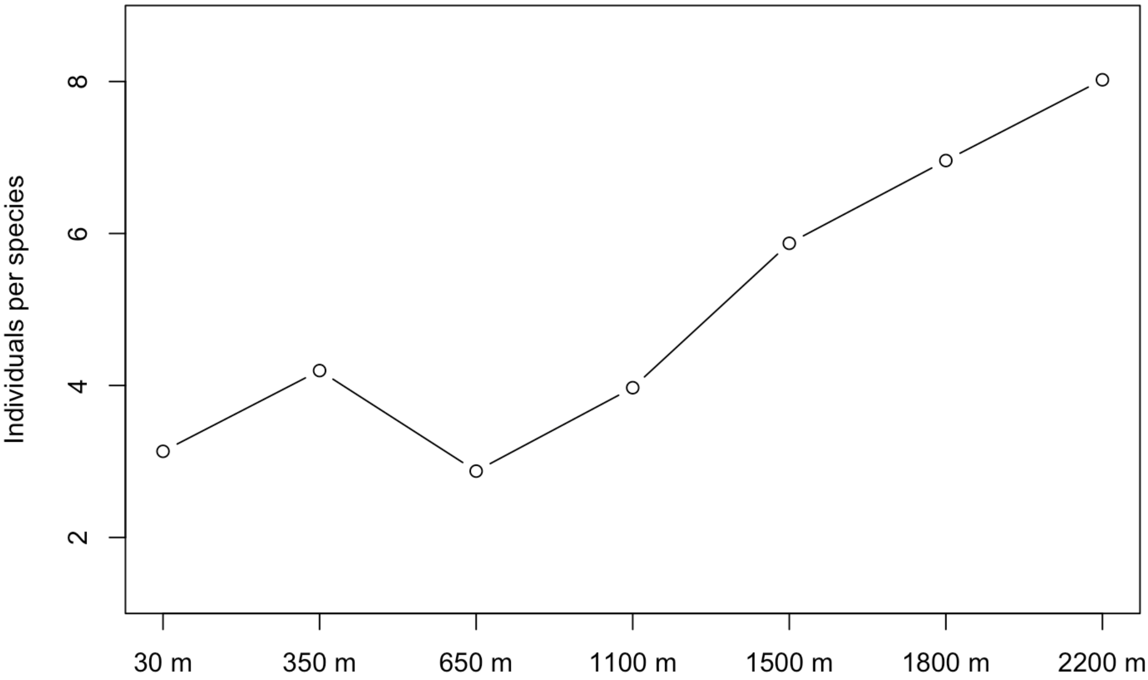


Fig. 22 No. of individuals per species recorded along the forested altitudinal gradient on Mt. Cameroon.

The Lowland Forest

On average, 3.40 individuals per species were mist-netted in the lowland forest (Fig. 21): 3.13 at 30 m a.s.l., 4.20 at 350 m a.s.l. and 2.87 at 650 m a.s.l. (Fig. 22). Species evenness (Fig. 23), as well as the species richness (Fig. 24) of birds recorded by mist-netting was the lowest at 30 m a.s.l. and it grew with elevation within the lowland forest.

The Mid-Elevation Forest

On average, 4.92 individuals per species were mist-netted in the mid-elevation forest (Fig. 21): 3.97 at 1100 m a.s.l. and 5.87 at 1500 m a.s.l. (Fig. 22). Species evenness (Fig. 23) and species richness (Fig. 24) recorded by mist-netting was the highest in this type of forest, but while species evenness grew with elevation in the mid-elevation forest, species richness declined.

The Montane Forest

On average, 7.67 individuals per species were mist-netted in this forest type (Fig. 21): 6.96 at 1800 m a.s.l. and 8.02 at 2200 m a.s.l. (Fig. 22). Species evenness was similar in the two elevations (Fig. 23), whereas species richness was higher at 1800 m a.s.l. than at 2200 m a.s.l. according to the mist-netting data (Fig. 24).

Beta-Diversity Along the Elevational Gradient

Beta-diversity (Jaccard's Index) calculated from our overall mist-netting data was the highest between 30 and 350 m a.s.l., and in the transition zone of the lowland and mid-elevation forest, i.e. between the plots at 650 and 1100 m a.s.l. (Fig. 26). It was still relatively high between 1100 and 1500 m a.s.l. On the other hand, relatively low beta-diversity of bird communities has been found between within particular forest types, i.e. between the plots at 350 and 650 m a.s.l., between the plots at 1500 and 1800 m a.s.l. and between the plots at 1800 and 2200 m a.s.l.

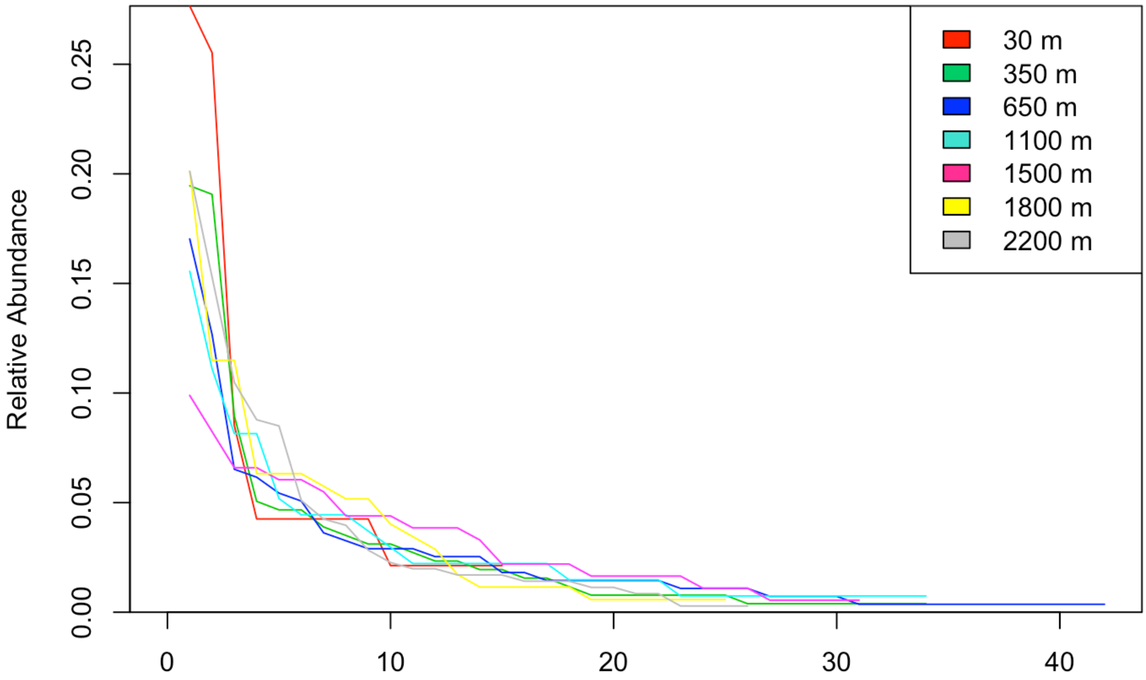


Fig. 23 Rank-abundance curves per plot. Flatter curves point at higher species evenness, i.e. evenness in species abundance per plot.

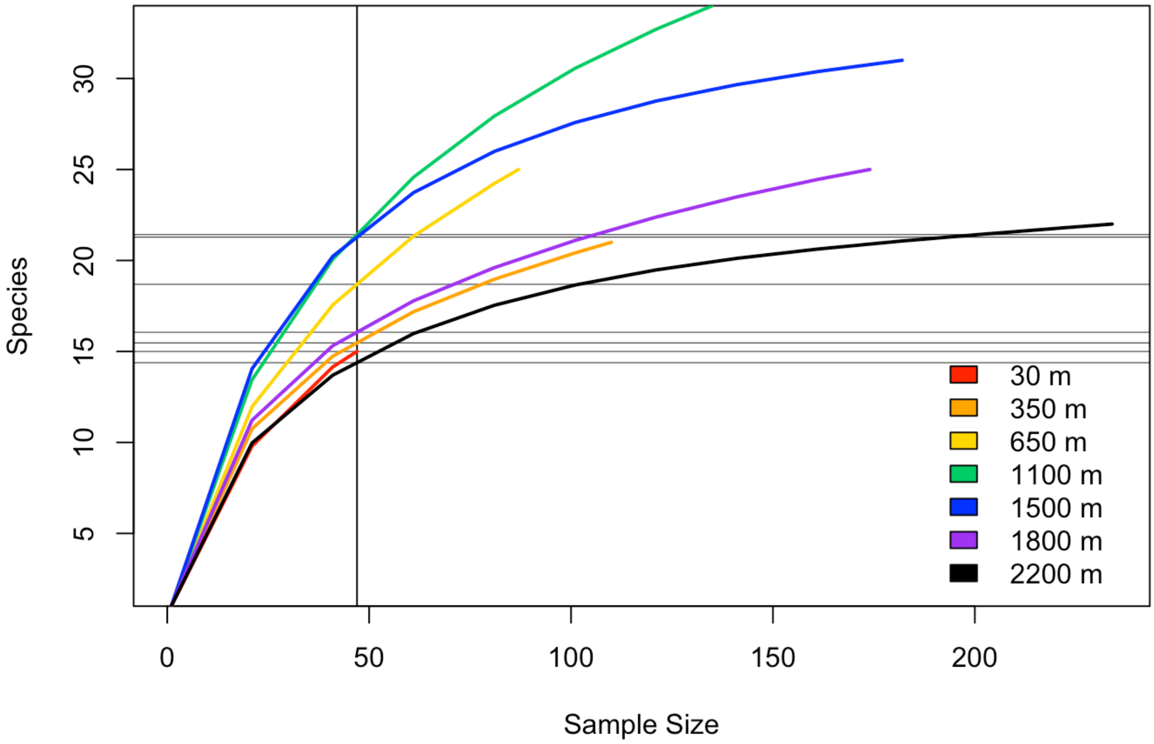


Fig. 24 Rarefaction curves per plot. The proximity of the curve's end to the asymptote reflects the success of species sampling, i.e. if any curve reaches the asymptote, the entire community is sampled, and netting more individuals will not result in any additional new species detections. The vertical line marks the smallest reached sample size. The horizontal lines mark the number of species sampled at the time when the smallest sample size was reached at a given plot.

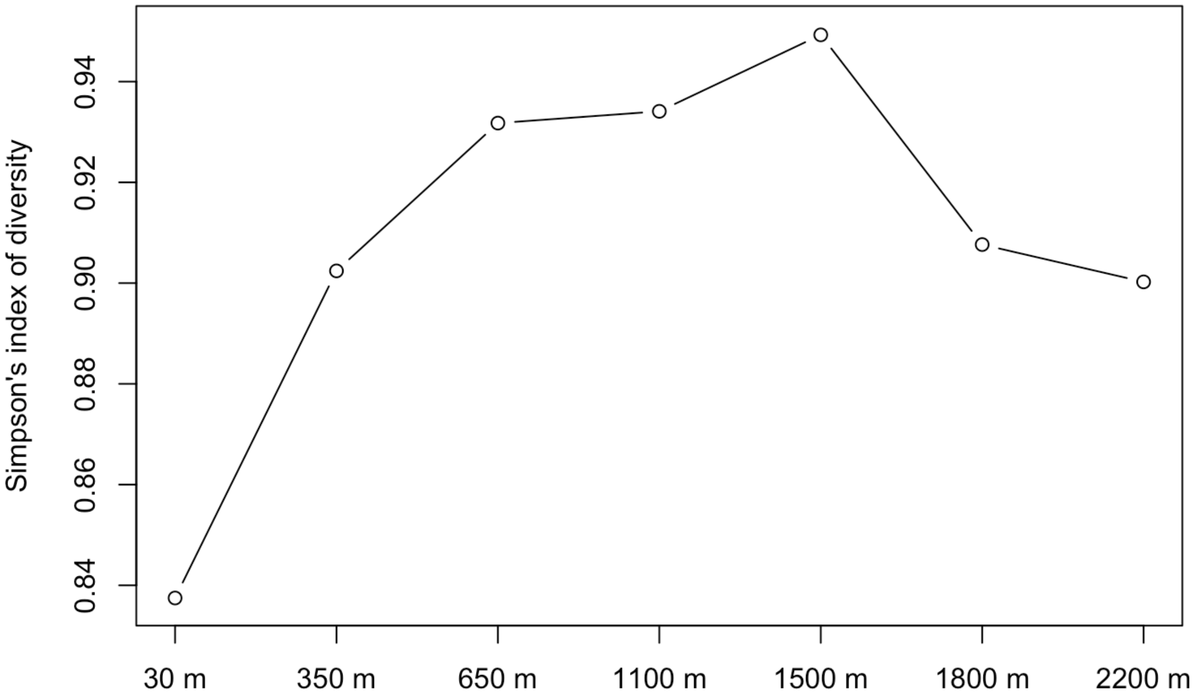


Fig. 25 Species diversity (Simpson's index) along the elevational gradient of Mt. Cameroon. The index operates between 0 and 1, the proximity to 1 marks the highest possible diversity, based on species richness and abundance. Plot elevations are in m a.s.l.

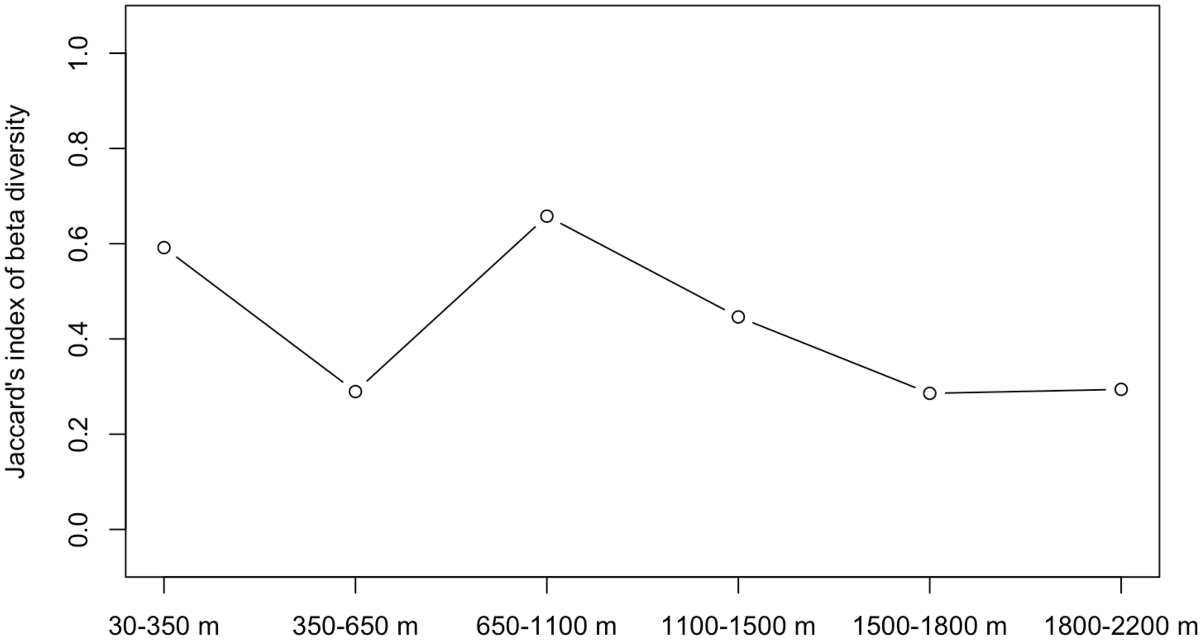


Fig. 26 Beta-diversity (Jaccard's index) along the gradient on Mt. Cameroon. The dots represent the beta-diversity between pairs of plots. Plot elevations are in m a.s.l.

3.2.5 Community Composition on Mt. Cameroon: Feeding Guilds

Insectivores

Insectivores form the most diverse and abundant feeding guild of birds on Mt. Cameroon, with a total of 61 species detected by mist nets. Insectivores dominated the forests of Mt. Cameroon both in individual and species numbers: the proportion of individuals belonging to this guild followed a hump-shaped pattern across the elevational gradient, with the peak at 1100 m a.s.l. (Fig. 27A), and the proportion of insectivorous species followed a flatter hump-shaped trend, with a slight negative skew, and peaked at 1500 m a.s.l. (Fig. 27B).

Since insectivores formed about 66% of all mist-netted species, I further divided them into groups based on their foraging method to see whether there is a higher probability of mist-netting any of them based on the substrate they acquire their food from:

Foliage-Gleaning Insectivores (FGIs):

Overall, 36 out of the 101 check-listed species of FGIs were mist-netted on Mt. Cameroon. Of the 36 detected FGI species, 50% forage on the forest floor (1 out of 2), 50% forage in the understory (18 out of 36), 37.5% forage in the sub-canopy (12 out of 32), and 16.67% forage in the canopy (5 out of 30). Forest-floor foragers made up 4.33%, understory foragers made up 58.94%, sub-canopy foragers made up 20.01%, and canopy foragers made up 16.71% of the relative mist-netted FGI individuals. FGIs dominated the plots at 30 m a.s.l., 1500 m a.s.l., 1800 m a.s.l. and 2200 m a.s.l. in abundance (Fig. 28A), and all plots in species numbers, except 30 .a.s.l., where the number of FGI species was equal to the number of ground-searching insectivore species (Fig. 28B).

On average, the undetected FGIs were heavier than the mist-netted FGIs (Kruskal-Wallis, $\chi^2 = 4.91$, d.f. = 1, P = 0.027), but the majority of the missed FGIs were small, and thus could have been detected, had they collided with the net.

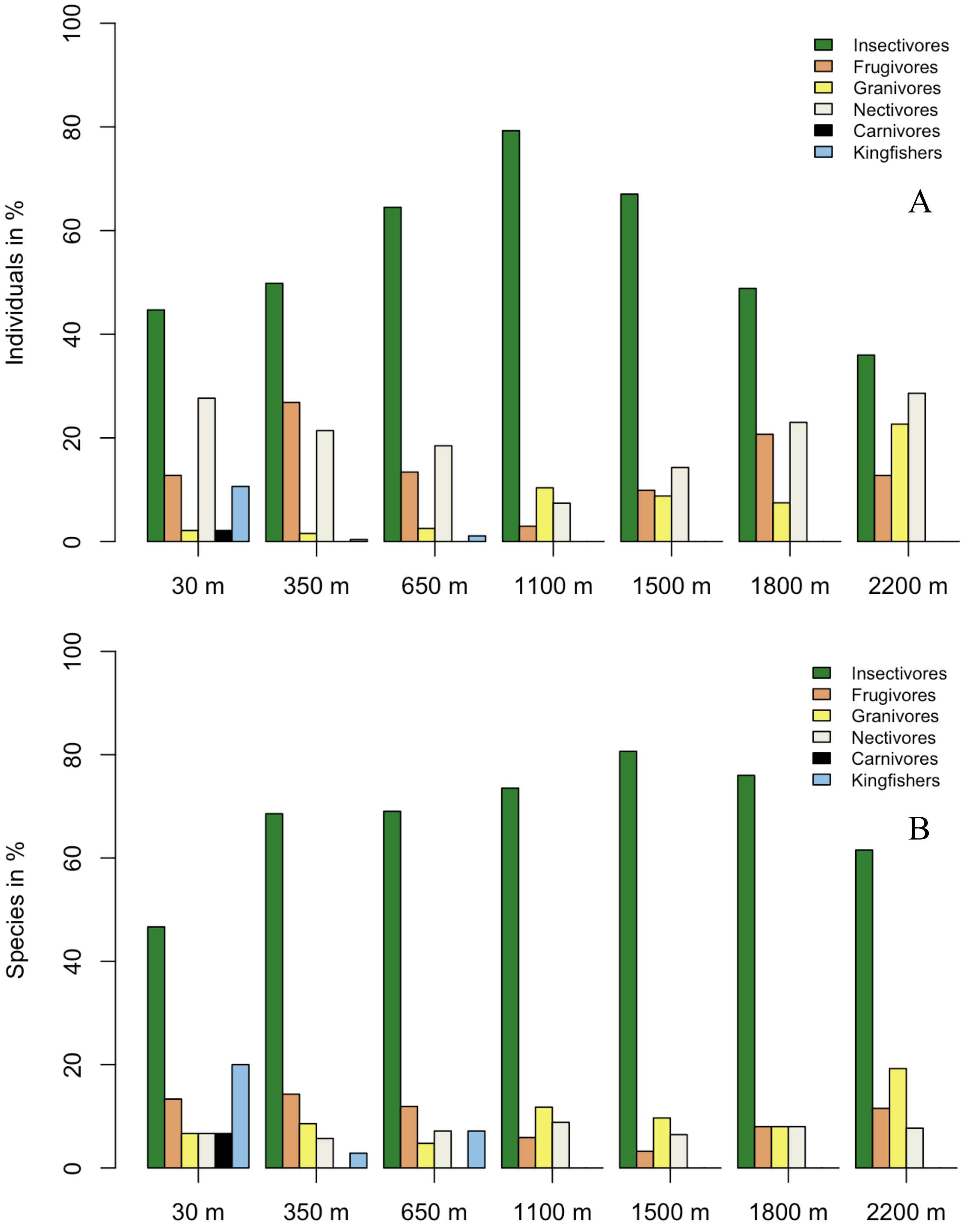


Fig. 27 Proportions of mist-netted individuals (A) and species (B) belonging to six feeding guilds along the forested altitudinal gradient on Mt. Cameroon. Elevations of the plots are in m a.s.l.

Ground-Searching Insectivores (GSIs):

Sixteen out of 26 check-listed species of GSIs were mist-netted on Mt. Cameroon. Mist-netting recorded 7 of 9 small GSIs, 1 of 2 mid-sized GSIs, and 2 of 6 large GSIs. GSIs were the dominant group within insectivorous individuals between 350 and 1100 m a.s.l., and the second most dominant group in this respect at all the other plots (Fig. 27A). However, this feeding guild was relatively rare in the Bimbia-Bonadikombo forest (30 m a.s.l.). In respect to species numbers, GSIs were the second most dominant sub-group in all plots between 350 m a.s.l. and 1800 m a.s.l., equally dominant with FGIs at 30 m a.s.l., and equally low in numbers as the following two sub-groups (Fig. 27B).

Aerial / Flycatching Insectivores (AFIs):

Six of out 19 check-listed species of AFIs were mist-netted on Mt. Cameroon. None of the AFIs forage on the forest floor. Mist-netting detected 3 out of 5 understory foragers, 1 out of 7 sub-canopy foragers and 2 out of 7 canopy foragers within this guild. Few AFIs were mist-netted in the lowland and montane forest. Their abundance peaked at 1500 m a.s.l. and then dropped with growing elevation, as did their individual proportions (Fig. 27A). Most AFI species were mist-netted at 650 m a.s.l. (n = 3) while most AFI individuals were recorded at 1500 m a.s.l. (n = 8; Fig. 27B).

Bark-Probing Insectivores (BPIs):

3 out of 6 check-listed BPIs were mist-netted on Mt. Cameroon. None of the BPIs forage on the ground. Both species that prefer foraging in the understory were mist-netted, 1 of the 2 species of BPIs that forage in the sub-canopy was mist-netted and neither of the BPIs that forage in the canopy were mist-netted. No BPIs were mist-netted at 30 and 350 m a.s.l. Their proportions both in species and mist-netted individuals were low in all plots, but BPI individuals were the third dominant sub-group at both plots in the montane forest (Fig. 27A, B), particularly at 2200 m a.s.l.

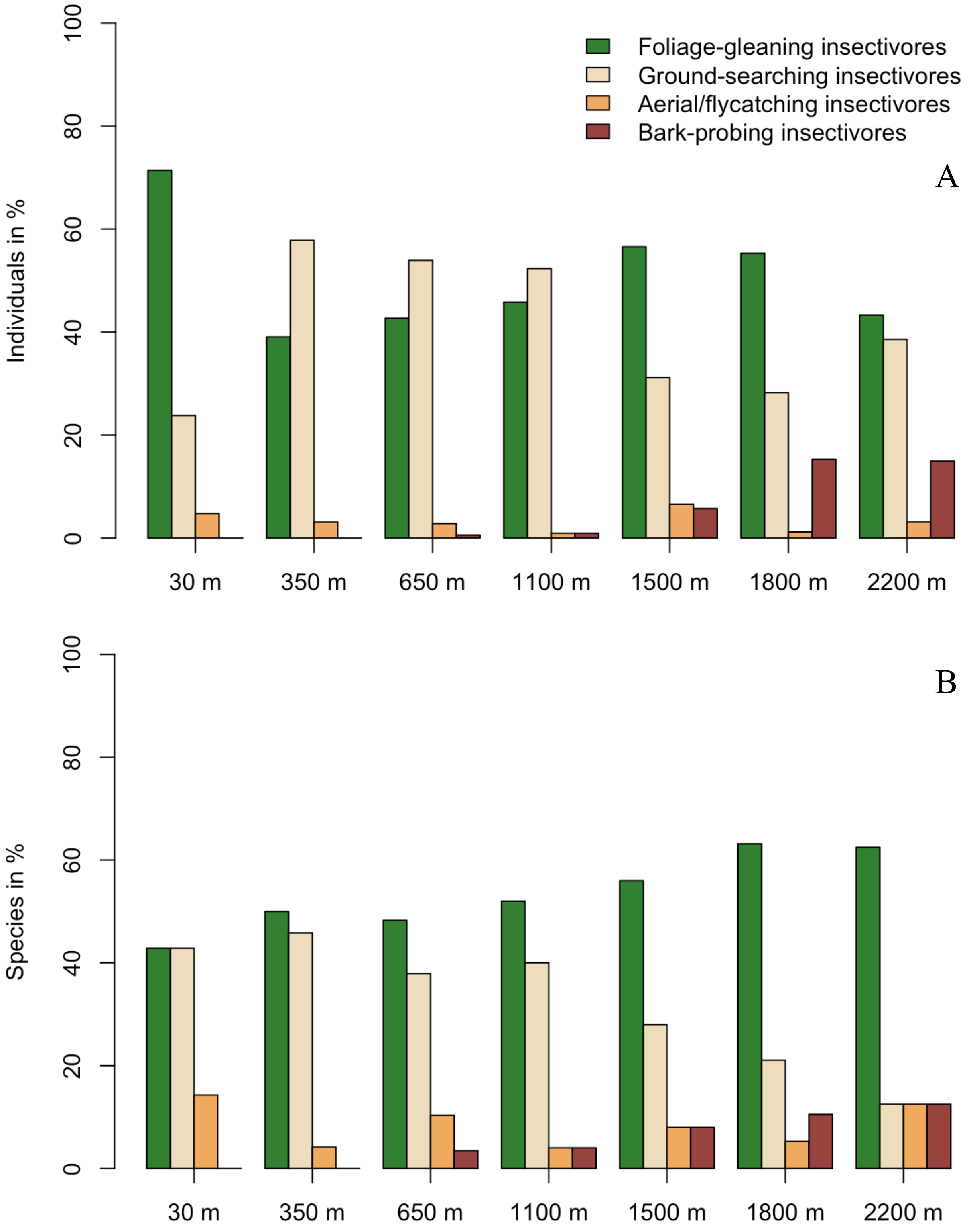


Fig. 28 Proportions of insectivore individuals (A) and species (B) mist-netted on Mt. Cameroon, belonging to four specialist groups based the substrate they acquire their food from, listed in the top-right legend. Elevations of the plots are in m a.s.l.

Frugivores

A total of 10 frugivorous species were detected by mist-netting along the forested altitudinal gradient on Mt. Cameroon. The proportion of the individuals of this guild followed a bimodal distribution, with the peaks at 350 and 1800 m a.s.l. and low abundance in the mid-elevation forest (Fig. 27A). The proportion of frugivorous species was similarly high across all plots in the lowland forest, where it peaked at 350 m a.s.l., whereas it was the lowest at 1500 m a.s.l. (Fig. 27B). None of the frugivores recorded on Mt. Cameroon prefer foraging in the ground. Two species (one small and one medium-sized) have no stratum preferences and were thus likely to appear in the understory, but only the smaller one (*Andropadus latirostris*) was detected by mist nets. It was recorded in all plots in the lowland and represents 28.2% of all mist-netted frugivorous individuals (based on relative abundance). Five species of frugivorous understory foragers are known to occur on Mt. Cameroon. Three are medium-sized, and two are small. One of the small species (*Andropadus virens*) was detected by mist nets across all plots in the lowland forest and represents 7% of all mist-netted frugivorous individuals (based on relative abundance). All small sub-canopy foragers that are known to occur across all forest types were mist-netted, most frequently in the montane forest. Altogether, they represented 17.1% of all mist-netted frugivorous individuals (based on relative abundance). More than half of Mt. Cameroon’s frugivores are canopy foragers, and while only four of the 21 species were mist-netted, they represented 47.4% of all mist-netted frugivorous individuals (based on relative abundance). This is mainly caused by the great abundance of *Andropadus tephrolaemus* at high elevations, especially at 1800 m a.s.l., where 35 individuals of this species were mist-netted – more than any other species in any plot. For this reason, the relative abundance of *A. tephrolaemus* formed 44.6% of all mist-netted frugivorous individuals (based on relative abundance).

Granivores

A total of 10 granivorous species were detected by mist-netting along the forested altitudinal gradient on Mt. Cameroon. The individuals of this guild constituted a minor part of the mist-netted community in the lowland forest, reached higher proportions in the mid-elevation forest, and peaked at 2200 m a.s.l. (Fig. 27A). A similar trend could be seen in respect to the proportions of species of this guild (Fig. 27B). According to our species checklist, 77.8% of granivores forage on the ground. All but one small forest-floor foraging granivores were detected by mist nets. Mist-netted individuals of all forest floor foragers of this guild represented 54.7% of the mist-netted granivorous community (based on relative abundance). Two of three species of the granivorous understory foragers were recorded by mist nets. They formed 42.6% of the guild's relative abundance due to the high abundance of *Linurgus olivaceus* between 1500 and 2200 m a.s.l. The only species within this guild that mainly forages in the sub-canopy (*Nigrita fusconota*) was detected by mist nets and represents the remaining 2.7% of the granivorous community (based on relative abundance).

Nectarivores

A total of 5 nectarivorous species were mist-netted in the forests of Mt. Cameroon. The proportion of nectarivorous individuals followed a U-shaped pattern across the plots and peaked at 2200 m a.s.l. (Fig. 27A). The proportion of species belonging to this guild remained fairly constant across all elevations but peaked at 1100 m a.s.l. (Fig. 27B). Our mist-netting data conclude that nectarivores are among the most abundant (or most frequently mist-netted) birds inhabiting the forests of Mt. Cameroon, reaching high abundances in the montane forest, albeit appearing in higher numbers than most species in the lowland forest, too. All nectarivores in our checklist are small. In fact, three of them (*Cinnyris batesi*, *Cinnyris ursulae* and *Cinnyris reichenowi*) are the smallest mist-netted birds in our dataset (6.17, 6.5, and 6.6 respectively). None of the nectarivores in our checklist forage on the forest floor. Two highly abundant understory foragers, who replace each other along the gradient (lowland specialist *Cyanomitra olivacea* and montane specialist *Cyanomitra oritis*) were mist-netted. They formed 46.71% of the mist-netted nectarivorous community (based on relative abundances). Likewise, two sub-canopy foragers were mist-netted: the relatively rare *Cinnyris ursulae*, and the most abundant netted nectarivore, *Cinnyris reichenowi*, together forming 50.92% of the mist-netted nectarivorous community (based on relative abundances). In fact, *Cinnyris reichenowi* was the second most common species in our dataset (based on relative abundances). The remaining 2.37% of the mist-netted nectarivorous individuals belonged to a canopy-foraging species, *Cinnyris batesi*.

Carnivores

The only mist-netted carnivore was a single individual of *Accipiter tachiro* at 30 m a.s.l. (Fig. 27A, B).

Kingfishers (Alcediniidae)

Five species of kingfishers were mist-netted, and only in the lowland forest. Two species were small, two were medium-sized and one was large. Overall, the largest number individuals (n = 6) and species (n = 4) belonging to this group were recorded at 30 m a.s.l. (Fig. 27A, B), which is unsurprising due to the proximity of this plot to a stream and the sea.

3.3 Comparison of Mist-Netting and Point Counts

3.3.1 Species Detection

For the comparison of mist-netting and point counts, I only used those mist-netting terms that were conducted in the exact same dates as point counts. Point counts detected 172 species across 7 plots in one term per elevation. Mist-netting detected 82 species in the same plots during the same terms. Overall, the mist-netting method detected 9 species undetected by point counts: *Alcedo leucogaster, Anthus cinnamomeus, Cinnyris ursulae, Euplectes capensis, Indicator maculatus, Nigrita fusconota, Sasia africana, Spermophaga haematina* and *Zoothera crossleyi.*

The Lowland Forest

Of the 180 species check-listed in the lowland forest, 39 were mist-netted and 115 point-counted. Thus, mist-netting missed 78.3% and point counts missed 36.1% of the species from our lowland checklist. Six species detected by mist nets were missed by point counts in the lowland forest: *Alcedo leucogaster, Cryptospiza reichenowi, Sasia africana*, *Zoothera camaronensis, Zoothera crossleyi* and *Turdus pelios.*

The Mid-Elevation Forest

Of the 127 species check-listed in the mid-elevation forest, 47 were mist-netted and 81 point-counted. Thus mist-netting missed 62.99% and point counts 36.22% of the species from our mid-elevation checklist. Eleven species detected by mist nets were missed by point counts in the mid-elevation forest: *Andropadus curvirostris, Anthus cinnamomeus, Aplopelia larvata, Campethera petiti, Cinnyris ursulae, Cryptospiza reichenovii, Illadopsis rufiventer, Indicator maculatus, Nigrita fusconota, Ploceus melanogaster* and *Spermophaga haematina.*

The Montane Forest

Of the 72 species check-listed in the montane forest, 33 were mist-netted and 49 point-counted. Thus, mist-netting missed 45.8% and point counts missed 31.9% of the species from our montane checklist. Five species detected by mist nets were missed by point counts in the montane forest: *Alethe poliocephala, Estridla nonnula, Euplectes capensis, Indicator maculatus,* and *Ploceus insignis.*

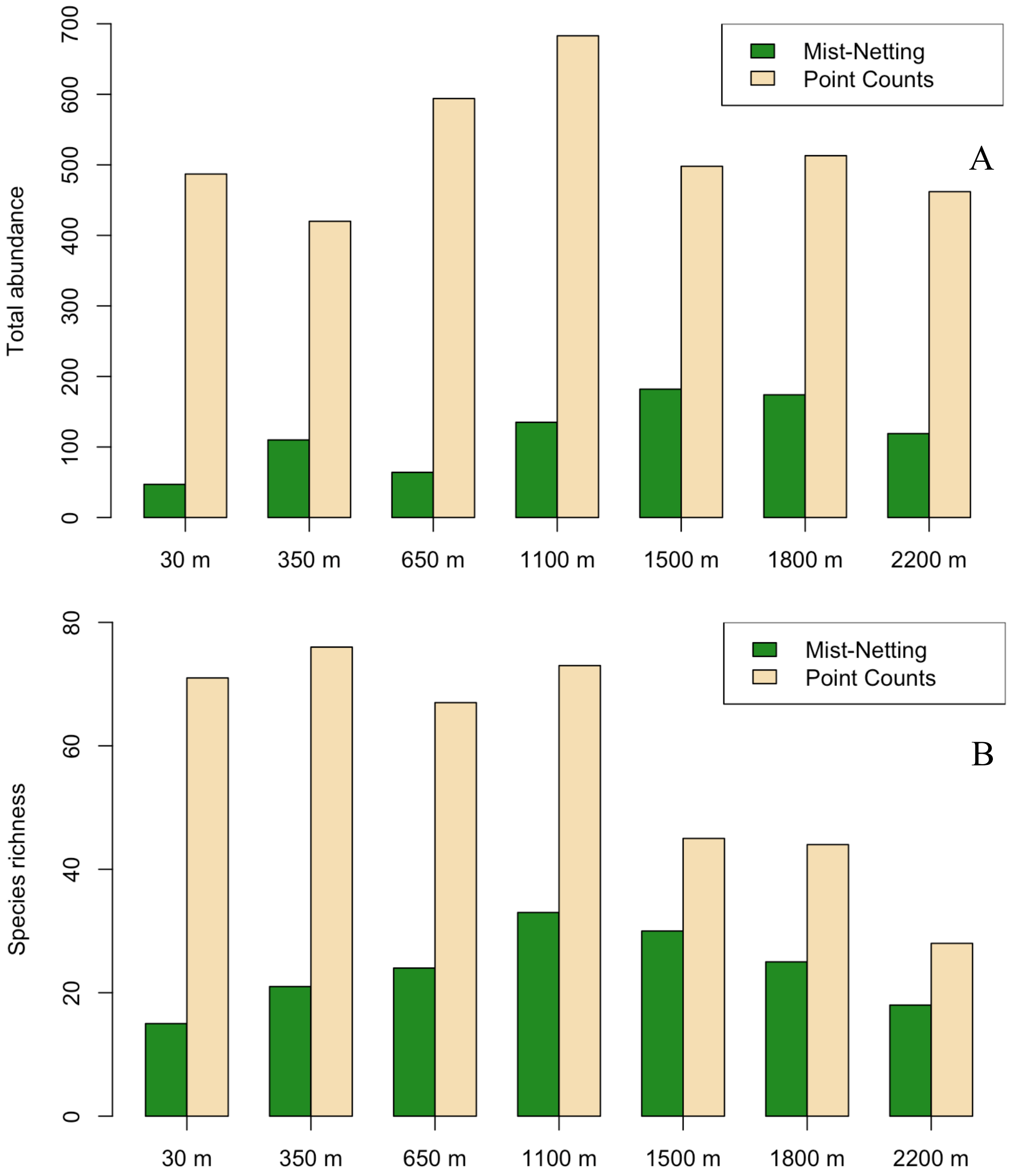


Fig. 29 Total abundances (A) and species richness (B) recorded by mist nets (green) and point counts (cream) during the same terms across 7 plots along the forested elevational gradient on Mt. Cameroon.

3.3.2 Species Richness, Diversity and Abundance Estimates

The point count method recorded a rather low-plateau pattern of species richness, with a decline in species richness above 1100 m a.s.l. The mist-netting method revealed a hump-shaped pattern of species richness with a mid-elevation peak around 1100 m a.s.l. (Fig. 29A). The total number of individuals as detected by point counts did not vary too much across elevations, but peaked at 1100 m a.s.l. The total abundance of birds as detected by mist nets was greater in the mid-elevation and montane forest (Fig. 29A).

Mist-netting detected fewer species than point counts (Kruskal-Wallis, $\chi^2 = 32.31$, p-value < 0.001; Fig. 29B; Table 2), and the elevational abundances calculated from mist-netting data were lower than the elevational abundances calculated from point count data in all plots except 350 m a.s.l., where the difference in the mean abundance recorded by each methods was only 2.68% (Wilcoxon rank sum test, W = 749, P > 0.2). *Cryptospiza reichenowi* and *Estrilda nonnula* were more likely to be mist-netted than point-counted (Table 2).

Point counts recorded higher species evenness of bird communities than mist-netting in all plots (Fig. 30A, B, C). Moreover, the trends in species evenness across the elevations varied between the methods: following the gradient uphill, point counts estimated maximum species evenness at 650 m a.s.l. (i.e. the lowest slope of the curve, Fig. 30 A), and a continuously declining evenness further uphill (Fig. 30B, C), while mist-netting estimated maximum species evenness at 1500 m a.s.l. (Fig. 30B), and a similarly high relative abundance of a few dominating species in all the other plots (Fig. 30). As a result, the estimates of species evenness were very different between the methods in the lowland forest (Fig. 30A) and more similar at higher elevations (Fig. 30B, C), particularly at 1500 m a.s.l (Fig. 30B).

Not surprisingly, species diversity estimates (Simpson's Index) based on mist-netting data were lower in comparison with point-count data at all elevations on Mt. Cameroon (Fig. 31). Both methods also differed in species diversity patterns recorded across the elevations. Data based on point counts show that species diversity declined continuously with elevation whereas data based on mist-netting data revealed a hump-shaped pattern with the peak at 1500 m a.s.l. (Fig. 31).

Beta diversity estimates (Jaccard's Index) were very similar for both methods between each neighbouring elevational plots but differed in magnitude (Fig. 32). The greatest beta diversity revealed by both methods was between 650 and 1100 m a.s.l., at the transition zone of the lowland and mid-elevation forest. Relatively low beta-diversity was confirmed by both methods within particular forest types (Fig. 32).

Rarefaction curves based on point count data (Fig. 33A) are generally flatter and closer to an asymptote at the end of the curves if compared to mist-netting (Fig. 33B). This is simply because point counts are able to detect more species. Rarefaction curves also show a relatively clear altitudinal trend in case of point counts, with growing species richness up to 650 m a.s.l. and a decline with growing elevation thereafter (Fig. 33A) whereas mist-netting data rather separated the elevations into two groups – mid elevations (650, 1100 and 1500 m a.s.l.) and low and high elevations (30, 350, 1800 and 2200 m a.s.l.).

Both methods confirm that Mt. Cameroon's bird communities are dominated by insectivores as much in species richness as in abundance. In concordance with our mist-netting data, the point-count data confirm that their dominance increases toward the mid-elevation at 1100 m a.s.l. (Fig. 34A). It then drops again until it reaches a plateau in the montane forest (Fig. 44A), while, according to our mist-netting data, their dominance further declines with growing elevation in the montane forest, where it almost levels with that of the nectarivorous guild near the treeline (Fig. 34B).

According to point counts, frugivores are the second most abundant guild across all elevations in the forests of Mt. Cameroon (Fig. 34B), whereas according to mist-netting, they are the second most abundant group only in the lowland forest, and their rank is overtaken by nectarivores in the mid-elevation and montane forest (Fig. 34A). Each method found the guilds' proportions to reach various levels of dominance per plot. Nevertheless, there is an apparent elevational pattern in the proportions of individuals belonging to the three most abundant guilds (insectivores, frugivores and nectarivores), especially between 350 and 1800 m a.sl., which is similar for both surveying methods: insectivores follow a positive hump-shaped pattern with a mid-elevational peak, whereas frugivores and nectarivores follow a negative hump-shaped pattern with a mid-elevational minimum (Fig. 34A, B).

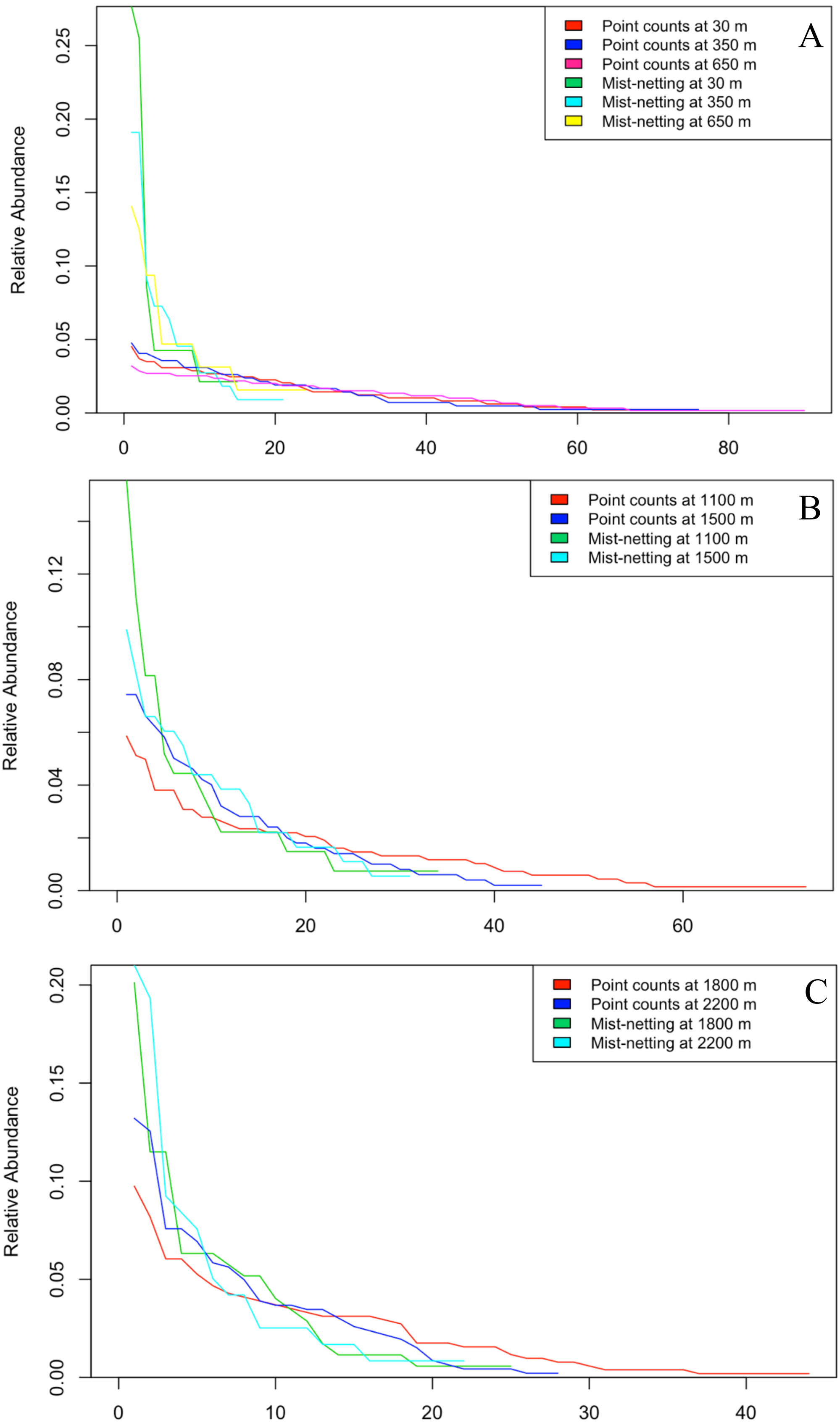


Fig. 30 Rank-abundance curves drawn from point-count and mist-netting data collected during identical terms in the lowland forest (A), mid-elevation forest (B) and montane forest (C). Flatter curves point at higher species evenness.

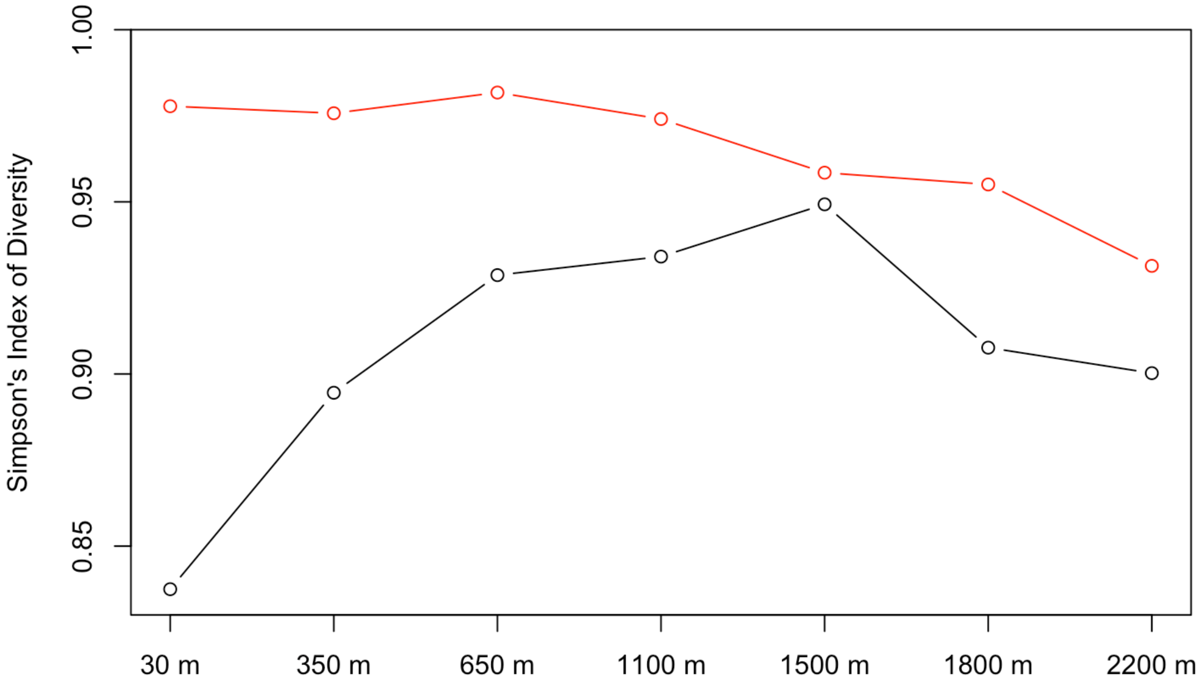


Fig. 31 Simpson's index of diversity along the elevational gradient of Mt. Cameroon based on point-count (red line) and mist-netting (black line) data collected during identical terms. The index operates between 0 and 1. The proximity to 1 marks maximum diversity, based on species richness and abundance. Plot elevations are in m a.s.l.

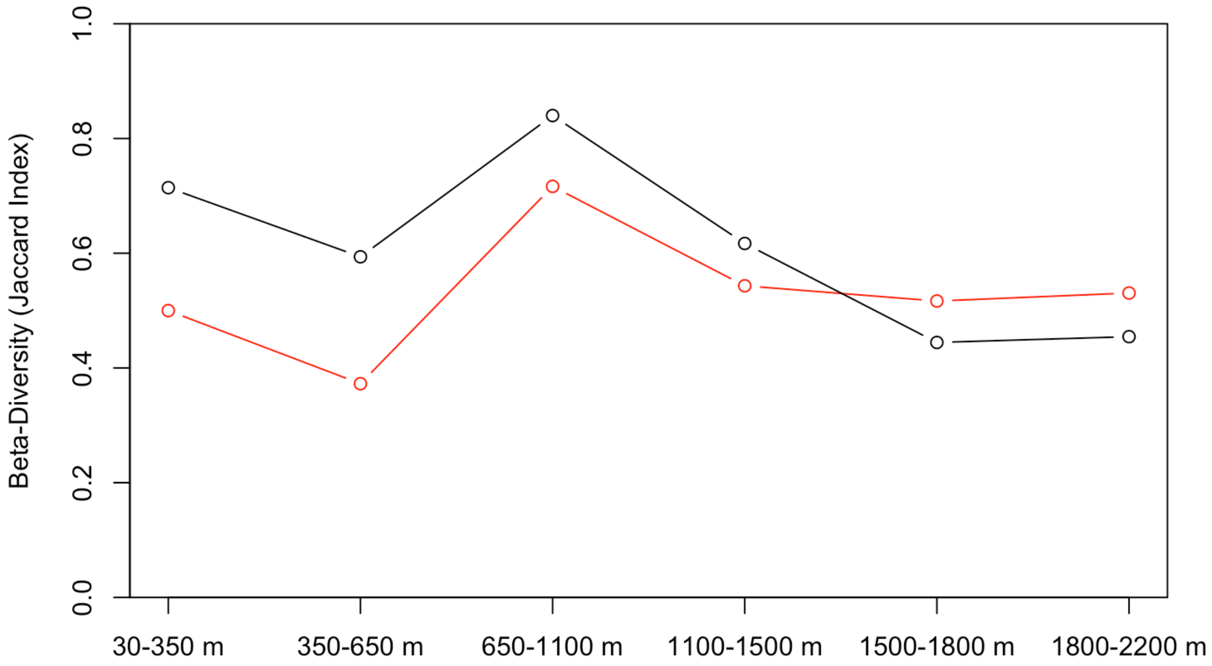


Fig. 32 Beta diversity interpreted by Jaccard's index along the gradient on Mt. Cameroon based on point-count (red line) and mist-netting (black line) data collected during identical terms. The dots represent the beta-diversity between pairs of plots. Plot elevations are in m a.s.l.

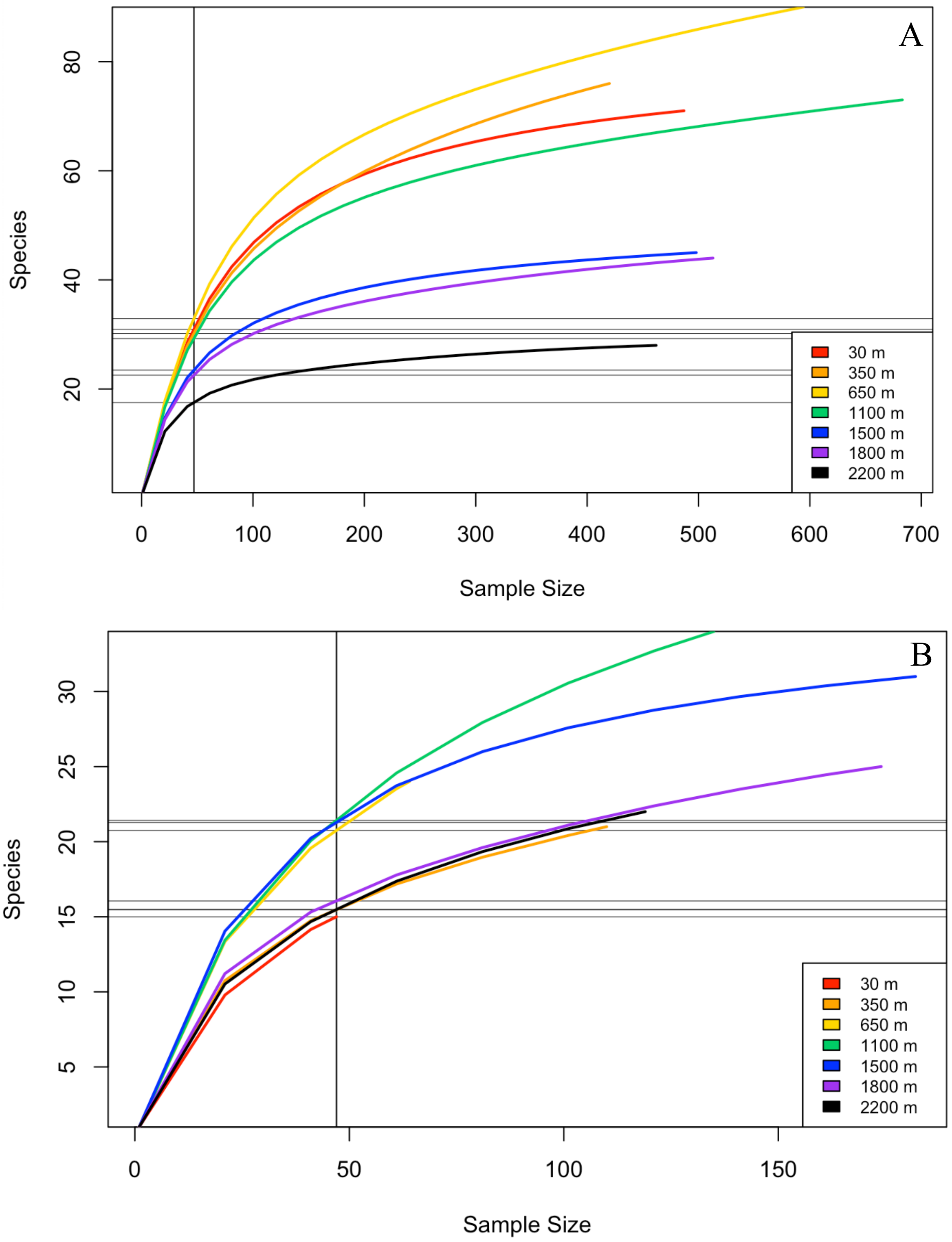


Fig. 33 Rarefaction curves per plot based on point-count data (A) and mist-netting data (B) collected during identical terms. The proximity of the curve's end to the asymptote reflects the success of species sampling, i.e. if any curve reaches the asymptote counting or mist-netting more individuals will not result in any additional new species detections. The vertical line marks the smallest sample size reached by mist-netting, and the horizonal lines show the number of species detected when the smallest total abundance was reached at the given plot.

Granivore proportions were equally low in all lowland plots, slightly increase in the mid-elevation forest and remained fairly similar across all higher plots. Mist-netting detected a more pronounced increase in their proportions at 2200 m a.s.l. (Fig. 34A).

Kingfishers were only detected in the lowland forest by both surveying methods, whereas carnivores made up a minimal proportion of Mt. Cameroon’s recorded community.

Finally, in contrast to mist-netting, point-count data show a higher proportion of frugivorous species in all plots of the mid-elevation and montane forest, equal or somewhat lower proportions of granivorous species in the lowland forest and lower proportions of this guild in all higher elevation sites, and much lower proportions of nectarivorous species in all plots (Fig. 35A, B).

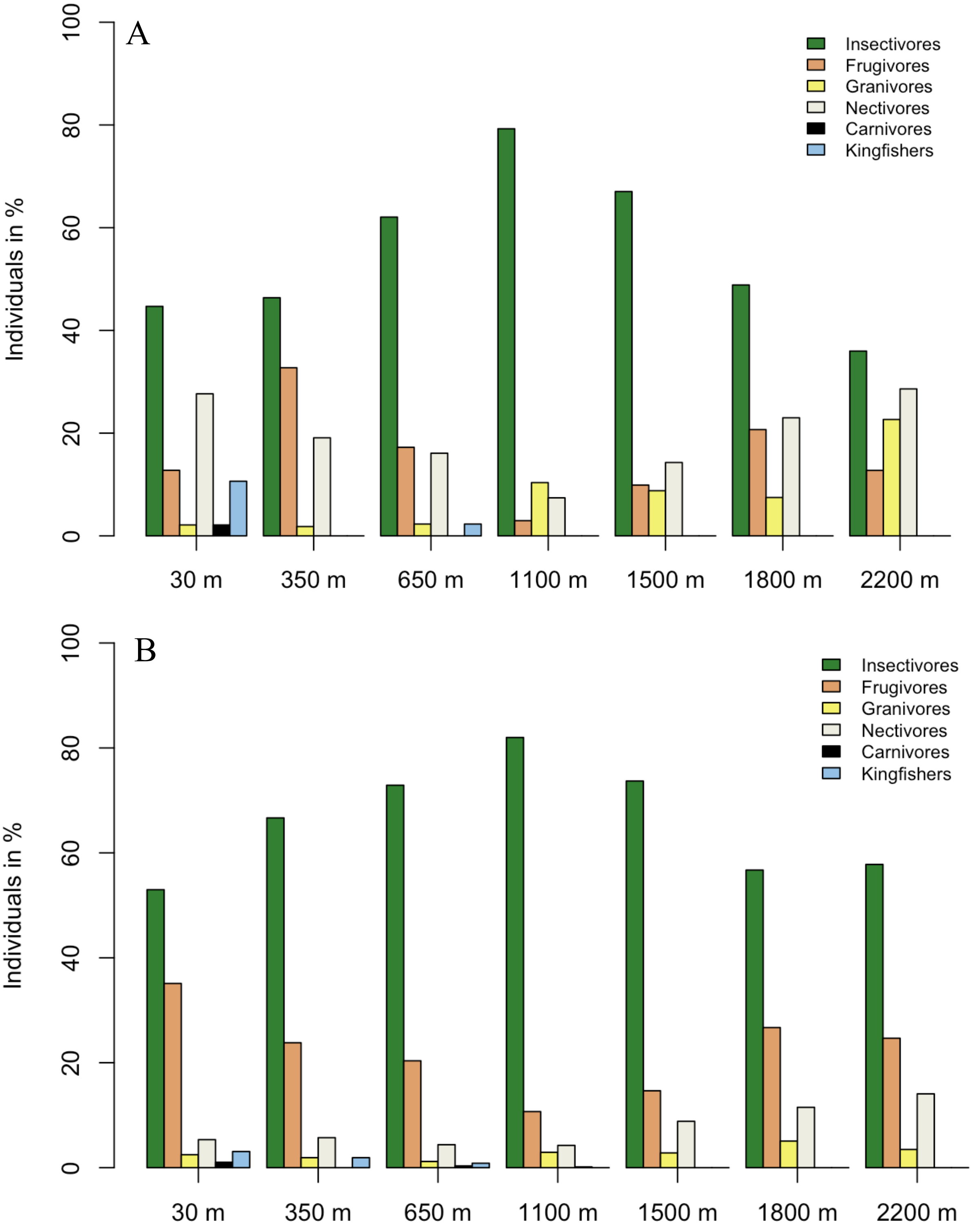


Fig. 34 Proportions of individuals mist-netted (A) and point counted (B) in all elevational plots on Mt. Cameroon. The birds are divided into six feeding guilds listed in the top-right legend.

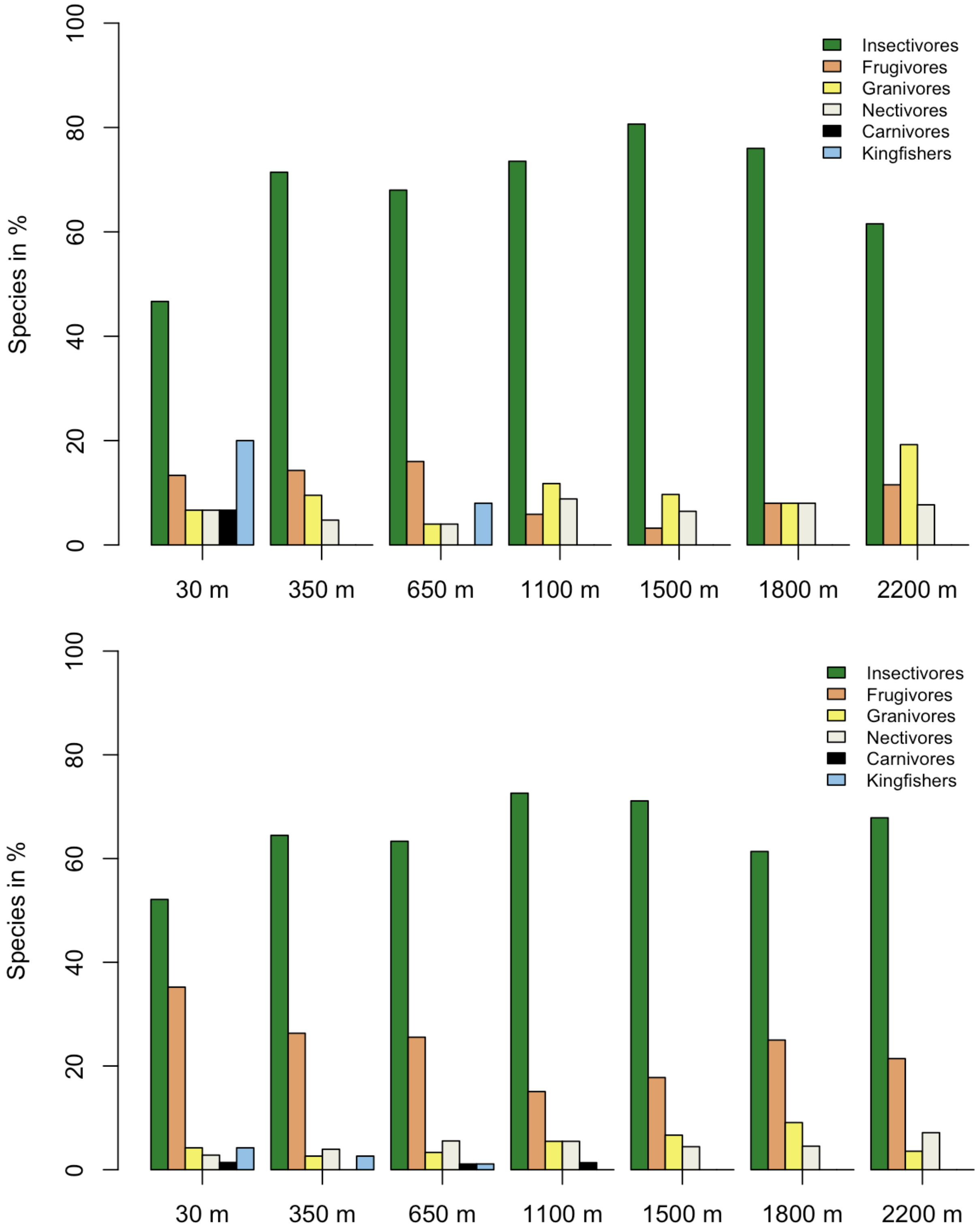


Fig. 35 Proportions of species mist-netted (A) and point counted (B) in all elevational plots on Mt. Cameroon. The birds are divided into six feeding guilds listed in the top-right legend.

3.3.4 Correlation Between Capture Rate and Point Count Density

The correlation (Spearman's correlation coefficient) between capture rate (CR; i.e. no. of birds per species recorded per 1000 mist-netting hours) and point count density (PCD; i.e. no. of birds per species recorded per 10 ha) grew with elevation (Fig. 36). The resulting CR/PCD ratio was high for species well represented in the mist-netting data if compared to the point-count data, and low for species that were underrepresented in mist nets or completely missed. The CR/PCD ratio was not calculated for species that were missed by point counts.

Bimbia-Bonadikombo site, 30 m a.s.l.

Size did not explain the growing CR/PCD ratio at this elevational plot (Kruskal-Wallis, $\chi^2 = 1.81$, d.f. = 2, $P > 0.2$) and nor did their flocking behaviour (Kruskal-Wallis, $\chi^2 = 0.90$, d.f. = 2, $P > 0.2$). The CR/PCD ratio could also be explained by the foraging stratum preferences of the mist-netting birds (Kruskal-Wallis, $\chi^2 = 17.58$, d.f. = 4, $P = 0.0015$), as sub-canopy and canopy foragers were underrepresented in the mist-netting data from this elevational plot. Feeding guilds also seem to explain the variance in the CR/PCD ratio (Kruskal-Wallis $\chi^2 = 12.73$, d.f. = 5, $P = 0.026$), but this is due to the few species of kingfishers, nectarivores and the one carnivore recorded at this plot, which makes it impossible to test further with Dunn tests. Finally, *Cyanomitra olivacea* was the most abundant species at this site according to point counts and mist nets alike (Fig. 36).

Bamboo Camp site, 350 m a.s.l.

Bird size did not explain the growing CR/PCD ratio at this elevational plot (Kruskal-Wallis, $\chi^2 = 4.812$, d.f. = 2, $P = 0.09$), albeit the large species were substantially underrepresented in the mist-netting data collected at this plot. It was also not explained by their flocking behaviour (Kruskal-Wallis $\chi^2 = 3.7253$, d.f. = 2, $P = 0.155$), nor by their feeding guild (Kruskal-Wallis, $\chi^2 = 5.15$, d.f. = 4, $P > 0.2$). However, the CR/PCD ratio could be explained by the birds' foraging stratum preferences (Kruskal-Wallis, $\chi^2 = 18.67$, d.f. = 4, $P < 0.001$), as birds with no stratum preferences and those preferring the forest floor were mist-netted in greater numbers than birds from higher strata at this elevational plot. Finally, *Cyanomitra olivacea* was the most abundant species at this site according to point counts and mist nets alike (Fig. 37).

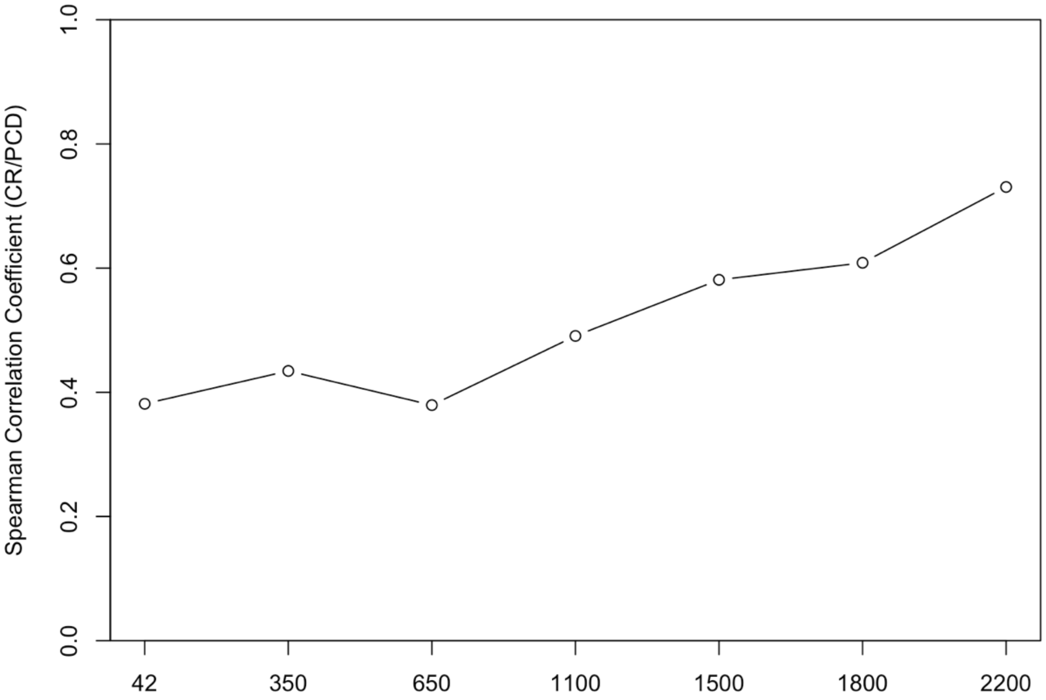


Fig. 35 The correlation between capture rate and point count density interpreted by Spearman's correlation coefficient along the forested elevational gradient on Mt. Cameroon. The elevational plots are in m a.s.l.

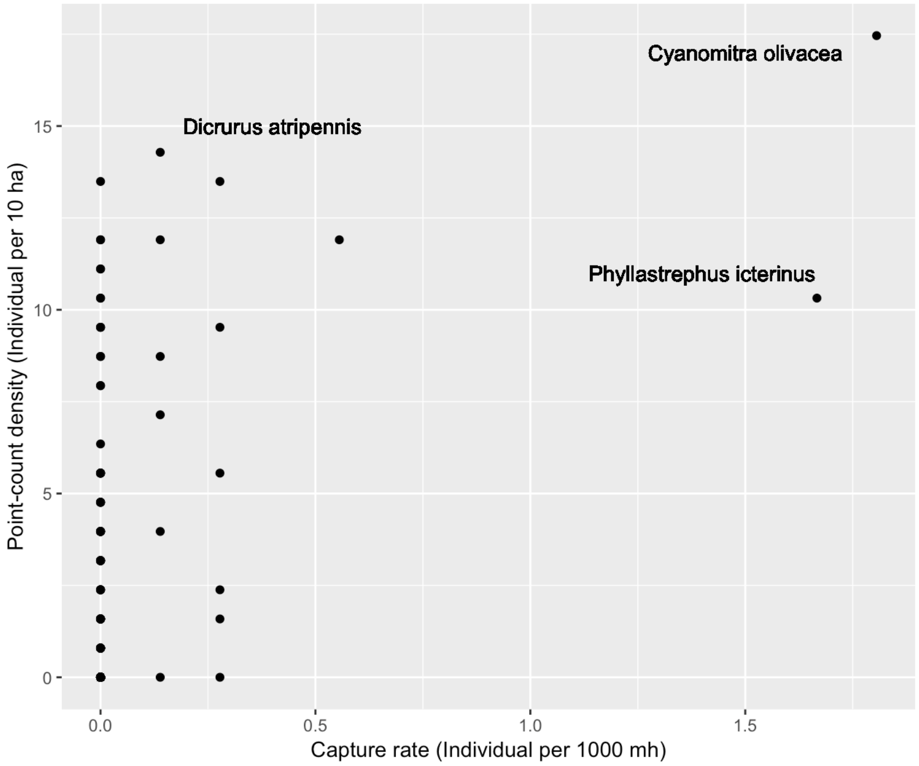


Fig. 36 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 30 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.3815, S = 1479082, $P < 0.001$.

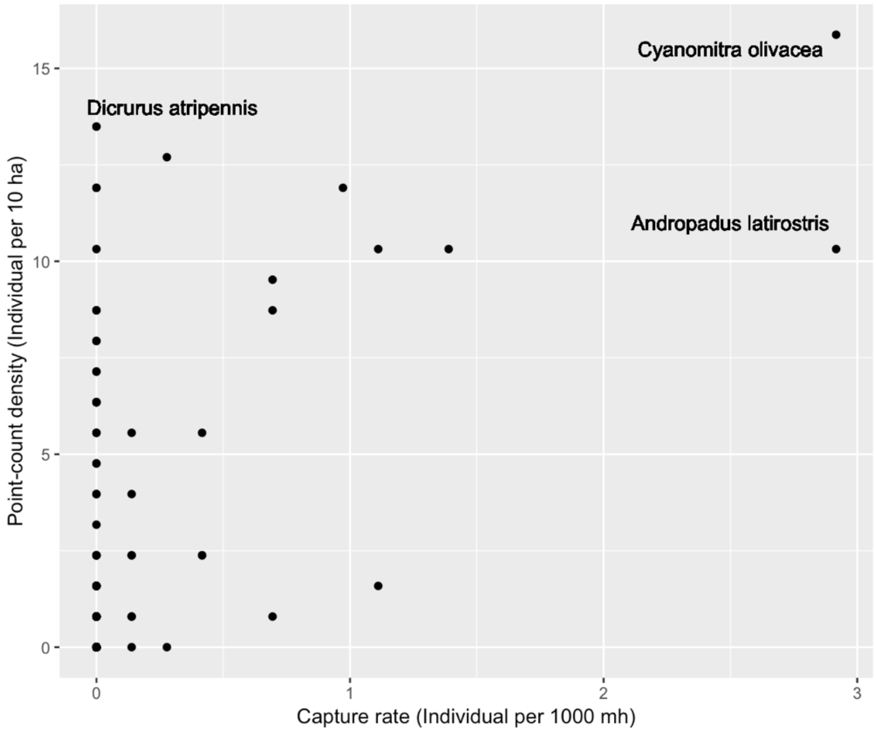


Fig. 37 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 350 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.4344, S = 1352641, P < 0.001.

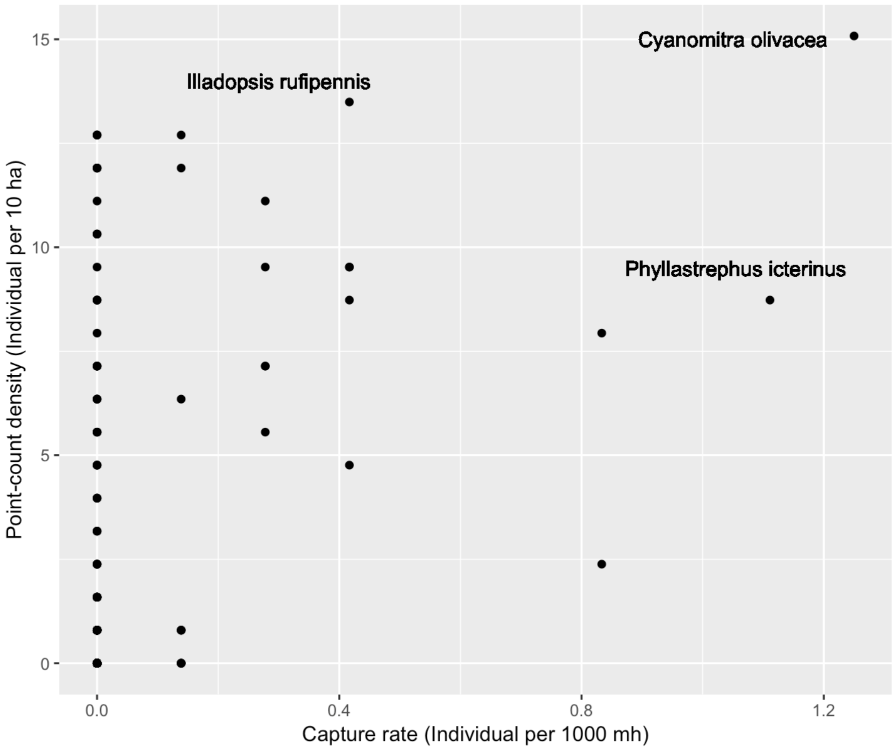


Fig. 38 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 650 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.3794, S = 1484157, P < 0.001

Drinking Garri site, 650 m a.s.l.

At 650 m a.s.l., the CR/PCD ratio was significantly higher for small species (Kruskal-Wallis, $\chi^2 = 8.762$, d.f. = 2, P = 0.0125) while large species were completely missed by mist nets at this elevational plot. Forest-floor and understory foragers had a higher CR/PCD ratio than sub-canopy foragers, canopy foragers, and those who had no stratum preferences, so the difference in the CR/PCD ratio could be explained by the birds' foraging stratum preferences (Kruskal-Wallis, $\chi^2 = 11.185$, d.f. = 4, P = 0.0246). Flocking behaviour did not explain the variance in CR/PCD ratio for any of the species at this elevational plot (Kruskal-Wallis, $\chi^2 = 3.546$, d.f. = 2, P = 0.170), nor did their feeding guild (Kruskal-Wallis, $\chi^2 = 2.617$, d.f. = 5, P > 0.2), probably due to the low number of recorded granivorous species, who had the highest CR/PCD ratio (n = 3, mean CR/PCD = 5.83) and low number of recorded nectarivorous species with similarly high CR/PCD (n = 5, mean = 5.17), whereas the numerous frugivorous and insectivorous species' average CR/PCD ratios were five-fold lower. Finally, *Cyanomitra olivacea* was the most abundant species at this site according to point counts and mist nets alike (Fig. 38).

Planti Camp site, 1100 m a.s.l.

The CR/PCD ratio at this elevational plot was not explained by species size (Kruskal-Wallis, $\chi^2 = 3.0248$, d.f. = 2, P > 0.2). It was also not explained by their flocking behaviour (Kruskal-Wallis, $\chi^2 = 1.9051$, d.f. = 2, P > 0.2) nor by their feeding guilds (Kruskal-Wallis, $\chi^2 = 3.9369$, d.f. = 4, P > 0.2). It seemed, however, to be explained by their foraging stratum preference (Kruskal-Wallis, $\chi^2 = 17.382$, d.f. = 4, P = 0.0016), as more forest-floor and understory foragers were mist-netted than point-counted at this elevational plot. Finally, *Phyllastrephus poliocephalus* was the most abundant species at this plot according to point counts, while the highest abundances according mist-netting are those of *Alethe poliocephala* (Fig. 39).

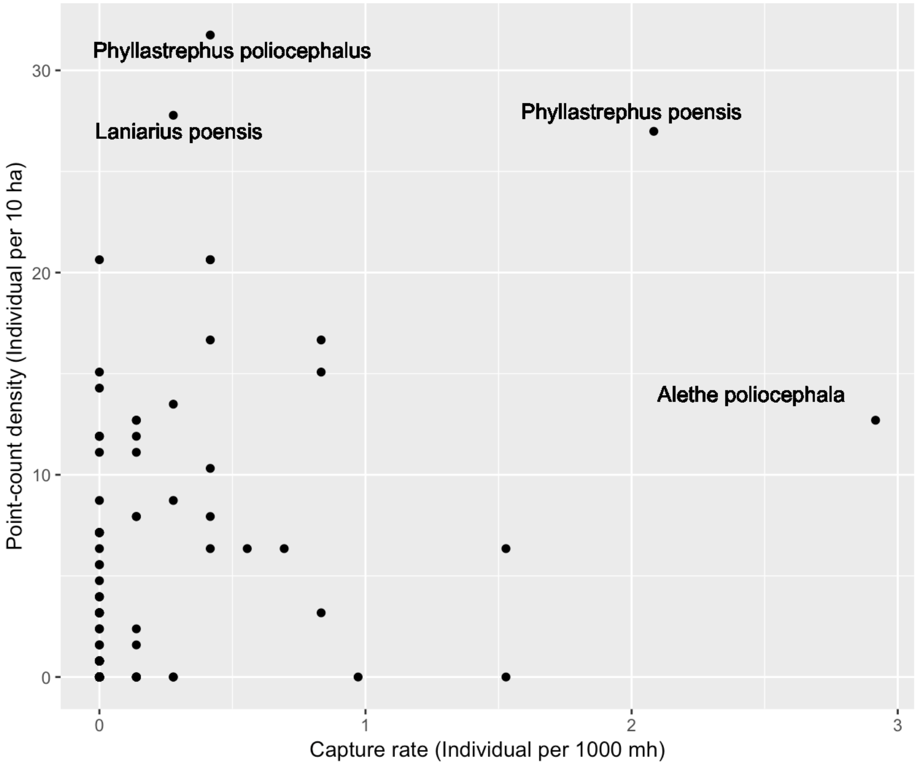


Fig. 39 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 1100 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.4908, S = 1217760, P < 0.001.

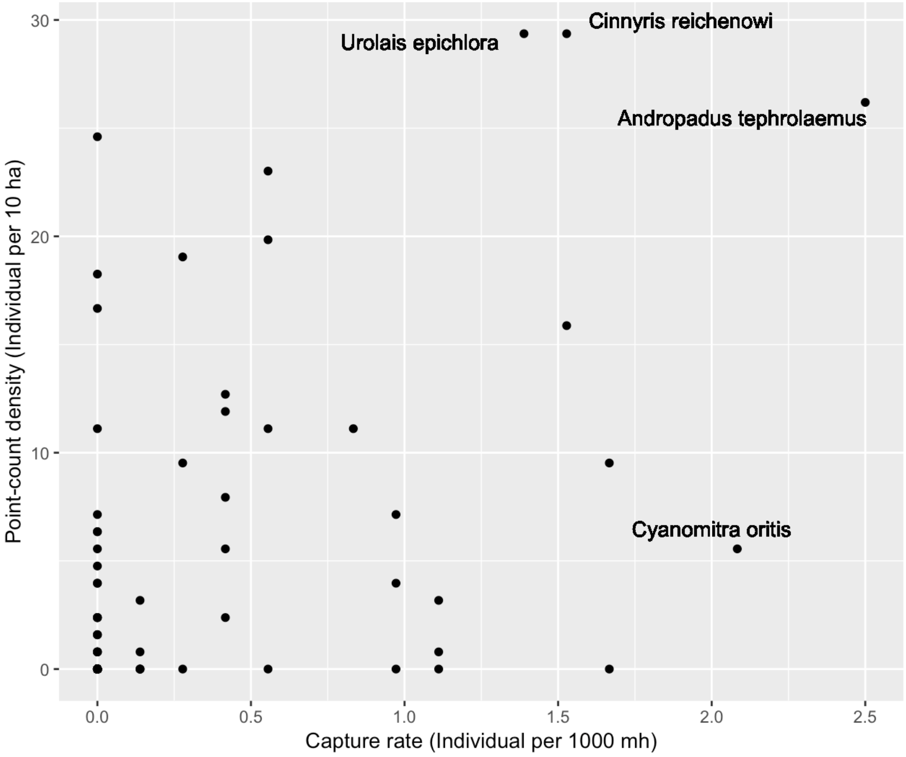


Fig. 40 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 1500 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.5812, S = 1001553, P < 0.001.

Crater Lake site, 1500 m a.s.l.

Size could explain the variance in the birds' CR/PCD ratio at 1500 m a.s.l. (Kruskal-Wallis, $\chi^2 = 7.2411$, d.f. = 2, P = 0.0268), as more small birds were mist-netted. Foraging stratum preferences did not explain the variance in the birds/ CR/PCD ratio at this plot (Kruskal-Wallis, $\chi^2 = 5.834$, d.f. = 4, P > 0.2) and neither did the birds' flocking behaviour (Kruskal-Wallis, $\chi^2 = 0.1611$, d.f. = 2, P > 0.2). Feeding guilds were a only near-significant predictor explaining the birds' CR/PCD ratio at 1500 m a.s.l. (Kruskal-Wallis, $\chi^2 = 7.258$, d.f. = 3, P = 0.0641), probably due to the low number of nectarivorous species with a high CR/PCD ratio (n = 2, mean CR/PD = 21.35). Finally, *Cinnyris reichenowi* and *Urolais epichlora* were the most abundant species at this elevational plot according to point counts, whereas mist nets recorded the highest abundances of *Andropadus tephrolaemus* here (Fig. 40).

Elephant Camp site, 1800 m a.s.l.

Even though all large point-counted species at this elevational plot were missed by mist nets, size did not explain the variance in CR/PCD ratio at this site (Kruskal-Wallis, $\chi^2 = 5.438$, d.f. = 2, P = 0.0659), probably due to the low number of detected large birds (n = 5), yet the mean CR/PCD of small birds was higher (7.04) than the mean CR/PCD of medium-sized birds (4.42). Flocking behaviour did not explain the variance in the CR/PCD ratio at this elevational plot either (Kruskal-Wallis, $\chi^2 = 3.2067$, d.f. = 2, P = 0.2012), although the ratio was substantially higher for solitary birds (n = 27, mean CR/PCD = 7.45) than that of the facultatively (n = 10, mean CR/PCD = 2.30) or never flocking birds (n = 7, mean CR/PCD = 1.94). Feeding guilds also did not explain the variance at this plot, but the result is near-significant (Kruskal-Wallis, $\chi^2 = 7.421$, d.f. = 3, P = 0.0596). It is probably due to the low number of recorded species of nectarivores with the highest CR/PCD ratio (n = 2, mean CR/PCD = 22.94) and granivores (n = 4, mean CR/PCD = 11.16). Foraging stratum preference was the only predictor that seemed to explain the variance (Kruskal-Wallis, $\chi^2 = 14.287$, d.f. = 4, P = 0.0064), as mist-netting missed a lot of the point-counted canopy and sub-canopy foragers at this elevational plot. Finally, *Andropadus tephrolaemus* was the most abundant bird at this plot according to mist nets, whereas it ranked as the second most abundant species at this plot according to point counts (Fig. 41).

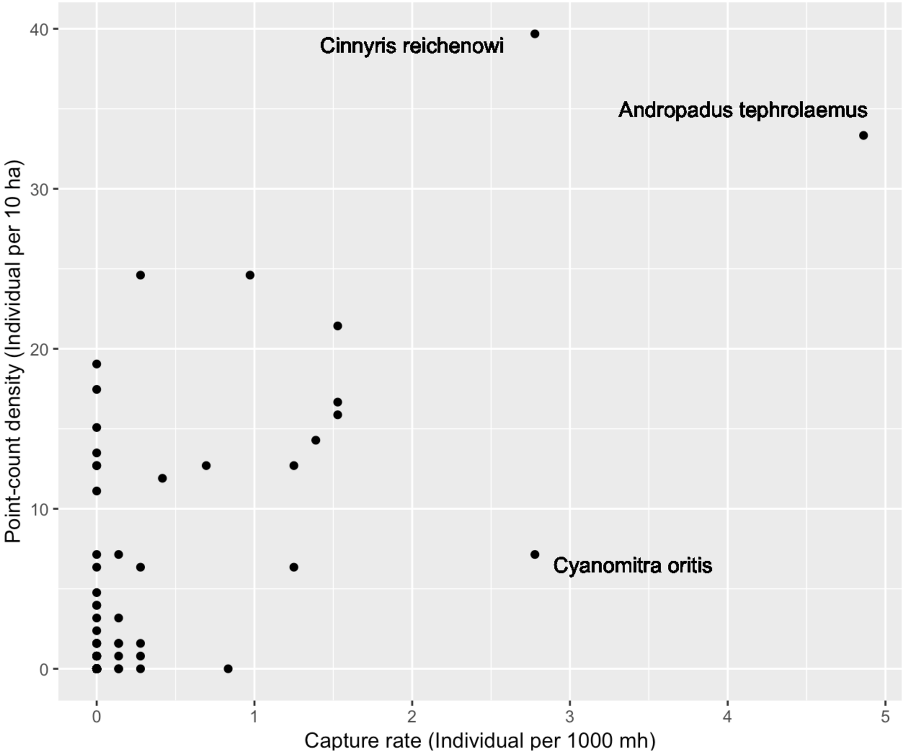


Fig. 41 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 1800 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.6086, S = 936009, P < 0.001.

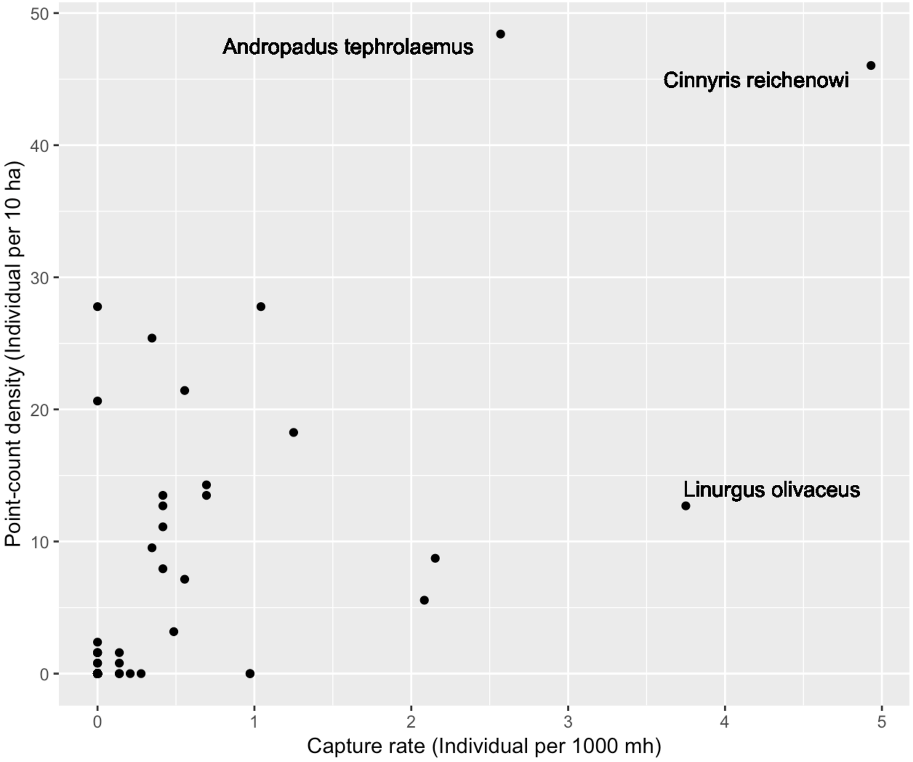


Fig. 42 Capture rate (i.e. no of birds per 1000 mist-netting hours) and point-count density (i.e. no. of birds per 10 ha) recorded at 2200 m a.s.l. The labels mark two species with the highest capture rate and two species with the highest point-count density. Spearman's correlation coefficient = 0.7307, S = 644126, P < 0.001

Mann Spring site, 2200 m a.s.l.

Size did not explain the variance in the CR/PCD ratio among species at this elevational plot (Kruskal-Wallis, $\chi^2 = 4.661$, d.f. = 2, p-value = 0.0973), and nor did their foraging stratum preference (Kruskal-Wallis, $\chi^2 = 4.960$, d.f. = 4, P > 0.2), or flocking behaviour (Kruskal-Wallis, $\chi^2 = 0.849$, d.f. = 2, P > 0.2). Feeding guilds seemed to be the only explaining predictor of the variance in the birds' CR/PCD ratio at this plot (Kruskal-Walli,s $\chi^2 = 9.48$, d.f. = 3, P = 0.0235), but due to the low number of recorded representative species of granivores (n =1) and nectarivores (n = 2), who had the highest CR/PCD at this elevational plot, it is impossible to test finding this further. Finally, *Andropadus tephrolaemus* was the most abundant species at this plot according to point counts, and *Cinnyris reichenowi* was the most abundant according to mist nets (Fig. 42).

Table 2. Average capture rate (CR) to point count density (PCD) estimate CR/PCD*100 for all species recorded by point counts and and/or mist-netting during the same surveying terms. The CR/PCD ratio is not calculated for species that were not detected by point counts. The species are listed according to their CR/PCD Ratio in descending order. Additional information about species average size (S = small, M = medium, L = large), trophic guild (I = insectivore, F = frugivore, G = granivore, N = nectarivore, C = carnivore, ALC = kingfisher (Alcediniidae)), preferred foraging stratum (FF = forest floor, US = understory, SC = subcanopy, C = canopy, or no preference).

Species	Size	Trophic Guild	Preferred Foraging Stratum	CR (ind/1000 mh)	PCD (ind/10 ha)	CR/PCD Ratio
Euplectes capensis	S	G	FF	0.97	0	/
Anthus cinnamomeus	S	I	FF	0.83	0	/
Alcedo leucogaster	S	ALC	US	0.28	0	/
Cinnyris ursulae	S	N	SC	0.28	0	/
Indicator maculatus	M	I	SC	0.28	0	/
Nigrita fusconotus	S	G	SC	0.14	0	/
Sasia africana	S	I	US	0.14	0	/
Spermophaga haematina	S	G	FF	0.14	0	/
Zoothera camaronensis	M	I	FF	0.14	0	/
Cryptospiza reichenovii	S	G	FF	3.19	0.79	403.8
Ploceus melanogaster	S	I	US	3.96	3.17	124.92
Campeghaga petiti	M	I	C	0.42	0.79	53.16
Cyanomitra oritis	S	N	US	7.64	24.6	31.06
Estrilda nonnula	S	G	FF	0.49	1.59	30.82
Turdus pelios	M	I	FF	6.32	24.6	25.69
Phyllastrephus xavieri	S	I	C	0.83	3.97	20.91
Alethe poliocephala	S	I	FF	5.97	30.95	19.29
Zoothera crossleyi	L	I	FF	0.42	2.38	17.65
Andropadus curvirostris	S	I	US	0.28	1.59	17.61
Aplopelia larvata	L	G	FF	0.14	0.79	17.72
Cinnyris batesi	S	N	C	0.14	0.79	17.72
Linurgus olivaceus	S	G	US	6.25	36.51	17.19
Phyllastrephus icterinus	S	I	US	4.17	29.37	14.2
Poliolais lopezi	S	I	US	2.22	17.46	12.71
Cyanomitra olivacea	S	N	US	6.39	54.76	11.67
Andropadus latirostris	S	F	No pref.	3.89	33.33	11.67
Alcedo quadribrachys	M	ALC	US	0.28	2.38	11.76
Cossypha isabellae	S	I	FF	5	43.65	11.45
Andropadus tephrolaemus	M	F	C	11.74	131.75	8.91
Muscicapa sethsmithi	S	I	US	0.14	1.59	8.81
Nigrita bicolor	S	G	US	0.14	1.59	8.81
Smithornis sharpei	M	I	US	0.14	1.59	8.81
Cinnyris reichenowi	S	N	SC	9.24	115.08	8.03

Species	Size	Trophic Guild	Preferred Foraging Stratum	CR (ind/1000 mh)	PCD (ind/10 ha)	CR/PCD Ratio
Phyllastrephus poensis	S	I	US	2.22	27.78	7.99
Stiphrornis erythrothorax	S	I	FF	0.69	8.73	7.9
Cisticola chubbi	S	I	US	3.61	50	7.22
Alethe diademata	M	I	FF	1.94	26.98	7.19
Dendropicos elliotii	M	I	SC	0.97	14.29	6.79
Illadopsis rufipennis	S	I	FF	1.53	24.6	6.22
Bleda notatus	M	I	FF	0.83	14.29	5.81
Speirops melanocephalus	S	I	SC	0.56	9.52	5.88
Parmoptila woodhousei	S	I	US	0.14	2.38	5.88
Psalidoprocne fuliginosa	S	I	C	1.04	22.22	4.68
Kakamega poliothorax	M	I	FF	1.94	42.86	4.53
Urolais epichlorus	S	I	SC	3.68	81.75	4.5
Andropadus virens	S	F	US	1.67	39.68	4.21
Ploceus insignis	M	I	US	0.49	11.9	4.12
Sheppardia bocagei	S	I	FF	0.42	10.32	4.07
Pseudoalcippe abyssinica	S	I	US	3.26	80.95	4.03
Camaroptera chloronota	S	I	US	0.69	17.46	3.95
Elminia albonotata	S	I	US	1.39	36.51	3.81
Pogoniulus atroflavus	S	F	C	0.14	3.97	3.53
Illadopsis cleaveri	S	I	FF	0.69	19.84	3.48
Prinia bairdii	S	I	US	0.83	28.57	2.91
Phylloscopus trochilus	S	I	SC	0.07	2.38	2.94
Muscicapa adusta	S	I	SC	0.49	19.05	2.57
Bradypterus lopezi	S	I	FF	1.81	72.22	2.51
Zosterops senegalensis	S	I	C	0.83	35.71	2.32
Pogoniulus bilineatus	S	F	SC	0.35	15.08	2.32
Accipiter tachiro	L	C	SC	0.14	6.35	2.2
Terpsiphone rufiventer	S	I	US	0.97	46.83	2.07
Laniarius poensis	M	I	US	1.25	62.7	1.99
Deleornis fraseri	S	I	SC	0.42	21.43	1.96
Turtur brehmeri	L	G	FF	0.28	15.08	1.86
Turtur tympanistria	M	G	FF	0.35	19.05	1.84
Dyaphorophyia concreta	S	I	US	0.42	23.81	1.76
Trochocercos nitens	S	I	SC	0.42	23.81	1.76
Pogoniulus coryphaea	S	F	SC	0.35	20.63	1.7
Ploceus bicolor	S	I	SC	0.28	18.25	1.53
Criniger calurus	M	I	US	0.42	31.75	1.32
Phylloscopus poliocephalus	M	I	C	0.42	31.75	1.32
Halcyon malimbica	L	ALC	US	0.14	11.11	1.26

Species	Size	Trophic Guild	Preferred Foraging Stratum	CR (ind/1000 mh)	PCD (ind/10 ha)	CR/PCD Ratio
Hylia prasina	S	I	SC	0.56	46.03	1.22
Phylloscopus herberti	S	I	C	0.28	23.81	1.18
Bleda syndactyla	M	I	FF	0.28	26.98	1.04
Platysteira cyanae	M	I	SC	0.42	48.41	0.87
Laniarius atroflavus	M	I	US	0.63	73.02	0.86
Hedydipna collaris	S	F	SC	0.14	19.05	0.73
Criniger chloronotus	M	I	US	0.14	19.84	0.71
Dyaphorophyia castanea	S	I	SC	0.14	28.57	0.49
Dicrurus atripennis	M	I	US	0.14	39.68	0.35
Alcedo cristatus	S	ALC	US	0	0.79	0
Andropadus ansorgei	S	I	C	0	22.22	0
Andropadus gracilirostris	M	F	US	0	5.56	0
Andropadus montanus	M	F	US	0	19.84	0
Apaloderma aeqatoriale	M	I	SC	0	3.17	0
Apalis binotata	S	I	US	0	1.59	0
Apalis cinerea	S	I	C	0	84.92	0
Apalis jacksoni bambulensis	S	I	SC	0	12.7	0
Apaloderma narina	L	I	SC	0	1.59	0
Apalis nigriceps	S	I	C	0	10.32	0
Apalis rufogularis	S	I	SC	0	14.29	0
Apaloderma vittatum	M	I	SC	0	7.14	0
Apus apus	M	I	C	0	3.17	0
Baepogon indicator	M	F	C	0	11.9	0
Bathmocercus rufus	S	I	FF	0	6.35	0
Buccanodon duchaillui	M	F	C	0	21.43	0
Bycanistes albotibialis	L	F	C	0	1.59	0
Bycanistes fistulator	L	F	C	0	9.52	0
Calyptocichla serinus	M	F	C	0	13.49	0
Campethera cailliautii	M	I	SC	0	0.79	0
Campethera nivosa	M	I	SC	0	4.76	0
Camaroptera superciliaris	S	I	US	0	0.79	0
Campethera tullbergi	M	I	C	0	7.14	0
Centropus leucogaster	L	I	US	0	2.38	0
Ceratogymna atrata	L	F	C	0	14.29	0
Ceratogymna elata	L	F	C	0	1.59	0
Cercococcyx olivinus	M	I	C	0	0.79	0
Ceuthmonaches aereus	M	I	SC	0	27.78	0
Chrysococcyx cupreus	M	I	SC	0	35.71	0
Chrysococcyx klaas	S	I	SC	0	7.14	0

Species	Size	Trophic Guild	Preferred Foraging Stratum	CR (ind/1000 mh)	PCD (ind/10 ha)	CR/PCD Ratio
Cinnyris chloropygius	S	N	US	0	5.56	0
Cinnyris superbus	S	N	SC	0	0.79	0
Coluba sjostedti	L	F	C	0	5.56	0
Columba unicincta	L	F	C	0	5.56	0
Coracina caeruleogrisea	M	I	C	0	6.35	0
Corythaeola cristata	L	I	C	0	1.59	0
Cossyphicula roberti	S	I	US	0	2.38	0
Cuculus clamosus	L	I	C	0	4.76	0
Cyanomitra cyanolaema	S	N	C	0	15.08	0
Dicrurus modestus	M	I	C	0	11.11	0
Dryoscopus angolensis	M	I	C	0	7.14	0
Dyaphorophyia tonsa	S	I	C	0	11.9	0
Eurystomus gularis	L	I	C	0	0.79	0
Francolinus camerunensis	L	G	FF	0	2.38	0
Fraseria ocreata	M	I	C	0	1.59	0
Gymnobucco calvus	M	F	SC	0	1.59	0
Gymnobucco peli	M	F	SC	0	2.38	0
Gypohierax angolensis	L	F	C	0	2.38	0
Halcyon badia	M	ALC	SC	0	7.94	0
Hirundo rustica	S	I	SC	0	0.79	0
Illadopsis fulvescens	S	I	US	0	12.7	0
Indicator conirostris	M	I	SC	0	0.79	0
Indicator exilis	S	I	SC	0	2.38	0
Indicator willcocksi	S	I	SC	0	2.38	0
Ixonotus guttatus	M	F	C	0	6.35	0
Macrosphenus concolor	S	I	SC	0	28.57	0
Macrosphenus flavicans	S	I	SC	0	25.4	0
Malaconotus multicolor	M	I	C	0	3.97	0
Malimbus nitens	M	I	SC	0	4.76	0
Malimbus rubicollis	M	I	SC	0	0.79	0
Neocossyphus poensis	M	I	FF	0	5.56	0
Neocossyphus rufus	M	I	FF	0	0.79	0
Nesocharis shelleyi	S	I	No pref.	0	6.35	0
Nicator chloris	M	I	US	0	23.81	0
Nigrita canicapillus	S	I	C	0	0.79	0
Nigrita luteifrons	S	I	SC	0	14.29	0
Onychognathus fuldigus	L	F	C	0	1.59	0
Onychognathus walleri	L	F	C	0	31.75	0
Oriolus brachyrynchus	M	I	SC	0	24.6	0

Species	Size	Trophic Guild	Preferred Foraging Stratum	CR (ind/1000 mh)	PCD (ind/10 ha)	CR/PCD Ratio
Oriolus nigripennis	M	I	C	0	30.95	0
Oxylophus levaillantii	L	I	US	0	3.17	0
Phyllastrephus albigularis	S	I	US	0	1.59	0
Phylloscopus sibilatrix	S	I	C	0	5.56	0
Picathartes oreas	L	I	FF	0	0.79	0
Ploceus albinucha	S	I	C	0	1.59	0
Ploceus preussi	M	I	C	0	0.79	0
Poeoptera lugubris	M	F	C	0	0.79	0
Pogoniulus scolopaceus	S	F	SC	0	14.29	0
Pogoniulus subsulphureus	S	F	C	0	27.78	0
Polyboroides typus	L	F	SC	0	3.17	0
Prionops caniceps	M	I	SC	0	0.79	0
Psalidoprocne nitens	S	I	SC	0	0.79	0
Psittacus erithacus	L	F	C	0	3.17	0
Pycnonotus barbatus	M	F	No pref.	0	9.52	0
Sarothrura pulchra	M	I	FF	0	11.11	0
Saxicola troquatus	S	I	FF	0	0.79	0
Serinus burtoni	M	F	SC	0	5.56	0
Schoutedenapus myoptilus	S	I	C	0	1.59	0
Smithornis rufolateralis	S	I	US	0	10.32	0
Stizorhina fraseri	M	I	US	0	23.81	0
Streptopelia semitorquata	L	G	FF	0	3.17	0
Sylvietta dentii	S	I	C	0	2.38	0
Tauraco macrorhynchus	L	F	C	0	75.4	0
Tockus camurus	L	I	SC	0	0.79	0
Tockus fasciatus	L	F	SC	0	8.73	0
Trachylaemus purpuratus	L	F	SC	0	2.38	0
Treron calvus	L	F	C	0	43.65	0
Tricholaema hirsuta	M	F	SC	0	11.9	0
Tropicranus albocristatus	L	I	US	0	3.17	0
Turtur afer	M	G	FF	0	0.79	0

4 Discussion

4.1 Mist-Netting on Mt. Cameroon

Over the course of the study, 1424 individuals of 92 species were mist-netted throughout all mist-netting terms during the dry season on Mt. Cameroon. The majority of individuals and new species were detected during the first day of the three-day mist-netting terms in most plots, and more birds were recorded before noon than in the afternoon, which is not unusual for tropical forests (Bell 1982, Blake 1992). Two plots in the lowland forest deviated from these findings, where mist-netting recorded more individuals during the second day of mist-netting. There was also an improvement in catch success in two other plots after the second day of mist-netting, and although fewer species kept being added to the dataset with each passing day, not a single mist-netting day failed to add at least one new species.

Even though each mist-netting hour and mist-netting day enriched our dataset for valuable information, my findings uncover several limitations of the method. Mist-netting has been considered superior to point counts by some authors in that it does not rely on the observer's auditory and visual skills (DeSante *et al.* 1993, Peach *et al.* 1996), it simplifies species identification (Herrera 1978), and can be performed by less experienced observers, who may in turn gain valuable skills in handling birds and obtain familiarity with the detected species (Ralph *et al.* 1995). Furthermore, mist-netting has been proven as more effective in detecting secretive species (e.g. Wallace *et al*. 1996, Gram & Faaborg 1997, Rappole *et al.* 1998, Mason 1996, Blake and Loiselle 2001, Wang and Finch 2002) and understory birds in areas with high understory foliage density and low canopy (Martin *et al.* 2017). Nonetheless, netting success is influenced by the overall detectability of local avifauna, which, in turn, is controlled by a set of factors.

4.1.1 Limits of Mist-Netting: Entanglement, Escape and Evasion

Standard mist-nets' mesh size and the strength of the net influence the outcome of mist-netting. Perhaps the most straightforward factor that affects netting success is the birds' size. Our mist-netting data confirm that mist nets efficiently detect small birds (mean weight < 30 g). The mean weight of netted species in our study is shifted from ca. 25 g to ca. 33 g because our captures included 4 large species of birds (mean weight > 70 g). Their mean weight ranges between 122 and 347 g, which is about 4 to 11 times more than the size of the average netted bird. Large species are more likely to escape after colliding with the net simply because they are less likely to become entangled (Terborgh 1977, Pardieck & Waide 1992), whereas species below ~ 8 g are deemed too small to be successfully mist-netted because they may easily slip out (Terborgh 1977). The latter observation of Terborgh (1977) is not confirmed by out mist-netting data, as some of the small mist-netted species' body mass was below 7 g, and one of them, *Cryptospiza reichenowi* was the second most mist-netted bird during the course of our study.

Birds learn to avoid mist nets (Marques 2013), and because catches are expected to decline with time (Ralph & Scott 1981), some authors have only used captures recorded within the first four hours of netting (Latta *et al.* 2011). For us, this would mean a great loss of valuable information, as catches recorded within the first four hours only represented more than 50% of daily catches in 6 of the 36 days of mist-netting on Mt. Cameroon. Catch rate, however, may also decline with each passing day. Overall, in our data, the variance in total catches during the first mist-netting day was substantially greater than any other day, while days two and three detected similar numbers of birds. Maximum catch was reached during the first day at 5 of our 7 plots, whereas in the remaining two plots, maximum individuals were detected on the second mist-netting day. Likewise, there was a decline in catch numbers after the second mist-netting day in 5 of the 7 plots, and an increase in catch numbers after the second mist-netting day in the remaining two. In conclusion, although daily catch numbers generally declined from the first to the third day of mist-netting at our plots along the elevational gradient on Mt. Cameroon, additional days still brought a significant amount of information. Therefore, I suggest that it is efficient and advisable to use mist nets for at least three days in the environments of tropical rainforests, especially when the method is used for studies based on detecting individuals, as is further suggested by several authors who found the mist-netting method to be useful in various kinds of assessment: de Pinho *et al.* (2009) found that mist nets accurately assess territoriality and site fidelity, Ruiz-Gutiérrez *et al.* (2012) and Faaborg *et al.* (2013) recommend the use of mist nets for survival assessment, Wang & Finch (2002) recommend using mist nets for monitoring birds during migration, and Blake & Loiselle (2016) found that long periods of mist-netting bring valuable information about population dynamics in habitats undergoing restoration.

As per species detection, mist-netting added significantly fewer new species to the dataset after the first day of mist-netting in all plots, yet new species kept being added to the dataset in all days and in all plots. Therefore, I further stress that using mist nets for three days is efficient, since shorter terms would not be sufficient for detecting rare or secretive species. However, if detecting secretive species is the primer benefit of mist-netting, shifting mist nets to other locations each consecutive mist-netting day is probably more efficient than keeping them in one place, given the environment is simple enough to allow for a swift net replacement (Marques *et al.* 2013). Marques *et al.* (2013) noted, that if moving the nets requires researches to find a new suitable terrain and clean new trails for the nets, consequently leading to the loss of a whole mist-netting day, it is not worth moving the net, as this outweighs the advantages of moving it to a new place. If moving the nets does not consume a significant amount of time, it may increase mist-netting success by as much as 30% (Marques *et al.* 2013).

4.1.2 Limits of Mist-Netting: Environmental and Behavioural Factors

Karr (1981) pointed out several key factors that influence mist-netting success. They include environmental elements, such as weather or habitat structure, and also dissimilarities in the birds' behaviour, e.g. variability in vertical movements and time spent within the range of the net, or differences in flight distance and flight frequency. Remsen and Good (1996) argued that mist-netting data could not be used to assess relative abundance because of such behavioural differences within and between studied plots, and that point counts are better in this respect, while some authors found mist-netting and point counts to be equally good in estimating relative abundance (Wang & Finch 2002).

Environmental Factors

Our main data were all collected during the dry season, although data from some elevations come from different months (November, December, February or March) or a variety of months within the season (the averaged total abundances coming from several terms of mist-netting at 350 and 650 m a.s.l.). Detectability varies at any site and at any time (Link & Sauer 2007, Gorresen *et al.* 2009), and the actual capture rate is merely a function of bird activity, therefore anything that may affect bird activity will affect the capture rate (Remsen and Good 1996), may it be climate (McCain 2009B) or habitat structure (Goerck 1999).

In respect to weather, such factors could be rain and daily changes in temperature. Our research during the dry season was never disrupted by rain, therefore I expect temperature to have the greatest effect on detectability in this regard. Temperature in the tropics is more stable than in the temperate zone, and Janzen (1967) described how stable temperature is across elevational belts of tropical mountains throughout the year. Within-day temperature fluctuations increase with elevation (Adams *et al. 1*920), so if temperature alters the detectability of birds by altering the patterns of their activity, its effect should be increasingly evident with growing elevation (McCain 2009B).

The activity pattern across all plots in the lowland and mid-elevation forest is noticeably similar, with activity peaking in the early-to-mid morning and declining in the warmest part of the day – noon to early afternoon, as expected according to Blake (1992). On Mt. Cameroon, the detected activity in the lowland forest was much lower than at higher elevations, with noticeably lower catch numbers. The time of minimum activity is delayed more and more with growing elevation within the lowland forest. Low activity in the morning could also be affected by temperature and habitat structure in the lowland forest, which has a continuous vegetation cover with a substantially more closed canopy in comparison with the mid-elevation forest, which is disrupted by vast open areas (Proctor *et al.* 2007). Because of this, the amount of sunlight reaching the interior of the forest in the early morning hours is substantially lower in the lowland forest. As mentioned above, the activity pattern throughout the plots in the lowland and mid-elevation is similar, but activity is high in the mid-elevation forest from early morning. Since the mid-elevation forest is dramatically different from the lowland forest in its amount of vast open areas (Proctor *et al.* 2007), sunlight reaches the understory much sooner in this environment. As a result, insectivores with high metabolic rate may be able to start foraging in the earliest hours to compensate for the energy loss at night (Chmel *et al.* 2016). In contrast to the lowland forest the all-day minimum in bird activity occurred in the early afternoon in both elevational plots in the mid-elevation forest. Moving further uphill, the pattern does not change significantly at 1800 m a.s.l. The area near this plot is similar to the mid-elevation forest in its openness, as it is located near areas of early successional stages, where volcanic activity disturbed the forest ca. 20 years ago. In any case, the montane forest starts at this point, rich in mosses and lichens, with shrubs in the understory and missing the lianas that are typically found in the lowland forest, adding to its structural complexity. Bird activity/detectability was high from the early morning at 1800 m a.s.l. and continuously declined. It did not, however, experience such a sharp cessation in the early afternoon as it did at lower elevations, rather, it continuously declined until the sunset. Our highest plot at 2200 m a.s.l. was located near the timberline, past which the savannah encroaches. The edge of the montane forest has a dense understory and a still fairly high canopy (20-30 m; Proctor *et al.* 2007). Bird activity here experienced a single peak in the late morning, and then a continuous decline. The pattern of bird activity in this plot substantially differed from the plots at lower elevations.

In her study, where she tested Janzen's hypothesis that mountain passes are physiologically "higher" in the tropics (Janzen 1967; see below), McCain (2009B) argued that within-day temperature variation could affect bird activity, especially at higher altitudes, where within-day temperature fluctuations are the most noticeable (Adams *et al.* 1920), and this is clear in our temperature data as well. Overall, bird activity peaked in the morning and declined continuously thereafter, which is in agreement with the observations of Blake (1992).

The pattern of bird activity only followed a hump-shaped pattern at the highest elevation, which could be explained by McCain's (2009B) observation as temperatures fluctuate more at 2200 m a.s.l. than at any other elevational plot.

Furthermore, there is an evident drop in activity in the early afternoon (between 12 p.m. and 2 p.m.) in all plots below 1800 m a.s.l., a minor drop in the same timeframe at 1800 m a.s.l., and no such decrease in activity at 2200 m a.s.l. This discontinuity in bird activity is followed by an increase in activity in the lowland and mid-elevation forest, but not in the montane forest. This could be explained by peaking temperatures causing a cessation of activity due to a higher physiological stress imposed on the birds during this time in the more humid lowland and mid-elevation forest. The effect of temperature on bird activity is not easy to test along such complex elevational gradients as this, therefore I hesitate to draw further conclusions.

Lastly, rainfall affects activity in a straightforward fashion. Although the mist nets were not in use during rainfall, there was a consistently lower bird activity during the rainy season on Mt. Cameroon. This resulted in very low catch numbers in contrast with mist-netting in the same plots during the dry season. Nonetheless the difference was not as substantial at 1100 m a.s.l. as in the remaining two plots, especially not in the estimated species richness, which was equal in both seasons, but even the number of netted individuals during the rainy season at this plot surpassed the total catch in any of the lower plots during the dry season. It is important to note, however, that mist-netting in the rainy season was only conducted during times with little-to-no rainfall, and the shifts in activity after rainfall are not surprising, as birds make use of the chance to finally forage. Interestingly, it is not only movement that is hindered during the rainy season, but also singing activity, as Vokurková *et al.* (2018) have found.

Behavioural Factors

The rate at which behavioural factors affect species detectability is generally hard to test. Birds' foraging stratum preferences could, however, hint at the potential of mist-netting them. The structure of tropical rainforests caused by the complex vertical distribution of plant biomass drives vertical stratification of bird communities (Smith 1973, Terborgh 1977, Parker & Brown 2000). As a consequence, interference competition is reduced by resource partitioning (Koen 1988, Styring & bin Husin 2004), which in turn allows for the coexistence of numerous avian species in areas with high vertical heterogeneity (MacArthur & MacArthur 1961, Goetz *et al.* 2007). The fact that the proportion of mist-netted birds based on their stratum preferences changed with forest structure is not surprising. On Mt. Cameroon, forest-floor and understory foragers were more likely to be mist-netted in the lowland and the lower mid-elevation forest. However, in the montane forest, sub-canopy and canopy foragers were equally or more likely to be mist-netted.

About half of the mist-netted birds between 350 and 1100 m a.s.l. were forest-floor foragers, followed by understory foragers. The proportion of sub-canopy and canopy foragers never exceeded 10% between 30 and 1100 m a.s.l., while the proportion of forest-floor foragers dropped to 25% at 1500 m a.s.l., and below 25% in the montane forest, equalizing the probability of detecting birds of all foraging stratum preferences. The variance in the probability of mist-netting birds based on their vertical movement patterns changes dramatically above 1100 m a.s.l., where mist-netting also detected the highest diversity. These findings are similar to those of Terborgh (1977) who observed that the vertical stratification of foraging zones relaxed with growing habitat patchiness and high near-ground foliage density in the high-elevation forest of the Cordillera Vilcabamba, Peru. As a result, more species from higher strata hit the nets (Terborgh 1977).

Terborgh (1977) also found that excess diversity in the most diverse part of the forest mainly consisted of insectivores, which holds true for our findings as well. Similarly, Chmel *et al.* (2016) found that proportions of insectivorous birds grow with foliage density. Due to the strict stratification of communities in the lowland forest, mist-netting misses more species than it does in areas with dense understory vegetation and lower canopy (Chmel *et al.* 2016, Martin *et al.* 2017). Ground-to-canopy mist nets would be useful between 350 and 1100 m a.s.l., where the probability of mist-netting sub-canopy and canopy foragers is much lower than above 1100 m a.s.l., as they have been proven to substantially increase the amount of detected species per plot in tropical rainforests (Chmel *et al.* 2016). This holds true especially for frugivores feeding in the canopy, which are often underrepresented in understory-mist-net data collected in tall forests (Blake and Loiselle 2001).

Flocking birds may be easier to detect because they move around in great numbers. This was not found to be the case on Mt. Cameroon. One of the reasons is that the majority (n = 160) of check-listed species on Mt. Cameroon do not form flocks, and only 35 species do so often and 47 occasionally. Only 7 species who often form flocks were detected by mist nets, and although two of them are the most relatively abundant species on Mt. Cameroon, their numbers only form 14.79% of the overall mist-netted community. The second reason that could explain why they were mist-netted in such low quantities is that only 10 of the missed birds that often form flocks are small. One of them, *Pholidornis rushiae* may be even too small (5.25 g) to be mist-netted (Terborgh 1977), and only three remaining small birds that often form flocks forage near the ground or in the understory. The finding that solitary birds are better represented in capture data is in agreement with Arizaga *et al.* (2011), who found that mist-netting is better at detecting small solitary birds. However, given the high abundance of the few flocking birds mist-netted on Mt. Cameroon, and the low proportions of such birds in the observed community on Mt. Cameroon (i.e. the species in our checklist), I am reluctant to conclude that the weak representation of regularly flocking birds in our mist-netting data is solely a matter of the limits of mist-netting.

4.1.3 Limits of Mist-Netting in Comparison with Point Counts

Species Richness and Abundance

Point counts detected more individuals and more species than mist-netting did in all plots, which is in agreement with the widely accepted notion that point counts are better than mist-netting at detecting species richness (Gram & Faaborg 1997, Whitman *et al.* 1997, Blake & Loiselle 2000, Blake & Loiselle 2001, Wang & Finch 2002, Derlindati & Caziani 2005). Point counts also detected higher relative abundances for most species, which is in agreement with Remsen and Good (1996), who found mist-netting to be ineffective at estimating relative species abundances. In terms of species detection, however, mist-netting revealed species undetected by point counts in each forest type and estimated higher relative abundances for a number of species.

During the same terms of surveying, point counts missed 9 mist-netted species. The general consensus implies that mist-netting is better than point counts in detecting cryptic or otherwise secretive understory species (Wallace *et al.* 1996, Gram & Faaborg 1997, Rappole *et al.* 1998, Blake & Loiselle 2001, Wang & Finch 2002) particularly small insectivores (Arizaga *et al.* 2011). It is true that most of the species missed by point counts yet detected by mist nets forage in the understory or near the forest floor, at least in the primary forest. There are a few sub-canopy foragers among them, all of whom were detected in the mid-elevation and montane forest, where the probability of mist-netting birds with such foraging stratum preferences is higher than in the lowland forest (see above).

Aside from the species missed by point counts, mist-netting detected higher relative abundances than point counts for a number of species: *Cyanomitra oritis, Estrilda nonnula, Cryptospiza reichenowi, Linurgus olivaceus, Phyllastrephus xavieri* and *Andropadus latirostris, Ploceus melanogaster* and *Stiphronis erythrothorax.* These species are secretive and overall not too vocally active (Sedláček *et al.* 2015). Moreover, estimates of relative abundance were similar between the methods (variance = 0 ± 1) for*, Campephaga petiti, Andropadus curvirostris, Aplopelia larvata, Cinnyris batesi, Hirundo rustica, Nigrita bicolor, Phylloscopus trochilus, Turdus pelios, Parmoptila woodhousei, Pogoniulus atroflavus, Alcedo quadribrachys, Muscicapa sethsmithi* and *Smithornis sharpei.* All these birds belong to relatively rare species on Mt. Cameroon (Ferenc *et al.* 2016), except or *Turdus pelios*, which is probably more vocally active during the dry season (Sedláček *et al.* 2015). Point counts estimated much higher abundances than mist-netting for 49 species. Martin *et al.* (2017) found that the two methods' performance is site-dependent. They noted that "bottom-heavy" communities (i.e.

communities with a substantial proportion of birds active in the lower strata) are better assessed by mist nets, whereas "top-heavy" communities (i.e. communities with a substantial proportion of birds active in the canopy) are better assessed by point counts. Mt. Cameroon's communities vary in this respect along the gradient. Therefore, I suggest using a combination of methods for areas with high habitat variability, or the use of ground-to-canopy nets in areas with top-heavy communities, such as the lowland forest of Mt. Cameroon.

Species Diversity and Trophic Guilds

In comparison to point counts, mist-netting estimated lower species diversity in all plots, especially in the lowland forest. Diversity across the elevations estimated using mist-netting data reveals a hump-shaped pattern. This is not unusual in the tropics, but it is more typical for dry mountains (McCain 2009A). On the other hand, the diversity pattern detected by point counts follows a decreasing low-plateau trend, which is typical for wet mountains (McCain 2009A). Since Mt. Cameroon is a wet mountain, and point counts are generally more efficient in detecting species richness (Gram & Faaborg 1997, Whitman *et al.* 1997, Blake & Loiselle 2000, Blake & Loiselle 2001, Wang & Finch 2002, Derlindati & Caziani 2005), I do not recommend using understory mist nets for species diversity or richness estimation on wet tropical mountains with high canopy. This was the case of the lowland rainforest on Mt. Cameroon, where mist-netting was much less effective if compared to higher altitudes. However, due to the relatively high number of species that were detected by mist-nets and missed during point counts (n = 9), I recommend using mist nets to complement point counts during diversity assessment surveys.

On the other hand, between-elevation beta diversity estimates of both methods followed an almost identical trend on Mt. Cameroon. Both revealed the largest beta diversity between 30 and 350 m a.s.l., and between 650 and 1100 m a.s.l. Each pair of plots marks a transition zone between the different types of rainforest (Djomo Nana *et al.* 2015). The plot at 30 m a.s.l. (Bimbia-Bonadikombo Community Forest) is isolated from the lowland rainforest of Mt. Cameroon and placed about 20 km apart (Ferenc *et al.* 2016). The area between 650 and 1100 m a.s.l. is on the boundary between the closed-canopy lowland forest and the open mid-elevation forest, and the structure and species composition of the vegetation is quite distinct in each plot (Hořák *et al.* 2019). These findings are in agreement with Hořák *et al.* (2019) who found that compositional and functional diversity was driven by the distance between the study plots and dissimilarity in their tree community.

Furthermore, both methods detected similar abundance distribution patterns of the two most diverse guilds on Mt. Cameroon: insectivores and frugivores. Both methods detected an unchanging trend in nectarivorous species proportions along the gradient and a mild decrease in their abundance in the mid-elevation forest, but mist-netting data show a substantial increase in their proportions in the montane forest, a growth not so evident in our point-count data. Similarly, mist-netting data estimated higher granivore proportions than point counts in the montane forest. It seems that mist-netting is quite effective in estimating abundances of these feeding guilds as the birds are active and mobile.

Given the noticeable similarities in detected trends among the two methods, I recommend the use of mist nets as a complement to point counts in the assessment of community composition and species turnover.

4.2 Ecological Patterns Detected by Mist-Netting

4.2.1 Species Richness

Species richness is expected to decrease linearly with increasing elevation (e.g. MacArthur 1972, Terborgh 1977). However, this is not always the case, especially not on tropical mountains, where species richness may follow a hump-shaped pattern, decreasing low plateau pattern or low plateau trend with a mid-elevational peak (McCain 2009A). Our mist-netting data point at a hump-shaped pattern in species richness with two peaks Mt. Cameroon, which is unexpected for such stable wet tropical mountains (McCain 2009A, Ferenc *et al.* 2016) but has been demonstrated to occur across elevational gradients for a variety of taxa (e.g. Colwell & Hurtt 1994, Rahbek 1995, 1997). The hump at 650 m a.s.l. could simply be an artefact of the greater sampling effort at this location (Herzog 2005), although I partially controlled for it by averaging the number of individuals per species by the number of mist-netting terms per elevation. Still, each season added previously undetected species into the dataset, which means that the detected species richness at elevations with larger sampling effort was higher than it would have been be, had we only conducted one term of mist-netting in those plots. Furthermore, the peak in diversity at 1500 m a.s.l. could be caused by the phenomenon explained above: the relaxation of vertical stratification of birds at higher elevations allows for a higher capture rate of species from higher forest strata (Terborgh 1977), therefore mist nets do not only detect more individuals but also more species than they would – and did – in the lowland forest. The shape of the curve will mirror the interactions and correlated variations among a range of biotic and abiotic variables (Lomolino 2001). For such reasons, one must interpret diversity trends detected by mist nets with caution. Point counts are a more efficient method in this matter, as I discuss above.

The distribution of species richness along any montane gradient responds to habitat variability (MacArthur *et al.* 1966, Karr 1971, Goerck 1999, Hořák *et al.* 2019). The estimates of beta-diversity reveal a high species turnover between two pairs of elevations: 30 and 350 m a.s.l., and 650 and 1100 m a.s.l. Each plot within the two pairs represents a distinct forest type, and the plots are also far apart therefore a high species turnover is expected even over short distances (McCain and Beck 2015). This has been recently confirmed to be the case on Mt. Cameroon (Hořák *et al.* 2019), and I discuss this further below.

Janzen (1967) proposed a hypothesis that suggests that due to small fluctuations of temperatures along elevational bands on tropical mountains, tropical birds should have narrow climatic specializations. As a result, their ranges should be smaller than the ranges of temperate birds residing at similar elevations, because they are used to substantially higher fluctuations in temperature. However, temperatures fluctuate more at higher altitudes in the tropics as well (Adams *et al.* 1920), which led Stevens (1992) to hypothesize that montane species should does have wider ranges. Both Janzen's (McCain 2009B) and Stevens's (McCain & Knight 2013) hypotheses have been tested globally. McCain tested Janzen's hypothesis on various groups of vertebrates including birds and concluded that only breeding birds' elevational range sizes are smaller in the tropics, but in general, Janzen's hypothesis does not apply to them, instead, their elevational range is best explained by mountain height (McCain 2009B). Similarly, McCain & Knight (2013) found little-to-no support for Rapoport's elevational rule.

I am only able to comment on the applicability of Janzen's and Steven's hypotheses on Mt. Cameroon based on the presence or absence of birds recorded in particular plots and the measured beta diversity between the plots. Mist-netting detected the greatest diversity of birdlife on Mt. Cameroon between 1100 and 1500 m a.s.l. Incidentally, these elevations have the highest species turnover of all elevations in the primary forest. Our data on species richness across all plots collected using each method including random walks found that most species on Mt. Cameroon live in the lowland and species richness sharply declines above 1100 m a.s.l. Of the 242 check-listed species on Mt. Cameroon, 132 species inhabit one forest type, 85 species inhabit two forest types, and 25 occur in all three forest types. Of the 132 species that live in only one forest type, 101 occur in the lowland forest (out of 179), 19 in the mid-elevation forest (out of 126) and 12 in the montane forest (out of 72). 47 of the 101 (46.53%) lowland specialist, 15 of the 19 (78.95%) mid-elevation specialists and 9 of the 12 (75%) montane specialists occurred in only one of our plots. In total, 63 species that occurred in more than one plot (25.93%), 53 species that occurred in more than two plots (21.81%) and 42 species that occurred in more than three plots (17.70%) have been detected in the montane forest, and on the contrary, 109 species that occurred in more than one plot (44.86%), 74 species that occurred in more than two plots (30.45%) and 31 species that occurred in more than three plots (12.76%) have not been detected in the montane forest. If climatic variability causes the decline in species richness with growing elevation, and species best adapted for thriving in these conditions should *ergo* have a higher tolerance for temperature fluctuations, such species should be those with the mid-point above 1100 m a.s.l., where species richness on Mt. Cameroon starts to decline. If Rapoport's elevational rule is to be present on Mt. Cameroon, these species should have been detected in a greater number of plots than the species whose mid-point is below 1100 m a.s.l. The opposite is true: 40 such species have been detected on Mt. Cameroon in more than two plots, while 85 species with the mid-point at or below 1100 m a.s.l. have been detected in more than two plots. Besides, given that the elevational difference between the plots at 650 and 1100 m a.s.l. is much greater than the elevational difference between the rest of the plots, it appears that the lowland group has greater elevational ranges. Moreover, larger ranges at higher elevations would be reflected in an increasingly lower species turnover between plots at higher elevations. On Mt. Cameroon, however, species turnover at the highest elevations is equal to or slightly larger than the species turnover estimated in the primary lowland. This is in line with the general assumption that little variation in community composition is to be expected between sites belonging to a single habitat (assuming the lowland and montane separately; Poulin *et al.* 2000). It seems unlikely that Rapoport's elevational rule can be observed on Mt. Cameroon's birdlife. The expected decrease in range size with growing elevation is more likely to be in effect (Ferenc *et al.* 2016) and given the great habitat heterogeneity among and between the forest types, more answers on the distribution of species may be given by looking at the biotic factors influencing them.

4.2.2 Competitive pressures

Range compression and expansion of species may be affected by the presence or absence of competitors (Terborgh & Weske 1975, Remsen & Graves 1995). Closely related species have similar ecological demands, and thus are likely to compete for resources (Terborgh 1971, Diamond 1975). They must specialize, i.e. partition resources, or one will eventually outcompete the other from the environment (e.g. Diamond 1975, Grant & Grant 2006, Bregman *et al.* 2015). Elevational replacements of congeners as a result of competition have been described on tropical mountains (Bull 1991, Terborgh 1971), yet few researchers have decided to test competitive interactions as a factor that restricts species ranges on tropical mountains (but see Jankowski *et al.* 2010). Indeed, it is not an easy task to control for possible competition between closely related species, especially not in species-rich habitats, such as Mt. Cameroon. One hundred forty-three of the check-listed species on Mt. Cameroon live on the mountain with at least one congeneric species, thus their distribution is likely to be shaped by the relationship between them.

Competitive interactions between species need to be experimentally tested, but the obvious patterns of co-occurrence and absence of congeners in certain forest types or elevations hint at the possibility of these interactions taking place. The following assumptions have been drawn from all our available data. While some congeners may partition resources by foraging for the same type of food in distinct forest strata (e.g. *Baepogon*, *Dicrurus, Dyaphorophyia* or *Oriolus*) or by utilizing different foraging methods (e.g. *Glaucidium* or *Illadopsis*), some can coexist because they are specialized for different types of food (e.g. *Nigrita*) or use a combination of some of the above mentioned mechanisms (*e.g. Andropadus* or *Nigrita*). Those that have similar feeding or foraging preferences either completely exclude and/or "replace" each other in different forest types or elevations (e.g. *Cisticola, Columba, Elminia, Muscicapa* or *Onychognathus*) or have a slight overlap in some elevations, most often at 30, 350, 650 and 1100 m a.s.l., and sometimes at 1500 m a.s.l. Where data are available, some species show an asymmetry in abundance, thus a possible dominance over their congeners in overlapping ranges (e.g. *Cyanomitra, Illadopsis, Laniarius* or *Turtur*), while some occur in equal numbers in at least a part of their overlapping range (e.g. *Oriolus*). Other congeners co-occur in much greater abundances than anywhere else in their range (e.g. *Phyllastrephus*), while some species have only been detected in particular elevations where they coexist with their similarly specialized congeners and nowhere else (e.g. *Laniarius poensis, Neocossyphus rufus, Phyllastrephus albigularis, Turtur afer* or *Turtur brehmeri*). This mostly happens at 1100 and 1500 m a.s.l. The greater number of ecologically similar species co-occurring in some particular elevations could be explained by a greater carrying capacity and/or area of some of the elevational belts. Data on resource abundance and distribution on Mt. Cameroon are so far unavailable. The extent in which any competitive stress or release shapes community composition on Mt. Cameroon cannot be estimated without appropriate experimental testing.

4.2.3 Feeding Guilds

As mentioned above, range boundaries are shaped by various biotic and abiotic forces and the species' response to these forces (MacArthur *et al.* 1966, Karr 1971). Not surprisingly, such response varies between different subsets of species. We may observe differences in avian community composition along the gradient if we divide the birds into their respective trophic guilds (Terborgh 1977). Mist-netting detected striking patterns of community composition along the altitudinal gradient of Mt. Cameroon in regard to two of its most diverse trophic groups of birds: insectivores and frugivores.

The proportion of insectivores follows a steady growth toward the mid-elevation and then an equally steep continuous decline in proportions toward the timberline. Terborgh (1977) argues that insectivores are attracted to structural complexity which, on Mt. Cameroon, constantly grows with elevation but remains fairly complex in the high-elevation forests, too, where the canopy is still fairly tall, (20-30 m; Proctor *et al.* 2007) and where the understory is denser than it is in the lowland forest. Structural complexity cannot explain the decline in insectivore proportions in the higher elevations. Chmel *et al.* (2016) found, using ground-to-canopy mist nets, that insectivores prefer sites with dense foliage cover, but are particularly interested in sites with young foliage. Given that the mid-elevation is rich in shrubs and herbs (Proctor *et al.* 2007) and that it is often disturbed by forest elephants, unlike the montane (Ferenc *et al.* 2016), I believe these findings fit our observations on the prevalence of insectivores in the mid-elevation forest, and their decline at higher elevations. Nonetheless, a possible decline in resource abundance may also contribute to the decline in insectivore numbers toward the timberline but controlling for resource abundance was beyond the scope of this study. Since insectivores make up more than a half of all check-listed avifauna on Mt. Cameroon, I further divided them into specialists based on the substrate they acquire their food from. Foliage-gleaning insectivores (FGIs) are the most diverse group of insectivores, and they dominate every plot on Mt. Cameroon in species proportions. Their dominance, in this respect, grows toward the montane forest. In abundance, however, FGIs make up a smaller portion of the community than ground-searching insectivores (GSIs) in the primary lowland forest and at 1100 m a.s.l. GSIs then appear in lower proportions in the higher mid-elevation forest and at 1800 m a.s.l., only to re-gain slightly higher abundances at 2200 m a.s.l. Nonetheless, their species proportion in the community gradually decreases with growing elevation. An interesting pattern can also be seen in the proportion of bark-probing insectivores (BPI), who are completely missing in our data from below 650 m a.s.l., and their proportions continually grow toward the highest elevation, becoming the third most abundant group of insectivores in the montane forest. Their absence in our lowland data may be the result of the strict vertical stratification of foraging zones explained above, because BPIs are expected to be abundant in lowland forest with a great variety of bare, insect-rich tree-trunks (Terborgh 1977). Finally, insectivores who hunt for prey in the air (AFIs) are underrepresented in our mist-netting data.

Frugivore proportions follow an opposite, albeit bimodal, trend – their proportions continuously decrease toward the mid-elevation at 1100 m a.s.l. then increase again. Chmel *et al.* (2016) also noted that densities of frugivorous birds decline with increasing foliage density, but the general lack of fruit-rich canopy in the mid-elevation forest may better explain why their numbers are so low in this forest type, as their numbers increase again in the montane at 1800 m a.s.l. The proportions of frugivorous species at the edge of the forests (at 30 m a.s.l. and 2200 m a.s.l.) is substantially lower than in the neighbouring plots. This may still be caused by undersampling due to the use of understory mist nets. Canopy mist nets have been shown to detect higher proportions of frugivores (Derlindati & Caziani 2005).

Nectarivores are the most abundant guild on Mt. Cameroon. Nectarivorous species proportions remain constant across the entire gradient, while their abundances follow a negative unimodal trend with minimum abundances at the mid-elevation and reach unusually high rates in the topmost plot. Terborgh (1977) noted that lowland forests, through their complex vertical stratification, may offer a variety of resources, while montane forests may offer a higher abundance of resources.

Finally, granivore proportions increase at 1100 m a.s.l., where they reach a plateau, and reach their maximum proportions at 2200 m a.s.l.

Hořák *et al.* (2019) found that the recorded functional dissimilarity of avian assemblages along the forested gradient on Mt. Cameroon was solely influenced by distance between sampling plots, which hints at a high spatial heterogeneity. When controlling for effects that influence communities within the elevational bands where they conducted point counts, they found that tree composition, distance between the points, leaf area index and solar radiation all explained functional dissimilarity (Hořák *et al.* 2019. Considering my points above in relation to the elevational zonation of trophic guilds, it would be interesting to investigate how the factors described by Hořák *et al.* (2019 influence the distribution of birds within particular guilds.

4.2.4 Species Abundance Along the Gradient

The area of zonal communities declines with elevation (Lomolino 2001), and as ranges shrink, abundances are expected to follow (Brown 1984, Gaston *et al.* 2000, Blackburn & Gaston 2006). In recent years, however, the supposedly ubiquitous positive abundance-range size relationship has been repeatedly rebutted: bird assemblages on tropical mountains have been found to be largely abundant (Fjeldså 1999, Ryan *et al.* 1999, Sekercioğlu & Riley 2005, Reif *et al.* 2006, Hořák *et al.* 2010, Djomo Nana *et al.* 2014, Ferenc *et al.* 2016). Our mist-netting data confirm Ferenc *et al.*'s (2016) findings based on point counts, implying species abundance grows with elevation on Mt. Cameroon.

In order to explain high abundances of species in species-poor areas, MacArthur *et al.* (1972) proposed the so-called "density compensation hypothesis". According to the hypothesis, communities in areas with low species richness may increase their abundance as they fill the available ecological space (MacArthur *et al.* 1972). Ferenc *et al.*'s (2016) point-count data revealed a monotonic decline in species richness with growing elevation, typical for wet tropical mountains (McCain 2009A), and that total abundances are fairly stable across all elevations. This means that an absolute density compensation is taking place on Mt. Cameroon, as abundances remain constant while species richness declines. Our data are unfit to confirm this, as mist-netting highly underestimated total species abundance and richness on Mt. Cameroon, especially in the lowland forest. Regardless, mist-netting revealed at least one possible mechanism driving density compensation in avifauna according to Wright (1980), which I have already hinted at above – an apparent competitive release in the species-poor montane forest. Niche theory (Case & Gilpin 1974) predicts that an ecological release in species-poor areas will cause the realized niches of local fauna to expand, as competitive pressures among closely related species subside. Consequently, the given species is able to utilize more space and resources, and, as a result, increase its population density (MacArthur *et al.* 1972, Wright 1980). The fact that mist nets on Mt. Cameroon detected an increasingly higher proportion of birds confined to high foraging strata hints at the possibility of such release.

Further possible explanations for the high abundance of montane birds have been proposed: a specialization hypothesis which assumes that species in areas of long-term eco-climatic stability are highly specialized and thus can maintain high abundances (Fjeldså *et al.* 2012), and that species avoid extinction by maintaining high abundances in small ranges, as small population size would be moved by an extinction filter (Williams *et al.* 2009). All three mechanisms are mutually non-exclusive, and all may play a part in keeping the populations of montane species dense.

4.2.5 The Problem at the Foothill

Secondary-growth vegetation has replaced many of world's lowlands forests, yet it is a crucial habitat for bird species, migrant or resident (Terborgh & Weske 1969, Karr 1971, Martin 1985, Blake & Loiselle 2001) as it minimizes the effects of fragmentation in the surrounding area. Although species richness in secondary forests is generally lower than in the old-growth, high species richness and abundance is possible in such forests due to various factors including resource abundance (Blake & Loiselle 2001). Barlow *et al.* (2007) noted that secondary-growth forests act as "safety nets" for tropical species richness.

Mist-netting in the small forest fragment surrounded by secondary-growth forest and plantations at the foothill of Mt. Cameroon (Bimbia-Bonadikombo Community Forest, 30 m a.s.l.) recorded an unusually low number of species (n = 15) and individuals (n = 47), albeit the number of observed species that occur here is among the highest of all elevations (n = 117). The community forest at this elevation is the only large remnant of littoral forest in the region (Ferenc *et al.* 2018). The possible explanation for this contrast is that species persist here in very low densities due to fragmentation effects (Ferenc *et al.* 2018), or that mist-netting missed most of the species and individuals of birds, which are mostly confined to the canopy in this forest.

The structurally diverse forest is not protected by the Mount Cameroon National Park (MNCP), which only protects the forest above 300 m a.s.l. Ferenc *et al.* (2018) compared bird and butterfly species richness and abundance with tree species richness and volume at the same plots we used in the lowland forest. Although tree species richness and volume were the highest at 30 m a.s.l. bird and butterfly species richness and abundance were the lowest at this plot. Unable to identify the direct cause of the low diversity, the authors argue that the secondary-growth forest at the foothill of Mt. Cameroon suffers from nearby fragmentation and habitat alterations (Dranzoa 1998, Owiunji & Plumptre 1998). Ferenc *et al.* (2018) also reported a lack of ground-feeding birds in this forest. The presence of crabs in this area may impose competitive pressures on ground-feeding birds, hindering their foraging success (Ferenc *et al.* 2018). Moreover, understory birds have been found to be generally more sensitive to forest fragmentation (Şekercioğlu *et al.* 2002) and even selective logging (Hamer *et al.* 2015), which could explain why mist-netting in this forest returned such a low abundance and richness of birds.

Nonetheless, our mist-netting data show that 24 of the 138 species (17.39%) that have been recorded here throughout the course of our study do not occur anywhere else on Mt. Cameroon, while our point count data further increase this number to 30 species. Also, the majority of kingfishers we detected by either method were recorded in this forest, which is not surprising considering the plot's proximity to a stream and the sea. Rappole *et al.* (1998) argue that mist-netting is more effective in secondary-growth forests than point counts. Our mist-netting and point-count data are in disagreement with their findings, as are those of Blake & Loiselle (2001) in the lowlands of Costa Rica.

5 Conclusion

Understanding macroecological processes on a global scale is only possible through a thorough examination of the underlying mechanisms that form these processes within various types of habitat across all latitudes and altitudes. It is unsurprising that many ecological trends once deemed universal are proven to be violated in the exceptionally complex tropical environments. Given the restricted amount of available literature on Afromontane avifauna and the ongoing callous habitat destruction in Africa and worldwide (Lambin *et al.* 2001, Hamadi *et al.* 2016) paired with the effects of the ongoing climate crisis on the montane populations of African birds (Sekercioğlu *et al.* 2012, Hamadi *et al.* 2016), it is essential to pinpoint the most time- and cost-efficient surveying methods. Most importantly, though, these methods must overcome as many biases as possible, providing as accurate results as possible. Only then are we able to create and apply measures for effective nature conservation.

I conclude that mist-netting is a vital method for use in bird community assessments in species-rich areas with high habitat heterogeneity, where point counts, albeit more efficient at recording species richness and abundance, may miss a considerable number of secretive species recorded by mist nets. The method has its biases: it mainly detected small, active birds, and its efficiency was habitat-dependent. As Martin *et al.* (2017) suggested and I hereby confirm, understory mist nets are more efficient in habitats with low canopy height and dense understory vegetation cover. Moreover, in agreement with Terborgh (1977), I conclude that mist-netting is more efficient at detecting birds from higher forest strata past the point of decline in species richness along the elevation, i.e. past the lowland forest, where competitive release allows birds to expand their realized niche. Ground-to-canopy mist nets may uncover additional species that are usually missed by understory mist nets. However, they require more physical effort and are very sensitive to weather, especially wind (Derlindati & Caziani 2005).

Mist-netting was similarly efficient at detecting some key trends along the gradient as point counts, such as beta-diversity between elevational plots or community composition changes in relation to the birds' feeding guilds. Also, even if mist-netting is not as efficient at measuring relative abundances as point counts, it clearly exposed the negative abundance-area relationship appearing on Mt. Cameroon, following the assumption that area declines with growing elevation as Ferenc *et al.* (2016) have found.

The forests of Mt. Cameroon are remarkably complex. The primary rainforests within the MCNP change from a tall lowland forest with a complex vertical stratification and dense canopy, through an open mid-elevation forest with a dense understory layer rich in shrubs and herbs, to a tall montane rainforest with dense understory and fairly open canopy. This habitat diversity hinders the effectivity of a single surveying method along the gradient, simply because each method works differently in various environments. For this and several other reasons discussed above, I highly suggest the simultaneous use of mist-netting and point counts along such structurally diverse altitudinal gradients because they complement each other considerably, together providing a thorough examination of the local avifauna.

Finally, the secondary lowland forest within and around the Bimbia-Bonadikombo Community Forest (BBCF) hosts various kinds of environments including coastal forests, mangroves and swamps, which are threatened by nearby logging. Protecting this environment is crucial, as secondary forests act as “safety nets” for tropical species richness (Barlow *et al.* 2007). Moreover, while several species inhabiting this forest can be found in the primary forests of Mt. Cameroon, too, the overall community composition in this forest is strikingly different from the one observed in MCNP. The area of this forest is not protected by MNCP thus I highly suggest a more intensive cooperation between the managements of the BBCF and MNCP. My results further support Ferenc *et al.*’s (2018) suggestion, that due to its unique flora and fauna, the BBCF should be considered a unique location for the conservation of biodiversity of global importance, as it has recently been found to be continuously exploited and logged.

Bibliography:

Adams, C.C., Burns, G.R, Hankinson, T.L., Moore, B. & Taylor, N. (1920) Plants and animals of Mount Marcy, New York, Part I. *Ecology* 1, 7

Arizaga, J., Vilches A., Alonso, D. & Mendiburu, A. (2011) Monitoring communities of small birds: a comparison between mist-netting and counting. *Bird Study* 58(3), 291-301. DOI: 10.1080/00063657.2011.586415

Barlow, J., Meste, L.A.M., Gardner, T.A. & Peres C.A. (2007) The value of primary, secondary and plantation forests of Amazonian birds. *Biological Conservation* 136(2):212-231. DOI: 10.1016/j.biocon.2006.11.021

Bell H.L. (1982) A bird community of New Guinean lowland rainforest. 3 Vertical distribution of the avifauna. *Emu* 82, 143–162. DOI: 10.1071/MU9820143

Bibby CJ, Burgess ND, Hill DA (2000) *Bird census techniques*. Academic Press, London

Blackburn, T.M., Cassey, P. & Gaston, K.J. (2006) Variations on a theme: sources of heterogeneity in the form of the interspecific relationship between abundance and distribution. *Journal of Animal Ecology* 75, 1426-1439. DOI: 10.1111/j.1365-2656.2006.01167.x

Blake J.G. (1992) Temporal variation in point counts of birds in a lowland wet forest in Costa Rica. *The Condor* 94, 265–275. DOI: 10.2307/1368816

Blake J.G. & Loiselle, B.A. (2000) Diversity of birds along an elevational gradient in the cordillera central, Costa Rica. *The Auk* 117(3), 663-686. DOI: 10.1642/0004-8038(2000)117[0663:DOBAAE]2.0.CO;2

Blake J.G. & Loiselle, B.A. (2001) Birds assemblages in second-growth and old-growth forests, Costa Rica: perspectives from mist nets and point counts. *The Auk* 118, 304–326. DOI: 10.1676/wils-128-02-255-267.1

Blake, J.G. & Loiselle, B.A. (2016) Long-term changes in composition of bird communities at an "undisturbed" site in eastern Ecuador. *The Wilson Journal of Ornithology* 128(2), 255-267. DOI: 10.1676/wils-128-02-255-267.1

Borrow, N. & Demey R. (2014) *Birds of West Africa, Second Edition*. Christopher Helm. London.

Bregman, T.P., Lees, A.C., Seddon, N., MacGregor, H.E.A., Darski, B., Aleixo, A., Bonsall, M.B. & Tobias, J.A. (2015) Species interactions regulate the collapse of biodiversity and ecosystem function in tropical forest fragments. *Ecology,* 96, 2692-2704. DOI: 10.1890/14-1731.1.sm

Brown, J.H. (1984) On the relationship between abundance and distribution of species. *The American Naturalist,* 124, 255–279. DOI: 10.1086/284267

Brown, J.H., Stevens, G.C. & Kaufman, D.M. (1996) The geographic range: Size, shape, boundaries, and internal structure. *The Annual Review of Ecology, Evolution, and Systematics* 27, 597-623. DOI: http://10.1146/annurev.ecolsys.27.1.597

Bull, C.M. (1991) Ecology of Parapatric Distributions. *The Annual Review of Ecology, Evolution, and Systematics,* 22, 19-36. DOI: 10.1146/annurev.es.22.110191.000315

Case, T.J. & Gilpin, M.E. (1974) Interference competition and niche theory. *Proceeding of the National Academy of Sciences.* 71, 3073-7. DOI: 10.1073/pnas.71.8.3073

Chmel K., Rieger, J., Paul, L. & Novotny, V. (2016) Vertical stratification of an avian community in New Guinean tropical rainforest. *Population Ecology* 58, 535-547. DOI: 10.1007/s10144-016-0561-2

Colwell, R.K. & Hurtt, G.C. (1994) Nonbiological gradients in species richness and a spurious rapoport effect. *The American Naturalist* 144, 570-595. DOI: 10.1086/285695

De Pinho, J.B., Esteves Lopes, L., Maldonado-Coelho, M., Rubio, T.C. & Bernardon, B. (2009) Habitat Associations and Nests of Band-tailed Antbirds (*Hypocnemoides maculicauda*) in the Brazilian Panatal. *The Wilson Journal of Ornithology* 121(1), 153-159. DOI: 10.1676/08-003.1

DeSante, D.F. Burton, K.M. & Williams, O.E. (1993) The Monitoring Avian Productivity and Survivorship (MAPS) program second annual report. *Bird Population* 1, 68–97.

Derlindati, E.J. & Caziani, S.M. (2005) Using canopy and understory mist nets and point counts to study bird assemblages in Chaco forests. *Wilson Bull* 117, 92–99. DOI: 10.1676/03-063

Diamond, J.M. (1975) Assembly of species communities. Pages 342-444 in M. L. Cody and J. M. Diamond, editors. Ecology and evolution of communities. Harvard University Press, Cambridge, Massachusetts, USA.

Djomo Nana, E., Sedláček, O., Bayly, N., Ferenc, M., Albrecht, T., Reif, J., Motombi, F.N. & Hořák, D. (2014) Comparison of avian assemblage structures in two upper montane forests of the Cameroon volcanic line: lessons for bird conservation. *Biodiversity and Conservation*, 23, 1469–1484. DOI:10.1007/s10531-014-0677-7

Djomo Nana, E., Sedláček, O., Doležal, J., Dančák, M., Altman, J., Svoboda, M., Majeský, Ľ. & Hořák, D. (2015), Relationship between Survival Rate of Avian Artificial Nests and Forest Vegetation Structure along a Tropical Altitudinal Gradient on Mount Cameroon. Biotropica, 47, 758-764. DOI: 10.1111/btp.12262

Dranzoa, C. (1998) The avifauna 23 years after logging in Kibale National park, Uganda. *Biodiversity and Conservation,* 7, 777-797. DOI: 10.1023/A:1008892419940

Estades, C.F., Escobar, M.A., Tomasevic, J.A., Vukasovic, M.A. & Páez, M. (2006) Mist-Nets Versus Point Counts in The Estimation of Forest Bird Abundances in South-Central Chile. *Ornitologia Neotropical* 17, 203-2012.

Faaborg, J., Arendt, W.J., Toms, J.D., Dugger, K.M., Cox, W.A. & Mora, M.C. (2013) Long-term decline of a winter-resident bird community in Puerto Rico. *Biodiversity and Conservation* 22, 63-75. DOI 10.1007/s10531-012-0399-7

Ferenc, M., Fjeldså, J., Sedláček, O., Nije Motombi, F., Djomo Nana, E., Mudrová, K. & Hořák, D. (2016) Abundance-area relationships in bird assemblages along an Afrotropical elevational gradient: space limitation in montane forest selects for higher population densities. *Oecologia* 181, 225-233. DOI 10.1007/s00442-016-3554-0

Ferenc, M., Sedláček, O., Tropek, R., Albrecht, T., Altman, J., Dančák, M., Doležal, J., Janeček, Š., Maicher, V., Majeský, Ľ. N. Motombi, F. ,Murkwe M., Sáfián. S., Svoboda, M., Hořák, D. (2018) Something is missing at the bottom: Importance of coastal rainforests for conservation of trees, birds and butterflies in the Mount Cameroon area. *African Journal of Ecology.* 56, 679-683. DOI: 10.1111/aje.12506

Fishpool, L.D.C. & Evans, M.I. (2001) *Important Bird Areas in Africa and Associated Islands: Priority Sites for Conservation*. Newbury andCambridge, UK. Pisces Publications and BirdLife International.

Fjeldså J. (1999) The impact of human forest disturbance on the endemic avifauna of the Udzungwa Mountains, Tanzania. *Bird Conservation International* 9, 47–62. DOI: 10.1017/S0959270900003348

Fjeldså J., Kiure J., Doggart N., Hansen L.A. & Perkin A. (2010) Distribution of highland forest birds across a potential dispersal barrier in the Eastern Arc Mountains of Tanzania. *Steenstrupia* 32, 1–43

Fjeldså J., Bowie R.C.K. & Rahbek C. (2012) The role of mountain ranges in the diversification of birds. *The Annual Review of Ecology, Evolution, and Systematics* 43(43), 249–265. DOI:10.1146/annurev-ecolsys-102710-145113

Fonge B., Yinda G., Focho D., Fongod A. & Bussmann R (2005) Vegetation and soil status on an 80 year old lava flow of Mt. Cameroon, West Africa. *Lyonia* 8, 17–39

Fry, C.H., Keith, S. & Urban, E.K. (1982-2004) *The birds of Africa*. London: Academic Press, London.
Fer, K.J., Blackburn, T.M., Greenwood, J.J.D., Gregory, R.D. Quinn, R.M. & Lawton, J.H. (2000) Abundance-occupancy relationships. *Journal of Applied Ecology* 37(Suppl. 1), 39-59. DOI: 10.1046/j.1365-2664.2000.00485.x

Gill F. & Donsker D. (eds) (2014) IOC world bird list (version 4.2). http://www.worldbirdnames.org/. Accessed April 2014

Goral, F. & Schellenberg, J. (2018). goeveg: Functions for Community Data and Ordinations. R package version 0.4.2. https://CRAN.R-project.org/package=goeveg

Gorresen, P.M., McMillan, G.P., Camp, R.J. & Pratt, T.K. (2009) A spatial model of bird abundance as adjusted for detection probability. *Ecography,* 32, 291-298. DOI: 10.1111/j.1600-0587.2008.05646.x

Graham, C.H., Smith, T.B. & Languy, M. (2005) Current and historical factors influencing patterns of species richness and turnover of birds in the Gulf of Guinea highlands. *Journal of Biogeography* 32, 1371-1384. DOI: 10.1111/j.1365-2699.2005.01284.x

Gram, W.R., & Faaborg, J. (1997) The distribution of Neotropical migrant birds wintering in the El Cielo Biosphere Reserve, Tamaulipas, Mexico. *The Condor* 99, 658–670. DOI: 10.2307/1370478

Grant, P.R. & Grant, B.R. (2006) Evolution of character displacement in Darwin's finches. *Science* 313, 224-226, DOI: 10.1126/science.1128374
Goerck, J. M. (1999) Distribution of birds along an elevational gradient in the Atlantic forest of Brazil: implications for the conservation of endemic and endangered species. *Bird Conservation International* 9, 235-253. DOI: 10.1017/S0959270900003439

Goetz S., Steinberg D., Dubayah R. & Blair B. (2007) Laser remote sensing of canopy habitat heterogeneity as a predictor of bird species richness in an eastern temperate forest, USA. *Remote Sensing of Environment* 108, 254–263. DOI: 10.1016/j.rse.2006.11.016

Hallbritter, H., Alexander, J.M., Edwards, P.J. & Billeter, R. (2013) How comparable are species distributions along elevational and latitudinal climate gradients? *Global Ecology and Biogeography* 22, 1228-1237. DOI: 10.1111/geb.12066

Hamadi, I.D., Ferger, S.W., Cordeiro, N.J., Howell, K.M., Schleuning M., Boehning-Gaese, K. & Hof C. (2016) Changes in abundances of forest understorey birds on Africa's highest mountain suggest subtle effects of climate change. *Diversity and Distributions* 22, 288-299. DOI: 10.1111/ddi.12405

Hamer, K.C., Newton, R.J., Edwards, F.A. Benedick, S., Bottrell, S.H. & Edwads D.P. (2015) Impacts of selective logging on insectivorous birds in Borneo: The importance of trophic position, body size and foraging height. *Biological Conservation*, 188. 82 - 88. DOI: 10.1016/j.biocon.2014.09.026

Hawkins, B.A., Porter, E.E. & Diniz-Filho, J.A. (2003). Productivity and history as predictors of the latitudinal diversity gradient of terrestrial birds. *Ecology,* 84,1608–1623. DOI: 10.1890/0012-9658(2003)084[1608:PAHAPO]2.0.CO;2

Herrera, C.M. (1978) Ecological Correlates of Residence and Non-Residence in a Mediterranean Passerine Bird Community. *Journal of Animal Ecology* 47, 871-890. DOI: 10.2307/3676

Herzog, S.K., Kessler, M., & Bach, K. (2005) The elevational gradient in Andean bird species richness at the local scale: a foothill peak and a high-elevation plateau. *Ecography* 28, 209-222. DOI: 10.1111/j.0906-7590.2005.03935.x

Holt R.D., Lawton J.H., Gaston K.J., Blackburn T.M. (1997) On the relationship between range size and local abundance: back to basics. *Oikos*, 78, 183–190. DOI: 10.2307/3545815

Hořák D., Sedláček O., Reif J., Riegert J. & Pešata M. (2010) When savannah encroaches on the forest: thresholds in bird-habitat associations in the Bamenda Highlands, Cameroon. *African Journal of Ecology* 48, 822– 827. DOI: 10.1111/j.1365-2028.2009.01155.x

Hořák, D., Ferenc, M., Sedláček, O., Njie, F., Svoboda, M., Altman, J., Albrecht, T., Nana, E., Janeček Š., Dančák, M., Majeský, Ľ, Lltonga E., Doležal, J. (2019) Forest structure determines spatial changes in avian community along an elevational gradient in tropical Africa. *Journal of Biogeography.* In press.

Jankowski, E.J., Robinson, S.K. & Levey, D.J. (2010) Squeezed at the top: Interspecific aggression may constrain elevational ranges in tropical birds. *Ecology* 91(7), 1877-1884. DOI: 10.1890/09-2063.1

Janzen, D.H. (1967) Why mountain passes are higher in the tropics. *The American Naturalist* 101, 233-249. DOI: 10.1086/282487

Karr, J.R. (1971) Structure of Avian Communities in Selected Panama and Illinois Habitats. *Ecological Monographs* 41, 457-481. DOI: 10.2307/1942366

Karr, J.R. (1981). Surveying birds with mist nets. *Studies in Avian Biology* 6, 62–67.

Klopfer, P.H., and R.H. MacArthur (1960) Niche size and faunal diversity. *The American Naturalist* 96, 293-300. DOI: 10.1086/282130

Koen, J.H. (1988) Stratal distribution and resource partitioning of birds in the Knysna Forest, South Africa. *African Journal of Ecology* 26, 329–238. DOI: 10.1111/j.1365-2028.1988.tb00974.x

Kozak, K.H. & Wiens, J.J. (2010) Accelerated rates of climatic-niche evolution underlie rapid species diversification. *Ecology Letters* 13, 1378-1389. DOI: 10.1111/j.1461-0248.2010.01530.x

Lambin, E.F., Turner, B.L., Geist, H.J., Agbola, S.B., Angelsen, A., Bruce, J.W., Coomes, O.T., Dirzo, R., Fischer, G., Folke, C., George, P.S., Homewood, K., Imbernon, J., Leemans, Rik., Li, X., Moran, E.F., Mortimore, M., Ramakrishnan, P.S., Richards, J.F., Skanes, H., Steffen, W., Stone, G.D., Svedin, U., Veldkamp, T.A., Vogel, C. & Xu, J. (2001) The causes of land-use and land-cover change: moving beyond the myths. *Global Environmental Change*, 11, 261–269. DOI: 10.1016/S0959-3780(01)00007-3

Latta, S.C., Tinoco, B.A., Astudillo, P.X. & Graham C.H. (2011) Patterns and magnitude of temporal change in avian communities in the Ecuadorian Andes. *The Condor* 113(1), 24-40. DOI: 10.1525/cond.2011.090252

Link, W.A. & Sauer, J.R. (2007) Seasonal components of avian population change: joint analysis of two large-scale monitoring programs. *Ecology* 88(1), 49-55. DOI: 10.1890/0012-9658(2007)88[49:SCOAPC]2.0.CO;2

Lomolino M. V. (2001) Elevation gradients of species-density: historical and prospective views. *Global Ecology & Biography.* 10, 3-13. DOI: 10.1046/j.1466-822x.2001.00229.x

MacArthur, R.H., Diamond, J.M. & Karr, J.R. (1972): Density compensation in island faunas. *Ecology* 53, 330-342 DOI: 10.2307/1934090

MacArthur, R.H. & MacArthur, J.W. (1961) On bird species diversity. *Ecology* 42, 594–598. DOI: 10.1111/geb.12410

MacArthur, R.H. & MacArthur, A.T. (1974) On the use of mist nets for population studies of birds. *Proceeding of the National Academy of Sciences*, 71, 3230–3233. DOI: 10.1073/pnas.71.8.3230

MacArthur, R. H., Recher, H. & Cody, M. (1966) On the relation between habitat selection and species diversity. *The American Naturalist,* 100, 319-332. DOI: 10.1086/282425

Marques, J.T., Ramos Pereira, M.J., Marques, T.A., Santos, C.D., Santana, J., Beja, P. & Palmeirim, J.M. (2013) Optimizing Sampling Design to Deal with Mist-Net Avoidance in Amazonian Birds and Bats. *Proceedings of the National Academy of Sciences of the United States of America* 8*,* e74505 DOI: 10.1371/journal.pone.0074505

Martin, T.E. (1985) Selection of Second-Growth Woodlands by Frugivorous Migrating Birds in Panama: An Effect of Fruit Size and Plant Density? *Journal of Tropical Ecology,* 1, 157-170. DOI: 10.1017/S0266467400000213

Martin, T.E., Nightingale, J., Baddams, J., Monkhouse, J., Kaban, A., Sastranegara, H., Mulyani, Y., Blackburn, G.A. & Simcox, W. (2017) Variability in the Effectiveness of Two Ornithological Survey Methods between Tropical Forest Ecosystems. PLoS ONE 12, e0169786. DOI: 10.1371/journal.pone.0169786

McCain, C.M. (2005) Elevational Gradients in Diversity of Small Mammals. *Ecology* 86(2), 366-372. DOI: 10.1890/03-3147

McCain, C.M. (2007) Area and Mammalian Elevational Diversity. *Ecology* 88(1), 76-86. DOI: 10.1890/0012-9658(2007)88[76:AAMED]2.0.CO;2

McCain, C.M. (2009) Global analysis of bird elevational diversity. *Global Ecology and Biogeography.* 18, 346-360. DOI: 10.1111/j.1466-8238.2008.00443.x

McCain, C.M. (2009) Vertebrate range sizes indicate that mountains may be higher in the tropics. *Ecology Letters* 12, 550-560. DOI: 10.1111/j.1461-0248.2009.01308.x

McCain, C.M. & Knight, K.B. (2013) Elevational Rapoport's rule is not pervasive on mountains. *Global Ecology and Biogeography* 22(5/6), 750-759. DOI: 10.1111/geb.12014

McCain, C.M. & Beck, J (2016) Species turnover in vertebrate communities along elevational gradients is idiosyncratic and unrelated to species richness. *Global Ecology and Biogeography* 25, 299-310. DOI: 10.1111/geb.12410

Mittelbach, G.G., Schemske, D.W., Cornell, H.V., Allen, A.P., Brown, J.M., Bush, M.B., Harriso,n S.P., Hurlbert, A.H., Knowlton N., Lessios H.A., McCain, C.M., McCune, A.R., McDade, L.A., McPeek, M.A., Near T.J., Price, T.D., Ricklefs, R.E., Roy, K., Sax, D.F., Schluter, D., Sobel, J.M. & Turelli, M. (2007). Evolution and the latitudinal diversity gradient: speciation, extinction and biogeography. *Ecology Letters*, 10, 315–331. DOI: 10.1111/j.1461-0248.2007.01020.x

Nichols, J.D., Hines, J.E., Sauer, J.R., Fallon, F.W., Fallon, J.E., & Heglund, P.J. (2000). A doubleobserver approach for estimating detection probability and abundance from point counts. *The Auk,* 117, 393–408. DOI: 10.1642/0004-8038(2000)117[0393:ADOAFE]2.0.CO;2

Ogle, D.H., Wheeler, P. & Dinno, A. (2019) FSA: Fisheries Stock Analysis. R package version 0.8.24, https://github.com/droglenc/FSA.

Oksanen, J., Blanchet, F.G., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., Minchin, P.R., O'Hara, R.B., Simpson, G.L., Solymos, P., Stevens, M.H.M. Szoecs, E. & Wagner H. (2019). vegan: Community Ecology Package. R package version 2.5-5. https://CRAN.R-project.org/package=vegan

Owiunji, I. & Plumptre, A.J. (1998) Bird communities in logged and unlogged compartments in Budongo Forest, Uganda. *Forest Ecology and Management* 108(1), 115-126. DOI: 10.1016/S0378-1127(98)00219-9

Pardieck, K. & Waide, R.B. (1992) Mesh Size as a Factor in Avian Community Studies Using Mist Nets. *Journal of Field Ornithology* 63(3), 250-255. URL: https://www.jstor.org/stable/4513703
Parker, G.G. & Brown M.J. (2000) Forest canopy stratification—is it useful? *The American Naturalist* 155, 473–484. DOI: 10.1086/303340

Peach, W.J., Baillie, S.R. & Balmer, D.E. (1996) The use of constant effort mist-netting to measure between-year changes in the abundance and productivity of common passerines. *Bird Study*, 43, 142–156. DOI: 10.1080/00063659609461007

Poulin, B., Lefebvre, G. & Pilard, P. (2000) Quantifying the Breeding Assemblage of Reedbed Passerines with Mist-Net and Point- Count Surveys. *Journal of Field Ornithology* 71, 443-454. DOI: 10.1648/0273-8570-71.3.443

Proctor, J., Edwards, I.D., Payton, R.W. & Nagy L. (2007) Zonation of forest vegetation and soils on Mount Cameroon, West Africa. *Plant Ecology* 192, 251-269. DOI 10.1007/s11258-007-9326-5

R Core Team (2019). R: A language and environment for statistical computing, Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/

Rahbek, C (1995) The Elevational Gradient of Species Richness: A Uniform Pattern? *Ecography* 18(2), 200-205. DOI: 10.1111/j.1600-0587.1995.tb00341.x

Rahbek, C. (1997) The Relationship Among Area, Elevation, and Regional Species Richness in Neotropical Birds. *The American Naturalist* 149(5), 875-902. DOI: 10.1086/286028

Rahbek, C. (2005) The role of spatial scale and the perception of large-scale species-richness patterns. *Ecology Letters* 8, 224-239. DOI: 10.1111/j.1461-0248.2004.00701.x

Ralph, C.J., & Dunn, E.H. (2004) Monitoring bird populations using mist nets. *Stud. Avian Biol:* 29.
Ralph, C.J., Sauer, J.R. & Droege, S. (1995) Monitoring bird populations by point counts. USDA Forest Service General Technical Report PSW-GTR-149. DOI: 10.2737/PSW-

Ralph, C.J. & Scott, J.M. (eds) (1981) Estimating numbers of terrestrial birds. *Studies in Avian Biology* 6.

Rappole, J.H., K. Winker, & G.V.N. Powell (1998) Migratory bird habitat use in southern Mexico: mist nets versus point counts. *Journal of Field Ornitholo*gy 69, 635–643.

Reif, J., Hořák, D., Sedláček, O., Riegert, J., Pešata, M., Hrázský Z., Janeček Š. & Storch, D. (2006) Unusual abundance-range size relationship in an Afromontane bird community: the effect of geographical isolation? *Journal of Biogeography* 33, 1959-1968. DOI: 10.1111/j.1365-2699.2006.01547.x

Remsen, J.V. & Good, D.A. (1996) Misuse of data from mist-net captures to assess relative abundance in bird populations. *The Auk* 113, 381–398. DOI: 10.2307/4088905

Remsen, J.V. & Graves, W.S. (1995) Distribution patterns of *Buarremon* bursh-finches (Emberizinae) and interspecific competition in Andean birds. *The Auk* 112(1), 225-239. DOI: 10.2307/4088781

Ruiz-Gutiérrez, V., Doherty, P.F., Santana C., E., Martínez, S.C., Schondube, J., Munguía, H.V. & Iñigo-Elias, E. (2012) Survival of resident neotropical birds: considerations for sampling and analysis based on 20 years of bird-banding efforts in Mexico. *The Auk* 129(3), 500-509. DOI: 10.1525/auk.2012.11171

Robinson, S.K. & Terborgh, J. (1995) Interspecific aggression and habitat selection by Amazonian birds. *Journal of animal Ecology* 64, 1-11. URL: https://www.jstor.org/stable/5822

Root, T. (1988) Energy constraints on Avian distribution and abundance. *Ecology*, 69, 330–339. DOI: 10.2307/1940431

Ryan P.G., Bento C., Cohen C., Graham J., Parker V., Spottiswoode C. (1999) The avifauna and conservation status of the Namuli Massif, northern Mozambique. *Bird Conservation International* 9, 315–331. DOI:10.1017/S0959270900003518

Santamaría-Rivero W., Leyequién, Hernández-Stefanoni, J.L. & Wood, P. (2016) Influence of landscape structure and forest age on the richness and abundance of differend bird feeding guilds and forest-dependent birds in a seasonal dry tropical forest of Yucatan, Mexico. *Tropical Ecology* 57(2), 313-332. ISSN: 0564-3295

Sedláček, O., Vokurková J., Ferenc, M., Nana Djomo, E., Albrecht, T. & Hořák D. (2015) A comparison of point counts with a new acoustic sampling method: a case study of bird community from the montane forests of Mount Cameroon. *Ostrich*, 86, 213-220. DOI: 10.2989/00306525.2015.1049669

Shaffer M.L. (1981) Minimum population sizes for species conservation. *BioScience* 31(2), 131–134. DOI:10.2307/1308256

Sekercioğlu, C.H., Primack, R.B. & Wormworth, J. (2012) The effects of climate change on tropical birds. *Biological Conservation* 148, 1-18. DOI: 10.1016/j.biocon.2011.10.019

Sekercioğlu C.H. & Riley A. (2005) A brief survey of the birds in Kumbira Forest, Gabela, Angola. *Ostrich* 76, 111–117. DOI: 10.2989/00306520509485483

Smith, A.P. (1973) Stratification of temperate and tropical forests. *The American Naturalist,* 107, 671-683. DOI: 10.1086/282866

Styring A.R., bin Hussin M.Z. (2004) Foraging ecology of woodpeckers in lowland Malaysian rain forests. *Journal of Tropical Ecology,* 20, 487–494. DOI: 10.1017/S0266467404001579

Stevens, G.C. (1992) The elevational gradient in altitudinal range: an extension of Rapoport's latitudinal rule to altitude. *The American Naturalist,* 140, 893-911. DOI: 10.1086/285447.

Terborgh, J. (1971) Distribution on environmental gradients: theory and a preliminary inter-pretation of distributional patterns in the avifauna of the Cordillera Vilcabamba, Peru. *Ecology* 52(1), 23-40. DOI: 10.2307/1934735

Terborgh, J. (1977) Bird Species Diversity on an Andean Elevational Gradient. *Ecology* 58(5), 1007-1019. DOI: 10.2307/1936921

Terborgh J., Robinson, S.K., Parker III, T.A., Munn, C.A. & Pierpont, N. (1990) Structure and Organization of an Amazonian Forest Bird Community. *Ecological Monographs* 60(2), 213-238. DOI: 10.2307/1943045

Terborgh, J., & Weske, J.M. (1969) Colonization of secondary habitats by Peruvian birds. *Ecology* 50, 765-782. DOI: 10.2307/1933691

Terborgh, J. & Weske, J.S. (1975) The role of competition in the distribution of Andean birds. *Ecology* 56, 562-576. DOI: 10.2307/1935491

Vokurková, J, Motombi, F.N., Ferenc, M. Hořák, D. & Sedláček, O. (2018) Seasonality of vocal activity of a bird community in an Afrotropical lowland rain forest. *Journal of Tropical Ecology.* 34, 53-64. DOI: 10.1017/S0266467418000056

Wallace, G.E., H. González-Alonso, M. K. McNicholl, D. Rodríguez-Batista, R. Oviedo-Prieto, A. Llanes-Sosa, B. Sánchez-Oria, & E. A. H. Wallace (1996) Winter surveys of forest-dwelling Neotropical migrant and resident birds in three regions of Cuba. *The Condor* 98, 745-768. DOI: 10.2307/1369856

Wang, Y. & Finch, D.M. (2002) Consistency of mist netting and point counts in assessing landbird species richness and relative abundance during migration. *The Condor* 104, 59-72. DOI: 10.1650/0010-5422(2002)104[0059:COMNAP]2.0.CO;2

Whitman, A.A., Hagan III, J.M. & Brokaw, N.V.L. (1997) A comparison of two bird survey techniques used in a subtropical forest. *The Condor* 99, 955–965. DOI: 10.2307/1370146

Wickham, H. (2016) ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York.

Williams, S.E., Williams, Y.M., VanDerWal, J., Isaac, J.L., Shoo, I.P. & Johnson, C.N. (2009) Ecological Specialization and Population Size in a Biodiversity Hotspot: How Rare Species Avoid Extinction. *Proceedings of the National Academy of Sciences of the United States of America* 106(Suppl. 2), 19737-19741. DOI: 10.1073/pnas.0901640106

Willig, M.R., Kaufman D.M. & Stevens R.D. (2003) Latitudinal gradients of biodiversity: pattern, process, scale, and synthesis. *The Annual Review of Ecology, Evolution, and Systematics* 34, 273–309. DOI: 10.1146/annurev.ecolsys.34.012103.144032

Wright, S.J. (1980) Density Compensation in Island Avifaunas. *Oecologia* 45, 385-389. DOI: 10.2307/193409

Zuckerberg, B., Bonter, D.N., Hochachka, W.M., Koenig, W.D., DeGaetano, A.T. & Dickinson, J.L. (2011) Climatic constraints on wintering bird distributions are modified by urbanization and weather. *Journal of Animal Ecology* 80, 403–413. DOI: 10.1111/j.1365-2656.2010.01780.x

Appendix

Picture 1 The secondary lowland forest at the Bimbia-Bonadikombo Community Forest, 30 m a.s.l. Photo: Ondřej Sedláček.

Picture 2 The sea near our plot at the Bimbia-Bonadikombo Community Forest. Photo: Ondřej Sedláček.

Picture 3 Point-counting at the Bimbia-Bonadikombo Community Forest, 30 m a.s.l. Photo: Ondřej Sedláček.

Picture 4 The mid-elevation forest with vast open areas and dense, herbaceous understory. Photo taken during my visit to Mt. Cameroon in September 2018.

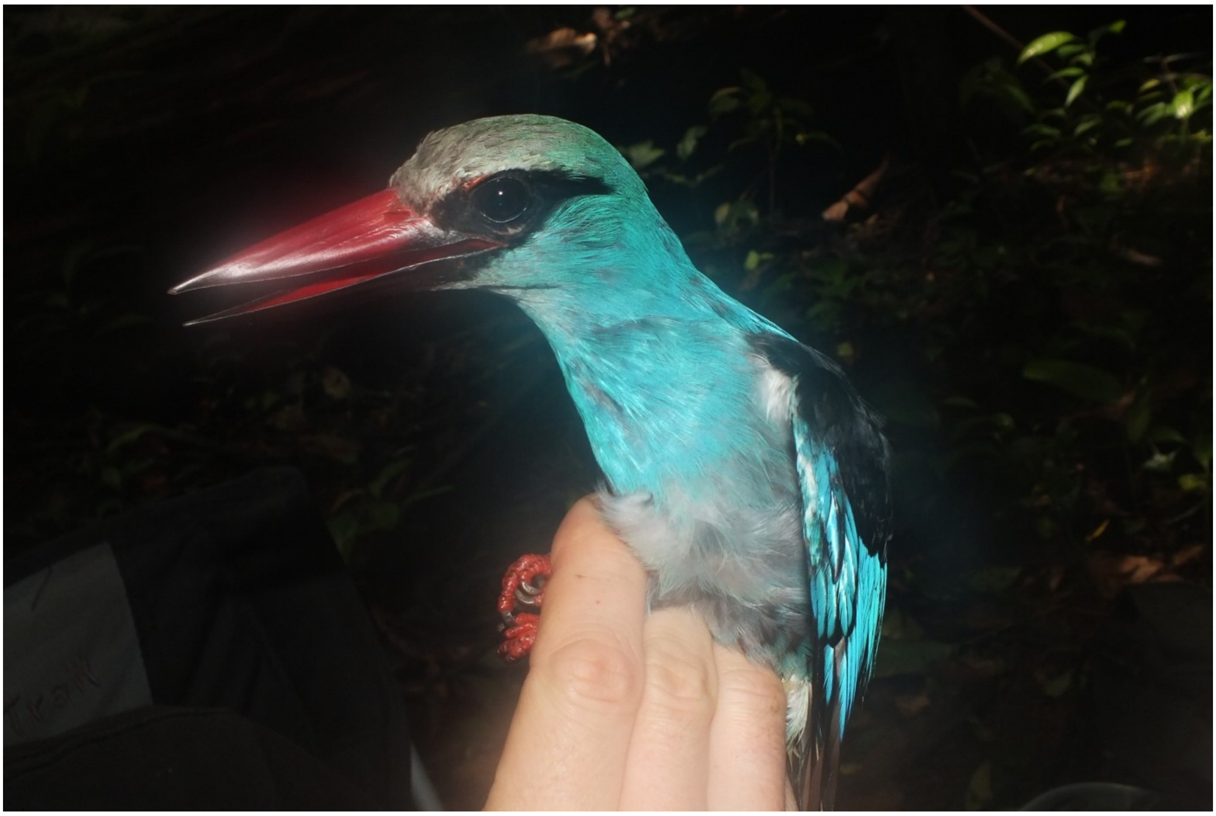
Picture 5 Crater lake, near our plot in the mid-elevation forest at ca. 1500 m a.s.l. Taken during my visit to Mt. Cameroon, September 2018.

Picture 6 Early succession at one of the lava flows on the border between the mid-elevation and montane forest. Photo taken during my visit to Mt. Cameroon in September 2018.

Picture 7 The montane forest with dense understory and open canopy, lacking lianas that are common in the lowland and mid-elevation forest. Photo taken during my visit to Mt. Cameroon, near Mann's Spring, ca 2200 m a.s.l., in September 2018.

Picture 8 The treeline at ca. 2250 m a.s.l., where the montane forest meets the savannah. Photo: Ondřej Sedláček.

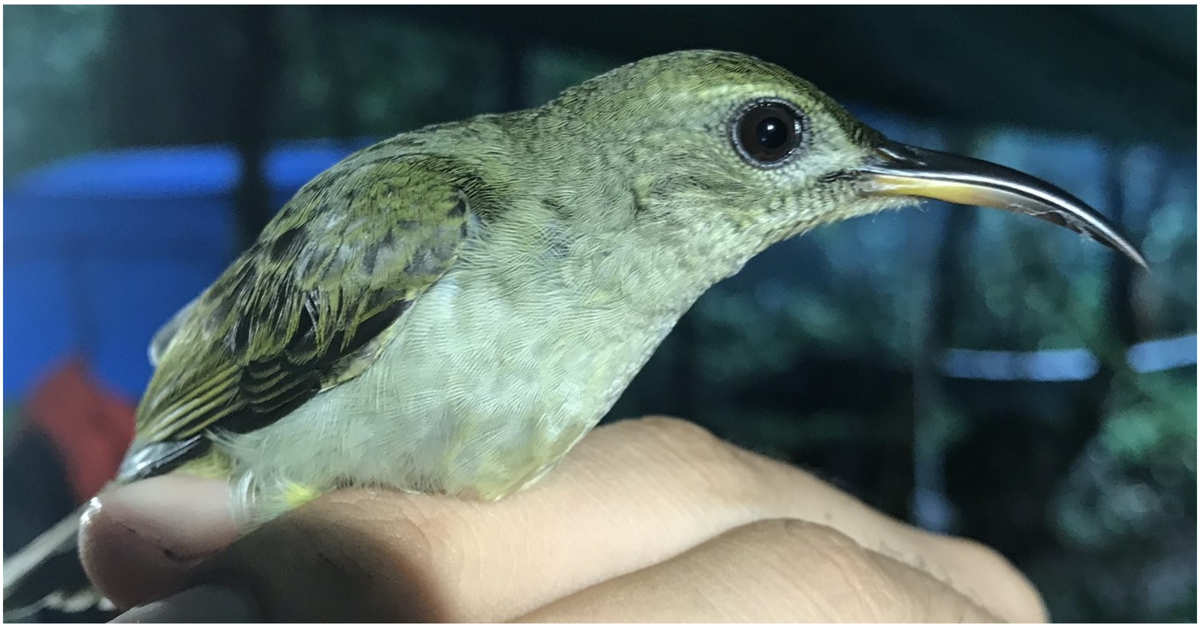
Picture 9 The treeline at ca. 2250 m a.s.l., where the montane forest meets the savannah. Photo: Ondřej Sedláček



Picture 10 *Halcyon malimbica* mist-netted at the Bimbia-Bonadikombo Community Forest, 30 m a.s.l. Photo: Ondřej Sedláček.

Picture 11 *Dyaphorophyia concreta.* Mist-netted during my visit to Mt. Cameroon at Drinking Garri, 650 m a.s.l., in September 2018.

Picture 12 *Cossyphicula roberti.* Mist-netted during my visit to Mt. Cameroon at Drinking Garri, 650 m a.s.l., in September 2018.



Picture 13 *Cyanomitra olivacea.* Mist-netted during my visit to Mt. Cameroon at Drinking Garri, 650 m a.s.l., in September 2018.

Picture 14 *Ceyx lecontei,* the world’s smallest kingfisher. Mist-netted during my visit to Mt. Cameroon at Drinking Garri, 650 m a.s.l., in September 2018.

Picture 15 *Cinnyris reichenowi.* Mist-netted during my visit to Mt. Cameroon at Mann’s Spring, 2200 m a.s.l., in September 2018.

Picture 16 *Cyanomitra oritis.* Mist-netted during my visit to Mt. Cameroon at Mann's Spring, 2200 m a.s.l., in September 2018.

Picture 17 *Linurgus olivaceus.* Mist-netted during my visit to Mt. Cameroon at Mann's Spring, 2200 m a.s.l., in September 2018.

Picture 18 *Serinus burtoni* . Mist-netted during my visit to Mt. Cameroon at Mann's Spring, 2200 m a.s.l., in September 2018.

Picture 19 *Cryptospiza reichenovii* . Mist-netted during my visit to Mt. Cameroon at Mann's Spring, 2200 m a.s.l., in September 2018.

Picture 20 *Laniarius atroflavus*. Photo: David Hořák

Table 1. List of species detected by mist-netting (Captures) or point counts (Counts) in each plot along the forested gradient of Mt. Cameroon. The list includes infromation about species size (S = small, M = medium, L = large), feeding guild (Alc = kingfisher (Alcediniidae), C = carnivore, F = frugivore, G = granivore, I = insectivore, N = nectarivore) and preferred foraging stratum (FF = forest floor, US = understory, SC = sub-canopy, C = canopy or NP = no preference). Capture and count numbers were collected during surveys conducted at the same time. Numbers of birds mist-netted at the Mann's Spring site (2200 m a.s.l.) are averaged records of birds from two mist-netting sessions.

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Accipiter tachiro	L	C	SC	Nets	1	/	/	/	/	/	/
				Counts	5	/	2	1	/	/	/
Alcedo cristatus	S	Alc	US	Nets	/	/	/	/	/	/	/
				Counts	1	/	/	/	/	/	/
Alcedo leucogaster	S	Alc	US	Nets	2	/	/	/	/	/	/
				Counts	/	/	/	/	/	/	/
Alcedo quadribrachys	M	Alc	US	Nets	2	/	/	/	/	/	/
				Counts	3	/	/	/	/	/	/
Alethe diademata	M	I	FF	Nets	/	5	2	4	3	/	/
				Counts	/	11	12	8	3	/	/
Alethe poliocephala	S	I	FF	Nets	/	8	6	21	7	1	/
				Counts	/	13	10	16	/	/	/
Andropadus ansorgei	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	11	8	9	/	/	/	/
Andropadus curvirostris	S	I	US	Nets	/	1	/	/	1	/	/
				Counts	/	1	1	/	/	/	/
Andropadus gracilirostris	M	F	US	Nets	/	/	/	/	/	/	/
				Counts	3	2	2	/	/	/	/
Andropadus latirostris	S	F	NP	Nets	4	21	3	/	/	/	/
				Counts	15	13	12	2	/	/	/
Andropadus montanus	M	F	US	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	9	16	/
Andropadus tephrolaemus	M	F	C	Nets	/	8	2	3	18	35	18,5
				Counts	/	2	7	21	33	42	61
Andropadus virens	S	F	US	Nets	2	7	3	/	/	/	/
				Counts	17	15	11	7	/	/	/
Anthus cinnamomeus	S	I	FF	Nets	/	/	/	2	4	/	/
				Counts	/	/	/	/	/	/	/
Apalis binotata	S	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	2	/	/	/	/	/
Apalis cinerea	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	26	31	24	26
Apalis jacksoni bambuluensis	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	1	15	/	/	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Apalis nigriceps	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	13	/	/	/	/
Apalis rufogularis	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	6	/	11	1	/	/	/
Apaloderma aeqatoriale	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	1	3	/	/	/	/
Apaloderma narina	L	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	2	/	/	/	/
Apaloderma vittatum	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	4	5	/	/
Aplopelia larvata	L	G	FF	Nets	/	/	/	/	1	/	/
				Counts	/	/	/	/	/	1	/
Apus apus	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	2	/	2	/	/	/	/
Baepogon indicator	M	F	C	Nets	/	/	/	/	/	/	/
				Counts	5	3	7	/	/	/	/
Bathmocercus rufus	S	I	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	3	5	/	/	/
Bleda notatus	M	I	FF	Nets	2	3	1	/	/	/	/
				Counts	7	3	8	/	/	/	/
Bleda syndactyla	M	I	FF	Nets	/	/	2	/	/	/	/
				Counts	15	10	9	/	/	/	/
Bradypterus lopezi	S	I	FF	Nets	/	/	/	/	2	7	4
				Counts	/	/	/	9	24	31	27
Buccanodon duchaillui	M	F	C	Nets	/	/	/	/	/	/	/
				Counts	13	3	8	/	3	/	/
Bycanistes albotibialis	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	2	/	/	/	/	/	/
Bycanistes fistulator	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	12	/	/	/	/	/	/
Calyptocichla serinus	M	F	C	Nets	/	/	/	/	/	/	/
				Counts	8	1	8	/	/	/	/
Camaroptera chloronota	S	I	US	Nets	/	3	2	/	/	/	/
				Counts	/	3	14	5	/	/	/
Camaroptera superciliaris	S	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	1	/	/	/	/	/
Campeghaga petiti	M	I	C	Nets	/	/	/	/	2	1	/
				Counts	/	/	/	/	/	1	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Campethera cailliautii	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	/	/	/
Campethera nivosa	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	3	1	2	/	/	/	/
Campethera tullbergi	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	5	3	/
Centropus leucogaster	L	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	2	1	/	/	/	/
Ceratogymna atrata	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	17	1	/	/	/	/	/
Ceratogymna elata	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	/	2	/	/	/	/	/
Cercococcyx olivinus	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	1	/	/	/	/	/
Ceuthmonaches aereus	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	6	8	12	9	/	/	/
Chrysococcyx cupreus	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	10	8	16	11	/	/	/
Chrysococcyx klaas	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	4	1	2	1	1	/	/
Cinnyris batesi	S	N	C	Nets	/	/	1	/	/	/	/
				Counts	/	/	1	/	/	/	/
Cinnyris chloropygius	S	N	US	Nets	/	/	/	/	/	/	/
				Counts	/	2	1	4	/	/	/
Cinnyris reichenowi	S	N	SC	Nets	/	/	/	/	11	20	35,5
				Counts	/	/	/	/	37	50	58
Cinnyris superbus	S	N	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	1	/	/	/	/
Cinnyris ursulae	S	N	SC	Nets	/	/	/	2	/	/	/
				Counts	/	/	/	/	/	/	/
Cisticola chubbi	S	I	US	Nets	/	/	/	/	11	10	5
				Counts	/	/	/	8	20	18	17
Columba sjostedti	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	5	2
Columba unicincta	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	7	/	/	/	/
Coracina caeruleogrisea	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	7	/	/
Corythaeola cristata	L	I	C	Nets	/	/	/	/	/	/	/
				Counts	2	/	/	/	/	/	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Cossypha isabellae	S	I	FF	Nets	/	/	/	6	12	9	9
				Counts	/	/	/	4	12	16	23
Cossyphicula roberti	S	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	3	/	/	/
Criniger calurus	M	I	US	Nets	/	/	3	/	/	/	/
				Counts	11	17	12	/	/	/	/
Criniger chloronotus	M	I	US	Nets	/	1	/	/	/	/	/
				Counts	5	7	13	/	/	/	/
Cryptospiza reichenovii	S	G	FF	Nets	/	/	/	11	8	2	2
				Counts	/	/	/	/	/	1	/
Cuculus clamosus	L	I	C	Nets	/	/	/	/	/	/	/
				Counts	5	/	1	/	/	/	/
Cyanomitra cyanolaema	S	N	C	Nets	/	/	/	/	/	/	/
				Counts	4	2	4	9	/	/	/
Cyanomitra olivacea	S	N	US	Nets	13	21	9	3	/	/	/
				Counts	22	20	19	8	/	/	/
Cyanomitra oritis	S	N	US	Nets	/	/	/	5	15	20	15
				Counts	/	/	/	8	7	9	7
Deleornis fraseri	S	I	SC	Nets	/	3	/	/	/	/	/
				Counts	14	7	6	/	/	/	/
Dendropicos elliotii	M	I	SC	Nets	/	/	/	/	3	2	2
				Counts	/	/	/	2	7	/	9
Dicrurus atripennis	M	I	US	Nets	1	/	/	/	/	/	/
				Counts	18	17	15	/	/	/	/
Dicrurus modestus	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	1	8	4	1	/	/
Dryoscopus angolensis	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	9	/	/	/
Dyaphorophyia castanea	S	I	SC	Nets	/	/	1	/	/	/	/
				Counts	13	8	15	/	/	/	/
Dyaphorophyia concreta	S	I	US	Nets	/	/	/	2	/	1	/
				Counts	/	2	1	17	8	2	/
Dyaphorophyia tonsa	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	6	9	/	/	/	/
Elminia albonotata	S	I	US	Nets	/	/	/	1	4	2	3
				Counts	/	/	/	10	14	8	14
Estrilda nonnula	S	G	FF	Nets	/	/	/	/	/	/	3,5
				Counts	/	/	/	/	2	/	/
Euplectes capensis	S	G	FF	Nets	/	/	/	/	/	/	7
				Counts	/	/	/	/	/	/	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Eurystomus gularis	L	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	1	/	/	/	/	/
Francolinus camerunensis	L	G	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	3	/	/
Fraseria ocreata	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	2	/	/	/	/
Gymnobucco calvus	M	F	SC	Nets	/	/	/	/	/	/	/
				Counts	1	/	1	/	/	/	/
Gymnobucco peli	M	F	SC	Nets	/	/	/	/	/	/	/
				Counts	2	/	1	/	/	/	/
Gypohierax angolensis	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	2	1	/	/	/	/	/
Halcyon badia	M	Alc	SC	Nets	/	/	/	/	/	/	/
				Counts	/	5	5	/	/	/	/
Halcyon malimbica	L	Alc	US	Nets	1	/	/	/	/	/	/
				Counts	11	3	/	/	/	/	/
Hedydipna collaris	S	F	SC	Nets	/	/	/	1	/	/	/
				Counts	4	/	10	10	/	/	/
Hirundo rustica	S	I	SC	Nets	/	/	1	/	/	/	/
				Counts	/	/	/	/	/	1	/
Hylia prasina	S	I	SC	Nets	2	/	/	1	/	/	/
				Counts	12	15	15	16	/	/	/
Illadopsis cleaveri	S	I	FF	Nets	/	/	3	1	1	/	/
				Counts	/	3	6	16	/	/	/
Illadopsis fulvescens	S	I	US	Nets	/	/	/	/	/	/	/
				Counts	5	6	5	/	/	/	/
Illadopsis rufipennis	S	I	FF	Nets	2	5	3	1	/	/	/
				Counts	2	12	17	/	/	/	/
Indicator conirostris	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	1	/	/	/	/	/	/
Indicator exilis	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	3	/	/	/	/	/	/
Indicator maculatus	M	I	SC	Nets	/	/	/	1	/	1	/
				Counts	/	/	/	/	/	/	/
Indicator willcocksi	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	/	3
Ixonotus guttatus	M	F	C	Nets	/	/	/	/	/	/	/
				Counts	6	1	1	/	/	/	/
Kakamega poliothorax	M	I	FF	Nets	/	/	/	6	3	5	/
				Counts	/	/	/	21	16	16	1

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Laniarius atroflavus	M	I	US	Nets	/	/	/	/	/	2	2,5
				Counts	/	/	/	6	23	31	32
Laniarius poensis	M	I	US	Nets	/	/	/	2	4	3	/
				Counts	/	/	/	35	29	15	/
Linurgus olivaceus	S	G	US	Nets	/	/	/	/	7	11	27
				Counts	/	/	/	1	9	20	16
Macrosphenus concolor	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	12	11	13	/	/	/	/
Macrosphenus flavicans	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	5	11	16	/	/	/	/
Malaconotus multicolor	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	4	1	/	/	/
Malimbus nitens	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	6	/	/	/	/	/	/
Malimbus rubicollis	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	1	/	/	/	/
Muscicapa adusta	S	I	SC	Nets	/	/	/	/	1	1	1,5
				Counts	/	/	/	/	4	4	16
Muscicapa sethsmithi	S	I	US	Nets	/	/	1	/	/	/	/
				Counts	/	2	/	/	/	/	/
Neocossyphus poensis	M	I	FF	Nets	/	/	/	/	/	/	/
				Counts	3	1	3	/	/	/	/
Neocossyphus rufus	M	I	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	/	/	/
Nesocharis shelleyi	S	I	NP	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	8	/
Nicator chloris	M	I	US	Nets	/	/	/	/	/	/	/
				Counts	10	9	11	/	/	/	/
Nigrita bicolor	S	G	US	Nets	/	/	1	/	/	/	/
				Counts	1	/	1	/	/	/	/
Nigrita canicapillus	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	1	/
Nigrita fusconotus	S	G	SC	Nets	/	/	/	1	/	/	/
				Counts	/	/	/	/	/	/	/
Nigrita luteifrons	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	7	9	2	/	/	/	/
Onychognathus fuldigus	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	/	1	1	/	/	/	/
Onychognathus walleri	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	2	2	35

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Oriolus brachyrynchus	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	7	8	16	/	/	/	/
Oriolus nigripennis	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	1	15	19	3	1	/
Oxylophus levaillantii	L	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	/	1	3	/	/	/
Parmoptila woodhousei	S	I	US	Nets	/	1	/	/	/	/	/
				Counts	2	1	/	/	/	/	/
Phyllastrephus albigularis	S	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	2	/	/	/	/	/
Phyllastrephus icterinus	S	I	US	Nets	12	10	8	/	/	/	/
				Counts	13	13	11	/	/	/	/
Phyllastrephus poensis	S	I	US	Nets	/	/	/	15	1	/	/
				Counts	/	/	/	34	1	/	/
Phyllastrephus xavieri	S	I	C	Nets	/	/	6	/	/	/	/
				Counts	/	2	3	/	/	/	/
Phylloscopus herberti	S	I	C	Nets	/	/	/	/	2	/	/
				Counts	/	/	/	18	12	/	/
Phylloscopus poliocephalus	M	I	C	Nets	/	/	/	3	/	/	/
				Counts	/	/	/	40	/	/	/
Phylloscopus sibilatrix	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	2	4	/	1	/
Phylloscopus trochilus	S	I	SC	Nets	/	/	/	/	/	/	0,5
				Counts	/	/	/	1	1	/	1
Picathartes oreas	L	I	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	1	/	/	/	/
Platysteira cyanae	M	I	SC	Nets	/	/	/	/	/	/	3
				Counts	/	/	/	7	21	16	17
Ploceus albinucha	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	1	1	/	/	/	/
Ploceus bicolor	S	I	SC	Nets	/	/	/	2	/	/	/
				Counts	/	/	/	11	6	6	/
Ploceus insignis	M	I	US	Nets	/	/	/	/	3	/	0,5
				Counts	/	/	/	/	15	/	/
Ploceus melanogaster	S	I	US	Nets	/	/	/	7	12	6	3,5
				Counts	/	/	/	/	/	/	4
Ploceus preussi	M	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	/	/	/
Poeoptera lugubris	M	F	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	1	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Pogoniulus atroflavus	S	F	C	Nets	/	/	1	/	/	/	/
				Counts	1	3	1	/	/	/	/
Pogoniulus bilineatus	S	F	SC	Nets	/	/	/	/	/	1	1,5
				Counts	/	/	1	9	/	9	/
Pogoniulus coryphaea	S	F	SC	Nets	/	/	/	/	/	/	2,5
				Counts	/	/	/	/	/	14	12
Pogoniulus scolopaceus	S	F	SC	Nets	/	/	/	/	/	/	/
				Counts	7	7	4	/	/	/	/
Pogoniulus subsulphureus	S	F	C	Nets	/	/	/	/	/	/	/
				Counts	15	13	7	/	/	/	/
Poliolais lopezi	S	I	US	Nets	/	/	/	6	8	2	/
				Counts	/	/	/	19	1	2	/
Polyboroides typus	L	F	SC	Nets	/	/	/	/	/	/	/
				Counts	1	/	1	1	1	/	/
Prinia bairdii	S	I	US	Nets	/	/	/	3	3	/	/
				Counts	/	/	/	26	10	/	/
Prionops caniceps	M	I	SC	Nets	/	/	/	/	/	/	/
				Counts	/	1	/	/	/	/	/
Psalidoprocne fuliginosa	S	I	C	Nets	/	/	/	/	7	/	0,5
				Counts	/	/	/	4	5	17	2
Psalidoprocne nitens	S	I	SC	Nets	/	/	/	/	/	/	/
				Counts	1	/	/	/	/	/	/
Pseudoalcippe abyssinica	S	I	US	Nets	/	/	/	1	4	11	7,5
				Counts	/	/	/	15	25	27	35
Psittacus erithacus	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	4	/	/	/	/	/	/
Pycnonotus barbatus	M	F	NP	Nets	/	/	/	/	/	/	/
				Counts	1	1	3	/	3	2	2
Sarothrura pulchra	M	I	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	14	/	/	/	/
Sasia africana	S	I	US	Nets	/	/	1	/	/	/	/
				Counts	/	/	/	/	/	/	/
Saxicola troquatus	S	I	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	/	1
Serinus burtoni	M	F	SC	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	5	2
Sheppardia bocagei	S	I	FF	Nets	/	/	/	3	/	/	/
				Counts	/	/	/	13	/	/	/
Schoutedenapus myoptilus	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	/	/	2	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Smithornis rufolateralis	S	I	US	Nets	/	/	/	/	/	/	/
				Counts	/	4	9	/	/	/	/
Smithornis sharpei	M	I	US	Nets	/	/	/	1	/	/	/
				Counts	/	/	/	2	/	/	/
Speirops melanocephalus	S	I	SC	Nets	/	/	/	/	/	1	3
				Counts	/	/	/	/	/	2	10
Spermophaga haematina	S	G	FF	Nets	/	/	/	1	/	/	/
				Counts	/	/	/	/	/	/	/
Stiphrornis erythrothorax	S	I	FF	Nets	/	5	/	/	/	/	/
				Counts	/	1	9	1	/	/	/
Stizorhina fraseri	M	I	US	Nets	/	/	/	/	/	/	/
				Counts	12	7	11	/	/	/	/
Streptopelia semitorquata	L	G	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	4	/	/	/
Sylvietta dentii	S	I	C	Nets	/	/	/	/	/	/	/
				Counts	1	1	1	/	/	/	/
Tauraco macrorhynchus	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	14	15	15	15	14	22	/
Terpsiphone rufiventer	S	I	US	Nets	1	2	1	3	/	/	/
				Counts	15	16	16	10	2	/	/
Tockus camurus	L	I	SC	Nets	/	/	/	/	/	/	/
				Counts	1	/	/	/	/	/	/
Tockus fasciatus	L	F	SC	Nets	/	/	/	/	/	/	/
				Counts	5	5	1	/	/	/	/
Trachylaemus purpuratus	L	F	SC	Nets	/	/	/	/	/	/	/
				Counts	2	/	/	1	/	/	/
Treron calvus	L	F	C	Nets	/	/	/	/	/	/	/
				Counts	7	10	6	5	8	19	/
Tricholaema hirsuta	M	F	SC	Nets	/	/	/	/	/	/	/
				Counts	7	1	6	1	/	/	/
Trochocercos nitens	S	I	SC	Nets	/	1	2	/	/	/	/
				Counts	4	3	9	14	/	/	/
Tropicranus albocristatus	L	I	US	Nets	/	/	/	/	/	/	/
				Counts	4	/	/	/	/	/	/
Turdus pelios	M	I	FF	Nets	/	1	1	11	8	9	15,5
				Counts	/	/	/	8	4	8	11
Turtur afer	M	G	FF	Nets	/	/	/	/	/	/	/
				Counts	/	/	/	1	/	/	/
Turtur brehmeri	L	G	FF	Nets	1	1	/	/	/	/	/
				Counts	9	5	5	/	/	/	/

Species	Size	Feeding guild	Preferred foraging stratum	Detected via	Bimbia 30 m	Bamboo Camp 350 m	Drinking Garri 650 m	Planti Camp 1100 m	Crater Lake 1500 m	Elephant Camp 1800 m	Mann's Spring 2200 m
Turtur tympanistria	M	G	FF	Nets	/	1	/	1	/	/	0,5
				Counts	2	3	1	14	/	4	/
Urolais epichlorus	S	I	SC	Nets	/	/	/	3	10	11	2,5
				Counts	/	/	1	26	37	21	18
Zoothera camaronensis	M	I	FF	Nets	1	/	/	/	/	/	/
				Counts	/	/	/	/	/	/	/
Zoothera crossleyi	L	I	FF	Nets	/	2	/	1	/	/	/
				Counts	/	/	/	3	/	/	/
Zosterops senegalensis	S	I	C	Nets	/	/	/	/	6	/	/
				Counts	/	/	7	15	14	9	/

Table 2 Checklist of species recorded across 7 forested elevational plots (30, 350, 650, 1100, 1500, 1800 and 2200 m a.s.l.) by mist nets, point counts or during random walks during the dry season on Mt. Cameroon. The list show whether the species was detected by mist nets, its body mass, size, preferred foraging stratum, feeding guild, foraging method, frequency of flocking behaviour and recorded relative abundance.

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Accipiter erythropus	*Missed*	124	Large	Understory	Carnivore	Taking	Never	/
Accipiter melanogaster	*Missed*	677.5	Large	Sub-canopy	Carnivore	Taking	Never	/
Accipiter tachiro	*Recorded*	347.1	Large	Sub-canopy	Carnivore	Taking	Never	1
Actitis hypoleucos	*Missed*	63	Medium	Forest floor	Insectivore	Ground-searching	Never	/
Alcedo cristatus	*Missed*	15.5	Small	Understory	Kingfisher	Taking	Never	/
Alcedo leucogaster	*Recorded*	14.95	Small	Understory	Kingfisher	Taking	Never	1,13
Alcedo quadribrachys	*Recorded*	36	Medium	Understory	Kingfisher	Taking	Never	2
Alethe diademata	*Recorded*	31.6	Medium	Forest floor	Insectivore	Ground-searching	Never	3,69
Alethe poliocephala	*Recorded*	29.85	Small	Forest floor	Insectivore	Ground-searching	Never	9,08

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Anabathmis reichenbachii	*Missed*	9.8	Small	Understory	Nectarivore	Taking	Never	/
Andropadus ansorgei	*Missed*	19.1	Small	Canopy	Insectivore	Foliage-gleaning	Never	/
Andropadus curvirostris	*Recorded*	23.95	Small	Understory	Insectivore	Foliage-gleaning	Never	0,67
Andropadus gracilis	*Missed*	23	Small	Understory	Frugivore	Taking	Never	/
Andropadus gracilirostris	*Missed*	31.25	Medium	Understory	Frugivore	Taking	Never	/
Andropadus latirostris	*Recorded*	26.55	Small	No preference	Frugivore	Taking	Never	8,39
Andropadus montanus	*Missed*	32.05	Medium	Understory	Frugivore	Taking	Never	/
Andropadus tephrolaemus	*Recorded*	36.1	Medium	Canopy	Frugivore	Taking	Regular	13,31
Andropadus virens	*Recorded*	24.45	Small	Understory	Frugivore	Taking	Never	2,19

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Anthus cinnamomeus	*Missed*	24.5	Small	Forest floor	Insectivore	Ground-searching	Never	/
Anthreptes rectirostris	*Missed*	10.6	Small	Canopy	Insectivore	Foliage-gleaning	Never	/
Apaloderma aeqatoriale	*Missed*	60.5	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Apalis binotata	*Missed*	8.35	Small	Understory	Insectivore	Foliage-gleaning	Facultative	/
Apalis cinerea	*Recorded*	9.9	Small	Canopy	Insectivore	Foliage-gleaning	Facultative	3
Apalis jacksoni bambulensis	*Missed*	8.65	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	/
Apaloderma narina	*Missed*	73	Large	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Apalis nigriceps	*Missed*	8.35	Small	Canopy	Insectivore	Foliage-gleaning	Facultative	/
Apalis rufogularis	*Missed*	8.35	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Apaloderma vittatum	*Missed*	55.3	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Aplopelia larvata	*Recorded*	139.35	Large	Forest floor	Granivore	Taking	Never	1
Apus apus	*Missed*	36.45	Medium	Canopy	Insectivore	Aerial/fly-catching	Regular	/
Baepogon clamans	*Missed*	45.85	Medium	Understory	Frugivore	Taking	Never	/
Baepogon indicator	*Missed*	45.85	Medium	Canopy	Frugivore	Taking	Regular	/
Bathmocercus rufus	*Missed*	16.2	Small	Forest floor	Insectivore	Ground-searching	Never	/
Bleda notatus	*Recorded*	36.7	Medium	Forest floor	Insectivore	Ground-searching	Facultative	2,83
Bleda syndactyla	*Recorded*	48	Medium	Forest floor	Insectivore	Ground-searching	Facultative	0,67
Bradypterus lopezi	*Recorded*	18.3	Small	Forest floor	Insectivore	Foliage-gleaning	Never	4,33

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Bubo poensis	*Missed*	660.5	Large	Forest floor	Carnivore	Taking	Never	/
Buccanodon duchaillui	*Recorded*	41.8	Medium	Canopy	Frugivore	Taking	Never	0,25
Buteo augur	*Missed*	670	Large	Forest floor	Carnivore	Taking	Never	/
Bycanistes albotibialis	*Missed*	566.667	Large	Canopy	Frugivore	Taking	Never	/
Bycanistes fistulator	*Missed*	1159.5	Large	Canopy	Frugivore	Taking	Never	/
Calyptocichla serinus	*Missed*	38.75	Medium	Canopy	Frugivore	Taking	Never	/
Camaroptera brachyura	*Missed*	10	Small	Understory	Insectivore	Foliage-gleaning	Facultative	/
Campethera cailliautii	*Missed*	47	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Camaroptera chloronota	*Recorded*	10.65	Small	Understory	Insectivore	Foliage-gleaning	Facultative	1,96

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Campethera nivosa	*Missed*	37.15	Medium	Sub-canopy	Insectivore	Bark-probing	Never	/
Campeghaga petiti	*Recorded*	31.35	Medium	Canopy	Insectivore	Foliage-gleaning	Never	1,5
Campeghaga quiscalina	*Missed*	35.35	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Camaroptera superciliaris	*Missed*	9.45	Small	Understory	Insectivore	Foliage-gleaning	Facultative	/
Campethera tullbergi	*Missed*	56.8	Medium	Canopy	Insectivore	Bark-probing	Never	/
Caprimulgus nigriscapularis	*Missed*	48	Medium	Understory	Insectivore	Foliage-gleaning	Never	/
Centropus leucogaster	*Missed*	314.75	Large	Understory	Insectivore	Foliage-gleaning	Never	/
Centropus monachus	*Missed*	204	Large	Understory	Insectivore	Foliage-gleaning	Never	/
Ceratogymna atrata	*Missed*	1161.5	Large	Canopy	Frugivore	Taking	Facultative	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Ceratogymna elata	*Missed*	1925	Large	Canopy	Frugivore	Taking	Never	/
Cercococcyx olivinus	*Missed*	65	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Ceuthmonaches aereus	*Missed*	65.45	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Ceyx lecontei	*Recorded*	10.5	Small	Understory	Kingfisher	Taking	Never	0,29
Cinnyris batesi	*Recorded*	6.17	Small	Canopy	Nectarivore	Taking	Never	1,13
Cinnyris chloropygius	*Missed*	7.1	Small	Understory	Nectarivore	Taking	Never	/
Cinnyris johannae	*Missed*	13.05	Small	Sub-canopy	Nectarivore	Taking	Never	/
Cinnyris reichenowi	*Recorded*	6.6	Small	Sub-canopy	Nectarivore	Taking	Never	22,17
Cinnyris superbus	*Missed*	15.85	Small	Sub-canopy	Nectarivore	Taking	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Cinnyris ursulae	*Recorded*	6.5	Small	Sub-canopy	Nectarivore	Taking	Never	2
Cisticola anonymus	*Missed*	15	Small	Understory	Insectivore	Foliage-gleaning	Facultative	/
Cisticola chubbi	*Recorded*	16.6	Small	Understory	Insectivore	Foliage-gleaning	Facultative	8,67
Coluba sjostedti	*Missed*	349	Large	Canopy	Frugivore	Taking	Regular	/
Columba unicincta	*Missed*	390.5	Large	Canopy	Frugivore	Taking	Regular	/
Corvus albus	*Missed*	550	Large	Understory	Carnivore	Taking	Never	/
Coracina caeruleogrisea	*Missed*	47.3	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Corythaeola cristata	*Missed*	942	Large	Canopy	Insectivore	Foliage-gleaning	Regular	/
Cossypha isabellae	*Recorded*	24.3	Small	Forest floor	Insectivore	Ground-searching	Never	9

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Cossyphicula roberti	*Missed*	20	Small	Understory	Insectivore	Foliage-gleaning	Never	/
Criniger calurus	*Recorded*	36.1	Medium	Understory	Insectivore	Foliage-gleaning	Regular	1
Criniger chloronotus	*Recorded*	42.1	Medium	Understory	Insectivore	Foliage-gleaning	Regular	1,33
Cryptospiza reichenovii	*Recorded*	12.65	Small	Forest floor	Granivore	Taking	Facultative	5,75
Cuculus clamosus	*Missed*	86.2	Large	Canopy	Insectivore	Foliage-gleaning	Never	/
Cuculus solitarius	*Missed*	73.45	Large	Understory	Insectivore	Foliage-gleaning	Never	/
Cyanomitra cyanolaema	*Missed*	15.95	Small	Canopy	Nectarivore	Taking	Never	/
Cyanomitra olivacea	*Recorded*	9.6	Small	Understory	Nectarivore	Taking	Never	11,02
Cyanomitra oritis	*Recorded*	11.2	Small	Understory	Nectarivore	Taking	Never	11,15

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Cyanomitra verticalis	*Missed*	12.6	Small	Sub-canopy	Nectarivore	Taking	Never	/
Cypsurius parvus	*Missed*	14.05	Small	Canopy	Insectivore	Aerial/fly-catching	Facultative	/
Deleornis fraseri	*Recorded*	11.65	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	1,04
Dendropicos elliotii	*Recorded*	37.3	Medium	Sub-canopy	Insectivore	Bark-probing	Never	2,33
Dicrurus atripennis	*Recorded*	39.7	Medium	Understory	Insectivore	Aerial/fly-catching	Never	0,94
Dicrurus modestus	*Recorded*	47.3	Medium	Canopy	Insectivore	Aerial/fly-catching	Never	0,25
Dryoscopus angolensis	*Missed*	32.8	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Dyaphorophyia castanea	*Recorded*	13.7	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	0,46
Dyaphorophyia concreta	*Recorded*	11.4	Small	Understory	Insectivore	Foliage-gleaning	Never	1,25

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Dyaphorophyia tonsa	*Missed*	11.5	Small	Canopy	Insectivore	Foliage-gleaning	Never	/
Elminia albonotata	*Recorded*	8.85	Small	Understory	Insectivore	Foliage-gleaning	Never	2,5
Elminia nigromitrata	*Missed*	10.25	Small	Understory	Insectivore	Foliage-gleaning	Never	/
Eremomela badiceps	*Missed*	10.6	Small	Canopy	Insectivore	Foliage-gleaning	Regular	/
Estrilda nonnula	*Recorded*	7.9	Small	Forest floor	Granivore	Taking	Regular	3,5
Euplectes capensis	*Recorded*	23.3	Small	Forest floor	Granivore	Taking	Never	7
Eurystomus gularis	*Missed*	96.55	Large	Canopy	Insectivore	Aerial/fly-catching	Never	/
Falco subbuteo	*Missed*	214.5	Large	Canopy	Insectivore	Foliage-gleaning	Never	/
Francolinus camerunensis	*Missed*	551	Large	Forest floor	Granivore	Taking	Facultative	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Fraseria cinerascens	*Missed*	18.75	Small	Understory	Granivore	Taking	Never	/
Francolinus lathami	*Missed*	269	Large	Forest floor	Granivore	Taking	Regular	/
Fraseria ocreata	*Missed*	33.85	Medium	Canopy	Insectivore	Foliage-gleaning	Regular	/
Francolinus squamatus	*Missed*	475	Large	Forest floor	Granivore	Taking	Never	/
Glaucidium sjostedti	*Missed*	140	Large	Forest floor	Insectivore	Foliage-gleaning	Never	/
Glaucidium tephronotum	*Missed*	87.9	Large	Forest floor	Insectivore	Ground-searching	Never	/
Gymnobucco calvus	*Missed*	59	Medium	Sub-canopy	Frugivore	Taking	Regular	/
Gymnobucco peli	*Missed*	53	Medium	Sub-canopy	Frugivore	Taking	Facultative	/
Gypohierax angolensis	*Missed*	1698	Large	Canopy	Frugivore	Taking	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Halcyon badia	*Recorded*	55.7	Medium	Sub-canopy	Kingfisher	Taking	Never	0,25
Halcyon malimbica	*Recorded*	79	Large	Understory	Kingfisher	Taking	Never	1
Hedydipna collaris	*Recorded*	7.25	Small	Sub-canopy	Frugivore	Taking	Never	1
Himantornis haematopus	*Missed*	390	Large	Forest floor	Insectivore	Ground-searching	Never	/
Hirundo preussi	*Missed*	13	Small	Sub-canopy	Insectivore	Aerial/fly-catching	Regular	/
Hirundo rustica	*Missed*	16.7	Small	Sub-canopy	Insectivore	Aerial/fly-catching	Never	1
Hylia prasina	*Recorded*	12.35	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	1,33
Hylia violacea	*Missed*	15.75	Small	Canopy	Insectivore	Foliage-gleaning	Facultative	/
Chalcomitra rubsecens	*Missed*	10.25	Small	Sub-canopy	Nectarivore	Taking	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Chrysococcyx caprius	*Missed*	32	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Chrysococcyx cupreus	*Missed*	37.5	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Chrysococcyx klaas	*Missed*	27.9	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Illadopsis cleaveri	*Recorded*	28.5	Small	Forest floor	Insectivore	Ground-searching	Never	1,02
Illadopsis fulvescens	*Missed*	29.3	Small	Understory	Insectivore	Foliage-gleaning	Regular	/
Illadopsis rufipennis	*Recorded*	23.55	Small	Forest floor	Insectivore	Ground-searching	Facultative	2
Indicator conirostris	*Missed*	31.25	Medium	Sub-canopy	Insectivore	Aerial/fly-catching	Never	/
Indicator exilis	*Recorded*	18.4	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	0,33
Indicator maculatus	*Recorded*	48.5	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	1

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Indicator willcocksi	*Missed*	18	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Ixonotus guttatus	*Missed*	35.1	Medium	Canopy	Frugivore	Taking	Regular	/
Kakamega poliothorax	*Recorded*	36.6	Medium	Forest floor	Insectivore	Ground-searching	Never	4,67
Lamprotornis purpureus	*Missed*	115.5	Large	Canopy	Carnivore	Taking	Never	/
Laniarius atroflavus	*Recorded*	43	Medium	Understory	Insectivore	Foliage-gleaning	Never	2,25
Laniarius poensis	*Recorded*	42.7	Medium	Understory	Insectivore	Foliage-gleaning	Never	3
Linurgus olivaceus	*Recorded*	22.05	Small	Understory	Granivore	Taking	Regular	15
Lonchura bicolor	*Missed*	9.5	Small	Forest floor	Granivore	Taking	Regular	/
Lophaetus occipitalis	*Missed*	1291.25	Large	Forest floor	Carnivore	Taking	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Macrosphenus concolor	*Recorded*	13.9	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	0,63
Macrosphenus flavicans	*Missed*	13.4	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	/
Malaconotus bocagei	*Missed*	26.4	Small	Canopy	Insectivore	Foliage-gleaning	Never	/
Malaconotus cruentus	*Missed*	73.55	Large	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Malaconotus gladiator	*Missed*	50.71	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Malaconotus multicolor	*Missed*	44.55	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Malimbus nitens	*Missed*	37.7	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	/
Malimbus rubicollis	*Missed*	57	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Megaceryle maxima	*Missed*	340.5	Large	Understory	Carnivore	Taking	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Milvus migrans	*Missed*	855	Large	Forest floor	Carnivore	Taking	Facultative	/
Muscicapa adusta	*Recorded*	9.6	Small	Sub-canopy	Insectivore	Aerial/fly-catching	Never	1,17
Msucicapa infuscata	*Missed*	18.45	Small	Sub-canopy	Insectivore	Aerial/fly-catching	Never	/
Muscicapa sethsmithi	*Recorded*	9	Small	Understory	Insectivore	Aerial/fly-catching	Never	0,5
Myiagra pluto	*Missed*	13	Small	Understory	Insectivore	Foliage-gleaning	Facultative	/
Neocossyphus poensis	*Recorded*	51.8	Medium	Forest floor	Insectivore	Ground-searching	Never	0,83
Neocossyphus rufus	*Missed*	63.95	Medium	Forest floor	Insectivore	Ground-searching	Never	/
Nesocharis shelleyi	*Missed*	7.4	Small	No preference	Insectivore	Foliage-gleaning	Never	/
Nicator chloris	*Recorded*	48.2	Medium	Understory	Insectivore	Foliage-gleaning	Never	0,5

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Nigrita bicolor	*Recorded*	11.25	Small	Understory	Granivore	Taking	Facultative	0,5
Nigrita canicapillus	*Missed*	18.05	Small	Canopy	Insectivore	Foliage-gleaning	Facultative	/
Nigrita fusconotus	*Recorded*	9.1	Small	Sub-canopy	Granivore	Taking	Facultative	1
Nigrita luteifrons	*Missed*	13.15	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	/
Onychognathus fuldigus	*Missed*	95.35	Large	Canopy	Frugivore	Taking	Regular	/
Onychognathus walleri	*Missed*	87.75	Large	Canopy	Frugivore	Taking	Facultative	/
Oriolus brachyrynchus	*Missed*	48.25	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Oriolus nigripennis	*Missed*	53.65	Medium	Canopy	Insectivore	Foliage-gleaning	Never	/
Otus icterorhynchus	*Missed*	73.5	Large	Forest floor	Insectivore	Ground-searching	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Oxylophus levaillantii	*Missed*	122.5	Large	Understory	Insectivore	Foliage-gleaning	Never	/
Pandion haliaetus	*Missed*	1520	Large	Forest floor	Carnivore	Taking	Never	/
Parmoptila woodhousei	*Recorded*	9.4	Small	Understory	Insectivore	Foliage-gleaning	Facultative	1,38
Pernis apivorus	*Missed*	751.5	Large	Forest floor	Carnivore	Taking	Never	/
Phoneiculus castaneiceps	*Missed*	23.8	Small	Canopy	Insectivore	Bark-probing	Regular	/
Pholidornis rushiae	*Missed*	5.25	Small	Canopy	Insectivore	Foliage-gleaning	Regular	/
Phyllastrephus albigularis	*Missed*	24	Small	Understory	Insectivore	Foliage-gleaning	Regular	/
Phylloscopus herberti	*Recorded*	9	Small	Canopy	Insectivore	Foliage-gleaning	Never	2
Phyllastrephus icterinus	*Recorded*	18.95	Small	Understory	Insectivore	Foliage-gleaning	Regular	6,61

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Phyllastrephus poensis	*Recorded*	26.85	Small	Understory	Insectivore	Foliage-gleaning	Facultative	8
Phylloscopus poliocephalus	*Recorded*	47.9	Medium	Canopy	Insectivore	Foliage-gleaning	Facultative	3
Phylloscopus sibilatrix	*Missed*	10.7	Small	Canopy	Insectivore	Foliage-gleaning	Never	/
Phylloscopus trochilus	*Recorded*	8.5	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	0,5
Phyllastrephus xavieri	*Recorded*	22.9	Small	Canopy	Insectivore	Foliage-gleaning	Regular	1,17
Picathartes oreas	*Recorded*	225	Large	Forest floor	Insectivore	Ground-searching	Never	0,25
Pitta angolensis	*Missed*	226.5	Large	Forest floor	Insectivore	Ground-searching	Never	/
Platysteira cyanae	*Recorded*	67.4	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Never	3
Ploceus albinucha	*Missed*	14.7	Small	Canopy	Insectivore	Foliage-gleaning	Regular	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Ploceus bicolor	*Recorded*	27.3	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	2
Ploceus cucculatus	*Missed*	36	Medium	Sub-canopy	Insectivore	Foliage-gleaning	Regular	/
Ploceus insignis	*Recorded*	34.65	Medium	Understory	Insectivore	Foliage-gleaning	Facultative	1,75
Ploceus melanogaster	*Recorded*	23.05	Small	Understory	Insectivore	Foliage-gleaning	Never	7,13
Ploceus preussi	*Missed*	31.55	Medium	Canopy	Insectivore	Foliage-gleaning	Facultative	/
Poeoptera lugubris	*Missed*	39	Medium	Canopy	Frugivore	Taking	Regular	/
Pogoniulus atroflavus	*Recorded*	17.9	Small	Canopy	Frugivore	Taking	Never	0,25
Pogoniulus bilineatus	*Recorded*	12.55	Small	Sub-canopy	Frugivore	Taking	Never	1,25
Pogoniulus coryphaea	*Recorded*	12	Small	Sub-canopy	Frugivore	Taking	Never	2,5

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Pogoniulus scolopaceus	*Recorded*	15.7	Small	Sub-canopy	Frugivore	Taking	Never	0,33
Pogoniulus subsulphureus	*Recorded*	9.55	Small	Canopy	Frugivore	Taking	Never	0,33
Poliolais lopezi	*Recorded*	12.3	Small	Understory	Insectivore	Foliage-gleaning	Facultative	5,33
Polyboroides typus	*Missed*	659.75	Large	Sub-canopy	Frugivore	Taking	Never	/
Prinia bairdii	*Recorded*	12.2	Small	Understory	Insectivore	Foliage-gleaning	Facultative	3
Prionops caniceps	*Missed*	52	Medium	Sub-canopy	Insectivore	Aerial/fly-catching	Regular	/
Psalidoprocne fuliginosa	*Recorded*	12.15	Small	Canopy	Insectivore	Aerial/fly-catching	Never	3,75
Psalidoprocne nitens	*Missed*	9.8	Small	Sub-canopy	Insectivore	Aerial/fly-catching	Regular	/
Psalidoprocne pristoptera	*Missed*	11.45	Small	Understory	Insectivore	Aerial/fly-catching	Facultative	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Pseudoalcippe abyssinica	*Recorded*	18.8	Small	Understory	Insectivore	Bark-probing	Never	5,88
Psittacus erithacus	*Missed*	402	Large	Canopy	Frugivore	Taking	Regular	/
Pycnonotus barbatus	*Missed*	36.3	Medium	No preference	Frugivore	Taking	Facultative	/
Sarothrura pulchra	*Missed*	43.65	Medium	Forest floor	Insectivore	Ground-searching	Never	/
Sasia africana	*Recorded*	9	Small	Understory	Insectivore	Bark-probing	Never	0,25
Saxicola troquatus	*Missed*	15	Small	Forest floor	Insectivore	Ground-searching	Never	/
Serinus burtoni	*Missed*	32.6	Medium	Sub-canopy	Frugivore	Taking	Regular	/
Sheppardia bocagei	*Recorded*	17.9	Small	Forest floor	Insectivore	Ground-searching	Never	3
Schoutedenapus myoptilus	*Missed*	27.4	Small	Canopy	Insectivore	Aerial/fly-catching	Regular	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Smithornis rufolateralis	*Missed*	19.9	Small	Understory	Insectivore	Aerial/fly-catching	Never	/
Smithornis sharpei	*Recorded*	37.5	Medium	Understory	Insectivore	Aerial/fly-catching	Never	1
Spermophaga haematina	*Recorded*	10.9	Small	Forest floor	Granivore	Taking	Facultative	1,13
Speirops melanocephalus	*Recorded*	22.65	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	2
Spizaetus africanus	*Missed*	1073.25	Large	Canopy	Carnivore	Taking	Never	/
Stephanoaetus coronatus	*Missed*	3647.5	Large	Forest floor	Carnivore	Taking	Never	/
Stiphrornis erythrothorax	*Recorded*	15.9	Small	Forest floor	Insectivore	Ground-searching	Never	2,21
Stizorhina fraseri	*Missed*	35.65	Medium	Understory	Insectivore	Foliage-gleaning	Never	/
Streptopelia semitorquata	*Missed*	214	Large	Forest floor	Granivore	Taking	Never	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Strix woodfordii	*Missed*	270.7	Large	Forest floor	Insectivore	Ground-searching	Never	/
Sylvia borin	*Missed*	19	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	/
Sylvietta dentii	*Missed*	8.4	Small	Canopy	Insectivore	Foliage-gleaning	Never	/
Sylvietta virens	*Missed*	8.5	Small	Understory	Insectivore	Foliage-gleaning	Facultative	/
Tauraco macrorhynchus	*Missed*	246.5	Large	Canopy	Frugivore	Taking	Never	/
Tauraco persa	*Missed*	257.5	Large	Sub-canopy	Frugivore	Taking	Never	/
Telacanthura melanopygia	*Missed*	52	Medium	Canopy	Insectivore	Aerial/fly-catching	Facultative	/
Terpsiphone rufiventer	*Recorded*	15.35	Small	Understory	Insectivore	Foliage-gleaning	Never	2,48
Thescelocichla leucopleura	*Missed*	62.5	Medium	Understory	Insectivore	Foliage-gleaning	Regular	/

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Tockus camurus	*Missed*	111.5	Large	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	/
Tockus fasciatus	*Missed*	251.25	Large	Sub-canopy	Frugivore	Taking	Regular	/
Trachylaemus purpuratus	*Missed*	82.5	Large	Sub-canopy	Frugivore	Taking	Facultative	/
Treron calvus	*Missed*	202.15	Large	Canopy	Frugivore	Taking	Regular	/
Tricholaema hirsuta	*Missed*	50.25	Medium	Sub-canopy	Frugivore	Taking	Never	/
Tropicranus albocristatus	*Missed*	295.5	Large	Understory	Insectivore	Foliage-gleaning	Never	/
Trochocercos nitens	*Recorded*	11.6	Small	Sub-canopy	Insectivore	Foliage-gleaning	Never	1,04
Turtur afer	*Missed*	63.5	Medium	Forest floor	Granivore	Taking	Never	/
Turtur brehmeri	*Recorded*	122.5	Large	Forest floor	Granivore	Taking	Never	0,83

Species	Mist-netting success	Weight (in grams)	Size	Preferred foraging stratum	Feeding guild	Method	Frequency of flocking behaviour	Relative abundance
Turdus pelios	*Recorded*	64.2	Medium	Forest floor	Insectivore	Ground-searching	Never	7,53
Turtur tympanistria	*Recorded*	66.85	Medium	Forest floor	Granivore	Taking	Never	0,72
Tyto alba	*Missed*	334	Large	Forest floor	Carnivore	Taking	Never	/
Urolais epichlorus	*Recorded*	11.25	Small	Sub-canopy	Insectivore	Foliage-gleaning	Facultative	6,63
Urotriorchis macrourus	*Missed*	491.5	Large	Sub-canopy	Carnivore	Taking	Never	/
Zoothera camaronensis	*Recorded*	34.5	Medium	Forest floor	Insectivore	Ground-searching	Never	0,83
Zoothera crossleyi	*Recorded*	73.8	Large	Forest floor	Insectivore	Ground-searching	Never	0,64
Zosterops senegalensis	*Recorded*	9.5	Small	Canopy	Insectivore	Foliage-gleaning	Never	6